THE MAMMALS OF THE TRANSVAAL

BY

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I hereby state that this thesis, except where specifically indicated to the contrary in the text, is my own original work.

I.L. Rautenbach

ABSTRACT

The primary object of this study is to provide a checklist of the mammals occurring within the Transvaal. A general biological account of each species forms the bulk of this treatise, - discussing, in order of sequence, firstly the taxonomic status of each species as based on a study of available museum specimens. Thereafter the distribution of each species is discussed, and illustrated with a map of known distribution. Remarks are presented on the various environmental factors that may influence individual species ranges. Habitat preferences, habits, and food preferences are then discussed. Available data on breeding seasonality, as based on the monthly ratio of reproductively active and inactive females, are given. External measurements and masses of males and females are tabulated. Records of occurrence based on the number of museum specimens from each locality, and the institution where these specimens are housed, are finally listed for each species. The text is supplemented by a gazetteer, giving the latitudinal and longitudinal coordinates of all the collecting localities.

This study is based on some 12 000 museum specimens, the greatest majority housed in the Transvaal Museum collections. During the field work phase of this project, 57 localities were sampled. This yielded the majority of the specimens and the greater part of the data on which this book is based. Information gained from a study of earlier collected material supplements these data files. Additional information such as sight records, field observations, and the published accounts of other scientists, have also been incorporated into the central data files and have been discussed in relation to my own findings.

The results of selected studies comprise the discussion. The basic behavioural trends and mean mass of all the carnivore species of the Transvaal are employed to speculate on how interspecific competition is avoided. The distribution of all southern African mammals is employed to statistically evaluate the

validity of the biotic zones previously empirically recognized for this subcontinent. The distribution patterns of Transvaal mammals are statistically analysed to subdivide the biotic zones overlying the Transvaal into community types of zoogeographical significance. Other zoogeographical phenomena are discussed in relation to regional species diversity. Reprints of papers arising from this study, and particularly the discussion, are bound in as appendices to this report.

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INTRODUCTION

During the last two decades there has been an increased awareness on a wide front of the tremendous intrinsic value of the highly diversified wildlife of Africa. This has led especially to a resurgence of scientific interest in the mammal fauna of the continent. Biologists and environmentalists are concerned about the detrimental impact on the environment of unchecked human population growth, and of ever-increasing and intensifying industrial, mining and agricultural developments. These threaten the continued existence of the fauna as well as the flora in more than one way over large areas, quite often with country-wide effects. Since 1950, employment opportunities for biologists have greatly increased, which in turn have resulted in a spate of published information dealing with our biotic environment. Ever-increasing scientific demands and intra-disciplinary competition have further stimulated biologists to greater productivity. New information is documented, accumulated, assimilated and evaluated in conjunction with existing information (most often facilitated by computers), and the resulting infomation is employed to probe deeper into the mysteries of nature or to provide management policies. In this process, scientists often succeed in offering some answers and, more often, they pose further intriguing questions. The printed information sources have become so vast that it has become impossible for a scientist to accumulate everything dealing with a more generalized subject such as African mammalogy, thus necessitating specialization. The two centres of greatest activity in mammal research have undoubtedly been east and southern Africa, focussing in particular on larger mammals and on conservation.

In all these activities, southern African museums have played a prominent role, and are continuing to do so. Museums were the first institutions to undertake the documentation of local fauna and flora. One has only to refer to the pioneering works of Andrew Smith, W. Sclater and P. Sclater and in later

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years the published accounts of Shortridge (1934), Roberts (1951), and Ellerman *et al.* (1953) to appreciate the sound foundation museologists have laid for subsequent increased scientific activity. Museum scientists continue to keep abreast of scientific developments by accumulating data and evaluating their own research results in relation to the published work of others. This can be appreciated from the work of, to mention but a few, Smithers (1971), Smithers and Lobao Tello (1976), and the publication "*The Mammals of Africa: an Identification Manual*", edited by Meester and Setzer.

Traditionally the main function of the museum scientist is to study the taxonomic and systematic relationships of taxa, to evaluate their taxonomic importance, to allocate scientific names to species and higher taxa, and to arrange taxa in such a way as to reflect phylogenetic relationships, as well as to produce identification keys. This in turn has allowed meaningful research on distribution and zoogeography. Initially this work was performed purely on preserved museum specimens. However, systematics and taxonomy encompass virtually all biological disciplines. The availability of masses of biological information has enabled the museum systematist to utilize genetic, ecological, behavioural and other biological information on which to base decisions with regard to taxonomic status and phylogenetic relationships. This puts a heavy but challenging burden upon the museologist. Not only has he to familiarize himself with all the taxa within his chosen field (group) of specialization (viz. c. 320 species of southern African mammals) as in the past, but he now also has to be conversant with developments in other disciplines such as ethology and zoogeography in his pursuit of systematic relationships. I believe that there is now as great a need as ever for modern systematists to pursue their interest for many years to come, and that museums will continue to be the main centres for the study of taxonomy and systematics.

The traditional museum specimen has always played a central role in the scientific endeavours towards a better understanding of natural phenomena. In certain groups (viz. bats, insectivores

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and rodents), museum collections will for many years continue to form the main centres from which general biological information on species is drawn. In fact, with regard to small mammals, I am of the opinion that there is a direct correlation between the quantity of available material for any particular taxon, and the detailed state of knowledge on its general biology. For that reason alone, continued and dynamic expansion of collections on a scientific basis is essential.

The specimens lying in museum drawers are thus valuable possessions of the biological sciences in that they represent the permanent physical definitions of our current concepts of species and higher taxa. They are even more important in that they are studied and restudied in the taxonomic context, thus providing the science of biology with one of the rare opportunities to accurately repeat experiments over a long time span on a controlled basis. There is a continued need for expanding collections, firstly to increase our knowledge of variation and the implication thereof on existing taxonomic frameworks, and secondly to increase our knowledge of the general biology of both rare and common species.

Expanding a collection is first of all the responsibility of its curators, and contributions from other workers should not be expected to contribute more than a most welcome bonus. My colleague and I realised that an increase in the expansion rate of the Transvaal Museum mammal collection, so as to meet ever-increasing scientific demands and to continue as a worthwhile source of reference and information, would involve a concerted effort on our part. After deliberation with my director, Dr C.K. Brain, and the chairman of the Transvaal Museum Board of Trustees, Prof. F.C. Eloff, I decided to sacrifice the project I was engaged on at the time in favour of a generalised study of the mammals of the Transvaal. The new project was planned along the same lines as Dr Smithers' now well known studies on the mammals of Botswana, Mocambique, and currently Rhodesia.

The Transvaal was an obvious choice for a survey study of this kind. The entire southern African subcontinent needs closer scientific attention to mammals, especially research based

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on survey work. The subcontinent is, however, too big an area for a single research and survey effort, and cooperative efforts have obvious disadvantages and drawbacks. As mentioned before, Botswana, Rhodesia and Mocambique have received recent attention from Dr Smithers, working in cooperation with other staff members of the Rhodesian National Museums and Mr Jose Lobao Tello in Mocambique. It was thus decided to choose for a similar study the area closest to home, i.e. the Transvaal. This choice also has the added advantage of bordering on the areas covered by Dr Smithers and his associates, thus forming a regional extension of their work. Although choosing a political area for study is nonsensical in biological terms, it has many practical, logistic and legal advantages. Furthermore, with the exception of the Cape Province, some survey work has already been undertaken in the Orange Free State (Lynch, 1975 and in progress); Natal (Pringle, 1974, 1977 and in progress); South West Africa (Coetzee, in progress); Eastern Cape (Swanepoel, in progress). Such individual surveys of political areas will eventually combine to form a meaningful whole.

The first and obvious objective I set out to achieve was to make available a mammal collection for the Transvaal that would satisfy the standards of a modern museum serving the needs of the modern biologist, more particularly the systematist, in terms of quantity and quality. It would further provide a checklist of the mammals occurring within this Province and the distribution of each species while offering speculations on edaphic factors that may influence range. A natural outcome of proper processing and data-recording at the time of collecting during the entire field-work phase of this project is that certain facets of the biology, ecology, food preferences and breeding of each species are documented and related to the work of others, notably Smithers (1971).

This work sets out to collate information collected by the author with the published accounts of others in order to portray the present state of knowledge of the mammals of the Transvaal. It was hoped that this work would serve as a basis from which workers intending more detailed work on particular species could start. Above all, it was hoped that the reader would learn to appreciate the tremendous potential of a permanent collection which includes all relevant data with each specimen. Some 12 000 specimens have been examined from various museum collections, of which more than half have been added since 1973 to the Transvaal Museum's collection, which came into being as early as c. 1915.

THE STUDY AREA

Geography and Demography:

The Province of the Transvaal lies between 22°S and 28°S latitude and between 25°E and 32°E longitude (Fig.1) with an area of 286 000 square kilometres. The Transvaal is the second biggest province (after the Cape Province), and encompasses 23% of the total land mass of the Republic of South Africa. The northern border of the Province is bounded by Rhodesia and Botswana, the southern border by the Orange Free State and Natal, and the eastern border by Swaziland and Mocambique. The northern Cape Province and southern Botswana lie to the west.

The Transvaal has a population of c. 9,6 million people, consisting of 6,8 million Blacks belonging to six separate nations, 2,6 million Whites, and 0,2 million Asians and Coloureds. De-population of the rural areas is considered a serious problem as more and more people flock to urban centres. Johannesburg is the largest city in the Republic, and the second largest in Africa, with c. 1,5 million inhabitants. The various towns of the Witwatersrand complex house countless further numbers of all races. This high population density can partly be ascribed to the fact that the Witwatersrand complex is the world's largest gold mining centre and a thriving industrial complex. The mine dumps rising starkly from the surrounding country are a feature of the landscape and are clear evidence of the vast industry dependent upon the treasure house nearly four kilometres below the surface.

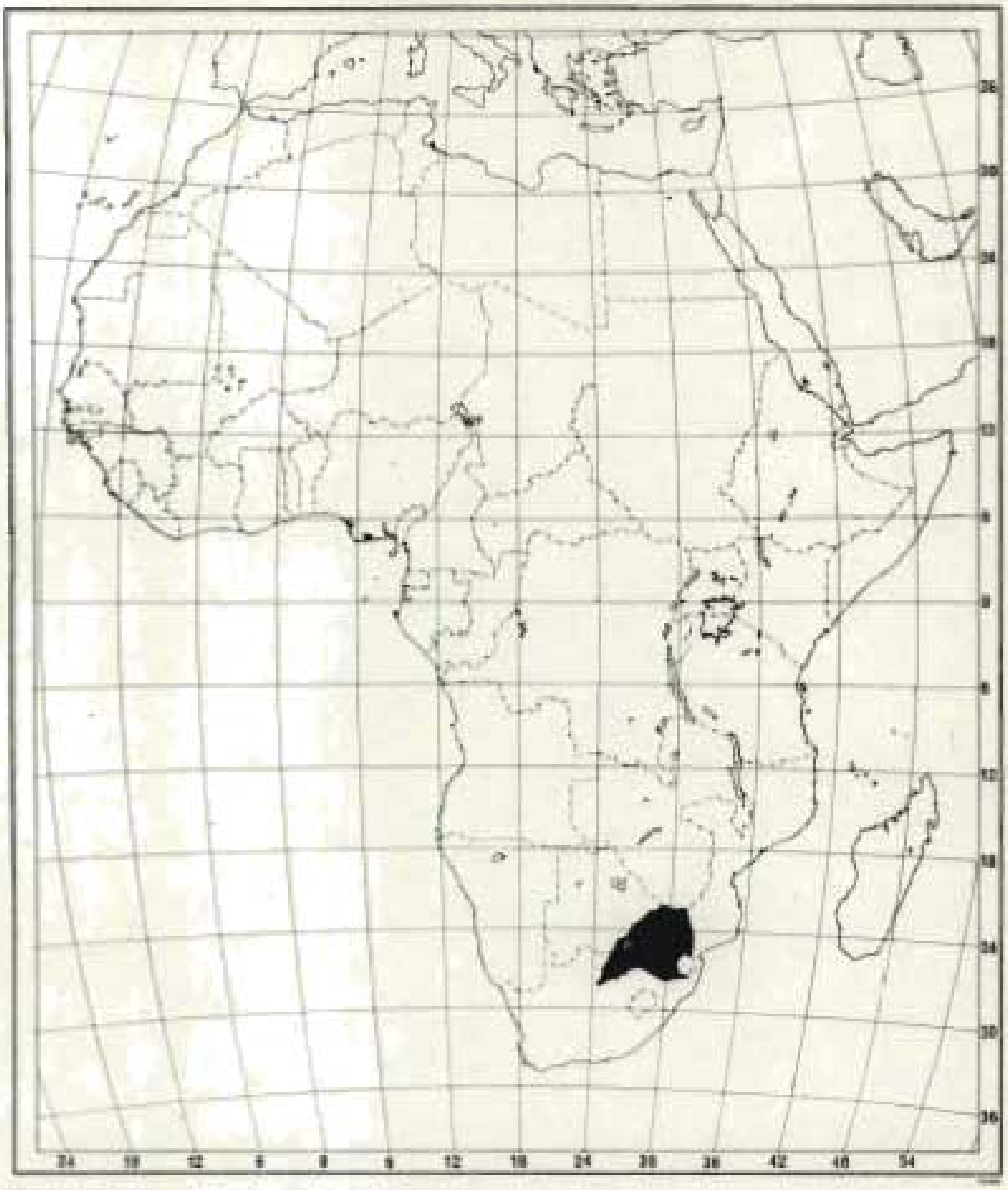

Fig.1: The study area in relation to Africa.

Black homelands comprise about 40 percent of the total area of the Transvaal, and have been included in this project as part of the study area of the Transvaal.

Weather and Topography:

The elevation of the land surface of the Republic of South Africa, which rises in a series of four plateaus from the coast, has a profound influence on the weather and climate. The major part of the Transvaal lies on the central plateau. This plain has a general altitude of 1 230 metres, but rises towards the north-east to more than 1 850 metres, and gradually slopes down towards the west. It is bisected by the Magaliesberg mountain range along the northern edge of the Witwatersrand. To the north of the Magaliesberg mountains lies the basin formed by the Bushveld igneous complex, with a floral composition quite distinct from the southern highveld. To the east of the escarpment lies the Transvaal lowveld, with elevations as low as 580 metres towards the north-east.

The highveld of the southern Transvaal, Orange Free State, and the north-eastern Cape is the "body" of the inner plateau (Fig.2). Regular winter frosts inhibit the growth of woody plants, and this area is therefore characterised by rolling grassland plains. North of the Magaliesberg mountains the plateau slopes down into the Bushveld basin towards the Limpopo river trough. However, within this basin three well-defined upland blocks can be distinguished in the Transvaal (Fig.2). In the north-western Transvaal there is the undulating Waterberg (or Palala) plateau, and in the north the Soutpansberg highlands which drop sharply towards the wide Limpopo trough beyond. Between these two highland blocks lies the granitic Pietersburg plain which, with an average elevation of 1 250 metres, is considerably lower than the flanking highlands but significantly higher than the surrounding Bushveld basin itself. The Pietersburg plateau has a floral composition similar to that of the southern Transvaal highveld.

The great escarpment divides the South African river systems into two. Almost the entire central plateau is drained

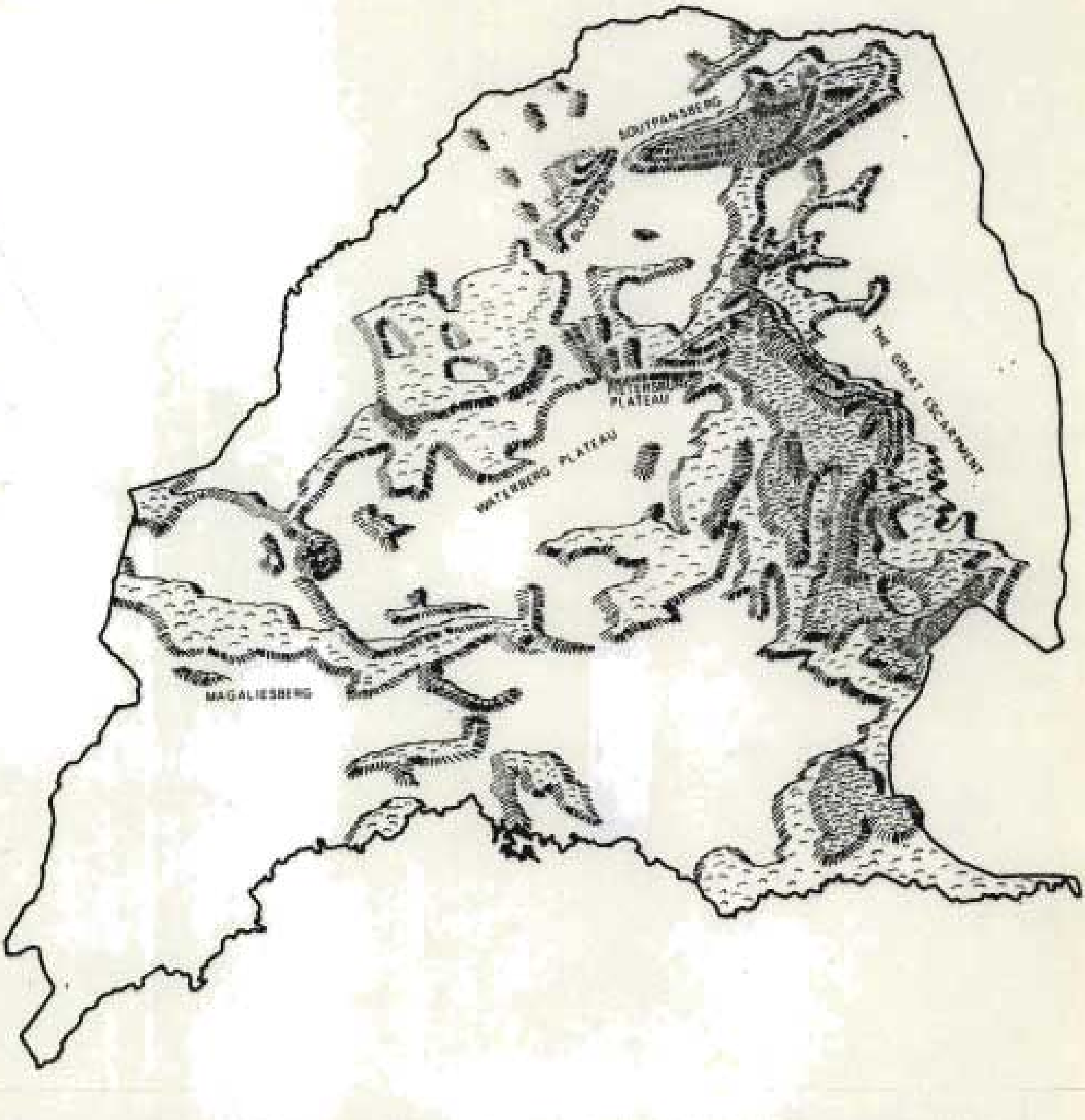

Fig.2: Map illustrating the main topographical features of the Transvaal. The Magaliesberg separates the highveld grasslands of the south from the Bushveld basin towards the north. The eastern Transvaal lowveld is bordered on its west by the great escarpment.

westwards by the Orange river and its tributaries. The escarpment is thus in fact a continental divide, separating east- and west-flowing drainage systems. The exception is the Bushveld basin to the north of the Witwatersrand, where rivers such as the Komati, Crocodile, Olifants and Limpopo have broken eastwards through the main scarp, having their headwaters well back on the interior plateau.

The Mocambique current along the east coast of South Africa, and the Benguela current along the west coast, exert a great influence on the climate of this southern subcontinent. The west coast is washed by the cold waters of the Benguela current, which result in a lower rainfall and lower average temperatures for the western regions. As a result of the warm Mocambique current which flows down the east coast, the eastern regions of South Africa not only have a higher mean annual temperature, but receive a considerably higher mean annual rainfall. This means that regional precipitation decreases from the east towards the west, a pattern also discernible on a smaller scale in the Transvaal (see Fig.3).

The Transvaal receives its rains mainly during the summer months of October to April. Winter precipitation is neglibible. The greatest part of Transvaal precipitation occurs with thunderstorms, which reach their maximum seasonal frequency in February and their maximum diurnal frequency at about 16h00. These are most common on the Transvaal highveld; thus precipitation associated with thunderstorms occurs in Johannesburg on an average 61 days of the year. Rainfall associated with thunderstorms is of short duration, and very intense; prolonged heavy rains are rare.

By combining topography, rainfall, and the vegetation adapted to these factors, the Transvaal can be divided into four major regions, each with its own characteristic climatic pattern. These areas are also recognized as being of zoogeographical importance, and are discussed more fully in a zoogeographical context in the Results section. A brief discussion on the characteristic climatic patterns of each of these regions is given here. The four regions are: the eastern Transvaal lowveld; the southern Transvaal highveld; the northern

Transvaal north of the Magaliesburg and west of the great escarpment; and the western tip of the north-western steppe (South-West Arid), which occurs peripherally in the extreme south-western Transvaal.

In the low-lying areas of the eastern Transvaal lowveld mean annual precipitation varies from 500 mm in the northeast, to c. 700 mm towards the south (Fig.3). Rainfall increases rapidly with altitude along the escarpment, so that in places more than 2 000 mm per year have been recorded. On the average, 65 rainy days can be expected in low-lying areas between the months November to March in any rainy season, while over 120 rainy days can be expected along the escarpment. In both areas highest precipitation occurs during January. Rain is mainly accompanied by intense thunderstorms; falls in excess of 300 mm in one day have been recorded. Against the escarpment orographic rain and mists frequently occur. Hail is an uncommon occurrence in the lowveld, falling only once or twice per year. The climate is warm to hot, and a high humidity makes summer days very oppressive in the lowveld. Cooler weather prevails against the escarpment. Mean maximum temperatures of 30°C are recorded during summer, but on rare occasions temperatures may rise to 43°C. Mean minimum temperatures of 8°C occur in midwinter, whilst extremes may reach -2°C. Frost is seldom experienced. During winter, sunshine duration is about 75% of that possible. In summer, however, sunshine duration is only around 50% of that possible. Winds blow mainly from the south-south-east or the north-north-west and may infrequently reach gale force against the mountains.

On the Transvaal highveld, precipitation decreases from 900 mm p.a. in the east to 650 mm p.a. in the west (See Fig.3). Precipitation is almost exclusively due to afternoon showers and thunderstorms, and 85% of the rainfall occurs during the summer months of October to March, with peak during January. On an average, 60 or more thunderstorms per year can be expected on the highveld. Such storms normally are short but violent with severe lightning and strong gusting south-westerly winds. Hail is not uncommon; in fact this region has the highest hail

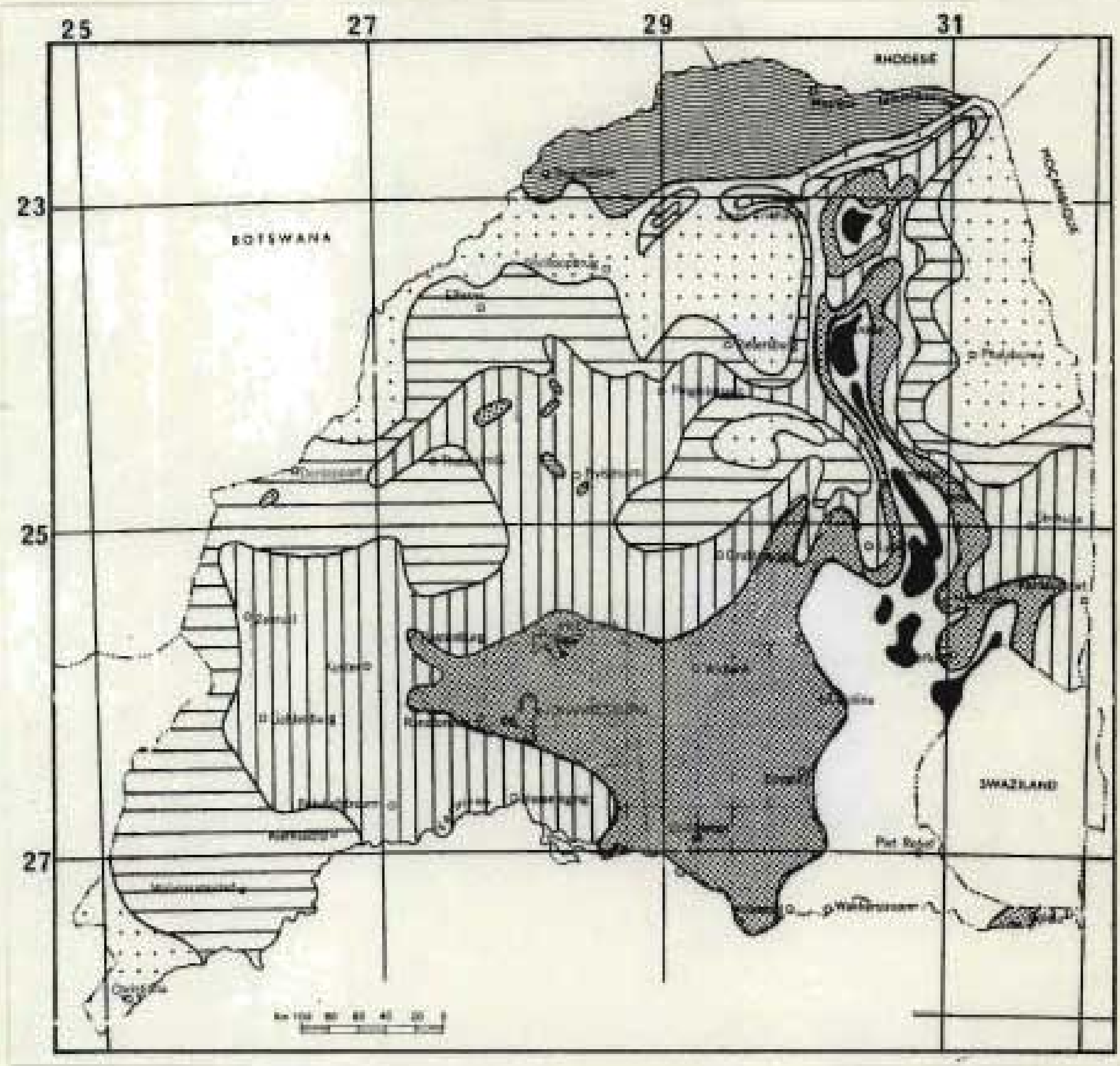

Fig.3: Map illustrating the main rainfall zones in the Transvaal. The area represented by the horizontal wavy lines receives on the average between 301 and 400 mm p.a.; the stippled areas 401-500 mm p.a.; the areas indicated by horizontal lines receive 501-600 mm p.a.; the areas indicated by vertical lines, receive 601-700 mm p.a.; the dark stippled area could expect 701-800 mm p.a.; the blank area 801-1000 mm p.a.; and the dark areas receive from 1001 to more than 2000 mm precipitation p.a.

frequency in South Africa. Snow is very uncommon during winter, but frost occurs frequently, with an average of 120 days during the period May to September. On the whole winds are light, except for short periods during thunderstorms. Very occasionally tornadoes occur. Sunshine duration during summer is c. 60% and in winter c. 80%. A mean maximum temperature of 27°C is attained during January, while the absolute maximum may rise to 38°. A mean minimum temperature of 0°C is reached during July, but temperatures may sink as low as -13°C.

The climate of the Limpopo and Olifants river basins of the northern Transvaal is semi-arid and very hot, but the Waterberg plateau and the Soutpansberg have a more humid and somewhat cooler climate. Mean annual rainfall varies from c. 380 mm in the Limpopo river basin to over 700 mm in some parts of the Waterberg (Fig.3). The rainy season is from November to March, with a peak during January. About 50 to 80 rain days per year can be expected. Hail occurs half as frequently as on the highveld. Rainfall is not very reliable, with an average of one drought year expected in every ten years. Winters are dry, mild and pleasant. The mean maximum temperature of 32°C is reached during January, absolute maximum exceptionally rising to 42°C. The mean minimum temperature of 4°C occurs during July, temperatures on rare occasions dropping to as low as -7°C. Prevailing winds are mainly light to moderate from the northeast. The duration of bright sunshine exceeds 80% of the possible during July, and 60% during summer.

The portion of the South West Arid region occurring in the extreme south-western Transvaal is part of a greater semi-arid region that receives on the average about 250 mm of rain in the west and about 500 mm towards the east (Fig.3). Again, rainfall is largely due to showers and thunderstorms during the period October to March. Hail sometimes accompanies thunderstorms. The rainfall peak is reached during February or March. An average of up to ten rain days per month may be expected during the rainy season. However, during the usually dry and sunny winter months unsettled weather may occur once or twice a month. This is occasionally (c. five times per year) accompanied

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by snow on the far southern mountain ranges; however, snow has not been recorded in the small Transvaal portion of the South-West Arid region. This northern region, however, experiences extremely cold and unpleasant weather during and after snowfalls in the south. Sunshine hours amount to 70 to 80% of the possible sunshine duration, even during the peak of the cloudy (or rainy) season. Mean maximum temperature is 33^{O}C during January, temperatures in extreme cases rising to 43^{O}C. Mean daily minimum temperature is 0^{O}C during the coldest month (July), whilst extremes may plummet to -11^{O}C. Frost can be expected for a total of 10 days per year from May to September. Winds are usually north-westerly. Depending on the degree of denudation as a result of overgrazing or agriculture, severe dust storms may occur.

Agriculture, Forestry and Conservation:

Agriculture is practised on an intensive scale in the Transvaal. Virtually all arable land on the Transvaal highveld has been under the till. In the northern Transvaal, animal husbandry predominates. In some regions of the eastern Transvaal lowveld tropical fruit is grown, whereas along the escarpment and on the slopes of the Soutpansberg sylviculture is practised most intensively. Maize is the Republic's most important crop, taking up some four million hectares. The Transvaal is the largest producer in the country of this grain and of potatoes. The Transvaal is the third largest producer of wheat after the Cape Province and the Orange Free State. Some 3,5 million cattle are kept in the Transvaal, second only to the 4,0 million in the Cape Province. However, only three million sheep are reared in the Transvaal, as opposed to the 34 million found in the Cape Province.

Apart from the areas under sulviculture, the Department of Forestry manages some 1,2 million hectares of natural areas in the Republic. Catchment areas comprise some 1,0 million hectares, proclaimed wilderness areas 185 000 hectares, nature reserves 7 500 hectares, and areas where drift sand is controlled, 16 500 hectares. The Department of Forestry is thus the biggest single landowner in South Africa. It controls vast

undisturbed/..

undisturbed areas that cannot be expropriated for any sort of development because of their delicate ecological nature and importance. Such areas are currently being developed as strictly controlled recreation, research, and nature conservation assets. Although the Department of Forestry is seldom credited as such, it is in fact a conservation agency of major importance with activities throughout the country and especially in the Transvaal.

This brings us to nature conservation in the Transvaal. The role of the State Department of Forestry has been mentioned. In relation to other official conservation agencies, the Department of Forestry has been more passive in terms of conservation and management research, legal enforcement, and tourism. These facets, however, receive active attention as the Department becomes more involved in conservation as related to the particular objectives with the natural areas under its control.

The National Parks Board's Kruger National Park in the eastern Transvaal lowveld (Fig.4), is probably South Africa's best-known international tourist attraction. It lies on the border of Mocambique, and comprises 25 000 square kilometres. The Kruger National Park dates from 1898, when President Paul Kruger set aside a tract of land for conservation, then known as the Sabi Game Reserve. Just after the Second War of Independence, the area was re-proclaimed as a game reserve, with the addition of the Shingwidzi area as well as other areas between the Sabi and Limpopo rivers. Lt Colonel J. Stevenson-Hamilton was appointed the first game warden. The Park was first opened to the public in 1928, and is today one of the greatest tourist attractions of the Republic. Management and associated research were put on a sound footing with the appointment of Dr U. de V. Pienaar who succeeded Dr T.G. Nel as biologist in 1958. Under Dr Pienaar's dynamic guidance, management and research within the Kruger National Park was expanded until the Park became one of the most active and renowned research centres in all Africa. Frequent reference is made in this text to some of Dr Pienaar's many research papers, especially to his detailed documentations of the distribution and densities of the mammals occurring within the Park (Pienaar, 1963 and 1964).

Nature conservation outside the Kruger National Park and State lands is managed by the Transvaal Provincial Administration's Division of Nature Conservation. The Division was created in 1947, and grew steadily into a large and effective organization, managing the various conservation activities within the Transvaal. It is charged with the scientific management of their more than 20 nature reserves scattered throughout the Province (Fig.4). In addition it is conducting conservation-oriented research, as well as game capturing and translocation, research on and control of problem animals, outdoor recreation in reserves, administration of hunting and fishing within the province, advice to private owners on the management of their reserves and a host of other activities.

There are 503 privately owned nature reserves comprising a total of 1 279 050 hectares scattered throughout the Transvaal. These mostly belong to farmers who proclaim their farms as nature reserves, and practice conservation in conjunction with their normal farming activities. They have to comply to certain regulations set by the Transvaal Provincial Division of Nature Conservation before registration is accepted. Mention must be made to the enormous privately owned reserves bordering on the Kruger National Park, particularly Timbavati and Sabi-Sands (Fig.4). Here owners of individual farms have agreed to manage their farms on a collective basis for the purpose of conservation, private relaxation and hunting.

Several municipalities also manage nature reserves of various sizes and for various reasons. Some examples are Pretoria, Krugersdorp and Pietersburg. To the best of my knowledge none of these municipalities employ trained staff for the management of their reserves. Pretoria's Maria van Riebeeck Nature Reserve falls under the management of the section in charge of public parks, playgrounds and recreational areas.

Fig.4/...

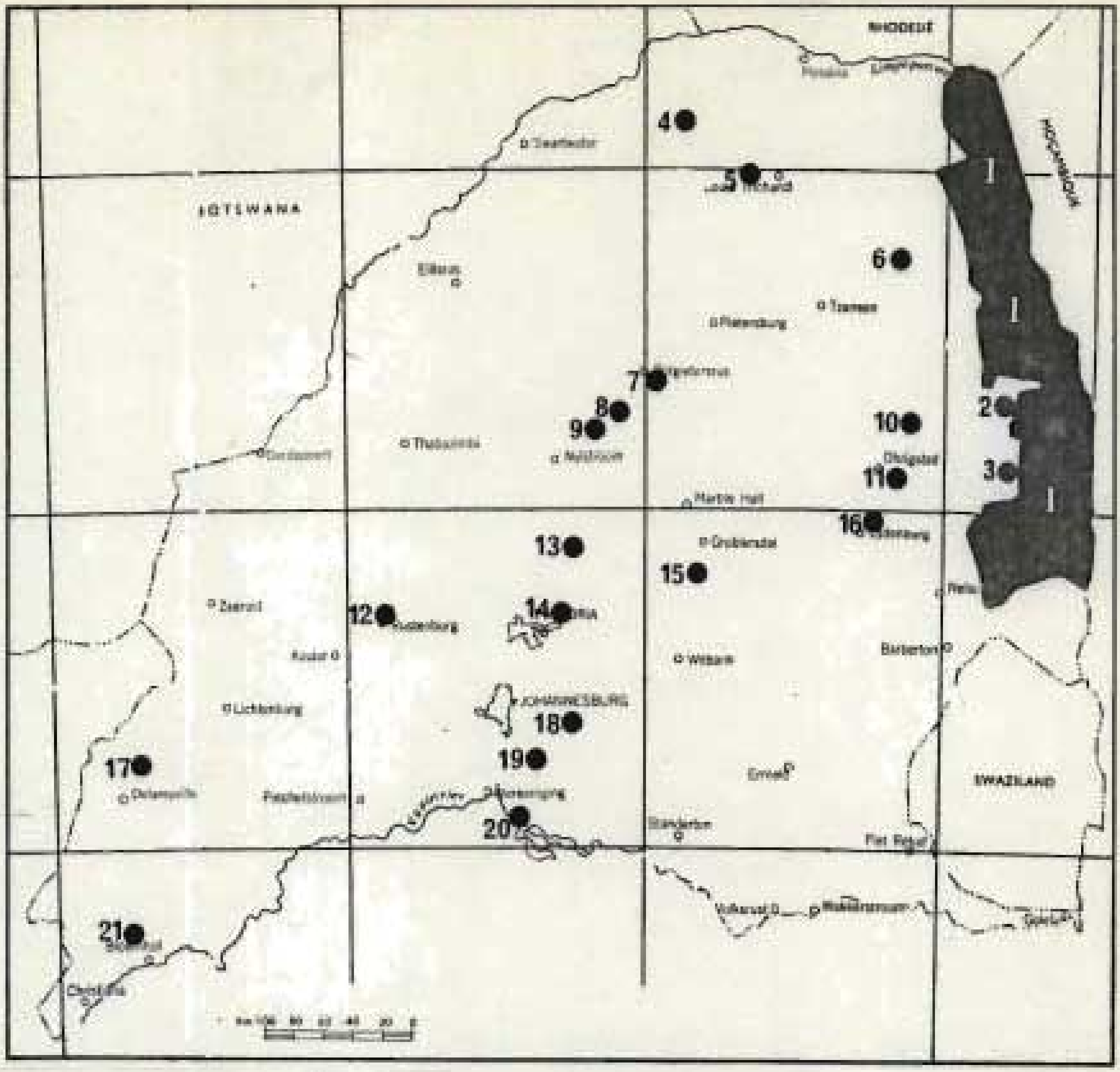

Fig.4: The main conservation areas within the Transvaal: 1 - Kruger National Park; 2 - Timbavati Private Nature Reserve; 3 - Sabi-Sands Private Nature Reserve; 4 - Langjan Provincial Nature Reserve; 5 - Happy Rest Prov. Nat. Res.; 6 - Hans Merensky Prov. Nat. Res., 7 - Percy Fyfe Prov. Nat. Res.; 8 - Doorndraai Dam Prcv. Nat. Res.; 9 - Nylsvley Prov. Nat. Res.; 10 - Blyde River Canyon Prov. Nat. Res.; 11 - Ohrigstad Dam Prov. Nat. Res.; 12 - Rustenburg Prov. Nat. Res.; 13 - Rust-de-Winter Dam Prov. Nat. Res.; 14 - Roodeplaat Dam Prov. Nat. Res.; 15 - Loskop Dam Prov. Nat. Res.; 16 - Te Kuilen Prov. Nat. Res.; 17 - Barberspan Prov. Nat. Res.; 18 - Maryvale Prov. Bird Sanctuary; 19 - Suikerboschrand Prov. Nat. Res.; 20 - Vaal Dam Prov. Nat. Res.; 21 - S.A. Lombaard and the Bloemhof Dam Prov. Nat. Reserves.

MATERIALS AND METHODS

The materials and methods of mammal collecting have been adequately discussed by Smithers (1971). Since my approach to this survey has been very similar to his, only the salient points and major areas of difference are mentioned here.

Initially this project was planned so as to first analyse all existing material and records from the Transvaal, in order to establish which areas had been extensively collected and which not. This approach was not very rewarding as it soon became apparent that former collectors had recorded only those species of which actual museum specimens were taken. Sight records, and other observations essential for a survey of this kind, were unfortunately not noted. Collecting localities to be visited during this survey were therefore chosen so as to cover the Transvaal as evenly as possible (see Fig.5), taking care to sample as many areas as possible with different environmental characteristics of vegetation, rainfall, soil types, etc. The localities samples are marked with an asterisk in the gazetteer.

Field work was conducted mainly by only three persons, equipped with a Toyota LandCruiser loaded with the necessary equipment to sustain three persons in the field for about a fortnight at a time. Collecting trips were organized and led by a European staff member of the mammal department, usually myself. My associate, Mr N.J. Dippenaar, or our technician, Mr J.G. de Jager, sometimes relieved me. We were at all times accompanied by our two black preparators, Messrs Samual Rantlakwe and Stephens Mothlasedi.

Field work was commenced during February, 1973, and continued till August, 1977. A normal field trip lasted 15 days, during which time two localities were each sampled for a week.

A Rhodesian manufactured snap trap, colloquially known as the Rhodesian Museum Special, was most commonly employed. It is of approximately the same dimensions as the American product with the commercial name of Museum Special, but is constructed

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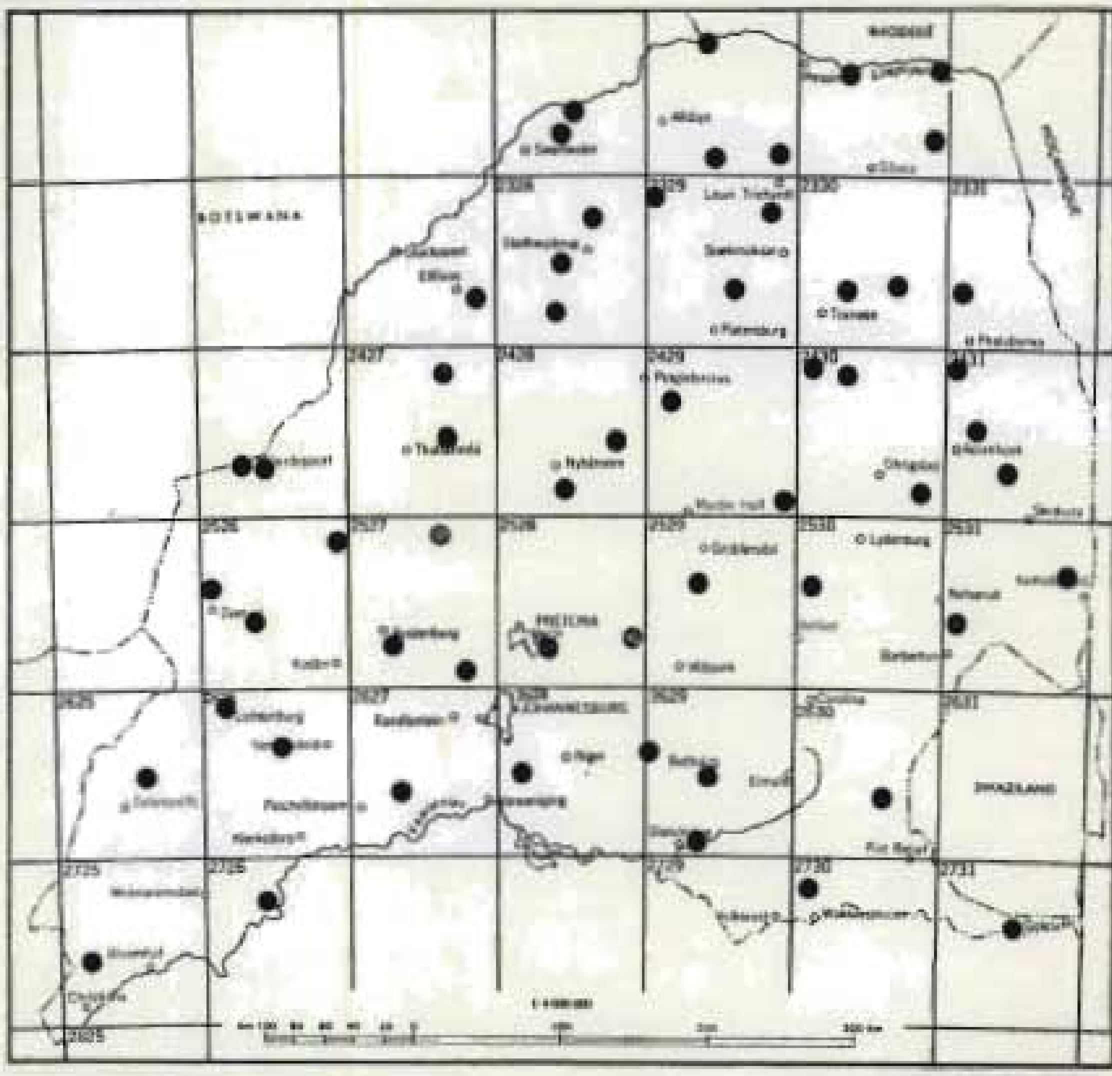

Fig.5: Collecting localities sampled since the initiation of this survey in 1973.

of different materials and also has a different triggering device. Further trapping was done with the Victor rat and mouse traps. Many smaller mammal species are known to have trap preferences. For this reason aluminium alloy Sherman collapsible live traps were employed to increase the choice of traps. Rodent moles and golden moles were trapped with Macabee gopher traps. Six carnivore live traps, locally made from 25 mm mesh metal wire, 0,3 x 0,3 x 0,9 metres in dimension, proved invaluable in obtaining smaller carnivores, especially genets. Bats were mostly collected by mist nets. The use of a 12 guage shotgun and a ,22 calibre rifle was essential in procuring specimens of hares, springhares, cane rats, dassies, primates, etc. In many instances the use of firearms augmented trapping and netting, for example of bats and small carnivores. Collecting was aimed almost exclusively at species smaller than a jackal.

Some animals such as hares, springhares and galagos could be collected only by shooting them at night. Conditions permitting, night hunting was conducted every night for two to five hours. Night hunting on foot was soon found to be unproductive, and all subsequent endeavours were from the back of a patrolling field vehicle, utilizing two very strong spotlights to dazzle the animals.

All localities visited were within easy reach of a day's driving, and all but a few localities were easily accessible by road. Fuel and water were always within easy reach. It was nevertheless necessary to streamline our efforts in order to obtain and process as many specimens as possible, as well as to sample the maximum number of habitat types at any given locality. Traplines, each consisting of 100 traps spaced five to ten metres apart, were therefore employed as standard trapping units. Each team member was responsible for at least one, and usually two, such trap lines. We thus always deployed between 300 and 600 traps during field operations, and on rare occasions even more. Carnivore and mole traps were set and checked on our way to and from our traplines. A small collapsible trail bike increased our mobility, and further resulted in considerable savings in fuel and time.

Traps were checked, cleared and rebaited at dawn and during late afternoons. Mist nets were strung and manned at dusk and during the early evening. Night hunting was conducted between 20h00 and 24h00.

The greatest majority of specimens was brought to camp in the mornings. They were fumigated with technical ether to kill ectoparasites in order to minimize the danger of infection. Specimens were catalogued and relevant data recorded by the team leader, whereafter they were skinned, stuffed, pinned, and the skulls safely stored, by the two preparators. An extra skull label was attached to the skinned body, which was returned to the team leader for dissection and recording of reproductive status and stomach contents. Stomachs of carnivores were routinely preserved in formaldehyde for later detailed analysis in the laboratory. Upon completion of the daily cataloguing and data recording the team leader spent the rest of the day until the afternoon trap round on reconnaisance, daytime collecting, or interviewing local inhabitants concerning the regional occurrence of animals.

To streamline the data recording and curatorial processes, I have done away with the traditional field catalogue. Only an expedition diary of events and of locality descriptions was kept. Blank catalogue cards as in Fig.6 were prestamped with official sequential Transvaal Museum accession numbers before each trip. Such a card was allotted to each specimen, which means that that specimen immediately received its permanent accession number. Thus none of the specimens collected during this survey has a field number. Relevant data were entered on the card while processing the specimen. From this catalogue card, a skin label and two skull labels were written out (Fig.6). These labels were then tied to the specimen, whereafter it went to the preparators. The catalogue cards were sequentially stored in a watertight container, which was kept in a safe place.

Once back at the Museum, cleaning of the skulls commenced immediately, either by hand or by means of a dermestid colony. The skins were unpinned, fumigated and stored in transit cabinets.

Fig.6/...

Transvaal Museum : Department of Mammals

T.M. No. 17249 Species Pipistrellus nanus Sex ♂

24 · 7 :1970 Det. by: I.L.R.

Collector: A.G. White Fld No. A.G.W. 8

Skinned: J.M. Seete Alt.

Locality: 3 mi. N.E. Komatipoort, E.Tvl.

Lat. 25 · 25 ' S; Long. 31 · 55 ' E (2531 Bd.)

Habitat: Caught by hand c. ibhoo with several others in the rolled-up

~~Notes:~~ growth-tip of a banana plant. Near residence. Stomach empty.

Mat.		Condition
Skin	✓	
Skull	✓	
Skel.		
Alc.		

Measurements

Total	79
Tail	35
H.Ft.	6 cu/su
Ear	9
F. Arm	30,5
B.Wt.	4,5 g.

Reproductive status

♂	Testis abdominal/~~scrotal~~				4 X 1,5	mm
♀	Pr.	Lact.	Not Pregnant	Nipples	No Embrios	mm

TRANSVAAL MUSEUM, BOX 413, PRETORIA
T.M. No. 17249 Date 24:7:70 Sex ♂
Name Pipistrellus nanus
Locality 3 mi. N.E. Komatipoort, E.Tvl.
Collector A.G. White Skinner J.M. Seete

♂ No.AGW 8

Tot: 79
T: 35
HF: 6
E: 9
F.Arm: 30,5
Mass: 4,5

25 · 25 ' S; 31 · 55 ' E
HABITAT: Rolled-up growth-tip of banana plant

TM 17249
♂ Pipistrellus
Komatipoort

Fig.6: The record forms completed for each specimen in the field. At the top is a reproduction of the catalogue record card; in the centre the face and reverse side of the skin label; and at the bottom the skull tag, if which two were prepared, one for the skull and the other for the body.

Once/...

Once the skulls were cleaned and their numbers written on the crania and mandibles, the specimens could be identified and the identifications noted on the catalogue cards. The specimens were packed away, and species distribution maps, as well as data sheets for reproductive and external measurements and mass were updated by entering those data accrued during the trip. Subsequently the collection was entered into a numerical accession catalogue, and finally the catalogue cards were filed in a project data register arranged by species.

Data routinely recorded from fresh specimens in the field (see Fig.6), are as follows: accession number; locality, with exact modifiers; coordinates and quarter degree square (we always carried appropriate 1:250 000 topocadastral maps); sex; date of collection; collector; skinner(s); the various specimen elements taken and how they were preserved; external measurements and mass; notes on habitat, behaviour and anything else thought relevant; stomach contents; and reproductive condition. Additional notes were entered on the back of the catalogue card. More recently we have endeavoured to karyotype live-trapped specimens, particularly of the rarer species. Further details on data recording are given by Smithers (1971).

In addition to material collected in the course of this survey, further information derived from specimens curated in the following institutional collections (abbreviations in brackets), were incorporated in this report: Transvaal Museum (TM); the Smithsonian Instute's U.S. Museum of Natural History (SI); the reference collection of the National Parks Board, housed in Skukuza (NKW); Durban Museum (DM); the reference collection of the Zoology Department of the University of Pretoria (UP); Rhodesian Museums (RM). Several small private collections (Priv. coll.) have also been considered.

During final analysis, information from catalogue cards, specimens, and field diaries and available published references formed the basis of the text that follows.

Each species is dealt with individually according to the following plan: First the taxonomic status of each species is discussed in terms of currently accepted taxonomic views and how the material from the Transvaal relates to these views. This is followed by an illustrated account of distribution based on a distribution map on which each locality whence a species is recorded, is indicated. Solid symbols represent material records, while open symbols are representative of sight or literature records. The deduced range of the species is indicated on the distribution map by a shaded area. Where possible species ranges are correlated with environmental factors such as rainfall, vegetation, etc. As far as possible, the preferred habitat of each species is then discussed. This is followed by an account of known habits. Food preferences and feeding strategy are thereafter dealt with. Information on breeding seasonality of the female is given in terms of the monthly ratio of non-pregnant, pregnant and lactating animals. The mass and external measurements of males and females are tabulated. The sequence of external measurements in the text is always given in the same order, i.e. (abbreviations in brackets): Total length (Tot.); Tail length (T); Hind foot length including claw (H.ft.); Ear (Ear); Forearm (F.arm); Mass (Mass). The last section for each species is a list of records of occurrence. The number of specimens studied from each locality, as well as the present location of those specimens is first given. Secondly a list of localities is given from which sight records have been recorded, as well as reference to published distribution accounts.

ACKNOWLEDGEMENTS

This project would not have been possible were it not for the consent and cooperation of the various landowners, be they private or institutional, who allowed me to collect and observe on their properties. These owners are too numerous to mention individually by name, but their various properties are marked with an asterisk in the gazetteer. I would like to express my gratitude to them for the facilities and friendly acceptance extended to me and my associates.

A project of this magnitude and nature represents a considerable investment in both institutional capital and manpower. I am therefore grateful to my director, Dr C.K. Brain, as well as to the Board of Trustees of the Transvaal Museum, in particular the chairman, Prof. F.C. Eloff, for entrusting me with the responsibility of initiating this undertaking and to carry it through to the end. I would also like to pay tribute here to the following Transvaal Museum staff members: Mrs M.C. Erasmus and her entire administrative staff, for administering my grants and for handling the various financial aspects of this venture. The library staff deserves a special word of thanks for finding a vast amount of literature and numerous references, as well as for making endless photocopies. They deserve to be mentioned by name: Miss M. Oberholzer, former librarian; Mrs D. van Driel, present librarian; Miss R. Bester and Miss E. Grobler, librarian assistants. Typing a biological manuscript requires an interest in the subject matter, as well as special attention to detail and a primary understanding of the style of science writing. In this Mrs E. du Plooy excelled. To all my colleagues in the Transvaal Museum, a special word of thanks for their assistance, help, keen interest, and encouragement.

Thus far I have deliberately not mentioned my friends and associates in the mammal department, as they deserve a separate tribute. Nico Dippenaar, associate curator; Gerhard de Jager, technical assistant; Samual Rantlakwe and Stephens Mothlasedi, preparators; they have done more than expected in assisting me in various ways.

The South African Council for Scientific and Industrial Research partly financed this project, by allocating annual grants for the period 1973 to 1976. This was an allocation very much appreciated, especially since it allowed progress at full pace without serious financial restraints. I trust that the C.S.I.R. considers its grants to me as a worthwhile investment.

The two men to whom I most owe my professional training are Dr Henry W. Setzer, former curator of African mammals at the U.S. Museum of Natural History, Smithsonian Institution, and particularly Prof. J. Meester, Natal University, Pietermaritzburg. Prof. Meester and Dr Setzer also encouraged me throughout the duration of this project, apart from giving advice and rendering assistance in numerous ways. Dr Setzer, for instance, made available a computor generated list of the specimens from the Transvaal in the holdings of the Smithsonian Institution. Prof. Meester acted as my promotor for degree purposes, and as such has critically read this manuscript.

Dr Reay H.N. Smithers set an example and a standard by his own endeavours, on which I based my own efforts. Typical of the gentleman he is, Dr Smithers was at all times prepared to give advice, provide information or assistance, and to give encouragement and credit where appropriate.

During this project Prof. J.A.J. Nel and his B.Sc. (Hons.) classes of the years 1973 to 1976, accompanied me each February on a field trip within the Transvaal. This formed part of the training program of post-graduate students at the University of Pretoria. I appreciate the enthusiastic and willing assistance of the students through the years. Also a word of appreciation to Prof. Nel for his friendship, advice and encouragement. Prof. J. du P. Bothma, also of the Zoology Department of the University of Pretoria, also was a continued source of help and encouragement. Mr Clark Scholtz worked as a undergraduate assistant in the mammal department during university holidays. In this capacity he assisted in various ways, and eventually undertook a field trip to the southern Transvaal for the purpose of this survey. When Mr Scholtz specialized as an entomologist in his post-graduate work, he did all the analyses of carnivore stomach contents. I am indebted to him for his contributions.

Information on relevant specimens housed in the following institutions, has been incorporated in this study: The Smithsonian Institution's U.S. Museum of Natural History, Durban Museum, Rhodesian Museums, the reference collection of the National Parks Board housed at Skukuza, and the reference collection of the University of Pretoria. I greatly appreciate the opportunity to utilize these collections.

I needed various permits from several instances to conduct collecting within the Transvaal. The cooperation of the Transvaal Provincial Administration's Division of Nature Conservation in this respect, is especially appreciated. I am also grateful for permits granted by the Department of Plural Affairs to work in tribal homelands, and to the Department of Forestry for permits to work on State forestry lands. The Department of Trigonometrical Survey made specially prepared negatives, from which the distribution maps I employed, were printed.

To all my other friends, associates and colleagues whose names are not mentioned here: thank you very much for your interest, help, specimens donated, challenges, criticism and encouragement.

Last but not least, a very special word of thanks to my wife and two children for all they contributed towards the success of this study. They have tolerated my long absences from home; and when at home, my disappearances into my study every night after supper. For more than a year my family shared the hardships of field work with me, where my wife has taken some recording duties upon herself, apart from proving herself a very competent driver during night time operations. During the first half of 1977, my wife devoted every morning to assist me in collating data, and to compile the gazetteer.

ORDER INSECTIVORA

Family Macroscelididae

1. Size larger (head and body length of adults over 160 mm); hallux absent; two pairs of mammae; I^1 more than twice length of I^2; I^3 with two roots ... ... *Petrodromus*

Size smaller (head and body length under 160 mm); hallux present; three pairs of mammae; I^1 less than twice length of I^2; I^3 single rooted... ... *Elephantulus*

Elephantulus Thomas and Schwann, 1906

1. Three lower molars (eleven lower teeth). ... *brachyrhynchus*

Two lower molars (ten lower teeth)... 2

2. P^1 with lingual cusp; P^2 molariform, with two well-developed lingual cusps; I^2 bicuspid when unworn; soles of hind feet brown; overall colour yellowish-brown . ... *intufi*

P^1 lacking lingual cusp; P^2 sectorial with at most one lingual cusp; I^2 unicuspid; soles of hind feet black; overall colour greyish ... ... *myurus*

Elephantulus intufi (A. Smith, 1836) Bushveld elephant-shrew
Bosveld-klaasneus

TAXONOMIC NOTES:

The treatment here followed is that of Corbet and Hanks (1968), rather than that of Ellerman *et al.* (1953), who include also forms of *E. rupestrus* (A. Smith, 1831) in *E. intufi*.

Roberts (1951) refers Transvaal material to *E. i. intufi*. Where Smithers found Botswana material to be remarkably uniform in colour, the various series collected from the Transvaal exhibit considerable variation. The series from Mmabolela Estates

corresponds/...

corresponds best with Roberts' (1951) account of the nominate race, being dark grey, tinged with rust-brown dorsally, with the buffy patch behind the ear very pronounced. The series from Motlateng lacks the rust-brown colour of the previous series, while the series from Scrutton is dorsally much paler and is probably referable to *E. i. kalaharicus*, described by Roberts (1951). The Montrose Estates series is dorsally pale grey without the rust brown of other series, and the buffy tinge behind the ears is faded. Remarkably little variation is demonstrable within any one series.

Corbet (1974) considers subspeciation unlikely in the western part of the species range. Corbet and Hanks (1968) did not pay detailed attention to subspecies, which therefore cannot be ruled out entirely. Nevertheless, in the light of the above described variation in colouration, it is difficult to draw any conclusions on subspecific variation without studying material from elsewhere in the range, and consequently no subspecies are recognized here until an analysis of geographic variation is made.

DISTRIBUTION:

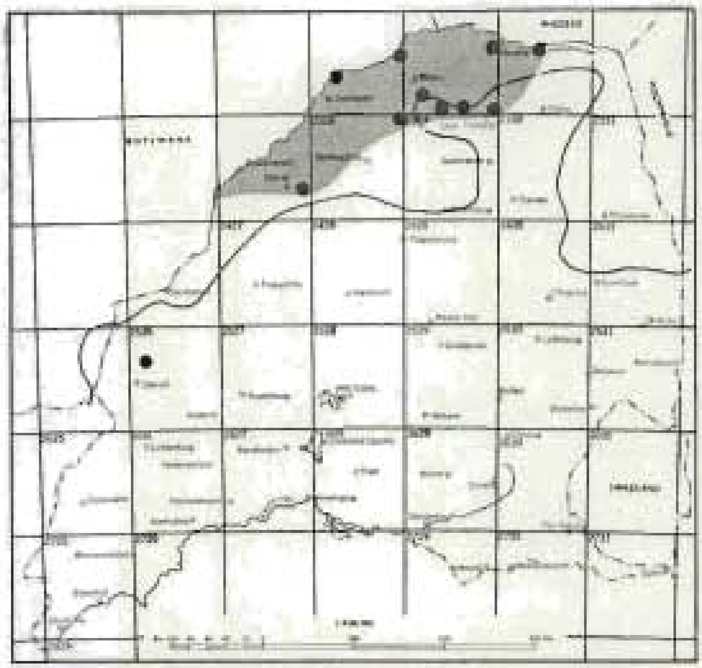

Fig. 7: The distribution of *E. intufi* in the Transvaal.

The species is restricted in the Transvaal to the more arid plains of the northwest. Of the 61 known locality records throughout the species range, no less than 58 lie within areas receiving less than 500 mm rainfall per annum. The 500 mm isohyte is indicated on the distribution map. One atypical record is from Angola (1715BA), and needs verification. The second is from south of the Sou
pansberg. The third is the type locality of the species, given as: "Flats beyond Kurrichaine, Marico district, western Transvaal". Skead (1973) pinpoints this as 25°21'S, 26°11'E (=2526AC). Seen in the light of the remarkable correlation of the

range/...

range with a region in which annual rainfall is less than 500 mm, the currently accepted geographic position of the type locality, receives more than 500 mm annual precipitation, is questioned. Further collecting is needed to ascertain whether or not topotypes substantiate Skeads (op.cit.) opinion.

Based on available evidence Transvaal material appears to be isolated from that from Botswana. The vegetation and topography of Sectors 1 and 2 in eastern Botswana (see Smithers, 1971:3-17) act as the eastern limit to the Botswana population. The combination of the Limpopo riverbed, its associated forests and the broken rocky terrain along this river appear to act as the northern limit to the distribution of the Transvaal population. The northeastern foothills of the Zoutpansberg, in combination with the Levuvhu and/or Nzhelele rivers, are believed to form its eastern boundary.

HABITAT:

This species prefers the loose sandy plains soils of arid regions. In the Transvaal it is associated predominantly with thorn shrub, at the base of which burrows are excavated. It seems to favour a very sparse grass cover, which is probably well suited to its partially saltatorial locomotion.

The seven specimens from Scrutton were, unexpectedly, all collected on a gentle rise liberally covered with rocks of fist size and bigger. The entire area is dominated by stunted mopane shrub, with a sparse sour-grass cover. The same trapline also produced a series of 13 *E. myurus* Thomas and Schwann, 1906. This particular sampling area is intermediate in character between the preferred habitats of these two sympatric species, and it is of interest that they meet in this common habitat (possibly an ecotyne?). Excavation of burrows is unlikely in this area, which supports Roberts' (1951) view that the species in Damaraland and the Namib desert has refuges under rocks or in rock crevices.

Isolated specimens have been trapped on very compacted soil at Huwi Private Nature Reserve in *Acacia* shrub.

HABITS:

E. intufi/...

E. intufi is diurnal, but appears to be more crepuscular during very warm weather. Single shallow burrows are excavated at the base of shrubs, or occasionally under fallen logs. From these burrows runways crisscross the area, normally from one shrub to the next. Along these runways the animals dart at lightning speed when disturbed. Although feeding was never observed, these runways are presumably an aid in the search for food, and may also aid in intraspecific social contact.

The speed at which this species travels is astonishing. Since they are reluctant to take standard bait, unbaited snaptraps were placed diagonally across the runways at Mmabolela Estates. Individuals were then provoked to dash for safety along their runways, but their speed was such that the traps were invariably tripped without once catching a specimen. Eventually liberal quantities of syrup were added to the standard peanut-butter and oatmeal bait. This attracted ants which were found to be effective as a bait. Other specimens were collected by shooting them with a revolver loaded with .22 dust shot.

When disturbed at a distance from its burrow, an individual will take refuge under the nearest shrub. Its cryptic colouration makes it almost impossible to detect while it remains motionless.

As far as could be established, each individual occupies its own burrow or set of burrows. At higher population densities these individual refuges are arranged in a loose community over a large area, and are interconnected by a maze of runways.

<u>FOOD</u>:

All the stomachs examined contained predominantly ants (Formicidae), while other small insects were also observed. The stomach contents were well masticated and identification of the contents was not attempted.

<u>BREEDING</u>:

Pregnant females were collected during March and August. This supports the conclusion made by Smithers (1971) that the species breeds during summer. Smithers (*op.cit.*) recorded pregnancies during February, August, October and November. The mean number of foetuses per female was 1,6 (N=6). Two is the most

common/...

common number (see also Smithers, 1971), with one implanted in each uterine horn. No triplets were recorded, although Smithers (1971) recorded isolated cases.

MEASUREMENTS AND MASS:

Males

	$\bar{x}$	N	Min.	Max.
Tot.	229,9	14	212	249
T.	115,1	14	102	128
H.Ft.	31,4	14	29	34
Ear	22,7	14	21	24
Mass	45,9	9	35	55

Females

	$\bar{x}$	N	Min.	Max.
Tot.	233,6	20	204	256
T.	117,2	20	103	129
H.Ft.	30,6	19	29	34
Ear	22,4	19	20	25
Mass	51,9	10	40	74

RECORDS OF OCCURRENCE:

Specimens examined, 43: Huwi, 1 (TM); Langjan, 3 (TM); Mmabolela Estates, 10 (TM); Mogalakwena river, 2 (TM); Montrose Estates, 9 (TM); Motlateng, 7 (TM); Njellele river, 1 (TM); Scrutton, 7 (TM); Swarthoek, 2 (TM); Zoutpan Farm 459, 1 (TM).

Elephantulus myurus (Thomas & Schwann, 1906) Naked-tailed elephant-shrew

Kaalstert-klaasneus

TAXONOMIC NOTES:

Roberts (1951) recognises three subspecies in the Transvaal, i.e. *E. m. myurus* Thomas and Schwann, 1906 from Woodbush; *E. m. jamesoni* Chubb, 1909 from Johannesburg; and *E. m. mapogonensis*

Roberts/...

Roberts, 1917 from the Njellele river. Corbet and Hanks (1968) concluded that mean upper toothrow length decreases northwards, and because of this implied size cline could find no grounds for the recognition of discrete subspecies. The latter view is accepted here pending multivariate analysis of geographic variation. geographic variation.

DISTRIBUTION:

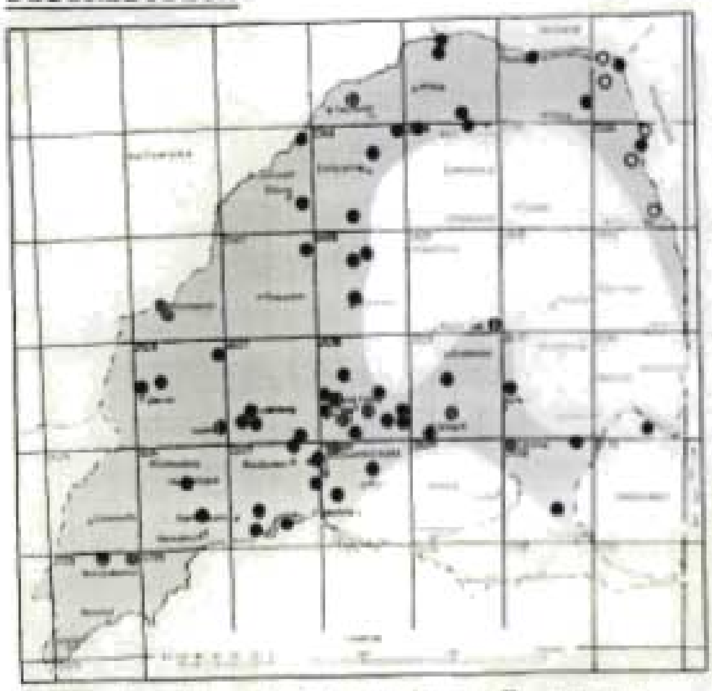

Fig. 8: The distribution of *E. myurus* in the Transvaal.

The species is evenly distributed throughout the Transvaal. In the northwestern Transvaal its range overlaps with that of *E. intufi*, but they are here ecologically separated by their respective selection of habitat. It has most probably been overlooked in the Potgietersrus, Tzaneen and Acornhoek areas.

The range of the species in southern Africa shows an entirely eastern distribution pattern (from c.24^{O}E longitude), but on present evidence it cannot be correlated with any single environmental factor. In the west this species is replaced by *E. rupestris* (A. Smith, 1831), which has similar habitat requirements.

HABITAT:

A completely rupicolous species. Optimum habitat appears to be large rock debris which offers abundant crevices and crannies for refuge. The species is also to be found, at much lower densities, on unbroken hillslopes, or even isolated rocky outcrops on valley floors or plains.

HABITS:

The naked-tailed elephant shrew is predominantly diurnal,

but/...

but appears also to be partly crepuscular or even nocturnal. Although high numbers may occur in favourable habitat, it usually goes about singly, occasionally in pairs. It uses the rock-crevices and holes in its environment as permanent refuges, but the use of nesting material has not been recorded.

While lying in wait for dassies, individuals were often observed basking in the sun. When disturbed they utter a short high-pitched shriek and dart for the nearest cover. The species is extremely agile, and effortlessly jumps one metre gaps from rock to rock at lightning speed. Perhaps because of the uneven terrain in which they live, the individuals observed appeared to be more saltatorial than the previous species.

They were observed to hunt from cover, and then retreat immediately to devour their prey. Specimens were readily procured with baited snaptraps or live-traps. They appeared to feed to some extent on peanut-butter and oatmeal bait, as specimens were often retrieved from snaptraps with their mouths full of this bait.

FOOD:

Small insects, especially ants (Formicidae).

BREEDING:

Monthly frequencies of pregnant and non-pregnant females.

	J	F	M	A	M	J	J	A	S	O	N	D
Total	7	13	5	6	5	-	11	12	2	4	-	-
Not pregnant	5	11	2	6	5	-	11	6	-	1	-	-
Pregnant	2	2	3	-	-	-	-	6	2	3	-	-

These data suggest that parturition is restricted to the warmer wetter summer months, from August to March, as suggested by Smithers (1971).

The mean number of foetuses recorded was:

$\bar{X}$ = 1,89; N = 18; Observed range 1-2.

Implantation: 1L: 1L1R: 1R

1L	1L1R	1R
1	16	1

Measurements/...

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	262,6	56	202	291
T.	137,1	55	104	153
H.Ft.	36,9	59	29	40
Ear	24,6	59	18	30
Mass	60,9	60	48	80

Females

	$\bar{X}$	N	Min.	Max.
Tot.	262,6	58	219	290
T.	135,8	59	101	156
H.Ft.	36,3	61	31	40
Ear	24,8	61	19	29
Mass	60,0	59	41	98

RECORDS OF OCCURRENCE:

Specimens examined, 248: Al-te-vêr, 17 (TM); Belfast, 3 (TM, 1; Sl, 2); Bloemendal, 2 (TM); Boschkop, 3 (TM); Bronkhorstspruit, 1 (TM); Daspoort, 1 (TM); De Hoop, 10, (TM); Dordrecht, 7 (TM): Gadzingwe, 2 (NKW); Geelhoutkloof, 1 (TM); Geelhoutkop, 1 (TM); Gladdespruit, 1 (TM); Gladstonbyridge, 4 (TM); Greefswald, 3 (TM); Hammanskraal, 8 (TM); Huwi, 3 (TM); Iscor, 1 (TM); Johannesburg, 5 (TM); Joshua Moolman, 24 (TM); Koster, 4 (TM); Kromdraai, 1 (TM); Langlaagte, 1 (TM); Levuvhu river, 4 (TM); Loskopdam, 2 (TM); Meyerspark, 1 (TM); Middelburg, 7 (TM); Mooigenoeg, 2 (TM); Mooiplaas, 1 (TM); Motlateng, 4 (TM); Nicorel, 1 (TM); Njellele river, 3 (TM); Observatory, 2 (TM); Olifantspoort, 1 (TM); Onderstepoort, 1 (TM); Onverwacht, 1 (TM); Pafuri, 2 (NKW); Palala river, 1 (TM); Papkuilfontein, 1 (TM); Platbos, 3 (TM); Ratsegaai, 5 (TM); Rayton, 1 (TM); Renosterpoort, 5 (TM); Rietspruit, 2 (TM); Rochdale, 4 (TM); Rosslyn, 1 (TM); Rustenburg, 8 (TM, 1: Sl,7); Rykvoorby, 3 (TM); Scrutton, 13 (TM); Sterkfontein, 1 (TM); Suikerboschrand, 15 (TM); Tweefontein, 3 (TM); Urk, 1 (TM); Venterskroon, 1 (TM); Warmbad, 3 (TM);

Waterkloof/...

Waterkloof, 1 (TM); Weltevreden, 1 (TM); Witbank, 10 (SI); Witpoort, 9 (TM); Witwatersrand, 4 (TM); Wolmaranstad, 10 (TM, 1; SI, 9); Wonderboom, 3 (TM); Zandspruit, 2 (TM); Zeerust, 1 (SI); Zoutpansberg, 5 (TM).

Additional records: Open circles represent localities in the Kruger National Park, listed by Pienaar (1964).

Elephantulus brachyrhynchus (A. Smith, 1836) Short-snouted elephant-shrew

Kortneus-klaasneus

TAXONOMIC NOTES:

Roberts (1951) recognises two subspecies in the Transvaal, namely *E. b. brachyrhynchus* (A. Smith, 1836), described from Rustenburg, and distributed throughout the western Transvaal bushveld; and *E. b. tzaneenensis* Roberts, 1929, then known only from the type locality, Tzaneen.

No sufficiently large series from any particular locality within the Transvaal is at present available, to allow assessment of intra-population variation. Material from various localities within the Transvaal exhibits considerable variation in pelt colouration, but no consistent pattern could be distinguished. There is nevertheless a tendency for material from lower rainfall areas to be lighter. Three specimens from Tzaneen and one from Ohrigstad are darkest, supporting Corbet's (1974) view that variation within the species is almost clinal, with montane forms tending to be darker. Following Corbet and Hanks (1968), who believe that adequate samples would render most, if not all, subspecies invalid, none are recognised here.

DISTRIBUTION:

In the Transvaal, the short-snouted elephant-shrew is confined to the Tropical Bush and Savannah veld types, as defined by Acocks (1975). Over its entire range the species is restricted to the Southern Savannah Woodland biotic zone. Towards the northwest

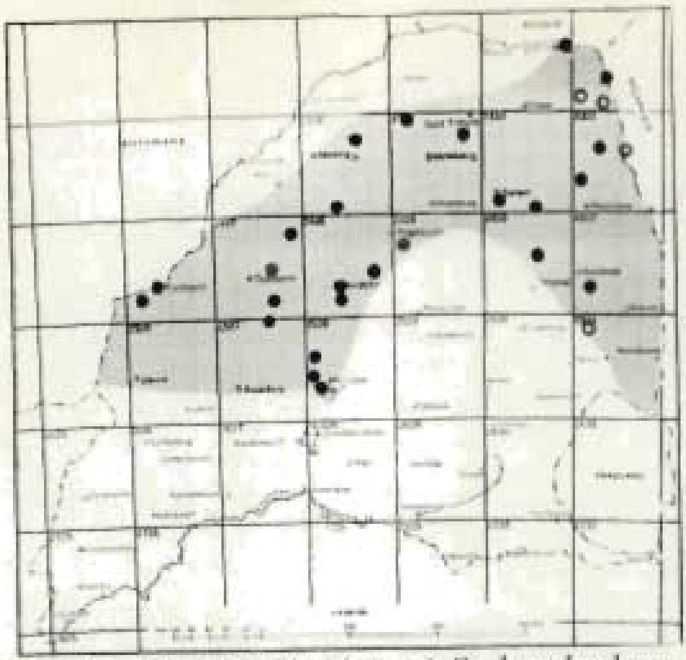

Fig. 9: The distribution of *E. brachyrhynchus* in the Transvaal.

the ranges of *E. brachyrhynchus* and *E. intufi* overlap, while this species' range overlaps completely with that of *E. myurus* in the Transvaal. These three species are however segregated by their habitat requirements.

Whereas the species has probably been overlooked in the south of the eastern Transvaal lowveld, it is doubtful whether it occurs in the Arid Sweet Bushveld along the Limpopo river in the northwestern Transvaal.

HABITAT:

While *E. intufi* prefers open habitat with thin ground cover, *E. brachyrhynchus* has a decided preference for denser cover. The majority of specimens were caught in riverine forest or associated brush, with dense grass cover. One specimen was procured at the foot of a rocky slope amongst good grass cover at Madimbo, another at Marken in a dry rocky riverbed with tall grass, reeds and trees with sandy patches. The remainder of the material was trapped in Acacia woodland savannah and mopane shrub with grass. Sandy soil does not appear to be as important to this species as to *E. intufi*.

HABITS:

Predominantly diurnal, with some crepuscular activity recorded. The species is probably solitary, and because of the nature of its preferred habitat can be expected to be less saltatorial than the previous two species. No instances of burrowing or the use of runways have been observed.

FOOD:

Small insects, particularly ants (Formicidae).

BREEDING:/...

BREEDING:

Monthly frequencies of pregnant and non-pregnant females.

	J	F	M	A	M	J	J	A	S	O	N	D
Total	1	-	2	7	-	-	4	-	1	2	1	1
Not pregnant	-	-	1	7	-	-	4	-	1	-	1	-
Pregnant	1	-	1	-	-	-	-	-	-	2	-	1

Smithers (1971) recorded a pregnant female in June.

Four of the five pregnant females carried twins, all 1L1R. The fifth had only one foetus in the left uterine horn.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	205,9	16	185	230
T.	96,3	16	85	112
H.Ft.	28,1	16	26	30
Ear	20,8	16	19	23
Mass	43,6	8	39	55

Females

	$\bar{X}$	N	Min.	Max.
Tot.	212,4	28	177	230
T.	97,6	28	85	108
H.Ft.	28,8	29	26	31
Ear	20,0	28	17	22
Mass	45,9	20	31	53

RECORDS OF OCCURRENCE:

Specimens examined, 48: Blijdschap, 3 (TM); Donkerpoort, 1 (TM); Dordrecht, 2 (TM); Droogedal, 2 (TM); Gravelotte Mines 1 (TM); Groothoek, 1 (TM); Letaba Ranch, 2 (SI); Mabohlelene, 1 (NKW); Madimbo, 1 (TM); Mahlangene, 1 (NKW); Mooigenoeg, 2 (NKW); Mooimeisiesfontein, 1 (TM); Mosdene, 1 (TM); Nicorel, 1 (TM); Nwambiya Pan, 2 (NKW); Nylstroom, 2 (TM); Perkeo, 1 (TM); Platbos, 1 (TM); Pretoria, 1 (TM); Rissik, 1 (Priv. coll.

- R. Dean/...

- R. Dean); Rooykrans, 2 (TM); Rosslyn, 1 (TM); Rustenburg, 2 (SI); Thabazimbi, 9 (SI); Tzaneen, 2 (TM); Urk, 1 (TM); Zoutpan, 3 (TM).

Additional records: Open circles represent localities in the Kruger National Park, listed by Pienaar (1964).

Petrodromus Peters, 1846

Petrodromus tetradactylus (Peters, 1846) Four-toed elephant-shrew
Bos-klaasneus

P. t. beirae Roberts, 1913

TAXONOMIC NOTES:

On available evidence, the Transvaal population is completely isolated. Owing to lack of material, neither Roberts (1951), Corbet and Neal (1965), or Corbet and Hanks (1968) assigned it to any of the subspecies recognised by them, although Corbet and Neal (*op.cit.*) considered the possibility that it may represent a new subspecies.

On comparing the five specimens available from the Transvaal with series of *P. t. warreni* Thomas, 1918 from Natal, *P. t. swynnertoni* Thomas, 1918 from Rhodesia, and *P. t. beirae* from Mocambique, they resemble the last race most closely in respect of dorsal and ventral colour, the white tufts at the base of the ears, as well as their bright buffy flanks. The Transvaal material is thus provisionally placed under *P. t. beirae*.

DISTRIBUTION:

The species is restricted to the north-eastern corner of the Transvaal. Pienaar (1964) considers it to be relatively common in the northern district of the Kruger National Park. Along the Limpopo river west of the Park it is very scarce.

HABITAT:

The specimens procured during this survey were collected outside

the/...

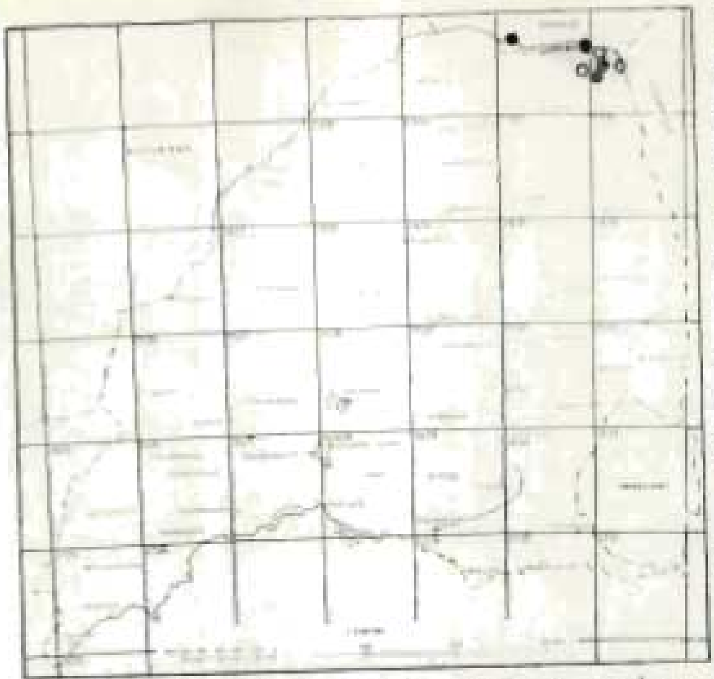

Fig.10: The distribution of *P. tetradactylus* in the Transvaal.

the Kruger National Park, in dense riverine forest, although it is a forest species and not restricted to riverine forest only. In the Park it is to be found in "... forested areas and thickets, particularly *Androstachys johnsonii* forests ..." (Pienaar, 1964).

HABITS:

Roberts (1951) and Ansell (1960) claim that the species is diurnal in habits, but observations at Madimbo during 1974 confirm Pienaar's (*op.cit.*) view that it is largely nocturnal with some daytime activity. Daylight activity recorded at Madimbo was confined to the early mornings and late afternoons.

The four-toed elephant-shrew feeds on the insect fauna occurring in and on the detritus of forest-floors. On three occasions solitary individuals were observed drumming the substrate with their hind feet. The impression was gained that this is a mechanism to disturb subsurface insects into action for easier detection, rather than being a communication medium. Only solitary animals were seen, suggesting a non-gregarious life-style.

All attempts to trap this species with a variety of baits failed, and specimens were therefore collected with a small-bore shotgun.

Roberts (1951) claims that *P. tetradactylus* utilizes disused termite mounds as refuges, but no termitaria were found in the Madimbo study area, and no information could be obtained to the nature of the refuges utilized in this area.

FOOD:

Small/...

Small insects including ants.

BREEDING:

No pregnant females were collected. Ansell (1960) recorded foetuses during January and July. Pienaar (1964) found a single suckling young during January.

MEASUREMENTS AND MASS:

Data available from one specimen only.

Male
TM 24620: 312-123-60-38 (Sequence of data presentation: Tot., T., H.ft., E.).

RECORDS OF OCCURRENCE:

Specimens examined, 5: Punda Milia, 2 (NKW); Madimbo, 2 (TM); Mahlangene, 1 (NKW).

Additional records: East of Beit Bridge on Limpopo river in Rhodesia (Smithers, *in litt.*).

Family Erinaceidae

Erinaceus Linnaeus, 1758
Erinaceus frontalis Smith, 1831 South African hedgehog
Suid-Afrikaanse krimpvarkie
E. f. frontalis Smith, 1831

TAXONOMIC NOTES:

Two subspecies are recognised by Corbet (1974), i.e. *E. f. frontalis* in the southern and eastern parts of southern Africa, and *E. f. angolae* (Thomas, 1918) from Angola and S.W.A., the latter race being the smaller. Corbet (*op.cit.*) states that they are dubiously distinguishable, while Smithers (1971), quoting Hill and Carter (1941), is of the opinion that neither size nor colouration differs sufficiently to justify the recognition of subspecies.

The/...

The S.W.A. and Angola population appears to be geographically isolated from the south-eastern population. No records exist between 21^{O} and 24^{O}E longitude. On this basis subspecies separation appears justifiable. *E. f. frontalis* ranges from the southern tip of Zambia (Ansell, 1960), through western Botswana, eastern Rhodesia, western Transvaal, the O.F.S., western Natal and the northeastern Cape Province.

DISTRIBUTION:

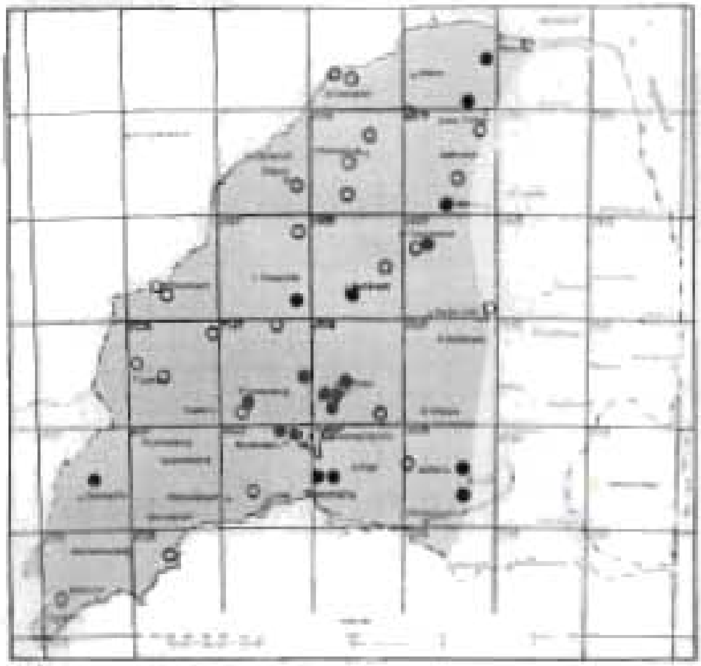

Fig.11: The distribution of *E. frontalis* in the Transvaal.

In the Transvaal the species is limited to the area west of 30^{O}E longitude, with the exception of the record from Mr C. Nel (*pers. comm.*) from the farm Scrutton on the Limpopo river. Two unconfirmed records exist from the eastern Transvaal lowveld, namely from the Phalaborwa district and the Malelane district. Pending confirmation in the form of specimen records, these claims are provisionally rejected, and the species consequently is considered to be absent from the eastern Transvaal lowveld, including the Groblersdal district.

West of 30^{O}E longitude the species occurs from the Limpopo to the Vaal river.

HABITAT:

Hedgehogs were collected in a diversity of habitats, demonstrating a wide habitat tolerance from open grasslands to Acacia shrub and even scrub-covered rocky kopjes. However, pinpointing habitat preferences is difficult, as distribution could not consistently be correlated with any single environmental factor. Adequate cover in the form of dense grass or shrub appears to be

essential/...

essential. The range furthermore overlaps only areas with a very good drainage system.

HABITS:

Terrestrial and nocturnal, although some daylight activity is recorded, especially after rains. Hedgehogs are sensitive to extreme temperatures, this perhaps being responsible more than anything else for their nocturnal habits. During the winter animals become torpid in the safety of their refuges, but on mild evenings, Smithers (1971) recorded low levels of activity.

Solitary hedgehogs are most often encountered, and occasionally adult pairs or females with young. Animals spend the day in the shelter of organic debris, holes, or under grass tufts and even dense low shrub. These refuges are of temporary nature, except when a female is raising a litter, when a crude nest is constructed to harbour the young during their dependent period.

Occasionally specimens are found in snaptraps baited with fresh meat, or when the regular bait attracts large numbers of ants. The majority of specimens are, however, caught by hand during night hunting operations. Individuals are frequently found in gardens, in Pretoria notably in the suburbs north of the Magaliesberg. As they are slow and relatively easy to catch with dogs, hedgehogs are heavily preyed upon by the Bantu who regard them as a delicacy.

FOOD:

Insectivorous; beetles and ants are most frequently recorded. Smithers (1971) recorded a centipede and a frog as food items. Food is very thoroughly masticated, making identification difficult.

BREEDING:

Young are born during the summer season (Smithers, 1971). A lactating female was collected in February. In addition, two litters were reported during December and one during January. Litter size ranged from three to six.

MEASUREMENTS/...

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	208,4	10	190	246
T.	20,5	10	18	26
H.Ft.	31,4	10	30	39
Ear	24,6	10	19	30
*Mass	106,0	2	74	138

Females

	$\bar{X}$	N	Min.	Max.
Tot.	215,7	4	223	260
T.	21,7	4	25	25
H.Ft.	34,0	4	31	42
Ear	24,5	4	23	34
Mass	267,0	2	200	334

* Both males weighed were immature.

RECORDS OF OCCURRENCE:

Specimens examined, 34: Barberspan, 1 (TM); Derdepoort, 1 (TM); de Wildt, 2 (TM); Ermelo, 19 km NW, 1 (SI); Hatfield, 1 (TM); Irene, 1 (TM); Jakkalspruit, 1 (TM); Krugersdorp, 1 (TM); Mopani, 1 (DM); Olifantspoort, 1 (Priv. coll.); Pietersburg, 1 (TM); Pretoria, 7 (TM, 6; SI, 1); Pretoria North, 2 (U.P.); Rissik, 2 (Priv. coll.); Rochdale, 1 (TM); Rooiberg, 2 (TM); Silverton, 1 (TM); Silverton Park, 1 (TM); Skinner's Court, 1 (TM); Suikerboschrand, 1 (TM); Tarlton, 1 (TM); Vereeniging, 1 (TM); Waterkloof, 1 (TM); Zebediela, 1 (TM).

Additional records: Sight records from Al-te-vêr, Blijdschap, Brandhoek, Buffelspoort, De Hoop, Dordrecht, Ferndale, Fort Klipdam, Groothoek, Huwi, Lynnwood Glen, Mmabolela Estates, Modderfontein, Mooigenoeg, Mooiplaas, Mosdene, Nicorel, Olifantspoort, Platbos, Renosterpoort, Rolspruit, Rykvoorby, Scrutton, Urk, Welgedaan, Welgevonden, Witpoort, Zandspruit.

Family/...

Family Soricidae

1. Tail without long bristles; small paired foramina on frontals; vestigal PM^3 and PM_3 present (nine teeth in upper tooth row, 7 teeth in lower tooth row); PM_3 sometimes detected only from alveolus, the tooth itself being lost ... ... *Myosorex*
Tail with bristle hairs; paired foramina on frontalis absent 2

2. PM^3 present; PM_3 absent (9 teeth in upper tooth row; 6 teeth in lower tooth row).. ... *Suncus*
PM^3 and PM_3 both absent (8 teeth in upper tooth row; 6 teeth in lower tooth row) ... ... *Crocidura*

Myosorex Gray, 1838

1. Ventral colour pale grey, tail bicoloured with a sharp line of distinction between the light brown to dark brown dorsal and the fawn to off-white ventral colour; feet pale; three fissures in anterior region of palate more or less in line ... ... *varius*
Ventral colour buffy brown, tail more evenly coloured, dark brown to black dorsally, becoming gradually paler below; feet dark; no overlap between posterior edges of paired anterior palatal fissures and anterior edge of a central fissure ... ... *cafer*

Myosorex varius Smuts, 1832 Forest shrew
Bos-skeerbek

TAXONOMIC/...

TAXONOMIC NOTES:

Following Meester (1958), Meester *et.al.* (1964), and Heim de Balsac and Meester (1977), the species is here regarded as monotypic, with *M. transvaalensis* Roberts, 1924, as well as *M. v. pondoensis* Roberts, 1946, *Sorex capensis* Smuts, 1832, and *Sorex herpestes* Duvernoy, 1838 as synonyms.

DISTRIBUTION:

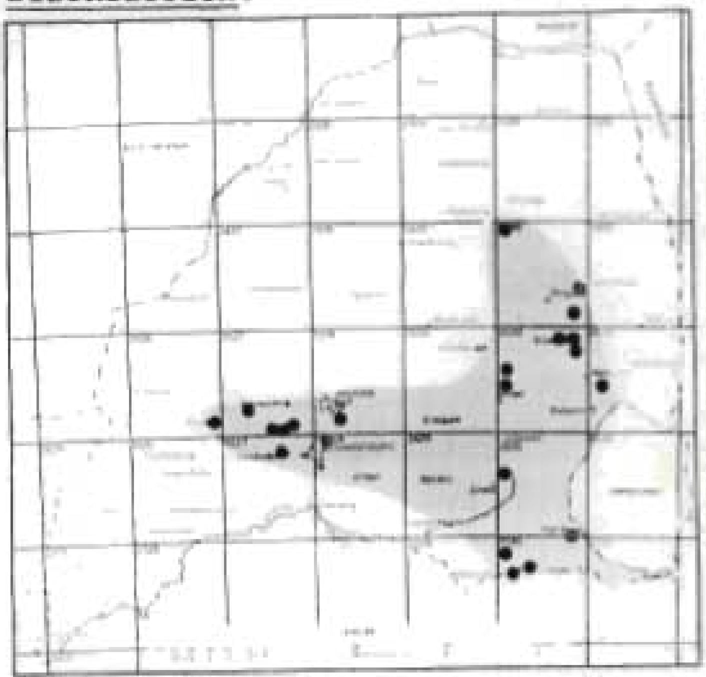

Fig.12: The distribution of *M. varius* in the Transvaal.

In the Transvaal *M. varius* characteristically occurs at altitudes higher than 1 300 metres, although in the Cape Province it is to be found at sea level along the east and west coasts. In the Transvaal *M. varius* occurs from the Wolkberg southwards along the escarpment to Natal, and from the escarpment it radiates westwards along the Bankenveld False Grassveld (Acocks, 1975) to Pretoria, Johannesburg, Rustenburg and Koster. The series from the Wolkberg represents a new range extension, forming the most northern limit of the known distribution of this species.

The populations from the Pretoria and Rustenburg areas appear to be geographically isolated from those found along the escarpment, although the species may have been overlooked in the 160 km zone separating these two areas.

HABITAT:

In the Transvaal this species prefers moist conditions with dense grass cover. It is particularly abundant in the Northeastern Sourveld (Acocks, 1975) of the escarpment slopes; furthermore a long series has been collected by R.M. Davis on the van Riebeeck Nature Reserve, near Pretoria, in densely vegetated marshy areas. This dependence on a moist, very humid microhabitat renders the species extremely vulnerable to cold veld fires.

M. varius and *M. cafer* overlap in range, but do not appear to have exactly similar habitat requirements. At Wolkberg, the only locality where both species were found together, seven *M. varius* specimens out of a series of eight were taken in montane forest, as opposed to 25 *M. cafer* specimens in a series of 26, which were collected in montane grassland. According to Meester (*in litt.*) *M. varius* is elsewhere far more widely distributed in both grassland and forest, while *M. cafer* has a more restricted distribution and is more or less confined to forest.

On the escarpment slopes *M. varius* is not necessarily restricted to stream banks, whereas on the Transvaal highveld it is apparently dependent on permanent surface water close by as well as on the associated vegetation. Mist over the escarpment can presumably satisfy the moisture requirements of the species in the absence of rain.

HABITS:

The species is active for shorter periods both day and night, although trapping success indicates a peak of activity at night. It is often trapped in runways together with *Otomys* spp., *Praomys natalensis* and *Rhabdomys pumilio*. This shrew species, however, is unlikely to construct its own runways, as, in the absence of the rodents mentioned above, it is found in areas without obvious runways. It is readily trapped in snap- or live traps, and is attracted by regular bait.

FOOD:

Insects and other small invertebrates.

BREEDING:

Monthly frequencies of non-pregnant, pregnant and lactating females recorded.

Total/...

	J	F	M	A	M	J	J	A	S	O	N	D
Total	2	4	1	9	8	-	-	8	2	1	-	-
Non-pregnant	1	0	0	5	8	-	-	8	0	0	-	-
Lactating	0	3	0	4	0	-	-	0	1	1	-	-
Pregnant	1	1	1	0	0	-	-	0	1	0	-	-

The available data suggest parturition during the summer months September to March.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	119,3	97	100	137
T.	37,9	97	29	45
H.Ft.	14,4	96	10	17
Ear	9,1	97	5	12
Mass	11,4	82	8	18,4

Females

	$\bar{X}$	N	Min.	Max.
Tot.	119,8	100	103	135
T.	39,3	100	32	45
H.Ft.	14,4	100	12	16
Ear	8,7	96	5	11
Mass	11,4	85	7	19

RECORDS OF OCCURRENCE:

Specimens examined, 260: Belfast, 4 (SI); Blyde Forest Reserve, 18 (TM); Carolina, 7 (SI); Ceylon, 1 (TM); Danielsrust, 1 (TM); Droogheuwel, 2 (TM); Ermelo, 1 (TM); Grootsuikerboschkop and Elandslaagte, 21 (TM); Kastrol Nek, 4 (TM); Koster, 4 (TM); Langfontein, 1 (TM); Mariepskop, 11 (TM); New Agatha Forest Reserve, 8 (TM); Piet Retief, 5 (TM); Rietvlei Dam, 156 (TM); Rietfontein, 2 (TM); Rustenburg, 2 (TM); Sabie, 1 (TM); Spitzkop, 3 (TM); Uitkomst, 4 (TM); Uitkyk and Paranie, 3 (TM); Wakkerstroom 1 (TM).

Myosorex/...

Myosorex cafer (Sundevall, 1846) Dark-footed forest shrew
Donkerpoot bos-skeerbek

M. c. cafer (Sundevall, 1846)

TAXONOMIC NOTES:

Heim de Balsac and Meester (1977) recognise two subspecies, with the Transvaal population belonging to the nominate race. *M. c. cafer* includes *M. tenuis* Thomas and Schwann, 1905 and *M. swinnyi* Chubb, 1909, as synonyms.

DISTRIBUTION:

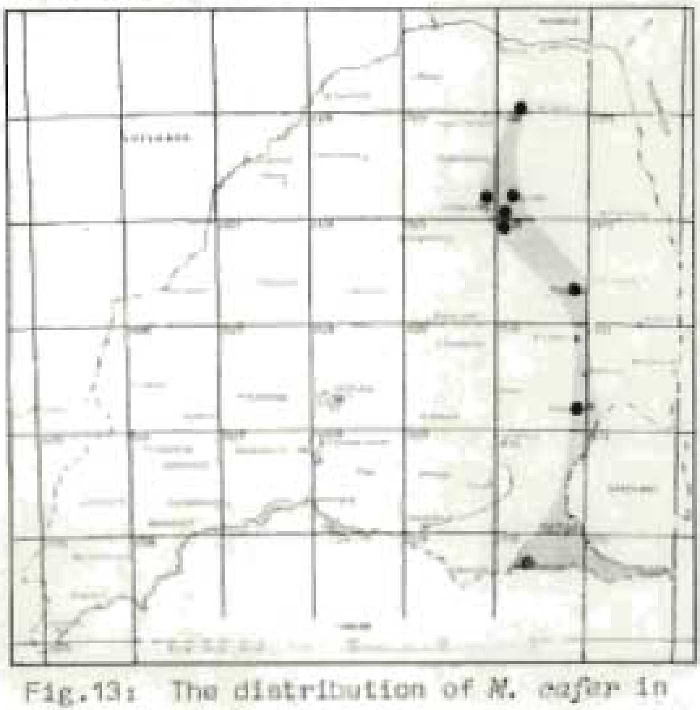

Fig.13: The distribution of *M. cafer* in the Transvaal.

In the Transvaal the habitat requirements of this species restrict it to the eastern escarpment and the southern slopes of the Zoutpansberg with its higher precipitation through rain and mist. In Natal and the northeastern Cape the species is restricted to the coastal belt.

The record from Kastrol Nek is suspect at present, and should be confirmed by a longer series from that area. The small available series corresponds to the description of *M. varius*, with the exception of TM 4319, which in most characters corresponds to *M. cafer*.

HABITAT:

Like the previous species, it is very dependent on a moist, humid microhabitat under dense vegetation. As pointed out previously, *M. cafer* atypically exhibits a preference for montane grassland at Wolkberg, with only one specimen collected in a wooded ravine next to a mountain stream. However, according to

Meester/...

Meester (*in litt.*) it is in most places more forest-restricted than *varius*.

HABITS:

As far as could be established, similar to *M. varius*.

FOOD:

Insects and other small invertebrates.

BREEDING:

One lactating female collected during March.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	119,2	27	113	140
T.	40,3	27	36	51
H.ft.	14,6	27	13	20
Ear	8,9	27	7	11
Mass	11,5	19	9	17

Females

	$\bar{X}$	N	Min.	Max.
Tot.	126,1	13	112	141
T.	42,9	13	39	51
H.ft.	14,6	13	13	16
Ear	10,0	13	9	11
Mass	13,1	7	10	17

RECORDS OF OCCURRENCE:

Specimens examined, 48: Acre, 1 (TM); Barberton, 1 (SI); Entabeni, 1 (TM); Haenertsburg, 3 (TM); Kastrol Nek, 1 (TM); Mariepskop, 9 (TM); New Agatha Forest Reserve, 25 (TM); Snelsburg, 1 (TM); Tzaneen Estates, 1 (TM); Woodbush, 5 (TM).

Suncus/...

Suncus Ehrenberg, 1832

1. Size larger, condylo-incisive length of skull 19,2-20,7 mm; upper toothrow 7,4-8,7; condylo-incisive length of mandible 11,0-12,6 mm; colour greyish above, paler grey below, dorsal and ventral colour intergrading gradually ... ... *lixus*
Size smaller, condylo-incisive length of skull 17,0 mm and less; upper toothrow 7,1 mm and less; upper toothrow 7,1 mm and less; condylo-incisive length of mandible 10,4 mm and less 2

2. Size larger, condylo-incisive length of skull 15,1-17,0 mm; upper toothrow 6,0-7,1 mm; condylo-incisive length of mandible 8,7-10,4 mm; colour greyish to chestnut above, silvery fawn below with a sharp line of demarcation ... ... *varilla*
Size smaller, condylo-incisive length of skull 13,9-15,2 mm; upper toothrow 5,3-6,3; condylo-incisive length of mandible 8,1-9,2 mm; colour greyish brown above, greyish below, dorsal and ventral colour intergrading gradually ... ... *infinitesimus*

Suncus varilla Thomas, 1895 Dwarf shrew
Dwerg-skeerbek

S. v. orangiae (Roberts, 1924)

TAXONOMIC NOTES:

The subspecies is recognised by Meester and Lambrechts (1971), and includes *S. orangiae natalensis* Roberts, 1949, as a synonym.

DISTRIBUTION:

Restricted to the southwestern and central Transvaal.

HABITAT:

Very/...

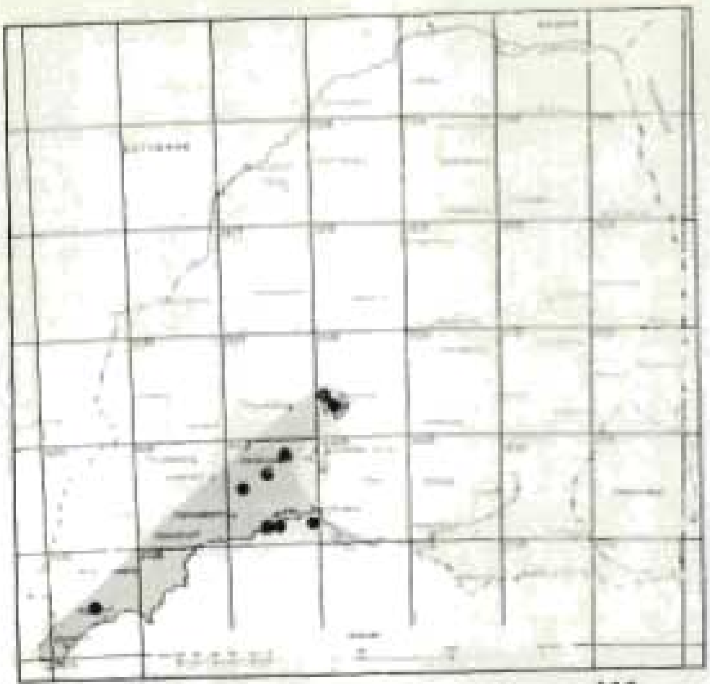

Fig.14: The distribution of *S. varilla* in the Transvaal.

Very little is known about this species. In the Transvaal the dwarf shrew is restricted to Pure and False Grassveld elements (Acocks, 1975), as well as the flood-plain grasslands of the Nyls river east of Nylstroom. Elsewhere *S. varilla* is associated with Karroid and False Karroid, and possibly Cape Macchia veld types. It would thus appear to be an inhabitant of essentially non-wooded areas.

Roberts (1951) points out that all three species of *Suncus* use termitaria as refuges, although they are also to be found in other situations. It is suggested that *S. varilla* survives under arid conditions by utilizing termite mounds , which maintain a constant temperature and high relative humidity, micro-habitat requirements believed to be essential also for this species. In addition an abundant food source is available to the shrew without once having to leave its termitarium. When the macrohabitat is favourable after rains, the animals can leave the termite mounds to forage, mate, find nesting materials or new refuges.

HABITS:

Very little information available. It would however appear to be primarily solitary in nature, as evidenced from specimens taken in termitaria. Like other members of the Soricidae it appears to be both diurnal and nocturnal, with trapping yielding specimens throughout the day and night.

BREEDING:

A/...

A pregnant female with three foetuses was collected during September.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	89,8	6	84	93
T.	30,8	6	27	33
H.ft.	9,3	6	8,5	10
Ear	7,5	6	6	9
Mass	-	-	-	-

Females

	$\bar{X}$	N	Min.	Max.
Tot.	88,7	6	86	91
T.	32,8	6	30	36
H.Ft.	9,2	6	9	10
Ear	6,8	6	5	8
Mass	-	-	-	-

RECORDS OF OCCURRENCE:

Specimens examined, 15: Bloemhof, 1 (TM); Boschbank, 1 (TM). Cyferfontein, 2 (TM); Droogheuwel, 1 (TM); Frederikstad, 1 (TM); Hartebeesfontein, 1 (TM); Parys, 2 (TM); Pretoria, 1 (TM); Rosslyn, 4 (TM); Wonderfontein, 1 (TM).

Suncus lixus Thomas, 1898 — Greater dwarf shrew
Groter dwerg-skeerbek

S. l. gratulus Thomas and Schwann, 1907

DISTRIBUTION:

The eastern Transvaal lowveld, and bushveld areas north and northwest of Pretoria. Not recorded from the more arid bushveld of the northwestern and northern Transvaal along the Limpopo river valley. Apart from the two extreme north-eastern records in the Kruger National Park, all other records fall within the 500 mm

isohyte/...

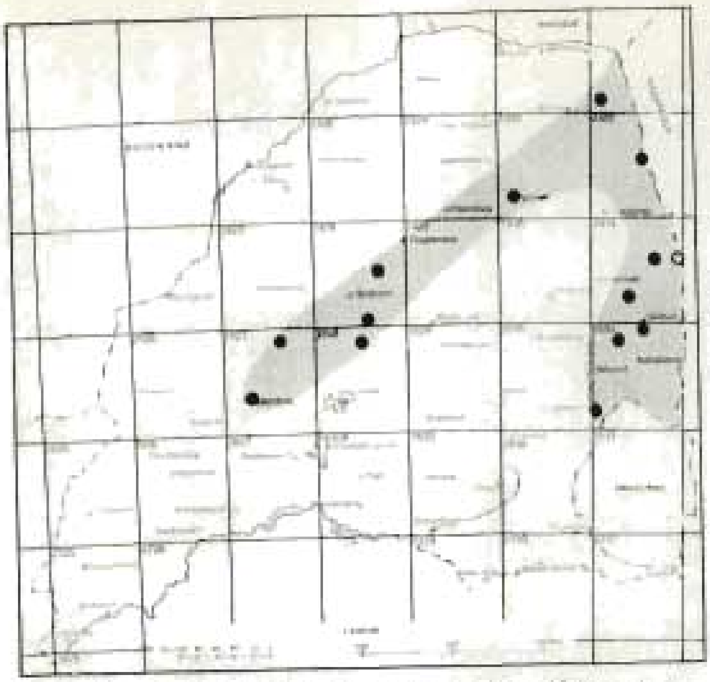

Fig.15: The distribution of *S. lixus* in the Transvaal.

isohyte. Furthermore, all records throughout the species range fall consistently within woodland savannah, and it would appear that this species replaces the previous one (which is restricted to non-wooded areas) in bushveld regions.

HABITAT:

Reported by Roberts (1951) to occur in termite mounds as well as in other situations. Not recorded from termitaria during this survey, but a specimen was procured on the banks of the Pienaars river near Assen. The riverine forest here forms a two meter high continuous canopy, with sparse herbaceous plants on the black turf soil. At the time (early winter) the soil was very damp, thus meeting the moisture requirements of this species.

HABITS:

Apparently similar to *S. varilla*. See also Ansell (1960).

BREEDING:

The female mentioned above was not pregnant when collected during May. Ansell (1960) recorded a female carrying three foetuses during January.

MEASUREMENTS AND MASS:

Males

	Tot.	T.	H.ft.	E.		Mass
TM 3489:	107	42	12,5	10	=	- g.
TM 19074:	121	47	12	9	=	g.

TM 12779/...

Females

	Tot.	T.	H.ft.	E.	Mass
TM 12779:	87,5	36	10,5	6 =	g.
TM 20021:	115	41	11	10 =	4 g.

RECORDS OF OCCURRENCE:

Specimens examined, 13: Barberton, 1 (TM); Buffelspoort, 1 (TM); Malahla-Pang, 1 (TM); Naboomspruit, 1 (TM); Newington, 11 km N, 1 (TM); Nwanetzi, 1 (TM); Pretoriuskop, 1 (TM); Rust de Winter, 1 (TM); Rustenburg, 1 (TM); Settlers, 1 (TM); Shilowa, 1 (TM); Skukuza, 1 (TM); Zomerkomst Forest Reserve, 1 (TM).

Additional records: Open circle after Meester and Lambrechts (1971).

Suncus infinitesimus (Heller, 1912) Smallest dwarf shrew
Kleinste dwergskeerbek

S. i. chriseos (Kershaw, 1921)

DISTRIBUTION:

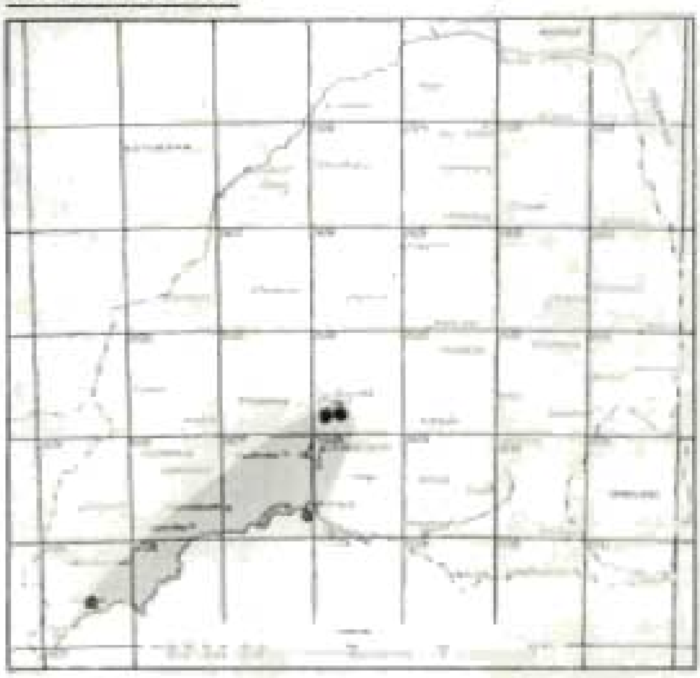

Fig.16: The distribution of *S. infinitesimus* in the Transvaal.

Southern and southwestern Transvaal, as well as Natal and the coastal regions of the eastern Cape Province (Meester and Lambrechts, 1971). Also the southeastern tip of the Orange Free State (Lynch, 1975). A very scarce species which undoubtedly has been overlooked in many areas.

HABITAT:

Most distribution records are from owl pellet remains. Three live specimens were

procured/...

procured during this survey, all in termite mounds.

HABITS:

One of the three animals captured alive in a termite mound, an adult male, was found with two others in a grass nest within the mound. Unfortunately the other two escaped.

In captivity, this species is mostly solitary by nature. It is terrestrial, and active for short periods both by day and by night.

FOOD:

Insectivorous. In captivity it thrives on minced meat or Pronutro. Drinks water regularly.

BREEDING:

No pregnancies recorded.

MEASUREMENTS AND MASS:

	Tot.	T.	H.ft.	E.		Mass
Males						
TM 3493:	73	26	7,7	6	=	- g.
TM 3659:	86	24	10	8	=	- g.
TM 19680:	85	30	9	7	=	- g.
TM 25594:	71	25	7	8	=	2,0 g.
Females						
TM 3660:	80	23	9	7	=	- g.
TM 19681:	71	25	8	7	=	- g.

RECORDS OF OCCURRENCE:

Specimens examined, 10: Erfenis, 2 (TM); Menlo Park, 1 (TM); Rietvlei Dam, 1 (TM); Sesmylspruit, 1 (TM); S.A. Lombard Nature Reserve, 1 (TM); Waterkloof, 2 (TM); Van Riebeeck Nature Reserve, 2 (TM).

Crocidura Wagler, 1832

(After Dippenaar, *in litt.*)

1. Blackish brown above, dark brown below; fovea usually present on talonid of M_3 ... ... *mariquensis*
Paler; greyish brown to pale fawn.. 2

2. Small, condylo-incisive length of skull 15,4-18,4 mm; greyish brown to greyish fawn dorsally, ventrally grey to silver grey 3
Larger, condylo-incisive length of skull 19,0-30,6 mm 4

3. Very small, condylo-incisive length of skull 15,4-17,8 mm; dorsally grey brown to greyish fawn, ventrally silvery grey, tail usually bicoloured; entoconid on M_3 usually lacking.. *bicolor*
Larger, condylo-incisive length of skull 17,6-18,6; grey brown above, grey below; interorbital region very broad, M_3 with hypoconid conical and entoconid well developed ... ... *maquassiensis*

4. Relatively small, condylo-incisive length of skull 19,0-22,5 mm; dorsally buffy brown or grey brown, ventrally grey or drab grey ... 5
Larger, condylo-incisive length of skull 21,6-30,6 mm 6

5. Buffy-brown dorsally, silvery-grey ventrally, no entoconid on lingual surface of M_2 ... ... *cyanea*
Buffy-brown to dark brown dorsally, grey ventrally, entoconid on lingual surface of M_3... ... ... *silacea*

6. Occurring on Eastern Escarpment and further east only; large, condylo-incisive length of skull 25,0-28,8 mm .. .. *flavescens*
Throughout Transvaal; condylo-incisive length of skull 21,6-24,1 mm in zone of overlap with *C. flavescens* in eastern Transvaal.. ... ... *hirta*

Crocidura flavescens (I. Geoffroy, 1827) Red musk shrew
Rooi-skeerbek

TAXONOMIC NOTES:

Heim de Balsac and Barloy (1966) regard the widespread pan-African *C. occidentalis*, including *C. o. suleika* of the eastern escarpment of Rhodesia, as only subspecifically different from southern African *C. flavescens*. Meester (1963), and more recently Dippenaar (*pers. comm.*), are of the opinion that the Rhodesian and southern African populations differ sufficiently to warrant species separation. According to this view *C. flavescens* is a monotypic species which is geographically isolated from *C. occidentalis*, and differs from it in being richer in colour, with a paler, silvery grey belly. Currently Meester (*pers. comm.*) is of the opinion that *occidentalis* and *flavescens* constitute a superspecies, but until evidence for this view can be produced, Heim de Balsac and Meester (1977) is followed.

DISTRIBUTION:

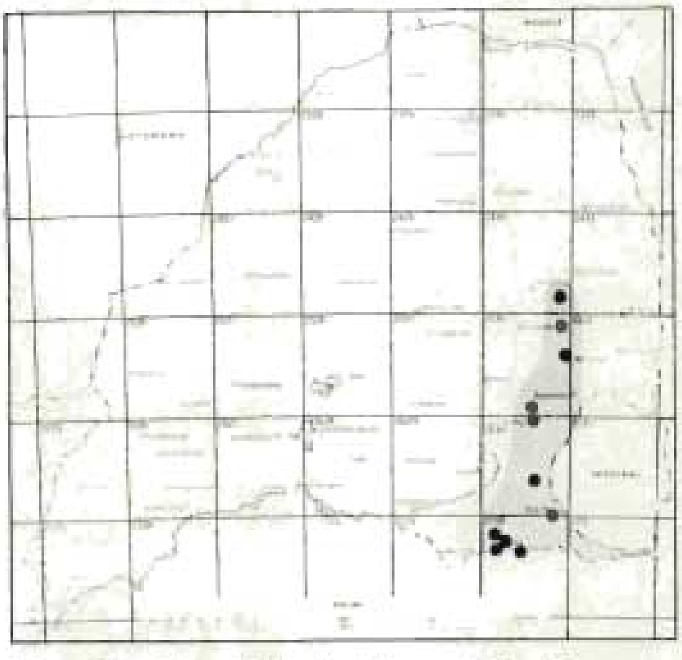

Fig.17: The distribution of *C. flavescens* in the Transvaal.

Meester (1963) suggests that the break in the escarpment formed by the Olifants river acts as a northern barrier to the range of this species, and this belief is substantiated by the results of this survey. In the Transvaal *C. flavescens* occurs only on the southern parts of the eastern escarpment, and from here southwards along the eastern part of the country to the coastal areas of the Eastern Province and south-western Cape Province. As pointed out by Meester (1963), this species is restricted to areas with mean annual precipitation of 500 mm and more (750 mm in the Transvaal), although other as yet undefined factors also restrict its range. One specimen referable to this species (SI 342502) was collected in Little Namaqualand, where its moisture requirements are probably met by regular mist.

HABITAT:

C. flavescens ranges through several vegetation types, i.e. Cape macchia, temperate and subtropical grassland, coastal forest-savanna mosaic, evergreen forest and sometimes relatively dry woodland and savanna (Meester, 1963). Dense vegetation is however a prerequisite which, in combination with high rainfall, provides a suitable microhabitat. In the Transvaal the species is found mostly in montane grasslands with their rocky environment and dense grass cover. Also found in wooded ravines in association with decayed vegetable matter, or under the roots of shrubs and trees. It has further been recorded from houses, stone walls, gardens, dense undergrowth in the bush, vleis and the banks of streams, or open coastal grasslands (see Meester, 1963).

HABITS:

Terrestrial, and to some extent rupiculous. It is active both by day and by night, although activity appears to reach a peak at night. In captivity, it constructs loose, open grass nests, but also burrows under rocks (Meester, *op.cit.*). Appears to be solitary, except when mating or when a female is raising a litter.

BREEDING:

No pregnant or lactating females were recorded.

FOOD:

Invertebrates. In captivity minced meat, liver, rodent carcasses, mealworms or Pronutro.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	161,4	12	130	177
T.	55,7	12	45	65
H.Ft.	16,4	12	12	18
Ear	11,2	11	9	12
Mass	26,7	7	20	39

Females

	$\bar{X}$	N	Min.	Max.
Tot.	162,7	9	150	170
T.	55,4	9	52	59
H.ft.	16,6	9	14	17
Ear	11,1	9	10	13
Mass	22,2	5	18	25

RECORDS OF OCCURRENCE:

Specimens examined, 30: Al-te-vêr, 3 (TM); Blyde Forest Reserve, 2 (TM); Carolina 3 (TM, 1; SI, 2); Gladdespruit, 1 (TM); Goedgevonde, 3 (SI); Graskop, 1 (Priv. coll.); Joshua Moolman, 2 (TM); Kastrol Nek, 3 (TM); Langfontein, 3 (TM); Nelspruit, 1 (TM); Piet Retief, 2 (TM); Spitzkop, 3 (TM); Wakkerstroom, 2 (TM); Witbank, 1 (SI).

Crocidura cyanea (Duvernoy, 1838) Reddish-grey musk shrew
Rooigrys-skeerbek

C. c. infumata (Wagner, 1841)

TAXONOMIC NOTES:

Meester (1963) recognizes two subspecies of *C. cyanea*, i.e. *C. c. cyanea* (Duvernoy, 1838) from the west, with mean rainfall below 500 mm p.a., and *C. c. infumata* from the higher-rainfall areas of the east.

Distinction between *C. c. infumata*, *C. h. hirta* Peters, 1852 and *C. silacea* Thomas, 1895 can be difficult where their ranges overlap in the eastern parts of southern Africa, especially in the Transvaal. However, morphological characteristics are more distinctive elsewhere in the subcontinent, and this led Meester (1963) to recognize all three forms.

DISTRIBUTION:

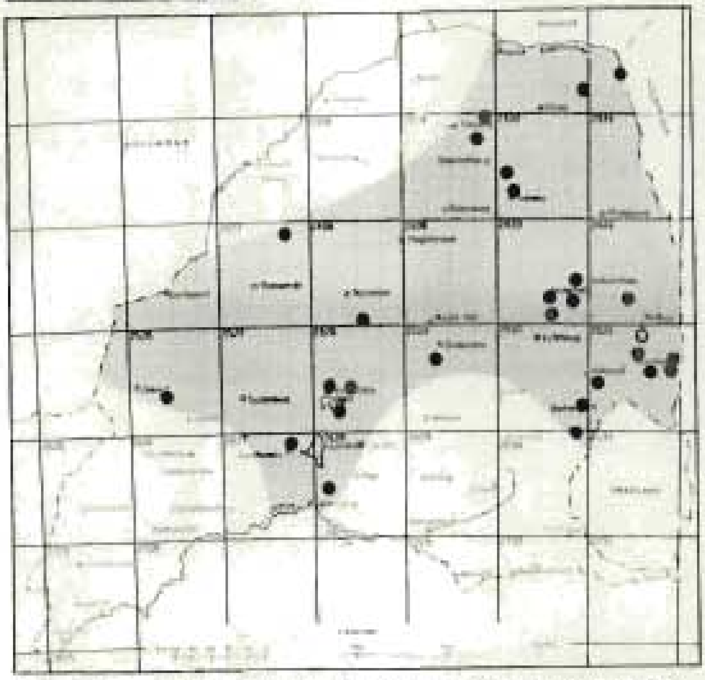

Fig.18: The distribution of *C. cyanea* in the Transvaal.

Whereas Meester (1963) defined the distribution as eastern and northern Transvaal and westwards to Pretoria, new records acquired from Groot Marico and Vaalwater suggest that the species is distributed throughout the province, with the possible exception of the Limpopo river valley.

No clear relationship is apparent between the range of this species and known topographic or physiographic features (Meester, 1963). In the Transvaal the species is more common in wooded areas, although it is also found on the highveld grassland (Vereeniging and Carolina). The range is confined to Moreau's (1952) Southern Savanna, corresponding roughly to the above 500 mm mean annual rainfall zone.

HABITAT:

C. cyanea exhibits a relatively wide habitat tolerance, with good cover a common denominator. In the Transvaal specimens have been taken especially from dense grass and/or scrub, particularly on streambanks. It has also been collected from marshy areas along riverbeds, or in reedbeds, and has further been recorded from amongst rocky hillsides with either dense or sparse grass cover, even amongst huge boulders. Also recorded from montane forests and hedges around farmlands.

HABITS:

Very little information is available. Predominantly nocturnal, as specimens were trapped mainly at night. Some diurnal activity was nevertheless also recorded.

FOOD:

Insectivorous.

BREEDING:

Lactating females were collected during April and October, while a pregnant female was collected during December with two foetuses in the left uterus. Smithers (1971) recorded a pregnancy during March.

MEASUREMENT AND MASS:

Males

	$\bar{x}$	N	Min.	Max.
Tot.	132,1	25	110	159
T.	52,1	24	42	60
H.Ft.	13,1	24	11	16
Ear	8,8	25	6	10
Mass	8,8	19	5	11

Females

	$\bar{x}$	N	Min.	Max.
Tot.	125,9	20	105	143
T.	48,5	20	40	55
H.Ft.	12,2	20	9	15
Ear	8,2	19	5	10
Mass	9,4	11	5	11

RECORDS OF OCCURRENCE:

Specimens examined, 57: Barberton, 1 (SI); Blijdschap, 3 (TM); Blyde Forest Reserve, 5 (TM); Doornhoek, 1 (TM); Ferndale, 8 (TM); Heuningklip, 1 (TM); Hectorspruit, 1 (TM); Hillcrest, 1 (TM); Komatipoort, 1 (SI); Levuvhu river, 3 (TM); Loskopdam Nature Reserve, 1 (TM); Louis Trichard, 1 (TM); Machindudzi, 1

(NKW); Malelane, 1 (NKW); Mariepskop, 7 (TM); Mokeetsi, 1 (TM); Ohrigstad Nature Reserve, 1 (Priv. coll. - N.J. Jacobsen); Othawa, 1 (TM); Parani, 1 (TM); Pienaars River Dam, 1 (TM); Platbos, 1 (TM); Pretoria North, 1 (TM); Rosslyn, 1 (TM); Settlers, 5 km NE, 2 (TM); Suikerboschrand, 2 (TM); Stoneyspruit, 4 (TM); Sweet Homes, 2 (TM); Waterkloof, 3 (TM).

Additional records: Open circle after Pienaar (1964).

Crocidura silacea Thomas, 1895 Grey musk shrew
Grys-skeerbek

TAXONOMIC NOTES:

Some authors consider *C. silacea* as synonomous with *C. c. infumata* (i.e. Smithers, 1971). Meester (1963 and *in litt.*) on the contrary confirms that, considering the available evidence, both forms are valid, *C. c. infumata* being lighter buffy-brown dorsally, with a silvery grey abdomen, while *C. silacea* is darker brown with a darker grey abdomen. Meester (1963) points out that *C. c. infumata* lacks the entoconid on the M_3, which is present in *C. silacea*. This character may, however, not be constant (Meester, *in litt.*).Evidence suggest that we are dealing with sibling species.

Meester (1963) regards *C. silacea* as monotypic, with *C. holobrunneus* Roberts, 1931, as a synonym.

DISTRIBUTION:

The species ranges through most of the Transvaal. Meester (1963) points out that all known localities are within areas receiving more than 500 mm rainfall p.a., which would exclude the north-western and extreme northern Transvaal along the Limpopo river. If it is limited by rainfall it is possible that *C. silacea* has been overlooked in the south-western Transvaal, especially since one record exists from south-eastern Botswana near the Transvaal border (see Smithers, 1971). No close relationships with physiographic or topographic features are apparent.

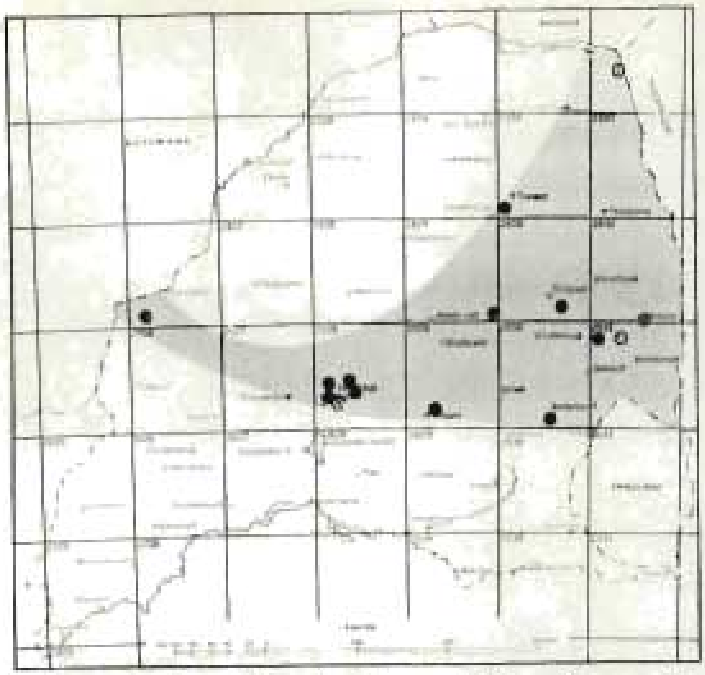

Fig.19: The distribution of *C. silacea* in the Transvaal..

HABITAT:

Like the previous species, *C. silacea* appears to have a relative wide habitat tolerance. It is however scarcer, and little biological information is available about it. It has been recorded from under and amongst trees and shrub, in rocky habitats, in riverine grassland and in the open veld. Apparently it also benefits from human habitation (Meester, 1963), since specimens are on occasion caught by domestic cats.

HABITS:

Nothing is known of its social, feeding, nesting and breeding habits.

FOOD:

Insectivorous.

BREEDING:

No pregnant or lactating females have been recorded.

MEASUREMENTS AND MASS:

Males

	$\overline{X}$	N	Min.	Max.
Tot.	122,4	7	111	134
T.	52,0	7	43	66
H.Ft.	12,3	7	11	14
Ear	8,8	7	8	11
Mass	8	1	-	-

Females/...

Females

	$\bar{X}$	N	Min.	Max.
Tot.	123,1	6	107	132
T.	50,2	6	44	54
H.Ft.	12,6	7	11	14
Ear	8,5	7	8	9
Mass	6,0	6	5	8,5

RECORDS OF OCCURRENCE:

Specimens examined, 17: Carolina, 48 km E, 2 (SI); De Hoop, 1 (TM); Derdepoort, 1 (TM); Droogedal, 1 (TM); Mariepskop, 1 (TM); Mayville, 1 (TM); Mkiwene, 1 (NKW); Pretoria North, 1 (TM); Pretoria Railway Station, 1 (TM); Roodeplaat, 2 (TM); Sabie River, 2 (TM, 1; NKW, 1); Tzaneen, 10 km W, 1 (SI); Witbank, 9 km E, 2 (SI).

Additional records: Open circle after Pienaar (1964).

Crocidura hirta Peters, 1852 Lesser red musk shrew
Klein-rooi-skeerbek

C. h. hirta Peters, 1852

TAXONOMIC NOTES:

C. hirta is a polytypic species, with two subspecies in southern Africa. The Transvaal population is referred to *C. h. hirta* by Meester (1963). Its colour is generally darker than that of *C. h. deserti* Schwann, 1906, which occurs in the western lower-rainfall areas of Botswana and S.W.A. Colour of Transvaal material is variable, with paler specimens overlapping in colour with *C. h. deserti*.

Meester (*in litt.*) mentions that *C. h. hirta* presents taxonomic problems in the south-eastern Transvaal and the Mocambique-Zululand border area, where it is small and dark, and difficult to distinguish from *C. silacea* and *C. cyanea*, although *hirta* is on the average slightly larger.

DISTRIBUTION:

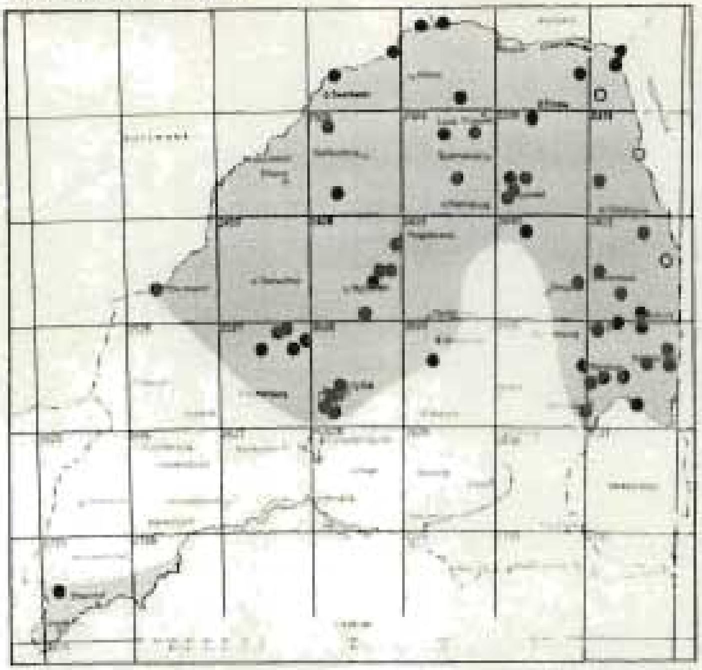

Fig.20: The distribution of *C. hirta* in the Transvaal.

Widely distributed throughout the bushveld areas of the Tropical Bush and Savannah, and Inland Tropical Forest veld types of Acocks (1975). A record from Christiana falls in an eastward extension of Acocks' (1975) Kalahari Thornveld and Shrub Bushveld. No records exist from the highveld grasslands.

Meester (1963) states that the range of this subspecies appears to be restricted almost tirely to the above - 500 mm mean annual precipitation zone. Where it occurs in the north-western, northern and north-eastern Transvaal, mean annual rainfall is less than 500 mm p.a., but here the species is mostly found in association with riverine vegetation.

HABITAT:

This species utilizes a wide range of habitat types. The most preferred habitat appears to be vegetation associated with watercourses, viz. dense grass, shrub, forests or marshes. It is however also found in the veld away from watercourses, sometimes in areas with very poor ground cover. It is also to be found in hedges around farmlands, old lands, and even in rocky terrain. It has been recorded from montane forests and undifferentiated montane communities, as well as termitaria (Meester, 1963). In addition specimens are frequently found around human habitation, where they nest in compost heaps, garden refuge, under logs or piles of thatching, and even in outbuildings. Captive animals that escaped in the laboratory, managed to survive for prolonged periods in the Transvaal Museum buildings.

HABITS/...

HABITS:

Under natural conditions it appears to be predominantly solitary, although captive animals live amicably together in groups of two or more, especially when each is provided with an exclusive refuge. The lesser red musk shrew is mainly nocturnal, although some specimens were trapped by day.

Captive individuals construct nests of grass or other suitable soft materials, normally under cover. They have also been reported to burrow from time to time (Meester, 1963).

Meester (*op.cit.*) reported that two captive specimens consumed half their weight in food daily. They are also quite ferocious; a captive male on occasion managed to kill a white mouse bigger than itself, which was introduced into its cage in order to test interspecies aggression. The rodent was consumed within two days. In the veld trapped rodents are often damaged by shrews feeding on them, the brains, testes and lungs of the rodent normally being eaten first. Instances of cannibalism in *C. h. hirta* were observed by Meester (1963).

FOOD:

Insectivorous, to some extent carnivorous. Specimens kept in the laboratory thrived on Pronutro mixed to a paste with water. Captive animals drank water regularly.

BREEDING:

Pregnant and lactating females were recorded from November to May. This suggests a breeding season during the warm wet months of summer. Litter sizes varied from 2-5 (N=7; $\bar{x}$=3,8). Meester calculated mean litter size to be 3,4, with variation from 1 to 5. He calculated the gestation period to be about 18 days, and found that an adult female can produce two litters per season, and may breed for the first time during the season of birth.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	137,3	73	112	163
T.	48,3	73	39	62
H.Ft.	14,7	73	11,5	16
Ear	9,5	72	5	12
Mass	16,1	26	11,1	24

Females

	$\bar{X}$	N	Min.	Max.
Tot.	136,7	71	110	155
T.	46,0	71	35	55
H.Ft.	13,4	70	10	17
Ear	9,4	70	5	12,5
Mass	14,9	34	8	22

RECORDS OF OCCURRENCE:

Specimens examined, 184: Acornhoek, 1 (TM); Amsterdam, 6 (TM); Barberton, 1 (SI); Barcleys, 1 (TM); Blijdschap, 8 (TM); Blokspruit, 1 (TM); Brooklyn, 8 (TM); Brummeria, 1 (TM); Buffelsdraai, 1 (TM); Chikwarakwara, 1 (RM); Coopersdal, 2 (TM); Cyprus, 2 (TM); Dendron, 1 (TM); Derdepoort, 2 (TM); Duiwelskloof, 1 (TM); Elandsrivier, 1 (DM); Fort Klipdam, 3 (TM); Irene, 2 (TM); Geluk Grecy Camp, 1 (TM); Jericho, 8 (TM); Hatfield, 1 (TM); Hectorspruit, 2 (TM); Hillcrest, 9 (TM); Kaapmuiden, 2 (TM); Klossiespan, 1 (TM); Komatipoort, 4 (SI); Letaba Ranch, 3 (TM); Levuvhu river, 2 (TM); Loskopdam Nature Reserve, 1 (TM); Lynnwood, 4 (TM); Lynnwood Glen, 3 (TM); Lynnwood Manor, 3 (TM); Machindudzi, 1 (NKW); Magalakwena river, 1 (TM); Mariepskop, 1 (TM); Matupa, 1 (NKW); Mbangari, 1 (NKW); Menlo Park, 18 (TM); Meyerspark, 1 (TM); Mmabolela Estates, 1 (TM); Montrose Estates, 3 (TM); Mooigenoeg, 1 (TM); Moorddrift, 3 (TM); Moonlight, 1 (TM); Mosdene, 1 (TM);
Nelspruit, 1 (TM); New Muckleneuk, 6 (TM); Nylsvley, 1 (TM); Othawa, 4 (TM); Pafuri, 1 (NKW); Phaben, 1 (NKW); Pretoria, 6 (TM); Queenswood, 2 (TM); Rhodes Drift, 1 (TM); Rietondale Agric. Exp. Farm, 1 (TM); Roodekuil, 2 (TM); Roodeplaat, 1 (TM); RR Ranch, 1 (TM); Sabie river, 1 (TM); Settlers, 1 (TM); Silverton,

3 (TM); Skukuza, 2 (NKW); Stoneyspruit, 7 (NKW); Sunnyside, 1 (TM); Swartkop Airport, 1 (TM); Sweet Homes, 1 (TM); Ten Bosch Estates, 2 (TM); Tzaneen, 2 (SI); Tzaneen Estate, 1 (TM); U.P. Exp. Farm., 2 (TM); Verwoerdburg, 1 (TM); Villieria, 3 (TM); Waterkloof, 6 (TM); Witrivier, 1 (TM).

Additional records: Open circles after Pienaar (1964).

Crocidura mariquensis (A. Smith, 1844) Black musk shrew
Swart-skeerbek

C. m. mariquensis (A. Smith, 1844)

TAXONOMIC NOTES:

Meester (1963) concluded that available evidence did not warrant the inclusion of *C. pilosa* Dobson, 1890 in *C. mariquensis*, and consequently retained *C. pilosa* as the name of this small blackish-brown species, although listing *mariquensis* as a possible earlier name.

The subsequent rediscovery of the skull of the second syntype, not previously examined by Meester, led him to conclude that the two species were in fact the same (Meester, 1964). Therefore *C. mariquensis* becomes the prior name, with *C. pilosa* and its allies as junior synonyms.

DISTRIBUTION:

Distributed throughout the Transvaal in areas with mean annual rainfall more than 500 mm. Distribution appears to be limited by rainfall, although the species has as yet not been recorded throughout this zone in southern Africa. Other limiting factors may be involved, such as its preference for marshland. It is relatively abundant but difficult to trap, and may have been overlooked in many areas, such as the southwestern Transvaal and the southern Kruger National Park.

HABITAT:

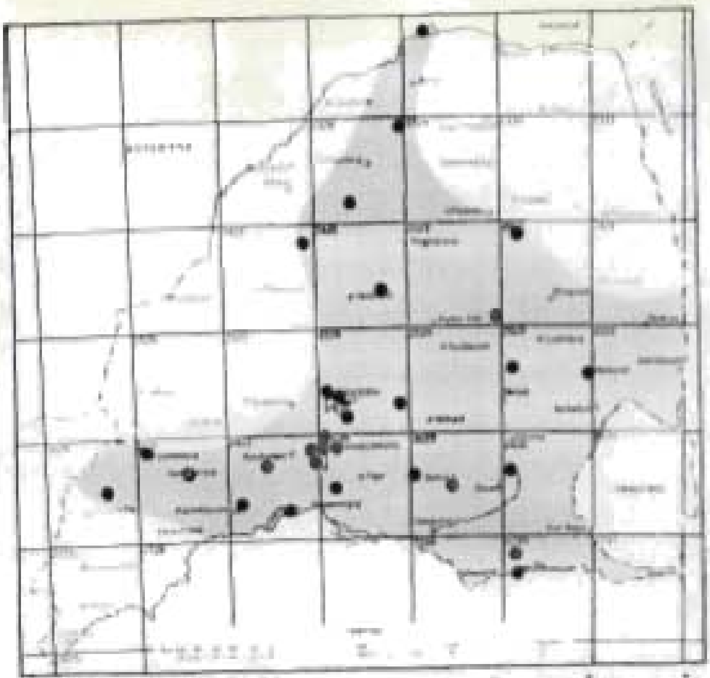

Fig.21: The distribution of *C. mariquensis* in the Transvaal.

The black musk shrew is very specific in its habitat requirements. All 104 specimens taken in the course of this project were collected in marshy conditions. The ground was always waterlogged, and on occasion specimens were taken in 10 mm of water. The habitat was further characterized by dense semi-aquatic vegetation such as swamp grass or reed-beds.

HABITS:

Active both by day and by night, although trapping results indicate a possible activity peak during darkness. In areas where *Otomys irroratus* (the vlei rat) or *Dasymys incomtus* (the swamp rat) occur, the black musk shrew is trapped in their runways, which it obviously utilizes. However, in the absence of these rodents, *C. mariquensis* is trapped randomly in the dense aquatic vegetation, suggesting that it does not construct its own runways. Live-trapping yielded better results than snap-trapping.

Meester (1963) found that captive individuals normally construct nests; only occasionally did they construct burrows. Considering the waterlogged condition of the substrate in their preferred habitat, nesting is probably the rule in the wild state.

FOOD:

Insectivorous.

BREEDING:

Pregnant and lactating females were recorded during October, January and February. Two to seven foetuses per female, $\bar{X}$=4,2.

MEASUREMENTS/...

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	131,7	57	112	147
T.	50,9	57	43	62
H.Ft.	15,7	57	12	18
Ear	7,4	57	5	9
Mass	15,2	49	5	20

Females

	$\bar{X}$	N	Min.	Max.
Tot.	127,3	66	110	150
T.	47,6	66	41	60
H.Ft.	14,8	66	10	17
Ear	7,5	66	5	9
Mass	10,4	59	4	18

RECORDS OF OCCURRENCE:

Specimens examined, 197: Baragwanath, 2 (TM); Barrage, 1 (TM); Bossies, 1 (TM); Brooklyn, 1 (TM); De Hoop, 2 (TM); Dordrecht, 15 (TM); Elandsfontein, 2 (TM); Ermelo, 1 (TM); Florida, 1 (TM); Germiston, 1 (TM); Goedehoop, 3 (TM); Grootsuikerboschkop and Elandslaagte, 5 (TM); Hornsnek, 1 (TM); Johannesburg, 1 (TM); Langfontein, 2 (TM); L.C. de Villiers, 1 (TM); Menlo Park, 1 (TM); Motlateng, 1 (TM); Nelspruit, 1 (SI); Nylsvley, 5 (TM); Platbos, 10 (TM); Potchefstroom, 2 (TM); Pretoria, 2 (TM); Ratsegaai, 8 (TM); Renosterpoort, 14 (TM); Rhodes Drift, 1 (TM); Rolspruit, 18 (TM); Rietfontein, 12 (TM); Rietvleidam, 37 (TM); Suikerboschrand, 33 (TM); The Downs, 1 (TM); Uitkomst, 2 (TM); Van Riebeeck Nature Reserve, 1 (TM); Wakkerstroom 7 (TM); Wonderboom, 1 (TM).

Crocidura bicolor Bocage, 1889 Tiny musk shrew
Dwerg-skeerbek

C. b. bicolor Bocage, 1889

DISTRIBUTION/...

DISTRIBUTION:

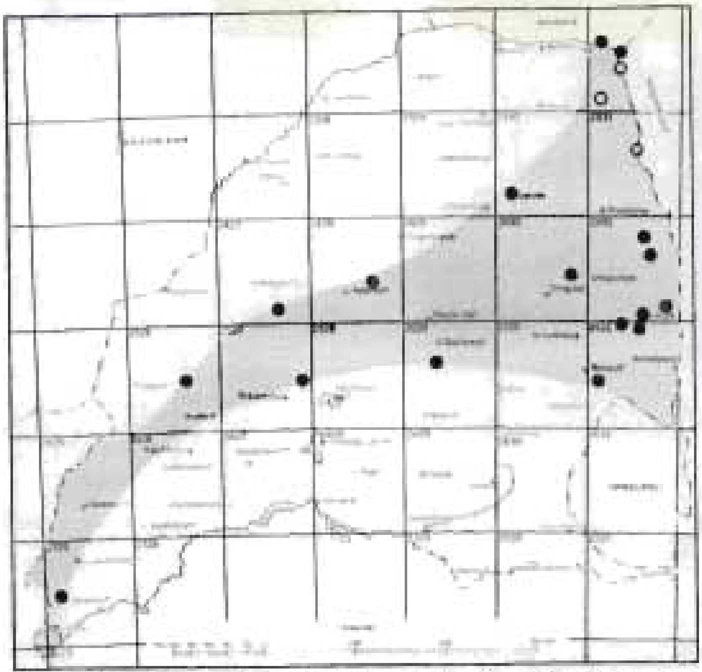

Fig.22: The distribution of *C. bicolor* in the Transvaal.

Eastern Transvaal lowveld, central and southwestern Transvaal. This subspecies has not previously been recorded from highveld grassland areas. A specimen from Christiana was collected in Acocks' (1975) Kalahari Thornveld and Shrub Bushveld. A record from Barberspan falls within the grassveld zone, where it was recorded from owl pellet remains. Lynch (1975) lists two new records from the Orange Free State, which, if substantial, represent an extensive sou ward range extension. (Lynch incorrectly assigned his material to the subspecies *C. b. woosnami* Dollman, 1916). One of these localities (2926 AA) falls within the grassveld zone, whereas the other (3025AA) is from Acocks' (1975) False Karoo veld type. It would thus appear that *bicolor* may be expected to occur on the Transvaal highveld grasslands.

No clear correlation could be found between the range of this subspecies and edaphic factors. In the Transvaal the majority of records are from wooded areas. Meester (1963) points out that the range correlates roughly with the 500 mm isohyte, with some records falling just outside the above 500 mm mean annual precipitation zone. He concludes that locality records are too scattered to show any close relationship with rainfall, but feels justified in regarding this form as being restricted to a moderately moist environment.

HABITAT:

This species favours good cover. In the Transvaal it has been recorded from areas with a good grass cover. Smithers (1971) recorded it from *Baikiaea* woodland on Kalahari sand, riverine

shrub/...

shrub and floodplain grass. Also found under rubbish heaps and woodpiles (Vesey-FitzGerald, 1962). In the Transvaal two specimens were captured by breaking open termite mounds, which they were utilizing as refuges.

HABITS:

Very little is known about this species. The two specimens collected in termite mounds had both constructed grass nests within the mound. Several other such nests were found abandoned.

FOOD:

Insectivorous.

BREEDING:

A pregnant female with two foetuses was collected in April. Meester (1963) records pregnancies during November and December, as does Ansell (1964).

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	91,9	4	80	99
T.	37,0	4	26	39
H.Ft.	9,6	4	9	10
Ear	6,8	4	6	8
Mass	4,4	3	4	5

Females

	$\bar{X}$	N	Min.	Max.
Tot.	87,2	5	69	100
T.	33,4	5	21,5	42
H.Ft.	9,1	5	8	10,5
Ear	6,9	5	6,5	7,5
Mass	3,0	5	2	3

RECORDS OF OCCURRENCE:

Specimens examined, 20: Barberspan, 1 (Priv. coll. - W.R. Dean); Blyde River Canyon Nature Reserve, 1 (TM); De Wildt, 1 (TM); Klossiespan, 1 (TM); Loskopdam Nature Reserve, 2 (TM); Matupa, 1 (NKW); Mbangani, 1 (NKW); Nylsvley, 1 (Priv. coll. - N. Jacobsen); Nwanetsi, 1 (NKW); Pafuri, 2 (NKW); Paranie, 1 (TM); Rooikrantz, 1 (TM); Skukuza, 4 (NKW); Tshokwane, 1 (NKW); Zomerkomst Forest Reserve, 1 (TM).

Additional records: Localities in Rhodesia after Smithers, (*in litt.*). Open circles in the Kruger National Park, after Pienaar (1964).

Crocidura maquassiensis Roberts, 1946 Maquassi musk shrew
Maquassie-skeerbek

TAXONOMIC NOTES:

This species is known from only three specimens, all three subadults with no apparent wear on the teeth, and the pelage possibly still that of immature animals. Meester (1963) expresses some doubt as to the validity of this species, and suggests that when more material becomes available it may prove to be an extreme variant of *C. silacea*. He later (*in litt.*) suggested that it may be a southern representative of *C. suaveolens*, but this needs factual confirmation.

DISTRIBUTION:

Two of the three specimens representing this species were collected from localities within the Transvaal. This type locality is Klipkuil, Maquassi, Wolmaransstad district. The other locality is Motlateng, Blouberg.

HABITAT:

The type specimen was caught in a house. The Motlateng specimen was found under a rock on the mountainside with grass and scattered trees. The environment was very moist with rivulets forming after rains.

HABITS:/...

HABITS:

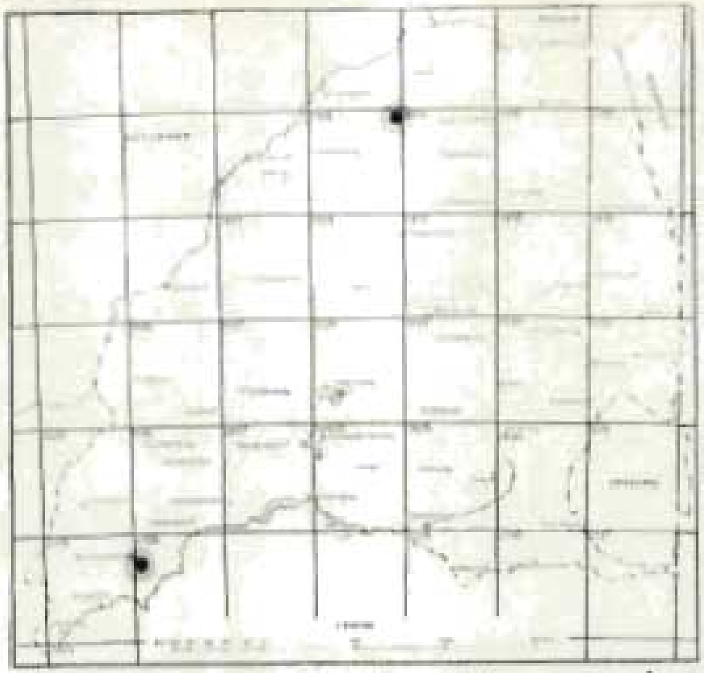

Fig.23: The distribution of *C. maquassiensis* in the Transvaal.

No information available.

FOOD:

Insectivorous.

BREEDING:

No information available.

MEASUREMENTS AND MASS:

Males
TM 5289: 102-44-11,5-8 = ?
TM 12261: 117-43-11,5-9 = ?
Sequence of data Tot., HB., H.Ft., E., Weight.

RECORDS OF OCCURRENCE:

Specimens examined, 2: Klipkuil, 1 (TM); Motlateng, 1 (TM).

Family Chrysochloridae

This is an extremely specialized family, endemic to Africa. All members are adapted to a fossorial existence in that the the eyes are rudimentary and covered by skin; the body is fusiform with no external eyes, ears or tail; the forelegs and -claws are well developed for digging; the fur is close-set; and the muzzle terminates in a thick leathery pad. The family is further characterized by the bright metallic sheen of the fur, and its insectivorous diet.

Most golden mole species are very cunning and/or rare, and difficult to procure, as evidenced by the poor samples in Museums. It is thus understandable that the family has been subjected to widely divergent taxonomic treatments (see Meester, 1974), and that new species and subspecies are still being described, e.g.

Amblysomus/...

Amblysomus julianae Meester, 1972; *Erimitalpa granti namibensis* Bauer and Niethammer, 1959; and *Amblysomus tytonis* Simonetta, 1968. The latter two forms were originally described from owl pellet remains.

(Key modified after Meester, 1971)

1. Larger species; length of skull 32,8 mm and more, width 20,2 mm and more; upper toothrow 12,7 mm and more; zygomatic arch produced upward posteriorly and meeting lambdoid crest at the back	*Chrysospalax*
Smaller species: length of skull 30,5 mm and less; width 20 mm and less; upper toothrow less than 12 mm; zygomatic arch not produced upward posteriorly to meet lambdoid crest	2
2. Ten upper and lower teeth in each jaw half	*Chlorotalpa*
Normally only nine upper and lower teeth in each jaw half; if a tenth is present (in *Amblysomus gunningi*) it differs in appearance from those preceding it, and also from the homologous tooth in the preceding genus	3
3. P^1 and P_1 molariform; lower molars without talonid; skull broad, breadth/length index 69-76%; bases of hairs yellow	*Calcochloris*
P^1 and P_1 triconid and sectorial; lower molars with talonid; skull narrower, breadth/length index 57-71%; base of hairs slate grey	*Amblysomus*

Chrysospalax/.

Chrysospalax Gill, 1883

Chrysospalax villosus (A. Smith, 1833) Rough-haired golden mole
Grasveldse kruipmol

C. v. rufopallidus (Roberts, 1924)
C. v. rufus (Meester, 1953)
C. v. transvaalensis (Broom, 1913)

TAXONOMIC NOTES:

Meester (1974), following Ellerman *et al.* (1953), is of the opinion that *villosus* is no more than specifically distinct from *C. trevelyani* (Günther, 1875), contrary to the belief of Roberts (1951), who places it in the monotypic genus *Bematiscus* Cope, 1892.

Meester (*op.cit.*) recognizes three subspecies from the Transvaal, i.e. *rufopallidus* from Wakkerstroom; *rufus* from Spitzkop, Sabie; and *transvaalensis* from Pretoria. A specimen from Belfast I assign to *C. v. rufus*.

DISTRIBUTION:

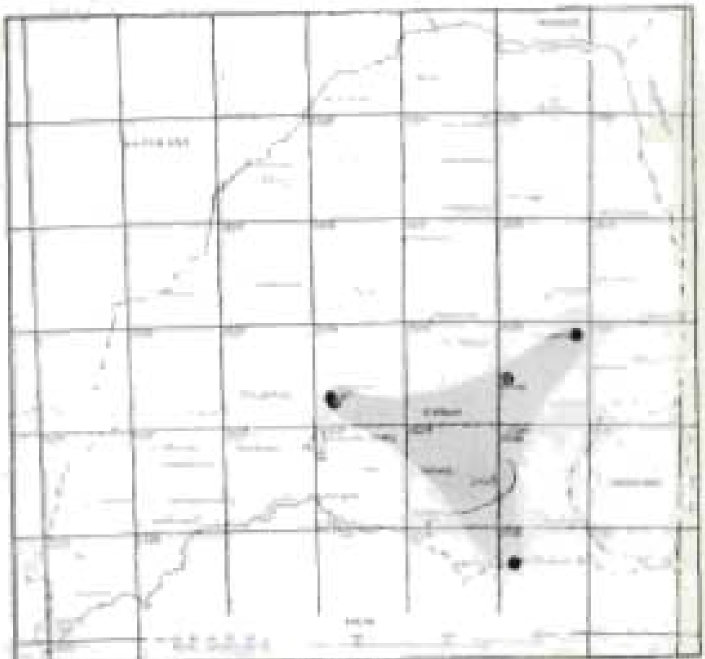

Fig.24: The distribution of *C. villosus* in the Transvaal.

Restricted in the Transvaal to the central and south-east central districts. All known localities throughout the species range fall within the above 750 mm mean annual precipitation zone, with the exception of Pretoria, which falls in the 500-750 mm zone. Locality records are, however, too scattered and habitat requirements too poorly defined to allow further speculation on factors limiting or favouring distribution. Distribution is very localized, as is reflected also by the degree of subspeciation.

HABITAT:

Roberts (1951) noted that the species appears to inhabit grasslands, especially meadow-like ground on the border of marshes.

HABITS:

Fossorial, but unlike the other golden moles, the rough-haired golden mole leaves its tunnel entrances open, which suggests that it forages to a large extent on the surface, especially after rains, as was observed by Roberts (*op.cit.*). Roberts kept a specimen in captivity, and was struck by the unerring speed with which it could find the tunnel entrance when disturbed. He considers this as of great survival value.

FOOD:

Insectivorous. Roberts (1951) fed his captive animal live grasshoppers, and he noticed that the mole apparently could detect their presence on the surface as it would soon emerge to prey on them.

BREEDING:

Roberts (1951) refers to a pregnant female, but does not say during which month it was collected. No further information on breeding is available.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Total	171,7	3	165	175
H.Ft.	16,3	3	14	18
Mass	105	1	-	-

Females

	$\bar{X}$	N	Min.	Max.
Total	147,5	4	138	160
H.Ft.	17,4	4	16	20
Mass	103,5	2	65	142

RECORDS OF OCCURRENCE:

Specimens examined, 17: Belfast, 1 (TM); Lynnwood Glen, 1 (TM); Pretoria, 3 (TM); Spitzkop, 7 (TM); Wakkerstroom, 5 (TM).

Chlorotalpa Roberts, 1924

Chlorotalpa sclateri (Broom, 1907) Sclater's golden mole
Sclaterse kruipmol

C. s. montana Roberts, 1924

DISTRIBUTION:

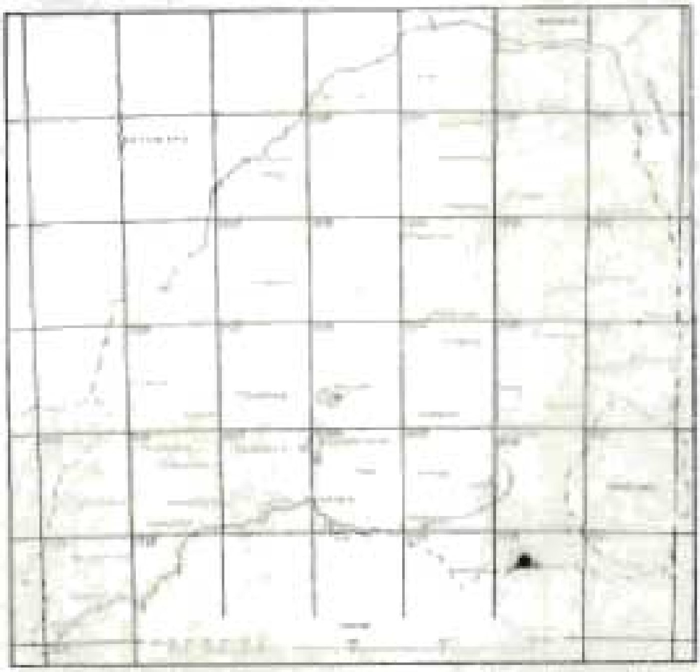

Fig.25: The distribution of *C. slateri* in the Transvaal.

Restricted in the Transvaal to Kastrol Nek near Wakkerstroom. Meester (1974) also mentions its range as extending to Pretoria, but later (*in litt.*) refutes that in the light of the discovery of *A. juliana* (Meester, 1972a).

HABITAT:

Roberts (1951) collected the species in peaty soil in sheltered kloofs of mountains, or in forests.

HABITS:

Very little information could be amassed on this species. According to Roberts (1951) it constructs predominantly shallow burrows just under the surface, and possibly utilizes the root systems of trees and shrubs for the protection of its nesting chambers. Tunnels radiate from such trees, and from here meander from tree to tree.

FOOD:

Insectivorous.

BREEDING/...

BREEDING:

To date no females in breeding condition have been collected.

MEASUREMENTS AND MASS:

Only one specimen (a female) available from the Transvaal.

TM 2901: Total-100; H.Ft.-11; Mass-?

RECORD OF OCCURRENCE:

Specimen examined, 1: Kastrol Nek, 1 (TM).

Calcochloris Mivart, 1867

Calcochloris obtusirostris (Peters, 1851) Yellow golden mole
Geel-kruipmol

C. o. limpopoensis (Roberts, 1946)

TAXONOMIC NOTES:

Ellerman *et al.* (1953) point out that the name *Calcochloris* antedates the more commonly used name *Chrysotricha* Broom, 1907, for this genus, but regard both as synonyms of *Amblysomus*. Roberts (1951) recognizes *Chrysotricha*, whereas Simonetta (1968) agrees with the viewpoint of Ellerman *et al.* (1953). Meester (1974) however points out that the striking fur colouration, broader skull and more molariform P^1 and P_1 justify separation. The latter viewpoint is here adhered to.

DISTRIBUTION:

This species is found in the Transvaal only in the extreme north-east, where it has been recorded by Pienaar (1964) from within the Kruger National Park borders.

HABITAT:

Pienaar (*op.cit.*) is of the opinion that the species is confined to the Nyandu and Machai sandveld plateau on the eastern boundary of the Park.

HABITS/...

HABITS:

No information available.

FOOD:

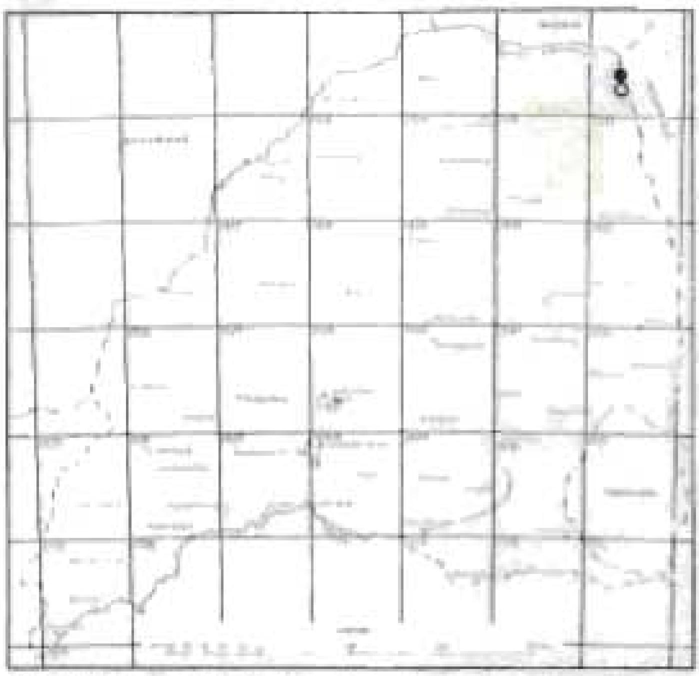

Fig.26: The distribution of *C. obtusirostris* in the Transvaal.

Pienaar (1964) observed it to be fond of termites and Tenebrionid larvae. He also suggests that the young of various burrowing lizards may be taken.

BREEDING:

No pregnant or lactating females have been recorded.

MEASUREMENTS AND MASS:

The specimens collected by Pienaar (1964) have measurements as follows:

Males
NKW8: Total-91; H.Ft.-10
NKW15: Total-110; H.Ft.-11

Females
NKW6: Total-93: H.Ft.-11
NKW7: Total-100; H.Ft.-10

RECORDS OF OCCURRENCE:

Specimens examined, 6: Machaisandveld, 4 (NKW); Oosgrenssandveld, 1 (NKW); Wambia blok, 1 (NKW).

Amblysomus Pomel, 1848

(Key modified after Meester, 1974)

1. Thirty-six teeth, M^3 and M_3 absent; well developed talonid on lower molars 2
Thirty-eight to forty teeth, M^3 sometimes, and M_3 usually present, but if so differing from molars anterior to it; talonid of lower molars feebly developed or absent . *gunningi*

2. Colour brown to blackish, without any reddish, and not becoming markedly paler on sides than on midback ... ... *iris*
Colour reddish-brown, becoming markedly paler on sides than on midback 3

3. Dorsal colouration darker; skull longer and narrower (breadth/length index 57-68%); posterior palate not shortened ... ... *hottentotus*
Dorsal colouration paler; skull shorter and wider (breadth/length index 67-71%); posterior palate shortened ... ... *julianae*

Amblysomus gunningi (Broom, 1908) Gunning's golden mole
Gunningse kruipmol

DISTRIBUTION:

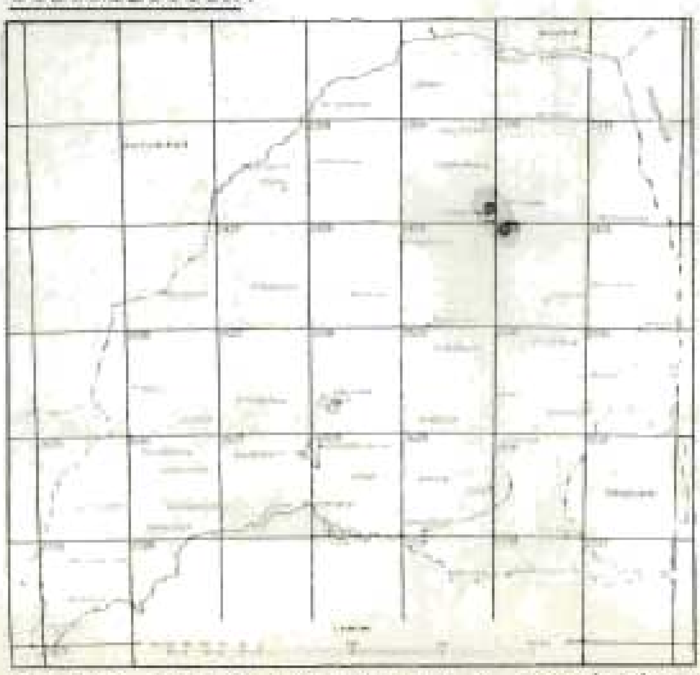

Fig.27: The distribution of *A. gunningi* in the Transvaal.

This species has a very limited distribution, and until recently has been known only from the type locality (Woodbush, 2330CC). During 1974 a new locality was recorded some 20 km south of the type locality, at the New Agatha forest reserve at Seralakop.

HABITAT/....

HABITAT:

The holotype was collected in ploughed lands. Several topotypes were collected in forests of the escarpment. The specimen from Seralakop was collected in an open montane grassland plateau, where the soil is a reddish-brown loam.

HABITS:

At Seralakop it was evident that more than one Gunning's golden mole inhabited the grassy plateau where they were studied. They occurred side-by-side with the rodent mole (*Cryptomys hottentotus*). The golden moles constructed deep tunnels from which mounds of earth are pushed to the surface, as well as tunnels just below the surface where the thin crust of earth was forced upwards, thus creating the characteristic golden mole "tracks". An attempt to dig individuals out was unsuccessful, but through this endeavour it became apparent that individuals tunnel extensively. The deep tunnel system appeared to be permanently in use, whereas the shallow tracks were of only semi-permanent nature. In whatever system mole-traps were set, the golden moles simply burrowed underneath them without triggering the traps.

FOOD:

Insectivorous.

BREEDING:

No pregnant or lactating females have been recorded.

MEASUREMENTS AND MASS:

Males

TM 3382: Total-125; H.Ft.-14,2

TM 3383: Total-130; H.Ft.-13,5

TM 3384: Total-125; H.Ft.-13,2

Females

TM 703: Total-126; H.Ft.-15,0

TM 3387: Total-123; H.Ft.-14,0

TM 3388: Total-120; H.Ft.-13,5

TM 23722: Total-120; H.Ft.-15,0

RECORDS OF OCCURRENCE:

Specimens examined, 8: New Agatha Forest Reserve, 1 (TM); Woodbush, 7 (TM).

Amblysomus hottentotus (A. Smith, 1829) Hottentot golden mole
Hotnot-kruipmol

A. h. hottentotus (A. Smith, 1829)

TAXONOMIC NOTES:

The following forms are considered as synonoms of this subspecies by Meester (1974): *longiceps* Broom, 1907; *garneri* Roberts, 1917; *drakensbergensis* Roberts, 1946; and *orangensis* Roberts, 1946.

DISTRIBUTION:

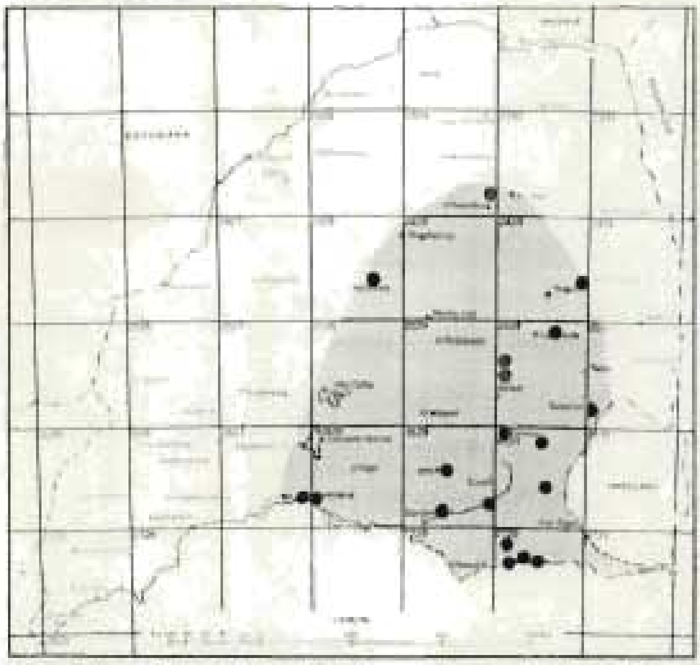

Fig.28: The distribution of *A. hottentotus* in the Transvaal.

The eastern and south-eastern Transvaal, except the lowveld. No records are available of this species occurring in the Transvaal at altitudes lower than 700 metres, irrespective of rainfall. In the Transvaal the Hottentot golden mole occurs only in areas receiving more than 500 mm mean annual rainfall, and apparently this is also the rule elsewhere throughout its range in southern Africa. In the Transvaal this species has been recorded only from Ferralitic and Ferruginous Lateritic soils, as shown by the Soil Map of South Africa (Soils Research Institute, Dept. Agricultural Tech. Services, Pretoria 1965).

A/...

A record from Haenertsburg represents the most northern limit of the species range.

HABITAT:

Soft ground, mostly sandy or sandy loam soils, although specimens have been procured in a black clayey soil near Amsterdam. Always found on level ground, predominantly in grasslands. According to Roberts (1951) it occurs in forests at times. While a number of specimens were trapped in the vicinity of streams or marshes, this is probably not significant, since as many were trapped a great distance away from water.

HABITS:

Activity was recorded both by day and by night. Although it has been recorded to burrow just under the surface of the ground, it more often constructs deeper tunnels from which mounds of earth are pushed to the surface. According to Roberts (1951) grass-lined nesting chambers are constructed for the young. On occasion the Hottentot golden mole will venture on the surface, especially after heavy rains, where it falls easy prey to owls. It may co-exist with rodent moles in certain areas.

FOOD:

Insectivorous, presumably feeding mostly on ground-living larvae, pupae and worms, as is mentioned also by Roberts (1951).

BREEDING:

No pregnant or lactating females were collected from the Transvaal. Roberts (1951) mentions that the species is reproductively active during the rainy season, although he does not cite specific case histories. A series of four females was collected on the banks of the small Caledon river in the Golden Gate National Park during November 1969. Two were reproductively inactive, the third was lactating and the fourth was pregnant (two embryos, 1L; 1R).

MEASUREMENTS/...

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	126,8	12	108	140
H.Ft.	14,3	11	10	17
Mass	71,0	2	56	86

Females

	$\bar{X}$	N	Min.	Max.
Tot.	121,3	17	105	138
H.Ft.	14,3	18	10	17
Mass	64,8	6	62	78

RECORDS OF OCCURRENCE:

Specimens examined, 42: Barberton, 1 (TM); Begin Der Lyn, 1 (TM); Belfast, 4 (TM); Bethal, 1 (TM); Carolina, 1 (TM); Devils Knuckles, 1 (TM); Dullstroom, 2 (TM); Goedgevonde, 2 (SI); Grootsuikerboschkop and Elandslaagte, 1 (TM); Haenertsburg, 1 (SI); Joshua Moolman, 1 (TM); Kastrol Nek, 4 (TM); Krantzview, 1 (TM); Kruisementfontein, 1 (TM); Langfontein, 1 (TM); Mariepskop, 3 (TM); Nylsvley, 1 (TM); Roodepoort, 1 (TM); Vlakfontein, 1 (TM); Wakkerstroom, 11 (TM); Zandfontein, 2 (TM).

Amblysomus iris (Thomas & Schwann, 1905) Zulu golden mole
Soeloelandse kruipmol

A. i. septentrionalis Roberts, 1913

TAXONOMIC NOTES:

Meester (1974) is followed in recognizing this subspecies. Simonetta (1968) regards *littoralis* and *septentrionalis* as subspecies of *A. corriae* Thomas and Schwann, 1905. Meester regards *corriae* and *septentrionalis* as subspecies of *iris*, with *littoralis* a synonym of *A. i. iris*.

DISTRIBUTION/...

DISTRIBUTION:

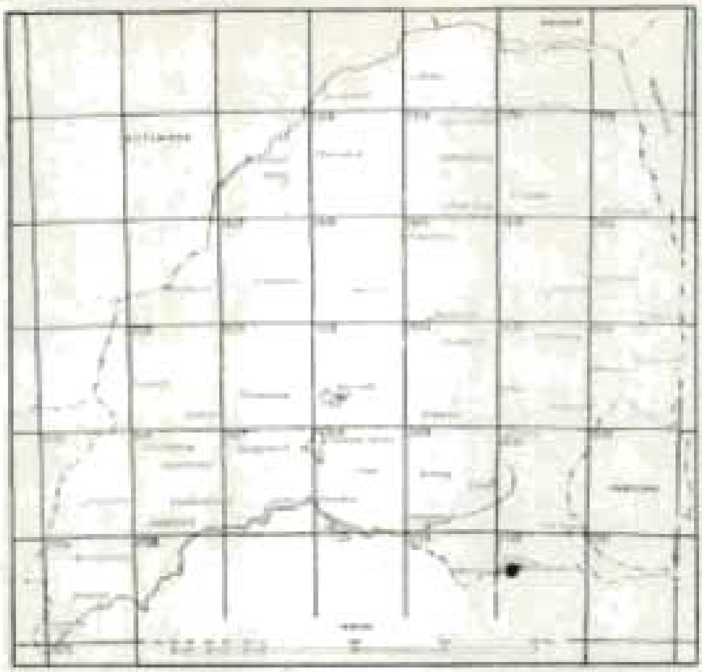

Fig.29: The distribution of *A. iris* in the Transvaal.

The species is known in the Transvaal only from the type locality of the subspecies at Wakkerstroom.

HABITAT:

No information is available on the habitat requirements of the species.

HABITS:

No information available.

FOOD:

Insectivorous.

BREEDING:

The holotype (TM 710) was gravid when collected on 14th November, 1909. No other breeding information has been recorded.

MEASUREMENTS AND MASS:

No field measurements are recorded for the type. Specimens collected from elsewhere in the Republic vary as follows:

Males

TM 8990: Total-119; H.Ft.-14 (Knysna)
TM 8993: Total-117; H.Ft.-14 (Jonkersberg)

Females

TM 705: Total-111; H.Ft.-12 (Knysna)
TM 8989: Total-120; H.Ft.-14 (Knysna)
TM 8991: Total-113; H.Ft.-13 (Knysna)
TM 8992: Total-115; H.Ft.-12 (Jonkersberg)

RECORD OF OCCURRENCE:

Specimens/...

Specimens examined, 1: Wakkerstroom, 1 (TM).

Amblysomus julianae Meester, 1972 Juliana's golden mole
Julianase kruipmol

DISTRIBUTION:

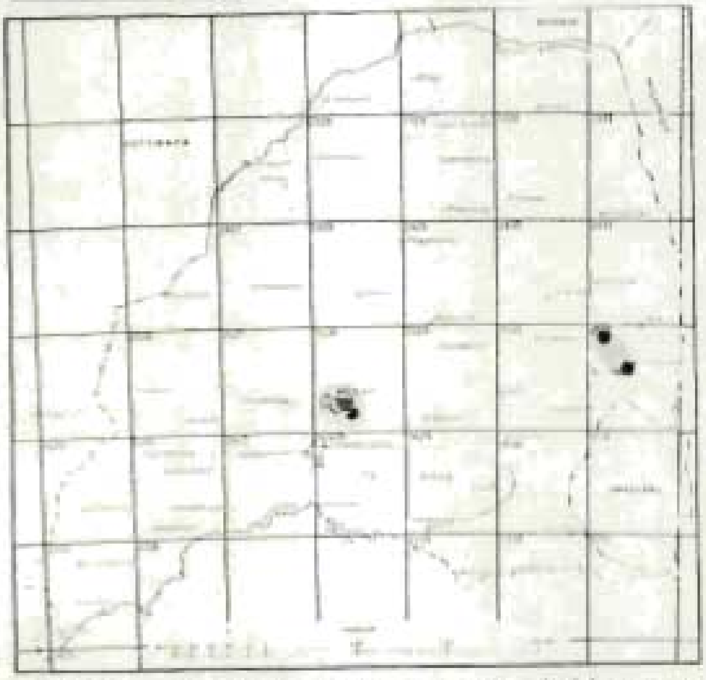

Fig.30: The distribution of *A. julianae* in the Transvaal.

Known from only three general areas, all within the Transvaal, i.e. the type locality near Pretoria, and the Numbi Gate and Machuluane in the Kruger National Park. The latter two records are in fact the only records of the occurrence of the genus *Amblysomus* in the eastern Transvaal lowveld.

HABITAT:

As pointed out by Meester (1972), this species is apparently not restricted to a very limited spectrum of climatic conditions. The fact that it is the only representative of *Amblysomus* in the Transvaal lowveld indicates a much wider habitat tolerance than is found in the other members of the genus. If its implied rarity and isolated occurrence in time prove true, this would argue on the other hand for an animal with very limited habitat requirements. The exact habitat of the Numbi specimen was not recorded, except that it is from a bush savannah region. The Pretoria specimens were collected on the boundary between highveld grassland and bush savannah, in sandy soil at the northern foot of a low hill, amongst rocky outcrops.

HABITS:

Little/...

Little is known except that it constructs both the deep and shallow tunnel-systems typical of golden moles. Meester (1972) kept a live specimen under observation, but very little could be learnt from it other that it spent most of its time underground, and came to the surface, where its food was deposited, only when hungry. It appeared to prefer moist soil, presumably since tunnels are easier to construct and are more durable in this. Active both day and night.

FOOD:

Insectivorous. Meester (*op.cit.*) found that in captivity it took ground beef, earthworms, cockroaches, mealworm larvae, grasshoppers and other small insects readily, but not snails or slugs.

BREEDING:

None of the four specimens Meester (*op.cit.*) used as basis for the description of the species, was dissected to ascertain breeding condition. Of two specimens collected subsequently, one collected on the 15th February 1975 by the Transvaal Museum taxidermist Mr George Goode, was pregnant, with one embryo in the right horn of the uterus.

MEASUREMENTS AND MASS:

So far only eight specimens represent the species:

Males

TM 15992: Total-98; H.Ft.-12; Mass-?

TM 19373: Total-106; H.Ft.-11,5; Mass-?

Females

TM 16916: Total-100; H.Ft.-9; Mass-?

TM 16917: Total-99; H.Ft.-10; Mass-?

TM 25431: Total-100; H.Ft.-11,5; Mass-23 gram

NKW 3: Total-92; H.Ft.-10; Mass-19 g

NKW 4: Total-93; H.Ft.-10; Mass-26 g

* Uncatalogued: Total-102; H.Ft.-12; Mass-?

Specimen/...

* Specimen collected by mr N.J. Dippenaar, Transvaal Museum, and donated to the Smithsonian Institution, Washington, D.C.

RECORDS OF OCCURRENCE:

Specimens examined, 8: Machulwane, 2 (NKW); Numbi Gate, 1 (TM); Shere, 1 (TM); The Willows, 3 (TM, 2; SI, 1); Tiegerpoort, 1 (TM).

ORDER CHIROPTERA

This is a big and diversified order, and is perhaps the most interesting and challenging group of mammals to study. Bats are the only mammals which have achieved true flight; they are the only land mammals that can boast navigation by sonar or echo-location; and in southern Africa the majority of hibernating mammals are to be found amongst the Microchiroptera. Yet of all the mammal groups in Africa, bats have been scientifically the most neglected. Many systematic and distributional problems remain to be solved, while virtually nothing is known about their behaviour, ecology, reproduction, flight patterns, migrations, hibernation, or details of their methods of echolocation.

The economic importance of the Chiroptera in southern Africa is hardly appreciated. On the debit side the damage done by fruit bats to tropical fruit crops is well-known, although to the best of my knowledge not accurately assessed as yet. On the credit side is the exclusively insectivorous diet of the Microchiroptera, a trait which may have an important bearing on biological insect pest control.

Yet bats suffer severely from the whims, prejudices, ignorance and superstition of man. Many instances of bat massacres have become known during the past few years, mostly inadequately motivated and unnecessary, resulting from a lack of knowledge and understanding. Although conclusive scientific evidence is lacking, the use of insecticides may pose a serious threat to our bat populations, as many of these poisons appear to accumulate in the livers and fat tissues of bats feeding on the insects that survive spraying. At the moment it is not known how these accumulated insecticides affect bats, although it is likely that particularly breeding success is adversely affected.

However, civilization has also unintentionally benefited some species of bats. The construction of buildings, mines, tunnels and bridges, and the planting of fruit orchards and other trees in otherwise treeless areas, have not only offered more daylight roosts or refuges, but also possibly enabled some species to extend their historical ranges. This aspect will be further elucidated under the species discussions which follow.

(Key/...

(Key adapted from Hayman and Hill, 1971)

1. Second digit terminating in a claw; margin of ear conch forming a complete ring; tragus always absent; interfemoral membrane greatly reduced, little more than a narrow band along inside margin of hind legs; tail absent or rudimentary; cheek teeth simple, without well-developed cusp pattern ... ... MEGACHIROPTERA

Second digit without a claw; margin of ear conch not forming a complete ring; tragus generally present (absent in Rhinolophidae and Hipposideridae); interfemoral membrane generally well-developed; tail generally well-developed (absent in one family); cheek teeth cuspidate, generally with a clearly defined W-pattern ... ... MICROCHIROPTERA

SUBORDER MEGACHIROPTERA

Family Pteropodidae

Subfamily Pteropodinae

1. Ears with white basal tufts .. .. *Epomophorus*

Ears without white basal tufts 2

2. Forearm 110-130 .. .. *Eidolon*

Forearm 65-102 ... ... *Rousettus*

Epomophorus Bennett, 1836

1. One post-dental palatal ridge ... ... *wahlbergi*

Two post-dental palatal ridges ... ... *crypturus*

Epomophorus/..

Epomophorus wahlbergi (Sundevall, 1846) Wahlberg's epauletted fruit bat
Wahlbergse witkol-vrugtevlermuis

E. w. wahlbergi (Sundevall, 1846)

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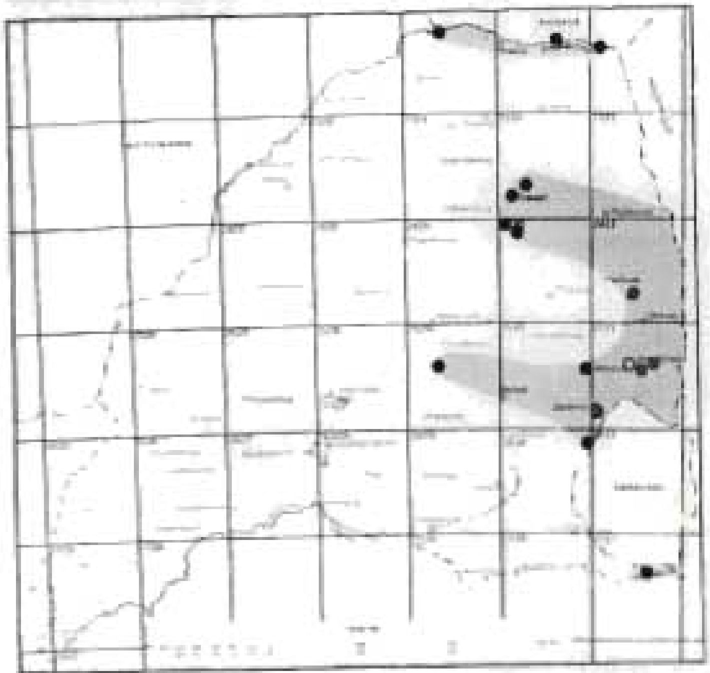

Fig.31: The distribution of *E. wahlbergi* in the Transvaal.

This species has a very wide distribution in Africa. In the Transvaal it is limited to the eastern regions (but not necessarily the eastern lowveld) with a subtropical climate and higher mean annual rainfall.

HABITAT:

By day this species roosts in large, densely foliated trees. By night it appears to search for food mostly along natural watercourses (viz. wild figs and African ebony), and often in subtropical fruit orchards. Rosevear (1965) considers *Epomophorus* as typically inhabiting open woodland rather than forest. Broadly speaking this is true for *wahlbergi*, but field observations suggest that it is specifically dependent on riverine forests. Two apparently essential habitat requirements are concentrated here, namely wildfruit-bearing trees and trees big enough to roost in. It has not been possible to establish whether or not epauletted fruit bats drink water.

HABITS:

A semi-gregarious species which roosts in loose aggregations of 30 to 200 individuals (Smithers, 1971) in large trees with dense canopies. The very young cling to their mothers, whereas juveniles roost independently. Roosting trees are utilized permanently or semipermanently.

Daytime colonies appear to split up during the night when feeding. At particularly good fruit trees a large number of bats were often observed, but never as many as in daytime colonies. Often the two closely related species, *E. wahlbergi* and *E. crypturus*, would feed in the same tree at the same time.

Indications are that once an individual is satiated, it spends the rest of the night roosting in a tree other than the one utilized by day, while resting and digesting its food. Presumably this is also the time for preening and breeding. Lone individuals were often found resting in trees, intermittently uttering the unique pinging noise characteristic of this genus.

In feeding, the fruit is generally picked and carried to a nearby tree, where a few bites are taken from it, after which the half-eaten fruit it discarded for another. Judging from the accumulations of these half-devoured fruit, these bats repeatedly use the same branch when feeding.

FOOD:

Wild fruit typical of subtropical regions, especially wild figs and African ebony. When these are available this species can cause damage to cultivated fruits such as litchis, guavas, peaches and plums.

BREEDING:

No pregnant or lactating females were collected during this survey.

MEASUREMENTS AND MASS:

Males

	$\bar{x}$	N	Min.	Max.
Tot.	169	18	144	211
H.Ft.	22,9	16	21	26
Ear	24,2	17	22	26
F.arm.	85,3	16	79	92
Mass	145,7	9	117	165

Females/...

Females

	$\bar{X}$	N	Min.	Max.
Tot.	140,4	10	122	144
H.Ft.	21,4	8	18	23
Ear	24,4	9	22	28
F.arm	77,7	10	68	85
Mass	112,3	4	94	140

RECORDS OF OCCURRENCE:

Specimens examined, 34: Barberton, 3 (TM, 1; SI, 2); Chikwarakwara, 1 (RM); George's Valley, 1 (TM); Greefswald, 1 (TM); Hectorspruit, 3 (TM); Loskopdam, 5 (TM); Malelane, 3 (TM, 2; NKW, 1); Malta Farm, 1 (TM); Nelspruit, 2 (TM); Newington, 11 km N., 1 (TM); Pongola, 6 (TM); Sweet Home, 2 (TM); The Downs, 2 (TM); Tzaneen Estate, 3 (TM).

Epomophorus crypturus (Peters, 1852) Peters' epauletted fruit bat
Klein vrugtevlermuis

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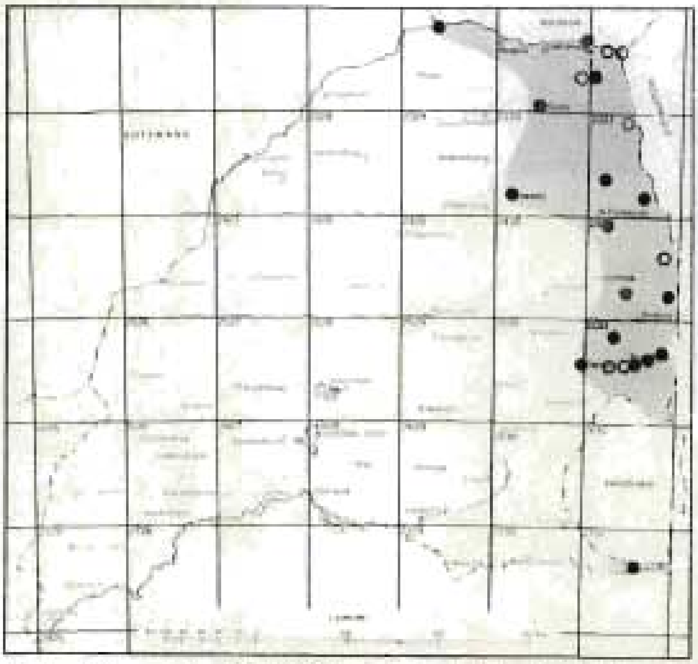

Fig.32: The distribution of *E. crypturus* in the Transvaal.

In the Transvaal *E. crypturus* is sympatric with the previous species, except that *E. crypturus* has as yet not been recorded as far west as the Loskop dam Nature Reserve, where *E. wahlbergi* has recently been collected. On the other hand *E. wahlbergi* appears to be absent from the area between Tzaneen and the Limpopo river. North of the Zoutpansberg both species appear to be restricted to the riparian forests of the Njellele and Limpopo rivers. The range of *crypturus* in southern Africa correlates very well with the above 500 mm mean annual rainfall zone, although it may utilize rivercourses as corridors into areas receiving less rain.

HABITAT:

Available information indicates habitat requirements similar to those of the previous species.

HABITS:

The behaviour of the two local species is too poorly known to demonstrate specific differences.

FOOD:

Frugivorous.

BREEDING:

A pregnant female was collected during September, with one 25 mm foetus implanted in the right uterus. Three lactating females with their young were collected during November, one of which had a recent placental scar in the left uterus. Smithers (1971) indicates that in Rhodesia parturition occurs between November and February.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	147,9	17	130	168
H.Ft.	19,7	17	16	25
Ear	24,2	17	20	28
F.arm	77,5	20	66	86
Mass	107,6	6	82	135

Females

	$\bar{X}$	N	Min.	Max.
Tot.	130,8	27	106	142
H.ft.	20,0	27	17	23
Ear	23,4	27	21	26
F.arm	75,2	27	68	82
Mass	75,1	11	48	93

RECORDS OF OCCURRENCE:

Specimens examined, 56: Greefswald, 2 (TM); Hectorspruit, 2 (TM); Klaserie-Olifants river confluence, 1 (TM); Komati river, 4 (TM); Letaba, 1 (NKW); Pongola, 1 (TM); Pretoriuskop, 4 (NKW); Punda Milia, 4 (TM, 2; NKW, 2); Madimbo, 10 km E., 1 (TM); Nelspruit, 1 (TM); Newington, 11 km N., 6 (TM); Othawa, 1 (TM); Sibasa, 15 (TM); Ten Bosch Estates, 11 (TM); Tshokwane, 1 (NKW); Tzaneen Estate, 1 (TM).

Additional records: 2229AB (Smithers, *in litt.*); open circles in Kruger National Park after Pienaar (1964).

Eidolon Rafinesque, 1815

Eidolon helvum (Kerr, 1792) Straw-coloured fruit bat
Geel-vrugtevlermuis

E. h. helvum (Kerr, 1792)

DISTRIBUTION:

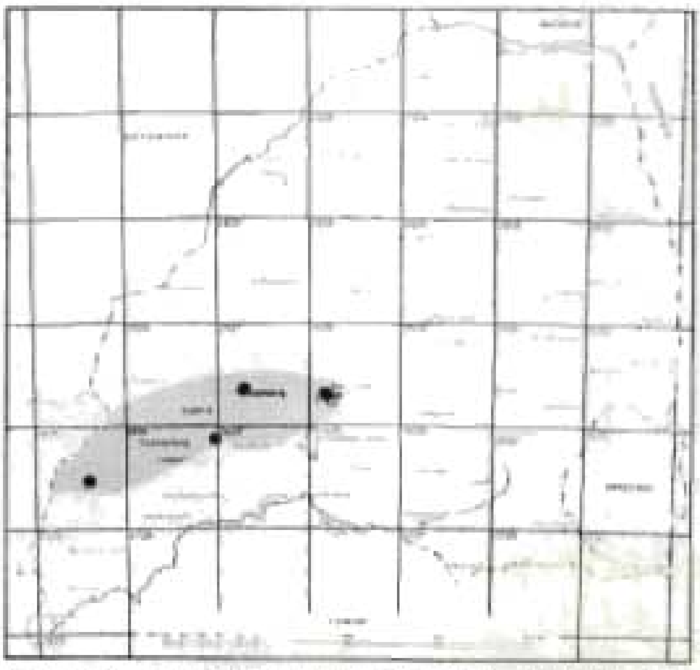

Fig.33: The distribution of *E. helvum* in the Transvaal.

This essentially tropical central African bat is a rare migrant to southern Africa, where lone individuals are usually recorded. In the Transvaal it is therefore very rare, whereas it is particularly common in central African forests Rosevear (1965). The known records of distribution in the Transvaal is therefore unlikely to reflect its true occurrence in the Province, which is likely to be sporadic but widespread.

HABITAT:

Prefers large trees for roosts, preferably in

forests/...

forests. Also reported from boabab trees. See Rosevear (1965) for a summary of optimum habitat requirements in West Africa.

HABITS:

A gregarious species roosting by day in large trees in groups varying from a few dozen to 200 000 (Ogilvie, P.W. and M.B., 1964). Individuals hang freely, suspended by their hind feet. These daytime quarters are, in central Africa, occupied permanently or semi-permanently, depending on the seasonal availability of edible fruit in the vicinity. In the Transvaal this fruit bat appears to be a solitary wanderer. A colony is noisy and restless by day, but by contrast relatively quiet at night when feeding. The colony leaves its roost at sundown, individuals flying out in loose aggregations in the same direction. See Rosevear (1965) for a more detailed account.

FOOD:

Rosevear (1965) mentions the fruit and flower buds of the following trees as food items: silk-cotton (*Bombax* sp.), boabab (*Adansonia*), several species of palms and wild figs (*Ficus* sp.). No information is available on the diet of migrants in southern Africa, although cultivated fruit is at times a part of their diet.

BREEDING:

No records exist of females in breeding condition collected on this subcontinent. Considering the gregarious nature of the species, breeding is improbable in southern Africa, owing to low population density.

MEASUREMENTS AND MASS:

Of the four specimens known from the Transvaal only one has been measured, namely a juvenile male, TM 8947: Tot. 140; T. 20; H.ft. 15; Ear 10; F.arm 108.

RECORDS OF OCCURRENCE:

Specimens examined, 4: Barberspan, 1 (Private collection); Rustenburg, 1 (TM); Steynsdorp, 1 (TM); Wildeharthoek, 1 (TM).

Rousettus Gray, 1821

Rousettus aegyptiacus (E. Geoffrey, 1810) Egyptian fruit bat
Egiptiese vrugtevlermuis

R. a. leachi (A. Smith, 1829)

DISTRIBUTION:

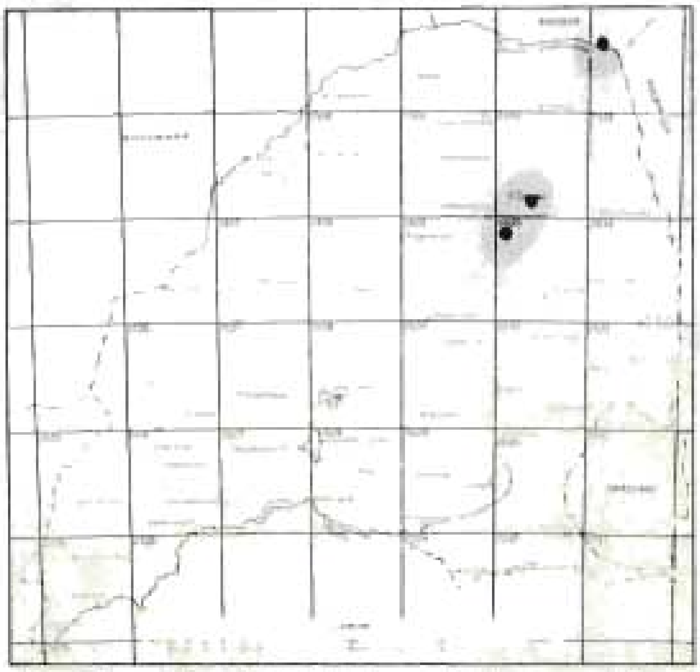

Fig.34: The distribution of *R. aegyptiacus* in the Transvaal.

In the Transvaal recorded from only four localities in the eastern lowveld. Of these, only two are known permanent daytime quarters, namely the wet Matlapitsi dolomite cave and sinkhole, and a cave near Barberton. The other two records are of animals collected by night; specimens from Letsitele are almost certain from the Matlapitsi colony.

HABITAT:

Appears to be dependent on caves for daytime roosts, and in the Republic has never been observed to utilize any other roosts. Rosevear (1965) regards this dependence on caves or cave-like structures, such as tombs or pyramids, as a character common to the genus. By night the Egyptian fruit bat may be found on nearby suitable fruit trees.

HABITS:

A gregarious species; in the Matlapitsi cave as many as c. 2 000 were observed in one colony. They hang suspended from the roof by their hind feet in closely packed groups, in poor light creating the impression of a woven mat. The very young cling to their mothers. Subadults huddle together in small groups in cracks in the ceiling or in oblique walls.

This is the only fruit bat which can navigate by means of echolocation (Möhres and Kulzer, 1956), which enables it to utilize the dark interior of caves. This probably also explains its remarkable powers of manoeuvering. Novick (1958) suggests that this faculty has evolved independently from that of the Microchiroptera. The sound impulses emitted by insectivorous bats are laryngeal in origin as opposed to the sounds caused by the tongue-clicking of this species, which are emitted through the open corners of the mouth.

This species was observed feeding in large numbers on ripe litchi fruit near Letsitele during December 1963. Its feeding behaviour is very similar to that of *Epomophorus*. Fruit is picked while hovering, and always carried to a wild tree at the edge of the orchard. While feeding the animal hangs suspended from a branch by its hind feet. It is a wasteful feeder, like other fruit bats, in that only one or two bites are taken from the litchi before it is discarded.

FOOD:

The only food source recorded in the Transvaal are litchis. Rosevear (1965) lists dates, guavas, mangoes, bananas and wild figs, which undoubtedly are also utilized locally when available.

BREEDING:

Two lactating females with their newborn young were collected in the Matlapitsi cave during February. According to Rosevear (1965), gestation lasts for four months, with normally one young at a time born per mother.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	154,9	6	146	176
T.	15,6	6	13	19
H.ft.	25,5	6	23	28
Ear	22,6	6	22	32,5
F.arm	88,6	5	84	100
Mass	106,4	5	90	161

Females

	$\bar{X}$	N	Min.	Max.
Tot.	163,4	7	151	173
T.	16,6	7	14,5	18
H.ft.	25,6	7	23	27
Ear	23,0	7	22	24
F.arm	95,8	5	98	92
Mass	137,6	5	128	141

RECORDS OF OCCURRENCE:

Specimens examined, 18: Letsitele, 3 (TM); Malta Farm, 1 (TM); Matlapitsi cave, 12 (TM); The downs, 2 (TM).

Additional records: Chikwarakwara, Smithers (*in litt.*).

SUBORDER MICROCHIROPTERA

(Key after Hayman and Hill, 1971)

1. With a distinct tail extending past the interfemoral membrane 2
   Tail almost entirely enclosed within the inter-femoral membrane... 3
2. Free terminal portion of tail emerges above middle of upper surface of inter-femoral membrane ... ... Emballonuridae
   Free terminal portion of tail enclosed in

but/...

but projecting considerably beyond hind margin of interfemoral membrane ... Molossidae

3. Muzzle without nose-leaves .. .. Vespertilionidae
Muzzle with nose-leaves... 4

4. Muzzle with deep central longitudinal slit lined with fleshly dermal outgrowths . ... Nycteridae
Face without a deep central slit, but with well-developed nose-leaves covering muzzle 5

5. Posterior nose-leaves subtriangular, with erect pointed tip; toes with three phalanges... ... ... Rhinolophidae
Posterior nose-leaves with upper edge either elliptical in outline or tridentate; toes with two phalanges ... ... Hipposideridae

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Family Emballonuridae

Taphozous E. Geoffroy, 1818

1. Fur above grizzled, the tips of the hair whitish, underside pure white; length of skull over 21,5 mm; forearm 58-64 ... ... *mauritianus*
Fur above unicolour; length of skull less than 21,5 mm; forearm 60-67.. ... ... *perforatus*

Taphozous (Taphozous) mauritianus (E. Geoffroy, 1818) Mauritian tomb bat
Witlyf vlermuis

DISTRIBUTION:

This monotypic species is rare in southern Africa, although

it/...

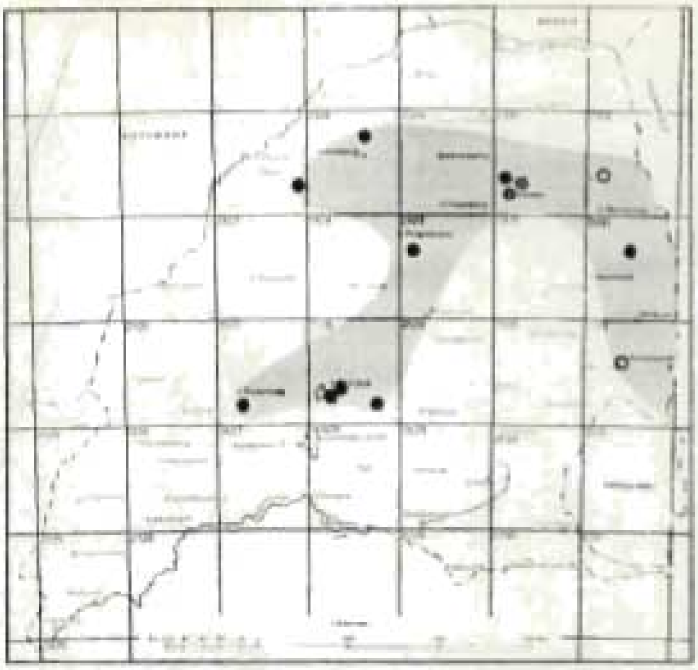

Fig.35: The distribution of *T. mauritianus* in the Transvaal.

it has a wide distribution in Africa south of the Sahara. In the Transvaal, as elsewhere through its range on the subcontinent, it is restricted to woodland savannah. The species is absent from the northwestern Transvaal and adjoining southern Botswana. The range of *T. mauritianus* correlates closely with areas receiving more than 500 mm rainfall per year. The known records falling in areas receiving less than 500 mm average annual precipitation (i.e. Steilloopbrug district, and the Okavango and Francistown in Botswana), are close to swamps and rivers, the latter albeit seasonal. This implies a dependence on either open water or riparian forests.

HABITAT:

Under natural conditions it utilizes the trunks of big trees for daytime roosts. Civilization offers additional roosts in the form of exotic trees (viz. specimen from Rustenburg, collected in a bluegum tree), or walls of buildings just under the overhang of the roof, especially thatched roofs.

HABITS:

Rests by day, singly or mostly in small groups of up to eight individuals. The animals cling to the vertical surface of their refuge, head pointing to the ground. They are very alert, and when disturbed always hastily scramble out of sight, while maintaining their upside-down position. Judging from accumulations of faeces and urine marks, groups have preferred sites which are occupied at least semi-permanently.

They/...

They are nocturnal animals, although Smithers (1971) quotes a low incidence of daytime activity. By night they are silent, solitary, swift fliers, never reported to hunt higher than treetop level. They are easily recognized in flight by the pure white abdomen and parchment-coloured wings. The females carry their babies clinging to the abdomen during flight.

FOOD:

Insectivorous.

BREEDING:

No pregnant or lactating females were collected in the Transvaal. Smithers (1971) reports females with offspring during October in Rhodesia.

MEASUREMENTS AND MASS:

Male

	$\bar{x}$	N	Min.	Max.
Tot.	110,0	11	100	131
T.	21,5	11	17	25
H.ft.	12,3	10	9	14
Ear	18,2	11	13	21
F.arm	62	6	61	63
Mass	29,3	4	26	32

Female

	$\bar{x}$	N	Min.	Max.
Tot.	110,0	5	105	116
T.	22,0	5	20	23
H.ft.	13,6	5	12,5	14
Ear	19,4	5	18,5	21
F.arm	63,0	3	61	66
Mass	31,5	2	31	32

RECORDS OF OCCURRENCE:

Specimens examined, 22: Bronkhorstspruit, 1 (TM); Derdepoort, 5 (TM); Duiwelskloof, 1 (TM); Groothoek, 3 (TM);

Hartebeesfontein, 2 (NKW); Huwi, 5 (TM, 2; CM, 3); (TM); Nicorel, 1 (TM); Olifantspoort, 1 (TM); Pretoria, 1 (TM); Sweet Home, 1 (TM); Tzaneen Estate, 1 (TM).

Additional records: Open circles in the Kruger National Park, after Pienaar (1964).

Taphozous (Taphozous) perforatus (E. Geoffroy, 1818) Egyptian tomb bat
Egiptiese witlyf vlermuis

Although this species has, strictly speaking, never been recorded within the borders of the Republic, it is certain to occur in the extreme northern Transvaal. Smithers (1971) has recorded it along the eastern tip of Botswana (2229 AB) at the joint border with Rhodesia and the Transvaal. It has further been recorded from scattered localities in the southern districts of Rhodesia.

Family Nycteridae

Nycteris G. Cuvier and E. Geoffroy, 1795
Nycteris thebaica (E. Geoffroy, 1818) Egyptian slit-faced bat
Egiptiese langoorvlermuis
N. t. capensis A. Smith, 1829

TAXONOMIC NOTES:

Roberts (1951) and Shortridge (1934) regard *capensis* as a separate species, with *damarensis* Peters, 1870, as a subspecies. Ellerman *et al.* (1953) consider both to be subspecies of *thebaica*, while Hayman and Hill (1971) are doubtful with regard to the subspecies status within *thebaica*. However, they acknowledge the existence of forms differing in size throughout the species range in Africa. With subspecies differences thus undisputed but unresolved, Transvaal material is here referred to *N. t. capensis*, this being

the/...

the senior synonym of all southern races.

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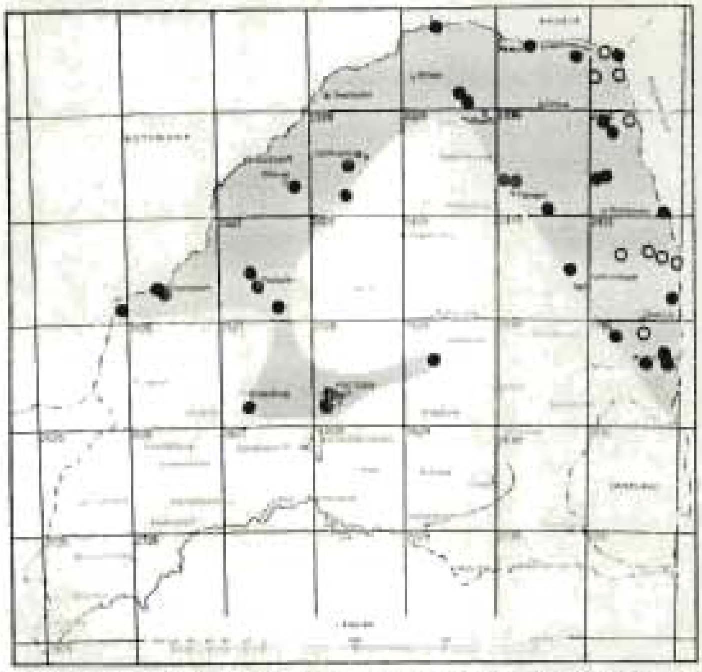

Fig.36: The distribution of *N. thebaica* in the Transvaal.

This is a relatively common bat found throughout the bushveld regions of the Transvaal.

As in the Transvaal, the range of *N. t. capensis* elsewhere in southern Africa appears to be confined to open woodland.

HABITAT:

The Egyptian slit-faced bat is a cave-dwelling species which also utilizes man-made structures such as the dark interiors of attics, disused buildings, tombs, culverts, bridges and mines for its daytime roosts. Smithers (1971) records two colonies known to have occurred in hollow boabab trees at Ngoma and Gweta for many years.

HABITS:

A semi-gregarious species, colonies varying between 6 and c.600. Individuals roost in loose aggregations, suspended by their hind feet from the roof. They emerge at dusk and hunt individually.

This species is a relatively slow but very agile flier. It hunts about a meter or two above the ground, easily avoiding bushes and such-like obstacles. It also preys on ground-living insects. According to Rosevear (1965) the ultrasonic impulses necessary for echolocation are emitted through the nostrils and not through the open mouth as is customary in the Microchiroptera.

Field observations suggest that during the night this bat utilizes a roost other than the normal day-time quarters, to rest and clean itself. Verschuren (1957) found that members of

the/...

the family Nycteridae do not feed on the wing, but consume their prey at these nocturnal perches, which are regularly used, as evidenced by faeces and insect remains on the ground.

N. thebaica appears not to hibernate. Wingate (*in prep.*) has found it to exhibit seasonal migrations in Natal, although as yet its destination in winter has not been located

FOOD:

Insectivorous, mostly small insects because of the limited gape of the mouth. However, Felten (1956) observed the species in S.W.A. to regularly prey upon scorpions, which were carried to a nearby disused storeroom where they were consumed.

BREEDING:

Pregnant females were collected during August and October, and lactating females during November. Smithers (1971) recorded pregnancies during September. This suggests parturition during early summer. In each instance there was one foetus in the right uterine horn.

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	110,6	39	98	117
T.	52,8	39	44	57
H.ft	10,7	36	9	12
Ear	33,1	37	28	39
F.arm	46,7	17	44	49
Mass	10,3	31	9	14

Female

	$\bar{X}$	N	Min.	Max.
Tot.	113,3	59	90	125
T.	54,9	59	48	63
H.ft	10,8	54	9	12
Ear	33,3	59	28	38
F.arm	47,9	35	42	51
Mass	11,6	41	7	16

RECORDS/...

RECORDS OF OCCURRENCE:

Specimens examined, 117: Blyde river Nat. Res., 1 (TM); Bongu Gorge, 1 (NKW); Bordeaux, 5 (TM); Dordrecht, 2 (TM); Duiwelskloof, 1 (TM); Greefswald, 7 (TM); Hectorspruit, 7 (TM); Howell Davies Caves, 1 (TM); Huwi, 6 (TM); Komatipoort, 1 (TM); Letaba Ranch, 9 (TM); Leydsdorp, 2 (TM); Loskopdam, 6 (TM); Olifantspoort, 2 (TM); Mokeetsi, 5 (TM); Mooigenoeg, 5 (TM); Mooiplaas, 1 (TM); Mutale, 1 (TM); Pafuri, 3 (NKW); Pretoria, 7 (TM); Pretoriuskop, 1 (TM); Punda Milia, 1 (TM); Rochdale, 1 (TM); Rooykrans, 8 (TM); Scrutton, 1 (TM); Secheili's Oude Stat, 3 (TM); Shingwidzi, 5 (TM 4; NKW, 1); Ten Bosch Estate, 5 (TM); Thabazimbi, 11 (TM, 1; SI, 10); Tshokwane, 3 (NKW); Welgevonden, 5 (TM).

Additional records: Open circles in Kruger National Park, after Pienaar (1964).

Rhinolophus Lacépède, 1799

Key adapted from Hayman and Hill (1971)

1. Face and/or lateral margins of sella liberally furnished with long hairs; connecting process low, rounded; greatest breadth of horseshoe generally over 9 mm	2
Sella naked; connecting process rounded or pointed; greatest breadth of horseshoe generally under 9 mm	3
2. Forearm 62-67; skull length 26-30 mm	*hildebrandti*
Forearm 50-60; skull length 24-25 mm ...	*fumigatus*
3. Anterior upper premolar, when present, external to toothrow; canine and P^4 in contact; connecting process bluntly pointed	4
Anterior upper premolar in toothrow; canine and P^4 not in contact; connecting process blunt	

or/...

or sharply pointed 5

4. Forearm 50-57 ... ... *olivosus*

Forearm 45-50 ... ... *darlingi*

5. First phalanx of fourth finger notably shortened in relation to metacarpal length ... *landeri*

First phalanx of fourth finger not notably shortened in relation to metacarpal length 6

6. Sella cuneate or wedge-shaped; no marked contrast between crown areas of anterior and posterior lower premolars; forearm 44-48 *blasii*

Sella parallel-sided; strong contrast between crown areas of anterior and posterior lower premolars ... ... *simulator*

Rhinolophus hildebrandti Peters, 1878 Hildebrandt's horseshoe bat
Hildebrandtse vlermuis

Rhinolophus h. hildebrandti Peters, 1878

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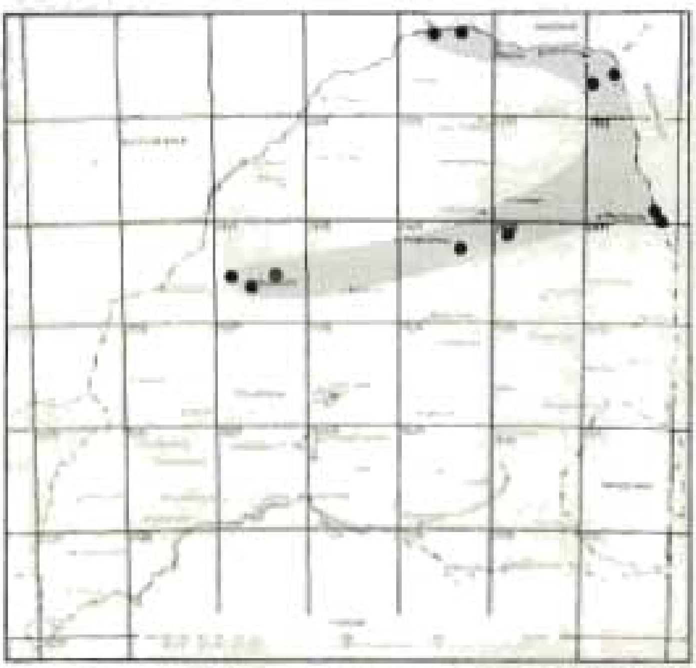

Fig.37: The distribution of *R. hildebrandti* in the Transvaal.

The Transvaal population forms the southern extreme of the species range in Africa. Throughout Africa this species is restricted to the east. In the Transvaal, as elsewhere through its range, Hildebrandt's horseshoe bat is restricted to woodland savannah. It is inexplicably absent from the western woodland regions of northern Botswana, Caprivi and southeastern Angola.

HABITAT/...

HABITAT:

In the Transvaal recorded from caves, mines, disused buildings and, according to Pienaar (1964), hollow boabab trees. Both Roberts (1951) and Ansell (1960) record the species being found hanging freely suspended from the branches of trees.

HABITS:

Colonies are small, 12 being the biggest recorded (Smithers, 1971). Individuals hang separately. Day-time quarters may be shared with such species as *Hipposideros caffer* and *Miniopterus schreibersi*, eg. at Sandspruit Cave no.1 near Thabazimbi.

FOOD:

Insectivorous.

BREEDING:

None of the females collected in the Transvaal were reproductively active. Smithers (1971) recorded pregnancies during October.

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	117,9	13	111	130
T.	38,4	13	33	43
H.ft	14,7	12	125	16
Ear	31,5	12	27,5	33
F.arm	64,5	6	61	69
Mass	24,1	9	20	26,3

Female

	$\bar{X}$	N	Min.	Max.
Tot.	117,4	8	111	128
T.	38,7	9	35	44
H.ft	14,4	10	12	17
Ear	32,8	9	31	34
F.arm	64	3	62	66
Mass	26,4	8	24	31

RECORDS/...

RECORDS OF OCCURRENCE:

Specimens examined, 25: Bongu Gorge, 1 (NKW); Dongola Kop, 2 (TM); Fairfield, 2 (TM); Greefswald, 1 (TM); Gorge Rest Camp, 1 (TM); Mphahlele river, 1 (TM); Punda Milia, 2 (NKW); Punda Milia-Machindudzi, 1 (NKW); Sandspruit, 2 (TM); Thabazimbi, 10 (SI); The Downs, 2 (TM).

Rhinolophus fumigatus Rüppel, 1842 Rüppel's horseshoe bat
Afrikaanse vlermuis

TAXONOMIC NOTES:

Ellerman *et al.* (1953) suggest that *fumigatus* is the prior name for the species formerly called *aethiops*, and this view is supported by Hayman and Hill (1971). Where Ellerman *et al.* (1953) consider *aethiops* to be the southern race of the species, Hayman and Hill (1971) point out that recent authors differ widely in their interpretation of the taxonomic relationships of especially *aethiops*, and as a consequence are unable to define subspecies or synonyms. Following Hayman and Hill (*op. cit.*) no subspecies are recognized in the Transvaal.

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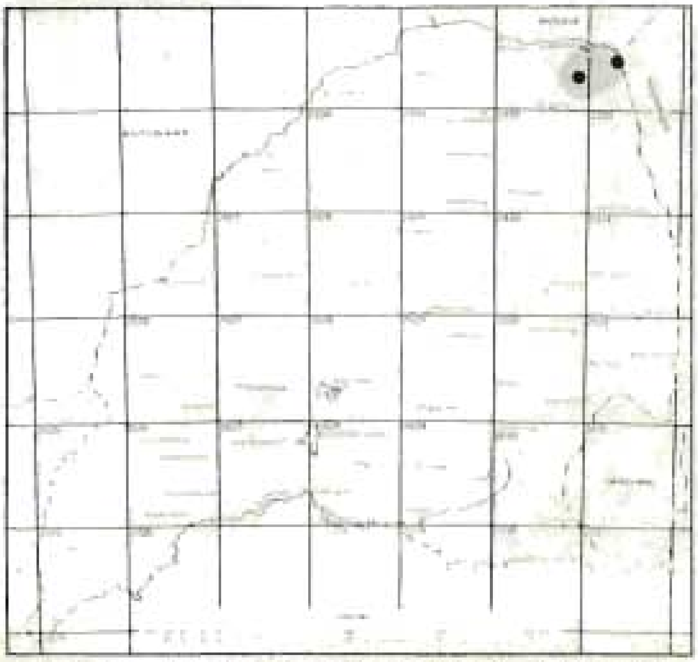

Fig.38: The distribution of *R. fumigatus* in the Transvaal.

In southern Africa the species was formerly known only from the west, from little Namaqualand to Angola (Roberts, 1951; Ellerman *et al.*, 1953). Ansell (1960) subsequently recorded it from Zambia, and recently Smithers (*in litt.*) has shown it to be fairly widespread in Rhodesia. In the Transvaal the species is currently

known/...

known only from the north-east, viz. one locality in the Kruger National Park (Rautenbach, 1975), and another on the Levuvhu river just outside the Park.

HABITAT:

The two specimens recorded from the Transvaal were both collected in hollow boabab trees. According to Rosevear (1965) the species is also to be found in caves and smaller crevices formed by rock debris. Rosevear (*op.cit.*) is of the opinion that this species is an inhabitant of open woodlands, although its present known range in southern Africa does not extend over all known open woodlands.

HABITS:

Aellen (1952) observed a small colony to roost closely packed together, which is atypical for the Rhinolophidae. The two specimens collected in the Transvaal were both solitary. Very little is otherwise known of the habits of Rüppel's horseshoe bat.

FOOD:

Insectivorous.

BREEDING:

No information available.

MEASUREMENTS AND MASS:

	Tot.	T.	H.ft.	E.	F.arm.		Mass
Male							
TM 25530:	105	29	10	25	53	=	14g
Female							
Chir. NKW 86:	95	30	9	24	51	=	14g

RECORDS OF OCCURRENCE:

Specimens examined, 2: On Levuvhu river, 1 (TM); Machindudzi, 1 (NKW).

Rhinolophus/...

Rhinolophus clivosus Cretzschmar, 1828 Geoffroy's horseshoe bat
Geoffroyse vlermuis

R. c. augur Andersen, 1904
R. c. zuluensis Andersen, 1904

TAXONOMIC NOTES:

R. clivosus includes, as synonyms, *geoffroyi* A. Smith, 1829, and *ferrumequinum* Dobson, 1878, as understood by Harrison (1959) and Ansell (1960). *R. c. zuluensis* includes *zambesiensis* Andersen, 1904, as a synonym.

R. c. augur and *R. c. zuluensis* are both here considered to occur in the Transvaal, the former in the western and northern, and the latter in the eastern Transvaal. However, the possibility that *zuluensis* may be a synonym of *augur* was mentioned by Meester *et al.* (1964) and may well be confirmed if more material becomes available. The two subspecies are separated on the basis of colour, *zuluensis* being darker. The two forms are sympatric in the Pretoria, Witwatersrand and Rustenburg area. Specimens in the Transvaal Museum collection collected before 1906 can be shown to be consistently lighter than recent acquisitions from the same area, eg. the Krugersdorp district. This suggests that specimens may fade in time, a possibility which should be kept in mind if the status of these two forms is reconsidered with colour as a diagnostic feature.

DISTRIBUTION:

Geoffroy's horseshoe bat occurs throughout the province, with the exception of the more arid northwestern Transvaal. The species has most probably been overlooked in the southwestern Transvaal and in the large area of the Kruger National Park between Skukuza and Punda Milia.

HABITAT:

A cave-dwelling species, with an apparent preference for caves with high humidity.

HABITS:

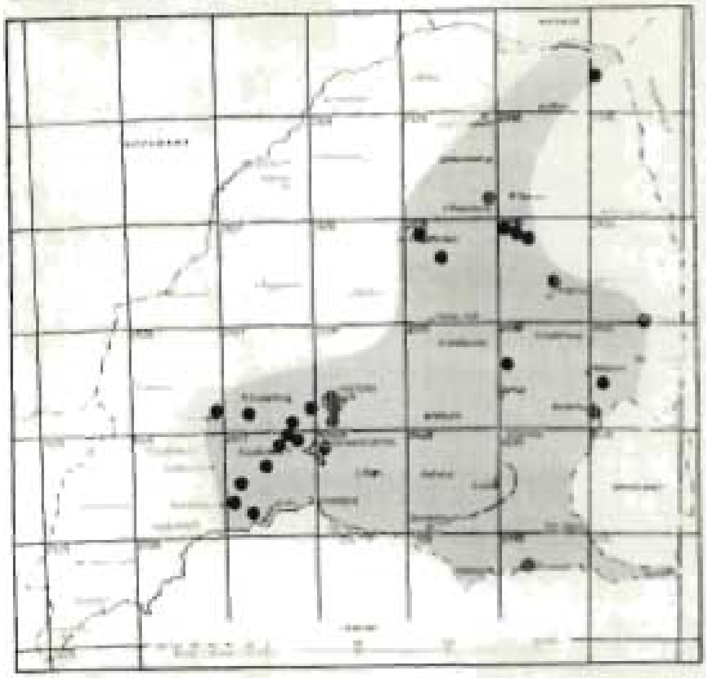

Fig.39: The distribution of *R. clivosus* in the Transvaal.

R. clivosus has been one of the species receiving close attention during the past 15 years through the activities of the Transvaal Museum Bat Banding Committee. The most important point that has emerged is that this species is migratory only to a limited extent, and that all known migrations are local. The disturbance of banding operations may have a causal effect on these local migrations.

R. clivosus is normally torpid during winter, although it intermittently displays low-level activity. It roosts individually or in small colonies hanging loosely from the cave roof. These bats emerge from their cave approximately 30 minutes after sunset. Hunting seems to be at a peak during the early hours of the night. Geoffroy's horseshoe bats were on several occasions observed resting in regular nighttime roosts other than the daytime refuges. An individual collected at Dullstroom regularly came to roost in a farmhouse kitchen. Droppings and the wings of smaller beetles, and especially moths, characterize the night roosts of *R. clivosus*. It probably also feeds on other insects which can be consumed *in toto*.

FOOD:

Entirely insectivorous, with an apparent preference for moths and smaller beetles.

BREEDING:

Pregnant females were collected only during November, with

foetuses/...

foetuses ranging in crown-rump length from 25-30 mm. Only one foetus per female.

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	95,9	63	80	112
T.	32,2	63	27	38
H.ft	11,1	57	9	13
Ear	21,1	63	18	24
F.arm	53,1	32	52	56
Mass	16,2	20	13	20

Female

	$\bar{X}$	N	Min.	Max.
Tot.	97,2	75	85	11
T.	31,7	75	27	38
H.ft	10,6	74	8	14
Ear	21,2	75	18	24
F.arm	53,8	28	51	57
Mass	17,0	24	12	25

RECORDS OF OCCURRENCE:

Specimens examined, 152: Barberton, 1 (TM); Cave of Death, 1 (TM); Cyprus, 2 (TM); Echo Caves, 4 (TM); Frederikstad, 1 (TM); Groenkloof, 1 (TM); Grootsuikerboschkop and Elandslaagte, 1 (TM); Howell Davis Cave, 2 (TM); Johannesburg, 1 (TM); Kastrolnek, 3 (TM); Kosterfontein, 1 (TM); Krugersdorp, 2 (TM); Makapans Cave, 4 (TM); Monument Park, 1 (TM); Olifantspoort, 1 (TM); New Agatha Forest Reserve, 8 (TM); Peppercorn, 1 (TM); Potchefstroom, 6 (TM); Pretoria, 60 (TM, 5; SI, 55); Punda Milia, 1 (NKW); Skurweberg, 5 (TM); Sterkfontein, 8 (TM); The Downs, 1 (TM); Uitkomst, 6 (TM); Uitkyk, 5 (TM); Venterskroon, 6 (TM); West Drie Fontein Cave, 1 (TM); Wonderfontein, 17 (TM); Woodbush, 1 (TM).

Additional records: Skukuza, Ellerman *et al.* (1953:57).

Rhinolophus/...

Rhinolophus darlingi Andersen, 1905 Darling's horseshoe bat
Darlingse vlermuis

R. d. darlingi Andersen, 1905

TAXONOMIC NOTES:

R. d. darlingi includes *barbertonensis* Roberts, 1924, as a synonym. Ellerman *et al.* (1953) believe that *R. d. damarensis* Roberts, 1946, is also a synonym of *darlingi*, unlike Hayman and Hill (1971) who are followed here.

DISTRIBUTION:

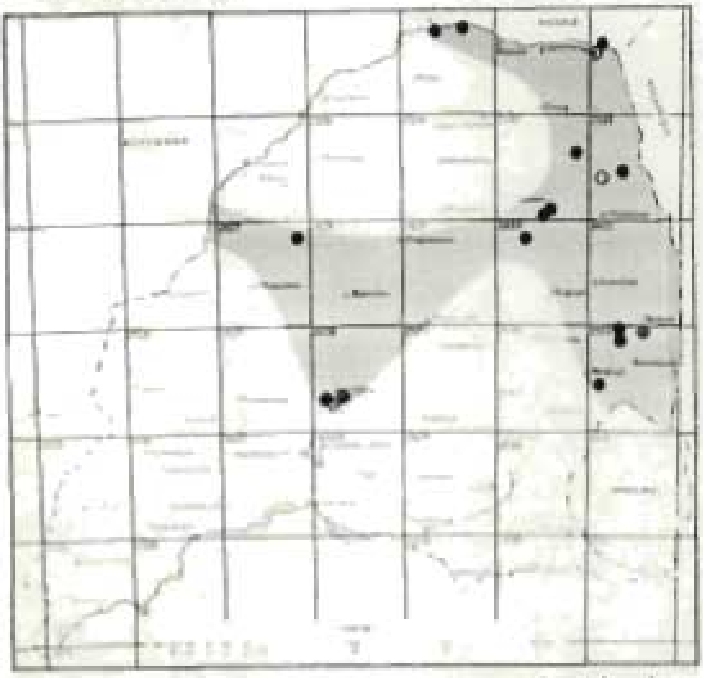

Fig.40: The distribution of *R. darlingi* in the Transvaal.

As elsewhere throughout its range in southern Africa, the species is restricted in the Transvaal to bushveld areas, as well as the eastern escarpment at Ofcolaco and Leydsdorp. It is probably widespread in these wooded areas of the Transvaal, although overlooked in many districts.

HABITAT:

Since Darling's horseshoe bat is more often encountered in caves it is an indication that, like the rest of the Rhinolophidae, it is principally a cave-dweller. It has also been collected from mines (eg. Gravelotte mine), attics, deserted constructions and shallow rock crevices. All localities in the Transvaal are situated in open woodland. Two specimens were collected in riverine forest at Greefswald 37MS, in the vicinity of rocky outcrops, where a further series was subsequently collected by day in shallow crevices.

HABITS:

Absolute/...

Absolute darkness during daylight resting periods is not essential as specimens were often collected roosting in dimly lit sites, eg. rock crevices or old abodes. This species roosts in small loose aggregations of two to 15 individuals, hanging upside-down from cave roofs, rafters, etc. Judging from the amount of guano, these roosts are not occupied for prolonged periods.

FOOD:

Insectivorous.

BREEDING:

A single pregnant female was collected during October, with one 22 mm foetus in the right horn of the uterus.

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	81,2	16	70	91
T.	28,5	16	21	36
H.ft	9,2	14	8	10
Ear	20,3	13	18	25
F.arm	45,5	4	44	48
Mass	8,0	6	7	9

Female

	$\bar{X}$	N	Min.	Max.
Tot.	85,5	28	75	95
T.	30,1	28	24	35
H.ft	8,7	27	7	10
Ear	20,4	26	17	22
F.arm	46,2	17	45	49
Mass	9,4	20	6,5	14

RECORDS OF OCCURRENCE:

Specimens examined, 45: Baviaanspoort, 6 (TM); Birthday Mines, 1 (TM); Chikwarakwara, 1 (RM); Cyprus, 3 (TM); Dongola Kop, 1 (TM); Gravelotte Mine, 8 (TM); Greefswald, 4 (TM);

Leydsdorp/...

Leydsdorp, 3 (TM); Makupane Cave, 2 (TM); Malalaspruit, 1 (NKW); Matupa Kop, 1 (NKW); Mooigenoeg, 2 (TM); Platbos, 1 (TM); Pretoria, 1 (TM); Skukuza Koppies, 9 (TM, 5; NKW, 4); Uitkyk, 1 (TM).

Additional records: Open circle in Kruger National Park, after Pienaar (1964).

Rhinolophus landeri Martin, 1838 Lander's horseshoe bat
Landerse vlermuis

R. l. lobatus Peters, 1852

TAXONOMIC NOTES:

Roberts, 1951 regards *lobatus* as a distinct species. The view here presented is that of Hayman and Hill (1971). The two marked colour phases which occur elsewhere in the range of this species (Rosevear, 1965), have also been noted in the Transvaal, namely a pale grey to grey brown phase, and a bright rufous phase.

DISTRIBUTION:

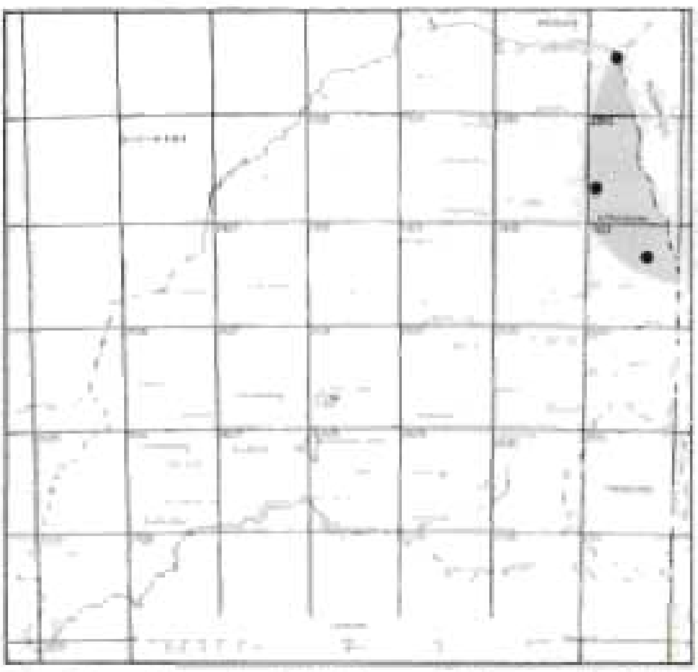

Fig.41: The distribution of *R. landeri* in the Transvaal.

Known only from the northern parts of the eastern Transvaal lowveld.

HABITAT:

In the Transvaal Lander's horseshoe bat has been noted to utilize caves, a pumphouse, and rafters under thatched roofs as daylight abodes. Transvaal records indicate an association with drier open woodland, but Rosevear (1965) notes it to also occur on high mountains,

rain/...

rain forests and Guinea woodland, supporting the view of Verschuren (1957) that this bat is very adaptable to its specific vegetational surroundings.

HABITS:

R. landeri may roost solitarily, or in small isolated groups suspended from the roof, not actually in bodily contact. Eisentraut (1940) recorded some torpid individuals in a cave colony, while others were active, suggesting that body temperature and activity are independent of environmental conditions. However, recent studies indicate that hibernating bats become active as a result of internal as well as external stimuli (see van der Merwe, 1973a and b, 1975).

FOOD:

Insectivorous.

BREEDING:

No pregnant or lactating females have been recorded to date.

MEASUREMENTS AND MASS:

Only five specimens (four males and one female) are known from the Transvaal, of which four are housed in the reference collection of the National Parks Board in Skukuza.

Males

	Tot.	T.	H.ft.	E.	F.arm.		Mass
TM 25538:	84	27	9	17	44	=	9g
NKW (Chir.) 81:	78	25	8,5	19	43	=	10g
NKW (Chir.) 82:	80	25	9	19	45	=	11g
NKW (Chir.) 72:	75	25	8	16,5	43	=	?
Female							
NKW (Chir.) 83:	82	25	8,5	19	44	=	9g

RECORDS OF OCCURRENCE:

Specimens examined, 4: Letaba Ranch, 1 (TM); Ngirivane, 1 (NKW); Levuvhu, 2 (NKW).

Rhinolophus blasii Peters, 1866 Peak-saddle horseshoe bat
Saalneusvlermuis

R. b. empusa Andersen, 1904

TAXONOMIC NOTES:

Roberts (1951) and earlier authors regard *empusa* as a distinct species. The more recent treatment of Hayman and Hill (1971) is followed here.

DISTRIBUTION:

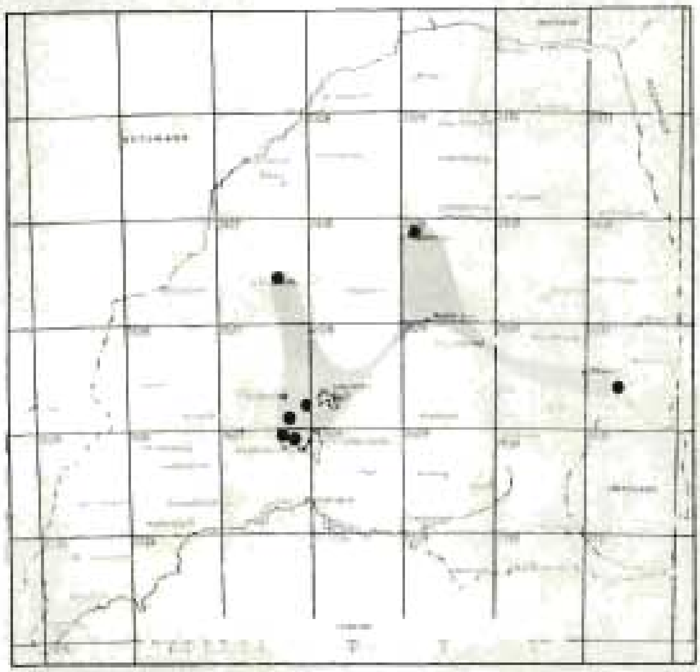

Fig.42: The distribution of *R. blasii* in the Transvaal.

Transvaal records are too scattered to define the distribution pattern. It would however appear that elsewhere in Africa this species is restricted to open woodland. As the peak-saddle horseshoe bat occurs also in Rhodesia, it may have been overlooked in the northern north-eastern Transvaal.

Records from the Krugersdorp district represent the most southern limit of the species' range in Africa.

HABITAT:

Very little is known of the habitat requirements of this species. Thus far it has been reported to utilize only dark caves and mines as daytime roosts. From its known range it can be concluded that it is essentially an inhabitant of open woodland.

HABITS:

From isolated observations on *R. blasii*, behaviour appears to be similar to that of other Transvaal Rhinolophidae, in that it

is/...

is principally a cave dweller. It also typically roosts in small groups suspended from the cave roofs, with individuals not in physical contact. During regular visits to dolomite caves in the Krugersdorp district, the species was recorded only occasionally, suggesting that it is to some extent migratory, although it is impossible to determine whether migration is seasonal. *R. blasii* has been recorded to hibernate in these caves during winter.

FOOD:

Insectivorous.

BREEDING:

No pregnant or lactating females were collected in the Transvaal.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	76,3	18	70	100
T.	26,1	18	21	30
H.ft	9,1	18	7	10
Ear	18,0	18	15	21
F.arm	44,9	17	41,4	46,7
Mass	4,2	3	2,1	7,5

Females

	$\bar{X}$	N	Min.	Max.
Tot.	75,3	14	62,5	89
T.	26	14	21	30
H.ft	8,7	14	7	10
Ear	17,5	14	15	20
F.arm	46,0	16	43,3	47,4
Mass	2,6	2	2,1	3

RECORDS OF OCCURRENCE:

Specimens examined, 37: Imperial Mine, 1 (TM); Krugersdorp, 4 (TM); Makapansgat, 5 (TM); Rooiberg, 2 (TM); Sandspruit, 7 (TM); Skurweberg, 1 (TM); Sterkfontein, 1 (TM); Uitkyk, 13 (TM); Uitkomst, 3 (TM).

Rhinolophus simulator Andersen, 1904 — Bushveld horseshoe bat
Bosveld vlermuis

DISTRIBUTION:

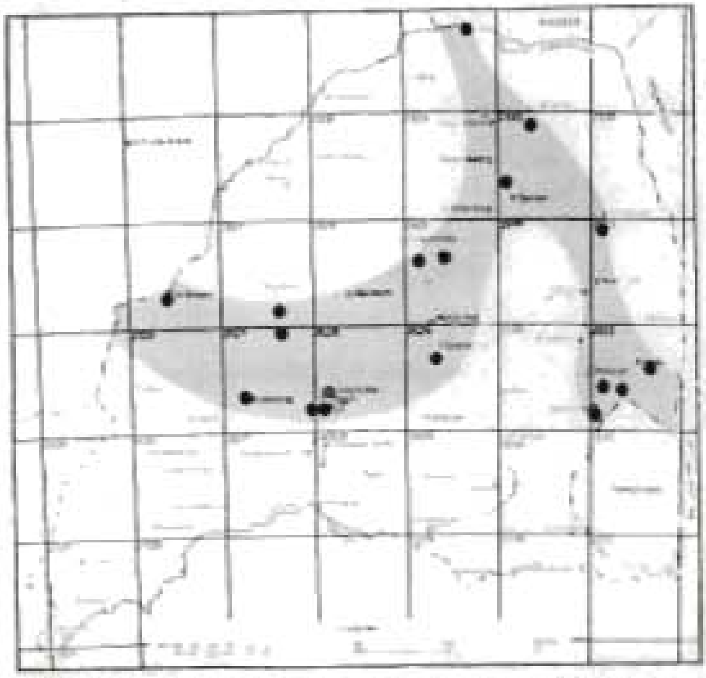

Fig.43: The distribution of *R. simulator* in the Transvaal.

In the Transvaal this species is restricted to undifferentiated woodland savanna. Only one record exists from mopane woodland, which the species seems to avoid in Rhodesia and elsewhere. The range of *R. simulator* appears to be restricted by rainfall, as known records in southern Africa (with two exceptions) fall in areas receiving more than 500 mm precipitation per annum.

HABITAT:

Recorded only from the dark interior of caves and deserted mines.

HABITS:

Although smaller colonies are often encountered, specimens taken from Derdepoort, Potgietersrus and Entabeni State Forest were all from relatively large aggregations of *circa* 300. Individuals hang loosely suspended from the roof. Some caves and mines were very wet whereas others were dry, which implies that relative humidity is not vital in the choice of a refuge.

Of 12 specimens collected at Potgietersrus during January 1974, seven were adult females apparently in the final stages

of/...

of lactation, judging from the condition of their nipples. Five subadults of this series were roosting away from their mothers and had already reached adult size (Fore-arm length $\bar{X}$ = 46,0 mm as compared to 46,5 mm in seven adults). The subadults were grey as compared to the rufous colouration of the females. From preserved material it appears that the *circa* 300 bats present in the cave at the time constituted a maternity colony, and that the offspring had become independent once adult size was attained. An all-female colony encountered during September showed a high incidence of pregnancy.

A rufous colour phase has been recorded in *R. simulator* from the eastern Transvaal by Roberts (1951). According to Roberts (*op. cit.*) the young begin with a whitish fur, and then pass through a yellow phase to the adult rufous phase. The rufous and normal adult colour phases occur in the same areas and no other differences could be found between them.

A specimen was collected in a rondavel at Loskopdam where it regularly fed during the early evening on insects attracted to the lamp.

Judging from the amount of guano found under colonies, refuges are utilized permanently or semi-permanently.

FOOD:

Insectivorous.

BREEDING:

In the January series discussed above seven adult females were lactating. Another series of 11 females, taken during September at Derdepoort, contained nine pregnant females. The similarity in weights of subadults from a Potgietersrus series, as well as the similar sizes of foetuses from the Derdepoort series, indicate a restricted breeding season during early summer. Pregnant females each carried only one foetus, ranging in size between five and seven millimeters.

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	76,2	15	64	86
T.	26,2	15	22	30
H.ft	8,5	15	7	10
Ear	20,8	15	18	23
F.arm	44,5	19	43	46
Mass	8	5	8	8

Female

	$\bar{X}$	N	Min.	Max.
Tot.	79,2	39	68	90
T.	26,0	39	21	32
H.ft	7,9	38	7	10
Ear	22,2	39	19	24
F.arm	45,9	39	44,1	48
Mass	9,2	39	8	11

RECORDS OF OCCURRENCE:

Specimens examined, 67: Cinnabar, 2 (TM); Dongolakop, 1 (TM); Groothoek, 12 (TM); Hectorspruit, 5 (TM); Howell Davies Caves, 10 (TM); Imperial Mine, 4 (TM); Klein Letaba, 1 (TM); Loskopdam Nature Reserve, 1 (TM); Mokeetsi, 1 (TM); Mooimeisiesfontein, 9 (TM); Mooiplaas, 11 (TM); Rhoda, 3 (TM); Rooikrans, 1 (TM); Rustenburg, 1 (DM); Skurweberg Cave, 2 (TM); Uitkyk, 1 (TM); Wonderboom, 2 (TM).

Family Hipposideridae

1. Larger; rostrum at least half as long as braincase; forearm over 42 ... ... *Hipposideros*
Smaller; rostrum less than half the length of braincase; forearm 31-35... ... ... *Cloeotis*

Hipposideros/...

Hipposideros Gray, 1831

Hipposideros caffer (Sundevall, 1846) Common African leaf-nosed bat
Kaapse blaarneus vlermuis

TAXONOMIC NOTES:

Two extreme colour phases occur in this species, namely a common dark grey phase with light-coloured hair-basis, and an orange-rufous phase. Intermediate colour phases are also represented in the Transvaal Museum collections.

DISTRIBUTION:

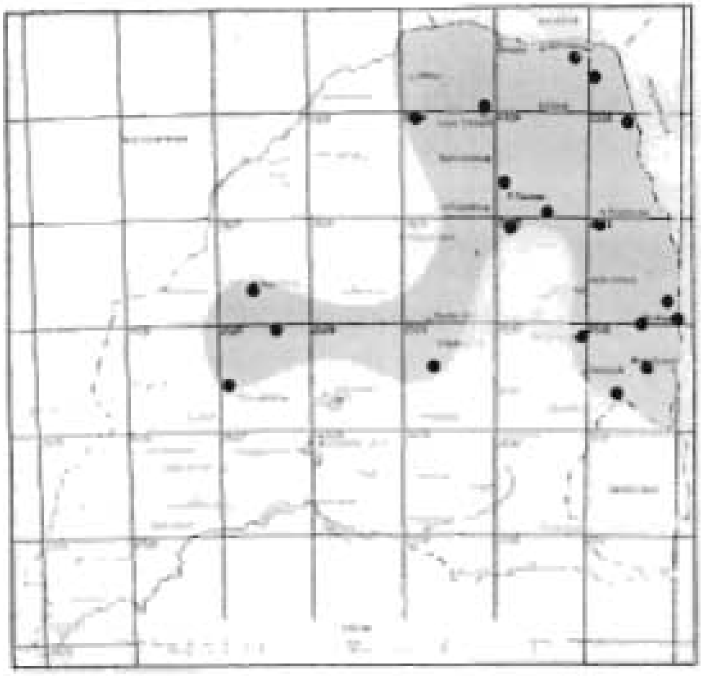

Fig.44: The distribution of *H. caffer* in the Transvaal.

Widely distributed in wooded areas of Africa, except the central forested regions (Hayman and Hill, 1971). In the Transvaal the species is restricted to the bushveld region. It is conspicuously absent in the dry Limpopo river valley of the north-western and northern Transvaal.

There is a tendency for the range of this species to be restricted to the above 500 mm rainfall zone in the Transvaal, Rhodesia and Botswana. Exceptions to this are to be found in the lower rainfall area of the north-eastern Transvaal and adjoining south-eastern Rhodesia, where the habitat requirements are probably met by permanent rivers and associated vegetation.

HABITAT:

The common African leaf-nosed bat is essentially a cave dweller, and in the Transvaal as elsewhere it resides in colonies of several hundreds. It also utilizes the dark interiors of old mines. Smaller colonies are also to be found under the roofs of old houses

and/...

and even in concrete pipe culverts. It appears to be associated with wooded regions; this may be related to feeding behaviour (see below).

HABITS:

Under optimum conditons *R. caffer* congregates in colonies of several hundreds. Individuals roost well apart, suspended from the ceiling of the refuge.

Smithers (1971) suggests that it may be dependent on water, which is borne out by its moisture-restricted range. It is a slow, agile flyer, often observed flying continuously over water surfaces; it has also been observed flying at tree-top level, and even sometimes at ground level at kraal sites as observed by Smithers (1971). Flight behaviour suggests that it feeds on the wing (see also Rosevear, 1965), although Roberts (1951) is of the opinion that it takes its prey from leaves and not in flight.

FOOD:

Insectivorous.

BREEDING:

No records are available of pregnant or lactating females.

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	86,8	30	73	97,5
T.	28,9	31	23	35
H.ft	8,7	24	7	10
Ear	14,7	24	10	17
F.arm	47,7	16	46	49
Mass	9,1	17	8	10,5

Female

	$\bar{X}$	N	Min.	Max.
Tot.	85,5	25	73	92

T./...

T.	31,1	26	23	36
H.ft	8,3	25	5	10
Ear	15,5	25	11	18
F.arm	46,6	15	44	49
Mass	8,4	17	6	15

RECORDS OF OCCURRENCE:

Specimens examined, 72: Hectorspruit, 9 (TM); Leydsdorp, 3 (TM); Loskopdam Nature Reserve, 3 (TM); Louws Creek, 1 (TM); Mokeetsi, 2 (TM); Mooimeisiesfontein, 4 (TM); Munweni Cave, 3 (NKW); Mutale, 3 (TM); Punda Milia, 1 (NKW); Rhoda, 19 (TM); Rustenburg, 4 (TM); Shingwidzi, 3 (NKW); Skukuza, 1 (TM); Thabazimbi, 2 (SI); The Downs, 9 (TM); Tshokwane, 1 (NKW); Tzaneen, 1 (TM); Urk, 2 (TM); Zwarthoek, 1 (TM).

Additional records: Open circles in Kruger National Park, after Pienaar (1964).

Cloeotis Thomas, 1901

Cloeotis percivali Thomas, 1901 Short-eared trident bat
Drietandneus-vlermuis

C. p. australis Roberts, 1917

DISTRIBUTION:

In the Transvaal the species is known from three localities in the Pretoria and Rustenburg districts, and from an isolated locality at Komatipoort. However, it occurs widely, although nowhere abundant, in Rhodesia, and is also to be found in north-eastern Botswana. It is therefore likely that this species has been overlooked throughout the northern bushveld regions of the Transvaal.

HABITAT:

All specimens were taken in caves and mines.

HABITS/...

HABITS:

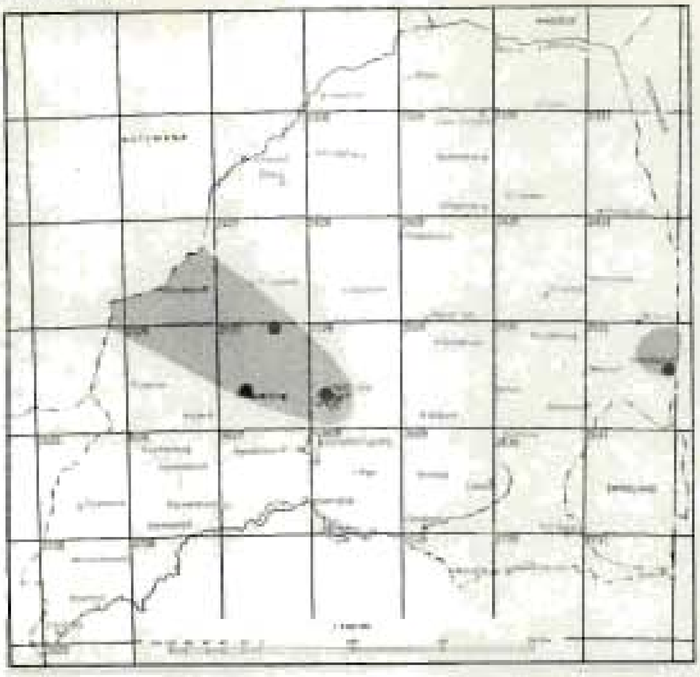

Fig.45: The distribution of *C. percivali* in the Transvaal.

Roberts (1951) encountered large colonies, from which it can be concluded that this is a gregarious species. Nothing else is known about its life history.

FOOD:

Insectivorous.

BREEDING:

No pregnant or lactating females were collected. Smithers (1971) recorded pregnancies during October.

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	62,8	4	57	69
T.	27,3	4	23	31
H.ft	6,5	4	6	7
Ear	8,5	4	8	9
F.arm	34,1	6	33,1	34,7
Mass	-	-	-	-

Female

	$\bar{X}$	N	Min.	Max.
Tot.	62,3	4	56	68
T.	25,0	4	22	27
H.ft	6,3	4	6	7
Ear	8,4	4	8	9
F.arm	34,3	4	33,2	35,2
Mass	-	-	-	-

RECORDS/...

RECORDS OF OCCURRENCE:

Specimens examined, 10: Komatipoort, 1 (TM); Mooimeisiesfontein, 5 (TM); Rustenburg, 1 (TM); Waterberg, 1 (TM); Wonderboom, 2 (TM).

Family Vespertilionidae

1. 1. Second phalanx of third digit about three times as long as first; braincase high and rounded ... ... Miniopterinae
   Second phalanx of third digit not especially elongated... 2
2. 2. Ears not funnel-shaped, without deep emargination below tip; tragus short and broad, or long and narrow, but not sharply pointed; braincase not particularly high and rounded Vespertilioninae
   Ears funnel-shaped, with deep emargination below tip; tragus long, narrow, sharply pointed; braincase high and rounded... ... Kerivoulinae

---

Subfamily Vespertilioninae

1. Six upper, six lower cheek teeth on each side... ... ... *Myotis*
Less than six upper and six lower cheek teeth.. 2

2. Two upper incisors on each side 3
One upper incisor on each side 5

3. Wings with a conspicuous dark reticulate pattern on a pale background .. .. *Glauconycteris*
Wings unicolour 4

4. Upper jaw with two premolars on each side *Pipistrellus*

Upper/...

Upper jaw with one premolar on each side ... ... *Eptesicus*

5. Skull with a distinct posteriorly-projecting helmet: ear tragus long, tapering ... ... *Scotophilus*

Skull normal; ear tragus half-moon shaped *Nycticeius*

Myotis (Chrysopteron) welwitschii (Gray, 1866) Welwitsch's bat
Welwitsch se langhaar-vlermuis

DISTRIBUTION:

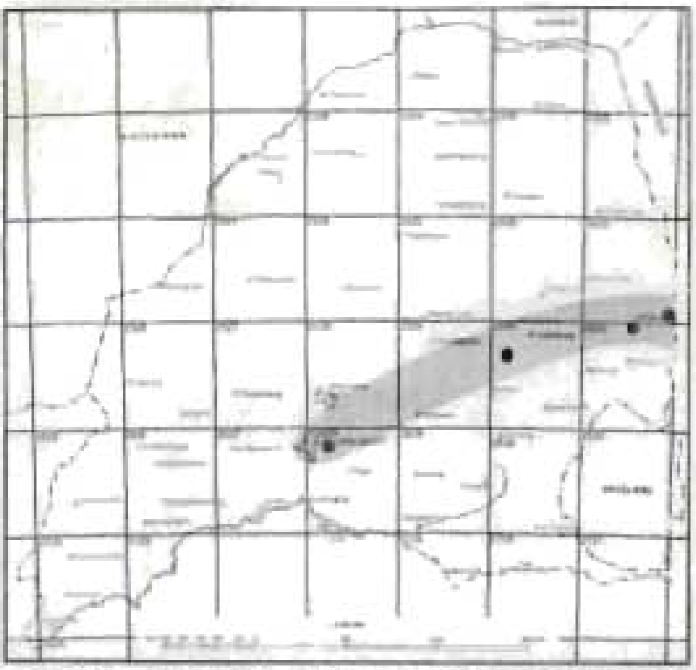

Fig.46: The distribution of *M welwitschii* in the Transvaal.

Throughout its range in Africa this rare species is known only from scattered localities. In the Transvaal it is known from four localities, two in the eastern Transvaal lowveld, and two on the highveld.

HABITAT:

A specimen from Boksburg was collected in a factory. Two specimens from the Kruger National Park were both collected by day, roosting individually in a scrubby bush in the Lebombo mountains. Nothing is known of the conditions under which the Belfast specimen was collected.

HABITS:

From the isolated encounters mentioned above, it would appear that Welwitsch's bat is solitary in habits.

FOOD/...

FOOD:

Insectivorous.

BREEDING:

No information available.

MEASUREMENTS AND MASS:

Two of the specimens known from the Transvaal are housed in the Skukuza reference collection of the National Parks Board. They are:

	Tot.	T.	H.ft.	Ear	F.arm	Mass
NKW (Chir.) 98: ♀:	109	54	8	22	57	= ?g
Uncatalogued and unsexed:	116	50	9,5	22	57	= 14,3g

Only one of the two Transvaal Museum specimens has been measured namely:

TM 17035: ♂:	127	61	10	18	57	= ?g

RECORDS OF OCCURRENCE:

Specimens examined, 4: Boksburg, 1 (TM); Elandsklip, 1 (TM); Nwaswitsake, 1 (NKW).

Unnamed locality at 25°03'S;31°32'E, 1 (NKW).

Myotis (Selysius) tricolor (Temminck, 1832) Cape hairy bat
Kaapse langhaarvlermuis

DISTRIBUTION:

In the Transvaal it is recorded from the south-eastern Transvaal lowveld, and from the central and southern Transvaal. All available records of *M. tricolor* in southern Africa are from areas with mean annual rainfall of 500 mm or more, which explains its absence from the northern Transvaal. The range of the Cape hairy bat is possibly also affected by the availability of suitable caves.

All/...

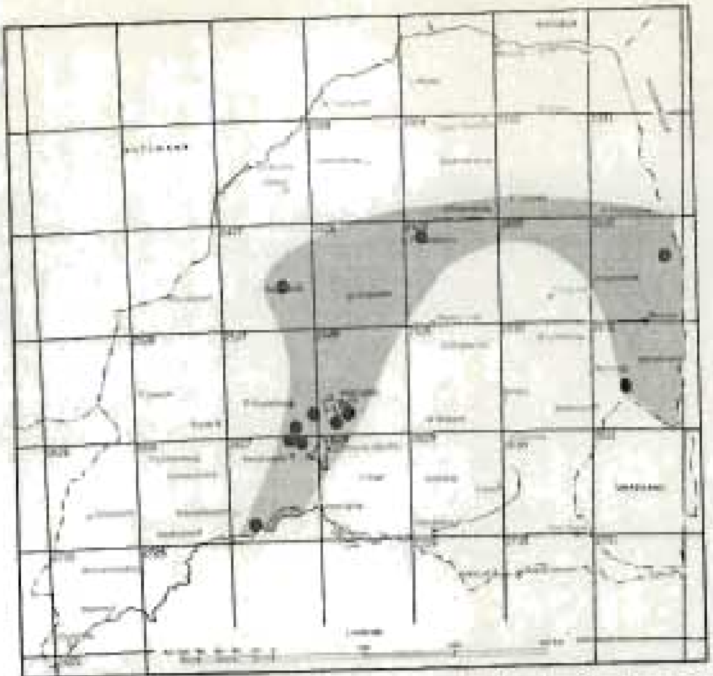

Fig.47: The distribution of *M. tricolor* in the Transvaal.

All over Africa this species has an easterly distribution, and this may explain why it has not been recorded from the south-western Transvaal.

HABITAT:

M. tricolor prefers caves or disused mining adits as daytime retreats. The surrounding veld types do not appear to be of any great importance as it occurs in most of the bush-veld as well as parts of the highveld grassland. As suggested by Roberts (1951), it would appear that the Cape hairy bat is partial to refuges with higher relative humidities.

HABITS:

A social species which normally congregates in fair numbers, either hanging or clinging with fore and hind claws to the roof. It is migratory to a limited extent as it irregularly visits the Krugersdorp dolomite caves. These migrations are unlikely to be seasonal as specimens have been collected throughout the year in both highveld and bushveld caves.

FOOD:

Insectivorous.

BREEDING:

No pregnant or lactating females have been collected in the Transvaal.

MEASUREMENTS/...

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	106,2	14	95	118
T.	44,0	14	35	54
H.ft	10,7	13	9,5	13
Ear	16,0	14	14	19
F.arm	49,9	14	47,5	52,0
Mass	12,4	5	8	15

Female

	$\bar{X}$	N	Min.	Max.
Tot.	108,7	21	95	121
T.	49,2	20	43	56
H.ft	11,3	21	10	13
Ear	16,9	21	13	19
F.arm	50,9	19	46,6	53,4
Mass	11,7	6	10	14

RECORDS OF OCCURRENCE:

Specimens examined, 38: Cave of Death, 1 (TM); Ficus Cave, 5 (TM); Gansfontein, 1 (TM); Irene, 3 (TM); Louws Creek, 4 (TM); Makapans Cave, 3 (TM); Peppercorn Cave, 3 (TM); Satara, 1 (NKW); Schurweberg Caves, 3 (TM); Sterkfontein, 1 (TM); Uitkomst, 4 (TM); Uitkyk, 4 (TM); Venterskroon, 4 (TM); Zandspruit Caves, 1 (TM).

Nycticeius Rafinesque, 1819

Nycticeius (Scoteinus) schlieffeni (Peters, 1859) Schliefen's bat

Klein-dakvlermuis

N. s. australis Thomas and Wroughton, 1908

DISTRIBUTION:

This small bat is widespread and common over most of Africa from south of the Sahara to Zululand, in open woodlands of more

arid/...

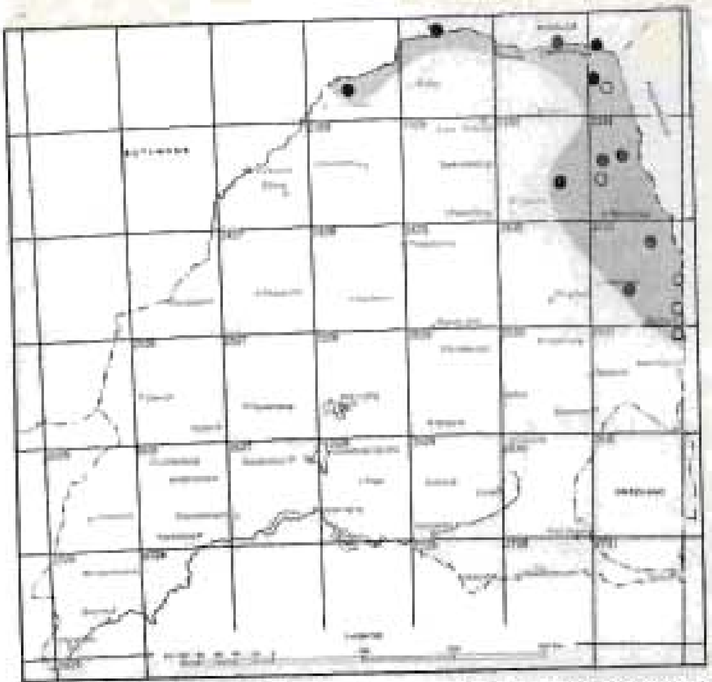

Fig.48: The distribution of *N. schlieffeni* in the Transvaal.

arid areas (Rosevear, 1965). In the Transvaal it is limited to the eastern and extreme north-eastern lowveld, almost exclusively within the boundaries of the Kruger National Park. The range of this species in southern Africa does not appear to be affected by any single environmental factor. In the Transvaal it would appear that the eastern escarpment and the Zoutpansberg act as barriers, although the same cannot be said of the Lebombo mountains.

HABITAT:

Schliefen's bat appears to have a wide habitat tolerance. It has been collected in areas receiving between as little as 250 mm and as much as 1 500 mm mean annual rainfall. It utilizes huts, larger houses, cellars and narrow crevices in branches as daytime roosts (Rosevear, 1965), as well as rock crevices and lofts of disused buildings (Pienaar, 1964). According to Pienaar (1964) and Smithers (1971) the species is dependent on open water in the form of marshes, water-holes or rivers. All southern African records are from open woodland.

HABITS:

N. schlieffeni, being gregarious, roosts together in large numbers. It rests in narrow crevices as do the Molossidae, with the abdomen pressed against the substrate and the wings tucked in against the body. According to Shortridge (1934) it is one of the first bats to emerge at dusk. It is very agile in flight and is regularly observed to hunt insects over water surfaces.

FOOD/...

FOOD:

Insectivorous.

BREEDING:

No pregnant or lactating females have been recorded to date.

MEASUREMENTS AND MASS:

Male

	Tot.	T.	H.ft.	E.	F.arm.		Mass
NKW (Chir.) 13:	71	26	6	12	29	=	5,2g
NKW (Chir.) 14:	72,5	28,5	4,5	9,5	28	=	3,5g
NKW (Chir.) 12:	61	20	6	10	30	=	5,0g
Female							
TM 7092:	70	30	5	8	31	=	?g
NKW (Chir.) 69:	70	28	5,5	13	32	=	3,5g
NKW (Chir.) 32:	68	26	7	8	30	=	4,0g

RECORDS OF OCCURRENCE:

Specimens examined, 11: Chikwarakwara, 1 (RM); Al-te-Vêr, 1 (TM); Hans Merensky Prov. Nat. Res., 1 (TM); Mbageni, 1 (NKW); Mbyashish, 1 (NKW); Nwambu, 2 (NKW); Othawa, 2 (TM); Punda Milia, 2 (TM, 1; NKW, 1).

Additional records: Specimen records from the Rhodesian border in quarter degree square 2229AB and 2230BC, are based on Rhodesian Museums material (Smithers, in litt.). Open circles in Kruger National Park, after Pienaar (1964).

Pipistrellus Kaup, 1829

1. Second upper incisor very reduced .. *kuhli*
Second upper incisor not very reduced, only slightly smaller than first 2

2. Braincase flatter, cranium nearly level with muzzle.. ... ... *rusticus*

Braincase/...

Braincase clearly raised above level of muzzle ... ... *nanus*

Pipistrellus (Pipistrellus) nanus (Peters, 1852) Banana bat
Piesangvlermuis

TAXONOMIC NOTES:

Following Hayman and Hill (1971), no subspecies are recognized.

DISTRIBUTION:

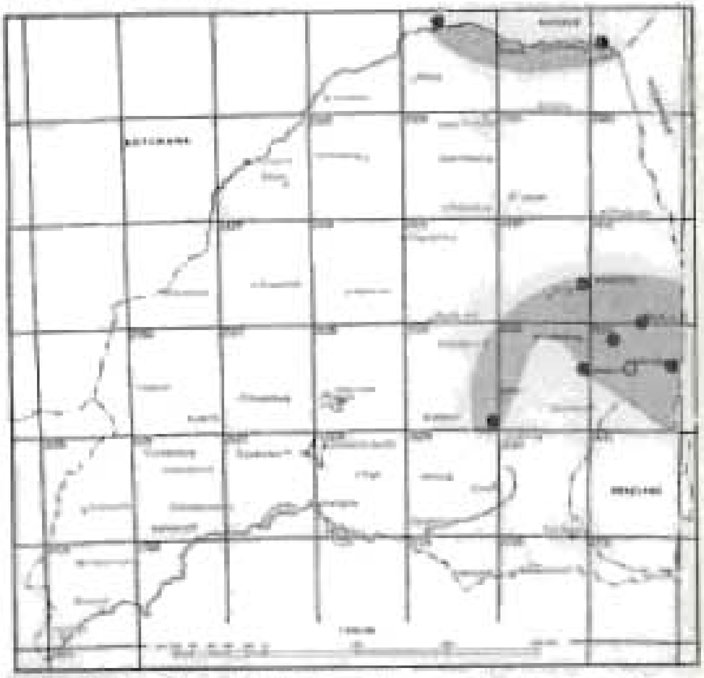

Fig.48: The distribution of *P. nanus* in the Transvaal.

Particularly common in the south-eastern Transvaal lowveld with 500-750 mm mean annual rainfall. It has further been collected at Roossenekal in a valley with some subtropical vegetation, particularly bananas. As in Botswana, S.W.A., Angola and the Caprivi (Smithers, 1971), all Transvaal records are from the vicinity of large rivers, which explains the two records along the Limpopo river (2229 AB and 2231 AC). With the exception of these two records, all other known localities in southern Africa lie in wooded areas receiving more than 500 mm rainfall p.a.

HABITAT:

The banana bat is most often recorded from the rolled-up terminal leaves of wild or cultivated banana plants. Rosevear (1965), however, states that the banana bat also on occasion takes refuge between banana fruit-bunches, in oil palms, amongst thatch,

under/...

under rafters and even in culverts. Roberts (1951) states that it may also utilize indigenous *Strelitzia* plants, while Shortridge (1934) observed individuals flying out of holes in veranda poles.

HABITS:

A semi-gregarious species which normally roosts in rolled-up banana leaves in small groups of up to four individuals. All specimens personally collected either crawled deep into the leaves or otherwise hid in the outer fold, so that they were snugly sandwiched. 11 Roossenekal specimens were collected after rain, and all were in the outer folds of the leaves, dorsally situated to avoid the stream of water running down the leaf chute.

Flight is slow and erratic, from virtually ground level to the height of the tree canopy. Small groups are often observed hunting insects over water surfaces and as such are easily netted.

FOOD:

Insectivorous.

BREEDING:

No pregnant or lactating females were collected in the Transvaal. Shortridge (1934) records twin foetuses in October.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	78,9	23	72	83
T.	35,0	23	32	40
H.ft	6,5	23	6	8,5
Ear	10,0	22	9	12
F.arm	31,2	26	29,8	33,0
Mass	3,9	8	3	5

Females

	$\bar{X}$	N	Min.	Max.
Tot.	81,2	29	78	88
T.	36,7	29	34	42
H.ft	6,7	29	6	8
Ear	10,0	29	9	11,5
F.arm	31,9	26	30,9	34,0
Mass	5,3	8	4	6

RECORDS OF OCCURRENCE:

Material examined, 55: Chikwarakwara, 1 (RM); De Hoop Private Nat. Res., 11 (TM); Komatipoort, 5 km NE, 24 (TM); Mariepskop, 13 (TM); Nelspruit, 1 (TM); Pretoriuskop, 1 (NKW); Skukuza, 4 (TM, 1; NKW, 3).

Additional records: Specimens housed in the Rhodesian Museums collected from 2229AB (Smithers, *in litt.*). Open circles in Kruger National Park area, after Pienaar (1964).

Pipistrellus (Pipistrellus) kuhli (Natterer, 1817) Kuhl's pipistrelle
Kuhlse vlermuis

P. k. broomi Roberts, 1948

DISTRIBUTION:

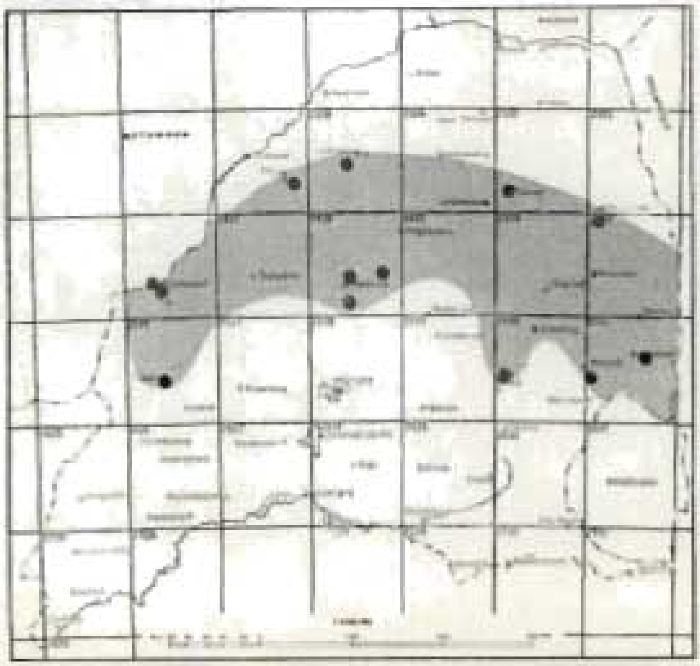

Fig.50: The distribution of *P. kuhli* in the Transvaal.

Kuhl's pipistrelle is widely distributed through woodland regions of the Transvaal, except in the north. As elsewhere in southern Africa, its range correlates well with the 500 mm isohyet. It has never been recorded from mopane woodland, which may explain its absence from the north and north-east of the province.

Absent/...

Absent in the southern Transvaal grasslands.

HABITAT:

As remarked by Roberts (1951) and Smithers (1971), this species takes refuge by day under the loose bark of dead trees. One specimen was collected in this habitat near Groot Marico, and two near Naboomspruit. A single specimen was collected at Derdepoort at dusk as it emerged from under the roof of an old farmhouse.

HABITS:

P. kuhli is one of the first bat species to emerge at dusk. It is a slow but very acrobatic flier, hunting insects wherever they occur in quantity. A number of specimens were procured at Derdepoort from a group flying for a fair period of time approximately eight metres above a cabbage field. More often this species is seen flying about over open still water surfaces, where it is easily netted. All specimens collected in flight were procured at dusk and during the first two hours of darkness. On occasion it is recorded flying around in houses where it is probably attracted by insects around the light.

FOOD:

Insectivorous.

BREEDING:

Two pregnant females were collected during October. Both carried single three mm foetuses in the left uterus. A single male with much enlarged testis (13 mm as opposed to the normal five mm), was collected during March, which may indicate that this is the mating season.

MEASUREMENTS AND MASS:

Male

	$\bar{x}$	N	Min.	Max.
Tot.	76,0	16	63	80
T.	28,6	16	20	33
H.ft	5,7	15	5	7
Ear	10,5	15	9	12
F.arm	28,9	13	25	31
Mass	4,6	14	4	6

Female

	$\bar{x}$	N	Min.	Max.
Tot.	80,0	5	76	84
T.	29,8	5	26	32
H.ft	6,3	4	5	8
Ear	10,2	5	7	12
F.arm	31,0	3	31	31
Mass	5,8	4	4	7

RECORDS OF OCCURRENCE:

Material examined, 23: Barberton, 1 (TM); Ferndale, 1 (TM); Hector Spruit, 1 (TM); Huwi, 1 (TM); Mooigenoeg, 1 (TM); Mooiplaas, 2 (TM); Mosdene, 1 (TM); Ngorongora, 2 (TM); Nylsvley, 2 (TM); Rhoda, 1 (TM); Rissik Priv. Nat. Res., 8 (TM); Tzaneen Estate, 2 (TM); Welgevonden, 1 (TM).

Pipistrellus (Pipistrellus) rusticus (Tomes, 1861) Rusty bat
Roeskleurvlermuis

P. r. rusticus (Tomes, 1861)

There are no specimens of this species in the Transvaal Museum collections. However, Roberts (1951) and Ellerman *et al.* (1953) refer to specimens taken from the Transvaal, presumably now in the collections of the British Museum (Natural History). These authors record it as occurring at Pretoria, Hectorspruit and Tzaneen. Smithers has collected it at the Shashi-Limpopo river confluence.

Eptesicus/...

Eptesicus Rafinesque, 1820

1. 1. Cranial portion of skull elevated above rostrum ... ... *zuluensis*
   Cranial portion of skull not elevated above rostrum . ... *capensis*

Eptesicus zuluensis Roberts, 1924 Aloe bat
Alwynvlermuis

DISTRIBUTION:

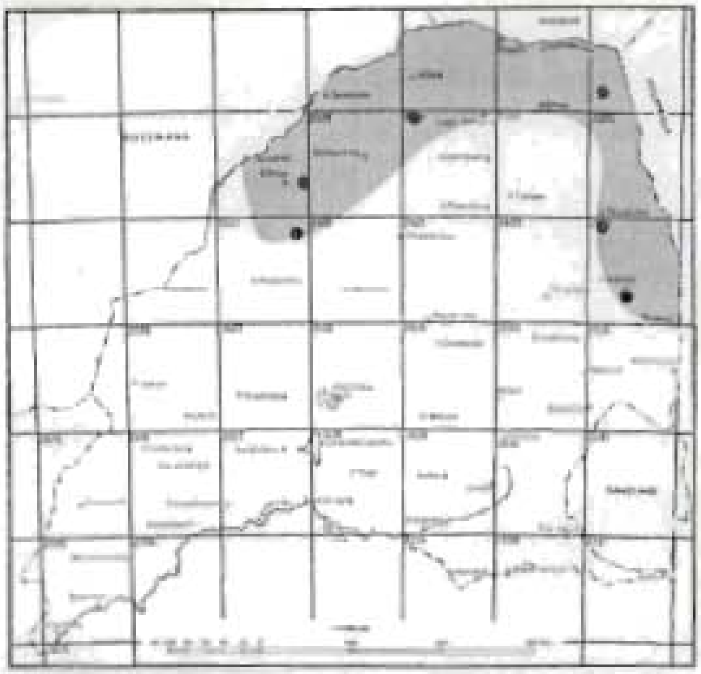

Fig.51: The distribution of *E. zuluensis* in the Transvaal.

The species is known only from scattered localities through its range, which is limited to the southern portion of Africa. In the Transvaal it is known from localities in the northern and northeastern regions.

It appears to be restricted to woodland savannah and has an apparent affinity for regions receiving more than 500 mm rainfall per annum.

HABITAT:

Nothing definite is known about the habitat requirements of *E. zuluensis*. It is reputed to take refuge by day amongst the dead leaves of aloes, hence the vernacular name. The specimen collected from Ellisras was shot with .22 dust shot around a farmhouse, where it appeared to have emerged from under the eaves.

HABITS:

No information available.

FOOD:

Insectivorous.

BREEDING:

No pregnant or lactating females have been collected.

MEASUREMENTS AND MASS:

Only four of the seven Transvaal specimens were measured.

Males

	Tot.	T.	H.Ft.	Ear	F.arm.		Mass
TM 19372:	77	32	5	9,5	31	=	7g
TM 24752:	78	35	5	11	31	=	3g
Females							
TM 17293:	89	46	8	12	30	=	?g
TM 24087:	78	31	7	11	32	=	4g

RECORDS OF OCCURRENCE:

Material examined, 7: Newington, 11 km N, 1 (TM); Platbos, 1 (TM); Shiela, 2 (TM); Stangene Windmill, 1 (NKW); Tamboties-kloof, 1 (TM); Urk, 1 (TM).

Eptesicus capensis (A. Smith, 1829) Cape serotine
Kaapse dakvlermuis

E. c. capensis (A. Smith, 1829)

TAXONOMIC NOTES:

The systematic relationships and taxonomy of the entire genus are not as yet fully understood (Hayman and Hill, 1971). As a consequence no subspecies are recognized here.

DISTRIBUTION:

A common and widespread species with a wide habitat tolerance. It occurs throughout the Transvaal irrespective of vegetation or

rainfall/...

rainfall.

HABITAT:

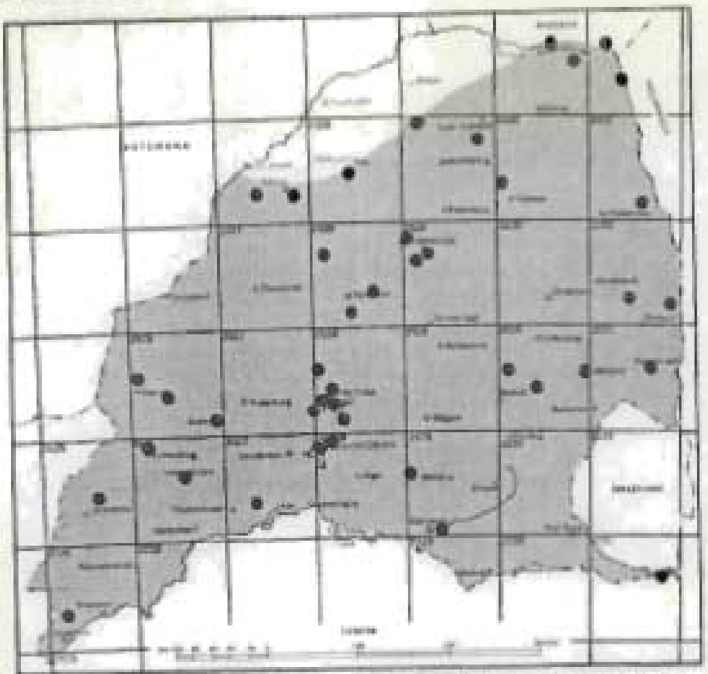

Fig.52: The distribution of *E. capensis* in the Transvaal.

Prefers confined spaces in which to spend the day, and is therefore found in crevices within roofs and walls, between beams and rafters, in rocks or loose stones and, according to Roberts (1951), amongst the dry leaves of aloes. In the Transvaal it has also been collected from under the loose bark of dead trees. The Cape serotine is attracted to open water, where it is easily collected.

HABITS:

Although it is generally believed not to congregate in colonies, aggregations of approximately 20 individuals were encountered at Christiana, Dullstroom and Delareyville. In all three instances farm buildings offered ample refuge. The Cape serotine is often reported to hunt insects in congregations, especially over water but on occasion also over bush clearings.

E. capensis apparently does not hibernate to the same extent as for instance *Miniopterus schreibersi*, if at all. It is often collected during winter. A group watched at Dullstroom during May was active only during windless nights, in spite of low temperatures resulting in heavy frost. At the other extreme many specimens were collected directly underneath corrugated iron roofs exposed to direct summer sun, which indicates a wide temperature tolerance.

FOOD:

Insectivorous/...

Insectivorous.

BREEDING:

Pregnant females were collected during October (three) and November (two). Two females each carried only one foetus, two females had twins, and one triplets. Smithers (1971) and Shortridge (1934) have also recorded twins and triplets in this species. Lactating females were recorded during September, November and December. These data suggest a parturition season during the first half of summer.

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	82,4	41	69	97
T.	31,0	40	23	38
H.ft	6,5	41	4	9
Ear	11,7	41	9	14
F.arm	31,8	29	29	35
Mass	5,9	30	4	10

Female

	$\bar{X}$	N	Min.	Max.
Tot.	90,4	51	70	115
T.	33,6	51	25	46
H.ft	7,6	50	5	9
Ear	14,3	50	8	15
F.arm	34,3	33	31	39
Mass	7,3	35	4	10

RECORDS OF OCCURRENCE:

Material examined, 121: Al-te-Vêr, 2 (TM); Barberspan Prov. Nat. Res., 8 (TM); Blijdschap, 1 (TM); Bryanston, 1 (TM); Chikwarakwara, 1 (RM); Ferndale, 1 (TM); Groothoek, 2 (TM); Grootsuikerboschkop, 7 (TM); Hectorspruit, 1 (TM); Hennopsrivier, 1 (TM); Huwi, 1 (TM); Johannesburg, 1 (TM); Kempton Park, 2 (TM); Koster, 1 (TM); Lady Selborne, 3 (TM); Letaba, 1 (NKW);

Leeuspoor/...

Leeuspoor, 1 (TM); Maria van Riebeeck Mun. Nat. Res., 3 (TM); Mokeetsi, 3 (TM); Mutale River, 1 (TM); Nelspruit, 1 (TM); Nylsvley, 1 (TM); Neimans Farm, 2 (SI); Nwambi Pan, 2 (NKW); Onderstepoort, 3 (TM); Othawa, 3 (TM); Potgietersrus, 2 (TM); Pretoria, 14 (TM); Pretoria Zoo Farm, 1 (TM); Ratsegaai, 15 (TM); Rolspruit, 1 (TM); Roodepoort Farm, 4 (TM); Rissik Priv. Nat. Res., 4 (TM); Sycamore Station, 1 (TM); Tshokwane, 1 (NKW); Urk, 7 (TM); Vaalwater, 1 (TM); Welgedaan, 10 (TM); Welgevonden, 1 (TM); Witpoort, 3 (TM); Zebediela, 1 (TM); Zeerust, 1 (TM).

Glauconycteris Dobson, 1875
Glauconycteris variegata (Tomes, 1861) Butterfly bat
G. v. variegata (Tomes, 1861) Vlindervlermuis

A widespread species in Africa, although scarce in southern Africa and known from only a few scattered localities. An undated, unsexed and uncatalogued specimen was found in the Transvaal Museum collection. The locality given on the label, "Krabbefontein, Zoutpansberg", could not be traced. The only coordinate given for "Soutpansberg" by Skead (1973) was therefore accepted for lack of further information. Smithers (*in litt.*) has recorded the species at Chikwarakwara (2231 AC) on the Transvaal-Rhodesian border. No further information on its occurrence in the Transvaal is available.

Scotophilus Leach, 1821

1. Length skull 19,6-23; length forearm 50-65; underparts usually yellow ... ... *nigrita*
Length skull 16-19,1; length forearm 43-50; underparts usually beige ... ... *leucogaster*

Scotophilus/...

Scotophilus nigrita (Schreber, 1774) Yellow house-bat
Geel-dakvlermuis

S. n. dingani (A. Smith, 1833)

TAXONOMIC NOTES:

Roberts (1951) assigned a specimen from Pretoria to *S. herero* Thomas, 1906 (reduced to subspecific rank under *S. nigrita* by Hayman and Hill (1971)) on the basis of its pure white abdomen. Both Rosevear (1965) and Smithers (1971) consider such specimens as constituting the one extreme of individual variation within *S. nigrita*. The specimen from Pretoria is therefore regarded as representing *S. n. dingani*, while the race *herero*, if valid, is considered not to occur in the Transvaal.

DISTRIBUTION:

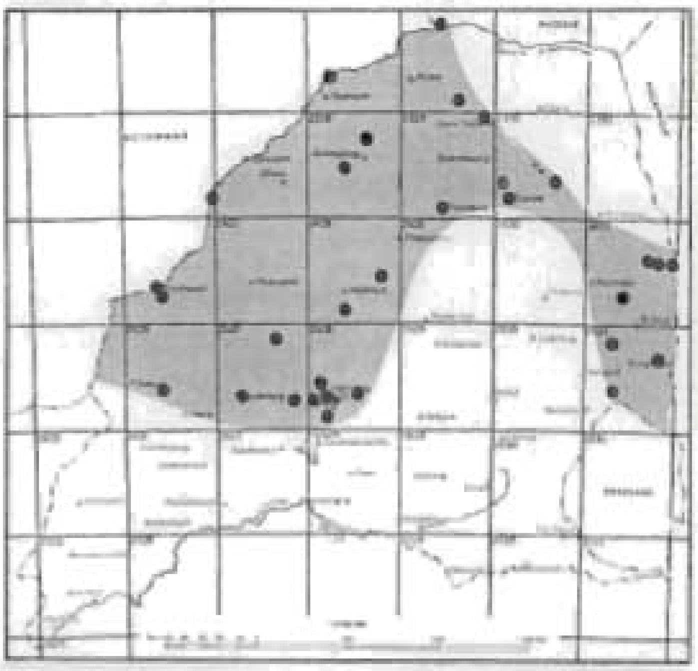
Fig.53: The distribution of *S. nigrita* in the Transvaal.

Widespread in Africa, according to Rosevear (1965) occurring in all types of vegetation except desert. In southern Africa all known localities occur in Keay's (1959) savannah woodland (types 16-26). It is, however, unrecorded from Keay's (*op.cit.*) wooded steppe with abundant *Acacia* and *Commiphora*, as found in most of Botswana.

In the Transvaal the range of *S. nigrita* also coincides well with Acock's (1975) subtropical bush and savannah veld types. Nowhere in southern Africa is it recorded from grassveld.

HABITAT:

It/...

It appears to utilize a wide range of daytime roosts. Generally however it prefers confined crevices in which to hide, as found in rock walls, between beams and rafters and in cracked walls of old abodes and barns. A specimen was collected in a house in Cullinan, which for some time roosted under a couch in the lounge, where it eventually gave birth. Several other specimens were collected flying about in houses. Roberts (1951) recorded it from the deserted nests of woodpeckers and barbets.

HABITS:

Rosevear (1965) and Smithers (1971) have recorded small colonies of up to 12 individuals roosting together. This was never encountered in the Transvaal, and only solitary individuals were found in roosts.

A female with two very small young clinging to her nipples was caught while flying about in a house in Pretoria. No other lactating females collected in flight were carrying their young.

This species is one of the first bats to emerge at dusk. It usually flies high and fast in a straight flightpath. The yellow house-bat, like many other bats, is often to be seen hunting insects over open water, where it flies much lower and is consequently easily trapped. While spinfishing with small artificial lures at dusk at Hartebeestpoortdam, an individual was seen to swoop down at the lure just before it hit the water. The bat dropped in the water as a result of the collision, but was not hooked. It swam out fast, directly towards the shore.

FOOD:

Insectivorous.

BREEDING:

A pregnant female was collected during March, and one during October. Lactating females were recorded during November and December. Two lactating females were collected with their offspring, in both cases twins. Three of four gravid females carried twins, the fourth triplets. Twins appear to be the rule. (See Rosevear, 1965 and Smithers, 1971).

MEASUREMENTS/...

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	131,7	25	119	143
T.	52,5	26	45	64
H.ft	11,1	24	8	13
Ear	15,9	26	13	20
F.arm	55,8	28	51	57
Mass	26,6	11	15,2	32

Female

	$\bar{X}$	N	Min.	Max.
Tot.	131,9	18	101	146
T.	51,6	19	34	60
H.ft	10,7	19	8,5	13
Ear	14,9	19	8	19
F. arm	55,2	21	51	58
Mass	27,3	11	14,5	42

RECORDS OF OCCURRENCE:

Material examined, 63: Buffelsdraai, 1 (TM); Cullinan, 1 (TM); Ferndale, 5 (TM); Hans Merensky Prov. Nat. Res., 1 (TM); Irene, 1 (TM); Kosmos, 1 (TM); Lady Selborne, 1 (TM); Louws Creek, 2 (TM); Mmabolela Estate, 1 (TM); Mokeetsi, 4 (TM); Mooigenoeg, 2 (TM); Mooiplaas, 1 (TM); Mooivlei, 2 (TM); Mosdene, 1 (TM); Newington, 7 km N, 1 (TM); Nicorel, 1 (TM); Onderstepoort, 1 (TM); Pietersburg, 2 (TM); Pretoria, 19 (TM); Pretoria North, 1 (TM); Pretoria Zoo Farm, 1 (TM); Pretoriuskop, 2 (NKW); Rietgat, 1 (TM); Rissik, 1 (TM); Rustenburg, 1 (SI); Satara, 1 (NKW); Semane Windmill, 1 (NKW); Shinkelegane, 1 (NKW); Soutpansberg, 1 (TM); Ten Bosch Estates, 1 (TM); Tzaneen, 1 (TM); Waterpoort, 1 (DM); Welgevonden, 1 (TM).

Additional records: Open circle in Kruger National Park area, after Pienaar (1964).

Scotophilus/...

Scotophilus viridis (Peters, 1852) Lesser yellow house-bat
Klein geelvlermuis

TAXONOMIC NOTES:

I am following Koopman (1975), in calling the smallest of the three southern African *Scotophilus* species by the name *viridis*, instead of *leucogaster* (Cretzschmar, 1826) as suggested by Hayman and Hill (1971).

DISTRIBUTION:

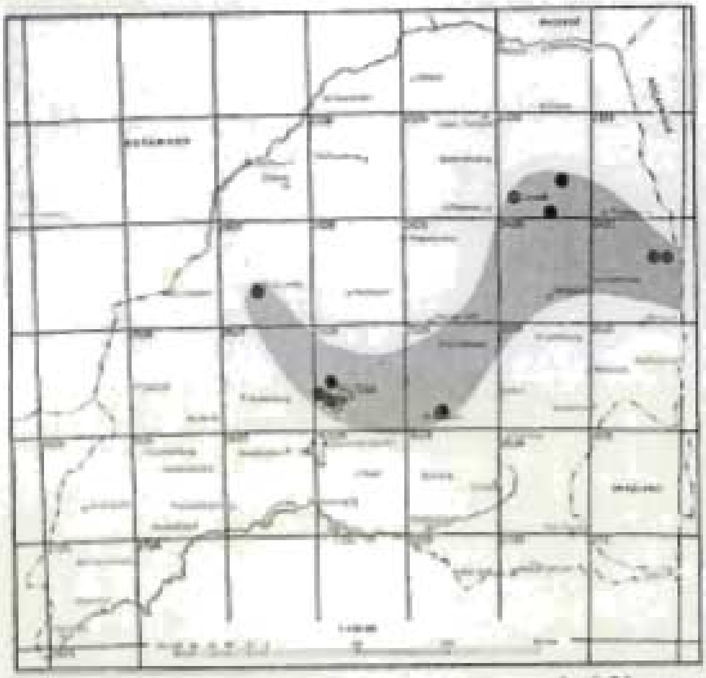

Fig.54: The distribution of *S. viridis* in the Transvaal.

Locality records are too scattered to allow detailed analysis of distribution. In the Transvaal the range appears to be restricted to the above 500 mm mean annual rainfall zone, but this is not the case beyond the borders of the Province, especially in Rhodesia and Mocambique. All known records are from wooded areas. Distribution is apparently to a large extent governed by the proximity of larger rivers or other suitable open water surfaces, since the majority of collecting sites are near such water bodies.

HABITAT:

Very little is known of this species, but it would seem to be very similar to *S. nigrita* with regard to habitat requirements. A number of specimens were procured at or in human dwellings, but it could not be established exactly where they were roosting.

HABITS:

Apparently similar to those of *S. nigrita*.

FOOD/...

FOOD:

Insectivorous.

BREEDING:

No gravid or lactating females were collected in the Transvaal.

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	110,8	6	97	122
T.	44,1	6	36,5	52
H.ft	10,1	5	8,5	12,5
Ear	14,1	6	9	16
F.arm	48,7	9	44,0	51,4
Mass	14,7	3	13	17

Female

	$\bar{X}$	N	Min.	Max.
Tot.	118,1	6	104	144
T.	46,8	6	39	60
H.ft	11,7	6	9	13
Ear	16,0	6	12	18
F.arm	49,3	4	47,0	50,7
Mass	26,3	3	15	35

RECORDS OF OCCURRENCE:

Material examined, 15: Griffin Mine, 1 (TM); Hans Merensky Prov. Nat. Res., 1 (TM); Jane Furse Hospital, 1 (TM); Onderstepoort, 1 (TM); Pretoria, 6 (TM); Satara, 1 (NKW); Semane Windmill, 1 (NKW); Thabazimbi, 24 km SE, 2 (SI); Tzaneen, 1 (TM).

Subfamily Kerivoulinae

Kerivoula/...

Kerivoula Gray, 1842

Kerivoula lanosa (A. Smith, 1847) Lesser woolly bat
Klein wolhaarvlermuis

K. l. lucia Hinton, 1920

Hayman and Hill (1971) tentatively regard this race as a subspecies of *K. harrisoni*, but draw attention to the fact that this species-complex is one of the chief taxonomic problems remaining in the genus *Kerivoula*. Rosevear (1965) regards the characters used by Aellen (1959) to separate *harrisoni* and *lanosa*, as too unstable to be relied upon. Ellerman *et al.* (1953) are thus followed here in referring *lucia* to *K. lanosa*, especially since Hayman and Hill (1971) mention the possibility that *harrisoni*, *lanosa* and *muscilla* may represent not distinct species but merely local races of one widespread species, of which *K. lanosa* is the prior name.

K. lanosa is known from only one locality in the Transvaal, namely the Njellele river, Zoutpansberg district (TM 8864, male; 90-40-10-10-32=? g). Nothing is known of the general biology of this rare species in this Province.

Subfamily Miniopterinae

Miniopterus Bonaparte, 1837

1. Forearm 42-44; skull length c. 14 .. *fraterculus*
Forearm c. 42-47; skull length c. 15. ... *schreibersi*

Miniopterus fraterculus Thomas & Schwann, 1906 Lesser long-fingered bat

TAXONOMIC NOTES:

Superficially all species of this monotypic subfamily appear very similar, but with a wide size range. Size is the major

characteristic/...

characteristic used to distinguish the various forms, but has led to a confused taxonomic situation with 18 named forms in Africa. Hayman and Hill (1971) have simplified the taxonomy by recognizing only four species in Africa, employing mainly comparative skull sizes. They have found that in many regions a larger and smaller form co-exist, a situation also existing in the Transvaal.

Following Hayman and Hill (1971), *M. fraterculus* is recognized as a distinct species, *pace* Koopman (1966), who considers it a form of *M. minor* Peters, 1867, and Ellerman *et al.* (1953), who maintain that this species is not separable from *M. s. natalensis* (A. Smith, 1834).

DISTRIBUTION:

Fig.55: The distribution of *M. fraterculus* in the Transvaal.

Fairly widely distributed in Africa, but nowhere common, in contrast to the next species. In the Transvaal it has been collected at only one locality, in the Barberton district.

HABITAT:

Recorded only from caves.

HABITS:

No information available except that it is a social species, and at times found amongst larger colonies of *M. schreibersi* (Harrison, 1959; Laycock, *pers. comm.*).

FOOD:

Insectivorous.

BREEDING:

No information available.

MEASUREMENTS AND MASS:

Only two specimens available:

		Tot.	T.	H.ft.	Ear	F.arm		Mass
TM 1994:	♂:	98	48	8	8	42,1	=	?g
TM 1993:	♀:	99	52	8	8	41,5	=	?g

RECORDS OF OCCURRENCE:

Specimens examined, 2: Buffaloe Mine, 2 (TM).

Miniopterus schreibersi (Kuhl, 1819) Schreiber's long-fingered bat
M. s. natalensis (A. Smith, 1834)

DISTRIBUTION:

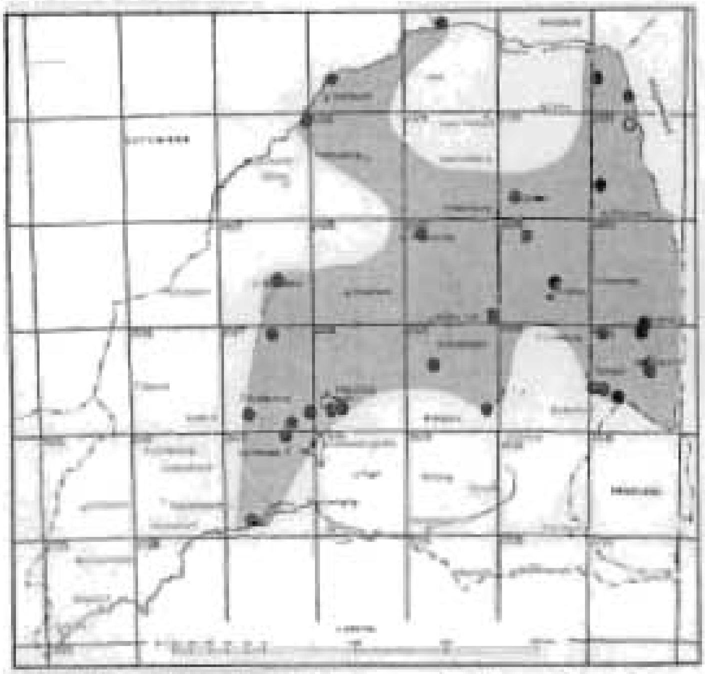

Fig.56: The distribution of *M. schreibersi* in the Transvaal.

A widely distributed and common species throughout Africa south of the Sahara. In the Transvaal it has a patchy distribution. Apart from one locality in the O.F.S. (Lynch, 1975), and one on the Vaal river it appears to be absent from the highveld grasslands. The majority of Transvaal records are from bushveld areas, and from areas transitional between the bushveld and pure grassland. The limits of the species range in southern Africa are closely correlated with the above 500 mm mean annual rainfall zone. In lower rainfall areas the few known localities are near major water sources, eg. records from near Swartwater and Beit Bridge on the Limpopo river.

HABITAT:

Schreiber's long-fingered bat is primarily a cave-dwelling species, but is also to be found in simulacrum situations such as roofs, mines, culverts and, according to Roberts (1951), in crevices in rocks and trees. As distribution indicates, it is to a certain extent dependent on open water surfaces.

HABITS:

A gregarious species which roosts in colonies of up to several thousands, in tightly compressed aggregations, against the roofs and walls of caves. Individuals hang from their hind feet, or cling by all fours to the rock.

Hibernation and migration have been studied by van der Merwe (1973a and b, and 1975) in Transvaal colonies. In essence he found that *M. schreibersi* migrates south to highveld caves bordering on bushveld regions, firstly to mate and later to hibernate during the winter in an environment with a much lower temperature and a high humidity in order to escape the winter period of relative shortage of insect food. During summer the colonies migrate north to the bushveld regions, where maternity colonies are formed and young are born early in the season. Young are deposited in nursery colonies, with females roosting in separate aggregations.

M. schreibersi is an exceedingly fast flyer and is often netted over water. Observations near Roossenekal suggest that individuals regularly use night-time roosts later at night to rest, utilizing beams under open verandahs, pumphouses, open garages etc.

FOOD:

Insectivorous.

BREEDING:

Pregnant females were collected during October and November, carrying only one foetus per female. Van der Merwe (1973a and b and 1975) found that mating takes place during autumn in the hibernation caves. Parturition occurs during early summer in maternity caves.

MEASUREMENTS/...

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	112,4	54	102	128
T.	52,9	55	46	60
H.ft	9,5	55	8	11
Ear	10,6	56	8	13
F.arm	44,7	25	42	48
Mass	10,1	33	6	13

Female

	$\bar{X}$	N	Min.	Max.
Tot.	108,9	39	93	118
T.	51,9	41	46	58
H.ft	9,6	35	8	11
Ear	10,5	38	9	12
F.arm	45,4	12	44	47
Mass	10,2	19	7,8	12,6

RECORDS OF OCCURRENCE:

Material examined, 113: Barberton, 2 (TM); Buffelspoort, 1 (TM); Cyprus, 1 (TM); De Hoop, 1 (TM); Donkerpoort, 16 (TM); Echo Caves, 1 (TM); Ficus Cave, 3 (TM); Garsfontein, 3 (TM); Gatkoppies, 6 (TM); Groenkloof, 3 (TM); Hectorspruit, 8 (TM); Letaba Ranch, 1 (TM); Loskopdam Prov. Nat. Res., 1 (TM); Louws Creek, 2 (TM); Makapans Cave, 1 (TM); Matupa, 2 (NKW); Monument Park, 5 (TM); Mmabolela Estates, 1 (TM); Olifantspoort, 1 (TM); Pretoria, 5 (TM); Punda Milia, 1 (NKW); Rooiberg, 1 (TM); Shingomeni, 4 (TM); Skukuza, 3 (TM, 2; NKW, 1); Skurweberg, 17 (TM); Tzaneen, 1 (TM); Uitkomst, 7 (TM); Venterskroon, 1 (TM); Wonderfontein, 14 (TM).

Additional records: Open circles in the Kruger National Park area, after Pienaar (1964).

Family/...

Family Molossidae

1. Skull distinctly flattened (depth of braincase about a third of its width)... ... *Sauromys*
Skull not conspicuously flattened .. .. *Tadarida*

Sauromys Roberts, 1917

Sauromys petrophilus (Roberts, 1917) Roberts' flat-headed bat
Platkop losstertvlermuis

S. p. petrophilus (Roberts, 1917)

TAXONOMIC NOTES:

Roberts (1951) and Ellerman *et al.* (1953) synonymized this genus with *Platymops* Thomas, 1906, but it was restored to generic rank by Peterson (1965) and Hayman and Hill (1971).

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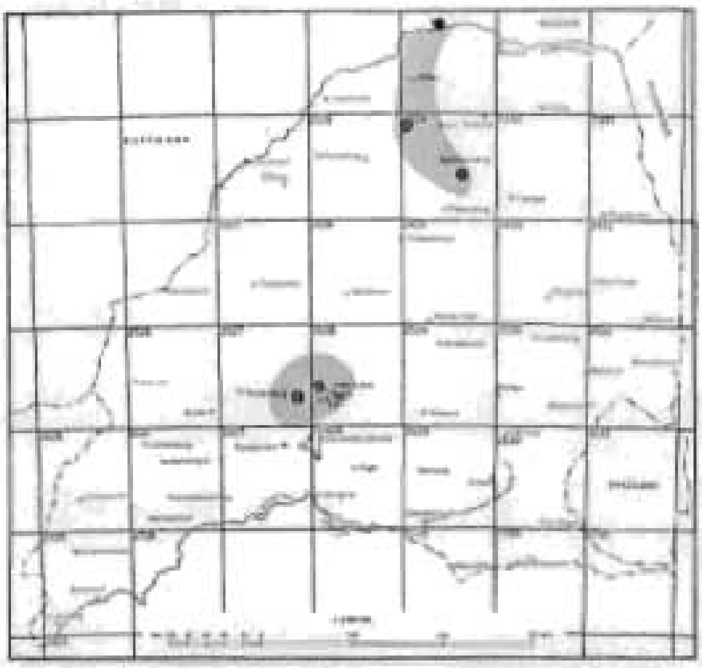

Fig.57: The distribution of *S. petrophilus* in the Transvaal.

This species is confined to southern Africa. In the Transvaal, Rhodesia and Botswana it is known from scattered localities, only in wooded areas. Seen in the light of its specialized habitat requirements, it is unlikely to be widely distributed in any area, but it is nonetheless believed to have been overlooked in many regions of the Transvaal.

HABITAT:

All specimens recorded from their day-time roosts were found in very narrow rock crevices. The distinctly flattened skull is an adaptation to this mode of life.

HABITS/...

HABITS:

Mostly found occurring singly or in pairs (Smithers, 1971). A series collected at Bandolierskop was, however, from a small colony roosting under loose rock slabs. Judging from the amount of guano, this site is utilized as a permanent roost. Specimens were in fact procured from the same colony in exactly the same site on three occasions over a two-year period. In one instance the bats were found with 18 lizards (genus *Platysaurus*). The species is also on occasion netted over water.

FOOD:

Insectivorous.

BREEDING:

No gravid or lactating females have been recorded so far.

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	110,1	9	103	127
T.	37,7	9	30	49
H.ft	9,1	9	6	13
Ear	17,2	9	15	22
F.arm	42,5	8	38	48
Mass	12,8	9	9	16

Female

	$\bar{X}$	N	Min.	Max.
Tot.	114,1	7	100	131
T.	36,6	7	29	45
H.ft	9,0	7	8	10
Ear	18,0	7	15	22
F.arm	44,1	7	41	50
Mass	15,0	6	13	22

RECORDS OF OCCURRENCE:

Material examined, 14: Hartebeespoortdam, 1 (TM); Pietersburg, 40 km N., 10 (TM); Rosslyn, 1 (TM); Urk, 2 (TM).

Additional records: Rhodesian Museums material collected from 2229AB (Smithers, *in litt.*).

Tadarida Rafinesque, 1814

1. M^3 reduced, cusps rarely more than a V pattern; palatal emargination small or absent; ears generally conjoined, sometimes with post-aural tuft; size small to large, forearm 27-66	Subgenus *Mops*
M^3 not reduced, cusps forming N pattern	2
2. Palatal emargination absent or rudimentary; ears conjoined, often with post-aural tuft, which is sometimes well-developed; size medium, forearm 37-42	Subgenus *Chaerepho*
Palatal emargination well-developed; ears generally separate; size medium to large, forearm 45-66...	Subgenus *Tadarida*

Subgenus *Mops* Lesson, 1842

1. Size larger, forearm 58-66; skull length 26-28..	*midas*
Size smaller, forearm 44-50	*condylura*

Tadarida (Mops) midas (Sundevall, 1843) Midas bat
Midas se vlermuis

T. m. midas (Sundevall, 1843)

DISTRIBUTION/...

DISTRIBUTION:

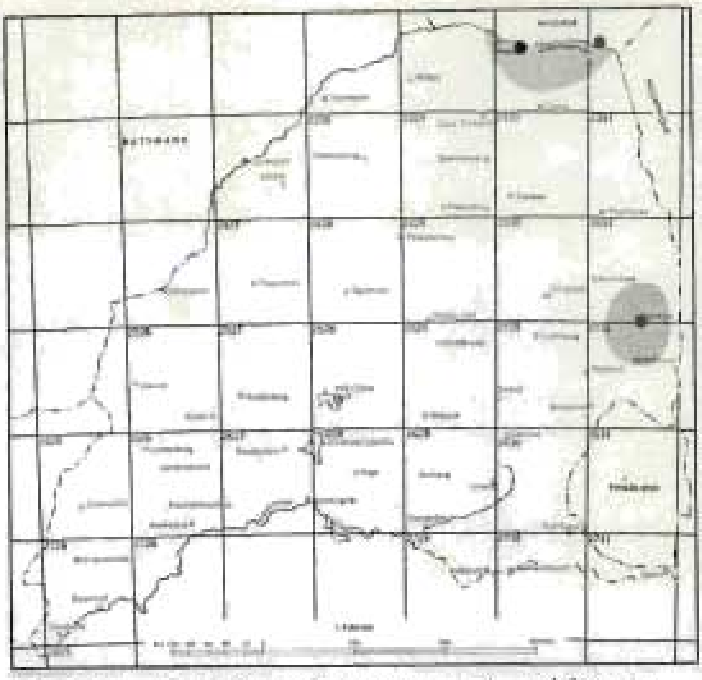

Fig.58: The distribution of *T. midas* in the Transvaal.

Widely distributed in Africa, but in southern Africa known from scattered localities only. The specimen recorded by Pienaar (1972) from Skukuza represents the southernmost limit of this species' range. All known localities in southern Africa are conspicuously associated with major water sources: in the Transvaal permanent pools in the Limpopo river, and the Sabie river near Skukuza.

HABITAT:

A series collected in the Messina district was secured as the animals emerged from an opening under the eaves of a farmhouse. During the day the animals occupied the spaces between the rafters and the corrugated iron roof, where it is almost impossible to reach them. Smithers (1971) recorded the species as utilizing other human dwellings in the same way. Verschuren (1957) collected a series in hollow trees. It is very likely that it also takes refuge in rock crevices.

HABITS:

A social species, roosting in groups of from about 25 to several hundred (see Smithers, 1971). The roosts are occupied permanently or semi-permanently, and are characterized by a heavy odour. According to Smithers (*op.cit.*), supported by observations on the Messina series, it prefers total darkness in its roosts. The Messina population shared an attic with *Tadarida pumila* and *Nycteris thebaica*. The Midas bat emerges shortly after dark, and is a high, slow and straight flier.

FOOD:

Insectivorous.

BREEDING:

No pregnancies were recorded in the Transvaal. Smithers (1971) recorded pregnant females between December and February, with one foetus in the left uterus per female.

MEASUREMENTS AND MASS:

Male

	$\bar{x}$	N	Min.	Max.
Tot.	144,1	4	136	153
T.	44,1	4	39	51
H.ft	12,3	4	9	13,6
Ear	28,2	4	26,3	31
F.arm	64,5	4	62	66
Mass	41,7	4	37	49

Female

	$\bar{x}$	N	Min.	Max.
Tot.	144,0	4	139	149
T.	51,5	4	49	54
H.ft	10,3	4	9	11
Ear	28,8	4	28	29
F.arm	63,3	4	61	65
Mass	39,0	4	30	45

RECORDS OF OCCURRENCE:

Material examined, 7: Scrutton, 6 (TM); Skukuza, 1 (NKW).

Additional records: Rhodesian Museums material collected from Buffalo bend and Chikwarakwara (Smithers, *in litt.*).

Tadarida (Mops) condylura (A. Smith, 1833) Angola free-tailed bat
Angolase losstertvlermuis

TAXONOMIC/...

TAXONOMIC NOTES:

Hayman and Hill (1971), following Rosevear (1965), regard this as a monotypic species, and their approach is followed here. Koopman (1966) and Hayman and Hill (1971) consider *T. niveiventer* (Cabrera and Ruxton, 1926) a distinct species, *pace* Ellerman *et al.* (1953) who regard it as a race of *T. condylura*. *T. condylura* includes *T. angolensis* (Peters, 1870) as a synonym.

DISTRIBUTION:

Fig.59: The distribution of *T. condylura* in the Transvaal.

Ranges over the greater part of Africa. In the Transvaal it is known only from the eastern Transvaal lowveld. According to Hayman and Hill (*op.cit.* it is restricted to forests or savannah woodland.

HABITAT:

Pienaar (1964) found that in the Kruger National Park the Angola free-tailed bat colonizes caves. It has also been recorded from attics. Rosevear (1965) states that it lives in hollow trees. It has been shown to have a wide habitat tolerance, but excluding semi-deserts (Smithers, 1971).

HABITS:

A gregarious species roosting in colonies of up to several hundred.

FOOD:

Insectivorous.

BREEDING/...

BREEDING:

Smithers (1971) recorded three gravid females collected during January.

MEASUREMENTS AND MASS:

Data are available from only one male from the Smithsonian Institution collection.

NM 740: 115-36-14-19-?=25 g

Females

	$\bar{X}$	N	Min.	Max.
Tot.	107,0	5	92	121
T.	36,4	5	34	40
H.ft	12,1	5	11	13
Ear	16,1	5	11	20
F.arm	45,9	6	44	48,5
Mass	23,8	4	16	27

RECORDS OF OCCURRENCE:

Material examined, 7: Komatipoort, 1 (SI); Letaba, 1 (NKW); Skukuza, 5 (NKW).

Additional records: Open circles in Kruger National Park, after Pienaar (1964).

Subgenus *Chaerephon* Dobson, 1874

Tadarida (Chaerephon) pumila (Cretzschmar, 1830 or 1831)

Little free-tailed bat

Klein losstertvlermuis

TAXONOMIC NOTES:

Hayman and Hill (1971) point out that too many poorly defined subspecies names are ascribed to *pumila* (*sensu lato*), thus complicating the taxonomic, zoogeographic and distributional picture, and that it is therefor better to regard this as a monotypic species for the time being. Includes *limbata* Peters, 1852, as a

synonym/...

synonym.

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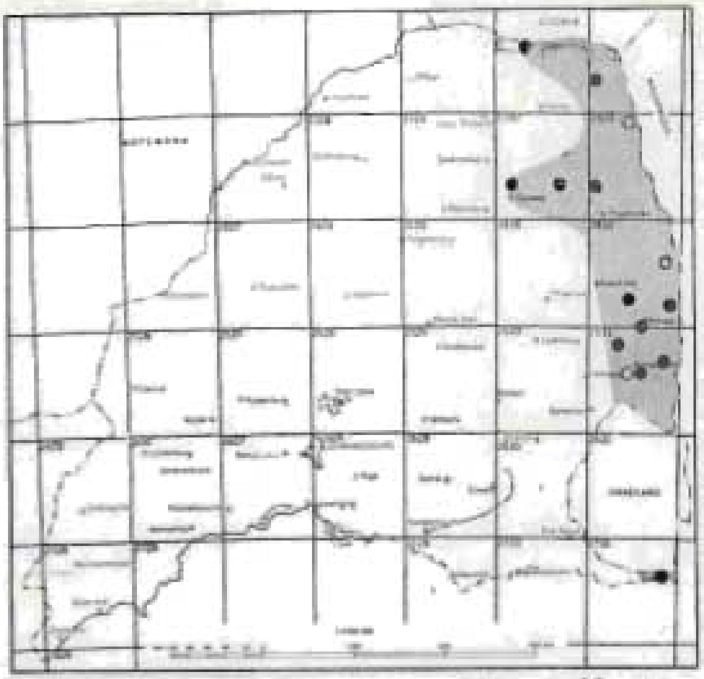

Fig.60: The distribution of *T. pumila* in the Transvaal.

In southern Africa it has a distinctly eastern distribution. In the Transvaal it is limited to the eastern lowveld and the escarpment, where it is fairly common. In southern Africa it would appear that its distribution is regulated by the proximity of abundant permanent open water sources.

HABITAT:

All Transvaal records are from colonies utilizing human settlements. It is more often recorded from under corrugated iron roofs, but a series was procured from Letaba Ranch as it emerged from under the eaves of a thatched roof. Rosevear (1965) mentions it utilizing a crevice in a tree trunk. As pointed out by Smithers (1971), it always occurs close to permanent water.

HABITS:

The little free-tailed bat is a social species, roosting in colonies of up to several hundred. These roosts are occupied permanently. It must have a wide temperature tolerance, resting as it does immediately below corrugated iron roofs.

The presence of such a colony is easily detected as the members become very restless and noisy at dusk. They emerge after dark in small batches through regularly used crevices under the eaves. It would appear that males emerge first.

FOOD:

Insectivorous/...

Insectivorous.

BREEDING:

13 females collected during November were all pregnant, all with one foetus each, implanted in the right horn of the uterus. Nine females collected during December were all lactating. Smithers (1971) recorded pregnancies from August to February, with a distinct peak during December.

MEASUREMENTS AND MASS:

Male

	$\bar{x}$	N	Min.	Max.
Tot.	95,6	14	77	100
T.	34,5	14	30	37,5
H.ft	7,9	15	6	10
Ear	16,8	14	12	19
F.arm	38,9	13	37	45,5
Mass	10,2	13	7,8	13

Female

	$\bar{x}$	N	Min.	Max.
Tot.	97	52	89	108
T.	34,5	52	30	40
H.ft	8,5	52	6	10
Ear	17,0	51	14	19
F.arm	38,8	47	37	41
Mass	11,8	46	9	16

RECORDS OF OCCURRENCE:

Material examined, 72: Hans Merensky Prov. Nat. Res., 12 (TM); Leeuwspoor, 9 (TM); Letaba Ranch, 6 (TM); Malelane, 3 (TM); Mokeetsi, 1 (TM); Othawa, 1 (TM); Punda Milia, 10 (TM, 7; NKW, 3); Pretoriuskop, 1 (NKW); Scrutton, 2 (TM); Skukuza, 6 (NKW); Ten Bosch Estates, 20 (TM); Tshokwane, 1 (NKW).

Additional records: Open circles in Kruger National Park area, after Pienaar (1964).

Genus/...

Subgenus *Tadarida* Rafinesque, 1814

1. 1. Size larger, forearm 63-66 .. .. *africana*
Size smaller, forearm 44-53 .. .. *aegyptiaca*

Tadarida (Tadarida) africana (Dobson, 1876) Giant African free-taile bat
Transvaalse losstert-vlermuis

This species was described from the Transvaal, but its exact type locality was never recorded. *T. africana* is known only from the holotype and five other specimens, collected as far apart as the Sudan and Ethiopia. Its validity is recognized by recent authorities eg. Hayman and Hill (1971). No specimens other than the holotype have been collected from the Transvaal. The holotype was not examined.

Tadarida (Tadarida) aegyptiaca (E. Geoffroy, 1818) Egyptian free-tail bat
Egiptiese losstert vlermuis

T.a. aegyptiaca (E. Geoffroy, 1818)
T. a. bocagei (Seabra, 1900)

TAXONOMIC NOTES:

Ellerman *et al.* (1953) regard *bocagei* and *aegyptiaca* as distinct species. Hayman and Hill (1971), who are followed here, consider these forms distinct at subspecies level, with *aegyptiaca* the prior name. The two forms are distinguished on relative sizes (Ellerman *et al.*, 1953), particularly forearm length. Using this parameter it would appear that both occur in the Transvaal. The possibility of a size cline was investigated, but insufficient material is available to confirm this.

On/...

On available material, the trend is for the smaller western subspecies *bocagei* (forearm less than 47,5 mm) to occur over most of the Transvaal to as far east as the escarpment, and north to the Zoutpansberg. All specimens from the eastern Transvaal lowveld and north of the Zoutpansberg are of the larger eastern form *aegyptiaca* (forearm 47,5 mm and more). However, the larger form has also been recorded towards the western Transvaal, i.e. Vaalwater (TM 24748; 48,5 mm) and Rust de Winter (TM 24959; 49 mm). Too little material is available to demonstrate the possible role of sexual dimorphism.

Pending a detailed study of this group based on more adequate material both subspecies are here retained and recognized within the Transvaal.

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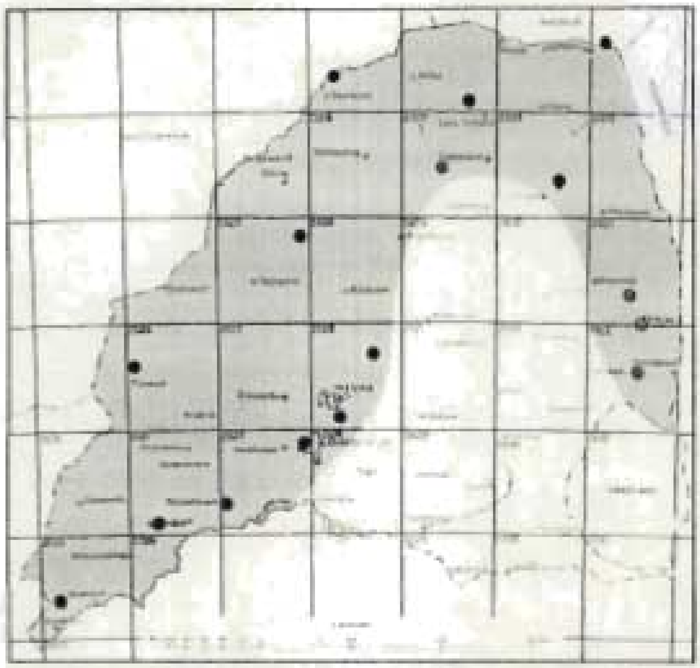

Fig.61: The distribution of *T. aegyptiaca* in the Transvaal.

Occurs throughout most of the Province, except possibly the south-eastern regions where it may have been overlooked.

HABITAT:

Most localities in the Transvaal are in woodland savanna, but a number of specimens have been taken from four localities in the south-western Transvaal highveld.

It has been reported to use crevices in corrugated iron roofs and sheds as daytime roosts. Recently a number of specimens were collected in narrow rock crevices and slits, while looking for *Sauromys petrophilus*. Also recorded from caves (Smithers, 1971). Shortridge (1934) recorded the Egyptian free-tailed bat from hollow trees and under the loose bark of dead *Acacia* trees.

HABITS:

An extremely fast flier, while presumably hunting for insects or searching for drinking water. Roosts individually, more often in small colonies of c.20; colonies of several hundred have been recorded (Shortridge, 1934). Judging from the amounts of guano present, these roosts are occupied permanently or semipermanently.

FOOD:

Insectivorous.

BREEDING:

Single pregnant females were collected during September, October and December.

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	108,1	14	95	117
T.	37,9	14	30	47
H.ft	8,6	12	6	11
Ear	19,0	14	17	21
F.arm	46,7	6	45	48
Mass	15,1	8	11	20,5

Female

	$\bar{X}$	N	Min.	Max.
Tot.	114,8	6	98	126
T.	41,5	6	38	46
H.ft	9,5	6	8	11
Ear	19,8	6	19	21
F.arm	49,0	4	48	50
Mass	15,4	5	14	18

RECORDS OF OCCURRENCE:

Specimens examined, 38: Enkeldoorn, 1 (TM); Florida, 14 (TM); Hans Merensky Prov. Nat. Res., 3 (TM); NuMuckleneuk, 1 (TM);

Malelane, 1 (TM); Maria van Riebeeck Mun. Nat. Res. 1(TM); Mmabolela Estates, 1 (TM); Newington, 11 km N., 2 (TM); Othawa, 1 (TM); Pietersburg, 40 km N., 2 (TM); Potchefstroom, 1 (TM); Platbos, 1 (TM); Pretoria, 2 (TM); Rochdale, 1 (TM); Rykvoorby, 3 (TM); Venterskroon, 2 (TM); Welgedaan, 1 (TM).

Additional records: Material collected from Chikwarakwara, housed in the Rhodesian Museums (Smithers, *in litt.*). Open circle in the Kruger National Park, after Pienaar, (1964).

ORDER PRIMATES

SUBORDER ANTHROPOIDEA

Family Cercopithecidae

Subfamily Cercopithecinae

1. Face elongated; very broad ischial callosities: tail shorter than head and body; size large, c.60-90 cm	*Papio*
Shorter face; snout rounded; small, rounded callosities; tail longer than head and body ...	*Cercopithecus*

Papio Erxleben, 1777

Papio ursinus Kerr, 1792 — Chacma baboon, Kaapse bobbejaan

P.u. griseipes Pocock, 1911

P.u. orientalis Goldblatt, 1926

P.u. occidentalis Goldblatt, 1926

TAXONOMIC NOTES:

Dandelot (1974), following Roberts (1951), recognizes three subspecies in the Transvaal. *P.u. griseipes* occurs north of the Zoutpansberg, *orientalis* is to be found in the eastern regions, with *occidentalis* occurring in the western Transvaal. The latter species includes *nigripes* Roberts, 1932 as a synonym. The boundary between the ranges of *orientalis* and *occidentalis* is not clearly established.

The limited material housed in the Transvaal Museum substantiates Dandelot's (*op.cit.*) and Roberts' (1951) views that *occidentalis* can be distinguished from the other two by its blackened hands, feet and tail. However, Dandelot (*op.cit.*) admits that he is not familiar with the species and that it is likely that too many subspecies are being recognized.

DISTRIBUTION:

A common species, and as a result of the damage it causes to cultivated crops, regarded as a pest by farmers and as a

problem/...

problem animal by conservation agencies. Present throughout the Transvaal, with the exception of the southwestern and southeastern regions. It is unlikely that *P. ursinus* ever occurred in the southwestern Transvaal, as this area falls outside its known range. The apparent absence of baboon in the southeastern Transvaal can only be ascribed to eradication programmes, if it has not been overlooked in collecting.

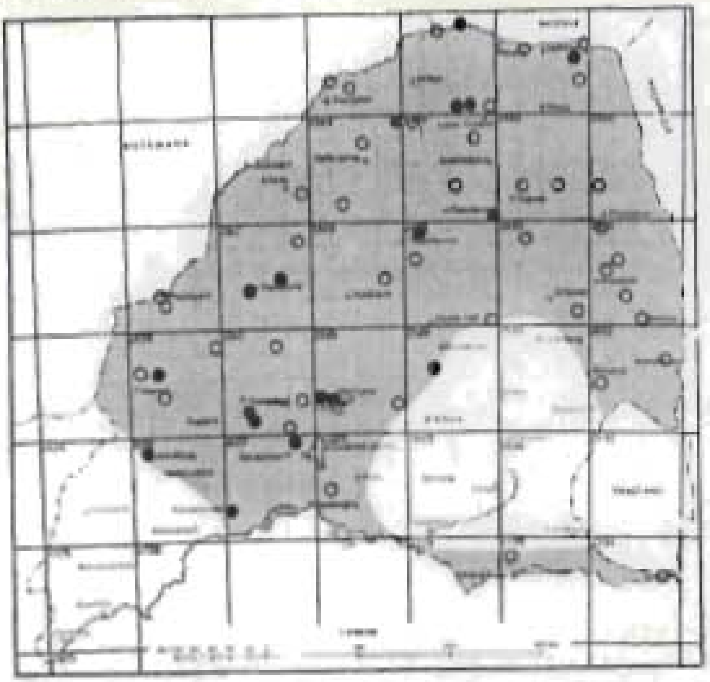

Fig.62: The distribution of *P. ursinus* in the Transvaal.

HABITAT:

The chacma baboon has a wide habitat tolerance. As far as can be ascertained, its range is limited by the availability of open water and suitable sleeping places such as rocky cliffs or high trees.

HABITS:

The ecology and behaviour of the chacma baboon in southern Africa have been relatively well studied by a number of scientists, notably Bolwig (1957, 1959, 1963), Hall (1962a and b), and especially Stoltz (1970), Stoltz and Saayman (1970), Saayman (1968, 1971a and b). Horr and Washall (1964) give a good general account of the ecology and behaviour of the baboon. A summarized account of all this research is given here.

P. ursinus is a highly social species. Troops consist of ten to more than a 100 individuals, comprised of both sexes and all age groups. A very definite dominance order has been described with a few of the strongest fully adult males in combination forming a so-called central hierarchy which controls the

troop/...

troop. Dominance in females varies. A low-ranking female in oestrus rises in the hierarchal system, probably as a result of the attention afforded her by consorting males. A female with her newly-born baby forms the centre of the troop's attention and protection. A baboon troop appears to be a close and inbred society which functions as a unit. See Maxim and Buettner-Janusch (1963) for the genetic implications of such a closed unit, where an individual normally spends his entire life in the troop in which it was born. A baboon is vulnerable when alone, and will make anxious efforts to rejoin its troop.

Although territoriality in the baboon is as yet unconfirmed (see Maxim and Buettner-Janusch, 1963), *P. ursinus* utilizes home ranges of varying sizes. Home ranges of adjacent troops overlap peripherally, and peaceful coexistence within these overlapping areas seems to be the rule. However, when one troop penetrates the core area of another, fierce inter-troop fighting has been observed. Through necessity sleeping places, water sources and certain feeding areas are sometimes shared between troops. Baboon troops never sleep on the ground, for fear of predators, but utilize trees or rocky cliffs.

No permanent pair bonds exist. As a female progresses through the cycle of sexual receptivity, she tends to mate with most of the adult males in the troop; the less dominant ones first and the dominant ones during the height of oestrus. Oestrus is signalled by the red and swollen condition of the sexual skin surrounding the female genitalia.

The vigilance behaviour and defensive organization of a troop has been well documented. Leopards as aggressors are no match for the defensive organization of a baboon troop by day. Vigilance behaviour has been observed in young adults and adults of both sexes, thus refuting the popular belief of a single permanent sentinel (Hall, 1960a; Maxim and Buettner-Janusch, 1963).

The greater part of the day is spent in the search for food, with social interactions especially during early mornings and late afternoons. Grooming is an important social action, and occurs between males and females during courtship, as well as between females and their offspring.

Baboons/...

Baboons are very intelligent animals, which learn fast to advantageously manipulate objects (van Lawick Goodall, van Lawick and Packer, 1973; Bolwig, 1961 and 1963).

FOOD:

Omnivorous, with plant material constituting the largest bulk of the diet; 92% as found by Moolman and Breytenbach (1976). According to them invertebrates are either highly preferred or essential food items, since they were found in stomach contents throughout the year. Dart (1963) discusses the carnivorous trait of baboons, and concludes that baboons are more carnivorous than scientific field observations would indicate, as a result of a year-round physiological protein demand.

BREEDING:

As far as can be ascertained, throughout the year. Young baboons of varying ages have been observed in troops during all seasons.

MEASUREMENTS AND MASS:

Data available from only three adult males:

	HB	T.	H.ft	Ear		Mass
TM 26934:	1390	585	201	58mm	=	20kg
TM 26941:	1420	560	200	40mm	=	19kg
TM 27178:	1209	522	207	54mm	=	18,7kg

RECORDS OF OCCURRENCE:

Specimens examined, 24: Boekenhoutkloof 315, 2 (TM); Donkerpoort, 1 (TM); Fernwood, 2 (TM); Klaserie, 1 (TM); Lekkerskraal, 1 (TM); Lichtenburg, 1 (TM); Loskopdam Prov. Nat. Res., 7 (TM); Magaliesberg, 1 (TM); Makapansgat, 1 (TM); Motlateng, 1 (TM); Mutale river, 1 (TM); Potchefstroom, 1 (TM); Rochdale, 1 (TM); Rustenburg, 1 (TM); Uitkyk, 1 (TM); Vliegepoort, 1 (TM) Zeerust, 1 (TM).

Additional/...

Additional records: Sight records from Al-te-vêr, Blijdschap Priv. Nat. Res., Blyde Forest Res., Buffelspoort, Charleston, Cyprus, De Hoop Priv. Nat. Res., Dordrecht, Ferndale, Fort Klipdam, Greefswald, Groothoek, Hans Merensky Prov. Nat. Res., Huwi, Jack Scott Priv. Nat. Res., Langfontein, Leeuwspoor, Letaba Ranch, Madimbo, Mmabolela Estates, Mooigenoeg, Mooiplaas, Mosdene, Nicorel, Olifantspoort, Levuvhu river, Othawa, Parkfield and Delamere, Platbos, Renosterpoort, Rhoda, Rochdale, Rykvoorby, Sandringham, Scrutton, Silkaatsnek, Suikerboschrand Prov. Nat. Res., Sweet Home, Ten Bosch Estates, Timbavati Priv. Nat. Res., Uitkyk and Paranie, Urk, Wolkberg, Zandspruit.

Records from the Kruger National Park area after Pienaar (1964).

Cercopithecus Linnaeus, 1758
Subgenus *Cercopithecus* Linnaeus, 1758

1. Outer surface of arms black or darker than the back; limbs and much of the tail predominantly black *albogularis*
Outer surface of arms not black, usually paler than body; limbs not predominantly black; tail if black only at distal end ... ... *pygerythrus*

Cercopithecus (aethiops) pygerythrus (F. Cuvier, 1821)

Vervet monkey
Blou-aap

C.p. pygerythrus (F. Cuvier, 1821)

TAXONOMIC NOTES:

The taxonomy and systematic relationships of the members of this large and widespread genus are complicated. Within the Transvaal there is no apparent geographic variation in *C. pygerythr* at subspecies level. Dandelot (1974) is followed here in ascribing Transvaal material to the superspecies *aethiops*, species *pygerythrus*.

DISTRIBUTION:

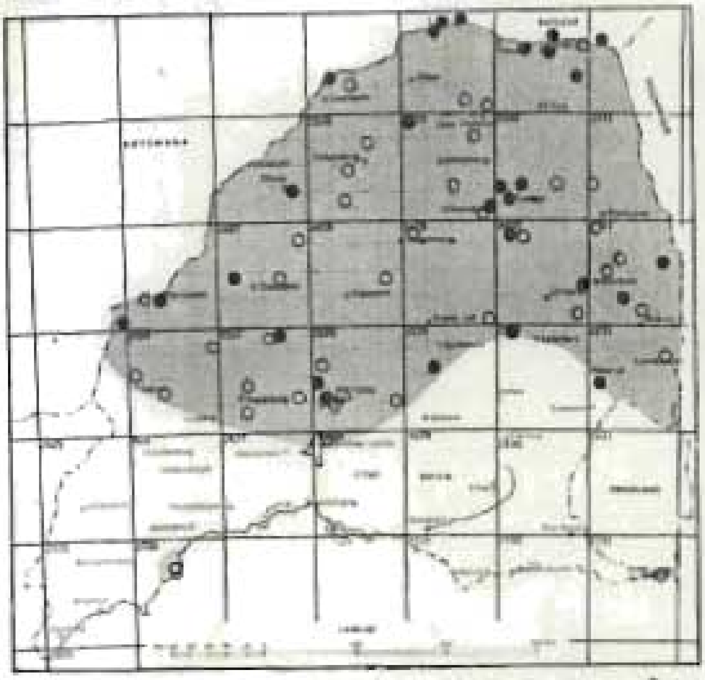

Fig.63: The distribution of *C. pygerythrus* in the Transvaal.

In the Transvaal, the range of the vervet monkey is closely associated with woodland savanna. For this reason it is found only in the wooded areas to the north of the Magaliesberg range, and the eastern Transvaal lowveld. A common species throughout its range, and regarded as a pest in many agricultural areas, whence it is actively eradicated.

HABITAT:

In this Province vervet monkeys, as elsewhere through its extended range on the continent, live in drier habitats than those of any other member of the genus. It has successfully adapted to the various forms of woodland savanna, and consequently has a wide geographical distribution and a wide habitat tolerance. It is also very abundant. *C. pygerythrus* occasionally ventures marginally into montane forest but not at all into pure grasslands. It exhibits a marked preferenc for riverine forests. But since water is required regularly, it is not clear whether the water or the lusher riverine vegetation is the main attraction.

HABITS:

The ecology and social biology of the vervet monkey have been well documented by Brain (1965), Gartlan and Brain (1968), Hall and Gartlan (1965), Saayman (1969), Struhsaker (1966 and 1967),

and/...

and Tappen (1960). A brief summary of their results follows:

C. pygerythrus is a social species. Troops are heterosexual, with the number of individuals per troop ranging from seven to 53. Average group size is of the order of 24. The group may consist of subgroups, and individuals pushed out to the periphery of the social order of the group are commonly observed. Social organization is variable, and this is to a large extent interpreted as an adaptation to different ecological conditions. A social order is always maintained, with dominant and/or older males occupying high-ranking positions. Grooming, social play encounters and agonistic behaviour are all part of the social make-up of the species. Females devote a lot of time and attention to infants, either their own or alternatively those of other mother Females furthermore actively defend any youngster of the group.

Basically *C. pygerythrus* has a flexible social system in order to accommodate shorter-term changes in ecological conditions. Aspects such as sex ratios, the amount of intra-group aggression, and the type and frequency of interactions are believed possible to change within a few generations. Acquired skills or new adaptations apparently are transferred through the mother-infant relationship.

Vervet monkeys are basically arboreal. However owing to the nature of their preferred habitat they spend a large proportion of the day on the ground. It is thus the most terrestrial species of the genus. At nights a group sleeps in trees, where it divides into subgroups huddling together for warmth on cold nights. Subgroups rejoin the next morning. During the day vervets roam as a close-knit unit. The area over which the group spreads at any time can be related to the quality of the habitat.

Each group has a home range within which it maintains a territory. The sizes of the home range and the territory vary, and are related to the quality of the habitat and abundance of food, rather than to group size. The territory is actively defended by all members of the troop except infants. Scent marking has been observed and related to territorial maintenance, as have the noisy displays by males in treetops on the periphery

of/...

of their territories.

Three types of communication have been observed between troop members, namely facial expressions, body stances and vocalizations. It was found that the vervet monkey, possibly since it is more terrestrial, relies more on facial expressions and body stances than do other members of the genus. This is seen as an adaptation to avoid undue attention by predators.

BREEDING:

Whereas Struhsaker (1967) records *C. pygerythrus* as a seasonal breeder in central Africa, Smithers (1971) presents data indicating that this species breeds throughout the year. No gravid females were collected in the Transvaal.

Unlike the baboon, female vervet monkeys display no external physical change that can be correlated with oestrus (Struhsaker, 1967). Females indicate receptivity by presenting to adult males. According to Struhsaker (*op.cit.*) females can mate while still pregnant or lactating, and the period of oestrus may vary from one to more than sixty days.

FOOD:

The vervet monkey is an opportunistic omnivore, feeding mostly on plant material such as leaves, buds, seeds and fruit. Insects are relished, while small reptiles and even young chicks are taken (Smithers, 1971). Vervet monkeys often become a nuisance in agricultural areas and fruit orchards. See also Maberley (1963) and Pooley (1968) for food items recorded.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	1138	11	1000	1255
T.	602	12	530	673
H.ft.	137	10	130	147
Ear	37,5	11	31	45
Mass	5,9 kg	5	4,0	7,0

Females/...

Females

	$\bar{X}$	N	Min.	Max.
Tot.	1080	6	1001	1160
T.	575	6	522	640
H.ft.	125	5	118	130
Ear	35,8	6	34	40
Mass	4,3	2	-	-

RECORDS OF OCCURRENCE:

Specimens examined, 49: Blouberg, 4 (TM); Boschfontein, 1 (TM); Buffelsdraai, 2 (TM); Chikwarakwana, 1 (RM); Fairfield, 3 (TM); Greefswald, 1 (TM); Huwi, 1 (TM); Levuvhu river, 1 (TM); Loskopdam Prov. Nat. Res., 1 (TM); Mariepskop, 5 (TM); Mmabolela Estates, 1 (TM); Mutale river, 4 (TM); Olifantspoort, 3 (Private collection); Othawa, 1 (TM); Pretoria, 3 (TM); Rochdale, 1 (Private collection); Satara, 2 (TM); Scrutton, 1 (TM); Secheili's Oude Stat, 1 (TM); Sweet Home, 1 (TM); The Downs, 2 (TM); Tzaneen, 2 (SI); Uitkyk Priv. Nat. Res., 1 (TM); Vygeboschlaagte, 1 (TM); Woodbush, 4 (TM).

Additional records: Material housed in Rhodesian Museums from 2229 AB, 2229 BA and 2230 BC (Smithers, *in litt.*).

Sight records from: Modderfontein, Al-te-vēr, Blijdschap Priv. Nat. Res., Blyde Forest Res., Brandhoek, Buffelspoort, Charleston, Cyprus, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Ferndale, Fort Klipdam, Groothoek, Hans Merensky Prov. Nat. Res., Leeuwspoor, Letaba Ranch, 10 km E. Madimbo, Mooigenoeg, Mosdene Priv. Nat. Res., Nicorel, Othawa, Parkfield and Delamere, Platbos, Renosterpoort Priv. Nat. Res., Rhoda, Rykvoorby, Sandringham Priv. Nat. Res., Silkaatsnek Priv. Nat. Res., Ten Bosch Estates, Timbavati Priv. Nat. Res., Urk, Welgevonden, Zandspruit, Zoutpan, Wolkberg.

Open circles on the distribution map within the Kruger National Park area are after Pienaar (1964).

Cercopithecus/...

Cercopithecus (mitis) albogularis (Sykes, 1831)

Samango monkey

Samango-aap

C.a. erythrarchus Peters, 1852

TAXONOMIC NOTES:

The taxonomic treatment of Dandelot (1974) is followed here.

DISTRIBUTION:

Fig.84: The distribution of *C. albogularis* in the Transvaal.

C. albogularis has an easterly distribution throughout Africa. As elsewhere throughout its range, the samango monkey has a patchy and easterly distribution in the Transvaal, being closely associated with the isolated patches of evergreen forests of the escarpment. These forest patches are often widely separated by areas of country into which *albogularis* fails to spread. Vagrants are on occasion reported from dense riverine gallery forests some distance away from the evergreen forests, for instance at Pafuri (Pienaar, 1964).

HABITAT:

Very narrowly adapted to the high evergreen forests of mountains and coastal areas. In this respect it is ecologically similarly adapted to the other tropical members of the genus in Africa, except that *C. albogularis* is the only highly arboreal member of the genus ranging this far south on the continent. This suggests that the species is ecologically relatively more successful.

Like/...

Like the majority of species of the genus, the samango monkey is almost entirely arboreal. It is thus essentially restricted to evergreen forests. However Brain (1965) suggests that not only ecological factors restrict the species to evergreen forests. *C. albogularis* might have exhibited a gradual spread into riverine forests, were it not for the fact that vervet monkeys are so well established here. Inter-specific competition is thus another factor limiting the range of samango monkeys.

HABITS:

Apart from some observations by Brain (1965 and 1968), very few detailed studies have been conducted on the behaviour and ecology of this species. However, J. Scorer (in progress) has recently completed a field study in the Transvaal on this species, and his results should be published shortly.

The samango monkey is a social species. Group size is smaller than than of the vervet monkey, and estimated to be on average between 15 and 20 individuals. Groups are heterosexual, and unlike the vervet it is difficult to distinguish between the sexes. It is highly arboreal, sleeping and spending the largest part of the day in the forest canopy where the animals are well concealed and difficult to observe. However, troops have been observed feeding on the ground in open patches within the forest at Lake Sibaya in Zululand. Normally a very vocal animal, a troop will fall absolutely silent when closely approached by an observer. It appears to have home ranges since certain troops are known to occur in limited and exclusive areas for prolonged periods.

Grenadilla farmers from Woodbush claim that samango monkeys ca damage to crops. It has been reported from Entabeni Forest Station to eat the bark of young pine trees bordering endemic forests, causing die-offs or stunted growth of the trees. At Mariepskop I have observed two bold males habitually raiding the "boma" of a native dwelling for whatever food is available, normally mealie porridge. However, these are all isolated instances, and there is no reason to consider samango monkeys an economic pest. On the contrary, as a result of dwindling

habitat/...

habitat in southern Africa, there is every reason for concern for its continued existence.

MEASUREMENTS AND MASS:

Data from only five animals available:

Males

	Tot.	T.	H.ft	Ear
TM 4483:	1220	695	140	39mm
TM 4772:	1250	730	150	37mm
Females				
TM 3411:	1170	650	132	34mm
TM 3412:	1170	650	144	34mm
TM 4773:	1018	608	130	35mm

RECORDS OF OCCURRENCE:

Specimens examined, 10: Leydsdorp, 1 (TM); Malta, 1 (TM); Mariepskop, 2 (TM); Sekororo, 4 (TM); Woodbush, 2 (TM).

Additional records: Sight records from Cyprus, Parkfield and Delamere, Wolkberg. Literature record from Pafuri (Pienaar, 1964).

SUBORDER PROSIMII

INFRAORDER LORISIFORMES

Family Galagidae

Galago E. Geoffroy, 1796

1. Size large; adult skull with sagittal crest; P^1 higher than P^2 ... ... *crassicaudatus*
Size small; no sagittal crest; P^1 and P^2 subequal ... ... *senegalensis*

Galago/...

Galago crassicaudatus E. Geoffroy, 1812 Grand galago
Bosnagaap

G.c. umbrosus Thomas, 1917

DISTRIBUTION:

Fig.65: The distribution of *G. crassicaudatus* in the Transvaal.

G. crassicaudatus has an entirely eastern distribution in the Transvaal. Essentially it occurs in the eastern Transvaal lowveld and on the escarpment, as well as in the eastern sector of the area north of the Zoutpansberg. However, the grand galago utilizes corridors in the form of riverine and montane forests, to penetrate as far westwards as Louis Trichardt and Potgietersrus. The latter record is based on a detailed description of an animal observed by the owner of the farm Groothoek.

HABITAT:

Observations in the Transvaal support the findings of Doyle and Bearder (1977), that the grand galago is very narrowly adapted to montane forests and high riparian forests. Not once was this animal observed outside this particular habitat in the Transvaal, although Doyle and Bearder (*op.cit.*) mention isolated instances where this has galago ventured into other habitats.

HABITS:

Doyle and Bearder (1977) summarize all the research conducted on both species of *Galago* in southern Africa. Especially Doyle, Bearder and their co-workers have made a substantial contribution in the understanding of the ecology, socio-biology

and/...

and breeding of *G. crassicaudatus* and *G. senegalensis*, both in captivity and in the wilds. All my own random observations support their findings and conclusions.

The grand galago is a nocturnal, arboreal and social animal. It is strictly nocturnal, commencing activity just after sunset and ceasing just before sunrise. Daylight hours are spent sleeping well concealed in nests or forks of high trees. Nocturnal activity patterns show a bimodal curve of high activity just after sunset and again during the hours just before dawn. Between these peaks the animals rest or sleep. Approximately one kilometer is traversed per night, normally following a circular route.

G. crassicaudatus is highly adapted to an arboreal life, and it seldom ventures to the ground. Locomotion under undisturbed conditions is a slow deliberate quadrupedal walk on branches. However, hopping as well as jumping over greater distances regularly occur. This is a social species and is normally encountered in small groups of up to six individuals, mostly constituting a family group. A female with her infants, and sometimes her juvenile offspring, form the basis of such social groups. Allogrooming has been observed and is seen as serving a social function. Autogrooming, regularly accompanied by urine-washing, occurs especially upon waking.

The grand galago was found to maintain home ranges (Doyle and Bearder, 1977); one such home range was determined to encompass seven hectares. The owners of a home range know it intimately. Well-established routes are followed through the home range. The various areas within a home range are utilized by rotation, apparently in correlation with food availability and abundance. A number of sleeping places are maintained within such a home range, each occupied for short periods of time.

Females construct nests of green leaves and twigs where they can give birth. The infants remain hidden in these nests for the first few days of their lives. Hereafter the mother takes them along on her nightly excursions.

FOOD:

Gum secreted by trees constitute a major part of the diet. This is followed by other plant material such as fruit, flower secretions and seeds (Doyle and Bearder, 1977). Insects represent c. 5% of the diet. Exotic fruits are also taken in orchards adjoining natural habitat.

BREEDING:

G. crassicaudatus has a distinct and restricted breeding season in southern Africa. Mating occurs during midwinter (June/July). Gestation period is c. 130 days. Parturition is within a period of three weeks, as from the beginning of November. Doyle and Bearder (1977) relate this birth periodicity to an adaptation to seasonal food availability. Normally twins are born, with triplets and singletons recorded as minority events.

I collected only one pregnant female, with two foetuses, cr 58 mm, implanted 1L:1R.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	712	16	630	785
T.	383	16	350	440
H.ft.	92,5	15	84	101
Ear	60,7	15	54	65
Mass	1,27	9	0,55	1,65 kg

Females

	$\bar{X}$	N	Min.	Max.
Tot.	588	5	501	715
T.	319	5	285	388
H.ft.	83,0	5	80	88
Ear	55,4	4	48,5	63
Mass	0,74	2	-	- kg

RECORDS OF OCCURRENCE:

Specimens/...

Specimens examined, 29: Blesbokspruit, 1 (TM); Chikwarakwara, 1 (RM); Cyprus, 1 (TM); Greefswald, 1 (TM); 10 km E. Madimbo, 1 (TM); Mariepskop, 2 (TM); Mokeetsi, 1 (TM); Mutale, 1 (TM); New Agatha Forest Reserve, 7 (TM); Newington, 1 (TM); Othawa, 1 (TM); Nelspruit, 1 (TM); Paranie Priv. Nat. Res., 2 (TM); Rochdale, 1 (Priv. coll.); Uitkyk Priv. Nat. Res., 1 (TM); Woodbush, 2 (TM); Zoutpansberg, 4 (TM).

Additional records: Sight records from Groothoek, Leeuwspoor, Letaba Ranch, Levuvhu river, Parkfield and Delamere, Scrutton, Sweet Home. Specimens are housed in Rhodesian Museums, collected from 2230 BC (Smithers, *in litt.*). Open circles on the distribution map in the Kruger National Park area, after Pienaar (1964).

Galago senegalensis E. Geoffroy, 1796 — Lesser galago, Nagaap

G.s. moholi A. Smith, 1839

DISTRIBUTION:

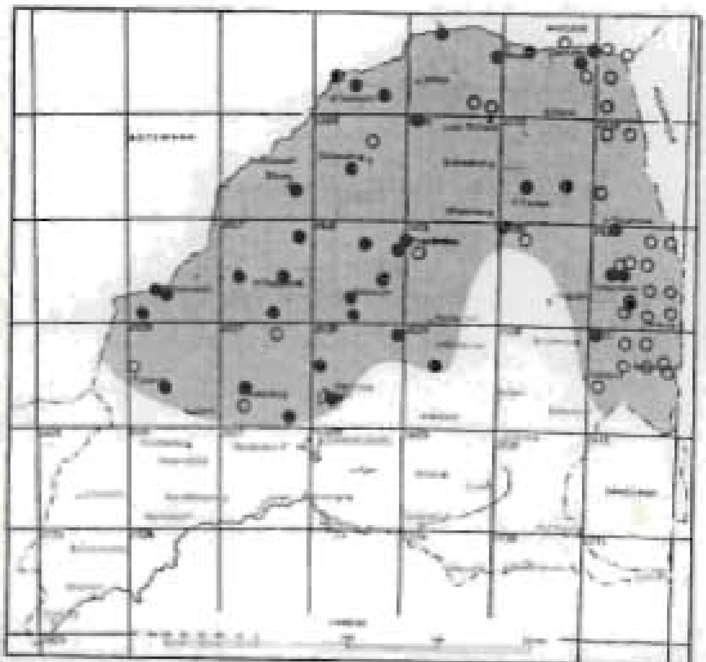

Fig.66: The distribution of *G. senegalensis* in the Transvaal.

In the Transvaal the lesser galago is widely distributed in all woodland savanna areas. An abundant species, whose range is limited by the availability of open woodland or shrubland.

HABITAT:

Unlike the former species, *G. senegalensis* is markedly dependent upon open woodland associations and, to a lesser extent, open shrubland. The lesser galago is seldom if ever

encountered/...

encountered in the domain of the grand galago, while it is entirely absent from the highveld grasslands. Smithers (1971) presents data showing that the lesser galago is particularly associated with stands of *Acacia* spp., and he relates this to the high insect diversity found in *Acacia* trees, and forming part of the galago's insectivorous diet.

<u>HABITS</u>:

As pointed out by Doyle and Bearder (1977) in the collation of their earlier research work, it is very similar in habits to the grand galago. It is also a social, arboreal and entirely nocturnal species. Exclusive home ranges are kept, within which several nests are built for the purpose of parturition. Allo-grooming and autogrooming, the latter in association with urine-washing, have been described. A bimodal peak of high nocturnal activity, similar to that of the previous species, with a period of rest and/or sleep during the middle of the night, is typical.

Compared to *G. crassicaudatus*, the lesser galago is a far more agile and active animal, capable of jumps over long distances. This species furthermore spends much more time on the ground than the former, apparently in search of insects. Individual members of a social or family group disperse early at night to forage on their own, after an initial short spell of intra-group social activities.

<u>FOOD</u>:

Exclusively *Acacia* gum and insects. During winter gum forms the major part of the diet, supplemented by insects (see Doyle and Bearder, *op.cit.*). This dependence upon gum may account for the lesser galago's geographical attachment to *Acacia* spp., as mentioned above.

<u>BREEDING</u>:

Unlike Smithers (1971), Doyle and Bearder (1977) find the lesser galago to be a seasonal breeder, producing off-spring during summer. There are two birth seasons per summer, the first during October, followed by a post-partum oestrus period. The second birth season is during January/February. Gestation period ranges from 121 to 124 days. Two young are normally born per mother.

In the Transvaal only one pregnant female was collected, during September. The animal had only one foetus, implanted in the left uterus horn, cr.35 mm.

MEASUREMENTS AND MASS:

Males

	$\bar{x}$	N	Min.	Max.
Tot.	381	51	330	420
T.	221	51	186	246
H.ft.	58,7	51	50	66
Ear	37,6	51	30	46
Mass	177	26	145	212

Females

	$\bar{x}$	N	Min.	Max.
Tot.	375	8	350	400
T.	226	8	190	227
H.ft.	58,3	7	50	63
Ear	36,6	8	35	39
Mass	155	4	126	176

RECORDS OF OCCURRENCE:

Specimens examined, 70: Al-te-vêr, 2 (TM); Chikwarakwara, 1 (RM); Donkerpoort en Zandspruit, 2 (TM); Droogedal, 1 (TM); Fairfield, 2 (TM); Ferndale, 1 (TM); Geelhoutkloof, 1 (TM); Georges Valley, 1 (TM); Greefswald, 1 (TM); Hans Merensky Prov. Nat. Res., 2 (TM); Huwi, 1 (TM); Kempiana, 3 (TM); Lilliput, 2 (TM); Loskopdam Prov. Nat. Res., 3 (TM); 10 km E. Madimbo, 1 (TM); Marico, 3 (TM); Maringaskraal, 1 (TM); Moorddrift, 4 (TM); Mmabolela Estates, 1 (TM); Mooiplaas, 1 (TM); Mosdene Priv. Nat. Res., 2 (TM); Mutale river, 5 (TM); New Agatha, 1 (TM); Newington, 1 (SI); Nylstroom, 2 (TM); Olifants river, 1 (TM); Othawa, 2 (TM); Platbos, 1 (TM); Potgietersrus, 1 (TM);

Pretoria/...

Pretoria, 1 (TM); Rhenosterkop, 3 (TM); Rooikranz, 2 (TM); Rustenburg, 1 (TM); Sandringham, 2 (TM); Scrutton, 1 (TM); Sweet Home, 1 (TM); Uitkomst, 1 (TM); Urk, 3 (TM); Welgevonden, 1 (TM); Zondagsfontein, 1 (TM); Zoutpan, 3 (TM).

Additional records: Material housed in the Rhodesian Museums, collected from 2230 BC (Smithers, *in litt.*). Sight records from Buffelspoort, Cyprus, Ferndale, Groothoek, Letaba Ranch, Mooigenoeg, Nicorel, Olifantspoort, Parkfield and Delamere, Rochdale, Rykvoorby, Tenbosch Estates, Uitkyk and Paranie Priv. Nat. Res. The open circles in the Kruger National Park area on the distribution map are after Pienaar (1964).

ORDER PHOLIDOTA

Family Manidae

Manis Linnaeus, 1758

Manis temminckii Smuts, 1832 Pangolin
Ietermagog

DISTRIBUTION:

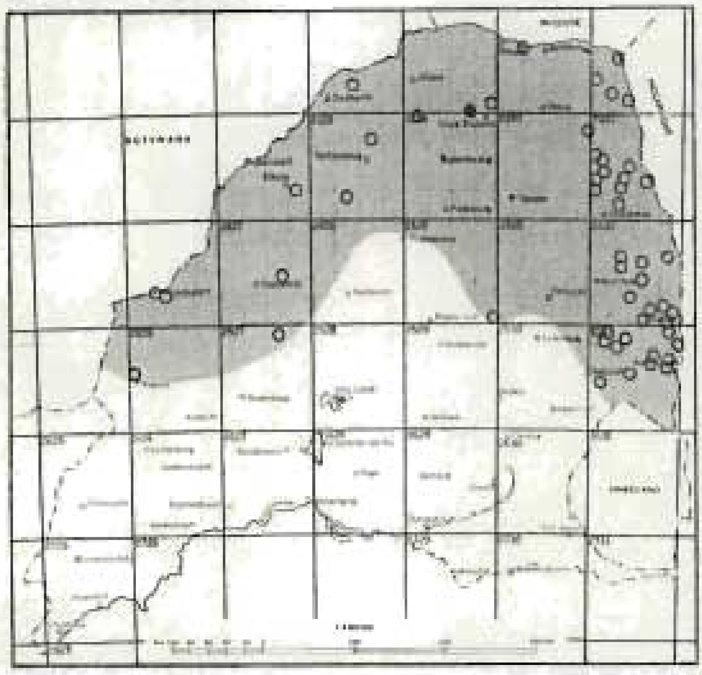

Fig.67: The distribution of *M. temmincki* in the Transvaal.

Records from the Transvaal indicate that this animal is restricted to woodland savanna areas. However, Lynch (1975) reports some past and some more recent records from the highlands of the Orange Free State, which suggest that the pangolin may have occurred on the Transvaal highveld during historical times. The last specimens from the Transvaal were taken at the turn of the century. I have some records, as based on carcass remains found in private possession, suggesting that this animal still persists in the Transvaal outside the Kruger National Park. I have, nonetheless, not the slightest doubt that it is now extremely rare and endangered here. For all the time I have spent in the field, I have never come across live pangolins in the Transvaal. The majority of records indicated on the distribution map are based on more than one verbal confirmation of occurrence, from persons living at that particular locality. Apparently, however, the conservation status of the pangolin is satisfactory in the Kruger National Park, since Pienaar (1964) has recorded it from several localities.

HABITAT:

Very little is known of the habitat requirements of this animal. As pointed out, Transvaal records indicate an association with woodland savanna, whereas Lynch (1975) lists its occurrence in grassveld associations. Smithers (1971) has also recorded it from floodplain grasslands, riparian woodlands, dry scrublands and woodlands. No records exist from dense forests or from mountainous areas.

HABITS:

The pangolin is probably the least known medium-sized mammal in southern Africa. Information pertaining to its habits is restricted to isolated observations by Shortridge (1934); Roberts (1951), and Smithers (1971).

It is an extremely shy and retiring animal, and appears to be predominantly nocturnal, thus rendering observation even more difficult. However, Smithers has (*op.cit.*) recorded some daytime activity. Unlike its close relative *M. tricuspus* Rafinesque, 1820, *M. temmincki* is entirely terrestrial. It has so far been recorded to be exclusively solitary in nature. In spite of the fact that it is widely believed to excavate its own burrows, no substantiating evidence exist. Neither does it live exclusively on the inhabitants of termite mounds (see Smithers, 1971) by breaking open the mounds with its strongly developed claws, but also on harvester termites and ants.

Smithers (1971) discusses locomotion. This animal is almost bipedal. When progressing in a leisurely manner, the front feet assist only irregularly in balancing. The tail is used extensively as balancing or supporting organ, especially when the animal is moving at speed on the hind limbs only. Being a relatively slow-moving creature and also fairly easy to detect, it is very susceptible to human predation. Some black tribes relish the flesh. Various parts of the body are allegedly used by black medicine men. Several such medicine shops in Pretoria display parts of pangolins on their shelves, and shop owners are prepared to purchase more for processing.

When the pangolin is touched or put under stress, it curls

up/...

up characteristically in a tight ball around its own head. The sharp-edged scales of the back and flanks afford effective protection, and could even cause deep cuts if it is attempted to prize the animal open.

FOOD:

No information available from the Transvaal. Smithers (1971) recorded certain ant (Formicidae) and termite (Isoptera) genera as constituting the sole diet. Since food items are collected with the long sticky tongue, a fair amount of sand and other foreign particles are also taken in.

BREEDING:

No information available from the Transvaal. Smithers (1971) r cords a pregnancy during July, whereas Ansell (1960) observed a bir in captivity during August.

Van Ee (1978) kept some animals under observation in captivity, and observed mating. Mounting is sideways and the male forces his hindparts underneath the female. Gestation period is 139 days. Only singletons have been recorded to be born so far. The mother carries her infant on her back, leaning it against the broad fat tail.

MEASUREMENTS AND MASS:

Neither of the two specimens taken from the Transvaal, were weighed or measured. A male specimen taken in the Caprivi in 1970 had a total length of 910 mm, tail length of 410 mm, and a hind foot length of 70 mm. The mass was not recorded. Smithers (1971) supplies data for two specimens taken in Botswana.

RECORDS OF OCCURRENCE:

Specimens examined, 2: Soutpansberg, 2 (TM).

Sight or verbal records from local inhabitants from: Alte-vêr, Buffelspoort, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Huwi, Letaba Ranch, Nicorel, Parkfield

and/...

and Delamere, Mooigenoeg, Mooiplaas, Othawa, Rochdale, Rykvoorby, Scrutton, TenBosch Estates, Timbavati Priv. Nat. Res., Uitkyk and Parani Priv. Nat. Res., Urk. The open circles in the Kruger National Park area on the distribution map are based on Pienaar (1964).

ORDER LAGOMORPHA

Family Leporidae

1. Mesopterygoid region narrow; space immediately behind palate much narrower than least longitudinal diameter of palatal bridge (palatal bridge averages more than 140 percent of mesopterygoid width) ... ... *Pronolagus*
Mesopterygoid region wider; space immediately behind palate a little narrower than, or subequal to, but most often wider than length of palatal bridge (which averages less than 130 percent of mesopterygoid width)... ... ... *Lepus*

Pronolagus Lyon, 1904

1. Very small bullae, their length less than one tenth of the length of the skull ... *crassicaudatus*
Length of tympanic bullae more than one tenth of length of skull 2
2. Length of skull less than 85 mm ... ... *rupestris*
Length of skull more than 85 mm ... ... *randensis*

Pronolagus crassicaudatus (I. Geoffroy, 1832) Natal red rock hare
Natalse rooihaas

P. c. ruddi Thomas and Schwann, 1905

TAXONOMIC NOTES:

The genus *Pronolagus* is in dire need of revision. However, an understanding of speciation and an insight into geographic and nongeographic variation is severely hampered by a lack of study material. Petter (1972), following Ellerman *et al.*

(1953)/...

(1953), recognizes five subspecies in *P. crassicaudatus*, and ascribes specimens from the Transvaal to *P. c. ruddi*. This treatment is followed here, pending acquisition of more material and a revision of the genus.

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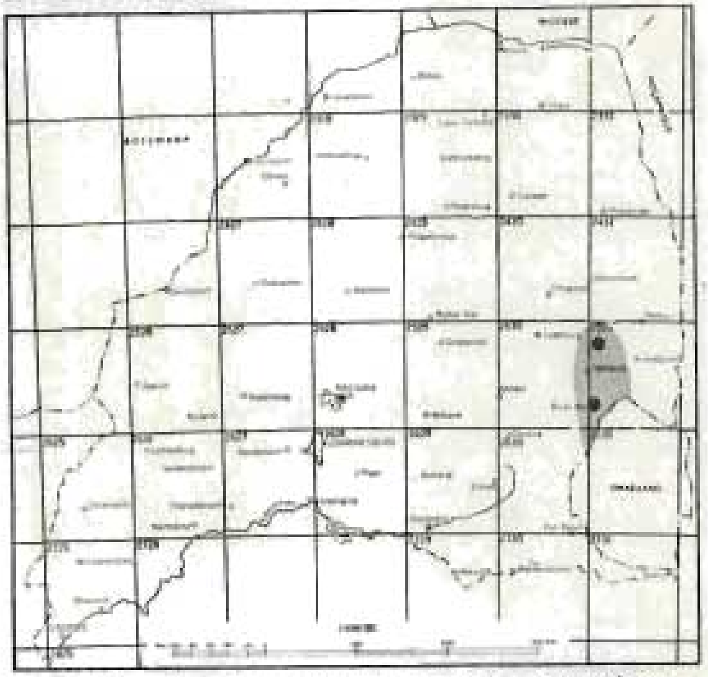

Fig.68: The distribution of *P. crassicaudatus* in the Transvaal.

Only two specimens are available from the Transvaal, one from Barberton and the other from Legogot. It would thus appear that *P. crassicaudatus* ranges only marginally into the southeastern Transvaal from Zululand, Natal and the eastern Cape Province. See Pringle (1974) for an account of distribution in Natal.

HABITAT:

Prefers rocky situations as are usually found on hill slopes and summits. Red rock hares do not burrow, and therefore rely on natural rock crevices for refuge. It is dependent on a good grass cover for grazing, and also for protection and concealment when lying up during the day.

HABITS:

Virtually nothing is known of the habits of the Natal red rock hare, mostly as a result of its secretive and nocturnal habits. Pringle (1974) claims that it occurs in small colonies, probably constituting family units of only a few individuals. Local distribution is limited to areas with suitable rock crevices for refuge. Colonies often occur in close proximity to rock dassie (*P. capensis*) colonies, as a result of a joint dependence on rocky areas. Just like the other two *Pronolagus* species, the Natal red rock hare utilizes permanent toilet sites where the characteristic disc-like droppings are deposited at the base of a rock. It would appear that individuals in fact squat on the edge of the rock while defeacating over its edge.

FOOD:

Grazers.

BREEDING:

No information available.

MEASUREMENTS AND MASS:

Only one male and one female available from the Transvaal. They are:

		Tot.	T.	H.ft	Ear
TM 645:	♂:	579	57	96	74
TM 1473:	♀:	590	40	95	95

None of these specimens were weighed.

RECORDS OF OCCURRENCE:

Specimens examined, 2: Barberton, 1 (TM); Legogot, 1 (TM).

Pronolagus randensis Jameson, 1907 — Rand red hare, Johannesburgse rooihaas

P. r. capricornis Roberts, 1926
P. r. makapani Roberts, 1924
P. r. powelli Roberts, 1924
P. r. randensis Jameson, 1907

TAZONOMIC NOTES:

Ellerman *et al.* (1953), followed by Petter (1972), recognize no less than four subspecies within the Transvaal. These are

capricornis/..

capricornis from the Soutpansberg; *makapani* from Makapan's cave near Potgietersrus; *powelli* from the Rustenburg district; and *randensis* from Pretoria to Parys and westwards. As remarked by Petter (*op.cit.*), many of the currently recognized forms are probably invalid. The original descriptions of all these subspecies were primarily based on the fur colour of very small samples. Subsequent material proved that the original descriptions do not adequately describe nongeographic and geographic variation, thus invalidating many of the earlier subspecific characters and necessitating a re-examination of subspecies. However, red rock hares are very habitat-specific, and as such populations are often isolated from each other. In the Transvaal, for instance, the Soutpansberg (*capricornis*), Waterberg (*makapani*), and Magaliesberg (*powelli* and partly *randensis*) populations are totally isolated from each other. Since geographical isolation is an important factor in subspeciation, the subspecies currently recognized for the Transvaal (Petter, 1972) are retained, pending a re-evaluation of geographic variation.

DISTRIBUTION:

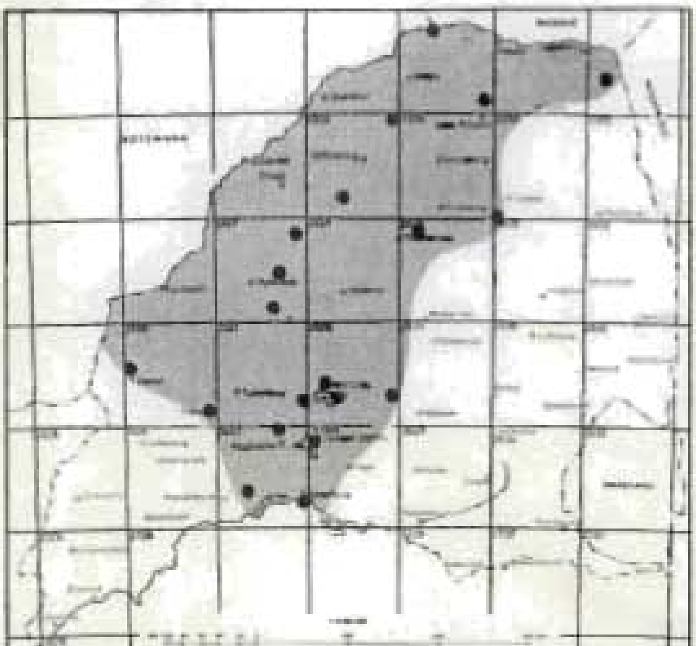

Fig.69: The distribution of *P. randensis* in the Transvaal.

P. randensis is limited to the rocky, mountainous areas of the northern, central and western Transvaal. It is absent from the southwestern Transvaal, probably due to a lack of suitable habitat, as well as from the eastern and southeastern Transvaal where it is replaced by the other two *Pronolagus* species.

HABITAT:

Like *P. crassicaudatus* it is closely

confined/...

confined to rocky hills and rock faces in association with grass and shrub. These situations offer rock crevices and dense shrub cover which are exploited as permanent or semi-permanent refuges. Although red rock hares may venture into adjoining plains to graze, they never seem to wander very far from these refuge situations.

HABITS:

Terrestrial and to some extent rupiculous. The Rand red rock hare is nocturnal, emerging at sunset to graze. During the day individuals lie up in the concealment of rock crevices, or under the protection of vegetation growing at the base of large rocks. They appear to have set habits and escape routes. On several occasions I have flushed individuals from vegetation at the base of a rock. Upon returning the next day, many individuals were flushed at the same spot and followed exactly the same escape route as the day before. At the farm Rykvoorby in the Zeerust district, several individuals were observed sunning themselves in the leeward protection of large rocks from a prevailing cold wind.

Occurs singly or in pairs. Like *P. crassicaudatus*, it defeacates at specific toilet sites which remain in use for prolonged periods. As in all the southern African Lagomorpha, the faeces are disclike individual pellets. These toilet sites are very easy to detect, and being in rocky terrain on mountain slopes or summits, they serve as a clear indication of the presence of rock hares in an area. Although red rock hares have legs they are remarkably fleet-footed and agile. They progress at high speed in especially rocky terrain, dodging and weaving between boulders, or jumping from rock to rock. The fur is extremely fine and dense, and comes off very easily. Attempts at dragging a rock hare from a refuge are more likely to be rewarded with only a handful of fur.

FOOD:

Grazers.

BREEDING:/...

BREEDING:

The only record of breeding is that of a single lactating female collected during May.

MEASUREMENTS AND MASS:

Males

	$\bar{x}$	N	Min.	Max.
Tot.	526	13	495	590
T.	90,4	14	73	207
H.ft	93,3	14	82	205
Ear	84,1	14	78	100
Mass	2,20	3	2,1	2,3

Females

	$\bar{x}$	N	Min.	Max.
Tot.	535	8	472	570
T.	93,4	8	73	105
H.ft	97,9	8	90	105
Ear	81,8	8	78	85
Mass	2,47	5	2,1	2,7

RECORDS OF OCCURRENCE:

Specimens examined, 25: Bon Accord, 1 (TM); Dordrecht, 1 (TM); Greefswald, 1 (TM); Hennops river, 2 (TM); Johannesburg, 1 (TM); Klapperfontein, 1 (Priv. coll.); Koster, 1 (TM); Makapansgat, 1 (TM); Motlateng, 1 (TM); New Agatha For. Res., 2 (TM); Platbos, 1 (TM); Renosterpoort, 1 (TM); Rooikrans, 3 (TM); Rykvoorby, 1 (TM); Silverton, 2 (TM); Soutpansberg, 2 (TM); Swartkrans, 1 (TM); Witpoort, 1 (TM); Zandfontein, 1 (TM).

Additional records: Pienaar (1964) records this species from 2432 CC.

Pronolagus/...

Pronolagus rupestris (A. Smith, 1834) Smith's red hare
Smithse rooihaas

P. r. barretti Roberts, 1949

DISTRIBUTION:

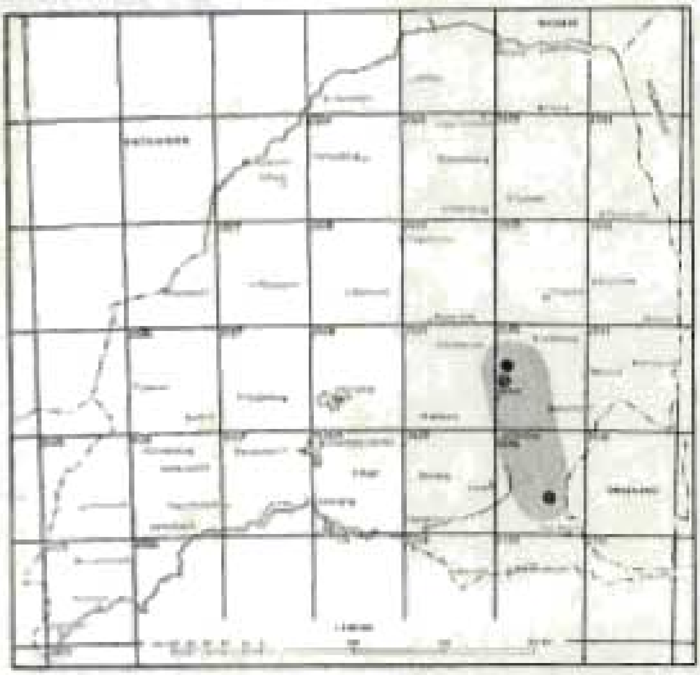

Fig.70: The distribution of *P. rupestris* in the Transvaal.

Restricted to the southeastern Transvaal, where it has been recorded from only three localities - all three along the escarpment. In the Transvaal the three species of *Pronolagus* are thus allopatric.

HABITAT:

Similar to the other *Pronolagus* species, *P. rupestris* is narrowly confined to rocky situations, mostly in association with adequate grass and/or shrub cover on hill slopes and summits.

HABITS:

Isolated observations on Smith's red rock hare suggest that it has similar habits to the other *Pronolagus* species. A group of five individuals was observed one night on a gentle rocky slope on the properties Grootsuikerboschkop and Elandslaagte. These animals were apparently not disturbed by our spotlight. Although all five grazed in the same general area, they did not appear to act as a social group. Probably since the grass cover was very dense, the animals jumped onto rocks to gain better vantage points when disturbed. During the period under observatio they did not venture further than 30 metres away from their rock refuges. During the day some individuals were flushed where they were lying up under the cover of very dense grass some 20 metres away from the nearest rock.

FOOD:/...

FOOD:

Only two stomachs were analysed, the contents of which were finely masticated. It was, however, possible to establish that grass leaves predominated over grass stems. It is further interesting to note that although the winter grass in the habitat appeared to be dry, some green growth must have been present since the food in the stomachs consisted almost totally of green matter.

BREEDING:

The only breeding record available is that of a lactating female taken during May.

MEASUREMENTS AND MASS:

Data available from only four specimens. They are:

	Tot.	T.	H.ft	Ear	Mass
TM 20196: ♂:	470	65	82	85	1,0kg
TM 23812: ♀:	534	88	88	83	1,8kg
TM 23813: ♀:	534	77	88	80	2,1kg
SI (Field no.192): ♀:	430	71	81	75	1,2kg

RECORDS OF OCCURRENCE:

Specimens examined, 4: Belfast, 1 (SI); Joshua Moolman Priv. Nat. Res., 1 (TM); Grootsuikerboschkop and Elandslaagte, 2 (TM).

Additional records: Pienaar (1964) speculates that the red rock hares observed in the northern parts of the Kruger National Park, may be *P. rupestris*. One specimen was subsequently collected, which I identified as *P. randensis*, although with some uncertainty.

Lepus Linnaeus, 1758

(Key modified after Smithers, 1971)

1. Larger, greatest skull length 80-96; gular collar reddish-buffy; dorsal and ventral colour normally meet without a buffy or yellowish tinge marking the zone of contact on the sides ... *saxatilis*
Smaller, greatest skull length 73-88; gular collar pale buffy white or only faintly tinged buffy; where dorsal and ventral colour meet along the sides the zone of contact is often marked by a buffy or yellowish tinge ... ... *capensis*

Lepus capensis Linnaeus, 1758 — Cape hare
Kaapse vlakhaas

TAXONOMIC NOTES:

This genus is clearly in need of revision. Petter (1972) recognizes three species as occurring in the Transvaal, i.e. *L. capensis*, *L. saxatilis* and *L. crawshayi* de Winton, 1899. However, the diagnostic characters proposed by Petter (*op.cit.*) at species level are variable, and I was unable to distinguish *crawshayi*. The latter is therefore treated as a synonym of *saxatilis*, thus allowing me to utilize the diagnostic characters used by Smithers (1971) for *capensis* and *saxatilis* only.

Petter (*op.cit.*) furthermore lists no less than 35 described races for *L. capensis*, with *bedfordi* Roberts, 1932; *ermeloensis* Roberts, 1932; and *ochropus* Wagner, 1844, recognized as the subspecies occurring in the Transvaal. With no clear understanding of the scope of non-geographic and especially geographic intraspecific variation, I consider it unjustified to refer material from the Transvaal to any of these three subspecies.

DISTRIBUTION:

The Cape hare is common on the southern Transvaal highveld grasslands. From here a peculiar fingerlike extension ranges northwards into the woodland savanna zone all along the Springbok Flats. The only exception is the specimen from Shingomene in

the/...

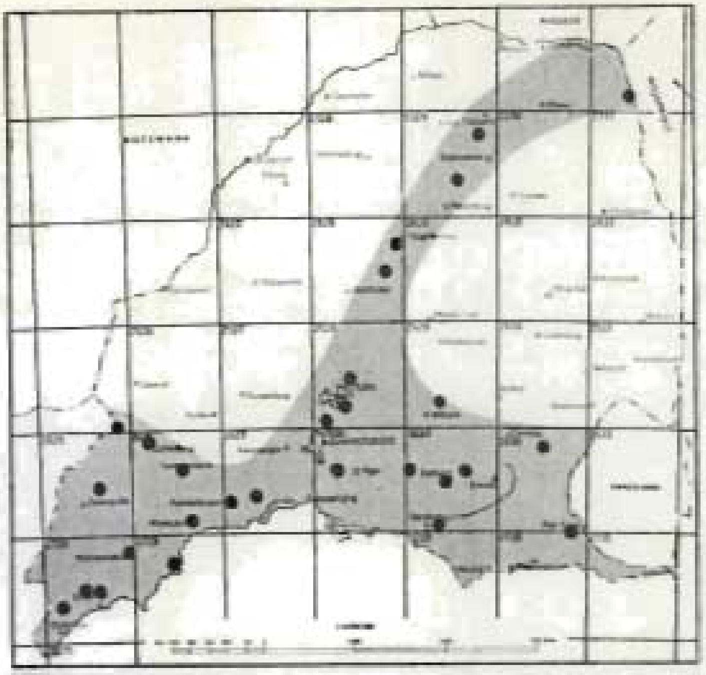

Fig.71: The distribution of *L. capensis* in the Transvaal.

the north of the Kruger National Park, the status of which is uncertain as I could not assign it with certainty to *L. capensis*. In the light of the inferred predelic-tion of the Cape hare for pure grasslands and the lightly wooded Springbok flats, it is desirable to obtain more material from Shingomene to verify the occurrence of the Cape hare, not only in the Kruger National Park, but in the entire woodland savanna of the eastern Transvaal lowveld.

HABITAT:

Smithers (1971:257) analyses the different habitat requirements of *L. capensis* and *L. saxatilis*. He clearly demonstrates that the Cape hare has a marked preference for open grassy areas, avoiding denser woodland altogether and occurring only marginally in shrub of various kinds. In the case of specimens taken in a shrub environment, Smithers was able to show that they were always taken near open grassland areas. My data support Smithers' findings. Seventy-seven percent of the specimens from the Transvaal were definitely taken from open areas such as grasslands, cultivated lands, kraals, airstrips etc. The conditions under which the remaining 23% of specimens were taken are not known but it can be assumed that at least some were also collected from such open areas.

HABITS:

It is indeed amazing that an animal as common and as easy to observe as either of the two local *Lepus* species has not

been/...

been intensively studied in terms of ecology, behaviour etc. Existing knowledge of their general biology is based on incidental observations of especially collectors. The lack of attention *Lepus* species have received from local investigators can probably be attributed to their strictly nocturnal habits. Isolated records of daytime activity exist, but these are under abnormal conditions, viz. feeding on overcast days as observed by Smithers (1971). During the day the Cape hare lie up against tufts of grass or other similar cover. With the ears pulled back and with its cryptic colour, it is very difficult to detect during the day, even at short distances. Probably for that reason the Cape hare is not easily flushed, unless one almost steps on it by accident.

L. capensis is solitary, except during the mating season when more than one male may accompany a female. Groups of Cape hares are occasionally seen, but this is always at places affording very good grazing, which serves to attract several individuals to a restricted area. Young are kept hidden in the form until weaned. Thereafter they disperse and do not remain with the mother.

FOOD:

Grazers. Stomach contents are very finely masticated, rendering identification very difficult.

BREEDING:

Three pregnancies were recorded during November. Lactating females were taken during February (1), July (1), November (5), and December (1). Two of the three pregnant females had two foetuses (1L; 1R), and the third had only one foetus (1L). Smithers (1971) had an equally small sample, but on combining our data it would appear that *L. capensis* has a long breeding season.

MEASUREMENTS AND MASS:

Males/...

Males

	$\bar{X}$	N	Min.	Max.
Tot.	512	24	450	570
T.	82,8	23	67	110
H.ft	109	24	94	117
Ear	110	24	96	134
Mass	1,95	12	1,20	3,00 kg

Females

	$\bar{X}$	N	Min.	Max.
Tot.	550	24	480	590
T.	82,8	25	71	115
H.ft	111	25	103	120
Ear	110	25	97	140
Mass	2,22	19	1,75	3,00 kg

RECORDS OF OCCURRENCE:

Specimens examined, 73: Bandolierskop, 2 (TM); Barberspan, 2 (TM); Blijdschap Priv. Nat. Res., 1 (TM); Bloemhof, 1 (TM); Brandhoek, 2 (TM); Ermelo, 3 (SI); Fort Klipdam, 2 (TM); Goedehoop, 6 (TM); Klerksdorp, 1 (TM); Koppieskraal, 1 (TM); Lichtenburg, 1 (SI); Maria van Riebeeck Mun. Nat. Res., 1 (TM); Mosdene, 3 (TM); Panfontein, 6 (TM); Piet Retief, 1 (SI); Potchefstroom, 3 (TM); Potgietersrus, 5 (SI); Pretoria Zoo's Farm, 2 (TM); Randjiesfontein, 1 (TM); Ratsegaai, 2 (TM); Rietfontein, 1 (TM); Rolspruit, 3 (TM); Roodeplaatdam, 1 (TM); Roodepoort, 3 (TM); S.A. Lombaard Prov. Nat. Res., 10 (TM); Shingomene, 1 (NKW); Vlakfontein, 1 (TM); Welgedaan, 4 (TM); Witpoort, 2 (TM); Wolmaransstad, 1 (SI).

Lepus saxatilis F. Cuvier, 1823 Scrub hare
Kolhaas

TAXONOMIC NOTES:

As pointed out before, I find Petter's (1972) diagnostic

characters/..

characters separating *L. crawshayi* from *L. capensis* and *L. saxatilis* to be too variable to allow separation. Like Smithers (1971), I am therefore following Roberts (1951) in recognizing only two *Lepus* species in southern Africa, the larger being *L. saxatilis*, with *L. crawshayi* as a synonym. Three subspecies are recognized from the Transvaal by Roberts (*op.cit.*) and Petter (*op.cit.*), namely *bechuanae* Roberts, 1832, from northwestern Transvaal; *subrufus* Roberts, 1913, from southeastern Transvaal; and *zuluensis* Thomas and Schwann, 1905, from the eastern and northern Transvaal. I was unable to assign material from the Transvaal with any certainty to any of these races, and consequently do not recognize any subspecies pending a taxonomic revision of the entire genus.

DISTRIBUTION:

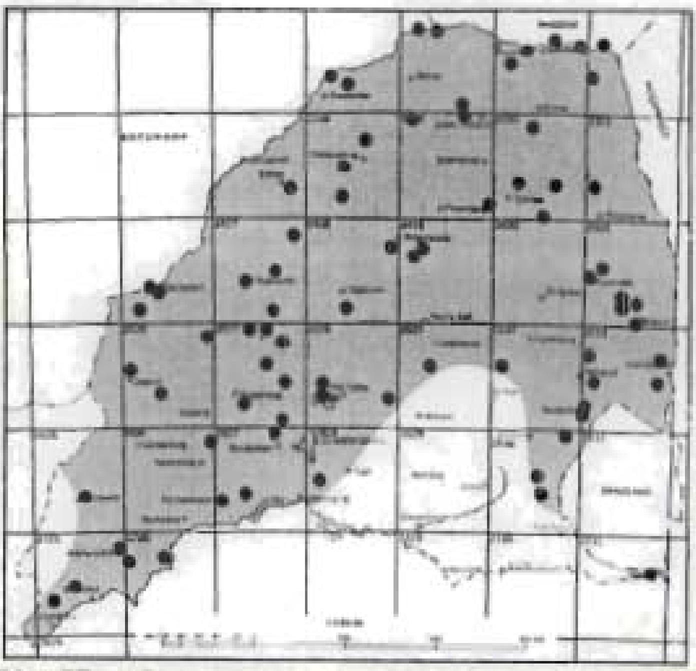

Fig.72: The distribution of *L. saxatilis* in the Transvaal.

Widely distributed throughout the Transvaal, except for the eastern portion of the highveld in the Belfast, Bethal, Standerton and Volksrust districts. Although the possibility exists that the scrub hare has been overlooked, I believe it more likely to be absent due to a lack of suitable habitat in these areas.

HABITAT:

Smithers (1971) demonstrates the wide difference in habitat requirements of the two *Lepus* species. Where *L. capensis* prefers open grassland, *L. saxatilis* has a marked preference for a scrub environment. Smithers was also able to show that where scrub hares have been collected in open areas, it was always in the near close vicinity of scrub associations whence these animals wandered at night in search

of/...

of more palatable food.

An analysis of 81 specimens taken in the Transvaal, for which habitat records are available, reveals the same preference for scrub. Eleven percent were taken in cultivated lands, mostly with scrub associations in the vicinity. A further 19% were collected in open grassland conditions (viz. airstrips), again mostly in the close vicinity of scrub. A total of 57 specimens (79%) were collected in scrub or woodland associations. Where *L. saxatilis* has been collected on the highveld, it has been mostly where some form of scrub cover was available, viz. areas of bush encroachment or scrub along streambe

HABITS:

Very little is known about the general biology of *L. saxatilis*, other than what was learned from intermittent observations by collectors. The scrub hare is predominantly nocturnal, and very rarely seen active by day. It is solitary, except when mating during which time one or more males accompany a female is in oestrus.

During the day individuals rest in forms under a shrub or bush, preferably with some grass to afford extra concealment. They lie up with the head pulled in and the ears folded flat along the back. In this position a scrub hare is very difficult to detect, as a result also of its cryptic colouration blending effectively with the background.

FOOD:

Grazers. Food is finely masticated, rendering identification very difficult.

BREEDING:

The monthly incidence of non-pregnant, lactating and pregnant females from the Transvaal is as follows:

Tot./...

	J	F	M	A	M	J	J	A	S	O	N	D
Tot.	11	2	8	4	4	1	1	4	-	3	8	4
Non-Pregnant	2	0	2	3	0	1	1	2	-	1	1	0
Lactating	5	2	4	0	4	0	0	0	-	2	5	2
Pregnant	4	0	2	1	0	0	0	2	-	0	2	2

Smithers (1971) analyses a much bigger sample, and concludes that breeding occurs throughout the year. Implantation is irregular. Average number of foetuses per female = 1,9; with observed range from one to three in fifteen females. Twins occurred in 10 instances, triplets twice, and singletons three times.

MEASUREMENTS AND MASS:

Male

	$\bar{X}$	N	Min.	Max.
Tot.	554	51	450	640
T.	91,3	45	70	119
H.ft	112	49	100	127
Ear	109	50	95	148
Mass	2,2	30	1,4	2,9

Female

	$\bar{X}$	N	Min.	Max.
Tot.	582	78	490	628
T.	94,5	74	75	122
H.ft	114	73	99	128
Ear	112	72	97	143
Mass	2,6	46	1,6	3,5

RECORDS OF OCCURRENCE:

Specimens examined: Al-te-vêr, 2 (TM); Arnhemburg, 1 (TM); Barberspan, 2 (TM); Barberton, 5 (TM, 1; SI, 4); Beestekraal, 4 (TM); Brandhoek, 3 (TM); Brits, 1 (TM); Buffelspoort, 1 (TM); Derdepoort, 12 (TM); Donkerpoort and Zandspruit, 2 (TM); Dordrecht, 2 (TM); Droogedal, 1 (TM); Greefswald, 2 (TM); Groothoek, 2 (TM); Grootsuikerboschkop and Elandslaagte, 1 (TM); Hans Merensky Prov. Nat. Res., 1 (TM); Huwi, 3 (TM); Joshua Moolman Priv. Nat. Res., 2 (TM); Kaalplaas, 6 (TM); Klaserie, 1 (TM); Klipkuil, 1 (TM); Leeuwspoor, 4 (TM); Letaba Ranch, 1 (TM); Loskopdam Prov. Nat. Res., 2 (TM); Lydenburg, 8 (TM); 10 km E Madimbo, 1 (TM); MalaMala, 4 (TM); Malelane, 3 (NKW); Marico district, 2 (TM); Mmabolela Estates, 4 (TM); Mooigenoeg, 2 (TM); Mooiplaas, 2 (TM); Moorddrift, 1 (TM); Newington, 1 (SI); Nicorel, 2 (TM); Olifantspoort, 2 (TM); Olifants river, 2 (TM); Onderstepoort, 3 (TM); Othawa, 4 (TM); Panfontein, 4 (TM); Piet Retief, 2 (SI); Platbos, 1 (TM); Potchefstroom, 1 (TM); Potgietersrus, 4 (SI); Pretoria, 1 (TM); Punda Milia, 1 (NKW); Renosterpoort Priv. Nat. Res., 2 (TM); Rhodes drift, 1 (TM); Rissik Priv. Nat. Res., 4 (TM); Rochdale, 1 (TM); Rooikrans, 2 (TM); Rykvoorby, 1 (TM); S.A. Lombaard Prov. Nat. Res., 5 (TM); Sabi river, 1 (TM); Sandringham, 4 (TM); Scrutton, 2 (TM); Steynsdorp, 1 (TM); Suikerboschrand Prov. Nat. Res., 2 (TM); Swartkrans, 1 (TM); Swellendam, 2 (TM); TenBosch Estates, 1 (TM); Tshipise, 3 (SI); Uitduiker, 1 (DM); Uitkomst, 1 (TM); Uitkyk and Paranie, 2 (TM); Umhlumi, 1 (TM); Urk, 1 (TM); Vliegenpoort, 1 (TM); White river, 4 (SI); Welgedaan, 2 (TM); Welgevonden, 2 (TM); Wilgekuil, 2 (TM); Witpoort, 1 (TM); Wolmaransstad, 2 (SI); Woodbush, 1 (TM); Worcester Mine, 2 (TM); Zana Ranch, 1 (TM); Zandspruit, 1 (TM); Zebediela, 1 (TM); Zoutpansberg, 3 (TM).

Additional records: Rhodesian Museums material taken from 2230 BC; 2231 AC; 2231 AD in Rhodesia on the Transvaal border (Smithers, *in litt.*). Open circles in the Kruger National Park on the distribution map after Pienaar (1964).

ORDER RODENTIA

1. External form very specialized for fossorial life; reduced tail, small eyes, short ears, mole-like appearance	Bathyergidae
External form not specialized for fossorial life ..	2
2. Body covered with long quills, head and body length over 500 mm	Hystricidae
Not combining these characters	3
3. Bipedal, highly specialized for saltatorial life	Pedetidae
Not specialized for bipedal locomotion	4
4. Tail bushy, thickly haired throughout its length	5
Tail not well haired throughout its length	6
5. Interorbital constriction well-marked	Muscardinidae
No interorbital constriction	Scuiridae
6. Size large, head and body length over 300 mm; incisors heavily grooved	Thryonomyidae
Not combining these characters	Cricetidae Muridae

---

Family Bathyergidae

1. Cheek teeth simplified to ring-pattern in adult; posterior tooth cut early in life; jugal bone fitting into a long groove on zygoma; face not prettily marked	*Cryptomys*
Cheek teeth retaining one inner and one outer fold to old age; posterior tooth cut late in life; jugal bone fitting dove-tail fashion into zygoma; face prettily marked - black cap on head, white ring around ear, cheeks black, nose white	*Georychus*

Cryptomys/...

Cryptomys Gray, 1864

Cryptomys hottentotus (Lesson, 1826) Common mole-rat
Hotnot grysmol

C.h.hottentotus (Lesson, 1826)
C.h.natalensis (Roberts, 1913)

TAXONOMIC NOTES:

The taxonomic problems of *Cryptomys* are not yet satisfactorily resolved. It may in fact prove to be far more complicated than hitherto realized because of localized distribution, resulting from its fossorial habits and consequent inability to disperse across certain ecological barriers.

de Graaff (1975) is followed here in recognizing two subspecies in the Transvaal. The main distinguishing character between these two taxa is the absence of inguinal mammae in *natalensis* (Roberts, 1951 and de Graaff 1975). Whatever differences there may be in coat colouration are obscured by subspecific variat

DISTRIBUTION:

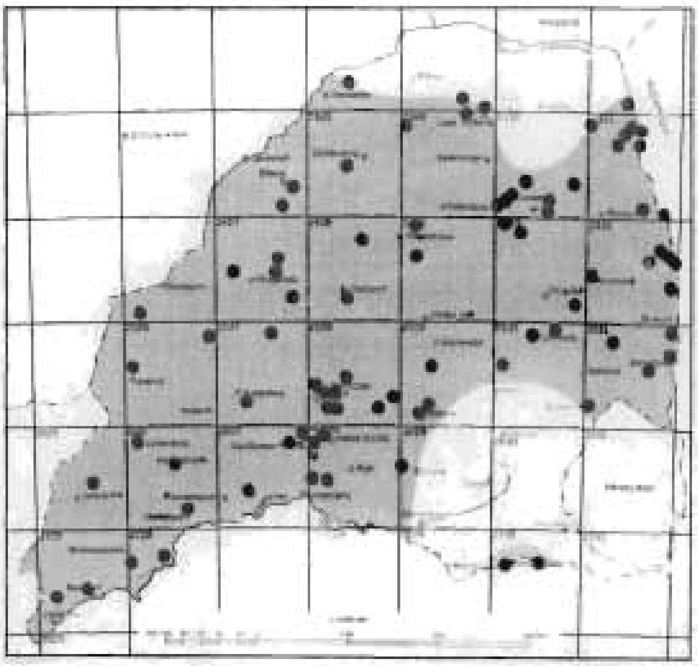

Fig.73: The distribution of *C. hottentotus* in the Transvaal.

The mole-rat is widely distributed over the entire Province, and as such displays a wide habitat toleranc Since it has been recorded from south-western of Botswana (Smithers, 1971), *C. hottentotus* has probabbly bee overlooked in the northern Transvaal along the Limpopo river. It may similarly have been overlooked in the south-eastern Transvaal in the Carolina and Standerton districts.

According to de Graaff (1975) *C. h. hottentotus* occurs in the western, southern and northern Transvaal; and *natalensis* in the Witwatersrand and Pretoria

areas/...

areas northward to Nylstroom, and from here eastwards to the eastern Transvaal. These subspecific distribution patterns could not be correlated with specific environmental factors.

HABITAT:

C. hottentotus appears not to be limited by any environmental factor other than soil type. Contrary to the form *damarensis*, the two Transvaal subspecies are not entirely restricted to loose sandy soils, although they exhibit a preference for these. They have for instance been recorded in black turf on the farms Witpoort (Potchefstroom district), and Olifantspoort (Rustenburg district). Specimens have also been recorded from soils with a high gravel content, especially on the slopes and at the bases of mountains. The species has also been observed to be active in marshy areas, parts of the tunnel systems in some instances being temporarily inundated.

HABITS:

A fossorial species which rarely ventures above ground. Small colonies, probably family groups, occupy a tunnel system. It seems that the nest chamber (de Graaff, 1962) forms the centre of underground activity. From here the tunnels radiate in all directions in search of food. The nest is lined with vegetable matter.

Excavating is done with the incisors, and the loosened soil is pushed up to the surface through side-shafts constructed for that purpose. These excavated mounds of soil on the surface also serve to seal off the underground system from the atmosphere. Mole-rats are very sensitive to above-ground conditions, and as soon as a tunnel system is opened, the occupants are quick to reseal it with loose soil. It is this aspect of the behavioural reportoire of the rodent-mole which renders it so susceptable to trapping by inserting spring-loaded traps in an opened burrow.

See Eloff (1951, 1951a and 1954) for discussions on the ecology of this species, and also de Graaff (1962, 1964) for a description of typical tunnel systems.

Judging from the fresh mounds encountered during the year, *C. hottentotus* is more active in summer than in winter. However, the occupants of a tunnel system can be trapped during winter, even though less easily, which indicates some winter activity.

Although mole-rats are blind, they can detect movement probably by a tactile response to air movement, and in captivity mole-rats will attack with the formidable protruding incisors.

FOOD:

Food items are always finely masticated, rendering identification almost impossible. It seems reasonable to assume that the species feeds on the underground stems of grasses (including lawns) as well as bulbs, roots and tubers.

BREEDING:

In the Transvaal monthly pregnancy rates for females recorded, are: February (11%), March (55%), August (11%). Lactating females were recorded during January and April. Smithers (1971) recorded pregnancies during February and July. These samples are too small to be conclusive, but the inference is that parturition occurs throughout the year.

The mean number of foetuses per female was 1,75 (N=8). Implantation was: 1L 1R (2X); 1L 2R (1X); 2L 1R (1X); 0L 1R (2X); 1L 0R (2X).

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	167,4	97	120	197
T.	16,5	96	5	28
H.Ft.	23,2	102	15	35
Ear	0	102	0	0
Mass	81,1	46	40	150

Females

	$\bar{X}$	N	Min.	Max.
Tot.	147,9	179	120	203
T.	16,9	179	8	34
H.Ft.	22,9	181	18	38
Ear	0	181	0	0
Mass	74,6	128	28	181

RECORDS OF OCCURRENCE:

Specimens examined, 325: Al-te-Vêr, 1 (TM); Barberspan, 2 (TM); Barberton, 1 (SI); Birchleigh, 6 (TM); Bloemhof, 4 (TM); Blouberg, 5 (TM); Blyde Forest Res., 9 (TM); Bosbokrand, 17 (SI); Brandhoek, 1 (TM); Bronkhorstspruit, 1 (TM); Bububu River, 1 (NKW); Buffelspoort, 4 (TM); Ceylon, 1 (TM); Crown Mines, 2 (TM); Donkerpoort and Zandspruit, 3 (TM); Droogedal, 1 (TM); Faai Proefpersele, 3 (NKW); Fairfield, 2 (TM); Fountain Blue, 1 (TM); Geelhoutkloof, 2 (TM); Groothoek, 1 (TM); Grootsuikerboschkop and Elandslaagte, 1 (TM); Hectorspruit, 4 (TM); Henley-on-Klip, 4 (TM); Huwi, 2 (TM); Klerksdorp, 1 (TM); Klipkuil, 2 (TM); Letaba, 1 (NKW); Leydsdorp, 14 (TM); Lindanda, 2 (NKW); Loskopdam Prov. Nat. Res., 3 (TM); Lydenburg, 1 (TM); Mahewane, 1 (NKW); Mahungumule, 1 (NKW); Malta, 8 (TM); Mamaranga, 8 (TM); Maria van Riebeeck Mun. Nat. Res., 4 (TM); Mashegadzi, 1 (NKW); Menlo Park, 1 (TM); Mlondozi Road, 4 (NKW); Muckleneuk Hill, 2 (TM); Montrose Estates, 6 (TM); New Agatha Forest Res., 9 (TM); Ngirivane, 1 (NKW); Nkokodzi, 1 (NKW); Nwamayiwani, 1 (NKW); Nylstroom, 4 (TM, 1; SI, 3); Olifantspoort, 2 (TM); Percy Fyfe Prov. Nat. Res., 4 (TM); Piet Retief, 7 (SI); Pretoria, 2 (TM, 1; SI, 1); Pretoria Zoo's Farm, 4 (TM); Pumbe Sandveld, 4 (NKW); Ratsegaai, 1 (TM); Renosterkamp, 1 (NKW); Renosterpoort Priv. Nat. Res., 8 (TM); Rissik, 3 (TM); Robertshain, 1 (TM); Rochdale, 1 (TM); Rolspruit, 2 (TM); Roodeplaatdam, 1 (TM); Roodepoort, 1 (TM); Rosslyn, 1 (TM); Rustenburg Prov. Nat. Res., 3 (TM); Rykvoorby, 2 (TM); Satara, 2 (NKW); Shibanwanene, 1 (NKW); Shingomene, 1 (NKW); Shingwidzi, 2 (NKW); Stungwane, 2 (NKW); Silverton Botanical Gardens, 1 (TM); Silwane, 1 (TM); Suikerboschrand Prov. Nat. Res., 2 (TM); Swarthoek, 21 (TM); Swartkops, 3 (TM); Sweet Home, 3 (TM); Tamboekieskloof, 1 (TM); The Willows, 1 (TM); Tweefontein Collery, 5 (TM); Tzaneen, 38 (TM, 5; SI, 33); Valhalla, 1 (TM); Vereeniging, 2 (SI); Verwoerdburg, 1 (TM); Wakkerstroom, 3 (TM); Waynek, 1 (TM); Welgedaan, 1 (TM); Welgevonden, 1 (TM); Witbank, 8 (TM); Witpoort, 1 (TM); Zandspruit 168, 1 (TM); Zoutpansberg, 1 (TM); Zwartkop Air Port, 2 (TM); Zwartkop Country Club, 15 (TM).

Georychus/...

Georychus Illiger, 1811

Georychus capensis (Pallas, 1778) Cape mole-rat
Kaapse blesmol

TAXONOMIC NOTES:

Considering the limited number of specimens available of this species, and especially the variation observed within the material, I at present consider it advisable to follow de Graaff (1975) in regarding this as a monotypic species.

DISTRIBUTION:

Fig.74: The distribution of *G. capensis* in the Transvaal.

de Graaff (*op. cit.*), without stating reasons, questions the validity of the record from Belfast (the type locality of the synonom *yatesi* Roberts, 1913). However, apart from the type specimen collected and donated to the Transvaal Museum in 1913, another donated specimen was received from the same locality in 1944. de Graaff (1975) does not mention a third specimen in the collection of the Transvaal Museum, collected at Ermelo in 1951 and donated by P. du Toit. Although uncertainty about the exact origin of donated specimens is possible, the fact that three specimens were independently donated over a 39-year period from the same general region of the Transvaal, is evidence of the credibility of these records.

HABITAT:

Very little information is available on the habitat requirements of this species. According to Roberts (1951) it occurs only in loose or sandy soils, usually bordering on pans.

HABITS/...

HABITS:

As far as known, very similar to those of *Cryptomys*.

FOOD:

Bulbs (Roberts *op.cit.*), and presumably other subsurface plant material.

BREEDING:

No information available.

MEASUREMENTS AND MASS:

		Tot.	T.	H.ft	E
TM 1243:	♂:	180	25	32	0 = ?
TM 10342:	♀:	180	23	31,5	0 = ?

The third specimen is a subadult male.

RECORDS OF OCCURRENCE:

Specimens examined, 3: Belfast, 2 (TM); Ermelo, 1 (TM).

Family Thryonomyidae

Thryonomys Fitzinger, 1867
Thryonomys swinderianus (Temminck, 1827) Cane rat
Rietrot

DISTRIBUTION:

Examination of the distribution of this species in southern Af- ca reveals the range to be restricted to wooded regions. In the Transvaal the only exception is an unverified claim of its occurrence on the highveld by the owner of the Joshua Moolman Private Nature Reserve (district Amsterdam). The Vaal River offers abundantly suitable habitat, but the species has never been recorded from it (see also Lynch, 1975).

Considering the habitat requirements of the species, a dependence on woodland regions appears coincidental, and prompted

further/...

further investigation. It is suggested that in the Transvaal *T. swinderianus* occurs only along the Limpopo and Komati River headwaters, which drain eastwards into the Indian Ocean. The species is absent from the Vaal and Orange River drainage systems flowing west to the Atlantic. In the Transvaal these drainage systems coincide with major vegetation types, the former with woodland the latter with grassveld. This would lend credence to the record from Joshua Moolman Private Nature Reserve, which is situated on an eastward draining system.

Further records from Natal and the eastern Cape Province are needed to substantiate this suggestion.

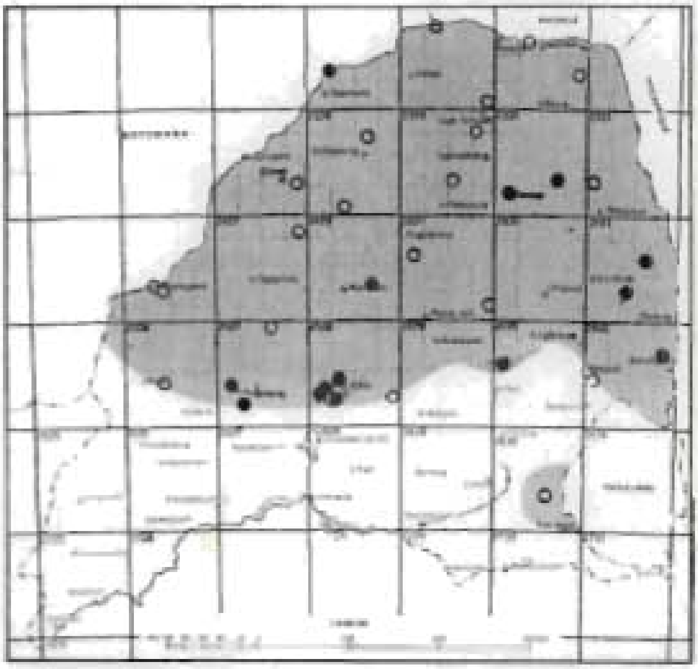

Fig.75: The distribution of *T. swinderianus* in the Transvaal.

HABITAT:

In the Transvaal the cane rat has been recorded only in association with rivers or swamps. It is particularly partial to the tall, dense grass cover or reedbeds associated with permanent water. Roberts (1951) refers to the damage this species can cause in sugarcane fields. I have also observed damage to wheat fields, but always close to a permanent water source with its associated natural habitat, to which the animals retreat after the harvest. Wheat fields thus appear to be only temporarily inhabited.

HABITS:

The presence of cane rats is easily detected by their characteristic runways, the grass and reed cuttings left at feeding sites, and the uniquely shaped faecal pellets resembling date pips. *T. swinderianus* is gregarious, often playing or feeding communally, at times as much as 500 meters from water. Most observations indicate nocturnal activity, although in more remote areas it has been observed to be crepuscular.

In the more heavily frequented areas alongside water a maze of runways is formed, some meandering into the water, others to feeding areas. Roberts (1951) observed cane rats to be fond of swimming. Individuals lie up by day under dense vegetation near these runways, and when disturbed flee along them. This habit is capitalized on by the Bantu to trap cane rats, placing conical traps woven from reeds and grass in the runs. The meat of this species is very tasty and regarded as a delicacy by tribesmen.

FOOD:

Entirely vegetarian. Judging from cuttings found in runways, it feeds on grass, reeds, sedges and semi-aquatic plants. Also recorded to be destructive to agricultural crops such as sugar cane, wheat and maize. A maize plant is brought down by gnawing through the stem, and the cob is then eaten.

BREEDING:

A pregnant female was collected during November, carrying four foetuses implanted 3L:1R. Shortridge (1934) reports new born litters during June and August. Smithers (1971) records a pregnancy during November, and young animals collected in May, August and November. This scant information suggests aseasonal breeding.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	587,3	8	365	805
T.	169	5	133	209
H.Ft.	88,8	8	72	102
Ear	31,4	8	26	40
Mass	4,1	4	1,7	6,3 kg

Females/...

Females

	$\bar{x}$	N	Min.	Max.
Tot.	520,8	5	420	601
T.	139,4	5	109	162
H.Ft.	74,6	5	64	81
Ear	29,4	5	27	32
Mass	1,8	4	0,7	2,6 kg

RECORDS OF OCCURRENCE:

Specimens examined, 24: East Lynne, 1 (TM); Garstfontein, 3 (TM); Grootsuikerboschkop and Elandslaagte, 1 (TM); Hans Merensky Prov. Nat. Res., 1 (TM); Kingfisherspruit, 1 (NKW); Mmabolela Estates, 2 (TM); Mooiveld, 1 (TM); Nylsvlei, 1 (TM); Othawa, 1 (TM); Pretoria, 1 (TM); Pretoria North, 2 (TM); Retiefskloof, 1 (TM); Roodeplaatdam, 1 (TM); Rustenburg, 1 (TM); TenBosch Estates, 3 (TM); Tzaneen, 3 (TM).

Additional records: Sightings from Blydschap Priv. Nat. Res., Buffelspoort, De Hoop Priv. Nat. Res., Dordrecht, Ferndale, Fort Klipdam, Greefswald, Groothoek, Hans Merensky Prov. Nat. Res., Huwi, Letaba Ranch, on the Levuvhu river, Joshua Moolman Priv. Nat. Res., Mooigenoeg, Mooiplaas, Nicorel, Olifantspoort, Othawa, Parkfield and Delamere, Platbos, Renosterpoort Priv. Nat. Res., Scrutton, Uitkyk and Paranie Priv. Nat. Res. Throughout the entire Kruger National Park along rivers and streams (Pienaar, 1964).

Hystrix Linnaeus, 1758

Hystrix africae-australis Peters, 1852 — Cape porcupine
Ystervark

DISTRIBUTION:

The porcupine is distributed widely in the Transvaal. However, because of its secretive nature it is not frequently encountered. Many records are based on the tell-tale quills found. Judging from the frequency of such quills, the porcupine must be

relatively/...

relatively abundant and has probably been overlooked in the South-eastern Transvaal.

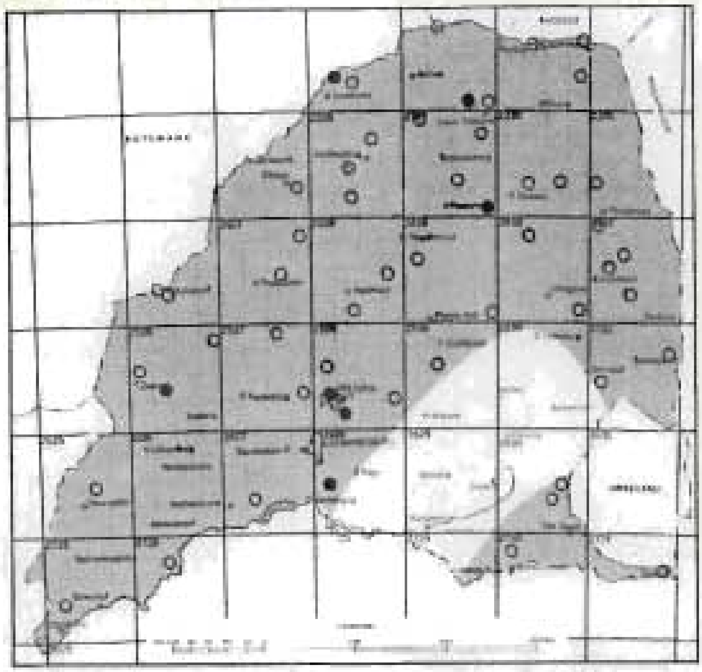

Fig.76: The distribution of *H. africae-australis* in the Transvaal.

HABITAT:

The porcupine has a wide habitat tolerance, and has been recorded from all vegetation associations in the Transvaal (including the escarpment), and from all habitat types. It is partial to rocky terrain by day, where it utilizes caves and crevices as lairs.

HABITS:

In the Transvaal porcupines were found to be active only by night, although Ansell (1960) reports some diurnal activity. By day they take refuge in caves or rock crevices. Judging from spoor and quills found, antbear burrows are utilized in the absence of rocky terrain. No evidence could be found of porcupines excavating their own burrows. On the farms Donkerpoort and Zandspruit (Thabazimbi district), a small family group was observed sunning themselves at a cave entrance. When disturbed they immediately fled to the darkness of the cave. Lairs are used at least semi-permanently, as shown by the large quantities of bones often found accumulated here, and used for gnawing on.

Porcupines are normally encountered singly at night, occasionally in pairs, or as a female with her young. As a result of rattling the short, hollow quills on the tail, their movements are noisy. As mentioned by Pienaar (1964) and Smithers (1971), porcupines have a tendency to travel along roads. Individuals appear placid and slow when undisturbed. However, when aggravated they move amazingly fast to escape. The species defends itself by constantly turning its back on the aggressor, and sometimes

also/...

also by unexpectedly moving backwards, thus driving the quills into the face of the aggressor. Porcupines fall prey to bigger predators, although it is unknown whether a safe and effective way of killing porcupines exists without the predator being wounded.

At high population densities, porcupines are extremely destructive. Trees are often ringbarked (see also Pienaar, 1964). This animal is also destructive to cultivated crops, such as maize, pumpkins and watermelons, where it destroys far more than it needs to eat.

FOOD:

Vegetarian, according to Smithers (1971) partial to roots and bulbs.

BREEDING:

A pregnant female with three foetuses (cr 180-190) was collected during February. Implantation was 2L:1R. This, together with data presented by Shortridge (1934), Ansell (1960) and Smithers (1971), suggests parturition during summer.

MEASUREMENTS AND MASS:

Males

	$\bar{x}$	N	Min.	Max.
Tot.	732	2	660	804
T.	72,5	2	40	105
H.Ft.	90,5	2	83	98
Ear	36	2	31	41
Mass	12	1	-	- kg

Females

	$\bar{x}$	N	Min.	Max.
Tot.	777,7	3	680	848
T.	73,3	3	50	85
H.Ft.	93	3	89	100
Ear	40,3	3	30	49
Mass	12,7	3	9,1	16,5 kg

RECORDS OF OCCURRENCE:

Specimens examined, 6: Ferndale, 1 (TM); Maria van Riebeeck Mun. Nat. Res., 1 (TM); Mmabolela Estates, 1 (TM); Pretoria North, 1 (TM); Rochdale, 1 (TM); Suikerboschrand Prov. Nat. Res., 1 (TM).

Additional records: Sightings from Al-te-Vêr, Barberspan Prov. Nat. Res., Blijdschap Priv. Nat. Res., Blyde Forest Res., Bandhoek, Buffelspoort, Cyprus, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Ferndale, Fort Klipdam, Greefswald, Groothoek, Hans Merensky Prov. Nat. Res., Huwi, Joshua Moolman Priv. Nat. Res., Langfontein, Leeuwspoor, Letaba Ranch, on Levuvhu river, Loskopdam Prov. Nat. Res., 10 km E Madimbo, Mooigenoeg, Mooiplaas, Mosdene Priv. Nat. Res., Nicorel, Othawa, Parkfield and Delamere, Platbos, Renosterpoort Priv. Nat. Res., Rhoda, Rissik Priv. Nat. Res., Rykvoorby, Sandringham Priv. Nat. Res., Scrutton, Silkaatsnek Priv. Nat. Res., Sweet Home, Ten Bosch Estates, Timbavati Priv. Nat. Res., Tweepoort, Uitkyk and Paranie Private Nat. Res., Urk, Welgedaan, Welgevonden, Witpoort, Wolkberg, Zandspruit 168, Zoutpan. Open circles in Kruger National Park area on the distribution map after Pienaar (1964).

Family Scuiridae

1. Fur bristly; a pale stripe on either side of the body; occipitonasal length 55-62,9 mm; palate well over half of occipitonasal length; lachrymal enlarged ... ... *Xerus*

Fur not bristly; no pale stripes on either side of the body; occipitonasal length 57,4 mm and less; palate normally clearly less than half the occipitonasal length; lachrymal not enlarged ... ... *Paraxerus*

Xerus Ehrenberg, 1833

Xerus inaurus (Zimmermann, 1780) Ground squirrel
Waaierstertmeerkat

DISTRIBUTION/...

DISTRIBUTION:

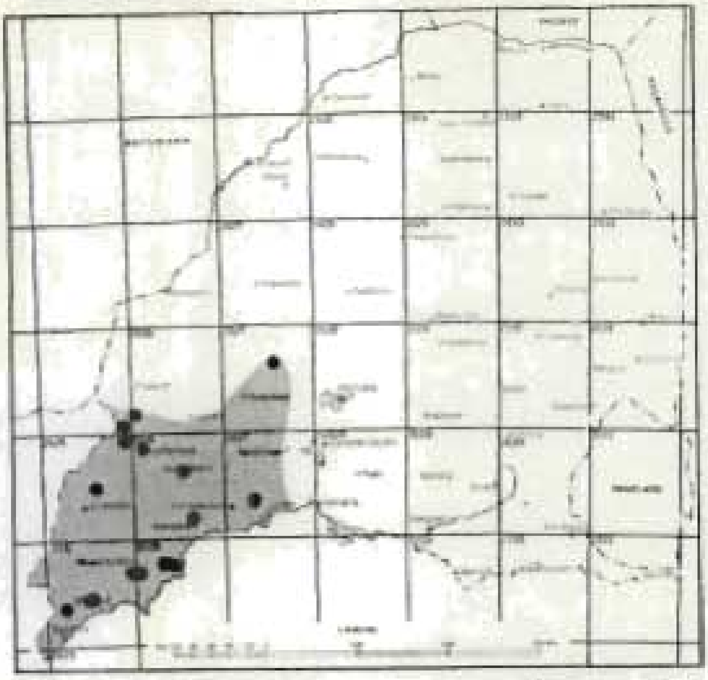

Fig.77: The distribution of *X. inaurus* in the Transvaal.

X. inaurus occurs only marginally in the south-western Transvaal. The apparently atypical record from Beestekraal (Brits district) is based on two specimens collected during the Zoological Survey in 1937. The ground squirrel is widely distributed in the more arid regions of western southern Africa. The range of the species does not correlate well with any single edaphic factor, but appears to be determined by a combination of rainfall (less than 500 mm average annual precipitation), soil types (preference for calcareous tufa soil according to Amtmann, 1975), and habitat preference (open plains).

HABITAT:

As indicated by Smithers (1971), *X. inaurus* is partial to open ground situations within a variety of plant associations, but invariably with a clear view of the surroundings of the warren. Another factor Smithers (*op.cit.*) found to be important (substantiated by records from the Transvaal), is hard, often calcareous, ground allowing construction of semipermanent burrows.

HABITS:

The species is terrestrial and gregarious. Colonies of as many as 30 individuals construct communal warrens which are occupied permanently or semi-permanently through successive generations. Parts, or even complete warrens, are often found inexplicably abandoned.

Ground/...

Ground squirrels are diurnal. Surface activity commences when the sun has risen, with grooming, play and sentinel duty. They do not appear above ground on cold, windy, or rainy days. The occupants feed in the vicinity of the burrows, keeping the vegetation close-cropped in a radius of about 100 meters from the warren. When disturbed while out feeding, they run back to the warren, crouching close to the ground, but may seek refuge in nearby disused burrows. This animal is very curious however, and shortly after a disturbance it will cautiously reappear from the burrow in attempting to determine the source of disturbanc Initially only the snout is stuck out of the entrance, then the head, and when feeling completely secure, the animal will emerge, sitting on its haunches in an upright position. Ground squirrels are often seen sunning themselves or keeping watch in this position, with the tail held characteristically over the back and head for shade, or possibly as a disguise against raptors, as is suggested by Smithers (1971).

X. inaurus often share a burrow system with the yellow mongoose, *C. penicillata*, the suricate, *S. suricatta*, or both.

BREEDING:

Two pregnancies were recorded, one in October and one in August. Each female carried two foetuses, cr $\bar{X}$=66 mm. Of five females collected during November, four were lactating.

Smithers (1971) presents data suggesting that the species breeds throughout the year.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	452	12	407	520
T.	204	12	185	232
H.Ft.	61,8	12	57	65
Ear	11,8	6	9	15
Mass	423	2	286	561

Females/...

Females

	$\bar{X}$	N	Min.	Max.
Tot.	435	28	325	490
T.	200	28	110	239
H.Ft.	64,3	28	55	76
Ear	12,7	18	5	33
Mass	564	9	298	800

RECORDS OF OCCURRENCE:

Specimens examined, 50: Barberspan, 1 (TM); Beestekraal, 2 (TM); 18 km S Jacobsdal, 2 (TM); Klerksdorp, 4 (TM); Klipkuil, 4 (TM); Lichtenburg, 10 (SI); Maquassie, 1 (TM); Panfontein, 7 (TM); Pretoria Zoo's Farm, 1 (TM); Ratsegaai, 4 (TM); S.A. Lombard Prov. Nat. Res., 9 (TM); Syfergat, 3 (TM); Welgedaan, 2 (TM).

Additional records: Sightings from Brandhoek, Welgedaan.

Paraxerus Forsyth Major, 1893

Paraxerus cepapi (A. Smith, 1836) Bush squirrel

Geelpoot (Boom) eekhorinkie

P. c. cepapi (A. Smith, 1836)

TAXONOMIC NOTES:

A polytypic species, but only the nominate race is acknowledged in the Transvaal. Amtmann (1975) suggests that too many subspecies are probably recognized, but a revision of the species is very unlikely to affect the taxonomic status of the Transvaal form.

DISTRIBUTION:

In the Transvaal the species is restricted to well-wooded areas, although it may occur in a variety of tree and shrub associations. It is absent from the Pietersburg plateau and the escarpment. 26°S latitude is the southernmost limit of the

species'/...

species range.

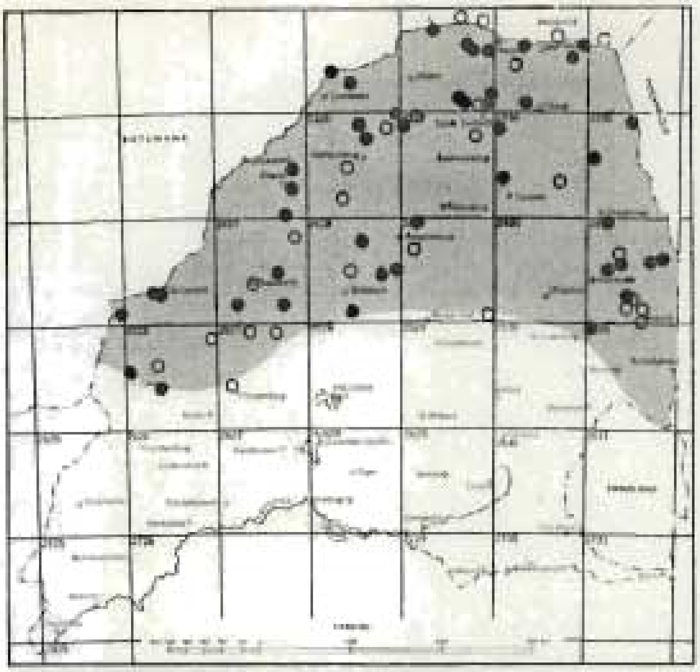

Fig.78: The distribution of *P. cepapi* in the Transvaal.

HABITAT:

P. cepapi has a distinct dependence on woodland, and in the Transvaal occurs in no less than nine of the woodland associations defined by Acocks (1975). The bush squirrel does not seem to favour any particular type of Tropical Bush and Savannah, but several *Acacia* species, *Colophospermum mopane*, *Combretum* and *Terminalia* woodland species dominate within its range in the Province. The bush squirrel is also encountered in riverine woodland, and very often on rocky outcrops and mountain cliff faces with woodland cover.

As far as can be established, it is not dependent on surface water.

HABITS:

Bush squirrels are largely arboreal, but regularly spend long periods on the ground looking for food in the vicinity of trees. They are extremely agile rodents, jumping easily from branch to branch, or between rocks. The species is strictly diurnal. On cold, windy or rainy days these animals remain largely inactive.

Viljoen (1975) found this species to be social, with an average group size of five. A group is maintained through its characteristic smell. Bush squirrels also maintain home ranges. The are playful animals, and utter shrill chriping noises when communicating. See Viljoen (*op.cit.*) for a discussion on vocalization. Bush squirrels normally nest in hollow tree trunks, and when

disturbed/...

disturbed while foraging, take refuge there or in any other hole available in the tree, or even in rock crevices. When no hollows in trees are available, they are very adept at hiding from the observer behind branches.

During mating periods, Viljoen (1975) observed that dominance, scent marking and the chasing of young and/or intruders are displayed by both sexes.

FOOD:

Mainly vegetarian. Smithers (1971) lists the fruit of *Ficus* spp *Zizyphus mucronata*, *Acacia* spp. and *C. mopane*; the pods, seeds, and fresh shoots of *Acacia* spp.; and green grass. Viljoen (*op.cit.*) studied seasonal food preferences and found bush squirrels to be mainly herbivorous, although insects played a major part in the diet during certain months.

BREEDING:

Pregnant females were collected in October and November. Implantation was 0L2R=2; and 0L1R=1. Lactating females were collected in March (one) and April (three out of a total of five). Smithers (1971) found the species to be capable of breeding throughout the year, but with a marked peak during the summer months of October to April.

According to Viljoen (1975) females enter an anoestrus period during winter, but may also remain polyoestrous under favourable conditions. She found litter size to be an average of two, and that this low number goes along with a low mortality rate up to the age of six months. Gestation period is 55 days. Viljoen (*op.cit.*) found males to exhibit a seasonal pattern of reproduction.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	360	67	277	578
T.	169	65	115	210

	$\bar{X}$	N	Min.	Max.
H.Ft.	43,3	67	26	49
Ear	18,6	66	15	40
Mass	190	28	76	242

Females

	$\bar{X}$	N	Min.	Max.
Tot.	351	61	290	425
T.	169	61	116	215
H.Ft.	43,3	61	38	49
Ear	20,6	61	13	22
Mass	195	24	130	265

RECORDS OF OCCURRENCE:

Specimens examined, 120: Al-te-vêr, 5 (TM); Blouberg, 1 (TM); Buren, 1 (TM); Cumberland, 1 (TM); Donkerpoort and Zandspruit, 2 (TM); Elim, 1 (TM); Ferndale, 1 (TM); Geelhoutkloof, 2 (TM); Greefswald, 2 (TM); Huwi, 3 (TM); Kempiana, 5 (TM); Klaserie-Olifants rivers confluence, 7 (TM); Kongo, 1 (TM); Leeuwenhoek, 2 (TM); Letaba Ranch, 3 (TM); Lilliput, 1 (TM); Nicorel, 1 (TM); Maasstroom, 1 (TM); Madimbo, 1 (TM); Mokeetsi, 2 (TM); Mooiplaas, 1 (TM); Mooigenoeg, 1 (TM); Moorddrift, 1 (TM); Mosdene, 6 (TM); Motlateng, 2 (TM); Mmabolela Estates, 1 (TM); Mutale river, 7 (TM); 10 km N. Newington, 1 (TM); Njelelle river, 2 (TM); Nwanedzi, 2 (TM); Olifants river, 1 (TM); Othawa, 1 (TM); Percy Fyfe Prov. Nat. Res., 2 (TM); Punch Bowl, 1 (TM); Rissik Priv. Nat. Res., 1 (TM); Rochdale, 2 (TM); Rooikrans, 6 (TM); Rykvoorby, 1 (TM); Sandringham, 2 (TM); Satara, 2 (TM); Scrutton, 4 (TM); Secheili's Oude Stat, 3 (TM); Sheila, 9 (TM); Singwidzi, 8 (TM); Sterkstroom, 1 (TM); Tamboekieskloof, 1 (TM); Thabazimbi, 2 (TM, 1; SI, 1); Tokwe, 1 (TM); Tshipise, 3 (SI); 2 km E. Witrivier, 2 (TM); Wyliespoort, 1 (TM); Zeerust, 1 (SI).

Additional records: Sightings from Blijdschap Priv. Nat. Res., Buffelspoort, Charleston, Dordrecht, Groothoek, Hans Merensky Prov. Nat. Res., Mala Mala, Mooigenoeg, Parkfield and Delamere, Platbos, Rhoda, Timbavati Priv. Nat. Res., Uitduiker,

Urk/...

Urk, Welgevonden, Zandspruit 168. The species occurs commonly throughout the entire Kruger National Park (Pienaar, 1964).

Family Pedetidae

Pedetes Illiger, 1811

Pedetes capensis (Forster, 1778) Spring hare
Springhaas

TAXONOMIC NOTES:

Roberts (1951) and earlier authors use the species name *afer* which, as pointed out by Ellerman *et al.* (1953), is a synonym of the earlier name *capensis*. Roberts (*op.cit.*) recognizes six southe African subspecies, and is followed by Meester *et al.* (1964), who suggest that probably too many subspecies are recognized. Misonne (1974) recognizes no subspecies. The subspecies of this species are clearly in need of revision, and until this has been undertaken no subspecies are recognized in the Transvaal.

DISTRIBUTION:

P. capensis occurs widely and abundantly throughout most of t Province, except for a large area in the south-east. Whereas the species may have been overlooked in this area of the highveld, its absence from the lowveld is substantiated by Pienaar's (1964) findings that springhares are absent in the Kruger National Park south of the Olifants river. The species has also not been recorded from Swaziland, the lowlands of Natal, and adjoining regions of Mocambique.

The absence of springhares from the south-eastern Transvaal could not be explained by a preference for sandy for any particula soil types as might have been expected. In the northern regions of the Kruger National Park for instance, *P. capensis* is present on exactly the same soil type as is found in the south, i.e. "Reddish Brown Sandy Soils", classified by van der Merwe (1941) under the heading "Unleached Subtropical Soils". Neither average annual precipitation, nor geological formations or grassveld types, offer satisfactory explanations for its pattern of distributi

Some unidentified limiting factors in specific veld types (Acocks, 1975) may be responsible for the absence of this species from the south-eastern Transvaal. Within the Transvaal, the area where *P. capensis* is absent coincides closely with Acocks' (1975) "Lowveld" and "Arid Lowveld" veld types; both Inland Tropical Forest types; the "North Eastern Sandy Highveld" of the Pure Grassveld Types; and the False Grassveld Types, the "Bankenveld to Sour Sandveld Transition", and "Piet Retief Sourveld" veld types.

The factors limiting the range of this species are not understood, and identifying these would be doubtless be rewarding in bringing to light interesting facets of the life history of this hitherto much neglected species.

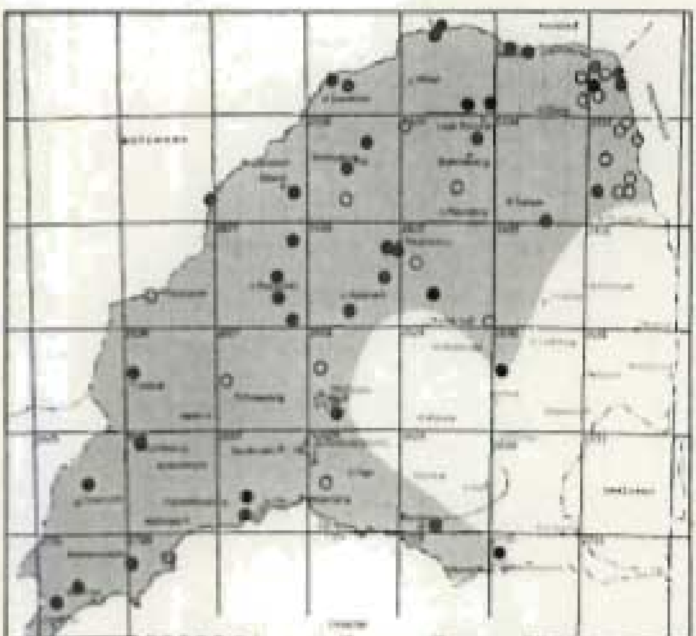

Fig.79: The distribution of *P. capensis* in the Transvaal.

HABITAT:

In my experience *P. capensis* has two important habitat requirements, namely a loose sandy substrate in which to excavate burrows, and open areas. As pointed out by Smithers (1971), burrows are almost exclusively encountered in sandy soils or sandy alluvium, although the home range may not be restricted to areas with such soft soils. It is probably as a result of this dependence on soft soils

that/...

that the species has a discontinuous distribution (Misonne, 1974). An exception to this was recorded on the farm Witpoort (district Potchefstroom), where spring hare burrows were found in black clay on the banks of a stream.

Spring hares prefer flat open country, probably as a result of their saltatorial locomotory habit. In whatever veld type they are encountered, spring hares are to be found in open, denuded areas. Areas of high incidence were airstrips, old lands, heavily overgrazed areas near Bantu villages, stockades, and water troughs as well as grassy areas recovering from veldfires. Obviously the spring hare benefits from modification of the environment by man.

The species appears to be independent of open water.

HABITS:

P. capensis is entirely terrestrial, with a saltatorial mode of locomotion. The hind limbs are therefore extremely powerful, as is the tail which assists in locomotion mainly as a balancing and steering organ. The front limbs are comparatively poorly developed, and are employed in excavating subsurface vegetable food by means of the well-developed claws on each of the five phalanges.

The species is also exclusively nocturnal, appearing only well after sunset, and retiring before sunrise. It is inactive during rainy nights. The eyes typically reflect bright green in the light of a strong torch, rendering this species very vulnerable to night hunting. Individuals display head bobbing in such a light. Spring hares are intelligent creatures, and when hunted constantly with a light, soon learn to take refuge in burrows immediately when the light appears.

Although large numbers of spring hares may concentrate in an area, the species is in fact solitary. On occasions two individuals may be observed together, presumably during the mating season. Burrows are solitary, and not arranged in warrens.

These/...

These burrows vary in depth, length and complexity, but usually have an emergency exit, which can be opened from the inside. According to Roberts (1951) a nest chamber is constructed for rearing offspring, but is unlined. Occupants seldom venture more than 200-300 meters from their burrows, and when disturbed flee to the sanctuary of these burrows.

High springhare populations can be very destructive to crops, and under such conditions they need to be culled.

BREEDING:

Pregnant females were collected during March, October and November, lactating females during March and November. Smithers (1971) presents data showing that the species breeds throughout the year. As in Botswana (Smithers, *op.cit.*), Transvaal populations bear only one young per female, implantation being irregular.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	798	29	705	985
T.	405	29	335	553
H.Ft.	150	29	130	163
Ear	74,2	29	61	87
Mass	3,1	21	2,0	4,0 kg

Females

	$\bar{X}$	N	Min.	Max.
Tot.	788	33	672	939
T.	404	33	245	520
H.Ft.	149	33	127	167
Ear	73,0	33	65	85
Mass	3,0	22	2,1	4,0 kg

RECORDS OF OCCURRENCE:

Specimens examined, 87: Al-te-Vêr, 1 (TM); Arcadia 649, 1 (TM); Barberspan, 1 (TM); Blijdschap Priv. Nat. Res., 1 (TM);

Buffelsdrift/.

Buffelsdrift, 1 (TM); Donkerpoort 448, 1 (TM); Ermelo, 3 (SI); Greefswald, 2 (TM); Grootsuikerboschkop and Elandslaagte, 1 (TM); Huwi, 1 (TM); Klipkuil, 2 (TM); Langfontein, 2 (TM); Letaba Ranch, 1 (TM); Leydsdorp, 1 (TM); Lichtenburg, 2 (SI); Maria van Riebeeck Mun. Nat. Res., 1 (TM); Moorddrift, 2 (TM); Mmabolela Estates, 2 (TM); Mosdene, 1 (TM); Nicorel, 1 (TM); Nwambia Pan, 1 (NKW); Panfontein, 2 (TM); Platbos, 1 (TM); Potgietersrus, 4 (SI); Pretoria Zoo's Farm, 3 (TM); Rissik Priv. Nat. Res., 2 (TM); Rochdale, 2 (TM); Rooiberg, 2 (SI); Roodepoort, 1 (TM); Roodepoort 383, 1 (TM); Rooikrans, 3 (TM); Rykvoorby, 3 (TM); Sandrivier, 1 (TM); Scrutton, 1 (TM); Swarthoek, 6 (TM); Swellendam, 4 (TM); Tihomwene, 1 (NKW); Venterskroon, 1 (TM); Waterberg, 1 (TM); Welgedaan, 8 (TM); Welgevonden, 1 (TM); Witpoort, 1 (TM); Wolmaranstad, 8 (SI); Zandspruit en Donkerpoort, 1 (TM).

Additional records: Sightings from Brandhoek, Buffelspoort, De Hoop Priv. Nat. Res., Dordrecht, Fort Klipdam, Groothoek, Mooigenoeg, Suikerboschrand Prov. Nat. Res., Urk, Zoutpan. Open circles in Kruger National Park on distribution map after Pienaar (1964).

Family Muscardinidae

Graphiurus Smuts, 1832

1. Premolar very small	Subgenus *Graphiu*
Premolar not much reduced	Subgenus *Claviglis*

Subgenus *Graphiurus* Smuts, 1832

Graphiurus (Graphiurus) ocularis (Smith, 1829) Black and white dormouse
Gemsbokmuis

According to Roberts, 1951; Ellerman *et al*, 1953; and

Misonne/...

Misonne, 1974 this species occurs at Linokana, northwest of Zeerust. Skead (1973) regards Linokana as a synonym of Dinokana, whose coordinates are listed as 25°27'S; 25°52'E. The whereabouts of the actual specimen are unknown, but it is probably in the Vienna Museum.

This species is poorly represented in museums, and consequently its known distribution appears patchy. Roberts (1951) remarks that the species has the flattened skull typical of rock-crevice frequenters, and in my experience of it elsewhere it is in fact rupicolous, although the first one I collected was found in a tree.

Subgenus *Claviglis* Jentink, 1888

1. Skull flattened, usually 29-32 mm; hind foot 18-23 mm ... ... *platyops*
Skull not flattened, usually under 29 mm, hind foot 14-19 mm ... ... *murinus*

Graphiurus (Claviglis) platyops Thomas, 1897 Rock dormouse
Klipwaaierstertmuis

DISTRIBUTION:

This species is poorly represented in museum collections, and its known range consequently appears patchy. The environmental factors influencing distribution are therefore uncertain, but *G. platyops* requires a rocky or wooded environment. With this in mind, the following factors appear to limit distribution:

With one exception in Mocambique (Smithers, 1971), distribution records from the Transvaal, Rhodesia, Botswana and Mocambique are all from altitudes higher than 609 metres (2 000 ft.). Altitude in turn affects vegetation, and this species apparently avoids

Acock's/...

Acock's (1976) Lowveld, Arid Lowveld and Mopane woodland veld-types in the eastern Transvaal lowveld. Its avoidance of mopane woodland explains its absence from the northern Transvaal and southern Rhodesia at altitudes higher than 609 meters.

The species is absent from the Pietersburg plateau, the western Transvaal and most of the southern Transvaal highveld, as well as the Orange Free State, probably as a result of the absence of discontinuity of suitable habitat. Apart from the fact that it could have been overlooked, no satisfactory explanation for its absence in the Waterberg area of the north-western Transvaal can be offered. Smithers (1971) recorded a specimen from Botswana at locus 2326DA, which suggests that *G. platyops* may occur in this region.

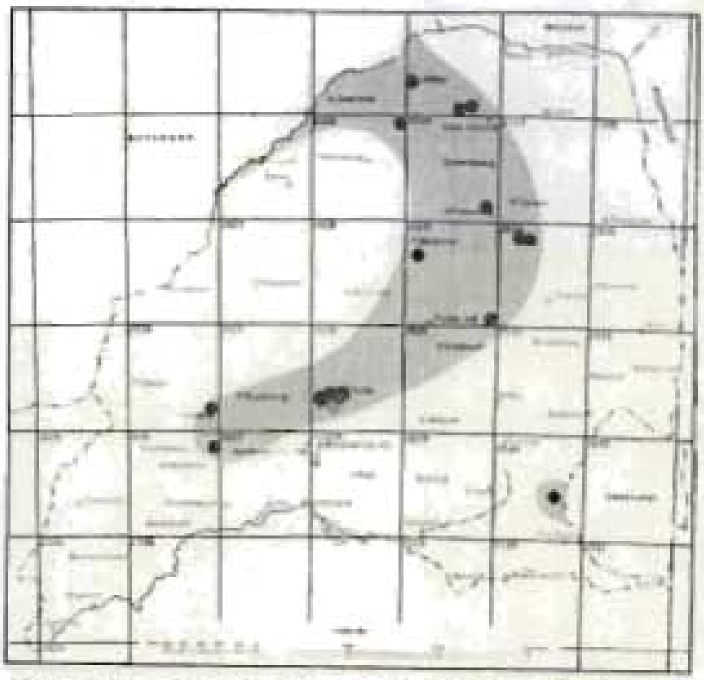

Fig.80: The distribution of *G. platyops* in the Transvaal.

HABITAT:

G. platyops has a marked preference for rock debris with abundant crevices, preferably close to woody vegetation. In the absence of rocky terrain, the rock dormouse is sometimes found in big trees, where it nests in holes. Occasionally it is found in association with dassies, while Roberts' notes on a specimen label claim that an animal was trapped in a cave. (TM 1597 trapped during June 1915 near Carolina).

HABITS:

Rupicolous or arboreal. Apparently nocturnal, and solitary outside the breeding season. Seldom caught. Indications are that the species hibernates.

FOOD/...

FOOD:

Stomach contents indicate that it is predominantly vegetarian, and to some extent insectivorous. Stomach contents were finely masticated, preventing identification of food. The fact that specimens are more often trapped with meat as bait indicates a carnivorous tendency.

BREEDING:

No pregnant or lactating females were collected. Ansell (1960) records a pregnant female in February, and juveniles in November and December.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	175	10	168	193
T.	71,4	10	60	80
H.Ft.	20,3	10	19	22
Ear	13	10	9	16
Mass	39,5	2	39	40

Females

	$\bar{X}$	N	Min.	Max.
Tot.	173	12	154	195
T.	71,6	12	63	85
H.Ft.	19,7	12	17	22,5
Ear	15	11	8	18
Mass	48,7	3	40	65

RECORDS OF OCCURRENCE:

Specimens examined, 30: 11 km N Alldays, 1 (TM); Amsterdam, 1 (TM); Cyprus, 1 (TM); De Hoop Priv. Nat. Res., 1 (TM); Groothoek, 2 (TM); Kameeldrif, 1 (TM); Kosterfontein, 5 (TM); Malta, 2 (TM); Motlateng, 7 (TM); Modderfontein, 1 (TM); Pretoria, 1 (TM); Pretoria North, 1 (TM); Rochdale, 1 (TM); Steynsdorp, 1 (TM); Waterpoort, 2 (DM); Wonderboom, 1 (TM); Woodbush, 1 (TM).

Graphiurus/...

Graphiurus (Claviglis) murinus (Desmarest, 1822) Forest dormouse
Boswaaierstert-
muis

TAXONOMIC NOTES:

Forty-five described forms of this taxon are provisionally included in *murinus* by Misonne (1974). Although it is possible to separate some of these forms on a regional basis, it is impossible on a Pan-African scale. Consequently no subspecies are recognized here.

The taxonomy of this species is urgently in need of revision, (L.W. Robbins, *pers.comm.*).

The characteristic domed skull of this species is not as consistently distinct as may be indicated by the key, and it overlaps in shape with the flattened skull of *G. platyops*. Skull length is a more reliable parameter, although a small overlap with the previous species is demonstrable. Hind foot length apparently does not overlap. *G. murinus* is a less robust species than *platyops*, with ventral colouration displaying more white, and dorsal colouration a lighter shade of grey when examined in a series.

DISTRIBUTION:

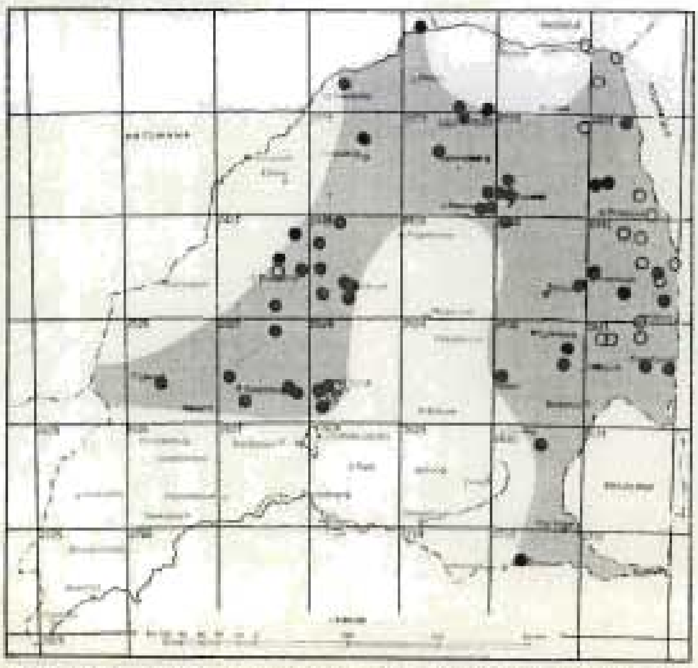

Fig.81: The distribution of *G. murinus* in the Transvaal.

Widely distributed throughout well-wooded regions of the Transvaal. It is absent from the highveld grasslands, with the exception of specimens from Jessyvale plantation (Carolina district) and Kastrolnek (Wakkerstroom district), which were trapped amongst rocks. Presumably overlooked along the Limpopo

river/...

river in the north-western Transvaal.

HABITAT:

In the Transvaal it was collected in various veld types, all of which include trees large enough to have holes for use as refuges. Unlike the previous species, it also occurs in mopane woodland. Also taken in aloes (Smithers and Tello, 1976), as well as amongst large rocks. It thus overlaps in habitat preference with *platyops*.

The forest dormouse is often found to occupy the roofs of houses and sheds, the area under floorboards, and Bantu huts. In outhouses it frequently nests in bundles of rags or paper.

HABITS:

Nocturnal and sometimes crepuscular. Arboreal and to a limited extent rupicolous. Apparently solitary, except while a female rears her young, or is in oestrus. Occupies holes in trees, where it rests during the day. It is likely that this species hibernates at certain times in winter.

FOOD:

Graminivorous and insectivorous.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	170	17	159	188
T.	77,1	17	70	92
H.Ft.	16,9	17	13	20
Ear	15,3	17	13	19
Mass	24,0	6	19	28

Females

	$\bar{X}$	N	Min.	Max.
Tot.	171,6	23	159	194
T.	76,6	21	67	95
H.Ft.	16,5	21	15	19
Ear	15,2	22	12	19
Mass	23,1	11	15	32

RECORDS/...

RECORDS OF OCCURRENCE:

Specimens examined, 80: Acornhoek, 2 (TM); Al-te-Vêr, 1 (TM); Belfast, 1 (SI); Boekenhoutpoort, 1 (TM); Bokfontein, 1 (TM); Buffelsdraai, 2 (TM); Derry, 1 (TM); Elandsfontein, 1 (TM); Ferndale, 3 (TM); Haenertsburg, 3 (TM, 2; SI, 1); Hartebeespoortdam, 1 (TM); Hectorspruit, 3 (TM); Jessievale, 1 (TM); Kastrolnek, 6 (TM); Komatipoort, 1 (SI); Koperfontein, 1 (TM); Letaba Ranch, 2 (TM, 1; SI, 1); Mareio, 1 (NKW); Mariepskop, 2 (TM); Mokeetsi, 2 (TM); Montrose Estates, 4 (TM); 20 km N. Nelspruit, 1 (TM); New Agatha Forest Res., 1 (TM); 11 km N. Newington, 1 (TM); Nicorel, 1 (TM); Nylstroom, 1 (SI); Olifantspoort, 1 (TM); Othawa, 1 (TM); Platbos, 1 (TM); Pretoria North, 5 (TM); Punch Bowl, 1 (TM); Rankins pass, 1 (TM); near Rhodes drift, 1 (TM); Rietspruit, 1 (TM); Rissik Priv. Nat. Res., 1 (TM); Rooikrans, 3 (TM); Rustenburg, 1 (SI); Singwitzi, 3 (TM, 2; NKW, 1); Snelsberg, 1 (TM); Soutpansberg, 1 (TM); Steenvlakke, 1 (TM); Swartkops, 2 (TM); Tshokwane, 1 (NKW); Tzaneen Estate, 1 (TM); Tzaneen, 1 (SI); Vaalwater, 2 (TM); Waynek, 1 (TM); White River, 2 (SI); Wonderboom, 1 (TM); Woodbush, 1 (TM).

Additional records: Live specimens from Donkerpoort and Zandspruit, Madimbo. Open circles in Kruger National Park area on distribution map after Pienaar (1964).

Family Muridae

(Adapted from Misonne, 1974)

1. M^3 the largest tooth	Otomyinae
M^1 the largest tooth	2
2. M^1 with three cusps in first row	Murinae
M^1 with two cusps in first row	3
3. Pattern of upper molars as in in Misonne, 1974:10:Fig.2)..	Gerbillinae
Pattern of upper molars not as above	4
4. Soles of hind feet partly hairy	Cricetinae
Soles of hind feet naked	Dendromurinae Cricetomyinae

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Subfamily/

Subfamily Murinae

(Adapted from Misonne, 1974)

1. Fur spiny	*Acomys*
Fur not spiny	2
2. Lines or stripes on back	3
No lines or stripes on back	4
3. One dark line on back	*Lemniscomys*
More than one line on back	*Rhabdomys*
4. Strong interorbital constriction	*Dasymys*
No strong interorbital constriction	5
5. T 7 present on M^1 or at least replaced by a strong ridge	*Thamnomys*
T 7 on M^1 absent	6
6. Rows of cusps on M^1 markedly distorted...	7
Rows of cusps on M^1 not markedly distorted...	8
7. Extreme distortion of cusps; size small, head and body length not over 70 mm; underparts brown or reddish brown	*Mus*
Medium distortion of cusps; size larger, head and body length over 70 mm; upperparts grey or brownish-grey	*Praomys*
8. Dark marking in front of the eye	*Thallomys*
No dark marking in front of the eye	9
9. Palatal foramina penetrating between molars; molars clearly cuspidate	*Aethomys*
Incisive foramina not penetrating between molars; molars not clearly cuspidate, with a tendency to become laminate	*Rattus*

Acomys Geoffroy, 1838

Acomys spinosissimus Peters, 1852 Spiny mouse
Stekelmuis

A. s. transvaalensis Roberts, 1926

TAXONOMIC/...

TAXONOMIC NOTES:

There is no consensus amongst authors on the taxonomic treatment of this genus, which is badly in need of revision. Setzer (1975) considers all South African material to represent *subspinosus* Waterhouse, 1838. He distinguishes this species from the more northern *spinosissimus* by its shorter nasals (9,5 mm or less). However, material from the Transvaal is very variable in this parameter, and in fact tends to fall predominantly within the size range Setzer (*op.cit.*) cites for *spinossimus*, of 9,8 mm or more.

Roberts (1951), Ellerman *et al.* (1953), Meester *et al.* (1964) and Davis (1974) all agree that *subspinosus* is restricted to the southern Cape Province. In fact, available records in the Transvaal Museum indicate that a wide gap separates Cape *Acomys* from the more northern ones. The above authors disagree on the status of Transvaal material, which are continuous in distribution with those from Rhodesia, Botswana and Mocambique. Examination of material from the Transvaal suggests that the approach of Meester *et al.* (1964) with regard to taxonomic status, is the most realistic. Hence, Transvaal material is assigned to the species *spinosissimus*, subspecies *transvaalensis*, pending a revision of the genus.

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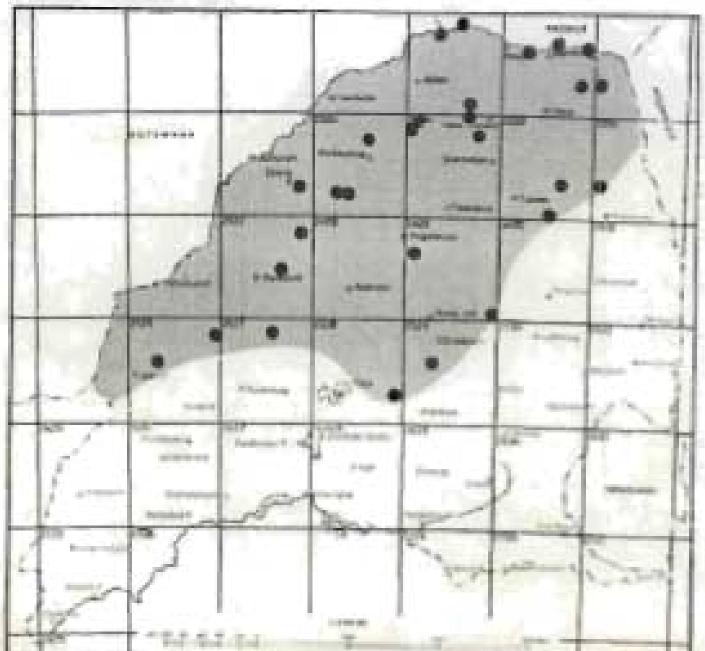

Fig.82: The distribution of *A. spinosissimus* in the Transvaal.

In spite of its preference for mountain summits, this species occurs only in the woodland region north of the Magaliesberg. It is absent from the highveld grassland areas of the southern Transvaal and the Orange Free State. Its absence from the south-eastern Transvaal lowveld is confirmed when considering the overall distribution pattern/...

pattern in Botswana, Rhodesia and Mocambique.

The records from the central Transvaal represent a considerable extension of the known distribution of *A. spinosissimus*.

HABITAT:

All but one specimen were taken in rocky environments, with a marked preference for mountain summits. Accumulations of rock debris with abundant crevices are preferred, although the species is also found on gentler slopes with scattered rock, sand and fairly good grass cover. Only one specimen from the Transvaal was collected away from a rocky mountainous environment, in riverine forest on the farm Buffelspoort (district Assen). In Mocambique however, Smithers and Tello (1976) regularly recorded this species in alluvium along rivers and in savannah veld.

HABITS:

It is to a large extent rupiculous, nocturnal and possibly crepuscular. Mostly solitary, in spite of high population densities recorded in small areas. Within such areas many separate refuges are available for the solitary individuals. Nests are constructed in rock crevices, using plant material within. The faeces are characteristically cylindrical, and very dry even when fresh. Based on circumstantial evidence the species can exist without open water.

FOOD:

Graminivorous and to a small extent insectivorous.

BREEDING:

Incidence of pregnant, lactating and non-pregnant females through the months of the year.

Total/...

	J	F	M	A	M	J	J	A	S	O	N	D
Total	3	3	9	14	2	2	2	4	4	7	0	0
Not Pregnant	1	2	2	6	2	2	2	4	4	4	-	-
Lactating	1	0	3	6	0	0	0	0	0	2	-	-
Pregnant	1	1	3	2	0	0	0	0	0	1	-	-

These data, supported by evidence from Smithers (1971), suggest that parturition is restricted to the summer months.

Average number of foetuses per female was 3,3; N=9; Obs. range 2-6; implantation irregular.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	166	59	146	190
T.	75,1	59	62	90
H.Ft	16,0	59	12	18
Ear	13,6	54	11	16
Mass	21,7	58	14	29

Females

	$\bar{X}$	N	Min.	Max.
Tot.	162	45	146	185
T.	74,8	45	57	84
H.Ft	15,8	45	13	18
Ear	13,1	39	9	17
Mass	21,3	43	13	34

RECORDS OF OCCURRENCE:

Specimens examined, 106: Blijdschap Priv. Nat. Res., 4 (TM); Buffelspoort, 1 (TM); De Hoop Priv. Nat. Res., 9 (TM); Donkerpoort and Zandspruit, 4 (TM); Dordrecht, 3 (TM); Greefswald, 1 (TM); Groothoek, 2 (TM); Hans Merensky Prov. Nat. Res., 9 (TM); Huwi, 5 (TM); Letaba Ranch, 2 (TM); on Levuvhu river, 8 (TM); Leydsdorp, 2 (TM); Loskopdam Prov. Nat. Res., 4 (TM); 10 km E. Madimbo, 2 (TM); Mooigenoeg, 8 (TM); Nicorel, 1 (TM); Platbos, 4 (TM); Punda Milia, 3 (NKW); Renosterpoort, 2 (TM);

Rochdale/...

Rochdale, 5 (TM); RR Ranch, 9 (U.P. Ref. coll.); Scrutton, 1 (TM); Urk, 6 (TM); Wilhanshohe, 1 (TM); Zandspruit, 4 (TM); Zeerust, 3 (SI); Zoutpansberg, 3 (TM).

Additional records: Specimens housed in National Museums of Rhodesia collections, collected at 2229 BB and 2230 BC (Smithers, *in litt.*).

Aethomys Thomas, 1915

1. First lower molar without anterior median cusp but often with a small tubercle or cingulum; molar toothrow over 6,3 mm and subequal or equal to the greatest diameter of the bullae size larger; tail subequal to length of head and body; ... ... *A. (A.) chrysophilus*

First lower molar with anterior median cusp; molar toothrow less than 6,3 mm and usually longer than the greatest diameter of the bullaw size smaller; tail longer than head and body; .. .. *A. (N.) namaquensis*

Aethomys (Micaelamys) namaquensis (Smith, 1834) Namaqualand rock mouse

Namakwalandse klipmuis

TAXONOMIC NOTES:

The genus is in need of revision, and no subspecies are accordingly recognized here.

A. n. arboreus (Peters, 1852), distinguished by its pure white belly, has been recorded from isolated localities in the Transvaal, but its taxonomic status is uncertain. Unlike some instances Botswana (Smithers, 1971), none were found to utilize an arboreal habitat in the Transvaal, but occurs predominantly in rocky environments as in Mocambique (Smithers and Tello, 1976).

Other/...

Other forms recognized from the Transvaal by earlier authors are *monticularis* (Jameson, 1909), *drakensbergi* (Roberts, 1926), and *ischochloides* (Roberts, 1926).

DISTRIBUTION:

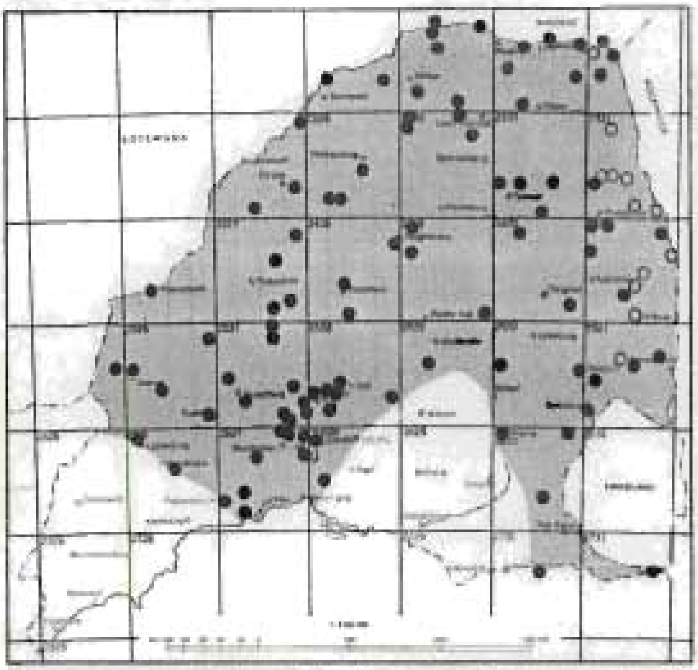

Fig.83: The distribution of *A. namaquensis* in the Transvaal.

The Namaqualand rock mouse occurs widely and abundantly throughout most of the Province. Records from the extreme northeastern Cape suggest that it may have been overlooked in the adjoining south-western Transvaal. Its absence from the Witbank, Bethal and Standerton areas may however be real since the species has not been recorded further south in the O.F.S. This absence correlates approximately with the presence of *Themeda* grassland on turf, although the absence of a suitable rocky habitat, rather than soil or vegetation is the probable limiting factor.

HABITAT:

In the Transvaal it prefers any type of rocky habitat, although not always confined to it. It overlaps to a limited extent with *A. chrysophilus* by being infrequently occurring in woodland savannah and even shrub savannah. *A. namaquensis* occurs in all the rocky features of a moutainous environment

HABITS:

A social species. Small colonies sometimes construct large nests of piled up grass and twigs, complete with tunnels and nest chambers. These nests are normally encountered in rock crevices, but may also be found in the lower forks of

trees/...

trees or even on the ground under shrubs. However, construction of such huge communal nests is not invariable, nor is the communal mode of life.

Judging from trapping results, the Namaqualand rock mouse is terrestrial, rupicolous, to a limited extent arboreal, and nocturnal.

FOOD:

Graminivorous and herbivorous.

BREEDING:

Distribution of breeding females through the year:

	J	F	M	A	M	J	J	A	S	O	N	D
Total	16	16	29	15	10	3	14	23	12	17	1	2
Not pregnant	2	3	10	4	6	3	14	21	11	9	-	1
Lactating	8	5	10	6	2	-	-	-	-	1	-	-
Pregnant	6	8	9	5	2	-	-	2	1	7	1	1

The data presented above support the conclusion reached by Smithers (1971), that *A. namaquensis* is a seasonal breeder. Some evidence of post-partum oestrus was found, with pregnant females also lactating.

The average number of foetuses is as follows: $\bar{X}$=3,3; N=43; Obs. range 1-5. Implantation is irregular.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	261	247	206	302
T.	146	249	107	205
H.Ft	25,5	244	20	30
Ear	17,1	240	14	23
Mass	49,5	134	33	80

Females/...

Females

	$\bar{X}$	N	Min.	Max.
Tot.	262	236	195	305
T.	140	230	105	168
H.Ft	25,6	232	19	31
Ear	17,3	222	14	23
Mass	48,1	166	28	88

RECORDS OF OCCURRENCE:

Specimens examined, 476: Arnhemburg, 1 (TM); Baragwanath, 1 (TM); Blijdschap Priv. Nat. Res., 5 (TM); Blouberg, 1 (TM); Blyde Forest Res., 5 (TM); Buffelspoort, 2 (TM); Cyprus, 1 (TM); Daspoortberg, 13 (TM); De Hoop Priv. Nat. Res., 9 (TM); 7 km from Dinokana on road to Zeerust, 1 (TM); Donkerpoort and Zandspruit, 13 (TM); Dordrecht, 4 (TM); Elandsfontein, 1 (TM); Ferndale, 1 (TM); Fountains Valley, 2 (TM); Greefswald, 16 (TM); Groothoek, 9 (TM); Grootsuikerboschkop and Elandslaagte, 5 (TM); Hans Merensky Prov. Nat. Res., 7 (TM); Hennops river, 3 (TM); Huwi, 6 (TM); Irene, 1 (TM); Iscor works, 14 (TM); Johannesburg, 12 (TM); Joshua Moolman Priv. Nat. Res., 5 (TM); Kilnerton, 2 (TM); Klipfontein, 2 (TM); Kongo, 3 (TM); Koster, 1 (TM); Kosterfontein, 2 (TM); Krugersdorp, 1 (TM); Langjan Prov. Nat. Res., 1 (TM); Leeuwspoor, 1 (TM); Letaba Ranch, 20 (TM, 6; SI, 14); On Levuvhu river, 7 (TM); Leydsdorp, 1 (TM); 8 km N. Lichtenburg on road to Ottoshoop, 2 (TM); Loskopdam Prov. Nat. Res., 11 (TM); 10 km E. Madimbo, 12 (TM); Magalakwin, 4 (TM); Magaliesberg, 9 (TM); Malelane, 1 (TM); Meyerspark, 5 (TM); Mmabolela Estates, 6 (TM); Mokeetsi, 2 (TM); Mokko, 2 (TM); Montrose Estates, 1 (TM); Mooigenoeg, 8 (TM); Mooimeisiesfontein, 2 (TM); Moorddrif, 2 (TM); Nelspruit, 10 (SI); 11 km N. Newington, 4 (TM); Njelelle river, 3 (TM); Olifantspoort, 3 (TM); Olifants river, 6 (TM); Pafuri, 1 (TM); Palala river, 1 (TM); Piet Retief, 22 (SI); Percy Fyfe Prov. Nat. Res., 4 (TM); Platbos, 8 (TM); Potchefstroom district, 1 (TM); Pretoria, 13 (SI); Ratsegaai, 8 (TM); Renosterpoort Priv, Nat. Res., 7 (TM); Rhoda, 3 (TM); Rietondale, 2 (TM); Rietspruit, 1 (TM); Rissik, 1 (TM); Rochdale, 7 (TM); Roodeplaat, 5 (TM); Rooiberg, 3 (SI); Rooikrans, 1 (TM); Rustenburg, 12 (SI); Rustenburg Prov. Nat. Res., 2 (TM); Rykvoorby, 10 (TM); Schurweberg, 1 (TM); Scrutton, 6 (TM); Soutpansberg, 1 (TM); Sterkfontein, 3 (TM); Suikerboschrand Prov. Nat. Res., 1 (TM); Swartkops, 2 (TM); Swartkrans, 17 (TM); Sweet Homes, 1 (TM); Tweespruit, 1 (TM); Uitkomst, 12 (TM); Uitkyk and Paranie, 9 (TM); Urk, 8 (TM); Venterskroon, 1 (TM); Warmbad, 2 (TM); Waterkloof, 2 (TM); Wilhanshohe, 3 (TM); Witpoort, 11 (TM); Wonderboom, 12 (TM); Wonderfontein, 1 (TM); Worcester Mine, 2 (TM); Zandspruit, 4 (TM); Zoo Hill, 2 (TM).

Additional records: Open circles in the Kruger National Park on the distribution map after Pienaar (1964).

Aethomys (Aethomys) chrysophilus (de Winton, 1897) Bush (African) rat

A. c. chrysophilus (de Winton, 1897) Afrikaanse rot

TAXONOMIC NOTES:

Davis (1975) regards all the named taxa in southern Africa as belonging to the nominate race. I follow him in considering all Transvaal material as *A. c. chrysophilus* until the taxonomy of the species has been revised. Considerable interpopulation variation is demonstrable in the Transvaal, but cannot be interpreted here without taking into account geographic and nongeographic variation of the species throughout its entire range.

The races acknowledged by Roberts (1951) as occurring in the Transvaal, and regarded here as synonyms, are: *capricornis* Roberts, 1926; *tzaneenensis* Jameson, 1909; and *pretoriae* Roberts, 1913.

DISTRIBUTION:

Davis' (1975) conclusions that *A. chrysophilus* is an inhabitant of the southern savannah woodland in the Transvaal is supported by the majority of records. However, the records from the highveld grassland (excluding those from Christiana in the

extreme/...

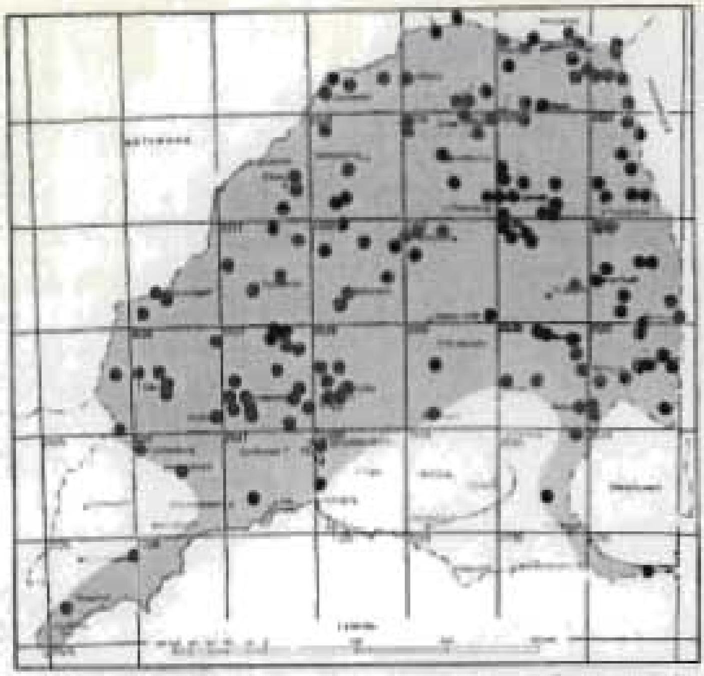

Fig.84: The distribution of *A. chrysophilus* in the Transvaal.

extreme south-west, and Golela in the extreme south-east, falling in wooded veld types) are inexplicable.
As in many other instances in the genus *Aethomys*, these specimens could not be assigned with absolute certainty to this species. However, they resemble *chrysophilus* most closely, and are considered as such until a revision of the genus offers more clarity.

HABITAT:

This species is territorial and inhabits wooded plains exclusively, with dependence on some form of ground cover, normally grass or scrub. It has been recorded from a variety of soil types. On occasion it is also found on the lower slopes of mountains, where it may co-exist with *A. namaquensis*. As far as can be established, the bush rat is solitary, and according to Roberts (1951) it constructs burrows under bushes or rocks. It is often found in the dense grass or thorn fences surrounding cultivated lands, where it may be trapped in runways. It is uncertain whether these runways are constructed by this species or by another small mammal. According to Roberts (1951) it also occupies termite mounds.

HABITS:

Nocturnal, terrestrial and mainly solitary.

According to Choate (1972) the bush rat occupies burrows and hollows under rocks, where nests are constructed. Chaote (*op.cit.*) suspects a degree of territorialism. Stiemie and Nel (1973) studied nest construction behaviour in captivity, and concluded that one of the functions of a nest is thermo-regulation.

They/...

They found both sexes to indulge in nest building.

Choate (*op.cit.*) and Brooks (1972) recorded nipple clinging. Meester and Hallett (1970) equate this habit with smaller litter size and better parental care. Brooks (1972) postulates that nipple-dragging does not occur during the normal nocturnal activities of the mother.

FOOD:

Herbivorous and graminivorous.

BREEDING:

Monthly distribution of reproductive females collected.

	J	F	M	A	M	J	J	A	S	O	N	D
Total	12	24	10	26	7	-	22	5	17	16	10	2
Non-pregnant	2	7	2	12	6	-	18	5	16	6	4	0
Lactating	5	7	2	8	0	-	3	0	0	2	2	1
Pregnant	5	10	6	6	1	-	1	0	1	8	4	1

These data support the findings of Choate (1972), that *A. chrysophilus* is a polyoestrus species which breeds throughout the year, with a marked peak during summer. Post-partum oestrus has been observed by Choate (*op.cit.*) and by myself.

The average number of foetuses per female is as follows: $\bar{X}$=3,3; N=41; Obs. range 1-5. Implantation is irregular.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	272	463	210	345
T.	150	449	107	188
H.ft	27,7	459	22	32
Ear	19,9	450	16	23
Mass	76,7	331	38	112

Females/...

Females

	$\bar{X}$	N	Min.	Max.
Tot.	280	455	214	344
T.	149	450	102	182
H.Ft	27,4	477	20	33
Ear	20,8	471	16	24
Mass	68,1	344	26	125

RECORDS OF OCCURRENCE:

Specimens examined, 935: Acornhoek, 2 (TM); Acre (Farm 2), 3 (TM); Al-te-Vêr, 36 (TM); Badplaas, 14 (SI); Barberton, 22 (TM, 4; SI, 18); Blijdschap Priv. Nat. Res., 6 (TM); Blokspruit, 1 (TM); Blouberg, 17 (TM); Bochem, 4 (SI); Bosbokrand, 6 (SI); Buffelsdraai, 2 (TM); Buffelspoort, 7 (TM); Canton, 1 (TM); Cyprus, 6 (TM); De Hoop Priv. Nat. Res., 8 (TM); Dinokana, 7 (TM); Donkerpoort and Zandspruit, 13 (TM); Doornhoek, 2 (TM); Dordrecht, 5 (TM); Dreadmouth, 1 (TM); Droogedal, 2 (TM); Elandsfontein, 1 (TM); Ellisras, 2 (SI); Ferndale, 2 (TM); Fort Klipdam, 5 (TM); Geelhoutkloof, 2 (TM); George's Valley, 4 (TM); Gravelotte, 2 (TM); Greefswald, 1 (TM); Groenkloof, 2 (TM); Groothoek, 9 (TM); Haenerstburg, 9 (SI); Hammanskraal, 1 (TM); Hans Merensky Prov. Nat. Res., 6 (TM); Hectorspruit, 3 (TM); Hennops river, 8 (TM); Huwi, 9 (TM); Johannesburg, 1 (TM); Joshua Moolman Priv. Nat. Res., 2 (TM); Jones' hut, 4 (TM); Kalkfontein, 1 (TM); Klaserie, 10 (TM); Komatipoort, 12 (TM); Koperfontein, 1 (TM); Koster, 6 (TM); Kruger Kloof Nat. Res., 1 (TM); Kwaggavlakte, 1 (TM); Langjan Prov. Nat. Res., 3 (TM); Letaba Ranch, 4 (TM); Letaba Rest Camp, 1 (TM); on Levuvhu river, 7 (TM); Leydsdorp, 2 (TM); Lichtenburg, 4 (SI); Loskopdam Prov. Nat. Res., 22 (TM); Louis Trichardt, 2 (TM); Lydenburg, 1 (TM); Lydenburg Prov. Fisheries Inst., 1 (TM); Mabohlelena, 1 (NKW); 10 km E. Madimbo, 8 (TM); Magalakwin, 3 (TM); Magaliesberg, 1 (TM); at Makapan's cave, 1 (TM); Malelane, 49 (TM, 4; SI, 45); Malta, 3 (TM); Malapeni river, 2 (TM); Namarango, 2 (TM); Mariepskop, 17 (TM); Mmabolela Estates, 8 (TM); Mokeetsi, 12 (TM); Montrose Estates, 4 (TM); Mooigenoeg, 6 (TM); Mooimeisiesfontein, 1 (TM); Mooiplaas, 5 (TM); Moonlight

2 (TM); Moorddrift, 14 (TM); Mosdene, 2 (TM); Munweni, 1 (NKW); Mutale river, 3 (TM); Nelspruit, 9 (TM, 1; SI, 8); 11 km NE Newington, 1 (TM); Njelelle river, 1 (TM); Nylstroom, 13 (TM, 10; SI, 3); Nwambia Pan, 12 (TM, 7; NKW, 5); Nwanedzi, 1 (TM); Olifantshoek, 1 (TM); Olifantspoort, 22 (TM); Olifants river, 7 (TM); Onderstepoort, 1 (TM); Othawa, 5 (TM); Pafuri, 1 (NKW); Paranie Priv. Nat. Res., 21 (TM); Percy Fyfe Prov. Nat. Res., 2 (TM); Platbos, 7 (TM); Potgietersrus, 14; (TM, 2; SI, 12); Pretoria, 11 (SI); Pretoria North, 1 (TM); Pretoria Zoo's Farm, 9 (TM); Punda Milia, 12 (TM, 6; NKW, 6); Ratsegaai, 2 (TM); Rhoda, 4 (TM); Rochdale, 1 (TM); Roodekuil, 1 (TM); Roodeplaat, 2 (TM); Rustenburg, 55 (SI); 23 km W. Rustenburg, 1 (TM); Rustenburg Prov. Nat. Res., 2 (TM); Rykvoorby, 12 (TM); Sama, 1 (TM); Sandringham, 3 (TM); Sand river, 1 (TM); Satara, 8 (TM); Schurweberg, 8 (TM); Scrutton, 8 (TM); Sekeroro, 3 (TM); Sibasa, 2 (TM); Shingwedzi, 4 (TM, 2; NKW, 2); Shingwedzi-Dzombo rivers confluence, 1 (TM); Skukuza, 2 (NKW); Soutpansberg, 16 (TM); Spitskop, 1 (TM); Sweet Home, 4 (TM); Tamboekieskloof, 2 (TM); TenBosch Estates, 4 (TM); Thabazimbi, 27 (SI); Tshakuhma malaria Camp, 1 (TM); Tshipise, 8 (SI); Tshokwane, 1 (TM); Tzaneen, 27 (SI); Tzaneen Estates, 8 (TM); Uitkomst, 3 (TM); Urk, 3 (TM); Vereeniging, 1 (SI); Waterkloof, 3 (TM); Welgedaan, 6 (TM); Welgevonden, 2 (TM); Wilgefontein, 1 (TM); Wilhanshohe, 8 (TM); Witbank, 25 (SI); Witpoort, 2 (TM); Witrivier, 12 (SI); Wolmaranstad, 14 (SI); Wonderboom, 1 (TM); Woodbush, 2 (TM); Worcester Mine, 2 (TM); Zandspruit 168, 3 (TM); Zeerust, 29 (SI); Zoutpan, 8 (TM).

Dasymys Peters, 1875

Dasymys incomtus (Sundevall, 1847) Swamp rat
Waterrot

D. i. incomtus (Sundevall, 1847)

TAXONOMIC NOTES:

A monotypic genus. Although Misonne (1974) does not

acknowledge/..

acknowledge geographic variation within the species, I consider it likely because of the restricted habitat preference and resultant patchy distribution of this species. Roberts' (1951) interpretation of subspecies relationships is consequently followed here by provisionally assigning the Transvaal material to *D. i. incomtus*. Races are currently differentiated solely on subjective interpretation of coat colour. However, final acceptance of subspeciation depends on statistical analyses of variation, not solely on coat colouration but also using morphometric parameters.

DISTRIBUTION:

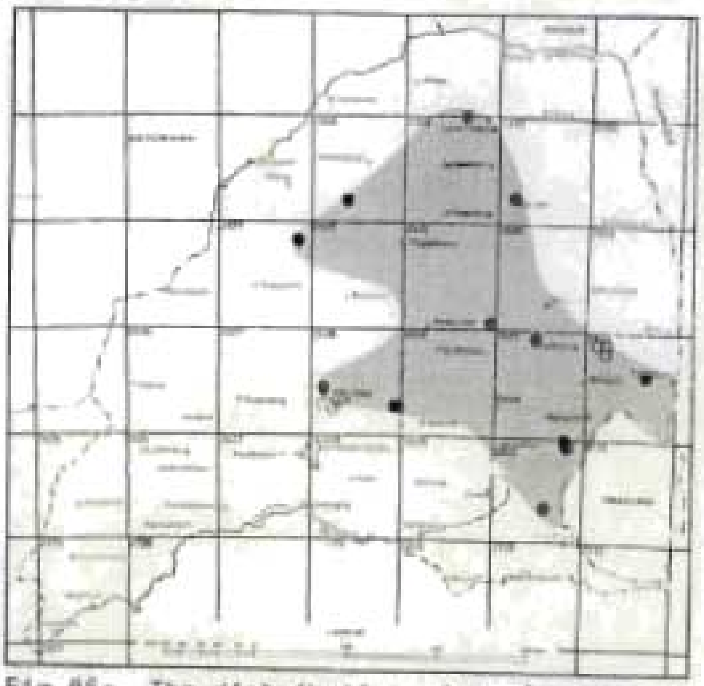

Fig.85: The distribution of *D. incomtus* in the Transvaal.

All the records from the Transvaal west of 30°E longitude present a considerable westward extension of the known range of this species (see Misonne, 1974). Throughout its entire range, all known records of the species coincide with areas receiving more than 500 mm mean annual precipitation.

HABITAT:

As implied by the vernacular name, the swamp rat is entirely restricted to marshy areas with a dense grass or semi-aquatic plant cover. Where encountered, the soil was permanently saturated with water, at times even inundated. Agricultural exploitation of such areas would obviously endanger its continued existence locally.

HABITS:

Terrestrial, and to some extent aquatic. Judging from trapping records, it appears to be nocturnal, solitary and occurring at low population densities. No evidence of the construction of runways, as in Botswana (Smithers, 1971), could be found in the Transvaal. Domed nests are built at ground level under matted vegetation. Roberts (1951) found instances of the species inhabiting burrows in river banks. In many localities *D. incomtus* coexists with *Otomys* spp. Like *Otomys*, it scatters grass and reed cuttings in its feeding areas.

FOOD:

The stems of grasses and semi-aquatic plants. Smithers (1971) recorded traces of insects in the stomachs.

BREEDING:

No pregnant or lactating females were collected in the Transvaal. Smithers (1971) recorded a total of four pregnancies in August, October and December.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	283	14	240	326
T.	131	14	110	145
H.Ft	32,4	14	28	36
Ear	20,7	14	16	24
Mass	100	7	69	152

Females

	$\bar{X}$	N	Min.	Max.
Tot.	265	14	241	307
T.	123	14	111	147
H.Ft	31,2	14	29	35
Ear	19,6	14	18	22
Mass	87,7	7	78	100

RECORDS OF OCCURRENCE:

Specimens examined, 38: Arnhemburg, 2 (TM); De Hoop Priv.

Nat. Res., 1 (TM); Dordrecht, 2 (TM); Faai Renosterkamp, 7 (NKW); Gladdespruit, 1 (TM); Hectorspruit, 1 (TM); Joshua Moolman Priv. Nat. Res., 2 (TM); Lydenburg Prov. Fisheries Inst., 1 (TM); Onderstepoort, 2 (TM); Platbos, 3 (TM); Renosterpoort Priv. Nat. Res., 1 (TM); Soutpansberg, 7 (TM); Tzaneen Estates, 8 (TM).

Lemniscomys Trouessart, 1881

Lemniscomys griselda (Thomas, 1904) Single-striped mouse
Eenstreepmuis

TAXONOMIC NOTES:

Roberts (1951) acknowledges two subspecies from the Transvaal; *spinalis* Thomas, 1916 from the "upper Limpopo River valley bushveld", and *sabiensis* Roberts, 1946 from the eastern Transvaal lowveld. He separates them entirely on coat colour. However, inter- and intra-population variation as well as intergradation are so great in this character that I am unable to detect any definite pattern of geographic difference. No subspecies are consequently recognized in the Transvaal.

DISTRIBUTION:

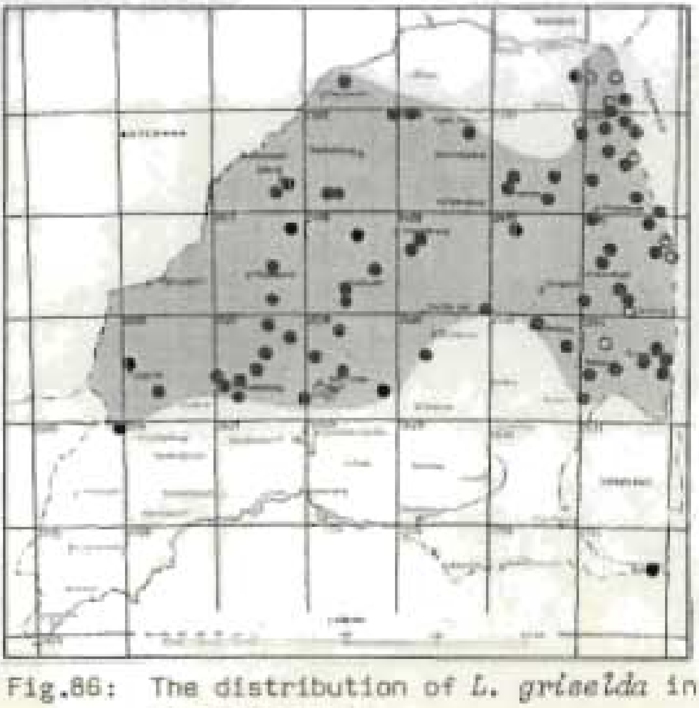

Fig.86: The distribution of *L. griselda* in the Transvaal.

The known range of this species in southern Africa coincides with altitudes below 1218 meters (4 000 ft), although altitude alone does not appear to be the limiting factor. Altitude directly affects vegetation, and this species is restricted to wooded areas, in the Transvaal particularly undifferentiated woodland

savannah/...

savannah. *L. griselda* is absent not only from the highveld grasslands, but also from the Pietersburg plateau and the Waterberg area. Although the single-striped mouse occurs in mopane veld in the northern Kruger National Park, it avoids this habitat elsewhere in the northern Transvaal and southern Rhodesia.

HABITAT:

L. griselda is dependent on the protection of good grass cover or at least low bushy shrubs. This suggests that the specula- it may be restricted to only certain types of grass of grass associations, which may explain its absence on the highveld grasslands.

HABITS:

L. griselda is diurnal, and Roberts (1951) refers in this respect to the characteristic thin, black membrane between the skull and the skin. He interprets this as protection against the heat of the sun. The species makes definite runs through denser grass stands. It is entirely terrestrial.

FOOD:

Graminivorous and herbivorous.

BREEDING:

Distribution of pregnant, lactating and non-pregnant females throughout the year.

	J	F	M	A	M	J	J	A	S	O	N	D
Total	4	2	1	11	8	-	7	1	9	11	12	1
Non-pregnant	1	0	0	6	8	-	7	1	9	7	11	1
Lactating	1	1	0	3	0	-	0	0	0	2	0	0
Pregnant	2	1	1	2	0	-	0	0	0	2	1	0

The available evidence suggest seasonal breeding, with parturition during summer.

Average number of foetuses per female: $\bar{X}$=5,7; N=9; Obs. range 3-11.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	251	97	210	291
T.	127	97	100	154
H.Ft	27,1	97	22	31
Ear	16,1	97	12	19
Mass	56,2	75	32	89

Females

	$\bar{X}$	N	Min.	Max.
Tot.	246	97	210	275
T.	123	97	70	147
H.Ft	27,0	97	23	31
Ear	16,1	97	12	19
Mass	51,8	80	27	74

RECORDS OF OCCURRENCE:

Specimens examined, 221: Al-te-Vêr, 9 (TM); Alberry, 1 (TM); 2 km N. Beestekraal, 1 (TM); Blijdschap Priv. Nat. Res., 7 (TM); Bosbokrand, 2 (SI); Buffelsdrift, 1 (TM); Buffelspoort, 3 (TM); Coopersdal, 2 (TM); De Hoop Priv. Nat. Res., 2 (TM); Cyprus, 1 (TM); Donkerpoort, 1 (TM); Dordrecht, 6 (TM); Geelhoutkloof, 1 (TM); Gorge rest camp, 1 (TM); Gravelotte, 7 (TM); Groothoek, 6 (TM); Hans Merensky Prov. Nat. Res., 10 (TM); Hectorspruit, 6 (TM); Huwi, 7 (TM); Jakkalspruit, 1 (TM); Komatipoort, 10 (SI); Kruger Kloof Priv. Nat. Res., 1 (TM); Leeuwspoor, 3 (TM); Letaba rest camp, 1 (TM); Letaba Ranch, 10 (TM); 54 km N. Letaba rest camp, 2 (TM); On Levuvhu river, 1 (TM); Lichtenburg, 3 (SI); Loskopdam Prov. Nat. Res., 1 (TM); Mabohlelene, 1 (NKW); Malelane, 1 (SI); Mamarango, 1 (TM); Mothlabantu, 1 (NKW); Mooigenoeg, 1 (TM); Mooiplaas, 7 (TM); Mokeetsi, 2 (TM); Mosdene, 3 (TM); Motlatent, 1 (TM); 11 km N. Newington, 2 (TM); Nwambia Pan, 1 (NKW); Olifants river rest camp, 1 (TM); Othawa, 3 (TM); Parani Priv. Nat. Res., 2 (TM); 10 km E. Pienaars river station, 1 (TM); Platbos, 8 (TM); Punda Milia, 1 (NKW); Renosterpoort Priv. Nat.

Res./...

Res., 1 (TM); Rhoda, 2 (TM); Rietspruit, 1 (TM); Rissik Priv. Nat. Res., 4 (TM); Roodekuil, 1 (TM); Rooikrans, 1 (TM); Rustenburg, 5 (SI); 21 km W. Rustenburg, 3 (TM); Rykvoorby, 2 (TM); Sandringham Priv. Nat. Res., 2 (TM); Satara rest camp, 2 (TM); Schurweberg, 1 (TM); Shangani ranger's camp, 3 (TM); Shingamene, 2 (NKW); Shingwidzi, 5 (TM); TenBosch Estates, 15 (TM); Tshokwane, 1 (TM); Tzaneen, 3 (SI); Tzaneen Estates, 13 (TM); Urk, 3 (TM); Witriver, 3 (SI); Zebediela, 1 (TM); Zoutpan, 4 (TM).

Mus Linnaeus, 1758

1. Size larger; general colour brown; hands and feet brownish, underparts light brown ... ... *musculus*
Size smaller; general colour reddish, hands and feet whitish, underparts pure white ... ... *minutoides*

Mus minutoides A. Smith, 1834 — Dwarf mouse
Dwergmuis

TAXONOMIC NOTES:

I follow Ellerman *et al.* (1953) and Petter and Matthey (1975), in regarding *Leggada* Gray, 1837 as a synonym of *Mus*.

Roberts (1951), Ellerman *et al.* (1953) and Meester *et al.* (1964) recognize only one polytypic species in southern Africa, namely *minutoides*. Petter and Matthey (1975) distinguish a second species, *indutus* (Thomas, 1910), occurring in Botswana, the Transvaal and the Orange Free State, on its different diploid somatic chromosome number and configuration. *M. indutus* has been regarded as a subspecies by previous authors.

In attempting to separate the large series of *Mus* material in the Transvaal Museum, none of the morphological characters so far proposed enabled me to separate the series consistently into the two taxa here under consideration. Furthermore, Pocock (1974) claims a southward range extention of *M. sorella* (Thomas,

1909)/...

1909) of several thousand kilometers, after studying an unspecified sample from owl pellets collected at Makapansgat, near Potgietersrus. Until nongeographic and geographic variation of the local forms of this genus is studied in detail on a pan-African basis, Pocock's claim is not recognized here.

The genus is badly in need of revision, and until such time all material from the Transvaal is tentatively regarded as representing *minutoides*. No subspecies are recognized for the same reaso

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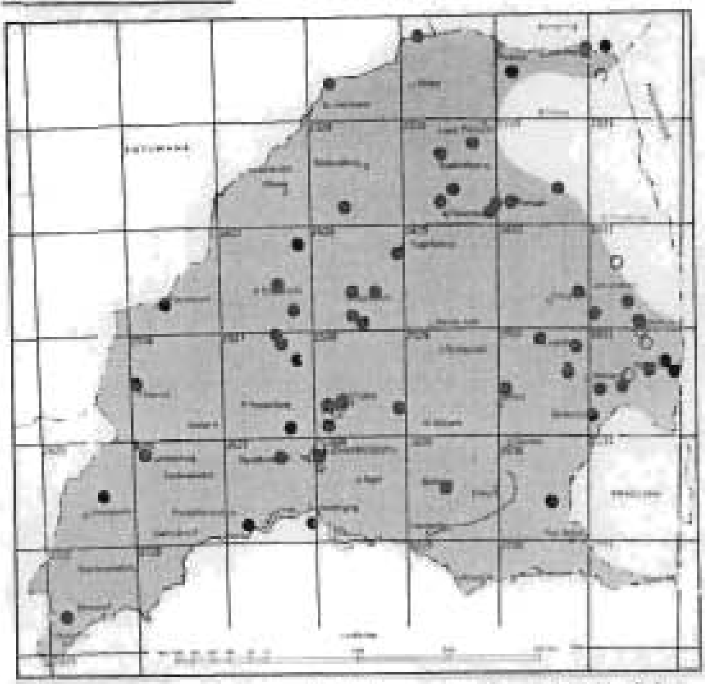

Fig.87: The distribution of *M. minutoides* in the Transvaal.

It is widely distributed throughout the Transvaal, although it has not bee recorded from some areas viz. north-eastern Transvaal. No preference for any particular veld type is evident.

HABITAT:

Although widespread its relative scarcity suggests that it may have a limiting factor, probably related to habitat. One common factor found wherever it has been recorded is good ground cover affording protection, normally in the form of grass. It has been taken from rocky hillslopes with good grass cover.

HABITS:

The dwarf mouse is nocturnal and entirely terrestrial. It constructs nests in the form of balls of grass and other plant material, in which the young are born and reared. These nests are normally situated in hollows under rocks, in fallen logs, tree roots, grass tufts or any other concealed space. According to

Smithers/...

Smithers (1971) it may also excavate shallow burrows in which to hide.

Rodent census-trapping was conducted on a monthly basis at S.A. Lombard Provincial Nature Reserve during 1969, and the results confirm Smithers' (*op. cit.*) suggestion that this species is subject to population explosions.

Partly commensal with man.

BREEDING:

No pregnant or lactating females were recorded. Smithers' (1971) records indicate seasonal breeding.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	97,3	63	82	114
T.	41,1	63	30	48
H.Ft	12,5	63	8	15
Ear	9,8	62	7	14
Mass	5,5	49	2	12

Females

	$\bar{X}$	N	Min.	Max.
Tot.	99,7	77	82	160
T.	41,7	77	20	51
H.Ft	12,6	77	8	14
Ear	10,2	75	8	14
Mass	6,2	56	3	10

RECORDS OF OCCURRENCE:

Specimens examined, 174: Barberton, 7 (TM, 2; SI, 5); Belfast, 1 (SI); Blijdschap Priv. Nat. Res., 2 (TM); Bosbokrand, 1 (SI); Buffelsdraai, 1 (TM); Daspoort, 3 (TM); Derry, P.O. Skeenshoek, 1 (TM); Donkerpoort and Zandspruit, 1 (TM); Dordrecht, 1 (TM); Erfenis, 2 (TM); Fort Klipdam, 1 (TM); Goedehoop, 4 (TM); Haenertsburg, 1 (SI); Hans Merensky Prov. Nat. Res., 1 (TM); Hartebeesfontein, 1 (TM); Hectorspruit, 1 (TM); Haughton Estates, 1 (TM); Jericho, 1 (TM); Joshua

Moolman Priv. Nat. Res., 8 (TM); Komatipoort, 1 (SI); Lydenburg, 2 (TM); 10 km E. Madimbo, 1 (TM); Malelane, 4 (SI); Mariepskop, 1 (TM); Mayville, 1 (TM); Menlo Park, 1 (TM); Moorddrif, 1 (TM); Mooimeisiesfontein, 2 (TM); Mooiplaas, 8 (TM); Mmabolela Estates, 1 (TM); Muckleneuk hill, 1 (TM); Nelspruit, 2 (SI); 11 km N. Newington, 1 (TM); Nelspruit, 2 (SI); Nuffield, 2 (TM); Nylstroom, 7 (SI); Othawa, 10 (TM); 13 km W. Pietersburg, 1 (TM); Platbos, 1 (TM); Potgietersrus, 9 (SI); Pretoria, 1 (TM); Pretoria Zoo's Farm, 6 (TM); Renosterpoort Priv. Nat. Res., 1 (TM); Rhodes drift, 2 (TM); Rissik Priv. Nat. Res., 2 (TM); Rooiberg, 4 (SI); Rykvoorby, 2 (TM); Settlers malaria camp, 1 (TM); Skukuza, 4 (NKW); Spitzkop, 1 (TM); TenBosch Estates, 1 (TM); Toulon Gate, 1 (TM); Townlands, 3 (TM); Tshipise, 1 (SI); Tzaneen, 3 (SI); Tzaneen Estates, 1 (TM); Uitkomst, 3 (TM); Uitkyk and Paranie Priv. Nat. Res., 23 (TM); Venterskroon, 1 (TM); Viljoensdrift, 9 (TM); Voortrekker Monument, 3 (TM); Welgedaan, 3 (TM); Zoo Hill, 1 (TM).

Additional records: Open circles in Kruger National Park, as indicated on the distribution map after Pienaar (1964).

Mus musculus Linnaeus, 1758 — House mouse
Huismuis

DISTRIBUTION:

Thus far recorded mainly from the more densely populated southern Transvaal. Pienaar (1964) records the species at Shangoni ranger's station in the northern Kruger National Park. This, together with the fact that traps were seldom set specifically for this species, suggests that the house mouse may well have a wider distribution than that indicated by the accompanying distribution map.

HABITAT:

Commensal with man, this exotic species is to be found in

houses/...

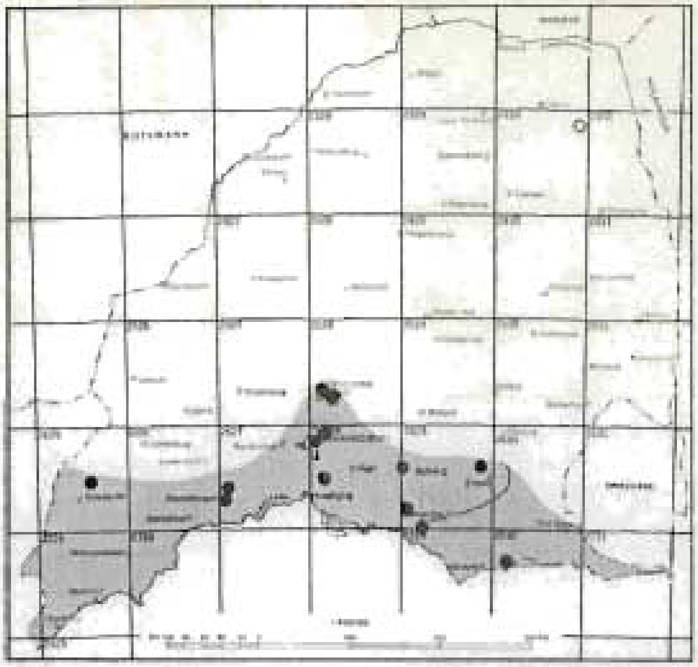

Fig.88: The distribution of *M. musculus* in the Transvaal.

houses, huts, storerooms, kraals, compost heaps and granaries. As yet never recorded in entirely wild environment.

HABITS:

Predominantly nocturnal. Solitary, occurring in pairs or sometimes small groups. Sheltered nests are constructed from whatever material is available. Normally difficult to trap where abundant food is stored.

FOOD:

Graminivorous, but as mentioned by Smithers (1971), a wide range of household foods will be taken.

BREEDING:

A lactating female was taken in January. No other records are available.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	158,8	13	133	194
T.	78,9	13	65	94
H.Ft	17,3	13	16	19
Ear	14,2	12	12	17
Mass	15,1	10	9	24

Females/...

Females

	$\bar{X}$	N	Min.	Max.
Tot.	164,7	7	146	178
T.	81,1	7	73	85
H.Ft	13,3	7	14	19
Ear	13,3	7	11	15
Mass	17,0	5	11	25

RECORDS OF OCCURRENCE:

Specimens examined, 33: Barberspan Prov. Nat. Res., 2 (TM); Ermelo, 3 (SI); Johannesburg, 1 (TM); Potchefstroom, 6 (TM, 5; SI, 1); Pretoria, 4 (TM); Rietfontein hospital, 1 (TM); Rolspruit, 3 (TM); Standerton, 6 (TM, 1; SI, 5); Suikerboschrand Prov. Nat. Res., 4 (TM); Wakkerstroom, 3 (TM).

Open circle in Kruger National Park on distribution map after Pienaar (1964).

Praomys Thomas, 1915

Praomys (Mastomys) natalensis (Smith, 1834) Multimammate mouse
Vaalveldmuis

TAXONOMIC NOTES:

The genus, and in particular this species, presents great taxonomic problems. Recent work in southern Africa indicates that what has hitherto been considered as a single species, *P. natalensis*, consists of phenetically similar, sometimes sympatric populations with diploid chromosome numbers of 32 and 36 respectively. Until such time as the specific status of these genetic variants can be evaluated no subspecies are recognized, and the species is treated conservatively.

DISTRIBUTION:

A very common rodent, distributed widely throughout the Transvaal.

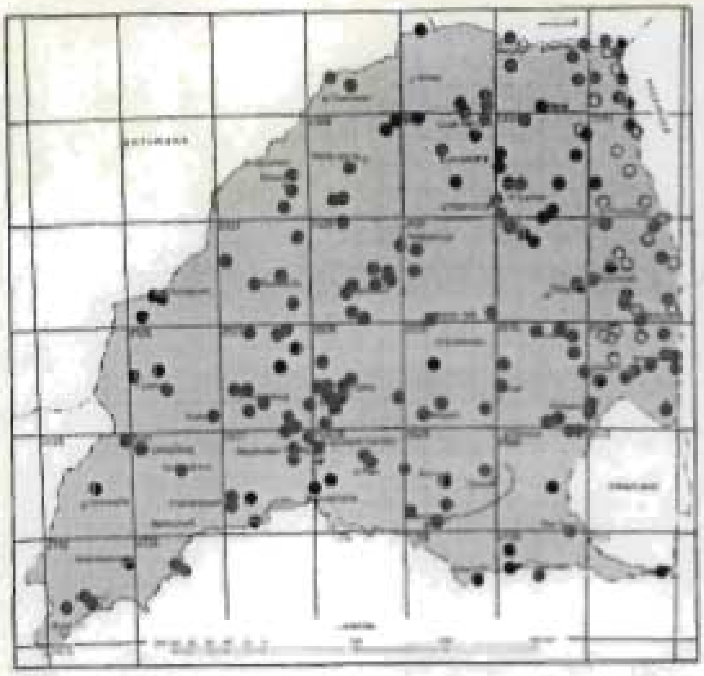

Fig.89: The distribution of *P. natalensis* in the Transvaal.

HABITAT:

Collected in most habitat types in the Transvaal. Occurs on fairly level ground where its main habitat requirement appears to be good cover, normally in the form of grass or low shrub. The presence or absence of trees plays no apparent role in habitat selection.

The multimammate mouse is very adaptable, and uses a great variety of refuges, viz. rock debris, fallen logs, termite mounds, or it may excavate its own burrow. *P. natalensis* is partly commensal with man, and could be a serious health threat as an intermediate host of several diseases, viz. plague. Th multimammate mouse is particularly common in strips of natural habitat along cultivated lands, where numbers can increase to pest proportions. Apart from that, sporadic population explosions occur, viz. in the Transvaal during 1969. According to Smithers (1971) it is partly dependent on water.

Because of its relatively high densities and wide distribution, it forms a very important link in the food chain, as prey for a large variety of mammalian and avian predators.

HABITS:

Terrestrial, mainly nocturnal and partly crepuscular. Solitary, pairs or family groups. Meester (1960) studied postnatal development in this species, and among other interesting observations, found that the young of a previous litter assist in caring for the next litter.

The multimammate mouse is very aggressive, especially at high population densities when a high frequency of agonistic behaviour is recorded. The species is cannibalistic, and often devours carcasses not immediately removed from traps.

FOOD:

Graminivorous, sometimes herbivorous, omnivorous or even cannibalistic.

BREEDING:

Monthly incidence of non-pregnant, lactating and pregnant females.

	J	F	M	A	M	J	J	A	S	O	N	D
Total	20	29	23	23	14	3	33	-	11	12	38	22
Non-pregnant	13	9	3	11	11	3	33	-	11	9	32	20
Lactating	3	5	10	8	1	0	0	-	0	1	2	0
Pregnant	4	15	10	4	2	0	0	-	0	2	4	2

Average number of foetuses per female is: $\bar{X}$=11,63; N=41; Min. = 5; Max. = 17.

These results support the findings of Coetzee (1965 and 1967) and Smithers (1971), that the species is a seasonal breeder. Coetzee (1967) points out that it is mainly the juveniles born at the end of summer that survive the winter to commence breeding at the beginning of the next summer.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	202	721	150	254
T.	96,2	700	75	131
H.Ft	21,6	741	16	25
Ear	16,2	691	14	22
Mass	41,3	513	21	82

Females/...

Females

	$\bar{X}$	N	Min.	Max.
Tot.	198	648	150	245
T.	93,5	646	73	125
H.Ft	21,3	657	18	26
Ear	17,8	651	13	22
Mass	38,5	500	21	22

RECORDS OF OCCURRENCE:

Specimens examined, 1 476: Acornhoek, 7 (TM); Acre Farm 2, 1 (TM); Al-te-Vêr, 62 (TM); Arnhemburg, 9 (TM); Barberspan Prov. Nat. Res., 8 (TM); Barberton, 44 (TM, 2; SI, 42); Belfast, 6 (SI); Birthday Mine, 1 (TM); Blinkwater, 1 (TM); Blijdschap Priv. Nat. Res., 3 (TM); Bloemhof, 3 (TM); Blokspruit, 2 (TM); Bochem, 4 (SI); Bosbokrand, 13 (SI); Bright Bridge, 1 (TM); Brakvlakte, 2 (TM); Brandhoek, 3 (TM); Brooklyn, 1 (TM); Buffelspoort, 14 (TM); Carolina, 3 (SI); Ceylon, 1 (TM); Corona, 1 (TM); Crocodile Bridge camp, 3 (TM); Cyprus, 2 (TM); Danielsrus, 2 (TM); De Hoop Priv. Nat. Res., 10 (TM); Derdepoort Radio Station, 6 (TM); Derry, 1 (TM); 12 km W. Devon, 1 (TM); Doornhoek, 6 (TM); Donkerpoort and Zandspruit, 4 (TM); Dordrecht, 4 (TM); Droogedal, 1 (TM); Ellisras, 17 (SI); Ermelo, 15 (SI); Ferndale, 6 (TM); Filmans Farm, 1 (TM); Fontainebleau, 1 (TM); Fountains valley, 4 (TM); Fort Klipdam, 7 (TM); Geluk, 6 (TM); Goedehoop, 14 (TM); Gravelotte, 5 (TM); Groothoek, 8 (TM); Grootsuikerboschkop and Elandslaagte, 7 (TM); Haenertsburg, 26 (SI Halfway House, 1 (TM); Hans Merensky Prov. Nat. Res., 9 (TM); Hectorspruit, 2 (TM); Heuningklip, 3 (TM); Honeydew, 2 (TM); Houghton Estates, 3 (TM); Huwi, 3 (TM); Iscor works, 9 (TM); Isis Estates, 3 (TM); Jericho, 1 (TM); Johannesburg, 1 (TM); Jones' Hut, 1 (TM); Joshua Moolman Priv. Nat. Res., 19 (TM); Kalkfontein, 1 (TM); Klaserie, 1 (TM); Klipfontein, 2 (TM); Koedoespoort, 1 (TM); Komatipoort, 7 (TM); Koperfontein, 1 (TM); Koster, 2 (TM); Kromdraai, 6 (TM); Langfontein, 13 (TM); Leeuwspoor, 1 (TM); Letaba rest camp, 1 (TM); Letaba Ranch, 4 (TM); on Levuvhu river, 10 (TM); Leydsdorp, 1 (TM); Lichtenburg, 11 (SI); Loskopdam Prov. Nat. Res., 10 (TM); Louis Trichardt, 1 (TM); Lower Sabie, 3 (TM); Lukasrand, 1 (TM);

Lydenburg/...

Lydenburg Prov. Fisheries Inst., 8 (TM); Lynnwood, 1 (TM); Machai pan, 1 (NKW); 10 km E. Madimbo, 3 (TM); Malelane, 40 (TM, 7; SI, 31; NKW, 2); Malta Farm, 5 (TM); Mamarango, 1 (TM); Marble Hall, 1 (TM); Mariepskop, 31 (TM, 27; SI, 4); Mmabolela Estates, 7 (TM); Montrose Estates, 1 (TM); Mooigenoeg, 7 (TM); Mooiplaas, 13 (TM); Moorddrif, 4 (TM); Mosdene, 10 (TM); Motlateng, 4 (TM); Mutale river, 7 (TM); Naboomspruit, 3 (TM); Narina, 8 (TM); Nelspruit, 23 (SI); 11 km N. Newington, 12 (TM, 5; SI, 7); Nylstroom, 53 (TM, 7; SI, 46); Nylsvlei, 2 (TM); Nwambia Pan, 4 (TM, 2; SI, 2); Olifantshoek, 1 (TM); Olifantspoort, 13 (TM); Olifants river, 3 (TM); Olifants river rest camp, 2 (TM); Othawa, 24 (TM); Pafuri rest camp, 3 (TM, 2; NKW, 1); Panfontein, 12 (TM); Paranie Priv. Nat. Res., 9 (TM); Pienaars river dam, 1 (TM); Piet Retief, 4 (TM, 2; SI, 2); Platbos, 5 (TM); Potchefstroom, 15 (TM, 11; SI, 4); Potgietersrus, 12 (SI); Potters hill 4085, 1 (TM); Pretoria, 44 (TM, 17; SI, 27); Pretoria Zoo's Farm, 3 (TM); Punda Milia, 5 (NKW); Ratsegaai, 7 (TM); Renosterpoort Priv. Nat. Res., 2 (TM); Rhoda, 2 (TM); Rhodes drift, 1 (TM); Rietfontein, 1 (TM); Rietondale, 1 (TM); Rissik Priv. Nat. Res., 17 (TM); Rolspruit, 29 (TM); Roodekuil, 5 (TM); Roodeplaat dam, 2 (TM); Roodepoort, 3 (TM); Roodepoort 383, 33 (TM); Rooiberg, 2 (SI); Rosslyn, 2 (TM); Rustenburg, 3 (SI); Rykvoorby, 2 (TM); Sandhurst, 1 (TM); Sandringham, 5 (TM); Satara rest camp, 2 (TM); Schurweberg, 3 (TM); Sekororo, 5 (TM); 5 km E. Settlers, 6 (TM); Shangoni, 3 (TM); Sheila, 1 (TM); Shingomene, 5 (TM, 3; SI, 2); Shingwidzi rest camp, 6 (TM); Sibasa, 2 (TM); Skukuza, 18 (TM, 17; SI, 1); Sonop, 1 (TM); Soutpansberg, 5 (TM); Spitskop, 4 (TM); Standerton, 57 (TM, 2; SI, 55); Sterkfontein, 1 (TM); Sterkspruit, 1 (TM); Suikerboschrand Prov. Nat. Res., 22 (TM); Sunnyside, 3 (TM); Suurbekom, 3 (TM); Swartkrans, 2 (TM); Tambotieskloof, 3 (TM); TenBosch Estates, 10 (TM); Thabazimbi, 18 (SI); The Downs, 7 (TM); Townlands, 3 (TM); Tshakuma malaria camp, 1 (TM); Tshipise, 10 (SI); Tshokwane, 2 (TM); Tzaneen, 80 (SI); Uitkomst, 5 (TM); Urk, 5 (TM); van Riebeeck Mun. Nat. Res., 1 (TM); Vereeniging, 37 (SI); Wakkerstroom, 6 (TM); Waterkloof, 1 (TM);

Welgedaan, 13 (TM); Welgelegen, 1 (TM); Welgevonden, 3 (TM); Windhoek, 4 (TM); Witpoort, 4 (TM); Witbank, 4 (SI); Witrivier, 59 (SI); Wolmaranstad, 1 (SI); Wonderfontein, 1 (TM); Worcester Mine, 6 (TM); Zandspruit, 11 (TM); Zeerust, 6 (SI); Zoutpan, 9 (TM).

Rattus Fischer, 1803

Rattus rattus (Linnaeus, 1758) House rat

Huisrot

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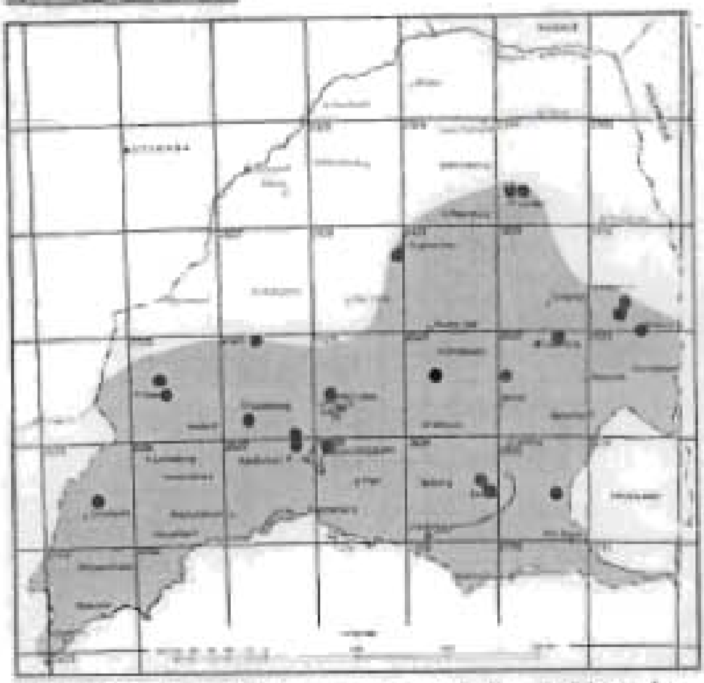

Fig.90: The distribution of *R. rattus* in the Transvaal.

An exotic species distributed over large areas of the Transvaal, where it has been introduced following human settlement. It is possibly absent from the more remote and sparsely populated areas of the northern Transvaal, but no serious attempt has even been made to study the distribution of this species and it may therefore have been overlooked. Smithers (1971) relates the range extensions of the house rat with railway links.

HABITAT:

Entirely commensal with man, and is never found far from human dwellings, storehouses, stables, compost heaps etc. It is otherwise quite adaptable, and improvises sheltered nests with any available material, occasionally even digging short

burrows/...

burrows. According to Misonne (1974) it is dependent on water, although at many localities in the Transvaal readily available sources were not obvious.

HABITS:

A very agile, nocturnal creature. Often found on ceilings, from which they venture by scaling rough walls, pipes, or rafters. Judging from the noises made on ceilings of infested houses, the house rat is quite playful, and active the entire night.

It is a social or semi-social species, with groups nesting together. Young are reared in lined nests. The Transvaal Museum has a formalin preserved example of the so-called "Rat Kings":- the tails of a litter becoming inextricably entangled, thus keeping each member stationary. These animals are then fed and cared for by others.

A certain amount of intelligence has to be ascribed to the house rat. It persisted in spite of a host of eradication approaches, some more ingenious than practical. As soon as one or a few individuals are killed with whatever device, others soon learn the danger and avoid it.

R. rattus is very destructive, devouring a wide range of materials, damaging others for nesting purposes and fouling the rest with excreta. Instances were recorded where holes were gnawed through wood to gain access. It is also a health threat, carrying fleas capable of spreading bubonic plague (Davis, 1948).

FOOD:

It is entirely omnivorous and has been noted to feed on dry hides, stored grain, fresh vegetables, dried products, lard and fresh meat. Bacon was found to be an effective bait, as the species ignores other baits with the abundance of food normally available.

BREEDING:

A single pregnancy recorded during March, implantation 0L 5R=5. Two lactating females were collected during March, one in November. However, because of its sheltered existence, and food supply independent of the environment, it could be expected to breed throughout the year.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	348	16	290	410
T.	190	16	162	237
H.Ft	33,6	16	28	38
Ear	22,2	16	18	27
Mass	111	13	76	175

Females

	$\bar{X}$	N	Min.	Max.
Tot.	374	19	322	438
T.	200	19	152	242
H.Ft	34,8	19	30	39
Ear	23,0	19	20	26
Mass	135	16	80	188

RECORDS OF OCCURRENCE:

Specimens examined, 41: Barberspan, 1 (TM); Bon Accord dam, 4 (TM); Bryanston, 1 (TM); Ceylon, 1 (TM); Ermelo, 3 (TM, 1; SI, 2); Ferndale, 2 (TM); Grootsuikerboschkop and Elandslaagte, 1 (TM); Heuningklip, 1 (TM); Ireach, 1 (TM); Johannesburg, 4 (TM); Joshua Moolman Priv. Nat. Res., 1 (TM); Kromdraai, 1 (TM); Loskopdam Prov. Nat. Res., 1 (TM); 11 km N. Newington, 1 (TM); Olifantspoort, 2 (TM); Othawa, 3 (TM); Potgietersrus, 1 (SI); Skukuza, 5 (NKW); Sweet Homes, 2 (TM); Tzaneen, 1 (SI); Uitduiker, 1 (TM); Zeerust, 3 (SI).

Rhabdomys Thomas, 1916

Rhabdomys pumilio (Sparrmann, 1784) Striped mouse

Streepmuis

TAXONOMIC NOTES:

Roberts (1951) recognizes no less than 20 subspecies in southern Africa, of which three were described from the Transvaal, i.e. *dilectus* de Winton, 1897, from the north-east; *moshesh* Wroughton, 1905, from the southern and central regions; and *vaalensis* Roberts, 1946, from Bloemhof. Recent authorities viz. Meester *et. al.* (1964) and Coetzee (*pers. comm.*), question the validity of all the described forms. They are of the opinion that only an eastern and a western subspecies, related to different rainfall regions, may be recognized. Smithers (1971) finds this acceptable, and ascribes Botswana material to *R. p. bechuanae* (Thomas, 1892). However, until the species has been entirely revised, no subspecies are recorded here.

DISTRIBUTION:

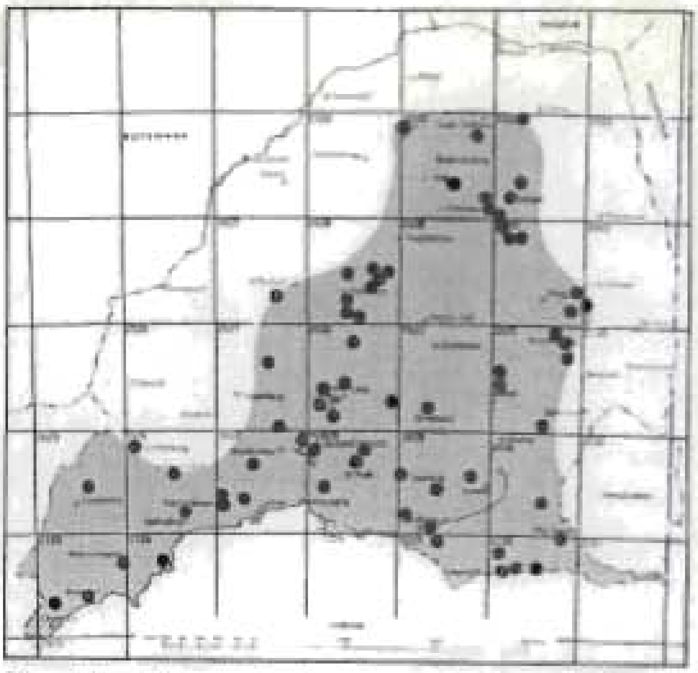

Fig.91: The distribution of *R. pumilio* in the Transvaal.

In the Transvaal the distribution of *R. pumilio* correlates very well with altitudes of 1 200 metres (4 000 Ft) and higher. This is however not the case elsewhere in the Republic, where the species occurs all the way down to sea level. Should this apparent restriction to higher altitudes prove to be consistent in the Transvaal, the populations from the Zoutpansberg, Pietersburg plateau, Waterberg plateau, and the highveld grasslands are all geographically isolated from each other. This phenomenon could be of taxonomic importance in an analysis of geographic variation.

More/...

More important, its distribution can also be associated with *Hyparrhenia* and *Themeda* grass cover, whereas it avoids *Eragrostis*, not only in northern and north-eastern Transvaal, but also in southern Rhodesia and northern and eastern Botswana.

HABITAT:

In the Transvaal it is typically associated with dense grassland. The striped mouse exhibits a marked preference for shorter but denser grass cover, even in the Subtropical Bush and Savannah zone of northern Transvaal. At the farm Cyprus, it was recorded exclusively from grassy hill-slopes above the treeline. Elsewhere in wooded regions of the Transvaal it can be found in grass and shrub associations, occasionally with scattered trees. It is primarily an inhabitant of plains.

HABITS:

The striped mouse is diurnal with activity peaks in the early mornings and late afternoons, but with a low frequency of activity recorded at night. It constructs characteristic meandering runways, which are also utilized by other small mammals such as *Myosorex varius*. Burrows are constructed at the bases of grass tufts or low bushes. Stiemie and Nel (1973) demonstrate that in captivity both sexes indulge in the construction of well-designed nests.

R. pumilio is occasionally recorded as being commensal with man. However, in my experience this occurs especially at the end of summer with the highest population levels and increasing environmental stress in the natural habitat.

FOOD:

Graminivorous.

BREEDING:

Monthly frequencies of non-pregnant, lactating and pregnant females:

Total/...

	J	F	M	A	M	J	J	A	S	O	N	D
Total	24	23	14	5	9	-	12	11	4	1	21	13
Non-pregnant	12	4	3	1	9	-	11	11	4	1	17	6
Lactating	1	3	6	1	0	-	0	0	0	0	1	1
Pregnant	11	16	5	3	0	-	1	0	0	0	3	6

Although the sample is unrepresentative, the above data suggest seasonal breeding. However, Smithers (1971) presents indications that the species breeds throughout the year in Botswana.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	190,9	357	128	265
T.	86,6	412	67	122
H.Ft	21,4	425	18	25
Ear	13,5	375	13	25
Mass	36,8	298	22	58

Females

	$\bar{X}$	N	Min.	Max.
Tot.	191	285	140	233
T.	86,7	311	60	115
H.Ft	21,2	336	17	24
Ear	12,9	325	9	21
Mass	35,7	250	23	64

RECORDS OF OCCURRENCE:

Specimens examined, 877: Acre Farm 2, 2 (TM); Barberspan Prov. Nat. Res., 18 (TM); Barotta, 2 (TM); Beestekraal, 2 (TM); Belfast, 2 (SI); Benoni, 1 (TM); Blijdschap Priv. Nat. Res, 1 (TM); Bloemendal, 1 (TM); Bloemhof, 12 (TM);Blouberg, 9 (TM); Blyde Forest Res., 21 (TM); Brandhoek, 8 (TM); Carolina, 2 (SI); Ceylon, 1 (TM); Cyprus, 5 (TM); Danielsrust, 1 (TM); Derdepoort Radio Station, 19 (TM); Driefontein, 4 (TM); Ermelo, 8 (SI); Fort Klipdam, 11 (TM); Fountainebleau, 2 (TM); Fountains valley, 1 (TM); George's Valley, 1 (TM); Geyers Farm, 8 (TM); Goedehoop, 27 (TM); Golden Harvest, 1 (TM); Grootsuikerboschkop and Elandslaagte, 12 (TM); Haenertsburg, 82 (TM); Iscor Works, 9 (TM); Isis Estates, 1 (TM); Johannesburg, 5 (TM); Joshua Moolman Priv. Nat. Res., 24 (TM); Klerksdorp, 1 (TM); Krugersdorp, 2 (TM); Langfontein, 19 (TM); Malta, 1 (TM); Maria van Riebeeck Nat. Res., 4 (TM); Mariepskop, 17 (TM, 10; SI, 7); Maquassie, 3 (SI); Mosdene Priv. Nat. Res., 9 (TM); Naboomspruit, 4 (TM); New Agatha Forest Res., 11 (TM); Nylstroom, 1 (TM); Nylsvley, 1 (TM); Onderstepoort, 14 (TM); Panfontein, 6 (TM); Piet Retief, 34 (SI); Platrand Station, 1 (TM); Potchefstroom, 75 (TM, 74; SI, 1); Pretoria, 58 (TM, 47; SI, 11); Pretoria Zoo's Farm, 5 (TM); Ramanas, 1 (TM); Ratsegaai, 5 (TM); Renosterpoort Priv. Nat. Res., 1 (TM); Rietvleidam, 99 (TM, 97; SI, 2); Rissik Priv. Nat. Res., 1 (TM); Rolspruit, 27 (TM); Roodepoort 383, 23 (TM); Rust de Winter, 2 (TM); 5 km NE Settlers, 7 (TM); Spitskop, 21 (TM); Standerton, 11 (SI); Sterkfontein, 1 (TM); Strydpan, 1 (TM); Suikerboschrand Prov. Nat. Res., 16 (TM); Swartkrans, 2 (TM); Sweet Homes, 2 (TM); The Downs, 3 (TM); Tweefontein Coal Mine, 5 (TM); Tzaneen, 35 (SI); Tzaneen Estates, 6 (TM); Valhalla, 3 (TM); Vlakpan, 1 (TM); Wakkerstroom, 9 (TM, 8; SI, 1); 3 km E. Wakkerstroom, 1 (TM); Waterberg, 1 (TM); Waterkloof Air Force Base, 1 (TM); Welgedaan, 6 (TM); Winterkraal, 8 (TM); Witbank, 2 (SI); Witpoort, 4 (TM); Witrivier, 3 (SI).

Thallomys Thomas, 1920

Thallomys paedulcus (Sundevall, 1846) Tree rat
Boomrot

TAXONOMIC NOTES:

Ellerman *et al.* (1953) regard *Thallomys* as a synonym of the subgenus *Aethomys*, but as pointed out by Meester *et al.* (1964) this view is not generally accepted. Roberts (1951) recognizes; *nigricauda* Thomas, 1882, *shortridgei* Thomas and Hinton, 1923, *damarensis* (de Winton, 1897), and *moggi* Roberts, 1913 as full

species/...

species. Recent authors (Misonne, 1974) regard the genus as monotypic.

Too many subspecies recognized by external features exclusively, are currently recognized. However, a revision of the species will almost certainly reveal subspeciation at a modest level, as shown by geographic variation throughout the entire range. Subspeciation will most probably be found to be correlated with the western more arid regions (lighter coloured *nigricauda*), and with the more temperate eastern regions (darker coloured *paedulcus*).

Roberts (1951) and Ellerman *et al.* (1953) recognize the forms *moggi* Roberts, 1913, and *acaciae* Roberts, 1915, from the Transvaal. Apart from a series of darker coloured immature specimens bred in captivity from stock originated from Zebediela Estates, not enough geographic variation in external features could be detected to justify the recognition of two subspecies in the Transvaal. Transvaal specimens are not ascribed to any subspecies here.

DISTRIBUTION:

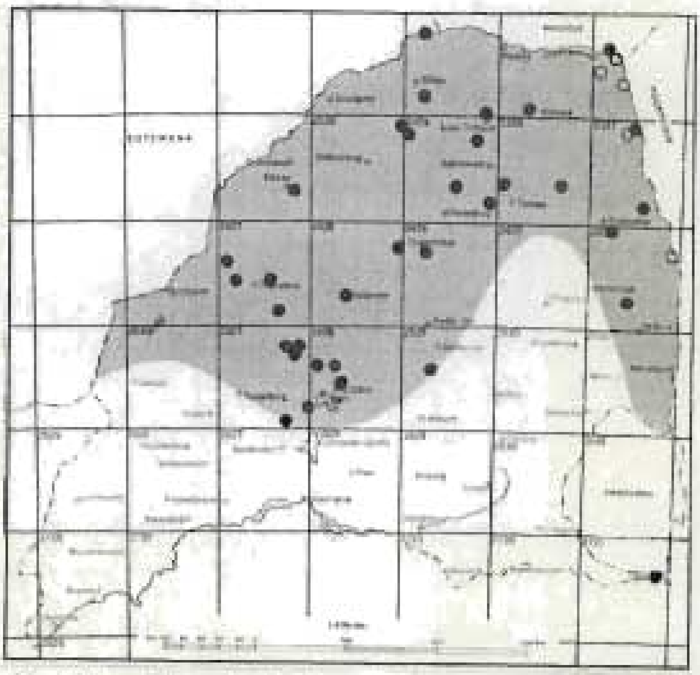

Fig.92: The distribution of *T. paedulcus* in the Transvaal.

It occurs throughout the northern regions of the Province. In the Transvaal the range of *T. paedulcus* correlates very well with woodland veld types, all grouped under the subheading Tropical Bush and Savannah Types by Acocks (1975). Habitat requirements as defined below act as a limiting factor on distribution.

HABITAT/...

HABITAT:

It has so far been recorded only in association with *Acacia* trees.

HABITS:

It is almost entirely arboreal, only rarely venturing to the ground in search of food. In the Kalahari Gemsbok National Park a few specimens were collected from conspicuous stick nests constructed in the outer branches of *Acacia* trees, as described by Shortridge (1934). It is, however, unproven that *Thallomys* is responsible for the construction of these nests. The majority of records from the Kalahari, and all records from the Transvaal, are of animals occupying hollows and cracks in tree trunks or even living under loose bark, where grass nests have been constructed. Judging by the nesting space available, two or more individuals may occupy a nest. Large accumulations of faeces inside and at the bases of nests typify this species and suggest that such nests are in permanent use.

Nocturnal, leaving the nest at dusk. Small groups of these agile rodents are occasionally observed playing and running along thicker branches to reach the canopy where they feed. The tree rat is apparently a social or semi-social species.

Smithers (1971) found Shortridge's (1934) observation that individuals can be easily smoked out of their nests not to hold true in Botswana. I have employed this technique quite successfully in the Kalahari, but the opportunity never arose in the Transvaal.

FOOD:

Vegetarian, feeding mostly on leaves of *Acacia* species. Smithers (1971) observed animals feeding on leaves, pods and green twigs of *Acacia* trees. He also observed feeding on *Boschia albitrunca* and *Ziziphus mucronata* leaves.

BREEDING:

A pregnant female was recorded in February, another in

October/...

October. Smithers (1971) noted pregnancies during February, March, April and October. This suggests a summer breeding season.

MEASUREMENTS AND MASS:

Males

	$\bar{x}$	N	Min.	Max.
Tot.	276	35	239	327
T.	142	35	123	184
H.Ft	23,8	35	20	28
Ear	20,7	35	16	24
Mass	75,7	16	32	116

Females

	$\bar{x}$	N	Min.	Max.
Tot.	270	38	238	315
T.	141	38	120	174
H.Ft	23,0	38	20	28
Ear	20,5	38	18	23
Mass	67,7	17	44	102

RECORDS OF OCCURRENCE:

Specimens examined, 97: Blijdschap Priv. Nat. Res., 4 (TM); Blouberg, 2 (TM); Brights Bridge, 1 (TM); Donkerpoort and Zandspruit, 1 (TM); Fairfield, 4 (TM); Fort Klipdam, 1 (TM); Hammanskraal, 2 (TM); Hans Merensky Prov. Nat. Res., 1 (TM); Huwi, 1 (TM); Jericho, 1 (TM); Langjan Prov. Nat. Res., 2 (TM); Leeuwspoor, 1 (TM); Letaba rest camp, 3 (TM); Loskopdam Prov. Nat. Res., 3 (TM); Mokeetsi, 2 (TM); Moorddrift, 5 (TM); Motlateng, 1 (TM); Njelelle river, 1 (TM); Nylstroom, 1 (TM); Nwambia Pan, 2 (NKW); Olifants river, 1 (TM); Othawa, 1 (TM); Punchbowl, 1 (TM); Rhodes drift, 2 (TM); Roodeplaat, 7 (TM); Roodekuil, 1 (TM); Rooikrans, 1 (TM); Schurweberg, 4 (TM); Shingwidzi, 2 (TM, 1; NKW, 1); Swarthoek, 2 (TM); Tshalungwa fontein, 1 (NKW); Uitkomst, 2 (TM); Wilgekuil, 1 (TM); Wilhanshohe, 1 (TM); Woodbush, 4 (TM); Zebediela, 24 (TM); Zoutpan, 3 (TM).

Additional records: Record from 2231 AC based on material housed in Rhodesian Museums (Smithers, *in litt.*). Open circles in the Kruger National Park indicated on the distribution map, after Pienaar (1964).

Thamnomys Thomas, 1907
Subgenus *Grammomys* Thomas, 1915

1. Ears with subauricular tuft of white hairs, although not always present; fur colour greyer ... *cometes*
No such tuft of white hairs; fur colour less grey ... ... *dolichurus*

Thamnomys (Grammomys) cometes Thomas and Wroughton, 1908
Forest mouse
Kusmuis

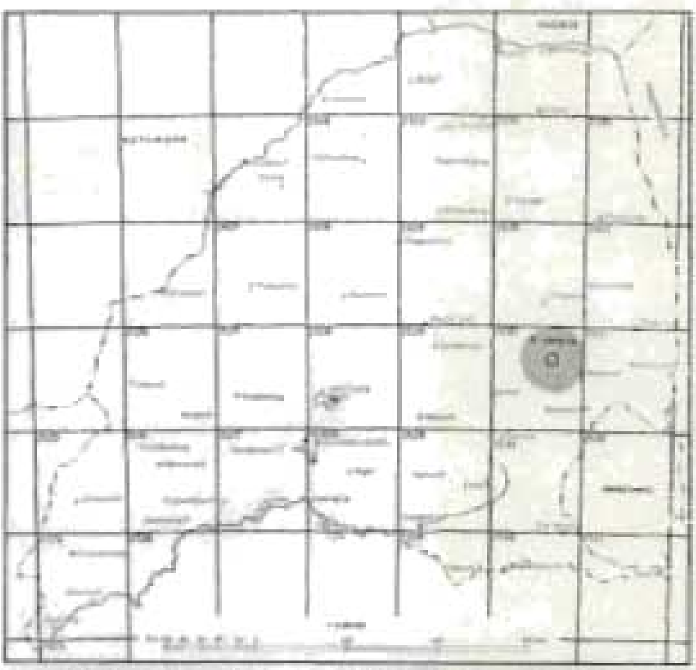

Fig.93: The distribution of *T. cometes* in the Transvaal.

The record indicated on the distribution map is from Houtboschloop, and is mentioned by Davis (1974). It is based on two specimens collected during 1966 by the Oxford University Expedition, and was verbally reported to Davis by Coleman. The specimens were not examined by Davis, and no further records of this species exist for the Transvaal. Locality records are so scattered throughout the total range

that/...

that it is impractical to speculate whether this particular record represents a relict population, or is based on a misidentification.

Davis (*op.cit.*) believes that the forest mouse has a preference for denser forests. Smithers and Tello (1976), on the other hand, consider forest fringes and thickets as the more typical habitat, which would imply an overlap in habitat with the next species.

Thamnomys Thomas, 1907

Thamnomys (Grammomys) dolichurus (Smuts, 1832) Thicket rat
Bosmuis

TAXONOMIC NOTES:

A lighter and a darker colour phase occur in the Transvaal, but no subspecies are recognized here pending a revision of the confused taxonomic status of the genus. The majority of specimens from the Transvaal fit the description of *T. d. baliolus* Osgood, 1910. However, a specimen was collected on the Limpopo river, ten kilometres east of Madimbo, that fits the descriptions of the lighter coloured *surdaster* Thomas and Wroughton, 1908, from Tanzania, and *tongensis* Roberts, 1931 from Zululand. This suggests that the limited material available does not demonstrate the full scope of variation within the species, and that the recognition of subspecies is premature.

DISTRIBUTION:

Scattered records from the northeastern Transvaal only. The species is believed to be scarce in the Province, and may therefore have been overlooked elsewhere in the eastern regions. According to Misonne (1974) it is common in tropical Africa.

HABITAT:

In the Transvaal it is recorded from montane and riverine forests. According to Misonne (1974) it lives in thickets and

bushes/...

Fig.84: The distribution of *T. dolichurus* in the Transvaal.

bushes along forest margins.

HABITS:

The thicket rat is nocturnal, and partly arboreal. According to Roberts (1951) large nests of grass and leaves are constructed in tangled bush, or in hollows or even in forks in trees. These nests are occupied by family groups.

FOOD:

Vegetarian.

BREEDING:

A pregnant female with three foetuses (2L:1R; cr=18) was collected during September.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	279	2	275	283
T.	163	2	160	166
H.Ft	23,5	2	23	24
Ear	17,5	2	17	18
Mass	-	-	-	-

Females

	$\bar{X}$	N	Min.	Max.
Tot.	274	7	235	290
T.	164	7	140	180
H.Ft	23,1	7	22	24
Ear	17,4	7	16	19
Mass	43,7	3	36	54

RECORDS/...

RECORDS OF OCCURRENCE:

Specimens examined, 7: 10 km E. Madimbo, 1 (TM); Pafuri, 1 (NKW); Tzaneen, 5 (SI).

Subfamilies Cricetomyinae and Dendromurinae

1. Size large, head and body length over 300 mm ...	*Cricetomys*
Size medium or small, head and body length under 200 mm	2
2. Upper incisors plain; tail length under 60% of head and body length	*Saccostomys*
Upper incisors grooved	3
3. Tail length over 90% of head and body length ...	*Dendromus*
Tail length under 60% of head and body length... ...	4
4. Pterygoid fossae far behind toothrows...	*Malacothrix*
Pterygoid fossae not behind toothrows...	*Steatomys*

Cricetomys Waterhouse, 1840

Cricetomys gambianus Waterhouse, 1840 Giant rat
Reuserot

TAXONOMIC NOTES:

Roberts (1951) and Ellerman *et al.* (1953) recognize four subspecies in southern Africa, and ascribe material from the Transvaal to the form *haagneri* Roberts, 1926. Meester *et al.* (1964), followed by Smithers (1976), consider these four southern African forms probable synonyms of *viator* Thomas, 1904. Ewer (1967) is followed here in not recognizing any subspecies, since local and geographic variation of this widely distributed species have not been studied in sufficient detail to clarify the status of the various described forms.

DISTRIBUTION/..

DISTRIBUTION:

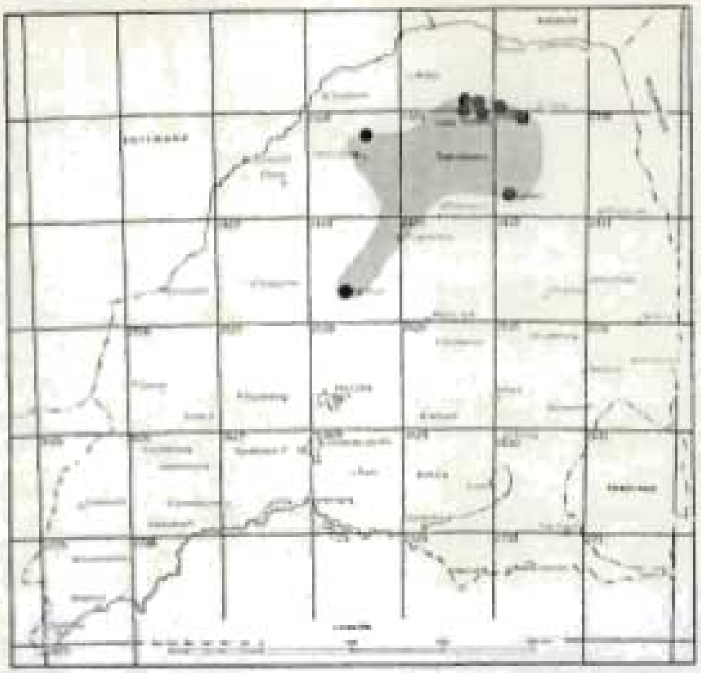

Fig.95: The distribution of *C. gambianus* in the Transvaal.

This species ranges over most of tropical and subtropical Africa, from West Africa to Kenya and from the Sudan to the northern Transvaal and Zululand in the south. The giant rat is known in the Transvaal from a few localities in the vicinity of the Zoutpansberg, and from a single specimen collected in 1919 at Nylstroom. The species is considered to be common elsewhere in Africa (Ewer, 1967; Misonne, 1974), and its scarcity in the Transvaal is ascribed to its peripheral occurrence here.

HABITAT:

In the Transvaal it is recorded from woodland savanna only. Whereas Roberts (1951) claims the species to be restricted to forested regions, Ewer (*op.cit.*) reviews the available evidence and supports Sanderson's (1940) view that the habitat requirements may range from deep forests to the vicinity of human habitation, as long as the need for a reasonable amount of cover is satisfied.

HABITS:

Very little is known of *C. gambianus* in the wild, other than that it is a docile, solitary, nocturnal, burrowing species, predominantly graminivorous (see Roberts, 1951). Morris (1963) studied the tunnel systems of the giant rat, and found them to be extensive. The entrance is often plugged with earth

from/...

from within in order to render it less conspicuous. Several escape tunnels end just under the surface. A nest chamber is lined with vegetable matter, while a separate toilet chamber is utilized for defecation.

Ewer (1967) studied the behaviour of *C. gambianus* extensively in captivity, and only a few aspects of her work can be mentioned here. The species is solitary, with males and females occupying separate burrow systems. Micturition was observed, and the sexes maintain contact through olfactory, and to a lesser extent vocal communication. Agonistic behaviour was also studied. The species is nocturnal, and ventures outside the refuges for short periods of not longer than five hours. It hoards food in the nest by collecting smaller food items in the cheek pouches, and carrying bigger items in the teeth. Ewer (*op.cit.*) also studied toilet and comfort movements. Coprophagy was regularly observed. The young have a relatively long period of development, and maternal care is extensive.

FOOD:

Graminivorous (Roberts, 1951); omnivorous in captivity (Ewer, *op.cit.*).

BREEDING:

No pregnant or lactating females were recorded from the Transvaal. Ewer (1967) studied the reproductive behaviour and postnatal development of *C. gambianus*, but does not comment on the possibility of seasonality in breeding. She found the gestation period to be 27-28 days. Litter size varies between one and four.

MEASUREMENTS AND MASS:

Males

	$\bar{x}$	N	Min.	Max.
Tot.	771	7	740	815
T.	421	7	390	451
H.Ft	71	7	67	75
Ear	40,9	7	39	45
Mass	991	1	-	-

Females

	$\bar{X}$	N	Min.	Max.
Tot.	736	10	690	780
T.	399	10	365	445
H.Ft	69,3	10	66	72
Ear	41,2	10	38	48
Mass	1292	1	-	-

RECORDS OF OCCURRENCE:

Specimens examined, 24: Louis Trichard, 7 (TM); Nylstroom, 1 (TM); Tshakuma malaria camp, 1 (TM); Tzaneen Estates, 1 (TM); Vreemdeling, 2 (TM); Zoutpansberg, 12 (TM).

Additional records: Reported from Nicorel, Parkfield and Delamere, Rochdale.

Saccostomus Peters, 1846

Saccostomus campestris Peters, 1846 Pouched mouse
Wangsakmuis

TAXONOMIC NOTES:

Roberts (1951) recognizes two subspecies from the Transvaal, *streeteri* Roberts, 1914 and *limpopoensis* Roberts, 1914. Meester *et al.* (1964) regard all described forms of *S. campestris* as representing a colour cline, and thus recognize no subspecies, and neither does Misonne (1974). This view is followed here.

DISTRIBUTION:

The species is widely distributed in the Transvaal woodlands and throughout the rest of southern Africa. It is, however, absent from the Pure and False Grassveld Types of Acocks (1975) in the southern Transvaal and the O.F.S. highveld regions, as well as from most of the Karoo. The range thus correlates well with areas with some form of woodland.

HABITAT:/...

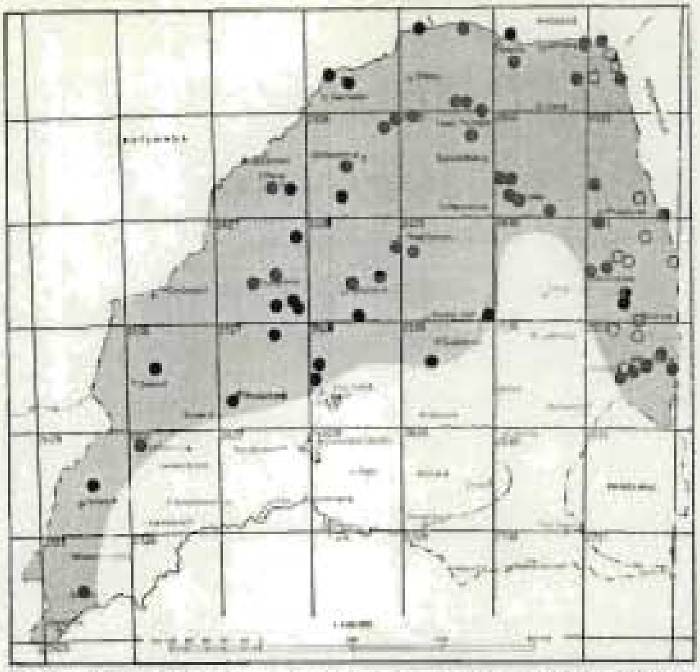

Fig.96: The distribution of *S. campestris* in the Transvaal.

HABITAT:

The apparent dependence on wooded vegetation, suggested above, can only be explained by considering the poorly documented food preferences of this animal. It is graminivorous, and although Smithers (1971) recorded grass seeds as a food item, available evidence suggests that the species is dependent on woody-plant seeds to the extent that trees are a habitat prerequisite. Otherwise it has a wide habitat tolerance, being recorded from a variety of substrates (see also Smithers, 1971). In the Transvaal, however, the pouched mouse is more often encountered in areas with sparse grass cover.

HABITS:

The pouched mouse is terrestrial. It constructs burrow systems, which are occupied by solitary individuals, pairs, or sometimes family groups. No preference for a particular substrate or location could be established, and according to Smithers (1971) holes or burrows of other animal species may occasionally be utilized instead.

The species is slow, rather docile and nocturnal. It wanders great distances from its nest, to collect seeds which are stuffed in the cheek pouches (Smithers, 1971). One specimen with particularly full pouches collected and stored no less than eight grams of seeds in this way. These food items are transported back to the nest, where they are presumably hoarded, as in the case of *Cricetomys gambianus*.

FOOD:/...

FOOD:

Graminivorous, collecting the fallen seeds of *Acacia* trees especially, but also of *Grewia*, *Combretum* and mopane trees. Smithers (1971) has also recorded collection of grass seeds, but this was never observed in the Transvaal. In captivity the pouched mouse is omnivorous, feeding even on small insects. Shortridge (1934) and Roberts (1951) observed termites and insects to be taken under natural conditions.

BREEDING:

Monthly distribution of non-pregnant, lactating and pregnant females is as follows.

	J	F	M	A	M	J	J	A	S	O	N	D
Total	12	2	18	12	4	-	4	2	3	5	2	-
Non-pregnant	5	0	15	10	4	-	4	2	3	3	2	-
Lactating	1	1	3	0	0	-	0	0	0	1	0	-
Pregnant	6	1	0	2	0	-	0	0	0	1	0	-

The above data, together with those presented by Smithers (1971), indicate that this species is a seasonal breeder, with parturition occurring from October to the end of April.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	165	93	130	236
T.	41,7	93	29	87
H.Ft	19,4	93	15	33
Ear	16,6	93	12	22
Mass	47,6	72	25	100

Females

	$\bar{X}$	N	Min.	Max.
Tot.	166	105	133	195
T.	41,1	105	26	58
H.Ft	17,1	104	13	26
Ear	15,4	103	9	26
Mass	50,1	92	15	75

RECORDS OF OCCURRENCE:

Specimens examined, 250; Al-te-Vêr, 2 (TM); Barberspan, 1 (TM); Blijdschap Priv. Nat. Res., 4 (TM); Bochem, 1 (SI); Bosbokrand, 1 (TM); Buffelspoort, 2 (TM); De Hoop Priv. Nat. Res., 1 (TM); Dongola reserve, 2 (TM); Dordrecht, 1 (TM); Ellisras, 1 (SI); Gravelotte mines, 3 (TM); Groothoek, 10 (TM); Hectorspruit, 10 (TM); Huwi, 1 (TM); Komatipoort, 5 (SI); Letaba Ranch, 3 (TM); Letaba Reserve, 5 (SI); on Levuvhu river, 8 (TM); Loskopdam Prov. Nat. Res., 1 (TM); 10 km E. Madimbo, 3 (TM); Malelane, 15 (NKW, 2; SI, 13); Mmabolela Estates, 3 (TM); Mokeetsi, 1 (TM); Montrose Estates, 1 (TM); Mooigenoeg, 11 (TM); Mosdene Priv. Nat. Res., 5 (TM); Mooiplaas, 4 (TM); Motlateng, 3 (TM); Newington, 1 (SI); Nylstroom, 1 (SI); Nwambia Pan, 2 (NKW); Othawa, 5 (TM); Panfontein, 1 (TM); Platbos, 7 (TM); Potgietersrus, 35 (SI); Pretoria Zoo's Farm, 2 (TM); 19 km NW Pretoria, 3 (TM); Rhoda, 1 (TM); Rhodes drift, 2 (TM); Rochdale, 6 (TM); Rooiberg, 1 (SI); Rooikrans, 1 (TM); Rustenburg, 2 (SI); Sandringham, 2 (TM); Settlers, 3 (TM); Springbok koppies, 1 (TM); Swarthoek, 1 (TM); Swellendam, 1 (TM); TenBosch Estates, 1 (TM); Thabazimbi, 4 (SI); Tshipise, 14 (SI); Tzaneen, 16 (SI); Tzaneen Estates, 3 (TM); Urk, 2 (TM); Welgevonden, 9 (TM); Zandspruit, 10 (TM); Zeerust, 1 (SI); Zoutpan, 4 (TM).

Additional records: Material housed in Rhodesian Museums from 2231 AC and 2230 AC (Smithers, *in litt.*). Open circles in the Kruger National Park indicated on the distribution map after Pienaar (1964).

Dendromus Smith, 1829

1. Fifth hind toe with nail	2
Fifth hind toe with claw	3
2. Larger, skull over 21 mm	*mysikae*
Smaller, skull under 21 mm	*melanotis*

3. Larger, skull over 22 mm ... ... *mesomelas*
Smaller, skull under 22 mm ... ... *mystacalis*

Dendromus nyikae Wroughton, 1909 — Climbing mouse, Klimmuis

D. n. longicaudatus Roberts, 1913

TAXONOMIC NOTES:

Roberts (1951) considers *longicaudatus* to be a valid species, whereas Ellerman *et al.* (1953) regard it as a synonym of *mesomelas*. Meester *et al.* (1964) and Misonne (1974) recognize *nyikae* from the Transvaal, with *longicaudatus* as a subspecies. I am following Meester *et al.* (1964) in recognizing *D. nyikae longicaudatus* in the Transvaal, until the genus is reviewed.

DISTRIBUTION:

Fig.97: The distribution of *D. nyikae* in the Transvaal.

The species is known from only single specimens from two localities in the Transvaal. The first is the type locality of *longicaudatus* (Tzaneen Estate), and the second is Hans Merensky Provincial Nature Reserce.

HABITAT:

The specimen from Hans Merensky Provincial Nature Reserve was collected in dense grass in mopane woodland. The conditions under which the type specimen was collected are not known.

HABITS:/...

HABITS:

As far as can be established, the same as those of the next species.

FOOD:

No information is available.

BREEDING:

No information is available.

MEASUREMENTS AND MASS:

Only one male specimen available.

TM 24595: 173-94-20-15=13 g.

RECORDS OF OCCURRENCE:

Specimen examined, 1: Hans Merensky Prov. Nat. Res., 1 (TM).

Additional records: Tzaneen Estates (Roberts, 1951).

Dendromus melanotis Smith, 1834 — Grass climbing mouse
Gras klimmuis

TAXONOMIC NOTES:

Following Meester *et al.* (1964), no subspecies are recognized here. The status of several of the nine forms listed by Roberts (1951) under *D. mesomelas* is unclear.

DISTRIBUTION:

A widely distributed species in southern Africa, although nowhere recorded in numbers. Further material is required to delineate accurately the range in the Transvaal. It would, however, appear to be absent from the extreme southwestern Transvaal,

as/...

as well as from the northwestern and northern regions. The species is not recorded from most of the Kruger National Park, with only one record reported by Pienaar (1964) from Pretoriuskop. It has possibly been overlooked elsewhere in the Park.

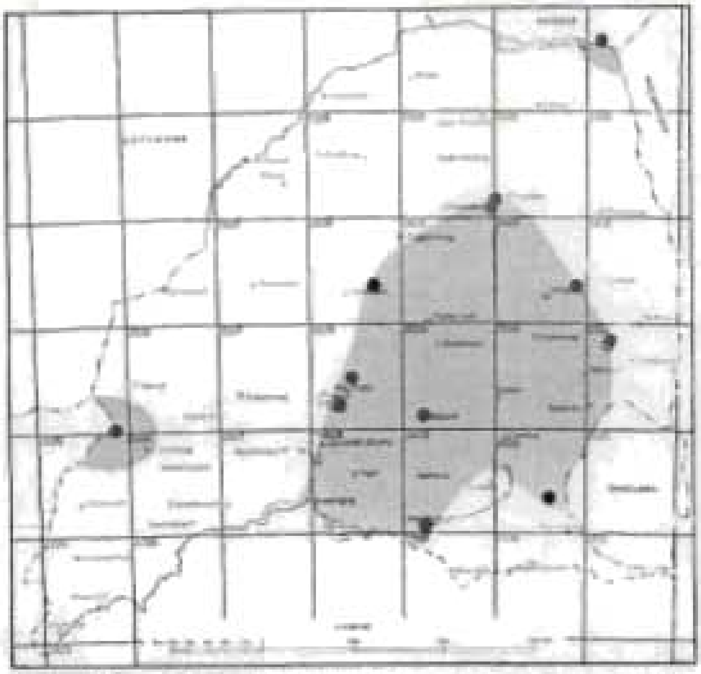

Fig.98: The distribution of *D. melanotis* in the Transvaal.

HABITAT:

D. melanotis is adapted to life in dense, tall stands of grass. No other habitat requirements are known.

HABITS:

Lives mostly in grass tufts above ground level, and sometimes also in shrubs. It rarely ventures to the ground, which may partly explain the poor trapping success experienced for this species. It is nocturnal, and Smithers (1971) found it to be territorial in habit.

In contrast to Pienaar (1964), who found this species to construct a subterranean nest, Smithers (1971) observed it to build little grass nests during the breeding season only, which are suspended about a metre above the ground from a few grass stalks. Both Shortridge (1934) and Roberts (1951) state that the species utilizes burrows, but this was never observed in the Transvaal.

Whereas the long tail is not truly prehensile, when stationary the animal twines it around a grass stalk for additional support, especially when the front paws are being used for other purposes such as feeding.

FOOD:

According to Smithers (1971) it is both graminivorous and insectivorous. No observations in this respect have been made

in/...

in the Transvaal.

BREEDING:

No pregnant or lactating females were collected from the Transvaal. Smithers (*op.cit.*) recorded pregnancies in Botswana and Rhodesia from December to March.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	152	19	128	185
T.	84,0	19	64	108
H.Ft	14,7	19	16	21
Ear	14,7	19	12	18
Mass	8,3	17	4	14

Females

	$\bar{X}$	N	Min.	Max.
Tot.	153	11	132	198
T.	84,2	11	67	118
H.Ft	17,2	11	15	20
Ear	15,5	11	14	17
Mass	8,2	8	5,9	12

RECORDS OF OCCURRENCE:

Specimens examined, 30: Boekenhoutskloofdrift, 1 (TM); Garsfontein, 1 (TM); Haenertsburg, 8 (SI); Joshua Moolman Priv. Nat. Res., 1 (TM); Lichtenburg, 2 (SI); Nylsvlei, 5 (TM); Pretoriuskop, 4 (NKW); Standerton, 1 (TM); Tzaneen, 6 (SI); Witbank, 1 (TM).

Additional records: Chikwarakwara (Smithers, *in litt.*).

Dendromus mesomelas Brants, 1827 Climbing mouse
Klimmuis

D m. mesomelas Brants, 1827

TAXONOMIC/...

TAXONOMIC NOTES:

Pending a revision of the genus, Meester *et al.* (1964) is followed here in referring Transvaal specimens to the nominate race.

DISTRIBUTION:

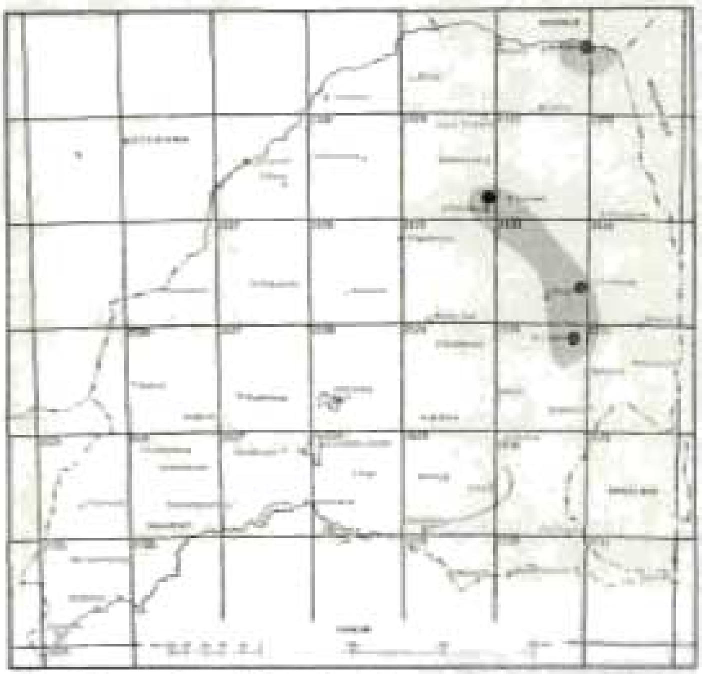

Fig.99: The distribution of *D. mesomelas* in the Transvaal.

The distribution records of *D. mesomelas* are much more scattered than those of the previous species, and its total range is therefore poorly defined. It has, however, not been recorded from most of S.W.A., Botswana and the Cape Province (in the latter case records are restricted to eastern coastal areas). In the Transvaal available evidence suggests an easterly distribution, with no records from the western bushveld areas nor from the highveld grasslands. More records are required to establish correlations between range and environmental factors. To date no specimens are known from Acocks' (1975) Pure and False Grassveld Types, and the species may therefore be dependent on a wooded element in its vegetational environment. Misonne (1974) considers it a "bush species".

HABITAT:

As far as can be determined it is similar to that of the previous species, except that woody plants appear to play some part in its habitat requirements. According to Smithers and Tello (1976) it prefers tall grass in wetter habitat.

HABITS:

Nocturnal/...

Nocturnal, solitary. Constructs grass nests (Misonne, 1974) in trees and shrubs or even uses small bird nests (Sclater, 1900).

FOOD:

Vegetarian, and partly insectivorous (Smithers, 1971).

BREEDING:

No pregnant or lactating females were collected in the Transvaal.

MEASUREMENTS AND MASS:

Only one male and one female have been measured.

	Tot.	T.	H.ft	Ear		Mass
TM 24650, ♂:	176	97	21	17	=	12g
TM 3397, ♀:	177	102	18	16	=	?

RECORDS OF OCCURRENCE:

Specimens examined, 4: 10 km E. Madimbo, 1 (TM); Mariepskop, 1 (TM); Spitzkop, 1 (TM); Woodbush, 1 (TM).

Dendromus mystacalis Heuglin, 1863 — Lesser climbing mouse / Kleiner klimmuis

D. m. jamesoni Wroughton, 1909

TAXONOMIC NOTES:

In following Meester *et al.* (1964), Transvaal specimens are all regarded as *D. m. jamesoni*, which includes *pongolensis* Roberts, 1931, as a synonym.

DISTRIBUTION:

Although the total range of this species in southern Africa is more restricted than that of *nyikae* and *mesomelas*, *D. mystacalis* is better represented than any of the other three species occurring in the Transvaal. It has not been recorded in the extreme southwestern and northern regions of the

Province/...

Province, but is relatively widespread in the remainder of the Transvaal.

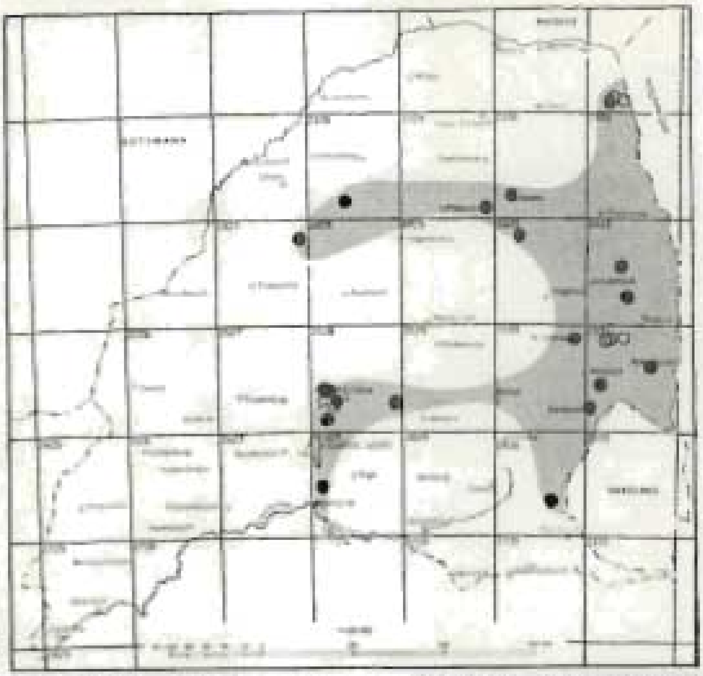

Fig.100: The distribution of *D. mystacalis* in the Transvaal.

HABITAT:

Similar to most other species of *Dendromus* in that dense, preferably tall stands of grass appear to be an essential habitat requirement. Smithers and Tello (1976) recorded 1-2 metre high grass stands of mainly *Hyparrhenia* sp. as ideal. A number of specimens from various localities were collected in marshy areas or near open water. However, the main attraction is the taller and denser grass stands associated with water. Six specimens were collected on a rocky hillside with dense grass cover on the farms Uitkyk and Paranie. The rest are from plains and valleys.

HABITS:

Very similar to the other *Dendromus* species, being mostly solitary and nocturnal, and constructing grass nests (Misonne, 1974 above ground level in grass tufts, with two opposing entrances (Roberts, 1951). The biology of the genus is too poorly known to indicate specific behavioural differences.

FOOD:

Graminivorous, and to a lesser extent insectivorous.

BREEDING:

The only record of breeding activity is of a pregnant female with eight foetuses collected during March .

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	149	16	132	169
T.	85,6	16	75	95
H.Ft	18,1	16	16	20
Ear	12,9	16	8,5	15
Mass	8,5	10	5	14

Females

	$\bar{X}$	N	Min.	Max.
Tot.	148	17	132	171
T.	85,2	17	75	103
H.Ft	16,9	16	15	18
Ear	13,4	17	10	17
Mass	6,8	9	4,5	9

RECORDS OF OCCURRENCE:

Specimens examined, 42: Barberton, 1 (TM); Dordrecht, 2 (TM); Hartebeeshoek, 1 (TM); Hectorspruit, 2 (TM); Joshua Moolman Priv. Nat. Res., 4 (TM); Kempiana, 1 (TM); Koedoespoort, 2 (TM); Malta, 1 (TM); 11 km N. Newington, 1 (TM); Onderstepoort, 1 (TM); Othawa, 2 (TM); Paranie Priv. Nat. Res., 1 (TM); Platbos, 2 (TM); Pretoria, 1 (TM); Renosterpoort Priv. Nat. Res., 3 (TM); Spitzkop, 3 (TM); Stangene, 1 (NKW); Suikerboschrand Prov. Nat. Res., 1 (TM); Tzaneen, 4 (TM); Uitkyk Priv. Nat. Res., 5 (TM); Woodbush, 2 (TM); Zwartkop 356, 1 (TM).

Additional records: Open circles in Kruger National Park as indicated on distribution map, after Pienaar (1964).

Malacothrix Wagner, 1843

Malacothrix typica (Smith, 1834) Large-eared mouse

Grootoormuis

TAXONOMIC NOTES:

The status of most subspecies listed by Roberts (1951) and Ellerman *et al.* (1953) is doubtful. In agreement with Meester *et al.* (1964) no subspecies are recognized here pending a revision. According to an ongoing study, the ventral colouration may prove to be a distinctive subspecific parameter, since available evidence suggests that two colour phases are geographically isolated.

DISTRIBUTION:

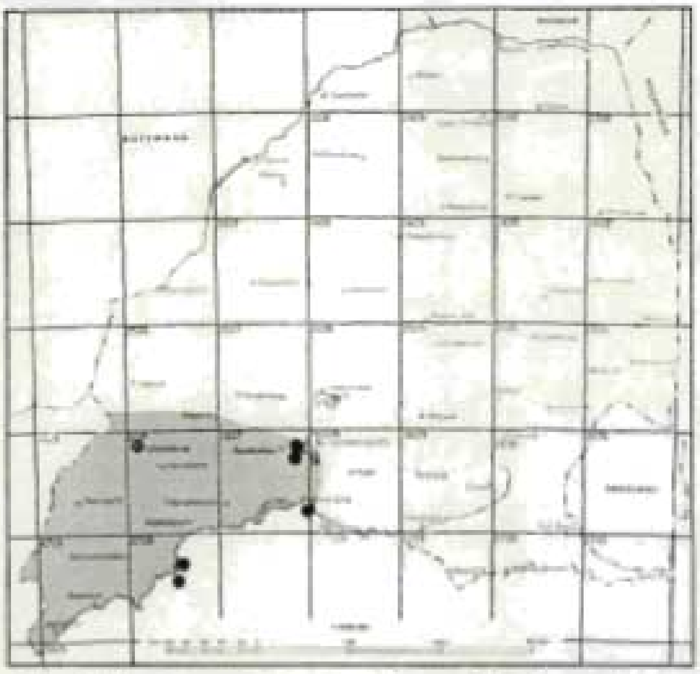

Fig.101: The distribution of *Malacothrix typica* in the Transvaal.

Occurs only peripherally in the southwestern Transvaal. The overall range of the species indicates that it has been overlooked in the Lichtenburg, Delareyville and Bloemhof districts of the extreme southwestern Transvaal. Occurs in lower rainfall areas.

HABITAT:

Most specimens are caught by hand at night on hard ground with sparse vegetation, with the aid of spotlights. Dry pans are favoured. However, any small mammals are easily detected and caught under such conditions. Since the large-eared mouse is only rarely caught in traps, this observation may bias the definition of habitat requirements, which may in fact prove to be wider.

HABITS:

M. typica wanders randomly at night over great distances. Terrestrial, and also appears to be solitary in habit. It is not a very fast runner, and is easily caught by hand, especially

when/...

when it tries to hide under the meagre protection available on and around pans. According to Roberts (1923) and Smithers (1971) it constructs a 20-25 mm wide, nearly vertical tunnel which ends in a nest chamber. In captivity domed grass nests are made.

FOOD:

No information available from the Transvaal. In a series collected from Carnavon during 1977 all had finely masticated green vegetable matter in their stomachs. This agrees with the findings of Smithers (1971) that the large-eared mouse is vegetarian.

BREEDING:

Smithers (*op.cit.*) recorded parturition from August to April under captive conditions. He also noted the gestation period to range between 22 and 35 days.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	105	18	80	117
T.	34,4	18	27	42
H.Ft	18,8	18	16	21
Ear	18,9	18	14	22
Mass	-	-	-	-

Females

	$\bar{X}$	N	Min.	Max.
Tot.	103	11	94	135
T.	37,1	11	28	75
H.Ft	19,5	11	17,5	26
Ear	19,8	11	17	22
Mass	7,3	3	7	8

RECORDS/...

RECORDS OF OCCURRENCE:

Specimens examined, 31: Angra Pequina, 12 (TM); Boschbank, 1 (TM); Ganskuil, 2 (TM); Kliprivieroog, 1 (TM); Kruisementfontein, 6 (TM); Pretoria Zoo's Farm, 2 (TM); Roodepoort, 5 (TM).

Genus *Steatomys* Peters, 1846

TAXONOMIC NOTES:

Ellerman *et al.* (1953) consider the genus to be monotypic in southern Africa. On the other hand, Ansell (1960) and Meester *et al.* (1964) recognize three species on this subcontinent, two of which occur in the Transvaal, i.e. *S. pratensis* Peters, 1846, and *S. krebsii* Peters, 1852. The latter viewpoint is here adhered to.

However, the characters used by Meester *et al.* (*op.cit.*) do not satisfactorily key our Transvaal material into two clear taxa. As an identification criterion, the mammary formula can be applied only to a minority of females (see also Smithers, 1971:324). Greatest skull length overlaps completely in the two taxa. The bicoloured tail similarly is not a consistent character.

The specimens from the Transvaal could be separated in a logical and consistent manner by employing differential dorsal and ventral colouration. The taxa thus separated correlate almost entirely with the two major veldtypes in the Transvaal, i.e. grassland and woodland respectively.

This genus is in need of revision, and until such time the two species recognized in the Transvaal are separated on the characteristics employed in the following key:

1. Dorsal colour uniformly greyish-
brown; ventral fur pure white to the base ... ... *pratensis*
Dorsal colour buffy brown interspersed with
black; ventral fur white-tipped with grey
base ... ... *krebsii*

Steatomys pratensis Peters, 1846 Fat mouse
Vetmuis

DISTRIBUTION:

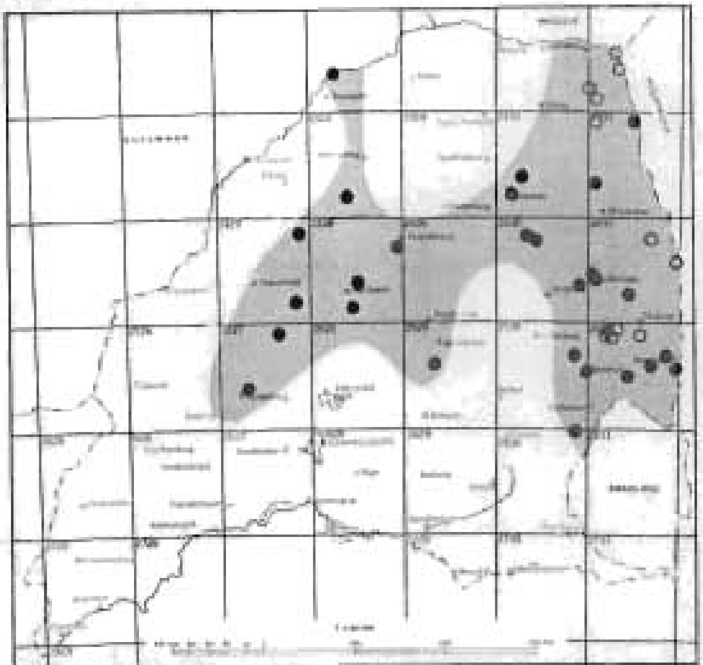

Fig.102: The distribution of *Steatomys pratensis* in the Transvaal.

Distributed through most of the woodland regions of the Transvaal. It has not been recorded from the Pietersburg plateau, presumably due to unsuitable habitat. Its apparent absence from the extreme western wooded areas of Derdepoort and Zeerust is confirmed by the absence of the species from adjoining areas in Botswana (see Smithers, 1971), but cannot be explained. All records west of 29°E longitude represent extensions of the known species range.

It is entirely absent from the grassveld areas of the southern Transvaal.

HABITAT:

All specimens were taken on plains, mostly on sandy soil. The fat mouse appears to be associated with trees or shrub, but at present the nature of this association is not understood. Grass cover varied from sparse to very dense and tall, as found near water.

HABITS:

Nocturnal and terrestrial. Occurring singly or in pairs. Excavates a burrow which ends in a grass-lined nest. Smithers (1971) mentions two pairs which he found torpid when dug out of their nests, but does not mention during which month these

animals/...

animals were collected. However, the possibility of this species hibernating or aestivating is small, since Transvaal Museum specimens were trapped throughout the year. The species is distinguished by the large amounts of fat stored subcutaneously.

FOOD:

Graminivorous.

BREEDING:

A lactating female was collected during February. Smithers (1971) recorded pregnancies during February and December, and lactating females during February, March, April, October and December.

MEASUREMENTS AND MASS:

Males

	$\bar{x}$	N	Min.	Max.
Tot.	130	39	117	157
T.	43,1	39	32	55
H.Ft	16,3	39	14	19
Ear	14,1	38	10	16
Mass	21,2	22	12	29

Females

	$\bar{x}$	N	Min.	Max.
Tot.	135	39	110	162
T.	43,8	39	33	53
H.Ft	16,2	39	14	19
Ear	14,8	38	10	17
Mass	25,3	22	10	44

RECORDS OF OCCURRENCE:

Specimens examined, 95: Acornhoek, 8 (TM); Bosbokrand, 1 (SI); Buffelspoort, 1 (TM); Cyprus, 1 (TM); Dordrecht, 2 (TM); Hectorspruit, 8 (TM); Komatipoort, 4 (SI); Letaba Ranch, 2 (TM); Loskopdam Prov. Nat. Res., 1 (TM); Malelane, 2 (SI);

Mariepskop, 3 (TM); Messina, 1 (TM); Mkiwene, 1 (NKW); Mmabolela Estates, 2 (TM); Nelspruit, 1 (SI); Nylstroom, 6 (SI); 11 km N. Newington, 1 (TM); Othawa, 2 (TM); Platbos, 5 (TM); Potgietersrus, 4 (SI); Rissik Priv. Nat. Res., 1 (TM); Rooiberg, 2 (SI); Rustenburg, 1 (SI); Sekororo, 4 (TM); Shingwidzi, 2 (NKW); TenBosch Estates, 3 (TM); Tzaneen, 15 (SI); Tzaneen Estates, 8 (TM); White river, 2 (SI).

Additional records: Open circles in the Kruger National Park, as indicated on the distribution map after Pienaar (1964).

Steatomys krebsii Peters, 1852 — Krebs' fat mouse
Krebse vetmuis

DISTRIBUTION:

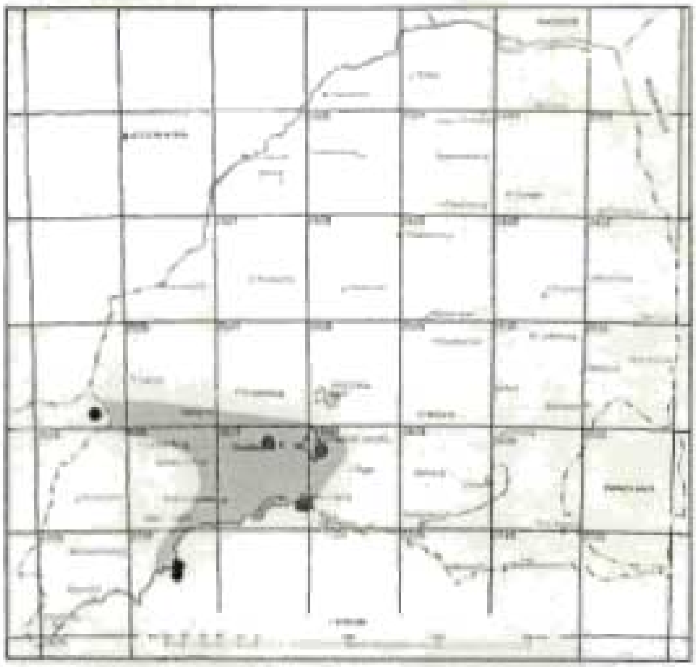

Fig.103: The distribution of *Steatomys krebsii* in the Transvaal.

Known only from five scattered localities in the southwestern Transvaal, where it has been recorded from Pure and False Grassveld Types, as well as sourish mixed bushveld, Kalahari thornveld and shrub bushveld (as defined by Acocks, 1975). *S. krebsii* does not overlap at all in range with *S. pratensis* or *S. minutus* Thomas, 1926, and its range cannot be correlated with any particular environmental factor.

HABITAT:

Very little is known about the habitat requirements of this species, other than that it requires relatively flat, and

preferably/...

preferably sandy, areas with some sort of plant cover for protection.

HABITS:

Nocturnal, terrestrial. Excavates short burrows ending in nesting chambers.

FOOD:

No information is available.

BREEDING:

No pregnant or lactating females were recorded.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	122	10	116	137
T.	45,7	10	40	51,5
H.Ft	15,4	10	14	16,5
Ear	15,7	10	13	17
Mass	-	-	-	-

Females

	$\bar{X}$	N	Min.	Max.
Tot.	118	6	111	126
T.	43,7	6	39	52
H.Ft	15,2	6	14	16
Ear	16,1	6	15	17,5
Mass	-	-	-	-

RECORDS OF OCCURRENCE:

Specimens examined, 16: Alberton, 1 (TM); Angra Pequina, 6 (TM); Kruisementfontein, 3 (TM); Mafeking, 1 (TM); Witfontein, 1 (TM); Zandfontein, 4 (TM).

Mystromys/...

Mystromys Wagner, 1841

Mystromys albicaudatus (Smith, 1834) White-tailed rat
Witstertrot

DISTRIBUTION:

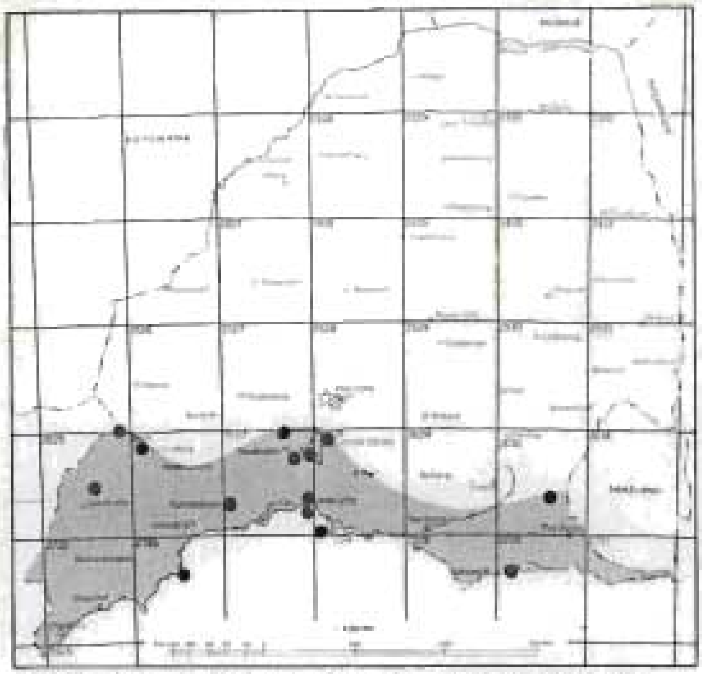

Fig.104: The distribution of *Mystromys albicaudatus* in the Transvaal.

Distributed in low numbers throughout most of the Transvaal highveld. Presumably it has been overlooked in many highveld areas as a result of its apparently rare status. All known locality records fall within Pure and False Grassveld Types (Acocks, 1975). It has not been recorded from Tropical Bush and Savannah veld types.

HABITAT:

In the Transvaal the white-tailed rat has been recorded from areas with a more than averagely dense grass cover. Since it is a burrowing animal, sandy soi[l] is preferred. However, two specimens were collected on Joshua Moolman Private Nature reserve from a rocky area with good grass cover.

HABITS:

Terrestrial and nocturnal, *M. albicaudatus* is a burrowing species. Austin Roberts collected a specimen at the entrance of a 46 cm vertical burrow (notes on specimen label). The species also takes refuge in cracks in the ground or in burrows constructed by other animals, viz. the suricate (see Roberts, 1951:436).

Meester and Hallett (1970) studied the postnatal development of some southern African rodents. They found that although

M. albicaudatus breeds relatively slowly, its young are afforded better parental care, resulting in a higher survival rate than in many other Southern African rodents.

FOOD:

Seeds and other vegetable matter.

BREEDING:

A single pregnant female with 3 foetuses (2L:1R; cr 6 mm) was collected in July. Walker (1964) claims that this species breeds throughout the year. Meester and Hallett (1970) recorded no births in captivity between mid-April and mid-June, and concluded that even though more data may indicate some breeding activity during this period, it would be at a much reduced level.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	198	13	163	231
T.	60,3	13	52	80
H.Ft	26,2	13	24	30
Ear	22,9	13	20	25
Mass	95,7	2	78	111

Females

	$\bar{X}$	N	Min.	Max.
Tot.	198	13	158	230
T.	61,4	14	53	78
H.Ft	25,3	13	24	28
Ear	23,0	14	21	25
Mass	78	2	81	75

RECORDS OF OCCURRENCE:

Specimens examined, 30: Angra Pequina, 3 (TM); Baragwanath, 3 (TM); Ganskuil, 1 (TM); Joshua Moolman Priv. Nat. Res., 2 (TM); Lichtenburg, 1 (SI); Modderfontein, 1 (TM); Parys, 2 (TM); Potchefstroom, 3 (TM); Pretoria Zoo Farm, 1 (TM);

Swartkrans, 2 (TM); Roodepoort, 1 (TM); Verdun, 1 (TM); Vereeniging, 1 (TM); Viljoensdrift, 1 (TM); Wakkerstroom, 3 (TM); Weltevreden, 1 (TM); Wildehondfontein, 3 (TM).

Additional records: Barberspan (W.R. Dean, *in litt.*).

Subfamily Gerbillinae

1. Bullae enlarged, showing on the dorsal surface of the skull	*Desmodillus*
Bullae not showing on the dorsal surface of the skull...	2
2. Soles of hind feet haired; zygomatic plate normal; cheekteeth sub-laminate	*Gerbillurus*
Soles of hindfeet naked; zygomatic plate projecting far forwards; molars laminate	*Tatera*

Desmodillus Thomas and Schwann, 1904

Desmodillus auricularis (A. Smith, 1834) Namaqua gerbille
Namakwalandse nagmuis

TAXONOMIC NOTES:

Meester *et al.* (1964), Smithers (1971) and Petter (1975) find no justification for recognizing any of the subspecies described. This view is followed here.

DISTRIBUTION:

It occurs only peripherally in the western Transvaal. The record from Scrutton in the northern Transvaal, reported by C. Nel and J.A.J. Nel (*pers.com.*), is doubtful since no specimens were collected. If confirmed it would be an eastward range extension of c. 200 km, from the Botswana range of the species.

Fig.105: The distribution of *Desmodillus auricularis* in the Transvaal.

HABITAT:

Smithers (1971) collected this species on hard ground and compacted sand with some cover in the form of karroid bushes or grass. He found the Namaqua gerbille to be particularly associated with calcareous ground on the fringes of pans or calcareous pans with low ground cover such as grass or karroid bush. Nel and Rautenbach (1975) studied habitat selection of Kalahari rodents, and found that *D. auricularis* shows a preference for fine soils with or without chalky outcrops, such as calcrete riverbanks and silty rivercourses.

HABITS:

A terrestrial and strictly nocturnal species. Burrow entrances may be in the open or hidden at the bases of bushes, but always with a ramp of excavated sand at the lip. Judging by the closeness of the individual burrow systems to each other and the well defined pathways interconnecting burrow entrances, Nel (1967) concludes that the species may be social. However, Nel and Stutterheim (1973) later found it to be solitary in habits. Nel (1967) studied the burrow systems of this species, and found that it excavates complicated and extensive systems. The entrances are 53 mm in diameter, and slope down steeply to an average depth of 30-60 cm. A system normally has several entrances, some of which are blocked with sand. Blind alleys (especially in calcareous areas) and storage chambers are common. Nesting chambers may be present but are not the rule. Faeces are deposited at random throughout the system.

FOOD/...

FOOD:

Graminivorous. Both Nel (1967) and Smithers (1971) record the "dubbeltjie" (*Tribulus terrestris*) as a favourite food item, which is stored in quantity in the storage chambers of the burrow system. Nel (*op.cit.*) further lists the seeds of the mesquite tree (*Prosopis* sp.). It also feeds on the seeds of grasses and annuals.

BREEDING:

No pregnant or lactating females were collected in the Transvaal. Smithers' (1971) data suggest that breeding occurs throughout the year. Unfortunately Nel and Stutterheim (1973) do not cite the months of birth of the litters whose post-natal development they studied. However, they found that the male is tolerated by the female only for the brief period during mating, and therefore plays no role in parental care. Nipple-clinging is not practised, the young being carried in the mouth. Observed litter size was low ($\bar{X}$=2,0), and the post-natal development of young was also relatively slow compared to that of other rodent species. Smithers (*op.cit.*) recorded an average litter size of 3,9, with an observed range of 3-7.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	182	6	155	197
T.	78,5	6	66	86
H.Ft	23,6	6	23	25
Ear	10,8	6	10	11,5
Mass	-	-	-	-

Females/...

Females

	$\bar{x}$	N	Min.	Max.
Tot.	177	7	163	188
T.	79,7	7	70	87
H.Ft	22,6	7	22	23
Ear	10,6	7	9	11,5
Mass	-	-	-	-

RECORDS OF OCCURRENCE:

Specimens examined: 16: Bloemhof, 1 (TM); Geyers farm, 3 (TM); Panfontein, 12 (TM).

Additional records: Grootpan (Davis, 1971); Scrutton (C. Nel, *pers.comm.*).

Tatera Lataste, 1882

1. Colour of upper parts brighter reddish, texture of fur sleek, silky; tail dark on the upper side, dark-tipped; pads of hind feet dark; mammary formulae 2-2 = 8 ... ... *leucogaster*

Colour of upper parts duller, lighter, less reddish, texture of fur fluffy, or somewhat harsh; tail less dark on the upper side, white-tipped; pads of hind feet lighter; formulae 1-2 = 6 ... ... *brantsii*

Tatera leucogaster (Peters, 1852) Bushveld gerbille
Bosveldse nagmuis

TAXONOMIC NOTES:

According to Davis, (1962), this species is incorrectly included in *T. afra* (Gray, 1830) by Ellerman *et al.* (1953).

As pointed out by Davis (1971), there is remarkably little

discontinuity/...

discontinuity in the distribution of this species, and populations appear to intergrade fairly evenly throughout the range. Davis (*op.cit.*) therefore did not attempt recognition of subspecies, and his approach is adopted here. The subspecies described from the Transvaal are: *limpopoensis* Roberts, 1929; *salsa* Wroughton, 1906; *tsaneenensis* Roberts, 1929; *pretoriae* Roberts, 1929; and *mitchelli*, Roberts, 1929. Roberts (1951) arranged these forms under the species *schinzi* Noack, 1889, which itself is regarded a synonym of *leucogaster* (Davis, 1971).

DISTRIBUTION:

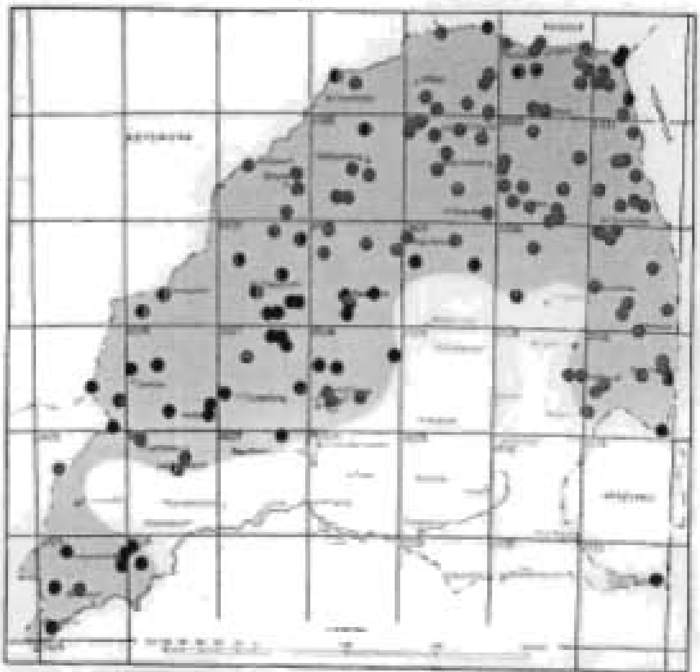

Fig.106: The distribution of *Tatera leucogaster* in the Transvaal.

The bushveld gerbille is a common rodent and widespread in the Transvaal. Although it is typically a bushveld species , it also occurs in the southern and southwestern Transvaal highveld grasslands. It is, however, absent from the south-eastern grassveld regions of the Province which extend as far north as Lydenburg. The overall distribution of this species can as yet not be correlated with any known edaphic factor.

HABITAT:

Found in woodland or shrub savannah, mopane woodland, and in sparse or dense stands of grass. The species has a preference for softer soils such as loose or slightly compacted sand, but has occasionally been recorded on harder soils and even gravel areas. It appears to select the more open aspects of its environment, and is therefore commonly encountered in

old/...

old cultivated lands. Optimum habitat appears to be open scrubland on loose sandy soil with very little grass.

HABITS:

A nocturnal, terrestrial and burrowing animal. It is a social species, with one or more individuals occupying a burrow. Burrows are mostly arranged in warrens, but solitary burrows are also encountered, especially in less favourable habitat. Burrow entrances are located at the bases of trees and especially shrubs, less often in the open. Distinct runways interconnect the burrow entrances of a warren.

Occupants clean and extend their burrow systems each night, judging by the freshly excavated soil observed at the entrances in the morning. A burrow system is fairly extensive, normally with more than one entrance, with blind alleys ending just under the surface permitting emergency escapes, and with grass-lined nesting chambers (see also Shortridge, 1934).

FOOD:

Seeds and other vegetable matter.

BREEDING:

Monthly frequency of non-pregnant, lactating and pregnant females.

Total/...

	J	F	M	A	M	J	J	A	S	O	N	D
Total	2	2	31	8	20	2	17	38	21	9	14	1
Non-Pregnant	0	2	9	7	19	2	16	36	19	5	10	1
Lactating	1	0	8	1	1	0	1	1	0	3	2	0
Pregnant	1	0	14	0	0	0	0	1	2	1	2	0

Mean litter size 4,6 (N=21; range 3-7). Implantation irregular.

Though scanty, the above date suggest a seasonal breeding pattern. However, Smithers (1971) found that this species breeds throughout the year.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	276	482	210	321
T.	148	493	121	173
H.Ft	33,5	504	27	36
Ear	20,9	493	18	24
Mass	71,2	331	32	109

Females

	$\bar{X}$	N	Min.	Max.
Tot.	278	541	225	330
T.	149	531	120	175
H.Ft	33,3	564	24	38
Ear	20,7	552	18	26
Mass	68,5	365	37	114

RECORDS OF OCCURRENCE:

Specimens examined, 1137: Acornhoek, 1 (TM); Al-te-Vêr, 61 (TM); Barberspan Prov. Nat. Res., 4 (TM); Birthday Mine, 1 (TM); Blijdschap Priv. Nat. Res., 6 (TM); Blinkwater, 2 (TM); Blouberg, 1 (TM); Buffelsdraai, 1 (TM); Buffelspoort, 7 (TM); Chuniespoort, 1 (TM); Crocodile Bridge Camp, 1 (TM);

Derry Post Office, 2 (TM); Donkerpoort and Zandspruit, 6 (TM); Dordrecht, 4 (TM); Dorset, 1 (TM); Droogedal, 7 (TM); Ellisras, 21 (SI); Fort Klipdam, 1 (TM); Geelhoutkloof, 1 (TM); Gravelotte Mines, 7 (TM); Greefswald, 15 (TM); Groothoek, 2 (TM); Guy's farm, 1 (TM); Hans Merensky Prov. Nat. Res., 9 (TM); Hectorspruit, 15 (TM); Huwi, 14 (TM); Jakkalspruit, 1 (TM); Kalkfontein, 2 (TM); Klaserie, 10 (TM); Klein Letaba, 1 (TM); Klipkuil, 2 (TM); Komatipoort, 119 (TM, 4; SI, 115); Koster, 1 (TM); Kosterfontein, 2 (TM); Kwaggavlakte, 1 (TM); Lanjan Prov. Nat. Res., 9 (TM); Leeuwspoor, 2 (TM); Letaba Ranch, 44 (TM, 7; SI, 37); Letaba, 9 (TM); 54 km N. Letaba rest camp on Tsenda river loop road, 3 (TM); Leydsdorp, 1 (TM); On Levuvhu river, 8 (TM); Lichtenburg, 47 (SI); 7 km N. Lichtenburg on road to Ottoshoop, 2 (TM); Mabohlelene, 4 (NKW); 10 km E. Madimbo, 9 (TM); Magalakwin, 1 (TM); Malelane, 32 (TM, 2; SI, 30); Malopeni river, 3 (TM); Mamarango, 4 (TM); Mmabolela Estates, 22 (TM); Mokeetsi, 12 (TM); Montrose Estates, 5 (TM); Mooigenoeg, 9 (TM); Mooiplaas, 3 (TM); Moorddrift, 7 (TM); Mopani, 3 (TM); Mutale river, 3 (TM); Nelspruit, 34 (SI); Newington, 18 (SI); 11 km N. Newington, 8 (TM); Njelelle river, 7 (TM); Mahlangene, 2 (NKW); Maseya fontein, 3 (NKW); Nwambia pan, 17 (TM, 15; NKW, 2); Nwambu windpomp, 3 (NKW); Nwanedzi, 2 (TM); Nwanedzi river, 17 km N. Letaba on Shingwidzi river, 1 (TM); Nylstroom, 7 (TM); Olifants river, 21 (TM); Othawa, 17 (TM); Pafuri camp, 4 (TM); Panfontein, 44 (TM); Paranie Priv. Nat. Res., 6 (TM); Pentonville, 2 (TM); Platbos, 11 (TM); Potgietersrus, 7 (TM, 1; SI, 6); Premier mine, 4 (TM); Pretoria, 11 (TM, 10; SI, 1); Pretoria Zoo's Farm, 8 (TM); Pretoria North, 1 (TM); Ramathlabama, 1 (TM); Renosterpoort, 6 (TM); Rhoda, 6 (TM); Rietondale, 3 (TM); Rissik Priv. Nat. Res., 3 (TM); Rooiberg, 29 (SI); Rooikrans, 4 (TM); Runde, 1 (TM); Rykvoorby, 11 (TM); Sama, 1 (TM); Sandrivier, 6 (TM); Scrutton, 9 (TM); Sekeroro, 1 (TM); Setlagodi, 1 (TM); Sheila, 8 (TM); Shingomene, 2 (TM); Shingwidzi, 6 (TM); 25 km NW Shingwidzi on road to Punda Milia, 3 (TM); Sibasa, 1 (TM); Skukuza koppies, 16 (TM); Steelpoort, 1 (TM); Swarthoek, 5 (TM); Swartkrans, 1 (TM); Schweizer Reneke, 2 (TM); Tambotieskloof, 9 (TM); TenBosch Estates, 5 (TM); Thabazimbi, 14

(TM)/...

(TM); Toulon, 1 (TM); Tshipise, 15 (SI); Tshokwane, 3 (TM); Tzaneen, 7 (SI); Tzaneen Estates, 4 (TM); Urk, 7 (TM); Vaalwater, 4 (TM); 24 km S. Vivo on Kalkbank road, 1 (TM); Vygeboom, 1 (TM); Waterpoort, 1 (TM); Welgedaan, 18 (TM); Welgevonden, 3 (TM); Wilgekuil, 1 (TM); Wilhanshohe, 2 (TM); Wolmaranstad, 65 (SI); Woodbush, 1 (TM); Worcester mine, 4 (TM); Zana Ranch, 7 (TM); Zandfontein, 4 (TM); Zandspruit, 4 (TM); Zeerust, 12 (SI); Zoutpan, 8 (TM).

Tatera brantsii (A. Smith, 1834) Highveld gerbille
Hoëveldse nagmuis

T. b. brantsii (A. Smith, 1834)

TAXONOMIC NOTES:

This species is again incorrectly included in *T. afra* (Gray, 1830) by Ellerman *et al.* (1953)(Davis, 1962).

The material from the Transvaal answers to the description of the nominate race, especially in the presence of a buffy grey patch on the chest. Synonymous forms from the Province are *maccalinus* (Sundevall, 1847), *draco* Wroughton, 1906, and *miliaria* Wroughton, 1906.

DISTRIBUTION:

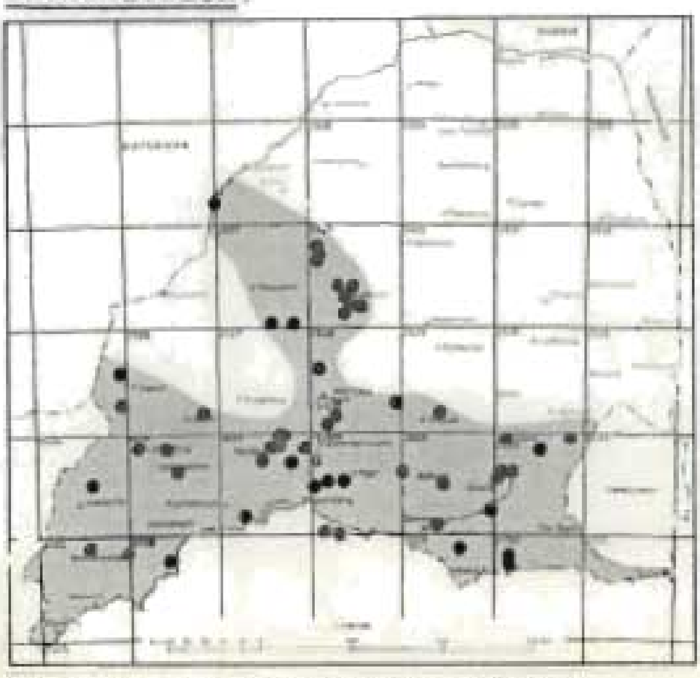

Fig.107: The distribution of *Tatera brantsii* in the Transvaal.

A very common rodent in the entire highveld grasslands of the Transvaal, and often considered a pest in agricultural areas. It ranges with a fingerlike projection into the bushveld as far as 24°S latitude, via Pretoria, Nylstroom and Vaalwater. The species also occurs in the woodland areas of the

Zeerust/...

Zeerust district on the Botswana border. The overall range of the highveld gerbille does not correlate entirely with any single environmental factor. Generally it is an inhabitant of sub-tropical grasslands (through most of its range in the Republic) and wooded steppe (Botswana).

<u>HABITAT</u>:

Sandy soils, irrespective of the ground cover (Nel and Rautenbach, 1975). As in the case of *T. leucogaster*, it selects the more open aspects of its environment, which it clears further by browsing on ground cover. According to Smithers (1971) the highveld gerbille is capable of tolerating drier conditions than the previous species.

<u>HABITS</u>:

Like *T. leucogaster*, *T. brantsi* is saltatorial. It is a nocturnal, terrestrial and burrowing species. The construction and utilization of burrows are very similar to the situation in the previous species, except that it is more prone to concentrate individual burrows in warrens.

Meester and Hallett (1970) studied the post-natal development of the highveld gerbille. Young are transported by nipple-clinging, although mouth-carrying by both parents was also observed. Development of young is relatively slow compared to that of other species, and this can be correlated with better parental care and the better protection afforded by nest chambers in the burrows.

<u>FOOD</u>:

Seeds of grasses, bushes and trees, including *Acacia* trees (according to Shortridge, 1934). Also other vegetable matter such as grass leaves and stems.

<u>BREEDING</u>:

No pregnant or lactating females were collected during this survey. Measroch (1954) recorded breeding throughout the year, and his observations are substantiated by those of Smithers (1971)

Measroch/...

Measroch (*op.cit.*) recorded a mean of 2,6 foetuses per litter, Smithers (*op.cit.*) 3,3, and Meester and Hallett (1970) 2,0. Mean gestation period is 22,5 days (Measroch, 1954).

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	273	114	202	315
T.	140	114	103	174
H.Ft	34,7	114	19	42
Ear	21,3	114	12	29
Mass	78,5	64	32	122

Females

	$\bar{X}$	N	Min.	Max.
Tot.	282	123	200	350
T.	146	123	104	186
H.Ft	35,2	123	28	47
Ear	21,8	122	14	34
Mass	81,2	66	25	126

RECORDS OF OCCURRENCE:

Specimens examined, 220: Arnhemburg, 5 (TM); Barberspan, 4 (TM); Begin der Lyn, 2 (TM); Brandhoek, 24 (TM); Carolina district, 4 (TM); Dinokana, 2 (TM); Dreyer's Farm, 1 (TM); Droogheuwel, 1 (TM); Ermelo, 6 (SI); Ermelo, 13 km to Chrissiesmeer, 10 (TM); Florida, 1 (TM); Goedehoop, 9 (TM); Halfway House, 1 (TM); Hardekoolbult, 1 (TM); Hartebeesfontein, 5 (TM); Heidelberg, 3 (TM); Jakkalspruit, 1 (TM); Langfontein, 3 (TM); 31 km Lichtenburg to Ventersdorp, 2 (TM); Maria van Riebeeck Mun. Nat. Res., 1 (TM); Mooivlei, 1 (TM); Nylstroom, 25 (TM, 1; SI, 24); 6 km E. Nylstroom, 3 (TM); 16 km E. Nylstroom, 3 (TM); 3 km Oranjeville to Heilbron, 1 (TM); 13 km Oranjeville to Villiers, 1 (TM); Ottoshoop, 1 (TM); Paardekop, 2 (TM); Pretoria Zoo's Farm, 2 (TM); Ratsegaai, 6 (TM); Renosterpoort, 2 (TM); Rolspruit, 20 (TM); Roodepoort 383, 2 (TM); Rietfontein, 2 (TM); Rietvlei, 2 (TM); Smithfield, 1 (TM); Sterkfontein, 2 (TM); Suikerboschrand Prov. Nat. Res., 3 (TM);Suurbekom, 8 (TM); Tarlton, 2 (TM); Vaalwater, 1 (TM); Venterskroon, 3 (TM); Vereeniging, 1 (SI); Vlakfontein, 2 (TM); Vygeboom, 3 (TM); Vygeboomspoort, 1 (TM); Wakkerstroom, 16 (TM); Welman's Farm, 4 (TM); Witfontein, 1 (TM); Wolmaranstad, 1 (TM); 44 km Wolmaranstad to Schweizer Reneke, 2 (TM); Wonderfontein, 7 (TM); Zandrivier, 2 (TM); Zoutpan, 1 (TM).

Gerbillurus Shortridge, 1942

Gerbillurus paeba (A. Smith, 1836) — Pygmy gerbil, Klein nagmuis

G. p. coombsi (Roberts, 1929)

DISTRIBUTION:

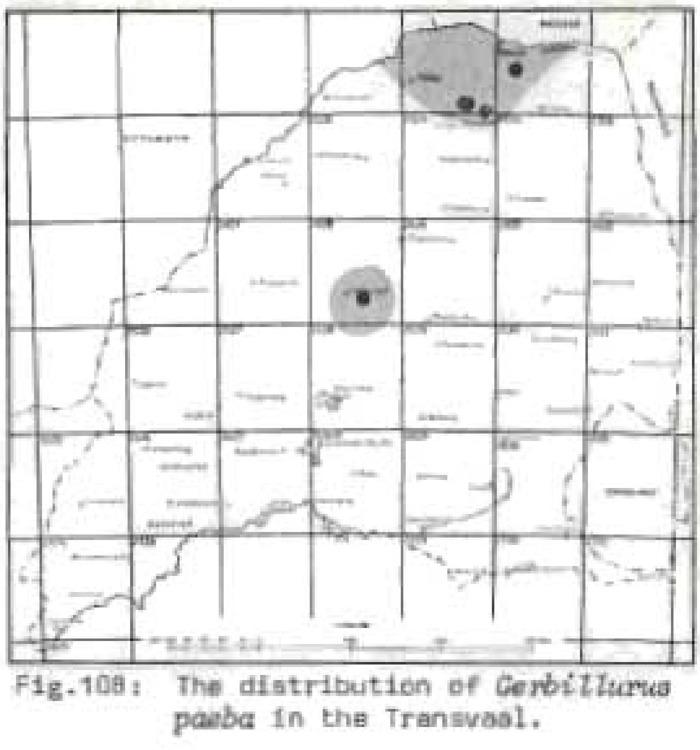

Fig.108: The distribution of *Gerbillurus paeba* in the Transvaal.

Distributed throughout the entire western semi-arid regions of southern Africa, and occurs only peripherally in the Transvaal. In this Province it is essentially restricted to the sandy areas north of the Zoutpansberg. The specimen from Nylstroom is far out of the normal range, and this record should be confirmed. It was collected 16 km east of Nylstroom on 15th April 1966 by C. Roché.

HABITAT:

Restricted to sandy (preferably loose sand) areas. Nel and Rautenbach (1975) point out that in the Kalahari this species

predominates/.

predominates in areas with coarser sand, whereas it is rare or absent in areas with compacted fine soils or hard substrates.

HABITS:

Nocturnal, terrestrial and saltatorial. It constructs fairly extensive tunnels, arranged in small warrens. Entrances are normally at the bases of bushes or grass tufts, with the excavated soil forming an obvious ramp. The individual tunnels in warrens are often interconnected. Tunnel entrances are often plugged by day with loose sand. Grass-lined nesting chambers are constructed.

Stutterheim and Skinner (1973) studied the behaviour of this species, (albeit the subspecies *G. p. paeba* (A. Smith, 1834) from the Kalahari) in captivity. A wide range of behavioural patterns are discussed, among which are hoarding, dominance and agonis behaviour. Like Smithers (1971), they observed rather small litter sizes. Nipple-clinging was not observed. The tunnel entrance is sealed by the female when she leaves her suckling offspring in the nest.

FOOD:

Graminivorous (Smithers, 1971).

BREEDING:

Smithers' (1971) data suggest breeding throughout the year, although Stutterheim and Skinner (1973) state that increased temperatures and daylight induce fertility.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	190	8	188	198
T.	102	8	96	109
H.Ft	24,0	8	23	26
Ear	14,7	8	14	15
Mass	23,3	3	20	28

Females/...

Females

	$\bar{X}$	N	Min.	Max.
Tot.	187	10	144	224
T.	100	10	50	114
H.Ft	24,5	10	21	28
Ear	15,1	10	13	18
Mass	26	3	25	28

RECORDS OF OCCURRENCE:

Specimens examined, 20: Montrose Estates, 10 (TM); 16 km E. Nylstroom, 1 (TM); Rochdale, 2 (TM); Tshipise, 4 (SI); Zwarthoek, 3 (TM).

Subfamily Otomyinae

Otomys Cuvier, 1823

1. No grooves on lower incisors; found only in SE Transvaal in rocky habitat ... ... *sloggetti*
One deep outer and one shallow inner groove on lower incisors 2

2. 9-10 laminae on M^3 ... ... *laminatus*
6-7 laminae on M^3 3

3. Posterior petrotympanic foramen small and slitlike; generally 7 laminae on M^3, but occasionally only 6; hind foot length 25-28 mm; ring of orange hair around eye; no sharp angle present on the side of the nasal bone ... ... *angoniensis*
Posterior petrotympanic foramen large and round generally 6 laminae on M^3, but occasionally 7; hind foot length 29-34 mm; ring of orange hair around eye absent; a sharp angle present on the side of the nasal bone ... ... *irroratus*

Otomys/...

Otomys laminatus Thomas and Schwann, 1905 Laminated vlei rat
Bergvleirot

TAXONOMIC NOTES:

Meester *et al.* (1964) recognize three of the five described subspecies, i.e. the nominate race; *silberbaueri* Roberts, 1919; and *mariepsi* Roberts, 1929. They regard *pondoensis* Roberts, 1924, and *fannini* Roberts, 1951, as synonyms of *laminatus*.

Roberts (1951) based the description of *mariepsi* on a single specimen collected in 1925 at Mariepskop. He distinguishes this subspecies on its bright rusty colouration, narrower skull, and the presence of six instead of seven laminae on $M\bar{1}$. However, Roberts (1951) himself points out that the last character is a variable one.

In 1951 a series of five specimens was collected at Spitzkop. With respect to fur colouration and the width of the braincase, they resemble the nominate race and *fannini*. With respect to the zygomatic width and the number of laminae on $M\bar{1}$ they are closest to the description of *mariepsi*. This suggest that non-geographic and geographic variation within the species is greater than that reflected by the specimens currently available. Thus no sub-species are recognized here, pending the acquisition of more material and a revision of the genus.

DISTRIBUTION:

In the Transvaal known only from the type locality and from Spitzkop. It is probably restricted to the eastern Transvaal escarpment. The type locality represents the northernmost record for this species.

HABITAT:

Submontane and coastal grasslands (Misonne, 1974).

HABITS:

Very little has been documented on the habits of this species, but in all probability they are very similar to those of

O. irroratus/..

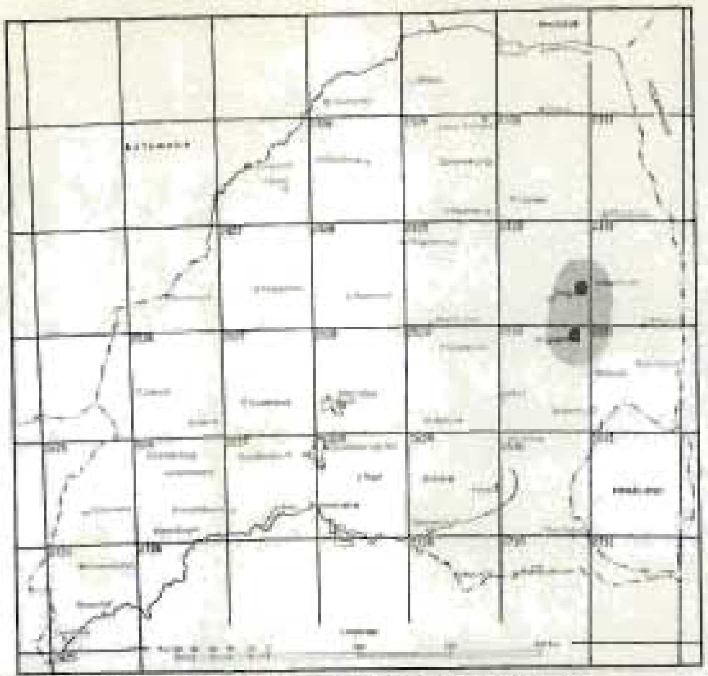

Fig.109: The distribution of *Otomys laminatus* in the Transvaal.

O. irroratus and *O. angoniensis*.

FOOD:

No data available.

BREEDING:

No information.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	283	4	225	324
T.	99,8	4	85	113
H.Ft	28	4	22	34
Ear	19	4	17	22
Mass	190	3	150	250

Data available from one female only.

	Tot.	T.	H.ft	Ear		Mass
TM 10262:	308	111	31	22	=	110g

RECORDS OF OCCURRENCE:

Specimens examined, 6: Mariepskop, 1 (TM); Spitzkop, 5 (TM).

Otomys/...

Otomys angoniensis Wroughton, 1906 | Angoni vlei rat
Angoni vleirot

O. a. rowleyi Thomas, 1918

TAXONOMIC NOTES:

Roberts (1951) recognizes three subspecies as occurring in the Transvaal, i.e. *sabiensis* Roberts, 1929; *pretoriae* Roberts, 1929; and *tugulensis* Roberts, 1929. He lists these under the species *tugulensis*, which is a synonym of *angoniensis*. Following Meester *et al.* (1964), these three subspecies are considered synonyms of *O. a. rowleyi*.

DISTRIBUTION:

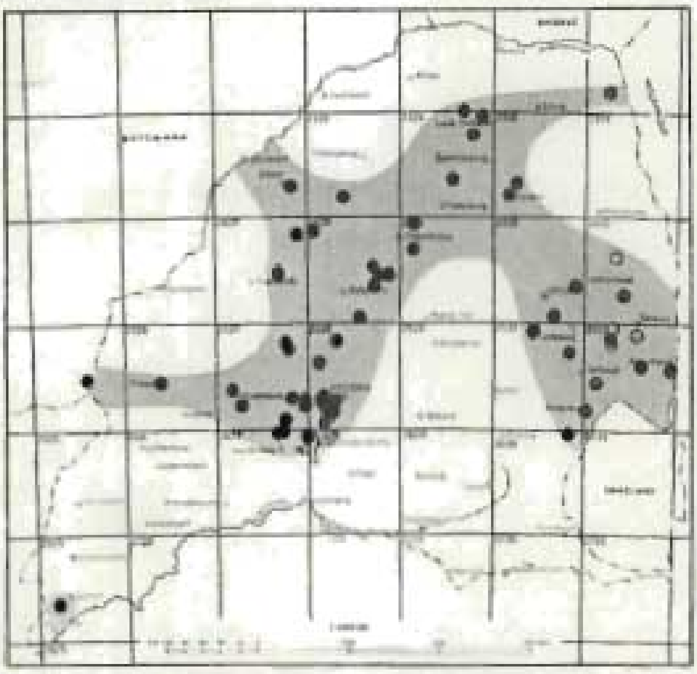

Fig.110: The distribution of *Otomys angoniensis* in the Transvaal.

Essentially an inhabitant of tropical bush and savannah in the Transvaal, and tropical coastal forests in Natal. In the Transvaal it also occurs on the highveld grassland, but then only on the fringes bordering woodlands (viz. Randfontein). The specimens from Christiana were collected in Acocks' (1975) Kalahari Thornveld and Shrub Bushveld.

HABITAT:

The Angoni vlei rat is found mostly amongst dense stands of reeds, sedges or semi-aquatic grasses on the edge of permanent water sources. This species is, however, not restricted to such a habitat, and is also found in dense grass far from water (viz. Mosdene). On the farm Groothoek, a specimen was trapped on a hill slope amongst dense grass and rocks, approximately 50 meters away from a dry watercourse.

Davis/...

Davis (1973) studied the life history of *O. irroratus* on a reserve southeast of Pretoria, where the distributional ranges of *O. irroratus* and *O. angoniensis* overlap. He found that in his study area, *irroratus* is associated with moist, almost marshy soils and the vegetation typical thereof. *O. angoniensis* occurs on adjacent drier ground with a different vegetation community. Davis (*op.cit.*) considers this difference in ecological distribution to be the result of either a specific association with a particular plant community, or more likely competitive exclusion.

HABITS:

This species is predominantly nocturnal, with some daylight activity recorded. It is terrestrial, does not normally construct burrows, but occupies grass nests at the bases of grass tufts. Well-used pathways, strewn with droppings and grass cuttings, are typical features of the Angoni vlei rat. It occurs singly, in pairs or in family groups. Home ranges are apparently maintained. As may be expected, it is at home in water.

FOOD:

Vegetarian, feeding mostly on grass stems and leaves. Also graminivorous to a lesser extent (Smithers, 1971).

BREEDING:

Monthly incidence of non-pregnant, lactating and pregnant females:

	J	F	M	A	M	J	J	A	S	O	N	D
Total	2	3	1	1	4	-	10	-	-	3	4	-
Non-pregnant	0	0	0	0	0	-	10	-	-	0	1	-
Lactating	1	1	0	0	1	-	0	-	-	0	0	-
Pregnant	1	2	1	1	3	-	0	-	-	3	3	-

Smithers (1971) recorded pregnancies in March, October and December. The available evidence suggest parturition during the warmer, wetter months of the summer season.

Mean/...

Mean number of foetuses per litter is 2,9 (N=14;2-5). No regular pattern of implantation is discernible.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	217	91	140	279
T.	78,9	91	43	102
H.Ft	25,6	91	19	35
Ear	19,3	91	11	28
Mass	89,9	56	25	138

Females

	$\bar{X}$	N	Min.	Max.
Tot.	223	97	143	272
T.	78,6	97	44	125
H.Ft	25,1	97	20	31
Ear	19,6	96	13	25
Mass	96,6	56	47	216

RECORDS OF OCCURRENCE:

Specimens examined, 222: Arnhemburg, 3 (TM); Barberton, 2 (SI); Blijdschap Priv. Nat. Res., 1 (TM); Brooklyn, 19 (TM); Donkerpoort and Zandspruit, 1 (TM); Dordrecht, 3 (TM); Faai, 1 (NKW); Ferndale, 1 (TM); Fort Klipdam, 3 (TM); Fountains valley, 4 (TM); Geluk Grecy camp, 1 (TM); Golden Harvest, 1 (TM); Groothoek, 1 (TM); Hector spruit, 1 (TM); Heuningfontein, 1 (TM); Hennops river, 7 (TM); Huwi, 1 (TM); Iscor Works, 6 (TM); Jericho, 4 (TM); Klipfontein, 2 (TM); Louis Trichard, 1 (TM); Lynnwood, 1 (TM); Lydenburg Prov. Fisheries Inst., 1 (TM); Mariepskop, 3 (TM); Mosdene Priv. Nat. Res., 3 (TM); Naboomspruit, 1 (TM); 11 km N. Newington, 2 (TM); Nylsvlei, 6 (TM); Ohrigstad Prov. Nat. Res., 1 (TM); Olifantspoort, 7 (TM); Percy Fyfe Prov. Nat. Res., 11 (TM); Platbos, 3 (TM); Pretoria, 10 (TM); Ramathlabama, 1 (TM); Rietvleidam, 14 (TM); Roberts Heights, 3 (TM); Rustenburg, 3 (SI); 8 km W. Rustenburg, 3 (TM); Schurweberg, 2 (TM); Settlers, 13 (TM); Stangene, 1 (NKW); Sterkfontein, 1 (TM); Swartkrans, 16 (TM); Tzanee 5 (TM); Tzaneen Estates, 7 (TM); Uitkomst, 1 (TM); Uitkyk and Paranie Priv. Nat. Res., 2 (TM); 16 km S. Vaalwater on Beauty Road, 3 (TM); Waterkloof, 1 (TM); Welgedaan, 7 (TM); White river, 17 (SI); Wilgekuil, 2 (TM); Zoutpan, 4 (TM); Zoutpansberg, 3 (TM).

Additional record: Open circle in the Kruger National P on the distribution map after Pienaar (1964).

Otomys irroratus Brants, 1827 — Vlei rat
Vleirot

TAXONOMIC NOTES:

The species *cupreus* Wroughton, 1906, recognized by Rober (1951), is considered a synonym of *irroratus* (Meester *et al.*, 1964; Misonne, 1974). Roberts (1951) regards the following forms as occurring in the Transvaal: *cupreus*; *cupreoides* Roberts, 1946; and *randensis* Roberts, 1929. Subspecies statu in *irroratus* is as yet unsatisfactorily resolved. Meester *et* (*op.cit.*) recognize only two subspecies. Therefore, no atte is made to assign Transvaal material to subspecies pending revision of the genus.

DISTRIBUTION:

Restricted to the grasslands of the highveld, as well as the montane grasslands of the Drakensberg es and the Soutpansberg.

HABITAT:

Restricted to wet, almost marshy, ground wi stands of grass, reeds or sedges as are normal edges of permanent water sources. On the Wol this species was procured in montane grassla from streams or marshes, although the soil

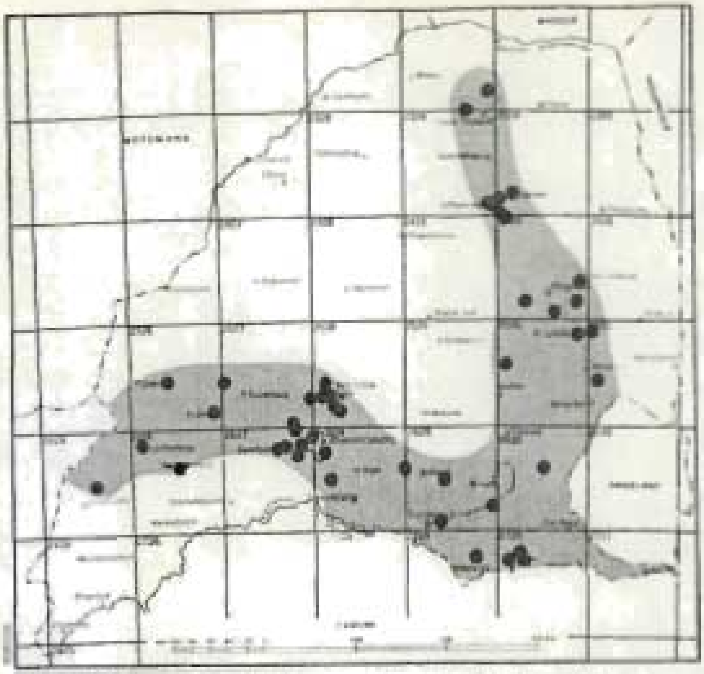

Fig.111: The distribution of *Otomys irroratus* in the Transvaal.

also Davis (1973) for a detailed description of the preferred habitat on the Maria van Riebeeck Nature Reserve (Pretoria).

HABITS:

Essentially crepuscular, but with a fair amount of diurnal and nocturnal activity (Davis, 1973). The vlei rat is terrestrial, and constructs grass nests on the surface under the protection of grass tufts or other suitable plants. Like *O. angoniensis*, it utilizes well-demarcated runways, typically scattered with the characteristic elongated, yellow-greenish faecal pellets, as well as grass cuttings remaining at feeding sites. *O. irroratus* is at home in water.

Davis (1973) studied post-natal and adult behaviour. He found that complex threat and communication patterns exist, all features of an antisocial nature. Territories are maintained, and marking behaviour is described. Nipple-clinging is commonly practiced by the young.

FOOD:

Vegetarian.

BREEDING:

Monthly incidence of non-pregnant, lactating and pregnant females:

Total/...

	J	F	M	A	M	J	J	A	S	O	N	D
Total	1	2	2	1	3	-	3	5	-	1	5	11
Non-Pregnant	0	1	0	0	1	-	3	5	-	0	2	6
Lactating	0	0	1	1	2	-	0	0	-	1	1	2
Pregnant	1	1	1	0	0	-	0	0	-	0	2	3

The above data support the findings of Davis (1973), that the species has a prolonged breeding season from early August to late April. Breeding appears to be continuous for the nine months with no obvious peaks or breaks in activity.

The mean number of foetuses per litter is 3,2 (N=9; range 1-7), and is slightly higher than the figure of 2,33 derived by Davis (*op.cit.*). No regular pattern of implantation is obvious. Davis (*op.cit.*) estimated the gestation period to be 40 days. The young develop relatively fast.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	240	160	153	315
T.	89,4	157	53	122
H.Ft	29,9	171	23	53
Ear	20,4	171	14	25
Mass	122	121	59	178

Females

	$\bar{X}$	N	Min.	Max.
Tot.	244	129	172	306
T.	89,4	128	70	115
H.Ft	29,4	133	26	35
Ear	20,7	136	17	27
Mass	114	108	71	238

RECORDS OF OCCURRENCE

Specimens examined, 349: Acre Farm 2, 2 (TM); Alberton, 2 (TM); Barberspan Prov. Nat. Res., 1 (TM); Begin der Lyn, 1 (TM); Bloemhof, 1 (TM); Blyde Forest Res., 4 (TM); Capital

Park/...

Park, 2 (TM); Dassieklip, 2 (TM); Elandsfontein, 1 (TM); Fountains Blue, 2 (TM); Goedehoop, 2 (TM); Groot Marico, 1 (TM); Grootsuikerboschkop and Elandslaagte, 6 (TM); Haenertsburg, 6 (SI); Hartebeesfontein, 1 (TM); Heuningklip, 2 (TM); Isis Estates, 1 (TM); Kastrolnek, 7 (TM); Kliprivierskoog, 1 (TM); Koster, 1 (TM); Kromdraai, 3 (TM); Langfontein, 1 (TM); Maria van Riebeeck Mun. Nat. Res., 2 (TM); Mariepskop, 3 (TM); 4 km E. Moedwil, 1 (TM); Monument Park, 1 (TM); Necorner, 1 (TM); New Agatha Forest Res., 9 (TM); Ohrigstad Prov. Nat. Res., 1 (TM); Onderstepoort, 3 (TM); Parys, 2 (TM); Piet Retief, 4 (SI); Pretoria, 21 (TM, 12; SI, 9); Randfontein, 1 (TM); Ratsegaai, 8 (TM); Rietfontein, 5 (TM); Rietvlei, 1 (TM); Rietvlei dam, 140 (TM); Rolspruit, 12 (TM); Roodepoort, 1 (TM); Roodepoort 383, 17 (TM); Spitzkop, 32 (TM); Sterkfontein, 2 (TM); Suikerboschrand Prov. Nat. Res., 7 (TM); Swartkrans, 1 (TM); Tzaneen, 11 (TM, 3; SI, 8); Uitkyk Priv. Nat. Res., 2 (TM); Voortrekkerbad, 1 (TM); Wakkerstroom, 1 (TM); Windhoek 649, 1 (TM); Witkoppen, 1 (TM); 2 km E. Witrivier, 1 (TM); Woodbush, 1 (TM); Zoutpansberg, 6 (TM).

Otomys sloggetti Thomas, 1902 — Rock karoo rat
Klip karoorot

O. s. turneri Wroughton, 1907

TAXONOMIC NOTES:

Misonne (1974) states that this is a highly variable species. Meester *et al.* (1964) are followed here, and the small series from the Transvaal is provisionally ascribed to *O. s. turneri*.

DISTRIBUTION:

In the Transvaal it is recorded only from the montane grasslands at Wakkerstroom.

HABITAT/...

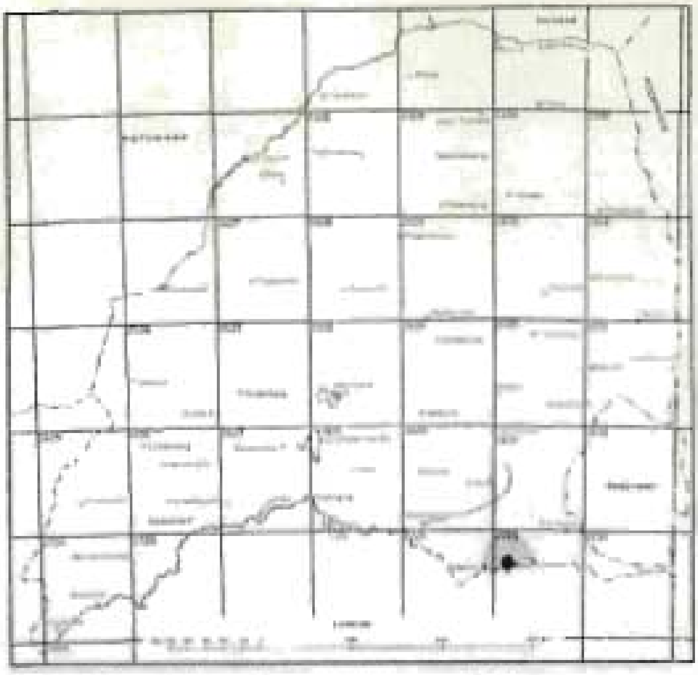

Fig.112: The distribution of *Otomys sloggetti* in the Transvaal.

HABITAT:

Good grass cover and moist conditions of higher altitudes, as well as karoid vegetation in the eastern Karoo.

HABITS:

The habits of this species are poorly known. It inhabits rock crevices, where it constructs grass nests (Roberts, 1951). In Lesotho it is known as the ice rat, because of its habit of sunning itself when there is snow on the ground.

FOOD:

No information available.

BREEDING:

No information available.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	184	5	154	224
T.	54,6	5	50	64
H.Ft	22,6	5	22	23
Ear	18,4	5	16	21
Mass	-	-	-	-

Females/...

Females

	$\bar{X}$	N	Min.	Max.
Tot.	215	3	207	218
T.	66,7	3	62	68
H.Ft	23,7	3	23	24
Ear	19,7	3	18	22
Mass	-	-	-	-

RECORDS OF OCCURRENCE:

Specimens examined, 11: Wakkerstroom, 11 (TM).

ORDER CARNIVORA

(Modified from Coetzee, 1977)

1. All cheekteeth rudimentary and wide apart; canines well developed; greatest skull length over 125 mm; ears large and pointed	Protelidae
Cheekteeth not greatly reduced	2
2. Upper carnassial (P^4) the dominant cheektooth; postero-internal to it is one very small, practically functionless molar which may be shed	3
At least one well developed and functional upper molar	4
3. Face long, jaw very powerful; 32 to (usually) 34 teeth; skull with sagittal crest well developed, forming a keel-like ridge; limbs long, with four fingers and toes	Hyaenidae
Face relatively short; usually 28 or 30 teeth; sagittal crest mostly not keel-like; limbs long, with five fingers and four toes	Felidae
4. Limbs long, adapted for running; four toes, four or five fingers (but the pollex, when present, does not reach the ground); skull long, cheek teeth at full dentition at least 6/7; ears large and erect, 80 mm and more in length ...	Canidae
Limbs not particularly adapted for running, usually rather short; cheek teeth 6/6 or less; ears rather short	5
5. Only one upper molar; bullae mostly robust and flattened, not divided into two compartments; five fingers and toes	Mustelidae
Two upper molars; bullae either rudimentary or divided into two compartments; four or five toes...	Viverridae

---

Family Canidae

(Modified from Coetzee, 1977)

1. Cheek teeth at full dentition 8/8 or usually 7/8; carnassial teeth not clearly differentiated (Subfamily Otocyoninae)... ... *Otocyon*
Cheekteeth not more than 6/7; carnassials differentiated... 2

2. M^2 reduced, smaller than the paracone (antero-external cusp) of M^1; palate width between carnassials more than half palate length measured from anterior edge of canines; skull large and robust, greatest length over 180 mm and zygomatic width over 120 mm; no pollex; ears rounded; body irregularly mottled (Subfamily Simocyoninae) ... ... *Lycaon*
M^2 less markedly reduced; palate width between carnassials far less than half palate length behind anterior margin of canines; smaller, greatest length under 180 mm and zygomatic width under 110 mm; with a small pollex (Subfamily Caninae) 3

3. Tail length over half head and body length; greatest skull length usually under 150 mm; frontals flat, post-orbital processes concave above ... ... *Vulpes*
Tail length less than half head and body length; greatest skull length over 150 mm in adults; frontals elevated; post-orbital processes convex above ... ... *Canis*

Subfamily Otocyoninae

Otocyon Müller, 1839

Otocyon megalotis (Desmarest, 1822) Bat-eared fox
Bakoorvos

O. m. megalotis (Desmarest, 1822)

DISTRIBUTION:

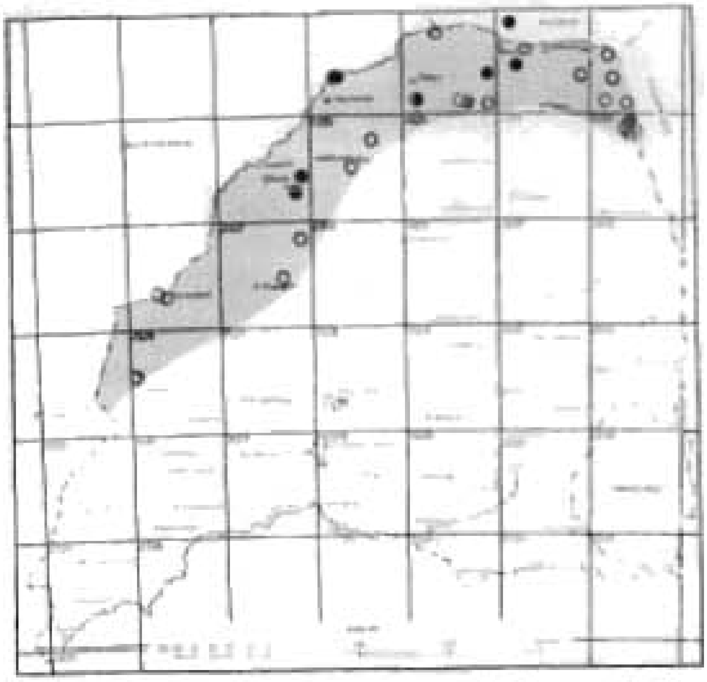

Fig.113: The distribution of *O. megalotis* in the Transvaal.

North-western, northern and north-eastern Transvaal, along the Transvaal/Botswana border, most of the way within 100 kilometers of the Limpopo river where it forms this border (Limpopo river basin).

The specimen taken at Rochdale was collected about one kilometer from the foot of the Soutpansberg. The species has not been recorded south of the Soutpansberg mountain range, although it is recorded east of Blouberg, in the break between this mountain and the Soutpansberg range.

The described distribution pattern above supports the suggestion by Smithers (1971), that the Botswana and Transvaal populations are continuous, linked for example by the Mmabolela Estates population. Coetzee (1977) considers the Transvaal and Botswana populations to represent the same subspecies. It is very likely that there is a continuous influx into the Transvaal of individuals from across the border (see below).

The distribution pattern of *O. megalotis* in the Transvaal correlates very well with that of the arid sweet bushveld, mopane bushveld, mixed bushveld and sourish mixed bushveld veld types, grouped by Acocks (1975) as Tropical Bush Savannah. No dependable evidence could be found that it still occurs in the south-western Transvaal, as suggested by Coetzee (1977). It may have occurred in these grassland areas during historical

times/...

times, but if so, suffered subsequent eradication, primarily as a result of dense human settlement and heavy cultivation.

O. megalotis is very scarce over its entire range in the province, and is seldom if ever encountered. The highest densities were found on the Botswana/Transvaal border. Human density is higher in the Transvaal than in Botswana, and the resultant greater attrition of wildlife can probably in part be blamed for the lower bat-eared fox population levels in the Transvaal. This, coupled with the fact that it is more often encountered closer to the border, suggests that its niche has been vacated in the Transvaal, with a resultant influx from Botswana. The foot-and-mouth disease control fence along the border does not serve as an effective barrier (personal observations).

It appears to be rare or endangered within the limits of the Transvaal, and warrants positive conservation measures.

The described eastwards extension of the range of this species in Botswana and Rhodesia (Smithers, 1971) is also demonstrable in the Transvaal, and was reported by Pienaar (1970) to have occurred during the period 1963-1967. A specimen (female, Smithsonian collection, no. 384712) collected in January, 1967 near Tshipise supports this contention. Mr C. Nel, owner of the farm Scrutton, reported its simultaneous appearance on his farm. Scrutton is bounded by the Limpopo and Njelele rivers. Both are perennial, but offer no serious faunal barriers. Individuals thus could have reached the borders of the Kruger National Park, but here would be confronted by the Levuvhu river, which under normal rainfall conditions may form a faunal barrier, as suggested by Pienaar (op.cit.). Pienaar's reasoning that the species invaded the Park via Mozambique as a consequence of the barrier effect of the Levuvhu, is unlikely to be correct in the light of Smithers' observation (*pers.comm.*) that it readily swims across rivers in Rhodesia. In order to reach the Kruger National Park via Mozambique, foxes would have to cross the Limpopo from the north in Mocambique, where it is a permanent stream. However, available data suggest that such an eastwards extension along the Limpopo river valley up to the Kruger National Park

may/...

may also have occurred through the Transvaal.

HABITAT:

What information could be obtained on habitat requirements substantiates the well-documented findings of Smithers (1971). It prefers the open grassland savannah associations of the lower rainfall areas, and is particularly associated with the grassy aspects of stunted stands of especially *Terminalia, Rhigozum, Grewia, Combretum, Copaifera mopane* and *Acacia*, with grass of a coarser hard nature. Soil varies from a fine greybrown or light red sand to a sandy loam. The species range lies in a summer rainfall area with annual precipitation between 325-450 mm. Altitude varies between 300-650 metres.

HABITS:

Bat-eared foxes were in all instances encountered at night. From personal observations in the Kalahari Gemsbok National Park, and from information presented by Smithers (1971) and Pienaar (1970), this species is either semi-diurnal or crepuscular and nocturnal. In many nocturnal species known also to be semi-diurnal, their regional strictly nocturnal habits are ascribed to human disturbance. However, in this case Pienaar (1970) suggest that the strictly nocturnal habits of the Kruger National Park population may be a form of protective behaviour of colonists in a new area, presumably against raptor predation. This view is partially substantiated by Smithers' (1971) observations that this species is very sensitive to changes in its environment.

This is a social species, at times encountered in groups of up to 12 individuals. Solitary individuals were more frequently encountered in the Transvaal, but this may be a result of low population levels.

More often than not it is seen in the open denuded aspects of its habitat, as well as in ploughed lands, especially peanut lands, whether to hunt insects or feed on raw peanuts. This preference for open spaces, coupled to its apparent lack of fear of vehicles, results in a high incidence of road kills over the entire distributional range.

Smithers (1971) studied bat-eared foxes in captivity. His results can be summarized as follows:
They become very tame in captivity, and make excellent pets. They are nimble on their feet and can run very fast over short distances. Characteristically they are known for abrupt directional changes when running, as well as for dodging and weaving. They are playful creatures in captivity and in the wilds alike. They love playing with balls, sticks and other light objects. Olfactory sense is well developed but vision less well.

A family group lives, and its young are born and reared, in self-constructed burrows, or also in burrows of other species, modified as required. Both male and female participate in rearing the young. Among the various noises uttered, a rattling growl made while playing was the most common. Urine marking, the use of fixed toilet sites and submissive behaviour were also observed.

FOOD:

Only three stomachs were available for analysis. One was empty. The remaining two contained the following:

Isoptera - Hodotermitidae
Coleoptera - Carabidae - *Anthia* sp. (adults)
Grass cuttings
Soil

The grass cuttings and soil are believed to have been taken incidentally while feeding on termites. The adult Coleoptera were masticated into very small pieces.

Anthia is the so-called "oogpister", which squirts an irritating fluid substance towards the aggressor. It is perhaps surprising that bat-eared foxes find these animals palatable.

Coetzee (*pers.com.*) collected a specimen after dusk in the Kalahari during January 1967, with no less than 14 000 individuals of *Hodotermes* sp. and one scorpion in its stomach. Smithers (1971) and Bothma (1966a) record a marked preference for Invertebrates, especially Scorpionidae, Coleoptera and Isoptera. Smaller rodents, snakes and lizards are also taken when available. Wild fruits

and/...

and green grass are eaten on occasion.

BREEDING:

No gravid females were collected but a lactating female was collected during March. Two to six young are born at a time. Indications are that the peak of parturition is from September to December (Smithers, 1971; Shortridge, 1934).

MEASUREMENTS AND MASS:

Only one male was available for data recording.

TM 19748: 834-261-145-136=4,3kg

Data from the only available female are as follows:

TM 25470: 853-314-143-128=4,2kg.

RECORDS OF OCCURRENCE:

Specimens examined, 5: Huwi, 1 (TM); Mmabolela Estates 1 (TM); Rochdale, 1 (TM); Shingwedzi, 1 (NKW); Tshipise, 1 (SI). Coyote-getter returns from 2229 CC, 2229 DB, 2228 CB (records and material housed by the Transvaal Provincial Administration Division of Nature Conservation).

Additional records: Sightings from Greefswald, Donkerpoort and Zandspruit, Huwi, Mooigenoeg, Mooiplaas, Nicorel, Parkfield and Delamere, Platbos, Rochdale, Rykvoorby, Scrutton, Urk, Welgevonden, Open circles in the Kruger National Park on the distribution map after Pienaar (1970). A record from 2230 AA in Rhodesia is based on material housed in the Rhodesian National Museums (Smithers, *in litt.*).

Subfamily Simocyoninae

Lycaon Brookes, 1827

Lycaon pictus (Temminck, 1820) Hunting dog
Wildehond

L. p. pictus (Temminck, 1820)

TAXONOMIC/...

TAXONOMIC NOTES:

The nominate subspecies was described from the coast of Mozambique. *L. p. zuluensis* Thomas, 1904, described from the Pongola river, and *L. p. venaticus* (Burchell, 1824), from the upper Orange river, were recognized by Allen (1939), but overlap in range with *L. p. pictus*, and both have been included in the typical subspecies by Coetzee (1977). *L. p. zuluensis* has been separated on the basis of pelt colouration patterns of the holotype and two paratypes, as well as the relatively smaller skull dimensions of the holotype. Roberts (1951) and H. and J. van Lawick-Goodall (1970) demonstrate considerable variation in colour patterns and skull size in *L. pictus*, which limit their value as taxonomic characters.

DISTRIBUTION:

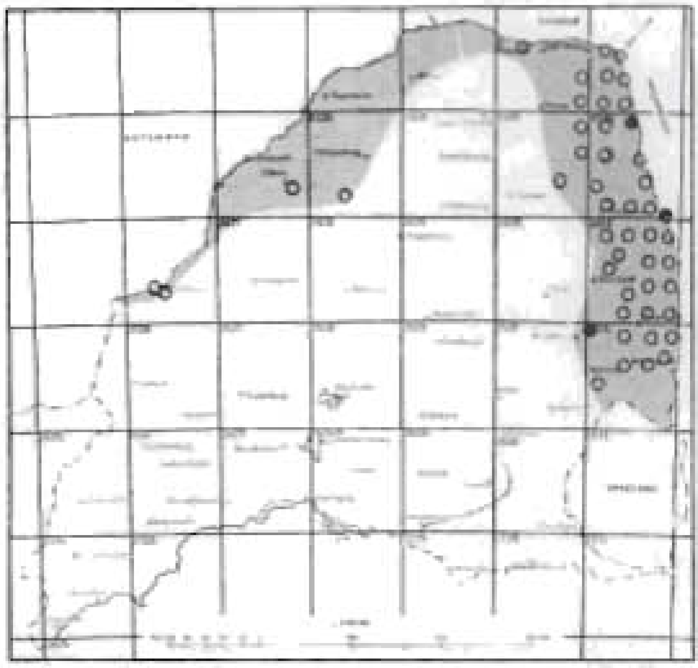

Fig. 114: The distribution of *L. pictus* in the Transvaal.

No stable populations occur anywhere outside the Kruger National Park. Migrants occasionally enter the more remote agricultural areas of north-eastern and northern Transvaal from Botswana and possibly from Rhodesia. These are, however, isolated instances, and the intruders are mercilessly hunted down. Long since exterminated throughout the rest of Transvaal (See also Shortridge, 1934). The Kruger National Park populations fluctuate in numbers primarily due to Rickettsial epizootics. The estimated numbers in this area just prior to 1963 were between 315 and 360 individuals (Pienaar, 1963).

HABITAT/...

HABITAT:

This species has an exceptionally wide habitat tolerance. It can be found in arid scrub savannah with seasonal surface water for prolonged periods, or in open plains and wooded areas with permanent water. Apparently dependent on surface water according to Shortridge (1934). Pienaar (1963) records the focal point of population density to be in the mountainous areas of the southern district and the western half of the northern district of the Kruger National Park. Smithers (1971) does not confirm the preference for broken hilly country which this plies. Optimum habitat consists of open plains with concentrations of small and medium-sized antelope species. Avoids forests (Ansell, 1960).

HABITS:

A social species. A hierarchy is a normal framework for most social mammal species and, in the case of the wild dog, a separate ranking order for males and females is present within a pack (H. and J. van Lawick-Goodall, 1970). In extreme cases packs consisting of up to 100 individuals have been noted (Shortridge, 1934), and packs of 35-40 individuals are also recorded (Smithers, 1971). This is, however, believed to be exceptional, as the per capita energy expenditure in hunting ventures in such cases is not justified by the small proportional energy return in the form of food, provided that the entire pack hunts as a unit. Ten to 15 individuals seem to be an optimum number in this respect, which is more commonly reflected in nature. In S.W.A. single individuals have been observed hunting alone. In the Transvaal outside the Kruger National Park single or paired individuals are the rule as a result of hunting pressure.

Wild dogs roam extensively, following the movements of game concentrations, and can truly be termed a nomadic species. The only occasion when the pack will temporarily remain in an area is when newly born litters are kept in dens while they are too young to endure a nomadic existence. It is not certain whether packs maintain temporary home ranges.

Wright/...

Wright (1960) found that hunting dogs, together with the leopard, are the most economical of predators. They utilize everything killed to the maximum. The well-organized hunting technique of the hunting dog is seldom admired by sentimentalists who abhor its killing technique. The leader normally selects the victim, often from amongst a large herd, and this animal is then run down till exhausted, at speeds of up to 60 km/h, and then killed. Only one or a few individuals actively pursue the prey with the rest of the pack following behind, until this spearhead is exhausted and is then replaced by fresher teammates. When the prey drastically changes direction, one of the followers cuts it off by a shorter interception route. Medium-sized prey have been reported to be completely devoured within minutes.

Hunting dogs are mainly diurnal, and normally hunt during the cooler periods of the day, or at any time on cool or overcast days. They have been reported to hunt on bright moonlit nights, but this may be the exception. The possibility that night hunting could be opportunistic should, however, not be ruled out.

Three basic sounds have been described, namely an alarm call, a nervous chattering when the kill has been made or during mating, and a communicative single call-note repeated eight to ten times, mostly in the morning, to rally the other members of the pack (Shortridge, 1934, and Smithers, 1971).

The strong, unpleasant odour of this animal has been referred to by many authors. Smithers (1971) speculates on the possibility of this being partly the result of stress. No references could be found to the presence of scent glands and their possible role in social relationships.

Young in the pack appear to be the concern of all, and are fed solid food by regurgitation. Initially the mother stays with the pups for protection and to suckle them, and is then fed in the same way.

<u>FOOD</u>:

No data obtained.

/...

A true carnivore, which selects and hunts its own food according to demand, and ignores carrion altogether. Prefers social antelope species in the smaller and medium-sized range but is capable of killing even adult zebra (H. and J. van Lawick-Goodall, 1970). Readily takes the young of big game such as buffalo. Roberts (1951) recorded a pack of wild dogs hunting cane rats (*Thryonomys*) in dense grass, by spreading out and driving from one end to the other. Domestic animals such as goats and donkeys are also taken. The only exception in the medium-sized group appears to be full-grown warthog and bushpig males, which possess the means of successful defence.

Smithers (1971) records instances of cannibalism when a member of the pack is incapacitated. Killing of injured pack members may have adaptive significance,since the individual not contributing to the interests of the pack has become redundant.

BREEDING:

No data obtained from the Transvaal. A strong tendency is evident for parturition to occur during the dry season, mainly between April and September. One litter per year. Litter sizes between two and sixteen have been recorded, seven being the mean. Gestation period 72-80 days. Six or seven pairs of teats (Ewer, 1973 p.308). The young are born in disused and modified antbear holes lined with nesting material.

SIZES AND MASS:

No data obtained.

RECORDS OF OCCURRENCE:

Specimens examined, 12: Junction Letaba and Olifants rivers, 3 (TM); Sabi Game Reserve, 1 (TM); Shingwedzi, 1 (TM); White river, 7 (TM).

Additional records: Sightings from Dordrecht, Hans Merensky Prov. Nat. Res., Huwi, Letaba Ranch, Mooigenoeg, Mooiplaas, Othawa, Sandringham Priv. Nat. Res., Scrutton, TenBosch Estates, Timbavati Priv. Nat. Res., Uitkyk and Paranie Priv. Nat. Res.

Open/...

Open circles in the Kruger National Park on the distribution map after Pienaar (1963).

Subfamily Caninae

Vulpes Oken, 1816

Vulpes chama (A. Smith, 1833) Cape fox
Silwervos

TAXONOMIC NOTES:

A monotypic species.

DISTRIBUTION:

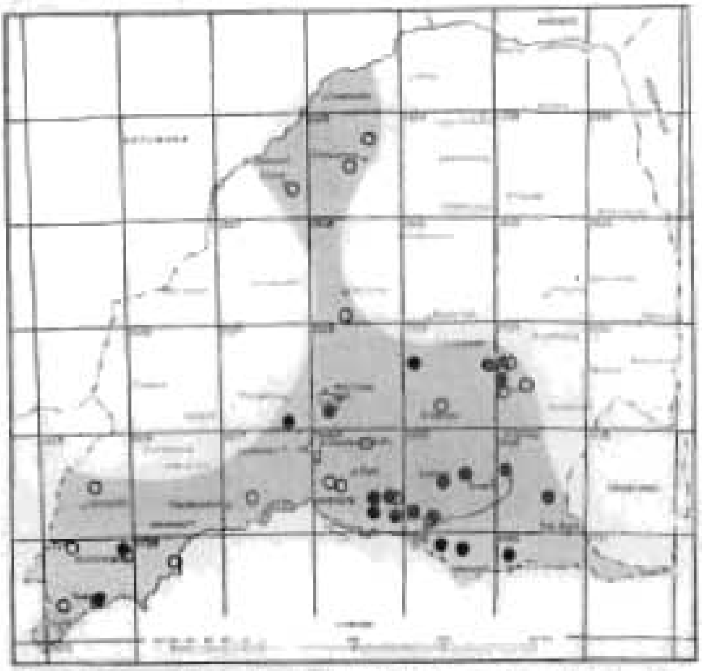

Fig. 115: The distribution of *V. chama* in the Transvaal.

Coetzee (1977) lists the distribution as Transvaal, eastern lowveld excluded. Although fragmentary, the available data support this statement. Certainly not recorded in the Kruger National Park (Pienaar, 1963), and neither could any evidence be found of its occurrence north of the Soutpansberg, or on the escarpment.

Although normally associated with grassland, it also occurs in open parts of lightly wooded country. Thus a good correlation was found between its range and that of certain vegetation types as defined by Pole-Evans (1953). It occurs on all three Grassland veld types, as well as the "Thorn country" subdivision of his Parkland vegetation type. The silver fox is absent from the more heavily wooded "Evergreen and deciduous tree and brush" and "Subtropical ever-

green/...

green and deciduous tree and thorn forest" vegetation zones (Pole-Evans, *op.cit.*).

Extrapolating from this it has almost certainly been overlooked in the area between Zeerust and Derdepoort towards the west, as well as in the Groblersdal, Potgietersrus and Ohrigstad areas towards the east. An area with apparently suitable habitat where the species possibly does not occur is the Pietersburg plateau grassland.

HABITAT:

Has a marked preference for open country ranging from pure grassveld to savannah grassland and open scrub or thornveld. It appears to be more often encountered in areas to a greater or lesser extent denuded of grass. On the other hand, the silver fox is a relatively small animal, and can easily be overlooked in a normal grass stand.

HABITS:

Very little is known about this secretive animal. Solitary individuals are normally encountered, and occasionally pairs, presumably during the mating season. It is a nocturnal animal and, according to Shortridge (1934), occasionally crepuscular. During the day it lies up under the cover of brush or rocks, or in burrows (Roberts, 1951). Shortridge (1934) describes its call as a "bark". The apparent preference for denuded areas results in a high incidence of road kills.

FOOD:

Only one stomach was available for analysis. This was almost empty, with only 72 cc of carrion. However, feeding habits are fairly well documented by Bothma (1966a and 1966b) and Smithers (1971). Preys on rodents, small birds, eggs, reptiles, insects, and Arachnida, all of which are actively hunted. Apparently about the biggest animal it is capable of hunting is a hare (*Lepus*). Takes carrion to a lesser extent, and also vegetable matter. Appears to be an opportunistic feeder. No reliable

records/...

records exist of predation on domestic stock. yet it is often hunted because of the stigma attached to any fox or jackal. The more common Afrikaans vernacular name (Silwerjakkals) may in part be responsible for this association with true jackals, which are known to kill domestic stock.

BREEDING:

All available records indicate that the silver fox is a strictly seasonal breeder, with parturition during the latter half of September and the first half of October. Brand (1963) records five births in captivity during this period. This is substantiated in the wild by Shortridge (1934) and Smithers (1971). During December 1974 a female and two young were observed, suggesting that the female alone is responsible for rearing the young. One to four pups per litter. Gestation period 51-52 days (Shortridge, 1934).

SIZES AND MASS:

The data from only two males ara available:

TM 19586: 860-380-125-90=?

TM 20267: 850-320-115-96=3,0kg

The data from the only available female are as follows:

TM 19164: 890-370-140-90=?

RECORDS OF OCCURRENCE:

Specimens examined, 10: Belfast, 1 (SI); Ben Schoeman Highway at Lyttleton/Clubview turnoff, 1 (TM); Ermelo, 1 (SI); Goedehoop, 3 (TM); Joshua Moolman Priv. Nat. Res., 1 (TM); Langfontein, 1 (Priv. coll.); Uitkomst, 2 (TM). Coyote-getter returns from 2725 BB, 2729 BA, 2628 DD, 2629 CD, 2729 AB, 2628 DB, 2629 CC, 2628 DC, 2530 AC, 2628 DB, 2529 AC, 2630 AC, 2529 BD, 2725 DA, 2628 DA (records and material housed by the TPA Division of Nature Conservation).

Additional records: Sightings from Barberspan Prov. Nat. Res., Brandhoek, Grootsuikerboschkop and Elandslaagte, Huwi, Nicorel, Suikerboschrand Prov. Nat. Res., Welgedaan, Welgevonden,

Witpoort/...

Witpoort. Literature records from Belfast, Bloemhof, Delmas, Dullstroom, Heidelberg, Machadodorp, Middelburg, Schweizer Renecke, Warmbaths, Wolmaransstad (Bothma, 1966).

Canis Linnaeus, 1758

1. Carnassials relatively small, length of upper less than 83% of M^1+M^2 and that of lower 130% of M_2+M_3; tip of tail white; ears dark grey behind; dark stripe on either flank ... ... *adustus*
Carnassial/molar ratio as defined above over 83% in the upper and over 130% in the lower tooth row; tip of tail not white; ears reddish-brown behind; no dark stripe on either flank ... ... *mesomelas*

Canis adustus Sundevall, 1846 — Side-striped jackal
Witkwasjakkals

C. a. adustus Sundevall, 1846

DISTRIBUTION:

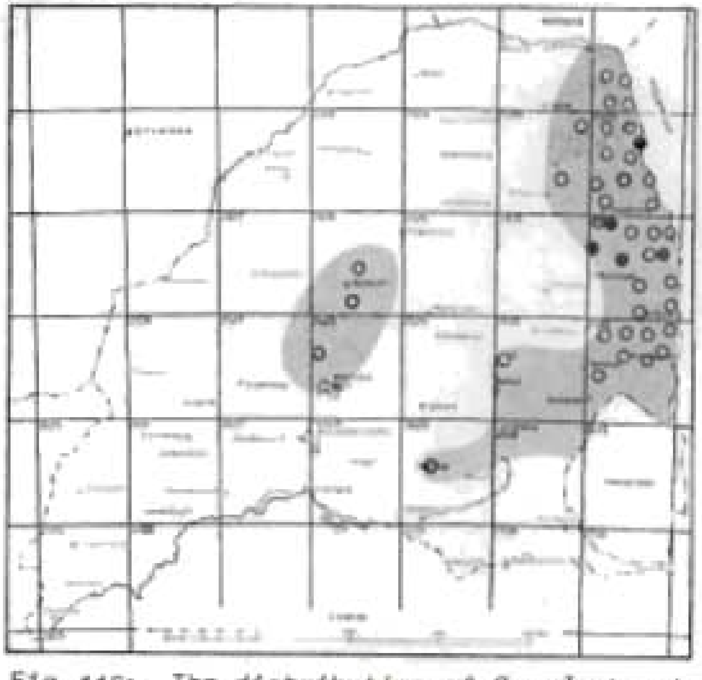

Fig. 116: The distribution of *C. adustus* in the Transvaal.

The eastern Transvaal lowveld, as well as the Belfast, Dullstroom, Nylstroom and Pretoria districts. Records from west of the escarpment are suspect if not based on museum specimens. However, a record from Bethal is based on three specimens collected by Bothma (1965); one from

Dullstroom/...

Dullstroom is from mr Leo Davis (*pers.comm.*), who has trapped in this area; and records from the Nylstroom and Pretoria districts are from personal observations. These highveld records substantiate the observations of Haagner (in Shortridge, 1934) on the distribution of this species in the Transvaal. No confirmation of its occurrence in northern Transvaal, as claimed by Coetzee (1977), has been found.

The distribution correlates well with that of some of Acock's (1953) Tropical Bush and Savannah Types, i.e. the lowveld, arid lowveld, Springbok flats, mopani-veld and mixed bushveld elements, as well as the north-eastern sandy highveld and *Themeda* veld elements of the Pure Grassveld Types.

A similar relationship can also be found with Pole Evans' (1935) subtropical evergreen deciduous tree and thorn forest in particular, as well as evergreen and deciduous tree and bush. The Dullstroom and Bethal records fall within this short grass veld type.

However, these apparent relationships do not explain the fact that this species has never been recorded in mopani-veld areas north of the Soutpansberg in Transvaal and southeastern Botswana. Its restricted range can therefore not be satisfactorily explained only on the basis of preferred habitat types.

The Bethal and Dullstroom records are from areas completely outside the wooded country this species has hitherto been recorded from, and the possibility of these specimens having been migrants should not be overlooked until more information can be obtained. These localities are on the upper reaches of the Olifants and Komati rivers, and it is possible that the side-striped jackal has ventured this far into the highveld along wooded river courses. The Olifants and Elands rivers may similarly serve as a corridor to the Springbok flats, where a permanent population is known to exist.

<u>HABITAT</u>:

All records, except those from Bethal and Dullstroom, are from well wooded, predominantly subtropical areas such as the lowveld. All these areas are well watered, with mean annual

rainfall/...

rainfall between 250 and 750 mm. However, the side-striped jackal avoids forests (Pienaar, 1963).

HABITS:

Always encountered singly or in pairs, and apparently does not form bigger groups. So far observed only during the night, but in areas relatively undisturbed by humans also crepuscular, and occasionally even active during the day (Roberts, 1951; Smithers, 1971). Lies up amongst scrub and tall grass during the day, and uses antbear and other burrows only for refuges and for giving birth. As stated by Smithers (1971), it is shy and keeps on the move when observed in the beam of a spotlight. However, one individual observed north of Pretoria stood and looked at the vehicle at a distance of 20 metres for approximately three minutes before wandering off into the bush. The call is a series of short barks, unlike the drawn-out howl of *C. mesomelas*.

FOOD:

Smithers (1971) and Bothma (1965) reported on the contents of altogether 15 stomachs. A preference for small vertebrates, carrion, insects, fruit and vegetable matter is evident from their findings, suggesting that it is an opportunistic feeder. Although Bothma (1965) found sheep remains in the stomach of a young male, Shortridge (1934) and Roberts (1951) agree that this species is unlikely to attack healthy domestic stock. As in three cases reported by Smithers (1971) of side-striped jackals feeding on the carcasses of cattle and goats in Mashonaland, the male reported by Bothma may have come across a dead sheep on which it fed.

BREEDING:

No data obtained from the Transvaal.

Brand (1963) records two litters born in captivity during September. Smithers (1971) recorded pregnant females collected during August, September and November. From this meagre information it appears that side-striped jackal breeding inclines to

be/...

be seasonal, occurring at the onset of the wet season. Gestation period 70 days (Shortridge, 1934); 57 to 60 days (Asdell, 1946).

SIZES AND MASS:

No data obtained.

RECORDS OF OCCURRENCE:

Specimens examined, 10: Kempiana, 3 (TM); Klaserie, 2 (TM); Mahlati, 1 (TM); Olifants river, 2 (TM); Satara, 2 (TM).

Additional records: Sightings from Buffelshoek, Grootsuikerboschkop and Elandslaagte, Hans Merensky Prov. Nat. Res., Letaba Ranch, Mosdene Priv. Nat. Res., Rhoda, Rissik Priv. Nat. Res., TenBocsh Estates, Toulon, Uitkyk and Paranie Priv. Nat. Res., Zoutpan (Pretoria). Open circles in the Kruger National Park on the distribution map after Pienaar (1963); Farm Zeekoeigat 145 from Bothma (1965).

Canis mesomelas Schreber, 1775 — Black-backed jackal
Rooijakkals

C. m. mesomelas Schreber, 1775

TAXONOMIC NOTES:

Roberts (1951) and Coetzee (1977) recognize three subspecies in southern Africa, apart from two extralimital ones. The southern African races are *C. m. mesomelas*, originally described from the "Cape of Good Hope", ranging from the Cape Province, through the Transvaal to Rhodesia and Mocambique, and recognized by its dark coat colouration and large skull size; *C. m. arenarum* (Thomas, 1926) distributed through S.W.A. and Botswana, lighter in colour with a smaller skull; and *C. m. achrotes* (Thomas, 1926) from the Namib desert, with body colour lightest and skull size smallest.

Since the distribution of the species is continuous throughout its range, both Roberts and Coetzee are somewhat vague as to the exact geographic boundaries of these three subspecies, and list their ranges in terms of political areas. Both agree that the Transvaal population represents *C. m. mesomelas*, while Smithers (1971) assigns the Botswana material he studied to *C. m. arenarum*. Some doubt nevertheless exists as to which subspecies Transvaal material should be assigned to, particularly in the case of specimens from near the Botswana border. Considerable variation in subspecific characters was observed in Transvaal specimens.

Smithers (1971) could find no consistency in body colour as a distinctive subspecies character in *C. m. arenarum* from Botswana. Similarly, Ferguson (*pers.comm.*) found great variation in colour within populations from the Kalahari Gemsbok National Park (*C. m. arenarum*) and the Transvaal (?*C. m. mesomelas*). Transvaal Museum material collected in the Transvaal is equally variable.

Specimens from localities as far apart as Mmabolela Estates (bordering on Botswana and thus again possibly in the range of *C. m. arenarum*) and Wolmaransstad are very similar in that they display much more black than white in dorsal colour, in other words the characteristics of *C. m. mesomelas*. On the other hand, specimens from a relatively small area in the eastern Transvaal lowveld (Letaba to Sabie rivers) vary in that either black or white may predominate in the dorsal saddle. In the same series, ventral colour varies from the entire belly, inguinal region and front legs being pure white, to a condition with no white at all but varying shades of yellow instead.

As in the Botswana series, Transvaal subadults are paler, with the saddle an ill defined drab brown colour flanked by yellowish brown. The latter in fact resemble a very old specimen (TM 16785) collected in the Kalahari Gemsbok National Park in 1970. This similarity may be due to the black and white bristle hairs being absent in subadults, whereas the very old specimen has again lost these hairs. Obviously the age of the specimen should be taken into account when comparing colour. No reference could be found to the possibility of seasonally induced moulting in black-backed jackal.

Smithers (1971) found skull length to be a more useful characteristic in separating *C. m. mesomelas* and *C. m. arenarum*. The ranges cited by him are tabulated below. Lombaard (1971), working on some 400 skulls, collected at various localities in the Transvaal, established ageing criteria for the black-backed jackal. His graphs indicate that the species reaches physical maturity at approximately nine months of age, i.e. ten weeks after full permanent dentition is attained. From nine months onwards mean increase in skull length is neglible. He also demonstrates enormous variation in skull length in adults. His figures (maximum/minimum of sexes combined, and the means of males and females separately) are included in the following table:

	C.m.mesomelas	*C.m.arenarum*	Lombaard's Sample
Greatest skull length	171-175	152-171	140-172; $\bar{X}$♂ 164; $\bar{X}$♀ 1
Basal skull length	160	141-164	130-165; $\bar{X}$♂ 151: $\bar{X}$♀ 1

Comparing Lombaard's measurements with variation in greatest skull length and basal length cited for *mesomelas* and *arenarum* (Smithers, 1971), it is obvious that Lombaard's ranges overlap the combined ranges in both parameters for both subspecies. However, when Lombaard's mean values for adult males and females are compared with the values for the two subspecies, the Transvaal population dealt with by him resembles *C. m. arenarum* more closely, *pace* Roberts (1951) and Coetzee (1977)

A sample of some 1 200 black-backed jackal skulls collected in various parts of the Transvaal by the Transvaal Provincial Division of Nature Conservation was made available through the kind permission of dr S.S. du Plessis (Director) and mr W.J. Ferguson (Professional Officer, Predator Control Research). The greatest skull lengths of all these specimens were measured.

The adult males in the sample were then divided into groups collected in the same degree square, and the mean of each such degree square sample was calculated, as well as the standard deviation and standard error of the mean, to test the possibility

of/...

of a size cline existing either from north to south or from west to east (Fig.117). No positive conclusions could be arrived at in this way.

The values for all adult males from each degree South latitude were then grouped, and the means, standard deviations and standard errors of the means of the combined samples calculated to examine the possibility of a size cline from north to south (Fig.118). The results indicate a possible cline, but inadequate samples from 22-23, 23-24, and 28-29 degrees latitude tend to obscure any trends that do occur.

It was consequently decided to test the nine centre degree squares whence adequate samples are available, i.e. from 24 to 27 degrees S latitude, and 27 to 30 degrees E longitude (area outlined in Fig.117) for geographic variation. Again adult males from the three degree squares of the same degree latitude were treated as a combined sample, and the means $\bar{X}\pm 1SD$ and $\bar{X}\pm 1SE_M$ were calculated. Fig.119 illustrates an increase in average maximum skull length in the sample from north to south in this area.

The hypothesis that mean greatest skull length of populations from each of the degrees latitude (24^{o}-27^{o}) does not differ significantly was then tested by computing respective Normal deviates (Hunter, Box and Horn, 1968). Results are tabulated in Table 1. The sample from 24^{o}-25^{o}S latitude differs significantly at the 5% level from the sample from 25^{o}-26^{o}S latitude. Similarly, the sample from 25^{o}-26^{o}S latitude differs significantly at the 5% level from that from the 26^{o}-27^{o}S latitude sample. The sample from 24^{o}-25^{o}S latitude, differs from the sample from 26^{o}-27^{o}S latitude at the 1% level, which is highly significant. This strongly suggests a southwards increase in mean greatest skull length of black-backed jackal in the sample area.

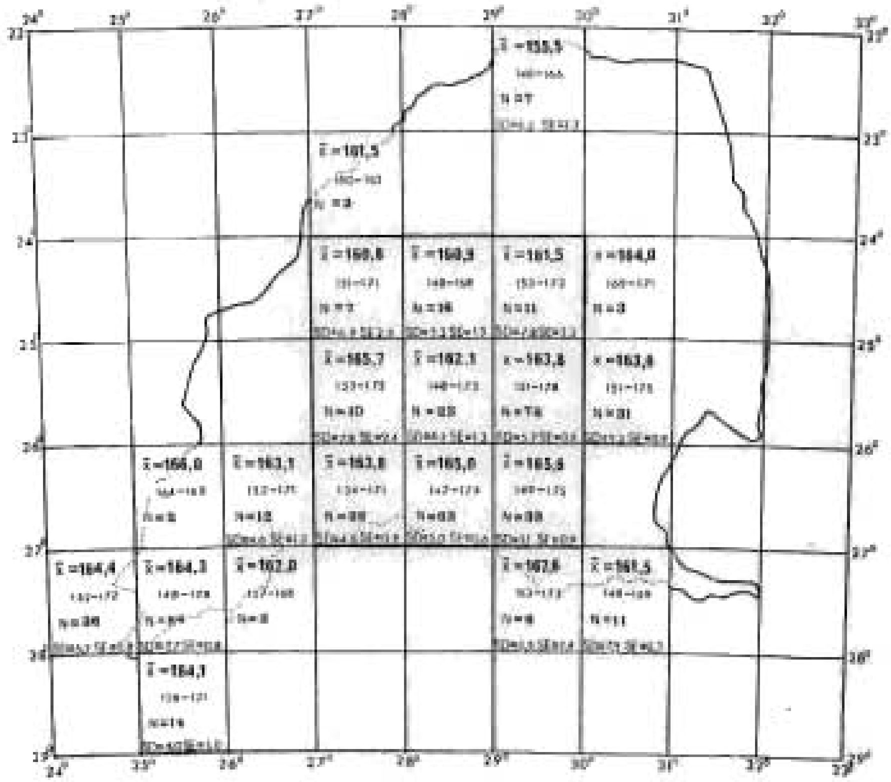

Fig.117: The calculated basic statistical values per degree square of greatest skull length in adult male and female black-backed jackals. The mean ($\bar{X}$), range, sample size (N), two standard deviations (SD), and two standard errors of the mean (SE) values are indicated.

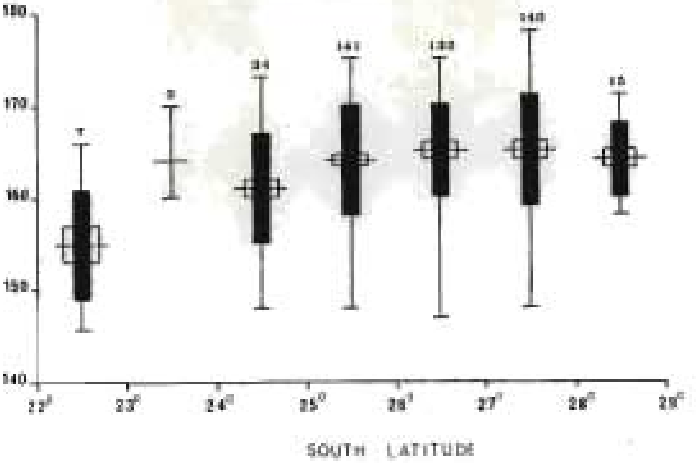

Fig.118: Graphic representation of greatest skull length in black-backed jackal (sexes combined), samples analysed from each degree latitude between 22°S and 29°S. The sample size from each degree latitude is given above the diagramatic presentation of the statistical values. Observed ranges for each sample are indicated by a vertical line, $\bar{X}\pm2SE_M$ by a hollow rectangle bisected by a vertical line ($\bar{X}$), and $\bar{X}\pm2SD$ by a solid rectangle.

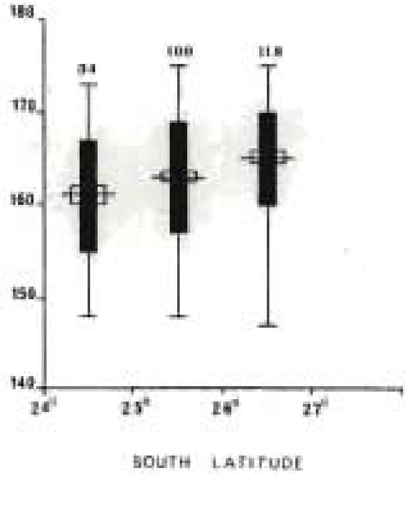

Fig. 119: Graphic representation of greatest skull length in black-backed jackals (sexes combined) from the area between 27°E and 30°E longitude for 24°S, 25°S, and 26°S latitude respectively. Other explanations as in Fig. 118.

Table 1: Values of the normal deviate z for greatest skull length of male black-backed jackals from different latitudes in the Transvaal. Levels of significance are indicated in brackets.

	24-25°S Lat	25-26°S Lat.	26-27°S Lat.
24-25°S Lat.			
25-26°S Lat.	2,02* (5%)		
26-27°S Lat.	4,18** (1%)	2,12** (5%)	

A clinal southwards increase in size throughout the species range offers a more acceptable alternative to the rather confusing taxonomic relationships reported for *C. m. achrotes*, *C. m. arenarum* and *C. m. mesomelas*. Pending detailed studies on subspecies status in *C. mesomelas*, I provisionally assume that such a cline could also be shown over the entire range of the species in southern Africa, and that the described subspecies in this area are not valid. The nominate race is therefore the only form recognized, with *C. m. achrotes* and *C. m. arenarum* as synonyms. Accordingly the black-backed jackal from the Transvaal is here assigned to *C. m. mesomelas*. The two central African subspecies, *C. m. schmidti* and *C. m. elgonae*, have not been compared, and may prove valid in relation to this southern race.

DISTRIBUTION:

Widely distributed throughout the Transvaal. It has, however, not been recorded on the eastern escarpment, although it can be expected to be found on the top and at the foot of this mountain range. It may have been overlooked at the eastern limits of the Soutpansberg north-east of Sibasa, as it is found up to the northern and southern base of the western part of this mountain range.

Judging/...

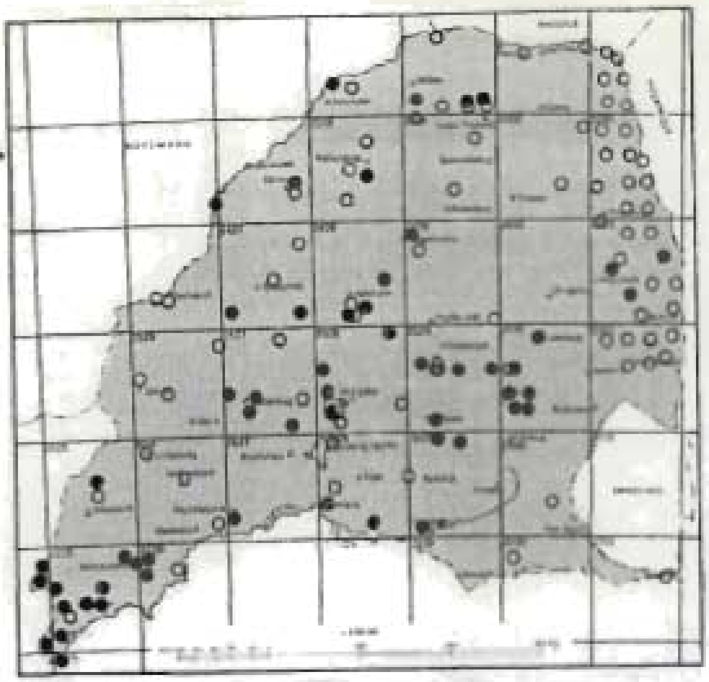

Fig. 120: The distribution of *C. mesomelas* in the Transvaal.

Judging from popular accounts *C. mesomelas* is much more abundant in the highveld regions, thus creating the impression that this species is gradually being replaced by *C. adustus* in the area of sympatry, *C. mesomelas* there becoming scarcer. This gradual replacement of *C. mesomelas* by *C. adustus* has been documented by Shortridge (1934) for the Caprivi, Zambia, Malawi and Mocambique, as well as by Smithers (1971) for northern Botswana. This may also be true in the Transvaal. However, it must be kept in mind that small livestock farmers on the Transvaal highveld are very sensitive to the presence of this predator, which results in predator control by the Transvaal Provincial Administration Nature Conservation Division, particularly on the highveld, where this type of farming is prevalent. Apart from the Groblersdal district, very little control has been undertaken in the bushveld areas, resulting in fewer specimens being recorded. Thus more records of this cunning and resourceful animal exist on the highveld, which happens to fall outside the range of *C. adustus*, suggesting, I think erroneously, that it is more common here.

Based on data accumulated by this project the black-backed jackal appears to hold its own against the side-striped jackal in their area of overlap within the Transvaal. In this respect Pienaar (1963) cites it as being common in the central Kruger National Park, and scarcer in the southern and northern districts. He calculated numbers as stabilized at approximately 500 for the whole area. In contrast he considers the side-striped jackal to be nowhere common in the Kruger National Park, and estimates their numbers to be not more than 300.

HABITAT/

HABITAT:

Because of the predominance of records from sheep farming areas a breakdown of habitats whence specimens have been recorded will be biased towards the grassland areas of the high-veld. The records analysed by Smithers (1971) for Botswana populations show a similar preference for open grasslands.

My observations do, however, agree with those of Shortridge (1934) and Smithers (1971) in that black-backed jackals appear to have a wide habitat tolerance and occur equally in open grassland, scrubland and open savannah as well as light woodland. In the Serengeti, Wyman (1967) found black-backed jackals typically only in bushveld and the transition zone bordering the open plains. but *C. aureus* Linnaeus, 1758, there occupies the open plains.

C. mesomelas has not been recorded in the Transvaal from dense forests such as riverine or montane forest, montane grassland or very mountainous or rocky habitat.

HABITS:

Mainly a nocturnal animal. In areas relatively undisturbed by civilization individuals are occasionally encountered during the day, especially in the mornings and late afternoons. In farming areas it is never seen during the day and has adopted an extremely cautious and elusive mode of life. In these areas black-backed jackals are rarely if ever seen either by day or by night, but their call is often heard, especially at dusk.

Black-backed jackals have a reputation as sheep killers, but their reputation in this respect today is blacker than they deserve. Often sheep massacres by domestic dogs are blamed on jackals.

Both Shortridge (1934) and Roberts (1951) speculate on the effect of farming and its resultant disturbance of the environment on changes in the feeding habits of the black-backed jackal, and my own views support theirs. Shortridge (1934) documented instances of S.W.A. farmers regarding jackals as not significantly harmful, and possibly even beneficial, as a check on parabotulism by removing carrion from the veld. However, intensive farming practices have resulted in extermination of the larger predators,

and/...

and thus depriving jackals of a potential food source in the form of leftovers from kills. In addition, heavy sheep grazing pressures have certainly depleted the micro-habitat of small mammals and some bird species, with a resultant drop in population densities. The jackal is thereby deprived of its natural prey. It is consequently reasonable to assume that jackals were forced to turn to sheep and goats as a substitute prey. Grafton (1965) attribute the black-backed jackal's ability to survive as a larger predator in areas occupied and cultivated by man, to its remarkably adaptable food habits.

Normally solitary individuals are encountered, although pairs or even small groups, presumably small family parties, are also seen. The young are born and cared for in burrows. According to Sclater (1900) both parents participate in rearing the young. Smaller food items are brought to the burrow in their mouths, otherwise the young are fed by regurgitation. Escape exits facilitate easy escape for the young when disturbed, while adults hide in brush or dense grass by day.

My experience confirms that of Shortridge (1934), that these animals are particularly difficult to trap in areas where they are subjected to high and continuous hunting pressure.

In view of its economic importance it is amazing how little is known of this species. Van der Merwe (1953) discusses certain aspects. However, behaviour, social structure, territoriality and home range sizes are all facets so far virtually unstudied. This undoubtedly is due to the secretive nature of the species. Fragmentary evidence, however, suggests that adult black-backed jackal move over extensive areas. Bothma (1971) recorded tagged animals found as far as 103 km from the tagging site.

FOOD:

Frequency of occurrence of food items in eight black-backed jackal stomachs is as follows:

Carrion		6
Coleoptera:	Scarabaeidae	4
	Curculionidae	2

Tenebrionidae/...

Tenebrionidae	2
Unidentified	1
Orthoptera: Acrididae	4
Gryllidae	2
Lepidoptera: *Heterocera* caterpillar	2
Annelida: *Lumbricus*	2
Green grass (Undet.)	4
Leaves (Undet.)	2
Seeds (Undet.)	2
Peanuts + Shells	2
Small sticks	3
Mammalia: Rodentia	2
Aves (Undet.)	1
Total:	41

The above sample is too small to reflect the feeding habits of black-backed jackals accurately. However, this aspect of the biology of the species has received much attention from various authors. It is well known that jackals are carrion eaters and scavenge on the kills of larger predators in a balanced ecosystem. Wyman (1967) found that in the Serengeti *C. mesomelas* hunts the abundant Thompson's gazelle (*Gazella thomsoni* Gunther, 1884) which is the biggest wild animal on record to have been killed by this jackal. Similarly Hirst (1969) reports it as killing impala lambs in the Transvaal. In areas where prey is less abundant scavenging and carrion eating supply the main diet, eg. Ngorongoro crater (H. and J. van Lawick-Goodall, 1970), and elsewhere it relies on insects for the main bulk of its diet, eg. in the Kalahari (Bothma, 1966).

Other food items recorded from stomach contents are: carrion, domestic stock, hare, springhare, rodents, insectivores, ungulate placentas during the calving season, birds, snakes, lizards, arachnids, insects, cultivated crops, wild fruit, and grass (Shortridge, 1934; Grafton, 1965; Bothma, 1971a; Smithers, 1971). The black-backed jackal is highly adaptable in its feeding habits, and is quite capable of living an omnivorous life. This undoubtedly adds to its considerable success in spite of determined eradication efforts.

BREEDING:

No pregnant females were collected in this survey. Wilhelm (in Shortridge, 1934) states that young are born during November and December in S.W.A. Brand (1963) recorded a well-marked breeding season extending from mid-August to mid-November in captive jackals in the National Zoological Gardens, Pretoria. Fairall (1968) recorded births during August, September and October in the Kruger National Park, while in the Serengeti births have been recorded from July to September (Wyman, 1967). One subadult, collected during February 1973 near Rustenburg was aged at 5 months, using the criteria of Lombaard (1971), which suggests an estimated date of birth in September. This indicates a birth season from late winter to early summer, at the onset of warmer, wetter weather conditions.

SIZES AND MASS:

Males:

	$\bar{X}$	N	Min.	Max.
Tot.	835	12	670	1 150
T.	307	12	235	340
H.Ft.	162	12	155	170
Ear	111	12	100	118
Mass	8,22	26	5,0	9,3

Females:

	$\bar{X}$	N	Min.	Max.
Tot.	810	15	655	1 110
T.	290	15	225	338
H.Ft.	149	15	100	170
Ear	106	15	95	116
Mass	7,6	19	6,3	8,5

Judging from the above males are slightly bigger and heavier than females on the average.

RECORDS OF OCCURRENCE:

Specimens examined, 53: Kwaggavlakte, 2 (TM); Lydenburg,

1 (TM)/...

1 (TM); Magalakwin, 1 (TM); Mmabolela Estates, 1 (TM); Mooivlei, 1 (TM); Mosdene, 2 (TM); Olifantspoort, 1 (TM); Onderstepoort, 1 (TM); Othawa, 2 (TM); Pienaars river, 1 (TM); Rochdale, 1 (TM); Rooiberg, 1 (SI); Sandringham, 2 (TM); Satara, 11 (TM); Tsongani, 1 (TM); Uitkomste, 1 (TM); Valhalla, 1 (TM); Wolmaransstad, 21 (TM); Zoutpan (Pretoria district), 1 (TM). All other localities whence material is available, as indicated on distribution map, are based on coyote-getter returns housed at the headquarters of the Transvaal Provincial Administration's Division of Nature Conservation.

Additional records: Sightings from Al-te-ver Barberspan Prov. Nat. Res., Blijdschap Priv. Nat. Res., Brandhoek, Buffelspoort, Charleston, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Ferndale, Fort Klipdam, Greefswald, Groothoek, Grootsuikerboschkop and Elandslaagte, Hans Merensky Prov. Nat. Res., Huwi, Joshua Moolman Priv. Nat. Res., Langfontein, Leeuwspoor, Letaba Ranch, Madimbo, Loskopdam Prov. Nat. Res., Modderfontein, Mooigenoeg, Mooiplaas, Nicorel, Parkfield and Delamere, Platbos, Pretoria Zoo's Farm, Ratsegaai, Renosterpoort Priv. Nat. Res., Rhoda, Rissik Priv. Nat. Res., Rolspruit, Rykvoorby, Scrutton, Silkaatsnek, Suikerboschrand Prov. Nat. Res., TenBosch Estates, Timbavati Priv. Nat. Res., Urk, van Riebeeck Mun. Nat. Res., Welgedaan, Welgevonden, Zandspruit. Open circles in the Kruger National Park indicated on the distribution map after Pienaar (1963).

Family Mustelidae

(Modified from Coetzee, 1977)

1. Tail long but thickened and fleshy at base; short fur; M^1 much enlarged, more or less square; five upper cheek teeth (Lutrinae)	2
Tail not thickened; hair long, fur not thick-set; M^1 much smaller than carnassial, narrow; four upper cheek teeth or less. ...	3

2. Feet with rudimentary webs, nails absent or small and blunt; mastoid process well-formed, situated immediately behind external ear opening, bending slightly backwards; greatest skull length usually over 115 mm in adults ... ... *Aonyx*
Feet clearly webbed, with claws; mastoid process weak; skull length normally less than 110 mm ... *Lutra*

3. A broad white or off-white band on upper parts contrasting with black flanks; ears atrophied; mastoid process prominent; greatest skull length over 100 mm; four upper and lower cheek teeth (Mellivorinae)... ... ... *Mellivora*
Upper parts with longitudinal bands (black and white); ears well-formed; mastoid process not prominent; greatest skull length less than 85 mm; cheek teeth 4/5, 3/4 or 3/3, but never 4/4 (Mustelinae) 4

4. No white markings below eyes; white on forehead continuous with that of neck; three upper cheek teeth; smallest space between auditory bullae exceeds interpterygoid space ... ... *Poecilogale*
White markings below eyes; white on forehead separated from white on neck; four upper cheek teeth; smallest space between auditory bullae less than interpterygoid space ... ... *Ictonyx*

Subfamily Lutrinae

Aonyx Lesson, 1827

Aonyx capensis (Schinz, 1821) Cape clawless otter
Groot-otter

A c. capensis (Schinz, 1821)

DISTRIBUTION/....

DISTRIBUTION:

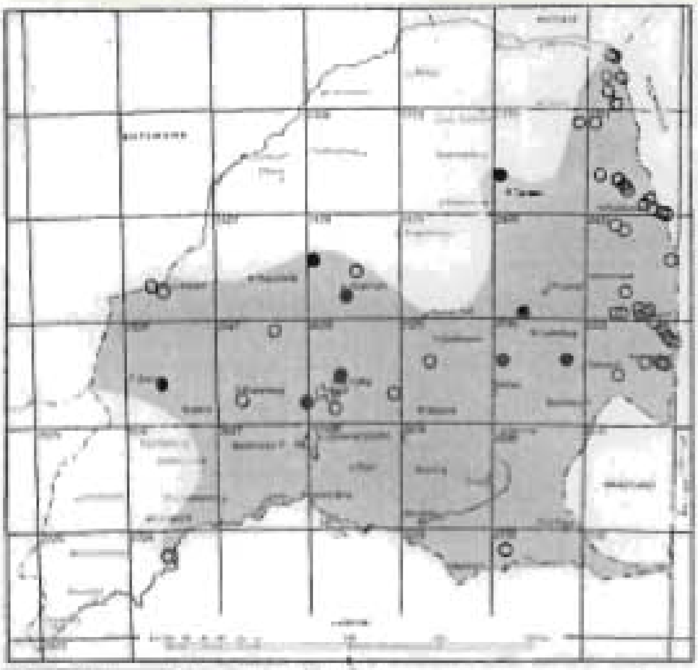

Fig.121: The distribution of *A. capensis* in the Transvaal.

Eastern, central, southern and western Transvaal. Only one confirmed record from along the Vaal river, but has almost certainly been overlooked elsewhere along this watercourse.

Although the known distribution of *A. capensis* in the Transvaal at present forms a somewhat patchy pattern, evidence suggests that it can be found along most of the permanent dams and perennial rivers of the province. The construction of large reservoirs as well as smaller farm dams has certainly increased suitable habitat, and evidence is available that this species is utilizing some of these new water surfaces, i.e. Pienaars River dam, Rietvlei dam, Olifantsnek dam, and farm dams in the Dullstroom area.

A. capensis in Transvaal is conspicuously absent along the entire Limpopo river. Spoor and other signs have been found in the Marico riverbed where it becomes the border between the Transvaal and Botswana, before its confluence with the Crocodile river to become the Limpopo. Although the Limpopo today is a seasonal river, permanent pools in the rivercourse offer good habitat. Lack or scarcity of preferred prey may explain the absence of this species here, although the possibility that it has been overlooked should also be borne in mind.

HABITAT:

Can be found in areas with a permanent water source, preferably quiet and secluded still waters or slow-flowing streams. Cover along the edge of the water is apparently important, as

this/...

this was present in most areas where otters were recorded. Pitman (in Shortridge, 1934) states that *A. capensis* is more of a marsh-frequenter than *L. maculicollis*. Not many marshland areas exist in the Transvaal, and the few minor ones are more often than not drained or destroyed. Personal observations indicate that the clawless otter has a preference for shallower water. Domestic pressures on water surfaces and the associated vegetation may in various possible ways act as a limiting factor on population density.

HABITS:

Active mainly during the night, although feeding, playing and sunning have been recorded during the day, especially during early mornings and late afternoons. Normally, however, otters rest by day in thick vegetation along the water, under exposed tree roots overhanging the water, or in tunnel systems. Some of these tunnel entrances open under the water surface. It is not known whether clawless otters construct their tunnels themselves, but this is unlikely since their feet are not adapted to digging. No other species can, however, be suggested as being responsible for such excavations.

Although otters are restricted to permanent water, they sometimes wander great distances inland (Shortridge, 1934; Ewer, 1973:180). The reason may be that sub-aquatic life becomes scarce seasonally, thus forcing the animals to seek prey inland.

Observations at Dullstroom indicate that clawless otters do not remain permanently in one area, but move up and down the streams. This view is supported by Rowe-Rowe (1977a,b,c).

The clawless otter is highly adapted to a semi-aquatic mode of life. The perhaps unexpected absence of webs between the digits allows a high degree of dexterity, enabling it to feel for food items in crevices and under rocks (Ewer, 1973). Shortridge (1934) remarked on the agility of clawless otters, which enabled them to escape falling prey to crocodiles.

Normally clawless otters are found in pairs, although groups

of/...

of up to four have been recorded (Dullstroom). In captivity the food is immersed regularly in water while feeding.

An extremely difficult animal to trap, as found also by Shortridge (1934). Traps were always set where the characteristic spoor were found, normally in sandy riverbeds. From following tracks it repeatedly became obvious that clawless otters have no trouble in sensing this abnormality in their environment, and in all instances the traps were avoided. Shortridge (1934) and Ewer (1973) credit them with an acute sense of smell.

FOOD:

Four stomachs were available for study. Two were completely empty, the other two contained fish remains. In the first, 43 ml of food comprised remains of a large *Barbus* species (five plus years old, i.e. c. one kg). The second contained 80 ml of remains, consisting of a cichlid of c. 220 grams. In both cases traces of otter hair, presumably its own, were present. Both these animals were killed within a three-month period in the same dam near Nylstroom, because of alleged predation on the resident waterfowl.

The spoor of two animals were studied daily for 6 days along the Pienaars river, north of Assen. During one night an individual accumulated 12 fresh-water mussels, which it deposited on the riverbank. These mussels were left untouched after traps were set in the vicinity, presumably due to this human disturbance, or possibly because the mussels had become tainted.

At Dullstroom a site was found to be frequented by a group of four. This site was visited regularly and the remains of a guineafowl were found one morning.

According to Shortridge (1934) and Smithers (1971) clawless otters also feed on crabs, insects, frogs, monitor lizards, mud-tortoises, aquatic birds, eggs, and rodents. However, examination of various scats found on this survey indicated that the largest proportion of the diet consists of fresh-water crabs. Rowe-Rowe (1977a,b, and c) found that crabs are by far the preferred prey, present in more than 95% of all scats examined by

him/...

him. Other food items recorded by Rowe-Rowe, in order of preference were: frogs, fish, birds, mammals, reptiles, insects and molluscs.

BREEDING:

No project data available. Shortridge (1934) records the estimated birth of two young brought to him as being during October. Smithers (1971) cited births during April, and Ansell (1960) cited July and August.

SIZES AND MASS:

The data from only two males and two females are available.

	Tot.	T.	H.ft	Ear		Mass
Males						
TM 23952:	1235	475	?	?	=	5kg
TM 25597:	1244	476	103	26	=	17kg
Females						
TM 23951:	1350	475	?	?	=	12kg
TM 24055:	1168	431	152	25	=	12kg

RECORDS OF OCCURRENCE:

Specimens examined, 12: Alma, 1 (TM); Ferndale, 1 (TM); Grootsuikerboschkop and Elandslaagte, 3 (TM); J.G. Strydom Park, 2 (TM); Mokeetsi, 1 (TM); Roodeplaatdam, 1 (TM); Schagen, 1 (TM); Schurweberg, 1 (TM); Waterfall, 1 (TM).

Additional records: Sightings from Brandhoek, Buffelspoort, Ferndale, Langfontein, Loskopdam Prov. Nat. Res., Mooiplaas, Mooigenoeg, Mosdene Priv. Nat. Res., Olifantspoort, Othawa, Renosterpoort Priv. Nat. Res., van Riebeeck Mun. Nat. Res. Open circles in the Kruger National Park on the distribution map after Pienaar (1964).

Lutra Brisson, 1762

Lutra maculicollis Lichtenstein, 1835 Spotted-necked otter
Klein-otter

L. m. maculicollis Lichtenstein, 1835

DISTRIBUTION/..

DISTRIBUTION:

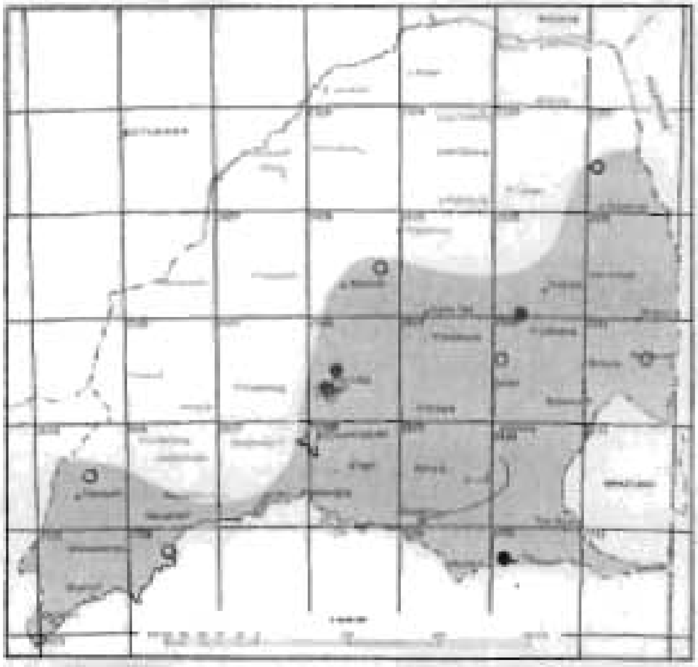

Fig.122: The distribution of *L. maculicollis* in the Transvaal.

The scattered records available suggest a distribution pattern similar to that of *Aonyx capensis*, i.e. the eastern Transvaal lowveld, as well as the central, southern and south-western Transvaal. The range does not seem to be limited by geographic factors other than the availability of permanent water, containing adequate prey densities.

The record from east of Wakkerstroom is of a specimen collected by H.L. Jameson in 1903. It is not known whether the spotted-necked otter is still represented in this area.

As in the case of *A. capensis*, *L. maculicollis* is conspicuously absent along the Limpopo river. This observation is verified by Smithers (1971), who also did not record either of these two species in Botswana along this watercourse. It would appear that the permanent pools in the Limpopo lack some essential factor for the successful existence of otters, although it is also possible that this species has been overlooked.

Interpretation of available records suggest that it is less abundant in the Transvaal than the clawless otter, but this may be biased by its relatively more secretive and shy nature. However, low frequency of spoor encountered supports the impression of the relative scarcity of the spotted-necked otter.

HABITAT:

Larger streams and rivers, natural or manmade areas of permanent still water, high altitude mountain streams with a rapid flow (i.e. Dullstroom district), as well as swamps (Smithers, 1971).

Good/...

Good cover in the form of reeds, scrub or riverine forest appears to be essential. As in the case of the former species, increasing recreational and farming activities detrimental to the vegetation along water masses may limit population densities.

HABITS:

This species is more aquatic in its habits than *A. capensis*, and is thus less prone to wander away from its waterly domain (Shortridge, 1934 and Smithers, 1971). Runs are often formed parallel to the edge of the water, although the purpose of these is unknown. Two such runs were studied at Rietvlei dam, and both led to a tree, also on the edge of the water. The earth under and between the roots was excavated and the resultant chamber had presumably been used as a retreat.

It is mainly nocturnal, although Roberts (1951), Dorst and Dandelot (1970) and A.G. White (*pers. comm.*) recorded activity during the day in undisturbed areas, especially during early mornings and late afternoons. A small group was observed by Mr White, basking in the sun on the river banks.

According to Roberts (1951), Pienaar (1964), Dorst and Dandelot (1970) and Smithers (1971), the spotted-necked otter is solitary at times, but is also to some degree sociable, with a group of ten the biggest recorded.

Roberts (1951) found that prey is devoured in a secluded spot on the river bank, or on a drifting platform of vegetable matter.

FOOD:

No specimens were obtained during the survey. According to Shortridge (1934), Roberts (1951), Proctor (1963), Pienaar (1964), and Dorst and Dandelot (1970), fish is the preferred prey. Other incidental food items recorded by these authors are rodents, waterbird eggs, amphibians, molluscs, crabs, and insects. Rowe-Rowe (1977a and c), however, found from a scat analysis that crabs are most frequently recorded as

food/...

food item, closely followed by fish (trout). Crabs, do not, however, rate quite as highly in its diet as is the case with the clawless otter.

BREEDING:

Ansell (1960) recorded a litter of three born in November or December, on the Zambezi river, Zambia. According to Roberts (1951) and Proctor (1963), mating takes place during July and parturition during September.

SIZES AND MASS:

None of the Transvaal Museum specimens were measured or weighed.

RECORDS OF OCCURRENCE:

Specimens examined, 4: Pretoria, 1 (TM); Wakkerstroom, 1 (TM); Waterval, 1 (TM); Kameeldrift, 1 (TM).

Additional records: Sightings from Barberspan Prov. Nat. Res., Brandhoek, Grootsuikerboschkop and Elandslaagte, Mosdene Priv. Nat. Res. Open circles in the Kruger National Park on the distribution map after Pienaar (1964).

Subfamily Mellivorinae

Mellivora Storr, 1780

Mellivora capensis (Schreber, 1776) Honey-badger
Ratel

M. c. capensis (Schreber, 1776)

DISTRIBUTION:

In the Transvaal it is distributed throughout the bushveld areas north of the Magaliesberg, as well as the eastern Transvaal lowveld. Shortridge (1934), Roberts (1951) and Coetzee (1977) describe the distribution in general terms as from the Cape

Province/...

Province northwards, thus creating the impression that it can also be expected on the highveld grasslands of the Transvaal and the Orange Free State. In addition, the wide habitat tolerance of this species also leads one to expect it to occur on the highveld regions of the Transvaal. Thus the possibility that the honey-badger has either been overlooked or exterminated on the highveld grasslands should be kept in mind.

However, due to the complete lack of any substantial evidence supporting its past or present occurrence on the Transvaal highveld, and in agreement with the rather inadequate distribution map of Dorst and Dandelot (1970), *M. capensis* is here regarded as being restricted to the wooded parts of the Transvaal north of the Magaliesberg and the eastern lowveld.

Honey badgers are very seldom encountered in the Transvaal, and it seems possible that the species is rare and/or endangered in the province outside the Kruger National Park.

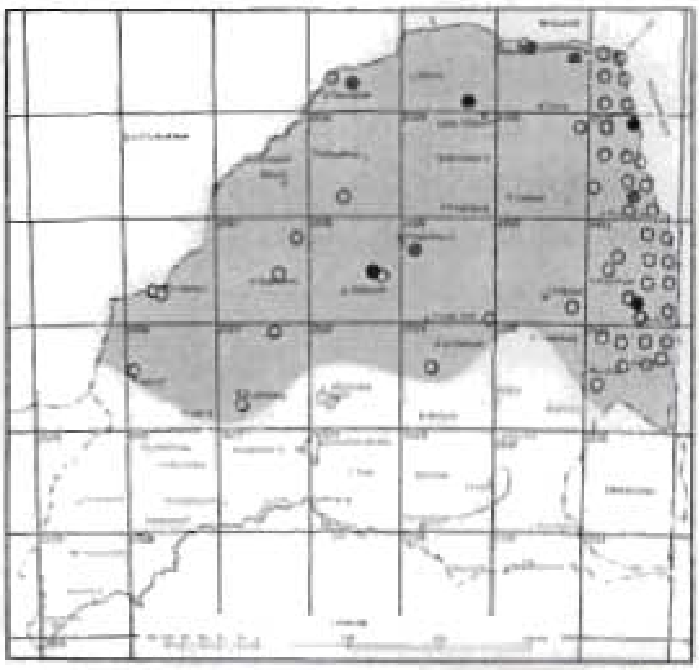

Fig.123: The distribution of *M. capensis* in the Transvaal.

HABITAT:

Shortridge (1934), Dorst and Dandelot (1970) and Smithers (1971) accentuate the wide habitat tolerance of this species. They recorded a wide diversity of habitat types in which it was found, namely grasslands, floodplain grasslands, swamp fringes, riverine woodlands, savannas, scrub sandveld and rocky kopjes. Data accumulated by this project support these findings, except that the true grassveld of the highveld appears to be unsuitable.

HABITS/...

HABITS:

A predominantly nocturnal species; but to a limited extent active during the day, especially during the cooler hours of the early morning and late afternoon. Normally it is solitary, sometimes seen in pairs. The fact that no family groups with physically mature offspring are recorded suggests that the young are abandoned as soon as they can fend for themselves.

Its aggressive, corageous and bold nature is well documented in the literature, as is the fact that honey badgers go for the groi and genitalia when attacking. In this way much larger animals can be killed by causing excessive blood loss. Ewer (1973) credits the species with great powers of endurance, although it is not a swift runner.

The loose-fitting hide in conjunction with the subcutaneous layer of fat, render it almost impervious to attack by other carnivores of medium size, such as dogs (Smithers, 1971). In addition the honey badger is an immensely strong animal for its size Like Smithers (1971), I experienced an example of its strength at Loskop dam when an individual was live-trapped and the trap, constructed of 14 guage 25 mm wire mesh, was completely wrecked in its successful attempts to escape.

Aardvark burrows, rock crevices or caves are utilized for lairs, although the species is a prolific digger and can excavate its own burrows (Dorst and Dandelot, 1970). The young are born and reared in such lairs.

Friedman's (1955) research confirms the legend of the association to mutual advantage between the honey guide (*Indicator indicator*) and the honey badger. He also confirms the honey badger' ability to climb trees in order to reach high-up beehives. According to Dorst and Dandelot (1970) the honey badger is, however, capable of finding beehives unguided.

As was also found by Smithers (1971), the observations made during this survey suggest that honey badgers often travel along roads. It can spray a strong-smelling liquid from the anal glands when trapped or wounded (Smithers, 1971), although the smell is not as bad as in that of the striped polecat. Smithers considers the honey badger to be short-sighted, in contrast with the views of FitzSimons (in Shortridge, 1934).

FOOD:

No information obtained during this survey. Food items recorded by Shortridge (1934) and Smithers (1971) are: rodents, young birds, eggs, poultry, reptiles, locusts, beetles, Myriapoda, fruit and other vegetable matter.

Both authors, as well as Roberts (1951), mention its preference for honey. However, its good adaptation to digging, together with the preponderance of subterranean animals found by Smithers (1971) in the six stomachs he analysed, suggest that honey is only a secondary food item.

Ewer (1973), *pace* Shortridge (1934), states that carrion is taken, and that limited scavenging takes place from time to time.

BREEDING:

No specimens were collected during this survey. Fairall (1968) recorded mating during February, June and December. Ansell (1960) recorded a birth in December, and Brand (1963) one in February. From this meagre evidence, breeding appears to be non-seasonal. Gestation period is approximately 180 days (Dorst and Dandelot, 1970). Two young per litter (Shortridge, 1934; Brand, 1963).

SIZES AND MASS:

None of the available specimens were measured or weighed.

RECORDS OF OCCURRENCE:

Specimens examined, 10: Al-te-vēr, 1 (TM); Boekenhout, 1 (TM); Mala Mala, 3 (DM); Mutale river, 1 (TM); Njelele and Limpopo river confluence, 1 (TM); Nwanedzi, 1 (TM); Rochdale, 1 (TM); Shingwidzi, 2 (TM, 1; NKW, 1). Division of Nature conservation coyote-getter returns from 2429 AC.

Additional/...

Additional records: Sightings from Blyde Forest Res., Buffelspoort, Charleston, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Groothoek, Letaba Ranch, Loskopdam Prov. Nat. Res., Mooigenoeg, Mooiplaas, Mmabolela Estates, Mosdene Priv. Nat. Res., Olifantspoort, Othawa, Dordrecht, Platbos, Rykvoorby, Sandringham Priv. Nat. Res., Scrutton, TenBosch Estates, Timbavati Priv. Nat. Res., Uitkyk and Paranie Priv. Nat. Res. Open circles in the Kruger National Park on the distribution map after Pienaar (1964).

Subfamily Mustelinae

Poecilogale Thomas, 1883

Poecilogale albinucha (Gray, 1864) Striped weasel
Slangmuishond

P. a. albinucha (Gray, 1864)

TAXONOMIC NOTES:

Roberts (1951) and Coetzee (1977) both list *Poecilogale albinucha transvaalensis* Roberts, 1926 as the subspecies which occurs in the Transvaal (type locality Tzaneen). Roberts (1951) in addition recognizes one specimen (TM 3919) from Randfontein as belonging to *P. a. bechuanae* Roberts, 1931 (type locality Vryburg, Cape Province). Coetzee (1977) does not refer to this specimen. Furthermore, it is possible that *P. a. lebombo* Roberts, 1931 (type locality Ubombo, Natal) may occur in the south-eastern districts of the Transvaal.

The skulls of the holotypes of all three subspecies were smashed upon collection. Their recognition is, however, based on qualitative differences in the dorsal colouration of the holotypes, as well as relative body sizes. The holotype of *P. a. transvaalensis* is described as darkest, with the dorsal colour an "antimony-yellow". *P. a. bechuanae* is "slightly lighter yellowish above, most noticably at the root of the tail", while *P. a. lebombo* is "yellowish white" (Roberts, 1951).

However/...

However, on examining the nine specimens available from Transvaal, the confusing subspecies status within *Poecilogale albinucha* becomes apparent. The ranges of the above-mentioned three subspecies are not known in the Transvaal, and in addition, specimens displaying hitherto undescribed dorsal colouration phases were collected. As mentioned, subspecies recognition relies mostly on the varying shades of yellow on the back. During 1975 a specimen (TM 25073) was collected from Dullstroom which is dorsally pure white apart from the normal three longitudinal black stripes, with only the faintest traces of yellow on the nape of the neck and the distal two-thirds of the tail. Another specimen (TM 25422; roadkill, eastern bypass, Pretoria) is also light coloured, the dorsal area being a dirty white, with traces of yellow on the nape of the neck and the hindquarters. The tail is dirty white. Neither of these two specimens answers to the description of the four southern African subspecies recognized by Coetzee (1977), who expresses his doubts about the validity of all the described subspecies.

The holotype and two topotypes of *P. a. lebombo* were all collected on the same day. The one topotype (TM 5603) is identical to the holotype, but the other (TM 5602) is a noticeably darker yellow, and can best be compared to the holotype of *P. a. bechuanae*. A specimen from Wakkerstroom (within the expected range of *P. a. lebombo*) is the darkest yellow in the series except for the holotype of *P. a. transvaalensis*, and resembles the latter most closely.

The available sample is considered to be too small to allow comparison of relative body size in relation to subspecies recognition. No correlation could be found between age and colouration.

The discussed colour variation above appears to represent normal population variation, ranging from almost completely white to antimony yellow. However, the only direct evidence in support of such nongeographic variation is the variation described above in the three specimens from Ubombo.

Based on this evidence, and considering the great variation in the total sample, all three subspecies mentioned are here provisionally regarded as synonyms of the nominate race.

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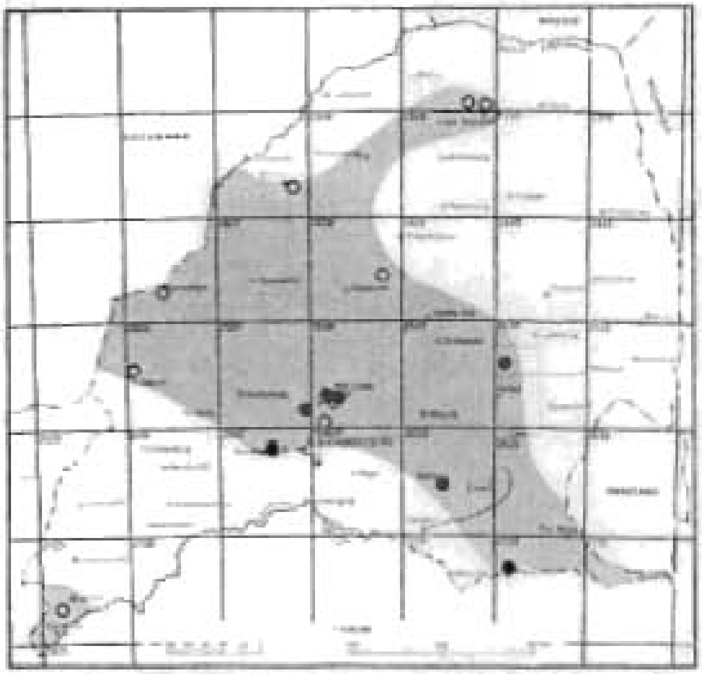

Fig. 124: The distribution of *P. albinucha* in the Transvaal.

Recorded only from the central, western and south-eastern Transvaal, as well as near Louis Trichardt. It is very likely to have a wider occurrence, but has been overlooked because of its small size and secretive nature.

HABITAT:

Available evidence indicates a fairly wide habitat tolerance. In the Transvaal the snake mongoose occurs on the highveld grasslands, the arid western bushveld and the edge of the mopani veld at the northern foot of the Zoutpansberg. Smithers (1971) took a specimen in Botswana on Kalahari sand with scattered scrub and a sparse ground cover. No reason for its absence from the eastern Transvaal lowveld and the area north of the Zoutpansberg can be offered, and it may in time be found here.

HABITS:

Solitary or in pairs; sometimes small family groups are encountered. In the latter case they have been observed to closely follow each other when afoot, thus forming a train (Roberts, 1951 and Rowe-Rowe, 1974).

Predominantly a nocturnal species, but not to the same extent as the polecat *Ictonyx striatus*. Rowe-Rowe (1969, 1974, 1978) as well as Alexander and Ewer (1959) describe some diurnal

activity/...

activity in captive animals. Terrestrial, and indications are that it excavates its own burrows. The long slender body is possibly a specialization to hunting burrowing rodents, as is suggested also by Shortridge (1934) and Roberts (1951).

According to Shortridge (1934) this is a bloodthirsty carnivore, and often kills more than it needs to. Rowe-Rowe (1969, 1978), and Alexander and Ewer (1959) observed that prey is always taken to the retreat, and when more than its immediate food requirements is available, hoarding of food takes place. Alexander and Ewer (*op.cit.*) describe the peculiar stance of their study animals of backing up against a vertical surface when defaecating. They also describe, as does Smithers (1971), the use of toilet sites near the nest box, and suggest that this serves as a sign of occupation.

Killing of prey, mostly rodents, is fast and efficient by siezing it by the neck or throat and shaking it till motionless. This is followed by bites on the head. Rowe-Rowe (1969, 1978) and Shortridge (1934) believe that the weasel relies heavily on its olfactory senses in locating prey. Smithers (1971) and Ewer (1973) agree on the presence of anal scent glands and the fact that these are actively used in defence. The smell of the fluid is however not as pungent as that of the polecat.

The late Mr J. Roets, from the district Zeerust related (*pers.comm.*) his observations on an individual seen while hunting spring hares at night in peanut lands. The weasel came as close as one metre to the observer without taking any notice of him or his bright electric lantern. This could have been due to a lack of fear of humans, or because of its pre-occupation with hunting rodents (*Praomys natalensis*), in which it was observed to be very adept. The weasel followed them under the stacks of dried peanut plants, and all four observed attempts were successful.

See Rowe-Rowe (1978) for an account on mating, maternal behaviour and post-natal development.

<u>FOOD</u>:

Only two stomachs were available for analysis, and both

contained/...

contained rodent remains (*Praomys natalensis*). Ewer (1973) considers *P. albinucha* a pure carnivore. It has been observed to take strips of meat, dead mice and chicks, but this was under captive conditions. The claim by FitzSimons (in Shortridge, 1934), and Shortridge (1934) that it can kill animals up to the size of a hare or springhare is discounted by Smithers (1971) and Rowe-Rowe (1974). Alexander and Ewer (1959) offered their captive animals a pigeon, a hawk and an adult rabbit, which were all ignored, apparently because of their size. Repeated claims that this animal is responsible for raids on chicken runs must therefore be questioned.

BREEDING:

None of the females collected was pregnant or lactating. Lancaster (in Shortridge, 1934) collected a pregnant female with two foetuses during October. Alexander and Ewer (*op.cit.*) observed sexual activity in two subadult captive animals during August. Rowe-Rowe (1978) recorded reproductive activity during summer only. Gestation period is 32 days, and maximum litter size three.

SIZES AND MASS:

	Total	Tail	H.Ft.	Ear	Mass
Males					
TM 1191	430	150	35	19	?
TM 25073	515	180	44	15	403
TM 25422	496	150	38	19	350
Females					
TM 3919	490	145	33	18	?
TM 8862	235	110	20	15	?
TM 20060	408	74	36	18	?

RECORDS OF OCCURRENCE:

Specimens examined, 9: Goedehoop, 1 (TM); Grootsuikerboschkop and Elandslaagte, 1 (TM); Hennops river, 1 (TM); Koedoespoort, 1 (TM); Pretoria, 2 (TM, 1; SI, 1); Tzaneen, 1 (TM); Wakkerstroom district, 1 (TM); Witfontein, 1 (TM).

Additional/...

Additional records: Sightings from Huwi, Mosdene Priv. Nat. Res., Mooiplaas, Parkfield and Delamere, Rochdale, Rykvoorby, Welgedaan.

Ictonyx Kaup, 1835

Ictonyx striatus (Perry), 1810 — Striped polecat, Stinkmuishond

TAXONOMIC NOTES:

Roberts (1951) recognizes no fewer than four distinct species of *Ictonyx* in southern Africa, three of which were proposed by himself. They are: *I. striatus* (Perry, 1810); *I. limpopoensis* Roberts, 1917; *I. orangiae* Roberts, 1924; and *I. kalaharicus* Roberts, 1932. Shortridge (1934) accepts these species proposed by Roberts. Ellerman *et.al.* (1953) consider the three species described by Roberts as conspecific with *I. striatus*, and reduce them to subspecific rank, recognizing 12 southern African subspecies, while Coetzee (1977) reduces this number to ten.

Of the numerous forms described by Roberts (see Roberts, 1951) and still regarded as valid subspecies by Coetzee (1977), three have type localities within the Transvaal, i.e. *I. s. limpopoensis* (type locality Mooivlei, Rustenburg); *I. s. maximus* Roberts, 1924 (type locality Wakkerstroom); and *I. s. pretoriae* Roberts, 1924 (type locality Boekenhoutfontein, Pretoria). The type locality of a fourth subspecies *I. s. orangiae* Roberts, 1924, is close enough to the Transvaal to warrant consideration here (i.e. *Angra Pequina*, district Bothaville, O.F.S.).

These four subspecies are differentiated by qualitative variation in the black and white colouration, as well as differences in skull size. Ellerman *et.al.* (1953) and Lundholm (unpublished typescript, Transvaal Museum: Mammals of South West Africa) question the usefulness of some of the taxonomic characters employed, and consequently the validity of some of

these/...

these subspecies.

Having examined the holotypes and the other material available from the Transvaal, I agree with Coetzee (1977) that this species in in need of revision. Accordingly no subspecies are recognized here for the present.

DISTRIBUTION:

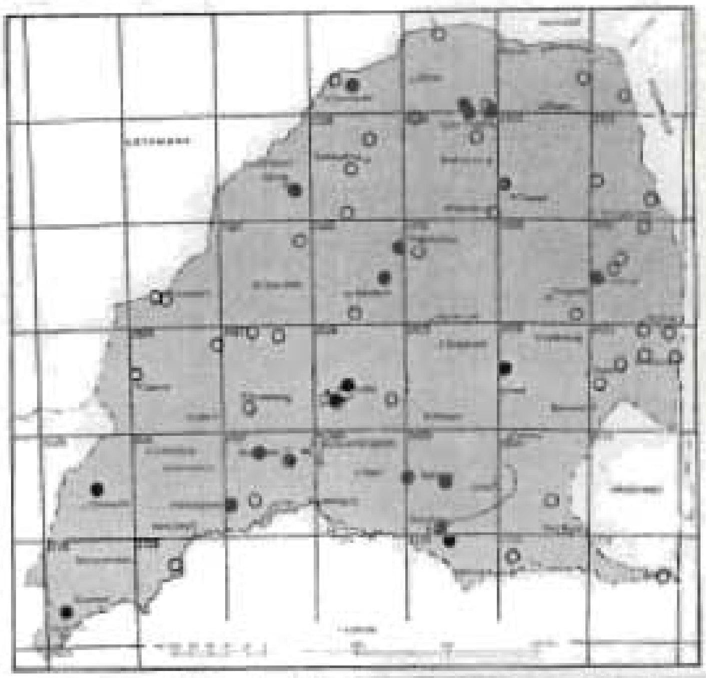

Fig. 125: The distribution of *I. striatus* in the Transvaal.

Widely distributed throughout the Province.

HABITAT:

The wide distribution of this species also reflects its wide habitat tolerance, as pointed out also shared by Smithers (1971) and Coetzee (1977). It has been documented by Smithers and by Coetzee to occur from the coastal sand dunes of the Namib desert to the high rainfall areas of the eastern districts of Rhodesia. Shortridge (1934) lists the following habitat types: amongst mountains and in kloofs, waterless sand plains, karoo, bushveld, forest, swamps and the sea-coast. In the Transvaal it has been recorded from all the major veld and habitat types.

HABITS:

From the literature it would appear to be predominantly nocturnal, but with limited diurnal activity. However, I agree with Smithers (1971) that the species is strictly nocturnal and becomes active only during the late evening. I could also find no account of daytime activity from the Bantu residents living at the various collecting localities. During the day the animals lie up in burrows constructed by themselves or by other animals, or in rock crevices and even hollow tree trunks (Rowe-Rowe, 1974). I found a specimen

which/...

which was lying up in daytime in a spring hare burrow at Naboomspruit.

The specimens procured by means of night-shooting were all solitary, as found also by Shortridge (1934). Pairs or small family groups travelling together are not mentioned in the literature.

In spite of claims that they are capable of killing guineafowl, ground squirrels, hares and spring hares, as well as conducting poultry raids (Shortridge, 1934; Roberts, 1951), Rowe-Rowe (1974) observed that his captive animals could not handle live prey larger than 200 gram rats, especially as polecats are not particularly agile. The blunt digging claws are not well suited to hunting bigger prey. Stomach content analyses thus far also suggested that only smaller prey is taken. Rowe-Rowe (1974) regards the species to be well adapted to locating and digging out insects as well as average-sized rodents. He found them quite adept at killing snakes, for which one would expect at least a certain amount of agility. According to Shortridge (1934) and Ewer (1973) the olfactory sense is quite important in hunting. Ewer believes that movement of the prey triggers the killing mechanism, which may explain the fact that more prey are often killed than is necessary. Polecats, like African striped weasels, in instances of overkill hoard the excess food.

Ewer (1973) mentions marking with the anal sack secretions. The use of the anal sack and its very pungent fluid contents (butyl mercaptan) is well known as a defence mechanism, and is documented by many authorities. When disturbed, the tail is raised forward over the back and the body and tail hair is erected to create the impression of larger size, the head is tucked in and the animal stands high on the hind legs while the rear end is maneouvered towards the aggressor. I had personal experience of trapped wild polecats displaying this posture and being capable of ejecting the anal sack secretions over a distance of a metre and a half. As can be borne out by many a farmer whose dogs have confronted polecats in the veld, the odour of the anal sack remains in clothes and on the skin for up to three days, in spite of repeated washing with soap

and/...

and hot water. This smell suffices to discourage many a potential predator, with the exception of brown hyaena (Mills, *pers.comm.*) which has been seen eating a polecat. According to Roberts (1951) polecats feign death for periods of up to half an hour in order to escape predation.

Polecats are terrestrial, with only a single record of climbing. FitzSimons (in Shortridge, 1934) recorded an instance where an individual was found three metres up in a tree. My data confirm the terrestrial mode of life as well as the observatio by Smithers (1971), that individuals prefer open spaces and thus travel along dry stream beds, roads and tracks. This probably accounts for the high incidence of road kills in this species. During the course of this project we soon learnt to benefit from this preference when trapping, by setting traps where farm roads or tracks cross dry gullies or stream beds. This preference for open spaces is probably in some way correlated with hunting technique.

See Rowe-Rowe (1978) for an account of mating behaviour, maternal behaviour and post-natal development.

The disparity in sex ratios in the animals collected is quite conspicuous. In the Transvaal this ratio is 12 males to two females, while in Botswana it is 19:9. One is tempted to consider male territoriality, or care of offspring by females, as possible causes for the preponderance of males.

I am aware of various individuals kept in captivity, and Shortridge (1934) point out that they become quite tame in captivity.

<u>FOOD</u>:

Five stomachs were available for study. The contents were as follows:

Insecta	unidentified	2
Coleoptera	Tenebrionidae larvae	3
	Cerambycidae larvae	2
	Scarabaeidae larvae	1
	Scarabaeidae adults	2

	Cetoniidae (?*Pachnoda*) larvae	3
Lepidoptera	Noctuidae	2
Centipede	*Scolopendria*	2
Scorpionidae	unidentified	2
Amphibia	*Tomopterna* or *Breviceps*	2
Aves	unidentified	2
Parasites	unidentified	1
Soil		traces

This small sample suggests a preference for invertebrates, particularly Insecta.

Other food items recorded by Shortridge (1934), Smithers (1971) and Rowe-Rowe (1974) are: rodents, birds' eggs, birds, reptiles, amphibians, and Solifugae. Ewer (1973) and Smithers (1971) agree that polecats are partial to insects. Ewer found that her captive animals also took bread and milk. She suggests that the species is relatively polyphagous, although available data from stomach contents suggests a bias towards insects.

BREEDING:

A lactating female was collected during November 1973. No further breeding data are available from the Transvaal. Shortridge (1934) suggests that they may breed from January to March in S.W.A. Smithers (1971) is of the opinion that young may be born over a more extensive period, a viewpoint borne out by the lactating female found in November. Rowe-Rowe (1978) recorded eight births between October and November only.

SIZES AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	563	12	490	600
T.	219	12	180	250
H.Ft.	59	12	50	67
Ear	27	12	23	31
Mass	0,97	7	0,47	1,4 kg

Females/...

Females

	$\bar{X}$	N	Min.	Max.
Tot.	545	2	540	550
T.	224	2	205	243
H.Ft.	57	2	56	58
Ear	27	2	25	29
Mass	0,5 kg	1	?	?

RECORDS OF OCCURRENCE:

Specimens examined, 28: Acornhoek, 1 (TM); Barberspan Prov. Nat. Res., 1 (TM); Brooklyn, 1 (TM); Goedehoop, 3 (TM); Grootsuikerboschkop and Elandslaagte, 1 (TM); Huwi, 1 (TM); Leslie, 10 km to Standerton, 1 (TM); Mokeetsi, 1 (TM); Mosdene, 1 (TM); New Gate, 1 (TM); Pienaars river dam, 4 (TM); Platrand station, 1 (TM); Potchefstroom, 1 (TM); Potgietersrus, 1 (SI); Pretoria, 1 (TM); Rochdale, 1 (TM); Roodepoort, 1 (TM); Swellendam, 1 (TM); Welgedaan, 2 (TM); Wildfontein, 1 (TM); Wonderfontein, 1 (TM); Zoutpansberg, 1 (TM).

Additional records: Sightings from Blyde Forest Res., Blijdschap Priv. Nat. Res., Brandhoek, Buffelspoort, Dordrecht, Greefswald, Groothoek, Joshua Moolman Priv. Nat. Res., Langfontein, Leeuwspoor, Letaba Ranch, Mmabolela Estates, Mooigenoeg, Mooiplaas, Nicorel, Olifantspoort, Parkfield and Delamere, Platbos, Renosterpoort Priv. Nat. Res., Rissik Priv. Nat. Res., Rykvoorby, Sandringham Priv. Nat. Res., Timbavati Priv. Nat. Res., Uitduiker, Uitkyk and Paranie Priv. Nat. Res., Urk, Welgevonden, Witpoort, Wolkberg, Zandspruit 168. Open circles in the Kruger National Park on the distribution area after Pienaar (1964).

Family Viverridae

(Modified from Coetzee, 1977)

1. Feet compressed, with short claws; pelage spotted; no bony tube to auditory orifice;

post/---

post-orbital process poorly developed in the jugal part (Viverrinae) 2

Feet with freer digits and fossorial claws; unspotted; with a bony tube to auditory orifice; well developed post-orbital process (Herpestinae) 3

2. Large, greatest skull length exceeding 140 mm; length of hind feet more than 120 mm.. *Viverra*

Smaller, greatest skull length less than 110 mm; length of hind feet less than 100 mm... ... ... *Genetta*

3. Four toes on fore and hind feet... 4

Forefeet with functional clawed pollex; four or five toes on hind feet 5

4. Only three premolars in each toothrow (36 teeth); interorbital space less than two-thirds of post-orbital constriction; orbits closed by a bony ring; back with brown or dark brown crescent-like markings on the posterior two-thirds of the body; tail appears slender, not bushy ... ... *Suricata*

Four upper premolars and three or four lower premolars in each tooth-row (38 or 40 teeth); interorbital space about equal to or wider than postorbital constriction; orbits not closed posteriorly; back not marked with crescent-like markings; tail bushy ... ... *Paracynictis*

5. Hind foot with four digits; skull relatively high, greatest height (measured at the external auditory meatus, and including the anterior part of the bulla) just less than half the condylo-incisive length; anterior part of bulla much enlarged, posterior portion only slightly inflated; six cheek teeth ... ... *Cynictis*

Hind foot with five digits, although hallux is often reduced and may even be absent; skull relatively lower; anterior part of bulla mostly uninflated, if inflated then not dominant over posterior part; five or six cheek teeth ... 6

6./...

6. P^4 with posterior lobe (metacone) elongated, the triangle formed between the posterior surface of P^4 and the anterior edge of M^1 therefore wider at its base, when measured at the level of the two protocones, than height of the triangle taken from its base towards the nearest point of contact between P^4 and M^1 ... ... *Herpestes*
P^4 with posterior lobe not so elongated; triangle between P^4 and M^1 with base narrower than height 7

7. Six upper cheek teeth; tail length more than three-quarters the length of head and body 8
Five upper cheek teeth; tail length less than three-quarters the length of head and body 9

8. Hallux vestigal or untraceable; colour greyish, tail tip usually white; carnassial poorly developed, both upper molars flat-crowned; palate does not extend far behind toothrow (width of extension greater than length) ... ... *Rhynchogale*
Hallux less reduced; colour brownish, tail not white; upper molars cuspidate; palate extends further behind toothrow (width of extension far less than length) ... ... *Ichneumia*

9. Large, head and body length over 470 mm; condylo-incisive length over 100 mm in adults; claws short ... ... *Atilax*
Smaller, head and body length under 460 mm, condylo-incisive length under 90 mm; claws relatively longer 10

10. Posterior (ectotympanic) portion of bulla much larger than the interior (entotympanic) part; larger, head and body length

usually/...

usually over 300 mm and condylo-incisive length over 57 mm in adults; posterior parts of back with transverse black or brown bands ... ... *Mungos*

Posterior portion of bulla projects only slightly further down than inflated anterior part; smaller, head and body length under 290 mm, condylo-incisive length under 58 mm; no transverse bands on the back ... *Helogale*

Subfamily Viverrinae

Viverra Linnaeus, 1758

Civettictis Pocock, 1915

Viverra civetta (Schreber, 1778) African civet
Siwet

V. c. australis Lundholm 1955

TAXONOMIC NOTES:

Petter (1969) and Rosevear (1974), like Pocock (1915) and Allen (1939), discuss the taxonomic status of *Civettictis* in relation to the genus *Viverra*, and conclude that the only African representative of *Civettictis* is sufficiently different from its Asiatic relatives (genus *Viverra*) to warrant separate generic status. Hollister (1918) and Ellerman *et al.* (1953), followed by Coetzee (1977), all regard *Civettictis* as of subgeneric status under the genus *Viverra*. Ellerman *et al.* (*op.cit.*) point out that Pocock (*op.cit.*) compared *civetta* only with *sibetha* (the Indian species of *Viverra*), while ignoring the other two Oriental species, i.e. *megaspila* and *tangalunga*. Subsequent examination of *megaspila* convinced Ellerman *et al.* (1953) that it is in some ways intermediate between *civetta* and *sibetha*, implicating that the taxonomic gap between the African and Asian species is much narrower.

Whereas all the unique taxonomic characters of the African civet as defined by Pocock (1915), Petter (1969), and Rosevear (1975), are acknowledged, the view of Hollister (1918) and Ellerman *et al.* (1953) are followed here, namely that *Civettictis* is different at subgeneric level. None of the advocates of the generic status of *Civettictis* satisfactorily compared the African species with all its Asiatic relatives. This confusion clearly results from studying insufficient quantities of material and further attention is therefore warranted, especially with the advent of modern techniques such as chemotaxonomy.

DISTRIBUTION:

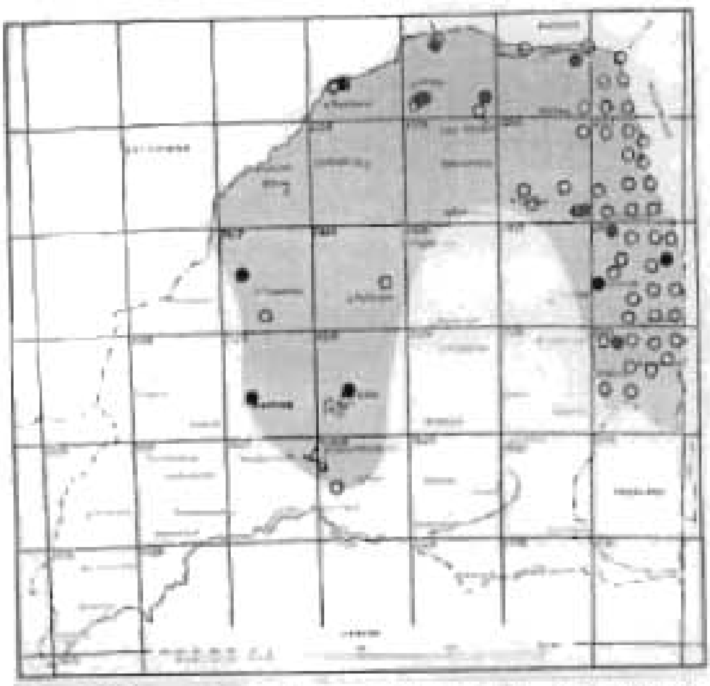

Fig.126: The distribution of *V. civetta* in the Transvaal.

Known distribution records within the Transvaal fall consistently within the Tropical Bush and Savanna veld types, as defined by Acocks (1975). The accompanying distribution map may create the impression of two separated populations, i.e. one in the central Transvaal including the Pretoria, Nylstroom, Thabazimbi and Rustenburg area, and an eastern to northern population. However, extrapolation from the correlation with Tropical Bush and Savanna distribution suggests that this species may have been overloo in this hiatus and elsewhere in wooded areas north of the Zeerust, Pretoria, Belfast line, assuming the availability of suitable habitat. The only areas where civets may not occur in the northern regions of the Transvaal are the Pietersburg plateau grassveld and the Inland Tropical Forests of the plateau.

Civets are unlikely to occur on the highveld grassland,

except/...

except possibly along the Vaal river in riverine bush.

HABITAT:

Like Smithers' (1971) findings, my data indicate an association with riverine and subriverine woodlands. Three sightings were obtained away from this habitat, but always in the near vicinity of water and its associated vegetation. At Mapungubwe, one such sight record is from rocky undulations adjoining the Limpopo river.

The presence of permanent water does not seem to be as important as the presence of riverine forests, as indicated by a trap-retrap study by Dr R. Booth and Dr A. Morris (*pers.comm.*) on the farm Othawa, Sabi-Sand private nature reserve. Some individuals were regularly recorded in dry stream beds with good cover on the banks. The absence of civets along the permanent streams of the highveld confirms the importance of riparian woodlands.

HABITS:

The live-trap study on Sabi-Sand was conducted at irregular intervals over a prolonged period. The results suggest territoriality. Territoriality is also suspected by Randall (1977). Randall did establish that home ranges are maintained. Toilet sites (civetries) are used for defeacating by more than one individual. Civets have a preference for travel along roads or any other naturally open route (Randall, 1977).

Observations indicate this species to be exclusively nocturnal. It is terrestrial, although Randall (1977), confirming observations by Ewer (1974), relates an incident of a tame subadult climbing into the lower branches of a shrub. Ewer (1974) in fact concludes from a study of sexual behaviour that civets have only in recent times exchanged an arboreal way of life for a terrestrial one. Normally only solitary individuals are encountered (Randall, 1977), although pairs were also observed by Shortridge (1934) and Smithers (1971). Shortridge

(1934) observed them to be good swimmers. Individuals lie up by day in burrows constructed by other animals, or in thick bush. Smithers (1971) describes the gait as slow and cumbersome, though stealthy. Yet this species is capable of a fair speed when disturbed, and its cryptic colouration allows it to disappear fast in the minimum of cover.

Ewer (1973 and 1974) intensively studied the behaviour of three pairs of civets in captivity. To date this is the most detailed account on the ethology of this species, and some aspects are briefly mentioned below.

Civets are rather timid and unaggressive animals.

The body colour is extremely cryptic even in relatively open terrain. The conspicious neck stripe of this non-sociable species serves to direct bites from conspecific rivals during fights to those areas with no vital organs near the surface. The senses of smell and hearing are well developed, and vision is of the normal nocturnal type. The range of facial expressions is restricted. Defensive threat is achieved by erecting the mane of hair, and thus appearing bigger and more fearsome.

Civets are rather silent animals, but the vocalizations observed are discussed by Ewer (*op.cit.*) and Randall (*op.cit.*). There are three types of agonistic sounds, and three different types of 'miau', the most important being the "contact call" serving to direct lost young.

The dung pile (civetrie), normally near the refuge, appears to have some significance in marking, as does micturation. The males display flehmen when smelling the urine of females. Both sexes display perfume marking, depositing the contents of the anal glands on horizontal as well as vertical surfaces, in the latter case by backing up against the object. Marking and locomotory activity increase during mating, and it seems that animals in natural conditions range over wider areas during this time to increase the chances of finding a mate. Perfume marking is also increased in unfamiliar surroundings or on new objects.

Paws/...

Paws are not primarily employed in securing prey, but the killing repertoire includes a number of progressive forms of attack with the jaws, described as the run-away bite, the bite-and-throw, the bite-and-shake, and the killing bite. Mammals, snakes and lizards are eaten from the head down. Civets display scent rubbing, i.e. rolling in any strong smelling or unfamiliar animal food.

Mating behaviour, reproduction, maternal care and the development of the young are also described. Ewer's experimental animals were sexually mature at approximately one year, and their first litter was born when the female was 14 months old. Kittens are born at a relatively advanced stage, with the eyes open.

<u>FOOD</u>:

Only one stomach was available for analysis. It contained three amphibians (*Bufo* sp.) and one rodent (*Otomys* sp.).

This is the most omnivorous of the carnivores studied in the Transvaal. It readily takes dead or living vertebrates, invertebrates, carrion and vegetable matter. It is partial to the fruit of the palm (*Hyphaene* sp.). For a complete list of the food items recorded, see Shortridge (1934); Pienaar (1963); Bothma (1965); Smithers (1971); Ewer (1973 and 1974), and Randall (1977).

<u>BREEDING</u>:

Smithers (1971) recorded a gravid female in January and a juvenile in April, and suggested that parturition occurs during the rainy season. Brand (1963) and Fairall (1968) recorded births during August and December, and consider the possibility of two litters being born per year. Bates (1905) and Ewer (1973) recorded mating throughout the year and births only during the dry season in Cameroun and Ghana. Vanderput (1937) recorded births during October and March. Randall (1977) observed breeding activity between August and December, with the size of the litter ranging from one to four. According to various authors, litter size varies from two to five.

SIZES/...

SIZES AND MASS:

Only two specimens available.

	Tot.	T.	H.ft	Ear		Mass
Male						
TM 17723:	1249	463	130	50	=	?
Female						
TM 19167:	1260	430	130	50	=	16,0kg

RECORDS OF OCCURRENCE:

Specimens examined, 32: Acornhoek, 1 (TM); Brak river, 2 (TM); Bridgewater, 1 (TM); Croc. Ranch Priv. Nat. Res., 7 (TM); Klaserie-Olifants river confluence, 1 (TM); Langjan Prov. Nat. Res., 1 (TM); Mutale river, 3 (TM); Olifants river, 2 (TM); Pretoriuskop camp, 2 (TM); Roodeplaat Exp. Station, 1 (TM); Rustenburg, 1 (TM); Satara, 6 (TM); Tsongani, 3 (TM); Vorster, 1 (TM). Material collected by the Nature Conservation division, from coyote getter returns, from 2330 CD, 2229 CC, 2229 AC, 2228 CB, 3330 DD.

Additional records: Sightings from Greefswald, Hans Merensky Prov. Nat. Res., Letaba Ranch, Madimbo, Mmabolela Estates, Mosdene Priv. Nat. Res., Olifantskop, Othawa, Parkfield and Delamere, Sandringham Priv. Nat. Res., Scrutton, Suikerboschrand Prov. Nat. Res., Sweet Homes, TenBosch Estates, Timbavati Priv. Nat. Res., Uitkyk and Paranie Priv. Nat. Res. Open circles in the Kruger National Park on the distribution map after Pienaar (1964)

Genetta Oken, 1816

1. With a conspicuous dorsal crest of long black hair; hind feet black; tip of tail white ... ... *genetta*
No dorsal crest of long hair; hind feet not black; tip of tail black ... ... *tigrina*

Genetta/...

Genetta genetta (Linnaeus, 1758)   Small-spotted genet
Kleinkol-muskejaatkat

G. g. pulchra Matschie, 1902

TAXONOMIC NOTES:

Although the taxonomy of the genus is still uncertain there appears to be no uncertaintv concerning the status of this subspecies in the Transvaal (Coetzee, 1977).

DISTRIBUTION:

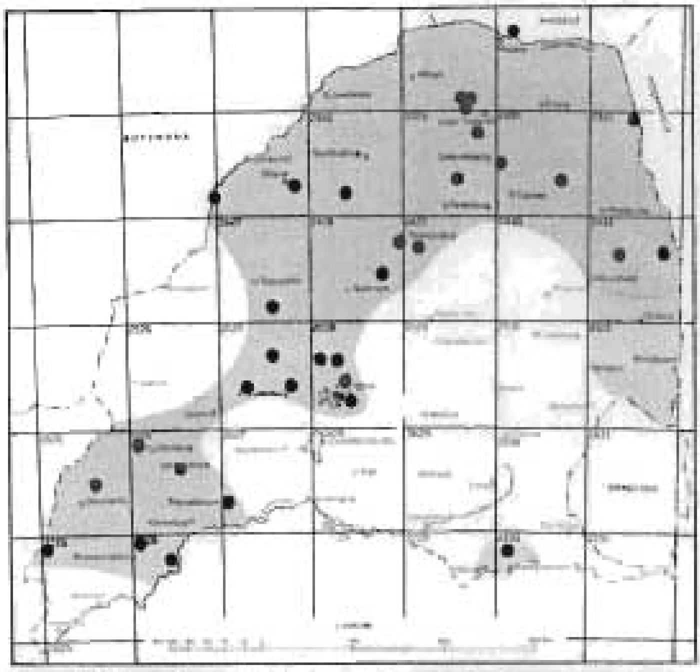

Fig.127: The distribution of *G. genetta* in the Transvaal.

A very common carnivore fcund in most wooded parts of the Transvaal. It has almost certainly been overlooked in the Zeerust, Derdepoort, and Thabazimbi areas of the western Transvaal. Absent from most of the highveld grasslands, except that it is found in isolated instances in riverine bush.

The presence of trees and underbrush appears to be an essential habitat requirement, and the apparent absence of *G. genetta* from the southern and central regions of the Transvaal can possibly be attributed to the absence of this component. The predominant veld types this area are Pure and False Grassveld (see Acocks, 1975), and the lack of adequate arboreal habitat here is considered to be a limiting factor in these highveld areas. However, the species may be shown to occur throughout the riverine bush of this area, while bush encroachment will certainly favour its distribution.

The records from Delareyville,

Schweizer/...

Schweizer-Reneke, Wolmaransstad and Leeudoringstad in the southern Transvaal are all from thorn country intrusions from the west into grassland areas. The record from Potchefstroom, lying in pure grassland, cannot be explained satisfactorily.

HABITAT:

All available records of *G. genetta* are in association with some form of shrub or woodland. As can be concluded from this close association with wooded veld types, and as was found also by Smithers (1971), this is the most essential habitat component required by this genet. It can exist in waterless areas (Shortridge, 1934), and is also found in very rocky terrain.

HABITS:

Strictly nocturnal. Solitary individuals are normally encountered, but occasionally pairs are seen. Young solitary individuals shot at night indicate that the offspring leave their family when weaned. This also confirms that the species is non-gregarious, apart from the male-female breeding relationship. It is not known whether the male participates in the rearing of young.

Small-spotted genets are both arboreal and terrestrial. However, field observations indicate that trees are used primarily as refuges when disturbed at night, and as lairs by day. It is also stated to utilize rock crevices, hollow trees and spring hare burrows as lairs. Most hunting appears to be at ground level.

This genet is fairly easily trapped by means of live traps baited with carcasses of small birds, rodents, strips of meat and intestines. Trapping success is higher during the late winter months, presumably since prey is then relatively scarce. Although individuals were often found hunting in dense short grass, they often appear to utilize roads, tracks and dry streambeds when travelling. Trapping success along these routes is consistently higher than elsewhere.

A/...

A few instances of resightings of individuals in a given area, admittedly over short periods, suggest territoriality (see also Shortridge, 1934).

However, this remains to be confirmed by a more detailed study.

FOOD:

Food items recorded from 12 stomachs analysed.

Muridae		7
Aves		6
Orthoptera	Gryllidae	5
	Acrididae	4
Scorpionidae		4
Solifugae		4
Lepidoptera	Noctuidae	3
Coleoptera	Scarabaeidae	3
Eggs	Undet.	1
Vegetable matter		4

As can be deduced from the above table, genets hunt for their prey mainly at ground level. This was confirmed by visual observations. Rodents that could be identified were *Praomys natalensis*, *Otomys* sp., and *Saccostomus campestris*, which are all terrestrial. All except one of the identifiable bird remains were of the genus *Cisticola*, a grass roosting bird. In one particular stomach 83 caterpillars, belonging to the genera *Euxoa* and *Spodoptera* (Noctuidae, Lepidoptera), were found. According to Dr L. Vári (*pers.comm.*) *Spodoptera* caterpillars feed on grass, and *Euxoa* on the leaves of herbaceous plants, thus in both cases at or near ground level.

Not all prey are terrestrial though. Smithers (1971) twice recorded the tree rat (*Thallomys paedulcus*) as a prey item, and once a forest dormouse (*Graphiurus murinus*). One other exception is a feather which appears to be that of a raptor chick. According to Dr A.C. Kemp (*pers.comm.*) its downy texture, relatively long size, and the presence of an aftershaft suggests that this particular genet had raided a raptor nest containing

young/...

young.

An interesting aspect that warrants closer examination concerns feeding behaviour. Undigested rodent remains were poorly masticated. Most had their skulls crushed, probably in being killed. The rodents were bitten in half and swallowed without further chewing. No signs were evident of any attempt to remove the skin, fur, intestines, feet, head or tail. Full benefit is thus obtained of the nutritional value of the prey.

Another interesting observation that warrants mention concerns the presence of compacted bundles of hair, feathers and bone found in some stomachs. These are obviously of low nutritional value, and although it has never been recorded, it is possible that these pellets are regurgitated when the digestible portion of the prey has passed further along the intestinal track.

Of the vegetable matter recorded, most consisted of bits of leaves and grass believed to have been taken with the prey. One instance recorded, however, was of 25 berries of a *Grewia* sp., which must have been actively selected.

Genets take carrion readily, as can be concluded from the high trapping success obtained with this species.

Other food items recorded, through other projects, are shrews, bats, Isoptera (Smithers, 1971), hares, guinea-fowl and poultry (Shortridge, 1934); and amphibians (Pienaar, 1964).

BREEDING:

A pregnant female with two embryos (1L; 1R) was collected during January. Lactating females were collected during February and April. Smithers (1971) recorded pregnant females only during the summer months October to February. From the data available, it thus appears that reproduction is restricted to the summer months.

SIZES/...

SIZES AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	922,7	9	802	984
Tail	456,0	9	422	483
H.Ft.	90,0	9	81	98
Ear	55,6	9	50	61
Mass	1,91	4	1,65	2,3 kg

Females

	$\bar{X}$	N	Min.	Max.
Tot.	907,3	16	807	980
Tail	427,5	16	392	500
H.Ft.	87,2	16	80	90
Ear	53,3	16	45	60
Mass	1,89	10	1,5	2,3 kg

RECORDS OF OCCURRENCE:

Specimens examined, 40: Amalia, 1 (TM); Blijdschap Priv. Nat. Res., 2 (TM); Barberspan Prov. Nat. Res., 2 (TM); Beestekraal, 1 (TM); Brandhoek, 1 (TM); Brits, 1 (TM); Dordrecht, 1 (TM); Fort Klipdam, 1 (TM); Hammanskraal, 1 (TM); Hans Merensky Prov. Nat. Res., 1 (TM); Huwi, 2 (TM); Langfontein, 1 (TM); Montrose Estates, 1 (TM); Mooivlei, 6 (TM); Mosdene Priv. Nat. Res., 1 (TM); Pienaars river, 1 (TM); Potchefstroom, 1 (TM); Pretoria, 1 (TM); 20 km E. Pretoria, 1 (TM); Pretoria Zoo's Farm, 2 (TM); Potgietersrus, 1 (SI); Ratsegaai, 1 (TM); Rooikrans, 1 (TM); Rustenburg, 1 (TM); Satara, 1 (TM); Shingwidzi, 1 (NKW); Soutpansberg, 1 (TM); Waterpoort, 1 (TM); Wolmaransstad, 1 (TM); Zana Ranch, 1 (TM); Zoutpan, 1 (TM).

Additional records: Skins in private collections examined at Groothoek, Rochdale and Timbavati Priv. Nat. Res. The record from 2230 AC in Rhodesia on the Transvaal border, is based on material in the Rhodesian National Museums (Smithers, *in litt.*). Pienaar (1964) lists records of occurrence throughout the Kruger National Park.

However, considering the uncertainty of correctly

distinguishing/

distinguishing by sight between the two sympatric species of genets (*genetta* and *tigrina*), Pienaar's records are not shown on the distribution map.

Genetta tigrina (Schreber, 1778)
Genetta tigrina rubiginosa Pucheran, 1855 Rusty-spotted genet
Rooikol-muskejaatkat

TAXONOMIC NOTES:

Since the status of *G. tigrina*, and therefore also that of *G. rubiginosa*, is uncertain, the various taxa are grouped by Coetzee (1977) under *G. tigrina* (*sensu lato*). This approach is also followed here.

Coetzee (*op.cit.*), quoting the revision of the genus by J.C. de Meneses Cabral, concludes that *G. genetta, G. angolensis, G. mossambica, G. tigrina* and *G. (?t.) rubiginosa* are probably the four valid species to be recognized in non-tropical southern Africa. In spite of this species diversity, there appears to be no problem concerning the taxonomic status of *G. t. rubiginosa* in the Transvaal in terms of the recognition of *G. tigrina* (*s.l.*). However, the taxonomic complexity of the genus, as stressed by Coetzee (*op.cit.*), is also underlined when studying population variation of this particular species within the Transvaal.

Cabral (in Coetzee, 1977) claims a correlation between the pelt colour and skull size of *G. t. rubiginosa*, with increasing mean annual precipitation. Accordingly, animals from areas with less than 375 mm mean annual rainfall have a paler pelt colour and a greatest skull length of c. 90 mm in males and c. 87,5 mm in females. In the higher rainfall areas, e.g. the eastern escarpment of the Transvaal, the animals are darker and the greatest skull length is c. 95 mm in both sexes.

This view was tested on material available from the Transvaal. Greatest skull lengths of specimens were grouped by sex according to localities receiving a mean annual precipitation

of/...

of less than 600 mm, 600-800 mm, and more than 800 mm (on the escarpment as much as 1 400 mm p.a.)

	Males			Females		
ean annual recipitation	<600 mm	600-800 mm	>800 mm	<600 mm	600-800 mm	>800 mm
Greatest kull length	93,5	88,3	90,0	87,6	89,8	88,2
	11	18	3	10	14	5
in.	84,1	74,6	85,1	77,5	78,2	78,9
ax.	107,1	96,5	93,9	97,8	94,9	93,4

Although some of the sample sizes are small, indications are nonetheless that greatest skull length does not relate to a higher rainfall in the Transvaal.

An unusually large specimen (male, TM 24852) with a greatest skull length of 107,1 mm, was collected at Ten Bosch Estates. This is an area with mean annual precipitation of 500-600 mm. This suggests that the material currently available for taxonomic revisions of this genus does not fully reflect neither geographical nor nongeographical variation within each species.

DISTRIBUTION:

A common carnivore evenly distributed over the bushveld areas of the Transvaal, i.e. roughly north of 26°S latitude. A wooded environment appears to be required.

It is not recorded from the Pure and False Grassveld veld types (as defined by Acocks, 1975) of the southern Transvaal highveld (excluding bushveld intrusions). One apparent exception is the case of a specimen taken at Dullstroom, situated in a north-easterly fingerlike extension of highveld grassland. This animal was trapped in shrub on the banks of the upper reaches of the Crocodile river, which is

believed/...

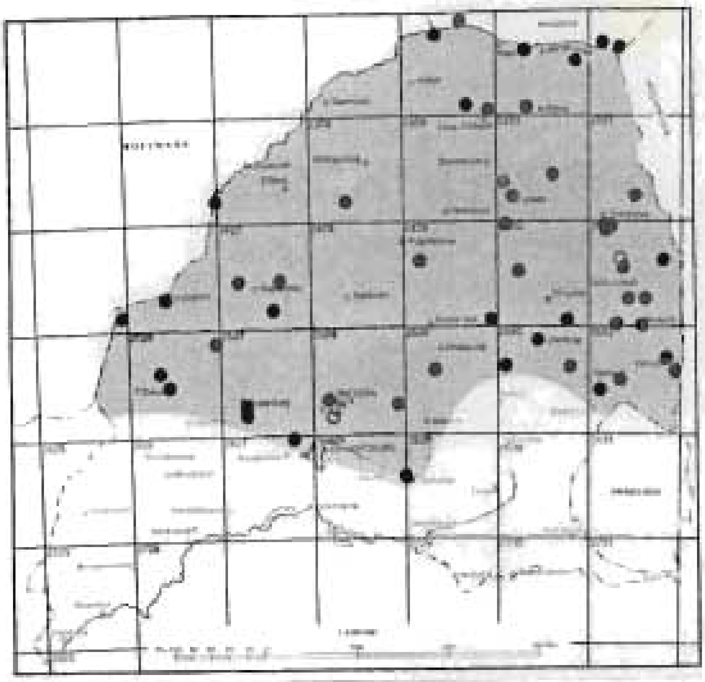

Fig. 128: The distribution of *G. tigrina* in the Transvaal.

believed to provide a corridor of suitable habitat into an otherwise uninhabitable environment. The species is probably absent also from the Pietersburg Plateau Grassveld (as defined by Acocks, 1975).

Rusty-spotted genets appear to be abundant in montane forests which Acocks (1975) defines as Inland Tropical Forest Types. A series was collected at Wolkberg.

This animal appears to have been overlooked along the upper reaches of the Limpopo river, as the habitat there appears favourable.

HABITAT:

Like the former species, the rusty-spotted genet demonstrates a marked dependence on wooded areas, although it is not yet clear whether this dependence is physical or behavioural. In this respect some of the Wolkberg specimens , were trapped in bluegum plantations. A further essential element of its habitat requirements is permanent water, as pointed out by Shortridge (1934) and Smithers (1971). In the Transvaal all animals were collected within a radius of a kilometer or two from a permanent natural watersource.

Rusty-spotted genets also employ rocky environments to their advantage in various ways, presuming the presence of the two habitat requirements mentioned above.

HABITS/...

HABITS:

All indications are that *G. t. rubiginosa* is terrestrial to a large extent (Smithers, 1971). Accordingly, its continued dependence on wooded habitat warrants closer scrutiny, especially with reference to the possibility that it may be in the process of exchanging an arboreal way of life for a terrestrial one (Ewer, 1974). It is nonetheless very much at home in trees, and uses the latter as a retreat when disturbed.

Rusty-spotted genets lie up during the day in holes in the ground constructed by other animals e.g. spring hares, or in hollow trees, logs, dense underbrush, or tall thick grass. It is a social species. More often than not single individuals are encountered; only occasionally pairs are seen, presumably during the period of courtship.

Leyhausen (1956, 1965) and Ewer (1974) discuss the killing technique of genets. When killing bigger prey animals the hind feet are used extensively in order to overcome and subdue the prey. The latter is normally gripped on either side of the body with the hind feet, while the genet rolls over on its side. Iterant snapping was observed - i.e. a series of swift but not well directed bites, normally in the neck region. Each bite is progressively better directed towards a lethal area.

Dücker (1957 and 1965) describes mating behaviour and, according to Ewer (1973), genets closely resemble felids in this. Ewer (*op.cit.*) considers the felids the more efficient killers, and speculates that the mating behaviour and postures are specially adapted to prevent the mating instinct from switching to a killing instinct. The similarity between felids and genets in mating behaviour could thus also be seen as a reflection of the high killing efficiency of genets, approaching that of felids.

According to Rowe-Rowe (1971), the eyes of kittens open at the age of c. 10 days, they can eat solid foods at c. 35 days, and kill prey for the first time at about seven months of age. The mother transports her young in her mouth, gripping them along

the/...

the middle of their backs (Dücker, 1957).

Genets mark by depositing an anal sack secretion, in the case of males mostly by way of standing on the hands while backing up against vertical objects are available. Females mark only on horizontal surfaces (see Fiedler, 1957; Ewer, 1973).

FOOD:

Frequency of occurrence of food items from a sample of 22 stomachs:

Muridae	see text	15
Insectivora	*Crocidura* sp.	2
Chiroptera	*Eptesicus capensis*	1
Aves	2 X *Cisticola*	3
Amphibia	*Breviceps*	3
Isoptera	*Hodotermes*	3
Orthoptera	Gryllidae	7
	Acrididae	6
Coleoptera	Scarabaeidae (adults)	5
Diptera + carrion		
Scorpiones	Scorpionidae	3
	Buthidae (± 75 mm)	1
Myriapoda	*Scolopendria*	1
Solifugae	*Solpuga*	1
Plant material	Grass/leaves/twigs	4
	Fruit	1
	Seeds (*Acacia* and *Grewia*)	3
	Stick	1

As in the case of *G. genetta*, it is apparent from the food items listed above, that rusty-spotted genets feed mainly at ground level. Apparently, however, they do not dig for food, judging from the absence of Coleoptera larvae.

By far the most popular food item recorded consists of rodents. *Otomys* sp. was recorded three times, *Aethomys* sp. four times, and *Praomys natalensis* four times. Four rodent remains were unidentifiable. Of the two *Crocidura* recorded, one was identified as *C. cyanea*. The Cape serotine (*Eptesicus capensis*) is known to roost under loose bark, where it probably was found

by/...

by the genet. This genet may have caught the bat during a resting period at night, since *E. capensis* is observed to be the first bat species to take to the air at dusk.

Of the three instances in which Isoptera was recorded, one stomach contained c. 220 *Hodotermes* individuals, and a second c. 69.

The presence of carrion and *Cyclorrapha* (Diptera) maggots suggest that genets do on occasion scavenge. The stick recorded was from a live-trapped animal and is an atypical food item.

As in the case of the previous species, but not as often, the rodent remains consisted only of balls of hair and bone. From four undigested rodent remains it would appear that the carcasses were torn into smaller bits, although this is only to expected when fully grown large rodents such as *Otomys* sp. and *Aethomys* sp. are taken. A young *Aethomys* was swallowed intact. Rodents are consumed entirely, including heads, tails, feet and intestines, and in one instance a *Otomys* female with two foetuses of cr. 20 mm was recovered.

BREEDING:

12 Females were collected during all months of the year except March, June, September and December. The only two pregnancies were recorded during November. In the first case three embryos were found (cr. 22 mm, implantation 2L; 1R). The second female had three foetuses (cr. 85 mm, implantation 2L; 1R).

Smithers (1971) recorded a single lactating female during February in Botswana, and in Rhodesia pregnancies from August to February. Fairall (1968) records kittens seen during February in the Kruger National Park, as does Pienaar (1964). Other records from Shortridge (1934), and Ansell (1960), refer to pregnancies during October and November.

From available evidence the breeding season seems to be restricted to the warmer, wetter months of the summer season.

SIZES/...

SIZES AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	912,3	28	680	1078
T.	444,9	28	438	527
H.Ft.	81,9	28	75	105
Ear	44,9	28	35	56
Mass	1,95	10	0,84	2,7 kg

Females

	$\bar{X}$	N	Min.	Max.
Tot.	884,0	30	650	1024
T.	425,0	30	410	502
H.Ft.	83,8	32	60	98
Ear	44,8	29	30	52
Mass	1,77	16	1,0	2,4 kg

RECORDS OF OCCURRENCE:

Specimens examined, 85: Buffelshoek, 1 (TM); De Hoop Priv. Nat. Res., 1 (TM); Doispan, 1 (NKW); Donkerpoort, 1 (TM); Dordrecht, 1 (TM); Exeter, 1 (DM); Fairfield, 1 (TM); Ferndale, 2 (TM); Greefswald, 2 (TM); Grootsuikerboschkop and Elandslaagte, 1 (TM); Grootfontein, 1 (TM); Groothoek, 1 (TM); Kempiana, 1 (TM); Killarney, 4 (TM); Klaserie-Olifants rivers confluence, 2 (TM); Komatipoort, 1 (SI); Loskopdam Prov. Nat. Res., 1 (TM); Lydenburg, 1 (TM); Molelane, 1 (SI); Miragoma, 1 (TM); Mooiplaas, 1 (TM); Mooivlei, 1 (TM); Mokeetsi, 6 (TM); Mutale river, 5 (TM); New Agatha Forest Res., 4 (TM); Newgate, 2 (TM); Njelelle river, 1 (TM); Nwanetzi, 1 (TM); Olifantspoort, 1 (TM); Olifants river, 5 (TM); Othawa, 2 (TM); Paranie Priv. Nat. Res., 3 (TM); Renosterpoort, 1 (TM); Rhoda, 1 (TM); Rochdale, 1 (TM); Rolspruit, 1 (TM); Rooikrans, 2 (TM); Rustenburg, 2 (TM); Sandringham Priv. Nat. Res., 1 (TM); Satara, 1 (TM); Scrutton, 1 (TM); Secheli's Oude Stat, 1 (TM); Sheila, 6 (TM); Skukuza, 1 (NKW); Sterkfontein, 1 (TM); TenBosch Estates, 2 (TM); Tzaneen Estates, 2 (TM); Wonderboom, 1 (TM); Zandspruit 168, 1 (TM); Zeerust, 1 (SI).

Additional/...

Additional records: Skins examined at Timbavati Priv. Nat Res.; live-trapped animal handled at Irene; three records from Rhodesia on the Transvaal border, based on material housed in the Rhodesian National Museums. The sight records quoted by Pienaar (1964) are not listed because of the difficulty of distinguishing between wild individuals of the two species.

Subfamily Herpestinae

Suricata Desmarest, 1804

Suricata suricatta (Schreber, 1777) Suricate
Stokstertmeerkat

S. s. suricatta (Schreber, 1777)

DISTRIBUTION:

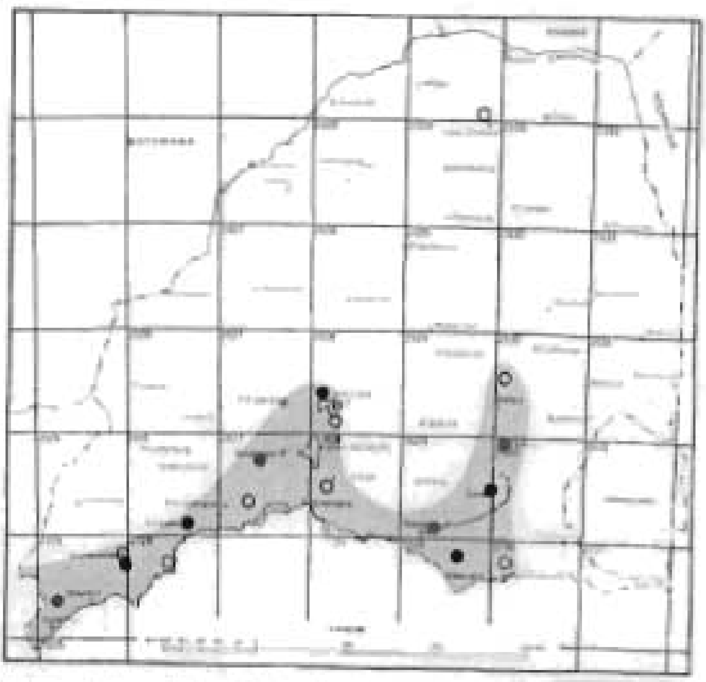

Fig. 129 The distribution of *S. suricatta* in the Transvaal.

In the Transvaal the suricate is restricted to the Pure and False Grassveld (Acocks, 1975) of the highveld, and also the Kalahari Thornveld and Shrub Bushveld intrusions from the west into the Schweizer Reneke, Bloemhof and Bothaville districts. It is also recorded from a finger-like extension of the highveld in the Belfast and Dullstroom area. The most easterly records for this species coincide with $30^{\circ}15'$E longitude,

although/...

although the False Grassveld (see Acocks, 1975) in south-eastern Transvaal extends another 75 km eastwards as far as 31°00'E longitude, suggesting that the suricate may have been overlooked here.

The atypical record from north of Louis Trichardt is from a colony introduced by Dr E. Marais to his private reserve, on old lands in a valley in the Zoutpansberg, where the animal seems to flourish.

HABITAT:

As can be expected, the suricate avoids bushveld areas, being adapted to open plains. Since it is similar to the banded mongoose in many respects, it is tempting to look upon the suricate as the grassland counterpart of the banded mongoose which is restricted to bushveld areas.

As demonstrated by the colony established at Louis Trichardt (see also Smithers, 1971), it is possible for the suricate to exist in scarcely wooded areas, provided that the vicinity of the warren is devoid of bush, thus offering a clear view of the normally rather small home range.

Firm, sometimes even hard ground is preferred, presumably mainly because warrens of a more permanent nature can be constructed in such a substrate.

BEHAVIOUR:

A well-known characteristic of the suricate is the various upright postures it adopts at burrow entrances. The first posture is seen when sunning itself, supported by the hind feet, with the tail flat on the ground. The second posture is an alert or lookout position, standing upright on the toes and balanced with only the tip of the tail on the ground. The slightest disturbance results in a scramble for the safety of the warren.

Suricates are strictly diurnal, appearing on the surface after sunrise, initially to sun themselves. They retreat before dusk. They are also inactive during rainy or heavily overcast and cold days. Their diurnal nature is reflected in the anatomy of the eye (Walls, 1942). The tapetum lucidum, characteristic

of/...

of nocturnal mammals, is absent. In addition, the high proportion of cones in the retina is a functional adaptation to high light intensities, as is also the fact that the pupil can close down to a narrow aperture.

S. suricatta is terrestrial, partly fossorial and gregarious. Groups normally consist of two to three family units comprising 10-15 individuals. These groups construct communal warrens on open plains, and forage as a group in the close vicinity of the warren. While foraging, stone are turned over for hidden bits of prey, while some prey is actively excavated with the well-developed long front claws. Suricates often occupy warrens in association with ground squirrels (*Xerus inaurus*), and yellow mongoose (*Cynictis penicillata*) (See also Smithers, 1971). As found on Maria van Riebeeck reserve, suricate colonies move from time to time to warrens in other areas for reasons as yet unknown.

Suricate teeth are well adapted to an insectivorous diet, being sharp-cusped and interlocking, with the carnassial shears poorly developed. According to Ewer (1973) vertebrate prey, when encountered by chance, is nevertheless killed with a high degree of skill, employing a single well-directed killing bite in the neck region. Ewer speculates that the ancestral Herpestinae have been solitary and more predaceous. She postulates that modern suricates retained their typical predaceous killing abilities, in spite of their derived foraging and insectivorous nature, since these are still advantageous in the behavioural repertoire as a means of supplementing the diet.

Ewer (1975) recognizes several distinct sounds, each provoking a different kind of conspecific reaction. The most important ones are contact sounds when foraging to maintain group cohesion; a "hawk-alarm" call, and three types of threat sounds.

Both sexes display scent marking employing the secretions of the anal sack. The simple anal drag technique is more common, but males occasionally also mark on vertical surfaces by cocking the hind leg to deposit the contents of the anal pouch (see Ewer, 1963a).

Ewer/...

Ewer (*op.cit.*) studied suricate mating behaviour in captivity, and concludes that as a consequence of the social nature of this species there is very little courtship behaviour, probably since the partners already know each other. Scent marking and playful fighting are, however, intensified during premating behaviour. Ewer (1963) could not detect any submissive signals, except that females are dominant in access to food. Although flehmen is more typical of the felids, it is displayed also by suricate males in response to female urine.

The young are born and reared in nest chambers within the warren. According to Dücker (1963) their eyes open within 10 to 14 days; they take solids between the 23rd and the 30th day, and are weaned after seven to nine weeks. The young are normally carried by means of a neck grip.

Shortridge (1934) states that suricates can be independent of free water.

<u>FOOD</u>:

Only three stomachs were available for analysis. The contents, with frequency of occurrence, are listed below:

Coleoptera	Scarabaeidae	Adults	2
		Larvae	3
	Cetoniinae		1
	Tenebrionidae	Adult	1
Lepidoptera	Noctuidae		2
Myriapoda			1

Zumpt (1968) examined the contents of 18 stomachs. Thirteen contained arthropod remains. Three stomachs also contained grass and seeds. Only one frog was recorded in the entire sample, supporting Ewer's (1963) comments on the incidental killing of vertebrates.

Smithers (1971) analysed the contents of 17 stomachs, and similarly, invertebrates predominated, only three stomachs containing four reptiles.

BREEDING/...

BREEDING:

A lactating female was collected during November. Smithers (1971) collected a gravid female during February. Shortridge (1934) recorded a pregnant female collected in November. Ewer (1973) recorded births during November and December, while Brand (1963) recorded parturition from September to January in captive animals. These records suggest that suricates breed during the warmer rainy months of the year.

MEASUREMENTS AND MASS:

Males

	$\bar{x}$	N	Min.	Max.
Tot.	477,6	11	445	510
T.	201,2	11	180	223
H.Ft	65,8	11	60	70
Ear	17,8	11	14	20
Mass	788	3	465	1000 g

Females

	$\bar{x}$	N	Min.	Max.
Tot.	500,8	8	470	550
T.	210,3	8	200	230
H.Ft	65,0	8	62	71
Ear	17,1	8	15	20
Mass	740	2	480	1000 g

RECORDS OF OCCURRENCE:

Specimens examined, 16: Carolina, 3 (TM); Ermelo, 1 (TM); Klerksdorp, 1 (TM); Makwassie, 4 (TM); Onderstepoort, 1 (TM); Roodepoort 383, 2 (TM); Welgedaan, 1 (TM); Wolmaransstad, 2 (SI); Wonderfontein, 1 (TM). Coyote-getter returns collected by the Division of Nature Conservation from 2729 BA.

Additional records: Sightings from Brandhoek, Grootsuikerboschkop and Elandslaagte, Langfontein, Parkfield and Delamere, Suikerboschrand Prov. Nat. Res.; van Riebeeck Mun. Nat. Res., Witpoort.

Paracynictis/.

Paracynictis Pocock, 1916

Paracynictus selousi (de Winton, 1896) Selous' mongoose
Klein-witstertmuishond

P. s. selousi (de Winton, 1896)

DISTRIBUTION:

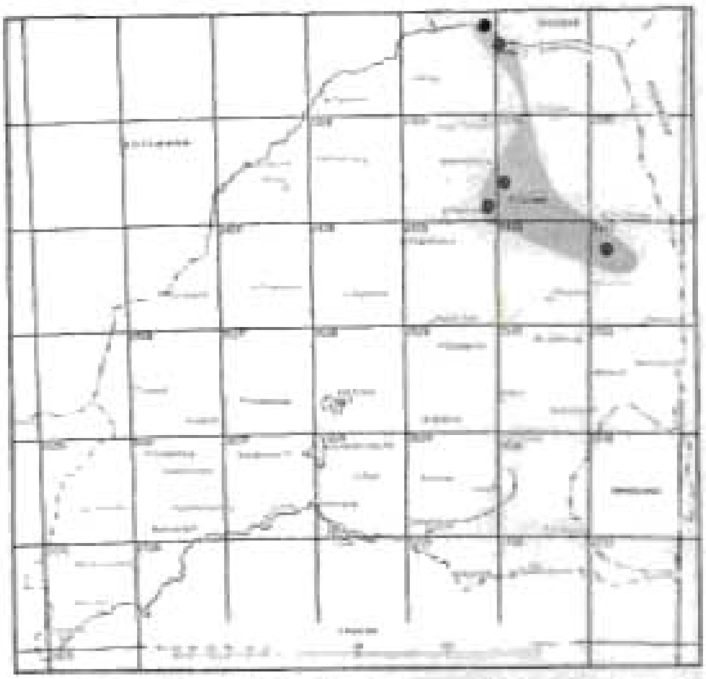

Fig. 130: The distribution of *P. selousi* in the Transvaal.

So far it has been recorded only from the north-eastern regions: one record from the lowveld, two from the escarpment and one from the Limpopo river. According to Coetzee (1977) Selous' mongoose has been recorded in northern Zululand and the southern tip of Mocambique (*P. s. sengaani* Roberts, 1931. Type in Transvaal Museum collection, TM 6082; Maputa 2632DD). Judging from distributional records in the Transvaal, *P. s. sengaani* could be geographically isolated, or else Selous' mongoose has been overlooked in the south-eastern Transvaal, (provided that the species has a continuous distribution).

It possibly has also been overlooked in the extreme north-western Transvaal, since it was collected in Botswana by Smithers (1971) close to the Transvaal border, i.e. east of Stockpoort (2326CD), as well as near the Limpopo-Shashi river confluence (2128DD).

The species is scarce within its range in the Republic of South Africa (see also Shortridge, 1934), possibly because this is the southern limit of its range.

HABITAT/...

HABITAT:

Smithers (1971) suggests that Selous' mongoose is favoured by open shrub and woodland associations on sandy soils. Personal observations in northern Zululand substantiate this.

HABITS:

A nocturnal and partly diurnal species, normally encountered singly or in pairs. It is terrestrial, and excavates its own burrows under cover of bushes (Smithers, 1971). The burrows may have more than one entrance.

FOOD:

Smithers (1971) analysed 34 stomachs, and found that it utilizes a wide range of food items. However, from his data it is evident that Invertebrates, especially insects, are taken more frequently than Vertebrates. Of the vertebrates, murids were the most commonly recorded food item. Smithers (*op.cit.*) is however, of the opinion that rodents would have rated higher as a preferred food item if it had not been for low rodent population densities resulting from drought conditions during the first two years of his survey.

BREEDING:

Smithers (1971) recorded a lactating female during February, and two pregnant females during February and September in Botswana, as well as a pregnant female during August in Rhodesia. Shortridge (1934) documented a gravid female in October. Indications thus are that parturition occurs during the warm wet months of the year.

MEASUREMENTS AND MASS:

Males

	Tot.	T.	H.ft	Ear		Mass
TM 6201:	685	304	101	25	=	?
TM 6239:	666	279	75	37	=	?
TM 7567:	870	410	110	40	=	?
TM 7886:	866	415	106	45	=	?

Females/...

Females

	Tot.	T.	H.ft	Ear		Mass
TM 6240	758	340	118	32	=	?
TM 7887	835	395	105	42	=	?
TM 11599	720	310	108	35	=	?

RECORDS OF OCCURRENCE:

Specimens examined, 8: Road between Klaserie and Hoedspruit, 1 (NKW); Messina, 1 (TM); Mokeetsi, 5 (TM); Woodbush, 1 (TM).

Additional data: Record from Rhodesia on the Transvaal border, based on specimens in the Rhodesian National Museums (Smithers, *in litt.*).

Cynictis Ogilby, 1833

Cynictis penicillata (G. Cuvier, 1829) Yellow mongoose
Geelmuishond

TAXONOMIC NOTES:

Roberts (1951) and Ellerman *et al.* (1953) recognize 12 subspecies. In reviewing the subspecies of *C. penicillata*, Lundholm (1955) concludes that there is no justification for recognizing any subspecies. He points out that some subspecies were founded on non-valid characteristics which exhibit seasonal variation within any population, i.e. the colour coat and the absence or presence of the white tailtip. In addition, the authors describing these subspecies had not always taken into account the chronological age of their type material, nor the nongeographic variation in the morphometric parameters normally used for taxonomic purposes.

Lundholm (*op.cit.*) describes a cline in colouration, from yellow in the south to grey in the north of the range, apart from local seasonal colour changes. In addition, he demonstrates an even intergradation between population means with regard to basal skull length, head and body length,

tail/...

tail and hind foot length and tooth measurements, which consequently render all these parameters of little value in separating subspecies.

On examining the 76 specimens from the Transvaal, the seasonal absence of a white tailtip claimed by Lundholm (*op. cit.*) was not found to be valid. A non-white tailtip was found to be the exception rather than the rule during both summer and winter. The coast of a few specimens, however, were stained by the soil in which they had burrowed, and had to be washed before this feature became apparent.

Lundholm's (1955) approach is nevertheless followed here in recognizing no subspecies. The series from the Transvaal varies in colour from greyish with a red undercoat towards the north, through pale yellowish to rufous in the south.

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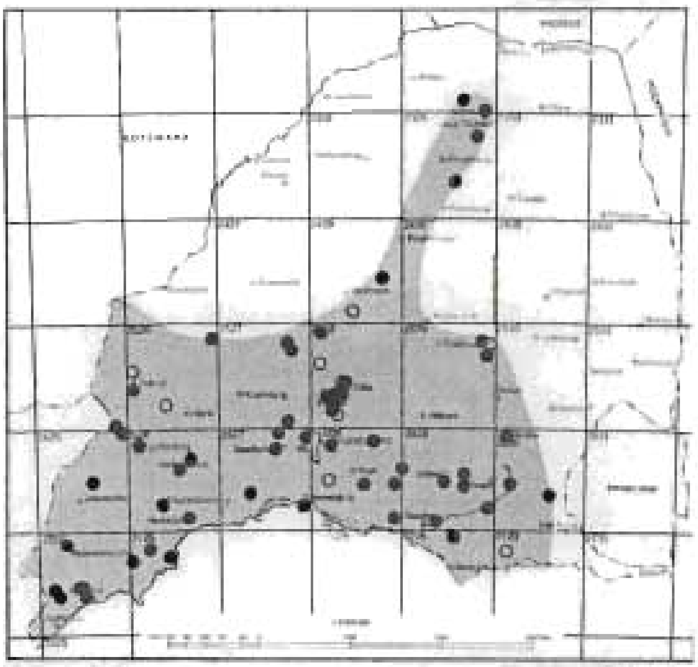


Fig. 131: The distribution of *C. penicillata* in the Transvaal.

Evenly distributed in the Transvaal south of 25°S latitude, as far east as the Piet Retief and Lydenburg districts on the edge of the escarpment. A northerly fingerlike extension of the range is evident from the central Transvaal, stretching as far north as Montrose Estates in the Waterpoort area of the Zoutpansberg.

This is a common carnivore of the Pure and False Grassveld (defined by Acocks, 1975) of the Transvaal highveld. However, records from north of 25°45'S latitude are all from Acock's (1975) Tropical Bush and Savannah Veld Types, the three particular

elements/...

elements of the latter being defined as "turf thornveld", "mixed" and "sourish mixed bushveld".

HABITAT:

The yellow mongoose prefers open sandy terrain, with cover ranging from pure grassveld to open *Acacia* shrubland or parkland (see also Smithers, 1971). During this survey it became evident that *Suricata* is less abundant in the Tropical Bush and Savannah areas of its range than in the pure grassveld This is seen as an indication that grassveld better fulfils the habitat requirements of the species. An additional explanation may be that in bushveld regions *C. penicillata* exists in competition with *Mungos mungo* (banded mongoose), *Helogale parvula* (dwarf mongoose) and *Herpestes sanguineus* (slender mongoose) for food, shelter and space. All four these species are small diurnal carnivores, but the latter three are restricted to the bushveld areas of the Transvaal.

HABITS:

A diurnal species as shown by field observations, and also by the absence of the tapetum lucidum (typical of nocturnal mammals) in the eye (Walls, 1942). FitzSimons (in Shortridge, 1934) and Smithers (1971) recorded some nocturnal activity, presumably during bright moonlit nights. This was never encountered in the Transvaal.

Cynictis is terrestrial and semi-gregarious. It constructs warrens which vary in size from a simple system with only two exits and occupied by only two individuals, to an elaborate warren with numerous interconnected burrows normally occupied by eight to ten individuals. Roberts (1951) recorded a warren occupied by 50 individuals, but this seems exceptional. Yellow mongoose often occupy warrens together with suricate (*Suricata suricatta*) and ground squirrels (*Xerus inauris*). As *Cynictis* is not as active a burrower as the other two species, it can be postulated that in such communal warrens *Cynictis* benefits from the labours of *Suricata* and *Xerus*.

Yellow mongoose are often seen sunning itself at burrow

entrances/...

entrances during the early mornings and late afternoons. At these times they often adopt an upright "alert" posture, similar to that of *Suricata*. The slightest suspicion of danger initiates a scramble for the security of the burrows.

During the main part of the day *Cynictis* roams the veld in the vicinity of its warren, mostly singly but occasionally in pairs, in search of prey. As observed also by Shortridge (1934), the yellow mongoose does not scratch and dig in search of insects as much as does *Suricata*. As shown by the relatively long canines and well-developed carnassial shears, this is a more predaceous species which actively hunts vertebrate prey. According to Ewer (1973) the yellow mongoose is an efficient killer, as shown also by its solitary hunting mode, which serves to avoid conspecific interference.

Roberts (1951) refers to the communal use of toilet sites.

The young are born and reared in nest chambers. It is not known whether the male participates in the rearing and feeding of the litter. The young start eating solids on c. day 16, and are weaned by six weeks (Ewer, 1973, quoting Zumpt, *pers.comm.*).

Cynictis adapts well to human settlement, and persists in heavily overgrazed areas. In cultivated areas, its burrows are constructed in the strips of veld separating lands, from where it hunts for the insects, rodents and small birds attracted to the crops and to the natural cover surrounding it.

FOOD:

In a sample of 23 stomachs analysed, the following food items were recorded in the frequencies indicated:

Orthoptera	Acrididae	13
	Gryllidae	6
Coleoptera	Scarabaeidae	9
	Tenebrionidae	6
	Chrysomelidae	1
	Carabidae	1

Cerambycidae/..

	Cerambycidae	1
	Curculionidae	2
	Elateridae	1
Isoptera	Termitidae	2
	Hodotermitidae	3
Dermoptera	Forficulidae	3
Lepidoptera	Noctuidae	4
	Sphingidae	1
	Geometridae	1
	Notodontidae	1
Hemiptera		2
Hymenoptera	Formicidae	1
Solfugidae	*Solpuga*	2
Myriapoda		4
Rodentia	*Praomys natalensis*	2
Hair of an	unidentified rodent	1
Reptilia	*Leptotyphlops acutifrons*	1
Amphibia	*Breviceps adspersus*	2
Aves	egg	1
Grass		1
Peanuts		2
Fruit		1
Bait/carrion		5

Invertebrates are by far the most important food item in the above sample. In the case of insects, adults and instars were present in approximately equal proportions. Zumpt (1968a and b) examined the contents of 58 stomachs, and concludes that *Cynictis* is a mixed feeder, with the principle food items insects and rodents. The sample above, as well as those of Zumpt (*op. cit.*), Smithers (1971) and Herzig-Straschil (1976), show a remarkably low incidence of birds, reptiles and amphibians.

The relatively low proportion of rodents in the quoted samples may be due to the fact that the majority of rodent species are crepuscular or nocturnal, so that by day this carnivore has to locate a rodent retreat and attempt to extract the prey. Its predaceous hunting behaviour pattern and its specially adapted teeth, however, lead one to expect a higher proportion of vertebrate prey.

Although/...

Although this species is not as easily trapped as genets or slender mongoose, the mere fact that five individuals were attracted into traps baited with rodent bodies indicates that it scavenges to some extent when the opportunity arises, as was observed also by Zumpt (*op.cit.*).

BREEDING:

Lactating females were collected during February and March, and two pregnant females during November and December (number of foetuses two and five respectively). Ewer (1973, citing Zumpt, *pers.comm.*), Jacobsen (*pers.comm.*), and Brand (1963), consider the birth period to be from October to January, with one to four young per litter. Smithers (1971) recorded pregnancies during February, March, July, October and November. These records substantiate Smithers' (1971) suggestion of a peak breeding period during the summer, with sporadic breeding during winter.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	534,5	25	414	620
T.	216,0	25	184	255
H.Ft	68,4	25	59	77
Ear	30,1	23	20	35
Mass	842,9	7	650	1000 g

Females

	$\bar{X}$	N	Min.	Max.
Tot.	538,3	31	465	618
T.	221,5	31	180	288
H.Ft	68,1	30	50	77
Ear	31,4	31	20	38
Mass	829,1	11	514	1000 g

RECORDS OF OCCURRENCE:

Specimens examined, 88: Barberspan, 2 (TM); Begin der Lyn, 1 (TM); Bloemhof, 1 (TM); Blijdschap Priv. Nat. Res., 2 (TM); Brandhoek, 3 (TM); Carolina, 1 (TM); Delmas, 1 (TM); Derdepoort Radio Station, 1 (TM); Ermelo, 1 (SI); Fontainebleau, 1 (TM); Fort Klipdam, 2 (TM); Goedehoop, 1 (TM); Hartebeesfontein, 1 (TM); Hatfield, 2 (TM); Holbank, 1 (TM); Irene, 1 (TM); Jacobsdal, 1 (TM); Jan Smuts airport, 1 (TM); Jericho, 1 (TM); Joshua Moolman Priv. Nat. Res., 2 (TM); Kilnerton, 1 (TM); Klerksdorp, 1 (TM); Klipkuil, 4 (TM); Leeudoringstad, 1 (TM); Lichtenburg, 5 (SI); Makwassie, 2 (TM); Montrose Estates, 4 (TM); Mosdene, 1 (TM); Oorbietjiesfontein, 2 (TM); Panfontein, 9 (TM); Pienaars river dam, 2 (TM); Pretoria, 2 (TM, 1; SI, 1); Pretoria Zoo's Farm, 1 (TM); Ratsegaai, 2 (TM); Rolspruit, 2 (TM); Roodepoort 383, 1 (TM); Rietondale, 2 (TM); S.A. Lombaard Prov. Nat. Res., 3 (TM); Schweizer Reneke, 1 (TM); Tarlton, 1 (TM); 32 km W. Ventersdorp, 1 (TM); Viljoensdrift, 1 (TM); Welgedaan, 6 (TM); Wilgekuil, 2 (TM); Witpoort, 1 (TM); Zandspruit, 1 (TM); Zwarthoek, 1 (TM). Specimens obtained through control programs by means of coyote getters, currently housed by the Division of Nature Conservation, from 2528AA; 2528CB; 2529BB; 2629DA; 2628DD; 2628DB; 2628DA; 2729BA; 2729BD; 2725CA.

Additional records: Sightings from Langfontein, Mosdene Priv. Nat. Res., Rissik Priv. Nat. Res., Roossenekal, Rykvoorby, Suikerboschrand Prov. Nat. Res., van Riebeeck Mun. Nat. Res., Zoutpan.

Herpestes Illiger, 1811

1. Size larger, total length of adults one metre and over; length of skull exceeding 90 mm; normally with six upper and six lower cheek teeth	*ichneumon*
Size smaller; total length of adults not exceeding 60 cm; length of skull not exceeding 65 mm; six upper and five lower cheek teeth ...	*sanguineus*

Herpestes/...

Herpestes (H.) ichneumon (Linnaeus, 1758) Egyptian mongoose
Groot-grysmuishond

H. i. cafer (Gmelin, 1788)

DISTRIBUTION:

From what little is known about the distribution of this species in southern Africa, its range appears to coincide with areas with a mean annual rainfall of more than 500 mm. In the Transvaal the Egyptian mongoose is restricted to the south-eastern lowveld, which receives an annual precipitation of between 500 and 750 mm, in contrast to the 250-500 mm of the north-eastern Transvaal lowveld. Although central and western Transvaal also lie in the 500-750 mm mean annual precipitation area, the escarpment probably acts as a barrier in the spread of this mongoose.

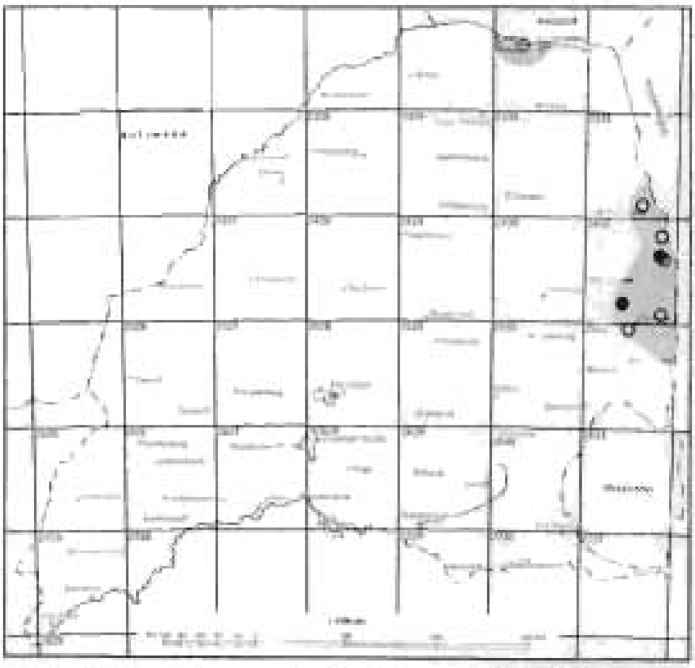


Fig. 132: The distribution of *H. ichneumon* in the Transvaal.

H. ichneumon is scarce within the borders of the Republic of South Africa, and therefore appears to be rare or endangered locally.

HABITAT:

The Egyptian mongoose is poorly represented in study collections, and little is known of its habitat requirements and behaviour. It occurs in well-wooded areas near permanent water, as well as in underbrush, wet vleis and reed-fringed swamps. In the Kruger National Park it has also been recorded from woodland savannah, although it is not stated how far away it occurs from water (Pienaar, 1964; Coetzee, 1977; Smithers, 1971). Taylor

(1970)/...

(1970) to the contrary, claims its habitat to be "... most open habitats..." in Kenya.

HABITS:

Predominantly diurnal, entirely terrestrial, and usually solitary, but on occasion pairs are encountered. Shortridge (1934) claims that it sometimes forms packs of up to 14 individuals. Dorst and Dandelot (1970) state that when such family parties roam about as a group, they do so in single file thus creating the impression of a giant snake. From the accounts of mating behaviour by Cücker (1960), and the interpretation thereof by Ewer (1973), *H. ichneumon* appears to be a more social species than was formerly appreciated.

Ewer (1973) has observed this species breaking eggs by holding them in the forepaws and throwing them backwards between the hind legs against a rock.

The Egyptian mongoose utilize burrows, overhaning banks and the exposed roots of trees along watercourses as shelters. According to Shortridge (1934) this species takes to water readily and swims well, although not as well as *Atilax paludinosus*.

FOOD:

No stomachs were available for analysis from the Transvaal. Ewer (1973) considers the Egyptian mongoose a mixed feeder. This is substantiated by the findings of Shortridge (1934), Roberts (1951) and Smithers (1971), who recorded rodents, small birds, eggs, reptiles, frogs, grasshoppers, beetles and aquatic fauna such as crabs and fish, in its food.

BREEDING:

No information is available from the Transvaal or elsewhere in southern Africa.

MEASUREMENTS AND MASS:

Of all the specimens housed in the Transvaal Museum, only

three/...

three males collected from outside the Transvaal have been measured.

	Tot.	T.	H.ft	Ear		Mass
TM 9852:	1237	662	100	17	=	?
TM 10156:	1100	559	102	32	=	?
TM 20723:	1100	540	110	34	=	?

RECORDS OF OCCURRENCE:

Specimens examined, 2: Newington, 1 (DM); Satara camp, 1 (TM).

Additional records: Sightings from Scrutton. Open circles in the Kruger National Park on the distribution map after Pienaar (1964).

Herpestes (G.) sanguineus (Rüppell, 1835) Slender mongoose
Bosveldmuishond

TAXONOMIC NOTES:

This species is in urgent need of revision, as stressed also by Meester *et al.* (1964) and Coetzee (1977). In view of this, no attempt is made here to assign the material collected from the Transvaal to any of the numerous described subspecies. It may include more than one species.

DISTRIBUTION:

It is widely distributed in the wooded areas of the Transvaal. Present also in the riverine woodland and shrub along the Vaal river and its tributaries as far upstream as Vereeniging. It is nowhere else found on the pure grasslands of the highveld. As in the case of the Vaal river records, the record from the Dullstroom area is the result of individuals using the wooded banks of the Crocodile river as a corridor into an otherwise unsuitable region. The record from Golela is again from the well-wooded lowveld.

HABITAT/...

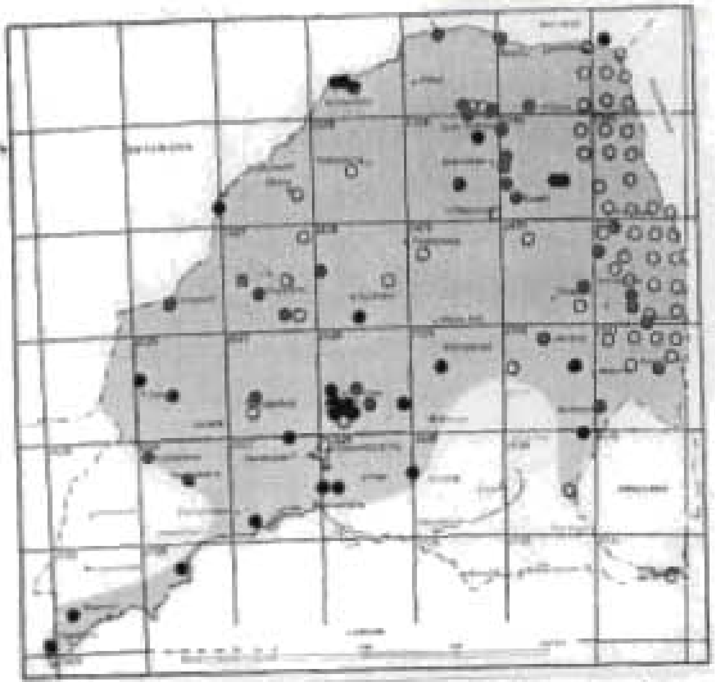


Fig.133: The distribution of *H. sanguineus* in the Transvaal.

HABITAT:

A common carnivore, equally abundant in the eastern lowveld and the more arid bushveld regions of central, north-western and the far norther Transvaal. It would appear that the only limiting factor to its distribution is adequate cover. As pointed out by Smithers (1971), and substantiated by data accumulated through this project, *H. sanguineus* is more common in well watered areas. It is however not clear whether this higher population density is allowed by the presence of water, by the better cover afforded by riparian shrub or woodland, or even possibly by a higher prey density.

Slender mongoose were often observed amongst rocky outcrops, where they utilize the cover of rocks and the refuge of crevices to great advantage.

HABITS:

The most predaceous of the Herpestinae in the Transvaal. The entire behavioural make-up is that of a very efficient killer. It is almost exclusively solitary, a behavioural characteristic ascribed to the true predator by Ewer (1973), since intraspecific interference is hereby avoided. On rare occasions pairs are seen together, presumably during the mating season.

Its movements are quick, smooth and silent with an almost feline elegance. Unlike the more insectivorous species it does not scrape and scratch around for insects, but merely sniffs at probable prey retreats. The slender mongoose utilizes cover very

efficiently/..

efficiently, and an observer normally see it only when crossing a clearing or road, always at a run with the characteristic black tailtip slightly turned up.

The specimens collected in the Transvaal, as well as all visual observations made, were during daylight hours. This is contrary to the general tendency for the more predaceous small carnivores to be solitary and nocturnal (see Ewer, 1973:277). This seemingly contrasting behavioural pattern must be part of its niche occupation. Shortridge (1934) however, claims some nocturnal activity for this species.

During cold, windy days the slender mongoose is seldom seen and it is likely that it does not leave its retreat, as suggested also by Smithers (1971). During normal days hunting activity appears to be at a peak during the cooler hours of the morning and afternoon. During the heat of the midday these animals rest in the shade during summer or in sunny patches amongst dense cover on cold days. One animal was observed and photographed at Renosterpoort Private Nature Reserve during July, sunning itself while stretched out on a rock amongst shrub.

Taylor (1970) found that *H. sanguineus* has an average home range of 1 km^2 in east Africa.

All observations made in the Transvaal indicate that this is a totally terrestrial species, although Shortridge (1934) claims that it is a good climber and sometimes take refuge or hunts birds in trees, or even utilizes holes high up on tree trunks when breeding. I agree with Taylor (1970), that the slender mongoose exhibits uncontrolled agility in climbing, relying mostly on momentum to get up into trees.

Smithers (1971) has observed captive animals breaking chicken eggs by holding them with the forepaws and catapulting them between the hind legs against a stone to break them.

H. sanguineus utilizes footpaths and clearings in especially dense riverine bush to a large extent, as is often trapped at or near such paths. The canopy of the trees affords protection against raptors when the slender mongoose ventures into the relatively openness of footpaths. As can be expected from non-

gregarious/...

gregarious carnivores, it does not make many sounds, and is also quiet when live-trapped.

The slender mongoose utilizes burrows excavated by other mammals, as well as hollow logs and rock crevices as retreats, where the young are born and reared. It is not known whether the male participates in the rearing of young.

If not severely disturbed, the slender mongoose adapts well to human settlement. Instances have been recorded where individuals have lived at or near homesteads, taking no notice of regular human activity. This point is well illustrated by the fact that a specimen was trapped in the gardens of the Union Buildings, Pretoria, during 1974.

FOOD:

19 Stomachs were available for examination. Four were empty, and the following food items were recorded in the remainder, at the frequencies of occurrence given:

Rodentia	see text	8
Bait/carrion	(indicated by the presence of *Cyclorrhapha* maggots)	3
Orthoptera	Acrididae	2
	Gryllidae	2
Coleoptera	Scarabaeidae	3
	Tenebrionidae	1
	Elateridae	1
Lepidoptera	Sphingidae	1
Isoptera	Hodotermitidae	1
Aves	feathers (unidentified)	3
Reptilia	Lacertidae (*Eremias* sp.)	1
Amphibia	*Phrynomerus bifasciatus*	1
Leaves/grass		2

Of the rodent remains, four were unidentifiable since digestion was too far advanced, and all that remained were tightly compacted balls of fur. Of the other four rodent remains found, two were identified as *Praomys natalensis*, the other two as

Aethomys/...

Aethomys sp. From these four carcasses it would appear that rodent prey is torn into little bits and well masticated. The entire rodent is devoured as indicated by the presence of heads feet, tail and intestines. The single frog specimen recorded, belongs to a species having toxic skin glands. Insects were present in both their adult and instar stages.

Pace Shortridge (1934), the slender mongoose was four to take carrion, as indicated by the presence of *Cyclorrhapha* (Diptera) maggots.

The high percentage occurrence of vertebrates in the above sample, as well as in the sample analysed by Smithers (1971), supports the view by Ewer (1973) that *H. sanguineus* is a very predaceous carnivore. However, invertebrates are also utilized to a large extent as food, presumably in relation to the population densities of vertebrate prey species. Bates (1905), Shortridge (1934), and Roberts (1951) ascribe poultry raids to the slender mongoose. Ansell (1965) collected a slender mongoose with the remains of tree squirrels in its stomach.

BREEDING:

Only one pregnant female was collected, in October (two embryos, 1L; 1R, cr. 28 mm). Lactating females were collected during November (2), December (1) and January (1).

Smithers (1971) recorded pregnancies during November and December, and lactating females during February and March. From the combined records it would appear that parturition occur during summer in southern Africa, possibly during the first half of the season. Taylor (1969) mentions the possibility of two litters per year.

MEASUREMENTS AND MASS:

Males/...

Males

	$\bar{X}$	N	Min.	Max.
Tot.	554,9	37	410	630
T.	267,7	35	194	310
H.Ft	59,4	34	45	70
Ear	22,7	35	14	28
Mass	531,2	14	363	650 g

Females

	$\bar{X}$	N	Min.	Max.
Tot.	523,8	37	425	590
T.	262,7	38	212	290
H.Ft	53,5	37	44	60
Ear	21,6	35	15	26
Mass	402,4	11	277	498 g

RECORDS OF OCCURRENCE:

Specimens examined, 125: Alma, 1 (TM); Al-te-Vêr, 1 (TM); Apies river, 2 (TM); Barberton, 1(TM); Blijdschap Priv. Nat. Res., 1 (TM); Blinkwater, 1 (TM); Brandhoek, 2 (TM); Capital Park, 2 (TM); Doornhoek, 1 (TM); Elim, 1 (TM); Fairfield, 2 (TM); Ferndale, 2 (TM); Fort Klipdam, 2 (TM); Greefswald, 3 (TM); Grootsuikerboschkop and Elandslaagte, 3 (Priv. col.), Hans Merensky Prov. Nat. Res., 1 (TM); Hectorspruit, 1 (TM); Johannesburg, 1 (TM); Killarney, 2 (TM); Klaserie, 4 (TM); Loskopdam Prov. Nat. Res., 1 (TM); Lydenburg, 1 (TM); Lynnwood, 1 (TM); Mariepskop, 5 (TM); Menlo Park, 1 (TM); Miragoma, 1 (TM) Mmabolela Estates, 1 (TM); Montrose Estates, 4 (TM); Mooiplaas, 1 (TM); Mooivlei, 3 (TM); Mokeetsi, 3 (TM); Newgate, 1 (TM); Newington, 2 (TM); Njelelle river, 3 (TM); Onderstepoort, 5 (TM); Pienaars river dam, 9 (TM); Pretoria, 6 (TM); Pretoria Zoo's Farm, 2 (TM); Ratsegaai, 2 (TM); Rayton, 1 (TM); Renosterpoort, 1 (TM); Rissik, 2 (TM); Rolspruit, 1 (TM); Rooikrans, 1 (TM); Rustenburg, 1 (TM); Rykvoorby, 1 (TM); Sandrivier, 1 (TM); Skukuza, 1 (NKW); Soutpansberg, 7 (TM); Suikerboschrand Prov. Nat. Res., 3 (TM); Swartkop, 1 (TM); Swartkrans, 1 (TM); Swawelpoort, 1 (TM); Thabazimbi, 1 (SI);

Tzaneen/...

Tzaneen, 5 (TM); Venterskroon, 2 (TM); Vereeniging, 1 (SI); Welgedaan, 6 (TM); Zana Ranch, 1 (TM). Material and data from coyote-getter returns, housed by the Division of Nature Conservation from 2724DD; 2228CB.

Additional records: Sightings from Blyde Forest Res., Charleston, Cyprus, Donkerpoort and Zandspruit, Groothoek, Huwi, Leeuspoor, Letaba Ranch, Madimbo, Olifantspoort 149, Olifantspoort 328, Mosdene Priv. Nat. Res., Parkfield and Delamere, Platbos, Rochdale, Sandringham Priv. Nat. Res., Suikerboschrand Prov. Nat. Res., TenBosch Estates, Timbavati Priv. Nat. Res., Tweepoort, van Riebeeck Mun. Nat. Res., Welgevonden, Wolkberg. Open circles in the Kruger National Park on the map after Pienaar, (1964). Record from Rhodesia on the Transvaal border based on material housed in the Rhodesian National Museums (Smithers, *in litt.*).

Rhynchogale Thomas, 1894

Rhynchogale melleri (Gray, 1865) — Meller's mongoose / Mellerse muishond

R. m. langi Roberts, 1938

DISTRIBUTION:

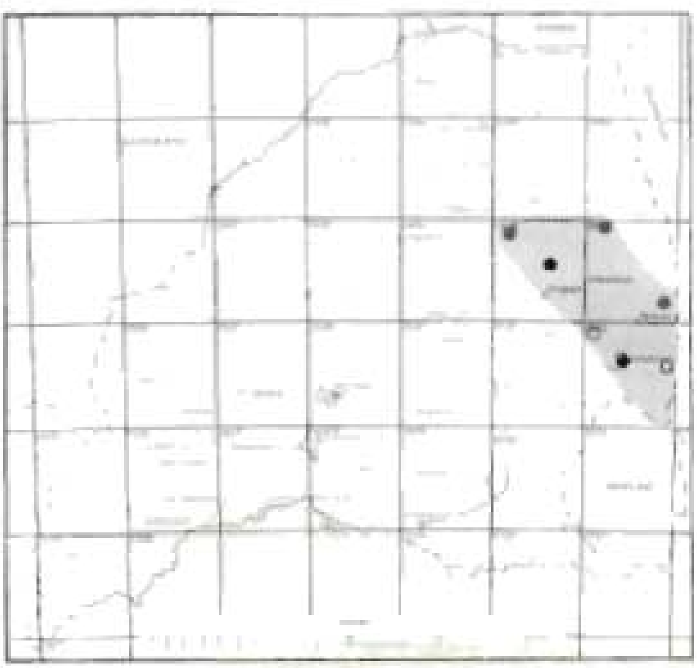


Fig. 134: The distribution of *R. melleri* in the Transvaal.

Limited to the south-eastern Transvaal lowveld and adjoining escarpment. A sight record from the Downs was made by Mr N. Jacobsen in the mountain pass to Matlapitsi. The overall distribution of this species suggest a correlation with high rainfall, nowhere occurring in areas receiving less than 500 mm p.a.

The/...

The records presented here represent the only part of its range falling within the borders of the Republic of South Africa. This species therefore appears to be rare and/or endangered in the Republic.

HABITAT:

Very little is known about Meller's mongoose, and it is poorly represented in study collections. Ansell (1960) suggests that it occurs in woodlands, and possibly in other habitat types. Pienaar (1964) recorded it from mountainous parts of the Kruger National Park, and Jacobsen's record was also from a mountainous area. Walker (1964) mentioned a litter found by V.J. Wilson in a cave on a rocky hill in Zambia.

HABITS:

Solitary, mainly nocturnal, but with some diurnal activity. Terrestrial (See Ansell, 1960 and Walker, 1964).

FOOD:

Wild fruit, termites, beetles, grasshoppers, lizards and possibly rodents (Roberts, 1951; Ansell, 1964; Walker, 1964 and Pienaar, 1964). Ewer (1974) concludes that the wide, blunt-cusped molars and the molarised carnassials indicate an omnivorous diet.

BREEDING:

Walker (1964) mentions a newborn litter and a gravid female both collected in December.

MEASUREMENTS AND MASS:

As only two specimens are available from the Transvaal, the measurements of the entire series housed in the Transvaal Museum collection are given here; two from the Transvaal, the rest from Swaziland and Tanzania.

Males/...

Males

	$\bar{X}$	N	Min.	Max.
Tot.	835,0	6	725	975
T.	357,8	6	300	412
H.Ft	97,2	6	87	103
Ear	36,5	6	29	93

Females

	$\bar{X}$	N	Min.	Max.
Tot.	773,2	6	677	852
T.	338,5	6	312	394
H.Ft	89,7	6	87	95
Ear	36,2	6	31	39

None of the specimens were weighed.

RECORDS OF OCCURRENCE:

Specimens examined, 5: Matjulwana, 1 (NKW); Olifants and Klaserie rivers confluence, 1 (TM); Perkeo, 1 (TM); Tshokwane, 1 (NKW).

Additional records: Sight record from The Downs (Jacobsen, *pers.comm.*). Open circles in the Kruger National Park on the distribution map after Pienaar (1964).

Ichneumia I. Geoffroy, 1837

Ichneumia albicauda (G. Cuvier, 1829) White-tailed mongoose
Witstertmuishond

I. a. grandis (Thomas, 1890)

DISTRIBUTION:

Evenly distributed in the eastern Transvaal lowveld. From here a westwards extension radiates into the rest of the Transvaal between 24°30'S and 26°S in the West and 27°S in the East. The white-tailed mongoose is relatively more common in the eastern Transvaal lowveld, at altitudes of less than 600 metres (2000 ft), than

elsewhere/...

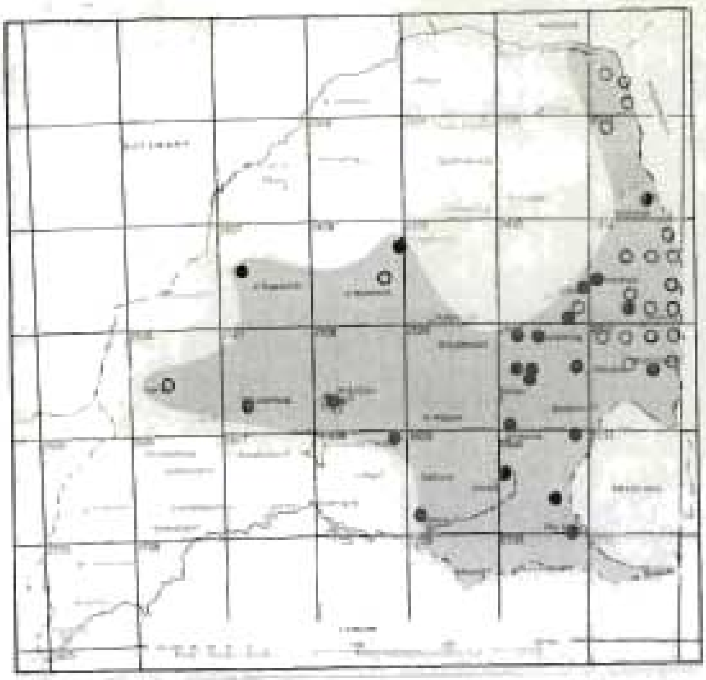


Fig. 135: The distribution of *I. albicauda* in the Transvaal.

elsewhere in Transvaal at higher altitudes. Population density thus appears to be favoured by lower altitudes, although human settlement may also be the cause of this disparity.

As will be pointed out later, *I. albicauda* is dependent on the presence of permanent water, and although the low altitude of the Limpopo river basin may be favourable, permanent water is limited. The Limpopo river is a seasonal river, and although there are permanent pools in the rivercourse, they are presumably too far apart to render this river suitable as an upstream corridor.

Based on the available evidence, it would appear that altitude and especially permanent streams are limiting factors to the distribution of *I. albicauda*.

HABITAT:

Both sight records and material records are from the vicinity of streams with a permanent flow. This dependence is not essentially correlated with riparian woodland or shrub, as many animals were recorded one or two kilometers away from the nearest watercourse.

Cover in the form of heavy woodland or brush, however, appears to be important. Even tall dense grass is suitable, as a specimen was taken at Amsterdam in such habitat.

Taylor (1970) describes the habitat of this species as "light

woodland/...

woodland to plains" in Kenya.

HABITS:

Nocturnal, although FitzSimons (in Shortridge, 1934) and Dorst and Dandelot (1970) state that in undisturbed areas it is partly diurnal. By day it takes refuge in porcupine lairs or antbear burrows, cavities amongst treeroots or dense undergrowth or grass.

It appears to be terrestrial.

Dorst and Dandelot (1970) claim that the species is partly arboreal, but Smithers (1971) disagrees.

The long legs, fast walk and long bushy white tail are characteristic when seen briefly at night. It is a surprisingly fast runner when disturbed.

Solitary individuals are encountered as a rule, but occasionally pairs are seen, presumably during the mating season. According to Smithers (1971), the white-tailed mongoose is an avid digger, as shown also by the well-developed front claws. It does not, however, excavate its own burrows. Ewer (1973) considers this species to be largely insectivorous, for which constant digging and excavating for hidden prey is necessary. It also scavenges around human settlements if left undisturbed, and an explanation of the high incidence of sight records on roads is that it scavenges on road kills, as in fact many other smaller carnivores do.

Taylor (1970) found the home range of individuals to be eight square kilometres in Kenya.

FOOD:

Two stomachs were available for analysis. The one contained some remains of a guinea-fowl, especially the crop contents, from which it can be assumed that eating commenced in the chest region. The fact that this specimen took a guinea-fowl is surprising, since it must have caught it either by day on the ground, or by night in a tree. Either way it indicates atypical behaviour for an essentially nocturnal, non-arboreal species.

The/...

The other stomach contained exclusively insect remains, namely Coleoptera (adults and larvae), Orthoptera, Hymenoptera, Ephemoptera, nymphs, Culicidae (Diptera) larvae, and Lepidoptera larvae.

Food items recorded by other authors are: rodents up to the size of cane rats, reptiles, toads, crabs and in particular earthworms (indicating a preference for river banks, termites, eggs, fruit and other vegetable matter (Shortridge, 1934; Smithers, 1971).

BREEDING:

No information was obtained from the Transvaal. Smithers (1971) recorded gravid and lactating females from Rhodesia from October to February. Shortridge (1934) found a pregnant female during November, and some two-week old juveniles during December.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	930,5	4	897	980
T.	420,5	4	402	460
H.Ft	119,2	4	115	122
Ear	41,5	4	35	46
Mass	-	-	-	-

Females

	$\bar{X}$	N	Min.	Max.
Tot.	1005,8	4	947	1090
T.	440,8	4	411	480
H.Ft	132,5	4	123	140
Ear	41,2	4	35	45
Mass	3,6 kg	1	-	-

RECORDS OF OCCURRENCE:

Specimens examined, 19: Acornhoek, 1 (TM); Alkmaar, 1 (TM); Arnhemburg, 1 (TM); Bridgewater, 1 (TM); Grootfontein,

1 (TM)/...

1 (TM); Hectorspruit, 3 (TM); Letaba camp, 1 (NKW); Machadodorp, 1 (TM); Mariepskop, 1 (TM); Misgunfontein, 1 (TM); Nelspruit, 1 (TM); Newington, 1 (DM); Piet Retief, 2 (TM, 1; SI, 1); Potgietersrus, 1 (SI); Pretoria, 1 (TM); Rustenburg, 1 (TM). Coyote-getter returns housed at the Transvaal Division of Nature Conservation from 2530CB; 2530AC; 2530AA; 2530CC; 2628BB; 2629CC; 2630AC.

Additional records: Sightings from Blyde River Forest Res., and Ferndale, Othawa. Open circles in the Kruger National Park on the distribution map after Pienaar (1964).

Atilax F. Cuvier, 1826

Atilax paludinosis (G. Cuvier, 1777) Water mongoose
Kommetjiegatmuishond

TAXONOMIC NOTES:

Roberts (1951) recognizes the subspecies *transvaalensis* Roberts, 1933 (described from Mokeetsi), as ranging over most of the Transvaal, with *paludinosus* (G. Cuvier, 1777) restricted to the south-eastern Transvaal and ranging into Natal, Zululand and the Cape Province. Hollister (1918), however, points out that the slight variation in colour of the pelage employed as a subspecific character is of little taxonomic value. Likewise, Smithers (1971) found a wide local variation in colour between individuals. A long series of *paludinosus* from Knysna housed in the Transvaal Museum collection exhibits similar individual variation in colouration. Although the Knysna series is predominantly darker than Swaziland and Transvaal material, considerable overlap exists, and consequently no subspecies are recognized here.

DISTRIBUTION:

It is evenly distributed over the major part of the Transvaal. Absent only from the arid north-western Transvaal along

the/...

the Limpopo river basin.

Both the other two aquatic carnivores, *Aonyx capensis* and *Lutra maculicollis* are also absent from this area. This may be ascribed to the lack of suitable permanent streams or possibly inadequate food sources in the permanent pools of this area.

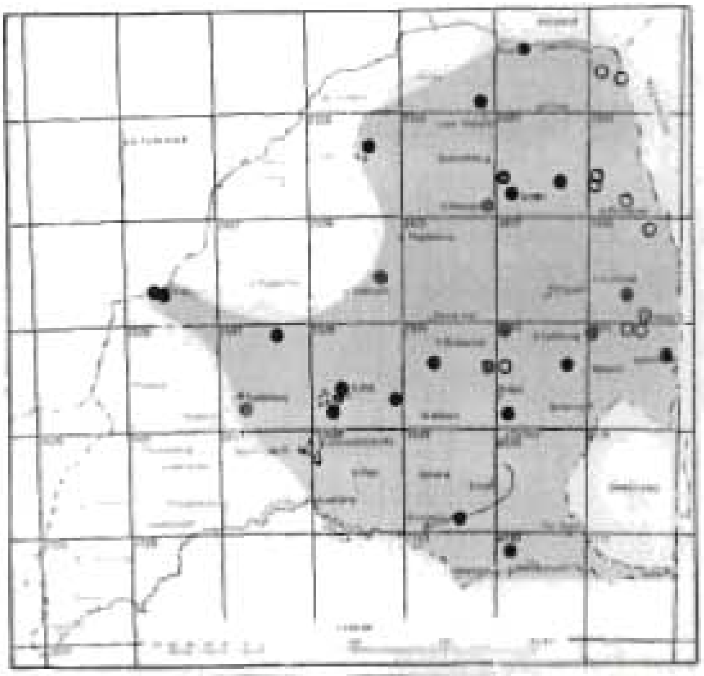


Fig.136: The distribution of *A. paludinosus* in the Transvaal.

This species has almost certainly been overlooked on the Transvaal highveld in the south-west, especially along the Vaal river. It also occurs in Swaziland (Ranches Limited, 2631BA).

HABITAT:

As the water mongoose is semi-aquatic, it is dependent on a permanent water source in the form of rivers, marshes or dams. A further important requirement is reasonable cover along the edge of the water, such as brush, reeds or dense tall grass.

HABITS:

In the Transvaal this is an exclusively nocturnal animal. Observations in this respect are substantiated by the bright reflection, in the beam of a spotlight, of the tapetum lucidum, characteristic of the nocturnal mammalian eye. Animals are normally encountered singly or in pairs. Pienaar (1964) recorded small family groups on occasion. Individuals never roam far from water, and quite often footpaths are trampled open along which they travel in search of food. Water mongooses are completely terrestrial.

The/...

The species is semi-aquatic, and takes to water readily. It swims and dives well, although not as well as the two otter species. The forepaws have thin mobile fingers without an interconnecting web, which are used for feeling in crevices and picking up stones in search of prey in shallow water. The dexterity of the forepaws is also illustrated in the breaking of eggs (see Ewer, 1973). The method used is slightly different than in the other mongoose species where this phenomenon has been documented. The egg is grasped with both forepaws while the animal rears up vertically to its full height. The egg is then hurled down as hard as possible on the ground in front of the animal.

The water mongoose feeds extensively on Crustacea and the teeth, particularly the posterior premolars, are robust for breaking the hard exoskeletons.

The anal sacks open in the anal pouch which is lined also with cutaneous glands. The anal sack secretion is normally deposited by a simple anal drag on horizontal surfaces. Individuals, especially males, may occasionally also rear up in a handstand position to deposit this secretion on vertical objects (Ewer, 1973).

Immersing of food in drinking water under captive conditions has often been observed. Lyal-Watson (1963) is of the opinion that this is a simulation of food-finding under natural conditions. Ewer (1973) believes that additionally this has a stimulating effect on eating, and that food items not otherwise relished will be eaten if "caught" in this way.

Marsh mongoose spend the day lying up amongst reeds and dense grass on the edge of permanent water sources. Young are reared in tunnels or burrows under overhanging banks (Shortridge, 1934).

FOOD:

Only one stomach became available for study, with crab remains the sole contents. Smithers (1971) in addition recorded frogs, rats and mice, as well as lesser quantities of beetles

and/...

and termites. The fruit of the African ebony (*Diospiros mespiliformis*) has also been recorded. Shortridge (1934) recorded cane rats, ground nesting birds, snakes, tadpoles and poultry. Poultry remains were recorded once by Rowe-Rowe (1974). In addition Rowe-Rowe found the remains of nine fish in an analysis of 121 scats. Crustacea are, however, preferred by far, although a high proportion of the other food types is also recorded.

BREEDING:

No records are available from the Transvaal. Smithers (1971) noted pregnant and lactating females during November and December in Rhodesia. Ansell (1960) collected a gravid female in Zambia during October, and FitzSimons (in Shortridge, 1934) mentions a litter born during August near Port Elizabeth.

SIZES AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	858,7	4	785	900
T.	360,0	4	305	395
H.Ft	104,4	5	96	115
Ear	36,2	5	35	40
Mass	3,9	2	3,6	4,2 kg

Females

	$\bar{X}$	N	Min.	Max.
Tot.	801,2	6	700	975
T.	335,3	6	270	362
H.Ft	98,5	6	87	107
Ear	32,2	6	23	37
Mass	-	-	-	-

RECORDS OF OCCURRENCE:

Specimens examined, 11: Haenertsburg, 1 (TM); Irene, 2 (TM); Killarney, 1 (TM); Mokeetsi, 2 (TM); Montana, 1 (TM); Olifantspoort Priv. Nat. Res., 1 (TM); Tzaneen Estates, 2 (TM); White river, 1 (TM). Material accrued through coyote-

getter/...

getter control programs, and housed by the Division of Nature Conservation, examined from 2328BC; 2529BD; 2530AA; 2530CC; 2629DC.

Additional records: Sightings from Buffelspoort, Groot-suikerboschkop and Elandslaagte, Hans Merensky Prov. Nat. Res., Langfontein, Letaba Ranch, Loskopdam Prov. Nat. Res., Mooigenoeg, Mooiplaas, Mosdene Priv. Nat. Res., Olifantspoort, Othawa, Parkfield and Delamere, Renosterpoort Priv. Nat. Res., Scrutton, Ten-Bosch Estates. The open circles in the Kruger National Park represent the records from Pienaar (1964).

Mungos E. Geoffroy and G. Cuvier, 1795

Mungos mungo (Gmelin, 1788) Banded Mongoose

Gebande muishond

M. m. taenianotus (A. Smith, 1834)

M. m. grisonax (Thomas, 1926)

TAXONOMIC NOTES:

Two subspecies are listed by Coetzee (1977) as occurring in the Transvaal, i.e. *M. m. taenianotus* in the eastern Transvaal lowveld, and *M. m. grisonax* in the rest of the Transvaal bushveld west of the escarpment. Allen (1939) and Roberts (1951) regard *taenianotus* as a junior synonym of the nominate race and, Roberts believe that the latter subspecies is the one found in the eastern Transvaal. However, the type locality of the type specimen of *M. mungo* is uncertain, given as "Asia" in the original description, but interpreted as meaning the Cape of Good Hope by Allen (1939), and Natal by Roberts (1951).

Coetzee (1977) is followed here, in accepting *M. m. mungo* as occurring in west Africa, and with *taenianotus*, originally described from Natal, as the valid name for material from the eastern Cape, Natal, the eastern Transvaal, Rhodesia and Mozambique

M. m. taenianotus is markedly darker than *grisonax*. Not

only/...

only the general body colour is a much darker gray, but so are the transverse dorsal bands. In addition, *taenianotus* exhibits a very pronounced buffy tinge dorsally, which is hardly noticeable in *grisonax*.

Considering the habitat requirements of the species, the escarpment is believed to act as a barrier, allowing very little if any, interbreeding between these two subspecies in the Transvaal.

DISTRIBUTION:

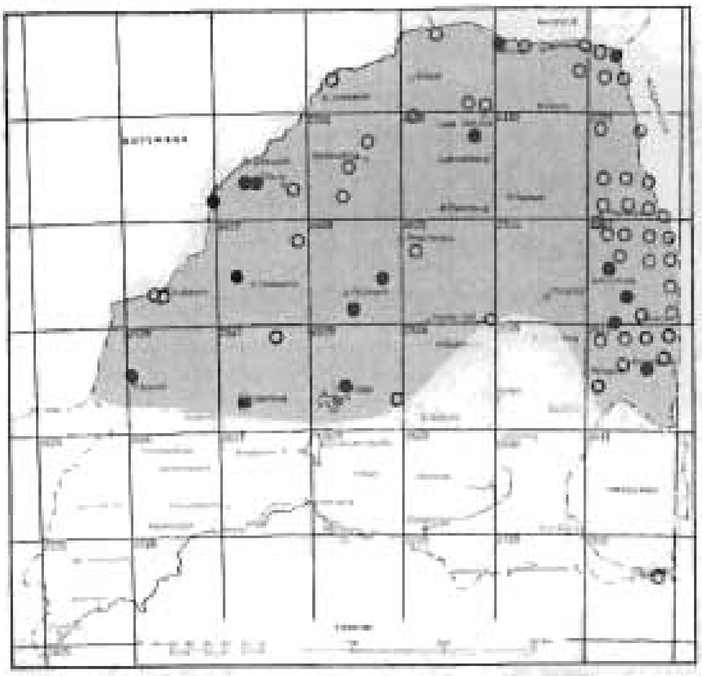


Fig. 137: The distribution of *M. mungo* in the Transvaal.

Widely distributed throughout the Tropical Bush and Savannah veld types of the Transvaal, as well as in the small portion of similar habitat found at Golela in the extreme south-eastern corner of the Transvaal. Absent from the montane forests and sour grasslands of the escarpment.

HABITAT:

The most essential habitat requirement is woodland or savannah plains with accumulations of organic detritus harbouring a rich insect life. The banded mongoose is also to be found in riverine forests with underbrush. As found by Shortridge (1934) and Smithers (1971), the impression gained in Transvaal is that higher population densities are to be found near permanent water sources. The reason seems to be that the banded mongoose is to a large extent dependent on surface water. It has been observed by Simpson (1966) to drink water when available, normally in the mornings or towards dusk. Banded mongoose have, however, also been recorded from waterless areas where they are believed to utilize the body fluids of insects

to/...

to satisfy their moisture requirements.

HABITS:

This is a strictly diurnal species. It is also exclusively terrestrial. *M. mungo* is to a large extent dependent on disused termitaria, utilizing the exposed shafts as permanent or occasional refuges. Other structures such as antbear burrows are also used on occasion (Rood, 1975). It is not known whether it can excavate its own burrows. Shortridge (1934) has observed it to occasionally utilize rock crevices as abodes.

The banded mongoose is a social species, normally found in groups between 10 and 15. Unusually large groups of up to 35 have been recorded by Simpson (1964), Smithers (1971) and Rood (1975). Packs are relatively stable, and the sex ratio is approximately 1:1 (Rood, *op.cit.*). A communal den is used, and during the day the group forages together. Very large groups splinter into smaller units when searching for food (Smithers, 1971). Rood (1975) found that while the pack is foraging, one or more adults guard the young at the den. The pack forages in the mornings and afternoons, and lies up during the heat of the day.

A fair amount of noise is made when foraging by scratching and digging amongst debris for insects, and by the constant chirping and twittering noises uttered to maintain group cohesion. Small stones and bits of wood are turned over, while leaves are raked and loose soil turned over with the forepaws in a constant search for food. Any vertebrate prey incidentally flushed is leapt upon with surprising speed and agility. Smell appears to play an important role in locating prey.

Observations in the Transvaal suggest that packs feed over a wide range. Simpson (1966) considers the species territorial, and Rood (1975) found the mean home range size of a pack to be 80,4 hectares in Ruwenzori National Park. Packs defend their territories. Different refuges are used almost every night. When disturbed during the day, some individuals may rear up on the hind legs to obtain a better view, and if the threat persists the entire pack runs for the nearest temporary refuge such as a termite mound, a hollow log or even dense brush. Such a fleeing colony was once traced to where it was hiding in the shallow shaft of an old termitarium, all piled on top of each other, with the top individual barely 25 cm from the surface. Thus cornered, threat display was exhibited, which involved erecting the hair and uttering a spitting growl (see also Simpson, 1966, for a description of threat postures).

When breaking pill millipedes, molluscs, or eggs, the object is held in the forepaws and thrown backwards between the hind legs, repeating the process till it breaks (see Simpson, 1964 and 1966; Ewer, 1973). Chicken eggs can, however, also be cracked with the mouth.

Ewer (1973) observed no rivalry over an oestrus female, and regards this as reflecting a high degree of social integration. When two or more females give birth at the same time, they may alternatively accept both their own and the other litter, so that litters become joint property. Immature and adults were observed by Shortridge (1934) to indulge in social playing near dens before dark.

FOOD:

Four stomachs were available for analysis. These contained the following food items, with frequency of occurrence as indicted

Orthoptera	Acrididae	2
	Gryllidae	2
Coleoptera	Scarabaeidae	3
	Curculionidae	1
	Tenebrionidae	1
Hymenoptera	Formicidae	1
Blattaria	Blattidae	1
Diplopoda	*Scolopendria*	1
Chilopoda	Unidentifiable	1
Reptile/Amphibian skeletal remains:		
Reptilia	*Lygodactylus capensis*	1

The above records, as well as those presented by Shortridge

(1934)/...

(1934), Pienaar (1964), Smithers (1971) Ewer (1973) and Rood (1975), indicate that this species is predominantly insectivorous. Fruit, rodents, ground-nesting birds and eggs, reptiles, amphibians and molluscs have also been recorded as being taken on occasion. Rood (*op.cit.*) found only 12% vertebrate remains in a scat analysis.

BREEDING:

No pregnant females were collected during this survey. Ewer (1973), in summing up the literature available, concludes that *M. mungo* is a non-seasonal breeder (see also Simpson, 1966). Shortridge (1934) and Ansell (1960), however, recorded breeding only during the early summer months. Rood (1975) found that packs display synchronized breeding, and can breed up to four times a year.

WEIGHTS AND MASS:

Males:

	$\bar{X}$	N	Min.	Max.
Tot.	585,2	12	562	615
T.	226,3	12	202	252
H.Ft	78,9	12	63	90
Ear	27,1	12	23	36
Mass	1,3	5	1,0	1,6 kg

Females:

	$\bar{X}$	N	Min.	Max.
Tot.	590,4	5	545	670
T.	246,6	5	190	238
H.Ft	78,3	5	72	84
Ear	24,6	5	22	26
Mass	1,4	2	1,3	1,5 kg

RECORDS OF OCCURRENCE:

Specimens examined, 24: Blijdschap Priv. Nat. Res., 1 (TM); Doispan, 1 (NKW); Fairfield, 2 (TM); Hector Spruit, 1 (TM); Junction of Matlabas and Limpopo rivers, 1 (TM); Messina, 2 (TM);

Mooivlei/...

Mooivlei, 5 (TM); Mosdene Priv. Nat. Res., 3 (TM); 11 km N. Newington, 1 (TM); Pafuri, 1 (NKW); Pelgrimsrus, 1 (TM); Pienaars river dam, 1 (TM); Rustenburg, 1 (TM); Rissik Priv. Nat. Res., Rykvoorby, 1 (TM); Sandringham Priv. Nat. Res., 1 (TM); Steenbokpan, 1 (TM).

Additional records: Sightings from Buffelspoort, Charleston, De Hoop Priv. Nat. Res., Dordrecht, Gollela, Greefswald, Groothoek, Huwi, Joshua Moolman Priv. Nat. Res., 10 km E. Madimbo, Mmabolela Estates, Mooigenoeg, Mooiplaas, Nicorel, Othawa, Parkfield and Delamere, Platbos, Renosterpoort Priv. Nat. Res., Rochdale, Rhoda, Scrutton, TenBosch Estates, Timbavati Priv. Nat. Res., Uitkyk and Paranie Priv. Nat. Res., Urk, Welgevonden. Open circles in the Kruger National Park on the distribution map represents the records of Pienaar (1964).

Helogale Gray, 1862

Helogale parvula (Sundevall, 1846) Dwarf Mongoose
Dwergmuishond

DISTRIBUTION:

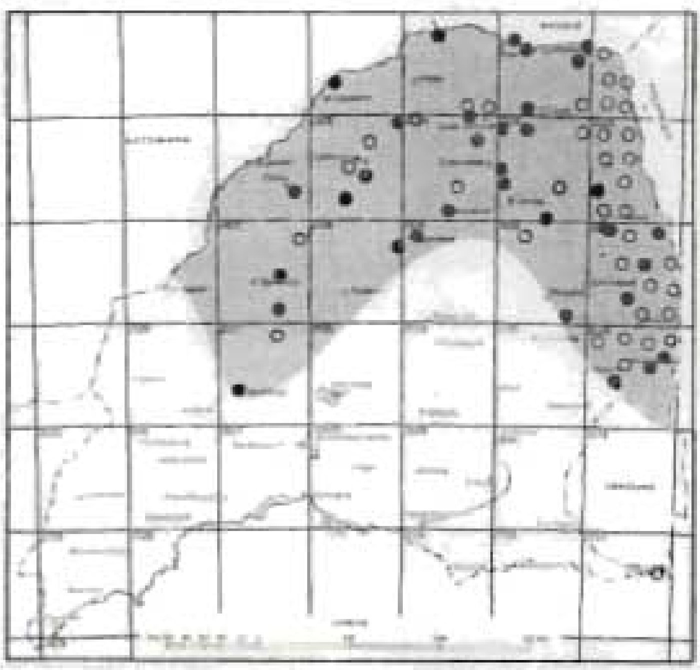


Fig. 138: The distribution of *H. parvula* in the Transvaal.

The dwarf mongoose is evenly distributed throughout most of the bushveld areas of the Transvaal, including the Tropical Bush and Savannah extension from the east into the Golela area. Thus far not recorded from the Zeerust area, although it is believed to be present.

H. parvula/...

H. parvula is absent from the highveld grasslands of southern Transvaal.

HABITAT:

As can be concluded from the distribution pattern, the dwarf mongoose is dependent on well-wooded areas, with accumulations of organic detritus harbouring a rich insect fauna. Smithers (1971) found that in Botswana it is particularly associated with *Acacia* woodland or shrub, and *Terminalia-Combretum* shrub. These are normally associated with sandy ground. In these areas the dwarf mongoose is very dependent on termite mounds for refuges. However, they also inhabit termitaria and forage in riverine forests (Mmabolela Estates), or cleared areas such as old lands (Huwi Private Nature Reserve).

H. parvula has also been observed foraging on the lower slopes of koppies and rocky ridges in the Transvaal and has even been recorded to modify rock crevices to serve as dens (Madimbo).

Good cover in the form of dense grass or shrub, fallen trees and dead branches, logs etc. appears to be important.

HABITS:

Helogale parvula is completely diurnal, leaving their warrens after sunrise and returning well before sunset, sometimes as early as 15h30 on cold days. According to Smithers (1971) it does not emerge at all on very cold and windy, or overcast and rainy days.

It is also a social species, (as is predominantly the case with diurnal carnivores). Normal group size varies from 6-12 individuals, with occasional cases of 20-30 individuals per pack being the maximum so far recorded. Groups live in communal dens, and forage as a group.

Disused termite mounds are most often utilized as dens. These are characterized by several entrances and the tunnels run very deep. These converted termite mounds are typically hard, with the surrounding soil also hard and compacted. According to Smithers (1971) ordinary burrows may also be excavated,

and/...

and sometimes rodent burrows are converted. Dens are normally situated at the base of a tree or bush, and have several entrances.

Smithers (1971) is of the opinion that a dwarf mongoose pack has a permanent residence, and utilizes several additional secondary refuges distributed over its home range. My own view, based on several visits to Huwi Private Reserve, is that a group has several such residences distributed over its range and that these are occupied for short periods in rotation, probably depending on the relative availability of food in the vicinity of any of these abodes.

These warrens are characterized by the scats deposited nearby, allowing assessment of their relative importance as overnight refuges, and when last occupied.

The species is not very shy, and is therefore easily observed. It is quite noisy when foraging, scratching amongst dry leaves and debris, sniffing and digging at every likely-smelling prey refuge. It also utters a constant chirping noise to maintain group cohesion.

When disturbed, an alarm call is uttered and the group then scurries for the nearest cover, normally very dense grass or brush, hollow logs, or hollow termite mounds. When there is little disturbance, some individuals may rear up on their hind legs, using the tail as support, to obtain a better view. This possibly also acts as an early warning system to the rest of the pack, as activity amongst the rest often ceases or decreases when some members adopt such a posture. Having taken refuge, their intrinsic curiosity, however, soon gets the better of them, and when the observer remains quiet, individuals peering around their hiding places within minutes start testing the air and re-assessing the situation. Strange stationary objects such as vehicles or motorcycles do not disturb them, and soon they will resume their normal activities.

Helogale parvula is terrestrial, with no tree climbing whatsoever recorded. When individuals were observed amongst rocks, they did not appear very agile and stayed on ground level

foraging/...

foraging amongst the rocks, with no jumping from rock to rock ever observed.

Some areas within the range of the species are waterless and it is very possible that it can exist without surface water as suggested by Smithers (1971), by utilizing metabolic water. Water is, however, utilized when available.

Although predominantly insectivorous, Zannier (1965) has observed it to take vertebrates, which are killed efficiently with a single neck bite, suggesting a more carnivorous phylogenetic past. Snakes are attacked with repeated bites at the fastest-moving areas of their bodies. Both Zannier (1965) and Smithers (1971) have observed dwarf mongoose to efficiently break eggs by propelling them through the hind legs against a solid object.

In captivity females were found to be dominant over males (Zannier, 1965).

Since sexual partners already are acquainted through constant social interactions within the group, Zannier (1965) and Ewer (1973) find that the duration of a sexual bond is short. The males display increased marking with anal gland secretions, and sexual partners also mark each other. Copulation is preceded by some chasing and/or mock fighting, thus increasing sexual excitation. First mountings are brief, but this further increases excitation of the partners, and leads to full copulation lasting as long as five minutes. These activities are accompanied by short repetitive vocalizations. The male may bite the female at the side of the neck when it has mounted.

The male assists in feeding the young. Weaned juveniles accompany the group while foraging. The adults catch insects, and while holding these in their mouths, offer them to the young. Catching insects is time-consuming, making regurgitation impractical. Carrying prey as small as insects back to the warren will again tax the energy of the parents unduly (see Ewer, 1973).

Marking with anal gland secretions is normally achieved by means of a simple anal drag, although the handstand technique is to a lesser extent also performed on vertical objects. Dr A. Rasa (cited *pers. comm.* by Ewer, 1973) considers anal sack

secretions/...

secretions to be the personal signature of an individual, mostly serving to confirm its partnership in this particular group, or mutual ownership of a refuge, and to facilitate the integration of the group. Dr Rasa has however found a different gland in *Helogale parvula*, namely the cheek gland, the secretion of which carries a hostile message. Its smell evokes conspecific threat display. Cheek gland marking is always accompanied by the deposition of anal gland secretions. The anal sack secretions last for about a fortnight, but the cheek gland secretions for only 48 hours.

FOOD:

Six stomachs were available for study. The various food items recorded are listed below, with the frequency of occurrence indicat

Orthoptera	Acrididae	4
	Gryllidae	1
Coleoptera	Scarabaeidae	3
	Tenebrionidae	2
	Carabidae	1
Lepidoptera	Noctuidae	1
	Saturniidae	1
Dictyoptera	Blattidae	3
Isoptera	Hodotermitidae	3
Centipedes	*Scolopendria*	3
Scorpiones	Scorpionidae	1
Solpugidae		1
Amphibia	*Pyxicephalus* and *Bufo*	2

As found also by Smithers (1971), these food remains were thoroughly masticated. Only the instar stages of insects were recorded.

The above analysis substantiates the results of Shortridge (1934), Zannier (1965) and Smithers (1971), in that *Helogale parvula* is predominantly an insectivore. Vertebrate prey is believed not to be actively hunted, but is nevertheless taken when encountered. Apart from insects and other Invertebrata,

the/...

the following less important food items have been recorded by the abovementioned workers: Muridae, Reptilia, Amphibia, the chicks and eggs of ground-nesting birds, wild fruit and berries.

BREEDING:

No pregnant or lactating females were recorded during the course of this project. Shortridge (1934) recorded a litter of approximately one month old during April, and a half-grown litter found in July. Ansell (1960) recorded a pregnant female in December, and a newborn litter in October. Smithers (1971) recorded two pregnancies during February. These data suggest parturition during summer.

However, Taylor and Webb (1955), and Zannier (1965) are of opinion that *H. parvula* can breed repeatedly with up to four litters per year outside southern Africa. Two to six young are born per litter, after a gestation period of 50-54 days.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	355,8	30	282	424
T.	152,2	30	120	189
H.Ft	42,5	30	32	55
Ear	15,4	28	9	19
Mass	238,5	6	182	281 g

Females

	$\bar{X}$	N	Min.	Max.
Tot.	342,6	20	297	385
T.	147,3	20	118	170
H.Ft	41,3	21	35	48
Ear	16,4	19	14	20
Mass	184,5	6	140	282 g

RECORDS/...

RECORDS OF OCCURRENCE:

Specimens examined, 70: Blijdschap Priv. Nat. Res., 1 (TM); Donkerpoort, 1 (TM); Dordrecht, 1 (TM); Elim, 1 (TM); Greefswald, 2 (TM); Griffin Mine, 3 (TM); Hectorspruit, 8 (TM); Huwi, 1 (TM); Klaserie, 7 (TM); Klein Letaba, 1 (TM); Letaba Ranch, 1 (TM); Louws Creek, 1 (TM); 10 km E. Madimbo, 1 (TM); Magalakwin, 1 (TM); Maribashoek, 1 (TM); Mokeetsi, 3 (TM); Moorddrift, 1 (TM); Motlatent, 1 (TM); Mmabolela Estates, 2 (TM); Mutale river, 1 (TM); Newington, 1 (TM); 11 km N. Newington, 1 (TM); Njelelle river, 4 (TM); Olifants river rest camp, 2 (TM); Pelgrimsrus, 1 (TM); Pelwane-drif, 1 (NKW); Pietersburg, 1 (TM); Rooikrans, 2 (TM); Rustenburg, 3 (TM); Sama, 2 (TM); Scrutton, 1 (TM); Sheila, 10 (TM); TenBocsh Estates, 1 (TM); Zoutpansberg, 1 (TM).

Additional records: Sightings from Buffelspoort, Charleston, Cyprus, Fort Klipdam, Hans Merensky Prov. Nat. Res., Leeuwspoor, Nicorel, Othawa, Parkfield and Delamere, Platbos, Rochdale, Timbavati Priv. Nat. Res., Urk, Welgevonden. Open circles in the Kruger National Park on the distribution map are based on Pienaar (1964). A specimen from 2230AC, in Rhodesia, is housed in the Rhodesian National Museums (Smithers, *in litt.*).

Family Protelidae

Proteles I. Geoffroy, 1824

Proteles cristatus (Sparrman, 1783) Aardwolf

P. c. cristatus (Sparrman, 1783)

DISTRIBUTION:

Evenly distributed throughout the Transvaal, although the species is nowhere common. So far it has not been recorded in the extreme northern and north-eastern Transvaal, and neither in the

south-western/...

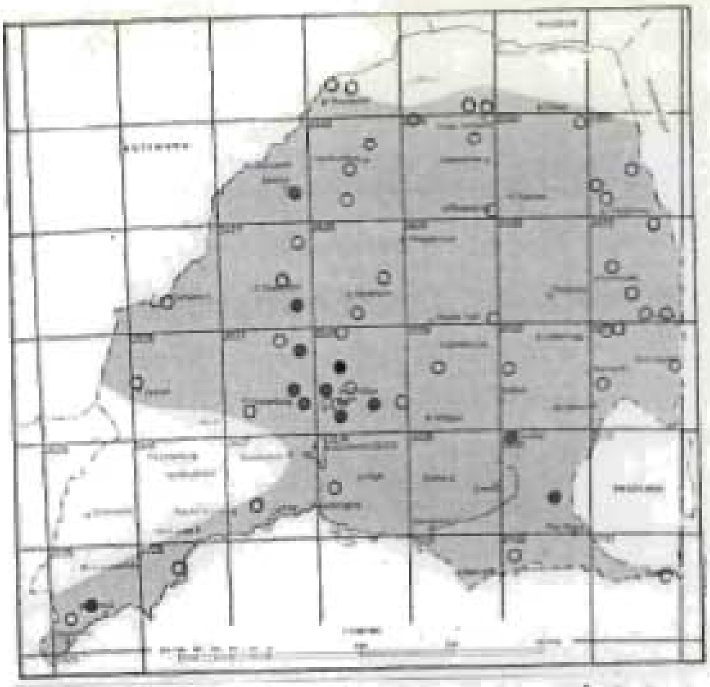


Fig. 139 The distribution of *P. cristatus* in the Transvaal.

south-western Transvaal in the Delareyville and Ventersdorp districts. The species has probably been overlooked in these areas, although Smithers (*in litt.*) did not record it in Rhodesia along the Limpopo either. It is absent from the montane forests of the escarpment.

The aardwolf is under high hunting pressure in sheep-farming and other intensively developed agricultural areas of the highveld, because of its alleged predation on domestic stock. For this reason it is in danger of disappearing from these areas altogether.

HABITAT:

The species has a fairly wide habitat tolerance, as is suggested by its wide distribution. It has been recorded from a diversity of habitats such as the gravel plains of the Namib desert (personal records, 1967 and 1978), and the wooded south-eastern Transvaal with a mean annual rainfall in excess of 600 mm. It is nonetheless evident that aardwolf favour open areas in any region, viz. the Transvaal pure grasslands, or open areas in savannah or shrub savannah (See also Shortridge, 1934; Smithers, 1971). It is also found in valleys of broken hilly country, but as pointed out by Shortridge (1934) its distribution peters out in forested regions.

HABITS:

Aardwolf are predominantly nocturnal, with only isolated

records/...

records of any activity during the mornings and afternoons. They have been observed sunning themselves outside their dens at all hours of the day.

They otherwise spend their days lying up in burrows or under cover of vegetation. When disturbed in the latter case, they make for the nearest burrow or rock crevice.

Normally a disused antbear-hole is used as a den, but according to Smithers (1971) they may also enlarge spring hare burrows for dens. Smithers (*op.cit.*) found aardwolf to be avid diggers in captivity, constructing their own burrows, but this could so far not be substantiated under natural conditions.

Von Ketelhodt (1965, 1966) found that aardwolf do not dig effectively in the wilds, and that they cannot break into termite mounds. This accounts for the fact that the harvester termite *Trinervitermes* is normally fed upon. These are collected individually on the ground surface.

Anybody who has heard the rustling sound of a colony of harvester termites at night will agree with Ewer (1973) that the ear pinnae are enlarged in order to locate the exact presence of this source of food.

Proteles cristatus is mostly encountered singly, but occasionally pairs are found. Roberts (1951), Shortridge (1934) and Smithers (1971) record some instances of five or six individuals together in a group, which may comprise a male and female with their subadult litter. Litters are born and reared in subterranean dens. According to Ewer (1973) the play of the young is predominantly related to escape behaviour.

Although *Proteles cristatus* is closely related to the hyaenas, it is almost entirely insectivorous. The teeth are much reduced, the canines less so. The relatively strong jaw and temporal muscle attachment suggest that the canines are used fo defence (Ewer, 1973).

When cornered or wounded, the animal adopts a defensive threat posture, with the hair of the mane erected to appear

more/...

more formidable. According to Ewer (1973) it threatens with its mouth closed, but in a personal encounter with a lightly wounded animal the canines were bared, and the animal did in fact bite repeatedly. Threat was accompanied by loud deep-throated growls, explosive barks and even surprisingly loud roars. The overall impression was one of total viciousness, yet with limited effectiveness.

Under stress the secretions of the anal glands, which have a foul smell, may be ejected (Shortridge, 1934; Smithers, 1971). According to Ewer (1973) the aardwolf has, apart from the anal glands, a number of smaller glands situated between the anal sacks, which open independently into the anal pouch.

FOOD:

Six stomachs became available for analysis.
All six contained vast quantities of harvester termites (Isoptera: Termitidae: *Trinervitermes*), as well as lesser quantities of grass and soil presumably taken in with the termites. Only one stomach contained a millipede. On the average the stomach contents displaced 300 cc water, with one exception which displaced 1 500 cc of water.

Shortridge (1934) quotes a sample of 50 stomachs examined, with Isoptera by far the chief constituent. These findings were also reflected by 5 stomachs examined by Bothma (1965), as well as others examined by Ansell (1964); Azzaroli and Simonetta (1966); Wells (1968) and Smithers (1971).

From all these records it is overwhelmingly evident that the aardwolf relies on termites as its principle food source. In the cases quoted above a total of more than 100 stomachs yielded no remains of poultry or domestic stock.
This, coupled with the characteristic rudimentary teeth of the species, argues strongly against any allegations of poultry raiding or the killing of domestic stock of any kind.

A very low percentage of ants, locusts, beetles, grubs, Lepidoptera, spiders, small rodents, reptiles and nestlings of ground-nesting birds is occasionally taken.

BREEDING/...

BREEDING:

Females were collected during February, March and May, but none were pregnant or lactating. Shortridge (1934) recorded births during November and December. Smithers (1971) collected pregnant females during July and October, and lactating females during January and April. These limited records suggest a prolonged breeding season.

Two to four young per litter.

MEASUREMENTS AND MASS:

	Tot.	T.	H.ft	Ear		Mass
Males						
TM 20251:	920	240	150	90	=	7,0kg
TM 20266:	860	220	140	95	=	5,5kg
TM 24478:	838	274	144	100	=	6,5kg
Females						
TM 14069:	890	240	147	98	=	?
TM 19601:	835	203	138	87	=	5,0kg
TM 24110:	940	250	140	100	=	?
TM 25468:	1022	261	156	96	=	8,7kg

RECORDS OF OCCURRENCE:

Specimens examined, 17: Brits, 1 (TM); 8 km NW Carolina, 1 (TM); Hammanskraal, 2 (TM); Hartebeespoort, 1 (TM); Huwi, 1 (TM); Joshua Moolman Priv. Nat. Res., 2 (TM); Langfontein, 1 (Priv. coll.), Maria van Riebeeck Mun. Nat. Res., 1 (TM); Onderstepoort, 1 (TM); Panfontein, 2 (TM); Pretoria, 1 (TM); 35 km E. Pretoria on N4 Highway, 1 (TM); Roodekuil, 1 (TM); Rooiberg, 1 (TM).

Additional records: Sightings from Al-te-Vêr, Blijdschap Priv. Nat. Res., Brandhoek, Buffelspoort, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Grootsuikerboschkop and Elandslaagte, Leeuwspoor, Letaba Ranch, Loskopdam Prov. Nat. Res., Mooigenoeg, Mooiplaas, Mosdene Priv. Nat. Res., Mmabolela Estates, Nicorel, Olifantspoort, Othawa, Parkfield and Delamere, Pienaars river dam, Platbos, Renosterpoort Priv. Nat. Res., Rissik Priv. Nat. Res., Rochdale, Rykvoorby, Sandringham Priv. Nat. Res., Suikerboschrand Prov. Nat. Res., Uitkyk

and/...

and Paranie Priv. Nat. Res., Urk, 20 km S. Warmbaths, Welgedaan, Welgevonden, Witpoort, Wolkberg, Zandspruit. Open circles in the Kruger National Park on the distribution map after Pienaar (1964).

Family Hyaenidae

1. Ears pointed; body not spotted; back heavily maned; upper molar less reduced with largest measurement twice or more that of first premolar	*Hyaena*
Ears rounded; body spotted; back not maned; upper molar much reduced, much smaller than first upper premolar which is often absent in adults	*Crocuta*

Hyaena Brisson, 1762

Hyaena brunnea Thunberg, 1820 Brown hyaena
Strandjut

DISTRIBUTION:

The brown hyaena has a broken distribution in the Tropical Bush and Savannah areas of the central and the entire northern Transvaal. It is also reported by von Richter (1972) to occur in the south-western Transvaal, from areas lying within the Kalahari Thornveld and Shrub Bushveld veld types as defined by Acocks (1975). It has nowhere been recorded from the pure grassveld areas of southern Transvaal, although it may have occurred or still may occur in these areas, since Lynch (1975) reports brown hyaenas from the grassveld areas of the adjoining Orange Free State, while Skinner (1976) presents records from the Transvaal highveld.

Since the southern Transvaal grassveld area is under intensive

mixed/...

mixed agricultural exploitation, natural prey as well as carrion would be at a premium. Vagrants consequently would be forced out of the area or alternatively forced to prey on domestic stock, and in the latter case would very soon be detected and killed. It would therefore appear that the brown hyaena has been eradicated in this region if in fact it ever occurred here.

The bushveld towards the north is predominantly utilized for cattle farming, and consequently supports a lower human population, and the ecosystem is less disturbed. This allows some brown hyaena populations to survive. Surprisingly enough, since 1970 no fewer than four brown hyaenas have been donated to the Transvaal Museum, all killed within a radius of 50 kilometers from central Pretoria.

The brown hyaena appears not to be rare or endangered in the Transvaal, although its position will probably deteriorate in future.

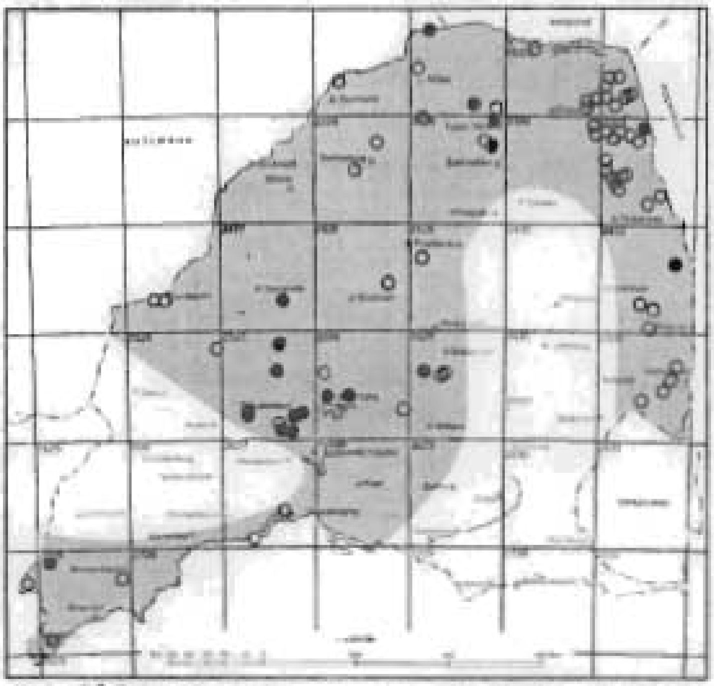


Fig. 140: The distribution of *H. brunnea* in the Transvaal.

HABITAT:

Extant populations in the Transvaal are restricted to woodland savannah and shrub savannah. According to Smithers (1971) it can exist in areas without free water, where it is more successful than the spotted hyaena. von Richter (1972) stresses the fact that it is essentially an inhabitant of the South West Arid and the adjacent drier parts of the Southern Savannah biotic zones. In the higher rainfall areas of the south-eastern Transvaal (500 mm and more p.a.) the brown hyaena is scarce, but becomes more abundant towards the more arid north-eastern section (Pienaar, 1963 and 1969).

HABITS/...

HABITS:

The species is normally encountered singly, or occasionally in pairs (Mills, 1978). Sometimes small packs are observed (Smithers, 1971), presumably constituting family groups. Brown hyaenas may aggregate in numbers around a carcass, but afterwards they separate again. Brown hyaenas live in very large, partially overlapping home ranges the size of which reflects the availability of food. Within each home range several individuals of all ages and sexes live, most of them related (Mills, *op.cit.*).

They are predominantly nocturnal animals, but are occasionally seen in daylight in remote areas. Shortridge (1934) found them to be less cunning and thus easily trapped in the remote areas of S.W.A. In settled areas, however, they have become very secretive and extremely cunning, to the extent that their presence in some areas is only revealed when employing coyote-getters in black-backed jackal control measures.

The calls of the brown hyaena are many and varied (Shortridge, 1934), and they are quite noisy around a carcass. They are however not as noisy as the spotted hyaena, and the 'laughing cackle' characteristic of the latter has not been recorded for the brown hyaena.

These animals lie up by day, normally in antbear holes, otherwise in caves, crevices or thick bush cover. Dens are occupied permanently or semi-permanently, where the young are born and reared. Quite often food is brought back to be devoured at the den (see Shortridge, 1934), although young can be fed by regurgitation. See Mills (1978) for a more detailed account of social behaviour.

Mills (1974, 1976, 1978) points out that the brown hyaena is m more of a scavenger than the spotted hyaena. This is born out by its more robust teeth, which are better adapted for the crushing of bones (see also Shortridge, 1934 and Ewer, 1973). However, most authorities agree that it also hunts and kills its own prey in the form of medium-sized animals, and newborn or diseased individuals, especially when carrion is not available.

Pienaar (1969) and Smithers (1971)

namely/...

state that the brown hyaena is more aggressive compared to the spotted hyaena, less of a scavenger and more inclined to make its own kills, but this is contradicted by long-term direct observations by Mills (*op.cit.*). Pienaar (1969) claims that '... Kudu appears to be by far the preferred prey of brown hyaena, followed by waterbuck, impala and zebra. Full-grown adults of all these prey species are run down and killed with ease by brown hyaenas, which normally hunt in smaller packs than the spotted variety'.

Neither Pienaar or Smithers quote direct observations regarding the predation abilities of *H. brunnea*. Stevenson-Hamilton (quoted by Pienaar, 1969) observed hyaenas at their den near Skukuza during 1941-1943, and assumed that dead impala rams dragged to their dens, as well as the remains of other animals found in the vicinity, were killed by members of this particular pack.

One phenomenon which would partly explain the presence of entire carcasses of big game animals in the possession of brown hyaenas, is that of surplus killing by other predators (discussed by Kruuk, 1972). This has been recorded in lion, leopard, spotted hyaena and hunting dogs. It is, however, a rare phenomenon and is normally recorded only during particular climatological circumstances inhibiting the predator-avoidance reactions of prey animals. The frequency of predation in brown hyaena tabulated by Pienaar (1969) is very low in comparison with that of the true predators.

Bearing in mind that the teeth of brown hyaenas are better adapted to scavenging, and assuming that in the Hyaenidae body size, social complexity and group size is related to success in predation, the brown hyaena appears to be more of a scavenger and less predaceous than the spotted hyaena, as stated by Shortridge (1934), Skinner (1976), Mills (1978).

FOOD:

Only two stomachs were available for analysis of the contents. The first contained carrion, some insects and vegetable matter. The second hyaena was shot on a turkey farm 45 km west of Pretoria, at a remote spot where turkeys that have died

of/...

of diseases were dumped. The animal was in the habit of visiting the dump every night for a meal, and the owners eventually decided to kill it. Not unexpectedly the stomach was full of turkey remains, which had been devoured entirely, including the feathers.

Apart from feeding on carrion, the species has been reported to feed on insect larvae at a rotten carcass (Skinner, *pers.comm.*), ground birds, eggs, tortoises, reptiles (i.e. python), fish, insects, wild fruit, afterbirths, smaller antelope, young or disabled larger game, lion cubs, and polecats (Shortridge, 1934; Pienaar, 1964 and 1969; Smithers, 1971; Skinner, 1976; Mills, 1978).

BREEDING:

The carcass of a lactating female was donated to the Transvaal Museum during March, 1972. Brand (1963) recorded parturition in captivity during January and February. Smithers (1971) records a pregnant female collected during October. Skinner (1976) states that whelping occurs seasonally in the Transvaal from August to November, and that the mean litter size is three.

MEASUREMENTS AND MASS:

	Tot.	T.	H.ft	Ear	Mass
Males					
TM 17655:	1600	202	202	152	= ?
TM 19800:	1460	177	152	139	= ?
TM 25430:	1442	208	209	158	= 36,5kg
Females					
TM 18859:	1210	210	200	140	= 26,9kg
TM 19200:	1445	300	208	157	= 28,9kg

RECORDS OF OCCURRENCE:

Specimens examined, 29: Assen, 1 (TM); Bandolierskop, 2 (TM) Beestekraal, 2 (TM); Hekpoort, 1 (TM); Jack Scott Priv. Nat. Res., 1 (TM); Olifantspoort, 3 (Priv. coll.); Rhodes Drift, 1 (TM); Onderstepoort, 1 (TM); Pelindaba, 1 (TM); Rustenburg, 2 (TM); Satara, 1 (TM); Shingwidzi, 1 (TM); Skeerpoort, 1 (TM); Uitkomst, 2 (TM); Waterberg, 2 (TM); Waterpoort, 1 (TM); Zoutpansberg, 6 (TM). Material accrued through coyote-getter

programs/...

programs, and stored by the Division of Nature Conservation, examined from 2527DC; 2528CB; 2529AC; 2725AA.

Additional records: Sightings from Blijdschap Priv. Nat. Res., Groothoek, Jack Scott Priv. Nat. Res., Loskopdam Prov. Nat. Res., Mmabolela Estates, Mooigenoeg, Mooiplaas, Mosdene Priv. Nat. Res., Nicorel, Othawa, Parkfield and Delamere, Renosterpoort Priv. Nat. Res., Rochdale, Scrutton, TenBosch Estates, Urk, Welgevonden, Zandspruit 168, Zoutpan. Open circles in the Kruger National Park on the distribution map are based on Pienaar (1963). Von Richter (1972) reports the brown hyaena from 2229CA; 2724BD; and 2725BD; and Skinner, amongst others, from 2725CC; 2627CD and DA.

Crocuta Kaup, 1828

Crocuta crocuta (Erxleben, 1777) Spotted hyaena
Gevlekte hyaena

DISTRIBUTION:

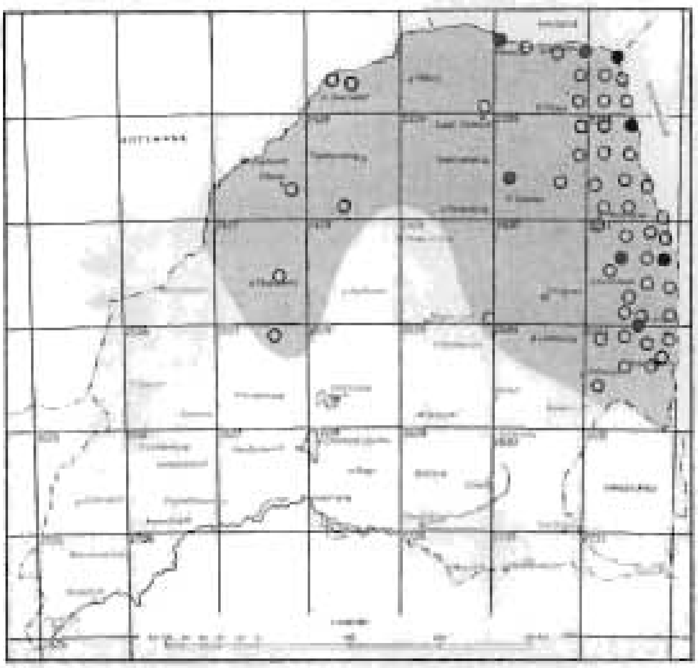


Fig.141: The distribution of *C. crocuta* in the Transvaal.

In historical times the spotted hyaena was distributed throughout Africa south of the Sahara (Shortridge, 1934) and inhabited every type of country (Coetzee, 1977). In the Transvaal this species has now been eradicated in all areas outside the major conservation areas of the eastern Transvaal. Migrants may occasionally enter the northern Transvaal from Rhodesia or Botswana, but are then immediately persecuted. A specimen record from

near/...

near Tzaneen is from a specimen in the Transvaal Museum collection collected during 1925. The farmers in the vicinity, however, claim the continued presence of individuals.

Some farmers in the Ellisras and Thabazimbi districts in the north-western Transvaal also claim occasional visits by spotted hyaenas. It would, however, appear that resident spotted hyaenas have been exterminated everywhere in the Transvaal, apart from the Kruger National Park and the adjacent private conservation areas. It is common in the latter areas (Pienaar, 1964 and 1969), but von Richter (1972) (also quoting Kettlitz, *pers. comm.*) is probably correct in stating that in the Transvaal in general, the spotted hyaena is the scarcer of the two species.

HABITAT:

It has a wide habitat tolerance and can occupy most habitats from semi-deserts to montane forests, and from sea level to the snow line of high mountains (Coetzee, 1977). Smithers (1971) and von Richter (1972) both concluded that the species is favoured by the moister eastern parts of southern Africa. Spotted hyaenas can, however, also exist in areas without surface water, as pointed out by Smithers (1971), although they are here outnumbered by the brown hyaena.

HABITS:

According to Ewer (1973), spotted hyaenas are true predators, but scavenge in order to supplement their rations. The more popular belief is that they hunt only when carrion is not available. The teeth are well adapted to deal with the bones and tough skin left by other predators. Estes (1967a,b) concludes that where true predators and their prey are abundant, hyaenas exist largely as scavengers provided their requirements do not exceed the carrion food source. Where true predators are scarce or absent, or where the remains of their kills are unobtainable, hyaenas will become active and successful hunters.

"Spotted hyaenas are arch opportunists and will not overexert

themselves/...

themselves, by hunting their own food, if there is the least chance that they may obtain sufficient sustenance from carrion left by other predators, or where they find it feasible to rob a lesser predator of its kill. This predisposition of spotted hyaenas to appropriate carcasses killed by other predators places them second to lions in the order of dominance of the predator society." (Pienaar, 1969)

Crocuta crocuta is basically a nocturnal animal, but is also active during the day. Kruuk (1966 and 1972) found that behaviour differs between day and night. By day the species tends to scavenge, which accounts for the general belief that it is predominantly a scavenger. By night, however, spotted hyaenas switch roles and become efficient hunters and killers. During darkness hunting is done in packs. Where hunting does occur during the day, it is generally done individually or by smaller groups. Kruuk (1966) found that of all observations on hyaenas feeding, 82% were of their own kills, 11% of the carcasses were killed by other predators, and 7% of cases were doubtfull. He in fact found that in Ngorongoro lions and hyaenas have changed roles, in that hyaenas hunt and lions scavenge. Spotted hyaenas numerically far exceed the lion populations in Ngorongoro, and to a lesser extent also in the Serengeti.

The spotted hyaena has a complex social structure, with the females physically larger than the males and dominant over them. It is thus a matriarchal system. In the Ngorongoro the hyaenas form social groups, or 'clans', ranging from 10 to 100 individuals per clan (Kruuk, 1972). They are territorial and actively defend their territories. The females are permanent members of the clan, but the males may change membership.

In the Serengeti the situation is more complex, due to the migratory patterns of ungulate prey species. Three systems are described as occurring here (Kruuk, 1972) namely "resident" clans similar to the Ngorongoro clans, "follower" clans, following the migratory herds, and "commuters", having permanent dens, but which travel between their dens and the prey wherever they may be.

According/...

According to Wickler (1964) the curious penis-like structure of the female clitoris may be related to her social dominance. Additionally, a pair of swellings composed of fibrous tissue are present, resembling a scrotum. These phenomenona have resulted in the general belief that the spotted hyaena is hermaphroditic. In adulthood the clitoris can be distinguished in structure from a penis, and during oestrus it changes entirely. During greeting ceremonies mutual genital sniffing is preceded by a display of the genitalia to the other members of the pack. Wichler's belief is that genitalia of normal female structure would impair the social dominance of the female.

Very little courtship is apparent during the breeding season, since the partners are already familiar with each other through their social ties. Mating behaviour is clearly adapted to the unusual form of the female genitalia. An oestrus female attracts the attention of several males, resulting in rivalry in which the largest male normally succeeds.

Probably because they are social and territorial, spotted hyaenas scent-mark with the secretions of the anal glands. The entire group may scent-mark an object, sometimes a grass stalk for lack of anything better, the dominant females first. This is done by squatting over the stalk while everting the anal pouch and smearing the contents on the stalk.

Following the movements of hyaenas and studying their behaviour in the wooded eastern Transvaal is extremely difficult and poses many difficulties. Nevertheless, records kept by the research division of the Kruger National Park in Skukuza (Pienaar, 1969), and the findings of Bearder (1975) from the adjoining private nature reserves, indicate that spotted hyaenas behave in a fashion very similar to that of their east African plains conspecifics, and are just as predaceous. Eloff (1964) found the same to be true of Kalahari hyaenas.

FOOD:

As mentioned above, spotted hyaenas by preference would scavenge on carrion of virtually every description and are capable of utilizing left-overs unpalatable to other carnivores. According

to/...

to Pienaar (1969) they are even capable of dealing with the thigh-bone of an adult buffalo.

When carrion is not available, spotted hyaenas are very capable hunters, either solitary or in packs. In East Africa. their order of prey preference is wildebeest, zebra, and Thomson's gazelle (Kruuk, 1966 and 1972). In the Kruger National Park, the order of preference recorded by Pienaar (1969) for the period 1954-1966 is impala, wildebeest, waterbuck, and kudu; as well as the young and crippled of all other species, including lion. Bearder (1977) found that impala and giraffe were the most common food items, although it was impossible to ascertain whether these were hunted.

Balestra (1962) records small mammals, birds, crabs, snails and vegetable matter found in four stomachs he analysed, and comments on the attacks on man for which the spotted hyaena is notorious. Deane (1962) found considerable amounts of grass to be taken. Van Lawick Goodall and van Lawick (1970) observed cubs to eat the fresh dropping of ungulates (possibly for the vitamins, Ewer, 1973), while adults relish the faeces of wild dogs. Smithers (1971) analysed ten stomachs, and found remains of impala, duiker, wildebeest, reedbuck, lechwe, gemsbok and spring hare. Both Kruuk (1968) and Smithers (1971) recorded instances of cannibalism.

BREEDING:

Fairall (1968) found the species to be a non-seasonal breeder, as was also suggested by Ansell (1960). This conclusion is supported by the findings of Smithers (1971).

Ewer (1973) discusses the necessity for predators to have a prolonged period of maternal care after weaning, during which the young can learn hunting techniques and familiarize themselves with the social system. As a result females do not breed more often than every second year.

MEASUREMENTS AND MASS:

Data for only two males are available:

	Tot.	T.	H.ft	Ear		Mass
TM 19370:	1535	275	235	123	=	58,1kg

TM 19371/...

TM 19371: 1455-245-230-117mm=49,0kg

RECORDS OF OCCURRENCE:

Specimens examined, 9: Pafuri river, 1 (TM); Sabie river, 1 (TM); Sand river, 1 (TM); Satara, 2 (TM); Shingwidzi, 1 (TM); Skukuza, 1 (TM); Timbavati Priv. Nat. Res., 2 (TM). Material collected by coyote-getters and housed in the Transvaal Division of Nature Conservation, examined from 2230BC; 3330CA.

Additional records: Sightings from Al-te-vẽr, Buffelspoort, Charleston, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Hans Merensky Prov. Nat. Res., Huwi, Letaba Ranch, 10 km E. Madimbo, Mmabolela Estates, Othawa, Parkfield and Delamere, Rhoda, Sandringham Priv. Nat. Res., Scrutton, TenBosch Estates, Uitkyk and Paranie Priv. Nat. Res. Open circles in the Kruger National Park on the distribution map from Pienaar (1963).

Family Felidae

(Modified from Smithers, 1975)

1. Claws, when retracted, not covered by sheaths; body with solid black spots, a black line from inner corner of eye down either side of nose to upper lip; face short, skull arched, in profile short and high, length 146-203 mm; hyoid apparatus unspecialized; long-legged... *Acinonyx*

Claws when retracted covered by sheaths; body unicolour or with rosettes as well as spots or indistinctly marked with bars and spots; skull in profile less arched 2

2. Hyoid apparatus modified by conversion of median part of suspender into a long elastic tendon; size large, skull length in adults

175 mm or more ... ... *Panthera*

Hyoid apparatus of the normal mammalian type, suspender a chain of bones end to end; size smaller, skull length in adults not exceeding 155 mm ... ... *Felis*

Acinonyx Brookes, 1828

Acinonyx jubatus (Schreber, 1776) Cheetah
Jagluiperd

DISTRIBUTION:

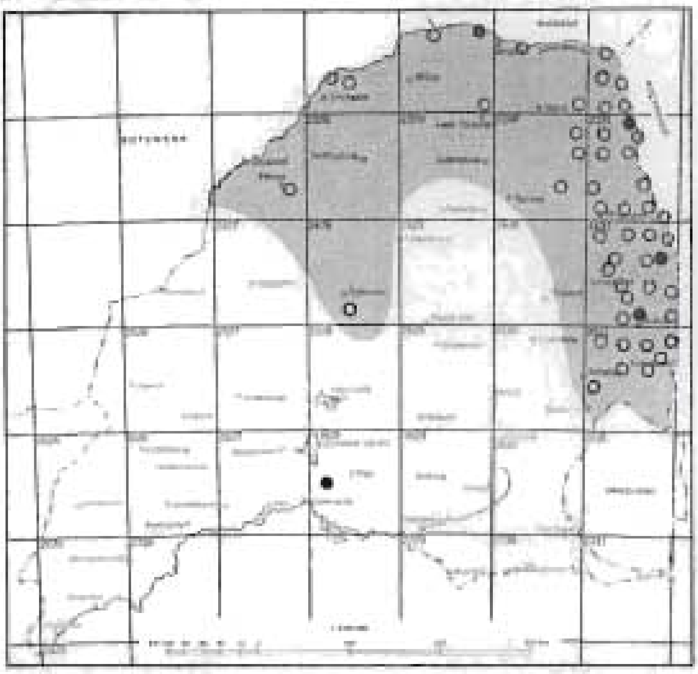


Fig. 142: The distribution of *A. jubatus* in the Transvaal.

The cheetah is today exceedingly rare in the Transvaal, with resident populations occurring only in the Kruger National Park. Pienaar (1963, 1969) estimates the total numbers to be 219 in 1963, and 263 in 1969, with the highest concentrations in the southern sections of the Park.

Individuals are occasionally sighted in the more remote areas of the northern Transvaal, having presumably crossed the Limpopo river from Botswana and Rhodesia. Three animals reported from Huwi Private Nature Reserve near Ellisras arrived just before the game-fencing was completed, and are still present, although seldom seen. A record from near Nylstroom is from animals reintroduced on a private nature reserve. Whereas the species occurred in southern Transvaal in historical times, it has now completely disappeared from these areas, except for animals re-introduced in the

Suikerboschrand/...

Suikerboschrand Provincial Nature Reserve.

HABITAT:

The exact habitat preferences and/or tolerances of cheetah still are a controversial matter. The general belief is that it favours open grassland or lightly wooded areas. Eaton (1974), however, found that the population he studied could also successfully utilize open woodland as well as dense woodland. All observations in the Transvaal are from wooded areas. However, since the cheetah has been exterminated in the highveld areas of the Transvaal, habitat preferences as reflected by population densities in the various regions are now impossible to assess.

In the Kruger National Park highest population densities are found in the southern section (Pienaar, 1963), which has a higher rainfall than the northern section.

HABITS:

The cheetah is renowned for its speed when running down its quarry, and possesses very distinctive anatomical adaptations to this particular way of hunting. According to Ewer (1973:227), this is an extraordinary evolutionary adaptation to hunting on open plains, where the other bigger felids, mainly adapted to areas with good cover, are out of their depth. The cheetah nonetheless displays the three basic felid hunting techniques, i.e. stalking (when cover is available), an orientated neck bite or a throat bite according to the size of the prey, and utilizing the paw(s) to fell it. This implies that the cheetah need not be at a disadvantage in densely wooded areas with regard to procuring food. Perhaps the reason for the cheetah's precarious position in the Transvaal should be sought in its low-ranking position in the predator hierarchy of the bushveld. Cheetahs are often robbed of their prey by lions, leopards and hyaenas, and are even preyed upon by these more powerful predators (Schaller and Lowther, 1969; Pienaar, 1969).

The/...

The normal hunting procedure of the cheetah is to stalk its prey until it is detected. It then breaks into a run, mostly from a distance of 100-200 metres in more open areas. When the chase is unsuccessful, the cheetah gives up after a few hundred metres to avoid unnecessary waste of energy. When within reach, the prey is knocked over with a swift blow of a forepaw directed at the legs, flank or rump. The victim is killed by a well-directed neck bite if small; bigger game by a throat bite causing suffocation or possibly damage to the central nervous system by dislocating the vertebrae (see Kruuk and Turner, 1967; Schaller, 1968a and 1969a; Eaton, 1970a and b).

Cheetah normally do not remain at the carcass once they have fed, since they prefer fresh meat. They are therefore not succeptible to coyote-getters. Isolated instances of carrion eating have, however, been reported in the Kruger National Park (Pienaar, 1969).

Typical of the felids, the female becomes attractive to males a few days before she is prepared to mate, which results in rivalry and fighting amongst the attending males.

The cheetah is neither solitary nor a highly social animal. It is sometimes seen in groups of up to eight (Pienaar, 1969; Eaton, 1974), but the significance of these associations is not understood beyond simple mother and offspring relations. The cheetah is territorial, and where it follows the seasonal movements of Thomson's gazelle in the Serengeti, it returns to the same area and occupies ranges of 20-25 square miles in successive seasons (Schaller, 1970; Eaton 1969b and 1970c). When scent-marking, the urine is directed backwards onto an object such as a rock or bush (Fiedler, 1957 and Eaton, 1970c). The territories are protected when necessary, but home ranges may overlap and hostile encounters are restricted through mutual avoidance. Big groups are often seen together, and Ewer (1973) is of the opinion that although individually territorial, littermates tend to maintain contact throughout adulthood.

The species is predominantly diurnal, but also nocturnal to some extent.

FOOD/...

FOOD:

The cheetah preys on small and medium-sized antelope, as well as the young of the bigger species.

Through carcass data, Pienaar (1969) estimated the prey preference in the Kruger National Park to be reedbuck, the young of kudu, waterbuck and tsessebe, and adult or young impala. Smithers (1971, quoting Labuschagne *pers.comm.*) lists springhare as an important food item in the Kalahari Gemsbok National Park. Smaller prey such as hares, spring hares, dassies, cane rats and ground-nesting birds may in fact rate higher as a source of food than currently realised. Schaller (1968a) considers 26 kg the maximum prey mass that can be hunted down individually.

BREEDING:

Fairall (1968), Adamson (1969), and Eaton (1970) all recorded a peak of births during the autumn months March to May. Indications are that females breed approximately once every two years, provided previous litters were raised successfully. Gestation period is 90-93 days, and three to four cubs are born to a litter.

MEASUREMENTS AND MASS:

A male specimen from the Limpopo river (Farm River 141), donated to the Transvaal Museum, had a total length of 2055 mm, a tail length of 770 mm and weighed 45 kg.

RECORDS OF OCCURRENCE:

Specimens examined, 7: River 141, 1 (TM); Sabie river, 1 (TM); Satara, 4 (TM); Shingwidzi, 1 (TM).

Additional records: Sightings from Charleston, Greefswald, Hans Merensky Prov. Nat. Res., Huwi, Letaba Ranch, Mmabolela Estates, Othawa, Parkfield and Delamere, Rissik Priv. Nat. Res., Sandringham Priv. Nat. Res., Scrutton, Suikerboschrand Prov. Nat. Res., Swellendam, TenBosch Estates, Timbavati Priv. Nat. Res., Uitkyk and Paranie. Open circles in the Kruger National Park on the distribution map

from /...

from Pienaar (1963).

Panthera Oken, 1816

1. Body with distinct rosettes and spots, no tuft on the end of the tail, males without manes; averaging smaller, total length of skull about 175-260 mm; sagittal crest, mastoid process and paroccipital process not prominent ... ... *pardus*

Body unicolour, lacking rosettes, the adults not spotted, the end of the tail tufted, males normally with a mane on the head and neck; averaging larger, total length of the skull about 253-400 mm; sagittal crest, mastoid process and paroccipital process prominent ... ... *leo*

Panthera pardus (Linnaeus, 1758) Leopard
Luiperd

P. p. pardus Linnaeus, 1758

TAXONOMIC NOTES:

Although a variety of subspecies has been described from Africa available material is inadequate to allow proper statistical assessment of their validity. Consequently, Smithers (1975) is followed here in regarding all southern African material as representing the nominate race.

DISTRIBUTION:

The leopard is widely distributed throughout the bushveld areas of the Transvaal. It has become extremely shy and cunning, and persists even in areas where it is intensively hunted. It is more commonly found in mountainous retreats where human disturbance is minimal and persecution difficult. A specimen was,

for/...

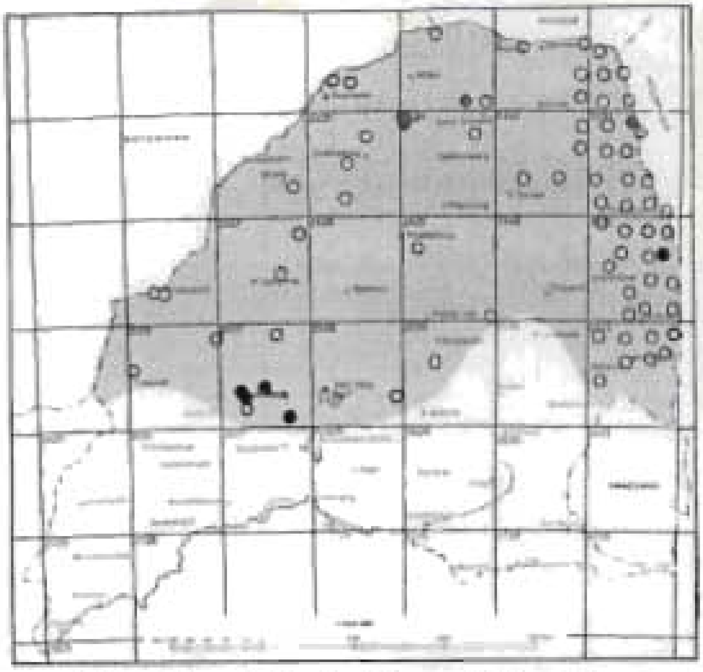


Fig. 143: The distribution of *P. pardus* in the Transvaal.

for instance, collected during 1976 along the Magaliesburg range 50 km west of Pretoria.

It does not occur at all on the highveld grasslands of the southern Transvaal. Literature records are vague regarding its possible occurrence in this area during historical times. It is, however, to some extent dependent on a wooded environment, and it is therefore unlikely that it ever occurred on the highveld proper, the natural domain of the cheetah.

<u>HABITS</u>:

The leopard is very agile, and is the best climber of the larger felids. It hunts by choice amongst good cover. Contrary to the general belief that the leopard jumps on its prey from ambush on a horizontal tree-branch, Kruuk and Turner (1967) found that it hunts only from the ground. They found the leopard to be an expert at stalking or lying in wait amongst good cover for antelope to move within reach. Kruuk and Turner (*op.cit.*) in fact observed a leopard sleeping in a tree; when it became aware of prey within reach, it jumped down and launched its attack from terra firma. A leopard is no match for the defences of a baboon troop by day, and it therefore takes peripheral animals while the troop is sleeping at night. Baboons are, however, not as much a preferred prey as is commonly accepted (see Pienaar, 1969).

The leopard normally hunts alone. In fact, Shortridge (1934) is of the opinion that males and females remain together only during mating time. As befitting the best climber of the Felidae, the

leopard/...

leopard protects its prey from other thieving predators by storing it up a tree. Ewer (1973, citing Brain *pers.comm.*) notes that this is not done when there are no potential food thieves in an area.

P. pardus is predominantly nocturnal, lying up by day in caves, rock crevices, or dense bush cover, or on horizontal tree branches. In more remote areas with little human disturbance it has been observed to be active in the mornings or late afternoons.

Eisenberg and Lockhard (1972) studied leopards in the forests of Ceylon, and found that each individual has a permanent home range. The home ranges of males and females may overlap, but not those of the same sex. Home range sizes were remarkably small, the largest measured being 10 km^2. Ownership was found to be maintained mainly by vocalization and marking. Tree scratching has until recently been accepted as merely a way of sharpening the claws. Ewer (1973) examines the available evidence and concludes that it also serves as an intraspecific communication mechanism. Strategically situated trees are selected, and defecation and micturation accompany tree scratching. When marking, the urine is sprayed backwards onto a bush or other suitable object (Fiedler, 1957).

A female with young carries smaller prey back to her offspring to feed on, otherwise she simply leads the young back to where she has left her prey.

FOOD:

Only three stomachs were available for an analysis of the contents. The first contained 210 cc meat of unidentifiable origin, some vegetable matter, and some leopard hair, probably its own from grooming. The second stomach contained 550 cc of dassie remains, a bit of vegetable matter and a small amount of sand. The third contained only a few unidentifiable feathers and small amount of grass.

Pienaar (1969) concludes that in the Kruger National Park the leopard is the most important predator of impala, reedbuck, nyala, bushbuck, duiker, steenbuck, Sharpe's grysbuck, klipspringer and baboon. He remarks that in general these prey species do not exceed the weight of a full-grown leopard.

"In/...

"In the absence of large mammalian species leopards revert to a diet of smaller mammals and even lesser fare without apparent hardship and, in addition to -heir natural cunning, this probably accounts for the fact that these wily predators are able to subsist in areas close to civilization in which the other large carnivores have long ceased to exist." (Pienaar *op.cit.*) It can also feed on insects and fish under unusual circumstances (Fey, 1964).

Pienaar's (1969) findings bear out Ewer's (1973) comment that the leopard hunts by choice in good cover, and that its prey species are thus commonly those that frequent this habitat type. The diet is probably the most varied found among large predators. Pienaar (*op.cit.*) recorded 31 prey species apart from the small prey taken; Mitchel *et.al.* (1965) recorded 21 species in the Kafue; Kruuk and Turner (1967) 20 species in the Serengeti.

BREEDING:

Neither of the two females collected during this survey was pregnant.

The species is a non-seasonal breeder. Gestation period is 90-95 days, and the average litter size is two to three. (Turnbull Kemp, 1967; Fairall, 1968; Adamson, 1969; Eisenberg and Lockhart, 1972).

MEASUREMENTS AND MASS:

Data on four males are available:

	Tot.	T.	H.ft	Ear		Mass
TM 17452:	2060	770	240	60	=	47,3kg
TM 18767:	1760	660	?	?	=	?
* TM 19199:	2010	750	240	?	=	40 kg
No number	2151	712	265	81	=	63,5kg

Two females were measured:

	Tot.	T.	H.ft	Ear		Mass
TM 17505:	1925	730	220	80	=	29,5kg
* TM 19198:	1800	692	188	?	=	25 kg

* Weighed and measured without skin

RECORDS/...

RECORDS OF DISTRIBUTION:

Specimens examined, 14: Blouberg, 1 (TM); Glenferness, 1 (TM); Rochdale, 1 (TM); Rustenburg, 2 (TM); Rustenburg Prov. Nat. Res., 2 (TM); Shingwidzi, 1 (TM); Satara, 3 (TM); Marikana Quarry, 1 (TM); Mason's Cave, 1 (TM); Olifantspoort, 1 (Priv. coll.).

Additional records: Blijdschap Priv. Nat. Res., Buffelspoort, Charleston, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Greefswald, Groothoek, Hans Merensky Prov. Nat. Res., Huwi, Jack Scott Priv. Nat. Res., Letaba Ranch, Loskopdam Prov. Nat. Res., 10 km E. Madimbo, Mmabolela Estates, Mooigenoeg, Mooiplaas, Nicorel, Nooitgedacht, Othawa, Parkfield and Delamere, Platbos, Renosterpoort Priv. Nat. Res., Rhoda, Rochdale, Rykvoorby, Sandringham Priv. Nat. Res., Scrutton, Sweet Homes, Swellendam, TenBosch Estates, Timbavati Priv. Nat. Res., Uitkyk and Paranie Priv. Nat. Res., Urk, Welgevonden, Zandspruit 168. Open circles in the Kruger National Park on the distribution map represent data from Pienaar (1963).

Panthera leo (Linnaeus, 1758) Lion
Leeu

P. l. krugeri (Roberts, 1929)

TAXONOMIC NOTES:

Smithers (1975), following Ellerman *et al.* (1953), suggests that the lion should be considered monotypic owing to a lack of adequate material facilitating statistical analysis. Regional forms are however recognized for the sake of convenience.

DISTRIBUTION:

Where the lion in historical times occurred throughout the Transvaal, it has now been exterminated in all areas except the larger conservation areas of the eastern Transvaal lowveld.

The/...

Records from near Ellisras and Nylstroom are from animals kept in captivity on private nature reserves.

Occasionally vagrants enter the agricultural areas of the Transvaal. During 1972/3 one such animal was reported from the Nylstroom-Naboomspruit area, which had presumably originated from Botswana. During 1974, a young male, presumably from the eastern Transvaal, received enormous publicity when it appeared in the Heidelberg district. This animal was eventually tranquilized from a helicopter and is currently being kept on Huwi Private Nature reserve near Ellisras.

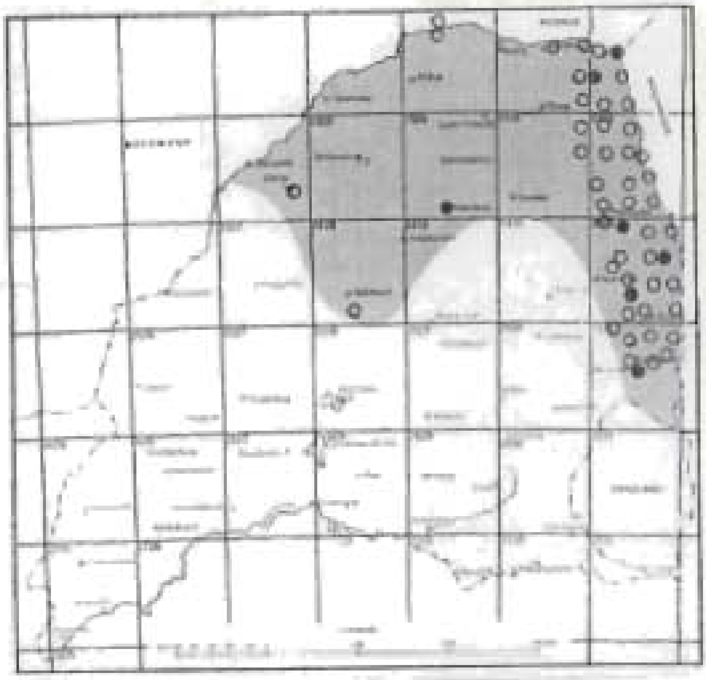


Fig.144: The distribution of *P. leo* in the Transvaal.

HABITAT:

The species has a wide habitat tolerance, and can exist in most types of country. In the Transvaal it has been found only in the eastern Transvaal bushveld in recent times, but in the past it also occurred on the highveld (Shortridge, 1934). It avoids forests. Ewer (1973), however, points out that the lion is not well adapted to a plains existence, being dependent on good cover for hunting.

HABITS:

The African lion has been intensively studied by many authors, and only a few of the more recent and more comprehensive accounts can be cited here. However, Guggisberg's (1955) and Adamson's (1960 books can be recommended for more detailed accounts.

The lion differs from the rest of the Felidae in that it is a social animal, living in small troops of seldom more than 12 individuals. These groups co-operate in hunting, but quarrelling over the proceeds of the hunt is not uncommon. This quarrelling, and the fact that food sharing is much less equitable than in *Lycaon pictus*, are regarded by Schaller and Lowther (1969) as a reflection of incomplete adaptation to social life.

Prides/...

Prides normally consist of a few males and a majority of females, together with their cubs. Individual lions are, however, not an exception. The lion is a good stalker, but is rather dependent on good cover. In fact, one of the reasons why the traditional roles of lions and hyaenas are reversed in the Ngorongoro crater (Kruuk, 1966), could be the lack of good cover, rendering the spotted hyaena's method of hunting more successful.

When hunting in a group, Schaller and Lowther (1969) observed lions to employ three basic techniques. The first is to fan out and flush game. The second is for a few individuals to circle around the quarry, so that the main body of the troop can flush it towards a few ambushers. The third method is to use their familiarity with the topography to drive game into a cul de sac. Lions have no aversion to carrion, and will feed on a kill for several days, despite its decaying condition, until finished. They protect their kill by simply staying in the vicinity.

Lion prides have ranges, and adjoining ranges may overlap. Each range, however, has a core area which does not overlap with the range of any other tribe (See Schaller and Lowther, 1969; Makacha and Schaller, 1969). As lions defend these ranges, they can be considered territorial, according to Ewer (1973). It is normally the males which actively defend these territories. Nomadic lions following the movements of herds, and thus without permanent territories, have also been recorded.

According to Schaller (1967), the urine may be used as a marking substance, in which case the secretions of the anal sacs are added. The urine is directed backwards to spray a suitable object (Fiedler, 1957).

Lions are predominantly nocturnal animals, hunting by night. However, in undisturbed areas they may also be active during the day. Normally, a pride rests by day at or near any sort of shade. Lions do not cover great distances during their hunts (see Ewer, 1973). They are dependent on water, although they may not drink very regularly.

FOOD/...

FOOD:

The stomach of only one male was available for examination of the contents, but was empty.

In general, lions prey on medium-sized antelope of slightly more than their own average weight. From published accounts it would appear that wildebeest constitutes the principal prey. In terms of actual preference, Pienaar (1969) has calculated that in the Kruger National Park the lion's major prey is the waterbuck.

In general, however, lions prey on a large variety of species, with availability playing an important role. Lions may also take small prey. Guggisberg (1960) has recorded rodents, tortoises, termites, grass, various wild fruits and even fish when rivers dry up. Cannibalism has also been recorded, when a dead conspecific is regarded as food.

BREEDING:

Lions are non-seasonal breeders. Gestation period is between 105 and 112 days. The female leaves the pride to give birth, but rejoins it after a few weeks. One to six young areborn pe litter. Females with young do not come into oestrus again for two years, when the young have become independent. Cubs are weaned at the age of eight months (see Shortridge, 1934; Fairall, 1968; Schaller, 1968b; Adamson, 1969), but remain dependent well into their second year.

MEASUREMENTS AND MASS:

I had the opportunity to measure and weigh only two males. They were:

	Tot.	T.	H.ft	Ear		Mass
TM 24004:	2880	880	370	130	=	177,2kg
TM 24119:	2440	840	?	127	=	?

RECORDS OF OCCURRENCE:

Specimens examined, 11: Malelane 389, 1 (TM); Othawa, 1 (TM); Pafuri river, 2 (TM); Pietersburg, 1 (TM); Punda Milia, 1 (TM); Roodekranz, 1 (TM); Sabie river, 1 (TM);

Satara/...

Satara, 3 (TM).

Additional records: Sightings from Charleston, Greefswald, Letaba Ranch. on Levuvhu river, Huwi, 10 km E. Madimbo, Malongo Flats, Rhoda, Rissik Priv. Nat. Res., Sandringham Priv. Nat. Res., TenBosch Estates, Timbavati Priv. Nat. Res. Open circles in the Kruger National Park on the distribution map represent the records from Pienaar (1963). The record from Rhodesia on the Transvaal border is reported by Smithers (*in litt.*).

Felis Linnaeus, 1758

(Modified from Smithers, 1975)

1. Ears elongate, distinctly tufted at the tips with long black hair, backs of the ears jet black with a varying number of white hairs	*caracal*
Ears not elongate, not distinctly tufted, not black overall on the back...	2
2. Upper parts of body unicolour or only indistinctly barred and/or spotted...	*libyca*
Upper parts of body distinctly barred and/or spotted	3
3. Size larger; height at the shoulder in adults over 380 mm; legs long, hind foot over 150 mm	*serval*
Size smaller; height at the shoulder in adults not over 260 mm; legs short, hind foot less than 120 mm	*nigripes*

Felis nigripes (Burchell, 1824) Black-footed cat
Swartpootwildekat

F. n. nigripes Burchell, 1824

DISTRIBUTION/.

DISTRIBUTION:

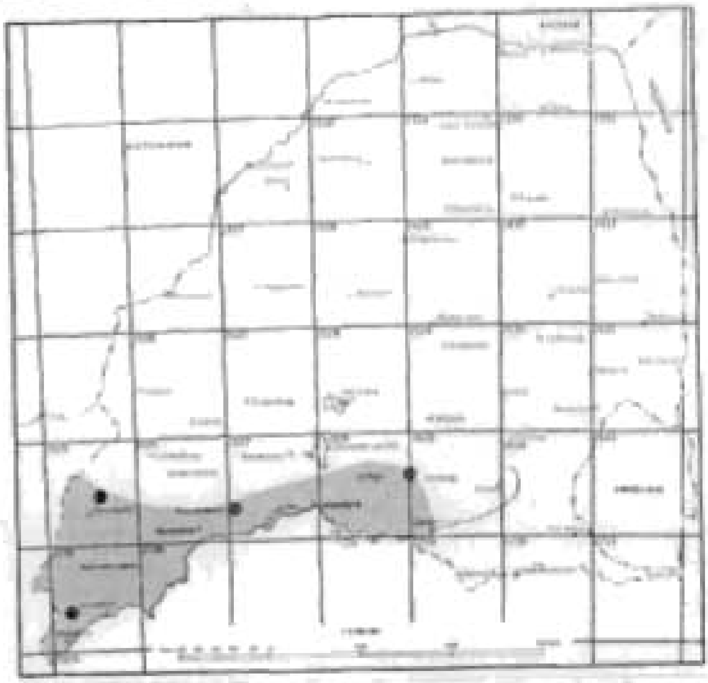


Fig. 145: The distribution of *F. nigripes* in the Transvaal.

Recorded only from the *Cymbopogon-Themeda* veld and the Kalahari Thornveld and Shrub Bushveld of the south-western Transvaal. A specimen collected at Barberspan attempted to raid a duck-trap, but was trapped (see Milstein, 1975). The animal was donated to the National Zoo, but died and is now in the collections of the Transvaal Museum.

An animal seen at Dullstroom bore a strong resemblance to *F. nigripes*, but as it was not possible to collect the specimen, the record is not listed. Various farmers in the central and south-eastern Transvaal claim to have seen this species, and one farmer even kept an individual in captivity. All these records are, however, too far out of the known range of the species to be acceptable without substantiating material. The complicating factor is that *F. nigripes* appears to cross-breed with the domestic cat. Striking examples of what would normally be taken for the black-footed cat may be seen i the business centre of Pretoria on a Saturday morning. For the moment these records are thus considered to refer to feral animals of domestic cat X black-footed cat ancestry. Shortridge (1934) also comments on such hybrids.

HABITAT:

Very little is known about the black-footed cat. From available data it would appear that it is an inhabitant of arid and semi-arid open country with some cover in the form of shrub. TM 20819 from near Christiana was collected in an old cultivated land.

HABITS/...

HABITS:

It is primarily nocturnal. Various observations in the Kalahari Gemsbok National Park however point to some diurnal activity, especially during early mornings and late afternoons.

Black-footed cats are solitary, and it is said that they lie up during the day in the holes of spring hares and other burrowing animals (Shortridge, 1934).

Like all true felids, the black-footed cat is an efficient killer, displaying the typical well-directed neck-bite. The canine normally passes between two vertebrae and thus severs the spinal cord (Leyhausen, 1965). Unlike other Felidae however, *F. nigripes* females have a very short oestrus period, allowing males to mate only during a five- to ten-hour period, with approximately 12 copulations during this time. Being the smallest of the Felidae, and in addition living in areas where it is more exposed than some other species, this short mating period is seen as a protective adaptation to prevent predation (Leyhausen, 1965).

FOOD:

Two stomachs were available for analysis.
The first contained feathers and parasites. The second contained one Solifugid spider, as well as grass and leaves.

Leyhausen and Tonkin (1966) found that it eats grass readily in captivity, and in fact does not thrive unless it is regularly provided with fresh grass. Bothma (1965) found some green grass also in the stomach of a wild specimen he collected.

The black-footed cat appears to rely mainly on small mammals and birds for food. The largest rodent recorded as being taken is the ground squirrel (*Xerus inaurus*) (Bothma, 1965). As it is strictl diurnal, this points to some diurnal activity in *F. nigripes*. Smithers (1971) recorded adults of Coleoptera, Araneae and reptiles as being taken.

BREEDING/...

BREEDING:

A pregnant female was collected during November. She had two foetuses, one in each uterine horn, with cr. length 105 mm.

According to Leyhausen and Tonkin (1966) the species produces one litter per year during spring. The gestation period is 63-68 days, and one or two kittens are born per litter.

MEASUREMENTS AND MASS:

No male specimens are represented in the collections.

Females:

	Tot.	T.	H.ft	Ear		Mass
TM 8913:	470	140	80	50	=	?
TM 20566:	500	73	93			1,07kg
TM 20819:	570	155	95	55	=	2,0kg

RECORDS OF OCCURRENCE:

Specimens examined, 4: Barberspan Prov. Nat. Res., 1 (TM); Potchefstroom, 1 (TM); Rolspruit, 1 (TM); Welgedaan, 1 (TM).

Felis serval (Schreber, 1776) Serval cat
Tierboskat

F. s. serval Schreber, 1776

DISTRIBUTION:

All the records from the Transvaal are from Tropical Bush and Savannah veld types as defined by Acocks (1975). The species apparently does not occur on the highveld grasslands of the southern Transvaal. It has never been recorded from the Orange Free State either. However, Mr L. Oates (Regional Officer, Transvaal Provincial Administration, Division of Nature Conservation) (*pers. comm.*) reported a sighting by his field staff on Suikerboschrand Provincial Nature Reserve. The animal jumped a fence, and some of its hair left behind on the barbed wire was sent to the S.A.P. Forensic laboratories, where

the/...

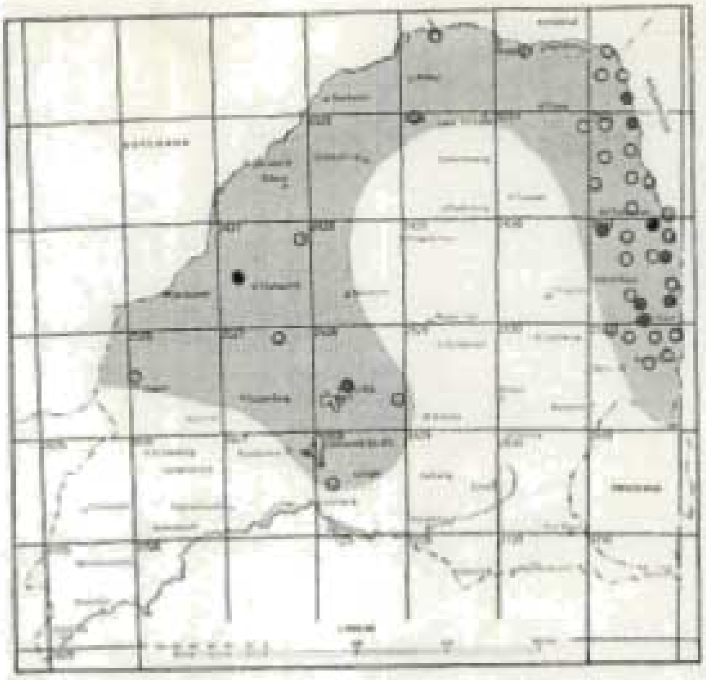


Fig.146: The distribution of *F. serval* in the Transvaal.

the record was confirmed upon microscopic examination. This is accepted as a peripheral record, as patches of suitable habitat in the form of wooded kloofs are to be found on the reserve.

Pienaar (1964) recorded the serval as common in the Kruger National Park, especially so in the palm-studded plains of the northern Lebombo flats. Elsewhere in the Transvaal it is exceedingly rare. Because of its stealthy and secretive habits it may have been overlooked in many areas, especially the northern-central area in the districts of Groblersdal, Nylstroom and Potgietersrus.

The serval has never been recorded, during either this survey or that of Smithers (1971), from along the Limpopo river valley upstream from the Swartwater area, but may have been overlooked.

HABITAT:

Both Shortridge (1934) and Smithers (1971) stress the importance of a permanent water source within the home-range. These findings are substantiated by data accumulated through the Transvaal survey, although the permanent source of water need not be a natural one, cattle drinking troughs or constructed dams being sufficient.

As can be concluded from the section on distribution, cover in the form of wooded savannah, riverine forests, shrub or even tall grass or reed beds is an essential habitat requirement. Shortridge (1934) also lists level forests or thickly

bush/...

bush-covered plains with comparatively heavy rainfall as optimum habitat types, and adds that the species does not necessarily avoid hilly country.

HABITS:

The serval is nocturnal and rarely seen by day. By day servals hide in thick bush, grass or reedbeds, and have also been recorded to use antbear or porcupine burrows for this purpose. As mentioned above, they do not habitually wander far from water.

Shortridge (1934) suggests that the unusually long legs are an adaptation to high speed, similar to those of the cheetah. Leyhausen (1965b), to the contrary, found that the serval is not adapted for sprinting, and that the long legs are rather adapted for hunting in long grass. Dominis and Edey (1968) photographed servals rearing up on their hind legs with the body extended almost vertically, in order to swipe at low-flying birds. They have seen a serval successfully procure a dove in this manner.

The serval is unusually adept at using the paws in raking rodents and other prey from crevices where they have taken refuge. In killing small prey such as rodents, a forceful downward blow is delivered with a front paw (see Ewer, 1973).

The remarkably large ears of the serval are related by Ewer (1973) to its distribution being limited to warmer climates. The ears represent an increase of the heat-radiating surface, and thus function in maintaining body temperature. The better hearing afforded by the large ears is also advantageously employed in hunting small prey in dense cover.

The serval is an expert climber, although it is not normally an arboreal species. Shortridge (1934) recorded servals taking refuge in trees when pursued by dogs. Kemp (*pers.comm.*) observed servals in Rhodesia climbing trees after roosting birds and nestlings.

Fiedler (1957) observed servals to micturate by directing the urine backwards through the legs on a bush or other suitable object.

FOOD/...

FOOD:

No information is available from the Transvaal. Smithers (1973) recorded a preference for rodents up to the size of a cane rat. He also recorded birds, reptiles, fish, Coleoptera and Orthoptera, as well as green grass. Shortridge (1934) claims that serval also take small antelope and hares, and relates known instances of serval taking lambs and young goats. Verschuren (1958) found that four out of seven stomachs analysed from Garamba National Park contained mainly vegetable matter.

BREEDING:

No records are available from the Transvaal. Documented evidence suggests parturition during the warmer wet summer months of August through to March, with the possibility of a more extended breeding season (see Shortridge, 1934; Ansell, 1960; Pienaar, 1964; Fairall, 1968; Ansell, 1971).

MEASUREMENTS AND MASS:

No data are available from the material housed in the Transvaal Museum.

RECORDS OF OCCURRENCE:

Specimens examined, 22: Babatdraai, 1 (TM); Fairfield, 1 (TM); Pienaars river dam, 5 (TM); Sabie river, 2 (TM); Satara, 10 (TM); Shingwidzi, 1 (TM); Shingamene, 1 (NKW); Tshokwane, 1 (NKW).

Additional records: Sightings from Buffelspoort, Greefswald, Letaba Ranch, Mala-Mala, Othawa, Platbos, Renosterpoort Priv. Nat. Res., Rykvoorby, Scrutton, Suikerboschrand Prov. Nat. Res., TenBosch Estates, Urk. Open circles in the Kruger National Park area on the distribution map from Pienaar (1963).

Felis caracal Schreber, 1776 Caracal

Rooikat

F. c. limpopoensis (Roberts, 1926)

DISTRIBUTION/..

DISTRIBUTION:

The caracal is evenly distributed throughout the bushveld areas of the Transvaal. No records exist of its occurrence on the highveld grasslands of the southern Transvaal. The species is, however, believed to have been overlooked or exterminated on the highveld, as it is recorded from the grasslands of the Orange Free State (Lynch, 1975).

The caracal is not often encountered, but this could be the result of its solitary and secretive nature. It is not readily attracted to carrion, and this dislike may favour the survival of caracal over black-backed jackal in sheep farming areas where coyote-getters are used as a predator-control measure. As mentioned below, caracal readily attack domestic small stock.

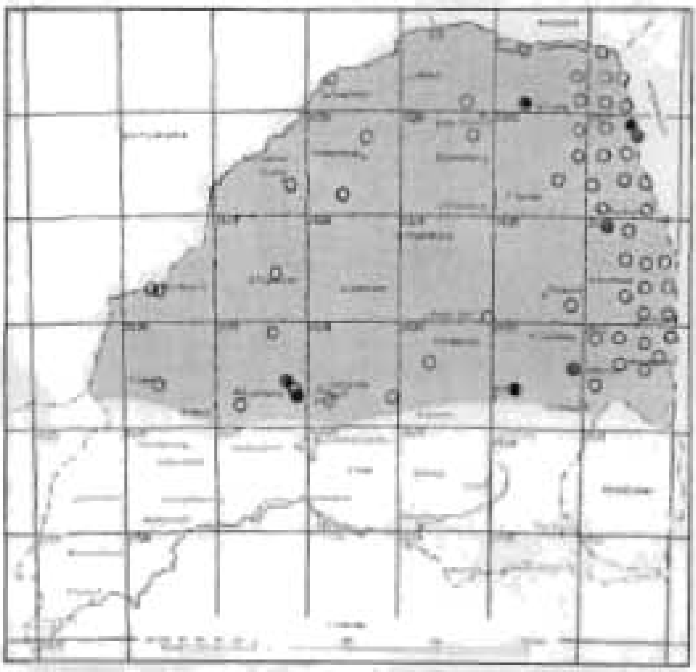


Fig.147: The distribution of *F. caracal* in the Transvaal.

HABITAT:

F. caracal has a wide habitat tolerance. In the Transvaal it has been mostly recorded from wooded areas and in the Orange Free State from highveld grasslands. From observations it would appear that the caracal is to a high degree associated with rocky, mountainous surroundings. It would thus appear that good cover in the form of woodland, shrub or rocks is an essential habitat requirement.

A specimen from east of Belfast was collected in montane grassland, whereas sightings in Blyde Forest Reserve were made in montane forests. In general however, results substantiate Shortridge's (1934) observation that caracal avoid tropical or evergreen forests.

HABITS/...

HABITS:

Generally *F. caracal* is solitary, with only a few instances of pairs recorded. All observations during this survey were made at night, bearing out the view of most authorities that the caracal is a nocturnal species. However, in undisturbed areas it may also be active during daylight hours (see Smithers, 1971).

The caracal is terrestrial under normal circumstances, but it is a good climber when the necessity arises. Shortridge (1934) and Smithers (1971) observed caracal to take refuge in trees when pursued by dogs. Since it has been recorded to prey also on guineafowl, presumably mostly at night, it has to climb the trees in which they roost. Most of its hunting is, however, done on the ground, as pointed out by Smithers (1971).

Like all the Felidae, the caracal is a very efficient hunter, capable of killing prey up to the size of springbok ewes and half-grown impala (see Shortridge, 1934). Dominis and Edey (1968) have observed that the caracal, like the serval rears up on its hind legs with the body almost vertically extended, to catch birds in flight.

Perhaps the most striking feature of the caracal is its black ear tufts. The significance of these is not yet fully understood. Ewer (1973) has observed two individuals exchanging ear twitches, and believes that this may function as a medium of social communication.

FOOD:

Two stomachs were available for analysis. Of the first, 84% of the contents were the remains of warthog (*Phacochoerus aethiopicus*), 3,6% consisted of chicken feathers and 12,4% of unidentifiable vegetable matter. The second stomach contained 91,7% bird remains (including chicken feathers), 5,3% vegetable matter and 2,9% caracal hair, presumably its own. These two animals were killed on the same day at the same locality, which could explain the presence of chicken-like feathers in both stomachs.

It/...

It is not known whether the caracal killed the warthog mentioned above by itself. Caracal however do not come back to kills and as a rule do not feed on carrion. Theoretically it is possible for a caracal to kill an animal the size of a young warthog. Shortridge (1934) mentions an adult springbok ewe and a young kudu being killed by caracal. Azzaroli and Simonetta (1966) saw a Kirk's dik-dik (*Rhynchotragus kirki*) being killed, and found the remains of three *Madoqua phillipsi* in stomachs analysed.

Other food items recorded are dassies, rodents, guineafowl, ground-living birds, hares and monkeys. Bothma (1965) recorded grapes in the single stomach he analysed.

Caracal take small stock readily. Some farmers employing intensive black-backed jackal control measures are of opinion that caracal are fast becoming a menace equal to what jackals were.

BREEDING:

No data are available from the Transvaal. Fairall (1968) recorded kittens found from November to May in the Kruger National Park. Shortridge (1934) recorded a pregnancy in September. Ansell (1960) recorded a gravid female in September and juveniles during November and January. Smithers (1971) states that in Rhodesia young are born from September to December. Two to four young are born per litter (Shortridge, 1934).

MEASUREMENTS AND MASS:

The data from only three males were recorded:

	Tot.	T.	H.ft	Ear		Mass
TM 19214:	995	250	180	85	=	7,7kg
TM 19215:	1035	280	200	90	=	9,1kg
TM 19422:	1020	240	185	80	=	

RECORDS OF OCCURRENCE:

Specimens examined, 9: Brits, 1 (TM); Hartebeespoort, 1 (TM); Machadodorp, 1 (TM); Nelspruit to Crocodile Valley Estates, 2 (TM); Njelelle river, 1 (TM); Olifants river, 1 (TM);

Shingwidzi/...

Shingwidzi, 2 (TM).

Additional records: Blijdschap Priv. Nat. Res., Blyde Forest Res., Buffelspoort, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Ferndale, Greefswald, Hans Merensky Prov. Nat. Res., Huwi, Letaba Ranch, Loskopdam Prov. Nat. Res., Mmabolela Estates, Mooigenoeg, Mooiplaas, Nicorel, Olifantspoort, Othawa, Renosterpoort Priv. Nat. Res., Rochdale, Scrutton, Silkaatsnek Priv. Nat. Res., TenBosch Estates, Uitkyk and Paranie Priv. Nat. Res., Urk, Welgedaan. Open circles in the Kruger National Park on the distribution map from Pienaar (1964).

Felis libyca (Forster, 1780) — Cape wild cat / Vaalboskat

F. l. cafra Desmarest, 1822

TAXONOMIC NOTES:

Haltenorth (1953) considers *F. libyca* a synonym of the older *F. silvestris* Schreber, 1777, the European wild cat. However, Pocock (1951) and Smithers (1975), after examining the available evidence, have retained *F. libyca* until further and more conclusive evidence on the relationship between the two species can be produced.

The material from the Transvaal, consisting of 19 specimens, is darker in colour with more distinct markings than specimens collected from Botswana and South West Africa, and thus answers to the description of *F. l. cafra*. A specimen from Derdepoort, on the Botswana border, does not exhibit any intermediate characteristics between *F. l. cafra* from the Transvaal and *F. l. griselda* as recognized from Botswana, but more material is necessary to study intergradation between these two subspecies.

DISTRIBUTION:

The Cape wild cat is distributed widely throughout the Transvaal, but because of its solitary and strictly nocturnal habits

it/...

it is not often encountered. It is, however, the most common species of the Felidae in southern Africa.

It has almost certainly been overlooked in the area covered by the 2428, 2429 and 2430 degree squares, as well as in the central highveld districts in the south. A record from Wakkerstroom district represents the type locality of *Felis ocreata (=libyca) rusticana* Thomas, 1928 (a synonym of *F. l. cafra* according to Smithers 1975).

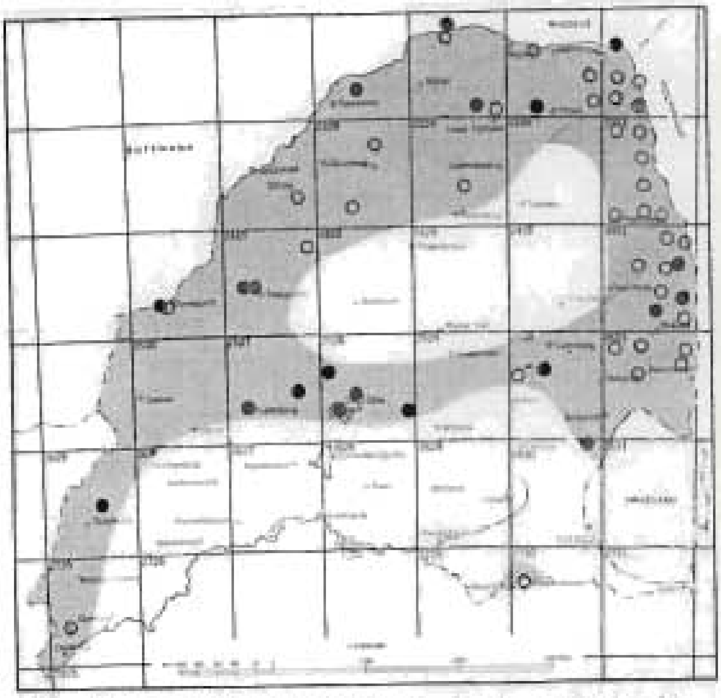


Fig. 148: The distribution of *F. libyca* in the Transvaal.

HABITAT:

The Cape wild cat has a wide habitat tolerance, and in the Transvaal it is found in most habitat types. According to Smithers (1975) it is absent from tropical and montane forests as well as from deserts. So far it has not been recorded from the eastern Transvaal escarpment. Good cover in the form of dense brush, long grass or even rocks is an essential habitat requirement. The Cape wild cat is often found considerable distances from known watering places, but according to Shortridge (1934) drinks regularly.

HABITS:

All encounters with the Cape wild cat were with solitary individuals, confirming the view of Shortridge (1934) and Smithers (1971) that the species is solitary in habit, like the majority of other Felidae. All records from the Transvaal indicate that the Cape wild cat is almost exclusively nocturnal (see also Pienaar, 1964), but in more remote areas it may be active by day under cool or cloudy weather conditions (Shortridge,

1934/...

1934). During the day animals lie up above ground in the shelter of bush or hollow trees or amongst rocks.

Very little is known about this animal, and whatever knowledge is available is based on casual observations. It has, however, been established that the wild cat regularly marks specific trees by scratching them with its claws (Ewer, 1974). In the other Felidae where this behaviour has been observed it appears to be associated with territoriality, thus suggesting that the Cape wild cat may be territorial as well. In this respect Smithers (1971) found three tame individuals to be extremely intolerant of each other, and one would always chase the other two away.

Wherever members of this species have been encountered during night-hunting operations, they appeared to be completely unconcerned by a spotlight focussed on them or by the proximity of a vehicle. They appear to be predominantly terrestrial, although when pursued or wounded they will take refuge in trees where they are quite at home.

The fact that the Cape wild cat freely interbreeds with domestic cats is well-documented, and needs no further comment here. For further details on interbreeding see Shortridge (1934) and Smithers (1971).

FOOD:

Three stomachs were available for an analysis of their contents, and the following food items were recorded, with the frequency of each item noted:

Muridae	*Otomys* sp.	2
	Aethomys sp.	1
Soricidae	*Crocidura*	1
Aves	Undet.	2
Orthoptera	Gryllidae - *Gryllus* sp.	1
	Acrididae	1
Endoparasites	Undet.	2

None of the four small mammals were finely masticated. Only the heads were crushed, indicating a single killing bite.

The/...

The intestines were found separately, suggesting that these had been removed and eaten separately. The shrew recorded is an interesting observation since small carnivores, in particular the Felidae, generally regard shrews as unpalatable.

Smithers (1971) analysed no fewer than 80 stomachs, and found Muridae to be by far the most common food item. Other less important food items recorded by Smithers (*op.cit.*) are Aves, Reptilia, Amphibia, Pisces, Solifugae, Insecta and wild fruits. The biggest prey species taken was *Pedetes capensis*, the spring hare, and hares (*Lepus* sp.). Smithers (*op.cit.*) refutes the claim by Shortridge (1934) that *F. libyca* as a rule prey on the young of domestic stock and small antelope. He agrees, however, with the latter author that African wild cats may become poultry thieves, and that they avoid carrion.

BREEDING:

Lactating females were taken in the Transvaal during March and May. Shortridge (1934) recorded newly born kittens during March. Smithers (1971) recorded gravid and lactating females during January, February, September and November. It would thus appear that it is mainly a seasonal breeder, and that young are born during the warmer wet months of summer.

MEASUREMENTS AND MASS:

The data from only two adult females were recorded. These are as follows:

	Tot.	T.	H.ft	Ear		Mass
TM 23557:	859	300	141	63	=	3,3kg
TM 23848:	888	315	135	58	=	4,1kg

RECORDS OF OCCURRENCE:

Specimens examined, 31: Arnhemburg, 1 (TM); Badfontein, 4 (TM); Brits, 1 (TM); Fairfield, 4 (TM); Mazite dam, 1 (TM); Mooigenoeg, 1 (TM); Njelelle river, 2 (TM); Pienaarsriver dam, 7 (TM); Pretoria, 2 (TM); Renosterpoort Priv. Nat. Res., 1 (TM); Rochdale, 1 (TM); Satara, 3 (TM); Swellendam, 1 (TM); Vliegenpoort, 1 (TM); Zoutpan, 1 (TM).

Additional/...

Additional records: Barberspan Prov. Nat. Res., Dordrecht, Fort Klipdam, Greefswald, Grootsuikerboschkop and Elandslaagte, Huwi, MalaMala, Mooigenoeg, Mooiplaas, Nicorel, Parkfield and Delamere, Platbos, Scrutton, TenBosch Estates, Welgedaan. Open circles in the Kruger National Park area on the distribution map, reflects the data given by Pienaar (1964). Records from Rhodesia on the Transvaal border are based on material housed in the Rhodesian National Museums.

ORDER TUBULIDENTATA

Family Orycteropodidae

Orycteropus G. Cuvier, 1798

Orycteropus afer (Pallas, 1766) — African antbear, Aardvark

O. a. afer (Pallas, 1766)

TAXONOMIC NOTES:

As pointed out by Meester (1972), many of the 18 subspecies currently recognized may be invalid. Their validation, and the establishment of the limits of distribution of each, are hampered by scarcity of comparative material. However, only the nominate race is recognized for the Republic of South Africa. Furthermore, Smithers (1971), in reviewing the taxonomic status of Botswana material, concludes that this also belongs to *O. a. afer*, rather than *O. a. albicaudatus* Rothschild, 1907. Transvaal material is therefore ascribed to the nominate race. However, since the antbear ranges widely over most of the Ethiopian region some degree of subspeciation is very likely. This problem remains to be resolved.

DISTRIBUTION:

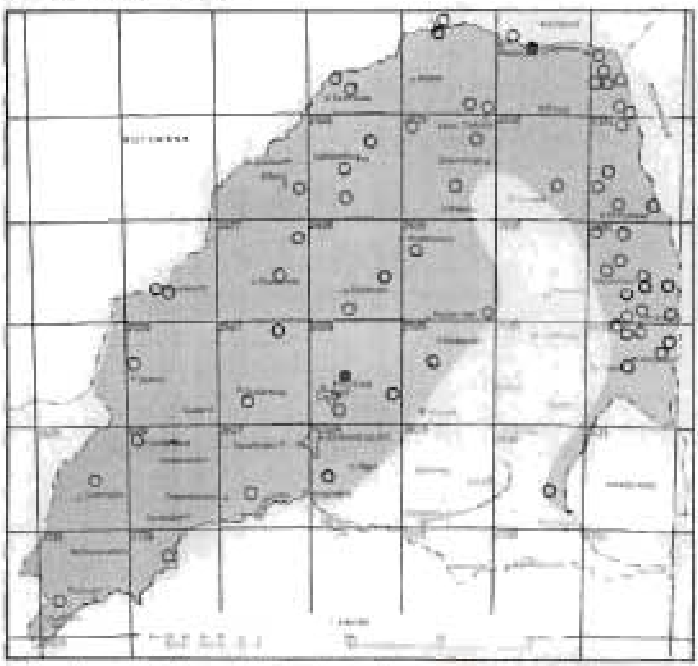


Fig.146: The distribution of *O. afer* in the Transvaal.

As elsewhere in the Ethiopian region, the antbear is widely distributed in the Transvaal. It has, however, not been recorded from the Belfast, Carolina and Volksrust districts in the southeast, nor from the Ventersdorp district in the west. The possibility exists that it has been exterminated in these areas, or that alternatively it has been overlooked.

HABITAT/...

HABITAT:

Although antbears are very seldom seen their occurrence and habitat preference can easily be determined by the presence of their very characteristic burrows. The antbear appears to have a very wide habitat tolerance, as is also reflected by its wide geographical distribution. Burrows have been recorded from a wide variety of environmental conditions and most plant associations in the Transvaal, with the exception of dense forests, rocky mountainous terrain and areas subject to seasonal flooding. Prefers sandy ground for burrowing.

HABITS:

As yet the ecology and behaviour of the antbear have not been studied in detail. Most observations are based on sporadic brief sightings, as well as on tracks and burrows. Melton (1976) collates and reviews the scattered information pertaining to the biology of this animal.

The antbear is totally terrestrial, nocturnal and mostly solitary. Antbears have a large home range as indicated by the fact that they cover an average distance of between nine and 14 kilometres each night in search of food (Melton, 1976). Animals follow a zig-zag path when foraging, thus covering a strip of ground 30 cm wide.

It is commonly believed that antbears rely solely on termites, breaking open termite mounds to reach these insects. Melton (*op.cit.*) found that in fact termite mounds are often ignored in favour of other insects, particularly ants. He was able to demonstrate that termites are quiescent during the dry season, and that the antbear then concentrates on different food sources. However, during the wet season, termite mounds are regularly opened in order to feed on the inhabitants. An antbear may destroy mound by making a single large burrow into its centre at ground level. Especially in the larger mounds, several excavations around the base of the mound allow access to its contents. An interesting behaviour pointed out by Melton (1975) is that antbears sometimes, intentionally or unintentionally, harvest a mound on a sustained yield basis. An excavation is made so as

not/...

not to entirely destroy the mound. The next day the termites close the hole up with moist earth, thus creating an area of easy access into the otherwise rock-hard outer surface of the mound. The mound is then repeatedly revisited and harvested at irregular intervals.

Burrows play an important part in the life of an antbear. These burrows appear to be spaced throughout the large home range. Smithers (1971) discusses three kinds of excavations. The first kind includes those made to gain access to a food source. Secondly there are deep but simple burrows made as temporary refuges. The third kind is utilized on a more permanent basis, and ere individuals take up residence and the young are born. Through prolonged use and constant enlarging, these may attain considerable size. Melton (1976) relates an instance in Zambia where three men entered a burrow to hunt for the occupant. They were recovered only 10 days later after their friends had excavated a veritable labyrinth of tunnels, almost six metres deep, to recover their bodies. A host of small and medium-sized vertebrates utilize antbear holes (see Smithers, 1971). For instance, it has been suggested that warthog can only colonize an area where antbears have burrows which the warthog can utilize as retreats.

Both sexes have an anal scent gland emitting a strong-smelling yellow substance (Pocock, 1924), although the function of this has as yet not been determined. Melton (1975) notes an interesting behaviour pattern, namely covering the excreta in a shallow excavation with loose soil. It would appear that at times other conspecifics uncover this to utilize the toilet site for the same purpose. Melton (*op.cit.*) suggests that the burying of faeces may be important in the avoidance or attraction of other individuals.

FOOD:

Ants and termites are taken almost exclusively and in large quantities. The two specimens collected during this survey had also consumed enough sand to make up 18% of the wet weight of the stomach contents. This probably results from the habit of collecting ant and

termites/...

termites with the long sticky tongue, when sand is inadvertedly taken in. Traces of other food items have been recorded, viz. insect larvae and mice (Smithers, 1971; Melton, 1976).

BREEDING:

The single female collected in the Transvaal, was not pregnant. Smithers recorded three pregnancies during May, July and August. A single young is born after a gestation period of seven months (see Melton, 1976). For the first fortnight the neonate remains in the burrow, but thereafter accompanies the mother on her nocturnal trips. The young remains with the female until she gives birth again.

MEASUREMENTS AND MASS:

Only two specimens were taken from the Transvaal, a male and a female. Only the female was weighed and measured.

	Tot.	T.	H.Ft	Ear		Mass
TM 20319:	1430	480	230	165	=	32kg

See Smithers (1971) for information on six specimens.

RECORDS OF OCCURRENCE:

Specimens examined, 2: Roodeplaat dam, 1 (TM); Scrutton, 1 (TM).

Additional records: Sightings or indirect evidence (viz. burrows) from: Barberspan Prov. Nat. Res., Blijdschap Priv. Nat. Res., Brandhoek, Buffelspoort, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Fort Klipdam, Greefswald, Groothoek, Hans Merensky Prov. Nat. Res., Huwi, Joshua Moolman Priv. Nat. Res., Letaba Ranch, Loskopdam Prov. Nat. Res., Mmabolela Estates, Mooigenoeg, Mooiplaas, Mosdene Priv. Nat. Res., Nicorel, Olifantspoort, Othawa, Parkfield and Delamere, Platbos, Pretoria Zoo's Farm, Renosterpoort Priv. Nat. Res., Rhoda, Rissik Priv. Nat. Res., Rochdale, Rykvoorby, Sandringham Priv. Nat. Res., Suikerboschrand Prov. Nat. Res., Swellendam, Ten-Bosch Estates, Timbavati Priv. Nat. Res., Urk, van Riebeeck Mun. Nat. Res., Welgedaan, Welgevonden, Witpoort, Zandspruit. Records from the Transvaal border at 2229 BB and 2230 AA in Rhodesia have been reported by Smithers (*in litt.*). The map records from the Kruger National Park are from Pienaar (1964).

ORDER PROBOSCIDEA

Family Elephantidae

Loxodonta F. Cuvier, 1827

Loxodonta africana (Blumenbach, 1797) African elephant

L. a. africana (Blumenbach, 1977)

DISTRIBUTION:

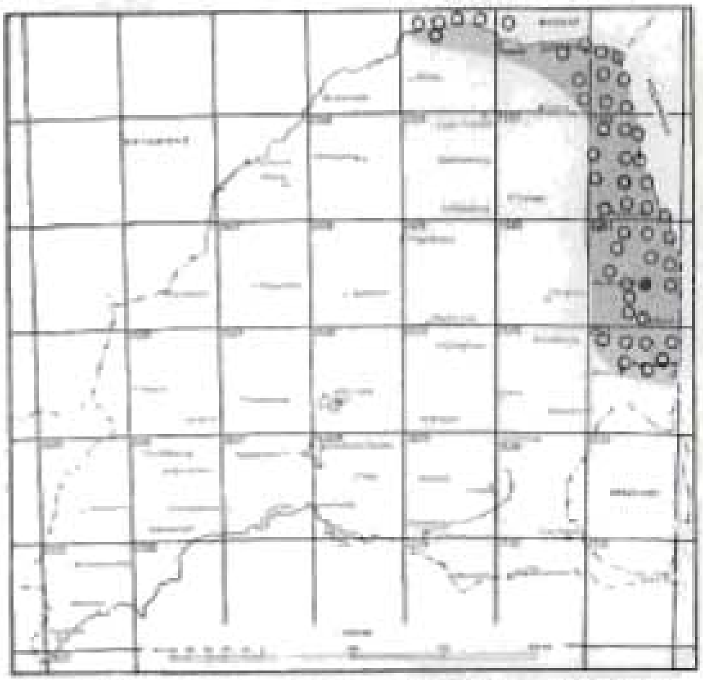


Fig.147: The distribution of *L. Africana* in the Transvaal.

During historical times the African elephant ranged throughout the entire Transvaal. However, like the other very large mammals, the two rhinoceros species and the hippopotamus, the elephant was subjected to intensive hunting pressure by "sportsmen", ivory traders, and farmers. Thus the elephant was exterminated throughout the Transvaal during the previous century, except in the area of the present-day Kruger National Park. Even here numbers were precariously low when the park was proclaimed. However, immigration from Mocambique and a high level of reproductive success has enabled the Kruger Park population to increase very rapidly. Today their numbers have to be curtailed through a culling program (Pienaar, 1963b). A viable population occurs at the border of the Transvaal with Rhodesia and Botswana at the Limpopo-Shashi river confluence (Smithers, 1971). Some of these animals regularly break the foot and mouth disease fence for short breeding bouts within the Transvaal. However, thus far they have always returned to their regular haunts north of the Limpopo river.

The/...

The African elephant migrates over extensive areas (Smithers, 1971), and it is known that many animals have roamed between the Kruger National Park and Mocambique. Recently an elephant fence has been completed along the eastern boundary of the Park so that the resident population can now roam only within the confines of the Park.

<u>HABITAT</u>:

Formerly the African elephant ranged throughout virtually the entire Ethiopian region, which illustrates its wide habitat tolerance. It exists, or formerly existed, in virtually all types of habitat, including rain forests, bush savanna woodlands, grasslands and even semi-arid regions. However, it would appear to prefer wooded areas over pure grasslands. Ansell (1974) points out that it occurs from sea level to altitudes of more tan 3 500 metres. Since elephants require to drink regularly, a permanent water source is a a prerequisite.

<u>HABITS</u>:

Elephants are primarily gregarious creatures, occurring in herds of up to 30, and sometimes more. The common herd size is, however, c. 10 individuals. Herd structure and composition are relatively stable. Solitary animals, particularly bulls, are frequently encountered. The African elephant is active during both day and night, although there is a strong tendency to rest and doze in the shade of big trees during the warmest part of the day. Sikes (1966) points out that this is very necessary to prevent the skin from drying out, which may result in irritating itching. It would appear that elephant utilize bushes and forests more for the cover and protection afforded than for food. Elephants normally prefer grass, although trees are utilized to some extent (Buss, 1961).

Much has been said and written about elephant damage to woodland vegetation. The Tsavo saga is well known. The literature dealing with elephants damaging the woody component of a savanna to the extent that it turns into pure grassland, is extensive. The majority of earlier papers on this topic are speculative and

sometimes/...

sometimes even emotional. The problem stems mainly from large concentrations of elephants converging and being contained in wildlife sanctuaries without population densities being controlled particularly when breeding success is high. Recently, however, Buss (1961) van Wyk and Fairall (1969), and Wing and Buss (1970) have critically analysed the effect of various elephant densities on their plant environment. The problem of elephant damage to the environment is directly related to the management policy of individual park authorities. All parks are unnatural ecological units, where natural migrations of large mammals are curtailed. Some park authorities favour an attitude of minimum interference, thus allowing nature to take its own course in these circumstances. The more commonly favoured policy is to manage a park for the benefit of the entire fauna and flora of the region. The latter is the policy adopted by the South African National Parks Board for the Kruger National Park. Here elephant and other large mammal populations are controlled on the basis of the carrying capacity of their environment (see Pienaar and van Niekerk, 1963; Pienaar, van Wyk and Fairall, 1966; Pienaar, 1969; van Wyk and Fairall, 1969).

The elephant is an important component of any ecological system. At optimum densities the elephant undoubtedly plays a significant part in maintaining the floristic environment at a composition favourable to other species, for example by counteracting bush encroachment. Wing and Buss (1970) calculated that the elephant population in the Kibale forest deposits 22 612 tons of dung per annum, or 105 tons per square mile; - certainly no minor contribution in the conversion and movement of energy, and in improving the habitat. Elephant are partial to fruit and seeds in season, and it has been shown that seeds germinate better after passing through the intestines of an elephant (Smithers, 1971). Seeds are also dispersed in this way. Elephant dung retains its moisture for considerable periods, thus providing an excellent substrate for a germinating plant to establish itself. During droughts, elephants dig for water in

dry/...

dry river beds, thus also making it available to other animals. When moving, elephants usually travel in single file, thus opening up bush and creating pathways also that can be used by other creatures.

Buss (1961), and Ian and Oria Douglas-Hamilton (1975) found that the family group is the basic unit of elephant society. A family group consists of an assemblage of closely related cows and their offspring. When a family unit becomes too big, it splits into subunits. Subunits and units continue to remain members of a larger kinship group or herd, and often meet and remain together for some time. The Douglas-Hamiltons speculate that kinship ties between units may go back as far as 100 years or more. A matriarchal female leads a family unit. Adult bulls are not permanent members of family units, and normally join only when a cow is in oestrus. Short (1966) observed that during the initial phases of oestrus, a cow is mated by several different bulls, with very little competition between bulls. As oestrus proceeds, fighting may break out amongst the attending bulls. In any case, one bull establishes mastery and drives the others off. Elephants mate repeatedly, as often as four times in two hours. Copulation is brief, lasting f less than a minute. Buss and Smith (1966) observed no form of courtship behaviour. There is also no prolonged relationship of partners after the mating period.

FOOD:

Elephants are both browsers and grazers. Buss (1961) points out that the elephant he studied preferred grass. Pienaar and Brynard (1960) list over a 100 plant species utilized by elephant in the Kruger National Park.

BREEDING:

Breeding occurs throughout the year with no distinct seasonal acceleration (Buss and Smith, 1966). Hanks (1969) on the other hand, suggests that breeding increases during the rainy season to benefit from the better foraging conditions. A single calf is born after a gestation period of 22 months

(Simpson/...

(Simpson and Kinloch, 1954), or rarely twins (Seth-Smith and Parker 1967). Some females begin breeding at the age of seven years, and all females have bred by the time they are 11 years old.

MEASUREMENTS AND MASS:

None of the specimens in the Transvaal Museum collection have been measured. Bullock (1962a and b) and Hanks (1969c) provide some information on the weights of elephant, and Smithers (1971) gives the measurements and weights of two animals.

RECORDS OF OCCURRENCE:

Sight records from Charleston, Greefswald, Letaba Ranch, Levuvhu river, 10 km E Madimbo, Malongo flats, Othawa, Rhoda, Sandringham Priv. Nat. Res., TenBosch Estates, Timbavati Priv. Nat. Res. The records from the Transvaal border in Rhodesia were reported by Smithers (*in litt.*). The map records for the Kruger National Park, are based on Pienaar (1963).

ORDER HYRACOIDEA

Family Procaviidae

1. Dorsal spot black; lower toothrow with one tooth less than upper; adults with six teeth in lower toothrow and seven in upper ... ... *Procavia*
Dorsal spot yellowish; equal number of teeth in upper and lower tooth-row; adults with seven in each case ... ... *Heterohyrax*

Procavia Storr, 1780

Procavia capensis (Pallas, 1766) Cape dassie
Klipdas

DISTRIBUTION:

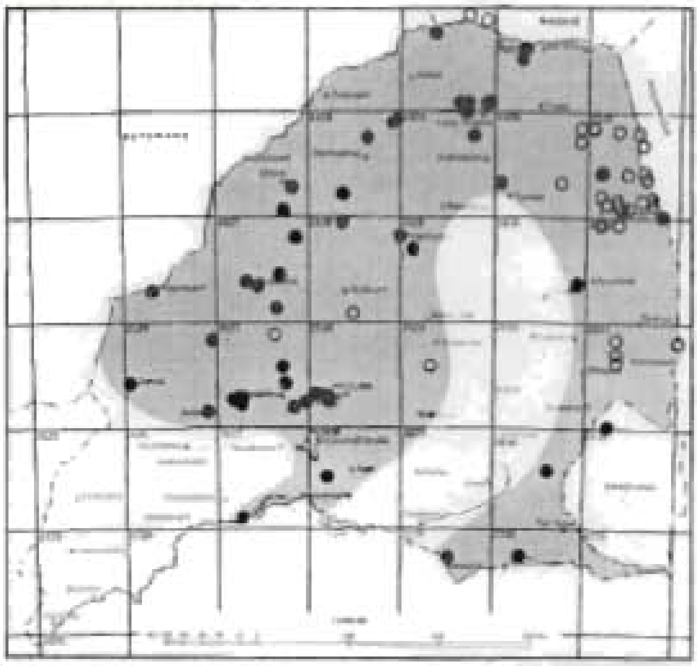


Fig.148: The distribution of *P. capensis* in the Transvaal.

The Cape dassie is widely distributed throughout the Transvaal in areas where suitable habitat is available. It is very habitat-specific, and for that reason the overall range is patchy. This animal may have been overlooked along the escarpment in the Ohrigstad and Lydenburg districts. Absent from the southwestern Transvaal.

HABITAT:

It is closely confined to rocky areas on mountains and kopjes. Rocky hillsides, krantzes, cliff faces and piles of boulders or smaller rock debris

affording/...

affording adequate protection and refuge in the form of crevices, are preferred. Where available, the additional cover of trees and shrubs is sought. During feeding bouts, dassies venture away from these safe refuge areas via well-used pathways onto the surrounding plains. They may wander great distances in search of food, and it is believed that they colonize outlying koppies in this way. Cape dassie populations have been recorded from isolated koppies some 20 km apart on the gravel plains of the Namib desert. Relatively independent of free water.

HABITS:

The Cape dassie is primarily diurnal, although Fourie (1974) has observed feeding activities during bright moonlight nights. This animal has a poorly developed thermoregulatory system, and for this reason has developed several compensatory behaviours. During cold spells, dassies remain within their rock crevice shelters where they huddle to conserve body heat. Presumably these shelters also have less variable temperatures than outside ambient temperatures. There are two daily feeding bouts, one during early mornings and the other during late afternoons, when ambient temperatures are neither too high or too low. Dassies sunning themselves at high vantage points are a common sight. This is normally observed during early mornings before the morning feeding bout, and at sunset after the afternoon feeding bout. During the warmer period of the day, animals rest in the shade. On cold and windy days they remain within their rock crevices.

Several individuals share a refuge, but each animal has its own unique basking spot. Dassies are well adapted to a rupiculous mode of life, being small and stout with short limbs, and with tactile hair all over the body, to aid in exploring and living in confined spaces. The soles are leathery and smooth, facilitating traction even on wet rocks. The soles are also the only places containing high concentrations of sweat glands. For their small, stout appearance, dassies are remarkably fast and agile animals when disturbed.

The/...

The Cape dassie appears to be a creature of habit. It defeacates and urinates at regular spots, thus creating large deposits of dung and, under arid conditions on certain types of rock formations, thick layers of dehydrated urea. The latter has been extensively utilized in the past for its alleged medicinal properties. Even today limited quantities are still marketed under the name "Hyracium". Dassies repeatedly use the same routes to and from their feeding grounds. This results in a radiating pattern of pathways starting at the crevices. On several occasions I have observed dassies to dash over long distances for their own crevices when disturbed, rather than take refuge in nearby available crevices. When on a feeding bout, dassies consume as much food as possible in as short a time as possible. This is probably aimed at reducing the time they are vulnerable to predation.

The Cape dassie is a social animal, occurring in groups ranging from five to more than a 100 individuals each group occupying crevices over a small selected area.Fourie (1974 and 1977) has studied the social organization and methods of communication of the Cape dassie. His findings are summarized here:

Visual and olfactory communication signals are limited to little more than enforcing acoustic communication signals. Erections of the tactile hair of the dorsal spot during agonistic encounters, and the secretions of the dorsal gland, are two examples. The dorsal gland secretions play a role in reproductive behaviour and in mother-infant relationships. Acoustic communication, on the other hand, constitutes an important and widely used means of information transfer. Fourie could distinguish 21 distinct vocal sounds which are linked through intermediate variations and combinations. None of these sounds is entirely characteristic of a particular situation, and they may als be used in other, apparently unrelated situations. This led Fourie (1977) to suggest that the elicitation and type of sound given depend on the level of excitement an animal experiences. The most commonly heard sound is the sharp bark in alarm situations, normally uttered by a dominant adult to warn other members

of/...

of the group of impending danger.

As a social animal, the Cape dassie has a large repertoire of agonistic behaviour patterns, most of them aimed at maintaining distance between feeding individuals, or in dominance conflicts. Fourie (1974) describes the well-defined appeasement behaviour patterns which always accompany intraspecific aggression. However, it would appear that adaptation to a social life style is not complete, as evidenced by the general lack of social grooming, restricted play behaviour, a loose mother-infant bond, and the mechanisms operating to keep individuals spaced apart during feeding in order to avoid fighting. This can also be related to the high level of intraspecific agonism observed in *P. capensis*.

FOOD:

Both a browser and a grazer. A large variety of food plants are utilized, although Smithers (1971) recorded a preference for the leaves and growth tips of woody plants in Botswana. Fourie (1974) recorded a remarkable adaptability to a wide spectrum of foods, both in captivity and in the wild. Even the bark of trees is chewed during droughts. I have observed two individuals feeding on the peeling bark of a large dead *Euphorbia* tree.

BREEDING:

I have recorded a pregnant female during January, two lactating females also in January and another lactating female in February. The pregnant female had three embryos (2L:1R; cr 60 mm). Smithers (1971) recorded pregnancies during January, February, March, September and November.

Fourie (1974) and Millar (1971) recorded mating behaviour from January to July, with a peak during late March and early April. During this period the incidence of rival fighting between sexually active males is markedly higher than at any other time of the year. Gestation period is about seven and a half months. Parturition coincides with early and midsummer when food is freely available in sufficient quantities.

The/...

The young are precocious and relatively independent of their mothers at birth. Infants are weaned within three to five months.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	476	26	376	560
T.	-	-	-	-
H.ft.	66,5	26	56	91
Ear	31,9	25	28	37
Mass	2,8	10	1,5	4,3 kg

Females

	$\bar{X}$	N	Min.	Max.
Tot.	499	31	415	628
T.	-	-	-	-
H.ft	66,1	30	62	78
Ear	31,9	28	27	38
Mass	3,26	12	1,8	4,3 kg

RECORDS OF OCCURRENCE:

Specimens examined, 83: Blijdschap Priv. Nat. Res., 2 (TM); Blyde river, 2 (TM); Donkerpoort and Zandspruit, 1 (TM); Dordrecht, 2 (TM); Greefswald, 2 (TM); Groothoek, 1 (TM); Hennops river, 1 (TM); Huwi, 1 (TM); Joshua Moolman Priv. Nat. Res., 2 (TM); Junction Olifants and Letaba rivers, 3 (TM); Kastrol nek, 4 (TM); Koperfontein, 5 (TM); Koster, 1 (TM); Leipzig, 1 (TM); Magaliesberg, 3 (TM); Matshetse koppies, 1 (NKW); 37 km SE Messina, 1 (TM); Mooigenoeg, 1 (TM); Mokeetsi, 4 (TM); Motlateng, 2 (TM); Nicorel, 1 (TM); Niekerkshoop, 1 (TM); Olifantspoort, 1 (TM); Piggs peak, 1 (TM); Platbos, 1 (TM); Potgietersrus, 1 (TM); Pretoria, 3 (TM); Rochdale, 2 (TM); Rooikoppies, 1 (TM); Rooikrans, 4 (TM); Rustenburg, 5 (TM, 1; SI, 4); Scrutton, 1 (TM); Suikerboschrand Prov. Nat. Res., 3 (TM); Schurweberg, 2 (TM); Tambotieskloof, 2 (TM); Thabaphiri, 2 (TM); Thabazimbi, 1 (SI); Venterskroon, 1 (TM); Vliegepoort, 1 (TM); Volksrust, 2 (TM); Voortrekkerhoogte,

1 (TM)/...

1 (TM); Waterpoort, 1 (TM); Weltevreden, 2 (TM); Wyliespoort, 3 (TM); Zandspruit, 1 (TM); Zeerust, 1 (SI).

Additional records: Sightings from Buffelspoort, Hans Merensky Prov. Nat. Res., Parkfield and Delamere, Loskopdam Prov. Nat. Res., Rissik Priv. Nat. Res. Records on the Transvaal border at 2229 BA and 2229 BB in Rhodesia, are reported by Smithers (*in litt.*). The open circles in the Kruger National Park on the distribution map represent the records of Pienaar (1964).

Heterohyrax Gray, 1868

Heterohyrax brucei (Gray, 1868) Bruce's yellow-spotted dassie
Geelkoldas

H. b. ruddi (Wroughton, 1910)

H. b. granti (Wroughton, 1910)

TAXONOMIC NOTES:

Bothma (1971) lists two subspecies as occurring in the Transvaal. The first is *H. b. granti*, which is limited to the more humid parts of the northeastern Transvaal receiving an annual precipitation in excess of 1 250 mm. *H. b. ruddi* is the more common form, ranging through the remainder of the Transvaal, as well as eastern Botswana, Rhodesia and central western Mocambique. Both forms are provisionally recognized for the Transvaal, although many of the 23 subspecies currently recognized in *H. brucei* may in time prove to be invalid.

DISTRIBUTION:

The yellow-spotted dassie is more restricted in range than *P. capensis*. In the Transvaal it is to be found only in the northern districts in those areas with suitable habitat. As pointed out by Smithers (1971), *H. brucei* appears unable to colonize more remote isolated koppies, as such occurring only on major mountain ranges.

HABITAT:/...

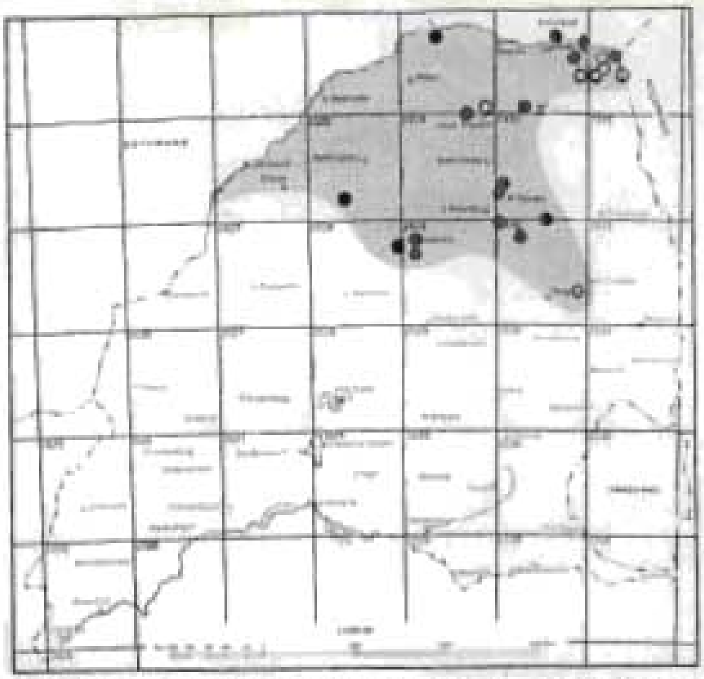


Fig.149: The distribution of *H. brucei* in the Transvaal.

HABITAT:

The habitat requirements of the yellow-spotted dassie appear to be similar to those of *P. capensis*, being restricted to mountainous areas with rock-faces, krantzes and piles of loose boulders where the abundant rock crevices are utilized as refuges. Shady trees and shrubs are favoured when available in such rocky places.

HABITS:

As yet the ecology and behaviour of this animal have not received serious scientific attention. From sporadic observations it is known to be a diurnal and social animal. Its behaviour and social structure appear to be similar to those of *P. capensis*. In fact, in many areas where these two species occur sympatrically they share the same refuges, vantage points and feeding areas and it is difficult in the field to establish which is which.

FOOD:

From what little evidence is available, *H. brucei* prefers to browse. Stomach contents are very finely masticated, rendering identification of the contents impossible, but Smithers (1971) observed *Ficus pretoriae* and *Croton* spp. shrubs to be taken. Watson and Turner (1965) list the plant species utilized by *H. brucei* in the Serengeti, and conclude that there this animal is almost totally a grazer.

BREEDING:

The females collected during this survey were all non-gravid. None of the earlier material collected had breeding

status/...

status recorded. Smithers (*op.cit.*) noted only one pregnancy during April.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	404	14	310	482
T.	-	-	-	-
H.ft.	61,7	12	55	67
Ear	30,1	13	27	32
Mass	1,01	3	0,7	1,7 kg

Females

	$\bar{X}$	N	Min.	Max.
Tot.	455	19	331	540
T.	-	-	-	-
H.ft	65,2	18	56	72
Ear	30,5	19	25	38
Mass	1,46	4	0,6	2,3 kg

Average mass probably too low, as a consequence of small sample size.

RECORDS OF OCCURRENCE:

Specimens examined, 48: Dordrecht, 1 (TM); Greefswald, 2 (TM); George's valley, 2 (TM); Groothoek, 1 (TM); Leydsdorp, 1 (TM); 10 km E Madimbo, 1 (TM); Malta, 3 (TM); Maribashoek, 2 (TM); Mariepskop, 2 (TM); Mokeetsi, 4 (TM); Moorddrift, 1 (TM); Mutale river, 15 (TM); Njelelle river, 4 (TM); Soutpansberg, 7 (TM); Tula.Mila kop, 1 (NKW); Woodbush, 1 (TM).

Additional records: Material housed in the Rhodesian Museums, taken in Rhodesia on the Transvaal border at 2230 BC (Smithers, *in litt.*). Open circles in the Kruger National Park on the distribution map after Pienaar (1964).

ORDER PERISSODACTYLA

1. Heavily built; heavy limbs, with three digits; the orbit not ringed with bone; cheek teeth relatively simple; body not striped; with two horns on the nose ... ... Rhinocerotidae

Lightly built; slender limbs, with one digit; the orbit ringed with bone; cheek teeth complex; body, neck and limbs striped; no horns on nose... ... ... Equidae

---

Family Rhinocerotidae

1. Upper lip squared; nuchal hump prominent when head is raised... ... ... *Ceratotherium*

Upper lip narrow, the tip prehensile; no such nuchal hump ... ... *Diceros*

Ceratotherium Gray, 1867

Ceratotherium simum (Burchell, 1817) Square-lipped (white) rhinoceros

Breëlip (wit) renoster

C. s. simum (Burchell, 1817)

DISTRIBUTION:

At the turn of the century the southern square-lipped rhinoceros was on the brink of extinction, with only an estimated 200 individuals surviving in the area of the present-day Umfolozi Provincial Game Reserve. It was through the dedicated efforts of early conservation champions like Kirby (1920), Lang (1923 and 1924), and later Mr Ian Player and the Natal Parks Board that it was saved from total extinction.

The square-lipped rhinoceros occurred throughout the bushveld areas of the Transvaal during historical times, with the exception of the Springbok Flats and the montane woodlands of the/...

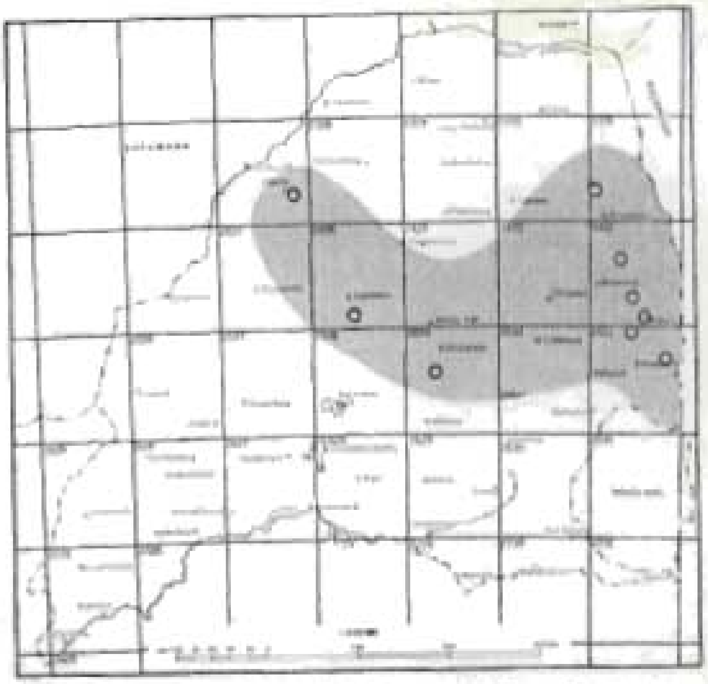


Fig.150: The distribution of *C. simum* in the Transvaal.

the escarpment (Player and Feely, 1960). No evidence exists of its past occurrence on the grasslands of southern Transvaal. Kirby's (1920) claim that the last square-lipped rhinoceros was killed in the Transvaal in the Nwatimhiri bush during 1896, is now generally accepted. It was only 65 years later, with the advent of modern tranquilizing and immobilization drugs and techniques (Harthoorn and Player, 1964; Harthoorn, 1962), that the square-lipped rhinoceros could be reintroduced to some of its former haunts in the Transvaal. It was initally resettled in the Kruger National Park (Pienaar, 1970). When this and subsequent reintroductions proved highly successful, other provincial, municipal and private game reserves were restocked throughout the former range in the Transvaal.

With rigorous protection this southern subspecies has increased in numbers throughout its natural range to the extent that it has been removed from the list of endangered mammals (Red Data Book, 1966). This should be regarded as a compliment to conservation agencies in South Africa, particularly the Natal Parks, Game and Fish Preservation Board.

<u>HABITAT</u>:

According to Player and Feely (1960), *C. simum* has four basic habitat requirements. As a grazer it has a marked preference for short grass. Water is essential since the square-lipped rhinoceros drinks daily, and in addition requires the means to wallow regularly, especially during summer. Adequate cover in the form of thicket is required for protection against adverse climatic conditions. Topography is the other habitat requirement;

rather flat terrain is preferred, and steeply undulating country is never occupied.

HABITS:

The social structure, behaviour and territoriality of *C. simum* have been studied by Player and Feely (1960), Foster (1960), and Owen-Smith (1971; 1972).

The square-lipped rhinoceros cannot be termed a social animal in the true sense of the word. Of all mature males, about two-thirds are territorial and solitary, except for brief periods when they are consorting with oestrus females. Adult subsidiary bulls are also solitary. There is, however, a strong bond between females and their offspring, and such females accompanied by the most recently born and a previous calf constitute the commonest group. Several such units may temporarily congregate at good feeding areas or drinking points, where as many as 20 individuals may be observed together. Two immature bulls may also form a temporary association until they reach maturity.

The hearing and eyesight of the square-lipped rhinoceros are poorly developed, but the sense of smell is acute. This animal drinks water regularly, and is particularly fond of wallowing in mud, especially during summer. Sand baths are taken throughout the year. Apparently white rhinos are active during both day and night. However, during particularly warm days, animals are apt to rest in the shade. During cold and windy days they retreat to the protection of thickets. Grazing is most often observed during early mornings and late afternoons. I have, however, come across grazing animals at night. Water is drunk during both night and day.

Female-calf units utilize home ranges of 10-15 square kilometres, favouring different sections during different periods. These home ranges are unique and independent, and overlap extensively with those of other female-calf units. The home range patterns of adolescent groups are not as yet fully understood. However, it seems that such groups confine themselves to fixed home ranges of four to ten square kilometres, although some individuals move about erratically (Owen-Smith, 1972).

Owen-Smith (1971, 1972) pays particular attention to territoriality in bulls. Only dominant bulls maintain territories of one to two square kilometres, which are mutually exclusive. Subsidiary bulls are allowed within these territories, provided they acknowledge their subordination to the resident bull when challenged. A territory is marked by the dungheaps of the territorial bull, although other individuals may also use these heaps. However, only territory owners scatter their droppings, presumably to enhance the olfactory impact thereof.
Territorial bulls further mark their territories by spraying their urine over ground and vegetation they disturbed just prior to urination. A territory is maintained also through direct encounters with rivals, mostly through ritualized agonistic behaviour. A territorial bull does not so much defend his territorial domain, as maintaining his dominance within that space. For that reason owners are reluctant to leave their territories, since in doing so they lose their dominant status. When they do leave, for instance to drink water or to explore, dominance behaviour such as spray-urination and the scattering of faeces is discontinued. Females wander through several territories at will. However, oestrus females are retained within his territory by the owner by means of herding behaviour for several days, until he has successfully mated her. Owen-Smith (*op.cit.*) convincingly argue that territories serve primarily to provide owners with exclusive participation in reproduction.

FOOD:

Almost exclusively a grazer, preferring *Urochloa*, *Panicum* and *Digitaria* species. Rooigras, *Themeda triandra*, is not preferred except when regenerating after a veld fire (Player and Feely, 1960). This animal has a marked preference for shorter grass stands, while it will also take small shrubs and creepers during droughts (Foster, 1960).

BREEDING:

Reproduction is not seasonally restricted. However, according to Owen-Smith (1972), the onset of oestrus appears to be

stimulated/...

stimulated by a flush of green grass. This results in a mating peak during spring, and a calving peak during autumn after a gestation period of slightly less than 16 months. Interval between births is two years or more (Pienaar, 1960). Normally a single calf is born per female, and only occasionally twins.

MEASUREMENTS AND MASS:

The Transvaal Museum possesses no specimens from the Transvaal province. Foster (1960), and Player and Feely (1960) provide some data.

RECORDS OF OCCURRENCE:

Sight records from Charleston, Huwi, Letaba Ranch, Loskopdam Prov. Nat. Res., Othawa, Rissik Priv. Nat. Res., TenBosch Estates, Timbavati Priv. Nat. Res. See Pienaar (1963 and 1970) for an account of the square-lipped rhinoceros' current status in the Kruger National Park.

Diceros Gray, 1821

Diceros bicornis (Linnaeus, 1758) Hooked-lipped (black) rhinoceros
Haaklip (swart) renoster

D. b. bicornis (Linnaeus, 1758)

TAXONOMIC NOTES:

Following Joubert (1970), the present-day Transvaal population is assigned to the nominate race. The animals currently in the Kruger National Park, originated from the Natal population. Joubert (*op.cit.*) shows that the Natal and S.W.A. populations do not differ at subspecies level, and assigns both populations to *D. b. bicornis*.

DISTRIBUTION:

The black rhinoceros occurred throughout the bushveld regions of the Transvaal during historical times (du Plessis, 1969).

Indiscriminant

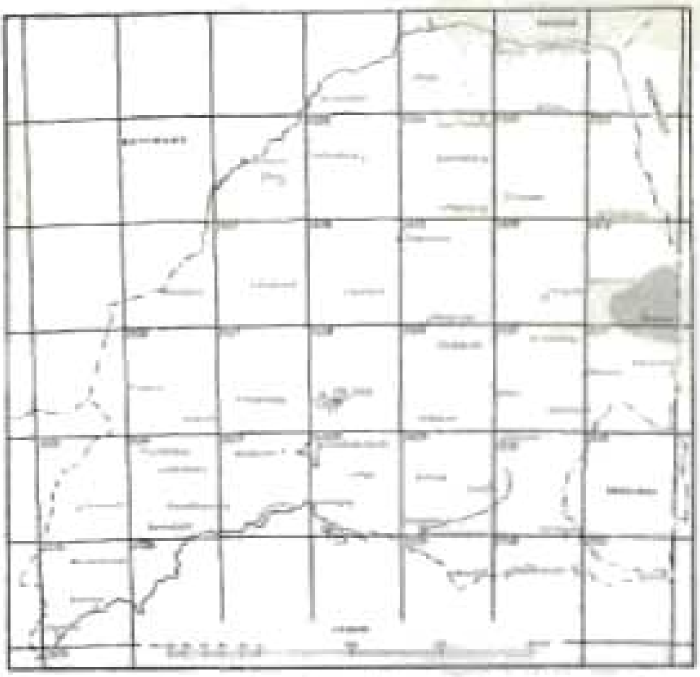


Fig.151 : The distribution of *D. bicornis* in the Transvaal.

Indiscriminate slaughter by hunters during the latter half of the century, however, reduced their numbers dramatically, so that only a few individuals were known to occur in the remote eastern Transvaal lowveld (Pienaar, 1963) and the Lydenburg district (Sclater, 1900). According to Pienaar (*op.cit.*), the last animal in the Transvaal was seen in 1936 in the Nwatimhiri bush near Skukuza in the Kruger National Park. During 1971, 20 animals from the Natal game reserves were successfully resettled in the Kruger National Park (Hitchins, Keep and Rochat, 1972).

HABITAT:

The black rhinoceros apparently has a wide habitat tolerance. However, some form of woody vegetation, preferably shrubs or herbs, is a habitat requirement. According to Ritchie (1963) it occurs in rain forests, savanna plains, or semi-deserts, but not in areas with a hot humid atmosphere. Since the black rhinoceros is rather sedentary in habits, and requires to drink water daily, a permanent water source within walking distance of its regular haunts is another important habitat requirement. Hitchins, Keep and Rochat (1972) found that during warm weather, individuals utilize available shade on relatively cooler hilltops as midday resting areas.

HABITS:

The literature dealing with the black rhinoceros is exhaustive. However, recently Schenkel and Schenkel-Hulliger (1969),

and/...

ORDER ARTIODACTYLA

1. At least one pair of upper incisors; non-ruminant	2
No upper incisors; ruminant	3
2. Muzzle long, ending in a flat disc containing the nostrils; feet narrower, with lateral hooves not touching the ground; tail thin; hair on body noticeable, at least dorsally	Suidae
Muzzle broad, not ending in a disc; feet broader, with lateral hooves reaching the ground; tail thick (and shorter in proportion); body hairs sparse and inconspicuous, giving generally naked appearance ...	Hippopotamidae
3. Lower (incisiform) canine lobed; horns a simple skin-covered bony projection	Giraffidae
Lower (incisiform) canine simple, not lobed; horns which may be present only in the males in some species, covered with a horny sheath	Bovidae

Family Suidae

1. Lower canines completely abrading with upper, thus without widely-spreading upper tusks; three upper incisors; full dentition 42 to 44	*Potamochoerus*
Lower canine wearing against only the lower part of the upper, leaving summits free as widespreading tusks; only one upper incisor; full dentition 34	*Phacochoerus*

Genus/...

Genus *Potamochoerus* Gray, 1854

Potamochoerus porcus (Linnaeus, 1758) Bush pig

Bosvark

P. p. koiropotamus (Desmoulins, 1831)

DISTRIBUTION:

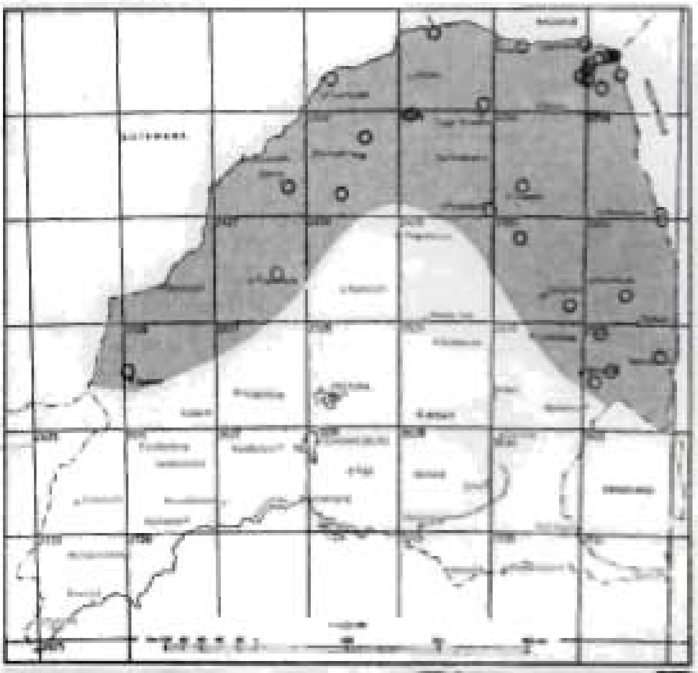


Fig.153: The distribution of *P. porcus* in the Transvaal.

The range of the bush pig in the Transvaal as derived from this survey, corresponds exactly with the past and present distribution given for the species by du Plessis (1969). Available evidence therefore suggests that *P. porcus* is one of the few game mammals holding its own against encroaching civilization, probably as a consequence of its nocturnal and secretive nature and also of the inaccessability of its preferred habitat. However, population density has almost certainly declined.

Zoogeographically, *P. porcus* is restricted to the better-drained regions of the northern and eastern Transvaal woodland savanna, as well as the Inland Tropical Forests of the escarpment. It does not occur on the relatively dry Springbok Flats, nor on the highveld grasslands.

HABITAT:

Confined to well-watered areas with associated dense vegetation. Riverine forests with dense underbush or dense tall grass or reedbeds are favourite haunts. On the escarpment the bush pig occurs in the high evergreen forests, where it seems to congregate along watercourses as well, sometimes even very

small/...

small streams. It is not clear whether the presence of water is the main attraction in the habitat of this animal, or the denser vegetation associated with water.

Smithers (1971) is of the opinion that the bush pig is one of the species that benefits from agricultural efforts which, by eroding away wilderness areas thereby create even more favourable habitat. This results in bush pigs being regarded as a problem animal in certain areas.

HABITS:

Predominantly nocturnal, especially in much disturbed areas. In undisturbed areas, bush pigs have on occasion been recorded to be active by day (Astley Maberley, 1950; Smithers, 1971; Scotcher, 1973). They are gregarious, with sounders ranging from two to 11 individuals. Phillips (1926), Astley Maberley (1950) and Skinner, Breytenbach and Astley Maberley (1976) mention that a senior boar assumes leadership, and dictates the activities of a sounder. In general the species is very secretive and cunning, and is seldom seen. It is very difficult to control where it has become an agricultural pest, as this animal is shy of lights and its eyes do not reflect light in the dark. Bush pigs can also use their sharp lower canines as defensive weapons. The result is that most hunters are reluctant to use dogs against bush pigs, as these can be seriously injured or even killed.

Sounders lie up by day, well hidden in underbush or tall dense grass. Phillips (1926) recorded the utilization of hollow tree trunks and rock crevices as daytime retreats. A retreat is used for several weeks before being abandoned for another in a different area. Trees are marked along certain sections of regular paths (Skinner *et al.*, 1976), but the significanceof this is not understood.

Phillips (1926) relates an interesting interaction between the bush pig, elephant and baboon. Bush pigs were observed following the tracks of elephants, utilizing food unearthed by these animals. In turn, baboons (as well as vervet monkeys according to Astley Maberley, 1950) feed on insects in

areas/...

areas dug up by bush pigs. Phillips (1926) comes to the conclusion that the habit of bush pigs of unearthing tracts of ground with their snouts and canines causes little or no harm to the forest itself. Phillips (1926) and Astley Maberley (1950) believe that this habit is useful in aerating the soil and aids in the dispersal and germination of seeds. Rooting areas are re-utilized in rotation (Skinner *et al.*, 1976).

FOOD:

Omnivorous, living on underground rhyzomes, bulbs, tubers, as well as wild fruit, insects, and carrion. See Phillips (1926) for a list of food items utilized in the Knysna area. If the opportunity presents itself, poultry and newborn lambs and kids are taken (Skinner *et al.*, 1976).

BREEDING:

Smithers (1971) suggests that *P. porcus* is a seasonal breeder, with parturition during the first half of the summer season. Observations in the Transvaal of the presence or absence of young animals in sounders support this.

MEASUREMENTS AND MASS:

No data available.

RECORDS OF OCCURRENCE:

Specimens examined, 1: Pafuri, 1 (TM).

Additional records: Sightings from Blyde Forest Reserve, Cyprus, Donkerpoort and Zandspruit, Dordrecht, Greefswald, Huwi, Mmabolela Estates, Nicorel, Othawa, 10 km E. Madimbo, Parkfield and Delamere, Rykvoorby, Scrutton, Sweet Home, Ten Bosch Estates, Uitkyk and Paranie, Urk, Wolkberg. Open circles in Kruger National Park on distribution map after Pienaar (1963).

Genus/...

Genus *Phacochoerus* F. Cuvier, 1817

Phacochoerus aethiopicus (Pallas, 1766) Warthog Vlakvark

P. a. sundevallii Lönnberg, 1908

DISTRIBUTION:

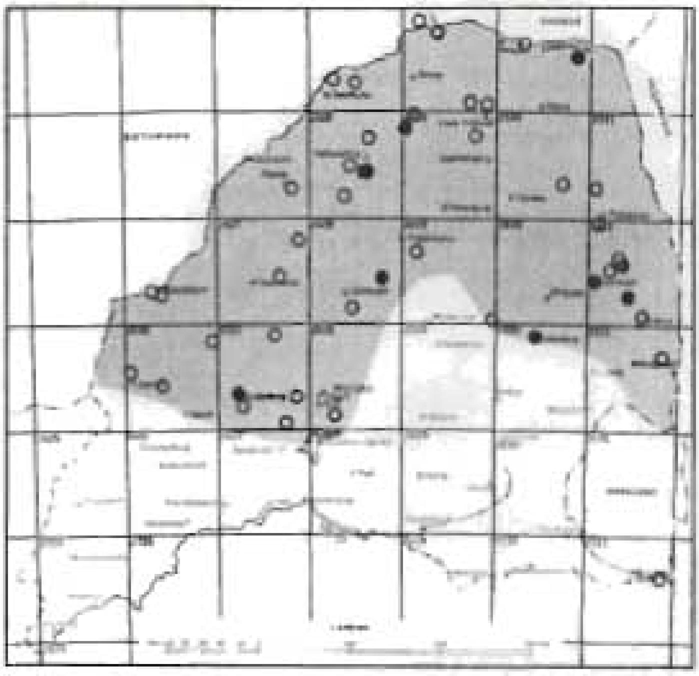


Fig.154: The distribution of *P. aethiopicus* in the Transvaal.

In the Transvaal it is restricted to woodland savanna regions. On his map relating the past distribution of the warthog, du Plessis (1969: 58) indicates it as having occurred on the highveld grasslands of the southern Transvaal and northern Orange Free State, without quoting substantiating sources. No past or present record could be found of its occurrence in these areas. It is therefore concluded that the present distribution of *P. aethiopicus* in the Transvaal closely reflects its historical range, although population densities are declining sharply.

HABITAT:

In general the warthog avoids areas of thick bush such as riverine and montane forests. It prefers the open aspects of *Acacia* woodlands and scrub, and is also found in *Baikaea* and *Mopane*. Has an apparent preference for short grass, and is often seen utilizing overgrazed areas. According to Field (1970b) and Smithers (1971), warthog are particularly associated with vleis and floodplains, although the species is not dependent on them.

HABITS/...

HABITS:

Entirely diurnal. Clough and Hassan (1970) studied the daily activity patterns of four individuals, and found that they exhibited three major activities, i.e. feeding, lying and walking. Although the pattern is not distinct, it would seem that the animals were more active in the mornings and afternoons, resting during the middle of the day. Warthogs drink water daily, although Smithers (1971) suggests that when pressed they can subsist on metabolic water for short periods.

Warthogs are encountered singly, or more often in pairs or small family groups of up to seven individuals. Child, Roth and Kerr (1968) present evidence suggesting that this animal is monogamous during the rutting season. They also found that males mature slower than females. Simpson (1964) has observed intraspecific fighting between males and the consequent establishment of a dominance order, as well as courtship behaviour and mating. Ewer (1958) also describes intraspecific fighting, which consists of the two males pushing against each other snout to snout. When the one eventually gives way, the other attempts to gash his rival in the side while it is off balance.

Normally warthogs spend the night in antbear holes, which often are heavily infested with the tick *Ornithodoros* which is a tick fever vector. According to Zumpt (1960) and Travassos Santos Dias (1963), the warthog is consequently an important vector of this disease. Sows give birth to their litters in antbear holes. When disturbed by day, warthogs also take refuge in these holes, entering with the hindquarters first so as to fend off the threat with their formidable tusks while retreating. Typically warthogs feed while resting on the elbows so as to reach the food source. They mostly graze, although roots and tubers are sometimes burrowed out with the rhinarium and the tusks. In times of stress, grasses at the bases of throny shrubs inaccessible to other grazers are utilized by pushing unwanted vegetation out of the way with the tusks by a typical continuous nodding motion of the head. The tusks are also used very effectively as a defense weapon, when cornered.

FOOD/...

FOOD:

Strictly vegetarian, feeding predominantly on annual and perennial grasses, as well as on underground rhizomes and tubers. See Field (1970) and Smithers (1971) for a list of plants utilized.

BREEDING:

Seasonal, with farrowing taking place between September and December. A birth peak is reached in October and November (Child, Roth and Kerr, 1968). In Botswana, the breeding season appears to be between October and January (Smithers, 1971), whereas it is from November to December, and sometimes as late as April, in the Kruger National Park (Pienaar, 1963). Litter sizes range up to seven young per litter.

MEASUREMENTS AND MASS:

Data available from only two animals:

		Tot.	T.	H.ft	Ear		Mass
TM 24005:	♂:	1420	360	260	120mm	=	43 kg
TM 19925:	♀:	1420	320	240	110mm	=	37,5kg

RECORDS OF OCCURRENCE:

Specimens examined, 22: Acornhoek, 1 (TM); Blouberg, 1 (TM); Kempiana, 1 (TM); Koedoekop, 4 (TM); Lemington, 1 (TM); Lydenburg, 5 (TM); Magalakwin, 2 (TM); Mosdene, 1 (TM); Mutale river, 1 (TM); Olifantspoort, 1 (Priv. coll.); Othawa, 1 (TM); Rochdale, 1 (Priv. coll.); Rustenburg, 2 (TM).

Additional records: Sightings from Al-te-vêr, Blijdschap Priv. Nat. Res., Buffelspoort, Charleston, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Ferndale, Greefswald, Groothoek, Leeuwspoor, Hans Merensky Prov. Nat. Res., Nicorel, Huwi, Letaba Ranch, Mmabolela Estates, Mooigenoeg, Mooiplaas, Olifantspoort, Parkfield and Delamere, Platbos, Rhoda, Rissik Priv. Nat. Res., Rykvoorby, Sandringham, Jack Scott Priv. Nat. Res., Scrutton, Silkaatsnek Priv. Nat. Res., TenBosch Estates, Timbavati Priv. Nat. Res., Urk, van Riebeeck Mun. Nat.

Res.,/...

Res., Welgevonden, Zandspruit. Open circles in the Kruger National Park on the distribution map after Pienaar (1963).

Family Hippopotamidae

Genus *Hippopotamus* Linnaeus, 1758

Hippopotamus amphibius Linnaeus, 1758 Hippopotamus
Seekoei

H. a. capensis Desmoulins, 1825

DISTRIBUTION:

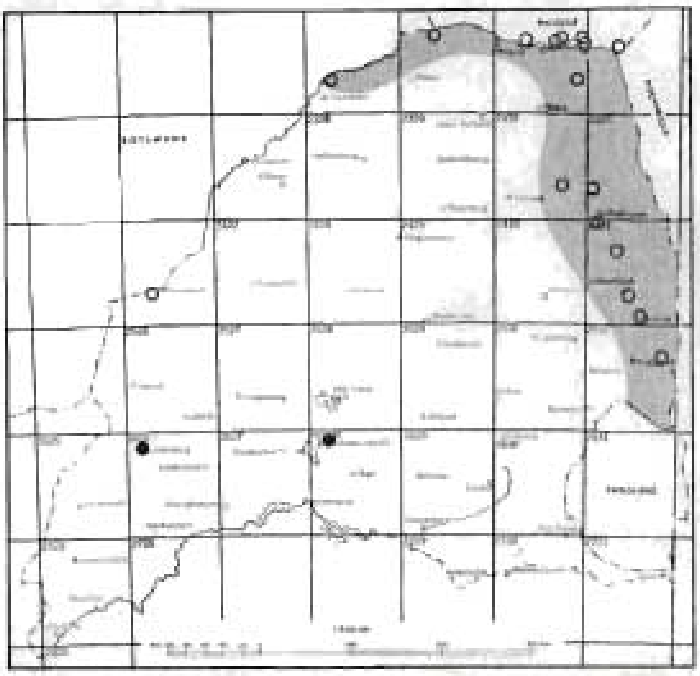


Fig. 155: The distribution of *H. amphibius* in the Transvaal.

Du Plessis (1969) showed that the hippopotamus previously occurred in suitable waterways throughout the entire Transvaal north of the Magaliesberg, the eastern Transvaal lowveld, and the Vaal river. Since then it has been completely eradicated from both the Vaal and Orange rivers, and also elsewhere in the Transvaal except for the Kruger National Park and bordering private game reserves in the eastern Transvaal lowveld, as well as two private reserves higher up along the Limpopo river bordering Botswana.

The three records outside the present-day range indicated by stippling on the distribution map, are historical. The animal from Lichtenburg was collected in 1928, while the female shot at Kempton Park during 1956 must have been a vagrant from the eastern Transvaal. The last remaining animals from the

Derdepoort/...

Derdepoort area were shot by the Transvaal Nature Conservation Division during the late 1960's as a result of damage caused to irrigation crops.

HABITAT:

During the day these truly amphibious mammals are aquatic, preferring underwater sandbanks in open water on which to rest and sleep partly submerged. These daytime resting places may be several miles from the night-time feeding areas. By night hippo are terrestrial grazers, preferring short grasslands near water.

HABITS:

By night hippos leave their aquatic habitat to graze on nearby grasslands. Individuals may wander up to five kilometres away from water nightly in search of food. In overpopulated areas the bulls especially are known to spend the day in mud wallows far from water, in order to remain in the distant but better grazing areas (Bere, 1959). Hippos lose body moisture rapidly through the skin, and it is imperative for their survival to counter water loss and consequently skin damage by remaining in the water by day.

Hippos are normally seen dozing in shallow water by day. Groups may vary from two up to 200 in droughts, when suitable pools are at a premium. Optimum group size is, however, about 15, both sexes and all age groups being represented. Young animals are often seen resting their heads on their mothers' backs. Mating has been observed to occur by day in water, and is prolonged (personal observations; also Scotcher, 1973). This is preceeded by noisy and apparently aggressive courtship behaviour. Bulls often engage in fights, inflicting serious wounds with their sharp canines which may result in the death of one contestant. It is, however, uncertain whether these fights are territorial in nature, or in competition for a receptive cow.

Much has been written on the detrimental effects of high hippo densities on the vegetation of their feeding areas. The

situation/...

situation in the Queen Victoria Park in Uganda has been studied by Bere (1959), Field (1970), Lock (1972), Spinage (1959), and Thornton (1971), and Pienaar, van Wyk and Fairall (1966) give details of how the problem was dealt with in the Kruger National Park. In both Parks it was imperative to drastically reduce the population and thereafter maintain it annually at a set level. Overpopulation led to overgrazing, denudation of the soil and erosion. Unless action was taken a serious population crash was inevitable through starvation, disease, increased aggression and infant mortality.

As pointed out by Bere (1959), hippos provide a continuous application of organic manure in the water. This benefits the growth of microscopic plant life upon which fish feed. Hippos are thus seen as a factor in a continued heavy yield of fish. Hippos are also important agents in the ecology of swamps. They maintain the flow of water through reed and papyrus beds by their pathways to feeding grounds and also between pools of open water.

FOOD:

Predominantly grazers. Can cause extensive damage to grain crops. See Field (1970), Lock (1972) and Thornton (1971) for a list of plant species utilized, and a discussion on the effect of hippo overgrazing on the species composition and ground cover in grazing areas.

BREEDING:

Throughout the year (Shortridge, 1934; Ansell, 1960; Smithers, 1971). Normally one young is born per female, in the water. The newborn starts suckling within three hours, and has been observed to do so seven times a day (Brown, 1924).

MEASUREMENTS AND MASS:

No data accrued during this survey, as no specimens were collected. Ansell (1965) and Pienaar, van Wyk and Fairall (1966) present some information.

RECORDS OF OCCURRENCE:

Specimens examined, 2: Boesmansdrift, 1 (TM); Kempton Park, 1 (TM).

Additional records: Sight records from Charleston, Greefswald, Hans Merensky Prov. Nat. Res., Letaba Ranch, Levuvhu river, 10 km E. Madimbo, Mooigenoeg, Mmabolela Estates, Othawa, Rhoda, Segondi, TenBosch Estates, Timbavati. Sight records reported by Smithers (*in litt.*) from 2230 AD, 2230 BC, 2230 BD, 2231 AD. Open circles in Kruger National Park on distribution map after Pienaar (1963).

Family Giraffidae

Genus *Giraffa* Brisson, 1762

Giraffa camelopardalis (Linnaeus, 1758) Giraffe
Kameelperd

G. c. giraffa (Boddaert, 1785)

DISTRIBUTION:

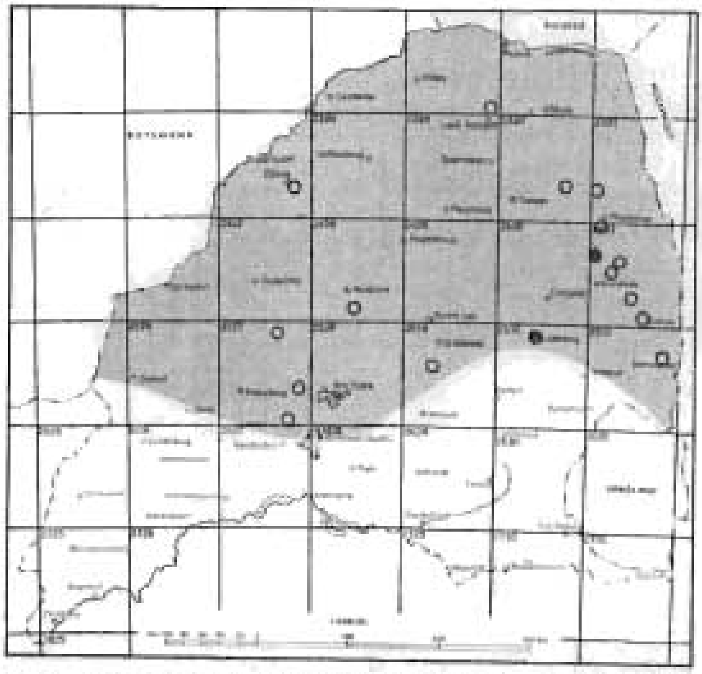


Fig. 156: The distribution of *G. camelopardalis* in the Transvaal.

The giraffe had at one time almost disappeared from the Transvaal. According to Pienaar (1963) only c. 30 individuals were known to occur at the time of proclamation of the old Sabi and Shingwidzi reserves. From then on, however, giraffe have increased steadily within the Kruger National Park. Outside the Park, its natural range (Fig.156) in the Transvaal has shrunk to only the south-eastern Transvaal lowveld.

(Kettlitz/...

(Kettlitz, 1962; and du Plessis, 1969). In historic times the giraffe occurred throughout the savanna and especially in the *Acacia* woodlands of the Province (du Plessis, *op.cit.*). A widespread interest in conservation in recent years has resulted in giraffe reintroductions to several private and Provincial nature reserves, as well as on private farms throughout the western wooded regions of the Transvaal. Although these reintroduced herds have restricted mobility, the current overall range of the giraffe in the Transvaal is reminiscent of its historical range.

HABITAT:

Lightly wooded plains and open scrubland. The giraffe seem to have a preference for *Acacia* woodlands, and do not seem to feed in pur mopane woodlands. Foster (1966) mentions bulls occurring in what he terms a "forest" in the Nairobi National Park. This may, however, be an artefact of overpopulation and overutilization of preferred habitat.

HABITS:

Predominantly diurnal, with some nocturnal movements. Although the giraffe is a gregarious animal, social bands are not strongly developed. Foster (1966), Dagg (1958) and Foster and Dagg (1972) consider giraffe to have a loose herd structure. Females and their offspring mostly constitute a herd, but solitary bulls are more often encountered than these herds. Immature bulls tend to form bachelor herds, where a physical dominance hierarchy is set up (Coe, 1967). When bulls do join a herd, they generally remain for only a few days.

Foster and Dagg came to the conclusion that bulls wander from herd to herd in search of receptive females.

Typical flemen is displayed. Should the cow be in oestrus, the bull remains with the herd and mating takes place with very little courtship behaviour. During his stay a consort bull will ward off any other adult bulls from the receptive cow. However,

sexual/...

sexual advances by immature bulls are ignored.

Intraspecific aggression occurs only between males by means of "necking" behaviour. The head is used as a club, and according to Spinage (1968) this may be the reason why male skulls are heavier and with better developed horns.

Calves are weaned as early as one month of age, when they start to subsist on plant food. This makes them independent at a very early age. It is not uncommon for a calf to stray from its mother for days while in the company of another herd.

Home ranges of 62-85 square kilometres are maintained (Foster and Dagg, 1972). Territories are, however, not defended. Giraffes drink water when available, but according to Foster and Dagg (*op.cit.*) they may exist without water for several months. Giraffe are obviously adapted to browse on trees and shrubs between two and five metres in height. However, individuals often feed on plants lower than two metres high. Giraffe browsing may result in typical browse lines and may also alter the shape or stunt the growth of a tree or shrub (Foster, 1966).

The long slender neck of the giraffe is moved in a characteristic fashion when walking to retain balance. Walking and galloping are typical in this animal, which has a rocking gait with both legs of the same side on the ground simultaneously.

FOOD:

Predominently browsers, feeding on terminal growth shoots and leaves of trees and shrubs. Dagg (1958 and 1960), Foster (1966), Leuthold and Leuthold (1972), and Oates (1972) provide extensive lists of food plants utilized. It avoids mopane.

BREEDING:

Singletons are born throughout the year, although Brynard and Pienaar (1960), Fairall (1968), Pienaar (1963) and Foster and Dagg (1972) all claim two discrete birth peaks annually. The gestation period is 15 months, and a female can give birth every 18 months.

MEASUREMENTS AND MASS:

No data accrued by this survey.

RECORDS OF OCCURRENCE:

Specimens examined, 5: Klaserie, 4 (TM); Lydenburg, 1 (TM).

Additional records: Sightings from Buffelspoort, Charleston, Hans Merensky Prov. Nat. Res., Huwi, Jack Scott Priv. Nat. Res., Letaba Ranch, Loskopdam Prov. Nat. Res., Othawa, Parkfield and Delamere, Rhoda, Rissik Priv. Nat. Res., Sandringham Priv. Nat. Res., Silkaatsnek Priv. Nat. Res., TenBosch Estates, Timbavati Priv. Nat. Res. Open circles in the Kruger National Park on the distribution map after Pienaar (1963).

Family Bovidae

(Adapted from Ansell, 1972)

1. Face gland well developed and lying in a preorbital fossa ... ... 2.
Face gland absent or rudimentary, no preorbital fossa... 4

2. Pedal glands well developed on fore feet only, rudimentary or absent on hind feet; tail medium to long; mammae one pair; body size medium to large ... ... Alcelaphinae
Pedal glands either completely absent (*Oreotragus*) or well developed on all four feet; tail short or rudimentary, mammae two pairs body size small to medium 3

3. Head tuft present; no ethmoid fissure, no reduction of nasals ... ... Cephalophinae
No head tuft ... ... Antilopinae

4./...

4. Hind leg with metatarsal gland, marked by a prominent black tuft of hair; false hooves absent; premaxillo-maxillary vacuity present ... ... Aepycerotinae
No such metatarsal gland... 5

5. Pedal glands on all four feet 6
Pedal glands absent, or at least rudimentary... 7

6. Size medium; horns, present only in males, spike-like; coat woolly... ... ... Peleinae
Size large; horns in both sexes, long and not spike-like; coat not woolly... ... ... Hippotraginae

7. Horns either more or less smooth throughout and present in both sexes, or spiral, usually keeled, and present or absent in females... ... Bovinae
Horns distinctly ridged, not spiral or keeled, and absent in females ... ... Reduncinae

---

<u>Subfamily Bovinae</u>

1. Horns present in males only... ... ... *Tragelaphus*
Horns present and well developed in both sexes 2

2. Horns spirally twisted, thinner in female than male; male with dewlap and tufted forehead *Taurotragus*
Horns not spirally twisted; not combining the characters of the last genus... ... ... *Syncerus*

Genus *Syncerus* Hodgson, 1847

Syncerus caffer (Sparrman, 1779) Cape buffalo
Kaapse buffel

S. c. caffer

DISTRIBUTION:/

DISTRIBUTION:

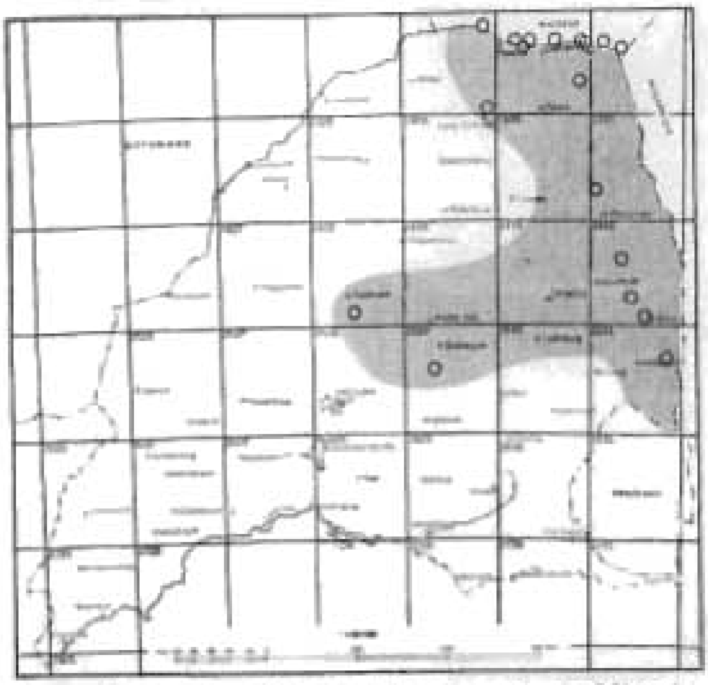


Fig.157: The distribution of *S. caffer* in the Transvaal.

Du Plessis (1969) discusses the historical distribution of the Cape buffalo, and concludes that it ranged throughout all the woodland savanna regions of the Transvaal. He agrees with Ansell (1972) that the buffalo never existed on the highveld grasslands of the Transvaal. Today buffalo are to be found only in game reserves in this Province, notably the Kruger National Park. Pienaar (1963) reports on their remarkable recuperative powers of increasing to c. 10 000 after being almost completely decimated by the rinderpest. Buffalo populations in the Park thrive so well today that management is essential. Also found in private reserves bordering the Kruger National Park. Free-ranging buffalo still occur in south-eastern Rhodesia. Although some may from time to time stray across the Limpopo, the foot and mouth disease fence is an effective barrier in preventing entrance to the Republic. The species has been re-introduced to a number of smaller private and Provincial reserves in the Transvaal.

HABITAT:

Dependent on water, and requires woodland savanna in which to graze during the day. It avoids extensive tracts of grasslands such as floodplains, although according to Smithers (1971) buffalo may visit them at night. Particularly fond of extensive reed beds and shrubs near water.

HABITS/...

HABITS:

A gregarious animal, occurring sometimes in herds of well over 1 000. Smaller herds of about 100 are however the median herd size (Eltringham and Woodford, 1973). Solitary bachelor bulls are often encountered. Blancou (1958) suggests that an adult bull strives to acquire a few cows, at least during the breeding season, and that a larger herd consists of a number of these smaller units. Bulls have on occasion been observed to fight for the possession of a female. Such intraspecific aggression is, however, low key and very few physical injuries are inflicted. Cows leave the herd for a short time to give birth, but rejoin it as soon as possible.

A herd may be seen grazing in the early mornings and late afternoons. Generally the hotter part of the day is spent lying down to ruminate and rest. Most grazing is done at night, often followed by a daily movement to more shady daytime resting areas (Leuthold, 1972; Vesey-Fitzgerald, 1969). Water is needed daily, and the buffalo is fond of wallowing in mud. It has been suggested that the layer of dried mud on the back affords protection against stinging insects.

Eltringham and Woodford (1973) estimate the home range of a normal-sized herd to be c. ten square kilometres. The home range of adjoining herds overlap.

The Cape buffalo has an undeserved reputation of being cunning, destructive and dangerous towards humans. This is totally untrue for a healthy and undisturbed herd. It is only when a seriously wounded buffalo is pursued on foot that it should be approached with proper care and respect.

FOOD:

Primarily a grazer. Field, Harrington and Pratchett (1973), Leuthold (1972), and Sinclair and Gwynne (1972) studied food plants taken and range utilization. The amount of grass taken differs through the seasons, and can be as low as 11% at the end of the dry season.

BREEDING/...

BREEDING:

Blancou (1958), and Pienaar, van Wyk and Fairall (1966) find the calving season to be correlated with the rainy season. Only singletons are born. Gestation period is between 330 and 346 days (Vidler, Harthoorn, Brocklesby and Robertshaw, 1973).

MEASUREMENTS AND MASS:

No data accrued during this survey. Van Zyl and Skead (1964), and Pienaar, van Wyk and Fairall (1966) provide some information.

RECORDS OF OCCURRENCE:

Sight records from Charleston, Letaba Ranch, Levuvhu river, Loskopdam Prov. Nat. Res., 10 km E. Madimbo, Othawa, Parkfield and Delamere, Rissik Priv. Nat. Res., Scrutton, TenBosch Estates, Timbavati Priv. Nat. Res. Smithers (*in litt.*) reports buffalo from the following quarter degree squares in Rhodesia on the Transvaal border: 2229 BB, 2230 AC, 2230 AD, 2230 BC, 2230 BD, 2231 AC, 2231 AD. Open circles in the Kruger National Park on the distribution map after Pienaar, 1963.

Genus *Tragelaphus* Blainville, 1816

1. Horns in a more open spiral forming two complete twists; larger, shoulder height about 1,5 metres ... ... *strepsiceros*

Horns in a narrower spiral, forming about one complete twist; shoulder height not exceeding 1,17 metres 2

2. Horns well over 56 cm; well developed mane, throat and ventral fringe in males; females with body pattern consisting practically of only vertical stripes; tail longer, rather less bushy ... ... *angasi*

Horns not exceeding 56 cm; males with less well developed mane, without throat and ventral fringe;

females/...

females with pattern of spots and horizontal as well as vertical stripes, as in males; tail shorter and very bushy ... ... *scriptus*

Tragelaphus angasi Gray, 1849 Nyala
Inyalabosbok

DISTRIBUTION:

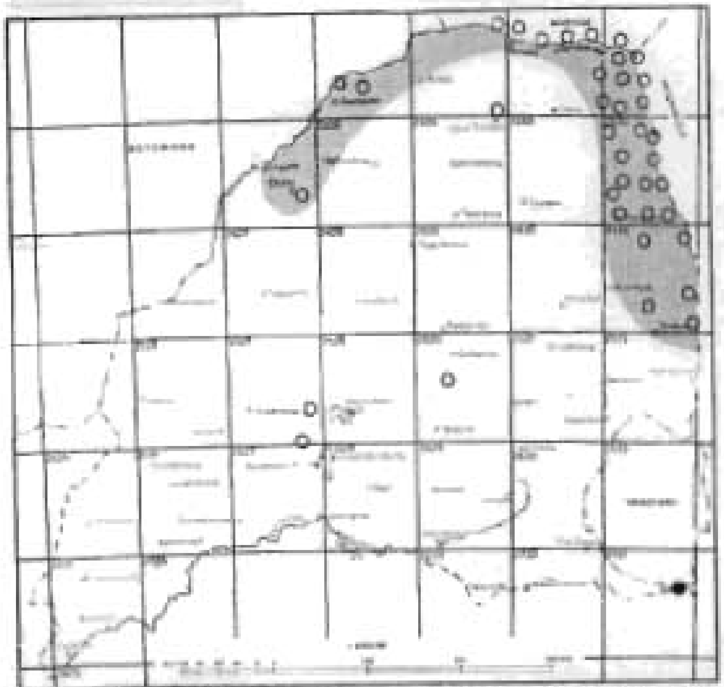


Fig. 158: The distribution of *T. angasi* in the Transvaal.

The overall range of the nyala is restricted to southeastern Africa, where its distribution is very localized (Ansell, 1972). In the Transvaal it occurs naturally in the Kruger National Park and adjoining areas, as well as along the Limpopo river valley as far west as Ellisras. Also recorded from Golèla in the extreme southeastern Transvaal. The natural range is indicated by the stippled area on the distribution map. Nyala have been successfully introduced to four known localities outside the normal range. According to Pienaar (1963) nyala has increased its range in the Kruger National Park over the past 50 years. The nyala also appears to be spreading westwards along the Limpopo river. According to M.P.S. Berry (*pers.comm.*), the nyala has until recently been unknown on Mmabolela Estates in the Swartwater district.

HABITAT:

The nyala appears to frequent the denser bush aspects of

savanna/...

savanna woodland. It is often observed in the vicinity of water, where it is believed to be attracted by the riparian forest.

HABITS:

Very little is known about this antelope. Occurs singly, or in heterosexual groups of up to 30 animals. Small groups of females, accompanied only by their lambs, are also seen on occasion. Two or more adult males sometimes constitute a bachelor herd. Nyala appear to be more active during early morning and late afternoon. The movements and activities of the species at night are unknown. Roberts (1951) remarks on the double bark uttered by both sexes.

FOOD:

Delicate browser and does some grazing (Pienaar, 1963). This is substantiated by Vincent, Hitchens, Bigalke and Bass (1968), who examined 100 stomachs. They provide a list of food plants utilized in northern Zululand, and conclude that its food constitutes 70% browsing and 30% grazing.

BREEDING:

Pienaar (1963) and Davison (1971) claim a birth peak during the later and drier part of the year (July-November), Vincent *et al.* (1968) could not discern a distinct birth peak in Natal. Normally one young is born per female. Vincent *et al.* (*op.cit.*) record pregnant females still nursing young.

MEASUREMENTS AND MASS:

No information accrued during this survey. Vincent *et al.* (1968) provide some data from Natal.

RECORDS OF OCCURRENCE:

Specimens examined, 1: Pongola, 1 (TM).

Additional records: Sightings from Al-te-vêr, Huwi, Jack

Scott/...

Scott Priv. Nat. Res., Letaba Ranch, Loskopdam Prov. Nat. Res., Mmabolela Estates, Othawa, Parkfield and Delamere, Rhoda, Scrutton, Silkaatsnek Priv. Nat. Res.

According to Smithers (*in litt.*), nyala occur in Rhodesia on the Transvaal border, in the following quarter degree squares: 2229 BB, 2230 AD, 2230 BC, 2230 BD, 2231 AC. Open circles in the Kruger National Park on the distribution map after Pienaar (1963).

Tragelaphus scriptus Pallas, 1766 — Bushbuck
Bosbok

T. s. roualeyni Gordon-Cumming, 1850
T. s. sylvaticus Sparrman, 1780

TAXONOMIC NOTES:

Ansell (1972) is followed here in accepting the occurrence of two subspecies in the Transvaal. *T. s. roualeyni* occurs in the eastern Transvaal lowveld, and *sylvaticus* throughout the rest of the Province. As remarked by Ansell (*op.cit.*), this species displays considerable geographic and nongeographic variation, and the currently accepted subspecies should be subjected to critical revision. Considering the bushbucks particular attachment to its preferred habitat, such a revision should be conducted with reference to zoogeographic factors, such as drainage systems.

DISTRIBUTION:

The range of the bushbuck in the Transvaal correlates entirely with Acocks' (1975) Tropical Bush and Savanna veld types. It is widely distributed and fairly common in this zone. The range of *T. scriptus* has not changed in modern times (see du Plessis, 1969), probably as a result of its retiring habits. It quite often occurs on farms without the owners being aware of it.

HABITAT/...

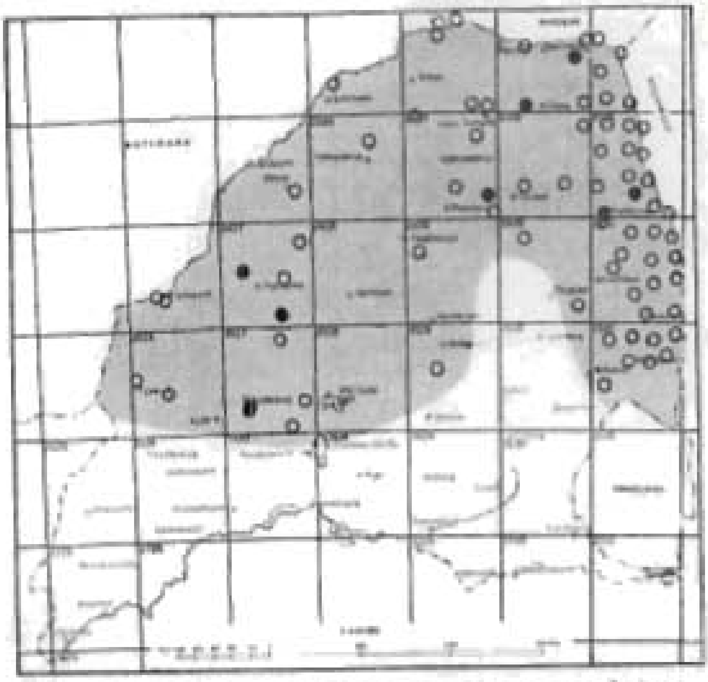


Fig. 159: The distribution of *T. scriptus* in the Transvaal.

HABITAT:

Very dependent on the presence of permanent water. As implied by its common name, the bushbuck has a marked preference for dense scrub or riparian forest. Simpson (1974a:83) is of the opinion that dense scrub is more likely to be preferred bushbuck habitat, but that the absence of permanent water close by normally leads to the use of riparian vegetation much closer to water. This preference is understandable in view of the animal's browsing habits - scrub presents food uniformly at a convenient height, in contrast to riparian forests.

HABITS:

Bushbuck are predominantly nocturnal, but in undisturbed areas may be observed during early mornings, late afternoons, or overcast days. Generally bushbuck remain in the concealment of dense scrub by day. Individuals have been observed to sunbath regularly in safe areas (Shaw, 1947). Bushbuck rams have a reputation of being courageous and dangerous when wounded or cornered. The sharp horns can be lethal. The species readily takes to water, and is a good swimmer.

Elder and Elder (1970) and Simpson (1974a) agree that *T. scriptus* is primarily a solitary animal, as many as 75% of sightings being of single individuals. Groups consist of three to six animals, and can be comprised of either males, females and immatures, or females with their offspring. Females are known to conceal newly born lambs in tall grass or dense

scrub/...

scrub. Elder and Elder (*op.cit.*) and Simpson (*op.cit.*) noted an association between bushbuck and baboons and vervet monkeys. This is especially seen during the activity period of bushbuck in the early mornings and late afternoons. Simpson (1974a) suggests that bushbuck favour such an association because of the security afforded by ever watchful baboons.

Mean home range size is about 6 hectares. During the dry season when the population is confined to the riparian forest it may be as little as 0,4 hectare (Simpson, 1974). During the rainy season, the formation of pools and pans allows the population to disperse. Individuals never range more than 2 km away from the river.

By establishing ageing criteria for bushbuck, Simpson (1973 and 1974) was able to determine that the mean longevity is 11,4 years, and the maximum life span 15 years. Somatic maturity is attained at three years, and females can first conceive between 14 and 19 months of age.

FOOD:

On the basis of visual records, and stomach content analysis, Simpson (1974a, b) concludes that the bushbuck is predominantly a selective browser with seasonal preferences for certain plant species. It is possible for bushbuck to exist by feeding exclusively on only one plant species under external pressures such as hunting and habitat disturbances. Simpson (*op.cit.*) lists plant species eaten and their proportional seasonal utilization.

BREEDING:

Authorities agree that bushbuck breeds throughout the year (Wilson and Child, 1964; Allsop, 1971; and Simpson, 1974a). However, where Wilson and Child (1964) could not detect any seasonality, Allsop (1971) and Simpson (1974a) describe two annual birth peaks, i.e. February to March, and September to November. One lamb is born per female. Pastpartum oestrus may occur (Simpson, *op.cit.*) and females are reproductively active from 14 months of age.

MEASUREMENTS/.

MEASUREMENTS AND MASS:

No specimens were collected during this survey, and none of the 18 specimens collected prior to the survey were measured or weighed. However, Wilson and Child (1964) give data of animals collected in Rhodesia during tsetse-fly control operations.

RECORDS OF OCCURRENCE:

Specimens examined, 18: Bridge Water 307, 1 (TM); Nwanedzi, 1 (TM); Mutale river, 4 (TM); Njellele river, 4 (TM); Olifants river, 1 (TM); Phalaborwa, 1 (TM); Rooikrans, 4 (TM); Rustenburg district, 1 (TM); Woodbush, 1 (TM).

Additional records: Sightings from Blijdschap Priv. Nat. Res., Blyde Forest Reserve, Buffelspoort, Charleston, Cyprus, Donkerpoort and Zandspruit, Ferndale, Fort Klipdam, Greefswald, Groothoek, Hans Merensky Prov. Nat. Res., Huwi Jack Scott Priv. Nat. Res., Leeuwspoor, Letaba Ranch, Loskopdam Prov. Nat. Res., 10 km E. Madimbo, Mmabolela Estates, Mooigenoeg, Mooiplaas, Nicorel, Olifantspoort, Othawa, Parkfield and Delamere, Platbos, Rhoda, Rochdale, Rykvoorby, Sandringham Priv. Nat. Res., Scrutton, Silkaatsnek Priv. Nat. Res., Sweet Home, TenBosch Estates, Timbavati Priv. Nat. Res., Uitkyk and Paranie Priv. Nat. Res., Urk, Wolkberg. Smithers (*in litt.*) recorded the species from Rhodesia on the Transvaal border, in the 2231 AC quarter degree square. Open circles in the Kruger National Park on the distribution map after Pienaar (1963).

Tragelaphus strepsiceros (Pallas, 1766) Kudu
Koedoe

T. s. strepsiceros (Pallas, 1766)

DISTRIBUTION:

The distribution of kudu in the Transvaal coincides closely with that of Acocks' (1975) Tropical Woodland and Savanna veld types The kudu is evenly distributed throughout all these woodlands, and can be regarded as a relative abundant antelope.

The/...

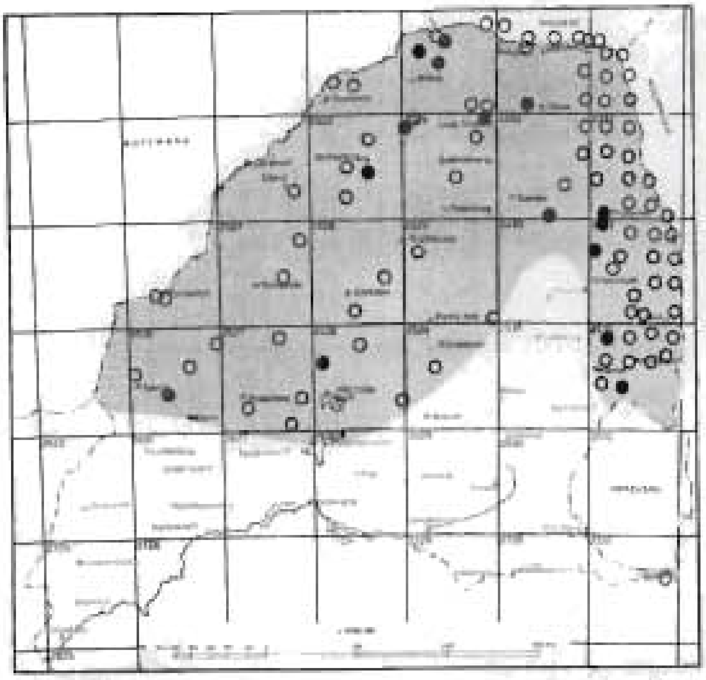


Fig.160: The distribution of *T. strepsiceros* in the Transvaal.

The species seems to hold its own against hunting pressure, partly as a result of conservation efforts and partly also as a result of its retiring nature.

The range of this animal in the Transvaal has not changed significantly during recent times (see Kettlitz, 1962; du Plessis, 1969). Kettlitz (*op.cit.*) estimates the Transvaal population outside the Kruger National Park to be 10 000, while Pienaar (1963) cites that within the Park to be 5 500 - 6 000.

Absent from the southern Transvaal highveld and the montane forests of the escarpment.

HABITAT:

The kudu has a marked preference for dense brush rather than open woodland. This is probably since the former provides better cover, as well as a higher concentration of leaves for browsing. The kudu also seems to prefer broken terrain. Although it is claimed that kudu can exist without water for lengthy periods, Simpson and Cowie (1967) and Simpson (1972) point out that kudu populations congregate in brush along water courses during the dry season, which may indicate a dependence on water.

HABITAT:

Like the other the representatives of the genus *Tragelaphus* in the Transvaal, the kudu is not a very gregarious antelope, and rather secretive in habits. Herds normally are comprised of adults, immature and young of both sexes, but many deviations from this pattern occur. Solitary bulls or small exclusively adult male herds are common.

Simpson and Elder (1968 and 1969), and Simpson (1972) established ageing criteria for this species. They consider mean natural life expectancy to be eight years.

Simpson and Cowie (1967) and Simpson (1972) studied seasonal movements of kudu. During the rainy season, when food and water are abundantly available, kudu are widely dispersed. However, during the dry season, populations concentrate in areas where food, water and cover are still available, notably along river courses. Simpson (1972) suggest that the kudu is cold sensitive. He bases this on the fact that herds seek out areas with relatively higher air temperatures during winter. By night, herds are to be found mostly in warm air pockets along rivers, on east facing slopes during early mornings, and on west-facing slopes during late afternoons. All these factors combined have a regulating effect on population densities.

Kudu are active both by day and by night.

FOOD:

Predominantly a browser. Wilson (1965) and Leuthold (1971) discuss feeding habits and preferences, and list food plants found to be utilized. They conclude that food preferences vary locally and seasonally, and are to some extent related to availability.

BREEDING:

Ansell (1960) and Wilson (1965) indicate that the kudu has an extended breeding season. Although lambs are dropped throughout the year, there is a birth peak from December to April (Simpson, 1966; Wilson, 1965; Dassman and Mossman, 1963; Brand, 1963). One lamb is born at a time, and is well hidden in dense vegetation during the first few days of its life.

MEASUREMENTS AND WEIGHTS:

No specimens accrued during this survey, and no data were collected from animals collected earlier. Data on Rhodesian kudu are supplied by

Wilson (1965 and 1970).

RECORDS OF OCCURRENCE:

Specimens examined, 36: Blouberg, 3 (TM); Brombeek, 2 (TM); Klaserie, 1 (TM); Kongo, 1 (TM); Letitia, 2 (TM); Leydsdorp, 5 (TM); Louis Trichardt, 2 (TM); Magalakwena river, 5 (TM); Marico district, 1 (TM); Njellele river, 3 (TM); 8 km N. Numbi Gate, 2 (TM); Olifants river, 4 (TM); Phalaborwa, 3 (TM); Sheila, 1 (TM); Three sisters, 1 (TM); Zoutpan, 1 (TM).

Additional records: Sightings from Al-te-vêr, Blijdschap Priv. Nat. Res., Buffelspoort, Charleston, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Ferndale, Fort Klipdam, Greefswald, Groothoek, Hans Merensky Prov. Nat. Res., Huwi, Jack Scott Priv. Nat. Res., Leeuwspoor, Letaba Ranch, Loskopdam Nat. Res., 10 km E. Madimbo, Mmabolela Estates, Mooigenoeg, Mooiplaas, Mosdene Priv. Nat. Res., Nicorel, Nooitgedacht, Olifantspoort, Othawa, Parkfield and Delamere, Platbos, Renosterpoort Priv. Nat. Res., Rhoda, Rissik Priv. Nat. Res., Rochdale, Rust de Winter dam, Rykvoorby, Sandringham Priv. Nat. Res., Scrutton, Silkaatsnek Priv. Nat. Res., TenBosch Estates, Timbavati Priv. Nat. Res., Uitkyk and Paranie Priv. Nat. Res., Urk, Welgevonden, Zoutpan, Zandspruit. According to Smithers (*in litt.*), kudu have been seen in Rhodesia on the Transvaal border the following quarter degree squares: 2229 BB, 2230 AA, 2230 AD, 2230 BC, 2230 BC, 2231 AC. The open circles in the Kruger National Park on the distribution maps are after Pienaar (1963).

Genus *Taurotragus* Wagner, 1855

Taurotragus oryx (Pallas, 1766) Eland

T. o. oryx (Pallas, 1766)

DISTRIBUTION:

The eland ranged throughout the entire Transvaal in historical times (du Plessis, 1969). The range of this animal

has/...

has been reduced in this Province during the last 300 years to the extent that free-ranging herds persist only in the north-eastern Transvaal. Kettlitz (1962) reports small herds in the Molongo Flats and the Shingwidzi area, totalling c. 100 individuals. Pienaar (1963) describes the recovery of the eland population after it was virtually eliminated from the present-day Kruger National Park by rinderpest and hunters at the turn of the century. Today it occurs in the northern districts of the Park, totalling c. 450 animals. Elsewhere in the Transvaal the eland has been reintroduced on Provincial and private nature reserves.

The stippled area on the distribution map represents the range of free-ranging herds.

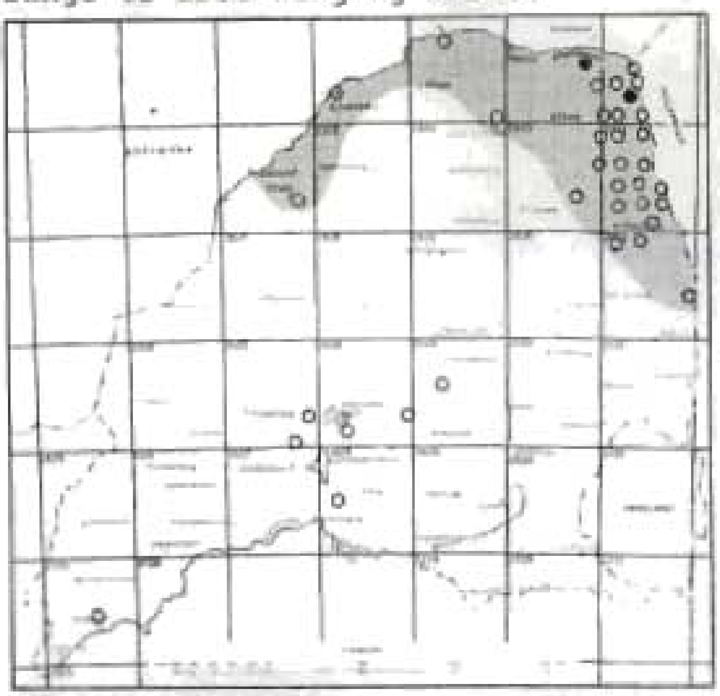


Fig. 161: The distribution of *T. oryx* in the Transvaal.

HABITAT:

The eland seems to have a wide habitat tolerance, as shown by its historical range. It can exist in areas as diverse as the South West Cape and Southern Savanna Woodland biotic zones.

HABITS:

The docile nature and wide habitat tolerance of the eland have captured the attention of animal husbandry scientists and biologists since the turn of the century. Its potential use as a domesticated farm animal especially in semi-arid regions has received attention as far afield as Russia. See Skinner (1972) for a review of progress in this field, and for a comparison of breeding and protein production between Afrikaner cattle and the eland. Yet, after 80 years of pre-occupation with the domestic potential of the eland, its ecology and social behaviour under natural

conditions/...

conditions have only recently received serious scientific considerati notably by Underwood (1975).

The eland prefers to browse, but also grazes readily. Both sexes are horned. Horns are employed, amongst other uses, to break higher branches, thus enabling the animal to browse to a height of two metres and more (Hirst, 1961). It has been observed that the eland can exist quite well in arid areas without water, creating its own metabolic water from the food it consumes (Smithers, 1971). However, where water is available, the eland drinks regularly.

The eland seems to be primarily diurnal, although Hofmeyer (1970) states that it also feeds at night. In spite of its bulk, the eland is renowned for its jumping ability, being capable of easily clearing normal fences. Two metre high fences, however, contain this animal.

Underwood (1975) studied the social behaviour of the eland. His findings are summarised as follows: Basic daily activities include grooming, ruminating, walking, and especially feeding. The proportion of time spent on each varies seasonally. It is a gregarious animal, but group structure is unstable, with constant splitting up and reforming of groups. Strangers are allowed to join a herd at will. A dominance order is maintained, which is enforced by a series of threats and symbolic attacks derived from the charge. Dominance encounters comprise the locking of horns and pushing the opponent away. This is rarely serious. Male dominance thus obviously is linked to mass, which in turn increases with age. Dominance ensures access to all resources, including receptive females. Underwood (*op.cit.*) considers the eland mating system as unique amongst antelope in that the bull's access to a receptive female is determined purely on the basis of dominance rank. This is explained as an adaptation to nomadism and to the once large groups necessary for anti-predator defence in open country.

The courtship behaviour of the eland is not elaborate, consisting only of chinning and mounting. Basic calls are aggressive vocalizations, a contact call and an alarm call.

FOOD/...

FOOD:

Hirst (1961), Hofmeyer (1970), Roth and Osterberg (1971), and Underwood (1975) have studied food preferences and feeding habits. It appears that eland can subsist on a wide range of food plants in an equally wide range of habitats. It does, however, seem to select food, and selection varies seasonally in relation to availability. Eland definitely prefer browsing over grazing.

BREEDING:

Calves are born throughout the year, but there is a definite birth peak during late winter and early summer. The time of the birth peak varies regionally within the period August to December. Singletons are born, and are weaned at six months of age. Neonates are hidden in dense vegetation for the first few days of their lives. Oestrus lasts c. three days, and an oestrus cycle three weeks. Gestation period ranges from 255 to 284 days. Heifers can conceive at the age of 18 months (see Hirst, 1961; Skinner, 1966; Slainthorpe, 1972; Wilson, 1969).

MEASUREMENTS AND MASS:

No data available from this survey. Wilson (1969) provides data on body sizes and mass from Rhodesia.

RECORDS OF OCCURRENCE:

Specimens examined, 3: Mutale river, 1 (TM); Nwashitsumbe, 2 (TM).

Additional records: Sightings from Greefswald, Hans Merensky Prov. Nat. Res., Huwi, Jack Scott Priv. Nat. Res., Loskop-Dam Prov. Nat. Res., Mmabolela Estates, Parkfield and Delamere, Renosterpoort Priv. Nat. Res., S.A. Lombard Prov. Nat. Res., Silkaatsnek Priv. Nat. Res., Suikerboschrand Prov. Nat. Res., van Riebeeck Mun. Nat. Res. Open circle in the Kruger National Park on the distribution map after Pienaar (1963).

Subfamily/...

Subfamily Cephalophinae

1. Horns directed backwards in plane of face; ears proportionately shorter (< 90 mm) and rounded at tips ... ... *Cephalophus*
Horns directed upwards, forming an obtuse angle with the plane of the face; ears longer (> 110 mm) and pointed ... ... *Sylvicapra*

Genus *Cephalophus* H. Smith, 1827
Cephalophus natalensis A. Smith, 1834 Red duiker
Rooiduiker

C. n. amoenus Wroughton, 1911

DISTRIBUTION:

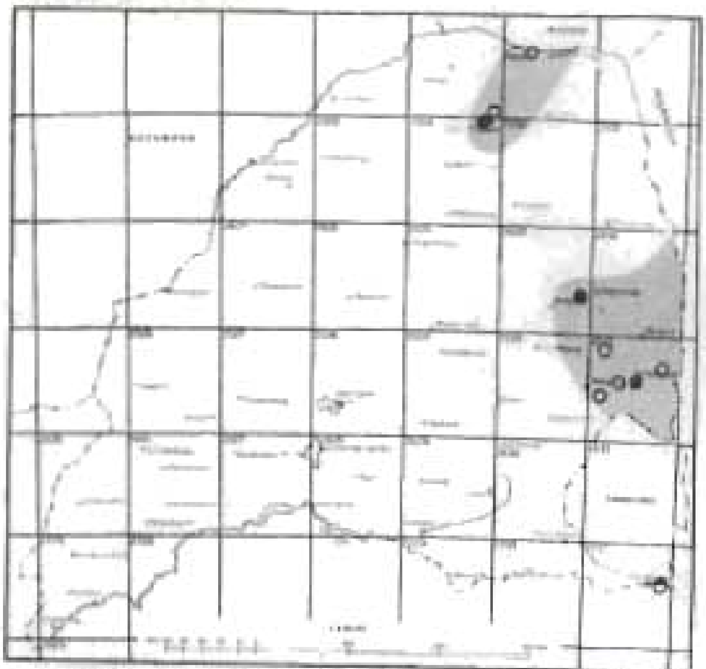


Fig. 162: The distribution of *C. natalensis* in the Transvaal.

Du Plessis (1969) presents evidence suggesting that the red duiker used occur in the eastern Transvaal lowveld in suitable habitat. Both du Plessis (*op.cit.*) and Pienaar (1963) conclude that the existence of the red duiker in the Transvaal is currently precarious. It is only known to occur in the southeastern Transvaal, at a few localities on the southern slopes of the Zoutpansberg, and along the Limpopo river.

HABITAT:

Restricted to forested areas. Prefers the densely wooded

regions/...

regions of especially the escarpment and the Zoutpansberg. Also to be found on other forest-clad mountain slopes, in wooded ravines, and to a lesser extent along riverine forests.

HABITS:

Very little is known about this rare and secretive antelope. It appears to be active mostly at night, but some daylight activity has been recorded during early mornings and late afternoons by Heinichen (1972). The majority of animals seen were solitary. Heinichen (*op.cit.*) suggests that this animal may be territorial, and also that individuals defeacate at communal dung heaps.

FOOD:

Heinichen (1972) lists the plant species observed to be eaten, and those identified from stomach content analyses. Her findings support the observation by Pienaar (1963) that this animal is a delicate browser.

BREEDING:

No information available.

MEASUREMENTS AND MASS:

Heinichen (*op.cit.*) cites the measurements taken from a single male. Only two of the six specimens housed in the Transvaal Museum, both females, were measured.

	Tot.	T.	H.ft	Ear		Mass
TM 17693:	775	120	220	78	=	?kg
TM 26940:	910	106	200	71	=	10,0kg

RECORDS OF OCCURRENCE:

Specimens examined, 6: Malelane, 3 (TM); Mariepskop, 2 (TM); Tramp, 1 (TM).

Additional records: Sightings from Leeuwspoor, Parkfield and Delamere, Scrutton, TenBosch Estates, Uitkyk and Paranie Priv. Nat. Res. Open circles in the Kruger National Park on the distribution map after Pienaar (1963).

Genus *Sylvicapra* Ogilby, 1837

Sylvicapra grimmia (Linnaeus, 1758) Grey duiker
Gewone duiker

S. g. transvaalensis Roberts, 1926
S. g. caffra Fitzinger, 1869

TAXONOMIC NOTES:

Ansell (1972) considers his proposed subspecies as only doubtfully valid. However, until the taxonomic situation can be clarified by an in-depth study, Ansell (*op.cit.*) is followed here. *S. g. transvaalensis* is recognized from the western Transvaal, while *caffra* occurs throughout the rest of the Province.

DISTRIBUTION:

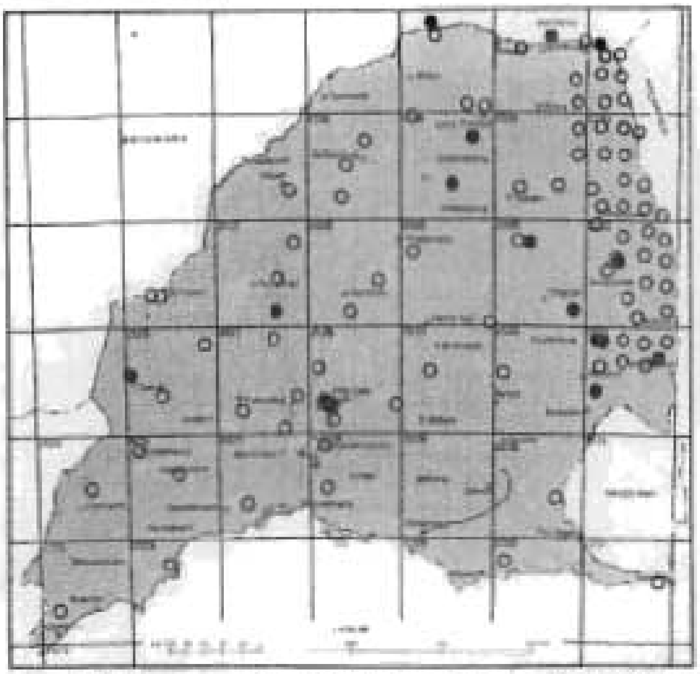


Fig. 163: The distribution of *S. grimmia* in the Transvaal.

A very common antelope, even to this day persisting in suitable habitat throughout the entire Province.

HABITAT:

Authorities agree that this animal is primarily adapted to woodland savanna, which affords not only browsing but also the required cover (Roberts, 1951; Wilson and Clarke, 1962; Wilson, 1966; Smithers, 1971). However, the grey duiker also occurs on the Transvaal highveld where in a number of instances animals were encountered in pure stands of grassveld. It would be of interest to compare the feeding habits of this predominantly browsing species on the highveld, with the findings of Wilson and Clarke (1962) and Wilson (1966) from woodland. The duiker is obviously a very hardy and adaptable species with a relatively wide habitat tolerance,

surviving/...

surviving in more densely populated areas because of its elusiveness, when other antelopes have long since disappeared. It can survive without water for prolonged periods.

HABITS:

Whereas Sikes (1958) and Wilson (1966) found the grey duiker to feed during the early mornings and late afternoons, such diurnal activity was never observed in the Transvaal. This can most probably be ascribed to frequent human disturbance in this Province. Active animals were encountered only during night-hunting operations. Most observations were of solitary animals, although adult pairs or a female with her kid were not uncommon. However, no group was observed to consist of more than two individuals.

Duikers lie up by day in the cover of brush, or tall grass in the absence of woody vegetation. According to Wilson and Roth (1967) and Smithers (1971), duikers are not dependent on surface water, although they will drink when water is available. Most often, however, metabolic water is acquired from the food items eaten. As mentioned by Smithers (*op.cit.*), duikers are avid diggers in search of succulent bulbs and tubers, which are required for satisfying metabolic water requirements. The characteristic triangular sloping holes dug by duiker are commonly found in the veld. Wilson (1966) and Wilson and Roth (1967) correctly point out that duikers maintain home ranges, quite often far removed from natural water sources.

Sikes (1958) observed a captive male displaying a courtship dance to a female prior to mating. In the wild, females hide their neonates in dense vegetation.

FOOD:

Authorities all agree that the grey duiker is predominantly a delicate browser, and prefers tender leaves, shoots, fruits and flowers (Wilson and Clarke, 1962; Wilson, 1966; Smithers, 1971). As mentioned, tubers and bulbs are dug out, whereas insects, guinea fowl and turkey chicks, and even meat are occasionally eaten (Maberley, 1964; Wilson, 1966). Wilson (*op.cit.*)

presents/...

presents evidence that grass is taken only exceptionally.

The feeding preferences of duikers on the Transvaal highveld remain to be determined.

BREEDING:

Riney and Child (1960), Wilson and Clarke (1962), and Smithers (1971) found that the grey duiker breeds throughout the year in Botswana. Implantation is normally 1R, which also means that single ton lambs are the rule

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	1026	3	925	1125
T.	106	3	105	107
H.ft	300	3	290	320
Ear	117	3	110	125
Mass	16,3	2	-	-

Females

	$\bar{X}$	N	Min.	Max.
Tot.	1077	5	1080	1110
T.	111	5	105	113
H.ft	298	5	285	320
Ear	127	5	115	146
Mass	15,9	4	10	20

Wilson and Clarke (1962) and Smithers (1971) present data related to sizes and mass, based on much larger samples from Botswana.

RECORDS OF OCCURRENCE:

Specimens examined, 27: Austin Roberts Bird Sanctuary, 3 (TM); Blijdschap Priv. Nat. Res., 1 (TM); Blyde Forest Res., 1 (TM); Fort Klipdam, 1 (TM); Kempiana, 1 (TM); Maringa, 6 (TM); Mmabolela Estates, 1 (TM); 8 km N. Numbi Gate, 1 (TM); Parani Priv. Nat. Res., 1 (TM); Potgietersrus, 1 (TM); Pretoria District, 1 (TM); Rooikrans, 1 (TM); Rykvoorby, 1 (TM); Sekororo, 5 (TM); TenBosch Estates, 1 (TM); Waterberg, 1 (TM).

Additional/...

Additional records: Sightings from Modderfontein, Barberspan Prov. Nat. Res., Blyde Forest Res., Brandhoek, Buffelspoort, Charleston, Cyprus, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Ferndale, Greefswald, Groothoek, Grootsuikerboschkop and Elandslaagte, Hans Merensky Prov. Nat. Res., Huwi, Jack Scott Priv. Nat. Res., Langfontein, Leeuwspoor, Letaba Ranch, On Levuvhu river, Loskopdam Prov. Nat. Res., 10 km E. Madimbo, Mooigenoeg, Mooiplaas, Mosdene Priv. Nat. Res., Nicorel, Olifantspoort, Othawa, Parkfield and Delamere, Platbos, Pretoria Zoo's farm, Ratsegaai, Renosterpoort Priv. Nat. Res., Rhoda, Rissik Priv. Nat. Res., Rykvoorby, Rochdale, Sandringham Priv. Nat. Res., Scrutton, Silkaatsnek Priv. Nat. Res., Suikerboschrand Prov. Nat. Res., Sweet Home, Timbavati Priv. Nat. Res., Tweepoort, Urk, van Riebeeck Mun. Nat. Res., Welgedaan, Welgevonden, Witpoort, Zandspruit, Zoutpan. Open circles in the Kruger National Park on the distribution map after Pienaar (1963).

Subfamily Reduncinae

1. Bare patch below ear; tail bushy ...	*Redunca*
No bare patch below ear; tail not bushy..	*Kobus*

Genus *Redunca* H. Smith, 1827

1. Larger, horns 25 cm or more over the outside curve, the horns curving forward well above the level of the ears; one pair of inguinal glands; shoulder height about 75-90 cm	*arundinum*
Smaller, horns less than 25 cm over the outside curve, the horns curving forward at about the level of the tips of the ears; two pairs of inguinal glands; shoulder height less than 75 cm	*fulvorufula*

Redunca/...

Redunca arundinum (Boddaert, 1785) Reedbuck
Rietbok

R. a. arundinum (Boddaert, 1785)

DISTRIBUTION:

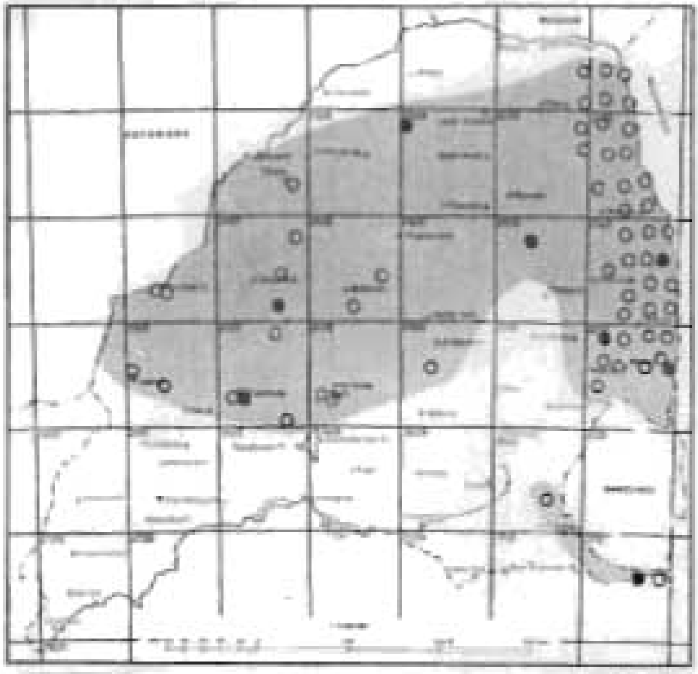


Fig. 154: The distribution of *R. arundinum* in the Transvaal.

Recent records indicate that the reedbuck occurs in suitable habitat throughout most of the Southern Savanna Woodlands, while it is absent from the grasslands of the southern Transvaal highveld. It also appears to be absent along most of the Limpopo river valley. Du Plessis (1969) includes both these areas in the historical range, although he cites only one record from the highveld along the Vaal river. The highveld today probably no longer offers suitable habitat, if ever it did.

HABITAT:

Well-grassed flats or low, rolling hills adjoining marshes or rivers, where reeds or similarly tall vegetation occurs. The latter is required for protection. A permanent water source in the vicinity is a habitat requirement.

HABITS:

Jungius (1970 and 1971b) reports on a study of the social behaviour, general biology and locomotion of this species. It is predominantly nocturnal, but may be active in less disturbed areas during the early morning and late afternoons. During the heat of the day, it rests and chews the cud in the

shade/...

shade and concealment of tall grass or reeds. The reedbuck is very dependent on open water, since it drinks daily.

The males maintain and defend territories. Normally the reedbuck occurs in small family groups, although Jungius (1971b) found that during drier periods larger aggregations may be observed on the better remaining feeding grounds. The females give birth in isolation, and keep their newborn young in concealment for about two months. The young are visited daily to feed and groom them.

FOOD:

Grazers. Jungius (1971a) discusses food preferences, and the plant species taken. He found that the reedbuck is an unselective grazer, feeding for a large part on plants considered to be unpalatable to other ungulates.

BREEDING:

Jungius (1970) concludes that the reedbuck is not a seasonal breeder. Although fawns are dropped throughout the year, there is a definite birth peak from December to May. Single fawns are born. Only 1R implantation has been recorded thus far (Smithers, 1971).

MEASUREMENTS AND MASS:

Only three of the specimens in collections from the Transvaal, have been measured.

		Tot.	T.	H.ft	Ear		Mass
TM 16660:	♀:	1637	275	380	175	=	?
SI 248 :	♀:	1260	270	345	140	=	?
TM 16659:	♂:	1637	276	375	175	=	?

RECORDS OF OCCURRENCE:

Specimens examined, 19: Blouberg, 1 (TM); Komatipoort, 1 (TM); Leydsdorp, 1 (TM); 8 Km N. Numbi Gate, 2 (TM); Pongola, 1 (TM); Rooikrans, 1 (TM); Rustenburg, 5 (TM, 4; SI, 1); Satara, 1 (TM); Sekororo, 6 (TM).

Additional records: Sightings from Buffelspoort, Donkerpoort and Zandspruit, Ferndale, Hans Merensky Prov. Nat. Res., Huwi, Jack Scott Priv. Nat. Res., Joshua Moolman Priv. Nat. Res., Leeuwspoor, Letaba Ranch, Loskopdam Prov. Nat. Res., Mooigenoeg, Mooiplaas, Mosdene Priv. Nat. Res., Othawa, Platbos, Rhoda, Rissik Priv. Nat. Res., Rykvoorby, Sandringham Priv. Nat. Res., TenBosch Estates, Uitkyk and Paranie Priv. Nat. Res. Open circles in the Kruger National Park on the distribution map after Pienaar (1963).

Redunca fulvorufula (Afzelius, 1815) Mountain reedbuck
Rooiribbok

R. f. fulvorufula (Afzelius, 1815)

DISTRIBUTION:

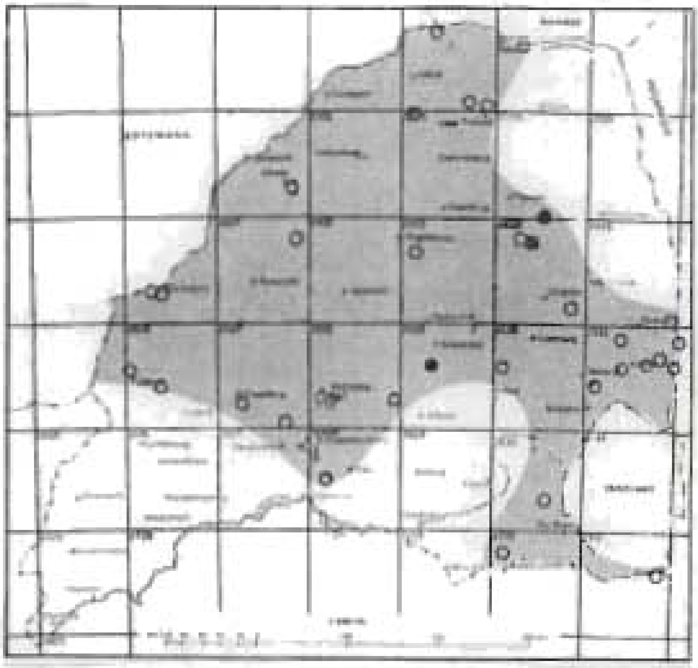


Fig.185: The distribution of *R. fulvorufula* in the Transvaal.

Available records agree closely with the findings of Kettlitz (1962). The Transvaal records represent the northern limits of the subspecies' range, although the mountain reedbuck occurs marginally in southeastern Botswana (Smithers, 1971). It is absent from the northeastern Transvaal and most of the highveld, as a result of a lack of suitable habitat. Within the overall range as indicated on the distribution map, occurrence is patchy and can be related to availability of habitat.

HABITAT:

The mountain reedbuck is habitat specific. It is to be found only in broken hilly country and on the slopes of higher mountains, while higher summits are avoided. Cover in the form of tall grass, shrub or high woodland appears to be preferred, and these vegetation types are predominantly restricted to lower mountain slopes. This dependence on some form of cover is probably why higher summits, or the mist belt as stated by Kettlitz (1962), are avoided. Cover is considered an essential habitat requirement by Irby (1977).

HABITS:

Very little is known about this very shy but alert antelope, as it is seldom seen by virtue of its relatively inaccessible habitat. Irby (1973, 1977) studied its population dynamics at Loskopdam. It is encountered singly, in pairs or in small one-male herds of up to 20 individuals (Irby, 1977; Mason, 1977). Nocturnal, although it also feeds on lower slopes during the early mornings and late afternoons. The mountain reedbuck rests under cover during the heat of the day. Like the southern reedbuck it utters a sharp piercing whistle when alarmed, whereafter it normally flees with a characteristic rocking-horse motion.

Males maintain and defend territories.

FOOD:

Predominantly grazers (See Mason, 1977).

BREEDING:

Lambs are dropped throughout the year (Irby, 1973) with an apparent peak during the first half of summer, when one lamb per female is born (Mason, 1977).

MEASUREMENTS AND MASS:

No specimens were collected during this survey, and none of the Transvaal Museum's earlier acquisitions were measured.

RECORDS OF OCCURRENCE:

Specimens examined, 72: De Diepte, 1 (TM); Leydsdorp, 12 (TM); Loskop Dam Prov. Nat. Res., 59 (TM).

Additional records. Sightings from Blyde Forest Res., Cyprus, Ferndale, Greefswald, Groothoek, Grootsuikerboschkop and Elandslaagte, Huwi, Jack Scott Priv. Nat. Res., Joshua Moolman Priv. Nat. Res., Langfontein, Leeuwspoor, Mooigenoeg, Mooiplaas, Olifantspoort, Parkfield and Delamere, Platbos, Renosterpoort Priv. Nat. Res., Rochdale, Rykvoorby, Scrutton, Suikerboschrand Prov. Nat. Res., TenBosch Estates, Uitkyk and Paranie Priv. Nat. Res., Urk. Open circles in the Kruger National Park on the distribution map after Pienaar (1964).

Genus *Kobus* A. Smith, 1840

Kobus ellipsiprymnus (Ogilby, 1833) Waterbuck
Waterbok

K. e. ellipsiprymnus (Ogilby, 1833)

DISTRIBUTION:

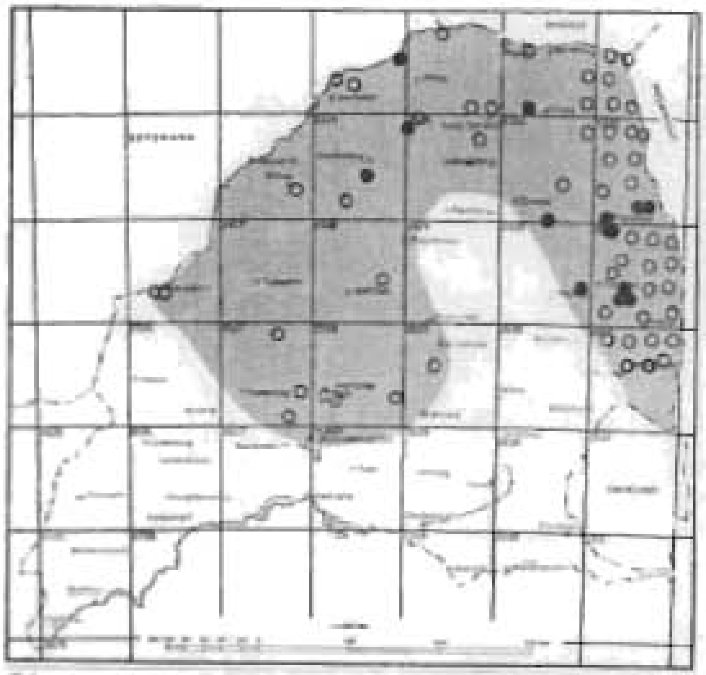


Fig.166: The distribution of *K. ellipsiprymnus* in the Transvaal.

Available records agree closely with those given by Kettlitz (1962), although more herds have been reintroduced to properties in the south-central Transvaal since 1962. The waterbuck is still relatively common along major watercourses in the northern and eastern Transvaal, but is entirely absent from the grasslands of the southern Transvaal highveld. This attachment to Southern Savanna

Woodlands/...

Woodlands was found also by du Plessis (1969), who shows that no marked changes have occurred in the range during historical times.

<u>HABITAT</u>:

Waterbuck are restricted to permanent water sources from which they wander no further than two kilometres. Open parkland with good grass cover is preferred for grazing, while denser riverine vegetation such as reedbeds, is utilized for cover and refuge. Rocky areas near water are especially favoured, although no explanation for this can be offerred other than that the grasses associated with such rocky areas are especially palatable. See Herbert (1971) for a more detailed discussion of habitat requirements.

<u>HABITS</u>:

Herbert (1971) studied the waterbuck in the eastern Transvaal, and related his findings to those of earlier authors.

Feeding occurs both by day and by night (Spinage, 1968; Herbert, 1971). However, both authors record activity peaks in the cool of the mornings and late afternoons. Herds spend the nights along the river, where they continue to feed during the early morning. At about 10h00 the herds leave the river to rest under shady trees. In the late afternoons there is a movement back to the river area to drink and resume grazing. Feeding activity is most intensive during the afternoon.

Dominant males maintain territories of <u>c</u>. three square kilometres (Kiley-Worthington, 1965). The median herd size appears to be four to fifteen individuals. A herd normally consists of a consorting territorial bull, and a more stable group of adult females, subadults and juveniles. Such female herds have home ranges that do not necessary coincide with male territories, so that males are on occasion solitary when females leave their domain. Subdominant males and subadults form bachelor herds. See Kiley-Worthington (1965) and Herbert (1971)

for/...

for a detailed account of social structure, as well as sexual behaviour, mating, and the female-calf relationship.

FOOD:

Predominantly a grazer, especially in disturbed areas. Both Spinage (1968) and Herbert (1971) found the pioneer grass *Cynodon dactylon* to be a preferred food plant.

BREEDING:

Predominantly singleton calves are dropped throughout the year, but there is a birth peak during October and another during February/March (Brand, 1963; Pienaar, 1963; Child, 1968; Fairall, 1968; Herbert, 1971).

MEASUREMENTS AND MASS:

No specimens were collected during this survey, and only two of the previously acquired specimens in the Transvaal Museum collection have been measured. They are:

		Tot.	T.	H.ft	Ear
TM 16691:	♂:	2470	380	530	198mm
TM 16696:	♀:	1525	275	470	?mm

Smithers (1971) gives data of two animals collected in Botswana.

RECORDS OF OCCURRENCE:

Specimens examined, 35: Blouberg, 4 (TM); Exeter, 1 (TM); Klaserie-Olifants river confluence, 4 (TM); Letaba, 2 (TM); Leydsdorp, 3 (TM); Magalakwin river, 3 (TM); Mariepskop, 1 (TM); Mazintonto, 1 (TM); Njelelle river, 1 (TM); Olifants river, 1 (TM); Othawa, 9 (TM); Phalaborwa, 2 (TM); Nwanedzi, 1 (TM); 2 km N. Sabie, 1 (TM); Sheila, 1 (TM).

Additional records: Sightings from Al-te-vêr, Blijdschap Priv. Nat. Res., Buffelspoort, Charleston, Dordrecht, Greefswald, Hans Merensky Prov. Nat. Res., Huwi, Jack Scott Priv. Nat. Res., Letaba Ranch, Loskop Dam Prov. Nat. Res., Mooigenoeg, Mooiplaas, Mosdene Priv. Nat. Res., Mmabolela Estates, Othawa,

Parkfield/...

Parkfield and Delamere, Renosterpoort Priv. Nat. Res., Rhoda, Rochdale, Sandringham Priv. Nat. Res., Scrutton, Silkaatsnek Priv. Nat. Res., TenBosch Estates, Timbavati Priv. Nat. Res., Urk. Open circles in the Kruger National Park on the distribution map after Pienaar, (1964).

Subfamily Hippotraginae

1. Horns rising nearly vertically above the orbits ... ... *Hippotragus*
Horns rising behind orbits, and sloping back more or less in line with the facial plane ... ... *Oryx*

Genus *Hippotragus* Sundevall, 1846

1. Colour black or chestnut; ears pointed, not drooping at the tips; underparts well-defined white; shoulder height up to about 1,4 metres; horns longer, about 85-160 cm ... *niger*
Colour pale reddish-brown; ears long and distinctly drooping at the tips; whitish of underparts less well-defined; shoulder height about 1,4-1,6 metres; horns shorter, about 60-100 cm... ... ... *equinus*

Hippotragus niger (Harris, 1838) Sable antelope
Swartwitpens

H. n. niger (Harris, 1838)

DISTRIBUTION:

The historical range of the sable as given by du Plessis

(1969)/...

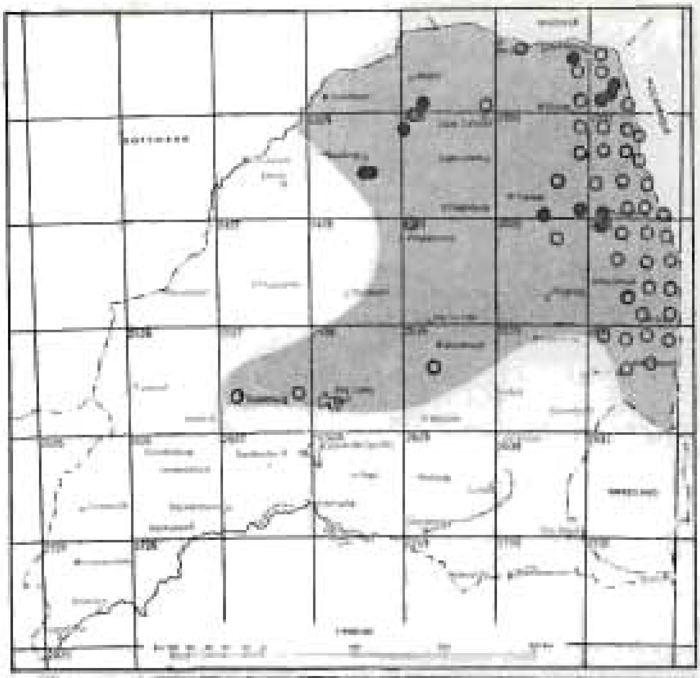


Fig.167: The distribution of *H. niger* in the Transvaal.

(1969), coincides with the Southern Savanna woodlands of southern Africa. According to du Plessis (*op.cit.*) there have been no major changes in the overall distribution of this species in recent times. However, the sable is in fact becoming locally scarce outside the Kruger National Park. Free-ranging herds are known from the Pietersburg, Soutpansberg, Letaba and Pilgrim's Rest districts (Kettlitz, 1962). Sable are also reintroduced to Provincial and private nature reserves as fast as individuals become available. Within the Kruger National Park a fairly substantial population continues to react favourably to sound conservation policies (Pienaar, 1963). The sable has disappeared from the northwestern Transvaal, while it never existed on the grasslands of the Transvaal highveld.

HABITAT:

Various open woodland or shrub communities, interspersed with grasslands. Avoids both closed woodland and extensive areas of open grassland. Dependent on water.

HABITS:

A gregarious animal. Females, together with immatures and juveniles, form herds normally consisting of 20-25 individuals, sometimes as many as 40. These herds are dominated by an adult territorial bull. Subdominant males are driven out of the herd at the age of about three years, whereafter they either remain solitary, or form small bachelor herds. A social hierarchy is

maintained/...

maintained amongst the cows, with the dominant female playing a leading role in group activities (see Wilson and Hirst, 1977).

A pregnant cow leaves the herd to deliver her calf in isolation. The calf is kept hidden for two weeks, before it is allowed to join the herd. The mother-calf relationship appears to be relatively loose (Wilson and Hirst, *op.cit.*).

Child and Wilson (1964) found that free-ranging sable herds follow seasonal cyclic routes over a wide area, and the tendency to regularly follow the same routes is very strong.

FOOD:

A selective grazer, although a limited amount of browsing has been recorded (Smithers, 1971). See Child and Wilson (1964), and Wilson and Hirst (1977) for a description of the grass species composition in preferred sable habitat. The nutritional quality of the habitat is considered by Wilson and Hirst (*op.cit.*) to be a major limiting factor to population increase.

BREEDING:

A seasonal breeder, although the calving peak varies regionally (Child and Wilson, 1964; Fairall, 1968; Child, 1968; Wilson, 1969). Gestation period is 240-248 days (Wilson and Hirst, 1977).

MEASUREMENTS AND MASS:

No specimens were collected during this survey, and none of the earlier specimens were measured or weighed.

RECORDS OF OCCURRENCE:

Specimens examined, 35: Blouberg, 6 (TM); Brak river, 1 (TM); Crocodile Ranch, 2 (TM); Free State Mine, 2 (TM); Leydsdorp, 1 (TM); Magalakwin, 3 (TM); Pongola river, 2 (TM); Mutale river, 3 (TM); Nwashitsumbe north, 4 (TM); Olifants river, 3 (TM); Phalaborwa, 4 (TM); Sheila, 3 (TM); Stangene

dam/...

dam, 1 (TM).

Additional records: Sightings from Charleston, Hans Merensky Prov. Nat. Res., Letaba Ranch, Loskop Dam Prov. Nat. Res., Othawa, Parkfield and Delamere, Scrutton, Silkaatsnek Priv. Nat. Res., Timbavati Priv. Nat. Res., Urk. Literature records from Percy Fyfe Prov. Nat. Res., Rustenburg Prov. Nat. Res., Ermelo Ranch (Wilson and Hirst, 1977). Open circles in the Kruger National Park as shown on distribution map after Pienaar (1963).

Hippotragus equinus (Desmarest, 1804) Roan antelope
Bastergemsbok

H. e. equinus (Desmarest, 1804)

DISTRIBUTION:

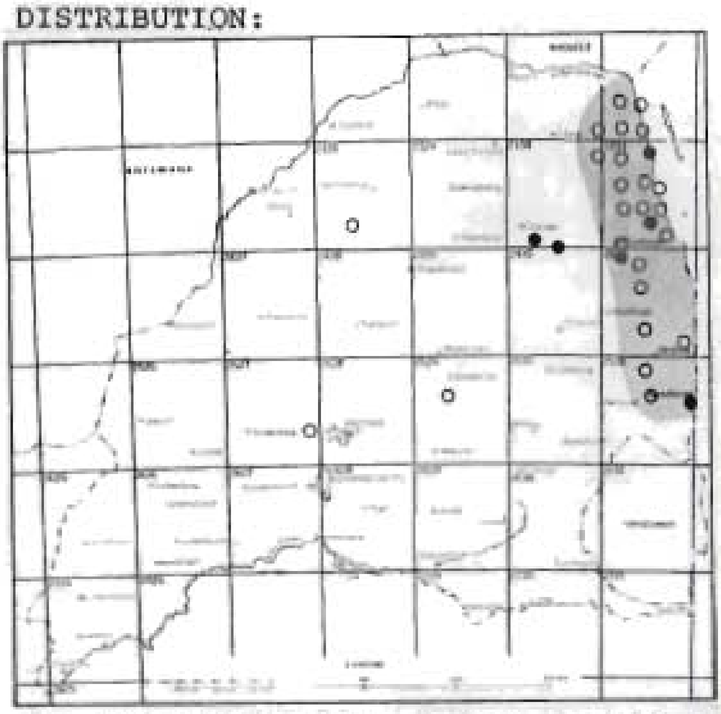


Fig. 168: The distribution of *H. equinus* in the Transvaal.

Du Plessis (1969) presents evidence that the historical range of the roan coincided with the Southern Savanna woodland of southern Africa. In recent times this animal has disappeared from most of the Transvaal woodlands, partially as a result of a natural decline, as suggested by Ansell (1972). Free-ranging herds are today found only in the Kruger National Park (Pienaar, 1963), with a few isolated herds protected in reserves in the Waterberg and Pilgrims Rest districts (Kettlitz, 1962).

HABITAT:

Preferably lightly wooded plains, with good grass cover to

satisfy/...

satisfy its selective grazing demands.

HABITS:

The social behaviour, ecology, and population limiting factors were studied independently by Joubert (1971) and Wilson and Hirst (1977). The former study was conducted in the confines of the Kruger National Park, the latter elsewhere in the Transvaal.

The roan antelope is a gregarious animal, with a median herd size of between 12 and 15 animals, and a maximum of 20 to 25 individuals. Herds are dominated by a single, adult territorial bull. The surplus subdominant males are ejected from the herd, and exist either as singletons, or congregate in small bachelor herds. The cows in the herd maintain a stable straight-line dominance hierarchy. Characteristically the leader of a female/young herd is the dominant cow. Adult males are intolerant of each other and defend a so-called "intolerance zone" of c. 600 m diameter (Joubert, 1971). Dominance in both sexes is asserted by display, or else by low, moderate, or high intensity fighting. However, a sustained dominance order enhances herd stability.

Mating behaviour and copulation are described by Joubert (*op.cit.*) and Wilson and Hirst (1977). The cow leaves the herd to give birth in isolation. For the first six weeks of its life, the neonate is kept hidden, whereafter it joins the herd with its mother.

FOOD:

A selective grazer. Wilson and Hirst (1977) consider the availability of suitable grazing all year as a major population limiting factor.

BREEDING:

Roan antelope are non-seasonal breeders and drop their calves throughout the year (see Wilson and Hirst, 1977). The cow may enter a post-partum oestrus cycle. Gestation period is 275 days.

MEASUREMENTS/...

MEASUREMENTS AN[D ...][S]:

No sp were collected during this survey. None the pr llected specimens were measured except for two sp in the Caprivi during 1969. They are:

	Tot.	T.	H.ft	Ear
♂:	2730	540	620	310mm
♀:	2630	530	600	290mm

S OF OCCURRENCE:

Specimens examined, 10: Komatipoort, 1 (TM); Letsitele river, 2 (TM); Leydsdorp, 1 (TM); Nwanedzi river, 4 (TM); Sheila, 1 (TM); Shingwidzi, 1 (TM).

Additional records: Sightings from Dordrecht, Othawa, Silkaatsnek. Loskop Dam Prov. Nat. Res. and Percy Fyfe Prov. Nat. Res. (Wilson and Hirst, 1977). Open circles in the Kr National Park indicated on the distribution map afte Pienaar (1963).

Gemsbok

Genus *Oryx* Blainville, 1816

Oryx gazella (Linnaeus, 1758)

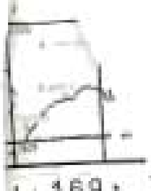
O. g. gazella (Linnaeus, 1758)

DISTRIBUTION:

Free-ranging populations previously occu more arid western and northwestern Trans long since disappeared. Herds have be varying degrees of success on a few ture reserves.

HABITAT:

Open grassland, Karroo woodland of the more arid Although the gemsbok occasion



1g.169:
ti

Intraspecific
the Kalahari Gem

Gemsbok drink
they must exist on m
desert plants. Smithe
at least part of their w
mentions observations of
bulbs with the front hoov
(1972) in *O. beisa* in the
mentions that gemsbok develo
conditions.

Additional records: Sightings from Dordrecht, Huwi, Leeuwspoor, Rissik Priv. Nat. Res., Silkaatsnek Priv. Nat. Res., Urk.

Subfamily Alcelaphinae

1. Horns smooth throughout and directed downwards initially; a prominent facial tuft of hairs, neck mane, and a fringe of hairs on either throat or chest between forelimbs; colour either bluish-grey or blackish ... ... *Connochaetes*

Horns directed upwards from the base; no facial tuft, mane or fringe on throat or chest; colour variously rufous, yellowish or brownish, not bluish-grey or blackish 2

2. Face much elongated; horns set on a pedicle and with a distinct double curvature ... ... *Alcelaphus*

Face not so markedly elongated; horns not on a pedicle, and with a more or less single curve... ... *Damaliscus*

Genus *Connochaetes* Lichtenstein, 1814

1. Horns directed forwards and downwards before curving up; nasals and muzzle not noticeably elongated; tail white ... ... *gnou*

Horns directed outwards and slightly downwards before curving up; nasals and muzzle elongated; tail black... ... ... *taurinus*

Connochaetes gnou (Zimmermann, 1780) Black wildebeest
Swartwildebees

DISTRIBUTION:

The historical range of the black wildebeest in the Transvaal was restricted to the southern grassveld plains. At the

turn/...

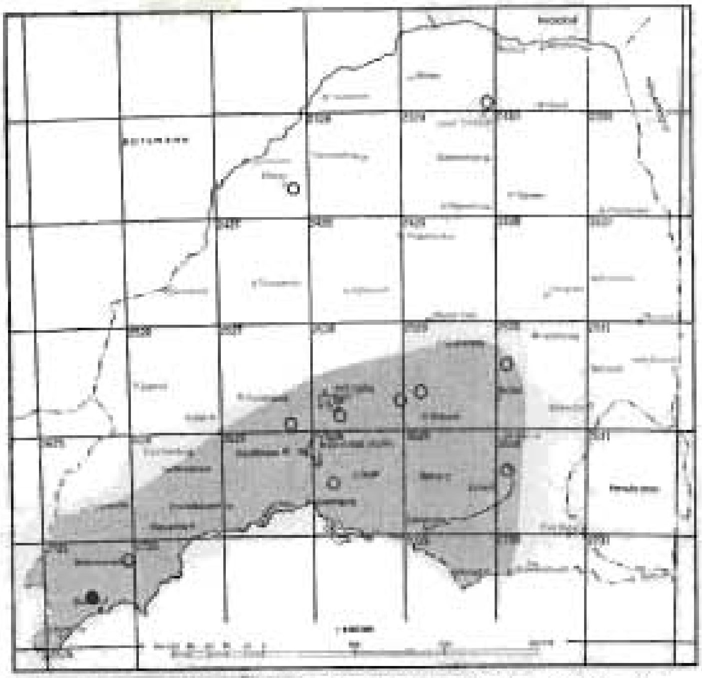


Fig. 170: The distribution of *C. gnou* in the Transvaal.

turn of the century this once very abundant species was on the brink of extinction (see Kettlitz, 1955 and 1962; Brand, 1965; du Plessis, 1969). Very strict conservation measures have been introduced to save it. Although the black wildebeest is not flourishing today, a number of small herds are firmly established on Provincial and private nature reserves throughout most of its former range. Von Richter (1971) pays tribute to a few conservation-minded farmers, by whose action this animal was saved from extinction in the nick of time. The records from Huwi, and from the Parkfield and Delamere properties, are of animals recently introduced outside the natural range of the black wildebeest.

<u>HABITAT</u>:

The open plains of central South Africa, especially the Karoo of the northern Cape and the grasslands of the Orange Free State and southern Transvaal. Prefers short grassveld, where it tends to remain. Von Richter (1971a) points out that this should be borne in mind when considerating the prevention of overgrazing and erosion.

<u>HABITS</u>:

Von Richter (1971a and 1972) studied the biology, ecology and behaviour of black wildebeest. His findings are summarized here.

It is a predominantly diurnal, gregarious animal which congregates in herds ranging in size up to <u>c</u>. 30 individuals. Three basic social organizations are discernible, namely adult

female/...

female herds including also yearlings and calves, bachelor herds, and territorial bulls. The latter have for many years been considered as outcasts from the herd, whereas in fact they constitute the cream of the male crop.

Territorial bulls actively defend their domains and exhibit a close attachment to them, especially during the short rutting season. The female herd has a home range of c. 100 ha, which includes the territories of several bulls. During the rutting season, a territorial bull may endeavour to retain a wandering female herd in his territory and mate with receptive cows for as long as possible, before the neighbouring bull succeeds in enticing the herd into his territory for the same purpose.

Pregnant females do not leave the herd to give birth in isolation. The neonate follows the mother soon after birth. During the short calving period, the young bulls interfere with the neonates, and are therefore expelled from the herd, to join bachelor herds. The latter form a male breeding reservoir, from which the territorial bulls are replaced.

FOOD:

Grazers, utilizing mainly grass, but also karoid shrub. Van Zyl (1965) and von Richter (1976a) discuss the various plant species utilized and those favoured.

BREEDING:

Strictly seasonal breeders, with the majority of calves dropped within a 21-day period. Peak calving seasons vary geographically in South Africa, but all fall within the first half of summer (von Richter, 1971a).

MEASUREMENTS AND MASS:

No data available.

RECORDS OF OCCURRENCE:

Specimens examined, 1: S.A. Lombard Prov. Nat. Res., 1

(TM)/...

(TM).

Additional records: Sightings from Grootsuikerboschkop and Elandslaagte, Huwi, Jack Scott Priv. Nat. Res., Parkfield and Delamere, Renosterpoort Priv. Nat. Res., Suikerboschrand Prov. Nat. Res., van Riebeeck Mun. Nat. Res. Literature records from Heuningkrans, Waterval, Welgelegen. Also unspecified localities in the Badplaas, Belfast and Johannesburg districts (Brand, 1965; Kettlitz, 1955 and 1962; von Richter, 1971b).

Connochaetes taurinus (Burchell, 1823) Blue wildebeest
Blouwildebees

C. t. taurinus (Burchell, 1823)

DISTRIBUTION:

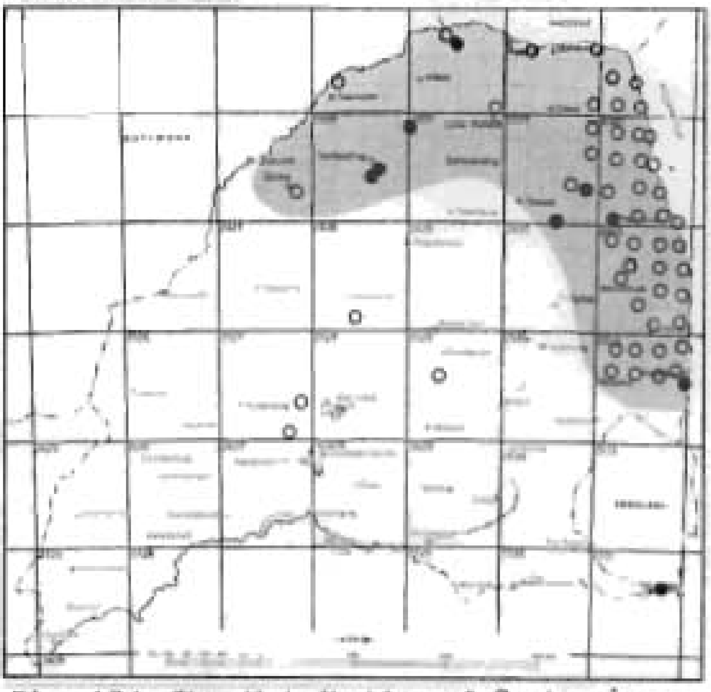


Fig. 171: The distribution of *C. taurinus* in the Transvaal.

Du Plessis (1969) shows that the blue wilde bees used to range throughout the Transvaal during historical times. In recent times the range has been reduced, and the wildebeest is today absent from the entire Transvaal highveld, as well as from the western Transvaal (see also Kettlitz, 1955 and 1962). Population numbers are slowly declining, partly as a result of intensified farming activities. Some farmers actually favour the extermination of wildebeest on account of its ability to spread the disease "snotsiekte" to cattle.

HABITAT:

As a grazer, the blue wildebeest prefers pure grasslands,

floodplain/...

floodplain grasslands, grassy plains in the open aspects of bush savanna, or light open woodlands.

HABITS:

The ecology and behaviour of the blue wildebeest have received wide attention, amongst others by Talbot and Talbot (1963), Watson (1967), Estes (1966 and 1969), and Petersen and Casebeer (1972). In general the habits of the blue wildebeest are very similar to those of the black wildebeest. It is also a predominantly diurnal animal. The blue wildebeest is fully gregarious, forming smaller and more sedentary herds, or larger migratory aggregations of up to 10 000 individuals. In the Transvaal the migratory habits of the blue wildebeest have long since been curbed by fences and the provision of artificial permanent water points.

The social behaviour of blue wildebeest is very similar to that of the black wildebeest. Females and their young of the year form the most numerous and cohesive social groups. Yearling males are ejected from these groups, to join bachelor herds. Territorial bulls space themselves throughout optimum habitat, and actively defend their domains through most of the year. In large migratory aggregations all three these social categories may be represented, and the functional interactions remain the same as in the sedentary groups. Migratory dominant bulls constantly establish small temporary territories wherever the herd-aggregation pauses.

Rutting and parturition are seasonal phenomena. Females deliver their young while remaining within the protection of the herd. The neonate is capable of following his mother and the rest of the herd within minutes.

FOOD:

Almost exclusively grazers. Casebeer and Kos (1970), and Smithers (1971) discuss some food preferences in Kenya and Botswana.

BREEDING:

Seasonal, with the majority of calves dropped within a

21-day period during the rainy season.

MEASUREMENTS AND MASS:

No specimens were collected during this survey, and no data were recorded for earlier acquisitions.

RECORDS OF OCCURRENCE:

Specimens examined, 23: Blouberg, 3 (TM); Komatipoort, 1 (TM); Kongo, 2 (TM); Leydsdorp, 1 (TM); Lydenburg, 2 (TM); Magalakwin, 6 (TM); Olifants river, 2 (TM); Phalaborwa, 1 (TM); Pongola, 4 (TM); Silwana's location, 1 (TM).

Additional records: Sightings from Charleston, Greefswald, Hans Merensky Prov. Nat. Res., Huwi, Jack Scott Priv. Nat. Res., Loskopdam Prov. Nat. Res., Letaba Ranch, 10 km E. Madimbo, Mmabolela Estates, Othawa, Parkfield and Delamere, Rissik Priv. Nat. Res., Sandringham Priv. Nat. Res., Scrutton, Silkaatsnek Priv. Nat. Res., TenBosch Estates. Open circles in the Kruger National Park on the distribution map after Pienaar (1963).

Genus *Alcelaphus* Blainville, 1816

Alcelaphus buselaphus (Pallas, 1766) Cape hartebeest
Rooihartebees

A. b. caama (G. Cuvier, 1804)

TAXONOMIC NOTES:

Smithers (1971) discusses some geographic and non-geographic variables in *A. buselaphus*, and assigns Botswana material to *A. b. caama*. Following his findings and considering the opinion of Ansell (1972), Transvaal material is assigned to the same subspecies.

DISTRIBUTION:

According to du Plessis (1969), early records of the Cape Hartebeest indicate that it occurred in the far western and

northern/...

northern Transvaal, bordering Botswana. Today, natural herds have disappeared entirely, and the only remaining animals are those rigorously protected on farms and reserves within the historical range.

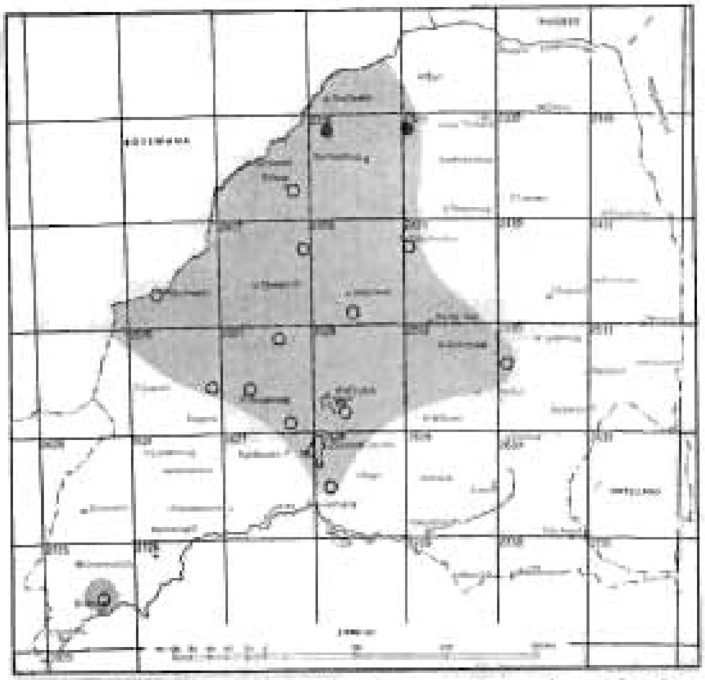


Fig. 172: The distribution of *A. buselaphus* in the Transvaal.

HABITAT:

As a grazer, the hartebeest is to be found on the open grassy plains of open woodlands, open savannas, and flood-plain grasslands. Smithers (1971) is of the opinion that, since it is reluctant to enter thick woodland, the latter acts as a barrier to the dispersal of the species.

HABITS:

The hartebeest is a gregarious species, with herds of up to 300 individuals and congregations of up to 10 000 recorded from Botswana by Smithers (1971). Two types of social organizations exist. The first is a harem herd, typically consisting of a dominant bull and a number of cows with their young of the year. Such a herd remains a stable unit for prolonged periods, and can be found in areas of preferred habitat. Subdominant males congregate in bachelor herds, and are normally found in marginal habitat (see Backhaus, 1959; Kok, 1975). This animal seems to be primarily diurnal, with activity peaks recorded during the early mornings and late afternoons (Kok, *op.cit.*).

Dominant males are territorial, and actively defend their domains, and thus the harems, against rival males. Such a territory is constantly maintained by a variety of behavioural, visual and olfactory activities, for example the repeated use of dungheaps. A territory, together with the harem, is maintained for periods in excess of three years, i.e. for as long as the owner is physically fit enough to ward off the challenges of bachelors. Since the cows remain within the territory of a bull, the latter has total access to oestrus females for as long as he maintains his territory. Kok and Opperman (1975) relate the forage quality of territories to the size of a harem, and consequently to the genetic success of a territorial bull, as interpreted by the number of offspring sired during his lifetime.

FOOD:

Exclusively a grazer. Kok and Opperman (1975) and Kok (1975) analyse the grass composition in preferred habitat in the Orange Free State, and list the species favoured as food items.

BREEDING:

Although calves are dropped throughout the year, there is a definite calving peak just prior to the rainy season, in October. Normally a single calf is born after a gestation period of c. eight months.

Females leave the herd just prior to parturition, to give birth in isolation. Cows are placentophagous, and keep their young hidden for a number of days before allowing them to join the herd (Ansell, 1970; Kok, 1975).

MEASUREMENTS AND MASS:

No specimens were collected during the course of this survey, and none of the earlier specimens were weighed or measured. Smithers (1971) cites some data from Botswana.

RECORDS OF OCCURRENCE:

Specimens examined, 9: Blouberg, 8 (TM); Vaalpenskraal, 1 (TM).

Additional records: Sightings from Buffelspoort, Grootsuikerboschkop and Elandslaagte, Huwi, Jack Scott Priv. Nat. Res., Mooigenoeg, Rissik Priv. Nat. Res., Suikerboschrand Prov. Nat.

Res., van Riebeeck Mun. Nat. Res. According to Kettlitz, also the S.A. Lombard Prov. Nat. Res., Nietverdiend, and the Rustenburg, Waterberg, and Potgietersrus districts.

Genus *Damaliscus* Sclater and Thomas, 1894

1. Face with white blaze; lower limbs white or partly white; smaller, shoulder height not exceeding about 102 cm	*dorcas*
Face without white blaze; limbs wholly coloured; larger, shoulder height about 117 cm or more...	*lunatus*

Damaliscus dorcas (Pallas, 1766) Blesbok

D. d. phillipsi Harper, 1939

TAXONOMIC STATUS:

Two valid subspecies are recognized, i.e. *D. d. dorcas*, the bontebok, and *D. d. phillipsi*, the Blesbok.

DISTRIBUTION:

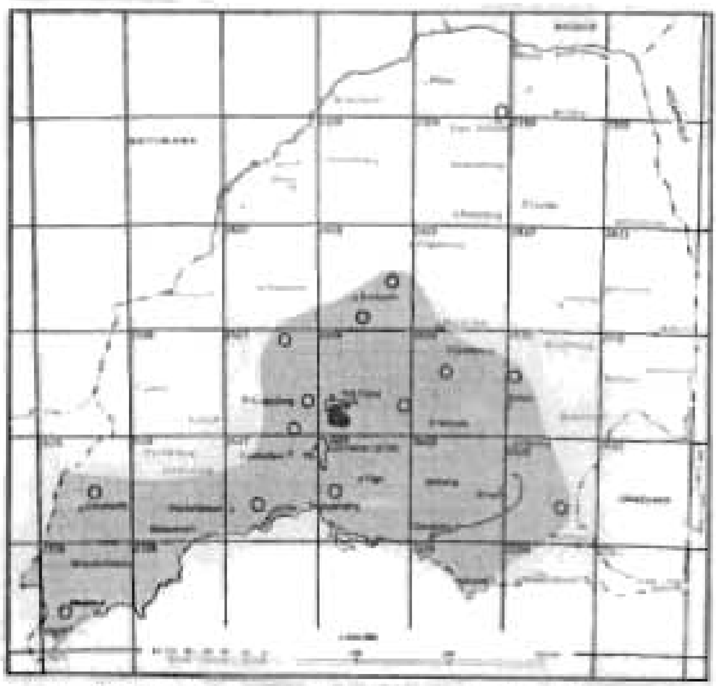


Fig.173: The distribution of *D. dorcas* in the Transvaal.

The overall present-day range does not differ significantly from the historical range (du Plessis, 1969), although blesbok are today locally scarce or absent as a result of intense agricultural pressure. The blesbok is typically a grassland-adapted creature, with the result that it occurs in the Transvaal only on the highveld. Records falling within woodland areas,

viz./...

viz. the Louis Trichard district as indicated on the distribution map, are zoogeographically atypical reintroductions by over-enthusiastic landowners.

HABITAT:

Open grassland. Du Plessis (1972) analysed various grassland plant communities but found that blesbok do not specifically prefer one over another.

HABITS:

As in many other gregarious antelope species in Africa, three social categories can be distinguished in a blesbok population. The first includes the large herds consisting of females and juveniles, termed "nursery herds" by du Plessis (*op.cit.*). The second social category, commonly known as bachelor herds, consists exclusively of young reproductively inactive males, and for that reason du Plessis prefers to call them "male herds". The third category consists of solitary males, each living on an exclusive and restricted area for at least part of the year. Du Plessis avoids using the term "Territorial male" for these animals. Lynch (1974) studied territoriality in blesbok, and considers the solitary males to be territorial in defending and maintaining these exclusive areas. However, a territorial male leaves his exclusive area to join a herd aggregation at certain times of the year, at which time all behaviours associated with territoriality disappear.

The social life of blesbok is dominated by feeding and reproduction. Before the onset of the rutting season in March, smaller groups are scattered throughout the area. Each such small group of females is retained by a territorial male within his exclusive area. During the rut, a territorial male is intolerant of rivals entering his territory, and will chase them out immediately. After the rut, blesbok form large mixed aggregations, with only some territorial males retaining their domains. These mixed aggregations are broken up again at the onset of the lambing season, when females segregate to form nursery herds. (see du Plessis, 1972; Huntley, 1972;

Rowe-Rowe/...

Rowe-Rowe, 1972; and Lynch, 1974 for more detailed discussions.)

Females give birth while remaining in the herd. The young is delivered by day, normally in a lying-down position. The afterbirth is not eaten when expelled several hours later. The lamb is capable of running with its mother and the rest of the herd within five minutes.

The blesbok is a diurnal animal, with peaks of activity during the early morning and late afternoon. During the greater part of the day blesbok rests or sleeps, either standing up or lying down. This rest is, however, constantly interrupted to chase off harassing flies, or to scratch and lick their bodies.

FOOD:

Exclusively a grazer. Van Zyl (1965) and du Plessis (1972) list preferred plant species, and du Plessis discusses forage selection.

BREEDING:

Some females are sexually mature at 18 months, but the majority only become sexually active at 28 months. Males mature sexually even later (Kettlitz, 1967). Males begin to participate in the rut only from their third year. The blesbok is a seasonal breeder, with a parturition peak during December and January. A single lamb is born per female (du Plessis, 1972).

MEASUREMENTS AND MASS:

None of the Transvaal Museum specimens were weighed or measured.

RECORDS OF OCCURRENCE:

Specimens examined, 8: Austin Roberts Bird Sanctuary, 1 (TM); Groenkloof plantation, 1 (TM); Rietvlei dam, 6 (TM).

Additional records: Sightings from Barberspan Prov. Nat. Res., Buffelspoort, Grootsuikerboschkop and Elandslaagte, Jack Scott Priv. Nat. Res., Joshua Moolman Priv. Nat. Res.,

Mosdene/...

Mosdene Priv. Nat. Res., Nooitgedacht, Parkfield and Delamere, Renosterpoort Priv. Nat. Res., Rissik Priv. Nat. Res., Silkaatsnek Priv. Nat. Res., Suikerboschrand Prov. Nat. Res., Welgedaan, Witpoort.

Damaliscus lunatus (Burchell, 1823) Tsessebe
Basterhartbees

D. l. lunatus (Burchell, 1823)

DISTRIBUTION:

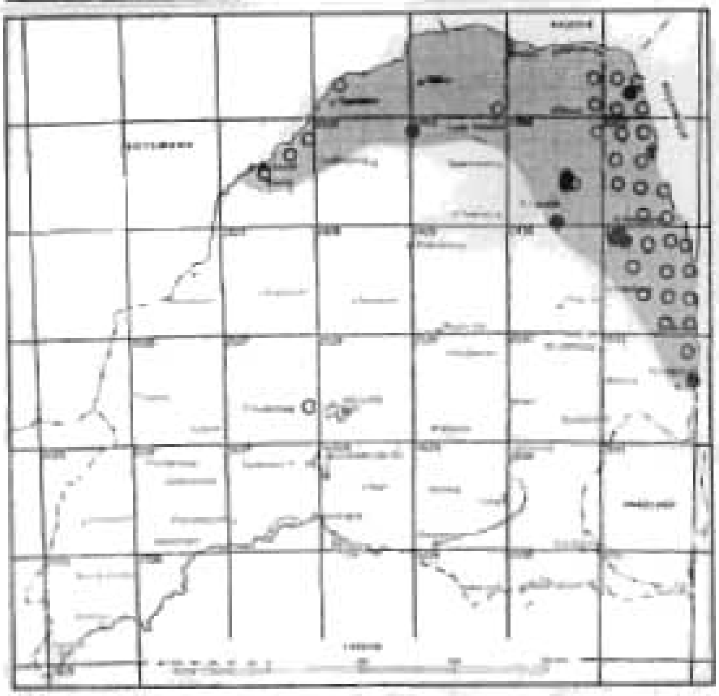


Fig. 174: The distribution of *D. lunatus* in the Transvaal.

During historical times the tsessebe occurred throughout all the bushveld communities of the Transvaal (du Plessis, 1969). Today, it is very scarce and localized in the Transvaal, and is in fact in danger of extinction outside the Kruger National Park (Kettlitz, 1962). It occurs throughout the Kruger National Park, with the bulk of the population centred north of the Letaba river (Pienaar, 1963). Outside the Park, it still occurs in isolated localities in the northeastern lowveld, the northern Transvaal, and along the Limpopo river in the Potgietersrus and Waterberg districts (Kettlitz, 1962).

HABITAT:

Open woodland and open grassland mosaic (Smithers, 1971). Where available, floodplain grassland appears to be favoured. Joubert (1972) and Joubert and Bronkhorst (1977) state that

it/...

it exhibits a distinct preference for the eastern open plains at the foot of the Lebombo mountains, although scattered herds are also encountered in the mixed *Combretum/Mopane* woodland savanna. Never far from permanent water.

HABITS:

Joubert (1972) and Joubert and Bronkhorst (1977) found that in the Kruger National Park tsessebe herds typically consist of seven to eight individuals. A harem herd is always led by a dominant male, who maintains and defends a territory of two to four square kilometres. The bull assumes total leadership of the herd. The harem herd otherwise consists of females of varying ages, as well as the young of the year. Such a harem herd is entirely confined to the territory of its particular male. Although a female herd remains permanently in a particular male's territory, herding is nevertheless one of the prominent activities of the territorial bull. This is achieved by means of a ritualized dominance display.

Territorial behaviour, and the maintenance of a territory by its owner are described in detail by Joubert (1972). The territory is maintained by a variety of visual and olfactory signals, viz. defeacation, pre-orbital gland secretions, soil horning, pawing, and static-optic marking. The male often leaves his harem herd in order to patrol his relatively large territory. Any intruder is actively engaged and chased from the territory.

During the calving season, all young males are evicted from the herd, upon which they join a bachelor herd. Such a bachelor herd does not have a fixed area of activity, but moves about on the peripheries of established territories, fleeing when confronted by territorial bulls.

FOOD:

Grazers (Joubert and Bronkhorst, 1977). Smithers (1971) examined 17 stomachs, all containing nothing but grass.

BREEDING:

The tsessebe has a well-defined calving season, from mid-September to the end of December (Joubert, 1972). The rutting season commences early in January. One calf is born per female (Smithers, 1971).

MEASUREMENTS AND WEIGHTS:

No specimens were acquired during this survey, and none of the existing specimens had been weighed or measured. However, Smithers (1971) gives relevant data for seven males and seven females from Botswana.

RECORDS OF OCCURRENCE:

Specimens examined, 22: Blouberg, 7 (TM); Klaserie-Olifants river confluence, 1 (TM); Komati river, 1 (TM); Letaba drift, 2 (TM); Leydsdorp, 3 (TM); Mahlati fontein, 1 (TM); Nwashitsumbe, 4 (TM); Olifants river, 1 (TM); Selati-Olifants river confluence, 1 (TM); Sheila, 1 (TM).

Additional records: Sightings from Hans Merensky Prov. Nat. Res., Mmabolela Estates, Parkfield and Delamere, Silkaatsnek, Timbavati Priv. Nat. Res. Open circles in the Kruger National Park indicated on the distribution map after Pienaar (1963).

Subfamily Aepycerotinae

Genus *Aepyceros* Sundevall, 1847

Aepyceros melampus (Lichtenstein, 1812) Impala
Rooibok

A. m. melampus Sundevall, 1847

DISTRIBUTION:

The most common antelope in the Transvaal. Free ranging herds still occur throughout the Transvaal bushveld on farms and nature

reserves/...

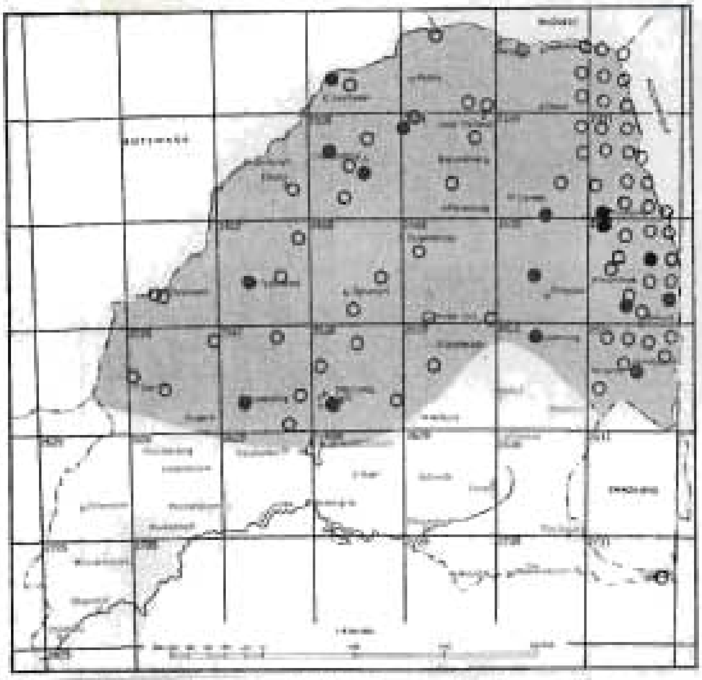


Fig.175: The distribution of *A. melampus* in the Transvaal.

reserves. The impala is restricted to woodland savanna regions, and is absent from the southern Transvaal grasslands. Bigalke (1971) lists two historical records from the Vaal river in the extreme southwestern Transvaal. However, since impala occasionally migrate far outside their normal range, it is impossible to tell whether Bigalke's records are of vagrants or residents.

HABITAT:

According to Schenkel (1966a and b) the following three components are essential for ideal impala habitat. The most important component seems to be adequate cover in the form of fairly thick bush, woodland savanna or even open forest. Permanent water is also essential, and impala rarely wander more than two kilometres away from it. Schenkel regards a light to moderate slope as a third habitat prerequisite.

HABITS:

The impala has been the subject of many studies, and only a few can be referred to here.

Jarman (1970) found that impala herds maintain home ranges, and that each herd is very attached to its particular home range. When environmental conditions deteriorate to the extent that a herd must leave, it will return at the earliest opportunity. Because of this attachment, and also its strict habitat requirements, it appears likely that populations in a particular area are in fact isolated from each other. Young (1972) found that the impala is relatively sedentary in habits, with small parts of the home ranges of about 0,9 square kilometres utilized per day. Young (*op.cit.*) found that movements are limited to a distance of as little as three kilometres per day. He also stresses the daily dependence on water.

Impala are more active by day than by night. Herds actively feed in the early mornings for c. four hours. This is followed by resting and ruminating at midday. Another peak of feeding activity follows from c. 17h00 to 21h00. Later at night herds bed down under trees or in the open (Schenkel, 1966a). Robbel and Child (1970), Young (1972), and Jarman and Jarman (1973) give more detailed accounts of daily activities.

Anderson (1972) differentiates six social groups. The first is the female herd, which normally keeps to optimum impala habitat, viz. flood plains and river terraces. Yearling males are forced out of female herds at the onset of the rut, and then form yearling male herds. At the same time, existing adult male herds disperse, so that individual dominant males can establish territories. After the rut, male herds reform and concentrate in shrubland. The yearling male herd which had formed before the rut breaks up and rejoins the females after the rutting season.

During the rut, the territorial males are very restless, and spend less time feeding and ruminating. They visibly lose physical condition during this time. Females are courted, and male intruders are kept out of the territories. Intraspecific male aggression reaches its height during the rut, For more detailed accounts of herd composition, social behaviour, courtship, copulation and intragroup relationships, see Schenkel (1966a and b), Robbel and Child (1970), and Jarman and Jarman (1973).

FOOD:

Impala obtain their food by either grazing or browsing, but with a preference for browse. See Schenkel (1966), Azavedo (1968), Stewart (1971), and McAllister and Bornman (1972) for a more detailed account of feeding habits, and lists of preferred plant species.

BREEDING:

Impala are strictly seasonal breeders, with the majority of lambs dropped within a period of two weeks during mid-summer. The exact date of the calving peak varies geographically, but falls within the period December-January. Gestation period is 195-204 days. Young males are physically capable of fertilization from c. 13 months of age, but do not participate in the rut until considerably older. A marked increase in adult testis weight takes place a few months prior to the rutting season. Spermatogenesis declines after the rut, but never stops altogether (Kerr, 1965; Skinner, 1971).

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	1578	9	1450	1712
T.	304	9	287	331
H.ft	425	9	306	460
Ear	146	9	137	165
Mass	51	8	39	60

Females

	$\bar{X}$	N	Min.	Max.
Tot.	1493	16	1412	1581
T.	280	16	250	400
H.ft	408	15	300	450
Ear	141	16	137	162
Mass	42	15	28	52

RECORDS OF OCCURRENCE:

Specimens examined, 65: Austin Roberts Bird Sanctuary, 1 (TM); Blouberg, 3 (TM); Koedoesrand, 1 (TM); Leydsdorp, 3 (TM); Lydenburg, 5 (TM); Magalakwin, 3 (TM); Malelane, 11 (TM); Mmabolela Estates, 1 (TM); Newington, 1 (SI); Nwanetzi, 9 (TM); 8 km N. Numbi Gate, 2 (TM); Phalaborwa, 2 (TM); Pretoria Farm 264, 1 (TM); Rustenburg, 7 (TM); Sheila, 3 (TM); Tshokwane, 10 (TM); Vliegepoort, 2 (TM).

Additional records: Sightings from Al-te-vêr, Blijdschap Priv. Nat. Res., Buffelspoort, Charleston, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Ferndale, Fort Klipdam, Greefswald, Groothoek, Hans Merensky Prov. Nat. Res., Huwi, Jack Scott Priv. Nat. Res., Leeuwspoor, Letaba Ranch, 10 km E. Madimbo, Loskop Dam Prov. Nat. Res., Marble Hall, Mooigenoeg, Mooiplaas, Mosdene Priv. Nat. Res., Nicorel, Othawa, Parkfield and Delamere, Platbos, Renosterpoort Priv. Nat. Res., Rhoda, Rissik Priv. Nat. Res., Rochdale, Rust de Winter dam,

Rykvoorby/...

Rykvoorby, Sandringham Priv. Nat. Res., Scrutton, Silkaatsnek Priv. Nat. Res., TenBosch Estates, Timbavati Priv. Nat. Res., Uitkyk and Paranie Priv. Nat. Res., Urk, Welgevonden, Zandspruit 168, Zoutpan. Widely distributed in the Kruger National Park the open circles in this area on the distribution map after Pienaar (1963).

Subfamily Antilopinae

1. Females horned; well-marked face pattern; large dorsal gland with white hairs present	*Antidorcas*
Not as above	2
2. No pedal glands; hair thick and hollow, coat of peculiar bristly texture; hoves truncated, the animal walking on the extreme tips... ...	*Oreotragus*
No pedal glands present; coat and hooves normal, not as described above...	3
3. Inguinal glands present; a bare patch below the ear; a knee tuft present on each foreleg	*Ourebia*
No inguinal glands; no bare patch below the ear; no knee tufts	4
4. Pedal glands opening into interdigital space by a long cleft; surface of preorbital gland invaginated; horns at an angle to the facial plane	*Raphicerus*
Pedal glands opening into interdigital space by a small circular orifice; surface of preorbital gland not invaginated; horns more or less in line with the facial plane... ...	*Neotragus*

Genus *Antidorcas* Sundevall, 1847

Antidorcas marsupialis (Zimmermann, 1780) Springbuck

Springbok

A. m. marsupialis (Zimmermann, 1780)

DISTRIBUTION:

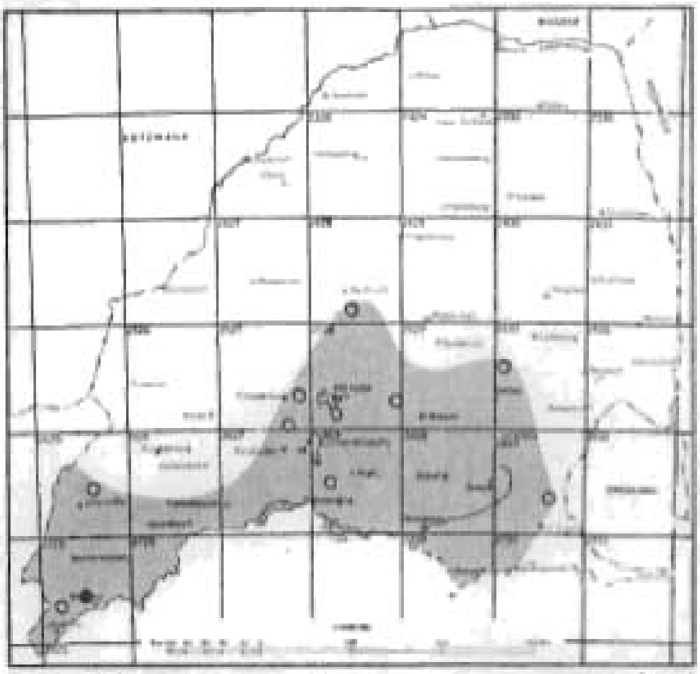


Fig. 178: The distribution of *A. marsupialis* in the Transvaal.

Once a very abundant antelope, today it is restricted to only a few suitable Provincial and private nature reserves where there it is actively conserved. Du Plessis (1969) presents evidence that during historical times springbuck also occurred in the light thorn bush country of the Springbok Flats in the Nylstroom, Potgietersrus and Pietersburg districts. It is today absent from most of these areas, and is primarily restricted to the grassland plains of the southern Transvaal.

HABITAT:

Springbuck are well adapted to life on the open plains of especially the western semi-arid regions of southern Africa, as well as the highveld grasslands of the southern Transvaal and the Orange Free State. Low shrub, especially Karroid shrub, seems to be a preferred habitat requirement, but open woodlands are entirely avoided. Springbuck can survive for many days without water, especially when succulent vegetation is available. However, water is essential when only dry feed is available.

HABITS/...

HABITS:

The best known habit of springbuck is undoubtedly the mass migrations (or treks) of many thousands of animals which took place in the past when the species was still abundant. Many authors have documented the phenomenon and have speculated on the causes, but to date this behaviour remains a fascinating mystery. Cronwright-Schreiner (1925) dedicated an entire book to mass springbuck migrations, while Eloff (1959), Child and le Riche (1969), and Bigalke (1966 and 1972) have also touched on the subject.

The springbuck is a social species, almost always encountered in herds of varying sizes. Bigalke (1970 and 1972) and David (1978a and b) discuss seasonal social structure. Mixed herds of males and females of all age groups are not frequently encountered. During the onset of the rut in autumn, Bigalke (1970 and 1972) and David (1978a&b) observed the following changes in group structure in South Africa: Young males are evicted from mixed herds, whereafter they form bachelor herds not participating in the rut. Adult males become territorial, whereas adult females with their seven months' old female lambs of the previous lambing season form smaller harem herds. These smaller female herds are tended by territorial males, which have been observed to display herding behaviour. The territorial males are in any event agonistic to any male rivals during the rut. See David (1978b) for a more detailed account of territoriality in springbuck rams. Bigalke (1970 and 1972) concludes that these rams do in fact retain their females throughout the rut as harem herds. However, David (1978b) found that males do not have permanent harems, since groups of females are fluid in composition and highly mobile.

After the rutting season, smaller mixed groups disperse in search of good feeding areas. During the lambing season from September to November, females tend to congregate with their newborn lambs. For the first few days of their life, lambs are kept hidden. Later they congregate in so-called nurseries, with their mothers feeding in the vicinity. The mother-lamb bond is not as strong as in other antelope viz. wildebeest

and/...

and blesbok. With improving veld conditions after the rains, large herds congregate on the better feeding areas.

Bigalke (1972) also discusses other social behaviours, such as urination, defecation, comfort behaviour, territorial marking, and mating behaviour, as well as locomotion, stances and attitudes. Springbuck are famous for their gigantic leaps when suddenly alarmed, as well as for the spectacular pronking (stotting), which is an acrobatic, bouncing, stiff-legged jump performed in situations of increasing and decreasing tensions and also in play amongst young. During pronking the dorsal crest of long white hair on the back is erected in a characteristic manner.

Springbuck are primarily diurnal, with activity peaks during the cooler periods of the day. Herds are inactive during the midday heat. Skinner (1972) and van Zyl (1968) consider the springbuck to have tremendous farming potential. Carcass yield is good, and the meat is of superior palatability compared to other venison.

<u>FOOD</u>:

They are selective grazers and browsers, and utilize a wide variety of forage plants. Many plant species eaten are poisonous to domestic stock. There is also evidence that springbuck grazing is complementary to the requirements of domestic stock (Skinner, 1972). Springbuck diets throughout the year consist of 45% grass and 55% shrub. Springbuck survive through the winter on nutritious dry perennial grasses, but in summer shrubs are selected almost exclusively. See Bigalke (1966 and 1972) for further detail.

<u>BREEDING</u>:

Births have been recorded throughout the year, but 90% of the lambs are dropped from September to November (Bigalke, 1966, 1970 and 1972; Skinner and van Zyl, 1970; David, 1978a). While Bigalke claims a second smaller birth peak in spring, Skinner and van Zyl could not confirm it. 80% of ewes conceive at the age of seven months (Skinner, 1972), but are physically fully mature at only <u>c</u>. 18 months (Rautenbach, 1971). Only single embryos, always implanted in the right uterine horn, have been recorded by van Zyl (1966). The gestation period is c. 171 days (Bigalke, 1971).

MEASUREMENTS AND MASS:

Only two specimens are available from the Transvaal, neither measured or weighed. See Smithers (1971) for relevant data.

RECORDS OF OCCURRENCE:

Specimens examined, 2: S.A. Lombard Prov. Nat. Res., 2 (TM).

Additional records: Sightings from Barberspan Prov. Nat. Res., Grootsuikerboschkop and Elandslaagte, Jack Scott Priv. Nat. Res., Joshua Moolman Priv. Nat. Res., Renosterpoort Priv. Nat. Res., Rissik Priv. Nat. Res., Silkaatsnek Priv. Nat. Res., Suikerboschrand Prov. Nat. Res., van Riebeeck Mun. Nat. Res., Welgedaan.

Genus *Oreotragus* A. Smith, 1834

Oreotragus oreotragus (Zimmermann, 1783) Klipspringer

O. o. transvaalensis Roberts, 1917

DISTRIBUTION:

Du Plessis (1969) indicates that during historical times the klipspringer occurred throughout the Transvaal. How he reached that conclusion is not clear, since he does not cite any historical references to its occurrence on the southern Transvaal highveld. Recent records of occurrence are all from the Southern Savanna Woodland biotic zone (see distribution map). It seems likely that klipspringer in fact never occurred on the highveld grasslands, most probably as a result of the absence, or extreme isolation, of suitable habitat.

HABITAT/...

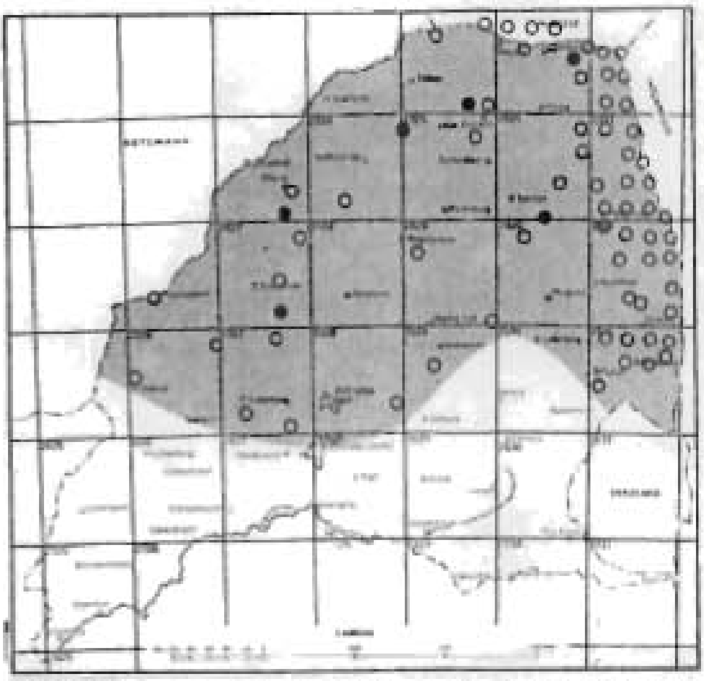


Fig.177: The distribution of *O. oreotragus* in the Transvaal.

HABITAT:

The klipspringer is very habitat-specific, being restricted to rocky terrain afforded by mountains and randjies, or rocky outcrops along rivers. This is locally manifested in a patchy distribution pattern.

HABITS:

A fairly common antelope, persisting in many settled areas, probably as a result of the relative inaccessability of its preferred habitat and its cryptic colouration. Wilson and Child (1965) further ascribe its survival in densely settled areas to a high reproductive potential.

Klipspringers are probably best known for the unique pose they strike on high vantage points at sunset, with all four feet bunched together and the head held high. Thus far I have been unable to establish whether both sexes participate in this behaviour, or whether it is limited to the behavioural repertoire of territorial males as a form of static-optic marking. Klipspringers are very agile, easily scaling steep rock faces or jumping crevices. The oval-shaped hooves are an adaptation to locomotion in difficult rocky terrain.

Adult pairs are most often encountered, but occasionally singletons or small groups of three or more are seen. Casual observations over several one-week periods at several different localities strongly suggest that klipspringers are both territorial and monogamous, since the same pairs or individual were repeatedly seen in the same areas. Normally klipspringers are shy and retiring. However, at Madimbo two adult pairs, each accompanied by a juvenile, were regularly observed from a vehicle at a distance of 20 metres, without showing any sign of unease.

Klipspringers appear to be diurnal, with feeding peaks during early mornings and late afternoons. During the heat of the day they lie up in the shade of rocks or bushes. They were never observed at night. A great deal of feeding is done within their mountainous habitat (Wilson and Child, 1965), but like Wilson and Child I have often observed animals feeding on the adjacent plains.

FOOD:

Browsers. Often observed to feed on growth tips of *Acacia* trees. Wilson and Child (*op.cit.*) recorded *Vellozia equisetifolia* and *Euphorbia tirucalli* as favoured food items. Smithers (1971) found wild figs, as well as the pods and leaves of *Acacia* trees and several forbs in stomach contents.

BREEDING:

Wilson and Child (1965) present evidence indicating that the klipspringer breeds throughout the year.

MEASUREMENTS AND MASS:

Only one of the specimens in the Transvaal Museum collection was measured and weighed, namely

		Tot.	T.	H.ft	Ear		Mass
TM 19789:	♂:	950	65	226	88	=	11,5kg

See Wilson and Child (1965) for further information from Rhodesia, arranged by sex and age.

RECORDS OF OCCURRENCE:

Specimens examined, 13: Blouberg, 1 (TM); Leydsdorp, 1 (TM); Limpopo river, 1 (TM); Mutale river, 2 (TM); Rochdale, 1 (TM); Rooikrans, 5 (TM); Sabi Game Res., 1 (TM); Tamboekieskloof, 1 (TM).

Additional/...

Additional records: Sightings from Blijdschap Priv. Nat. Res., Buffelspoort, Cyprus, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Greefswald, Groothoek, Hans Merensky Prov. Nat. Res., Huwi, Jack Scott Priv. Nat. Res., Letaba Ranch, Loskop Dam Prov. Nat. Res., Madimbo, Mala Mala, Mooigenoeg, Nicorel, Olifantspoort, Othawa, Parkfield and Delamere, Platbos, Renosterpoort Priv. Nat. Res., Rhoda, Rykvoorby, Scrutton, TenBosch Estates, Timbavati Priv. Nat. Res., Uitkyk and Paranie Priv. Nat. Res., Zandspruit 168, Urk. Open circles in the Kruger National Park on the distribution map after Pienaar (1963). Open circles in Rhodesia bordering the Transvaal after Smithers (*in litt.*).

Genus *Ourebia* Laurilland, 1842

Ourebia ourebi (Zimmermann, 1783) — Oribi, Oorbietjie

O. o. ourebi (Zimmermann, 1783)

DISTRIBUTION:

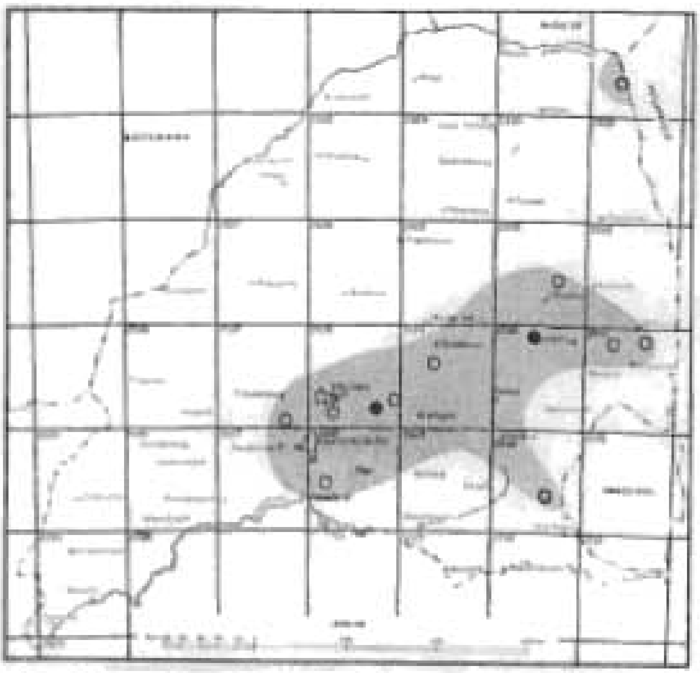


Fig.178: The distribution of *O. ourebia* in the Transvaal.

Oribi are very vulnerable where formal protection is inadequate (Ansell, 1972), and even under optimum protection they do not always react favourably (Pienaar, 1963). However, this antelope seems to react better to conservation measures on the highveld than in the eastern Transvaal bushveld. Although the overall range of oribi in the Transvaal has not changed drastically since historical

times/...

times (du Plessis, 1969), its numbers have decreased dramatically, and in many areas it has been locally exterminated. The majority of recent distribution records indicated on the distribution map are of re-introductions. The range indicated here is very similar to that given by Kettlitz (1962).

HABITAT:

According to Ansell (1972), the oribi occurs in the higher rainfall areas of both the Southern Savanna Woodland and Southern Savanna Grassland biotic zones. However, it is partial to open grassland areas or floodplains, which may explain why it is faring better on the Transvaal highveld than in the eastern Transvaal lowveld where it was known to occur naturally in the past. Observations in the Caprivi strip support Smithers' (1971) remark that oribi prefer areas of burnt grassland. Sourveld grasslands are favoured according to Tait (1969).

HABITS:

Studies on the ecology and behaviour of this relative poorly known antelope are currently under way by scientists of the Transvaal Division of Nature Conservation. My limited observations on oribi support those of Smithers (1971). The oribi is diurnal, with feeding peaks during the morning and late afternoon This animal lies up during the heat of the day in the protection of dense grass. Normally oribi occur in pairs, although small groups have been observed on the Caprivi floodplains. These animals were not wary at all, and an observer could approach them on foot to within about 40 metres. When disturbed, they uttered a sharp whistle and fled for a short distance before stopping to look at the source of disturbance.

FOOD:

Grazers (Tait, 1969).

BREEDING:

No information available.

MEASUREMENTS/

MEASUREMENTS AND MASS:

No data were recorded from the Transvaal specimens. However, data from five specimens collected from Babaja in the Caprivi, are as follows:

Males:

	Tot.	T.	H.ft	Ear		Mass
TM 17077:	905	70	300	100	=	13,2kg
TM 17078:	900	80	290	100	=	10 kg
TM 17123:	1110	70	300	110	=	14,5kg

Females:

TM 17079:	1050	70	310	110	=	17,7kg
TM 17128:	1095	95	325	110	=	16,4kg

RECORDS OF OCCURRENCE:

Specimens examined, 4: Branddraai, 3 (TM); Bronkhorstspruit, 1 (TM).

Additional records: Sightings from Jack Scott Priv. Nat. Res., Joshua Moolman Priv. Nat. Res., Nooitgedacht section of the Loskopdam Prov. Nat. Res., Renosterpoort Priv. Nat. Res., Suikerboschrand Prov. Nat. Res., Van Riebeeck Mun. Nat. Res.. Records from 2231 CB and 2531 BA . after Pienaar (1963).

Genus *Raphicerus* H. Smith, 1827

1. Pelage of the upper parts uniform reddish or yellowish ... ... *campestris*
   Pelage of the upper parts speckled, with many whitish hairs interspersed among the reddish ones ... ... *sharpei*

Raphicerus/..

Raphicerus campestris (Thunberg, 1811) Steenbok
R. c. capricornis Thomas and Schwann, 1906

DISTRIBUTION:

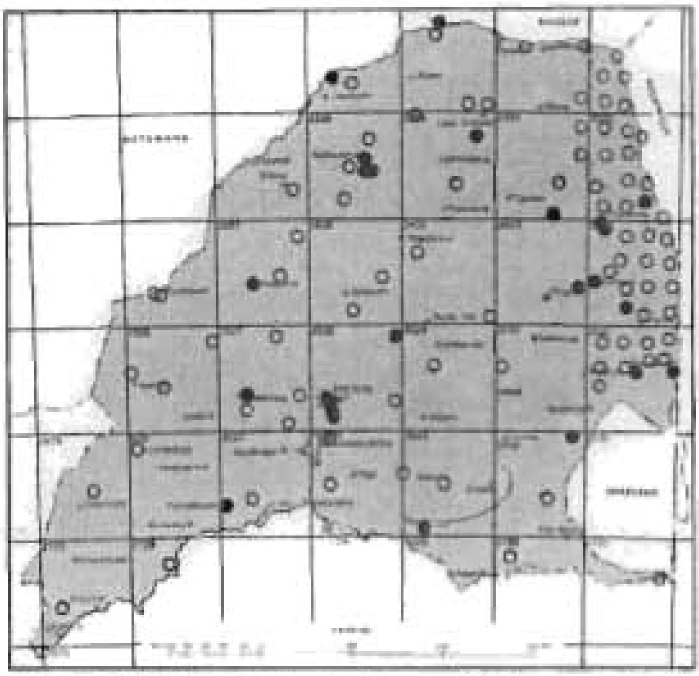


Fig. 179: The distribution of *R. campestris* in the Transvaal.

Widely distributed throughout the Transvaal, except in mountainous or very densely wooded areas. Possibly owing to its small size and retiring habits, the steenbok persists in settled areas.

HABITAT:

Although it occurs throughout the Transvaal in a variety of plant associations, the steenbok prefers open grasslands, or lightly wooded areas and shrubland with open grassy aspects. Steenbok are therefore partial to cultivated lands, both from the habitat aspect and for the good foraging available there. See Smithers (1971) for a quantitative analysis of habitat preferences.

HABITS:

The steenbok is one of the commonest and most widely distributed ungulates in southern Africa. Yet, until recently it has received very little attention from research workers, except for a few remarks on sex ratios (van Bruggen, 1964; Penzhorn, 1971; Rowe-Rowe, 1971; Oates, 1972). However, steenbok ecology and behaviour are currently being studied by a biologist of the Transvaal Division of Nature Conservation.

Smithers (1971) correctly states that the steenbok is predominantly diurnal in undisturbed areas,

with/...

with peaks of feeding activity during the early morning and late afternoon. During the heat of the day it rests under cover of dense vegetation. However, in heavily disturbed areas it may become nocturnal, as judged by the number of active individuals encountered during night hunting operations.

Occurs singly or in pairs, or as females with a single lamb. According to Smithers (1971), individuals maintain a very circumscribed home range. Huntley (1972) refers in passing to the maintenance of a territory. I have repeatedly observed individuals in the same area, but have never had the opportunity to establish whether or not a territory is in fact maintained.

FOOD:

Grazers and browsers. Smithers (1971) analysed the contents of 25 stomachs, and concludes that equal amounts of graze and browse are taken. However, Huntley (1972) observed the feeding strategy of a young male, which showed a marked preference for forbs.

BREEDING:

The steenbok breeds throughout the year (Wilson and Kerr, 1969; Smithers, 1971), with an apparent peak during November and December. Only one young is born per female, with ovulation and implantation occurring randomly between the left and right ovaries and uterine horns.

MEASUREMENTS AND MASS:

Males

	$\bar{X}$	N	Min.	Max.
Tot.	837	6	785	875
T.	56,2	6	47	75
H.ft	257	6	243	275
E.	103	6	95	121
Mass	11,1	4	9,9	12

Females/...

Females

	Tot.	T.	H.ft	Ear		Mass
TM 17745:	715	51	223	100	=	?
TM 24193:	854	50	263	110	=	?

RECORDS OF OCCURRENCE:

Specimens examined, 30: Acornhoek, 2 (TM); Arnhemburg, 1 (TM); Austin Roberts Bird Sanctuary, 1 (TM); Blijdschap Priv. Nat. Res., 1 (TM); Gravelotte, 1 (TM); Koedoeskop, 1 (TM); Komatipoort, 1 (TM); Letaba river, 1 (TM); Magalakwin Farm 666, 3 (TM); Malelane, 2 (TM); Maria van Riebeeck Mun. Nat. Res., 1 (TM); Mariepskop, 1 (TM); Mmabolela Estates, 1 (TM); Newington, 1 (TM); Potchefstroom, 1 (SI); Pretoria, 1 (TM); Renosterkop, 2 (TM); Rustenburg, 1 (TM); Sheila, 1 (TM); Standerton, 2 (TM); Steilloop, 2 (TM); Thabazimbi, 1 (SI); Verwoerdburg, 1 (TM).

Additional records: Sightings from Al-te-vêr, AE and CI property at Modderfontein, Barberspan Prov. Nat. Res., Brandhoek, Buffelspoort, Charleston, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Ferndale, Fort Klipdam, Goedehoop, Greefswald, Groothoek, Grootsuikerboschkop and Elandslaagte, Hans Merensky Prov. Nat. Res., Huwi, Jack Scott Priv. Nat. Res., Joshua Moolman Priv. Nat. Res., Langfontein, Leeuwspoor, Letaba Ranch, Loskop Dam Prov. Nat. Res., Madimbo, Mooigenoeg, Mooiplaas, Mosdene Priv. Nat. Res., Nicorel, Olifantspoort, Parkfield and Delamere, Platbos, Pretoria Zoo's Farm, Renosterpoort Priv. Nat. Res., Rhoda, Rissik Priv. Nat. Res., Rochdale, Rolspruit, Rykvoorby, Sandringham Priv. Nat. Res., Scrutt Suikerboschrand Prov. Nat. Res., TenBosch Estates, Timbavati Priv. Nat. Res., Uitkyk and Paranie Priv. Nat. Res., Urk, van Riebeeck Mun. Nat. Res., Welgedaan, Welgevonden, Witpoort, Zandspruit 168. Open circles in the Kruger National Park on the distribution map after Pienaar (1963). Record from 2229 AI in Rhodesia on the Transvaal border from Smithers (*in litt.*).

Raphicerus/...

Raphicerus sharpei Thomas, 1897 — Sharpe's grysbok
Tropiese grysbok

R. s. colonicus Thomas and Schwann, 1906

DISTRIBUTION:

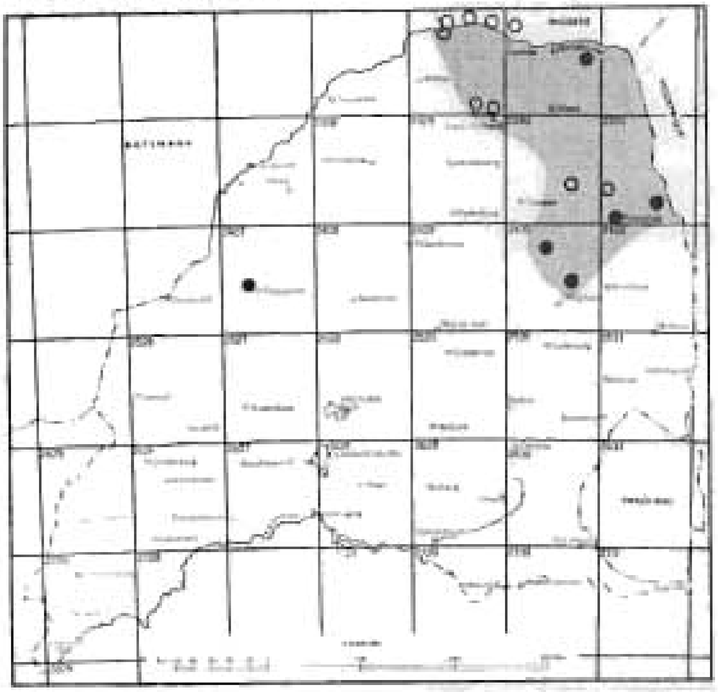


Fig. 180: The distribution of *R. sharpei* in the Transvaal.

Endemic to the Southern Savanna Woodland biotic zone, but within this it has a restricted range. In the Transvaal it occurs only in the north-eastern section. A single record exists from Thabazimbi in the northwestern Transvaal, but it is doubtful whether the species still occurs in this region. It disappeared from the south-eastern Transvaal during recent times (Roberts, 1951; du Plessis, 1969).

HABITAT:

Roberts (1951) defines the habitat as hot low-lying country, where this species is found amongst thorny shrub at the bases of rocky koppies. Smithers (1971) also recorded animals from hard ground with a light grass, woodland or shrub cover, as well as from subriverine woodland, open woodland and pure mopane stands.

HABITS:

Sharpe's grysbok is not often seen, and consequently very little is known of its habits.

It occurs singly, in pairs, or as a female with her single young of the year. Sharpe's grysbok is nocturnal, but with some daylight activity recorded. During the day individuals rest

in/...

in the protected shade of dense grass and shrub. The droppings are deposited in middens, which are utilized over long periods (Smithers, 1971).

FOOD:

Predominantly a browser (70% of food intake), it also takes graze (Smithers, *op.cit.*).

BREEDING:

Smithers (1971) analysed the data assembled by himself, Shortridge (1934), and Kerr and Wilson (1967). He reaches the conclusion that Sharpe's grysbok breeds throughout the year. Implantation is irregular, and only one lamb is born at a time.

MEASUREMENTS AND MASS:

None of the earlier specimens housed in the Transvaal Museum were measured, and no specimens were collected during this survey.

RECORDS OF OCCURRENCE:

Specimens examined, 13: Branddraai 409, 4 (TM); Hampton 320, 5 (TM); Letaba, 1 (TM); Mutale river, 1 (TM); Phalaborwa, 1 (TM); Sekororo, 1 (TM).

Additional records: Sightings from Greefswald, Hans Merensky Prov. Nat. Res., Letaba Ranch, Parkfield and Delamere, Rochdale. Records from Rhodesia on the Transvaal border from Smithers (*in litt.*). Open circles in the Kruger National Park on the distribution map after Pienaar (1963).

Genus *Neotragus* H. Smith, 1827

Neotragus moschatus (von Deuben, 1846) Suni

Soenie

N. m. zuluensis (Thomas, 1898)

DISTRIBUTION/

DISTRIBUTION:

Fig.181: The distribution of *N. moschatus* in the Transvaal.

In southern Africa this species has an entirely eastern distribution, and is generally to be found in coastal areas or as far as c. 160 km inland. It thus occurs only peripherally in the Transvaal. Recorded from the Nyandu bush in the north-eastern Kruger National Park (Pienaar, 1963). An ex-zoo specimen now in the Transvaal Museum collection, was caught near Barberton during 1963.

HABITAT:

Dense brush and thicket on relatively dry ground (Roberts, 1963; Ansell, 1972).

HABITS:

A small and secretive antelope. It is not often encountered, partly as a result of the dense nature of its preferred habitat. Heinichen managed to make some preliminary observations in Zululand. The suni appears to be diurnal, with activity recorded especially in the early mornings and late afternoons. However, Pienaar (1963) considers it to be nocturnal. Appears to be monogamous, with a pair apparently occupying a small territory. Communal dung heaps are used. It has been observed that individuals tend to sleep repeatedly under the protection of the same dense bush.

FOOD:

Mainly shrub, but also dry leaves and fruit. See

Heinic en/...

Heinichen (1972) for a list of food plants recorded.

BREEDING:

No information available. In Central Africa the lambing season is during November-December.

MEASUREMENTS AND MASS:

See Heinichen (*op.cit.*) for data recorded from one male and one female.

RECORDS OF OCCURRENCE:

Specimens examined, 1: Barberton, 1 (TM).

Additional records: Nyandu bush (Pienaar, 1963).

Subfamily Peleinae

Genus *Pelea* Gray, 1851

Pelea capreolus (Forster, 1790) — Grey rhebuck, Vaal Ribbok

DISTRIBUTION:

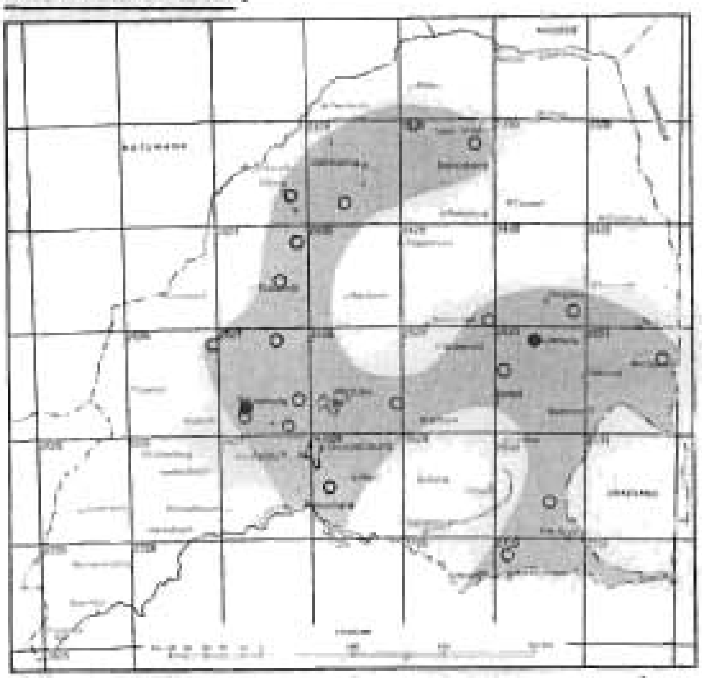


Fig. 182: The distribution of *P. capreolus* in the Transvaal.

Endemic to South Africa. It has a peculiar range in the Transvaal (see distribution map). However, the range illustrated here and independently derived through this survey, correlates very well with the distribution given by Kettlitz (1962). This animal is

restricted/..

restricted to areas south of 24^{o}S latitude, and occurs at altitudes above 1 200 metres (Kettlitz, *op.cit.*). It is not particularly rare within its favoured habitat, probably as a result of the relative inaccessability of its haunts. In addition, it is widely considered inedible by hunters because of the parasitic fly larvae found under the skin, and this undoubtedly results in lower hunting pressure.

HABITAT:

Montane grasslands. According to Kettlitz (1962) the mist belt just above the ecological limits of the mountain reedbuck is preferred.

HABITS:

Oboussier (1970) has confirmed the taxonomic distinctness of this genus demonstrating that available procedures and evidence fail to throw any light on the phylogenetic relations of *Pelea*. Because of its taxonomic uniqueness, and the relative ease with which this species can be observed, it is amazing that it has to date not been studied intensively. Esser (1971) has admittedly given some attention to certain biological and behavioural aspects, but his results were presented as a mimeographed internal report, which I could not trace.

Grey rhebuck occur in small herds of five to ten animals, comprised of both sexes and all age groups. The herd is led by a dominant ram. They are diurnal as far as could be established, with activity particularly during the early morning and late afternoon. I have never observed grey rhebuck during night hunting operations. When disturbed, the animal utters a shrill whistle, and takes flight with a rocking-horse gait. The tail is wagged in a characteristic manner, thus displaying the white underside. The flashing of the white underside of the tail serves as a conspecific warning mechanism for conspecifics.

FOOD:

Grazers.

BREEDING/...

BREEDING:

No information available.

MEASUREMENTS AND MASS:

None of the five specimens previously housed in the Transvaal Museum have been measured or weighed. No specimens were collected during the course of this survey.

RECORDS OF OCCURRENCE:

Specimens examined, 5: Lydenburg, 2 (TM); Rustenburg, 3 (TM).

Additional records: Sightings from Blijdschap Priv. Nat. Res., Blyde Forest Res., Buffelspoort, De Hoop Priv. Nat. Res., Donkerpoort and Zandspruit, Dordrecht, Grootsuikerboschkop and Elandslaagte, Huwi, Jack Scott Priv. Nat. Res., Joshua Moolman Priv. Nat. Res., Langfontein, Olifantspoort, Platbos, Renosterpoort Priv. Nat. Res., Silkaatsnek Priv. Nat. Res., Suikerboschrand Prov. Nat. Res., TenBosch Estates, Urk, Zandspruit 168.

DISCUSSIONS

The results of combining selected phenomena for all those species occurring in the Transvaal, yielded interesting results.

A. Coexistence in Transvaal Carnivora

An attempt is here made to explain coexistence of the 33 Transvaal carnivore species.

Rather than work out niche occupation by the various carnivores, which to be meaningful would involve quantifying resource utilization in various axes by carnivores in specific communities, the approach here taken is to look at various attributes of co-occurring species, and then to see where and if competition may come into force. This is done by considering in combination average species mass, basic food preference, daily activity regimen, habitat selection, distribution patterns and specific social characteristics. Trends in adaptations were also considered, especially the advantage of differential body size in coexisting carnivores preying on the same food types, as variation in body size could affect prey size taken. It was also necessary to catagorize behaviour, in the full realization that the behavioural scope of each species may well be wider than the particular category to which it is designated.

Table 2 lists the 33 carnivore species occurring within the Transvaal, with average weight, expressed in kg of both sexes combined, indicated for each species. Weight data are based on Transvaal Museum records, supplemented by relevant information from Smithers (1971). Samples sizes (N) are indicated. The logarithmic values for the means of species weights as expressed in grams were calculated and are also given.

Based upon personal observations and unpublished data (Rautenbach, *in prep.*; Nel, *in prep.*), as well as published information (viz. Smithers, 1971; Rowe-Rowe, 1977 a and b), an integral numerical value has been assigned to the daily activity regime of each species. These range from exclusively nocturnal with a Roman numerical value of i, to exclusively diurnal with a numerical value of v (Table 2). Categories ii and iv denote

nocturnal/...

nocturnal species with some diurnal activity, and diurnal species with occasional nocturnal activities respectively. Similarly, integral Arabic numerical values 1 through 5 have been designated for the solitary to gregarious behavioural range, ranked from very solitary with a numerical value of 1, through to very gregarious with a numerical value of 5. The various species were each assigned to one of these five social category values on the grounds of average social grouping, allowing for other situations mentioned in the literature.

The integral values assigned to these two behavioural patterns considered (activity and social groupings), are only arbitrary points spaced along a continuum and each represent an average categorized value considered most typical for the species. Judgement herein was subjective. I could not use more than five subdivisions with any accuracy, but in spite of this the resultory divisions are found to be both convenient and meaningful.

Hunting behaviour is adapted to basic food preference. Diet and the mode of acquiring nourishment are other important aspects of the adaptive behavioural makeup of a species' accompanying avoidance of competition. Also considered in this discussion, then, are the four basic feeding methods or food types of carnivores, i.e. scavenging, omnivorous, insectivorous (denoting a diet of any invertebrate), and predacious. In assigning each species listed in Table 2 to a feeding category, it must be stressed that carnivores are opportunistic with regards to food items taken, especially under low interspecific competitive conditions. Only what is considered to be the primary or optimum feeding trait of a species when under more intense interspecific competition, is considered here.

In Figure 174 the integral values of the activity regimen and the social structure are plotted against each other for each species. Intraspecific social interrelationships are presented on the horizontal axis, and the activity regimen on the vertical axis.

Those species falling within the limits of behavioural values 1i, 1ii, 2i and 2ii in Fig.1, are all nocturnal and solitary,

and/...

Table 2: The 33 carnivores occurring in the Transvaal. Average body weight expressed in kg, the log. value of the mean body weight in grams, as well as the daily activity, social structure and basic feeding categories to which each species is assigned, are indicated. See text for further explanations. I = Insectivorous, P = Predacious, O = Omnivorous, and S = Scavenging.

Species	Average Weight (kg)	Log. Weight (gram)	Daily Activity Regimen	Social Structure	Basic Feeding Adapta-tion
Otocyon megalotis	3.4 (N=7)	3.53	iii	3	I
Lycaon pictus	22.0 (N=12)	4.34	v	5	P
Vulpes chama	2.9 (N=22)	3.46	i	1	P
Canis adustus	10.0 (N=5)	4.00	ii	1	O
Canis mesomelas	7.8 (N=48)	3.89	ii	2	O
Aonyx capensis	12.1 (N=4)	4.08	iii	3	I
Lutra maculicollis	4.5 (N=1)	3.65	ii	3	I
Mellivora capensis	8.9 (N=5)	3.95	ii	2	I
Poecilogale albinucha	0.4 (N=4)	2.60	ii	3	P
Ictonyx striatus	1.1 (N=10)	3.04	i	2	I
Viverra civetta	12.4 (N=5)	4.09	i	1	O
Genetta genetta	1.9 (N=15)	3.28	i	2	P
Genetta tigrina	1.9 (N=24)	3.28	i	2	P
Suricata suricatta	0.7 (N=19)	2.85	v	5	I
Paracynictus selousi	1.6 (N=39)	3.20	i	2	I
Cynictis penicillata	0.8 (N=20)	2.90	iv	3	I
Herpestes ichneumon	3.1 (N=14)	3.49	v	3	P
Herpestes sanguineus	0.5 (N=25)	2.70	v	1	P
Rhynchogale melleri	2.8 (N=1)	3.45	ii	1	O
Ichneumia albicauda	3.6 (N=1)	3.56	i	2	P
Atilax paludinosus	4.3 (N=5)	3.63	i	1	I
Mungos mungo	1.3 (N=7)	3.11	v	5	I
Helogale parvula	0.2 (N=13)	2.30	v	5	I
Proteles cristatus	9.9 (N=14)	4.00	i	1	I
Hyaena brunnea	36.1 (N=7)	4.56	ii	2	S
Crocuta crocuta	69.7 (N=8)	4.84	ii	4	P
Acinonyx jubatus	35.1 (N=3)	4.55	iv	2	P
Panthera pardus	41.7 (N=4)	4.62	ii	1	P
Panthera leo	204.1 (N=4)	5.31	ii	4	P
Felis nigripes	1.5 (N=8)	3.18	ii	1	P
Felis serval	0.6 (N=5)	3.98	i	1	P
Felis caracal	10.5 (N=10)	4.02	ii	1	P
Felis libyca	4.7 (N=58)	3.67	ii	1	P

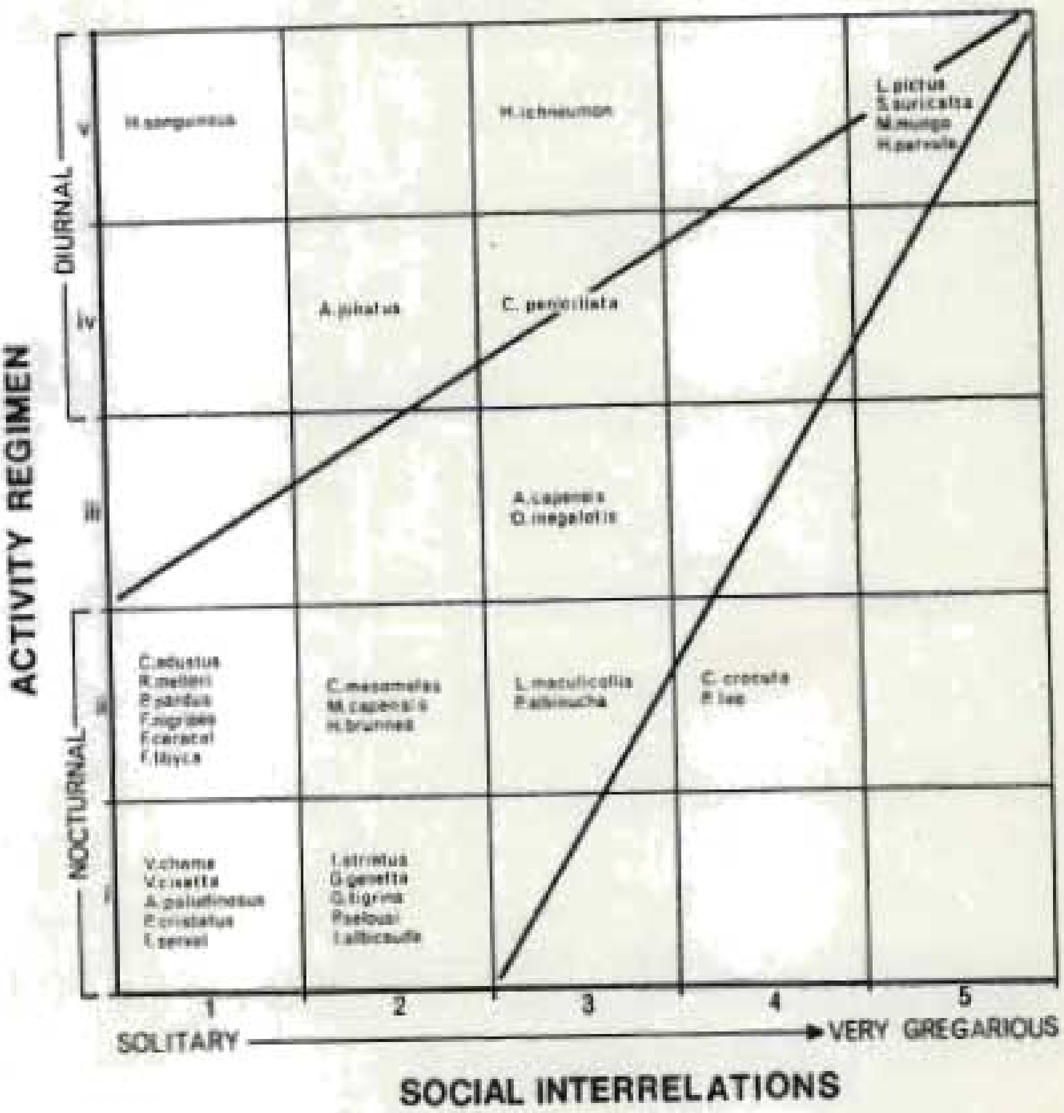


Figure 174: Graphical presentation of species separation by plotting the categoric values assigned to intra-specific social relations against the categoric values of daily activity cycles. See text for further explanations.

and represent the majority of the Transvaal Carnivora, namely 58%. The lines in Fig.1 connect the upper values for both variables of this nocturnal/solitary block, with the upper values of the very gregarious and exclusively diurnal group (value 5v). All species falling between these two lines are considered to represent a trend from a solitary and a nocturnal existence to an entirely gregarious and diurnal mode of life. No less than 82% of all carnivores in the Transvaal follows this trend. *Lutra maculicollis*, *P. albinucha*, *O. megalotis* and especially *A. capensis* are behaviourally intermediate between the two extremes within this trend. It is within this trend that interspecific competition is potentially the highest, as will be elaborated below. Three of the four species at the extreme diurnal/gregarious end of the trend (Fig.174) are small insectivores and thus potentially in direct competition.

Eighteen percent of the carnivore species under consideration do not conform to this trend, and has adopted a strategy which seems to minimize possible competition. However, where four species have radiated towards a diurnal/solitary mode of life (*H. sanguineus* very successfully), only two species radiated a short distance towards a nocturnal/gregarious existence.

There are no extremely nocturnal/gregarious species (value 5i), although the lion and the spotted hyaena are approaching this condition. A possible explanation for the poor radiation towards an extreme nocturnal/gregarious behavioural range could be the difficulty of maintaining group structure in the dark. Smaller gregarious species are mostly insectivorous and diurnal and finding food in the dark may also present difficulties, apart from the difficulty in locating predators in time. Schaller and Lowther (1969) consider the lion, in contrast to the wild dog, as incompletely adapted to a social life since lions frequently quarrel over the proceeds of a hunt. If their interpretation is correct, the true position of the lion on the graph in Fig.174 may be more towards the left, and consequently even closer to the general trend.

Crocuta crocuta is basically a nocturnal animal, but may also be active during the day. According to Kruuk (1966 and 1972) the species tends to scavenge by day, and become efficient

pack/...

pack hunters and killers by night. The spotted hyaenas has a complex matriarchal social system, with the females physically bigger than the males and dominant to them. *Crocuta crocuta* thus has radiated successfully some distance away from the trend, towards a nocturnal/gregarious existence.

Otocyon, although regarded by most as a nocturnal species, has a diurnal mode of life in undisturbed areas during winter. In settled areas, however, it becomes exclusively nocturnal. In discussing the eastwards range extension of the species in the Transvaal, Pienaar (1970b) mentions that it is exclusively nocturnal in the Kruger National Park, and ascribes this to a form of protective behaviour of colonists in a new territory. In the Transvaal as a whole the species is almost entirely nocturnal, but on the other hand it occurs for the most part in this Province only in settled areas. Studies elsewhere (Nel, *in prep.*) show that activity is perhaps correlated to the need to thermoregulate efficiently. Most observations on the bat-eared fox in the Transvaal are of solitary or small groups of animals, but again, this would depend on the time of year of observations (Nel, *op.cit.*). This species is thus plotted in the position 3iii within the trend, although it could be argued that the Transvaal population should be plotted together with the lion just outside the trend.

It thus would appear that a vacuum exists at the nocturnal/gregarious end of the behavioural range, but that carnivores in the Transvaal do not utilize it, for reasons at present not fully understood.

Herpestes sanguineus is the most predacious of the Herpestinae in the Transvaal, being an efficient killer of vertebrate prey. It is furthermore solitary and diurnal, in contrast to the general tendency for the more predacious small carnivores to be solitary and nocturnal (see Ewer, 1973:277). This seeming anomaly could result from an adaptive radiation to utilizing resources (especially habitat and food) with a low utilization pressure.

Herpestes ichneumon and *C. penicillata* are only partly social species. When hunting for food both species are solitary,

in/...

in this respect thus reminiscent of *H. sanguineus*. *Herpestes ichneumon* is predacious, whereas *C. penicillata* is insectivorous. The distributional ranges of these two species furthermore do not overlap at all. *Cynictis penicillata* is unique in the sense that when actively seeking food, it is a solitary insectivore in contrast to the other diurnal insectivores which are social species.

The cheetah displays the three basic felid hunting techniques, i.e. stalking, utilization of the forepaws to fell its prey, and an oriented neck or choking throat bite according to the size of the prey. However, the cheetah atypically for a felid outruns its quarry and possesses distinctive anatomical adaptations for this particular way of hunting. This mode of hunting can best be performed in daylight, and there appears to be very little need for group participation. The cheetah thus clearly acquired behavioural and physical adaptations to enable it to radiate adaptively into a less competitive area. Of the four carnivores above the trend illustrated in Fig.174, the cheetah utilizes a different tophic level as a result of being much larger than the others. Yet the survival of the cheetah is threatened. Perhaps the reason for its precarious conservation status in the Transvaal should be sought in its low ranking position in the predator hierarchy. Cheetahs are often robbed of their prey by lions, leopards and hyaenas, and are even preyed upon by these more powerful predators (Schaller and Lowther, 1969; Pienaar, 1969).

In Figure 175 the four basic feeding categories are presented by vertical columns, each of which are divided in diurnal and nocturnal subsections. The nocturnal subsections are stippled. Each species was assigned to its appropriate column with regards to its basic feeding behaviour and characteristic daily activity cycle. Position against the vertical axis was assigned by the logarithmic value of the average adult body mass as expressed in grams. The principle is that clustering of species indicates possible interspecific competition, and vice versa. This is based on the correlation between the size of the predator and the size of the prey it can effectively

handle/...

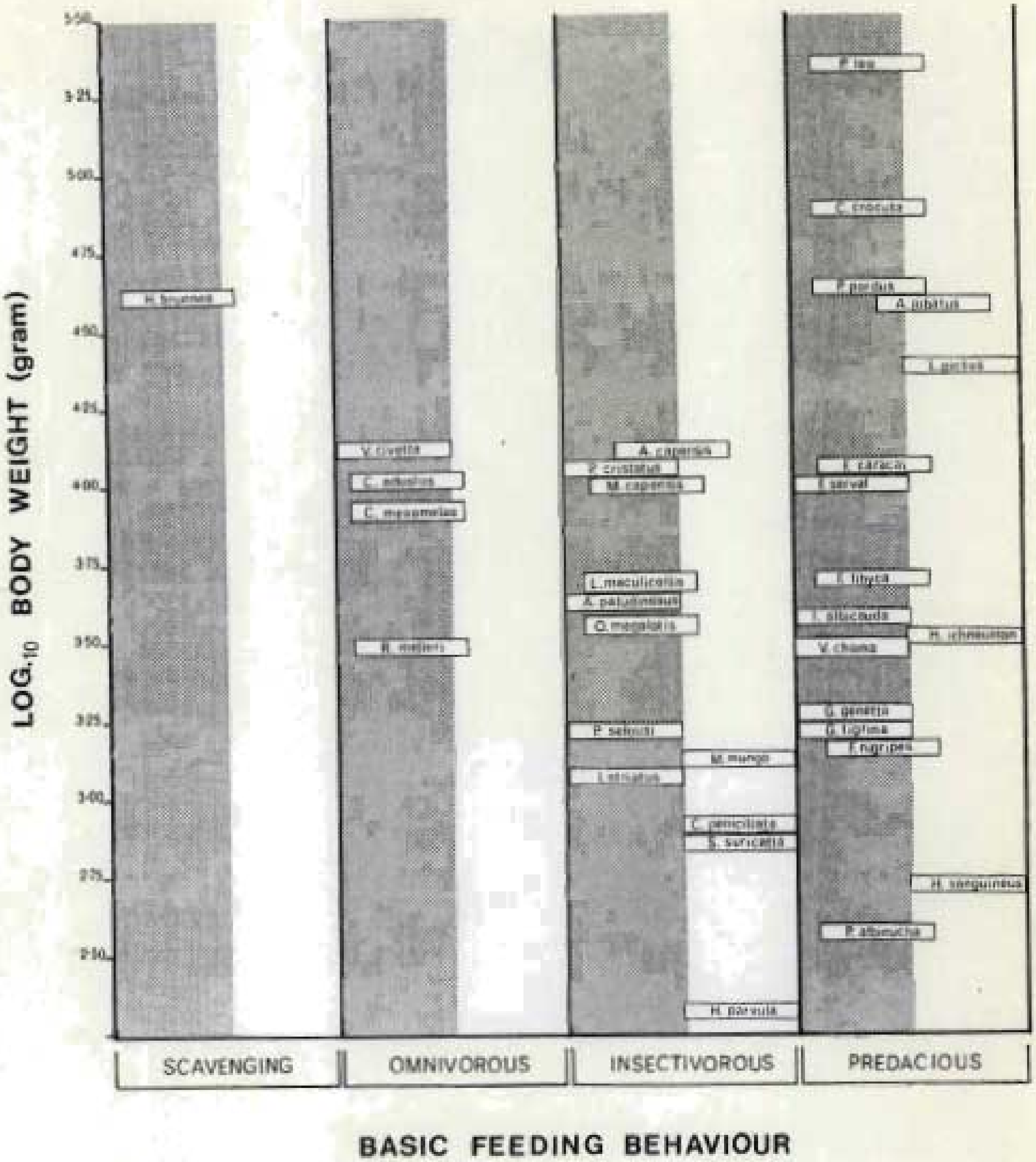


Figure 175: Graphical presentation of niche occupation. The four basic feeding categories are presented as vertical columns, each subdivided by a stippled column denoting nocturnal activity and a unstippled column denoting daylight activity. Species are assigned to their appropriate columns, and are vertically spaced against the X-axis representing the log. value of the mean body weight in grams.

handle, or usually catches. It has been calculated that the maximum mass of prey that can be handled with efficiency by an individual true predator, is in the order of maximum 1½ times that of the predator itself. Group cooperation accounts for a higher ratio between the individual predator and the prey. It conversely follows that a big carnivore could not exclusively hunt very small prey since the energy gain herein would not warrant the investment in such an energy expenditure.

A strong bias towards the insectivorous and predacious modes of life is evident (Fig.175). The ratio of species between the four feeding classes is 1:4:12:16. Forty-eight percent of Transvaal carnivores are predacious, which is considered to be the primary feeding trait of the Order. The remaining 52% have radiated away from a true predacious existence towards utilization of other protein resources, and have also behaviourally adapted themselves to procuring it. Furthermore, no less than 75% of all species are predominantly nocturnal. The mean weight of the species in the Omnivorous category is 8,25 kg, that of the Insectivores is 4,07 kg, and the Predators 25,82 kg.

I agree with Skinner (1976) that *H. brunnea* is basically a scavenger. This is further substantiated by the special dental and skull adaptations acquired to cope with a scavenging way of life. Such a life style is for several reasons an uncertain existence, with chance playing no minor role. This is reflected in the single species represented in this category as well as the fact that it is primarily solitary, presumably in order to avoid excessive intraspecific competition for limited resources. Considering the apparent hardships of a scavenging life style, a lower mean weight may be an appropriate manner of reducing the energy requirements of the species. However, all indications are that the brown hyaena is in all aspects primarily adapted towards capatilizing on the proceeds of the hunting endeavours of the larger predators.

An omnivorous life style is seen as the most opportunistic of all, and can include as food items vertebrates which are actively hunted, as well as insects, carrion and vegetable matter,

especially,

especially fruit. The concept of a smaller body size as a means of reducing the energy requirements of the species with such a precarious existence, can be illustrated by the fact that the mean species weight in the Omnivorous category is only 8,3 kg, as opposed to the $\bar{X}$ 25,8 kg of the Predacious category and $\bar{X}$ 36,1 kg of *H. brunnea* in the Scavenging category.

Rhynchogale melleri is much smaller than the other three species in the Omnivorous category, and from this it is concluded that overlap in feeding interests is small. *Viverra civetta* is ecologically separated from *C. mesomelas* and *C. adustus*. The latter two species are inhabitants of the open plains, and avoid forests. Like Smithers' (1971) findings, my own observations on *V. civetta* indicate a close association with riverine and subriverine woodlands. *Canis adustus* is limited in range to the eastern Transvaal lowveld and a small area north of Pretoria. *Canis mesomelas* ranges throughout the Transvaal. The two species are thus partly sympatric, and as is suggested in Fig.175, may be in conflict here. Whereas Shortridge (1934) and Smithers (1971) speculate that *C. mesomelas* is being gradually replaced by *C. adustus* in the overlapping zone, this could not be demonstrated in the Transvaal. According to Pienaar (1963) *C. mesomelas* is numerically the more successful species in the Kruger National Park. *Canis adustus* is however slightly larger than *C. mesomelas*, and indications are that it relies less on vegetable matter as a food source.

The insectivorous feeding category has the lowest mean body weight. This is considered as a significant adaptation to the small size of the individual prey, and the quantity and effort required on the part of the carnivore to fulfill its energy requirements. There are three clusters in this category that warrant closer scrutiny (see Fig.175).

Aonyx capensis is the biggest member of the insectivorous group. It is an aquatic mammal subsisting almost entirely on crabs (Rowe-Rowe, 1977a and b). The terrestrial *P. cristatus* is the biggest carnivore living on Insecta, namely almost exclusively termites (especially *Triner vitermes*). It is not well equipped to dig out subterranian termites. *Mellivora capensis*

is/...

is also terrestrial and overlap in range with the aardwolf. It however hunts invertebrates bigger than termites, especially spiders. The honeybadger is particularly well adapted to procuring this subterranian prey.

Lutra maculicollis, *A. paludinosis* and *O. megalotis* also form a cluster in Fig.175. The latter species is however a terrestrial inhabitant of the open plains, while the former two are to varying degrees semi-aquatic. The spotted-necked otter and the marsh mongoose appear to be in conflict as they both rely heavily on crustaceans in their respective diets, and furthermore overlap in range and habitat requirements. *Atilax paludinosus* is however a more versatile animal by being more mobile on land. It therefore wanders greater distances away from water and utilizes a wider spectrum of food resources. It is furthermore believed to hunt for aquatic prey only in the shallows, as opposed to *L. macullicollis*.

Cynictis penicillata and *S. suricatta* also overlap in distributional range. Where the suricate is very gregarious and almost exclusively insectivorous, the yellow mongoose is a solitary hunter which takes vertebrate prey apart from invertebrates.

The predacious category is the true domain of the Felidae, and no felid has radiated away from it. They are specialist killers, the only group capable of handling prey larger than themselves singlehanded. This is achieved mostly by means of a lethal well-directed single neckbite, or derivations thereof. Felidae are in general also expert stalkers.

Of the nonfelids in this feeding category, the mustelid *P. albinucha* is an exception, in that it behaves very similarly to the Felidae with regards to killing efficiency and the size of prey that can be handled. The rest, i.e. the viverrids, canids and *Crocuta* all belong conditionally to the predacious category. *Crocuta crocuta* and *L. pictus* rely on group cooperation to kill, and are relatively inefficient predators when solitary. The rest of the nonfelids all rely on the other food sources already discussed, and when they kill, it is mostly prey much smaller than themselves (if domestic stock is excluded)

Very/...

Very little is known of the serval, but from whatever information is available it would appear not to be in conflict with the caracal, as is indicated in Fig.175. The serval appears to be restricted to areas with permanent surface water and its associated forests, and preys mostly on rodents. The caracal on the other hand, is not partial to forests and is a true predator of prey more equal in size to itself.

The ranges of *V. chama* and *I. albicauda* overlap only peripherally in the Transvaal. *Felis libyca* on the other hand, is widely distributed and overlap with the ranges of both the former species. *Felis libyca* and *V. chama* is separated in size to the extent that it presumably avoid conflict by means of differential choice in prey size. *Ichneumia albicauda* is restricted to riverine forests, whereas *F. libyca* has a wide habitat tolerance. The latter species therefore appears to be a universalist, the former a specialist extremely well adapted to its particular narrow niche. In the zone of contact between these two species, it can therefore be postulated that *I. albicauda* has the edge in a competitive situation.

The two species of genets are partly sympatric. Our own experience agrees with that of Smithers (1971) in that these two species are ecologically separated. *Genetta tigrina* prefers habitat close to water while *G. genetta* exists away from it. The range of *F. nigripes* overlaps partially with that of *G. genetta*, and not at all with *G. tigrina*. However, so little is known about the general biology of the black-footed cat, that no suggestions can be offered as to how it avoids conflict with the small-spotted genet.

ZOOGEOGRAPHY

B. A numerical re-appraisal of the southern African Biotic Zones

The distribution of all southern African mammals are employed to statistically evaluate the validity of the biotic zones previously emperically recognized for this subcontinent.

Zoogeography/.

Zoogeography has been defined as "... the scientific study of the distribution of animals on earth ..." (Udvardy, 1969:1). Through the years a number of attempts have been made to classify animal life into meaningful distributional units, and the field has been subdivided in diverse ways towards different ends. Perhaps the suggested subdivision most pertinent to this discussion, is that proposed by Darlington (1957:11) who distinguishes three possible levels of approach:

1) Geographical distribution over the entire earth;
2) regional distribution over selected segments of the earth;
3) local distribution, including species geography ("the geographical distribution of species in relation to each other and to ecology and evolution").

This study will consider a statistical analysis of the distributional trends of southern African mammals, in an effort to re-evaluate the validity and credibility of the emperically derived biotic zones of the southern subcontinent. It is primarily aimed at the second level of Darlington's zoogeographical approach, and deals with the regional distribution of the mammals of southern Africa. Unfortunately regional studies such as this are often bound to political, rather than natural, areas.

Udvardy (1969:6) distinguishes faunistic and regional zoogeography from dynamic causal zoogeography. He furthermore distinguishes specifically between zoogeography and ecology. Zoogeography in its purest sense concerns itself with the reasons for the arrival and settling of a species in a certain area. A study of why and how a species is able to live in that particular area is an ecological problem. Similarly, Simpson (1965:71-73) recognizes three levels of zoogeography, i.e. geographical, ecological, and historical. Both the zoogeographical and ecological attributed of distribution are the product of evolutionary processes during the course of time; hence, explanatory models can only be framed on a historical basis.

An accurate and detailed knowledge of subspeciation is essential in most modern computations aimed at causal zoogeography. The reverse is, however, also true; a consideration of the biogeography of taxa is important when studying subspeciation.

Zoogeography and taxonomy are thus interdependent. The subspecific status of the majority of southern African mammals is, in the modern context, unsatisfactorily resolved and this severely hampers any detailed and accurate biogeographical analysis. Available analytical procedures based on subspeciation, have therefore not been considered in this discussion pending further detailed survey work and subsequent taxonomic studies on the subspecies level. Consequently, this study is essentially limited to Udvardy's static faunistic and regional zoogeographical approach and is thus primarily ecological in context.

The major biogeographical zones or provinces currently accepted for Africa stem from Sclater (1896). He subdivided Africa into four subregions, i.e. the Sahara, West Africa, Cape and Malagasy. Recently, the Malagasy subregion was upgraded to regional status (Darlington, 1957). Hence the current concept of the Ethiopian region, is African south of the Sahara.

Chapin (1923, 1932), working on the avifauna of Zaire (formerly Belgian Congo), combined former approached (viz. Wallace, 1876; Sclater, 1896; Reichenow, 1900; Sharpe, 1983), with his own knowledge of the birds of tropical Africa. He divided Zaire into distinct avifaunal regions, which he based on vegetation types best fitting the distriubtion of birds. Chapin then attempted to follow these avifaunal regions into adjacent countries, eventually arriving at a subdivision of the Ethiopian region into biogeographical districts. His West African subregion, as well as his East and South African subregion, correspond closely to the subregions of Sclater (*op.cit.*). Both their approaches were essentially aimed at a broad separation of tropical forests from savannas and deserts.

In Chapin's (1932) treatise of Africa, southern Africa was subdivided into only two faunal districts, i.e. an eastern, and a western-arid district. Chapin's work was soon accepted (see Bates, 1924; and Lynes, 1924). However, Chapin (1932) himself comments that the least satisfactory portion of his zoogeographical map of Africa is the southern African district. He considers further subdivision necessary here, especially in order to accommodate the highveld grassland and the woodland savanna, as well as tropical montane and coastal forests.

Moreau (1952) collates and critically discusses the Tertiary geology and climate of Africa. In this light, he analyses the distribution of passerine avifauna of Africa, firstly by biomes, and secondly with respect to its affinities with the avifaunas of Europe and Asia. He geographically subdivides these main biomes into smaller biotic zones. He considers affinities both on generic and specific level, and found differences between these derived biotic zones, to be great.

With regards to southern Africa, Moreau (*op.cit.*) retains Chapin's (1923) South West Arid district more or less unaltered, as a biotic zone. However, Moreau introduces the concept of the Southern Savanna biotic zone, which combines Chapin's eastern, climatically moderate, woodland districts. As suggested by Chapin (1932), Moreau now also recognizes montane forests as distinct on a biotic zone level. He furthermore recognizes the small, but floristically very rich and distinct winter rainfall area round Cape Town, with its Mediterranean climate, as a separate biotic zone.

Moreau (1952) uses both the terms "biotic zone" and "biome". The first term has a definite zoogeographical connotation, the second ecological. According to Smith (1966), the biotic province (zone) concept "... embraces a continuous geographic area that contains ecological associations distinguishable from those of adjacent provinces (zones), especially at the species and subspecies level ...". The biome, on the other hand, is a major ecosystem, and is seen by Smith as "... a broad ecological unit characterized by the distinctive life forms of the climax species, plant or animal ...". Southern African biotic zones can in reality also be seen as biomes, except that as such they are only parts of the major biomes of Africa. Whatever the case, Moreau can be credited to be one of the first to employ the correct terminology in an African zoogeographical treatise, with consideration to concepts and terms developed in related fields such as ecology. This distinction between "biotic zone" and "biome" is recognized and applied in this report.

Davis/...

Davis (1962) employs the southern African portion of Moreau's (1952) biogeographical map in an analysis of distribution patterns of the local Muridae. He agrees with Moreau in the validity of the South-Western Cape as a biotic zone. But Davis' (*op.cit.*) main zoogeographical contribution lies in the fact that for the first time the biotic zones, which were founded on avifaunal distributional data, are analysed from a mammal point of view, albeit on only one family. Davis slightly alters the borders of the biotic zones to conform with the vegetation map of Keay (1959).

In a discussion on the origins of the southern African mammal fauna, Meester (1965) accepts Davis' modified version of Moreau's biotic zones. Whereas Davis' generalized attempts in subdividing the biotic zones went unnoticed, Meester's definite recognition of the Namib as a subzone of the South West Arid, and the Grassland as a subzone of the Southern Savanna (Fig. 176), was soon accepted. This approach to the recognition of biotic zones is even more compatable with the biome concept.

There are other proposed systems for subdividing the subcontinent into major biogeographic units, viz. those of Liversidge (1962) and Winterbottom (1962). However, the biotic zone concept as outlined above, has become commonly accepted as relevant from an ecological viewpoint, especially with regards to higher vertebrates. It is also, to my knowledge, the only zoogeographical system considered in recent years for work on mammal distribution (see Davis, 1962; Meester, 1965). It is therefore appropriate that biotic zones should receive closer scrutiny here, especially since no less than three currently recognized major biotic zones (one with two subzones) are represented in the Transvaal. Meester's (1965) refined version of Moreau's (1952) biotic zones (Fig.176) is analysed in this report.

The African biotic zones and subzones have been emperically derived by considering main vegetation types as to how they best fit the distribution of species, initially of birds and later mammals. The zones are thus largely subjective. A number of species may be confined to a single biotic zone (endemics), but

very/...

very few of these have ranges coinciding entirely with the boundaries of the particular zone in which they occur. Generally their ranges are more restricted. Such endemic species are few in number, and yet they serve as the main argument to justify the recognition of the biotic zone. The majority of species occur over several biotic zones, since their distributions are limited by factors more generalized than those governing the vegetation types on which the biotic zones are primarily based. These widespread species apparently formerly served no role in justifying the recognition of biotic zones.

Duellman (1965:677) proposes a statistical analysis to express the validity of biogeographical subdivisions, based on the known distribution of all species in the entire area. He termed it the "Faunal Resemblance Factor", which is statistically expressed as FRF = 2C/N1 + N2; where C equals the number of species in the first zone, and N2 equals the number of species in the second zone. An index value of 0.000 would indicate no taxonomic resemblance between two zonal faunas, and an index of 1.000 would indicate complete identity. A value of 0.500 would indicate that one-half of the species in each of the two zonal faunas are held in common, provided that they are of equal size. In the case of unequal-sized faunas, both dissimilarity in species composition and relative equality in species density, are expressed. Duellman's (*op.cit.*) formula is a simplified, yet equally as effective, derivative of the Burt coefficient (Burt, 1958). Both these formulas take the average of the two samples as the denominator (contrary to the Simpson and Jaccard coefficients - see Simpson, 1960), in an effort to reduce the effect of difference in size between them. However, the influence of differential faunal sizes is not entirely eliminated, and is therefore yet another factor expressing similarity or dissimilarity between zones. These formulas are furthermore designed for taxa of whom the geographical distributions of species are not well known. Only the presence or absence of taxa is of great importance. The Duellman coefficient is therefore ideally suited for this analysis, and was decided upon being the simplest of the two mentioned here.

The/...

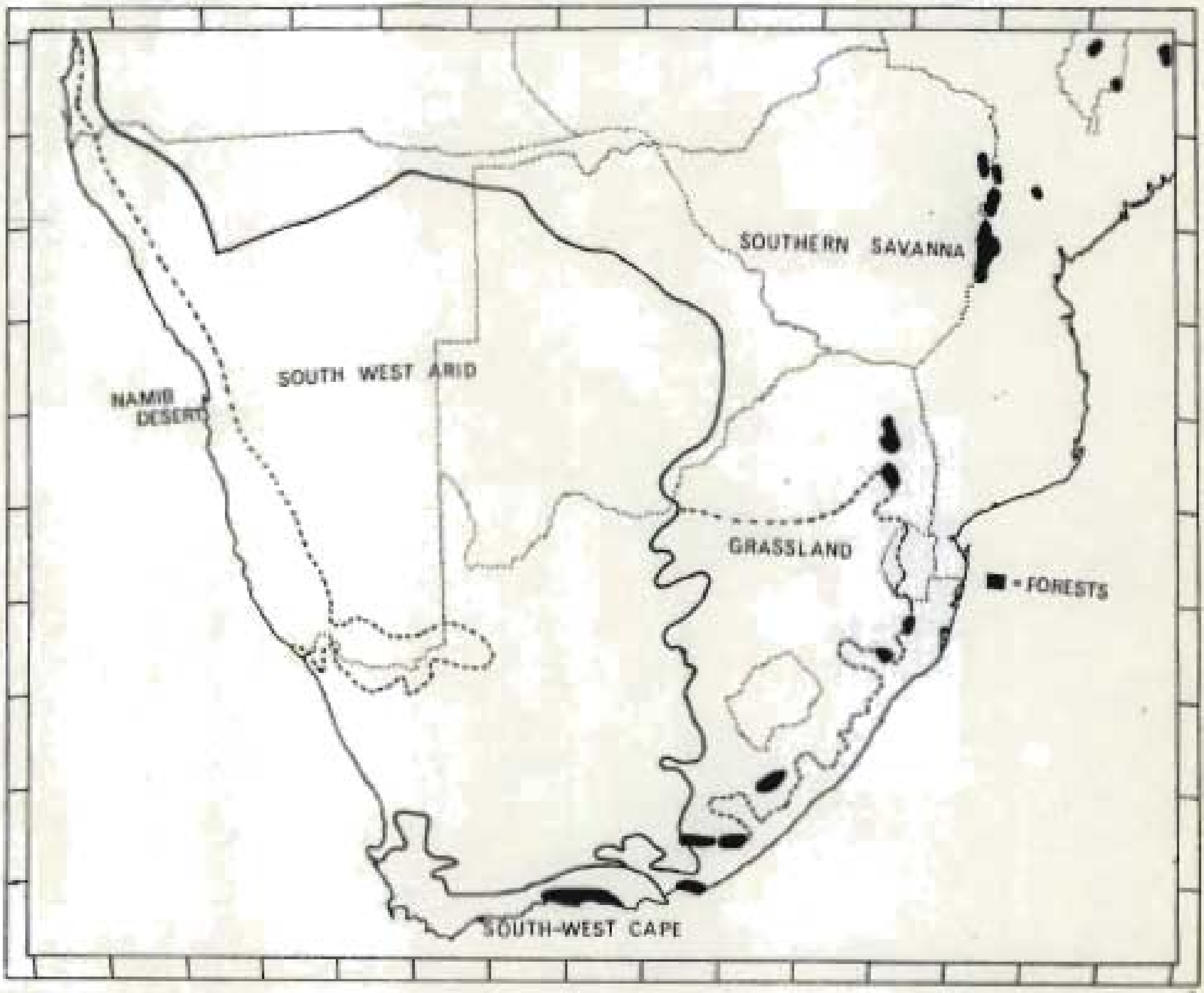


Fig.176: The southern African biotic zones, after Meester (1965).

The distributions of 275 species of southern African mammals are given in Table 3. This list was compiled from updated but unpublished distribution maps kept in the Transvaal Museum for curatorial purposes, as well as from the literature, particularly Smithers (1971), Davis (1974), Pringle (1974) and Lynch (1975). The taxonomic treatise of the various contributors to "The Mammals of Africa: an Identification Manual", edited by Meester and Setzer, was followed. In the calculation of FRF indices, the Southern Savanna Grassland and Woodland subzones and the Namib subzone, were treated as hypothetically valid zones, as indicated in Table 3. The list excludes feral and exotic species, as well as poorly known endemics of doubtful taxonomic status. As far as possible, the natural (historic) ranges of species were considered, thus compensating for human impact. Species with extremely limited ranges, or known from only a few localities, were considered as representative of the biotic zone in which they occur. Where the majority of localities for a species fall within a given zone, with only a few isolated instances falling just inside an adjacent zone, these were considered as typical only of the zone where the distribution is concentrated, and not as a constituent of the mammal fauna of the second zone. However, if such scattered typical of that zonal fauna as well. Judgement was subjective. Typical Forest zone species occurring outside that zone, but restricted to riverine forests, were considered as pure forest zone species. However, the influence of dispersal corridors such as the Kuiseb and Orange rivers, were not taken into account.

The distribution of bats as a group is particularly poorly documented, which may adversely influence the results of this analysis. Excluding bats from this analysis was therefore considered. However, certain mammalian taxa, as well as nutritionally and ecologically adapted groups, demonstrate diverse latitudinal clinal trends in composition and densities (Nel, 1975). Thus it was decided to include the meagre information on bats in this analysis in an effort to retain a more balanced image of trends in overall mammalian ecological distribution.

A simple matrix of similarity indicating the degree of inter-

relationships,

Table 3: Distribution of southern African mammals according to Biotic Zones.

	Namib	S.W. Arid	S.W. Cape	S. Sav. Woodl.	S. Sav. Grassl.	Fores
Petrodromus tetradactylus	-	-	-	X	-	X
Macroscelides proboscideus	X	X	-	-	-	-
Elephantulus intufi	X	X	-	X	-	-
Elephantulus rupestris	-	X	-	-	-	-
Elephantulus myurus	-	-	-	X	X	-
Elephantulus edwardi	-	X	-	-	-	-
Elephantulus brachyrhynchus	-	-	-	X	X	-
Erinaceus frontalis	-	X	-	X	X	-
Myosorex varius	-	-	X	X	X	X
Myosorex cafer	-	-	-	X	X	X
Suncus lixus	-	-	-	X	-	-
Suncus gracilis	-	-	-	-	X	-
Sylvisorex megalura	-	-	-	-	-	X
Crocidura occidentalis	-	-	-	X	-	X
Crocidura flavescens	-	-	X	-	X	X
Crocidura luna	-	-	-	-	-	X
Crocidura mariquensis	-	-	-	X	X	-
Crocidura hirta	-	X	-	X	X	X
Crocidura silacea	-	-	-	X	X	X
Crocidura cyanea	X	X	-	X	X	X
Crocidura maquassiensis	-	-	-	X	X	-
Crocidura bicolor	-	X	-	X	-	-
Chrysospalax trevelyani	-	-	-	X	-	X
Chrysospalax villosus	-	-	-	X	X	X
Cryptochloris wintoni	-	X	-	-	-	-
Cryptochloris zyli	-	-	X	-	-	-
Chrysochloris asiatica	-	X	-	-	-	-
Chrysochloris visagiei	-	X	-	-	-	-
Eremitalpa granti	X	X	X	-	-	-
Chlorotalpa sclateri	-	X	-	-	X	-
Chlorotalpa duthiae	-	-	-	-	-	X
Chlorotalpa arendsi	-	-	-	-	-	X
Calcochloris obtusirostris	-	-	-	X	-	-
Amblysomus gunningi	-	-	-	-	-	X
Amblysomus hottentotus	-	-	-	X	X	X

	Namid	S.W. Arid	S.W. Cape	S. Sav. Woodl.	S. Sav. Grassl.	Forest
Amblysomus iris	-	-	-	X	X	X
Amblysomus julianae	-	-	-	X	X	-
Eidolon helvum	-	X	-	X	X	-
Epomophorus wahlbergi	-	-	-	X	-	X
Epomophorus gambianus	-	-	-	X	-	-
Epomophorus crypturus	-	-	-	X	-	-
Epomophorus angolensis	-	-	-	X	-	-
Rousettus aegyptiacus	-	-	-	X	-	X
Rousettus angolensis	-	-	-	-	-	X
Taphozous mauritianus	-	-	-	X	-	-
Taphozous perforatus	-	-	-	X	-	-
Coleura afra	-	-	-	X	-	-
Nycteris hispida	-	-	-	-	-	X
Nysteris grandis	-	-	-	-	-	X
Nycteris macrotis	-	-	-	X	-	X
Nycteris woodi	-	-	-	X	-	X
Nycteris thebaica	X	X	-	X	-	X
Rhinolophus hildebrandti	-	-	-	X	-	X
Rhinolophus fumigatus	-	X	-	X	-	-
Rhinolophus clivosus	-	-	X	X	X	X
Rhinolophus darlingi	X	X	-	X	-	-
Rhinolophus landeri	-	-	-	X	-	-
Rhinolophus blasii	-	-	-	X	-	-
Rhinolophus capensis	-	X	X	X	-	-
Rhinolophus simulator	-	-	-	X	-	-
Rhinolophus denti	-	X	-	X	-	-
Rhinolophus swinnyi	-	-	-	X	-	-
Hipposideros commersoni	-	X	-	X	-	-
Hipposideros caffer	-	X	-	X	-	X
Triaenops persicus	-	-	-	X	-	-
Cloeotis percivali	-	-	-	X	-	-
Myotis welwitschii	-	-	-	X	X	-
Myotis seabrai	-	X	-	-	-	-
Myotis lesueuri	-	-	X	-	-	-
Myotis tricolor	-	X	-	X	X	-
Myotis bocagei	-	-	-	X	-	-

	Namid	S.W. Arid	S.W. Cape	S. Sav. Woodl.	S. Sav. Grassl.	Fore
Nycticeius schlieffeni	-	X	-	X	-	-
Pipistrellus nanus	-	-	-	X	-	X
Pipistrellus kuhli	-	-	-	X	-	X
Pipistrellus rusticus	-	-	-	X	-	X
Pipistrellus rueppelli	-	-	-	X	-	-
Eptesicus rendalli	-	-	-	X	-	-
Eptesicus hottentotus	X	X	-	X	-	-
Eptesicus melckorum	-	-	X	-	-	-
Eptesicus zuluensis	X	X	-	X	-	-
Eptesicus somalicus	-	-	-	X	-	-
Eptesicus capensis	-	X	-	X	X	-
Eptesicus notius	-	-	X	-	-	-
Glauconycteris variegata	-	-	-	X	-	-
Laephotis wintoni	-	-	-	X	-	-
Scotophilus gigas	-	-	-	X	-	-
Scotophilus nigrita	-	-	-	X	-	-
Scotophilus leucogaster	-	X	-	X	-	-
Kerivoula argentata	-	-	-	X	-	-
Kerivoula harrisoni	-	-	-	X	-	-
Kerivoula lanosa	-	-	-	X	-	X
Miniopterus fraterculus	-	-	-	X	-	-
Miniopterus schreibersi	X	X	-	X	X	X
Otomops martiensseni	-	-	-	X	-	-
Sauromys petrophilus	-	X	-	X	-	-
Tadarida acetabulosus	-	-	-	X	-	-
Tadarida midas	-	X	-	X	-	-
Tadarida nivelventer	-	-	-	X	-	-
Tadarida condylura	-	-	-	X	-	X
Tadarida nigeriae	-	X	-	X	-	-
Tadarida chapini	-	-	-	X	-	-
Tadarida pumila	-	-	-	X	-	-
Tadarida fulminans	-	-	-	X	-	-
Tadarida aegyptiaca	-	X	X	X	X	X
Tadarida ansorgei	-	-	-	X	-	-
Galago crassicaudatus	-	-	-	X	-	X
Galago senegalensis	-	X	-	X	-	X

	Namib	S.W. Arid	S.W. Cape	S. Sav. Woodl.	S.Sav. Grassl.	Fores
Papio cynocephalus	-	-	-	X	-	-
Papio ursinus	X	X	X	X	X	X
Cercopithecus mitis	-	-	-	X	-	X
Cercopithecus aethiops	-	X	-	X	-	X
Manis temmincki	-	X	-	X	X	-
Otocyon megalotis	-	X	-	X	-	-
Vulpes chama	X	X	-	X	X	-
Canis mesomelas	X	X	-	X	X	-
Canis adustus	-	-	-	X	-	-
Lycaon pictus	-	X	-	X	-	-
Ictonyx striatus	X	X	-	X	-	-
Poecilogale albinucha	-	X	-	X	X	-
Mellivora capensis	-	X	-	X	-	-
Lutra maculicollis	-	X	-	X	X	-
Aonyx capensis	-	X	-	X	X	-
Nandinia binotata	-	-	-	-	-	X
Viverra civetta	-	-	-	X	-	-
Genetta genetta	X	X	X	X	X	-
Genetta tigrina	-	-	X	X	-	X
Genetta rubiginosa	-	-	-	X	-	-
Genetta mossambica	-	-	-	X	-	-
Suricata suricatta	X	X	-	-	X	-
Paracynictis selousi	-	-	-	X	-	-
Bdeogale crassicauda	-	-	-	X	-	-
Cynictis penicillata	-	X	-	X	X	-
Herpestes ichneumon	-	-	-	X	-	-
Herpestes pulverulentus	-	X	-	-	X	-
Herpestes sanquineus	-	X	-	X	X	X
Herpestes ratlamuchi	-	X	-	X	-	-
Rhynchogale melleri	-	-	-	X	-	X
Ichneumia albicauda	-	-	-	X	-	X
Atilax paludinosus	-	X	X	X	X	X
Mungos mungo	-	X	-	X	-	-
Helogale parvula	-	X	-	X	-	-
Proteles cristatus	X	X	-	X	X	-
Hyaena brunnea	X	X	-	X	X	-
Crocuta crocuta	X	X	-	X	X	-

	Namib	S.W. Arid	S.W. Cape	S. Sav. Woodl.	S. Sav. Grassl.	Fores
Felis libyca	X	X	X	X	X	-
Felis nigripes	-	X	-	-	X	-
Felis serval	-	-	X	X	-	-
Felis caracal	X	X	-	X	X	-
Panthera pardus	X	X	X	X	X	X
Panthera leo	-	X	X	X	X	-
Acinonyx jubatus	-	X	-	X	-	-
Orycteropus afer	-	X	-	X	X	-
Loxodonta africana	-	X	-	X	-	-
Procavia capensis	X	X	X	X	X	X
Procavia welwitschii	X	X	-	-	-	-
Heterohyrax brucei	-	-	-	X	-	-
Dendrohyrax arboreus	-	-	-	X	-	-
Diceros bicornis	-	X	X	X	-	-
Ceratotherium simum	-	X	-	X	X	-
Equus zebra	X	X	-	-	-	-
Equus burchelli	-	X	X	X	X	-
Potamochoerus porcus	-	-	X	X	-	X
Phacochoerus aethiopicus	-	X	-	X	-	-
Hippopotamus amphibius	-	X	X	X	X	-
Giraffa camelopardalis	-	X	-	X	-	-
Cephalophus natalensis	-	-	-	X	-	X
Cephalophus monticola	-	-	-	X	-	X
Sylvicapra grimmia	-	X	X	X	X	-
Raphicerus campestris	-	X	X	X	X	-
Raphicerus melanotis	-	-	X	X	-	-
Raphicerus sharpei	-	-	-	X	-	-
Ourebia ourebi	-	-	-	X	X	-
Neotragus moschatus	-	-	-	X	-	-
Oreotragus oreotragus	X	X	-	X	-	-
Madoqua kirki	-	X	-	-	-	-
Pelea capreolus	-	X	X	X	X	-
Redunca arundinum	-	-	-	X	-	-
Redunca fulvorufula	-	-	-	X	X	-
Kobus ellipsiprymnus	-	X	-	X	-	-
Kobus vardoni	-	-	-	X	-	-

	Namib	S.W. Arid	S.W. Cape	S. Sav. Woodl.	S. Sav. Grassl.	Fore
Kobus leche	-	-	-	X	-	-
Aepyceros melampus	-	X	-	X	-	-
Aepyceros petersi	-	X	-	X	-	-
Antidorcas marsupialis	X	X	-	-	X	-
Oryx gazella	X	X	-	X	-	-
Hippotragus leucophaeus	-	-	X	-	-	-
Hippotragus niger	-	-	-	X	-	-
Hippotragus equinus	-	-	-	X	-	-
Damaliscus lunatus	-	-	-	X	-	-
Damaliscus dorcas dorcas	-	-	X	-	-	-
Damaliscus dorcas phillipsi	-	X	-	-	X	-
Alcelaphus buselaphus	-	X	-	X	X	-
Alcelaphus lichtensteini	-	X	-	X	-	-
Connochaetes taurinus	-	X	-	X	-	-
Connochaetes gnou	-	-	-	-	X	-
Tragelaphus scriptus	-	-	X	X	-	-
Tragelaphus spekei	-	-	-	X	-	-
Tragelaphus angasi	-	-	-	X	-	-
Tragelaphus strepsiceros	-	X	-	X	-	-
Taurotragus oryx	-	X	X	X	X	-
Syncerus caffer	-	-	-	X	-	-
Lepus capensis	-	X	-	X	X	-
Lepus saxatilis	-	X	-	X	X	-
Bunolagus monticularis	-	X	-	-	-	-
Pronolagus crassicaudatus	-	-	-	X	-	-
Pronolatus rupestris	-	X	-	X	X	-
Pronolagus randensis	-	X	-	X	X	-
Bathyergus janetta	-	X	-	-	-	-
Bethyergus suillus	-	-	X	-	-	X
Georychus capensis	-	X	X	-	X	-
Cryptomys damarensis	-	X	-	-	-	-
Cryptomys hottentotus	-	X	-	X	X	X
Hystrix africaeaustralis	X	X	-	X	X	X
Petromus typicus	X	X	-	-	-	-

	Namib	S.W. Arid	S.W. Cape	S. Sav. Woodl.	S. Sav. Grassl.	Fores
Thryonomys swinderianus	-	-	-	X	-	-
Thryonomys gregorianus	-	-	-	X	-	-
Xerus inauris	-	X	-	-	X	-
Xerus princeps	-	X	-	-	-	-
Heliosciurus rufobrachium	-	-	-	X	-	X
Funisciurus congicus	-	X	-	-	-	-
Paraxerus palliatus	-	-	-	-	-	X
Paraxerus cepapi	-	-	-	X	-	-
Pedetes capensis	X	X	-	X	X	-
Graphiurus ocularis	-	X	X	-	-	-
Graphiurus platyops	-	X	-	X	X	-
Graphiurus murinus	-	X	-	X	X	X
Cricetomys gambianus	-	-	-	X	-	X
Dendromus nyikae	-	-	-	-	-	X
Dendromus melanotis	-	X	X	X	X	X
Dendromus mesomelas	-	-	X	X	X	X
Dendromus mystacalis	-	-	-	X	X	X
Malacothrix typica	-	X	-	-	X	-
Mystromys albicaudatus	-	-	X	-	X	-
Petromyscus monticularis	-	X	-	-	-	-
Petromyscus collinus	X	X	-	-	-	-
Saccostomus campestris	-	X	X	X	X	-
Steatomys pratensis	-	X	-	X	-	-
Steatomys krebsi	-	X	-	-	X	-
Steatomys minutus	-	X	-	X	X	-
Acomys spinosissimus	-	-	-	X	-	X
Acomys subspinosus	-	-	X	-	-	X
Aethomys granti	-	X	-	-	-	-
Aethomys namaquensis	X	X	X	X	X	-
Aethomys chrysophilus	-	X	-	X	-	-
Aethomys nyikae	-	-	-	X	-	-
Dasymus incomtus	-	-	X	X	X	-
Mus indutus	-	-	-	X	X	-
Mus minutoides	X	X	X	X	X	X
Lemniscomys griselda	-	X	-	X	-	-
Pelomys fallax	-	-	-	X	-	X
Praomys natalensis	-	X	X	X	X	X

	Namib	S.W. Arid	S.W. Cape	S. Sav. Woodl.	S. Sav. Grassl.	Fore
Praomys shortridgei	-	-	-	X	-	-
Praomys verreauxi	-	-	X	-	-	X
Rhabdomys pumilio	X	X	X	X	X	X
Thallomys paedulcus	X	X	-	X	-	-
Thamnomys cometes	-	-	-	-	-	X
Thamnomys dolichurus	-	-	-	X	-	X
Zelotomys woosnami	-	X	-	-	-	-
Parotomys brantsi	X	X	X	-	-	-
Parotomys littledalei	X	X	-	-	-	-
Otomys laminatus	-	-	-	X	X	X
Otomys angoniensis	-	X	-	X	X	-
Otomys saundersiae	-	-	X	-	X	-
Otomys irroratus	-	X	X	X	X	X
Otomys sloggetti	-	-	-	-	X	-
Otomys unisulcatus	-	X	-	-	-	-
Desmodillus auricularis	X	X	-	-	-	-
Gerbillurus vallinus	X	X	-	X	-	-
Gerbillurus tytonis	X	-	-	-	-	-
Gerbillurus paeba	X	X	X	X	-	-
Gerbillurus setzeri	X	-	-	-	-	-
Tatera leucogaster	X	X	-	X	-	-
Tatera afra	-	-	X	-	-	-
Tatera brantsii	-	X	-	X	X	-
Tatera inclusa	-	-	-	X	-	-
Total (275 species)	43	136	50	209	91	73
Percentage of total fauna	15,6	49,5	18,2	76,0	33,1	26,6
Total no. of endemic species	2	16	7	60	3	12
% endemics to total zonal fauna	4.65	11.76	14.00	28.71	3.30	16.[illegible]

relationships of mammalian faunas of southern African biotic zones, is given in Table 4. Absolute numbers of species in common are indicated below the diagonal. Italic numerals on the diagonal indicate the number of species in each zone, and the bracketed numerals underneath these denote the known number of endemic species. Above the diagonal is an index of faunal resemblance, calculated after Duellman (1965).

It must be stressed that subcontinental distributional data is as yet very incomplete for the majority of species, particularly so in the Cape Province and South West Africa. Furthermore, the accuracy of this analysis will be greatly enhanced if conducted on the subspecies level, rather than on a species level. This ideal will be delayed for many years as a result of the unsatisfactory status of the knowledge of subspeciation in southern African mammals.

On the other hand, a more intimate knowledge of the distribution patterns of species does not necessarily imply a high incidence of range extensions into biotic zones where they have previously been unrecorded. When species ranges are better known and the occurrence of not too many species are recorded in new zones, the results of this analysis will not change dramatically. A more accurate FRF analysis facilitated by subspecies consideration, will probably only enhance the findings of this treatment since a higher degree of endemism is expected. Whatever the case, the following points are pertinent from Table 4 and warrant further comment here, especially with regard to my aim to assess the validity of biotic zones as viable biogeographical areas.

Superficially, the FRF indices of all zones under consideration, are low enough to warrant their consideration as distinct zones (Table 4). Closer scrutiny is however essential.

The Namib is closest related to the South-West Arid, albeit with a FRF index as low as 0.458. The Namib's FRF indices when calculated against the other zones are, however, much lower, which confirms distinctness from these. The Namib possesses only two endemic species (Table 3), i.e. *G. tytonis* and *G. setzeri*. However, by far the greatest majority (41) of the Namib's total

mammal/...

Table 4: Resemblance of mammalian faunas of the six southern African Biotic Zones and Subzones. (See text for explanation; italic numerals on diagonal indicate total number of species in zone, the numerals in brackets underneath these denote the known number of endemic species).

	S. Sav. Woodl.	S.W. Arid	S.Sav. Grassl.	Forest	S.W. Cape	Namib
S. Sav. Woodl.	*209* (60)	,580	,500	,404	,247	,238
S.W. Arid	100	*136* (16)	,573	,201	,290	,458
S. Sav. Grassl.	75	65	*91* (3)	,341	,411	,299
Forest	57	21	28	*73* (12)	,309	,138
S.W. Cape	32	27	29	19	*50* (7)	,237
Namib	30	41	20	8	11	*43* (2)

mammal fauna (43) consists of a faction of the bigger South-West Arid fauna (some species also occur elsewhere). Consequently it can be considered as merely a depauperate fauna of the latter, resulting from the inhospitable nature of the Namib. The Namib's biogeographical uniqueness thus lies not so much in its typical endemic fauna, or its faunal composition for that matter, but rather in the fauna it does not possess. The Namib is therefore considered here as a biotic zone of full rank. Detailed analysis have shown that the Namib can be further subdivided, on the basis of the sand dunes being faunistically more depauperate than the gravel plains (see Coetzee, 1969).

In spite of its tremendous floral diversity, the South-Western Cape is also very depauperate in mammal fauna. However, it must be pointed out that this is, in terms of intensive mammal surveying, the most neglected biotic zone of all. It has seven endemic taxa as far as is known, viz. *C. syli*, *M. leseuri*, *E. melakorum*, *E. notius*, *D. d. dorcas*, *T. afra*, and the extinct *H. leucophaeus*, (see Table 3). The remainder of the faunal element is made up of mammal species shared with other biotic zones. This zone shares 32 species with the woodland zone, and 29 with the Grassland zone. However, as a result of the enormous differential species diversity between the Woodland and the South-West Cape, the FRF analysis indicates a closer resemblance between the latter zone and the less diversified Grassland zone, with an index of 0.411. It is interesting to note that the South-West Cape and the Grassland zones are unconnected.

The Forest zone is also quite distinct from the rest. It is faunistically closest related to the Southern Savanna Woodland subzone with a FRF index of 0.401. It possesses 12 endemic species (see Table 3).

The Woodland and Grassland zones and the South-West Arid zone are the three areas related closer to each other than any other combination of zones. Their individual FRF indices in relation to each other, are however considered low enough to warrant their individual recognition. Since the Grassland has been considered a subzone of the Southern Savanna biotic zone,

closest/...

closest resemblance is expected between it and the related Woodland subzone. This is, however, not the case. Both in terms of absolute number of species in common, and FRF index, the Woodland and South-West Arid are faunistically closest related (100 species in common; FRF index 0.580). This is followed by: a closer resemblance between Grassland and South-West Arid in terms of FRF indices (0.573); but in terms of number of species in common, a closer resemblance between Grassland and Woodland (75 species). This inconsistency can be ascribed to the disproportionate sizes of the three zonal faunas and as compensated for by Duellman's formula especially designed for such instances. The Southern Savanna Woodland has by far the richest mammal fauna; 209 species, representing 76.0% of the total southern African mammal fauna, occur here, - including 60 endemics (predominantly bats). This is followed by the South-West Arid, with a total diversity of 136 species, i.e. 49.5% of the total of 275 southern African species, with 16 endemics. The Savanna Woodland undoubtedly offers the highest variety of habitats, being ecologically more diversified both horizontally and vertically. Its rich species diversity could be related to this fact more than any other.

The temptation is great to assume that the respective faunal elements of other zones have originated by a radiation of Woodland-adapted species. Undoubtedly this is true in many instances, especially in the case of species which do not rely on trees as an integral element in their habitat requirements. On the other hand, the high number of endemics typical of the Woodland and South-West Arid areas combined (76 species), can be interpreted as a faunal element specialized towards a dependance on woodland in some manner or other. The fact that such a large portion (100 species) of the non-endemic fauna of the Woodland apparently radiated adaptively into the South-West Arid, is reflected by the highest FRF index of all (0.580). Mostly due to lower average annual precipitation, the latter zone has not such a well developed woodland flora, and consequently a less diversified mammal fauna.

The same situation could also be demonstrated with Grassland adapted species finding suitable habitat in adjacent

Woodland Savanna (FRF index 0.500) and South-West Arid (FRF index 0.573). Forests are scattered through three zones, and has higher FRF indices with these, than with the unadjacent Namib and South-West Arid. This trend of a relatively higher FRF index reflecting a sharing of species between adjacent zones, numerically radiating clinally from the Woodland Savanna, appears to be the rule. There is one exception, i.e. South-West Cape being faunistically closest to the unadjacent Grasslands, with a FRF index of 0.423.

Nel (1975) found an almost linear correlation between number of species and mean annual precipitation in a latitudinal direction in southern Africa. The result is a low to high gradient in species densities from west to east, as mean annual rainfall increases. This is particularly the case in bats. Nel could also find no real correlation between species density and altitutde. The altitudinal profile of southern Africa is relatively low, which probably explains this phenomenon. This, however, needs closer study to confirm its validity.

It would appear from the results of this analysis that a low to high gradient in species densities could also be demonstrated in a south to north direction. Species densities increase from 50 in the South-West Cape, to 91 in the Grassland, to 136 in the South-West Arid, to 209 in the Woodland. Although rainfall again undoubtedly plays some role in this trend, other causal factors such as decreasing latitude, temperature, faunal origin and dispersion, will have to be considered in a more detailed analysis.

From the above discussions, pertinent considerations can be summarized as follows:

1) Six biotic zones are recognized here as viable biogeographical entities, as deducted from this analysis (Fig.177). Where the Grassland and the Woodland have formerly been regarded as subzones of the then Southern Savanna biotic zone, terminology may hence be confusing when referring to these as biotic zones of full rank. In order to retain the Pan-African implications and perspective of the term Southern Savanna, I suggest

that/...

hat these two biotic zones be known as the Southern Savanna oodland and the Southern Savanna Grassland biotic zones. This uggestion is made in the full realization that in the latter ase, the definition of a savanna is stretched to the limit. erminology for the Namib biotic zone remains unchanged, bar he indication of its elevated zonal status.

) Biotic zones are here regarded as the largest biogeographic nits in which southern Africa could be subdivided, i.e. the outhern Savanna Woodland, the Southern Savanna Grassland, the he Forest, the Namib, the South-West Arid, and the South-West ape.

) Very few species have such a wide habitat tolerance that hey occur in all biotic zones. Endemism is, on the other hand. qually as unusual. In the majority of instances, species are hared between various combinations of zones, and the unique eature of the FRF analysis is to take this into account, apart rom endemism. Therefore, a high FRF index indicates a high ncidence of shared species and therefore closer faunal simila- ity.

4) The FRF analysis in fact takes three characteristics into onsideration when expressing the faunal distinctness of a zone, .e. the respective species densities of the two zones under nsideration, the number of species in common, and indirectly so the number of distinctive species of each zone. Based on results of the FRF analysis, the Namib zone is deducted to fully distinct from the South-West Arid. It is considered a bona fide biotic zone in full realization of the fact that as a very small distinctive fauna. The Grassland is simi- y considered to be a distinct biotic zone, rather than a ne. In both these instances, one of the previous consider- s for their recognition as zones of lower rank, was the low e of endemism.

he six biotic zones recognized here as biogeographical es, correlates very well with what I regard as major ical biomes in southern Africa.

e FRF indices of the South-West Arid, the Woodland and

the/...

the Grassland as compared with each other, are all over 0.500. There is no established value over which a zone cannot be considered statistically valid, and judgement is therefore subjective. The FRF value of these zones in question, are here considered low enough to warrant their recognition as valid biotic zones. In comparison Armstrong (1972) consideres Merriam's (1890) life zones, which the former author tested with Duellman's FRF analysis, as valid with indices as high as 0.847. In the present analysis, the generally lower FRF indices could be ascribed to disproportionate faunal densities between certain zones. These differences between the sizes of zonal faunas are here regarded as a valid criterion in considering the rank of a particular zone.

7) With the exception of seven species, the remainder of the 68 southern African bat species are all recorded from the Southern Savanna Woodland, amongst other zones. The presence of the bat fauna in the other biotic zones, are dramatically less (five in the Namib; 20 in the South-West Arid; six in the South West Cape; seven in the Grassland; and 18 in Forests). The Chiroptera is the least known group of mammals in southern Africa, and although Duellman's (1965) formula partly compensates for this shortcoming, it has an undeterminable bearing on the accuracy of the above observation. The inference is, however, that as a group bats has a remarkable attachment to Woodland Savanna.

8) Biotic zones are emperically derived by consideration of major vegetation types. Although the former are proved to be significant from a faunal point of view, it does not necessarily reflect the best way to describe faunal distribution patterns, especially since individual ranges of species seldom overlap entirely with any biotic zone. Biotic zones as significant biogeographical entities, should rather, from a faunal point of view, be seen as illustrating the gross direct relationship of the animal to its floral environment, and to a lesser extent, also to the physical environment. In the context of biotic zones, faunal interrelationships should therefore be interpreted from an ecological point of view.

9)/...

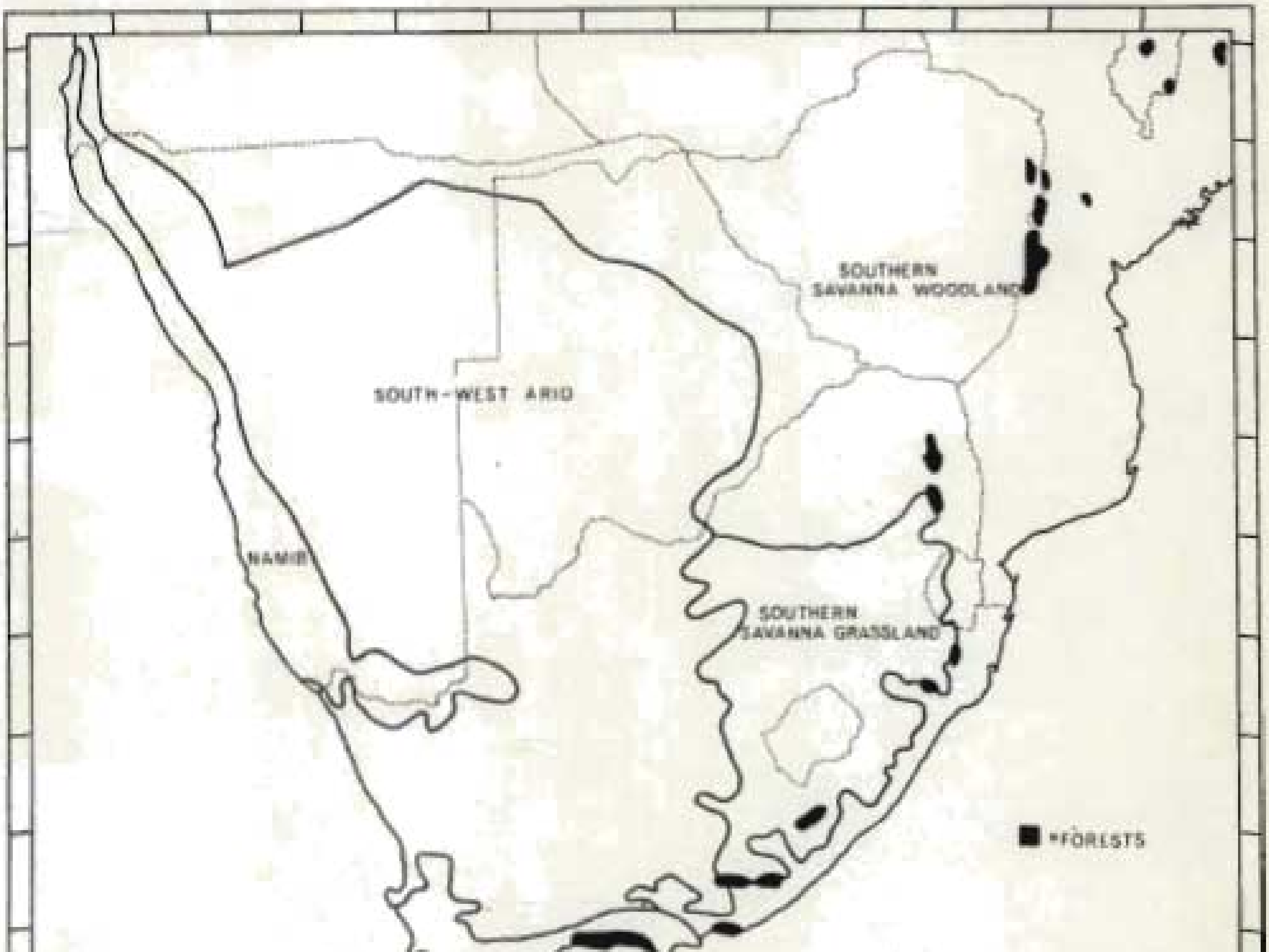


Fig.177: The six biotic zones which are here recognized as viable biogeographic entities.

9) Continued intensive mammal surveying in southern Africa is considered essential for a better understanding of both subspeciation and zoogeographical interpretation, through more detailed analysis. Especially the Chiroptera throughout the subcontinent, and the faunas of South-West Arid and South-West Cape biotic zones, need intensive attention in terms of surveying. It is however, not expected that a more intimate knowledge of these aspects will dramatically change the results and implications of this analysis.

C. Ecological Distribution of the Mammals of the Transvaal

The four biotic zones overlying the Transvaal are here subdivided into ten zoogeographical units of lower taxonomic rank, i.e. community types. The latter are defined in terms of the veld types described by Acocks (1975). The validity of, and the interrelationships between, community types are tested by means of Duellman's (1965) Faunal Resemblance Factor. A simple phenogram constructed by using Sokal and Sneath's (1963) WPGMA, which illustrates faunal relationships between community-types, is given. Westward and southward declines in species densities are indicated. Species density, faunal diversity, and eastward and westward flowing drainage systems are related to each other and are also employed to indicate areas of varying ecological complexity within the Transvaal.

Since the sum total of macroclimatic conditions generally influences the existence, distribution and maintenance of plant formations, the combination of climatic zones and vegetational formations would be adequate for the broad chorological grouping of animal habitats and division of land suitable for the grouping of animal distributions (Udvardy, 1969:250). With regard to defining zoogeographical areas, Davis (1962) considers "... vegetation as the most meaningful ecological summary of the influences of soil, climate, topography and other static and dynamic environmental factors". This method in zoogeography of relating animal distributions to established plant formations is ecological in its approach, hence the subtitle of this discussion.

In/...

In the main text which deals with the biology of all mammal species occurring in the Transvaal, the distributional attributes of individual species are discussed, - where possible in relation to the influence of environmental factors and ecological requirements. This approach involves the lowest level of zoogeographical resolution, namely autecology. From a cursory glance through these species accounts it is obvious that the distributional attributes of most species appear to be unique. Having considered the autecology of individual species, it is now of interest to know to what extent these situations are indeed unique, or whether in fact they form part of a larger trend of distribution.

In section B of this chapter I have statistically assessed the validity of southern African biotic zones as derived by Moreau (1952), Davis (1962), and Meester (1965), from a consideration of the vegetation types (or biomes) of the subcontinent. My statistical treatment is based on the distributions of the greatest majority of mammal species occurring in this region. As a result, biotic zones are recognized as the widest possible zoogeographic entities of this subcontinent. Of the six biotic zones found to be valid, no less than four overlie the Transvaal, i.e. the Southern Savanna Woodland, the Southern Savanna Grassland, Forest, and the South-West Arid. These are therefore zoogeographically the largest units of ecological subdivision of this Province.

As was pointed out by Chapin (1932), further subdivision of biogeographical regions or units is always possible, and in fact often necessary. With the four biotic regions occurring in the Transvaal as basis, the distribution of Transvaal mammals is related to vegetation types in order to further subdivide the Transvaal into smaller biogeographical areas of lower taxonomic rank, here termed community-types. This study is aimed at the third level of Darlington's (1957:11) zoogeographical approach, in that it deals with the local distribution of the mammals of the Transvaal. Similarly and for the same reasons as in the previous discussion, this study is also limited to Udvardy's (1969:6) static faunistic and regional approach.

In/...

In the present report Smith's (1966:12) definition of communities is followed, i.e. "... a naturally occurring assemblage of plants and animals that live in the same environment, are mutually sustaining and interdependent, and are constantly fixing, utilizing and dissipating energy". Smith (*op.cit.*) elaborates further by pointing out that communities are for practical reasons often thought of as distinct and well demarcated natural units. However, community boundaries are more often than not hard to define, with the one community blending into the next.

J.P.H. Acocks (1975) divides South Africa into 70 different units that he terms veld types. These plant associations are in essence ecological plant communities, each under the influence of its own unique set of environmental conditions. Acocks' work is used as the basis in defining the community types described below and subsequently testing of the latter for significance as zoogeographical units. In the Transvaal, Acocks (*op.cit.*) recognizes 18 such plant communities. On the basis of the distribution patterns of Transvaal mammals, this number of community types is regarded as too numerous, and the differences between them too small, for all to be recognized. Following a priori reasoning these 18 have been reduced to ten, recognized on the basis of qualitative and quantitative composition of dominant plant species, as well as of the physical environment. In my definitions of community types I remained within the boundaries of the various biotic zones (as previously discussed) overlying the Transvaal territory. As will furthermore be evident, Acocks' (1975) veld types occurring within the Province, are here mostly grouped as entities on the basis of strong mutual affinities. Based on mammalian distribution patterns within the Transvaal, the validity of these derived communities are numerically tested as valid bioecological entities.

The gross composition and structure of all proposed community types are evident from the names applied to them. Some generalized terms need qualification. Highveld refers to the entire southern Transvaal area characterized by rolling grassland plains and a higher altitude. The term bushveld denotes all the wooded areas lying to the north and east of the highveld, whereas the

term/...

term lowveld refers to the woodland area below and to the east of the Drakensberg escarpment.

The ten community types to be tested as biogeographical units are defined below. They are derived from a grouping of Acocks' (1975) 18 veld types occurring in the Transvaal, and are illustrated in Fig.178.

Southern Savanna Grasslands:

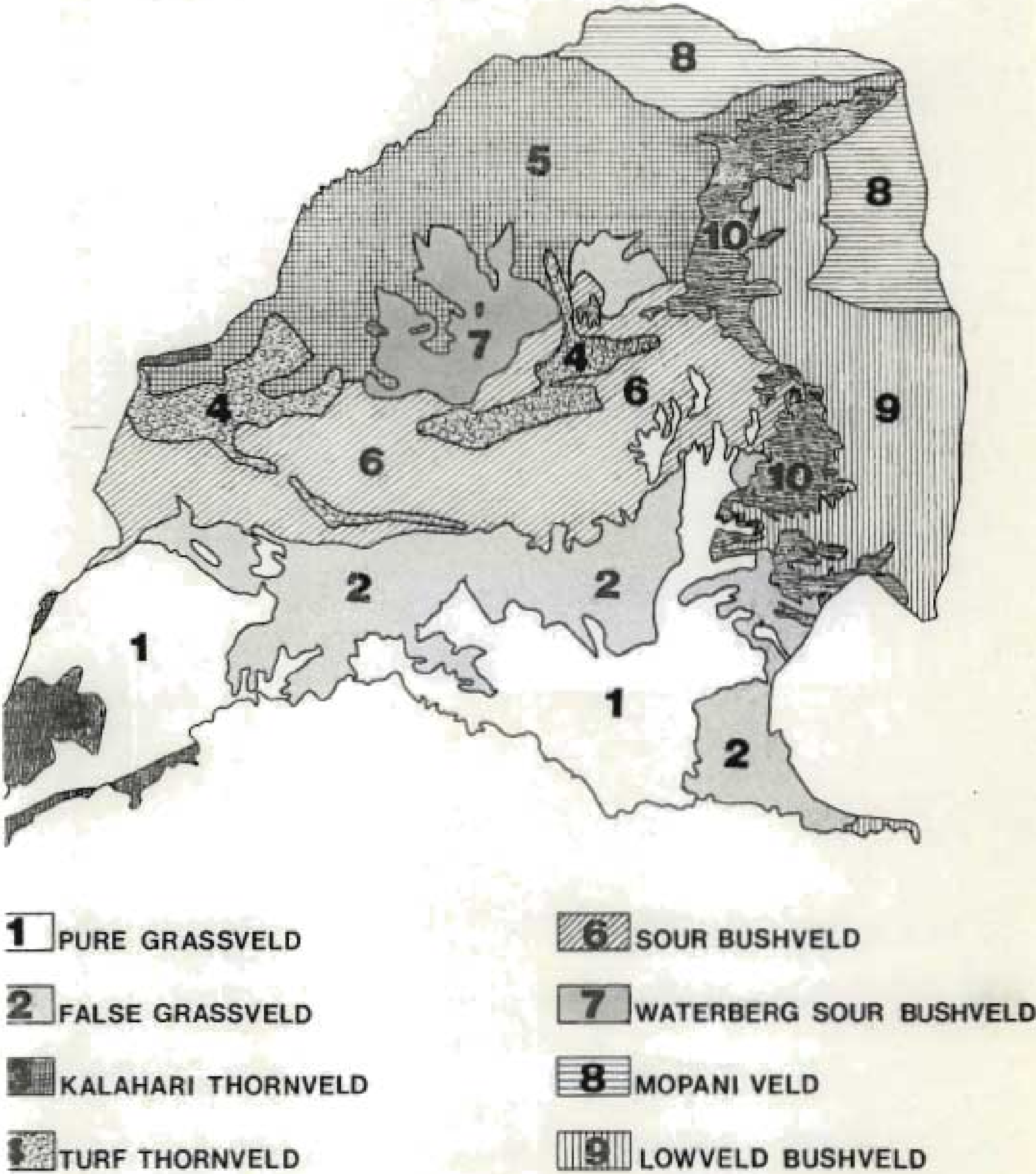
This is a distinct biotic zone (See previous discussions), generally referred to as the "highveld". In the Transvaal it is physiognomically characterized by a relatively high altitude (1 400 metres and higher), and (in its natural state) by treeless rolling plains with intermittent randjies. The soils are brown to reddish brown ferrugineous lateritic and highveld prairie soils. It lies in the summer rainfall area of 500-1000 mm mean annual precipitation. Winters are cold, with regular hoar frost, and lowest temperature is below $0^{\circ}C$, viz. Potchefstroom: lowest annual grass minimum mean temperature (July) is $5,2^{\circ}C$, lowest annual grass minimum temperature - $17,0^{\circ}C$ (Weather Bureau, 1965. Climate of S.A. Part 8). Duration of frost period c 120 days. Frost is the most important factor inhibiting bushveld woody vegetation. The latter may only be scattered above the frost-line on the warmer (but drier) northern and western aspects of randjies and mountains. The drainage system of the highveld grasslands is predominantly via the Vaal and Orange rivers, westwards through arid and semi-arid regions to the Atlantic ocean (See Fig.180). The Transvaal highveld grasslands are here subdivided into two community types (i.e. communities 1 and 2).

Community Type 1: PURE GRASSVELD COMMUNITY:

(See Acocks, 1975; in the Transvaal in constitutes his veld types, numbers 48, 50, 52, 54, 57). These veld types "... are tropical in affinity and are distinguished from one another mainly by the different proportions in which a handful of species occur...", Acocks (*op.cit.*). This entirely tropical affinity was an important consideration in the recognition of this community.

Annual/...

Fig.178: Community types of the Transvaal (modified after Acocks, 1975).


1 PURE GRASSVELD
2 FALSE GRASSVELD
3 KALAHARI THORNVELD
4 TURF THORNVELD
5 ARID SWEET BUSHVELD
6 SOUR BUSHVELD
7 WATERBERG SOUR BUSHVELD
8 MOPANI VELD
9 LOWVELD BUSHVELD
10 INLAND TROPICAL FOREST

Annual precipitation 500-1000 mm. A few typical grass species are: *Themeda triandra*, *Tristachya* spp., *Eragrostis* spp., *Digitaria* spp. (see Acocks, 1975, for a full description of floral elements).

Community Type 2: FALSE GRASSVELD COMMUNITY:

(See Acocks, 1975; in the Transvaal it constitutes his veld types 61, 62, 63, and also 67, - i.e. the isolated Pietersburg Plateau). Veld type 61, i.e. Bankenveld, is in size by far the most prominent element of this community. In plant species composition, the Pietersburg Plateau is very similar to the Bankenveld.

This community represents a subclimax vegetation which is probably maintained by annual burning. Acocks (*op.cit.*) speculates that the climax could be an open savanna of *Acacia caffra*, which is in fact at present the case along the northern margin, also in the form of sour bushveld which occurs throughout the area above the frost line on randjies and hills. The veld is very sour throughout. The subclimax status of this community is the main reason for its distinction here.

Rainfall varies from 600-1000 mm p.a., with the largest area of this community falling in the 700-800 mm p.a. zone.

Typical grass types are: *Trachypogon spicatus*, *Themeda triandra*, *Schizachyrium sanguineum*, *Panicum natalense*, *Hyparrhenia hirta*, *Andropogon* spp., *Heteropogon contortus*, *Elyonurus argenteus*, *Laudetia simplex*, *Setaria flabellata*, *Eragrostis* spp., *Brachiaria* spp. This community is also characterized by a wealth of forbs, viz. *Thesium*, *Spenostylis*, *Pentanisia*, *Mansonia*, *Gnidia*, and *Trichodasma* spp.

<u>Tropical Bush and Savanna Bushveld</u> (Acocks, 1975):

The biggest landmass of the Transvaal supports woodland in some form or other. The greatest majority of tree species are deciduous. This area (excluding Tropical Forests) is utilized mostly for ranching, or in some areas also for the production of subtropical fruit and tobacco. Rainfall is relatively low (<u>c</u>. 250-750 mm). Altitude is considerably lower than that of the highveld, and consequently the winters are mild and the summers hot. Veld fires are a natural element in the ecology.

Acocks (1975) groups all his savanna and bushveld veld types as "Tropical Bush and Savanna", and the majority of these correspond with the Southern Savanna Woodland biotic zone. However, the westernmost member of the Tropical Bush and Savanna Types, (i.e. Kalahari Thornveld and Shrub Bushveld), falls within the South-West Arid biotic zone, and thus was carefully scrutinized for separate community status.

Community Type 3: KALAHARI THORNVELD:

Whereas this community is floristically transitional between western and eastern veld types, it supports a South-West Arid biotic zone faunal element, and thus justified recognition as a separate community in this analysis. Its sheer size alone seen in a southern African context (predominantly to the west of the Transvaal border), certainly warrants recognition.

Unlike all the eastern woodland veld types, this community falls outside the 500 mm isohyte, sharing this feature with the South-West Arid biotic zone. This community furthermore has a drainage system to the Atlantic, sharing this feature with the Grassland community-types and the rest of the South-West Arid biotic zone. The two main portions of this community lie at an altitude in excess of 1 200 metres, very similar to communities 1 and 2 (See Fig.178). The two smaller portions of this community (to the north) are below this elevation. It receives regular frost, but by no means as extensively as on the highveld proper.

Typically this community occurs on deep, loose sand over calcareous tufa. However, the small extreme north-western portion on the Botswana border occurs anomalously on turfy soil. A small outlier of this community occurs in the central Transvaal near the Pienaars River settlement, but is considered here as part of community 6. This community consists floristically of *Acacia erioloba* savanna with grasses of the dry *Cymbopogon-Themeda* veld, in addition to some species typical of community 2 (see Acocks, 1975:39, for further details).

Physio-/...

Physiognomically this community is characterized by its flat, featureless sandy plains, and the absence of any randjies or mountains. Although this area does not lend itself to agriculture, it has in recent years been extensively ploughed for mealie production (with doubtful success).

Southern Savanna Woodlands:

Occur in the eastern Transvaal lowveld, the central, northern and north-western Transvaal, and are often collectively referred to as the "bushveld". This area (excluding the Tropical Forests) is characterized by substantial stands of woody vegetation, predominantly *Acacia* tree spp. and *Hyparrhenia* and *Eragrostis* grasses. The drainage system of the Southern Savanna Woodland biotic zone (including the Forest biotic zone) is in an easterly direction, notably through the Limpopo, Olifants, Letaba, Sabie and Crocodile rivers (Fig.180). Some of these rivers originate in the Grassland community types of the highveld. This is zoogeographically very important in that these rivers provide habitat in the form of riverine woodland for woodland adapted species in zoogeographic regions where these species cannot otherwise exist.

Acocks (1975) defines no less than nine veld types in this area (excluding Kalahari Thornveld = community 3). Apart from being too numerous for individual consideration on a community level, from a biogeographical point of view the inherent floristic differences between all nine of these veld types are too small for recognition. With the aid of Dr P. Theron of the Botany Department, University of Pretoria, these nine veld types have therefore been lumped into six communities, which are to be tested for significance as ecozoogeographical entities.

Community Type 4: TURF THORNVELD:

This community constitutes four isolated areas of extremely flat country, with norite and quartzite rocky outcrops, which collectively surround the Waterberg complex to the east, south and west. The two easterly portions overlie portions of the so-called Springbok Flats. All four components have relatively

hot/...

hot summers, and average annual rainfall varies from 450-750 mm. Altitude ranges between 600 and 1 200 metres.

Soil types can be either red, grey or black turf, which I believe may prevent the occurrence of burrowing animals. Under natural conditions this is an open thornveld area, but it tends to thicken up when the grass cover is reduced by grazing mismanagement (Acocks, 1975).

Typical trees include: *Acacia tortilis, A. nilotica, A. gerrardii, A. mellifera, A. gillettiae, A. tenuispina, A. karroo, Dichrostachys cinerea, Maytenus* spp., *Grewia* spp. Characteristic grasses are: *Panicum* spp., *Digitaria* spp., *Themeda triandra, Eragrostis* spp., *Bothriochloa insculpta*.

Community Type 5: ARID SWEET BUSHVELD:

According to Dr G. Theron (*pers.comm.*) the bushveld west of the escarpment and just north of the Magaliesberg is very sour, but becomes progressively sweeter northwards. He therefore suggested the division of this area (excluding the Waterberg and Turf Thornveld communities) into arid sweet and sour bushveld entities.

The Arid Sweet Bushveld community, as here understood, includes Acocks' (1975) Arid Sweet Bushveld veld type (14), which coincides roughly with the Limpopo river valley. The Mixed Bushveld veld type (18) is floristically of a transitional nature, and the parts thereof lying between the Limpopo river valley and the Waterberg complex, the north-eastern Turf Thornveld component, and the Pietersberg Plateau, have been incorporated as part of this community.

The soils are either Kalahari sand on lime, or light brown sand (Department of Agriculture. 1941. Soil map of South Africa. Government Printer, Pretoria). Elevation is between 600 and 1 200 metres (along the Limpopo river valley proper 600-920 metres), and mean annual rainfall 250-750 mm, declining westwards. It is important to note that this area is very arid, i.e. with the minimum of permanent natural water. All rivers, including the Limpopo, are seasonal.

Typical/...

Typical trees are: *Combretum apiculatum*, *Grewia flava*, *Terminalia sericea*, *Boscia albitrunca*, *B. foetida*, *Commiphora* spp., *Acacia senegal*, *A. mellifera*, *A. giraffa*, *A. tenuispina*, *A. erubescens*, *Adansonia digitata*, *Burkea africana*, *Kirkia acuminata*, *Dichrostachys* spp. Grass cover is dominated by *Eragrostis* spp., but also includes *Schmidtia pappophoroidea*, *Digitaria* spp., *Panicum* spp., *Aristida congesta*, *A. graciliflora*, *Enneapogon* spp.

Community Type 6: SOUR BUSHVELD:

A large and floristically diverse sour bushveld floral community, lying west of the escarpment between the Magaliesberg and the Waterberg complex. Includes Acocks' (1975) Sourish Mixed Bushveld (19), as well as the southern portion of his Mixed Bushveld (18), veld types. This community is thus floristically recognized not so much for its homogeneity, but rather for its heterogeneity. Altitude ranges from 600 metres at the upper reaches of the Olifants river at Marble Hall, to 1 200 metres. Rainfall tapers off westwards from 500 mm to 350 mm p.a.

The more prominent tree species are: *Faurea saligna*, *Acacia caffra*, *Protea caffra*, *Ochna pulchra*, *Dombeya rotundifolia*, *Burkea africana*, *Diplorhynchus condulocarpon*, *Albizia rhodesica*, *Terminalia sericea*, *Combretum* spp., *Sclerocarya caffra*, *Mundulea sericea*. *Hyparrhenia* grasses are predominant; also with *Elyonurus argentatus*, *Schizachyrium sanguineum*, *Laudetia simplex*, *Andropogon amplectens*, *Trachypogon capensis*, *Themeda triandra*, *Brachiaria* spp., *Hyperthelia dissoluta*.

Community Type 7: WATERBERG SOUR BUSHVELD:

As suggested by Dr G. Theron (*pers.com.*), Acocks' (1975) Sour Bushveld veld type (20), typical of the Waterberg, is recognized here at community level. It is floristically quite distinct from surrounding areas. This community is thus comprised of the flora of the bushveld mountains. In less rocky parts it is an open savannah of tall, straight *Faurea saligna* trees with a great diversity of sour grass species, which are peculiarly

useless/...

useless for grazing. In the more rugged areas, the floral composition forms dense mixed bushveld.

Altitude 1200-1500 metres. The areas with altitudes higher than 1 500 metres on the Waterberg support outlyers (relics?) of Inland Tropical Forests (community 10). Soil is of a sandy rubbly nature, very poor and sour. Rainfall ranges from 650 to 900 mm p.a.

Typical trees and shrubs include *Faurea saligna*, *Acacia caffra*, *Protea caffra*, *Combretum* spp., *Kirkia wilmsii*, *Ficus* spp., etc. See Acocks (1975) for a more complete account of the trees and a list of grass species of this area.

Community Type 8: MOPANI VELD:

The most homogenous community of all. The dominant vegetation is *Colophospermum mopane*. In the north-west it is typically shrubby, in the east consists mostly of trees of up to 20 metres, which is also more mixed floristically. The soil type throughout is reddish brown sand (Department of Agriculture. 1941: Soil Map of South Africa. Government Printer, Pretoria). Rainfall varies between 250 and 500 mm p.a. This is the only community receiving less than 10 mm precipitation per month in at least three consecutive months during winter. Altitude between 300 and 450 metres in the east, and 400 to 750 metres in the western sector. Frostfree.

Other plant species always present are: *Acacia nigrescens*, *Combretum imberbe*, *C. apiculatum*, *Lonchocarpus capassa*, *Terminalia prunioides*, *Adansonia digitata*.

Community Type 9: LOWVELD BUSHVELD:

Includes Acocks' (1975) Lowveld (no.10) and Arid Lowveld (no.11) veld types. It comprises primarily the area south of the Olifants river below the escarpment, with a fingerlike extension along the base of the escarpment to the north of the river. Rainfall varies from 400-875 mm p.a., and altitude between 167 and 1 000 metres. Frostfree. Soil types vary considerably, and have an important influence on the flore. Three major soil

types/...

types can be distinguished, i.e. granite outcrops with relatively higher rainfall and greyish sandy soils; red granite outcrops with lower precipitation and red sandy soil; and the basalt soils of the Lebombo flats.

Typical flora of the entire region includes: *Acacia nigrescens*, *Sclerocarya caffra*, *Combretum* spp., *Terminalia sericea*, *Dichrostachys cinerea*, *Grewia* spp., *Strychnos madagascariensis*.

Community Type 10: INLAND TROPICAL FOREST TYPES:

This community is considered a distinct major veld type by Acocks (1975), and consists of two regular veld types, i.e. North-eastern Mountain Sourveld and Lowveld Sour Bushveld. It also corresponds roughly with the Forest biotic zone as understood by Moreau (1952), Davis (1962), and Meester (1965). Therefore, this community should theoretically prove to be taxonomically prove to be taxonomically very distinct from the others recognized here in the following statistical analyses, by having low FRF indices.

In its climax form this community constitutes high tropical forests, located on the southern and south-eastern mountain slopes of the Drakensberg escarpment, with outliers on the higher, wetter parts of the mountains westwards to the Waterberg. However, through forestry and its resultant dehydration, fires and exploitation, large tracts of forests reverted to sour grassveld at the higher altitudes, and to a scrubby thornveld on the escarpment and slopes.

This community is nonetheless treated as an entity in its historical botanical context. Although drastic floral changes have been induced in areas, possibly with resultant changes in the qualitative status of mammalian niches, these floral changes are by no means absolute. Altitude varies between 615 and 2 100 metres and higher. Annual mean rainfall ranges from 875 to 2 500 mm. This is also the only Community receiving any significant winter (June-August) precipitation, mainly between 25 and 125 mm. Mist is a common phenomenon, and undoubtedly an important inherent ecological factor.

The/...

The occurrence of the 177 Transvaal mammal species in the ten community types is listed in Table 5. Only the presence or absence of a species in a particular community type (or part thereof) is indicated, and only the ranges of species as documented in the main text, are analysed. Some communities which peripherally overlie the Transvaal may therefore be under-represented. Exotic species such as *R. rattus* and *M. musculus* are not listed. Historical ranges of game species are taken into account only where definite records exist.

This analysis takes into account only the overall geographic ranges of species, and is insensitive to the detailed ecological requirements of a species. For instance, Woodland adapted species recorded from riverine forests in the Grassland communities, are sometimes plotted as occurring in the latter in spite of the fact that they may not be able to survive in a true grassveld environment. This approach is infrequently necessitated by the lack of detailed ecological knowledge of a species or inadequate data on specimen labels. Furthermore, some species common throughout one or more community types are peripherally recorded from an adjacent community. This is an ecotonal effect. Such records are nevertheless accepted. If, with more detailed information, situations such as mentioned above can be allowed for, the results of this analysis will be enhanced.

Duellman's (*op.cit.*) statistical analysis to express faunal resemblance between zoogeographical areas is termed the "Faunal Resemblance Factor" (referred to as FRF hereafter), and is also discussed by Armstrong (1972) and in section B of this chapter. FRF is statistically expressed as $2C/N_1+N_2$; where C equals the number of species in common between the two zones compared, N_1 equals the number of species in the first zone, and N_2 the number of species in the second zone. An index of 0,000 would indicate bo taxonomic resemblance between two zonal faunas, and an index of 1,000 would indicate complete identity. Duellman's formula is a simplified derivative of the Burt coëfficient (Burt, 1958). Both formulae take the sum of the two samples as the denominator. In the case of this particular analysis, this formula is very appropriate since it considerably reduces the effect of very disproportionate faunal sizes between zones. The influence of

differential/

Table 5: Distribution of 177 endemic Transvaal mammal species according to community types.

	1	2	3	4	5	6	7	8	9	10
Elephantulus intufi	-	-	-	-	X	-	-	X	-	-
Elephantulus myurus	X	X	X	-	X	X	X	X	-	X
Nasilio brachyrhynchus	-	-	-	-	X	X	X	X	X	X
Petrodromus tetradactylus	-	-	-	-	X	-	-	X	-	X
Erinaceus frontalis	X	X	X	-	X	X	-	X	-	-
Myosorex varius	X	X	-	-	-	X	-	-	-	X
Myosorex cafer	-	-	-	-	-	-	-	-	-	X
Suncus varilla	X	x	-	-	-	X	-	-	-	-
Suncus lixus	-	-	-	X	-	X	-	X	X	X
Suncus infinitesimus	X	X	-	-	-	-	-	-	-	-
Crocidura flavescens	X	X	-	-	X	-	-	-	-	X
Crocidura cyanea	-	X	-	-	X	X	-	X	X	X
Crocidura silacea	-	X	-	-	X	X	-	-	X	X
Crocidura hirta	-	-	X	-	X	X	-	X	X	X
Crocidura mariquensis	X	X	-	X	X	X	-	X	X	-
Crocidura bicolor	-	-	X	-	-	X	X	X	X	X
Crocidura maquassiensis	X	-	-	-	X	-	-	-	-	-
Amblysomus gunningi	-	-	-	-	-	-	-	-	-	X
Amblysomus hottentotus	X	X	-	-	-	-	-	-	-	X
Amblysomus julianae	-	X	-	-	-	-	-	-	X	X
Calcochloris obtusirostris	-	-	-	-	-	-	-	X	-	-
Chlorotalpa sclateri	-	X	-	-	-	-	-	-	-	-
Chrysospalax villosus	X	-	-	-	-	-	-	-	-	X
Epomophorus wahlbergi	-	-	-	-	-	X	-	X	X	X
Epomophorus crypturus	-	-	-	-	-	-	-	X	X	X
Eidolon helvum	X	-	-	X	-	-	-	-	-	-
Rousettus aegyptiacus	-	-	-	-	-	-	-	X	-	X
Taphozous (Taphozous) mauritianus	-	X	-	-	X	X	-	X	X	X
Nycteris thebaica	-	-	-	X	X	X	X	X	X	X
Rhinolophus hildebrandti	-	-	-	-	-	X	X	X	X	X
Rhinolophus fumigatus	-	-	-	-	X	-	-	-	-	X
Rhinolophus clivosus	X	X	-	-	-	X	-	-	-	X
Rhinolophus darlingi	-	-	-	-	X	X	-	X	X	X
Rhinolophus landeri	-	-	-	-	-	-	-	X	X	-
Rhinolophus blasii	-	X	-	-	-	X	X	-	X	-
Rhinolophus simulator	-	X	X	X	-	X	-	X	X	X
Hipposideros caffer	-	-	-	-	X	X	-	X	X	X

	1	2	3	4	5	6	7	8	9	10
Cloeotis percivali	-	-	-	X	-	X	-	-	X	-
Myotis (Chrysopteron) welwitschii	X	X	-	-	-	-	-	-	X	-
Myotis (Selysius) tricolor	-	X	-	-	-	-	X	-	X	-
Nycticeius (Scoteinus) schlieffeni	-	-	-	-	X	-	-	X	X	X
Pipistrellus (Pipistrellus) nanus	X	-	-	-	-	-	-	X	X	-
Pipistrellus (Pipistrellus) kuhli	X	-	X	-	X	X	X	-	X	X
Pipistrellus (Pipistrellus) rusticus	-	-	-	-	-	-	-	X	X	X
Eptesicus (Eptesicus) zuluensis	-	-	-	-	X	-	-	X	X	-
Eptesicus (Eptesicus) capensis	X	X	-	X	X	X	-	X	X	X
Glauconycteris variegata	-	-	-	-	X	-	-	X	-	-
Scotophilus nigrita	-	X	-	X	X	X	-	X	X	X
Scotophilus leucogaster	-	X	-	X	-	X	-	-	X	X
Kerivoula argentata	-	-	-	-	-	-	-	-	-	X
Miniopterus fraterculus	-	-	-	-	-	-	-	-	-	X
Miniopterus schreibersi	-	X	-	-	X	X	X	X	X	X
Sauromys petrophilus	-	-	-	-	X	X	-	X	-	-
Tadarida (Mops) condylura	-	-	-	-	-	-	-	X	X	-
Tadarida (Mops) midas	-	-	-	-	-	-	-	X	X	-
Tadarida (Chaerephon) pumila	-	-	-	-	-	-	-	X	X	X
Tadarida (Tadarida) aegyptiaca	X	X	-	-	X	X	-	X	X	-
Papio ursinus	X	X	-	X	X	X	X	X	X	X
Cercopithecus (aethiops) pygerythrus	-	-	-	X	X	X	X	X	X	X
Cercopithecus (mitis) albogularis	-	-	-	-	-	-	-	-	-	X
Galago crassicaudatus	-	-	-	-	X	-	-	X	X	X
Galago senegalensis	-	-	-	X	X	X	X	X	X	X
Manis temminckii	-	-	-	-	X	X	X	X	X	-
Pronolagus crassicaudatus	-	-	-	-	-	-	-	-	-	X
Pronolagus randensis	X	X	-	-	X	X	X	X	-	X
Pronolagus rupestris	X	X	-	-	-	-	-	-	-	-
Lepus capensis	X	X	X	-	X	X	X	X	-	-
Lepus saxatilis	X	X	-	X	X	X	X	X	X	X
Cryptomys hottentotus	X	X	-	X	X	X	X	X	X	X
Georychus capensis	X	-	-	-	-	-	-	-	-	-
Hystrix africae-australis	X	X	X	X	X	X	X	X	X	X
Thryonomys swinderianus	X	X	-	X	X	X	-	X	X	X
Xerus inaurus	X	-	X	-	-	-	-	-	-	-

	1	2	3	4	5	6	7	8	9	10
Paraxerus cepapi	-	-	-	X	X	X	X	X	X	X
Pedetes capensis	X	X	X	-	X	X	X	X	X	-
Graphiurus (Graphiurus) ocularis	-	-	-	-	-	X	-	-	-	-
Graphiurus (Claviglis) platyops	-	X	-	-	X	X	-	-	-	X
Graphiurus (Claviglis) murinus	X	X	-	X	X	X	X	X	X	X
Acomys spinosissimus	-	-	-	-	X	X	X	X	X	-
Aethomys (Micaelomys) namaquensis	-	X	-	-	X	X	X	X	X	X
Aethomys (Aethomys) chrysophilus	X	X	-	X	X	X	X	X	X	X
Dasymys incomtus	-	X	-	-	X	X	-	-	X	X
Lemniscomys griselda	-	-	-	X	X	X	X	X	X	X
Leggada minutoides	X	X	-	X	X	X	X	X	X	X
Praomys (Mastomys) natalensis	X	X	X	X	X	X	X	X	X	X
Rhabdomys pumilio	X	X	X	X	X	X	X	-	-	X
Thallomys paedulcus	-	-	-	-	X	X	X	X	X	X
Thamnomys (Gramnomys) dolichurus	-	-	-	-	X	-	-	X	-	X
Thamnomys (Gramnomys) cometes	-	-	-	-	-	-	-	-	-	X
Cricetomys gambianus	-	-	-	-	X	-	X	-	-	X
Saccostomus campestris	X	-	-	X	X	X	X	X	X	X
Dendromus nyikae	-	-	-	-	-	-	-	-	X	-
Dendromus melanotis	X	X	-	-	-	X	-	X	-	X
Dendromus mesomelas	-	-	-	-	-	-	-	X	-	X
Dendromus mystacalis	-	X	-	X	X	X	-	X	X	X
Malacothrix typica	X	X	X	-	-	-	-	-	-	-
Steatomys pratensis	-	-	-	X	X	X	X	X	X	X
Steatomys krebsi	X	X	X	-	-	-	-	-	-	-
Mystromys albicaudatus	X	X	-	-	-	-	-	-	-	-
Desmodillus auricularis	X	X	-	-	-	-	-	X	-	-
Tatera leucogaster	X	X	X	X	X	X	X	X	X	X
Tatera brantsii	X	X	X	-	X	X	X	-	-	-
Gerbillurus paeba	-	-	-	-	X	X	-	X	-	-
Otomys laminatus	-	-	-	-	-	-	-	-	-	X
Otomys angoniensis	X	X	-	X	X	X	X	X	X	X
Otomys irroratus	X	X	-	-	X	X	-	X	-	X
Otomys sloggetti	-	X	-	-	-	-	-	-	-	-
Otocyon megalotis	-	-	X	-	X	X	X	X	-	-
Lycaon pictus	-	-	-	-	X	-	-	X	X	-
Vulpes chama	X	X	X	X	X	X	-	-	-	-

	1	2	3	4	5	6	7	8	9	10
Canis adustus	X	-	-	-	-	X	X	X	X	-
Canis mesomelas	X	X	X	X	X	X	X	X	X	-
Aonyx capensis	X	X	-	-	-	X	X	X	X	X
Lutra maculicollis	X	-	-	-	-	X	-	X	X	-
Mellivora capensis	-	-	-	-	X	X	X	X	X	X
Poecilogale albinucha	X	X	-	-	X	X	-	-	-	-
Ictonyx striatus	X	X	-	-	X	X	-	X	X	X
Viverra civetta	-	-	-	X	X	X	-	X	X	X
Genetta genetta	X	-	X	-	X	X	X	X	X	X
Genetta (t.) rubiginosa	X	X	-	X	X	X	X	X	X	X
Suricata suricatta	X	X	X	-	-	-	-	-	-	-
Paracynictis selousi	-	-	-	-	-	-	-	X	X	X
Cynictis penicillata	X	X	X	-	X	X	-	-	-	-
Herpestes (H.) ichneumon	-	-	-	-	-	-	-	X	X	-
Herpestes (G.) sanguineus	X	X	-	X	X	X	X	X	X	X
Rhynchogale melleri	-	-	-	-	-	-	-	-	X	X
Ichneumia albicauda	X	X	-	-	X	X	-	X	X	X
Atilax paludinosus	X	X	-	-	X	X	-	X	X	X
Mungos mungo	-	-	-	-	X	X	-	X	X	-
Helogale parvula	-	-	-	-	X	X	-	X	X	X
Proteles cristatus	X	X	-	X	X	X	X	X	X	X
Hyaena brunnea	X	X	X	X	X	X	-	X	X	X
Crocuta crocuta	-	-	-	-	X	X	X	X	X	-
Acinonyx jubatus	-	-	-	-	X	-	-	X	X	-
Panthera pardus	-	X	-	X	X	X	X	X	X	X
Panthera leo	-	-	-	-	X	X	-	X	X	-
Felis nigripes	X	-	-	-	-	-	-	-	-	-
Felis serval	-	-	-	-	X	X	-	X	X	-
Felis caracal	-	-	-	X	X	X	X	X	X	X
Felis libyca	X	X	-	-	X	X	-	X	X	X
Orycteropus afer	X	X	X	-	X	X	X	X	X	-
Loxodonta africana	-	-	-	-	X	X	-	X	X	-
Procavia capensis	X	X	-	X	X	X	X	X	X	X
Heterohyrax brucei	-	-	-	-	X	-	-	X	-	X
Ceratotherium simum	-	-	-	-	X	X	-	X	X	-
Diceros bicornis	-	-	-	-	-	-	-	X	X	-
Equus burchelli	-	X	-	-	X	X	-	X	X	-
Potamochoerus porcus	-	-	-	-	X	X	X	X	X	X

	1	2	3	4	5	6	7	8	9	10
Phacochoerus aethiopicus	-	X	-	X	X	X	X	X	X	-
Hippopotamus amphibius	X	X	-	-	X	-	-	X	x	-
Giraffa camelopardalis	-	-	-	X	X	X	-	X	X	-
Syncerus caffer	-	-	-	-	X	X	-	X	X	-
Tragelaphus angasi	-	-	-	-	X	X	-	X	X	-
Tragelaphus scriptus	-	-	-	X	X	X	X	X	X	X
Tragelaphus strepsiceros	-	X	-	X	X	X	X	X	X	-
Taurotragus oryx	-	X	-	-	X	X	-	X	X	-
Cephalophus natalensis	-	-	-	-	X	-	-	X	X	X
Sylvicapra grimmia	X	X	X	X	X	X	X	X	X	X
Redunca arundinum	-	-	-	-	X	X	X	X	X	X
Redunca fulvorufula	X	X	-	-	X	X	-	X	X	X
Kobus ellipsiprymnus	-	-	-	X	X	X	-	X	X	X
Hippotragus niger	-	-	-	X	X	X	-	X	X	-
Hippotragus equinus	-	-	-	-	X	X	-	X	X	-
Oryx gazella	-	-	X	X	X	X	-	-	-	-
Connochaetes gnou	X	X	-	-	-	-	-	-	-	-
Connochaetes taurinus	-	-	-	X	X	X	-	X	X	-
Alcelaphus buselaphus	X	X	-	-	X	X	-	-	-	-
Damaliscus dorcas	X	X	-	X	X	X	-	-	-	-
Damaliscus lunatus	-	-	-	X	X	-	-	X	X	-
Aepyceros melampus	-	-	-	X	X	X	X	X	X	-
Antidorcas marsupialis	X	X	X	X	-	-	-	-	-	-
Oreotragus oreotragus	-	-	-	-	X	X	X	X	X	X
Ourebia ourebia	-	X	-	-	-	X	-	-	-	X
Raphicerus campestris	X	X	X	X	X	X	X	X	X	-
Raphicerus sharpei	-	-	-	-	X	-	-	X	X	X
Neotragus moschatus	-	-	-	-	-	-	-	-	-	X
Pelea capreolus	X	X	-	X	X	X	X	-	X	X

differential faunal sizes is however not entirely eliminated, and is therefore another parameter in the calculation of faunal resemblance, apart from the sum of the species held in common and endemic species.

A simple matrix of similarity indicating the degree of interrelationships between the mammal faunas of the Transvaal community types, is given in Table 6. The italic numerals on the diagonal indicate the total number of species in each community. Absolute number of species in common between any two community types is given below the diagonal. Above the diagonal is an index of faunal similarity between any two communities, calculated after Duellman (1965).

As pointed out by Armstrong (1972), the greatest failing of the FRF analysis is that it appears to be more detailed than it really is. Proper caution must be exercised in drawing conclusions from it. Nevertheless, certain comprehensible patterns of relationship emerge from this analysis. The mean of 45 FRF indices in Table 2 is 0,541, with one standard deviation = 0,171. In view of this, indices above c 0,700 and below 0,370 are of particular interest.

From Table 5 it is concluded that only four species range through all ten community types, i.e. *Hystrix africae-australis*, *Praomys natalensis*, *Tatera leucogaster* and *Sylvicapra grimmia*. Twenty-six species (14,7%) have such wide habitat tolerances that they are recorded in eight or more community types. All 34 Transvaal bat species are represented in wooded areas (community types 4-10), whereas only 14 of these occur also in the Grassland and the Kalahari Thornveld communities. Bats thus appear to have a particular attachment to well-wooded areas, which is not surprising in view of their life history and particularly their feeding habits.

The Pure and False Grassveld communities (nos 1 and 2, Fig. 178) are faunistically very closely related, with an FRF index of 0,779. This is to be expected since these two communities combined constitute the Grassland biotic zone in the Transvaal (see section B of this chapter). This fact is reflected by the considerably lower FRF indices between these two Grassland

communities/..

Table 6: Resemblance of mammalian faunas of the ten Transvaal community types. See Text for explanation; italic numerals on diagonal indicate the total number of species in each zone. Numerals allocated in text to each community type for convenient reference, indicated in brackets.

	Pure Grassveld (1)	False Grassveld (2)	Kalahari Thornveld (3)	Turf Thornveld (4)	Arid Sweet Bushveld (5)	Sour Bushveld (6)	Waterberg Sour Bushv (7)	Mopani Veld (8)	Lowveld Bushveld (9)	Inland Tropical Fore
re Grassveld (1)	*72*	,779	,460	,448	,511	,556	,458	,443	,415	,43
lse Grassveld (2)	60	*82*	,382	,489	,586	,660	,468	,490	,515	,52
lahari Thornveld (3)	23	21	*28*	,296	,292	,322	,368	,227	,194	,18
rf Thornveld (4)	28	33	12	*53*	,556	,595	,571	,503	,556	,48
id Sweet Bushveld (5)	48	58	21	47	*116*	,848	,606	,832	,776	,65
ur Bushveld (6)	52	65	23	50	98	*115*	,655	,793	,797	,66
terberg Sour shveld (7)	30	33	16	32	53	57	*59*	,575	,594	,53
pani Veld (8)	43	50	17	44	99	94	52	*122*	,874	,67
wveld Bushveld (9)	39	51	14	47	90	92	52	104	*116*	,67
land Tropical rest (10)	38	48	12	37	71	72	43	75	73	*10*

communities and the other eight communities, all with index values below 0,660 (Table 6). The FRF index of 0,779 between the Pure and False Grassveld communities is low enough to allow them to be recognized as distinct community types of the Grassveld biotic zone. The isolated Pietersburg plateau forms a significant part of the False Grassveld community. It is significant to observe that both Grassveld communities show the highest faunal similarity to the adjacent Sour Bushveld community (no.6). This fact can in part be ascribed to floral bushveld intrusions carrying woodland-adapted mammal species into the Grasslands, a phenomenon not allowed for in Table 5 as a result of our present superficial knowledge of the ecological requirements of some species. Apart from that, there is a general tendency for adjacent faunal areas to have greater faunal resemblances than non-adjacent areas. This can be ascribed to an ecotonal effect, as well as to migratory efforts of populations under optimum conditions.

The Kalahari Thornveld community (no.3) peripherally represents the South-West Arid biotic Zone in the Transvaal. It shows closest faunal resemblance to the adjoining False Grassveld community (FRF index 0,460), followed closely by its resemblance to the Pure Grassveld community (FRF index 0,382). It also has the same westward drainage system as the Grassveld community types. Communities four to nine together constitute the Southern Savanna Woodland biotic zone, and the Kalahari Thornveld community is very distinct from all these with FRF indices lower than 0,368 (Table 6). However, only a small fraction of the South-West Arid biotic zone is represented in the Transvaal in the form of the Kalahari Thornveld community. I previously pointed out that species ranges very seldom precisely coincide with the boundaries of zoogeographic areas. It is therefore understandable that only 28 of the 136 species found in the South-West Arid are present in the small portion of this biotic zone lying in the Transvaal. The Kalahari Thornveld community is therefore most probably underrepresented in the Transvaal. Its complement of only 28 species in the Transvaal (Table 6) has the effect of producing very low FRF indices in relation to the bigger and

faunistically/.

faunistically better represented communities. The faunal relationships of the Kalahari Thornveld community, expressed as FRF indices, are therefore probably unnaturally low. However, the Kalahari Thornveld is accepted as a valid community type within the Transvaal, also because it forms part of the much greater South-West Arid biotic zone, which has been proved to be a valid zoogeographic entity (Section B of this chapter).

The Inland Tropical Forest community-type (no.10) in the Transvaal generally corresponds with the Forest biotic zone of earlier authors (Moreau, 1952; Davis, 1962; Meester, 1965). In the previous section of this chapter I have found the Forest biotic zone to be unique in southern Africa. It is therefore accepted as a valid community-type within the confines of the Transvaal. However, where earlier authors concentrated on true high tropical forests in their climax status, this paper also considers the substantial tracts of recently deforestated land that have reverted to sour grassveld and scrubby thornveld, as part of the Inland Tropical Forest community. This explains the discrepancy between the earlier discussion in this chapter where the species-complement of the Forest biotic zone is given as 73, whereas in the present study the total species diversity is put at 101. The Inland Tropical Forest community, as here understood, is thus a more heterogeneous floral community, with large tracts of subclimax vegetation, which allow certain faunal elements of adjoining successional stage. Nevertheless, this community is faunistically quite distinct from all the rest, with FRF indices lower than 0,673. Faunistically, it most closely resembles the four surrounding woodland communities.

Community types four to nine combined closely correspond to the Southern Savanna Woodland biotic zone. They furthermore represent eight different veld types as described by Acocks (1975). Within these communities, the three highest FRF indices are all above 0,800. The highest of all FRF indices (0,873) is between the Mopani Veld (no.8) and the adjoining Lowveld Bushveld (no.9), both situated to the east and below the eastern escarpment. Almost as high is the index value of 0,848 between the Arid Sweet Bushveld community (no.5) and the Sour Bushveld community (no.6), both situated to the west of the escarpment. The Arid Sweet

Bushveld/...

Bushveld community (no.5) and the Mopani Veld community (no.8) are faunistically also closely related with an FRF index of 0,832, in spite of the fact that communities 5 and 6 are entirely separated from the eastern Transvaal lowveld by the escarpment with its associated Inland Tropical Forest community type. However, a portion of the Mopani Veld community (no.8) reaches the northern Transvaal via Rhodesia, and thus forms a continuum between the two western communities and the eastern Transvaal lowveld. Although the FRF indices mentioned here are high and can therefore be related to close faunal similarity, they are nevertheless accepted here as indicative of differences between faunal areas on the community type level. By comparison, Armstrong (1972) accepts his defined Coloradian community types as valid with FRF indices as high as 0,853. Furthermore, Rautenbach (*in press*, b) found the highest index value between biotic zones (which are of higher taxonomic rank than community types, i.e. faunistically more distinct with consequent lower FRF values), to be 0,580. In relation to the FRF values found between biotic zones, indices in the order of 0,850 are considered marginally acceptable between community types falling within the same biotic zone. This also implies that FRF indices much lower than 0,800, between community types from the same biotic zone, should be subjected to careful scrutiny.

Compared to the FRF indices between community types 5, 6, 8 and 9 discussed above, the indices of the Turf Thornveld (no. 4) and the Waterberg Sour Bushveld (no.7) appear low; less than 0,600 in the case of the former, and less than 0,655 in the case of the latter community. Both these areas are very small compared to the other communities. Because of their larger size the other communities have been sampled at more localities. Since the FRF analysis is based purely on the presence or absence of a species within a given area (in some instances on one record only), it follows that it is possible to compile a more complete faunal list of the more extensively sampled larger areas than of the smaller areas which are normally sampled at only one or two localities. Experience has shown that the field techniques used are c 80% effective in sampling the fauna of a given locality. It could thus be postulated that the Turf Thornveld

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and the Waterberg Sour Bushveld communities are under-represented in this study, which would lead to relatively lower FRF indices. This argument could also serve to explain the low FRF indices of the Kalahari Turf Thornveld.

Furthermore, the ranges of few species correspond entirely to the borders of zoogeographical areas. Species almost invariably occupy parts of one or more such areas. The larger such a zoogeographic area, the more likely it is that a widespread species may occur in some part of it and therefore the larger an area the more faunistically diverse it becomes. It is therefore suggested that any very small region will show a high faunal disparity when compared with a larger zone as a result of a relatively low species diversity. On the other hand. both communities under discussion here possess some ecological aspect which may inhibit the occurrence of many mammal species. The soil type of the Turf Thornveld is heavy clay, - very hard when dry and extremely wet after rain with a very long water retention period. This is believed to inhibit any burrowing species. The Waterberg Sour Bushveld community, on the other hand, is almost entirely mountainous, which is restrictive to flatland- and wetland-adapted species.

Considering the above arguments, the decision whether or not to accept the validity of communities 4 and 7 is mostly subjective on the available information. The argument based on the prohibitive influence of intrinsic ecological factors in these two communities appears to be the more convincing. The Turf Thornveld and the Waterberg Sour Bushveld communities are therefore provisionally accepted as valid.

An elementary cluster analysis (Fig.179) in the form of a phenogram is based on the FRF indices given in Table 6. The phenogram was constructed with the aid of an IBM 370/158 computor employing Sokal and Sneath's (1963:309) "weighted pair-group method using arithmetic averages (WPGMA)", which is a subprogram of the NT-SYS package stored at the C.S.I.R. Inasmuch as the figure represents a certain loss of information over the similarity matrix from which it is derived, certain of the broad relationships between community-types noted above are readily

apparent/...

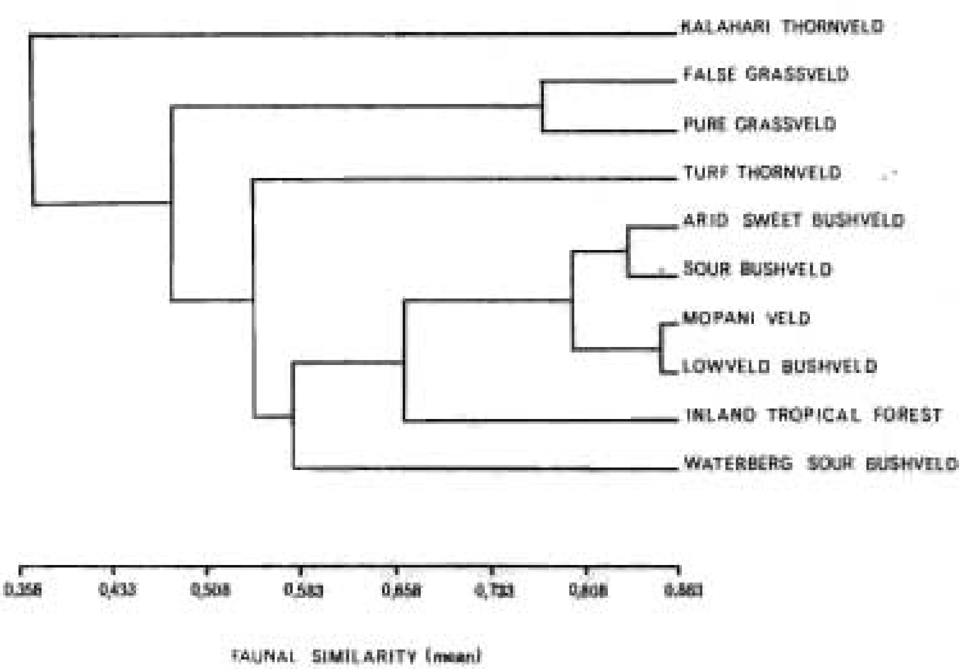

Fig.179: Similarity phenogram of ten Transvaal community types: for explanation see text.

apparent.

The distinctive character of the Southern Savanna Grassland and Southern Savanna Woodland biotic zones, as well as of the South-West Arid biotic zone, is very evident by the clustering of the community types belonging to them. However, the Forest biotic zone as represented by only the Inland Tropical Forest community type, clusters together with Woodland community types. This can be explained as an artefact of its floral heterogeneity as a result of partial deforestation and the resultant influx of secondary vegetation of Woodland and Grassland origin and its related fauna. The distinctiveness of the relatively small community types (i.e. Turf Thornveld, Waterberg Sour Bushveld and Kalahari Thornveld) are distorted to an unknown extent in Fig. 179 as a consequence of their small recorded faunal diversity.

From a faunistic point of view, rivers are not of importance as only sources of water for animal intake, but also as dispersal barriers or corridors. Drainage systems are the net result of rainfall, topography, soil types etc., and in combination with these have an important influence on vegetation. A study of drainage systems from a zoogeographic point of view is thus actually a study of the sum of several environmental features, as expressed by their combined influence on faunal dispersal patterns.

It is evident from Fig.180 that a watershed exists along the northern margin of the highveld grasslands. The highveld Grassland community-types have a simple drainage system via the Vaal river and eventually the Orange river, to the Atlantic ocean. The wooded areas of the Transvaal are drained towards the Indian ocean by three systems, i.e. the extensive Limpopo system (including amongst others the Pafuri, Letaba and Olifants rivers), the Komati system (including the Sabie and Crocodile rivers), and the Maputo system via Swaziland (including the Pongola river).

The zoogeographic importance of drainage systems, although as yet not fully understood, is suggested in Fig.179. The two Grassland and the Kalahari Thornveld community types, all three with a westward draining system, are separated from all the rest

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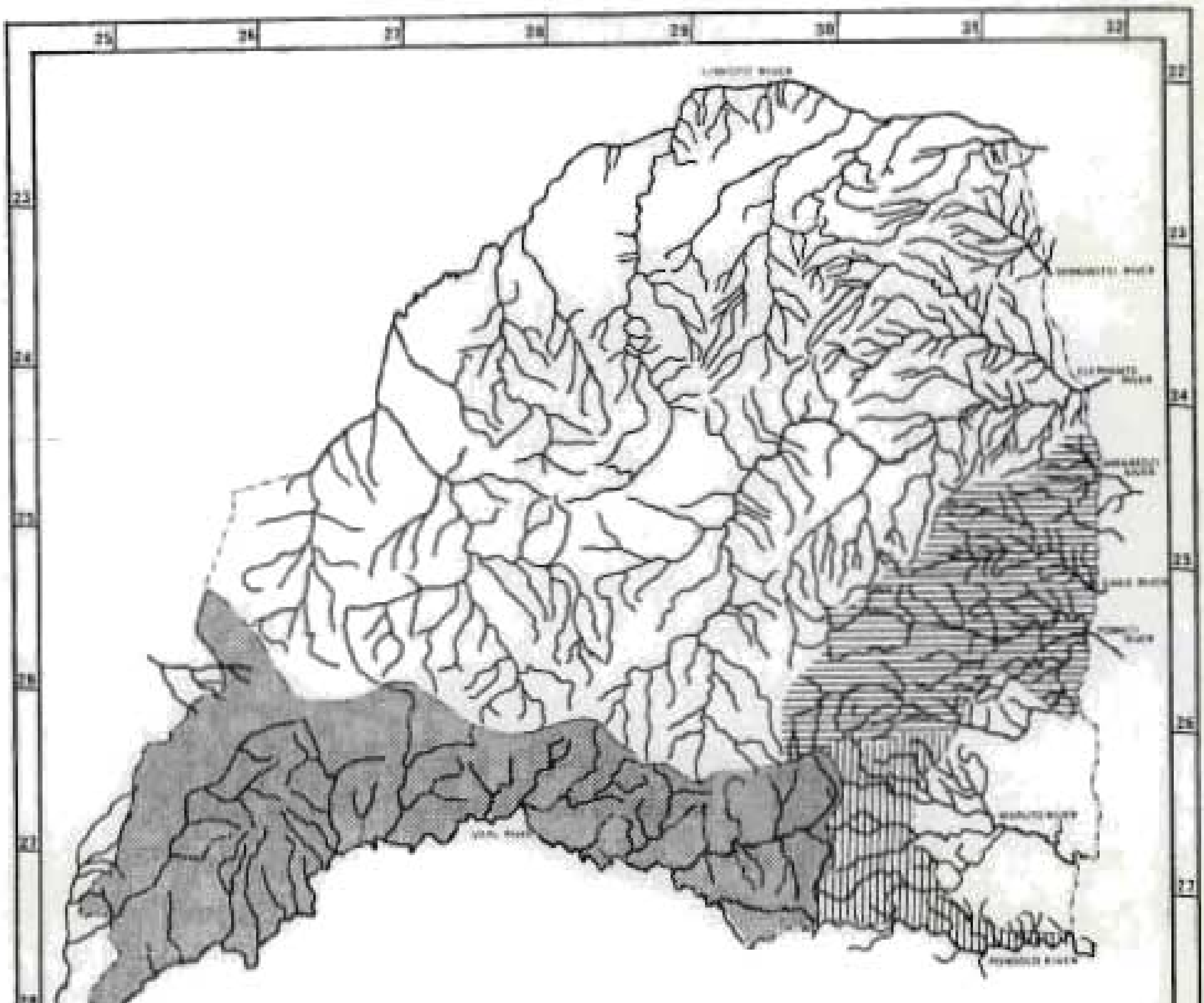

Fig.180: The Transvaal drainage systems. Legend: Unstippled area, Limpopo drainage system; stippled area, Vaal/Orange drainage system; horizontal lines, Komati drainage system; vertical lines, Maputo drainage system.

at an average FRF value of less than 0,500 and are therefore very distinct from them. All seven of the remaining community-types cluster together at average FRF indices of more than 0,540, and are drained by the three systems towards the Indian ocean.

Species density is defined by Armstrong (1972:334) as the number of species per arbitrarily defined unit area. Species diversity on the other hand, is a measure of the relative density of species in ecological units, and as such is a reflection of the ecological complexity of the ecosystem in question (see Smith, 1966:15-26); and Udvardy, 1969:293-300). When units of analysis are arbitrary subdivisions of an area such as in this study, species density and species diversity may be quite different and ought to be distinguished carefully. However, when the unit areas correspond to ecological units, a knowledge of species density may allow assessment of faunal diversity. In this study, species density of Transvaal mammals is assessed in half-degree square unit areas. These unit areas are compared with ecological units as expressed by community types. Such a comparison will provide a graphic expression of faunal diversity, and thus also of relative ecological complexity, apart from serving as a gross cross-check on the validity of the community types defined.

To analyze species density in the Transvaal, this Province is subdivided in 104 area-units corresponding to half-degree squares. Each of the quadrants is approximately 50 by 50 kilometres (c 31 x 31 miles), i.e. 2 500 kilometres in area. By employing the squares formed by each latitudinal and longitudinal half-degree, known biotic and physiographic units are neither selected for nor avoided. Along the borders only quadrants overlying Transvaal territory over more than half their area, are incorporated in this analysis (see Fig.181). Individual half-degree square unit areas are identified by partially following Davis' (1948) well-known quarter-degree grid system, i.e. the full-degree coordinates to the north-west of a quadrant identify the degree square in which it lies. Within such a degree square, the four half-degree quadrants are identified by the capital letters A through D, assigned from left to right from the top left quadrant to the bottom right quadrant, eg. 2528A.

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In the review of the general biology of all Transvaal mammals in the main text, the extrapolated geographical ranges of species are delineated and shaded by consideration of known locality records within the Transvaal, as well as in adjoining political territories. By overlying a transparent copy of the half-degree square unit area quadrants over each of 177 species maps, the number of species per quadrant were determined. Introduced species such as *Rattus rattus* and *Mus musculus* are again not included in this analysis. A species is considered to occupy a given quadrant if one-half or more of the quadrant overlies its range. In the case of species known from only one, or from more but very isolated localities, and where geographical ranges can as a consequence not be extrapolated, only the quadrants in which a known locality falls were noted. The absolute mammalian species density in each of the 104 quadrants was assigned to four class intervals, namely 25-44; 45-64; 65-84; and 85-104 species per quadrant, and is graphically presented in Fig.181.

In an analysis of the density of Transvaal mammals, the mean species density per quadrant is 67,5, the range is 28 to 101, and one standard deviation equals 21,5.

The quadrants south of 26 degrees latitude in Fig.181 all exhibit densities that are consistently lower than 64. These, together with the seven quadrants of similar low species densities to the north of the 26 degree latitude and between the 29th and the 31st degree longitude, all correspond very strongly with the highveld Grassland and the Kalahari Thornveld community types typical of the southern Transvaal region. The majority (24 out of 27) of these quadrants exhibit densities below 45 species per quadrant. It is furthermore significant that 11 out of the 13 quadrants falling within the 45 to 64 species per quadrant class interval and centred over the highveld region, correspond strongly with the False Grassveld community type. The small and isolated Pietersburg Plateau, also belonging to the latter community type, is not apparent at the present level of resolution.

With the exception of the five westernmost quadrants between the 25th and 26th degrees latitude, the remainder of the quadrants not mentioned as yet have species densities in excess of 65 species per quadrant, and correspond strongly to Woodland and Forest community types. The five westernmost quadrants with species

densities/...

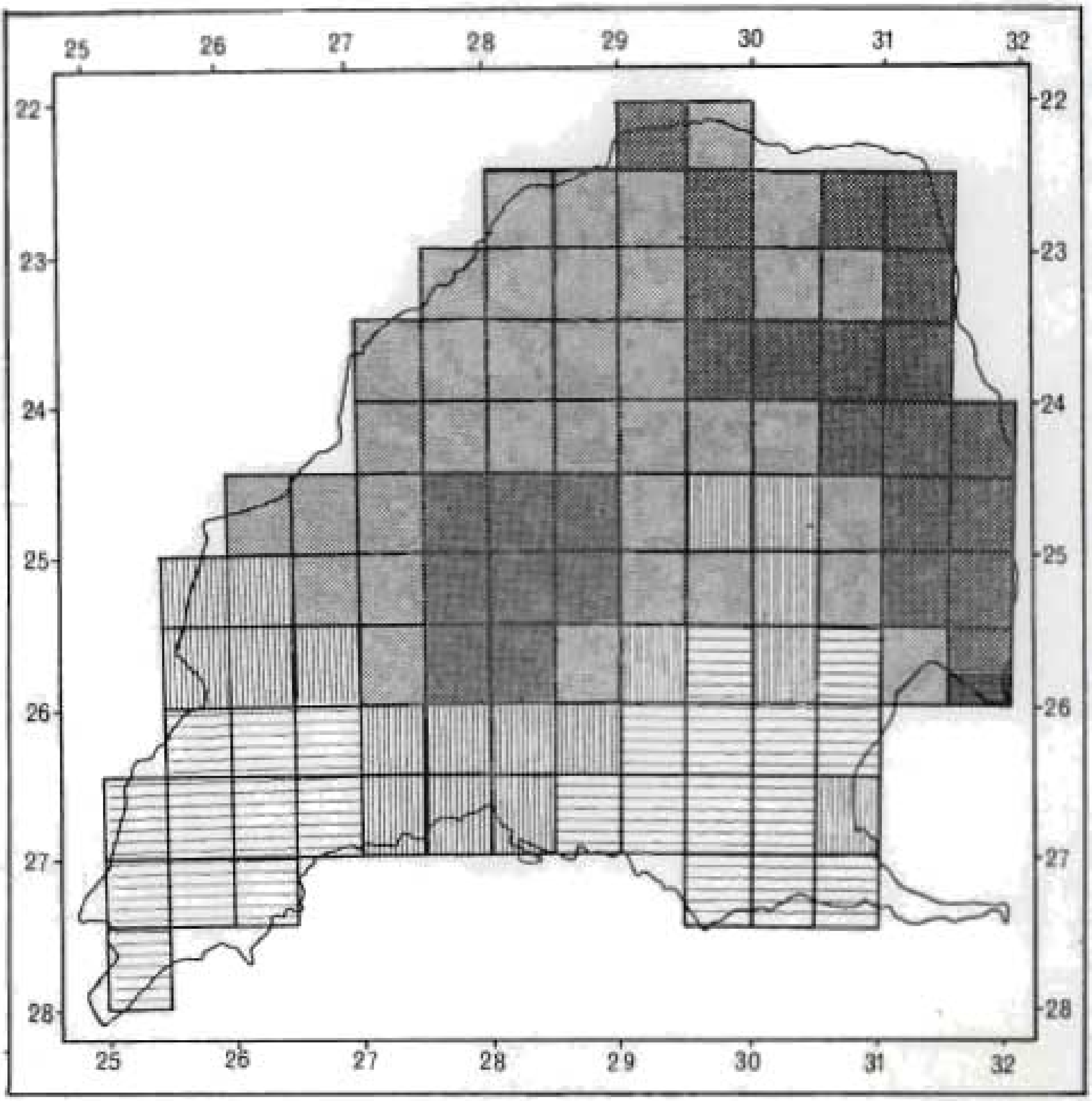

Fig.181: Absolute species density of mammals in the Transvaal. Legend: 25-44 species per quadrat, horizontal lines; 45-64, vertical lines; 65-84, light stippling; 85-104, dark stippling.

densities are also centred over Woodland community types. The topography of this area is, however, very homogeneous through the absence of significant mountain ranges, and it is therefore probably to be for that reason ecologically less complex, with a consequently lower species density.

All the quadrants east of 31 degrees longitude, falling in the class interval of 85-104 species per quadrant, are centred over the eastern Transvaal lowveld with its Mopani and Lowveld Bushveld community types. The eight quadrants falling within the class interval of highest species density, immediately to the north of Pretoria in the central Transvaal, are unexpected and is probably the result of a combination of topographical, ecological and geographical factors. It also could be relatively better sampled. It is however noteworthy that they are centred over a large part of the Springbok Flats.

The Forest community-type does not show up at the present level of resolution (See Fig.181).

Simpson (1964) and Armstrong (1972) point out that areas of variable relief offer more varied ecological opportunities than those with more monotonous terrain. Quadrants centred over areas of such varied relief will as a consequence tend to exhibit higher species densities. The same principle applies when quadrants overly two or more community types, where the typical species diversities of each community type combine to form the species density of the unit area in question. This phenomenon is probably demonstratable to a lesser extent in the majority of quadrants in the Transvaal. However, it is particularly obvious in the fact that the very narrow Forest community type can not be discerned at the present level of resolution. The variable species densities in the northern Transvaal to the west of the escarpment, and possibly also the unexpectedly high species densities of the quadrants overlying the Springbok Flats in the central Transvaal, can also in part be explained in this manner.

The average species densities of each vertical and horizontal column of quadrants, as shown in Fig.181, are given in Table 7. A very definite trend of declining species density is obvious

Table 7: Average species densities of Transvaal mammals per column of quadrats: A in a west to east direction (14 vertical columns), and B in a north to south direction (12 horizontal columns).

A

West to East →

39,3	42,6	48,2	52,8	66,0	76,6	80,0	71,9	69,3	63,8	63,2	66,5	93,0	94,0
3	5	6	5	7	8	9	9	10	11	10	10	7	4

B

North to South →

84,0	84,4	81,4	84,9	80,7	79,8	76,9	68,2	41,7	40,1	39,7	42,0
2	7	8	9	10	12	13	13	11	12	6	1

from north to south, whereas a similar but less consistent declining trend can be discerned from east to west. Since increasing species diversity is in the main a gross index of higher ecological complexity (See Udvardy, 1969:293-300), the declining trends to the west and south illustrated in Table 7 suggest that the eastern Transvaal lowveld and the northern Transvaal are ecologically more complex than the west and south. Furthermore, the relatively lower species densities of the five south-westernmost quadrants overlying woodland region (2525A and B, and 2526A, C and D), can also in part be explained by suggesting that this region is ecologically the least diverse of the wooded areas of this Province.

Pertinent aspects of the above discussion, can be summarized as follows:

1. Four of the six southern African biotic zones overly the Transvaal. These areas are further subdivided into ten zoogeographic units of lower rank, here called community types. Community types are concluded to be viable zoogeographical units as based on the FRF analysis. The status of two community types, i.e. Turf Thornveld and the Waterberg Sour Bushveld, are subject to some doubt because of their small size. They are, however, accepted as valid community types based on inherent ecological features prohibiting occurrence of some mammalian species.

2. The FRF analysis is a deductive technique based on the direct interrelationship of an animal to its ecological environment. Each community type is recognized as a zoogeographic unit by its unique qualitative and quantitative combination of mammal species, which as a faunal entity is dependent on the unique set of physical and biological conditions typical of the community type.

3. The two Grassveld community types, in combination with the Kalahari Thornveld, have on the average a lower species diversity ($\bar{X}$=60,7) than do the seven Woodland and Forest community types ($\bar{X}$=97,4). This areal difference is also confirmed by FRF indices being all below 0,660 between any two members of the two combinations of community types mentioned. The three southern community types are associated with a westward drainage system

which/...

which serves the arid and semi-arid regions, which are also characterized by a relatively undiversified mammalian fauna. The seven faunistically more diversified northern community types are all served by an eastern drainage system. Increasing species diversity indicates higher ecological complexity. In the Transvaal the differences in southern and northern faunal diversity, and consequently ecological complexity, can thus be correlated with drainage systems running westward and eastward respectively.

4. The marked differential faunal diversity and ecological complexity mentioned above, superficially appear to be orientated in the Transvaal in a north-south direction. However, from an examination of drainage systems, species densities within this Province, and a knowledge of the faunal diversity of adjoining areas, it is postulated that this observed orientation is in fact a geographical artefact of two major faunas respectively adapted to an eastern more moderate, and a western more arid complex of environmental conditions. The observed attachment of Transvaal bat species to wooded areas suggests that as a group it forms a prominent constituent of the more diversified eastern fauna.

5. An analysis of species density plotted per half-degree square unit areas in the Transvaal, correlates roughly with some community types. It furthermore reveals a decline from north to south.

This is in concordance with many other groups of organisms throughout the world exhibiting declining species densities away from the equator (Udvardy, 1969). A similar, but less consistent, declining trend in species density is also discerned in the Transvaal from east to west. This can be related to a gradual change from a more diversified eastern fauna to a less diversified western fauna. Since species density and diversity are gross indicators of ecological complexity, it is suggested that the northern and eastern Transvaal are ecologically more complex than the southern and western Transvaal.

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Appendix I

Gazetteer of localities

	Lat./Long.
Acornhoek	24°35'S, 31°05'E
Acre, Farm 2; 16 km SW Haenertsburg	23°59'S, 30°03'E
Alberton	26°16'S, 28°07'E
Alberry Farm, 24 km NE Pretoria	c.25°36'S, 28°25'E
Alicecot, 5 km WNW Newington	24°51'S, 31°24'E
Alkmaar, Farm 286; Nelspruit	25°27'S, 30°50'E
Alldays, 10 km W	22°40'S, 29°01'E
Alma, Waterberg	24°29'S, 28°04'E
* Al-te-ver, Farm 103; 1 km SSE Maasstroom	22°45'S, 28°28'E
Amalia	27°13'S, 25°03'E
American Cave cf. Uitkomst	
Amsterdam, Farm 408; Ermelo	26°38'S, 30°40'E
Amsterdam, Farm 116; Dendron	23°15'S, 29°28'E
Angra Pequina, Farm 8; Bothaville	27°29'S, 26°31'E
Apies River, Pretoria	25°41'S, 28°12'E
Arcadia, Farm 649; 25 km from Waterpoort	24°43'S, 29°19'E
Arnhemburg, Farm 151; Carolina	26°03'S, 30°50'E
Assen	25°09'S, 27°36'E
Babalala, Kruger National Park	22°54'S, 31°14'E
Babatdraai cf. Mbabat cf. Timbavati River	24°03'S, 31°40'E
Badfontein, Lydenburg	25°23'S, 30°22'E
Badplaas, 48 km E	25°57'S, 30°34'E
* Bandolierskop, Soutpansberg	23°18'S, 29°50'E
Baragwanath, Johannesburg	26°16'S, 27°58'E
* Barberspan Prov.Nat.Res., 24 km E Delarey-ville	26°34'S, 25°36'E
Barberton, 22 km W	25°47'S, 30°54'E
Barberton, 11 km SW	25°49'S, 31°01'E
Barberton, 3 km SW	25°49'S, 31°01'E
Barckleys Muckleneuk, Pretoria cf. Pretoria	
Barotta, Farm 17; 43 km E Louis Trichardt	23°02'S, 30°16'E
Barrage, Vaal River	26°46'S, 27°41'E
Baviaanspoort, Farm 330; 19 km NE Pretoria	25°41'S, 28°22'E
Beestekraal, 37 km NW Brits	25°23'S, 27°35'E
Begin der Lyn, Farm 474; Amersfoort	26°47'S, 29°58'E
Belfast, 13 km NNE	25°34'S, 30°04'E
Benoni	26°10'S, 28°18'E
Ben Schoeman Highway, 2 km N of Lyttelton-Clubview Exit	c.25°40'S, 28°11'E

	Lat./Long.
Bethal	26°28'S, 29°28'E
Birchleigh, Kempton Park	26°04'S, 28°14'E
Birthday Goldmine, Tzaneen	c.23°22'S, 30°52'E
Black Hills, Leydsdorp cf. Leydsdorp	
* Blijdskap Priv. Nat. Res., 5 km N Bandolierskop	23°15'S, 29°46'E
Blinkwater, Farm 165; Soutpansberg	23°27'S, 30°04'E
Bloemendal, Farm 283; 14 km NE Nigel	26°20'S, 28°35'E
Bloemhof	27°39'S, 25°31'E
Bloemhof, Farm 92; Wakkerstroom	27°14'S, 30°15'E
Blokspruit, Farm 157; Warmbad	25°04'S, 27°44'E
Blouberg, 64 km NW Pietersburg	23°08'S, 29°01'E
* Blyde Forest Reserve, 10 km N Graskop	24°52'S, 30°51'E
Blyderivier Canyon Prov. Nat. Res.	c.24°35'S, 30°47'E
Bochem Farm 145; 42 km NW Brakrivier Bridge	23°11'S, 28°49'E
Boekenhout, Nylstroom	24°38'S, 28°40'E
Boekenhoutkloof, Farm 315; Pretoria	25°42'S, 28°04'E
Boekenhoutskloofdrift, Farm 286; 32 km E Pretoria	25°31'S, 28°30'E
Boekenhoutspoort, Farm 364; 35 km NW Nylstroom	24°32'S, 28°07'E
Bokfontein, Farm 448; 10 km SSW Brits	25°43'S, 27°46'E
Boksburg (midtown)	26°14'S, 28°15'E
Bon Accord, Pretoria	25°38'S, 28°11'E
Bonqu Gorge	c.23°58'S, 31°51'E
Bordeaux, 8 km E Waterpoort	22°54'S, 29°42'E
Bosbokrand, 32 km N	24°33'S, 31°02'E
Boschbank, Farm 12; 4,8 km W Sasolburg	26°48'S, 27°57'E
Boschfontein, Farm 15; 21 km W Lydenburg	25°05'S, 30°14'E
Boschkop, Johannesburg	26°26'S, 27°59'E
Bossies Railroad Siding, 8 km E Barberspan	26°34'S, 25°41'E
Botanical Gardens, Silverton cf. Silverton	
Bothaville (O.F.S.), 17 km from Tvl./O.F.S. border	27°22'S, 26°36'E
Brak River, Vivo	c.22°50'S, 29°14'E
Brakrivier Bridge, 40 km NW Bochem	23°11'S, 28°49'E
Brakvlakte, Parys	c.26°52'S, 27°22'E
Branddraai, Farm 409; Lydenburg	24°34'S, 30°40'E

	Lat./Long.
* Brandhoek, Farm 78; 32 km SE Leeudoringstad	27°17'S, 26°26'E
Bridgewater, Farm 307; Rustenburg	24°30'S, 27°14'E
Brights Bridge on Crocodile R. near Makoppa P.O.	24°24'S, 27°06'E
Brits	25°38'S, 27°46'E
Brombeek, Farm 272; Soutpansberg	22°32'S, 29°23'E
Bronkhorstspruit	25°49'S, 28°45'E
Brooklyn, Pretoria	c.25°45'S, 28°14'E
Brummeria, Pretoria	25°45'S, 28°18'E
Bryanston, Johannesburg	26°04'S, 28°05'E
Bububu River, Kruger National Park	c.23°08'S, 31°00'E
Buffalo Mine, Barberton	25°47'S, 31°03'E
Buffelsdraai, Farm 151; 59 km N. Brits	25°07'S, 27°40'E
Buffelsdrift, Farm 3; Thabazimbi	23°47'S, 26°58'E
Buffelshoek, Farm 340; N of Sabi Sand Priv. Nat. Res.	24°40'S, 31°33'E
* Buffelspoort, Farm 149; 5 km NE Assen	25°07°S, 27°37'E
Buffelspoort Dam, Rustenburg	25°47'S, 27°29'E
Buren, 128 km NW Potgietersrus	c.23°37'S, 27°52'E
Burgerspark, Pretoria	25°43'S, 28°11'E
Byashishi River, Kruger National Park	23°26'S, 31°09'E
Candover Railway station, 8 km N cf. Leeuwspoor Farm 647	
Canton, Farm 280; Mogalakwena Bridge	22°47'S, 28°45'E
Capital Park, Pretoria	25°43'S, 28°11'E
Carlton, Krugersdorp cf. Tarlton	
Carolina, Transvaal	26°04'S, 30°06'E
Carolina, 8 km NW	26°02'S, 30°03'E
Carolina, 48 km E	25°57'S, 30°34'E
Cave of Death, Irene cf. Verwoerdburg	
Ceylon, Farm 197; 3 km W Sabie	25°05'S, 30°43'E
Charleston, Farm 378; Sabie Sands Priv. Nat. Res.	24°54'S, 31°35'E
Chikwarakwara, Rhodesia	c.22°22'S 31°07'E
Christiana	27°55'S 25°10'E
Chromedale, Railway station, 8 km N	c.24°40'S, 27°20'E
Chuniespoort, Pietersburg	24°14'S, 29°31'E
Cinnabar, Barberton cf. Barberton	

	Lat./Long.
Coopersdal, Farm 1; Barberton	25°32'S, 31°55'E
Copperfontein, Waterberg cf. Koperfontein	
Corona, Railway station, 3 km SE	25°27'S, 27°39'E
Crocodile Bridge Camp, Kruger National Park	25°21'S, 31°55'E
Croc. Ranch, Letaba	23°55'S, 30°55'E
Cullinan	25°40'S, 28°31'E
Cyferfontein, Parys cf. Zyferfontein	
* Cyprus, Farm 68; 13 km SW Ofcolaco	24°12'S, 30°17'E
Danielsrust, Farm 518; Krugersdorp	25°58'S, 27°43'E
Daspoort, Pretoria	25°43'S, 28°10'E
Daspoort Berg (Rand), Pretoria	25°44'S, 28°03'E
Dassieklip, Farm 109; (at Rail Crossing) Volksrust	27°16'S, 29°46'E
Davel, 19 km NW Ermelo	26°26'S, 29°53'E
De Diepte Plantation, Pilgrims Rest	24°54'S, 30°46'E
* De Hoop, Priv. Nat. Res., 40 km N Roossenekal	24°57'S, 29°57'E
Delmas	26°07'S, 28°40'E
Derdepoort Radio Stasie, Pretoria	c.25°43'S, 28°18'E
Derry, P.O. Skeenshoek, New Dendron	c.23°21'S, 29°25'E
Devil's Knuckels, Lydenburg	c.25°07'S, 30°37'E
Devon, 12 km W	26°25'S, 28°21'E
De Wildt, 16 km E	25°38'S, 27°56'E
Dinokana, Zeerust	25°27'S, 25°52'E
Doispan, Kruger National Park	c.24°58'S, 31°17'E
Dongolakop, District of Messina	22°14'S, 29°41'E
* Donkerpoort, Farm 448; 24 km E Thaba-zimbi	24°35'S, 27°40'E
Doornhoek, Farm 68; Komati River	26°01'S, 30°53'E
* Dordrecht, Farm 578; 20 km S. Marken	23°50'S, 28°23'E
Dorset, Waterberg	24°04'S, 28°10'E
Dreadmouth, Farm 223; Potgietersrus.	22°40'S, 28°46'E
Dreadnaught, cf. Dreadmouth	
Driefontein, Farm 379; Waterberg	24°31'S, 28°26'E
Droogedal, Farm 120; Marico	24°52'S, 26°10'E
Droogheuwel, Farm 251; Randfontein	26°11'S, 27°40'E
Duiwelskloof, 16 km N Tzaneen	23°42'S, 30°08'E
Dullstroom	25°25'S, 30°06'E
Dzueni, 8 km NE Krokodilbrug	25°18'S, 31°54'E

	Lat./Long.
East Lynn, Pretoria, cf. Pretoria	
Elandsfontein, Germiston	26°10'S, 28°13'E
Elandsfontein, Farm 440; 10 km W de Wildt P.O.	25°38'S, 27°51'E
Elandsfontein, Farm 440; 18 km NW Warmbaths	24°47'S, 28°08'E
Elandsfontein, Farm 34; 4 km NW Lichtenburg	26°08'S, 26°08'E
* Elandslaagte, Farm 131; Dullstroom	25°25'S, 30°06'E
Elands River, Rustenburg	25°18'S, 27°29'E
Elands River Bridge, 5 km S on Rustenburg-Thabazimbi Road	25°21'S, 27°16'E
Eldoraigne, Pretoria	25°50'S, 28°09'E
Elim, Soutpansberg	23°09'S, 30°03'E
Ellisras, 8 km NE	23°38'S, 27°49'E
Enkeldoornspoort, Farm 207; 16 km SE Rust de Winter	25°18'S, 28°40'E
Entabeni, Soutpansberg	22°59'S, 30°15'E
Erdzak, Farm 9; Standerton	26°59'S, 29°15'E
Erfenis, Farm 269; Viljoensdrift	26°49'S, 27°59'E
Erfnest, Viljoensdrift cf. Erfenis	
Ermelo, 13 km to Chrissiesmeer	26°26'S, 30°03'E
Ermelo	26°31'S, 29°59'E
Ermelo, 19 km NW	26°26'S, 29°53'E
Ermelo, 32 km NW	26°27'S, 24°40'E
Exeter, Farm 244; Sabi Sand Priv. Nat. Res.	24°45'S, 31°21'E
Faai proefpersele, Kruger National Park	25°12'S, 31°16'E
Faai-Stungwane	25°12'S, 31°16'E
Fairfield, Farm 306; Rustenburg	24°35'S, 27°12'E
* Ferndale, 8 km SE Groot Marico	25°38'S, 26°24'E
Ficus Cave, Makapansgat, Potgietersrus cf. Makapansgat	
Fig Tree Store, 9 km to Tonga Bridge on Komati R.	c.25°50'S, 31°51'E
Florida, Roodepoort	26°11'S, 27°55'E
* Fort Klipdam, Farm 852; 27 km N Pietersburg	23°42'S, 29°33'E
Fontainebleau, Johannesburg/Krugersdorp	26°06'S, 27°58'E
Fontains (Valley), Pretoria	25°57'S, 28°12'E
Free State Mine, Leydsdorp cf. Leydsdorp	
Frederikstad, 24 km N Potchefstroom	26°30'S, 27°10'E

	Lat./Long.
Gadzingwe River, 14 km SW Shingwidzi	23°10'S, 31°33'E
Garsfontein, Pretoria	25°48'S, 28°18'E
Gatkoppies, 24 km E Thabazimbi	24°36'S, 27°37'E
Geelhoutkloof, Farm 275; 48 km NW Naboomspruit	24°15'S, 28°35'E
Geelhoutkop, Nylstroom	24°17'S, 28°25'E
Geluk, Farm 1113; Potgietersrus	24°38'S, 28°52'E
Georges Valley, Farm 632; 6 km SE Haenertsburg	24°01'S, 30°04'E
Germiston	26°13'S, 28°09'E
Gladdespruit, Carolina	26°01'S, 30°48'E
Glastonhury Ridge, 29 km SE Pretoria	25°52'S, 28°24'E
Glenferness, Farm 1; Blouberg	23°03'S, 29°01'E
* Goedehoop, Farm 302; 11 km S Bethal	26°32'S, 29°27'E
Goedgevonde, Farm 134; 68 km SW Piet Retief	27°24'S, 30°29'E
Golden Harvest, Randburg cf. Randburg	
Gorge Rest Camp, Kruger National Park	23°58'S, 31°51'E
Graskop Municipal Camping Site	24°56'S, 30°51'E
Gravelotte Mines, Letaba	23°57'S, 30°36'E
Greefswald, Farm 37; 75 km W Messina Tvl.	22°12'S, 29°23'E
Grenshoek Forest, Tzaneen	23°47'S, 30°05'E
Griffin Mine, Leydsdorp	23°59'S, 30°31'E
Groenkloof, Pretoria	25°48'S, 28°12'E
Grootfontein, Farm 562; Pilgrim's Rest	24°57'S, 30°45'E
* Groothoek, Farm 99; 25 km ESE Potgietersrus	24°21'S, 29°08'E
Groot Letaba Game Reserve	23°59'S, 31°49'E
Groot Letaba Reserve	23°40'S, 31°02'E
Groot Marico	25°35'S, 26°25'E
Grootpan, Farm 475; 40 km WSW Koster	25°58'S, 26°31'E
* Grootsuikerboschkop, Farm 124; Dullstroom	25°25'S, 30°06'E
Haenertsburg, 3 km E	23°55'S, 29°57'E
Halfway House	25°59'S, 28°08'E
Hammanskraal, Pretoria	25°24'S, 28°16'E
Hampton, Farm 320; Rustenburg	24°34'S, 27°16'E
* Hans Merensky Prov. Nat. Res., 30 km NE Letsitele	23°40'S, 30°41'E

	Lat./Long.
Hape Hut, Pafuri area, Kruger National Park	22°26'S, 31°15'E
Hardekoolbult, Farm 548; Thabazimbi	24°57'S, 27°35'E
Hartebeesfontein, 10 km SW Randfontein	26°14'S, 27°37'E
Hartebeesfontein, Farm 493; 13 km NE Orpen	24°23'S, 31°30'E
Hartebeesfontein, Farm 558; Warmbaths	24°58'S, 27°48'E
Hartebeeshoek, T.P.A. Nursery, Pretoria North	c.25°40'S, 28°10'E
Hartebeespoort, Farm 482; Brits	25°45'S, 27°53'E
Hartebeespoortdam	25°45'S, 27°51'E
Hatfield, Pretoria	25°45'S, 28°15'E
Hector Spruit, Barberton	25°26'S, 31°41'E
Heidelberg	26°31'S, 28°22'E
Hekpoort, Farm 504; 12 km W Hartebeeshoek Satellite Station	25°55'S, 27°37'E
Henley on Klip, Meyerton	26°33'S, 28°04'E
Hennopsrivier, Farm 489; 24 km W Pretoria	25°48'S, 27°59'E
Hennops River, Johannesburg/Hartebeespoort Dam Road	25°46'S, 27°59'E
Hennops River, Pretoria	25°51'S, 27°56'E
Hercules, Pretoria	25°43'S, 28°07'E
Hermanusdorings P.O., 19 km to Hoopdal P.O.	c.24°06'S, 27°36'E
Heuningklip, Farm 72; Krugersdorp	26°02'S, 27°47'E
Heuningkrans, District Wolmaranstad	c.27°15'S, 25°55'E
Hillcrest, Pretoria	25°45'S, 28°15'E
Hlatid cf. Mahlati	
Holbank, Farm 265; Ermelo	26°33'S, 30°10'E
Honeydew	26°05'S, 27°56'E
Hoopdal P.O., 32 km to Bright's Bridge	c.24°23'S, 27°14'E
Hornsnek, 32 km NW Pretoria	25°38'S, 28°04'E
Houghton Estates, Farm 56; Johannesburg cf. Johannesburg	
Houtbosdorp, 3 km E	23°55'S, 29°58'E
Houtbosloop Valley, Lydenburg	25°22'S, 30°41'E
Howel Davies Caves, 24 km SE Potgietersrus	24°20'S, 29°11'E
* Huwi Priv. Nat. Res. 11 km SE Ellisras	23°45'S, 27°50'E
Imperial Mine, Louws Creek	25°39'S, 31°18'E
Incomati River	25°50'S, 32°45'E

	Lat./Long.
Ireagh, Farm 263; 25 km E Bosbokrand	24°51'S, 31°19'E
Irene Cape Coloured Primary School cf. Verwoerdburg	
Irene cf. Verwoerdburg	
Iscor Works, Pretoria	25°46'S, 28°09'E
* Jack Scott Priv. Nat. Res. 30 km W Pretoria	25°55'S, 27°45'E
Jacksontuin P.O., 44 km E	25°43'S, 27°46'E
Jacobsdal, 19 km S	c.25°50'S, 26°04'E
Jakkalsspruit, Waterberg cf. Nylstroom	
Jane Furse Hospital	c.25°52'S, 29°23'E
Jan Smuts Airport	26°08'S, 28°14'E
Jericho P.O. 40 km N Brits	25°17'S, 27°47'E
Jessievale Plantation, 48 km SE Carolina	26°14'S, 30°32'E
Johannesburg (at Observatory)	26°11'S, 28°04'E
Jones Hut, Limpopo	c.22°23'S, 31°16'E
* Joshua Moolman Priv. Nat. Res., 9 km W, Amsterdam	26°41'S, 30°36'E
Junction Ermelo-Lake Chrissie and Lothair Roads	26°28'S, 30°02'E
Junction Matlabas and Limpopo Rivers	23°41'S, 27°00'E
Junction Mogol and Mokolo Rivers	23°38'S, 27°49'E
Junction of Olifants River-Gorge/Satara Roads, 5 km S towards Satara	24°09'S, 31°50'E
Kaapmuiden, Barberton	25°32'S, 31°19'E
Kaapmuiden, 19 km to Nelspruit	c.25°32'S, 31°11'E
Kalkbank, 49 km NNW Pietersburg	23°31'S, 29°20'E
Kalkfontein, Farm 173; P.O. Soetdorings	23°23'S, 29°25'E
Kameeldrift, Farm 298; 13 km NE Pretoria	25°39'S, 28°18'E
Kastrol Nek, Wakkerstroom	27°18'S, 30°19'E
Kempiana, Farm 90; 35 km E Acornhoek	24°27'S, 31°21'E
Kempton Park	26°06'S, 28°13'E
Killarney, P.O. Schagen, Nelspruit	c.25°24'S, 30°47'E
Kilnerton, Pretoria	25°45'S, 28°18'E
Kingfisherspruit, Kruger National Park	24°26'S, 31°28'E
Klaserie, 11 km N	c.24°20'S, 31°03'E
Klaserie, 32 km N Bosbokrand	24°33'S, 31°02'E
Klaserie-Olifants Rivers confluence	24°05'S, 31°14'E
Klein Letaba, 14 km W	23°08'S, 30°19'E
Klerksdorp	26°51'S, 26°40'E

	Lat./Long.
Klipfontein, Farm 203; 20 km NW Johannesburg	26°05'S, 27°59'E
Klipkuil, Farm 104; Maquassi, Wolmaransstad	27°19'S, 26°01'E
Kliprivierso og, Farm 299; Johannesburg	26°18'S, 27°50'E
Klopperfontein, Kruger National Park	22°40'S, 31°09'E
Klossiespan, Farm 279; 38 km N Christiana	27°37'S, 25°10'E
Koedoekop, Magalakwin River	23°35'S, 28°40'E
Koedoespoort, Pretoria	25°45'S, 28°18'E
Koedoesrand, Potgietersrus	23°24'S, 28°14'E
Komatipoort, 3,2 km N	25°26'S, 31°56'E
Kongo, Farm 53; 56 km W Messina	22°21'S, 29°27'E
Kopbeenpan, Farm 291; 46 km S Maasstroom	23°09'S, 28°32'E
Koperfontein, Farm 37; Waterberg	24°03'S, 28°22'E
Koppieskraal, Farm 157; 10 km W Heidelberg	26°27'S, 28°15'E
Kosmos, W. shore of Hartbeespoortdam	25°44'S, 27°51'E
Koster, 9 km to Groot Marico	c.25°48'S, 26°48'E
Koster, Rustenburg	25°52'S, 26°54'E
Kosterfontein, Farm 460; 3,2 km N Koster	25°48'S, 26°56'E
Krabbefontein, Soutpansberg cf. Louis Trichardt	
Krantzview, Carolina cf. Carolina	
Kranz, Rustenburg cf. Rustenburg	
Kromdraai, Krugersdorp	25°58'S, 27°47'E
Kruger Kloof Nature Reserve, Lydenburg	c.25°06'S, 30°31'E
Krugersdorp	26°05'S, 27°46'E
Kruisementfontein, Viljoensdrift	26°47'S, 27°59'E
Kwaggasrand, Pretoria-West	25°47'S, 28°05'E
Kwaggasvlakte, Farm 317; Rustenburg cf. Selonskraal, Farm 317	25°40'S, 27°04'E
Ladyselborne, Pretoria	25°42'S, 28°08'E
* Langfontein, Farm 84; 18 km ENE Wakkerstroom	27°13'S, 30°08'E
Langjan Prov. Nat. Res., 11,2 km N. Vivo	22°50'S, 29°12'E
Langlaagte, Johannesburg	26°13'S, 27°58'E
L.C. de Villiers Stadium, Pretoria	25°45'S, 28°16'E
Leeudoringstad	27°14'S, 26°14'E
Leeudrif, Farm 89; Vaalwater	24°15'S, 28°06'E
* Leeuwspoor, Farm 647; on Pongola River South of Golela	27°25'S, 31°52'E

	Lat./Long.
Leeuwenhoek, Farm 112; Marico	24°46'S, 26°20'E
Legogot, Nelspruit	25°14'S, 31°06'E
Leipzig, Farm 264; Blouberg, Pietersburg	23°07'S, 28°55'E
Lekkerskraal, Waterberg	c.25°52'S, 27°23'E
Lemington, Farm 519; Matlabas River Rustenburg cf. Rustenburg	
Leslie, 16 km to Standerton	26°29'S, 29°01'E
Letaba Drift, Farm 727; Leydsdorp	23°39'S, 30°35'E
* Letaba Ranch, Farm 8; 40 km N Phalaborwa	23°43'S, 31°05'E
Letaba Rest Camp, Kruger National Park	23°51'S, 31°35'E
Letaba Rest Camp, 54 km N on Tsenda River Loop, Kruger National Park	c.23°32'S, 31°27'E
Letaba River, Junc, with Olifants River, Kruger National Park	23°59'S, 31°50'E
Letitia, Farm 93; Zoutpansberg	22°28'S, 29°10'E
Letsitele River, Tzaneen	c.23°55'S, 30°16'E
Letsitele, Letaba, Tvl.	23°52'S, 30°23'E
* Levuvhu River, Vendaland	22°40'S, 30°53'E
Levuvhu-Limpopo junction	22°25'S, 31°17'E
Leydsdorp, 12 km SW Gravelotte	23°59'S, 30°31'E
Lichtenburg, 24 km W, 12 km N	26°02'S, 25°56'E
Lichtenburg, 24 km W, 6,4 km N	26°05'S, 25°56'E
Lichtenburg, 31 km to Ventersdorp	c.26°14'S, 26°26'E
Lichtenburg	26°09'S, 28°09'E
Lichtenburg, 7 km N on Rd to Ottoshoop	c.26°05'S, 26°07'E
Lichtenburg, 35 km NNW	25°59'S, 25°52'E
Lilliput, Farm 246; 16 km SW Messina	22°28'S, 29°55'E
Limpopo-Umzingwane confluence	22°12'S, 29°55'E
Lindanda Memorial, 13 km NE Tshokwane, Kruger National Park	24°42'S, 31°54'E
Long One Cave, Uitkomst Private Nat. Res. cf. Uitkomst	
* Loskopdam Prov. Nature Reserve	25°25'S, 29°20'E
Louis Trichardt	23°03'S, 29°54'E
Louw's Creek, Barberton	25°39'S, 31°18'E
Lower Sabie, Kruger National Park	25°07'S, 31°50'E
Lukas Ridge, Pretoria cf. Pretoria	
Lynnwood, Pretoria cf. Pretoria	
Lydenburg	25°06'S, 30°27'E

	Lat./Long.
Lydenburg	25°06'S, 30°27'E
Lydenburg Prov. Fisheries Inst.	c.25°06'S, 30°27'E
Lynnwood Manor, Pretoria	25°45'S, 28°19'E
Lynnwood Glen, Pretoria	25°45'S, 28°19'E
Mabaalstad, 13 km to Zeerust	c.25°49'S, 26°29'E
Mabohlelene, Kruger National Park	23°25'S, 31°16'E
Mabohlene cf. Mabohlelene	
Mabula, 12 km to Rooiberg, Warmbaths	c.24°48'S, 27°52'E
Machadodorp	25°40'S, 30°15'E
Machaisandveld	c.22°37'S, 31°23'E
Machindudzi, near Pafuri, Kruger National Park	22°32'S, 31°16'E
Machulwane cf. Matjulwana	
* Madimbo, 10 km E, on Limpopo	22°20'S, 30°58'E
Mafeking, Northern Cape P.	25°52'S, 25°38'E
Magalakwin, Farm 666; Potgietersrus	23°36'S, 28°36'E
Magalakwin Riv., cf. Mogalakwena River	
Magaliesberge, Krugersdorp/Rustenburg	25°45'S, 27°10'E to about 28°E
Magaliesberg, Pretoria	c.25°41'S, 28°12'E
Magoebaskloof, 16 km W. Tzaneen	23°52'S, 30°00'E
Maguwane River cf. Mahewane River	
Mahewane River, Kruger National Park	23°00'S, 31°00'E
Mahlangene, Kruger National Park	22°38'S, 31°07'E
Mahlati, Kruger National Park	23°18'S, 31°32'E
Mahungumela, 27 km SSE Shingwidzi	23°18'S, 31°16'E
Makapan Caves cf. Makapansgat	
Makapansgat, Farm 39; Potgietersrus	24°09'S, 29°11'E
Makwassie Townlands	27°19'S, 25°59'E
Malahla-Panga, Kruger National Park	22°53'S, 31°05'E
Malala Spruit, 40 km NW Letaba, Kruger National Park	23°36'S, 31°23'E
Malamala, Farm 359; Sabi Sand Priv. Nat. Res.	24°48'S, 31°34'E
Malawu River, Acornhoek	c.24°37'S, 31°37'E
Malelane, 14 km to Komatipoort	c.25°27'S, 31°38'E
Malelane, Kruger National Park	25°28'S, 31°31'E
Malelane 11 km SW	25°31'S, 31°24'E

	Lat./Long.
Malelane, Farm 389; Malelane	25°29'S, 31°31'E
Malongo Flats, 60 km E Messina	c.22°26'S, 30°40'E
Malopene River, near Malopene Rest Camp, Kruger National Park	c.23°50'S, 31°12'E
Malta, Farm 65; 19 km W Ofcolaco	24°10'S, 30°15'E
Mamaranga, Letaba	c.23°52'S, 30°37'E
Mapungubwe (cf Greefswald), 75 km W Messina	22°12'S, 29°23'E
Mara Research Station, 50 km SW Louis Trichardt	23°08'S, 29°33'E
Marble Hall, Groblersdal	24°58'S, 29°17'E
Marejo, Kruger National Park	24°32'S, 31°46'E
Maria van Riebeeck Mun. Nat. Res., Pretoria dist.	25°53'S, 28°17'E
Maribashoek, Farm 50; Potgietersrus	24°13'S, 29°07'E
Marico district	c.25°40'S, 26°25'E
Marico and Limpopo Rivers junction	24°12'S, 26°53'E
Mariepskop Forest Reserve	24°41'S, 30°54'E
Mariepskop Mountain	24°41'S, 30°54'E
Marikana Quarry, Rustenburg	25°40'S, 27°29'E
Mariguma, Great Letaba	c.23°37'S, 30°52'E
Maringaskraal, Sabie River, Mocambique	c.25°07'S, 31°07'E
Maseyafontein, Kruger National Park	22°27'S, 31°07'E
Mashegadzi, 5 km SW Shingwidzi	23°10'S, 31°25'E
Mason's Cave, Uitkomst, Farm 499; Pretoria	25°55'S, 27°45'E
Matibi Dist., Rhod.	c.22°00'S, 30°30'E
Matjulwana, Kruger National Park	25°25'S, 31°25'E
Mathlabantu Picket, Kruger National Park	25°18'S, 31°16'E
Matlapitsi Caves, 16 km W The Downs	24°10'S, 30°06'E
Matshetsi koppies, Kruger National Park	23°34'S, 31°07'E
Matupa, Kruger National Park	25°03'S, 31°19'E
Mayville, Pretoria	25°43'S, 28°11'E
Mazintontopick, Acornhoek	c.24°37'S, 31°22'E
Mazitedam, Kruger National Park	24°43'S, 31°50'E
Mbabat cf. Timbavati River	24°03'S, 31°40'E
Mbangari, Timbavati River, Kruger National Park	24°14'S, 31°38'E
Mbagein Klipskeure cf. Mbangari	
Menlo Park, Pretoria	25°47'S, 28°15'E
Messina	22°21'S, 30°03'E

	Lat./Long.
Messina, 37 km SE	c.22°32'S, 30°16'E
Meyerspark, Pretoria	25°45'S, 28°19'E
Middelburg	25°46'S, 29°28'E
Miragoma, Farm 684; Letaba	23°38'S, 30°35'E
Misgunfontein, Lydenburg cf. Lydenburg	
Mkiwene Outpost, Kruger National Park	25°06'S, 31°13'E
Mlondozi Road, Kruger National Park	c.25°05'S, 31°58'E
* Mmabolela Estates, 24 km NW, Maasstroom, Tvl.	22°41'S, 28°15'E
Modderfontein, 5 km W Kempton Park	26°06'S, 28°10'E
Moedwil P.O., 4 km E Rustenburg	25°37'S, 27°01'E
Mogalakwena River, Potgietersrus/Pietersburg	22°28'S, 28°56'E
Mogreine Copper Mine	25°25'S, 26°20'E
Mokeetsi, Farm 376; NW Duiwelskloof	23°40'S, 30°05'E
Mokka, Farm 274; Mogalakwena Bridge Zoutpansberg	22°44'S, 28°50'E
Montana Small Holdings, Pretoria	25°40'S, 28°20'E
Montrose Estates, Soutpansberg	22°54'S, 29°37'E
Monument Park, Pretoria	25°48'S, 28°14'E
* Mooigenoeg, Farm 83; 8 km S Derdepoort, Tvl.	24°43'S, 26°17'E
Mooimeisiesfontein, Farm 147; Thabazimbi	25°01'S, 27°37'E
Mooiplaas, Farm 355; 14 km W Pretoria	25°48'S, 28°05'E
* Mooiplaas, Farm 94; 18 km SSE, Derdepoort	24°45'S, 26°24'E
Mooiveld, Rustenburg cf. Rustenburg	
Mooivlei, Farm 4; Thabazimbi	23°49'S, 26°58'E
Moonlight, Farm 111; Potgietersrus	23°14'S, 28°13'E
Moorddrift, Farm 289; 11 km SW Potgietersrus	24°17'S, 28°57'E
Mopani, (Railway St.), Soutpansberg	22°37'S, 29°52'E
Morgenzon, 50 km NE Standerton	26°44'S, 29°37'E
* Mosdene Private Nature Reserve, 3 km SE Naboomspruit	24°36'S, 28°46'E
Motlateng, Blouberg	23°05'S, 28°58'E
Mphongolo River, Kruger National Park	c.22°53'S, 31°07'E
Mphahlele River, Tzaneen	24°16'S, 29°37'E
Muckleneuk Hill, Pretoria	25°44'S, 28°10'E
Munweni, Kruger National Park (Munywini)	24°57'S, 32°00'E
Mutale River	c.22°30'S, 30°50'E
Mutlumubi, Kruger National Park	24°47'S, 31°52'E

	Lat./Long.
Naboomspruit	24°30'S, 28°43'E
Navors, Pretoria	25°44'S, 28°16'E
Necorner, Wakkerstroom cf. Wakkerstroom	
Neiman's Farm, 8 km NE Ellisras	23°37'S, 27°47'E
Nelspruit	25°28'S, 30°59'E
Nelspruit, to Crocodile Valley Citrus Estates	c. 25°27'S, 30°54'E
Nelspruit, 7 km E, 3 km S	25°29'S, 30°59'E
Nelspruit, 20 km W	25°25'S, 30°47'E Bd.
Nelspruit, 56 km W	25°25'S, 30°31'E
Nerina, 8 km E Duiwelskloof cf. Sweet Homes	
* New Agatha Forest Reserve, 10 km SE Haenertsburg	24°01'S, 30°04'E
Newgate, Farm 389; Soutpansberg	22°58'S, 29°56'E
Newington, 11 km N	24°45'S, 31°25'E
Newington, 5 km WNW	24°51'S, 31°24'E
New Muckleneuk, Pretoria cf. Pretoria	
Ngorongora	c. 25°37'S, 30°07'E
Ngirivane Cave, Kruger National Park	24°20'S, 31°41'E
Ngirivane, Kruger National Park	24°20'S, 31°41'E
* Nicorel, Farm 343; 18 km N. Steilloop	23°16'S, 28°37'E
Niekerkshoop, 19 km S. Jacobsdal	c. 25°38'S, 26°04'E
Njellele River, Zoutpansberg	c. 22°55'S, 30°18'E
Njellele River, Junction with Limpopo	22°21'S, 30°22'E
Nkokodzi River, 19 km SW Shingwidzi, Kruger National Park	23°14'S, 31°19'E
Numbi Gate, (6 km in vicinity) Kruger National Park	25°08'S, 31°12'E
Num-Num, Farm 568; 16 km E, Nylstroom	24°34'S, 28°31'E
Nwamayiwani River, 8 km E Shingwidzi	23°07'S, 31°31'E
Nwambiya Pan, Kruger National Park	22°41'S, 31°23'E
Nwambu Windmill, Kruger National Park	23°23'S, 31°19'E
Nwanedzi River, 17 km N Letaba on Shingwidzi Road, Kruger National Park	23°47'S, 31°29'E
Nwanedzi, 8 km SW Satara, Kruger National Park	24°25'S, 31°40'E
Nwashitsumbe, Kruger National Park	22°46'S, 31°16'E
Nwashitsumbe-Noord, Kruger National Park	22°45'S, 31°16'E
Nwaswitshaka River, Kruger National Park	c. 25°03'S, 31°32'E
Nylstroom	24°47'S, 28°25'E
Nylstroom, 11 km to Vaalwater via Alma	24°38'S, 28°19'E

	Lat./Long.
Nylstroom, 6 km E	24°40'S, 28°29'E
Nylstroom, 16 km E	c.24°47'S, 28°35'E
Nylsvley Prov. Nature Reserve, Naboomspruit	24°40'S, 28°43'E
Ohrigstaddam Prov. Nature Reserve	24°57'S, 30°38'E
Olifantshoek, Rustenburg	c.25°40'S, 27°15'E
Olifantskop, Farm 425, 32 km S Thabazimbi	24°53'S, 27°29'E
Olifantspoort, Farm 149 JQ; 5 km NE Assen	25°49'S, 27°16'E
* Olifantspoort, Farm 328; 19 km S Rustenburg	25°49'S, 27°16'E
Olifants River Bridge, Pietersburg	24°24'S, 29°45'E
Olifants River Rest Camp, Kruger National Park	24°05'S, 31°44'E
Olifants River, Kruger National Park	c.24°03'S, 31°15'S
Onderstepoort, Pretoria	25°37'S, 28°12'E
Onverwacht, Farm 532; 13 km ESE Bronkhorstspruit	25°50'S, 28°53'E
Oorbietjiesfontein, Farm 293; Klerksdorp	26°47'S, 26°23'E
Oosgrenssandveld	22°37'S, 31°23'E
Oranjeville, 13 km to Villiers	c.26°59'S, 28°20'E
Oranjeville, 3 km to Heilbron	c.26°59'S, 28°11'E
* Othawa, Farm 242; Sabi Sands Priv. Nat. Res., 16 km N Newington	24°45'S, 31°26'E
Ottoshoop	25°45'S, 25°58'E
Paardekop, Volksrust	27°10'S, 29°37'E
Pafuri river	c.22°26'S, 31°19'E
Painville, Johannesburg cf. Johannesburg	
Palala River, Waterberg (Junct. Limpopo)	23°05'S, 27°53'E
Palmietfontein, Farm 374; 16 km N Klerksdorp	26°43'S, 26°44'E
Panfontein, Farm 270; Bloemhof	27°35'S, 25°27'E
Papkuilfontein, Farm 469; 16 km ENE Cullinan	25°36'S, 28°42'E
Paranie Priv. Nat. Res. 19 km SSE Nelspruit	25°37'S, 31°07'E
* Parkfield, Farm 725; and Delamere, Farm 731; 16 km NE Louis Trichardt	22°55'S, 29°54'E
Parys, O.F.S.	26°54'S, 27°27'E
Pelgrimsrus	24°54'S, 30°46'E
Pelindaba, 32 km W Pretoria	25°48'S, 27°53'E
Pelwane Drif, Kruger National Park	24°25'S, 31°35'E
Pentonville, Farm 216; Waterberg	23°31'S, 27°16'E
Peppercorn's Cave, Makapansgat, Potgietersrus	24°08'S, 29°12'E
Percy Fyfe Prov. Nature Reserve, Potgietersrus	24°03'S, 29°07'E
Perkeo, Farm 223; 32 km N Ohrigstad	24°28'S, 30°36'E
Phaben(i)	c.25°07'S, 31°08'E

Phalaborwa	23°57'S, 31°07'E
Pienaars River Bridge, 22 km N on Assen-Thabazimbi Rd.	c.24°56'S, 27°35'E
Pienaars River Bridge, 10 km N on Assen-PO - Thabazimbi Road	25°03'S, 27°39'E
Pienaarsrivier Station, 10 km E to Rust de Winter	c.25°12'S, 28°23'E
Pienaarsriver Dam cf. Roodeplaat Dam	
Pienaars River Station, 1 km S on Pretoria Rd.	25°12'S, 28°18'E
Pietersburg	23°56'S, 29°29'E
Pietersburg, 24 km S to Chuniespoort	24°07'S, 29°27'E
Pietersburg, 40 km N on Louis Trichardt Rd.	23°36'S, 29°40'E
Pietersburg, 12 km NW on Vivo Road	c.23°47'S, 29°25'E
Piet Retief	27°00'S, 30°48'E
Piet Retief, 68 km SW cf. Goedgevonde	27°24'S, 30°31'E
Piggs Peak, Swaziland	25°59'S, 31°15'E
Pitsane, Mafeking, Cape P.	25°45'S, 25°05'E
* Platbos, 32 km NW Vaalwater	24°13'S, 27°52'E
Platrand Station, Standerton	27°05'S, 29°28'E
Pongola	27°22'S, 31°36'E
Potchefstroom	26°44'S, 27°04'E
Potchefstroom, 5 km ENE	26°43'S, 27°06'E
Potgietersrus	24°11'S, 29°00'E
Potgietersrus, 11 km SW	24°17'S, 28°57'E
Potter Hill, Farm 4085; New Castle, Natal	27°29'S, 29°47'E
Premier Mine, Cullinan	25°40'S, 28°31'E
Pretoria (at Zoo)	25°44'S, 28°11'E
Pretoria, Farm 264; Lydenburg	24°33'S, 30°24'E
Pretoria, 19 km NW	25°35'S, 28°03'E
Pretoria, 35 km E on N4 Highway	c.25°46'S, 28°37'E
Pretoria, 20 km E on N4 Highway	c.25°46'S, 28°27'E
Pretoria District	c.25°43'S, 28°11'E
Pretoria North	25°40'S, 28°10'E
Pretoria, Rietvlei Water Scheme Reserve	25°45'S, 28°12'E
Pretoria, Fountains Valley cf. Fountains Valley	
Pretoria, 19 km NW	c.25°35'S, 28°03'E
Pretoria, 8 km S	25°53'S, 28°13'E
* Pretoria Zoo's Farm, 6 km NE Lichtenburg	26°07'S, 26°12'E

Pretoriuskop Camp, Kruger National Park	25°10'S, 31°16'E
Pumbe Sandveld	c.24°22'S, 31°53'E
Punch Bowl, Farm 799; Soutpansberg	22°58'S, 29°56'E
Punda Milia, Kruger National Park	22°41'S, 31°02'E
Pyramid Station, N. of Pretoria	25°40'S, 28°14'E
Queenswood, Pretoria cf. Pretoria	
Ramanas, Farm 536, Pilgrims Rest	24°51'S, 31°00'E
Ramatlhabama, Bots.	25°38'S, 25°34'E
Randfontein	26°10'S, 27°42'E
Randjiesfontein, Farm 405; Pretoria	25°58'S, 28°08'E
Rankin's Pass, 51 km E Thabazimbi	24°32'S, 27°55'E
* Ratsegaai, Farm 204; 13 km W Ventersdorp	26°22'S, 26°32'E
Rayton, 32 km E	25°45'S, 28°32'E
Renosterkamp near Pretoriuskop, Kruger National Park	25°12'S, 31°16'E
* Renosterpoort Priv. Nat. Res., 15 km NE Bronkhorstspruit	25°45'S, 28°56'E
Retiefkloof, (=Olifantspoort), Farm 328; Rustenburg	25°49'S, 27°16'E
Rhenosterkop, Farm 463; Bronkhorstspruit	25°07'S, 28°56'E
* Rhoda, Farm 9; 13 km S Phalaborwa	24°03'S, 31°06'E
Rhodes Drift, Tvl./Rhod. Border	22°12'S, 29°12'E
Rietondale Agric. Exp. Farm, Pretoria cf. Pretoria	
Rietfontein Hospital, Johannesburg	26°07'S, 28°07'E
Rietfontein, Farm 286; 12 km SW Middelburg	25°47'S, 29°24'E
Rietfontein, Farm 2; Johannesburg	26°03'S, 28°04'E
Rietgat, Plot 102; Pretoria District	c.25°43'S, 28°11'E
Rietondale, Pretoria	25°43'S, 28°14'E
Rietspruit, Farm 412; 6 km NE Nylstroom	24°40'S, 28°27'E
Rietspruitpoort, Waterberg	23°49'S, 27°43'E
Rietvlei Water Scheme Reserve, Pretoria	25°53'S, 28°17'E
* Rissik Priv. Nat. Res., 8 km E Warmbaths	24°53'S, 28°27'E
River, Farm 141; 28 km NW Messina	22°13'S, 29°52'E
Robertshain cf. Johannesburg	
Roberts Heights cf. Voortrekkerhoogte	
* Rochdale, Farm 700; 8 km E Waterpoort	22°54'S, 29°42'E
Roedtan Station, 8 km N on Zebediela Rd.	c.24°31'S, 29°09'E
* Rolspruit, Farm 127; 7 km E Leslie	26°25'S, 29°00'E
Roodekrantz, Farm 27; NE Hoedspruit	24°06'S, 31°21'E

	Lat./Long.
Roodekuil, Farm 179; 48 km N Brits	25°15'S, 27°49'E
Roodeplaat Exp. Station, Pretoria	25°37'S, 28°21'E
Roodeplaat Dam, 16 km NE Pretoria	25°37'S, 28°22'E
Roodepoort	26°11'S, 27°52'E
* Roodepoort, Farm 383; 15 km E Standerton	26°55'S, 29°23'E
Rooiberg, Warmbad	24°49'S, 27°48'E
Rooiberg, 3 km W	24°50'S, 27°48'E
Rooikoppies (Roodekopjes), Farm 417; Brits	25°37'S, 27°45'E
Rooikrans, Farm 538; Thabazimbi	24°53'S, 27°39'E
Roossenekal Township	25°12'S, 29°56'E
Roseberry Plain, 5 km S. Sasolburg	28°51'S, 28°49'E
Rosslyn, Pretoria	25°38'S, 28°06'E
RR Ranch (=New Belgium, Farm 608), Confluence of Palala River and Koedoesloop, Vaalwater	23°48'S, 28°16'E
Runde, Farm 592; Louis Trichardt	22°44'S, 29°48'E
Rust de Winter	25°13'S, 28°30'E
Rustenburg, 8 km W	25°38'S, 27°08'E
Rustenburg, 16 km SW	25°47'S, 27°10'E
Rustenburg, 3 km E	25°40'S, 27°17'E
Rustenburg, 48 km SE	27°20'S, 25°50'E
Rustenburg, 8 km S	25°44'S, 27°15'E
Rustenburg, 13 km W, 10 km S	25°46'S, 27°08'E
Rustenburg, 13 km W, 3 km S	25°42'S, 27°08'E
Rustenburg Nature Reserve, 11 km S Rustenburg	25°46'S, 27°16'E
* Rykvoorby, Farm 96; 9 km N Zeerust	25°29'S, 26°04'E
SABS Building, Pretoria	25°43'S, 28°11'E
Sabie	25°06'S, 30°48'E
Sabie Poort, Kruger National Park	25°11'S, 32°01'E
Sabie River, Skukuza camp	24°59'S, 31°35'E
S.A. Lombaard Prov. Nature Reserve, 14 km NW Bloemhof	27°35'S, 25°30'E
Sama, Farm 1; Leydsdorp	23°31'S, 30°02'E
* Sandringham Priv. Nat. Res., 17 km ENE Acornhoek	24°30'S, 31°14'E
Sand River, near Messina	c.22°16'S, 30°06'E
Sandspruit Cave No. 1., Rooiberg (cf. Donkerpoort, Farm 448)	24°37'S, 27°40'E
Santa, 11 km N Dullstroom	25°20'S, 30°10'E

	Lat./Long.
Satara Rest Camp, Kruger National Park	24°23'S, 31°47'E
Schagun, Farm 273; Nelspruit	25°24'S, 30°47'E
Schoemanskloof, 24 km NE Machadodorp	25°28'S, 30°21'E
Schurweberg, Pretoria	25°48'S, 27°59'E
Schweizer Reneke	27°10'S, 25°18'E
Scrutton, Farm 23; km E Messina	22°17'S, 30°17'E
Secheili's Oude Stad, Farm 6; 80 km N Zeerust	24°53'S, 25°58'E
Sechelesondestad cf. Secheili's Oude Stad	
Segondi, 120 km E Messina	22°20'S, 30°37'E
Sekororo, Leydsdorp	24°15'S, 30°24'E
Selati - Olifants Rivers Confluence	24°02'S, 31°10'E
Selonskraal, Farm 317; Rustenburg	25°40'S, 27°04'E
Semane windmill, 8 km W Satara, Kruger National Park	24°23'S, 31°43'E
Sesmylspruit, Pretoria	c.25°50'S, 28°10'E
Setlagodi Native Reserve, Delareyville	c.26°22'S, 25°13'E
Settlers, 18 km ESE Warmbad	24°58'S, 28°33'E
Shalungwafontein cf. Tshalungwafontein	
Shangoni Rangers Camp, Kruger National Park	23°14'S, 30°59'E
Sheila, Farm 10; Leydsdorp	24°04'S, 31°09'E
Shere, Pretoria	25°45'S, 28°21'E
Shibangwanene (cf. Shisanganene)	
Shidzibane - Mahambane, Kruger National Park	22°37'S, 30°59'E
Shikelenkane River, 19 km E Satara, Kruger National Park	24°24'S, 31°54'E
Shilowa, 40 km S Shingwidzi, Kruger National Park	23°27'S, 31°31'E
Shingomeni, Kruger National Park	22°51'S, 31°27'E
Shingwidzi/Dzombo rivers confluence, Kruger National Park, 21 km SE Shingwidzi Rest Camp	23°14'S, 31°33'E
Shingwidzi-Restcamp, Kruger National Park	23°06'S, 31°27'E
Shingwidzi Rest Camp, 32 km SW, Kruger National Park	23°11'S, 31°14'E
Shingwidzi, Spruit 25 km NW on Road to Punda Milia	c.22°59'S, 31°16'E
Shisanganene	24°28'S, 31°59'E
Shugams Kraal, Groot Letaba Game Reserve	23°59'S, 31°49'E
Sibasa, Soutpansberg	22°58'S, 30°29'E
Silkaatsnek Priv. Nat. Res., 28 km W Pretoria	25°42'S, 27°53'E
Silverton, Pretoria	25°45'S, 28°18'E

	Lat./Long.
Silwana's Location, Letaba	23°43'S, 30°50'E
Skeerpoort, Brits	c.25°48'S, 27°46'E
Skinner's Court Valley, Pretoria	25°44'S, 28°09'E
Skukuza, Kruger National Park	24°59'S, 31°35'E
Skukuza Koppies, Kruger National Park	25°05'S, 31°36'E
Skurweberg Cave cf. Hennopsrivier, Farm 489 cf. Mooiplaas, Farm 355	
Smithfield, Farm 115; on Lothair Road	26°26'S, 30°14'E
Snelsburg, Woodbush cf. Woodbush	
Sonop, 13 km W Devon	c.26°22'S, 28°39'E
Soutpansberg	c.23°00'S, 29°40'E
Spitzkop, Sabie	25°09'S, 30°49'E
Springbokkoppies, Waterberg	c.24°52'S, 27°52'E
Standerton, 26 km on Ermelo Road	26°46'S, 29°29'E
Standerton	26°57'S, 29°15'E
Standerton, 16 km W	26°50'S, 29°05'E
Stangene Windpomp, Kruger National Park	22°50'S, 31°14'E
Steelpoort, Lydenburg	24°44'S, 30°14'E
Steenbokpan, Farm 295; 120 km NW Vaalwater	23°40'S, 27°18'E
Steenvlakte, Pretoria District	c.25°43'S, 28°11'E
Steilloop, Farm 403; Potgietersrus	23°26'S, 28°36'E
Sterkfontein, Krugersdorp	26°01'S, 27°44'E
Sterkspruit, Farm 709; Carolina	25°55'S, 30°42'E
Sterkstroom Malaria Camp	c.22°52'S, 29°37'E
Sterkstroom, Zeerust	25°39'S, 26°32'E
Steynsdorp	26°09'S, 26°59'E
Stoneyspruit, Barberton	25°27'S, 31°58'E
Strydpan, Farm 243; Delmas	26°13'S, 28°38'E
* Suikerboschrand Prov. Nat. Res., 16 km W Heidelberg	26°32'S, 28°12'E
Sunnyside, Pretoria cf. Pretoria	
Swarthoek, Farm 794, Soutpansberg	22°59'S, 29°53'E
Swartkop Air Port, Pretoria	25°50'S, 28°10'E
Swartkrans, Farm 172; Krugersdorp	26°01'S, 27°42'E
Swawelpoort, 20 km E Pretoria via Lynnwood Drive-In	25°50'S, 28°23'E
* Sweet Home, Farm 458; Duiwelskloof	23°42'S, 30°16'E
Swellendam, Farm 92; 4 km SSW Maasstroom	22°45'S, 28°26'E
Sycamore (Station), 16 km NE Waterval Boven	25°37'S, 30°26'E
Syfergat, Farm 56, 11 km SE Leeudoringstad	27°16'S, 26°18'E

	Lat./Long.
Tambotiekloof, Farm 607; Ellisras	$23^{o}55'S, 27^{o}44'E$
Tarlton, Krugersdorp	$26^{o}05'S, 27^{o}38'E$
* Ten Bosch Estates, Farm 162; 10 km NE Hectorspruit	$25^{o}20'S, 31^{o}50'E$
Thabaphiri Priv. Nat. Res., 24 km N Brits	$25^{o}26'S, 27^{o}44'E$
Thabazimbi, 35 km SW	$24^{o}52'S, 27^{o}13'E$
Thabazimbi, 26 km SE	$24^{o}40'S, 27^{o}22'E$
The Downs, 24 km W Ofcolaco	$24^{o}08'S, 30^{o}11'E$
Theespruit, Farm 156; Carolina	$26^{o}01'S, 30^{o}51'E$
The Willows, 11 km E Pretoria	$25^{o}46'S, 28^{o}20'E$
Three Sisters, Farms 254 and 256; Barberton	$25^{o}37'S, 31^{o}20'E$
Tiegerpoort Plots, 20 km SE Pretoria	$25^{o}53'S, 28^{o}25'E$
Tihomwene, Kruger National Park	$22^{o}44'S, 31^{o}05'E$
Timbavati Priv. Nat. Res.	$24^{o}23'S, 31^{o}20'E$
Timbavati River	$24^{o}03'S, 31^{o}40'E$
Timondwene cf. Tihomwene	
Tokwe, Farm 234; 32 km SW Messina	$22^{o}27'S, 29^{o}45'E$
Toulon, Farm 383; Pilgrim's Rest	$24^{o}57'S, 31^{o}35'E$
Townlands	$25^{o}44'S, 28^{o}11'E$
Tromp, Farm 252; Louis Trichardt	$23^{o}02'S, 29^{o}47'E$
Trooivlei, 42 km NW Bochem	$23^{o}11'S, 28^{o}49'E$
Tshakuhma Malaria Camp, Sibasa	$23^{o}04'S, 30^{o}18'E$
Tshalungwafontein, Kruger National Park	$22^{o}33'S, 31^{o}04'E$
Tshipise, 2 km NE	$22^{o}36'S, 30^{o}12'E$
Tshokwane, Kruger National Park	$24^{o}47'S, 31^{o}52'E$
Tsongani, Zoutpansberg	c.$22^{o}52'S, 29^{o}52'E$
Tula-Mila kop, Pafuri, Kruger National Park	c.$22^{o}26'S, 31^{o}19'E$
Tweefontein Collery, Witbank Dist.	$25^{o}48'S, 29^{o}18'E$
Tweepoort, Farm 404; 2 km NE Amsterdam	$26^{o}37'S, 30^{o}44'E$
Tzaneen	$23^{o}50'S, 30^{o}10'E$
Tzaneen, 10 km SE	$23^{o}52'S, 30^{o}15'E$
Tzaneen, 22 km on Gravelotte Rd.	c.$23^{o}49'S, 30^{o}20'E$
Tzaneen, 19 km N	$23^{o}40'S, 30^{o}10'E$
Tzaneen	$23^{o}52'S, 30^{o}00'E$
Tzaneen, 9 km NE	$23^{o}43'S, 30^{o}15'E$
Tzaneen Estate, Letaba	$23^{o}48'S, 30^{o}10'E$
Tzaneen, 24 km W	$23^{o}54'S, 29^{o}59'E$
Uitduiker, Farm 17; 16 km S Northam	$25^{o}04'S, 27^{o}21'E$

	Lat./Long.
Uitkomst, Farm 499; 51 km W Pretoria	25°55'S, 27°45'E
Uitkyk cf. Krugersdorp	
* Uitkyk en Paranie P.N.R.; 19 km SE, Nelspruit	25°36'S, 31°07'E
Umhlumna cf. Barberton	
University of Pretoria Experimental Farm, Pretoria	25°45'S, 28°15'E
* Urk, Farm 10 (=Blouberg Priv. Nat. Res.), 13 km W Vivo	23°02'S, 29°07'E
Vaalpenskraal, Farm 282; Potgietersrus	23°08'S, 28°09'E
Vaalwater, 16 km on Beauty Rd.	c.24°09'S, 28°04'E
Vaalwater, Waterberg	24°18'S, 28°07'E
Valhalla, Pretoria	25°49'S, 28°09'E
* van Riebeeck Nature Reserve, Rietvleidam	25°53'S, 28°17'E
Vendaland, On Levuvhu River	22°46'S, 30°52'E
Ventersdorp, 32 km W	c.26°20'S, 26°28'E
Ventersdorp, 16 km W to Coligny	c.26°20'S, 26°38'E
Venterskroon	26°53'S, 27°16'E
Venterstroom, Potchefstroom cf. Venterskroon	
Verdun, 16 km W Oranjeville	26°59'S, 28°05'E
Vereeniging, 16 km NE	26°34'S, 28°01'E
Verwoerdburg	25°52'S, 28°14'E
Villieria cf. Pretoria	
Vivo, 24 km on Kalkbank Road, Pietersburg	c.23°14'S, 29°16'E
Vlakfontein, Farm 238; S Roodepoort	26°12'S, 27°50'E
Vlakfontein, Farm 69; Carolina	26°13'S, 30°30'E
Vlakpan, Farm 537; Naboomspruit	24°31'S, 28°52'E
Vliegepoort, Thabazimbi	24°38'S, 27°19'E
Volksrust, 32 km W	c.27°21'S, 29°32'E
Voortrekkerbad, 14 km S Burgersfort	c.24°49'S, 30°20'E
Voortrekkerhoogte, S of Pretoria	25°48'S, 28°11'E
Voortrekker Monument, Pretoria	25°57'S, 28°11'E
Vorster, Farm 775; Letaba	23°54'S, 30°50'E
Vreemdeling, Farm 236; Louis Trichardt	22°59'S, 30°02'E
Vygeboom, Waterberg	c.24°52'S, 28°22'E
Vygeboomspoor , Farm 456; Waterberg	24°47'S, 28°26'E
Vygeboschlaagte, Farm 236-JQ; Brits	25°20'S, 28°01'E
Wakkerstroom, 2 km E	27°21'S, 30°09'E
Warmbad, Carolina	26°04'S, 30°06'E
Warmbaths, 20 km S on Main Road	25°04'S, 28°19'E

	Lat./Long.
Warmbaths, 6 km N on Nylstroom Road	24°50'S, 28°20'E
Waterberg	c.24°45'S, 27°40'E
Waterkloof Air Port, Pretoria	25°48'S, 28°16'E
Waterkloof, Pretoria	25°47'S, 28°15'E
Waterkloofrif, Pretoria	25°47'S, 28°15'E
Waterpoort, Soutpansberg	22°54'S, 29°37'E
Waterval, Farm 230; district Witbank	25°35'S, 29°08'E
Waterval Onder, 2 km N on Nelspruit Road	25°39'S, 30°24'E
Waterval, Farm 385; Lydenburg	24°57'S, 30°18'E
Weinek Farm, 3 km W Rooiberg	23°02'S, 27°58'E
* Welgedaan, Farm 292; 25 km NNE Christiana	27°41'S, 25°14'E
Welgelegen, Farm 107; district Ermelo	26°22'S, 30°05'E
* Welgevonden, Farm 449; 16 km SW Steilloop	23°32'S, 28°25'E
Weynek, Waterberg	24°27'S, 27°42'E
Wildeharthoek, Pretoria cf. Pretoria	
Wilgekuil, Farm 181; 50 km N Brits	25°14'S, 27°45'E
Wilhanshohe, Farm 78; 11 km NW Bochum	23°12'S, 29°04'E
Windhoek, Farm 649; 33 km N Louis Trichardt	22°50'S, 29°54'E
Winterskraal, Farm 55; Wakkerstroom	27°10'S, 30°11'E
Witbank	25°53'S, 29°14'E
Witbank, 10 km E	25°52'S, 29°17'E
Witfontein, Farm 262; Randfontein	26°13'S, 27°33'E
* Witpoort, Farm 419; 24 km E Potchefstroom	26°40'S, 27°20'E
Witrivier, 17 km W	25°18'S, 30°51'E
Witrivier, 2 km E	25°05'S, 31°02'E
Witwatersrand	c.26°07'S, 28°07'E
Wolmaransstad, 44 km to Schweizer-Reneke	c.27°08'S, 25°34'E
Wolmaranstad	27°12'S, 25°59'E
Wolmaransstad, 21 km N on Klerksdorp Road	c.27°08'S, 26°02'E
Wolmaransstad, 8 km S	27°17'S, 25°58'E
Wolmaransstad, 10 km N, 8 km W	27°07'S, 25°28'E
Wonderboom, Pretoria	25°41'S, 28°12'E
Wonderboom South, Pretoria	25°42'S, 28°12'E
Wonderfontein, Farm 103 ; Oberholtzer	26°19'S, 27°28'E
Wonderfontein, 48 km E Middelburg	25°48'S, 29°53'E
Woodbush, Pietersburg	23°49'S, 29°54'E
Woodbush Forest Reserve, 24 km W Tzaneen	23°54'S, 29°59'E
Worcester Mine, Barberton cf. Barberton	

	Lat./Long.
Wyliespoort, 18 km N Louis Trichardt	22°54'S, 29°56'E
Zandfontein, Farm 566; Waterberg	24°43'S, 28°40'E
Zandfontein, Viljoensdrif	26°47'S, 27°55'E
Zandrivier, Farm 142; 7 km S of Vaalwater	24°22'S, 28°05'E
* Zandspruit, Farm 168; 63 km NNW Rustenburg	25°10'S, 26°57'E
* Zandspruit, Farm 449; 24 km E Thabazimbi	24°35'S, 27°40'E
Zebediela	24°18'S, 29°15'E
Zeerust, 32 km NE	25°25'S, 26°20'E
Zomerkomst Forest Reserve, Politsi	c.23°47'S, 30°07'E
Zondagfontein, Farm 300; Potgietersrus	22°48'S, 23°45'E
Zoo Hill, Pretoria	25°43'S, 28°11'E
Zoutpan, Farm 459; Soutpansberg	22°57'S, 29°20'E
Zoutpan, Pretoria	25°24'S, 28°06'E
Zoutpansberg cf. Soutpansberg	
Zoutpanschool, Farm Zoutpan 367; 10 km E	23°54'S, 27°29'E
Zuurbekom, Farm 297; Westonarea	26°18'S, 27°47'E
Zuurbron, Wakkerstroom	27°18'S, 30°26'E
Zwarthoek, Soutpansberg cf. Swarthoek	
Zwartkop, Farm 356; Pretoria District	25°50'S, 28°08'E
Zwartkop Country Club, Pretoria	25°51'S, 28°10'E
Zyferfontein, Farm 195; Parys	26°54'S, 27°36'E

Appendix II

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COEXISTENCE IN TRANSVAAL CARNIVORA

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ABSTRACT

How coexisting carnivore species avoid interspecific competition is examined by consideration of their more prominent physical and behavioral characteristics. An attempt is made to explain coexistence of the 33 Transvaal carnivore species. The behavioral characteristics, which are considered here in various combinations, are daily activity regimen, food preference, habitat preference, geographical distribution, and social structure. The mean species body weight as an indicator of the size of prey on which a carnivore exists is also incorporated. Eighty-two % of the carnivores are shown to form a trend ranging from a nocturnal/solitary mode of life to an entirely diurnal/gregarious existence.

INTRODUCTION

Some two decades ago this paper might well have been titled "Niche occupation by Transvaal carnivores." The concept that each species fulfills a unique functional role in a specific place dates back to Grinnell (1924) and Elton (1927), and has served a useful function in subjectively describing the niche of an animal. However, it never really explained in detail how each animal fills its particular niche. Modern study of the niche and niche theory flows from Hutchinson's (1957) landmark paper, and allows quantification of the role each animal plays, from measurements of the amounts of various resources (axes in a hypervolume) utilized. Prior to this, Gause's (1934) experiments led to the idea that competition serves to separate species, and therefore the niches they fill. Competition through evolutionary time therefore led to separation of resource utilization in coexisting species, and the niches species occupy are therefore as much an outcome of evolution as, for example, their physical characteristics. On the other hand, although the physical characteristics of a particular species may be fairly constant over much of its distributional range, the exact niche it occupies (not in the descriptive Eltonian sense but in the analytical Hutchinsonian one) usually varies, depending on the habitat it occupies and the nature of other species in the community.

The mammal fauna of the Transvaal has been intensively surveyed over the last five years (Rautenbach, in preparation). This Province possesses a particularly rich mammal fauna, consisting of 175 species of which 33 are carnivores. Adaptation and radiation has led to different parts of resources being utilized, especially food and activity periods by different members of this assemblage of carnivores. It is of interest to note how resources are shared and competition lessened, and coexistence enhanced.

Rather than work out niche occupation by the various carnivores, which to be meaningful would involve quantifying resource utilization in various axes by carnivores in specific communities, the approach here taken is to look at various attributes of co-occurring species, and then to see where and if competition may come into force. This is done by considering in combination average species mass, basic food preference, daily activity regimen, habitat selection, distribution patterns, and specific social characteristics. Trends in adaptations are also considered, especially the advantage of differential body size in coexisting carnivores preying on the same food types, as variation in body size could affect prey size taken (Rosenzweig, 1966). It was also necessary to categorize behavior, in the full realization that the behavioral scope of each species may well be wider than the particular category to which it is designated.

Table 1.—*The 33 species of carnivores occurring in the Transvaal. Average body weight expressed in kg, the log. value of the mean body weight in grams, as well as the daily activity, social structure, and basic feeding categories to which each species is assigned, are indicated. See text for further explanations. I = Insectivorous, P = Predatory, O = Omnivorous, and S = Scavenging.*

Species	Average weight (kg)	N	Log. weight (g)	Daily activity regimen	Social structure	Basic feeding adaptation
Otocyon megalotis	3.4	(7)	3.53	iii	3	I
Lycaon pictus	22.0	(12)	4.34	v	5	P
Vulpes chama	2.9	(22)	3.46	i	1	P
Canis adustus	10.0	(5)	4.00	ii	1	O
Canis mesomelas	7.8	(48)	3.89	ii	2	O
Aonyx capensis	12.1	(4)	4.08	iii	3	I
Lutra maculicollis	4.5	(1)	3.65	ii	3	I
Mellivora capensis	8.9	(5)	3.95	ii	2	I
Poecilogale albinucha	0.4	(4)	2.60	ii	3	P
Ictonyx striatus	1.1	(10)	3.04	i	2	I
Viverra civetta	12.4	(5)	4.09	i	1	O
Genetta genetta	1.9	(15)	3.28	i	2	P
Genetta tigrina	1.9	(24)	3.28	i	2	P
Suricata suricatta	0.7	(19)	2.85	v	5	I
Paracynictus selousi	1.6	(39)	3.20	i	2	I
Cynictis penicillata	0.8	(20)	2.90	iv	3	I
Herpestes ichneumon	3.1	(14)	3.49	v	3	P
Herpestes sanguineus	0.5	(25)	2.70	v	1	P
Rhynchogale melleri	2.8	(1)	3.45	ii	1	O
Ichneumia albicauda	3.6	(1)	3.56	i	2	P
Atilax paludinosus	4.3	(5)	3.63	i	1	I
Mungos mungo	1.3	(7)	3.11	v	5	I
Helogale parvula	0.2	(13)	2.30	v	5	I
Proteles cristatus	9.9	(14)	4.00	i	1	I
Hyaena brunnea	36.1	(7)	4.56	ii	2	S
Crocuta crocuta	69.7	(8)	4.84	ii	4	P
Acinonyx jubatus	35.1	(3)	4.55	iv	2	P
Panthera pardus	41.7	(4)	4.62	ii	1	P
Panthera leo	204.1	(4)	5.31	ii	4	P
Felis nigripes	1.5	(8)	3.18	ii	1	P
Felis serval	9.6	(5)	3.98	i	1	P
Felis caracal	10.5	(10)	4.02	ii	1	P
Felis libyca	4.7	(58)	3.67	ii	1	P

METHODS

Table 1 lists the 33 carnivore species occurring within the Transvaal, with average weight, expressed in kg of both sexes combined, indicated for each species. Weight data are based on Transvaal Museum records, supplemented by relevant information from Smithers (1971). Samples sizes (N) are indicated. The logarithmic values for the means of species weights as expressed in g were calculated and are also given.

Based upon personal observations and unpublished data (Rautenbach, in preparation; Nel, in preparation), as well as published information (see Smithers, 1971; Rowe-Rowe, 1977a, 1977b), an integral numerical value has been assigned to the daily activity regime of each species. These range from exclusively nocturnal with a Roman numerical value of i, to exclusively diurnal with a numerical value of v (Table 1). Categories ii and iv denote nocturnal species with some diurnal activity, and diurnal species with occasional nocturnal activities, respectively. Similarly, integral Arabic numerical values 1 through 5 have been designated for the solitary to gregarious behavioral range, ranked from very solitary with a numerical value of 1, through to very gregarious with a numerical value of 5. The various species were each assigned to one of these five social category values on the grounds of average social grouping, allowing for other situations mentioned in the literature.

The integral values assigned to these two behavioral patterns considered (activity and social groupings) are only arbitrary points spaced along a continuum, and each represents an average categorized value considered most typical for the species. Judgement herein was subjective. We could not use more than five subdivisions with any accuracy, but in spite of this the resulting divisions are found to be both convenient and meaningful.

Hunting behavior is adapted to basic food preference. Diet and the mode of acquiring nourishment are other important aspects of the adaptive behavioral makeup of a species' accompanying avoidance of competition. Also considered in this study, then, are the four basic feeding methods or food types of carnivores, that is scavenging, omnivorous, insectivorous (denoting a diet of any invertebrate), and predacious. In assigning each species listed in Table 1 to a feeding category, it must be stressed that carnivores are opportunistic with regard to food items taken, especially under low interspecific competitive conditions. Only what is considered to be the primary or optimum feeding trait of a species when under more intense interspecific competition is considered here.

In Fig. 1 the integral values of the activity regimen and the social structure are plotted against each other for each species. Intraspecific social interrelationships are presented on the horizontal axis, and the activity regimen on the vertical axis. In Fig. 2 the four basic feeding categories are presented by vertical columns, each of which is divided into diurnal and nocturnal subsections. The nocturnal subsections are stippled. Each species was assigned to its appropriate column with regard to its basic feeding behavior and characteristic daily activity cycle. Position against the vertical axis was assigned by the logarithmic value of the average adult body mass, expressed in g. The principle is that clustering of species indicates possible interspecific competition, and vice versa. This is based on the correlation between the size of the predator and the size of the prey it can effectively handle, or usually catches. It has been calculated that the maximum mass of prey that can be handled with efficiency by an individual true predator is 1.5 times that of the predator itself. Group cooperation accounts for a higher ratio between the individual predator and the prey. It conversely follows that a big carnivore could not exclusively hunt very small prey because the energy gain herein would not warrant the investment in such an energy expenditure.

RESULTS AND DISCUSSION

Those species falling within the limits of behavioral values 1i, 1ii, 2i, and 2ii in Fig. 1, are all nocturnal and solitary, and represent the majority (58%) of the Transvaal Carnivora. The lines in Fig. 1 connect the upper values for both variables of this nocturnal/solitary block, with the upper values of the very gregarious and exclusively diurnal group (value 5v). All species falling between these two lines are considered to represent a trend from a solitary and a nocturnal existence to an entirely gregarious and diurnal mode of life. No less than 82% of all carnivores in the Transvaal follow this trend. *L. maculicollis*, *P. albinucha*, *O. megalotis*, and especially *A. capensis* are behaviorally intermediate between the two extremes within this trend. It is within this trend that interspecific competition is potentially the highest, as will be elaborated below. Three of the four species at the extreme diurnal/gregarious end of the trend (Fig. 1) are small insectivores and thus potentially in direct competition.

Eighteen % of the carnivore species under consideration do not conform to this trend, and have adopted a strategy, which seems to minimize possible competition. However, where four species have radiated toward a diurnal/solitary mode of life (*H. sanguineus* very successfully), only two species radiated a short distance toward a nocturnal/gregarious existence.

There are no extremely nocturnal/gregarious species (value 5i), although the lion and the spotted hyena are approaching this condition. A possible explanation for the poor radiation towards an extreme nocturnal/gregarious behavioral range could be the difficulty of maintaining group structure in the dark. Smaller gregarious species are mostly insectivorous and diurnal and finding food in the dark may also present difficulties, apart from the difficulty in locating predators in time. Schaller and Lowther (1969) consider the lion, in contrast to the wild dog, as incompletely adapted to a social life because lions frequently quarrel over the proceeds of a hunt. If their interpretation is correct, the true position of the lion on the graph in Fig. 1 may be more towards the left, and consequently even closer to the general trend.

C. crocuta is basically a nocturnal animal, but may also be active during the day. According to Kruuk (1966, 1972) the species tends to scavenge by day, and to become efficient pack hunters and killers by night. The spotted hyena has a complex matriarchal social system, with the females physically bigger than the males and dominating them. *C. crocuta* thus has radiated successfully some distance away from the trend, towards a nocturnal/gregarious existence.

Otocyon, although regarded by most as a nocturnal species, has a diurnal mode of life in undisturbed areas during winter. In settled areas, however, it becomes exclusively nocturnal. In discussing the eastward range extension of the species in the Transvaal, Pienaar (1970) mentions that it is exclusively nocturnal in the Kruger National Park, and ascribes this to a form of protective behavior of colonists in a new territory. In the Transvaal as a whole the species is almost entirely nocturnal, but on the other hand it occurs for the most part in this Province only in settled areas. Studies elsewhere (Nel, 1978) show that activity is perhaps correlated to the need to thermoregulate efficiently. Most observations on the bat-eared fox in the Transvaal are

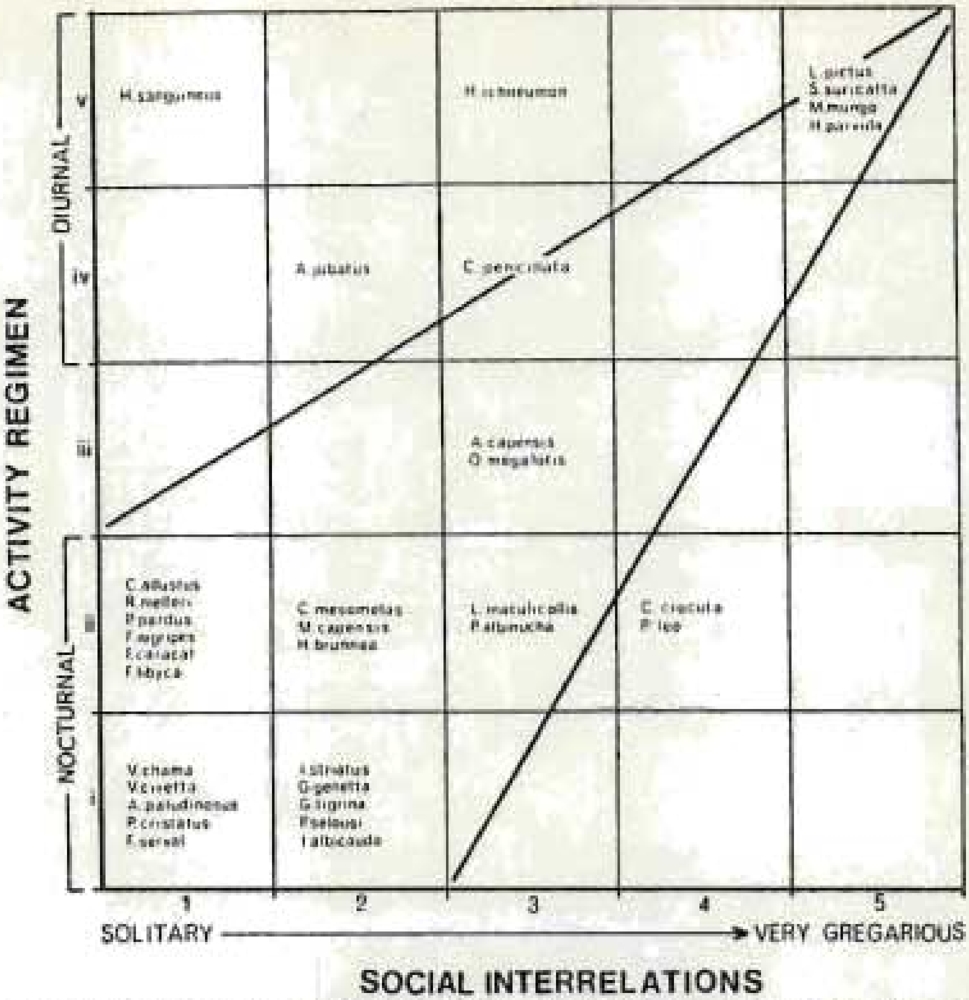

Fig. 1.—Graphical presentation of species separation by plotting the categoric values assigned to intraspecific social relations against the categoric values of daily activity cycles. See text for further explanations.

of solitary or small groups of animals, but again this would depend on the time of year of observations (Nel, 1978). This species is thus plotted in the position 3iii within the trend, although it could be argued that the Transvaal population should be plotted together with the lion just outside the trend.

It thus would appear that a vacuum exists at the nocturnal/gregarious end of the behavioral range, but that carnivores in the Transvaal do not utilize it, for reasons at present not fully understood.

H. sanguineus is the most predacious of the Herpestinae in the Transvaal, being an efficient killer of vertebrate prey. It is furthermore solitary and diurnal, in contrast to the general tendency for the more predatory small carnivores to be solitary and nocturnal (see Ewer, 1973:277). This seeming anomaly could result from an adaptive radiation to utilizing resources (especially habitat and food) with a low utilization pressure.

H. ichneumon and *C. penicillata* are only partly social species. When hunting for food both species are solitary and in this respect they are reminiscent of *H. sanguineus*. *H. ichneumon* is predatory, whereas *C. penicillata* is insectivorous. The distributional ranges of these two species furthermore do not overlap at all. *C. pencillata* is unique in the sense that when actively seeking food it is a solitary insectivore, in contrast to the other diurnal insectivores, which are social species.

The cheetah displays the three basic felid hunting techniques—stalking, utilization of the forepaws to fell its prey, and an oriented neck or choking throat bite according to the size of the prey. However, the cheetah atypically (for a felid) outruns its quarry

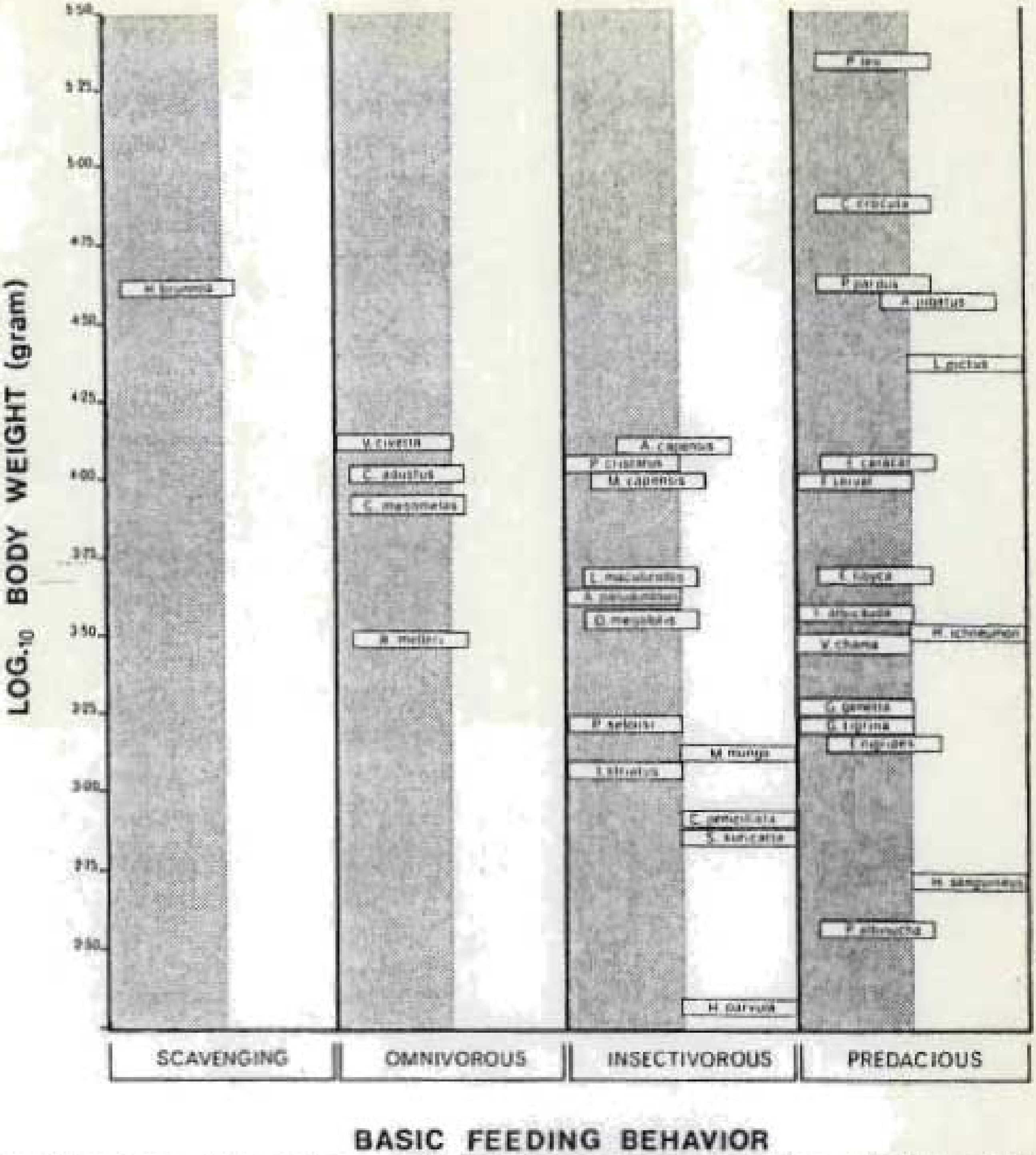

Fig. 2.—Graphical presentation of niche occupation. The four basic feeding categories are presented as vertical columns, each subdivided by a stippled column denoting nocturnal activity and an unstippled column denoting daylight activity. Species are assigned to their appropriate columns and are vertically spaced against the X-axis representing the log. value of the mean body weight in grams.

and possesses distinctive anatomical adaptations for this particular way of hunting, which can best be performed in daylight. There appears to be very little need for group participation. The cheetah thus clearly acquired behavioral and physical adaptations to enable it to radiate adaptively into a less competitive area. Of the four carnivores above the trend illustrated in Fig. 1, the cheetah utilizes a different trophic level as a result of its larger size. Yet the survival of the cheetah is threatened. Perhaps the reason for its precarious conservation status in the Transvaal should be sought in its low ranking position in the predator hierarchy. Cheetahs are often robbed of their prey by lions, leopards, and hyenas, and are even preyed upon by these more powerful predators (Schaller and Lowther, 1969; Pienaar, 1969).

A strong bias towards the insectivorous and predacious modes of life is evident (Fig. 2). The ratio of species between the four feeding classes is 1:4:12:16. Forty-eight % of Transvaal carnivores are predacious, which is considered to be the primary feeding trait of the Order. The remaining 52% have radiated away from a true predacious existence toward utilization of other protein resources, and have behaviorally adapted themselves to procuring them. Furthermore, no less than 75% of all species are predominantly nocturnal. The mean weight of the species in the omnivorous category is 8.25 kg, that of the insectivores is 4.07 kg, and the predators 25.82 kg.

We agree with Skinner (1976) that *H. brunnea* is basically a scavenger. This is further substantiated by the special dental and cranial adaptations acquired to cope with a scavenging way of life. Such a life style is for several reasons an uncertain existence, with chance playing no minor role. This is reflected in the single species represented in this category as well as the fact that it is primarily solitary, presumably in order to avoid excessive intraspecific competition for limited resources. Considering the apparent hardships of a scavenging life style, a lower mean weight may be an appropriate manner of reducing the energy requirements of the species. However, all indications are that the brown hyena is in all aspects primarily adapted towards capitalizing on the proceeds of the hunting endeavors of the larger predators.

An omnivorous life style is seen as the most opportunistic of all, and can include as food items vertebrates (which are actively hunted), insects, carrion, and vegetable matter, especially fruit. The concept of a smaller body size as a means of reducing the energy requirements of the species with such a precarious existence can be illustrated by the fact that the mean species weight in the omnivorous category is only 8.3 kg, as opposed to the mean of 25.8 kg of the predatory category and mean of 36.1 kg of *H. brunnea* in the scavenging category.

R. uelleri is much smaller than the other three species in the omnivorous category, and from this it is concluded that overlap in feeding interests is small. *V. civetta* is ecologically separated from *C. mesomelas* and *C. adustus*. The latter two species are inhabitants of the open plains and avoid forests. Like Smithers' (1971) findings, our own observations on *V. civetta* indicate a close association with riverine and subriverine woodlands. *C. adustus* is limited in range to the eastern Transvaal lowveld and a small area north of Pretoria. *C. mesomelas* ranges throughout the Transvaal. The two species are thus partly sympatric, and as is suggested in Fig. 1 may be in conflict here. Although Shortridge (1934) and Smithers (1971) speculate that *C. mesomelas* is being gradually replaced by *C. adustus* in the overlapping zone, this could not be demonstrated in the Transvaal. According to Pienaar (1963) *C. mesomelas* is numerically the more successful species in the Kruger National Park. *C. adustus* is however slightly larger than *C. mesomelas*, and indications are that it relies less on vegetable matter as a food source.

The insectivorous feeding category has the lowest mean body weight. This is considered as a significant adaptation to the small size of the individual prey, and the quantity and effort required on the part of the carnivore to fulfill its energy requirements. There are three clusters in this category that warrant closer scrutiny (see Fig. 1).

A. capensis is the biggest member of the insectivorous group. It is an aquatic mammal subsisting almost entirely on crabs (Rowe-Rowe, 1977*a*, 1977*b*). The terrestrial *P. cristatus* is the biggest carnivore living on Insecta, namely almost exclusively termites (especially *Trinervitermes*). It is not well equipped to dig out subterranean termites. *M. capensis* is also terrestrial and overlaps in range with the aardwolf. It however hunts invertebrates bigger than termites, especially spiders. The honeybadger is particularly well adapted to procuring this subterranean prey.

L. maculicollis, *A. paludinosis*, and *O. megalotis* also form a cluster in Fig. 1. The latter species is however a terrestrial inhabitant of the open plains, whereas the former two are to varying degrees semiaquatic. The spotted-necked otter and the marsh mongoose appear to be in conflict as they both rely heavily on crustaceans in their respective diets, and furthermore overlap in geographic range and habitat requirements. *A. paludinosus* is however a more versatile animal because it is more mobile on land. It wanders greater distances away from water and utilizes a wider spectrum of food resources. It is furthermore believed to hunt for aquatic prey only in the shallows, as opposed to *L. maculicollis*.

C. penicillata and *S. suricatta* also overlap in distributional range. Where the suricate is very gregarious and almost exclusively insectivorous, the yellow mongoose is a solitary hunter, which takes vertebrate prey as well as invertebrates.

The predatory category is the true domain of the Felidae, and no felid has radiated away from it. They are specialist killers, the only group capable of handling prey larger than themselves singlehanded. This is achieved mostly by means of a lethal well-directed single neckbite, or derivations thereof. Felidae are, in general, also expert stalkers.

Of the nonfelids in this feeding category, the mustelid *P. albinucha* is an exception, in that it behaves very similarly to the Felidae with regard to killing efficiency and the size of prey that it can handle. The remainder, that is the viverrids, canids, and *Crocuta*, all belong conditionally to the predatory category. *C. crocuta* and *L. pictus* rely on group cooperation to kill, and are relatively inefficient predators when alone. The remainder of the nonfelids rely on the other food sources already discussed, and when they kill, it is mostly prey much smaller than themselves excluding domestic stock.

Very little is known of the serval, but from the information that is available, it would appear not to be in conflict with the caracal, as is indicated in Fig. 1. The serval appears to be restricted to areas with permanent surface water and its associated forests, and preys mostly on rodents. The caracal, on the other hand, does not prefer forests and is a true predator of prey more equal in size to itself.

The geographic ranges of *V. chama* and *I. albicauda* overlap only peripherally in the Transvaal. *F. libyca*, on the other hand, is widely distributed and overlaps with the ranges of both the former species. *F. libyca* and *V. chama* are separated in size to the extent that they presumably avoid conflict by means of differential choice in prey size. *I. albicauda* is restricted to riverine forests, whereas *F. libyca* has a wide habitat tolerance. The latter species therefore appears to be a universalist, the former a specialist extremely well adapted to its particular narrow niche. In the zone of contact between these two species, it can be postulated that *I. albicauda* has the edge in a competitive situation.

The two species of genets are partly sympatric. Our own experience agrees with that of Smithers (1971) in that these two species are ecologically separated. *G. tigrina* prefers a habitat close to water, whereas *G. genetta* exists away from it. The range of *F. nigripes* overlaps partially with that of *G. genetta*, and not at all with *G. tigrina*. However, so little is known about the general biology of the black-footed cat, that no suggestions can be offered as to how it avoids conflict with the small-spotted genet.

CONCLUSIONS

A behavioral trend is indicated in carnivores, which ranges from a direct correlation between a nocturnal/solitary mode of life, to an entirely diurnal/gregarious existence. We conclude that 82% of the Transvaal carnivores fall within this trend. Presumed adaptive radiation away from this trend is restricted to six species. Carnivores are considered incapable of adapting to an entirely nocturnal/gregarious life style.

In the majority of coexisting species interspecific competition is avoided, primarily through different food sources, differences in size of food items (correlated to different body size of the carnivores), or differential use of habitat types. However, in the instances of the two jackal species, *L. maculicollis* and *A. paludinosus*, as well as *F. nigripes* and *G. genetta*, at least partial interspecific competition is suspected. A more intimate knowledge of the general biology of these six species may in time show more subtle mechanisms of avoiding conflict.

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Appendix III

Rautenbach, I.L. 1978. A Numerical Re-appraisal of the southern African Biotic Zones. *Bull. Carn. Mus. Nat. Hist.* *6*:175-187.

(Paper presented at the Second International Colloquium on the taxonomy and ecology of the small mammals of Africa. September, 1977. Powdermill, Pittsburgh, U.S.A.)

A NUMERICAL RE-APPRAISAL OF THE SOUTHERN AFRICAN BIOTIC ZONES

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ABSTRACT

The acceptability and credibility of the empirically derived biotic zones of southern Africa are mathematically tested by means of Duellman's (1965) Faunal Resemblance Factor analysis. The distribution of 275 southern African mammalian species is analyzed. A total of six biotic zones, including three that were formerly regarded as subzones, are found to be viable biogeographic entities of full zonal status.

INTRODUCTION

Zoogeography has been defined as ". . . the scientific study of the distribution of animals on earth . . ." (Udvardy, 1969:1). Through the years a number of attempts have been made to classify animal life into meaningful distributional units, and the field has been subdivided in diverse ways toward different ends. Perhaps the suggested subdivision most pertinent to this paper is that proposed by Darlington (1957:11), who distinguishes three possible levels of approach: 1) geographical distribution over the entire earth; 2) regional distribution over selected segments of the earth; 3) local distribution, including species geography ("the geographical distribution of species in relation to each other and to ecology and evolution").

This study will consider a statistical analysis of the distributional trends of southern African mammals, in an effort to re-evaluate the validity and credibility of the empirically derived biotic zones of the southern subcontinent. It is primarily aimed at the second level of Darlington's zoogeographical approach, and deals with the regional distribution of the mammals of southern Africa. Unfortunately regional studies such as this are often bound to political, rather than natural, areas.

Udvardy (1969:6) distinguishes static faunistic and regional zoogeography from dynamic causal zoogeography. He furthermore distinguishes specifically between zoogeography and ecology. Zoogeography in its purest sense concerns itself with the reasons for the arrival and settling of a species in a certain area. A study of why and how a species is able to live in that particular area is an ecological problem. Similarly, Simpson (1965:71–73) recognizes three levels of zoogeography—geographical, ecological, and historical. Both the zoogeographical and ecological attributes of distribution are the product of evolutionary processes during the course of time; hence, truly explanatory models can only be framed on a historical basis.

An accurate and detailed knowledge of subspeciation is essential in most modern computations aimed at causal zoogeography. The reverse is, however, also true; a consideration of the biogeography of taxa is important when studying subspeciation. Zoogeography and taxonomy are thus interdependent. The subspecific status of the majority of southern African mammals is, in the modern context, unsatisfactorily resolved, and thus severely hampers any detailed and accurate biogeographical analysis. Available analytical procedures based on subspeciation have therefore not been considered in this study pending further detailed survey work and subsequent taxonomic studies on the subspecies level. Consequently, this study is essentially limited to Udvardy's static faunistic and regional zoogeographical approach, and is thus primarily ecological in context.

The major biogeographical zones or provinces currently accepted for Africa stem from Sclater (1896). He subdivided Africa into four subregions—the Sahara, West Africa, Cape, and Malagasy. Recently, the Malagasy subregion was upgraded to regional status (Darlington, 1957). Hence the current concept of the Ethiopian region is Africa south of the Sahara.

Chapin (1923, 1932), working on the avifauna of Zaire (formerly Belgian Congo), combined former approaches (Wallace, 1876; Sclater, 1896; Reichenow, 1900; Sharpe, 1893) with his own knowledge of the birds of tropical Africa. He divided Zaire into distinct avifaunal regions, which he based on vegetation types best fitting the distribution of birds. Chapin then attempted to follow these avifaunal regions into adjacent countries, eventually arriving at a subdivision of the Ethiopian region into biogeographical districts. His West African subregion, as well as his East and South African subregions, correspond closely to the subregions of Sclater (1896). Both approaches were essentially aimed at a broad separation of tropical forests from savannas and deserts.

In Chapin's (1932) treatise of Africa, southern Africa was subdivided into only two faunal districts—an eastern and a western-arid district. Chapin's work was soon accepted (see Bates, 1924; Lynes, 1924). However, Chapin (1932) himself comments that the least satisfactory portion of his zoogeographical map of Africa is the southern African district. He considers further subdivision necessary here, especially in order to accommodate the highveld grassland and the woodland savanna, as well as tropical montane and coastal forests.

Moreau (1952) collates and critically discusses the Tertiary geology and climate of Africa. In this light, he analyzes the distribution of passerine avifauna of Africa, firstly by biomes, and secondly with respect to its affinities with the avifaunas of Europe and Asia. He geographically subdivides these main biomes into smaller biotic zones. He considers affinities both on generic and specific level, and found differences between these derived biotic zones to be great.

With regard to southern Africa, Moreau (1952) retains Chapin's (1923) South West Arid district more or less unaltered, as a biotic zone. However, Moreau introduces the concept of the Southern Savanna biotic zone, which combines Chapin's eastern, climatically moderate, woodland districts. As suggested by Chapin (1932), Moreau now also recognizes montane forests as distinct on a biotic zone level. He furthermore recognizes the small, but floristically very rich and distinct winter rainfall area around Cape Town, with its Mediterranean climate, as a separate biotic zone.

Moreau (1952) uses both the terms "biotic zone" and "biome." The first term has a definite zoogeographical connotation, the second ecological. According to Smith (1966), the biotic province (zone) concept ". . . embraces a continuous geographic area that contains ecological associations distinguishable from those of adjacent provinces (zones), especially at the species and subspecies level . . . ." The biome, on the other hand, is a major ecosystem, and is seen by Smith as ". . . a broad ecological unit characterized by the distinctive life forms of the climax species, plant or animal . . . ." Southern African biotic zones can in reality also be seen as biomes, except that as such they are only parts of the major biomes of Africa. Whatever the case, Moreau can be credited to be one of the first to employ the correct terminology in an African zoogeographical treatise, with consideration to concepts and terms developed in related fields such as ecology. This distinction between "biotic zone" and "biome" is recognized and applied in this report.

Davis (1962) employs the southern African portion of Moreau's (1952) biogeographical map in an analysis of distribution patterns of the local Muridae. He agrees with Moreau in the validity of the South Western Cape as a biotic zone. However, Davis' (1962) main zoogeographical contribution lies in the fact that for the first time the biotic zones, which were founded on avifaunal distributional data, are analyzed from a mammalian point of view, albeit on only one family. Davis slightly alters the borders of the biotic zones to conform with the vegetation map of Keay (1959).

In a discussion of the origins of the southern African mammalian fauna, Meester (1965) accepts Davis' modified version of Moreau's biotic zones. Although Davis' generalized attempts to subdivide the biotic zones went unnoticed, Meester's definite recognition of the Namib as a subzone of the South West Arid, and the Grassland as a subzone of the Southern Savanna, was soon accepted. This approach to the recognition of biotic zones is even more compatible with the biome concept.

There are other proposed systems for subdividing the subcontinent into major biogeographic units, especially those of Liversidge (1962) and Winterbottom (1962). However, the biotic zone concept as outlined above has become commonly accepted as relevant from an ecological viewpoint, especially with regard to higher vertebrates. It is also, to my knowledge, the only zoogeographical system considered in recent years for work on mammal distribution (see Davis, 1962; Meester, 1965). It is therefore appropriate that biotic zones should receive closer scrutiny here, especially because no less than four currently recognized major biotic zones (two with two subzones each) are represented in southern Africa. Meester's (1965) refined version of Moreau's (1952) biotic zones is analyzed in this report.

METHODS

The African biotic zones and subzones have been empirically derived by considering main vegetation types and how they best fit the distribution of species, initially of birds and later of mammals. The zones are thus largely subjective. A number of species may be confined to a single biotic zone (endemics), but very few have ranges coinciding entirely with the boundaries of the particular zone in which they occur. Generally their ranges are more restricted. Such endemic species are few in number, yet serve as the main argument to justify the recognition of the biotic zone. The majority of species occurs over several biotic zones, because the distributions are limited by factors more generalized than those governing the vegetation types on which the biotic zones are primarily based. These widespread species apparently formerly served no role in justifying the recognition of biotic zones.

Duellman (1965:677) proposes a statistical analysis to express the validity of biogeographical subdivisions, based on the known distribution of all species in the entire area. He termed it the "Faunal Resemblance Factor", which is statistically expressed as FRF = 2C/N1 + N2, where C equals the number of species in common between the two zones compared, N1 equals the number of species in the first zone, and N2 equals the number of species in the second zone. An index value of 0.000 would indicate no taxonomic resemblance between two zonal faunas, and an index of 1.000 would indicate complete identity. A value of 0.500 would indicate that one-half of the species in each of the two zonal faunas are held in common, provided that they are of equal size. In the case of unequal-sized faunas, both dissimilarity in species composition and relative equality in species density are expressed. Duellman's (1965) formula is a simplified, yet equally effective, derivate of the Burt coefficient (Burt, 1958). Both formulas take the average of the two samples as the denominator (contrary to the Simpson and Jaccard coefficients see Simpson, 1960), in an effort to reduce the effect of difference in size between them. However, the influence of differential faunal sizes is not entirely eliminated, and is yet another factor expressing similarity or dissimilarity between zones. These formulas are furthermore designed for taxa of whom the geographical distributions of species are not well known. Only the presence or absence of taxa is of great importance. The Duellman coefficient is therefore ideally suited for this analysis, and was decided upon as being the simplest of the two mentioned here.

RESULTS

The distributions of 275 species of southern African mammals are given in Table 1. This list was compiled from updated but unpublished distribution maps kept in the Transvaal Museum for curatorial purposes, as well as from the literature, particularly Smithers (1971), Meester and Setzer (1971–1977), Davis (1974), Pringle (1974) Lynch (1975) and Smithers and Lobão Tello (1976). The taxonomic treatise of Meester and Setzer (1971) was followed. In the calculation of FRF indices, the Southern Savanna Grassland and Woodland subzones and the Namib subzone were treated as hypothetically valid zones, as indicated in Table 1. The list excludes feral and exotic species, as well as poorly known endemics of doubtful taxonomic status. As far as possible, the natural (historic) ranges of species were considered, thus compensating for human impact. Species with extremely limited ranges, or known from only a few localities, were considered as representative of the biotic zone in which they occur. Where the majority of localities for a species fall within a given zone, with only a few isolated instances falling just inside an adjacent zone, these were considered as typical only of the zone where the distribution is concentrated, and not as a constituent of the mammal fauna of the second zone. However, if such scattered localities are deep into the second zone, they were considered typical of that zonal fauna as well. Judgment was subjective. Typical Forest zone species occurring outside that zone, but restricted to riverine forests, were considered as pure forest zone species. However, the influence of dispersal corridors, such as the Kuiseb and Orange rivers, were not taken into account.

The distribution of bats as a group is particularly poorly documented, which may adversely influence the results of this analysis. Excluding bats was considered. However, certain mammalian taxa, as well as nutritionally and ecologically adapted groups, demonstrate diverse latitudinal clinal trends in composition and densities (Nel, 1975). Thus it was decided to include the meagre information on bats in an effort to retain a more balanced image of trends in overall mammalian ecological distribution.

A simple matrix of similarity, indicating the degree of interrelationships of mammalian faunas of southern African biotic zones, is given in Table 2. Absolute numbers of species in common are indicated below the diagonal. Italic numerals on the diagonal indicate the number of species in each zone, and the bracketed numerals underneath these denote the known number of endemic species. Above the diagonal is an index of faunal resemblance, calculated after Duellman (1965).

Table 1.—*Distribution of southern African mammals according to Biotic Zones.*

Taxa	Biotic Zones					
	Namib	South West Arid	South West Cape	Southern Savanna Woodland	Southern Savanna Grassland	Forest
Petrodromus tetradactylus	—	—	—	X	—	X
Macroscelides proboscideus	X	X	—	—	—	—
Elephantulus intufi	X	X	—	X	—	—
Elephantulus rupestris	—	X	—	—	—	—
Elephantulus myurus	—	—	—	X	X	—
Elephantulus edwardi	—	X	—	—	—	—
Elephantulus brachyrhynchus	—	—	—	X	X	—
Erinaceus frontalis	—	X	—	X	X	—
Myosorex varius	—	—	X	X	X	X
Myosorex cafer	—	—	—	X	X	X
Suncus lixus	—	—	—	X	—	—
Suncus gracilis	—	—	—	—	X	—
Sylvisorex megalura	—	—	—	—	—	X
Crocidura occidentalis	—	—	—	X	—	X
Crocidura flavescens	—	—	X	—	X	X
Crocidura luna	—	—	—	—	—	X
Crocidura mariquensis	—	—	—	X	X	—
Crocidura hirta	—	X	—	X	X	X
Crocidura silacea	—	—	—	X	X	X
Crocidura cyanea	X	X	—	X	X	X
Crocidura maquassiensis	—	—	—	X	X	—
Crocidura bicolor	—	X	—	X	—	—
Chrysospalax trevelyani	—	—	—	X	—	X
Chrysospalax villosus	—	—	—	X	X	X
Cryptochloris wintoni	—	X	—	—	—	—
Cryptochloris zyli	—	—	X	—	—	—
Chrysochloris asiatica	—	X	—	—	—	—
Chrysochloris visagiei	—	X	—	—	—	—
Eremitalpa granti	X	X	X	—	—	—
Chlorotalpa sclateri	—	X	—	—	X	—
Chlorotalpa duthiae	—	—	—	—	—	X
Chlorotalpa arendsi	—	—	—	—	—	X
Calcochloris obtusirostris	—	—	—	X	—	—
Amblysomus gunningi	—	—	—	—	—	X
Amblysomus hottentotus	—	—	—	X	X	X
Amblysomus iris	—	—	—	X	X	X
Amblysomus julianae	—	—	—	X	X	—
Eidolon helvum	—	X	—	X	X	—
Epomophorus wahlbergi	—	—	—	X	—	X
Epomophorus gambianus	—	—	—	X	—	—
Epomophorus crypturus	—	—	—	X	—	—
Epomophorus angolensis	—	—	—	X	—	—
Rousettus aegyptiacus	—	—	—	X	—	X
Rousettus angolensis	—	—	—	—	—	X
Taphozous mauritianus	—	—	—	X	—	—
Taphozous perforatus	—	—	—	X	—	—
Coleura afra	—	—	—	X	—	—
Nycteris hispida	—	—	—	—	—	X
Nycteris grandis	—	—	—	—	—	X
Nycteris macrotis	—	—	—	X	—	X
Nycteris woodi	—	—	—	X	—	X
Nycteris thebaica	X	X	—	X	—	X
Rhinolophus hildebrandti	—	—	—	X	—	X
Rhinolophus fumigatus	—	X	—	X	—	—
Rhinolophus clivosus	—	—	X	X	X	X

Table 1.—*Continued.*

Taxa	Biotic Zones					
	Namib	South West Arid	South West Cape	Southern Savanna Woodland	Southern Savanna Grassland	Forest
Rhinolophus darlingi	X	X	—	X	—	—
Rhinolophus landeri	—	—	—	X	—	—
Rhinolophus blasii	—	—	—	X	—	—
Rhinolophus capensis	—	X	X	X	—	—
Rhinolophus simulator	—	—	—	X	—	—
Rhinolophus denti	—	X	—	X	—	—
Rhinolophus swinnyi	—	—	—	X	—	—
Hipposideros commersoni	—	X	—	X	—	—
Hipposideros caffer	—	X	—	X	—	X
Triaenops persicus	—	—	—	X	—	—
Cloeotis percivali	—	—	—	X	—	—
Myotis welwitschii	—	—	—	X	X	—
Myotis seabrai	—	X	—	—	—	—
Myotis lesueuri	—	—	X	—	—	—
Myotis tricolor	—	X	—	X	X	—
Myotis bocagei	—	—	—	X	—	—
Nycticeius schlieffeni	—	X	—	X	—	—
Pipistrellus nanus	—	—	—	X	—	X
Pipistrellus kuhli	—	—	—	X	—	X
Pipistrellus rusticus	—	—	—	X	—	X
Pipistrellus rueppelli	—	—	—	X	—	—
Eptesicus rendalli	—	—	—	X	—	—
Eptesicus hottentotus	X	X	—	X	—	—
Eptesicus melckorum	—	—	X	—	—	—
Eptesicus zuluensis	X	X	—	X	—	—
Eptesicus somalicus	—	—	—	X	—	—
Eptesicus capensis	—	X	—	X	X	—
Eptesicus notius	—	—	X	—	—	—
Glauconycterus variegata	—	—	—	X	—	—
Laephotis wintoni	—	—	—	X	—	—
Scotophilus gigas	—	—	—	X	—	—
Scotophilus nigrita	—	—	—	X	—	—
Scotophilus leucogaster	—	X	—	X	—	—
Kerivoula argentata	—	—	—	X	—	—
Kerivoula harrisoni	—	—	—	X	—	—
Kerivoula lanosa	—	—	—	X	—	X
Miniopterus fraterculus	—	—	—	X	—	—
Miniopterus schreibersi	X	X	—	X	X	X
Otomops martiensseni	—	—	—	X	—	—
Sauromys petrophilus	—	X	—	X	—	—
Tadarida acetabulosus	—	—	—	X	—	—
Tadarida midas	—	X	—	X	—	—
Tadarida niveiventer	—	—	—	X	—	—
Tadarida condylura	—	—	—	X	—	X
Tadarida nigeriae	—	X	—	X	—	—
Tadarida chapini	—	—	—	X	—	—
Tadarida pumila	—	—	—	X	—	—
Tadarida fulminans	—	—	—	X	—	—
Tadarida aegyptiaca	—	X	X	X	X	X
Tadarida ansorgei	—	—	—	X	—	—
Galago crassicaudatus	—	—	—	X	—	X
Galago senegalensis	—	X	—	X	—	X
Papio cynocephalus	—	—	—	X	—	—
Papio ursinus	X	X	X	X	X	X
Cercopithecus mitis	—	—	—	X	—	X

Table 1.—*Continued.*

	Biotic Zones					
Taxa	Namib	South West Arid	South West Cape	Southern Savanna Woodland	Southern Savanna Grassland	Forest
Cercopithecus aethiops	—	X	—	X	—	X
Manis temmincki	—	X	—	X	X	—
Otocyon megalotis	—	X	—	X	—	—
Vulpes chama	X	X	—	X	X	—
Canis mesomelas	X	X	—	X	X	—
Canis adustus	—	—	—	X	—	—
Lycaon pictus	—	X	—	X	—	—
Ictonyx striatus	X	X	—	X	—	—
Poecilogale albinucha	—	X	—	X	X	—
Mellivora capensis	—	X	—	X	—	—
Lutra maculicollis	—	X	—	X	X	—
Aonyx capensis	—	X	—	X	X	—
Nandinia binotata	—	—	—	—	—	X
Viverra civetta	—	—	—	X	—	—
Genetta genetta	X	X	X	X	X	—
Genetta tigrina	—	—	X	X	—	X
Genetta rubiginosa	—	—	—	X	—	—
Genetta mossambica	—	—	—	X	—	—
Suricata suricatta	X	X	—	—	X	—
Paracynictis selousi	—	—	—	X	—	—
Bdeogale crassicauda	—	—	—	X	—	—
Cynictis penicillata	—	X	—	X	X	—
Herpestes ichenumon	—	—	—	X	—	—
Herpestes pulverulentus	—	X	—	—	X	—
Herpestes sanguineus	—	X	—	X	X	X
Herpestes ratlamuchi	—	X	—	X	—	—
Rhynchogale melleri	—	—	—	X	—	X
Ichneumia albicauda	—	—	—	X	—	X
Atilax paludinosus	—	X	X	X	X	X
Mungos mungo	—	X	—	X	—	—
Helogale parvula	—	X	—	X	—	—
Proteles cristatus	X	X	—	X	X	—
Hyaena brunnea	X	X	—	X	X	—
Crocuta crocuta	X	X	—	X	X	—
Felis libyca	X	X	X	X	X	—
Felis nigripes	—	X	—	—	X	—
Felis serval	—	—	X	X	—	—
Felis caracal	X	X	—	X	X	—
Panthera pardus	X	X	X	X	X	X
Panthera leo	—	X	X	X	X	—
Acinonyx jubatus	—	X	—	X	—	—
Orycteropus afer	—	X	—	X	X	—
Loxodonta africana	—	X	—	X	—	—
Procavia capensis	X	X	X	X	X	X
Procavia welwitschii	X	X	—	—	—	—
Heterohyrax brucei	—	—	—	X	—	—
Dendrohyrax arboreus	—	—	—	X	—	—
Diceros bicornis	—	X	X	X	—	—
Ceratotherium simum	—	X	—	X	X	—
Equus zebra	X	X	—	—	—	—
Equus burchelli	—	X	X	X	X	—
Potamochoerus porcus	—	—	X	X	—	X
Phacochoerus aethiopicus	—	X	—	X	—	—
Hippopotamus amphibius	—	X	X	X	X	—
Giraffa camelopardalis	—	X	—	X	—	—

Table 1.—*Continued.*

	Biotic Zones					
Taxa	Namib	South West Arid	South West Cape	Southern Savanna Woodland	Southern Savanna Grassland	Forest
Cephalophus natalensis	—	—	—	X	—	X
Cephalophus monticola	—	—	—	X	—	X
Sylvicapra grimmia	—	X	X	X	X	—
Raphicerus campestris	—	X	X	X	X	—
Raphicerus melanotis	—	—	X	X	—	—
Raphicerus sharpei	—	—	—	X	—	—
Ourebia ourebi	—	—	—	X	X	—
Neotragus moschatus	—	—	—	X	—	—
Oreotragus oreotragus	X	X	—	X	—	—
Madoqua kirki	—	X	—	—	—	—
Pelea capreolus	—	X	X	X	X	—
Redunca arundinum	—	—	—	X	—	—
Redunca fulvorufula	—	—	—	X	X	—
Kobus ellipsiprymnus	—	X	—	X	—	—
Kobus vardoni	—	—	—	X	—	—
Kobus leche	—	—	—	X	—	—
Aepyceros melampus	—	X	—	X	—	—
Aepyceros petersi	—	X	—	X	—	—
Antidorcas marsupialis	X	X	—	—	X	—
Oryx gazella	X	X	—	X	—	—
Hippotragus leucophaeus	—	—	X	—	—	—
Hippotragus niger	—	—	—	X	—	—
Hippotragus equinus	—	—	—	X	—	—
Damaliscus lunatus	—	—	—	X	—	—
Damaliscus dorcas dorcas	—	—	X	—	—	—
Damaliscus dorcas phillipsi	—	X	—	—	X	—
Alcelaphus buselaphus	—	X	—	X	X	—
Alcelaphus lichtensteini	—	X	—	X	—	—
Connochaetes taurinus	—	X	—	X	—	—
Connochaetes gnou	—	—	—	—	X	—
Tragelaphus scriptus	—	—	X	X	—	—
Tragelaphus spekei	—	—	—	X	—	—
Tragelaphus angasi	—	—	—	X	—	—
Tragelaphus strepsiceros	—	X	—	X	—	—
Taurotragus oryx	—	X	X	X	X	—
Syncerus caffer	—	—	—	X	—	—
Lepus capensis	—	X	—	X	X	—
Lepus saxatilis	—	X	—	X	X	—
Bunolagus monticularis	—	X	—	—	—	—
Pronolagus crassicaudatus	—	—	—	X	—	—
Pronolagus rupestris	—	X	—	X	X	—
Pronolagus randensis	—	X	—	X	X	—
Bathyergus janetta	—	X	—	—	—	—
Bathyergus suillus	—	—	X	—	—	X
Georychus capensis	—	X	X	—	X	—
Cryptomys damarensis	—	X	—	—	—	—
Cryptomys hottentotus	—	X	—	X	X	X
Hystrix africaeaustralis	X	X	—	X	X	X
Petromus typicus	X	X	—	—	—	—
Thryonomys swinderianus	—	—	—	X	—	—
Thryonomys gregorianus	—	—	—	X	—	—
Xerus inauris	—	X	—	—	X	—
Xerus princeps	—	X	—	—	—	—
Heliosciurus rufobrachium	—	—	—	X	—	X
Funisciurus congicus	—	X	—	—	—	—

Table 1.—*Continued.*

Taxa	Biotic Zones					
	Namib	South West Arid	South-West Cape	Southern-Savanna Woodland	Southern-Savanna Grassland	Forest
Paraxerus palliatus	—	—	—	—	—	X
Paraxerus cepapi	—	—	—	X	—	—
Pedetes capensis	X	X	—	X	X	—
Graphiurus ocularis	—	X	X	—	—	—
Graphiurus platyops	—	X	—	X	X	—
Graphiurus murinus	—	X	—	X	X	X
Cricetomys gambianus	—	—	—	X	—	X
Dendromus nyikae	—	—	—	—	—	X
Dendromus melanotis	—	X	X	X	X	X
Dendromus mesomelas	—	—	X	X	X	X
Dendromus mystacalis	—	—	—	X	X	X
Malacothrix typica	—	X	—	—	X	—
Mystromys albicaudatus	—	—	X	—	X	—
Petromyscus monticularis	—	X	—	—	—	—
Petromyscus collinus	X	X	—	—	—	—
Saccostomus campestris	—	X	X	X	X	—
Steatomys pratensis	—	X	—	X	—	—
Steatomys krebsi	—	X	—	—	X	—
Steatomys minutus	—	X	—	X	X	—
Acomys spinosissimus	—	—	—	X	—	X
Acomys subspinosus	—	—	X	—	—	X
Aethomys granti	—	X	—	—	—	—
Aethomys namaquensis	X	X	X	X	X	—
Aethomys chrysophilus	—	X	—	X	—	—
Aethomys nyikae	—	—	—	X	—	—
Dasymus incomtus	—	—	X	X	X	—
Mus indutus	—	—	—	X	X	—
Mus minutoides	X	X	X	X	X	X
Lemniscomys griselda	—	X	—	X	—	—
Pelomys fallax	—	—	—	X	—	X
Praomys natalensis	—	X	X	X	X	X
Praomys shortridgei	—	—	—	X	—	—
Praomys verreauxi	—	—	X	—	—	X
Rhabdomys pumilio	X	X	X	X	X	X
Thallomys paedulcus	X	X	—	X	—	—
Thamnomys cometes	—	—	—	—	—	X
Thamnomys dolichurus	—	—	—	X	—	X
Zelotomys woosnami	—	X	—	—	—	—
Parotomys brantsi	X	X	X	—	—	—
Parotomys littledalei	X	X	—	—	—	—
Otomys laminatus	—	—	—	X	X	X
Otomys angoniensis	—	X	—	X	X	—
Otomys saundersiae	—	—	X	—	X	—
Otomys irroratus	—	X	X	X	X	X
Otomys sloggetti	—	—	—	—	X	—
Otomys unisulcatus	—	X	—	—	—	—
Desmodillus auricularis	X	X	—	—	—	—
Gerbillurus vallinus	X	X	—	X	—	—
Gerbillurus tytonis	X	—	—	—	—	—
Gerbillurus paeba	X	X	X	X	—	—
Gerbillurus setzeri	X	—	—	—	—	—
Tatera leucogaster	X	X	—	X	—	—
Tatera afra	—	—	X	—	—	—
Tatera brantsii	—	X	—	X	X	—
Tatera inclusa	—	—	—	X	—	—

Table 1.—*Continued.*

Taxa	Biotic Zones					
	Namib	South West Arid	South West Cape	Southern Savanna Woodland	Southern Savanna Grassland	Forest
Total (275 species)	43	136	50	209	91	73
Percentage of total fauna	15.6	49.5	18.2	76.0	33.1	26.6
Total no. of endemic species	2	16	7	60	3	12
% endemics to total zonal fauna	4.65	11.76	14.00	28.71	3.30	16.44

DISCUSSIONS

It must be stressed that subcontinental distributional data is as yet incomplete for the majority of species, particularly so in the Cape Province and South West Africa. Furthermore, the accuracy of this analysis will be greatly enhanced if conducted on the subspecies level, rather than on a species level. This ideal will be delayed for many years as a result of the unsatisfactory status of the knowledge of subspeciation in southern African mammals.

On the other hand, a more intimate knowledge of the distribution patterns of species does not necessarily imply a high incidence of range extensions into biotic zones where they have previously been unrecorded. When species geographic ranges are better known and the occurrence of not too many species are recorded in new zones, the results of this analysis will not change dramatically. A more accurate FRF analysis facilitated by subspecies consideration will probably only enhance the findings of this treatment because a higher degree of endemism is expected. Whatever the case, the following points are pertinent from Table 2 and warrant further comment here, especially with regard to my aim to assess the validity of biotic zones as viable biogeographical areas.

Superficially, the FRF indices of all zones under consideration are low enough to warrant their consideration as distinct zones (Table 2). Closer scrutiny is however essential.

The Namib is most closely related to the South West Arid, albeit with a FRF index as low as 0.458. The Namib's FRF indices when calculated against the other zones are, however, much lower, which confirms distinctness from these. The Namib possesses only two endemic species (Table 1), namely *G. tytonis* and *G. setzeri*. However, by far the greatest majority (41) of the Namib's total mammal fauna (43) consists of a faction of the bigger South West Arid fauna (some species also occur elsewhere).

Table 2.—*Resemblance of mammalian faunas of the six southern African Biotic Zones and Subzones. (See text for explanation; italic numerals on diagonal indicate total number of species in zone, the numerals in brackets underneath these denote the known number of endemic species).*

Biotic Zones	Southern Savanna Woodland	South West Arid	Southern Savanna Grassland	Forest	South West Cape	Namib
Southern Savanna Woodland	*209* (60)	.580	.500	.404	.247	.238
South West Arid	100	*136* (16)	.573	.201	.290	.458
Southern Savanna Grassland	75	65	*91* (3)	.341	.411	.299
Forest	57	21	28	*73* (12)	.309	.138
South West Cape	32	27	29	19	*50* (7)	.237
Namib	30	41	20	8	11	*43* (2)

Consequently it can be considered as merely a depauperate fauna of the latter, resulting from the inhospitable nature of the Namib. The Namib's biogeographical uniqueness thus lies not so much in its typical endemic fauna, or its faunal composition for that matter, but rather in the fauna it does not possess. The Namib is therefore considered here as a biotic zone of full rank. Detailed analysis has shown that the Namib can be further subdivided, on the basis of the sand dunes being faunistically more depauperate than the gravel plains (see Coetzee, 1969).

In spite of its tremendous floral diversity, the South Western Cape is also very depauperate in mammalian fauna. However, it must be pointed out that this is, in terms of intensive mammal surveying, the most neglected biotic zone of all. It has seven endemic taxa as far as is known—*C. zyli*, *M. leseuri*, *E. melckorum*, *E. notus*, *D. d. dorcas*, *T. afra*, and the extinct *H. leucophaeus* (see Table 1). The remainder of the faunal element is made up of mammalian species shared with other biotic zones. This zone shares 32 species with the Woodland zone, and 29 with the Grassland zone. However, as a result of the enormous differential species diversity between the Woodland and the South West Cape, the FRF analysis indicates a closer resemblance between the latter zone and the less diversified Grassland zone, with an index of 0.411. It is interesting to note that the South West Cape and the Grassland zones are unconnected.

The Forest zone is also quite distinct from the others. It is faunistically most closely related to the Southern Savanna Woodland subzone with a FRF index of 0.401. It possesses 12 endemic species (see Table 1).

The Woodland and Grassland zones and the South-West Arid zone are the three areas related more closely to each other than any other combination of zones. Their individual FRF indices in relation to each other are however considered low enough to warrant their individual recognition. Because the Grassland has been considered a subzone of the Southern Savanna biotic zone, closest resemblance is expected between it and the related Woodland subzone. This is, however, not the case. Both in terms of absolute number of species in common and FRF index, the Woodland and South-West Arid are faunistically most closely related (100 species in common; FRF index 0.580). This is followed by a closer resemblance between Grassland and South West Arid in terms of FRF indices (0.573), but in terms of number of species in common, a closer resemblance between Grassland and Woodland (75 species). This inconsistency can be ascribed to the disproportionate sizes of the three zonal faunas and as compensated for by Duellman's formula, especially designed for such instances. The Southern Savanna Woodland has by far the richest mammalian fauna; 209 species, representing 76.0% of the total southern African mammal fauna, occur here, including 60 endemics (predominantly bats). This is followed by the South West Arid, with a total diversity of 136 species, that is 49.5% of the total of 275 southern African species, with 16 endemics. The Savanna Woodland undoubtedly offers the highest variety of habitats, being ecologically more diversified both horizontally and vertically. Its rich species diversity could be related to this fact more than any other.

The temptation is great to assume that the respective faunal elements of other zones have originated by a radiation of Woodland-adapted species. Undoubtedly this is true in many instances, especially in the case of species, which do not rely on trees as an integral element in their habitat requirements. On the other hand, the high number of endemics typical of the Woodland and South West Arid areas combined (76 species) can be interpreted as a faunal element specialized towards a dependance on woodland in some manner or other. The fact that such a large portion (100 species) of the non-endemic fauna of the Woodland apparently radiated adaptively into the South West Arid is reflected by the highest FRF index of all (0.580). Mostly due to lower average annual precipitation, the latter zone has a less developed woodland flora, and consequently a less diversified mammalian fauna.

The same situation could also be demonstrated with Grassland-adapted species finding suitable habitat in adjacent Woodland Savanna (FRF index 0.500) and South-West Arid (FRF index 0.573). Forest is scattered through three zones (Southern Savanna Woodland, Southern Savanna Grassland, and South-West Cape), and has higher FRF indices with these than with the non-adjacent Namib and South-West Arid. This trend of a relatively higher FRF index reflecting a sharing of species between adjacent zones, numerically radiating clinally from the Woodland Savanna, appears to be the rule. There is one exception, that is South West Cape being faunistically closest to the non-adjacent Grassland, with a FRF index of 0.423.

Nel (1975) found an almost linear correlation between number of species and mean annual precipitation in a latitudinal direction in southern Africa. The result is a low-to-high gradient in species densities from west to east, as mean annual rainfall increases. This is particularly the case with bats. Nel could also find no real correlation between species density and altitude. The altitudinal profile of southern Africa is relatively low, which probably explains this phenomenon. This, however, needs closer study to confirm its validity.

It would appear from the results of this analysis that a low-to-high gradient in species densities could also be demonstrated in a south to north direction. Species densities increase from 50 in the South West Cape, to 91 in the Grassland, to 136 in the South West Arid, to 209 in the Woodland. Although rainfall again undoubtedly plays some role in this trend, other causal factors such as decreasing latitude, temperature, faunal origin, and dispersion, will have to be considered in a more detailed analysis.

CONCLUSIONS

1) Six biotic zones are recognized as viable biogeographical entities, as deduced from this analysis. Where the Grassland and the Woodland have formerly been regarded as subzones of the then Southern Savanna biotic zone, terminology may hence be confusing when referring to these as biotic zones of full rank. In order to retain the Pan-African implications and perspective of the term Southern Savanna, I suggest that these two biotic zones be known as the Southern Savanna Woodland and the Southern Savanna Grassland biotic zones. This suggestion is made in the full realization that in the latter case, the definition of a savanna is stretched to the limit. Terminology for the Namib biotic zone remains unchanged, indicating its elevated zonal status.

2) Biotic zones are here regarded as the largest biogeographic units in which southern Africa could be subdivided, that is Southern Savanna Woodland, Southern Savanna Grassland, Forest, Namib, South West Arid, and South West Cape.

3) Very few species have such a wide habitat tolerance that they occur in all biotic zones. Endemism is, on the other hand, equally as unusual. In the majority of instances, species are shared between various combinations of zones, and the unique feature of the FRF analysis is to take this into account, apart from endemism. Therefore, a high FRF index indicates a high incidence of shared species and therefore closer faunal similarity.

4) The FRF analysis in fact takes three characteristics into consideration when expressing the faunal distinctness of a zone: the respective species densities of the two zones under consideration; the number of species in common; and indirectly the number of distinctive species of each zone. Based on the results of the FRF analysis, the Namib zone is deduced to be fully distinct from the South West Arid. It is considered a bona fide biotic zone in full realization of the fact that it has a very small distinctive fauna. The Grassland is similarly considered to be a distinct biotic zone, rather than a subzone. In both these instances, one of the previous considerations for their recognition as zones of lower rank was the low degree of endemism.

5) The six biotic zones recognized here as biogeographical entities, correlate very well with what I regard as major ecological biomes in southern Africa.

6) The FRF indices of the South West Arid, the Woodland, and the Grassland, as compared with each other, are all over 0.500. There is no established value over which a zone cannot be considered statistically valid, and judgement is therefore subjective. The FRF value of these zones in question are here considered low enough to warrant their recognition as valid biotic zones. In comparison Armstrong (1972) considers Merriam's (1890) life zones, which the former author tested with Duellman's FRF analysis, as valid with indices as high as 0.847. In the present analysis, the generally lower FRF indices could also be ascribed to disproportionate faunal densities between certain zones. These differences between the sizes of zonal faunas are here regarded as a valid criteria in considering the rank of a particular zone.

7) With the exception of seven species, the remainder of the 68 southern African bat species are all recorded from the Southern Savanna Woodland, among other zones. The presence of the bat fauna in the other biotic zones is dramatically less (five in the Namib; 20 in the South West Arid; six in the South West Cape; seven in the Grassland; and 18 in the Forest). The Chiroptera is the least known group of mammals in southern Africa, and although Duellman's (1965) formula partly compensates for

this shortcoming, it has an undetermined bearing on the accuracy of the above observation. The inference is, however, that as a group bats have a remarkable attachment to Woodland Savanna.

8) Biotic zones are empirically derived by consideration of major vegetation types. Although the former are proved to be significant from a faunal point of view, it does not necessarily reflect the best way to describe faunal distribution patterns, especially because individual geographic ranges of species seldom overlap entirely with any biotic zone. Biotic zones as significant biogeographical entities should rather, from a faunal point of view, be seen as illustrating the gross direct relationship of the animal to its floral environment, and to a lesser extent, to the physical environment. In the context of biotic zones, faunal interrelationships should therefore be interpreted from an ecological point of view.

9) Continued intensive mammal surveying in southern Africa is considered essential for a better understanding of both subspeciation and zoogeographical interpretation, through more detailed analysis. Especially the Chiroptera throughout the subcontinent, and the faunas of South West Arid and South West Cape biotic zones, need intensive attention in terms of surveying. It is however, not expected that a more intimate knowledge of these aspects will dramatically change the results and implications of this analysis.

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Appendix IV

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ECOLOGICAL DISTRIBUTION OF THE MAMMALS OF THE TRANSVAAL (VERTEBRATA: MAMMALIA)

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(With four Text-figures)

ABSTRACT

The four biotic zones overlying the Transvaal are subdivided into ten zoogeographical units of lower taxonomic rank, i.e. community types. The latter are defined in terms of the veld types described by Acocks (1975). The validity of, and the interrelationships between, community types are tested by means of Duellman's (1965) Faunal Resemblance Factor. A simple phenogram constructed by using Sokal and Sneath's (1963) "weighted pair-group method using arithmetic averages" (WPGMA), illustrating faunal relationships between community types, is given. Westward and southward declines in species densities are indicated. Species density, faunal diversity, and eastward and westward flowing drainage systems are related to each other and are also employed to indicate areas of varying ecological complexity within the Transvaal.

INTRODUCTION

Zoogeography gained much of its initial inspiration and impetus from the work of plant geographers. The dependence of distinctive plant associations on specific sets of climatic and edaphic conditions was obvious to early rural man, and eventually inspired attempts by botanists to scientifically subdivide the flora of the world and/or of continents into easily recognizable vegetational zones, viz. the work of von Humbolt and Bonpland (1807), Kerner (1863) and Warming (1909). As a result of the successes of plant geographers, earlier zoogeographers initially attempted to explain animal distribution by also employing temperature, humidity or gross climatic patterns as major faunistic indicators, but with varying degrees of success, viz. Allen (1871) and Merriam (1892, 1894 and 1898).

Botanists such as Kerner and Warming demonstrate that certain major structurally-biologically adapted vegetation types correspond to specific crucial environmental factors. Major climatic zones were therefore found to be characterized by particular dominant plant formations, which provide a more natural biogeographic system of grouping than does attempting to relate animal distribution to climate. Such plant formations are expressed by taxonomically sometimes unrelated plant taxa in life forms; i.e. the morphological manifestation of evolutionary adaptations to prevailing environmental conditions. This approach is practical in the sense that it is manifested in a certain tangible floral uniformity which is evident and easy to describe.

Since the sum total of macroclimatic conditions generally influences the existence, distribution and maintenance of plant formations, the combination of climatic zones and vegetational formations would be adequate for the broad chorological grouping of animal habitats and division of land suitable for the grouping of animal distributions (Udvardy, 1969: 250). With regard to defining zoogeographical areas, Davis (1962:56) considers ". . . vegetation as the most meaningful ecological summary of the influences of soil, climate, topography and other static and dynamic environmental factors." This method in zoogeography of relating animal distributions to established plant formations is ecological in its approach, hence the title of this paper.

In a study dealing with the biology of all mammal species occurring in the Transvaal (Rautenbach, in press), the distributional attributes of individual species are discussed, – where possible in relation to the influence of environmental factors and ecological requirements. This approach involves the lowest level of zoogeographical resolution, namely autecology. From a cursory glance through these species accounts it is obvious that the distributional attributes of most species appear to be unique. Having considered the autecology of individual species, it is now of interest to know to what extent these situations are indeed unique, or whether in fact they form part of a larger trend of distribution.

In another previous paper (Rautenbach, 1978) I statistically assess the validity of southern African biotic zones as derived by Moreau (1952), Davis (1962), and Meester (1965), from a consideration of the vegetation types (or biomes) of the subcontinent. My statistical treatment is based on the distributions of the greatest majority of mammal species occurring in this region. As a result, biotic zones are recognized as the widest possible zoogeographic entities of this subcontinent. Of the six biotic zones found to be valid, no less than four overlie the Transvaal, i.e. the Southern Savanna Woodland, the Southern Savanna Grassland, Forest, and the South-West Arid. These are therefore zoogeographically the largest units of ecological subdivision of this Province.

As was pointed out by Chapin (1932), further subdivision of biogeographical regions or units is always possible, and in fact often necessary. With the four biotic regions occurring in the Transvaal as basis, the distribution of Transvaal mammals is related to vegetation types in order to further subdivide the Transvaal into smaller biogeographical areas of lower taxonomic rank, here termed community types. This study is aimed at the third level of Darlington's (1957:11) zoogeographical approach, in that it deals with the local distribution of the mammals of the Transvaal. Similarly and for the same reason as in the previous study (Rautenbach, 1978), this study is also limited to Udvardy's (1969:6) static faunistic and regional approach.

In the present report Smith's (1966:12) definition of communities is followed, i.e. ". . . a naturally occurring assemblage of plants and animals that live in the same environment, are mutually sustaining and interdependent, and are constantly fixing, utilizing and dissipating energy". Smith elaborates further by pointing out that communities are for practical reasons often thought of as distinct and well demarcated natural units. However, community boundaries are more often than not hard to define, with the one community blending into the next.

Acocks (1975) divides South Africa into 70 different units that he terms veld types. These plant associations are in essence ecological plant communities, each under the influence of its own unique set of environmental conditions. Acocks' work is used as the basis in defining the community types described below and subsequently testing of the latter for significance as zoogeographical units. In the Transvaal, Acocks recognizes 18 such plant communities. On the basis of the distribution patterns of Transvaal mammals, this number of community types is regarded as too numerous, and the differences between them too small, for all to be recognized. Following a priori reasoning these 18 have been reduced to ten, recognized on the basis of qualitative and quantitative composition of dominant plant species, as well as of the physical environment. In my definitions of community types I remained within the boundaries of the various biotic zones (as previously discussed) overlying the Transvaal territory. As will furthermore be evident, Acocks' veld types occurring within the Province, are here mostly grouped as entities on the basis of strong mutual affinities. Based on mammalian distribution patterns within the Transvaal, the validity of these derived communities are numerically tested as valid bioecological entities.

The gross composition and structure of all proposed community types are evident from the names applied to them. Some generalized terms need qualification. Highveld refers to the entire southern Transvaal area characterized by rolling grassland plains and a higher altitude. The term bushveld denotes all the wooded areas lying to the north and east of the highveld, whereas the term lowveld refers to the woodland area below and to the east of the Drakensberg escarpment.

Species density is defined by Armstrong (1972:334) as the number of species per arbitrarily defined unit area. Species diversity on the other hand, is a measure of the relative density of species in ecological units, and as such is a reflection of the ecological complexity of the ecosystem in question (Smith, 1966:15; Udvardy, 1969:293). When units of analysis are arbitrary subdivisions of an area such as in this study, species density and species diversity may be quite different and ought to be distinguished carefully. However, when the unit areas correspond to ecological units, a knowledge of species density may allow assessment of faunal diversity. In this study, species density of Transvaal mammals is assessed in half-degree square unit areas. These unit areas are compared with ecological units as expressed by community types. Such a comparison will provide a graphic expression of faunal diversity, and thus also of relative ecological complexity, apart from serving as a gross cross-check on the validity of the community types defined.

METHODS

The ten community types to be tested as biogeographical units are defined below. They are derived from a grouping of Acocks' (1975) 18 veld types occurring in the Transvaal, and are illustrated in Fig. 1.

The soil types have been taken from: "Soil map of South Africa." Department of Agriculture, 1941. Pretoria, Government Printer.

SOUTHERN SAVANNA GRASSLANDS:

This is a distinct biotic zone (see previous discussions), generally referred to as the "highveld". In the Transvaal it is physiognomically characterized by a relatively high altitude (1400m and higher), and (in its natural state) by treeless rolling plains with intermittent randjies. The soils are brown to reddish-brown ferrugineous lateritic and highveld prairie soils. It lies in the summer rainfall area of 500 to 1000mm mean annual precipitation. Winters are cold, with regular hoar frost, and lowest temperature is below 0°C, viz. Potchefstroom: lowest annual grass minimum mean temperature (July) is 5,2°C, lowest annual grass minimum temperature - 17,0°C (Weather Bureau, 1965. Climate of South Africa, Part 8). Duration of frost period ± 120 days. Frost is the most important factor inhibiting bushveld woody vegetation. The latter may only be scattered above the frostline on the warmer (but drier) northern and western aspects of randjies and mountains. The drainage system of the highveld grasslands is predominantly via the Vaal and Orange rivers, westwards through arid and semi-arid regions to the Atlantic Ocean (Fig. 3). The Transvaal highveld grasslands are here subdivided into two community types (i.e. communities 1 and 2).

Community Type 1: PURE GRASSVELD COMMUNITY:

(See Acocks, 1975; in the Transvaal it constitutes his veld type numbers 48, 50, 52, 54, 57). These veld types ". . . are tropical in affinity and are distinguished from one another mainly by the different proportions in which a handful of species occur . . .", (Acocks). This entirely tropical affinity was an important consideration in the recognition of this community.

Annual precipitation 500 to 1000mm. A few typical grass species are: *Themeda triandra*, *Tristachya* spp., *Eragrostis* spp., *Digitaria* spp. (see Acocks, 1975, for a full description of floral elements)

Community Type 2: FALSE GRASSVELD COMMUNITY:

(See Acocks, 1975; in the Transvaal it constitutes his veld type numbers 61, 62, 63, and also 67, – i.e. the isolated Pietersburg Plateau). Veldtype 61, i.e. Bankenveld, is in size by far the most prominent element of this community. In plant species composition, the Pietersburg Plateau is very similar to the Bankenveld.

This community represents a subclimax vegetation which is probably maintained by annual burning. Acocks speculates that the climax could be an open savanna of *Acacia caffra*, which is in fact at present the case along the northern margin, also in the form of sour bushveld which occurs throughout the area above the frost line on randjies and hills. The veld is very sour throughout. The subclimax status of this community is the main reason for its distinction here.

Rainfall varies from 600 to 1000mm p.a., with the largest area of this community falling in the 700 to 800mm p.a. zone.

Typical grass types are: *Trachypogon spicatus*, *Themeda triandra*, *Schizachyrium sanguineum*, *Panicum natalense*, *Hyparrhenia hirta*, *Andropogon* spp., *Heteropogon contortus*, *Elyonurus argenteus*, *Loudetia simplex*, *Setaria flabellata*, *Eragrostis* spp., *Brachiaria* spp. This community is also characterized by a wealth of forbs, viz. *Thesium*, *Sphenostylis*, *Pentanisia*, *Mansonia*, *Gnidia*, and *Trichodesma* spp.

TROPICAL BUSH AND SAVANNA BUSHVELD:

The largest landmass of the Transvaal supports woodland in some form or other. The greatest majority of tree species are deciduous. This area (excluding Tropical Forests) is utilized mostly for ranching, or in some areas also for the production of subtropical fruit and tobacco. Rainfall is relatively low (ca 250 to 750mm). Altitude is considerably lower than that of the highveld, and consequently the winters are mild and the summers hot. Veld fires are a natural element in the ecology.

Acocks (1975) groups all his savanna and bushveld veld types as "Tropical Bush and Savanna", and the majority of these correspond with the Southern Savanna Woodland biotic zone. However, the westernmost member of the Tropical Bush and Savanna Types, (i.e. Kalahari Thornveld and Shrub Bushveld), falls within the South-West Arid biotic zone, and thus was carefully scrutinized for separate community status.

Community Type 3: KALAHARI THORNVELD:

Whereas this community is floristically transitional between western and eastern veld types, it supports a South-West Arid biotic zone faunal element, and thus justified recognition as a separate community in this analysis. Its sheer size alone seen in a southern African context (predominantly to the west of the Transvaal border), certainly warrants recognition.

Unlike all the eastern woodland veld types, this community falls outside the 500mm isohyte, sharing this feature with the South-West Arid biotic zone. This community furthermore has a drainage system to the Atlantic, sharing this feature with the Grassland community-types and the rest of the South-West Arid biotic zone. The two main portions of this community lie at an altitude in excess of 1200m, very similar to communities 1 and 2 (Fig. 2). The two smaller portions of this community (to the north) are below this elevation. It receives regular frost, but by no means as extensively as on the highveld proper.

Typically this community occurs on deep, loose sand over calcareous tufa. However, the small extreme north-western portion on the Botswana border occurs anomalously on turfy soil. A small outlier of this community occurs in the central Transvaal near the Pienaars River settlement, but is considered here as part of community 6. This community consists floristically of *Acacia erioloba* savanna with grasses of the dry *Cymbopogon-Themeda* veld, in addition to some species typical of community 2 (see Acocks, 1975:39, for further details).

Physiognomically this community is characterized by its flat, featureless sandy plains, and the absence of any randjies or mountains. Although this area does not lend itself to agriculture, it has in recent years been extensively ploughed for mealie production (with doubtful success).

SOUTHERN SAVANNA WOODLANDS:

Occur in the eastern Transvaal lowveld, the central, northern and north-western Transvaal, and are often collectively referred to as the "bushveld". This area (excluding the Tropical Forests) is characterized by substantial stands of woody vegetation, predominantly *Acacia* trees and *Hyparrhenia* and *Eragrostis* grasses. The drainage system of the Southern Savanna Woodland biotic zone (including the Forest biotic zone) is in an easterly direction, notably through the Limpopo, Olifants, Letaba, Sabie and Crocodile rivers (Fig. 3). Some of these rivers originate in the Grassland community types of the highveld. This is zoogeographically very important in that these rivers provide habitat in the form of riverine woodland for woodland adapted species in zoogeographic regions where these species cannot otherwise exist.

Acocks (1975) defines no less than nine veld types in this area (excluding Kalahari Thornveld = community 3). Apart from being too numerous for individual consideration on a community level, from a biogeographical point of view the inherent floristic differences between all nine of these veld types are too small for recognition. With the aid of Dr G. Theron of the Botany Department, University of Pretoria, these nine veld types have therefore been lumped into six communities, which are to be tested for significance as ecozoogeographical entities.

Community Type 4: TURF THORNVELD:

This community constitutes four isolated areas of extremely flat country, with norite and quartzite rocky outcrops, which collectively surround the Waterberg complex to the east, south and west. The two easterly portions overlie portions of the so-called Springbok Flats. All four components have relatively hot summers, and average annual rainfall varies from 450 to 750mm. Altitude ranges between 600 and 1200m.

Soil types can be either red, grey or black turf, which I believe may prevent the occurrence of burrowing animals. Under natural conditions this is an open thornveld area, but it tends to thicken up when the grass cover is reduced by grazing mismanagement (Acocks, 1975).

Typical trees include: *Acacia tortilis*, *A. nilotica*, *A. gerrardii*, *A. mellifera*, *A. gillettiae*, *A. tenuispina*, *A. karroo*, *Dichrostachys cinerea*, *Maytenus* spp., *Grewia* spp. Characteristic grasses are: *Panicum* spp., *Digitaria* spp., *Themeda triandra*, *Eragrostis* spp., *Bothriochloa insculpta*.

Community Type 5: ARID SWEET BUSHVELD:

According to Dr Theron (pers. comm.) the bushveld west of the escarpment and just north of the Magaliesberg is very sour, but becomes progressively sweeter northwards. He therefore suggested the division of this area (excluding the Waterberg and Turf Thornveld communities) into arid sweet and sour bushveld entities.

The Arid Sweet Bushveld community, as here understood, includes Acocks' Arid Sweet Bushveld veld type (14), which coincides roughly with the Limpopo river valley. The Mixed Bushveld type (18) is floristically of a transitional nature, and the parts thereof lying between the Limpopo river valley and the Waterberg complex, the north-eastern Turf Thornveld component, and the Pietersberg Plato, have been incorporated as part of this community.

The soils are either Kalahari sand on lime, or light brown sand. Elevation is between 600 and 1200m (along the Limpopo river valley proper 600 to 920m), and mean annual rainfall 250 to 750mm, declining westwards. It is important to note that this area is very arid, i.e. with the minimum of permanent natural water. All rivers, including the Limpopo, are seasonal.

Typical trees are: *Combretum apiculatum*, *Grewia flava*, *Terminalia sericea*, *Boscia albitrunca*, *B. foetida*, *Commiphora* spp., *Acacia senegal*, *A. mellifera*, *A. giraffa*, *A. tenuispina*, *A. erubescens*, *Adansonia digitata*, *Burkea africana*, *Kirkia acuminata*, *Dichrostachys* spp. Grass cover is dominated by *Eragrostis* spp., but also includes *Schmidtia pappophoroides*, *Digitaria* spp., *Panicum* spp., *Aristida congesta*, *A. graciliflora*, *Enneapogon* spp.

Community Type 6: SOUR BUSHVELD:

A large and floristically diverse sour bushveld floral community, lying west of the escarpment between the Magaliesberg and the Waterberg complex. Includes Acocks' Sourish Mixed Bushveld (19), as well as the southern portion of his Mixed Bushveld (18), veld types. This community is thus floristically recognized not so much for its homogeneity, but rather for its heterogeneity. Altitude ranges from 600m at the upper reaches of the Olifants river at Marble Hall, to 1200m. Rainfall tapers off westwards from 500 to 350mm p.a.

The more prominent tree species are: *Faurea saligna*, *Acacia caffra*, *Protea caffra*, *Ochna pulchra*, *Dombeya rotundifolia*, *Burkea africana*, *Diplorhynchus condylocarpon*, *Albizia rhodesica*, *Terminalia sericea*, *Combretum* spp., *Sclerocarya caffra*, *Mundulea sericea*. *Hyparrhenia* grasses are predominant; also with *Elyonurus argentatus*, *Schizachyrium sanguineum*, *Loudetia simplex*, *Andropogon amplectens*, *Trachypogon capensis*, *Themeda triandra*, *Brachiaria* spp., *Hyperthelia dissoluta*.

Community Type 7: WATERBERG SOUR BUSHVELD:

As suggested by Dr Theron (pers. comm.), Acocks' Sour Bushveld veld type (20), typical of the Waterberg, is recognized here at community level. It is floristically quite distinct from surrounding areas. This community is thus comprised of the flora of the bushveld mountains. In less rocky parts it is an open savannah of tall, straight *Faurea saligna* trees with a great diversity of sour grass species, which are peculiarly useless for grazing. In the more rugged areas, the floral composition forms dense mixed bushveld.

Altitude 1200 to 1500m. The areas with altitudes higher than 1500m on the Waterberg support outlyers (relics?) of Inland Tropical Forests (community 10). Soil is of a sandy rubbly nature, very poor and sour. Rain fall ranges from 650 to 900mm p.a.

Typical trees and shrubs include *Faurea saligna*, *Acacia caffra*, *Protea caffra*, *Combretum* spp., *Kirkia wilmsii*, *Ficus* spp., etc. See Acocks (1975) for a more complete account of the trees and a list of grass species of this area.

Community Type 8: MOPANI VELD:

The most homogenous community of all. The dominant vegetation is *Colophospermum mopane*. In the north-west it is typically shrubby, in the east consists mostly of trees of up to 20m, which is also more mixed floristically. The soil type throughout is reddish-brown sand. Rainfall varies between 250 to 500mm p.a. This is the only community receiving less than 10mm precipitation per month in at least three consecutive months during winter. Altitude between 300 and 450m in the east, and 400 to 750m in the western sector. Frostfree.

Other plant species always present are: *Acacia nigrescens*, *Combretum imberbe*, *C. apiculatum*, *Lonchocarpus capassa*, *Terminalia prunioides*, *Adansonia digitata*.

Community Type 9: LOWVELD BUSHVELD:

Includes Acocks' Lowveld (no. 10) and Arid Lowveld (no. 11) veld types. It comprises primarily the area south of the Olifants river below the escarpment, with a fingerlike extension along the base of the escarpment to the north of the river. Rainfall varies from 400 to 875mm p.a., and altitude between 167 and 1000m. Frostfree. Soil types vary considerably, and have an important influence on the flora. Three major soil types can be distinguished, i.e. granite outcrops with relatively higher rainfall and greyish sandy soils; red granite outcrops with lower precipitation and red sandy soil; and the basalt soils of the Lebombo flats.

Typical flora of the entire region includes: *Acacia nigrescens*, *Sclerocarya caffra*, *Combretum* spp., *Terminalia sericea*, *Dichrostachys cinerea*, *Grewia* spp., *Strychnos madagascariensis*.

Community Type 10: INLAND TROPICAL FOREST TYPES:

This community is considered a distinct *major* veld type by Acocks, and consists of two regular veld types, i.e. North-eastern Mountain Sourveld and Lowveld Sour Bushveld. It also corresponds roughly with the Forest biotic zone as understood by Moreau (1952), Davis (1962), and Meester (1965). Therefore, this community should theoretically prove to be taxonomically very distinct from the others recognized here in the following statistical analyses, by having low FRF indices.

In its climax form this community constitutes high tropical forests, located on the southern and south-eastern mountain slopes of the Drakensberg escarpment, with outliers on the higher, wetter parts of the mountains westwards to the Waterberg. However, through forestry and its resultant dehydration, fires and exploitation, large tracts of forests reverted to sour grassveld at the higher altitudes, and to a scrubby thornveld on the escarpment and slopes.

This community is nonetheless treated as an entity in its historical botanical context. Although drastic floral changes have been induced in areas, possibly with resultant changes in the qualitative status of mammalian niches, these floral changes are by no means absolute. Altitude varies between 615 to 2100m and higher. Annual mean rainfall ranges from 875 to 2500mm. This is also the only Community receiving any significant winter (June–August) precipitation, mainly between 25 to 125mm. Mist is a common phenomenon, and undoubtedly an important inherent ecological factor.

The occurrence of the 177 Transvaal mammal species in the ten community types is listed in Table 1. Only the presence or absence of a species in a particular community type (or part thereof) is indicated, and only the ranges of species as documented in the general biology of the mammal species of the Transvaal (Rautenbach, in press) are analysed. Some communities which peripherally overlie the Transvaal may therefore be underrepresented. Exotic species such as *Rattus rattus* and *Mus musculus* are not listed. Historical ranges of game species are taken into account only where definite records exist.

This analysis takes into account only the overall geographic ranges of species, and is insensitive to the detailed ecological requirements of a species. For instance, Woodland adapted species recorded from riverine forests in the Grassland communities, are sometimes plotted as occurring in the latter in spite of the fact that they may not be able to survive in a true grassveld environment. This approach is infrequently necessitated by the lack of detailed ecological knowledge of a species or inadequate data on specimen labels. Furthermore, some species common throughout one or more community types are peripherally recorded from an adjacent community. This is an ecotonal effect. Such records are nevertheless accepted. If, with more detailed information, situations such as mentioned above can be allowed for, the results of this analysis will be enhanced.

A simple matrix of similarity indicating the degree of inter-relationships between the mammal faunas of the Transvaal community types, is given in Table 2. The italic numerals on the diagonal indicate the total number of species in each community. Absolute number of species in common between any two community types is given below the diagonal. Above the diagonal is an index of faunal similarity between any two communities, calculated after Duellman (1965).

Duellman's (1965) statistical analysis to express faunal resemblance between zoogeographical areas is termed the "Faunal Resemblance Factor" (referred to as FRF hereafter), and is also discussed by Armstrong (1972) and Rautenbach (1978). FRF is statistically expressed as $2C/N_1 + N_2$; where C equals the number of species in common between the two zones compared, N_1 equals the number of species in the first zone, and N_2 the number of species in the second zone. An index of 0,000 would indicate no taxonomic resemblance between two zonal faunas, and an index of 1,000 would indicate complete identity. Duellman's formula is a simplified derivative of the Burt coëfficient (Burt, 1958). Both formulae take the sum of the two samples as the denominator. In the case of this particular analysis, this formula is very appropriate since it considerably reduces the effect of very disproportionate faunal sizes between zones. The influence of differential faunal sizes is however not entirely eliminated, and is therefore another parameter in the calculation of faunal resemblance, apart from the sum of the species held in common and endemic species.

To analyse species density in the Transvaal, this Province is subdivided in 104 area-units corresponding to half-degree squares. Each of these quadrants is approximately 50 by 50km (ca 31 × 31 miles), i.e. 2500km² in area. By employing the squares formed by each latitudinal and longitudinal half-degree, known biotic and physiographic units are neither selected for nor avoided. Along the borders only quadrants overlying Transvaal territory over more than half their area, are incorporated in this analysis (Fig. 4). Individual half-degree square unit areas are identified by partially following Davis' (1948) well-known quarter-degree grid system, i.e. the full-degree coordinates to the north-west of a quadrant identify the degree square in which it lies. Within such a degree square, the four half-degree quadrants are identified by the capital letters A through D, assigned from left to right from the top left quadrant to the bottom right quadrant, eg. 2528A.

In a review of the general biology of all Transvaal mammals (Rautenbach, in press), the extrapolated geographical ranges of species are delineated and shaded by consideration of known locality records within the Transvaal, as well as in adjoining political territories. By overlying a transparent copy of the half-degree square unit area quadrants over each of 177 species maps, the number of species per quadrant were determined. Introduced species such as *Rattus rattus* and *Mus musculus* are again not included in this analysis. A species is considered to occupy a given quadrant if one-half or more of the quadrant overlies its range. In the case of species known from only one, or from more but very isolated localities, and where geographical ranges can as a consequence not be extrapolated, only the quadrants in which a known locality falls were noted. The absolute mammalian species density in each of the 104 quadrants was assigned to four class intervals, namely 25–44, 45–64, 65–84 and 85–104 species per quadrant, and is graphically presented in Fig. 4.

RESULTS AND DISCUSSION

As pointed out by Armstrong (1972), the greatest failing of the Faunal Resemblance Factor (FRF) analysis is that it appears to be more detailed than it really is. Proper caution must be exercised in drawing conclusions from it. Nevertheless, certain comprehensible patterns of relationship emerge from this analysis. The mean of 45 FRF indices in Table 2 is 0,541, with one standard deviation = 0,171. In view of this, indices above ca 0,700 and below 0,370 are of particular interest.

From Table 1 it is concluded that only four species range through all ten community types, i.e. *Hystrix africae-australis*, *Praomys natalensis*, *Tatera leucogaster* and *Sylvicapra grimmia*. Twenty-six species (14,7%) have such wide habitat tolerances that they are recorded in eight or more community types. All 34 Transvaal bat species are represented in wooded areas (community types 4–10), whereas only 14 of these also occur in the Grassland and the Kalahari Thornveld communities. Bats thus appear to have a particular attachment to well-wooded areas, which is not surprising in view of their life-history and particularly their feeding habits.

The Pure and False Grassveld communities (nos 1 and 2, Fig. 1) are faunistically very closely related, with an FRF index of 0,779. This is to be expected since these two communities combined constitute the Grassland biotic zone in the Transvaal (Rautenbach, 1978). This fact is reflected by the considerably lower FRF indices between these two Grassland communities and the other eight communities, all with index values below 0,660 (Table 2). The FRF index of 0,779 between the Pure and False Grassveld communities is low enough to allow them to be recognized as distinct community types of the Grassveld biotic zone. The isolated Pietersburg plateau forms a significant part of the False Grassveld community. It is significant to observe that both Grassveld communities show the highest faunal similarity to the adjacent Sour Bushveld community (no. 6). This fact can in part be ascribed to floral bushveld intrusions carrying woodland-adapted mammal species into the Grasslands, a phenomenon not allowed for in Table 1 as a result of our present superficial knowledge of the ecological requirements of some species. Apart from that, there is a general tendency for adjacent faunal areas to have greater faunal resemblances than non-adjacent areas. This can be ascribed to an ecotonal effect, as well as to migratory efforts of populations under optimum conditions.

The Kalahari Thornveld community (no. 3) peripherally represents the South-West Arid biotic Zone in the Transvaal. It shows closest faunal resemblance to the adjoining False Grassveld community (FRF index 0,460), followed closely by its resemblance to the Pure Grassveld community (FRF index 0,382). It also has the same westward drainage system as the Grassveld community types. Communities 4 to 9 together constitute the Southern Savanna Woodland biotic zone, and the Kalahari Thornveld community is very distinct from all these with FRF indices lower than 0,368 (Table 2). However, only a small fraction of the South-West Arid biotic zone is represented in the Transvaal in the form of the Kalahari Thornveld community. Rautenbach (in press) points out that species ranges very seldom precisely coincide with the boundaries of zoogeographic areas. It is therefore understandable that only 28 of the 136 species found in the South-West Arid are present in the small portion of this biotic zone lying in the Transvaal. The Kalahari Thornveld community is therefore most probably under-represented in the Transvaal. Its complement of only 28 species in the Transvaal (Table 2) has the effect of producing very low FRF indices in relation to the bigger and faunistically better represented communities. The faunal relationships of the Kalahari Thornveld community, expressed as FRF indices, are therefore probably unnaturally low. However, the Kalahari Thornveld is accepted as a valid community type within the Transvaal, also because it forms part of the much greater South-West Arid biotic zone, which has been proved to be a valid zoogeographic entity (Rautenbach, 1978).

The Inland Tropical Forest community-type (no. 10) in the Transvaal generally corresponds with the Forest biotic zone of earlier authors (Moreau, 1952; Davis, 1962; Meester, 1965). In a previous paper (Rautenbach, 1978), I have found the Forest biotic zone to be unique in southern

Africa. It is therefore accepted as a valid community-type within the confines of the Transvaal. However, where earlier authors concentrated on true high tropical forests in their climax status, this paper also considers the substantial tracts of recently deforestated land that have reverted to sour grassveld and scrubby thornveld, as part of the Inland Tropical Forest community. This explains the discrepancy between an earlier paper (Rautenbach, 1978) where the species-complement of the Forest biotic zone is given as 73, whereas in the present study the total species diversity is put at 101. The Inland Tropical Forest community, as here understood, is thus a more heterogeneous floral community, with large tracts of subclimax vegetation, which allow certain faunal elements of adjoining communities into an area where they cannot exist in the climax successional stage. Nevertheless, this community is faunistically quite distinct from all the rest, with FRF indices lower than 0,673. Faunistically, it most closely resembles the four surrounding woodland communities.

Community types 4 to 9 combined closely correspond to the Southern Savanna Woodland biotic zone. They furthermore represent eight different veld types as described by Acocks (1975). Within these communities, the three highest FRF indices are all above 0,800. The highest of all FRF indices (0,873) is between the Mopani Veld (no. 8) and the adjoining Lowveld Bushveld (no. 9), both situated to the east and below the eastern escarpment. Almost as high is the index value of 0,848 between the Arid Sweet Bushveld community (no. 5) and the Sour Bushveld community (no. 6), both situated to the west of the escarpment. The Arid Sweet Bushveld community (no. 5) and the Mopani Veld community (no. 8) are faunistically also closely related with an FRF index of 0,832, in spite of the fact that communities 5 and 6 are entirely separated from the eastern Transvaal lowveld by the escarpment with its associated Inland Tropical Forest community type. However, a portion of the Mopani Veld community (no. 8) reaches the northern Transvaal via Rhodesia, and thus forms a continuum between the two western communities and the eastern Transvaal lowveld. Although the FRF indices mentioned here are high and can therefore be related to close faunal similarity, they are nevertheless accepted here as indicative of differences between faunal areas on the community type level. By comparison, Armstrong (1972: 331) accepts his defined Coloradian community types as valid with FRF indices as high as 0,853. Furthermore, Rautenbach (1978) found the highest index value between biotic zones (which are of higher taxonomic rank than community types, i.e. faunistically more distinct with consequent lower FRF values), to be 0,580. In relation to the FRF values found between biotic zones, indices in the order of 0,850 are considered marginally acceptable between community types falling within the same biotic zone. This also implies the FRF indices much lower than 0,800, between community types from the same biotic zone, should be subjected to careful scrutiny.

Compared to the FRF indices between community types 5, 6, 8 and 9 discussed above, the indices of the Turf Thornveld (no. 4) and the Waterberg Sour Bushveld (no. 7) appear low; less than 0,600 in the case of the former, and less than 0,655 in the case of the latter community. Both these areas are very small compared to the other communities. Because of their larger size the other communities have been sampled at more localities. Since the FRF analysis is based purely on the presence or absence of a species within a given area (in some instances on one record only), it follows that it is possible to compile a more complete faunal list of the more extensively sampled larger areas than of the smaller areas which are normally sampled at only one or two localities. Experience has shown that the field techniques used are $\pm$ 80% effective in sampling the fauna of a given locality. It could thus be postulated that the Turf Thornveld and the Waterberg Sour Bushveld communities are under-represented in this study, which would lead to relatively lower FRF indices. This argument could also serve to explain the low FRF indices of the Kalahari Turf Thornveld.

Furthermore, the ranges of few species correspond entirely to the borders of zoogeographical areas. Species almost invariably occupy parts of one or more such areas. The larger such a zoogeographic area, the more likely it is that a widespread species may occur in some part of it and therefore the larger an area the more faunistically diverse it becomes. It is therefore suggested that any very small region will show a high faunal disparity when compared with a larger zone as a result of a relatively low species diversity. On the other hand, both communities under discussion here possess some ecological aspect which may inhibit the occurrence of many mammal species. The soil type of the Turf Thornveld is heavy clay, – very hard when dry and extremely wet after rain with a very long water retention period. This is believed to inhibit any burrowing species. The Waterberg Sour Bushveld community, on the other hand, is almost entirely mountainous, which is restrictive to flatland- and wetland-adapted species.

Considering the above arguments, the decision whether or not to accept the validity of communities 4 and 7 is mostly subjective on the available information. The argument based on the prohibitive influence of intrinsic ecological factors in these two communities appears to be the more convincing. The Turf Thornveld and the Waterberg Sour Bushveld communities are therefore provisionally accepted as valid.

An elementary cluster analysis (Fig. 2) in the form of a phenogram is based on the FRF indices given in Table 2. The phenogram was constructed with the aid of an IBM 370/158 computor employing Sokal and Sneath's (1963:309) "weighted pair-group method using arithmetic averages (WPGMA)", which is a subprogram of the NT-SYS package stored at the C.S.I.R. Inasmuch as the figure represents a certain loss of information over the similarity matrix from which it is derived, certain of the broad relationships between comunity-types noted above are readily apparent.

The distinctive character of the Southern Savanna Grassland and Southern Savanna Woodland biotic zones, as well as of the South-West Arid biotic zone, is very evident by the clustering of the community types belonging to them. However, the Forest biotic zone as represented by only the Inland Tropical Forest community type, clusters together with Woodland community types. This can be explained as an artefact of its floral heterogeneity as a result of partial deforestation and the resultant influx of secondary vegetation of Woodland and Grassland origin and its related fauna. The distinctiveness of the relatively small community types (i.e. Turf Thornveld, Waterberg Sour Bushveld and Kalahari Thornveld) are distorted to an unknown extent in Fig. 2 as a consequence of their small recorded faunal diversity.

From a faunistic point of view, rivers are not of importance as only sources of water for animal intake, but also as dispersal barriers or corridors. Drainage systems are the net result of rainfall, topography, soil types etc., and in combination with these have an important influence on vegetation. A study of drainage systems from a zoogeographic point of view is thus actually a study of the sum of several environmental features, as expressed by their combined influence on faunal dispersal patterns.

It is evident from Fig. 3 that a watershed exists along the northern margin of the highveld grasslands. The highveld Grassland community-types have a simple drainage system via the Vaal river and eventually the Orange river, to the Atlantic Ocean. The wooded areas of the Transvaal are drained towards the Indian ocean by three systems, i.e. the extensive Limpopo system (including amongst others the Pafuri, Letaba and Olifants rivers), the Komati system (including the Sabie and Crocodile rivers), and the Maputo system via Swaziland (including the Pongola river).

The zoogeographic importance of drainage systems, although as yet not fully understood, is suggested in Fig. 2. The two Grassland and the Kalahari Thornveld community types, all three with a westward draining system, are separated from all the rest at an average FRF value of less than 0,500 and are therefore very distinct from them. All seven of the remaining community-types cluster together at average FRF indices of more than 0,540, and are drained by the three systems towards the Indian ocean.

In an analysis of the density of Transvaal mammals, the mean species density per quadrant is 67,5, the range is 28 to 101, and one standard deviation equals 21,5.

The quadrants south of 26° southern latitude in Fig. 4 all exhibit densities that are consistently lower than 64. These, together with the seven quadrants of similar low species densities to the north of 26° southern latitude and between 29° and 31° eastern longitude, all correspond very strongly with the highveld Grassland and the Kalahari Thornveld community types typical of the southern Transvaal region. The majority (24 out of 27) of these quadrants exhibit densities below 45 species per quadrant. It is furthermore significant that 11 out of the 13 quadrants falling within the 45 to 64 species per quadrant class interval and centred over the highveld region, correspond strongly with the False Grassveld community type. The small and isolated Pietersburg Plateau, also belonging to the latter community type, is not apparent at the present level of resolution.

With the exception of the five westernmost quadrants between 25° and 26° southern latitude, the remainder of the quadrants not mentioned as yet have species densities in excess of 65 species per quadrant, and correspond strongly to Woodland and Forest community types. The five westernmost quadrants with lower species densities are also centred over Woodland community types. The topography of this area is, however, very homogeneous through the absence of significant mountain ranges, and it is therefore probably for that reason ecologically less complex, with a consequently lower species density.

All the quadrants east of 31° eastern longitude, falling in the class interval of 85–104 species per quadrant, are centred over the eastern Transvaal lowveld with its Mopani and Lowveld Bushveld community types. The eight quadrants falling within the class interval of highest species density, immediately to the north of Pretoria in the central Transvaal, are unexpected and is probably the result of a combination of topographical, ecological and geographical factors. It also could be relatively better sampled. It is however noteworthy that they are centred over a large part of the Springbok Flats.

The Forest community-type does not show up at the present level of resolution (See Fig. 4).

Simpson (1964) and Armstrong (1972) point out that areas of variable relief offer more varied ecological opportunities than those with more monotonous terrein. Quadrants centres over areas of such varied relief will as a consequence tend to exhibit higher species densities. The same principle applies when quadrants overly two or more community types, where the typical species diversities of each community type combine to form the species density of the unit area in question. This phenomenon is probably demonstratable to a lesser extent in the majority of quadrants in the Transvaal. However, it is particularly obvious in the fact that the very narrow Forest community type cannot be discerned at the present level of resolution. The variable species densities in the northern Transvaal to the west of the escarpment, and possibly also the unexpectedly high species densities of the quadrants overlying the Springbok Flats in the central Transvaal, can also in part be explained in this manner.

The average species densities of each vertical and horizontal column of quadrants, as shown in Fig. 4, are given in Table 3. A very definite trend of declining species density is obvious from north to south, whereas a similar but less consistent declining trend can be discerned from east to west. Since increasing species diversity is in the main a gross index of higher ecological complexity (Udvardy, 1969:293), the declining trends to the west and south illustrated in Table 3 suggest that the eastern Transvaal lowveld and the northern Transvaal are ecologically more complex than the west and south. Furthermore, the relatively lower species densities of the five south-westernmost quadrants overlying woodland region (2525A and B, and 2526 A, C and D), can also in part be explained by suggesting that this region is ecologically the least diverse of the wooded areas of this Province.

CONCLUSIONS

1. Four of the six southern African biotic zones overly the Transvaal. These areas are further subdivided into ten zoogeographic units of lower rank, here called community types. Community types are concluded to be viable zoogeographical units as based on the FRF analysis. The status of two community types, i.e. Turf Thornveld and the Waterberg Sour Bushveld, are subject to some doubt because of their small size. They are, however, accepted as valid community types based on inherent ecological features prohibiting occurrence of some mammalian species.

2. The FRF analysis is a deductive technique based on the direct interrelationship of an animal to its ecological environment. Each community type is recognized as a zoogeographic unit by its unique qualitative and quantitative combination of mammal species, which as a faunal entity is dependent on the unique set of physical and biological conditions typical of the community type.

3. The two Grassveld community types, in combination with the Kalahari Thornveld, have on the average a lower species diversity ($\bar{X} = 60{,}7$) than do the seven Woodland and Forest community types ($\bar{X} = 97{,}4$). This areal difference is also confirmed by FRF indices being all below 0,660 between any two members of the two combinations of community types mentioned. The three southern community types are associated with a westward drainage system which serves the arid and semi-arid regions, which are also characterized by a relatively undiversified mammalian fauna. The seven faunistically more diversified northern community types are all served by an eastern drainage system. Increasing species diversity indicates higher ecological complexity. In the Transvaal the differences in southern and northern faunal diversity, and consequently ecological complexity, can thus be correlated with drainage systems running westward and eastward respectively.

4. The marked differential faunal diversity and ecological complexity mentioned above, superficially appear to be orientated in the Transvaal in a north-south direction. However, from an examination of drainage systems, species densities within this Province, and a knowledge of the faunal diversity of adjoining areas, it is postulated that this observed orientation is in fact a geographical artefact of two major faunas respectively adapted to an eastern more moderate, and a western more arid complex of environmental conditions. The observed attachment of Transvaal bat species to wooded areas suggests that as a group it forms a prominent constituent of the more diversified eastern fauna.

5. An analysis of species density plotted per half-degree square unit areas in the Transvaal, correlates roughly with some community types. It furthermore reveals a decline from north to south. This is in concordance with many other groups of organisms throughout the world exhibiting declining species densities away from the equator (Udvardy, 1969). A similar, but less consistent, declining trend in species density is also discerned in the Transvaal from east to west. This can be related to a gradual change from a more diversified eastern fauna to a less diversified western fauna. Since species density and diversity are gross indicators of ecological complexity, it is suggested that the northern and eastern Transvaal are ecologically more complex than the southern and western Transvaal.

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TABLE 1: Distribution of 177 endemic Transvaal mammal species according to community types.

	1	2	3	4	5	6	7	8	9	10
MACROSCELIDIDAE										
Elephantulus intufi	—	—	—	—	X	—	—	X	—	—
" *myurus*	X	X	X	—	X	X	X	X	—	X
Nasilio brachyrhynchus	—	—	—	—	X	X	X	X	X	X
Petrodromus tetradactylus	—	—	—	—	X	—	—	X	—	X
ERINACEIDAE										
Erinaceus frontalis	X	X	X	—	X	X	—	X	—	—
SORICIDAE										
Myosorex varius	X	X	—	—	—	X	—	—	—	X
" *cafer*	—	—	—	—	—	—	—	—	—	X
Suncus varilla	X	X	—	—	—	X	—	—	—	—
" *lixus*	—	—	—	X	—	X	—	X	X	X
" *infinitesimus*	X	X	—	—	—	—	—	—	—	—
Crocidura flavescens	X	X	—	—	X	—	—	—	—	X
" *cyanea*	—	X	—	—	X	X	—	X	X	X
" *silacea*	—	X	—	—	X	X	—	—	X	X
" *hirta*	—	—	X	—	X	X	—	X	X	X
" *mariquensis*	X	X	—	X	X	X	—	X	X	—
" *bicolor*	—	—	X	—	—	X	X	X	X	X
" *maquassiensis*	X	—	—	—	X	—	—	—	—	—
CHRYSOCHLORIDAE										
Amblysomus gunningi	—	—	—	—	—	—	—	—	—	X
" *hottentotus*	X	X	—	—	—	—	—	—	—	X
" *julianae*	—	X	—	—	—	—	—	—	X	X
Calcochloris obtusirostris	—	—	—	—	—	—	—	X	—	—
Chlorotalpa sclateri	—	X	—	—	—	—	—	—	—	—
Chrysospalax villosus	X	—	—	—	—	—	—	—	—	X
PTEROPODIDAE										
Epomophorus wahlbergi	—	—	—	—	—	X	—	X	X	X
" *crypturus*	—	—	—	—	—	—	—	X	X	X
Eidolon helvum	X	—	—	X	—	—	—	—	—	—
Rousettus aegyptiacus	—	—	—	—	—	—	—	X	—	X
EMBALLONURIDAE										
Taphozous (Taphozous) mauritianus	—	X	—	—	X	X	—	X	X	X
NYCTERIDAE										
Nycteris thebaica	—	—	—	X	X	X	X	X	X	X
RHINOLOPHIDAE										
Rhinolophus hildebrandti	—	—	—	—	—	X	X	X	X	X
" *fumigatus*	—	—	—	—	X	—	—	—	—	X
" *clivosus*	X	X	—	—	—	X	—	—	—	X
" *darlingi*	—	—	—	—	X	X	—	X	X	X
" *landeri*	—	—	—	—	—	—	—	X	X	—
" *blasii*	—	X	—	—	—	X	X	—	X	—
" *simulator*	—	X	X	X	—	X	—	X	X	X
HIPPOSIDERIDAE										
Hipposideros caffer	—	—	—	—	X	X	—	X	X	X
Cloeotis percivali	—	—	—	X	—	X	—	—	X	—
VESPERTILIONIDAE										
Myotis (Chrysopteron) welwitschii	X	X	—	—	—	—	—	—	X	—
" *(Selysius) tricolor*	—	X	—	—	—	—	X	—	X	—
Nycticeius (Scoteinus) schlieffeni	—	—	—	—	X	—	—	X	X	X
Pipistrellus (Pipistrellus) nanus	X	—	—	—	—	—	—	X	X	—
" " *kuhli*	X	—	X	—	X	X	X	—	X	X
" " *rusticus*	—	—	—	—	—	—	—	X	X	X

Table 1: continued.

	1	2	3	4	5	6	7	8	9	10
Eptesicus (Eptesicus) zuluensis	—	—	—	—	X	—	—	X	X	—
,, ,, *capensis*	X	X	—	X	X	X	—	X	X	X
Glauconycteris variegata	—	—	—	—	X	—	—	X	—	—
Scotophilus nigrita	—	X	—	X	X	X	—	X	X	X
,, *leucogaster*	—	X	—	X	—	X	—	—	X	X
Kerivoula argentata	—	—	—	—	—	—	—	—	—	X
Miniopterus fraterculus	—	—	—	—	—	—	—	—	—	X
,, *schreibersi*	—	X	—	—	X	X	X	X	X	X
MOLOSSIDAE										
Sauromys petrophilus	—	—	—	—	X	X	—	X	—	—
Tadarida (Mops) condylura	—	—	—	—	—	—	—	X	X	—
,, ,, *midas*	—	—	—	—	—	—	—	X	X	—
,, *(Chaerephon) pumila*	—	—	—	—	—	—	—	X	X	X
,, *(Tadarida) aegyptiaca*	X	X	—	—	X	X	—	X	X	—
CERCOPITHECIDAE										
Papio ursinus	X	X	—	X	X	X	X	X	X	X
Cercopithecus (aethiops) pygerythrus	—	—	—	X	X	X	X	X	X	X
,, *(mitis) albogularis*	—	—	—	—	—	—	—	—	—	X
GALAGIDAE										
Galago crassicaudatus	—	—	—	—	X	—	—	X	X	X
,, *senegalensis*	—	—	—	X	X	X	X	X	X	X
MANIDAE										
Manis temmincki	—	—	—	—	X	X	X	X	X	—
LEPORIDAE										
Pronolagus crassicaudatus	—	—	—	—	—	—	—	—	—	X
,, *randensis*	X	X	—	—	X	X	X	X	—	X
,, *rupestris*	X	X	—	—	—	—	—	—	—	—
Lepus capensis	X	X	X	—	X	X	X	X	—	—
,, *saxatilis*	X	X	—	X	X	X	X	X	X	X
BATHYERGIDAE										
Cryptomys hottentotus	X	X	—	X	X	X	X	X	X	X
Georychus capensis	X	—	—	—	—	—	—	—	—	—
HYSTRICIDAE										
Hystrix africae-australis	X	X	X	X	X	X	X	X	X	X
THRYONOMYIDAE										
Thryonomys swinderianus	X	X	—	X	X	X	—	X	X	X
SCIURIDAE										
Xerus inauris	X	—	X	—	—	—	—	—	—	—
Paraxerus cepapi	—	—	—	X	X	X	X	X	X	X
PEDETIDAE										
Pedetes capensis	X	X	X	—	X	X	X	X	X	—
MUSCARDINIDAE										
Graphiurus (Graphiurus) ocularis	—	—	—	—	—	X	—	—	—	—
,, *(Claviglis) platyops*	—	X	—	—	X	X	—	—	—	X
,, ,, *murinus*	X	X	—	X	X	X	X	X	X	X
MURIDAE										
Acomys spinosissimus	—	—	—	—	X	X	X	X	X	—
Aethomys (Micaelamys) namaquensis	—	X	—	—	X	X	X	X	X	X
,, *(Aethomys) chrysophilus*	X	X	—	X	X	X	X	X	X	X
Dasymys incomtus	—	X	—	—	X	X	—	—	X	X
Lemniscomys griselda	—	—	—	X	X	X	X	X	X	X
Leggada minutoides	X	X	—	X	X	X	X	X	X	X

TABLE 1: continued.

	1	2	3	4	5	6	7	8	9	10
Praomys (Mastomys) natalensis	X	X	X	X	X	X	X	X	X	X
Rhabdomys pumilio	X	X	X	X	X	X	X	—	—	X
Thallomys paedulcus	—	—	—	—	X	X	X	X	X	X
Thamnomys (Grammomys) dolichurus	—	—	—	—	X	—	—	X	—	X
,, ,, *cometes*	—	—	—	—	—	—	—	—	—	X
CRICETIDAE										
Cricetomys gambianus	—	—	—	—	X	—	X	—	—	X
Saccostomus campestris	X	—	—	X	X	X	X	X	X	X
Dendromus nyikae	—	—	—	—	—	—	—	—	X	—
,, *melanotis*	X	X	—	—	—	X	—	X	—	X
,, *mesomelas*	—	—	—	—	—	—	—	X	—	X
,, *mystacalis*	—	X	—	X	X	X	—	X	X	X
Malacothrix typica	X	X	X	—	—	—	—	—	—	—
Steatomys pratensis	—	—	—	X	X	X	X	X	X	X
,, *krebsi*	X	X	X	—	—	—	—	—	—	—
Mystromys albicaudatus	X	X	—	—	—	—	—	—	—	—
Desmodillus auricularis	X	X	—	—	—	—	—	X	—	—
Tatera leucogaster	X	X	X	X	X	X	X	X	X	X
,, *brantsii*	X	X	X	—	X	X	X	—	—	—
Gerbillurus paeba	—	—	—	—	X	X	—	X	—	—
Otomys laminatus	—	—	—	—	—	—	—	—	—	X
,, *angoniensis*	X	X	—	X	X	X	X	X	X	X
,, *irroratus*	X	X	—	—	X	X	—	X	—	X
,, *sloggetti*	—	X	—	—	—	—	—	—	—	—
CANIDAE										
Otocyon megalotis	—	—	X	—	X	X	X	X	—	—
Lycaon pictus	—	—	—	—	X	—	—	X	X	—
Vulpes chama	X	X	X	X	X	X	—	—	—	—
Canis adustus	X	—	—	—	—	X	X	X	X	—
,, *mesomelas*	X	X	X	X	X	X	X	X	X	—
MUSTELIDAE										
Aonyx capensis	X	X	—	—	—	X	X	X	X	X
Lutra maculicollis	X	—	—	—	—	X	—	X	X	—
Mellivora capensis	—	—	—	—	X	X	X	X	X	X
Poecilogale albinucha	X	X	—	—	X	X	—	—	—	—
Ictonyx striatus	X	X	—	—	X	X	—	X	X	X
VIVERRIDAE										
Viverra civetta	—	—	—	X	X	X	—	X	X	X
Genetta genetta	X	—	X	—	X	X	X	X	X	X
,, *(tigrina) rubiginosa*	X	X	—	X	X	X	X	X	X	X
Suricata suricatta	X	X	X	—	—	—	—	—	—	—
Paracynictis selousi	—	—	—	—	—	—	—	X	X	X
Cynictis penicillata	X	X	X	—	X	X	—	—	—	—
Herpestes (Herpestes) ichneumon	—	—	—	—	—	—	—	X	X	—
,, *(Galerella) sanguineus*	X	X	—	X	X	X	X	X	X	X
Rhynchogale melleri	—	—	—	—	—	—	—	—	X	X
Ichneumia albicauda	X	X	—	—	X	X	—	X	X	X
Atilax paludinosus	X	X	—	—	X	X	—	X	X	X
Mungos mungo	—	—	—	—	X	X	—	X	X	—
Helogale parvula	—	—	—	—	X	X	—	X	X	X
PROTELIDAE										
Proteles cristatus	X	X	—	X	X	X	X	X	X	X
HYAENIDAE										
Hyaena brunnea	X	X	X	X	X	X	—	X	X	X
Crocuta crocuta	—	—	—	—	X	X	X	X	X	—

TABLE 1: continued.

	1	2	3	4	5	6	7	8	9	10
FELIDAE										
Acinonyx jubatus	—	—	—	—	X	—	—	X	X	—
Panthera pardus	—	X	—	X	X	X	X	X	X	X
,, *leo*	—	—	—	—	X	X	—	X	X	—
Felis nigripes	X	—	—	—	—	—	—	—	—	—
,, *serval*	—	—	—	—	X	X	—	X	X	—
,, *caracal*	—	—	—	X	X	X	X	X	X	X
,, *libyca*	X	X	—	—	X	X	—	X	X	X
ORYCTEROPODIDAE										
Orycteropus afer	X	X	X	—	X	X	X	X	X	—
ELEPHANTIDAE										
Loxodonta africana	—	—	—	—	X	X	—	X	X	—
PROCAVIIDAE										
Procavia capensis	X	X	—	X	X	X	X	X	X	X
Heterohyrax brucei	—	—	—	—	X	—	—	X	—	X
RHINOCEROTIDAE										
Ceratotherium simum	—	—	—	—	X	X	—	X	X	—
Diceros bicornis	—	—	—	—	—	—	—	X	X	—
EQUIDAE										
Equus burchelli	—	X	—	—	X	X	—	X	X	—
SUIDAE										
Potamochoerus porcus	—	—	—	—	X	X	X	X	X	X
Phacochoerus aethiopicus	—	X	—	X	X	X	X	X	X	—
HIPPOPOTAMIDAE										
Hippopotamus amphibius	X	X	—	—	X	—	—	X	X	—
GIRAFFIDAE										
Giraffa camelopardalis	—	—	—	X	X	X	—	X	X	—
BOVIDAE										
Syncerus caffer	—	—	—	—	X	X	—	X	X	—
Tragelaphus angasi	—	—	—	—	X	X	—	X	X	—
,, *scriptus*	—	—	—	X	X	X	X	X	X	X
,, *strepsiceros*	—	X	—	X	X	X	X	X	X	—
Taurotragus oryx	—	X	—	—	X	X	—	X	X	—
Cephalophus natalensis	—	—	—	—	X	—	—	X	X	X
Sylvicapra grimmia	X	X	X	X	X	X	X	X	X	X
Redunca arundinum	—	—	—	—	X	X	X	X	X	X
,, *fulvorufula*	X	X	—	—	X	X	—	X	X	X
Kobus ellipsiprymnus	—	—	—	X	X	X	—	X	X	X
Hippotragus niger	—	—	—	X	X	X	—	X	X	—
,, *equinus*	—	—	—	—	X	X	—	X	X	—
Oryx gazella	—	—	X	X	X	X	—	—	—	—
Connochaetes gnou	X	X	—	—	—	—	—	—	—	—
,, *taurinus*	—	—	—	X	X	X	—	X	X	—
Alcelaphus buselaphus	X	X	—	—	X	X	—	—	—	—
Damaliscus dorcas	X	X	—	X	X	X	—	—	—	—
,, *lunatus*	—	—	—	X	X	—	—	X	X	—
Aepyceros melampus	—	—	—	X	X	X	X	X	X	—
Antidorcas marsupialis	X	X	X	X	—	—	—	—	—	—
Oreotragus oreotragus	—	—	—	—	X	X	X	X	X	X
Ourebia ourebi	—	X	—	—	—	X	—	—	—	X
Raphicerus campestris	X	X	X	X	X	X	X	X	X	—
,, *sharpei*	—	—	—	—	X	—	—	X	X	X
Neotragus moschatus	—	—	—	—	—	—	—	—	—	X
Pelea capreolus	X	X	—	X	X	X	X	—	X	X

TABLE 2: Resemblance of mammalian faunas of the ten Transvaal community types. See text for explanation; italic numerals on diagonal indicate the total number of species in each zone. Numerals allocated in text to each community type for convenient reference, indicated in brackets.

	Pure Grassveld (1)	False Grassveld (2)	Kalahari Thornveld (3)	Turf Thornveld (4)	Arid Sweet Bushveld (5)	Sour Bushveld (6)	Waterberg Sour Bushveld (7)	Mopani Veld (8)	Lowveld Bushveld (9)	Inland Tropical Forest (10)
Pure Grassveld (1)	*72*	,779	,460	,448	,511	,556	,458	,443	,415	,439
False Grassveld (2)	60	*82*	,382	,489	,586	,660	,468	,490	,515	,525
Kalahari Thornveld (3)	23	21	*28*	,296	,292	,322	,368	,227	,194	,186
Turf Thornveld (4)	28	33	12	*53*	,556	,595	,571	,503	,556	,481
Arid Sweet Bushveld (5)	48	58	21	47	*116*	,848	,606	,832	,776	,654
Sour Bushveld (6)	52	65	23	50	98	*115*	,655	,793	,797	,667
Waterberg Sour Bushveld (7)	30	33	16	32	53	57	*59*	,575	,594	,538
Mopani Veld (8)	43	50	17	44	99	94	52	*122*	,874	,673
Lowveld Bushveld (9)	39	51	14	47	90	92	52	104	*116*	,673
Inland Tropical Forest (10)	38	48	12	37	71	72	43	75	73	*101*

TABLE 3: Average species densities of Transvaal mammals, per column of quadrats: A in a west to east direction (14 vertical columns), and B in a north to south direction (12 horizontal columns).

A: West to East.

$\bar{X}$	39,3	42,6	48,2	52,8	66,0	76,6	80,0	71,9	69,3	63,8	63,2	66,5	93,0	94,0
N	3	5	6	5	7	8	9	9	10	11	10	10	7	4

B: North to South.

$\bar{X}$	84,0	84,4	81,4	84,9	80,7	79,8	76,9	68,2	41,7	40,1	39,7	42,0
N	2	7	8	9	10	12	13	13	11	12	6	1

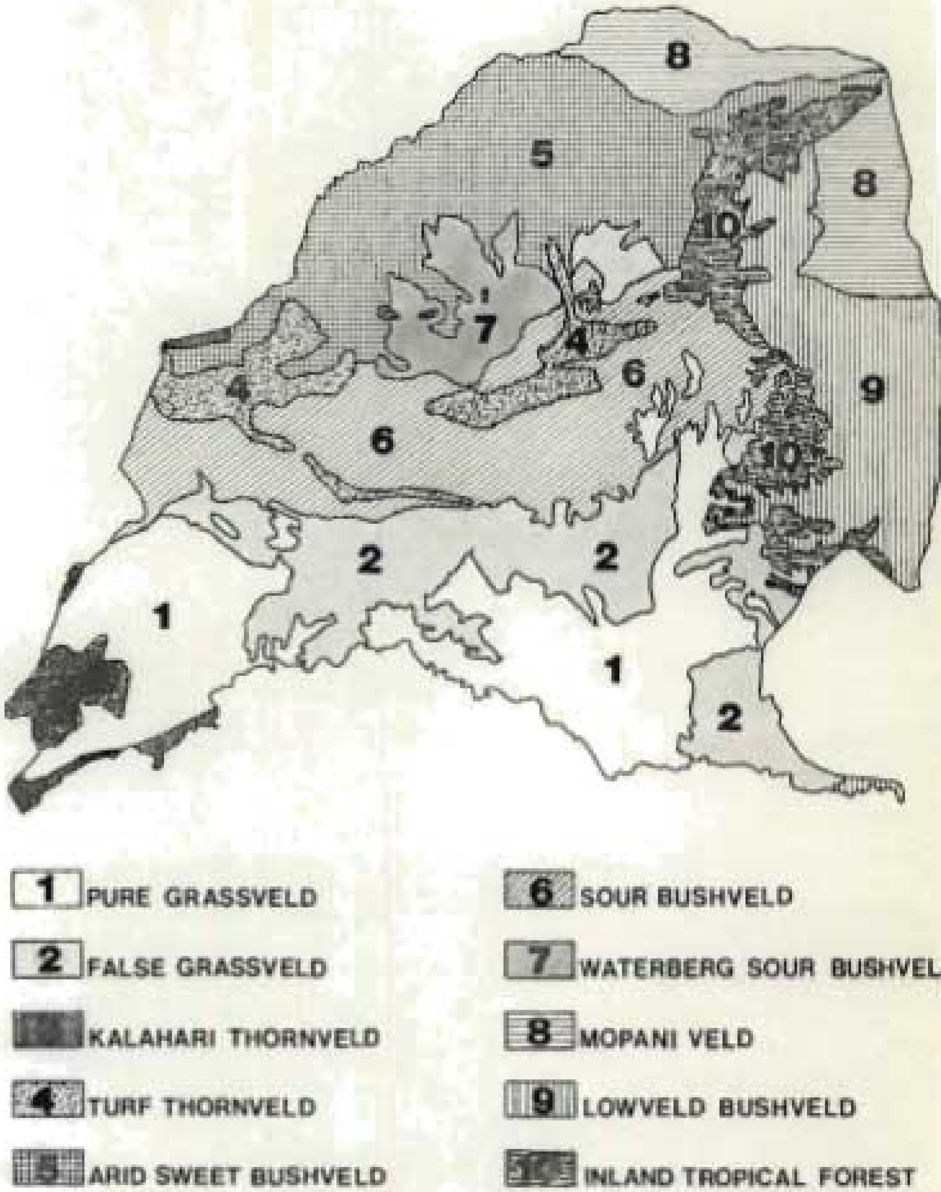

FIG. 1: Community types of the Transvaal (modified after Acocks, 1975).

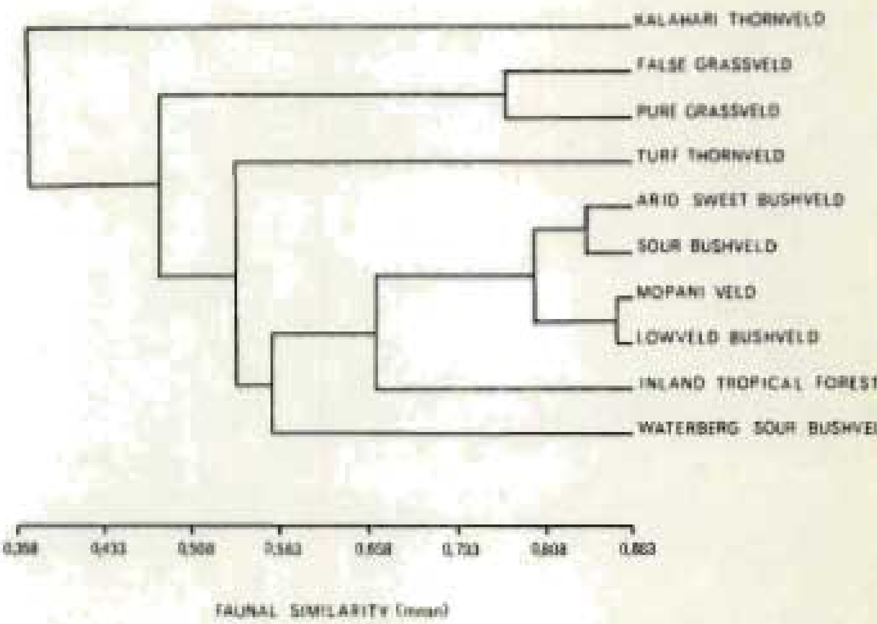

Fig. 2: Similarity phenogram of ten Transvaal community types: for explanation see text (also see Table 2).

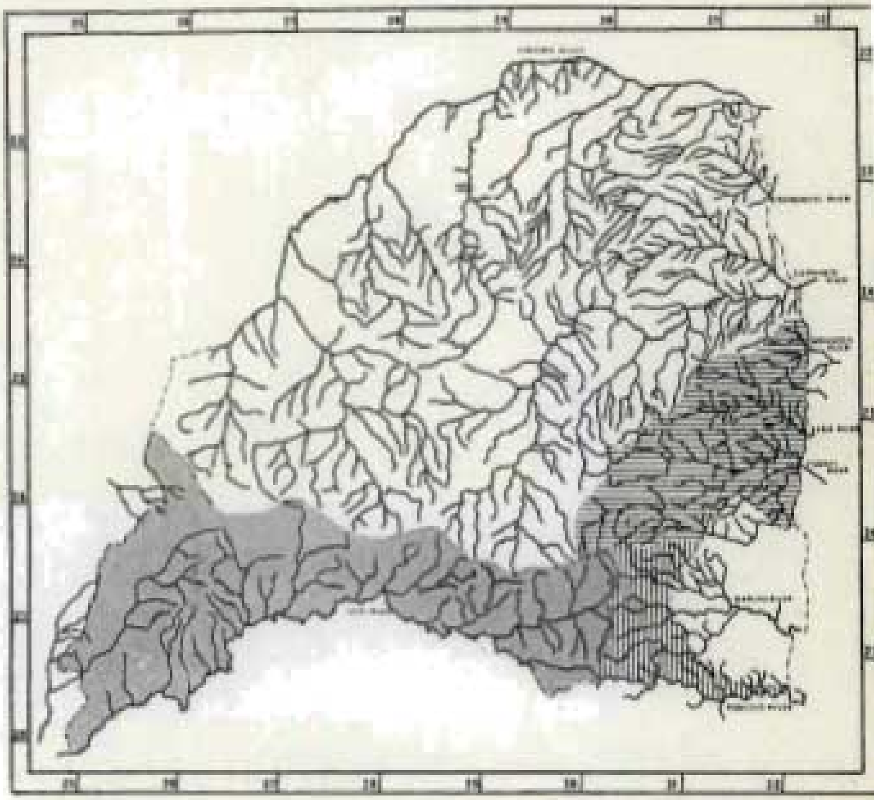

FIG. 3: The Transvaal drainage systems. Legend: Unstippled area, Limpopo drainage system; stippled area, Vaal/Orange drainage system; horizontal lines, Komati drainage system; vertical lines, Maputo drainage system.

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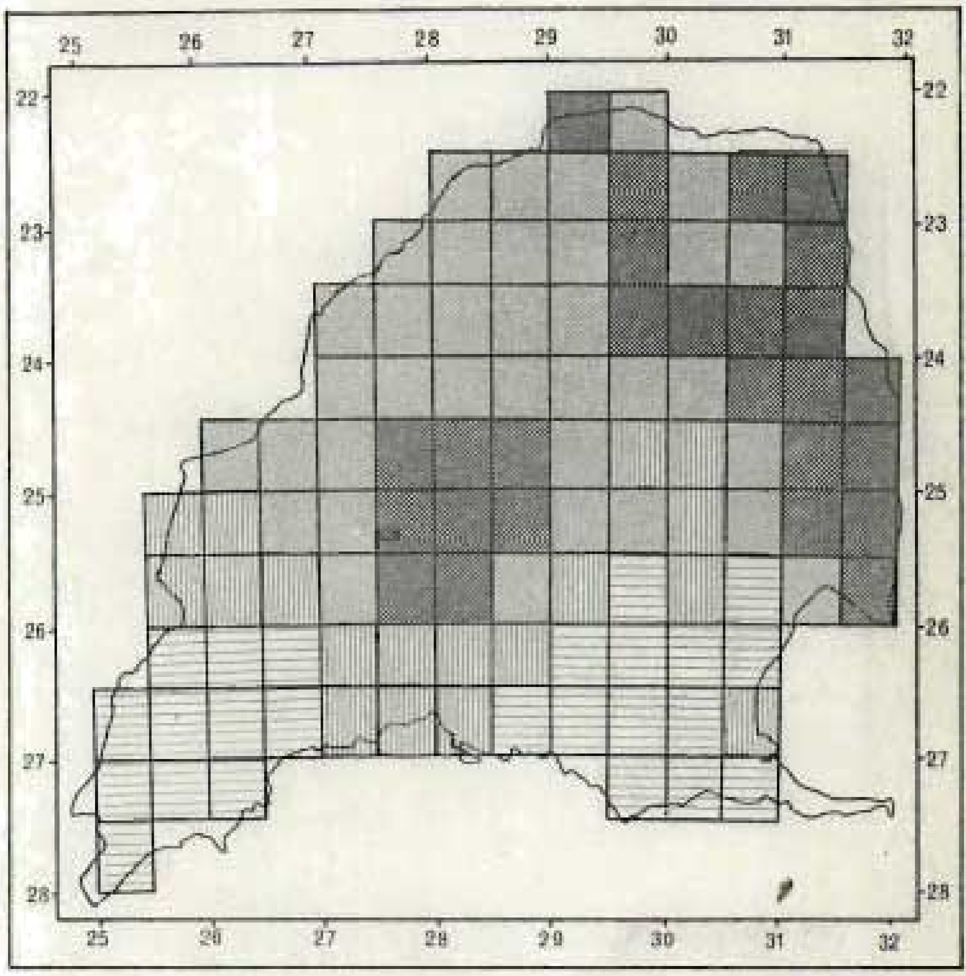

FIG. 4: Absolute species density of mammals in the Transvaal. Legend: 25–44 species per quadrat, horizontal lines; 45–64, vertical lines; 65–84, light stippling; 85–104, dark stippling.