

Antidorcas evolution and dietary adaptations in changing palaeoenvironments in southern Africa

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BACKGROUND INFORMATION

Springbok (genus *Antidorcas*) was an abundant, herbivorous antelope present in many hominin-bearing deposits in Africa. Traditional studies assert that there are no less than 4 species present throughout the temporal period of 2.8-0.8 Ma in southern Africa. *Antidorcas bondi* was thought to be a grazing species, part of a grazing succession, feeding on the newest shoots (Brink and Lee-Thorp 1992). The ancestral *Antidorcas recki* was believed to have been a predominantly browsing species (Luyt 2001). The extant, *Antidorcas marsupialis* is believed to have been a mixed feeder throughout, adapting its diet to the changing palaeovegetation conditions. The potential fourth species, *Antidorcas australis*, has relatively little known about its palaeoecology and its taxonomic assignment as a distinct species from *Antidorcas marsupialis* is debated (Vrba 1974, Gentry 1978,1992), there is the suggestion that it was a transitional form between *A. recki* and *A. marsupialis*.

Species identifications are made on visual assessment (Vrba 1973) and morphological measurements. A multi-method analysis of diet is conducted on these *Antidorcas* species to understand the prevailing vegetation types present in the geographic and temporal area. The link between faunal evolution and climatic changes is a long-standing one (e.g. Vrba 1985; Potts 1998; De Menocal 2004, Hopley et al. 2007) but remains to be resolved. The predominant pattern is one of increasing grasslands with marked transitions at 2.5 Ma and 1.7 Ma.

METHODS

Morphological Measurements

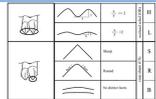
Measurements are used alongside visual dental landmark assessments to identify remains to species and locate where species changes occur. Dentition shows what the animal is capable of eating but cannot be used as a dietary proxy to prove what they did consume.



Mesowear

The macro-level wear on permanent molars is assessed according to the occlusal relief of the tooth and the cusp shape.

Protocol set out by Fortelius and Solounias (2000).



Dental Microwear Textural Analysis (DMTA)

Microscopic wear imprinted on the dental enamel facets showcase the last few meals eaten by that individual. Wear patterns are unique to the type of vegetation and the mastication process of the species consuming it. Values are produced for direction and shape of wear (Ungar et al. 2007)

Stable Isotope Analysis (Carbon and Oxygen)

Vegetation consumed during dental enamel formation is preserved and visible through isotopic analysis. Plants fix carbon according to vegetation type, with woodland vegetation being more depleted in carbon than tropical grasses. Higher carbon values are therefore indicative of a greater grazing component in the diets of herbivores.

Phytolith Analysis

Phytoliths are plant remains that can be preserved in dental calculus. Bovids from Sterkfontein and Swartkrans have not been examined for phytoliths previously. Dental calculus will be scraped from fossilised dentition to be analysed for the presence of phytoliths. Where present they will provide conclusive evidence of vegetation type present and consumed in that individual animal's lifetime.

MATERIALS:

Permanent dental molars.

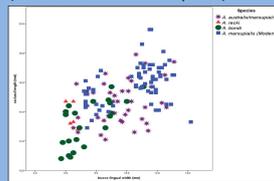
Fossil materials: *Antidorcas bondi*, *Antidorcas recki*, *Antidorcas australis* and *Antidorcas marsupialis*. Supplementary species to provide grazing (*Damaliscus dorcas/pygargus*) and browsing (*Tragelaphus strepsiceros*) signals.

Collections: Sterkfontein Member 4 and 5 (East, Stw53 Infill and West) Swartkrans Member 1 (hanging remnant and lower bank), 2 and 3, Cradle of Humankind, Gauteng Province, South Africa.

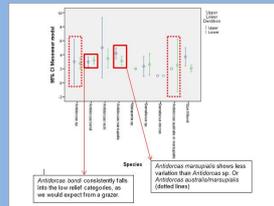
Modern materials: *Antidorcas marsupialis* to provide levels of anticipated intra-specific variation, *Damaliscus pygargus* (blesbok) to provide a known grazing signal and *Tragelaphus strepsiceros* (greater kudu) to provide a known browsing signal.

RESULTS

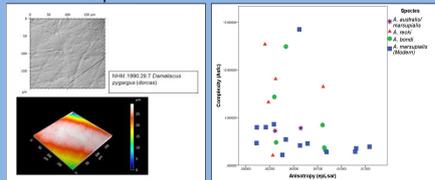
Occlusal length of permanent dental molars remains relatively consistent through time, whereas bucco-lingual width increases from c.1.7 Ma in at least 2 *Antidorcas* species (*A. bondi* and *A. marsupialis*).



Antidorcas bondi consistently falls into the lower relief categories for mesowear, as would be typical of a grazing species. Fossil *Antidorcas marsupialis/ australis* shows greater variation than modern *A. marsupialis*, with statistical analyses showing this is not due to sexual dimorphism. Thereby hinting at the presence of 2 populations with differing diets, probably of separate species.



Fossil *A. marsupialis* displays a greater browsing signal than modern *A. marsupialis*. Surface complexity indicates significantly different diets for modern *Antidorcas* and those in Sterkfontein Member 4, Member 5 (west) and Swartkrans Member 3. Suggestive of a greater browse(trees and shrubs) component in the diet than in modern samples.



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DISCUSSION

Preliminary analysis supports the idea of increased grassland, particularly after c.1.7Ma (Lee-Thorp et al. 2007).

No pulses of faunal turnover are yet apparent in the dataset (dataset sample size enlargement is pending).

Antidorcas sp. (combined fossil specimens of *Antidorcas australis* and *A. marsupialis*) exhibit greater variation in all methods than that of modern *Antidorcas marsupialis*. Hinting that *A. australis* warrants separate species status.

Antidorcas bondi is consistently shown to be a grazing species through all methods, supporting Brink and Lee-Thorp (1992)'s finding from other sites in South Africa.

Antidorcas recki is typically shown to be a browsing species through all methods, supporting Luyt (2001).

Marked change is noted between Swartkrans Member 2 and 3 in increased tooth width for *Antidorcas marsupialis* and *Antidorcas bondi*, suggesting considerable influencing forces, presumably these are dietary driven adaptations and therefore indicative of changing palaeoenvironments.

FURTHER WORK

- Geometric morphometric analysis of selected *Antidorcas australis/ marsupialis* fossils to understand their taxonomic assignment.
- Phytolith analysis of *Antidorcas* dental remains from all Member of interest .
- Increase sample sizes in all categories.
- Isotopic analysis (carbon and oxygen)

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