Comparison of the diurnal activity patterns of blue wildebeest and red hartebeest

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Differences in diurnal activity patterns exist between blue wildebeest *Connochaetes taurinus* and red hartebeest *Alcelaphus buselaphus*. Seasonality also appeared in the patterns of each species. In summer, wildebeest spend less time grazing and more time lying and standing than do hartebeest and this difference is emphasized in winter. Wildebeest also spend more time in the shade whereas hartebeest do not show any regular pattern in their use of shade. These results are discussed in relation to thermoregulatory adaptations and the possible divergence in methods of satisfying energy requirements in the two species.

Daar bestaan verskille in die aktiwiteitspatrone van die blouwildebees *Connochaetes taurinus* en rooihartbees *Alcelaphus buselaphus*, asook seisoensverskille binne die onderskeie spesies. Die wildebees wei minder en is meer onaktief as die hartbees gedurende die somer en die verskil is in die winter meer opmerklik. Wildebeeste bring ook meer tyd in die skaduwee deur, terwyl hartbeeste geen bepaalde patroon openbaar nie. Hierdie bevindings word bespreek in terme van verskille in die metodes wat die onderskeie spesies gebruik om hulle energiebehoeftes te bevredig en termoregulering te bewerkstellig.

Keywords: Activity patterns, blue wildebeest, red hartebeest, shade-seeking, thermoregulatory behaviour

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Introduction

Daily activity patterns of ungulates are influenced by environmental factors and vary between species, reflecting a compromise to a number of factors that act simultaneously on the animals (Leuthold 1977). It is reasonable to assume that variations in the patterns occurring between species inhabiting the same area would reflect their physiological adaptations or relative tolerance of the prevailing environmental conditions.

The present study compares the daily activity of blue wildebeest and red hartebeest. These species belong to the same tribe *(Alcelaphini)* (Vrba 1984), but their habitat association and distribution (Smithers 1983) suggest that they have different ecological requirements. By quantifying their activity patterns it was attempted to evaluate some of the differences in ecological adaptations of the species and define some of their thermoregulatory requirements.

Study area

The study was conducted in a 260 ha fenced reserve 12 km north of Pretoria. The vegetation is classified as turf-thornveld by Acocks (1975) and consists of a mosaic of *Acacia* woodland patches dominated by *Acacia robusta, A. karoo, A. caffra* and *A. nilotica* interspersed with long grassveld dominated by *Hyperthelia dissoluta, Cymbopogon plurinoides, Themeda triandra* and *Setaria* spp. as well as short grass overgrazed areas on turf soils where the dominant grasses are *Aristida congesta, Dicanthium pyllosum* and *Cynodon dactylon*. There is also a vlei where the dominant grass is *Imperata cylindrica*. The habitat thus provided diverse conditions from whioh both species could select their requirements freely.

Methods

Wildebeest occurred in one herd of 15 individuals comprising one adult bull, nine adult cows, four yearlings and one calf, while hartebeest congregated in one herd of 16 individuals comprising two adult bulls, 10 adult cows and four yearlings. All individuals were recognized by characteristics such as horn shape and size, colour or marks and scars.

Individual activity was recorded between 06h00 and 18h00 local time. Observations were made from a parked vehicle at a distance of 50 to 100 m using binoculars. Generally, more than one animal was observed at any time.

Eight behavioural categories were recognized, namely, grazing, browsing, walking, lying, standing, running, drinking and social interaction. Prevailing weather conditions were recorded at 15-min intervals and included: temperature in the shade, percentage cloud cover, wind speed, wind direction and precipitation.

Each activity change was recorded to the nearest minute with the date, individual's number, sex, age (adult, yearling or calf) and location (sun or shade). The data were entered directly onto computer code sheets and were analysed on the University of Pretoria's computer using SAS data handling procedures (Ray 1982). Data were analysed as percentage time spent in each activity category from the totals of all individuals monitored. Activity in shade refers to activity not undertaken in direct sunlight, as when under tree canopies, when cloud cover was more than 50% and during the proximate hour after sunrise and before sunset. Shade-seeking behaviour comprised only the time spent in shade that was actively sought i.e. under tree canopies.

Field work was conducted over two periods: February

and March (summer), and June and July (winter). Total time spent observing wildebeest and hartebeest in summer added to 254 and 252 h respectively, whereas 440 and 502 h were spent during winter. Activity categories which comprised less than 1% of the overall time budget were omitted from further analysis. The total data presented therefore do not add up to exactly 100%. Significance of differences were tested using Anova on angular transformation of the percentage time data (Rohlf & Sokal 1969), and setting significance at the 5% level.

Results

Seasonal activity differs both within and between the species (Table 1). Wildebeest show some seasonal variations while in hartebeest significant differences occur in all categories.

Table 1 Seasonal activity budgets of wildebeest and hartebeest (percentage time spent in each activity category)

		Grazing	Lying	Standing	Walking
Wildebeest	Winter	25,76^{a}	48,03^{c}	18,69^{d}	7,33^{f}
	Summer	24,41^{b}	39,07$^{c''}$	24,06^{e}	11,73^{f}
Hartebeest	Winter	53,23^{ab}	36,05$^{c''}$	8,41^{de}	1,96^{f}
	Summer	38,57^{ab}	31,07^{c}	19,48^{e}	10,79^{f}

Variables with the same superscript are significantly different but (") is not significantly different.

Diurnal activity patterns in summer and winter are described in Figures 1 and 2. In summer, wildebeest grazing takes place mainly in the early morning and declines as the day progresses (Figure 1). The hartebeest follows with a similar pattern but tends to maintain a higher level of grazing activity throughout. In wildebeest, lying reaches two pronounced peaks at 09h00 and 13h00 but declines both in the early and late hours of the day. The hartebeest show a moderate increase in this activity from early morning onwards, most of the activity concentrating in the afternoon. Winter activity patterns are markedly different both between and within the species (Figure 2). Lying behaviour in the wildebeest is similar to the summer pattern whereas the hartebeest lie more in the morning when compared with the summer period. The hartebeest grazing pattern reaches a peak at 13h00 and remains at a higher level towards the late hours of the day in contrast to the summer pattern (Figure 1).

The percentage of each activity on a gradient of ambient temperature, measured in the shade is described in Figure 3. Wildebeest show a peak in grazing between 22°C and 26°C, while hartebeest grazing activity fluctuates along the temperature gradient. Inactive behaviour (standing and lying) of the wildebeest reaches higher levels between 14°C and 21°C and again between 27°C and 37°C. Hartebeest show the same trend

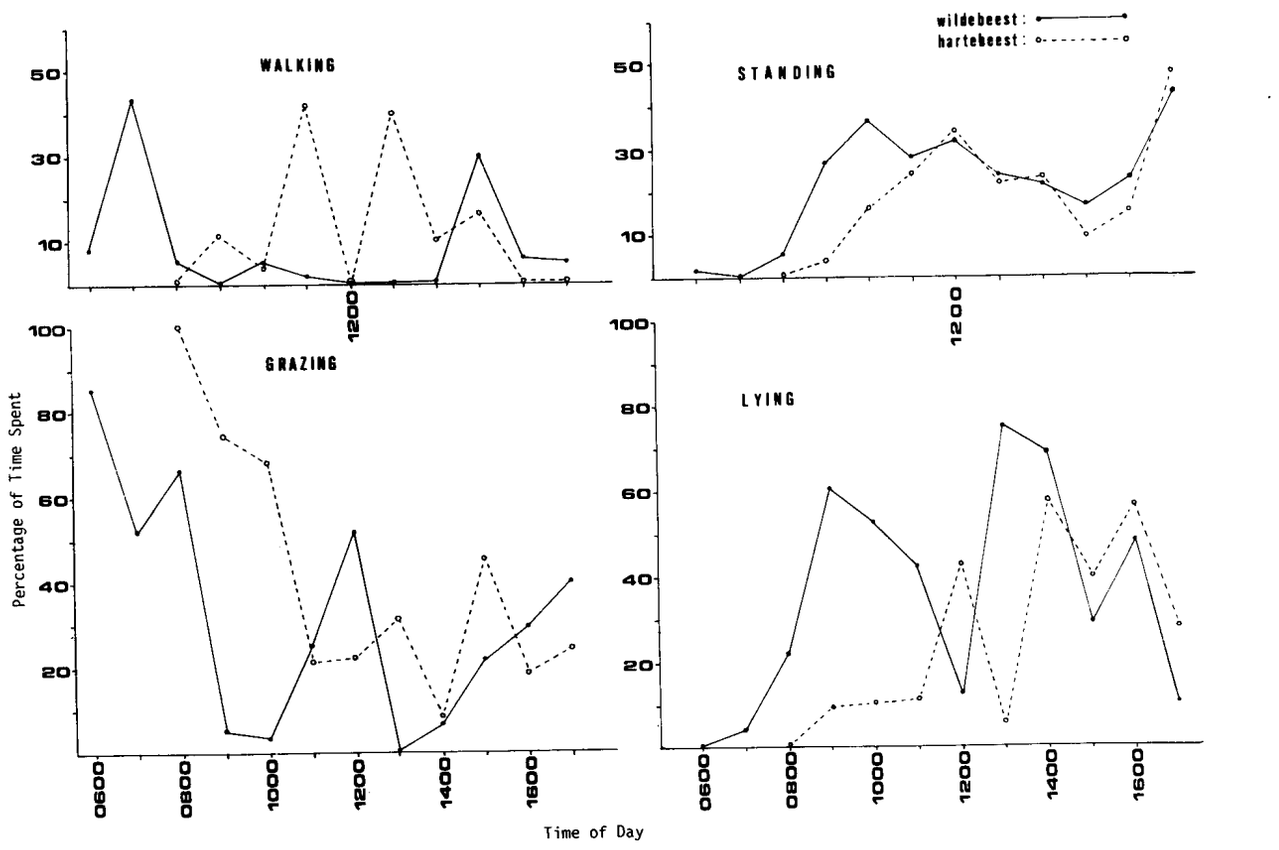

Figure 1 Diurnal activity in summer.

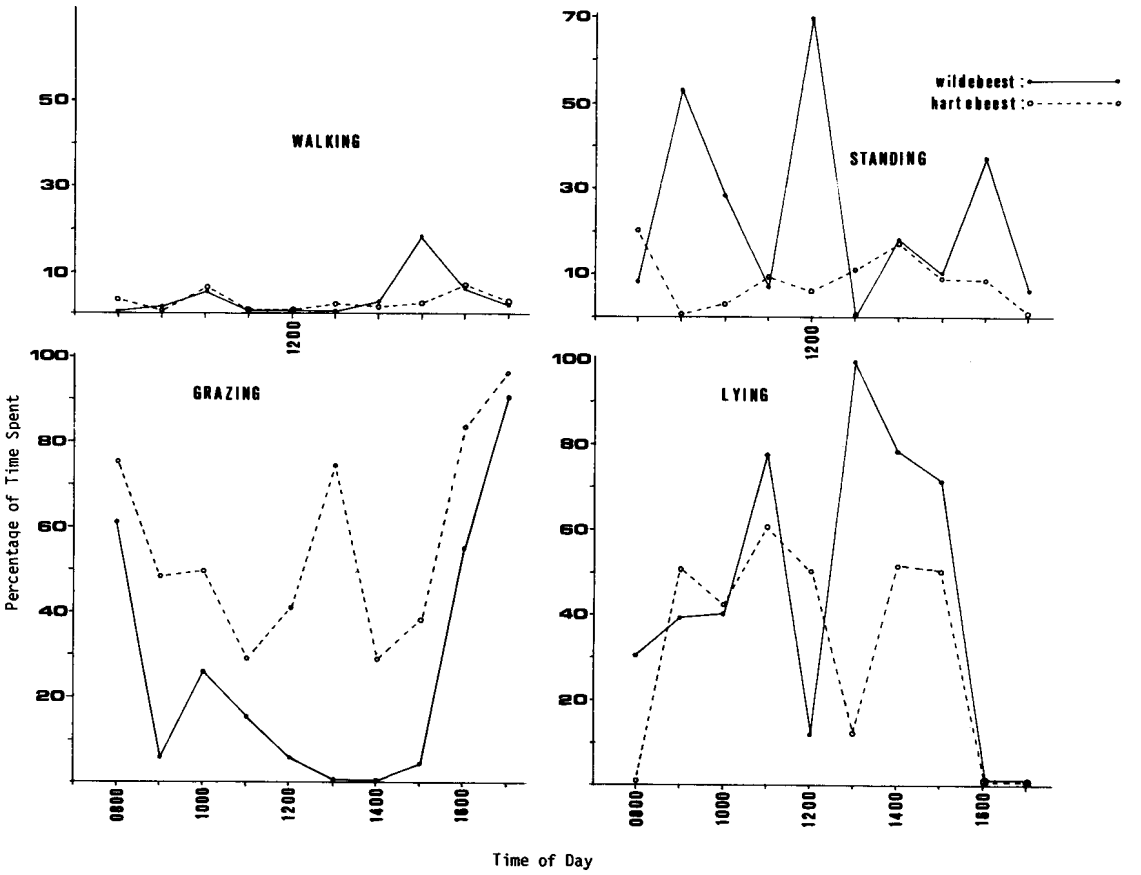

Figure 2 Diurnal activity in winter.

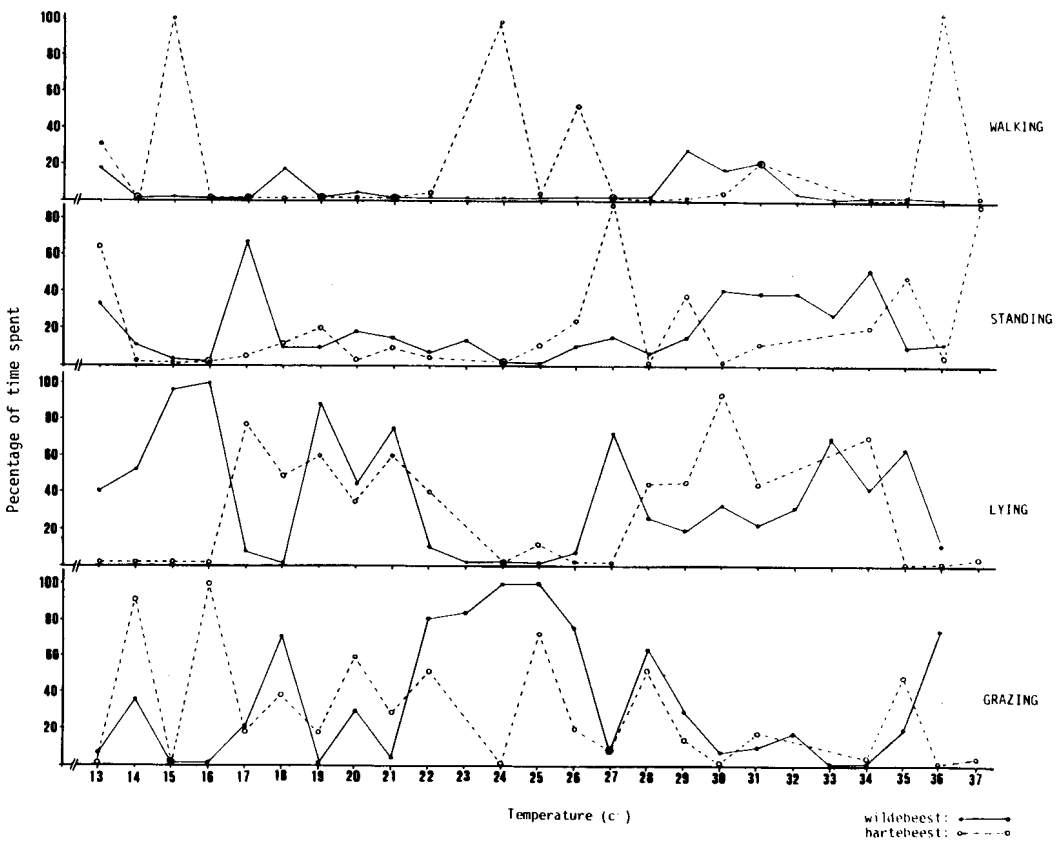

Figure 3 Percentage time spent in different activity categories at different shade temperatures.

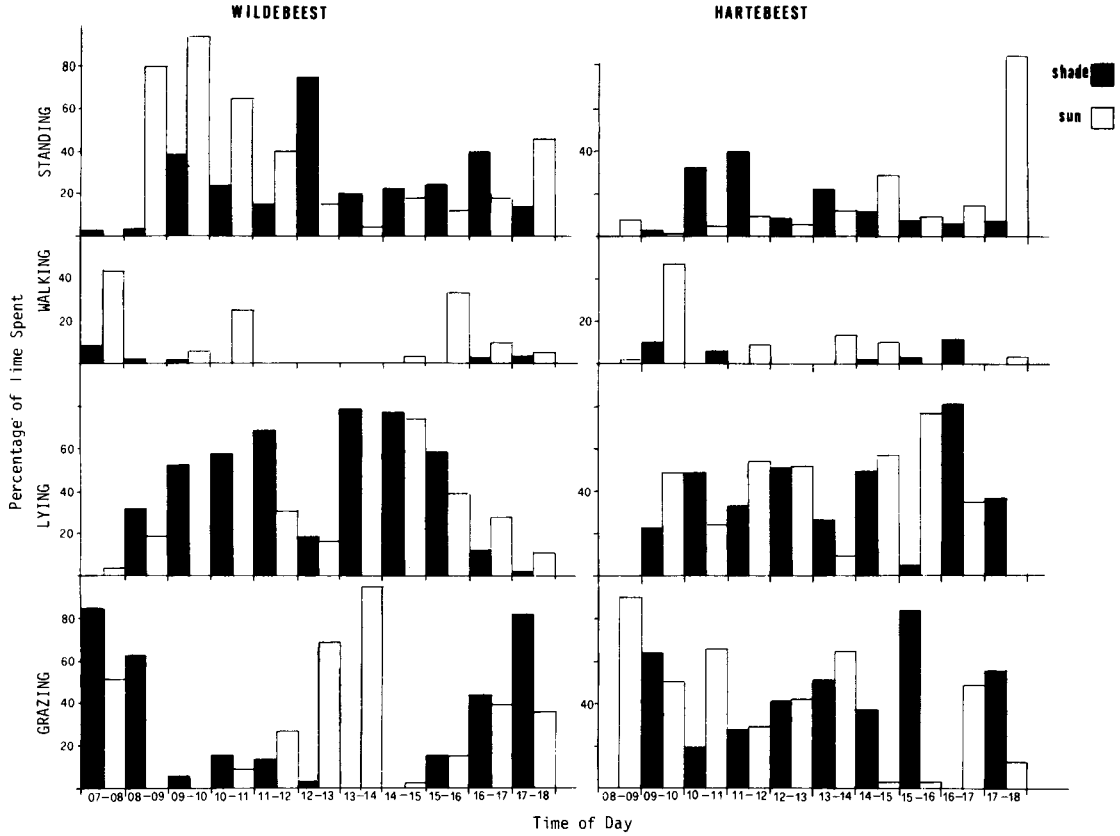

Figure 4 Diurnal activity patterns in sun and shade (both seasons).

in these behaviour patterns, with the exception that standing is less evident above 26°C and lying does not occur below 16°C.

Distinct differences appear when diurnal activity is related to the animal being in sunlight or shade (Figure 4). Although the grazing pattern of wildebeest peaks at 12h00 in the sun in summer, overall more time is spent grazing in the shade as this activity concentrates in the early and late hours of the day. The rest of the day is spent mainly lying or standing in the shade. Hartebeest also spent considerable time in the shade, but the results do not indicate any trend, and both active and inactive periods are evenly distributed between sun and shade.

Shade-seeking behaviour is illustrated in Figure 5. In summer, both species tend to seek shade while standing or lying. The grazing pattern in shade differs, however; hartebeest spend a larger proportion grazing in shade thus reducing the percentage of time spent standing and lying in shade. In winter, wildebeest and hartebeest tend to spend an equal proportion of resting time in sun or shade.

When separated on the basis of sex, two main differences exist in the percentage time spent at the different activities in both seasons (Figure 6). Females of both species grazed more than did males, and adult cows spent more time grazing in the shade, whereas adult bulls of both species grazed more in the sun. The 5,7% difference in time spent grazing between mature male and female wildebeest is not significant but the 13,4% difference in hartebeest is (χ^2 6,4; $P > 0{,}02 < 0{,}01$; 1*d.f.*). When activities of the three main age groups are compared, the hartebeest yearlings are similar to adults in most categories, whereas wildebeest yearlings spend more time grazing in the sun and more time lying in the shade (Figure 6).

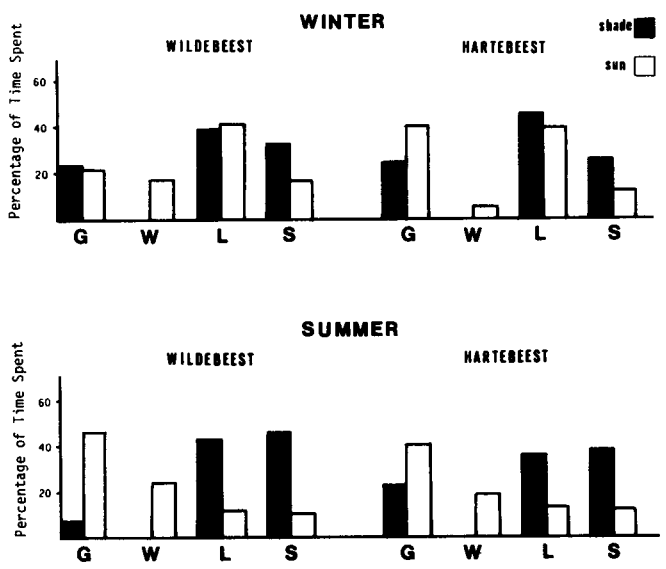

Figure 5 Shade-seeking behaviour in summer and winter for the main activity categories. G–grazing, W–walking, L–lying, S– standing.

Discussion

Before comparing the activity patterns of wildebeest and hartebeest it is worth considering similar studies on the

Figure 6 Percentage time spent in different activity categories for different age and sex categories.

species. Time devoted to grazing by wildebeest is lower than that found by Berry, Siegfried & Crowe (1982) in the Etosha National Park (25,3% *cf.* 33%). It is also lower than in other African ungulates whereas the proportion of time devoted to grazing in hartebeest (45,6%) is within the estimates of the predicted foraging time in relation to body mass (Owen-Smith 1982). Wildebeest grazed for approximately the same percentage of time during both seasons, which concurs with the observations of Berry *et al.* (1982). On the other hand, hartebeest graze more during winter, which may be related to a decrease in food availability or quality in the dry season (Jarman & Jarman 1973; Leuthold 1977).

The isolation of proximate environmental factors which bring about changes in animal behaviour is one of the main issues in ecological research. This study attempted to relate changes in weather conditions to activity patterns. Comparative physiological studies on thermoregulation of wildebeest and hartebeest have been done under controlled laboratory conditions (Taylor 1968; Maloiy & Hopcraft 1971). Evaporative water loss was reduced by two physiological adaptations in both species, namely a rise in body temperature during the day (Taylor 1970) and panting (Taylor, Robertshaw & Hofmann 1969; Finch 1972). These similarities put the hartebeest and wildebeest on a common physiological footing and enable us to evaluate the magnitude of different aspects of thermoregulatory behaviour.

Ambient temperature could be related to changes in activity while the comparison of different degrees of cloud cover, wind speed and wind direction did not show any correlation with changes in activity. Berry, Siegfried & Crowe (1984) observed that orientation of the body of the wildebeest in the Etosha National Park was related to sun and wind direction. Shade is more readily available in the study area and therefore obviates the need for such orientation to reduce heat load. The occurrence of rainfall was too low to justify analysing the role of this factor.

The major differences between the two species in this study relate to the amount of time devoted to grazing and the tendency of the wildebeest to seek shade, particularly during the middle of the day. The occurrence of the two species in sunlight or shade substantiates the difference found in their daily and seasonal activity patterns. While the wildebeest seem to respond to environmental pressure in the form of heat stress, the hartebeest do not. These differences are accentuated in the hot summer where wildebeest spend a higher proportion of the inactive categories under shade. Furthermore, the proportion of time spent in all activity categories in the sun or shade differs significantly between the species (χ^2 22,48; P <0,01; 1 *d.f.*) as hartebeest spend more time in the sun during the summer.

The trends in shade-seeking behaviour and diurnal activity patterns can be related to factors causing heat stress and are more specifically defined as temperature and solar radiation. The effect of radiation varies, depending on the characteristics of the pelage (Lewis 1977, 1978). Hofmeyr (1981) found that wildebeest are at a disadvantage as their thin pelage and dark skin do not provide significant protection against solar heat gain, whereas the hartebeest has a thicker pelage and a lower absorbance value (0,66 *vs* 0,84). This can explain the more frequent use of shade by the wildebeest and its tendency to concentrate its active periods in the early and later parts of the day.

Sex-dependent variations in activity patterns have been reported before (Spinage 1968; Clough & Hassam 1970). These were related to the greater amount of time that females spend grazing (Leuthold & Leuthold 1978). The differences in this case can be related to the higher energy needs of the female for pregnancy and lactation.

The pelage of the yearling wildebeest is thicker and absorbs less heat (absorbance 0,7) than the adult pelage (Hofmeyr 1981) while the pelage of the hartebeest yearling does not seem to differ from that of the adult. Hence it appears that different energy requirements (Berry & Louw 1982) and different properties of the pelage may cause the heterogeneity between the two wildebeest age classes.

In conclusion, wildebeest seem to be more inactive and better able to satisfy their nutritional requirements during short feeding bouts in between resting in the shade during summer. Overall it seems to fit the model of a true bulk feeder that quickly fills its digestive tract with roughage that is then given an adequate time to

digest (Hofmann & Stewart 1972).

The hartebeest seems to conform more to the model of a selective feeder spending a greater part of its daily time foraging, its less absorbent pelage allowing it to be relatively independent of shade. This strategy, however, necessitates an increase in time spent feeding during winter.

The findings of this study also imply that thermoregulatory behaviour can be considered a modification of a general pattern dominated by other factors such as nutrition (Lewis 1977) or predation (Berry 1980). The similarities in activity patterns could thus derive from a common ancestry in the *Alcelaphini*. The superimposed thermoregulatory adaptations result in the wildebeest making effective use of a woodland savanna where shade is available (Greenacre & Vrba 1984), while the hartebeest can survive on open grass plains of the more arid areas.

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