speculate that the release of just six cheetahs in a park renowned for its high density of lions was unlikely to be a success.

For most species in Gorongosa, their extinction or low number was due to excessive hunting, but this was probably not so for roan antelope and tsessebe - the tsessebe was extinct before poaching caused massive declines in the numbers of other herbivores. Both roan and tsessebe prefer to feed in medium-height grass swards and are sensitive to changes in sward structure. The declines in their numbers may have been, at least partly, a consequence of competition for food with more-numerous and larger grazers, particularly those that favoured a short sward.

The Gorongosa strategy considers Kruger to be the most suitable source of numerous buffaloes for Gorongosa, despite the presence of Tb amongst Kruger's wild buffaloes and the high cost of screening animals to ensure that they are Tb-free. The strategy does not address why Marromeu Buffalo Reserve, just c.150 km eastwards of Gorongosa, on the southern Zambezi delta, and with several thousand buffaloes was not considered as a source population. At Marromeu, buffaloes are numerous enough for sport hunters in the adjacent coutadas to be allowed to shoot them (and, according to rumours, some hunters shoot buffaloes even within the Reserve - control is difficult in this watery environment). Gorongosa NP is within the catchment of Pungwe River, but the watershed between the Zambezi and Pungwe catchments lies just c.20 km northwards. The Urema trough (rift valley) that Gorongosa spans extends northwards until it is dissected by the Zambezi River. As one moves northwards along this trough, there is no significant barrier to animal movement and there can be little doubt that the Gorongosa system is more closely related biogeographically to the Zambezi system than to the more-distant Limpopo system in which Kruger lies. The Gorongosa strategy acknowledges that the same type of FMD virus is found in buffalo in southern Mozambique as in buffalo in Kruger, but that a different type occurs in buffalo in western Zimbabwe and the Zambezi Valley. It called for a study to determine which types are in Gorongosa's native buffaloes, and thus to define the acceptable sources of buffaloes for supplementation. However, it appears that this was not done, because although there are plans to release more buffaloes in Gorongosa, the origin of these will depend on work to determine the health status of the resident buffaloes.

The objectives over the first 10 years of the Gorongosa project are to increase rapidly the numbers of large herbivores and to re-establish the grazing succession. It is pointed out that the impact of the present levels of predation and poaching will be proportionally greater on small numbers of animals released gradually, than on the same total numbers introduced rapidly. The timetable for release will be accelerated if some species can be released directly into the park via temporary enclosures, rather than via the sanctuary. It is anticipated that after 10 years the sanctuary will be used only for breeding rare or endangered species, such as rhinos, roan and tsessebe. The proposal to translocate elephants to Gorongosa is made against a background of a current population of c.250 animals that run or hide from tourists, but which conflict with people living near the Pungwe River on the park boundary. Translocating more elephants is mainly in order to provide tourists with good, easy sightings of well-behaved elephants. The target is a population of 1000 elephants, but the strategy does not consider how the population will be maintained at this number, nor what effect the elephants will have on the vegetation. The strategy considers elephants in the Gonarezhou – Kruger system to be the nearest, genetically-similar source population for Gorongosa. There may be a lesson to be learnt from the translocation of elephants from Gonarezhou NP, Zimbabwe, to the nearly Save Valley Conservancy during the 1990s. Approximately 600 elephants were moved <15 years ago, but already managers are concerned about the effects of elephants on the woodlands and plan to reduce the number of elephants in the Conservancy.

Wild Dog Translocation to Hwange National Park

During October 2006, 16 wild dogs were released after spending five months in a rehabilitation facility near Hwange NP, Zimbabwe. The dogs had been moved from South Africa earlier during the year. There are already wild dogs in Hwange and its surrounds and the release site was within the territory of one local pack. Within a few weeks of release, two freed dogs were killed by lions. This translocation appears to have been executed without reference to the IUCN Guidelines for Re-introductions. Regardless of what is currently limiting the number of wild dogs in the Hwange region, it is unlikely that this release will lead to any long-term increase in the number of dogs. Perhaps factors other than ecological ones, maybe publicity or fundraising, were the main drivers behind this supplementation?

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Many people provided information, directly or via the websites and reports. Where it is not clear that the IUCN Guidelines for Re-introductions were, are and will be followed, I refrain from naming correspondents in order - as the saying goes - to protect the innocent. Ms Jessica Groenendijk (*jessica@fzs.org*) and Ms Heloise de Villiers provided valuable information about the translocations to Luangwa and Limpopo respectively.

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Behavioral modification in meta-population management of black rhino, Southern Africa

Black rhino are in the midst of a conservation crisis (Linklater, 2003) (***see photo 1***). Of the world's approximately 65,000 black rhino in 1970 habitat loss and hunting for horn reduced the species to

Photo 1: Black rhinoceros (*Diceros bicornis*) & field ranger @ Wayne Linklater

approximately 2,450 individuals by the early 1990s (Amin *et al.*, 2006). To avert the crisis and facilitate a recovery, black rhino are being translocated across the African continent into safer reserves, re-introduced to new reserves for the expansion of the meta-population, and transferred between reserves for demographic and genetic management, particularly of small populations. Moreover, the removal or 'harvest' of rhino from reserves with large endemic populations not only supplies rhino for translocation but also serves to improve breeding and survival rates by keeping densities in those donor reserves below carrying capacity. In this way translocation, along with habitat and population protection, has facilitated an initial, although slow, recovery such that there are now around 3,610 black rhinoceros (Emslie, 2004).

Unfortunately, injury and death are common after the release of black rhino, particularly if there are already conspecifics resident at the release site, thus limiting the success of black rhino translocations and ultimately species recovery. The most common causes of injury and death are behavioral mediated: stress-related debilitation, collisions with both artificial and natural hazards like fences, and conspecific fighting. Our objective, therefore, was to improve understanding about the behavioral ecology of the species and trial ways of improving survivorship and breeding after translocation by modifying rhino post-release behavior in ways that might reduce injury and death. In particular, we considered that black rhinoceros behavior might be modified by manipulating the scent environment into which individuals are released or currently live (Linklater, 2004).

Approach

Using an adaptive-management (science-by-management) framework we have followed the fates of 88 black rhinos captured from donor reserves and translocated since 2002 to 15 reserves ranging in size from 670 to 45,000 ha including small private reserves and larger National Parks. Major donor populations included Hluhluwe-iMfolozi Park in South Africa and Etosha National Park in Namibia. While the black rhino were held temporarily in boma (reinforced enclosures) prior to release we conducted scent presentation tests to measure their olfactory capabilities. To monitor post-release behavior and outcomes the rhinos were fitted with horn-implant transmitters that emit a radio signal for up to 22 months after installation. After release data have been collected from located rhinos on more than 4,000 occasions to date. Data collected include a combination of direct behavioral observations, remotely tracking the track and sign of known individuals, and location data obtained via direct observation or triangulation. Several scent broadcasting experiments have been conducted; some about the reserves or release sites before re-introductions and others within donor populations from which some of the rhino were captured for translocation. We broadcast rhino scent in the form of urine and dung about the release site or reserve prior to a release, or about 1 km^2 areas within the Hluhluwe-iMfolozi donor populations and measured for changes in black rhinoceros movement and activity.

Discussion

Black rhinos are a relatively asocial species and therefore probably depend on the scent from dung and urine to communicate with conspecifics. In the scent presentation experiments black rhinoceros responded differently to dung and urine from conspecifics that differed in their sex, reproductive status, individual identity, and dominance. We also showed that dung serves as an olfactory signal for at least 30 days after it is deposited. Thus, black rhinos do indeed possess a sophisticated olfactory communication system. Rhino released into reserves where conspecific dung had been spread moved further from the release site initially and traveled more about the reserve than rhinoceros released into reserves where conspecific dung had not been spread. The effect was greatest for rhino whose own dung was spread compared to those that encountered the dung of other rhino. We interpreted these results as indicating that the presence of dung facilitated initial exploration or 'confidence' (see also Linklater et al. 2006). There was also a tendency for rhinos to settle next to areas spread with the dung of other rhino than in areas seeded with their own dung or no-dung controls. Although solitary and aggressive, black rhino still prefer to settle in areas apparently occupied by other rhino, perhaps because dispersing rhino use the presence of conspecifics as a cue to find suitable habitat when they are unfamiliar with the area. We speculate that the effect might also reduce the probability of conflict and accident. Thus, preliminary results support our hypothesis that scent functions as a conspecific attractant and might be used to facilitate home range establishment and formation of social and breeding relationships (Linklater et al., 2006).

Scent broadcasting in the Hluhluwe-iMfolozi donor population demonstrated that black rhino reduced their feeding activity in areas spread with the scents of other, previously unfamiliar, rhino. While browsing intensity in control sites where sand had been spread increased, browsing rates in areas broadcast with scent decreased. The effect last for up to 9-months after the dung is spread and also appears to be greatest and more persistent when female, compared with male, scent is broadcast. It may be that black rhino avoid areas with unfamiliar scent. This avoidance response means that scent might be used to reduce black rhino activity in some areas or spread in other areas to encourage rhino to leave the area to feed. In this way scent broadcasting might be used to limit or encourage emigration or dispersal.

Managing post-release behavior for improved survival involves more than just olfactory management. Our findings indicate that several aspects of the release strategy also influence translocation success. For example, we describe the advantages of releasing rhino from individual sites that are spaced across the landscape (i.e., free-release) in tandem with a scent-broadcasting regime (Linklater *et al.*, 2006) rather than the technique of releasing all rhino from the same site from boma most used in the past. So long as the reserve is large enough to accommodate multiple well-spaced release sites, free-releasing appears to reduce encounter rates and conflict during the immediate post-release period when the rhino are in an unfamiliar habitat and social context, and removes the costs in time, money and disruption of on-site boma construction and the need for an additional acclimation challenge to rhino. Reserve size and the density of rhinos also affect post-release success. Our measures of movement and association with conspecifics after releases indicated that black rhino endeavor to avoid each other, in a way that probably minimizes confrontation and conflict. However, the results show there to be a threshold somewhere between reserve sizes of 11,500 and 18,000 ha and population densities greater than 0.05 rhino per km^2 (or less than 20 km^2 per rhino) when association and movement rates after release become elevated. In reserves smaller than 11,500 ha released rhino regularly encountered the fenced boundary and other rhino. Three rhino sustained injuries requiring intervention to three rhino and four died. All of the injuries and two of the deaths were fight-related. All but one of the deaths occurred on reserves 11,500 ha or smaller. These results indicate that reserves smaller than 18,000 ha pose an increasing risk to rhino survivorship as reserve size declines due to increasing rates of encounter by the rhino with the key hazards associated with post-release mortality: fences and other rhino. The tendency for rhino released at lower densities and in larger reserves to almost entirely avoid associating with other rhino suggests that the high rates of association in smaller reserves are forced upon the rhino by smaller reserve size and higher population density.

Our work demonstrates the usefulness of understanding black rhinoceros behavioral ecology to help refine criteria for selecting between release strategies and the reserves to receive rhino. A better understanding of black rhino behavior is likely to also provide new ways of improving population management. The ecology of communication by scent, in particular, is a promising avenue of investigation for the development of innovative wildlife management tools.

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Twelve years of mammal re-introductions and introductions by the Australian Wildlife Conservancy

The Australian Wildlife Conservancy (AWC) is an independent, non-profit organization dedicated to the conservation of Australia's threatened wildlife. AWC's strategy for conserving all Australian animal species and the habitats in which they live includes: establishing wildlife sanctuaries, implementing practical, on-ground conservation programs, conducting scientific research, and public education. This national organization manages 15 wildlife sanctuaries across Australia, covering a total area of over 1.1 million hectares. AWC have successfully conducted numerous threatened mammal translocations. Combined with existing fauna, AWC sanctuaries now protect more than 55% of all Australian mammal species.

Methodology and Results

Between 1994 and 2006 AWC translocated 16 species of mammals to four wildlife sanctuaries in Western Australia