
Notes and records

Consumption of grass by black rhinoceroses in the Thicket Biome

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The black rhinoceros (*Diceros bicornis*, L.), despite its large (c. 850 kg) size, is a selective browser (Owen-Smith, 1992; Ganqa, Scogings & Raats, 2005), unlike the larger white rhinoceros (*Ceratotherium simum*, Burch.), which is a grazer (Owen-Smith, 1992). The black rhinoceros concentrates on forbs and low (c. 0.5 m) woody plants (Owen-Smith, 1992), and grass is not a significant component (<5%) of the diet (Owen-Smith, 1992; Mabinya *et al.*, 2002). Grass may only become relatively more important in the wet season (Goddard, 1968; Hall-Martin, Erasmus & Botha, 1982) when it is green and more abundant (O'Connor, Goodman & Clegg, 2007). The black rhinoceros has a relatively narrow prehensile upper lip to pluck leaves and twigs effectively and this, coupled with its lack of incisors, makes grazing difficult (Clemens & Maloiy, 1982). In addition, the black rhinoceros is less efficient at cell wall digestion than white rhinoceroses, mainly because of its smaller gut capacity and shorter gut retention times (Owen-Smith, 1992).

However, unpublished research in the Addo Elephant National Park, South Africa, using faecal analysis, suggests that as much as 21% of black rhinoceros diet may be grass (M. Landman, pers. comm., 2007). This is more than triple what has been previously reported (Goddard, 1968; Hall-Martin *et al.*, 1982; Owen-Smith, 1992; Mabinya *et al.*, 2002) and is particularly striking for the Thicket Biome, which does not have a well-developed grass layer (Low & Rebelo, 1996). Thus, we tested this assertion by collecting data from another site in the Thicket Biome. We describe the extent to which grass and browse were consumed by black rhinoceroses and whether the proportional occurrence changes seasonally. We defined 'browse' as

being any dicotyledonous plant (i.e. all woody species, shrubs and forbs), while 'grass' included all monocotyledonous species (i.e. grasses and sedges).

Our study was conducted at the Great Fish River Reserve (GFRR) in the Eastern Cape Province, South Africa. The vegetation is classified as Xeric Succulent Thicket, which is characterized by a high proportion of succulent shrubs, trees and lianas (e.g. *Grewia robusta*, Burch., *Portulacaria afra*, Jacq. and *Rhigozum obovatum*, Burch.), generally lower than 3 m (Low & Rebelo, 1996). There are few grass and forb species present (Low & Rebelo, 1996). However, grass is more abundant adjacent to watercourses (D.M. Parker, pers. obs.) and the perennial Great Fish River runs for c. 25 km through the reserve. Black rhinoceroses were re-introduced to the GFRR in 1986 and have thrived (Ganqa *et al.*, 2005).

The GFRR experiences relatively low (c. 400 mm⁻¹) seasonal rainfall, with most falling in autumn (March–May) and spring (September–November) and we recognized a wet (autumn and spring) and a dry (summer and winter) season. Fresh faecal samples were collected during each season (wet season: n = 40; dry season: n = 28) by visiting randomly located black rhinoceros middens across the reserve using the existing road network between February and September 2005. Faecal samples were oven-dried at 60°C for 5 days (mean dry mass per sample = 218.47 ± 76.99 g) and a 50 g sub-sample removed. The majority (37.5 ± 2.6 g) of all sub-samples consisted of fine material that passed through a 0.5 cm sieve. This fine material was used for further analysis, as it would contain remnants of grass. In total, we sampled 1.5 kg of dried fine material in the wet season and 1.1 kg in the dry season. A microhistological analysis was conducted on the fine material using standard techniques (MacLeod, Kerley & Gaylard, 1996; Parker & Bernard, 2006). Grass and browse were distinguished based on characteristic epidermal structures (see Parker & Bernard, 2006). Frequency of occurrence values (%) were calculated by recording the first 100 identifiable fragments of each plant type in each sample (MacLeod *et al.*, 1996; Parker & Bernard, 2006).

The faeces of black rhinoceroses at the GFRR were dominated (86.15 ± 2.39%) by browse and grass made up a smaller proportion (15.02 ± 2.23%) of the dung.

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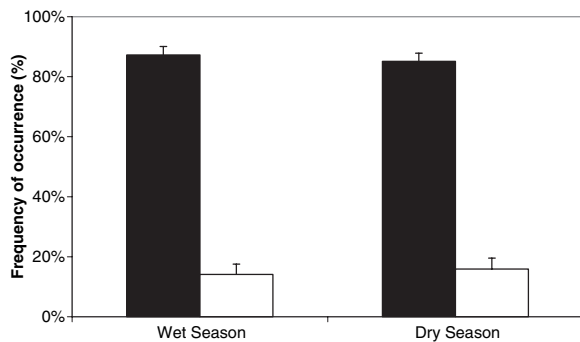


Fig 1 The seasonal importance (%) of grass (open bars) and browse (dark bars) in the dung of black rhinoceroses as determined by microhistological analysis. Values are mean \pm SD error bars

Significantly more browse was present compared to grass (t -test; $P < 0.05$; $t_{14} = 3.54$). The same pattern was evident at a seasonal level and there was no significant difference in the proportion of browse (one-way MANOVA; $P > 0.05$; $F_{1,6} = 0.002$) or grass ($P > 0.05$; $F_{1,6} = 0.01$) in the dung between the two seasons (Fig. 1). The relatively small values for variance suggest that throughout the reserve, and in both the wet and the dry season, black rhinoceroses consumed similarly small amounts of grass.

Our estimate of the proportion of grass fragments in the dung of black rhinoceroses is higher than any previously published estimate (between 0.1% and 5%) (Goddard, 1968; Hall-Martin *et al.*, 1982; Owen-Smith, 1992). However, this may be an artefact of the different methods of diet analysis employed (e.g. feeding time; Goddard, 1968). As a diet assessment technique, faecal analysis tends to overestimate fibrous plant species (e.g. grass) and underestimate the importance of succulent (e.g. forb) species (Vavra, Rice & Hansen, 1978; McInnes, Vavra & Krueger, 1983). Interestingly, the occurrence of grass in the dung of black rhinoceroses from GFRR was lower than that reported for the Addo Elephant National Park (M. Landman, pers. comm., 2007), despite the use of the same technique. Kerley & Landman (2006) suggest that the high grass component in the dung of black rhinoceroses may be an indirect effect of elephants (*Loxodonta africana*, Blumenbach) that have been present at unusually high densities (3 elephants km^{-2}) for over 50 years. They argue that the elephants have reduced woody vegetation cover and density, resulting in more elephant paths and reducing the number of foraging opportunities on woody vegetation for black rhinoceroses. However, it is also possible that the observed differences between the two sites

reflect differences in the vegetation. While both sites are within the Thicket Biome, a difference in the consumption of easily digested succulent species between the two sites would be reflected as an increase in the proportion of grass in the faecal analysis (e.g. the potentially higher consumption of *Mesembryanthemum aitonis*, Jacq. at Addo). Thus, we argue that the proportion of grass was inflated in the Addo study, as it was more likely to pass into the faeces (McInnes *et al.*, 1983).

Goddard (1968) and Hall-Martin *et al.* (1982) recognized that grass tended to be relatively more important in the wet season, when green growth was stimulated. Our results did not reflect this pattern, and there was no significant seasonal change in the proportion of grass fragments. Although the availability of grass was not measured in our study, it is unlikely that black rhinoceroses will include more grass in their diet when grass is more available. This is because browse plants contain about twice as much protein as grass, which is more constant over the annual cycle (O'Connor *et al.*, 2007). In addition, the mouth morphology and gut physiology of the black rhinoceros would have restricted the amount of grass in their diet to accidental ingestion whilst feeding on low forbs and shrubs (Clemens & Maloiy, 1982; Owen-Smith, 1992).

We have shown that although black rhinoceroses may consume grass, the majority of their dung consists of browse. In addition, in a semi-arid landscape, the consumption of grass did not increase during the wet season. Future research should employ standard methods of diet assessment to reduce the inherent bias associated with an individual technique and to allow comparison between studies and sites.

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