Terrestrial Mammal Conservation

Global evidence for the effects of interventions for terrestrial mammals excluding bats and primates

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12. Habitat protection

Background
Habitat destruction is the largest single threat to biodiversity and habitat fragmentation and degradation often reduces the quality of remaining habitat. Habitat protection is therefore one of the most frequently used conservation interventions, particularly in the tropics and in other areas with large patches of surviving natural vegetation.

Habitat protection can be through the designation of legally protected areas, using national or local legislation. It can also be through the designation of community conservation areas or similar schemes, which do not provide formal protection but may increase the profile of a site and make its destruction less likely. Alternatively, protection can be of entire habitat types, for example through the European Union’s Habitats Directive. On a smaller scale, habitat protection may involve ensuring areas of important habitat are retained during detrimental activities.

12.1. Legally protect habitat for mammals

https://www.conservationevidence.com/actions/2559

- **Seven studies** evaluated the effects of legally protecting habitat for mammals. One study each was in Zambia, the USA, Tanzania, Brazil, Nepal and India and one was a systematic review of sites with a wide geographic spread.

COMMUNITY RESPONSE (0 STUDIES)
POPULATION RESPONSE (7 STUDIES)

- **Abundance (7 studies):** A systematic review of protected areas across the globe found that 24 of 31 studies reported an increase in mammal populations in protected areas relative to unprotected areas. Three studies (including two site comparison studies), in Zambia, the USA and Nepal, found that populations of red lechwe, black bears and one-horned rhinoceros grew following site protection or were higher than in adjacent non-protected sites. One of three site comparison studies, in Tanzania, Brazil and India, found that populations of more mammal species increased inside protected areas than in adjacent unprotected areas. One study found that populations of only three of 11 species were higher on protected than on unprotected land whilst the third study found that 13 of 16 species were less abundant in a protected area than in a nearby unprotected area.

BEHAVIOUR (0 STUDIES)

**Background**

Legally protecting habitat may reduce its conversion and degradation by humans. This may in turn increase the abundance and diversity of mammals that make use of that habitat.

Assessing the effectiveness of protected areas is particularly difficult. For example, protected and unprotected areas might start off with different quality habitats (protection being granted to the best quality habitat). Protected areas are also more likely to be in remote areas, so less accessible to threats such as harvesting (Joppa & Pfaff 2009). Finally, effectiveness is best monitored over long timescales, but this increases the chance that other factors influence the ecosystem. The most reliable studies would compare protected and unprotected areas over time, and possibly correct for some of the biases.

See also: Biological resource use — Use wildlife refuges to reduce hunting impacts.
A review of the Kafue National Park in Zambia (1) found that following establishment of a national park, the population of red lechwe *Kobus leche leche* increased. In 1950, when the national park was established, there were approximately 100 red lechwe. By 1985, the population was estimated at 3,400 animals. Methods used by studies to estimate the population in 1950 were not given but, in 1985, a study used aerial surveys to determine abundance.

A site comparison study in 1981–1990 in a mixed forest area in North Carolina, USA (2) found that there were more black bears *Ursus americanus* in a bear sanctuary than on adjacent non-sanctuary land. Bears were detected at a higher rate in the bear sanctuary (0.01–0.04 bear visits/station/day) than outside the sanctuary (0–0.01 bear visits/station/day). In 1981, a total of 136 bait stations (68 in the sanctuary and 68 on adjacent non-sanctuary land) were established. The two parts of the study area were approximately equal in size and, combined, covered >400 km². In 1981–1990, at each station, two open cans of sardines were nailed to a tree. After five days, bait stations were revisited and any signs of bear visits noted. It was unclear how often the bait stations were baited each year.

A replicated, paired, site comparison study in 1990–2001 in seven savanna areas in Tanzania (3) found that populations of more mammal species increased inside protected national parks than in adjacent unprotected areas, but that population declines were also more frequent in protected than unprotected areas. In all seven comparisons, populations of more mammal species increased in national parks (0–20%) than in unprotected areas (0–5%). However, in six of seven comparisons, populations of more mammal species also declined in national parks (5–62%) than in unprotected areas (0–21%). In one of seven comparisons, the opposite was found (national parks: 0%, unprotected areas: 22%). Between May 1990 and May 2001, large mammals in seven zones, each spanning a national park and surrounding area, were surveyed from aeroplanes. Planes followed transects and two observers recorded numbers of animals seen between parallel rods attached to the aircraft. Population densities were calculated and assigned to cells covering the
area surveyed. Population estimates over 10 years in each cell were used to determine changes in both protected and unprotected areas.

A site comparison study in 2005–2007 in two sites mostly composed of secondary forest in Pará, Brazil (4) found that 13 of 16 species were less abundant in a protected area than in a nearby unprotected area. Results were not tested for statistical significance. Populations of 13 of 16 species were lower in the protected area (0–4.5 photos/100 camera-trap nights) than in a nearby unprotected area (0.1–5.0 photos/100 camera-trap nights). Three of the 16 species were more abundant in the protected area (0.2–4.5 photos/100 camera-trap nights) than in the unprotected area (0.2–4.1 photos/100 camera-trap nights). Vegetation in the protected area was largely secondary rainforest and, in the unprotected area, 65% was secondary forest and 35% was pasture. Five camera-trap surveys were carried out between July 2005 and November 2007 at 10–22 locations in a protected area and 10–22 locations in a nearby unprotected area. Cameras were placed 50–70 cm above ground level at each location. Each camera took one photograph every 5 minutes. Relative abundance of species was estimated by dividing the number of photos of a species by the number of trap-nights.

A systematic review in 2013 of the effectiveness of protected areas across the globe, but especially in Latin America (5) found that 24 of 31 studies reported an increase in mammal populations in protected areas relative to unprotected areas. Seven of 31 studies reported a decline or no change in mammal populations in protected areas relative to unprotected areas. Twelve studies used a before-and-after methodology and 19 studies were site comparisons.

A before-and-after study in 1950–2011 in an area dominated by forest and grassland in western Nepal (6) found that greater one-horned rhinoceroses *Rhinoceros unicornis* numbers more than tripled over 38 years after the establishment of a national park. Rhinoceros numbers declined >80% (from 800 in 1950 to 147 in 1972) during the 23 years before the establishment of the national park. However, during the 38 after the establishment of the national park, numbers increase by >70% (from 147 in 1972 to 534 in 2011). The study area became the Chitwan National Park in 1973. Since 1975, rhinoceroses were protected by the Nepal Army and, in 2007, a nationwide anti-poaching programme was launched. In
1986–2003, eighty-three rhinoceroses were translocated from Chitwan National Park to other reserves. Monitoring details are not provided.

A site comparison study in 2011–2013 in two agricultural and forest areas in north-eastern India (7) found that the number of species and abundance of seven of 11 large mammal species did not differ between a protected wildlife sanctuary area and community managed land. The number of species was similar in the protected (17 species) and the community managed areas (16 species). Seven of 11 large mammal species had similar abundances in the protected area and on community managed land (data reported as model results). Three species were more abundant in the protected area and one was more abundant on the community managed land. In October–November 2011 and August–September 2012, eleven sites were established in the wildlife sanctuary and 14 sites in the community managed land. At each site, a 500 × 5-m U-shaped transect, divided into 20-m segments, was surveyed by two observers for signs of mammal presence. In April–June 2013, twenty-two infrared cameras were deployed in the wildlife sanctuary and 18 were deployed in the community managed areas. Cameras were attached to trees, 25 cm above ground. They operated 24 hours/day and were baited with rotting bananas and smoked dried fish.

(1) Howard G.W. & Chabwela H.N. (1987) The red lechwe of Busanga Plain, Zambia—a conservation success. *Oryx*, 21, 233–235.

(2) Powell R.A., Zimmerman J.W., Seaman D.E. & Gilliam J.F. (1996) Demographic analyses of a hunted black bear population with access to a refuge. *Conservation Biology*, 10, 224–234.

(3) Stoner C., Caro T.I.M., Mduma S., Mlingwa C., Sabuni G. & Borner M. (2007) Assessment of effectiveness of protection strategies in Tanzania based on a decade of survey data for large herbivores. *Conservation Biology*, 21, 635–646, https://doi.org/10.1111/j.1523-1739.2007.00705.x

(4) Negroes N., Revilla E., Fonseca C., Soares A.M., Jácomo A.T. & Silveira L. (2011) Private forest reserves can aid in preserving the community of medium and large-sized vertebrates in the Amazon arc of deforestation. *Biodiversity and Conservation*, 20, 505–518, https://doi.org/10.1007/s10531-010-9961-3

(5) Geldmann J., Barnes M., Coad L., Craigie I.D., Hockings M. & Burgess N.D. (2013) Effectiveness of terrestrial protected areas in reducing habitat loss and population declines. *Biological Conservation*, 161, 230–238, https://doi.org/10.1016/j.biocon.2013.02.018
12.2. Encourage habitat protection of privately-owned land

https://www.conservationevidence.com/actions/2560

- We found no studies that evaluated the effects on mammals of encouraging habitat protection of privately-owned land.

‘We found no studies’ means that we have not yet found any studies that have directly evaluated this intervention during our systematic journal and report searches. Therefore, we have no evidence to indicate whether or not the intervention has any desirable or harmful effects.

Background

Most land is privately-owned by individuals or businesses. Whilst most of this land is not managed for wildlife conservation, some areas are operated as private nature reserves (e.g. Lanhholz 1996), or as part of larger protected areas, including corridors and buffer zones (e.g. Environmental Law Institute 2003, Figgis 2004). On other land, a wide range of individual actions may be taken to promote or conserve wildlife. The effectiveness of these individual actions is covered under those specific interventions. This intervention more generally considers the effectiveness of promoting habitat conservation among private landowners.

Environmental Law Institute (2003) Legal tools and incentives for private lands conservation in Latin America: building models for success. Environmental Law Institute, Washington, USA Figgis, P. (2004) Conservation on private lands: the Australian Experience. International Union for Conservation of Nature, Gland, Switzerland.
12.3. Build fences around protected areas

https://www.conservationevidence.com/actions/2561

- **Two studies** evaluated the effects on mammals of building fences around protected areas. One study was in Kenya\(^1\) and one was in Mozambique\(^2\).

**COMMUNITY RESPONSE (1 STUDY)**

- **Richness/diversity (1 study)**: A before-and-after study in Kenya\(^1\) found that after a fence was built around a protected area, mammal species richness initially increased in both study sites, but subsequently declined at one of the sites.

**POPULATION RESPONSE (2 STUDIES)**

- **Abundance (2 studies)**: A paired sites study in Mozambique\(^2\) found that inside a fenced sanctuary there were more mammal scats than outside the sanctuary. A before-and-after study in Kenya\(^1\) found that after a fence was built around a protected area, mammal abundance initially increased in both study sites, but it subsequently declined at one of the sites.

**BEHAVIOUR (0 STUDIES)**

**Background**

Fences may be constructed around protected areas to keep out poachers or predators, including invasive species (e.g. Hayward & Kerley 2009). They may also prevent other potentially damaging incursions, such as by off-road vehicles that may damage habitat, or casual entry by people on foot who may disturb mammals. Where protected areas are surrounded by land in which there are greater threats to wild mammals, such as persecution of carnivores, fences may reduce losses of such species by preventing them encountering these threats. Possible disadvantages of fences include inhibiting species’ dispersal, potentially leading to reductions in genetic diversity.
Hayward M.W. & Kerley G.I.H. (2009) Fencing for conservation: Restriction of evolutionary potential or a riposte to threatening processes? *Biological Conservation*, 142, 1–13, https://doi.org/10.1016/j.biocon.2008.09.022

A before-and-after study in 1963–2011 at two montane forest and alpine grassland sites within a conservation area in central Kenya (1) found that after installing fencing around the protected area, mammal abundance and species richness increased initially but, at one site, abundance and richness subsequently declined. At both sites, following fence installation around the protected area, a declining trend in mammal abundance and species richness changed to an increasing trend (data reported as model results). However, at one of these sites, eight years after the fence was installed, abundance and species richness had again declined significantly, though there was no significant decline at the other site (data reported as model results). Nightly censuses of wildlife at watering holes and salt licks were carried out between approximately 15:00 h 08:00 h, at two lodges in Aberdare Conservation Area, in 1963–2011. In 1991, fencing was built around the 38 km perimeter of the park closest to the study sites and, by 2009, the entire conservation area was fenced.

A paired sites study in 2014 in a savanna reserve in Sofala, Mozambique (2) found that inside a fenced sanctuary there were more mammal scats than outside the sanctuary. More mammal scats were collected inside the fenced sanctuary (268 scats) than outside of it (207 scats). Scats were produced by 24 species, including nine antelope species, at least three carnivores, two primates, blue wildebeest *Connochaetes taurinus*, zebra *Equus quagga*, porcupine *Hystrix africaeaustralis*, scrub hare *Lepus saxatilis*, warthog *Phacochoerus africanus*, bushpig *Potamochoerus larvatus* and African buffalo *Syncerus caffer*. In June–August 2014, mammal scats were collected along ten 5 km × 5-m transects in Gorongosa National Park. Five transects, >1 km apart, were located inside a 62-km² fenced wildlife sanctuary and five were located outside of it. The fence was constructed between August 2006 and September 2014. Scats were detected by two observers and the identity of species that produced the scat was determined by direct observation or based on the experience of the local rangers or field guides.
12.4. Retain buffer zones around core habitat

https://www.conservationevidence.com/actions/2562

- We found no studies that evaluated the effects on mammals of retaining buffer zones around core habitat.

‘We found no studies’ means that we have not yet found any studies that have directly evaluated this intervention during our systematic journal and report searches. Therefore, we have no evidence to indicate whether or not the intervention has any desirable or harmful effects.

Background

Protected areas are usually subject to the influence of activities in surrounding areas. Buffer zones around core habitat in protected areas are usually areas of land which do not receive full protection and are not subject to the same management intensity of core areas, but on which there may be some degree of limit to activities such as hunting, agriculture and development. In some cases, buffer zones themselves can provide additional habitat for mammals (Paolino et al. 2016) though this can also expose them to a higher level of human-related threats (van der Meer et al. 2013).

van der Meer E., Fritz H., Blinston P. & Rasmussen G.S.A. (2013) Ecological trap in the buffer zone of a protected area: effects of indirect anthropogenic mortality on the African wild dog Lycaon pictus. Oryx, 48, 285–293, https://doi.org/10.1017/s0030605312001366

Paolino R.M., Versiani N.F., Pasqualotto N., Rodrigues T.F., Krepschi V.G. & Chiarello A.G. (2016) Buffer zone use by mammals in a Cerrado protected area. Biota Neotropica, 16, e20140117, https://doi.org/10.1590/1676-0611-bn-2014-0117
12.5. Increase size of protected area

https://www.conservationevidence.com/actions/2563

- **One study** evaluated the effects on mammals of increasing the size of a protected area. This study was in South Africa\(^1\).

**COMMUNITY RESPONSE (0 STUDIES)**

**POPULATION RESPONSE (0 STUDIES)**

**BEHAVIOUR (1 STUDY)**

- **Behaviour change (1 study)**: A before-and-after study in South Africa\(^1\) found that expanding a fenced reserve resulted in the home range of a reintroduced group of lions becoming larger but the core range becoming smaller.

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**Background**

Large protected areas may be better able to support viable populations of mammals than are smaller areas. However, protected area effectiveness may also be linked to sites being surrounded by similar habitat, having strong public support, effective law enforcement, low human population densities and sufficient financial resources (Struhsaker *et al.* 2005). Where these are not in place, factors such as activities of surrounding human populations may have a greater impact on species survival (Parks & Harcourt 2002).

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Parks S.A, & Harcourt A.H. (2002) Reserve size, local human density, and mammalian extinctions in U.S. protected areas. *Conservation Biology*, 16, 800–808, https://doi.org/10.1046/j.1523-1739.2002.00288.x

Struhsaker T.T., Struhsaker P.J. & Siex K.S. (2005) Conserving Africa’s rain forests: problems in protected areas and possible solutions. *Biological Conservation*, 123, 45–54, https://doi.org/10.1016/j.biocon.2004.10.007

A before-and-after study in 2000–2001 at a primarily savanna site in South Africa (1) found that expanding a fenced reserve resulted in the home range of a reintroduced group of lions *Panthera leo* becoming larger but the core range becoming smaller. Following fence removal, the
home range was larger (74 km²) than prior to fence removal (38 km²). The opposite was true for the core range (after fence removal: 2 km²; before fence removal: 11 km²). In December 1994, a pride of five lions was reintroduced to the fenced Greater Makalali Conservancy, where lions had previously become extinct. Two male lions were subsequently removed and replaced by two new males in 1999. In October 2000, the fenced area was enlarged from 11,089 ha to 13,600 ha, by removing a fence between the conservancy and a neighbouring game reserve. Lions were monitored through visual observations for six months before and six months after fence removal. The home range was defined as the smallest area containing 95% of the distribution used and the core range was the smallest area containing 50% of distribution used.

(1) Druce D., Genis H., Braak J., Greatwood S., Delsink A., Kettles R., Hunter L. & Slotow R. (2004) Population demography and spatial ecology of a reintroduced lion population in the Greater Makalali Conservancy, South Africa. *Koedoe, 47* 103–118, https://doi.org/10.4102/koedoe.v47i1.64

12.6. Increase resources for managing protected areas

https://www.conservationevidence.com/actions/2564

- **One study** evaluated the effects on mammals of increasing resources for managing protected areas. This study was in Tanzania¹.

**COMMUNITY RESPONSE (1 STUDY)**

- **Species richness (1 study):** A site comparison study in Tanzania¹ found that mammal species richness was higher in a well-resourced national park, than in a less well-resourced forest reserve.

**POPULATION RESPONSE (1 STUDY)**

- **Abundance (1 study):** A site comparison study Tanzania¹ found that there were greater occupancy rates or relative abundances of most mammal species in a well-resourced national park than in a less well-resourced forest reserve.

BEHAVIOUR (0 STUDIES)
A site comparison study in 2013–2014 in two forested protected areas in the Udzungwa Mountains, Tanzania (1) found that in a well-resourced protected national park, there was greater mammal species richness and occupancy rates or relative abundances for most mammal species compared to those in a forest reserve managed with fewer resources. Estimated mammal species richness was higher in the national park (29 species) than in the forest reserve (18 species). Modelled occupancy rates (a measure of the proportion of sites used by species) were higher in the national park compared to the forest reserve for three species and were lower for one species. For species occurring at both sites, but in insufficient numbers to perform occupancy modelling, relative abundances were higher in the national park compared to the forest reserve for five species and were lower for one species. One site was a 177-km² forest within a well-resourced national park where poaching was considered to be rare. The other was a 200-km² forest reserve, managed with fewer resources and where poaching for bushmeat occurred. Each area was surveyed using camera traps, over 917 camera-trap days in the national park and 850 camera-trap days in the forest reserve, between July 2013 and February 2014.

(1) Hegerl C., Burgess N.D., Nielsen M.R., Martin E., Ciolli M. & Rovero F. (2017) Using camera trap data to assess the impact of bushmeat hunting on forest mammals in Tanzania. *Oryx*, 51, 87–97, https://doi.org/10.1017/s0030605315000836