P. R. CONDY

THE POPULATION STATUS, SOCIAL BEHAVIOUR, AND DAILY ACTIVITY PATTERN OF THE WHITE RHINO (*CERATOTHERIUM SIMUM SIMUM*) IN KYLE NATIONAL PARK, RHODESIA

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BY

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A thesis submitted to the University of Rhodesia in partial fulfilment of the degree of Master of Science in Tropical Resource Ecology.

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INTRODUCTION

There are two species of rhinoceros in Africa. Members of the order Perissodactyla, family Rhinocerotidae, the two species are:-

Diceros bicornis (Linnaeus) - the black, hook-lipped or prehensile-lipped rhinoceros

Ceratotherium simum (Burchell) - the white, square-mouthed or square-lipped rhinocerôs

The two species differ in anatomical structure, habitat preference, feeding habits, temperament and behaviour while the terms "white" and "black" are misnomers since both species are grey in colour. Ceratotherium simum is larger and heavier, has noticeably square lips and a distinct nuchal hump. The head is longer and heavier, and the species is a grazer with particular preference for short grass. The longer head and square lips are suitable adaptations to its feeding habits while the nuchal hump, consisting mainly of muscle and the hypertrophied nuchal ligament (Alexander and Player, 1965) is an adaptation of functional significance providing support for the large head. The species probably originally occupied the watershed plateaus of Southern, Central, and Eastern Africa wherever grassland and savanna vegetation types were predominant. It has a particularly docile temperament and a well-organized social system.

Diceros bicornis is smaller, more temperamental and, since it is primarily a browser, tends to prefer habitats which provide an abundance of browse material. The head is shorter and lighter, the distance from eye to ear being disproportionately shorter than in its counterpart. The lips are

triangular in shape, the upper lip being characterized by a small extension giving the species its "prehensile-lipped" nomenclature. The lighter head and prehensile lip enable the animal to browse.

The skin colour of both species is grey. Superficial variations do occur but are dependant upon the soil colour of local mud and dust wallows. Both species wallow regularly, particularly in the hot seasons. The term "white rhino" probably derives from the Afrikaans "wit renoster", which means "wide rhino", referring to the broad lips.

There are two subspecies of Ceratotherium in Africa:-

(1) Ceratotherium simum simum (Burchell) - the Southern white rhino, hereafter referred to as the "white rhino".

(2) Ceratotherium simum cottoni (leydekker) - the Northern white rhino, hereafter referred to as the "Northern white rhino".

Separation of these two species has been described as "a remarkable case of discontinuous distribution" (Attwell, 1943). No geological or other evidence for this separation has been suggested and since it appears that no specific differences have developed, separation must have occured within recent geological time (Attwell, 1948).

I.1. Distribution of the Southern Race of white (square-lipped) rhinoceros (Ceratotherium simum simum)

I.1.a. Original distribution.

All town, place, river, and regional names referred to in the text but not indicated on any maps are listed in alphabetical order and accompanied by a description and grid reference in Appendix I.

The Southern white rhino (Ceratotherium simum simum) was described by Burchell in 1812 from specimens collected near Kuruman (see Map 1) in the Northern Cape Province, South Africa (Burchell 1817).

The accounts of hunters and explorers of last century suggest that the white rhino was distributed throughout most of Southern Africa north of the Orange river. It has been suggested by Player and Feely (1960) that their original range (see Map 1) coincided with the distribution, prior to European occupation, of the veld types classed together as "Bushveld" (Tropical Bush and Savanna) by Acocks (1953, Map I) in South Africa.

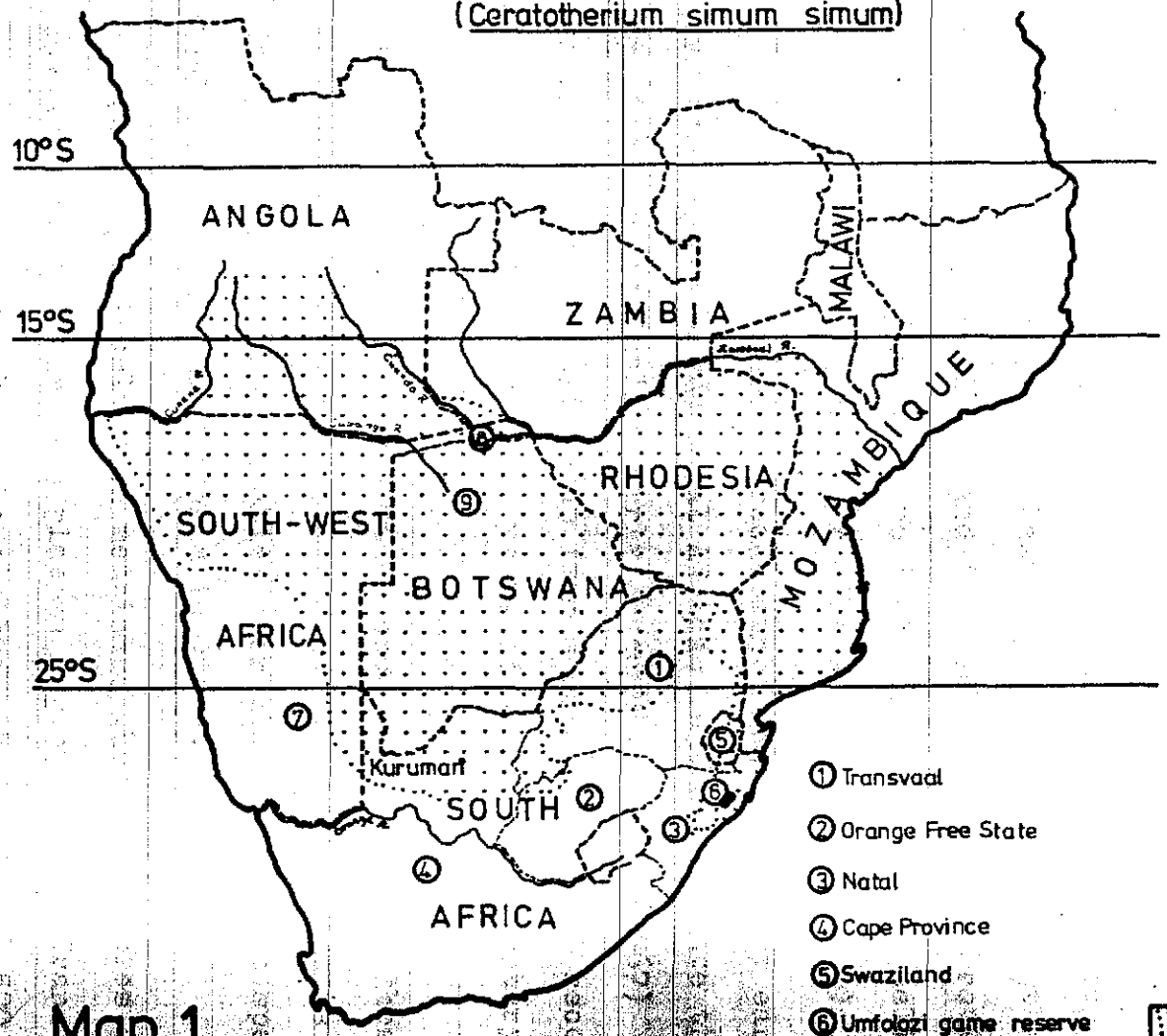
The Orange river appears to have formed the southern boundary to its distribution (Roosevelt, 1915 and Shortridge, 1934). This clearly corresponds to the south-western limits of the Bushveld (Acocks, 1953) and according to Player and Feely (1960) there is no evidence that it permanently resided in the "Mixed" and "Sour" grassveld types (Acocks, 1953) of the high plateau zones in the Transvaal and Orange Free State Provinces of South Africa.

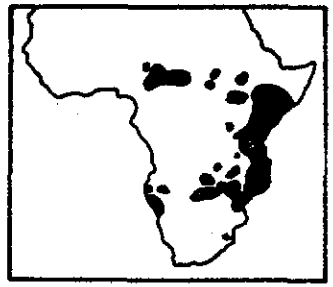
Roosevelt (1915) and Lang (1924) suggest that there is no reliable evidence that the Southern square-lipped rhinoceros ever occurred within the memory of man further north than the Zambezi river. Ansell (1959) suggests however that the species may have existed in extreme south-western Barotseland. The northern limit to its distribution in Angola appears to be unknown (Hill and Carter, 1941) but it is known to have occurred between the Cunene and Chobi rivers (Player and Feely, 1960).

Historical data collected by Shortridge (1934)

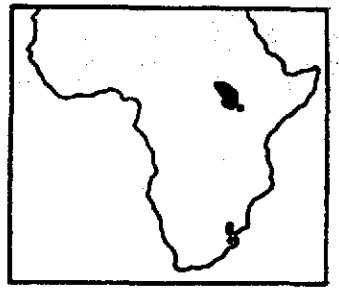
Original distribution of the Southern White Rhinoceros

(Ceratotherium simum simum)





Black rhino: distribution 1970



White rhino: distribution 1960

Map 1

indicate that it once extended across northern Botswana to the Okovango, the Caprivi Strip and south-eastern Angola. In South-West Africa the species once existed in Namaqualand and the districts of Grootfontein and Gobabis "and elsewhere in the more level parts of South-West Africa". Selous (1881) writes "twenty years ago this animal seems to have been very plentiful in the western half of Southern Africa; now it must be almost extinct in that portion of the country." The Namib desert along the west coast and the Kalahari desert in the south formed the western and southern boundaries to its distribution in South-West Africa.

From the Zambezi mouth in the east the species ranged southwards through Portuguese East Africa (Mozambique), the "Bushveld" area of Swaziland and into Zululand (Natal Province, South Africa) where the southern limit to its range is believed to have been the Umhlatuzi river (Player and Feely, 1960).

In Rhodesia numerous rock paintings, records of early hunters and explorers and local African legends indicate that the species was originally fairly abundant. Roth (1967) has compiled a distribution map from shooting or sight records made during the last, and early years of the present century. However, since place, district, and river names varied and very few, if any, actual grid references were given by these early observers, accurate reconstruction of these sites is doubtful. Nevertheless valuable information about the species' original distribution in Rhodesia is given.

It has previously been mentioned that the species appears not to have occupied the high plateau regions of the Transvaal and Orange Free State where the altitude ranges from 1 500 - 2 000 metres. In Rhodesia however the species appears to

have preferred the high watershed plateau (1 000 - 1 524 metres) between the Zambezi and Sabi drainage systems. Roth (1967) indicates that there is little evidence supporting its occupation of the lower and hot regions below the Zambezi escarpment (400 - 1 000 metres), while definite evidence exists indicating that the species occupied the low (400 - 1 000 metres) and hot regions of Mozambique north of the Pungwe river (the Rt. Hon. Sir Hugh Beadle, pers. comm.). Roth (1967) indicates, although doubtfully, that it may have existed between the junctions of the Sabi and Lundi rivers (400 - 1 000 metres) and along the banks and adjacent areas of the Limpopo river where, in some instances, the altitude varies between 200 - 400 metres. Using altitude as a criterion it would appear that there should be no reason why the species did not occupy the regions below the Zambezi escarpment and the plateau areas of the Transvaal and Orange Free State.

The white rhino's dependance upon suitable grazing material as its only source of food must tend to have placed certain limitations on its distribution, while the apparent indifference to a need for suitable cover or refuge-providing vegetation suggest no specific requirement for this factor in its habitat. The species appears however to be relatively dependent upon accessible water supplies and, if not dependent upon, certainly enjoys regular mud baths, particularly during the hot seasons.

Examination of Roth's map indicates that the most abundant sight or shooting records are found in areas close to the headwaters and catchment areas of a number of the ultimately larger rivers in Rhodesia. Notable exceptions, such as the Dett Vlei, the middle reaches of the Hunyani river, the area between the Sabi - Lundi junction, and the southern bank and

adjacent region of the Limpopo river east of Beitbridge do however exist. Nevertheless most of these areas are well supplied with permanent and accessible drinking water, and suitable wallow sites such as vleis and the edges of pans.

The most abundant records of the white rhino's presence occur on the watershed plateau between Gwelo and Salisbury, and the Dett Vlei area. The lack of records from large parts of the country may in part be due to less frequent visits by travellers and hunters. It is suggested however that in Rhodesia the species probably ranged over most of the country between altitudes of 1 000 - 1 524 metres and tended to occupy permanently well watered areas providing accessible drinking supplies and abundant wallow sites, even where such areas occurred below 1 000 metres (see Map 2).

I.1.b. The decline of the species and its present distribution.

From the time of its description in 1812 the number of white rhino began to decline. Its elimination coincided and progressed thereafter with three principal and related factors; the invasion of interior Southern Africa by Europeans, the increase in sport and commercial hunting, and the aquisition of firearms by the Natives.

By 1880 the species had been eliminated from the Northern Cape Province, South-West Africa, and Botswana. By 1896 the Transvaal had been eclipsed from its range (Player and Feely, 1960).

By the turn of the century it was thought that the species had been eliminated from Mozambique (Player and Feely, 1960 and Roth, 1967). In 1935 however, the Rt. Hon. Sir Hugh Beadle photographed a white rhino he shot between Villa Gouveia and

Macossa, north of the Pungwe river in the neighbourhood of a Kraal of which one, Tega, was the Kraal head. He states "I also confirm that at that time in this particular locality the square-lipped rhinoceros were plentiful. I still recollect seeing herds of as many as five in one herd. I might also mention, however, that as far as my recollection goes, their presence was fairly localised in the one area as I did not see them in areas any considerable distance from Tega's Kraal." Sir Hugh Beadle also mentions that a friend of his, "who was shooting in the area claims he saw square-lipped rhinoceros there as late as 1945." The photograph taken by Sir Hugh Beadle in 1935 is unmistakably that of a white rhino. The species was therefore not eliminated from Mozambique by the turn of the present century and it is suggested that at least two small localized populations remained in Southern Africa by 1935, one in Zululand and the above mentioned.

In Rhodesia the species had been virtually exterminated by the turn of the century. Selous (1908) mentions that in the country between the Sebakwe and "Hanyani" rivers, both black and white rhinoceros were still fairly common in 1878, "and it was only after 1880 that the numbers of both species commenced to be seriously reduced in this part of South Africa." The reduction in number of both species was apparently partly due to an increase in the hunting for their horn, brought about by reduced profits from ivory hunting. Coryndon (1894) suggests that because the white rhino was larger, carried more fat, and generally had larger and more valuable horns, it was shot in preference to the black rhino. In addition the white rhino, as mentioned, occupied the higher and better watered areas of the country, and was therefore probably encountered more frequently by the travellers and settlers who preferred

to occupy these climatically more suitable parts of the country.

Coryndon (1894) records shooting two in Rhodesia in 1892 by which stage the species was considered to be almost, if not quite, extinct. Lang (1923) mentions however that the last South African white rhinoceros "of the open veldt" was shot in Rhodesia, in 1895.

Roth (1967) suggests that in Rhodesia a few stragglers must have survived after 1893, and has evidence that an experienced hunter observed at close quarters a bull and cow white rhino at a pan between Chipinda Pools and the Sabi river, close to the Mozambique border, as late as 1923. In view of the evidence of their existence in Mozambique in 1935, the above report is considered to be quite possible. He has further evidence of isolated shooting records, one in 1912 near "Gota Gota hills" just below the Zambezi escarpment and another in 1913, again in the south-eastern part of Rhodesia, on the "Tshingwezi" river between the Lundi and Nuanetsi rivers.

~~In 88 years (1812 - 1900) the Southern white rhino had been reduced to near extinction. Its last stronghold at the turn~~ of the century, apart from those in Mozambique, consisted of a small population of unknown number occupying the Umfolozi Game Reserve, proclaimed in 1897, and adjacent land in Zululand, South Africa. In 1922 the Chief Game Conservator for Zululand, Major Vaughan-Kirby, estimated the number at 20. However it appears that this estimate was strategically conservative to avoid deproclamation of Umfolozi, a step being called for by nearby European farmers to reduce the Tsetse problem. In 1932 another count was made and 180 were counted in the game reserve and approximately 30 in the adjoining crown land (Foster, 1960). In 1953 a census by the Natal Parks, Game and Fish Preservation

Board (Natal Parks Board) gave a possible total of 506 and in 1959 a probable 607 animals (Player and Feely, 1960). Further counts were done in 1965, 1967 and 1968 and gave estimates totalling 912, 1 000 and 1 020 respectively (Vincent, 1969) even though a large number had been captured and removed by 1968.

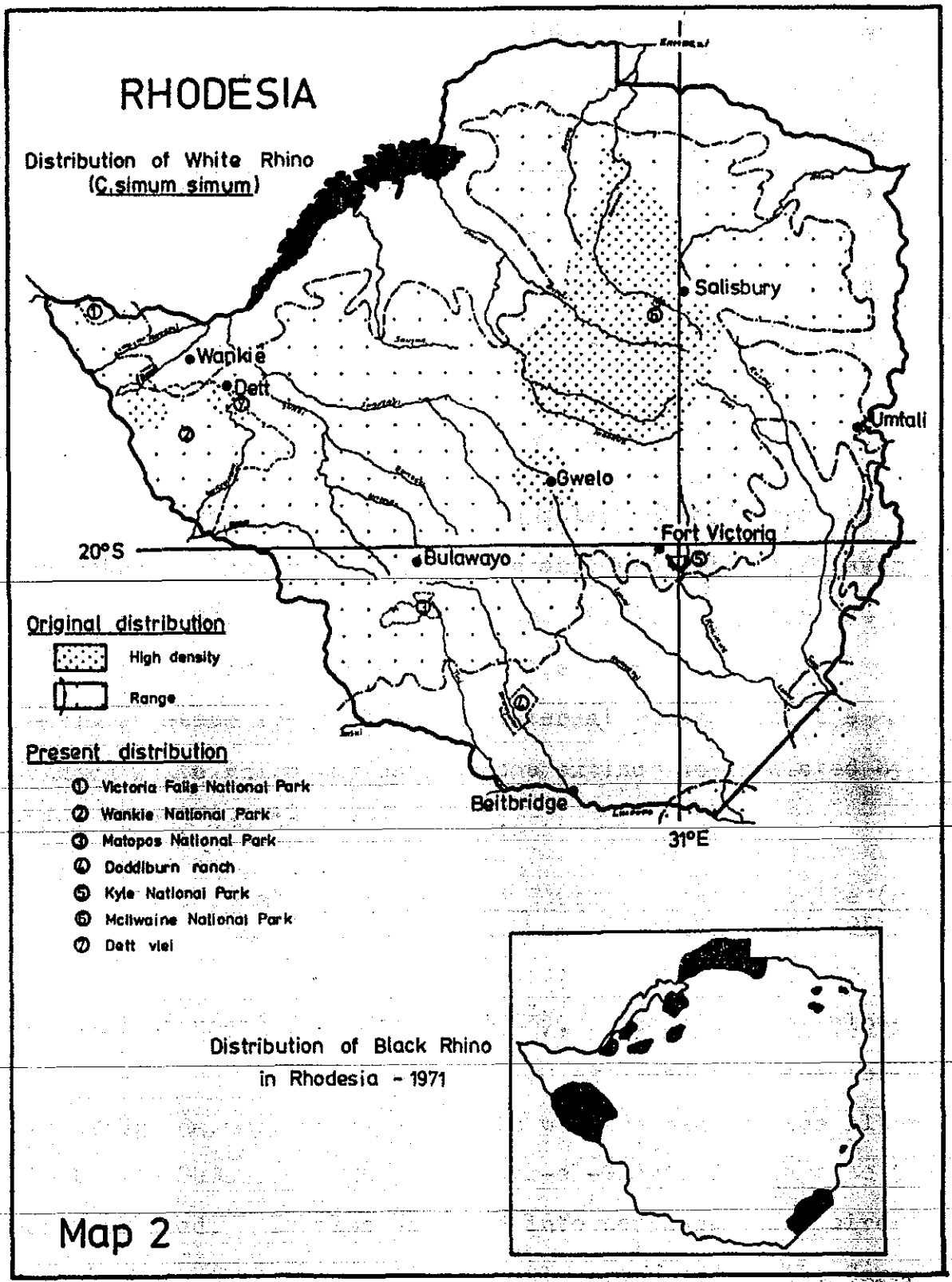
The proclamation of Umfolozi Game Reserve in 1897 enabled protection of the species, and together with increased control on poaching and native squatter encroachment, the species began to increase in number. As early as 1924, Lang suggested that in order to ensure their preservation some of these white rhino should be transported into other regions. By the late 1950's it was thought that the population build up was approaching, and unless preventative measures were taken, was likely to exceed the carrying capacity. Since the population was confined to a relatively limited area the effect of overstocking or a disease epidemic could endanger the future existence of the species. It was decided therefore to remove as many rhino as necessary and in 1961 the Natal Parks Board initiated its famed "Operation Rhino". (Player, 1966 and 1967) with the following objectives;

(1) To re-establish breeding nuclei in Southern Africa.

(2) To export selected specimens to Zoos overseas.

(3) To establish small populations (one to six pairs) in State Nature Reserves, private Nature Reserves, and Zoos within the Republic of South Africa (Rochat and Steele, 1968).

From 1961 to 1972 the species was restored to many of its former habitats in Southern Africa and its future ensured. By the end of March, 1972, 1 109 white rhino had been captured of which 98 had been released in Rhodesia (see Map 2), 35 in


RHODESIA
Distribution of White Rhino
(C.simum simum)
Salisbury
Wankie
Dett
Umtali
Gwelo
Fort Victoria
20°S
Bulawayo
Original distribution
High density
Range
Present distribution
① Victoria Falls National Park
② Wankie National Park
③ Matopos National Park
④ Doddiburn ranch
⑤ Kyle National Park
⑥ Mcilwaine National Park
⑦ Dett viei
Beitbridge
31°E
Distribution of Black Rhino
in Rhodesia - 1971
Map 2

Wankie National Park, 33 in Kyle National Park, 13 in Matopos National Park, four in Victoria Falls National Park, three in McIlwaine National Park and 10 on Doddieburn Ranch (Gwanda) owned by the Henderson brothers. In August 1972 a further five were brought into Rhodesia by the Southern Sun Hotel corporation and released in the Dett Vlei, bringing the total number reintroduced into Rhodesia to 103. The remainder, some 1 011 animals, have been shipped to Zoos, Zoological Gardens, Nature Reserves, and Game Reserves in South Africa, Europe, the United Kingdom, Scandinavia, the Netherlands, the United States, Canada, Japan, Cuba, India, Zambia, Botswana, Kenya, Mozambique, and Swaziland (Player, 1972).

The early history of the Umfolozi Game Reserve is well documented by Foster (1960), Player and Feely (1960), Player (1966 and 1972) and Vincent (1969 and 1970). But for the dedication of those concerned with the protection of the species by State legislation and internal management, the Southern white rhino may have become extinct as predicted by Selous (1893) and Coryndon (1894).

I.2. Distribution of the Northern Race of white (square-lipped) rhinoceros (Ceratotherium simum cottoni).

The distribution of this species (see inset, Map 1) has been well documented by Sidney (1965). According to Selous (1908) the range of this race in 1900 extended from the north west of Uganda, northwards along the western bank of the Albert Nile to the Sudan, and along the Bahr-el-Ghazal drainage to the border of Chad. It also extended into north-western Zaire (Congo) where the species is presently protected in the Garamba National Park.

Roosevelt (1915) gives the range as the west side of the

Nile from the Arau river (north-west Uganda) northwards through the Lado Enclave along the west bank as far as Shambe (Sudan) and west across the Bahr-el-Ghazal drainage towards the border of Chad.

The occurrence of this northern race was only confirmed in 1900 and within its suggested range was, like the southern race in Rhodesia, found in certain localized habitats (Sidney 1965). Foster (1967) mentions that it is indigenous only to the west of the White (Albert) Nile and is found in the West Nile district of Uganda, Bahr-el-Ghazal and Equitoria Provinces of the Sudan and the Garamba National Park.

As previously mentioned, the square-lipped rhinoceros (Ceratotherium simum) has not been known to inhabit the region between the north bank of the Zambezi and the Lado Enclave. This stretch of country does however contain large areas of woodland and savanna woodland of similar form (Wild and Fernandes, 1967) to the vegetation found in parts of its range in Rhodesia. At what stage the square-lipped rhinoceros disappeared from this intermediate territory is not known, "but it is doubtless quite recent, for the Nile race has developed but slight structural differences" (Roosevelt, 1915).

I.3. Distribution of the black (hook-lipped) rhinoceros (Diceros bicornis).

Numerous documents on the distribution of this species exist. It is more widely distributed in Africa than the square-lipped species (see Map 1) and at no stage did it suffer an equivalent depression in numbers as did Ceratotherium simum.

From the Umfolozi and Hluhluwe Game Reserves in Zululand its range passes northwards through Mozambique, Tanzania and Kenya. It is rarely found in the south-western region of

Angola but more commonly throughout the Kaokoveld (north-western) region of South-West Africa and occasionally in the Etosha Pan region. In Botswana very few remain. It is still found in Malawi in the Southern and Central Provinces where it is most numerous in the Mwabvi, Nasunga and Kota-Kota Game Reserves. In Zambia it is still fairly numerous and the largest numbers are found in the Northern and Eastern Provinces on both sides of the Luangwa river (Ansell, 1969). The remainder are found in localized pockets in the Central and Southern Provinces. In Uganda the species is found in the northern, eastern and central regions. The Murchison Falls National Park provides the only protection for black rhino in Uganda. From the north-eastern regions of Uganda the species extends into the Sudan where it is found to the east of the Nile in Equitoria Province only. In Zaire it occurs only in the south-east and east Katanga. In Chad the species is found in the southern and central regions and its range may extend into the northern regions of the Central African Republic. (Roosevelt, 1915, Sidney, 1965 and Dorst and Dandelot, 1970).

Kerr and Fothergill (1971) have compiled a distribution map for the species in Rhodesia (Map 2). It is found most abundantly in the Zambezi valley north of Kariba, in certain areas adjacent to Kariba, and in the Wankie National Park. Isolated populations occur in the Darwin (North) district. In recent years however, a capture and relocation operation has been undertaken by personnel of the Department of National Parks and Wild Life Management, the rhino being captured in the Darwin district, northern Tribal Trust Lands and occupied areas adjacent to Kariba. Most captured animals have been released in the Ghona-re-zhou National Park (south-eastern lowveld). Kerr and Fothergill (1971) estimate the total

population in Rhodesia to be some 740 animals of which about 440 occur on National Land.

I.4. The purpose and objectives of this study.

Vincent (1970) and Player (1972) describe the difficulty of ensuring the survival of Umfolozi Game Reserve itself, but the motivating force demanding its survival was the white rhino. Having eventually secured the future of the reserve, the Natal Parks Board directed attention to securing the future survival of the white rhino. As most of the effort was directed towards establishing breeding nuclei in both former and foreign habitats, the operation involved both monetary and human expenditure, and the future of the species is now considered secure.

Many of the re-established populations, particularly in Southern Africa, have successfully adapted to their new environments and are breeding. In some instances these reintroduced populations have in turn increased the importance and necessity for the long term survival of the Nature Reserves and Game Reserves in which they are confined. It is necessary therefore that such populations are carefully managed, particularly since a new problem hitherto experienced only in Umfolozi looms in the future; that of overpopulation in some of its many new and widely differing, enclosed habitats.

At present the species is too few in number in any one place to permit selective culling for detailed scientific research.

Should the population in any one place exceed the optimum size it is likely that reduction will take the form of further translocations. Any study of the species in its local habitat

in Rhodesia is confined therefore to the living animal.

It is the second largest terrestrial mammal and since it is predominantly a short grass grazer, it encounters both intraspecific and interspecific competition for food within the boundaries of the sanctuaries where it exists.

Attention has been given to its intraspecific behaviour (Owen-Smith 1971) which has been found to play a large part in the distribution of individuals within a confined population. This in turn influences the pressure of occupation to which portions of its habitat are subjected, a matter of managerial importance.

The reintroduced white rhino (Ceratotherium simum simum) population at Kyle National Park, Rhodesia, provides an ideal opportunity for a comparative intraspecific behavioural study, and a study of the effects, if any, that different environmental conditions and a lower population density have had on aspects of the ecology of the species. Special emphasis is placed on :-

(1) Territory size, distribution, and related behavioural activities of dominant adult males.

(2) Home range size, distribution, and related behavioural activities of all other sex-age groups (i.e. adult females, adult females with calves, non-territorial adult males and sub-adults of both sexes).

(3) The effects of food and water availability, topography, and the presence of roads, streams and fireguards on (1) and (2) above.

(4) The effects of veld burning on (1) and (2) above.

(5) Daily activity patterns.

In addition an attempt has been made to compile as accurately as possible the history of the species' introduction to Kyle, an identification index of all individuals for future research, and the present status of the population.

CHAPTER II

THE STUDY AREA

Kyle National Park is situated 32 kilometres (km) south-east of Fort Victoria (Map 2) and lies between the two arms of Lake Kyle (31°E., 20° 10'S.) an irrigation reservoir completed in 1961. The dam wall is built across the Mtilikwe river just below the original junction of the Mtilikwe and Mshagashe rivers. These two rivers provide the bulk of the water retained by the wall. Water from the lake is used to irrigate the south-eastern lowveld sugar, wheat and citrus schemes. The lake is situated on the southern edge of the central Rhodesian plateau at an altitude of 1 050 metres (m).

II.1. History of the study area.

Basuto cattle owners occupied the area at the beginning of the century and in time it became over-grazed and over cultivated. The tribesmen cut down much of the woody vegetation, and the area was frequently burnt to improve the grazing. At some stage the tribesmen were evicted and the area became state-owned public grazing land, while a portion of it, now entirely flooded, became a quarantine area for imported livestock. Regular annual burning continued throughout this period and fires were often started by Africans hunting in the area (Ferrar and Kerr, 1971).

Kyle National Park was established in 1960 and brought to an end the indiscriminate burning and over-grazing. During its first three years approximately 210 animals were introduced. These included: white rhino (*C. simum simum*) zebra (*Equus burchelli*) giraffe (*Giraffa camelopardalis*) buffalo (*Syncerus caffer*) eland (*Taurotragus oryx*) sable (*Hippotragus*

niger) waterbuck (Kobus ellipsiprymnus) wildebeest (Connochaetes taurinus) impala (Aepyceros melampus) and ostrich (Struthio camelus). During the following years further white rhino were introduced, as well as oribi (Ourebia ourebi) tsessebe (Damaliscus lunatus) blesbok (Damaliscus albifrons) lichtenstein's hartebeest (Alcelaphus lichtensteini) and nyala (Tragelaphus angasi). A few species such as steenbok (Raphicerus campestris) duiker (Sylvicapra grimmia) bushbuck (Tragelaphus scriptus) reedbuck (Redunca arundinum) kudu (Tragelaphus strepsiceros) and bushpig (Potamochoerus porcus) were indigenous to the area. In 1970 warthog (Phacochoerus aethiopicus) were introduced and during 1971 the blesbuck were removed.

There are no large predators in the Park apart from the indigenous side-striped jackal (Canis adustus). Pythons (Python sebae), and crocodiles (Crocodylus niloticus) which are numerous in the lake, may remove a few animals although very few such records exist.

In 1968 the kudu population was reduced in a culling exercise in order to avoid an anticipated overpopulation problem. During the same year severe frosts, following on a season of unusually poor rains, severely depleted the availability of food in the park. Further kudu were found dead as a result of the combined effects of overpopulation and a poor food supply (Wilson, 1970). Numerous other species also suffered die-offs from July to October, the reedbuck population suffering a spectacular reduction by some 70% and 404 carcasses were found. During the middle of November of the same year exceptionally low and unseasonal temperatures caused further deaths, and the carcasses of an additional 151 reedbuck, 21

sable, 12 bushbuck, six kudu, five buffalo and five wildebeest were found. The side-striped jackal population was also reduced although no carcasses were found (Ferrar and Kerr, 1971).

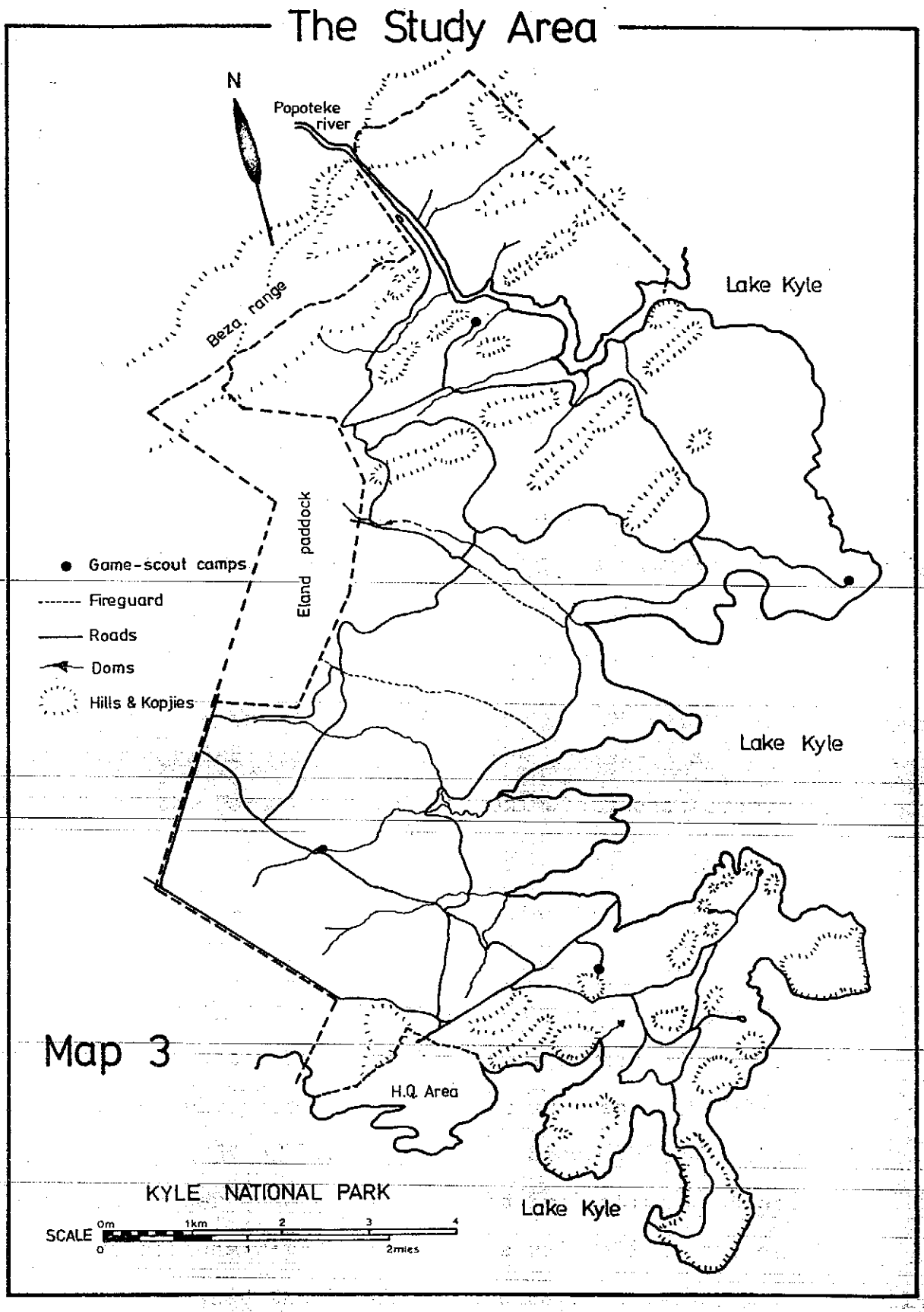
Apart from the kudu reduction, no other culling operations have been undertaken.

II.2. Physical Features of the study area.

Kyle National Park lies at an average of 1 050m. The eastern and southern borders (Map 3) are formed by lake Kyle, while a 2,4m high game fence forms the western and northern boundaries. The northern fence traverses the top of the Beza hill range which rises approximately 400m above the rest of the Park. At the base of the Beza range the country is broken by numerous hills and ridges while further south it becomes increasingly flat and gently undulating. In the south-east it becomes increasingly broken and is characterized by large dome-shaped granite outcrops (kopjies) consisting largely of bare exposed rock, with smaller kopjies of a more broken nature interspersed between them.

The Park is approximately 6 170 hectares (ha) in area. However within the proclaimed boundary the eland paddock (425 ha) the Headquarters area (162 ha) and an unfenced section in the Beza range north of the present fence (178 ha) reduce the effective game area to some 5 405 ha (Ferrar, pers. comm.).

Within the game area a network of roads provides tourists with adequate game-viewing opportunities. Three two-roomed game-scout camps are situated in the game area, so that on each day at least six African game-scouts are on patrol within the area.


The Study Area
N
Popoteke river
Beza range
Lake Kyle
Eland paddock
Game-scout camps
Fireguard
Roads
Doms
Hills & Kopjies
Lake Kyle
Map 3
H.Q. Area
KYLE NATIONAL PARK
Lake Kyle
SCALE
0m 1km 2 3 4
0 1 2miles

Numerous small seasonal streams drain the Park. All have small catchment areas, most have headwaters in the form of small vleis, and they all drain into the lake. There are two very small dams and one small maintained waterhole, built near the eland paddock upstream from a small unsuccessful dam wall, in the central section of the Park. Ferrar and Kerr (1971) note that no point in the Park is further than three miles from the lakeshore. Water is therefore not a limiting factor in the dispersal of game.

Two permanent fireguards in the centre of the Park provide some measure of fire control. However as the Park is small and has only one border susceptible to fire encroachment, wild fires are not common. When they do occur they are usually started by lightening and quickly brought under control. The two fireguards mentioned are frequently used as roads by staff and tourists, so they require little maintenance and are effective. Planned annual and rotational burns are carried out and most of the grassland and savanna regions of the Park are burnt approximately once every three years.

As a result of the fluctuating levels of the lake, much of the lakeshore is exposed during the dry season and inundated during the wet season. Large areas adjacent to the low level water line are therefore devoid of vegetation. During the early years of the lake's existence it filled to approximately 65% of its capacity. Since 1964 the increasing demand for water made by the Lowveld irrigation schemes, and a number of seasons with below average rainfall in the catchment areas, have caused the level to fluctuate between 25% to 45% only. The land inundated by the higher levels between 1961 and 1963

was left barren when the water receeded (Map 4). Grasses are slowly recolonizing this area and small, graded, contour ridges have reduced the soil loss.

II.3. Climate of the study area.

Daily rainfall and temperature figures are recorded at the Fisheries Research Centre situated in the Headquarters (H.Q.) area of the Park. This area is somewhat more sheltered than most of the game area and is the only place in the Park where such records are kept. Rainfall and temperature figures recorded at the Research Centre are shown in Tables 1,2 and 3 and Figures 1 and 2.

The annual rainfall is extremely variable (Figure 1) and although rain can fall in every month, there is a definite wet season from November to March. Approximately 82% of the total annual precipitation falls during this period.

Temperatures also follow a seasonal trend, giving rise to a distinct summer and winter. Inter-seasonal periods are less well defined but do occur. The spring season, before the main rains, is characterized by increasing maximum and minimum temperatures while the autumn season after these rains shows the opposite trend in temperature.

The maximum and minimum temperatures rise rapidly in August and September (Figure 2). Since this period follows the relatively dry and cold winter, during which the quality and quantity of food has become increasingly depleted, it is the period of greatest stress for the animals. The average daily temperature reaches a maximum in December and thereafter decreases to a minimum in July.

Table 1. Mean monthly rainfall figures (mm) for Kyle National Park from 1962 to 1972

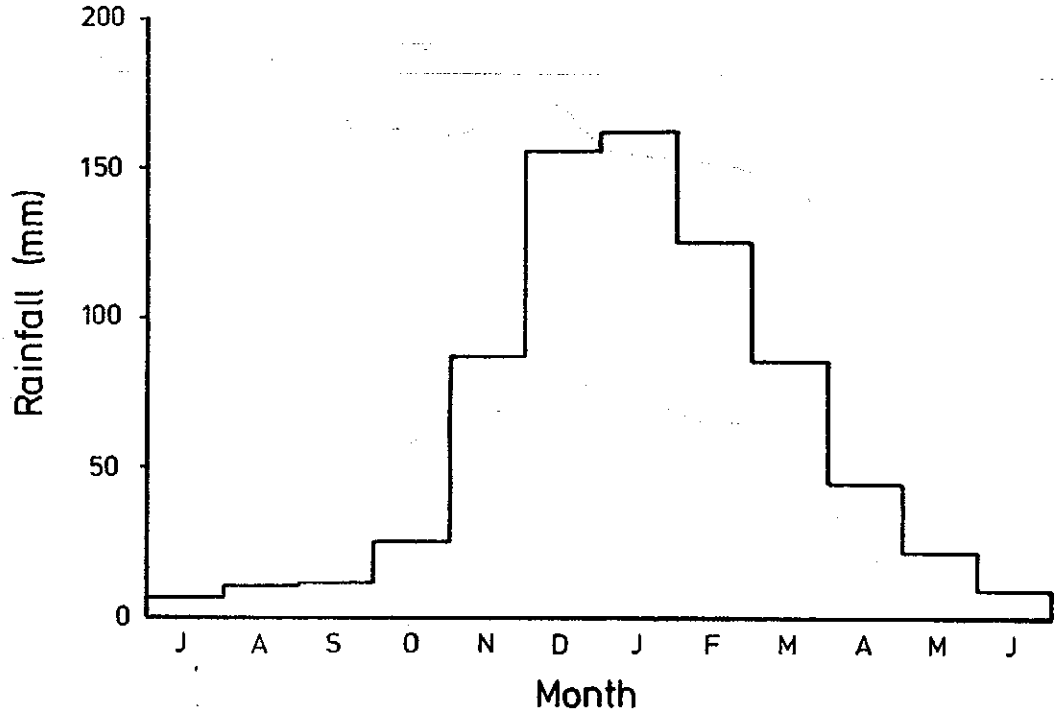
Month	J	A	S	O	N	D	J	F	M	A	M	J
Rainfall	6,4	10,3	11,1	25,5	87,6	154,2	161,5	125,2	85,6	45,5	21,9	9,6

Table 2. Total annual rainfall figures (mm) for Kyle National Park from 1962 to 1972

Year	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Rainfall	1013,9	919,9	902,1	282,3	818,4	833,6	498,3	932,7	482,9	660,9	733,4

Table 3. Mean maximum and minimum monthly temperature (^{o} Celsius) for Kyle National Park from 1969 to 1972

Month	J	A	S	O	N	D	J	F	M	A	M	J
max. temp.	20,1	23,7	27,1	27,5	27,3	28,7	26,9	26,6	26,1	24,8	22,0	19,5
min. temp.	8,1	10,8	13,9	16,8	17,6	18,6	19,1	18,1	17,8	15,3	11,4	9,2



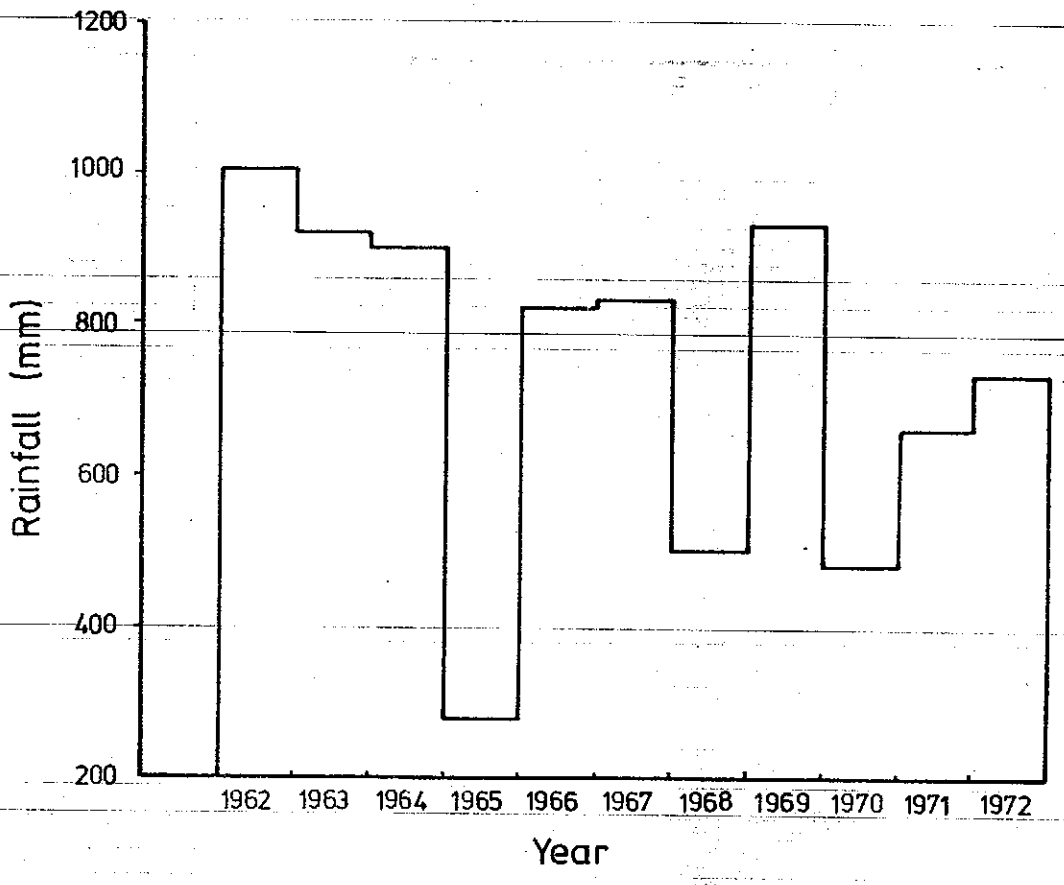


Figure 1. Mean monthly (top) and total annual rainfall (bottom) (mm) for Kyle National Park from 1962 to 1972.

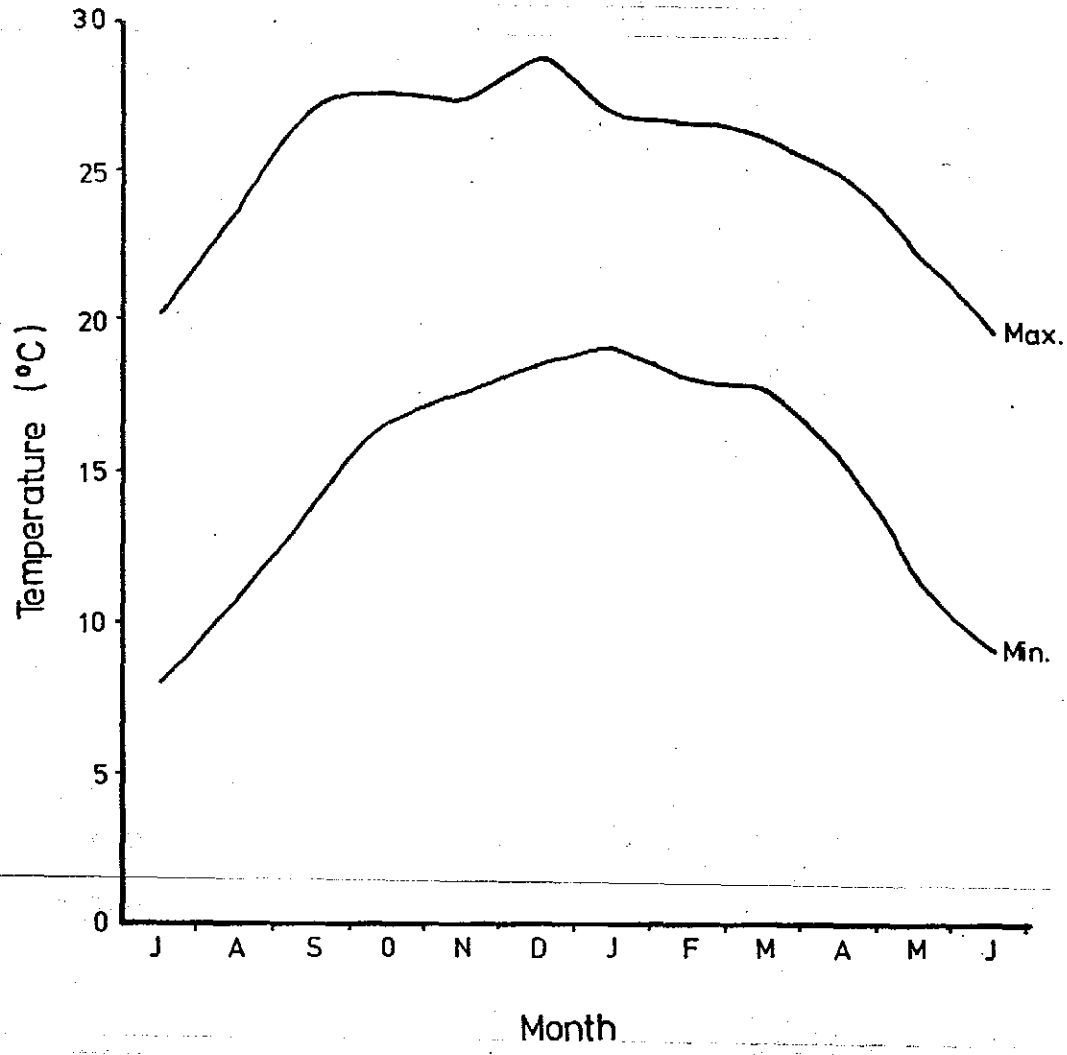


Figure 2. Mean monthly maximum and minimum temperature (^{o}C) for Kyle National Park from 1969 to 1972.

During June and July light ground frosts can occur, the low lying drainage lines in the southern portion of the Park being most susceptible.

II.4. Soils of the study area.

The southern end of the Park is composed largely of light-coloured, sandy soils derived from the underlying granite shield. The western part of this area is an undulating grassland (Map 4) with anthills, supporting mature trees, scattered along the sides and crests of the ridges. Small seasonal streams and vleis occur in the drainage lines between the ridges and the soils are generally dark grey clays and clay-loams. The eastern part consists of the broken kopje country described in section II.2, with the sandy soils occuring between the granite outcrops.

The rest of the Park is composed of a red soil derived from the basement complex of banded ironstone and gold-belt schist. These soils are more fertile than the sand but often so shallow, particularly on the slopes of the Beza complex, that the sub-surface rock formations are exposed. The soil is generally clay to clay-loam in texture. Most of this red soil region supports savanna and woodland vegetation types (Map 4).

II.5. Vegetation of the study area.

According to Wild and Fernandes (1967) Kyle National Park lies in the "Deciduous Miombo Savanna Woodland" (characterized by the trees Brachystegia spiciformis and Julbernardia globiflora) region of central Rhodesia. As a result of the indiscriminate wood cutting and burning prior to the Parks establishment, large areas have been reduced to fire-maintained sub-climax grassland. With improved control

over the frequency and timing of fires, many parts of this grassland have developed into regrowing successional woodland. The vegetation in the Park is therefore varied and ranges from open grassland to closed-canopy miombo woodland.

Wilson (1970), Ferrar and Kerr (1971) and Ferrar (1973) have described the vegetation of the study area. Ferrar (1973) has described it in the greatest detail, and has 13 physiognomic types all of which occur in one of three major divisions; grassland, savanna and woodland. Since the white rhino in the study area appear to depend entirely on grass as a food source, the amount and composition of the grass layer is of particular relevance to this study. Ferrar's description of the vegetation is therefore somewhat modified so as to emphasize the grass component, while the separation into the three major divisions is retained.

The vegetation pattern is indicated on Map 4. Dotted lines are used to separate vegetation types within each of the three major divisions.

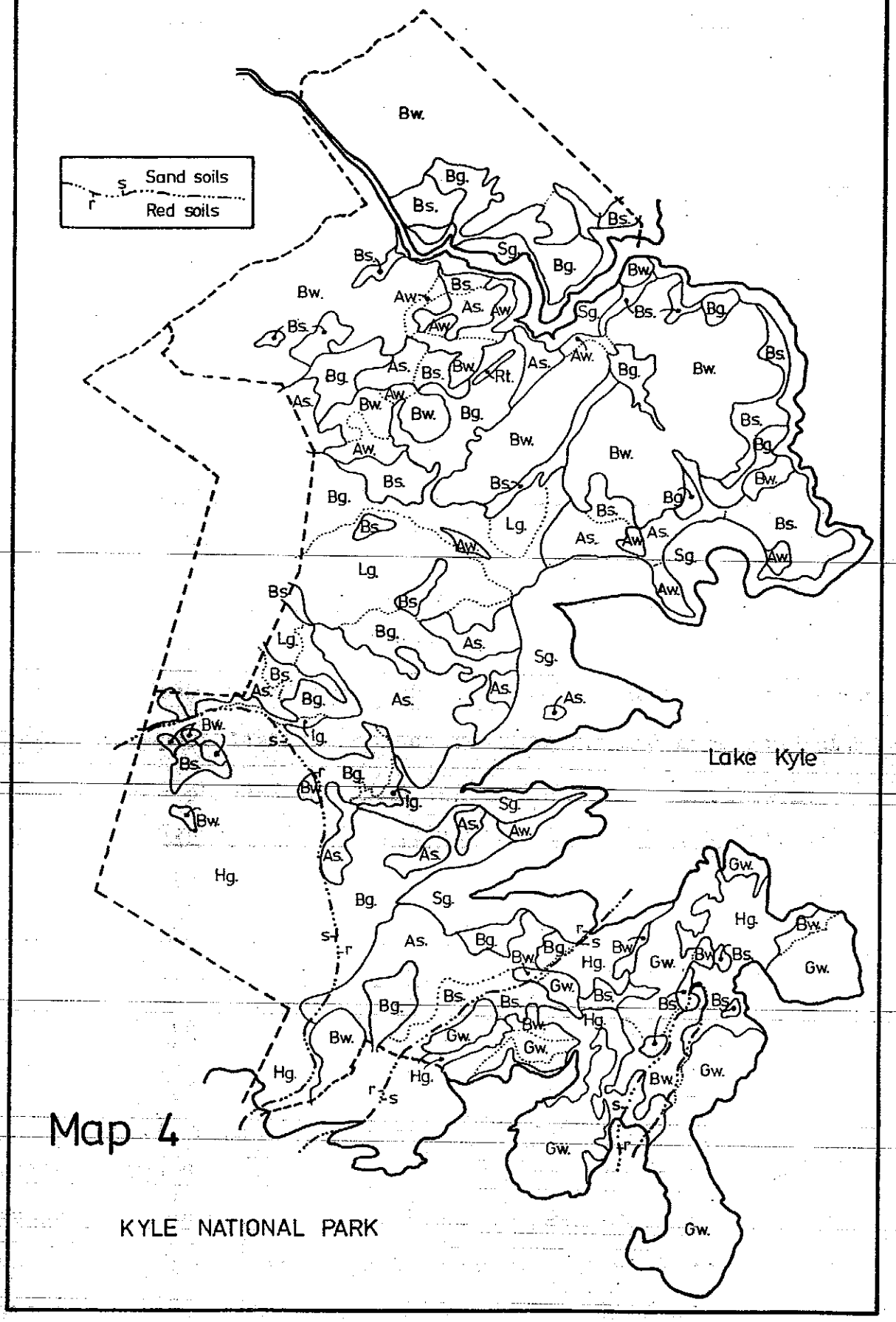
II.5.a. The grassland.

This category comprises some 45% of the study area and is characterized by a continuous grass sward with scattered anthills. The vegetation on the anthills varies from large mature trees and shrubs to a very low and sparse grass cover due to excessive grazing.

There are five different grassland types.

(i) Hyparrhenia grassland (Hg.) - occurs on the sand soils of the undulating south-eastern part of the study area. Basal cover is relatively poor and tall grasses (over 1m) are dominant. Large anthills supporting mature trees are scattered along the sides and crests of the undulations.

Vegetation



Between the crests vleis and small streams have developed, and anthills occurring here are poorly covered by well-grazed Cynodon dactylon. The dominant grasses are Hyparrhenia filipendula, Trachypogon spicatus and Hyperthelia dissoluta. No trees and very few shrubs or forbs occur in the grassland.

(ii) Loudetia grassland (Lg) - occurs in the central part of the study area on shallow red soils. Basal cover is very poor, belts of exposed ironstone occur frequently, and the grass is of medium height (up to 1m). Loudetia simplex is the dominant grass and occurs as pure stands over large areas. Trees occur in some areas of the grassland, particularly on and near anthills, the more common species being Pterocarpus rotundifolius, Peltophorum africanum and Combretum spp..

(iii) Brachiaria grassland (Bg) - comprises the remaining grassland areas on the red soils. The soil is generally deeper and more fertile than (ii) above and the grass species composition is distinctly different and more complex. The dominant grasses are Brachiaria brizantha, Hyperthelia dissoluta, Hyparrhenia filipendula and Themeda triandra, and basal cover is better than (ii) above. The legume Dolichos kilimandscharicus occurs in the herb layer and is dominant in isolated patches. Peltophorum africanum is one of the most common trees, and patches of invading Acacia karroo occur in some places.

(iv) Imperata grassland (Ig) - occurs on the dark clay soils of the drainage lines. Since the streams in these drainage lines are seasonal, their courses as well as narrow zones along the edges support grasses. Pure dense stands of short Imperata cylindrica occur along the edges of the streams

and Cynodon dactylon often occurs on the stream beds.

(v) lakeshore grassland (Sg) - occurs along the lake shore above the normal high water level of recent years. This area was originally inundated and a grass cover is slowly redeveloping. The common grasses are Rhynchelytrum repens, Sporobolus pyramidalis and Eragrostis spp.. Along the seepage zone and on the anthills Cynodon dactylon is dominant and provides an important source of food in this area.

II.5.b. The savanna.

This category comprises about 21% of the study area. It is characterized by a discontinuous grass sward with scattered trees which sometimes represent successional stages of the climax woodland. The species composition is complex and largely seral. These areas were probably reduced to near grassland by the fire regime practised before the formation of the Park. Extensive shrub and tree invasion is now evident as a result of less frequent burning.

There are two different savanna types.

(i) Acacia savanna (As.) - occurs on the deeper red soils of the study area and is characterized by two pioneer Acacia species, A. karroo and A. rehmanniana. The grass component is mixed but the more common species are Themeda triandra, Hyparrhenia filipendula, Heteropogon contortus and Cynodon dactylon.

(ii) Bush savanna (Bs.) - occurs on the shallow red soils where the basement formation is often exposed. As with the lakeshore grassland, the vegetation in this category is so mixed it is difficult to characterize on a species basis. Trees are not limited to the vicinity of anthills but scattered throughout the area. The common species are Combretum fragrans,

Pterocarpus rotundifolius and Peltophorum africanum. The grass cover is generally poor and consists of numerous species, Hyparrhenia filipendula, Brachiaria brizantha, Themeda triandra, Andropogon gayanus and Setaria spp. being the most common.

II.5.c. The woodland.

This category comprises some 34% of the study area. It is characterized by a closed tree canopy and generally a very sparse or absent grass cover.

There are four different woodland types.

(i) Acacia woodland (As.) - occurs on the deeper red soils and has a relatively open canopy. The characteristic trees are A. karroo and A. rehmanniana. The grass layer is often dense and of medium height (up to 1m) and consists of the more palatable species such as Panicum maximum and Themeda triandra. The shrub layer is not well developed.

(ii) Brachystegia woodland (Bw.) - occurs on both the red and sand soils, and is of the miombo type which characterizes the whole area according to Wild and Fernandes (1967). It is probably the climax vegetation type in the study area. Pure Brachystegia spiciformis woodland occurs on the slopes and foothills of the Beza range. The ground is strewn with small rocks and stones, and the grass cover is sparse.

On the gentle, red soil slopes away from the Beza complex and in the southern sandveld and kopje areas, true miombo woodland occurs with B. spiciformis and Julbernardia globiflora as the co-dominant trees. The grass cover is poor and often absent. The common species are Aristida congesta and Eragrostis spp..

(iii) Granite woodland (Gw.) - occurs in the south-eastern

kopje area in association with the granite outcrops. The species diversity is too great to characterize this woodland type by species. On the deep sand soils around the base of the kopjies thicket vegetation often occurs. The tree component is generally a Brachystegia spiciformis - Julbernardia globiflora association, while on the tops of the kopjies where the soil is deep enough Brachystegia glaucescens always occurs. The remains of old kraal sites are common in this area and they now support a complex association of trees and shrubs. The grass component is largely Hyparrhenia filipendula in the open areas and Setaria and Eragrostis spp. on the kopjies. The grass cover beneath the woodland is often very sparse and where it does occur Eragrostis spp. are common.

(iv) Riverine thicket (Rt.) - occurs most frequently in the northern section of the Park along the streams. It is a very limited vegetation type and too complex to characterize by species.

CHAPTER III

THE METHODS AND TECHNIQUES EMPLOYED IN THIS STUDY

III.1. Identification of individual white rhino.

In the first month of this project, most of the white rhino in the study area were identified, described and photographed, and in the weeks that followed all of the remaining rhino were identified and described, and all but two individuals were photographed. A set of the most representative photographs of each animal or pair of animals was carried in the field and referred to whenever necessary.

The following features were used to identify the individuals, and where possible the individuals were photographed so as to show these features on the photographs;

(a) Sex - of particular value in the case of cows, some with very similar features, but whose current calves are of different sexes.

(b) Body size - of general value. In the case of sub-adults this is of limited value over long periods, as adult body size is only attained between six to eight years of age. Cows accompanied by calves may appear relatively larger or smaller, depending upon the size of the calf. In this case other features can be used to identify the pair.

(c) Scars - of particular value provided the scars are permanent. In some cases individuals can be identified on this feature alone. Mud from frequent wallowing tends to obliterate all but the largest and most obvious scars.

(d) Ears - in many cases pieces of skin have at some

stage been torn from the outer edges of one or both ears, producing a characteristic silhouette. A fringe of hair along the edge of the ears may be present to a greater or lesser extent. Holes in the ears may also be present.

(e) Horns - the shape and size of both horns generally provide the most suitable criteria for individual identification, except in the case of calves where horn development is poor. The shape and size of the horns varies with age and they may continue to grow for most of the individuals life. The anterior horn of adults, particularly males, may suffer some damage or be completely lost, in which case regrowth is usually stunted. The posterior horn is not often marked or lost, but where the anterior horn has been lost it may grow unusually large.

(f) Temperament - each individual has a characteristic temperament and tolerance for cars, horses, and humans. This is particularly noticeable since many of the imported animals, now adults, have been subjected to close association with vehicles and humans at some stage in their past. The progeny of these individuals, some of which are now either adults or sub-adults, are more nervous and less tolerant.

(g) Associations - sub-adults of the same sex and similar age sometimes associate in pairs for a long time. Two pairs, one of males and the other of females, were known to exist throughout the study period and were therefore easily identified.

Every member of the Kyle white rhino population was identified by one or more of these features. In Appendix II a description of each adult and sub-adult is given together with its date of birth or introduction, its age class (see

Chapter IV) its social status, and in the case of adult cows, the number of calves they have had.

Apart from the sex, and presence of scars, no other feature used to identify an individual is permanent. Regular close observation of each individual is necessary in order to ensure correct identification, particularly in the case of young growing animals and adult males who may lose or damage their horns during social conflicts. Wounds may be sustained at any time, particularly during conflicts between adult males, which may leave characteristic scars.

III.2. Division of the study area into study blocks.

The effective game area of Kyle National Park was divided for convenience into six study blocks (see Map 5). The section of the study area north of the Popoteke river was not included as no white rhino occupy this area. The boundaries of the study blocks were chosen arbitrarily and usually followed roads or streams.

The size of each study block varied according to the predominant vegetation type of the area, which in turn dictated the amount of time required to thoroughly search each block. In view of the limited time available for the study, it was decided that each study block must be of suitable size to enable a thorough search in one day.

Six consecutive days of each week (Monday to Saturday) were spent in the field searching these blocks for white rhino. On the seventh day a tour over all the roads was usually undertaken and when possible certain areas, selected on the basis of interesting or unusual observations recorded during the previous six days, were revisited.

The regular pattern of searches ensured that all relevant parts of the study area were visited an equal number of times. This system was selected in order to ensure that the final individual distribution pattern gave a true reflection of the size and distribution of territories and home ranges. On a few occasions the sequence of searches was interrupted to conduct 12 and 24-hour activity studies, and then resumed on completion of these studies.

Two people were involved in these searches and most of it was done on foot, while on a few occasions the study blocks near the H.Q. area were searched on horseback.

III.3. Data recording.

III.3.a. Individual distribution.

A six figure grid system (see Map 5) was superimposed on a 1:25 000 map of Kyle National Park. The shape and orientation of the study area made it difficult to devise a grid system based on the quarter degree grid system as applied to Rhodesia. Consequently, the grid system shown on Map 5 has no relation to degree lines of latitude and longitude. This enabled the site occupied by a white rhino to be located on the map to within 70 metres. If necessary aerial photographs were referred to for exact location of the site.

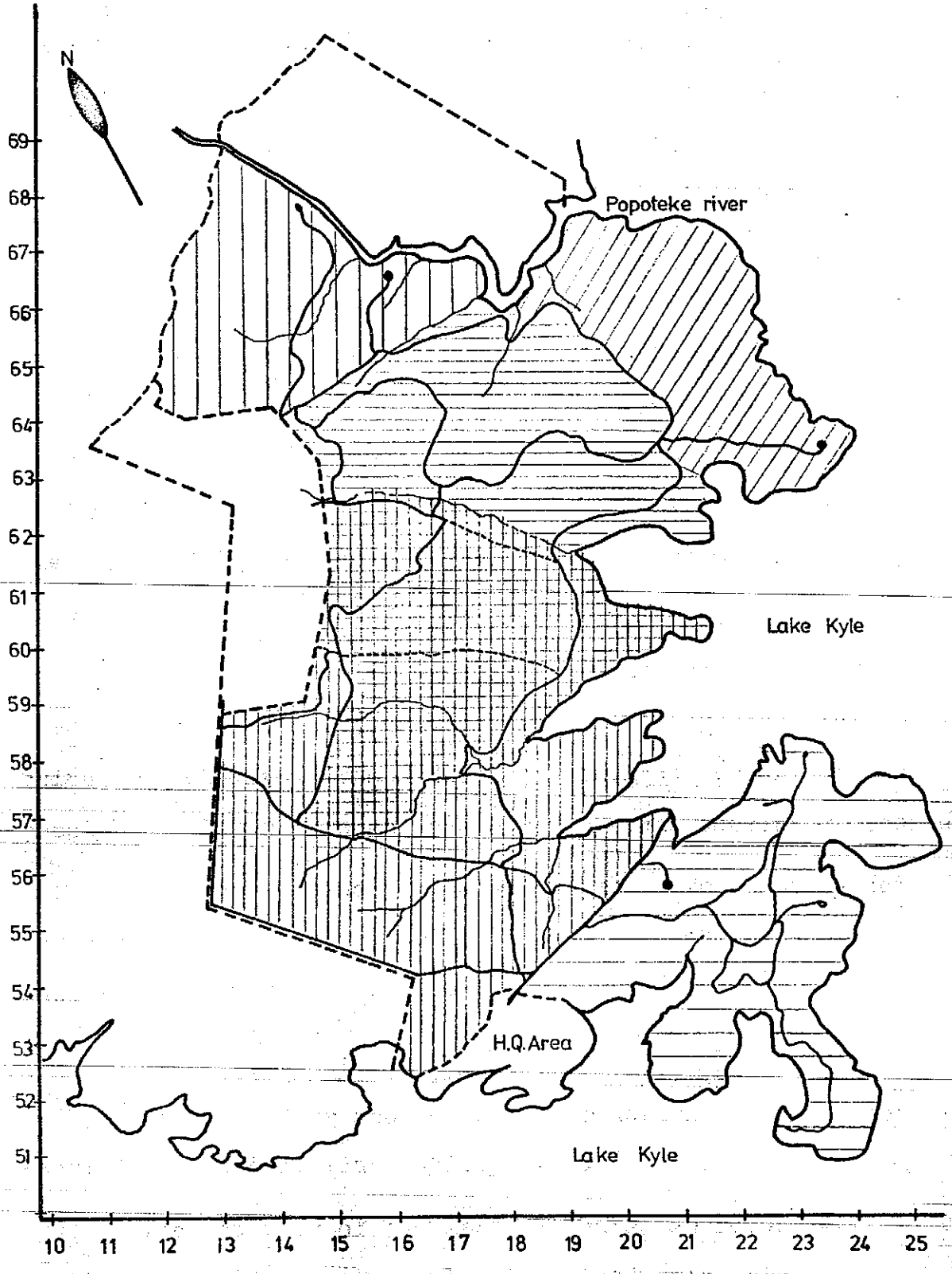
During the searches of the study blocks, and during the travels to and from these blocks, every observation of a white rhino was recorded on a field sheet. The following information was recorded;

(i) Site - six-figure grid reference.

(ii) Date and time.

(iii) Animal reference number.

Study blocks and grid system



Map 5

(iv) Sex and age class (adult, sub-adult, juvenile) - to facilitate identification.

(v) Activity at the time of observation - activities were classified as lying down, feeding, drinking, or walking.

(vi) Behaviour at the time of observation - behaviour was classified as spray-urinating, urinating, defecating and dung-kicking, defecating, associated (two or more animals together) or confronted (by one or more other white rhino).

While searching the study blocks, middens and scrapemarks (discussed in Chapter V) were often found. The sites of recent scrapemarks and any large well-used middens were recorded. The distribution of scrapemarks was used as an initial indication of the distribution of territories. Once the actual distribution of territories was known, only very recent scrapemarks were recorded.

During the daily searches any white rhino seen to be involved in a conflict, or associated with any other white rhino, was observed from a discrete distance for as long as possible. Their movement and behaviour was carefully recorded.

Towards the end of the study two to four hours each day were spent recording the movements and behaviour of individual territorial bulls.

III.3.b. Activity studies.

Three 24-hour and four 12-hour activity studies were carried out on individual white rhino.

The activity of the study animals was recorded continuously and not at regular time intervals only. The latter method is often used to record daily activity patterns, particularly in the case of herd animals or where more than

one animal is being simultaneously studied. Continuous recording necessitates continuous observation of the animal. Certain activities, which may not be detected if recording is done only at regular time intervals, are observed and recorded by the continuous method. The percentage of the study period spent by the animal doing various activities, such as feeding and sleeping, are derived from absolute figures in the case of continuous recording. With discontinuous recording, the number of times an animal is observed performing a particular activity is often used to estimate the percentage of the study period spent doing that particular activity. This can result in under or overestimates of the importance of particular activities.

As only one animal at a time was being observed, and in view of the above mentioned disadvantages of discontinuous recording, it was decided to record continuously the activity of the study animal throughout the period of observation.

Throughout these studies only one observer at a time was near the study animal, and at all times avoided disturbing the animal. However on a few occasions, particularly at night during the 24-hour studies, when close approach was necessary, the observers presence was noticed. The disturbance was soon overlooked provided the observer remained motionless. The activity of the animal on such occasions was classed as standing and looking.

Only one observer was involved in the 12-hour studies while for two of the three 24-hour studies, four observers, each taking four-hour shifts, were involved. During the first of the 24-hour studies only two observers were involved, each doing eight-hour shifts. Contact between the on-duty

observer and the relief observer at the end of a shift was achieved by using small, portable, two-way radio sets. Change of observers was therefore rapid and the study animal was not disturbed.

Activities were classed as follows;

(i) Lying down.

(ii) Feeding.

(iii) Walking.

(iv) Standing.

(v) Social interaction .

Feeding always involves walking and standing. For an activity to be classed as walking the animal must have been walking with purpose, such as towards water or between feeding sites, and not feeding as it moved along.

Frequently an animal will stand motionless with head raised and ears focusing in one direction after another. On other occasions the head will be lowered so that the lips are close to or actually touching the ground. Its eyes may be closed but the ears continue to focus in all directions. In the former case the animal is probably listening while in the latter case it is dozing. Both these activities were classed as standing.

Time spent actually involved in a confrontation with another white rhino was classed in the social interaction category.

The animals observed during the 12 and 24-hour studies were selected from animals known to be relatively unconcerned by the close approach of humans. The following animals were studied;

(i) Adult territorial male (No.6) one 24-hour study.

(ii) Adult territorial male (No.18) one 24-hour and two 12-hour studies.

(iii) Adult subsidiary male (No.32) two 12-hour studies.

(iv) Adult female and calf (No's 4 and 5) one 24-hour study.

III.4. Time schedule.

A brief resumé of the time schedule to which this study was operated is given below.

1972

May 24th to June 17th - individual identification and photography. Distribution of individuals, scrapemarks and middens.

July 7th to 11th - as above. July 7th and 8th 12-hour activity studies on adult territorial male 18 and adult subsidiary male 32.

September 1st to 26th - distribution of individuals. September 21st to 22nd 24-hour activity study on adult territorial male 6.

October 21st to 23rd - distribution of individuals.

November 29th to December 14th - distribution of individuals.

1973

January 12th to 25th - individual distribution. January 14th and 15th 12-hour activity studies on adult males 18 and 32. January 17th to 18th 24-hour activity study on adult male 18. January 18th to 19th 24-hour activity study on adult female and calf 4 and 5.

CHAPTER IV

THE POPULATION HISTORY, PRESENT STATUS AND REPRODUCTIVE ASPECTS OF THE WHITE RHINO IN KYLE NATIONAL PARK

IV.1. Introduction of white rhino.

On September 3rd, 1962, four white rhino were released in Kyle National Park. These four were part of a consignment of eight white rhino brought to Rhodesia by Operation White Rhino (Davison and Condy, 1963). The remaining four in this first consignment were released in the Matopos National Park (see Map 2).

During 1965 six more rhino from Umfolozi Game Reserve were released at Kyle. During 1966 further white rhino, also from Umfolozi, were introduced. No further introductions have taken place since 1966.

Unfortunately, as inadequate records have been kept, the exact number of introductions in 1966 cannot be determined. The history of introductions is shown in Appendix III. The information shown in this Appendix was obtained from the Natal Parks Board (South Africa) and the Department of National Parks and Wild Life Management (Rhodesia). According to this information, 23 white rhino were introduced during the course of 1966, but as one female died soon after arrival the number of effective introductions in 1966 was 22. The total number of introductions to the study area$ was therefore 33, or 32 effective introductions.

In Appendix IV, a calendar of births, deaths, and introductions since 1962 is given. According to this information, in which the above figure of 23 introductions in 1966 is acknowledged, there should have been 35 white rhino in the study

area at the end of 1972.

This however was not the case, and at the end of 1972 only 33 white rhino were known to exist. The origin of this discrepancy is not quite known. The births and deaths are believed to have been accurately recorded, particularly since the Park is patrolled daily by at least six game-scouts. It is however possible that two white rhino from Umfolozi, consigned to Kyle National Park, were released in the Loskop Nature Reserve (Transvaal Province, South Africa) due to the breakdown of one of the transport vehicles in 1966. The breakdown has been confirmed but the fate of the two white rhino is unknown. It is possible that they were not eventually released in Kyle National Park.

The number of effective introductions to Kyle National Park during 1966 may therefore have been 20 and not 22 as previously mentioned. This would reduce the final figure of 35, shown in Appendix IV, to 33, and would correspond with the actual known population of 33 at the end of 1972.

No confirmation, with regard to the whereabouts of the two white rhino possibly left at Loskop, has been received from the authorities at the Loskop Nature Reserve. The records shown in Appendices III and IV have not been reduced, and as they are, they reflect the records of the Natal Parks Board and the Department of National Parks and Wild Life Management.

IV.2. The population increase from 1962 to 1972.

Appendix IV indicates the change in population size from 1962 to 1972. In Figure 3 this change, as well as the yearly distribution of births and deaths, is illustrated. It should be noted that as Appendix IV suffers from the above

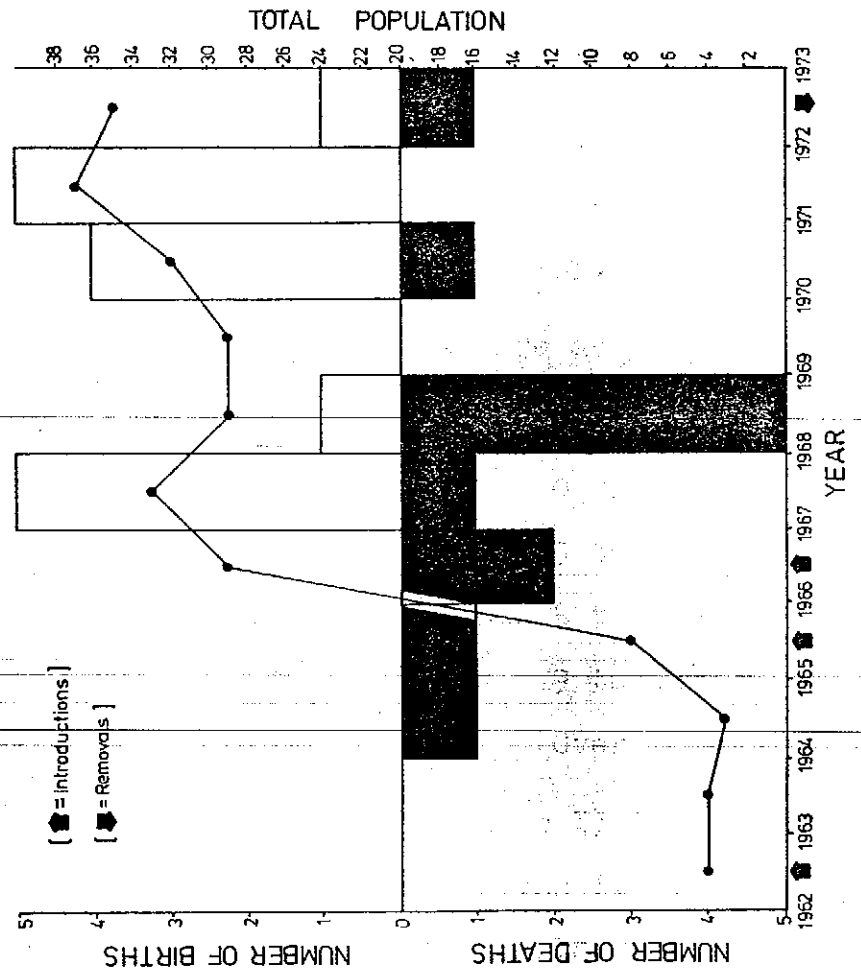


Figure 3. Changes in the size of the white rhino population in Kyle National Park from 1962 to 1972.

mentioned discrepancy, the total population changes shown in Figure 3 reflect the same discrepancy. The yearly distribution of births and deaths shown in this figure, also taken from Appendix IV, is however considered to be an accurate record of what has actually taken place.

IV.3. The size, age and sex structure of the population at the 1st January, 1973.

The present population consists of 33 individuals, and the age and sex structure is shown in Table 4 and Figure 4.

Every individual in the population has been allocated to a particular age class according to its approximate age in years at the 1st January, 1973.

The age classes are as follows:-

Class	Age in years	Description
I	0 to 3	Juvenile (J)
II	3 to 6	Sub-adult (SA)
III	6 to 9	Adult (A)
IV	9 to 12	Adult (A)
V	Over 12	Adult (A)

The juvenile category (class I) is comprised of calves at foot. The sub-adult category (class II) consists of calves at foot which are over three years old, and other animals who tend to associate in pairs of the same sex and of relatively similar age. The age of first conception appears to be approximately six years (See section IV.4) and animals over six years old are classed as adults (classes III, IV and V).

The age of the juveniles and sub-adults has been determined by back reference to their month of birth (Appendix IV). The dates given in this Appendix are either the date on which

Table 4.

Age and sex structure of the white rhino population in Kyle National Park at the 1st January, 1973.

No.	Date of arrival		Approximate age		Class	Sex	
	Introduced	Born	At Introduction	At 1st Jan, 1973		Male	Female
1	12.8.65		2½ years	9yrs. 10mths	IV		A
2		March 1971		1 " 9 "	I		J
3	2.10.66		2 years	3" 3 "	III	A	
4	3.9.62		2½ years	12 " 9 "	V		A
5		July 1971		1 " 5 "	I		J
6	3.9.62		2½ years	12 " 9 "	V	A	
7	16.10.66		Mature	Mature	V	A	
8	26.8.65		"	"	V		A
9		19.6.70		2yrs. 6mths	I		J
10	24.10.66		Mature	Mature	V		A
11		22.7.70		2yrs. 5mths	I	J	
12					V	A	
13					V	A	
14					V		A
15		10.4.72		- 8mths	I	J	
16					V		A
				2yrs. 5mths	I	J	

17		7.7.70		2yrs. 5mths	I	J	
18					V	A	
19	16.10.66		3 years	9 " 2 "	IV		A
20		1971		2 " -	I		J
21	9.10.66		Mature	Mature	V		A
22		16.8.71		1yr. 4mths	I		J
23	3.9.62		3½ years	13yrs. 9 "	V	A	
24		6.4.67		5 " 8 "	II		SA
25		15.4.67		5 " 8 "	II		SA
26	23.10.66		Mature	Mature	V		A
27		Oct.1970		3yrs. 2mths	II	SA	
28	23.10.66		2 years	3 " 2 "	III	A	
29		Aug.1967		5 " 4 "	II	SA	
30					V		A
31		Apr.1971		1 " 9 "	I	J	
32	1966?				III	A	
33		10.12.67		5 " - "	II	SA	

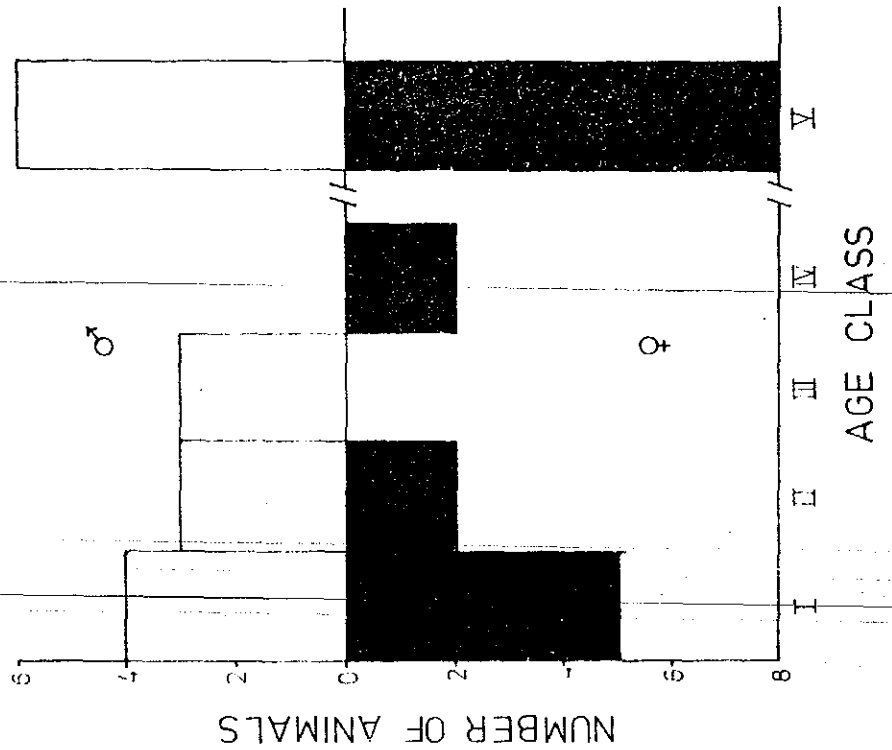


Figure 4. The age and sex structure of the white rhino population in Kyle National Park at the 1st January, 1973.

the animal was born or the date when it was first seen. During the study every cow was seen at least once every two to three days, so the date on which a calf was first seen is considered to be within two to three days of its birth. Very reliable local knowledge enabled identification of which cow gave birth on the dates or during the months indicated in Appendix IV. It was then possible to estimate the age, to the nearest month, of the juvenile or sub-adult in question.

The ages of some of the adults were also obtained by back reference, in this case to the records shown in Appendix III. The age of all captured animals was estimated by the Natal Parks Board capture officer. Notes, concerning the shape and size of the anterior horn in particular, were made by those involved in their capture and transport. These notes, in addition to reliable local knowledge, have enabled identification of some of the animals now living in the study area. These individuals are listed in the column titled "Thesis" of Appendix III.

The approximate ages of some individuals at capture were classed as "Mature" by the Natal Parks Board capture officer (see Appendix III). The age at which this classification was introduced is unknown. The animals identified in the present population as those who were introduced at a "Mature" age have been allocated to class V.

In some cases it has not been possible to identify reliably members of the present population with the descriptions shown in Appendix III. The individuals concerned are numbers 12, 13, 14, 16, 18 and 32. Since numbers 12, 13 and 18 are territorial bulls and as large as members of class V, they have been allocated to this class. Numbers 14 and 16 are large

females who have both had at least one calf. They have therefore been allocated to class V. Number 32 has been allocated to class III because it is believed that it was introduced as a calf in 1966, and it is of similar size and shows the same degree of horn development as other class III individuals.

In Figure 4 the age class axis (x-axis) is shown to be discontinuous between classes IV and V. This has been done in order to indicate that age class V consists of known aged animals, as in the other classes, and in addition, all those animals whose ages are either unknown or have been classed as "Mature", but whose ages are believed to be over 12 years.

At the 1st January, 1973, the sex ratio of the study population (16 males : 17 females) did not differ significantly from unity.

IV.4. Reproductive aspects.

By making use of very reliable local knowledge to identify some of the study animals with the records shown in Appendix III, and the records (Appendix IV) kept by the Warden of the study area, some aspects of the reproductive biology of the white rhino in the study area can be extrapolated.

No reliable records on the length of the gestation period are available from the study population. Mentis (1972) quotes the following records on the length of the gestation period; 548 to 578 days, 614days, 584 days, 476 days and 482 days. In order to obtain the estimates shown in Table 5, an average gestation period of 540 days or 18 months is assumed.

(i) Adult cow number 4 - introduced on the 3rd September, 1962, approximate age two and a half years. First calf was born on the 4th May, 1963. Approximate age of number

4 at birth of first calf was eight years, three months. Assuming a gestation period of 18 months, first conception took place when number 4 was approximately six years, nine months old.

Second calf (number 5) was born in July, 1971. Approximate age of number 4 at birth of second calf was 11 years, four months, Assuming a gestation period of 18 months, second conception took place when number 4 was approximately nine years, 10 months old. The calving interval was approximately three years, one month.

(ii) Adult cow number 1 - introduced on the 12th August, 1965, approximate age two and a half years. First calf (number 2) was born in March, 1971. Approximate age of number 1 at birth of first calf was eight years, one month. Assuming a gestation period of 18 months, first conception took place when number 1 was approximately six years, seven months old.

(iii) Adult cow number 14 - first calf born in June, 1967, and died on the 29th September, 1968. Second calf (number 15) was born on the 10th March, 1972. Calving interval was approximately four years, 10 months.

(iv) Adult cow number 21 - introduced on the 9th October, 1966 with a three year old calf. This calf died in August, 1967. Second calf (number 22) was born on the 16th August, 1971. Calving interval was approximately seven years, 10 months.

Table 5. Estimates of reproductive data from the white rhino population at Kyle National Park.

No.	Age at				Calving interval
	1st conception	1st birth	2nd conception	2nd birth	
4	6yrs.9mths	8yrs.3mths	9yrs.10mths	11yrs.4mths	3yrs.1mth
1	6yrs.7mths	8yrs.1mth	-	-	-
14	-	-	-	-	4yrs.10mths
21	-	-	-	-	7yrs.10mths

At the 1st January, 1973, there were 10 adult cows (age classes III to V) all of which have calves, and two sub-adult cows (age class II) both of which appear pregnant.

IV.5. Seasonal breeding.

A total of 16 births had occurred by the 1st January, 1973 (see Appendix IV). The months in which 15 of these births occurred have been reliably recorded. By assuming an 18 month gestation period, the months in which conceptions took place can be determined.

The results are shown in Figure 5 along with the average monthly distribution of rainfall for Kyle National Park from 1962 to 1972. In Figure 3, the yearly distribution of births from 1962 to 1972 is shown.

Conceptions were recorded in all but four months of the year. Although there were 13 conceptions in the six months from September to February and only two conceptions in the remaining six months, it would be unwise at this early stage to regard the white rhino in the study area as being seasonal in their breeding.

It is difficult to envisage the proximate and ultimate

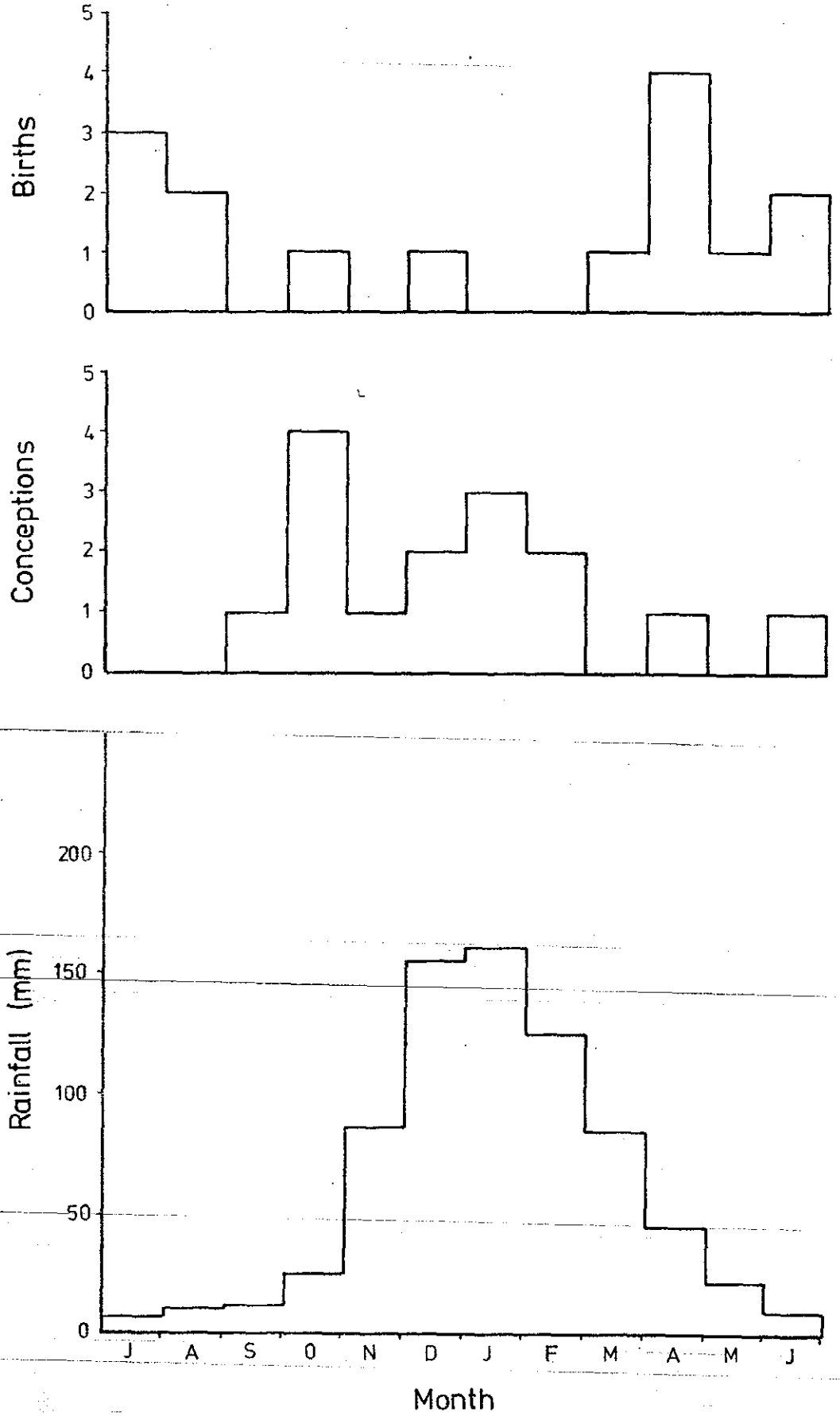


Figure 5. The monthly distribution of births (above) and conceptions (middle) for the white rhino population, and the average monthly rainfall (bottom), for Kyle National Park from 1962 to 1972.

causes of the seasonal period suggested in Figure 5.

IV.6. Mortality.

Since 1962 a total of 12 deaths have been recorded (see Appendix IV). The yearly distribution of deaths from 1962 to 1972 is shown in Figure 3.

The high death rate recorded for 1963 may be attributable to the unfavourable conditions in the study area from July to November. During this period, four of the five deaths in 1963 were recorded. In addition, numerous other species suffered die-offs during this same period (see Chapter II, section 1).

Unfortunately only one post-mortem has been done on the white rhino. The results of this post-mortem, done on a pregnant cow, are not worth consideration as it was done by unqualified and inexperienced people. It is however known that death in some cases has been due to drowning, falling over precipices, and wounds sustained in fights. The two former causes indicate unfamiliarity with the new environment.

The yearly distribution of deaths is shown in Figure 3, while the yearly distribution of deaths and the sex of the dead animals is shown in Figure 6. Of the 12 deaths that have been recorded between 1962 and 1972, nine have been females and three have been males. This ratio (three males to nine females) is not significant at the 5% level.

From 1964 to 1968, 10 of the 12 deaths occured, while from 1969 to 1972 only two have occured. Excluding the four deaths that occured late in 1968, there were six other deaths from 1964 to 1968 and two from 1969 to 1972.

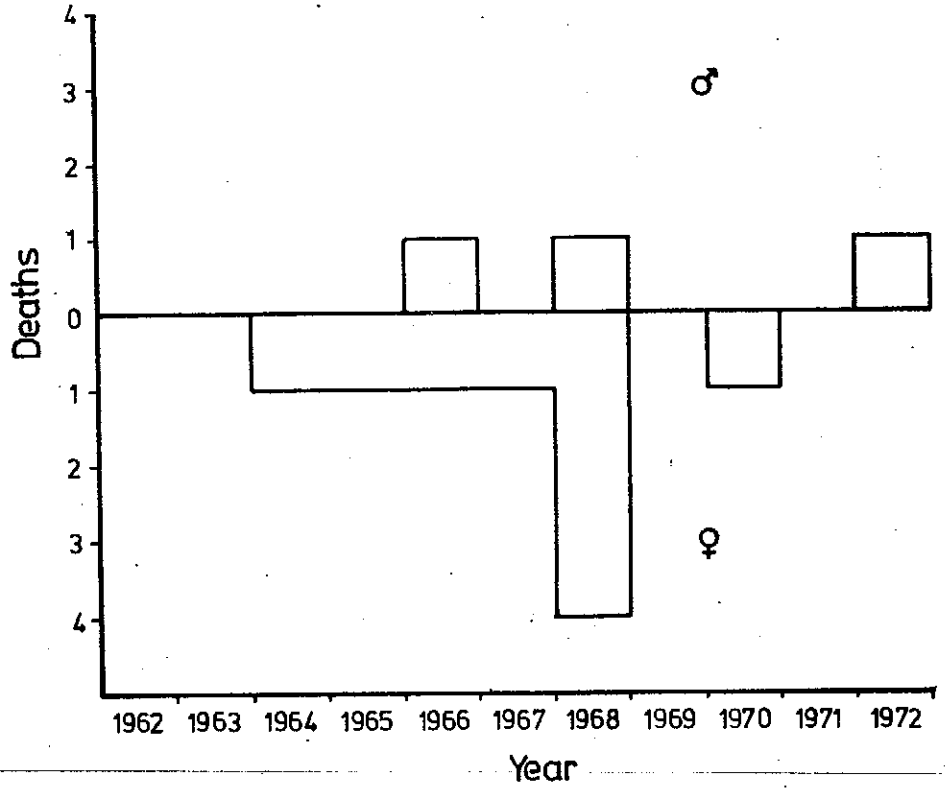


Figure 6. The yearly distribution of deaths, and the sex of the dead animals, from the white rhino population in Kyle National Park.

Discussion

Between 1962 and 1966, 32 effective introductions were officially recorded. This may not be accurate, and it is possible that only 30 effective introductions took place. After 1966 no further introductions occured. At the end of 1966, assuming that 32 effective introductions did take place, there were 29 individuals in the study area. At the 1st January, 1973, there were 33, after two had been removed in the early part of 1972 and released in the McIlwaine National Park.

The increase from the end of 1966 to the 1st January, 1973, of only four animals, is very low. In the present population however, all 10 adult cows have calves at foot. Assuming a calving interval of four years, 10 adult cows will have produced 10 calves, between nought to four years of age, if the birth rate was at a maximum. Since this is in fact the case, and in addition the only two sub-adult cows both appear to be pregnant, the natality of the established population is exceptionally high. Nevertheless, the population has not experienced a substantial increase as yet.

The mortality has been high, particularly amongst the adults, since of the 12 deaths so far recorded, only two have been calves. In 1968 the mortality was higher than in any other year. Five deaths occured of which four took place between September and November. From July to November of 1968, numerous other species suffered die-offs, and in the case of reedbuck, the die-off assumed spectacular proportions (Ferrar and Kerr, 1971). Although no post-mortems were done on the rhino, it is suspected that they died as a result of the combined effects of malnutrition and an exceptionally cold and

unseasonal spell in mid-November.

Between 1964 and 1968, 10 of the total 12 deaths occurred, and from 1969 to 1972 there were only two. Separation of the deaths into these two periods is not based on any particular criterion, apart from to emphasize that the introduced population initially suffered a high mortality. This may not be a valid approach, in terms of data selection to fit a hypothesis. Nevertheless of all the deaths recorded, only two have been calves, and the rest adults. Since all the calves that have been born in the Park can be accounted for, 10 of the 12 deaths were introduced animals. This suggests that the introduced population initially suffered a high mortality, and as the population became more settled and established, the mortality declined. The causes of all deaths ~~is~~ are not actually known, but apart from those in late 1968 whose deaths have been tentatively attributed to malnutrition and unusual cold, death has been due to some factors which indicate an unfamiliarity with the new environment.

The experience of translocation must have caused some degree of psychological stress, and combined with unfamiliarity with the new environment and the nutritional stress resulting from unusual seasonal conditions in 1967/68, the mortality amongst the introduced animals has been high. After 1968, by which stage the introduced individuals had become familiar with their new environment, the mortality declined. An additional factor which indicates that most of the introduced individuals had become acclimatized and settled after 1968, is the commencement of births in 1970 followed by more in 1971. Assuming an 18 month gestation period, most of these calves were probably conceived during 1969 and 1970. Although five

calves were born in 1967, they were conceived prior to translocation. The first calf known to have been conceived in Kyle National Park was born in May, 1968. There were no births in 1969, so that 1970 was the first year in which a number of calves were born, all of whom were conceived in the new environment, after 1968.

The age structure of the present population, as indicated in Figure 4, represents that of a population tending towards old age. This is due to the artificial structure of age class V, as a result of translocation. Age class V does not indicate a high proportion of senescent individuals for the following reasons;

(1) It is not continuous with the three year span of the other age classes. There is no suitable alternative to age class V as it stands, and as a result it has been unrealistically expanded by assigning to it all those individuals known or believed to be over 12 years old.

(2) The life span of white rhino may be over 36 years (Player and Feely, 1968). Some individuals in class V are known to be only 12 to 14 years old. Age class V therefore contains a number of individuals who have lived only approximately one third of their life spans. Individuals assigned to age class V are therefore not necessarily senescent.

The trend shown by age classes I, II, III and IV (see Figure 4) is that of an expanding population. This is in fact an accurate assessment of the present status of the population.

From the limited data available it appears that first conception, in the females of the study population, occurs at an age of six to seven years. Owen-Smith (1972) has found

that in Zululand first parturition occurs at six to seven years of age. Assuming an 18 month gestation, first conception in these animals occurs at between four to five years of age. Limited data available on the calving interval indicates that in the study population it appears to vary from three to nearly eight years. Owen-Smith (1972) indicates that the calving interval for the Zululand population is only two to three years.

Estimates for the age of first conception and length of calving interval for the Kyle white rhino population have been obtained from translocated females. The apparent delay in the age of first conception and increased calving interval, shown by some individuals in the study population, may be due to the stress associated with translocation to a foreign environment. The two females (numbers 1 and 4) from which the estimates of age at first conception have been obtained, were translocated at an age of two and a half years. With a calving interval of two to three years in the parent population, these two individuals may have been removed from their mothers at an unusually early age. This may have increased the stress experienced as a result of translocation.

Two sub-adult cows (numbers 24 and 25) in the present population at Kyle appear to be pregnant. At the 1st January, 1973, both were approximately five years, eight months old, and if they are pregnant, are likely to undergo first parturition at ages of six to seven years. This would correspond to Owen-Smith's estimate for the age at first parturition. Both cows were born in the study area in 1967, and have not therefore suffered the experience of translocation.

Owen-Smith (1972) suggests that reproduction is not

seasonally restricted, although the onset of oestrus may be stimulated by the flush of green grass in spring. As a result there may be a mating peak in spring and a calving peak in autumn, some 16 to 18 months later.

This observation appears, at this early stage, to apply in the study population. However as only 16 births have so far taken place in Kyle, the existence of a seasonal breeding pattern is not positively acknowledged as yet. Furthermore, a period of adjustment for the translocated individuals would be expected before any seasonal trend in breeding became apparent.

The high mortality shown by the introduced population during 1962 to 1968 in Kyle National Park, although followed by a decline in mortality and rapid increase in natality from 1969 to 1972, raises the question regarding the success of the introduced white rhino populations elsewhere in Rhodesia.

Herbert and Austen (1972) believe that of the 35 white rhino introduced to Wankie National Park, only 26 of the original individuals exist, and the population total is approximately 32. Numerous calves and sub-adults are now present in the population. Mortality has been due to various factors, some such as thirst, stuck in mud and killed by a train, indicating unfamiliarity with the environment. Of the nine recorded deaths, all but one have been adults. The trend has therefore been similar to that experienced at Kyle. The numerous calves and sub-adults suggests that a viable population has now been established.

In August, 1972, five white rhino were released on Dett Vlei by the Southern Sun Hotel Corporation. Only two remain, the others are believed to be dead. Thirteen white

rhino were released in the Matopos National Park (Anon, 1968). By September, 1971, the population consisted of 20 individuals (Attwell, pers. comm.). Three white rhino were originally introduced to McIlwaine National Park (Anon, 1968). One has died and two from Kyle National Park have been introduced, and the present population consists of only four individuals (Attwell, pers. comm.). Four white rhino were originally introduced to Victoria Falls National Park (Anon, 1968). It is believed that only two remain (Attwell, pers. comm.). Ten white rhino were introduced to Doddiburn Ranch by the Henderson Brothers, in November, 1971. At present the population still consists of ten individuals (Henderson, I. pers. comm.).

Apart from the population in Matopos National Park, the populations elsewhere in Rhodesia have experienced only a very slight increase (Kyle National Park) decreased (Wankie, Victoria Falls and McIlwaine National Parks and the Dett Vlei populations) or remained constant (Doddiburn Ranch). Only the populations at Kyle, Matopos and Wankie National Parks, and at Doddiburn Ranch, can be considered as viable. These populations, particularly the ones in Kyle and Matopos National Parks, have the potential to act as breeding stock for future dispersal within Rhodesia. An interest in releasing white rhino on private land has developed in South Africa (Anon, 1968) and may do so in Rhodesia, the Doddiburn and Dett Vlei populations being examples of such a trend. If this trend develops in Rhodesia, the rapidly expanding populations, at Kyle National Park in particular, could provide a source of white rhino for this purpose, as well as for restocking those National Parks which do not as yet support viable populations. In view of the rate at which the Kyle population has begun to expand, indicating the rate at which other established populations could expand,

early encouragement of private purchase may alleviate a potential crisis in these breeding populations.

Careful management and a close watch on the rate of increase within these breeding populations, particularly at Kyle and Matopos National Parks, and consideration of the high mortality shown by introduced populations, will be of importance to the future dispersal of the species within Rhodesia.

Summary

Official records indicate that between 1962 and 1966, 33 white rhino were introduced to Kyle National Park. One died soon after arrival reducing the number of effective and official introductions to 32. It is possible that only 30 effective introductions took place. After 1966 there were no further introductions, and at the end of that year the population total was officially 29.

By the beginning of 1972, there were 35 white rhino in Kyle National Park. Two were moved to McIlwaine National Park in February and March, 1972. At the end of 1972 there were 33 white rhino in the study area.

The increase from 29 in 1966 to 33 in 1972 is poor. Mortality was greatest, amongst the introduced individuals, from 1964 to 1968. From 1969 to 1972 mortality declined whereas natality has increased and is at present at a maximum. All 10 adult cows have calves, and the only two sub-adult cows both appear to be pregnant.

No thorough post-mortems have been done. Death, particularly between 1962 and 1968, could have been due to a combination of the experience of translocation, unfamiliarity with the new environment and nutritional stress. More females have died than males.

The age structure represents that of a population originating artificially but now expanding rapidly.

The age at first conception, calculated from the history of introduced females, is between six to seven years of age. The calving interval varies from three to seven years. In Zululand the age of first conception is between four to five years, and the calving interval is two to three years. The

delayed age of first conception, and increased calving interval for introduced females in the study area, may be a consequence of the stresses of translocation to a new and foreign environment. Two sub-adult females, both born in the study area, appear to be pregnant. If so, their age of first conception will resemble that found in Zululand.

There have been more conceptions from September to February than from March to August, and more births from March to August than from September to November. As the number of births has so far been relatively few, seasonal breeding is not as yet positively suspected.

The established white rhino populations in Kyle, Matopos and Wankie National Parks are expected to increase rapidly, particularly ~~those at Kyle and~~ Matopos National Parks. These two populations could provide a source of white rhino for future dispersal within Rhodesia. Careful management of these two populations is therefore important.

CHAPTER V

THE SOCIAL ORGANIZATION OF THE WHITE RHINO AT KYLE NATIONAL PARK

Introduction

Owen-Smith (1971 and 1972) has suggested that adult male white rhino maintain a territorial system based on "a space - correlated dominance relationship". A dominant or "territorial" male (tam) defends an individual area, referred to as a "territory" against intrusion by other tams, but may share a territory with other adult non-territorial or "subordinate" males (sams). The territories are mutually exclusive and non-overlapping.

Females and cow-calf units occupy an area which is not defended against intrusion by any other white rhino. These occupied, non-defended areas, are referred to as "home ranges", and they may overlap each other extensively as well as overlapping male territories (Owen-Smith, op. cit.).

Results

V.1. Territorial behaviour.

Within the white rhino population at Kyle National Park, the behavioural characteristics are similar, in most respects, to those found by Owen-Smith in Zululand. The behaviour of territorial bulls in the study population is characterized by the following features;

(a) Occupation of a territory - a territorial bull occupies a territory which he defends against adjacent territory owners. The territories are non-overlapping, and most of the study area is divided into territories (see Map 6).

Occasionally a tam may wander out of his territory into

another, and may encounter the resident tam. A silent, tense confrontation develops, and during this confrontation actual contact between the two animals is rare (Plate I). Both animals advance towards each other with their heads up and ears forward (Plate I, bottom). Before actual contact is made they retreat a few steps (Plate I, middle) wipe their anterior horns over the ground or a low bush and then advance again. On rare occasions the resident tam may charge the intruder as opposed to a steady advance. When this happens both animals lower their heads and the anterior horns may clash momentarily (Plate I, top) and quite audibly.

Throughout the conflict the intruder steadily retreats until the border of the residents territory is reached. On all three occasions that this type of conflict was witnessed, the intruder owned the adjacent territory. On reaching the border between the two territories, the animals quite suddenly and without any warning parted company, and walked back into their territories. On two of the three occasions I followed one of the tams once the conflict had ended. Both times the observed tams made straight for the nearest wallow in their territory and spent up to two hours lying in the mud. Emerging eventually from the wallow, both the tams being followed then embarked on what could be termed "a boundary patrol". Within five hours they had walked almost the entire way round the perimeter of their territories, spray-urinating (see (b) below) once every five to 10 minutes, and stopping occasionally to graze for two to five minutes at a time. On one of the two occasions, the tam I was following nearly encountered the same tam that had been involved in the earlier conflict. This tam also appeared to be carrying out a boundary patrol, and had also recently wallowed.

PLATE I

Conflict between territorial bulls

p: Physical contact is occasionally made. Both animals have their heads lowered and the anterior horns may clash briefly.

ddle: The bulls retreat a few steps before advancing towards each other again.

ttom: The conflict consists largely of advances towards each other. Heads are held up and anterior horns cross but do not often clash.

rs are pointed forwards throughout the encounter.

(Photo's Dr. J. Hanks)

Having completed their boundary patrols, the tams again wallowed, in both cases in the same wallows visited previously. After lying in the mud, for 26 minutes in one case and 73 minutes in the second case, both tams emerged and began grazing quietly. One grazed slowly towards the interior of his territory while the other was found in the vicinity of the same wallow three hours later.

(b) Spray-urination - as a territorial bull moves through his territory, he frequently urinates in the form of two to five backwardly directed spasmodic bursts. Each burst is ejected in the form of a fine spray (Plate II, above) which as a result of its aerosol form, leaves a fine film of urine over the ground or vegetation behind the animal.

Before the bursts of urine are ejected, the animal drags one hind foot and then the other over the ground. Two broad, shallow furrows are formed. These furrows are referred to as "scrapemarks" (Plate III and IV). The number of times a tam may drag his hind feet before urinating varies. In the centre of his territory he ~~may drag each hind foot~~ once only (Plate III) while when close to, or actually on the boundary of his territory, each foot may be dragged a number of times (Plate IV). Extended scrapemarks were initially used to determine the approximate boundaries of the territories in the study area.

The whole ritual, referred to as "spray-urinating", does not appear to be related to any particular surface feature, and is carried out at random as the tam moves through his territory. It is sometimes performed at a small bush (Plate III, bottom) and often on the edge of roads (Plate III, top, and Plate IV).

PLATE II

Territorial behaviour

Top: spray-urination.

Bottom: dung-kicking.

PLATE III

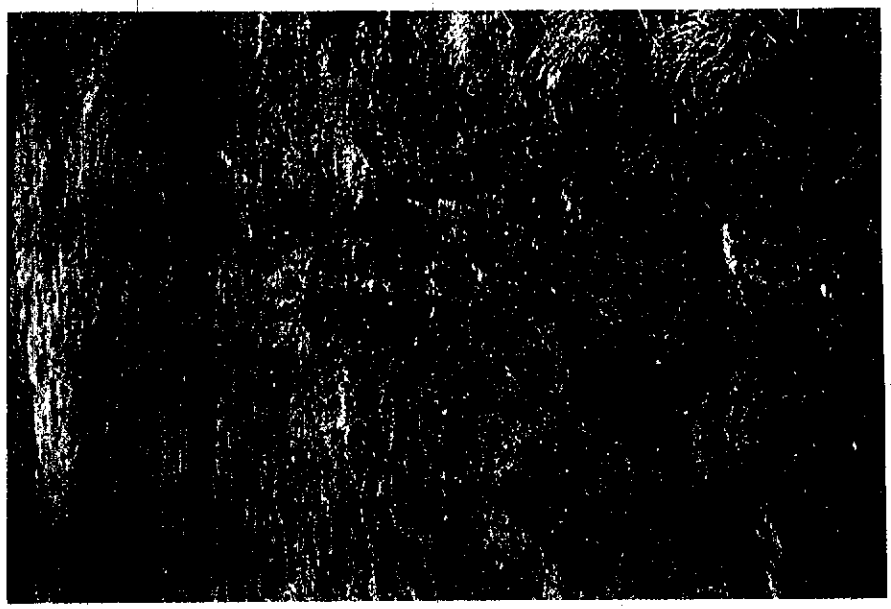
Scrapemarks

Top: Short scrapemarks on the side of a road well within a territory. Spray-urination was directed onto the road.

Bottom: Longer scrapemarks on a territory boundary. Spray-urination was directed towards a small bush in this case.

PLATE IV

Extended scrapemarks on the boundary of a territory.



The frequency (number of times) and intensity (length of scrapemarks and number of bursts) of the ritual varies. Near or on his boundary it is performed frequently and intensely, while in the centre of his territory it may not be performed more than once an hour. One tam was observed to perform the ritual once every three to eight minutes while walking along a boundary, and maintained this frequency for at least 30 minutes. Both frequency and intensity are increased when a tam encounters another tam or sam from a foreign territory, or a sam resident in his own territory. When approaching or accompanying a cow-calf unit, only the intensity is increased.

When in a foreign territory the ritual appears to be abandoned altogether. Only on one occasion has a tam been observed to spray-urinate while in a foreign territory.

(c) Dung-kicking - whenever a tam defæcates, the fallen dung is scattered by backwardly directed kicking movements of one then the other hind feet (Plate II, bottom, and Plate V, bottom).

As a result of this particular behaviour feature, large, scattered heaps of dung (middens) are formed (Plate VI). These middens vary in size from approximately two to 25 square metres. The site of a midden does not appear to be related to any particular surface feature, such as bushes. They are scattered throughout a territory and vary in number from six to 15 per territory.

Defæcation by tams is not confined to a midden, but they will always defæcate at one if they come across it. On some occasions a tam has been observed to cease grazing, while in the vicinity of a midden, and go to the midden and defæcate. Whether or not a tam defæcates at a midden, the dung is always

PLATE V

Defæcation and dung-kicking

p: Cows, calves and subordinate males do not kick their dung. Defæcation is not confined to a midden.

ttom: Territorial males exhibit dung-kicking, using the hind feet, after defæcation. The dung is scattered backwards.

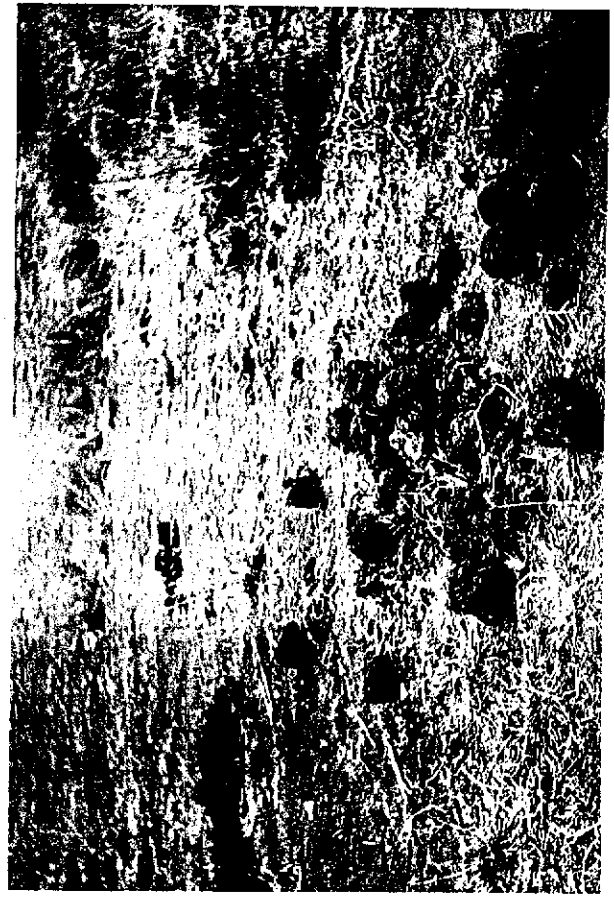


PLATE VI

A dung heap or "midden"

A territorial male deposits his dung towards the centre a midden and then scatters it towards the peripheral zones. central hollow in the midden is formed.

(Photo Mr. D. Parry)

scattered. When in a foreign territory, a tam will always scatter his dung, whether defæcation occurs at a midden or not.

The behaviour of a tam at a midden within his territory is also characteristic. Before defæcating it may spend some time sniffing parts of the midden and often spray-urinates at the same time (Plate VII, top). It then shuffles through the midden dragging all four feet (Plate VII, bottom). Having positioned itself in the centre of the midden it usually dung-kicks, then defæcates, and then again scatters the new dung. A tam always defæcates in the centre of a midden, and as a result of the dung-kicking before and after defæcation, the middens tend to have a central hollow with the dung scattered outwards (see Plate VI).

V.2. ~~Subordinate behaviour.~~

A subordinate bull (sam) in most cases occupies an area which falls within the boundaries of a territory (see Map 7). He may therefore encounter the resident tam. When this happens the sam does ~~not flee, but stands~~ his ground, flattens his ears ~~backwards, and emits loud shrieks and bellows.~~ The tam, who makes no noise and at all times has his ears pointed forwards (see Plate I) may make a short charge. When this happens both animals lower their heads and their anterior horns may clash briefly. The sam retreats rapidly for a few steps as the tam charges, but does not usually turn and flee. After up to five brief sparring matches, the tam wanders off, spray-urinating intensely. As soon as he has moved from 10 to 40 metres away from the sam, the latter walks briskly away. The engagement is not vicious and wounds are rarely sustained.

Sams may wander into a foreign territory where they may encounter the resident tam. On only one occasion was an

PLATE VII

Midden behaviour of territorial males

op: The ram usually sniffs over parts of the midden and often spray-urinates at the same time.

ottom: Before defaecating a ram sometimes shuffles through the midden dragging all four feet. He then stands in the middle of the midden and defaecates.

(Photo's P. D. Parry)

encounter between a tam and a sam, both foreign to each other, witnessed. In this particular case the tam was in fact the intruder, and encountered a resident sam. The conflict, although possessing all the features of a conflict between a resident tam and sam as described above, was the most aggressive that has been witnessed. The advances made by the tam gave the appearance of an attack and not the less aggressive charge as mentioned above. Throughout the conflict, which was watched for one and a quarter hours and was in progress when first observed, the intruding tam remained quiet while the resident sam uttered very loud and high pitched shrieks each time the tam attacked. As opposed to merely sparring at each other, the tam frequently made long sweeping thrusts with his anterior horn, and inflicted large wounds on the neck and sides of the sam's face. Frequently the tam charged the sam from the side, and on one occasion the sam was knocked over onto his side. While on the ground the sam was attacked mercilessly. The conflict was brought to an end by the intervention of the resident tam, who when some 50 metres away, galloped towards the fighting pair. He stopped some few metres short of the pair, appeared to push the sam way, and immediately turned his attention to the tam. The conflict then assumed the quiet and tense nature as described earlier for a conflict between two tams. Within seconds of the onset of this conflict, the sam fled at a gallop and was found two hours later approximately one and a half miles away. On closer observation he was seen to be severely lacerated, and bleeding from large wounds on his neck, forehead and belly regions. This was the only conflict witnessed throughout the study in which wounds were sustained. The following day this sam was again found, and had a thick layer of congealed mud round his head and neck regions.

On one occasion only was a conflict between two resident sams witnessed. The conflict was of very similar nature to the dominant-subordinate conflict. The larger sam made no noise, while the smaller one shrieked and bellowed. The former made the advances with ears pointed forwards, while the latter retreated and held its ears well flattened onto its neck. Their anterior horns clashed, very briefly, only three times during the 30 minutes over which the conflict lasted. Eventually both animals abruptly left each other and began grazing. After grazing in close proximity for 12 minutes, the smaller sam walked away, and the larger sam made no attempt to follow.

Subordinate bulls do not spray-urinate nor dung-kick. They may defæcate at a midden if one is nearby, but it is not confined to a midden. The dung, when defæcation occurs at a midden, is usually deposited on the perimeter of the midden. The animal then simply walks off, leaving the dung in its natural form (see Plate V, top). A sam may spend some time sniffing at parts of the midden. No sam was ever observed standing within the midden. Urination is performed in a strictly functional manner, and takes the form of a solid stream directed between and behind the hind legs.

Throughout the study it was noticed that sams appeared to avoid meeting a tan if one was nearby. They merely moved slowly away, and no tan was seen to actually chase after a sam.

The distribution pattern of each individual sam is shown on Map 7.

V.3. Female behaviour.

The social behaviour of females is characterized by tolerance of all other females, whether accompanied by a calf or not, and young sub-adult males. Essentially cow-calf units

are solitary, while adult and sub-adult cows may associate with other adult or sub-adult cows and sub-adult bulls.

Associations of short duration, particularly near resting places, salt licks, wallows and drinking places, may develop between mature females and sub-adults of both sexes. If some of the adult cows have calves, these associations may comprise up to 11 animals, which is the maximum number ever seen together during the study period. Such associations are however temporary and do not usually last for more than two to three hours.

Sub-adult cows, of which there are only two in the study area, appear to form long lasting associations with other sub-adult cows. The two sub-adult cows in the study area were associated together throughout the study. Adult cows with calves may form associations with sub-adult males, particularly if the male concerned is the cow's previous calf. These males are subordinate in the territorial system, and are therefore usually more confined in their range than the cow-calf unit, whose home range may overlap one or more territories. As the unit wanders, within its home range, but crosses from one territory into another, a *sam* which may have accompanied it in one territory then leaves the association and may be replaced by a second *sam* from within the new territory. If the units home range occurs within a territory, a sub-adult male, particularly if it is the previous calf of the cow concerned, will remain associated with the unit for many months.

Females of all ages and male calves do not spray-urinate or exhibit dung-kicking. As soon as defecation has taken place, the animals walk off, and it is not confined to a midden (see Plate II, top). If defecation occurs at a midden,

the dung is usually deposited on the peripheral zones. Defecation by a cow usually stimulates defecation by the calf. Although a cow will tolerate the close presence of other cows and sub-adults of both sexes, she will not tolerate the close presence of an adult male unless she is in oestrus, in which case only a tan will accompany her. The sequence of events that occur when an adult male approaches a cow, whether or not she is in oestrus or has a calf, is shown in Plate VIII. An adult male, whether subordinate or territorial, will approach a cow if one is nearby. The initial approach is usually hesitant (Plate VIII, top) and when he gets to within some five to 10 metres, she turns and faces the bull. With her head raised and extended forwards, and ears flattened backwards, she emits guttural "snorts" which appears to be a warning reaction. She remains facing the bull and at this stage a sam will usually move away and leave the cow. A tan however usually persists, and after hesitating while the cow snorts, will advance further. The warning snorts are usually increased and the cow's lips curl upwards in a fashion similar to a canine snarl. If these warning snorts do not disuade further advance by the tan, and he either remains very close or advances further, she charges the tan (Plate VIII, middle) snorting loudly. The charge is stopped before contact between the two is made. The tan usually retreats a few steps and the cow then moves a few metres away. If a calf is present, regardless of its sex, it remains close to its mother's side throughout the conflict. On some occasions the calf has walked up to the advancing bull, lowered its head and appeared to challenge the bull. On every occasion the bull has retreated a few steps. No animosity towards a calf has ever been witnessed when a bull, sam or tan, has come into close contact with a calf, and many such

PLATE VIII

Interaction between a cow and a territorial bull

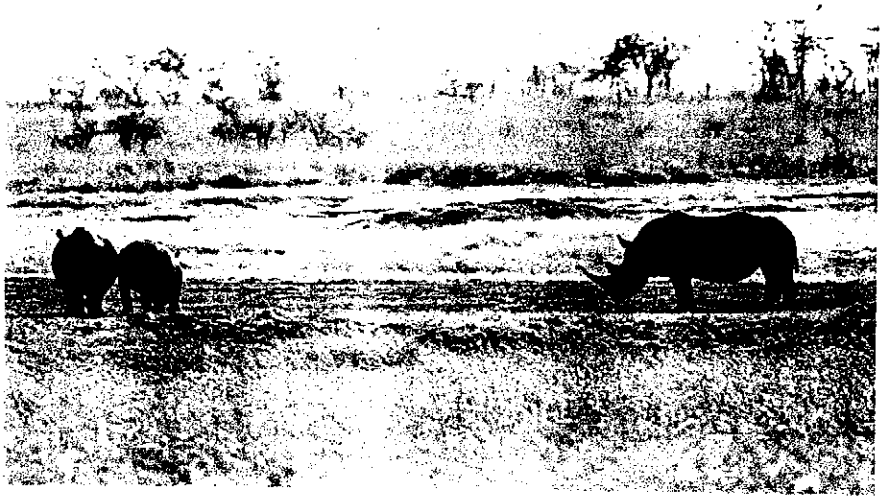
op: Initial approach by the tan is hesitant. The cow does not necessarily face the approaching bull.

iddle: If the tan continues to approach after the cow has emitted warning snorts, she charges. Contact is not usually made.

ottom: The tan may accompany the cow for two days to three weeks. The cow maintains an individual distance of one to two metres, except when mating occurs, throughout the association.

(The cow is in the foreground)

(Photé's Dr. J. Manks)



occasions have been observed.

Having retreated as the cow charged, the tam remains close by and the process is usually repeated. On each subsequent occasion after the initial approach by the tam, the cow allows a closer approach. Ultimately the cow, its calf, and the tam will settle down in close association, and may remain associated as such for two days to two or three weeks (Plate VIII, bottom). Mating has not been observed, but an association between a cow and a tam, which lasts for more than two or three days, possibly only occurs if the cow shows signs of oestrus. Throughout the association the cow appears to maintain an individual distance of one to two metres. If the tam approaches closer, she will lift her head and without turning to face the tam, emits the warning snorts. A tam has never been seen to approach closer than one to two metres, but if she is in oestrus contact between the two is assumed to occur at some stage.

If, during the established association, the cow approaches the territory boundary, the tam moves ahead of her and attempts to prevent her further advance. No actual contact is made between the two. The tam merely grazes, usually in a broadside position, ahead of the cow. She usually turns slowly, grazing all the time, and they move slowly off in another direction. On one occasion the association was deliberately disturbed and the animals chased beyond the assumed territory boundary. The tam followed the cow for approximately 100 metres into the foreign territory, and then returned to his own territory. The cow and her calf continued into the adjacent territory. On the second of the two occasions that such an association was deliberately disturbed, the association had been in operation for 10 days. The tam did not return

immediately to his territory, but remained with the cow and calf for three hours in the foreign territory. The following day the tan was found back in his territory, and the cow-calf unit was accompanied by the resident tan of the new territory into which they had been chased.

V.4. Population density.

As has been mentioned in Chapter IV, there are 33 white rhino in the study area. The area which can be occupied by the white rhino in Kyle National Park is some 5 405 ha in extent. However, as no white rhino have crossed the Popotete river and occupied the section of the Park north of this river (see Map 3) which is approximately 542 ha in area, the area occupied by white rhino at the 1st January, 1973 was approximately 4 863 ha.

The crude population density in the study area is therefore one white rhino per 147,4 ha. This is approximately equivalent to 0,7 rhino per square kilometre. Part of the available 4 863 ha is comprised of the Beza hill range, and numerous small hills and kopjies. The white rhino do not occupy the Beza range nor do they appear to use the sides and crests of many of the larger hills and kopjies. The ecological density is therefore higher than the crude density. It is difficult to assess accurately the area not occupied within the available range, due to its slope or inaccessibility, but it is estimated to be some 450 ha. The area actually occupied by white rhino in the study area is approximately 4 413 ha. The ecological density is therefore approximately one white rhino per 133,7 ha or approximately 0,8 rhino per square kilometre.

Discussion

The social organization shown by the white rhino in Kyle National Park is essentially similar to what Owen-Smith (1971 and 1972) has found in the Umfolozi - Corridor - Hluhluwe game reserve complex in Zululand.

Owen-Smith (1971) has proposed that territorial behaviour in white rhino is characterized by the following four features; range exclusiveness, ritualized encounters, confinement of oestrus cows, and scent marking. All four characteristics are present in the territorial system that occurs within the study population at Kyle National Park.

Cave (1966) has demonstrated the existence of preputial glands in Ceratotherium. The presence of these eccrine sweat glands in the prepuce and glans is unusual, as this variety of sweat gland usually occurs in the non-hairy skin regions, such as the foot pads, of other mammals. Cave suggests that they can be best interpreted as scent glands of sexual significance. At no stage during the study has a cow been seen to investigate the penis of a bull. Since mating has not been witnessed, this may possibly occur. The spray-urinating ritual carried out by territorial bulls suggests some form of scent marking, and these preputial glands may possibly play a more significant role as far as territorial dominance is concerned, rather than being of direct sexual significance.

The significance of the dung-kicking ritual is not entirely understood. Since a tam spray-urinates over the region of the midden on which the dung is deposited, the kicking action may transfer a scent, originating from the dung and urine, to the soles of the hind feet. As the animal walks

away, he may leave a short trail of a characteristic scent. The dung itself may have a characteristic scent so that scattering it may also serve as a form of scent marking. The strong odour that emanates from a large scattered midden may also serve to indicate the presence of a territory. The manner in which a tam shuffles through a midden, and defecates in the centre, which necessitates standing in the midden, may support the idea that a scent trail, even though probably only very short, is deposited as a result of this behaviour. As mentioned, sams and cows do not scatter their dung nor deposit it in the centre of a large midden. They are not likely to leave a scent trail.

The scent marking ritual of spray-urination indicates the presence of a dominant animal. Direct encounters with rivals and subordinates is not therefore necessary in order to assert dominance. The increased frequency and intensity of the ritual on or near the territory boundary serves notice to potential intruders, and indicates the strength of the territorial instinct.

The population density over much of the Umfolozi game reserve is approximately five white rhino per square kilometre, and is substantially higher than that in Kylo. Nevertheless a strong territorial system exists in the study area. This will be discussed further in Chapter VI.

The conflict witnessed between two resident sams suggests that amongst the subordinates a hierarchy exists. The dominance of one sam over another may only be asserted during a direct encounter, since as mentioned, sams do not spray-urinate or dung-kick. Within a territory there may be a hierarchal structure with the tam at the top, asserting his dominance both

directly and indirectly, followed by sams arranged in order of dominance achieved through direct encounters with each other. Size may play a role in the subordinate hierarchy, particularly since the order is arranged through direct conflict between the contestants. In each case within the study area, the tam is in fact the largest bull within the territory.

No change in territory ownership occurred during the study, so the fate of a deposed tam is unknown. Owen-Smith (1971) suggests that when this occurs, the deposed tam assumes a subordinate position within the structure, and usually remains in the same territory. He ceases spray-urination immediately and slowly abandons dung-kicking.

Subordinate bulls do not appear to associate with cows for a long time, unless they are sub-adults. A sam, whether adult or sub-adult, is confined in his range. This feature will be further discussed in Chapter VI. Territorial males will associate with cows, and if the cow was accompanied by a sub-adult sam, it will be chased away by the tam. Only a tam enters into a long association with a cow, and as his territory and its food resource is shared with other adult and sub-adult males, it appears that the territorial system is centred about the opportunity to associate with a cow for a long period. Owen-Smith (1971) has suggested that territoriality in the white rhino may be a system ordering reproductive competition among males. The results of this study suggest that this hypothesis is tenable.

The northern white rhino (C. simum cottoni) that occur in the West Nile White Rhino Reserve, Uganda, are commonly seen in groups of 12 or more. Movement of the animals is strongly influenced by the occurrence of rain and available drinking

water. The population density is approximately 0,4 rhino per square kilometre (Foster, 1967). From these observations it appears that a territorial system, if it exists, is less rigid than displayed by the Southern race.

Behaviour of the black rhinoceros has been studied by Klingel and Klingel (1966), Goddard (1967), Schenkel and Schenkel - Hulliger (1969) and Hitchins (1969). All suggest that black rhino have well defined overlapping home ranges and do not display territoriality. The predominantly solitary way of life of the black rhino is not considered to indicate intraspecific intolerance and territorial behaviour. According to Schenkel and Schenkel - Hulliger (1969) aggression occurs to a certain degree between bulls and less frequently between a bull and a cow or her calf.

Although it is maintained that territoriality does not occur in the black rhinoceros, certain features such as spray-urinating and dung-kicking by mature bulls do occur. It has been suggested that these features are carried out so as to provide indirect communication with other individuals whose home ranges overlap each other. Olfactory orientation and communication is possible as a result of these features (Schenkel and Schenkel - Hulliger, 1969).

The spray-urinating and dung-kicking shown by the adult male white rhino must also serve as a means of olfactory orientation and communication. Unlike the black rhino, the adult male white rhino at Kyle and Umfolozi do not have overlapping home ranges. This feature appears to be the essential difference between the black and white rhino populations so far studied, and does suggest that territories are not maintained by adult male black rhino.

The basic reason for this difference is difficult to understand. It might be a result of low population density or of insufficient observation or different interpretation by the operators. It might be an inherent difference between the two species. However it would appear that further investigations into the behaviour of black rhino would be of value.

Territorial behaviour, and the theoretical concepts of territoriality, have received a great deal of attention, particularly over the last twelve years. Many African species have been found to maintain a territorial system. These systems vary from seasonal to permanently fixed territories, moving territories, and territories which are not limited only to horizontal space but include vertical space as well. Territoriality is not limited to terrestrial species, but occurs in both aquatic and avian species.

The literature on territorial behaviour, both scientific and popular, is voluminous, and interpretations, definitions and hypotheses have been formulated with gay abandon in many cases.

Detailed behavioural analysis of the system that manifests itself amongst the white rhino in the study area, and comparison of these features with territorial African ungulates has not been attempted. The study was initiated as a comparative study to confirm or reject the behavioural features which occur amongst white rhino as discovered by Owen-Smith (1971). The system that has been found in Kyle National Park is essentially similar and in agreement with that found by Owen-Smith (op. cit.).

Certain pertinent features, which are considered to be

Further contributions to the knowledge regarding territoriality in the white rhino, and not contradictions to what is known, will be discussed in Chapter VI.

Summary

The social organization of white rhino in Kyle National Park is similar to that found in the Zululand game reserves. The behaviour of territorial bulls, subordinate bulls and cows shows similar features to what has been found in Zululand (Owen-Smith, 1971 and 1972).

A territorial bull occupies an area which he defends from intrusion by adjacent territorial and adjacent subordinate bulls. The scent marking behaviour, carried out more frequently near the territory boundaries, by a dominant bull, enables the maintenance of his dominance without necessitating involvement in direct conflicts with intruders. A dominant bull shares his territory with other adult males who assume a subordinate position. Amongst the subordinate individuals there appears to be a heirarchy. The position of a subordinate within this heirarchy may be determined in part by individual size. The territorial bull is the senior member of this heirarchy.

The population density in the study area is much lower than in the Zululand game reserves, but the territorial systems in both areas showt very similar features.

Only territorial bulls enter into long associations with adult females. The territorial system is therefore probably based upon competition, amongst the males, for the opportunity to breed.

The Northern white rhino appear not to maintain a rigid territorial system. Information is however limited and the population density is very low.

The social behaviour of black rhino is similar to white

rhino but territoriality does not appear to occur. They occupy home ranges which often overlap. Adult males exhibit spray-urination and dung-kicking, and since territoriality does not appear to occur, these behavioural features have been interpreted as a means of olfactory orientation and communication between the occupants of overlapping home ranges.

CHAPTER VI

THE DISTRIBUTION OF INDIVIDUAL WHITE RHINO IN KYLE NATIONAL PARK

Introduction

Chapters V and VI, although both concerned with territoriality in the white rhino at Kyle National Park, have been separated so that behaviour or "social organization", and "distribution" can be discussed individually. Both are however intimately related to each other.

Results

VI.1. The distribution of individuals.

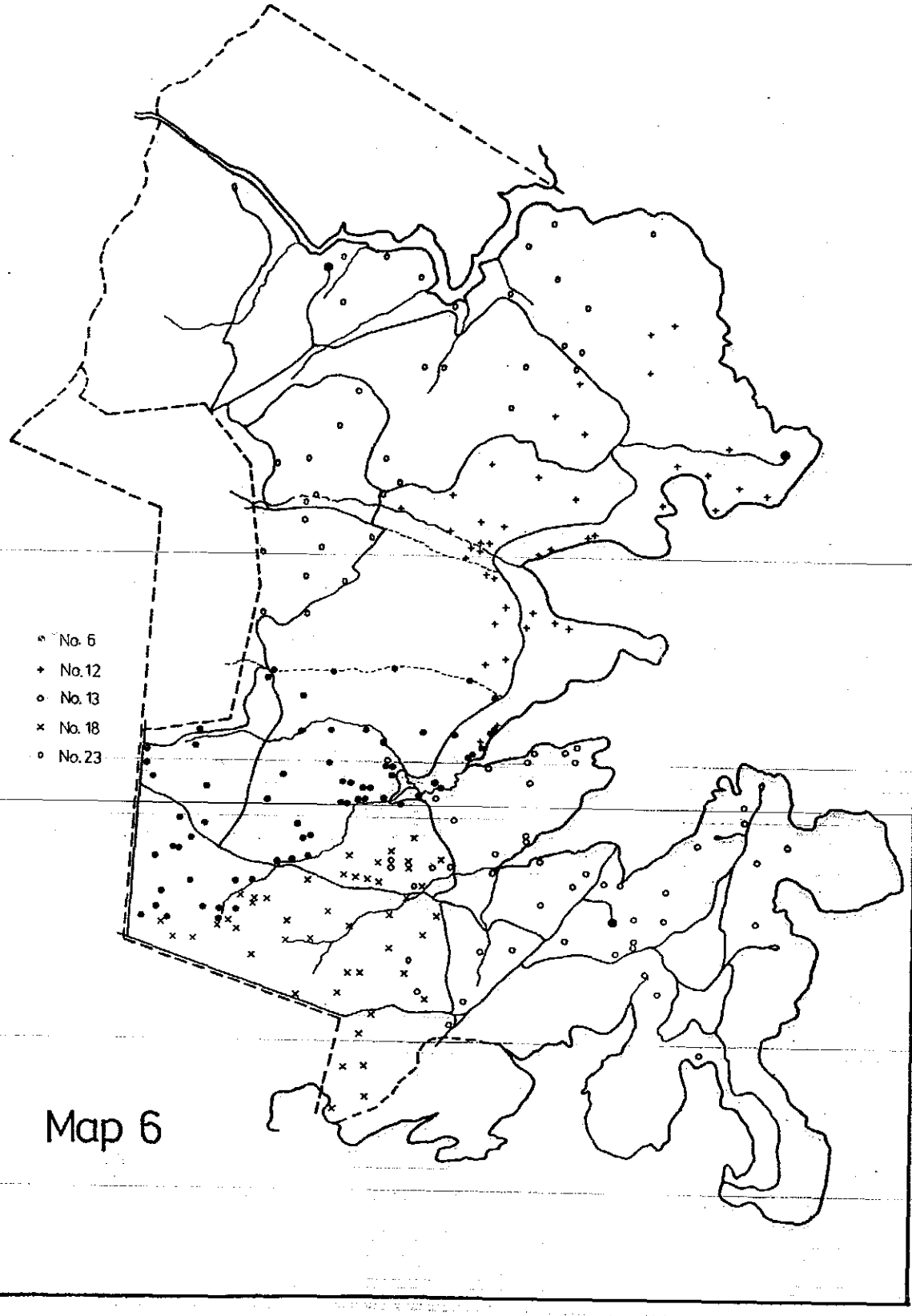
The distribution pattern of each white rhino in the study area is shown on Maps 6 to 11. The site of a white rhino at the time of observation was recorded as indicated in Chapter III, Section 3.a.. The sites on which each individual white rhino had been seen during the course of the study were then plotted on Maps 6 to 11, using the same grid system as was used in the field recording of these sites.

VI.1.a. The distribution of adult and sub-adult males.

The distribution patterns of each adult and sub-adult male white rhino in the study population are shown on Maps 6 and 7. There are nine adults (age classes III, IV and V) and two sub-adults (age class II) and all but numbers 32 and 33, which moved about as a pair throughout the study, move about individually or sometimes associated with a cow and a calf.

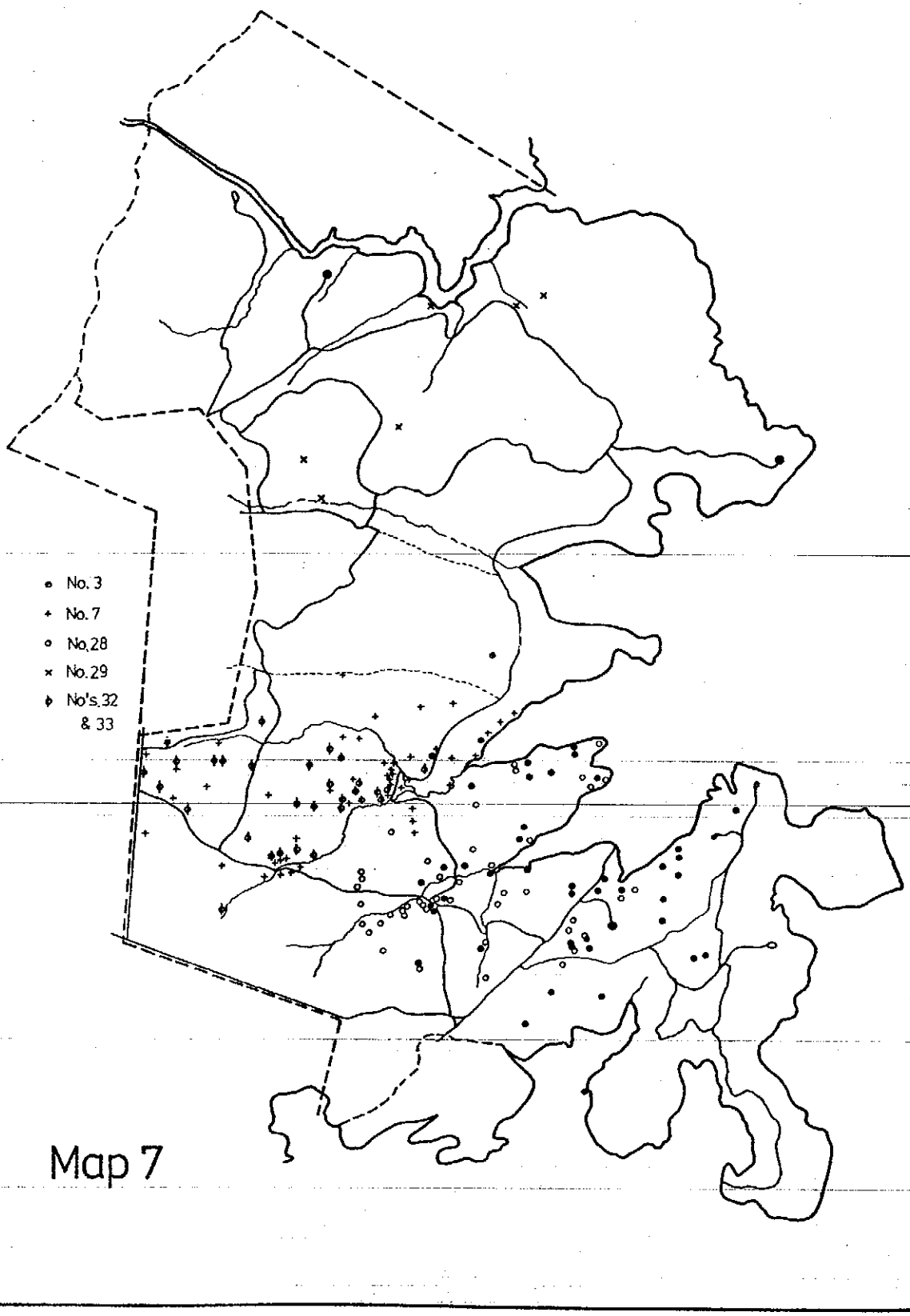
On Map 6 the individual distribution patterns of territorial males (tams) is shown. The individuals concerned are numbers 6, 12, 13, 18 and 23. All are adults in age class V and their individual history and description is given

Distribution of Territorial males



Map 6

Distribution of Subordinate males



Map 7

in Appendix II.

On Map 7 the individual distribution pattern of all other adults or sub-adults is shown. These individuals are not territorial and are referred to as subordinate males (sams). The adults concerned are numbers 3, 28 and 32 (age class III) and 7 (age class V) and the sub-adults (age class II) are numbers 29 and 33. The history and description of each individual is given in Appendix II.

As numbers 32 and 33 were associated together every time they were observed, their distribution patterns have been shown as such on Map 7.

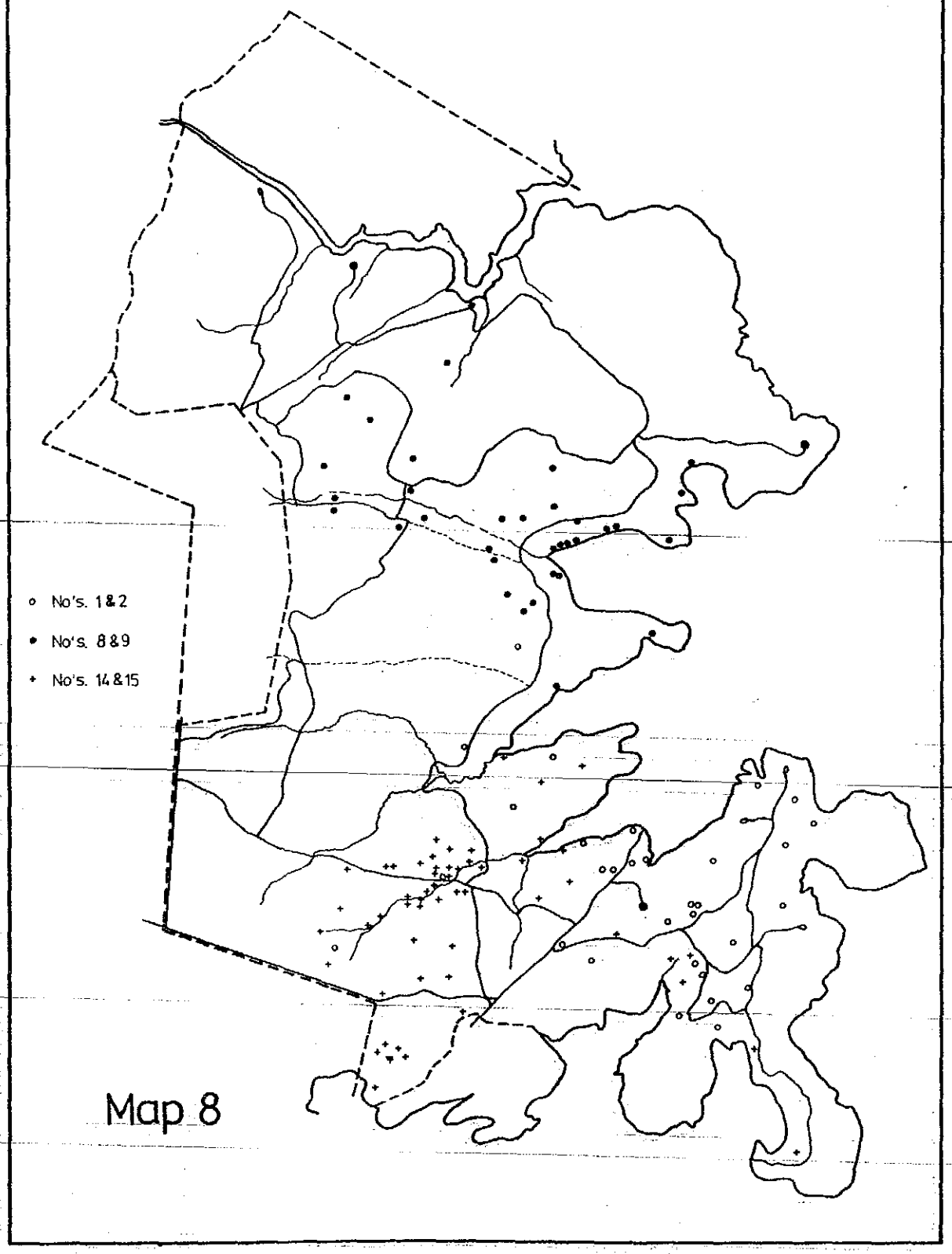
VI.1.b. The distribution of adult and sub-adult females.

The distribution of each adult and sub-adult female white rhino in the study population is shown on Maps 8 to 11. There are 10 adults (age classes IV and V) each with a calf, and two sub-adults (age class II) neither of which have calves but both appear pregnant. The history and description of each individual, including the calves, is given in Appendix II.

The cows remained closely associated with their calves throughout the study period, and sometimes associated for short periods with other cows and their calves. An adult cow and her calf will be referred to as "a cow-calf unit" and the distribution of these units is shown on the Maps. The cow and her calf have been numbered consecutively, the first number of each pair referring to the cow and the second to the calf.

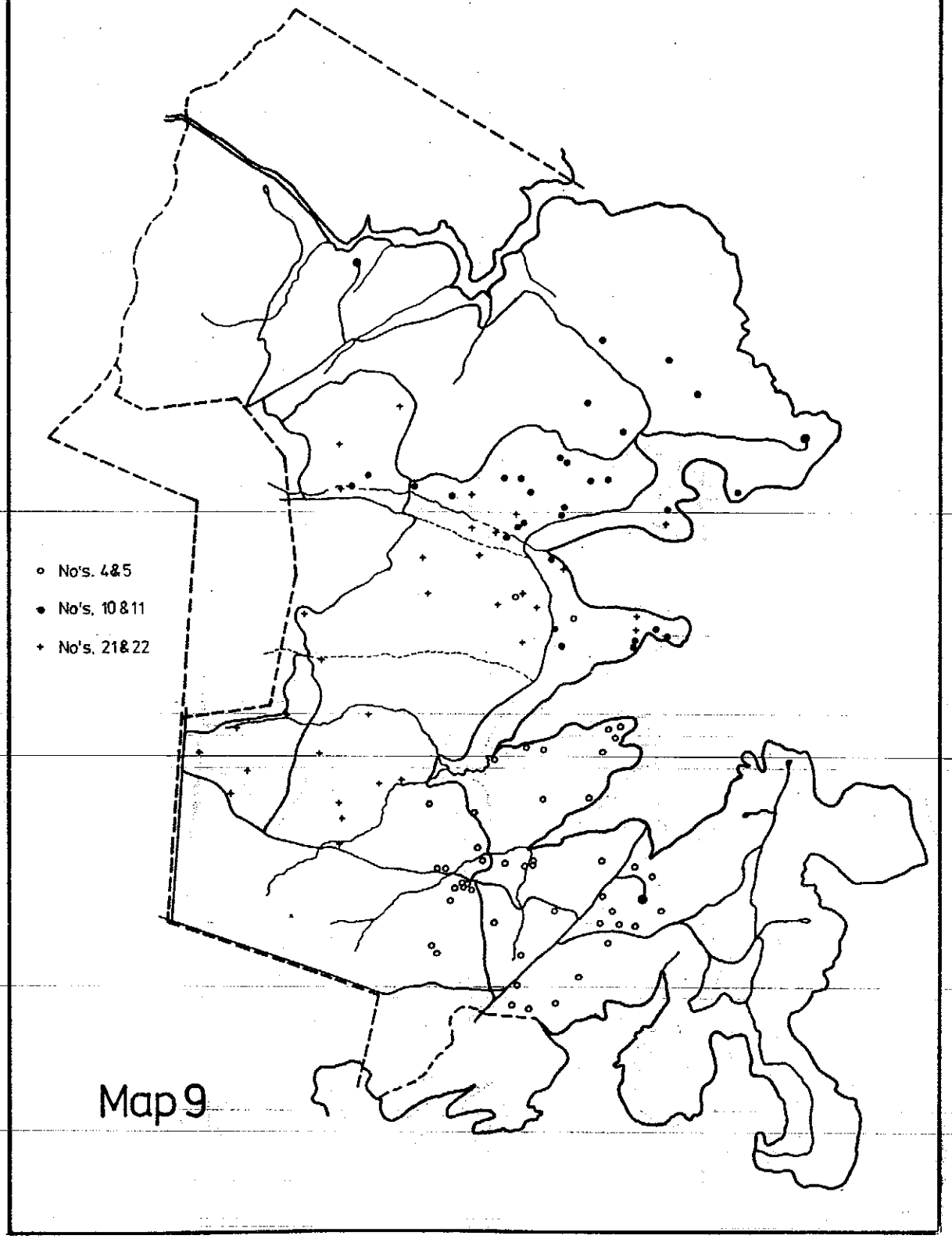
On each of Maps 8 to 10, the distribution of only three cow-calf units is shown. As far as has been possible each map shows the distribution of cow-calf units which occupy different parts of the study area. This has been done so as to avoid the confusion that would occur had the distribution of all 10

Distribution of adult females



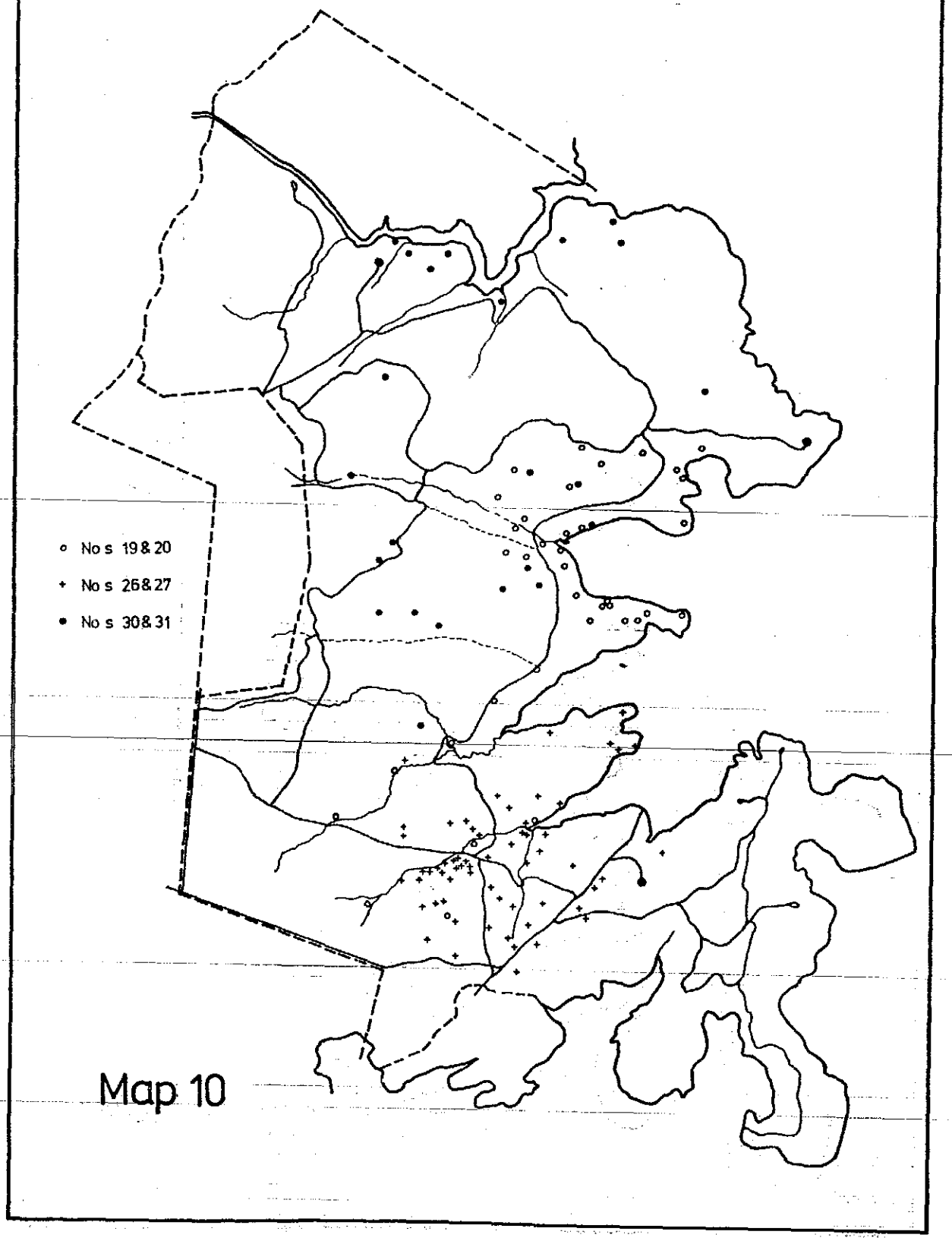
Map 8

Distribution of adult females



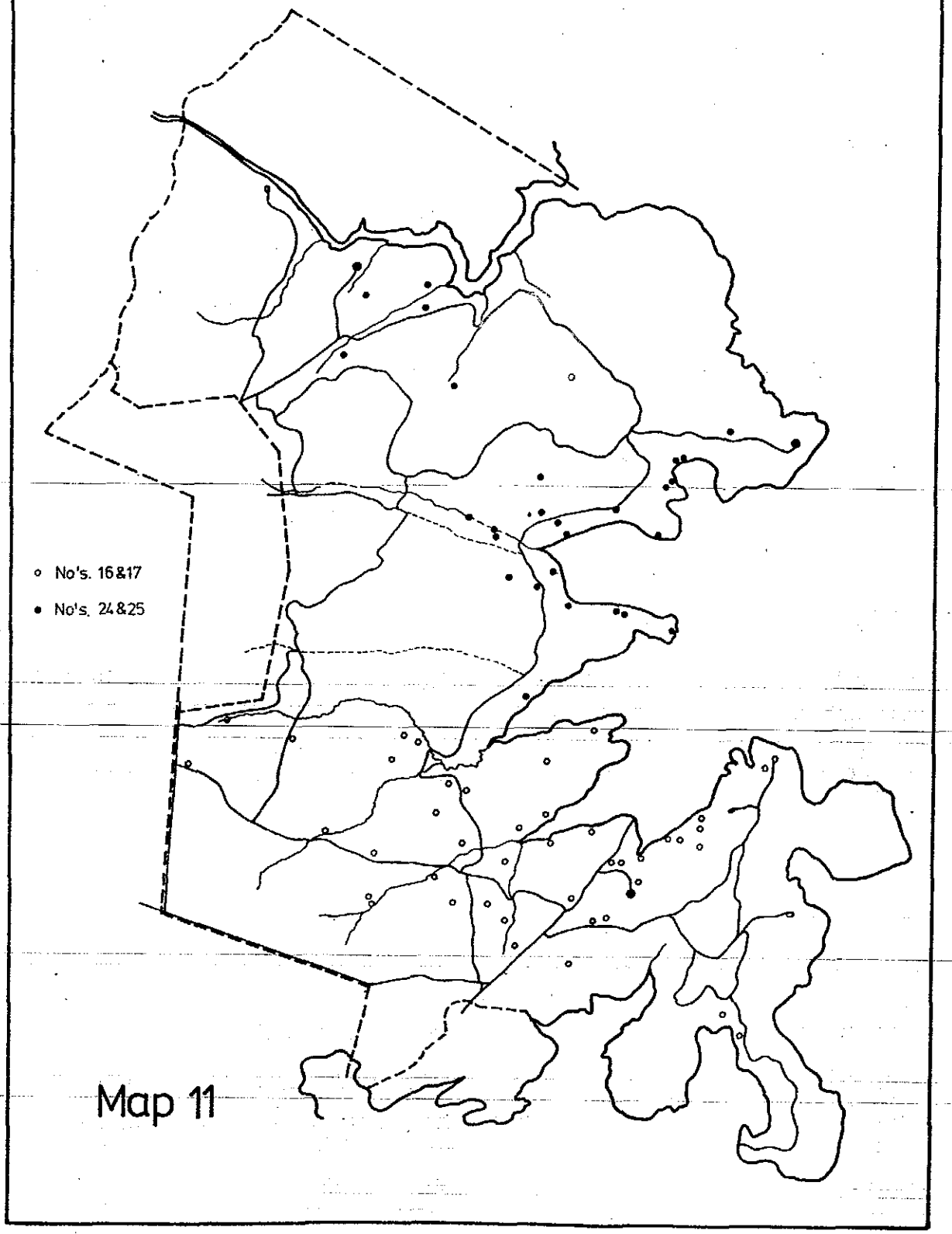
Map 9

Distribution of adult females



Map 10

Distribution of adult and sub-adult females



Map 11

cow-calf units been shown on less than four maps.

On Map 11 the distribution of only one cow-calf unit is shown. The distribution of the two sub-adults, numbers 24 and 25, who were associated together at every observation, has therefore been shown as such, on Map 11.

VI.2. Territory distribution and size.

Five territorial males existed in the study area at the 1st January, 1973. The males concerned have been indicated in VI.1.a.. The territories occupied by these individuals will be referred to as follows;

(1) Territory 6 - occupied by tam 6.
(2) Territory 12 - occupied by tam 12.
(3) Territory 13 - occupied by tam 13.
(4) Territory 18 - occupied by tam 18.
(5) Territory 23 - occupied by tam 23.

The distribution of these territories is indicated by the distribution of the tams as shown on Map 6. Although the individual distribution pattern of these tams do not overlap, and the areas they occupy could be delineated, no attempt to define the exact boundaries, in the form of a line drawn on a map, has been made. Additional site observations, particularly in the case of tams 12 and 23, would be required before this could be done in an accurate and conclusive manner.

The estimates, shown below in Table 6, for the size of each territory, are therefore based on a local knowledge of their supposed boundaries.

Table 6. Estimates of the size of each white rhino territory, at 1st January, 1973, in Kyle National Park

Territory	Estimated size in km^2
6	6
12	8
13	11
12	5
23	10
* unoccupied	0

* The unoccupied areas are the Beza hills, a small triangle between territories 6, 12 and 23 and the southern-most regions of territory 13.

VI.3. Female home range distribution and size.

There were 11 home ranges in the study area at the 1st January, 1973. The females concerned have been indicated in VI.1.b..

The distribution of home ranges is indicated by the distribution of the individual cow-calf units and the sub-adult pair, shown on Maps 8 to 11.

As can be seen from these maps, home ranges overlap extensively and tend to be concentrated in two zones of the study area. The two zones are the southern and south-eastern areas, and the central to northern regions.

Because the home ranges overlap so extensively, and because they are areas which are not defended and so do not have "boundaries" that are maintained as in the case of territories, no attempt has been made to delineate these home

ranges. It is not possible to estimate satisfactorily the size of the home ranges. Very crude estimates indicate that they vary from approximately three to 20 square kilometres.

A particular home range will be referred to by the number of the cow which occupies that home range. The number of each cow, and calf where applicable, which occupies each home range, is shown on the Maps (Maps 5 to 11).

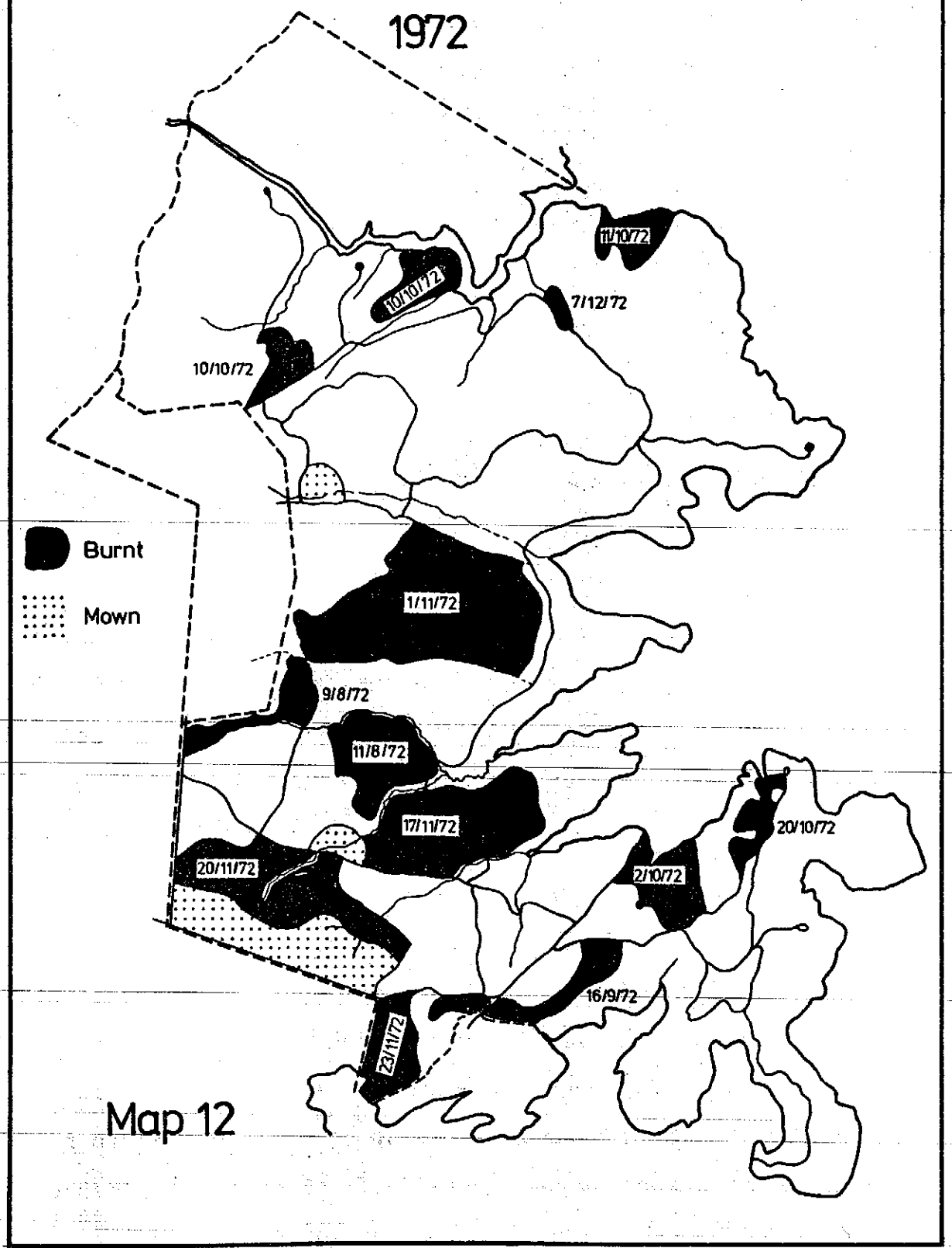
VI.4. The veld burning and mowing programme in Kyle National Park during 1972.

On Map 12 the pattern of veld burning, and the dates on which each burn was done are indicated.

The areas that were mown are also indicated on Map 12. Since the mowing was carried out whenever possible from September to December, no dates are shown. All mowing was completed by the middle of December.

As can be seen from Map 12, burns were well distributed throughout the study area. According to Ferrar (pers. comm.) approximately 22% of the effective game area (see Chapter II, section 2) of Kyle National Park was burnt in 1972, and of this burnt area, approximately 32% lies in the grassland and savanna regions of the Park (see Map 4).

Burning and mowing programme



Map 12

Discussion

The social behaviour and organization that occurs in the population of white rhino at Kyle National Park has been outlined and discussed in Chapter V. The territorial behaviour of the white rhino in the study area shows very similar essential features to what has been found by Owen-Smith (*op. cit.*) in the Zululand white rhino populations.

There are however certain pertinent features which differ from what has been found in Zululand, and since they relate to individual distribution, they are discussed in this chapter in preference to Chapter V.

Owen-Smith (*op. cit.*) has maintained that non-territorial males are confined to a particular territory and assume a subordinate status within the territory. As indicated in Chapter V, a similar system has been found in the study population at Kyle National Park. On Map 6 the distribution of territories is shown, and on Map 7 the distribution of *sams* is shown. If these two maps are superimposed, it will be seen that all *sams*, except number 28, are confined to one territory only.

Number 28 (age class III) occupies part of territories 13 and 18. Until September, 1972, number 28 remained associated with adult cow number 26 and her calf number 27. Number 28 was the first calf of number 26, and the association itself appears to be unusual (Owen-Smith, 1972). Before, and after September by which stage number 28 had become independent, it moved freely between the above two territories.

It appears that number 28 occupied a home range of its own and was not confined to one territory. Adult male number 3 occupied territory 13 (see Maps 6 and 7) and is the

same age as number 23. While in territory 13 number 28 was often associated with number 3, but as soon as it moved across into territory 18 the association terminated and number 3 remained in territory 13.

The apparently unusual distribution of number 28, which at no stage showed signs of dung-kicking or spray-urinating, may result from the relatively infrequent visits, by the two tams concerned, to the areas which it occupies. Although only one such case appears to occur in Kyle, it would seem to suggest that where the population density is very low, sams may not be confined to a territory.

The population density in the study area is low in comparison to that in Owen-Smith's study area (five per square kilometre). Territories are larger in Kyle (from five to 11 square kilometres) than in the Zululand populations (one to two square kilometres) but are vigorously maintained, and almost the entire inhabitable area of the Park is included in one or other of the territories. No attempt to territorialize those areas not frequently, or never visited by tams, has appeared to have been made by the sams.

It seems possible that territoriality is an inherent feature displayed by mature male white rhino. The confinement of other non-territorial adult males may be less specific where the population density is low, or the territories so large that the dominant animal is unable to assert his dominance, directly or indirectly, frequently enough throughout his territory.

Three of the five territories occur in the southern sections of the Park, and only two in the northern regions. The two territories in the south-western section (territories 6 and 18) are smaller than those in the northern regions

(territories 12 and 23) and that in the south-eastern section (territory 13). The vegetation pattern (shown on Map 4) shows that the two smaller territories (6 and 18) are situated largely in the grassland regions of the Park, while the two territories (12 and 23) in the northern regions consist of large areas of Brachystegia woodland in which the grass cover is poor. Territory 13 in the south-eastern kopje region is the largest of the territories. In this region numerous large kopjies (see Gw, Map 4) and large areas of Brachystegia woodland occur. The grass cover on the kopjies is poor, sometimes absent, and inaccessible to the white rhino. In the woodland the grass cover is also very poor. Various isolated patches of grassland occur in this region, and the distribution pattern of tam 13 in this area corresponds to the distribution of these grassland areas.

Unfortunately no vegetation transects were done to determine the ratio of grassland to woodland in each territory. However, from a comparison vetween the distribution of territories (Map 6) and vegetation types (Map 4) it appears that the size of a territory is related to the abundance of grassland in the particular area concerned.

The distribution of sams (Map 7) shows that of the six, five occur in the territories that lie largely in the southern grassland regions. The size of the northern territories are such that the tams concerned would not be expected to maintain their dominance over the entire area. However no attempt appears to have been made by sams to usurp parts of these territories. They have stayed in the grassland regions and remained subordinate. Territory 6 contains three sams (7, 32 and 33), territories 18 and 13 contains one sam (28) that

occupies parts of each of these territories, territory 13 contains an additional sam (3), territory 23 contains one sam (29) and territory 12 is not occupied by any sams.

The distribution of female home ranges (Maps 3 to 11) shows an essentially similar trend. Most home ranges occur in the southern and south-eastern grassland regions (home ranges 1, 4, 14, 16 and 26) and in the savanna and grassland regions of the central section (home ranges 3, 10, 19, 21, 24 and 25). Home range 30 appears to include most of the northern woodland regions of the study area. The distribution of individuals indicates, in some cases, a concentration of activity in a small area within the home range. These small areas are in some cases used by more than one cow-calf unit whose home ranges overlap and include such an area (Cow-calf units 1, Map 3, 4, Map 9, and 26, Map 10). These areas may be described as "core areas" (Jewell, 1966), but do not occur in all home ranges. There do not appear to be any "monopolized zones" (Jewell, 1966).

The size of the home ranges varies from approximately three to 20 square kilometres. Owen-Smith (1972) states that in his study populations the basic home range of a cow covers 10 to 15 square kilometres, and the animals favour different sections of their home ranges at different periods.

Most of the site observations were made in September, December and January, so it is not possible at this stage to discuss whether there is a seasonal movement either within a home range or territory, or in the form of an extension of the home range or territory. The burning programme does not appear to have altered in any way the distribution of individuals. As can be seen from Map 12, the burns have been well distributed

throughout the study area so that they would not be expected to alter the pattern of territories or home ranges. In addition, there appears to be no concentration on the burnt areas by the members of a home range or territory within which the burnt areas occur.

The distribution of territories indicates that certain natural features of the study area, such as streams, and artificial features such as roads, fireguards and paths, form the boundaries of territories. Home ranges do not appear to be delimited by artificial or natural features. The core areas, when they occur within home ranges, are usually situated nearby streams or the lake shore. All streams are seasonal and were dry for most of the study period. The sides, beds, and adjacent areas of most of these streams are covered by short grasses, some of which such as Cynodon dactylon appear to be strongly selected for. This may explain the concentration of activity in these regions, while the lake-shore core areas provide wallow sites and water.

The Beza hill range is not occupied by any white rhino. The grass cover is poor and the sides of the range are steep, and therefore probably inaccessible to the rhino. A small triangular area between territories 6, 12 and 23, and lying between the two fireguards in the centre of the study area, has not been occupied by tams. Most of this area is of the savanna vegetation category but there are large areas of Brachiaria grassland. Other such grassland and savanna regions have been occupied by tams. This particular area falls within certain home ranges. Without a more detailed assessment of the physical structure and vegetation of this area, it is not possible at this stage to understand why this area has not been occupied by any adult or sub-adult males.

Watson and Moss (1970) have discussed whether behaviour, via socially-induced mortality, can limit a breeding population. No evidence as yet from the study population is available on the validity of their hypothesis. It is however worth giving consideration, be it only theoretical, to this idea.

Dominant or territorial behaviour has limited the distribution of most of the adult and sub-adult male white rhino in the study area, in the sense that these animals are not able to wander as they please throughout the study area. There seems to have been an apparent preference, exercised in the first instant, for the availability of food. Where most of these individuals have confined themselves, or been confined by the behavioural system, the food supply is greatest. However the territorial instinct is such that some individuals have ignored these areas, and developed territories elsewhere. In these areas the abundance of grass is limited and the territories are large. It appears therefore that the size of a territory is related in the first instance to food availability. Thereafter an increase in population density may result in a compression of territories. However, if this occurs in the territories in which food availability is already restricted, nutritional stress would ultimately occur. Under natural, unconfined conditions, such a phenomena would not be expected to develop. In a confined population this might however occur.

It appears theoretically possible that in a confined population, such as the white rhino population at Kyle National Park, behaviour could result in the limitation of population size through socially-induced mortality as a result of nutritional stress.

As has been mentioned in Chapter IV, the population at Kyle is expanding at a maximum rate. There are at present four male calves (age class I) that in time will become confined to one or other territories as subordinates. The subordinates, at present confined to the territories, might be expected to usurp certain parts of these territories and effect a compression of territories in the future.

It would be of great value to monitor the changes which seem likely to occur in the distribution of individuals, and the size and distribution of territories. The information so obtained may help to clarify many of the hypotheses found in recent literature.

Furthermore, the confinement of adult and sub-adult males to certain parts of the study area has a direct effect on the degree to which these areas are utilized by the white rhino. Over-utilization of a particular area will not be alleviated by removing any but those individuals whose confined ranges incorporate the over-utilized areas in question.

In Chapter IV it was indicated that at present the natality of the white rhino in the study population is at a maximum. This suggests that the population is likely to expand fairly rapidly in the future. This may in turn lead to a compression of territories and an increased concentration on the grassland areas that fall within these compressed territories. As a result certain areas, particularly the grassland regions, may be subjected to over-utilization. If, and when this occurs, the individuals that occupy these areas must be removed.

It appears that amongst the males, only the tams breed. When over-utilization of the grassland regions becomes evident,

some rhino will have to be removed. Removal of the sams, who are not contributing to the growth and success of the population, is suggested. However, before such an operation of removal can be undertaken, the distribution of territories and identification of the tams and sams would be necessary. It is suggested that an attempt be made to continuously monitor the distribution of territories and maintain an accurate identification index of all white rhino that are present in the population at all times. A programme of this nature could be introduced as one of the official research projects for Kyle National Park.

Summary

The distribution pattern of adult male white rhino indicates that territories are non-overlapping, and non-territorial subordinate males are in most cases confined to the territory in which they live. In one case only does a subordinate male occupy parts of two territories. These parts are visited less frequently, by the dominant males concerned, than other parts of their respective territories. Where the density of territorial males or the frequency of their visits to particular areas are low, subordinate males may not be confined to a territory, but occupy home ranges of their own.

The white rhino population density in the study area is much lower than that in the Zululand game reserves. Territories are larger but home ranges are both smaller and larger than that in Zululand.

The size and distribution of territories, and the distribution of home ranges, appears to be related to the distribution and abundance of grass. Territories in the woodland areas are larger than those in the grassland areas. The distribution of subordinate males indicates a preference for areas in the southern grassland regions of the study area. No attempt appears to have been made by subordinate bulls to move out of the grassland areas and usurp parts of the large territories of the woodland regions.

No seasonal movement, within home ranges or territories, or an extension of home ranges or territories has been detected. Observations were not evenly distributed throughout the year, so that the possibility of such movements is not excluded. The 1972 burning programme did not alter distribution patterns.

This may be due to the dispersion of burns throughout the study area.

Practically the entire area available to the white rhino falls within one of the five territories. The Bena hill range and parts of the south-eastern kopje area are not occupied. These areas are probably inaccessible to white rhino. A small section in the centre of the Park is occupied by cows and cow-calf units, but no territorial or subordinate males occupy this area. The reason for this is not known.

Confinement of adult and sub-adult males to sections of the study area may result in over-utilization of these areas. Since the white rhino population in the study area is likely to expand rapidly, this situation may develop in the future. Degradation of the habitat in one or more specific areas will only be alleviated by removal of those individual rhino which are confined to the region in which these degraded areas develop. As the subordinate males do not appear to contribute directly to the growth rate of the population, it is suggested that in the first instance, these individuals are removed.

CHAPTER VII

A QUANTITATIVE ASSESSMENT OF THE ACTIVITY OF THE WHITE RHINO IN KYLE NATIONAL PARK

Introduction

Very little information is available on diurnal and nocturnal activity patterns of African ungulates. A few studies on various species have been performed, but all have been of short duration varying from six to 12 hours, and most have been done during the daylight hours only.

The almost complete lack of knowledge on the activity of African ungulates over a 24-hour period, continuing through both the day and night, has prompted this study. However, the results obtained are specific to the conditions which exist at Kyle National Park. Furthermore, as only three 24-hour studies were carried out, the results are not as yet considered to be typical of the activity pattern of the white rhino at Kyle National Park.

Results

VII.1. Selection of the study animals.

An activity study requires close observation of the animal or animals being studied. Generally this necessitates following the animals for a predetermined length of time as it goes about its normal routine, undisturbed by the observer.

Since this study is basically a behavioural study, it was decided to concentrate on territorial males. However, as both time and assistance were available, the activity studies were expanded to include a cow with a calf and a subordinate male.

The individuals that were selected for these studies

were chosen from those territorial and subordinate males and cow-calf units that were known to be relatively undisturbed by the close proximity of humans.

Three 24-hour and four 12-hour studies were carried out. The methods used in these studies have been outlined and discussed in Chapter III, section 3.b.. The animals studied, and the length of the study on each animal are also shown in Chapter III, section 3.b.. The dates on which each study was done are shown in Chapter III, section 4.

It was originally hoped that the studies done in July (12-hour studies on tam 18 and sam 32) and September (24-hour study on tam 6) 1972, would be repeated in January, 1973, so that it might be possible to determine a seasonal difference in activity. Unfortunately the 24-hour study on tam 6 in January, 1973 had to be abandoned after 10 hours as he was lost from sight in dense woodland at 0430 hours, as the moon went down. A search for him was abandoned at 0830 hours as he had still not been located. At 0930 hours, tam 18 was found and at 1000 hours an alternate 24-hour study was initiated on this individual.

The three 24-hour studies were arranged so as to coincide with the full moon.

VII.2. The 12-hour studies.

All but one of the 12-hour studies were carried out from 0600 to 1800 hours. The first 12-hour study on tam 18 was carried out from 0730 to 1930 hours.

The results of these studies are shown in Table 7. The distances travelled by the rhino during these studies has been estimated by plotting the site records, recorded throughout the study, on the 1:25 000 map of the study area (see Map 4), and then estimating the distance covered.

Table 7.

Results of the 12-hour activity studies on the white rhino at Kyle National Park

Date	Season	Animal		Activity (% of 12 hours)					Number of times in 12 hours			Distance travelled (km)
		Number	Status	Feeding	Lying	Standing	Walking	*Interact	Drinking	Urinating	Defecating	
7.7.72	Dry	18	tam	63,1	21,7	3,1	12,1	-	2	7	1	± 3,0
8.7.72		32	sam	28,6	52,0	3,0	16,4	-	1	2	2	± 5,0
14.1.73	Wet	18	tam	43,5	30,4	6,3	19,8	-	1	13	1	± 8,0
15.1.73		32	sam	31,0	34,0	20,4	10,6	4,0	1	2	2	± 4,0
Average for all four studies				41,6	34,5	8,2	14,7	1,0	1		1.5	± 5,0

*Interact = Social Interaction.

Table 8.

Results of the 24-hour activity studies on the white rhino at Kyle National Park

Date	Season	Animal		Activity (% of 24 hours)					Number of times in 24 hours			Distance travelled (km)
		Number	Status	Feeding	Lying	Standing	Walking	*Interact	Drinking	Urinating	Defecating	
21.9.72	Dry	6	tan	38,5	39,0	11,0	6,9	4,6	2	21	4	± 10,0
17.1.73	Wet	18	tan	42,5	29,8	9,0	9,2	9,5	2	43	4	± 15,0
18.1.73		4	cow	48,2	26,9	17,2	6,0	1,7	3	6	6	± 6,0
Average for all three studies				43,1	31,9	12,4	7,4	5,3	2			± 10,0

*Interact = Social Interaction.

For all four studies an average of the percent of the 12 hours spent on each activity has been calculated. The average number of times that the animal drinks, and the average distance travelled in each 12-hour study has also been calculated for all of the 12-hour studies. An average of the number of times each animal was seen to urinate and defecate during the 12-hour period has not been indicated. This has been done because the frequency of urination and defecation is affected by an animal's social status. A sam does not spray-urinate, and urination, as with defecation, occurs only when naturally necessary. A bam however spray-urinates as he moves about his territory, and will defecate at every midden or any fresh rhino dung that he comes across. The frequency of urination and defecation is not related only to natural metabolic processes, but is also related to dominant behaviour.

VII.3. The 24-hour studies.

The results of these studies are shown in Table 7. The design of this table is the same as Table 7 and no average of the frequency of urination and defecation has been shown for reasons similar to those discussed in VII.2.. In this case however there are no sams, but instead a cow, in which the frequency of urination and defecation are controlled by the rate of natural metabolic processes.

The activity patterns of each individual studied for a 24-hour period are shown in Figures 7 to 9. The figures show the number of minutes, in each of the 24 hours, spent by each individual performing the various activities (feeding, lying down, standing, walking, and social interaction) shown in Table 8.

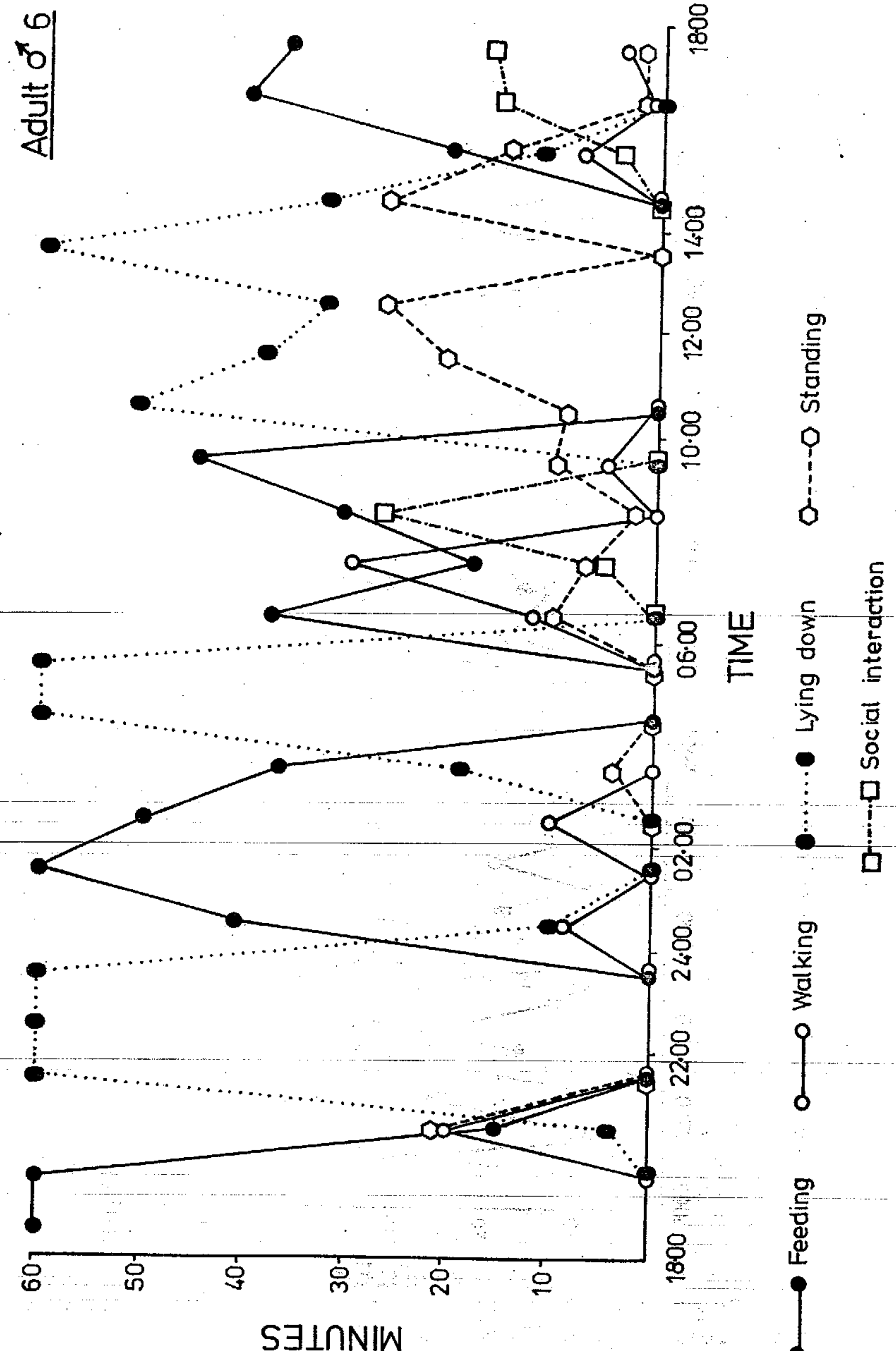


Figure 7. Twenty-four hour activity pattern of an adult territorial male (number 6) white rhino, recorded from the 21st to 22nd September, 1972, at Kyle National Park.

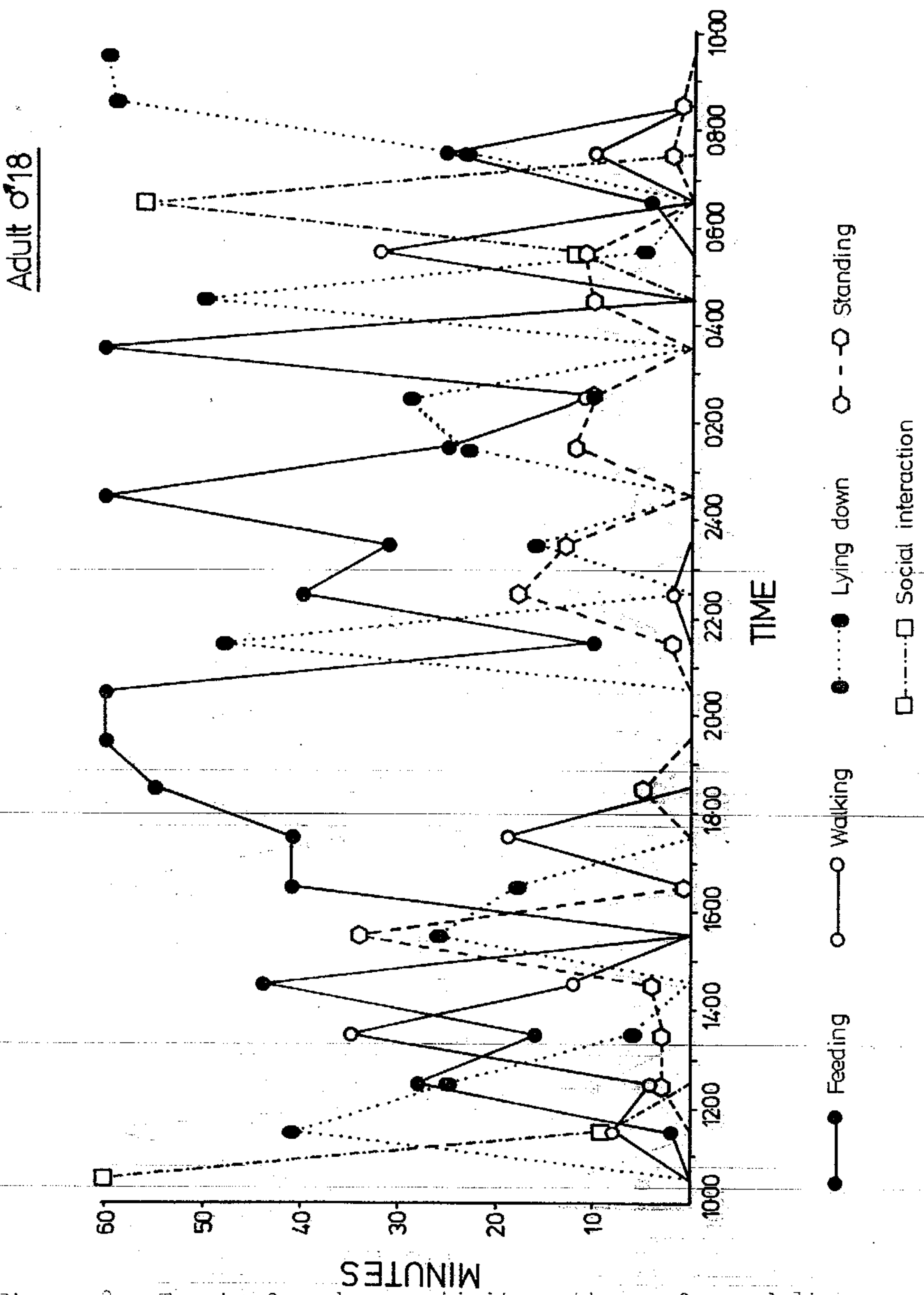


Figure 8. Twenty-four hour activity pattern of an adult territorial male (number 18) white rhino, recorded from the 17th to 18th January, 1973, in Kyle National Park.

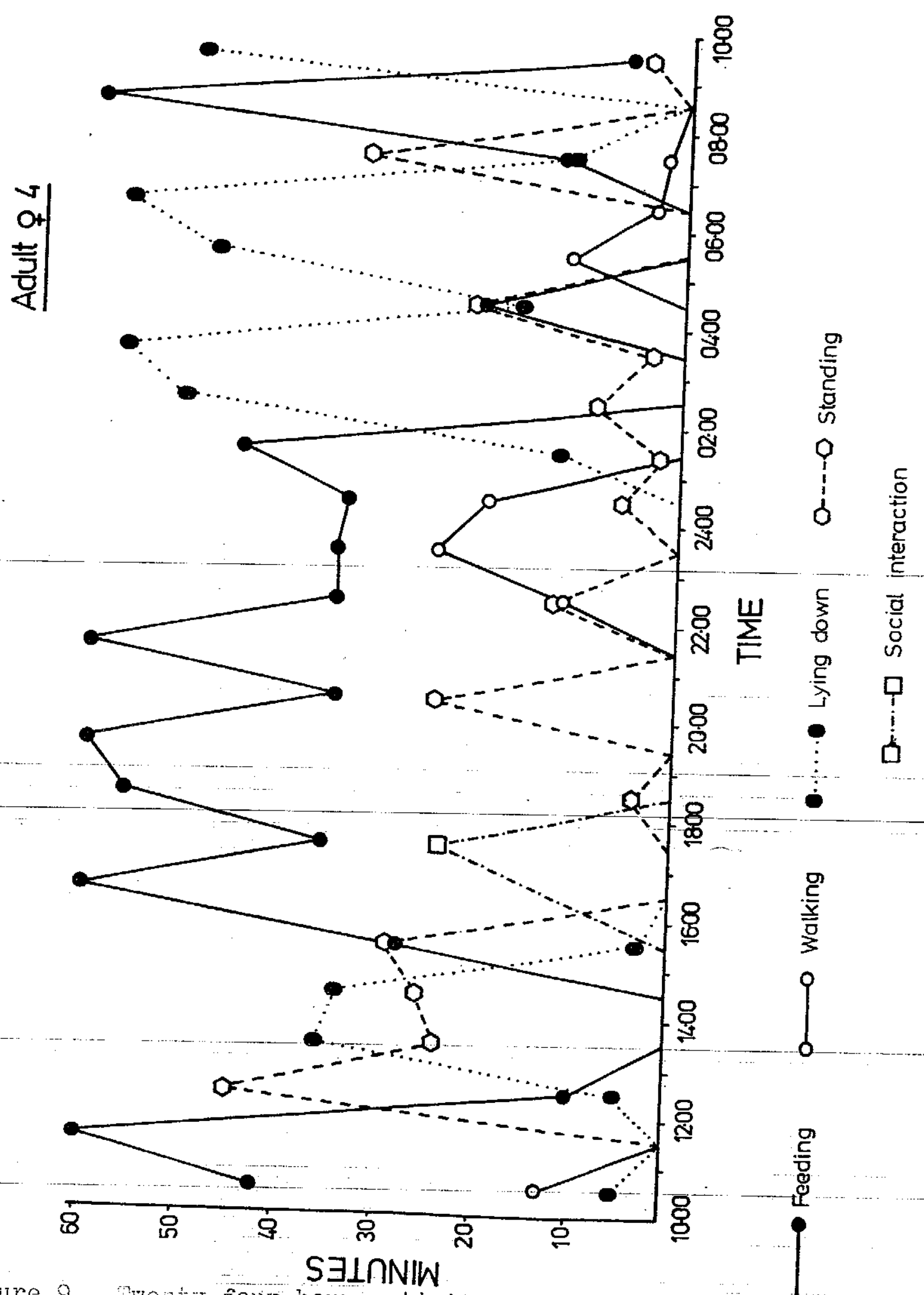


Figure 9. Twenty-four hour activity pattern of an adult cow (number 4) white rhino, recorded from the 18th to 19th January, 1973, in Kyle National Park.

Discussion

As has been mentioned in the introduction of this Chapter, the results obtained from these activity studies are not as yet considered to indicate conclusively the activity pattern of the white rhino in the study area. Nevertheless the results serve as an initial indicator and will be discussed as such.

From the limited data available it appears that over both a 12 and 24-hour period the white rhino in the study area spent approximately 40% of the time feeding, and approximately 30% of the time lying down. The remainder of the time is spent standing, walking, and involved in conflicts with other white rhino. Since the activity classed as "standing" includes time spent "dozing" (see Chapter III, section 3.b.) the amount of time spent "resting" (i.e. lying down and dozing) is in fact higher than the figure of 30% given above. During the night observation periods it was often difficult and sometimes not possible to determine whether the observed animal was standing and dozing, standing and looking, or standing and feeding in one place. In most cases it was usually possible to detect whether the animal was feeding by listening for the sound of grass being ripped up, and if in an area of short grass (less than half a metre) and movement of the head was visible, it was possible to determine whether the animal was feeding or looking about. However, when the study animal was in an area of long grass (over one metre), although feeding could usually be heard, it was not possible to differentiate between standing and looking or standing and dozing. Even during the day this difficulty arose on occasions. As a result the "standing" activity has not been differentiated into looking around, or dozing, so that

the percentage of time over 12 and 24-hour periods spent resting is not known, but is higher than the figure of 30% given for lying down only.

All the individuals that were studied, for both 12 and 24-hour periods, except the cow (number 4) occupied the southern grassland regions of the study area (see Map 4). In these areas grass was abundant throughout the year, although the quality of the grass, and the amount of green growth in the sward, appeared to be somewhat decreased during the later part of the dry season, particularly in August and September. The amount of time spent feeding, during this period, might therefore be expected to be high. In addition, the amount of time spent walking, or the distance travelled, would be expected to increase as well, as the animal would be expected to have to increase its search for palatable grass. The 24-hour study done on tan 5 in September shows a surprisingly low period of time spent feeding. In addition, there appear to be no obvious differences between wet and dry season activities.

As so few studies were done, and the activities of white rhino seem to be affected by their social system, it would be unwise at this stage to suggest any positive seasonal trend in activity pattern. In addition the programme of burning that was carried out in 1972 (see Map 12) particularly in the southern and south-eastern regions of the Park, further confused any seasonal trend in feeding activity that might otherwise have been detected. All the animals studied for 24-hour periods each spent from 40% to 60% of the 24 hours on one or more of the burnt areas within their territories (6 and 13) or home range (4). This may have been due to the predominance of burnt areas as opposed to unburnt areas, or due to selection for various

possible reasons, such as the food quality, or visibility, or both.

A comparison of 12 and 24-hour periods suggests that time spent feeding and lying are relatively similar, whereas walking, standing and involvement in social interactions appears to vary. Clearly, further 24-hour studies are required to confirm these preliminary observations. It is worth noting that most of the hours in which feeding was recorded for the bull 50 minutes occured at night between 1900 hours and 0600 hours. Peaks of lying down occured between approximately 0300 hours and 0600 hours, and from approximately 1200 hours to 1400 hours.

At Kyle National Park where ample and well distributed water supplies are available throughout the year, the white rhino appear to drink once in 12 hours and twice in 24 hours. Drinking lasts for from two to five minutes at a time. From the limited data of the 12 and 24-hour studies, it appears that the white rhino usually drink in the late afternoon or early evening and again towards the middle of the night. Had the 24-hour studies not been done, it may have appeared that the white rhino in the study area drink only once in every 24 hours and possibly that they may not drink for two or three days.

Defecation occurs from four to six times in a 24-hour period. However, as has been mentioned in Chapter V, section 1.c., a territorial bull will always defecate at a midden if he comes across one, so that a tam may defecate on occasions more frequently than four to six times in a 24-hour period. The frequency of urination is directly affected by the social status of an individual. As can be seen from Tables 7 and 8, a tam urinates much more frequently than a sam or a cow. Urination

by a tam is always in the form of spray-urination. The results from Table 3 indicate that the more time that is spent involved in social interactions, the greater the frequency of spray-urination. However, even when no time is spent involved in social interactions, the frequency of spray-urination can be low (Table 7, tam 13, dry season) or high (Table 7, tam 13, wet season). In the former case tam 13 spent all 12 hours in the centre of his territory, and in the later case the same animal spent four of the 12 hours close to his territory boundary.

The distance travelled by a white rhino in the study area over both a 12 and 24-hour period varies from three to eight kilometres in 12 hours and from six to 15 kilometres in 24 hours. The average distance travelled by the study animals was approximately five kilometres in 12 hours and approximately 10 kilometres in 24 hours. During the 24-hour study on tam 18, 9,5% of the 24 hours was spent involved in social interactions (see Table 8). From Figure 3 it can be seen that at the onset of the study tam 13 spent the whole of the first hour of the study involved in a social interaction. This interaction involved the adjacent territory owner, tam 13 (see Map 6) and had been in progress for at least one hour before the study commenced. As soon as the conflict terminated, tam 13 spent the following 72 minutes lying in a wallow and then proceeded on a "boundary patrol" of the eastern boundary of his territory. The amount of time spent walking in the 24 hours was therefore high (9,2%) and the distance travelled (approximately 15,0 kilometres) was also high.

The results obtained from these activity studies indicate that although an approximately similar amount of time was spent by tams, sams, and a cow, feeding and lying down over a 12 or 24-hour period, the amount of time walking and standing

varies considerably. Many more studies, preferably lasting for 24 hours, are required before any regular or typical pattern of activity for the white rhino in the study area can be determined.

The inconclusiveness of these studies, although carried out carefully and accurately, suggests that any activity study done over a period of less than 24 hours and repeated only twice may not provide satisfactory information as regards a typical activity pattern of the animal or species studied. Only a preliminary indication of the activity pattern is obtained.

Spinage (1968) has studied the daily activity of the Uganda defassa waterbuck (Kobus defassa ugandae) in the Queen Elizabeth Park, western Uganda. Activity was recorded at four-minute intervals for continuous periods of 12 hours on two or three consecutive days, and for single nocturnal periods. The results have been expressed as the time spent on each activity per hour. Adult females spend an average of 64,1% feeding and 3,6% lying down per hour during the day in the dry season, while during both wet and dry seasons adult males spend an average of 43,7% feeding and 12,7% lying down per hour during the day. An average for the wet and dry season of 30,8% feeding and 6,7% lying per hour during the nocturnal period was obtained for an adult male. Unfortunately these results are not directly comparable to those obtained for the white rhino at Kyle National Park. However it appears that the Uganda defassa waterbuck that were studied spend more time feeding, and less time lying, than the white rhino at Kyle National Park.

Bell (1970) has suggested that the non-ruminant, such as a zebra, is capable of a higher rate of assimilation of

protein than the ruminant, because the rate of passage of ingesta through the horse's alimentary canal is much faster than through a ruminant digestive tract. The non-ruminant might therefore be expected to have to feed for a longer time than the ruminant in order to obtain an equivalent amount of protein, or alternately, to ingest a far greater amount of food over a similar period of time. Before giving further consideration to this point, it would be necessary to consider the size of the waterbuck (ruminant) and white rhino (non-ruminant) on a basis of metabolic body size, and since no information on this aspect is available, a conclusive comparison between the nutritional efficiency of the two species is not as yet possible. However it is surprising that the non-ruminant white rhino appears to spend only approximately 40% of a 24-hour period feeding. The shape and size of the white rhino's lips may enable a very rapid intake of food, but would not appear to facilitate any intricate selection of the type of grass ingested.

The waterbuck studied by Spinage (1968) show a nocturnal feeding peak between 2400 hours and 0200 hours, which is similar to the nocturnal feeding pattern shown by the white rhino that were studied in Kyle National Park. The waterbuck spent little time sleeping or resting at night, whereas the white rhino spent large portions of the night actually lying down. This difference may possibly be related to predator activity in the Queen Elizabeth Park, while there are no large predators in Kyle National Park.

Hanks, Stanley Price and Wrangham (1969) have also studied the waterbuck (Kobus defassa). They found that in the dry season grazing reaches a peak in mid-morning and again towards the evening. Most of the lying down occurs between

1000 and 1400 hours, but the animals frequently rise to feed for short spells during this period, and there is little grazing during the night. It appears that they did not carry out any continuous nocturnal studies however, so there may in fact have been a peak of grazing at some stage during the night and early morning, and less time lying, as has been found by Spinage (1963). During the wet season Hanks et. al. (1969) found that the activity pattern of male and female defassa waterbuck differ greatly, while during the dry season the activity patterns are similar. The difference may possibly be due to the seasonal territorial behaviour of adult males.

Herbel and Nelson (1966) found that over a year long period, Hereford and Santa Gertrudis cows spent an average of 42,3% and 37,2%, respectively, grazing over a 24-hour period. There were generally four grazing periods; at about midnight, for approximately three hours after daybreak, at midday, and in the late afternoon for approximately three hours. The activities varied little by season. They also found that there is no apparent relationship between grazing time and quantity of forage per unit area. This observation may imply that with respect to an apparently non-selective grazer such as the white rhino, where the quality of ingested forage does not necessarily offset the lack of quantity of forage, the amount of feeding during the dry season, when both quantity and quality of forage may be reduced, should not differ greatly from the amount of feeding during the wet season.

Clough and Hassam (1970) have studied the daily activity of the warthog (Phacochoerus aethiopicus) in the Queen Elizabeth National Park, Uganda. They found maximum feeding occured in the early morning, late afternoon, and evening. This follows a similar trend to the white rhino at Kyle, the waterbuck

studied by Hanks et. al. (1969) and the cattle studied by Herbel and Nelson (1966). Clough and Hassam (1970) suggest that the amount of time spent feeding is related to the size of the animal, since the larger the animal, the more developed are its teeth, and food ingestion is more rapid. The amount of time spent feeding by the warthog, studied from 0600 to 2000 hours, varied from approximately 24% to 45%, with an overall mean of 30,5%.

Owen (1970) has studied the daily activity of sitatunga that inhabit the base of the Cherangani Hills north-east of Kitale (01° 00'N, 35° 00'E) in Kenya. During the daylight hours the sitatunga show feeding peaks from 0600 hours to 1100 hours, and from 1600 hours to 1900 hours. Resting, which includes both lying and standing but not feeding, occurs generally between 1200 hours and 1700 hours, with a peak of lying between 1500 and 1600 hours, and a peak of standing without feeding between 1400 and 1500 hours. No nocturnal studies were done, and the daylight activity pattern shows an essentially similar pattern to the white rhino daytime activity in Kyle National Park.

Summary

Activity studies on the white rhino at Kyle National Park were carried out for 12 and 24-hour periods. Only three 24-hour studies and four 12-hour studies were done. The results obtained provide a preliminary indication of the activity pattern of the white rhino in the study area.

Both the 12 and 24-hour studies indicate that the white rhino spend approximately 40% of the time feeding and approximately 30% of the time lying down, while the amount of walking, standing, and involvement in social interactions varies.

The rhino that were studied travelled an average of five kilometres in 12 hours and 10 kilometres in 24 hours. They drink approximately once every 12 hours.

Over a 24-hour period there were feeding peaks from 1300 hours to 2000 hours, 2400 hours to 0200 hours and from 0600 hours to 1000 hours. Most feeding occurs at night. Most lying down occurs from 0300 hours to 0600 hours, and from 1200 hours to 1400 hours.

Although only 30% of the time is spent actually lying down, the amount of time spent resting is greater than 30%, since the white rhino frequently doze while standing.

The amount of walking, and the frequency of urination and defecation varies. In the males, these factors are increased if the individual being studied is territorial. Non territorial males, and cows, defecate and urinate approximately five times in 24 hours. The frequency of urination and defecation by territorial males is higher, and varies according to the animals position in relation to the boundaries of his territory. Closer to the boundary, the frequency of urination

is high, and is lower when he is in the centre of his territory. The amount of time spent walking by a territorial animal is increased if he becomes involved in a boundary conflict with an adjacent territory owner.

GENERAL DISCUSSION

The white rhino population at Kyle National Park has a birth rate which is close to the maximum. The limited data available from introduced cows indicates that they have so far shown a calving interval of approximately four years. This is longer than the two to three year calving interval found in the female white rhino in the Umfolozi - Corridor - Hluhluwe game reserve complex. It is possible that the extended calving interval shown by the introduced females at Kyle National Park is a result of the experience of translocation, and now that the population appears to have settled down in its new environment, the calving interval may decrease to approximately three years.

The age of first conception is higher amongst the introduced females at Kyle National Park than is found in the Zululand game reserves. This too may decrease to the four to five years of age at first conception found amongst the female white rhino in Zululand.

A decrease in the calving interval, and the age at first conception, will make possible an increase in the rate of population increase. Attention has recently been given to the population dynamics of the African elephant, and it has been found that "a change in the duration of the calving interval is more important as a population regulating mechanism than a change in the age at puberty" (Hanks and McIntosh, 1973). A decrease in the calving interval of the white rhino population at Kyle may possibly play a similarly important role in the growth rate of this population.

Mortality, particularly neonatal mortality, plays a

very important role in controlling the growth of elephant populations (Hanks and McIntosh, 1973). The mortality in the Kyle white rhino population appears to have decreased since 1968. If mortality plays a similarly important role in controlling the growth rate of white rhino populations, it would appear that with an apparently decreasing mortality, and a decrease in the calving interval, the population in Kyle National Park is likely to expand fairly rapidly.

The possibility of an expansion is in itself a pleasing prospect. The potential problem that lies ahead, if this expansion is realised, is the ability of the habitat of Kyle National Park to withstand this increase.

The existence of this viable white rhino population has increased the importance of Kyle National Park, from both a tourist point of view, and for the long term security of the white rhino in Rhodesia. Its continued existence as a National Park is possibly somewhat secured by its white rhino population. Careful management of the white rhino population should therefore be an important feature in the management of the area as a whole.

At some stage in the future a decision will have to be made regarding the carrying capacity of white rhino in Kyle National Park, and when, and how many white rhino should be removed. This study has not, unfortunately, been concerned with the relationship between the size of the white rhino population, its food requirements, and the quantity and quality of the food supply, in Kyle National Park. It is therefore not possible to estimate the white rhino carrying capacity of the Park.

There are however certain factors which can be

considered at the present stage, and they may help to formulate a policy as regards the management of these white rhino.

At present the population density, although relatively low in comparison to the population density of white rhino in the Zululand game reserves, is such that ample opportunity is given to tourists to observe white rhino at both distant and close quarters. The well-dispersed system of roads may be largely responsible for these ample opportunities. From the tourist aspect, there is little need for an increase in the population density that exists at the present stage. Since the Park is situated in one of the tourist areas of Rhodesia, it is possible that as wide a spectrum of wild life as is reasonably possible would be of value. Over-utilization of the grasslands by the white rhino will be to the detriment of other grazing species, such as wildebeest, tsessebe, reedbuck, buffalo, zebra, and sable, and could be detrimental to some of the species, such as impala, which rely on grass to supplement the relatively poor supply of browse material. The white rhino in Kyle show a marked preference for short grasses, and the green growth that occurs at the bases of the tufts of taller grasses. Areas that are heavily grazed by white rhino, such as anthills themselves, and the adjacent areas (Plate IX) are reduced to areas with a very sparse grass cover, consisting largely of stoloniferous grasses such as Cynodon dactylon. The tendency of white rhino to graze at soil level reduces the grass cover in other areas as well. Such areas, particularly on the red soils, become susceptible to bush encroachment. The reversion of grassland to scrubland, assisted by the white rhino, has been recorded in Umfolozi Game Reserve (Player and Feely, 1960). A large population of white rhino would

PLATE IX

Isolated examples of the impact on their habitat made by the white rhino at Kyle National Park

op: A well grazed anthill on the lakeshore. The grass on the anthill is largely Cynodon dactylon.

(Photo Dr. J. Hanks)

~~ottom: A heavily grazed anthill in the southern sand grassland~~ region. The grass on the anthill is Cynodon dactylon.

therefore not be of great benefit to the Park, particularly if it is intended to maintain as wide a diversity of mammal species as possible.

Already parts of the southern sand grassland areas are showing signs of excessive grazing pressure, most of which is probably due to the white rhino. Although this only occurs in isolated patches to date, additional white rhino, particularly if they are confined to this grassland area, could possibly substantially increase the amount of overgrazed areas.

It is suggested that a population consisting of some 45 white rhino, of which a maximum of 30 should be adults, would be a maximum population size.

It has been previously mentioned that the white rhino at Kyle National Park could act as a breeding nucleus for further dispersal of the species in Rhodesia. Supplementation of the smaller populations at present found in some of the National Parks, and provision for private purchase, could be made possible.

If Kyle National Park is to fulfill this role, a fairly large breeding population will be necessary, and if the population in the Park is limited to some 30 adult individuals, a high proportion of post-pubertal, non-senescent females will be necessary. It appears that non-territorial males do not participate in the reproductive system (Owen-Smith, 1971 and 1972). A large proportion of non-territorial males in a population that is to be limited in size will reduce the number of breeding females that can be supported. It seems reasonable therefore to limit the number of non-territorial males. However they play an important role in the social system by way of providing competition for the opportunity to become dominant, and in turn

ensure that only the larger and more vigorous individuals can perpetuate the population.

There are only five dominant males capable of breeding in the present population. If some 20 breeding females are to be supported, it may be necessary to allow for a slight increase in the number of breeding males. Some areas in Kyle National Park have not yet been territorialized, so there appears to be room for an additional few territories without causing undue compression of the present territories. However, there does not appear to have been any attempt, as yet, by any of the subordinate bulls to effect a slight compression of territories. Instead they appear to have shown a preference for the already territorialized grassland areas. By allowing for an increase in the number of adult males, it may only increase the pressure in the already present territories, with a possible concentration in the southern grassland area. Such a situation would not be satisfactory, since these areas already support 18 of the 33 white rhino (see Maps 6 to 11) in the Park. If the southern grassland area is not preferred, the central red soil grasslands, savanna, and Acacia woodland areas, where at present nine of the remaining 33 white rhino have concentrated, would probably be subjected to an increased pressure as an alternative.

It would not be wise to attempt to predict whether further territories will be formed, or as an alternative, the adult males will concentrate in the territorialized grassland and savanna regions in the southern and central areas of the Park. Time alone will tell, but whatever happens it will be possible to artificially control the number of adult males, whether territorial or subordinate, that concentrate in the grassland areas.

The adult cows show a similar tendency as the adult males to concentrate in the predominantly grassland areas. If the white rhino in the study area are to be considered as a breeding nucleus, these areas should be allowed to support the cows rather than additional territorial and subordinate males.

It is difficult to arrive at what could be considered as an optimum ratio of subordinate to territorial males, since age relationships must also be considered, apart from mere numbers, if the apparent purpose of the territorial system is allowed to have its full effect. However, if the population is limited to some 30 adults, of which some 20 are adult females, approximately 10 males, which is very nearly the situation at present, would be required. There is no reason why the present distribution and number of territories should be changed by allowing an increase in competition for dominance, and since the life span of white rhino may be as long as 30 or more years, there may in fact be little change in the present territories for some years to come. One or two additional territories may be developed by the present subordinates, and this may in fact be desired so as to increase slightly the number of breeding males.

After this stage it may be advantageous to limit the size of the adult male population to only a few more than the number of territorial males. Excess adult males could be removed, and the full compliment of males should be made up with young, strongly competitive males. Any deposed territorial males, and an excess of subordinates in the territories that occur in the grassland areas, should also be removed.

Transport of white rhino is made easier if young, small

animals are captured. However it is necessary to maintain a suitably balanced population at Kyle with respect to the age structure. If the ages of the individual rhino at Kyle are at all times known, it will be possible to remove both adults and sub-adults while maintaining an age structure in which there is a preponderance of younger animals.

As there are only apparently five males which participate in the breeding system, and if a number of the older females are removed, there is a likelyhood of inbreeding to some degree. This problem will be increased if the territorial bulls remain dominant for a long time, such as for a period spanning two to three calving intervals, or eight to 12 years. Over such a period they may fertilize their own progeny, particularly since it would be preferable to retain some of their progeny as replacements for the older introduced females, which at present constitute the entire compliment of breeding females in the Park. Even if the population is not managed on the basis of being a breeding nucleus for restocking purposes, some degree of inbreeding will still occur, particularly when the present territorial bulls are deposed by other bulls that have been born in the Park.

It may become necessary to introduce some white rhino from another population, which in turn increases the necessity to have other such populations in Rhodesia. Because of the territorial system which exists in a confined population of white rhino, such as occurs at Kyle National Park, introduction of foreign males may not be successful. There may be excessive fighting as has already been experienced when a foreign male is introduced to a confined population (see Appendix II, description of adult male number 28). Since introduced males will be foreign to all territorial males,

severe fighting can be expected, particularly if there has been a slight increase in the number of territories by the time the foreign animals are introduced. It would appear that if inbreeding becomes a danger, foreign cows should be introduced in preference to foreign males. Apart from the possible fighting, an introduced male will not have an immediate effect in diversifying the genepool, and may in fact never achieve this since it may never become dominant. Foreign cows will have a more rapid, and more certain effect in helping to avoid excessive inbreeding, if and when it occurs.

If the trend in private purchase of white rhino increases, the relatively high mortality shown by introduced white rhino should be given consideration. If it is desired to establish a viable population elsewhere in Rhodesia, a fairly large population should be considered. The small populations introduced to the Dett Vlei, and the McIlwaine and Victoria Falls National Parks do not appear to have been successful, while the smallest introduced population that has so far appeared successful is the population of 10 white rhino at Doddiburn Ranch.

Pienaar (1970) has found that the white rhino introduced to the Kruger National Park (South Africa) did not settle in the mopane (Colophospermum mopane) veld into which they were released, but wandered great distances in search of more suitable grassland areas. Further introductions were therefore released in these more suitable areas, and attempts to settle populations in the mopane veld were a complete failure. According to Pienaar, the areas preferred by the white rhino are the only areas in Kruger National Park which are not covered by dense woodland or thicket vegetation, and where there is a permanent water supply.

These findings are worth consideration when new populations are introduced elsewhere in Rhodesia.

SUMMARY

The social behaviour of the white rhino population in Kyle National Park is very similar to the social system found in the Zululand white rhino populations, and confirms the findings of Owen-Smith (1971 and 1972).

The distribution of territories indicates that certain natural physical features, such as streams, hills, and kopjies form the boundaries of certain territories. Artificial physical features, such as roads, fireguards and paths are also utilised as territory boundaries.

The distribution of individuals, and the distribution and size of territories and home ranges appear to be related to the distribution and abundance of grasslands. Territories and home ranges in the woodland areas are larger than those in the grassland areas, and fewer individuals occupy these woodland areas than the grassland areas.

The activity pattern, indicated by only five activity studies, suggests that approximately 40% of the time is spent feeding and 30% of the time is spent lying down. The total amount of resting is higher than 50%. Over a 24-hour period there are peaks of feeding from 1900 hours to 2000 hours, 2400 hours to 0200 hours, and from 0600 hours to 1000 hours. Most feeding occurs at night. Most lying down occurs from 0300 hours to 0600 hours and from 1200 hours to 1400 hours.

The white rhino population in Kyle National Park is likely to start expanding rapidly in the future. It is suggested that approximately 45 white rhino, of which some 20 are adult females and 10 are adult males, would be a maximum population size. When the population exceeds this size, the

excess white rhino should be captured and used to supplement smaller populations elsewhere in Rhodesia, or sold to private enterprise. A possible management programme for the white rhino in Kyle National Park is outlined.

APPENDIX I

AN INDEX OF TOWN, PLACE, RIVER, AND REGIONAL NAMES REFERRED TO IN THE TEXT BUT NOT INDICATED ON ANY OF THE MAPS.

The accompanying grid references have been obtained from "Philip's Large Print Atlas for Southern Africa", 34th edition, 1969, printed by George Philip and Son Limited, London.

BAHR-EL-GHAZAL - South-eastern Province of Sudan.

BAROTSLAND - South-western Province of Zambia.

CHIPINDA POOLS - On the Lundi river (Rhodesia) Approximately 21° 15'S, 31° 52'E.

EQUITORIA - Southern Province of Sudan.

ETOSHA PAN - North central area of South-West Africa in the Ovamboland region, 19° 45'S, 16° 15'E.

GARAMBA NATIONAL PARK - North-eastern corner of Zaire near Faradje (3° 45'N, 29° 43'E).

GOBABIS - A town in central South-West Africa. 22° 29'S, 18° 59'E.

GOTA GOTA HILLS - A range of hills in the Zambezi valley north-east of Kariba. A maximum altitude of 1 290m. Approximately 16° 17'S, 29° 4'E.

HLUHLUWE GAME RESERVE - North of Umfolozi Game Reserve, Zululand.

KAOKOVELD - North-western region of South-West Africa, separated from the coast by a northern extension of the Namib desert.

KATANGA - South-eastern Province of Zaire.

LADO ENCLAVE - Was Anglo-Egyption Sudan and Uganda. Now in Equitoria Province, Sudan, and North Uganda.

LUANGWA RIVER - Rises in the north-eastern region of Zambia near the Malawi border and flows in a south-westerly direction to its confluence with the Zambezi at Feira (15° 35'S, 30° 22'E).

MACOSSA - A town in central Mozambique. 17° 53'S, 33° 56'E.

MURCHISON FALLS NATIONAL PARK - Northern Uganda. 2° 15'N, 31° 30'E.

PUNGWE RIVER - Rises near Mt. Inyangani (eastern districts of Rhodesia - 18° 20'S, 32° 50'E) and flows south-eastwards through Mozambique to the mouth at Beira (19° 46'S, 34° 52'E).

TSHINGWEZI RIVER - Runs in a north-easterly direction to its confluence with the Lundi river near Chipinda Pools.

UMHLATUZI RIVER - South of Umfolozi Game Reserve in Zululand (Natal Province, South Africa).

KAOKOVELD	-	North-western region of South-West Africa, separated from the coast by a northern extension of the Namib desert.
KATANGA	-	South-eastern Province of Zaire.
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MACOSSA	-	A town in central Mozambique. 17° 53'S, 35° 36'E.
MURCHISON FALLS NATIONAL PARK	-	Northern Uganda. 2° 15'N, 31° 30'E.
PUNGWE RIVER	-	Rises near Mt. Inyangani (eastern districts of Rhodesia - 18° 20'S, 32° 50'E) and flows south-eastwards through Mozambique to the mouth at Beira (19° 46'S, 34° 52'E).
TSHINGWEZI RIVER	-	Runs in a north-easterly direction to its confluence with the Lundi river near Chipinda Pools.
UMHLATUZI RIVER	-	South of Umfolozi Game Reserve in Zululand (Natal Province, South Africa).

VILLA GOUVEIA - A town in central Mozambique close to the eastern border of Rhodesia north of Umtali.
18° 5'S, 33° 13'E.

ZULULAND - North-western region of Natal Province, South Africa.

APPENDIX II

SEX, AGE, SOCIAL STATUS AND DISTINGUISHING FEATURES OF THE WHITE RHINO POPULATION IN KYLE NATIONAL PARK AS ON THE 1ST JANUARY 1973

NOTES Age classes

I	0 - 3 years
II	3 - 6 years
III	6 - 9 years
IV	9 - 12 years
V	Over 12 years

No. 1 Adult female.

One female calf (No.2) born March 1971.

Introduced 12.8.65 (approx. age 2½ years) from Umfolozi.

Age class IV (9 years, 10 months).

Distinguishing features: Anterior horn short, curved well back and has a blunt tip. Posterior horn about half the length of anterior horn, pyramid-shaped with a slight curve towards anterior horn near tip. A small cow, easily confused with adult female No. 16 which has a male calf at present.

No. 2 Juvenile female.

Calf of No. 1, born March 1971 at Kyle.

Age class I (1 year, 9 months).

Distinguishing features: Horns undeveloped, no marks on body.

No. 3 Adult male.

"MARUFU" Introduced 2.10.66 (approx. age 2 years) from Umfolozi.

Subordinate bull.

Age class III (8 years, 3 months).

Distinguishing features: Anterior horn well formed, still slightly short, curved and with a pointed tip. Posterior horn wedge-shaped and fairly sharp. Small notch in lower right ear and a large raised round scar on left rump. Smaller in size than the mature bulls.

No. 4 Adult female.

"NGOLOTI" Two calves (a) Female born 4.5.68, captured 18.2.72 and sent to Lake McIlwaine National Park. Notch in lower right ear.

(b) Female (No.5) born July 1971.

Introduced 3.9.62 (approx. age 2½ years) from Umfolozi.

Age class V (12 years, 9 months).

Distinguishing features: Anterior horn long, curved and pointed. Posterior horn large, about a third the length of anterior horn and fairly well pointed. Two small holes (ex. ear tags) through middle of left ear. Large cow.

No. 5 Juvenile female.

Calf of No. 4, born July 1971 at Kyle.

Age class I (1 year, 5 months).

Distinguishing features: Horns undeveloped, no marks on body.

No. 6 Adult male.

"NGEZANA" Introduced 3.9.62 (approx. age 2½ years) from Umfolozi.

Territorial bull.

Age class V (12 years, 9 months).

Distinguishing features: Anterior horn long, curved and sharp. Posterior horn well developed, leans slightly forwards. Wire mark where anterior horn thins out from thicker base portion. Sliver of skin removed from inner edge of left ear. Large very tame bull.

No. 7 Adult male.

Introduced 16.10.66 (age mature) from Umfolozi.

Subordinate bull.

Age class V (mature).

Distinguishing features: Horns very characteristic, anterior horn broken low down, tip rounded. Posterior horn very well developed, curved slightly backwards, pointed and slightly longer than remains of anterior horn. No marks on body. Large bull.

No. 8 Adult female.

"MANDIWANA" One female calf born 19.6.70 (No.9).

Introduced 26.8.65 (age mature) from Umfolozi.

Age class V (mature).

Distinguishing features: Anterior horn short, slightly curved and pointed. Posterior horn small, set well back from anterior horn and keel-shaped. Small round scar (may not be permanent) on left side where barrel joins hind quarters. Small thin scar on left side of face. Medium sized cow. Can be confused with adult female No. 14 "Masiwanda" which has male calf at present, pyramid shaped posterior horn and blunter anterior horn.

No. 9 Juvenile female.

"TORY" Calf of No. 8, born 19.6.70 at Kyle.

Age class I (2 years, 6 months).

Distinguishing features: Horns undeveloped, no marks on body.

No. 10 Adult female.

One male calf born 22.7.70 (No. 11) at Kyle.

Introduced 24.10.66 (age mature) from Umfolozi.

Age class V (mature).

Distinguishing features: Anterior horn short, broken, barrel-shaped with rounded, smooth tip and vertical groove running down front. Posterior horn pointed, large base, thin neck, and about same length as anterior horn. Large round raised scar on right rump. Medium sized cow.

No. 11 Juvenile male.

Calf of No. 10, born 22.7.70 at Kyle.

Age class I (2 years, 5 months).

Distinguishing features: Anterior horn fairly well developed. Posterior horn undeveloped. Heavily tufted ears.

No. 12 Adult male.

Introduced 1966? (age mature) from Umfolozi.

Territorial bull.

Age class V (mature).

Distinguishing features: Anterior horn long, curved and pointed. Posterior horn pyramid shaped, sharp and

leaning slightly forward. Left ear has ridge running from tip to centre of ear, 2-3 inches long. No marks on body. Large bull.

No. 13 Adult male.

Introduced 1966? (age mature) from Umfolozi.

Territorial bull.

Age class V (mature).

Distinguishing features: Anterior horn well developed, not as long as No. 12, and top 3 inches broken off. Posterior horn pyramid-shaped, well developed, about a third the length of anterior horn. No marks on body, large bull, well developed tufts on ears.

No. 14 Adult female.

"MASIWANDA" Two calves - (a) Female calf, born 1967, died 29.9.68.

(b) Male calf, born 10.4.72 (No. 15).

Introduced 1966? (age mature) from Umfolozi.

Age class V (mature).

Distinguishing features: Anterior horn thick based, curved half way up, short with rounded tip. Posterior horn set well back from anterior horn, pyramid-shaped, pointed. Can be confused with adult female No. 8 which has older female calf at present and wedge-shaped anterior horn. Small tear in outer edge of right ear.

No. 15 Juvenile male.

Calf of adult female No. 14, born 10.4.72 at Kyle.

Age class I (8 months).

Distinguishing features: Horns undeveloped, no marks on body.

No. 16 Adult female.

One male calf (No. 17) born 7.7.70 at Kyle.

Introduced ? from Umfolozi.

Age class V (mature).

Distinguishing features: Anterior horn short, thick based and curved backwards near tip, flat blunt tip (probably broken at some stage). Posterior horn pyramid-shaped. Can be confused with adult female No. 1, but is a larger cow, longer anterior horn (blunt) and has a male calf at present.

No. 17 Juvenile male.

Calf of No. 16, born 7.7.70 at Kyle.

Age class I (2 years, 5 months).

Distinguishing features: Hairy fringe around ears, horns undeveloped, no marks on body.

No. 18 Adult male.

"GNUBENDE" Introduced ? from Umfolozi.

Territorial bull.

Age class V (mature).

Distinguishing features: Anterior horn short, thick based, straight and sharply pointed. Posterior horn situated close to anterior horn, also thick based, keel-shaped and short. Well developed tufts on ears, hairy fringe round both ears. Notch in tip of left ear in addition to natural tuft. Medium sized bull, not as big as adult male No. 6.

No. 19 Adult female.

One female calf (No. 20) born 1971.

Introduced 16.10.66 (approx. age 3 years) from Umfolozi.

Age class IV (9 years, 2 months).

Distinguishing features: Anterior horn short, broken, remainder thick based and broad. Posterior horn situated close to anterior horn, sharp tip curved towards anterior horn. No marks on body except hairline scar on left side of face below eye (may not be permanent). Small cow (same size as No. 1). Small piece of skin hanging from bottom of left ear. Can be confused with No. 10 which has round scar on right rump.

No. 20 Juvenile female.

Calf of No. 19, born 1971 at Kyle.

Age class I (2 years).

Distinguishing features: Anterior horn straight, well developed. Posterior horn undeveloped as yet. No marks on body.

No. 21 Adult female.

Two calves - (a) Female introduced 9.10.66 (approx. age 3 years) died August 1967.

(b) Female (No. 22) born 16.8.71 at Kyle.

Introduced 9.10.66 (age mature) from Umfolozi.

Age class V (mature).

Distinguishing features: Anterior horn thick and curved well forward. Tip flat (cut on capture), cut surface

about 2½ inches diameter. Posterior hrn long, thin, pointed and curved towards anterior horn. Horns very characteristic. No marks on body. Large cow, fairly nervous.

No. 22 Juvenile female.
Calf of No. 21, born 16.8.71 at Kyle.
Age class I (1 year, 4 months).

Distinguishing features: Horns undeveloped, no marks on body.

No. 23 Adult male.
"NYONI" Introduced 3.9.62 (approx. age 3½ years) from Umfolozi.
Territorial bull.
Age class V (13 years, 9 months).

Distinguishing features: Anterior horn long, curved generally well formed. Tip recently broken off. Posterior horn small, keel-shaped, situated well forward. Small kidney-shaped scar on right rump.

No. 24 Adult female.
"SUSAN" Born 6.4.67 at Kyle.
Age class II (5 years, 8 months).

Distinguishing features: Anterior horn curved, angled forwards, fairly long. Posterior horn short, rounded tip curved slightly backwards. Looks pregnant, small cow easily confused with No. 25 which has a wedge-shaped posterior horn and is slightly larger, also pregnant. Usually associated with No. 25. No marks on body.

No. 25 Adult female.

Born 15.4.67 at Kyle.

Age class II (5 years, 8 months).

Distinguishing features: Anterior horn well curved (more so than No. 24), longish, well formed pointed tip. Posterior horn wedge-shaped, flat, situated close to anterior horn. Easily confused with No. 24, but slightly larger and heavily pregnant at present. More nervous than No. 24. Usually associated with No. 24. No marks on body.

No. 26. Adult female.

Two male calves No. 27 and 28 born October 1970 and ~~introduced 23.10.66 respectively.~~

Introduced 23.10.66 (age mature) from Umfolozi.

Age class V (mature).

Distinguishing features: Anterior horn short and thick, barrell-shaped. Posterior horn pointed, slightly longer than anterior horn and tip has slight forward curve. Large cow. Easily confused with No. 10, but has no scar as does No. 10.

No. 27 Juvenile male.

~~Second calf of No. 26, born October, 1970 at Kyle.~~

Age class II (3 years, 2 months).

Distinguishing features: Horns undeveloped, no marks on body.

No. 28 Adult male.

"GUTU" First calf of No. 26, born in Umfolozi, introduced with No. 26 on 23.10.66 (approx. age 2 years).

Subordinate bull.

Age class III (8 years, 2 months).

Distinguishing features: Anterior horn shortish, curved and pointed. Posterior horn pyramid-shaped, rounded tip curved slightly backwards and situated well forward near base of anterior horn. Small bull, can be confused with No. 33, both same size and horns similar. No. 28 generally associated with No. 26 and 27, No. 33 generally associated with No. 32. Ears and tail hairless.

Captured at Kyle on 18.2.72 and moved to McIlwaine National Park but returned to Kyle on 28.3.72 due to excessive fighting.

No. 29 Adult male.

Born August 1967 at Kyle.

Subordinate bull.

Age class II (5 years, 4 months).

Distinguishing features: Anterior horn pointed, well curved, not fully developed. Wire mark about 3 inches from tip on anterior surface. Posterior horn flat and rounded, no point (appears to have been knocked off or worn flat). Small bull, wire mark on horn distinguishing it from No. 28 and No. 33.

No. 30 Adult female.

One male calf (No. 31) born April, 1971 at Kyle.

Introduced 1965? (age mature) from Umfolozi.

Age class V (mature).

Distinguishing features: Anterior horn short, thick based with ~~large~~ groove down anterior face. Posterior horn short and wedge-shaped with slight forward curve. Large cow, thin scar down left side of face below eye. Can be confused with No. 19 which has characteristic posterior horn. Shy cow.

No. 31 Juvenile male.

Calf of No. 30, born April 1971 at Kyle.

Age class I (1 year, 8 months).

Distinguishing features: Horns undeveloped, no marks on body.

No. 32 Adult male.

Introduced 1966? (age ?).

Subordinate bull.

Age class III.

Distinguishing features: Anterior horn long, curved and pointed. Posterior horn wedge-shaped with well formed ridge, ~~tip curved slightly forwards.~~ No marks on body, can be confused with No. 33 but is larger and has characteristic posterior horn. Can also be confused with No. 3 (both same size) but No. 3 has scar on rump. Is larger than No. 28 and posterior horn not as characteristic. Usually associated with No. 33.

No. 33 Adult bull.

Born 10.12.67 at Kyle.

Subordinate bull.

Age class II (5 years).

Distinguishing features: Anterior horn long, wide based and curved. Posterior horn rounded and curved slightly away from anterior horn, has a "knobbly" appearance. Smaller than No. 32, about same size as No. 28 and can be confused with No. 28 but posterior horn characteristic.

APPENDIX III

INTRODUCTION OF WHITE RHINO
(Ceratotherium simum simum)
TO KYLE NATIONAL PARK, RHODESIA

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