

# Activity pattern relates to body temperature variation of differently sized South African antelopes

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Heat stress can limit the activity time budget of ungulates due to hyperthermia, which is relevant for African antelopes in ecosystems where temperature routinely increases above 40 °C. Body size influences this thermal sensitivity as large bodied ungulates have a lower surface area to volume ratio than smaller ungulates, and therefore a reduced heat dissipation capacity.

We first tested whether the activity pattern during the day of three antelope species of different body size—eland, blue wildebeest and impala—is negatively correlated with the pattern of black globe temperature (BGT) [1]. Furthermore, we tested whether the larger bodied eland and wildebeest are less active than the smaller impala during the hottest days and seasons. To understand this adaptive behaviour, we investigated daily and seasonal variation in body temperature (T<sub>b</sub>) of these three species of antelope, using abdominally-implanted temperature data loggers [2].

The study was conducted at two climatically contrasting environments in South Africa, one with a less seasonal and mild winter (Mapungubwe National Park) and the other with a more seasonal, long and cold winter (Asante Sana Game Reserve) [1,2]. Since the habitat with long and cold winters would be suboptimal for these African antelopes, which evolved in less seasonal and hot environments, antelopes in Asante Sana were expected to exhibit a larger amplitude in T<sub>b</sub> and a lower minimum body temperature (MinT<sub>b</sub>) during winter to reduce T<sub>b</sub> and the ambient temperature (T<sub>b</sub>-T<sub>a</sub>) gradient to save energy.

Our results show that BGT was negatively correlated with the diurnal activity of eland, wildebeest and impala, particularly during summer. During spring, only the activity of the larger bodied eland and wildebeest was negatively influenced by BGT, but not for the smallest of the three species, the impala. We argue that spring, with its high heat stress, coupled with poor forage and water availability, could be critical for survival of these large African antelopes.

In both eland and impala, 24-hour body temperature amplitude did not differ between the study sites, regardless of season. Conversely, wildebeest in Mapungubwe showed a higher variability in the 24-hour amplitude of body temperature and also a lower MinT<sub>b</sub> during winter and spring than the wildebeest in Asante Sana. This variation in T<sub>b</sub> among Mapungubwe wildebeest was influenced by both the amplitude of ambient temperature (positive) and cumulative rainfall (negative), which was not the case for wildebeest in Asante Sana. We propose that the low MinT<sub>b</sub> of wildebeest in Mapungubwe was the result of nutritional stress during winter and spring; an evident response even during a year of average rainfall. Therefore, these wildebeest apparently live in a physiologically stressful environment.

With the predicted increase in the frequency and intensity of drought periods in southern Africa, wildebeest, and other grazers, will likely experience greater nutritional stress in the future. Our study contributes to understanding how endothermic animals can cope with extreme climatic conditions, which are expected to occur more frequently due to climate change.

All experimental procedures were approved by the Animal Ethics Screening Committee of the University of Witwatersrand (protocol no. 2007/60/4) and South African National Park.

## References

1. [1] Shrestha A.K., Van Wieren, S.E., Van Langevelde, F., Fuller, A., Hetem, R.S., Meyer, L.C.R., De Bie, S., Prins, H.H.T. (2014). Larger antelopes are sensitive to heat stress throughout all seasons but smaller antelope only during summer in an African semi-arid environment. *International Journal of Biometeorology* **58**:41-49
2. [2] Shrestha A.K., Van Wieren, S.E., Van Langevelde, F., Fuller, A., Hetem, R.S., Meyer, L.C.R., De Bie, S., Prins, H.H.T. (2012). Body temperature variation of South African antelopes in two climatically contrasting environments. *Journal of Thermal Biology* **37**:171-178