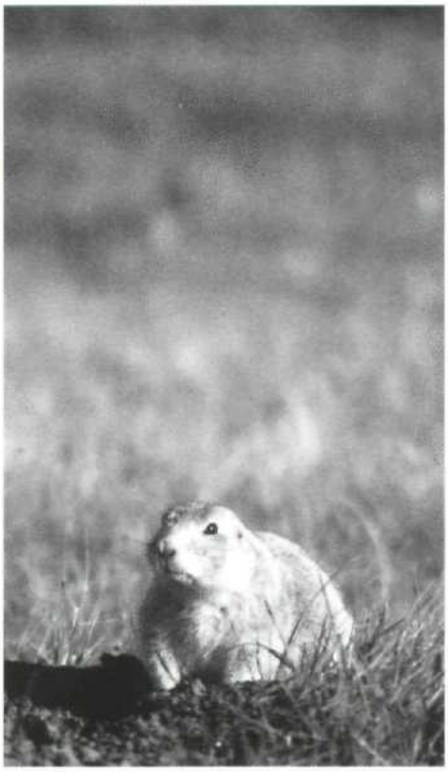
RESEARCH

Influence of Social Bonds on Post-Release Survival of Translocated Black-Tailed Prairie Dogs (*Cynomys ludovicianus*)

by Kristy Bly-Honness, Joe C. Truett and Dustin H. Long



Restoration of animal populations sometimes requires the translocation and release of groups into unoccupied areas within their former range (Griffith and others 1989). The long-term survival of released animals often depends on how well they adjust to their new surroundings during the first few weeks (Kleiman 1989). Wildlife ecologists think that social species may survive this early post-release period better if they are translocated in their original social units (Ackers 1992, Kleiman 1989). Kleiman (1989) contends that, if social unity cannot be maintained, forced socialization in captivity prior to release may create new social bonds that promote post-release survival. In this article, we report on an experiment in which we tested whether 1) maintenance of family unity or 2) opportunity for social bonding during two weeks of captivity affected survival of translocated black-tailed prairie dogs (*Cynomys ludovicianus*), a highly social species (Hoogland 1995). Average numbers counted in post-release censuses of translocated groups indicated that maintenance of family unity did not improve post-release survival but that holding unrelated animals together in captivity prior to release might have. The differences observed, however, were not significant in either case. Forced socialization, superior nutrition, or both could have induced better average survival in those temporarily held captive.

Black-Tailed Prairie Dogs

Black-tailed prairie dogs, one of five prairie dog species in North America, range from southern Canada to northern Mexico and from the Rocky Mountain foothills to the eastern Great Plains. They live in harem-polygynous, territorial family groups called coteries (Hoogland 1995). A coterie usually consists of a single adult male, three to four adult females, and several nonbreeding offspring (Hoogland 1995).

Although black-tailed prairie dogs once populated vast areas of the central North American grasslands, their numbers are now in serious decline from sylvatic plague (*Yersinia pestis*), control by humans, habitat fragmentation, and other factors. The declining abundance of this species and its proposal for listing under the Endangered Species Act (Van Putten and Miller 1999) have prompted increasing efforts to reestablish populations by translocation (Truett and others 2001).

The apparent selective advantage of their sociality (King 1955, Hoogland 1995) suggests that releasing black-tailed prairie dogs in original family groupings or, alternatively, pre-release socialization of animals from different families, might enhance post-release survival. Truett and his colleagues (2001) recommended translocating this species as coterie-coherent units. The maintenance of coterie unity, however, is

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often impractical and may increase the cost of the translocation (Dullum 2001). As a result, prairie dog social groups commonly are not translocated intact (Robinette and others 1995, Truett and Savage 1998, Dullum 2001, R. Matchett pers. comm.). Many translocations require a 14-day quarantine to protect against transmitting sylvatic plague (Marinari and Williams 1998) or other diseases (for example, monkey pox or tularemia), and this requirement may provide an opportunity to promote social bonding in captivity.

Study Area

We conducted our experiments on a 15-mile² (40-km²) section of the Bad River Ranches (BRR), which comprise about 220 miles² (570 km²) in Stanley and Jones counties near Fort Pierre, South Dakota. The BRR lies within the mixed-grass system of the northern Great Plains (Kuchler 1975). Soils are primarily clays derived from Createaceous Pierre Shale (Johnson and others 1995). The topography consists of flat to rolling uplands cut by the Bad River and intermittent drainages. Kuchler (1975) characterized the vegetation as a wheatgrass-needlegrass (*Agropyron smithii-Stipa viridula*) community. We have observed that buffalograss (*Buchloe dactyloides*) and blue grama (*Bouteloua gracilis*) also are widespread.

Methods

We translocated prairie dogs during July-September of 2001 and 2002 using a soft-release method described by Long and colleagues (in press). The soft-release strategy involves temporarily holding the translocated animals at release sites in escape-proof acclimation cages. Each acclimation cage consisted of a nestbox buried 4-4.5 feet (1.2-1.4 m) below ground level and connected by a flexible tube to an aboveground, welded-wire "retention" basket (Figure 1). Both years we released prairie dogs using 100 acclimation cages—ten cages at each of ten release sites. At each release site we spaced the acclimation cages 65-98 feet (20-30 m) apart in grid fashion to cover a 2.5-acre (1-ha) mowed area.

Figure 1. A plastic nestbox and flexible tube prior to burial in a section of mixed-grass prairie at Ted Turner's Bad River Ranches in central South Dakota. The nestbox and tube, along with a welded-wire retention "basket," are all part of an acclimation cage that researchers used to temporarily hold translocated black-tailed prairie dogs prior to release. *Photos courtesy of Kristy Bly-Honness*

The release procedure involved holding five to ten prairie dogs per acclimation cage (67 to 89 per release site) for five to ten days, then simultaneously releasing all at a given site (Figure 2). We released animals by simply removing the aboveground retention baskets one hour before sunrise or three hours before sunset. We made minimum population estimates by taking visual censuses periodically after prairie dogs were released from the acclimation cages.

In 2001, we compared post-release survival of prairie dogs held as same-coterie members (four sites) with those released as randomly trapped groups (six sites). Some of the randomly trapped animals (one complete group and half of two other groups) were quarantined for 14 days prior to release. We trapped both same-coterie and most of the mixed-coterie groups from prairie dog colonies on the ranch, while the quarantined prairie dogs were trapped from colonies in Badlands National Park and Ellsworth Air Force Base in South Dakota. To capture coterie members, we placed five to seven traps around one burrow entrance and, in some cases, 10 to 14 traps around a second entrance believed to be connected with the first entrance. To keep members of the same coterie together during translocation, we marked traps, trap sites, and acclimation cages with matching numbers and transported individuals in the traps that captured them. The number of prairie dogs released into same-coterie acclimation cages ranged from 3 to 11, depending on how many we could capture from the same coterie territory at source colonies.

In 2002, we compared post-release survival of randomly trapped prairie dogs that were quarantined prior to release with those that were not. At five release sites, we introduced prairie dogs that had been trapped in source colonies the same day. At five additional release sites, we introduced prairie dogs that had been quarantined since capture for 14 days indoors, in cages holding five to ten individuals. In the latter case, all animals released into a given acclimation cage had been held in the same quarantine cage.

Both years, we selected release sites and timed the releases to minimize differences between the two social groupings being compared. We visually matched the two groups of release sites in terms of vegetation, soils, and slope. We alternated releases between types of social grouping so mean release dates were similar.

We opportunistically controlled coyotes (*Canis latrans*) and badgers (*Taxidea* *taxus*) at or near release sites by ground-calling and aerial harvesting (Knowlton and others 1999) each year. Based on data from ranch-wide fecal line surveys (Knowlton 1984), we estimated that 16 and 12 coyotes initially occupied the project area in 2001 and 2002, respectively. Ground-callers removed six coyotes and one badger on or near release sites during July-October 2001. A larger proportion of the coyote population in the project area was probably removed in 2002 than in 2001. Ground-callers and aerial shooters removed 11 coyotes on or near release sites—five in March and six during July-October, 2002.

At monthly intervals for three months following release (2001) or two months post-release (2002), we counted animals seen aboveground on each release site (Figure 3). During each census period, we made 12 to 16 counts and assumed the maximum number counted to be the minimum number of released animals that survived. We conducted these counts during known periods of peak daily activity and in moderate weather (Menkens and Anderson 1993, Severson and Plumb 1998). To avoid double-counting prairie dogs, we made single scans across the census area.

We compared minimum survival rates at two months post-release. We used the two-month census results because our observations suggested loss rates among prairie dogs declined dramatically after two months (Long and others in press) and because the increasing recurrence of cold weather sometimes appeared to reduce aboveground activity after two months.

We compared mean percent minimum survival between different social groups each year. Because our data were not normally distributed, we used nonparametric Wilcoxen Signed Rank tests.

Results

In 2001, we released same-coterie groups of 72, 69, 69, and 71 prairie dogs at each of four sites and mixed-coterie groups of 71, 67, 73, 68, 67, and 86 prairie dogs at each of six sites (Table 1). Counts two months post-release indicated there to be lower average minimum survival in same-coterie groups (43.4 percent) than in mixed-coterie groups (53.5 percent). The difference, however, was not significant ($p = 0.17$).

In 2001, periodic observations of predators and their sign (tracks, scat) at release sites suggested losses to predation were highest during the first month after release. We observed incidents or signs of predation by coyotes, badgers, and raptors. We could not quantify either the total losses to predators or the losses to individual predator species.

In 2002, we released mixed-coterie groups of 76, 86, 75, 80, and 89 prairie dogs at each of five sites and mixed-coterie-quarantined groups of 75, 87, 75, 89, and 80 prairie dogs at each of five sites (Table 1). The majority of the individuals in all groups that year were juveniles. Counts two months post-release indicated that the mean minimum survival was higher in the mixed-coterie-quarantined groups (55.4 percent) than in the mixed-coterie groups (38.2 percent), but not significantly so ($p = 0.11$). Coyotes, raptors, and possibly badgers again killed prairie dogs during at least the first few weeks post-release.

Prairie dogs released as mixed-coterie groups appeared to initially exhibit greater social disorientation than those released as either same-coterie or mixed-coterie-quarantined groups. Individuals in mixed-coterie groups also ranged more widely within release sites during the first few days after release—they commonly ran from one nestbox to another, apparently in search of other family members. In contrast, prairie dogs released as same-coterie or mixed-coterie-quarantined groups tended to remain relatively near and defend the nestboxes from which they were released. Animals in these latter groups also seemed to exhibit more interactions typical of family groups: tactile greetings (for example, "ID kissing"; King 1955), play, and mutual grooming (Hoogland 1995).

Some prairie dogs from mixed-coterie groups and a few from same-coterie groups initially ranged beyond the release sites. In 2001 we observed seven prairie dogs, all from mixed-coterie groups, venture into the taller grass beyond the mowed areas. We also observed four animals from mixed-coterie groups and one from a same-coterie group disperse to nearby release sites. In 2002 short, exploratory forays outside release site edges were most apparent in mixed-coterie groups (ten) than in mixed-coterie-quarantined groups (two). We saw two prairie dogs—one each from a mixed-coterie and a mixed-coterie-quarantined group—disperse to other release sites.

Discussion

We expected that maintenance of coterie unity during translocations would enhance post-release survival. The post-release behavioral differences we observed in 2001 (for example, more extensive movements by mixed-coterie groups) bolstered this hypothesis. We assumed greater movement would correlate with increased rates of dispersal and predation. Thus we were surprised by the greater average minimum survival of those translocated as mixed-coterie groups.

Prairie dogs released by similar methods and monitored two months post-release in New Mexico survived at almost equal rates between same-coterie groups ($n = 3$, $\bar{x} = 44.0$ percent) and mixed-coterie groups ($n = 3$, $\bar{x} = 42.0$ percent)

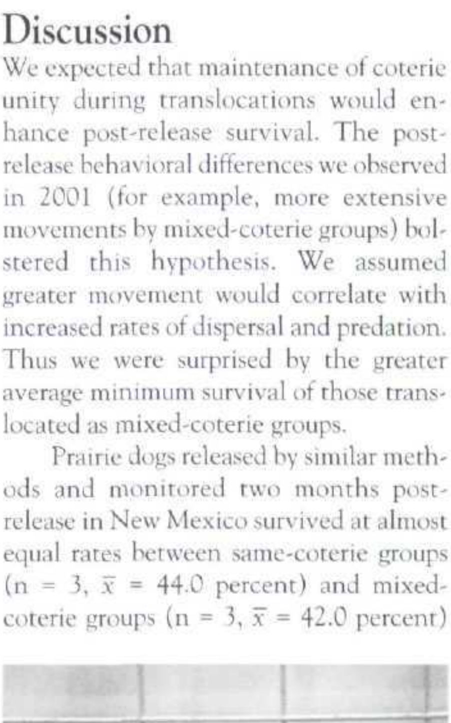

Figure 2. A black-tailed prairie dog (*Cynomys ludovicianus*) awaits its release from an acclimation cage. Although black-tailed prairie dogs once populated vast areas of the North American plains, they are now being considered for listing as federally endangered. Translocating them is one option for their restoration. Because of the possibility of transmitting sylvatic plague, which has killed many prairie dogs, many such translocations require a 14-day quarantine period before release.

Figure 3. Black-tailed prairie dogs on a mound following their release. Social contact, like the "ID kissing" seen in this photograph, is very important to these animals. Researchers noted this kind of prairie dog behavior both during the acclimation period and post-release, even among quarantined groups of prairie dogs (mixed coterie-quarantined) that did not live together before the experiment.

(D. Long unpublished data). But in this case, the same-coterie groups established more burrows six weeks post-release and exhibited greater survival and reproductive success the following year than the mixed-coterie groups (Shier 2004).

It is possible that some translocations contained social intergrades between coterie and mixed-coterie groups and that this may have compromised our results. For example, our method for keeping prairie dogs in their original coteries may not always have excluded non-coterie members because some individuals may leave their home coterie territory in search of bait (Hoogland 1995; D. Shier pers. comm.). Similarly, randomly trapped individuals occasionally could have been grouped with one or more coterie members, lending a family quality to mixed-coterie groups.

Observations we made of prairie dog behavior during quarantine suggested that some level of social bonding occurred in captivity. The five to ten randomly trapped individuals held in single cages invariably piled upon one another in one corner of the cage (see also Marinari and Williams 1998). Seldom did we see evidence of fighting or avoidance among the individuals in a cage, even though several coteries were often represented. By the second or third day of the quarantine period, we often observed "ID kissing" and allogrooming (see King 1955 and Hoogland 1995) among prairie dogs held together.

The higher proportion of juveniles in translocations we made during 2002 (see Table 1) may have contributed to the greater survival exhibited by the quarantined groups. Our observations of post-release "grouping" behavior in these quarantined animals supported the notion that juveniles formed coterie-like bonds more readily than adults. Observations by King (1955) and Hoogland (1995) suggest social cohesion promotes higher survival rates by enabling groups to better detect predators and subsequently avoid predation.

Two other factors—greater average size of juveniles in captive groups and the high-quality ration we fed captives—may have enhanced survival in quarantined animals in 2002. Some young-of-year juveniles we trapped were much smaller than usual (0.55-0.88 lbs [0.25-0.40 kg]) given the dates translocated, probably because of deficiencies in forage production caused by unusually low rainfall. The groups quarantined had a lower proportion of these small juveniles than did groups not quarantined. All sizes and ages of prairie dogs held captive appeared to gain weight faster than their counterparts in the wild, presumably because of better nutrition. Jacquart and colleagues (1986) observed that small size in Utah prairie dogs (*Cynomys parvidens*) correlated with low survival.

Differences in environmental conditions might have caused differences in survival between 2001 and 2002. Precipitation and the resulting vegetation height and density, factors known to influence survival of prairie dogs (Knowles 1986, Snell and Hlavachick 1980), were far greater in 2001 than in 2002. Badger diggings were most prevalent in coterie site burrows in 2001. In 2002, we found limited evidence of badger predation but more evidence (attempted excavations, scat, tracks, and visuals) of coyotes on all release sites. We think control of coyotes was more effective in 2002. Despite these potential influences, the mean minimum survival of groups was similar between 2001 ($\bar{x}$ = 50.0 percent) and 2002 ($\bar{x}$ = 47.1 percent).

Recommendations

Maintaining family unity will usually cost more than arbitrarily assembling groups from individuals trapped randomly (Dullum 2001). In our case, the increased cost was minimal because the same experienced people both trapped and translocated the animals. However, translocations often require using outside suppliers of prairie dogs who do not keep coteries intact, or training temporary personnel in the nuances of prairie dog social organization. These will add to costs.

Temporarily holding unrelated individuals together in captivity may enhance survival, but people who translocate prairie dogs will often be discouraged by the cost of having a suitable building, cages and food, and time commitments of trained personnel (Marinari and Williams 1998). However, the prairie dog quarantine required for disease control may be used to enhance survival or to further test the potential benefits of quarantine on the survival of translocated animals.

We believe quality of release sites, removal of tall vegetation, and short-term

Table 1: Minimum percent survival by social grouping, age and sex ratios, and release year of translocated black-tailed prairie dogs on the Bad River Ranches, South Dakota during 2001 and 2002.

Social Grouping (Year)	Release Site	Total	Males (%)	Females (%)	Animals Released Juveniles (%)	Minimum Surviving (%)
Same-Coterie	01_1	72	40.3	55.6	4.2	30.6
2001	01_4	69	29.0	53.6	17.4	68.1
	01_8	69	36.2	49.3	14.5	43.5
	01_10	71	39.4	46.5	14.1	32.4
	Mean	**70.3**	**36.2**	**51.2**	**12.6**	**43.4**
Mixed-Coterie	01_2_	71	12.7	29.6	57.7	56.3
2001	01_3_	67	44.8	47.8	7.5	49.2
	01_5	73	42.5	42.5	15.1	65.8
	01_6	68	41.2	50.0	8.8	51.5
	01_7	67	25.4	47.8	26.9	67.2
	01_9_	86	30.2	32.6	37.2	34.9
	Mean	**72**	**32.8**	**41.7**	**25.5**	**53.5**
Mixed-Coterie	02_2	76	7.9	9.2	82.9	26.3
2002	02_4	86	15.1	12.8	72.1	46.5
	02_5	75	17.3	17.3	65.3	60.0
	02_8	80	7.5	7.5	85.0	37.5
	02_10	89	13.5	10.1	76.4	22.5
	Mean	**81.2**	**12.3**	**11.4**	**76.3**	**38.2**
Mixed-Coterie	02_1	75	*	*	*	60.0
Quarantined	02_3	87	9.2	12.6	78.2	57.5
2002	02_6	75	10.7	12.0	77.3	66.7
	02_7	89	7.9	13.5	78.6	55.1
	02_9	80	*	*	*	38.7
	Mean	**81.2**	**9.3**	**12.7**	**78.0**	**55.4**

[1]All prairie dogs were quarantined prior to release.
[2]Fifty-two percent (35 of 67) of the prairie dogs were quarantined prior to release.
[3]Sixty percent (51 of 85) of the prairie dogs were quarantined prior to release.
*No sex and age ratios available.

predator exclusion may influence survival of translocated prairie dogs as much or more than the social character of translocated groups. Release sites with evidence of previous occupancy by prairie dogs—abundant shortgrass species 6 inches (15-cm) tall or less (for example, buffalograss and blue grama), slopes of less than 6 percent, and well-drained sandy loam or loam clay soils enable prairie dogs to detect predators and quickly excavate secure new burrows (reviewed by Truett and others 2001). Grazing, mowing, or burning tall vegetation in and around release sites facilitates colony expansion. Use of artificial nestboxes as in this study, surrounding release sites with temporary electric fencing to repel predators (Truett and Savage 1998), or removing problem coyotes and badgers during the first few weeks following release can help protect new colonies. The methodology described by Long and others (in press) offers a cost-effective strategy to reduce predation risk.

Theoretical considerations and the differences in behavior exhibited by animals we released in the different social groupings lead us to believe that retaining social bonds or forcing socialization in captivity might enhance survival. Comparative rates of survival determined by post-release census did not always support this expectation. It may be desirable to repeat these experiments using larger sample sizes and better controls. But, as our work illustrated, tight controls may be difficult to achieve. Moreover, the small differences in mean survival we found between social groupings suggest cost and convenience rather than expected survival differences may dictate which translocation methods people use.

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