'Behavioural ecology and management-induced niche shift of brown hyena in a closed reserve; implications for conservation management.'

Executive summary

Closed reserves are an increasingly common wildlife management strategy across southern Africa. They represent a practical solution to separate wildlife from surrounding human communities, thereby protecting both sides from threats such as human-wildlife conflict. However, the often small size of such reserves means they can represent a threat to the survival of species within them when natural processes such as emigration, immigrations and expansions of ranges are prohibited.

This may ultimately lead to inbreeding depression and at an extreme level, local extinction. Additionally, opportunities for spatial partitioning of potentially competing species may be limited, which may influence the community structure within the enclosed area, as well as the spatial organisation and activity patterns of subordinate species. As a result, wildlife populations living in closed reserves require close monitoring and management to ensure their long-term survival, and that conservation intentions are successful.

Differences in the behaviour of species living inside a closed reserve, compared to those free-ranging individuals may be expected given the varying environmental conditions, and such differences have been termed 'management-induced niche shift'.

Management-induced niche shift may manifest in a number of forms, influencing various aspects of a species' behavioural ecology, such as spatial and social organisation and activity patterns.

The Okonjima Nature Reserve, is ideally suited to studying carnivore management-induced niche shift. The 200km² reserve is fully surrounded by an electrified fence line, and bordered by commercial farmlands. It is home to a number of carnivore species, including leopard *Panthera pardus*, cheetah *Acinonyx jubatus*, spotted hyena *Crocuta crocuta* and brown hyena *Parahyaena brunnea*, as well as a host of mesopredator species. Brown hyena, classed as 'Near Threatened' by the IUCN, makes for an interesting species in which to study management-induced niche shift, for a number of reasons; it is a species with the potential to reach a high population density within a closed reserve, for example Welch and Parker (2016) recorded a 367 % population increase following the introduction of six individuals 10 years prior, equating to a density of 19 brown hyena/100 km². The species is subordinate to spotted hyena (Mills, 1990) and is therefore more likely to alter its behaviour to avoid direct encounters with this species on the reserve.

Within Namibia, brown hyena research has largely been restricted to coastal populations, or to a smaller extent, free-ranging individuals occurring on commercial farmlands, therefore this study will fill the void of information regarding brown hyena ecology on closed reserves. Finally, brown hyena is a species whose persistence across its range is threatened by lethal removal following real or perceived livestock-predation events and therefore is likely to increasingly rely on protected areas for its survival.

This project will focus on the behavioural ecology of the naturally occurring and free-ranging brown hyena population residing in the Okonjima Nature Reserve, using a number of non-invasive methods. GPS collars will be fitted to adult individuals to obtain high resolution spatial and activity data, and camera traps will be used to produce density and occupancy estimates and to study and sympatric carnivore interactions. Additionally, a full epidemiological study will be conducted to ascertain the disease prevalence in the brown hyena population. A genetic diversity study will also take place to evaluate the genetic diversity of the population, whivh, given that the population has remained closed within the reserve for some years, may have been compromised.

The results of the study will be published in peer-reviewed scientific journals and where appropriate as popular science media articles, to ensure the results are disseminated to a wide and appropriate audience to help achieve maximum impact. Understanding the behavioural ecology of species living in fenced reserves will not only help manage carnivore populations in reserves; the data will become increasingly relevant as the trend for wildlife-proof fencing used by the growing wildlife industry on private lands across southern Africa progresses (Weise et al. 2014), which will increasingly fragment wildlife populations.

Fencing is now a legal requirement for ranchers to own wildlife in Botswana, South Africa and Zambia (Lindsey et al. 2012). Within Namibia, 43 % of the landscape is currently used as commercial farmlands for domestic livestock (Barnes & de Jager 1995), however there is a rapid movement towards the farming of wildlife (Erbs 2004) and in particular the breeding of expensive species such as roan *Hippotragus equinus* and *sable Hippotragus niger*. The use of electrified fencing will essentially convert game ranches into fenced reserves, on which species will only continue to persist if tolerated by landowners.

Progress: The brown hyena project started in January 2018 with ten GPS Wireless Wildlife collars being purchased and the project being granted funding for 40 camera traps, protective boxes, SD cards, batteries and chargers by the Namibian Wildlife Conservation Trust. Varta batteries subsidised the cost of purchasing the batteries as part of their pledge to supporting conservation within Namibia. On the 25th January the first brown hyena was collared at the feeding site by Wahu gate. Due to the damage brown hyenas can inflict on themselves in a box trap, the decision was made to free-dart all hyenas. Dr. Diethardt Rodenwoldt, the AfriCat veterinarian darted the hyenas whilst he was feeding from bait put out for the purposes of darting. The hyena ran a short distance after the dart went in, but was actually so calm he then started eating the bait again until the effects of the drugs started to kick in. This was a young male, weighing 44.5 kg and standing 82 cm tall at the shoulder.

Four nights later the team darted another male hyena from the same area. This was a well known individual on Okonjima for having a broken 'floppy' ear. This was an older male who weighed 45.8 kg. The team then moved over to Dam Lisa and darted a female on the 8th February at a specially selected bait site, with another female darted at Dizzy Hill on the 12th February.

When the hyenas are sedated we take biological samples including hair and blood so that the disease prevalence and genetic diversity of the population can be evaluated. It also gives Dr. Rodenwoldt the chance to assess the health of each individual. We are currently receiving regular downloads of the spatial data from the collar and it seems the two males come from the same clan, whilst the two females come from different clans. We now plan to dart in the western section of the park and look forward to learning more about the hyenas through their spatial data. At the time of writing 1,340 spatial points have been downloaded from the four hyenas.

In-between darting activities, mapping of hyena signs across the park has been ongoing. Currently, 57 paste marks and 39 latrines have been identified and mapped. Paste marks are anal gland secretions placed on grass stalks throughout the territory of a clan and serve as a means of olfactory communication between clan members and along with latrines, sites where hyenas go to defecate, help warn intruders the area is occupied. Brown hyenas produce both a white and black paste mark; they are the only members of the hyena family to produce two different paste types. Paste marks and latrines are excellent sites for camera trap placements as the hyena is likely to stop still in front of the camera whilst sniffing, pasting or defecating, meaning clear photos of the front leg stripe patterns can be obtained. The front leg stripes of the brown hyena are individually unique and can therefore be used to identify individuals.

Whilst we wait for the delivery of the 40 camera traps, six cameras have been set up at latrines and paste marks to start monitoring hyena activity across the park. The cameras are capturing lots of hyena data and showing us which individuals have overlapping ranges and allowing us to start cataloguing individual identification images. We look forward to deploying the full 40 camera traps and start modeling the density of the Okonjima brown hyena population and gaining a better understanding of their ecology, which will ultimately help us to make well informed conservation management decisions.

We thank both the Namibian Wildlife Conservation Trust, Varta batteries Namibia, the National Council for Research Science and Technology and the Namibian Ministry of Environment and Tourism for supporting this project.

Update: Since the writing of this report we have now received a grant from the Namibian Wildlife Conservation Trust to fund the camera trap part of the study. We now have 40 camera traps set up across the park.