Small mammals at Maremani Nature Reserve

South Africa

by

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Introduction

Maremani Nature Reserve is situated in the northernmost part of The Republic of South Africa, along the Limpopo River at the border to Zimbabwe. The reserve is fenced, comprising approximately 40.000 ha. It consists of a collection of former farms that had a physical and biological impact on the nature. This implies that to a more or lesser degree the past land-use practices, the confinement of animals to fenced subdivisions, which do not necessarily represent ecological units, and the suppression of natural processes due to the provision of water and the exclusion of veld fires formed the starting point in 1999 for the reserve (Joubert 2002). Thus, the vision and mission of the Maremani Nature Reserve is the restoration of the natural attributes of the environment to a level where the area represents its original state.

The area is dominated by granite and sandstone formations. The soils derived from the granites are generally shallow, stony, nutrient poor and support a poor grass cover. Soils derived from sandstone often result in deep sands with a better grass cover than the granitic soils (Joubert 2002).
The reserve has been described in in detail with respect to geology, geomorphology and soil types (Barton 2002, Nel 2001). Botanical surveys have also been performed (Rooyen 2002) and 17 major vegetation types are described. In addition, studies of birds, reptiles and larger mammals have been performed. We visited the reserve from the 9th to 23rd October, 2018, to perform a preliminary small mammal survey.

Site, materials and methods.

Botanically, the reserve is within the lowveld bushveld region also known as semi-desert. The area receives very little precipitation, and the previous four years have been extremely dry. Accordingly, the herb and grass layer vegetation at the time of investigation was virtually absent, also due to intensive grazing by larger herbivores.

Due to the low precipitation, the number of available water-assemblages for small mammals were few. The Limpopo River was reduced to a few remnant water ponds, so was the Nzhelele River, whereas the Sand River was completely dry. Within the reserve, water was administered to larger wildlife in artificial water ponds but few of those were available to small mammals.

The taxonomy of African rodents is still far from resolved and many revisions have been made. We follow the nomenclature of the latest major synthesis by Monajem et al. (2015).

Habitats

For the present investigation, five different habitat types were monitored for small mammals:

Mopane shrub covers the larger part of the reserve on plains and low rocky hills. In this habitat, all herb and grass vegetation has been removed and only piles of *Mopane* leaves were left around bushes and tree trunks. Thus, the only cover for small mammals were rocks and debris. Trappings were performed at four locations, one close to Udini camp, two within the Sable enclosure and one close a the Rocky outcrop.

Rocky outcrops are remnants of former mountains, were few in numbers, and scattered throughout the reserve. Generally, they are without vegetation with the exception of a few bushes and small trees. Trappings were performed at one such location south of the main office.

Riverine habitats comprised partly riparian communities and partly stream communities. They had at places a thicket of tall grasses and reeds in the riverbed and thorny bushes along the riverbank. Trappings were performed at three locations, one at the riverbed of Sand River, one at the riverbed of Nzhelele River and one at the riverbank at the Nzhelele River.

Surrounding of buildings etc. often contained lush vegetation as well as dry grassy parts. At some places, small gardens are found, especially around the office of the reserve. Trappings were done within the fenced area of the main office.

Grassy areas. Malala Drift Road runs through and divides the Maremani Nature Reserve in two. The fences of the reserve are placed approx. 10 meters from the road, leaving an un-grazed strip. Smaller areas within the reserve are also enclosed and un-grazed, either because they are used as scientific controls or because they are used for wildlife rearing purposes. Trappings were done at four locations, two within the Sable enclosure, one within the Rhino Boma and one within the Elephant Boma.

Trappings

Small mammal biodiversity was investigated by means of standard transect trap lines. Each trap line comprised of 10 trap stations and each station had four traps: One Ugglan Special live trap, one Ugglan Lemming live trap, one Little Nipper snap-trap and one Quick snap-trap. The live traps were baited with fresh apple, peanut butter and müsli, the snap-traps with raisins and peanut butter. Most days at least four trap lines were active. Traps were checked and re-baited twice a day.

All the trapped animals were weighed to the nearest 0.5 g and measured with a ruler to the nearest mm (head and body, tail) and with a calliper to the nearest 0.1 mm (hind foot and ear). Skins and skulls of the trapped animals were preserved for later identification. They were salted and air-dried in the field and later frozen. Before cleaning of skulls, a sample of the masseter muscle from each was preserved in ethanol.

Results

Trappings were performed during ten days and resulted in 1292 trap-nights. On several occasions, ants removed the bait, and baboons destroyed one trap line and disturbed other traps.

In total, the trappings resulted in the catch of 40 small mammals, comprising 36 rodents, 3 shrews (*Crocidura maquassiensis*) and one elephant shrew (*Elephantulus intufi*). Among the 36 rodents, we found eight taxa, two of which we could not identify.

Most abundant among the rodents were a species of rock mouse (*Aethomys chrysophilus/ineptus*, 13 specimens) and a species of gerbil (*Gerbilliscus leucogaster*, 5 specimens). We also caught the Namaqua rock mouse, *Micaelamys namaquensis* (2 specimens), *Saccostomus campestris* (2 specimens) and one climbing mouse (*Dendromus melanotis*). In the grass within the office enclosure, we trapped four multimammate mice (*Mastomys natalensis* or *M. coucha*) and six smaller mice with cranial characteristics similar to *Mastomys*.

Three specimens with cranial characteristics similar to *Aethomys*/*Micaelamys*, but with shorter tails, were trapped. Two of these were caught in a kopje (rocky outcrop) and one in the enclosure Roan Camp 2.

Most rodents were either reproductively active or showed signs of becoming active. They were generally in good condition with subcutaneous and internal fat deposits.

Most small mammals were trapped in enclosures where ungulates were prevented from entering or where grazing pressure was low, so that there was some grass cover left. Per 100 trap nights, the catch in grass was 6.86, in rocky outcrop 2.5, in riverine vegetation 1.14, and in Mopane with no grass 0.36. The catch in the riverine vegetation is probably underestimated because baboons raided many of the traps here.

Apart from the small mammals trapped, the Smith's bush squirrel (*Paraxerus cepapi*) was common everywhere and cane rats (*Thryonomys swinderianus*) have been observed in the Sand River (Rieker Botha, pers. obs.). While driving at night, we saw a small-spotted genet (*Genetta genetta*).

Discussion

Though numbers caught at Maremani are too few to allow statistical analysis, it is remarkable that the catch per trap night is 20 times higher in enclosures with grass than in the surrounding Mopane bushveld, where large herbivores have access. In spite of the low catch, diversity was relatively high, with 10 species of small mammals identified among just 40 trapped individual specimens.

Taylor (1998) trapped small mammals in 14 protected areas in KwaZulu-Natal. He found between 1 and 12 species per area. The overall relative abundances (number of captures/100 trap nights) were between 0.4 and 11.1, but when analysed for individual habitats it could be as high as 18.7 in bushveld and 21.6 in wetland.

In a recent study of small mammals in Kruger National Park and three protected areas in Eswatini (Loggins et al. 2019), 11 species were recorded among 1,532 individuals caught. That study concluded that grass biomass was significantly related to species richness.

Annual rainfall in Musina is about 372 mm, but since 2014, precipitation has been well below that average with 2018 being a particularly dry year. There is no doubt, that prolonged droughts in combination with the relatively high ungulate grazing pressure has affected small mammal populations negatively. The almost complete removal of grass and herb cover means less food for granivores and herbivores and, eventually for insectivores too. It further increases exposure to predators. In the end, the resulting population reductions will have ecological implications for animals that feed on small mammals such as small mammalian carnivores, owls and birds of prey, and probably, many species of snakes.

A study in Umfolozi Game Reserve (Bowland 1986) showed higher small mammal abundance in areas where ungulates were culled compared to non-cull zones. The same study showed that differences between these areas were intensified during a drought and that small mammals were obliterated in areas where the cover was completely removed.

Taxonomy of African small mammals is far from resolved and the presence of sympatric sibling species complicates faunal and ecological studies. Two genera among the species encountered at Maremani are particularly problematic: *Aethomys* and *Mastomys*.

Both *Aethomys chrysophilu*s and *Aethomys ineptus* occur in the northern Limpopo region (Russo et al. 2006; Chimimba and Linzey 2008). *Aethomys ineptus* is externally indistinguishable from its sibling species, *A. chrysophilus*, but can be distinguished by chromosome number (2n = 44 in *A. ineptus*, 2n = 50 in *A. chrysophilus*), hemoglobin characteristics and mitochondrial DNA (Russo et al. 2006; Linzey and Chimimba 2008; Chimimba and Linzey 2008). The morphology of spermatozoa is also different with *A. ineptus* having a spatulate sperm head while *A. chrysophilus* has a falciform-shaped sperm head (Breed *et al.* 1988; Visser and Robinson 1987). We were not able to perform any of these analyses at Maremani and therefore we are not able to determine the specific identity of the captured *Aethomys*.

The genus *Micaelamys* was formerly included in the genus *Aethomys* (Chimimba et al. 1999). Russo et al. (2010) studied Cytochrome b sequences of 360 widely sampled individuals of *Micaelamys namaquensis* from southern Africa. They suggested the presence of at least eight lineages or haplogroups in contrast to a comprehensive intraspecific morphometric study (Chimimba 2001), that suggested the recognition of four subspecies differing in both cranial size and shape. Russo et al. (2010) concluded that the mtDNA diversity supported earlier views that *Micaelamys namaquensis* may represent a species complex.

The multimammate mouse *Mastomys natalensis* Smith, 1834 occurs throughout sub-Saharan Africa, making it the African rodent species with the largest distribution range. It has a wide habitat tolerance and occurs from sea level to high ground but is absent from extremely arid areas (DeGraaff 1981). It is also abundant in cultivated areas (Christensen 1996).

When Matthey (1966) identified three chromosome forms within this taxon, it was realized that it contained more than one species. However, the discrimination among most of the *Mastomys* species is often difficult, if not impossible, based on external characters. At least four *Mastomys* species are sibling species with no diagnostic external morphological criteria. However, they can be distinguished based on karyotypes and haemoglobin electrophoresis (Granjon *et al*. 1997).

Based on karyotypes and haemoglobin electrophoresis, Green *et al*. (1980) identified two sibling species of *Mastomys* in South Africa and Zimbabwe. They suggested using the name *natalensi*s Smith, 1834 for the 2n=32 species and *coucha* Smith, 1836 for the 2n=36 species, since their occurrence is consistent with the type localities of these taxa. The two species are not readily separated in the field or based on single morphological characters, but Dippenaar *et al.* (1993) were able to separate them based om multivariate (PCA) and univariate (discriminate function) analysis of cranial measurements.

Lecompte *et al*. (2005) could reliably identify the four *Mastomys* species *M. natalensis*, *M. erythroleucus*, *M. huberti* and *M. coucha* based on cytochrome b sequences. This approach requires only small quantities of total DNA, and it can be performed on a small piece of ear, tail or toe taken from live animals.

While eight species of the genus are recognised at present (Monadjem *et al*. 2015), *Mastomys natalensis* is still the most widespread species occurring in a wide range of habitats except primary forest, where it is only found within human habitations. In the area of the Maremani Reserve, *M. natalensis* and *M. coucha* are likely to be sympatric.

Scull morphology of many murine rodents is quite similar, but Rosevear (1969) noted that *Mastomys* could be separated by the fact that the palatine bone never extends further forward than the front lamina of M^2. Further, the suture between the palatine and palate proper is usually deeply V-shaped, with the tips of the V reaching to the junction between M^2 and M^1. The mesopterygoid fossa, where it abuts on the posterior margin of the palatine, is generally less than 1 mm wide. The anterior palatine foramina always reach to well between the molar rows. We used these characters to assign our specimens to the genus.

The only shrew species we caught we identified as the relatively rare *Crocidura maquassiensis*. Meester (1963) suggested that *Crocidura maquassiensis* was restricted to rocky habitats, but Taylor (1998) recorded it in both grassland and wetland.

Conclusion

We find that the number of species of small mammals recorded at Maremani is high and in accordance with numbers in other protected areas in South Africa (Taylor 1998; Loggins et al. 2019). Restoration of vegetation cover with increased rainfall will increase abundance of some of the species, and will possibly increase species richness. We believe that a few more rodent and insectivore species are likely to be present on the reserve.

In view of the possible presence of cryptic species and the lack of identification of two of the species caught, we suggest that molecular analysis be performed on the preserved muscle samples. DNA-barcoding of the species will allow non-destructive sampling and identification in future studies.

A repeated investigation of the small mammals at Maremani should be performed when rainfall has restored the ground cover of grass and herbs in the Mopane bushveld. Such a study should also establish density estimates of small mammal communities within major vegetation types and include a study of the bat fauna.

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