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## Copper Deficiency in Waterbuck: a Disease of Affluence?

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**G**orongosa National Park, situated largely within the tail end of the Great Rift Valley in the heart of Mozambique, was renowned for its vast herds of wildlife before Mozambique's devastating civil war. Most of the wildlife was eliminated during two decades of warfare and is only now beginning to recover, with help from the Gorongosa Restoration Project.

The centre of the park, geographical and ecologically, is the shallow Lake Urema and the surrounding floodplain which is inundated every summer. Apart from the floodplain, the park contains around twenty vegetation types, including miombo woodlands, acacia savanas, grasslands and forest (Stalmans and Beifuss).

During July 2011, I visited the Gorongosa National Park, partly to investigate a phenomenon that several staff had mentioned as a possible pathological sign for the post-catastrophic ecology of the Park. There is a large population (approx. 13,000) of waterbuck (*Kobus ellipsiprymnus*) on the Urema floodplain, with a proportion of the waterbuck reputedly showing bleached fur, and several territorial males with only one horn

(Franziska Steinbruch, pers. comm.) Here is possible nutritional explanation for these abnormalities, from a partly veterinary perspective. During my visit I confirmed that waterbuck seen on the edge of the floodplain include several or many pale-looking individuals, in which the full pigmentation of the pelage is not expressed. I also noticed a remarkably great incidence of one horned territorial males. Both symptoms could have the same cause. It is well-known that deficiency of copper can lead to bleaching of the fur, in both domestic and wild hoofed mammals. Copper-deficiency also affects bone formation and could possibly explain breakage of horns at the base during normal sparing among males.

So it appears, at least superficially, that there may be some incidence of copper-deficiency among the waterbuck at Gorongosa today, which would be consistent with the fact that the total population of this species is now about fourfold what it was at the heyday of the Park in the late sixties or early seventies.

This could fairly easily be tested by sampling: copper is stored in the liver and any carcasses of waterbuck could be sampled for liver copper concentration.

It could also prove consistent with experience at Lake Nakuru in Kenya, which has had extremely dense populations of waterbuck in a similar geological and ecological setting (Great Rift Valley). Maskall and Thornton (1989 and subsequent publications) documented deficiencies of trace elements including copper in waterbuck and impala at Lake Nakuru. If tissue samples are taken at Gorongosa it would be wise to include cobalt and molybdenum in the list of elements analysed because they are part of the same nutritional complex as copper, and in the case of Lake Nakuru cobalt was deficient while molybdenum was excessive, antagonizing copper (Maskall and Thornton 1989).

How could copper deficiency occur on the rich alluvial soils of the Urema Floodplain, with their rich grasses? The answer is based not on soil poverty but on overpopulation, as Ellen Dierenfeld (of Novus International) with her extensive experience of trace element deficiencies in zoo animals has helped to explain to me.

The waterbuck at Gorongosa today are overpopulated in the sense that this is the only species of large herbivore (> 60 kg body mass) that is so much more numerous than originally that a decrease in its population in the future seems inevitable; i.e. the current numbers of waterbuck at Gorongosa are unsustainable as the populations of other floodplain grazers such as hippo, buffalo, zebra, and wildebeest build up again. Given free access to all the best grazing, the waterbuck is able to eat a greater-than-usual proportion of its diet in the form of sulphur-rich plants such as herbaceous legumes.

These legumes include native genera such as *Rhynchosia* and *Tephrosia* and possibly also the exotic and invasive but very palatable *Mimosa pigra*, which is known to be common on the floodplain and which is known to be eaten by hippo (*Hippopotamus amphibius*), impala (*Aepyceros melampus*), and other grazers. This leads to relative richness of rumen contents in sulphur, which can be thought of as leading to a disease of affluence for the waterbuck because in a balanced community of grazers the nutrient-rich leguminous species would have been shared.

Sulphur antagonises copper in the rumen, leading to reduced absorption of copper from the small intestine. This is because sulphur, released by foregut fermentation, binds to copper to form insoluble copper sulphide, which tends to be defaecated. Although this hypothesised induced copper deficiency is not a problem in the sense that it is likely to prove self-correcting with the current rapid increase in the numbers of impala at Gorongosa, it is a sign that the waterbuck population is at its top and has nowhere to go but down, at least in the floodplain habitat. It remains to be seen whether the waterbuck will continue to expand into savanna and woodland in the Park in lieu of buffalo (*Syncerus caffer*), zebra (*Equus quagga*), and wildebeest (*Connochaetes taurinus*).

At the moment there is a sprinkling of waterbuck in woodland (e.g. seen by me between the main camp, Chitengo, and the Park gate) and I suspect that copper deficiency symptoms are not to be found in this vegetation type despite the abundance of forage.

If it is true that the waterbuck at Gorongosa are currently clinically or subclinically copper-deficient, then it remains unclear whether this would have occurred in the absence of an invasive alien presence of *Mimosa pigra*, an acacia-like woody species originating from South America, in the Park.

The overpopulation of waterbuck on the floodplain highlights the remarkable reluctance of the lion (*Panthera leo*) population at Gorongosa to congregate at the lake edge and to exploit the waterbuck, which could theoretically support an exponential increase in the lion population. This presents a once-in-a-lifetime opportunity for research for anyone interested in the relationship between waterbuck and lion, which has been ambivalent and remains controversial in view of a hypothesised chemical antipredator defence in the glandular skin of the waterbuck.

## References

- Maskall J E and Thornton I 1989. The mineral status of Lake Nakuru National Park, Kenya: a reconnaissance survey. *African Journal of Ecology* 27, 191-200.
- Stalmans M and Beilfuss R 2008. Landscapes of the Gorongosa National Park. Report for Gorongosa National Park, Gorongosa. 102 pp.



Figure 1: One-horned Waterbuck at GNP Picture taken by Adolfo Macadona



Figure 2: Waterbuck herds on the floodplain at GNP - Picture taken by Alan Short