Translocations in Conservation: Techniques and Effectiveness

**Introduction:**

Translocation involves relocating animals from one area to another (Gordon 1994) and is done to achieve both anthropogenic and ecological goals. Anthropogenic goals include removing problem animals, especially predators, to reduce conflicts with livestock or people (Athreya et al. 2011). Ecological goals include introducing novel genetic material to increase genetic diversity to avoid inbreeding (Trinkel et al. 2008), to establish new populations or reestablish extirpated populations (Rominger et al. 2004), and to relocate animals to instigate or mitigate cascading trophic effects (Bradley et al. 2005).

 Despite the benefits of translocations to conservation, there are potential drawbacks, including capture and post-release mortality, conflict with local human communities, and risks of dispersal to new regions and displacement of native species. Relocating an animal can cause stress and sometimes induce mortality (Clapp et al. 2014). Death also may occur from interactions with people when translocated individuals pose threats or nuisances (Alldredge et al. 2015). Additionally, translocations might serve only to spread problems as opposed to solving them, including predation on livestock and people, and transmission of disease (Gordon 1994). Finally, not only might translocations of predators increase threats to humans, but they also can affect other species if they disperse farther than expected (Gordon 1994).

 In light of these benefits and drawbacks, I will assess the factors that contribute to the translocation success of large carnivores, large herbivores, and small mammals, drawing from multiple studies of several species from around the world. For each group, I will compare the techniques used and evaluate whether they were successful in accomplishing their intended goals.

**Large Carnivores**

Factors that contribute to the success of translocations of large carnivores include age, whether animals are moved in groups, acclimation period, and presence of humans, livestock, and boundaries at release sites. I compared these across six studies of five different species, including lion *Panthera leo* (Hunter et al. 2007, Trinkel et al. 2008), leopard *Panthera pardus* (Athreya et al. 2011), cougar *Puma concolor* (Ruth et al. 1998), gray wolf *Canis lupus* (Bradley et al. 2005), and black bear *Ursus americanus* (Alldredge et al. 2015). The results of each study are in Table 1.

Higher success rates were apparent among younger animals that had an acclimation period and were moved to sparsely populated areas with an electric fence (Table 1). Leopard translocation was unsuccessful as aggression levels increased relative to attacks on humans, likely because the animals had no time to overcome the stress of capture (Athreya et al. 2011). By contrast, homing behavior decreased with the use of temporary holding pens for lions and wolves (Hunter et al. 2007, Trinkel et al. 2008, Bradley et al. 2005). Lions showed no strong tendency to move in the direction of their capture site after two months (Hunter 1998). Homing behavior was more consistent in cougars, gray wolves, and black bears, though this may be attributed to other factors such as age; subadults of these three species established themselves after release whereas adults moved towards their former ranges (Ruth et al. 1998, Bradley et al. 2005, Alldredge et al. 2015). The only exception was in two lion groups led by subadult males that initially showed homing behavior; this may be due to capture prior to reaching dispersal age, resulting in a tendency to return to their pride (Hunter 1998). The electric fences also prevented lions from escaping and discouraged settlement near it (Hunter 1998). Presence of humans and livestock at the release sites affected success as well for leopards, cougars, gray wolves, and black bears as they were not restricted by a boundary or were legally hunted as a threat and hence experienced population decline (Athreya et al. 2011, Ruth et al. 1998, Bradley et al. 2005, Alldredge et al. 2015).

 Success rates of translocations have been higher for social animals, such as lions and wolves, when related animals are moved together (Table 1). In wolves, site fidelity was higher for family groups versus individuals (Bradley et al. 2005). Lions behaved similarly as they formed prides containing either native or translocated females, but rarely both (Trinkel et al. 2008). Some degree of familiarity among individuals beforehand from an acclimation period is therefore important. Those released in groups also spent the majority of their time together (Hunter et al. 2007).

**Large Herbivores**

Factors that contribute to success of translocations of large herbivores are age, whether animals are moved in groups, and presence of predators and preexisting populations at the release sites. I compared these across four studies of two different species, including black rhinoceros *Diceros bicornis* (Linklater & Swaisgood 2008, Linklater et al. 2011) and bighorn sheep *Ovis canadensis* (Rominger et al. 2004, Clapp et al. 2014). The results of each study are compiled in Table 2.

Sociality explains the majority of successes when translocating large herbivores (Table 2). In social species such as bighorn sheep, mortality risk is reduced when individuals are relocated to an area that contains preexisting populations they can join (Clapp et al. 2014). Restoration may be most successful when one group is initially released, settles in, and later grows from the introduction of other individuals nearby (Clapp et al. 2014). In contrast, mortalities of calved and young adults in rhinos are associated with injuries from adult males of the same species, highlighting the importance of territory establishment and reproducing in the face of potential new competition (Linklater et al. 2011). Regarding age, both black rhino and bighorn sheep had higher mortality rates among juveniles, and predation played a major role in bighorn sheep but not rhinos as the latter has few natural predators (Rominger et al. 2004, Linklater & Swaisgood 2008).

**Small Mammals**

Factors that contribute to the success of translocations of small mammals are whether animals are moved in groups, acclimation period, evidence of past colonization at the release sites, season of capture, distance translocated, and presence of predators at the release sites. I compared these across two studies of two different species, including black-tailed prairie dog *Cynomys ludovicianus* (Shier 2006) and California ground squirrel *Otospermophilus beecheyi* (Van Vuren et al. 1997). The results of each study are compiled in Table 3.

 Soft-release methods, as with large mammals, are more effective because they allow animals to acclimate to their new surroundings and decrease homing tendencies (Table 3). The prairie dogs had time to adjust once transported (Shier 2006), whereas California ground squirrels were hard-released and dispersed farther (Van Vuren et al. 1997). This may be attributed to sociality and historical presence of the same species at the release sites, though. Prairie dogs remain together as family units, yet disperse when released with nonfamiliar conspecifics (Shier 2006). Moreover, past colonization by prairie dogs of the grasslands meant numerous burrows were available to the new coteries, promoting establishment; food and space were plentiful and decreased intraspecific competition and infanticide (Shier 2006). Ground squirrels were released into areas with other conspecifics that already had territories, potentially causing conflict (Van Vuren et al. 1997). Their solitary nature may also have permitted them to move freely around their home range, enhancing dispersal.

Presence of predators also influences small mammal translocations as a cause of mortality, potentially requiring heavy management. Season of capture is important too, though in differing ways. Survival rates among juvenile prairie dogs were highest in late summer, likely because food was plentiful and they were old enough to learn from experienced adults (Shier 2006). Translocation in ground squirrels was most successful in December as the animals emerged hungry from hibernation and were easily lured to baited traps (Van Vuren et al. 1997). Finally, the distance a ground squirrel is translocated is vital as individuals that were moved farther away homed less.

**Comparisons Among Groups**

Effectiveness of translocations in achieving conservation purposes depends on several factors that vary among groups. Size is one of the main elements, both in regard to animal behavior and practicality. Not only do some animals have larger territories, but such species are also harder to transport, monitor, and manage, increasing costs. Small mammals are easier to transport and manage if they live in rather stationary colonies (Shier 2006). Another key factor is sociality and familiarity among animals. When social species are moved together, survival, growth, and establishment rates are usually higher. Not only are young protected by numerous adults, but site fidelity is common since individuals remain with the group. Lions, bighorn sheep, prairie dogs, and wolves that were kept with their pack remained close to their release sites (Hunter et al. 2007, Trinkel et al. 2008, Clapp et al. 2014, Shier 2006, Bradley et al. 2005). In contrast, releasing several animals of a solitary species within close vicinity to one another, such as leopards and black rhinos, can have the opposite effect because of increased intraspecific conflict, particularly from territorial males, and enhance dispersal (Athreya et al. 2011, Linklater et al. 2011). Familiarity among individuals before release may not be as significant as family relations. Several lionesses that were introduced to one another in acclimation cages split shortly after release (Trinkel et al. 2008), and prairie dogs released with unrelated conspecifics had high mortality rates (Shier 2006). The exceptions to this were wolves and bighorn sheep. New packs were established after release among animals that did not know each other, and individuals in the latter acclimated better in the presence of pre-existing, though unfamiliar, herds (Bradley et al. 2005, Clapp et al. 2014).

The time allowed for species to acclimate to their new surroundings increases site fidelity; leopards, cougars, black bears, ground squirrels, and hard-released wolves homed the most (Athreya et al. 2011, Ruth et al. 1998, Alldredge et al. 2015, Van Vuren et al. 1997, Bradley et al. 2005). Presence of a fence in some studies makes comparisons difficult, though. Boundaries also make distance translocated mostly irrelevant, though in unfenced release areas, success was higher with larger distance in small mammals such as ground squirrels (Van Vuren et al. 1997). Because they have less capacity for traversing larger distances than large carnivores or herbivores, they won’t travel as far to return. In contrast, hundreds of kilometers might not prevent a large carnivore from heading back to its original territory.

 Age is important to consider as well since the translocation of unweaned juveniles is discouraged among all three groups. Subadults, though, display higher success rates among large carnivores such as cougars, wolves, and black bears since they don’t have established territories yet and thus display more site fidelity upon release (Ruth et al. 1998, Bradley et al. 2005, Alldredge et al. 2015). Sex is not as vital since there was little difference in survival rates between males and females; the primary exception was black rhino where cohorts composed of primarily males had higher mortality likely due to intraspecific fighting over territory and females (Linklater et al. 2011).

**Conclusion:**

Translocation in conservation is popular despite varying success rates in meeting the goals of population establishment and reduction of conflict between wildlife and humans. Factors relating to success differ both within and between groups in the animal kingdom. Several major trends are apparent. For large carnivores, success is primarily based on age, acclimation time, whether fences exist and social animals are relocated in groups, and status of livestock and humans at the release site. Success in large herbivores also depends on age, sociality, and presence of conspecifics at the release sites in addition to predation pressure. Finally, factors affecting the relocation of small mammals include whether families in colonial species are kept together, presence of predators, and acclimation time, though distance translocated, season of capture, and site quality upon arrival where social groups can establish their territories are important too.

 One of the most important elements to any translocation is monitoring, both during the initial release period and for weeks to years after, depending on the goal. I recently had the privilege of interning with Wildlife ACT (Africa Conservation Team), an organization dedicated to the monitoring of various endangered species in several parks throughout Zululand in the KwaZulu-Natal Province of South Africa. One of the events I was fortunate enough to participate in was a lion translocation at Tembe Elephant Park. Not only did we capture several young lionesses, but I also learned that the reserve is intending to bring in two new males to alleviate the inbreeding problem and establish a pride system as there are currently no proper family units. Continued monitoring efforts will be required for years to ensure managers reach desired outcomes. In this situation those objectives are increasing genetic diversity and stabilizing population structure, though the issue of whether the new individuals will survive and integrate with native conspecifics remains open to question. Apart from whether the translocations end up being successful, though, Tembe’s lions will serve as another example among many that illustrate an increasingly used technique in environmental management. Though it has its drawbacks related to both anthropogenic and ecological concerns, it has the potential to aid in the conservation of numerous threatened species if done in a manner backed by research.

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Table 1: Factors Affecting Translocation Success of Large Carnivores

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| --- | --- | --- | --- | --- | --- | --- |
| **Species** | **Age Translocated** | **Moved in Groups** | **Acclimation Period** | **Presence of Humans/Livestock at Release Sites** | **Presence of Boundaries at Release Sites** | **Citation** |
| Lion | Subadult/Adult | Yes | 6-8 Weeks | Yes | Yes | Hunter et al. 2007 |
| Lion | Subadult/Adult | Yes | 4-6 Weeks | Yes | Yes | Trinkel et al. 2008 |
| Leopard | Unknown | No | No | Yes | No | Athreya et al. 2011 |
| Cougar | Subadult/Adult | No | No | Yes | No | Ruth et al. 1998 |
| Gray Wolf | Subadult/Adult | Yes | 4+ Weeks | Yes | No | Bradley et al. 2005 |
| Black Bear | Subadult/Adult | No | No | Yes | No | Alldredge et al. 2015 |

Table 2: Factors Affecting Translocation Success of Large Herbivores

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Species** | **Age Translocated** | **Moved in Groups** | **Presence of Predators at Release Sites** | **Presence of Preexisting Populations at Release Sites** | **Citation** |
| Black Rhinoceros | Adults/Juveniles | No | Yes | Yes | Linklater & Swaisgood 2008 |
| Black Rhinoceros | Adults/Juveniles | Both | Yes | Yes | Linklater et al. 2011 |
| Bighorn Sheep | Adults | Yes | Yes | No | Rominger et al. 2004 |
| Bighorn Sheep | Adults | Yes | Yes | Both | Clapp et al. 2014 |

Table 3: Factors Affecting Translocation Success of Small Mammals

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Species** | **Moved in Groups** | **Acclimation Period** | **Evidence of Past Colonization at Release Sites** | **Season of Capture** | **Distance Translocated** | **Presence of Predators at Release Sites** | **Citation** |
| Black-Tailed Prairie Dog | Yes | Yes (Length Unknown) | Yes | Late Summer | Unknown | Yes | Shier 2006 |
| California Ground Squirrel | No | No | Yes | December | 300-2,000 Meters | Yes | Van Vuren et al. 1997 |