

Characteristics of the herbaceous layer in preferred grazing areas of six herbivore species in the south-eastern Kruger National Park

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The phytomass and species composition of the herbaceous layer in preferred grazing areas of zebra *Equus burchellii*, buffalo *Syncerus caffer*, waterbuck *Kobus ellipsiprymnus*, blue wildebeest *Connochaetes taurinus*, impala *Aepyceros melampus* and warthog *Phacochoerus aethiopicus* were investigated within the south-eastern portion of the Kruger National Park. The percentage frequency of herbaceous plants in Decreaser and Increaser categories, as determined by their reaction to different intensities of grazing, was established. The preferred grazing areas of the relevant herbivore species were compared in terms of phytomass, contribution of the Decreaser and Increaser categories, veld condition and degree of utilisation. The grazing areas of buffalo and zebra showed less utilisation than those of the other herbivore species. Warthog and impala were associated with over-utilised areas. It is clear that localised over-utilisation is an integral part of the natural grazing mosaic and should be managed as such in large African conservation areas.

Key words: grazing mosaic, herbaceous layer, Kruger National Park, management, over-utilisation, phytomass, veld conditions.

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Introduction

A common goal of wildlife management in large conservation areas in Africa has been to manage vegetation towards a climax to maintain nature in an "unaltered state" (Pienaar 1983). This approach implies the belief that such a state, which admittedly has a more appealing appearance than a degraded one, is also more acceptable in the conservation sense. Since different animal species differ in their habitat requirements, such a management approach may be detrimental to some species, while favouring others. Rejection or acceptance of this fact will depend on the conservation and/or management goals set for the area concerned.

As large national parks are usually managed for species diversity, the full spectrum of her-

bivore users must be catered for. It can therefore also be expected that such areas will contain over-utilised and under-utilised areas as part of a natural grazing system.

The aim of this study was to examine the habitat requirements of six selected herbivore species in a section of the Kruger National Park to test the overall hypothesis that a vegetation degradation gradient contributes to ecological separation and diversity of large herbivores. Validation of this premise required testing whether the forage production and degree of utilisation of the herbaceous layer influenced the ecological separation of buffalo *Syncerus caffer* (Sparman, 1779), blue wildebeest *Connochaetes taurinus* (Burchell, 1823), impala *Aepyceros melampus* (Lichtenstein, 1812), waterbuck *Kobus ellipsiprymnus* (Ogilby, 1833), warthog *Pha-*

cochoerus aethiopicus (Pallas, 1776) and zebra *Equus burchellii* (Gray, 1824) in the Lower Sabie - Crocodile Bridge area of the Kruger National Park during 1986 and 1987.

Methods

The phytomass and grass species composition of the herbaceous layer were established in those areas of the south-eastern Kruger National Park with which the following herbivores were associated: blue wildebeest, buffalo, Burchell's zebra, impala, warthog and waterbuck.

The roads and fire-breaks in the study area were used as transect routes from which initial observations on the distribution of these herbivores were made to establish their habitat requirements (Wentzel 1990). A preferred grazing area was one where most members of a group or lone individuals of a specific animal species were found feeding actively at the same locality during at least three of five consecutive transect investigations. Sampling was done using the centre of a herd or the position of a single animal as the centre of the sampling plot.

Herbaceous plant material was quantified using a disc pasture meter (Bransby & Tainton 1977), which has the advantage of providing quick and accurate results (Danckwerts & Trollope 1980). Twenty-five (total) points were sampled at two-step intervals along each of four imaginary but parallel transect lines, 10 m apart as described by Trollope *et al.* (1989). The amount of herbaceous plant material in the sward was calculated by the equation $Y = -3019 + 2260\sqrt{X}$ where Y represents the phytomass in kg/ha and X the mean height in centimetres above ground at which the disc stabilised (Trollope & Potgieter 1986). At each sampling point the herbaceous plant closest to the tip of the front shoe was also identified. According to Mentis (1981), who used 200 sampling points per sampling plot, the step-point method is accurate but less time-consuming than the wheel-point method.

The herbaceous species were identified and then categorised as defined by Trollope *et al.* (1989):

- *Decreaser species*
grass and other herbaceous species, the abundance of which decreases with over or under-utilisation
- *Increaser I species*
grass and other herbaceous species, the abundance of which increases with under-utilisation

- *Increaser IIa species*
grass and other herbaceous species, the abundance of which increases with light over-utilisation
- *Increaser IIb species*
grass and other herbaceous species, the abundance of which increases with moderate over-utilisation
- *Increaser IIc species*
grass and other herbaceous species, the abundance of which increases with heavy over-utilisation.

The percentage frequency of grasses in the above ecological categories was established. Methods for assessing veld condition are described by Tainton *et al.* (1980) and Westfall *et al.* (1983). The percentage frequency of every grass and other herbaceous species is multiplied by the plant species' forage factor (Trollope *et al.* 1990) and summed to give an indication of veld condition. The concepts of veld condition and forage factors used here are as defined by Trollope *et al.* (1989) and Trollope (1990).

Although Janse van Rensburg & Bosch (1990) criticise the broad subjective categorisation of grass species as Decreasers and Increasers, the classification of Trollope *et al.* (1989) was followed. The objective categorisation of plant species according to their reaction to grazing within a homogeneous habitat should, however, be addressed in future studies of this nature.

The degree of utilisation to which the herbaceous layer in the study area had been subjected was established by means of a utilisation index: Increaser I, Increaser IIa, Increaser IIb and Increaser IIc grass species were allotted values of -1,0; 0,33; 0,67 and 1,0 respectively. No value was allocated to the Decreaser grass species because their abundance in an area can decrease under the effect of under or over-utilisation. The frequency value of every grass species category was multiplied by the index values and summed. A sampling plot where only Increaser I grass species are recorded, will thus have a value of -100 and a sampling plot with only Increaser IIc grass species a value of 100.

The mean and standard deviation of herbaceous phytomass, increaser and decreaser component frequencies and veld condition scores were calculated for all the sampling plots of the preferred grazing areas of the relevant herbivore species. The null hypothesis of no difference between the preferred grazing areas of these herbivore species was then tested by Tukey's Studentised range test (Steel & Torrie 1980).

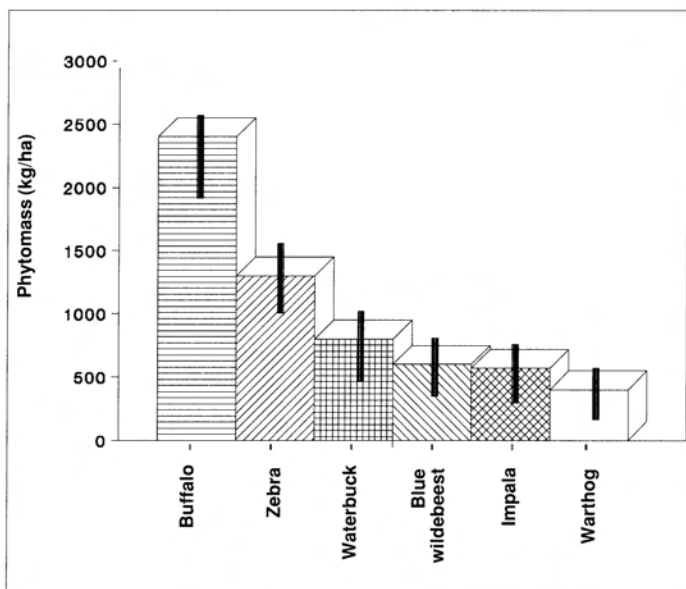


Fig. 1. The mean and standard deviation of phytomass in the herbaceous layer of the preferred grazing areas of six types of herbivore during 1986 and 1987 in the Lower Sabie - Crocodile Bridge area of the Kruger National Park.

Results and discussion

Phytomass of the herbaceous layer

The amount of herbaceous plant material present in the preferred grazing areas of the relevant herbivore species is illustrated in Figure 1. According to Tukey's Studentised range test there is a significant difference ($P < 0,05$) between the preferred grazing areas of buffalo and those of impala, warthog, waterbuck, and blue wildebeest.

De Wet (1988) recorded mean phytomass values of 1 600 and 1 900 - 2 000 kg/ha of herbaceous material in the grazing areas of blue wildebeest and zebra in the Central Region of the Kruger National Park, compared to 672 and 1 400 kg/ha respectively in this study. The difference is associated with seasonal movements of the blue wildebeest and zebra populations studied by De Wet (1988) between winter and summer grazing areas.

The herbaceous layer in each seasonal range is utilised by large blue wildebeest and zebra populations for part of the year only and thus this layer recovers more quickly than in this study area where a portion of the blue wildebeest and zebra populations was resident year-round. An example of such permanent residence is the area west of Nhlanguzwane Dam where permanent impala and warthog populations also reside. In buffalo grazing areas of the Central Region, De Wet (1988) found a mean phytomass of 2 200 - 2 300 kg/ha, compared to 2 357 kg/ha in this study area.

Differences in rainfall can also influence phytomass production, but as the Central Region receives less rain than the south-eastern portion of the Kruger National Park (Whyte 1985) the lower phytomass production in the heavily utilised portions of the study area is further evidence of intensive grazing pressure.

Herbaceous phytomass for grazing areas of

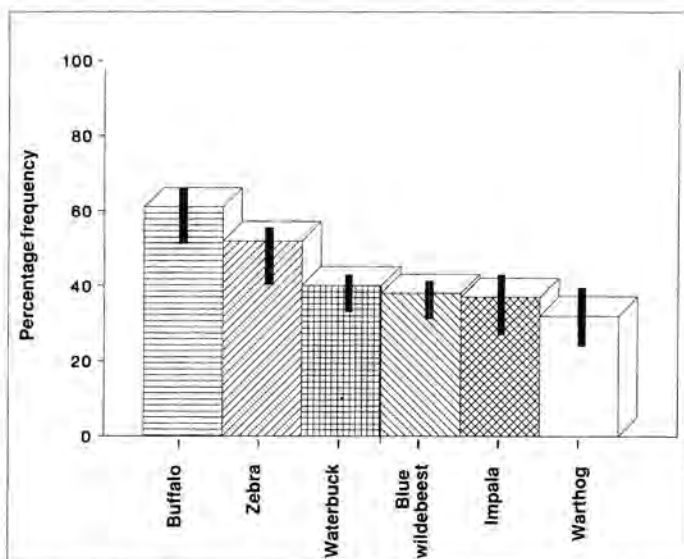


Fig. 2. The mean and standard deviation of the percentage frequency contribution of Decreaser herbaceous species in the preferred grazing areas of six types of herbivore during 1986 and 1987 in the Lower Sabie - Crocodile Bridge area of the Kruger National Park.

impala averaged 1 300 kg/ha in the Central Region (De Wet 1988) compared with 646 kg/ha in this study area. This difference reflects the permanent occupation of certain localities in the study area by impala and other herbivores such as blue wildebeest and warthog, as exemplified by the area just north of the Crocodile River and directly west of Nhlangezane Dam.

Herbaceous species composition

— Decreaser species:

These include grasses such as *Andropogon gayanus*, *Brachiaria nigropedata*, *Cenchrus ciliaris*, *Chloris mossambicensis*, *Digitaria eriantha*, *Diheteropogon amplexans*, *Eustachys paspaloides*, *Fingerhuthia africana*, *Ischaemum afrum*, *Panicum coloratum*, *Panicum maximum*, *Setaria incrassata*, *Setaria flabellata*, *Setaria sphacelata*, and *Them-*

da triandra. According to Tukey's Studentised range test there is a significant difference in herbaceous species composition ($P < 0,05$) between the preferred grazing areas of buffalo on the one hand and impala, warthog, and blue wildebeest on the other. It is also conspicuous that there are nearly twice as many Decreaser grass species in the grazing areas of buffalo compared to those of warthog (Figure 2).

— Increaser I species:

These include grasses such as *Cymbopogon plurinodis*, *Echinochloa colona*, *Eriochloa stapfiana*, *Hyperthelia dissoluta*, *Schizachyrium sanguineum*, *Sorghum versicolor* and *Sporobolus pyramidalis*. Tukey's Studentised range test, Scheffe's test and the Student-Newman-Keuls test (Steel & Torrie 1980) all accepted the null hypothesis of no difference regarding the abundance of In-

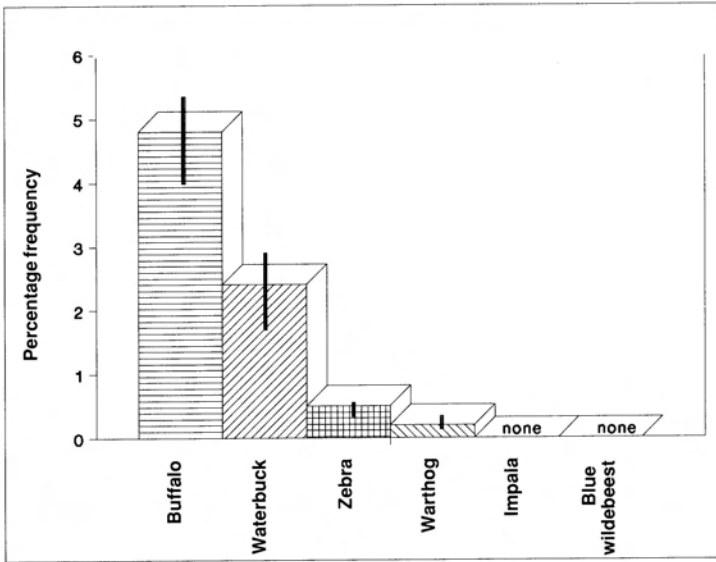


Fig. 3. The mean and standard deviation of the percentage frequency contribution of Increaser I herbaceous species in the preferred grazing areas of six types of herbivore during 1986 and 1987 in the Lower Sabie — Crocodile Bridge area of the Kruger National Park.

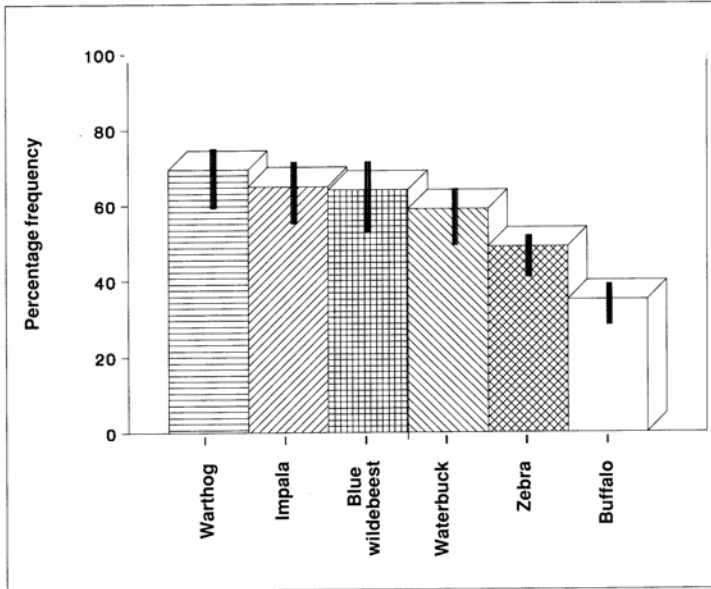


Fig. 4. The mean and standard deviation of the percentage frequency contribution of Increaser II herbaceous species in the preferred grazing areas of six types of herbivore during 1986 and 1987 in the Lower Sabie - Crocodile Bridge area of the Kruger National Park.

creaser I grass species in the respective preferred grazing areas of all the herbivores studied. This can be attributed to the relatively low frequency with which these grass species occur in the study area (Figure 3).

— Increaser II species:

Increaser IIa grasses include *Chloris roxburghiana*, *Heteropogon contortus*, *Sporobolus fimbriatus* and *Sporobolus smutsii*. Increaser IIb grasses include *Bothriochloa insculpta*, *Dactyloctenium geminatum*, *Digitaria argyrograpta*, *Enneapogon cenchroides*, *Enteropogon monostachyus*, *Eragrostis* species, *Pogonarthria squarrosa*, *Schmidtia pappophoroides*, *Tricholaena monachne* and *Urochloa mosambicensis*. Increaser IIc grasses include *Aristida adscensionis*, *Aristida congesta* subspecies *barbicollis*, *Aristida congesta* subspecies *congesta*, *Brachiaria eruciformis*, *Chloris virgata*, *Cynodon dactylon*, *Sporobolus nitens* and *Tragus berteronianus* as well as some forbs.

As regards the percentage frequency of the Increaser II grass species (Figure 4), there were significant differences ($P < 0,05$) between the preferred grazing areas of buffalo on the one hand, and impala, warthog, waterbuck and blue wildebeest on the other. Significant differences ($P < 0,05$) also existed between the grazing areas of zebra and warthogs. The impala, waterbuck, warthog, blue wildebeest, and in lesser degree the zebra are herbivores that are generally associated with areas showing varying degrees of overutilisation of the herbaceous layer.

Veld condition assessment

Significant differences ($P < 0,05$) were recorded in the veld condition of the preferred grazing areas of buffalo on the one hand and impala, warthog, waterbuck and blue wildebeest on the other. Significant differences ($P < 0,05$) also existed between the grazing areas of zebra and warthogs. Buffalo and zebra were the two herbivores associated with grazing areas where veld condition appeared

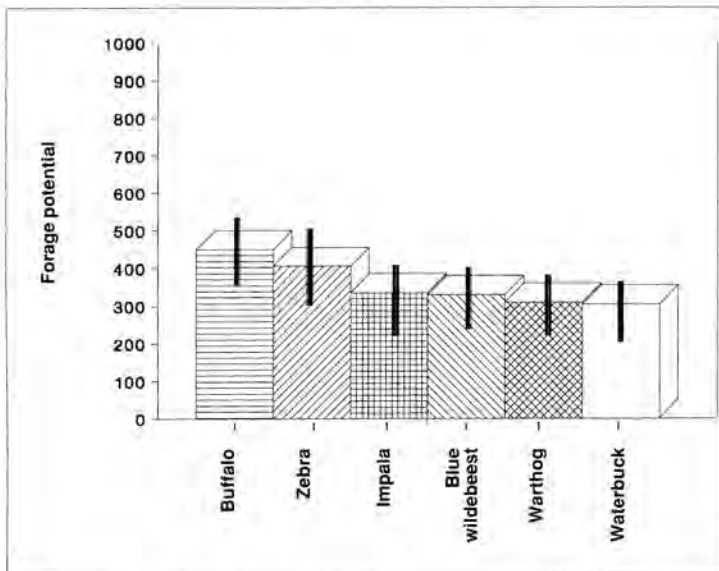


Fig. 5. A comparison of the mean and standard deviation of the veld condition in the preferred grazing areas of six types of herbivore during 1986 and 1987 in the Lower Sabie - Crocodile Bridge area of the Kruger National Park.

“best” (Figure 5). Notwithstanding recent criticism of the broad subjective categorisation of grass species, the results fit the implications from other studies on habitat use by grazing ungulates (De Wet 1988; Novellie 1990).

Degree of utilisation

Tukey's Studentised range test showed significant differences ($P < 0,05$) in degree of utilisation of the herbaceous layer between the preferred grazing areas of buffalo on the one hand and impala, warthog and blue wildebeest on the other. Significant differences ($P < 0,05$) also existed between the preferred grazing areas of zebra and impala as well as zebra and warthog.

Buffalo and warthog were associated respectively with under-utilised and heavily utilised herbaceous layers, which confirms the findings of Petrides (1974) in Uganda. The observation that warthogs prefer a heavily utilised or even over-utilised herbaceous layer also supports the conclusions of Field & Laws (1970) in Uganda, and Mason (1982) in Zululand, South Africa. Young (1972) and Engelbrecht (1986) also found that impala in the Kruger National Park are associated with a heavily utilised herbaceous layer. Veld condition and the degree of utilisation of the preferred grazing areas were closely related. The areas with the “best” veld condition were utilised least by the relevant heavy-use herbivore species.

There seemed to be a general correlation between phytomass production and species composition in the herbaceous layer: the higher the frequency of Increaser II grass species the lower the phytomass production of the herbaceous layer.

The results indicate that some degree of ecological separation exists between the herbivore species studied. This can be ascribed to differences in quantities and species compo-

sition of herbaceous plant material in the different grazing areas. Ecological separation is, however, compounded by inter and intra-specific competition and facilitation, which must also play a role in shaping the herbivore community by influencing the animals' habitat selection (Sinclair & Norton-Griffiths, 1982; Sinclair, 1985).

Conclusion

The herbaceous layer of the study area resembled a mosaic with under-utilised, lightly to heavily utilised and over-utilised areas.

Veld management is often geared towards improving veld condition and an increase in Decreaser grass species is widely regarded as indicative of veld in “good” condition. This premise conflicts with the study findings that not all herbivore species will benefit from veld in “good” condition, even if the herbaceous layer is dominated by Decreaser grass species such as *Themeda triandra*. Rather, it is to the benefit of all herbivore species that veld in different stages of utilisation should be present. Impala and warthog for example, are rarely found in areas where Decreaser grass species are dominant, but show a marked preference for areas with a high ratio of Increaser II grass species.

Management in large conservation areas should therefore aim to satisfy the habitat requirements of all organisms and attempt to safeguard all essential processes within such a system. Apart from the practical problems involving the “improvement” of over-utilised veld, it may well be that localised over-utilisation of the herbaceous layer within the grazing mosaic is desirable, within limits of “resilience” (Ferrari 1983) for the ecosystems concerned.

Relatively heavily utilised areas should thus be seen as necessary and often unavoidable facets of the natural veld in extensive conservation areas. This supports a view already

stated by Brooks & Macdonald (1983) for the Hluhluwe-Umfolozi Game Reserve in Natal, and by Pienaar (1983) and Novellie (1990) for African conservation areas in general. Provided that the heavily utilised areas do not threaten the existence of any grazing species by becoming too large, or lead to exposed surfaces and accelerated soil erosion, heavily utilised areas should also be regarded as an acceptable natural phenomenon.

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