

SOCIAL ORGANIZATION AND BEHAVIOUR OF THE WHITE RHINOCEROS

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Abstract - The social organization and behaviour of the white rhino is discussed as found in a relative low-density area like the Kruger National Park, as compared to a high-density area like Umfolozi Game Reserve. The territory size and home range were found to be larger when the rhino density was low. The population structure, reproduction and demography of a white rhino population are also discussed.

INTRODUCTION

The white rhinoceros *Ceratotherium simum simum* (Burchell) became extinct in the Transvaal in 1896. In 1961 the first white rhinoceroses were re-introduced from the Umfolozi Game Reserve to the Kruger National Park (KNP)¹⁷. Over a 12-year period a total of 345 white rhinoceroses were relocated to the KNP. By 1993 their numbers had increased to 1 875.

A study was begun in 1988 to ascertain the habitat preferences and dispersal of the white rhinoceros in the Kruger National Park¹⁴. The information discussed here was collected as a part of this study. Generous use was also made of the authoritative work done by Owen-Smith¹¹ on the behavioural ecology of the white rhinoceros in Zululand, Natal.

METHODS

Details of the study area and location are documented in Pienaar¹⁴. Fifteen white rhinoceroses were tracked using radio telemetry to ascertain their activities and habitat use. The immobilization and collaring procedures are explained by Pienaar & Hall-Martin¹⁶. All rhinoceroses fitted with transmitters occurred in areas of high white rhinoceros density (>0,5 per km²). These high density areas were mapped using the aerial census data which are collected annually in the Kruger National Park^{7,21}. The collared rhinoceroses were regularly tracked and observed on foot and all the locations were mapped on 1:50 000 topographic maps.

Where the number of observations was adequate, range boundaries were drawn in by hand and the areas involved measured with a planimeter. Only in this way could the interpretation of spatial relationships between animals be as precise as how it occurs in reality⁹.

The method used in this study was the minimum convex polygon, and involved drawing a polygon around the extremities of the observed locations^{3,10}. This allowed direct comparison of results with other studies carried out on white rhinoceros ranges employing similar methods^{1,2,11}. A major concentration of rhinoceros sightings within a given range was taken to be a core area and was mapped accordingly.

Conway & Goodman² considered 10 localities per group the minimum necessary for a reasonable estimate of range size. Samuel, Pierce & Garton¹⁹ considered 30 independent observations the minimum necessary to detect core areas. In the present study, the animals were tracked on foot to gather habitat information and only one observation per animal was made per day to ensure independence of successive observations. The 15 animals involved were tracked until the transmitter batteries ran down after a mean time lapse of 13,9 months¹⁵. Harris *et al.*⁵ mention

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factors that influence the accuracy of radio fixes and the problems associated with estimating home ranges from radio fixes. These problems were overcome by locating and visually observing the radio-marked rhinoceroses regularly.

Wet season (summer) and dry season (winter) ranges were mapped for each of the study animals. Winter was taken to begin with the drying of the grass layer and lasted till the grass started sprouting again after the first rains in spring. The wet season commences in November and lasts until April and the dry season ranges from May to October.

The annual range and core area sizes of white rhinoceros females and territorial males were compared using a Wilcoxon 2-Sample Test to detect any sex-related differences²⁰. The summer and winter range sizes of white rhinoceros females and territorial males were also compared with a *t*-test for seasonally-induced shifts in range size.

RESULTS

Sociobiology

Owen-Smith¹¹ distinguished five social categories differing in their patterns of interaction, spatial dispersion and roles in reproduction: i. juveniles; ii. subadults; iii. cows; iv. territorial adult males; v. subordinate adult males.

White rhino cows were usually accompanied only by a single calf, while white rhino bulls were most often solitary. Subadults tended to be associated in pairs, either of the same or opposite sex. Groups of three generally consisted of either a subadult attached to a cow-calf pair, or an adult male accompanying a cow plus calf. A few groups comprised three or more subadults and in one instance a group of seven subadults was seen. The average group size in the KNP was 2,1-2,3 animals.

Reproduction

Young females underwent their first oestrus at about 5 years of age, but remained in subadult groups until the birth of their first calf at 6,5-7 years of age. Thereafter they are usually accompanied only by their offspring and are regarded as adult cows. Young males are regarded as adult once they became solitary between 10 and 12 years of age and assume either territorial male or subordinate male behaviour patterns¹².

White rhino cows being accompanied by bulls is an indication of oestrus. A flush of green grass after rains seems to induce the onset of oestrus in cows. The proportion of cows in oestrus remains high through the wet season and early dry season months and thereafter drops to low levels¹³.

Dominant white rhino bulls investigated cows encountered within their territories, while cows responded with threatening snorts or roars. If a bull remained with a cow for more than a day, this was a sign that the cow was coming into oestrus. During the pre-oestrus consort period, the bull followed behind the cow and her companions. However, if a cow approached a territory boundary, the bull moved in front to block her progress. A confrontation sometimes ensued, with roars from the cow and squeals from the bull. If a cow was able to evade the bull and cross into the next territory, the bull did not follow and she was joined by the neighbouring bull. The pre-oestrus consort period typically lasted 1-2 weeks.

The onset of oestrus was indicated by the commencement of repeated approaches by the bull, accompanied by a hic-throbbing sound. Eventually the cow would let the bull mount her. Copulations lasted 15-30 minutes, with ejaculations every 4-5 minutes. The gestation period in white rhino is about 16 months and the mean intercalving interval is 2,5 years. Younger cows have shorter calving intervals than older cows¹³.

Home range

Territorial white rhino bulls occupied non-overlapping home ranges and left these territories only to proceed to and from water. In some instances one or two adult bulls shared the home range of a territorial bull but behaved in a subordinate manner. Territorial bulls ejected their urine in powerful sprays, while subordinate bulls and cows urinated in a conventional stream. Territorial males scattered their dung after defaecating, while subordinate males, females and subadults did not scatter their dung or only made a few ineffectual kicking movements¹³.

The annual range size of territorial white rhino males in the south-western KNP ranged from 6,2 to 13,8 km² with a mean of $9,9 \pm 3,4$ km². Associated core area sizes ranged from 1,7 to 4,2 km² with a mean of $2,7 \pm 0,8$ km². The boundaries of annual ranges for males did not overlap although short forays into neighbouring ranges were occasionally observed.

The annual range size of white rhino females ranged from 7,2 to 45,2 km² with a mean of $22,8 \pm 11,9$ km². The sizes of the associated core areas ranged from 2,9 to 8,9 km² with a mean of $4,7 \pm 2,1$ km². Annual ranges of females showed extensive overlap.

The mean annual range size of male white rhino differed significantly from that of females ($P=0,005$, $n=15$). There was also a significant difference in core area size for male and female white rhinos ($P=0,011$, $n=15$).

Two male territory take-overs were observed during the study period. In one case the defeated male moved to a neighbouring territory where he assumed a subordinate position. In the second case, the defeated male stayed on in the same territory but restricted his movements to a small area and assumed a subordinate position. In both cases the defeated territorial males ceased to spray-urinate or scatter their dung.

No seasonal movements, such as those mentioned by Heppes⁶ for the northern white rhinoceros *Ceratotherium simum cottoni*, were found in the present study although white rhinoceros females did show a seasonal variation in range size.

In the summer wet season, the mean range size of white rhino females in the KNP was $21,44 \pm 11,98$ km² compared with $11,64 \pm 6,2$ km² in the winter dry season ($P=0,03$, $n=8$). The wet season range size was comparable to the annual range size, whereas a reduction in range size was observed during the dry season. The ranges of territorial males did not show seasonally induced shifts in size. One white rhino female, however, had a dry season range that was larger than the wet season range.

Table 1. Comparison of white rhinoceros densities (animals km⁻²), male territory and female range sizes (km²) in four game reserves; The Kruger National Park, Umfolozi Game Reserve and Ndumu Game Reserve in South Africa and Kyle National Park in Zimbabwe

Area	Density	Male territory	Female range
Kruger	0,5 - 1,4	6,2 - 13,8*	7,2 - 45,2
Kyle	0,7	5 - 11*	3 - 20
Ndumu	0,6 - 1,8	2,5 - 13,9	4,7 - 22,9
Umfolozi	3,2 - 5,7	0,75 - 2,6*	8,9 - 20,5

* Male territory sizes are significantly smaller than female ranges.

Demography

The composition of the white rhino population in the south-western KNP was determined by ground surveys during 1988 and 1989. This population contained 16,8% adult males, 27,3% adult females, 32,4% subadults and 23,5% calves (N = 469). This was very similar to the composition Owen-Smith¹³ described for the Umfolozi Game Reserve. The lower number of adult white rhino males in the KNP is probably a result of emigration by males out of the high density study area.

In 1961 the first white rhino were reintroduced to the KNP from the Umfolozi Game Reserve¹⁷. By 1973 a total of 337 white rhino had been successfully relocated in the KNP. By 1993 this population had grown to 1 876 animals. From 1980 to 1993 the white rhino population in the KNP showed an average annual growth of 8,4%²². Even the serious droughts of the 1980s did not affect this growth. Owen-Smith¹³ described a rate of increase of 8-9% per annum for the white rhino population in the Umfolozi-Hluhluwe complex.

Table 2 Comparison of the demographic parameters of the white rhino populations in the Kruger National Park (KNP) and the Umfolozi Game Reserve (UGR).

	Subadults						
	Adults		Post-pubertal		Pre-pubertal	Calves	
	♂	♀	♂	♀		Juvenile	Infant
Age (years)	10-45	7-45	6-10	6-7	2,5-6	0,5-2,5	0-0,5
% of KNP population	16,8	27,3	7,9	2,1	22,4		23,5
% of UGR population	19,5	26,1	7,7	3,0	21,4		21,9

Owen-Smith¹³ also gave the following annual mortality figures for white rhino: Adult males 3%; adult females 1,2%; subadults 3%, juvenile calves (0.5-2.5 years) 3.5% and infant calves (0-0,5 years) 8,3%. The annual natality for adult cows (7-45 years) was 40%.

In the southern KNP 1 415 white rhinos were counted in 1993 for a mean density of 0.4 per km². In the high-density study areas white rhino densities were about 1,4 per km² (1 900 kg km⁻²)¹⁴. In the Umfolozi Game Reserve mean white rhino density was 3.2 per km² (4 300 kg km⁻²) with local densities as high as 5,7 animals per km², equivalent to a biomass of about 7 600 kg km⁻²¹¹.

DISCUSSION

A white rhino cow giving birth every 2,5 years between ages 6-40 years would produce 14 offspring in her lifetime. There is evidence from captive white rhinos in zoos that indicate that cows do not come into oestrus if there is only one bull⁹ with her. Although this is not always the case in free-ranging populations, a game farmer should keep this in mind if his white rhino population is not breeding successfully. It is always a good policy to have at least two mature bulls in a population just in case one gets injured accidentally.

The size of the founder population is also an important factor when establishing new populations, with larger founder populations being more successful⁴. If one introduced 10 white rhino on a 20 km² game farm with suitable habitat, this would generate a density of 0,5 rhino per km². A suitable

sex and age structure for such an introduced population would be: 2 adult males, 3 adult females and their 3 calves, one subadult male and one subadult female.

At the end of the dry season when water is scarce some males have to cross other territories on their way to water. This leads to a increase in conflict and more fighting ensues. In the Kruger National Park this contributes to an increase of adult male mortalities at end of dry season. On a game farm more than one waterpoint would lessen the friction between territorial males. Typical fighting wounds seen on male white rhino other than obvious lacerations on the head include broken jaw bones, wounds between hind legs, punctured abdomens, broken front legs and dislocated hind legs. These wounds are usually fatal.

A game farmer should also be able to distinguish territorial adult males from subordinate adult males. Territorial males mark their territories by spray urination and dung scattering. When confronted by a territorial male a subordinate male gives a threat display. He lifts his head, roars and makes short rushes at the territorial male. Old subordinate rhino bulls could be utilised for trophy-hunting purposes without any detriment to the population.

Predation does not have a big influence on a white rhino population. There have been a few cases in the KNP where white rhino calves were killed by lions. Animals with pieces of tail or ear missing that could indicate predation by hyaena are also seldom seen. Other accidental white rhino deaths include drowning, getting stuck in mud, falling off cliffs, being killed by elephants and burning in runaway fires.

When white rhino are released into a foreign environment they tend to wander far and wide before settling. Some of the first white rhino that were released in the KNP, to the north of Pretoriuskop, moved eastward and eventually settled north of Crocodile Bridge, a distance of 75 km. With subsequent releases the animals settled in the areas that had already been colonised by white rhino. When introducing white rhino to a game farm it will be a good idea to collect dung from the animals in the boma and place it at waterpoints and other exposed areas on the farm. This could help the animals in settling down sooner.

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