# ASSESSING TRANSLOCATION AND REINTRODUCTION AS MITIGATION TOOLS FOR TIPTON KANGAROO RATS (*DIPODOMYS NITRATOIDES NITRATOIDES*)

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*ABSTRACT*: Translocating protected animals to sites away from development has been used to mitigate loss of individuals. Translocation and reintroduction have been used to mitigate effects of development on Tipton kangaroo rats (*Dipodomys nitratoides nitratoides*) in the southern San Joaquin Valley in the 1990s. Returning kangaroo rats back to home areas after short-term disturbance has ended (reintroduction) may have been successful, but translocating Tipton kangaroo rats generally has not been successful, although additional measures could be tried to improve success. Additionally, few of these reintroductions or translocations were monitored long enough, or with the most appropriate techniques, to adequately determine outcomes. The use of trapping to determine success may not be appropriate. Instead, radio-tracking released kangaroo rats likely will give the best information on survival of translocated individuals. I discuss conditions that have affected the outcome of translocations and give recommendations for future efforts.

*Key words*: Tipton kangaroo rat, *Dipodomys*, translocation, reintroduction, conservation, mitigation

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The Tipton kangaroo rat (*Dipodomys nitratoides nitratoides*) is one of three taxa of kangaroo rats that are state and federally listed as endangered in the San Joaquin Valley. Tipton kangaroo rats occur on only 3-4% of their former range (Williams and Germano 1992) and their numbers continue to decline (Uptain et al. 1999). Additionally, like other rodents in the valley, Tipton kangaroo rats have experienced severe declines in population size in the past 7 years, likely due to unusually high amounts of rain that has led to impenetrable thickets of grass (Single et al. 1997). Disease may have also contributed to these declines (Single et al. 1997). Despite this species' protected status, development continues to be permitted in their habitat.

A potential means of mitigating the impact that development has on Tipton kangaroo rats is to move affected individuals to new areas where development will not occur or to release individuals back to a site after activities have ceased. Translocation is the overall term for moving organisms, whereas reintroduction is the term usually used when an organism is intentionally moved into a part of its native range from which it has disappeared or become extirpated in historic times as a result of human activities or natural catastrophe (IUCN 1987, Position Statement on Translocation of Living Organisms, 22nd Meeting of the IUCN Council, Gland, Switzerland, http://iucn.org/themes/ssc/pubs/policy/transe.htm). In this paper, I use the term reintroduction to indicate the capture, holding, and release of kangaroo rats back to the spot where they were trapped after construction activity is completed. I use the term translocation for moving kangaroo rats from areas to be permanently lost to human activities and into new areas within the historic range of the species. The desired outcome is that the majority of the translocated individuals will survive and reproduce in a new, uninhabited, and protected site, such that there is no net loss of endangered animals (Griffith et al. 1989). The translocation of the Perdido Key beach mouse (*Peromyscus polionotus trissyllepsis*) in Alabama successfully established this species in a part of its range where it had been extirpated (Holler et al. 1989). However, the eventual outcome of translocating animals often is not determined, and in the few cases where individuals have been monitored, translocation usually has not been successful (Fischer and Lindenmayer 2000). This is the case with Tipton kangaroo rats. Agencies responsible for the protection of this species have allowed the reintroduction and translocation of Tipton kangaroo rats several times in the 1990s as a means to mitigate the effects of development. Assessing the outcome of translocating this species has not been done in the majority of cases.

In this paper, I report on several reintroductions that have been conducted with this species, as well as 5 cases in which populations of this species have been translocated to other parts of its range because of development. I also discuss translocation efforts that have occurred with other kangaroo rat species. Finally, I discuss the problems and constraints associated with reintroduction and translocation of kangaroo rats and give recommendations for future work.

## REINTRODUCTIONS

There have been 4 reintroductions of Tipton kangaroo rats in Kern County (Table 1). In each case, animals were captured and held until activity at a site had ended. Kangaroo rats were housed in individual 5-gallon buckets that had a layer of about 3 cm of sand, and a metal can turned on its side was used as a shelter. Each bucket had either a metal top or a wire-mesh top to prevent the animal from escaping. I periodically gave the kangaroo rats about 100 ml of birdseed for food as well as putting in partially

Table 1. Results of holding and releasing Tipton kangaroo rats (TKR) at various sites within Kern County, California. Abbreviations of results are S = successful, U = uncertain, A = aborted, and N = not successful.

| Location | Year | Number Held | Number Days Held | Distance Moved (km) | Release Site Habitat Poor | Fair | Good | Outcome | Result |
|---|---|---|---|---|---|---|---|---|---|
| Reintroductions | | | | | | | | | |
| 1. ARCO Pipeline Repair - S. Coles Levee Oilfield | 1994 | 10 | 21 | — | | X | | 2 marked TKR caught 2 weeks later | S |
| 2. Texaco Pipeline Repair - S. Coles Levee Oilfield | 1995 | 9 | 34-78 | — | | X | | No trapping; 7 of 8 artificial burrows active 3 weeks later | U |
| 3. Chevron Site Cleanup - Kern Water Bank | 1996 | 3 | 31 | — | | X | | No follow-up done | U |
| 4. New Canal Construction - Kern Water Bank | 1999 | 5 | 69 | — | | | X | No follow-up done | U |
| Translocations | | | | | | | | | |
| 1. Delano Prison Site - to surrounding area | 1990 | 53 | — | 0.25 - 1 | X | | | Most burrows active[1] during 5 years post trapping | U |
| 2. Griffith Water Ski Development near Arvin - to Kern Water Bank | 1994 | 23 | 9 | 28 | | | X | 11 TKR caught (2 marked) 2 weeks after release | A[2] |
| 3. Shafter/Wasco Landfill - to Kern National Wildlife Refuge | 1995 | 33 | 36 | 37 | X | | | 4 marked TKR caught 2 days later; area flooded 10 days later and only 1 TKR caught 14 days after release | N |
| 4. Lamont Water Spreading Basin - to Environmental Studies Area of CSUB[3] | 1998 | 18 | 45-56 | 23 | | X | | Half burrows active 3 weeks after release; 1 TKR caught 5 months later; no activity in area 1 year later | N |
| 5. Jct. Hwy 119 & 43 - to Kern Water Bank | 2000 | 15 | 40-69 | 2 | | | X | 3 marked TKR caught during 6 months of monthly trapping; 2 new TKR caught | S? |

[1]Curt Uptain, unpublished reports 1990, 1995.

[2]TKR removed from site by U.S. Fish and Wildlife Service to avoid genetic contamination

[3]California State University, Bakersfield

dried grass. Once activity at a site has ceased, I constructed an artificial burrow for each kangaroo rat at the spot at which it had been captured. Artificial burrows were constructed using cardboard mailing tubes as tunnels and small boxes or potato chip tube containers as horizontal dens (Figure 1). The horizontal dens were placed about 30 cm underground, mimicking the depth of natural burrows (Germano and Rhodehamel 1995), and a paper towel and seeds were put in the container. Two mailing tubes, one at each end of the horizontal chamber, connected the chamber with the ground surface. Each artificial burrow was placed 3-10 m from another burrow.

Animals were held until project actions were completed and captivity varied from 21 to 78 days (Table 1). The first reintroduction project occurred in March 1994, when I was asked to hold and then release Tipton kangaroo rats from a site of an emergency pipeline repair on the South Coles Levee oilfield (SCLO) in the Coles Levee Ecosystem Preserve (CLEP). Eleven Tipton kangaroo rats, 2 Heermann's kangaroo rats (*D. heermanni*), and 2 deer mice (*Peromyscus maniculatus*) were caught within the fenced site. Ten Tipton kangaroo rats were released into artificial burrows 21 days after trapping ceased (1 Tipton kangaroo rat had died during trapping). I trapped at the site for 2 days 2 weeks later and captured 2 marked Tipton kangaroo rats, as well as 1 unmarked Tipton kangaroo rat, 2 Heermann's kangaroo rats, and 2 San Joaquin antelope squirrels (*Ammospermophilus nelsoni*) (Table 1).

In another case, 3 segments of a Texaco pipeline needed repair in the SCLO in 1995 (Table 1). Trapping of fenced segments took place over a 1.5 month period, and some kangaroo rats were held 78 days until repairs were completed. No post-reintroduction trapping occurred, but 7 of 8 artificial burrows showed activity by kangaroo rats when inspected 3 weeks later (Table 1). In 2 other cases, I was given Tipton kangaroo rats to hold until activity at the sites was completed. At the Chevron pipeline repair site, no follow up was conducted on the released kangaroo rats. Five Tipton kangaroo rats from the Kern Water Bank were placed into artificial burrows about 300 m east of their capture location because of new canal construction. I also did not retrap this site to determine success.

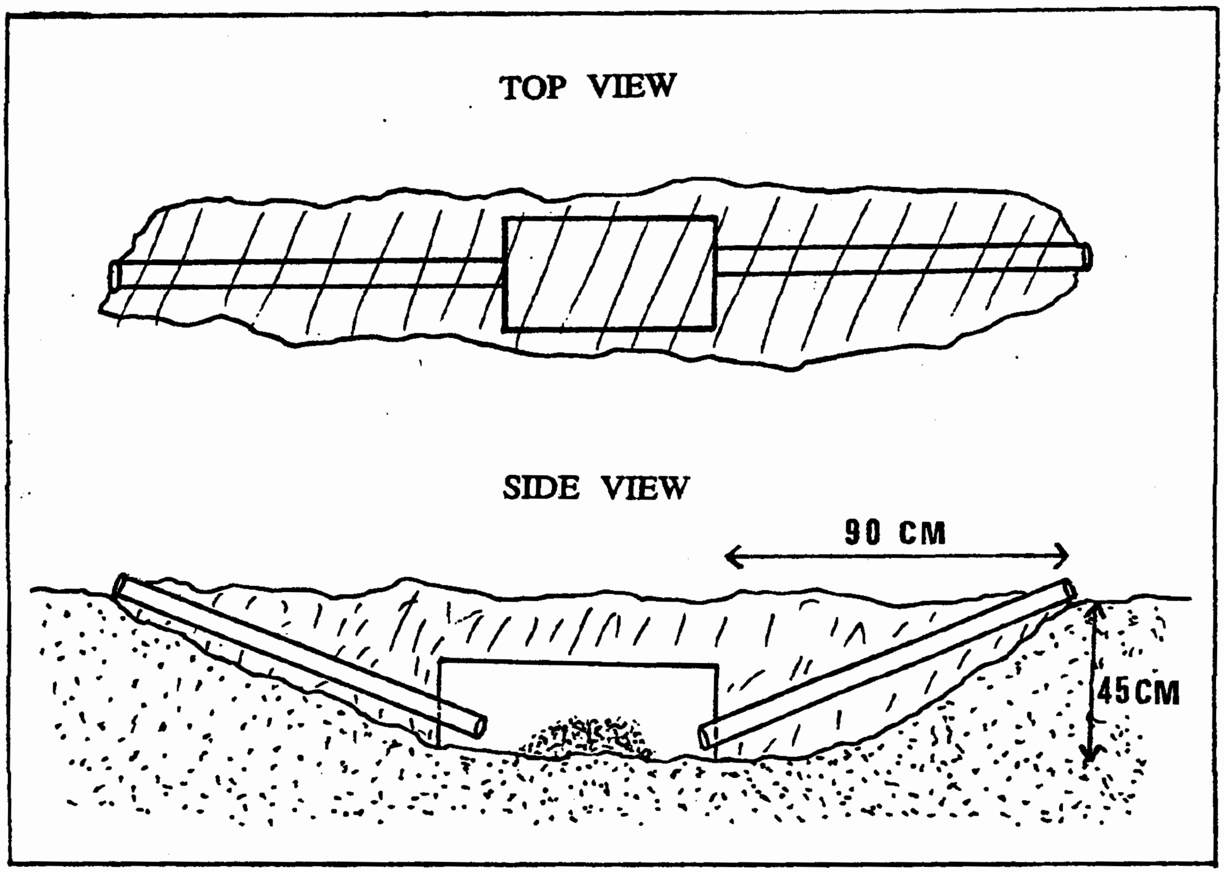


Figure 1. Representation of artificial burrows constructed for Tipton kangaroo rats (*Dipodomys nitratoides nitratoides*) at release sites, using cardboard mailing tubes as burrow openings and a box or a potato chip canister as the den. At a few sites, artificial burrows were constructed with only one burrow opening.

TRANSLOCATIONS

The first effort at translocating Tipton kangaroo rats was conducted at a prison site in Delano in Kern County (Table 1). Tipton kangaroo rats were captured and moved a short distance to a fallow field that had berms dug into it and artificial burrows were constructed in the berms (Curt Uptain, unpublished reports). The site was trapped intermittently for 5 years and the effort was considered a success because Tipton kangaroo rats were captured at the artificial burrows. Unfortunately, there seems to be no evidence that those kangaroo rats moved to the site were actually the animals captured at the artificial burrows. Numerous Tipton kangaroo rat burrows naturally occurred along road berms a short distance from the artificial burrows, and kangaroo rats from the road could have moved in to occupy the newly constructed artificial burrows. There is no evidence that those animals moved to the translocation site survived and contributed to the Tipton kangaroo rat population already in the area.

I translocated Tipton kangaroo rats from a site near Lamont in Kern County in 1994 (Table 1). They were moved 28 km to artificial burrows on the southeastern edge of the Kern Water Bank along Highway 119. Two weeks after the release of kangaroo rats into artificial burrows, trapping netted 2 marked and 9 unmarked Tipton kangaroo rats. Even though the U.S. Fish and Wildlife Service had permitted this translocation, there was immediate concern about genetic contamination of the area because of the distance the kangaroo rats had been moved. Although the translocated kangaroo rats were to be monitored for 2 years, it was decided that these kangaroo rats needed to be removed. Personnel authorized by the Service trapped at the site and removed as many translocated kangaroo rats as could be captured, so nothing is known about how the translocated animals would have faired at the site.

In early 1995, I was asked to hold a group of 33 Tipton kangaroo rats that had been removed from the Shafter/Wasco Landfill in Kern County (Table 1). No specific translocation site had been designated for these animals, and I was charged with finding a site. Because no private-property owners would consent to taking these animals, and because most nearby publicly owned sites contained abundant numbers of Tipton kangaroo rats, they were translocated to the northwestern end of the Kern National Wildlife Refuge. The soil in this part of the refuge is heavy clay, and probably accounted for the low number of resident Tipton kangaroo rats, but I thought the translocated animals would be able to become established using the artificial burrows as a home base until they could dig their own burrows. Unfortunately, about 1 week after translocating the kangaroo rats, abundant rain fell at the site. All of the artificial burrows became uninhabitable because they were inundated with water and cattle had collapsed several burrow systems. Only 1 Tipton kangaroo rat was captured at the site after 2 weeks and the fate of the other kangaroo rats was unknown (Table 1).

In 1998 I translocated 17 Tipton kangaroo rats from a wastewater disposal site near Lamont to the Environmental Studies Area (ESA) on the campus of California State University, Bakersfield (Table 1). This area afforded secure habitat that once was populated by Tipton kangaroo rats. However, trapping at the site 4 months after translocation captured only 1 Tipton kangaroo rat, and all sign of activity was absent several months after that. Large numbers of domestic cats (*Felis domesticus*) from nearby houses and barn owls (*Tyto alba*) from the thickly tree-covered portion of the ESA no doubt had a negative effect on the kangaroo rats. In addition, the endangered San Joaquin kit fox (*Vulpes macrotis mutica*) still resides on campus and is known to prey on kangaroo rats (Hawbecker 1943, White and Ralls 1993).

The most recent translocation involved 13 Tipton kangaroo rats taken from a site for a gas station (Table 1). The site for translocation was approximately 2 km away on the Kern Water Bank. This site was chosen because it was close to the original site, was not subject to development, and supported vegetation similar to the capture site. In addition, I have been trapping a plot about 300 m from the translocation site, and no Tipton kangaroo rats had been caught on the plot in 3 years of trapping prior to the translocation. The translocation site and the permanent trapping grid are on an isolated part of the Kern Water Bank and the lack of captures of Tipton kangaroo rats probably means no resident population of this species existed prior to translocation. However, Heermann's kangaroo rats were relatively numerous at the translocation site, but the site from which the Tipton kangaroo rats were removed also had Heermann's kangaroo rats and I have caught both species at many other southern valley locations (unpublished reports). I trapped the translocation site 3 nights a month for 6 months. I caught 3 translocated kangaroo rats and 2 new Tipton kangaroo rats in an area that had not had Tipton kangaroo rats in the past 4 years. Although not confirmed, these new individuals may represent reproduction of the translocated kangaroo rats. Because of these captures, this translocation effort could be classified a potential success. However, real success could only be claimed if this population increases and sustains itself over the next few years in concert with other naturally occurring populations of Tipton kangaroo rats in the valley.

## TRANSLOCATION OF OTHER KANGAROO RAT SPECIES

Salvage trapping and translocation has also taken place in one instance with the endangered San Bernardino kangaroo rat (*Dipodomys merriami parvus*), a species similar in size to the Tipton kangaroo rat. A short duration study found that 40% of translocated individuals survived on a reclaimed site 3 months after release (O'Farrell 1999). No provisions had been made to conduct a longer-term study.

In 1989, 60 giant kangaroo rats (*Dipodomys ingens*) were moved from areas of the Carrizo Plain in San Luis Obispo County to 2 sites within the Plain to study the effects of translocation (Williams et al. 1993). Thirty adult kangaroo rats (15 male and 15 female) were moved to each site. One site was a fallow field in which artificial burrows were constructed in a circular pattern radiating out from a center burrow. The site had little cover and no kangaroo rats survived after 1 year (Williams et al. 1993). The other site consisted of old kangaroo rat precincts that had not been occupied for at least 10 years. A number of kangaroo rats survived at this site, reproduced, and the population became quite large in a couple of years (Williams et al. 1993), but eventually went extinct (Dan Williams, personal communication).

## ASSESSING SUCCESS OF REINTRODUCTIONS AND TRANSLOCATIONS

Despite the lack of post-reintroduction monitoring, it is likely that kangaroo rats had a better chance at survival by being held and reintroduced to the same location from which they were captured than what would have occurred without such efforts. However, these efforts still require study to determine if these efforts are successful. Similarly, salvage trapping and translocation of Tipton kangaroo rats is a potential strategy when areas are approved for development, but it has yet to be shown that these translocated animals survive to establish themselves.

Ultimately, success of translocation probably should be measured as the establishment of a species in an area where it had not recently been present. Establishment means the survival of at least some adults with subsequent successful reproduction. Assessing the success of translocating Tipton kangaroo rats using trapping is difficult. In the 2000 study, it is possible that most of the Tipton kangaroo rats translocated survived but just were not caught in traps. Trapping alone does not generate enough data to determine the fate of most animals because kangaroo rats can disperse into very large areas that are too large to trap.

Although more costly and time consuming, radio-collaring reintroduced or translocated Tipton kangaroo rats would give better information on the immediate fate of animals. Radio-collared individuals could be tracked immediately after release. The fate of most individuals could be determined within several weeks. Traps could be set next to where radio-collared animals where found at any time, increasing the likelihood of capture. Monitoring the short-term fate of reintroduced Tipton kangaroo rats probably would be sufficient to determine if the reintroduction was successful. For translocated kangaroo rats, survival and reproduction is important, and trapping could be conducted on a yearly basis to determine if the population is expanding.

Reintroduction and translocation of Tipton kangaroo rats may be warranted in some instances, but the many obstacles to success need to be recognized. For reintroductions, limiting the time animals are kept in captivity is necessary so that home areas are not invaded by neighboring kangaroo rats. For translocations, the biggest barrier to surmount is finding an acceptable translocation site. In general, the site must not be too far away from where the animals are being removed so as not to mix genetic populations. Areas must have friable soils to allow kangaroo rats to dig burrows. Also, areas must be free, or almost free, of other Tipton kangaroo rats, should not have large numbers of predators, and should not have large numbers of competitors, such as Heermann's kangaroo rats. Can these places be found in the southern valley? It may be possible, but biologists and agency personnel should begin a process of identifying likely translocation areas, so that this decision is not made in haste when animals are being held in captivity. Another possibility is to use translocated kangaroo rats only to populate large areas of reclaimed farmland that have no existing kangaroo rats of any species. Although these areas may lack the cover necessary for immediate introduction, sites idle a few years may support necessary food and cover without much rodent competition. Problems of genetic contamination and possible introduction of disease across populations still remain, but would be minimized if kangaroo rats were not moved very far.

## MANAGEMENT RECOMMENDATIONS

Agencies charged with protecting Tipton's kangaroo rats should develop a program to implement and evaluate future reintroductions and translocations to determine the efficacy of these measures. It is critical that acceptable sites be found for translocated individuals. Additionally, appropriate monitoring methods need to be used to insure that adequate data are collected to measure success.

Areas that have the potential to serve as translocation sites need to be identified and an inventory of these sites needs to be maintained. Criteria for translocation sites are that the area is public land (to eliminate private-property conflicts), has friable soils, few predators, few or no Tipton kangaroo rats, and low numbers of competitors.

As mentioned above, it may be determined that translocations should only occur on reclaimed farmland, so a constantly updated list of sites needs to be kept.

Additional strategies for increasing the likelihood of immediate survival of translocated kangaroo rats should be explored. Besides supplying individuals with an artificial burrow stocked with food, it may be beneficial to surround the artificial burrow with a fence buried into the soil to prevent competitors and predators easy access to the released individuals (Holler et al. 1989). It may also prove beneficial to cover the fenced area with wire to exclude avian predators. Kangaroo rats eventually may burrow under the fence or the fence could be removed after a time sufficient for the animals to become accustomed to their new home.

Finally, several more long-term studies of reintroductions and translocations need to be conducted. Kangaroo rats should be intensively monitored just after reintroduction or translocation to determine survivorship. Radiotelemetry would be best for this phase. For translocations, long-term survival and reproduction of a population should be monitored by trapping a site at least twice a year for 2 years to assess reproduction and persistence of the population.

The translocation study in 2000 involved medium-term trapping to determine the outcome of translocated Tipton kangaroo rats, and showed that some adults survived at least 6 months. It remains equivocal, though, whether translocation truly mitigates for the effect of development. A common opinion is that if translocations fail, nothing is lost because the individuals would have died anyway from the permitted project. However, repeated application of this strategy without demonstrated success is ethically questionable. If translocation is not a viable mitigation tool, then the species would be better served and resources more effectively used by capturing affected individuals and using them for scientific and educational purposes.

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