Review of Black-Tailed Prairie Dog Reintroduction Strategies and Site Selection: Arizona Reintroduction

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Abstract—*The black-tailed prairie dog (Cynomys ludovicianus) was once widely distributed throughout the western United States; however, anthropogenic influences have reduced the species' numbers to 2 percent of historical populations. Black-tailed prairie dogs are described as a keystone species in the grassland ecosystem, and provide many unique services, including burrows for other species (e.g. burrowing owls [Athene cunicularia] and rattlesnakes [*Crotalus *spp.]), nutrient rich soil that, in turn, provides rich vegetation for grazers, and food for many carnivores and birds of prey. Several efforts have been made to reestablish this species to its historical range. In southeastern Arizona, a recent reintroduction effort was built upon work of scientists that identified potential suitable areas with characteristics similar to those of existing prairie dog colonies in Mexico. Prairie dogs were first translocated to the sites in 2008, and individuals still remain on the landscape today. We compare this to other reestablishment efforts, and provide suggestions on ways to increase success of future reintroductions.*

Introduction

Anthropogenic factors like land conversion and habitat destruction have become leading causes for decline in biodiversity worldwide (Wilson 1988), and have created a need for conservation or restoration of many species. One commonly used method of restoration is translocation. Translocation is the movement of living organisms from one area with free release in another (IUCN 1987), and can be used to establish, reestablish, or augment a population (Griffith and others 1989). A translocation is considered successful when the action results in a self-sustaining population (Griffith and others 1989). There are three classes of translocation: (1) Introduction: intentional or accidental movement of an organism outside its native range; (2) Re-introduction: the intentional movement of an organism into native range from which it has been extirpated by human activity or natural catastrophes; and (3) Re-stocking: movement of numbers of plants or animals of a species with the intention of building up the number of individuals of that species in an original habitat (IUCN 1987). For the purpose of this discussion, translocation will refer to the second category, re-introduction.

The black-tailed prairie dog (*Cynomys ludovicianus*; BTPD) is a burrowing rodent and is described as a keystone species in grassland ecosystems (Kotliar and others 1999, 2006; Miller and others 1994).This status suggests it provides a unique, significant service, disproportionately to its abundance (Hoogland 2006), that no other species can provide. BTPDs provide burrows for other species (e.g. burrowing owls [*Athene cunicularia*] and rattlesnakes [*Crotalus* spp.]), excavate nutrient rich soil that produces rich vegetation for grazers (e.g. pronghorn [*Antilocapra americana*] and bison [*Bison bison*]), and serve as food for many terrestrial carnivores and birds of prey (Whicker and Detling 1988, Kotliar and others 1999, Underwood and Van Pelt 2000). BTPDs also maintain grassland ecosystems by preventing woody encroachment, contributing to landscape heterogeneity, and creating fire breaks through the short vegetation on their colonies (Kotliar and others 1999, Underwood and Van Pelt 2000). The loss of a keystone species can have profound effects on an ecosystem, including loss of biodiversity and community integrity (Kotliar and others 1999). For example, at least nine species rely on prairie dogs, and some populations decline as prairie dogs are eradicated (Kotliar and others 1999). Other species of prairie dogs including Gunnison's (*C. gunnisoni*: GUPD), white-tailed (*C. leucurus*: WTPD), Utah (*C. parvidens*: UTPD), and Mexican (*C. mexicanus*: MXPD) also may serve similar roles (Davidson and Lightfoot 2007, Miller and others 1994, Miller and others 2000).

The BTPD was once widely distributed in North America, but was widely viewed as a pest, and control programs put into place over the past century have reduced their numbers to 2 percent of historical populations (Whicker and Detling 1988, Miller and others 1994). By 1960, the species was extirpated from Arizona (Underwood and Van Pelt 2000), making Arizona the only state within their former range to completely eliminate the BTPD. In 1972 an effort to reintroduce the BTPD was made near Elgin, Arizona. It was unsuccessful due to disagreement between parties involved about release sites and methods (Brown and others 1974), and prairie dogs being released on the landscape without any site preparation (Brown, personal communication).

In 2003, after petitions to list the BTPD and WTPD were determined unwarranted by the U.S. Fish and Wildlife Service, a multi-state

In: Gottfried, Gerald J.; Ffolliott, Peter F.; Gebow, Brooke S.; Eskew, Lane G.; Collins, Loa C., comps. 2013. Merging science and management in a rapidly changing world: Biodiversity and management of the Madrean Archipelago III; 2012 May 1-5; Tucson, AZ. Proceedings. RMRS-P-67. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

plan was proposed to monitor and manage prairie dogs across their ranges (McDonald and others 2011). In 2008, to improve grassland health across the BTPD's historical range, Arizona Game and Fish Department (AGFD) implemented a plan to translocate BTPDs to Las Cienegas National Conservation Area (hereafter, Las Cienegas; fig. 1), in southeastern Arizona, which is located within the Madrean Archipelago. We will review the methods used for site selection and translocation of BTPDs to Las Cienegas, compare these methods to those used in other translocations, and provide suggestions to increase the likelihood of successful future translocations.

Site Selection

A 2005 study, conducted by the University of Arizona, compared characteristics of currently occupied BTPD colonies in Mexico with characteristics of potential translocation sites at Las Cienegas in southeastern Arizona. Researchers evaluated grass cover, forb cover, bare ground, visual obstruction, shrub density, tree density, gravel, sand, silt/clay, and grass species richness (Coates 2005). Las Cienegas was deemed a suitable site for translocation, and in 2008 the first colony was prepared by AGFD (see colony preparation below).

Other translocation efforts have only evaluated slope, type of soil, and type of vegetation on potential translocation sites (Long 2006) as well as visible and historical evidence of former prairie dog occupancy (Long 2006, Truett and others 2001). In areas being considered as translocation sites, woody plants, shrubs, and tall grasses may have encroached (Truett and others 2001) and modification to the environment must take place to prepare sites for translocation of BTPDs.

Colony Preparation

The best sites for translocation are those with vacant, intact burrows (Long and others 2006); however, many translocations do not have access to intact burrow systems and must prepare overgrown sites for translocation. Methods of preparation include prescribed burns, mechanical shrub/woody plant removal, mowing, grazing, application of herbicides, seeding, and installation of artificial burrows (Truett and others 2001, U.S. Fish and Wildlife Service 2009).

Between 2008 and 2011, AGFD removed mesquite, mowed grass to <30 cm in height (the maximum height of vegetation preferred by BTPDs; Hoogland 1995), and installed 25 artificial burrows on each of four sites, 4 ha each, for translocation at Las Cienegas (fig. 2). A backhoe was used to install each artificial burrow that consists of one underground chamber, located 130-180 cm below ground accessible through a length of 10 cm diameter flexible tubing. Each burrow entrance was covered with an acclimation cage to deter initial dispersal (fig. 3), and four 20-25 cm deep starter burrows, one meter from the entrance of each artificial burrow, were dug around each artificial burrow entrance with an auger. Each colony site was located <5.6 km from another, within the dispersal range of BTPDs (up to 6 km; Hoogland 2006).

Methods of Capture and Group Composition

Arizona Game and Fish Department pre-baited 15 x 15 x 60 cm, double-door live traps (Tomahawk Live Trap Co., Wisconsin) and observed individuals at source populations, in New Mexico and Sonora, for 10 days prior to actual live-trapping. Observations serve to determine if the population is healthy (i.e., does not have plague), and to identify individual coteries, or family groups. After the initial 10 days, AGFD trapped BTPDs (of the *arizonensis* subspecies, which was historically found in Arizona), dusted for fleas, and translocated prairie dogs mostly together in observed coteries to increase success and reduce dispersal (Shier 2006a,b). A coterie is typically composed of one adult breeding male, three to four related breeding females, juveniles from the previous year, and yearlings (Hoogland 1995). AGFD translocated a minimum of 60 prairie dogs to three new colonies at Las Cienegas, and will translocate individuals to the fourth colony in October 2012.

In other translocation efforts with recipient sites in New Mexico and South Dakota, mixed family groups (randomly mixed prairie dogs from the same colony) had similar survival to same family groups, and workers discontinued transporting animals in family groups because "it was easier and more economical" (Long and others 2006). However, a study of the same prairie dog colony in New Mexico indicated that individuals translocated in family groups had higher reproduction and were five times more likely to survive post translocation than prairie dogs that were not translocated in family groups (Shier 2006a). The discrepancies in these two studies can be explained by the methods of evaluating survivorship, and the size of translocated family groups. Long and others (2006) estimated survivorship through visual counts of prairie dogs 2 months after translocation, whereas Shier estimated survivorship by live trapping all individuals and offspring 1 year after translocation (Shier 2006b). Also, same-family groups translocated to South Dakota were only partial family groups (average of five individuals per group) whereas "same-family" groups translocated to New Mexico were complete family groups (average of 11.3 individuals per group; Shier 2006b). This suggests that, wherever possible, family groups should be determined prior to capture and transport, and prairie dogs should be translocated as family groups to increase the chance of success.

Figure 1—Approximate location of Las Cienegas National Conservation Area, Arizona, indicated by star.

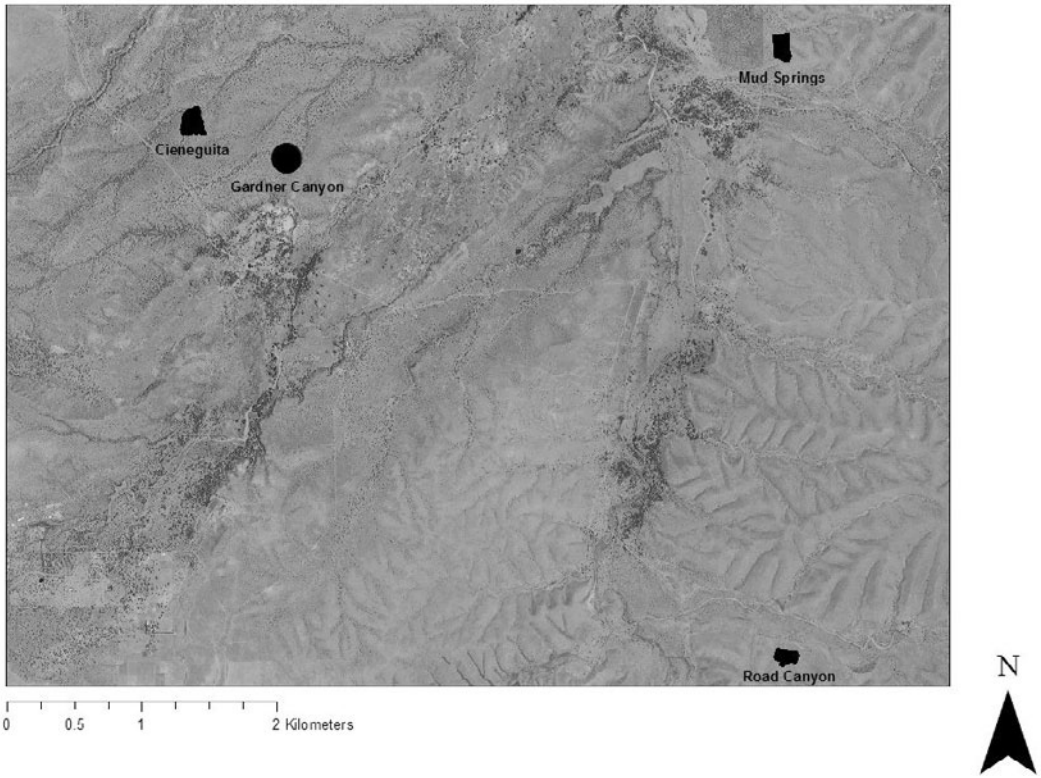

Figure 2—Colony locations at Las Cienegas National Conservation Area (Cieneguita, Road Canyon, Mud Springs) have received black-tailed prairie dogs (*Cynomys ludovicianus*). Gardner Canyon has been prepared but has not yet received prairie dogs.

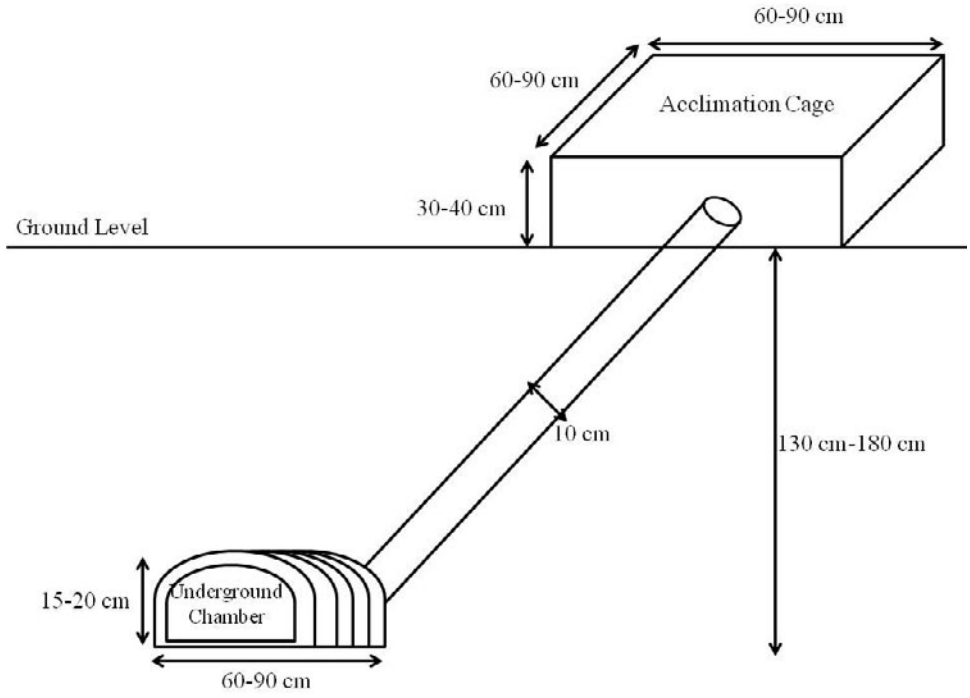

Figure 3—Artificial burrow consisting of an underground half-cylinder nest chamber connected to surface by 10-cm diameter flexible plastic tubing. Acclimation cage is placed above the burrow entrance to dampen dispersal and provide refuge from predators. Modified from Long et al. 2006.

Acclimation Cages

Hard release is the process of capturing, transporting, and releasing animals in a new location without any acclimation period (Clark and others 2002, Franzreb 2004). Soft release is the same process of animal capture and transport to a new location, but allows animals to acclimate to their new location for a period of days or weeks before release (Franzreb 2004).

Using the soft release method, AGFD installed wire acclimation cages over burrow entrances to dampen dispersal and provide refuge from predators (fig. 3). Prairie dogs were provided with food (Purina herbivore chow, Phoenix Zoo), carrots, and water *ad libitum* while the acclimation cages were in place to restore energy lost during transport, burrow excavation, and stress from being in a new environment (U.S. Fish and Wildlife Service 2009). Acclimation cages were left in place for 2 weeks; however, almost all prairie dogs excavated a tunnel out of the cages before their removal (Sarah Hale, personal observation of black-tailed prairie dogs at Las Cienegas, October 2011).

Prairie dogs not kept in acclimation cages have a higher probability of dispersal. During dispersal, prairie dogs are more vulnerable to predators, and therefore have high mortality rates (Hoogland 1995, 2006). One group of prairie dogs had 100 percent dispersal from starter burrows when acclimation cages were not used (Truett and others 2001). Another study found that, after acclimation cages were used for 5 to 15 days, most animals continued to use starter burrows for up to 1 year during which time they excavated new burrows nearby (Truett and others 2001). These findings suggest that the use of acclimation cages increases the success of translocations by reducing dispersal immediately following translocation.

Environmental Stochasticity

Las Cienegas National Conservation Area is located at the southwestern periphery of the BTPD's former range (fig. 4). This arid system is much harsher than more northerly locations, and may cause prairie dogs translocated to these systems to have poor survival and reproduction compared to prairie dogs in more temperate parts of their range (Facka and others 2010). Between May and June 2011, one BTPD population at Las Cienegas decreased by 54 percent, and only produced one juvenile that subsequently died, but at least 9 females showed signs of parturition (Hale, unpublished data). We speculate that this was due to lower than average rainfall that created a lack of available food resources. Furthermore, we speculate that lack of resources caused increased infanticide, and the need to forage farther away from the safety of burrows, making prairie dogs more vulnerable to predation; we documented three fatalities caused by predators on colony peripheries where tall vegetation obscured nearby predators (two coyotes [*Canis latrans*]; one red-tailed hawk [*Buteo jamaicensis*]).

Figure 4—Historical range of the black-tailed prairie dog (*Cynomys ludovicianus*: modified from Hall 1981). Approximate locations of source populations in New Mexico and Mexico are black circles. Approximate location of Las Cienegas National Conservation Area in Arizona is black square.

Our findings are consistent with another study that observed prairie dogs foraging on colony peripheries when resources were scarce, and found they were more vulnerable to predation (Koford 1958) than those foraging in colony centers. Drought lead to the collapse and local extirpation of several BTPD populations translocated to the Chihuahuan desert (Facka and others 2010). This suggests that drought years can greatly hinder translocations of BTPDs to their former range in arid regions.

After the precipitous population decline at one of the Las Cienegas colonies, AGFD began supplemental feeding starting in June 2011. The same feed provided to individuals in acclimation cages was placed at or near burrow entrances in an attempt to keep prairie dogs closer to burrows. No additional predation events were observed after supplemental feeding began, and only two more individuals disappeared from the colony between June and October while the supplemental feed was available (Hale, unpublished data). In 2012, supplemental feeding began in March to increase survival and reproduction, and at least 70 juveniles were observed at the same colony that produced only one the previous year (Holly Hicks, Sarah Hale, personal observation of black-tailed prairie dogs at Las Cienegas, April 2012). With the apparent massive improvement to recruitment, supplemental feeding will likely continue to be provided from March-July during dry years until the colony appears to be resilient in drought periods.

Population Augmentation

A translocation is considered successful when a population becomes self-sustaining (Griffith and others 1989). The three occupied colonies at Las Cienegas have not yet become self-sustaining (table 1), but, due to the drought and the unique nature of this translocation effort, it is too early to draw a conclusion. Because the three Las Cienegas populations are not yet self-sustaining, populations have been augmented yearly, usually in September or October, with new individuals, to increase numbers and genetic diversity, from the same source populations from which the new colonies are started (MacDonald Ranch, NM, Ladder Ranch, NM, Sonora, Mexico). Augmentation has also been recommended for populations of UTPDs when a significant decrease in the spring count is observed (U.S. Fish and Wildlife Service 2009) and was necessary for sustaining translocated populations of Gunnison's prairie dogs in Sevellita National Wildlife Refuge in New Mexico (Friggens and others 2009). Augmentation is not used in all translocations, but may prove to be a valuable tool in arid climates until populations can withstand drought and predation.

Conclusions

Arizona Game and Fish Department has returned a native species to the state after a 50-year absence. With the help of the University of Arizona, they were able to evaluate potential translocation sites in more detail than other translocation efforts. Reliable methods of site preparation and artificial burrow installation have been used; methods of capture, group composition and acclimation, as well as continued augmentation have all increased the likelihood of success of populations translocated to Las Cienegas.

The arid climate of Las Cienegas will continue to provide challenges in reestablishing the BTPD. Drought and predation have led to lower survival and reproduction than expected, but supplemental feeding at Las Cienegas seems to keep prairie dogs closer to their burrows, reduces risk of predation, and increases recruitment greatly. Continued supplemental feeding during drought periods will be crucial to permit the BTPD to become self-sustaining once again in the state. Future translocations in Arizona, and other arid regions, should consider the effects of drought, and provide supplemental food before population declines occur in these sensitive populations. In the long term, seeding sites and management for desired grass composition may be a tool to replace supplemental feeding. Augmentation may also be a useful method for increasing success of translocations, particularly in arid climates.

Acknowledgments

We thank Bill Van Pelt and Tim Snow for their early efforts in bringing the black-tailed prairie dog back to Arizona.

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Table 1—Population abundances for black-tailed prairie dogs (*Cynomys ludovicianus*) at each colony on Las Cienegas between 2008 and 2012. X indicates colony not yet in existence. Post-Augmentation indicates population size after new individuals were added to an existing colony. Population abundances prior to October 2011 are based on visual estimates, whereas after September/October 2011 all individuals were trapped and counted.

		Oct 2009		Oct 2010		Sept/Oct 2011		
	Oct 2008	Pre-augmentation	Post-augmentation	Pre-augmentation	Post-augmentation	Pre-augmentation	Post-augmentation	April 2012
Road Canyon	74[a]	18	57	18	43	10	40	≥23[b]
Mud Springs	X	68[a]	n/a	17	46	12	42	≥25[b]
Cieneguita	X	X	X	64[a]	n/a	20	40	99

[a]Colony received prairie dogs for the first time at this date.
[b]Spring count not completed at this date for these colonies.

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