Contents

THE MAMMALS OF BOTSWANA

by Reay H. N. Smithers

Supervisor: Dr. J. Meester, *Department of Zoology*

Submitted in partial fulfilment of the requirements for the degree of Doctor of Science, Faculty of Science, University of Pretoria, Pretoria.

The purpose of this study, which was undertaken over the years 1964-69, was to determine which species of mammals occur in Botswana and to contribute to our knowledge of their taxonomy, distribution, habitat requirements, habits, food and reproduction.

As this programme involved the services of a number of teams and individuals working independently and far from base, a system was devised whereby the observations and data were recorded in a standard manner for ease of later recovery and correlation.

The study area was divided into five sectors, and each sector was visited at least once during both the wet and dry seasons.

The data collected included sight records of easily recognizable species, material records based on skins and skulls, stomach contents (except those of the Chiroptera and Muridae) and reproductive tracts. All specimens were weighed and standard field measurements were taken. In addition, habitat preferences were noted and information on habits was recorded, augmented, where possible, by observations of specimens in captivity.

After three years of fieldwork, an interim report was published, giving information on distribution and habitat of the 146 species collected up to that date (Smithers, 1968). By the completion of the study in 1969 a further six species had been added to the list, making the total number, now dealt with, 152.

The introduction of the present report deals with: the objects of the study; the value of the results as a basis for further studies; the problem of field-work in terrain that is largely waterless and difficult of access; and other subjects of direct and indirect interest to the survey.

Further chapters deal with the study area, its situation, and political, topographical, ecological and other features; a gazetteer of place names and their *locus* on a quarter-degree grid system; a discussion on the planning of the survey; definitions of the terms used in the text and a glossary of abbreviations. The methods and techniques used in obtaining and processing material and the use of the record forms are discussed.

An outline of the classification used is provided. With some stipulated exceptions it follows that of Ellerman, Morrison-Scott and Hayman (1953).

A checklist follows, which deals in detail with each of the species studied. Keys to genera and species are given. The distribution of each species is briefly described, and plotted on a distribution map using a quarter-degree square system, distinguishing between sight and material records. The taxonomy of the species is discussed, if it presents problems, and habitat, habits and reproduction are described in the light of the information acquired in the course of the study. Sizes and weights are summarized, when samples consist of four or more specimens. Otherwise, individual values are given.

A list is provided of species which were not collected, but which might be expected to occur, as they have been taken in ecologically similar conditions in adjacent parts of surrounding territories.

Acknowledgement is made to those who provided the finance for the operation, assisted in the work, or were associated in various ways with it; and a bibliography and indices of scientific, English and seTswana names are given.

The data, on which the detailed analysis of habitat and food preference were based, remain available for further study in the archives of the National Museums of Rhodesia.

THE MAMMALS OF BOTSWANA

deur Reay H. N. Smithers

Promotor: Dr. J. Meester, *Departement Dierkunde*

Voorgelê tergedeeltelike vervulling van die vereistes vir die graad van Doktor in the Natuurwetenskap, Faukulteit Wis—en Natuurkunde, Universiteit van Pretoria, Pretoria.

Die doel van hierdie ondersoek, wat uitgevoer is gedurende die tydperk 1964 tot 1969, was om vas to stel watter species van soogdiere voorkom in Botswana en om 'n bydrae to maak tot ons kennis van hul taksonomie, verspreiding, habitat-vereistes, gewoontes, voedsel en voortplanting.

Aangesien hierdie program die dienste van verskeie spanne en individue meegebring het wat onafhanklik en ver van hul basis af gewerk het, was 'n sisteem uitgewerk waardeur die waarnemings en gegewens op 'n standaard manier aangeteken is vir gerieflike latere naslaan en korrelasie.

Die studiegebied was verdeel in vyf sektore, en elke sektor was ten minste een keer gedurende beide die nat en die droeë seisoene besoek.

Die gegewens wat versamel is het ingesluit visuele rekords van maklik herkenbare species en materiële rekords wat gebaseer is op velle en skedels, maaginhoude (behalwe die van die Chiroptera en Muridae) en voortplantingssisteme. Alle eksemplare was geweeg en standaard veldafmetings is gedoen. Verder is habitatvoorkeure en inligting oor gewoontes aangeteken, om later waar moontlik aangevul te word deur waarnemings in gevangenisskap.

Na drie jaar se veldwerk is 'n interim verslag gepubliseer wat inligting bevat het oor die verspreiding en habitat van die 146 species wat tot op daardie tydstip versamel is (Smithers, 1968). Teen die tyd toe die studie in 1969 afgehandel is, is 'n verdere sewe species by hierdie lys gevoeg, sodat 'n totaal van 153 nou behandel word.

Die inleiding van die huidige verslag handel oor: Die doelstellings van die opname; die waarde van die resultate as 'n basis vir verdere navorsing; die probleem van veldwerk in gebiede wat in 'n groot mate waterloos is en moeilik is om to besoek; en ander onderwerpe van direkte of indirekte belang vir die opname.

Verdere hoofstukke handel oor die studiegebied, insluitende die ligging daarvan sowel as die politieke, topografiese, ekologiese en ander kenmerke daarvan; 'n lys van plekname en hul lokusse op 'n kwartgraad ruitsisteem; 'n bespreking oor die beplanning van die opname; definisies van die terminologie wat gebruik word en 'n woordelys van afkortinge. Die metodes en tegnieke wat aangewend is om materiaal to verkry en verwerk en die rekordvorms wat gebruik is word in besonderhede behandel.

'n Raamwerk van die klasifikasie wat gebruik is word voorsien. Met sekere gestipuleerde uitsonderings volg dit die van Ellerman, Morrison-Scott en Hayman (1953).

'n Naamlys volg wat in detail handel oor elkeen van die species wat bestudeer is. Sleutels tot genera en species word verstrek. Die verspreiding van elke species word kortliks beskryf en aangedui op 'n verspreidingskaart, wat van 'n kwaartgraad ruitsisteem gebruik maak, en waarin onderskei word tussen visuele en materiële rekords. Die taksonomie van die species wat probleme bied word behandel en habitat, gewoontes en voortplanting word beskryf in die lig van die inligting wat verkry is in die loop van die opname. Mate en gewigte word opgesom wanneer steekproewe bestaan uit vier of meer eksemplare. Anders word individuele waardes verstrek.

'n Lys word voorsien van species wat nie versamel is nie maar wat na verwagting mag voorkom, aangesien hulle reeds versamel is in ekologies soortgelyke omstandighede in aanliggende dele van aangrensende gebiede.

Dank word uitgespreek aan die persone wat die projek finansieël ondersteun het, wat bygestaan het in die werk of wat op verskeie maniere daaraan verbonde was; en 'n bibliografie en registers van wetenskaplike, seTswana en Engelse name word verskaf.

Die gegewens waarop die gedetaileerde analise van habitat en voedselvoorkeur gebaseer is, is vir verdere studie beskikbaar in die argiewe wan die Nasionale Museums van Rhodesia.

This survey was made possible by grants provided by the Government of the Republic of Botswana together with financial and material assistance from the Smithsonian Institution, Washington, D.C., and Mr. C. S. Barlow of Johannesburg.

The costs of publication were met from grants provided by the South African Wildlife Foundation, affiliated to the World Wildlife Fund, and the Trustees of the National Museums of Rhodesia.

I acknowledge this assistance with grateful thanks.

Introduction

The increasing awareness, within recent years, of the value of African wildlife as a natural resource has led to a resurgence of interest in the mammalian fauna of the continent.

While, in the main, directed to the larger species this has, at the same time, stimulated interest in the smaller and less spectacular although by no means less interesting species, which constitute by far the larger proportion of the fauna.

In Botswana, these smaller species are of immense value as they have, from time immemorial, provided food and clothing for the indigenous peoples. In modern times, hides and skins have become articles of trade of increasing commercial value. The proper conservation of the species, in order that they may be utilized on a sustained yield basis has, therefore, become increasingly important.

In a country the size of Botswana, with its varied ecological conditions, it is of value to have an understanding of what species occur and where they occur. While this in itself is of use to administrators entrusted with the conservation of the fauna, it is also the basis on which many other facets of study, which are vital to them, can properly proceed.

The object of the present survey, initiated in January 1964, was to produce a checklist of the mammals, with particular reference to their distribution, and in addition such information on their taxonomy, habitat requirements, feeding and other habits and reproduction as it was possible to accumulate in the time allotted.

Five years were assigned to complete the fieldwork, with a further year to write up the results.

For ease of administration the work was carried out under the auspices of an independent body, set up for the purpose, designated the Botswana Mammal Survey. This organization was based on the Game Department, Francistown, and remained based there, after the reorganization of that Department as the Department of Wildlife and National Parks and the transfer of its Head Office to Gaborone.

It was recognized that the task, involving an area of over 220 000 square miles in which very little collecting had been done, was a formidable one, and that the results, with limited personnel and within such a relatively short period, would at best provide a very incomplete picture.

In addition to its large size, some two-thirds of the territory is largely waterless and sparsely inhabited. Travelling conditions are difficult owing to the heavy sand which necessitates the use of four-wheel-drive vehicles, which must be used in pairs in case of serious breakdown. In these areas, supplies of fuel for the vehicles and water to sustain the parties have to be carried, or arrangements made long in advance to have these dumped for their use.

The remaining third of the territory, embracing the Okavango delta and the areas adjacent to it, presents travelling problems of an entirely different kind. In the wet season long stretches of bottomless mud render movement difficult, at times impossible.

From the base in Francistown great distances had to be travelled to the outlying parts of the study area, over established but indifferent main routes and tracks, many of them suitable only for trucks or four-wheel-drive vehicles.

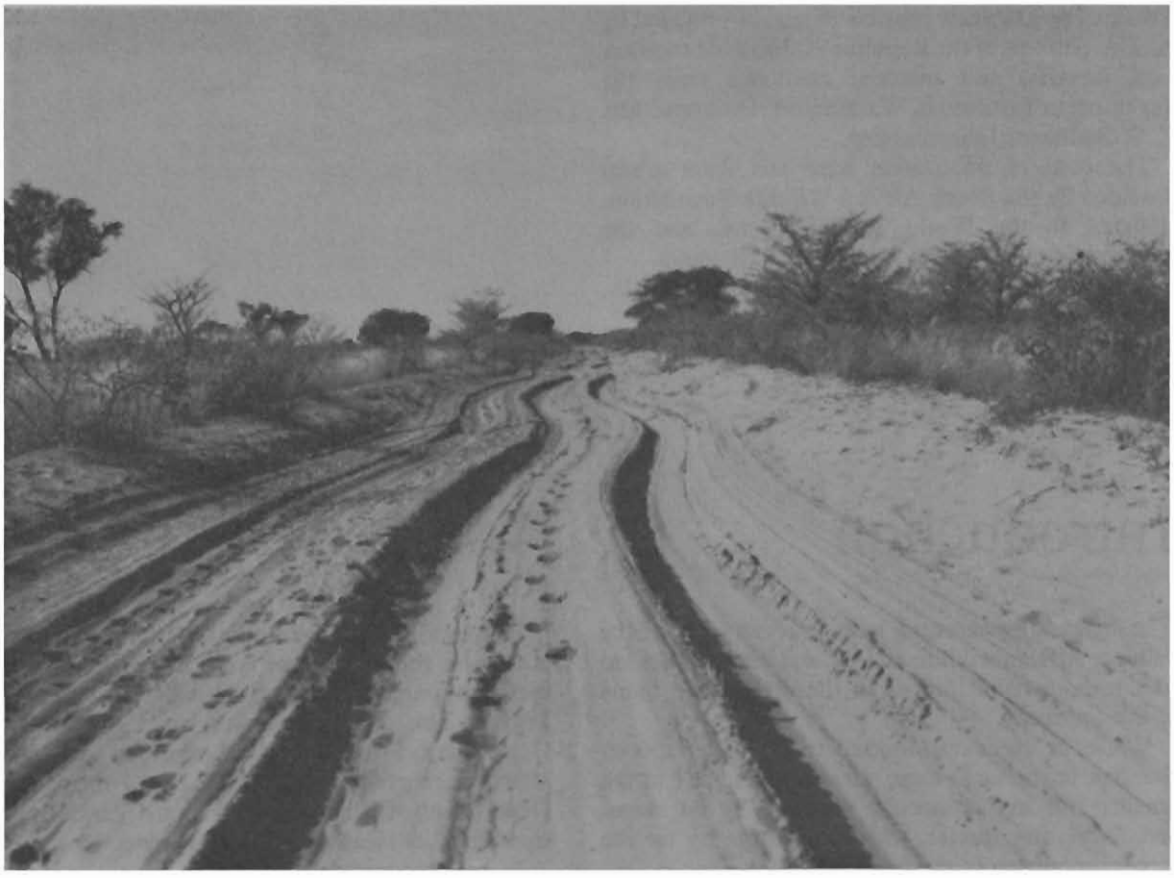


Plate 1 A 300-mile nightmare of sand. The old Francistown to Maun road. **Photo:** Author

During the course of the survey, marked improvements were made to certain of the main routes in the territory, in particular the road from Francistown to Maun which had been previously a 300-mile nightmare of heavy sand, in parts weaving snakewise where heavy transport trucks negotiating bends had cut deeply into the spoor. These improvements greatly facilitated access to remote parts of the territory.

The experience gained, during the six years of an avifaunal survey (Smithers, 1964), in an understanding of the conditions prevailing and the difficulties of the terrain, proved invaluable.

From the start it was recognized that the scope of the survey debarred the detailed investigation of certain facets of the bionomics of individual species, as, for example, the feeding habits of herbivores.

Such investigations, to be comprehensive, necessitate prolonged study in restricted areas, involving long-term observations on single or, at most, limited numbers of species, which was not possible under the conditions of the survey. The data on habits are, as a consequence, meagre. All stomach contents of herbivores were sampled, but examined only on the broad basis of the relative percentages of browse and graze. The samples, nevertheless, were preserved and retained in the hope that one day the sophisticated techniques, now being developed for the identification of masticated vegetable matter, may be applied to them, when they could become a valuable parallel asset to visual observations. On the other hand, particular attention was paid to the stomach contents of the carnivores which were preserved *in toto* and examined in detail in the laboratory.

As an offset to its own shortage of personnel, the survey was fortunate in obtaining substantial assistance from the Smithsonian Institution, Washington, D.C., who, through the good offices of Dr. H. W. Setzer, seconded fully-equipped teams, consisting of a mammalogist and an entomologist, over a three-year period. This was an ideal combination, the mammalogist attending to the collection and processing

of the material and the recording of the data, and the entomologist to the collection of ectoparasites.

The Botswana Department of Wildlife and National Parks seconded to the field-parties African Game Guards who very quickly picked up the techniques of processing the material, and whose knowledge of the territory and the languages of the indigenous peoples made them most valuable. A number of senior personnel of the Department became interested in the objects of the survey and made valuable contributions in the form of material and data. Further support was given by the field activities of the Rhodesian Schools Exploration Society, the Peterhouse Natural History Society and others whose efforts are acknowledged in the appropriate section of this paper. In the main, however, the bulk of the work was carried out by the writer, as Director of the survey, supported by members of the professional and technical staff of the National Museums of Rhodesia.

As compared with other parts of southern Africa, very little collecting had been carried out in Botswana. The pioneer hunters and explorers, in the main, confined their activities to the better watered eastern and north-eastern sectors, and the environs of the Okavango delta and Chobe River, leaving the arid central and south-western parts relatively unknown.

To reach these areas, long stretches of dry, sandy country had to be crossed where water supplies were uncertain, as, for example, between Kolobeng and the Botletle River, from the northern parts of the Makgadikgadi to the Mababe Depression, or from the present South West African border to Lake Ngami.

Although travel today in the remoter parts of Botswana remains a challenge to the best equipped expeditions with modern vehicles, the conditions experienced are mild compared with those experienced by early travellers. Travelling, as they did, at the pace of their heavily-laden ox-wagons, the very lives of man and beast depended on the possibility of finding water several days' journey ahead. Debilitated by malaria and other diseases, so easily avoided today by the use of modern drugs, often alone and far from assistance, the simplest accident could lead to disaster. In spite of these hardships and dangers they still, with dauntless courage, pursued their journeyings which often extended into years.

Their writings prove interesting reading today and reveal the shrinkages that have taken place in the distributional range of many species, particularly the larger game species, and the great reduction in their numbers caused by the wide habitat changes that have taken place through the influence of man.

Botswana is fortunate that, up to the present day, man's impact on the territory has been confined to limited areas, in particular to the heavily-settled areas along the line of rail from Ramatlabama to the Rhodesian border at Plumtree. The territory, and its habitat as a whole, remains at least as undisturbed as any part of southern Africa. The extension of these influences is, nevertheless, very apparent in the increasing number of artificial water-points being provided to allow domestic stock to utilize relatively undisturbed wilderness, much of which is marginal ground highly sensitive to this type of utilization. This is leading to degradation of the habitat over ever-widening areas.

The disease control fences which criss-cross the territory and run unbroken for immense distances (Kuki-Makalamabedi *c.* 200 miles), in many cases cut across the traditional lines of movement of some of the large mammal species such as wildebeest, *Connochaetes taurinus*, and zebra, *Equus burchelli*.

While a detailed long-term study of the effect of these fences on wildlife populations would be interesting, it appears that their effects can be devastating. Silberbauer (1965) points out that there were movements from the northern parts of the Central Kalahari Game Reserve in the winter season to the well-watered areas to the north and north-east. In 1964, a game census of the northern region of the reserve showed that 'the incidence of fresh wildebeest carcasses (i.e. within five days of death) was a tenth of the number of surviving animals, that is, that a tenth of the wildebeest population were dying every five days' (Silberbauer, 1965). Silberbauer notes that zebra would seem to have disappeared from this area altogether. Very large numbers of wildebeest carcasses were seen along the Makalamabedi fence in 1965 and many individuals, wandering along it on the western side, appeared to be in very poor condition. At that time, the country was in the throes of an unprecedented drought and these individuals in any case were in poor condition due to this factor. Being prevented by the fences from making their way northwards to the well-watered areas of the Botletle River and Lake Dow with their associated grasslands was certainly a factor leading to their deaths in large numbers.

The survey started work in the middle of a four-year drought, during which vast areas in the eastern parts of the territory became incapable of supporting cattle. Many of these were moved to the grasslands of the Makgadikgadi and Lake Dow where water and grass remained available, only the hardier goats remaining in the drought-stricken areas. At this time, parts of the eastern sector showed textbook examples

Plate 2 The trend towards the areas becoming sterile deserts. Overgrazed ground near Lephepe. **Photo:** Author

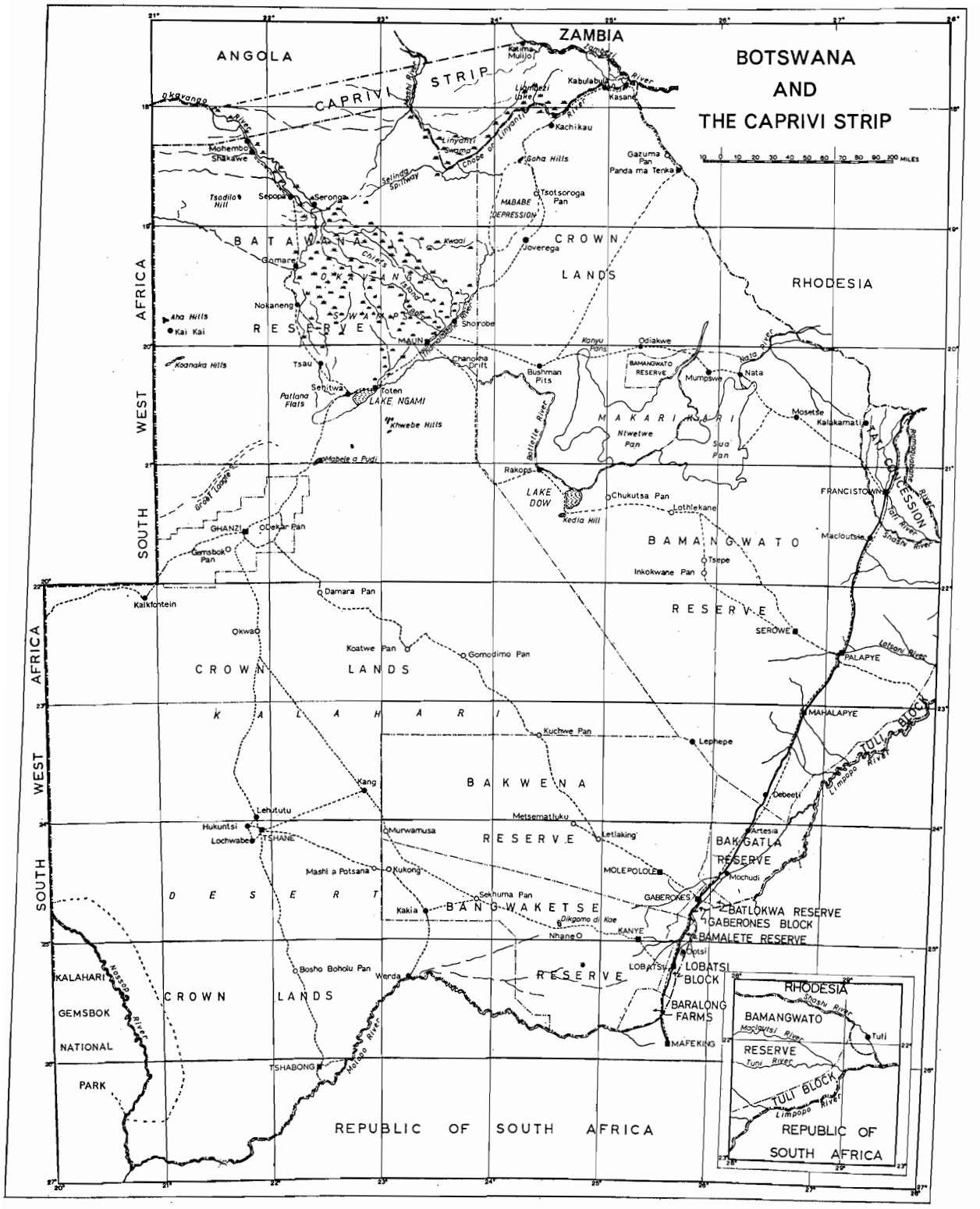
of over-utilization, the ground being bare and totally devoid of any trace of living vegetation, the mopane browsed clear to the height reached by goats. At walking height the untouched vegetation obscured the view, yet, by bending down below the graze-line, one could see several hundred yards in any direction.

The grasslands of the Makgadikgadi and Lake Dow formerly supported, at certain times of the year, vast herds of grazing animals such as wildebeest, *C. taurinus*, springbok, *Antidorcas marsupialis*, hartebeest, *Alcelaphus buselaphus*, and zebra, *E. burchelli*. The impact of this extra pressure, arising from the introduction of cattle, coupled with unfavourable seasonal conditions, has led to changes in habitat on an alarming scale and the almost total disappearance of this wildlife. Where palatable grasses once supported these great wildlife populations, today the sand, devoid of its cover, piles in little drifts, or races over the ground stinging the exposed surfaces of the skin. The change which has taken place in a few years needs no vegetational transects to show the trend towards the areas becoming sterile deserts useless to man or beast.

Authorities in Botswana are fully aware of the dangers inherent in such situations and the economic and aesthetic advantages accruing from the conservation of their wildlife resource.

In the controlled utlization of wildlife by safari hunting, Botswana has, to her own economic advantage, wisely made the fullest use of the potential available. In demonstrating the value of hunting as an economic form of land use, she has, at the same time, increased the chances of the survival of her wildlife.

Moves are afoot to set aside areas in the north-east so that the Chobe National Park and Moremi Game Reserve, the latter established by the peoples of Ngamiland, may be joined to form what could become one of the finest national parks in southern Africa. Further areas in the south-western parts of the



The Study Area.

Kalahari are destined to become wildlife reserves, in addition to the 20-mile strip already part of the Kalahari Gemsbok National Park, at present administered by the National Parks authorities of the Republic of South Africa.

The allocation of further land in the south-west would do much to ensure that an adequate sample of the natural habitat of the brown hyaena, *Hyaena brunnea*, would be reserved, thus ensuring the survival of this species, presently listed as being increasingly in danger of eventual extinction. It would also ensure the survival of the interesting spectrum of dry-land species particularly associated with the Kalahari.

While the activities of surveys of the type covered in this report have a negligible effect on populations of mammalian species, the handling of large numbers of specimens, necessary in order that the data are adequate, places an ethical responsibility on those involved to make the fullest possible use of each specimen collected.

In a realization that there was little to be gained by the collection of certain of the larger species, this was as far as possible avoided, especially in areas designated as National Parks. In these cases visual records were relied upon, information on their feeding habits and reproduction being left to those with the opportunity to pursue their investigations on a more detailed basis in circumscribed areas. Particular attention was, however, paid to the medium- and small-sized mammals about which even less is known.

In order that all those involved in the survey should be constantly reminded of their obligation to provide the fullest possible data on the material which they collected, a system was designed using record forms on which data were to be recorded under a list of headings. These forms were accompanied by a cyclostyled set of instructions setting out in detail the standard method of handling the specimens, stipulating the materials to be used (Smithers, 1967). These forms, later filed under the name of the species, greatly facilitated the recovery of the data.

Careful thought was given to the choice of the materials used, from the types of cords for attaching the numbered tags to the grades of paper and other materials for the forms and labels, in order to ensure that the records would not suffer unduly from the ravages of time or use.

While such considerations may not appear of major importance, experience has shown that it is, too often, the most interesting specimen whose label has so deteriorated that the data are indecipherable or from which it has become detached and lost through the use of unsuitable attachment materials.

Where skins are subjected to the tanning process, which is both abrasive and detrimental to materials, other than the hide itself, special care has to be exercised so that the numbered tags remain attached to the skin. Here a bookbinder's linen cord, No. 9 Page Cord, was found to be eminently suitable. For the labels for both skins and preserved material, a heavy grade of 'Syntosil' was used. This rayon plastic bonded material is singularly resistant to preservatives and when written on in a good-quality black waterproof ink may be boiled without loss of strength or legibility of the data recorded on it.

Botswana is, in common with other cattle-raising countries in Africa, subject to outbreaks of foot and mouth disease. On three occasions field-parties were operating in areas where outbreaks occurred when, in order to comply with veterinary regulations, the material was subjected to a three-month storage period after the outbreak had subsided. Few losses were incurred under these circumstances, in spite of the fact that the material had to be stored while still only partially processed.

This was due in no small measure to the use of sodium silicofluoride in the preservatives and in the tank treatment of the larger skins in the field, which rendered them highly resistant to the ravages of *Dermestes* and other insect pests which are very common, especially in the warmer months.

The main survey party normally consisted of two or three professional officers and from four to seven technicians and operated in the field for six to eight weeks at a time. The Smithsonian teams remained in the field for much longer periods. The main party, with its larger vehicles, carried its collections with it, while the Smithsonian teams returned occasionally to the nearest branch of the Department of Wildlife and National Parks to refit and store their collections for later transfer to base.

In the case of the main party it became the practice to refit immediately on return so that the unit was ready to leave at short notice for the next spell in the field. Thereafter, the task of finishing off the processing and preparation of the larger skins for tanning, the cleaning of the skulls, the labelling of the specimens, the examination of stomach contents and reproductive tracts and the writing up of the data and preparation of the regional lists was undertaken.

This part of the work proved even more time-consuming than the field-work and was carried out with the aid of my two African technicians, Gatzi and Silver.

In addition to the material collected, the teams

prepared lists of sight records of species for each of the areas visited.

Owing to the doubts that so often arise in connection with this type of record it was agreed, from the outset, to record these only for the most obvious and easily recognizable of the larger species. This narrowed the list to some 35 of the 153 species now known to occur in the territory.

These visual records are used in the text only if there is some supporting evidence, such as their known occurrence in adjacent areas of a similar ecological nature and where the observer, in my opinion, was known to be conversant with wildlife. This allowed of the use of information gathered in the course of two very useful undertakings, the first by Mr. P. Bromfield, while Game Officer, the second by the Department of Wildlife and National Parks, and initiated by Dr. G. Child. These projects involved the circulation, to a list of persons conversant with the wildlife of Botswana, of questionnaires. Dr. Child's survey included a gridded map so that the records might be accurately placed.

Because so many of the species of particular interest are nocturnal, it was necessary to adjust the normal routine of work to make better use of the hours of darkness.

Rodent lines were set from 4 p.m. to 5.30 p.m. and checked at about 6.30 p.m., 10.30 p.m., 12 p.m. and again at 6 a.m. After each of these visits the traps were rebaited and reset and remained *in situ* to be visited at intervals during the day.

Night-hunting with dazzling lights, either in vehicles or on foot, started about 8 p.m. and continued to 12 p.m. or later. Occasionally the hunting times were altered, parties leaving camp about midnight and returning before sunrise. On the whole this never proved as profitable as the 8 p.m. to 12 p.m. hunt.

Specimens collected at night were measured, weighed and labelled on return to camp, so as to be ready for processing at sunrise.

The hot hours of the middle of the day are generally the least productive of material so that, after midday, the opportunity was taken to make up sleep lost during the work of the previous night.

Although generally an area of low and sporadic rainfall, the Kalahari is subject to sudden and violent local storms, preceded by very strong winds. At the time of a particularly violent storm at Kakia Pan in February 1963, the vehicles were travelling in water pouring down the tracks before entering the rain itself, and the party had the unusual experience of watching a Kalahari pan fill to a depth estimated to be some 36 cm in the centre. This storm, measured at Kakia Store, gave 75 mm of rain in two hours.

These localized storms have a profound effect on the movement of the larger Bovids.

While the main survey team was working in the Tshane area in February 1967, very large numbers of springbok and hartebeest were present on two pans visible from the camp. On the fifth day after our arrival, very heavy thunder-clouds built up far to the south-east although the sky remained clear in the camp area. Towards evening rain was seen to be falling under these thunder-clouds and, by next morning, no springbok or hartebeest were seen on the two pans or anywhere within five miles on either side of the camp. While there is no definite evidence to support the suggestion that the two species moved towards the area where the rain fell, large numbers of both species were observed near Murwamusa on the return journey, three days later, in an area some 20 miles in a direct line from the camp-site, where rain had undoubtedly fallen.

The effect of rain on concentrations of springbok was referred to by Cronwright-Schreiner (1925) in describing the incredible numbers of springbok involved in mass-movement towards the end of the nineteenth century. He states 'no sooner does the rain fall than they disappear'.

While the spectacular mass-movement of springbok on a large scale no longer occurs, smaller mass-movements still take place. Child and Le Riche (1969) record 'treks' in 1946 (estimated 15 000) and in 1950 (which took three days to pass Tshabong) in the extreme south-western area.

In October 1969, a mass-movement of eland involving about 1 000 individuals, took place from the Tshane area southwards, passing near Tshabong and moving towards the border of the Republic of South Africa (Liversedge, *pers. comm.*).

These mass movements would be a profitable subject for detailed study.

Participation in a survey of this type, while providing a unique opportunity of gaining a superficial knowledge of a wide spectrum of wildlife is, nonetheless, frustrating in that so many avenues of investigation must be left unexplored. Every day in the field revealed glimpses of problems which there was no time to follow up. What, for example, are the factors that trigger off these mass-movements of springbok or eland; and why are the bateared foxes in the north-east suddenly extending their range into areas where formerly they were not found? Even after nearly five years of field-work there remains no less than ten species of bats for which there are only single locality

records, a further eight for which there are only two or three, and of these we have learnt little or nothing about their times of breeding or where they rest during daylight hours. It is still impossible to state with any degree of certainty the limits of distribution of a wide range of the smaller species of mammals; and, indeed, there are at least two genera of Murids, *Steatomys* sp. and *Mus* sp., in which it is impossible to be certain as to the species we are dealing with, nor has it been possible to contribute further evidence to resolve this dilemma.

In spite of these and other grave shortcomings it is hoped that the present contribution may direct interest towards the mammals of this interesting territory and provide a base from which further studies may proceed to a clearer understanding of the bionomics of the species which occur and the many other problems which remain unsolved.

To those who are prepared to follow up this work, Botswana has much to offer in return. The blistering heat of October days in the Kalahari gives way to sunsets of surpassing beauty and evenings that are cool and fragrant and which are as welcome as the first rays of the sun on a morning in mid-year when pre-dawn temperatures fall far below freezing-point. As a recompense for the tsetse flies and the mosquitoes, the Okavango delta offers in return a great spectrum of wildlife, including bird-life of great variety and abundance, against a background of scenery that is unique in southern Africa. The dead silence of the brilliant starlit nights is broken only by the call of wild creatures, or the mysterious rustlings and cracklings as nocturnal species move in the surrounding bush or, suddenly alerted, scurry away from the unaccustomed presence of man, a presence which seems an anomaly in their unspoiled wilderness.

REAY H. N. SMITHERS.
BOTSWANA MAMMAL SURVEY,
P.O. Box 167,
Francistown,
Botswana.

Acknowledgements

My first thanks are due to my wife Hazel for enduring the seemingly unending book-work which continued over several years and was done mostly in the evenings, and for her patience during my prolonged absences on field-work.

She was an active member of the main party during the first 18 months, keeping the journal, acting as photographer, driver of the Land Rover during the travelling and night work, assisting in the writing-up of the field-notes and in the recording of data on the material and was responsible for drawing the maps used in the paper.

I should like to express my appreciation of the encouragement given to the undertaking by the Hon. A. M. Dambe, then Minister of Mines, Commerce and Industries, and former members of his staff, Mr. P. W. Reardon and Mr. M. Hawkins, and also to Mr. A. J. Beebe, Financial Secretary.

From the commencement of the field-work in January 1964 I worked in close contact with the Game Department and, up to the time of his retirement enjoyed the most valuable assistance from the Game Officer, Mr. P. Bromfield, and members of his staff. Mr. Bromfield's knowledge of the territory and its wildlife and his ready co-operation did much to firmly establish the undertaking in its initial stages. He was responsible for seconding Mr. Reuben Nyirenda, who served up to his retirement in 1966, and later Mr. Richard Gabobolae and Mr. Olapile Leyakwa, all of whom became proficient in the technical processes involved in the survey and proved invaluable as interpreters and in their knowledge of parts of the country.

Mr. Reuben Nyirenda made some very interesting collections on his own, at times when the main party was not in the field, and both Richard Gabobolae and Olapile Leyakwa accompanied the Smithsonian teams from time to time.

Mr. M. Slogrove, now Game Ranger, Maun, took an active part in the work of the survey from the outset and maintained his interest through the whole

five years and indeed thereafter, making a most valuable contribution both in material and data.

With the reorganization of the Game Department in 1966, when it became the Department of Wildlife and National Parks, the same happy association continued with the Chief Game Warden, Mr. L. Tennant, and the Senior Game Warden, Mr. A. C. Campbell, to whom I owe a special debt of gratitude. Mr. A. C. Campbell provided the list of seTswana names used in the text and checked others collected by the main party or had been added by Mr. J. A. B. Hundleby, as well as being a substantial contributor both in material and visual records. Mr. J. Hornsted, Game Officer, Francistown, on which centre the survey was based, carried more than a fair share of administrative responsibility in arranging for firearms permits and the supply of ammunition and other necessities at the time of each field expedition, providing storage space for impedimenta during off periods and generally acting, not only as our agent, but in addition he and his wife were our hosts on many occasions.

Other members of Departments who contributed were Mr. R. Parris, Game Warden, Molepolole, Mr. C. P. Hepburn, Game Warden, Chobe National Park, and Dr. M. Bachmann of the Veterinary Department.

Mr. C. G. Coetzee, Director of the State Museum, Windhoek, and Mr. J. le Riche, Warden, Kalahari Gemsbok National Park, provided a list of visual records of the mammals seen in the park.

The survey could not have operated adequately without the co-operation and assistance of a number of Botswana Government Departments including Immigration, Tsetse Control, Geological Survey, Police and Veterinary, all of whom were called upon from time to time to straighten out our problems or to provide information. We are obliged to the Tribal Authorities for permission to work in the areas under their jurisdiction and to the Witwatersrand Native Labour Organization for supplies of fuel for the vehicles in outlying parts of the country and for hospitality at Shakawe.

The main party, on numerous occasions, enjoyed hospitality from District Commissioners and members of other Government Departments which was a most welcome break from the routine of field-work.

Dr. Graham Child who was seconded by the Trustees of the National Museums of Rhodesia to F.A.O. for a survey of the Chobe National Park and who later became Wildlife Ecologist to the Government of Botswana produced a most valuable collection from the park and, on his move to Gaborone, continued to be a prolific contributor both of material and data, from a wider field. Dr. Child was instrumental in circulating a questionnaire which produced a great deal of useful information.

During the operation of the survey a number of overseas workers visited Botswana on various short-term research projects and provided information from their field-notes or advance information from their papers in preparation. These included Prof. D. E. Birkenholz, Dr. R. Estes, Dr. Richard Lee, Prof. William Elder, Mr. Wolfgang von Richter, Dr. H. Robbel, Dr. D. M. Swarthout. A party from the Denver Museum of Natural History, under Dr. A. M. Bailey and Dr. R. E. Coy, spent several months in Ngamiland in 1969 collecting display material and were good enough to furnish me with copies of their data.

The survey owes a particular debt of gratitude to the Smithsonian Institution, Washington, D.C., and the associated organization in the Republic of South Africa, the Mammal Research Unit, University of Pretoria. Dr. H. W. Setzer, Assistant Curator of Mammals, United States National Museum, in charge of the field operations, seconded fully-equipped teams who operated under the administration of Dr. J. Meester. These teams, staffed in the first place by American graduates and later by personnel recruited in southern Africa, were in operation on and off over a three-year period. Without this help far less would have been accomplished. Those involved included the American graduates, Messrs. A. Risser, H. J. Herbert, A. Hardy, R. M. Davis and A. Moore, and the following recruited in the Republic of South Africa, Messrs. R. D. Heppelwhite, S. W. Goussard, A. W. Lamprechts, and T. N. Liversedge and S. Liversedge from Rhodesia.

Mr. T. N. Liversedge remained longest in operation, from November 1965 to December 1968, and made an outstanding contribution of over 4 000 specimens from a wide range of localities and continued to contribute after joining the Botswana Department of Wildlife and National Parks.

The Smithsonian Institution was good enough to allow me the opportunity of examining all their material en route to the United States and a system of exchange was arranged to the mutual advantage of the two organizations.

Mr. P. Smith, Mr. P. Brown, Dr. P. Graham, Mr. R. Wallace and Mr. P. Atkinson of the Tsetse Control Department and many private individuals contributed information of various sorts, including Mr. H. Selby, Mr. A. Challis, Mr. B. Muche, Messrs. Ian and Alan

Henderson, Mr. J. Lawrence, Mr. C. Jennings, the late Mr. 'Bobbie' Wilmot and Mr. Gordon Mackenzie, formerly Queen's Commissioner in the territory, Mr. D. T. Rowe Rowe, of Natal National Parks, Mr. N. Zaloumy and Dr. J. Condy, who provided a list of material he collected in Ngamiland identified by and now deposited in the Smithsonian Institution, Washington, D.C.

A number of past or present members of the professional and technical staffs of the National Museums of Rhodesia accompanied the main party on one or more field excursions, including Mr. G. L. Guy, Mr. M. P. Stuart Irwin, Dr. D. G. Broadley, Mr. M. A. Raath, Mr. V. J. Wilson, Mr. C. D. Simpson, Mr. T. W. Coffin Grey, Mr. K. W. Oake and Mr. R. E. Pletts. Mr. C. Wright and Mr. R. Chadwick each joined in their private capacity for a single expedition.

Valuable collections were presented to the survey by Dr. P. Lent of the University of Botswana, Lesotho and Swaziland; Prof. D. E. Birkenholz of the State University of Illinois; the Peterhouse School Natural History Society under Mr. P. Ginn, who have been engaged, most profitably, for some years on a survey of the Makgadikgadi and its environs; the Falcon College Natural History Society under Mr. J. Stakesby Lewis who, in the course of the survey of the Drotsky Caves, contributed an outstanding series of Chiroptera; and the Rhodesian Schools Exploration Society.

We are indebted to a number of authorities for the identification and checking of specimens or of items from stomach contents including Dr. D. L. Harrison of Sevenoaks, Kent, England (Chiroptera); Dr. G. B. Corbet, British Museum (Natural History) (Macroscelididae); Dr. J. Meester, Mammal Research Unit, Pretoria (Soricidae); Dr. D. G. Broadley, Umtali Museum (Reptilia and Amphibia); Dr. D. H. S. Davis, Medical Ecology Centre, Johannesburg (Muridae); Dr. C. G. Coetzee, State Museum, Windhoek (skulls from owl pellets); Dr. W. A. Sands, Termite Research Institute, London (Isoptera); Mr. B. L. Mitchell, Department of Agriculture, Salisbury (Isoptera); Dr. R. F. Lawrence, Albany Museum, Grahamstown (Myriapoda, Scorpiones and Solifugae); Dr. E. C. G. Pinhey, National Museum, Bulawayo (Insecta), and Dr. R. B. Drummond of the Division of Botany for the identification of herbarium specimens, and wild fruits and herbage from stomach contents.

We greatly appreciate the efforts of those who, confronted with the masticated remains of material from stomachs, were prepared to give up their valuable time to their identification.

Through the good offices of Dr. D. H. S. Davis of the Medical Ecology Centre, South African Institute of Medical Research, Johannesburg, access was given to all their Botswana records of Muridae, which are incorporated in this paper. These records, an accumulation of many years' work, often covered areas which the teams did not have the opportunity of visiting and were therefore the more valuable. In addition, Dr. Davis was kind enough to read through the section on the Muridae, making many useful comments and throughout the work I had frequent occasion to refer questions regarding this group of mammals to him.

Mr. W. F. H. Ansell of the Department of Game and Fisheries, Zambia, gave much helpful advice from his wide knowledge of mammals, and Mr. I. L. Rautenbach of the Transvaal Museum, Pretoria, was kind enough to compare material against types housed in that museum.

I should like to pay tribute to the African Technicians, Silver, Gatzi, Tobias, Thomas and Oliver, of the National Museums of Rhodesia, of which the first two named accompanied me on all the field expeditions. The processing of perishable material, especially during the hot summer months, demands long hours of work often from sunset far into the night and this, coupled with the arduous conditions of travel and the long distances involved, is an exhausting undertaking. All worked willingly and without complaint and the fine quality of the material is due to their efforts.

Dr. J. Meester of the Mammal Research Unit has been a constant source of inspiration and help throughout the whole undertaking and has furthermore read the manuscript and given a mass of helpful advice. I owe him a particular debt of gratitude.

It would not have been possible to undertake this survey without the financial assistance of the Government of Botswana, who provided the funds to cover the field-work. In these negotiations I should like, particularly, to thank Mr. A. J. Beebe, Financial

Secretary, for his part in negotiating for these funds and for arranging for their administration.

The costs of publication were met, in part, by the Trustees of the National Museums of Rhodesia and by a grant provided by the South African Wildlife Foundation, affiliated to the World Wildlife Fund, to whom my sincere thanks are due.

In addition, I have to thank my wife for drawing the maps, Mr. T. N. Liversedge for providing the line-drawings, and Mrs. S. Bawden, Mrs. D. N. Watson, Mrs. A. Eedes and my secretary, Mrs. R. Hanley, for typing, and in so many cases for re-typing, the manuscript.

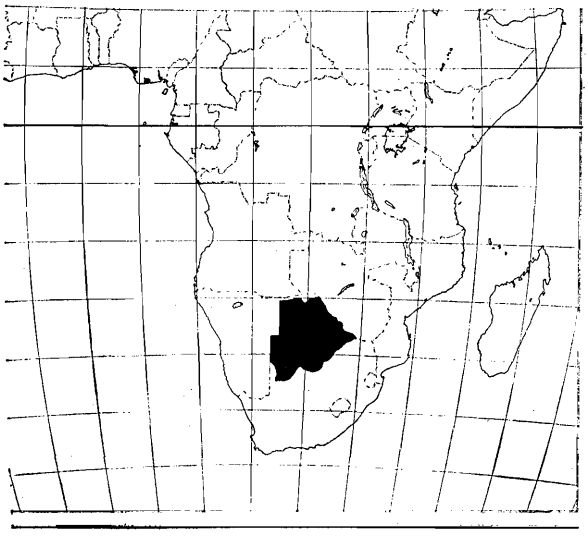
This work was submitted to the University of Pretoria for the D.Sc. degree in Zoology.

The Study Area

(Map p. 5)

Political

Botswana, which was administered for 81 years as a Protectorate (the Bechuanaland Protectorate) under the British Crown, attained independent status as a Republic on the 30th September, 1966.



Map ii

Size and Location

Some 220 000 sq. miles in area, Botswana lies between 17° and 27° S. latitude and 20° and 30° E. longitude. It is landlocked, being bordered on the north by the Caprivi Strip, in the north-east by Rhodesia, on the west by South West Africa and on the south-east and south by the Republic of South Africa. (Map ii)

General

It is a country of contrasts. The south-western parts of the Kalahari are arid, with a mean annual rainfall of less than 200 mm a year, and are devoid of surface water except for short periods after rain. The vegetational cover is sparse, with areas of ever-moving sterile red and white sand-dunes (*see* Frontispiece).

On the other hand, Ngamiland in the north has a mean annual rainfall of from 450-700 mm and is, in addition, amply provided with water from the Okavango River, the second largest river in southern Africa after the Zambezi (*see* Frontispiece).

Entering the territory at Mohembo, the Okavango River spreads out into a huge delta covering an area of 6 500 sq. miles. The rich riparian woodland and underbush along the rivers and fringing the swamp islands is in contrast to the sparse vegetation of the south-western Kalahari and includes huge evergreen trees, many of them fruit-bearing, palms, dense underbush and lush grasses.

Through the maze of swamp with its *Phragmites* and papyrus beds, its sud, aquatic grasses, islands and meandering channels, the water, entering at the height of the flood at one end, takes some five months to reach the other, a direct distance of barely 150 miles with a drop in altitude of only 160 ft. (Sepopa 3 281 ft.; Tsau 3 117 ft.).

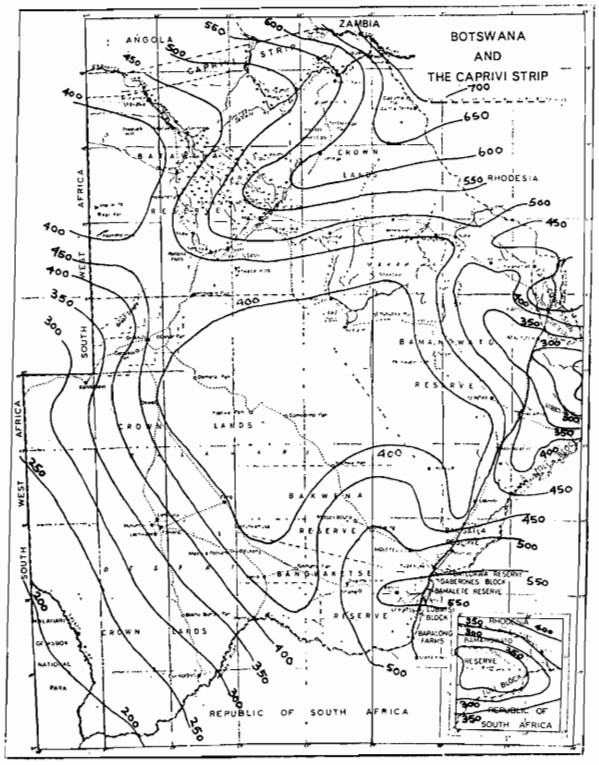
None of this water finds its way to the sea for, draining from the delta through the Matsebe, Thamalakane and Botletle rivers, it pours either into Lake Ngami or onto the open saline wastes of the Makgadikgadi Pan via Lake Dow, to seep into the ground or evaporate.

Topography

The greater part of the territory lies at an altitude of about 3 300 ft. The lowest altitudes are recorded in the extreme south-west in the vicinity of the confluence of the Nosop and Molopo rivers (2 930 ft.) and on the surface of the mud-flats of the Makgadikgadi (2 940 ft.). The highest altitudes are recorded in the northern parts of the Tati Concession (4 560

ft.); between Lobatse and Ramatlabama in the south-east, and west of this to Kanye (4 000 ft.), and on the South West African border at about 23° S. (4 000 ft.).

Most of the western, south-western, southern and the greater part of the north-eastern sectors are covered with a deep layer of Kalahari sand with few elevated features. These take the form of isolated kopjes and low hills, including Dikgomodikae in the south-east; the Khwebe and Mabeleapudi hills, just south of Lake Ngami; the Gubatsa Hills (3 150 ft.), north of the Mababe Depression; Kedia Hill near Lake Dow, and the Tsodilo Hills (4 511 ft.) in the extreme north-west.



Map iii

Rainfall

On the basis of a 40-year projection (Map iii) plotted on long- and short-term means (Botswana Weather Bureau, 1968), the driest areas lie in the extreme south-west, at 200 mm and less, the highest at the extreme north-east in the vicinity of Kasane, at over 700 mm.

From the south-west the mean rises from 200 mm to 450 mm in a belt of country running roughly north-west from Werda to Ghanzi, dropping off again eastwards, in the central and north-eastern parts of the Kalahari, to 400 mm and less.

The area immediately north of the Makgadikgadi has a rainfall of 450-500 mm and over, as opposed to the areas south of Makgadikgadi, which have a rainfall, in common with the central Kalahari, of 350-400 mm.

The distribution of some mammalian species is confined to areas with a rainfall in excess of 450 mm, as, for example, the black musk shrew, *Crocidura mariquensis*. This applies in Botswana as well as in the Republic of South Africa (Meester, 1969). The reddish-grey musk shrew, *C. cyanea*, which, in the Republic, is confined to rainfall areas in excess of 500 mm, has so far only been found in the Gaberone area (500-550 mm) and east of Kasane in Rhodesia (700 mm).

In the extreme north-west the rainfall drops to 400 mm and less, and, in the eastern extension of the Bamangwato, to as low as 250 mm.

The vegetational associations of the Kalahari, which extend eastward to near Artesia and thence through to the Transvaal border, coincide with an eastward extension of the area of low rainfall (450 mm and less) of the central and north-eastern parts of the Kalahari.

South of Artesia, the Kanye-Lobatse area enjoys a rainfall in excess of 550 mm, the highest in the eastern sector.

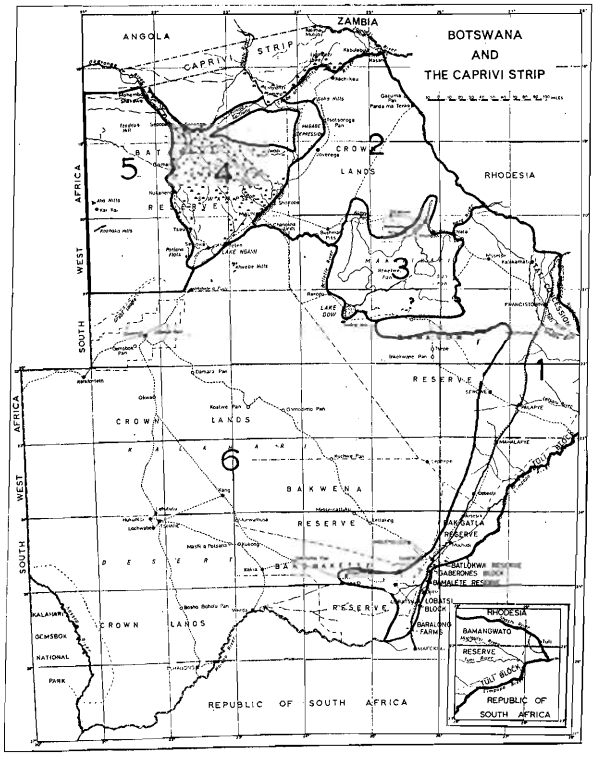
Description of Subdivisions Used

It was convenient for purposes of planning the field-work and the discussion on distribution in the text, arbitrarily to divide the study area into a series of subdivisions.

Unfortunately the new divisions of the State Lands and districts were not published (Map: Republic of Botswana 1/1 000 000 1970), until after the completion of the field-work and the preparation of the final draft of the text.

The six sectors demarcated, the Eastern; North-eastern; Makgadikgadi; Okavango delta; North-western and Kalahari (Map iv), very roughly follow the main vegetational and topographic features of the territory, although as later experience showed, not necessarily the faunistic boundaries. The Kalahari was further subdivided into three sectors, the northern, central and south-western.

These sectors can be characterized as follows:



Map iv

Eastern Sector (Map iv, 1)

The eastern sector lies west of the Rhodesian and Transvaal borders between the Nata River in the north and the Baralong Farms in the south. Bounded on the west by the eastern fringe of the Makgadikgadi, and following the watershed, which lies between 10 and 40 miles west of the railway line, southward, it includes two narrow belts of woodland and broken country extending westward. The first of these lies just south of the Makgadikgadi and, the second, west of Lobatse.

This sector includes extensive areas of broken country with rocky hills, of widely different geological types, including the Waterberg and Transvaal systems of the Lobatse district, the granites and gneisses of the Gaborone and Tati Concession areas, and the sandstones and granites of the eastern part of the Bamangwato.

This eastern sector is, in all its features, similar in character to the south-western parts of Rhodesia and the western parts of the Transvaal.

Pole Evans (1948) and Wild and Barbosa (1967) give details of the various vegetational associations which occur in this sector, some of which information is incorporated in the following description of this sector.

In the Baralong Farms, in the extreme south-east, the soil is sandy and the dominant trees, in the open parkland country, are camelthorn, *Acacia giraffae;* with other *Acacia* spp. including *A. karroo;* the wag 'n bietjie, *Zizyphus mucronata*, and *Rhus viminalis*. The country is very open with scattered shrubs, including *Grewia* spp. and a sparse covering of grasses including *Eragrostris* sp., *Schmidtia* sp., *Brachiaria* sp., and *Digitaria* sp. It is markedly different from most other parts of the eastern sector, being reminiscent of parts of the south-western Kalahari.

This area has been heavily utilized by domestic stock over a long period and is fairly heavily settled so that today, although it is suitable habitat for some of the medium and larger sized mammals, which occurred there in historical times, such as springbok, *A. marsupialis*, hartebeest, *A. buselaphus*, and gemsbok, *Oryx gazella*, they no longer occur. A feature of the landscape on crossing the border is the huge nests of the social weaverbird, *Philatarius socius*, this being the only part of the eastern sector in which they occur. This species is not found west of this area in Botswana except in the south-western Kalahari. Further indications of the close association of the Baralong Farms with the south-western Kalahari are the occurrence of such mammalian species as the lesser gerbil, *Gerbillurus paeba*, Brant's gerbil, *Tatera brantsi*, Namaqua gerbil, *Desmodillus auricularis*, long-eared desert mouse, *Malacothrix typica*, and ground squirrel, *Xerus inauris*, common in both areas.

Owing to the lack of suitable habitat in this area, as compared with most of the remainder of the eastern sector, the following species particularly associated with rocky habitat or woodland are absent: the spiny mouse, *Acomys spinosissimus*, bush squirrel, *Paraxerus cepapi*, klipspringer, *Oreotragus oreotragus*, rock dassie, *Procavia capensis*, yellow-spotted dassie, *Heterohyrax brucei*, and red rock hare, *Pronolagus crassicaudatus*.

Just to the north of the Baralong Farms in the Lobatse Block, the country changes, the central parts in particular being broken with rocky hills. The mean annual rainfall of this area is the highest found in the eastern sector, being in excess of 550 mm. A feature of the hills is its tall aloe, *Aloe marlothii*, up to 6m high, forming open stands. The hillsides are covered with a thick underbush of *Rhus* sp., *Vitex* sp. and *Z. mucronata* and a wide variety of *Acacia* spp. bushes and *Peltophorum africanum* trees.

Plate 3 *Aloe marlothii* on rocky hillside, near Kanye. **Photo:** Author

This broken country extends northwards past Gaborone, to the flatter, more open country in the Bakhatla Block, and west to Kanye, gradually tailing off in a series of isolated kopjes to Dikgomodikae, 50 miles further west. This is the last elevated feature in a distance of some 300 miles westwards to the South West African border at this latitude.

In the northern section of the Lobatse Block the country is more open and parklike, with *Acacia* spp., *P. africanum* and *Combretum* spp.

In the Gaborone area *Burkea* sp., *Terminalia* sp., *Combretum* sp., *Sclerocarya* sp., *Acacia* spp. and *Boscia albitrunca* occur in the form of an open woodland. West of Gaborone, except for the hills near Molepolole, the country flattens out, giving way to intrusions of Kalahari association in which certain mammal species associated with this type of terrain are found, including the ground squirrel, *X. inauris*, lesser gerbil, *G. paeba*, Namaqua gerbil, *D. auricularis*, and yellow mongoose, *Cynictis penicillata*. These do not occur eastwards in the more broken country.

A further conspicuous feature of this more open sandy country westwards of Gaberone is the occurrence of two bird species, the black korhaan, *Afrotis afra*, and white-tailed bush-lark, *Mirafra javanica*, which are associated with open country, being common in the Kalahari westwards and not found in other parts of the eastern sector.

It is unfortunate that the scale of the grid system used for mapping the distribution does not allow for such abrupt changes in the features of this part of the country. The impression given from the distribution maps is that these Kalahari forms are found through to the Transvaal border, which is not the case. The reason for this is the abrupt change, in a few miles, from flat open sandy terrain to rocky hills. West of Gaborone outlying hills rise out of the flat sandy country, carrying certain species associated with this type of terrain, including the rock dassie, *P. capensis*, and klipspringer, *O. oreotragus*.

The occurrence of the rock dassie, *P. capensis*, on two kopjes just west of Molepolole is interesting for,

while the species is quite capable of colonizing outlying areas of this sort far from the more continuous ranges of rocky hills (as, for example, Dikgomodikae), they were introduced to these two kopjes some 20 years ago (Jansen, *pers. comm.*) from the hills at Gaborone and have flourished there.

The southern part of the Bakhatla Block embraces the valley of the Notwani River, an area of broken country frequently mentioned in historical records as a rich big game area but today devoid of most of the species hunted by the early pioneers. This area is covered by *Acacia* woodland and scrub with scattered *Boscia* sp. trees, gnarled and heavily browsed to the height attainable by cattle and goats.

The northern part of this area levels out and is covered by a layer of Kalahari sand with camelthorn trees, *A. giraffae*, and an open scrub association of *A. detinens*, *Terminalis sericea*, *Combretum* sp., *Commiphora* sp., *Grewia* spp., and *Bauhinia* sp.; and characteristic Kalahari sand grasses including *Eragrostris* sp., *Aristida* sp., *Schmidtia* sp., and *Digitaria* sp. This type of country continues northward to north of Debeeti into the southern parts of the Bamangwato Reserve and through to the Transvaal border. As a consequence birds and mammals associated with the Kalahari, including the black korhaan, *A. afra*, ground squirrel, *X. inauris*, Namaqua gerbil, *D. auricularis*, and lesser gerbil, *G. paeba*, have a distribution through to the Transvaal border in this sector. This corridor of Kalahari sand divides the rocky country of the eastern sector into two parts, with a consequent break in the distribution of mammal species associated with broken rocky country, such as klipspringer, *O. oreotragus*, rock hare, *P. crassicaudatus*, two dassies, *P. capensis* and *H. brucei*, rock elephant shrew, *Elephantulus myurus* and spiny mouse, *A. spinosissimus*.

From south of Mahalapye to near Palapye a feature of the vegetation is the number of large knobbythorn trees, *Acacia nigrescens*.

Near Palapye, at a point 100 miles south of Francistown, on the main road, the southern limit of mopane, *Colophospermum mopane*, is found, although southwest of the main road there are a few isolated belts between Palapye and 20° S. From this area northwards this association, either in its woodland or scrub form, is a common feature of the vegetation, often forming pure stands over wide areas.

The Tati Concession and the eastern parts of the Bamangwato consist of broken country with hills and kopjes, either granite or gneiss (Plate 4).

The granite kopjes carry a rich vegetation including the following trees: *Pterocarpus angolensis*, *Albizia harveyi*, *Burkea africana*, *Kirkia acuminata*, *Ochna pulchra*, *Bolusanthus* sp., *Combretum* spp., *Sterculia acuminata* and *Commiphora* sp. and, in the valleys, there is a scrub association of *Acacia* spp. with some large trees including *Lonchocarpus capassa*.

Further important features of the northern part of this sector are intrusions of the Kalahari, which lie like fingers towards, but not crossing, the line of rail. Such an intrusion extends to some 45 miles southwest of Francistown and another to near Foley. Along these intrusions are found typical Kalahari mammal species such as the ground squirrel, *X. inauris*, suricate, *Suricate suricatta*, springbok, *A. marsupialis* and hartebeest, *A. buselaphus*.

The broken country tails off in the extreme northwest to flatter country towards the Makgadikgadi, with extensive areas of mopane which reach close to its south-eastern shoreline, to the near exclusion of the wide grassland fringe which is otherwise such a feature of it.

The narrow band of woodland and broken country extending in a westerly direction just south of the Makgadikgadi towards, but not reaching, Lake Dow provides suitable habitat for woodland species such as the bush squirrel, *P. cepapi*, which occur far westward into what is otherwise unsuitable habitat. At the same time this excludes other species associated with the more open country to the south and west, such as the ground squirrel, *X. inauris*, and springbok, *A. marsupialis*, from immediate access northwards to the open grasslands surrounding the Makgadikgadi. Access is, however, available to them by way of the south-western corner, over the avenue of open grasslands surrounding Lake Dow and the grasslands in the Rakops area, which merge with those surrounding the Makgadikgadi.

There is an extension of the woodlands of the eastern sector north of the Makgadikgadi Pan westwards to near Odiakwe. This is a barrier to some species associated with the Kalahari and the grasslands of the Makgadikgadi, as its southern boundary marks the northernmost limits of their distribution. This westward woodland extension is dealt with as part of the north-eastern sector.

The springbok, *A. marsupialis*, was, until recent years, common on the grasslands at the north-eastern end of the Makgadikgadi, but has never been recorded in Rhodesia, in spite of the fact that there is suitable habitat in the south-western corner of the Wankie National Park, some 20 miles east. This woodland barrier is sufficiently well developed to bar its progress, although it is not a barrier to the hartebeest,

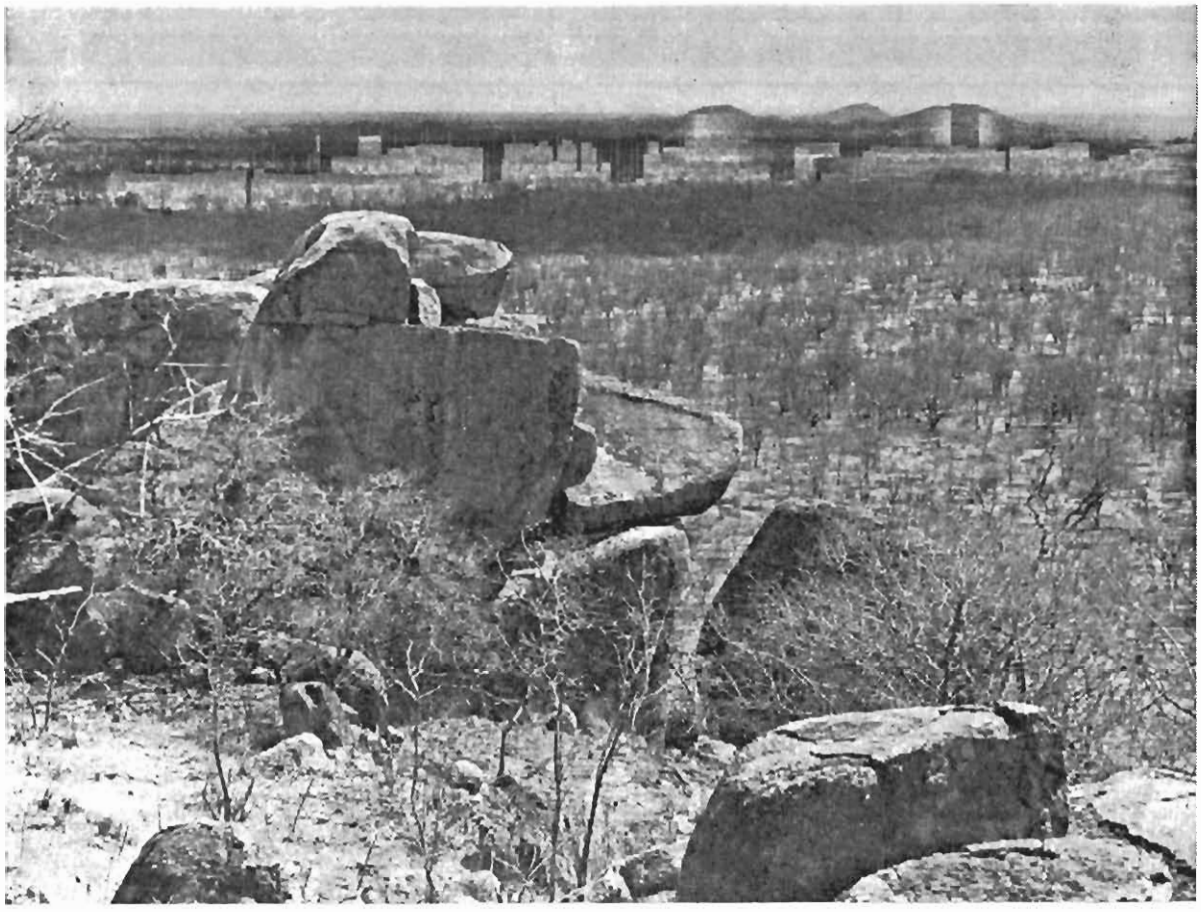


Plate 4 Wolfs Hill, a granite kopje in the Tati Concession. Dry season, 1965. **Photo:** Author

A. buselaphus, which has from time to time been recorded in this section of the Wankie National Park.

North-eastern Sector (Map iv, 2)

This sector extends from the Nata River northwards to Kasane and westwards along the Chobe River to the border of Ngamiland, southwards on the eastern fringes of the Mababe Depression and Okavango delta to the Botletle River and eastwards across the northern fringes of the Makgadikgadi.

For some distance north of the Nata River along the Rhodesian border, mopane woodland dominates, but, at about 40 miles north, it gives way to *T. sericea* woodland and scrub. A feature of this border is that parallel ridges of Kalahari sand run roughly south-west to north-east carrying *Baikiaea plurijuga* woodland, with *T. sericea* scrub and some mopane in the valleys and, in parts, open grassed vleis. On the Kalahari sand just south of the Chobe River there is an extensive area of *Baikiaea* woodland, extending from the Rhodesian border westwards nearly to Kachikau and southwards for about 40 miles along the border. Towards the Chobe River this gives way abruptly to an alluvial floodplain, narrow near Kasane and widening out westwards towards Kachikau.

This *Baikiaea* woodland has, associated with it, mukwa, *Pterocarpus angolensis; Guibortia coleosperma;* mugongo, *Ricinodendron rautanenii*, and some *Brachystegia spiciformis*, with a sparse grass cover. Near Dodo Cross-roads the mugongo woodland occurs over a very large area, the edible nut being much sought after by the Masarwa people. Elephant, *Loxodonta africana*, also eat the fruits, the nuts being in evidence in their droppings, while the edible external pulp is digested.

This *Baikiaea* woodland has, in parts, been heavily exploited for the production of the valuable hardwood timber 'Rhodesian teak', and mukwa, *P. angolensis*, leaving an open woodland association of *Burkea* sp.,

Dialium sp. and *Parinaria* sp., only scattered small, or unexploitable, *B. plurijuga* trees remaining.

Just north of Gazuma Pan on the Rhodesian border there is a wide westward extension of mopane woodland into the *Baikiaea* association.

A *T. sericea* woodland association covers a large part of the central area of this sector with belts of mopane and *Acacia* spp. Westwards, mopane woodland flanks the Okavango delta, extending, in the north, as far east as Kachikau.

Both de Beer (M. S.) and Wild and Barbosa (1967) show that the vegetation of the central part of this north-eastern sector is similar to that of the northern Kalahari, yet there is a clear faunistic boundary just south of the Botletle River and across the northern parts of the Makgadikgadi Pan. At this boundary many mammalian species associated with the Kalahari to the south are found at their northernmost limits of distribution. This may be owing to the fact that the north-eastern sector enjoys a slightly heavier rainfall (mean annual rainfall 500 mm and over) than the Kalahari to the south (400 mm and less), with the consequence that the *T. sericea* association is better developed, forming a more closed association unsuitable for species that have a habitat preference for more open country. Such species as springbok, *A. marsupialis*, hartebeest, *A. buselaphus*, ground squirrel, *X. inauris*, suricate, *S. suricatta*, and Namaqua gerbil, *D. auricularis*, do not occur north of the Botletle River in the sector extending from Chanoake Drift to Kumaha. All four species, nevertheless, occur on the open grassland, in the vicinity of Rakops and Lake Dow, which leads like an avenue from the Kalahari to the grassland fringes of the Makgadikgadi. This open grassland extends northwards up the drainage lines to Nxai Pan at the western end of the Makgadikgadi, and Ramatamusa at the eastern, providing suitable habitat for springbok, *A. marsupialis*, and hartebeest, *A. buselaphus*, which occur to the furthest extent of these grasslands. The suricate, *S. suricatta*, and Namaqua gerbil, *D. auricularis*, however, have not so far been found as far as the north-eastern parts of the Makgadikgadi.

Conversely, species such as the impala, *Aepyceros melampus*, sable, *Hippotragus niger*, and bush squirrel, *P. cepapi*, reach their southern limits in this sector, in the woodland which fringes these grasslands to the north of the Makgadikgadi. Both the impala and bush squirrel, nevertheless, occur in the woodland bordering the Botletle River to the west and in the westerly extension of the woodland to the south of the Makgadikgadi.

Makgadikgadi Pan (Map iv, 3)

The Makgadikgadi includes the two parts comprising the pan, i.e. the Ntwetwe Pan and the Sua or Nata Pan, and their associated open grasslands.

The pan surface consists of a dead flat layer of fine sterile silt. Owing to its intensely saline nature, arising from the deposition of salts, carried in by the waters of the Botletle, and in particular by the Nata River, which flow through beds of rock-salt, the silt is utilized in parts by wildlife as a 'salt lick'. Springbok, *A. marsupialis*, hartebeest, *A. buselaphus*, gemsbok, *O. gazella*, eland, *Taurotragus oryx*, and wildebeest, *C. taurinus*, have all been observed far out on the sterile pan surface or at a favourite 'salt lick' on it.

The great feature of the Makgadikgadi are the huge areas of open grassland which surround it. These grasslands are narrow in the east, where the mopane association closely fringes the pan, but very extensive in the north and west where the pan breaks up into a mosaic of dry mud-flats and grassland. The principal grasses are *Aristida meridionalis; Heteropogon contortus;* the spiky *Odyssea paucinervis*, whose underground stems form an important part of the diet of the springhare, *Pedetes capensis; Cymbopogon plurinodis; Sporobolus spicatus; Cynodon dactylon*, much sought after by grazers; *Eragrostris* spp.; *Cenchrus ciliaris*, and *Digitaria setivalva*.

A feature of the western and north-western parts of the Makgadikgadi is a belt of palms, *Hyphaene ventricosa*, in parts covering extensive areas or standing as isolated groves in the open grassland (Plate 5). On higher ground within this grassland huge baobabs, *Adansonia digitata*, stand isolated or in small groves, forming landmarks in the otherwise featureless country, with *A. kirkii* and knobbythorn, *A. nigrescens* trees and an open underbush of *Grewia* spp. and other shrubs.

Near the delta of the Nata River, in old watercourses and depressions and fringing the waterways leading from Lake Dow to the pan, there are muddy pools and swampy areas with reedbeds, *Phragmites communis*, sedges and lush swamp grasses including *Eriochloa mayeriana*. These reedbeds are used as shelters by a wide range of birds and mammals.

The open grasslands carry a rich assemblage of mammalian species, many of which also occur in the open scrub of the Kalahari, including springbok, *A. marsupialis*, hartebeest, *A. buselaphus*, and gemsbok, *O. gazella*. They are widely grazed over by wildebeest, *C. taurinus*, and zebra, *E. burchelli*, and carry a rich fauna of smaller species, including the springhare, *P. capensis*, Cape hare, *Lepus capensis*, and many species

Plate 5 An isolated grove of vegetable ivory palms, *Hyphaene ventricosa*, on the open grassland near Gweta, north-western Makgadikgadi. **Photo:** Author

of rodents which attract small predators to hunt over the grasslands at night.

The Makgadikgadi is a vast sump into which the Botletle and Nata rivers drain, the former into its south-west corner, the latter into the north-east.

This whole volume of water, spreading in huge shallow sheets on the surface, eventually either seeps into the ground or evaporates.

In years when both river systems deliver abnormally large volumes of water, the whole of the Makgadikgadi becomes a single huge shallow lake. This happened during 1954 and again in 1967. Normally the two sheets of water are not large enough to join, and they lie like two independent shallow lakes near the deltas of the two rivers. Under wind pressure, these shallow areas of water are moved around the pan exposing areas of soft mud and, when they evaporate, leave a white deposit of salts.

These shallow saline waters attract large numbers of white pelicans, *Pelecanus onocrotalus;* pink-back pelicans, *P. rufescens;* greater flamingoes, *Phoenicopterus ruber*, and lesser flamingoes, *P. minor*, together with waterfowl and waders. In January 1954, there was an almost unbroken band of flamingoes on the shoreline, for a distance of over 20 miles, estimated to number hundreds of thousands (Smithers, 1964).

In spite of its saline nature, wildebeest, *C. taurinus*, and eland, *T. oryx*, have been observed drinking this water.

A series of fossil drainage lines (*see* Northern Kalahari) is still clearly demarcated, and leads from as far afield as South West Africa (Okwa and Buitsivango), Molepolole and west of Shoshong towards the south-western fringes of the Makgadikgadi, showing that it is, in effect, a sump situated at the north-eastern corner of a saucer-shaped depression of immense size.

Okavango Delta (Map iv, 4)

The Okavango River, which rises in the Angola Highlands, enters Ngamiland in the north-west at Mohembo, near the Caprivi Strip boundary, at 19°15′ S. At this point it is a single, broad river but, thereafter, it widens to six to seven miles across. The eastern

bank is low-lying, the flank of the river consisting of a series of ill-defined channels and swamp with dense papyrus, *Cyperus papyrus*, beds rising three to five metres above water-level; beds of *P. communis* reeds, bullrush, *Typha australis*, sedges and aquatic grasses. There is a steep bank on the western side of the river which carries a well-developed, although narrow, riparian woodland association with huge trees, including *L. capassa*, *A. giraffae*, *A. nigrescens*, *Albizia harveyi*, *Ficus* sp., *Diospyros mespiliformis*, and *Kigelia pinnata*.

About 40 miles south of Mohembo the delta rapidly widens to form a triangular area of some 6 500 sq. miles of waterways and swamp, interspersed with islands of slightly higher ground, many small, others large (e.g. Chief's Island, 60 miles long by about 10 miles broad) with rich riparian woodland fringes.

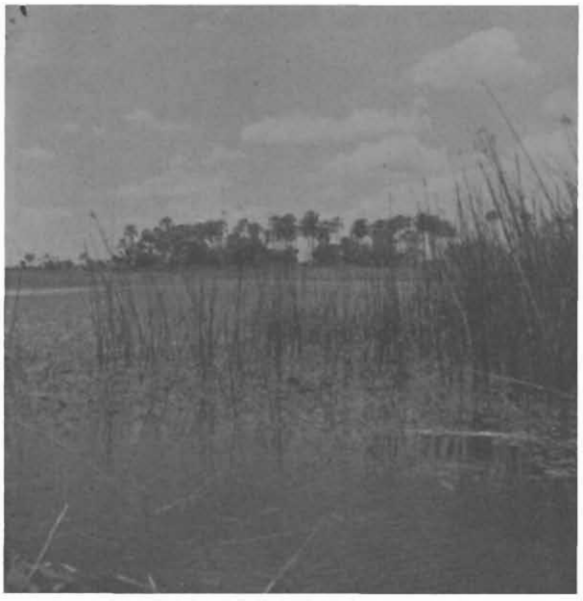


Plate 6 An island in the Okavango delta, near Shorobe, with vegetable ivory palms, *Hyphaene ventricosa*.
Photo: Author

The origin of this delta is given by du Toit (1925) as being caused by a sagging of the earth's crust over an area of some 100 miles broad by 300 miles long.

The delta is a maze of meandering channels and lagoons, with huge areas of floating sud, reed, *P. communis*, and papyrus, *C. papyrus*, beds, the latter predominating in most of the northern parts of the delta, but thinning out and being generally replaced by *P. communis* further south. In the shallower water, sedges and aquatic grasses predominate. The water is crystal clear, although appearing black in places; and fish, and hippopotamus paths on the bottom, can be clearly seen at depths of three to five metres.

When the Okavango River comes down in flood during March or April, the perennial waterways overflow, the water spreading out along the molopos and onto the flat dry ground. Large volumes of water are required to soak the dry, sandy soils and to fill these molopos and much is lost by evaporation and transpiration.

The excess pours out of the eastern and south-eastern fringes of the delta to form the Matsebe River, which flows into Lake Ngami; and the Thamalakane River, which flows south-westward along the eastern fringe of the delta and thence eastwards, via the Botletle River and Lake Dow, to the saline wastes of the Makgadikgadi, to evaporate or seep into the ground.

The variation in level of the delta area is only some 160 ft. in 150 miles and this, coupled with absorption and evaporation of the water and the obstruction caused by the mass of sud and aquatic vegetation, causes a time lag of some five months from the height of the floods at Mohembo till they reach Maun in the south-east.

As the floods recede at Maun, following their height about August, the annual rains fall. These usually commence about November, although not normally reaching their full effect until about January or February.

From near the origin of the Okavango delta the Taoghe River, an ill-defined waterway, meanders southward along the western fringe of the delta. In historical times this waterway continued south to Lake Ngami, forming the principal source of water in the lake. Andersson (1856) states that 'the Lake is fed by the Teoghe (Taoghe) at its north-west extremity'; and, in his 13-day journey by boat up this river from Lake Ngami, he records that 'only in three places was the depth less than five feet'. In those days hippopotamus abounded in the delta where the river entered the lake (Andersson, 1856). Today this delta area is open, dry grassland, which shallowly floods only in exceptional years.

Today the flow of the Taoghe River southward is interrupted north of Tsau. From this point to Lake Ngami, the old course of the river is visible in parts as a dry depression. The interruption has been ascribed to a 'sea of papyrus' growing the full width of its submerged valley (Brind Report, 1951-53, Field Survey) and covering a huge area.

Lake Ngami, south of the Okavango delta, is fed by the Matsebe River, which enters it at Toten, and,

in times of high flood, by water flowing from the Thamalakane River via the Nghabe River to the north-eastern end of the lake. The main body of the Thamalakane River water, however, forms the Botletle River which flows eastwards to Lake Dow and thence into the Makgadikgadi.

The deeper open waters in the Okavango delta are devoid of vegetation. The shallower fringing areas of permanent water carry a rich variety of water-lilies, *Nymphaeae* spp., *Ottelia* sp. and other purely aquatic plants. Papyrus, *C. papyrus*, and *P. communis* beds grow to a height of three to four metres above water-level in water one to two metres deep. Hippopotamus, *Hippopotamus amphibius*, are common in the northern parts of the delta, less common in the southern, although they are found throughout the length of the Thamalakane and along the Botletle River as far east as Kumaha.

Hippopotamus play an important role in keeping channels open and thus allowing the freer flow of the water. The reduction in their numbers which has taken place over the years may well be a factor in permitting the blockage of channels which formerly flowed.

Lechwe, *Kobus leche*, and sitatunga, *Tragelaphus spekei*, abound in the northern parts of the delta, the distribution of the latter today closely coinciding with the limits of the better-developed papyrus beds. Both species were formerly found further south in the delta and some distance eastward on the Botletle River (Andersson, 1856).

Fringing the areas of permanent water there is a mosaic of floodplain grassland and woodland. The principal grasses on the floodplain are *Cymbopogon* sp., *Panicum repens*, a highly palatable species widely used by grazers, *Andropogon* sp., *Echinochloa pyramidalis*, *Setaria* sp. and *Imperata* sp.

Plate 7 Riparian fringe of an Okavango delta island near Nokaneng with *Ficus* sp., *Phoenix reclinata* and thick underbush.
Photo: H. J. Smithers

On the rising ground, parts of which remain as islands at the time of the flood, and along the permanent waterways, there is a rich riparian woodland (Plate 7). This woodland includes huge trees, many of them fruit-bearing, among others *A. harveyi*, *Diospyros mespiliformes*, *Garcinia livingstonei*, wild figs, *Ficus* spp., vegetable ivory palms, *Hypaene ventricosa* and *Phoenix reclinata*, with climbers and a rich underbush of *Rhus* sp., *Grewia* sp., *Ximenia* sp. and other smaller trees and shrubs. This association is backed by a dry mopane, *C. mopane*, woodland, often as a pure association or with *Acacia* spp. and *Combretum* spp. This mopane woodland association surrounds the Okavango delta except in the extreme south, and extends broadly north-eastward to near Kachikau.

At times of exceptional flood, water may flow through the Makwegana or Selinda Spillway from the northern parts of the Okavango delta to the Linyanti (Chobe) River.

The Linyanti swamp has a vegetation similar to that of the northern parts of the Okavango delta, with extensive papyrus and *P. communis* beds in which lechwe, *K. leche*, and sitatunga, *T. spekei*, abound, and a surrounding floodplain. In the open waters hippopotamus, *H. amphibius*, occur; and puku, *Kobus vardoni*, are found on the dry fringes of these well-watered areas. The latter have not been recorded from the Okavango delta.

The Mababe Depression lies at the north-eastern corner of the delta and although normally dry, floods occasionally. Surrounded by mopane woodland, the grassland is dominated by *Cenchrus ciliaris* with *Chloris gayana* and areas of *Cynodon dactylon*, which is sought after by Bovid species, including wildebeest, *C. taurinus*.

North-west of this lies the Savuti swamp, which, in times of flood, is fed by water flowing through the Savuti channel, which leads from the southern part of the Linyanti.

Herds of wildebeest, *C. taurinus*, tsessebe, *Damaliscus lunatus*, and buffalo, *Syncerus caffer*, occur on the adjacent floodplain.

North-western Sector (Map iv, 5)

Bordered on the west by South West Africa, on the north by the Caprivi Strip, and on the east by the western fringe of the Okavango delta and Lake Ngami, this sector extends to the southern boundary of Ngamiland at 21° S. latitude.

The vegetation of the southern two-thirds of the area is tree and bush savanna (de Beer, M. S.) (*see* Kalahari), similar to that of the northern Kalahari. This association extends as far north as about Sepopa and 20°30′ S. on the South West African border. North of this is an intrusion of *Baikiaea* woodland with a fringe of mopane and *Acacia* spp. woodland between it and the riparian woodland of the Okavango delta.

Except along the western fringe of the delta, and in the extreme north, the area is dry without surface water except during the wet season, and has a mean annual rainfall of about 400-450 mm.

Both elephant, *L. africana*, and buffalo, *S. caffer*, utilize the dry western parts of the area during the wet season, when temporary water supplies are available, returning to the swamp as the country dries up. Just south of Nokaneng, well-established elephant paths run in a north-westerly direction from the delta.

A feature of the area is the Tsodilo Hills (4 511 ft.) which rise 1 260 ft. from flat country in the north. Both dassies and klipspringer have been stated to occur in the hills. Shortridge (1934) quotes a record by Passarge of the occurrence of the klipspringer but there is no material evidence to substantiate the occurrence of either klipspringers or dassies. West of Nokaneng near the South West African border, there are two elevated rocky features, the Aha and Koanaka Hills.

A further feature of the area is Drotsky's Caves lying to the south-east of the Koanaka Hills, a series of huge underground limestone caverns, connected by narrow passages which carry very large numbers of bats. Commerson's leafnosed bat, *Hipposideros commersoni*, which occur in huge numbers during most of the year, are interesting as they appear to vacate the caves in June. Dent's horseshoe bat, *Rhinolophus denti*, and the Egyptian slitfaced bat, *Nycteris thebaica*, are also found in lesser numbers.

West of Mohembo, and for some miles south along the South West African border, there are areas of wet vleis lying roughly east-west. These are sufficiently permanent to provide suitable habitat for the black musk shrew, *Crocidura mariquensis*, and the Angoni vlei rat, *Otomys angoniensis*. On the rising ground there are vegetable ivory palms, *H. ventricosa*, and a well developed riparian woodland and underbush.

Throughout the area there are a series of dry depressions lying roughly east-west.

Such species as the ground squirrel, *X. inauris*, particularly associated with the fringes of pans in the Kalahari, find suitable habitat in the southern part of the area and on the dry ground on the western fringe of the swamp, occurring as far north as Nokaneng. Here they were very uncommon; only one warren was located.

Several species were restricted to the extreme northern parts of this sector including Shortridge's mouse, *Praomys shortridgei*, which occurs only as far south as Sepopa, the butterfly bat, *Glauconycteris variegata*, de Winton's longeared bat, *Laephotis wintoni*, and the banana bat, *Pipistrellus nanus*.

The vervet monkey subspecies, *Cercopithecus aethiops helvescens*, with its characteristic white legs and feet was also found to be confined in its distribution to this area.

The southern part of this sector west of Lake Ngami and north to about 20°30′ S., with its huge areas of open grassland and open *T. sericea* and *Acacia* scrub, is similar to the northern parts of the Kalahari.

Kalahari (Map iv, 6)

The Kalahari, which covers two-thirds or more of the total area of Botswana, is the largest and most important sector of the territory.

It extends beyond the limits of Botswana into South West Africa and the northern central parts of the Republic of South Africa.

Within Botswana limits it is bordered on the south by the Molopo River, on the east by the western boundary of the eastern sector, in the north-east by the western extension of the woodland and scrub of the eastern sector, which runs south of the Makgadikgadi (*see* Eastern Sector), and in the north by the woodland just south of the Botletle River. It extends into the southern parts of Ngamiland, west of Lake Ngami to the South West African border at approximately 20°30′ S.

A finger of broken country intrudes into the Kalahari west of Kanye to Dikgomodikae, the last range of kopjes westwards, in otherwise flat country. The woodland here forms a mosaic with the Kalahari scrub.

The whole of the Kalahari lies at an altitude of approximately 3 000 ft. with few elevated features, and is covered with a deep layer of sand, except in the Ghanzi area, which is atypical, being characterized by quartzite and limestone outcrops with shallow soil. This atypical area extends north-eastwards in a narrow belt from the South West African border at about 20° S. to the area south of Lake Ngami.

Both de Beer (M. S.) and Wild and Barbosa (1967) divide the Kalahari (excluding the Ghanzi sector) into three main vegetational areas using slightly different nomenclature.

De Beer's nomenclature is used in the text as it is simpler and yet adequately describes the three subdivisions.

1. South-western Kalahari

Arid Shrub Savanna (de Beer, M. S.).

This area runs roughly parallel with the Nosop River in south-western Botswana to a depth of 25 miles eastwards in the north to 80 miles eastward in the south.

The vegetation of this low rainfall semi-desert area is sparse, the sand-dunes being devoid of living herbage except here and there on their fringes (*see* Frontispiece). On the ground between the dunes there is a low shrub growth of *Rhigozum* sp., *Acacia hebeclada* and *Grewia* sp. with a few scattered and stunted *Boscia albitrunca* and *Acacia* spp. trees.

The dome-like growth of *A. hebeclada*, associated in particular with the harder ground round pans in this area, affords effective shelter, on account of its thorny nature, to rodents, whose burrows are constructed within the thorny thicket, and to a number of birds particularly associated with this shelter, including the rufous-eared warbler, *Prinia pectoralis*, and black-chested prinia, *Prinia flavicans*.

The drifting sand held by these domes tends to raise them above normal ground-level.

Two mammals are restricted in their distribution to this area, viz. the shorteared elephant shrew, *Macroscelides proboscideus*, and Brant's karroo rat, *Parotomys brantsi*. The bushveld gerbil, *Tatera leucogaster*, which is otherwise widely distributed throughout the territory, does not occur in this south-western corner, and so far the following species found in other parts of the Kalahari have not been proved to occur: smallspotted genet, *Genetta genetta*, aardwolf, *Proteles cristatus*, and kudu, *Tragelaphus strepsiceros* (which, nevertheless, occurs narrowly in the northern parts of the area where there is a woodland intrusion).

Apart from these species the remainder are the same as are found in other parts of the Kalahari. Springbok, *A. marsupialis*, hartebeest, *A. buselaphus*, gembsbok, *O. gazella*, eland, *T. oryx*, wildebeest, *C. taurinus*, and steenbok, *Raphicerus campestris*, are common, springbok, hartebeest and eland occurring in large numbers. These heavy game populations are accompanied by similarly high numbers of predators including lion, *Panthera leo*, leopard, *P. pardus*, cheetah, *Acinonyx jubatus*, spotted hyaena, *Crocuta crocuta*, brown hyaena, *Hyaena brunnea*, and wild dog, *Lycaon pictus*. These predators, which drink water regularly in other parts of the territory, have to obtain their water requirements from their prey in

these dry areas as there is no surface water to be found except for short periods after rain. All the prey species listed above are independent of water, obtaining their requirements from succulent vegetation, by digging for bulbs and roots, or by eating tsamma melons, *Citrellus lanatus*, and cucurbits which grow in profusion in the sandy areas (Plate 8). The wildebeest which are dependent on water supplies in other areas, apparently, are versatile enough to adapt themselves to these arid conditions by obtaining their moisture requirements in a similar manner.

2. Southern and Central Kalahari

This comprises the:

Southern Kalahari bush savanna (de Beer, M. S.).

Central Kalahari bush savanna (de Beer, M. S.).

Both de Beer (M. S.) and Wild and Barbosa (1967) subdivide the southern and central parts of the Kalahari on the basis of the absence, in the southern sector, of *Lonchocarpus nelsii* and certain grasses, including *Cenchrus ciliaris*, *Digitaria eriantha* and *Aristida meridionalis*. In most other respects they are indistinguishable, with so many general characters in common, including the mammal species utilizing them, that for the purposes of this paper they are considered as a unit.

This area is covered in deep sand with a very open association of camelthorn, *A. giraffae*, *Acacia* spp. and *Boscia albitrunca* trees and *T. sericea*, *Grewia* spp., *Bauhinia macrantha*, and *Ochna* sp. shrub. The trees are often in small groups, in parts widely scattered, and often solitary, and widely separated. The shrub is open and takes the form of solitary bushes or small isolated clumps. The grass cover is usually sparse and includes *Eragrostris pallens*, *E. lehmanniana*, *Schmidtia kalahariensis*, and *Anthephora* sp. There is a great deal of bare ground between the grass tufts.

Wild and Barbosa (1967) include the Baralong Farms with their southern Kalahari dry tree and

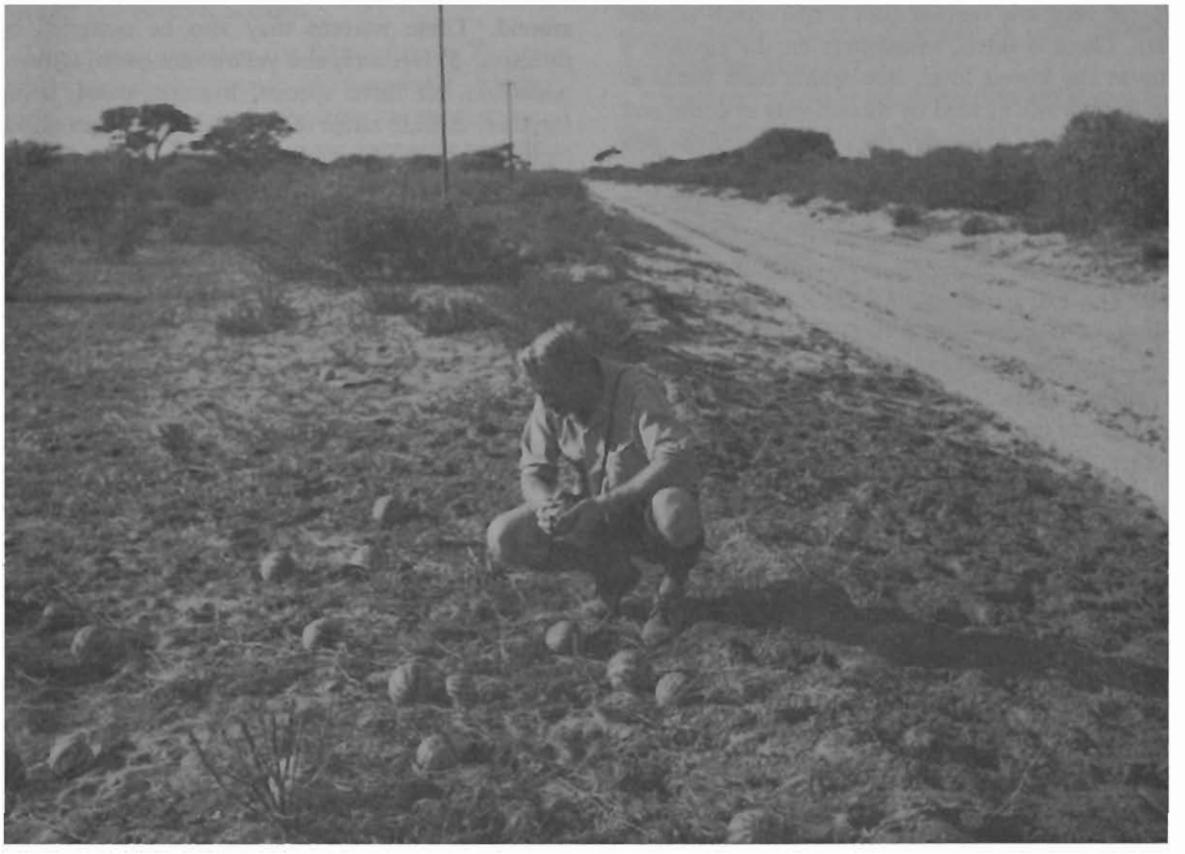


Plate 8 Tsamma melons, *Citrellus lanatus*, near Artesia. **Photo:** Author

shrub savanna; de Beer (M. S.) deals with them as a separate entity.

In this paper the Baralong Farms are, for convenience sake, dealt with as part of the Eastern Sector, in spite of the fact that their affinities lie more with the south and south-western Kalahari.

The belt of woodland and kopjes lying west of Kanye, extending to Dikgomodikae, is also included in the Eastern Sector.

The central and southern Kalahari bush savanna lies south of about 22°10′ S., east to about 24°30′ E. and south-west to near Molepolole and is bordered on the south by the Molopo River.

A feature of the area is the great number of pans which characterize it.

The pans vary in size, some being several miles across (Tshane), and have either a flat white dry mud surface, a sparse grass cover (Moshi a potsana), or a cover of very low karroid (salt bush) shrub (Lohohane). There is often, somewhere on the surface, a sump at the lowest level, into which such water as may occasionally be held by them, tends to drain, and where it remains long after the remainder of the pan is dry. Through trampling and wallowing by animals mud is carried away so that these sumps are lowered in this manner far below the general level of the pan surface, becoming in some cases considerable excavations. The extra moisture available at these sumps supports a slightly richer cover of grasses, shrub *Acacia* spp., and *Grewia* spp. than on other parts of the pan, and characteristically a solitary wag 'n bietjie, *Z. mucronata* tree or sometimes a few growing closely together.

In the southern and south-western Kalahari the fourstriped mouse, *Rhabdomys pumilio*, was commonly found in the vegetation round these sumps, while not occurring in the surrounding areas. The wag 'n bietjie trees provide shelter for a number of mammals during the heat of the day, the following were flushed from them: lion, leopard, spotted hyaena, bateared fox, and blackbacked jackal.

Kalahari pans are an important part of the habitat for many species occurring generally in the area.

The larger species of Bovids tend to congregate in their vicinity and they also provide suitable habitat for many smaller species, some of which are much commoner in their vicinity than in the sandy tree and bush savannah surrounding them. Of the larger Bovid species, particularly springbok, hartebeest, and gemsbok, are very commonly found on the grassy fringes, or making use of a 'salt lick' on their surfaces. Spring hares dig their burrows on the raised sandy fringes of the pans, or in the grassland itself, feeding on the grassland at night.

Cape hares, *Lepus capensis*, find suitable habitat in the grassland, lying up during the day in forms under small shrubs or at the base of grass tufts, while the scrub hare, *Lepus saxatilis*, occurs in the scrub bush around the pans, often being found at night feeding on the grassland alongside the Cape hare.

Ground squirrels, *X. inauris*, excavate their warrens in this grassland, having a preference for areas of harder ground, and where the underlying calcrete is broken up and close to the surface, forming stony ground. These warrens may also be occupied by suricates, *S. suricatta*, and yellow mongoose, *Cynictis penicillata*, all three species, in some cases, living together. A wide range of rodents use this grassland, including bushveld gerbil, *T. leucogaster*, Brant's gerbil, *T. brantsi*, Namaqua gerbil, *D. auricularis*, lesser gerbil, *Gerbillurus paeba*, and the pouched mouse, *Saccostomus campestris*, although none of these are specifically restricted to this niche, as they also occur in the sandy country around the pans.

The food available at night on this grassland which, as well as small mammals, includes insects, scorpions, hunting spiders, etc., and ground birds, including larks and sparrow larks, Alaudidae; coursers, Glareolidae; pipits, Motacillidae and plovers, Charidiidae, attract a number of small predators, including bateared foxes, *Otocyon megalotis*, blackbacked jackals, *Canis mesomelas*, and smaller Felids, all of which are commonly seen there after dark.

In some cases these pans have calcrete krantzes on their fringes, whose weathered sides are indented with holes and crannies used by barn owls, *Tyto alba;* striped polecats, *Ictonyx striatus*, and some rodents, including the Namaqua rock rat, *Aethomys namaquensis*, whose nests are constructed of piles of dry grass pulled into the crevices.

3. Northern Kalahari

Northern Kalahari Tree and Bush Savanna (de Beer, M. S.) (Plate 9).

This sector covers the remainder of the Kalahari west of the bounderies of the Eastern Sector. It is bordered in the north-east by the belt of woodland south of the Makgadikgadi, in the central sector by the woodland south of the Botletle River, and, in the west, extends into the southern part of Ngamiland to about 20°30′ S. latitude on the South West African border. The Ghanzi Farms are excluded as they are atypical.

The vegetational association of this sector extends across the Botletle River and covers the main portion of the North-eastern Sector to about 19° S. but here, takes on a slightly different form from that found south of the Makgadikgadi (*see* North-eastern Sector).

In the east this association continues through to the Transvaal border between about Mochudi and Debeeti (*see* Eastern Sector).

The association takes the form of open *T. sericea* scrub, on sandy ground, in favourable scattered localities, the *T. sericea* growing to medium-sized trees up to 10 ft. high but always forming a very open association. Camelthorn, *A. giraffae*, is less in evidence, the trees generally smaller than they are in the south-west, except in favourable localities. Other scrub trees occurring include *Burkea africana*, *Peltophorum africanum*, *Boscia albitrunca*, *Croton* sp., *Rhus* sp., *Combretum* sp., *Z. mucronata*, with the following shrubs *Croton* sp., *Grewia flava*, *Grewia* spp., *A. detinens*, and other species of *Acacia*, *Bauhinia* sp. and *Commiphora* sp.

There is much open grassland, often with scattered solitary trees and bushes and a great deal of bare sandy ground.

The open pans, characteristic of the remainder of the Kalahari, are few and far between and never so well developed, usually having a grassed surface (Mashoro Pan), although there are exceptions to this, as for example the pan at Lephepe, which is, however, small and insignificant compared with most of these in the south.

A feature of the northern part of the Kalahari is a series of dry depressions or fossil drainage lines most of which lie roughly west to east. The Okwa runs from the South West African border at *c.* 22°25′ S. east to *c.* 24° E., then north-east in the direction of Lake Dow. This is joined at about 24° E. by a further depression running from south to north. The Buitsivango (Hanahai) depression enters Botswana about 22° S., 21° E. on the South West African border to run south-eastwards joining the Okwa. North of the Okwa, the Deception Depression, rising in the Ghanzi Farms, leads east, again to about 24° E., then north-east towards Rakops on the Botletle River. Passarge, north of Deception, is well demarcated between 23° E. and 24° E., disappearing near the junction of the Kuki-Makalamabedi fence.

A further depression lies parallel and immediately east of the eastern boundary of the Central Kalahari Game Reserve in the direction of Lake Dow but disappearing about 22° S.

These depressions carry better developed woodland than the surrounding country. In the case of the Okwa Depression this woodland forms a belt along it, to a depth, in places, of up to 12 miles (Campbell, *pers. comm.*). At the western end of Deception (Van Zyl's Cutting) there are huge camelthorn *A. giraffae* and leadwood, *Combretum imberbe*, trees, which Roberts (1935) compares favourably with 'the scrawny trees of the central Kalahari'. The Buitsivango (Hanahai) and Passarge Depressions carry similar belts of woodland.

Roberts (1935) reports seeing a night ape, *Galago senegalensis*, at Damara Pan and a specimen was collected in the Hanahai not far from Damara Pan. These records are isolated, being far from their nearest limits of distribution, and point to the desirability of further investigation of those depressions in which this and other woodland species may eventually be shown to occur.

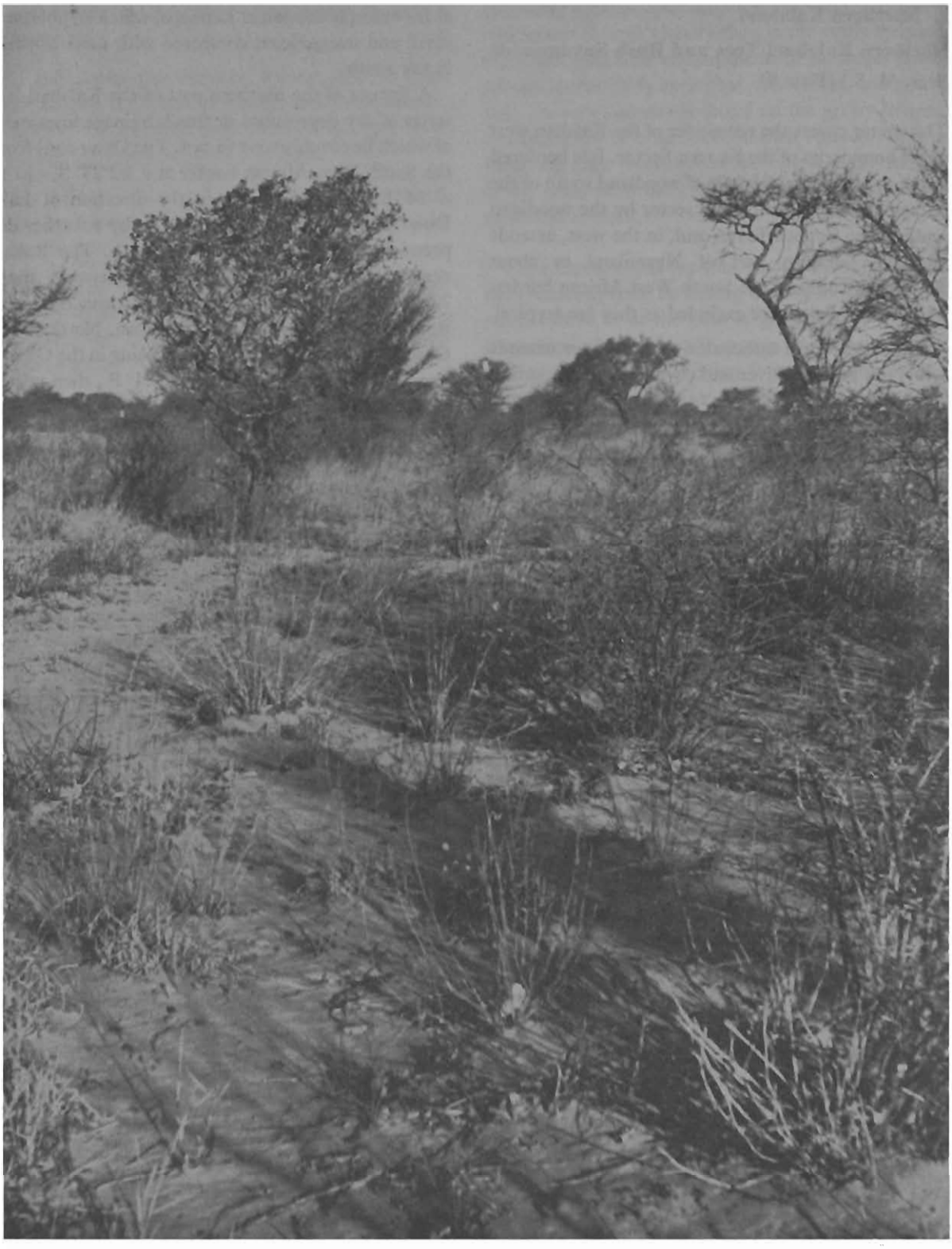


Plate 9 Northern Kalahari tree and bush savannah, 41 miles north-west of Lephepe. **Photo:** Author

Gazetteer

At the time of preparation of this paper a Commission had under consideration the renaming and spelling of place names. Certain recommendations had already been made prior to the work going to press, not all of which had been accepted. In addition to this the new 1/1 000 000 map was published (Republic of Botswana 1970) which uses many new spellings of place names.

In view of the fact that the manuscript had already been typed and the distribution maps drawn up, it was decided to continue with the old spellings in the text and on the maps, but to provide in this Gazetteer the new spelling of the place name in brackets after the old.

In the text there are three exceptions to this general rule, the new spellings being used throughout:

Old Spelling	*New Spelling*
Gaberones	Gaborone
Lobatsi	Lobatse
Makarikari	Makgadikgadi

Further changes have been made in the names of the areas, some of which are referred to as Reserves in the text and on the distribution maps. These names and their new equivalents are as follows:

Reserve	to	*District*
Bamangwato		Central
Bakwena		Kweneng
Bangwaketse		Ngwaketse
Bakgatla		Kgatleng
Batawana		Ngamiland
and		
Tati Concession		North-east
Lobatse Block		South-east
Crown Lands		State Lands

Aha Hills 19 21 C3
Artesia (Mosomane) 24 26 A2
Baralong Farms (Barolong) .. *c.* 25 25 C2
Bokspits 26 20 D3
Bosho Boholu (Bosobogolo Pan) 25 22 A3
Botletle River .. .. *c.* 20 24 A4
Bushman Pits 20 24 A2
Cade Pan (Xade) 22 23 C1
Camp 3 (Central Kalahari Game Reserve) 22 23 A4
Chanoake (Tshanoga) 20 23 B1
Chitabe 19 23 D1
Chobe River .. .. *c.* 17 24 D4
Chukutsa Pan (Tsokotse) 21 25 A3
Damara Pan 22 22 A2
Dekar Pan 21 21 D2
Debeeti (Dibete).. .. .. .. 23 26 C2
Dikgomodikae (Kgomodikae) .. 24 24 D3
Ditsinane 21 25 B4
Dodo Cross-roads (Dudu) .. 18 25 B4
Dow, Lake (Xau) .. .. .. *c.* 21 24 B1 & B3
Drodsky Caves 20 21 A2
Dukwe Gate 20 26 D1
Dutlwe (Dutlhe).. .. .. .. 23 23 D4
Foley 21 27 C2
Gaberones (Gaborone) 24 25 D2
Gazuma Pan (Kazuma) .. .. *c.* 18 25 A4 & B3
Gemsbok Pan 21 21 D1
Goha Hills (Geoha) 18 24 A3
Ghanzi.. .. .. 21 21 D2
Gobatsa Hills (Gubatsa) 18 24 C1
Gomare 19 22 A3
Gomodimo Pan 22 23 D1
Groot Laagte .. .. *c.* 21 21 B1
Gutsa Pan 20 25 A4
Gweta 20 25 A1
Hukuntsi 24 21 B2
Hunters Pan 19 25 B2
Jhari Pan (Uare).. .. .. .. 19 26 C1
Joverega (Geoverega).. .. .. 19 24 A1
Kabulabula (Kabolebole) 17 24 D4
Kachikau 18 24 A2
Kaikai (Khaekhae) 19 21 C3
Kakia (Khakhea) .. .. .. 24 23 C2 & 4
Kalakamati 20 27 C2
Kalkfontein 22 20 B2
Kang 23 22 D2
Kanye 24 25 C4
Kanyu 20 24 B2
Kasane.. .. .. 17 25 C3
Kedia Hill 21 24 B3
Kgwebe Hills 20 23 C1
Khuis 26 21 D2
Khutswe 23 24 A4
Khwebe Hills (Kgwebe) 20 23 C1
Koanaka Hills .. .. 20 21 A1 & 2
Kokong 24 23 A3
Kolongwaneng 26 21 D2
Kuki Gate (Kuke) 20 22 C4
Kumaga (Khumaga) 20 24 B3
Kutswe Pan.. .. .. 24 24 A3

Tshephe	21 25 D4
Tshwane	22 21 B4
Tsodilo Hills	*c.* 18 21 D1
Tsotsoroga	18 24 C2
Tubu Island	19 22 A4
Tuli Block	*c.* 23 27 B1
Tweerivieren (Two Rivers)	26 20 B3
Twetwe	21 27 D3
Vloorskop	25 20 D4
Werda	25 23 A3
Xade Pan	22 23 A3
Xultsa Pan	21 24 A1
Zelu Hill	21 28 D4
Zweizwe Pan	18 24 C2

TULI BLOCK FARMS

Basinghall (Devonshire)	23 27 A3
Charter Ranch (Part 4, 5)	22 29 A2
Gesond	22 28 B2
Glennel	22 29 A1
Helena	22 29 A1
Loensa La Moridi	22 29 A1
Martins Drift	22 27 D4
Mooimeisiesfontein	22 28 B3 & D1
Mopani	22 28 B4
Outspan	22 29 A1
Oxtonland	22 28 B3 & D1
Riverslee	23 27 C1
Rustig	22 28 B3 & D1
Sunnyside	23 27 B1
Tuli Block 8 & 9	21 28 C4
Zanzibar	22 28 B3 & D1

Methods and Techniques

Planning

As the study area was very large, it was recognized that as full a cover as might be desired could not be given in the time available.

In order to ensure that the main ecosystems would each be sampled to the fullest extent possible, the study area was divided into six sectors, one or more of which included representative samples of these ecosystems (Map iv, p. 13).

Within each of these sectors it was planned to establish a series of collecting stations, visiting each at least once in the dry and once in the wet season.

In the main this aim was achieved, although the same stations were not always used on subsequent visits where it was found, through experience, that others offered a more representative sample of the ecosystem involved.

In a territory that is largely waterless and sparsely inhabited, forethought in providing for the food and water supplies for the parties, involving two or three Europeans and five to seven African staff, was essential if they were to operate efficiently.

During an avifaunal survey (Smithers, 1964) Landrovers were found to be ideal for use both on the tracks and off them and equally useful in the present work, especially for night observation and hunting. Their capacity, however, was inadequate to carry the larger parties, together with their personal kit, equipment and sufficient fuel and water, to support them for a reasonable working period. In certain parts of the country where there was relatively hard ground, as, for example, in the eastern sector and round the Okavango in the dry season, it was possible to use a two-wheel-drive 5-ton Bedford truck. During the wet season in the Okavango, where muddy tracks were a problem, and in others where the sand was soft, it could only be used with difficulty, in conjunction with the Landrover fitted with the heavy-duty winch, which was in frequent use in pulling the heavier vehicle out of difficulties. Originally it was hoped that a four-wheel-drive 5-ton vehicle might be made available, which then could have been used anywhere, but funds for its purchase were not available. As a compromise a 1½-ton Ford four-wheel-drive truck was later provided which served the purpose well, although limited in carrying capacity compared with the 5-tonner.

When the 5-tonner was used, large ventilated collecting boxes were carried, 1·5 m long × 1 m broad × 0·7 m high, either fitted with five trays with soft fibre bottoms, on which specimens could be pinned and in which they could remain until dry, or with

trays with expanded metal bottoms in which larger skins, after salting, could be left to dry. Material handled in these containers returned in far better condition than when carried in other ways. With the use of the smaller 1½-ton Ford smaller containers had to be used.

In the Kalahari, fuel dumps had to be organized in advance of visits, the available space on the 5-tonner being used to carry water supplies.

In order to achieve the maximum coverage of the study area the Smithsonian teams and the main party were routed to areas not already being dealt with by members of the Botswana Department of Wildlife and National Parks and other associates.

From the outset it was recognized that, in order to fulfil the objects of the survey, much more information was required on the individual specimen than had generally been the practice to record in the past. Material already in Museum collections, while providing useful morphological and distributional data, lacked information on habitat, habits, food or reproduction, all of which was considered to be among the priorities in the knowledge required for the better understanding of the species.

Again, in anticipation that teams and individuals would be working independently, it was necessary to devise a system whereby they were constantly reminded of the type of information required and given a means of presenting this in a standard form.

To this end printed record forms were designed on which were set out an itemized list of the types of data which it was mandatory on participants to record (Smithers, 1967) (Fig. 1).

These forms, printed on the best quality paper, so as to withstand the rigours of use in the field, were carried in heavy-duty loose-leaf folders and at the conclusion of each stage of the field-work were filed under the name of the species. This greatly facilitated the recovery of data.

In addition a cyclostyled set of instructions was provided, elaborating on the methods to be used and the materials to be employed in processing and preparation of the specimens.

Participants used a serial numbering system, each number prefixed by his initials or a letter or letters assigned to him. The main party used the prefix BP. Each specimen collected was given a prefixed serial number, which was recorded on the appropriate section on the form, and the same prefix and number were applied to each of the parts of the specimen retained, such as the skin, skull, stomach contents, reproductive tract or other organs or the ecto- or endoparasites preserved.

In addition to the data, which have traditionally been applied to Museum material, sex, date and locality, the forms drew attention to the necessity of recording four measurements, five in the case of Chiroptera; the weight; the state of the mammae, indicating whether a female was lactating or dry; its reproductive status and if gravid, how many foetuses, whether implanted in the left or right uterine horns, and their measurements and weights.

In males the position of the testes, whether abdominal or scrotal, and their weight as a pair were recorded.

Spaces were provided for notes on the habitat in which the specimen was taken, a record of the stomach contents and a section for general notes such as the manner in which the specimen was taken, either trapped or shot, when it was taken, the type of baits used, the size of the herd from which it was taken, and any other information which might contribute to a knowledge of the species concerned.

Trapping

Trap-lines for rodents consisted of a unit of 60 'Museum Special' breakback traps, this being a convenient number to carry in one of the standard canvas carrying-bags. Normally 120 traps were set by each operator although, in exceptional cases, where the operator was not engaged in other duties at the time, up to 300 traps. These bags were equipped with a smaller canvas bag for the markers and another for the bait. Markers consisted of 12×6-cm luggage labels, sprayed with a bright scarlet or orange lacquer, with a loop of medium-weight string for attachment to a convenient high point adjacent to each trap set. The lines were set roughly in a straight line or a curve leading eventually back towards camp. The distances between the individual traps varied but the aim was that the marker of the next trap could be seen from the one before. This was important as the lines were visited after dark.

Where rodent activity was obvious, several traps were set close to each other, but otherwise they were laid without regard for this, usually under the cover of a bush or tuft of grass but often completely in the open. In woodland associations special groups of traps were set on the thicker branches or trunks of trees, or attached to the trunk itself with a nail through a hole bored in one end. These were useful for arboreal species such as *Thallomys paedulcus* and *Graphiurus murinus*, although not as effective as shooting with a ·22 or a ·410 and just after dark when the rodents were picked up in a dazzling light as they moved in the trees.

A wide variety of baits were used including peanuts,

bread, pastes of rolled oats, mealie-meal and oatmeal with peanut butter, fish oil, or the liquid from tinned meats and vegetables. One of the best all-round bait was rolled oats made into a paste with 'Purity' baby food, marrowfat and peas. Paste baits, while convenient to use and quick to apply, were particularly susceptible to being carried off by ants and, where these were troublesome, peanuts or vegetable marrow-pips were used as they remained longer on the trigger. In areas where there were likely to be shrews, *Crocidura* sp., or where they appeared in the traps, some traps were set baited with rodent meat.

'Museum Special' traps are on the light side for species such as *Otomys angoniensis* or *Dasymys incomtus* and in areas where they were present No. 4 breakbacks were also employed, one side of the spring being unhooked so as to soften up the blow and so avoid damage to the specimen.

Trap losses can be high through small predators, attracted by the catch, carrying this off along with the trap. Vervet monkeys and baboons were also troublesome in some areas and herds of wildebeest and buffalo also caused high trap losses through walking on them. Cattle seemed to be attracted by the markers and frequently chewed them off the bushes.

In the early stages steel gin-traps were used for small predators but soon discarded as they damaged the specimens and caused hardship. Single-gated, folding, live traps of sizes 25 × 20 × 80 cm and 23 × 23 × 66 cm were substituted and proved effective and useful for small predators such as the slender mongoose and genets. These were normally baited with doves or the carcasses of small mammals such as rodents, hares, squirrels, or the intestines of larger species.

Their efficacy was greatly enhanced if the body of the trap was hidden under cover or disguised by covering it with handfuls of grass or twigs, the gate only left free. It was also important to ensure, by means of piles of twigs, that access was not available to the end of the trap in which the bait was lying, thus forcing access to it via the open gate.

Mole rats were taken with 'Macabee' traps. Locating a line of heaps a fresh 'throw' was chosen where the subsoil pushed up by the animal still showed the form of the hole. A hole was dug at the site of the heap about 45 cm square to such a depth that the two holes leading to the heap were revealed. A pair of 'Macabees' joined together with a fine wire were set, one in each hole. Sometimes catches were made with this method within a few minutes although, occasionally, a much longer time elapsed before the mole rat came to investigate the disturbance caused by the opening. It became the practice to carry a few pairs of 'Macabees' in the cab of the vehicle and, by arranging to stop where 'heaps' were in evidence, to secure specimens during tea and lunch stops.

Various types of home-made live traps were also employed for Murids which were useful in securing live specimens for study.

Night-hunting

The great majority of the predators collected, and indeed specimens of many other species as well, were taken with the aid of dazzling lights at night.

The Landrover was equipped with a high-power spotlight on a lead long enough to allow of its use from the top of the cab. Two operators were settled on the top, one with the spotlight, the other with a 12-bore shotgun and a headlamp. Specimens located by the reflection from the eyes were taken, either directly from the cab, while held in the beam of the spotlight or, if out of range, the hunter would climb off the vehicle and follow up with the headlight, the spotlight and cab lights in the vehicle being temporarily shut off to avoid his movement being observed against a lighted background.

The headlamps were also used for excursions from camp on foot.

These methods proved quick, efficient, selective and humane for collection specimens and at the same time gave a quick means of visually recording nocturnal and other species occurring in an area, many of which are otherwise extremely difficult to locate.

For night-hunting a double-barrelled or repeating, well-choked, 12-bore shotgun was used with No. 6 (British) shot or AAA for heavier species. Light rifles (·222) with telescopic sights were used effectively by some operators but, in general, the shotgun was found to be the best all-round weapon and is certainly safer at night when dealing with species up to the size of a leopard.

Baits in the form of the carcasses of large species were used on occasion but a more effective manner of attracting predatory species over a broader area, was the dragging of baits late in the afternoon or on the outward journey during night observation or hunting. Intestines were frequently employed for this purpose and proved very effective.

The Record Forms

The data appertaining to each specimen collected was recorded on a form 22 × 14 cm on which were printed

a series of headings against which the appropriate data were entered (fig. i).

MAMMALS

SPECIES *Proteles cristatus*
SEX ♀
DATE 22 Jul. 1964 ALTITUDE .....
LOCALITY Nxai Pan
GRID REF or BEARING 1924 D4
COLLECTOR R.S. mithers COLL. No. BP 342
MEASUREMENTS: Overall 965 mm. Tail 255 mm.
Hindfoot 160c/ mm. Ear 104 mm.
..... mm. ..... mm.
WEIGHT 21 lbs. 13 ozs., or ..... gms.
REPRODUCTIVE STATUS: MAMMAE ~~Wet~~/Dry
Number FOETUS 4
Position FOETUS 2 R. 2 L.
HABITAT Open pan - very short grass
STOMACH CONTENTS 100% Trinervitermes rhodesiensis - 2½ lls mat.
NOTES Shot 9-15 pm. at hole in pan. 54° F.
TESTES: Abdominal/Scrotal
TESTES: Weight .....
POSITION MAMMAE .....
FOETAL MEASUREMENTS: Crown/rump 35-35-34-35 mm.; Hindfoot acc. 8 mm.; Weight –

Fig. i The record form

Notes on the methods used in obtaining this data and correlating it with the specimen from which it originated are as follows:

Collector's Name and Specimen Number

The name of the collector appears on each record form, the number assigned to each specimen being prefixed by his initials, for example, TNL 1254 refers to the twelve hundred and fifty-fourth specimen collected by T. N. Liversedge. The prefix BP refers to the material collected by the main survey party. A list of prefixes with the names of their users is as follows:

A.J.H.	A. J. Hardy, Smithsonian Institution.
A.L.M.	A. L. Moore, Smithsonian Institution.
B.P.	The main survey party led by the author.
C.	Dr. G. Child, Dept. of Wildlife and National Parks, Botswana.
D.L.B.	Prof. D. L. Birkenholz, Illinois State University, U.S.A.
F.A.	Falcon College, Rhodesia.
G.	G. L. Guy, formerly National Museum, Bulawayo.
H.J.H.	H. J. Herbert, Smithsonian Institution.
H.W.S.	Dr. H. W. Setzer, Smithsonian Institution, Washington, D.C.
M.E.C.	Medical Ecology Centre, Johannesburg.
M.S.	M. Slogrove, Dept. of Wildlife and National Parks, Maun.
O.M.	R. Wallace, Tsetse Control, Maun.
P.	Peterhouse Natural History Society, Rhodesia.
R. and R.N.	Reuben Nyirenda, formerly Department of Wildlife and National Parks, Francistown.
R.M.D.	R. M. Davis, Smithsonian Institution.
R.O.	Dr. H. Robbel, F.A.O., Rome.
S.J.L.	S. J. Liversedge, Umtali.
S.W.G.	S. W. Goussard, Smithsonian Institution.
T.N.L.	T. N. Liversedge, Smithsonian Institution.

At the time of collection, or on return to camp, each specimen, or portions of the specimen, were provided with labels bearing their collector's prefix and number.

In the case of bats, rodents and other small species, 'Syntosil' labels, 25 × 13 mm, on which the collector's prefix and number were written in waterproof black ink, were attached to the skin and the skull. When dealing with medium- and large-sized species, Dymo plastic labels were used.

In all these cases a temporary label was provided for the carcass so that the specimens obtained from its examination, which included stomach contents and reproductive tracts, were properly correlated with the skin and skull.

Sex

While in the majority of species the sex can be ascertained by external examination, as a routine, this was checked at the time of dissection of the carcass for recovery of the stomach contents and reproductive tracts.

Date

The date recorded is the date on which the specimen was collected. Where skins were obtained by purchase, or gift, the Date Section on the form was left blank, the date of purchase or gift recorded under Notes.

Locality

Collecting stations or localities from which observations or material were taken are located as accurately as possible on the basis of the 1/125 000 Bechuanaland maps published by the Directorate of Overseas Surveys, London, or where sections had not yet been

published, with reference to one or more of the following.

1/1 000 000 Republic of Botswana 1970.

1/1 000 000 Federation of Rhodesia and Nyasaland; Director of Federal Surveys, Salisbury, Rhodesia, sheet 3275.

1/1 000 000 World Aeronautical Chart; Government Printer, Pretoria, 1964. 3300, 3301, 3178, 3274, 3177, 3275, 3178.

1/4 000 000 Okavango River Delta; Directorate of Colonial Surveys, London, (Misc.) 216, 1954.

1/1 250 000 Bechuanaland Protectorate; Ordnance Survey Office, Southampton, 1935, 250/38.

1/500 000 Bechuanaland Protectorate; Geographical Section General Staff 3915, War Office, London, 1933.

Botswana; Directorate of Overseas Surveys, Misc. (448), London, 1962.

The distribution maps published in this paper are a reduction in outline of the 1 250 000 250/38 listed above, showing the principal towns, rivers, railway and road systems and a selection of settlements, police stations, stores, pans, tracks and other features. The route taken by the Vernay Lang Expedition of 1930 from Molepolole to Ghanzi through the central Kalahari, although not now traceable, is added, as this expedition produced the largest single mammal collection from Botswana available up to that date.

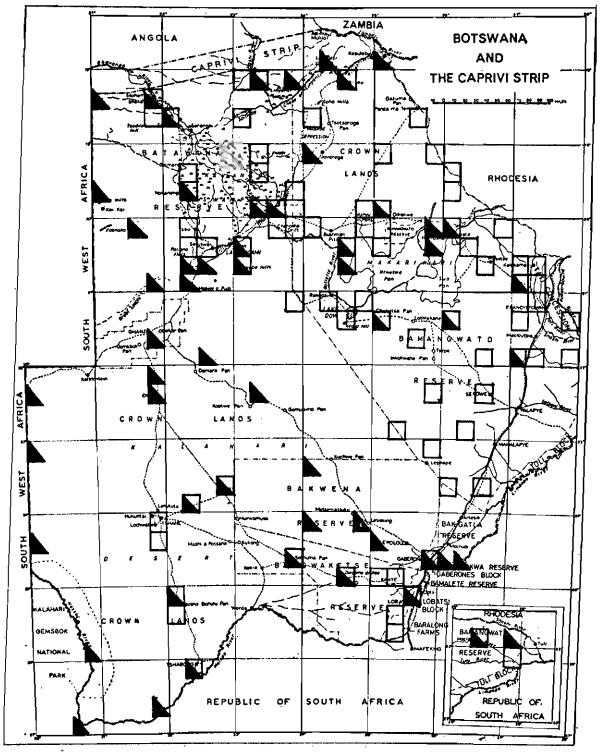
The whole map was overlaid with a blue non-photographic quarter-degree grid.

All material and visual records are plotted on the quarter-degree basis, material records by black squares, visual records by black triangles. This distinction is emphasized in the text.

The method adopted for indicating localities in the Gazetteer is a conversion of the system introduced by the Trigonometrical Survey of South Africa by the substitution of the lower-case letter in the alphabetical code by a numerical, i.e. a = 1, b = 2, c = 3, d = 4, so that 2319 Ba becomes 2319 B1 (Davis, 1958; Fitz-Simons, 1962).

As data on distribution has a relation to the activities and location of the collecting stations and the period spent in them, a map is provided showing the location of the collecting stations in which seven days or more were spent, either by the main party or the Smithsonian teams.

This highlights certain areas where further work would be profitable, in particular the eastern parts of the Central Kalahari Game Reserve and the sector just east of this and south of Lake Dow. The Central Kalahari Game Reserve as a whole is still less known



Collecting stations:
Smithsonian teams
Main survey party

than most other parts of Botswana and further investigation of the Passarge, Deception and Okwa Depressions and their associated pans would fill in an obvious gap in our knowledge.

Although Dr. D. H. S. Davis of the Medical Ecology Centre, Johannesburg, was good enough to provide information on the distribution of Muridae on the southern border along the Molopo River from the Baralong Farms to Werda, little is known of the medium- and large-sized mammals which may occur in this area.

The same applies to the Tuli Block Farms along the Limpopo River.

Measurements and Weights

As all mammal measurements are expressed in millimetres, the abbreviation mm is not used. Where units other than mm are used, this is stated, the standard abbreviations being used.

Weights are expressed in grams for the smaller specimens, in lbs. and ozs. for the larger.

The abbreviations used for the measurements and the methods used in obtaining these measurements (fig. ii) were as follows:

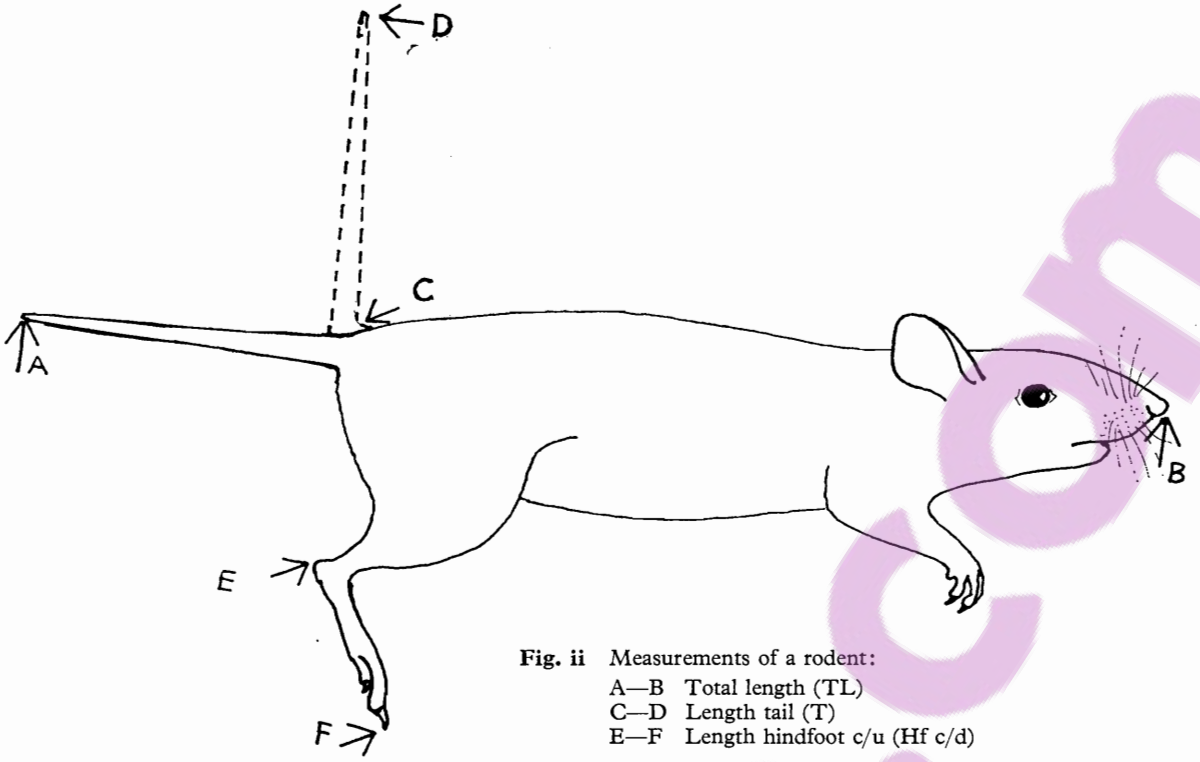


Fig. ii Measurements of a rodent:
A—B Total length (TL)
C—D Length tail (T)
E—F Length hindfoot c/u (Hf c/d)

TL

The total length of the specimen from the tip of the snout to the end of the vertebrae of the tail.
Muridae. The specimen laid on its side, pins inserted at the tip of the snout and the end of the vertebrae of the tail, and the measurement taken between the base of the pins (fig. iii).
Chiroptera. The specimen laid on its back and the measurement taken as in the case of Muridae.

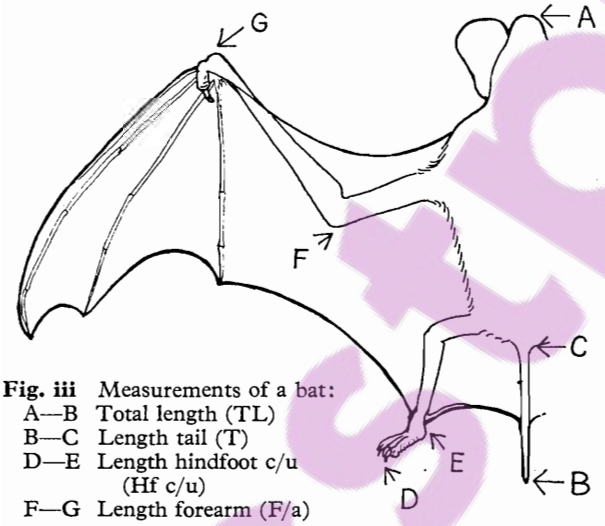


Fig. iii Measurements of a bat:
A—B Total length (TL)
B—C Length tail (T)
D—E Length hindfoot c/u (Hf c/u)
F—G Length forearm (F/a)

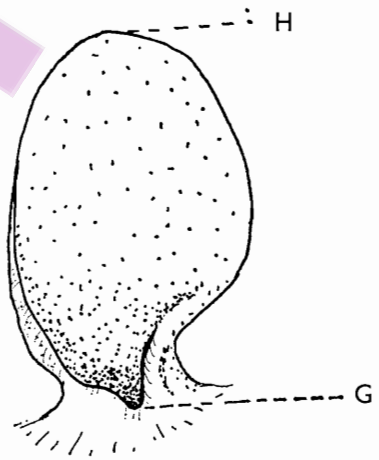


Fig. iv Ear measurement:
G—H Length Ear (E)

Medium-sized mammals (larger than Muridae and up to the size of a Jackal). The specimen laid on its side and measured directly.

Larger mammals. The specimen laid on its side, the measurement taken between pegs.

In the case of the Smithsonian teams the measurement of Muridae and Chiroptera was taken by laying them on a transparent plastic ruler.

T

The length of the tail, from the base of the tail to the end of the vertebrae of the tail.

Muridae. The body of the specimen hanging over the edge of the table, the tail lying on the top of the table, a pin placed at the end of the vertebrae of the tail and the measurement taken between the edge of the table and the base of the pin.

Chiroptera. In families with well developed tails (Molossidae, etc.) measurements were taken as in the case of the Muridae, in those with poorly developed tails (Emballonuridae, etc.) with dividers or transparent plastic ruler.

Medium and large mammals. The tail held at an angle to the line of the body, the measurement taken from the base of the tail to the end of the vertebrae of the tail.

T mid anus

Where, on account of the configuration of the tail, it was impossible to ascertain where the base of the tail lay (e.g. Manidae; some Bovidae; Orycteropodidae) the measurement was taken from the centre of the anus to the end of the vertebrae of the tail, the measurement then being designated 'T mid anus'.

Hf

The length of the hindfoot pressed flat against the ruler, the measurement taken from the heel to either:

c/u the end of the longest claw or hoof *or*

s/u excluding the claw or hoof.

E

The length of the ear measured from the notch of the ear to the furthest extremity of the cartilage of the ear, excluding hair or ear-tufts at the tip (fig. iv).

HB

The length of the head and body measured from the tip of the snout to the base of the tail or the total length less the length of the tail.

Weight

The weight of the freshly killed specimen was taken either in grams, g for the smaller specimens or in lbs. and ozs. for the larger. The main survey party used Ohaus triple-beam balances weighing up to 2 610 g and Salter hanging spring-scales 0-25 lb., 0-50 lb. and 0-300 lb. The Smithsonian parties used Salter spring-balances, graduated in grams, 0-500 g and the same larger scales as the main party.

Large specimens over 300 lb. were dismembered on top of the skin, to preserve, as far as possible, blood and other fluids, weighed in parts, the skin with the intestines, blood and fluids weighed as the last item. No allowance was made for the loss during skinning and dismemberment of the specimen of body fluids as this was judged to be only a small percentage of the whole weight. The largest specimen weighed in this manner was a zebra, *E. burchelli*, at 960 lb.

Unless otherwise stated the weight of gravid females is the net weight, i.e. the total weight less the weight of the foetus or foetuses.

F/a

The length of the forearm (in Chiroptera only) measured from the end of the ulna to the end of the carpus (fig. iii).

Tr

The length of the ear tragus (in Chiroptera only) measured from the base to the tip.

Where foetuses were present, the following measurements were recorded, where near full-term foetuses were being dealt with the TL and T are also given.

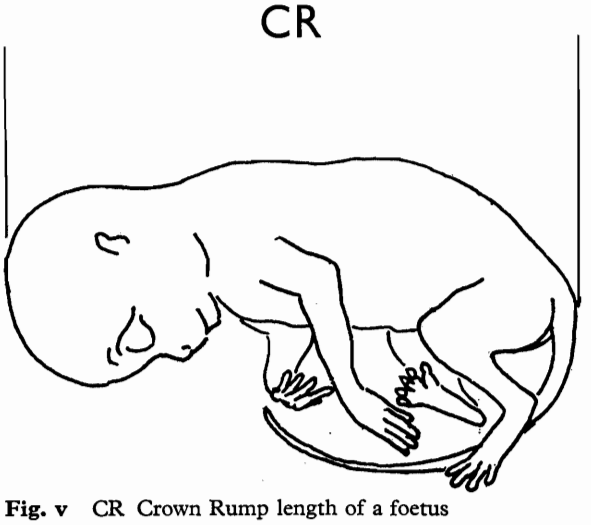


Fig. v CR Crown Rump length of a foetus

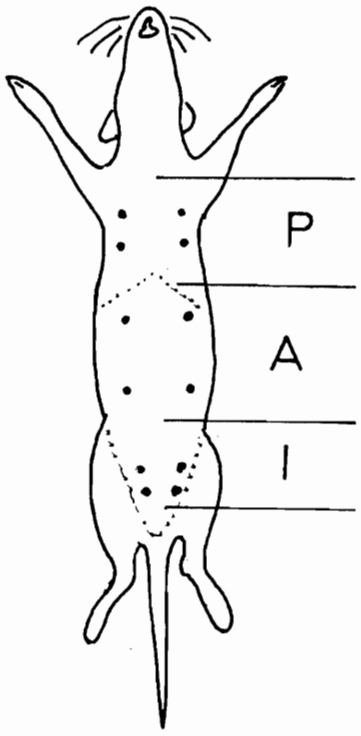


Fig. vi Small mammal showing position of the mammae. P = Pectoral; A = Abdominal; I = Inguinal

CR

The crown rump length, being the distance between the crown of the head and the rump, the foetus lying in the natural position in the uterus (fig. v).

Hf

Measured as for the adult specimen, if including the length of the soft cartilaginous hoofcap (Bovidae) then expressed Hf c/u.

Weight

The net weight of the foetus, with the umbilical cord severed at the body of the foetus. Where foetuses were weighed in the laboratory after preservation in 5% formalin, this was recorded as "ex formalin".

In the case of skull measurements, the following abbreviations are used:

Skull TL

The total length of the skull. The greatest distance between the most posterior part of the skull and the most anterior.

M^1—M^1

The measurement from the outside face to the outside face, at the widest point, of the first upper molars.

Skull Z.W.

The greatest width across the outside of the zygomatic arches.

Mammae

The position of the mammae in females of certain genera was recorded, e.g. *Tatera; Steatomys;* and *Cryptomys*, in others only where there did not appear to be adequate data in published works.

Their position in relation to the various regions of the body is indicated as P, pectoral; A, abdominal; I, inguinal, the number after the prefix the number of pairs present, the total number also being given, e.g.:

P2 12 = 8 indicates two pairs pectoral, two pairs inguinal, the total number of mammae being eight (fig. vi).

Habitat

A description of the topography and vegetation of each collecting station was recorded on a separate form. In addition, under the heading H*abitat*, on the record form, a brief description was given of the habitat in which the specimen was taken.

Stomach Contents

In the case of Bovids the stomach content was sampled, about a double handful being preserved in 5% Formalin in a plastic bag. In all other cases the whole stomach was preserved. Qualitative examination was carried out in the laboratory, the content being emptied on to a fine stainless steel screen and washed with a spray of water. The various items in the content were sorted and a visual estimate made of the percentage occurrence of each. Samples of such of the content as were later submitted to authorities for detailed examination, e.g. Reptilia, Isoptera, Scorpiones, Solifugae, Insecta, etc., were separated, preserved in 5% Formalin in plastic bags or in glass phials. Identifications immediately available were entered at the time of examination, returns from authorities as and when they were received. The analysis of the findings as appearing in the text is based on the information recorded on the record forms.

Reproductive Tract and Testes

At the time of examination of the carcass of females after skinning, the whole of the reproductive tract, with the bladder attached, was removed, numbered and pickled in plastic bags in 5% Formalin. This was examined for the presence of foetuses, either at the

time of removal or in the laboratory at a later date, the data so obtained, which included the number of foetuses and their position in either the right or left uterine horn, were entered on the record form.

In the case of males, the weight of the testes and their position, whether abdominal or scrotal, were recorded. The weight of the testes is the weight of the pair with the epididymis removed.

All reproductive tracts and testes were retained and are now in the collection of the National Museums of Rhodesia.

Notes

This section of the record form was provided in order to record information on the manner in which the specimen was taken, if trapped, the bait used; the time it was taken; the number of individuals comprising the herd; observations on habits and any other information which it was deemed to be of interest and would contribute to a fuller knowledge of the species concerned.

Treatment of material in the field

Small Specimens

The skins of all specimens up to the size of a hare, after skinning, were treated with a preservative composed of:

Borax	8 lb.
Sodium Silicofluoride	1 lb.
Heavy Magnesium Carbonate..	6½ lb.
Creosote Oil	4 tablespoons

and made up directly into study skins.

Medium and Large Specimens

In the case of the main party, after removal of the skin, this was immersed in a solution of 3 lb. Sodium Silicofluoride in 10 gallons of water for periods varying from half an hour for the smaller to overnight for the larger. A tank for this purpose was made from a tarpaulin laid in a pit in the ground. The skin was then salted, using No. 1 fine dairy salt, and rolled up, fur side outside, for periods of from six hours in the case of the smaller to 24 hours in the case of the larger, or they might be carried in this form between camps. They were then dried in the shade and, when nearly dry, folded, skin side outside, into a size convenient for packing. In the case of very large skins (buffalo, zebra) the first salting was shaken off the skin, the whole then resalted and rolled for a further 24 hour period before drying and folding.

Preserved Material

Muridae and Chiroptera. Where large series were obtained a sample was skinned and made up into study skins, the remainder injected with 5% Formalin and preserved in 5% Formalin in plastic bags.

Classification

The outline of classification used in this work in general follows Ellerman, Morrison-Scott and Hayman (1953), with certain exceptions, where I have adopted the treatment as set out in the various sections of the 'Preliminary identification manual for African mammals', Smithsonian Institution, Washington D.C. (1966-).

Class Mammalia
Order Insectivora
Fam. MACROSCELIDIDAE
Fam. ERINACEIDAE
Fam. SORICIDAE

Order Chiroptera
Fam. PTEROPODIDAE

Fam. EMBALLONURIDAE
Fam. MOLOSSIDAE
Fam. VESPERTILIONIDAE
Fam. NYCTERIDAE
Fam. RHINOLOPHIDAE
Fam. HIPPOSIDERIDAE

Order Primates
Fam. LORISIDAE
Fam. CERCOPITHECIDAE

Order Pholidota
Fam. MANIDAE

Order Carnivora
Fam. PROTELIDAE
Fam. HYAENIDAE
Fam. FELIDAE
Fam. CANIDAE
Fam. MUSTELIDAE
Fam. VIVERRIDAE

Order Tubulidentata
Fam. ORYCTEROPODIDAE

Order Proboscidae
Fam. ELEPHANTIDAE

Order Hyracoidae
Fam. PROCAVIIDAE

Order Perissodactyla
Fam. RHINOCEROTIDAE
Fam. EQUIDAE

Order Artiodactyla
Fam. SUIDAE
Fam. HIPPOPOTAMIDAE
Fam. GIRAFFIDAE
Fam. BOVIDAE

Order Lagomorpha
Fam. LEPORIDAE

Order Rodentia
Fam. BATHYERGIDAE
Fam. HYSTRICIDAE
Fam. PEDETIDAE
Fam. MUSCARDINIDAE
Fam. SCIURIDAE
Fam. THRYONOMYIDAE
Fams. CRICETIDAE, MURIDAE

Order INSECTIVORA

Family MAROSCELIDIDAE

Two genera are represented in the territory as follows-

1. Bullae much enlarged, showing conspicuously in the superior aspect of the skull; anterior teeth crowded together (fig. 1 (*b*)) . . *Macroscelides*
2. Bullae relatively small; anterior teeth with distinct spaces between (fig. 1 (*a*)) . . . *Elephantulus*

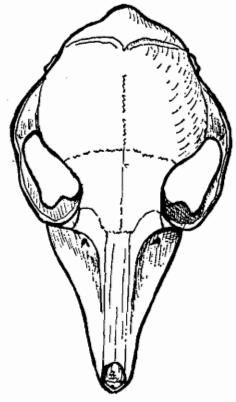


Fig. 1(a)

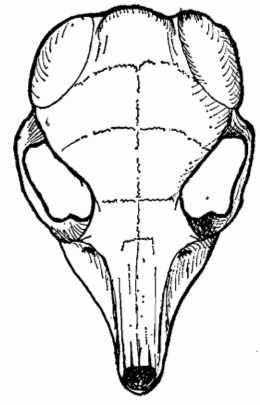


Fig. 1(b)

Fig. 1 Skulls of Elephant shrews
(*a*) Shorteared Elephant shrew, *Macroscelides proboscideus*
(*b*) Rock Elephant shrew, *Elephantulus myurus*

Genus MACROSCELIDES A. Smith, 1829

Macroscelides proboscideus

Shorteared Elephant Shrew

M. p. proboscideus (Shaw, 1800)

Taxonomic Notes

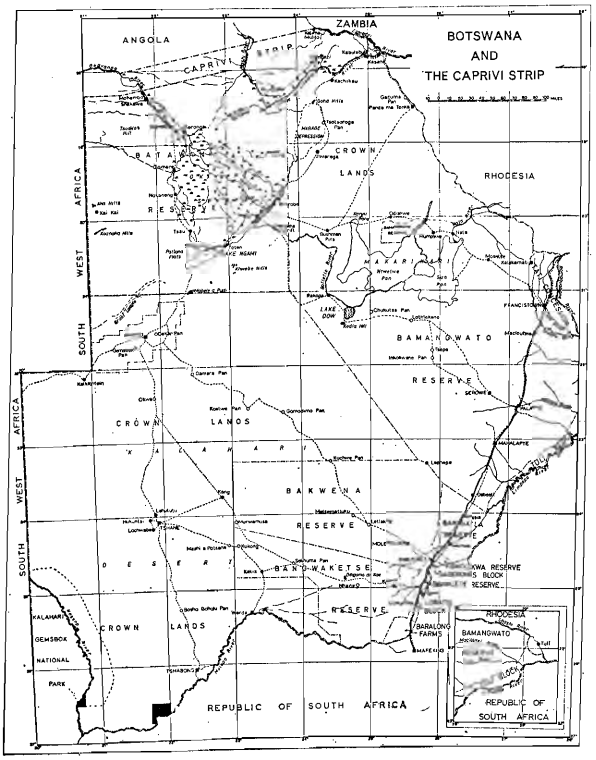
Corbet and Hanks (1968) consider *M. p. chiversi; M. p. hewitti; M. p. langi* and *M. p. isabellinus* as synonyms of *M. p. proboscideus.*

Distribution

Only three specimens were collected, two from Khuis, Molopo River, and one from Twee Rivieren, Kalahari Gemsbok National Park, in the extreme south-west.

Shortridge (1934) states that 'it does not seem to extend anywhere (in South West Africa) north of the Tropic of Capricorn' and records them as being 'plentiful around Berseba' (*c.* 25°50′ S. South West Africa), about 40′ north of Twee Rivieren, the northernmost record in Botswana. They have subsequently been taken at Okahandja *c.* 22° S., but this is far west and not necessarily an indication that they should be expected to be found further north in Botswana.

The type locality of *M. p. chiversi* Roberts is 76 miles north of Upington, the furtherest north that they have so far been taken in this sector of the Cape Province. These Botswana records extend the known distribution of the species northward within the area of mean annual rainfall of 250 mm, which extends northwards to about 25°30′ S. on the Nosop River. The species may, in time, be found in other parts of this area where there is suitable habitat but their distribution in the territory must be considered marginal in this the extreme south-west.



On all distribution maps:
■ indicates material record
◣ indicates visual record

Habitat

As the two specimens from Khuis were brought in by Africans no data is available on the habitat. The Twee Rivieren specimen in the Transvaal Museum was taken on 'calcareous outcrops with karroid bush' conditions which are found at Khuis on the banks of the dry Molopo River.

Habits

Diurnal, occur singly or in pairs, the burrows excavated under the cover of low bushes.

Food

Insectivorous.

Breeding

No information from Botswana. Shortridge (1934) records females with foetuses in the Berseba (South West Africa) area in August and September.

Sizes and Weights

MALES (Khuis, Molopo River)

No.	TL	T	Hf c/u	E	Weight
TNL 2600	225	122	36	23	40·0 g
TNL 2572	187	83	34	21	38·0 g

Genus ELEPHANTULUS Thomas and Schwann, 1906

1. Eleven teeth in the lower jaw . *E. brachyrhynchus*
   Ten teeth in the lower jaw 2
2. Soles of hindfeet brown; overall colour yellowish-brown; P^2 with two lingual cusps . *E. intufi*
   Soles of hindfeet black; overall colour greyish; P^2 with one, occasionally two, lingual cusps . . . . . *E. myurus*

Elephantantulus brachyrhynchus

Shortsnouted Elephant Shrew

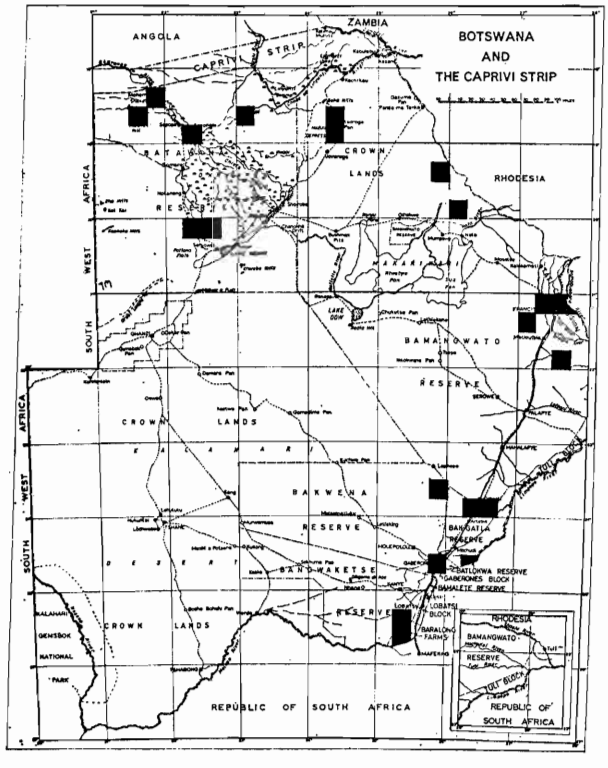
E. brachyrhynchus (A. Smith, 1836)

Taxonomic Notes

Corbet and Hanks (1968) state that 'more complete collections will in time render most, if not all, subspecific names invalid'.

Distribution

Occurs throughout the northern and north-eastern parts as far south as Tsau; in the northern parts of the Makgadikgadi east to the Rhodesian border and in the eastern sector from the Tati Concession south to Ramatlabama although probably not occurring between Mahalapye and Mochudi in the eastern extension of the Kalahari.



Shortridge (1934) states that they are confined to the north-eastern portion of South West Africa south to the Grootfontein district (*c.* 20° S.). On this basis the Tsau records may well represent their southernmost limits in the western parts of Botswana. The present limits of distribution in the territory follow roughly the limits of average annual precipitation of 450 mm.

E. brachyrhynchus and *E. intufi*, the bushveld elephant shrew, appear to be mutually exclusive, *E. brachyrhynchus* not occurring in the drier central and southern Kalahari.

Habitat

Although in the eastern sector occurring in the same areas as *E. myurus*, the rock elephant shrew, the two species are segregated by their habitat requirements, *E. brachyrhynchus* being confined to sandy ground with a light grass cover and scattered bushes, especially scrub *Acacia*, in the cover of which as well as under fallen logs and thorn fences, they dig their shallow burrows. *E. myurus*, on the other hand, is confined to a rocky habitat.

In certain areas, e.g. five miles west of Gaborone, *E. myurus* and *E. brachyrhynchus* occur within a few yards of each other in areas with kopjes, *E. myurus* among the rocks and *E. brachyrhynchus* on the sandy surrounds at their bases.

Although the habitat requirements of the two species *E. intufi* and *E. brachyrhynchus* are very similar, *E. brachyrhynchus* is normally found where there is a denser ground cover of shrubs and trees, whereas *E. intufi* occurs in very open country with a thin

scattered bush cover, often on the sandy fringes of pans where the vegetation is low and very sparse. Shortridge (1934) notes that in Zambia *E. brachyrhynchus* inhabits 'thick forest and dense underbush' while *E. intufi* in South West Africa 'may be met with on open plains covered with scattered shrub, in fairly thick bush or thin forest'.

Where the limits of distribution of the two species closely approach each other in the Tsau (*E. brachyrhynchus*)-Lake Ngami (*E. intufi*) areas the former represents the southernmost limits of the richer vegetation of the well-watered Okavango delta, the latter the northernmost limits of the dry open grassland and scrub savanna of the Kalahari.

Habits

Predominantly diurnal and in other habits very similar to *E. intufi*.

Food

Predominantly insects, including Formicidae and Isoptera.

Breeding

Although females have been taken both in the dry (March-August) and wet (October-February) seasons of the year, the only indication of breeding was a near full-term foetus, 1R, taken from a female from Ramatlabama in June.

Distribution of non-gravid and gravid females through the months of the year:

	J	F	M	A	M	J	J	A	S	O	N	D
Total	1	1	3	–	11	12	1	–	1	3	1	–
Non-gravid ..	1	1	3	–	11	11	1	–	1	3	1	–
Gravid	–	–	–	–	–	1	–	–	–	–	–	–

Sizes and Weights

MALES

TL	$\bar{X} = 210$;	$N = 25$;	Obs. range 200-227
T	$\bar{X} = 99$;	$N = 24$;	„ „ 89-108
Hf c/u	$\bar{X} = 30$;	$N = 25$;	„ „ 28- 34
E	$\bar{X} = 21$;	$N = 25$;	„ „ 19- 23
Weight	$\bar{X} = 44{\cdot}5$ g;	$N = 20$;	„ „ 33·0-52·0 g

FEMALES

TL	$\bar{X} = 216$;	$N = 23$;	Obs. range 200-222
T	$\bar{X} = 97$;	$N = 24$;	„ „ 90-105
Hf c/u	$\bar{X} = 30$;	$N = 25$;	„ „ 27- 33
E	$\bar{X} = 20$;	$N = 26$;	„ „ 18- 22
Weight	$\bar{X} = 42{\cdot}7$ g;	$N = 16$;	„ „ 30·0-52·0 g

Elephantulus intufi

Bushveld Elephant Shrew

E. intufi (A. Smith, 1836)

Taxonomic Notes

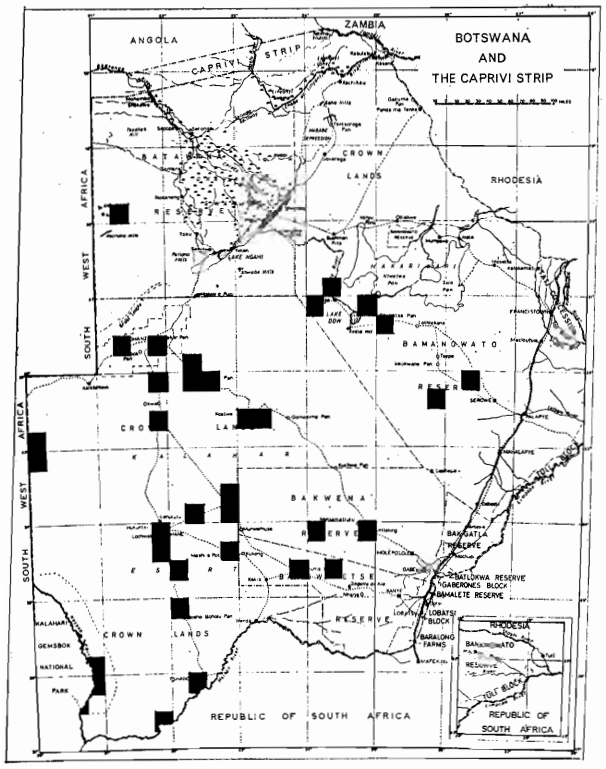
Throughout its range in Botswana the species shows a remarkable evenness in colour and corresponds well with the description of *E. i. kalaharicus* Roberts. Corbet (1966), however, states that there are unlikely to be any subspecific boundaries within this western part of its range.

Distribution

Occur throughout the central and southern Kalahari as far north as Rakops and Chukutsa Pans, at the south-western end of the Makgadikgadi; the Aha Hills in the west; Serowe and Letlhakeng in the east; not so far being taken in the eastern sector although they may, in time, be found there as the nominate form was taken at Kurrichane in the western Transvaal. Suitable habitat is available in the eastward extension of the Kalahari association, from some 20 miles south of Mahalapye to near Mochudi and extending to the Transvaal border, in which area they may also be expected to occur. Shortridge (1934) states that they occur throughout the northern part of South West Africa south to Karibib *c.* 23° S. Roberts (1951) records them south to Berseba *c.* 26° S. Hill and Carter (1941) list 72 specimens from central and southern Angola.

Habitat

Dry sandy ground with some scrub cover, particularly *Acacia* spp. The burrows are excavated under cover of a low bush or other cover and, from the entrance, radiate one or more well-worn branching trails, which gradually fade out towards the feeding grounds. These trails normally follow the cover of other shrubs, fallen



logs, etc. On frequent occasions the burrows and trails were found under the cover of thorn fences constructed round agricultural lands. At Chukutsa Pans, Kang and Sekoma Pan, the burrows were found on the raised sandy fringes of pans. Roberts (1951) states that in Damaraland and the Namib Desert 'they refuge under rocks or in rock crevices' but this has not been observed in Botswana, all refuges being excavations in sandy ground as described.

The distribution pattern of this species and *E. brachyrhynchus* suggests that they are mutually exclusive.

Habits

The species is almost entirely diurnal and Roberts (1951) aptly records that 'their fleet shadowy figures darting along the ground to the shelter of their burrows' are often the first indication of their presence. They are very fleet of foot, proceeding by short leaps as they scurry for shelter. If cut off from the burrow they will take to the cover of a bush, sitting motionless, when they are very difficult to detect in the shadows. If not further disturbed they soon resume activity.

Trapping is not so successful a manner of taking specimens as shooting with a ·22 pistol and dust-shot.

Food

Their food consists in the main of Formicidae and small insects, including grasshoppers. Shortridge (1934) states that they eat a small amount of vegetable matter but no evidence of this was found.

As in the case of *E. myurus* they can be taken with baits of peanuts or oatmeal impregnated with meat juices, but whether this attracts them or they visit to feed on the ants which congregate on the bait is uncertain.

Breeding

Distribution of non-gravid and gravid females through the months of the year.

	J	F	M	A	M	J	J	A	S	O	N	D
Total	3	5	2	–	4	7	5	3	–	3	3	–
Non-gravid ..	3	2	2	–	4	7	5	–	–	2	1	–
Gravid	–	3	–	–	–	–	–	3	–	1	2	–

Shortridge (1934) records three twin foetuses taken at Sandfontein, South West Africa (Mamuno, Botswana) in November.

The evidence suggests that the young are born during the warmer wetter months of the year from about August till February. It appears that two at a birth is the normal number, occasionally three, or one. The average number of foetuses was as follows:

Foetuses

Number $\bar{X} = 1{\cdot}9$ $N = 9$; Obs. range 1-3

Implantation in the sample was as follows:

1R2L	1R1L	1R
1	6	2

Sizes and Weights

MALES

TL	$\bar{X} = 230$;	$N = 14$;	Obs. range	211-248
T	$\bar{X} = 120$;	$N = 14$;	,, ,,	97-132
Hf c/u	$\bar{X} = 35$;	$N = 15$;	,, ,,	33- 37
E	$\bar{X} = 24$;	$N = 15$;	,, ,,	23- 25
Weight	$\bar{X} = 47{\cdot}0$ g;	$N = 8$;	,, ,,	41·0-56·0 g

FEMALES

TL	$\bar{X} = 242$;	$N = 25$;	Obs. range	222-272
T	$\bar{X} = 125$;	$N = 25$;	,, ,,	113-142
Hf c/u	$\bar{X} = 36$;	$N = 25$;	,, ,,	34- 37
E	$\bar{X} = 24$;	$N = 25$;	,, ,,	21- 26
Weight non-gravid	$\bar{X} = 52{\cdot}0$ g;	$N = 10$;	,, ,,	42·0-56·0 g
Weight gravid	$\bar{X} = 64{\cdot}1$ g;	$N = 8$;	,, ,,	51·0-71·0 g

Elephantulus myurus

Rock Elephant Shrew

E. myurus Thomas and Schwan, 1906

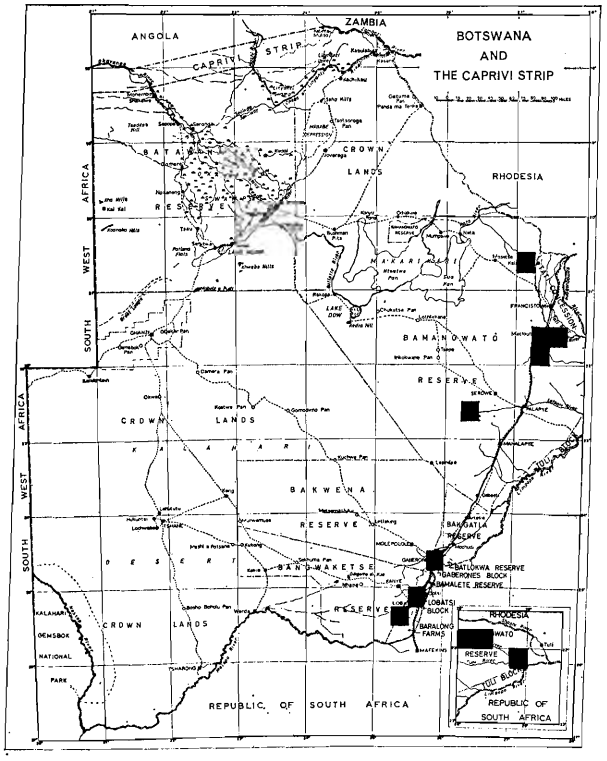
Taxonomic Notes

There is some variation in the number of lingual cusps in P^2, one being the normal number but, in material from the same locality, two are often present.

If subspecies can eventually be shown to be valid, then this material will be referable to *E. m. jamesoni* Chubb (1909).

Distribution

As a result of their habitat requirements (given hereunder), the species is circumscribed in its distribution, occurring only in the eastern parts of Botswana from the southern part of the Tati Concession southward, in rocky kopjes, to near Serowe and east to the Tuli Circle. Between Mahalapye and Mochudi



there is a break in distribution, owing to the absence of suitable habitat, in the sandy areas of the eastward extension of the Kalahari association. South of this the species is again found from Mochudi to Lobatse with a westward extension to the kopjes of Dikgomodikae.

Habitat

As the colloquial name suggests, this species is closely confined to a habitat of rocky kopjes or piles of boulders occurring only if there are sufficient holes and crannies to provide refuges. Within its range, more especially in granite formations, where the boulders or 'dwalas' rise cleanly from ground-level without the necessary cracks or crevices, they are absent, yet may be present in adjacent areas where the formations are more broken or exfoliated.

Adjacent to these refuges and usually under cover of overhanging rock-ledges, accumulations of droppings and the chitinous wing cases and other parts of insects indicate that they are in use. The droppings, if broken, show the well-masticated and indigestible chitinous remains of these insects, which appear to form their principal diet.

Habits

Although predominantly diurnal, they have been trapped at night (Soshong, Kalamare, Mabate) and there appears, therefore, to be some nocturnal movement, at least during the early hours of the morning before 6.30 a.m. and immediately after dark. They are, however, noticeably more active during the warmer hours of the day, this activity appearing to tail off before sunset. They tend to keep to the shady cover of overhanging rocks and other cover, such as overhanging branches or bushes, only sallying out momentarily to seize their prey. They are very quick in their movements and leap with agility from boulder to boulder over distances of up to about a metre, pausing to sit on their haunches in a shady corner, motionless, to watch the rock in front of them for their prey. If disturbed, they dive for their refuges but, if undisturbed for a few moments, they will reappear. At Rhodes Grave in the Matopos Hills, Rhodesia, visited by thousands of people yearly, they have become used to the presence of humans and show little signs of fear, moving about freely under the rocks, while under close observation.

There are no records of the species in stomach contents of small carnivores, but a barred owlet, *Glaucidium capense*, was caught at night at Kalamare, in the burred fruits of an overhanging shrub, when

feeding on a specimen in a trap. The use of cover in diurnal movement suggests a reaction to being picked up by small predatory birds.

They can be trapped on peanuts or oatmeal impregnated with meat and vegetable juices, but whether they visit the traps due to the attraction of this bait or the ants which feed on it is uncertain, although in view of the fact that ants constitute a large part of their diet, the latter is likely.

Food

Small insects with a high proprtion of Isoptera and Formicidae.

Breeding

Distribution of non-gravid and gravid females through the months of the year.

	J	F	M	A	M	J	J	A	S	O	N	D
Total	4	–	6	20	7	5	–	–	4	4	–	–
Non-gravid ..	4	–	5	19	7	5	–	–	–	4	–	–
Gravid	–	–	1	1	–	–	–	–	4	–	–	–

The sample is too small to arrive at any conclusion as to the time of dropping the young, the indications being that this takes place from about September through to April. Further information is requi ed to substantiate this.

The average number of foetuses was as follows:

Foetuses

Number $\bar{X} = 1{\cdot}7$; $N = 6$; Obs. range 1-2

Implantation in the sample was as follows:

IL	1R1L
2	4

Sizes and Weights

MALES

TL	$\bar{X} = 259$;	$N = 38$;	Obs. range 245-273
T	$\bar{X} = 142$;	$N = 34$;	„ „ 129-156
Hf c/u	$\bar{X} = 36$;	$N = 43$;	„ „ 35- 38
E	$\bar{X} = 26$;	$N = 42$;	„ „ 24- 27
Weight	$\bar{X} = 52{\cdot}4$ g;	$N = 19$;	„ „ 50·0-66·0 g

FEMALES

TL	$\bar{X} = 258$;	$N = 38$;	Obs. range 238-276
T	$\bar{X} = 140$;	$N = 30$;	„ „ 131-151
Hf c/u	$\bar{X} = 36$;	$N = 41$;	„ „ 34- 39
E	$\bar{X} = 25$;	$N = 38$;	„ „ 22- 27
Weight non-gravid	$\bar{X} = 52{\cdot}4$ g;	$N = 20$;	„ „ 41·0-67·0 g
Weight gravid	One weight only available—80·0 g		

Family ERINACEIDAE

Genus ERINACEUS Linnaeus, 1758

Erinaceus frontalis seTlhong Hedgehog

E. frontalis A. Smith, 1831

Taxonomic Notes

Two subspecies might be expected to occur in Botswana, *E. f. frontalis* which occurs in the southern and eastern parts of the continent and *E. f. angolae* from Angola and South West Africa. *E. f. angolae* is supposed to be smaller than *A. f. frontalis* but Hill and Carter (1941) point out that the type of *A. f. angolae* is a small specimen and quote the measurement of other specimens from Angola that are larger and more closely correspond to the measurements of *A. f. frontalis*.

	Hf c/u	E	Skull TL	1-M³
Type *E. f. angolae*	30·5*	26·0	45·7	23·4
Angola	34	—	49·1	24·7
Hill & Carter (1941)	35	—	47·2	24·1
O.F.S. and Transvaal *E. f. frontalis*	30-35	20-21	47-50·5	23·5-25·2
Botswana N = 9	$\bar{X} = 33$	26·6	46·3	22·8

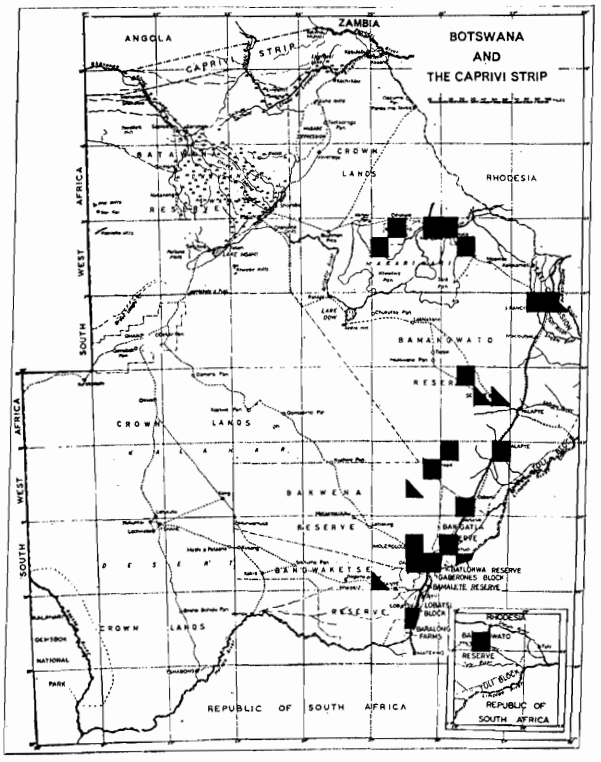
* Originally given s/u an estimated allowance for the length of the claws is made.

E. f. angolae is described as predominantly black with lines of white spines, as opposed to the speckled *A. f. frontalis*. Individuals predominantly black with lines of white spines have been taken alongside speckled individuals in the Wankie National Park, Rhodesia, and at Nata and Mampswe, Botswana. The colour of individuals is so variable as to make it questionable if this can be used to separate the two subspecies. Corbet (1968) states that they 'are dubiously distinguishable'. Until evidence to the contrary is obtained, it is considered that *E. f. angolae* is a synonym of *E. f. frontalis*.

Distribution

Apparently confined to the eastern parts of the territory from the northern parts of the Makgadikgadi, from Gweta to Nata; the Tati Concession south to Lobatse and west to the vicinity of Serowe, Lephepe, Molepolole and Kanyu.

There is an unconfirmed report from Ghanzi, and a piece of dorsal skin with the spines attached was



picked up on the roadside near Tsau. In the latter case, as there is the possibility that it might have been carried as 'medicine' and accidentally dropped, the record is disregarded until further evidence becomes available. It is recognized that even in areas where they are quite common (Francistown) they are only seen seasonally, furthermore, being generally nocturnal they are easily overlooked. Silberbauer (1965) states that they are common 'in all parts of the (Central Kalahari Game) Reserve' but no material is available and the observation is too general to map. Throughout their range in this part of the continent and northwards into Zambia their distribution is inclined to be patchy and, while they may be common in restricted areas, they may be absent in the surrounding country.

Several of the records (18 miles north-west of Serowe; Magogophate; Debeeti) are accepted on the basis of more than one skin, with spines attached, picked up under large trees. At Gweta it was known for two years that they occurred in the area, as a number of pieces of skin with spines attached were found under baobab, *Adansonia digitata*, trees alongside casts of verreaux's eagle owl, *Bubo lacteus*. These casts contained the spines and bones of hedgehogs, yet none were seen, although members of the survey were in the area on several occasions at the most favourable periods (*see* Habits). It was not until the third year that a specimen was eventually secured (C 1521). It appears that this owl, in the process of eating a hedgehog, strips the dorsal skin with the spines and discards it, as in most cases it was recovered whole. One baobab near Gweta had a very large accumulation of casts, loose bones and spines, and discarded skins at its base under a large overhanging branch that was apparently a feeding perch.[1]

Habitat

They were taken in a wide variety of habitats including open grassland (Mampswe), *Acacia* scrub (Nata), mopane woodland (Francistown), open *A. giraffae* woodland with scrub (Debeeti), in gardens in towns (Francistown, Gaborone), scrub-covered rocky kopjes (Lobatse), scrub on Kalahari sand (Lephepe). There does not seem to be any particular factor in common to all these, except that of the necessity of some sort of cover.

All the localities in which it has been taken have a mean annual rainfall of over 300 mm annually up to 500 mm in the Kanye area.

Habits

Terrestrial, predominantly nocturnal, although they have been seen moving during the day after rain (Sequane). Occur singly or in pairs or a female with young.

During the day they rest under piles of debris, heaps of garden rubbish, under matted grass or in holes in the ground. They do not appear to establish permanent resting places, a new situation being chosen after each movement.

Normally slow-moving they are, nevertheless, capable of a surprising turn of speed, which they accomplish by rising high on their long legs.

In captivity, in a large outdoor enclosure, during the warmer wetter months of about September to April they fed regularly. With the advent of the cooler weather in May, however, they appeared to lose their interest in food, some nights remained curled up in the piles of hay provided and not eating, even when the food was left overnight.

By late June they had become lethargic and ceased to eat altogether, although never reaching a state of complete 'hibernation' as, on warmer evenings, they

[1] Since going to press recorded in the Gemsbok National Park, Nossop Camp (Rautenbach, *in litt.*).

were seen to move around and would change their resting places.

With the advent of the warmer weather in August they would occasionally emerge to feed in the evenings and by September were feeding regularly and appeared to have regained their normal activiteness.

A pair, kept indoors during the same period, remained active and fed throughout the colder weather. They enter this state of temporary torpidity at the maximum weights. A male kept in the open reached its maximum weight in April, 568 g, against its August weight of 255·6 g.

Specimens taken during the months of March and April often have a thick layer of fat under the skin, which gives the skin between the spines a white translucent appearance.

In the light of these observations it is interesting to note the dates on which museum and zoological garden specimens were collected. Information on this was gleaned from 14 organizations and revealed that out of a total of 360 specimens from southern Africa, on which the date of collection was recorded, 335 were taken during the months of August to April, only 25 during May to July.

In the case of the material in the Botswana collection, two were taken at Sequane in June and one from Gaborone in May. In both cases they had emerged after an unprecedented and most unseasonable downpour of rain which probably flooded them out of their resting places.

Food

Very little information is available on their food under natural conditions, but the stomach contents of four specimens from Botswana were as follows:

BP 400	1 frog, *Pyxicephalus* sp.
BP 1075	small Coleoptera (adults)
BP 1657	1 centipede, *Scolopendra morsitans*
TNL 1129	98% termites, *Odontotermes latericius* 2% small Coleoptera (adults)

Three-quarters of the stomach content of BP 1075 consisted of round worms, 25% the remains of the small beetles. Mastication of the food is very thorough, making identification of the remains difficult.

In captivity, Millipedes were freely taken soon after they emerged with the onset of the rains, later these were refused. This might be due to the development of the odiferous fluid, which they secrete when handled, which does not appear to be so much in evidence in individuals unearthed during the colder, drier season of the year or for a time after they emerge. Grasshoppers, earth-worms, moths, Doryline ants, beetles, meal-worms, were eaten in addition to a diet of brown bread, sugar, milk and minced meat.

Breeding

No data are available on the time of dropping the young in Botswana. In adjacent territories the young are born during the months of October to March, four to six being the more normal number in a litter, but up to nine being known (Bulawayo, Rhodesia).

Birth weights vary from 9·8 g to 11·3 g.

Sizes and Weights

MALES

TL	$\bar{X} = 193$;	$N = 7$;	Obs. range 177-212
T	$\bar{X} = 19$;	$N = 7$;	,, ,, 17- 21
Hf c/u	$\bar{X} = 32$;	$N = 7$;	,, ,, 26- 38
E	$\bar{X} = 25$;	$N = 7$;	,, ,, 19- 28
Weight	$\bar{X} = 358$ g;	$N = 4$;	,, ,, 324-399 g

FEMALES

TL	$\bar{X} = 185$;	$N = 5$;	Obs. range 170-215
T	$\bar{X} = 21$;	$N = 5$;	,, ,, 19- 24
Hf c/u	$\bar{X} = 30$;	$N = 5$;	,, ,, 27- 33
E	$\bar{X} = 25$;	$N = 5$;	,, ,, 22- 27
Weight	Only two weights available—236 and 286 g		

Family SORICIDAE
Shrews

Two genera of shrews, *Suncus* and *Crocidura*, have been recorded from Botswana. *Suncus* is rare in the territory and is only recorded from two localities.

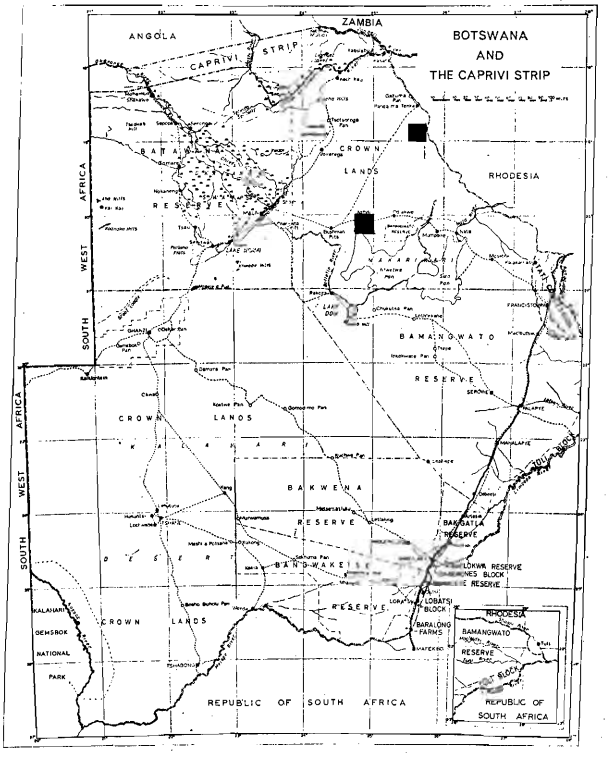
With 30 teeth, P^3 present . . . . . *Suncus*
With 28 teeth, P^3 absent . . . . . *Crocidura*

Genus SUNCUS Ehrenberg, 1833

Suncus lixus

Greater Dwarf Shrew

S. l. lixus (Thomas, 1898)



There are only two records of the occurrence of this species, one from Kanyu (from barn owl, *Tyto alba*, pellets) and the other from Nunga where a specimen was trapped. These records are a considerable westward extension of their known range of distribution. Nothing is known of their ecology in Botswana where they are obviously a rare species.

Genus CROCIDURA Wagler, 1832

1. Largest; total length greater than 215, condylo-incisive length greater than 30 . *C. occidentalis*
   Smaller; total length less than 160, condylo-incisive length less than 25 2
2. Medium-sized; total length 118 to 156, condylo-incisive length 22 to 25; colour normally off-white or pale fawn above . . . . . *C. hirta*
   Smaller; total length 90 to 140, condylo-incisive length less than 22, colour not off-white or pale fawn above 3
3. Small; total length 112-140, condylo-incisive length 19 to 22 4
   Very small; total length 90 to 115, condylo-incisive length less than 18 . . . *C. bicolor*
4. Black or very dark brown above, slightly paler

below; M_3 with fovea or hypoconid
. . . . . *C. mariquensis*
Greyish-brown or greyish-fawn above, pale grey below; M_3 without fovea or hypoconid *C. cyanea.*

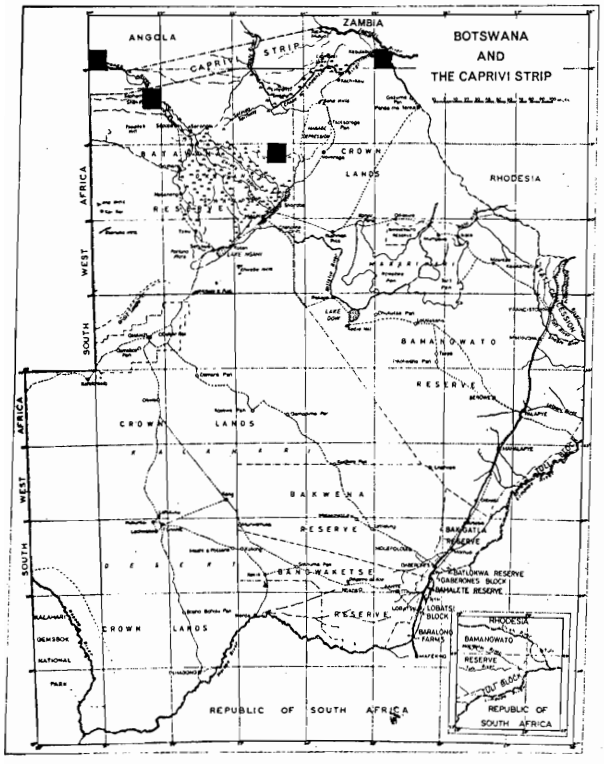
Crocidura occidentalis

Giant Musk Shrew

C. o. zuleika Dollman, 1915

Distribution

Confined to the extreme northern parts of the territory on the Okavango and Chobe rivers and in the northern parts of the Okavango delta. Although, in these areas, associated with swampy conditions with reed-beds, not so far taken in this type of habitat in the Okavango delta further south.



Habitat

The fringes of swamps and rivers, with reed-beds and lush semi-aquatic cover of sedges and grasses, on the fringes of swamp islands and wet vleis. All the Botswana records were taken from within the mean annual rainfall area in excess of 450 mm. Meester (1963) suggests that their failure to spread further south in the Okavango is due to their restriction to this higher rainfall zone.

Habits

Predominantly nocturnal, but were trapped during daylight hours (Kasane).

Food

While there are no data on stomach contents of specimens taken in the field, Meester (1963) lists food taken in captivity which includes birds, small mammals, frogs, toads, lizards and invertebrates. Caught in break-back traps on peanuts, they were probably more attracted by the ants and other insects which were feeding on this bait, than on the peanuts themselves. The destruction of trapped rodents, found pulled to pieces, is probably due to the carnivorous habits of this species along with other species of shrews.

Breeding

No information from Botswana. From the evidence of juveniles collected in Zambia and Tanzania in January, May, June, July, August, November and December. Meester (1963) concludes that the species 'does not undergo a non-breeding season as is found in other local species'.

Sizes and Weights

MALES

TL	$\bar{X} = 230$;	$N = 5$;	Obs. range	225-235
T	$\bar{X} = 91$;	$N = 5$;	„ „	87- 95
Hf c/u	$\bar{X} = 25$;	$N = 5$;	„ „	24- 26
E	$\bar{X} = 13$;	$N = 5$;	„ „	11- 13
Weight	$\bar{X} = 55{\cdot}2$ g;	$N = 5$;	„ „	50·5-64·0 g

FEMALES

TL	$\bar{X} = 224$;	$N = 5$;	Obs. range	215-232
T	$\bar{X} = 87$;	$N = 5$;	„ „	81- 90
Hf c/u	$\bar{X} = 25$;	$N = 5$;	„ „	24- 26
E	$\bar{X} = 13$;	$N = 5$;	„ „	12- 15
Weight	$\bar{X} = 46{\cdot}5$ g;	$N = 5$;	„ „	40·2-54·6 g

Crocidura hirta

C. h. deserti Schwann, 1906

Lesser Red Musk Shrew

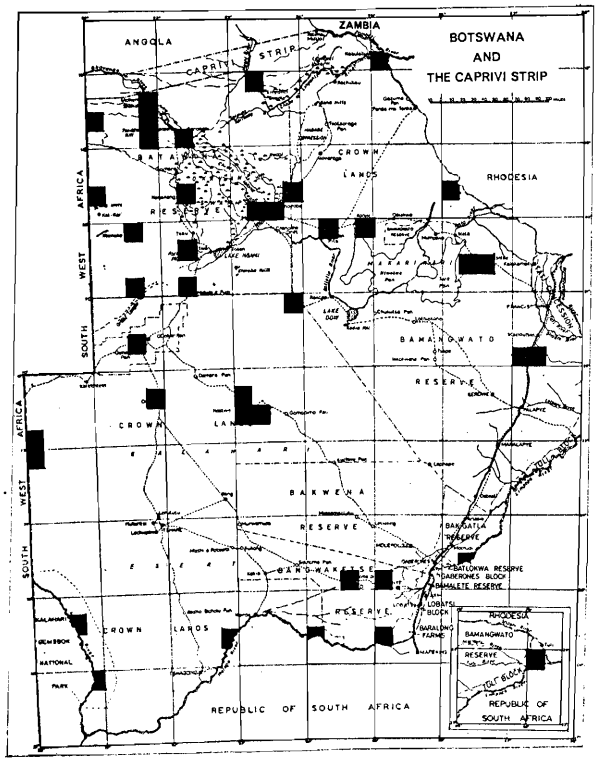
Taxonomic Notes

Two distinctly coloured forms occur in Botswana, the first very pale fawn with a white tail which is referred to *C. h. deserti* Schwann, 1906, and a second much darker, browner which in colour is intermediate between *C. h. deserti* and the still darker *C. h. hirta* from Mozambique.

In *C. h. deserti* from the Okavango delta and north-western parts of the territory the dark tips to the hairs of the upper-parts are darker than in specimens from the Kalahari, giving the material a slightly browner appearance and, owing to the irregularity in length of these hairs, the pelage has a grizzled appearance as opposed to the even colour of those from the Kalahari.

Distribution

Widely distributed throughout, *C. h. deserti* is replaced in the eastern sector from the Nata River to Ramatlabama by a form intermediate in colour between this subspecies and *C. h. hirta* Peters, 1852.



Habitat

The habitat notes accompanying the specimens show a clear preference for some type of bush cover whether on open ground, such as is found in the low bushes growing on fallowed lands, in the scrub bush found throughout the Kalahari, at Maun on the fringes of the riverine woodland, or at Tamafupi in thorn hedges in *Terminalia-Combretum* scrub. The localities in which they have been taken vary greatly in their vegetational cover from the very open country of the Baralong farms in the south-east, on red sand with scattered bushes and occasional *A. giraffae* trees, to the rich riverine woodland, on alluvium, of the Okavango delta. They appear to have a wide habitat tolerance, providing there is some type of low cover available, and are independent of water.

The intermediate forms at Masetsi and Foley were taken in mopane woodland, where there was some cover of low bushes, in one case in a pile of dry brushwood, washed up by flooding, near the Masetsi River and, west of Mochudi, in scrub.

Habits

Terrestrial, predominantly nocturnal, although specimens were taken at Tamafupi during the day.

Food

Generally insectivorous, but will take traps baited with the meat of rodents and, therefore, to some extent carnivorous as well. Have been taken on peanut baits but were probably more attracted by the ants which were eating it.

Breeding

No gravid females of *C. h. deserti* were taken but a very young male was taken at the junction of the Kuki-Makalamabedi fence in November. This specimen was very much lighter in colour than the adults, a very pale grey with only the faintest suggestion of a brown wash on the upper-parts. A slightly larger juvenile was taken at Foley also much lighter in colour than the adults, representing the intermediate form and, therefore, correspondingly darker than the juvenile from the Kuki-Makalamabedi. A gravid female of the intermediate form was taken at Masetsi

on the 23rd November with four foetuses, implanted 2R 2L, and another at Foley on the 2nd April with three foetuses, 2R 1L, suggesting a wide breeding season.

Sizes and Weights

MALES

TL	$\bar{X} = 129$;	$N = 14$;	Obs. range	122-140	
T	$\bar{X} = 44$;	$N = 14$;	,,	,,	42- 48
Hf c/u	$\bar{X} = 15$;	$N = 14$;	,,	,,	14- 17
E	$\bar{X} = 11$;	$N = 14$;	,,	,,	10- 13
Weight	$\bar{X} = 16{\cdot}9$ g;	$N = 12$;	,,	,,	14·0-20·0 g

FEMALES

TL	$\bar{X} = 132$;	$N = 18$;	Obs. range	118-149	
T	$\bar{X} = 46$;	$N = 18$;	,,	,,	42- 51
Hf c/u	$\bar{X} = 16$;	$N = 18$;	,,	,,	15- 17
E	$\bar{X} = 12$;	$N = 18$;	,,	,,	10- 14
Weight	$\bar{X} = 15{\cdot}1$ g;	N = 14;	,,	,,	12·0-20·0 g

Intermediates from eastern sector

FEMALES

TL	$\bar{X} = 141$;	$N = 5$;	Obs. range	128-147	
T	$\bar{X} = 48$;	$N = 5$;	,,	,,	42- 54
Hf c/u	$\bar{X} = 14$;	$N = 5$;	,,	,,	13- 16
E	$\bar{X} = 10$;	$N = 5$;	,,	,,	8- 11

Weight Only two available—21·0 g and 16·0 g

Crocidura bicolor

Tiny Musk Shrew

Taxonomic Notes

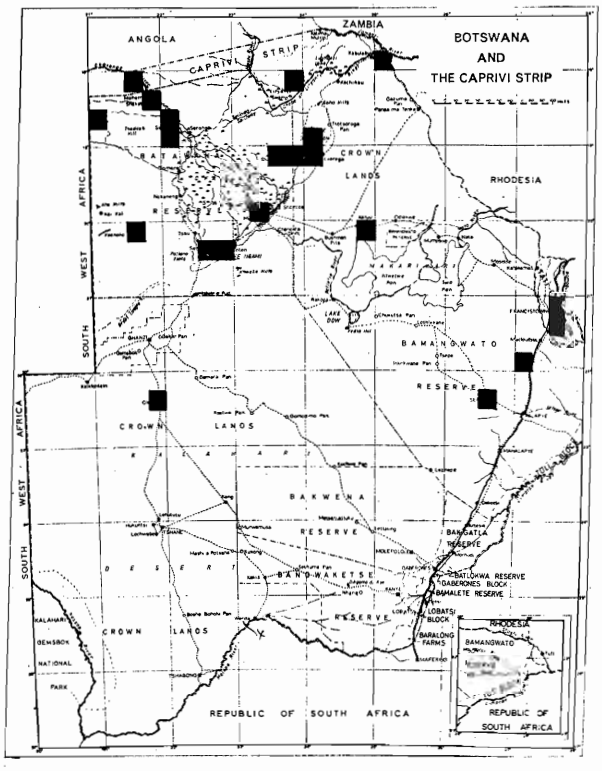
Two subspecies are recorded from the territory by Meester (1965), the darker *C. b. bicolor* Bocage from Kasane and Kasangula, with a doubtful record (from an owl pellet) from Kanye; and the lighter *C. b. woosnami* Dollman from the remainder of the territory.

Disregarding Meester's (1965) record of *C. b. bicolor* from Kanye for the moment, the material from the Tati Concession, Foley and Serowe, in its darker colour, is referred to *C. b. bicolor*, the remainder of the material, which is lighter in colour, is referred to *C. b. woosnami*, in spite of the fact that specimens from Maun and Sepopa do not entirely conform, some being lighter, others darker. Meester mentions a similar difficulty experienced with material from Sehitwa, this, in colour, more closely approaching *C. b. bicolor*. Further material is required to enable us to gain a clearer understanding of the distribution of the subspecies.

C. b. bicolor Bocage, 1898

Distribution

Confined to the extreme north-eastern part of the territory in the vicinity of Kasane and Kasangula on the Chobe River and to the northern parts of the eastern sector from the Tati Concession, Foley and Serowe areas.



Habitat

A Kasane the species was taken in *Baikiaea* woodland on Kalahari sand; in riverine scrub, some 25 metres

from the edge of the Chobe River; under fallen 'lutindi' grass on the floodplain, where the water had receded, and in short couch grass at the water's edge. At Serowe it was taken in light woodland at the base of sandstone kopjes. The species favours cover in the form of fallen logs and piles of dead brushwood.

Habits

No data available.

Food

Insectivorous.

Breeding

Meester (1965) records gravid females in November and December, and Ansell (1964) in the same months. C 1114 from Kasane taken on 6th December carried four foetuses, implanted 3R 1L.

Sizes and Weights

Series from Kasane and Kasangula.

MALES

TL	$\bar{X} = 108$;	$N = 9$;	Obs. range 90-120
T	$\bar{X} = 45$;	$N = 8$;	„ „ 36- 49
Hf c/u	$\bar{X} = 13$;	$N = 9$;	„ „ 12- 14
E	$\bar{X} = 9$;	$N = 7$;	„ „ 8- 10
Weight	$\bar{X} = 5{\cdot}8$ g;	$N = 8$;	„ „ 4·5-6·8 g

FEMALES

TL	$\bar{X} = 105$;	$N = 8$;	Obs. range 93-115
T	$\bar{X} = 43$;	$N = 8$;	„ „ 40- 46
Hf c/u	$\bar{X} = 12$;	$N = 8$;	„ „ 11- 12
E	$\bar{X} = 9$;	$N = 8$;	„ „ 7- 10
Weight	$\bar{X} = 5{\cdot}7$ g;	$N = 7$;	„ „ 4·2-6·8 g

C. b. woosnami Dollman, 1915

Distribution

Widely distributed throughout the northern part of the territory, south to the Okwa and north-western parts of the Makgadikgadi, replaced narrowly round Kasane and Kasangula, in the Tati Concession, and east of Serowe by *C. b. bicolor*.

Habitat

Specimens were taken on the fringes of swamp (Savuti), in riparian woodland (Maun), in wet vlei with long grass (Selinda Spillway; 50 miles west Shakawe), and also in dry areas (Drotsky's Cave, Okwa, Kanyu). All the Botswana material was taken in rainfall areas of under 600 mm.

Habits

Nocturnal, but, as they have been trapped during the day, to some extent diurnal as well.

Food

Insectivorous.

Breeding

No data available.

Sizes and Weights

MALE

TL 100; T 42; Hf c/u 12; E 8

FEMALES

TL	$\bar{X} = 100$;	$N = 4$;	Obs. range 93-108
T	$\bar{X} = 43$;	$N = 4$;	„ „ 39- 46
Hf c/u	$\bar{X} = 11$;	$N = 4$;	„ „ 9- 13
E	$\bar{X} = 8$;	$N = 4$;	„ „ 7- 11

Crocidura mariquensis

Black Musk Shrew

C. m. shortridgei St. Leger, 1932

Distribution

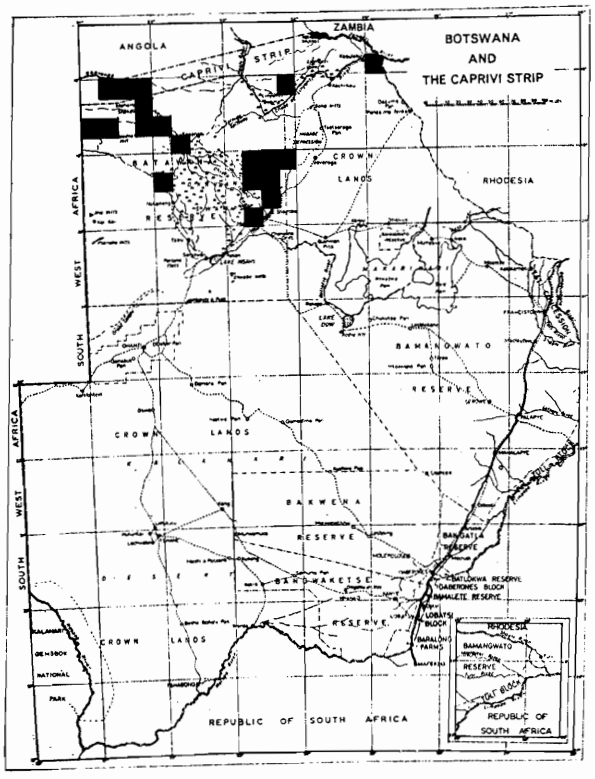
Confined to the northern parts of the territory, occurring throughout the Okavango delta, south to Nokaneng in the west and Maun in the east, and on the Chobe River and its associated swamp areas.

Habitat

The fringes of swamp and rivers, swamp islands, the backwaters of rivers and fringes of muddy pools in floodplain among swamp grasses, reed-beds and in other types of semi-aquatic vegetation. The specimens from the South West African border west of Shakawe were taken in wet vleis. Wet conditions appear to be an essential habitat requirement.

Habits

Nocturnal and diurnal. On the Chobe River, where they are very common in the above type of habitat, they used runs on the damp ground on the swamp fringe. While they no doubt contributed to keeping



these open, they may have been originally made by rodents such as *Otomys angoniensis* or *Dasymys incomtus* which abound in the swamp.

Food

Insectivorous, but no doubt carnivorous as well and to some extent responsible for the destruction of specimens of rodents caught in the swamp.

Breeding

The species appears to have a wide breeding season, gravid females being taken from August to April, the warmer wetter months of the year, none so far being recorded from May to July. Distribution of non-gravid and gravid females through the months of the year:

	J	F	M	A	M	J	J	A	S	O	N	D
Total	3	4	10	24	8	15	7	16	21	7	11	20
Non-gravid	3	1	7	23	8	15	7	10	20	6	8	16
Gravid	–	3	3	1	–	–	–	6	1	1	3	4

In a sample of 22 gravid females the average number of foetuses was as follows:

Foetuses
Number $\bar{X} = 3{\cdot}3$; $N = 22$; Obs. range 2-5

Sizes and Weights

MALES

TL	$\bar{X} = 144$;	$N = 51$;	Obs. range 128-156
T	$\bar{X} = 61$;	$N = 50$;	„ „ 50- 72
Hf c/u	$\bar{X} = 17$;	$N = 52$;	„ „ 15- 19
E	$\bar{X} = 9$;	$N = 52$;	„ „ 7- 11
Weight	$\bar{X} = 11{\cdot}7$ g;	$N = 46$;	„ „ 9·8-16·5 g

FEMALES

TL	$\bar{X} = 133$;	$N = 50$;	Obs. range 112-155
T	$\bar{X} = 56$;	$N = 50$;	„ „ 42- 71
S	$\bar{X} = 16$;	$N = 50$;	„ „ 13- 18
E	$\bar{X} = 8$;	$N = 50$;	„ „ 6- 10
Weight	$\bar{X} = 9{\cdot}0$ g;	$N = 50$;	„ „ 6·1-13·9 g

Crocidura cyanea

Reddishgrey Musk Shrew

C. c. infumata (Wagner, 1841)

Taxonomic Notes

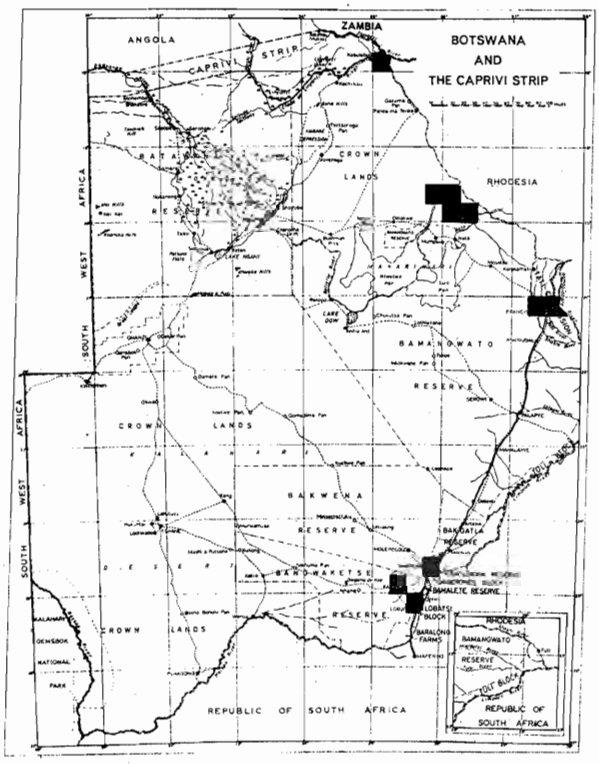
C. silacea Thomas, 1895, is considered a synonym.

Distribution

Confined to two areas, the northern from Kasane on the Chobe River narrowly southwards along the Rhodesian border to Francistown; the southern from Gaborone to Lobatse and west to the area round Kanye. Both of these areas fall within zones of mean annual rainfall above 450 mm to which Meester (1963) believes this species to be confined. The present records in the north are a westward extension of their known range of distribution.

Habitat

The notes appertaining to this relatively small sample (31 specimens) show no pattern of relationship to any particular type of habitat. On the Chobe River in the north, they were taken in dry woodland adjoining



the riverine association; north of Nata in dry *Terminalia-Combretum* scrub on white sand; in the township at Francistown; at the base of granite kopjes five miles west of Gaborone and in the broken hilly country near Lobatse and Kanye. Meester (1963) notes that the species has been taken 'in varied habitats, under trees, in old timber, under rocks and stones, in riverine grassland and in the open veld'. At Malitwale they were taken under a fallen tree, at Francistown under a pile of stones and bricks.

Habits

No data, but apparently both nocturnal and diurnal, as they were trapped during daylight hours (Francistown), and at night (Gaborone, Lobatse).

Food

Insectivorous.

Breeding

K 259, a female, taken on the 5th March, was gravid with two foetuses, implanted 1R 1L. Juveniles were taken at Francistown in January.

Sizes and Weights

Irrespective of sex.

TL	$\bar{X} = 125$;	$N = 4$;	Obs. range	112-139
T	$\bar{X} = 50$;	$N = 4$;	,, ,,	47- 52
Hf c/u	$\bar{X} = 14$;	$N = 4$;	,, ,,	12- 17
E	$\bar{X} = 9$;	$N = 3$;	,, ,,	7- 10

No weights available.

Order CHIROPTERA

Bats boMamathwane

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

. . . . *Suborder Megachiroptera*

Second digit without a claw (fig. 2); margin of ear conch not forming a complete ring; tragus present except in two families; interfemoral membrane generally well-developed; tail generally well-developed (absent in one family); cheek teeth cuspidate with generally clearly defined W-pattern

. . . *Suborder Microchiroptera*

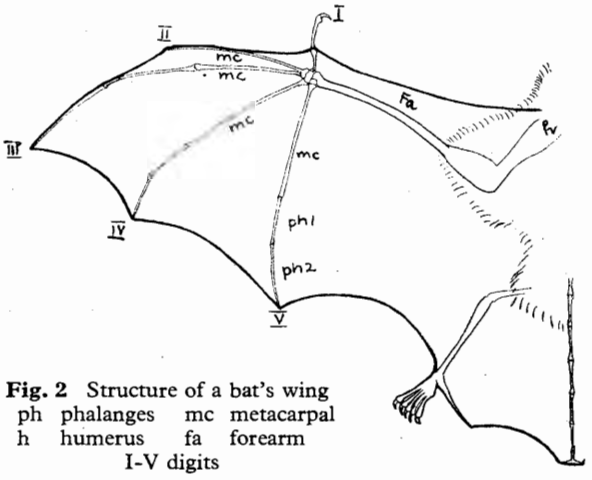


Fig. 2 Structure of a bat's wing
ph phalanges mc metacarpal
h humerus fa forearm
I-V digits

Suborder **Megachiroptera**
Fruit Bats

Owing to the generally arid nature of the territory, fruit bats are not widely distributed, being confined to the Okavango delta and the major river systems, where there are riparian forests with fruit-bearing trees.

Family PTEROPODIDAE

Post-dental palate markedly concave posteriorly; two palatal ridges posterior to teeth . . *Epomophorus*
Post-dental palate rather flat; five to seven palatal ridges posterior to teeth . . . . . *Epomops*

Genus EPOMOPHORUS Bennett, 1836

Epomophorus crypturus Peters' Epauletted Fruit Bat

E. crypturus Peters, 1852

Taxonomic Notes

There is a noticeable disparity between the sexes in the length of the skull anterior to the orbits, this being elongated in the male. The palate in the male extends further posterior to the last molar compared with the female. The braincase of the female is slightly more rounded and bulbous than in the male.

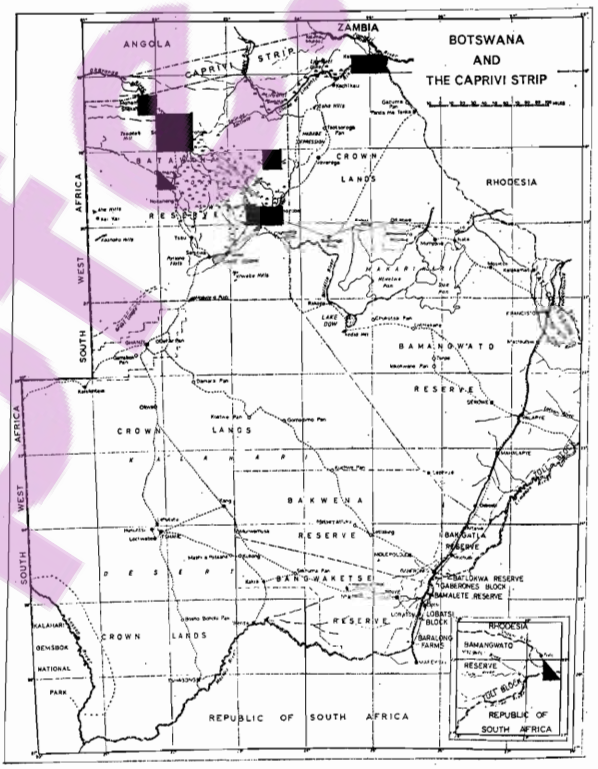
The colour varies greatly within the series available, BP 1939 from the Kwaai River being very pale creamy brown with a tinge of pink, BP 108 from Sepopa much darker, a light coffee brown.

Distribution

Occurs on the Chobe River and throughout the Okavango delta, as far south as Maun. Shortridge (1934) does not record this species from South West Africa, and there do not appear to be any records from the western Transvaal. In south-western Rhodesia they have been observed in fig trees, *Ficus* spp., at the Limpopo-Shashi River confluence (Irwin and Donnelly in Harrison, 1962) indicating that they probably will be found to occur in other parts of the eastern sector of Botswana in riverine woodland.

Habitat

In any dry area, such as Botswana, narrowly confined to riverine associations where there are fruit-bearing trees.



Habits

Nocturnal, gregarious, sometimes in large aggrega-

tions, *c.* 200 (Shakawe); *c.* 50 (Shorobe). Hanging during daylight hours under the canopy of trees with thick foliage, as for example *Kigelia pinnata* and *Ficus* spp.; at Shakawe, in the outer twigs of a high stand of bamboo in a garden fringing the Okavango River.

The males of the species have a characteristic call, a single, often repeated, musical bark uttered usually when hanging, or, less often, when flying. The eyes shine at night in the light of a dazzling light, glowing a dull red.

Food

Wild fruits, including *Ficus* spp., *Diospyros mespiliformis*, *Parinaria mobola*, *Sclerocarya caffra*. Where available, will also take cultivated fruits such as quinces, guavas, peaches and plums.

The species exhibits considerable local movements, which appear to be associated with the availability of wild fruits. These are normally bitten off, as the individual hovers in flight or lossely clings to surrounding foliage with the claws or the forearms and are carried in the mouth to a feeding point, which may be 100 or more yards from the source of food, where it is devoured, while hanging upside down by the feet. They are wasteful feeders and large accumulations of half-devoured fruit are found under these feeding points.

Breeding

There are no Botswana breeding records. In Rhodesia the young are born from November till about February. A juvenile with forearm 65 (BP 1941 Shorobe, March 1967) indicates that the breeding season may well be the same, at least in the eastern Okavango.

Sizes and Weights

MALES

TL	$\bar{X} = 164$;	$N = 17$;	Obs. range	153-170
Hf c/u	$\bar{X} = 23$;	$N = 17$;	„ „	20- 26
E	$\bar{X} = 27$;	$N = 19$;	„ „	22- 30
F/a	$\bar{X} = 84$;	$N = 6$;	„ „	82- 85
Weight	$\bar{X} = 103{\cdot}4$ g;	$N = 15$;	„ „	91·0-118·0 g

FEMALES

TL	$\bar{X} = 140$;	$N = 17$;	Obs. range	110-165
Hf c/u	$\bar{X} = 20$;	$N = 13$;	„ „	18- 24
E	$\bar{X} = 23$;	$N = 16$;	„ „	21- 27
F/a	$\bar{X} = 77$ g;	$N = 8$;	„ „	73- 79
Weight	Only two available—79·2 and 72·0 g			

Genus EPOMOPS Gray, 1870

Epomops dobsoni

Dobson's Epauletted Fruit Bat

E. dobsoni (Bocage, 1889)

Taxonomic Notes

Apart from the skull characters separating the two genera, *Epomops* and *Epomophorus* given in the key, *E. dobsoni* can be distinguished from *E. crypturus* by the much longer hair of the epaulettes in the males, *c.* 18 mm in *E. dobsoni; c.* 9 mm in *E. crypturus*. In *E. dobsoni* this hair is tinged yellow as opposed to the pure white of *E. crypturus*. In *E. dobsoni* the upperparts from the shoulders to the hindquarters are darker than in *E. crypturus*.

Distribution

Originally described from Angola, Hill and Carter (1941) state that 'it probably occurs throughout central Angola'. Ansell (1960) does not record them from the Barotseland Province although they occur north of this in Zambia. There are no records of their occurrence in South West Africa.

The species might be expected to occur, if only as a vagrant, in other parts of the northern sector of Botswana, where similar riverine conditions, to that in which it was taken at Kasane, are found.

This record is the furthest south that the species has so far been taken in this part of the continent.

Habitat

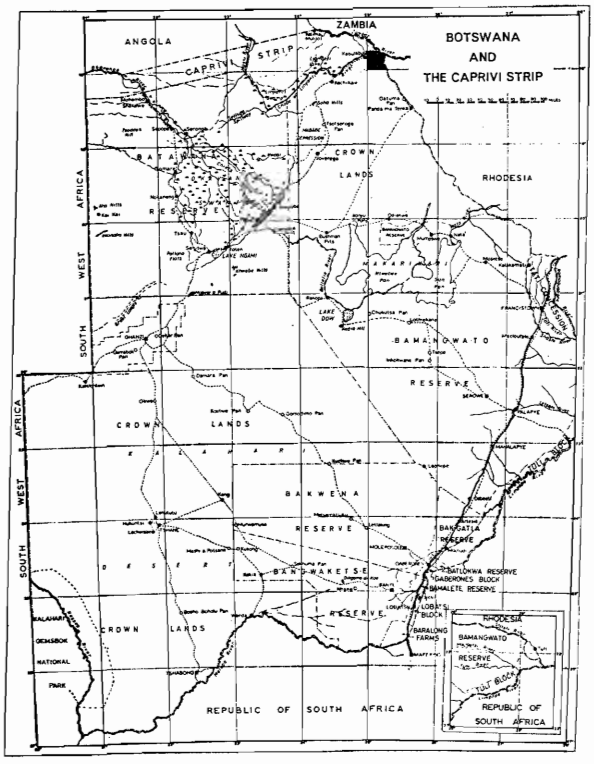
Only one specimen of this large fruit-eating bat was taken, this in company with a colony of Peters' epauletted fruit bats, *Epomophorus crypturus*, hanging in a tree in the riverine woodland at Kasane.

Habits

No information.

Food

Wild fruits.



Breeding

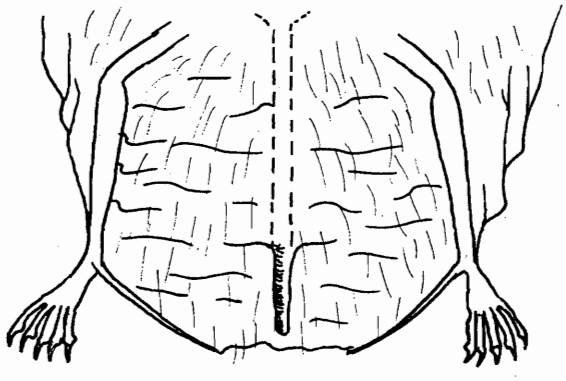
No information.

Size and Weight

Male TL 180; E 30; Weight 120·0 g.

Suborder **Microchiroptera** — Insect-eating Bats

1. With a distinct tail extending free of the interfemoral membrane 2
   Tail elmost entirely enclosed within the interfemoral membrane 3



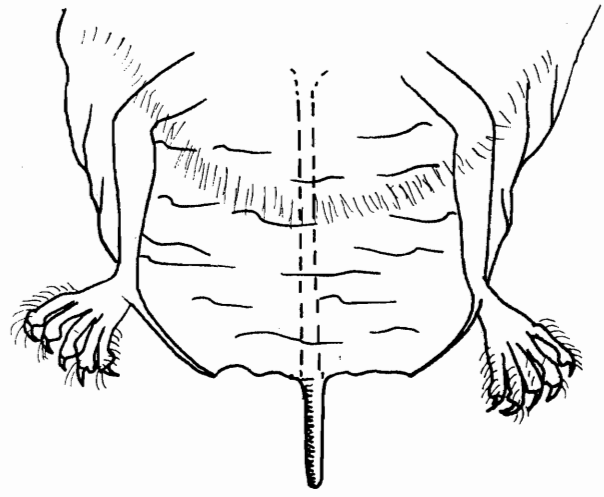
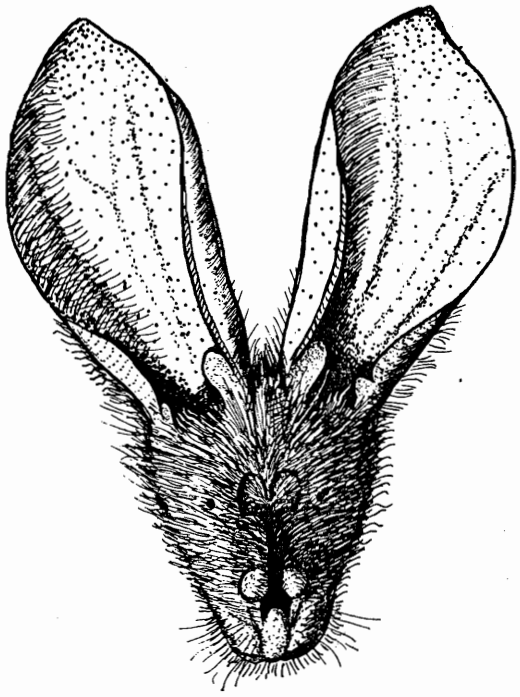
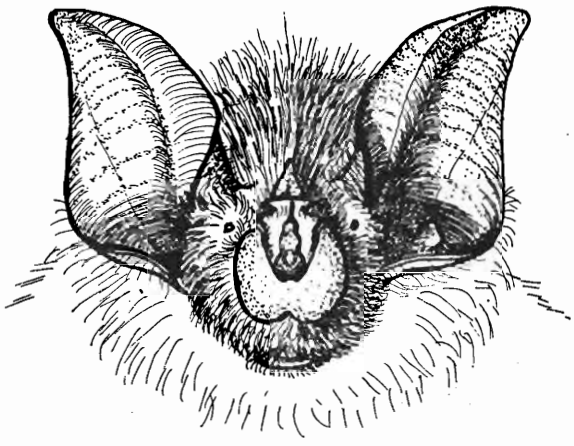
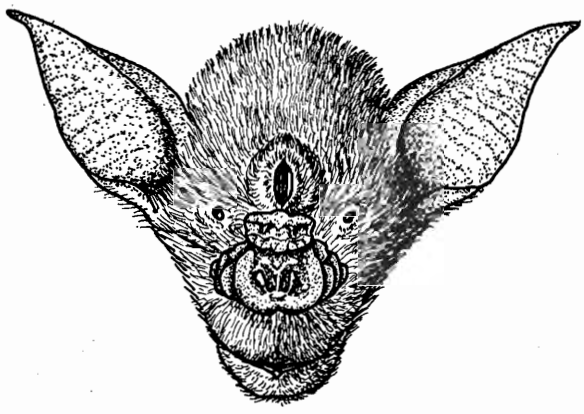


Fig. 3 Tails of bats
(*a*) Emballonuridae: *Taphosous* sp.
(*b*) Molossidae: *Tadarida* sp.





(*b*) Rhinolophidae: *Rhinolophus* sp.



(*c*) Hipposideridae: *Hipposideros* sp.

Fig. 4 Faces of bats

(*a*) Nycteridae: *Nycteris thebaica*

2. Free terminal part of tail emerging upwards from near the middle of the interfemoral membrane (fig. 3 (*a*)) . . . . . Emballonuridae

   Free terminal part of tail emerging from the posterior part of the interfemoral membrane and extending well beyond it (fig. 3 (*b*)) . Molossidae

3. No noseleaves . . . . . Vespertilionidae

   Face with noseleaves 4

4. Face with a deep central slit (fig. 4 (*a*)) . . . . . Nycteridae

   Face without a deep central slit 5

5. Posterior noseleaf subtriangular with an erect point (fig. 4 (*b*)) . . . . . Rhinolophidae

   Posterior noseleaf elliptical (fig. 4 (*c*)) . . . Hipposideridae

Family EMBALLONURIDAE

Genus TAPHOZOUS E. Geoffroy, 1818 — Tomb Bats

Only one genus of the family is represented in Botswana, with two species, *Taphozous mauritianus* with a very wide distribution in Africa south of the Sahara, and *T. perforatus* with an even wider range through north Africa to north-west India.

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

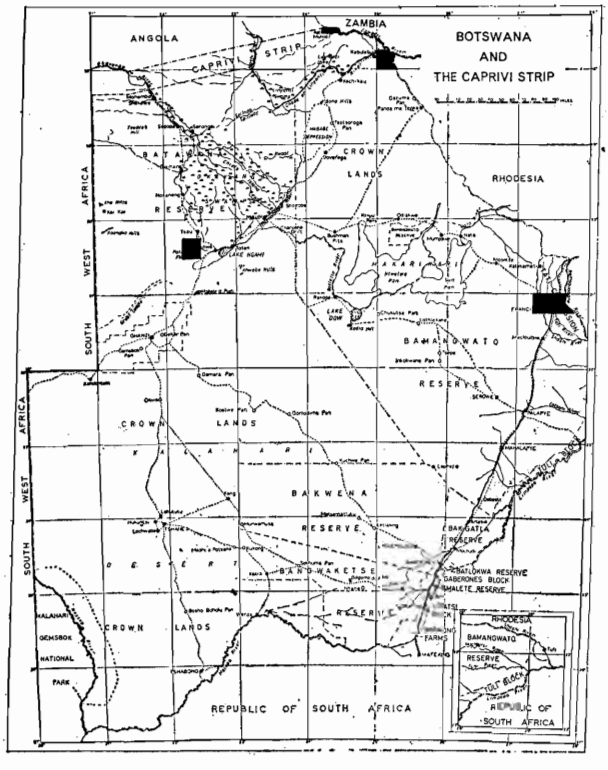
Taphozous mauritianus — South African Tomb Bat

T. mauritianus E. Geoffroy, 1818

(Skull, fig. 13 (*d*).)

Distribution

All records to date are from the northern parts of the country as far south as Sehitwa in the west and Francistown in the east. The species has a very wide distribution south of the Sahara and may in time, therefore, be expected to be taken in other parts of the territory. It occurs in Rhodesia (National Museum of Rhodesia), Zambia (Ansell, 1960) and the Transvaal (Roberts, 1951).



Habitat

Rests clinging to the outside walls of buildings in the shelter of the eaves (Francistown) with a marked preference for buildings with thatched roofs, and to the trunks and branches of trees in shaded situations (Caprivi, a colony of six, on a Cape Mahogony, *Trichilia emetica*, in riverine woodland). Occasionally flies into houses (Francistown). At Sehitwa netted over a muddy pool after dark. All the localities in which they have been taken in Botswana are in the vicinity of water.

Habits

Gregarious, but never occurring in large numbers, normally singles, pairs or up to six in a colony. Clings to the flat vertical surface of the wall, head downward, the feet apart, the belly close to the surface, in the shade. Preferred situations on the wall are often marked by urination, the staining in a characteristic square block some 15 cm long by 10 cm broad. If disturbed moves sideways, crablike, with agility taking cover round the corner of the building, or will fly off to the nearest tree, where they will scramble round the trunk or branch keeping out of sight of the observer. When resting appear always to be on the alert. At Robins, Rhodesia, with a choice of buildings in which the roof-beams jutted through the top of the wall as opposed to those with plain walls, they showed a marked preference for the latter, which allowed them unimpeded progress round the corner of the building when disturbed.

Normally nocturnal, but have been observed to take butterflies during daylight hours (Rushworth, *pers. comm.*).

The species is a fast flier, recognizable by its pure white belly and parchment-coloured wings.

At Sehitwa they were observed swooping low taking insects over water.

Food

Insectivorous.

Breeding

While there is no information from Botswana, they have been observed carrying the young in October in the Wankie National Park, Rhodesia (Rushworth, *pers. comm.*). These cling to the underparts of the females and remain in this position when they are in the resting places until ready to fly on their own.

Sizes and Weights

MALES (Katima Mulilo, Caprivi)

G 124; TL 120; T 35; Hf c/u 18; E 35
Weights, only two available—26·3; 27·7 g

FEMALES (Savuti)

TL	$\bar{X} = 101$;	$N = 5$;	Obs. range 90-115
T	$\bar{X} = 24$;	$N = 5$;	„ „ 20-29
Hf c/u	$\bar{X} = 16$;	$N = 5$;	„ „ 14- 17
E	$\bar{X} = 18$;	$N = 5$;	„ „ 15- 20

Weights, only two available—26·0; 26·1 g

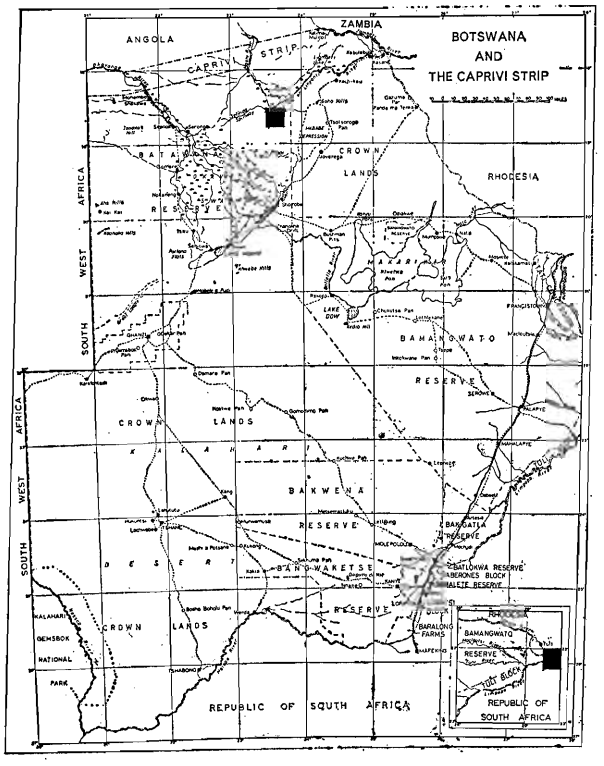
Taphozous perforatus

Egyptian Tomb Bat

T. p. rhodesiae Harrison, 1962

Distribution

The species has a wide range on the continent but, so far, has only been taken in Botswana at the Savuti-Chobe River confluence and in the extreme eastern part of the Bamangwato Reserve. The type locality of *T. p. rhodesiae* is within a mile or two of the border in this sector within the quarter-degree square shared by the two territories.



Habitat

Their habitat differs from *T. mauritianus* in that they prefer flat surfaces in dark places. They are unlikely to be found unless there are suitable crevices, in rocky outcrops or buildings, into which they can creep. This may be the reason for their absence in so much of Botswana, on the other hand, there is ample suitable habitat in the sandstone and granite kopjes in the eastern sector, where they should be looked for.

Irwin and Donnelly (1962) record taking the species in a cave, while others were seen in a large fractured rock atop a pinnacle-like hill at the Shashi-Limpopo confluence.

Habits, Food, Breeding

No data.

Sizes and Weights

The measurements of the topotypical series of *T. p. rhodesiae* is as follows:

MALES

TL	$\bar{X} = 96$;	$N = 5$;	Obs. range 90-100
T	$\bar{X} = 28$;	$N = 5$;	„ „ 25- 30
Hf c/u	$\bar{X} = 13$;	$N = 5$;	„ „ 12·6-13·3
E	$\bar{X} = 15$;	$N = 5$;	„ „ 15
F/a	$\bar{X} = 61·5$;	$N = 2$;	„ „ 61·2-61·8

Family MOLOSSIDAE
Freetailed Bats

Characterised by the tail, which projects beyond the hind margin of the inter-femoral membrane (fig. 3 (*b*)). Ears rounded, about as broad as high, the lips thick and wrinkled, the nostrils opening forward giving a distinct bulldog-like appearance.

Skull distinctly flattened (depth of braincase about a third of its width) (fig. 5 (*a*)) . . . . *Sauromys*

Skull not flattened (fig. 5 (*b*)) . . . *Tadarida*

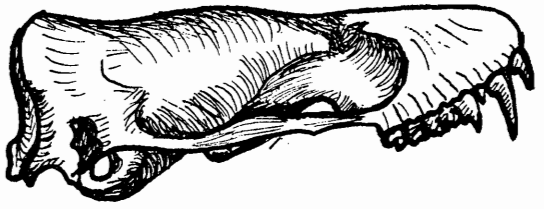


Fig. 5(a)

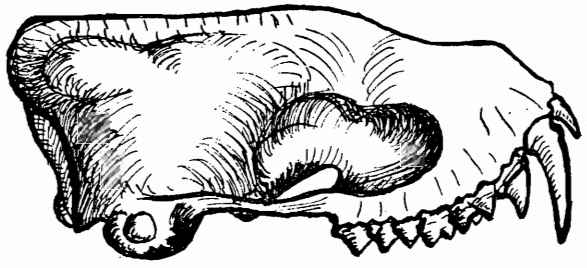


Fig. 5(b)

Fig. 5 Skulls of bats
(a) *Sauromys petrophilus*
(b) *Tadarida* sp.

Genus SAUROMYS Roberts, 1917
Sauromys petrophilus
S. p. petrophilus (Roberts, 1917)

Flatheaded Freetailed Bat

Taxonomic Notes

Commonly placed in the genus *Platymops*.

Distribution

Recorded from three localities in the eastern sector, at Francistown, Molepolole and Lobatse. As the species is specifically adapted to life in a specialized type of habitat, it is unlikely to be generally distributed in Botswana and, while it will probably be shown, in time, to be more widely distributed in the eastern sector, it is likely to be confined to this area.

Habitat

While all the specimens taken were netted, two individuals were seen in a narrow crevice between rocks on Francistown kopje. When attempts were made to secure them they simply crept deeper into the crevice, neither being secured. In Rhodesia they have been taken from under exfoliation on granite kopjes (Matopos). The skull is particularly adapted to crawling into the narrowest of cracks, being distinctly flattened (fig. 5 (*a*)).

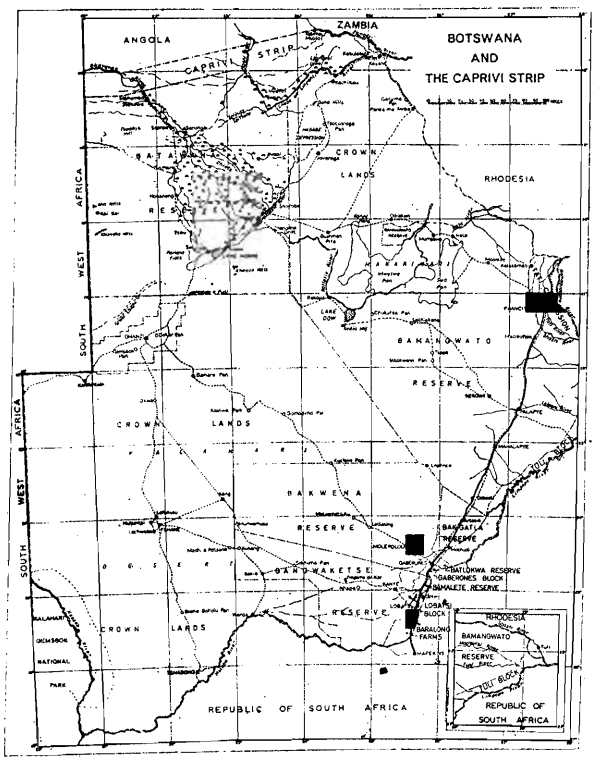
Habits

Appears to be rather a solitary species occurring singly or in pairs and not gregarious like *Tadarida*.

At Francistown they were visiting an open water-tank, either to collect insects or to sip water.

Food

Insectivorous.



Breeding

No information.

Sizes and Weights

MALES

TL	$\bar{X} = 100$;	$N = 3$;	Obs. range 96-105
T	$\bar{X} = 36$;	$N = 3$;	„ „ 33- 39
Hf c/u	$\bar{X} = 7$;	$N = 3$;	„ „ 6- 9
E	$\bar{X} = 17$;	$N = 3$;	„ „ 16- 18
F/a	$\bar{X} = 39$;	$N = 2$;	„ „ 39

FEMALES

TL	$\bar{X} = 97$;	$N = 4$;	Obs. range 93-105
T	$\bar{X} = 35$;	$N = 4$;	„ „ 31- 39
Hf c/u	$\bar{X} = 6$;	$N = 4$;	„ „ 6- 7
E	$\bar{X} = 14$;	$N = 4$;	„ „ 13- 15
F/a	$\bar{X} = 38{\cdot}5$;	$N = 2$;	„ „ 38- 39

Genus **TADARIDA** Rafinesque, 1814

Key to the subgenera of *Tadarida* (modified after Hayman, 1967).

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*.
2. M^3 not reduced, cusps forming N-pattern 2

Palatal emargination absent or rudimentary; ears conjoined, often with post-aural tuft (sometimes well-developed); size medium, forearm 35-52 . . . Subgenus *Chaerophon*.

Palatal emargination well-developed; ears generally separate; size medium to large, forea m 45-66 . . . . Subgenus *Tadarida*.

Subgenus **Mops** Lesson, 1842

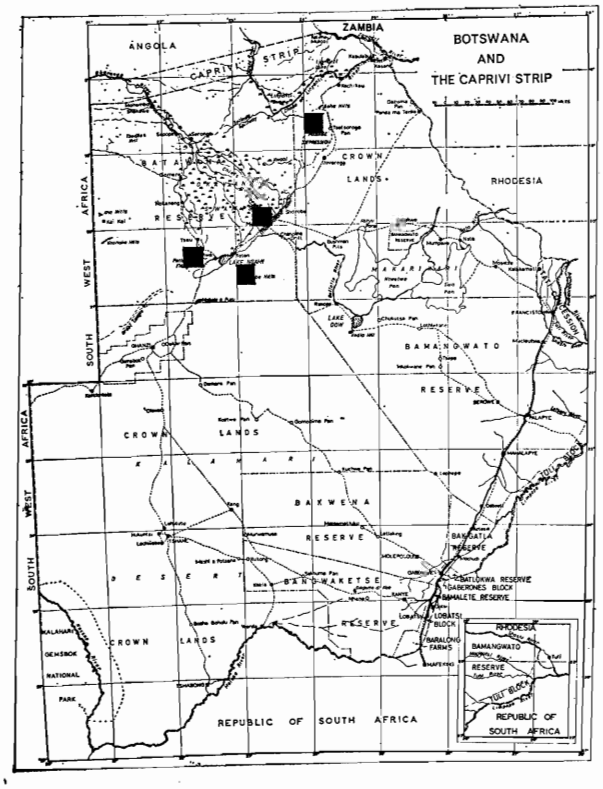
1. Size larger, forearm 58-66. . . . *T.* (*M.*) *midas*
2. Size smaller, forearm 45-50 . *T.* (*M.*) *condylura*

Tadarida (**Mops**) **midas** Sundevall's Freetailed Bat

T. (*M.*) *m. midas* (Sundevall, 1843)

Distribution

So far only recorded from the Okavango delta and the associated Savuti swamp, the material representing a considerable southward extension of the known range of the species on the continent. In parts (Maun and the Savuti) very common.



Habitat

At Maun rests under the corrugated-iron roof of a building in a colony estimated in 'hundreds', its resting places in other areas not having been located.

Slogrove (*in litt.*) reports that the resting colony at Maun was in the attic of a building with a corrugated-iron roof. This attic was divided into four rooms, the first with a slotted ventilation-grill opening to the exterior and an open manhole leading into the second room. Both these rooms were well-lighted and contained no bats. A further open manhole led from the second to the third fairly dark room which contained a few bats and there was a small hole in the wall of this third room leading to the fourth which was pitch-dark and contained the bulk of the colony.

This fourth room had two other small openings to the exterior, one under the apex of the roof, the other under the eaves, which were used by the bats in leaving the resting place just after sundown. Entrance was effected through the slotted ventilation-grill via the first, second and third rooms.

It appeared that in this situation at least, there was a very decided preference on the part of the *T. midas* to seek the darkest possible situation in which to rest.

At this colony specimens were secured by hanging a four-gallon tin under the holes from which they emerged. Dropping from the hole before opening the wings, they were trapped.

Habits

Start to feed shortly after sundown, the flight slow and straight, at a height of 15-30 metres. At Toten and Savuti they could just be reached with the aid of a dazzling light, in the beam of which they could be followed, not wavering in their flight, and secured with a 12-bore shotgun. At the water-hole in the Dautsa flats they were netted as they swooped down to take insects.

At the Savuti and Lake Ngami they appeared at sundown to feed over open ground on the fringes of and over the swamp; at the Dautsa flats at water-holes in the open plain and near Toten over a pan filled with water.

Verschuren (1957) collected a number of specimens from hollow trees and, on the Dautsa flats and Toten, it is likely that they use these in which to rest as there are no rocks or buildings. At Savuti there are a number of low hills with caves and crevices but they were not located there, but might well have been overlooked.

Rosevear (1965) states that in a colony 'the females seem to outweigh the males heavily in number'. This is not reflected in samples caught in the tin-trap taken from the house attic at Maun as follows:

	Males	*Females*
3. 9.67	2	4
19. 9.67	4	3
20. 9.67	6	6
21. 9.67	3	3
25. 9.67	1	2
2.12.67	4	12
20.12.67	4	5
22. 4.67	1	3
30. 6.67	1	1
20. 1.70	2	4
22. 1.70	11	6
28. 1.70	3	2
3. 2.70	9	14
	51	65

Rosevear (1965) states that 'the species lives in colonies of a dozen or more, sometimes less but, so far as is known, never more'. While, because of its situation, it is impossible to gauge the size of the Maun colony, it unquestionably numbers several hundred.

Food

Insectivorous.

Breeding

In a sample of 72 female specimens taken from the house attic in Maun over a few months of the year, gravid females were found between December and February as follows:

	J	F	M	A	M	J	J	A	S	O	N	D
Total	13	18	3	3	–	14	–	–	5	–	–	16
Non-gravid	7	11	3	3	–	14	–	–	5	–	–	15
Gravid	6	7	–	–	–	–	–	–	–	–	–	1

In every case the gravid female carried one foetus, implanted 1L.

The average weight of these foetuses (ex-formalin specimens) in the two months were as follows:

January:
Weight $\bar{X} = 5{\cdot}4$ g; $N = 6$; Obs. range 3·1- 7·4 g
February:
Weight $\bar{X} = 9{\cdot}5$ g; $N = 5$; „ „ 8·8-10·0 g

Four foetuses from February of weights 9·6-10·0 g, although still naked, appeared near full-term.

On the above basis it seems that the young are born about the months of February and March.

Sizes and Weights

MALES

TL	$\bar{X} = 144$;	$N = 38$;	Obs. range 127-160
T	$\bar{X} = 49$;	$N = 49$;	„ „ 45- 58
Hf c/u	$\bar{X} = 15$;	$N = 26$;	„ „ 13- 17
E	$\bar{X} = 28$;	$N = 38$;	„ „ 25- 32
F/a	$\bar{X} = 61$;	$N = 30$;	„ „ 59- 61
Weight	$\bar{X} = 48{\cdot}5$ g;	$N = 4$;	„ „ 42·0-52·3 g

FEMALES

TL	$\bar{X} = 142$;	$N = 44$;	Obs. range 126-150
T	$\bar{X} = 47$;	$N = 44$;	„ „ 40- 52
Hf c/u	$\bar{X} = 15$;	$N = 31$;	„ „ 13- 17
E	$\bar{X} = 27$;	$N = 44$;	„ „ 25- 30
F/a	$\bar{X} = 60$;	$N = 29$;	„ „ 59- 61
Weight	$\bar{X} = 44{\cdot}5$ g;	$N = 4$;	„ „ 41·0-48·0 g

A series of specimens preserved in 5% formalin from Maun taken for purposes of examination of the reproductive status had the following measurements and weights:

MALES (Maun)

TL	$\bar{X} = 141$;	$N = 24$;	Obs. range 132-150
T	$\bar{X} = 43$;	$N = 24$;	„ „ 40- 47
Hf c/u	$\bar{X} = 15$;	$N = 24$;	„ „ 15- 16
E	$\bar{X} = 25$;	$N = 24$;	„ „ 23- 26
F/a	$\bar{X} = 62$;	$N = 24$;	„ „ 59- 64
Weight	$\bar{X} = 55{\cdot}7$ g;	$N = 24$;	„ „ 40·1-68·5 g

FEMALES (Maun)

TL	$\bar{X} = 139$;	$N = 27$;	Obs. range 130-150
T	$\bar{X} = 41$;	$N = 27$;	„ „ 37- 47
Hf c/u	$\bar{X} = 15$;	$N = 27$;	„ „ 14- 15
E	$\bar{X} = 25$;	$N = 27$;	„ „ 25- 26
F/a	$\bar{X} = 61$;	$N = 27$;	„ „ 59- 62
Weight	$\bar{X} = 54{\cdot}0$ g;	$N = 27$;	„ „ 38·8-67·2 g

The measurement of this series of preserved as compared with freshly collected material reflects the shrinkage that might be expected in the total length; tail and more especially the ears, involving, as it does, the soft parts of the body. On the other hand, the length of the hindfoot c/u is the same for the two series and the length of the forearm nearly the same.

The increase in weight of the preserved Maun series may be due to the fact that they were all taken during the months of January and February, when food is very plentiful. This series again reflects the slightly larger size and heavier weight of the males.

Tadarida (Mops) condylura

Angola Freetailed Bat

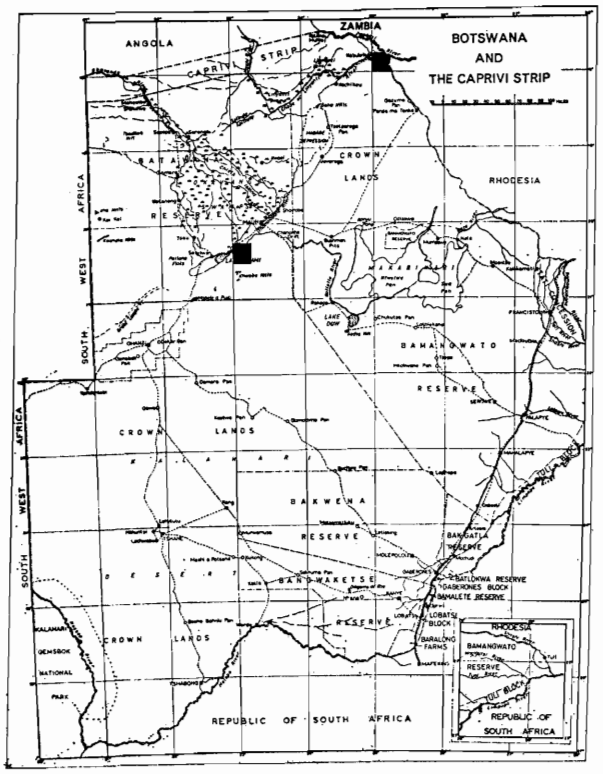
T. (*M.*) *c. condylura* (A. Smith, 1833)

Taxonomic Notes

In Botswana material there is no difference between the colour of the crown and the remainder of the back. In C 1171 from Kasane there is some white on the underparts, in the remainder none at all. In all cases the skulls have a distinct sagittal crest. These characters differentiate the series from *T. niveiventer* (Cabrera and Ruxton, 1926).

Distribution

The species is widely distributed over Africa south of the Sahara and is, according to Rosevear (1965), 'the commonest species of *Tadarida* (*Mops*) in collections'. There are only two records of its occurrence in Botswana, Kasane and Toten, and it is apparently uncommon in the territory. Rosevear (1965) states that 'there seem to be no records from the semi-



desert' and if this is generally the case then its distribution in Botswana is likely to be restricted to the northern and possibly the eastern parts of the territory.

Habitat

Unfortunately all the specimens taken in Botswana were either netted or shot and there is, therefore, no information on the resting places. Rosevear (1965) states that 'they live in hollow trees, sometimes in dozens, sometimes in larger colonies of a hundred or two, packed together in restricted cavities'. He also records them from under the roofs of houses.

In other parts of Africa they appear to have a wide habitat tolerance, excluding semi-desert.

Habits

No information.

Food

No information.

Breeding

Three females from Kasane, taken on the 26th January, were gravid, carrying one foetus each.

Sizes and Weights

MALES

TL	$\bar{X} = 118$;	$N = 6$;	Obs. range 110-125
T	$\bar{X} = 41$;	$N = 6$;	„ „ 38- 42
Hf c/u	$\bar{X} = 19$;	$N = 6$;	„ „ 18- 20
E	$\bar{X} = 13$;	$N = 6$;	„ „ 13

FEMALES

TL	$\bar{X} = 115$;	$N = 8$;	Obs. range 110-125
T	$\bar{X} = 39$;	$N = 8$;	„ „ 36- 42
Hf c/u	$\bar{X} = 18$;	$N = 8$;	„ „ 16- 19
E	$\bar{X} = 13$;	$N = 8$;	„ „ 12- 13

No weights available.

Subgenus **Chaerephon** Dobson, 1874

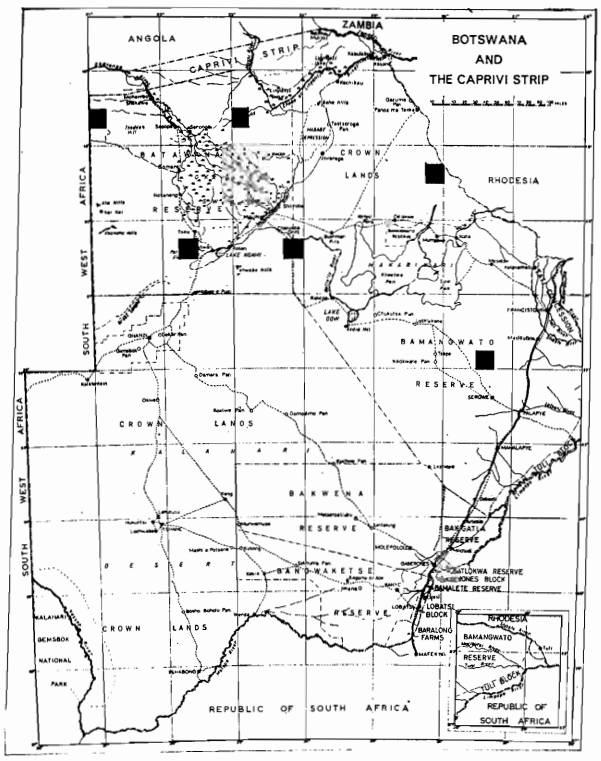
1. Conspicuous white lateral bands below along the flanks at the junction with the membrane, contrasting with the very dark brown colour above and below; forearm 44-50. . *T. (C.) nigeriae*
2. No white lateral bands; forearm 37-42 . . . . *T. (C.) pumila*

Tadarida (Chaerephon) nigeriae Spillmann's Freetailed Bat

T. (C.) n. spillmanni (Monard, 1932)

Taxonomic Notes

The wing membranes in four out of the five specimens from Botswana were distinctly whitish. In BP 1420 from Sehitwa it was, however, much darker, the character apparently being variable. The most characteristic features of the species are the dark colour of the upper-parts and the conspicuous white lateral bands on the underparts, along the flanks at the junction with the membrane. In four specimens this continues right along the flanks, in BP 1420 it is restricted to the posterior half.



Distribution

The six records of this species all lie north of 22° S. and are too few to assess their distribution in the territory. The species is not recorded from South West Africa (Shortridge, 1934) nor have they been taken in the Kalahari and they may, therefore, be absent from this semi-desert area.

Habitat

In eight of the nine records the species was netted over muddy pools, in the sixth, from Makalamabedi, Botletle River, a pair were taken under the bark of a dead camelthorn, *Acacia giraffae*, tree a mile from the river. Disturbed by a dazzling light they were heard scratching around as they moved, squeaking audibly.

At the Tsodilo Hills they were netted at the entrance to a small cave, which they were using as a resting place. This is not a normal situation for the species, which in other parts of Africa hangs under the roofs of houses 'both permanent and thatched' (Rosevear, 1965). Eight of the nine records are from savanna woodland, the sixth from a wide open plain with short grass (Dautsa Flats), where the woodland was several miles from the muddy pool over which they were netted.

Habits

No information.

Food

Insectivorous.

Breeding

No information.

Sizes and Weights

MALES

	TL	T	Hf c/u	E	F/a
BP 1756	106	35	12	18	—
BP 1863	130	39	11	20	49
BP 547	108	40	13	17	48

FEMALES

TL	$\bar{X} = 111$;	$N = 7$;	Obs. range 101-115
T	$\bar{X} = 39$;	$N = 7$;	„ „ 35- 43
Hf c/u	$\bar{X} = 12$;	$N = 7$;	„ „ 9- 12
E	$\bar{X} = 17$;	$N = 7$;	„ „ 17- 22
F/a	$\bar{X} = 47$;	$N = 6$;	„ „ 47- 49

Female BP 1420 weighed 19·8 g

Tadarida (Chaerephon) pumila

Little Freetailed Bat

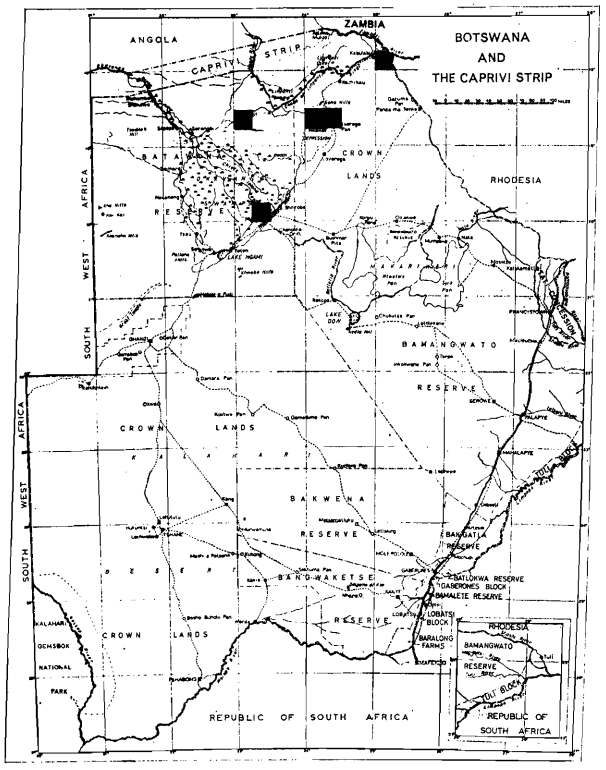
T. (*C.*) *pumila* (Cretzschmar, 1830 vee 1831)

Taxonomic Notes

There is a wide degree of dichromatism in the series from Kasane from specimens with the upper-parts very drab to a much lighter near light brown colour. The under-parts vary similarly, the flanks from a light suede grey to a light brown. Hayman (1967) feels that the data are not sufficient to properly determine which of the many subspecies are valid.

Distribution

With a wide distribution in Africa from Eritrea to Natal, the Congo and Gambia (Rosevear, 1965), the species has so far only been recorded from the northern parts of the territory. On the Chobe River they were taken in series during the months of August to February and in June at Kasane; at Lake Ngami (Shortridge, 1934); the Selinda spillway, Savuti and Maun.



There are no records from western Rhodesia, South West Africa (Shortridge, 1934) or the western Transvaal (Roberts, 1951). Hill and Carter (1941) record them from Forte Rocadas on the Cunene River. The indications are that in the southern part of Africa they are absent in the dry west.

Habitat

Such records as are available suggest an association with the better-watered parts of the territory along rivers and in swamp. In other parts of Africa information on their habitat is scanty. Rosevear (1965) notes that Verschuren found them living in a fresh-water swamp gallery forest 'a colony of half a dozen occupying a small crevice in the trunk of a tree, the entrance a very narrow crack'. At Kasane on the Chobe River the collection was made from colonies of 'dozens' in the roofs of houses. Here they were present during the months of January, February, June to August and October to December. At Maun a colony of *c.* 100-150 was found in a similar situation in the attic of a two-storied block of flats, within 150 yards of the Thamalakane River.

The remaining specimens were taken either by shooting them at dusk over the swamp (Selinda spillway; Savuti) or netting them on the edge of the swamp (Savuti).

The flight is erratic, at Savuti they were feeding over the swamp at about 12 metres high.

Habits

Gregarious, in parts (Maun; Kasane) living in colonies of 'dozens' or up to *c.* 100-150 (Maun). During the day hang up resting in the attics of houses, in a rather scattered formation, not forming closely-knit groups. At Maun the colony was resting under a corrugated-iron roof with a badly ventilated attic, where temperatures during the heat of the day must have reached high limits, as, in the room below, 105° F. was recorded.

Leaves the resting places after dark through very small crevices under the eaves. For an hour before emerging, the colony became very restless scurrying about on the ceiling and the beams and squeaking, making a great deal of noise.

At the Savuti swamp taken in solitary flight over the fringe of the swamp, the flight noticeably erratic making them difficult to shoot, the normal flight height approximately 12 metres but occasionally swooping to within three metres from the ground for short periods.

Food

Insectivorous, the specimens taken at Savuti appeared to be feeding on a small gnat that was rising from the swamp after sundown.

Breeding

At Kasane gravid females were taken in the months of August and October to February. In November very many hairless young were seen in the colonies, at Maun in February some of these were clinging to the parents, others hanging on their own.

Distribution of a series of non-gravid and gravid females from Kasane through the months of the year:

	J	F	M	A	M	J	J	A	S	O	N	D
Total	3	5	–	–	12	5	–	5	–	9	30	44
Non-gravid	–	3	–	–	12	5	–	4	–	–	23	18
Gravid	3	2	–	–	–	–	–	1	–	9	7	26

A series of 12 females taken in May and five in June were all non-gravid. These data suggest a breeding time during the warm wet summer months from August to February.

In all the above 48 gravid females implantation was 1R.

In what might reasonably be accepted as a random sample of 165 specimens taken in the roofs of houses at Kasane, during the months of October to February,

there were 45 males and 120 females. A sample taken in August showed roughly the same proportion of 3 males to 12 females, and in June, 1 male to 4 females.

Sizes and Weights

MALES

TL	$\bar{X} = 87$;	$N = 48$;	Obs. range	70-100
F/a	$\bar{X} = 37$;	$N = 10$;	„ „	36- 39
Weight	$\bar{X} = 11{\cdot}5$ g;	$N = 20$;	„ „	10·3-13·9 g

FEMALES

TL	$\bar{X} = 91$;	$N = 91$;	Obs. range	70-102
F/a	$\bar{X} = 37$;	$N = 12$;	„ „	36- 38
Weight gravid	$\bar{X} = 13{\cdot}6$ g;	$N = 46$;	„ „	12·1-16·7 g
Weight non-gravid	$\bar{X} = 12{\cdot}1$ g;	$N = 65$;	„ „	10·1-16·1 g

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Subgenus **Tadarida** Rafinesque, 1814

Tadarida (Tadarida) aegyptiaca

T. (T.) a. bocagei (Seabra, 1900)

Bocage's Freetailed Bat

Taxonomic Notes

Koopman (1966) in his revision selects the name *T. bocagei* as the name for the west-central Angolan populations of *T. aegyptiaca* thus making *T. a. bocagei* the name for the smaller, arid country, western subspecies. This is represented in Botswana by the two specimens from Molepolole mentioned by Koopman (1966) and a series of five from Tshane, with the following measurements:

F/a	$\bar{X} = 43{\cdot}4$;	$N = 5$;	Obs. range	42-45
Skull TL	$\bar{X} = 17{\cdot}2$;	$N = 5$;	„ „	17·1-17·5

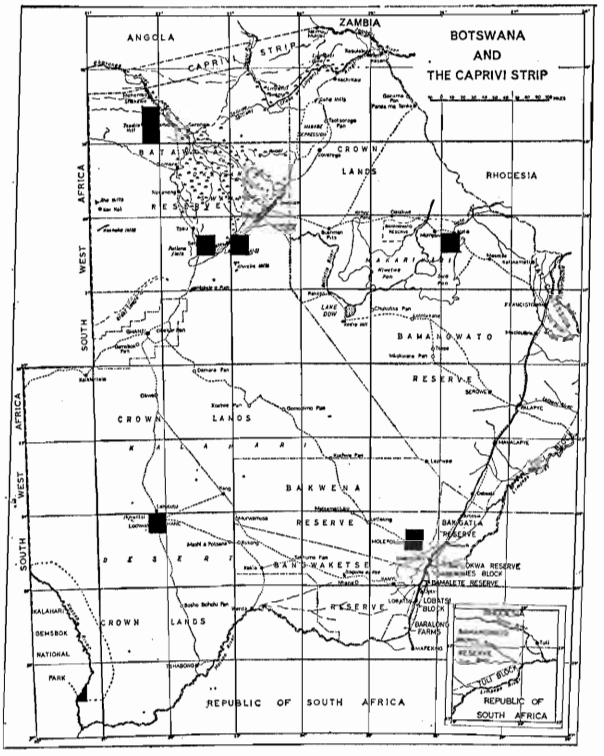
The average measurements of a further series from the Tsodilo Hills, while still falling within the limits given by Ellerman *et al.* (1953) for *T. a. bocagei* are distinctly larger:

F/a	$\bar{X} = 47{\cdot}3$;	$N = 7$;	Obs. range	47-48
Skull TL	$\bar{X} = 19{\cdot}8$;	$N = 4$;	„ „	18·6-20·2

Although two of these specimens have skull lengths over those given as the maximum, 19 mm, by Ellerman *et al.* (1953), the length of the forearm falls within the overlap zone of 47-47·5 recognized between the two subspecies. On this basis the two series are referred to as *T. a. bocagei* (Seabra).

Distribution

The species is widely distributed in Africa from Egypt to the Cape. In Botswana the records are scattered but, as they occur in the driest areas in the south-west in the mean annual rainfall zone of 200 mm as well as in the southern part of the Okavango delta in the 450 mm zone they might be expected to occur throughout the territory. Shortridge (1934) believes them to be widely distributed in South West Africa.



Habitat

Most of the localities in which they have been taken in Botswana are situated in open country including the bush savanna of the south-west, the open grasslands of the Makarikari and Lake Ngami and the open *Acacia nigrescens* woodland in the vicinity of the Tsodilo Hills in the north-west.

Habits

The species is a fast flier, an attribute which is best appreciated if they are seen skimming across the top of water to pick up insects or to sip from the surface in flight. At Tshane in February 1961 they were watched as they skimmed the surface of the water in a corrugated-iron tank some six metres in diameter. While the water-level was near the lip of the tank this manoeuvre was invariably successfully accomplished. When the level was dropped by a metre, however, many were unable to pull up quick enough and dashed themselves against the side resulting in many being collected. At Tsodilo Hills six were collected one evening after dashing themselves against a tree-trunk against which a pressure-lamp was hanging. In this case it seemed that they were trying to catch insects round the light (Guy, *pers. comm.*). A series was netted here at the entrance of a small cave in which they were resting.

The other Botswana specimens were taken by netting over water-holes and there is, therefore, no information on their resting places during daylight hours. Shortridge (1934) states that they rest in caves, lofts and hollow trees and behind the bark of large *Acacia* trees in large colonies (hundreds). Rosevear (1965) remarks that they are gregarious and 'live in caves or large buildings'. The numbers seen at Tshane in 1961 suggested that there were large colonies in the vicinity. In this area there are no caves and they certainly were not resting either in the settlement buildings or in the low calcareous krantzes overlooking the pan where they were assiduously sought for. There are, in the vicinity, stands of large camelthorn trees, *A. giraffae*, in which they might have been resting but they were not found.

Food

Insectivorous.

Breeding

No information.

Sizes and Weights

Tsodilo Hills series

MALES			
TL	$\bar{X} = 117$;	$N = 6$;	Obs. range 111-121
T	$\bar{X} = 42$;	$N = 6$;	„ „ 41- 44
Hf c/u	$\bar{X} = 11$;	$N = 6$;	„ „ 9- 12
E	$\bar{X} = 22$;	$N = 6$;	„ „ 21- 22
Weight	$\bar{X} = 17{\cdot}3$ g;	$N = 6$;	„ „ 15- 20 g
FEMALES			
TL	$\bar{X} = 120$;	$N = 12$;	Obs. range 115-125
T	$\bar{X} = 42$;	$N = 12$;	„ „ 39- 47
Hf c/u	$\bar{X} = 10$;	$N = 12$;	„ „ 9- 12
E	$\bar{X} = 21$;	$N = 12$;	„ „ 20- 23
Weight	$\bar{X} = 17{\cdot}8$ g;	$N = 12$;	„ „ 15- 20 g

Family VESPERTILIONIDAE
Vesper Bats

The largest family of bats, represented in Botswana by eight genera and ten species.

The circular or crescentic muzzles are simple and dog-like without noseleaves; eyes minute; the long tail included in the inter-femoral membrane or only the last single joint free.

1. Ear funnel-formed, posterior edge of the inter-femoral membrane with a hairy fringe *Kerivoula*
   Ear not funnel-formed, no hairy fringe . . 2
2. Second phalanx of third finger nearly three times as long as the first . . . . . *Miniopterus*
   Second phalanx of third finger not specially elongated 3

Fig. 6 Dentition of bats

(a) *Eptesicus* sp. with one upper premolar

(b) *Pipistrellus* sp. with two upper premolars

Fig. 7 Heads of bats

(a) *Eptesicus capensis*

(b) *Laephotis wintoni*

Fig. 8 Ear tragus of bats

(a) *Scotophilus nigrita*

(b) *Nycticeius schlieffeni*

3. Two upper incisors each side 4
   One upper incisor each side 7
4. Wings unicolor 5
   Wings with a conspicuous dark reticular pattern on a pale ground . . . . . *Glauconycteris*
5. Upper jaw with two premolars each side (fig. 6 (*b*)) . . . . . *Pipistrellus*
   Upper jaw with one premolar each side (fig. 6 (*a*)) 6
6. Ears longer than the head, over 18, skull elongate (fig. 7 (*b*) (fig. 10(*b*)) . . . . . *Laephotis*
   Ears less than the length of the head, under 18, skull normal (fig. 7 (*a*)) (fig. 10(*a*)) . *Eptesicus*
7. Skull with a distinct posteriorly projecting helmet, ear tragus long, tapering (fig. 8 (*a*)) . *Scotophilus*
   Skull normal, ear tragus half-moon shaped (fig. 8 (*b*)) . . . . . *Nycticeius*

Genus KERIVOULA Gray, 1842

Kerivoula harrisoni

Harrison's Woolly Bat

K. h. lucia Hinton, 1920

(Skull, fig. 14 (*b*).)

Distribution

Recorded in the extreme north-western parts of the territory as far south as Sepopa and from Molepolole (American Museum of Natural History). They appear to be uncommon everywhere throughout their range and are poorly represented in collections. They may, in time, be found in other parts of the northern and eastern parts of the territory although they are unlikely to occur in the drier areas.

Habitat

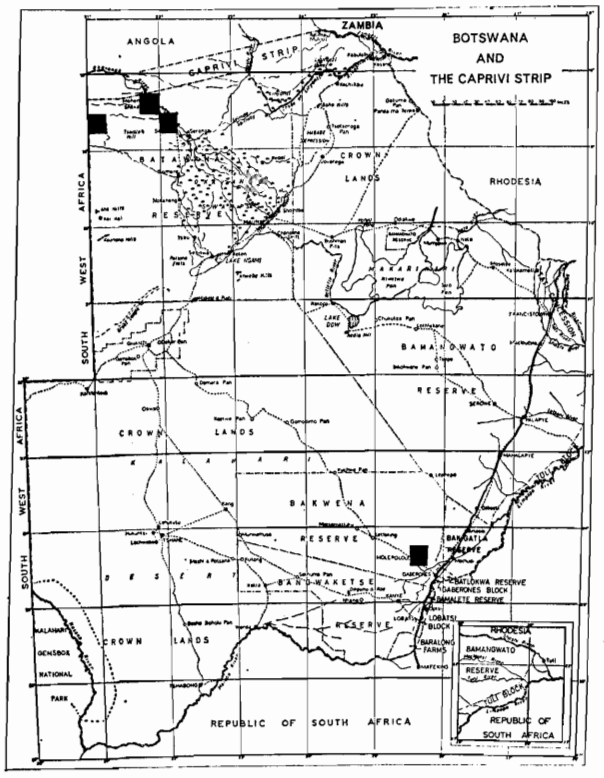
All the specimens were taken from the nests of weaver birds, *Ploceus* sp., and sunbirds, *Nectarinia senegalensis* (Sepopa).

Habits

No information.

Food

Insectivorous.



Breeding

No information.

Sizes and Weights

	TL	T	Hf c/u	E	Length tragus	Weight
MALES						
TNL 2823	77	37	7	13	9	6·0 g
FEMALES						
TNL 2821	80	39	7	13	9	7·0 g
TNL 2822	78	37	8	14	9	6·0 g
TNL 3351	76	35	8	13	8	8·0 g

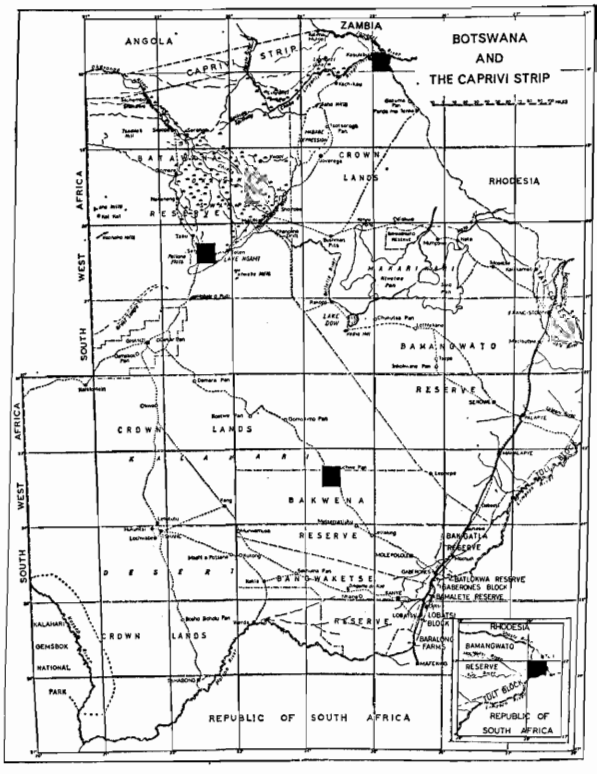
Genus MINIOPTERUS Bonaparte, 1837

Miniopterus schreibersi

Schreiber's Bat

M. s. natalensis (A. Smith, 1834)

(Skull, fig. 13 (*e*).)



Distribution

There are only four scattered records from Botswana, Kasane, Lake Ngami, Kuchwe Pan and Mabate, and, until further material is available, it is impossible properly to assess their distribution in the territory. Shortridge (1934) records the species in South West Africa only as far south as Gobabis (22°28′ S.), but they have also been taken at Klipfontein, Little Namaqualand (33°14′ S.) in the north-western Cape Province. They have been found to be widely distributed in adjacent territories and on this basis will probably, in time, be shown to be more common in Botswana than present records indicate.

Habitat

At Kasane they were taken in houses; the Kuchwe Pan specimen was collected by the Vernay Lang Expedition (Roberts, 1935) 'on a lorry on which it had taken refuge'. Shortridge (1934) records their being taken in series 'inside tents' at Grootfontein, South West Africa. There is no information on the

Lake Ngami specimen. In Rhodesia the species is commonly associated with caves, mine shafts and adits (Umtali) where they sometimes occur in very large numbers (hundreds); smaller colonies have been found under the roofs of houses.

Habits

This narrow-winged bat is an exceedingly fast flier, flashing over the surface of water to take insects or sip water (Mabate). While most of the individuals in colonies hang by their feet in clusters they are also as much at home clinging flat against the walls.

Food

Insectivorous.

Breeding

No information from Botswana. In Rhodesia gravid females have been taken in October, implantation all 1R.

Sizes and Weights

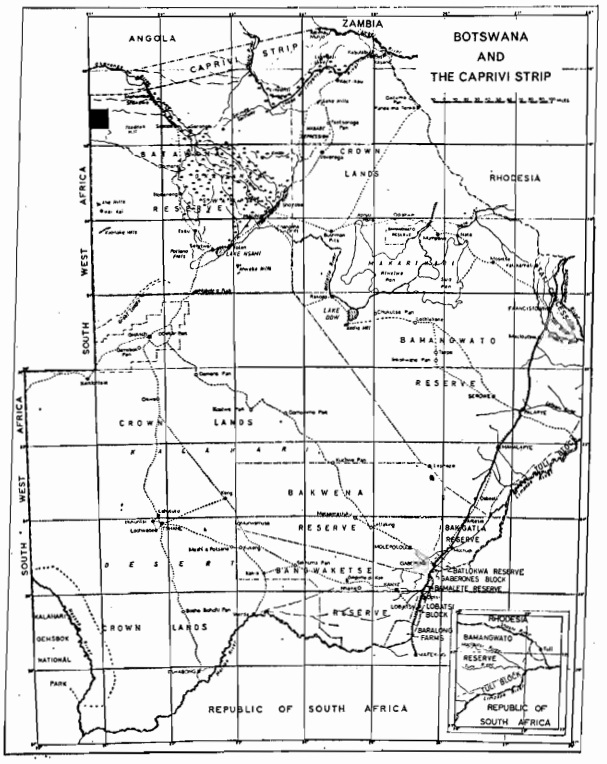
No data.

Genus GLAUCONYCTERIS Dobson, 1875

Glauconycteris variegata

Butterfly Bat

G. v. variegata (Tomes, 1861)



(Skull, fig. 13 (*c*).)

Although the species has a wide distribution in Africa south of the Sahara only one specimen was taken in Botswana in the extreme north-west (18 21 C1), netted over open water in open woodland. Nothing is known of their habits or time of dropping the young in Botswana. Lang and Chapin (1917) took them from native huts in small colonies up to ten but stated that they 'usually prefer to conceal themselves between suitable bunches of leaves'. Normally high-flying bats, the dark reticulation on the wings and sandy brown colour make them an easily distinguished species.

The measurement and weight of the single Botswana female is as follows:
TL 111; T 51; Hf c/u 11; E 15; Length tragus 7; Weight 13 g.

Genus PIPISTRELLUS Kaup, 1829

Key to the subgenera of Pipistrellus

1. Inner upper incisors deeply bifid, ventral surface pure white (fig. 9 (*c*)) . . Subgenus *Scotozous*
2. Inner upper incisors unicuspid or not very deeply bifid, ventral surface brown or grey (fig. 9 (*a*)) . . . . Subgenus *Pipistrellus*

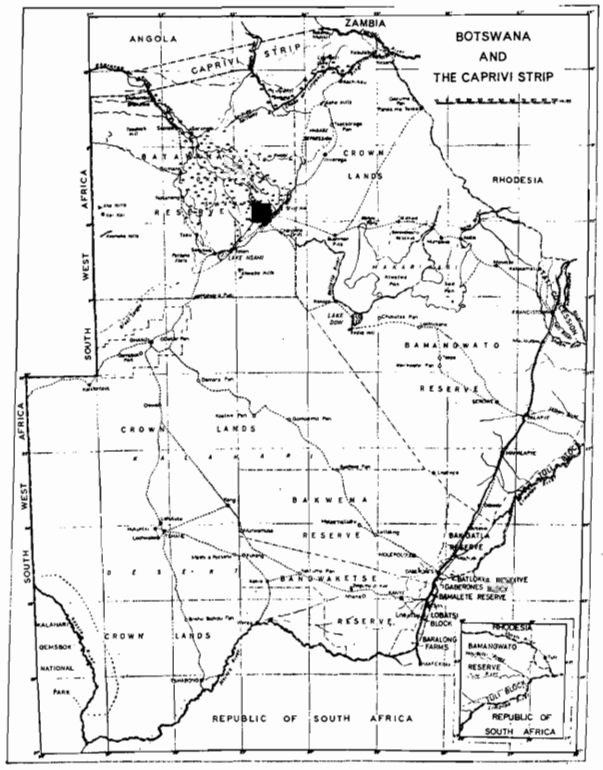
Fig. 9 Upper incisor teeth

(a) *Pipistrellus nanus* (b) *P. rusticus* (c) *P. rueppelli*

Subgenus **Scotozous** Dobson, 1875

Pipistrellus (Scotozous) rueppelli Ruppell's Pipistrelle

P. (S.) r. vernayi Roberts, 1932



Only known from a series of seven specimens taken at Maun, Ngamiland (Transvaal Museum, Pretoria). According to Roberts (1951) these were taken over Tamalakane River 'emerging at dusk and flitting above the water'. This species was not collected and, therefore, there is no information on its ecology.

Subgenus **Pipistrellus** Kaup, 1829

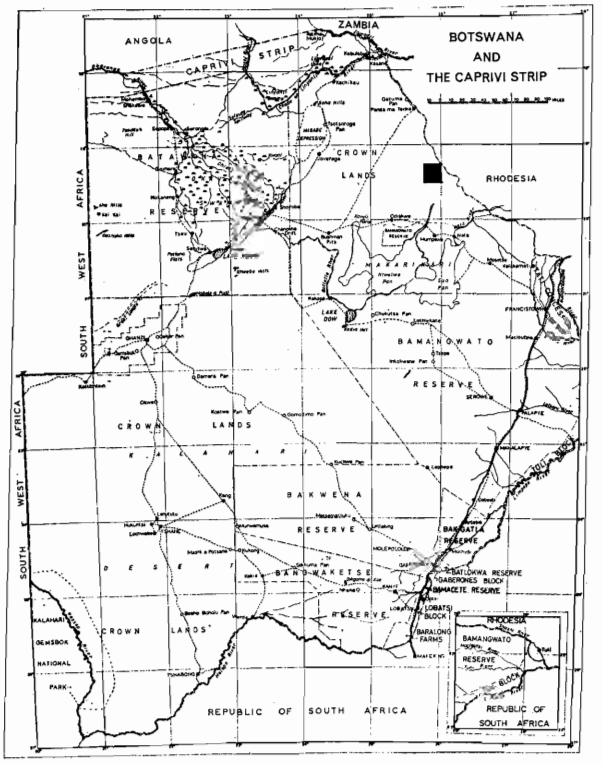
Key to the species of Pipistrellus

1. Second upper incisor very reduced . *P. kuhli*
   Second upper incisor not very reduced, only slightly smaller than first 2
2. Braincase flatter, cranium nearly level with muzzle (fig. 10 (*b*)) . . . . . *P. rusticus*
   Braincase clearly raised above level of muzzle (fig. 10 (*c*)) . . . . . *P. nanus*

Pipistrellus (Pipistrellus) kuhli

Kuhl's Pipistrelle

P. (P.) k. subtilis (Sundevall, 1846)



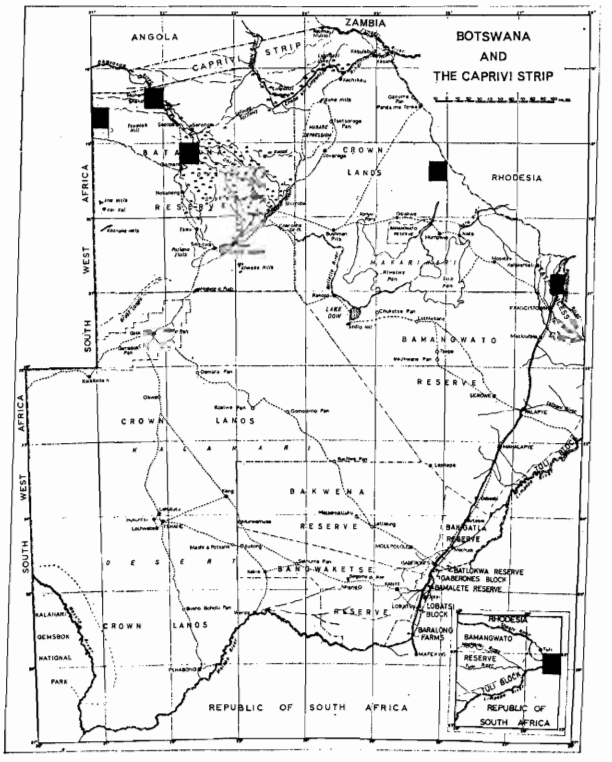
So far only recorded from Tamafupi. Shot at sundown among dead camelthorn trees, *A. giraffae*, on the fringe of an open area at a water-hole. Only one specimen was taken. There is no information on their ecology in Botswana although it was suspected that they were resting in dead trees. Occur alongside *P. (P.) rusticus* at Tamafupi.

The size and weight of the single female specimen are as follows:
BP 185; TL 74; T 33; Hf c/u 6; E 10; F/a 58; Weight 3·5 g.

Pipistrellus (Pipistrellus) rusticus

Rusty Pipistrelle

P. (P.) r. rusticus (Tomes, 1861)



(Skull, fig. 10 (*d*).)

So far only recorded from three localities in the extreme north-west; Tamafupi on the Rhodesian border; in the Tati Concession and at the Shashi-Limpopo River confluence.

All these specimens were either shot or netted and there is no information on their resting places. Occur alongside *P. (P.) kuhli* at Tamafupi.

Pipistrellus (Pipistrellus) nanus

Banana Bat

P. (P.) n. fouriei Thomas, 1926

(Skull, fig. 10 (*c*).)

Taxonomic Notes

Ellerman *et al.* (1953) considers this small pipistrelle as a subspecies of *P. culex*. Rosevear (1965) points out that 'it is impractical to draw a sharp line between *nanus* and *culex*, colour, size and the unicuspidity of the inner upper incisors being variable'. Hayman (1967) considers *fouriei* as 'probably a synonym (or at most a doubtful subspecies)' of *P. nanus*.

The material available is certainly immediately distinguishable from a series of *P. n. nanus* from Rhodesia both in colour and size. *P. n. nanus* in the southern part of the continent appears to have an eastern distribution, at least in the Republic of South Africa (Roberts, 1951); Rhodesia; and Zambia where Ansell (1960) notes that it is 'as yet unrecorded in Barotse and the western and central Provinces'. Hill and Carter (1941) record *P. nanus* north of the Mossamades district (*c.* 15° S.), *P. fouriei* from the area east of the coastal mountains at Capelongo on the Cunene River (*c.* 15° S.) in Angola. Shortridge (1934) records *P. fouriei* from the northern parts of South West Africa and eastern Caprivi.

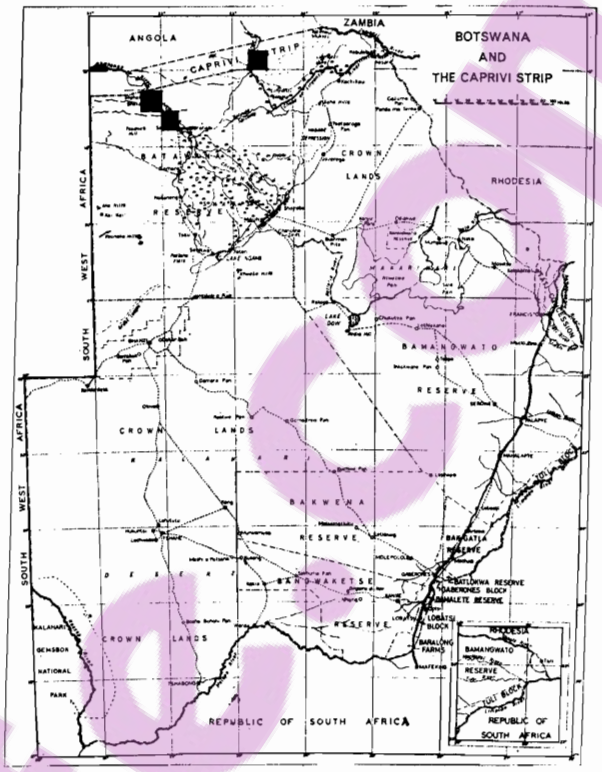
Until there is further clarification of the relationship of the nominate form and *P. n. fouriei*, it is proposed to consider the Botswana material as being referable to this latter subspecies. (Skull, fig. 10 (*c*).)

Distribution

Confined to the extreme north-western part of the territory at Shakawe and Sepopa, on the Okavango River, and extralimitally recorded from other localities on this river in Angola and South West Africa and on the Maschi River in the eastern Caprivi. In view of this last-named record, the species might be expected to occur within Botswana limits at least narrowly southwards along the Chobe River.

Habitat

All the records to date in Botswana, as well as those in South West Africa, Angola and the Caprivi, are from the vicinity of large rivers. Shortridge (1934) draws particular attention to this feature of the species in South West Africa. The Botswana material was all netted and there is, therefore, no information on their resting places. Shortridge (1934) states that in Ovamboland they were observed 'flying out of holes in verandah poles'.



Habits

The flight is slow and erratic as they flutter around bushes at a few feet above the ground or higher round the canopy of the trees. Where they occur they are quite common, At Sepopa up to half a dozen were seen feeding on insects over a muddy pool, several being netted.

Food

Insectivorous.

Breeding

No information from Botswana; Shortridge (1934) records twin foetuses from Ovamboland in October.

Sizes and Weights

P. (P.) n. fouriei

MALES

TL	$\bar{X} = 71$;	$N = 5$;	Obs. range 70-74
T	$\bar{X} = 30$;	$N = 5$;	,, ,, 29-32
Hf c/u	$\bar{X} = 6$;	$N = 5$;	,, ,, 5- 6
E	$\bar{X} = 10$;	$N = 5$;	,, ,, 10-11
F/a	$\bar{X} = 28$;	$N = 2$;	,, ,, 28
TL skull	$\bar{X} = 11{\cdot}4$;	$N = 2$;	,, ,, 11·2-11·6
Weight	$\bar{X} = 3{\cdot}8$ g;	$N = 5$;	,, ,, 3- 5 g

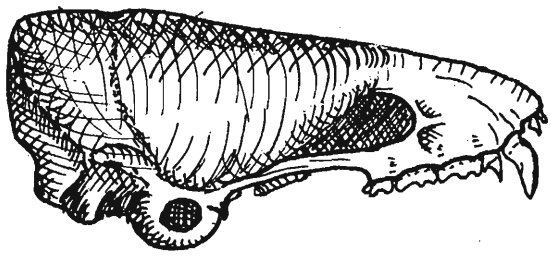
The sizes and weights of a series of the nominate form from Rhodesia are as follows:

P. (P.) n. nanus (Rhodesia)

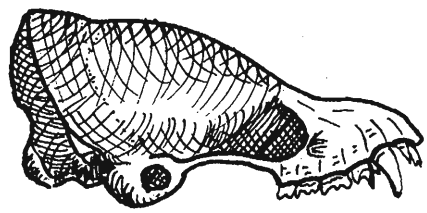
MALES

TL	$\bar{X} = 78$;	$N = 4$;	Obs. range 74-79
T	$\bar{X} = 35$;	$N = 4$;	,, ,, 34-37
Hf c/u	$\bar{X} = 7$;	$N = 4$;	,, ,, 11
E	$\bar{X} = 11$;	$N = 4$;	,, ,, 6- 7
F/a	$\bar{X} = 31$;	$N = 4$;	,, ,, 30-32
TL skull	$\bar{X} = 12{\cdot}0$;	$N = 4$;	,, ,, 11·6-12·3
Weight	$\bar{X} = 4{\cdot}0$ g;	$N = 4$;	,, ,, 4·0 g

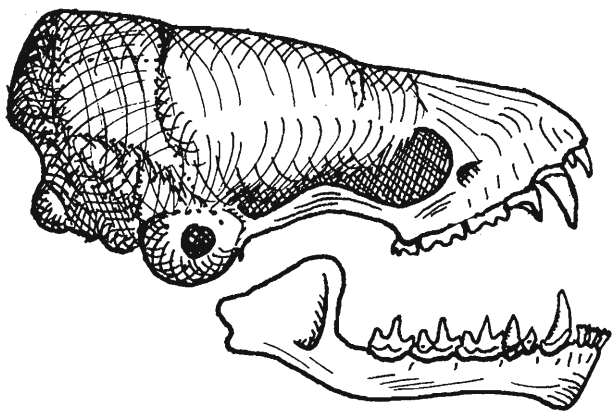
Fig. 10 Skulls of bats



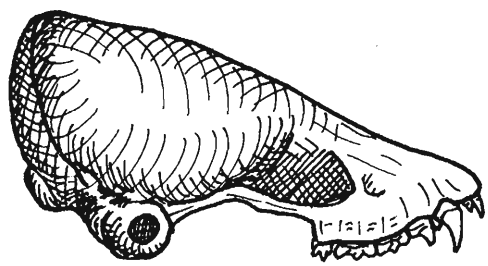
(a) *Eptesicus capensis*



(c) *Pipistrellus nanus*



(b) *Laephotis wintoni*



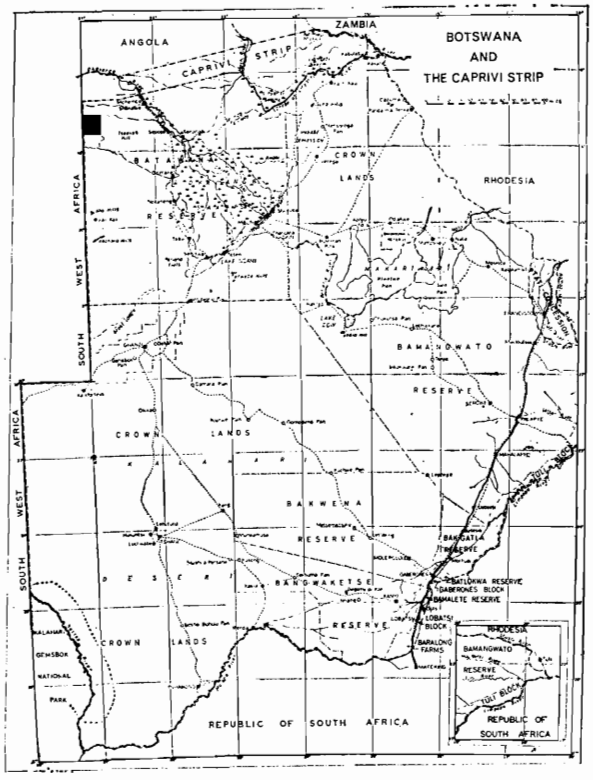
(d) *P. rusticus*

Genus LAEPHOTIS Thomas, 1901

Laephotis wintoni

L. w. angolensis Monard, 1935

De Winton's Longeared Bat



(Face, fig. 7 (*b*); Skull, fig. 10 (*b*).)

So far there is only one record from Botswana, taken on the South West African border in the extreme north-west (18 21 C1), where it was netted over a wet vlei. This subspecies is known from Angola, Katanga, Congo (Kinshasa) and Zambia but is everywhere uncommon.

The specimen, a male, had the following measurements and weight:
SWG 691 TL 96; T 41; Hf c/u 8; E 21; Tr. 10; Weight 6 g.

Genus EPTESICUS Rafinesque, 1820

Subgenus Eptesicus Rafinesque, 1820

1. Wing membranes white or translucent . . . . . *E. (E) rendalli*
   Wing membranes dark 2
2. Cranial portion of skull elevated above rostrum . . . . *E. (E) zuluensis*
   Cranial portion of skull not elevated above rostrum . . . . . *E. (E) capensis*

Eptesicus (Eptesicus) rendalli

Rendall's Serotine Bat

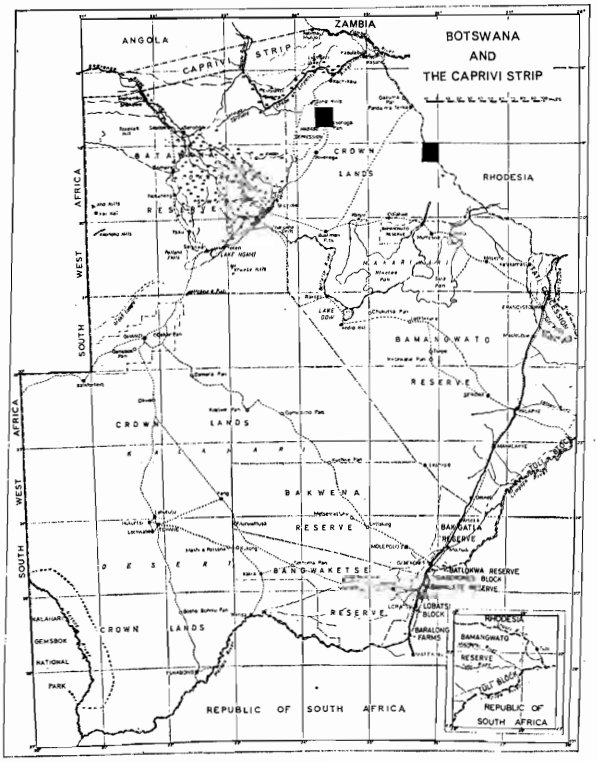
E. (E.) rendalli (Thomas, 1889)

Hayman (1967) associates the species with open woodland and the drier zones from Gambia through the Congo to Kenya, Sudan, Tanzania, Mozambique and Malawi. So far there is only one record from Botswana from 15 miles north-east of Nokaneng, where it was shot in dry open woodland a few miles from the fringe of the swamp. While nothing is known of its ecology in Botswana, Rosevear (1965) states that it seems rather solitary in habit although Lang and Chapin (1917) record finding half a dozen together in the Congo. The species rests inside thatched huts (Rosevear, 1965).

Eptesicus (Eptesicus) zuluensis

Aloe Bat

E. (E.) zuluensis Roberts, 1924



Hayman (1967) considers *vansoni*, placed by Ellerman *et al.* (1953) as a subspecies of *E. zuluensis*, as a synonym of *E. zuluensis*.

Only two specimens have been taken in Botswana, the first by the Vernay Lang Expedition in 1931 (Roberts, 1932) at Tsotsoroga Pan, described as a new species, *Neoromicia vansoni*, and a second specimen from 21 miles north of Tamafupi on the Rhodesian border.

This last-mentioned specimen was shot over an open track just after sundown in company with numerous *E. capensis*. There is no information on any aspect of their ecology in Botswana.

The measurements of the single specimen are as follows:
BP 297 TL 29; T 23; Hf c/u 7; E 7; skull TL 12·2.

Eptesicus (Eptesicus) capensis

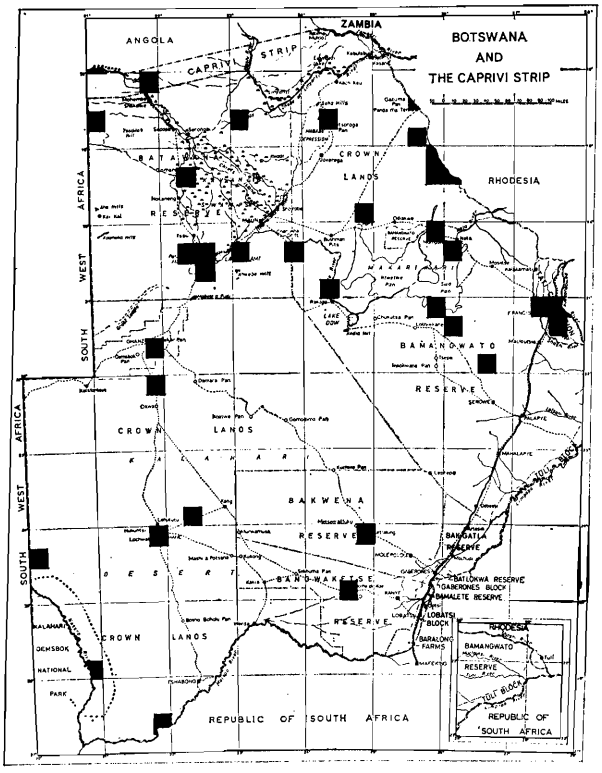
Cape Serotine Bat

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

(Face, fig. 7 (*a*); Skull, fig. 10 (*a*).)

Distribution

Widely distributed throughout the territory from the driest areas to the well-watered higher rainfall areas of the north. One of the commonest species.



Habitat

The species appears to have a wide habitat tolerance occurring, as it does, in the very open dry scrub and sand-dune terrain in the south-west (Khuis); in the rich riverine woodland of the Okavango delta (Gomoti); in mopane woodland (Tati Concession) and *Acacia* (Toten) woodland as well as in open *Acacia* scrub and round pans (Letlakeng Tshane) in the Kalahari.

Habits

There is no evidence of their congregating in colonies and the only evidence of their resting places was an unconfirmed record of a solitary individual emerging from beneath the loose bark of a dead camelthorn, *Acacia giraffae*, tree at Tamafupi. A diligent search of many dead trees during the day in this area did not reveal their presence. It appears that the species is more solitary than communal. Both Shortridge (1934) and Roberts (1951) state that they rest in the roofs of houses, in crevices in rocks or among loose stones in krantzes. None of these situations would be available to them at Tamafupi.

The species was commonly netted over water, in the drier areas over spillage round wells, in the Okavango over swamp or still backwaters. There is no evidence of their sipping water in flight in Botswana, although there is ample evidence of this in other parts of southern Africa (Shortridge, 1934). From the notes on the material collected they are obviously very attracted to water as many of the records were made by netting over it. At Tamafupi specimens were shot at dusk flying down the middle of the sandy track. It appeared that they were feeding on a regular beat as they were seen swinging from the track round some trees some 100 yards away and rejoining the track to fly down it. At the Gomoti River in thick riverine woodland they winged their way round the canopy of the trees at about six to nine metres high, occasionally swooping down to fly at about two metres above ground-level, again apparently on a regular beat.

Food

Insectivorous.

Breeding

There are no records of gravid females or very young specimens from Botswana. In Rhodesia gravid females have been taken in January. Shortridge (1934) records females with twin foetuses from Grootfontein in November and although he states that twin foetuses 'are more normal than singles' in the case of the small Rhodesian series of seven gravid females, four carried single foetus, two twins and one triplets.

Sizes and Weights

MALES				FEMALES			
TL	$\bar{X} = 75$;	$N = 36$;	Obs. range 67-84	TL	$\bar{X} = 81$;	$N = 20$;	Obs. range 77-90
T	$\bar{X} = 30$;	$N = 28$;	„ „ 27-35	T	$\bar{X} = 30$;	$N = 30$;	„ „ 29-36
Hf c/u	$\bar{X} = 8$;	$N = 35$;	„ „ 6- 9	Hf c/u	$\bar{X} = 7$;	$N = 19$;	„ „ 6- 9
E	$\bar{X} = 11$;	$N = 34$;	„ „ 8-14	E	$\bar{X} = 11$;	$N = 19$;	„ „ 10-14
F/a	$\bar{X} = 34$;	$N = 27$;	„ „ 29-32	F/a	$\bar{X} = 32$;	$N = 18$;	„ „ 30-35
Weight	$\bar{X} = 5{\cdot}4$ g;	$N = 8$;	„ „ 4- 7 g	Weight	$\bar{X} = 6{\cdot}5$ g;	$N = 17$;	„ „ 4- 8 g

Genus SCOTOPHILUS Leach, 1821

Taxonomic Notes

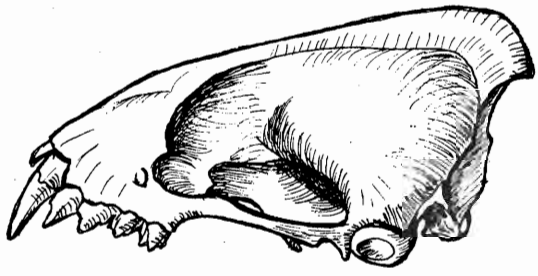
The great majority of the larger of the two species which occur in Botswana, *S. nigrita*, are yellow bellied; there are, however exceptions to this. BP 1171 and BP 1431 from Francistown, although adult, have very pale under-parts with only a faint tinge of yellow. There is some variation in this character juveniles having pale yellow under-parts and it is not unusual (Rhodesia) to find adults in which the yellow is less intense than in others, but all show it to some degree.

BP 1770 from 40 miles north-west of Serowe, however, has white under-parts, lacking any yellow tinge, yet in length of skull (20·1) and forearm (52) is clearly better referred to the larger *S. nigrita* than the smaller *S. leucogaster*. Thomas (1906) provided a name *S. n. herero* for these white-bellied, larger-sized *Scotophilus* originally taken in northern Damaraland (18° S., 17°30′ E.).

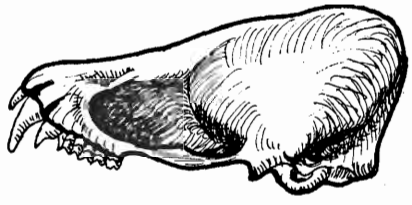
Roberts (1951) records specimens from the same locality, Serowe, where BP 1770 was taken, and also from Pretoria, Transvaal, which brings the subspecies, *S. n. herero*, well within the range of *S. n. dingani*. Roberts concluded that *S. n. herero* warranted specific status. BP 1770 was one of a series of nine *S. nigrita* netted over a muddy mopane pan, all the remainder of the series having yellow under-parts. Rosevear (1965) notes that 'the population from any one district bears a general stamp but is more or less inconstant (in the colour of the under-parts)' and quotes a series from Darfur in which the belly colour varies from white to various degrees of yellowing. On this basis the species with the white under-parts are considered as being a further example of this type of variation and are included with *S. n. dingani* (A. Smith).

The series of *S. nigrita* and *S. leucogaster* from Botswana fall within the limits of measurements in respect of the lengths of the forearm and skull given by Hayman (1967) for the two species (*see* Sizes and Weights). (Skull, fig. 11 (*a*).)

Fig. 11 Skulls of bats



(a) *Scotophilus nigrita*



(b) *Nycticeius schlieffeni*

Key to the species of *Scotophilus*.

Length skull 19·6-23; under-parts usually yellow; length forearm 50-65 . . . . . *S. nigrita*

Length skull 16-19·1; under-parts usually beige; length forearm 43-50 . . . . . *S. leucogaster*

Scotophilus nigrita

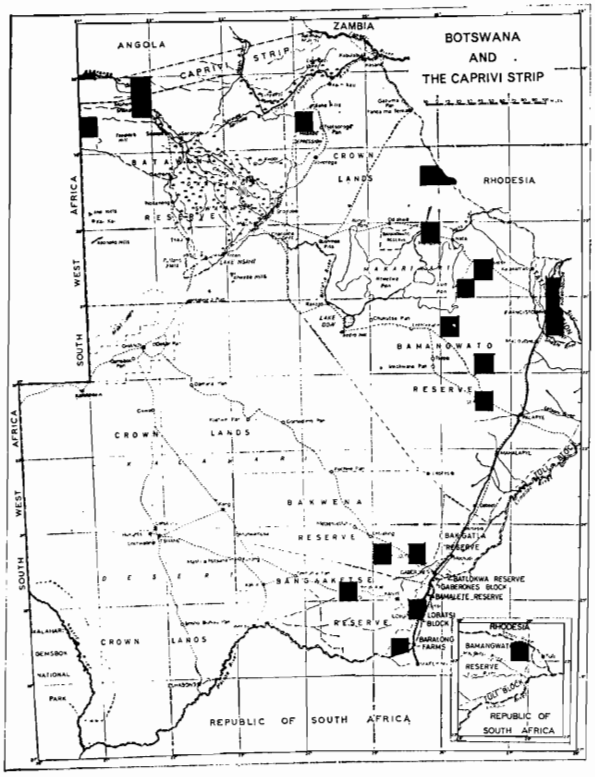
Yellow House Bat

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

(Ear tragus, fig. 8 (*a*).)

Distribution

Occurs in the extreme northern parts of the territory from the South West African border, west of Shakawe, to the Savuti and from Tamafupi on the Rhodesian border southward through the eastern parts of the Makgadikgadi to Serowe and east to the Tati Concession and the Tuli Circle. Southward there appears to be a break in distribution, the species re-occurring in the Molepolole, Dikomodikai, Baralong farms and Lobatse areas.



Habitat

All the Botswana material was either shot or netted over water and there is, therefore, no information on their resting places. In Rhodesia they have been taken from small colonies, up to half a dozen, in the roofs of houses and under the protection of broad eaves. Numbers have been observed congregating to feed over termite mounds in the early part of the wet season, to feed on the emerging flying forms. Many specimens have been taken through flying into houses at night.

Habits

A fast-flying species with a rather even flight. Feeds low over the ground, and as a consequence has been killed by vehicles on main roads.

Food

Insectivorous.

Breeding

No information from Botswana. In Rhodesia gravid and lactating females have been taken in October to December, the normal number of foetuses being two.

Sizes and Weights

MALES

TL	$\bar{X} = 129$;	$N = 7$;	Obs. range 120-135
T	$\bar{X} = 53$;	$N = 6$;	„ „ 51- 56
Hf c/u	$\bar{X} = 14$;	$N = 5$;	„ „ 10- 13
E	$\bar{X} = 16$;	$N = 7$;	„ „ 15- 19
F/a	$\bar{X} = 54$;	$N = 6$;	„ „ 53- 55

FEMALES

TL	$\bar{X} = 132$;	$N = 6$;	Obs. range 127-141
T	$\bar{X} = 49$;	$N = 6$;	„ „ 40- 58
Hf c/u	$\bar{X} = 13$;	$N = 6$;	„ „ 11- 17
E	$\bar{X} = 16$;	$N = 7$;	„ „ 12- 18
F/a	$\bar{X} = 54$;	$N = 8$;	„ „ 53- 55

IRRESPECTIVE OF SEX

TL skull	$\bar{X} = 21{\cdot}5$;	$N = 15$;	Obs. range 19·6-22·7

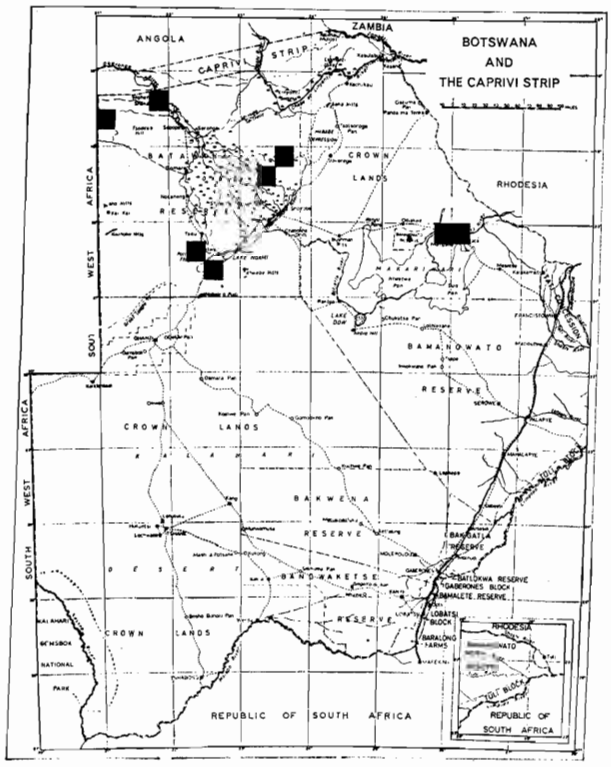
Scotophilus leucogaster

Lesser Yellow House Bat

S. l. viridis (Peters, 1852)

Distribution

Occurs throughout the Okavango delta as far south as Lake Ngami, with a single record from the South West African border west of Shakawe and in the north-eastern parts of the Makgadikgadi in the Mampswe and Nata areas. As the species has a wide



distribution on the continent from the Cape to Abyssinia and Senegal they will probably be shown, in time, to be more widely distributed, at least in the northern parts of Botswana, than present records indicate. In South West Africa Shortridge (1934) records the species from Grootfontein and the Okavango River.

Habitat

All the Botswana material was shot or netted and there is, therefore, no information on their resting places In view of Cretzschmar's (1926) remarks in the original description of the species that they were taken in hollow baobab trees, *Adansonia digitata*, they should be looked for in this situation and in other hollow trees. In certain areas in Botswana in which they occur (Gomoti River) this was the only type of shelter available, there being no buildings, caves or other types of shelter normally used by bats.

While they have been taken in the riverine woodland of the Okavango delta they have also been taken on open grassed plains (Dautsa Flats, Lake Ngami) where woodland is sparse and far removed (2-3 miles) from the places where they were netted and on the fringes of pans (Mampswe). They occur alongside *S. nigrita* (Gomoti River; Mampswe).

Habits

At the Gomoti River they appeared just before sundown (6.15 p.m.) feeding among the trees in the riverine woodland at heights of 5 to 10 m. The flight is fairly slow and generally even, with the usual quick deviations to secure the prey, round the fringe of the tree canopy.

Food

Insectivorous.

Breeding

No information from Botswana.

Sizes and Weights

MALES				
TL	$\bar{X} = 123$;	$N = 3$;	Obs. range	121-125
T	$\bar{X} = 49$;	$N = 4$;	,, ,,	45- 55
Hf c/u	$\bar{X} = 10$;	$N = 3$;	,, ,,	9- 12
E	$\bar{X} = 16$;	$N = 4$;	,, ,,	15- 16
F/a	$\bar{X} = 48$;	$N = 4$;	,, ,,	48
FEMALES				
TL	$\bar{X} = 119$;	$N = 4$;	Obs. range	114-127
T	$\bar{X} = 48$;	$N = 4$;	,, ,,	45- 50
Hf c/u	$\bar{X} = 10$;	$N = 4$;	,, ,,	9- 11
E	$\bar{X} = 15$;	$N = 4$;	,, ,,	15- 16
F/a	$\bar{X} = 49$;	$N = 4$;	,, ,,	47- 49
IRRESPECTIVE OF SEX				
TL skull	$\bar{X} = 18{\cdot}9$;	$N = 12$;	Obs. range	18·6-19·1

Genus NYCTICEIUS Rafinesque, 1819
Subgenus Scoteinus Dobson, 1878
Nycticeius (Scoteinus) schlieffeni

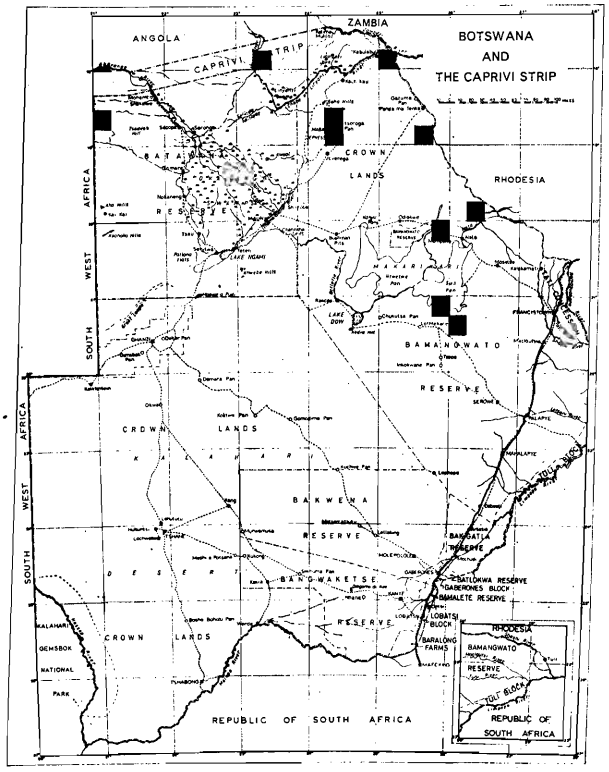
Schlieffen's Bat

N. (S.) s. fitzsimonsi (Roberts, 1932)

(Skull, fig. 11 (*b*); Ear tragus, fig. 8 (*b*).)

Distribution

Widespread and common over much of the continent south and east of the Sahara (Rosevear, 1965), this species has so far only been taken in the northern and north-eastern parts of the territory as far south as Nthane near the south-eastern corner of the Makarikari. Shortridge (1934) only records them from the northern parts of South West Africa.



Habitat

Unfortunately all the Botswana material was either netted or shot and there is, therefore, no information on their resting places. Rosevear (1965) records them as being taken from huts and larger houses, cellars and narrow crevices in branches.

At nine of the ten localities in which they were taken, they were associated with water in the form of wet vlei, water-holes or rivers. All the localities were situated in open woodland, including riverine woodland.

Habits

Their flight is erratic as they fly round the canopy of trees or between the branches. They emerge fairly early from the resting places moving before sunset, several specimens being taken at 6 p.m.-6.15 p.m.

Food

No information.

Breeding

No information.

Sizes and Weights

TL	$\bar{X} = 71$;	$N = 10$;	Obs. range 64-78
T	$\bar{X} = 29$;	$N = 11$;	„ „ 24-30
Hf c/u	$\bar{X} = 7$;	$N = 10$;	„ „ 5- 9
E	$\bar{X} = 11$;	$N = 9$;	„ „ 10-13
F/a	$\bar{X} = 29$;	$N = 15$;	„ „ 28-30

Family NYCTERIDAE
Slitfaced Bats

Characterized by the deep frontal groove extending from the nostrils to near the base of the ears which encloses the complicated noseleaf organs (fig. 4 (*a*)), and the large oval ears.

Genus NYCTERIS G. Cuvier and E. Geoffrey, 1795

Nycteris thebaica — Egyptian Slitfaced Bat

N. t. capensis A. Smith, 1829

(Skull, fig. 13 (*f*).)

Taxonomic Notes

N. t. damarensis Peters, 1871, from Damaraland is stated to be longer-eared, paler above and whiter below than the nominate form. In view of the possibility of the occurrence of this in the western areas of Botswana a series of specimens from the Drotsky's Caves, Sepopa and Nokaneng was compared with a series from Molopolole and other parts of the eastern sector of Botswana.

Comparison of the ear length of western and eastern Botswana material

Western	$\bar{X} = 34{\cdot}3$;	$N = 22$;	Obs. range 30-40
Eastern	$\bar{X} = 34{\cdot}6$;	$N = 12$;	„ „ 31-40

This reveals that the difference is slight, if anything the eastern material being slightly longer but both fall within the range given for *N. t. capensis* A. Smith, 1829, the subspecies occurring in the southern parts of the continent.

There is a wide variation in the colour of the upper-parts of both the Botswana series. In the western regions, within the same population, there are very pale (PCL 65/83) and very dark (BP 138) individuals, the same state of affairs ruling in the east and, owing to the variability of this character within a narrow range of country, it is not judged to be of sufficient importance to use as a means of separating the populations subspecifically.

The same applies to the colour of the under-parts, where some of the eastern individuals (BP 1789) are the whitest of all.

Among the series, BP 1879, from the Savuti, is a ginger colour, BP 1893, from the same locality, less rich in colour, a rich buffy brown, these species representing the 'rufous phase' which occurs from time to time throughout the southern range of the species.

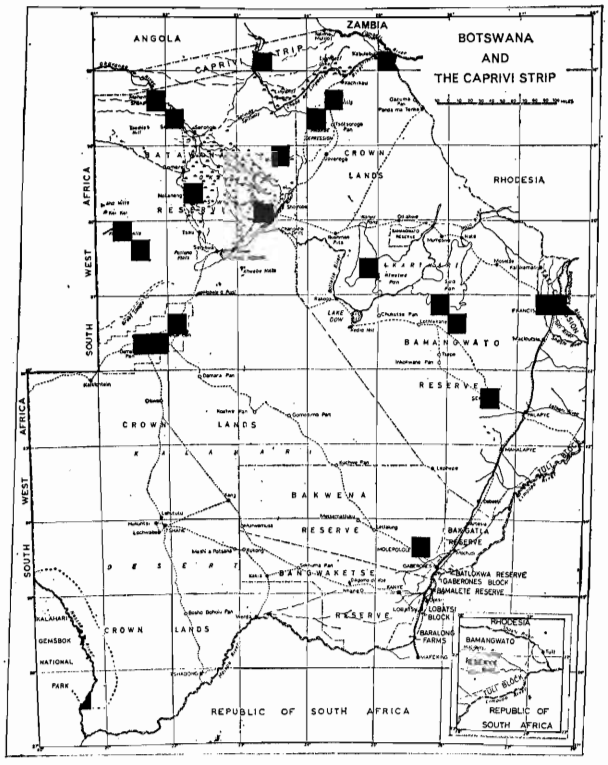
On this basis all the Botswana specimens are referred to *N. t. capensis* A. Smith.

Distribution

Widely distributed throughout the northern and eastern parts of the territory, as far south as the Ghanzi district in the west and Molopolole in the east, with a single record from the Kalahari Gembsbok National Park in the extreme south-west. In view of this last record, which is within the mean annual rainfall area of 250 mm, there does not seem any reason why they should not be found in the central Kalahari, although suitable daylight resting sites will be sparse except in the few scattered settlements. Shortridge (1934) records them as occurring throughout South West Africa.

Habitat

Taken in caves (Drotsky's Caves; Livingstone's Cave, Molopolole); in rondavels with thatched roofs (Kwaai); in hollow baobab trees, *Adansonia digitata* (Ngoma, Gweta); in outside storerooms (Nokaneng); in caverns in sansstone outcrops (near Serowe) and in Rhodesia from mine adits, and shafts.



Occurs in the Drotsky's Caves in very large numbers, in one cavern alone the colony was estimated to consist of between 5 and 600 individuals hanging from the 13-metre-high roof, in total darkness, up to 270 metres from the entrance. Temperatures here may run between 85° F. and 90° F. The individuals in the colony hung up in a scattered formation, not closely packed. At Savuti they occurred in dozens in a small cave in a kopje, the colony hanging some 10 metres from the entrance in total darkness. Total darkness is not, however, an essential requirement of the species as the storerooms at Nokaneng, where there was a colony of *c.* 20, were lit by small windows and in the case of the thatched rondavel on the Kwaai was quite well lit by window and doorway.

Near Serowe four specimens were taken froma colony of seven in a 1·8-metre-deep crevice, at the base of a sandstone outcrop, which was, at the same time, occupied by a porcupine, *Hystrix africaeaustralis*. There were about 20 in the hollow baobab at Gweta. The colony in the baobab at Ngoma has been known to occupy this situation for many years as it was there at the time of the 1949 Bernard Carp Expedition.

The species in Botswana appear to have a wide habitat tolerance occurring in woodland and open scrub.

Habits

The species has a slow erratic flight with fast wing-beats. They fly low, from a half to one metre above ground, and in scrub bush wing their way expertly between and around obstacles. At Savuti seen feeding, flying very slowly and erratically at about a metre above the short grass, now and then plummeting on to the ground, presumably to pick up ground insects.

A colony, smoked out of the baobab tree at Gweta at 11.30 a.m., fluttered around in a disorientated manner, eventually hanging up on neighbouring trees and low scrubs.

Food

The survey has no records of the food but Chapman (1958) records a long list of insects, identified by their remains at the roosts, concluding that the amount of each taken depended on what was available. At Savuti it was thought that they were taking Acriidae which abounded and which, it is noted, appear on Chapman's list. Felton (1956) records the species taking scorpions on open sandy ground in South West Africa carrying them to a resting place to eat.

Breeding

Three gravid females, each with a single minute foetus implanted 1R, were taken at the Drotsky's Caves in September. Further indications of the time of dropping the young are given by a series of females from the Kwaai River (December); Nokaneng (February) and Maun (January) in which the teats were well-developed with a bare patch round the mammae, the right-hand uterine horn swollen, indicating that the young had been dropped some time previously. A series of females taken in March and June were non-gravid. These data indicate a time of dropping the young during the warm, wet summer months of about September to February.

Sizes and Weights

MALES

TL	$\bar{X} = 105$;	$N = 16$;	Obs. range 91-120
T	$\bar{X} = 52$;	$N = 16$;	,, ,, 46- 58
Hf c/u	$\bar{X} = 13$;	$N = 17$;	,, ,, 12- 14
E	$\bar{X} = 34$;	$N = 17$;	,, ,, 31- 40
F/a	$\bar{X} = 49$;	$N = 11$;	,, ,, 47- 50
Weight	$\bar{X} = 11{\cdot}1$ g;	$N = 12$;	(Bulk sample)

FEMALES

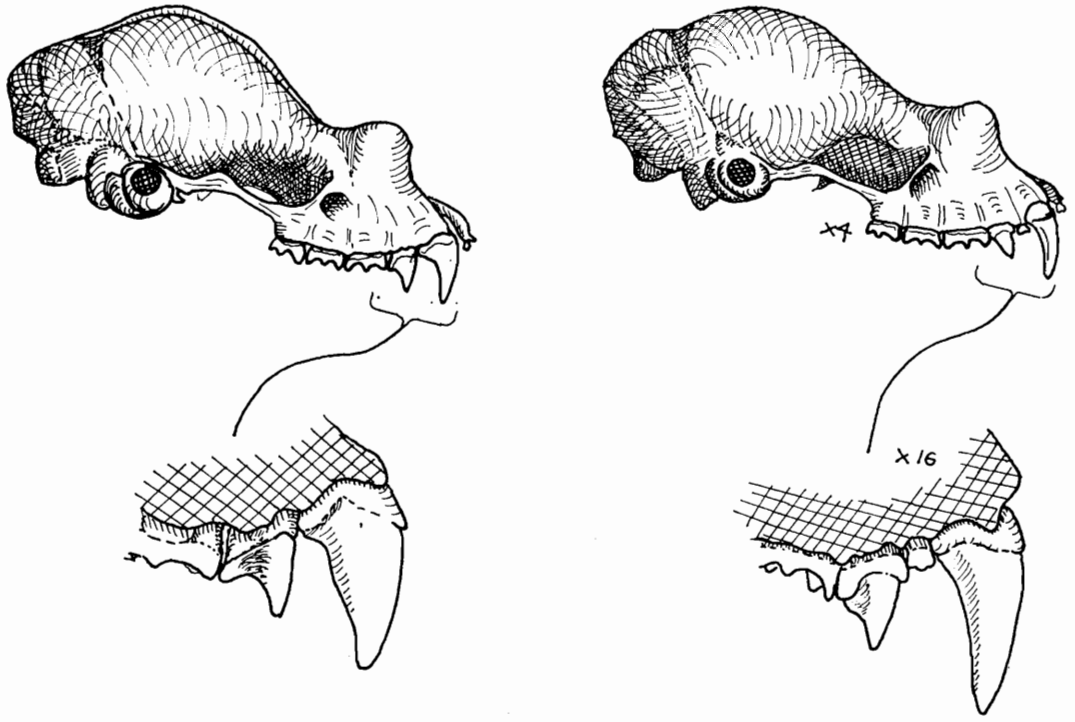
TL	$\bar{X} = 105$;	$N = 7$;	Obs. range 98-115
T	$\bar{X} = 53$;	$N = 7$;	,, ,, 50- 55
Hf c/u	$\bar{X} = 14$;	$N = 7$;	,, ,, 12- 18
E	$\bar{X} = 33$;	$N = 7$;	,, ,, 30- 34
F/a	$\bar{X} = 50$;	$N = 9$;	,, ,, 49- 52
Weight	$\bar{X} = 11{\cdot}7$ g;	$N = 12$;	(Bulk sample)

Family RHINOLOPHIDAE
Horseshoe Bats

Characterized by the complex horshoe-shaped nose-leaf (fig. 4 (*b*)). Large-eared, these widely separated and pointed.

Genus **RHINOLOPHUS** Lacepede, 1799

1. Size larger, forearm over 55, skull length over 23 . . . . *R. hildebrandti*
   Size smaller, forearm less than 55, skull length less than 23 2
2. Canine P^4 in contact; P^3 (if present) outside the tooth-row (fig. 12 (*a*)) . . . . . *R. darlingi*
   Canine separated from P^4 by P^3 (fig. 12 (*b*)) 3
3. Size larger, forearm 42-45, skull length over 17·5, overall darker—buffy on ventral surface . . . . . *R. simulator*
   Size smaller, forearm 42 or less, skull length under 17·5, overall paler, near white on ventral surface . . . . . *R. denti*



(a) *Rhinolophus darlingi* **Fig. 12** Skulls of bats (b) *Rhinolophus denti*

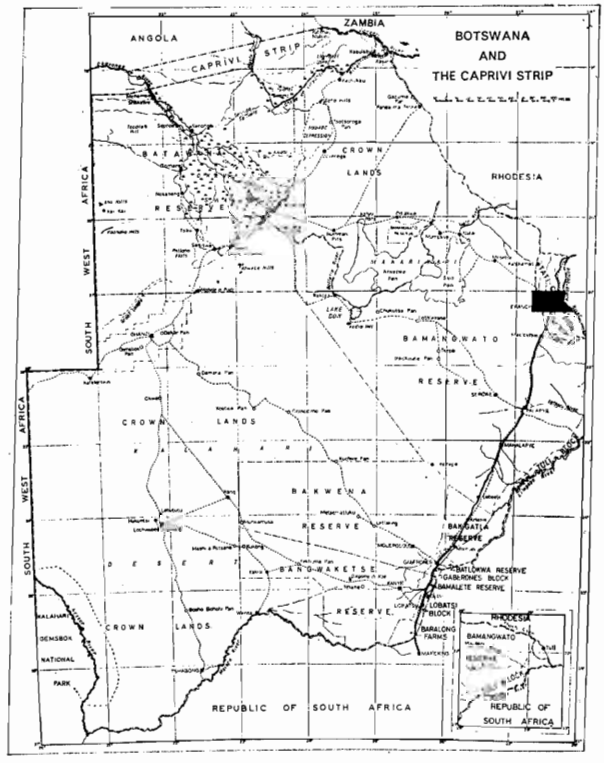
Rhinolophus hildebrandti

Hildebrandt's Horseshoe Bat

R. h. hildebrandti Peters, 1878

Distribution

The only records at the moment are from Francistown. The species is predominantly eastern in its distribution, the Francistown records being the farthest west it has so far been recorded at this latitude in southern Africa. As it has been taken a few miles east of the Shashi-Limpopo River confluence in Rhodesia and in the western Transvaal (Roberts, 1951) it may well, in time, be shown to occur in other parts of the eastern sector.



Habitat

There is no information on their resting places in the Francistown area as the specimens were netted. In Rhodesia they rest in caves, mine adits and shafts and are known from a filtration tower on a dam. Both Ansell (1960) and Roberts (1951) report them as being found in trees.

Habits

In Rhodesia the colonies are small, up to a dozen individuals, hanging separately from each other. Individuals occasionally fly into houses.

Food

Insectivorous.

Breeding

No data from Botswana, in Rhodesia gravid females have been taken in October.

Sizes and Weights

	TL	T	Hf c/u	E	F/a
MALE					
	106	39	13	30	62
FEMALES					
	108	38	12	32	63
	111	39	13	32	63

A bulk sample of 15 Rhodesian specimens gave an average weight of 27·4 g.

Rhinolophus darlingi

Darling's Horseshoe Bat

R. d. darlingi K. Anderson, 1905

(Skull, fig. 12 (*a*).)

Taxonomic Notes

Two subspecies are generally accepted:

R. d. darlingi Andersen, 1905, with a range of distribution including the Transvaal; Rhodesia; Angola; Malawi and Tanzania.

R. d. damarensis Roberts, 1946, confined to South West Africa.

According to Roberts (1946) *R. d. damarensis* is a 'paler drab grey than the eastern forms and in size larger'.

A series of six fresh specimens from Mashonaland, Rhodesia, are drab grey, four others are slightly browner, similar in colour to a series of five from western Rhodesia.

In the case of the greyer specimens the under-parts are correspondingly greyer and, where browner, correspondingly browner on the under-parts.

BP 2081 from the Tati Concession is drab grey, BP 1119 from the Tati Concession and BP 1121 from the Savuti more like the western Rhodesian series in being tinged brown. Although there are only the three specimens from Botswana, the variation in colour between them is no greater than the variation found in a Mashonaland series.

On the question of size the following table sets out a comparison between the measurements given by Roberts (1951) for *R. d. darlingi* and *R. d. damarensis*, a series from Mashonaland and western Rhodesia and the three Botswana specimens available.

R. d. darlingi (Measurements from Roberts, 1951)

F/a	47·5-49·0
Skull TL	19 -20
Hf c/u	8·0- 8·5
C—M_3	7·5- 8·0

R. d. damarensis (Measurements from Roberts, 1951)

F/a	48·0-50·5
Skull TL	19·5-20·5
Hf c/u	11 -13
C—M_3	7·6- 8·2

Mashonaland, Rhodesia material

F/a	$\bar{X} = 44·4$;	$N = 9$;	Obs. range 43 -46
Skull TL	$\bar{X} = 19·4$;	$N = 8$;	„ „ 19·1-20·1
Hf c/u	$\bar{X} = 8·5$;	$N = 7$;	„ „ 8·0- 8·8
C—M_3	$\bar{X} = 7·7$;	$N = 9$;	„ „ 7·5- 7·8

Western Rhodesian material

F/a	$\bar{X} = 45·6$;	$N = 5$;	Obs. range 45 -46
Skull TL	$\bar{X} = 18·8$;	$N = 3$;	„ „ 18·5-19·2
Hf c/u	$\bar{X} = 9·1$;	$N = 3$;	„ „ 9·0- 9·5
C—M_3	$\bar{X} = 7·5$;	$N = 4$;	„ „ 7·0- 7·7

Botswana material

F/a	$\bar{X} = 45·6$;	$N = 3$;	Obs. range 45 -46
Skull TL	$\bar{X} = 19·6$;	$N = 3$;	„ „ 19·1-20·0
Hf c/u	$\bar{X} = 8·7$;	$N = 3$;	„ „ 8·5- 9·0
C—M_3	$\bar{X} = 8·3$;	$N = 3$;	„ „ 7·6- 8·8

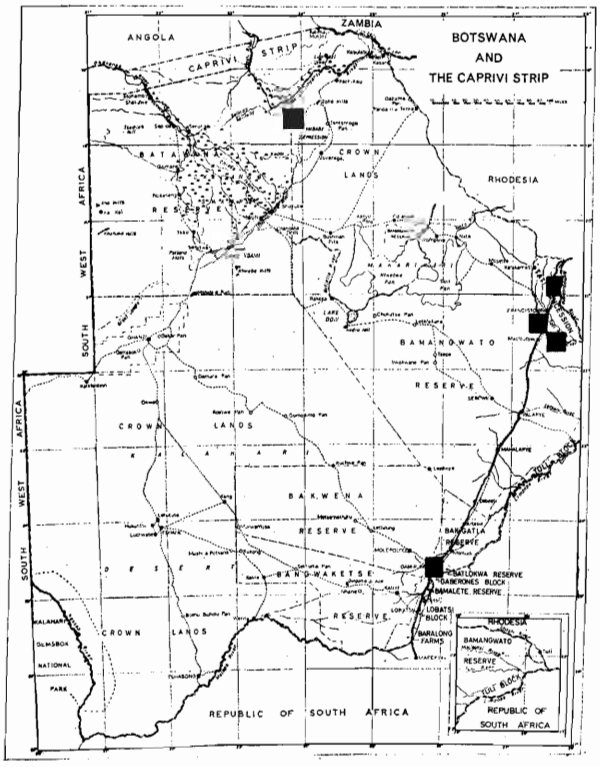
Roberts' measurements were based on a series of *R. d. darlingi* from the Transvaal which, in length of forearm, are larger than the series from Mashonaland, the type locality of *R. d. darlingi*.

In this character *R. d. damarensis* from South West Africa are larger still, neither the western Rhodesian nor Botswana material approaching the measurements given for this subspecies in respect of the length of the forearm.

As far as the length of the skull is concerned, the Botswana material averages 19·6, the measurements

falling within the limits set by Roberts for *R. d. damarensis*, 19·5-20·5, although they are only slightly larger than the Mashonaland series, 19·4.

The average length of the hindfoot of the Botswana



material is 8·7, the Mashonaland series 8·5, neither approaching the limits set by Roberts for *R. d. damarensis* 11-13.

The average length of the lower tooth row C-M_3 of the Botswana material 8·3, larger indeed than the figures given by Roberts for *R. d. damarensis* 7·6-8·2, the Mashonaland series 7·7.

Although the sample is very small the Botswana material approximates more closely to the smaller darker *R. d. darlingi* than to the larger paler *R. d. damarensis*.

Ellerman *et al.* (1953) consider that *R. d. damarensis* Roberts is a synonym of *R. d. darlingi* K. Andersen, to which the Botswana material is referred.

Distribution

The records of this species are too few and scattered to allow of an assessment of their limits of distribution. They occur in the Tati Concession; in the Gaborone area; with an isolated record from the Savuti.

In Rhodesia, while they are widely distributed in Mashonaland and the eastern parts of the territory, there are only two records from the dry western areas and none near the Botswana border.

Habitat

Unfortunately all the Botswana material was netted and there is, therefore, no information on their resting places. Roberts (1951) records the species from caves near Pretoria and Shortridge (1934) from caves, outhouses and stables in the Republic of South Africa. All the localities from which they have been taken in Botswana offer resting places of caves or buildings and all are situated in open woodland with rocky hills. In Rhodesia they are known from mine adits and shafts.

Habits

No information.

Food

Insectivorous

Breeding

No information.

Size

See Taxonomic Notes.

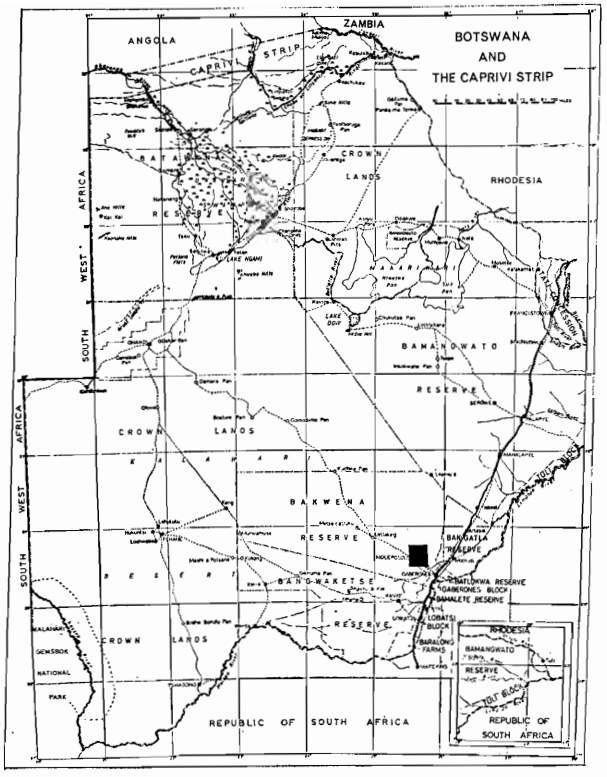
Rhinolophus simulator

Bushveld Horseshoe Bat

R. simulator K. Andersen, 1904

Represented from Botswana by a series of specimens in the collection of the American Museum of Natural History from Molepolole (Koopman, 1966), taken from a cave. The species was not collected.

Roberts (1951) records that it rests 'in caves and other shelters' and occurs in the western Transvaal (Rustenburg).

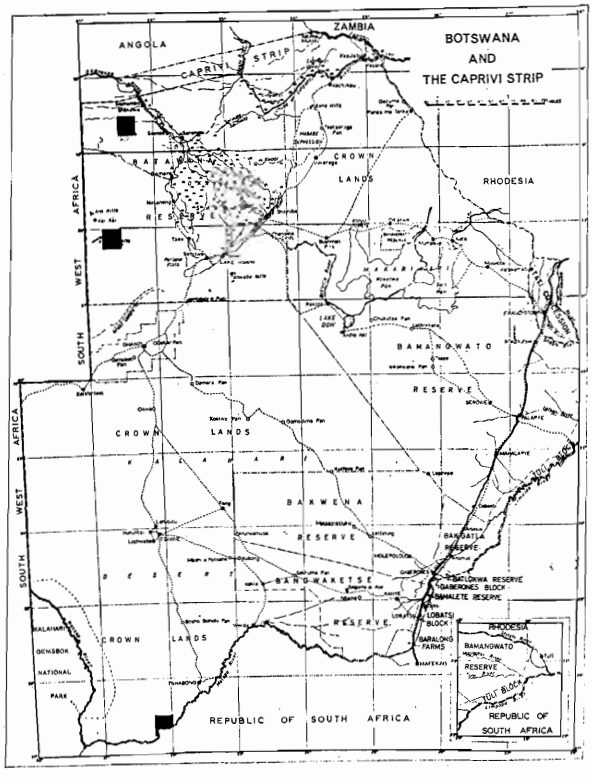


Rhinolophus denti

Dent's Horseshoe Bat

R. denti Thomas, 1904

(Skull, fig. 12 (*b*).)



Taxonomic Notes

The Botswana material, in common with material from southern Africa, generally conforms to the description of the nominate form, as opposed to *R. d. knorri* Eisentraut, which is smaller on average size. Rosevear (1965) considers that 'the differences are so slight that a new subspecies (*R. d. knorri*) scarcely seems justified'.

Distribution

So far only recorded from the western parts of the territory from the Tsodilo Hills, Drotsky Caves and Khuis on the Molopo River. Roberts (1951) states that they 'apparently only occur in the dry west from Upington and Kuruman district to the Kaokoveld in northern South West Africa'. Shortridge (1934) states that they occur 'throughout South West Africa', quoting records from the Orange River and Ovambo-

land. Ansell (1960) does not record the species from Zambia or Hill and Carter (1941) from Angola.

Wherever they occur they are sparse, never congregating in colonies of more than a few dozen or so and they may, therefore, have been overlooked.

Habitat

In the case of the Tsodilo Hills and Khuis records the specimens were netted and there is no information on their resting places. At Drotsky's Caves in June 1967 they were found clinging to the sides of stalactites in small numbers (dozens), one colony in semi-darkness 90 metres from the entrance, a second in pitch-darkness further into the cave (Liversedge, *pers. comm.*). Semi-dark crevices are available to them at the Tsodilo Hills but the only similar type of situation at Khuis are rock crevices in the calcareous outcrops on the banks of the dry Molopo River, or possibly wells.

The species has been taken in the Drotsky's Cave during the months of April to July and in September, which seems to suggest that, unlike other species present in the cave (e.g. *H. commersoni*), they remain there all the year round.

Habits

No information.

Food

Insectivorus.

Breeding

No information.

Sizes and Weights

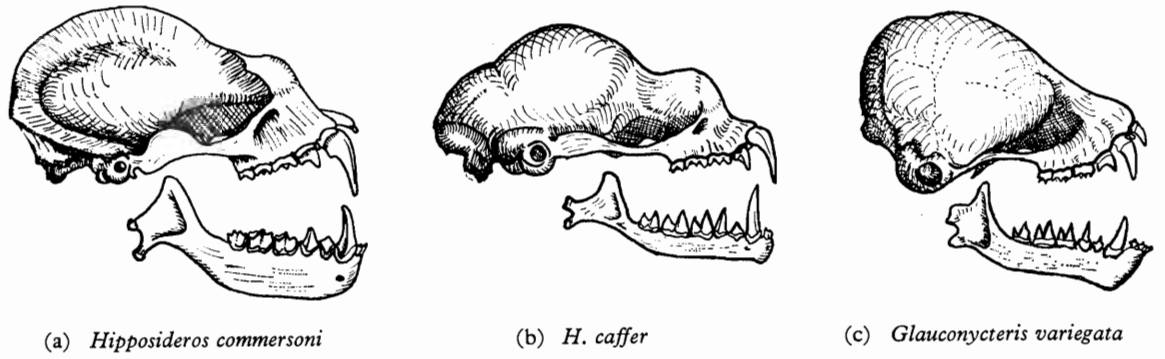
MALES

TL	$\bar{X} = 70$;	$N = 8$;	Obs. range 68-76
T	$\bar{X} = 21$;	$N = 8$;	„ „ 20-21
Hf c/u	$\bar{X} = 9$;	$N = 8$;	„ „ 9-10
E	$\bar{X} = 19$;	$N = 8$;	„ „ 18-21
F/a	$\bar{X} = 41{\cdot}6$;	$N = 13$;	„ „ 40-42
Weight	Bulk sample 35 males—200 g;		$\bar{X} = 5{\cdot}7$ g

FEMALES

TL	$\bar{X} = 69$;	$N = 8$;	Obs. range 66-76
T	$\bar{X} = 21$;	$N = 8$;	„ „ 19-23
Hf c/u	$\bar{X} = 9$;	$N = 8$;	„ „ 9-10
E	$\bar{X} = 18$;	$N = 8$;	„ „ 18-20
F/a	$\bar{X} = 42{\cdot}2$;	$N = 19$;	„ „ 40-44
Weight	Bulk sample 35 females—230 g;		$\bar{X} = 6{\cdot}6$ g

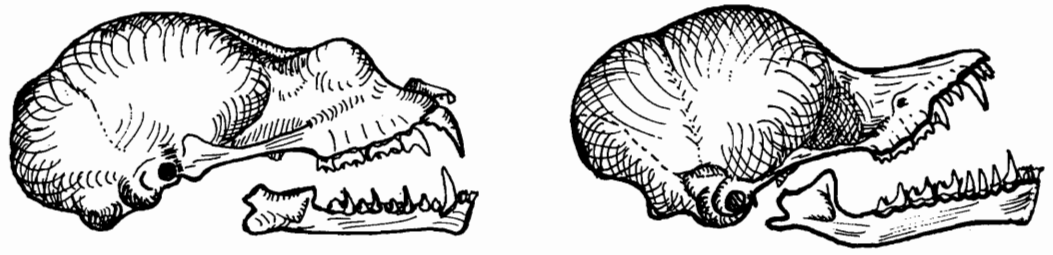
Fig. 13 Skulls of bats



(a) *Hipposideros commersoni* (b) *H. caffer* (c) *Glauconycteris variegata*

(d) *Taphosous mauritianus* (e) *Miniopterus shriebersi* (f) *Nycteris thebaica*

Fig. 14 Skulls of bats



(a) *Cleotis percevali* (b) *Kerivoula harrisoni*

Family HIPPOSIDERIDAE
Old World Leafnosed Bat

Although possessing a noseleaf roughly similar to that of the Horshoe Bats, the posterior leaf is rounded not triangular in shape (fig. 4 (*c*)). Often included in the family Rhinolophidae, I follow Rosevear (1965), who has pointed out certain essential anatomical and morphological characters in which they differ, in placing them in a family on their own.

1. Larger, rostrum half-length braincase, forearm over 42 (fig. 13 (*a*)) . . . . *Hipposideros*
2. Smaller, rostrum less than half-length of braincase, forearm less than 35·8 (fig. 14 (*a*)) *Cleotis*

Genus HIPPOSIDEROS Gray, 1831

1. Smaller, forearm under 50 . . . . *H. caffer*
2. Larger, forearm over 90 . . . . *H. commersoni*

Hipposideros caffer

South African Lesser Leafnosed Bat

H. c. caffer (Sundevall, 1846)

(Skull, fig. 13 (*b*).)

Taxonomic Notes

Two subspecies could possibly occur in Botswana, H. *c. caffer* (Sundevall, 1846) and *H. c. angolensis* (Seabra, 1898). Roberts quotes Andersen's measurements of these which show that *H. c. angolensis* is the larger of the two. Comparison of these measurements with the average measurements of a series of ten from Kasane indicates that this Botswana material should be referred to the smaller of the two subspecies, H. *c. caffer* (Sundevall).

	m^3—m^3 externally	Length c—m^3	F/a
H. c. caffer	6·0-6·2	5·7-6·2	Av. 48·6
H. c. angolensis	6·2-6·6	6·2-6·7	Av. 50·3
Kasane series	$\bar{X} = 6{\cdot}1$; $N = 7$	$\bar{X} = 5{\cdot}9$; $N = 9$	$\bar{X} = 45{\cdot}2$; $N = 10$
	O.r. 5·9-6·2	O.r. 5·9-6·0	O.r. 43-47

So far none of the brightly-coloured orange or yellow phases have been found in Botswana.

Distribution

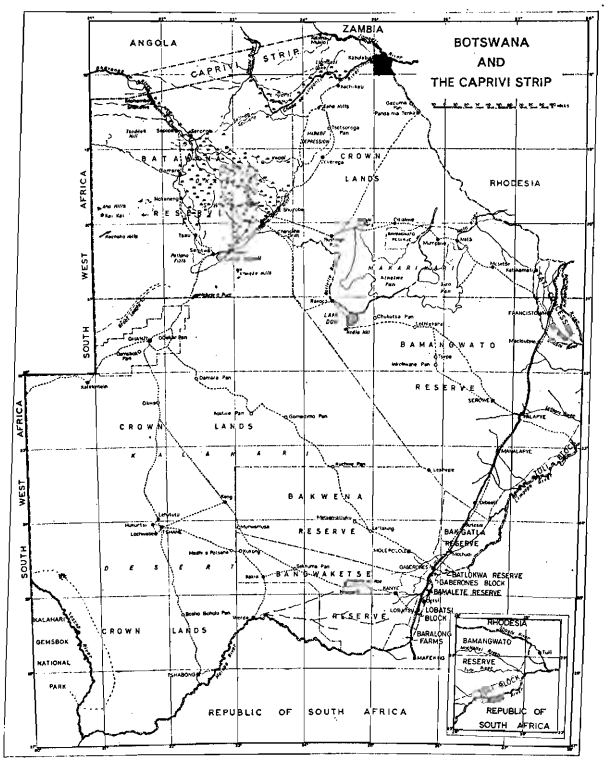
A species with a wide distribution on the continent they are so far only recorded from Kasane and Molepolole.* Shortridge (1934) records the species from the northern parts of South West Africa but has no records from the east anywhere near the Botswana border. There are no records from western Rhodesia.

Habitat

The Kasane series was taken under the roof of an old building, at Molepolole from a colony of dozens in Livingstone's Cave in complete darkness, the individuals in the colony hanging well separated from each other. The species is generally a cave dweller, in Rhodesia commonly being found in large colonies (hundreds) in old mine shafts and adits (Umtali, Hopefountain), in complete darkness. It has also been taken from pipe culverts under roads in smaller colonies.

In Botswana a species of open woodland where suitable resting places in the form of caves or houses are available.

*Molepolole record inadvertently omitted on distribution map.



Habits

A slow flier, often seen skimming round the canopy of trees in open woodland at a height of five or six metres, or even lower. In Rhodesia several have been recovered after being killed by flying into vehicles on main roads. Attracted by kraal sites, they fly low over the ground catching the insects flying above the cattle manure (Hartley, Rhodesia).

They may be dependent on the availability of water as frequently they have been observed sipping water in flight (Sabi and Mazoe rivers, Rhodesia) and netted while doing this.

Food

Insectivorous.

Breeding

There are no records of gravid females. The only indication of the time at which the young are born is a half-grown individual from Kasane taken in December. Ansell (1960) records gravid females in August and October in Zambia.

Sizes and Weights

MALES
TL $\bar{X} = 77$; $N = 10$; Obs. range 70- 88
Weight $\bar{X} = 8{\cdot}0$ g; $N = 16$; ,, ,, 62- 77 g

FEMALES
TL $\bar{X} = 79$; $N = 16$; Obs. range 70- 89
Weight $\bar{X} = 8{\cdot}0$ g; $N = 16$; ,, ,, 60-102 g

LENGTH FOREARM (irrespective of sex)
F/a $\bar{X} = 45{\cdot}2$; $N = 10$; Obs. range 43- 47

Hipposideros commersoni

H. c. marungensis (Noack, 1887)

Commerson's Leafnosed Bat

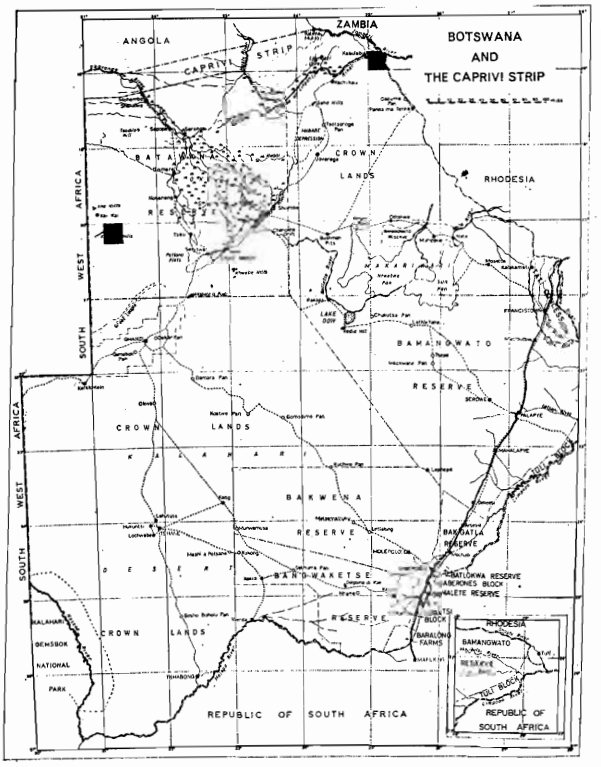
(Skull, fig. 13 (*a*).)

Taxonomic Notes

Two subspecies could occur in Botswana, *H. c. gigas* (Wagner, 1845) and *H. c. marungensis* (Noack, 1887). The average measurements of a series of ten specimens from Drotsky's Caves compared with those of *H. c. gigas*, as given by Rosevear (1965), and *H. c. marungensis* as given by Roberts (1951), are as follows:

	Skull length to front of canines	m^3—m^3	c—m^3	F/a
H. c. gigas	34-37	12·9-14·3	13·1-14·1	98-115
H. c. marungensis	31-34	11·6-12·5	11·7-12·5M	90-104
Drotsky's Caves (irrespective of sex)	$\bar{X}$ = 33·1; N = 9 O.r. 32·0-35·6	$\bar{X}$ = 12·1; N = 10 O.r. 11·8-12·5	$\bar{X}$ = 11·6; N = 10 O.r. 11·1-12·3	$\bar{X}$ = 100; N = 7 O.r. 98-103

Within the series from Drotsky's Cave, BP 1336 has a skull length of 35·6 which falls within the limits given for *H. c. gigas*. In other respects, however, this specimen conforms to the limits as laid down for *H. c. marungensis* to which, on the basis of the comparison as set out in the table, the Botswana material is referred.



Distribution

So far only recorded from a single specimen from Kasane and a series from Drotsky's Caves where, at certain times of the year, they are present in very large numbers. Shortridge (1934) suggests that it is a rare bat in South West Africa only occurring north of the Tropic of Capricorn, three specimens only being listed. Ansell (1960) states that they probably

occur throughout Zambia, although listing only three localities from which specimens have been collected.

Habitat

The Kasane specimen was taken under the roof of a house and was the only one taken, although bats were collected regularly by Dr. Child over a period of a year. The species has obviously used the Drotsky's Caves for resting for a very long period as there is a deep accumulation of bones and skulls on the floor which, although including Dent's horseshoe bat, *Rhinolophus denti*, and the Egyptian slit-faced bat, *Nycteris thebaica*, is predominantly composed of the remains of *H. commersoni*. The species is, however, not permanently in residence. Although present in hundreds in January, April, May, July and September, none were found in June. The colony rested, hanging from the roof, in two large caverns some 12 metres in height about 270 metres from the entrance, in pitch-darkness.

Habits

The species is gregarious, resting in large colonies but apparently exhibits some local movement as they are not always present in the resting places (Drotsky's Caves). A large bat was observed at Nokaneng hanging in a large *Acacia* tree above the camp at night, flying off temporarily and returning to the same tree. As there were no fruit bats in the vicinity, which are the only type comparable in size, it was thought to be *H. commersoni*. Unfortunately it was not secured.

Food

Insectivorous.

Breeding

There is no information on the breeding of the species in Botswana. Males taken in April in Drotsky's Caves had enlarged testes. They were very fat, with a layer of several mm on the inner lining of the stomach and on the internal organs.

Sizes

Drotsky's Caves

MALES			
TL	$\bar{X} = 154$;	$N = 17$;	Obs. range 139-164
T	$\bar{X} = 33$;	$N = 16$;	,, ,, 30- 35
Hf c/u	$\bar{X} = 23$;	$N = 17$;	,, ,, 20- 25
E	$\bar{X} = 32$;	$N = 17$;	,, ,, 30- 34
F/a	$\bar{X} = 102$;	$N = 5$;	,, ,, 100-103
FEMALES			
TL	$\bar{X} = 138$;	$N = 12$;	Obs. range 128-145
T	$\bar{X} = 29$;	$N = 10$;	,, ,, 26- 32
Hf c/u	$\bar{X} = 22$;	$N = 12$;	,, ,, 17- 24
E	$\bar{X} = 31$;	$N = 12$;	,, ,, 28- 33
F/a	Only two measurements available—98; 98		

Genus CLEOTIS Thomas, 1901

Cleotis percivali

African Trident Bat

C. p. australis Roberts, 1917

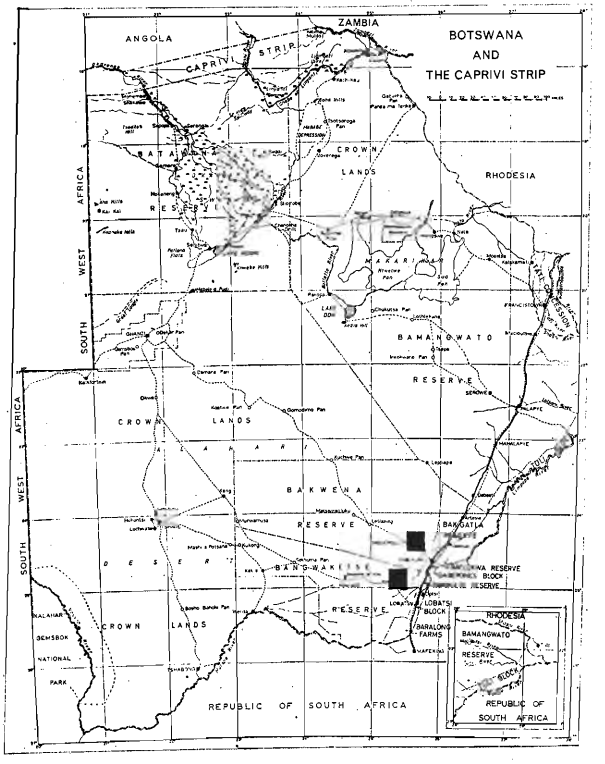
(Skull, fig. 14 (*a*).)

Distribution

Occurs from the Congo (Kinshasa) through Zambia, Rhodesia and the Transvaal to Swaziland. So far only recorded in the south-east of Botswana from Molepolole and Kanye (Koopman, 1966), the specimens being in the American Museum of Natural History.

Habitat

The Molepolole specimens were taken in Livingstone's Cave and all Rhodesian specimens to date have been taken in caves, mine adits and shafts. Roberts (1951) records the species from similar situations in the Republic of South Africa.



Habits

No information.

Food

Insectivorous.

Breeding

No information from Botswana, in Rhodesia gravid females were taken in October (Asbestos Mine, Umtali).

Sizes and Weights

No data.

Order PRIMATES
Family LORISIDAE

Genus GALAGO E. Geoffroy, 1796
Galago senegalensis moHwele Lesser Galago; Night Ape
G. s. moholi A. Smith, 1836
G. s. bradfieldi Roberts, 1931

Taxonomic Notes

Three subspecies of *G. senegalensis* have been described from the southern part of Africa as follows:
G. s. moholi A. Smith, 1836, from the banks of the Marico River, Western Transvaal.
G. s. bradfieldi Roberts, 1931, from Waterberg, South West Africa.
G. s. granti Thomas and Wroughton, 1907, from Inhambane district, Mozambique.

G. s. granti is very distinct, much more suffused with yellowish-brown above and below than the other two. This eastern form does not occur within Botswana limits, not being found west of the extreme eastern parts of Rhodesia. *G. s. moholi* and *G. s. granti* have not so far been shown to occur on the same ground in eastern Rhodesia yet it may be that *G. s. granti* is better considered as a separate species as in habits and food it differs widely from *G. s. moholi*.

G. s. bradfieldi is characterized by its lighter colour with very little or no suffusion of the yellow above or below and smaller in size (Roberts 1951) than *G. s. moholi*.

The series of material from the Gaborone area of Botswana, and in particular that from Sequane situated on the Marico River, is to all intents topotypical *G. s. moholi*, which, according to Roberts (1951), averages:

TL $\bar{X} = 379$; T $\bar{X} = 224$; Hf s/u $\bar{X} = 61{\cdot}5$; E $\bar{X} = 38$.

As against *G. s. bradfieldi:*

TL $\bar{X} = 360$; T $\bar{X} = 219$; Hf s/u $\bar{X} = 57{\cdot}0$; E $\bar{X} = 32$.

Within the series used to arrive at these figures for *G. s. bradfieldi* Roberts (1951) includes a range of 16 adult males and females from Ngamiland.

The nearest series in the Botswana collection (*see* Sizes and Weights) to South West Africa is a series of 32 specimens from the western Okavango, including material from the Tsodilo Hills, Aha Hills and localities between these areas, on the fringe of the swamp to the border area. The averages for this series as quoted (*see* Sizes and Weights) exhibit a range of similarities and dissimilarities with the figures given for *G. s. bradfieldi*. In overall size the western Okavango material appears slightly larger, the length of the tail being longer, slightly longer in fact than the measurements given by Roberts (1951) for *G. s. moholi*. Our series of near topotypical *G. s. moholi*, in this respect, at 226, also has longer tails than Roberts (1951) figures for this subspecies.

As far as the hindfoot measurements are concerned Roberts (1951) gives an average of 61·5 for *G. s. moholi;* our near topotypical series is 59 and the western Okavango series 57. In this respect the

western Okavango material averages closer to *G. s. bradfieldi*.

The average ear length given by Roberts (1951) for *G. s. moholi* is 38, in the near topotypical series it is 40, and in the western Okavango series 38, the indication being that the ears of *G. s. moholi* are slightly larger than material taken further west, but the difference is slight. Roberts (1951) average ear length of *G. s. bradfieldi*, including the 16 Ngamiland specimens, is 32 but this is not borne out by the figures arrived at (38) for our series from the western Okavango.

With the possible exception of the hindfoot measurement, therefore, there does not appear to be any difference in size between material from the south-eastern sector, which is near topotypical *G. s. moholi*, and material from the north-west of Botswana.

On the question of colour there appear to be two extremes within Botswana. In the material from the Gaborone-Sequane area the yellow suffusion on the upper and outer parts of the limbs is distinct, the under-parts, except for the immediate region of the belly, which is white, also suffused with a lighter yellow. The upper-parts of the body and head and the sides of the body are dark with a faint wash of yellow, more pronounced on the rump.

On the other hand in the material from the western Okavango the yellow suffusion on the upper and outer parts of the limbs is much paler, the bellies white, and the remainder of the under-parts with but a faint wash of yellow. In SWG 676 from the South West African border west of Shakawe the yellow wash on the under-parts is barely perceptible. In this respect this western Okavango series, as far as colour is concerned, corresponds more closely to *G. s. bradfieldi* than to *G. s. moholi*.

A series of 29 from localities in Ngamiland, 17 from the Makgadikgadi and 20 from the north-eastern sector, agree better with the colour of *G. s. bradfieldi* than *G. s. moholi* albeit here there is some intensification of the yellow on the limbs.

Twenty-one specimens from the eastern sector from the Tati Concession, the eastern parts of the Bamangwato, Serowe and south on the line of rail to Sedibe exhibit various stages of intergraduation between the characters of *G. s. moholi* and *G. s. bradfieldi*.

BP 875 and BP 874 from Mabate are darker yellow on the limbs and under-parts and, in the darker colour of the upper-parts, tend toward *G. s. moholi*. BP 849 from Madinare and BP 877 from Mabate on the other hand in the lighter suffusion of yellow seem closest to *G. s. bradfieldi* and it appears that the populations in these areas, as far as colour is concerned, represent a form intermediate between *G. s. moholi* and *G. s. bradfieldi*.

From the above considerations it appears that two subspecies are represented in the territory:

G. s. moholi A. Smith which occurs rather narrowly in the south-eastern parts in the Lobatse, Gaborone areas.

G. s. bradfieldi Roberts which occurs throughout the northern and north-eastern parts of the territory and the Makgadikgadi.

In addition intergrades between *G. s. moholi* and *G. s. bradfieldi* occur in the northern parts of the eastern sector.

P. 195 M. from Mampswe, Makgadikgadi, is interesting in that it shows a measure of albinism on the upper-parts, from the nape to the base of the tail.

The colour of the tails in fresh pelage varies considerably, often the distal half (BP 1317), one-third (BP 441), or the point only (BP 1311) being darker than the remaining proximal portion in material from the same areas. In some cases (BP 1310, BP 1916) the darkening is hardly perceptible.

Moult

Within the series there are ten specimens taken in the Makgadikgadi area in November 1964 that show very definite signs of a seasonal moult. The condition varies from individual to individual but is exemplified by BP 413, a male. Here there is an area from the nape to the shoulders in which the long hair is being replaced by short hair, the remaining long hair on the upper-parts gives the appearance of 'foxing'. In BP 393, a female, this replacement continues over the greater part of the upper-parts, the new hair coming in rather irregularly, no two of the series being the same in this respect.

Accompanied by this body moult, in some cases (e.g. BP 403 and BP 394) the tail is completely 'foxed' and has lost the woolly appearance of the full pelage, the hair sparse, matted and faded. In the extreme (BP 403) it is a very pale reddish colour. In other cases (BP 441, BP 442), although the moult is proceeding on the nape and shoulders, the pelage of the tail looks quite fresh.

An examination of a sample of 95 specimens for signs of moulting against the date of this moult reveals the following:

	Body Moult	Tail Moult	Total
January	—	—	5
February	2	—	11
March	—	—	3
April	—	1	18
May	—	—	3
June	—	—	3
July	—	—	17
August	1	—	7
September ..	—	2	4
October	—	—	—
November ..	15	10	19
December ..	1	2	5

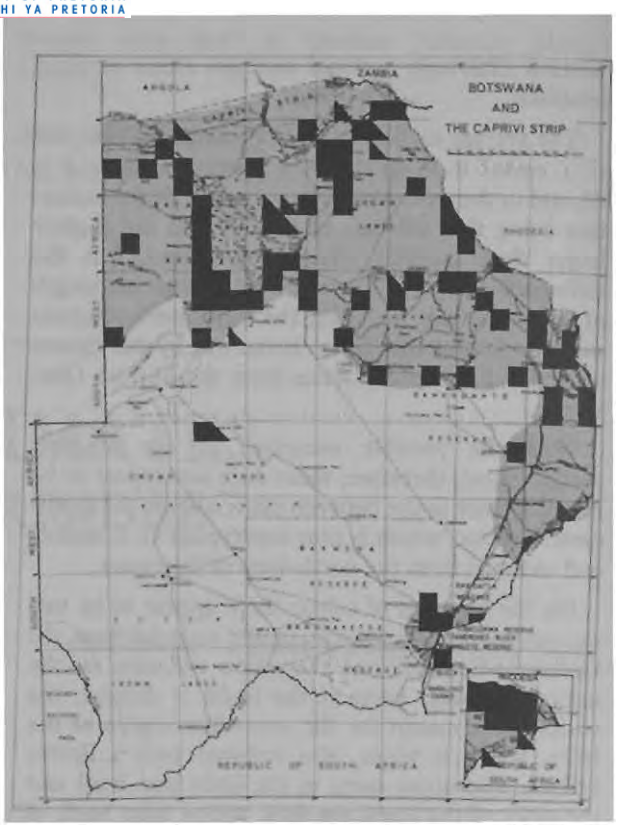
This indicates that the body moult starts about the onset of the warmer months in August continuing through to February, the tail moult during approximately the same period, the full winter pelage being carried through the months of about April to August.

Distribution

Widely distributed throughout the northern and eastern parts of the territory. On the South West African border they occur as far south as 21° S. (2021 C 3) where, west of the Okavango delta, they are sparse in the dry country. They are particularly common and widespread throughout the Okavango delta south to Mabeleapudi, along the Botletle River and throughout the woodland environs of the Makgadikgadi and in the country north and north-east of this to the Chobe River and Rhodesian border area. They are common and widespread throughout the eastern sector from the Nata River and Tati concession southward to just north of Debeeti, extending east to Serowe.

There is a break in distribution in the eastern sector from just north of Debeeti to Mochudi, where the open Kalahari associations extend eastwards to the Transvaal border, although they may be expected to be found narrowly in the riverine associations of the Limpopo River. From Mochudi they occur southwards to just south of Lobatse and west to near Kanye being absent in the extreme south-east.

Roberts (1935) states that at Damara Pan (22 22 B1) in the central Kalahari 'a *Galago* came and peered at me from a distance of a few feet' but was not collected. Subsequently a specimen was collected just west of this in the Okwa Depression (22 22 A2). These records are far outside their normal range of distribution. The Okwa Depression carries an association of *Acacia* woodland suitable for the species but, running roughly



east-west, has no apparent connection to the north or south-east with areas in which they normally occur.

At its eastern end the Okwa Depression swings north-eastward in the general direction of Lake Dow, near where the species has been taken. At its western end it crosses the South West African border at *c.* 22°50′ S. continuing through to Stamprietfontein and Gobabis 2°50′ further south than they have been taken in South West Africa (Shortridge, 1934). Only further investigation throughout the length of the Okwa Depression, from Lake Dow to the South West Africa border, and from the Okwa Depression northwards to Mabeleapudi will resolve the connection between these isolated records and their area of general occurrence northwards and north-eastwards.

Habitat

An analysis of the habitat in which 158 specimens were taken is as follows:

Riparian *Acacia* woodland and scrub including *Acacia* woodland on floodplain ..	60
Riparian woodland (including *Acacia*) ..	6
Acacia scrub	22
Mixed mopane *Acacia* woodland	15
Acacia woodland	8
Riverine mopane woodland	9

Dry mopane woodland	15
Burkea-Terminalia woodland	2
Baikiaea-Terminalia woodland	2
Terminalia-Acacia woodland	2
Terminalia-Combretum scrub	9
Misc.	8

The species is particularly associated with *Acacia* spp., 113 of the 158 specimens being taken in associations in which *Acacia* spp. are dominant or form a substantial proportion of the woodland or scrub. Sixty-six of these 113 were taken in riparian *Acacia* and the balance in dry associations with *Acacia*. The only other association which figures to any extent is mopane, *C. mopane*, in which 24 specimens were taken.

In dry country there is a very noticeable tendency for the species to be associated with riparian associations, particularly *Acacia* spp. (Rhodesia).

Acacia woodland or scrub is particularly rich in insect life and, as the species is predominantly insectivorous, this probably accounts to a large extent for its preference for associations in which *Acacia* spp. are dominant or well-represented.

In the north-eastern sector along the Rhodesian border where there are belts of *Baikiaea* woodland on Kalahari sand they are sparse in this as opposed to adjacent areas in which there are stands of *Acacia*.

Habits

Predominantly nocturnal, arboreal, normally occurring singly or in pairs but, on occasion, congregating in small numbers (Zelu Hill 'six in same tree', T. N. Liversedge; Nata, two parties of three each, Peterhouse Natural History Society; BP 62, Nokaneng, three). During daylight hours rests in hollow trees, on a bed of leaves and fine twigs, or a bed of similar material built against the trunk or among the finer branches of trees, especially *Acacia*, or using disused birds' nests (Hamerkop, *Scopus umbretta*, Mosetse. Recorded as using a hollow steel gate-post, the bed 70 cm from the top (Smithers) or under the eaves of a house (Smithers). Normally emerge from these resting places at sundown but have been collected at 3.30 p.m. (BP 259, Tamafupi); 4 p.m. (HJH 1197, Joverega); 5 p.m. (G 615 Makalamabedi, G. L. Guy) 6.30 p.m. (BP 247, Tamuseche).

The eyes very brightly reflect the light of a dazzling light after dark, which allows them to be picked up at great distances, up to 300 metres, from the source. While their eddish glow and the distance that the eyes are set apart in the head are similar to the reflection from the Genet, *Genetta* spp., the quick dropping or ascending from the branch on which they have been located clearly distinguishes them as they leap around or jump from tree to tree to avoid the glare. If isolated on a solitary tree they will often refrain from looking towards the light source for a considerable time sitting motionless, looking away from it. They are, however, normally inquisitive and, if held in a light, may be actuated to approach by clicking with the lips or other quiet sounds.

Their powers of leaping are very well developed, Roberts (1951) quotes a distance of four and a half metres but in descending leaps can certainly exceed this by at least two and a half metres (Tamafupi, tree to tree seven metres), Pitman (*see* Shortridge, 1934) records upward leaps of two and a half metres.

In captivity their acute powers of judgement can be easily observed. Often before leaping they will urinate on their front feet and rub these together, sometimes applying them to the back feet as well as if to ensure a better grip but perhaps as a technique of 'marking'.

A male in captivity would leap from a strategic point down onto the leg of a single-legged high table alighting on the leg in such a position, under the table-top, as must have brought it in mid-air very close to the table's edge. In the field the leap usually takes place from a reasonably substantial branch although they may land among the very fine outside twigs of a neighbouring tree. They appear to have no difficulty in moving about on and jumping into thorny trees such as *Acacia* or *Xixyphus*. Although predominantly arboreal, they have been observed to descend to the ground to feed or to move from widely separated trees, and, if disturbed in this position, will make for the nearest arboreal cover in high, somewhat disorientated leaps, as if not at home in this type of environment.

In the resting place they sleep curled up, the ears folded flat against the head.

The young are born in the resting places and according to Shortridge (1934) are carried clinging to the mother, although this has never been observed in Botswana, the young apparently being left in the resting place.

The call is a loud *tchak-tchak* repeated at slow intervals, sometimes sustained over quite long periods and they also utter a quiet twittering which can only be heard if at close quarters.

Food

The food is masticated very finely and it is impossible to identify the insect material which appears to constitute by far the largest item of food. In a series BP 874-BP 877 from Mabate a yellow-tinged opaque

material in the stomachs was thought to be a gum which they are reported to eat (Haagner, *see* Shortridge, 1934).

Breeding

Females carrying foetuses or lactating have been taken widely throughout the year, the breakdown data on a sample of 80 females collected being as follows:

	J	F	M	A	M	J	J	A	S	O	N	D
Total	5	16	10	14	4	1	6	7	3	1	10	3
Non-gravid	–	10	8	11	4	1	2	3	–	–	4	1
Lactating	–	–	1	3	–	–	–	1	–	–	–	–
Gravid	5	6	1	–	–	–	4	3	3	1	6	2

These figures suggest that they breed throughout the year.

The average number of foetuses is as follows:

Foetuses

Number $\bar{X}=1{\cdot}8$; $N=30$; Observed range 1–2

Of the 27 specimens on which there are data on implantation, in 22 cases implantation was 1R1L, in three 1L, in one each 1R and 2R.

Of the larger foetuses examined those of BP 1356A taken at Toten at weights of 9·6 g and 10·2 g and of TNL 4603A from near Kalakamati (20 27 C1) at 9·3 g and 9·6 g appeared to be near full-term, the foetuses having a sparse covering of hair. The remaining foetuses were minute or very small and only CR lengths are recorded. Details of foetuses over 5 g are as follows:

			CR	*Hf s/u*	*E*	*T*	*Weight (g)*
1	BP 1781	Serowe	33	—	—	—	5·0
		Serowe	31	—	—	—	—
2	BP 1312	Toten	35	14	—	47	6·4
		Toten	23	13	—	44	5·3
3	BP 7	Maun	43	17	—	—	6·2
		Maun	45	17	—	—	6·5
4	BP 1311	Toten	38	17	—	—	7·0
5	BP 1310	Toten	37	17	—	55	7·5
6	TNL 4603A	20 27 C1	44	19	11	59	9·3
		20 27 C1	43	19	11	59	9·6
7	BP 1356A	Toten	40	18	—	—	9·6

Shortridge (1934) records the number of young at a birth as 'one to two—twins seem to be of frequent occurrence', Ansell (1960) gives the number as two.

Sizes and Weights

MALES

TL	$\bar{X}=370$;	$N=48$;	Obs. range 304-409
T	$\bar{X}=227$;	$N=45$;	,, ,, 206-258
Hf c/u	$\bar{X}=57$;	$N=48$;	,, ,, 51- 62
E	$\bar{X}=38$;	$N=44$;	,, ,, 32- 41
Weight	$\bar{X}=155{\cdot}5$ g;	$N=33$;	,, ,, 124·8-189·6 g

FEMALES

TL	$\bar{X}=363$;	$N=42$;	Obs. range 326-395
T	$\bar{X}=223$;	$N=37$;	,, ,, 200-245
Hf c/u	$\bar{X}=56$;	$N=43$;	,, ,, 51- 62
E	$\bar{X}=35$;	$N=41$;	,, ,, 31- 41
Weight	$\bar{X}=150{\cdot}7$ g;	$N=30$;	,, ,, 132·1-176·7 g

On the basis of the above figures there does not seem to be any marked difference in size between adult males and females, except that adult males in series are slightly heavier.

Southern parts, Eastern Sector (Gaborone, Sequane) (*G. s. moholi*).

BOTH SEXES

TL	$\bar{X}=372$;	$N=6$;	Obs. range 327-400
T	$\bar{X}=226$;	$N=6$;	,, ,, 201-246
Hf s/u	$\bar{X}=59$;	$N=6$;	,, ,, 56- 62
E	$\bar{X}=40$;	$N=6$;	,, ,, 38- 42
Weight	$\bar{X}=147{\cdot}3$ g;	$N=6$;	,, ,, 102-161 g

Northern parts, Eastern Sector (Tati Concession, Eastern Bamangwato).

BOTH SEXES

TL	$\bar{X}=374$;	$N=9$;	Obs. range 334-409
T	$\bar{X}=232$;	$N=8$;	,, ,, 218-258
Hf s/u	$\bar{X}=55$;	$N=7$;	,, ,, 50- 63
E	$\bar{X}=36$;	$N=8$;	,, ,, 30- 38
Weight	$\bar{X}=142{\cdot}7$ g;	$N=7$;	,, ,, 114·3-172·5 g

Western Okavango (*G. s. bradfieldi*).

BOTH SEXES

TL	$\bar{X}=369$;	$N=31$;	Obs. range 330-425
T	$\bar{X}=225$;	$N=30$;	,, ,, 205-263
Hf s/u	$\bar{X}=57$;	$N=32$;	,, ,, 52- 63
E	$\bar{X}=38$;	$N=32$;	,, ,, 34- 42
Weight	$\bar{X}=153{\cdot}4$ g;	$N=18$;	,, ,, 125·0-188·0 g

Family CERCOPITHECIDAE

Genus CERCOPITHECUS Linnaeus, 1758

Cercopithecus aethiops

Kgabo Vervet Monkey

C. a. helvescens Thomas, 1926

C. a. ngamiensis Roberts, 1932

Taxonomic Notes

At least two subspecies appear to be represented in the territory.

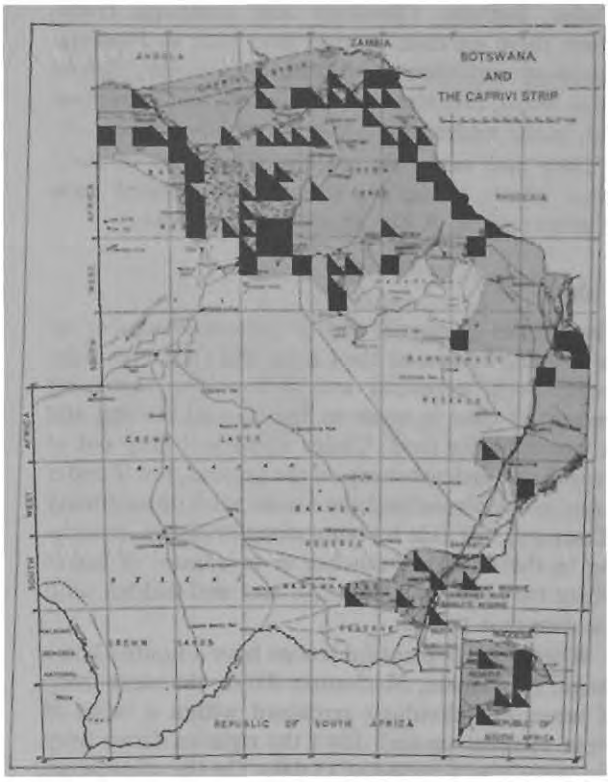
In specimens from the extreme north-west from Shakawe to the South West African border and southwards to about Sepopa the under and inner surface of the limbs, the hands and feet are whitish, the upperparts from the head to the hinder parts of the back with a bright yellow wash. These are referred to *C. a. helvescens* Thomas, 1926.

The whole of the material from the Okavango delta, the north-eastern sector and the northern parts of the eastern sector south to Debeeti is referred to *C. a. ngamiensis* Roberts, 1932. Here there is a darkening of the limbs, hands and feet, which are greyish not whitish. No material is available from the southern part of the eastern sector where *C. a. marjoriae* Bradfield, 1936, may be represented.

Within *C. a. ngamiensis* there is some variation in the colour of the back and its relationship with *C. a. marjoriae* and *C. a. helvescens* requires further study. It may be that, when further material is available from the extreme north-west, that it will be shown that the Botswana material is intermediate between *C. a. helvescens* and *C. a. ngamiensis* rather than *C. a. helvescens*. Ansell (1960) refers material from south-western Barotse Province to *C. a. helvescens*. None of the material from the northern parts of the Okavango delta, the eastern Caprivi or the Chobe River, however, is as yellow on the back or as white on the limbs, hands or feet as that from the north-western parts of Botswana presently referred to *C. a. helvescens*.

Distribution

Widely distributed throughout the Okavango delta and the northern and north-eastern parts of the territory as far south as Lake Ngami; along the Botletle River south to Rakops; in the northern parts of the Makgadikgadi and throughout the eastern sector south to about 23°30′ S., not extending westwards much further than the line of rail and the hills west



of Mahalapye and the south-eastern corner of the Makgadikgadi.

There is a break in their distribution in the eastern sector between about Mahalapye to Mochudi in the eastwards extension of the Kalahari association, although here they may occur along the Limpopo River.

South of this they occur in the eastern sector from Mochudi to Lobatse and westwards to Molepolole and Dikgomodikae.

Shortridge (1934) restricts the distribution of the species in the northern parts of the territory to the country 'watered by the . . . Okavango and Maschi (Chobe) rivers'. Roberts (1951) gives the distribution to include 'southern Bechuanaland' but this appears to be too sweeping as they have not so far been

visually recorded either in the central or southern Kalahari.*

Habitat

Predominantly a savannah species, the Vervet has a wide habitat tolerance, occurring in light woodland and riparian woodland, being absent in arid more open types of savannah and grassland, except marginally. They are particularly abundant in the Okavango delta and in the riparian woodlands of the Chobe, Botletle, Okavango and Limpopo rivers, where there are fruit-bearing trees such as *Ficus* sp., *Diospiros mespiliformes*, *Phyllogiton discolor*, *Sclerocarya birrea*, *Zizyphus mucronata*, *Garcinia livingstonei* and, in the undershrub, *Ximenia* sp., *Grewia* sp., etc.

They also occur far up the tributaries of these rivers where, in the dry season, only isolated pools of water persist. A pest in agricultural areas.

Habits

The species is diurnal and gregarious, troops of up to 50 being known on the Chobe and Okavango delta areas. Both terrestrial and arboreal, a surprising amount of time is spent on the ground moving and in searching for food. Under stress will drop out of trees for a quick get-away on the ground, but if under stress in open woodland conditions, with no continuity of canopy, will hide by lying along branches, crouching in the forks of branches or in clumps of leaves where they remain motionless and well-hidden until the danger is passed.

Where food is plentiful troops have a limited home range. At Mabate, Macloutsie River, the same troop of some 15 individuals remained within a range of some 1½ miles up and down the riparian forest from the camp over a period of 13 days. On the other hand, Brain (1965) records an 11-mile movement of a troop overnight in the western part of Rhodesia, during the height of the dry season in October.

While the vervet is, in the main confined to the better-watered areas of Botswana they will wander far from permanent water supplies. Shortridge (1934) states that they are unknown, except as rare migrants, in the dry and sparsely wooded plains between the Okavango and the low rocky hills in the vicinity of Grootfontein and Tsumeb, South West Africa, in which latter areas they occur in the rocky hills, depending on small permanent springs. The distance between these two areas is *c.* 120 miles.

He also records that Nama Hottentots record the wandering of vervets 100 miles up the Fish River in South West Africa.

In the north-eastern sector of Botswana, away from the Okavango delta and Chobe River, they are dependent on pans for a water supply, and can gain access to the water in the eyes of these pans, gouged out by elephants, long after the pan itself has dried up. They will, however, wander far from these watering points when temporary seasonal water supplies, or a supply of wild fruits are available, and may indeed be found anywhere throughout the area north of the Makgadikgadi, seasonally at times when fruits are available, in spite of the fact that it is devoid of surface water.

With the opening up of stock routes provided with boreholes (as in the north-east), vervets make use of this artificial supply, as was observed at Nunga.

Food

Predominantly vegetarian, the principal food appears to be wild fruits, berries (*see* Habitat), and seeds and seed-pods of *Acacia* spp., including *Acacia giraffae*.

While no evidence has been found in stomach contents from Botswana, elsewhere they are reported to eat lizards, young birds and birds' eggs.

They eat insects, in particular grasshoppers and termites, several stomachs showing a high proportion of the latter and, in agricultural areas, maize and sorghums are sought after.

Breeding

	J	F	M	A	M	J	J	A	S	O	N	D
Total	–	17	1	19	1	2	3	6	6	1	6	–
Non-gravid	–	16	1	16	1	2	2	4	3	1	5	–
Lactating	–	1	–	2	–	–	–	–	–	–	–	–
Gravid	–	–	–	1	–	–	1	2	3	–	1	–
Juveniles under 4 lb. 8 oz.	–	4	–	5	–	1	–	3	1	–	1	–

Each of the eight gravid females carried one foetus and weighed from 6 lb. 4 oz. to 7 lb. 4 oz. (net weight less weight foetus).

While the sample is small, the table records gravid females from July to September, in November and April, with juveniles present in February, April, July and November. These figures suggest that the young are born at any time throughout the year.

Female BP 525 was carrying a juvenile at 459 g; BP 1719 a foetus of 281·7 g which, from its sparse covering of hair, appeared to be nearly ready to be born which indicates a birth-rate of some 300-400 g.

* Since going to press Rautenbach (*in litt.*) has obtained a photorecord of the species 48 miles north of Twee Rivieren, Kalahari Gemsbok National Park, and states that the le Riche brothers can recall eight instances of single animals in the park.

Sizes and Weights

MALES

TL	$\bar{X}$ = 1142;	N = 30; Obs. range	1045-1295
T	$\bar{X}$ = 652;	N = 30; „ „	600- 750
Hf s/u	$\bar{X}$ = 144;	N = 30; „ „	133- 170
E	$\bar{X}$ = 38;	N = 30; „ „	31- 42
Weight	$\bar{X}$ = 12 lb. 2 oz.;	N = 29; „ „	8 lb. 8 oz.-17 lb. 8 oz.

FEMALES

TL	$\bar{X}$ = 1021;	N = 30; Obs. range	971-1111
T	$\bar{X}$ = 575;	N = 30; „ „	485- 653
Hf s/u	$\bar{X}$ = 125;	N = 30; „ „	115- 137
E	$\bar{X}$ = 35;	N = 30; „ „	30- 40
Weight	$\bar{X}$ = 9 lb.;	N = 30; „ „	7 lb. 8 oz.-11 lb. 8 oz.

The above sample of 30 specimens excludes material from the extreme north-west and indicates the size and weight differences in a series of males and females.

Genus PAPIO Muller, 1793

Papio ursinus

Tshwene Chacma Baboon

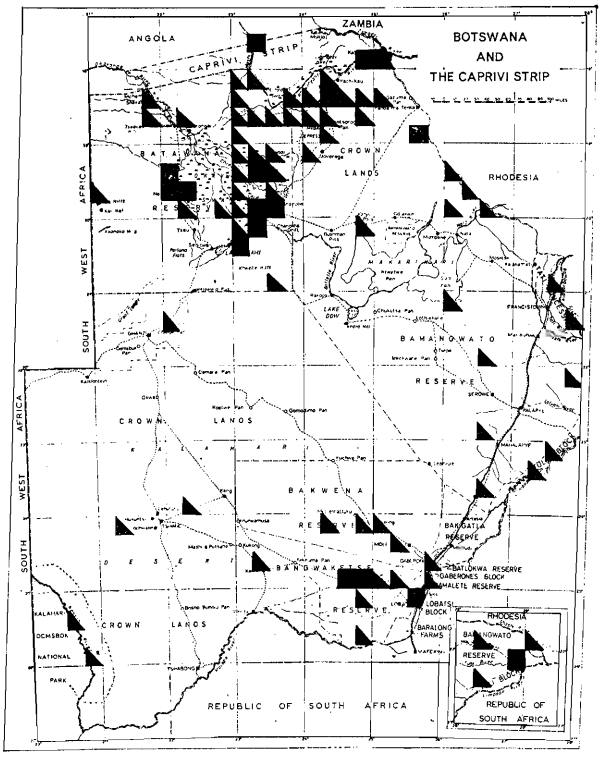
P. ursinus (Kerr, 1792)

Taxonomic Notes

There are too few adult specimens from Botswana to properly assess, at this juncture, the apparent difference which appears to exist between the southern (Dikgomodikae) and northern (Chobe River) specimens. The former are, in large adults, very distinctly darker in colour, with a profuse intermingling of black hairs along the back and on the hands, feet and tail, darker than any so far available from the northern parts of the territory.

The material from Dikgomodikae, Kanye and other parts of south-eastern and eastern Botswana, in its darker colour, may represent *P. u. occidentalis* Goldblatt, the material from the north, in its apparently lighter yellower colour, *P. u. griseipes* Pocock, a subspecies which, according to Dandelot (1968), provisionally includes *P. u. ngamiensis* Roberts and *P. u. chobiensis* Roberts as synonyms.

Until such time as adequate material is available no attempt is made to define the subspecies present.



Distribution

Widely distributed throughout the Okavango delta as far south as Lake Ngami, but closely confined to the swamp and not found in the dry country to the west, between the swamps and the South West African border, except as occasional wandering troops. Their scarcity here is reflected in the position in adjacent parts of South West Africa where Shortridge (1934) states that 'Grootfontein and Tsumeb constitute the north-eastern limit of the species . . . no baboon of any species occurring along the middle Okavango (River) within the confines of the Grootfontein district'. Sparse in the dry country to the south of this as far as Ghanzi. Occur throughout the north-eastern sector, sparse centrally but particularly common along the Chobe River and throughout the eastern sector south to Lobatse and west to Dikgomodikae. There are scattered records through the southern and south-western Kalahari including the Kalahari Gemsbok National Park, in all of which areas they are uncommon and easily overlooked. Present records in this sector were all made along

well-used routes, other parts of the area being difficult to access. Silberbauer (1965) records that baboons 'occur as summer visitors in the southernmost parts of the (Central Kalahari Game) Reserve'. On this basis it is likely that they are thinly distributed throughout the southern part of the central, the southern and south-western Kalahari, not so far recorded from the northern part of the Central Kalahari Game Reserve and the southern and south-eastern parts of the Makgadikgadi.

Habitat

The species has a wide habitat tolerance as is demonstrated by its presence in such widely differing ecological situations as the Okavango delta, the Kalahari and the rocky kopje country of the eastern sector.

Undoubtedly commoner in the well-watered areas they can, nevertheless, utilize dry country on at least a temporary basis where, like certain other species, they obtain their moisture requirements from Tsamma melons, *Citrellus lanatus*, wild fruits, roots and succulent vegetation. With the provision of water-points for settlement and along stock routes, they make use of this where it becomes available to them, in watering troughs, tanks or from spillage (Kokong, Dikgomodikae, Nunga). At Nunga a solitary old male baboon used the artificially-created pond, fed by a borehole, placed to attract game for photographic purposes; at Kukong a small troop used a watering-trough provided for domestic stock. Silberbauer (1965) records their presence during the summer months' in the southern parts of the Central Kalahari Game Reserve where water in any form is non-existent during the dry season. They are probably able to penetrate further into arid country during the wet season, from about October till March, when water is available in temporary pans and depressions, remaining only if melons and succulent vegetation are available as the country dries up.

In the Okavango delta the troops wander widely on the floodplain especially on the verges of molopos, or wherever there is water, using the riparian woodland of the islands to find shelter and resting places at night and in which to find wild fruits during the day.

In the eastern sector they are associated with rocky kopje country from which they wander widely to feed, being a pest in areas where agricultural crops are grown.

Habits

Diurnal, gregarious, forming troops of up to *c.*70 in the Chobe River area, smaller and more mobile troops of up to *c.* 30 in the Kalahari. Solitary individuals, thought to be old males, occasionally met with (Kanyu, west of Tshane and Kukong). Goussard in his notes on SWG 187 from Gomare states that this old male was known to the local inhabitants as being 'always alone'. Shortridge (1934) quotes instances of solitary, 'usually old, males' from the South West Africa border and quotes Steinhardt having met with a similar situation in the Kaokoveld.

Troops may occasionally meet and intermingle, apparently without any aggressive behaviour.

In the eastern sector rest at night in inaccessible rocky situations, in other areas, devoid of this type of refuge, in high trees, preferring those with a dense leafy cover (Okavango).

Dandelot (1968) quotes Shortridge (1934) in referring to *P. u. griseipes* as a 'tree baboon' and adds a note to *P. u. occidentalis* calling it a 'rock baboon'. If the southern populations in Botswana are indeed *P. u. occidentalis*, as they appear to be, they do not, for example in the Dikgomodikae area, confine themselves to the small rocky range of kopjes, and were often heard at sundown barking from far out on the flats where they had taken to the trees for the night, and they certainly feed far out on these flats.

The northern populations (*P. u. griseipes*) must of necessity use trees for safe refuge at night as there are only a few isolated kopjes, none of which, with the possible exception of the Tsodilo Hills in the north-west, offer sufficiently large krantzes to be accounted as safe refuges.

Dependent on a water supply or able to subsist for lengthy periods on the moisture obtained from wild melons, cucumbers or rhizomes and bulbs dug from the ground, or on other succulent vegetation, e.g. Stapeliaceae. During the wet season move widely from permanent water supplies. The observations of Silberbauer (1965) of baboons as summer visitors to the southern parts of the Central Kalahari Game Reserve may well be wandering troops destined to return to areas where water is available in the dry season.

Food

Omnivorous, although predominantly vegetarian, will also eat insects and occasionally carnivorous.

Identifiable material in stomach contents of species taken in the riverine forest at Kasane included the fruits of *Diospiros mespiliformis*, *Garcinia livingstonei* and other wild fruits; melon-pips; *Acacia tortilis* and *Acacia* spp. pods and an unidentifiable wild bean and, as the results of raiding, maize seeds and leaves and pumpkin pulp and pips. C 397 content from Kasane

consisted of 2/5 *D. mespiliformis* seeds and 3/5 green grass, C 406 the same seeds with a lesser amount of green grass. C 2642 contained grass seeds and HJH 1187 and 1136 *Ximenia* sp. fruits, B 1299 unidenti fiable caterpillars in small quantities.

Although in the 17 stomach contents examined insects only figure in one, authorities such as Roberts (1951) all mentioned their eating scorpions and insects and their occasional carnivorous habits have been documented (Davel, 1965).

Breeding

The data available are insufficient to properly assess the time of dropping the young in Botswana. Lactating females and tiny juveniles (under 3 lb.) have been taken in June and July. In June, Child (C 359) notes that a female taken at Kasane was copulating, in oestrus and at the same time lactating. Ansell (1960) and Shortridge (1934) state that there does not appear to be any particular breeding season, young being born at any time throughout the year.

Sizes and Weights

MALES

TL	$\bar{X}$ = 1451;	N = 9;	Obs. range	1320-1570
T	$\bar{X}$ = 725;	N = 9;	,, ,,	598- 840
Hf s/u	$\bar{X}$ = 223;	N = 9;	,, ,,	217- 236
E	$\bar{X}$ = 58;	N = 8;	,, ,,	54- 65
Weight	$\bar{X}$ = 70 lb.;	N = 9;	,, ,,	60- 96 lb.

FEMALES

TL	$\bar{X}$ = 1187;	N = 5;	Obs. range	1075-1255
T	$\bar{X}$ = 585;	N = 5;	,, ,,	556- 610
Hf s/u	$\bar{X}$ = 184;	N = 5;	,, ,,	176- 194
E	$\bar{X}$ = 50;	N = 5;	,, ,,	44- 52
Weight	$\bar{X}$ = 34 lb.;	N = 5;	,, ,,	31- 38 lb.

Order PHOLIDOTA

Family MANIDAE

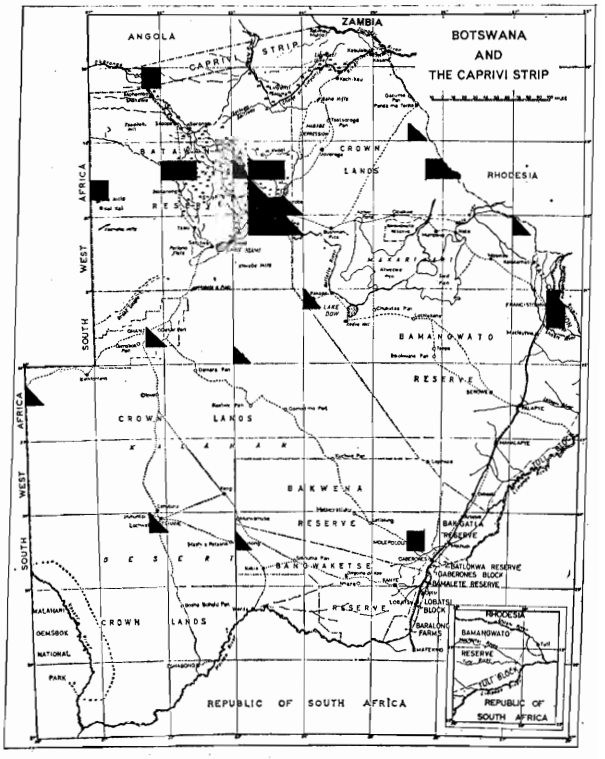
Genus MANIS Linnaeus, 1758

Manis temmincki Kgaga Pangolin

M. temmincki Smuts, 1832

Distribution

To date there are very few records but, such as there are, indicate that they are widely distributed in the northern parts of the country to the southern parts of the Okavango delta and the Tati Concession in the east. South of this, apart from the isolated record from Molepolole, there are only a few scattered visual records from the central parts of the Kalahari south to Lochwabe and Kukong and none from the extreme south-west. They are not listed among the mammals occurring in the Kalahari Gemsbok National Park (Coetzee and Burger, *in litt.*) and were not met with along the Molopo River. There are no records from the Makgadikgadi or the south-western parts of the Bamangwato Reserve east to the Transvaal border. Shortridge (1934) states that they occur throughout South West Africa although 'more numerous north of the Tropic of Capricorn'. Even in areas of known occurrence they are rarely contacted and it may be that they have, so far, been overlooked, in the above areas.



Habitat

The Botswana material was recorded from a variety of habitats. In the Okavango delta, where they appear to be more common than in other parts of the terri-

tory, they occur on floodplain both under riparian woodland conditions (Gomoti, Moremi Game Reserve) and floodplain grassland with some open scrub cover and permanently dry islands with riparian woodland and thick underbush (Nokaneng). At Nokaneng they were also found west of the swamp in dry sandveld with open scrub and at Aha Hills in dry rocky country with scrub and grass cover. In the Tati Concession they occur in *Acacia* scrub in association with rocky broken country and in the Tamafupi area on sandveld with grass and *Terminalia-Bauhinia* scrub and open pans.

At Mamuno and in the Central Kalahari Game Reserve, the conditions are sandveld with *Acacia* scrub and similar 20 miles west Rakops where there is some open woodland.

Habits

The species is by no means entirely nocturnal, several of the Botswana records being made during daylight hours. In Rhodesia, where they appear to be more common, they are often seen moving during the day being frequently picked up on main roads and brought into the Museum (Salisbury). The Moremi Game Reserve specimen was observed feeding on the dry fringe of the swamp at 11.30 a.m.

They are shy and, although quite noisy in moving through dry grass or underbush, will 'freeze' on sensing the observer at some yards away and therefore can be overlooked, more especially as their brown colour blends well with the background. When feeding they move low on the ground, most of the weight being carried by the back legs the front edges of the long curved claws on the front feet assisting irregularly in taking the weight. This can often be seen in the spoor, where the imprint of the roundish hindfeet and the scrape of the tail are characteristic with an occasional addition, often only on one side, of the imprint of the curved claws of the front feet which touch the ground on their leading surfaces.

Progress can also take place at a balance on the back legs, the tail hardly touching the ground.

Under stress they will rise on the back legs, the broad heavy tail taking the balance and proceed at quite a smart pace without the front claws touching the ground at all, the forelegs being held curved into the body. In tall grass they will pause, rise high on the back legs, and, steadied on the tail, gaze around. If touched or put under more than normal stress they will curl up into a tight ball, the head inside, and lie still, the broad tough scales of the back, sides and tail affording an effective protection to the soft underparts and head. In this position they are very difficult to prise open and large specimens require the efforts of several persons. Under these conditions the tail, which curves over the back, is worked from side to side and the slicing movement of the sharp scales on the side of the tail are capable of cutting severely.

Authorities state that the species excavates its own burrows but this has not been observed. They have, however, been observed to use ant-bear and spring hare burrows, although normally they appear to hide themselves in debris in shady bush cover during daylight hours.

Normally terrestrial an individual was observed to climb over a fallen log with ease and over a four-foot-high netting-fence, hooking the interstices of the wire with its curved front claws, steadying itself on its back legs and tail.

They are capable of forcing themselves through surprisingly small apertures.

M. crassicaudata, the Indian pangolin, is recorded by Adam (in Shortridge, 1934) 'when in fear of its life . . . to claw a hole into loose soil with almost incredible speed, and disappear in a few moments, closing the hole behind it with its tail'. This behaviour has not been observed in *M. temmincki* which under these conditions curls up.

Food

No information is available on the Botswana specimens as only one, a male, was handled, BP 2129 from Gomoti, Moremi Game Reserve, which was tagged and released on the 28th July, 1968. The other records are drawn from literature, trade material or specimens found dead. Information available from Rhodesian material shows that they feed on Formicidae and Isoptera, analysis of five stomach contents being as follows:

T 314	Makwiro, Rhodesia	100% Formicidae, *Camponotus* sp., including larvae Tr sand and debris
T 215	Umtali	75% Isoptera 20% Formicidae 5% Sand and pieces of grass
O 212	Salisbury	100% Formicidae, *Paltotpyreu tarsatus* Tr sand and debris
TG 1457	Lonely Mine	100% Formicidae, *Anplolepis custodiens* Tr Isoptera, gravel, grass stems and small sticks
NM 2724	Shangani R.	100% Formicidae, including larvae *Camponotus thales; A. custodiens* Sand, gravel and small sticks

Some of the gravel consisted of quite large irregular pieces up to four millimetres in diameter.

Two individuals taken alive and allowed free movement in the field were observed to dig up the underground nests of *Camponotus* sp. ants. These are not apparent to the observer on the surface. After some initial digging with the curved front claws the pangolin lowered itself to the ground, the front legs curled into the body and with slow movements of the sticky tongue among the ants, then running about on the surface, picked them up on the sticky tongue and injested them. Some of the ants were undoubtedly trapped as they bit into the tongue and were pulled into the mouth. After most of the ants on the surface were consumed further digging took place, the snout of the pangolin then being pushed into the exposed holes, the animal lying in this position for some moments. Although it could not be observed, presumably the tongue was exploring the holes for further prey.

Although both these pangolins were given access to termitaria, in one case broken open to make it more attractive, they both chose to find their own Formicid nests.

It might well be that the wrong species of Isoptera were being presented for Sweeney (1956) states that 'they seldom trouble to dig out termites' nests but, if they do, it is almost invariably the nest of an *Odontotermes* or *Microcerotermes* species'.

Sweeney shows that in the Sudan 'they refused all insect food' except Formicidae and Isoptera and that they are specific in their choice of Formicidae.

They appear to be independent of water although in captivity they would drink, the head held low over the surface, the long tongue moving in and out in the water.

Breeding

In the very young stages, under stress, the juvenile is entirely enveloped within the protection of the mother's body. As it grows to a stage where, because of its size, this is impossible the head and shoulders of the young is enveloped, its tail firmly clamped across the body of the female at about the level of the base of the tail. The female curls her tail across the shoulders of the young to shelter her own head at the same time.

Separated from the female and disturbed the juvenile would curl up on its own in the normal manner.

Apparently the young accompany the mother for a considerable length of time for a 26 lb. 9 oz. female from Beatrice, Rhodesia, was accompanied by a young male of 6 lb. 9 oz. which still sought the protection of her body when disturbed. This juvenile travelled on the mother's back, the long claws of its front feet firmly clamped under the scales on the female's flanks, the tail slightly to the one side of the tail of the female and clamped tightly to it.

No gravid females were taken but a specimen from Rhodesia was carrying a single foetus in July (Gwanda). Ansell (1960) for Zambia records an 18-in. juvenile in July (Namwala) and a birth in August (captivity). These records suggest that the young are born during the dry colder months of the year, just prior to the rainy season.

It was noted that, in the foetus from Gwanda, a male at 113·8 grams the scales were tough but soft with a transparent very soft edge, the claws of the front feet covered with a soft cartilaginous cover, the rear claws curved under the soles of the feet.

Sizes and Weights

Sweeney (1956) dealing with *Smutsia* (*Manis*) *temminckii* from the Sudan records specimens of an overall length of four and a half feet (1 370 mm) and a weight of 60 lb. which is far in excess of any known from the southern part of Africa (*see* also Roberts, 1951; Shortridge, 1934; and Sclater, 1900). To date the largest found in Rhodesia is a female from Beatrice at 26 lb. 9 oz. (*see under* Breeding).

Botswana

MALES

No.	*Locality*	*TL*	*T mid anus*	*Hf c/u*	*Weight*
BP 2129	Moremi Game Res.	730	364	56	13 lb. 8 oz.
MSA 93	Maun	880	440	59	—

Order CARNIVORA

Key after Coetzee (1967).

1. All cheek-teeth rudimentary and wide apart; canines well-developed; greatest skull length over 125 mm; ears large and pointed Protelidae
   Cheek-teeth not greatly reduced 2

2. Upper carnassial (P^4) the dominant cheek-tooth; 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 . . Musteilidae
   Two upper molars; bullae either rudimentary or divided into two compartments; four or five toes . . . . . Viverridae

Family PROTELIDAE

Genus PROTELES I. Geoffroy, 1824

Proteles cristatus Thukwe, Thukwi, mMabudu Aardwolf

P. cristatus (Sparrman, 1783)

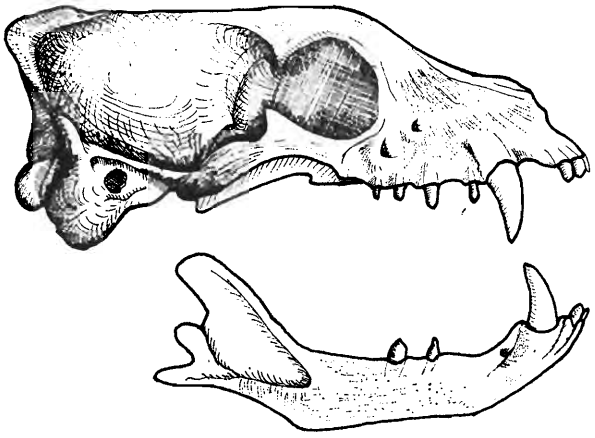
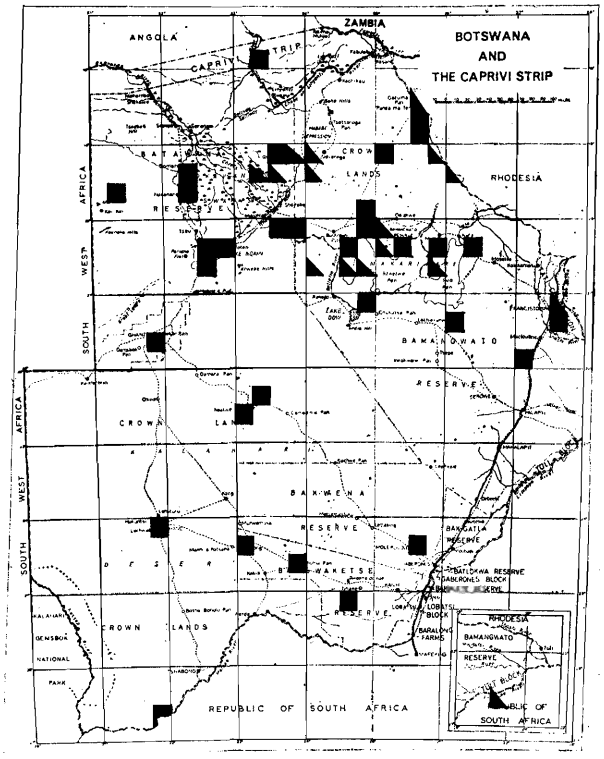


Fig. 15 Skull of Aardwolf, *P. crisatus*

Distribution

Widely distributed although there are so few records from south of Lake Ngami, Lake Dow and the Tati Concession that their status there must remain doubtful until further material is available. Shortridge (1934) states that they are widely distributed in South West Africa 'although nowhere abundant' and they may, therefore, occur in the western parts of the Kalahari, from which, at the moment, there are no records. No material is available from the northern parts of the Bakwena Reserve, the area south of the Makgadikgadi or the central parts of the eastern sector. As far as the last named area is concerned, as



they occur in the western Transvaal, they may be expected to be present.

In the north they are only recorded in Botswana as far north as 19° S., except in the east where they occur on the Rhodesian border at Pandamatenga, slightly

further north at 18°50′ S. They may, in time, be shown to occur north of the Okavango delta, as they have been taken on the Maschi River in the Caprivi Strip but they are noticeably absent from the *Baikiaea* woodland in the north-east and north-west and have never been seen north of this in the Chobe National Park (Hepburn).

In the Kalahari they are particularly associated with pans.

Habitat

An analysis of the types of association in which 24 specimens were taken is as follows:

Acacia scrub	7
Fringe pans	5
Floodplain grassland	2
Open grassland	3
Tree savanna	3
Terminalia-Combretum scrub	2
Airstrips	2
	24

All the above are very open associations. Of the three records listed as 'tree savanna' two are from near Nokaneng where this is on the fringe of floodplain and one from Nthane at the south-eastern corner of the Makgadikgadi. They have not so far been recorded in *Baikiaea* woodland.

Twelve of the records are from open grassland of various types either on the fringe of pans, floodplain or artificially created open ground (airstrip). Shortridge (1934) states that they 'mostly inhabit open sandplains or scrubby bush country and become scarcer in forest regions', a statement which the above data support.

They appear to be predominantly associated with open savannah grassland or scrub savannah but also occur in the valleys in broken hilly country. The reason for their absence from the extreme north-east and north-west is not clear except that they may not be able to utilize the *Baikiaea* woodland associations which occur in this area.

The species is common on the open grassland associated with the Makgadikgadi, the floodplain grassland of the Okavango delta, and in the vicinity of pans in the Kalahari.

Habits

Nocturnal, occur singly or in pairs although, on one occasion (Gweta), five were seen together, which possibly may have been a pair with a grown-up family.

Lie up during the day in burrows, either disused ant-bear, *O. afer*, holes or the enlarged holes of spring hares, *P. capensis*.

Near Dikgomodikae a disused ant-bear hole in which an aardwolf took refuge at night was, from the spoor, apparently in continual use. TNL 4537 was trapped in the entrance of an ant-bear hole.

In captivity avid diggers and may excavate holes for themselves but there is no conclusive field evidence to support this. On Nxai Pan a male and a female chased at night both took to shallow holes, one two metres long, the other three metres long, excavated in the sandy soil 8 to 15 mm below the hard calcareous surface layer. Neither ant-bears nor spring hares excavate in the surface of this pan itself, both preferring the sandy fringes. Bat-eared foxes, *O. megalotis*, however, do excavate holes on the pan at about the same size, 19 cm to 27 cm in diameter, and it is therefore impossible to say which species was originally responsible for them, although the bat-eared fox is inclined to dig deeper. In both cases the holes started originally, although the roof had partially caved in, on the edge of a springbok midden where the continual tramping had broken through the thin calcareous surface crust to the soft sand underneath. Disturbed at night the aardwolfs took to these holes lying in them with their heads sticking out, held in the light, until the observers approached closely when they disappeared down them. Neither of these burrows were occupied the following night and it seems that they were used only as temporary refuges.

Unlike the two species of jackals *C. mesomelas* and *C. adustus* the aardwolf is more prone to stand in the beam of a dazzling light, which appears to confuse them. As a consequence of this they are frequently killed by vehicles on roads at night.

Under stress the long hairs of the mane which extend from the nape of the base of the tail and the tail hairs are erected appearing to double the size of the animal and giving it a most formidable appearance. This may be accompanied by a deep-throated growling, a deep explosive bark, or a loud roar in surprising volume for such a comparatively small-sized animal. Although equipped with formidable canine teeth aardwolfs are not prone to use them but rather to frighten off aggressors by the erection of the mane and loud threatening growling. The young bark and growl softly.

Under stress the aardwolf can emit a heavy musk-like odour from anal glands, from which is secreted a bright ochre-yellow exudation. A young in the process of being reared would not accept its bottle until it had been thoroughly marked by squatting down on

it and rubbing the hindquarters from side to side on it. Adults in captivity persistently mark in this manner.

Food

Isoptera occurred in all the 20 stomach contents examined, in 18 of these, although accompanied by a high percentage of undigestible material such as sand, soil and small pieces of grass, constituting the only food material present.

In 18 stomachs it was possible to get an identification of the Isoptera present, four species only occurring, *Trinervitermes rhodesiensis*, *T. dispar*, *Hodotermes mossambicus* and *Fulleritermes coatoni*, these being present in the following number of stomachs:

T. rhodesiensis	16
H. mossambicus	5
T. dispar	1
F. coatoni	1

In four stomachs there were items other than Isoptera, BP 1910 containing traces of spiders and black beetles; BP 370, a preponderance of adult Lepidoptera, *Gynanisa maia*, a large brown moth, that were hatching out in great numbers in the mopane at Nata the evening that the specimen was taken. BP 370 contained a trace of Formicidae, *Camponotus* sp., and TNL 603 a trace of Solifugae, *Solpuga* sp.

An analysis of the percentage of food to the other apparently indigestible portion of the stomach content, consisting mainly of sand, soil and short lengths of grass, in three stomachs, was as follows:

	Food %	*Sand, Soil, etc.* %
TNL 4537	69	31
BP 1513	70	30
TNL 603	85	15

The sample examined shows a clear preference for Isoptera more especially of the species *T. rhodesiensis* and *H. mossambicus* although, when other types of food are readily available, as in the case of BP 370 in which the moth *Gynanisa maia* was present in very large numbers, these may be taken.

The aardwolf is frequently blamed for depradations on small domestic stock but the evidence does not support this nor is it likely that the degenerate peg-like molar teeth could deal with anything more substantial than soft-bodied insects, etc. Sclater (1900) quotes Sparrman and other authors who had examined their stomachs and 'found nothing but termites or white ants' and quotes a Mr. Cloete who examined more than 50 stomachs finding 'a purely insectivorous diet, ants (Isoptera?) being the chief constituent'. Some 20 stomachs of aardwolf taken in Rhodesia, mainly as road kills, revealed a similar state of affairs, Isoptera constituting the whole content with but traces of insecta, arachnida, etc.

Stomachs may contain up to 2½ lb. of termites, sand and other detritus (BP 342).

Breeding

Females carrying foetuses or lactating have been taken in the following months:

Distribution of non-gravid, lactating and gravid females through the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	1	1	3	3	–	2	1	–	–	1	1	–
Non-gravid	–	1	3	2	–	2	–	–	–	–	1	–
Lactating	1	–	–	1	–	–	–	–	–	–	–	–
Gravid	–	–	–	–	–	–	1	–	–	1	–	–

The sample is too small to base any definite decisions as to when the species drops its young, although the indications are that they may do so over a wide season of the year.

In Rhodesia the young are born towards the end of the year from just before or early in the rainy season from September through to December.

Captive young if taken less than about a third-grown are very difficult to rear and almost invariably develop a lack of correlation of movement, staggering and walking into obstructions and eventually die, which no dietary or vitamin treatment so far applied appears to correct. Taken about half-grown, however, they thrive in captivity. Gransdale (1964) remarks on the difficulty of maintaining them in captivity but in spite of this an individual lived in the Zoological Gardens in London for 12 years and 10 months.

The young are born in disused ant-bear holes.

Sizes and Weights

MALES

TL	$\bar{X} = 942$;	$N = 7$; Obs. range	910- 983
T	$\bar{X} = 231$;	$N = 7$; „ „	210- 253
Hf c/u	$\bar{X} = 161$;	$N = 7$; „ „	151- 167
E	$\bar{X} = 101$;	$N = 7$; „ „	92- 106
Weight	$\bar{X} = 19$ lb. 2 oz.;	$N = 6$; „ „	18 lb.- 20 lb. 8 oz.

FEMALES

TL	$\bar{X} = 969$;	$N = 8$; Obs. range	860-1015
T	$\bar{X} = 255$;	$N = 8$; „ „	223- 290
Hf c/u	$\bar{X} = 161$;	$N = 8$; „ „	154- 166
E	$\bar{X} = 100$;	$N = 8$; „ „	92- 106
Weight	$\bar{X} = 21$ lb. 3 oz.;	$N = 8$; „ „	19 lb. 3 oz.- 22 lb. 14 oz.

In overall length and length of tail females appear slightly larger than males which is reflected in their greater average weight.

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*

2. Ears rounded; body spotted; back not maned; upper molar much reduced, much smaller than first upper premolar which is often absent in adults . . . . . *Crocuta*

Genus HYAENA Brisson, 1762

Hyaena brunnea

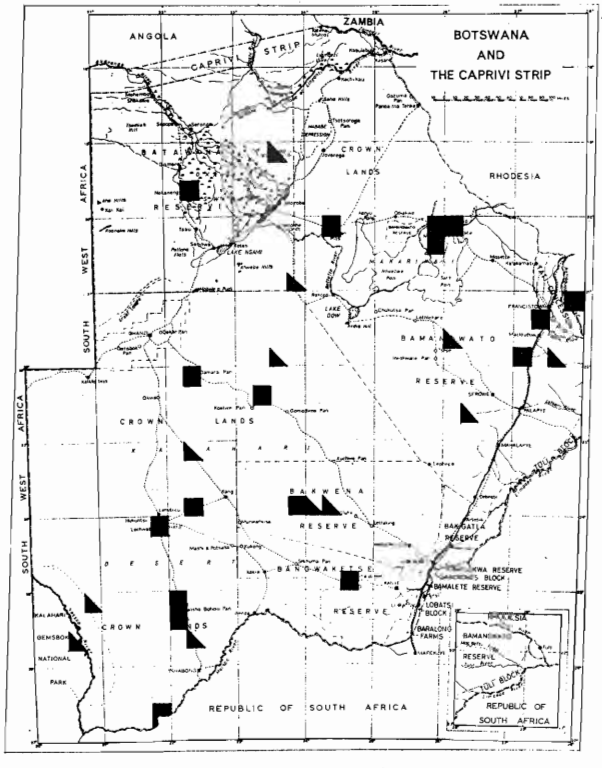
H. brunnea Thunberg, 1820

Phiritshwana Brown Hyaena

Distribution

Widely distributed throughout the southern, south-western and central Kalahari and northwards up the western fringe of the Okavango delta to Nokaneng and eastwards to the Moremi Game Reserve. Not so far recorded in the north-eastern sector, east of the delta, or in the eastern sector south of Foley.

Although there are no records from the extreme western part of the territory, north of the Kalahari Gemsbok National Park, they are likely to occur there as Shortridge (1934) records them as 'everywhere plentiful and well known' from the Grootfontein district (*c.* 19° S.) southwards and in the eastern parts of South West Africa. Shortridge particularly noted that the species was absent or exceedingly scarce east of the Okavango (River) and quotes Neale who stated that only the spotted hyaena, *Crocuta crocuta*, occurred in this area.



In view of Shortridge's remarks on its status in the Grootfontein district and the range of specimens he collected (seven) they may occur in other parts of the western Okavango north and west of Nokaneng.

They may also occur in the north-eastern sector at least narrowly along the Rhodesian border as they are recorded from adjacent parts of the Wankie National Park.

Habitat

Generally confined to dry open scrub and woodland savannah although penetrating northwards up the fringe of the swamp on the west to Nokaneng, in the east to the Moremi Wildlife Reserve on floodplain and open woodland. As they occur in the extreme south-western part of the territory where water is only available seasonally, or not at all if the rains fail, apparently independent of water. Westwards in South West Africa largely replaces the spotted hyaena, *Crocuta crocuta*, apparently being able to utilize drier more arid terrain. Throughout its range in Botswana occurs alongside the spotted hy ena. In the drier south-western area commoner than the spotted hyaena, the reverse being the case in the Okavango delta, the spotted replacing the brown hyaena altogether in the extreme north and in the Caprivi Strip.

Habits

Predominantly nocturnal, although sometimes seen during daylight hours (Nata, and *see* Silberbauer, 1965). Occurs singly or in pairs, occasionally in small packs of six to eight (Kweneng, Child, *in litt.*). Less of a scavenger than the spotted hyaena, and more inclined to make their own kills—known to raid small domestic stock, such as goats and sheep, but are in general less of a problem animal than the spotted

hyaena. Ullberg (*pers. comm.*) reports that in baiting for hyaenas the brown hyaena would come into the carcasses of freshly-killed springbok but were not attracted by skinned carcasses. The survey normally used skinned carcasses as baits and this may have been the reason that little success attended this method of locating them. In spite of this they fall victim to the intensive control measures taken against the spotted hyaena in ranching areas (Bulalima Mangwe, Rhodesia) and, on the perimeter of their range in the more intensively settled areas outside Botswana limits (Rhodesia), are becoming sparse, their distributional range gradually shrinking.

The species is apparently more secretive and less precocious than the spotted hyaena, less prone to operate in the vicinity of settlements, and more difficult to contact than the spotted hyaena. They are probably more common in the southern and south-western parts of the territory than present records indicate. In the Kang area, as an example, the survey operated between the hours of 8.30 p.m. to midnight or thereafter to a total of some 100 hours only seeing one individual, yet there were bales of skins (1967) estimated as representing some 50 individuals in the skin store at Kang, taken locally over an unknown period, by the indigenous people with the aid of steel traps or hunting with dogs.

Food

Only two stomach contents were available for examination, the first from near Shorobe which contained the bones, hair, hooves and other remains of a young lechwe, *Kobus leche*, and the pulp and pips of a melon. The second, from near Tshane, was taken at the carcass of a spotted hyaena, *Crocuta crocuta*, laid out on the pan as bait, the stomach containing bones, flesh and a few hairs left adhering to this carcass after skinning.

Authorities agree that they are carrion-eaters and they are reported as eating wild fruits. Shortridge (1934) records that in coastal areas they will eat dead porpoises, whales, fish and sea-birds washed up on the beaches. They are reported as killing young domestic stock such as sheep and goats (Bulalima Mangwe, Rhodesia), and it could be that the young lechwe, reported as being found in the stomach from Shorobe, had been killed by the individual concerned.

Breeding

A female BP 1674 taken in the Central Kalahari Game Reserve (2223A4) on the 18th October, 1966 (Liversedge), was carrying three foetuses, near to birth, weighing 675, 548 and 556 g respectively. This is the only evidence of breeding to date and neither Shortridge (1934) or Roberts (1951) provide data on this aspect of the species.

Details of the foetuses taken from BP 1674 are as follows:

	C/R	*T*	*Hf c/u*	*E*	*Weight*
Foetus 1	200	52	49	25	675 g
Foetus 2	170	52	52	27	548 g
Foetus 3	190	52	55	27	556 g

Sizes and Weights

MALES		*TL*	*T*	*Hf c/u*	*E*	*Weight*
C 3300:						
Bosobogolo Pan	4/68	1250	230	220	158	—
BP 2204:						
Shorobe	7/68	1390	252	222	152	86 lb.
TNL 2273:						
Tshane	2/67	1470	265	228	154	102 lb.
FEMALES						
C 3299:						
Bosobogolo Pan	4/68	1240	190	210	154	—
BP 2230:						
Mampshe	5/68	1543	187	208	150	—
BP 1674:						
22 23 A4	10/66	1350	240	215	154	97 lb.

Genus CROCUTA Kaup, 1828

Crocuta crocuta

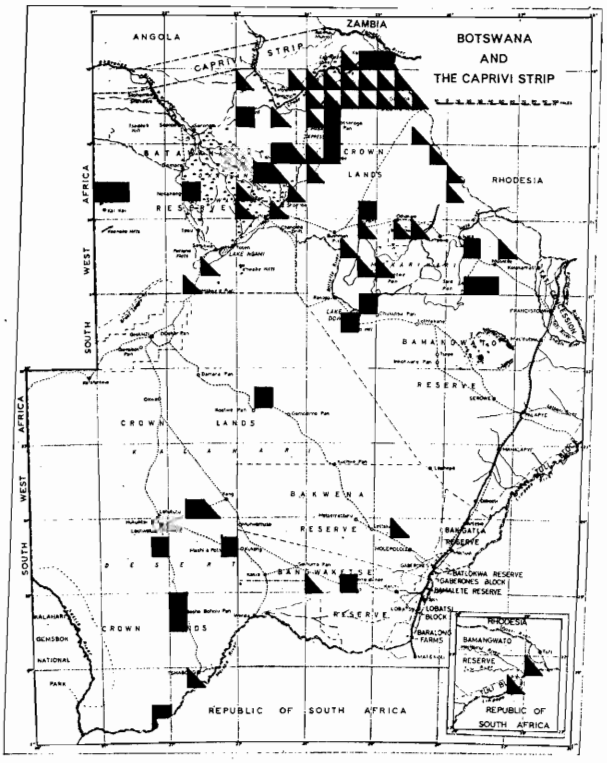
Phiri, leHolo Spotted Hyaena

C. crocuta (Erxleben, 1777)

Distribution

Widespread and common throughout the northern parts of the territory, south to Lake Dow and the southern parts of the Makgadikgadi. Not occurring, except perhaps as an occasional vagrant, in the eastern sector from the Tati Concession to the Baralong Farms, except in the extreme eastern extension of the Bamangwato Reserve where they still occur in the Tuli Circle and northern Tuli Block farms.

There is only one record from the Central Kalahari Game Reserve, just north of Kaotwe Pan, but Silber-



bauer (1965) in writing of this area states that they 'occur throughout'.

There are no records from the South West African border area, from the Aha Hills to the northern parts of the Kalahari Gemsbok National Park, where they are reported to occur (Burger, *in litt.*). The northern part of this area is not well known and they may occur as far south as 22° S., as Shortridge (1934) records their presence at Oas (Gobabis district) this 'apparently the most southern (recent) record for the spotted hyaena from South West Africa'. In view of this remark they might well be absent in the border area from about 22°-24°50′ S.

In the south and south-west Kalahari there are a number of records east of the Kalahari Gemsbok National Park as far north as Tshane and Kang and, in view of the above remarks, they may occur through the central Kalahari to connect up with the northern populations.

There are no visual or material records from the sector bounded by the southern parts of the Makgadikgadi, the eastern boundary of the Central Kalahari Game Reserve south to Letlhakeng or east to the Tuli Circle.

In the northern parts of its range they are much commoner than in the south and in parts, for example the Savuti and northern Okavango delta, if not seen, they may be heard almost nightly.

Habitat

The species has a wide habitat tolerance, being found in the arid scrub of the south-west Kalahari to the riverine woodland of the Okavango delta and the Chobe River. They are a great deal commoner in these northern areas than in the dry south in spite of the fact that in parts of the south-west there are heavy game populations. In the arid south they occur in areas (Bosobogolo Pan, Mabuasehube Pan) where there is no permanent surface water and where it may only be available for limited periods during the year or not at all if the rains fail. Where water is available they will drink. An adult with two young drank at Tsotsoroga Pan and what was believed to be the same group returned two evenings later and drank again. They are, in spite of this, apparently independent of a water supply.

There are no records at the moment of their occurrence in the hilly country of the eastern sector east of the line of rail except in the extreme eastern extension of the Bamangwato Reserve and northern Tuli Block farms. In adjacent territories they are, however, found in this type of terrain. (Umvukwes; Chindamora Reserve; Sebungwe, Rhodesia.)

Two individuals were flushed during daylight hours, one ten miles south of Tshane, the other seven miles south of Nata. The former was lying up in a patch of thick bush, the other an isolated reed-bed near a temporary water-hole. In the absence of holes and caves quoted as the resting places by Shortridge (1934) and others, they apparently use any type of shady cover and, although at night they range widely in open country, some type of cover for use during daylight hours is apparently a necessary habitat requirement.

Their presence in any area is dependent on the availability of a food supply in the form of wildlife or domestic stock. They are certainly commoner in areas where wildlife is abundant and a pest where there are cattle populations and little wildlife. In the latter case they are subjected to control in the form of hunting or poisoning, which certainly accounts, to some extent, for their scarcity in parts of the eastern sector.

Habits

Almost entirely nocturnal, although occasionally seen during daylight hours. Terrestrial, usually found in pairs, singly or in small family parties of an adult and two young. Will congregate in numbers where carrion is available (Selinda Spillway, five) and occasionally

hunt in packs (Joverega, five). Where hyaenas occur the remains of carcasses of prey killed by other predators such as lion are rarely found as the species, with its powerful jaws and heavy teeth, is well adapted to dealing with the bones and skin which remain and they leave nothing. Where more than one is involved, they are inclined to tear off a portion of the carcass and pull it some distance away before eating, thereby scattering it around. Although scavengers, they are also active predators where carrion is not available.

At Hendricks Pan, two or possible three spotted hyaenas followed two lions through the camp at night, and this association with lions has been observed in other parts of Botswana and elsewhere (Estes, 1967; Tamafupi). Selous (1890) records seeing 20 hyaenas following three lions on the Mababe. Estes (1967) records that spotted hyaenas will rob both lion, *Panthera leo*, and wild dog, *Lycaon pictus*, of their prey. Even if not doing this they will undoubtedly benefit from the lion's hunting for they so often leave bones and skin which the hyaenas will eat as soon as the lions have departed. Estes (1967) also provides evidence that they will kill on their own, usually very young animals, near newly born, but at times adults (wildebeest, *Connochaetes taurinus*).

Food

An analysis of the stomach contents of ten specimens was as follows:

Food Item	*No. of Occurrences*	*Note*
Bovidae	9	See text
Hyaenidae	1	,, ,,
Pedetidae	1	,, ,,
Misc...	1	,, ,,

In ten stomachs examined nine contained the remains, in the form of skin, hair, hoofs and bones, of Bovidae, the following being represented: impala, *A. melampus;* duiker, *S. grimmia;* wildebeest, *C. taurinus;* reedbuck, *R. arundinum;* lechwe, *K. leche;* and gemsbok, *T. oryx*. In the case of the reedbuck and, in one of the two cases where impala remains were identified, these had been laid down as baits.

In BP 470, 80% of the stomach contents consisted of a spring hare, *P. capensis*, Bovid remains, and a 15-cm piece of leather riempie.

BP 1870 was somewhat unusual as it was eating the carcass of another spotted hyaena, BP 1858 laid out as an experimental bait. There were no less than five spotted hyaenas round this bait when BP 1870 was shot.

BP 2131 contained a chewed-up slab of elephant skin.

In seven out of the ten it was impossible to say whether the hyaenas had killed the Bovid represented in their stomach content, and there is no evidence that this takes place in Botswana although there is ample evidence of this type of predation in other parts of Africa. In Rhodesia they have been known to kill fully-grown cattle (Nyamandhlovu) as well as donkeys (Gwaai).

Breeding

Three lactating females, in all cases the uterine horns showing signs, by their swollen appearance and greatly developed vascular system, that the young had been dropped some little time before, were taken in February, June and July. Two young were killed in an ant-bear hole in the Tuli Circle in May and Child (1968) records 'three small brown cubs in June' from the southern part of the Mababe Depression.

Stevenson-Hamilton (1912) states that 'the 2-3 young are born during the South African winter (*c.* April to August) in old ant-bear holes and other burrows'; Matthews (1939) for Tanzania stated that they had no definite breeding season which Ansell (1960) agreed might be the situation in Zambia.

The above record of a lactating female taken in February, the other two during the winter months (June, July), together with the juvenile records, suggests the possibility of an all round the year breeding season in Botswana, although further evidence is required to substantiate this. There might well be a peak of breeding in the winter months, with odd records at other times of the year.

Sizes and Weights

MALES

	TL	*T*	*Hf c/u*	*E*	*Weight*
BP 1870	1590	311	251	120	178 lb.
BP 2131	1600	260	275	127	175 lb.

FEMALES

TL	$\bar{X} = 1579$;	$N = 7$;	Obs. range	1448-1610
T	$\bar{X} = 268$;	$N = 7$;	,, ,,	227- 310
Hf c/u	$\bar{X} = 251$;	$N = 6$;	,, ,,	240- 265
E	$\bar{X} = 120$;	$N = 7$;	,, ,,	104- 130
Weight	$\bar{X} = 162$;	$N = 4$;	,, ,,	128- 185 lb.

Family FELIDAE

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. Hyoidean apparatus unspecialized. Long-legged . . . *Acinonyx*
   Claws when retracted covered by sheaths. Body unicolor or with rosettes or bars as well as spots or indistinctly marked with bars and spots. Skull in profile less arched 2

2. Hyoidean 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*
   Hyoidean 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*

Genus ACINONYX Brookes, 1828

Acinonyx jubatus

A. j. jubatus (Schreber, 1775)

leNgau, leTlotse Cheetah

Taxonomic Notes

There are several records of the form in which the spots coalesce into bars, formerly described as a separate species, the king cheetah, *A. rex* Pocock, 1927, now known to be a dimorphic form. Some of these have turned up in batches of trade skins but the exact localities from which they originate is not known. One skin from Moyabana in the possession of Mr. Clark was examined. This is now in the collection of the National Musuem of Botswana and remains the only specimen which it is possible to locate accurately (Plate 10). Challis (*in litt.*) reports the sighting of two individuals on van Riet's farm in the southern Tuli Block, 2327A4.

Distribution

Widely but sparsely distributed throughout, except in the eastern sector from the Nata River and the northern parts of the Tati Concession south to near Debeeti, although still found in the extreme eastern extension of the Bamangwato Reserve in the Tuli Circle area and northern Tuli Block farms. Absent from Debeeti south to the Baralong farms and in the whole of the eastern parts of the Bakwena and Bangwaketse Reserves.

Although there are no records from the Aha Hills south along the South West African border to the Kalahari Gemsbok National Park or eastwards in the southern part of the Central Kalahari Game Reserve they may, in time, be shown to occur as Shortridge (1934) states that 'they occur in the Gobabis district and elsewhere in the sand-plain country adjoining

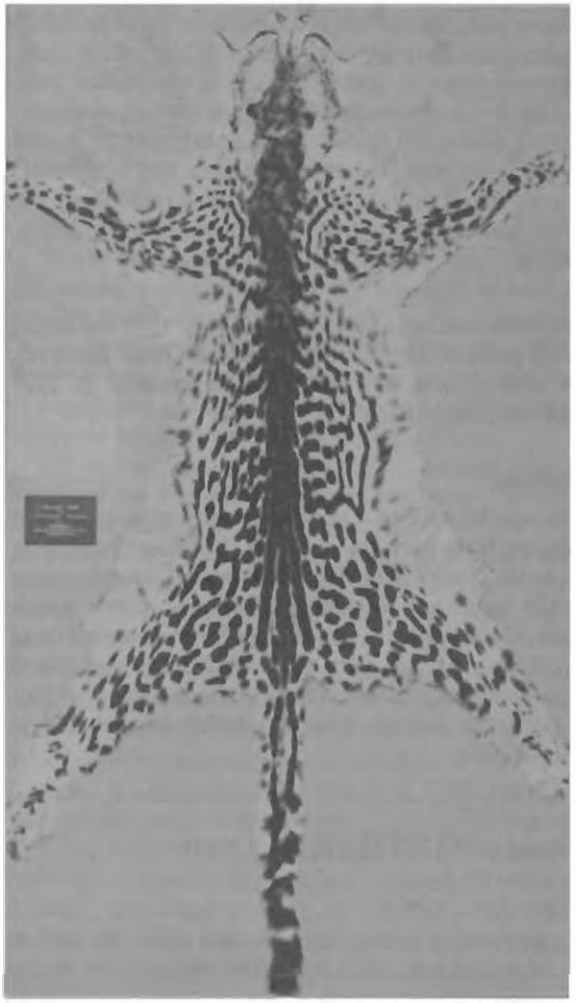
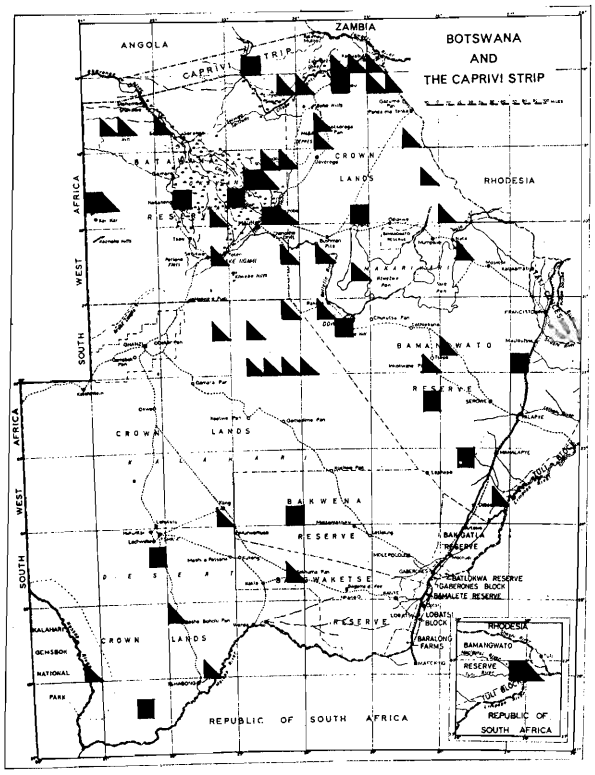


Plate 10 'King' Cheetah skin from Moyabana now in the collection of the National Museum of Botswana, Gaborone.



Bechuanaland' and Silberbauer (1965) 'they are found in all parts of the Central Kalahari Game Reserve'. In neither case, however, is there material to substantiate these claims.

Habitat

The species utilizes a wide variety of types of habitat ranging from open floodplain (Linyanti), where there is some cover of bush on the raised islands, open sandy scrub and woodland (Tshane), *Acacia* woodland (Gomoti River), etc. Except for purposes of lying up during the day, they avoid thick scrub and closed woodland, in general preferring more open country.

All these habitat types are widely represented in the territory.

Habits

Predominantly diurnal, but to some extent nocturnal as well, as it has been seen stalking oribi, *Ourebia ourebi*, at night on the floodplain at Linyanti and moving on the fringes of Nxai Pan and on tracks at Savuti after dark. BP 2126 from the Gomoti River was taken at 5.30 p.m., another being seen a mile further on. Normally found in pairs or family parties, but occasionally singly.

Food

Only two stomachs were available for examination, BP 2126 from the Gomoti River which contained the remains of an impala, *A. melampus*, and BP 645 from Tshane the remains of a springbok, *A. marsupialis*. Child (1969) records the killing of two adult impala, *A. melampus*, and a calf and a female duiker, *S. grimmia*, and quotes Mr. P. Brown who reported the killing of an ostrich, *Struthio camelus*, near Tsau. Stevenson-Hamilton (1932) states that in the Kruger National Park they concentrate on impala and waterbuck, *K. elipsiprymnus;* Shortridge (1934) that they will take tssessebe, *D. lunatus*, kudu, *T. strepiceros*, and waterbuck. Ansell (1960) includes guinea-fowl, *Numida mitrata*, and Labuscagne (*pers. comm.*) states that in the Kalahari Gemsbok National Park spring hares, *P. capensis*, constitute a large proportion of the diet of individuals. Dorst (1969) suggests that the taking of large species such as waterbuck, etc., is carried out by a group rather than individuals. It appears that they confine their attentions large to small and medium-sized prey, particularly antelope and large predominantly ground-living birds.

Breeding

No information available.

Sizes and Weights

			TL	*T*	*Hf c/u*	*E*	*Weight*
MALE							
BP 2207	Mababe	7/68	1876	735	315	80	—
FEMALE							
BP 2126	Gomoti River	7/68	1860	695	313	82	85 lb.

Genus PANTHERA Oken

1. Body with distinct rosettes and spots, no tuft on the end of the tail, no mane in the male, averaging smaller, total length of skull about 175-260 mm; sagittal crest, mastoid process and paroccipital process not prominent . . . . . *P. pardus*

2. Body unicolor, lacking roset es, 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 . . . . . *P. leo*

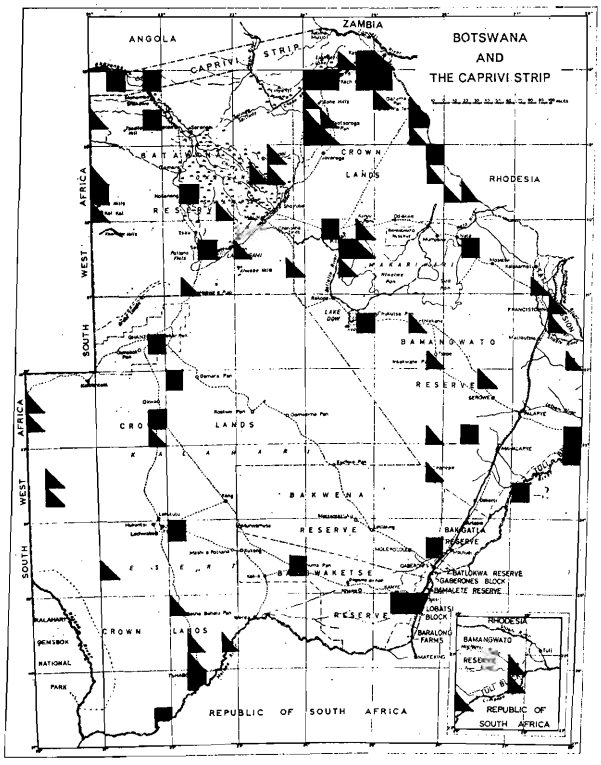
Panthera pardus

Nkwe Leopard

Panthera p. pardus Linnaeus, 1758

Distribution

Widely distributed throughout the territory. Although neither the Vernay Lang Expedition of 1930 (Roberts, 1935) or the survey have any material or visual record of the species in the Central Kalahari Game Reserve, Silberbauer (1965), states that they 'occur uniformly in all regions of the Reserve'.



The species persists even when intensively hunted, trapped and poisoned in ranching areas and still, on occasion, penetrates into settlements to raid small domestic stock. In 1965 an individual entered Francistown prowling around the perimeter of the B.B.C. radio transmitter apparently attracted by the Metropolitan Police dogs, then patrolling the area. This visit was carried out in spite of brilliant guard lights. Such visits are not uncommon in any settled area in the territory.

Habitat

The species has a wide habitat tolerance being recorded in open grassland and scrub, riverine woodland and in rocky hilly country.

They occur in the driest part of the country with a mean annual rainfall of 200 mm and less (Khuis) as well as in the well-watered higher rainfall areas such as the Okavango delta and Chobe National Park with a rainfall of between 450-700 mm. In the drier areas surface water may not be available to them for long periods.

Habits

Predominantly nocturnal but, in remote areas (south-west Kalahari), markedly diurnal and occasionally seen in the late evening (Savuti) or early morning (Kanyu). Occurs singly but often in pairs or family parties during the breeding season (Hendrick's Pan). Terrestrial but to some extent arboreal, lying up on the broad branches of trees or climbing to hide unconsumed portions of kills in them (Makalamabedi).

Where they are hunted become shy and retiring, but where undisturbed they are unafraid of vehicles or man (south-west Kalahari).

While more generally drinking regularly, where water is available, can populate areas where water is not available for long periods, up to nine months or longer in adverse seasons (Bosobogolo Pan).

Lie up during the day in caves, among piles of boulders on kopjes, clumps of tall grass (Moremi Game Reserve) or bush, sometimes, in the early morning or late evening, on open vantage points such as rocky ledges or high krantzes (Gubatsa Hills) where a wide vista of the countryside can be kept under observation.

The species is in most areas shy and retiring and difficult to contact but, as it tends to use established tracks in moving around, its presence is most often established by its spoor than by being seen. Will move in close to habitations and camps at night, perhaps through curiosity, although they will readily come in to fresh carcasses and are perhaps attracted by the presence of hides or meat in these camps. In visiting, normally quiet and unlikely to be noticed but, when moving in pairs, the characteristic hoarse cough, which may be repeated at regular intervals as they move, marks their presence.

Where there is rough country, such as is found in the rocky hill country of parts of the eastern sector, or extensive areas of thick bush, persists in the vicinity

of well-settled areas. Where there is a scarcity of small prey, individuals become problem animals, regularly raiding small domestic stock such as goats or sheep or calves. Has a taste for dogs which it has been known to kill and eat close to habitations.

Food

The only stomach content available for examination was a juvenile from near Tamafupi, BP 260, which contained the feathers of a medium-sized bird, thought to be a francolin. The mother of BP 1957 was shot near Pandamatenga killing goats and numerous reports of their predation on smallstock were recorded in the Okavango delta and its vicinity. In the Moremi Game Reserve the remains of a young impala, *A. melampus*, were found at night which it was thought from the evidence of the spoor, teeth and claw marks, had been killed by a leopard. Shortridge (1934) states that 'the largest animals killed by leopards according to my observation have been a kudu cow and immature donkeys'. Ansell (1960) in Zambia records the killing of a sitatunga, *T. spekei*, and Mitchell (1965) wildebeest, *C. taurinus*, and Lichtenstein's hartebeest, *A. lichtensteini*. Ansell (1960), includes in their prey birds, a crocodile, cane rats, *Thryonomys* sp., and porcupines, *H. africae-australis*, and Mitchell (1965), for the Kafue National Park, lists a wide range of small- and medium-sized mammals and catfish among the food, and both authors include baboons and monkeys. Stevenson-Hamilton (1932) records the killing of a waterbuck, *K. ellipsiprymnus*, cow.

Child (1968) records the following species from leopard kills in the Moremi Game Reserve: duiker, *S. grimmia;* baboon, *Papio ursinus;* impala, *A. melampus;* tsessebe, *D. lunatus;* bushbuck, *T. scriptus;* young roan, *H. equinus;* ant-bear, *O. afer*. While the predation of leopards on baboons has been widely stressed in literature, an adult leopard is no match for the co-operative efforts of a troop of baboons during daylight hours. At Wankie, Rhodesia, an incident of this type was observed, the leopard lying up near a water-hole and, being spotted by a large baboon, took to its heels. When the baboon charged it, the troop including many juveniles then following until the leopard took to a high tree where it was harried by members of the troop, the remainder sitting around on the ground at the base of the tree until sundown, when they straggled off leaving the leopard still marooned in the high branches. Baboons do, however, figure among the prey species but are probably taken from the fringes of the troop resting after dark or, if during daylight hours, solitary males or stragglers away from the troop.

In addition to the species mentioned by Child, the remains of a steenbuck, *R. campestris*, cached in the fork of a tree on the Makalamabedi fence, was thought to have been a leopard kill as were the remains of a young springbok, *A. marsupialis*, placed high in a gnarled camelthorn, *Acacia giraffa*, tree near Tshane.

In general the leopard appears to prefer small or medium-sized mammals but will occasionally take adults of larger species (tsessebe Child, 1968; kudu cow Shortridge, 1934). More especially in areas where prey species are sparse leopard will prey on domestic stock including poultry, sheep, goats and calves and become problem animals.

Breeding

No information available.

Sizes and Weights

Only two measurements and weights are available, as follows:

MALES

		TL	*T*	*Hf s/u*	*E*	*Weight*
BP 260 (Juv.):						
9.7.64	Tamafupi	1265	531	195	72	18 lb. 12 oz.
BP 1957:						
—	Pandamatenga	1942	790	260	80	110 lb.

In captivity for 14 months, estimated to be 19 months old at time of death.

Shortridge (1934) records a specimen from Diwai, western Caprivi, which had the following measurements:

MALE

TL	*T*	*Hf c/u*	*E*
1320	805	245	78

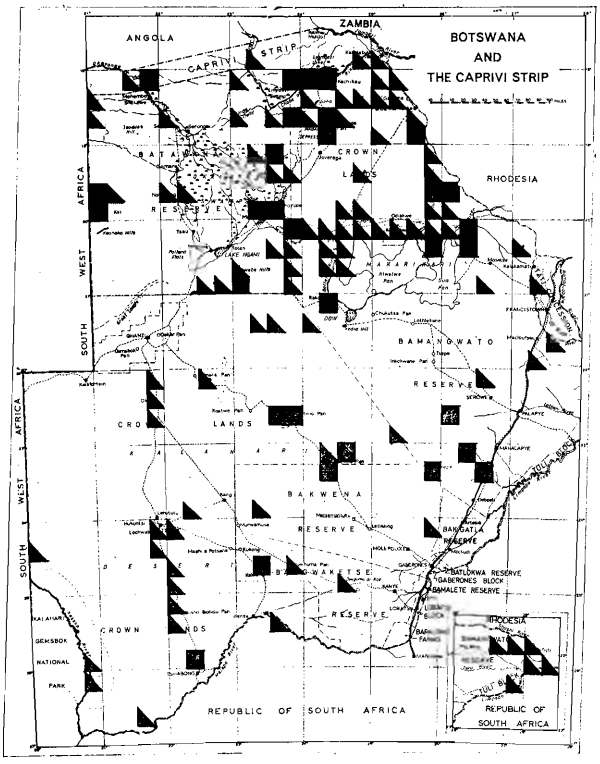
Panthera leo

Tau Lion

P. leo (Linnaeus, 1758)

Distribution

Widely distributed throughout, except in the settled parts of the eastern sector along the line of rail, occurring here, however, from time to time as vagrants. Not so far recorded within recent years in the south-east, east of Dikgomodikae. East of the line of rail occur in the extreme eastern extention of the Bamangwato Reserve in the vicinity of the Tuli Circle and



the northern Tuli Block farms. In the Tuli Circle it was estimated that, in December 1969, there was a population of 30-35 resident lions, not counting cubs below the age of six months. It was thought that the population was on the increase in numbers (Williams, Rhodesian National Parks, *in litt.*).

There are no records from the area south of the Makgadikgadi, bounded on the west by the Central Kalahari Game Reserve and on the east by a line between near Serowe, and the south-eastern corner of the Makgadikgadi. This area was visited on several occasions but no signs or reports of the species were recorded. Although this area is not particularly rich in large game species there is certainly sufficient to support at least a small population of lions. While there is no evidence at the moment it is most likely that they do occur from time to time, not remaining for any length of time.

South of this a specimen was shot in 1966 near Moyabana, and they were reported as being not uncommon visitors to this area as late as the early 1950's, black-maned lions being known (Clark, *pers. comm.*), and they have been seen *c.* 20 miles north-west of Serowe.

There are no records from the extreme west, on the South West African border, from the Aha Hills south to 24°15′ S. just north of the Kalahari Gemsbok National Park. Shortridge (1934), however, states that they occur all along the border on the South West African side and they are quite common in the Kalahari Gemsbok National Park and probably, therefore, they will in time be shown to occur throughout this area.

They appear to be absent from the eastern sector along the line of rail from Palapye southwards and from the south-eastern part of the territory south of Debeeti and east of Dikgomodikae except as vagrants.

The present pattern of distribution in Botswana reflects, albeit to a lesser degree, the marked change that has taken place in their distribution in other parts of southern Africa, where, in the face of settlement, they have disappeared from vast areas. The change in habitat brought about by settlement coupled with intensive hunting has led to the almost total disappearance of the herds of game on which they depend for food. Those remaining in these occupied areas, turning their attention to the domestic stock of the settlers, which provided a substitute food supply, were in turn the object of the most intensive persecution leading, in parts, to their total disappearance and the fact that they are now only found in remote or reserved areas.

Harris (1838) in the account of his expedition to southern Africa, 1836-37, in describing his hunting experiences in the country adjacent to the present-day borders of Botswana in the south-east (northern Cape Province) and east (western Transvaal), records frequent encounters with lions.

In 1871 Selous (1890) found that lions still occurred at Tati (old Tate).

By 1876, however, in recounting an experience with a lion near his camp at Seruli, Selous stated that lions were by then 'few and far between in this part of the country'.

In spite of their great reduction in numbers and their only occasional appearance in the eastern settled areas, they turn up in most unexpected places such as the individual which appeared on the kopje at Francistown in 1963.

Their occurrence today only as vagrants in the settled parts of the eastern sector is a manifestation of the pressures already tending to drive them westwards into less settled areas.

In the southern two-thirds of Botswana the game species, on which lions feed, move erratically, according to the vagaries of the season. Game will move from dry areas to areas where rain has fallen and the lions move with these moving populations. Within their distribution in this southern sector it is difficult,

therefore, to predict that lions will be present at all times of the year in any particular locality.

On the other hand, in areas such as the northern parts of the Okavango delta and the north-eastern sector, where there are heavy static, or relatively static, game populations, lions are resident throughout the year and in parts (Tamafupi, Moremi Game Reserve, north of the Kwhae River), are quite common.

Black-maned lions are not uncommon in the Kalahari (Okwa) and eastern Okavango, occurring alongside those of more normal tawny colour.

Selous (1890) records the shooting of 'two fine old male lions on the Mababe flat (in 1879), lying together under the same bush, one a full maned lion with a very dark coloured skin the other a very light coloured animal with scarcely any mane at all'.

Habitat

The species has a wide habitat tolerance and is found in all types of country from the well-watered parts of the Okavango delta, the dry arid plains of the south-western Kalahari and the broken hilly country of the eastern Bamangwato Reserve. Common on the islands in the Okavango delta, in the fringing riverine woodlands here and on the Chobe, Okavango and Botletle rivers, in the dry scrub and open grasslands of the Kalahari and in the *Baikiaea* woodlands of the north-east.

Habits

Lions may be found moving or hunting at any time of the day or night although normally they lie up during the hottest time of the day in shady places. Where they have been intensively hunted they tend towards more nocturnal habits and become shy and secretive.

They occur singly, in pairs (Tshane) or family parties (Linyanti, two adults, three juveniles), these often joining up to form prides as the young grow up. The largest pride recorded was at Nunga where there were '18 together with others some 300 yards away' (D. Swarthout). Silberbauer (1965) states that in the Central Kalahari Game Reserve 'Lions are more numerous than leopard, sometimes gregarious, forming prides of up to nine'. Child (*in litt.*) in a summary of lion contacts in the Chobe National Park records one pride of six, but much more commonly singles or pairs, and in a count on water-holes along the Nosop River and near Unions End the largest recorded was a pride of seven with many singles and pairs.

Where water is available they will drink regularly, especially after feeding, but can subsist without it and occur in the extreme south-west Kalahari where it may only be available to them for very limited periods during the year, or not at all during an entire season if the rains fail to materialize. At Bosobogola Pan in 1958 two lions entered the camp, removed two water-bags hanging on a vehicle, drank the wash-up water in a basin and attempted to gain access to a 40-gallon drum of water provided for the use of the camp. It would appear from this that they would certainly partake of water if it was available to them. Reported to drink at spillage from troughs at wells (five miles south of Tshane). In moving tend to use footpaths and tracks.

In the Okavango delta, and in particular in the Linyanti swamp, lions abound on the islands in the swamp. To reach these they either have to swim or walk through water from 50 cm to 100 cm deep for considerable distances. At Linyanti an island, about a quarter-mile across, situated some three miles into the swamp with a rich cover of evergreen trees, palms and underbush, which could only be reached by walking through the water, had three lions on it. Local reports stating that they moved freely between this and another smaller island about a mile away. Child (1968) records a lion and two (estimated) two-months-old cubs, swimming one and a quarter miles during the formation of Lake Kariba, and quotes other instances which demonstrate that they will freely take to water, swimming where necessary. At Savuti a lion crossed the deep channel within 50 metres of the camp at night, its noisy entry suggesting that it had plunged from the high bank into the water at the start of its swim.

Food

Child (1968) records the following species in a sample of 108 kills from north-eastern Botswana: buffalo, *Syncerus caffer;* wildebeest, *C. taurinus;* lechwe, *K. leche;* warthog, *Phacochoerus aethiopicus;* eland, *T. oryx;* waterbuck, *K. ellipsiprymnus;* zebra, *E. burchelli;* sable, *H. niger;* kudu, *T. strepsiceros;* puku, *K. vardoni;* tsessebe, *D. lunatus;* roan, *H. equinus;* and giraffe, *Giraffa camelopardalis.* Few kills were found which could be ascribed to lions but, among species not mentioned by Child, the following were recorded: impala, *A. melampus* (Moremi Game Reserve); hartebeest, *A. buselaphus* (near Tshane).

Three giraffe carcasses, one at Tamafupi and two on the Pandamatenga-Bushman Pits road, and a zebra, *E. burchelli*, on the flats near Kumaga, the remains of whose skin showed deep cutting presumably by their claws, were thought to have been killed by lions. During the B. Carp Expedition (1949) to the eastern Caprivi a number of carcasses of sitatunga,

T. spekei, and lechwe, *K. leche*, killed by lions, were found on islands in the swamp.

In addition to the species mentioned, Stevenson-Hamilton (1932) records their killing young hippo, *Hippopotamus amphibius;* reedbuck, *R. arundinum;* bushbuck, *T. scriptus;* and ostrich, *S. australis;* and Mitchell, Shenton and Uys (1965) include duiker, *S. grimmia*, and porcupine, *H. africaeaustralis*. Ansell (1960) includes rhino, *Diceros bicornis*.

Lions are known to kill and eat young elephants, *Loxodonta africana* (Wankie National Park, Rhodesia), and, at the other extreme, to take rodents (Shortridge, 1934).

In general, it appears that they will take any available warm-blooded prey.

Breeding

Judging from the visual records of cubs seen at Tamafupi in March and the Savuti in November, and data on the sightings of juveniles in all months of the year, excepting January to March (Child and Robbel, *in litt.*), the young appear to be born at any time throughout the year.

Both Shortridge (1934) and Ansell (1960) agree that they have no fixed breeding season.

Sizes and Weights

No lions were collected, the following data being kindly provided by Dr. D. Swarthout of the San Bernardino County Museum, for a male and a female taken at Jhari Pan and Nunga, respectively:

	TL	*T*	*Hf s/u*	*E*
MALE (Jhari Pan)	2590	863	405	134
FEMALE (Nunga)	3022	825	336	121

and the following data from R. Parris, Game Warden, Molepolole, for three individuals from near Tshabong:

	TL	*T*	*Weight*
MALES	2795	965	346 lb.
	2635	996	314 lb.
FEMALE	2476	965	234 lb.

In the Pandamatenga area, within Rhodesian limits, Mr. P. Johnstone records a male at 339 lb. and a female at 301 lb.

In the files of Messrs. Rowland Ward, the late Mr. Gerald Best stated (*in litt.*) that they had records of a lion and a lioness, collected by Mr. C. J. J. van Rooyen, in May 1959, from Pandamatenga, Botswana, at the following overall lengths and weights:

	TL	*Weight*
MALE (12 ft. 7½ in.)	3847	627 lb.
FEMALE (11 ft. 10 in.)	3607	493 lb.

These two records await confirmation.

Genus FELIS Linnaeus, 1758

1. Ears elongate, distinctly tufted at the tips with long black hair, back of the ears overall black with varying amount of white hairs . . *F. caracal*
   Ears not elongate, not distinctly tufted, not overall black on the back 3
2. Upper parts of body distinctly barred and/or spotted 3
   Upper parts of body unicolor or only indistinctly barred and/or spotted . . . . . *F. libyca*
3. Size larger; height at the shoulder in adults over 380 mm; legs long, hindfoot over 150 mm . . . . . *F. serval*
   Size smaller; height at the shoulder in adults not over 260 mm; legs short, hindfoot less than 120 mm . . . . . *F. nigripes*

Felis caracal Thwane Caracal

F. c. damarensis (Roberts, 1926)
F. c. limpopoensis (Roberts, 1926)

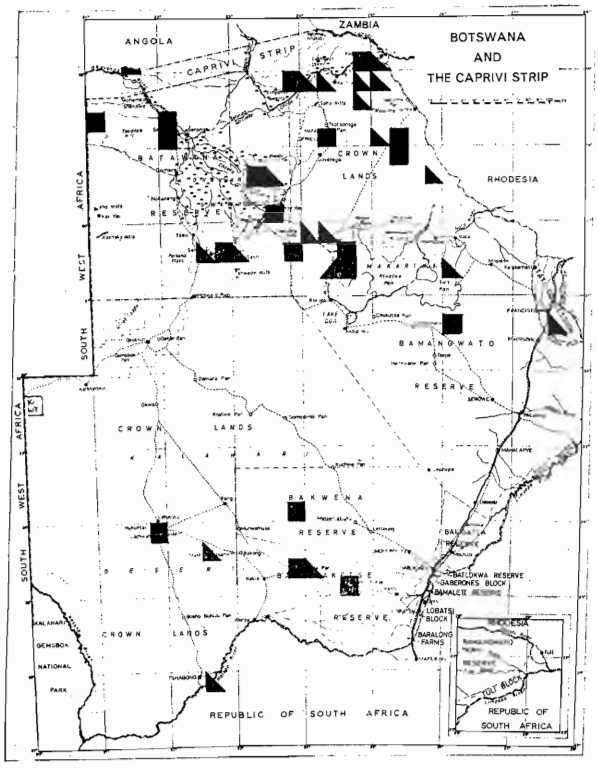
Taxonomic Notes

Material from the southern parts of the territory (Sekoma Pan, Tshane) is paler than that from the north and lacks the dark suffusion down the mid-dorsal line. The specimen from near Makalamabedi on the Botletle River is similarly pale but is immature. These southern specimens in their paler colour are referred to *F. c. damarensis* (Roberts, 1926) the distri-

bution of which in the territory, owing to the paucity of material, is not known. The northern material is referred to *F. c. limpopoensis* (Roberts, 1926) which on present evidence appears to occur throughout the northern part of the territory south to Lake Ngami, the western Makgadikgadi and east to the Tati Concession.

Distribution

The material and visual records available suggest a discontinuous distribution; occurring on the northern parts of the territory south to Lake Ngami, the Botletle River, western Makgadikgadi, Nthane, at the south-eastern corner of the Makgadikgadi, through to the Tati Concession, and, in the south, throughout as far north as the central part of the Bakwena Reserve.



Silberbauer (1965) visually records the species from the Central Kalahari Game Reserve and there are specimens from Stampriet and Sandfontein, South West Africa, in the collection of the Kaffrarian Museum, King William's Town, which at *c.* 22 19 B4 are close to the Botswana border just south of Mamuno. Although the Vernay Lang Expedition of 1930 (Roberts, 1935) did not record the species in its transect of the central Kalahari from Molepolole to Ghanzi, experience has shown that they are easily overlooked and it is believed that in time they will be proved to occur in the central parts of the Kalahari and west to the South West Africa border. As they occur in western Rhodesia they will no doubt be found in time in adjacent parts of the eastern sector.

Habitat

The species has a wide habitat tolerance being found in the arid shrub savannah of the south-west Kalahari as well as in the woodlands of the Okavango delta. Of the 11 records of the habitat in which specimens have been taken, seven were taken in woodland of various types, *Terminalia*, *Acacia*, mopane and mixed riverine. A further two were taken in palm savannah mosaic, with woodland on the higher ground, and open grassland and two in open *Acacia* scrub. It appears that some sort of cover in the form of woodland or scrub is a requirement, the species not inhabiting completely open grassland areas, except that it will penetrate this type of terrain in hunting at night. On the Patlana flats an individual, picked up in dazzling lights some considerable distance from cover on open grassland, when disturbed made off in the direction of the nearest cover and, with a few stops to look back, eventually, after a long chase in a vehicle, reached the cover of *Acacia* scrub and disappeared. At Khumaga several were seen at night near the fringe of the woodland where it tails off into the open grassland. The stomach of an individual collected near Khumaga included a Namaqua gerbil, *Desmodillus auricularis*, a species associated with the open grassland of the adjacent Makgadikgadi.

Habits

Predominantly nocturnal, but occasionally seen during daylight hours. All the specimens collected were taken after dark with the aid of a dazzling light, the earliest taken just after sundown (6.30 p.m.). In August 1968 an individual was seen on the Maun-Shorobe road in the late morning and in Rhodesia it has been seen at 4 p.m. (Nyamandhlovu) and 3 p.m. (Wankie).

The Maun-Shorobe record was made at the height of a rabies outbreak and the caracal was behaving in a peculiar way, turning round and round in the track, only making off when closely approached. Some miles away a wild cat, *Felis libyca*, was seen walking in the track at 11.30 a.m., quite unprecedented occurrences, and it was suspected that both animals may have been sick.

Unless seen on the move, the species would be very difficult to see during the day. A female in captivity would freeze, crouching behind the cover of clumps

of grass, or other object, motionless, in which position it seemed to disappear into its background. Even when acting in this way on an open cement slab it could scarcely be seen, more especially if facing the observer, when the black face markings and anterior parts of the back of the ears, which show in this position, acted as a sort of disruptive camouflage.

Shortridge (1934) states that in South West Africa they 'appear to hunt by day in cool or cloudy weather', Ansell (1960) records the species as nocturnal. Most other authors (Dorst, 1969; Astly Maberly, 1963; Williams, 1967) agree that the caracal is to some extent diurnal.

Normally terrestrial but to some extent arboreal. BP 315, when chased at night by dogs, took to a tree. In captivity they appear quite at home when climbing, but consideration of the food indicates that, when hunting at least, they are certainly predominantly terrestrial.

The species is very fleet of foot over short distances. Normally when running proceeds with a bounding motion with which it covers the ground very swiftly. The prey is stalked in a typically Felid manner, the final rush after the stalk being very fast and preceded by a careful settling of the back feet on the ground, as if to gain a maximum grip, the body low, head up, ears pricked, tail horizontal along the ground. In general the actions are very similar to a domestic cat except that the slapping of the prey with the front paws is a very powerful action with considerable force behind it.

Unlike the serval, *Felis serval*, which kills the prey with a downward slap of the front paws, the action in the caracal is sideways, much more like a domestic cat, or, if leaping to catch birds just rising from the ground, both paws are used, the hooked front claws securing the hold.

Live doves introduced to the enclosure were caught in mid-air with astonishing speed and dexterity.

Furred or feathered food, live or dead, was invariably played with before eating, being thrown around the cage with the front paws, claws extended, at times the caracal rising high up onto its back paws to wrestle with the prey held between the front paws.

In captivity an adult two-year-old female caracal, in eating hares, rabbits, guinea-pigs and large rats, invariably discarded the stomachs although there was no rejection of any parts of birds such as chickens, doves, francolin or guinea-fowl.

Unless taken from the wild before or at the time the eyes are opening, are intractable in captivity. A female taken just as the eyes were opening at two and a half years could still be handled and remained tame. It disliked being picked up unless thrown quickly on to its back when it would lie still in the arms of the holder. As might be expected, however, from a heavy animal of this sort, its play was rough. Great use was made of the dew-claws in holding and, lying down on the side or back and clasping with the front feet and dew-claws, the claws of the back feet were used as powerful cutting weapons. In such play in the female in captivity, however, the claws were not used to the extent they might have been and never caused more than tiny skin punctures and cuts. Hiding in a strategic point in the house, the caracal would bound out and throw herself at one's waist, clutching with both feet around it with mock biting. She also had the habit of throwing herself at the head and neck and mock biting. The great power even in these mock attacks leads one to believe that they would have little difficulty in dealing at least with the smaller antelopes, especially when the powerful jaw muscles and formidable canine teeth were put to their full use.

Usually occur singly, occasionally in pairs. The species is largely silent but purrs very softly like a kitten, this only heard if the ear is held very close to it. Nearing feeding time, or if called, the female in captivity would reply with a harsh *pr-purrr-kaaaaa*.

In aggression the ears are laid back on the sides of the head, the teeth fully bared, with the mouth partially open.

Food

The sample is too small to be able to point to any preferences. In a sample of ten stomachs the following items of food were found, noting the number of times they occurred:

Food Item	*No. of Occurrences*	*Note*
Muridae	4	See text
Aves	3	„ „
Bovidae	1	*A. melampus*
Leporidae ..	1	*Lepus* sp.
Peditidae ..	1	*P. capensis*
Reptilia	1	See text
Misc.	1	„ „

Muridae occurred more often than any other item of food, represented by the following species:

Species	*No. of Occurrences*
Gerbil, *Tatera* sp.	3
Namaqualand gerbil, *Desmodillus auricularis*	1
Pouched mouse, *Saccostomus campestris* ..	2
Dwarf mouse, *Mus* sp.	1
Multimammate mouse, *Praomys natalensis*	1

Aves were represented by the go-away bird, *Crinifer*

concolor, the button quail, *Turnix sylvatica*, and the red-billed francolin, *Francolinus adspersus*.

There is some doubt as to whether BP 2123 had killed the impala, *A. melampus*, which it had eaten. The meat in the stomach was still quite fresh and the animal had obviously been killed very recently. While impala abounded in the area none had been shot and there was no question of a wounded or dead animal being involved. On the other hand, the area abounded in larger carnivores, lions, leopards and cheetah, and it could have been killed by one of these and the remains made available to the caracal. The caracal, however, does not normally visit kills.

There are numerous records in literature of caracal killing medium-sized antelope, e.g. adult springbok, and a young kudu (Shortridge, 1934) and a half-grown impala and reedbuck (Stevenson-Hamilton). It may well be, therefore, that BP 2123 had killed the impala. Wilson (1966) lists two records of caracal preying on duiker, *S. grimmia*, and one attempted kill.

Reptilia were represented by the black-lined plated lizard, *Gerrhosaurus nigrolineatus*.

Breeding

There were no signs of breeding in females taken in Botswana in February, May, July, August and September. Shortridge (1934) quotes Wilhelm, who trapped a female in the Grootfontein district, South West Africa in September, with two fully developed foetuses. Stevenson Hamilton (1929) states that they 'probably have no very definite breeding season'. Ansell (1960) records a female with two foetuses in September and juveniles in November and January. In Rhodesia the young are born from about September to December, normally two at a birth.

Sizes and Weights

	TL	*T*	*Hf c/u*	*E*	*Weight*
MALES					
HJH 1104	1226	315	220	84	37 lb. 6 oz.
TNL 3500	1085	315	210	81	26 lb.
G 614	850	229	176	82	—
P 247 M	1065	255	203	83	25 lb. 8 oz.
FEMALES					
BP 94	1055	280	190	86	24 lb.
TNL 1853	1020	275	185	81	18 lb.
TNL 3544	990	285	195	72	17 lb. 8 oz.
P 99 M	950	340	180	81	18 lb. 10 oz.
BP 2123	1110	305	190	83	28 lb. 8 oz.

Felis libyca

Tibe, Phage Wild Cat

F. l. griselda Thomas, 1926

Taxonomic Notes

The Botswana series, numbering 46 males and 46 females, differs in colour and marking from material from the southern and eastern parts of the Republic of South Africa in the suppression of the marking on the upper-parts, and their paler tawnier grey colour. Within the series there is a measure of variation, the most noticeable being two specimens, BP 1975, 1976, from the junction of the Kuki-Makalamabedi fence which are much greyer on the upper-parts, lacking the tawny colour of the remainder. They are also whiter on the under-parts, yet a series of five from 40 miles north and two from 30 miles east of this locality conform in the colour, both of the upper- and under-parts, to the remainder of the series. Ten from the western Okavango are identical in colour with specimens from the Kaokoveld of South West Africa, while in a series of five from the Rhodesian border and the eastern sector of Botswana, from Pandamatenga southwards, there is a suggestion of a dark suffusion along the mid-dorsal line, more pronounced in some specimens (BP 754), than in others (BP 237), similar to the colour of specimens from the western parts of Rhodesia. Specimens from the northern and eastern Okavango delta (BP 1896, BP 1803), also have a dark suffusion along the mid-dorsal line, those from Lake Ngami (BP 1383), Chobe River (BP 1235) and the Kalahari (TNL 830, 1543) being similar to those from the western Okavango.

Pocock (1944) in his revision of the subspecies restricted *F. l. cafra* to the Cape Province, south of the Orange River in the west, eastwards to Natal and north to the Transvaal, including *F. l. namaquana* Thomas and *F. l. rusticana* Thomas as synonyms. Material from the central and eastern parts of Rhodesia, in its darker colour and more distinct markings, agrees with the description of *F. l. cafra*.

Pocock (1944) includes *F. l. namaquana* Thomas, *F. l. xanthella* Thomas and *F. l. vernayi* Roberts as synonyms of *F. l. griselda* whose distribution he restricts to southern Angola, Ovamboland, Kaokoveld. Damaraland, Great Namaqualand, Botswana and the Kalahari. Pocock mentions the colour phases of this subspecies, the much lighter whiter phase of which may be represented by the two specimens from the Kuki-Makalamabedi fence mentioned above. The

Plate 11 Female Wild Cat, *F. libyca*. **Photo:** H. J. Smithers

dominant phase, according to Pocock, is 'pale, tawny grey'.

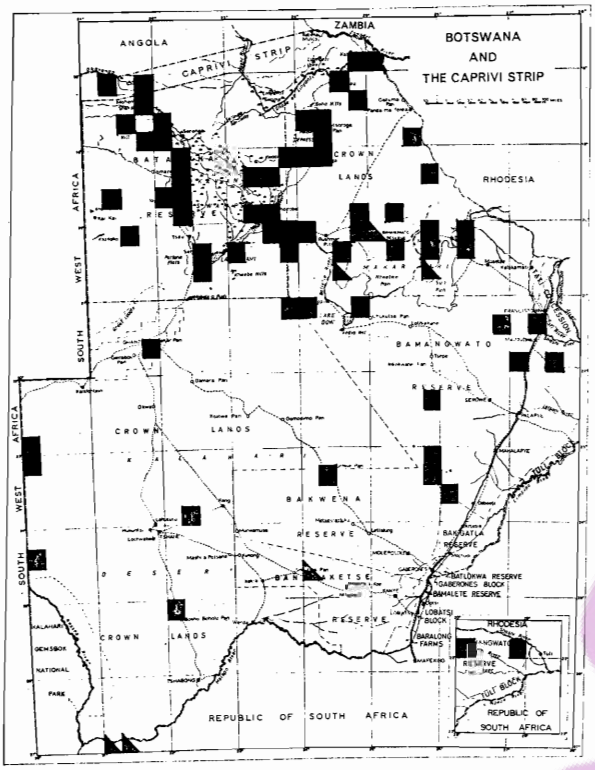
The whole of the Botswana series are referred to this western subspecies *F. l. griselda*, with the exception of those taken along the Rhodesian border and in the eastern sector, which are believed to represent a stage intermediate between the paler tawny grey *F. l. griselda* and the darker, more distinctly marked *F. l. cafra* of the central and eastern parts of Rhodesia, Transvaal and the southern parts of the continent. This intermediate form extends into the western parts of Rhodesia.

Within the Botswana series two specimens warrant special comment. BP 96 from Sepopa is much greyer than the remainder of the series from the western Okavango, is much more distinctly marked on the upper-parts, flanks and limbs and lacks the rich ochraceous colour on the under-parts, being greyer with black, not russet, spots and markings. The ears of this specimen have broad black tips, the russet colour of the back of the ears darker, less rich than the remainder. The loss of the rich red colour of the back of the ears, with varying degrees of blackening, is a feature of hybrids between domestic cats and *F. libyca*. BP 96 is believed to be a hybrid. BP 51 retains the rich red at the back of the ears but has pure white limbs, belly, chest and throat. The remainder of the upper-parts are tawny grey, like the remainder of the

western Okavango series and it is believed to be a partial albino.

Distribution

Widely distributed throughout. One of the commoner small predators. Although there is a lack of records from the eastern sector, from Foley southwards, it certainly occurs here as it is found in similar conditions in the western Transvaal and south-western Rhodesia.



Habitat

An analysis of the data recorded on a sample of 86 specimens collected mainly at night with the aid of dazzling lights is as follows:

Riverine woodland	6
Open grassland and floodplain	20
Acacia and *Baikiaea* woodland	20
Mopane woodland associated with the Okavango delta	4
Open *Acacia* scrub	15
Open burnt ground, aerodromes, cultivated ground	9
Fringe pans	6
Terminalia-Combretum scrub	4
Thick woodland (sepopa)	1
Kopjes	1
	86

These data demonstrate the wide habitat tolerance of the species which, as can be seen from the distribution records, occurs in the driest areas with a mean annual rainfall of 250 mm annually to those with over 700 mm, frequenting woodland of various types, scrub as well as open plains.

It is certainly less common in the drier parts than in the vicinity of the Okavango delta and river systems where, in parts, it is very common. At Tsau in February 1964 four were seen within the space of an hour within a distance of about two miles from camp, at Nokaneng, in the same month, it was not unusual to see two or three in an hour's run of some five miles down the fringe of the floodplain.

Habits

Predominantly nocturnal, but were seen moving during daylight hours (Makalamabedi gate, Tsau, Shorobe), occur singly or females with young (Makgadikgadi, Tsau). Predominantly terrestrial, but perfectly at home climbing trees to which they will take if under stress. Recorded by Shortridge (1934) as sleeping in hollow trees, the shelter of rocks or loose boulders.

Although individuals may become poultry thieves it is not thought that they would tackle young 'sheep and goats' as quoted by Shortridge (1934). The largest mammals found in stomachs were spring hares, *P. capensis*, and hares, *Lepus* spp., which are thought would be the largest prey they were likely to tackle. They are apparently not attracted by the carcasses of larger mammals, never having been seen at kills or baits laid for larger predators.

The species interbreeds freely with domestic cats, BP 96 from Sepopa being a hybrid. Characteristic of this hybridization is the loss of the reddish colour at the back of the ears which was a feature of the hybrids between a female *F. lybica* in captivity and domestic breeds. When this female was crossed with a pure *F. lybica* the reddish colour at the back of the ears persisted in the kittens.

Food

Number of occurrences, in a sample of 80 stomach contents, of various food items:

Food Item	*No. of Occurrences*	*Note*
Muridae	59	See text
Solifugae	14	,, ,,
Orthoptera	12	,, ,,
Reptilia	10	,, ,,
Aves	8	,, ,,

Food Item	No. of Occurrences	Note
Lepidoptera	2	Convolvulus Hawk Moth, *Herse convolvuli*
Scorpiones	2	*Parabuthus granulatus*
Leporidae	2	*Lepus* sp.
Muscardinidae	1	*Graphiurus* sp.
Amphibia	1	*Pyxicephalus adspersus*
Pisces	1	*Barbus* sp.
Isoptera	1	*Odontotermes* sp.
Myriopoda	1	Centipede, *Scolopendra morsitans*
Araneae	1	Undet.
Wild fruits	1	Undet.
Pedetidae	1	*P. capensis*
Sciuridae	1	*Paraxerus cepapi*
Muscardinidae	1	*Graphiurus* sp.

Muridae constituted by far the commonest food, in 44 stomach constituting the sole content, in four 50% or over.

Where the material was identifiable the following genera and species were represented, the number of occasions on which they occurred being indicated:

Tatera sp.	32	*Steatomys* sp.	4
Mus sp.	12	*Aethomys* sp.	2
Saccostomus campestris	6	*Dendromus melanotis*	1
Praomys natalensis	6	Indet.	13
Gerbillus paeba	5		

Solifugae are obviously palatable to a wide range of small carnivores, as will be seen from the data presented under the various species, but are only available during the warmer, wetter, months of the year, from about the onset of the rains in October to about May. During the colder season of the year they are not in evidence. Were they available on a year-round basis there is little doubt that they would be even better represented as an item of food. *Solpuga monteiroi* was recognisable in four stomachs, *Solpuga* sp. in three, while in the remaining seven the remains were unidentifiable.

Orthoptera were represented by the following families with the number of times they occurred:

Acridiidae	7	Tettigonidae	1
Gryllidae	5	Undet.	1
Stenopalmatidae	1		

Identifiable reptiles were as follows:

Variegated skink, *Mabuya varia*
Sundeval's skink, *Riopa sundevalli*
Legless skink, *Acontias percevali occidentalis*
Whistling gecko, *Ptenopus garrulus*
Sand lizard, *Eremias* sp.
Black-lined plated lizard, *Gerrhosaurus auritus*
Worm lizard, *Zygaspis quadrifrons*
Puff-adder, *Bitis ariatans*

Birds included:

Quail, *Coturnix* sp.
Dove, *Streptopelia* sp.
Korhaan, *Lophotis* sp.
Quelea, *Quelea quelea*
Button quail, *Turnix* sp.

Among the remaining items were two occurrences of the hare, *Lepus* sp., and one of a spring hare, *P. capensis*, which are the largest prey species so far recorded.

Breeding

Gravid females have been taken during the months of September, November, January and February as follows:

Distribution of non-gravid, lactating and gravid females through the months of the year.

	J	F	M	A	M	J	J	A	S	O	N	D
Total	8	7	6	3	6	4	4	–	2	1	3	1
Non-gravid	7	4	6	3	6	4	4	–	–	1	2	1
Lactating	–	1	–	–	–	–	–	–	–	–	–	–
Gravid	1	2	–	–	–	–	–	–	2	–	1	–

A juvenile with the eyes hardly open accompanied by the female parent, was taken at Nokaneng in February, and a female carrying a juvenile was seen near Nata, Makgadikgadi, in January.

Further records of juveniles are as follows:

No.	*Locus*	*Date*	*Weight*	*Hf c/u*
BP 1018	Lephepe	10/65	3 lb. 12 oz.	111
BP 1586	Magogophate	4/66	3 lb. 4 oz.	115
BP 2218	Mampswe	5/68	—	129

Shortridge (1934) for South West Africa quotes Wilhelm as stating that 'litters of three or four were found between October and December'. Ansell (1960) for Zambia records a female with three foetuses in March.

The above data suggest that the young are born during the warm wet months from about September to March.

The average number of foetuses is as follows:

Foetuses

Number $\bar{X} = 3{\cdot}4$; $N = 7$; Obs. range 2-5

The following table gives data on six gravid and one lactating female:

No.	*Locus*	*Month*	*No. of Foetuses*	*Implantation*	*CR of Foetus*
BP 37	Tsau	2/64	5	2R 3L	43- 47
BP 81	Nokaneng	2/64	Uterine horns	3 swellings 1R 2L	—
BP 508	Makalamabedi	11/64	2	1R 1L	46

No.	*Locus*	*Month*	*No. of Foetuses*	*Implantation*	*CR of Foetus*
C 2248	Cwikampa	9/66	3	1R 2L	—
TNL 1731	Tamafupi	9/66	3	1R 2L	115-118
TNL 216	150 m. S. Mamuno	1/67	4	2R 2L	70- 77
BP 1837	Tshane	2/67	4	1R 3L	85- 95

In captivity a female *F. libyca* from Rhodesia was bred with a male from Nokaneng, Botswana, the latter taken just as its eyes opened, a single kitten being born on the 25th February, 1966.

This female, one of two which having been taken as kittens before the eyes were open on the 18th August, 1962, adapted to captivity well and, free ranging, had her first litter on the 29th September, 1963.

Thereafter, at oestrus she was penned until introduced to a male from Botswana producing a single kitten from the mating in February 1966.

Thereafter, litters were produced at the following intervals:

No. Kittens	*Date*
2	August 1966
3	June 1967
1	October 1967
3	May 1968
3	February 1969
5	June 1969
5	October 1969

The situation as reflected, especially in 1969, is very different from that recorded in the field and a reflection of how, within the lifetime of the individual, the pattern of reproduction can change under conditions of domesticity.

Sizes and Weights

MALES

TL	$\bar{X} = 920$;	$N = 32$;	Obs. range	850-1005
T	$\bar{X} = 344$;	$N = 32$;	„ „	320- 375
Hf s/u	$\bar{X} = 153$;	$N = 34$;	„ „	135- 170
E	$\bar{X} = 70$;	$N = 34$;	„ „	64- 79
Weight	$\bar{X}$ = 11 lb. 3 oz.;	$N = 32$;	„ „	8 lb. 4 oz.-14 lb.

FEMALES

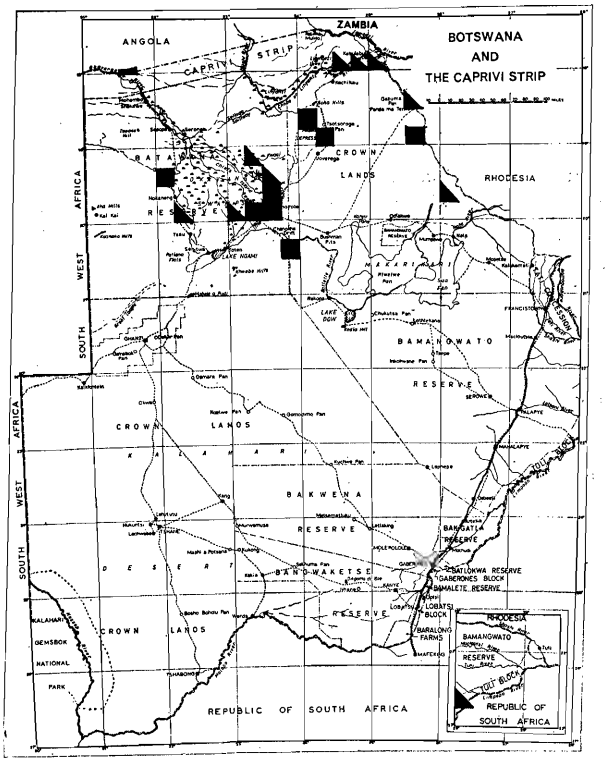
TL	$\bar{X} = 886$;	$N = 27$;	Obs. range	820- 947
T	$\bar{X} = 336$;	$N = 27$;	„ „	310- 370
Hf s/u	$\bar{X} = 147$;	$N = 27$;	„ „	138- 158
E	$\bar{X} = 68$;	$N = 27$;	„ „	62- 73
Weight	$\bar{X}$ = 9 lb. 6 oz.;	$N = 26$;	„ „	7 lb. 2 oz.-12 lb.

It appears that in series males are slightly larger in every respect, their average weights being considerably greater than females.

Felis serval

Tadi Serval

F. s. serval Schreber, 1776



Distribution

Occur throughout the Okavango delta and eastwards along the Botletle River at least as far as Makalamabedi; the Savuti and northern Mababe Depression, on the Chobe River and southwards along the Rhodesian border as far south as Ihari Pan. Not so far recorded in the central part of the north-eastern sector. In the east they have not been recorded between Ihari Pan and the northern Tuli Block farms. Von Richter (1969) states that skins of this species occasionally turn up in skin stores at Kang and Takatekwane which is very far south in country not normally considered suitable for them. It is always possible that these skins may have been brought into these areas from elsewhere. Teams have operated widely at various times of the year, more especially in the Kang area, without contacting the species or finding any of the local inhabitants who recognized an animal of this type. Shortridge (1934) states that 'the serval is rare and perhaps only of sporadic occurrence

in the southern south, central and coastal regions of South West Africa'. No material records can be traced to substantiate their occurrence in this area. Until such time as there are well-substantiated or material records from the southern parts of Botswana, therefore, it is proposed to leave the question of their occurrence in this dry country open for confirmation.

Habitat

The availability of water together with cover in the form of scrub, tall grass or reed-beds appear to be essential habitat requirements of this species.

Although Shortridge (1934) indicates the possibility of the occurrence of the species in dry waterless country he also states later 'I do not believe that this cat is ever resident at great distances from permanent water', which accurately fits the situation in Botswana.

All the Botswana specimens taken to date have been from areas where surface water is available either in the form of swamps, rivers, pans or water-holes. They are not uncommon in the Okavango delta and in the vicinity of the Botletle and Chobe rivers but to date there is only one record from the Limpopo River (22 28 C1), although they may be commoner here than this single record indicates. The records from the Rhodesian border area are all from areas where there are pans with water or water-holes, albeit not permanent in adverse seasons. On the Rhodesian side of the border the serval occurs on Little Deka Farm where the top reaches of the Deka River are a series of springs with permanent water and in the Robins area of the Wankie National Park and other points south to Sibanini, which is just over the border from Ihari Pan. In this area, however, they are much less common than in the better-watered areas of the Okavango and Chobe.

There are unconfirmed reports (Game Guard, Tamafupi) of their occurrence at Tamafupi.

The association of this species with availability of water is well marked in the drier parts of western Rhodesia and even in the higher rainfall areas (*c.* 40 inches per year and over) where it is particularly associated with wet vleis and along rivers.

The species is recorded from the western Transvaal (Rustenberg) and in view of this and the record from the northern Tuli Block farms it may well occur in other parts of the Limpopo River Valley in the border area.

Habits

Nocturnal, usually occurring singly or in pairs. During the day will lie up in thick bush (Tsau) or in patches of thick grass or reed-beds (Mashonaland, Rhodesia) or may use disused ant-bear holes in which they are known to breed (Stevenson Hamilton). Although individuals do raid poultry runs, in general, they do not apparently take such large prey as the caracal and no records of their attacking smallstock such as goats or sheep can be traced. In killing small prey such as rodents the action is very different from that of the caracal, being a downward blow delivered with considerable force.

The species if taken young tames well and becomes completely reconciled to human company. In Mashonaland they will hunt at night right up to the vicinity of farm buildings and regularly find their way into peri-urban built-up areas (Salisbury, Rhodesia).

Held in the beam of dazzling lights, typically Felid in action, moving off with an occasional pause to glance back or, if caught on open ground, will lie down flat in hollows to avoid the beam.

Food

Only three stomachs were available for examination, these containing the following items of food, noting the number of times they occurred:

Food Item	*No. of Occurrences*	*Note*
Muridae	3	See text
Solifugae	1	Indet.

The following species of Muridae were identifiable:

Species	*No. of Occurrences*
Multimammate mouse, *Praomys natalensis*	1
Fat mouse, *Steatomys pratensis*	2
Dwarf mouse, *Mus.* sp.	1
Gerbil, *Tatera* sp.	1
Indet.	1

In addition to the above the stomach of BP 549 contained a quantity of green grass and its faeces, the leg of a spider and fish-bones.

This sample, although small, shows a decided preference for Murids, a state of affairs which is supported by a larger sample from Rhodesia. Here out of 31 stomachs, 30 contained Murids, in 20 constituting the whole content. Two stomachs contained the remains of cane rats, *Thyronomys swinderianus*, five Aves, five Reptilia and one each Coleoptera and Orthoptera.

Out of the 30 stomachs containing Murids, 13 contained the remains of the vlei rat, *Otomys angoniensis*, these and the two records of cane rats, *T. swinderianus*,

indicating the association of the serval with wet conditions.

Breeding

No breeding records are available from Botswana. Indications from surrounding areas suggest that the young are born during the warmer wet summer months of August through to March. Ansell (1960) for Zambia records a female with two foetuses in September, juveniles in November and January, and Wilson (*in litt.*) for the same territory two full-term foetuses in September. Shortridge (1934) quotes a record for the Transvaal of three kittens in September, and others captured in July and August. In Rhodesia females with foetuses have been taken in November, January and March, small kittens in September, which suggests that they may have a more extended breeding season than present records indicate.

Sizes and Weights

MALES

	TL	*T*	*Hf c/u*	*E*	*Weight*
BP 1919	1090	330	196	85	21 lb. 8 oz.
BP 2106	1100	330	190	97	25 lb. 8 oz.

Shortridge (1934) records the measurements of a male from Mbambi, Okavango River (17 21 C_3), as follows:

—	1130	310	190	88	

FEMALES

	TL	*T*	*Hf c/u*	*E*	*Weight*
BP 549	1035	282	187	86	17 lb. 13 oz.
BP 1872	1125	315	193	92	22 lb.
BP 1921	1061	284	187	83	18 lb. 4 oz.

Felis nigripes

seBalabolokwane Blackfooted Cat

F. n. nigripes Burchell, 1823

Taxonomic Notes

The characters used to separate the northern *F. n. nigripes* Burchell, 1823, from the southern *F. n. thomasi* Shortridge, 1931, are in some respects unconvincing, yet in series the paler ground colour of the upper-parts, mentioned by Shortridge for *F. n. nigripes* is apparent in the Botswana material, as opposed to *F. n. thomasi*.

Burchell (1823) states that the 'general colour of the animal (*F. n. nigripes*) is tawny, or that of a light brown-ochre of painters; but fainter on the under-parts of the body'. The ground colour of the under-parts of the Botswana series is pure white and is only tinged tawny where this blends into the tawny colour of the flanks.

In BP 2008 the spots on the neck are elongated with distinct stripes which, with a short break, continue on to the top of the shoulders; in the other material there is no sign of stripes. Shortridge (1931) states that 'perhaps the most distinctive feature of this race (*F. n. thomasi*) is the intensity of the three throat rings, which, in all seven of the specimens examined take the form of unbroken black semi-circles narrowly edged with rufous. In ten from Botswana these are broken and ill defined' varying in colour from dusky blackish brown to pale rufous'.

While in all the Botswana material the third ring is broken and ill defined, in BP 4858 and 4872 from Tshabong and particularly in BP 1402 from Lake Ngami the first and the second rings are black.

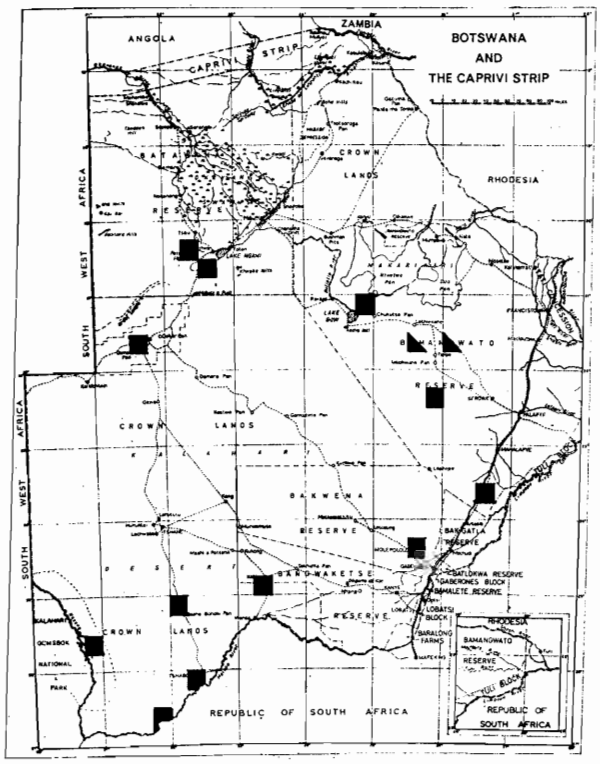
On the basis of the lighter more bleached look of the Botswana material, however, it can, in series, be distinguished from the darker more distinctly marked *F. n. thomasi*.

Distribution

Although there are only a few records of this species, such as are available suggest that they are confined to the central and south-western parts of the territory north to the Patlana Flats, west of Lake Ngami, the south-western parts of the Makgadikgadi and the central part of the Bamangwato Reserve south-west of Lotlhakane. In the south they occur eastwards to Debeeti and Molepolole.

Although a skin was reported from a trader's stock in Nokaneng this is far outside their known limits of distribution and its provenance must remain in doubt. It may have been taken further south. Skins for trade are carried considerable distances and the localities from which they were originally taken must always remain doubtful in spite of the fact this was claimed to have been taken 'locally'.

In South West Africa Shortridge (1934) states that they do not occur north of 20° S. which corresponds very well with the northernmost records in Botswana, on the Patlana Flats.



Habitat

Data on the habitat in which they were taken are available in the case of six specimens. These indicate a preference for open country; three were taken on open pans with a short grass or low karroid bush cover, one on an open plain with short grass and scattered clumps of low bush and higher grass and one on the fringe of the same open plain in *Acacia* scrub.

Throughout their range in southern Africa they are everywhere associated with dry open country with some cover of scrub bush.

Habits

The opportunity has not presented itself of keeping this species under observation for any length of time. Those seen in captivity have all showed signs of being intractable, quite unlike *F. lybica* in this respect. Quite apart from being nocturnal and therefore easily overlooked, they are not common anywhere in Botswana. In spite of the fact that somewhere in the region of 5-600 hours was spent at night with dazzling lights within their known range, only a few were contacted, all being solitary individuals.

The specimen taken on the Dautsa Flats was picked up in the light on the open short grassland at 11 p.m., but made off immediately for the cover of low scrub, not looking back until it was well-hidden. Followed up, it moved from this, in true Felid fashion, only looking back from time to time until it reached the next patch of bush cover, in which it was taken lying down, well-hidden.

The specimen from Lebung raided a trap-line for two nights, during which time it was seen making off, being taken on the third night at 10.30 p.m.

The three specimens from the south-west Kalahari were all taken between 9.30 p.m. and 10.30 p.m., TNL 4858 taking cover when disturbed by the light behind a small scrub bush. This feature of quickly taking cover may possibly have led to the species being overlooked.

Food

Only five stomachs were available for examination, these containing the following items of food, noting the number of times they occurred, as follows:

Food Item	*No. of Occurrences*	*Note*
Muridae	2	See text
Solifugae	2	Indet.
Aves	1	See text
Reptilia	1	*Agama hispida*
Coleoptera adults	1	Indet.
Araneae	1	*Palystes* sp.
Macroscelididae	1	*Elephantulus intufi*

Muridae were represented by a single individual of each of the following species:

Gerbil, *Tatera* sp.
Pouched mouse, *Saccostomus campestris*
Namaqua gerbil, *Gerbillurus paeba*

constituting the sole content in both stomachs.

Aves were represented by the double-banded courser, *Rhinoptilus africanus*, a terrestrial species common on the fringes of pans or on open ground in the territory.

In one stomach the Solpugid was identified as *Solpuga monteiroi*.

Reptilia were represented by the spiny agama, *Agama hispida*.

Breeding

No information available. The adult female taken in July showed no signs of pregnancy.

Sizes and Weights

MALES

	TL	*T*	*Hf s/u*	*E*	*Weight*
BP 1402	570	175	104	57	3 lb. 12 oz.
BP 2008	540	164	96	51	3 lb. 6 oz.
RMD 1180	631	198	103	52	3 lb. 7 oz.
TNL 4858	530	163	94	50	3 lb. 2 oz.
TNL 4875	515	170	93	46	2 lb. 4 oz.
TNL 4872	565	175	94	56	3 lb. 13 oz.

Shortridge (1934) gives the measurements of an unsexed specimen from 'Bechuanaland' as follows.

TL 337; T 169; Hf s/u 81

which, from its size, is obviously a kitten.

Family CANIDAE

1. Cheek-teeth at full dentition 8/8, or usually 7/8; carnassial teeth not clearly differentiated *Otocyon*
   Cheek-teeth 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 . . *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 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*

Genus OTOCYON Müller, 1836

Otocyon megalotis

moTlhose Bateared Fox

O. m. megalotis (Desmarest, 1822)

Distribution

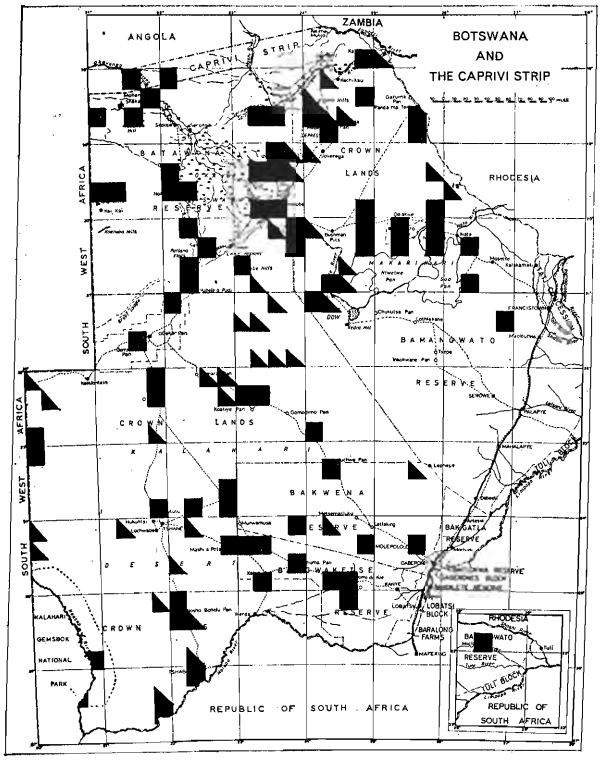
Widely distributed throughout, although they appear to be absent from the eastern sector from the Nata River to the southern parts of the Tati Concession, in the broken hilly country in the vicinity of Palapye, Serowe and Mahalapye and from Motshodi to Lobatse and west to Kanye.

Just south of the Tati Concession they occur at least as far east as Magogaphate (21=28C2) and, although there are no records from east of this, they may well occur through to the border as they are found in the Gwanda district, Rhodesia (Doddieburn Ranch), some 50 miles east.

They have not so far been taken in the south-western parts of the Bamangwato Reserve, east of the Central Kalahari Game Reserve, or from the southern parts of the Makgadikgadi, or east to the Transvaal border between Mahalapye and Motshodi although the country appears suitable. It is possible that they have been overlooked as it seems reasonable to suppose that there is a connection between the Botswana populations and those immediately over the border in the western Transvaal through the eastern extension of the Kalahari associations which penetrate through to the Transvaal in this sector.

Until late in 1965 they had not been recorded in the extreme north-east along the Chobe River. Since this date, however, they have been seen on several occasions in the vicinity of Kasane both on the riverine fringe and on the Kalahari sand south of the village where they appear to have settled (P. Hepburn, *in litt.*).

In March 1970, they were recorded for the first time on the new Victoria Falls airport, Rhodesia, some 40 miles east of Kasane, where ten were reported on one night patrol (Dept. Nat. Parks, Rhodesia). This suggests that the species is in the process of extending its range. In Rhodesia and the Transvaal within recent years there is further evidence that this is taking place. Until 1968 in Rhodesia they were only



known from as far east as Dett in the Wankie National Park, since then a specimen has been taken on the Manyoli River, Sebungwe, 110 miles east of Dett.

They were unknown east of Doddieburn Ranch, Gwanda, until 1967 when they were taken on Nuanetsi Ranch and subsequently still further east at Buffalo Bend on the Nuanetsi River. In June 1969 they were recorded for the first time from the northern part of the Kruger National Park (Pienaar, *in litt.*). There is good reason to suppose that they have not just been overlooked in the Sebungwe or Nuanetsi areas as, in the former, there had been officers of the Tsetse Control Department and National Parks on duty for many years and in the Nuanetsi district game cropping, involving night operations, had been in progress for several years. In the case of the Kruger Park, they surely would have been reported, if they had occurred in previous years, as the park is constantly patrolled.

Habitat

The species is particularly associated with open dry savannah grassland or scrub, particularly short grass or grassland with much bare ground, either on sand or on hard calcareous ground such as is found round pans, or calcareous pans with a grass or karroid bush cover.

These types of association cover a very large part of the territory, the open scrub taking the form of *Acacia* scrub and other types such as *Grewia*, *Terminalia* and *Bauhinia*.

Out of a sample of 76 specimens collected, 70 were taken in open grassland, either vlei grassland, floodplain grassland, grassland with scattered trees, usually *Acacia*, or open *Acacia* scrub. Twenty-nine of the 70 were taken on open grassland on the fringes of pans.

Of the balance of six not particularly associated with grassland, two were taken near Maun in the open mopane woodland, which fringes the Okavango swamp; three at the Aha Hills in thick *Acacia* scrub and one at Kanyu in the dense *Acacia detinens* thicket. In the latter two cases these associations are limited in extent and adjacent to areas of vlei grassland or floodplain grassland. In the case of the Maun record, the association in which they were found was abnormal and they may have been in transit or under stress.

In the Kalahari they are particularly associated with pans.

Habits

The species is both diurnal and nocturnal, in the south-west Kalahari, in particular, packs were frequently observed feeding on the fringes of pans during daylight hours, this latter feature appearing to be characteristic of the populations in the remoter areas of the Kalahari (Boshoboholu and Mabuasehubi pans). As they are particularly sensitive this might well be due to the lower level of disturbance in these remote areas. In captivity they quickly develop diurnal habits, although they are never so active during the day as from sunset onwards and in hot weather are soporific. They are avid diggers and will not hesitate to tackle the hardest ground. In captivity a female dug through four centimetres of cement-plastered wall in several places in order to gain access to termites working behind it and their excavations on Nxai Pan penetrated a hard calcareous layer.

They are restless and wary and even when lying up in the open in the heat of the day are keenly alert. normally they appear to return to the burrows during this period.

Their powers of smell are well-developed, in captivity the female had little difficulty in finding sultanas secreted in various parts of the room, or in locating her dish of food placed on a high bookcase.

Sight appears less well-developed than the other two senses and they will pass over grasshoppers presented to them provided they remain immobile.

Any movement is, however, quickly detected, apparently by sight, as in these cases the ears are not necessarily brought into play.

Although the colloquial name 'Draai-jakkals' (turning jackal) is often applied to the Cape Fox, *Vulpes chama*, as well as to this species, this confusion is a pity as it most aptly describes the characteristic ability of the bat-eared fox to suddenly, at high speed, double back on its tracks and to twist and dodge. They are extraordinarily nimble on their feet and fast over short distances, the bushy tail being flicked from side to side as they run, often, in a quick turn, in the opposite direction from the turn, thus confusing their pursuers.

In captivity they are very playful and will play with a ball or other light object, tossing it up in the air or racing around with it in their mouths for prolonged periods. This type of behaviour has been observed in the field at Nxai Pan where play of this type was noted with a piece of stick.

In captivity, the female, in particular, would play with a dog some four times her weight. As an opening gambit she would prance from side to side in front of him with a bobbing motion on the front legs, ears held up. If he took no notice she would either lie down in front of him and relax whining or move in and dig into him with her front claws, using the same technique as is used in digging out the prey, a very fast movement, the long claws repeatedly striking at the same spot. This usually had the desired effect but, if it failed, she would playfully bite the dog making use of her sharp well-developed canine teeth. Once the dog was roused to action and on his feet the fox would entice him to further action, the head held low, ears back, tail held in a high curve, prancing on the front feet from side to side in front of him. When being chased the agility of the fox easily enabled it to avoid contact by twisting and dodging and even turning and jumping over the dog.

Very much the same pattern was followed between the male and female fox although never to the same prolonged extent as between the female fox and the dog.

These postures, adopted towards the male fox or the dog, were often accompanied by a rattling growl which, when playing with the male fox, would be repeated by it. In boisterous play one of the pair would race past the other, bite and quickly leap out of the way of retaliation, often backward and upwards with all four feet clear of the ground at once. At closer quarters one of the pair, usually the female, would take a grip of the other with its teeth on the side of the neck and hold it down. The whining of the victim was the signal for the aggressor to let go.

Another type of play indulged in by the male and female foxes consisted of either suddenly rushing in, head lowered, tail high, ears back, growling at the other who would swing sideways presenting the rump with the tail held high or leaping with agility out of the way. The movement over, the attacked would repeat this performance on the attacker. This was accompanied by growling and sometimes biting would take place. The particular agility of the foxes was well demonstrated in these contests which would suddenly break off when one would fling itself down flat on the ground, ears down, tail flat, when the other would do likewise facing it within a few inches. After a few moments one or the other would get up and walk away, the performance being repeated if the other also got up and walked away.

The action of lying flat appeared to be an action of submission and was characteristic of the female fox in particular. Partial to having her ears or chin scratched, if one desisted in this action and moved off then she would follow and throw herself down at one's feet as if inviting further attention.

Both the male and female, when emerging towards evening through the aperture in the wall which gave access from their pen to the veranda of the house, would carefully examine their surroundings. Both were very sensitive to any change in the position of items of furniture, the edge of a carpet turned up, a jacket left on a chair, the door of a cupboard left open, or in fact any alteration in the situation from that with which they had become accustomed. These abnormalities would be examined from various angles with the greatest care, the nose extended, the ears pricked forward, the front legs extended forward, tail down, the body then moved cautiously forward. From this position the fox would then jump back and try another angle, getting nearer and nearer until the object could be sniffed at close quarters. Once satisfied the object would be disregarded but, often, if it was lying on the ground it would be marked, or, if above ground-level, a point on the ground near it would be marked. Once the terrain appeared to be in order marking proceeded to be carried out at intervals throughout it, especially if they had been excluded from it for a day or two. Until this process was complete no play took place.

Marking was carried out by both sexes by squatting and depositing a minute amount of urine.

During the time that the female was rearing the litter, up until at least the first four months, she would

always emerge from the hole first and carry out this examination with great thoroughness, the young in the meantime hanging around within easy reach of the hole.

If the female showed signs of anxiety or started to examine an object in the manner stated above they would dive for cover and watch from the safety of the hole. Once satisfied that the terrain was safe the female would call the young with a very soft double-noted *who-who* to which they quickly responded. If for any reason one of the litter raced for the hole, which they were inclined to do on the slightest provocation, the remainder would follow suit, the arrival of all four at the small entrance causing much growling and scuffling until all disappeared from sight.

For some days after their first forays from the shelter of the hole the young foxes tended to hang around within a few yards of it and would exhibit signs of panic if the observer moved to a position between them and the hole. If allowed the slightest leeway they would take cover in it.

After some two to three weeks when the young had commenced their own examinations of the terrain on emergence and were showing some confidence in their explorations, the female no longer called to them and appeared generally to disregard their activities. She would, however, return to where they were playing from time to time as if to check up on their safety. The juveniles, at least up to the age of about four months, showed no signs of marking.

On release onto the veranda in the evening it became the habit of the female to enter the study for a saucer of milk and sugar. Up to the age of some two months she would not permit the young to enter the study and would chase them away from the threshold, allowing them, however, the free range of the veranda itself.

The female showed very strong protective instincts as far as the young were concerned. During the catching, for weighing, the young, when handled, were very noisy giving tongue in a high-pitched shrill metalic chattering that was very unpleasant to the ear. At such times it was necessary to exclude the female from the site of the operation. If within earshot she would frantically try to go to their assistance.

On one occasion she bit a member of the household delegated to look after her in a separate room, the only occasion on which she was ever known to use her teeth on a human being when not being handled herself.

The author, when conducting weighing operations on a pack of nine housed in a large open paddock, was twice attacked, in each case by the mate of the individual being weighed. In neither case did the pair have young but had been observed as forming a definite attachment to each other within the paddock.

Apart from such times of stress the species in captivity is easy to handle and once settled shows no signs of aggressiveness towards human beings.

In the relationship of the female to the dog mentioned above there was no signs of viciousness until the female came into oestrus for the first time at the age of 18 months, when, quite suddenly, she started to attack him in an aggressive manner driving him from the room. They were, therefore, not reintroduced to each other during this period. No such aggressiveness was noticed towards the male fox but, shortly before she was due to have her first two litters, he was removed to another cage as a safety measure and remained segregated until these two litters were weaned.

Later experience showed that this was an unnecessary precaution for, not only does the male accompany the female and young in the field, but, in captivity, takes an active part in their rearing.

With the third litter born on the 7th October, 1969, the male was allowed to remain with the female. After the young were born he would freely enter the breeding burrow while the female was in attendance on the young. At times when she was outside he would visit the young as if to ascertain that they were safe and after the young had been weighed he would assist the female in carrying those already dealt with to another hole in the floor of the enclosure. On the conclusion of the process he would assist the female in carrying them back to the breeding chamber.

At 17 days' old the young first emerged from the hole. At this stage both the male and female parents tended to lie near the entrance and, if approached, would growl softly, this apparently a signal for the young to return to it. If they did not either parent would pick them up in its mouth and drop them into it, the male being as attentive to this task, if not more so, than the female.

Observations on family parties in the field suggests that, while it is possible that the male may temporarily leave the female at the time of birth of the young, the indications are that he rejoins the party as soon as they are mobile, as adult males and females have been seen together with half-grown young (*see under* Breeding).

After the first litter had been weaned the male was reintroduced to the female after a period of separation of some two and a half months, after the second litter three months. On both occasions they settled to one another immediately, a great deal of mu ual grooming

taking place. On the second occasion the male made unsuccessful attempts to mount the female. On both occasions the male was obviously the more demonstrative of the pair.

The grooming took the form of nibbling by one or the other, particularly the male, of the cheeks and at the base of the ears, the recipient holding the head high, the snout elevated.

In captivity the adults used the same corner of the enclosure to defecate and urinate and, even if outside this enclosure, would normally return to this spot to perform these functions.

At Nxai Pan an adult was seen to defecate at the base of a bush. Its determination to use that particular spot in the presence of observers warranted an examination of the area. Within a radius of about three metres from the bush there were a dozen separate defecations. As the observation was made in the middle of the dry season when scats would remain for a lengthy period this cannot be considered as 'midden' but rather to represent the use of a circumscribed area by one or two individuals only.

Food

The dentition of the species which, in its commonest form, consists of 46 teeth, lacks the heavy development of P^4M_1 into carnassials normal in the Canidae. It is well adapted for dealing with a diet consisting of small prey such as insects and their larvae, small rodents, scorpions, termites, etc. The jaw action in mastication is extremely fast and in dealing with large Coleoptera observations in captivity show that these are picked up, crunched several times very quickly, then dropped, the process repeated until the prey is quiescent, when they are thoroughly masticated prior to swallowing. Hard-bodied insects in general are broken up into very small pieces rendering their identification in stomach contents difficult. On the other hand, scorpions and solpugids are not subject to such severe treatment and, although broken, are recovered from the stomach content in an identifiable condition. In the case of scorpions, the tail normally becomes severed from the body but is swallowed including the sting and poison sac.

Coleoptera larvae and termites are recovered chewed but intact. Small mice such as *Mus minutoides* or juveniles of larger species often remain nearly wholly intact, the skulls crushed, larger mice are cut up into several sections and are subject to much more prolonged mastication. Reptiles are cut into small sections but not masticated beyond identification.

While birds do not figure in the stomach contents of 50 specimens examined and would not, therefore, appear to be actively sought after, nevertheless, in captivity, small birds such as quelea finches, *Quelea quelea;* bronze mannikins, *Lonchrua cucullata;* masked and spotted-backed weavers, *Ploceus velatus* and *P. cucullatus*, are freely taken, being well-masticated before being swallowed whole, with no attempt at plucking. Larger birds such as turtle doves, *Streptopelia capicola*, are eaten but observations in captivity suggest that they have some difficulty in dealing with these. As with the smaller species, the head and neck are eaten first. Normally the breast is tackled next, the soft feathers being eaten with the breast meat which is stripped from the bone. While the edges of the sternum may be eaten in the process the main body of this bone is discarded. The meat is stripped from the wings and legs and frequently the bones of these are discarded.

In a sample of 50 stomachs from 22 localities the following items of food were recorded, noting the number of times they occurred, as follows:

Food Item	*No. of Occurrences*
Coleoptera adults	26
Isoptera	26
Coleoptera larvae	20
Dry grass stems and leaves	18
Orthoptera	15
Muridae	12
Scorpiones	12
Wild fruits	9
Reptilia	8
Green grass	7
Solifugae	6
Lepidoptera	4
Formicidae	3
Myriapoda	3

Coleoptera adults and Isoptera occurred more often than any of the remaining items of food. In the former it was possible to recognize the following families:

Family	*No. of Occurrences*
Tenebrionidae	11
Scarabaeidae	3
Carabidae	2

Isoptera were represented by two species:

Species	*No. of Occurrences*
Hidotermes mossambicus	21
Macrotermes bellicosus	1
Indet.	6

Isoptera constitute the sole content in six stomachs, over 50% in a further five.

These data indicate a very decided preference for this one species of termite, *H. mossambicus*. Where

H. mossambicus occurred in stomachs, as might be expected with a harvester termite, the content contained many small pieces of dry grass stems and leaves, which presumably had been cut and were being carried by the prey when eaten. These were found in 18 stomachs and are recorded separately from blades of green grass which are deliberately cropped and eaten, and which, passed through the intestine entire or regurgitated, apparently have some beneficial mechanical effect in the digestive process, a phenomenon common to many carnivores.

As will be seen from the above table green grass was found in seven stomachs.

Coleoptera larvae were found in 20 stomachs, in five cases identified as Tenebrionidae. These larvae live subterraneously on the roots of grasses and other plants.

Orthoptera occurred in 15 stomachs, in two constituting the sole content. The following families were represented:

Family	*No. of Occurrences*	*Note*
Acridiidae	9	
Gryllidae	4	Including *Maxentius* sp.

Muridae were found in 12 stomachs. It is interesting to note that they were not recorded in stomach contents prior to January 1967, up to which stage 29 of the total sample of 50 had been collected. The first three years of the survey were carried out during the latter stages of a four-year drought, unprecedented in the annals of the territory, when Murid populations were at an extremely low level. By January 1967, this drought had broken and, by mid-1967, rodent populations had exploded to high levels. During the period from January 1967, therefore, they were more freely available than before and remains were found in 11 of the remaining 21 stomachs taken during this later period.

Number of Occurrences of Muridae in Stomach Contents

Period	*No. Collected*	*No. of Stomachs in which Muridae Present*
January 1964-January 1967	29	Nil
February 1967-	21	11

In five out of these 11 stomach contents Murid remains constituted the sole content. Five species were represented as follows, the number of occurrences being given:

Species	*No. of Occurrences*
Dwarf mouse, *Mus* sp.	5
Multimammate mouse, *Praomys natalensis*	4
Namaqualand Gerbil, *Gerbillurus paeba*	1
Gerbil, *Tatera* sp.	1
Fat mouse, *Steatomys pratensis*	1
Indet.	3

Both *P. natalensis* and *Mus* sp. were among the species recorded as undergoing a population explosion, the former by far the commoner. On this basis *P. natalensis* might have shown up in stomach contents to a much larger extent than *Mus* sp. but it is a much larger rodent. Comparative weights of adult specimens of the five species listed are as follows:

Mus sp.	$\bar{X} = 5{\cdot}6$ gm; $N = 100$
Praomys natalensis	$\bar{X} = 46{\cdot}7$ gm; $N = 100$
Gerbillurus paeba	$\bar{X} = 25{\cdot}5$ gm; $N = 100$
Tatera sp.	$\bar{X} = 66{\cdot}1$ gm; $N = 100$
Steatomys pratensis	$\bar{X} = 22{\cdot}6$ gm; $N = 55$

All the above, with the exception of the *Tatera*, are medium- to small-sized rodents. In the one case where the stomach content consisted solely of three *P. natalensis* these were juveniles. The one *Tatera* record is of a small-sized specimen. In the case of the eight records from May 1967 and June 1968, five from Shakawe, two from Nokaneng and one from Savuti, the areas abounded in *P. natalensis* and larger specimens were available, yet only juveniles were found in the stomach contents.

These data suggest that the bat-eared foxes find the smaller species or juveniles of the larger the more easily obtained.

Scorpions were found in 12 stomachs. Where identification was possible, the following species were recorded:

Species	*No. of Occurrences*
Parabuthus vaudus	1
Opisthophthalmus wahlbergi	2
O. carinatus	1
O. histrio	1
Indet.	9

Wild fruits occurred in nine out of 50 stomachs. In two it consisted of unidentifiable pulp, in the remaining seven, the fruits of the donkey berry, *Grewia* sp., which are widely utilized by smaller Bovids, monkeys and baboons, black-backed jackals and other carnivores, mice and birds.

In captivity dried fruit of various types such as sultanas, currants, apricots, were much sought after,

sultanas forming an integral part of the diet of the pair which bred successfully. Bananas were totally rejected, apple eaten on occasion.

Reptilia were found in eight stomachs represented by the following species of snakes and lizards:

Species	*No. of Occurrences*
Snakes	
Peters' worm snake, *Leptotyphlops scutifrons*	1
Quill-snouted snake, *Xenocalamus mechowi*	1
Lizards	
Legless skink, *Typhlacontias gracilis*	1
Whistling gecko, *Ptenopus garrulus*	1
Worm lizard, *Zygaspis quadrifrons*	1
Sand lizard, *Eremias* sp.	1
Sundeval's skink, *Riopa sundevalli*	1
Striped blindworm, *Typhlosaurus lineatus* ..	1
Rough-scaled sand lizard, *Ichnotropis capensis*	1
Indet.	1

Solifugae were found in six stomachs, being identifiable in four as *Solpuga monteiroi*, in two the remains unidentifiable.

Lepidoptera occurred in four stomachs, in two from the same locality, where they were hatching in large numbers, the Sphingid, the Convolvulous Hawk Moth, *Herse convolvuli*. In a further two stomachs unidentifiable Sphingid larvae were found.

Formicidae were represented in two stomachs by Myrmecinae, in a third by *Pheidole* sp.

Myriapoda were represented by the Centipede, *Scolopendra morsitans*, and millipedes in three stomachs.

The stomach content of BP 1827 was unusual, in containing 10% of Springbok, *A. marsupialis*, droppings. It is probable that the termites, which constited 80% of this content, were feeding on these droppings which were picked up fortuitously.

Individuals observed feeding in the field wandered slowly, the head moving from side to side, giving the appearance of a somewhat aimless movement, but no doubt on the alert, until it appeared that a sound was heard when they paused, head still in the normal position, ears moving. In close proximity to a subterranean noise, such as the movement of coleoptera larvae among grass roots, the head was lowered until the front fringes of the ears were parallel and close to the ground (Plate 12), the head and ears slowly moved until the exact position of the noise was fixed when they commenced digging. A similar action was observed in specimens in captivity, great care being exercised to fix the exact location of the disturbance before digging commenced. From the high proportion of subterranean coleoptera larvae, which occurred in 20 stomachs out of the sample of 50, these are much sought after. In captivity, small objects moved by a thread under a carpet, would immediately attract them and they would quickly and accurately locate it, digging immediately on top of it.

The holes dug in feeding are characteristic, being narrow and deep, not wider than the width of one foot, as either set of long claws alternatively hit the same spot.

Pelage and Moult

At birth the pelage is soft and woolly, consisting of a covering of underhair only, with no sign of the guard-hairs which only start to appear at about four to five weeks. At this stage the ill-defined dorsomedian reddish-brown or dark brown band from the shoulders to the base of the tail stands out distinctly from the general pale grey or buffy-grey of the pelage. In the majority of cases this breaks at the base of the bushy tail, which, for its first basal third, is buffy or pale grey, the remaining two-thirds with a dark band

Plate 12 Bateared Fox locating prey. **Photo:** Author

dorsally joining with the broad dark tip to the tail.

From four to five weeks onward the outer coat of guard-hairs develops. This consists of long hairs, either entirely black or with a distinct penultimate broad band of white with black tips of varying width. In its fullest development the coat of guard-hairs entirely covers the underhair giving the pelage a grizzled appearance, due to the admixture of the black tips and white bands, which gives a general overall greyish appearance to the individual at a distance. The coat of guard-hairs is normally composed of individual hairs of some 45-50 mm long, although lengths of up to 70 mm are recorded (TNL 1466 Mamuno).

When the guard-hairs on the centre of the back are broadly tipped with black they produce a dark central band, when less so, this dark band may not be in evidence or may be absent altogether.

As the individual advances in age the dark dorsal band may either be present, through the development of a liberal admixture of guard-hairs with broad black tips along the dorsal line, or be absent when these guard-hairs lack the broad balck tip, when the individual shows no sign of the dorsal band, the whole having then a grey grizzled appearance. The conspicuous broad black tip to the tail is present in all specimens examined.

The underfur varies in colour from light to dark smoke grey or buffy-grey at the base, this colour extending from 10 mm-20 mm from the base of the hairs, the tips lighter.

The limbs are darker from birth than the remainder of the body through a liberal admixture of black hairs. In the adult they are black.

In the young the ears are black on the outside, whitish inside, in the adults they tend to be less intensely black, more brown, or in some cases buffy-grey. Similarly the muzzle is black in the young, browner in the adults.

The guard-hairs moult first, followed by the underhair which in falling out may mat into untidy masses which eventually drop off or are pulled off in grooming. Specimens in the moult are recorded in all months between August and March, in some cases the coating of guard-hairs being completely absent, the undercoat thin and matted. In these cases the dorsal band shows distinctly as a brown or reddish-brown band, as in the juveniles, in some cases suffusing widely on the dorsal surface. There appears to be a wide variation in the timing of this moult as individuals with complete pelages of guard and underhair showing no signs of moult, are found during these same months. In general the pelages are at their prime in April-July, and it is accepted by the people of Botswana, who collect skins for manufacture into karrosses, that these are the best hunting months for this purpose, and they will not normally go out of their way to hunt them during the summer months.

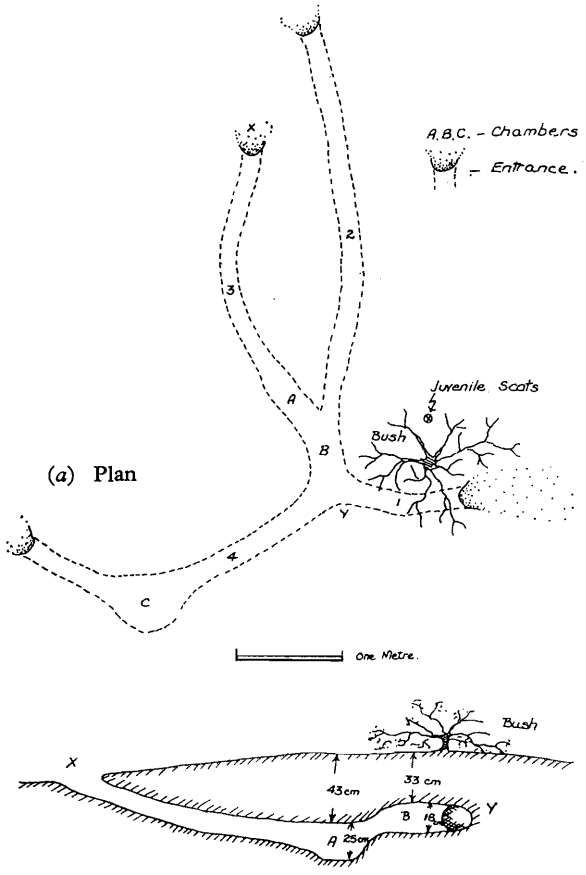
During the first year in captivity, a female moulted in August-September; the following year, after having littered down, not until January-February. The male of this pair moulted in the same months, the process taking some eight weeks to complete.

Breeding

The young are born in holes in the ground excavated by the parents. Shortridge (1934) records their using ant-bear, *Orycteropus afer*, or spring hare, *Pedetes capensis*, holes, these latter opened to suit their requirements. In captivity, both the male and female engaged in great digging activity from August onwards, at a time when, if the gestation period of *c.* 60-70 days as given by Haagner (1920) and Asdel (1946) is correct, would coincide with the period in which the female comes into oestrus. This digging was much more extensive than normal, in captivity extending to the limits allowed by the subterranean protective screening provided in the enclosure. The burrows extended to the depth of a metre, and two to three metres in length, allowing the adults to disappear completely underground. It continued in spite of the fact that a cement underground chamber 45 cm square and 30 cm high with an entrance tunnel two metres long and *c.* 20 cm square was provided, this constructed approximately to the pattern and to the measurements of a breeding hole excavated on Nxai Pan in 1964. In spite of their own burrow construction this cement construction was eventually used by the female for all three of her litters.

The breeding burrow excavated on Nxai Pan on the 1st December, 1964, had four entrances and three chambers. The main entrance, which, with spoor and the accumulation of juvenile scats lying adjacent to it, entered the ground under a small spreading thornbush, the first chamber (fig. 16 (*a*) B) being 1·2 m from the entrance, the roof of the chamber 33 cm from the surface, and opened sideways to some 18 cm in diameter. From this chamber another tunnel (fig. 16 (*a*) 2) ran for a distance of some 3 m gradually rising to the surface, apparently without a chamber. The third tunnel (fig. 16 (*a*) 3), 2·7 m long, had a chamber (fig. 16 (*a*) A) some 25 cm high, about 46 cm from the chamber in the main tunnel. The fourth tunnel (fig. 16 (*a*) 4), some 3 m long, had a chamber (fig. 16 (*a*) C) about 1·2 m from its entrance excavated sideways with the walls making it some 30 cm wide

Fig. 16 Diagram of the burrow of *O. megalotis*, Nxai Pan



(*a*) Plan

(*b*) Cross-section X—Y

and 18 cm high. This chamber was closer to the surface than the other two.

The ground in which this burrow was constructed had a hard calcareous layer a few centimetres below the surface and under this there was a deep layer of fine soft calcareous sand. The floor of the tunnel excavated in this sand was perfectly clean. Owing to the disturbance caused by the excavation it was impossible to say which chamber was in immediate use, the one juvenile female recovered from it, however, was taken in the chamber marked A on the plan, *c.* 70 cm below ground-level.

Attention was drawn to this particular breeding burrow by the presence of the female at the main entrance in the shelter of the bush in the late evening. Suspicion of young being present was aroused by her reluctance to run away on the approach of the vehicle, and confirmed by the presence of the accumulation of juvenile scats near the entrance. Careful search of the burrow revealed only one juvenile which appears unusual, in view of the figures given elsewhere. It is thought possible that she, or the male, which was not seen and which, from observations in captivity, takes part in the movement of the young, may have already moved the remainder of the litter for some reason. The ground was carefully brushed over in the vicinity of the excavation, and the main entrance closed and, as there was no sign of spoor next morning, she apparently had not returned.

Of a series of 39 females, three were gravid, two lactating heavily and one, although dry, showed from the condition of her reproductive tract evidence of having given birth to a litter some time previously. These were taken during the following months:

Distribution of non-gravid, lactating and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	2	6	3	4	3	6	4	2	3	3	2	1
Non-gravid	2	6	3	4	3	6	4	2	–	1	–	1
Lactating	–	–	–	–	–	–	–	–	–	–	2	–
Signs	–	1	–	–	–	–	–	–	–	–	–	–
Gravid	–	–	–	–	–	–	–	–	–	2	1	–

Shortridge (1934) records a litter of four cubs from Sandfontein, South West Africa, in November.

In captivity a female gave birth in four successive years in November, October, October and September.

Juveniles under the weight of 4 lb. were taken in January (3) and February (1).

The indications are that the young are born during the early summer months of September to December.

The three gravid females each carried five foetuses, one of the lactating females had three swellings on each uterine horn, the specimen taken in February recorded as having 'signs' of breeding two swellings on each horn. Unfortunately the reproductive tract of the second lactating female was not preserved.

On this basis the average number of foetuses was as follows:

Foetuses

Number $\bar{X} = 5$; $N = 4$; Obs. range 4-6

The female in captivity produced five, six, five and four young in the four litters, but only raised four on each occasion. In the first three litters she undoubtedly ate one, two and one on each occasion within the first 13 days as they completely disappeared from the cement tunnel. Crandall (1964) records litters of three and two in zoo specimens (National Zoological Park, Washington, D.C.) and quotes Haagner (1920) 'several litters of three' (National Zoological Gardens, Pretoria, Republic of South Africa).

Observations in the field of family parties suggest that two or three young only are reared. Shortridge

(1934) states that 'they go about singly, in pairs, often in threes, and sometimes in small parties up to five or six in number' and Austen (*in litt.*) reports that two to three is the normal number of young found in the Wankie National Park, Rhodesia.

In Botswana packs believed to be family groups have been observed as follows:

Locality	Date Observation	Total No. in Pack	No. of Juveniles Observed	No. of Juveniles Estimated
Nunga	Jan. 66	3	?	1
Tsaugara Pan	Jan. 65	3	2	
Morwamosu	Feb. 61	6	4	
Nokaneng	Mar. 57	3	2	
Nxai Pan	Mar. 64	4	2	
Nxai Pan	Mar. 64	4	2	
Nxai Pan	Mar. 64	5	?	3
Shakawe	May 67	3	?	1
Bosobogolo Pan	May 57	5	3	
Bosobogolo Pan	May 57	4	?	2
Bosobogolo Pan	May 57	6	?	4
Mamuno	July 67	3	?	1
Nxai Pan	July 64	3	2	

The indications from these figures, which suggest that 2-3 young (an average of 2·2) are reared, is that either there is considerable mortality in the very early stages or that litters of five are above the average.

Implantation in the series of four specimens was as follows:

3R3L	2R3L	2R2L
1	2	1

The birth-weight of individuals in a litter of five bred in captivity by the author varied from 99·4 g to 142·0 g. In the field this variation is reflected in the weights of near full-term foetuses in a female, BP 1671, with five, 106·5 g to 140·5 g and younger foetuses 83·7 g to 91·8 g for BP 1670.

On this basis birth-weights might be estimated as between 100 and 150 grams.

Hindfoot lengths in the series of five foetuses, BP 1671 and BP 1670, show little variation within each litter, there being a difference of 2 mm in the former case and 1 mm in the latter. In the case of a litter born in captivity the variation in the hindfoot lengths in the early stages of life was very considerable. At 35 days from the time of birth of this litter, there was a difference of 16 mm between two of the smaller individuals at 61 mm and the largest at 77 mm. At this age weights varied from 12 oz. to 1 lb. 5 oz.

Of the four juveniles comprising the second litter born in captivity two were exceedingly precocious and would wait by the door of the enclosure for food along with the mother. When the food was presented they would greedily partake of it, disregarding being stroked or even picked up. The other two were very shy and never approached the feeding dish, the mother taking mouthfuls of food to them at the entrance to the tunnel, where they awaited her. There is little doubt that the two precocious juveniles had a far larger food intake than the other two which is reflected in their weights at four weeks of 4 lb. 3 oz. and 4 lb. 2 oz. as opposed to 3 lb. 2 oz. and 3 lb. 1 oz. for the shy individuals.

Any estimate of the ages of young specimens in the field, therefore, based on either hindfoot length or weight must allow of considerable latitude. Again, the growth and development of an individual in a litter is likely to vary considerably, depending on the number in the litter and the consequent level of competition for food.

Details of the gravid females and their foetuses is as follows:

Female BP 1671 Camp 3 (22 23 A4) 16.10.66. TL 855; T 315; Hf c/u 135; E 127; Weight 10 lb. 10 oz. (net)

The weights and measurements of the foetuses were:

	R.H.S.		*L.H.S.*		
No.	1	2	1	2	3
Sex ..					
Hf c/u	35	35	36	37	37
T	67	65	65	65	73
E	20	20	17	16	18
Weight g ..	140·0	106·5	125·5	123·0	140·5

The foetuses were well-haired, the limbs showing black, with a dark brown line down the spine, the flanks intermingled with buffy, back of the ears dark grey, forehead grey, muzzles black, tail dark brown with a dark tip and a dark brown band down the dorsal side. On the basis of the evidence of weights of young born in captivity, they appeared to be nearly full-term.
Female BP 1670 Xade Pan (22 23 A3) 14.10.66. TL 810; T 320; Hf c/u 150; E 118; Weight 8 lb. 12 oz. (net).

The weights and measurements of the foetuses were:

	R.H.S.		L.H.S.		
No.	1	2	1	2	3
Sex					
Hf c/u	29	29	30	30	30
T	58	56	55	58	58
E	14	14	15	15	14
Weight g ..	90·1	90·1	91·8	88·1	83·7

The foetuses were sparsely haired, an even grey colour, the dark dorsal line in evidence, buffy on the flanks, with an overall golden sheen.

Sizes and Weights

In the series available females appear to be slightly larger and heavier, excepting that the length of the ears appears to be similar in both sexes.

MALES

TL	$\bar{X}$ = 827;	N = 25;	Obs. range 760-905
T	$\bar{X}$ = 298;	N = 25;	„ „ 230-340
Hf c/u	$\bar{X}$ = 149;	N = 25;	„ „ 140-161
E	$\bar{X}$ = 124;	N = 25;	„ „ 119-137
Weight	$\bar{X}$ = 8 lb. 14 oz.;	N = 22;	„ „ 7 lb. 8 oz.-10 lb. 13 oz.

FEMALES

TL	$\bar{X}$ = 839;	N = 29;	Obs. range 770-910
T	$\bar{X}$ = 303;	N = 29;	„ „ 278-340
Hf c/u	$\bar{X}$ = 150;	N = 29;	„ „ 139-165
E	$\bar{X}$ = 124;	N = 29;	„ „ 114-134
Weight	$\bar{X}$ = 9 lb. 1 oz.;	N = 29;	„ „ 7 lb.-11 lb. 13 oz.

BP 1642, an adult male with high shank and ear measurements brought into camp by an African, was abnormal in that it only weighed 5 lb. which was later ascertained to be due to the fact that it had been in captivity for some time and would not eat, its death being ascribed to starvation.

Again there does not appear to be any great seasonal variation in weight over the year, the heaviest weight for non-gravid females being recorded at 11 lb. 2 oz. and 11 lb. in November and May respectively, and males at 10 lb. 13 oz. and 10 lb. 8 oz. during the same months.

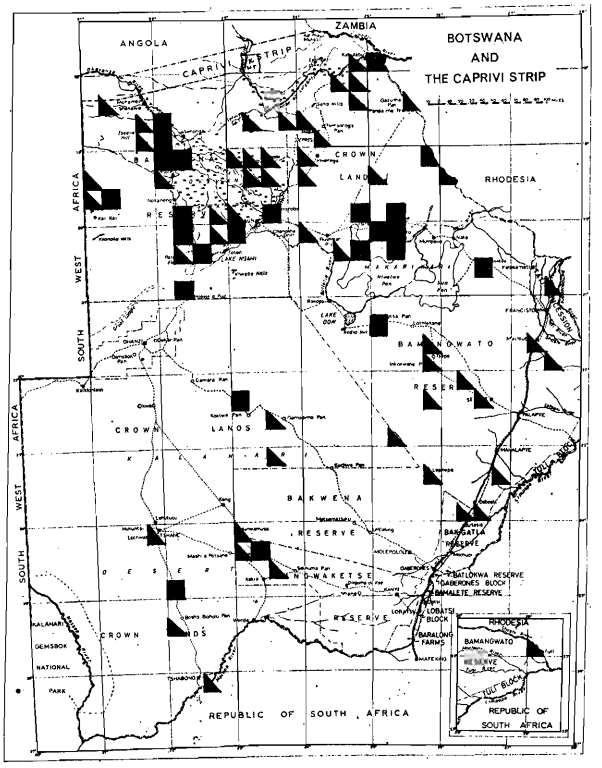
The two gravid females at 10 lb. 10 oz. and 8 lb. 12 oz. were both taken in October, the female in captivity had a weight of 11 lb. 8 oz. in the same months and produced her litter at this weight.

Genus LYCAON Brookes, 1827

Lycaon pictus

LeTlhalerwa, leTeane, leKanyane Wild Dog

L. p. pictus (Temminck, 1820)



Distribution

Although they appear to be widely distributed throughout the territory there are no material or visual records in the west from the Aha Hills south to the Molopo River. They have probably been overlooked in this sector as Shortridge (1934) states that they may be 'met with anywhere (in South West Africa) except in the extreme south'.

Habitat

The species has a very wide habitat tolerance being recorded from the arid shrub savannah of the Kalahari, with an annual rainfall of *c.* 200 mm, where open water is only available during very limited times of the year or may not be available at all for long periods, to the woodlands of the Okavango delta and Chobe River with an annual rainfall of up to 700 mm. They are not commonly found in broken hilly country and are most likely to be found where there are concentrations of medium to large-sized antelopes.

Habits

Gregarious, diurnal, packs of up to 35-40 known (Odiakwe 40, P. Bromfield; Moremi Game Reserve 27 and Tshabong 33 and 13, T. N. Liversedge), but 10-15 more normal, and packs of three, five and six on record. The species is particularly adapted to working in packs, which travel very swiftly and cover long distances being noticeably nomadic and not normally remaining in an area for any length of time. Teamwork in hunting is a noticeable feature, the pack having a regular leader who will single out an individual from a herd, the following dogs ignoring other herd members which, to the observer, appear closer at hand and more vulnerable. On the Patlana Flats west of Lake Ngami the leading two dogs chasing a young springbok appeared to try and turn the quarry, the others cutting the corner in an attempted kill. Although baits were frequently used to attract predators, in areas where wild dogs had been observed, they were never found at this bait, although they have been successfully poisoned returning to cattle kills in western Rhodesia, but this is apparently unusual. It appears that they have a preference for making their own kills.

Where larger species have been taken, e.g. kudu, they have been observed, on making contact, to tear mouthfuls from the running quarry until it collapses, a process which is used in killing cattle in ranching areas.

An individual run into near Odiakwe by one of the vehicles and yelping, injured on the road, was attacked by the remainder of the pack and torn to pieces before the vehicle could pull up and a fire-arm secured to destroy it, the pack making off on seeing the occupants on the road. The dead dog was so torn as to be useless as a specimen, being largely disembowelled the skin and flesh on several parts of the body being stripped from the bone, the tail and one ear being missing altogether.

Wild dogs were never seen in Botswana at night over the four years of field-work, in spite of the long hours spent with dazzling lights in search of predators, although there were numerous daylight sightings. This suggests that they are predominantly diurnal.

Packs show no fear of vehicles and little fear of man's presence. North of Lephepe a pack turned to approach a parked vehicle while one of the occupants was walking nearby, both being clearly visible to them.

Where they have been heavily hunted, however, such as in ranching areas in western Rhodesia, where they are a pest, they become very wary and difficult to approach.

When a pack was fired at near the southern end of the Mababe Depression they ran off barking with a deep hoarse bark which continued into the distance. The young in captivity whine and yelp like puppies.

A high-pitched *hoo-hoo-hoo* call heard near Nunga was ascribed by a Bushman tracker to be the call of this species, but they were not contacted.

In captivity the young have a very strong and disagreeable odour which persists even if they are shampooed frequently. A small pack of five kept in captivity in Salisbury, Rhodesia, however, which had been reared by hand and had become used to visitors, at 30 months' old evinced little evidence of smell even at close quarters, and it is thought that, to some extent, the strong smell associated with the species is an effect of stress.

Individuals which have been shot but not killed outright smell very strongly indeed.

Single specimens in captivity are difficult to handle and never seem to lose their cringing habit, lacking spirit. The small pack mentioned above was, on the other hand, alert and settled well to their unnatural environment. It appears that they require the association of others to function at normal efficiency.

Food

Out of a sample of 13 stomachs, seven were empty, the remaining six containing the remains of the following:

C 1442	Bovidae, common duiker,	*S. grimmia.*
RMD 1243	„	springbok, *A. marsupialis.*
TNL 5004	„	indet. (Impala ?)
TNL 5005	„	indet. (Impala ?)
TNL 3863	„	indet. (Kudu ?)
TNL 3864	Steenbok,	*Raphicerus campestris.*
Leporidae, scrub hare,		*Lepus sexatilis.*

It appears from published information (Shortridge, 1934; Roosevelt and Heller, 1914, etc.) that the species has a preference for medium-sized mammals but will take the smaller as well as the larger species as available. In ranching areas, in the absence of their natural food, can become a pest and cause great destruction.

In feeding, a pack of wild dogs causes great disturbance and scattering of herds of wildlife.

Breeding

None of the females taken during the following months were gravid:

February	*March*	*April*	*August*	*December*
1	3	3	1	2

and there is no evidence of the breeding season in Botswana.

Shortridge (1934) states that the young appear to be born from March onwards to September 'but the favourite months seems to be April', Ansell (1960) gives May to July, 2-8 cubs per litter. The young are born in disused ant-bear holes (Rhodesia) which they enlarge providing a chamber lined with grass for the litter. At the time of whelping the females scatter to have their young.

MALES

TL	$\bar{X} = 1348$;	$N = 8$;	Obs. range 1230-1425
T	$\bar{X} = 374$;	$N = 8$;	,, ,, 335- 400
Hf c/u	$\bar{X} = 245$;	$N = 8$;	,, ,, 240- 250
E	$\bar{X} = 140$;	$N = 8$;	,, ,, 130- 150
Weight	$\bar{X} = 48$ lb.;	$N = 7$;	,, ,, 34- 62 lb.

FEMALES

TL	$\bar{X} = 1330$;	$N = 8$;	Obs. range 1228-1460
T	$\bar{X} = 355$;	$N = 8$;	,, ,, 310- 375
Hf c/u	$\bar{X} = 239$;	$N = 8$;	,, ,, 226- 255
E	$\bar{X} = 139$;	$N = 8$;	,, ,, 129- 152
Weight	$\bar{X} = 49$ lb.;	$N = 5$;	,, ,, 35- 59 lb.

Genus VULPES Oken, 1816

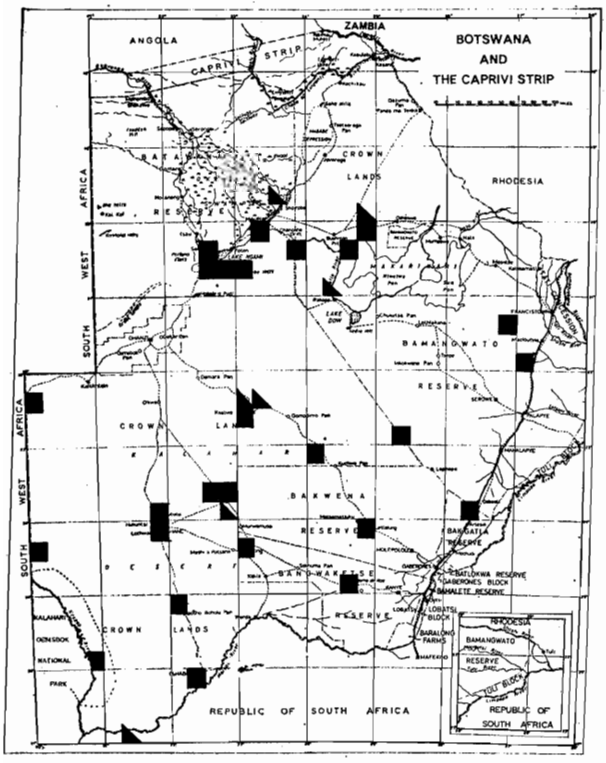
Vulpes chama

V. chama (A. Smith, 1833)

Lesie Cape Fox (Silver Jackal)

Distribution

Occur throughout the central and south-western Kalahari as far north as Lake Ngami, the Botletle River and the western parts of the Makgadikgadi north to Nxai Pan. Not so far recorded east of Nxai Pan or in the north-eastern part of the Central Kalahari Game Reserve and only occurring in the eastern sector in the intrusion of Kalahari association between Debeeti and Artesia. Not recorded east of Dikgomodikae in the south.



Although there are no records from the South West Africa border from 22°30′ S. northwards, they may well occur here at least as far north as the Groot Laagte. Shortridge (1934) states that they occur throughout South West Africa as far north as Grootfontein in the east and into the south and south-western portions of Angola, although Hill and Carter (1941) repudiate their occurrence in Angola.

Both Shortridge (1934) and Roberts (1951) include western Rhodesia in their range of distribution but they have never been recorded within Rhodesian limits and, judging from their distribution and habitat requirements in Botswana, their occurrence there seems most unlikely.

The visual record from the Chitabe, eastern Okavango, remains the furthest north they have been reported but on the evidence of their present known distribution this requires the confirmation of material and must be accepted with reservation until this is available.

Habitat

The types of association in which a sample of 30 specimens was taken is as follows:

Acacia scrub	15
Grassland fringe pan	7
Terminalia-Acacia scrub	4
Dry river-bed	2
Cleared bush	1
Open grassland	1
	30

These data indicate that they have a preference for open country. In 19 cases scrub of various types are recorded, these varying from open grassland, with scattered *Acacia* bushes, such as is found west of Lake Ngami, to open *Acacia* scrub or *Terminalia* scrub, such as is found extensively in the Kalahari.

In two cases (TNL 1354, BP 1385) it was recorded that the specimen was taken in *Acacia* woodland 'near a village', which suggests that the association would be degraded and more open than normal and lacking the grass cover through overstocking. One specimen (BP 2059) was taken near Maun in an area 'cleared of bush'. In the remaining seven cases, the specimens were taken on the grassland fringes of pans, an area of short grass with no accompanying scrub, although this was situated no great distance from it.

Habits

Nocturnal and for this reason very difficult to keep under observation. Disinclined to stand in the beam of a light, slinking off and making use of the cover of intervening bushes, into which they will crawl to avoid the disturbance, lying quite tightly until approached and then making off to use other cover.

Lie up during the day in the cover of bushes. One was flushed from this type of lair near Tshane during the day. They are reported to use holes as well but there was no evidence of this. In captivity, however, they are avid diggers. Shortridge (1934) states that under stress they will take to holes in the ground.

They are trapped and hunted with dogs in Botswana for their pelts which are prized for making karosses.

Food

Analysis of the contents of 23 stomachs was as follows:

Food Item	*No. of Occurrences*	*Note*
Coleoptera	14	See text
Muridae	12	„ „
Reptilia	7	„ „
Solifugae	6	„ „
Orthoptera	5	„ „
Isoptera	3	„ „
Aves	2	„ „
Scorpiones	2	indet.
Myriapoda	2	*Scolopendra morsitans*
Green grass	2	
Wild fruits	1	*Grewia* sp.

The food item of principal occurrence was Coleoptera found in 14 stomachs, including Dytiscidae, Scarabaeidae and Carabidae. Coleoptera constituted in five cases 80%, 60%, 40%, 10% and 10% of the total content.

Muridae were the next commonest item occurring in 12 stomachs, in four the pouched mouse, *Saccostomus campestris*, in two the multimammate mouse, *Praomys natalensis;* and in one each the lesser gerbil, *Gerbillurus paeba*, the Namaqua gerbil, *Desmodillus auricularis*, and a gerbil, *Tatera* sp. All these are found on relatively open ground and in addition *S. campestris* and *D. auricularis* are slow movers making them easy prey.

Reptilia occurred in seven of the 23 stomachs, Peters' worm-snake, *Leptotyphlops scutifrons*, occurring twice. This burrowing snake is apparently very palatable as it occurs in the stomach of a wide range of small mammals in Botswana as does the lizard, Sundevall's skink, *Riopa sundevalli*, which occurred in one content. Single occurrences of the following species were also recorded:

Lizards Spiny agama, *Agama hispida*
Kalahari blindworm, *Typhlosaurus lineatus*
Thick-tailed blindworm, *Acontias* sp.
Worm-lizard, *Amphisbaenidae*
Rough-scaled sand lizard, *Ichnotropus squamulosa*

Snakes *Tomauropeltis* sp.

Solpugidae occurred in six stomachs, in three *Solpuga monteroi*, constituting 60% and 45% in two stomachs.

Orthoptera occurred in five stomachs, in three cases constituting the whole content. These are generally very well masticated making identification difficult, although the following were recognized, *Cataloipus oberthuri*, *Duronia* sp. and *Acanthoplus* sp.

Isoptera were represented by *Hodotermes mossambicus* in two out of the three stomachs although only in small percentages.

Aves were represented by the crowned plover, *Stephanibyx coronatus*, and the double-banded courser, *Rhinoptilus africanus*, both species associated with the fringes of pans and open grassland and, being terrestrial, prone to predation at night.

Sixteen of the 24 specimens were taken before the break of the four-year drought at the end of 1966, eight from January 1967 onwards. Rodent populations prior to June 1966 were at an unprecedented low level and after the rains in 1967 built up very quickly in some areas to explosive levels. This is reflected in the percentage occurrence of Muridae in stomachs which showed a greatly increased percentage occurrence after January 1967 with a corresponding drop off in Solpugidae, Scorpiones remaining at a static level.

Percentage occurrence of three food items in stomachs prior to June 1966 and from January 1967 onwards

	Prior to June 1966 *Sample* 16	*From January 1967* *Sample* 8
Muridae	43·7%	87·5%
Solpugidae	31·2%	Nil
Scorpiones	12·5%	12·5%

Breeding

There was only one gravid female among the 13 collected:

	J	F	M	A	M	J	J	A	S	O	N	D
Total	–	2	3	–	2	2	–	1	–	3	–	–
Non-gravid	–	2	3	–	2	2	–	1	–	2	–	–
Gravid	–	–	–	–	–	–	–	–	–	1	–	–

The gravid female, from Tshabong, had a single small foetus 14·5 g, implanted 1R.

Juveniles at weights of 2-4 lb. were taken in December and February.

Shortridge (1934) states that a female from Berseba, South West Africa, was 'suckling cubs', in September.

Brand (1963) states that 'very little seems to be known about the species' and shows that the dates of dropping the litters under captive conditions in the National Zoological Gardens, Pretoria, is from mid-September till mid-October. Indications point to the young being born in the warm wet months of the year but further information is required.

Sizes and Weights

MALES

TL	$\bar{X}$ = 906;	N = 14; Obs. range	880-948
T	$\bar{X}$ = 360;	N = 14; „ „	293-393
Hf c/u	$\bar{X}$ = 145;	N = 14; „ „	138-150
E	$\bar{X}$ = 98;	N = 14; „ „	92-109
Weight	$\bar{X}$ = 6 lb. 10 oz.;	N = 12; „ „	5 lb.-7 lb. 4 oz.

FEMALES

TL	$\bar{X}$ = 892;	N = 10; Obs. range	860-977
T	$\bar{X}$ = 360;	N = 10; „ „	345-380
Hf c/u	$\bar{X}$ = 143;	N = 10; „ „	137-146
E	$\bar{X}$ = 94;	N = 10; „ „	87- 98
Weight	$\bar{X}$ = 6 lb. 6 oz.;	N = 10; „ „	5 lb.-7 lb.

Genus CANIS Linnaeus, 1758

Carnassials relatively small, length less than 83% of M^1+M^2 and 130% of M_2+M_3, tip of tail white; ears dark grey behind; dark stripe on either flank . . . . . *C. adustus*

Carnassial: molar ratio as above defined 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 . . . . . *C. mesomelas*

Canis adustus seKgee, raNtalaje Sidestriped Jackal

C. a. adustus Sundevall, 1846

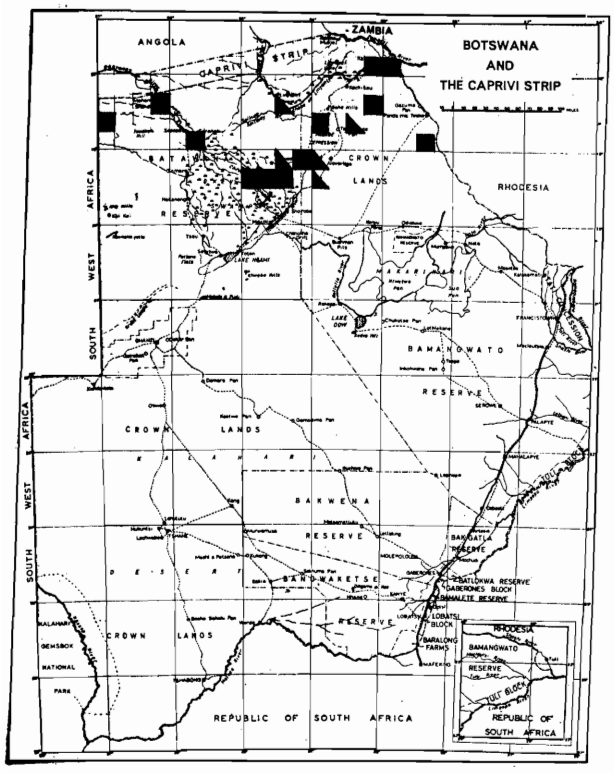
Distribution

The species is confined to the northern part of the territory from the South West African border at 18°45′ S., throughout the northern part of the Okavango delta south to 19°50′ S. and east to the Rhodesian border at 19° S. These limits correspond closely with the data given by Shortridge (1934) for South West Africa where he states that 'it occurs only in the Grootfontein district—from a little south of 19° S. . . . and the Caprivi'. In Rhodesia in the Wankie National Park, adjacent to the Botswana border, they are confined to the northern sector north of about 18°45′ S.

North of this they occur widely throughout Angola (Hill and Carter, 1941), throughout Zambia, (Ansell, 1960), and Malawi, (Sweeney, 1959) in the east south to Natal.

Habitat

All the records available are from well-watered areas, or at least seasonally well-watered areas, within the 400-700 mm mean annual rainfall area. They have been taken in a wide variety of associations from floodplain, grassland, mopane, *Acacia* and *Terminalia-Combretum* woodland. They apparently cannot utilise the more open bush and grassland savannah, such as is found in the Makgadikgadi area and throughout the Kalahari, in which *C. mesomelas* commonly occurs. Stevenson-Hamilton (1929) states that *C. adustus* 'favours rather more thickly wooded country' than *C.*



mesomelas and this would apply to the species in Botswana as compared with *C. mesomelas* with its wider habitat tolerance.

Habits

Occur singly or in pairs, not observed in larger numbers together. Predominantly nocturnal although seen moving just before sundown (Kwikampa, Chobe National Park) and occasionally during daylight hours (Savuti 11 a.m., Moremi Game Reserve 3.30 p.m.). Lie up during the day in scrub or tall grass and like *C. mesomelas* will use old ant-bear, *Orycteropus afer* (Kwaai R.), or other holes as refuges and for littering down.

Shy and difficult to approach with a dazzling light, in the beam of which they will only stand momentarily keeping on the move and only occasionally glancing back at it.

Both this species and *C. mesomelas*, when held in a light, tend to try and work into the wind presumably to try and identify the disturbance by scent. Once having picked it up they will move off without stopping.

The call of this species lacks the drawn out howl characteristic of *C. mesomelas*, being a short series of soft barks.

While there is no evidence from Botswana, in Rhodesia, where the two species occur on the same ground in farming areas (Thornpark, Salisbury), *C. mesomelas* has been observed to kill small stock and reported as killing day-old calves, whereas there is no evidence that *C. adustus* was involved in such predations. Both Roberts (1951) and Shortridge (1934) quote evidence from other areas in support of this, Shortridge in addition stating that 'according to Okavango natives it does little harm to young cattle or unwounded game'. Ansell (1960) states 'not a stock killer'. Examination of stomach contents both in Botswana (*see* Food) and Rhodesia tend to confirm this for, although those from Botswana contained the remains of large mammals, it seems most unlikely from their size that they were taken except in the form of carrion.

Food

In the sample of 12 stomachs available the following food items were identified noting the number of times they were found:

Food Item	*No. of Occurrences*	*Note*
Muridae	8	See text
Carrion	5	,, ,,
Wild fruits	3	,, ,,
Coleoptera	2	,, ,,
Orthoptera	2	,, ,,
Isoptera	2	,, ,,
Reptilia	2	,, ,,
Lepidoptera	1	,, ,,
Mammalia	1	,, ,,
Aves	1	,, ,,

Muridae was the commonest food item in the 12 stomachs examined, occurring in eight. In four of these *Praomys natalensis* were identifiable, in two *Mus* sp., in one each *Otomys angoniensis* and *Saccostomus campestris* and in one unidentifiable.

Carrion was the next commonest item occurring in eight stomachs, this being from dead animals not laid as baits and including portions of the skin with hair of eland, *Taurotragus oryx;* lechwe, *Kobus leche;* impala, *Aepyceros melampus*, and reedbuck, *Redunca arundinum*.

In two stomachs each Coleoptera (adults); Orthoptera; Isoptera (in one *Hodotermes mossambicus*, in the other unidentifiable), and Reptilia, represented by the scales of a snake and the remains of a small tortoise, were found.

Lepidoptera were represented in one stomach by the larvae of *Herse convolvuli;* Aves in another by the feathers of a small bird; Mammalia in another by a few sections of the quills of a porcupine, *Hystrix africaeaustralis*.

The following table gives a comparison of the percentage occurrence of food items in the sample of 12 stomachs from Botswana and a series of 37 from Mashonaland, Rhodesia.

Percentage occurrence of food items in 12 stomachs of *C. adustus* from Botswana and 37 from Rhodesia

	Botswana (12 *stomachs*) %	*Rhodesia* (37 *stomachs*) %
Carrion	45·2	10·8
Muridae	72·8	32·4
Orthoptera	18·1	5·4
Coleoptera	18·1	16·2
Isoptera	18·1	8·1
Reptilia	9·0	—
Lepidoptera	9·0	—
Formicidae	—	2·7
Wild fruits	18·1	54·0
Agricultural crops	—	32·4
Misc.	18·1	5·4
Aves	9·0	13·4
Dry grass	18·1	21·6
Green grass	9·0	16·2

As might be expected carrion is not so freely available to *C. adustus* in an intensely farmed area such as Mashonaland as compared with northern Botswana which carries a heavy population of wildlife including a wide range of predatory species, which is reflected in the higher percentage in Botswana as compared with Mashonaland. In three of the four stomachs from Mashonaland the remains were those of cattle, in one the skin and hair of a goat.

Rodents constituted a high percentage in both cases, Botswana 72·8%, Mashonaland 32·4%.

Wild fruits show a very high percentage occurrence in the Mashonaland sample at 54·0% as against 18·1% in the case of Botswana, where only *Grewia* sp., 'donkey berries' were found.

The range of wild fruits from Mashonaland was much wider, the following being identified in the stomachs:

Percentage occurrence of various wild fruits in a sample of 37 stomach contents of *C. adustus* from Mashonaland, Rhodesia

	%
'Muhacha', *Parinaria mobola*	8·1
'Mahobohobo', *Uapaca kirkiana*	5·4
Wild fig, *Ficus* sp.	10·8
Undet.	26·8

Again as might be expected, considering the intensive agricultural development of Mashonaland, as compared to northern Botswana, food crops are more freely available.

While no such items were found in the 12 stomach contents from Botswana, in the 37 from Mashonaland the following agricultural products were found:

Percentage occurrence of various agricultural products in a sample of 37 stomach contents of *C. adustus* from Mashonaland, Rhodesia

	%
Peanuts	10·8
Green mealies	8·1
Sunflower seeds	5·4
Pulp (1 pumpkin, 2 avocado pear, 1 undet.)	10·8

Taking the percentage of wild fruits and agricultural products together this shows a percentage occurrence in the 37 stomachs of 89·1% which appears to indicate a strong preference for this type of food where it is available.

Breeding

Adult females were taken during the following months:

January	February	May	June	August
1	2	2	2	1

none of these showing any signs of pregnancy and there is no information on the time at which the young are born.

As an indication of when gravid females or young might be expected to be found, in Rhodesia gravid females have been taken during the months of August, September and November as follows:

No.	Date	No. of Foetus	Implantation
T352	24.8.66	6	3R 3L
T353	29.9.66	6	3R 3L
T168	3.9.64	6	3R 3L
MR219	26.11.65	4	2R 2L
MR223	27.11.65	5	1R 4L

indicating that the young are born at the onset and during the early part of the rainy season.

Sizes and Weights

Unfortunately only three adult males and three adult females are available, the sample being too small to draw any definite conclusions as to the comparative sizes of the sexes.

Comparison with the weights and measurements of *C. mesomelas* shows that *C. adustus* is on average the larger of the two species and judging from the hind-foot measurement longer in the leg.

MALES

No.	*TL*	*T*	*Hf c/u*	*E*	*Weight*
SWG 743	1135	400	180	88	23 lb.
SWG 665	1155	405	185	90	21 lb. 4 oz.
TNL 3501	1140	390	190	90	21 lb. 4 oz.

FEMALES

No.	*TL*	*T*	*Hf c/u*	*E*	*Weight*
SWG 605	1133	391	178	90	20 lb. 8 oz.
SWG 751	1070	360	174	87	24 lb.
C 283	1080	365	182	94	—

C. mesomelas

Phokoje Blackbacked Jackal

C. m. arenarum (Thomas, 1926)

Taxonomic Notes

Thomas (1926) in his description of *C. m. arenarum* from Berseba, South West Africa, states 'colour paler throughout than in typical South African *C. m. mesomelas*. Dorsal colour with more white in it and less black, the white rings on the hairs at a maximum'. In the series of 24 adult specimens from Botswana the black hair of the 'saddle' is freely intermixed with white hairs, the proportion being greater than in specimens from the eastern Cape Province, *C. m. mesomelas* (no western Cape specimens being available).

Immature specimens in the Botswana series are paler, the saddle ill-defined and less black and white, the sides and limbs pale and lacking the tawny reddish colour of the adults. On the other hand, some of the adults cannot be accounted paler than material from the Eastern Province, in fact the richness of the colour of the sides and upper parts of the limbs of adult Botswana blackbacked jackals is a feature. Within the series from a wide range of localities some stand out particularly for the clearly defined black saddle intermixed with white hairs and the richness of the dark tawny reddish colour of the sides and upper limbs. BP 93 Sepopa is outstanding in this respect and is closely matched by BP 1925 Maun; TNL 4275 45 miles SW. Francistown; P 180M Mampswe; BP 2184 Mabate, and BP 537 and BP 575 from Kanyu, Makgadikgadi. Thomas (1926) states 'sides and belly almost without tawny wash' which would only apply to immature specimens from Botswana.

Thomas (1926) in describing the underparts of *C. m. arenarum* stated 'the greater part of the belly, especially the inguinal region and front of legs, really white'. In the series the colour of the underparts in the adults is very variable. It is indeed pure white in G 552 Makgadikgadi; BP 1925 Maun; BP 93 Sepopa; BP 2018 Lebung; TNL 4275 45 miles south-west of Francistown; BP 537 and BP 575 from Kanyu, but in BP 1911 Maun and TNL 835 Kuchwe Pan the hair is white with a broad grey base and buffy in BP 136 from Gomare. The colour and amount of black in the tails also varies, in BP 93 Sepopa it is basically reddish like the flanks, the remaining five-eighths of the length being black. In BP 577 Kanyu the hair of the tail is reddish-brown not black and in BP 575 from the same locality, similar, but to a lesser degree, being slightly blacker. In the remainder of the series the amount of black varies greatly.

Thomas' measurements of the type of *C. m. arenarum*, a male, as compared with Botswana and eastern Cape material is as follows:

Males TL	T	Hf c/u	E
C. m. arenarum type 1040	310	156	110
Botswana material			
$\bar{X}$ = 1034	321	167	107
N = 22	24	25	25
O.R. = 945-1120	281-360	154-179	98-118
E. Province material			
$\bar{X}$ = 997	313	158	107
N = 3	3	3	3
(Shortridge) *C. m. mesomelas* O.R. = 890-1110	280-350	150-170	105-112

On this basis there does not appear to be any noteable difference in the size of the three categories.

Roberts' (1951) figures for the greatest length of skulls of male *C. m. mesomelas* from the Albany district at minimum 171 to maximum 175 indicates that they are generally larger in this respect than a series of *C. m. arenarum* from 'Damaraland to the Transvaal' at minimum 155 maximum 168. The corresponding measurement of the Botswana series is as follows:

Greatest length skull $\bar{X} = 158$; $N = 21$; Obs. range 152-171

which indicates a closer agreement in the slightly smaller size with the figures for Roberts' series of *C. m. arenarum*.

The condylobasal length of the skull in the Botswana series is as follows:

$\bar{X} = 151$; $N = 23$; Obs. range 141-164.

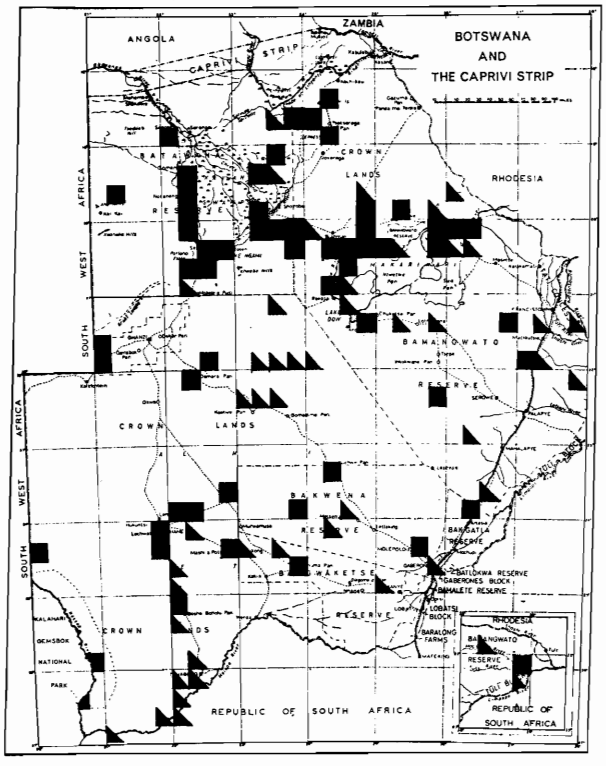
On this basis the Botswana series corresponds more closely to the smaller *C. m. arenarum* given as 'below 160' as opposed to *C. m. mesomelas* as 'over 160 to 180'.

In spite of the slender nature of the evidence in support of the subspecific status of *C. m. arenarum* as opposed to the nominate form, on the basis of the smaller size of the skulls of the former, the Botswana material is assigned to *C. m. arenarum* Thomas.

Distribution

The species has a wide distribution throughout most of the territory being absent, however, in the northern and eastern parts of the north-eastern sector. As they occur in the southern part of the Wankie National Park, Rhodesia, they might in time be found further north than the Nata River, its present furthest known northern limit in this eastern area, perhaps at least as far north as 19° on the Rhodesian border.

The furthest north that they have so far been taken in the west is just south of Sepopa, but are known to occur throughout south-western Angola (Hill and Carter, 1941). Shortridge (1934), on the other hand, excludes them from the Caprivi and the north-eastern parts of South West Africa which suggests that the Sepopo area may indeed be the northern limit of their range in the west.



Too little evidence is available from the area north of the Selinda Spillway to comment on their status in this area.

Throughout the extreme northern parts of the territory *C. mesomelas* is replaced by the sidestriped jackal, *C. adustus* (*see C. adustus*) there being a considerable overlap in the ranges of the two species in the Okvango delta, *C. adustus* occurring south to 18°50′ S. In this area they have been observed at night on the same ground within a few hundred yards of each other (Savuti).

Although there are no records from the central-western areas from the South West Africa border at 22° S. to 24°15′ S., as they occur in adjacent parts of South West Africa (Shortridge, 1934), it is thought that they have been overlooked as the area is ecologically similar to just east and south of this where they have been recorded.

In the eastern sector they occur right up to the outskirts of intensively populated areas.

Habitat

Analysis of the data on the habitat from which 74 specimens we e taken is as follows:

Grassland fringing pans	30
Acacia scrub	19
Floodplain grassland	6
Mopane woodland	5
A. giraffae woodland	3
Terminalia-Combretum scrub	3
Riparian woodland	2
Acacia-Bauhinia scrub	2
Vlei grassland	2
Cataphractus sp. scrub fringe of pan	1
Fallowed agricultural lands	1
	74

Of a sample of 74 records of the habitat in which specimens were taken 38 were taken in grassland, of these 30 on the grassland round pans, six on floodplain grassland and two in vleis.

There must be some bias here as a species such as the blackbacked jackal is the more easily picked up in dazzling lights at night in open areas. On the other hand, their secretive habits make them more difficult to collect under such conditions. There certainly seems a very clear habitat preference for open areas, more especially when it is noted that the remainder of the series were all taken in scrub, woodland and one in a fallowed agricultural land, the scrub and woodland in Botswana both being relatively open associations.

The above habitats comprise most of the associations found in the territory with the exception of the *Baikiaea* woodland of the extreme north-east and parts of the north-west. These records do not include the rocky hilly parts of the eastern sector from the Tati Concession south to Lobatse with its valley cultivation and relatively densely settled areas from which at the moment no material is available (the Debeeti record is from the eastern extension of Kalahari conditions). The species has, nevertheless, been seen in a number of localities in this sector and is frequently heard at night (*see* distribution map—visual records) and it is certainly present widely, even on the fringe of settled areas. This is confirmed by its presence in adjacent ecologically identical parts of Rhodesia and the western Transvaal.

Both 'open grassland round pans' and 'floodplain grassland' usually has scrub of some type within easy reach of a wide-ranging species such as this which will often, under stress in open country, make for the scrub not only for the cover which this provides, but also because there are normally more ant-bear and other holes in the softer, sandier ground associated with it, which the blackbacked jackal can use as refuges.

Seven records are from mopane woodland or riparian woodland. As far as the former is concerned, of the five records three were from mopane fringing the Thamalakane River (Maun) and two fringing the Okavango delta (Gomoti River). In these cases the woodland was open to night-hunting on established spoors. Other large areas of mopane woodland are not thus opened and there is probably a bias against obtaining material in this association. The same remarks apply to riparian woodland.

The information available indicates a wide habitat tolerance.

Habits

In relatively undisturbed areas (Bosobogolo Pan, Mabuasehube Pan and other pans in the south-western Kalahari), the species is diurnal as well as nocturnal. In settled areas where the disturbance factor is high (Maun and settlements on the western Okavango, Tsau, Nokaneng, Gomare and in the eastern sector) they are almost entirely nocturnal, moving from just before sundown until early light in the morning. In the south-west Kalahari they are frequently seen feeding on pans or in the scrub during daylight hours (cf. *Otocyon megalotis*) usually singly but often in pairs (TNL 4326/4327 45 miles south-west of Francistown; BP 93 Sepopa), and occasionally in larger numbers, these perhaps family parties (four, BP 135/136 Gomare; three, BP 2018 Lebung). Larger aggregations are found at baits (Bosobogola Pan, eight) or are attracted to spoors where baits have been dragged.

They have an association with lions and will follow on prides apparently to participate in kills when the larger predators have completed their meal. Such an association was witnessed at a pan south of Nunga where the lions were also accompanied by spotted hyaenas, *Crocuta crocuta*.

While in areas where surface water is available the black-backed jackal will drink regularly, there are areas in Botswana, e.g. the south-west and central Kalahari where surface water will not be available for periods of up to nine months or longer, yet where they are quite common. They will, where it is available (Odiakwe, Lebung), use the spillage from watering-points at wells or drink from the watering-troughs themselves.

Food

Number of occurrences of food items in a sample of 59 stomachs:

Food Item		*No. of Occurrences*	*Total No. of Occurrences*
Insecta	Orthoptera	16	
	Isoptera	9	
	Coleoptera	15	
	Dermaptera	1	
	Lepidoptera	2	
	Odonata	1	
	Undet.	3	47
Mammalia	Lorisidae	1	
	Leporidae	3	
	Pedetidae	1	
	Muridae	21	26
Carrion			25
Green grass			14
Wild fruits	*Grewia* spp.	9	
	Xixyphus mucronata	1	
	Melon pips and pulp	1	
	Undet.	1	12
Solifugae			10
Scorpiones			6
Reptilia			5
Aves			2
Myriapoda			2
Dry grass			5
Ball own hair			1

Collectively insects constituted the commonest item of food, occurring in 47 of the 59 stomachs examined. These were represented by six families of which Orthoptera were the commonest, followed by Coleoptera and Isoptera. In four stomachs, BP 135 and 1665; HJH 1186 and 1285 Orthoptera constituted 90-100% of the contents. In the majority of cases in which

Coleoptera occurred they constituted only a trace, or at most a small percentage of the contents although a much higher percentage occurred in BP 344 from Nxai Pan, 25%, and TNL 2178 from Mamuno, 80%.

The only Isoptera so far identified were *Macrotermes bellicosus* in RMD 1289 from Tsau and TNL 1622 from Chukutsa and *Hodotermes mossambicus* in BP 344 and BP 348 from Nxai Pan.

The second commonest food item consisted of small mammals and Murida . In the case of the small mammals, while there is no evidence to prove this, it is assumed that the jackal had killed them itself. The largest of these was the remains of a spring hare, *Pedetes capensis*, which constituted 20% of the content of RMD 1289 from Tsau. In three cases *Lepus* sp. had been eaten, in one case a night-ape, *Galago senegalensis*, an unusual item of food. In the remaining 21 cases Muridae were involved including, in six stomachs, *Tatera* spp.; in three *Mus* sp.; in two *Praomys natalensis* and in one each *Rhabdomys pumilio*, *Steatomys pratensis*, and *Otomys angoniensis*. Of these it is interesting to note that the *O. angoniensis* and particularly the *R. pumilio* are predominantly diurnal species.

Carrion ranked as the third commonest item of food, occurring in 25 stomachs. In six cases it consisted of bait, in the other 19 cases included impala, *Aepyceros melampus;* wildebeest, *Connochaetes taurinus;* springbok, *Antidorcas marsupialis;* reedbuck, *Redunca arundinum*, and domestic stock, including goats and cattle. In TNL 2178 10% of the content consisted of bat-eared fox, *Otocyon megalotis*, hair and bones. It is possible that the jackal may have killed this but in the absence of evidence it is included in this category.

Where baits were laid for predators it was noticeable that the blackbacked jackal would frequently show a preference for the stomach contents of Bovids such as wildebeest, springbok, impala, etc., eating this and leaving parts of the chopped up intestines which were lying alongside it. BP 575, BP 576 were taken at Kanyu on a line of chopped intestines and stomach, their stomach contents consisting only of the stomach content of the Bovid laid as bait, in this case a wildebeest, *Connochaetes taurinus*.

Green grass occurred in 14 out of the 59 contents. In seven of these cases the stomach containing the green grass was empty or nearly empty. In domestic dogs and cats it is commonly noticeable that green grass will be taken when the stomach is empty. Dry grass, as opposed to the green grass mentioned above, occurred along with other detritus in five contents but here the indications are that it is ingested fortuitously or along with Isoptera or other Insecta.

Wild fruits were found in 12 stomachs and consisted principally of *Grewia* spp. in nine, with single records of *Zizyphus mucronata* and melon pulp and seed, probably Tsamma, *Citrellus lanatus*.

Solifugae were found in ten stomachs in two cases identifiable as *Solpuga monteiroi*, and Scorpiones in six, in two cases identifiable as *Opisthopthalamus wahlbergi*. Solifugae constituted 95% of the stomach content of BP 577 from Makgadikgadi and in two cases, BP 1739, BP 1740 from Khumaga, Scorpiones the bulk of the content.

Reptilia were found in five stomachs and included the following snakes and lizards:

Snakes:
- Peters' worm snake, *Leptotyphlops scutifrons*
- Sundeval's shovel-snouted snake, *Prosymna sundevalli*
- Quill-snouted snake, *Xenocalamus bicolor*
- Puff-add r, *Bitis arietans*

Lizards:
- Spiny agama, *Agama hispida*

The unidentifiable remains of birds were found in two stomachs and Myriapoda, represented by the centipede, *Scolopendra morsitans*, in another two.

Miscellaneous items included dry grass in five, probably ingested with Isoptera or other insects, a piece of leather thong in one and a ball of its own hair in another.

Breeding

Distribution of females collected through the months of the year

J	F	M	A	M	J	J	A	S	O	N	D
5	8	2	3	8	3	5	4	1	1	1	5

None of the females collected by the survey were pregnant or lactating in spite of the fact that the sample shows a cover of every month of the year.

The series was taken over the four years 1964-68, the break of the four-year drought ending with the copious rains of October-February 1965. It is reasonable to suppose that the latter years of a stress period of this type would tend to have an effect on the breeding potential of the species. However, as will be seen by the following table there is a more adequate sample available from the years following this 1966-68 period than from 1964-65:

Year	1964	1965	1966	1967	1968
Females examined ..	7	9	5	15	10

Shortridge (1934) quotes Wilhelm stating that for South West Africa the young are born about November or December and it is noteworthy that only a single female was taken in each of the months September, October, November, all in 1968, which may well be, on the evidence of the juvenile records given, the months in which gravid females might be expected to be found.

The only evidence of the time of dropping the young is a series of eight juveniles taken during December to April as follows:

No.	Date Collected	Weight
BP 2065	27.12.67	8 lb. 12 oz.
RMD 1111	19.2.65	7 lb. 8 oz.
HJH 128	1.3.65	8 lb. 15 oz.
P 181 M	20.4.68	8 lb. 4 oz.
TNL 2250	1.2.67	9 lb.
TNL 2330	10.2.67	7 lb. 6 oz.
BP 1825	25.2.67	10 lb. 1 oz.
BP 1826	25.2.67	8 lb. 12 oz.

This seems to indicate that the young are born during the early months of the warmer, wetter weather from about September onwards.

Sizes and Weights

Measurements of adult *C. mesomelas* from Botswana irrespective of sex are as follows:

TL	$\bar{X}$ = 1005;	N = 47;	Obs. range 910-1120
T	$\bar{X}$ = 317;	N = 46;	„ „ 281- 360
Hf c/u	$\bar{X}$ = 163;	N = 49;	„ „ 140- 171
E	$\bar{X}$ = 105;	N = 46;	„ „ 94- 115
Weight	$\bar{X}$ = 15 lb. 14 oz.;	N = 40;	„ „ 12 lb.-20 lb.

From the information available on the range of males and females of *C. mesomelas*, females appear to be slightly smaller in every respect and lighter in weight than males:

MALES

TL	$\bar{X}$ = 1034;	N = 22;	Obs. range 945-1120
T	$\bar{X}$ = 321;	N = 24;	„ „ 281- 360
Hf c/u	$\bar{X}$ = 167;	N = 25;	„ „ 154- 179
E	$\bar{X}$ = 107;	N = 25;	„ „ 98- 118
Weight	$\bar{X}$ = 16 lb. 11 oz.	N = 19;	„ „ 13 lb. 8 oz. -20 lb.

FEMALES

TL	$\bar{X}$ = 987;	N = 23;	Obs. range 910-1050
T	$\bar{X}$ = 311;	N = 24;	„ „ 293- 360
Hf c/u	$\bar{X}$ = 160;	N = 26;	„ „ 140- 180
E	$\bar{X}$ = 102;	N = 26;	„ „ 94- 115
Weight	$\bar{X}$ = 15 lb.;	N = 20;	„ „ 12 lb.-20 lb.

Family MUSTELIDAE

Modified after Coetzee (1967).

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, not a thick-set fur; 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 mostly over 115 mm in adults (fig. 17 (*a*)) . . *Aonyx*
   Feet clearly webbed, with claws; mastoid process weak; skull normally less than 110 mm (fig. 17 (*b*)) . . . . . *Lutra*
3. A broad white or off-white band on the upperparts contrasting with the black flanks; ears atrophied; mastoid process prominent, greatest skull length over 100 mm; four upper and lower cheek-teeth . . . . . *Mellivora*
   Upperparts 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 . 4
4. No white markings below eye, white on forehead continuous with that of the 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*

Genus AONYX Lesson, 1827

Aonyx capensis

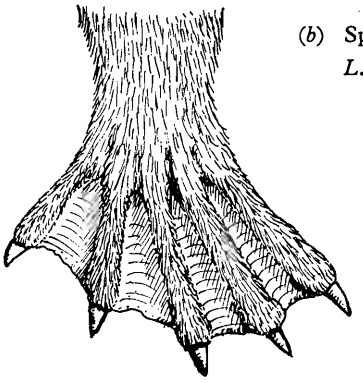
leNyibi Clawless Otter

A. c. capensis (Schinz, 1821)

(Foot, fig. 17 (*a*).)

Fig. 17 Feet of Otters

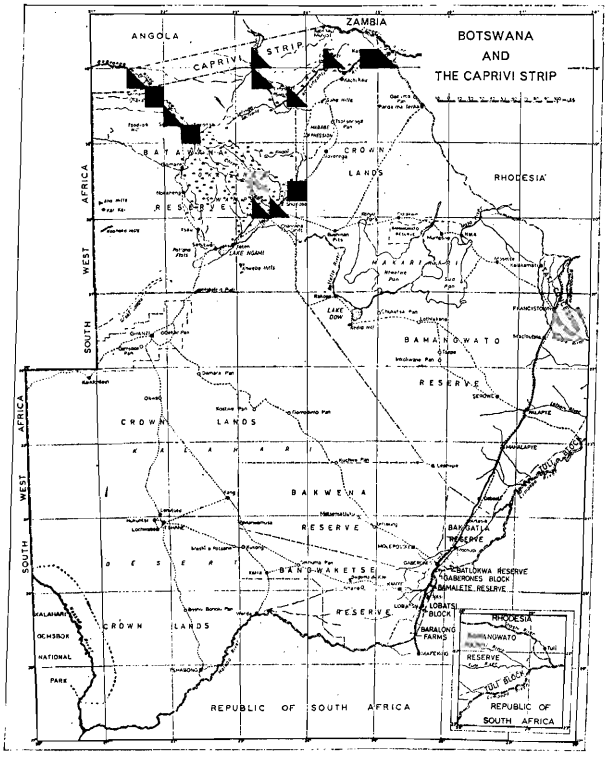
(*a*) Clawless Otter, *A. capensis*



(*b*) Spotted-necked Otter, *L. maculicollis*

Distribution

Occurs in the Okavango River and in the northern and eastern parts of its delta; in the west not further south than where the Okavango River broadens out into the swamp just south of Sepopa; in the east south to the Thamalakane River in the vicinity of Maun where they are quite common. Although there are no records between these two areas of known occurrence, they are reported to be present on either side of Chiefs Island in the intermediate area (Wilmot, *pers. comm.*). Common in the Chobe River throughout its length in Botswana and where it crosses the Caprivi Strip to the Zambian border.



Habitat

Aquatic, although they wander widely on dry land in the vicinity of rivers or on swamp islands, or long distances into otherwise dry country up wet vleis. Rests in thick vegetation adjacent to their aquatic habitat or in lairs in the banks of rivers, opening under water (Glendale, Rhodesia). Whether these are excavated by the otters themselves or are naturally formed is not known. In the case of the Glendale record there was a well-defined tunnel leading down from the cavity, this exposed due to drought conditions. In captivity they show no signs of digging nor are the feet adapted for this purpose.

Habits

Nocturnal and diurnal. At Shakawe a party of four were seen regularly, mornings and afternoons, near

the W.N.L.A. camp in the open waters of the Okavango River on the fringe of the reed-beds and the low grassy banks. Also seen at night in the water in this area. At Maun two regularly moved downriver in the early morning *c.* 8 a.m. returning in the evening *c.* 5.30 p.m. On the Chobe River frequently seen during daylight hours.

In the open waters at Shakawe, Sepopa, Maun and in the Chobe River *A. capensis* was seen more frequently than *L. maculicollis*. At Linyanti *L. maculicollis* was commoner in the shallow water among the floating aquatic vegetation and sedge-beds on the edge of the swamp than *A. capensis*, which was only seen in the open stretches of water within the swamp. On the other hand, the spoor of *A. capensis* indicated that it moved widely on the low islands on the fringes of the rivers and in the swamp.

Most sightings are of two, although at Shakawe four were seen regularly together. This latter party regularly played on a low grassy bank of the river leaping or sliding into the water, one after another, returning to repeat the performance for a quarter of an hour at a time. Local reports affirm that otters had occupied this paticular area for a period of some years (Boast, *pers. comm.*).

Very inquisitive and will approach boats, the head only showing, repeatedly diving and reappearing, although shy when out of the water.

Very playful, utilizing floating objects dragging them below surface and releasing them to float, or stones which, carried to the surface, are dropped to be retrieved from the bottom. In captivity tiny objects would be played with in this manner, the dexterity of the forefingers being particularly noticeable. In captivity fish and other food is eaten on the edge of the water with much washing and dunking.

Food

A pair were observed feeding, between Shakawe and Mohembo, on bream, *Tilapia* sp., which were caught and taken to a low grassy bank to be eaten. They would play with the fish in the water, coming up to the surface and with a jerk of the head, throwing it some distance, then submerging to reappear with it some distance away. To some extent at least this 'play' must have the effect of descaling. Scats, presumably of this species, contained, in addition to fish-scales, the remains of crabs, and insect remains. Unfortunately no stomachs are available for examination from Botswana but elsewhere the diet is stated to include frogs, aquatic birds, eggs, mussels and rodents. In three stomachs from Rhodesia two contained fish, in one case two trout (Inyanga), the third the remains of crabs.

When eating on dry land the food is frequently dunked in the water before eating. A female in captivity would carry its food to the edge of the pond lying on the bank head over the water and the food manipulated under water with the hands then carried to the mouth. After feeding this female would wash her hands, dunk her head and usually swim around for a few minutes before returning to the dish for further food.

Breeding

There are no data on breeding from Botswana but in Rhodesia the young are dropped about April (Salisbury). Ansell (1960) states that in Zambia (Livingstone) it was estimated from juveniles that they were born about July or August.

Sizes and Weights

None available from Botswana.

Genus LUTRA Brisson, 1762

Lutra maculicollis

leNyibi Spottednecked Otter

L. m. chobiensis Roberts, 1932

(Foo˙, fig. 17 (*b*).)

Distribution

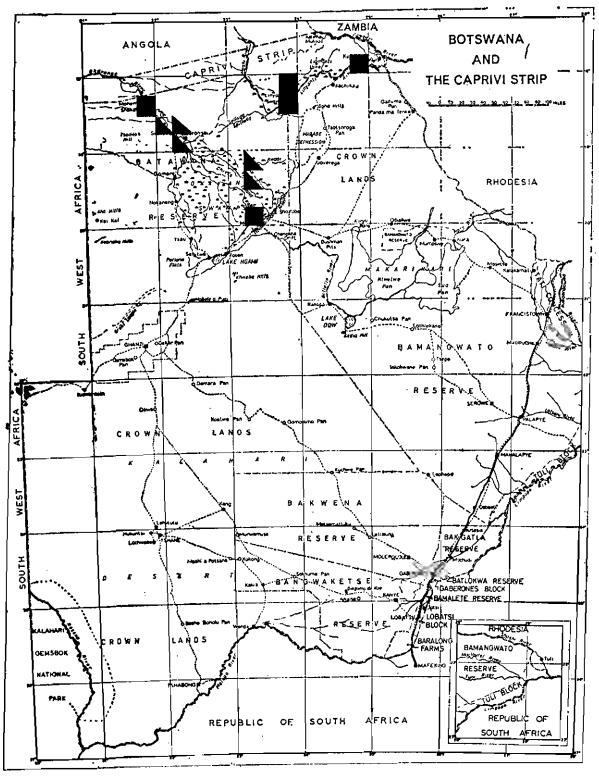
Only known from the Okavango River and its delta and the Chobe River with its associated swamp. In the Okavango delta recorded as far south as Maun in the east, Gomare in the west. Shortridge (1934) restricts their distribution to these areas.

Habitat

Confined to the larger areas of permanent water either in the form of rivers or swamp. Although predominantly aquatic will move onto dry land or damp areas but not to the same extent as the clawless otter, *Aonyx capensis*, being more exclusively aquatic.

Habits

Almost exclusively aquatic. Observations at Linyanti, where they were frequently seen in the early morning and late evening moving around among aquatic grasses



and sedges in shallow water on the edge of the swamp, suggest that they are predominantly nocturnal, markedly more so than the clawless otter, *A. capensis*. At the edge of the swamp at Linyanti distinct runs were formed along which they could move unobserved. If suspicious they would sit up on their hind-legs, the long neck extended, when the spotted neck would show up well. Very shy and difficult to approach. In other parts of the area found in open water (Chobe and Okavango rivers) or in open water in the swamp (Seronga area). Reported as plentiful as the clawless otter in the Seronga area although most skins in the possession of the indigenous people were clawless; suggesting that it may be, because of its shyer nature, more difficult to obtain. Normally solitary.

Food

No records.

Breeding

No records. Ansell (1960) records a litter of three from Livingstone, Zambia, from the Zambezi River, born in November or December.

Sizes and Weights

The only data available are from an immature female taken at Shakawe in June:
TL 965; T 390; Hf c/u 98; E 15; Weight 6 lb. 8 oz.

Genus MELLIVORA Starr, 1780

Mellivora capensis

Matshwane Honey Badger, Ratel

M. capensis (Schreber, 1776)

Taxonomic Notes

There is too great a variation in the colour and size of the light coloured band on the upperparts (Rhodesia, Zambia) for this to be used as a character to separate *M. c. capensis* and *M. c. vernayi*. Roberts states that the skull of *M. c. vernayi* is broader relative to its length than in *M. c. capensis* but at the moment this is based on too few specimens and until further material is available no subspecies are recognized.

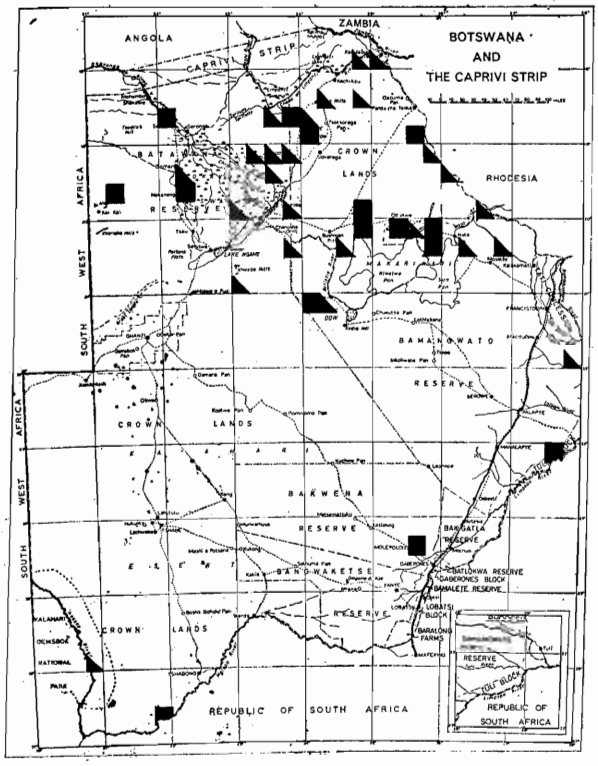
Distribution

The species has a wide distribution throughout. In the northern and eastern parts they are not uncommon and appear to be much more plentiful than in the more arid central and south-western areas from which they are very sparsely represented in the records. The material from the extreme south-west (mean annual rainfall 200 mm) demonstrates that they can utilize even the most arid areas found in the territory and it seems that their sparseness in the central and western parts of the territory has led to their being overlooked. Silberbauer (1965) states that they were scarce in the Central Kalahari Game Reserve, Shortridge (1934) that they are plentiful throughout the whole of South West Africa.

Within their range in the north there are areas where they appear to be quite plentiful, e.g. Rakops and the Savuti, where they were seen on several occasions; Nxai Pan and Mampswe.

Habitat

The records suggest that they have a wide habitat tolerance as they occur in rocky kopjes of the east, the scrub sandveld of the south-west and in the well-



watered areas of the Okavango delta. They have been taken in open grassland with scrub, open *Acacia* woodland, *Terminalia-Combretum* woodland and the riverine woodland and floodplain grassland of the western Okavango, on the fringes of swamp. Both Shortridge (1934) and Ansell (1960) stress their catholic choice of habitat.

Habits

Terrestrial, usually occurring singly or more frequently in pairs, predominantly nocturnal but seen during daylight hours at Savuti 10.30 a.m.; Gweta 9.30 a.m.; Nxai Pan 5 p.m. and Madinare 5 p.m. The survey has no records of the species climbing, as recorded by Ansell (1960) and Shortridge (1934, quoting FitzSimons). At Savuti the characteristic spoor indicated that they were using a disused ant-bear, *Orycteropus afer*, burrow and at Madinare there was similar evidence that they were using the shelter of a crevice in rocks on a kopje.

The aggressive nature of the species is well known and there are many records in literature to confirm this. A pair contacted by the roadside at Savuti was followed. On several occasions, without provocation, the male turned and advanced aggressively at a trot growling and showing its teeth, the lips curled back, the head held high. The attack was on several occasions pressed home with such ferocity as required evasive action. At Rakops a wounded individual showed similar aggressive tendencies.

The species is very powerful. At Nxai Pan a steel 'live trap' was destroyed, an individual entering the door at one end and tearing the other end to pieces to escape, hairs left on the wires confirming the species involved. It appeared that the animal not only tore its way out but returned to further mangle the trap with its teeth. It can more than hold its own with several dogs, the thick loosely-attached skin being almost impossible to penetrate or tear. They are difficult to kill with a 12-bore shotgun and AAA pellets, a specimen taken near Rakops on dissection showed that, although taken well within range, many of the pellets were held in the skin.

They are well known for their predations on poultry and ordinary wire-netting is torn to pieces to effect entry. They have been known to tear their way through heavy pig-netting.

Ansell (1960) records the species attacking a newborn kudu, *Tragelaphus strepsiceros*, and a suspected case of attack on an adult; Stevenson Hamilton (1932) the killing of a buffalo, *Syncerus cafer*, bull.

The species is a prolific digger, the diggings easily recognized by the marks of the long front claws. An individual feeding on Nxai Pan, kept under observation, was seen to proceed in a slow walk with a side to side rolling motion, nose to the ground, pausing every now and then to excavate in the hard pan surface. The eyesight appears to be poor as this individual passed the observer within 10-15 metres, continuing in its search, although there was no cover of any sort and it was only when it eventually moved down wind that it suddenly took fright and moved off at a fast run. This individual was digging out large 'Baboon' spiders from the pan, the excavations being 15-25 cm deep which, in spite of the hardness of the surface, appeared an effortless operation. In one place a slab of calcareous rock 30 cm square and 13 cm thick was moved aside to get at the prey.

They appear to make use of roads and have been killed on them by vehicles at night. BP 765 was taken in this manner at Odiakwe.

Wounded individuals smell strongly, the scent being heavy and evil-smelling, but lacking the decidedly unpleasant nature of the polecat, *Ictonyx striatus*.

They growl deeply and utter a high-pitched screaming bark when suddenly disturbed. They also grunt loudly especially when a pair are moving together. They flourish in captivity, under which circumstances

they are remarkably quiet and do not normally use the anal glands.

They can, under certain circumstances, climb trees, although only when specifically actuated to do so, as for example in robbing beehives. Friedmann (1955) records reliable evidence for the tree-climbing propensities for this purpose. Friedmann, after extensive research, acknowledges the widespread nature in African legend of the association of this species with the honeyguide, *Indicator indicator*, in guiding them to beehives and came to the conclusion that there was good evidence that this took place.

The species seems to have a considerable life span, there being several records of their living in zoological gardens for over 23 years (Crandall, 1964).

Food

Only six stomachs were available for examination, the various categories of food and the number of times they occurred in the sample being as follows:

Content	*No. of Occurrences*	*Remarks*
Scorpiones	4	See text
Arachnida	4	,, ,,
Muridae	3	,, ,,
Orthoptera	2	Including *Maxentius* sp.
Reptilia	2	See text
Aves	1	1 small bird indet.
Myriapoda	1	*Scolopendra morsitans*

Scorpiones occurred in the four stomachs constituting 90%, 90%, 60% and 10% of the total content. In three out of the four *Opisthopthalmus betchuanicus* were identified, in the fourth the species was not determined.

In the four stomachs containing Arachnida these were in every case large 'Baboon' spiders which hunt at night, or immediately after rain and live in 'silk'-lined holes in the ground. In BP 341 from Nxai Pan these constituted 100% of the content, in the three others in lesser proportions.

Three species of Muridae *Tatera brantsi*, *Praomys natalensis* and *Gerbillurus paeba* were identified and in the two stomachs containing Reptilia the spotted sandveld lizard, *Nucras intertexta*.

It is noticeable that with the exception of the Aves all the other items are the remains of species which burrow, including the Orthoptera, *Maxentius* sp., but whether they were dug up or caught on the surface of the ground cannot be ascertained. In the case of BP 341 from Nxai Pan it was feeding in the late afternoon when the spiders, which filled its stomach, had not yet emerged from their holes, and it may be that most of the food is dug up rather than being taken on the ground surface.

In Rhodesia there is evidence of its preying on beehives, probably more for the larvae in the combs than the honey itself, but no evidence of this appears in the sample available.

Breeding

The female from Boshuboholo Pan, taken in November, was lactating, the uterus enlarged and muscular, indicating that she had recently given birth to a litter. Ansell (1960) records newly-born young in December in Zambia. Further information on the breeding of this species is required.

Sizes and Weights

The only data available are as follows:

MALES

		TL	*T*	*Hf c/u*	*Weight*
BP 341	Nxai Pan	920	200	128	23 lb. 4 oz.
BP 501	Rakops	902	228	129	17 lb. 9 oz.
BP 506	,,	915	230	138	22 lb. 6 oz.
BP 765	Odiakwe	845	143	121	18 lb. 4 oz.
TNL 2904	Sepopa	630	150	100	8 lb.

FEMALE

TNL 4878	Boshuboholo Pan	880	225	119	17 lb.

Genus POECILOGALE Thomas, 1883

Poecilogale albinucha

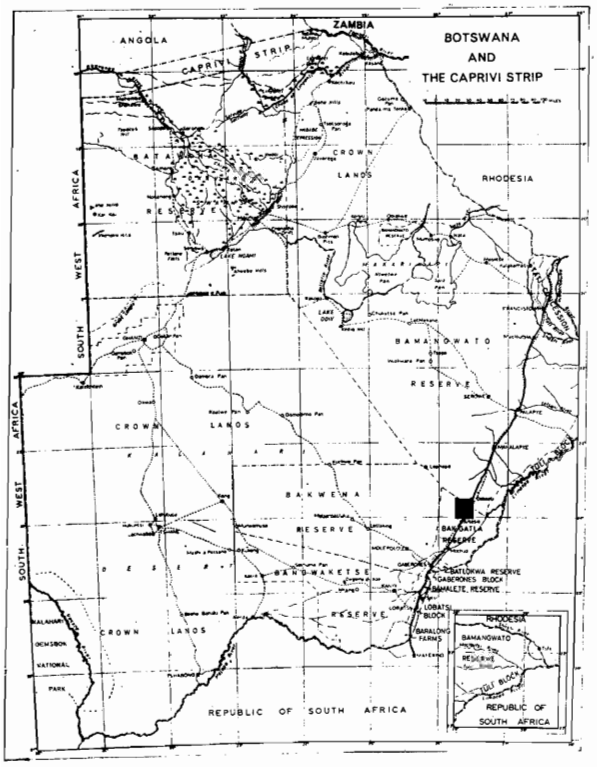
African Striped Weasel

P. a. bechuanae Roberts, 1931

Distribution

Only two specimens are recorded, a non-gravid female from Debeeti taken in July 1965 and the specimen listed by Shortridge (1934) from the junction of the Nosop and Molopo rivers. There are no records from South West Africa.

The type locality of *P. a. bechuanae* Roberts, Vryburg, Cape Province, is about 90 miles south of the



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Botswana border in the south-east and they are recorded from the Transvaal. They might, therefore, be expected to occur in other parts of southern and eastern Botswana.

In Rhodesia all records to date are from Mashonaland and the eastern districts. In the north-east they may occur in the eastern Caprivi Strip as Shortridge (1934) lists three specimens from Sesheke on the Zambezi River, Zambia, and Ansell (1960) states that they occur throughout Zambia.

Habitat

The Debeeti specimen was taken on Kalahari sand with scattered scrub and a thin grass cover, near the Debeeti kopjes.

Habits

Terrestrial, fossorial, predominantly nocturnal, but to some extent diurnal as well. The Debeeti specimen was caught by hand during the day and in Rhodesia they have been taken during daylight hours (Mtoroshanga and Highlands).

In captivity a male usually remained in the sleeping-box during the day only emerging about 6.30 p.m., then was active all night.

This male was reluctant to leave the sleeping-box during daylight hours, but could, with difficulty, be induced to do so by scratching on the side of the cage when it would, very reluctantly uncurl, and with the nose protruding from the entrance hole, would test the air, yawning repeatedly, and, with much stretching and further yawning, eventually emerge. In particularly cold weather sometimes not emerging from the sleeping-box at all, or only for short periods.

When walking slowly the body is held low on the ground, the tail horizontal. In running the back is hunched, progressing with a bobbing motion, tail horizontal.

In catching live prey such as mice or molerats the captive male would bite at the back of the head latching on tight and rolling its body round the victim, maintaining this tight hold until the prey was dead. It then invariably carried it back to the sleeping-box to be consumed. Food in the form of strips of meat would be carried in piece by piece until it was all stored before commencing to eat.

When the sleeping-box was padded with grass or other bedding this was invariably scratched out. Defecated and urinated in a set corner of the cage or in a corner of the sleeping-box. Slept rolled up, the tail swept over the head.

A poor climber with an uncertain hold on quite broad tree branches.

In the case of the Highlands, Rhodesia, record, two juveniles were taken during the day from a party of four, an adult and three, processioning across an open lawn, the adult leading.

Although the eyes shine weakly in a dazzling light at night, they are likely to be overlooked owing to their short stature, the highest part of the body a bare four inches from the ground and, as the head is held low in walking slowly, the reflections from the eyes could be obscured even by the barest of cover.

Avid and powerful diggers, cleared the accumulation of debris dislodged by the front feet by scraping back with these feet and pushing it between the back legs then moving it with a backwards movement of the whole body until it was well clear of the digging. Larger objects such as stones, once loosened, were pushed out of the way with the nose.

Under stress the hairs of the tail were erected and, if thoroughly aroused, secreted a noxious fluid from the anal glands which had a heavy objectionable smell, not, however, so powerful or persistant as that of the striped polecat, *Ictonyx striatus*. This smell was particularly noticeable when a strange female was introduced to the male in captivity and fighting ensued.

This captive male caught alive at a weight of 215 gm lived for five years and two months thereafter. Although two young females were introduced to this male at various times, after being partially segregated from it by an open wire-mesh door for purposes of introduction, in both cases they were eventually killed by it. In both cases on first introduction the male would follow the female round the enclosure, moving close and parallel to the female with his head at the level of her shoulders, eventually suddenly grabbing her by the neck, when they had to be separated. In the case of the second female, they appeared to have settled and occupied the same sleeping-box for some three months until she was found dead, badly bitten on the neck and the back of the head.

Would freely enter remarkably small holes and was able to turn round in these, entering and emerging head first.

In captivity drank water freely.

Food

Carnivorous, in captivity taking live and dead rodents, small birds and mole-rats. Although a wide variety of insects were introduced live to the cage, including termites, grasshoppers, moths, beetles and mealworms, at times when it was known that the weasel was hungry, no interest was evinced in any of them. Would eat the yolks of hens' eggs but was unable to deal with a whole unbroken egg. Shortridge (1934) states that the food consists of small mammals up to the size of a spring hare, *Pedetes capensis*, and guinea-fowl, *Numida mitrata*. He does not state as to whether these were his own observations or based on information given to him by other people but in captivity an adult male had difficulty in dealing with a medium-sized *Rattus rattus* and it seems most unlikely that they could kill either a spring hare or a guinea-fowl.

No stomach contents were available for examination.

Breeding

No data. Shortridge (1934) records a female from Sesheke taken in October, with two foetuses.

Sizes and Weights

		TL	*T*	*Hf c/u*	*E*	*Weight*
BP 1213	Female	439	185	32	18	227·0 g

Genus ICTONYX Kaup, 1835

Ictonyx striatus

Nakedi Striped Polecat

I. striatus (Perry, 1810)

Taxonomic Notes

Roberts (1951) lists four species of *Ictonyx* from the South African subregion, viz. *striatus*, *limpopoensis*, *orangiae* and *kalaharicus*, with altogether 12 subspecies.

Ellerman *et al.* (1953) relegate the four species to *I. striatus*, sinking the subspecies *nigricaucus* with *ghansiensis* and listing the other 11 subspecies as given by Roberts.

Of the 11 subspecies three, *ghansiensis* (Gemsbok Pan), *kalaharicus* (Kuchwe Pan) and *giganteus* (Shorobe), have type localities in Botswana, while two others, *limpopoensis* (Rustenburg, Transvaal) and *shortridgei* (Maschi R., Caprivi Strip) might well occur in the territory as the localities from which they were originally taken are adjacent to the Botswana border.

Ellerman *et al.* (1953), in discussing the species *I. kalaharicus* Roberts, as opposed to *I. striatus*, regards the differences between the two, which chiefly consist of a difference in the colour of the tail, as negligible. Apart from the colour of the tail, Roberts thought that his species *orangiae* also differed from *striatus* in the size of the skull but, as Ellerman *et al.* pointed out, his measurements showed that this was not a constant factor. They came to the conclusion that all Roberts' forms were conspecific with *I. striatus*.

The external characters of Roberts' subspecies may be summarized as follows:

ghansiensis Black dorsal stripes much reduced in width.
White tailed.

kalaharicus White dorsal stripes so broad as to absorb the black.
Terminal half of the tail black.

giganteus White dorsal stripes so broad as to absorb the black.
Terminal half of the tail black.

The breadth and extent of the white or the black stripes on the back depend greatly on the length of the hair, which may be related to the state of the moult or some individual factor. The extremes are demonstrated in BP 460, taken at Chukutsa Pan, in which the hair is quite short, giving the impression of narrow black and white stripes, while in BP 1742 from Khumaga the hair is very long, giving the impression of

broad stripes. Within each of the series available from Botswana there is some variation in these characters. In an adult from Tamafupi the stripes are broad whereas in a juvenile they are narrow. In two adult males from Gaborone, TNL 989, 980, in the former the stripes are broad, in the latter distinctly narrower.

As far as the amount of white on the tails is concerned the variation within a series from the same locality is even more pronounced. In a series of five from Debeeti two have black tails, two white tails and one a black tail with a white tip. Similarly, in a series from Gaborone three have white tails and two black tails with a trace of white in the middle. It is noticeable in Plates II and III of Roberts' (1935) paper that in the two specimens from Gemsbok Pan named by him, *I. orangiae ghansiensis* and *I. kalahari-cus nigricaudus*, in the former the tail is predominantly white, having a white base and broad white tip, while in the latter only the base is white, the remainder black.

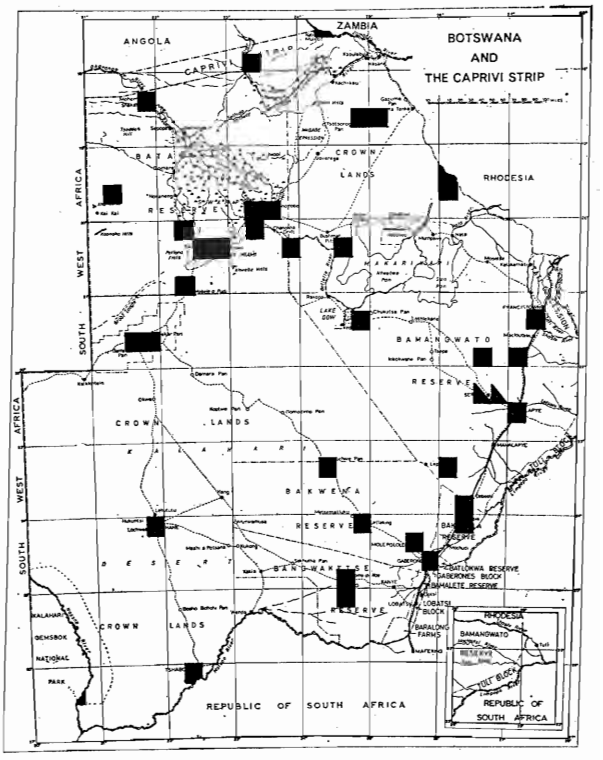
Again in the two specimens illustrated, in one the central dorsal black stripe continues through to the forehead, in the other it is broken by the broad white band across the top of the head. This variation is found in one out of three specimens from Tamafupi and one out of five from Debeeti. Even as subspecific characters the width of the stripes and the colour of the tail do not, therefore, appear to be valid. Similarly there is wide variation in the size of the white spot under the ear and the white spot on the forehead. In the latter it is very tiny in TNL 989 and very large in TNL 995B, both from Gaborone. The spot under the ear can, in the extreme, vary from side to side. In a specimen in the National Museum Collection, 0 269 from Beatrice, Rhodesia, it is very much larger on one side than the other. In the Botswana series its size is fairly constant, except that in the series from Debeeti, in BP 1279 it is very small, while in BP 1163 it is much larger.

The particular feature of Roberts' *I. k. giganteus* is its 'much larger size'. Comparison of the type of Roberts' *I. k. giganteus* with the larger specimens from various Botswana localities shows that it can hardly be considered 'very much larger' and there are small series of other specimens from each of these Botswana localities which are adult yet barely smaller:

	TL	*T*	*Hf c/u*	*E*	*Greatest Length Skull*	*Brain-case Width*
I. k. giganteus	670	300	65	29	72·2	34
Ghanzi 1401	610	270	69	32	72·0	33
Debeeti 1276	665	292	65	30	71·7	30
Tamafupi 207	559	204	58	32	71·0	33

on this basis it can hardly be considered as 'very much larger'.

Pending a revision of the subspecies none are recognized.



Distribution

Widely distributed throughout, although there are no records from the south-western areas along the South West Africa border from 22° S. south to the Kalahari Gemsbok National Park. As Shortridge (1934) states that the species occurs throughout South West Africa and, as they occur in ecologically similar conditions further east, they may simply have been overlooked in this area. Silberbauer (1965) states that they occur 'all over the Reserve (The Central Kalahari Game Reserve)' but there are no material records from this area.

Habitat

The species has a wide habitat tolerance, occurring in the well-watered areas of the Okavango delta, the riverine woodland of the Botletle River, as well as in the driest parts of the Kalahari. They have been taken in the broken hilly country of the eastern sector, on floodplain, grassland, open grassland, *Terminalia-Combretum* and *Acacia* scrub. As examples of the

extremes of their habitat tolerance Coetzee (1969) records them from sand-dunes and coastal hummocks of the Namib Desert, South West Africa, while on the other hand they are also found in the high rainfall areas (100-150 cm) of the eastern districts of Rhodesia.

They occasionally take up residence in close association with human habitations, a pair taking over a hole in a wall within a few yards of a house (Salisbury) and under a garage (Nyamandhlovu). At Tamafupi a pair were regularly seen in the vicinity of the permanent game camp.

Habits

Terrestrial and almost entirely nocturnal. Although Roberts (1951) and other authorities state that they have been seen during daylight hours all the Botswana records were made after dark, the indications being that they are rather late movers. At Lake Ngami, although the area was searched nightly with dazzling lights over a 14-day period they were never seen before 11.30 p.m. but thereafter were observed on several occasions up till 1 a.m. The Chukutsa Pan specimen was taken at 11.30 p.m., Tsau 10 p.m., Tamafupi 11.45 p.m., Tshane 10.30 p.m. They appear to make use of tracks and roads for moving around for they are frequently found run over. Under these circumstances they are prone to take up a defensive attitude instead of moving off, which probably increases their chances of being killed. The Tshane specimen was taken in this manner.

During the day they lie up in holes in the ground or in crevices in rocks. TNL 939 was taken in a hollow log.

In moving undisturbed the tail trails behind the body in a horizontal position. When disturbed they take up a defensive attitude, the tail curled forward over the back, the hair on the body and tail erected, the head tucked in, presenting their rear end, high on the back legs, towards the disturbance. In this position they can eject the evil-smelling secretion from the anal glands for a considerable distance.

When live-trapped or aroused they utter a high-pitched metallic scream which is very unpleasant to the ear.

Food

Unfortunately the species masticates its food very thoroughly making the identification of material difficult. In the case of the reptiles, however, the bodies get chopped into small sections and identification is normally possible.

Out of the sample of 19 stomachs eight contained the remains of adult Coleoptera, two Coleoptera larvae. This was the largest percentage occurrence recorded.

Reptiles occurred in five stomachs, three species being identified as follows:

Earth snake, *Tomauropeltis longicauda.*
Western worm lizard, *Zygaspis quadrifrons.*
Namaqua sand lizard, *Eremias namaquensis.*

Muridae and Orthoptera were found in four stomachs, Scorpiones and Solifugae in two stomachs and the Centipede, *Scolopendra morsitans*, in one.

Breeding

Adult females were taken during the following months:

J	F	M	A	M	J	J	A	S	O	N	D
1	–	3	–	3	1	2	1	–	–	–	–

None of these showed any signs of breeding activity. HJH 1397 from Tsau, a female taken in March, was accompanied by a young male. Two young specimens were taken at Gaborone in May and at Debeeti in July. Shortridge (1934) suggests that they may breed (in South West Africa) from January to March and while the above records of young from Tsau and Gaborone appear to confirm this, the Debeeti specimen suggests that the young may be born over a more extensive period.

Sizes and Weights

MALES

TL	$\bar{X}$ = 600;	N = 19; Obs. range	485-680
T	$\bar{X}$ = 252;	N = 19; „ „	210-295
Hf c/u	$\bar{X}$ = 63;	N = 19; „ „	56- 75
E	$\bar{X}$ = 30;	N = 19; „ „	24- 33
Weight	$\bar{X}$ = 2 lb.;	N = 14; „ „	1 lb. 8 oz.-3 lb.

FEMALES

TL	$\bar{X}$ = 598;	N = 9; Obs. range	559-605
T	$\bar{X}$ = 257;	N = 9; „ „	247-268
Hf c/u	$\bar{X}$ = 56;	N = 9; „ „	51- 60
E	$\bar{X}$ = 29;	N = 9; „ „	29- 31
Weight	$\bar{X}$ = 1 lb. 6 oz.;	N = 8; „ „	1 lb. 1 oz. 1 lb. 12 oz.

On a comparative basis Shortridge's (1934) range of specimens from South West Africa averages as follows:

MALES

TL	$\bar{X}$ = 603;	N = 14; Obs. range	548-675
T	$\bar{X}$ = 259;	N = 15; „ „	210-290
Hf c/u	$\bar{X}$ = 59;	N = 15; „ „	52- 65
E	$\bar{X}$ = 30;	N = 14; „ „	29- 34

FEMALES

TL	$\bar{X}$ = 605;	N = 4; Obs. range	550-640
T	$\bar{X}$ = 271;	N = 6; „ „	210-305
Hf c/u	$\bar{X}$ = 53;	N = 9; „ „	49- 59
E	$\bar{X}$ = 28;	N = 8; „ „	26- 31

In both these series it is interesting to note that the hindfoot is noticeably shorter in females than in males.

Family VIVERRIDAE

Key after Coetzee (1967).

1. Feet compressed, with short claws; pelage spotted; no bony tube to auditory orifice; postorbital process poorly developed in the jugal part . 2
   Feet with freer digits and fossorial claws; unspotted; with a bony tube to auditory orifice; well-developed postorbital process 3
2. Large, greatest skull length exceeding 140 mm; length hindfeet more than 120 mm . . *Viverra*
   Smaller, greatest skull length less than 110 mm; length hindfeet less than 100 mm . . *Genetta*
3. Four toes on fore and hindfeet 4
   Forefeet with functional clawed pollex; four or five toes on hindfeet 5
4. Only three premolars in each tooth-row (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*
   With 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. Hindfoot 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*
   Hindfoot with five digits, although hallux is often reduced and might 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. P^4 with posterior lobe (metacone) elongated, the triangle formed between the posterior surface of P^4 and 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 (fig. 18). . . . . *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 . . . . . *Ichneumia*
   Five upper cheek-teeth; tail length less than three-quarters the length of head and body . . 8
8. 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 9
9. Posterior (ectotympanic) portion of bulla much larger than the interior (entotympanic) part; larger, head and body length usually over 300 mm

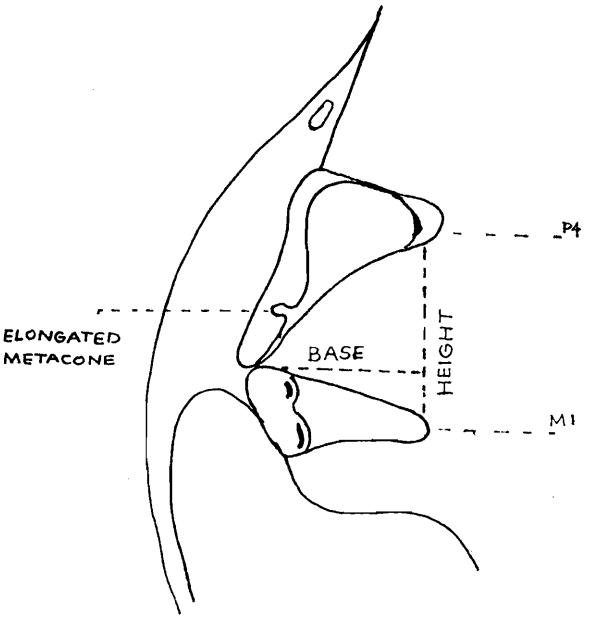


Fig. 18 P4 and M1 of *Herpestes* to indicate the base and height of the triangle formed by these teeth. After Coetzee (1967)

and condylo-incisive length over 57 mm in adults; posterior parts of back with transverse brown or dark brown bands . . . . . *Mungos*

Posterior portion of bulla projects only slightly lower 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*

Genus VIVERRA Linnaeus, 1758

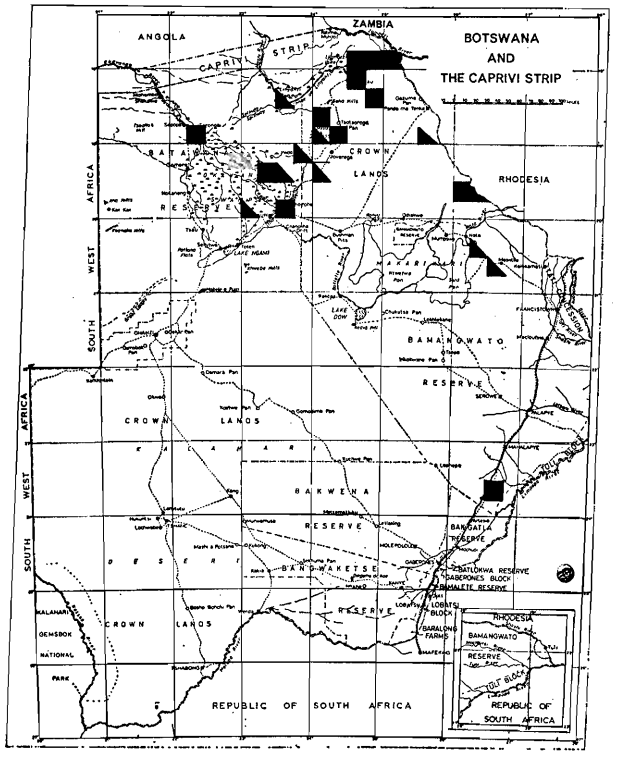
Viverra civetta

Tshipalore Civet

V. c. civetta Schreber, 1776

Distribution

Confined to the northern parts of the territory, occurring in the Okavango delta south to the Maun area, the Mababe Depression, the Savuti and the Kwikampa and in the vicinity of the Chobe River throughout its length within Botswana limits. Apparently absent in the central dry parts of the north-eastern sector, but occurring narrowly on the Rhodesian border south to 19°45′ S. and in the vicinity of Nata.



Shortridge (1934) does not record the species in South West Africa, stating that it is 'apparently confined to the eastern Caprivi (near the junction of the Chobe and Zambezi rivers)' but does not exclude the possibility of its occurrence in the Okavango Valley. Their occurrence just south of Sepopa would seem to confirm the likelihood of their being found there, more especially as they are known from southern Angola (Hill and Carter, 1941).

As they occur at Rustenburg in the western Transvaal there is the possibility that they may in time be shown to occur, at least narrowly, in the eastern sector of Botswana but there is only one record to date.

Habitat

All the Botswana records are from areas where water is available in the form of either rivers, swamp or pans, and the species appears to be confined to such areas, being absent from dry country. Most of the records are from riverine or subriverine woodland with the exception of the Nunga visual record where the specimen was seen in comparatively dry open woodland, but with permanent surface water available; and the record from south of Nata, from relatively open country near the Nata River.

The species is not common anywhere within its range in Botswana and too few specimens are available to properly review its detailed habitat requirements under Botswana conditions.

Habits

Nocturnal, terrestrial, usually found singly, sometimes two together, although all the records available are of solitary individuals.

At the Gomoti River they were seen at night on two occasions on the very edge of the swamp. Although BP 2098 was taken at the Gomoti River in riverine woodland it had obviously been feeding on the edge of the swamp as its stomach contained frogs and aquatic insects.

Normally the gait is slow, cumbersome and rather 'stealthy', but the species is capable of a fair speed when disturbed.

Food

Only three stomachs were available for examination containing the following items of food:

Food Item	*No. of Occurrences*	*Note*
Wild fruits	2	See text
Amphibia	2	„ „
Orthoptera	1	„ „
Coleoptera	1	„ „
Solifugae	1	Indet.

In two of the three stomachs wild fruits in the form of the external husks of the fruit of the palm, *Hyphaene ventricosa* and *Diospiros mespiliformis*, constituted over 90% of the contents.

Amphibia we e represented by the toads, *Bufo* sp. in one, and *Bufo carens* in the other.

Orthoptera were represented by Acridiidae; and Coleoptera by Dytiscidae larvae.

Breeding

One gravid female was taken at Kasane on the 25th January, 1965, with four foetuses, three males and one female. Details of these foetuses, which were well-haired and appeared near full-term, were as follows:

	♂	♂	♂	♀
C/R	145	155	155	140
Hf c/u ..	44	46	45	43
T	87	92	95	89
E	15	16	16	15
Weight ..	325 gm	333 gm	314 gm	319 gm

Implantation was 2R 2L. This female BP 1288 was gravid at a size of TL 1045; T 250; Hf c/u 155; E 68; and a weight of 10 lb. 9 oz. This is surprisingly small as a non-gravid female taken in July had the following measurements: TL 1220; T 350; Hf c/u 140; E 63; and weighed 24 lb., and weights of up to 32½ lb. are known from the territory (BP 1287).

The above gravid female BP 1288 and BP 1290, a juvenile female from the Chobe River taken on the 9th April, 1965, represent the total information so far available on the breeding of the species.

These suggest that they drop the young about the middle of the rainy season, in January or February.

Ansell's (1960) records for Zambia indicate that they breed there from about October-November.

Sizes and Weights

The only data available are as follows:

		TL	*T*	*Hf c/u*	*E*	*Weight*
BP 1289	Male	1225	420	145	60	31 lb. 4 oz.
BP 2098	Female	1220	350	140	63	24 lb.
BP 1288	Female	1045	250	155	68	13 lb. 8 oz. gross (10 lb. 9 oz. less foetuses)
BP 1287	Male	1270	440	135	60	32 lb. 8 oz.
BP 1290	Female Juvenile	710	250	90	45	3 lb. 8 oz.

Genus GENETTA Oken, 1816

1. With a conspicuous black dorsal crest of long black hair; hindfeet black; tip tail white . . . . . *G. genetta*
2. No dorsal crest of long hair; hindfeet not black; tip tail black . . . . . *G. tigrina*

Genetta genetta — Tshipa — Smallspotted Genet

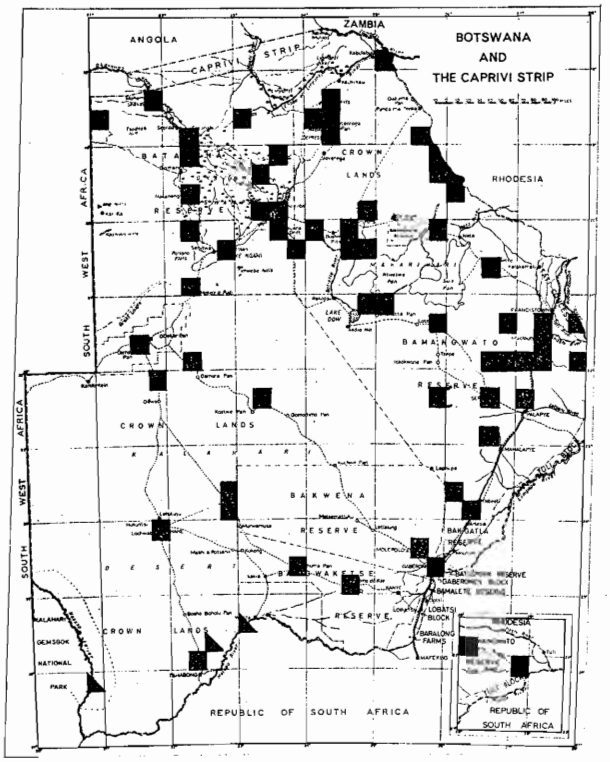
G. g. pulchra Matschie, 1902

Distribution

Widely distributed throughout, one of the commoner small predators.

Habitat

The species has a wide habitat tolerance, being found in all the major vegetational associations in the territory and in areas with a mean annual rainfall from less than 200 mm to over 700 mm. They occur in the heavy riverine forest and underbush of the Okavango delta, the rocky kopjes of the eastern sector and the



open dry scrub savannah of the central and south-west.

An analysis of the various types of association in which 100 out of the 109 specimens available for examination, where habitat data were recorded, is as follows:

Acacia woodland or scrub, including riverine *Acacia*	47
Mopane woodland or scrub	16
Terminalia-Bauhinia scrub	12
Unspecified riverine forest (Botletle River, Thamalakane River)	9
Open grassland with scattered bushes and trees	9
Kopjes with tree and bush cover	5
Baikiaea woodland	1
Miscellaneous	21
	100

In the case of the nine records from open grassland it was noticeable that the species did not occur unless there was some adjacent cover of scrub or isolated patches of trees with underbush. BP 1547 from four miles north-west of Sekoma Pan is a good example of this, being taken from a solitary tree surrounded by a patch of scrub *Acacia* in the middle of an otherwise extensive open grassland.

The data in general indicate that cover of scrub or woodland is an essential habitat requirement of the species, it being immaterial whether this is available in the well-watered areas of the Okavango delta or in the dry waterless bush savannah of the Kalahari.

Habits

Nocturnal, occurring singly or in pairs or family parties, terrestrial and arboreal. Most of the 109 specimens taken were shot after dark, the earliest time recorded being at 7 p.m., with records from then on until 2 a.m. The remainder were trapped in single-door live-traps on a wide variety of meat baits including squirrel, rodent and bird bodies, the intestines of hares, springbok and tsessebe. The use of this type of trap was found to be an efficient way of taking specimens.

The eyes of the species shine brightly in the beam of a dazzling light and can be picked up at long distances on pitch-dark nights. They do not appear to be unduly disturbed by such a light and will stand for long periods if held in it. If followed up on foot they are very sensitive to noise and if disturbed will slink off without looking at the light, pausing from time to time to gaze at it, or taking to a high vantage point such as a fallen log, a termite mound or a tree, to gaze back at the disturbance. In slinking away from such disturbances they will move with trees, an ant-heap or a patch of thick bush or other object between them and the source of disturbance. They are most often contacted on the ground at night. If pressed in these circumstances they will take readily to trees moving to the highest tips of the branches or taking cover behind stout branches to hide.

During the day, they rest in hollow logs, tree trunks or holes in the ground where they lie curled up sleeping, emerging shortly after dark. TNL 1371 from Kang, however, was found lying up in a thick low *Acacia* bush during the day.

Food

Number of occurrences, in a sample of 78 stomach contents, of various food items:

Food Item	*No. of Occurrences*	*Note*
Muridae	42	
Orthoptera	29	,, ,,
Scorpiones	21	,, ,,
Solifugae	18	,, ,,
Reptilia	14	,, ,,
Isoptera	12	,, ,,
Coleoptera	9	,, ,,
Aves	5	,, ,,
Myriapoda	4	,, ,,

Food Item	No. of Occurrences	Note
Insecta	4	Indet.
Green grass	4	,,
Bait	4	,,
Amphibia	2	,,
Chiroptera	1	*Eptesicus capensis*
Araneae	1	Indet.
Wild fruits	1	See text
Lepidoptera	1	Indet.
Soricidae	1	See text
Dictyoptera	1	Indet.
Muscardinidae	1	*Graphiurus murinus*
Stones	1	

Out of a sample of 78 stomach contents examined, Muridae constituted by far the most common constituent, occurring in 42 stomachs. The genera represented and the number of occurrences were as follows:

Species	No. of Occurrences
Pouched mouse, *Saccostomus campestris*	6
Tree mouse, *Thallomys paedulcus*	2
Lesser gerbil, *Gerbillurus paeba*	6
Fat mouse, *Steatomys pratensis*	6
Dwarf mouse, *Mus* sp.	7
Multimammate mouse, *Praomys natalensis*	7
Gerbil, *Tatera* sp.	5
Grey pygmy climbing mouse, *Dendromus melanotis*	2
Vlei rat, *Otomys angoniensis*	1
Rat, *Aethomys* spp.	1
Indet.	10

In 25 stomachs Muridae constituted the sole content and over 50% in a further ten.

The next commonest constituent, Orthoptera, occurred in 30 stomachs, the following families being represented:

Family	No. of Occurrences	Note
Acridiidae	14	See text
Pamphaginae	8	Including *Lamarkiana* sp.
Gryllidae	7	Including *Liogryllus bimaculatus*
Tettigonidae	4	Indet.
Stenopolmatidae	1	,,
Heterodininae	1	,,
Phasmidae	1	*Ichnotropis reyi*

In four stomachs Orthoptera constituted the whole stomach content, in two over 80%, but more commonly they represent only a small percentage, in 16 between a trace and 5%. Includes *Hemipetrodes bachmanni*.

Scorpiones ranked next, being present in 21 stomachs, the following genera and species being represented:

Species	No. of Occurrences
Uroplectes sp.	3
U. carinatus	1
Opisthopthalmus wahlbergi	5
Parabuthus vaudus	2
P. transvaalensis	1
P. flavidus	1
P. sp.	1
Indet.	8

Hunting spiders, Solifugae, ranked next, present in 18 stomachs. The wide occurrence of these in the stomachs of many small predators demonstrates their palatability. The following genera and species were identifiable:

Solpuga monteiroi	2
Solpuga sp.	1
Solpugyla darlingi	1
Indet.	14

Reptiles were represented in 14 stomachs, the following being identifiable:

Species	No. of Occurrences
SNAKES	
Spotted purple-glossed snake, *Calamelaps ventrimaculatus*	1
Peters' worm-snake, *Leptotyphlops scutifrons*	2
Spotted quill-snouted snake, *Xenocalamus bicolor maculatus*	2
Quill-snouted snake, *Xenocalamus* sp.	1
Shield snake, *Aspidelaps scutatus*	1
Centipede-eating snake, *Aparallactus capensis*	1
LIZARDS	
Sundeval's skink, *Riopa sundevalli*	7
Bibron's gecko, *Pachydactylus bibroni*	1
Spotted gecko, *P. punctatus*	1
Cape gecko, *P. capensis*	2
Dwarf gecko, *Lygodactylus capensis*	1
Skink, *Mabuya* sp.	1
Whistling gecko, *Ptenopus garrulus*	1
Kalahari blindworm, *Typhlosaurus lineatus*	1

Isopera were found in 12 out of the 74 stomachs, the following genera and species being identifiable:

Species	No. of Occurrences
Macrotermes bellicosus	3
Odontotermes sp.	1
Hodotermes mossambicus	7
Indet.	2

Coleoptera occurred in nine stomachs represented by the following families:

Family	*No. of Occurrences*
Scarabaeidae ..	1
Carabidae	1
Buprestidae	1 including *Steraspias amplipennis*
Indet.	6 including one record of larvae

Among other material occurring in lesser number were the following:

Aves occurred in five stomachs in the form of bones or feathers, in one case a turtle dove, *Streptopelia capicola;* Myriapoda in four stomachs in the form of the Centipede, *Scolopendra morsitans;* Insecta in four stomachs; Amphibia in two stomachs represented by *Breviceps adspersus*, *Pyxicephalus delallandi*, and *Chiromantis zerampelina;* green grass in four stomachs and a single occurrence each of wild fruits, *Grewia* sp.; a caterpillar; a bat, *Eptesicus capensis;* a shrew, *Crocidura* sp., one of the few records of the occurrence of this animal, normally unpalatable, in a stomach content; a dormouse, *Graphiurus murinus;* and an unidentified spider.

Bait was found in stomachs of individuals taken in traps and an accumulation of stones in BP 827.

Breeding

Gravid females were taken during the months of October to February.

Distribution of non-gravid and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	1	5	6	10	4	4	5	2	1	2	7	1
Non-gravid	–	4	6	10	4	4	5	2	1	1	6	–
Gravid	1	1	–	–	–	–	–	–	–	1	1	1

These data suggest that the young are born during the warm wet months of the year although a juvenile, BP 1548, from Sekoma Pan taken in June at 519 g suggests that the season may be extended later into the year. Shortridge (1934) gives a South West African record of three juveniles (about ten days old) taken in October. Ansell (1960) quotes a Zambian record of a female with two foetuses in February. The average number of foetuses was as follows:

Foetuses

Number $\bar{X} = 2{\cdot}8$; $N = 5$; Obs. range 2-4
Implantation in three cases being 1R1L and in the remaining two 2R2L.

Sizes and Weights

MALES

TL	$\bar{X} = 953$;	$N = 42$;	Obs. range 860-1050
T	$\bar{X} = 464$;	$N = 42$;	„ „ 430- 516
Hf s/u	$\bar{X} = 90$;	$N = 37$;	„ „ 82- 97
E	$\bar{X} = 54$;	$N = 35$;	„ „ 50- 60
Weight	$\bar{X} = 4$ lb. 6 oz.;	$N = 20$;	„ „ 3 lb. 15 oz.-5 lb.

FEMALES

TL	$\bar{X} = 936$;	$N = 12$;	Obs. range 890-1024
T	$\bar{X} = 459$;	$N = 12$;	„ „ 417- 516
Hf s/u	$\bar{X} = 88$;	$N = 11$;	„ „ 83- 92
E	$\bar{X} = 55$;	$N = 12$;	„ „ 51- 65
Weight	$\bar{X} = 4$ lb.;	$N = 10$;	„ „ 3 lb. 5 oz.-4 lb. 12 oz.

Males appear to be slightly larger than females averaging 6 oz. heavier.

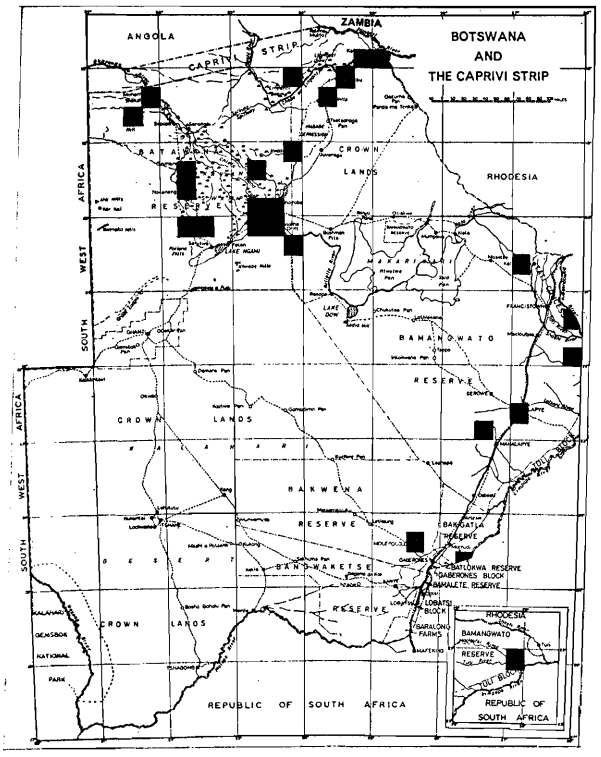
Genetta tigrina

G. t. rubiginosa Pucheran, 1855

Tshipa, Thokolo Rustyspotted Genet

Distribution

Narrowly confined to the vicinity of the Okavango delta, the Chobe River and their associated river and swamp systems in the north and to the eastern sector from the Tati Concession south to the Gaborone area. They are probably absent from the eastern extension of the Kalahari between Mahalapye and Mochudi, although they might be expected to occur in the riverine associations of the Limpopo River in this sector.



Habitat

Of the 35 specimens collected, 20 were taken in riverine woodland or underbush in the Okavango delta, on the Botletle, Chobe, Limpopo rivers, and the rivers of the Tati Concession. Of the balance 13 were taken in a variety of habitats such as *Acacia* woodland and scrub, mopane, cultivated lands, kopjes and floodplain grassland with scattered bush. While none of these can be considered as riverine conditions they were all within easy reach of open water or in the case of areas such as Tsau and the Moremi Reserve very closely associated with swamp or open water. Other records were from the top reaches of rivers systems, e. g. 33 miles NW. Mahalapye, Madinare and Kalakamati, where open water might not be permanently available but is likely to be for considerable periods following a season of good rains.

The two records from the Tsodilo Hills cannot be claimed to fall into the above categories except in so far as there is water available even in the driest of seasons in catchment in the rocks of these hills, which have in parts a good cover of underbush and trees.

It appears that the species is particularly associated with well-watered areas and its absence from the dry surrounding country shows that it does not favour these conditions. *G. genetta* on the other hand, found in well-watered areas alongside *G. tigrina*, e.g. in the Okavango delta, on the Chobe River and the eastern sector, colonizes the very driest and most arid parts of the country.

Shortridge (1934) restricts their distribution in South West Africa to 'close to the Cunene and Okavango rivers and in the Caprivi' in the extreme north, which corresponds with the findings from Botswana.

Habits

Nocturnal, terrestrial and arboreal, usually occurring singly, sometimes in pairs. Lie up during daylight hours in holes in the ground, hollow trees or logs and thick underbush. The species appears to be a late mover, not moving until some time after sundown, the earliest that a specimen was taken being 8.30 p.m. (BP 1083), and continuing active until at least the early hours of the morning, 2 a.m. (BP 148).

At Linyanti, Caprivi, an unusual incident was witnessed where a rustyspotted genet, which had apparently been lying up in thick riverine underbush, ran out and picked up a redbilled francolin, which had just been shot and wounded and had fallen close to the bush, and made off with it, being itself collected with the francolin in its mouth. This incident took place about 4 p.m.

Although predominantly terrestrial will, under stress, take to trees, climbing to the highest branches to hide itself among the foliage. BP 2146 was taken six metres up a mopane tree.

In other habits similar to *G. genetta*.

Food

Number of occurrences, in a sample of 30 stomachs, of various food items:

Food Item	*No. of Occurrences*	*Note*
Muridae	14	See text
Coleoptera (adults)	11	,, ,,
Orthoptera	8	,, ,,
Isoptera	7	Indet.
Solifugae	5	,,
Wild fruits	5	See text
Myriopoda	3	*Scolopendra morsitans*
Scorpiones	2	Indet.
Aves	2	,,
Anthropoda	1	Crab
Reptilia	1	See text
Amphibia	1	Indet.
Araneae	1	,,
Insecta	1	,,
Leaves	1	,,

Muridae constituted by far the largest food item in the sample, in seven cases being the sole content and

Plate 13: Rustyspotted Genet, *G. tigrina*. **Photo:** H. J. Smithers.

in three over 50%. Identifiable species were as follows:

Species	*No. of Occurrences*
Saccostomus campestris	5
Tatera sp.	3
Aethomys sp.	2
Dendromus melanotis	2
Indet.	3

Adult Coleoptera occurred in 11 stomachs.

Larvae would not be expected as the species is not a digger. The following families were represented:

Family	*No. of Occurrences*
Scarabaeidae	3
Cerambicidae	1
Carabidae	1
Curculionidae	1
Indet.	3

Orthoptera which occurred in eight stomachs were represented by the following families:

Family	*No. of Occurrences*
Acridiidae	5
Gryllidae	2
Tettigonidae	1

Two species of wild fruits were identifiable, the donkey berry, *Grewia* sp. and *Diospiros mespiliformis*.

Myriapoda were represented by the centipede, *Scolopendra morsitans*, whose occurrence in the stomachs of other small carnivores indicates its palatability.

Reptiles were represented by the remains of a chamaeleon, *Chamaeleo dilepis*, and an unidentified gecko.

At Mabate, where a small series of *G. tigrina* and *G. genetta* were taken on the same ground within a

period of five days of each other and where climatic conditions remained unchanged and one would presume that the food available to them would be similar, comparison of the stomach contents is as shown on the following table. This suggests that *G. genetta* is considerably more diverse in its food preferences. In the case of the Mabate records, *G. tigrina* shows a partiality for Muridae even when other food is available.

G. genetta		*G. tigrina*	
18.4.65		19.4.65	
BP 869	70% Reptilia	BP 895	100% Muridae
	10% Scorpiones	BP 896	100% Muridae
	10% Solifugae	23.4.65	
	10% Coleoptera	BP 944	90% Muridae
	Tr Orthoptera		10% Solifugae
22.4.65			
BP 926	50% Scorpiones		
	30% Reptilia		
	5% Isoptera		
	5% Myriopoda		
	5% Coleoptera		
	5% Stones		

Breeding

The only data available concerns a lactating female taken at Tsau in February 1965. In Rhodesia they drop their young from August through to February, there being no signs of breeding during the colder months of the year from April to July. Up to five young are recorded at a birth. Shortridge (1934) has a record from Sandfontein (Gobabis dist., South West Africa) for October, and Ansell (1960) records foetuses in October and a November record of a birth.

Sizes and Weights

MALES

TL	$\bar{X}$ = 1043;	N = 7;	Obs. range	970-1080
T	$\bar{X}$ = 512;	N = 7;	„ „	475- 535
Hf s/u	$\bar{X}$ = 92;	N = 7;	„ „	87- 98
E	$\bar{X}$ = 50;	N = 7;	„ „	47- 51
Weight	$\bar{X}$ = 4 lb.	N = 7;	„ „	4 lb.- 7 lb.

FEMALES

TL	$\bar{X}$ = 1035;	N = 7;	Obs. range	1005-1060
T	$\bar{X}$ = 513;	N = 7;	„ „	475- 540
Hf s/u	$\bar{X}$ = 91;	N = 7;	„ „	85- 93
E	$\bar{X}$ = 50;	N = 7;	„ „	46- 61
Weight	$\bar{X}$ = 5 lb.;	N = 7;	„ „	4 lb.-5 lb. 8 oz

Genus SURICATA Desmarest, 1804

Suricata suricatta

S. s. suricatta (Schreber, 1776)

Suricate

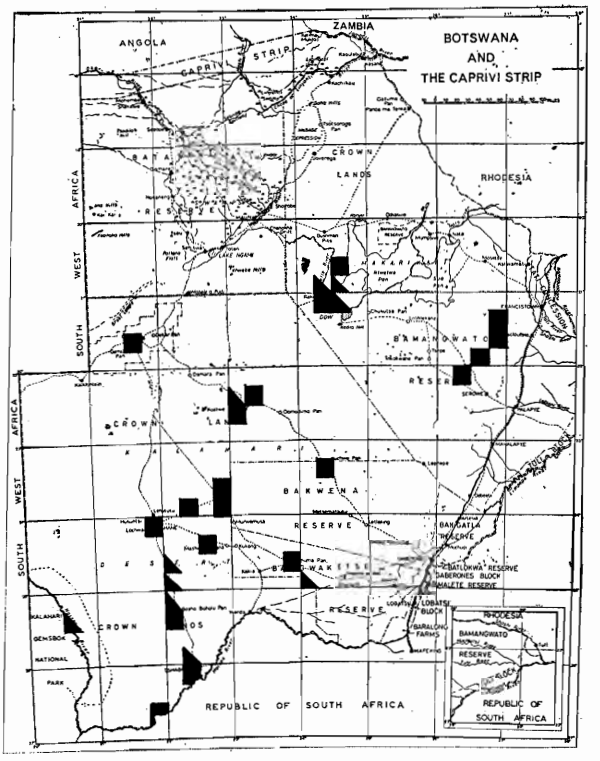
Taxonomic Notes

Following Meester (1964) *S. s. suricatta* includes *S. s. hamiltoni*, *S. s. lophurus*, *S. s. namaquensis* and *S. s. hahni*.

Distribution

Widely distributed, but localized in suitable habitat, throughout the Kalahari north to Ghanzi, the south-western corner of the Makgadikgadi and to within 45 miles of Francistown in a finger extension north-eastwards of the Kalahari association.

Not so far recorded east of Kuchwe Pan and Sekoma Pan in the south.



Habitat

Although widely distributed through the Kalahari within the limits as set out under Distribution, they are localized, being particularly associated with open ground such as is found on the fringes of the many dry pans (e.g. Tshane, Sekoma, Kuchwe, Gomodimo, etc., etc.) which are found throughout, and not in the intermediate sandy areas. They also occur on the

raised stony banks of dry watercourses (Molopo River) and on the raised grassland areas fringing the south-western corners of the Makgadigadi Pan and in areas of open *Acacia* scrub where this is situated on firm as opposed to sandy ground.

Most of the habitat in which they commonly occur is characterized by being firm, even hard ground, very often calcareous stony ground of the type so commonly associated with pans. Where the pans have open flat mud surfaces (e.g. Tshane, Sekoma) they are confined to the fringes. In the extreme south-west many of the pans, however, have a light grass and low 'karroid' scrub cover over their entire area in which cases the very centre of the pans may be utilized (between Tshane and Kang).

There appears to be some local movement from this circumscribed habitat during the wet season for a troop was contacted in sandy grassland, an association in which it is not normally found, three miles east of Sekoma Pan in January.

In feeding they seldom seem to wander more than 100-150 yards from the burrows, at such times they may be found on completely open ground or in surrounding woodland or scrub.

Habits

Diurnal, terrestrial, fossorial, gregarious, living in colonies of up to 25 or 30 individuals.
Approximate numbers of *S. suricatta* in colonies:

Sekoma Pan	18; 12; 20; 15
Tshane	11;
NW. Serowe	10; 10
Makgadikgadi	8
Mashi a Potsana	30; 15

Excavate warrens with many entrances in raised firm, hard or calcareous stony ground, the soil thrown out in the continued excavations eventually raising the level of the warren above the level of the surrounding ground.

They emerge from these warrens only when the morning sun is warm and retire to them well before sundown, not emerging at all on cold, overcast days or during rainy weather. They emerge very cautiously, first the nose, then head and shoulders carefully searching round for signs of danger, then sit up motionless, sitting on their haunches near the hole. Others will follow in the same manner until the whole colony is above ground. In this position watch is kept on the surrounding terrain by turning the head now and then from side to side in a quick movement. They are very sensitive and at the slightest disturbance will dive for the holes and disappear underground.

On sunny mornings will often deliberately sun themselves, sitting on their haunches, the front legs hanging down held firmly in to the body, assisting their balance with the tail, exposing their sparsely-haired bellies towards the warmth. An individual in captivity would move to the corner of the enclosure, where the first rays of the sun would strike, to gain advantage of this first warmth.

From the sitting position outside the holes one would eventually drop on to the front legs to move around which seemed to be a signal for the remainder to follow suit. When walking in search of food the head is held low, the tail trailing, the back sloping forward from the higher hindquarters giving a very characteristic profile.

The long front claws are ideally adapted for digging and when feeding they move slowly, pausing frequently to dig, the narrow, deep excavations and claw-marks being characteristic.

Throughout its range the species is frequently found occupying the same warrens as the ground squirrel, *Xerus inauris* (e.g. Sekoma Pan, 18 *S. suricatta*, 2 *Xerus inauris;* 45 miles south-west of Francistown, 10 *S. suricatta*, *c.* 6 *X. inauris*).

There is no competition for food between the two, the suricate feeding predominantly on beetle larva and other insects, the squirrel on vegetable matter.

In addition, pairs of yellow mongoose, *Cynictis penicillata*, also occupy holes in these warrens (Sekoma Pan). This species must to some extent compete for food with the suricate but it ranges over a far wide area in feeding and competition may be avoided to some extent in this manner.

Food

In a sample of 17 stomachs the following items of food were recorded, noting the number of times they occurred:

Food Item	*No. of Occurrences*	*Note*
Coleoptera larvae	15	See text
Scorpiones	8	„ „
Reptilia	3	„ „
Orthoptera	3	Grasshoppers
Coleoptera adults	2	See text
Myriapoda	2	„ „
Isoptera	2	Indet.

By far the commonest item of food was Coleoptera larvae found in 15 stomachs. The search for these subteranean larvae and the scorpions, which rank as the next most common item, is no doubt the reason for the persistent digging engaged in by individuals in feeding.

Scorpiones were found in eight stomachs which, as they only leave their holes after dark, except immediately after rain, and as the suricate is a diurnal feeder, would have to be dug out of the ground.

Reptilia and Orthoptera, grasshoppers, rank next occurring in three stomachs each. The following pecies of reptiles were identified:

Spiny agama, *Agama hispida*
Namaqua sand lizard, *Eremias namaquensis*
Legless skink, *Typhlosaurus lineatus*
Spotted sandveld lizard, *Nucras intertexta*

Adult Coleoptera; Myriapoda, represented once by the centipede, *Scolopendra morsitans* and once by millipedes; and Isoptera occurred in two stomachs each.

Breeding

The only indications of breeding is a female with four foetuses (17-19 grams) taken at Tshane in February. Shortridge (1934) records a female from Sandfontein (Gobabis district, South West Africa) with four foetuses taken in November. In common with other small carnivores of this type and with the above records as an indication, they probably breed during the warmer rainy months of the year from about October through to March.

Sizes and Weights

MALES

TL	$\bar{X} = 502$;	$N = 18$;	Obs. range 450-530
T	$\bar{X} = 220$;	$N = 17$;	„ „ 205-240
Hf c/u	$\bar{X} = 71$;	$N = 17$;	„ „ 63- 74
E	$\bar{X} = 21$;	$N = 14$;	„ „ 18- 26
Weight	$\bar{X} = 731$ g;	$N = 6$;	„ „ 626-797 g

FEMALES

TL	$\bar{X} = 491$;	$N = 8$;	Obs. range 450-515
T	$\bar{X} = 227$;	$N = 8$;	„ „ 190-230
Hf c/u	$\bar{X} = 70$;	$N = 8$;	„ „ 65- 74
E	$\bar{X} = 18$;	$N = 8$;	„ „ 17- 20
Weight	$\bar{X} = 720$ g;	$N = 6$;	„ „ 620-969 g

Genus PARACYNICTIS Pocock, 1916

Paracynictis selousi

Selous' Mongoose

P. s. ngamiensis Roberts, 1932

Taxonomic Notes

Within a series of seven specimens from the Maun area there is some variation in the overall colour of the upperparts MS 87 being much greyer than the remainder, BP 1912 slightly browner, more like specimens from western Rhodesia (*P. s. selousi*). The tip of the tails in all the Maun specimens are white except MS 87 which is off-white, slightly yellow and the faces and tops of the heads are greyer than in western Rhodesian specimens, except that, in the case of the browner specimen, BP 1912, the top of the he d is browner than in the remainder.

The colour of the underparts in the Maun series is lighter buff than in *P. s. selousi*, the difference, however, being slight.

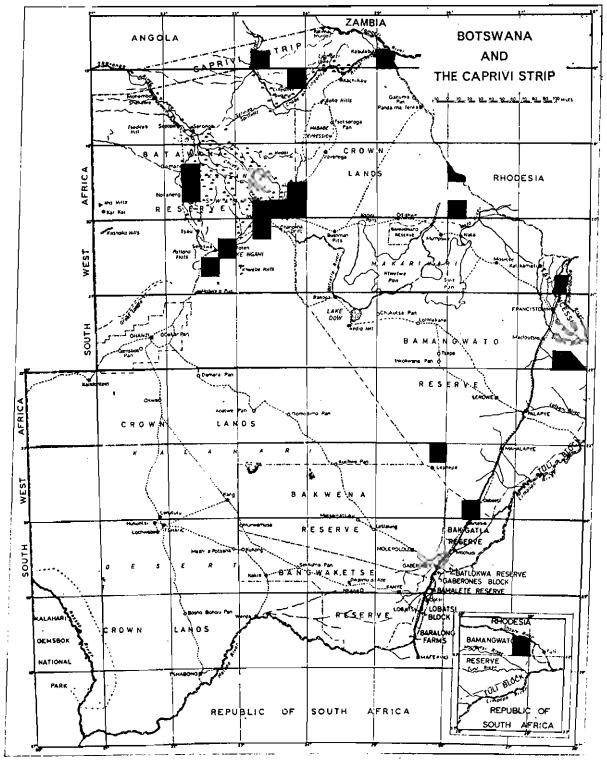
The material from Debeeti and Lephepe is again greyer on the upperparts and whiter on the underparts than *P. s. selousi*, but the top of the heads are browner, in this resembling *P. s. selousi*.

All the Botswana material is certainly greyer than *P. s. selousi* but, on present material, it is not possible to recognize two subspecies within it as was done by Roberts (1932) in describing *P. s. ngamiensis* from near Maun and *P. s. bechuanae* from the Tati Concession. Until further material is available it is proposed to consider *P. s. bechuanae* as a synonym of *P. s. ngamiensis* which has line priority over it.

Distribution

Occurs throughout the eastern Caprivi from the Maschi River east to Kasane, in the southern part of the Okavango delta as far north as Gomare in the west and 20 miles north of Shorobe in the east, and from Tamafupi on the Rhodesian border at *c.* 19°20′ S. narrowly throughout the eastern sector south to near Artesia, extending here westwards at about 23° S. to near Lephepe.

Shortridge (1934) suggests that they may occur 'in north-eastern South West Africa from about the latitude of Ghanzi (21°30′ S.) northwards'. If this is so they might be expected to occur west of the Okavango delta in the adjoining parts of Botswana but there are no visual or material records to support this at the moment.



Habitat

A summary of the types of habitat in which 46 specimens were collected is as follows:

Open *Acacia* scrub or woodland	16
Mopane woodland	2
Heavily grazed ground in scrub and woodland	6
Open areas—cultivation, airfields, floodplain, grassland	12
Terminalia-Combretum scrub	4
Sub-riverine (dry) woodland and scrub	4
Taken on roads	2
	46

While there must always be a bias in favour of the taking of material in relatively open country as opposed to thicker bush the above data, together with visual observations, suggest that the species has a preference for open scrub and woodland associations of various types. All of those, within the areas in which the material was taken, are associated with sandy soils including the mopane woodland which, in the areas north of Maun, is on sandy soil.

The distribution of the species might, taken generally, suggest an association with well-watered areas bu , while this applies to records from the northern part of the territory, it does not apply to those from the Rhodesian border, the areas between Debeeti and Artesia, Lephepe and west of Mahalapye, which are all dry and sandy and which they appear to be able to utilize quite satisfactori y.

Habits

Nocturnal, terrestrial, occurring singly or in pairs. Lie up during daylight hours in burrows excavated by themselves, usually under the cover of bushes or among tree-roots but often in the open (Nokaneng, fringe of the floodplain). They will, however, use ant-bear or spring hare holes as temporary refuges when under stress (Tamafupi, Sehitwa).

The burrows may have two or more entrances and are extensive judging from the accumulation of loose soil at the entrances. At Madinare a burrow entered at the base of a termite mound and connected with the openings within it.

The earliest recorded time of taking a specimen is 9 p.m. indicating that they are late movers, moving at least till the early hours of the morning (12.30 a.m., Nokaneng).

Food

The species utilizes a wide range of food, 15 categories being recorded in the sample of 34 stomachs as follows:

Food Item	*No. of Occurrences*	*Note*
Coleoptera	19	See text
Orthoptera	17	,, ,,
Isoptera	9	,, ,,
Solifugae	8	,, ,,
Scorpiones	7	,, ,,
Muridae	6	,, ,,
Reptilia	4	,, ,,
Amphibia	4	,, ,,
Myriapoda	4	,, ,,
Lepidoptera	3	Indet.
Araneae	3	,,
Insecta	3	,,
Aves	1	Lark? See text
Neuroptera	1	Indet.
Hymenoptera	1	,,
Green grass	1	

The commonest item in the stomachs was Coleoptera.

There was a larger number of occurrences of adults (15) than larva (six), in some cases both being present. Representatives of the following families were identified with the number of times they were recorded:

Family	*No. of Occurrences*	*Family*	*No. of Occurrences*
Scarabaeidae	4	Cerambycidae	1
Carabidae	3	Tettigonidae	1
Cuculionidae	1	Elateridae	1
Dytiscidae	1	Indet.	9
Tenebrionidae	1		

Orthoptera occurred in 17 contents, the following families being represented with the number of times they occurred:

Family	No. of Occurrences	Family	No. of Occurrences
Acridiidae	13	Pamphagidae	2
Tettigonidae	3	Blattidae	1
Gryllidae	3	Oedipodinae	1

Isoptera were found in nine stomachs, in six cases *Hodotermes mossambicus*, in three unidentifiable.

Solifugae were found in eight stomachs, in two cases, where it was possible to recognize the species, *Solpuga monteiroi*, in a further two cases *Solpuga* sp. and in four the material was unidentifiable.

Scorpiones occurred in seven stomachs, the following species being identifiable:

Parabuthus granulatus
Parabuthus sp.
Opisthophthalmus wahlbergi
O. sp.

Muridae were found in six stomachs, but in only three cases was it possible to identify the remains owing to the thorough mastication to which they had been subjected.

Identifiable material was as follows:

Gerbillurus paeba
Dendromus melanotis
Steatomys pratensis

Myriapoda were represented by the centipede, *Scolopendra morsitans*, on three occasions, and the millipede, *Sphaerotherium* sp., on one.

Reptilia were represented by the following species:

Peters' worm-snake, *Leptotyphlops scutifrons*
Shield snake, *Aspidelaps scutatus*
Cape gecko, *Pachydactylus capensis*
Spiny agama, *Agama hispida*

Amphibia were represented in four stomachs by toads, *Bufo* sp., and in one by the frog, *Pyxicephalus delalandi cryptotus*.

Lepidoptera; Araneae and indeterminable Insecta remains were found in three stomachs and Neuroptera; Hymenoptera and Aves in one. In the case of the single record of a bird this was a chick with the broken remains of a small egg possibly a lark, which unfortunately could not be properly identified.

Blades of green grass were found in one stomach.

In the light of the above the species appears to subsist mainly on insects, scorpions, hunting spiders, lizards, frogs and small rodents.

It is interesting to note that, bearing in mind the drought-stricken nature of the country during the first two years of the survey from 1964-66 during which period rodent populations were at a low ebb, there was only one case of rodents being taken.

Between January 1967 and June of that year, following the break of this drought, when rodent populations were building up or in some areas had already reached unprecedented levels, rodents were represented in five out of the eight stomachs available. It is thought that if a larger number of stomachs had been available for examination, after January 1967, the percentage of stomachs with rodents in them might have been much larger than the 17·6% calculated over the period January 1964 to June 1967.

Conversely the number of occurrences of Insecta of various types, with the exception of Coleoptera, dropped dramatically after January 1967 in favour of rodents while scorpions and hunting spiders dropped out altogether suggesting that, when available, a rodent diet is favoured but that, when they are not available, scorpions and hunting spiders in particular are substituted. This situation was noticed in the case of other small carnivores.

Number of occurrences in a sample eight stomachs prior to and after the break of the drought (January 1966)

Sample 8	Prior	After
Orthoptera	4	1
Coleoptera	3	3
Isoptera	2	Nil
Solpugidae	5	Nil
Scorpionidae	4	Nil
Myriopoda	1	Nil
Arachnida	2	Nil
Reptilia	2	Nil
Muridae	Nil	5

Breeding

Only two gravid and one lactating female were taken:

Distribution of non-gravid, lactating and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	1	10	7	–	–	3	2	1	4	–	–	–
Non-gravid	1	8	7	–	–	3	2	1	3	–	–	–
Lactating	–	1	–	–	–	–	–	–	–	–	–	–
Gravid	–	1	–	–	–	–	–	–	1	–	–	–

Shortridge (1934) quotes the record of a female with two foetuses in October (Zambia), Ansell (1960) has no records and there is only one Rhodesian record of a female with two minute foetuses taken in Wankie in August.

Although the sample is small the indications are that the species drops its young during the warm wet months of the year, probably from about September through to March. Further observations are, however, required to confirm this.

Sizes and Weights

MALES

TL	$\bar{X} = 774$;	$N = 22$;	Obs. range	733-890
T	$\bar{X} = 337$;	$N = 21$;	,, ,,	288-435
Hf c/u	$\bar{X} = 116$;	$N = 20$;	,, ,,	106-124
E	$\bar{X} = 43$;	$N = 20$;	,, ,,	39- 48
Weight	$\bar{X} = 3$ lb. 10 oz.;	$N = 18$;	,, ,,	3 lb. 1 oz.-4 lb. 12 oz.

FEMALES

TL	$\bar{X} = 744$;	$N = 25$;	Obs. range	635-810
T	$\bar{X} = 325$;	$N = 23$;	,, ,,	305-367
Hf c/u	$\bar{X} = 112$;	$N = 25$;	,, ,,	103-120
E	$\bar{X} = 45$;	$N = 20$;	,, ,,	41- 50
Weight	$\bar{X} = 3$ lb. 10 oz.;	$N = 21$;	,, ,,	3 lb.-4 lb. 8 oz.

There appears to be little or no sexual dimorphism in this species.

Genus CYNICTIS Ogilby, 1833

Cynictis penicillata

C. penicillata (G. Cuvier, 1829)

Moswe Yellow Mongoose

Taxonomic Notes

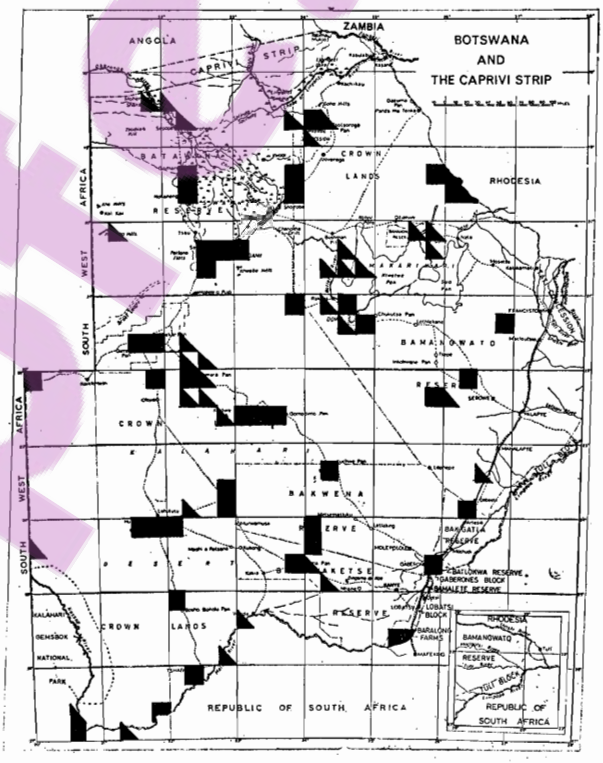
The colloquial name, yellow mongoose, is unfortunate as applied to Botswana material for, while *C. p. penicillata* from the southern parts of the Republic of South Africa is tawny-yellow on the upperparts, only the material from the southern parts of Botswana could be called yellow, the remainder being predominantly grey. Lundholm (1955*b*) shows that we are dealing with a cline in colour from the yellow *C. p. penicillata* of the Cape Province to the grey *C. p. cinderella* of northern South West Africa.

Specimens from Ramatlabama in the extreme south-east are yellowish, from the Savuti grey, with but the faintest wash of yellow.

Distribution

Widely distributed, except in the north-east north of Makgadikgadi, here extending up the eastern fringe of the Okavango Swamp to Savuti and up the Rhodesian border only as far as 19°15′ S.

Absent from the eastern sector from the Nata River south to near Mahalapye, then reappearing in the eastern extension of Kalahari conditions through to the Transvaal border between Mahalapye and Artesia. At Gaborone they occur just onto the fringe of the outlying rocky kopjes some five miles west of the town. Absent in the hilly country near Gaborone, south to the Lobatse area reappear in the open sandy scrub associations of the extreme south-east.



Habitat

An analysis of the habitat in which 81 specimens were taken is as follows:

Acacia scrub	22
Acacia-Combretum scrub	1
Terminalia-Acacia scrub	3
Acacia-Grewia scrub	7
Fringe pans	17
Fringe agricultural land	1
Open river-bed	9
Open parkland (*A. giraffae* and *A.* spp.)	6
Floodplain	12
Unspecified	3
	81

This data clearly indicates a preference for open sandy terrain whether in the form of scrub, floodplain, open parkland or the fringes of pans.

The three specimens taken in *Terminalia-Combretum* scrub were taken at Tamafupi where there are open vleis and open grassland round water-holes. The open parkland particularly refers to the area of the Baralong farms in the extreme south-east, the woodland, much of it degraded, being *Acacia giraffae*.

Habits

Predominantly diurnal, although they have been taken after dark (Camp 3, 8.45 p.m.; Kuki-Makalamabedi fence, 10 p.m.), and seen at night at Tamafupi, Tsokotsa Pans and the Baralong farms, indicating that they are, to some extent, nocturnal.

While the species is gregarious, living in colonies of up to eight (Takatekwane), they are usually found singly or in pairs. The colonies live in warrens with many entrances and frequently share them with the ground squirrel, *Xerus inauris*, and the suricate, *Suricata suricatta* (Tshane, 45 miles south-west of Francistown).

Shortridge (1934) states that they may occasionally kill the young of the ground squirrel. Single pairs or family parties may also occupy burrows (Baralong farms), these often with several openings, in the shelter of an *Acacia* or other thorny bush.

Food

In a sample of 50 stomachs the following items of food were recorded, noting the number of times they occurred, as follows:

Food Item	*No. of Occurrences*	*Note*
Coleoptera adults	17	See text
Isoptera	16	,, ,,
Orthoptera	16	,, ,,
Insecta	12	Indet.
Coleoptera larvae	10	,,
Muridae	8	See text
Scorpiones	7	,, ,,
Reptilia	6	,, ,,
Solifugae	2	,, ,,
Myriapoda	2	,, ,,
Aves	1	,, ,,
Amphibia	1	Frog
Carrion	1	Intestines

Adult Coleoptera constituted the commonest item of diet occurring in 17 stomachs, and the sole content in four. Representatives of three families were recognized among the otherwise well-masticated remains.

Family	*No. of Occurrences*
Scarabaeidae	2
Tenebrionidae	1
Coprinae	1
Indet.	14

Isoptera occurred in 16 stomachs, in four *Hodotermes mossambicus*, in the remainder unidentifiable.

Orthoptera occurred in 16 stomachs represented by the following families:

Family	*No. of Occurrences*
Acridiidae	14
Gryllidae	1
Blattidae	1

Orthoptera constituted the sole contents in five cases.

Unidentifiable Insecta occurred in 12 stomach and Coleoptera larvae in ten, the latter constituting the sole content in three.

Muridae were found in eight stomachs, *Praomys natalensis* being identifiable in two; Scorpiones in seven including *Colopus wahlbergi;* Reptilia in six, the following species being identifiable:

Striped Kalahari blindworm, *Typhlosaurus lineatus*
Spiny agama, *Agama hispida*
Spotted sand lizard, *Meroles suborbitalis*
Black and yellow sand lizard, *Eremias lugubris*
Sand lizard, *Eremias* sp.
Worm lizard, *Zygaspis quadrifrons*

Solifugae and Myriapoda, the latter represented by the centipede *Scolopendra morsitans*, occurred in two stomachs each and in one stomach each the following were found:

Aves, an unidentifiable small bird;
Amphibia, a frog;
Carrion, possibly the intestines of a hare.

Shortridge (1934) states that the species 'does not habitually dig and scratch about in the sand to the same extent as *Suricata* and *Mungos*'. Observations in Botswana on the contrary indicate that the species is a prolific digger and scratcher, the high percentage of Coleoptera larvae found in the stomachs, which have to be dug up, supporting the visual observations. The great majority of the food items on the other hand are terrestrial.

The single record of carrion in the stomach is unusual, although they can be trapped on rodent or bird bodies, they do not as a rule visit carcasses.

Breeding

Distribution of gravid, non-gravid and lactating females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	–	4	8	–	4	10	1	3	–	2	2	1
Non-gravid	–	2	4	–	4	10	–	3	–	1	1	1
Lactating	–	–	3	–	–	–	–	–	–	–	–	–
Gravid	–	2	1	–	–	–	1	–	–	1	1	–

The occurrence of gravid females in the months given in the table indicates a wide breeding season perhaps throughout the year. On the other hand while there is a single July record, ten females taken in June were non-gravid and it may be that there is sporadic breeding through the year with a peak somewhere during the months of October to March or April during which months five gravid females have been recorded.

Juveniles have been taken in January and May. The number of foetuses and implantations recorded were as follows:

BP 494	11/64	3	1R	2L	Minute
BP 1432	10/65	2	1R	1L	Near full-term
TNL 560	2/66	3	2R	1L	Minute
TNL 2546	2/67	5	2R	3L	CR 44-50
TNL 2610	3/67	2	1R	1L	CR 16-18
BP 2200	7/68	4	2R	2L	Minute

On the above basis the average number of foetuses is as follows:

Foetuses

Number $\bar{X} = 3{\cdot}2$; $N = 6$; Obs. range 2-5

Sizes and Weights

MALES

TL	$\bar{X} = 496$;	$N = 36$;	Obs. range 412-582
T	$\bar{X} = 210$;	$N = 36$;	„ „ 181-250
Hf c/u	$\bar{X} = 67$;	$N = 38$;	„ „ 61- 78
E	$\bar{X} = 30$;	$N = 33$;	„ „ 24- 36
Weight	$\bar{X} = 589$ g;	$N = 20$;	„ „ 478-797 g

FEMALES

TL	$\bar{X} = 506$;	$N = 30$;	Obs. range 447-580
T	$\bar{X} = 211$;	$N = 30$;	„ „ 180-245
Hf c/u	$\bar{X} = 67$;	$N = 29$;	„ „ 61- 76
E	$\bar{X} = 30$;	$N = 27$;	„ „ 25- 38
Weight	$\bar{X} = 553$ g;	$N = 18$;	„ „ 440-797 g

There does not appear to be any difference in sizes between a series of males and females; females average lighter in weight.

Genus **HERPESTES** Illiger, 1811

1. Size smaller, total length of adults not exceeding 60 cm; length skull not exceeding 65 mm . . . . . *H. sanguineus*
2. Size larger, total length of adults 1 metre and over; length skull exceeding 90 mm . *H. ichneumon*

Herpestes sanguineus

Ngano Slender Mongoose

H. sanguineus Rüppell, 1836

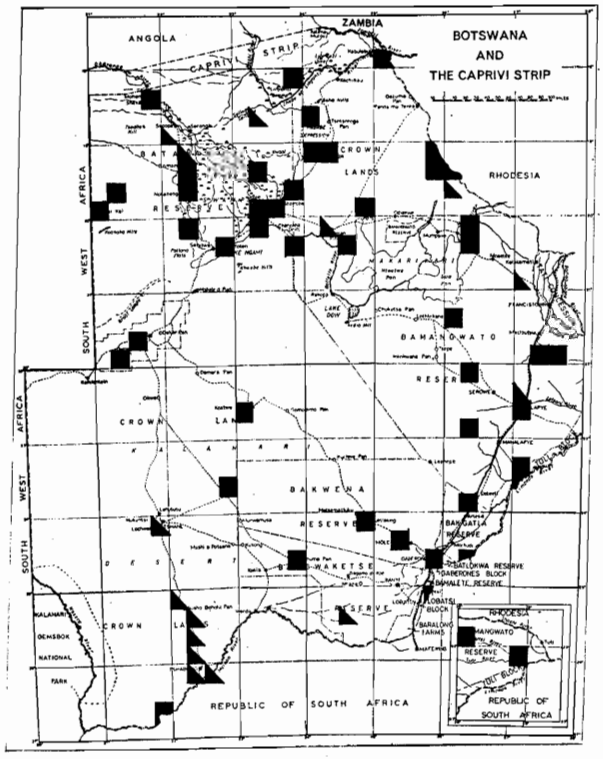
Taxonomic Notes

Material from the Chobe River is distinctly reddish or yellowish, a character which appears to be common to this species from the Zambezi Valley westwards within Rhodesian limits. Specimens from the Savuti at the north-eastern end of the Okavango delta show a tinge of reddish but more closely conform to the colour of a series from the Maun area which are greyer, the reddish tinge confined to the tail at the proximal end of the black tail-tip.

Specimens from the Botletle River west of the Makgadikgadi vary greatly in colour from very pale individuals with a tinge of reddish down the mid-back to very dark individuals with a considerable amount of reddish on the face and head.

A specimen from Sekoma Pan in the Kalahari is very bright red on the head and shoulders and down the mid-back, and a small series from Gaborone greyish overall with a tinge of reddish on the head and shoulders.

Meester (1964) states that the species is in need of revision and until this is carried out no attempt is made to deal with the material subspecifically.



Distribution

Widely distributed throughout the territory even in the most arid areas, providing there is some cover of bush, rocks, fallen trees or substantial piles of debris.

Habitat

An analysis of the types of association in which a sample of 51 specimens were taken is as follows:

Riparian scrub or woodland (including riverine *Acacia*)	21
Mopane scrub and woodland	2
Scrub bush near pans	5
Terminalia-Combretum scrub and woodland	10
Kopjes	4
Acacia woodland and scrub (dry)	4
Cultivation (with thorn fence)	1
Floodplain fringe	4
	51

The species is more common in well-watered areas than in dry country which is probably the reason for the larger numbers taken in riparian scrub or woodland.

In the majority of cases where the species was recorded in *Terminalia-Combretum* scrub and woodland the records indicated an association with termite mounds, fallen logs, or piles of debris. The same remarks apply to the four records from *Acacia* woodland and scrub. The single record from cultivated ground (Toten) noted that cover was available in the form of a thorn fence, a favourite habitat and one with which it has been associated in other parts of the country (Shakawe, Mahalapye, Tshane). The fringes of floodplain in he areas in which the four specimens were taken (Nokaneng, Lake Ngami, Shorobe, Savuti) all have ample cover of scrub bush, thickets or fallen trees.

Irrespective of the type of association, an essential requirement is cover of some sort, in the forms indicated: thickets, fallen or hollow trees, crevices in rocks or piles of boulders, thorn fences, holes in termite mounds or in the ground such as disused antbear or spring hare holes, etc.

Habits

Diurnal, terrestrial, normally solitary. Alert and quick in their movements, walk with a smooth motion, the

tail trailing, the black tip slightly turned up, nose to the ground, back slightly arched. When running the body is held flat without arching. Characteristically, when caught in the open and running for cover, flips its tail into the vertical position just before reaching this. When excited, or on the defensive, erects the hair on the body and the tail. When disturbed will freeze, standing motionless until the disturbance is located, or will rise to stand on the back legs, balancing with or without the aid of the tail, to obtain a better view.

Not in evidence in cold, overcast weather remaining in its retreat, but on warm mornings, if not hunting, will lie in the sun near the retreat stretched out full length or curled up, yet on the alert. From these refuges will wander widely in search of food and is, therefore, sometimes found in open places such as open grassland, floodplain or on the fringes of pans. When disturbed in such situations they make for the nearest shelter or take to holes in the ground.

They will occasionally live in close association with man. At Shakawe one lived in a roughly constructed retaining wall, between two occupied dwelling houses, not nine metres from one of them and at Tshane in a similar situation near the rest camp.

Prone to use tracks or pathways. Preyed on by some of the larger birds of prey, e.g. African hawk eagle, *Aquila fasciata*, is particularly sensitive to birds flying overhead, which it will carefully watch.

In captivity mainly silent, when young 'conversational' with a soft '*huh nwe*' frequently repeated. In play would take cover, the head suddenly emerging with the mouth opened to its widest possible extent as if in a mock attack, which was never forced home.

Owing to the size of hens' eggs was unable to break them with its teeth so, having manoeuvred them into a strategic position, would propel them between its back legs by flinging them with the front on to a rock or other hard object and so breaking them. This action was observed when the mongoose was given small stones, nuts, golf balls or other small objects to play with and would continue over considerable periods of time (*see Helogale parvula*, habits).

Will live in close association with man, taking up residence in suburban gardens and among farm outbuildings and if undisturbed becomes indifferent to his presence.

Food

In a sample of 20 stomachs the following items of food were found, noting the number of occurrences, as follows:

Food Item	*No. of Occurrences*	*Note*
Reptilia	7	See text
Isoptera	7	„ „
Muridae	6	„ „
Orthoptera	5	„ „
Coleoptera	4	Indet.
Insecta	4	„
Aves	2	„
Scorpiones	1	„
Lepidoptera	1	„
Wild fruits	1	„

Identifiable reptiles with a note on the number of times they occurred included the following:

Spotted sandveld lizard, *Nucras intertexta*	3
Agama lizard, *Agama* sp.	1
Common striped skink, *Mabuya striata*	1
Striped skink, *Mabuya punctatissimus*	1
Skink, *Mabuya* sp.	3
Black and yellow sand lizard, *Eremias lugubris*	1
Sand lizard, *Eremias* sp.	1
Rough-scaled sand lizard, *Ichnotropis capensis*	1
Bibron's burrowing adder, *Atractaspis bibroni*	1

The only Isoptera for which an identification was obtained was *Macrotermes bellicosus*, which formed the entire content of the stomach of BP 1188 from Debeeti.

Muridae occurred in six stomachs, most of the material consisting of fur only, and therefore unidentifiable, but with *Praomys natalensis* identified in two out of the six stomachs.

Orthoptera, consisting of grasshoppers, occurred in five stomachs, constituting the whole content in BP 2136 and 60% in BP 1555.

Adult Coleoptera and unidentifiable Insecta occurred in four stomachs, Aves in two, being the remains, mainly feathers, of small birds. Lepidoptera, Scorpiones and wild fruits were found in one stomach each.

The stomach of BP 936, which had been caught in a steel trap by an African and brought into camp, contained one of its own feet, which, although not the one held by the trap, had been chewed off.

Breeding

Only one gravid female was taken, at Shorobe in December with two foetuses, 1R 1L. Further evidence of breeding is given by two lactating females taken in February at Joverega and Toten. Neither Shortridge (1934) nor Ansell (1960) have information on the breeding of this species. In Rhodesia females with two foetuses have been taken in November and juveniles have been seen in March. The young are born in holes, hollow logs or rocky crevices.

Sizes and Weights

MALES

TL	$\bar{X} = 567$;	$N = 12$;	Obs. range 513-604
T	$\bar{X} = 264$;	$N = 11$;	„ „ 230-290
Hf c/u	$\bar{X} = 63$;	$N = 12$;	„ „ 61- 67
E	$\bar{X} = 25$;	$N = 12$;	„ „ 23- 29
Weight	$\bar{X} = 493$ g;	$N = 9$;	„ „ 342-626 g

FEMALES

In the absence of an adequate series the following are the sizes and weights of three females:

	TL	*T*	*Hf c/u*	*E*	*Weight*
BP 590	530	245	46	18	359 gm
TNL 1104	541	256	55	21	452 „
RMD 1060	482	224	52	21	341 „

Genus HERPESTES Illiger, 1811

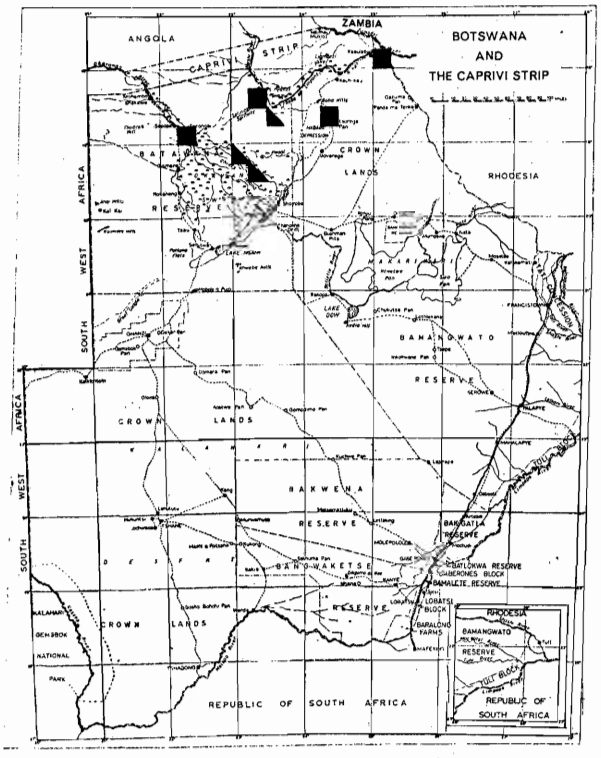
Herpestes ichneumon

Large Grey Mongoose

H. i. mababiensis Roberts, 1932

Distribution

Such records as are at present available suggest that they are confined to the vicinity of the Okavango River and the northern parts of the Okavango delta and Mababe Depression and throughout the length of the Chobe River. Shortridge (1934) states that in South West Africa they are 'restricted to the Okavango region and the Caprivi'. They occur widely in Angola (Hill and Carter, 1941) and south-western Zambia (Ansell, 1960), the Botswana records marking their southern limit of distribution in this western region.



There is ample suitable habit in the southern reaches of the Okavango delta and they should be sought for as they may have been overlooked.

Roberts' type of *H. i. mababiensis* from Tsotsoroga Pan was donated to the Vernay Lang Expedition and one cannot but speculate on its correct location, as the habitat in this vicinity, being predominantly dry mopane, is not normal for the species. Unfortunately, this specimen cannot be traced. Twenty miles further west there is certainly suitable habitat on the fringe of the Savuti channel and associated swamp area.

Habitat

Closely associated with riverine and subriverine woodland and underbush or wet vlei and the fringes of swamps where there is fringing cover of reed-beds, tall grass or underbush, never moving far from the vicinity of well-watered areas. In Rhodesia absent from the dry western areas although not uncommon in Mashonaland and the Eastern Districts. Where they occur in dry country they are narrowly confined to riparian associations, as in the Zambezi Valley in Rhodesia and the Okavango delta and Chobe River in Botswana.

Habits

Predominantly diurnal, terrestrial, usually solitary but commonly in pairs although recorded in packs of up to 14 (Shortridge, 1934) in other parts of southern Africa.

Food

No stomach contents are available from Botswana, but in Rhodesia frogs, rats and mice, reptiles, grasshoppers and beetles constitute their main diet. It is interesting to note that in three cases out of a sample of six containing rodent remains the vlei rat, *Otomys angoniensis*, a species closely associated with wet

conditions, was represented. This and the frogs suggest the association of this mongoose with areas where water is available.

Breeding

No information available, from Botswana or any of the surrounding countries.

Sizes and Weights

No data available from Botswana.

A small series from Rhodesia localities averages as follows:

MALES

TL	$\bar{X}$ = 1071;	N = 8; Obs. range	1005-1120
T	$\bar{X}$ = 497;	N = 8; „ „	470- 531
Hf c/u	$\bar{X}$ = 111;	N = 8; „ „	105- 114
E	$\bar{X}$ = 36;	N = 8; „ „	34- 38
Weight	$\bar{X}$ 7 lb. 2 oz.;	N = 8; „ „	5 lb. 12 oz.- 9 lb.

FEMALES

TL	$\bar{X}$ = 1068;	N = 7; Obs. range	952-1150
T	$\bar{X}$ = 497;	N = 8; „ „	464- 545
Hf c/u	$\bar{X}$ = 107;	N = 8; „ „	94- 114
E	$\bar{X}$ = 36;	N = 7; „ „	30- 42
Weight	$\bar{X}$ = 6 lb.;	N = 6; „ „	5 lb. 4 oz.- 7 lb.

Genus ICHNEUMIA I. Geoffroy, 1837

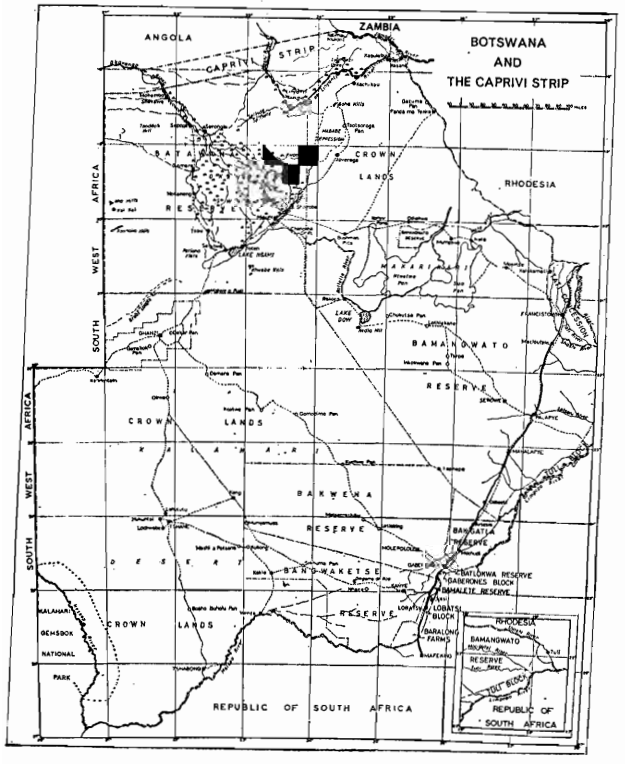
Ichneumia alibicauda

Whitetailed Mongoose

I. a. grandis (Thomas, 1890)

Distribution

So far only known from a limited area in the north-eastern part of the Okavango delta from the western extremity of the Moremi Game Reserve eastwards along the Kwaai and Gomoti rivers, which fringe the reserve on its northern and southern boundaries. In this area they are not uncommon and in addition to the specimens collected they were seen on several occasions. The species occurs in southern Angola (Hill and Carter, 1941) and in view of these Moremi Game Reserve records they may well occur in the intermediate area in the northern Okavango delta and along the Okavango River to the Angola border. Shortridge (1934) records them from the central and eastern Caprivi.



Habitat

Under Botswana conditions confined to well-watered areas in riverine or subriverine associations in the vicinity of rivers or swamp. In the Moremi Game Reserve observed at night in heavy woodland with patches of dense underbush and heavy grass cover and on the adjacent floodplain.

At Maxwee a female, accompanied by two juveniles, were taken in an open vlei with grass one foot high fringed by thick *Acacia* woodland.

Habits

Nocturnal, terrestrial usually occurring singly or in pairs. The long legs enable them to walk fast, with a restless gait, the head held low, the heavy hind-quarters higher than the shoulders giving the back a forward slope, the tail trailing the tip curled upwards. When disturbed freeze and may, if sufficiently actuated, erect the long hairs on the back and and white tail to give them an enlarged and formidable appearance. Can move surprisingly fast at the run, usually making for the nearest thick cover of bush or

will take to ant-bear or other holes for refuge, using these refuges to lie up during daylight hours. At the Savuti found using crevices in a rocky kopje.

Avid diggers, the long front claws used in feeding ideally adapted for this purpose but apparently does not excavate its own refuges.

The eyes shine poorly at night and, as the head is normally held low, difficult to pick up in a dazzling light, the whole animal usually being seen first.

In captivity observed to be a poor climber not at all at home even on relatively thick branches.

Will raid poultry runs, a pair being taken in this act in Rhodesia (P 117).

Normally silent, under stress growls, this punctuated by an explosive grunting and a clear short bark.

Food

No stomachs are so far available from Botswana but a series from Rhodesia shows that they have a catholic diet which includes toads; crabs; rodents; reptiles; insects, particularly Coleoptera, and including commonly, Scarabaeidae adults and larva and grasshoppers; termites and earthworms.

Toads and crabs occur very commonly, indicating a riverine preference.

Breeding

No information on breeding is available at the moment from Botswana but, as an indication of when this might be expected, in Rhodesia gravid or lactating females have been taken during the months of October to February. Shortridge (1934) records a gravid female with six foetuses from near Gobabis on 19th November and juveniles 'not more than a fortnight old' from Stampriet (Gobabis district) on 23rd and 27th December.

Sizes and Weights

Only three records are available, an adult female with two juveniles, a male and a female, taken together at Maxwee, 1923 B3 on the 1st February, 1969, as follows:

		Sex	*TL*	*T*	*Hf c/u*	*E*
TNL 4724	Adult	♀	1080	500	149	46
TNL 4725	Juvenile	♂	840	395	130	47
TNL 4726	Juvenile	♂	840	410	131	47

Genus ATILAX F. Cuvier, 1826

Atilax paludinosus

Tshagane Water Mongoose

A. paludinosus (G. Cuvier, 1829)

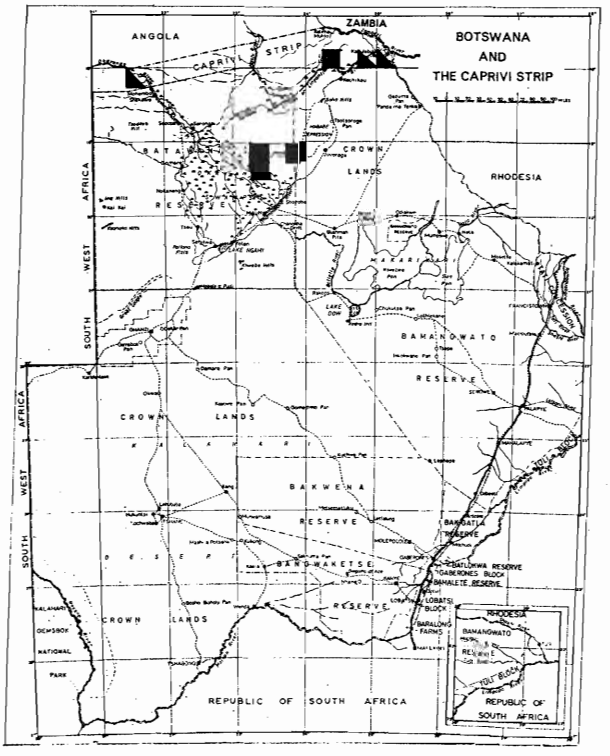
Taxonomic Notes

There is a wide variation in the colour of individuals from populations from limited areas (Salisbury district, Rhodesia). Hill and Carter (1941) remark on the fact that within a series from Angola two pelage colours are apparent, not recognizing any subspecies. Ellerman *et al.* (1953) list four subspecies for the South African region but none are here recognized.

Distribution

Confined to well-watered areas in the northern parts of the territory, on the Okavango River and swamp south-east to the Moremi Game Reserve, Gomoti River and on the Chobe River in the north-east.

Shortridge (1934) restricts their distribution in the northern parts of South West Africa to the Cunene and Okavango rivers and states that they occur in the eastern Caprivi. Their occurrence in Rhodesia and the Transvaal, where they are predominantly eastern in occurrence, indicates that they are unlikely to be found so far west as the Limpopo River Valley and other river valleys in eastern Botswana.



The species is apparently not common in any of the areas in which it has been taken.

Habitat

Narrowly confined to the vicinity of rivers and swamps where there is cover of reed-beds or aquatic grasses. Readily takes to water and swims and dives well, but equally at home on dry land, frequenting the fringes of aquatic habitat in riverine underbush into which they penetrate for considerable distances. Lie up in thick patches of aquatic grasses over water or on the fringes of swamp islands. Well-marked runs are formed from these, running out to the dry banks of the aquatic habitat (Moremi Game Reserve and Gomoti River). Under stress emit a heavy musk smell from their anal glands which although not very powerful is strongly persistent.

Habits

Nocturnal, terrestrial, to a considerable extent aquatic. As all the specimens were trapped, and in spite of active night-hunting in the areas in which they were taken, they were never seen and no observations are available on their habits.

In captivity lay up during the day deep in piles of hay provided, if disturbed emerged with the nose only protruding to investigate. Under stress growled and blew loudly through its nose and under extreme stress emitted an explosive bark.

Food

Only two stomach contents from Botswana were available for examination. As both the specimens were caught in live-traps the contents consisted mainly of the baits used, in one case a turtle dove, *Streptopelia capicola*, in the other a glossy starling, *Lamprotornis nitens*. One stomach (BP 2115) contained the fruits of *Diospiros mespiliformis*, the other (BP 2116) only the remains of the bait. The faeces of BP 2116 contained the pips of *D. mespiliformis* fruits as well as the remains of unidentifiable insects. *D. mespiliformis* is a common species in the riverine forest fringing the swamp in the area in which these specimens were taken (Gomoti River). In Rhodesia frogs, crabs, rats and mice, including the vlei rat, *Otomys angoniensis*, constitute the commoner items in stomach contents, with beetles and termites occurring in lesser quantity.

Breeding

No breeding records were available from Botswana but as in indication of the times when they may be expected to drop the young, females with foetuses and lactating females have been taken in Rhodesia in November and December. Shortridge (1934) does not give any breeding data for South West Africa, Ansell (1960) for Zambia records a female with almost full-term foetuses in October.

Sizes and Weights

MALE (Moremi Game Reserve)

No.	*TL*	*T*	*Hf c/u*	*E*	*Weight*
BP 1850	1005	405	130	38	9 lb. 13 oz.

MALES (Gomoti River)

BP 2115	915	385	120	39	8 lb. 14 oz.
BP 2116	1000	395	134	44	11 lb. 4 oz.

Genus MUNGOS E. Geoffroy and G. Cuvier, 1795

Mungos mungo leTototo Banded Mongoose

M. m. grisonax Thomas, 1926

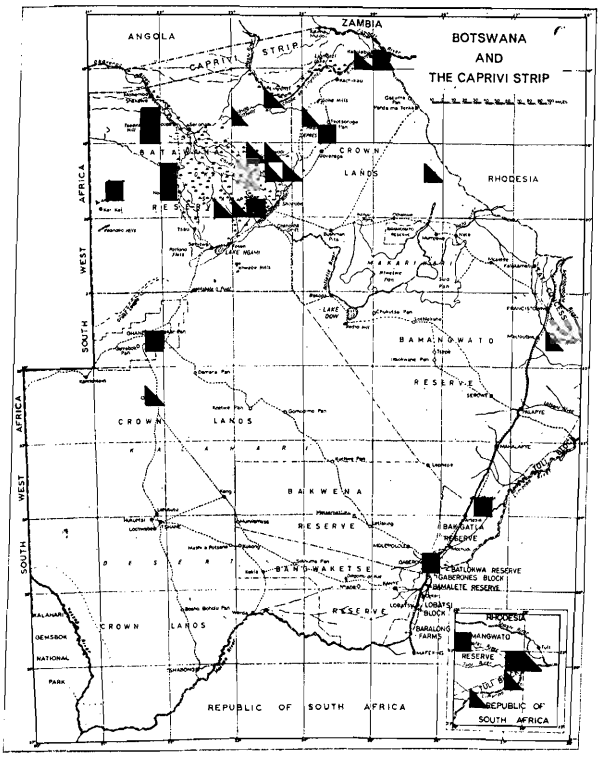
Taxonomic Notes

All the Botswana material is very pale compared with *M. m. mungo* of Natal and Zululand. The palest specimens of all come from Ghanzi and Debeeti which are, in overall appearance, grey with only a trace of pale rusty colour on the lighter transverse bands on the back. Specimens from the Okavango delta, while still pale, are tinged rusty colour overall, the ligher bands on the back with a darker rusty colour on their posterior half than in those from Ghanzi and Debeeti.

Specimens from the northern part of the eastern sector (Magogophate) are more like those from the Okavango delta, in the young, however, the rusty colour is more pronounced overall and the whole of the lighter bands on the back are rusty.

There are too few specimens to make a comparison of sizes and weights compared with *M. m. mungo*.

Meester (1964) includes *M. m. pallidipes* Roberts and *M. m. ngamiensis* Roberts with *M. m. grisonax* Thomas and I propose to follow this.



Distribution

Widely distributed throughout the northern parts of the country, in the west south to Ghanzi and the Okwa Depression, apparently absent from the Makgadikgadi and the area immediately north of the pan. Although few records are available from the eastern sector they occur from just south of the Tati Concession south to near Artesia, being widespread and common in the eastern extension of the Bamangwato Reserve through to the Tuli Circle and the northern Tuli Block farms.

Habitat

All the specimens from the Okavango delta, the Chobe River, the area east of Debeeti and Magogophate and Mabati, in the eastern extension of the Bamangwato Reserve, were taken in riverine woodland with thick underbush. The species is by no means confined, however, to this type of association as is shown by the records from the Aha Hills, Tsodilo Hills, Ghanzi, Okwa and Tamafupi. In these last-named localities, which are in arid areas, they were recorded as being associated with 'thick bush' mainly *Acacia*, or '*Acacia* woodland with underbush, many fallen dead trees and a dense cover of detritus on the ground'.

At the Tsodilo Hills the troops were found in the *Acacia nigrescens* woodland that fringed the foot of the hills.

In both the riverine and dry localities there were termite mounds, the holes in which are used by the species for both temporary and permanent refuges.

In the northern parts of the Okavango delta, where they are quite common, one comes to associate them with the type of thick woodland *Acacia* in which the densest concentrations of tsetse fly, *Glossina morsitans*, are found.

Although the troops will move on to open floodplain or grassland in feeding (Moremi Game Reserve, Nokaneng), or when moving from place to place, this is not the type of habitat with which they are generally associated.

Shortridge (1934) states that they 'favour the neighbourhood of rivers and vleis but may occasionally be found some distance from permanent water . . . in Gobabis they were met with close to dry rivers but only those with occasional water-holes in their beds'. The latter part of these remarks fits the situation east of Debeeti and at Magogophate and Mabati on the Macloutsie and Limpopo rivers.

In general one of the essential habitat requirements appears to be woodland with dense underbush preferably with fallen logs and other detritus on the ground and termite mounds.

Habits

Diurnal, terrestrial, gregarious, normally occurring in troops of from eight to twelve (Tsodilo Hills 8; Debeeti 10; Mabati 12) but larger concentrations known up to 30 (Nokaneng 20-30; Tsodilo Hills 30). A troop in the Moremi Game Reserve lived in holes in a deserted termite mound, this appearing to be the central refuge from which they wandered widely the troop splitting up into small units of about six to feed. They were seen on and off on several days in the vicinity of this termite mound in the late afternoon, not in the morning when presumably they were out feeding.

When a troop is disturbed it makes for the nearest thick bush in which, if pursued, it will take to any sort of holes that may be available, in some cases, judging by the spoor and scats around, well-established temporary refuges in the form of hollow logs, under dead trees (Gomati) which are frequently used (cf. *Helogale parvula*) and yet are not secure enough to be the permanent home.

In feeding the troops do not appear to use any established pattern of movement, seldom being found in the same area on two days running, except in the

immediate vicinity of the permanent home. These movements are probably governed by the availability of food, the temporary refuges allowing them to settle in an area, where food is abundant, for short periods. Simpson (1964) observed that a troop under observation for a month used three different warrens located in an area of more than one square mile. While no exact information is available it is thought that the troops move considerable distances in feeding. A troop which appeared during a tea-break by the roadside north of Shorobe was seen three-quarters of an hour later about a mile further up the road. While there is no confirmation that this was the same troop, it was the same number, seven, and moving in the same direction.

Troops move through thick underbush, with fallen leaves and other detritus very noisily, their scratching and digging being audible over some distance. They also appear to maintain contact by twittering and chirping. If disturbed members utter a high-pitched chitter when the troop will freeze, some individuals rising on to their back legs, the front hanging down close to the body (cf. *Helogale parvula*) to gain a better view, then scattering off through the undergrowth.

The amount of scratching and digging engaged in is reflected in the high proportion of beetle grubs in the stomach contents which, living subterraneously, can only be secured by digging.

Simpson (1964) observes the same behaviour in this species in dealing with a 'large egg' as was recorded with the dwarf mongoose, *H. parvula*. In this case, however, owing to the size of the mouth some eggs could be broken open by using the canine teeth.

Although many of the specimens were taken in areas where water is available they are obviously not dependent on this as other records (e.g. Okwa, Aha Hills) are from localities where water is not freely available, if at all. In captivity they drink, either lapping or dipping the forefeet and licking them (Simpson, 1964). In arid areas they must depend on the moisture derived from their food. In the Wankie National Park troops have been seen drinking at water-holes (Nyamandhlovu) but they do not do this avidly, only lapping a few times and then moving on.

Climbing, except on to fallen logs, which they will use as a vantage point, rising up on their back legs to look around, has not been witnessed, but Simpson (1964) quotes an instance where, when a troop was chased by wild dogs, *Lycaon pictus*, they 'climbed to the topmost branches of a tree pushed over by an elephant, where they were comparatively safe'.

Food

Only four stomach contents were available for examination. In all these there were Coleoptera larva, constituting 75% (with some adults), 40%, 20% and 5% of the individual content, indicating a strong preference for this type of food. Wild fruit, identifiable in one case as *Grewia* sp., occurred in three, constituting 70%, 20% and 20% of the individual content. This suggests a greater preference for this type of food than is usually suggested, Shortridge (1934) listing this type of diet as 'occasional' only.

Other items included Solpugidae; Insecta, indet.; Orthoptera, Acridiidae, which were found in one content each; and Coleoptera, adults and Reptilia, the latter represented by:

The worm lizard, *Zygaspis quadrifrons*
Peters' worm snake, *Leptotyphlops scutifrons*

which were found in two contents, the worm lizard, *Z. quadrifrons*, occurring twice.

Breeding

No gravid or lactating females were taken but, as an indication as to when they may drop the young, Shortridge (1934) records a female with six foetuses from Gobabis, South West Africa, taken in November and juveniles not over 14 days old from Stampriet-fontein (Gobabis district). Ansell (1960) for Zambia records foetuses in October, November and juveniles in December, January and February and quotes Uys who suggests a peak of dropping young about December. On this basis information should be sought during the warm wet months of the year from about August through to February.

Sizes and Weights

MALES

TL	$\bar{X} = 533$;	$N = 8$;	Obs. range 498- 586
T	$\bar{X} = 206$;	$N = 8$;	,, ,, 178- 232
Hf c/u	$\bar{X} = 76$;	$N = 8$;	,, ,, 74- 82
E	$\bar{X} = 23$;	$N = 8$;	,, ,, 21- 27
Weight	$\bar{X} = 794$ g;	$N = 7$;	,, ,, 460-1253 g

FEMALES

Only four measurements and two weights available:

	TL	*T*	*Hf c/u*	*E*	*Weight*
G 461	610	245	74	25	—
BP 890	540	225	81	22	1281 g
BP 1567	504	220	72	20	570 g
TNL 3039	560	220	73	27	—

Genus HELOGALE Gray, 1862

Helogale parvula

leSwekete Dwarf Mongoose

H. p. parvula (Sundevall, 1846)

Distribution

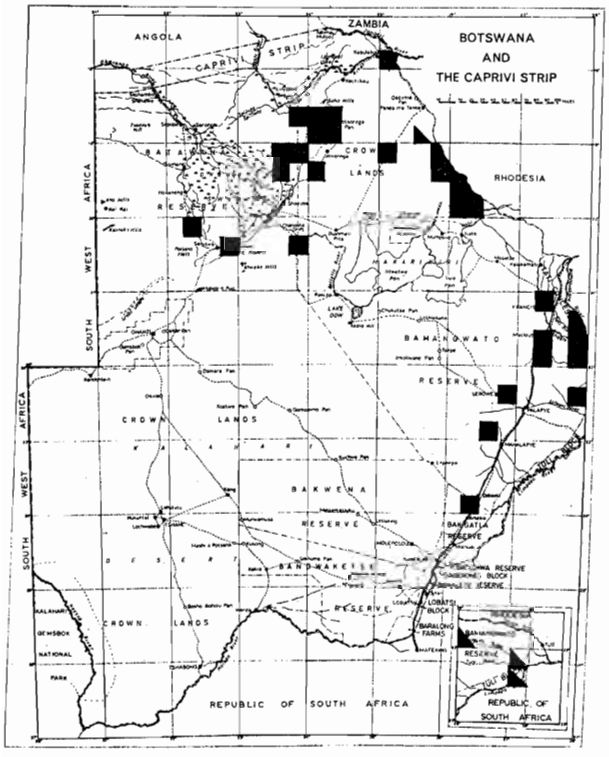
Widely distributed in the north-eastern sector and westwards south of the Okavango delta to Tsau. In the eastern sector occur from the Tati Concession south to Debeeti and narrowly westwards to near Serowe and Shoshong.

Absent from the Kalahari, the Makgadikgadi area, the north-western sector north of Tsau and the eastern sector south of Debeeti.

Habitat

An analysis of the habitat in which 52 specimens were taken is as follows:

Acacia woodland or scrub	7
Terminalia-Combretum scrub	26
Mopane scrub	6
Hard ground (cultivated areas or pans)	8
Granite kopjes	3
Riverine scrub	2
	52



Both *Acacia* woodland and scrub and particularly *Terminalia-Combretum* scrub are normally associated with sandy ground. It was particularly recorded, in the majority of cases, that the specimens, when taken in these associations, were found on or near areas of hard ground especially in association with active or quiescent termite mounds.

This applied also to the two taken in riverine scrub (Makalamabedi) where they formed part of a large colony occupying an ant-heap in the riverine forest.

In addition to the termite mounds or other type of hard pan ground a characteristic feature of typical dwarf mongoose habitat was areas in which there were accumulations of dead trees, fallen logs or piles of dead branches with some cover of trees or bushes.

Habits

Diurnal, terrestrial, gregarious, troops normally 8-10 but up to 20-30 known (Sand Ridge, BP 1900).

Troops have permanent residences in termite mounds or in extensive burrows, with many entrances, in hard ground and several frequently, but only temporarily used *pieds-à-terre* scattered within their home range. These may consist of shallow burrows, some apparently excavated by themselves, often under fallen logs, hollow fallen logs, hollow standing trees or piles of rocks. Shallow burrows may also be excavated under bushes or at the base of trees not more than 15 cm under the surface and up to 1·8 m long with several entrances (Tamafupi). It is possible that these had originally been made by a rodent and enlarged by the mongoose for, in captivity, while they were avid diggers they never produced burrows of their own, preferring to use a cement one provided or hollow logs lying on the surface of the enclosures.

When disturbed the troop makes for the nearest temporary refuge. They are reasonably easily moved from these by hammering on the logs or digging them out. Once in the permanent residence, however, it is almost impossible to move them as the burrows run deep underground.

The permanent residences were characterized by substantial accumulations of scats, including those of juveniles, near the entrances. Although these are found near the entrances of the temporary refuges they are never in any quantity.

At Madinare the permanent refuges were found under piles of rocks, some sign of excavation being in evidence in the form of ramps of soil at the entrances. In digging, the soil, once loosened with the claws on the front feet, is thrown backwards between the back legs with the front feet which are held together to form a scoop.

The troops scatter to feed, moving slowly through the undergrowth with much scratching and shallow digging, contact being maintained by a series of short abrupt '*perrips*' with answering '*perrips*' in a lower key, or musical '*chuchs*', audible to the human ear over short distances. The alarm call is a sharp '*chu-chwee*' the emphasis on the prolonged '*wee*'. When this is given by a member of the troop the remainder freeze, then, after a time, rise on their back legs and, balancing with the tail, search around for the cause of the disturbance, the head moving quickly, the remainder of the body held motionless. This alarm is given on spotting an observer in the field, and in captivity on the appearance of crows, birds of prey or domestic cats.

The dominant individual in a troop in captivity normally gave the serious alarm call '*chu-chwee*' and used the musical '*chuch*' rather than the '*perrip*'. Lesser disturbances such as falling leaves or noises are heralded by a series of quickly repeated '*perrips*'. The normal reaction after an alarm is to dive for a refuge, later emerging cautiously, the nose protruding from the hole to test the air, then the whole head, after which the individual emerges to sit up and look around.

Play was observed both in the field and in captivity in the form of mock fighting, two individuals rolling around on the ground interlocked or standing up on their back legs facing each other, the front legs touching and the opponents making mock slashes at the side of each others necks. When such play became too rough for either opponent the 'vanquished' would lie down on its side, moving the uppermost free front leg backwards and forwards as if pushing the opponent away. The play would then cease. This submissive action was used by the juveniles when suddenly confronted by an adult or on occasions where disputes arose among members of the troop over food, etc. It was also apparent when a strange individual was introduced to an established troop in captivity. Strangers of either sex or age were, after some initial sorting out of status, accepted by the troop.

In the field the species must, of necessity, on account of the type of terrain it inhabits, be independent of water. In captivity they will, however, drink. They make a clumsy job of lapping and frequently appear to prefer to drink by dipping the forepaw in the water repeatedly and licking it off.

Both in the field and in captivity they would emerge only after the sun was well up and would not emerge at all if the day was cold, rainy or overcast. They would return to the holes well before sunset, as early as 4 p.m. on cold days.

They would lie sunning themselves on logs or on the ground in the morning. At such times in particular mutual grooming was very much in evidence, one lying down while the other nibbled the side of its neck or the back of the head and shoulders.

In captivity the species relished the yolk and albumen of eggs which was lapped directly or the front paws dipped in it and then licked off. The dominant female was taken in the field when nearly adult and may, therefore, have had previous experience with eggs. She had little difficulty in dealing with them. Hens' eggs being too large in diameter she was unable to make any impression on them with her teeth and, after some initial trials to break them in this way, she manoeuvred them with her front feet, moving backwards, until she was close to and facing away from a rock in the enclosure. Grasping the egg in her front feet she then propelled it between her back legs with considerable force until it broke on the rock, when it was opened up with the teeth and the contents consumed. All members of the troop from time to time had the opportunity of dealing with hens' eggs and all dealt with them in this manner, some being more adept at aiming them correctly than others.

A younger female taken in the field as a juvenile was quite clumsy at first but improved with practice. She would carefully clear the ground in line with the rock or wall before propelling the egg, scraping the soil with the front claws and at the same time moving backwards. This process was sometimes continued to such a stage that a deep channel was produced which made it the more difficult, or in some cases impossible, to properly propel the egg, when it would have to be moved to another position.

A golf ball was dealt with in the same manner, the process in this case continuing sometimes for long periods, until the individual gave up. The indication here is that the individuals concerned were recognizing eggs rather by sight than by smell as otherwise the golf ball would have been discarded. On the other hand the behaviour may be inherent in certain species of mongoose for, a slender mongoose, *Herpestes sanguineus*, acted in a similar manner when given an egg, a hazel nut, a stone, or in fact any small hard object.

Food

The number of occurrences, in a sample of 21 stomachs, of various items of food were as follows:

Food Item	*No. of Occurrences*	*Note*
Coleoptera adults	8	See text
Coleoptera larvae	5	Including *Tetralobius* sp.
Isoptera	10	See text
Orthoptera	8	„ „
Insecta	7	Indet.
Araneae	2	'Baboon-spider'
Muridae	1	Juv. *Saccostomus campestris*
Reptilia	1	*Eremias* sp.
Scorpiones	1	Indet.
Solifugae	1	„
Lepidoptera	1	„
Myriapoda	1	*Scolopendra morsitans*

Unfortunately the food is very thoroughly masticated and detailed identification is difficult. The item of commonest occurrence in a sample of 21 stomachs was Coleoptera which was found in 13. In eight of these adults only were found, in five larvae which, being subterranean, would have had to be dug up. This would present no difficulty to the species with its long front claws and well-developed powers of digging. The area traversed by a feeding troop is covered with the small excavations made in the course of their search for subterranean food of this sort.

The second commonest food item consisted of Isoptera, in ten stomachs, the following species were recognized:

species	*No. of occurrences*
Hodotermes mossambicus	1
Macrotermes bellicosus	2
Odontotermes latericius	1
Odontotermes sp.	3
Indet.	3

Orthoptera occurred in eight stomachs represented by the following families:

Family	*No. of Occurrences*
Acridiidae	6
Gryllidae	2

The unidentifiable remains of Insecta occurred in seven stomachs.

Insects appear to constitute the bulk of the food, although reptiles and mice are also eaten. In captivity mice and small snakes, live or dead, as well as small birds were eaten.

Breeding

There are only two records of gravid females, both taken at Toten, as follows:

Distribution of gravid and non-gravid females through the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	3	2	–	2	1	2	5	2	2	2	1	–
Non-gravid	3	–	–	2	1	2	5	2	2	2	1	–
Gravid	–	2	–	–	–	–	–	–	–	–	–	–

Juveniles were taken at Tamafupi (BP 202) in March and at Madinare (BP 863) in April and others seen at both these localities during these months.

Ansell (1960) for Zambia gives two records, one of foetuses in December and a second of juveniles (7-10 days old), in October. Shortridge (1934) records juveniles 'not more than a month old in April and "half grown" in April and July'.

The sample is too small to provide conclusive data as to the time at which the young are born although the above indicates that it is in the rainy season from about November to March.

In the two gravid females one carried two foetuses, the other four, implantation being 1R 1L and 2R 2L, respectively.

Sizes and Weights

MALES

TL	$\bar{X} = 367$;	$N = 34$;	Obs. range 312-410
T	$\bar{X} = 166$;	$N = 24$;	„ „ 152-183
Hf c/u	$\bar{X} = 46$;	$N = 23$;	„ „ 42- 51
E	$\bar{X} = 17$;	$N = 21$;	„ „ 13- 19
Weight	$\bar{X} = 267$ g;	$N = 13$;	„ „ 227-341 g

FEMALES

TL	$\bar{X} = 372$;	$N = 19$;	Obs. range 327-426
T	$\bar{X} = 164$;	$N = 19$;	„ „ 142-193
Hf c/u	$\bar{X} = 46$;	$N = 19$;	„ „ 41- 49
E	$\bar{X} = 17$;	$N = 18$;	„ „ 14- 20
Weight	$\bar{X} = 269$ g;	$N = 11$;	„ „ 213-341 g

There does not appear to be any sexual difference in sizes and weights of this species.

Order TUBULIDENTATA
Family ORYCTEROPODIDAE

Genus ORYCTEROPUS G. Cuvier, 1798
Orycteropus afer Thakadu Antbear
O. a. afer (Pallas, 1766)

Taxonomic Notes

Roberts (1951) places a specimen from the Thamalakane River, Botswana, as *O. a. albicaudus* Rothschild, a subspecies stated to have 'a very short tail, which is pure white'. Roberts gives the dimensions of the type as HB 1319; T 330 giving a tail length of 28% of the head and body.

Roberts (1951) quotes measurements of three specimens from the Republic of South Africa which he places as *O. a. afer* (Pallas) which gives tail lengths of from *c.* 37% to 49% as follows:

HB	*T*	*T as a % HB*
990	485	49%
1216	444	37%
1419	608	43%

In comparison the Botswana series gives the following tail lengths as percentages of the lengths of the head and body:

MSa 67	965	535	55%
SWG 1278	968	587	60%
BP 1458	1052	553	51%
BP 78	1154	614	53%
BP 2125	1040	510	49%
BP 1798	1105	510	46%

Shortridge (1934) gives the measurement of a specimen from Sandfontein, South West Africa:

HB	*T*	*T as a % HB*
840	450	53%

and another which he ascribes to Roberts from Okahanja, South West Africa:

1168	502	43%

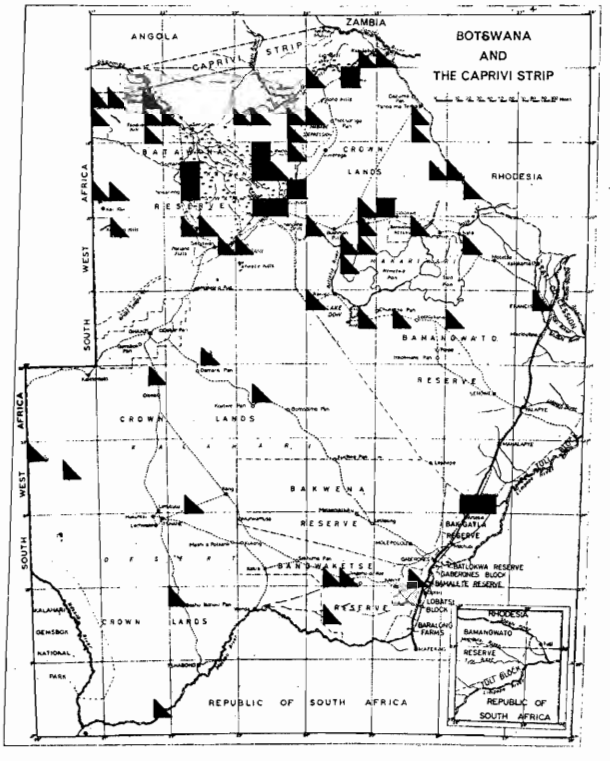
None of these have as short tails in proportion to the length of the head and body as the type of *O. a. albicaudus*.

Rothschild (1907) states that the tail of *O. a. albicaudus* is 'pure white'. In none of the Botswana specimens can the tail be claimed to be pure white. In BP 2125 from the Okavango delta the base of the tail above is dark like the rump, only the distal 160 mm white, this white continuing up the sides and the undersurface of the tail to its base. In BP 1458 from Debeeti the distal 300 mm is white above with a similar darkening towards the base and BP 78 from Nokaneng is similar, 260 mm of the tail being white.

On the above basis all the Botswana species are placed with *O. a. afer* (Pallas).

Distribution

Widely distributed throughout the territory except in the rocky hilly country of parts of the eastern sector where, however, they occur in the valleys.



Habitat

The species has a wide habitat tolerance occurring in open grassy plains, bush and open woodland, savannah and riverine woodland. They appear to have a preference for sandy soils associated with the above conditions, but are also found in mopane woodland on hard pan ground. All these types of habitat support ants and termites which are the principal food and the fresh diggings in the base of termite mounds and in the ground are often the only tangible evidence of their presence in an area.

In extensive areas of floodplain (Nokaneng), while they may be found wandering far on to the open plain, they are more closely associated with the raised sandy fringes or the fringes of islands on which their holes are found and in these areas, which remain dry in the season of floods, termites and true ants are found. They do, however, occasionally dig their holes in areas which seasonally flood which, if they are occupied, have to be evacuated. During the high floods of 1956 many holes on the Mababe Depression were flooding.

Not found on 'black cotton' soils (Nunga-Pandamatenga) or hard pan ground (Nxai Pan), where there are no ants or termites, except when in transit.

Habits

Nocturnal; only under exceptional circumstances, such as being flooded out, may they be seen during the day. It is reported that they have been killed by Bushmen when lying sleeping in the sun during daylight hours, when the holes become untenable through flooding. Terrestrial, solitary. Live in holes which they excavate themselves, mainly in sandy ground but they are capable of digging even in the hardest soils. These excavations appear to be divisible into three types:

(*a*) Diggings for food, of the type found at the base of termite mounds or on open ground which may be quite deep, sufficient to allow the animal to disappear underground, or quite shallow and only sufficient to allow the ingress of the head. These are not used as refuges.

(*b*) Temporary burrows used as refuges for a day or two but not permanently occupied. These are characteristic of agricultural lands in Rhodesia where, as the mealie crop reaches a sufficient height to afford cover, they are dug and which, from the evidence of the spoor, are not occupied for more than a day, or at most up to two to three days.

(*c*) The 'permanent' holes in which they appear to take up residence, when not on the move, and in which the young are born. These 'permanent' holes may, by prolonged use, and re-excavation eventually attain a considerable size, with a ramp of excavated material at the entrances, of which there may be several, all joining underground.

The presence of the ant-bear, in either the temporary or 'permanent' refuges, can usually be ascertained by the characteristic spoor and the mark of the trailing tail on the freshly excavated material at the entrance, and also by the presence of flies in the shade at the entrance to the hole, which will buzz around if disturbed and return to its shelter.

Dorst (1969) suggests that it is the female that makes use of the 'permanent' holes, the males being more vagabond.

Antbears are extraordinarily powerful animals and, caught digging, can scarcely be pulled out by the combined efforts of several people. They dig very deeply and quickly and even in soft ground a team of diggers cannot keep up with them as, being disturbed, the ant-bear digs ahead of them.

In moving they make use of paths and tracks, their exploratory burrowing being a hazard to vehicles.

It appears that they have a very extensive home range, Dorst (1969) suggests that they cover as much as 10 miles in a night, rarely visiting the same area on successive nights. They are slow movers walking with a lumbering jaunt but, when disturbed, rise on the legs and can run remarkably fast. The sight does not appear to be good as, when running, they will crash into bushes, trunks of trees and other obstructions, the thick skin not apparently being affected by such abrasive treatment.

Antbears, through their digging activities, play a very important part in the lives of many other animals who use their holes for shelter or in which to breed. The following table lists a range of mammals, birds and reptiles which have been observed to use ant-bear holes eithe: for these purposes.

MAMMALIA

Species	*Refuge*	*Breeding*	*Remarks*
Blackbacked jackal, *Canis mesomelas*	+	+	Pair with five young in antbear hole, Battlefields Ranch, Bembesi, Rhodesia (1958).
Sidestriped jackal, *Canis adustus*	+	+	Pair with young in antbear hole, Calgary, Salisbury, Rhodesia, and taking re-

Species	*Refuge*	*Breeding*	*Remarks*
			fuge in hole when chased, Melsetter (Raath).
Wild dog, *Lycaon pictus*	—	+	Pairs breeding in ant-bear holes on C.D.C. Matetsi Ranch, 1958. *See also* Shortridge (1934); Dorst (1969), etc.
Genet, *Genetta* sp.	+	—	In Mashonaland, Rhodesia, one of the two species of genets, either *Genetta genetta* or *G. tigrina* temporarily used an ant-bear hole on Thornpark Farm (author).
Genet, *Genetta genetta*	+	—	At Lephepe a wounded individual took to an ant-bear hole.
Slender mongoose, *Herpestes sanguineus*	+	—	Observed using disused holes (Toten, Tamafupi).
Yellow mongoose, *Cynictis penicillata*	+	—	When chased took to a disused hole (Lake Ngami).
Aardwolf, *Proteles cristatus*	+	+	Pairs bred in ant-bear holes in the Lonely Mine district in 1950 and 1969 (Ellman Brown, *in litt.*), and there are other reports of this (W. L. Sclater (1900); Dorst (1969); Roberts (1951), etc.).
Brown hyaena, *Hyaena brunnea*	+	+	Roberts (1951) records the breeding of this species in ant-bear holes. A hyaena, probably this species, was using a hole near Tshane as a refuge.
Spotted hyaena, *Crocuta crocuta*	+		W. L. Sclater (1900) records the use of antbear holes as refuges of this species.
Wild cat, *Felis lybica*	+	+	At Nokaneng kittens were found in a hole and at Nata a female wild cat carrying a kitten in its mouth, when chased, dropped it in the entrance of a hole and made off. The kitten was eventually recovered by digging.
Leopard, *Panthera pardus*	+		A leopard appeared from the spoor to be using a disused hole near Sekhoma Pan.
Warthog, *Phacochoerus aethiopicus*	+	+	Warthogs regularly use disused holes in which to rest and breed. In resting up to five may use the hole at the same time, in breeding only the pair and the progeny.
Steenbuck, *Raphicerus campestris*	+	—	A wounded steenbuck in open country used a hole for refuge (Lephepe).
Cape hare, *Lepus capensis*	+	—	Under stress Cape hares have been observed to take to the holes (Kwebe Hills; Nata).
Porcupine, *Hystrix Africae-australis*	+	+	Observations from the Salisbury area, Rhodesia, confirm the use of the holes by this species. Between Kang and Tshane a wounded porcupine took refuge in a deserted hole from which it could not be dislodged until dug out. Quills have been found in holes in several localities (Sehitwa, Shorobe, nr. Toten).
Pouched mouse, *Saccostomus campestris*	+	—	Near Maun rodent spoor was noticed entering an antbear hole. Trapping inside the entrance yielded a pouched mouse. There is no evidence to suggest that this species was breeding there but this is not unlikely, and it is probable that other Muridae use the holes both for refuge and breeding.

AVES

Species	*Refuge*	*Breeding*	*Remarks*
Anteating chat, *Myrmecocichla formicivora*	+	+	The anteating chat excavates a nesting cavity in the roof of the hole 18-24 in.

Species	*Refuge*	*Breeding*	*Remarks*
			from the entrance and rests in this at night.

REPTILIA

Species	*Refuge*	*Breeding*	*Remarks*
Python, *Python sebae*	+	+	Pythons incubate their eggs in antbear holes (Umtali).
Crocodile, *Crocodilus niloticus*	+	—	Crocodiles using semi-permanent water-holes will, when these dry up, seek refuge until the water-hole fills up, in antbear holes (Wankie National Park).

Food

Formicidae constituted the principal content in the three stomachs available, only traces of other food being present as follows:

No.	*Formicidae*	*Isoptera*	*Hemiptera (larvae)*
BP 1798	100%	—	—
BP 78	100%	Tr.	—
BP 2125	100%	Tr.	Tr.

BP 1798 collected on the Kwaai River, was particularly interesting as it had two fat mice, *Steatomys pratensis*, in its mouth, both considerably crushed through mastication. There seems little doubt that the antbear had deliberately picked these up in its mouth and was in the process of eating them when shot.

In the case of BP 2125 and BP 78 the Formicidae were identified as *Anoplolepis custodiens* and *Camponotus maculatus* respectively.

The predominance of Formicidae in this small sample is paralleled in a sample of eight contents from Rhodesia, where they occurred in seven, in four forming 100% of the content, and in the remaining three, 25%, 10% and a trace. Isoptera occurred in four; in two cases forming 100%, and in one case a trace. In three cases the Formicidae were identifiable as *Dorylus* sp., in one *Anoplolepis custodiens*. In one case 25% of the content consisted of melon pips and pulp, probably originating from melons grown for cattle food which abounded in the farmlands in which the specimen was taken (Hartley).

The stomach content invariably contains a high percentage of soil, sand, small stones and other debris ingested fortuitously with the food, in the case of BP 2125, 47% of the total content by weight.

Breeding

Only one pregnant female was taken with one foetus, implanted 1R, in July.

A further female BP 1798 taken on the Kwaai River in August was non-gravid.

FitzSimons (1919) states that a single young is born 'during the winter months May to July'. For Rhodesia there are two records of pregnant females taken in May and one in August all carrying a single foetus. Two non-gravid females were taken during both the months of October and November, and one in February.

The indications here are that a single young is born during the colder, drier months of the year from about May to August.

Sizes and Weights

MALES

		TL	*T (to mid anus)*	*Hf*	*c/u*	*E*	*Weight*
BP 78: Nokaneng	2/64	1768	614	276	180		140 lb.
BP 1458: Debeeti	8/65	1605	553	250	176		—
SWG 1278: Nokaneng	6/67	1555	587	270	181		116 lb.
MS a 67: Maun	8/68	1500	535	240	172		101 lb.

FEMALES

BP 2125: Gomoti River	7/68	1550	510	255	172		101 lb. 12 oz.
BP 1798: Kwai River	8/63	1615	510	235	172		—

Order PROBOSCIDEA

Family ELEPHANTIDAE

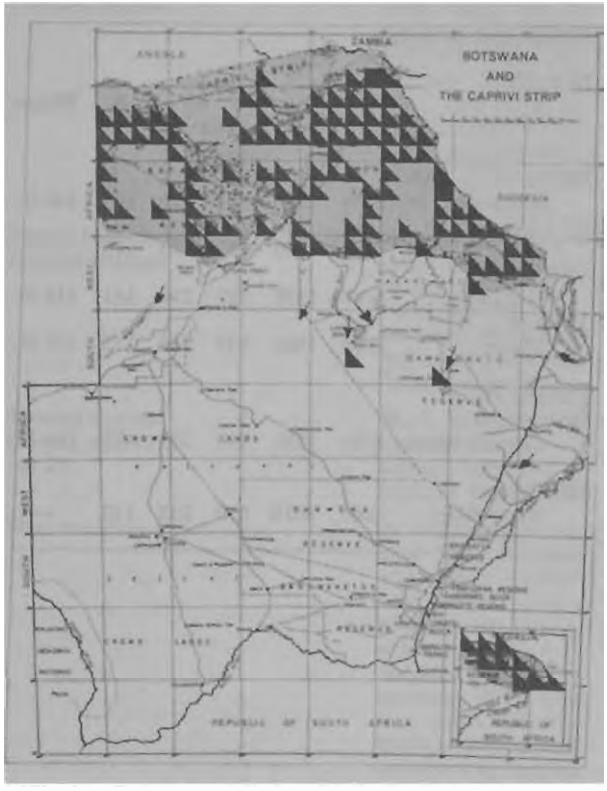
Genus LOXODONTA F. Cuvier, 1827

Loxodonta africana Tlou Elephant

L. a. africana (Blumenbach, 1797)

Distribution

Widespread and common throughout the Caprivi and northern parts of Botswana extending south to the Aha Hills, on the South West African border, and thence eastwards to near Tsau in the western Okavango, the Botletle River and the northern parts of the Makgadikgadi. East of the Makgadikgadi they occur south to the Dukwe Cordon and eastwards to the Rhodesian border, north of the Tati Concession. Small herds and individuals occasionally break their way through the cordon fence, penetrating southwestwards to Mosetsi, in the mopane woodland on the eastern fringe of the Makgadikgadi. There is today an artificial break in distribution between these northern populations and those in the extreme eastern extension of the Bamangwato Reserve on the Shashi River, and in the vicinity of the Tuli Circle. This artificial break was caused by a long-term control programme aimed at containing such elephant as remained in this eastern sector within an area, along the Shashi River, known at one time as the 'elephant containment area'. This control initiated in 1956 was designed to and has, in a large part, succeeded in keeping them off the Tuli Block farms and the Tati Concession, some 500 elephants being taken off in four to five years.



It is estimated that at December 1969 there remained a population of some 600-800 elephant in this area and adjacent parts of Rhodesia (Campbell, *pers. comm.*).

Within these ranges there is considerable local and seasonal movement especially affecting the populations in the drier areas of the central and eastern parts of the north-eastern sector, and the area west of the Okavango swamps. At any time of the year, however, one can be reasonably sure of contacting elephant throughout the length of the Chobe River, on the fringes of the Okavango swamp, along the Okavango and Maschi rivers and in the extreme eastern extension of the Bamangwato Reserve along the Shashi River.

In the area west of the Okavango and in the north-eastern sector there are distinct seasonal movements which involve large numbers of elephant which, with the onset of the rains or immediately preceding them, move into areas of dry country as surface water supplies become available in the form of temporary supplies in pans or water-courses, and a return to river valleys or swamp as these temporary supplies dry up. Child (1969) suggests that these movements are also dependent to some extent on the seasonal fruiting of trees.

These movements warrant study by the marking of large numbers of elephant before they can be claimed to be properly understood and such information at present available is based on general observation and experience of numbers of observers resident in the areas affected.

Child (1969) deals in some detail with movements over the Chobe River into the eastern Caprivi Strip, which is well-watered at all times of the year. Elephant move into the Caprivi each dry season, returning to Botswana with the onset of the rains in November or December. There is also a dispersal from the Chobe River area itself with, or just prior to, the onset of the rains, into the dry hinterland where from this time onwards, water becomes temporarily available in pans and water-courses. As these sources of supply dry up elephant will leave their immediate area for other and longer-lasting water supplies. These movements, because of the irregularity of the periods in which water remains available, are, to some extent, irregular.

The populations of elephants which, during the rainy season are found in the central parts of the north-eastern sector, move from this area, as it dries up, from about August onwards, in part returning northwards to the Chobe River or north-eastwards to the Zambezi River west of the Victoria Falls, westwards into the northern part of the Okavango delta (Moremi Game Reserve), or eastwards into the Wankie National Park, Rhodesia. Prior to the establishment of this last-named area as a national park, the country was to a large extent waterless, and such elephant as may have moved eastwards would have to find their way as far as the Gwaai River, the nearest permanent water supply which lies to the east of the park. With the establishment within the Wankie National Park of permanent artificial water supplies, however, large numbers of elephant move into it from August through to October from the north-eastern sector of Botswana, which is then rapidly drying up, and remain in the park until the onset of the rains in October or November. The dispersal of these populations of elephant in a westward direction into Botswana takes place in a relatively short time and in a season of good rains the great majority have left the park by December.

How far west individual herds move from this area is not known but there are a series of well-used and old-established elephant paths running roughly north-west-south-east all the way from the Rhodesian border, which are still well demarcated, and can be clearly seen from the air or the ground, crossing the Pandamatenga-Bushman Pits road, 80 miles west, and continuing over this towards the Okavango.

Apart from these relatively well-marked seasonal movements small herds and solitary individuals wander widely, finding their way into areas far from those in which elephant are normally found. These movements usually occur during the wet season.

Such occasional wanderings have carried them south to the Groot Laagte in the west, where three were reported in 1962 (Campbell, *pers. comm.*); the north-eastern part of the Central Kalahari Game Reserve; to Lake Dow and points immediately south of this; to near Moyabana and from the Shashi River area west to the railway line near Macloutsie and south-west to near Mahalapye. An individual found its way round the south-eastern corner of the Makgadikgadi to near Nthane in 1968 (Campbell, *pers. comm.*), and there is a report of one individual that wandered down the northern side of the fence to a point west of Inkokwane Pan. Such wanderings are largely unpredictable and their penetrations away from the normal areas of occurrence follow no particular pattern, nor can it be estimated how long they may spend there, or whether they will return by the same routes as on their outward journey. These occasional wanderings have been known since historical times for Bryden (1893) writes of a 'strange event' in the appearance of nine or ten elephant in the hills near the town of Molepolole. All these wanderers were shot.

In historical times elephant apparently had a wider distribution than today. Bryden (1893) records that Khama, as a youth (*c.* 1848), spoke of elephant in profusion at Shoshong. There was still a small population of elephant in this area up to 1925-30 and a vagrant was reported as late as 1968 (Campbell, *pers. comm.*). Livingstone (1857) records prodigious numbers on the south bank of Lake Ngami. Andersson (1856) writes of an encounter with a herd of 18 near Kobis (near Mabeleapudi). All these records are a good deal further south than they generally occur today, except as occasional wanderers. Selous (1890) regards the area between the Tati and Ramaquabane rivers (in the southern part of the Tati Concession), as 'one of the best hunting grounds (for elephant) to be found in South Africa'. Bromfield (*pers. comm.*) stated that following a period of years of intensive control in this area the last elephant was shot in the Tati Concession in 1961. Until 1963 it was quite normal to find signs of elephant, moving from the populations resident in the eastern part of the Bamangwato Reserve, as far west as the main road running south from Macloutsie, in the vicinity of the top

reaches of the Macloutsie River and its tributaries, although by 1966 they were only known there as occasional wanderers.

There is considerable evidence which suggests that elephant, more especially in the north-eastern parts of Botswana, have greatly increased in numbers within recent historical times. Child (1968) from local verbal evidence in this area and the eastern Caprivi states that 'elephant populations have increased very rapidly, especially during the last ten years'. The same remarks apply to the Wankie National Park, Rhodesia, which adjoins the Botswana border in the north-east where, judging by the remarks of Davison (1967), covering the early years of his administration of this area as Game Warden, as compared with the present situation, where, in 1970, 7 910 elephant were counted in this 5 600 sq. mile area at the end of the dry season.

Habits

Generally gregarious, they occur in small herds of up to 20-30, but solitary bulls often encountered and two or three bulls together or cow herds with young not infrequently met with. Elephant move both during the day and at night but, during the hottest hours of the day from about midday to 3 p.m., normally seek the shelter of shady trees where they stand about or sleep standing up. While elephant are dependent on water supplies, herds may not necessarily drink daily, often up to two or three days elapsing between visits to water. These visits are normally accompanied by bathing or spraying water over themselves with the aid of their trunks and, if it is available, wallowing in mud.

As water supplies dry up, elephant will dig for it, thus opening up and making water supplies available to other species which, in many cases, become solely dependent on these excavations towards the end of the dry season. This digging is carried out by the use of the tusks, sharp edges of the front feet and the tip of the trunk. While normally elephant will move from areas as water supplies dry up, if remaining, these excavations gradually become so deep that the water cannot be reached by other species. At Piri Pan in the north-eastern sector a small herd of four was using a hole which was some 30 inches deep and barely larger than the diameter of the trunk. This, starting as a wide excavation, had been dug out in the lower section by the use of the tip of the trunk. Water was slowly percolating into this hole and the individuals had necessarily to wait their turn to use it. At the time of the visit the herd bull was drinking, every now and then driving the others away, not relinquishing his position for about an hour, when he moved off, allowing another member of the herd to take its turn.

Child (1968) describes similar competition for water in the following year (1965) in the same area and the killing of two sable, *H. niger*, by elephant in disputes over a dwindling water supply. At Tamafupi elephant watering at a small hole were seen to chase off warthog, *P. aethiopicus*, zebra, *E. burchelli*, sable, *H. niger*, and buffalo, *S. caffer*, all of which hung around the water-hole until the elephant had left before attempting to drink. 1964 and the following year were the last two years of an unprecedented drought in Botswana and the surrounding areas and elephant were in poor condition (Child, 1968). A small herd watering at a newly opened borehole in the western part of the Wankie National Park, which was intensely saline, all died as a result.

While there are no published records of the distances travelled by elephants in Botswana, they appear to be capable of covering long distances at night when feeding or moving to water. When on the move they tend to string out into single file thus making well-defined paths which are regularly used, not only by elephant but also by many other species as well, more particularly carnivores.

Partial to 'salt licks' digging in these with the nails on the front feet and picking up the loosened soil with the tip of the trunk. Considerable excavations are created by long-established use of these 'licks' (Tamafupi, Kwikampa).

In protected areas, where they are relatively undisturbed, normally docile but, where harried or shot at, become aggressive and dangerous, especially the cow herds with young. During the logging activities in the Chobe area during the 1950s the elephant there gained a reputation as being bad-tempered and aggressive, even towards vehicles which, without provocation, they would chase and were known to attack logging trucks. In one such incident the trailer with three large teak logs aboard was thrown over as the result of an attack by an enraged cow elephant.

Food

Elephant are both grazers and browsers and, as well, make wide use of wild fruits, roots and the bark of various trees. They appear, from the evidence of the seeds in their droppings, to eat the seed pods of various *Acacias*, including *A. tortilis*, and to be partial to the pods of the camelthorn, *A. giraffae*. They have been observed to shake the branches of the trees to dislodge the pods as well as to pick them individually from the trees. The seeds of these *Acacias* appear to

germinate more freely after passage through their intestines.

They also eat the fruits of the vegetable ivory palm, *H. ventricosa*, and the wild almond, *Ricinodendron rautenenii*, the edible external coating being digested, the white endosperms, with their hard fibrous coverings, being commonly found in their droppings. They are also partial to the ripe fruits of the marula, *Sclerocarya caffra*, which grows in profusion in parts of the north-eastern sector, and will stand under these trees picking the fruit off the ground or shaking the trees to free them.

Breeding

The survey has no information on the time of dropping the young but sightings of very young individuals at widely divergent times of the year suggest that this takes place throughout the year, a single young at a birth. Although twin calves are of rare occurrence, Liversedge (*pers. comm.*) records the birth of twin calves in the Chobe National Park near Kasane in September 1970, an occurrence witnessed by a number of visitors, and Roth and Austen (1966) also record this occurrence from the Dett Valley, Rhodesia.

Sizes and Weights

The only data available are from two tuskless females, one of which, C 1248, was pregnant, from Serondella, Chobe River, taken in December 1965, and another, C 1346, taken in January 1966 (Child and Hepburn).

	TL	*T*	*Hf*	*E*	*Weight*
C 1248	6121	915	—	890	6 291 lb.
C 1346	6375	1093	483	965	7 098 lb.

(TL includes length trunk)

C 1346 stood 8 ft. 11 in. at the shoulder.

Order HYRACOIDEA

Family PROCAVIIDAE

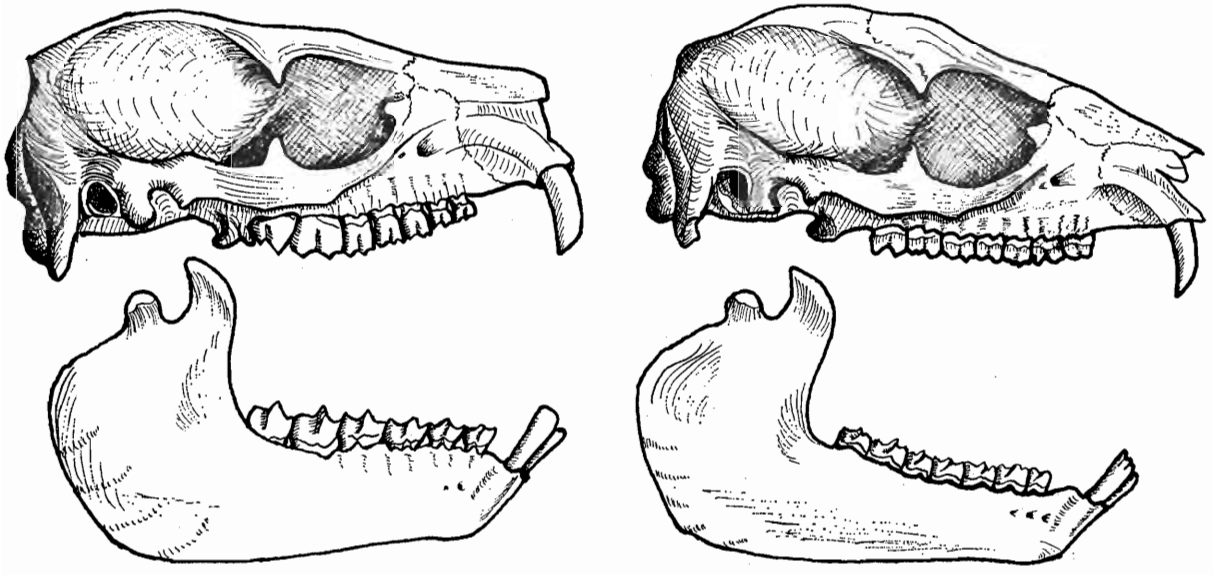


Fig. 19 Skulls of Dassies

(*a*) Rock Dassie, *P. capensis* (*b*) Yellow-spotted Dassie, *H. brucei*

1. Dorsal spot black; lower tooth-row with one tooth less than upper; adults with six teeth in lower tooth-row and seven in upper (fig. 19 (*a*)) . . . . . *Procavia*

2. Dorsal spot yellowish; equal number of teeth in upper and lower tooth-row; adults with seven in each case (fig. 19 (*b*)) . . . . *Heterohyrax*

Genus PROCAVIA Storr, 1780

Procavia capensis

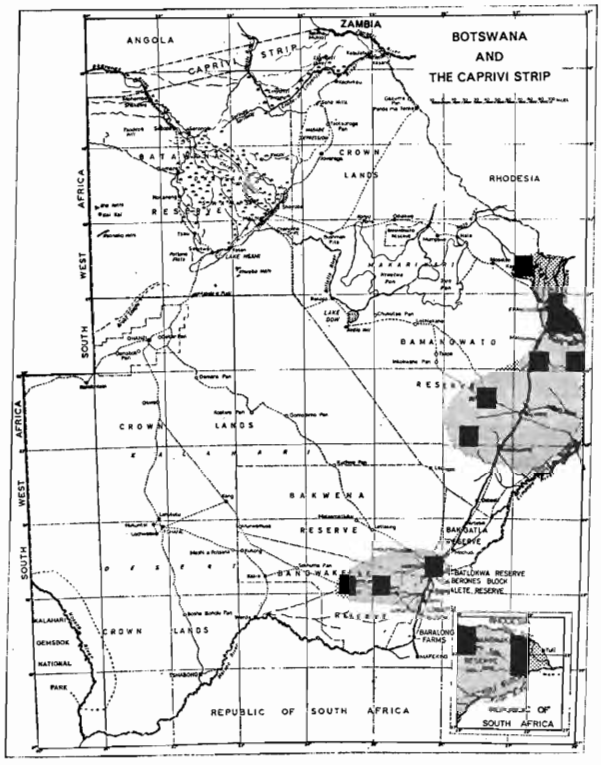
Pela Rock Dassie

P. capensis (Pallas, 1766)

(Skull, fig. 19 (*a*).)

Distribution

The distribution of the species closely follows the limits of the rocky, hilly country from the north of the Tati Concession to just south of Mahalapye, extending westwards to the rocky krantzes near Serowe and the Makhware and Shoshong Hills and east to the Rhodesian and Transvaal borders. There



is then a break in distribution southwards, where the open flat Kalahari associations extend eastwards to the border, the species reappearing in the rocky hills in the Gaborone, Lobatse areas and west to Dikgomodikae.

Although the species occurs in South West Africa in the mountainous and rocky country of the south and central parts at least as far north as the Waterberg mountains (Shortridge, 1934), it is unlikely that they will be found to occur in western Botswana owing to the lack of suitable habitat.

Habitat

Under Botswana conditions closely confined to areas of rocky kopjes, rocky hillsides, krantzes and piles of loose boulders, particularly where this type of habitat has some canopy of trees and bushes. As the species has colonized outlying kopjes far from the main ranges probably at times may temporarily use other types of cover. May wander far from their normal habitat in feeding, often making clearly-marked tracks, radiating from the crevices in which they live, to palatable bushes and trees.

Although suitable habitat is available in isolated areas of rocky hills and kopjes at Tsodilo Hills, Goha Hills and Kwebe Hills these are too far from its normal range to be colonized.

Habits

Diurnal, gregarious, living in colonies which vary in size according to the area of habitat available, sometimes only four or five in isolated small piles of rock. In continuous ranges, offering great extents of crevices and rocky cover, estimates of populations difficult, but may be in excess of several hundreds.

May be found feeding at any time during the day, provided it is warm and sunny, but reluctant to leave their rocky shelters if the weather is overcast or cold and not emerging during spells of wet weather.

Most obvious when sunning themselves on exposed rock surfaces in the early morning and late afternoon often, if there is a cold wind, in situations sheltered from it yet in the sun. Agile even on slippery steep rock surfaces or in climbing trees which they will do to considerable heights moving far out on to the thin branches to get at the young foliage.

The species must, perhaps under stress or population pressure, be capable of traversing considerable distances between suitable rocky habitat even when the barest of rock cover is absent in the intermediate areas. The nearest rocky habitat to Dikgomodikae, an isolated range of kopjes, which carry a heavy population of *P. capensis*, is in excess of 10 miles from the nearest kopjes eastwards and is the furthest western extension of suitable habitat in the open Kalahari associations in this sector.

The population of *P. capensis* living on the isolated

kopjes near Molepolole have an interesting history having been caught alive near Gaborone and transported to them in the 1950s where they have flourished (Jansen, *pers. comm.*).

In the Madinare, Mabate sectors *P. capensis* is found even on small isolated kopjes three to four miles from the main range and indeed occurs on quite small piles of rocks not more than four square metres and four metres high where there are suitable sheltered crevices in which to live.

Roberts (1951) states that 'in some areas overpopulation has driven them into the plains, where they have found shelter in burrows of other animals' which may well be the stress factor that has caused their dispersal to isolated rocky areas far from continous associations of this type of habitat.

Defecate and urinate in middens often separate from each other which, continually used over long periods, leads to enormous accumulations. Where the urine middens occur in certain types of rock formation, e.g. sandstone in dry climates and are sheltered from the weather, the urine crystallizes in deep layers (two feet deep; Clanwilliam, Cape Province). Such large accumulations have not been observed in Botswana although layers of up to 15 cm deep were seen in Mabate. The crystallized urine is said to have medicinal properties and is marketed in South Africa under the name of 'Hyracium' under which name it appears in the British Pharmacopoeia.

Frequently occurs in the same kopjes as the yellow-spotted dassie, *Heterohyrax brucei*, the two species apparently living in perfect harmony and have been seen sunning themselves on the same rocks and using identical refuges (Madinare, Mabate and Tate Concession).

The young of the two species play together and will sit close to each other in mixed parties when basking in the sun or sheltering (Mabate).

It is noticeable that the more isolated kopje areas are populated only by *P. capensis* (Madinare) which appears to be the more precocious of the two species in its movements.

Food

The species is predominantly a browser, although in other parts of southern Africa its grazing habits are well known. There was no obvious signs of grass in any of the stomachs examined although the possibility of this being present amongst ground-up unidentifiable material is not discounted. The food is ground up very fine making the identification of material from stomach contents difficult, unless their examination is accompanied by field observations.

In the northern parts of the eastern sector in the Mabate area, with its sandstone kopjes and kloofs, the ironstone kopjes of Matjemleeji and Foley, the following browse plants were identified from the largest particles from stomach contents, matched against the plants growing on the kopjes that showed the characteristic cutting of the leaf stems and small shoots:

Tiliaceae,	*Grewia subspathulata*
Euphorbiaceae,	*Croton* sp.
Scrophulariaceae,	*Antherothamnus rigida*
Moraceae,	*Ficus pretoriae*
Moraceae,	*Ficus smutsii*
Sapindaceae,	*Pappea capensis*
Capparidacese,	*Boscia* sp.
Capparidacese,	*Boscia albitrunca*
Combretaceae,	*Combretum apiculatum*
Urticaceae,	*Urera tenax*

These samples both of the dassies themselves and the food plants, were taken from kopjes where it was established beyond reasonable doubt that they were populated only by *P. capensis*, no *H. brucei* being seen.

Very heavy browsing of *Boscia albitrunca*, *Ficus pretoriae* and *Ficus smutsii* was noticed on several occasions, as if these were favoured.

In feeding, the species will move some distance from the kopjes in which they live. At Mabate they would feed on trees on the floor of the canyon 50 metres from the base of the rocks, at Foley at distances estimated at 15 metres. On the approach of the observed they would drop out of these, often three to four metres to the ground to make for the shelter of the rocks.

Breeding

Gravid females were taken during the following months:

	J	F	M	A	M	J	J	A	S	O	N	D
Total	2	–	6	12	7	–	–	–	1	–	1	–
Non-gravid	1	–	6	8	5	–	–	–	–	–	–	–
Gravid	1	–	–	4	2	–	–	–	1	–	1	–

TNL 862 taken in May at Gaborone had two near full-term foetuses at weights of 287 and 340 g.

Juveniles between 297 and 341 g have been taken in March and April, larger individuals of 1 022-1 249 g in June, September and October.

The sample is too small to arrive at any definite conclusions as to the time of the year in which the young are born, the indications being that the season is a wide one, at least from September through to May.

Sizes and Weights

MALES

Hf s/u	$\bar{X} = 73$;	$N = 16$;	Obs. range	61-79
Weight	$\bar{X} = 8$ lb. 8 oz.;	$N = 13$;	„ „	6 lb. 7 oz.-10 lb. 12 oz.

FEMALES

Hf s/u	$\bar{X} = 70$;	$N = 19$;	Obs. range	64-77
Weight	$\bar{X} = 8$ lb. 10 oz.;	$N = 17$;	„ „	6 lb. 12 oz.-12 lb. 10 oz.

Gravid females were taken at Hf s/u of 69-79 and weights of 6 lb. 8 oz.-11 lb. 4 oz.

P. capensis is a heavier built species than *H. brucei*, the Hf s/u lengths, however, not varying greatly.

Genus HETEROHYRAX Gray, 1868

Heterohyrax brucei

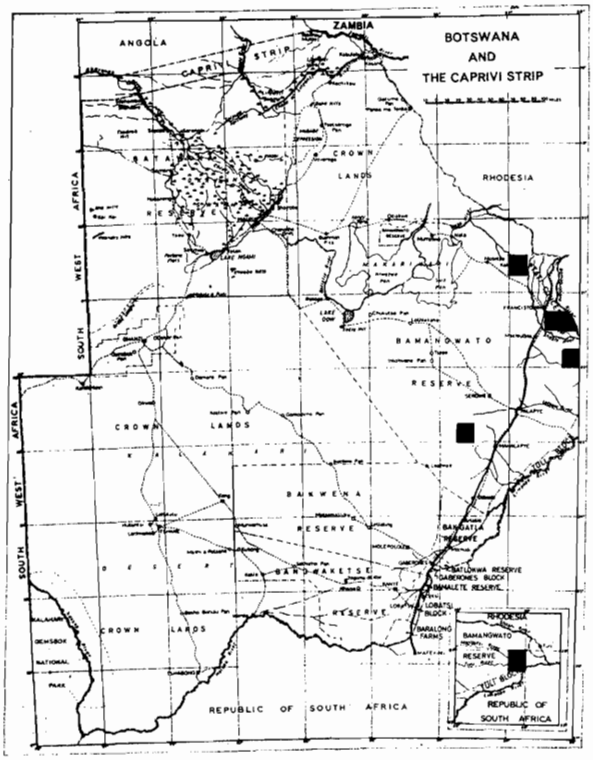
Pela Yellowspotted Dassie

H. b. ruddi (Wroughton, 1910)

(Skull, fig. 19 (*b*).)

Distribution

Apparently confined to the areas of rocky hills north of Mahalapye to the northern parts of the Tati Concession and west to the Makhware and Shoshong Hills and not so far recorded in the Gaborone,Lobatse areas, although suitable habitat is present. Their absence from the south-eastern parts of Botswana appears to correspond with their distribution in the western Transvaal where, although they occur in the Waterberg district adajcent to the areas of occurrence in Botswana, they are absent in the south-west adjacent to the Gaberone, Lobatse areas.



Although (Shortridge, 1934) states that the species is 'said to occur' in the Tshodilo Hills there is no evidence to support this and so far no signs of dassies have been observed there. His statement that 'Dassie skins in karrosses from northern Bechuanaland are largely referable to a species of *Heterohyrax*' suggests that they might occur but, so far, they have not been recorded from any of the isolated rocky kopjes (Goha Hills) in the north-east which is the only other suitable habitat that is available to them, nor do they appear to occur in the Kwebe Hills near Lake Ngami. As skins are widely traded in in Botswana they are likely to be carried long distances and they may well have originated in the eastern sector or from parts of north-western Rhodesia.

Habitat

Confined to areas of rocky kopjes, rocky hillsides, krantzes and piles of loose boulders, particularly where there is a cover of trees and bushes on which they browse.

More particularly confined to the larger and more extensive areas of this type of habitat and less prone to colonize small outlying kopjes and piles of boulders than the rock dassie, *P. capensis*.

Habits

Diurnal, gregarious, in habits very similar to *P. capensis* with which species they occur in close association, in parts (Mabate) occupying the same rocky crevices.

Food

Too few observations are available to point to the food preferences of this species or their relationship in this respect to *P. capensis* when occupying the same kopjes. At Matjemleejie they were seen feeding on *Ficus pretoria* which was growing in cracks in the rock where the branches were lying across them and on the leaves of *Croton* sp. shrubs. The stomach contents were too well masticated to allow of identification of the food items, which appeared to consist entirely of browse, no grass being identified in them. The food preferences of the two species *P. capensis* and *H. brucei* would be an interesting study under Botswana conditions.

Breeding

Only one gravid female was taken, BP 921, on the 22nd April at Mabate, which had two foetuses implanted 1R 1L. These were very well developed, near full-term, at 225 g and 218 g respectively. During this month many juveniles were observed at Mabate, Madinare and Matjemleejie and several collected at weights as low as 161 g-200 g. Female BP 866 taken at Madinare in the same month had a swollen muscular uterus; was lactating and was taken in company with a juvenile BP 855 at 245·5 g, which was thought to be her young.

So far April is the only month from which there are records of gravid females or young but the sample is small and further information is required.

Sizes and Weights

MALES

Hf s/u	$\bar{X} = 69$;	$N = 8$;	Obs. range 64-72
Weight	$\bar{X} = 5$ lb.;	$N = 8$;	„ „ 4 lb. 4 oz.-6 lb. 2 oz.

FEMALES

Hf s/u	$\bar{X} = 72$;	$N = 9$;	Obs. range 69-75
Weight	$\bar{X} = 6$ lb. 6 oz.;	$N = 6$;	„ „ 4 lb. 12 oz.-6 lb. 10 oz.

Although not differing to any great extent in average hindfoot length as compared with the rock dassie, *P. capensis*, this species is, in bodily weight, by far the lighter of the two.

Order PERISSODACTYLA

Key after Ellerman *et al.* (1953).

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 . . . . . Fam. Rhinocerotidae
2. Lightly built; slender limbs, with one digit; the orbit ringed with bone; cheek-teeth complex; body neck and limbs striped; no horns on nose . . . . Fam. Equidae

Family RHINOCEROTIDAE

1. Upper lip squared; nuchal hump prominent when head is raised . . . . . *Ceratotherium*
2. Upper lip narrow, the tip prehensile; no such nuchal hump . . . . . *Diceros*

Genus CERATOTHERIUM Gray, 1867

Ceratotherium simum

Squarelipped Rhinoceros

C. s. simum (Burchell, 1817)

The squarelipped, or white rhinoceros, became extinct in Botswana somewhere between 1880 and 1890. Bryden (1893) states that in Ngamiland and the north Kalahari region, 'where formerly it was plentiful, it has been, as I ascertained while hunting in that direction in 1890, finished for some years past'. Selous (1890) states that in 1874 they were 'fairly plentiful' to the south of Linyanti and on the Chobe

River, and in that year shot a specimen at Thamma Setsi (Tamuseche Pan), on the Rhodesian border (Dollman, 1921). Although he spent several months, in 1877, in the same area, he only saw the spoor of two and, during his eight months hunting in the Botletle, Mababe, Sunta and upper Chobe River area in 1879, he 'never saw even spoor' and states that the Bushman say they are 'finished'. In his address to the Zoological Society of London in June 1881, he states that while 20 years previously it seemed to be still plentiful in the western half of southern Africa, now 'unless it is still to be found between the Okavango and Cunene rivers it must be almost extinct'.

With the introduction of the species to the Wankie National Park, Rhodesia, individuals have wandered westwards over the border into Botswana. Two died near Odiakwe in 1968, when a pan, in the vicinity of which they had settled, dried up (not 1966 as stated in Smithers, 1968). Two adults and a calf were seen in June 1968 on the Nata River (1926C4; A. Challis, *in litt.*).

The Botswana Department of Wildlife and National Parks reintroduced four to the Chobe National Park in mid-1967 from Zululand, Republic of South Africa. At the time of writing these are still paddocked near Serondela.

The historical record shows that at one time they occurred in the eastern sector as Cumming (1850) mentions their presence near the Notwani River as well as on the Limpopo River (*c.* 23° S.) and Bryden (1899) says they were plentiful to the north and west of the Limpopo River between 'Secheles country and Lake Ngami'.

Genus DICEROS Gray, 1821

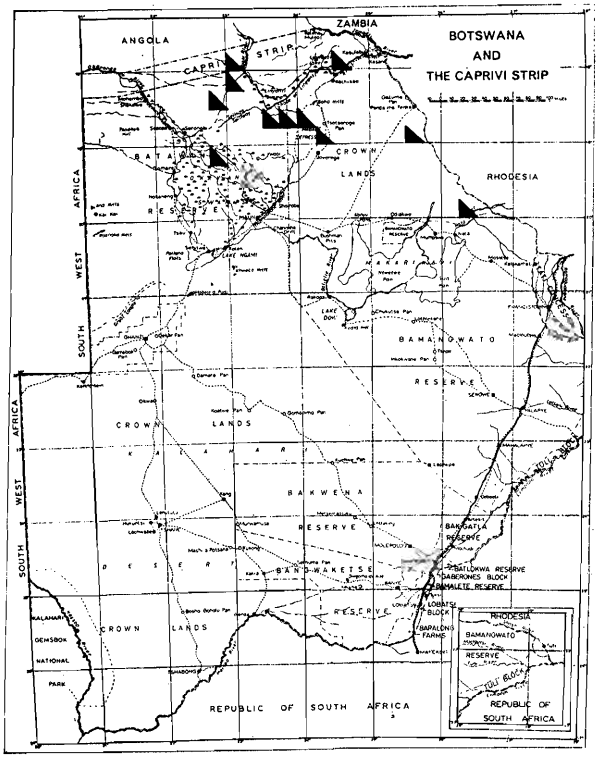
Diceros bicornis

D. b. bicornis (Linnaeus, 1758)

Tshukudu Black Rhinoceros

Distribution

Apparently only a few individuals remain in the territory, their distribution confined to the vicinity of the Kwando River where it crosses the southern border of the Caprivi; the Selinda spillway; Savuti swamp; Tsotsoroga Pan and immediately east of this (18 24D2 and 4); between Ngoma and Muchenje on the Chobe River, *c.* 25 miles west of Kasane, and possibly they may still be present on Chiefs Island in the Okavango delta. The numbers present have not to date been accurately assessed and it is impossible to determine whether some of the sightings or the spoor do not indeed refer to the same individual.



Smithers (1968) records that, according to information then available, their numbers were generally estimated to be 'less than 20', which is now thought to be an over-estimation.

Assiduous cross-questioning of responsible persons since the publication of Smithers (1968) has only added a few sightings. Child (1968) reports a single individual seen on the north-eastern edge of the Savuti swamp in January 1967; the sighting of three from the air on Chiefs Island, Okavango delta, by the late Mr. Bobby Wilmot and a W.N.L.A. air crew about 1962 and the sighting of two in the mopane between Joverega and Tsotsoroga in 1963 or 1964 by Mr. Wilmot.

Smith (*pers. comm.*) reports the sighting of two solitary individuals in March 1970, the first in the vicnity of the Kwando River, where it crosses the southern Caprivi boundary (18 23 A1), and the second nine miles west of Gatgara, the Sand Ridge Gap (18 23D4).

In March 1970 two individuals were known to be living in the Caprivi near the Kwando River (17 23C3) and the sighting by Smith near the Kwando River in Botswana may refer to one of these wandering over the border.

The remaining visual records are mapped on the basis of spoor or droppings, the most recent being that of Liversedge (*pers. comm.*) who reported spoor near the Kwando River in February 1970 (18 23A1).

The visual records from Nunga and the Nata River are probably individuals which have wandered into Botswana from the Wankie National Park where 46 have been reintroduced since 1961.

Child (*in litt.*) states that black rhinoceros were shot in what is now the Moremi Game Reserve 'within living memory'.

The distributional range of the species has shrunk tremendously within historical times. In Botswana and adjacent territories Harris (1838) records them from near the present south-eastern border of Botswana in the western Transvaal; Cumming (1850) from the vicnity of the Notwani River. Andersson (1856) writing of the 'immense quantity of game in the Tunobis area (north-west of Mamuno)' himself shot eight rhinoceros in the space of five hours, his party killing 'upwards of thirty rhinoceros', observing meanwhile that 'he never took a delight in useless slaughter'. At Ghanze (Ghanzi) Andersson (1856) reports that they were 'very numerous' several being shot. Unfortunately Andersson does not state in every case whether they were black rhinoceros ('Borele' or 'Keitloa') or white ('Monoohoo' or 'Kobaaba'), both of which he records as being present but from Ghanzi onwards, in his journey to Lake Ngami, he shot black rhinoceros near Kobis (Mabeleapudi) and north of Lake Ngami he records that they were 'constantly seen' in his journey up the Teoghe (Taoghe) River from the lake.

Selous (Dollman, 1921) shot this species in 1874 on the south bank of the Chobe River and at Thamma Setsi (Tamuseche Pan) on the Rhodesian border.

By 1890, Bryden (1893) states that 'the black rhinoceros (in Botswana) is now seldom heard of. A few linger in the swamps of the Chobe River—round Lake Ngami they have completely disappeared.'

'Matabele' Wilson (1914) states that during his visit to the Okavango (Shaleshanto) in 1913, the indigenous people told him that rhino still existed 'some miles to the west' of his camp.

It is doubtful if they ever occurred in the dry central and south-western Kalahari.

Family EQUIDAE

Genus EQUUS Linnaeus, 1758

Equus burchelli Pitse yanaga Pitse etilotsana Burchell's Zebra

E. b. antiquorum (H. Smith, 1841)

Taxonomic Notes

The nominate *E. b. burchelli* (Gray, 1824), which is recorded (Ellerman *et al.*, 1953) as having occurred in southern Botswana, is now extinct, the nearest areas where zebra are now found are the southern parts of the Tati Concession, eastwards to the Tuli Circle and northern Tuli Block farms.

In the northern parts of the territory two subspecies might occur, *E. b. chapmani* Layard, 1865 (*E. b. selousi* Pocock, 1897), which occurs in Rhodesia, and *E. b. antiquorum* (H. Smith, 1841), described from Angola.

Ellerman *et al.* (1953) distinguished these as follows:

Legs never wholly striped . . . *E. b. antiquorum*
Legs wholly striped to the hoofs . . *E. b. chapmani*

Populations in the north-eastern sector, in common with those in western Rhodesia, are, as far as the character of leg striping is concerned, very mixed, some being wholly striped to the hoofs (BP 254 from Tamafupi), others with weakly marked stripes below the knee joints, in some cases with practically no sign of marking below the knee. The populations appear intermediate between *E. b. chapmani* and *E. b. antiquorum*.

From visual observations of herds in the Okavango delta, the Savuti and Mababe and the Tuli Circle, these appear less distinctly marked below the knee than any seen in the Tamafupi area although some individuals are more marked than others. Hill (1942) in dealing with the material collected by the Vernay Lang Expedition of 1930 referred the Kwaai River and Mababe material to *E. b. antiquorum*.

Hill and Carter (1941) in dealing with material from Angola also refer material from northern South West Africa and Botswana to this subspecies.

Shortridge (1934) while recognizing the variability in the leg markings came to the conclusion that only one subspecies, *E. b. antiquorum*, occurred in northern South West Africa, extending eastwards to the Okavango.

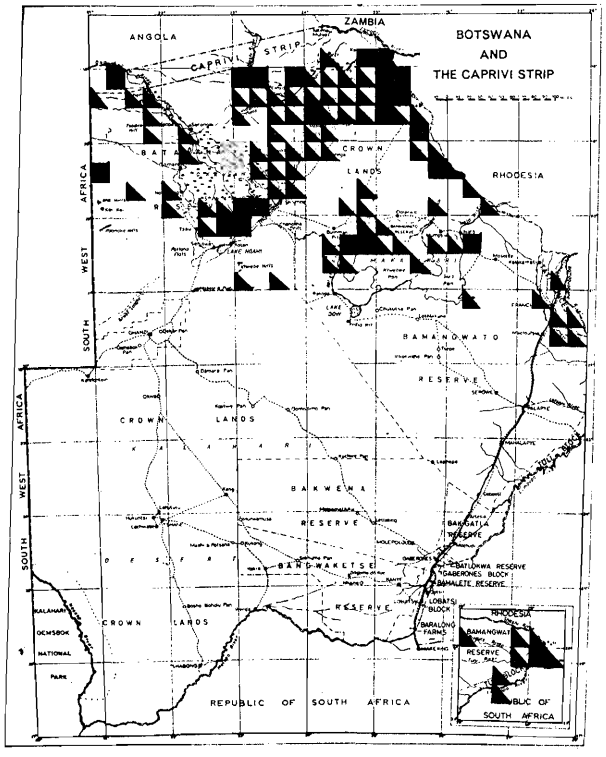
While it would be desirable to have further material from a number of points throughout the range of the species in northern Botswana, on present evidence, only one subspecies is recognized, *E. b. antiquorum*, with a distribution as given for the species except in the eastern sector and the eastern parts of the north-eastern sector, along the Rhodesian border, where there seems to be some intergrading with *E. b. chapmani*.

Ansell (*in litt.*) states that the zebra he has seen and the skins he has handled from the Maschi River in Barotse Province, Zambia have well-striped legs resembling *E. b. zambesiensis* which Cabrera (1936) thought was a synonym of *E. b. boehmi*.

No material is available from the Caprivi in the vicinity of the Maschi River.

Distribution

Widely distributed throughout the northern parts of the territory, in the west, south to the Aha Hills; throughout the southern part of the Okavango delta and thence south to the Kukwe cordon in the vicinity of the Kwebe Hills; throughout the northern parts of the Makgadikgadi, north of the Dukwe cordon, east to the Rhodesian border. Preserved on farms in the Tati Concession and occurring just south of this and eastwards in the eastern extension of the Bamangwato Reserve to the Tuli Circle and northern Tuli Black farms. The record from the south-eastern corner of the Makgadikgadi was a small herd that must have broken through the Dukwe cordon. They are not normally found today in this area.



Shortridge (1934) records their distribution in South West Africa, on the Botswana border, to 22° S. which is further south than they have been observed in Botswana. The area west of the Patlana flats is, however, little known and they may in time be shown to occur here.

Silberbauer (1965) states that a population of 160 were known in the vicinity of the Passarge Pans (in the north-eastern part of the Central Kalahari Game Reserve) in 1961 but 'this has been greatly depleted, if not exterminated, by the combined effects of drought and fencing'. In periods of drought a population living in this area would have to move either east to Lake Dow or north-east to the Botletle River to reach water and would, today, find their movement barred by the Kukwe and Makalamabeni fences. There are no recent reports of zebra within the reserve and presumably, therefore, they no longer exist.

Shortridge (1934) states that they are 'fairly plentiful in the western Caprivi' but the survey has no up-to-date information on their status in this area.

There is an unconfirmed report of zebra having been seen west of Mahalapye (23 26A2) in about 1966 which is not plotted on the map as this is well outside their normal range of distribution. The occurrence of wanderers in this area is, however, not impossible as they still occur in the Waterberg and Potgietersrust districts of the western Transvaal (Kettlitz, 1962) and there are still a few preserved on the southern Tuli Block farms.

Their range of distribution in southern Africa has shrunk considerably within historical times where they were at one time known to occur as far south as the Orange River (Lydekker, 1908).

The type of *Asinus burchelli* Gray collected by Burchell in 1825 was taken south of the Molopo River at Little Klibbolikhoni Fontein (27°50′ S., 24°25′ E.).

Cornwallis Harris (1838) reports 'vast herds of zebras' in the area of the Meritsane River just south of the present Botswana border, 'their incredible

numbers (with Tsessebe and Hartebeest) so impeding their progress that I had no difficulty in closing with them'.

Cumming (1850) states that they occurred in the 'Valley of the Bakgatla' (Bakgatla Reserve), Moffat (1856) near the Serule River, Livingstone (1857) near Kolobeng, Holub (1890) at the junction of the Marico and Limpopo rivers, which indicate their occurrence at least in the eastern sector of Botswana up till the end of the last century.

In the central part of the territory Livingstone (1857) records their presence at Chukutsa Pans, which is further south than they occur today in the Makgadikgadi area.

Habitat

Essentially a species of open country occurring on grassland, open scrub and light woodlands, where water is available.

Habits

Gregarious, normally occurring in small herds of from 6 to 20 but larger known, Nunga 40; Tamafupi *c.* 30; western Makgadikgadi 50-60 and seasonally congregating in much larger numbers, east of Kumaga 2-300; Kanyu *c.* 100; Savuti *c.* 150.

Throughout their range dependent on the availability of water and never moving far from its vicinity. Exhibiting some local movement with the advent of rains when they depend on temporary water supplies in pans and watercourses (east of Kumaga northwards to Nxai Pan; westwards from the Okavango towards the Aha Hills; eastwards out of the Moremi Game Reserve (Tinley, 1966)). Commonly associated with wildebeest, *C. taurinus*, the herds mixing on the feeding grounds.

Timid and excitable they appear to have acute powers of sight, scent and hearing.

Partial to sand-bathing, rolling on to the back in sandy places usually near water-holes.

Food

Zebras are predominantly grazers, although they are reported as digging for rhizomes (Tinley, 1966). Ansell (1960) states that they 'browse a little'. There is no evidence of browsing in Botswana, six stomachs examined contained only grass. They are particularly partial to areas of short grass such as is found on floodplains and they tend to congregate on burnt areas as the new grasses are flushing.

Sizes and Weights

MALES

	TL	*T*	*Hf c/u*	*E*	*Weight*	*Ht Shoulder*	*Ht Pel*
BP 200	3910 (on curve)	480	580	170	902 lb.	1346	1346
BP 254	2680	395	575	185	817 lb.	1346	1371
HJH 1203	2050	445	580	182	—	—	—
C 2833	2370	480	535	180	—	1210	1260
C 2832	2632	438	575	185	—	1285	1340
C 2831	2780	525	560	170	—	1290	1355
C 2834	2500	460	565	162	—	1225	1340
C 3280	2540	510	528	180	—	1180	1360
BP 2246	2642	433	464	—	—	—	—
FEMALE							
BP 2243	2489	508	584	—	—	—	—

Order ARTIODACTYLA

Key after Ansell (1968).

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 . . Fam. 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. . . . . Fam. Hippopotamidae
3. Lower (incisiform) canine lobed; horns a simple skin-covered bony projection . Fam. Giraffidae
   Lower (incisiform) canine simple, not lobed; horns, which may only be present in some species in the males, covered with a horny sheath . . . . . Fam. 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 wide-spreading tusks; only one upper incisor; full dentition 34 . . . . . *Phacochoerus*

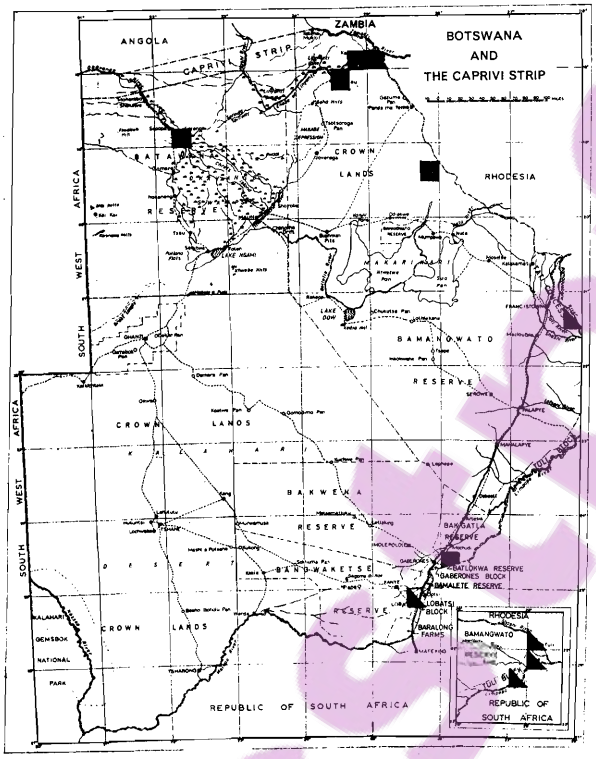
Genus POTAMOCHOERUS Gray, 1854

Potamochoerus porcus Kolobe yanaga, Kolobe nkotola, Kolobe topo, Kolobe dombo

P. porcus (Linnaeus, 1758) Bushpig

Taxonomic Notes

There is insufficient material to determine the subspecies which occurs. Ansell (1960) states that *P. p. maschona* Lonnberg occurs in the south-western parts of Zambia, Ellerman *et al.* (1953) that it is found in western Rhodesia. On geographical grounds this is the subspecies which might be expected to occur in northern and eastern Botswana. Hill and Carter (1941) comment on the wide individual variation. Until adequate material is available no attempt is made to place the Botswana material subspecifically.



Distribution

Very few records are available from the territory and these are so scattered that it is not possible at this stage to formulate an accurate picture of the distribution of the species.

In the Okavango delta they have been taken where the Okavango River branches out to form the swamp just south-east of Sepopa. Shortridge (1934) states that they have been (doubtfully) recorded in this area, the above record now confirms this. They are not uncommon on Impalila Island at the junction of the Chobe and Zambezi rivers in the eastern Caprivi (Carp Expedition, 1949), and in the riverine underbush of the Chobe River at Kasane, and immediately west of this in Botswana. A skull was picked up near Tamafupi and there are visual records from the Tati Concession and from the extreme eastern extension of the Bamangwato Reserve in the vicinity of the Tuli Circle and northern Tuli Block farms. In this last named area they are not uncommon. An individual was shot some years ago just east of Gaborone (Challis, *in litt.*), and there are reliable visual records from the Lobatse Block and the Government Farm near Bathoen Siding (Campbell, *in litt.*) in the south-east.

Habitat

Confined to well-watered areas where there is thick underbush or a heavy cover of long grass or reed-beds. This type of habitat is widespread in the Okavango delta where conditions appear to be ideal and it is surprising that they have so far only been found in the north-west near Sepopa. The species is, however, secretive, and it is possible to live in areas where they are quite common without seeing them and, in time, they may be shown to occur more widely in the Okavango delta than the present single record

indicates. They occur commonly in riverine underbush on the Chobe River in the Kasane area and westwards and on the north side of the river on the opposite bank near Kasane on the raised ground of Impalila Island, in thick patches of tall grass, reeds and underbush near the Zambezi and Chobe rivers. In the eastern section they occur in riverine underbush in the Tati Concession and on the Limpopo River and its tributaries in the south-east where there is thick cover. There is no information available on the habitat of the record from Tamafupi, as it is based on a skull picked up in the bush, but westwards in Rhodesia they occur in the Wankie National Park associated with areas of thick bush or broken country in areas where there are water-holes or watercourses.

Bushpig rank amongst the species that have benefited by man's development of wilderness areas for agricultural purposes, this creating an even more favourable habitat for them, in which they have thrived and increased in numbers.

Habits

Predominantly nocturnal, although occasionally, in areas where they are not disturbed, may be seen during the day. In Mashonaland, Rhodesia, where they are problem animals and subject to intensive control, are almost entirely nocturnal.

Secretive and cunning, they occur in pairs or sounders up to 11 (20 miles west of Kasane). Lie tight in thick underbush and do not flush easily, but when actuated to move, the individuals comprising the sounder, scatter in all directions. Under these conditions, individuals run very fast, the long hair on the mid-back streaming in the wind as they make for the nearest available cover, through which they can run at a surprising speed, the thick skin deflecting thorns and light obstructions. Where the bush cover is thin and there are good stands of long grass, bed down under the cover of matted grass which is trampled down for this purpose (Karoi, Rhodesia) the mat covering areas of up to five to six metres in diameter. Where they occur in broken hilly country, lie up in the cover of underbush on the rocky slopes.

From these resting places they wander widely to feed.

A female in captivity, allowed free range during daylight hours, moved in the shelter of hedges, thick grass or other cover, and appeared to avoid open ground. When running under stress, never raises the tail, a feature characteristic of the warthog, *P. aethiopicus*, under these circumstances.

Bushpig are powerful and courageous animals, and when wounded can be dangerous. At pig-shoots they have been known, when wounded, to turn on the hunter and with an upward, sideways swing of the head to inflict serious wounds with the lower canines which, being pointed, sharp-edged and slightly projecting from the jaw are formidable weapons. As in the case of the warthog, abrasion against the front surface of the upper canines keep these lower canines in a permanently sharp condition.

Bushpig in agricultural areas are problem animals and cause great destruction in peanut, field pea, sorghum and mealie lands, destroying by trampling much more than they eat as they push over the standing grain stalks to get at the green cobs.

They normally feed at night and are difficult to deal with as the eyes do not shine in a dazzling light and they are particularly sensitive to light and will run out of range not stopping until they are far removed from it. If approached under cover of dark, when feeding in mealie lands, they will freeze, motionless and silent, then suddenly make off at a high speed. As a consequence they are difficult to destroy by shooting and no other really satisfactory method has been devised to deal with them, except possibly by organized hunts with packs of dogs (Ansell, 1956). 'Still' hunting is probably as satisfactory a manner of dealing with them as any other yet devised. The hunter takes up a concealed stance where, from the fresh spoor, bushpig are known to feed and wait until they come within range. An African game guard on a 4 000-acre farm near Salisbury accounted for 82 over a 24-month period in this way.

The meat is much sought after by the indigenous people and if taken from a young animal is equal in palatability to the best pork.

Food

Omnivorous, largely living on roots and rhizomes and the underground stems of grasses but known to eat carrion, wild fruits, and Shortridge (1934) includes reptiles, eggs and young birds. No stomach contents are available from Botswana for examination.

A female in captivity avidly sought out old buried bones, rooting them out with the snout, and showing an obvious preference for those that were very old and weathered. These would be chewed for long periods.

Breeding

No data are available from Botswana.

In Rhodesia there are records of their farrowing during the following months, the number in the litters

being shown (National Museums of Rhodesia records, and Sowls and Phelps, 1968):

Month	*No. in Litter*
November	7
December	4
January	3
February	3; 5

Ansell (1960) for Zambia states that the young are mostly born in the rains, October to March, and only rarely at other times, usually litters of three or four, up to six known. W. Sclater (1900) gives the time as December and January, Kirby (1896) the same months, Stevenson-Hamilton (1912) as during the summer season (October to February).

The young are born in thick underbush or in the matted grass resting places described under Habitat, which appear to be reinforced by grass cropped and added to the 'roof' and on the ground underneath providing dry cover. Ansell (1960) refers to these structures as bowers, Sowls and Phelps (1968) aptly describe them as resembling 'small weathered hay-stacks'.

As the gestation period is given by Asdell (1964) as four months, pregnant females should be looked for in Botswana from about July onwards.

Sizes and Weights

No data available.

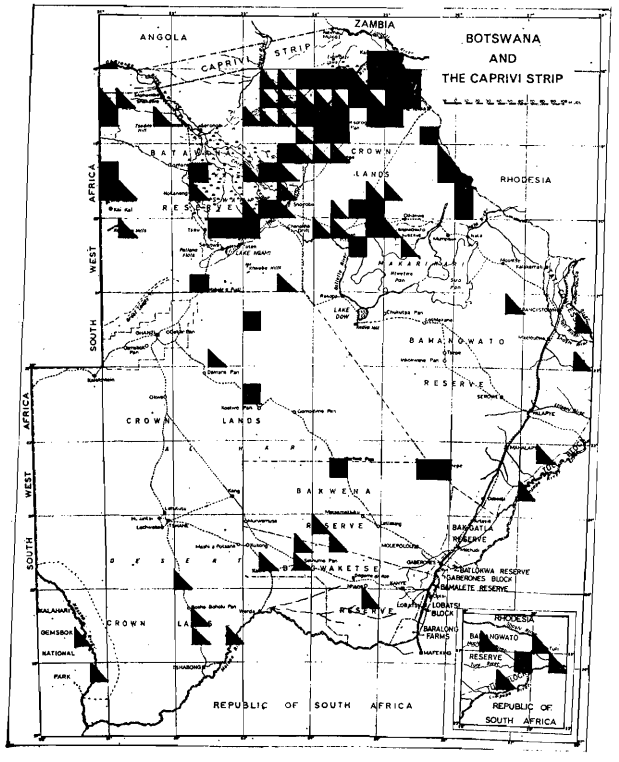
Genus PHACOCHOERUS F. Cuvier, 1826

Phachochoerus aethiopicus — Kolobe Warthog

P. a. sundevalli Lonnberg, 1908

Taxonomic Notes

Lundholm (unpub. mss.) considers *P. a. shortridgei* St. Leger (1932), originally described from the Grootfontein district, South West Africa, as a synonym of *P. a. sundevalli*.



Distribution

Widely distributed excepting in the west and north-eastern parts of the Kalahari and the south-western parts of the Bamangwato Reserve, including the southern parts of the Makgadikgadi from which two areas to date there are no visual or material records. They also appear to be absent from the southern parts of the eastern sector south of Debeeti. Shortridge (1934) states that they are comparatively numerous from 'Gobabis district to the Okavango' and although, at the moment, there are no records from the Aha Hills south to the Ghanzi district they may have been overlooked and will in time be shown to occur.

Warthog are much commoner in the well-watered northern parts of the territory than in the dry south where they are relatively sparse and rarely contacted. On the floodplain in the Moremi Game Reserve, Savuti and Kwaai River they are particularly common, Child (1968) records a visual observation of over 100 leaving a small water-hole less than four yards long.

Habitat

Open woodland and scrub including mopane, *Baikiaea*, *Terminalia* and *Acacia;* open grassland, pan and floodplain grassland and vleis. In the northern parts of the territory particularly associated with vleis and floodplains, where water is available, but not dependent on this as in the south they occur in arid

country where it may only be available seasonally (central, southern and south-western Kalahari; cf. Sahelian zone of West Africa, Dorst, 1969). Under such arid conditions it may be that, like other species (wildebeeste, *C. taurinus*) their moisture requirements are supplied through feeding on succulent underground roots and rhizomes.

In general the species avoids areas of thick bush and dense riverine forest.

Habitat

In Botswana the species occurs in a wide variety of habitats from the arid shrub savannah of the extreme south-west in an area of mean annual rainfall of less than 200 mm, where they are uncommon, to the north-east on the Chobe River in a rainfall area in excess of 750 mm where they occur in well-watered riverine associations and are common and plentiful.

In the south-west they occur in dry scrub with scattered camelthorn, *Acacia giraffa*, trees often in the vicinity of pans (Kakia, Sekhoma, Mpatutlwa), in country where there is no permanent surface water and where water is only available, even in the best seasons, for very limited periods, or may not be available at all from one season to the next. In the Okavango delta, Savuti and on the Chobe River they are particularly associated with open woodland, scrub and floodplain especially in areas adjacent to swamp, rivers and wet vleis and low-lying areas where there are rich stands of sedges and grasses such as *Cynodon* sp., *Imperata* sp., *Echinochloa* sp., on the leaves or succulent underground stems of which they feed. The seeding heads of *Dactyloctenium* sp. provide food for the weaners. 'On balance they appear to prefer the shorter grasses (e.g. *Cynodon* sp.) because they are easier to graze and many of which have swollen root storage organs' (Child, *in litt.*). These two conditions alone are so different as to make it difficult to generalize as far as the habitat requirements are concerned.

Habits

Diurnal, although Shortridge (1934) states that they may move around on moonlight nights. In Botswana they were not contacted after sunset.

Occur singly but more often in pairs or family parties (sounders) of up to five or six. The female or both parents may accompany the young and, while litters may number up to five, by the time the young are about half-grown commonly only two or three remain, indiciating a high mortality rate. At Savuti a female was accompanied by seven half-grown young, some of whom it was assumed were the progeny of another female.

In the Savuti Child (1968) records that the population around the swamp increased rapidly with the flooding of the area, declining as it dried up.

Lie up at night in antbear, *O. afer*, holes and will take to these during the day under stress, entering them backwards. In the dry cold months of June and July on cold windy days in the Tamafupi area warthog were not in evidence till quite late in the morning. A female with two three-quarter grown young, whose resting hole was kept under observation, did not emerge until 1 p.m. proceeding directly to a nearby water-hole to drink. Sowls and Phelps (1966) show that the body temperature of young warthogs responds quickly to outside low air temperatures, the burrows being warmer and remaining at an even temperature which is quickly raised by their presence in them providing sheltered warm conditions necessary for their survival. Child (*in litt.*) suggests that mud-wallowing is important in the regulation of the body temperature.

In the well-watered north warthog drink regularly. At the Savuti a sounder of two adults and two juveniles were seen to water twice in one day. They are also very fond of wallowing in mud and will lie for lengthy periods in muddy pools. In the south water is not available to them for long periods and they cannot either drink or wallow, yet their presence here shows that they can survive in these arid conditions.

During the rainy season they appear to be more widely dispersed, less confined to well-watered areas in the north, but this dispersal is local. Shortridge (1934) states that warthog 'trek far afield during and after the rains and may be found tens if not hundreds of miles from the dry weather haunts'. There is no evidence at the moment to suggest that such long distance movements involving 'hundreds of miles' might be the explanation of their presence in arid country in the south. Child (*in litt.*) considers the species as fairly localized (Moremi Game Reserve), one recognizable male not moving over two kilometres during a nine-month period.

Food

They feed mainly on grasses and the underground rhizomes of grasses. Partial to freshly sprouting grass on burnt patches, BP 583 from Kanyu had a stomach content consisting of 9/10 green grass, 1/10 rhizomes finely chewed. In vlei areas (Nunga), on the fringes of swamp (Gomoti R.) and round water-holes (Tamafupi) roots with the snout for the rhizomes of such

grasses as *Echinochloa* spp., *Imperata cylindrica* and couch grass, *Cyonodon dactylon*. The species shows a preference for feeding in damp or wet areas where grasses such as *Echinochloa* spp. and *Imperata* spp. remain fresh and the rhizomes succulent and full of moisture.

In areas where underground rhizomes are sought the ground becomes churned up to a depth of up to 10 to 15 cm over large tracts. Characteristically the species kneels to 'root' the upper edge of the snout serving as an efficient digging tool, the kneeling posture providing a firm base for the leverage of the head and neck in the process.

A sounder of three were surprised in the middle of the track near Sekhoma Pan eating the calcareous material laid down as road surfacing which presumably contained mineral salts. They were also seen at Kwikampa routing in a salt-lick opened up by elephant.

Breeding

Only one gravid female was taken, BP 2256 from Nunga in August 1968 with two foetuses, *c.* 200 g each, implanted 2L. This is lower than the more normal number of foetuses which, according to Ansell (1960) is three to four. Shortridge (1934) states that four is the normal number in a full litter.

Child and Röbbel (*in litt.*) state that in the Moremi Game Reserve litters were observed in November to January as follows:

Period	No. of Litters	No. in Litters	Mean No. in Litter
November	5	2-4	3·2
December 1-5	6	3-4	3·3
December 6-9	9	1-4	2·7
January 23-30	36	1-4	2·6

In western Rhodesia Child, Roth and Kerr (1968) state that farrowing takes place between September and December with most births in October and early November, pointing out that the farrowing season may vary locally.

While in northern Botswana the season appears to be between October and January, there is no information from the southern part of the territory.

The largest litter observed with a single female was seven, six of very similar size with another female. At Nokaneng in January a litter of six was seen in which two of the six were noticeably larger than the other four. A litter of seven was seen in the Wankie National Park in December and certainly contained two age groups. It appears that females may, under certain circumstances, adopt young.

Sizes and Weights

	TL	*T*	*Hf c/u*	*E*	*Weight*
MALES					
BP 583: Kanyu	1068	282	234	93	36 lb. 7 oz.
BP 1300: Tamafupi	1690	403	286	132	155 lb. 4 oz.
RMD 1288: Tsau	1575	391	270	135	—
TNL 1715: Tamafupi	1820	465	300	145	195 lb.
BP 2255: Nunga	1195	305	217	109	—
BP 2105: Gomoti R.	1210	320	235	99	60 lb.
FEMALES					
RMD 1271: Tsau	1215	310	235	105	—
HJH 1204: Joverega	726	182	156	64	11 lb. 15 oz.
TNL 3528: Shakawe	1360	360	240	113	85 lb.
SWG 1279: Nokaneng	1530	390	256	135	124 lb.
TNL 4048: Camp 4	1015	270	205	98	—
BP 2256: Nunga	1449	407	243	134	—

Family HIPPOPOTAMIDAE

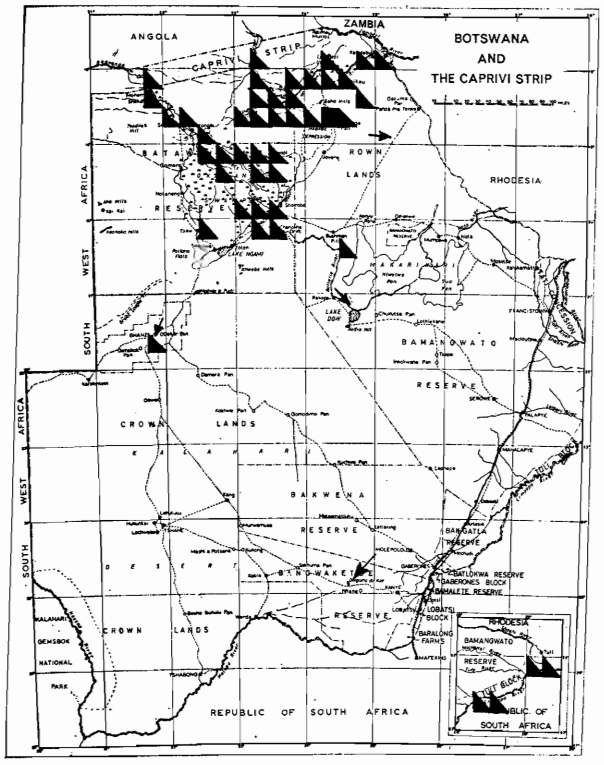
Genus HIPPOPOTAMUS Linnaeus, 1758

Hippopotamus amphibius — Kubu Hippopotamus

H. a. capensis Desmoulins, 1825

Distribution

Hippo occur in the Okavango River and its swamp delta, the Chobe, Botletle and Limpopo rivers. In the Okavango delta they are distributed throughout the northern parts, and may reach as far south as Tsau in the west in seasons of high flood. In the east they occur as far south as the Botletle River and eastwards



in this river at least as far as Kumaga. Common in the Chobe River and associated swamps and a few are still found in the Limpopo River in the vicinity of the northern Tuli Block farms, in the larger permanent pools and in similar conditions in the Shashi River near its junction with the Limpopo River.

The presence of hippo in the Selinda spillway and Savuti channel depends on the floods being high enough to ensure that they are well filled when hippo move out of their permanent habitat in the Chobe River and associated swamp areas travelling far along these waterways.

Subject to seasonal and vagrant movements which carry them far from their normal habitat range. In the north-eastern sector seasonally move eastwards during the rainy season, temporarily occupying pans and watercourses, returning as they dry up. Known to move south-eastwards along the Botletle River to near Lake Dow.

Vagrant movements have taken a hippo as far south as Ghanzi (1967) and an individual was shot near Dikomodikae in 1963. There is no satisfactory explanation of these quite unusual wanderings which carry them into totally unsuitable country. Such movements are known in other parts of southern Africa. The extensive wanderings of 'Huberta' in the 1930's were widely publicised and are referred to by Shortridge (1934).

Cornwallis Harris (1852) met with hippo in the Molopo River in the vicinity of the Baralong farms in the extreme south-east of the territory. Andersson (1856) reported that they abounded on the north side of Lake Ngami, Livingstone (1859) also reporting them in the lake during his visit in 1849, but they no longer reach it owing to the drying up of the Taoghe River which once drained from the swamp from near Tsau into the lake.

Habitat

Rivers and swamp where there is open water with sandbanks, preferably those surrounded by water on which to lie up, partially submerged, during the day. These daylight resting places may be situated several miles from the grazing grounds, which they visit after dark. In the Linyanti the daylight resting places were deep in the swamp where there were areas of open water with sandbanks.

Habits

Semi-aquatic and truly amphibious. Predominantly nocturnal they move from their aquatic habitat at night to graze on dry land. In rivers, such as the Limpopo, occupy the larger permanent pools, moving up and down river in flood season and returning to these permanent pools as the floods subside. Gregarious, found in schools of up to 15-20 in the more extensive stretches of open water, such as in the Chobe River, but normally in smaller numbers of from six to ten. In the Botletle River and parts of the Okavango delta singles or pairs occupy permanent pools of restricted size.

The records of seasonal wanderings are usually of single individuals, pairs (Kumaga) or small numbers (Tsau, three), the vagrant wanderers usually single individuals (Ghanzi, Dikomodikai).

During the day schools lie on submerged sandbanks in the water, the individuals packed together, the top of the heads and part of the backs above water. The young often lie up on the backs of their mothers so as to avoid total submersion. At night scatter to feed returning to the same pool to rest.

The bulls can be very aggressive and territorial fights, which leave the contestants scarred for life, are common. Females with young can be dangerous if approached too closely in small boats. They are inquisitive and, where undisturbed, will closely

examine these and may demonstrate by snorting or leaping out of the water which they have been known to do against observers on the banks. On dry land can run remarkably fast for their great size.

In moving tend to follow set routes, the pathways so created may be seen on the bottom in clear water (Gomoti River) and, in shallow swamp, are eventually gouged deeply into the mud (Linyanti). In the Linyanti swamp these paths, half to one metre deep through the reed-beds, could be followed for several miles usually ending up in areas of open water and were apparently routes taken when moving to feed at night on its fringes.

The pathways are characteristic, having a raised ridge in the middle with two deeper parallel channels on either side gouged out by the feet.

The movements of hippopotamus in swamp areas are an important factor in keeping the channels open and allowing of the free movement of the water through reed and papyrus beds. Attempts have been made, at great cost, to use machines to cut channels through the reed masses as a means of maintaining the flow of the water but, so far, these attempts have failed.

If disturbed at night on dry land invariably make for their aquatic habitat. Although normally occupying fairly static water are capable of making their way up-stream against fast-running water. An individual disturbed at first light in the Kasane rapids appeared to have little difficulty in making its way up a side issue where the current was very strong.

Hippo can remain under water for up to five to six minutes when they have to return to the surface to breathe. This return is heralded by a blast of air expelled through the nostrils, usually accompanied by a spray of water.

When defecating on dry land do so against an obstruction such as a bush or rock, scattering the faeces with the tail.

It has been suggested that the nutrients liberated by their excreta in the water is essential to a continued heavy yield of fish.

Food

Predominantly grazers they have also been recorded as eating lily tubers and sometimes herbs (Tinley, 1966). At Linyanti they were observed feeding on the grassland on the fringe of the swamp and on floating aquatic grasses. They can graze on surprisingly short grass, cropping very close to the ground level. Where grain crops are grown near the haunts of hippo they become crop raiders and can do great damage.

Breeding

The only data available on the time of dropping the young are three observations of very young calves seen with adults in the swamp near Shakawe in February and in the Chobe River in May. Shortridge (1934) and Ansell (1960) state that the young may be born at any time of the year. In all three observations the female with the calf were alone in quiet backwaters under which conditions females can be very aggressive.

Sizes and Weights

No data from Botswana as no specimens were collected.

Family GIRAFFIDAE

Genus GIRAFFA Brisson, 1762

Giraffa camelopardalis — Thutlwa Giraffe

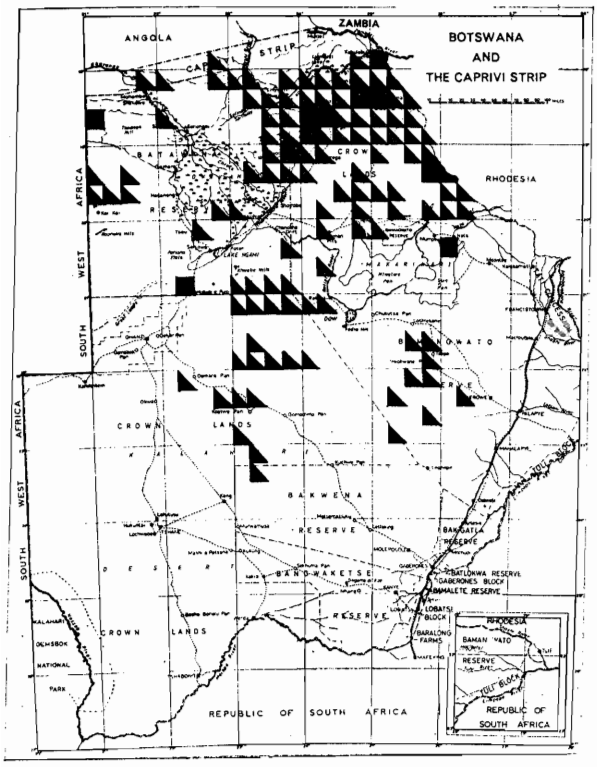
G. c. angolensis Lydekker, 1903

Distribution

Widely distributed throughout the northern and central parts of the territory as far south as the Aha Hills on the South West African border extending southwards, east of 22° E., to the north-western parts of the Bakwena Reserve; east through the southern part of the Central Kalahari Game Reserve to just north of Lephepe, west of Serowe and throughout the south-central parts of the Bamangwato Reserve as far north as the area just south of Lothlekane. Absent from the southern part of the Makgadikgadi but occurring along its northern border through Kanyu and Mampswe and north of the Nata River to the Rhodesian border.

A vagrant was recorded in 1968 (Campbell, *pers. comm.*), at the south-eastern corner of the Makgadikgadi on the northern side of the cordon fence, and three in 1962 just west of Mabeleapudi on the northern side of the Kuki fence. These vagrant wanderings can be expected from time to time on the perimeter of their distributional range.

Absent from the eastern part of the Ghanzi farms and adjacent area and the country round Lake Ngami.



The species is particularly common and widespread in the north-eastern sector which carries heavy populations.

Until recent years there were still a few giraffe in the eastern parts of the Bamangwato Reserve, between the Macloutsie and Shashi rivers, but there are no records of these since 1964 and it is thought that they no longer occur there.

It appears from the historical record that the distribution of giraffe has shrunk very considerably. About the early part of the nineteenth century giraffe occurred at least as far south as '30 miles south by west of Kuruman' in the northern Cape Province (Khosi Fountain; Burchell, 1822).

Cornwallis Harris (1852) reports that the Griquas hunted giraffe on the Molopo River, which forms the southern border of Botswana with the Republic of South Africa.

As late as 1891 Bryden and Selous saw a herd of giraffe in the Kolobeng area; Bryden (1890) records their presence in the 'hunting ground of Bathoen and his Bangwaketse people' (vicinity Kanye) and at Boulder Pits (Lobatse).

Stories have been handed down of the occurrence of giraffe in the northern parts of what is now the Kalahari Gemsbok National Park and there is a pan some 60 miles north of Tshabong called Mpatutlwa, which means 'the stomach of the giraffe'. Giraffe were reported some years ago as being seen just north of Sekhoma Pan in the Bangwaketse Reserve.

All these records are from areas far south of today's limits of distribution.

Habitat

Light open woodland and open scrub-covered plains. In the north-eastern sector where there are heavy populations, although they are frequently contacted in *Baikiaea* woodland or on open pans (Nxai Pan) in these cases they are on the move and they are far commoner in the belts of *Acacia*, the twigs and green leaves of which constitute one of their main foods. Other types of woodland are used for shelter or shade. In the scrub savannah of the central Kalahari there is ample scrub *Acacia* to provide a food supply. Here they tend to occur more commonly in the vicinity of belts and stands of *Acacia* which are found throughout.

Habits

Gregarious, occurring in herds of up to *c.* 50 (Silberbauer, 1965, Central Kalahari Game Reserve); 25-30 (Mababe) but more often in small herds up to six and often solitary males or females attending several young of approximately the same age or assorted age groups (20 miles north of Nxai Pan, one female with three one-third-grown young; Tamafupi, one female with one three-quarter-grown and three one-third-grown young; Kanyu, one female, one very young, two about one-third-grown). Adult females appear to 'adopt' weaned young, then move with them as independent groups, or juveniles may congregate in 'nursery herds' with no adults in attendance (Tamafupi).

In the north-eastern sector drink at water-holes and pools in watercourses and appear to be dependent on the availability of water, but in other areas, such as the Kalahari, appear independent of it occurring in terrain devoid of surface water except for brief periods in the year. In the south-western parts of the Bamangwato Reserve observed to drink from spillage at a pump (Moyabana).

Shortridge (1934) notes that in the Kaokoveld and Grootfontein districts of South West Africa he never saw giraffe spoor around water-holes or rivers. This is at variance with experience of the species in the north-eastern part of Botswana where their spoor is common in such situations, the splayed spoor of the front feet indicating that they had been drinking and there are numerous observations of them drinking

(Tamafupi, Savuti, Piri Pan, etc.). It may be that they drink at irregular intervals.

Predominantly diurnal, standing in sheltered places at night, but occasionally moving at night (Kanyu), although it appears that they feed only during daylight hours.

Young giraffe are a favourite prey of lions and may carry the scars of their claws through their lives. Adults, however, are normally a match for them and there are observations on record of lions being killed, by the powerful forward kick of their front feet (Davison, *pers. comm.*), in defending themselves or their young.

Giraffe have a curious rolling gallop, fore and hind legs on the same side moving in unison, the tail moving circularly, which carries them over the ground at considerable speed and they turn and twist past obstructions with remarkable agility considering their great bulk. They have keen eyesight, sense of smell and hearing. Normally silent, under stress they bellow like a calf. Old males have a strong smell of sweet musk.

Food

Giraffe are predominantly browsers feeding on the leaves and fresh twigs of a variety of bushes and trees, including a number of species of *Acacia*, including *A. giraffae* and *A. tortilis*, which appears to be a favourite food. C 2822 from the Savuti had been feeding mainly on mopane, *C. mopane*, and browsing on this species has been observed in the Mababe. Other species utlized include *Boschia* spp., *Combretum* spp., *Terminalia* sp.

Child (1968) lists the following species of food plants for the species in the Chobe National Park:

Boschia albitrunca	*C. mossambicense*
Terminalia sericea	*Zizyphus mucronata*
Acacia giraffae	*Baphia obovata*
A. tortilis	*Burkea africana*
A. hebeclada	*Dichrostachys cinerea*
Combretum hereroense	*Phyllogeiton discolor*
C. imberbe	*Lonchocarpus capassa*

In the Wankie National Park they have been observed grazing during the early and mid-summer months when the grass is green and fresh.

Breeding

From a series of five females collected on the Savuti by Child in April 1967 three were pregnant and one had a suckling calf. Judging from observations of very young individuals in July and September the indications are that they may drop the young widely throughout the year, perhaps with a peak towards the end of the rains about May through June.

Twin calves have been reported (Shortridge, 1934), but this may have been a case of a female 'adopting' another calf, which is not unusual in the species. There do not appear to be any records of females with twin foetuses.

Sizes and Weights

The following data was taken from a series of nine specimens from the vicinity of the Savuti by Dr. G. Child in April 1967.

MALES	*TL*	*T*	*Hf c/u*	*E*	*Height at Shoulder*	*Height at Withers*
C 2794 ..	5224	1500	1170	236	3490	2770
C 2797 ..	3919	959	1104	219	2559	2243
C 2802 ..	5029	965	1352	242	3378	2768
C 2824 ..	—	—	1099	216	2717	2209

FEMALES						
C 2795 ..	4456	895	1017	213	3003	2428
C 2796 ..	4395	895	1178	213	3010	2458
C 2822 ..	3942	902	1150	216	2819	2336
C 2823 ..	—	—	1130	203	2819	—
C 2825 ..	3759	750	1041	203	2032	2362

Family BOVIDAE

Key after Ellerman *et al.* (1953).

1. Horns poorly developed, present or absent in females, relatively short, straight, spike-shaped and simple. The largest horns a little over seven inches and below eight inches. Facegland present, and pre-orbital pit on the skull for its reception 2

   Horns well developed, usually somewhat curved (straight in *Oryx*), not spike-shaped, and in

measurement exceeds seven inches (except *Redunca fulvorufula* in which they curve forward at about the level of the tip of the ear) . . 5

2. Hooves short, truncated, giving an oval spoor. Pelage of bristles not hair . . *Oreotragus*
Hooves not particularly shortened, hairy pelage 3

3. Face gland specialized, prominent opening as a long slit down the face . . . *Sylvicapra*
Face gland less prominent and specialized, not forming a long opening 4

4. With a bare patch below ear; with knee tufts; horns ridged at base . . . . . *Ourebia*
No bare patch below ear; no knee tufts; horns not or little ridged at base . . . *Raphicerus*

5. Horns normally present in the males only. (No face glands.) 6
Horns normally present and well developed in both sexes 9

6. Horns twisted in a more or less open spiral, not heavily ringed. Usually the body has at least signs of stripes . . . . . *Tragelaphus*
Horns more or less lyrate in shape, or in the form of a forwardly directed arc of a circle, usually ringed; body without stripes 7

7. No lateral hooves; no supraorbital pits nor lachrymal vacuities; with premaxillo-maxillary vacuity; horns more or less lyrate; a vertical black streak on each hindquarter and white between them . . . . . *Aepyceros*
With lateral hooves; with supraorbital pits and lachrymal vacuities; no premaxillo-maxillary vacui y 8

8. Tail short and bushy; bare patch below ear; on average smaller; horns in the form of a forwardly directed arc of a circle and rarely as much as 18 inches . . . . . *Redunca*
Tail not bushy; no bare patch below ear; on average larger, horns not under 17 inches . . . . . *Kobus*

9. Horns in the male more or less lyrate in shape, ridged and usually hooked inwards at the tip; in the female smoother, shorter and lighter; cheek-teeth reduced, only five in lower jaw, five or six in the upper. Colour distinctive, pale sandy with black bands along the flanks, white underparts and a dark streak on the face. A band of long, white, erectile hairs along the spine from the mid-back to the tail. Face gland present and corresponding preorbital pit in the skull . *Antidorcas*
Little or less difference between the size of the horns of males and females. Not combining the characters of the last genus, generally larger 10

10. Horns long and straight; colour of body pale, with whitish limbs and dark marks on the face . . . . . *Oryx*
Horns curved 11

11. Horns rising from above the orbits, and curving back . . . . . *Hippotragus*
Horns of different shape 12

12. Horns spirally twisted, thinner in female than male. Usually with at least traces of stripes on body. Male with dewlap, and tufted forehead. (No face gland.) . . . . . *Taurotragus*
Horns not spirally twisted; colour different, not combining the characters of the last genus . 13

13. Build massive and ox-like. Horns not ringed, tending to meet in middle line of skull, at first directed outwards. Nasals short and broad (in Roberts figures only once over 200 mm). Tail not very long-haired, and not nearly reaching the ground. (No face gland.) . . *Syncerus*

13. Build less massive; antelopine or almost horse-like (*Connochaetes taurinus*, which has horns of similar shape to *Syncerus*, has the nasals long and narrow (only once under 200 mm in Roberts' figures, although all the skulls are smaller in condylobasal length than *Syncerus*) and the tail is very long-haired and nearly reaches the ground). With face gland, and at least a small pit in the skull for its reception 14

14. Horns smooth and curving downwards then upwards, directed either forwards or outwards. Back with mane. (Tail very long-haired, the hairs nearly reaching the ground.). . *Connochaetes*
Horns ringed and of a different shape; back without mane 15

15. Horns usually roughly S-shaped, and on pedicle; occiput about level with or in front of base of horns; face very long . . . . . *Alcelaphus*
Horns more lyrate, less specialized, not situated on pedicle; occiput behind base of horns; face rather less long . . . . . *Damaliscus*

Genus OREOTRAGUS A. Smith, 1834

Oreotragus oreotragus

moKabayane moTsweima Klipspringer

O. o. transvaalensis Roberts, 1917
O. o. stevensoni Roberts, 1926

Taxonomic Notes

The northern populations which occur from the Tati Concession south to Debeeti lack the golden-yellow colour on the shoulders and neck, characteristic of the southern populations, which occur in the Gaborone and the Lobatse areas. These seem to represent the two subspecies described by Roberts:

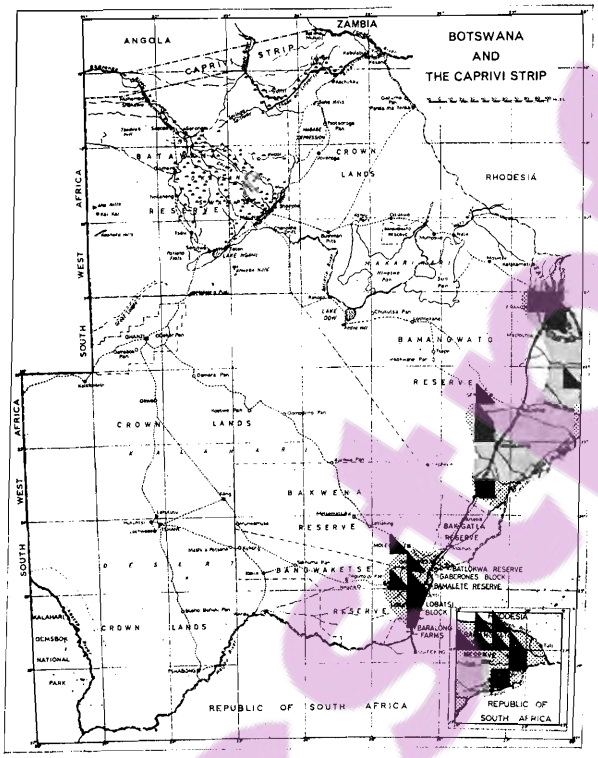
O. o. transvalensis Roberts, 1917. The southern populations from the Gaborone, Molepolole, Kanye and Lobatse areas.

O. o. stevensoni Roberts, 1946. The northern populations from the Tati Concession west to the Tuli Circle and south to Debeeti.

If these two subspecies intergrade this will take place in the northern Transvaal as there is a clear break in their distribution in Botswana, where the Kalahari associations extend eastwards to the Transvaal border in the area of Artesia.

Distribution

Where there is suitable habitat occur throughout the northern parts of the eastern sector from the Tati Concession south to Debeeti and east to the Tuli Circle, then with a break in distribution south to the Gaborone area where they are found west to near Molepolole and Kanye and south to Lobatse.



Shortridge (1934) states that they occur on the Tschorillo (Tshodilo) Hills, in the extreme north-west of Botswana, but there are no material records to substantiate this stat ment. They are found in the hills round Grootfontein, South West Africa, some 250 miles west of Tshodilo, this being the nearest recorded locality to Tshodilo from which they have so far been taken.

Although there are other areas which would provide suitable habitat for the species (Goha Hills; Kwebe Hills) these are too far removed and isolated from their normal distributed range. Shortridge (1934) quotes Neale (*in litt.*) who states that they have been shot at Mabela, 40 miles south of Kasane. This locality cannot be traced but it may be over the Rhodesian border as they do occur in the broken country in the northern part of the Wankie National Park and adjacent areas.

All historical records (Cumming, 1850; Bryden, 1893; Selous, 1893) refer to their occurrence in the 'mountains' and hills of the eastern sector. Bryden's record from Seleba Samontchana (Serui Hills, north-west of Mahalapye) is within the known present-day limits of their distribution.

Habitat

Confined to rocky hills and kopjes irrespective of the geological formation (granite in the Tati Concession; sandstone in the Mabate area).

Habits

Normally in pairs or a family party of three. Although they are recorded as occurring in small parties of up to six or eight in other parts of southern Africa no more than three have so far been seen together in Botswana (Mabate). Diurnal, feeding in the early morning or late evening and occasionally just after sundown. They lie up during the day in the shelter of rocks in secluded, sheltered areas. The oval hooves are specifically adopted to movement on rocky surfaces on which they move with agility, bounding across wide areas between boulders and up the steepest rocky slopes. They are shy and retiring and

will take cover behind boulders, looking round the side to watch the observer.

In the evening individuals will stand motionless on a rocky pinnacle, the feet bunched together, the head held high, in a pose unique to the species. In the evening and early morning will move out of their rocky habitat to feed on flat ground at the base of the kopjes. When disturbed they make directly for the rocks.

Unless seen against the skyline their grizzled pelage blends into the background and makes them very difficult to see when not moving.

Defecate in middens on flat ground in the higher parts of the hills, these middens apparently used over long periods as they become very large (Mabate, diameter *c.* 90 cm; 10 cm deep in centre).

Food

Browsers. Identifiable items in stomach contents included wild fig, *Ficus* sp., fruits (20% of the content in BP 942; 10% in BP 943); *Acacia* sp., pods and leaves of forbs, which were growing on the kopjes (undet.).

Breeding

A lactating female was taken at Mabate in April, females taken in March (1), May (2), and August (1), being non-gravid. In adjacent parts of Rhodesia Wilson (*in litt.*) records gravid females as follows:

February	Wankie National Park	10.2.70	Full-term
	Matopos National Park	5.2.67	CR 170
July	Matopos National Park	4.7.67	CR 50
August	Matopos National Park	29.8.67	CR 85
October	Wankie National Park	7.10.69	CR 178

This seems to indicate a wide breeding season.

Sizes and Weights

MALES (*O. o. stevensoni*)

No.	*TL*	*T*	*Hf c/u*	*E*	*Weight*
BP 942	855	75	205	80	21 lb. 2 oz.
BP 1285	836	75	214	88	19 lb. 8 oz.

FEMALES (*O. o. stevensoni*)

BP 943	890	72	205	80	22 lb. 5 oz.
BP 1286	925	76	210	95	25 lb. 12 oz.

MALE (*O. o. transvaalensis*)

TNL 1078	874	95	226	90	23 lb. 4 oz.

FEMALE (*O. o. transvaalensis*)

BP 1292	935	60	225	90	—
BP 2021	890	80	230	90	27 lb. 14 oz.

Genus SYLVICAPRA Ogilby, 1837

Sylvicapra grimmia — Phuti Common Duiker

S. g. steinhardti Zukowsky, 1924
S. g. splendidula (Gray, 1871)
S. g. transvaalensis Roberts, 1926

Taxonomic Notes

Roberts (1951) lists three subspecies as occurring in various parts of Botswana:
S. g. steinhardti Zukowsky, 1924. Range from South West Africa eastwards into the Kalahari.
S. g. splendidula (Gray, 1871). Range from Angola into Ngamiland.
S. g. transvaalensis Roberts, 1926. Range from the western Transvaal into southern Botswana.

There is a considerable degree of variation in the colour of the upperparts, the extent of white on the belly and the length of hair of the pelage within a population in a relatively circumscribed area.

In series, however, it is possible to recognize that material from the south-west Kalahari is paler in colour and yellower (TNL 4876, Tshabong), than material from the eastern sector (TNL 648, 709 near Tuli Circle) which is greyer, with a more liberal sprinkling of black hairs on the dorsal surface. These appear to represent *S. g. steinhardti* and *S. g. transvaalensis* respectively.

Material from the northern parts of Ngamiland, the Chobe River and the north-eastern sector is distinctly brighter, more ochraceous and appears to be best placed with *S. g. spendidula* (TNL 4901, Kwando River).

As an example of the variation in colour found within restricted areas, while TNL 4901 conforms to the description of *S. g. splendidula* in its brighter more ochraceous colour of the upperparts, TNL 4895 from the same locality (Kwando River 18 23A1) is

slightly darker but still more ochraceous than material from the Kalahari or from the eastern sector.

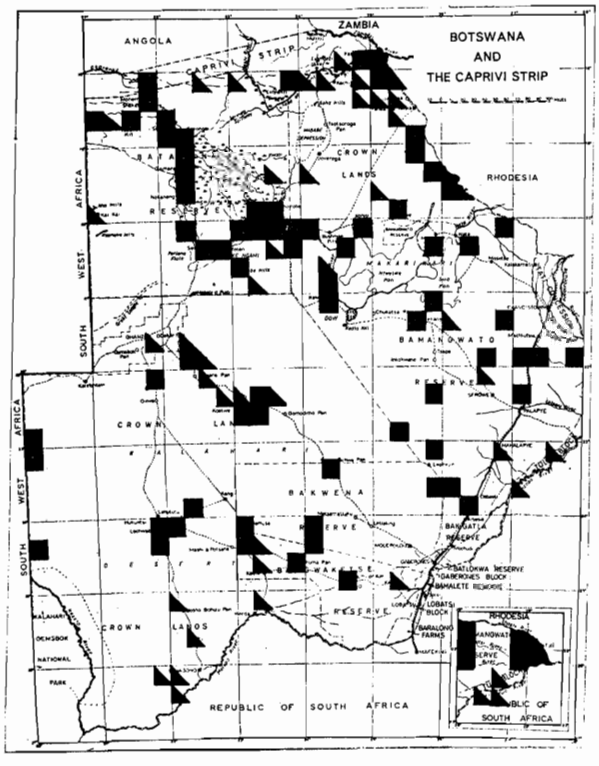
Between these areas there are wide areas of intergraduation although the paler *S. g. steinhardti* appears to have a distribution throughout the Kalahari, *S. g. transvaalensis* the eastern sector and *S. g. splendidula* the Okavango delta, the Chobe River area and the eastern parts of the north-eastern sector.

The length of the hair shows a surprising variation. In BP 1044 from near Lephepe this is normal (*c.* 25 mm), in BP 1041 from the same locality, taken the same evening, the hair is very long (*c.* 25-35 mm) and wavy.

Distribution

Widely distributed throughout the territory, although locally absent and absent in areas of open grassland, if there is no suitable cover.

Although there are no material records from the extreme south-west in the vicinity of the Gemsbok National Park, they were taken in the Tshane area and east of the park boundary (24 20 A3). Eloff (1959) records them from the park, in 29 traverses, 19 individuals being seen, Coetzee and Burger (*in litt.*) also list them for this area. Compared with their status in the eastern sector and the northern parts of the territory, more especially the Okavango delta and Chobe River areas where they are very common, in the dry south-west they are comparatively uncommon.



The species persists even in intensively developed farming and ranching areas and in the face of heavy hunting pressures. Historically most writings deal with the eastern part of the territory (Cumming, 1850; Livingstone, 1857; Holub, 1881; Selous, 1907). Judging from their widespread distribution today, there apparently has been little if any change in their distributional range in the territory in historical times.

Habitat

The great majority of the 129 specimens for which there are notes on habitat were collected after sundown with the aid of dazzling lights. At this time they are normally feeding.

In 117 cases there is an obvious preference for associations which provide cover, which appears to be an essential habitat requirement, not only for protection and shade in which to lie up during the heat of the day but, as the species is predominantly a browser, the leaves and twigs of shrubs on which to feed.

Twelve specimens out of 129 were taken in vleis, fallowed agricultural lands, cleared ground, or airstrips. In all these cases shrub or woodland cover was within easy reach and when disturbed their normal reaction was to make for this cover.

The species does not seem to be particularly associated with any one vegetation type, occurring in a wide variety of associations. The fact that 44 out of the 129 were taken in *Acacia* woodland and scrub is more a measure of the wide extent of occurrence of this type of association than of the preference of the species for it. In parts (Tamafupi) they were very common in *Terminalia-Combretum* scrub or mopane (Magogaphate) where there was some underbush.

An analysis of the data available is as follows:

Open grassland with scattered trees and bushes	19
Floodplain grassland with scattered trees and bushes	1
Vleis	3
Fallowed land, cleared ground, airstrips	9
Riverine woodland, *Acacia;* mopane	12
Riverine woodland, with evergreen trees and undergrowth	9
Swamp islands	2
Mopane woodland and scrub	16
Acacia woodland and scrub	39
Parklike *Acacia* woodland with scattered bushes	5
Baikiaea woodland	1
Terminalia-Combretum scrub	9
Terminalia-Acacia fringe of pans	1
Terminalia-Dichrostachys and *Acacia* scrub	1
Miscellaneous scrub not classified	2
	129

Habits

Predominantly nocturnal, although occasionally seen feeding in the early morning or late evening. During night observation with dazzling lights, individuals were found lying down in the shelter of bushes by 8 p.m., while others in the same area were still feeding as late as 1 a.m. In general most individuals had already taken cover in the shelter of bushes by 10 p.m., lying up to chew the cud.

Occur singly or in pairs or females with young.

Although they will drink water when this is available, not dependent on it. Even in the driest areas duiker stomach contents are characteristically liquid, the moisture accruing from wild fruits, such as *Solanum* spp. and the succulent bulbs and tubers for which they dig and which constitute an important part of their diet. In the drier areas they are avid diggers in their search for bulbs and tubers (Sekoma Pan).

In parts of the south-west water may not be available to them except for very limited periods during the year or not at all during a season if the rains fail.

Wilson (1966) records that over a three-year period in Zambia, duiker were not seen to drink, and in captivity could go without water for long periods although they would drink on occasion.

Except when feeding, duiker avoid open country and are essentially associated with open bush savannah or open woodland with some cover of underbush. In parts of the Okavango delta, they will lie up during the day in dense riverine underbush.

Food

Duiker are predominantly browsers, feeding on a wide variety of different types of vegetable matter, including the leaves, thin stems, fruits and flowers of trees, shrubs and forbs, underground bulbs and tubers and the bark of trees. While no detailed analysis has been undertaken of the stomach contents of the material from Botswana, examination in the field did not reveal any signs of grass in the stomachs. Wilson (1966) records that out of a series of six duiker observed feeding in open grass-covered drainage lines in Zambia, not one of them showed traces of grass in the stomachs and they were feeding on the forbs and dry leaves among the grass tufts. Out of a series of 191 stomachs, Wilson recorded grass in only eight and then only in small quantities.

Field observations on stomach contents from Botswana included the following readily identifiable items:
Wild fig, *Ficus* sp., fruits.
Snake berry, *Solanum* spp., fruits.
Tsamma melons, *Citrellus lanatus*, pulp and pips.
Mopane, *Colophospermum mopane*, young leaves and dry leaves.
Sour plum, *Ximenia caffra*, fruits and leaves.
Wag 'n bietjie, *Ziziphus mucronata*, fruits, dry and green; leaves and thin stems.
Donkey berry, *Grewia* spp., fruits.
Sprawling legume, *Neurautanenia* sp.
Knobby thorn, *Acacia nigrescens*, leaves and thin stems of young plants.
A. tortilis, curly seed pods, leaves and stems.
A. detinens, leaves and stems.
Boschia albitrunca and *B.* spp. leaves.
Carrion flower, *Duvalia polita*, succulent erect stems.
Lance tree, *Lonchocarpus capassa*, fallen leaves and seed pods.
Terminalia spp. fresh leaves and stems.
Diospiros mespiliformes, fallen fruits.
Dichrostachys sp., leaves and thin stems.
Bauhinia spp., leaves and flowers.
Combretum spp. fruits, leaves and thin stems.

In addition unidentifiable onion like wild bulbs together with their stems and flowers and the pulped remains of underground stems or tubers were also noted and on one occasion the dry bark of a tree.

BP 822 from Foley and H.J.H. 1069 from Tsaugara Pan both had a high percentage of mopane caterpillars, *Gonimbrasia belina*, in their stomachs. In BP 822, the caterpillars had obviously been specifically picked from the mopane scrub as there were only traces of leaves. Wilson (1966), in dealing with a very full list of vegetable matter from the stomachs of duiker in Zambia, records two instances of duiker eating guinea-fowl, *Numida mitrata*, chicks and lists other instances of the eating of flesh by the species. He also records the eating of the resin of *Combretum molle*, *Diplorhynchus condylocarpon*, and *Brachystegia boehmi* and it might be that the bark recorded in the stomach from Botswana was injested while eating resin.

Duiker will on occasion raid agricultural crops such as maize, sorghums, sweet potatoes and groundnuts. They have been observed eating the dry leaves of maize, picking them from the ground after the crop has been reaped.

Breeding

Distribution of non-gravid, lactating and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total sample	1	1	1	2	3	7	5	3	4	8	1	3
Non-gravid	–	–	–	–	1	–	–	–	–	–	–	–
Lactating	1	–	1	2	1	–	–	1	–	–	–	–
Gravid	–	1	–	–	1	7	5	2	4	8	1	3

The species appears to breed throughout the year.

Gravid or lactating females have been taken in every month of the year, the sample shows that 38 of the 39 females were either gravid or lactating.

In 23 specimens, where the necessary data had been recorded, implantation was 1R. This is in line with the position elsewhere (Symington and Paterson, 1969).

One foetus only was present in each of the 23 specimens. Ansell (1960) states that, in Zambia, twins occur occasionally. Shortridge (1934) quotes Stevenson Hamilton who states that 'twins, although common, seem to be of more frequent occurrence than in other South African antelope'.

In 20 specimens the female, although carrying a foetus, was dry. In three cases, in which the female was carrying a foetus, she was lactating.

Sizes and Weights

The following tables give the average sizes and weights of a series of males and females with full adult dentition. While the average lengths of the tails are given, owing to the variability of the results arrived at by individuals when dealing with this measurement, no degree of accuracy is claimed for the figures and they should be treated with caution.

MALES

TL	$\bar{X}$ = 1097;	N = 23;	Obs. range 1030-1160
T	$\bar{X}$ = 129;	N = 23;	„ „ 105- 160
Hf c/u	$\bar{X}$ = 326;	N = 25;	„ „ 290- 349
E	$\bar{X}$ = 129;	N = 24;	„ „ 115- 148
Weight	$\bar{X}$ = 41 lb. 2 oz.;	N = 24;	„ „ 33 lb. 12 oz.- 46 lb. 12 oz.

FEMALES

TL	$\bar{X}$ = 1135;	N = 37;	Obs. range 1050-1250
T	$\bar{X}$ = 150;	N = 36;	„ „ 122- 195
Hf c/u	$\bar{X}$ = 327;	N = 38;	„ „ 245- 355
E	$\bar{X}$ = 129;	N = 37;	„ „ 118- 145
Weight	$\bar{X}$ = 45 lb. 8 oz.;	N = 37;	„ „ 37 lb. 11 oz.- 56 lb.

Compared with the weights given by Wilson (1968) for a long series of males and females from eastern Zambia, the weights of the Botswana series average much heavier:

Eastern Zambia

MALES

Weight	$\bar{X}$ = 30 lb. 8 oz.;	N = 172;	Obs. range 28 lb.- 36 lb. 8 oz.

FEMALES

Weight	$\bar{X}$ = 31 lb.;	N = 81;	Obs. range 28 lb.- 37 lb.

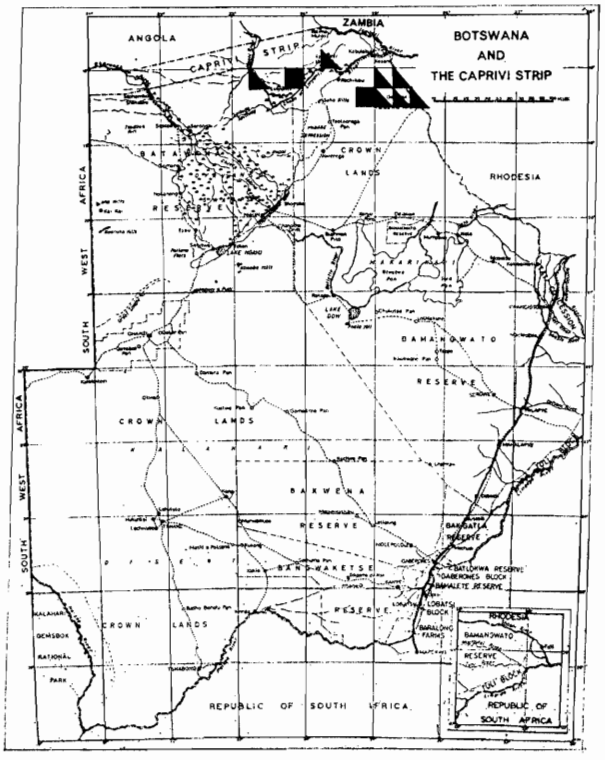
Females in both cases average heavier than males.

Genus OUREBIA Laurillard, 1841

Ourebia ourebi

Phubuhudu kganmae Oribi

O. o. rutila Blaine, 1922



Distribution

Confined to the north-eastern parts of the territory in the area of Gazuma Pan, on the Rhodesian border and narrowly westwards to 24°45′ E. Selous (1890) mentions that in north-western Rhodesia, even at this early date, they appeared to be confined to the Gazuma Pan area 'but nowhere else in the surrounding country'. Also recorded in the eastern Caprivi (B. Carp Expedition, 1949) from the Maschi River east to near Liambesi Lake. There appears to be a break in distribution westwards, as they have not been recorded between the Maschi and Okavango rivers in northern Botswana, but they are known to occur in northern South West Africa (Shortridge, 1934) and Angola (Hill and Carter, 1941).

Holub (1881) records the species from the Makgadikgadi but this may be a misidentification as it is far outside even its historical range, which other sources

give as north-eastern Botswana (Holub, 1890; Bryden, 1899), which roughly corresponds to their present-day distribution.

Habitat

Open grassland or floodplain in the vicinity of water. Partial to areas of burnt grassland.

Habits

Predominantly diurnal, appearing to feed in the early morning up to about 10 a.m. and late afternoon from 4 p.m. till shortly before sundown (Gazuma Pan). At Linyanti found lying in the open after dark (B. Carp Expedition, 1949). Normally occur in pairs, or occasionally in small numbers (Gazuma Pan, five).

Lie up during the heat of the day in patches of thick grass in open areas. When disturbed run off, bounding and jinking from side to side often with a loud whistle, pausing from time to time to look back at the source of the disturbance. Very inquisitive, but wary. On open grassland on Gazuma Pan a pair, after running off, stopped and then slowly and deliberately returned to within about 40 yards standing and watching for some time.

Food

Grazers.

Breeding

No data.

Sizes and Weights

No data.

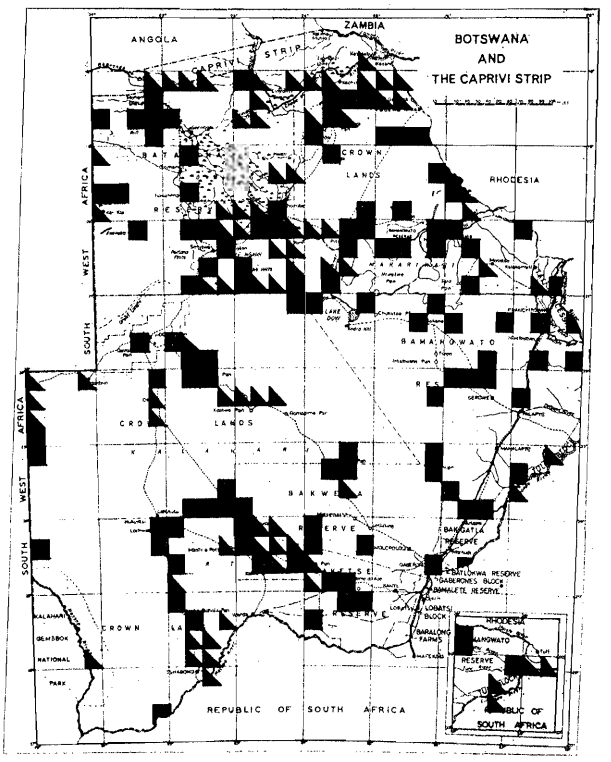
Genus RAPHICERUS H. Smith, 1827

1. Pelage on the upperparts uniform reddish or yellowish . . . . . *R. campestris*
   Pelage on the upperparts speckled, with many whitish hairs interspersed among the reddish ones . . . . . *R. sharpei*

Raphicerus campestris

Phuduhudu Puruburu Steenbok

R. c. steinhardti (Zukowsky, 1924)



Taxonomic Notes

Clearly the subspecies are in need of revision. The populations in the Kalahari, including the Makgadikgadi and its environs, are lighter in colour and yellower on the body and forehead, lacking the reddish tinge of those from the eastern, north-eastern sectors and the Okavango which are darker and redder. These eastern populations may be intermediates between *R. c. steinhardti* and *R. c. capricornis* Thomas and Schwann, from the eastern Transvaal, and in the Okavango between *R. c. steinhardti* and *R. c. kelleni* Jentnick from Angola.

Distribution

Widely distributed throughout but locally absent in areas of unsuitable habitat, as, for example, in the eastern sector, where they only occur in the valleys and not in the rocky broken country which covers a large part of the area, and in areas of open floodplain with only short grass and no cover.

Plate 14 Wounded steenbok, *R. campestris*, takes refuge in an antbear hole. Lephepe. **Photo:** Author

Most of the historical records deal with the occurrence of the species in the eastern part of the territory, Livingstone (1857); Baines (1877); Holub (1890). Bryden (1893) states that they occur throughout the territory from which it would seem that there has been little or no change in their distribution within historical times.

Habitat

One hundred and thirteen specimens out of the sample of 161 were taken either in open grassland, where there was some cover in the form of patches of tall grass or scattered bushes, or in scrub of various types. Of the remaining 48 only five were taken in what was described in the habitat notes as 'thick bush'. These records are from the Aha Hills and Mabeleapudi where, in parts, there are thick stands of *Acacia* scrub but in general the surrounding terrain is open. The balance of 43 specimens were taken in open woodland associations of several types including *Acacia*, mopane and *Terminalia*. The species is particularly associated with open scrub or grassland, but it will use the fringes of thick bush in which to shelter and will freely use woodland providing it is sufficiently open without too much underbush.

An analysis of the data available is as follows:

Open grassland with or without scattered trees and bushes	35
Fringes pans	20
Open ground including airstrips, clearings, cultivation	19
Vleis	10
Acacia woodland and scrub	23
Mopane woodland and scrub	14
Open woodland (unspecified)	6
Terminalia-Combretum scrub	28
Terminalia-Acacia scrub	1
'Thick bush' (unspecified)	5
	161

Habits

Predominantly diurnal, although in areas where they are subject to disturbance or hunting pressure may become predominantly nocturnal (Maun; Motopos, Rhodesia; Wilson, *in litt.*). Feeds mainly in the early morning and late afternoon and usually lies up during the hottest hours of the day and at night in stands of tall grass or in scrub bush, often in quite exposed places such as in small clumps of grass in the middle of open grassy plains. In overcast or cool weather in evidence throughout the day. Occur singly, in pairs or a female with young. During rutting the pairs keep in closer association than at other times of the year.

The species has a very circumscribed home range

estimated by Riney (*pers. comm.*) as less than 0·6 of a mile measured along a 10 mile track. Generally independent of water but have been recorded as drinking in western Rhodesia (Wilson, *in litt.*).

In general the species can utilize more open habitat than the duiker, *S. grimmia*, although in many areas the two occur on the same ground.

When wounded or under severe stress in open country will take to an -bear, *O. afer*, holes (Lephepe) (Plat 14) but generally rely on their speed to escape danger. When flushed inclined to pause and look back for the cause of the disturbance.

Food

Grazes and browses. In a sample of 25 stomach contents from Botswana, Wilson (*in litt.*) reports that there was an average of 50% browse, 50% grass. The species has a tendency to visit the fringes of freshly bulldozed tracks, cultivated ground, cleared ground and open degraded areas round villages where the disturbance of the ground favours the appearance of fresh shoots from the exposed roots of certain plants, forbs and annuals on which it feeds. In general they feed on open ground where there is a sparse or scattered grass cover, being partial to open burnt areas where forbs and shrubs are sprouting.

No detailed analysis has been carried out on the stomach contents, but examination in the field revealed the presence of the following readily identifiable browse plants:

Knobby thorn, *Acacia nigrescens*, leaves and thin stems of young plants.
'Mangwe', *Terminalia sericea*, fresh leaves.
Acacia spp., leaves and thin stems.
Boschia albitrunca, leaves.
Sour plum, *Ximenia caffra*, fruits, green and ripe.
Wag 'n bietjie, *Zizyphus mucronata*, fruits and leaves.
Mopane, *Colophospermum mopane*, leaves.
Snake berry, *Solanum* spp., fruits.
Donkey berry, *Grewia* sp., fresh leaves.

The above, while in some cases constituting a high percentage of the content, were in general overshadowed by a mass of unidentifiable, well-masticated leaves, shoots and twigs of annuals, forbs and grasses which appear to constitute the main diet of the species.

Breeding

Distribution of non-gravid, lactating and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total number	1	2	3	3	6	5	3	2	1	5	5	1
Non-gravid	–	–	–	–	–	–	–	–	–	–	–	–
Lactating	–	1	2	2	4	–	–	–	–	2	–	–
Gravid	1	1	1	1	2	5	3	2	1	3	5	1

The species appears to breed throughout the year. Females carrying foetus or lactating were taken in every month of the year, all the 37 females taken either being gravid or lactating.

Implantation in a sample of 18 in which the information was recorded was six implanted 1L; 11 1R, in every case one foetus only being present.

Wilson and Kerr (1968) found that ovulation occurred uniformly between both ovaries and implantation of the single foetus uniformly between the left and right horns of the uterus.

Sizes and Weights

The measurement of the tail is subject to so much variation in interpretation that it is disregarded for purposes of the following tables:

MALES

TL	$\bar{X}$ = 843;	N = 38;	Obs. range	773-910
Hf c/u	$\bar{X}$ = 273;	N = 39;	„ „	253-290
E	$\bar{X}$ = 114;	N = 37;	„ „	101-125
Weight	$\bar{X}$ = 24 lb.;	N = 37;	„ „	19 lb. 11 oz.-29 lb.

FEMALES

TL	$\bar{X}$ = 856;	N = 39;	Obs. range	790-920
Hf c/u	$\bar{X}$ = 271;	N = 38;	„ „	250-287
E	$\bar{X}$ = 113;	N = 38;	„ „	100-126
Weight	$\bar{X}$ = 24 lb. 14 oz.	N = 39;	„ „	21 lb. 4 oz.-29 lb.

Genus RAPHICERUS H. Smith, 1827

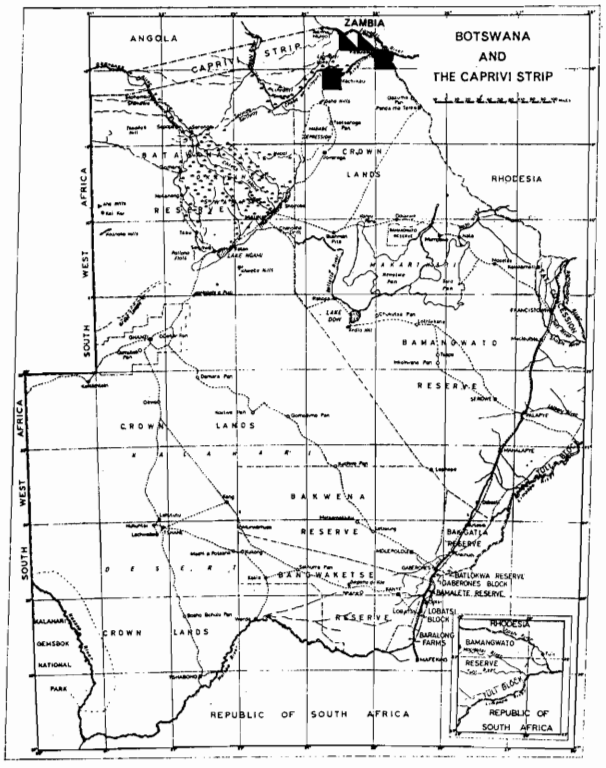
Raphicerus melanotis

Phuduhudu Sharpe's Steenbok

R. m. sharpei Thomas, 1897

Distribution

Confined to the extreme north-east in the vicinity of Kasane west to about Serondela and in the Pandamatenga area, where specimens have been taken near the border in Rhodesia. They are not uncommon in the eastern Caprivi along the Zambezi River east of Katima Mulilo (Carp Expedition, 1949). Shortridge



(1934) records the species in the eastern Caprivi, east of the Maschi River and as of possible occurrence in the central Caprivi. It is thought unlikely that they will be found in the latter area as the habitat is unsuitable and they are not recorded from Angola.

Bryden (1893) states that the species is 'a scarce antelope in the regions I write of' only seeing it once 'on the rugged table land above Mesa' (20 miles west of Foley). They do not occur today in this area although there are records from south-western Rhodesia and Roberts (1951) lists the species from Rustenburg, western Transvaal. They might, therefore, have occurred in the northern parts of the eastern sector in historical times, but today this is outside their known distributional range in Botswana.

Habitat

Roberts (1951) associates the species with 'stony kopjes where there is abundant thorny scrub'. In the Pandamatenga area they occur on hard stony basaltic ground with a light grass, woodland or scrub cover and to the south-east they are confined to the northern parts of the Wankie National Park, Rhodesia, in similar habitat being replaced south of this in sandy country by the steenbok, *R. campestris*.

Along the Chobe River from Kasane to Serondela and the Zambezi River in the eastern Caprivi Strip they occur in dry subriverine woodland and scrub inland from the riverine strip. In the Chobe National Park they were seen on the sandy plateau south of the Chobe River near Serondela in open woodland with a light grass and scrub cover, but never far from the riverine strip. Their occurrence here is atypical as usually they are associated with hard ground with a grass or scrub cover.

Wilson (*in litt.*) states that in parts of the northern section of the Wankie National Park they also occur in pure stands of mopane with no hills or rocky ground.

Habits

Inclined to lie close in thick underbush or patches of tall grass, flushing only when closely approached. Fast runners which, when flushed, dart off in a characteristic manner with the head and body low to the ground making them difficult to see even in low scrub. Normally they move far from the area of disturbance before stopping. The manner of progression in a smooth flat run is distinct from either the steenbuck, *R. campestris*, or the duiker, *S. grimmia*, both of which tend to bound and are inclined to stop from time to time to look back.

The droppings are deposited in small middens, which are used over long periods.

Normally they occur singly, in pairs, or a female with a single young. Nocturnal, but to some extent diurnal as well feeding in the late afternoon or early morning and lying up during the heat of the day in shady patches of thick scrub or tall grass.

Food

Predominantly a browser but will graze as well. Wilson (*in litt.*) reports that in the south-eastern lowveld of Rhodesia the proportions are on average 70% browse, 30% grass.

Breeding

Two gravid females were taken in the Pandamatenga area each carrying a single, near full-term, foetus in December. Shortridge (1934) records females in calf (north-eastern Transvaal) in October and November, Kerr and Wilson (1967) on a sample of 54 females from the south-eastern lowveld of Rhodesia report pregnant females in the months of January and April to October with no breeding peak indicated. The data available suggest that they breed throughout the year, a single young at a birth. Implantation is irregular.

Sizes and Weights

No data.

Genus TRAGELAPHUS Blainville, 1816

Key after Ansell (1968).

1. Larger, shoulder height about 1·5 m; horns in a more open spiral, forming two complete twists; false hooves of hindfeet with hairy fringed glands . . . . . *T. strepsiceros*
   Smaller, shoulder height not over 1 m; horns in narrow spiral, forming about one complete twist; false hooves without hairy fringed glands . 2
2. Hooves distinctly elongated, up to 20 cm long, with the back of the pasterns bare and rubbery . . . . . *T. spekei*
   Hooves not distinctly elongated, back of pasterns fully haired . . . . . *T. scriptus*

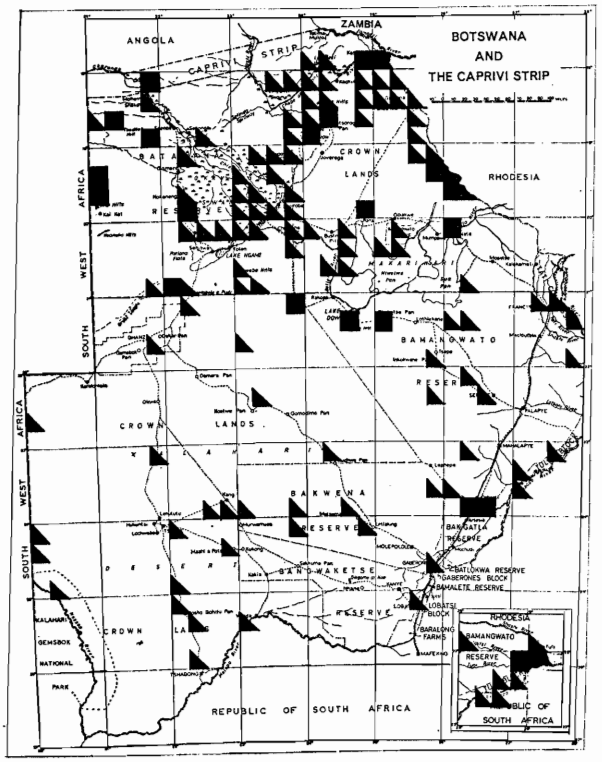
Tragelaphus strepsiceros

Tholo Kudu

T. s. strepsiceros (Pallas, 1766)

Distribution

Widely distributed throughout, but not so far recorded in the extreme south-west in the area of mean annual rainfall of 200 mm and under or in the south-east in the central Bangwaketse Reserve and Baralong Farms. In the dry areas much less common than in the better-watered northern part of the territory where they are locally abundant (Tamafupi, Savuti).



Habitat

Woodlands and thickets, less commonly in scrub unless the bushes are high and offer cover (junction Kuki-Makalamabedi fence, *Acacia* scrub, 2·5 m high, with tall grass). Kudu are recorded from most woodland types occurring, including *Baikiaea* (Tamafupi and Nunga); mopane (Tati Concession); *Acacia* (Nokaneng); mixed *Acacia*-mopane (Tsokotsa); and *Terminalia* (Jhari Pan). In the drier southern parts in Kalahari scrub they were associated with the scattered stands of *Acacia* woodland or thickets or where there was a coppice growth of *Terminalia*.

One of their habit requirements seems to be adequate cover for concealment, the nature of the ground being immaterial as they occur both in broken rocky terrain as well as on flat open sandveld.

Habits

Gregarious, occurring in small herds up to 15 to 20 (Mababe), often females with young only, including young males. The adult males often separate in smaller numbers of two to four together or solitary (BP 2258) or a herd of predominantly adult females with young and a single adult male.

Diurnal and nocturnal, they are shy and wary with keen senses and, in areas where they are subject to hunting pressures or other disturbance, are retiring and difficult to contact, keeping to the thicker cover and becoming more nocturnal in habits. Because of these habits they persist even in the most intensely farmed areas where they can become a pest where tobacco, maize, beans, peas and other agricultural crops are grown. In the northern part of the territory they partake of water freely, which they are unable to

do in the dry south-western parts of the Kalahari, where some at least of their moisture requirements are obtained from Tsamma melons, *Citrellus lanatus*, and probably other types of wild melons. The stomach of a female taken at the junction of the Kuki-Makalamabedi fence contained melon pips which it was concluded were Tsamma. They were not observed digging like Gemsbok, *O. gazella*, or hartebeest, *A. buselaphus*.

They have particularly large ears and characteristically, on being disturbed, the females face the observer, the ears cocked sideways and slightly upward, when they form a most obvious feature, dwarfing the rest of the head.

Food

Predominantly browsers, the following immediately recognizable in stomach contents:
Acacia tortilis leaves and seed pods, the latter green as well as dry.
Acacia spp., including *A. giraffae*, leaves.
Terminalia sericea leaves and their stems.
Croton sp. leaves.
Combretum sp. leaves and seeds.
Boschia sp. leaves.

Breeding

A gravid female with a 3½-lb. foetus implanted 1R was aken at Jhari Pan in September and a juvenile at Matjemleeji in April at a weight of 54 lb. with three inches of umbilical cord still attached. Visual observations of juveniles at various times of the year suggest that they may be born at any time during the year.

Sizes and Weights

Only one adult specimen, a female, was taken as follows:

TNL 4547A, Jhari Pan, September; TL 2570; T 470; Hf c/u 630; E 240; Weight 411 lb.

Tragelaphus spekei

Naakong seTatunga Sitatunga

T. s. selousi Rothschild, 1898

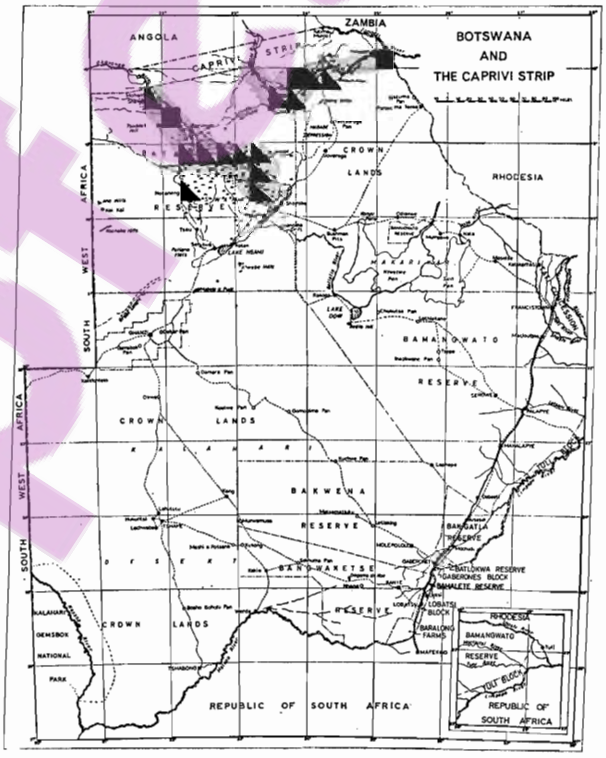
Taxonomic Notes

In the Linyanti swamp, two colour phases in the adults are known, the more normal blackish-brown and red. The B. Carp Expedition, 1949, took juveniles in both these colour phases, the males blackish-brown, the female bright red with a black dorsal band, four transverse stripes, a white lateral band and white spots on the haunches, the pattern, with the exception of the black dorsal bands, being lost in the adult females.

Distribution

Occurs throughout the swamps associated with the Okavango River and its delta south to *c.* 19°45′ S. (Nokaneng in the west and just west of Shorobe in the east) and in the swamps associated with the Chobe River throughout its length in Botswana. These two populations are today separated from each other but probably, in days gone by, were connected by way of the Selinda Spillway or the Savuti, Mababe Depression and Kwaai River. Selous (1890) records them from the reed-beds of the Mababe and Thamalakane River.

In historical times their distribution has shrunk considerably as Andersson (1856) records them from Lake Ngami. They were still to be found there in 1899 as a live specimen was brought back to the Zoological Societies Gardens in London (Bryden,



1893). Shortridge (1934) quotes Selous who states that they were also to be found on the 'upper Botletle River' localities much further south than they occur today.

In certain parts of their range (Linyanti swamps, Seopopa) they are quite common.

The eastern parts of the Caprivi are about as far east as they are likely to occur owing to the lack of suitable habitat, although there are unconfirmed reports of their presence on river islands with reed-beds narrowly just over the Rhodesian border.

Habitat

Semi-aquatic, spending most of their lives in dense *Papyrus* and *Phragmites* beds in swamp where the water is up to about knee deep. In times of high flood may be forced out of their normal habitat and then spend their time on the shallower fringes of the reed-covered swamps among floating aquatic grasses (Linyanti). Move on to fringing dry ground or swamp islands at night.

Habits

Gregarious, during the day loosely-knit groups of up to half a dozen individuals are met with, scattered over small areas, at night move in more tightly-knit herds of about the same maximum number. At Sepopa a herd of five were encountered at about 2 a.m., on a pitch-dark night, a quarter of a mile from the edge of the swamp in *Acacia* woodland (BP 109).

Lie up during the heat of the day on masses of fallen reeds in the swamp these 'beds' often over water (Linyanti) up to two feet or more deep. Nocturnal and diurnal found feeding in the early morning and late evening (Linyanti) and at night (Sepopa).

During the day, in dense reed-beds where the reeds may be up to 3-5 metres above the level of the water, with care, can be approached within shot-gun range. Under these circumstances they are very difficult to see and usually the best view that is obtained is the dark form through the massed reed stems. Masubia hunters have developed a quiet method of walking through the shallow water in approaching them, the toes of the feet entering the water first, then withdrawn slowly, so as to create the minimum disturbance.

If disturbed in these circumstances bound off with noisy splashing 30-50 metres where they stand motionless listening for further evidence of being followed. If the observer stands still they will recommence feeding after a few minutes, the characteristic 'plop' as they break the fresh tops of the sprouting reeds can, under these circumstances, be clearly heard.

Will, under stress, take to deep water and swim well. Under severe stress, recorded as submerging with only the nostrils above water. (Selous in Lydekker, 1926).

Where there are masses of fallen reed stems or floating islands of thick sud, will walk on these, the long hooves acting as prongs to hold together sufficient material to support their weight over the underlying water. When walking on soft muddy ground the spoor shows that the hooves splay widely apart, no doubt assisting their progress.

Many fall victim to prides of lions which take up residence on the swamp islands to feed on them and the lechwe, *K. leche*, the remains of several kills being found (Linyanti, B. Carp Expedition, 1949).

Food

Grazers, the fresh shoots of *Phragmites* sp. reeds, as well as aquatic and dry land grasses.

Breeding

Several very young calves were taken at Linyanti in June (B. Carp Expedition, 1949), at Sepopa local information indicated that the young were dropped in January and February. On the Okavango in South West Africa Shortridge (1934) records a young calf in August.

While sparse, these data indicate a wide breeding season, Ansell (1960) states that they calve throughout the year with a peak in the dry season (*c.* April-August).

Sizes and Weights

MALES

No.	*TL*	*T*	*Hf c/u*	*E*	*Weight*
BP 2267	2000	254	432	140	—
BP 109	1970	256	540	150	248 lb.

FEMALE

TNL 2902 Juv.	1110	200	390	114	40 lb.

Tragelaphus scriptus

seRolo-botlhoko Ngurungu Bushbuck

T. s. ornatus Pocock, 1900
T. s. roualeyni (Gray, 1852)

Taxonomic Notes

Two subspecies occur in the territory:

T. s. ornatus Pocock, 1900

In this subspecies the males are dark red with seven or eight transverse white stripes, a line of white spots longitudinally on the flanks, a series of about half a dozen white spots on the shoulders, up to 20 on the hindquarters and a dorsal crest of long white hairs from the shoulders to the base of the tail. Females are reddish-chestnut in colour with fewer transverse white stripes and spots.

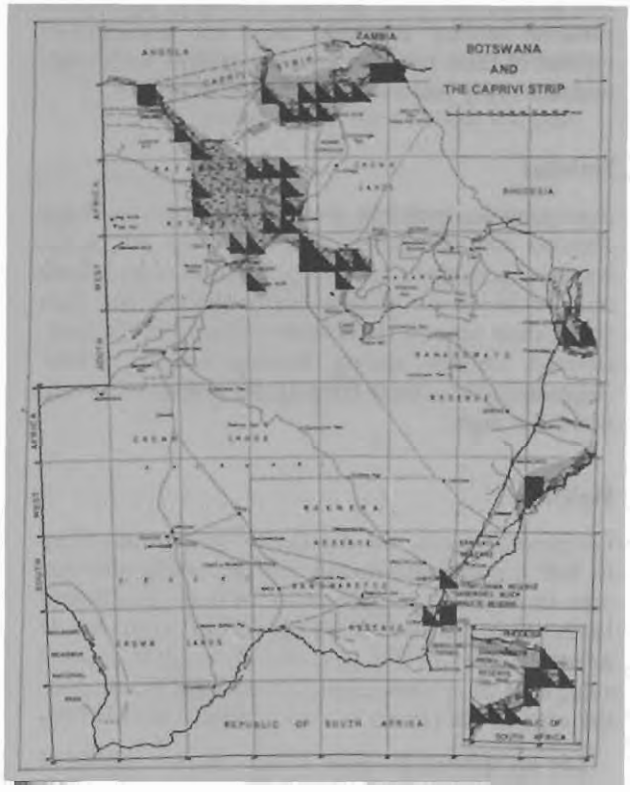
The young of both sexes are redder than the adults, the transverse stripes clearly marked, but the spots scarcely in evidence.

This subspecies occurs in the northern parts of the territory in the Okavango River valley; the Okavango delta south to the eastern end of Lake Ngami and the Kwebe Hills; the Botletle River to 20°45′ S.; and in the vicinity of the Chobe River throughout its length in Botswana.

T. s. roualeyni (Gray, 1852)

In this subspecies the males are much darker than in *T. s. ornatus* and lack the transverse white stripes, or they are very faint, with but a few spots on the hindquarters. The females are reddish, the white stripes and spots fewer and less well marked.

This subspecies occurs narrowly in the eastern sector in the Tati Concession and in the valleys of the Shashi and Limpopo rivers south to near Debeeti and in the Gaborone and Lobatse areas.



Distribution

The distribution of the two subspecies is as given above. In the northern parts of the territory the two populations on the Chobe River and in the Okavango delta and associated areas are separated. In historical times, however, these were probably joined into one by way of the Selinda Spillway and the Savuti, Mababe and Thamalakane rivers but this situation no longer exists, owing to dessication and silting up of the waterways.

Habitat

Riverine woodland with thick underbush or in dense reed-beds situated on river systems, or on the fringes of swamp, or swamp islands. There is an unconfirmed visual record from the Kwebe Hills which requires confirmation for, while there is ample thick undergrowth at the base of the hills, there is no permanent water. In other parts of southern Africa, however, they have been recorded in waterless country (Shortridge, 1934) although all other records in Botswana are from localities close to water.

Habits

Occur singly, in pairs or family parties of three. Generally nocturnal, occasionally found moving and feeding during the day (Mabate; Chobe River). Shy and retiring, with acute sense of hearing. The species has a very limited home range, pairs being found within a few hundred yards of the same spot over long periods (Makalamabedi, Botletle River). Lies up in

thick bush during the heat of the day but at night may feed out on the fringes (Mabate).

When disturbed may bark loudly before moving off, the bark loud and metallic.

Food

Grazers and browsers, stomach contents from various localities had the following approximate proportions of the two components:

	Browse	*Graze*
BP 522	50%	50% (green)
BP 532	10%	90% (green)
BP 545	100%	Trace (green)
BP 556	Nil	30%-(70% curdled milk)
BP 981	100%	Nil
BP 927	100%	Nil
BP 928	100%	Nil

The last three listed were from the eastern parts of the Bamangwato Reserve and Mabate area and were taken in April 1965 at the end of the four-year drought period when no green grass was available. The indications are that they will take green grass when it is available but, in its absence, turn predominantly to browse.

Identifiable contents in the browse consisted of the stems and fresher young leaves and budding heads of *Acalpa indica*, a low form growing in the riverine forest at Mabate, which constituted the major part of the stomach content of BP 927; fresh mopane leaves and their thin stems, green *Acacia* pods and seeds (perhaps from the already digested pods) and assorted leaves including *Boschia* sp.

Breeding

Three gravid females were taken:

No.	*Locality*	*Date*	*Foetus*	*Implanted*	*Weight Foetus*
C 1189	Chobe River	14.12.65	1	—	114 gm
BP 981	Matjembeji	1.5.65	1	1L	328 gm
BP 522	Makalamabedi	26.11.64	1	1L	10 lb. 10 oz. (near full-term)

At Makalamabedi two very young specimens were brought into camp on the 27th and 29th November, 1964, weighing 13 lb. 2 oz. and 6 lb. 7 oz. respectively, the last-named with the umbilical cord still attached.

This suggests rather a long breeding season, from about November to about June, and it may be that the young are dropped throughout the year as suggested by Ansell (1960) but further information is required to substantiate this.

Sizes and Weights

No.	*TL*	*T*	*Hf c/u*	*E*	*Weight*
BP 545	1488	205	376	160	91 lb.
FEMALE (*T. s. ornatus*)					
BP 522	1425	210	362	139	80 lb.
BP 928	—	—	—	—	69 lb.
BP 981	1320	200	360	135	67 lb. 8 oz.
C 1189	1340	225	329	143	65 lb.
JUVENILES (*T. s. ornatus*)					
BP 528 F.	—	89	213	85	6 lb. 7 oz.
BP 532 M.	1000	130	302	118	28 lb. 4 oz.
BP 556 M.	748	122	247	96	13 lb. 2 oz.
BP 927 M.	1150	176	341	129	51 lb.
MALE (*T. s. roualeyni*)					
TNL 4859	1420	215	355	136	86 lb.

Genus AEPYCEROS Sundervall, 1847

Aepyceros melampus

Phala Impala

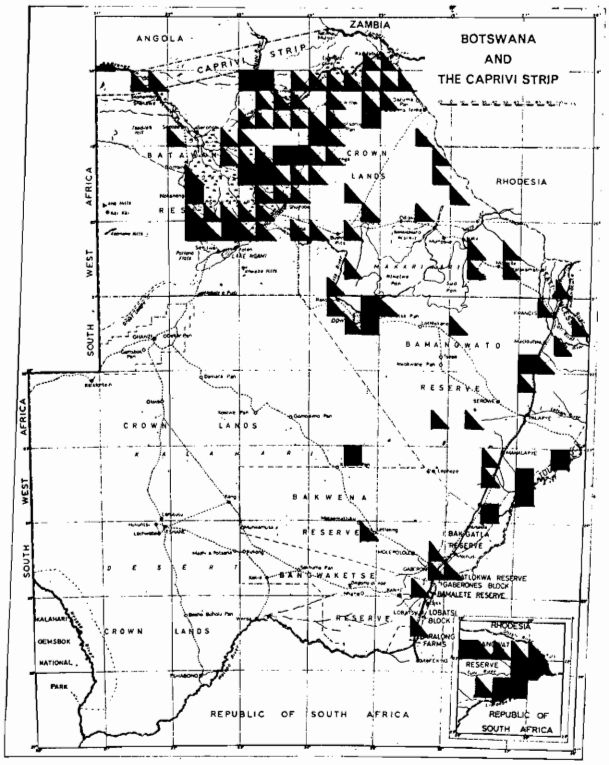
A. m. melampus (Lichtenstein, 1812)

Distribution

Occur throughout the valley of the Okavango River, the Okavango delta, the north-eastern sector, the environs of the Makgadikgadi and throughout the eastern sector south to Lobatse. In the southern part of the eastern sector they penetrate west, in suitable habitat, to just west of Moyabana and Letlaking and as far as the vicinity of Kuchwe Pan.

Very numerous in parts of their range (Moremi Game Reserve; Gomoti and Kwaai rivers; Hendricks Pan) but uncommon and only occurring in small numbers in the eastern parts of the Kalahari (Moyabana; Letlaking). In parts of their range locally absent, in others isolated populations are found (Makalamabedi; Moyabana).

So far there are no records from the central parts of the north-eastern sector.



Historical records all fall within their present limits of distribution (Cumming, 1850; Selous, 1881; Holub, 1881; Bryden, 1893; and Selous, 1907). Bryden (1893) states that they 'formerly abounded from South Bechuanaland northwards', but as throughout his work he was dealing predominantly with the eastern parts of the territory it is thought that he meant throughout this area, as they are unlikely at any time to have occurred in the dry country to the west.

Habitat

Light open woodland and scrub of various types including mopane, *Baikiaea*, *Acacia* and *Terminalia* and open riverine woodland. In general avoid open grassland and floodplain except marginally, or as vagrants or in transit. Child (1968) states that in the north-eastern area they are closely associated with mopane. This association is absent in other parts of the country where they occur, e.g. from *c.* 100 miles south of Francistown.

In such areas they are found in other open woodland types such as *Acacia*. Their occurrence west of Moyabana is in *Acacia* scrub which is found along drainage lines and not in the *Terminalia* scrub which predominates in other parts of the area.

Habits

Gregarious, occurring in small herds from half a dozen to 15 or 20 and in some areas in much larger herds of 50 to 100 (Gomoti River) or in congregations in the dry season of several hundreds (Moremi Game Reserve). Individuals and small herds are occasionally found straying onto open plains (Lake Dow) on the fringes of pans (Tsokotsa Pans) where they then, at least temporarily, occupy the same ground as the Springbok, *Antidorcas marsupialis*. Single solitary rams were seen on very open ground at Tsokotsa Pans and a single ram running with a herd of *c.* 150 springbok, *A. marsupialis*, on the Makgadikgadi west of Lake Dow.

There seems a tendency for most of the older males to separate from the herds during the time of dropping the young, running together in pure male herds, juvenile males remaining with the females.

They appear, in general, to be dependent on water. At Moyabana they were using artificial water supplies, as they may have been doing at Lephepe. On this basis their occurrence near Kuchwe Pan in the Kalahari is difficult to explain for the area is waterless and if they had moved from the east, which they are likely to have done, they must have traversed broad areas of waterless country. They are certainly not normally resident here, as they have not been reported on subsequent visits.

They feed at night as well as during the day, usually resting up in shady places during the hottest hours of the day.

Except during the heat of the day herds appear restless, always on the move with much tail-wagging and ear-twitching. If suddenly disturbed may suddenly break wildly in all directions leaping over bushes and imaginary obstacles with astonishing agility and grace, the herd gradually reassembling to gallop off out of harms way. Fleet of foot, they proceed with a bounding motion. They are wary, especially in approaching water, and if suspicious will delay drinking, until certain that there is no danger threatening, the herd standing testing the air and looking around. The alarm call is a loud snort, and at night, perhaps as a means of maintaining contact, members of the herd grunt loudly as they move.

Defecate in middens, which are usually of small size, not being used over long periods.

For details of sex and age class breakdown and fluctuations in populations in the north-east see Child (1968).

Food

Predominantly browsers, identifiable material including the fresh and dry leaves of mopane, *C. mopane*, fine twigs and leaves of *Acacia* spp. and the seed pods of *A. tortilis* both dry and green. Stomachs of specimens from Lake Dow contained some grass (BP 414).

Breeding

Only two females showing evidence of breeding were taken; BP 889 in April, which was lactating, and BP 2085 with one very small foetus (122 gm) in July, implanted 1L.

Child (1968) states that in the north-east calving is seasonal and most young are born within two to three weeks, although a small proportion may be dropped from four to six weeks after the peak in November.

Although there are no data at the moment from other parts of the territory there might well be a variation in the time of dropping the young as in Zambia Ansell (1960) states that whereas there is a 'sharply defined lambing season' this varies from September to October in the north-west as opposed to October to November in the middle Zambezi Valley. Shortridge (1934) states that in northern South West Africa they breed from September to October.

Kerr (1965) states that evidence shows that male impala become sexually mature at about 13 months of age but points out that it is doubtful whether, owing to competition with adult rams, they would have the opportunity of mating under natural conditions.

Sizes and Weights

North-eastern Sector

MALES

TL	$\bar{X}$ = 1697;	N = 11;	Obs. range	1550-1775
T	$\bar{X}$ = 346;	N = 7;	,, ,,	305- 360
Hf c/u	$\bar{X}$ = 453;	N = 11;	,, ,,	423- 461
E	$\bar{X}^1$ = 156;	N = 10;	,, ,,	144- 164
Weight	$\bar{X}$ = 128 lb.;	N = 9;	,, ,,	91- 151 lb.

MALES, JUVENILES

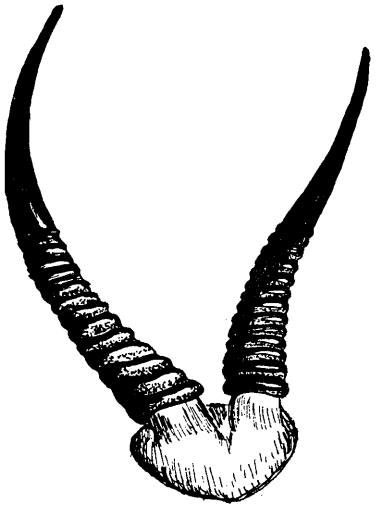
No.	*TL*	*T*	*Hf c/u*	*E*	*Weight*
BP 898	1390	240	411	149	74 lb.
BP 899	1370	276	420	137	74 lb.
BP 948	1200	235	386	136	45 lb.

FEMALES

TL	$\bar{X}$ = 1611;	N = 7;	Obs. range	1530-1765
T	$\bar{X}$ = 282;	N = 7;	,, ,,	270- 320
Hf c/u	$\bar{X}$ = 430;	N = 6;	,, ,,	410- 450
E	$\bar{X}$ = 148;	N = 7;	,, ,,	144- 157
Weight	$\bar{X}$ = 99 lb.;	N = 4;	,, ,,	83- 135 lb.

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 inguinal glands; shoulder height about 75-90 cm (fig. 20 (*a*)) . . . . . *R. arundinum*
2. Smaller, horns less than 25 cm over the outside curve, the horns curving forward about the level of the tips of the ears; two pairs inguinal glands; shoulder height less than 75 cm (fig. 20 (*b*)) . . . . . *R. fulvorufula*



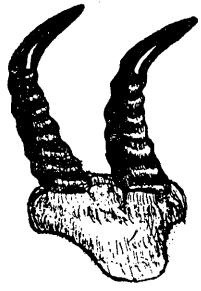


Fig. 20 Horns of Reedbuck

(*a*) Reedbuck, *R. arundinum* (*b*) Mountain Reedbuck, *R. fulvorufula*

Redunca arundinum

se Bugatla Reedbuck

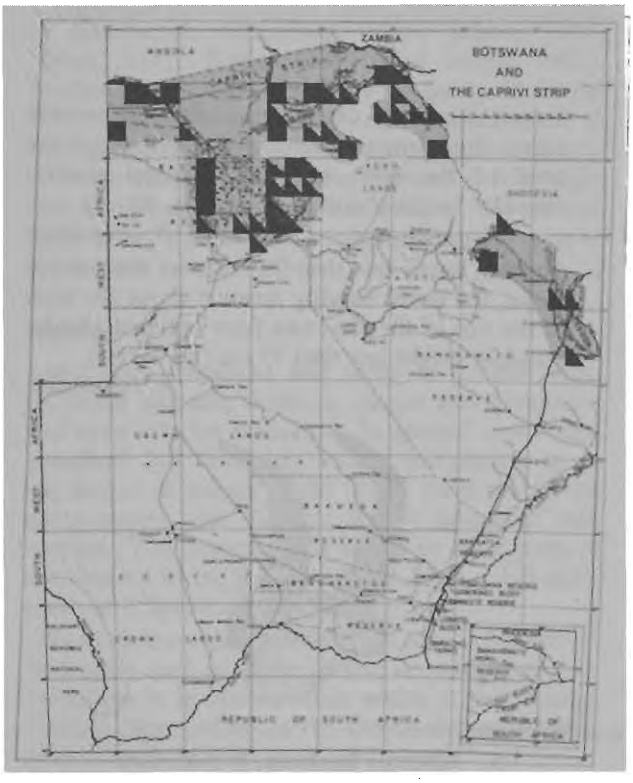
R. a. arundinum (Boddaert, 1785)

(Horns, fig. 20 (*a*).)

Distribution

Widely distributed, where there is suitable habitat, in the vicinity of the Okavango River, throughout the Okavango delta, the Mababe Depression, Savuti and in the vicinity of the Chobe River throughout its length both in the Caprivi and Botswana. In the extreme north-west occurs in vlei areas, the drainage lines of which remain permanently wet (west of Shakawe, on the South West African border). South of Kasane occurs in vleis south to 19° S. on the Rhodesian border. South of this there appears to be a break in distribution to the Nata River, again occurring between this river and the Tati Concession and west to Nata on the Makgadikgadi.

As they are found in the eastern parts of the Wankie National Park, east of this break, they might in time be found between 19° S. and the Nata River although, in general, there is a lack of suitable habitat. To date, however, there are no visual or material records from this area.



Shortridge (1934) states that they are confined to the northern parts of South West Africa.

Roberts (1951) records the species from Rustenburg, western Transvaal, on which basis they might well occur in the southern parts of the eastern sector of Botswana in the vicinity of the Limpopo River and its tributaries.

Most historical records fall within their present-day limits of distribution although both Smith (Kirby, 1940) and Cumming (1850) record them from the Molopo River which is much further south than they are known today.

Again, Andersson (1888) record them from Lake Ngami and Bryden (1893) states that they occur on the Botletle River, both of which records are outside their known present-day limits of distribution.

Habitat

Closely confined to open floodplain grassland, vleis, and grassy areas along rivers, where there are stands of high grass affording shelter, or reed-beds on the fringes of swamps. BP 2168 was taken near Maun in an open grassed area in mopane woodland.

Habits

Diurnal and nocturnal, feeding in the early morning and late evening, as well as after dark. In areas where they are subject to continual disturbance (e.g. the intensively farmed areas of Mashonaland, Rhodesia) tend to nocturnal habits as opposed to areas where they are preserved or undisturbed where they are more diurnal (Okavango). Lie up during the heat of the day in long grass, on floodplain, often in isolated stands. When disturbed run off with what Stevenson Hamilton aptly describes as 'a rocking horse motion', the tails raised, clearly showing the long white hair of its underside as a 'warning' flash which is clearly visible as they move off. In doing so the loud alarm whistle, characteristic of the species, may be heard.

During the heat of the day, if in thick long grass, may lie up tightly, only flushing when the observer is very close.

Occur singly or in pairs or occasionally in small herds of up to nine or ten (Mashonaland, Rhodesia),

although in Botswana the maximum number seen together was five (Gomare).

Where their normal habitat is burnt they will make use of adjacent scrub or tall grass in which to lie up. During the rains may move from vlei areas into adjacent grassland in which during the dry season they would not be found. In Mashonaland a herd of nine moved a mile, from the vlei in which they normally lived, into grassland, remaining for three days before returning to it.

Dependent on water and throughout their range associated with it.

Territorial fighting during the rutting season observed (June).

Food

Grazers.

Breeding

Females carrying single foetuses were taken in February, May and July, in all cases implanted 1R. The near full-term foetus of SJL 949 taken in February weighed 12 lb.

Sizes and Weights

	TL	*T*	*Hf c/u*	*E*	*Weight*
MALES					
TNL 3861	1610	265	465	162	170 lb.
SWG 1284	1710	290	418	175	159 lb.
SWG 1285	1890	445	470	154	228 lb.
BP 2168	1860	280	480	180	151 lb.
BP 2254	1790	292	387	203	—
JUVENILE MALES					
C 1368	1469	230	440	150	73 lb.
BP 2054	2035	200	364	139	44 lb.
BP 1869	1200	180	396	148	55 lb.
FEMALES					
SWG 1249	1470	295	430	155	105 lb.
BP 1856	1610	223	450	160	108 lb.
BP 2128	1660	215	450	168	125 lb
SWG 740	1680	325	415	140	118 lb
BP 65	1725	242	433	164	115 lb
SJL 949	1587	247	455	181	135 lb.

Redunca fulvorufula Mountain Reedbuck

R. f. fulvorufula (Afzelius, 1815)

(Horns, fig. 20 (*b*).)

Distribution

So far only recorded from the Government Farm, Lobatse, and 13 miles east of Molepolole, with visual records from the Lobatse Dam (Williams, *pers. comm.*). They are likely to be confined in distribution to the south-eastern parts of Botswana in the Gaborone, Molepolole, Kanye and Lobatse areas.

Gordon Cumming (1893) shot a pair in the vicinity of Gaborone in 1845 and Bryden (1893) states that they are found in the 'hills of the Protectorate (Botswana) as far north as the south of Khamas country' and doubts if they occur further north.

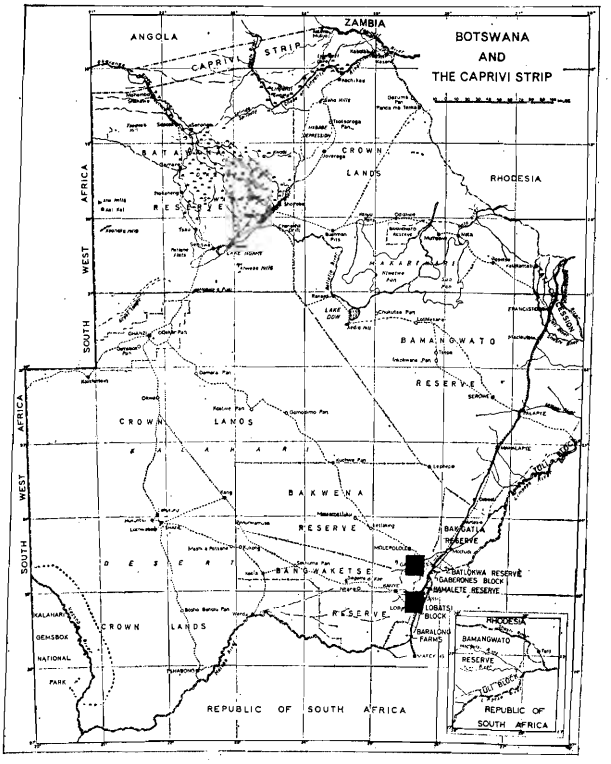
Roberts (1951) includes Rhodesia within their range but so far they are not recorded from this territory or from South West Africa.

Habitat

Rocky hills or broken country with some cover of light woodland, scrub and grass.

Habits

Solitary, occur in pairs or small herds, four were reported together at Lobatse (Williams, *pers. comm.*).



Stevenson Hamilton (1912) states that they have a shrill whistle like a reedbuck, *R. arundinum*. Although normally lying up during the heat of the day in cover on the hillsides descend from these to graze round the bases of the hills in the early morning and late evening. Reported as dependent on water by Stevenson Hamilton (1912).

Food

Grazers.

Breeding

No data available from Botswana. Sclater (1900) states that in the Republic of South Africa 'the young are born between October and December'.

Sizes and Weights

No data available on the Botswana material.

Genus KOBUS A. Smith, 1840

1. Larger, no inguinal glands; coat grizzled and harsh; males with horns curving forward in a smooth curve; rump with a distinct white ring . . . . *K. ellipsiprymnus*
   Smaller, with a pair of inguinal glands; coat not grizzled, less coarse; horns inclined lyrate; no white ring on rump 2
2. No face glands; coat rough; males with long lyrate horns; hoofs slightly elongated . . *K. leche*
   Face glands present; coat shorter and smoother; males with heavy short lyrate horns; hoofs not elongated . . . . . *K. vardoni*

Kobus ellipsiprymnus

leTimoga mo-Tomuga Waterbuck

K. e. ellipsiprymnus (Ogilby, 1833)

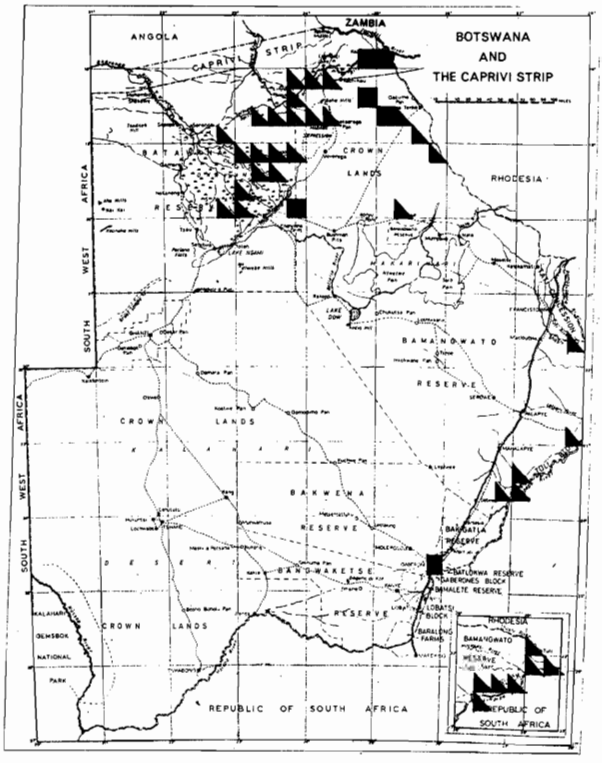
Distribution

Occur widely throughout the central and eastern parts of the Okavango delta as far south as Maun and northwards through the Savuti and Selinda spillway to the Chobe River where they are found throughout its length eastwards to Kasane. In the north-east occur south to Damucheche Pan on the Rhodesian border where they are uncommon. There is a visual record of a solitary individual near Odiakwe, just north of the Makgadikgadi, which is thought to be a vagrant, as they do not normally occur in this area.

There appears to be a break in distribution between these northern populations and those in the eastern sector from the southern parts of the Tati Concession and Tuli Circle southwards where small herds have been preserved on farms along the Limpopo River and its tributaries to 23°45′ S.

In 1969 a small herd, from which a specimen was secured, turned up near Gaborone where they had not been seen for many years, this being the most southerly record in Botswana.

The type locality of *K. ellipsiprymnus* given by Ogilby '25 days journey north of the Orange River between Lataku and the west coast of Africa' cannot



properly be placed. Roberts designated it as 'presumably on the Molopo River' which in itself might be interpreted as anywhere along the southern boundary of Botswana. The country west of Lataku (Kuruman) is not suitable habitat for the species, nor is the Molopo River west or north of this locality. One cannot but be struck by the likelihood that the original specimen came from some area north-east of Lataku (Kuruman). Early travellers and hunters all record their presence in this area. Bryden (1893) states that they are 'now (*c.* 1890) seldom met with near the Limpopo till past Selikas (22 27 D3) in Khama's country'. Bryden states, however, that they were 'in old days, abundant along the Limpopo and its affluents'. Harris (1838) states that the species is found only on the banks of rivers near the tropic, 'the Limpopo and Mariqua especially'. Cumming (1855) states that the species occurred 'along the Notwani River, north-western Transvaal' (Botswana). On this basis, the type locality might more properly be placed on the top reaches of the Notwani River in the Gaborone area.

Habitat

Occur in areas of light woodland and scrub, floodplain and vleis in the vicinity of swamps, rivers and pans. Throughout their normal range associated with permanent water but vagrants found wandering far from this (Odiakwe). Found both in rocky broken country as well as on floodplain, alluvium and sandy areas.

Habits

Occur in herds of up to 30 (Savuti), more usually about six to a dozen, single bulls often encountered (Kwikampa, Moremi Game Reserve).

Food

Predominantly grazers but are recorded (Pienaar, 1960) as taking some browse including wild fruits. Child (1968) mentions that *Cynodon dactylon* is eaten extensively by the species, their distribution locally being to some extent governed by its presence.

At the Savuti a herd of five was feeding in shallow water on freshly sprouting *Phragmites* sp. reeds.

Breeding

No data. Child (1968) states that they calve throughout the year with a peak in the cold dry months of the year.

Sizes and Weights

MALES

	TL	*T*	*Hf c/u*	*E*	*Weight*
C 1126	2110	380	520	220	280 lb.
BP 2244	2250	—	540	255	—

Kobus leche leTswee Lechwe

K. l. leche Gray, 1850

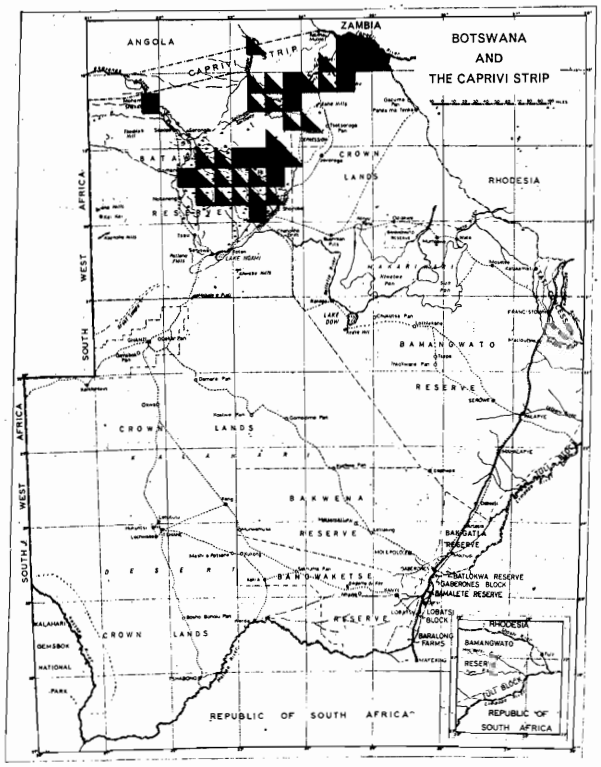
Taxonomic Notes

Livingstone (1857) records his journey up the Zonga River (Zoaga) (Botletle River) in search of Lake Ngami which he discovered on the 1st August, 1849. He returned east along the Zonga (Botletle River) past its junction with the Thamalakane and it was somewhere in this vicinity (Chanoake Drift?) that he reported 'an entirely new species of antelope called leche or lechwi', specimens of which he (or his companions Oswell or Murray) collected. While the latitude of the type locality is given as 21°, on modern day reckoning it would be nearer 20°7′ S. (20 23 B1). Andersson (1856) records hundreds of lechwe near the delta of the Teoge (Taoghe) River where it poured into Lake Ngami. Today the reed-beds are gone, the Taoghe River dry and that portion of the Lake Ngami depression in the vicinity of the old delta, open dry grassland.

The species no longer occurs either on the Botletle River or near Lake Ngami, the nearest locality from which it has been taken being some 30 miles north-west of Chanoakhe drift, in the Okavango swamps west of Maun, the furthest south that they now occur in the Okavango delta.

Distribution

Occurs throughout the Okavango delta from near Mohembo south to about 19°45′ S. and slightly further south, west of Maun, to 20° S.; the Savuti, the Selinda Spillway near its confluence with the Maschi (Chobe) River and throughout the swamp areas associated with the Maschi and Chobe rivers and the drainage system connecting the Zambezi and Chobe rivers across the eastern part of the Caprivi. Child (1968) notes that two populations are represented with a break in distribution between them, those on the Chobe River and those in the Okavango delta.



Habitat

Closely confined to inundated floodplain and shallow water areas on the fringes of swamp or rivers and narrowly on the adjoining dry floodplains.

Habits

Semi-aquatic, spending most of their time in shallow water among aquatic grasses or reed-beds (*Phragmites* sp.) but moving onto the adjoining dry ground, both during the day and at night. Gregarious, occurring in small herds of up to 20-25, often in much larger concentrations (Gomare, *c.* 60; eastern Caprivi, hundreds). At the height of the floods which cover the eastern part of the Caprivi the herds may be forced into the shallower water when concentrations of up to a thousand or more may be seen together. Child (1968) reports that Hepburn estimated that there was a movement of the species from the eastern Caprivi south into Botswana at times over two and a half thousand were present on the flats between Kabulabula to Ihaha.

Their presence in the Savuti and Selinda Spillway is dependent on the floodwaters reaching these areas when they move out on to them from the swamps associated with the Chobe River.

When disturbed herds move off in a lumbering gallop, if in the water, in a series of plunges. When galloping the horns are laid back on the shoulders, the nose stretched forward, often bounding high over imaginary obstacles like the impala, *A. melampus*. When ambling along the head is held low to the ground. When resting they lie up on the fringes of water often in damp places or on swamp islands.

Will penetrate deep into reed-beds in shallow water, at Linyanti herds were found about one and a half miles into the swamp and it appeared here that they were lying up on matted broken-down reed stems over shallow water on the fringes of islands. In these situations occur alongside the sitatunga, *Tragelaphus spekei*, as they do in other areas (northern Okavango delta).

Food

Grazers, floodplain grasses, semi-aquatic grasses and the young shoots of reeds, *Phragmites* sp.

Breeding

A female was taken on the Gomoti River in July carrying a single foetus, implanted 1L. Child (1968) records very young calves on the Chobe River between July and January, stating that in 1965 and 1966 most calves were dropped from the second week in September with a peak in December. On the Okavango River in South West Africa Shortridge (1934) records a female with a near full-term foetus in October. Selous in Lydekker (1926) states that the young are dropped (Linyanti and Chobe) towards the end of the dry season in October and November. Juveniles were seen in the western Okavango in January.

It appears that the young are born from about July through to January, the great majority from about September to December.

Lent (1969) states that 'it is likely that some births occur in all or nearly all months of the year' with a 'peak of births during the rainy season soon after the flood waters recede'.

The calves are born in stands of tall grass or reed-beds and while still very young remain there while the mothers feed out in the open.

Sizes and Weights

MALES

	TL	*T to mid anus*	*Hf c/u*	*E*	*Weight*
TNL 3860	2060	410	515	155	285 lb.
BP 2051	1940	390	485	135	—
BP 2140	2190	410	500	160	275 lb.
FEMALES					
BP 2152	1980	350	480	145	208 lb.

Kobus vardoni

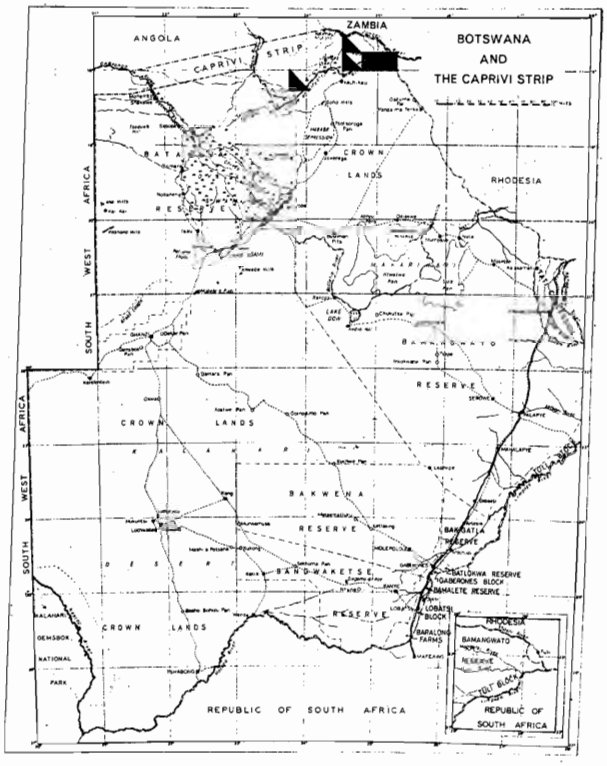
Puku Puku

K. v. vardoni (Livingstone, 1857)

Distribution

Confined to the extreme north-east in a limited area on the Chobe River between Kasane and Simwanza (17 24 D3).

Selous (1881) states that the species was numerous on the Pookoo Flats (17 24 D4, 17 25 C3) in 1874 when he saw groups of 50 and that they were found along the south bank of the Chobe River for about 70 miles from the Chobe Zambezi confluence. Child (1968) records only a relic population on the Chobe and Pookoo flats near Serondela and states that they have disappeared from the north bank of the Chobe within the last 40 years. The B. Carp Expedition of 1947 recorded them in the eastern Caprivi Strip on Imparira Island at the confluence of the Chobe Zambezi rivers and at Linyanti. Child (1968) states that Imparira Island was settled in 1958 and that by 1963 they had disappeared as had a small herd formerly known on the opposite bank of the Chobe (from Kasane). Child (1968) estimates that the entire population between Kasane and Simwanza numbers less than 100 (81-83).



Habitat

The dry fringes of swamps and rivers penetrating narrowly into light open woodland (Imparira Island).

Habits

Gregarious, occurring in small herds.

Food

Grazers.

Breeding

No data.

Sizes and Weights

No data.

Genus ANTIDORCAS Sundevall, 1847
Antidorcas marsupialis
A. m. hofmeyri Thomas, 1926

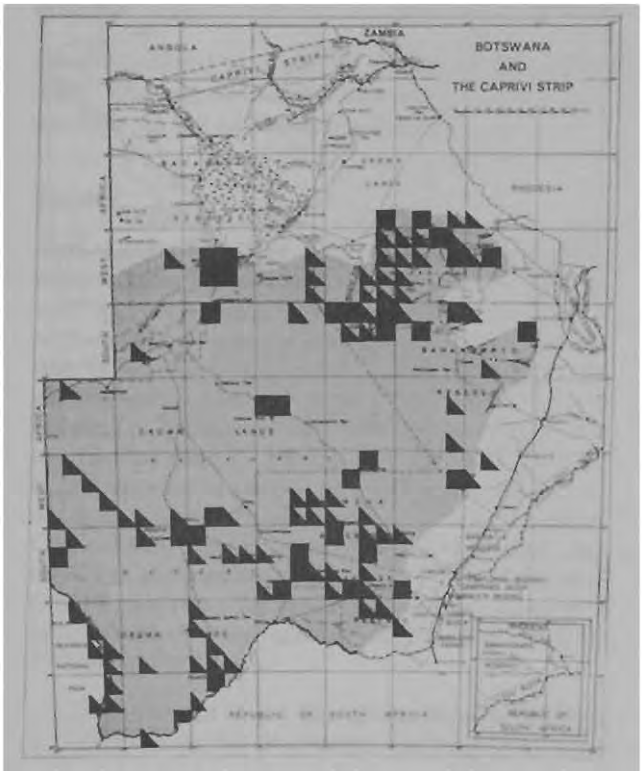
Tshephe Springbok

Distribution

Confined to the southern two-thirds of the territory excluding the eastern sector.

The northern limits of distribution are from the South West African border at about 20°30′ S., eastwards to Lake Ngami thence south of the Botletle River to near Makalamabedi and throughout the grasslands of the Makgadikgadi including Nxai Pan. They are absent from the south-eastern parts of the Makgadikgadi where the mopane association fringes the pan to the exclusion of the grassland. Their eastern limits of distribution extend to the limits of the open Kalahari association which extends to within 45 miles south-west of Francistown; to near Foley; Serowe, Lephepe, Molepolole, Kanye and the western parts of the Baralong farms in the extreme south-east.

At the moment there is no evidence of their occurrence through to the Transvaal border in the Mahalapye, Artesia sector, which might be expected as the ecological conditions are suitable. They are not, however, recorded in the adjacent districts of Rustenburg or Waterberg in the western Transvaal, although they do occur further south to the extreme south-western parts of the Transvaal (Kettlitz, 1962).



Although they no longer occur in the south-eastern parts of the Baralong farms, they did in historical times, as Bryden (1893) records that in 1890 he encountered 'a few springbok, the poor remnants of former crowds of game' just north of the border post of Ramatlabama but states that by 1890 they were 'pretty well cleared from the plains of southern Bechuanaland (Botswana) in the vicinity of the Transvaal border', although found west of this.

Although they occur within 25 miles of the Rhodesian border in the north-eastern parts of the Makgadikgadi they have not so far been recorded from Rhodesia, nor are they likely to be, as a deep belt of mopane woodland in this sector acts as a barrier to their north-eastern movement.

There is an unconfirmed visual record of a solitary springbok in the Chitabe, in the eastern part of the Okavango delta north of Shorobe (Holmes a Court, *pers. comm.*), which, although possible, seems doubtful and is, therefore, disregarded for the present.

The distribution of the species in the western parts of Botswana, coincides well with the information given by Shortridge (1934) for eastern South West Africa.

Historically most records fall within their known present-day distributional range (Cumming, 1850; Livingstone, 1857; Holub, 1881; Holub, 1890; and Selous, 1907).

Holub (1890) states that a lone springbok was shot near the Zambezi River shortly before his arrival but it is thought that this is an error of identification as the country in the vicinity is ecologically unsuitable for the species.

Habitat

In a sample of 54 specimens, 14 were taken in open bush savannah; 23 in open grassland and 17 in association with pans, either on the fringing grassland or marginally in the scrub surrounding them or on the pan itself, where this had a short grass or karroid bush cover throughout. Where pans have a flat mud surface (Makgadikgadi, Sekoma, Tshane, etc.) they are often found far from the shorelines, either in transit or visiting 'salt licks' on the brack surface.

Springbok are typically a species of very open

country, either grassland or open bush savannah, disinclined to enter woodland and thick scrub bush, except marginally. They are particularly associated with the grassland fringes of the many pans scattered throughout the Kalahari. Generally independent of water, Shortridge (1934) quotes instances of them drinking.

Habits

Gregarious, occur in small herds of a few individuals to 30-50 (Kalahari); 5-600 (Tsokotsa Pans, 150 miles south Mamuno, Sehitwa) and much larger congregations of up to *c.* 1 500 (Nxai Pan). On five occasions solitary males were taken, in four of these they were old individuals with well-worn teeth. In the case of the larger herds of over 500 these tend to scatter, in feeding, into smaller groups which, when disturbed, eventually join together in moving off.

During the heat of the day they may move to the shelter of scrub bush and lie down, some in the shade, some in the open. Not infrequently they are found lying down completely in the open and, in general, do not seem to require shade like other species. They appear to feed throughout the day as well as at night and, when caught in the beam of a dazzling light, have a tendency to drop the head as if trying to avoid the beam.

In areas where they are little disturbed they are far less shy and suspicious than in areas where they are subject to disturbance or hunting pressure. Under these latter circumstances they will make off when far from the observer and not stop until they are at a great distance (Nata, Makgadikgadi).

Individuals in a herd under stress, not themselves the particular subject of this stress, will trot along with the white dorsal crest, which extends from the shoulders to the tail, erected, the legs stiff. They may also 'pronk' an attitude characteristic of the species in which the head is held low to the ground, the legs stiff, the hoofs bunched together, the back arched, the dorsal crest fully erected, in which position they will spring upward and forward, or at an angle effecting prodigious leaps in the air as they proceed, then suddenly breaking into a full gallop.

On occasion they will congregate in vast numbers moving over long distances. While no such mass movements were witnessed, this phenomenon still occurs from time to time, there being a report of one in 1946 and another in 1950 in the south-west Kalahari (Child and Le Riche, 1969). Compared with the 'treks', as they were called by the Boer farmers in the northern Cape, of the 1880's to 1890's (Cronwright-Schreiner, 1925) today these mass movements involve far fewer numbers. Cronwright-Schreiner estimated that in the 1896 trek springbok covered a tract of country 138 miles by 15 miles.

The opening up of the northern Cape to farming development, the introduction of domestic stock, the fencing of huge tracts of country and hunting pressures have contributed to the reduction in numbers of the species since the end of the nineteenth century.

In 1956-58 it was unusual to cross the north-east corner of the Makgadikgadi, on the dry weather route, without seeing six or seven herds, totalling 3-400 individuals. Today one is fortunate to see one or two solitary individuals who make off at great speed at distances of 300-400 metres.

Food

Grazers and browsers. In a sample of 11 stomachs examined there was a variation from 100% grass to 100% browse with intermediate proportions of both. The extremes of either grass only (Makgadikgadi) or browse only (Putimalonwane) correlates with the situation in which the species was taken, in the former case on the vast open grassplains which fringe the area and, in the latter, in open *Acacia* scrub.

In some cases the grass was green (Tsokotsa), where the specimen was feeding on sprouting fresh grass, in others brown and dry (Rakops).

Identifiable portions of the browse included:
Camelthorn, *Acacia giraffae*, leaves;
A. haematoxylon, leaves;
A. detinens, leaves and pods;
Snakeberry, *Solanum* sp., fruit;
Boscia albitrunca, leaves;
Rhigozum trichotomum, leaves;
Wag 'n bietjie, *Ziziphus mucronata*, fruit and leaves;
Mopane, *C. mopane*, green and dry leaves;
Salsola sp., leaves;
Zygophyllum sp., leaves;
Donkey berry, *Grewia* sp., leaves.

In the stomachs containing *Solanum* sp. fruits, these had been swallowed whole. The succulent pulp of these fruits no doubt contributes to the moisture requirement of the species and is a common item in the food of other small ungulates (duiker, *S. grimmia;* steenbuck, *R. campestris*).

Springbok dig for succulent roots but not to the same extent as other dry land species such as gemsbok, *O. gazella*, duiker, *S. grimmia*, or hartebeest, *A. buselaphus*, all of which are persistent diggers.

Breeding

Gravid and lactating females were taken during the following months:

	May	July	August	November
Gravid	1	2	2	4
Lactating	1	–	–	–

The sizes and weights of the foetuses were as follows:

May 14 lb.
July 8 lb.; 76 gm.
August 7 lb.; 54 gm.
November 7 lb.; 7 lb.; 8 lb.; —.

This data is scanty but appears to indicate a time of dropping the young during the warm wet months of the year from about November to about January. The May record at 14 lb. was approaching full-term and would possibly have been dropped within a month or two which suggests that, at least on occasion, the young may be born during the cold wet months.

Bigalke (1970) states that in the northern Cape Province (Kimberley) the young are dropped between the months of August and November, with a peak in October, with odd records between February and June.

Sizes and Weights

MALES

TL	$\bar{X} = 1501$;	$N = 32$;	Obs. range 1390-1623
T	$\bar{X} = 244$;	$N = 29$;	,, ,, 146- 286
Hf c/u	$\bar{X} = 427$;	$N = 30$;	,, ,, 400- 455
E	$\bar{X} = 177$;	$N = 33$;	,, ,, 153- 195
Weight	$\bar{X} = 90$ lb.;	$N = 22$;	,, ,, 73- 105 lb.

FEMALES

TL	$\bar{X} = 1484$;	$N = 13$;	Obs. range 1375-1580
T	$\bar{X} = 256$;	$N = 13$;	,, ,, 200- 305
Hf c/u	$\bar{X} = 416$;	$N = 13$;	,, ,, 395- 462
E	$\bar{X} = 173$;	$N = 13$;	,, ,, 159- 187
Weight	$\bar{X} = 82$ lb.	$N = 9$;	,, ,, 67- 96 lb.

Genus ORYX Blainville, 1816

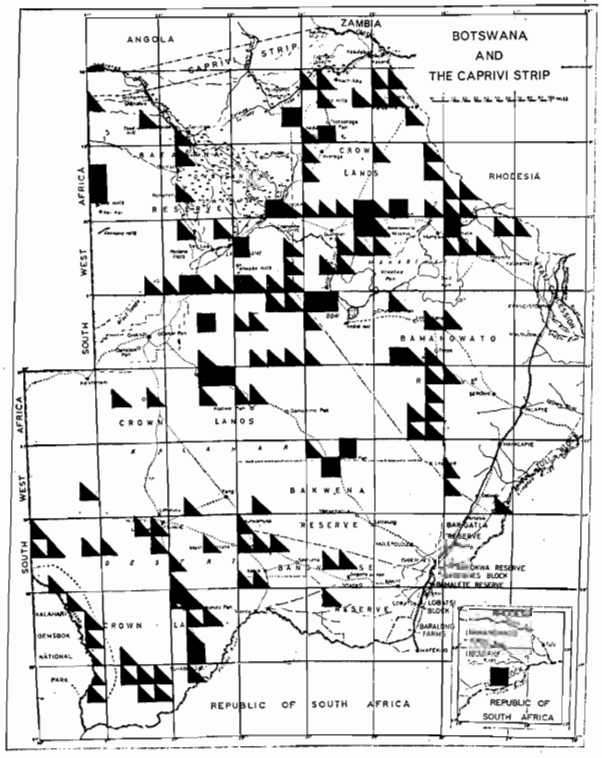
Oryx gazella

Kukama Gemsbok

O. gazella (Linnaeus, 1758)

Distribution

Widely distributed throughout, except in the northern and southern parts of the eastern sector. They occur through to the Transvaal border east of the line of rail in the Debeeti sector and are preserved on one or two farms on the Limpopo River in the northern Tuli Block.



In the north-east they penetrate eastwards into the Wankie National Park and the western Gwaai Reserve, Rhodesia. In South West Africa they occur throughout (Shortridge, 1934) not occurring, however, east of the Okavango River in the Caprivi. Kettlitz (1962) states that at this date there were only 15 in the Transvaal (in the Zoutpansberg and Bloemhof districts) and their 'total disappearance can hardly be stopped'.

To date they have not been recorded in the northern and central parts of the Okavango delta, apparently not penetrating into the swamps, although found in the fringing areas, or in the area north of the Kwaai River to the Angola border and the eastern Caprivi.

Cornwallis Harris (1852) records hunting gemsbok where he crossed the Molopo River, somewhere near the extreme south-eastern parts of Botswana stating that they were 'rare in this part of the country' as compared with Namaqualand. They no longer occur in this area but a few still occur in the Bloemhof district of the south-western Transvaal (Kettlitz, 1962).

Habitat

Open grassland, open bush savannah and light open woodland. Frequents the short open grassy areas round pans (Makgadikgadi and pans in the Kalahari). Will penetrate thick woodland (*Baikiaea*, mopane, *Acacia*) and scrub (50 miles south of Mabeleapudi), in this respect more precocious than either the springbok, *A. marsupialis*, or the hartebeest, *A. buselaphus*, which probably accounts for their presence in western Rhodesia, which is buffered from their more normal habitat of open country, by wide belts of woodland.

Habits

Gregarious, occurring in small herds of up to a dozen (north-east Makgadikgadi), frequently only two's and three's (Nata; Kanyu).

Move in the early mornings and late evening, usually resting up during the heat of the day, lying down in open country or in the shade of trees.

When disturbed move off at a trot, under severe stress gallop with the horns laid back on the shoulders, the tail streaming behind. When making off tend to break into single file.

Even in the most open country they are difficult to see, their colour and cryptic markings allowing them to blend into the background.

Wary and keen-sighted and, although generally independent of water, will drink when it is available. They are avid diggers obtaining at least some of their moisture requirements by digging up succulent roots and bulbs. Near Gweta these diggings, in an open sandy plain, were up to 18 inches deep and covered a wide area. They are dug with the front hoofs.

On the dry mud wastes of the Makgadikgadi have been found on two occasions far from the shoreline where it was thought that they were in search of salt-licks.

Food

Grazers. Four stomachs examined contained only green grass, in the fifth there were a few leaves but, as they appeared to be dry, they were probably picked up fortuitously. No sign of the remains of the succulent roots which they dig up were found and they may only do this when thirsty. Stomach contents normally have a high moisture content to an extent which suggests that they may masticate these roots to a degree where they are not recognizable by visual examination of the contents. Bushmen use the stomach content as a source of water, squeezing it and straining the liquid through grass into a skin laid underneath.

Breeding

Females with a 6 lb. 7 oz. and 8 lb. 4 oz. foetuses, implanted 1R were taken at Tsienyane and Mabuasefupi in November and February respectively, and very young individuals have been seen at Kukong in February and Makarikari in February and March, suggesting that the young are dropped during the warm wet months of the year from about December to about March, but further information is required to support this suggestion of seasonal breeding.

Sizes and Weights

MALES

No.	*TL*	*T*	*Hf c/u*	*E*	*Weight*
HJH 1385	1700	320	420	180	—
RMD 1240	2300	500	550	195	—
BP 582	2400	450	551	189	514 lb.
TNL 4846	2400	520	545	205	524 lb.
FEMALES					
BP 503	2250	430	523	199	438 lb.
BP 2248	2460	455	432	225	—
G 553 (Juv.)	1790	315	465	171	200 lb.
TNL 2325	2330	525	545	204	500 lb.

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 54 inches; horns longer, about 85-160 cm . . . . H. *niger*
   Colour pale reddish-brown; ears long and distinctly drooping at the tips; whitish of underparts less well-defined; shoulder height about 56-63 inches; horns shorter, about 60-100 cm . . . . . H. *equinus*

Hippotragus niger

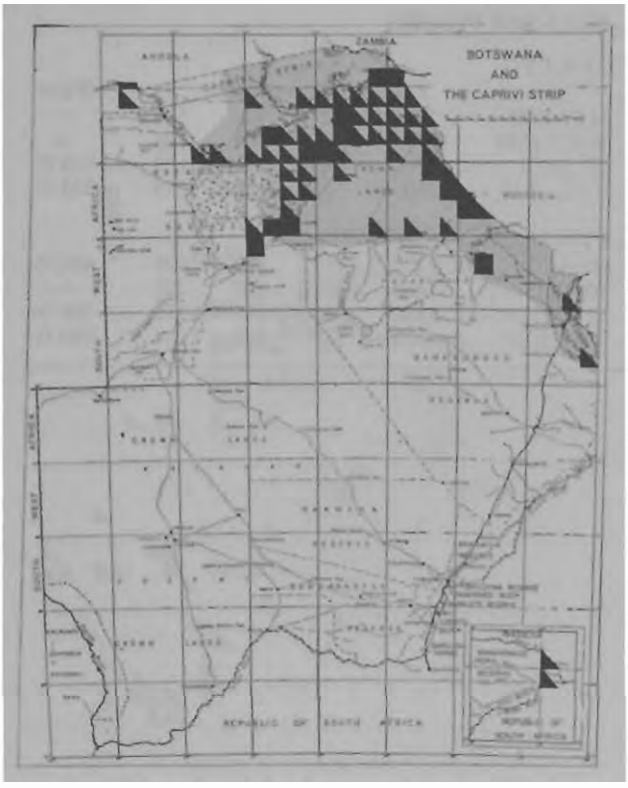
Kwalata entsho Sable

H. n. niger (Harris, 1838)

Distribution

Occur widely in the northern parts of the territory, although only reaching the western fringe of the Okavango delta near Sepopa, their distribution being predominantly confined to the area immediately north, north-east and east of the delta, from the Kwaai River south to near Toten. They occur throughout the north-eastern sector south to near the Botletle River and the northern parts of the Makgadikgadi and east of this from Nata to the Tati Concession and Tuli Circle quite narrowly along the western border of Rhodesia and the Transvaal. Sable still occur in the north-western Transvaal near the eastern extension of the Bamangwato Reserve.

The visual record from near Debeeti, quoted in the interim report Smithers (1968), is now thought to be a misidentification and is disregarded. Further visits to the area and questioning of residents have revealed no knowledge of the species in this area. The species does not occur anywhere near this in the Transvaal.



Shortridge (1934) states that they occur throughout the western Caprivi but there does not appear to be any evidence for this statement, the only specimen he records is from Shinyemba village on the Okavango (17 21 C4). To date there are no visual or material records from Botswana north of Sepopa on either side of the Okavango River. Although Hill and Carter (1941) state that they occur 'throughout the interior of Angola' until such time as there is some evidence for their occurrence in the extreme north-western parts of Botswana it is considered that they do not occur there.

Most historical records fall within their present known limits of distribution (Cumming, 1850; Selous, 1881; Andersson, 1881; Holub, 1890; and Bryden, 1893). The frequency of mention of their sighting or shooting between the Notwani River and the Tati Concession indicates that they were common in this sector in historical times.

Habitat

Open woodland and scrub, frequenting the fringes of vleis and grassland but avoiding extensive open areas of grassland and closed woodland. They have been recorded in *Acacia* (Tamafupi); *Baikiaea* (near Nunga); and mopane (Tsotsoroga) woodland. On the Rhodesian border between Hendricks Pan and the Nata River they occur in *Terminalia-Combretum* scrub and near Nata and in the Tati Concession in mopane and *Acacia* scrub.

Habits

Gregarious, occurring in small herds of six to a dozen or larger up to 40-50 (Savuti), solitary males often encountered (Selinda Spillway, Nunga, Tamafupi). Dependent on water. Child and Wilson (1964) show that they move considerable distances seasonally (in Zambia), Child (1968) states that regular counts along the Chobe River indicated the seasonal nature of their use of the Chobe Flats and a movement into dry country when water becomes temporarily available.

Food

Fredominantly grazers but will browse as well. At Tamafupi observed feeding on *Terminalia sericea*, mopane and *Combretum* sp.

Breeding

TNL 1698 a female taken at Tamafupi in September was gravid with a small foetus (138 g) implanted 1R. Tinley (1966) states that the young are born in the Moremi Game Reserve in November, Child (1968) for the Chobe National Park states that they are strictly seasonal breeders, the calves being dropped early in the year from about February, which coincided with information he obtained from Bushmen who gave the time as January and February. Wilson (1969), for western Rhodesia, shows that there is a definite peak of calving about March.

Sizes and Weights

MALES

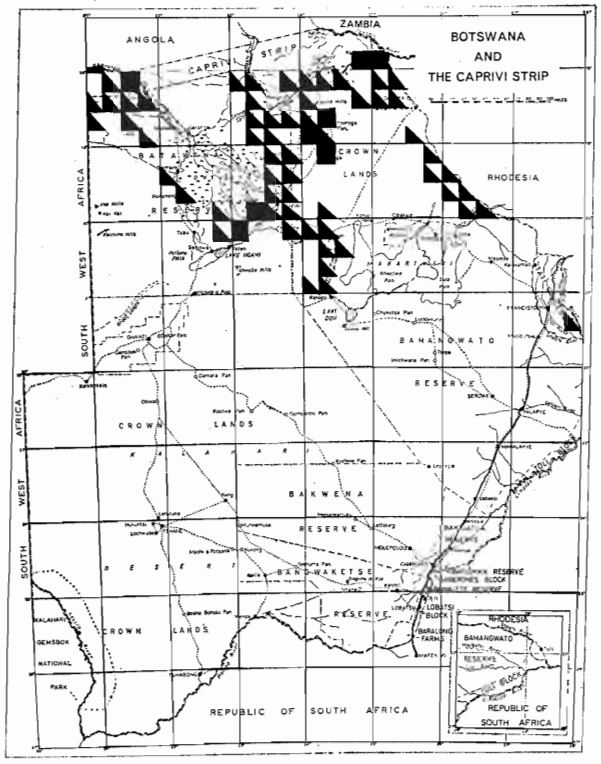
No.	*TL*	*T*	*Hf c/u*	*E*	*Weight*
TNL 1698	2425	440	550	225	420 lb.
BP 2258	2390	482	457	265	—
BP 1855	2392	515 (mid anus)	540	232	—
BP 218	2350	425	550	227	573 lb.

Hippotragus equinus Kwalata etshetlha Roan

H. e. cottoni Dollman & Burlace, 1928

Distribution

Occur in the northern parts of the territory in the valley of the Okavango River and in other parts of the extreme north-west, west to the South West African border; throughout the fringes of the Okavango delta; except in the north; on the Maschi River; the Savuti; eastern part of the Selinda Spillway extending eastwards to Tsotsoroga Pan and Joverega; and along the Chobe River and its environs throughout its length in Botswana and narrowly south along the Rhodesian border to the Nata River. Also occur from the south-eastern Okavango delta along the Botletle River to near Rakops. A small herd is preserved on a farm in the southern part of the Tati Concession.



Not so far recorded north of the Okavango delta to the Caprivi border, although Shortridge (1934) records them throughout the western Caprivi, nor in the central parts of the north-eastern sector.

Very few roan were contacted during the five years of field-work and the majority of the visual records were made by past and present members of the Department of Wildlife and National Parks or hunting safari personnel and the impression gained is that they are less common today than previously. Child (1968) considers that they are in danger of disappearing from much of the range in Botswana, mainly due to habitat deterioration, and advocates strict control in hunting the species. The only area where one has a reasonable chance of seeing roan is in the western parts of the Makgadikgadi but even here on several visits the total number noted was eleven, over a total period of about eight weeks.

A herd of 12 was seen just south of the Moremi Game Reserve in May 1969 (Wilson and Coffin Grey, *in litt.*).

Selous (1881) records the species along the Notwani and Limpopo rivers, and in the Tati area; Holub (1890) from Shoshong and near the Nata River; Bryden (1893) from Palapye northwards. These records indicate that the species formerly extended very much further south than today.

Habitat

There is too little information to formulate a general statement on their habitat. In the western Makgadikgadi they were seen in open scrub a few miles from the Botletle River, in the zone intermediate between the open grassland and the *Acacia* woodland and scrub which fringes the river in depths from a few hundred yards to several miles. They were never seen on the open grassland. At the Savuti they were seen in open mopane scrub at the base of the sand-ridge where three were seen at intervals over a week and a solitary individual on the airstrip cut into the scrub. Near Tamafupi they occurred in *Terminalia-Combretum* scrub; C 281 was taken in riverine woodland and scrub fringing the Chobe flats (Child) and BP 2257 at Nunga on the fringe of a wide open vlei in *Acacia* woodland. At Savuti several small herds were seen in mopane scrub.

They occur on the same grounds as the sable, *H. niger*, their distributions throughout the territory coinciding closely.

Habits

Gregarious, occurring in small herds the largest seen being 12 (eastern Okavango); another nine, comprised of one adult male and eight females and young (Nunga, Swarthout BP 2257), otherwise three to five (Savuti, western Makgadikgadi) and several twos (Savuti). Child and Wilson (1964) found that they are much more restricted in their movement than the sable, H. *niger*. Dependent on water.

Food

Predominantly grazers, although Child and Wilson (1964) show that to some extent they are browsers as well.

Breeding

No data.

Size

MALE

No.	*TL*	*T*	*Hf c/u*	*E*
BP 2257	2465	560	508	318

Genus TAUROTRAGUS Wagner, 1855

Taurotragus oryx — Phofhu Eland

T. o. oryx (Pallas, 1766)

Taxonomic Notes

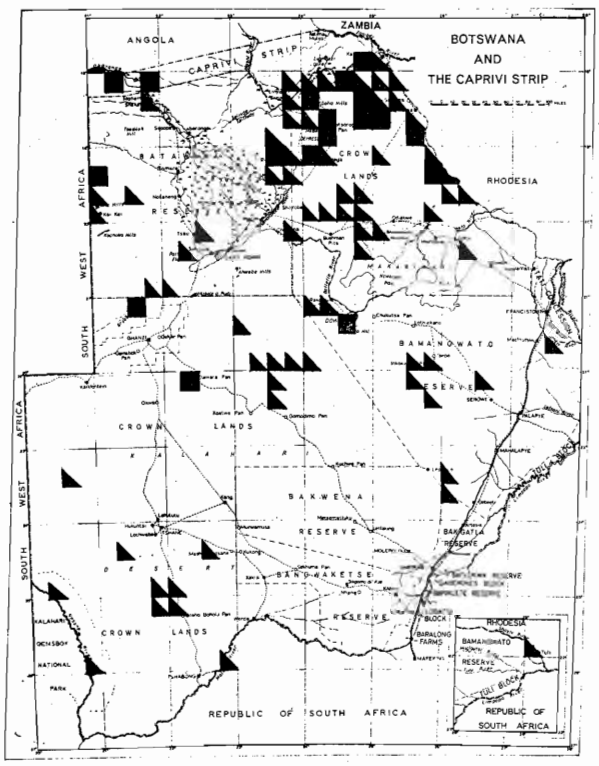
Although only a small series of trade skins from the south-west Kalahari were examined, the survey itself not having secured specimens, all these lacked the white striping on the back so characteristic of the species in Zambia and most of those seen from northern Botswana.

Hill (1942) in dealing with a series collected by the Vernay Lang Expedition taken in the northern parts of the territory (Shaleshanto, Mababe, Tsotsoroga and Kasane) states that five adults and one young lacked the white stripes, two adults had a single white stripe, one had two faint white stripes, one had four stripes and one five. On this basis this northern material appears intermediate between the nominate form and *T. o. livingstonei*.

Dr. K. Koopman of the American Museum of Natural History was good enough to examine the specimen taken by this expedition in the central Kalahari (Damara Pan) and reports that he was 'unable to detect any traces of stripes on it'.

Posselt (*in litt.*) dealing with a herd of domesticated eland in western Rhodesia states that there is nothing constant in the striping. The young are born with nine stripes on either side of the body, more distinctly on the foreparts of the body, less towards the hindquarters. These stripes remain in evidence for five to six months then gradually disappear. By the time the animal is three or four years of age, it may have lost all the markings but some may retain two or three or, on occasion, may retain all the stripes. The herd with which Posselt is dealing originated from wild stock from western Rhodesia which appear to vary in the amount of striping in individuals in this respect showing similarities to those from northern Botswana.

While further material is required to properly establish the northern limits of the unstriped *T. o. oryx*, it appears that these are found thoughout the south-west Kalahari, replaced northwards by populations intermediate between *T. o. oryx* and *T. o. livingstonei* of Zambia.



Distribution

Widely distributed, but generally absent within the Okavanga delta, occurring, however, in the dry surrounding country. Absent from the eastern sector, east of the line of rail, although small numbers are still found in the vicinity of the Tuli Circle. The record from just east of Macloutsie was made during the elephant control programme in the late 1950's and there are no recent records from this area.

At the moment the survey has no information from the Bakwena Reserve or south of this to the border, although they are locally common west of this in the south-west Kalahari.

Although there are no present-day records from the eastern sector south of the Tati Concession, they occurred there in historical times. Cumming (1850) records them from the Marico and Notwani rivers, Livingstone (1857) from near Kanye. Holub (1881) states that by the 1880's the species no longer occurred between Molepolole and Shoshong where formerly they were to be found.

Habitat

Open woodland and scrub. Independent of water but will drink if this is available. Near Kanyu individuals in a small herd were observed feeding on Tsamma melons, *Citrellus lanatus*, which occurred in the area in great profusion. These no doubt provide part of their moisture requirements.

Habits

Gregarious, occurring in herds of up to *c.* 50 (Tamuseche Pan), many of 6 to 20; much larger congregations of up to 1 000 or more known (May, 1963, 40 miles E. Tshane (Atkins, Game Dept. Records)). Large congregations are also recorded from the northern Kalahari (Selous, in Lydekker (1926)). Liversedge (*pers. comm.*) reported a very large congregation in 1969 near Tshabong generally moving southwards towards the Molopo River and across into the northern Cape Province. Shortridge (1934) records 'treks' of this type and states that they usually take place 'during or after the rains'. On this basis, unlike the movements of other species, they do not appear to have anything to do with availability of surface water.

Solitary bulls occasionally met with (Nxai Pan) and herds of calves only on record (Selous, in Lydekker, 1899; Child (1968)).

They do not appear to make use of shade in the heat of the day to the same extent as other species and have been observed feeding during the hottest hours in the open (Savuti, Kanyu, Patlana Flats).

When disturbed herds move off at a lumbering trot, the head held high, which pace they can maintain for long periods. Under stress they break into a gallop leaping over bushes with surprising agility, considering their great size. An individual disturbed near a five-strand fence near Makalamabedi walked up to it, stopped, then cleared it with a couple of feet to spare. They can clear a six-foot obstacle with little effort. Independent of water, but will drink when it is available.

Food

Predominantly browsers, but will graze when the grass is fresh and sprouting. Posselt (1963) records that a herd of domesticated eland in Rhodesia utilized 'a wide range of vegetation' having a great liking for various weeds such as marigold, *Tagestes minuta;* black jacks, *Bidens pilosa;* starburr, *Acanthospermum* spp.; and wild fruits such as marula, *Sclerocarya caffra;* wild oranges, *Strychnos* sp.; wild plum, *Ximenia caffra;* and Umhlakauwe, *Flueggea virosa*. Among browse species listed by Posselt the following are included: *Grewia* spp.; *Commiphora* sp.; mopane, *C. mopane;* wild Syringa, *Kirkia* sp.; Mangwe, *Terminalia* sp.; and *Euclea* sp.

Posselt (*in litt.*) states that 'there does not appear to be any vegetation that they will not eat . . . all are consumed at varying times of the year depending on their availability'.

Wilson (1970) mentions the preference shown by the species during the rainy season for *Grewia* spp. and provides a list of plants eaten by eland in western Rhodesia.

The horns are used, with a twisting motion, to break down substantial branches in order to gain access to the fresh leaves on the higher twigs.

Breeding

Juveniles have been observed in February (near Tshane); March (Dukwana, Ritchie, Game Dept. Records); June (Nunga); July (Tamafupi); July (Damucheche) and August (Werda). In a domesticated herd in Rhodesia there are records of births from every month of the year with a peak in August (Posselt, *in litt.*).

Sizes and Weights

No data.

Genus SYNCERUS Hodgson, 1847

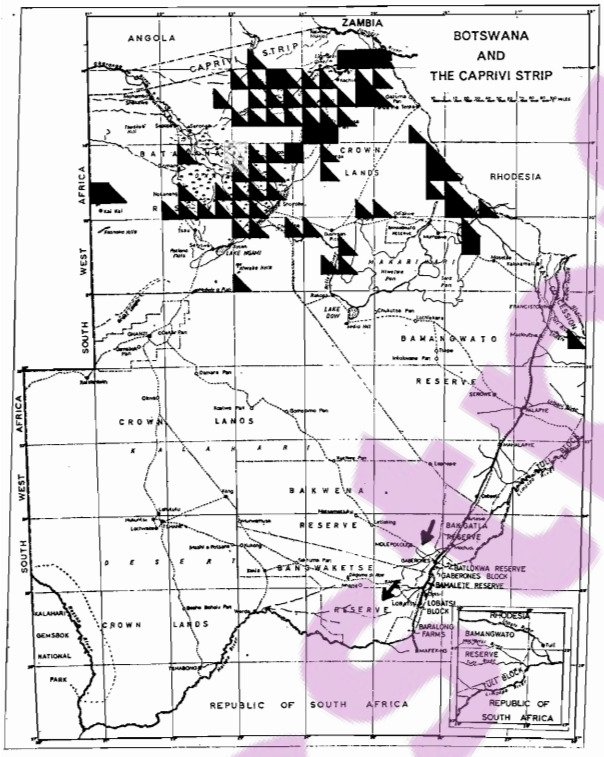
Syncerus caffer

Nare Buffalo

S. c. caffer (Sparrman, 1779)

Distribution

Widely distributed in the northern parts of the territory, occurring throughout the Okavango delta south to *c.* 20°15′ S. (although not within recent years recorded in the Okavango River valley north of Sepopa) and eastwards along the Botletle River to 20°45′ S. Occur in the valley of the Chobe River and associated swamp areas throughout its length; on the Selinda Spillway; the Savuti; Mababe Depression and in the northeastern sector south to the northern parts of the Makgadikgadi; the Nata River, with a small isolated population in the southern parts of the Tati Concession where they are present on farms. Not recorded in the dry central parts of the north-east sector.



(For the records outside this normal distributional range *see* Habits.)

Shortridge (1934) quotes records from northern South West Africa but there do not appear to be any material records from this area. He states that they occur on the Angola side of the Okavango River 'but seldom cross the river today owing to settlement on the south bank'.

Moffat (1842) records encounters with the species near the south-eastern part of what is now Botswana (Baralong country), Cotton Oswell (Selous, 1908) encounters large herds in the reed-beds on the Molopo River in 'southern Bechuanaland', Selous (1908) remarks that 'there is today not enough water to support a herd of buffalo either in the Molopo River or anywhere to the south'. They no longer occur so far south in Botswana.

Selous (1908) writing of his experiences in 1872 in the valley of the Limpopo found buffalo plentiful but by about 1886 they had ceased to exist.

The rinderpest epidemic of 1896 decimated buffalo populations in southern Africa, probably wiping out isolated populations on the perimeter of their range and, owing to settlement, they have never repopulated these areas.

Child (1968) records the build-up of populations in the Ngwezumba area in north-east (1824B4),

where until about 1944 to 1946 they were unknown, and in the area south-east to Nunga.

On the other hand heavy die-offs of buffalo are on record, Child (1968) writes of an occurrence of this sort in 1962 when it was estimated that 2 000 died in the Jhari Pan area and again in 1965 when there was a further heavy die-off in this area.

Habitat

Woodland, in the vicinity of water, generally avoiding open grassland or floodplain which, however, they will visit at night. Particularly associated with extensive reed-beds near water. Buffalo require woodland for shade and are often found standing or lying down in it during the hotter hours of the day. During the morning and late afternoon they will feed in scrub or in open woodland and are, throughout the range, dependent on water.

Habits

Gregarious, occurring in large herds of up to several hundred (Savuti, Mababe), solitary old males often found (Tamafupi, Hendricks Pan, Savuti). Subject to seasonal movements into dry country in the rainy season when they depend on temporary water supplies, returning to permanently watered areas as the temporary supplies dry up. The Aha Hills, Kuki-Makalamabedi fence and Nxai Pan records were made in the wet season, buffalo not normally being resident in these areas in the dry season. Tinley (1966) records the movement of the species out of the Moremi Game Reserve in the wet season, returning in the dry, Child (1968) states that they are more conspicuous in the Chobe River in the dry season 'possibly as a result of the influx of animals from waterless areas'. These movements warrant closer investigation.

The records of solitary buffalo shot in recent years near Molepolole and another just south of Kanye are a manifestation of the occasional vagrant movements of individuals which take them far from their normal habitat into country which, in this case, is totally unsuitable for the species. It is impossible to determine from where these vagrants originated.

Buffalo are inquisitive and herds will move towards observers, if they fail to get their scent, the head held high, nostrils testing the air. Their sense of scent is acute, but eyesight and hearing appear to be less well developed. When disturbed they move off at a lumbering gallop, the herd streaming out in a narrow line, heads held up, the horns laid back.

Wounded, the species can be very cunning and dangerous.

Food

Predominantly grazers, to a lesser extent browsers as well.

Child (1968) lists the following browse plants utilized by buffalo: *Baphia obovata; Dichrostachys cinerea; Pterocarpus stevensonii* and *Combretum* spp.

Although generally avoiding open country during the day will move on to open floodplain at night to feed (Savuti, Nokaneng) but found feeding during daylight hours in scrub (Mababe) and woodland (Tamafupi).

Six stomach contents subjected to examination in the field contained the following estimated percentages of graze and browse:

	Graze	*Browse*
C 2208	90%	10%
C 2209	90%	10%
C 2334	100%	Nil
C 2236	100%	Nil
C 2237	100%	Nil
BP 171	100%	Trace

Breeding

Females with foetuses were taken in August (2), June (1), at weight and CR length as follows:

Month	*CR*	*Weight*
August	330	—
„	440	—
June	280	2 lb. 8 oz.

Insufficient data is available to suggest whether they are seasonal breeders or not. Tinley (1966) records young in the Moremi Game Reserve during the period January to March.

Sizes

MALES *No.*	*TL*	*T*	*Hf c/u*	*E*
C 2208	3114	742	615	257
C 2334	3100	772	615	260
BP 2261	3330	764	508 (s/u)	287
FEMALES				
C 2236	2996	665	590	266
C 2237	3127	710	590	275
BP 2262	3202	775	483 (s/u)	280

Genus CONNOCHAETES Lichtenstein, 1812

Connochaetes taurinus

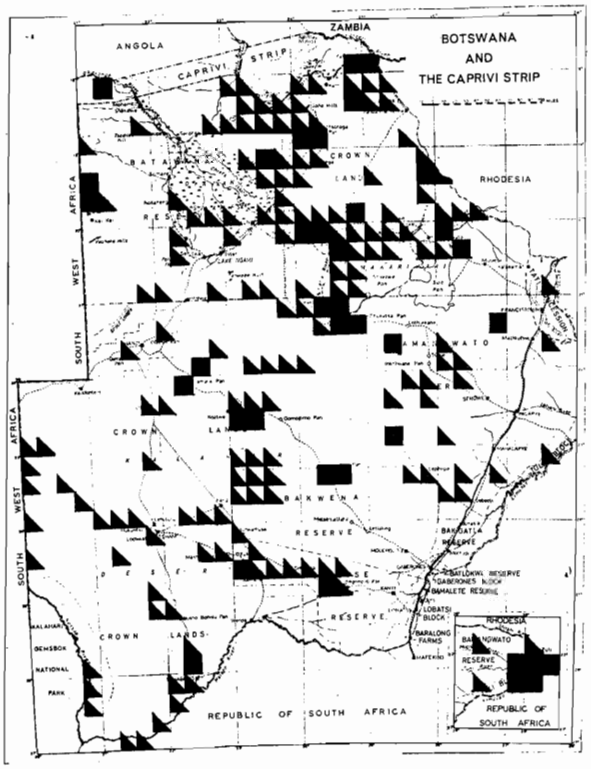
Kgokong Blue Wildebeest

C. t. taurinus (Burchell, 1823)

Distribution

Widely distributed, occurring throughout the territory except in the south-east, south of Debeeti, and east of Letlaking and Dikgomodikae.

Although there are no visual or material records from the western Caprivi, or the area immediately east of the Okavango River north of Seronga, Shortridge (1934) states that they occur in the western Caprivi and it seems probable, therefore, that they also occur in the adjacent parts of Botswana in this sector.



The historical record shows that the species certainly used to occur in the southern parts of the eastern sector. Holub (1881) and Selous (1893) record their occurrence on the Notwani River; Andersson (1888) from Molepolole and Oates (1889) from south of Mahalapye, areas in which they are no longer found.

Habitat

Open grassland, floodplain grassland, open bush savannah and light open woodland.

Habits

Gregarious, occurring in small herds from half a dozen to 40 or 50, in much larger up to several hundreds and even larger congregations of up to thousands. During the course of an avifaunal survey of Botswana in the years up to 1957 (Smithers, 1964) it was not an uncommon sight to see wildebeest in such numbers as made estimates difficult, but probably amounted to up to over six or seven thousand, on the grassland of the north-eastern Makgadikgadi during the latter part of the year. Ritchie (Game Dept. Cards) records an estimated 10 000 in this area as late as 1962. In December 1962 large numbers of juveniles were found dead scattered over the grassland of the northeastern Makarikari (Avifaunal Survey records). By 1964 the numbers had declined so tremendously that it was considered fortunate if a dozen were seen and in the latter years of the survey (1967-69) none at all were recorded in this area. Child (1968) accounts this as 'a classical example of a population eruption followed by the expected heavy mortality as the species exceeded its habitat resources'. It was noticeable that there was a heavy build-up in cattle population utilizing this area from about 1957 onwards which no doubt accentuated the habitat deterioration.

The herds in the southern and south-western parts of the territory were generally smaller, normally numbering up to 100, although in May 1957 a herd of several thousand was recorded 57 miles east of Kakia on the Kanye road (Avifaunal Survey records); in August 1962 *c.* 3 000 north-east of Sekuma Pan and in October 1962 *c.* 5 000 near the Sume Pan (Game Dept. cards).

There appears, on occasion, to be a movement of wildebeest from the Makgadikgadi area across the Rhodesian border into the southern part of the Wankie National Park. Davison (1950) records that up till 1935 there were no wildebeest in this part of the park, the last being shot near Kennedy siding in 1926. The drought of 1934 brought an influx to the permanent water in the southern part of the park and at the break of this drought, while the majority returned westwards, about twenty remained, these forming the nucleus of the present herds in the Ngamo and Kennedy areas.

Austen (*pers. comm.*) records a movement into the park in 1964, another drought year, 'numbering thousands'.

Food

Almost exclusively a grazer. Preferred grass species include *Cyonodon dactylon*, *Brachiaria humidicola* and *Panicum coloratum*.

Breeding

In the western Makgadikgadi area calves were seen in November, December, February and March, no other data is available.

Sizes and Weights

	TL	*T*	*Hf c/u*	*E*	*Weight*
MALES					
BP 1664	2390	635	550	200	—
BP 2173	1860	460 (mid anus)	510	195	415 lb.
BP 2263	2547	590	483	240	—
TNL 4340	2400	600	540	210	510 lb.
P 224M	—	530	533	220	—
FEMALES					
BP 574	2170	455	516	182	389 lb.
BP 2264	2250	547	432	190	—

Genus ALCELAPHUS Blainville, 1816

Alcelaphus buselaphus

Kgama Cape Hartebeest

A. b. caama (G. Cuvier, 1804)

Taxonomic Notes

Dolan (1965), after examination of skins of *Alcelaphus buselaphus caama* and *A. b. selbornei* in the British Museum (Nat. Hist.) as well as living specimens of *A. b. selbornei* in the gardens of the Zoological Society in Amsterdam and the Gatskill Game Farm, these living specimens imported from South West Africa, came to the conclusion that *A. b. selbornei* Lydekker (1913) was a synonym of *A. b. caama* (G. Cuvier) (1804).

While accepting this conclusion the opportunity has arisen to assess its validity by the examination of a series of 13 specimens from Botswana taken over the years 1966-68 by the Botswana Mammal Survey. In the hope that it might be possible to augment this series by borrowing material from museums in southern Africa, enquiries were initiated to ascertain the existence of comparative material, more especially skins, as G. Cuvier's (1804) original description of *Antelope dorcas* (= *A. b. caama*) from the Cape of Good Hope deals predominantly with their markings and colour, as does Sparrman's (1785) for specimens from Agter Bruintjes-Hoogte (headwaters of the Little Fish River, Cape Province). This revealed that while there were mounted specimens in these collections they were useless for comparative purposes as they had faded and their provenance was in doubt. The only study skin in existence appeared to be a single specimen in poor condition from Blaauberg, Transvaal, in the collection of the Transvaal Museum, Pretoria, which, although apparently adult, more closely fitted Lydekker's description of *A. b. selbornei* than G. Cuvier's *A. b. caama*.

Lydekker's type of *A. b. selbornei*, extracts from the description of which are given in Table I, came from the 'Kimberley Game Farm' (de Beers Consolidated Mines farm, Rooipoort, Kimberley, Republic of South Africa).

Both Lydekker and Ellerman *et al.* (1953) state that the hartebeest on the farm were imported from the Transvaal. Pringle, however, who was Game Keeper on Rooipoort from 1900, when de Beers purchased the farm, was convinced that those on the farm were indigenous (Secretary, de Beers Consolidated Mines, *in litt.*) and this conviction is reinforced by the fact that they occurred on a neighbouring farm, Drooglaagte, prior to 1900. (Talbot (whose father owned the property), *pers. comm.*)

The Game Book at Rooipoort records that hartebeest were shot regularly on the farm from 1907 onwards, the figures given being:

1907	5
1909	9
1910	21
1911	21

Du Plessis (1969) quotes figures, from the (Republic of South Africa) Agricultural Correspondence files, 1896-1908, in which the minimum and maximum numbers of hartebeest recorded from the Kimberley area is recorded by de Beers from 1902-08 as 470-877.

Such a large number in 1902 in the Kimberley area would certainly suggest that they would be present in 1900 and in any case it seems unlikely that the introduction of a species of this size would have been attempted prior to this date.

The return of the Kimberley Market Master round the turn of the century records that a great deal of game and game birds were sold in the market square.

It is curious in the light of the above that although his records mention the sale of duiker, steenbuck and springbok, no mention is made of hartebeest (R. Bigalke, *in litt.*).

From the above evidence it is reasonable to suppose that Pringle's statement was correct and that, in spite of the information given to Lydekker, the hartebeest, from among which the type of *A. b. selbornei* was taken, were naturally occurring in the area having built up under the protection afforded them by de Beers since they purchased Rooipoort in 1900.

As far as external characters are concerned the descriptions given by Sparrman (1785) for *A. b. caama* and Lydekker (1913) for *A. c. selbornei* are comprehensive and bear close comparison, more especially to throw into perspective the characters used by Lydekker in creating the subspecies *A. b. selbornei.* For convenience these are tabulated as follows:

TABLE I COMPARISON OF DESCRIPTIONS

Sparrman *A. b. caama*	Lydekker *A. b. selbornei*
1. General cinnamon colour.	1. Much paler general colouring yellow fawn or tawny. 2. Minor development and intensity of dark markings. 3. Less sharp definition of white on the sides. 4. Less sharp definition of white on lower rump. 5. General tawny tint tends to chestnut on the loins.
6. From hence (end of nuchal stripe) a dark oval spot extends over the whole ridge of the back terminating with its broader and obtuser end just above the tail.	6. Elsewhere back same colour as flanks.
7. There are two narrow stripes which take their rise behind each ear and afterwards run together all along the ridge of the neck.	7. Nuchal stripe indistinct.
8. Forehead covered with black hairs which, with a small admixture of brown ones, lie in a whorl. Two inches below this commences an oblong black spot which extends to the nostrils.	8. Face blaze instead of forming, with the exception of the narrow light band between the eyes, a continuous wholly black streak from the horns to the muzzle, is much broken up and everywhere mingled with fawn-coloured hairs. It practically stops short at the horns and is interrupted in the neighbourhood by a fawn area mingled with a few blackish hairs for a length of four inches while the nasal portion does not nearly reach the muzzle.
9. Forepart of shoulders covered with black hairs as are likewise the anterior part of the forelegs quite down to the hoofs these black hairs at the same time carried round them and rising behind up to the fletlock joints. This black colour is dispersed nearly in the same manner on the forepart of the hind legs. A good deal of the hindmost part of the haunch is covered with a wide black streak which reaches down to the knee.	9. Dark patch on shoulder and foreleg less intense than in typical race everywhere mingled with fawn hairs where it stops short of the knees on which it forms a dark patch.
10. Lower lip black.	
11. Upper and hind parts of haunches are of a pale yellow colour as well as the anterior and upper edge of them and inside of them and the belly. The posterior part of the forelegs are likewise of a somewhat lighter hue than the cinnamon colour above mentioned, which covers every other part of the animal.	
12. There is a pore an inch or an inch and a half below and before the internal angle of the eye—secretes matter like ear-wax.	
13. Vestiges of a beard or whiskers mentioned by M. Pallas as being on each side of the black spot on the under lip may likewise be seen.	
14. Hair fine about one inch in length.	
15. Ears with white hairs on the inside.	
16. Height shoulder "somewhat exceeding 4 ft.".	
17. Length horns measured along external curvature "from six to nine inches long". Roberts suggests error as they are a foot longer.	

The series from Botswana available for comparison with the above comprises a series of eight adult males, three adult females and two juveniles as follows:

No.	Date	Sex	Locus	TL	T	Hf c/u	E	Weight (lb.)
ADULT MALES								
C 1515	8.4.66	M	Rakops	2090	460	560	192	317
BP 1601	3.5.66	M	Taketokwane	2073	454	572	192	302
BP 1600	3.5.66	M	Taketokwane	2200	504	562	201	344
BP 1599	3.5.66	M	Taketokwane	2110	404	534	192	343
BP 1602	22.6.66	M	Motosoboyne Pan	2200	445	555	193	334
BP 1661	19.10.66	M	S. Bushman Reserve 22°24′ S. 23°29′ E.	2100	490	550	193	330
BP 1662	25.10.66	M	35 miles S. Ghanzi	2180	490	565	195	333
TNL 4223	24.5.68	M	45 miles SW. Francistown	2200	520	555	200	380
ADULT FEMALES								
BP 1764	3.12.66	F	37 miles NW. Serowe	2110	430	503	175	260
BP 1766	4.12.66	F	40 miles NW. Serowe	2070	485	525	187	232
TNL 4273	24.5.68	F	45 miles SW. Francistown	2110	500	545	192	300
JUVENILE FEMALES								
TNL 2191	25.1.67	F	150 miles S. Mamuno	1360	300	435	160	65
TNL 2231	30.1.67	F	25 miles ENE. Tshane	1990	465	535	194	195

All the eight male specimens listed have fully adult dentition and all show heavy tooth wear. In BP 1599 the lower incisors are worn down to the bases, the remainder of the teeth showing heavy, but very uneven, wear P_4 and M_1 being worn nearly to the junction with the lower jawbone by P_4.

Comparison of the characteristics of individuals of this series with the descriptions of *A. b. caama* and *A. b. selbornei* as set out in Table I, items 1-17, is as follows:

I. G. Cuvier (1804) in his original description of *A. b. caama* stated 'sa couleur est un fauve bai, plus brun sur le dos', fauve bai being interpreted as reddish-brown, or tawny bay (near chestnut, with a tinge of yellow. *Dictionary of Colour*, Maerz & Paul, London, 1930). Sparrman used the term 'cinnamon'. All these are open to a fair breadth of interpretation, cinnamon generally, however, being interpreted as a yellow (*see* Dauthenay, Repertoire de Couleurs, Cinnamon, Café au lait, 323; Maerz & Paul, 14, I, 10).

It is not possible to apply any one colour to the pelage of this species which, in every case, varies in colour depending on the particular circumscribed area of the pelage of the individual under examination. The species cannot by any means be considered as being of one colour except in the broadest terms. Within these broad terms and in accordance with the definitions as given by Dauthenay and Maerz and Paul BP 1601 and BP 1662 could well be described as cinnamon while BP 1599 is much darker and would better be described as a rich reddish-brown.

Lydekker in his description of *A. b. selbornei*, an 'adult' male, states that (compared with *A. b. caama*) it is 'much paler—a yellow fawn or tawny'. This lighter colour, more especially the yellow, is particularly associated with juveniles, cf. TNL 2231 and, in particular, BP 2284 a juvenile trade skin from the Makgadikgadi but also with the adult males BP 1601 or BP 1662.

From the series of adult males from Botswana there is obviously a wide variation in the general colour from the extremes available BP 1601, the light cinnamon or tawny specimen to BP 1599 the rich reddish-brown.

Lydekker in his description of *A. b. selbornei* notes the minor development and intensity of the dark markings. These remarks apply well to the difference between BP 1601 and BP 1599 in the former and markings being browner, less intense dark brown, the fringes of the markings diffused and less clearly outlined, in the latter the dark markings well-defined and nearly black. The extreme here is seen in BP 2284 a juvenile in which the markings are very poorly defined.

3. It is not understood what Lydekker meant by the 'white on the sides' for there is no white on the sides of this species. As he deals with the white on the rump in 4, presumably he meant the white on the lower parts of the belly. In the male series this is certainly very poorly defined being of small area and blending imperceptibly with the colour of the flanks.

In BP 2231 it is, however, much more clearly defined and in this specimen, and this specimen only, could the colour be defined as white, in all the others it is off-white or buffy-white. The scrotum of BP 1602 has a limited amount of pure white hairs surrounding its base but the hair on the scrotum itself is off-white.

4. Lydekker states that in *A. b. selbornei* there is a less sharp definition of the white on the lower rump. In none of the specimens, males, females or juveniles, is this marking white. At best in the juvenile BP 2284 it is off-white, in the adult male series buffy-white.

In the adult male series the 'white' of the rump blends with the darker colour of the lower rump and the demarcation is only well defined where it meets the darker colour of the posterior part of the saddle. In BP 1599 the demarcation is least well defined, in the juveniles much clearer.

5. The whole series reflects an agreement with Lydekker that the 'general tawny tint tends to chestnut on the loins' or at least in the juvenile specimens the lighter yellower colour darkens in this position.

6. Sparrman particularly mentions the 'saddle' so characteristic of the species. While difficult to see in the field it is an obvious character in all the Botswana material, particularly so in the juveniles, cf. BP 2284 but varying in intensity through the male series, in BP 1601 being particularly clearly marked, in BP 1599 tending to blend with the colour of the flanks, and in BP 1662 poorly defined. Towards the base of the tail in all cases it is clearly demarcated against the buffy-white or off-white of the rump but always less clearly demarcated against the shoulders and mid-back. Lydekker for *A. b. selbornei* states 'elsewhere the back the same colour as the flanks' with no mention of this feature. In the females there is a greater variation in the intensity of this 'saddle' from BP 1761 where it is barely perceptible to TNL 4273 where it is quite clear.

7. The 'two narrow stripes which take their rise behind each ear and afterwards run together all along the ridge of the neck' mentioned by Sparrman is described by Lydekker as 'the nuchal stripe' which he states is indistinct in *A. b. selbornei*.

In all the Botswana material this nuchal stripe is distinct there being a tendency for the colour to coalesce behind the ears into a single patch of black hair which then leads as a stripe along the ridge of the neck. The darker the specimen, e.g. BP 1599, TNL 4223, the less clearly, however, does the nuchal stripe appear against the generally darker colour of the neck.

8. In all the adult male Botswana specimens the forehead is covered with black hairs with a varying admixture of a few or more brown hairs, a narrow light band between the eyes and a black band from below this to the nostrils, or, in other words, a continuous black band from the base of the horns to the nostrils with a narrow light band between the eyes.

Lydekker's description of this marking states that it stops short of the horns, is much broken up by being mingled with fawn-coloured hair, and is interrupted in the neighbourhood of the horns, and 'does not reach the muzzle' features which closely resemble the situation in BP 2231 a juvenile female or in adult male BP 1662.

9. While it is impossible to determine whether the dark patch on the shoulder and foreleg is less or more intense than in the typical form Lydekker states that in *A. b. selbornei* this dark patch is everywhere mingled with fawn hairs. This is not so in BP 1599 or BP 1601 where it is an even very dark brown, nearly black, with an occasional white hair.

Now Lydekker, for *A. b. selbornei*, states that the continuation of this black marking down the front of the forelegs 'stops short of the knees on which it forms a dark patch'. This is not so in any of the adult males where it is continued right down to the hoofs as a very distinct band. In BP 1599 there is a measure of intermingling of cinnamon hairs with the black below the knee and the marking is not so intensely black at the hoof but is, nevertheless, quite distinct.

Those markings in fact correspond closely with the situation in *A. b. caama* as described by Sparrman, who goes on further to say that 'these black hairs at the same time carried round them (the hoofs) and rising behind up to the fetlock joints' a feature clearly seen in TNL 4223 and BP 1601 although less so in the other adult males.

As far as the hind legs are concerned Lydekker makes no mention of the dark markings, but all the adult males fit with Sparrman's description except that the marking could scarcely be called black, it is rather very dark brown, nearly black. Both these markings and the other dark markings on the bodies look black in the field but in effect they have an

irridescence which in some lights gives them a 'plum' sheen. This irridescence is so pronounced in some lights that when the animal is standing facing one in bright sunlight, shining from behind, the markings on the front of the face shine white as if the face had a white blaze. This feature is undoubtedly the basis of the story widely current that some of the hartebeest in the south-west have white faces.

10. The colour of the lower lip varies greatly in the series of adult males. In BP 1602 and BP 1601 it could be called black although as with the other markings it is in reality a very dark brown nearly black. In BP 1599 it is lighter grey-brown freely interminged with white hairs.

11. Sparrman's description of the colour of the upper and hind parts of the haunches as 'pale yellow' fit well with this feature of the series of adult males. Harris' illustration in 'Wild Sport of Africa' shows this white in a specimen from the Cashan Mountains (Magaliesberg, western Transvaal). However, the illustration of *A. b. caama* (*Bubalis caama*) in the 'Book of Antelopes', Sclater and Thomas (1894-1900), *1*, p.33, clearly indicates that this is pale yellow or white with a tinge of yellow.

The colour of the posterior part of the forelegs are indeed lighter in the adult male series than the 'cinnamon colour, which covers every other part of the animal' (Sparrman).

12. The gland mentioned by Sparrman is present in all the specimens examined, the waxy secretion being much sought after by the Bushmen as 'medicine'.

13. The whiskers on either side of the 'black' spot on the under-lip are present in all the specimens examined.

14. The hair is about an inch in length.

15. All the Botswana material has white hair on the insides of the ears.

16. Sparrman states that the shoulder height 'somewhat exceeds 4 ft.'. Measurement of the height of Botswana material closely agrees with this as follows:

	C	BP	BP	BP	BP	BP	TNL
No.	1551	1599	1600	1601	1602	1661	4223
Shoulder height (inches)	47½	48	50½	47	51	50	52

17. Sparrman stated that the length of the horns measured along the external curvature was from 'six to nine inches long'. Roberts (1951) suggested that this was an error. It may well be that Sparrman meant 1 ft. 6 in., as the series of horns of the four largest adult males from Botswana measure as follows:

No.	BP 1599	BP 1600	BP 1601	BP 1602
Horn length	1 ft. 10 in.	1 ft. 9½ in.	1 ft. 9½ in.	1 ft. 7¾ in.

As Dolan (1965) has pointed out, Lydekker in the year following his description of *A. b. selbornei* stated 'the pale coloration and imperfect development of the dark markings in this specimen (the type) seem to be abnormal, or due to immaturity, as other heads from the Kimberley herd show full development of the face blaze', and remarks that on this basis it was interesting to note that Lydekker did not revise his description (of *A. b. selbornei*).

Within the range of adult male material available from Botswana none can be said to correspond in every feature to Lydekker's description. The juvenile male BP 2284, however, does, except that the nuchal stripe is distinct. Moreover, the range of variation in the various characters used by Lydekker is well illustrated by the adult male series which ranges from a flank colour of pale fawn or tawny (almost yellow) BP 1601, through a dark tawny, BP 1600, to a rich reddish-brown, BP 1599, with variations in the markings of the legs, face and other parts of the body, as noted in the text above.

Observations of herds in the field clearly show the variation in colour and the difference in intensity of the dark markings. Unless seen at close quarters, the 'white' on the rump appears white, whereas in effect it is off-white or a pale yellow. This may have been why Harris illustrated the specimen from the Cashan Mountains with a pure white rump.

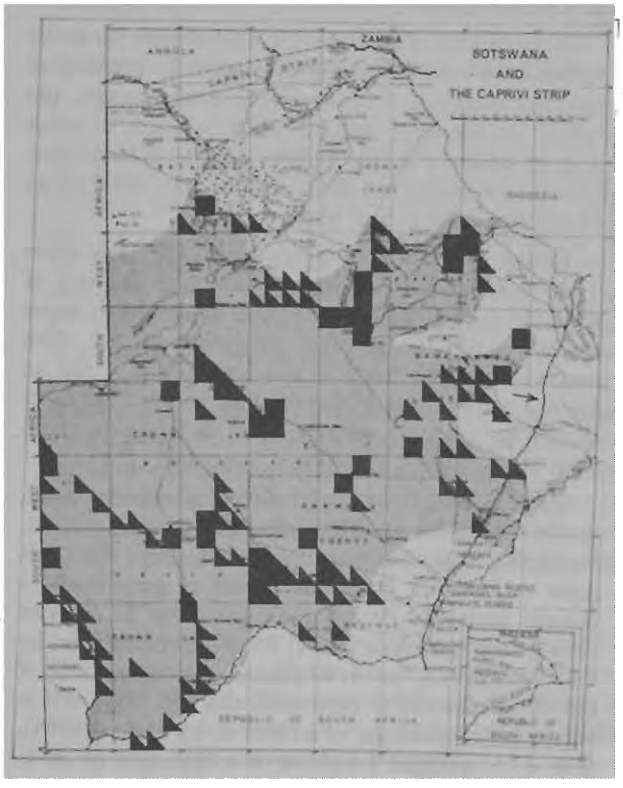
Taking the adult male specimen BP 1599 from Taketokwane, which was specifically picked out of the herd as the darkest individual available, in every respect, with the possible exception of the dark markings on the front of the leg, which is not so intense at the level of the hoof as in TNL 4223, it closely fits with the description of *A. b. caama*, given both by G. Cuvier (1804) and Sparrman (1785).

While noting, therefore, that there is some variation in the characters used by authors in dealing with *A. buselaphus* in the southern part of its range the adult male series from Botswana agrees in general more closely with the descriptions given by G. Cuvier (1804) and Sparrman (1784) for *A. b. caama* than by Lydekker (1913) for *A. b. selbornei* more especially if old adult material is examined. On this basis one is led to the conclusion, as arrived at by Dolan (1965), that *A. b. selbornei* Lydekker is a synonym of *A. b.*

caama G. Cuvier and that Lydekker must have based his description on a specimen that, while apparently adult, fell at an extreme of variation of colour and other characters normal in a population of *A. buselaphus*.

Distribution

The hartebeest is widely distributed throughout the southern and central parts of Botswana, in the west as far north on the South West African border as 20°15′ S., narrowly up the western fringe of the Okavango to Nokaneng, the furthest north that it has so far been recorded in Botswana. Immediately south of the swamp it occurs in the dry country between Toten and the swamp, the northern fringe of occurrence then well south of the Botletle River, swinging north again to enclose the whole of the Makgadikgadi and its associated open grasslands. In the north-east of the Makgadikgadi the species is found in the northward extension of these open grasslands and pan areas through to the Rhodesian border. South of this it is absent from the eastern areas from the Nata River, the Tati Concession and thereafter from the country east of the line of rail, except that, just south of Mahalapye and between this and Artesia it occurs in the open Kalahari associations eastwards to the Transvaal border.



The northern limit of distribution on the South West African border, i.e. 20°15′ S., corresponds very closely with its distribution in eastern South West Africa given by Shortridge (1934), its southern limits extending only just south of the Molopo Nosop River junction outside Botswana limits.

The populations found south of the Molopo River, in the northern part of the Cape Province of the Republic of South Africa, are largely composed of herds which, at certain times of the year, move southwards from Botswana, or herds which have been enclosed and afforded protection on private properties south of the river. Hartebeest still occur on the Kimberley Game Farm (Rooipoort) where they are afforded protection, and they have been introduced to reserved areas in Natal and other provinces of the Republic. They do not, however, occur naturally today south of Rooipoort and the extreme northern parts of the Cape Province.

Kettlitz (1962) estimates that there are some 200 hartebeest in the western parts of the Transvaal, in the main, these being found in the western parts of the Marico, Rustenburg, Waterberg and Potgietersrust districts. This distribution coincides with the eastward extension of distribution in Botswana to the Transvaal border between Mahalapye and Artesia although today, with the development of the eastern sector of Botswana, there is no movement across the border or if it does occur, it is sporadic.

The same sporadic movements also take place on the Rhodesian border, for small numbers of hartebeest occasionally find their way to the extreme south-eastern parts of the Wankie National Park north of the Nata River, following the relatively open country which leads as an avenue to the border.

The occurrence of the species east to 45 miles south-east of Francistown is due to their use of the relatively narrow avenues of open country reaching north-eastwards in this sector.

On occasion small numbers wander far outside the limits of distribution as laid down. In 1952, five appeared on Ingwezi Ranch some 60 miles south of Plumtree, Rhodesia, and 70 miles east of their nearest recorded area of occurrence in Botswana. They remained on this ranch for some years and then disappeared (Cobbold, *pers. comm.*). There is a report (White Hunters Safaris) of a few being seen 70 miles north of Bushman Pits, or 20 miles outside their limit as laid down. In the south they occasionally make their way east of Dikgomodikae, but do not normally remain any length of time.

Such wanderings can be expected anywhere on the perimeter of their distribution.

Most of the historical records of the occurrence of the species in Botswana fall within the limits of its present-day distribution (Cumming, 1850; Livingstone, 1857; Holub, 1881; Andersson, 1888; Bryden, 1893; and Selous, 1907).

Holub (1881), however, states that they occur as far north as the Chobe River and Gashuma flats (Gazuma Pan) and Holub (1890) records them from Pandamatenga. While it is doubted for ecological reasons that they ever occurred as far north as the Chobe River, it is interesting to note that Child and Savory (1964) records a 'reliable record in 1933 from near Pandamatenga (18 25 B4)' on the Rhodesian side of the border and from the northern corner of the Wankie National Park just south-east of this. They do not, however, normally occur in this area and these records may be of wanderers from their more normal area of distribution.

Selous (1881) restricts their range northwards to Lake Ngami in the west and the Seruli River in the east. It is curious that he did not see the species north of the Makgadikgadi as his route through to the Mababe took him through areas just north of the Makgadikgadi where they occur today.

Habitat

In Botswana the species is predominantly associated with dry savannah grassland, floodplain grassland or open bush savannah, associations which cover the greater part of the central and southern parts of the country west of the line of rail.

On the eastern fringe of the Makgadikgadi the floodplain grassland is limited in extent as compared with the northern and western areas, mopane and other woodland associations reaching to the fringe of the pan itself. Their occurrence in the Sua Spit area and immediately north of this is apparently due to their finding their way south from the Nata area where the grassland is more extensive rather than round the south-eastern part of the pan.

Thick woodland generally appears to form a barrier into which, and through which, they are reluctant to move although, in 1967, some 40 miles north of Serowe a herd of about 200 was found in open mopane. Here, however, there was a belt of open grassland some two or three miles north and from their behaviour they appeared to be on the move in its direction. It is possible that they may have been moved into it through stress.

Habits

Gregarious, herds of up to *c.* 300 observed, congregations of up to *c.* 10 000 (*see below*); Taketokwane *c.* 250; Rakops *c.* 200; Kakia *c.* 300, *c.* 100; 20 m. E. Werda 100; 20 m. W. Kanye 150; Mabitsane *c.* 50, *c.* 60; south of Makalamabedi on fence *c.* 55, *c.* 30, *c.* eight; many records of herds of three to eight southern Kalahari, Nxai Pan, Lephepe; Makgadikgadi; Rakops and in many parts of the southern Kalahari; solitary males not uncommon, three of the series of eight adult males collected were alone.

In the southern Kalahari great congregations, perhaps composed of a number of normally separate herds, are recorded: in the area of Sekhuma Pan, October 1962, *c.* 10 000 (D. J. Blaaw); 29 miles west Sekhuma Pan, May 1963, 'great numbers' (T. L. Motlnatlhedi); Tshenka Pan, August 1962, *c.* 3 000 (W. Akester); near Kukong, May 1963, *c.* 5 000 (D. Atkins); Lebung, December 1954, *c.* 2 000 (D. T. Rowe-Rowe); Lebung, December 1954 (a few miles east of the last record), *c.* 1 000 (D. T. Rowe-Rowe); Kanyane *c.* 2 000 (T. N. Liversedge).

Like other large mammal species, subject to irregular movements which, although they warrant close study, do not appear to conform to any regular pattern.

A herd of *c.* 150 was under observation for four days from a camp 25 miles east of Tshane in February 1967, where they appeared settled. The weather had been dry for a considerable time before arrival at this camp, January being a particularly dry month. On the afternoon of the 4th day heavy thunderheads built up a long distance east of the camp, by 4 p.m. the sky being black and leaden yet overhead and westwards the sky was relatively clear. From 5 p.m. till after dark heavy thunder was heard and continuous lightning seen only very little rain falling overnight in the camp area. By morning not a single hartebeest was to be seen and none were observed during the whole of the following dry four days.

This sudden movement of hartebeest during spells of dry weather with patchy but heavy rainstorms has been observed at the junction of the Kuki Makalamabedi fence where in November 1967, they suddenly appeared in the vicinity of the camp after a heavy downpour in that area, and where for several days previously no sign of them had been noted, and at Sekhuma Pan in February 1961 where a small herd disappeared from the camp area during thundery weather with rain falling around, but not in the vicinity of the pan.

Food

In all Botswana material available the stomach content consisted of 10/10 grass with only an occasional trace of other herbage probably taken fortuitously. The

species is apparently adaptable, for Van Zyl (1965) records that in the Lombard Nature Reserve, Bloemhof, a locality situated within the historical range of distribution of the species, the food consisted of 55·6% grass and 44·4% browse.

Breeding

Of the three adult females collected, BP 1764 from 37 miles north-west of Serowe taken on 3rd January, 1966, was lactating freely. From the condition of the reproductive tract she had dropped a calf some time previously, but how long previously it was impossible to estimate.

TNL 2191, a juvenile female taken on the 25th January, 1967, on the western border, south of Mamuno, was still suckling and many other juveniles about this age class were noted in the area round this date (T. N. Liversedge).

Very young, near newly-born juveniles were observed in herds in the southern part of the territory as follows:

February 1961, Tshane;
February 1961, Murwamusa;
August 1962, 20 m. E. Werda;
October 1963, Sekhuma Pan.

While the information is scanty, these records indicate a breeding season from about the time of the onset of the warmer weather in August through the early part of the rainy season to about December.

Sizes and Weights

(*See under* Taxonomic Notes.)

Genus DAMALISCUS Sclater and Thomas, 1894

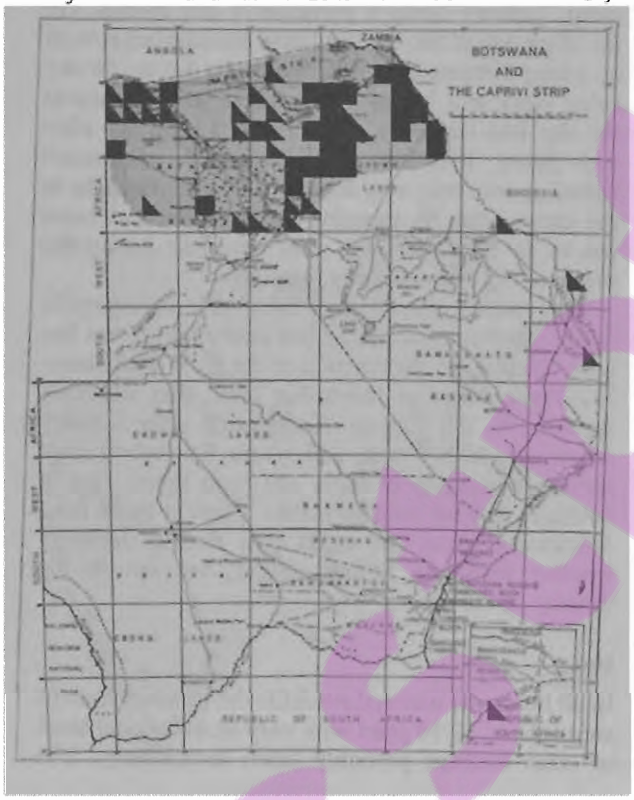
Damaliscus lunatus

Tshesebe Kabole Tsessebe

D. l. lunatus (Burchell, 1823)

Distribution

Occur throughout the northern parts of the territory in the west south to *c.* 20° S.; throughout the Okavango delta and on its eastern fringe to Joverega and east to the Rhodesian border at 19° S. Outside this they are recorded on the Rhodesian border at 20° S., where the Nata River crosses the border; in two localities in the Tati Concession and in the Tuli Block at 22°45′ S. In the case of the three last named localities, small numbers are preserved on farms. A few tsessebe still occur in the western parts of the Waterberg and Potgietersrust districts of the western Transvaal (Kettlitz, 1962).



The range of distribution of the species has in historical times shrunk considerably. When Burchell collected the original type (*c.* 1812) they then occurred as far south as near Kuruman, well south of the Botswana border (*c.* 27°30′ S.). They occurred further south than this in historical times as Cumming (1855) records them from near the junction of the Orange and Vaal rivers. Cornwallis Harris (1852) encounters vast herds just south of Mafeking (Meritsane River) and on the Mariqua River. Livingstone (1857) records large numbers near Kolobeng (Molepolole district) and describes the use of the 'hopo' with its brush fences and pit traps in which huge numbers of tsessebe and other big game were trapped.

The species no longer occurs in the southern parts of the eastern sector and, in fact, not commonly outside the northern parts of the territory. Tsessebe are sensitive to hunting pressure and, being inquisitive, are inclined to stand in the face of shooting making them subject to speedy destruction. This and, more especially, habitat change brought about by man's influences have contributed to their disappearance from vast areas.

Habitat

Open woodland and open grassland mozaic. Particularly associated with floodplain grassland; vleis where these are associated with open woodland of various types including *Acacia giraffae* (Savuti, Nokaneng); mopane (Selinda Spillway); mixed woodland including riverine woodland (Moremi Game Reserve).

Habits

Gregarious, occurring in small herds of half a dozen to a dozen, although larger concentrations have been recorded (Lydekker and Dollman, 1926), Ansell (1960) for Zambia 158. The herds contacted in the eastern Okavango varied in number from six to ten, the largest 14 (Nunga).

Child (1968) states that they are subject to some seasonal movement on the Chobe, numbers building up along the Chobe River in years when the pans southwards dry up. Although it is generally accepted that they are dependent on water, drinking regularly, Child (1968) states that they can apparently do without it for several months at a time. Herds seen at Nunga in June were not, from the absence of spoor, using the only surface water available in the area.

Food

Grazers, 17 stomachs examined contained only grass. They appear to be partial to burnt areas where the grass is sprouting and this factor is made use of by Bushmen in the Nunga area who burn the vleis annually for the specific purpose of attracting the species onto them and making their hunting easier. They will, however, eat grass even when dry.

Breeding

Suckling calves were taken in January, February and April, and small calves seen in October (Kwando) and November (Moremi Game Reserve).

Pregnant females with single foetuses were taken in April, June, August, September and October; large foetuses (16 lb., 24 lb.) in October.

The indications here are that the young are dropped during the early part of the warm wet season of the year from about November to December.

Ansell (1960) gives the calving time in Zambia as 'June to September, mainly July to August'.

Sizes and Weights

MALES					
TL	$\bar{X} = 2195$;	$N = 7$;	Obs. range	2100-	2300
T	$\bar{X} = 451$;	$N = 7$;	„ „	380-	535
Hf c/u	$\bar{X} = 540$;	$N = 6$;	„ „	505-	565
E	$\bar{X} = 199$;	$N = 7$;	„ „	195-	205
Weight	$\bar{X} = 313$ lb.;	$N = 6$;	„ „	275-	340 lb.
FEMALES					
TL	$\bar{X} = 2065$;	$N = 6$;	Obs. range	2000-	2150
T	$\bar{X} = 442$;	$N = 6$;	„ „	402-	493
Hf c/u	$\bar{X} = 517$;	$N = 7$;	„ „	510-	525
E	$\bar{X} = 187$;	$N = 6$;	„ „	182-	191
Weight	$\bar{X} = 287$ lb.;	$N = 5$;	„ „	258-	317 lb.

Order LAGOMORPHA

Family LEPORIDAE

Key after Meester (1964).

1. Mesopterygoid region narrow; space immediately behind palate much narrower than least longitudinal diameter of palatal bridge (palatal bridge averages more than 140 per cent 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 per cent, and usually less than 120 per cent of mesopterygoid width) . . . . . *Lepus*

Genus PRONOLAGUS Lyon, 1904

Pronolagus crassicaudatus

Tlholo Red Rock Hare

P. crassicaudatus (I. Geoffroy, 1832)

Taxonomic Notes

Petter (1967) differentiates between *P. crassicaudatus* and *P. randensis* as follows:

Very small bullae: their length less than 1/10 of the length of the cranium . . . *P. crassicaudatus*

Length of bullae more than 1/10 of the length of the cranium . . . . . *P. randensis*

Unfortunately there are only three specimens available from Botswana one of which is a juvenile (BP

891). The cranial and bullae measurements of the two adults are as follows:

	Skull Condylo-incisive Length	Bullae		
		Length	Breadth	Height
BP 1084	948	103	59	78
BP 1510	905	98	53	80

on this basis they correspond to Petter's definition of *P. randensis*.

Lundholm (1955), however, regards *randensis* as a synonym of *crassicaudatus* showing that the length of the bullae 'intergrades evenly from south to north', to which species the Botswana material is consigned.

On the basis of the meagre material available BP 1501 from Dikgomodikae, which is overall rufous, with pink underfur, the tips of the hairs on the back rufous brown, soles of the feet brown, the tail brown, suffused overall with dark brown, corresponds reasonably well with the description of *P. r. powelli* Roberts, originally described from the Rustenburg district, western Transvaal. The tail on the other hand does not have the 'distal third black', in its brown colour more closely approaching *P. r. makapani* Roberts of the northern Transvaal.

The two species from Shoshong and Mabate are much lighter in colour than the specimen from Dikgomodikae, the underfur light buffy, the tips on the back buffy, the soles of the feet light brown, the tail dark-tipped. These are more like material from the western parts of Rhodesia than any described from the Transvaal.

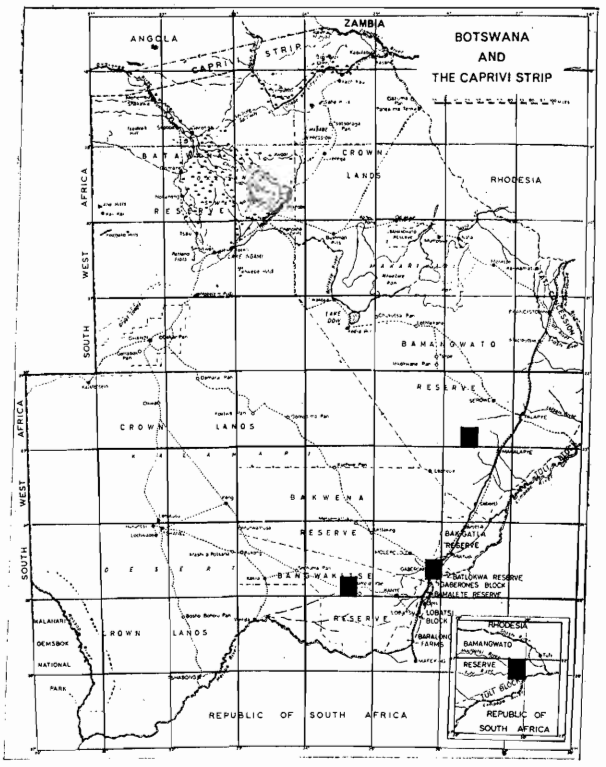
Until such time as more adequate material is available no subspecific differentiation can be applied to the Botswana material. Roberts (1935) places a Gaborone specimen in *P. r. randensis* Jameson.

Distribution

So far only shown to occur in the eastern extension of the Bamangwato Reserve; the Shoshong area; Gabane Hills, Gaborone and west to Dikgomodikae, within this range closely confined to areas of suitable habitat. There are unconfirmed reports of red rock hares from the Tsodilo Hills but no material is available and the report requires confirmation.

Habitat

Closely confined to areas of rocky hills and krantzes with some vegetational cover of grasses and shrubs,



normally never moving from their immediate vicinity.

The type of geological formation does not appear to matter for they occur on granite kopjes (Matopos); sandstone krantzes (Mabate) and basalt (Shoshong). The population at Dikgomodikae is isolated from the next nearest rocky area by at least 10-14 miles of flat scrub country, from which it would appear that under stress they must be capable of crossing this type of country in order to populate isolated habitats such as this.

Habits

Terrestrial, nocturnal, occur singly or in pairs. In some areas very common (Matopos, Rhodesia), but in all the areas where they have been taken in Botswana, apparently sparse, and few have been seen. Rest up during daylight hours in the shelter of rock crevices or under rocks well out of sight, emerging just before sundown, the Mabate specimen was collected after the sun had set while there was still just enough light to see it. The other two specimens were taken after dark with the aid of a dazzling light, in the beam of which the eyes can just be seen as they shine, albeit very dully.

All the Botswana material was taken in rocky habitat but will descend from this to feed at the bases of the kopjes on grassland or in scrub.

They are wary and alert and, if disturbed, will disappear in a remarkable way round rocks and make off with this cover between them and the observer.

Defecate in middens on the kopjes, these sometimes extensive (Mabate, about one metre in diameter) but scattered droppings also found. These droppings are characteristically round, rather flattened on the two opposite sides.

Food

Grazers.

Breeding

No information from Botswana. Shortridge (1934) records a female from South West Africa with two foetuses in January.

Sizes and Weights

MALES

No.		*TL*	*T*	*Hf c/u*	*E*	*Weight*
BP 1510	Dikgomodikae	530	115	95	85	5 lb.
BP 891	Mabate	485	80	92	81	4 lb. 2 oz.

FEMALES

BP 1084	Shoshong	548	99	84	89	5 lb. 4 oz.

Genus LEPUS Linnaeus, 1758

1. Larger, greatest length skull 80-96; gular collar reddish-buffy . . . . . *L. saxatilis*
   Smaller, greatest length skull 73-88; gular collar pale buffy white or only faintly tinged buffy . . . . . *L. capensis*

While in Botswana the two species are separable on the colour of gular collar, this does not necessarily hold for material for other territories. In the Makgadikgadi area the very pale grey colour of the upperparts of *L. capensis* distinguishes them from *L. saxatilis*. In the southern and south-western Kalahari the yellow band which separates the grey colour of the flanks from the white underparts in *L. capensis* distinguishes them from *L. saxatilis*.

Although it appears that, in series, *L. saxatilis* is the larger of the two species, there is considerable overlap in the measurements and weights.

A comparison of the habitat requirements of the two species reveals some interesting differences.

Shortridge (1934) states that *L. saxatilis* is 'partial to rocky or stony ground although its extensive range covers every other type of country—open sandveld, bushveld or forest—is much attracted by cultivation —concentrating in the vicinity of growing crops and garden lands'. Most of the other authorities quoted by Shortridge indicate an association with stony ground, kopjes and scrub bush.

Dealing with *L. capensis*, Shortridge (1934) states that it is 'essentially a sandveld species favouring arid and waterless plains—avoiding hills and the narrow stony valleys between hills'. The authorities he quotes all suggest association with open plains, Roberts stating that 'it is more partial to the open flats though it also occurs in the scrub side by side with the "Kolhaas" ' (*L. saxatilis*).

On this basis an analysis of the information on habitat recorded for a series of 265 *L. saxatilis* and 66 *L. capensis* from Botswana is interesting. The habitat in which these were taken is divided broadly into three categories:

1. *Cultivation:* This includes areas presently under crops, fallowed or derelict. In general once the crop had reached a height of about 20 to 30 cm it was not collected in. *L. saxatilis* in particular will utilize such lands even shortly after cultivation presumably in search of freshly sprouting grass and other food plants or the exposed succulent underground stems of predominantly subterranean grasses.

2. *Scrub or woodland:* The commonest scrub type is *Acacia*, but the category also includes secondary mopane, *Terminalia* or *Terminalia-Bauhinia* all of which carry a grass cover of varying types and densities. Woodland includes *Acacia*, *Brachystegia*, and *Baikiaea*, also with a grass cover.

In the case of *L. capensis* no specimen was taken in woodland and the category here is confined to scrub Mopane or *Acacia*.

3. *Open Grassland:* Includes floodplain grassland, which covers huge areas round the fringes of the Okavango swamp and in particular the Makgadikgadi Pan; pure grassland or the grassland round the fringes of pans, an association so characteristic of the pans in the Kalahari, or on the surface of pans where there is a grass cover.

The percentage occurrence of *L. saxatilis* and *L. capensis* in the three categories of habitat is as follows:

L. saxatilis	$N = 265$	*No.*	*Percentage Occurrence*
Cultivation		14	5·2
Scrub or woodland		214	80·8
Open grassland		37	14·0
		265	100·0

L. capensis	$N = 66$	*No.*	*Percentage Occurrence*
Cultivation		1	1·5
Scrub		10	15·1
Open grassland		55	83·4
		66	100·0

The above figures demonstrate a wide difference in the habitat requirements of the two species, *L. saxatilis* in the main being confined to scrub, *L. capensis* to open grassland.

In the case of the exceptions to this general rule, where 14% (37) of *L. saxatilis* taken were collected in open grassland and 15·1% (10) of *L. capensis* in scrub, investigation of the circumstances is revealing. Of the 37 specimens of *L. saxatilis* taken in open grassland 27 were taken on grassland fringing pans at Nata, Chukutsa Pans, Lephepe, Tshelenyane Pan, 25 miles east of Tshane, Mabuasehube Pan, Taketekwane Pan and Motsobonye Pan. Here the scrub associations fringe the grassland and the scrub hare wanders out at night onto the grassland in search of palatable species. During the day they lie up in adjacent scrub areas where there is an ample cover of longer grass or scrub bush and not in the open grassland.

Five were taken on the cleared ground of the aerodromes at Nokaneng, Kasane and Shakowe where again the above remarks apply.

Five were taken in vlei grassland but in two of these cases the vleis had been burnt and fresh green grass was sprouting which cannot but be attractive to the species drawing them out to feed from the surrounding scrub. In none of these cases were the vleis so extensive that their wanderings would take them far from their normal habitat in the fringing scrub.

At Nata (Makgadikgadi) the fringing scrub thins out gradually to the vast open grassland of the pans and, although *L. saxatilis* has been taken on this open grassland, they are never far from the fringing scrub and absent altogether a half-mile from it, where they are replaced on the open grassland by *L. capensis*.

At Nata the reverse is the case with *L. capensis* where they have been taken in the fringing scrub but only where it is still thin and open, being replaced by *L. saxatilis* where the scrub thickens up to a solid association.

5·2% of the specimens of *L. saxatilis* taken were in cultivation. This figure is low, in view of its obvious association with this type of habitat in other parts of Africa, e.g. Rhodesia, but perhaps this is explained by the fact that the areas of cultivation in Botswana are relatively small as compared with the more intensive agricultural development of Rhodesia.

As far as *L. capensis* is concerned, no specimen was taken in woodland, although ten or 15·1% were taken in scrub of various types.

Of these the six taken at Nata, Mampse and Tsokotsa Pans were in the fringing scrub of vast open grassland areas, the remarks made above applying in these cases where the occurrence is in the fringe areas and not in the closed scrub association. The two taken at Xade Pan and two at Mopipi were in areas of scrub-fringing pans, and the single specimen in cultivation was taken in a fallowed area on the fringe of Sekhoma Pan adjacent to the extensive area of open short grass fringing the pan.

During the day *L. capensis* was frequently flushed from wide open grassland areas, where they lie tight in their forms with the barest of cover, their light colour blending so well with the ground that they remain extremely well hidden. They were never flushed from closed scrub associations.

Lepus saxatilis

mMutla Scrub Hare

L. saxatilis F. Cuvier, 1823

Taxonomic Notes

Two species of *Lepus* occur in Botswana, the scrub hare, a large species predominantly confined to scrub, and the Cape hare which is smaller and predominantly confined to open grassland.

Petter (1967) in his key to the species of *Lepus* defines *L. saxatilis* F. Cuvier, the species used by Roberts (1951) and Allen (1954) for the scrub hare of southern Africa (which Ellerman *et al.* (1953) considers a synonym of *L. europaeus* Pallas) as follows: 'Large size; head and body length more than 500 mm; ear length more than 130 mm; length of cranium more than 92 mm.'

In thus defining the species Petter restricts it to 'the mountainous regions of southern South Africa'.

Two other species, *L. capensis* and *L. crawshayi*, Petter states to be of smaller size.

As far as the length of the head and body is concerned, all the Botswana material is smaller than the lower limit of 500 mm set by Petter for *L. saxatilis;* in a series of 216 specimens, irrespective of sex, it averages 432 mm.

In respect of the length of the ear, adult Botswana material has smaller ears than the 130 mm stipulated by Petter as the minimum for *L. saxatilis* as follows:

Length of ear in a series of scrub hares, *Lepus sexatilis*, from Botswana, irrespective of sex:

E $\bar{X} = 105$; $N = 216$; Obs. range 100-126.

There does not appear to be any appreciable sexual dimorphism as far as this character is concerned as is shown by the following figures:

Length of ear in a series of male and female scrub hares, *L. saxatilis*, from Botswana:

Males E $\bar{X} = 105$; N = 109; Obs. range 100-126.
Females E $\bar{X} = 106$; $N = 123$; Obs. range 100-118.

In the Botswana series there are only two specimens in which the ear length is over 120, both from Khuis, Molopo River, at 122 and 126.

Taking the average ear length from a series of localities from Khuis northwards and north-eastwards, there is a noticeable reduction from Khuis at 124 to the north-western Okavango at 108 and the extreme north-east at Kasane at 103 as will be seen in the following table.

Average ear lengths in a series of the scrub hare, *L. saxatilis*, from various localities in Botswana:

Khuis	E $\bar{X} = 124$;	$N = 2$;	Obs. range		123-126
Tshane	E $\bar{X} = 111$;	$N = 6$;	„	„	102-118
W. Okavango	E $\bar{X} = 108$;	$N = 27$;	„	„	100-120
Dikgomodikae	E $\bar{X} = 106$;	$N = 8$;	„	„	97-116
Lephepe-Lechana	E $\bar{X} = 104$;	$N = 35$;	„	„	96-115
Rakops-Tshokotsa	E $\bar{X} = 104$;	$N = 13$;	„	„	94-112
Lake Ngami	E $\bar{X} = 103$;	$N = 12$;	„	„	96-111
Maun-Shorobe	E $\bar{X} = 103$;	$N = 23$;	„	„	95-113
Tamafupi-Nunga	E $\bar{X} = 103$;	$N = 10$;	„	„	95-106
Francistown-Tuli Circle	E $\bar{X} = 102$;	$N = 36$;	„	„	95-111
Tsaugara	E $\bar{X} = 102$;	$N = 4$;	„	„	98-101
Kasane	E $\bar{X} = 103$;	$N = 7$;	„	„	100-105
Nata	E $\bar{X} = 101$;	$N = 10$;	„	„	95-108

A series from Mashonaland, Rhodesia, was generally smaller averaging as follows:
E $\bar{X} = 101$; $N = 37$; Obs. range 95-110.

While there are only a few published records of the length of the ear in the scrub hare, *L. saxatilis*, from its range in the Republic of South Africa, such as are available show a tendency for ear length to decrease from south to north as follows:

Length of ear in the scrub hare, *L. saxatilis* (notch to tip), irrespective of sex in the Republic of South Africa and South West Africa.

CAPE PROVINCE (Roberts, 1951)
E $\bar{X} = 143$; $N = 5$; Obs. range 132-153
NORTH-WESTERN CAPE PROVINCE AND CENTRAL SOUTH WEST AFRICA
E $\bar{X} = 140$; $N = 4$; Obs. range 137-144
ORANGE FREE STATE
E $\bar{X} = 110$; $N = 3$; Obs. range 100-120
TRANSVAAL (Roberts, 1951)
E $\bar{X} = 112$; $N = 5$; Obs. range 110-118
NATAL (Roberts, 1951)
E $\bar{X} = 102$; $N = 13$; Obs. range 96-110
GROOTFONTEIN DISTRICT, S.W.A. (Shortridge, 1934)
E $\bar{X} = 105$; $N = 25$; Obs. range 101-108
NORTHERN SOUTH WEST AFRICA (Shortridge, 1934)
E $\bar{X} = 105$; $N = 24$; Obs. range 92-118

Although in some cases the series is small, the figures show a reduction in ear length from the Cape Province northwards and north-eastwards. There is a tendency for longer ears in the more arid northern-central and north-west than in the north-eastern parts of its range, which is matched in Botswana, in that the western Okavango material is similarly longer eared (108) in series than the north-eastern (103).

Examination of the situation in further detail reveals that scrub hares with ears in excess of 130 mm, stipulated by Petter as the minimum for *L. saxatilis*, according to the figures given in Roberts (1951), occur from the coastal belt of the Cape Province, Bredasdorp (135), to the upper Karroo, Murraysburg (150), Upington (137) north beyond the Orange River to Hakscheen Pan (137), just west of the south-western extremity of Botswana, and to Kobos, South West Africa (144). Further north in the eastern central parts of South West Africa the length of ear drops to 120 at Ombu and near Fransfontein. Further north still in Ovamboland it drops to 105, as it does in the north-east to 105 in the Grootfontein area, an average of 27 specimens from the adjacent north-western areas of Botswana averaging 108.

Much further east in Mashonaland, Rhodesia, in a sample of 37, the ear length has dropped to 101.

In the eastern part of the Karroo, in the Republic of South Africa, there is a very sharp drop in ear

length over a distance of approximately 130 km between Murraysburg (150) and Middelburg (127), just as there is in the 180 km which separates Hakscheen Pan (137) from Khuis (124) in Botswana.

In the case of the Murraysburg-Middelburg situation, there is a bare 60 m difference in altitude between them and the nature of the terrain is very similar in the two localities, as it is indeed in the case of Hakscheen Pan and Khuis. Further material from these two areas and a closer examination of the ecological conditions in the two localities might assist in resolving why there is such a sudden drop in ear length within such a relatively short distance.

Taking the average total length of the skulls by regions, it is noticeable that those from the south-western Kalahari in the vicinity of Khuis and Tshane are larger than any of the remainder, TNL 2653 from Khuis being outstandingly the largest skull at 95·6. These are the regions from which the average ear length is the largest.

Just as in the case of the length of ear the total length of the skulls falls off north-westwards, the western Okavango material, which has large ears (108) has large skulls (89). Here in some cases the series are small and there are some anomalies, but, taking the extremes, from Khuis (93·3) to the Francistown, Tati Concession, (87·5), there is a distinct drop-off in the total length of the skull.

As far as the ear is concerned it was shown that between Hakscheen Pan (*L. s. auranti*) and Khuis there was a sharp drop in length from 137 to 124. Correspondingly there is a drop in the total length of the skull from 100·2 (Roberts, 1951, *L. s. auranti*) to the largest skull from Khuis 95·6, or the average of 93·3. This drop in length is considerably larger than between the total length of the nominate *L. s. saxatilis* from the Western Province of South Africa at 101·1 and *L. s. auranti* at 100·2.

Average total length of skulls (incisors to lamboid crest):

REPUBLIC OF SOUTH AFRICA

Upper Karroo (*L. s. megalotis*)
TL skull $\bar{X} = 103{\cdot}8$; $N = 3$; Obs. range 102-107
South-western Cape Province (*L. s. saxatilis*)
TL skull $\bar{X} = 101{\cdot}1$; $N = 6$; Obs. range 98·5-103
North-western Cape Province to Central S.W. Africa (*L. s. auranti*)
TL skull $\bar{X} = 100{\cdot}2$; $N = 4$; Obs. range 96·5-103
Transvaal (*L. s. subrufus*)
TL skull $\bar{X} = 92{\cdot}7$; $N = 8$; Obs. range 91·8-94
Natal (*L. s. zuluensis*)
TL skull $\bar{X} = 92{\cdot}0$; $N = 13$; Obs. range 89·5-95·5

BOTSWANA

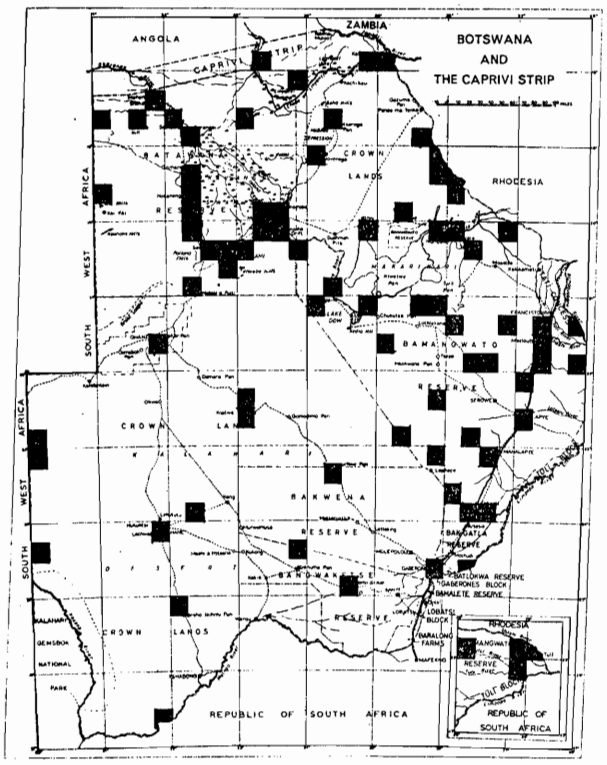
Khuis	$\bar{X} = 93{\cdot}3$;	$N = 2$;	Obs. range	90·9-95·6
Tshane	$\bar{X} = 90{\cdot}7$;	$N = 2$;	„ „	88·8-92·5
W. Okavango	$\bar{X} = 89{\cdot}1$;	$N = 13$;	„ „	84·0-92·3
Dikgomo-dikae	$\bar{X} = 87{\cdot}7$;	$N = 5$;	„ „	86·0-90·2
Lephepe-Lechana	$\bar{X} = 88{\cdot}2$;	$N = 15$;	„ „	86·2-93·7
Rakops-Tshokotsa	$\bar{X} = 86{\cdot}6$;	$N = 8$;	„ „	85·4-90·7
Lake Ngami	$\bar{X} = 88{\cdot}3$;	$N = 8$;	„ „	84·0-90·6
Maun Shorobe	$\bar{X} = 87{\cdot}5$;	$N = 10$;	„ „	84·5-91·0
Tamafupi-Nunga	$\bar{X} = 87{\cdot}4$;	$N = 15$;	„ „	81·4-91·0
Francistown-Tuli Circle	$\bar{X} = 87{\cdot}5$;	$N = 15$;	„ „	80·2-93·3
Tsaugara	$\bar{X} = 85{\cdot}9$;	$N = 4$;	„ „	86·0-86·0
Kasane	$\bar{X} = 88{\cdot}3$;	$N = 3$;	„ „	86·5-91·0
Nata	$\bar{X} = 88{\cdot}1$;	$N = 7$;	„ „	85·1-91·2

It is interesting to note that there is a similar sharp drop in the total length of the skull between Murraysburg (107) and Middelburg (99) (Roberts, 1951).

Roberts (1951) considers all the larger hares, occurring in southern Africa, to be subspecies of *L. saxatilis* F. Cuvier originally described from the 'Cape of Good Hope'. On the above basis there is some evidence of a cline in ear size and total length of skull, the largest occurring in the Cape Province and declining northwards and north-eastwards. Until, however, further material is available from the northern parts of the Cape Province and the two critical areas dealt with above, where there appears to be a break in the cline, no final conclusion can be reached in the matter.

In the meantime it is proposed to follow Roberts (1951) and consider the larger of the two species found in Botswana as *L. saxatilis*.

A number of subspecies of *L. saxatilis* have been described all of which on geographical grounds might be expected to occur or have been described from localities in Botswana. Among these are *L. s. herero* Thomas; *L. s. damarensis* Roberts, *L. s. bechuanae* Roberts; *L. s. ngamiensis* Roberts and *L. s. chobiensis* Roberts. Some of these are erected on minutae and it is doubted if they will stand the test of time. The colour of the pelage which has so largely been used in distinguishing these subspecies is very variable. The amount of black tipping of the hair of the upper-parts, which plays a large part in deciding as to whether a subspecies is light or dark, varies greatly even in series from the same area taken at the same time. Progress of the moult no doubt plays a part in



this colour change and requires study before these varying colours and markings can be properly evaluated as taxonomic characters.

Distribution

Widely distributed throughout the territory wherever there is suitable habitat of scrub or open woodland with a grass cover, generally absent from areas of open short grass.

Habits

Nocturnal, normally emerging to feed at sundown. Apparently sensitive to weather conditions being more in evidence on warm evenings than on cold. Observed feeding during the morning in overcast weather conditions (Madinare).

Lie up in 'forms' during daylight hours under scrub bush, usually where there is some grass to afford shelter and concealment. Returns to the same form at least over a period of several days. The forms are characteristic in shape, broader at either end, where the ground is flattened by the broader hind and fore portions of the individual. When lying up folds the ears back flat against the body, the head pulled in. In this position the drab colour of the body blends very effectively with the background affording effective concealment. Lie up very tight and will only flush with difficulty when closely approached.

Normally occur singly although, when the female is in oestrus, she may be accompanied by a male, sometimes more than one male (Nata).

The young are born fully haired and active and, as soon as weaned, break away on their own and do not remain in company with the parent.

Normally silent will squeal very loudly if wounded or caught alive when they will kick very viciously with the back legs and bite. Normally rely on their speed and jinking to avoid predators.

A high proportion of specimens lack the last few segments of the vertebrae of the tail, the ears nicked, indicating that interspecific fighting may be more common than observed.

Breeding

Distribution of non-gravid, gravid and females with breeding signs by months in a sample of 121 females

	J	F	M	A	M	J	J	A	S	O	N	D
Total	9	20	2	27	11	4	7	3	–	21	13	4
Non-gravid	1	5	1	10	7	1	2	1	–	8	1	–
Lactating	1	2	–	5	1	–	–	–	–	3	1	2
Signs*	–	–	–	4	–	1	–	–	–	–	–	1
Gravid	7	13	1	8	3	2	5	2	–	10	10	1

*Signs: This category is provided to cover reproductive tracts with swellings where no macroscopic foetus could be found or where the associated vascular system was abnormally developed, the walls of the uterus swollen and distended indicating that the young had recently been dropped, yet no signs of lactation were recorded on the forms.

Taking the sample of 121 females, gravid females have been taken in all months of the year except September, from which month no material at all was available. In most of these months, except September, lactating females or females, in which the swollen muscular uterus and the increased vascular condition indicates that young have been dropped sometime recently, have also been taken. These figures suggest that *L. saxatilis* breeds throughout the year.

Breeding apparently takes place even during periods of adverse conditions, for there are records of gravid females in April 1963; January, February and November 1964, and January, February, March, April, July and October 1965, all of which are dated during and at the end of the four years' drought when the country was in a serious plight.

Of a sample of 59, where there are details of the number and positioning of the foetuses in the uterine horns, there were six examples of triplets, 23 of twins and 30 single foetuses.

Two sets of triplets were taken in January 1965 before the break of the four year's drought, the remaining four after the break of this drought, three in February 1966, and one in April 1965. Reproduction certainly continues even under adverse conditions, although it was noticeable that of a series of seven adult females from Lechana, an area in the eastern section that was particularly heavily hit by the drought and which was almost totally devoid of any vestige of grass cover, only one was gravid, with one foetus.

There are 42 records out of the 131 prior to October 1965, when the drought broke, to support that breeding takes place even under the adverse conditions.

Implantation is apparently irregular as shown by the following table, there being, however, a tendency to implant 1L:

2R	1R	1R1L	1L	2L	2R1L	1R2L
6	6	11	20	5	5	1

The average number of foetuses is as follows:

Foetuses

Number $\bar{X} = 1{\cdot}6$; $N = 62$; Obs. range 1-3.

The smallest size of a gravid female *L. saxatilis* was a specimen from Chukutsa Pans, with two foetuses, at a size of TL 512, T 100, Hf c/u 120, E 102, and a weight of 3 lb. 9 oz.

Sizes and Weights

IRRESPECTIVE OF SEX			
TL	$\bar{X} = 531$;	$N = 227$;	Obs. range 480-590
T	$\bar{X} = 99$;	$N = 209$;	„ „ 80-121
Hf c/u	$\bar{X} = 114$;	$N = 253$;	„ „ 101-128
E	$\bar{X} = 105$;	$N = 216$;	„ „ 100-118
Weight	$\bar{X} = 4$ lb. 5 oz.	$N = 195$;	„ „ 4 lb.-7 lb.
Skull TL	$\bar{X} = 87{\cdot}8$;	$N = 151$;	„ „ 80·0-95·6
MALES			
Hf c/u	$\bar{X} = 113$;	$N = 119$;	Obs. range 104-128
E	$\bar{X} = 105$;	$N = 109$;	„ „ 100-126
FEMALES			
Hf c/u	$\bar{X} = 115$;	$N = 131$;	Obs. range 104-128
E	$\bar{X} = 106$;	$N = 123$;	„ „ 100-118

Lepus capensis Matshwaratsela Cape Hare

L. c. kalaharicus Dollman, 1910

L. c. langi Roberts, 1932

1. Upperparts pale greyish-buff faintly tinged with buff; a pale yellow area separating the white underparts from the greyish flanks; nape of neck, behind ears, pale buffy-white . *L. c. kalaharicus*
   Upperparts pale greyish-white with no buffy tinge; no pale yellow or only a faint tinge separating the white underparts from the greyish-white flanks; nape of neck, behind the ears, pale greyish-white . . . . . *L. c. langi*

Taxonomic Notes

This second and smaller species the Cape hare, *L. capensis*, differs markedly from *L. saxatilis* in its habitat requirements (*see* a comparison of the habitat requirements of *L. saxatilis* and *L. capensis*), and is clearly separable on morphological grounds from it. *L. saxalitis* has a more sombre speckled dark grey pelage with a distinct rufous buffy gular collar, *L. capensis*, on the other hand, is lighter in colour, less speckled, the gular collar lacking the rufous buff, being greyer and more like the general colour of the upperparts. Comparison of the average measurements, weights and the total length of skull of a series of specimens compared with those of *L. saxatilis* (*see* Sizes and Weights, *L. saxatilis* and *L. capensis*) reflects the smaller size of this species, except in respect of the length of the ear, which is the same in the two species.

L. capensis occurs in two distinct colour forms, those from the Makgadikgadi and surrounding areas, an overall light grey, with pure white underparts and a pale grey gular collar which entirely lacks the reddish-buffy of *L. saxatilis*. These specimens conform to the description of *L. c. langi*, Roberts.

The occurrence of this very pale subspecies from the Makgadikgadi, with its white calcaerous soils, is yet another example of the occurrence, in this unique area, of a pale subspecies particularly associated with it, a feature of a number of other mammals as well as birds.

The second, very differently coloured subspecies, occurs in the southern and south-western Kalahari. Here the flanks are lighter in colour than the upperparts, a yellow band separating the colour of the upperparts from the white underparts. These specimens conform to the description of *L. c. kalaharicus*, Dollman. The relationship of this subspecies, to others which have been described, with rather similar

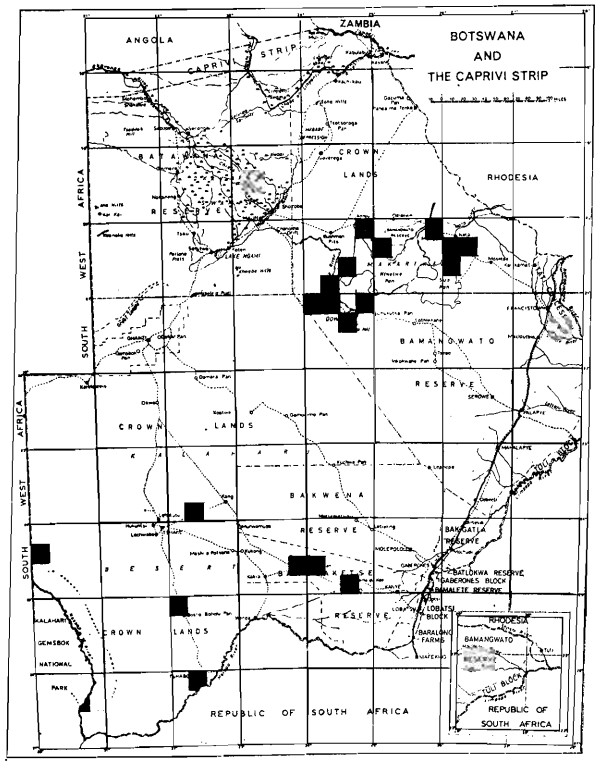
features, has not been studied, cf. *L. c. ochropus*, Wagner; *L. c. vernayi*, Roberts, etc.

The Makgadikgadi population is isolated from the population in the south by an area of country some 220 miles in breadth from which, so far, no *L. capensis* have been taken in spite of diligent search in apparently suitable habitat.

Distribution

Discontinuously distributed in two widely separated populations, the northernmost, *L. c. langi* Roberts, throughout the open grasslands fringing the Makgadikgadi, extending south-westwards to Lake Dow and Rakops; the southern, *L. c. kalaharicus* Dollman, throughout the southern and south-western Kalahari as far north as 23°45′ S., between Tshane and Kang, and from the South West African border east to Dikgomodikae, wherever there is similar habitat, which, in this southern areas, is mainly found on the fringe of pans.

The Vernay Lang Expedition of 1930 (Roberts, 1935) did not encounter this species in its transect of the Kalahari from Molepolole through to Ghanzi, although *L. saxatilis* was taken at Kaotwe Pan in the Central Kalahari Game Reserve, nor have they been encountered in the intermediate area. Silberbauer (1965) recorded both species from the Central Kalahari Game Reserve, but no specimens were collected to check if indeed both species were present. It appears, therefore, that there is no continuity of distribution between these southern and northern populations.



Habitat

(*See* comparison of the habitat requirements of *L. saxatilis* and *L. capensis*, under Habitat, *L. saxatilis*.)

Habits

Predominantly nocturnal, but observed at Rakops feeding during the day in overcast weather. Lie up in forms during daylight hours similar to, but in much more exposed situations, than *L. saxatilis*, often right out in the open with no overhead cover, from which they are just as difficult to flush.

Normally occur singly but, when the female is in oestrus, she may be accompanied by more than one male. At Rakops a female was being followed by three males (two collected) during daylight hours in overcast weather.

The very light-coloured subspecies found round the Makgadikgadi Pan and associated open grasslands blends well with the white calcareous soils of the area and, lying up in the form with the ears folded back, can be passed by at a few feet. When flushed and under stress freely takes to antbear and spring hare burrows for shelter, behaviour never observed in *L. saxatilis*.

As with *L. saxatilis* the young when weaned appear to disperse and do not remain with the parent.

Breeding

Distribution of non-gravid, gravid and females with breeding signs by months in a sample of 25 females

	J	F	M	A	M	J	J	A	S	O	N	D
Total	3	3	–	–	1	3	1	3	–	–	11	–
Non-gravid	–	1	–	–	–	–	–	3	–	–	2	–
Lactating	–	1	–	–	–	–	–	–	–	–	–	–
Signs*	–	–	–	–	–	–	–	–	–	–	2	–
No data	3	–	1	–	–	–	1	–	–	–	–	–
Gravid	–	1	–	–	–	3	–	–	–	–	7	–

* Signs: *See* note under *L. saxatilis*, Breeding.

Although the sample available is small there are indications of a wide breeding season. While the largest number of gravid or lactating females, or those whose uteri show signs of having already produced young, were taken during the warm wet months of the year, November and February, gravid females were also taken in June, in the middle of the driest, coldest time of the year.

It is interesting that this species was breeding in November 1964, the last year of the four-year drought, when the country generally was in its worst possible condition, nine out of the 11 specimens taken either being gravid or showing signs of having dropped young recently.

Of the sample of 11 gravid females, four carried one foetus, seven carried two, and two carried three foetuses. It is somewhat unusual to find three foetuses to a female, two being the more usual number. Both the females with triplets were taken in February 1967, after the country had recovered from the drought and was lush and green after the good rains of 1966 and 1967.

The average number of foetuses in the sample of 11 gravid females and two whose reproductive tract showed signs that the young had been dropped was as follows:

Foetuses

Number $\bar{X} = 1{\cdot}9$; $N = 13$; Obs. range 1-3.

Implantation is irregular, an analysis of a sample of 13 reproductive tracts providing the following data:

Implantation	1L	1R	1L	2R	1L	1R	2R	3R
No.	3		3		2	1	3	1

Sizes and Weights

Whole Botswana irrespective of sex

TL	$\bar{X} = 478$;	$N = 55$;	Obs. range 440-550
T	$\bar{X} = 88$;	$N = 48$;	„ „ 70-114
Hf c/u	$\bar{X} = 109$;	$N = 59$;	„ „ 95-121
E	$\bar{X} = 105$;	$N = 46$;	„ „ 95-120
Weight	$\bar{X} = 3$ lb. 8 oz.;	$N = 46$;	„ „ 3 lb.- 5 lb. 4 oz.

Makarikari (L. c. langi)

MALES

TL	$\bar{X} = 483$;	$N = 21$;	Obs. range 460-540
T	$\bar{X} = 87$;	$N = 21$;	„ „ 70-107
Hf c/u	$\bar{X} = 109$;	$N = 26$;	„ „ 95-120
E	$\bar{X} = 105$;	$N = 24$;	„ „ 99-120
Weight	$\bar{X} = 3$ lb. 8 oz.;	$N = 23$;	„ „ 3 lb.- 4 lb. 1 oz.

FEMALES

TL	$\bar{X} = 471$;	$N = 19$;	Obs. range 440-515
T	$\bar{X} = 90$;	$N = 14$;	„ „ 80-110
Hf c/u	$\bar{X} = 107$;	$N = 15$;	„ „ 101-112
E	$\bar{X} = 104$;	$N = 15$;	„ „ 95-110
Weight	$\bar{X} = 3$ lb. 12 oz.;	$N = 15$;	„ „ 3 lb. 3 oz.- 5 lb. 2 oz.

South and south-west Kalahari (L. c. kalaharicus)

MALES

TL	$\bar{X} = 491$;	$N = 10$;	Obs. range 441-535
T	$\bar{X} = 98$;	$N = 8$;	„ „ 88-114
Hf c/u	$\bar{X} = 116$;	$N = 8$;	„ „ 106-121
E	$\bar{X} = 107$;	$N = 10$;	„ „ 103-111
Weight	$\bar{X} = 3$ lb. 8 oz.;	$N = 8$;	„ „ 3 lb.-4 lb.

FEMALES

TL	$\bar{X} = 519$;	$N = 8$;	Obs. range 483-540
T	$\bar{X} = 99$;	$N = 8$;	„ „ 86-112
Hf c/u	$\bar{X} = 117$;	$N = 9$;	„ „ 114-125
E	$\bar{X} = 106$;	$N = 9$;	„ „ 100-118
Weight	$\bar{X} = 4$ lb. 5 oz.;	$N = 8$;	„ „ 3 lb.- 5 lb. 4 oz.

Order RODETIA

1. External form much specialized for fossorial life; tail reduced, small eyes, short ears, mole-like in appearance . . . Fam. BATHYERGIDAE
   External form not specialized for fossorial life 2
2. Body covered with long quills, head and body length over 500 mm . Fam. HYSTRICIDAE
   Not combining these characters 3
3. Bipedal, highly specialized for saltatorial life . . . Fam. 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 . . Fam. MUSCARDINIDAE
   No interorbital constriction Fam. SCIURIDAE
6. Size large, head and body length over 300 mm; incisors heavily grooved . . . . Fam. THRYONOMYIDAE
   Not combining these characters Fams. CRICETIDAE and MURIDAE

Family BATHYERGIDAE

1. Size larger; condylo-basal length 32-44 mm (usually above 40 mm in males, above 38 mm in females); colour dark, blackish-grey sometimes tinged with brown . . . . . *C. damarensis*
   Size smaller; condylo-basal length 26-40 mm (usually below 40 mm in males, below 38 mm in females); colour light, light seal-brown or silvery-fawn . . . . . *C. hottentotus*

Genus CRYPTOMYS Gray, 1864

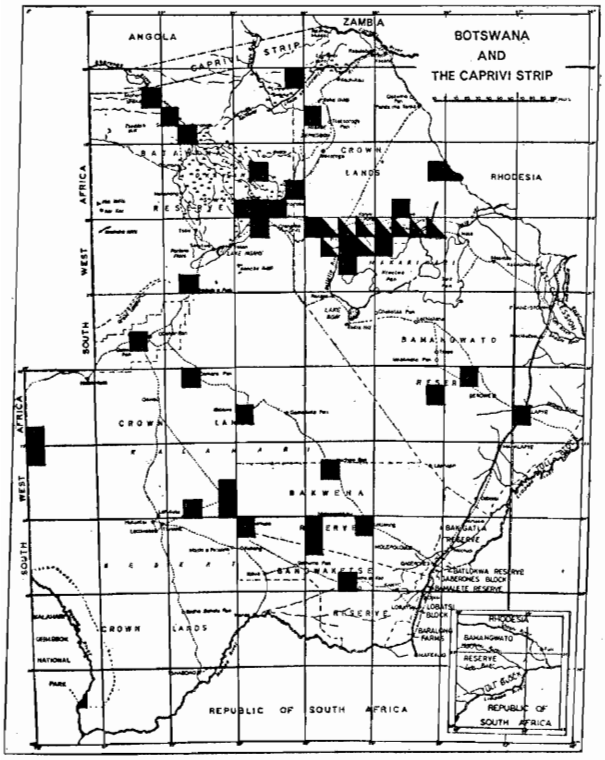
Cryptomys damarensis

Damara Mole-rat

C. damarensis (Ogilby, 1838)

Distribution

Widely distributed throughout in suitable habitat, except where they are replaced in the eastern sector by *C. hottentotus*, which occurs in the Tati Concession west to some 45 miles south-west of Francistown and narrowly along the Rhodesian and Transvaal borders south to Gaborone. Locally absent, perhaps through the lack of suitable food (de Graaff, 1968) or where the ground is too hard for burrowing.



Habitat

Sandy soil or sandy alluvium, particularly associated with Kalahari sand.

Habits

Communal, throws up mounds at intervals along the burrows. Active in burrowing and throwing up mounds, after the onset of the first rains about October and continuing throughout the wet season through to about May, less active with few fresh mounds to be found from June to September. These mounds are formed by excess soil excavated in burrowing, which is pushed up through an opening in the surface of the ground in the form of sausage-shaped rolls. The freshness of the underground burrowing can be judged by the form of these rolls for as the moist soil, from which they are formed, dries, they lose their form, old mounds looking like a dry pile of sand. The best trapping results are obtained by opening at the fresh mounds, but they can be trapped in older-looking mounds even during the drier months of the year (June to September), indicating that they are not entirely dormant at this time of the year.

Burrowing appears to proceed from a central point, the freshest mounds being the furthest from it, the mounds forming distinct lines. The distance between the mounds varies greatly, from half a metre to several metres. Mounds may attain a size of up to 60 or 70 cm across the base and 30 cm high.

If a mound is removed and the burrow opened, the molerat will, if undisturbed, visit the site of the disturbance, first poking its head out of the hole to scent the breeze, then returning to the burrow and pushing soil upwards to close the aperture.

If the ground is excavated deeply below the mounds, two or more burrows are found leading into the single burrow leading to the surface. If the last mound in a line is opened two burrows are found indicating the the molerat is excavating forward of this mound and pushing soil back and up into it.

Judging from the position in which they are caught in the traps, inserted into the open holes, they are pushing the sand back towards the mound or towards the now opened end of the burrow by pushing it backwards, the head invariably facing away from the opening.

They are very sensitive indeed to sounds or vibrations and, if the observer waits too near an open hole, as often as not they will not visit until he has moved to some distance from it. On the other hand, if left alone they will very quickly visit to close the holes, times of as little as two and a half minutes being recorded (Palapye).

During wet weather they may be found moving on the surface of the ground. It appears that this is more a movement of dispersal or possibly movement to richer feeding grounds rather than their being forced out by flooding, as the sandy soils in which they normally live, is not subject to this except in very unusual circumstances.

They leave their burrows through holes in the sandy mounds which remain open after they have moved out. At the Savuti lines of mounds led right down near to the edge of the water. There appears to be a central series of chambers and a more intricate system of burrows which presumably is that part of the burrow system in which the young are born and in which they rest.

They will bite savagely. In defence the head is thrown back, the mouth open, exposing the formidable incisor teeth.

Although the eyes are very small they can appreciate small movements and are quick to turn the head in their direction.

Food

The underground stems of grasses (Savuti, *Cynodon* sp.), bulbs, roots and tubers.

Breeding

Only two gravid females were taken, one in February with five foetuses, implanted 2R 3L and another in July with three, 1R 2L. The distribution of the sample of females taken over the months of the year is as follows:

	J	F	M	A	M	J	J	A	S	O	N	D
Total	6	19	5	3	9	7	6	12	4	–	4	3
Non-gravid	6	18	5	3	9	7	5	12	4	–	4	3
Gravid	–	1	–	–	–	–	1	—	–	–	–	–

Very young individuals of a TL of up to 140 and a weight of up to 45 g have been taken during January, February, July, August and November.

The sample is too small to arrive at any conclusion but the indication is that the young may be born widely throughout the year.

Sizes and Weights

MALES

TL	$\bar{X} = 166$;	$N = 32$;	Obs. range 150-196
T	$\bar{X} = 18$;	$N = 32$;	„ „ 11- 27
Hf c/u	$\bar{X} = 28$;	$N = 32$;	„ „ 27- 30
Weight	$\bar{X} = 99$ g;	$N = 8$;	„ „ 86-131 g

FEMALES

TL	$\bar{X} = 169$;	$N = 29$;	Obs. range 153-176
T	$\bar{X} = 19$;	$N = 29$;	„ „ 15- 33
Hf c/u	$\bar{X} = 28$;	$N = 29$;	„ „ 24- 31
Weight	$\bar{X} = 103$ g;	$N = 8$;	„ „ 96-110 g

Cryptomys hottentotus

Common Mole-rat

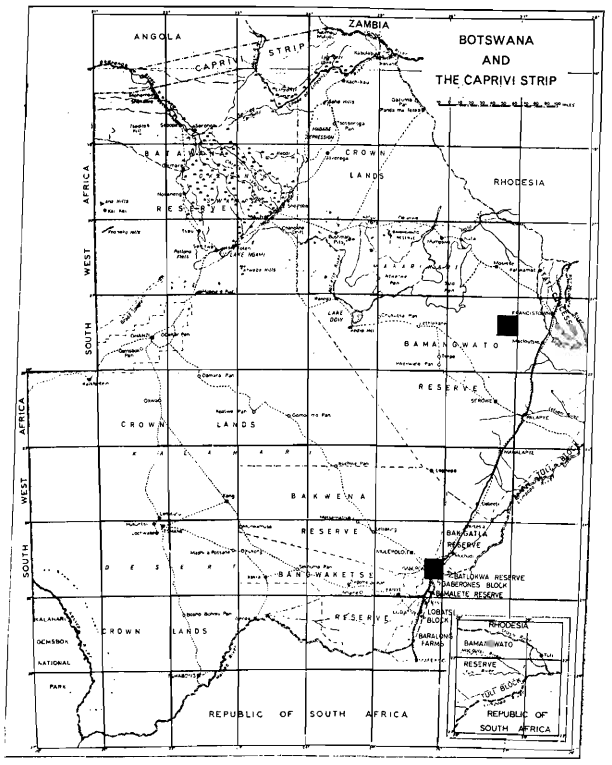
C. h. hottentotus (Lesson, 1826)

Taxonomic Notes

TNL 4323 and 4283 from 45 miles south-west of Francistown have tiny white headspots, in TNL 4315 from the same locality the headspot is absent.

Distribution

Replaces *C. damarensis* narrowly in the east from the Tati Concession west to 45 miles south-west of Francistown and south to Gaborone. Smithers (1968) was incorrect in placing material from Tamafupi with this species, this being, on the availability of further material, *C. damarensis*. While there are no specimens, at the moment, from between Mahalapye and Artesia in the eastern sector, it is suspected that when they are taken they will be shown to be *C. damarensis* on account of the eastward extension, in this sector, of the Kalahari associations.



In common with *C. damarensis* may be locally absent through the lack of suitable food (de Graaff, 1968) or where the ground is too hard for burrowing.

Habitat

While *C. damarensis* throughout its range in Botswana is in general associated with Kalahari sand, *C. hottentotus* appears capable of living in heavier sandy soils such as granite sands (Tati Concession, Gaborone).

Habits

Similar to *C. damarensis*. De Graaff (1962) describes a nest from the Kruger National Park, Transvaal, as of circular shape 25-27 cm in diameter, taken from 60 cm below ground-level, consisting of vegetable matter, closely knit together by fine adventitious roots. Eloff (1952) states that they live in small colonies of six to eight individuals all sharing a communal nest. In Rhodesia nine *C. darlingi* were trapped in a single burrow (Melsetter).

Food

The underground rhizomes of grasses, bulbs, roots and tubers.

Breeding

No information from Botswana.

Sizes and Weights

MALES			
TL	$\bar{X} = 145$;	$N = 4$;	Obs. range 133-160
T	$\bar{X} = 18$;	$N = 4$;	,, ,, 16- 18
Hf c/u	$\bar{X} = 25$;	$N = 4$;	,, ,, 22- 28
Weight	$\bar{X} = 72$ g;	$N = 4$;	,, ,, 47- 94 g
FEMALES			
TL	$\bar{X} = 146$;	$N = 8$;	Obs. range 135-162
T	$\bar{X} = 16$;	$N = 8$;	,, ,, 14- 19
Hf c/u	$\bar{X} = 24$;	$N = 8$;	,, ,, 22- 26
Weight	$\bar{X} = 57$ g;	$N = 6$;	,, ,, 46- 70 g

Family HYSTRICIDAE

Genus **HYSTRIX** Linnaeus, 1758

Hystrix africaeaustralis

Noko Porcupine

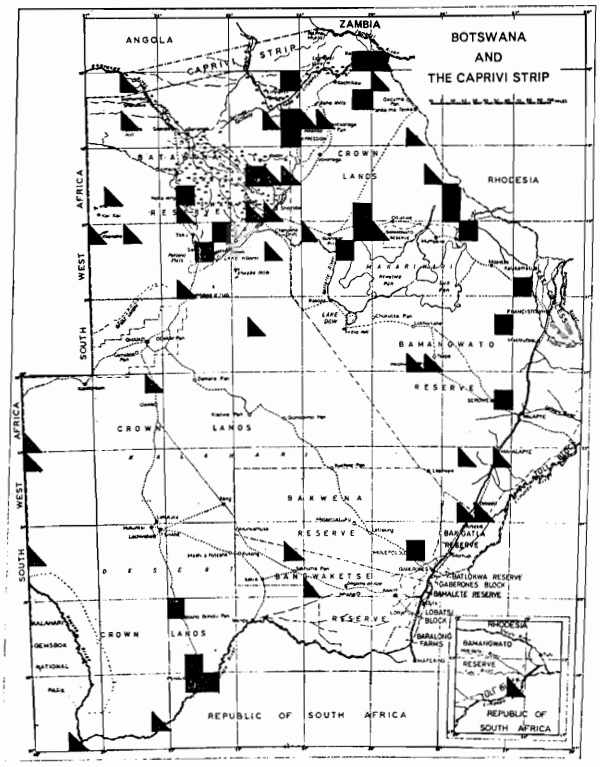
H. africaeaustralis Peters, 1852

Distribution

Widely distributed throughout but, on account of their habits, infrequently contacted. A number of the records mapped are based on predator kills (Kasane); on individuals killed on roads (Kabulabula, Gweta) or on the evidence of quills either at the entrance to holes or on tracks (Nata).

Habitat

They have a wide habitat tolerance, occurring in all the vegetational associations found in the territory from riverine woodland (Moremi Game Reserve) to dry scrub (Bangwaketse Reserve), and all types of terrain from rocky broken country (near Serowe) to sandy grassland (Gweta) or floodplain grassland (Savuti).



Habits

Nocturnal, terrestrial, occur singly or in pairs or a female with young. Although they are reported as being to some extent diurnal (Ansell, 1960) all the individuals contacted in Botswana were seen after dark with the aid of a dazzling light or the lights of vehicles. They have a marked tendency to use paths or tracks.

During the day they rest up in caves, fissures in rocks, or holes in the ground, which they may excavate themselves, although they frequently use disused antbear, *O. afer*, burrows. Near Serowe an individual was found using a hole under the shelter of a sandstone slab about 2 metres deep. Under stress they will use any hole large enough to enter, at Savuti a shallow hole in a termite mound not over a metre deep. They are difficult if not impossible to dislodge from these, as they erect the quills as anchors and solidly lodge themselves against the sides, and have to be dug out. TNL 4332 and 4347 were trapped at the entrance of disused antbear holes near Francistown. Their presence in the holes is usually revealed by the spoor in the soft sand or quills lying near the entrance and sometimes, but not always, the marks of the quills on the sides of the tunnel. Normally the quills lie flat along the back when using a hole and do not necessarily, therefore, leave marks on the sides.

They are very noisy when moving at night, especially if there is a pair, proceeding with a great deal of quill-rattling and grunting.

They usually proceed in a slow waddle but, under stress, can move quite fast. When disturbed at close quarters they can be aggressive and will suddenly run backwards on to the aggressor, the quills erected, or will freeze, standing motionless, presumably in the hope of not being noticed. Under stress rattle the open-ended hollow quills on the tail as a defence mechanism.

They are much sought after by the indigenous peoples, the meat being very palatable, and they also fall prey to the larger predators such as lion and leopard.

Avid and powerful diggers.

Food

Vegetarian, they dig for roots and bulbs which form an important part of their diet. A pest in areas where agricultural crops are grown, being particularly destructive in mealie lands, damaging much more than they eat. Will also dig up peanuts and eat pumpkins and melons.

Breeding

The only indication of the time of dropping the young was the capture of two juveniles at weight of 3 lb. 4 oz. and 3 lb. 12 oz. taken on 1st June near Francistown. On the basis of a growth curve (Roth, 1964) these might be approximately three months old being born about February or March.

These two juveniles were both taken from the same disused antbear hole.

Shortridge (1934) states that they are born during the summer months, Ansell (1960) records juveniles in August, December and March, and in Rhodesia near full-term foetuses (300 g) were recorded in November.

There may be a considerable difference in the development of foetuses as is shown by two taken from a female T57 in Rhodesia in November at sizes and weights of CR 233; 294 g and CR 180: 107 g respectively.

Sizes and Weights

MALES

	TL	*T*	*Hf c/u*	*E*	*Weight*
BP 1920	890	130	110	41	40 lb.
C 2244	688	—	89	39	22 lb.

	TL	T	Hf c/u	E	Weight
FEMALES					
BP 1791	905	120	105	46	49 lb. 15 oz.
SWG 1277	820	141	114	48	30 lb.
BP 2124	740	85 (mid anus)	105	45	24 lb.
BP 2107	720	90 (mid anus)	98	48	23 lb. 8 oz.
BP 2135	730	75 (mid anus)	93	46	19 lb.
BP 2055	600	75	84	31	12 lb.
TNL 4342	385	65	62	33	3 lb. 4 oz.
TNL 4332	370	65	61	34	3 lb. 12 oz.

Family PEDETIDAE

Genus PEDETES Illiger, 1811

Pedetes capensis

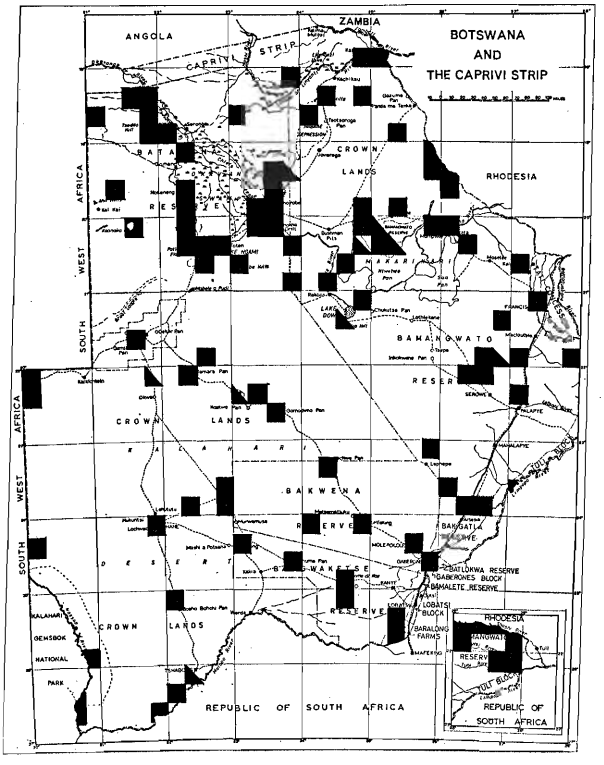
Ntole Spring Hare

P. c. damarensis Roberts, 1926

Taxonomic Notes

Conspicuous features of the Botswana series, as opposed to those from the southern part of the continent (*P. c. albaniensis*, Albany district), is that the forelimbs have a greater amount of white on the upperparts, the sides of the face paler. In addition, in the Botswana material the white of the underparts of the tail extends over the top of the tail behind the black tip in varying degrees, this being a particular feature of material from the Makgadikgadi and the south-western Kalahari, in which it is very conspicuous.

The whole of the Botswana material is referred to *P. c. damarensis* Roberts, although specimens from the southern part of the eastern sector in their slightly darker, less bright, colour overall, their rumps and the underparts of the tails less white, this not showing on the tops of the tails, may show some integraduation with *P. c. orangiae* Wroughton of the Orange Free State.



Distribution

Widespread and common throughout, wherever there is suitable habitat, absent from extensive areas within this range where the ground is hard, or rocky.

Habitat

An important requirement of the species is sandy ground in which to dig its burrows. They are noticeably absent from areas of hard pan ground in basalt

areas such as are found in the vicinity of Pandamatenga, parts of the central and north-eastern areas and in the eastern extension of the Bamangwato Reserve. They are generally absent from mopane scrub or woodland. Further east in Rhodesia the same position rules, spring hares being absent on the heavy clay soils although occurring on adjacent areas of granite and other sandy soils. In the eastern part of the Bamangwato Reserve, however, although absent in the area as a whole they are found in the alluvial fringes of the many watercourses, which drain eastwards to the Limpopo River, or on the patches of sand which in places cover the basalt soils. In the central Bamangwato Reserve there is some overlay of sand in parts and spring hares occur in these areas as opposed to the areas of heavy soils adjacent to them.

Spring hares are predominently grazers living on the underground rhizomes or surface stolons of 'quick' grasses which form nearly pure associations on floodplain and the open areas fringing pans or water-holes. There appears to be a very obvious preference for this very open type of habitat with suitable rhizomacous grasses. In some cases the ground may be hard and unsuitable for burrow construction (*see* following table categories (1), (2) and (3)) in which case the burrows are situated in adjacent sandy ground.

When collecting at night on the fringes of pans or on floodplain, great numbers of spring hares may be seen feeding on these open areas which, when disturbed, move off the hard ground towards the raised sandy fringes of the pans where their burrows are situated (Makgadikgadi, Nokaneng).

The following table gives a breakdown of the sample of 363 spring hares collected according to the type of habitat in which they were taken:

Category	*Habitat*	*No. Taken*
(1)	Vleis or dry river-beds	26
(2)	Fringe pans, on grassed pans or the the fringe of water-holes	61
(3)	Floodplain grassland	49
(4)	Riparian alluvial areas	7
(5)	Grassy plains, open short grass	77
(6)	Open short grass associated with habitations	9
(7)	Cultivated or fallowed areas or vicinity kraals	39
(8)	Open scrub	78
(9)	Thick bush	2
(10)	Mopane woodland	10
(11)	Areas of tall grass	2
(12)	Fringe *Baikiaea* woodland	3
		363

Categories (2) and (3) of the above table represent areas that are subject to heavy grazing pressures, either by wildlife or domestic stock, and category (1) is also subject to these pressures under certain conditions although to a lesser extent. Categories (6) and (7) are always subject to these pressures by domestic stock. On this basis 184 out of 363 were taken on areas subject to greater or lesser degrees of degradation due to the factors mentioned and there does, therefore, appear to be a tendency for spring hares to be found where areas are subject to heavy grazing pressures.

It is noticeable, when approaching kraals at night, which are normally surrounded by open often heavily degraded ground, that spring hares appear to be commoner than in the surrounding country through which one has just passed.

In two cases out of the 363 spring hares were taken in dense *Acacia* thickets but it is presumed that they took to these under stress as normally they avoid them.

They appear to be less common in areas with a heavy cover of tall grasses, only two out of 363 being taken in this type of association. It is admitted that they are more difficult to find in such areas and therefore there is a bias against their collecting. On the other hand, where there are extensive areas of tall grass forming dense closed associations there is a noticeable absence of signs of spring hare grazing, these being on the fringe where the grasses are shorter and the association much more open.

Suitable sandy soils of various origins with a pure short grass cover or a generally open cover of grass are found over the larger part of Botswana. In large areas there is, in addition, an open cover of scrub, particularly *Acacia* scrub, associated with other low bushes of *Grewia*, *Terminalia* or *Bauhinia*, etc. In some areas this open scrub is associated with scattered trees, often *Acacia giraffae*. In 78 cases out of the 363 spring hares were collected in open scrub with or without scattered trees.

Habits

Entirely nocturnal, not emerging from the burrows until well after dark. Occur singly or in pairs, the burrows dug in firm sandy ground, scattered and not forming warrens, although they may form aggregations where suitable ground is not generally available. Will move up to 300-400 metres from these burrows in search of food and will quickly return to them if disturbed.

Locomotion normally by leaping, kangaroo fashion, on the back legs; the short front legs, with their curved claws, used for digging or when moving, when

the head is lowered, some of the weight is taken on the fore edges of the curved claws. Under stress may move very fast in a leaping, jinking movement, the tail with its broad black tip, flung from side to side to confuse pursuers as well to maintain balance.

When held in a powerful light lowers the head, crouching on the ground, the ears lowered, but not remaining long in this position returning to a sitting position on the back legs to examine the source of the light, normally only a single eye at a time brightly reflecting the light, the ears erected. They have a characteristic habit, when caught in a light, of sitting up motionless, the eye shining in the beam then lowering the head to the ground and raising it up almost immediately, sometimes bobbing up and down several times in this manner. This habit and the single shining eye distinguishes a spring hare in a beam of light from other nocturnal species. If there still remains doubt the bobbing of the brightly shining eye as it moves off quickly confirms identification.

The burrows may have one or two entrances, the sand dug out forming an elongated ramp at the lip of the hole. There may be a further exit hole which is apparently opened from within the burrow as it does not have a ramp of loose sand. Where there are aggregations of burrows there may be interconnections between them.

If the burrow is in use the sand on the ramp is loose and often shows the characteristic spoor of the the elongated hindfoot with the long third toe, with its pointed triangular claw, and the two adjoining and much shorter toes, their claws normally imprinting less clearly towards the base of the imprint of the third toe. In relatively hard sand the marks of the front claws, used in excavation, show clearly on the sides of the burrow.

Roberts (1951) quotes a report stating that 'at fall of darkness they would spring out of the holes to be silhouetted against the sky above the level of the thorn trees for a moment'. This type of behaviour has not been observed, on the contrary, when about to emerge they remain for a time just inside the entrance to the burrow before raising the head out of it with the ears erected, then slowly emerging to remain for a time just outside the burrow only moving from it if satisfied that the terrain is safe. They appear to make every endeavour to return to their own holes if disturbed, not apparently using other holes for refuge.

The burrows are some 20-23 cm in diameter and, during daylight hours, the spring hares lie up in them normally within some 4-5 metres of the entrance. The indigenous peoples catch them with the aid of a long supple stick with a hook or a 'burred' seed-pod of various plants attached firmly on the end. In the case of the 'burr' this is pressed against the spring hare and the stick twisted so as to firmly embed the 'burr' in their long hair when they are dragged out (Ndebele).

The burrows reach to about one metre below the surface at their deepest point and may have many twists and turns, but are often relatively straight. These normally house a single individual or a pair sometimes with a single juvenile.

Juveniles appear to remain in the burrows for a considerable time after birth as they are not found free-ranging until they reach a hindfoot length of *c.* 142 and a weight of some 3 lb. Juvenile TNL 1084 from Sequane, the smallest in the collection with a hindfoot length of 138 c/u, was taken from a burrow by Africans by digging. Adult spring hares have an average hindfoot length c/u of 157 and an average weight of 6 lb. 11 oz. (*see* (Measurements and Weights).

Taking a series of 13 of the smallest lightest weight free-ranging juveniles collected at night, the smallest so far taken has a hindfoot length c/u of 142 and a weight of 2 lb. 12 oz. There is obviously a considerable size difference between these juvenile free-ranging individuals and the largest of the near full-term foetus at a hindfoot length c/u of 85 and a weight of 280·1 g.

The following table records the hindfoot length and weight of the 13 free-ranging juveniles:

List of Juvenile free-ranging spring hares taken in night-shooting operations

No.	Locus	Hf c/u	Weight
1. BP 894	Mabate	142	2 lb. 12 oz.
2. BP 1058	Lephepe	142	4 lb. 12 oz.
3. BP 1106	Lechana	145	5 lb. 8 oz.
4. BP 1387	Lake Ngami	151	4 lb. 2 oz.
5. BP 1487	Ramatlabama	145	4 lb. 12 oz.
6. BP 1506	Dikomodikae	150	4 lb.
7. BP 1815	Tshane	151	4 lb. 2 oz.
8. BP 1986	Maun	152	4 lb.
9. RMD 1028	Kasane	150	4 lb. 14 oz.
10. TNL 777	Zelu Hill	146	4 lb. 8 oz.
11. TNL 2545	Bokspits	151	4 lb. 8 oz.
12. TNL 4559A	Maun	149	3 lb. 2 oz.
13. TNL 4558A	Maun	152	3 lb. 12 oz.

Breeding

Gravid females were taken in every month of the year, in every case only one foetus being present.

	J	F	M	A	M	J	J	A	S	O	N	D
Total	26	64	13	16	13	28	7	18	4	13	17	8
Non-gravid	13	38	7	9	8	11	2	10	1	10	10	4
Gravid	13	26	6	7	5	17	5	8	3	3	7	4

Implantation is irregular, out of a sample of 82 the implantation was R40, L42.

The larger foetuses examined were as follows:

	No.	*Hf c/u*	*Weight g*
1.	BP 97	85	269·8
2.	HJH 1147	81	276·6
3.	BP 1468	74	249·6
4.	BP 1673	73	206·7
5.	BP 1745	71	248·0
6.	P 79 M	81	281·0
7.	P 196 M	75	238·5

(The shank length includes the length of the pre-natal cap.)

In the case of Nos. 1, 2, 3, 5 and 6 these were estimated to be near full-term, the foetuses covered with hair.

General

The spring hare plays a very important role as a source of protein to the Bushman. Silberbauer (1964) records that a single band may, in the course of any one year, kill up to 227 spring hares among the many other species which they use as food.

The species dresses out at a high percentage compared with others. A 6 lb. 5 oz. spring hare can yield 3 lb. 14 oz. of protein in the form of the meat, kidneys, liver and brains or about 60% of usable portion.

The Bushmen have not been observed to utilize the intestines of the spring hare although, in the case of most other species, the content is stripped from them and these are eaten.

Disused spring hare burrows are used by many other species as refuges or breeding places. Among species observed to use them were:
Pangolin, *Manis temmincki* (Rhodesia);
Striped Polecat, *Ictonyx striatus* (Dikgomodikae);
Slender Mongoose, *Herpestes sanguineus* (Toten);
Dwarf Mongoose, *Helogale parvula* (Tamafupi);
Yellow Mongoose, *Cynictis penicillata* (Lake Ngami);
Pouched Mouse, *Saccostomys campestris* (Gutsa Pan).

Although normally using antbear, *O. afer*, holes, the anteating chat, *Myrmecocichla formicivora*, was observed using spring hare holes near Odiakwe.

Sizes and Weights

Comparison of the measurements and weights of a series of males and females from the south-eastern part of the territory, as opposed to a series from the north-western (western Okavango), reveals that the latter are larger on average in all respects.

BP 87, a male, and BP 54, a female from Gomare and Nokaneng, each weighed 9 lb. and several weighed 8 lb. and over, 9 lb. being the highest weight recorded from any sector of the territory.

The figures given in the following table also reveal a difference in measurements and weights between males and females from the same areas, the males being slightly larger on average.

SOUTH-EAST

MALES

TL	$\bar{X} = 813$;	$N = 23$;	Obs. range 770-858
T	$\bar{X} = 435$;	$N = 23$;	„ „ 400-463
Hf c/u	$\bar{X} = 152$;	$N = 23$;	„ „ 145-160
E	$\bar{X} = 72$;	$N = 23$;	„ „ 67- 76
Weight	$\bar{X}$ = 6 lb. 14 oz.;	$N = 24$;	

FEMALES

TL	$\bar{X} = 801$;	$N = 21$;	Obs. range 758-860
T	$\bar{X} = 426$;	$N = 20$;	„ „ 405-451
Hf c/u	$\bar{X} = 153$;	$N = 22$;	„ „ 145-160
E	$\bar{X} = 71$;	$N = 22$;	„ „ 68- 75
Weight	$\bar{X}$ = 6 lb. 3 oz.;	$N = 24$;	

NORTH-WEST (Western Okavango)

MALES

TL	$\bar{X} = 850$;	$N = 12$;	Obs. range 800-910
T	$\bar{X} = 448$;	$N = 12$;	„ „ 417-485
Hf c/u	$\bar{X} = 161$;	$N = 14$;	„ „ 150-170
E	$\bar{X} = 75$;	$N = 14$;	„ „ 70- 80
Weight	$\bar{X}$ = 7 lb. 3 oz.;	$N = 13$;	

FEMALES

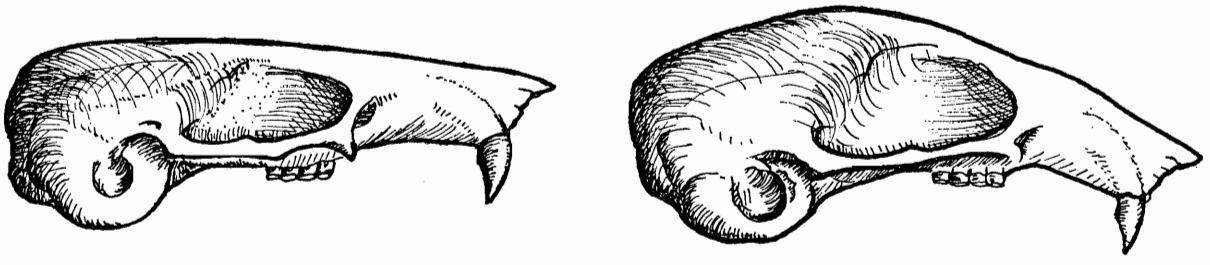
TL	$\bar{X} = 830$;	$N = 14$;	Obs. range 810-845
T	$\bar{X} = 429$;	$N = 12$;	„ „ 410-443
Hf c/u	$\bar{X} = 161$;	$N = 14$;	„ „ 153-182
E	$\bar{X} = 75$;	$N = 14$;	„ „ 69- 79
Weight	$\bar{X}$ = 7 lb. 3 oz.;	$N = 13$;	

Family MUSCARDINIDAE

Genus GRAPHIURUS Smuts, 1832 — Manthube

Averages larger, hindfoot 18-23; skull flattened, total length exceeding 28·5 (fig. 21 (*a*)) . . . *G. platyops*
Averages smaller, hindfoot 14-18; skull domed, total length less than 28·5 (fig. 21 (*b*)). . . . *G. murinus*

Fig. 21 Skulls of Dormice



(*a*) Rock Dormouse, *G. platyops* (*b*) Dormouse, *G. murinus*

Graphiurus platyops — Rock Dormouse

G. platyops Thomas, 1897

Taxonomic Notes

Pending a revision of the genus no subspecies are recognized.

Distribution

Confined to the northern parts of the eastern sector from the Tati Concession south to Debeeti.

Habitat

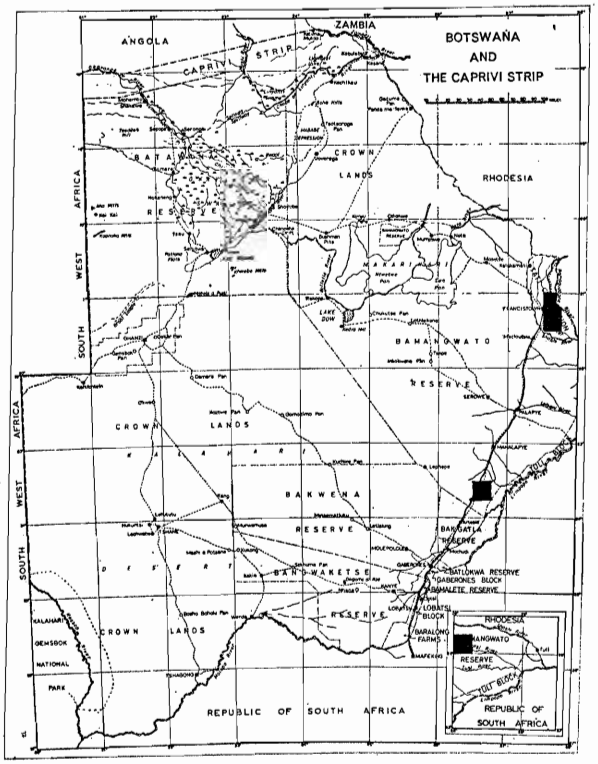
All five of the specimens available were taken in rocky kopjes, to which they appear to be closely confined. Ansell (1960) reports, however, that in Zambia, where there are no rocky kopjes, they live in trees.

Habits

Nocturnal, terrestrial, apparently either uncommon or difficult to trap.

Food

Stomach contents appear to be composed mainly of well-masticated seeds with traces of green vegetable matter and the chitinous remains of insects. The fore-limbs and chin, of both this species and *G. murinus*, are often characteristically stained with a reddish plum colour, thought to be caused by eating some type of insect.



Breeding

No data. Ansell (1960) records a female with foetuses in February, juveniles in November and December.

Sizes and Weights

MALES

TL	$\bar{X} = 187$;	$N = 4$;	Obs. range 161-211
T	$\bar{X} = 85$;	$N = 4$;	„ „ 87-105
Hf c/u	$\bar{X} = 20$;	$N = 5$;	„ „ 18- 23
E	$\bar{X} = 16$;	$N = 5$;	„ „ 14- 19
Skull TL	$\bar{X} = 289$;	$N = 5$;	„ „ 278-309
Weight	No data.		

FEMALES

No data.

Graphiurus murinus — Dormouse

G. murinus (Desmarest, 1822)

Distribution

Although there are no records to date from the eastern parts of the Central Kalahari Game Reserve, the south and south-western parts of the Kalahari, or the eastern sector south of Foley, the species otherwise appears to be widely distributed throughout and may have been overlooked in these areas.

Habitat

Taken in dry scrub where there are trees of sufficient size to provide holes for resting in, and in riverine woodland (Okavango delta). In dry countries associated with *Acacia giraffae* and *Zizyphus mucronata* trees and in the Okavango delta with *Conbretum imberbe*, *Acacia* spp., and mopane, *C. mopane*. The distribution of the species suggests that they have a wide habitat tolerance. Often found under the roofs of houses (Francistown, Shakawe).

Habits

Nocturnal, arboreal. The young are born in holes in trees which are also used for resting in during the day.

Food

Granivorous and insectivorous. Stomachs of specimens from Tshane showed traces of the dry outside covering of wag 'n bietjie, *Z. mucronata*, fruits.

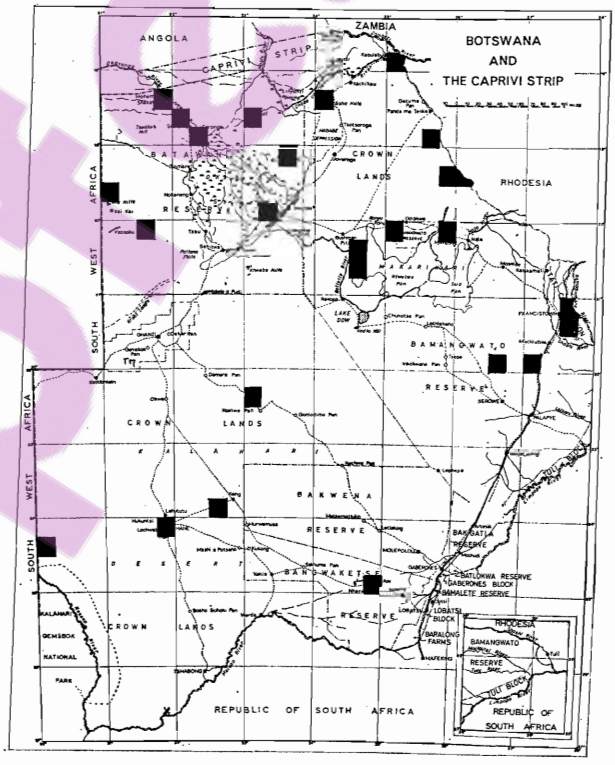
Sizes and Weights

MALES

TL	$\bar{X} = 159$;	$N = 11$;	Obs. range 139-191
T	$\bar{X} = 74$;	$N = 11$;	„ „ 64- 90
Hf c/u	$\bar{X} = 17$;	$N = 10$;	„ „ 15- 19
E	$\bar{X} = 16$;	$N = 11$;	„ „ 15- 18
Weight	No data.		

FEMALES

TL	$\bar{X} = 164$;	$N = 30$;	Obs. range 128-188
T	$\bar{X} = 76$;	$N = 32$;	„ „ 60- 89
Hf c/u	$\bar{X} = 17$;	$N = 34$;	„ „ 15- 20
E	$\bar{X} = 16$;	$N = 34$;	„ „ 13- 18
Weight	$\bar{X} = 26$ g;	$N = 11$;	„ „ 20-38 g



Family SCIURIDAE

1. Fur bristly; a pale stripe on either side of the body; palate well over half the occipitonasal length; occipitonasal length 55-62·9 mm; lachrymal enlarged . . . . . *Xerus*

   Fur not bristly; no pale stripes on either side of the body; palate normally clearly less than half the occipitonasal length; occipitonasal length 57·4 mm and less; lachrynal not enlarged . . . . . *Paraxerus*

Genus XERUS Ehrenberg, 1833

Xerus inauris

seKatamosima Ground Squirrel

X. inauris (Zimmermann, 1780)

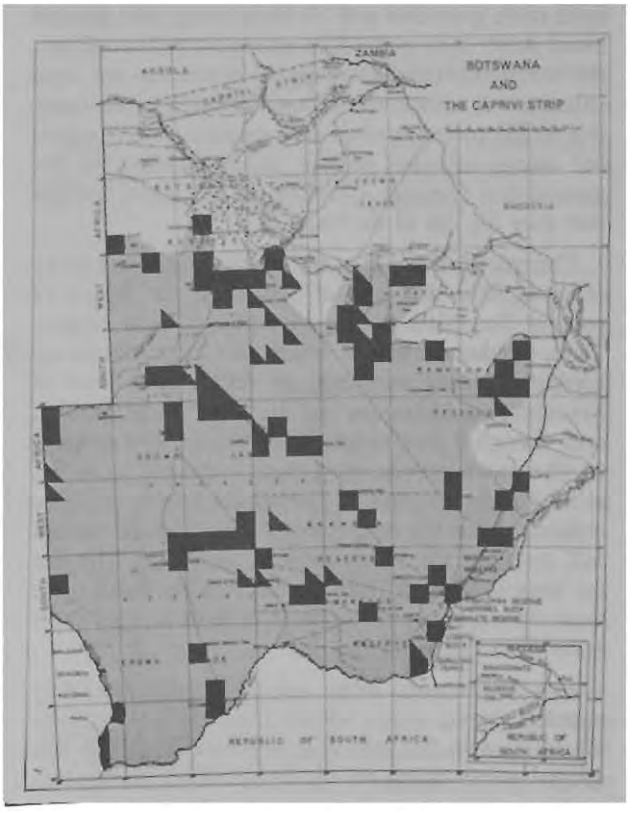
Taxonomic Notes

All the Botswana material has white incisor teeth thus distinguishing it from *X princeps* Thomas of northern South West Africa.

Distribution

Widely distributed throughout the central and south-west Kalahari as far north as 19°45′ S. on the South West Africa border and narrowly up the western fringe of the Okavango to just north of Nokaneng, on the fringe of the floodplain. Throughout the Lake Ngami area and the western Makgadikgadi but only as far east as near Odiakwe and Chukutsa Pans and, south of the Makgadikgadi, east to Lothlekane. Occur just north of, although absent in, the vicinity of Serowe, extending from here north-east on an extension of the open pan and grassland associations to within 45 miles of Francistown. Absent immediately south of Serowe but occurring at Mahalapye and eastwards to the Transvaal border at *c.* 23°30′ S. South of this they are found throughout the south-eastern part of the territory, excluding the rocky hills, although occurring in the valleys, wherever there is suitable habitat.

Shortridge (1934) records them as plentiful in the Gobabis area, 22°28′ S., the furthest north they are known in the eastern part of South West Africa, admitting that their north-eastern limit in this territory is unknown. The Botswana records on the border indicate that they may well occur as far north-east as *c.* 19°45′ S.



Habitat

An analysis of 236 records of the type of habitat in which specimens have been taken is as follows:

OPEN GROUND	
Open grassland	10
Fringes of pans or on fringes of floodplain	71
Overgrazed open ground	13
Open calcareous ground near pans, on the fringes of pans or in scrub-covered plains	23
Dry river-beds or dry watercourses	16
Open grassed pans	2
Low karroid scrub	1
	136
SCRUB	
Scrub *Acacia*	57
Scrub *Acacia* with other shrubs including *Terminalia*, *Grewia*, etc., on sandy ground	32
	89
WOODLAND	
Acacia woodland with open areas or overgrazed areas	11
	11

The records indicate a predominant association with open country. With the exception of the ten records from open grassland and 13 from overgrazed ground listed under open ground, in which the soil conditions are unspecified, the remaining 113 records are from situations in which the ground is hard, often stony due to the presence of calcareous pebbles and stones not always obvious on the general surface of the ground but forming a feature of the loose detritus that they dig out of the burrows.

The records listed in scrub are, in the great majority of cases, from this type of habitat on the fringes of pans or floodplain as, for example, at Lake Ngami, Tsau, Chukutsa Pans or where this scrub occurs on hard ground as at Kang, 45 miles south-west of Francistown, Mamuno, etc. In general the ground, even though it may be sandy, is consolidated or hard. In 32 cases, however, the ground is simply described as sandy, the presence of *Terminalia* usually being an indication that the sand is fairly loose and the species will certainly use sandy ground, providing it is not too loose to allow of burrow construction. In all these cases the situations are adjacent to areas of open short grass of the 'couch' type.

The 11 records from woodland although they stipulate 'open areas within this' do not provide information on the type of ground on which this was occurring but reference to the localities themselves indicates that in most cases this woodland is composed of a very open association of *A. giraffae*, in some cases, e.g. Nokaneng, adjacent to floodplain, or in others, e.g. Mabuasehube, to pans.

In the southwest Kalahari the species is particularly associated with pans. Where these have a flat, dry mud surface, as at Sekoma and Tshane, they occur either on the raised shoreline, which may vary in extent from a few yards to several hundreds of yards with an open short grass cover or with scattered *Acacia* bushes, or on the rising ground inland from these shorelines when the grassland gives way, sometimes quite abruptly, to *Acacia* scrub, in some cases with an open *A. giraffae* woodland.

Where, further inland, the rising pan fringe gives way to undulating plains of loose sand with scrub and longer grasses the species is not generally found and is not encountered until the fringe of the next pan is reached.

Conditions similar to these on pans are provided by dry riverbeds, e.g. Molopo River at Khuis, or watercourses, the Okwa Depression, where their hard consolidated beds or banks provide suitable habitat, these often being stony, e.g. at Khuis.

Certain of the Kalahari pans have no open flat mud surface, e.g. Mashi a Potsana, pans 25 miles north-east of Tshane and, while they have a surface harder than the general surface of the areas that surround them, are grass covered, or in the case of pans just south of Tshabong a covering of very low karroid or 'salt bush'. In these cases burrows are often found in the middle of the pans.

Habits

Gregarious, the size of the colonies difficult to assess as it is impossible to ascertain whether all the individuals have emerged from the burrows. Estimates have varied up to 30 in a colony (Lake Dow) but are generally smaller, 6-10 being common, and, on the fringe of their distribution (Nokaneng), a pair or three or four only.

Normally form warrens with many holes, the detritus thrown out forming a low mound raising the warren above the general ground-level. At Nokaneng and Lake Ngami, however, single holes were found. In any warren numerous disused burrows are found with no signs of fresh digging or spoor at their entrances and often characterized by having the entrances covered by spiders web. Completely deserted warrens are often found in areas where others are occupied. Warrens are frequently shared with the suricate, *S. suricatta*, and sometimes the yellow mongoose, *C. penicillata*.

Ranges to feed up to 100-120 metres from the warrens. When disturbed in the open, run back to the same burrow from which they emerged but under stress will take to other and more convenient burrows. When disturbed run, holding the body low on the ground the tail trailing, usually pausing near the entrance to sit upright on their haunches or right up on the toes, balancing with the tail, motionless looking around with quick movements of the head as they search for the cause of the disturbance. If further disturbed dive for the cover of the burrow.

They are very cautious when about to emerge and will wait for a moment or two with the nose just protruding from the burrow until they are satisfied it is safe to do so. When moving around feeding, or when sitting undisturbed, hold the tail swung over the back forming a flat brush, the hairs erected, the tip recurving backwards as if using it as a protection against the heat of the sun or possibly as a disguise against avian predators.

The species is exclusively diurnal, not emerging till the sun is well up and taking to their burrows well before sunset. Not emerging on cold or overcast days.

Breeding

Gravid females were taken in every month of the year excepting April and September during which months only one female and two females respectively were taken.

Distribution of non-gravid, lactating and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	10	27	28	1	14	33	5	2	2	7	5	3
Non-gravid	9	16	22	1	12	27	4	1	2	4	3	1
Lactating	—	9	1	–	—	—	–	–	–	1	1	–
Gravid	1	2	5	–	2	6	1	1	–	1	1	2

These data suggest that the species breeds throughout the year.

The average number of foetuses is as follows:

Foetuses

Number $\bar{X} = 2{\cdot}2$; $N = 27$; Obs. range 1-3.

Implantation appears to be irregular as can be seen from the following table:

1R	2R	2R1L	1R1L	1R2L	2L
1	5	2	7	3	9

Sizes and Weights

Comparative sizes and weights of series of males and females are as follows:

MALES

TL	$\bar{X} = 454$;	$N = 76$;	Obs. range	412- 508
T	$\bar{X} = 211$;	$N = 73$;	„ „	187- 245
Hf c/u	$\bar{X} = 68$;	$N = 78$;	„ „	61- 74
Weight	$\bar{X} = 649$ g;	$N = 40$;	„ „	511-1022 g

FEMALES

TL	$\bar{X} = 446$;	$N = 124$;	Obs. range	410- 487
T	$\bar{X} = 207$;	$N = 114$;	„ „	180- 245
Hf c/u	$\bar{X} = 66$;	$N = 125$;	„ „	60- 73
Weight	$\bar{X} = 600$ g;	$N = 89$;	„ „	511- 795 g

These figures suggest that the males are slightly larger and heavier than the females.

Within the series a male BP 1061 is outstandingly large with measurements and weight as follows: TL 500; T 230; Hf c u 70; Weight 2 lb. 4 oz. (1 022 g).

Genus PARAXERUS Forsyth Major, 1893

Paraxerus cepapi

seThora Bush Squirrel

P. c. cepapi (A. Smith, 1836)
P. c. chobiensis Roberts, 1932
P. c. maunensis Roberts, 1932
P. c. kalaharicus Roberts, 1932

Taxonomic Notes

Three subspecies have been described from Botswana:
P. c. chobiensis Roberts, 1932. Chobe River.
P. c. maunensis Roberts, 1932. Maun.
P. c. kalaharicus Roberts, 1932. Mabeleapudi.

The nominate form was taken on the Marico River, Rustenburg, in the western Transvaal not far from the Botswana border in the south-east.

Meester *et al.* (1964) and Amtmann (1966) include

P. c. maunensis, *P. c. kalaharicus* and the South West African subspecies *P. c. tsumebensis* Roberts, 1938, with *P. c. chobiensis*.

On the basis of colour the Botswana material falls into three distinct groups, from the north-western sector, the southern part of the eastern sector and the eastern Okavango. While within each of these groups there is a measure of variation in individual specimens, this is not so great as to prevent the recognition of from which of the three groups they originated.

	Group 1	Group 2	Group 3
	Southern parts Eastern sector	Eastern Okavango	North-western sector
Upper parts	Buffy, tinged ochraceous	Buffy grey	Dark, tinged ochraceous
Top head	Buffy, tinged ochraceous	Buffy grey	Ochraceous
Top fore and hind limbs	Buffy yellow	Greyish tinged buff	Pale ochraceous
Thighs	Buffy yellow	Buffy grey	Dark, tinged ochraceous; similar to upperparts
Tail	Pale, paler than upper-parts	Buffy grey like upper parts	Dark like upperparts
Upper fore-arms and shoulders	Ochraceous contrasting with upper-parts	Buffy grey tinged buffy slightly contrasting with upper-parts	Dark, tinged ochraceous, not contrasting with upper-parts

In skull measurements group 1 from the southern parts of the eastern sector is the largest, groups 2 and 3 smaller:

Group 1
Skull:
TL $\bar{X} = 44{\cdot}2$; $N = 8$; Obs. range 42·5-45·3
ZW breadth $\bar{X} = 25{\cdot}5$; $N = 8$; „ „ 24·8-26·5

Group 2
Skull:
TL $\bar{X} = 42{\cdot}6$; $N = 13$; Obs. range 41·3-44·2
ZW breadth $\bar{X} = 24{\cdot}4$; $N = 13$; „ „ 23·4-25·4

Group 3
Skull:
TL $\bar{X} = 41{\cdot}3$; $N = 13$; Obs. range 39·0-43·4
ZW breadth $\bar{X} = 23{\cdot}8$; $N = 8$; „ „ 22·8-25·4

Roberts (1951) gives the following figures for the total length of the skulls and the zygomatic widths of the nominate form and the two subspecies which he describes as follows:

P. c. cepapi (A. Smith)
Skull TL minimum 42·0 maximum 44·0 (15 specimens)
ZW „ 25·0 „ 27·0 („ „)

P. c. maunensis Roberts
Skull TL minimum 40·5 maximum 42·7 (27 specimens)
ZW „ 23·2 „ 26·0 („ „)

P. c. kalaharicus Roberts
Skull TL minimum 40·2 maximum 42·2 (4 specimens)
ZW „ 23·7 „ 24·6 („ „)

On this basis *P. c. cepapi* (A. Smith) is the largest of the three. Group 1 of the Botswana material agrees with *P. c. cepapi* in this respect as well as in colour.

On geographical grounds this might be expected as Group 1 originates from an area not far west of the type locality of *P. c. cepapi*. A particular feature of this material is the ochraceous colour of the fore and hind limbs respectively which contrasts with the colour of the remainder of the upperparts which are buffy.

The distribution of material with the above characters, now placed with *P. c. cepapi* (A. Smith), is limited to the eastern sector from the Tati Concession south to the Lobatse area and west to Kanye. Within Botswana limits there is a break in distribution between the population occupying this area and those northwards, where the Kalahari associations extend eastwards to the Transvaal border between Mochudi and north of Debeeti.

The second group (Group 2) of Botswana specimens from the eastern Okavango (Maun, Shorobe, Joverega) are very different in colour from those from the extreme south-east *P. c. cepapi*. These are very pale in colour overall, a buffy-grey on the upperparts. The crown of the head is scarcely differentiated from the back except in some cases where the tip of the nose above the nostrils is narrowly tinged ochraceous. The upperparts of the fore and hind limbs are off-white or in some cases off-white tinged

with buff, there being but the faintest suggestion of the extension of this colour on to the shoulders and the thighs. The tails are much paler than *P. c. cepapi* owing to the individual hairs having a lesser amount of black and broader bands of off-white or buffy. The underparts are white and there is an almost complete lack of the ochraceous colour at the base of the tail and round the anus, which, however, in some cases is tinged yellowish. The back of the ears are pale and have a liberal covering of white or off-white hairs.

In addition, in series, the total length of the skull and the zygomatic width are distinctly smaller than in *P. c. cepapi*.

It is proposed to revive the name *P. c. maunensis* Roberts to accommodate these pale-coloured populations which are found throughout the eastern and southern Okavango delta and eastwards in the southern parts of the north-eastern sector and northern parts of the Makgadikgadi to the Rhodesian border. It is unfortunate that Roberts chose a specimen from Maun as the type of this subspecies, as the material from Joverega even better demonstrates the characters of this subspecies as given by Roberts.

A series of 24 specimens from the Chobe River from Kabulabula east to Kasane, while most closely allied in colour and size to *P. c. maunensis*, can, in series, be separated from them.

Although some individuals show the influence of *P. c. maunensis* in their paler colour, in series they are generally darker, buffier overall, the upperparts of the limbs in their ochraceous colour contrasting with the colour of the upperparts. Roberts in his description of *P. c. chobiensis* indicates this difference when he stated that material from the Chobe River is 'in colour very much like *P c cepapi* except that the toes and underparts are whiter'. None of the series show the intensity of colour on the body or limbs seen in material from the extreme south-east (*P. c. cepapi*), they are furthermore whiter on the underparts and lack the ochraceous patch under the base of the tail and round the anus, the colour here being less pronounced and generally yellower. Again the back of the ears of this series are paler, with a sparse cover of whitish hairs, in this respect tending towards the white in *P. c. maunensis*.

The dimensions of the skulls of a series from this area are as follows:

Skull TL	$\bar{X} = 42{\cdot}1$;	$N = 8$;	Obs. range 41·5-43·8
ZW	$\bar{X} = 24{\cdot}6$;	$N = 8$;	„ „ 23·5-25·6

In these respects this material closely approximates to the dimensions of *P. c. maunensis*, but on the basis of colour it is proposed to retain the name *P. c. chobiensis* to accommodate this material.

The third group of Botswana material from the extreme north of the north-western sector (Tsodilo Hills, Shakawe and Aha Hills) is greyish on the upperparts, the top of the muzzle and forehead with a tinge of ochraceous, contrasting in colour with the remainder of the upperparts. The tail is distinctly dark, due to a liberal admixture of hairs in which the black bands are broad, in some cases covering up to seven-eighths of the total length of the individual hair.

The upperparts of the fore and hind limbs are pale buff with a tinge of ochraceous, this colour not extending to any extent on to the shoulders or thighs.

The hair of the underparts is off-white or ivory, this extending on to underparts of the fore and hind limbs, with a clearly defined ochraceous patch at the base of the tail extending to either side of the anus. The back of the ears are dark brown with a sparse covering of buffy hairs.

The most distinctive feature of this group of species is their very dark tails, darker than *P. c. kalaharicus* Roberts from Mabeleapudi or any other material from the southern parts of the north-western sector.

P. c. kalaharicus Roberts from Mabeleapudi at the extreme southern limits of the species in this sector is according to Roberts' description very like *P. c. maunensis* in 'size, shape of nasals and general coloration'. The type, however, is distinctly darker on the upperparts, the tail and the head, than the series from Maun but not nearly so dark on the tail as the material comprising group 3 of the Botswana material although in size it has been shown that in series it closely resembles group 3.

Roberts also describes a further subspecies *P. c. tsumebensis* from Tsumeb, South West Africa, 250 miles west of Shakawe in country that is ecologically similar. This is a dark-tailed form with a small skull (TL 39; ZW 24·4). Unfortunately the type remains the only representative of this subspecies and proper comparison in series with the western Okavango material is impossible.

P. c. kalaharicus Roberts is described on material from Mabeleapudi at the extreme southernmost limits of the distribution of the species in the western parts of Botswana. As a name for a population with dark tails it antedates *P. c. tsumebensis*.

Until further information is available *P. c. kalaharicus* is retained to accommodate the material from the Western Okavango which is so different from the pale-coloured *P. c. maunensis*.

Hill and Carter (1941) relegate a series from the southern plateau of Angola (Capelongo) to *P. c.*

phalaena but state that 'the colour of the upperparts is between isabelline and deep olive buff, the tail darker, the head isabelline', a description which is difficult to reconcile with the description of *P. c. phalaena* which Thomas states is 'pale grey, the crown of the head the same shade of grey as the back, the tail very light coloured'.

Hill and Carter's Angola series and those from north-western Botswana appear very similar in respect of their colour and size.

On the above basis the distribution of the various subspecies in broad outline is as follows:

P. c. cepapi (A. Smith, 1836). The eastern sector from the Tati Concession south to Debeeti, with a break in distribution within Botswana limits to Mochudi and from this area southward to Lobatse and west to the Kanye area.

This subspecies intergrades in the northern parts of its distribution with *P. c. maunensis*.

P. c. chobiensis Roberts, 1932. The northern part of the north-eastern sector along the Chobe River west to the Selinda Spillway intergrading southwards with *P. c. maunensis*.

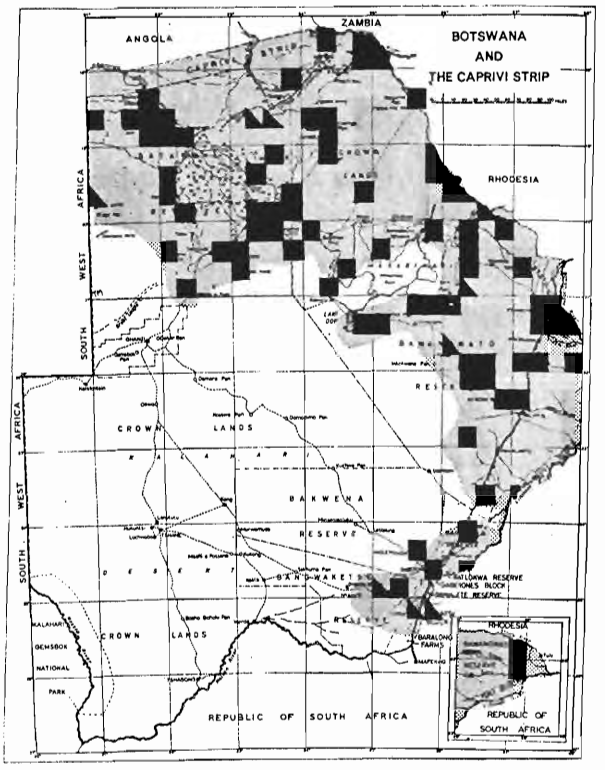
P. c. maunensis Roberts, 1932. The eastern part of the Okavango delta eastwards across the northern parts of the Makgadikgadi to the Rhodesian border intergrading with *P. c. chobiensis* in the northern part of its range and with *P. c. cepapi* in the eastern parts of the Makgadikgadi.

P. c. kalaharicus Roberts, 1932. The western parts of the Okavango delta north to the Caprivi Strip and west to the South West African borders and south to Mabeleapudi intergrading with *P. c. maunensis* south of the delta.

Distribution

Widely distributed throughout the northern parts of the territory from the Aha Hills in the west, Lake Ngami, and south to Mabeleapudi, the Kwebe Hills, Botletle River and throughout the northern parts of the Makgadikgadi east to the Nata River, wherever there is suitable woodland habitat. From the Nata River southwards, they are common throughout the eastern sector to just south of Lobatse, being absent in the extreme south-east in the Baralong farms and between Debeeti and Artesia in the eastward extension of the Kalahari scrub savannah, except in the riverine woodland of the Limpopo River.

In the south they occur west to near Dikgomodikae and Molepolole, further north, to the Shoshong and Makhware Hills and Inkokwane Pan, with an arm of distribution running westwards just south of Makgadikgadi to near Lake Dow in mopane and *Acacia*



woodland. They are absent in the open grassland of the southern part of the Makgadikgadi.

Habitat

An analysis of the habitat in which 536 specimens were collected clearly indicates that their principal habitat requirement is woodland, all 536 being taken in this type of association. Among the categories of woodland listed mopane, *C. mopane*, might take the form of the well-developed very fine stands found fringing the Okavango delta, where the trees formed an open pure forest reaching a height of 30 to 40 feet or the poorer type with trees up to 15-20 feet found in parts of the drier hinterland.

Riverine woodland was of various types including *Acacia* (*A. nigrescens*, *A. giraffae*, and other species), found as pure stands to the fringes of rivers or swamp (parts of the Botletle and Thamalakane rivers or at Tsau or Gomare on the western fringe of the Okavango swamp) or a richer type growing on alluvium found, in parts, along the Chobe, Kwaai, Botletle and Thamalakane rivers; on the fringes of swamp (Moremi Game Reserve) or on swamp islands (Nokaneng). This richer type of riverine woodland included a range of evergreen and fruit-bearing trees such as the wild fig, *Ficus spp.*; lance tree, *Lonchocarpus capassa;*

Diospyros mespiloformis; Garcinia livingstonei; Phyllogeiton discolor; Kigelia pinnata; and *Combretum imberbe*, etc., in some parts with vegetable ivory palms, *Hyphaena ventricosa*. The category *Acacia* woodland provides for the very large areas where *Acacia* of a variety of species forms nearly pure stands in dry country such as is found in parts of the north-eastern and eastern sectors.

The category mixed woodland covers the type of associations found in parts of the north-eastern and eastern sectors such as at Tamafupi where there are stands of *Acacia* in a predominantly *Terminalia-Combretum* association on sandy soil, or in the eastern sector where there are scattered *Acacia nigrescens* trees in an association of *Combretum* with a good cover of undershrubs.

The species is common in broken country where this has a woodland cover as, for example, on the ironstone ridges at Matjemleeji, in the Tate Concession, on the granite kopjes and dwalas between Francistown and Plumtree and in other parts of the eastern sector irrespective of the type of rocky terrain whether of sandstone (Mabate) or quartzite outcrops of the Waterberg system (vicinity Mochudi).

Within the miscellaneous category are parts of associations difficult to define as, for example, in the case of *C. imberbe*, where stands of these fringe pans in the north-east in otherwise mopane or *Acacia* associations, or the small stands of marula, *Sclerocarya caffra*, found in areas such as Odiakwe or Tsaugara Pan.

A breakdown of the 536 specimens according to the habitat in which they were taken is as follows:

Mopane woodland	158
Riverine woodland	150
Acacia woodland	82
Mixed woodland with *Acacia-Terminalia* and *Combretum*	51
Kopjes with woodland cover	38
Misc. woodland including *Sclerocarya caffra*, *Combretum imberbe*, etc.	33
Unspecified woodland	24
	536

The species, while particularly common in riverine woodland, in the north-east is rare or entirely absent except on the fringes of the *Baikiaea* woodland which covers a large area on Kalahari sand immediately south of the Chobe River.

Habits

Arboreal, but to some extent terrestrial, often seen feeding on the ground. Occur singly or in pairs or family parties. Diurnal, emerging from the holes in hollow trees, in which they sleep during the night, well after sunrise, retiring well before sunset; on cold, windy days little in evidence and not emerging at all during rain.

If disturbed while on the ground make for their resting holes, or other refuge holes within their home range, in which they take cover. Alternatively will run up the nearest tree proceeding to the tips of high branches among the foliage of which they will hide themselves or will lie prone on a branch, the tail flat, the legs straddling, or will sit in the fork of a tree in which situations they remain motionless and are very difficult to see. When taking to trees under stress they persistently keep the trunk or branch of the tree between them and the observer.

Food

Vegetarian. Unfortunately the food is masticated so thoroughly that it is impossible to identify items macroscopically from stomach contents. Observations show that they will eat a wide range of wild fruits either green or dry including *Ficus* spp., *Zizyphus mucronata*, *Acacia* spp. and mopane, *C. mopane*, pods and seeds; the fresh green shoots of *Acacia* spp. forbs and green grass (*Cyonodon dactylon*).

Breeding

Examination of a series of 256 reproductive tracts of adult females taken throughout the year revealed the presence of pregnant females in every month except May and September. During the cold dry months from May till September, however, only five were pregnant or lactating out of a series of 109 (4·5%) whereas from October to April, during the warmer wetter months, 48 out of 94 (51·0%) were pregnant or lactating. While the species appears to be capable of breeding throughout the year, there is a very marked increase during the summer months of October till April. Although the samples are small it is notable that a higher percentage of females were pregnant or lactating in November and December than in the other months.

Breakdown of the number of pregnant or lactating females in a sample of 256 through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total No.	8	29	22	53	17	20	44	21	12	5	16	9
Non-gravid	6	20	12	39	17	18	42	20	12	4	8	5
Lactating	–	2	2	4	—	1	—	—	—	–	3	–
Gravid	2	7	8	10	—	1	2	1	—	1	5	4

The average number of foetuses is as follows:

Foetuses

Number $\bar{X} = 2{\cdot}1$; $N = 39$; Obs. range 1-3.

Within this series there were 12 females with three foetuses; 18 with two foetuses; and 9 with a single foetus.

Implantation is irregular and in a sample of 34 pregnant females was as follows:

3L	2L	1L	1R	2R	1R1L	1R2L	2R1L	3R
2	2	1	7	1	12	4	2	2

Sizes and Weights

North-western (P. c. kalaharicus)

MALES

TL	$\bar{X} = 329$;	$N = 10$;	Obs. range 305-355
T	$\bar{X} = 162$;	$N = 10$;	„ „ 130-180
Hf c/u	$\bar{X} = 44$;	$N = 11$;	„ „ 36- 47
E	$\bar{X} = 20$;	$N = 11$;	„ „ 19- 21
Weight	$\bar{X} = 170$ g;	$N = 7$;	„ „ 117-200 g

FEMALES (*P. c. kalaharicus*)

TL	$\bar{X} = 329$;	$N = 12$;	Obs. range 315-355
T	$\bar{X} = 163$;	$N = 12$;	„ „ 135-181
Hf c/u	$\bar{X} = 44$;	$N = 12$;	„ „ 40- 47
E	$\bar{X} = 19$;	$N = 12$;	„ „ 16- 22
Weight	$\bar{X} = 147$ g;	$N = 10$;	„ „ 108-200 g

Maun, Shorobe (P. c. maunensis)

MALES

TL	$\bar{X} = 345$;	$N = 13$;	Obs. range 328-360
T	$\bar{X} = 169$;	$N = 13$;	„ „ 150-180
Hf c/u	$\bar{X} = 45$;	$N = 13$;	„ „ 43- 48
E	$\bar{X} = 19$;	$N = 12$;	„ „ 17- 20
Weight	$\bar{X}$ = Not available		

FEMALES (*P. c. maunensis*)

TL	$\bar{X} = 343$;	$N = 13$;	Obs. range 320-365
T	$\bar{X} = 162$;	$N = 13$;	„ „ 149-174
Hf c/u	$\bar{X} = 44$;	$N = 13$;	„ „ 42- 47
E	$\bar{X} = 19$;	$N = 14$;	„ „ 14- 21
Weight	$\bar{X}$ = Not available		

Gaberone (P. c. cepapi)

MALES

TL	$\bar{X} = 361$;	$N = 9$;	Obs. range 331-382
T	$\bar{X} = 180$;	$N = 8$;	„ „ 170-194
Hf c/u	$\bar{X} = 48$;	$N = 11$;	„ „ 43- 50
E	$\bar{X} = 20$;	$N = 11$;	„ „ 18- 22
Weight	$\bar{X} = 216$ g;	$N = 9$;	„ „ 173-240 g

FEMALES (*P. c. cepapi*)

TL	$\bar{X} = 365$;	$N = 3$;	Obs. range 349-385
T	$\bar{X} = 184$;	$N = 3$;	„ „ 183-185
Hf c/u	$\bar{X} = 48$;	$N = 3$;	„ „ 47- 48
E	$\bar{X} = 21$;	$N = 3$;	„ „ 18- 24
Weight	Only two available, 168 g and 235 g		

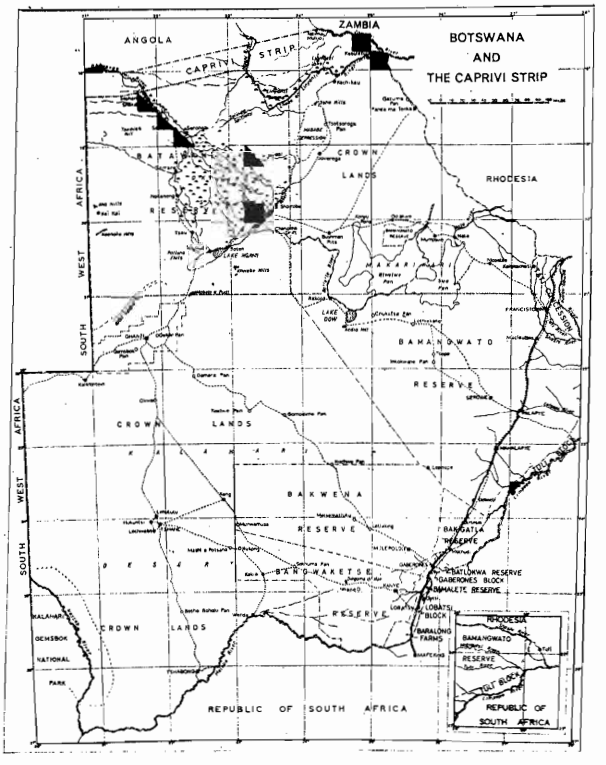
Family OCTODONTIDAE

Genus THRYONOMYS Fitzinger, 1867

Thryonomys swinderianus

Qa Qadi Greater Cane Rat

T. swinderianus (Temminck, 1827)



Distribution

Occur along the Okavango River and throughout the northern and eastern parts of the Okavango delta south to Maun. Not at the moment recorded in the western part of the delta south of Seronga, where there is ample suitable habitat and where they may have been overlooked. Common on the Chobe River at Kasane and in the swamps of the eastern Caprivi (Trollop Canal, B. Carp. Expedition, 1947) and Ansell (1966) records a specimen from near Shesheke (1724D2). There is a single record from the Limpopo River in the eastern sector (2327D1). Both on the Chobe and Limpopo rivers probably more widely distributed than present records indicate.

Habitat

Tall and matted grass and reed-beds on the fringes of rivers and swamp. In the Moremi Game Reserve a colony lived in an extensive area of matted grass about 50 cm deep on the river fringe; at Mohembo in

a *Phragmites communis* reed-bed (three metres high) at the base of the high river-bank. In both cases some of the habitat was situated on dry ground, the remainder wet or subject to flooding.

Habits

Gregarious, living in colonies of up to a dozen, nocturnal and, to some extent, diurnal. In the Moremi Game Reserve the main activity seemed to be from the early hours of the morning, about an hour before sunrise until about 7 a.m., and in the late evening. Here they emerged from cover to move about on the dry cleared area of a permanent camp visiting the kitchen area where they would pick up and eat scraps of vegetables, potato peel, etc. Individuals from this colony were found 50 metres from the swamp edge in tall grass in the riverine woodland. Near Kasane they were seen moving from about 5 p.m. until just after sunset, although there seemed to be some activity after dark.

Very distinct runs are formed in the grass and reed-beds by the activities of the colony, these leading to the edge of the water and to other parts of the area where there was food. Lie up during the day in the thicker parts of the habitat, on pads of dry vegetation, well hidden.

Food

Vegetarian, living on grasses, reeds, sedges and semi-aquatic vegetation. Small piles of the cut stems of the grasses and reeds on which they feed may be found in the runs.

Reported as destructive to agricultural crops such as mealies, pumpkins, and sweet potatoes in the western Okavango.

Breeding

The only indication of the time the young are born is given by a juvenile, C 1697 from Kasane, taken on the 1st May, 1966. Shortridge (1934) reports that newly-born litters were found on the Okavango (River) in June and August. In Rhodesia juveniles have been taken in August and November and a gravid female with three foetuses in November.

Sizes and Weights

No information from Botswana.

Families CRICETIDAE and MURIDAE

Peba Rats and Mice

Missone (1968) states that there is only one good character separating the Cricetidae from the Muridae, i.e. the shape of the molars.

Following his classification, the families Cricetidae and Muridae are kept together as the status of some subfamilies is not clear.

Family	*Subfamily*	*Genus*
CRICETIDAE	GERBILLINAE	*Gerbillurus*
		Tatera
		Desmodillus
	DENDROMURINAE	*Dendromus*
		Stratomys
		Malacothrix
	CRICETOMYINAE	*Saccostomus*
	OTOMYINAE	*Otomys*
		Parotomys
MURIDAE	MURINAE	*Acomys*
		Rhabdomys
		Lemniscomys
		Leggada—Mus
		Zelotomys
		Dasymys
		Thallomys
		Aethomys
		Praomys

Key to the subfamilies after Misonne (1968).

1. M^3 the largest tooth . . Subfam. Otomyinae
   M^1 the largest tooth 2
2. M^1 with three cusps in the first row . . . Subfam. Murinae
   M^1 with two cusps in the first row . . . 3
3. Pattern of upper molars as in fig. 22 . . Subfam. Gerbillinae
   Pattern of upper molars not as above . . . . Subfam. Dendromurinae
   . . . . Subfam. Cricetomyinae

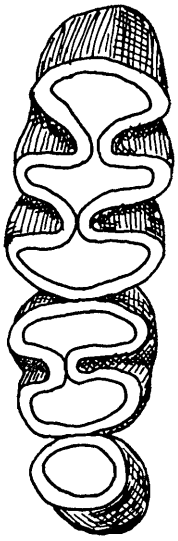


Fig. 22 Pattern of Gerbillinae upper molar (worn). After Ellerman *et al.* (1941)

Subfamily OTOMYINAE

Key after Misonne (1968).

Bullae much enlarged, minimum length 10·8 mm in adults . . . . . *Paratomys*

Bullae little or not at all enlarged, maximum length 9·5 mm . . . . . *Otomys*

Genus PAROTOMYS Thomas, 1918

Parotomys brantsi Brant's Karroo Rat

P. b. deserti Roberts, 1933

Taxonomic Notes

The series lacks the bright tawny-buff on the upperparts characteristic of *P. b. pallida* of Namaqualand, being overall greyer, with only a faint wash of tawny-buff. Although there is some variation in this character between material from the four localities, in general it conforms to the description of *P. b. deserti* Roberts, the type locality of which lies some 20 miles south of Khuis.

Distribution

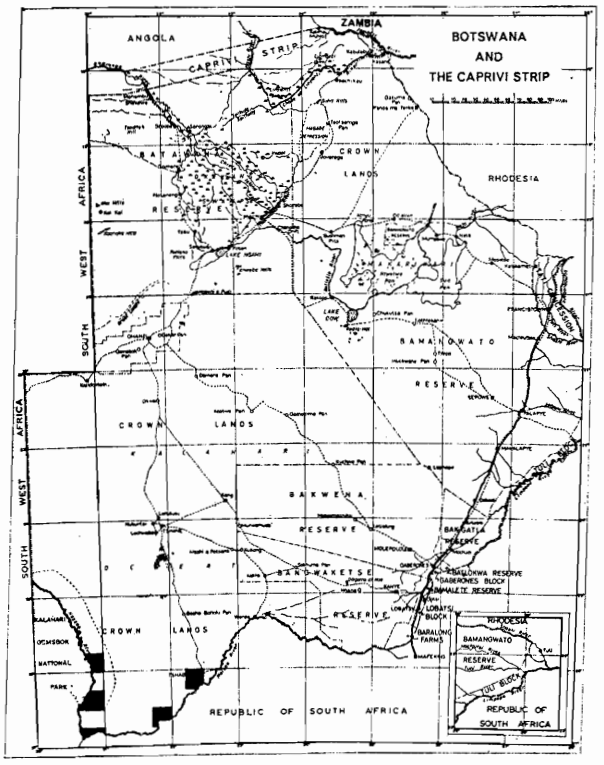
Confined to the extreme south-western Kalahari, south of *c.* 25°45′ S. and east to 22°30′. As they have been recorded in South West Africa at *c.* 24°30′ S. may in time be shown to occur further north in the Kalahari Gemsbok National Park.

Their present distribution in Botswana falls within the limits of the 300 mm mean annual rainfall zone.

As they are not recorded in the extreme north-eastern Cape Province along the Molopo River, will probably be found to be restricted to the south-western parts of Botswana.

Habitat

Hard sand areas and hard ground with a very open cover of low karroid bushes and sparse short grass in



open sand-dune country, in dry river-beds or on the fringes of pans with short grass cover.

Habits

Diurnal, live in warrens with many entrances excavated in hard sandy ground between the sand-dunes or in dry river-beds. During the day squats near the entrance to the burrow sitting up on its back legs and, on alarm, whistle loudly and stamp their back feet before taking cover in the burrow.

The open sand adjacent to the warren entrances is littered with droppings and the coarser stems of the grass and herbage, the finer portions of which they eat. This is normally cut and dragged back to the entrance to be eaten.

In captivity, under conditions where burrow construction is impossible, piles the uneaten finer sections of the vegetable food to construct a substantial domed shelter in which they rest with the nose protruding. Shortridge (1934) quotes Roberts as stating that shelters of this type are constructed in the wild but they have not so far been seen in Botswana.

Food

A vegetarian, living on grass, grass seeds and fresh green shoots of low-growing shrubs. In captivity thrive on a diet of fresh lucerne, carrots and moonga (finger millet).

Breeding

There are nine records of pregnant females, all from Bokspits, Nosop River, taken on the 24th and 25th February, 1967.

Foetuses

The average number of foetuses was as follows:
Number $\bar{X} = 2{\cdot}1$; $N = 9$; Obs. range 1-3.

Two females carried three foetuses, six two foetuses and one a single foetus. Implantation irregular.

Liversedge (*pers. comm.*) has observed the female carrying the young attached to the nipples (Tshabong).

Sizes and Weights

MALES

TL	$\bar{X} = 239$;	$N = 4$;	Obs. range 220-263
T	$\bar{X} = 93$;	$N = 4$;	„ „ 85-100
Hf c/u	$\bar{X} = 32$;	$N = 4$;	„ „ 29- 34
E	$\bar{X} = 18$;	$N = 3$;	„ „ 17- 19
Weight	Two only available, 130 g and 145 g		

FEMALES

TL	$\bar{X} = 246$;	$N = 18$;	Obs. range 227-274
T	$\bar{X} = 93$;	$N = 18$;	„ „ 80-110
Hf c/u	$\bar{X} = 32$;	$N = 17$;	„ „ 27- 34
E	$\bar{X} = 17$;	$N = 17$;	„ „ 15- 18
Weight non-gravid	$\bar{X} = 121$ g;	$N = 8$;	„ „ 89-155 g
Weight gravid	$\bar{X} = 138$ g;	$N = 9$;	„ „ 98-155 g

Genus OTOMYS Cuvier, 1823

Otomys angoniensis

O. a. maximus Roberts, 1924

O. a. pretoriae Roberts, 1929

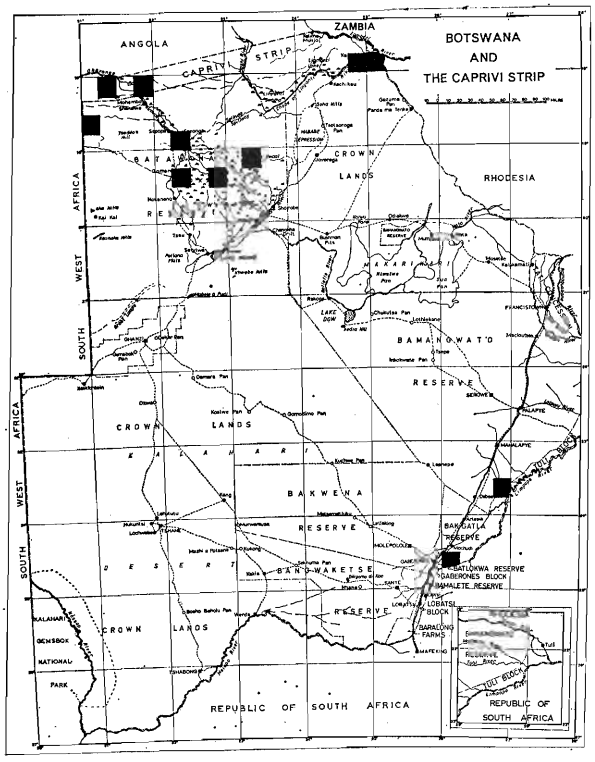
Angoni Vlei Rat

Taxonomic Notes

Two subspecies occur in the territory, *O. a. maximus* Roberts, confined to the northern parts of the territory, and *O. a. pretoriae* Roberts at present only recorded from two localities in the eastern sector. *O. a. maximus* is larger than *O. a. pretoriae* and has a relatively narrower skull.

Distribution

The species occurs in the extreme north-west on the Okavango River and adjacent parts of the delta south to Nokaneng and the Gomoti River (19 22 B4); on the Chobe River between Kasane and Serondela, on the Limpopo River at Sequane and the Notwani River, 10 miles north-west of Gaborone.



As the species occurs immediately east of the Botswana border in the Ootsi-Baralong farms area they may, in time, be found in suitable habitat in the extreme south-east, south of Gaborone. Their occurrence on the Limpopo River and its tributary, the Notwani, suggests that they may be found more widely on this river system than present records indicate.

Although, so far, they appear, in the north, to be confined to the north-western parts of the Okavango delta, there is ample suitable habitat east and south of its present limits of distribution and they may, in time, be found to be more widespread in the delta.

Habitat

The fringes of rivers, with reed-beds, sedge-beds and semi-aquatic grasses; the fringes of swamp and swamp islands with similar vegetation. Also occur in permanently wet vleis (50 miles west of Shakawe).

Habits

Predominantly nocturnal, but to some extent diurnal (Chobe River) as well. Occur singly or in pairs or family parties. Builds grass nests at the base of grass tufts, in or adjacent to permanently wet places, although reported as digging burrows in some areas (Shortridge, 1934). Distinct runs are formed in the grass in swamp or other wet places, piles of cut grass stems marking the places where they have been feeding. During the wet season exhibit some local movement from their normal damp habitat, and are then found on what at other times of the year is dry ground. In Mashonaland, Rhodesia, during the rains, taken about a mile from the Gwebi River, but confined to its near vicinity in the dry season.

Move freely about in shallow water, the runs often inundated in parts.

The flesh of the species is obviously attractive to other rodents and shrews and individuals caught in traps are often destroyed by being eaten, if the traps are not cleared at frequent intervals. Shortridge (1934) states that in the Okavango they are eaten by the indigenous peoples.

Food

Largely vegetarian, eating fresh semi-aquatic grasses, newly-sprouting reeds, *Phragmites sp.*, but will also eat grains and seeds. In Mashonaland in the wet season observed taking moonga (finger millet) seeds laid out as a food for ducks.

Breeding

The only evidence of the time of dropping the young is given by a series of three gravid females from Kasane as follows:

No.	*Month*	*Foetuses*	*Implantation*
C 905	October	5	4R 1L
C 1190	December	3	2R 1L
C 2669	March	3	2R 1L

and the presence of juveniles of weights 25-65 gm in the months of September, November, January and February. This indicates that the young are born at least during the warm wet months of the year from about August to March.

Further data are required from the cold dry months of the year from about April to August before we can be certain as to whether they breed throughout the year or if this is restricted from about August to March.

Sizes and Weights

MALES (Chobe River series)

TL	$\bar{X} = 296$;	$N = 14$;	Obs. range 259-330
T	$\bar{X} = 109$;	$N = 13$;	„ „ 95-122
Hf c/u	$\bar{X} = 37$;	$N = 14$;	„ „ 33- 42
E	$\bar{X} = 23$;	$N = 14$;	„ „ 21- 24
Weight	$\bar{X} = 178{\cdot}4$ g;	$N = 11$;	„ „ 112·0-242·8 g

FEMALES (Chobe River series)

TL	$\bar{X} = 283$;	$N = 6$;	Obs. range 217-317
T	$\bar{X} = 120$;	$N = 6$;	„ „ 100-150
Hf c/u	$\bar{X} = 35$;	$N = 6$;	„ „ 35- 39
E	$\bar{X} = 24$;	$N = 6$;	„ „ 23- 25
Weight	$\bar{X} = 205{\cdot}3$ g;	$N = 5$;	„ „ 140·5-255·1 g

Subfamily MURINAE

1. Upper incisors grooved . . . . . *Pelomys*
   Upper incisors not grooved 2
2. Fur spiny . . . . . *Acomys*
   Fur not spiny 3
3. Lines or stripes on the back 4
   No lines or stripes on the back 5
4. One dark line on the back. . . *Lemniscomys*
   More than one dark line on the back . . . . . *Rhabdomys*
5. Tail white or whitish . . . . . *Zelotomys*
   Tail not white or whitish 6
6. Strong interorbital constriction . . *Dasymys*
   No strong interorbital constriction . . . 7
7. Rows of cusps on M^1 markedly distorted . 8
   Rows of cusp on M^1 not markedly distorted 9
8. Extreme distortion of cusps; size small, head and body length not over 70 mm; underparts brown or reddish brown . . . . . *Mus-Leggada*
   Medium distortion of cusps; size larger, head and body length over 70 mm; upperparts grey or brownish-grey . . . . . *Praomys*
9. Dark marking in front of the eye. . *Thallomys*
   No dark marking in front of the eye . *Aethomys*

Pelomys fallax

Creek Rat

P. f. rhodesiae Roberts, 1929

Taxonomic Notes

Roberts (1951) states that his *P. f. rhodesiae* is 'similar to *P. f. australis* in respect of its long tail', there is, however, a considerable variation in length in a series from Kasane (*see* Sizes and Weights) from 114-183, the average tail length being: males 145; females 146. Roberts gives the minimum and maximum lengths of a series of four *P. f. rhodesiae* from the type locality, the Machile River, Zambia, as 150-167, from which it would appear that, if a larger series had been available, it might have been shown that Roberts' four specimens, which still fall within the observed range given for the Kasane series, had longer tails than the average.

There does not seem to be any size difference between the Kasane series and the measurements of *P. f. australis* or *P. f. vumbae* as given by Roberts (1951).

The Shakawe, Sepopa material, in small series, is indistinguishable from the material from Kasane which are clearly distinguishable from *P. f. vumbae*

Roberts in being less rusty-red and from *P. f. australis* in being less rusty-brown, both on the upper and underparts.

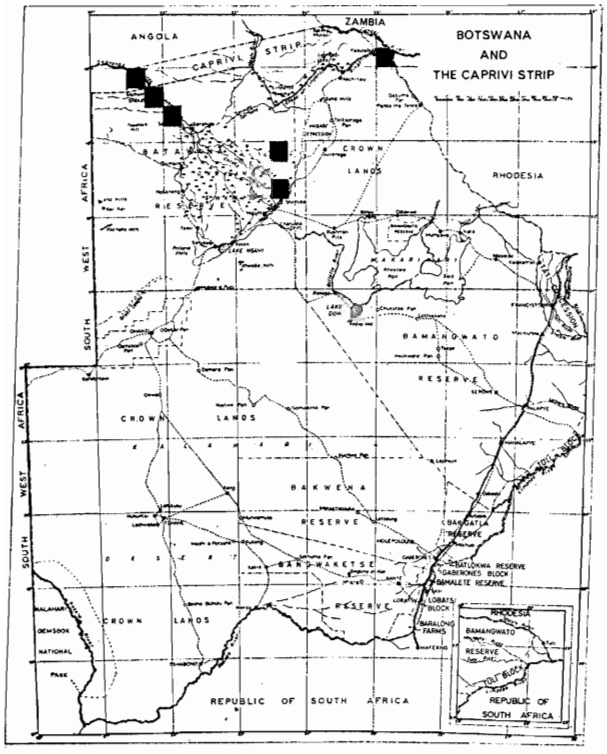
In very young specimens, of eight to nine grams, the dorsal black line, which runs from the crown of the head to the base of the tail, where it merges imperceptibly with the black top to the tail, is very distinct. By the time the individual has reached the weight of 20 g the long pelage has absorbed the distinctness of the dorsal line and it is, in some cases, barely perceptible. In some adults (Kasane C 642) it cannot be detected, in others, it is only present in part, e.g. mid-dorsally (Kasane C 1654).

In Kasane C 648 and C 677 there is a broad suffusion covering a larger part of the dorsal surface, the dorsal line being present but obscured by the general darkening of the surrounding pelage.

In certain lights the pelage has a distinct green or blue iridescence.

Distribution

So far, only recorded from the northern parts of the territory, in the north-west along the fringes of the Okavango River from Sepopa north-westwards throughout its length in Botswana; in adjacent parts of the Caprivi Strip; in the Okavango delta just north of Shorobe, in the Moremi Game Reserve and in the north-east on the Chobe River at Kasane. Shortridge (1934) states that it occurs 'in Ngamiland' suggesting a wider distribution than the above and, in view of the Shorobe record, this may indeed be the case, but no material exists at the moment from other parts of the Okavango delta to substantiate this statement. Shortridge (1934) and Roberts (1951) both record the species from the Zambezi River, Zambia; Ansell (1960) as 'throughout Zambia' in suitable habitat and Hill and Carter (1941) as 'probably occurring throughout Angola where there are streams'. The Botswana records mark its southern limit of distribution in this sector although in eastern Rhodesia *P. f. vumbae* occurs south to about 19° S. on the Vumba, Umtali.



Habitat

The fringes of rivers where there are reed-beds, matted aquatic grasses, sedges or other lush vegetation. This type of association is common throughout the Okavango delta, and it is curious, therefore, that the species is apparently so closely confined to the northern rivers and not more widely distributed in this apparently suitable habitat within the delta itself. The species is difficult to trap and can be missed if reliance is placed on trapping alone. Where they occur can often be seen sunning or feeding on the matted vegetation along the rivers edges. So far they have not been seen in this situation within the Okavango delta area, in spite of dilgent search.

Roberts (1951) specifically restricts the habitat to this type of situation stating that they occur 'in coarse vegetation along streams and rivers' although Shortridge (1934) quoting Grant (Beira) records their occurrence in 'all damp places' and Ansell (1960) in 'swamps, reedbeds and dambos'. In eastern Rhodesia they occur in matted vegetation along streams and in Mashonaland (Salisbury) in reed-beds fringing streams and wet vleis. The Sepopa specimens were shot on floating or stranded masses of reeds and other debris where they were feeding and sunning themselves during daylight hours.

Habits

Almost entirely diurnal and semi-aquatic.

Clearly defined runs are produced by this species which can, however, be confused with those made by *Otomys* and *Dasymys*.

Shortridge (1934) states that 'Okavango natives say that *Pelomys* lives above ground' and that 'no rat holes of any description were observed in the swamps and

reed-beds of the Okavango'. Liversedge (*pers. comm.*) states, on the other hand, that at Sepopa there were many *Pelomys* holes in the dry ground on the river-bank. In Mashonaland they are frequently turned up by the plough in dry ground adjacent to streams.

Food

The green tinge in stomachs indicates that they feed on green vegetable matter. Shortridge (1934) says they feed on 'reed shoots and other swamp vegetation'. At intervals on the runs small piles of cut grass stems and scraps of thin reed appear to confirm this.

Breeding

The only indications of the breeding season available are: Juveniles (29·6 g) 26.8.65; (21·5-28·6 g) 23-28.8.65; (34·5 g) 26.11.65; and two about newborn (8·6 g-9·8 g) 18.1.65, all from Kasane and at Shakawe on the western Okavango (11 g) 4.5.68. In addition a lactating female was taken at Kasane 20.3.67. All these records fall in the warmer wetter months of the year, August to April.

Sizes and Weights

MALES

TL	$\bar{X} = 292$;	$N = 20$;	Obs. range		220-365
T	$\bar{X} = 145$;	$N = 19$;	„	„	114-183
Hf c/u	$\bar{X} = 37$;	$N = 20$;	„	„	32- 40
E	$\bar{X} = 18$;	$N = 22$;	„	„	15- 20
Weight	$\bar{X} = 141{\cdot}5$ g;	$N = 10$;	„	„	100·5-170·4 g

FEMALES

TL	$\bar{X} = 287$;	$N = 30$;	„	„	239-330
T	$\bar{X} = 146$;	$N = 29$;	„	„	131-175
Hf c/u	$\bar{X} = 36$;	$N = 43$;	„	„	31- 41
E	$\bar{X} = 17$;	$N = 48$;	„	„	15- 20
Weight	$\bar{X} = 117{\cdot}9$ g;	$N = 7$;	„	„	100·3-149·8 g

Genus ACOMYS I. Geoffroy, 1838

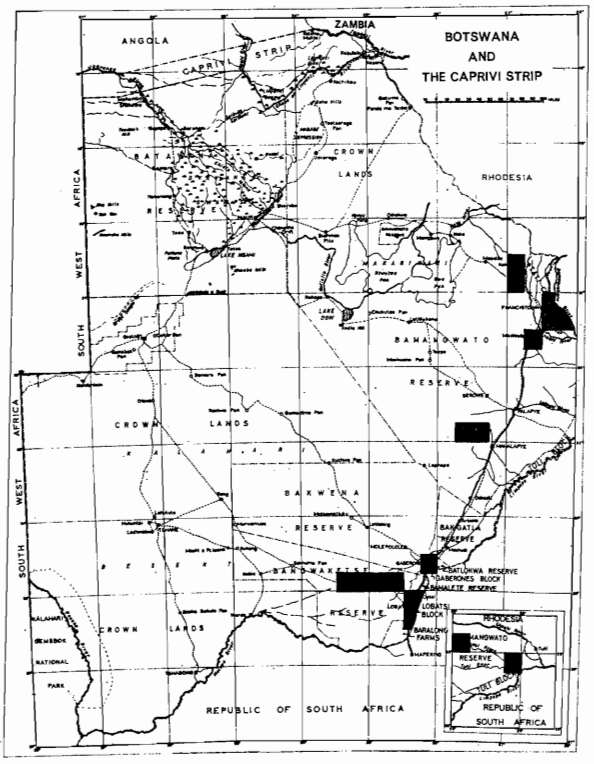
Acomys spinosissimus — Spiny Mouse

A. s. selousi de Winton, 1897

Taxonomic Notes

Setzer (1968) recognizes two subspecies *A. s. selousi* de Winton from western Rhodesia and *A. s. spinosissimus* Peters from eastern Rhodesia and western Mozambique. Peters' type of *A. s. spinosissimus* is stated to have a grey belly (c.f. Roberts, 1951), which Roberts suggested was due to staining. All the material in the collection of the National Museums of Rhodesia from eastern Rhodesia is white-bellied, as indeed it is from western Rhodesia and Botswana.

There is a wide variation in the colour of the upper-parts within series from localities both in Botswana and Rhodesia. Taking a series of 13 specimens from Moshaneng, all taken in March, there is a variation from a dark smoky grey (K 230) to an overall reddish with a broad suffusion of light smoky grey on the mid-back (K 190). In K 229 the front half of the back is smoky grey, the posterior half reddish, the two colours divided sharply and distinctly suggesting that the specimen is in the half-stage of a moult, the older faded hairs of the pelage being replaced by fresh smoky grey hair. This stage is apparent in other specimens (TNL 2119 from Francistown, etc.). In BP 1417 from Gaborone, where the general run of the series is dark smoky grey in colour, the pelage is overall pale bleached reddish. Further study on a year-round collection of material from a single locality



might show that the variation in colour is linked with the moult, but no such series is at present available.

The whole of the Botswana material is referred to *A. s. selousi* de Winton.

Distribution

Confined to the eastern sector from just west of Kalakamati, northern Tati Concession, south to Shoshong and east to near the Tuli Circle. There is a break in distribution southwards, where the Kalahari association extends eastwards to the Transvaal border between Mahalapye and Mochudi, the species then reoccuring from the Gaborone area to just south of Lobatse and west to Dikgomodikae.

Not recorded from South West Africa (Shortridge, 1934) and believed to be absent from the western parts of Zambia (Ansell, 1960).

Habitat

In the main confined to rocky kopjes, krantzes and rocky hillsides. In the Tati Concession and vicinity, in granite kopjes, tends to be confined to the higher parts of these kopjes on ledges and in the shelter of exfoliation or in caves, not being found lower down although conditions appear ideal.

Habits

Nocturnal, terrestrial, in parts quite large numbers may occupy the shelter provided by a cave or ledge, as many as nine being caught in a single trap in succession (Tati Concession), in others solitary, in pairs or family parties. Their presence can usually be detected by the accumulation of scats which are characteristically cylindrical, the ends broken off at right-angles, these normally slightly reddish in colour. Grass, leaves and other debris are dragged into the crevices to form a rough nest in which the young are born.

Food

Graminivorous and to some extent insectivorous.

Breeding

Gravid females have been taken in December, January, March and April, indicating a time of dropping the young to be during the warm wet months of the year.

Distribution of non-gravid and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	9	–	9	3	3	7	–	–	1	1	3	6
Non-gravid	8	–	1	2	3	7	–	–	1	1	3	4
Gravid	1	–	8	1	–	–	–	–	–	–	–	2

In a sample of 12 gravid females the average number of foetuses was as follows:

Foetuses

Number $\bar{X} = 3{\cdot}0$; $N = 12$; Obs. range 2-5.

the implantation irregular.

Sizes and Weights

This species is extremely delicate and is subject to damage in traps and by the predations of ants. Furthermore, even when caught alive, many are taken with damaged tails. The TL and T lengths are therefore inclined to be inaccurate and are not used.

Tati Concession

MALES			
Hf c/u	$\bar{X} = 17$;	$N = 10$;	Obs. range 16-18
E	$\bar{X} = 13$;	$N = 9$;	„ „ 12-14
FEMALES			
Hf c/u	$\bar{X} = 17$;	$N = 3$;	Obs. range 16-18
E	$\bar{X} = 13$;	$N = 3$;	„ „ 12-14

Gaberone, Moshaneng

MALES			
Hf c/u	$\bar{X} = 17$;	$N = 16$;	Obs. range 16-19
E	$\bar{X} = 13$;	$N = 11$;	„ „ 12-15
FEMALES			
Hf c/u	$\bar{X} = 17$;	$N = 8$;	Obs. range 16-17
E	$\bar{X} = 15$;	$N = 4$;	„ „ 14-15

Genus LEMNISCOMYS Thomas, 1904

Lemniscomys griselda

Singlestriped Mouse

L. g. fitzsimonsi Roberts, 1932

Taxonomic Notes

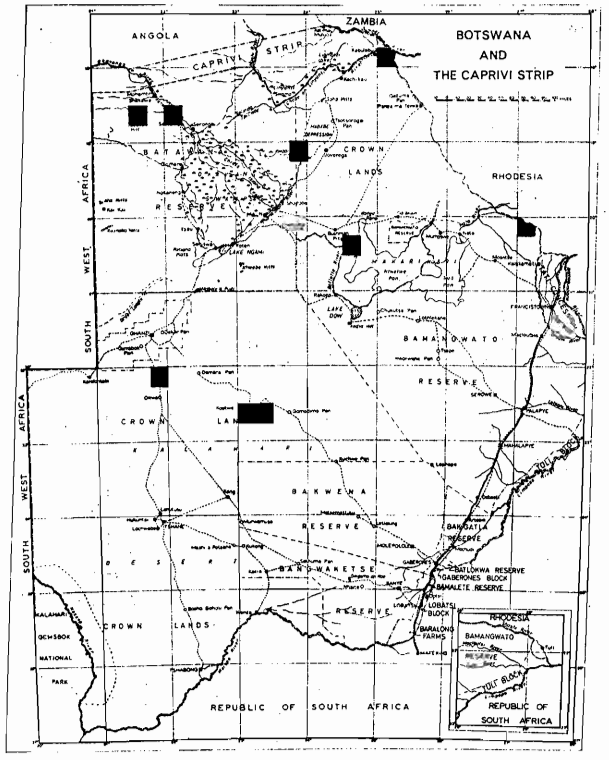
Material from the central Kalahari, the Kuke-Makalamabedi fence and Kumaga is lightest of all, the colour of the upperparts fitting well with Roberts' description of *L. g. fitzsimonsi* from Kaotwe Pan. This subspecies is very distinct, being clearly recognizable in its lighter colour from any other subspecies described.

The material from 35 miles south of Ghanzi is

buffier on the upperparts, less white and probably represents a form intermediate between *L. g. fitzsimonsi* and *L. g. sabulata* Thomas of the Gobabis district.

Tsodilo Hills material is still browner, buffier on the upperparts than that from Ghanzi. Specimens from Mandabe Dip and near Kasane on the Rhodesian border are darker than any of these and seem to represent a form between *L. g. fitzsimonsi* and the much darker *L. g. spinalis* Thomas of Rhodesia.

Until such time as there is sufficient material to show the relationship of *L. g. fitzsimonsi* to the other subspecies lying to the east and west of its range it is proposed to recognize it and consider the other forms occurring in Botswana as intermediate between it and, depending on their location, the other two subspecies mentioned above.



Distribution

The records are too few and scattered to be able to accurately assess their distributional range in the territory, throughout which they are obviously uncommon. At the junction of the Kuki-Makalamabedi fence (20 23 D4) a single specimen was taken in a week's trapping with three 60-unit trap-lines operating during the day. To date they have been taken at the Tsodilo Hills, Sepopa, Moremi Game Reserve, 35 miles south of Ghanzi, Kaotwe Pan, Kumaga, Maitengwe, on the Rhodesian border north of the Tati Concession and on the Rhodesia side of the border at Kasane.

Habitat

Taken in a wide variety of habitats as diverse as 'from a bush fence on the fringe of the swamp' at Sepopa to '*Terminalia-Acacia* scrub on red sand' on the Kuki-Makalamabedi fence.

In each of six cases, where full habitat notes are available, the common factor appears to be a good grass cover, including high stands up to a metre, not necessarily associated with damp ground, as the Sepopa record might suggest. Both Shortridge (1934) and Roberts (1935) mention grass as an essential factor in their habitat requirements and in Mashonaland they are common in stands of long grass, especially on the fringes of agricultural lands.

Habits

The species is predominantly diurnal and, like *Rhabdomys pumilio*, makes well-demarcated runways.

Food

Graminivorous.

Breeding

Only one gravid female was taken, TNL 2061, Hanahai, in October with three foetuses, implanted 3L.

Sizes and Weights

The only data available are as follows:

MALES

No.	*Locality*	*TL*	*T*	*Hf c/u*	*E*	*Weight*
TNL 2946	Sepopa	277	141	31	18	72 g
TNL 3042	Tsodilo	—	—	30	18	70 g
TNL 1988	Hanahai	187	75	26	17	54 g
TNL 2096	„	215	110	26	15	46 g

FEMALE

TNL 2061	Hanahai	241	124	26	15	56 g

Rhabdomys pumilio

R. p. bechuanae (Thomas, 1892)

Fourstriped Mouse

Taxonomic Notes

A series of eight adults from 25 miles east of the type locality of *R. p. deserti* (Dollman), Lehutitung (Lehututu), agree in certain characters with those given for this subspecies; in the pale colour and the light reddish stripes of the upperparts and the long tail (107). They have, however, a longer hindfoot (24·5) than the type of *R. p. deserti* (22·2). Roberts (1935) states that *R. p. deserti* is shorter-footed than *R. p. griquae* (Wroughton) (22·5) but this is not borne out when a series of *R. p. deserti* is examined; in fact they have, on average, longer hindfeet (24·5).

The series from Gaborone, Lobatse and the Baralong farms is, on the whole, distinctly darker overall, although some individuals are close to *R. p. deserti* in lacking the dark colour of the dorsal stripes, which are reddish like *R. p. deserti*. Roberts (1935) included three specimens from Gaborone with *R. p. deserti* on the basis of their redder dorsal markings. This population appears to be intermediate between *R. p. deserti* and the less rusty-coloured *R. p. vaalensis* of the western Transvaal.

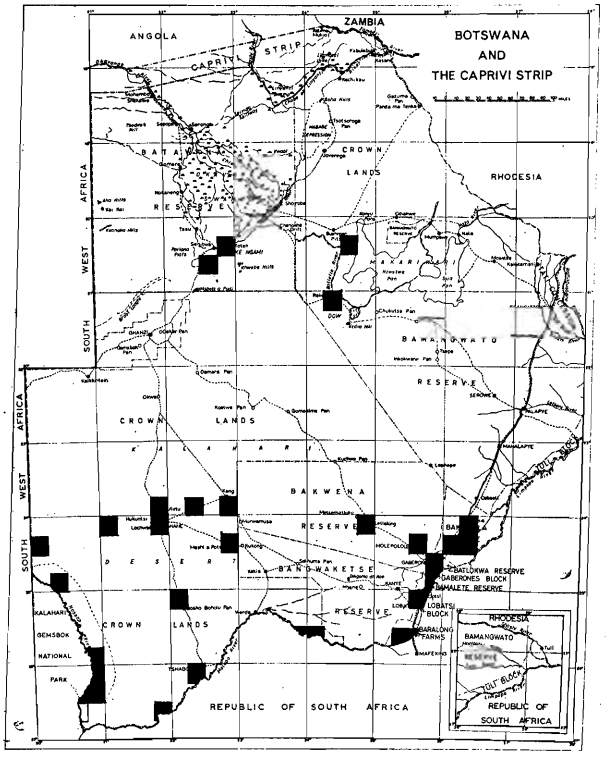
Coetzee (1967) at the Zoological Society of South Africa Symposium in Pretoria confirmed Lundholm's view that there are no valid subspecies, or at most only a few, perhaps an eastern, occurring in the mean annual rainfall area of 400 mm, and a western below 400 mm. On this basis the south-western Kalahari material might well be placed with *R. p. bechuanae* Thomas, 1892, of which *R. p. deserti* would become a synonym; the Gaborone, Lobatsi and Baralong Farms considered intermediate between *R. p. bechuanae* and the darker subspecies occurring further east.

The material from Lake Ngami and the Botletle River is darker on the upperparts than *R. p. bechuanae* and is also considered an intermediate form like those from Gaborone, Lobatse and the Baralong Farms.

The juveniles from 25 miles east of Tshane are on the whole slightly greyer than the adults, the stripes less well defined.

Distribution

Widespread through the southern parts of the territory north to about 23°45′ S. and again occurring in the Lake Ngami and the Botletle River area. At the moment they appear to be absent from the central Kalahari and the central and northern parts of the eastern sector. The Vernay/Lang Expedition (Roberts, 1935) did not collect this species on their transect through the central Kalahari, nor have they since been taken there in spite of the fact that there are many places where the ecological conditions are similar to that in the south-west Kalahari. In time they ought to be found further north, in the western border area, as they have been taken in South West Africa west of Mamuno, 22°15′ S., and also in parts of the eastern extension of the Bamangwato Reserve to the Tuli Circle and again immediately north of the Tate Concession, as they occur in adjacent parts of the western Transvaal and Rhodesia.



Habitat

Normally associated with grassland or *Acacia* scrub with grass they are frequently encountered using the shelter of thorn hedges round cultivated ground or

cattle kraals under which they make their burrows. In the south-western Kalahari they are particularly associated with the heavier growth of grass and *Acacia* scrub, often with *Zizyphus mucronata* trees, which flourish round the central sump drainage of pans, e.g. 25 miles east of Tshane, where this limited habitat supported a heavy population.

Habits

Predominantly diurnal, appearing most active in the early morning from about 5 a.m. to 8.30 a.m. and early afternoon from about 2.30 p.m. till 5.30 p.m. There appears to be some night activity as specimens have been taken between 9 p.m. and midnight but the numbers taken are very low compared with diurnal catches.

Form runs in dense grass or scrub bush, not venturing far onto the open ground around. Excavate holes even in hard ground, the entrances at the base of bushes or otherwise in sheltered cover and will use holes in ant heaps, or other cover.

At Tshane they entered rest huts and appeared to live as a commensal with man.

Food

Seeds of grass and annuals, *Acacia* pods and seed and the dried outer covering of *Zizyphus mucronata* berries.

Breeding

In the southern parts of the territory pregnant females were taken in January, February, June and July. Very young individuals were taken in January, February, May and June.

Distribution of non-gravid and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	2	27	2	–	3	10	1	–	–	–	–	–
Non-gravid	–	24	2	–	3	5	–	–	–	–	–	–
Gravid	2	3	–	–	–	5	1	–	–	–	–	–

The sample is too unbalanced to arrive at any definite conclusion although the indications are that they breed throughout the year. Davis (*in litt.*) states that the M.E.C. have breeding records in all months except August and September.

The average number of foetuses is as follows:

Foetuses

Number $\bar{X} = 5$; $N = 11$; Abs. range 3-9.

Implantation is irregular.

All the above breeding records were made after the break of the four-year drought during the years 1967-69.

Sizes and Weights

SW. Kalahari

MALES

TL	$\bar{X} = 211$;	$N = 8$;	Obs. range 204-216
T	$\bar{X} = 106$;	$N = 8$;	„ „ 102-110
Hf c/u	$\bar{X} = 24$;	$N = 12$;	„ „ 22- 27
E	$\bar{X} = 12$;	$N = 13$;	„ „ 11- 14
Weight	$\bar{X} = 42{\cdot}2$ g;	$N = 5$;	„ „ 32·0-55·0 g

FEMALES

TL	$\bar{X} = 214$;	$N = 11$;	„ „ 202-225
T	$\bar{X} = 105$;	$N = 11$;	„ „ 95-120
Hf c/u	$\bar{X} = 24$;	$N = 14$;	„ „ 23- 26
E	$\bar{X} = 12$;	$N = 13$;	„ „ 11- 15
Weight	$\bar{X} = 45{\cdot}7$ g;	$N = 9$;	„ „ 37·0-54·0 g

Lobatse, Gaberone, Baralong Farms

MALES

TL	$\bar{X} = 215$;	$N = 8$;	„ „ 202-227
T	$\bar{X} = 110$;	$N = 8$;	„ „ 100-119
Hf c/u	$\bar{X} = 25$;	$N = 9$;	„ „ 23- 26
E	$\bar{X} = 13$;	$N = 8$;	„ „ 13- 14
Weight	Not available.		

FEMALES

TL	$\bar{X} = 221$;	$N = 6$;	„ „ 203-227
T	$\bar{X} = 113$;	$N = 5$;	„ „ 102-119
Hf c/u	$\bar{X} = 24$;	$N = 6$;	„ „ 22- 24
E	$\bar{X} = 13$;	$N = 7$;	„ „ 12- 14
Weight	Not available		

Genus ZELOTOMYS Osgood, 1910

Zelotomys woosnami

Woosnam's Desert Rat

Z. woosnami (Schwann, 1906)

Taxonomic Notes

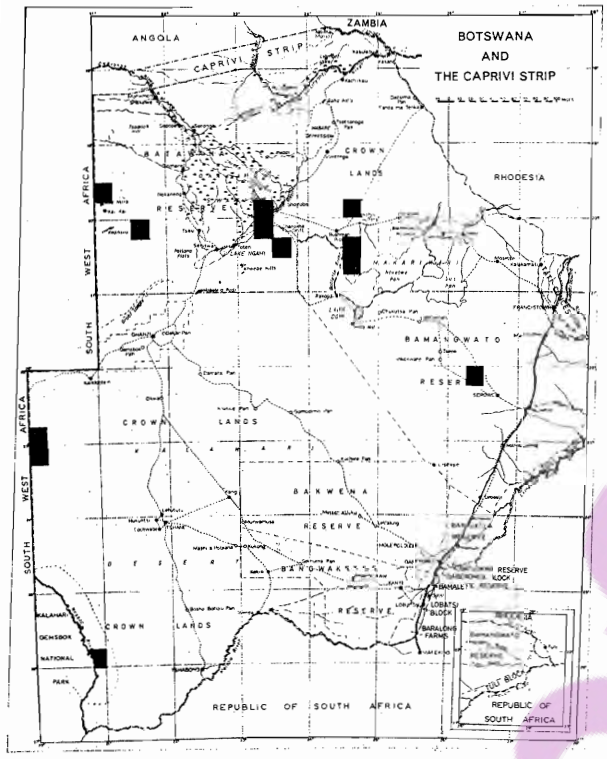
A series of 24 specimens of this little-known species shows that there is some variation in the colour of the upperparts. Schwann (1906) describes this as 'smoke grey and drab grey (Ridgway), more or less pencilled with black'. Three of the adults are smoke grey, the remainder drab grey, P137 M, DBA348, 349 and 480 in particular being washed with buffy giving an overall warmer colour than the three smoke-grey specimens.

The amount of black pencilling varies from DBA 447 in which it is barely perceptible, to DBA 366 in

which it is much more intense, giving the upperparts a darker appearance than the remainder.

Schwann states that the basal half of the hairs of the upperparts are slate-grey. In this series at least two-thirds of the individual hair is basally grey, lighter in colour at the tip, these interspersed with hairs tipped with black, giving the pencilled appearance mentioned by Schwann.

The juveniles are slightly darker in colour than the adults, lacking the pencilling on the upperparts. In MSS 158 the hairs of the underparts are broadly dark grey at the base giving a dark overall grey appearance to the underparts.



Distribution

Present records are too few and scattered to allow of a proper assessment of their distribution. Their presence along the South West African border; in the Kalahari Gemsbok National Park, in the south-west; near Serowe, together with their original collection on the Molopo River (Moloho, Bechuanaland) indicate that they will probably be shown to occur more widely than present records indicate. Further north they occur from the Aha Hills and Drotsky Caves east to Maun and in the western parts of the Makgadikgadi, including Nxai Pan. Shortridge (1934) gives the distribution in South West Africa as from Gobabis east to the Botswana border, which fits in with the Botswana records from just south of Mamuno.

Habitat

Nineteen out of the series of 24 were taken on sandy ground with sparse grass up to 45 cm high and a thin open scrub cover of *Acacia*, *Grewia* and *Terminalia*, on the raised fringes of Nxai Pan. The two specimens from the Botletle River were taken in *Acacia* scrub on sandy ground, in one case in riparian *Acacia* scrub. The Aha Hills, Drotsky Caves, 45 miles south of Mamuno, and Vloorskop specimens were taken in *Acacia* scrub on sandy ground with sparse grass.

All the records fall within a mean annual rainfall range of 200 to 500 mm.

Habits

Nocturnal, terrestrial, occur singly or in pairs or family parties. Shortridge (1934) states that they live in the burrows of other rodents, suggesting *Tatera* spp. Certainly wherever they were taken *Tatera* spp. were common. Woosnam (cf. Roberts, 1957) found them inhabiting holes under thorn trees at Kuruman, near pools of water in the Molopo River and in Gerbil burrows in Namaqualand.

Food

Graminivorous. Liversedge (*pers. comm.*) found the hair of other rodents in the stomachs, suggesting that they may be to some extent carnivorous. Ansell (c. 1960) records a specimen in captivity eating the carcasses of other rats.

DBA 345, 346 and 349 show traces of the same type of pinkish-brown staining on the chin, throat and forelimbs which is found in *Graphiurus* spp. which is thought to be caused by eating some type of insect.

Breeding

The distribution of non-gravid and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	–	4	1	2	2	1	–	1	–	–	1	–
Non-gravid	–	1	1	2	2	1	–	1	–	–	1	–
Gravid	–	3	–	–	–	–	–	–	–	–	–	–

Juveniles were taken at Nxai Pan during the months of February, March and April. Shortridge (1934) records a gravid female from Sandfontein, South West Africa, near the Botswana border at Mamuno in November. These dates suggest that the time of dropping the young is during the warm wet months of the year from about December to March.

The three gravid females carried the following number of foetuses:

No.	Locality	Date	No. of Foetuses	Implantation
DBA 345	Nxai Pan	14.2.67	11	5R 6L
DBA 349	,, ,,	16.2.67	5	2R 3L
DBA 342	,, ,,	13.2.67	5	2R 3L

The mammary formulae is three pairs pectoral and two inguinal.

Sizes and Weights

MALES

TL	$\bar{X}$ = 240;	N = 12;	Obs. range 209-260
T	$\bar{X}$ = 110;	N = 11;	,, ,, 102-118
Hf c/u	$\bar{X}$ = 27;	N = 12;	,, ,, 25- 28
E	$\bar{X}$ = 19;	N = 12;	,, ,, 17- 20
Weight	Only three weights available: 54·0, 57·0 and 50·0 g		

FEMALES

TL	$\bar{X}$ = 237;	N = 12;	Obs. range 208-264
T	$\bar{X}$ = 109;	N = 10;	,, ,, 97-116
Hf c/u	$\bar{X}$ = 26;	N = 12;	,, ,, 24- 27
E	$\bar{X}$ = 19;	N = 12;	,, ,, 16- 20
Weight	Only four weights available: 52·0, 56·0, 62·0 and 48·0 g		

SKULLS Nxai Pan Series Wear H Heavily worn
N Medium wear
F Very fresh, not worn

	TL	Upper Both Row	Zygo. Width	Inter-orb. Const.	Lgth. Nasals	Lgth.-wear Pal. Foramen
MALES						
DBA 479	273	50	139	50	106	65
DBA 446	319	53	162	49	127	82
DBA 348	348	55	183	55	140	88 H
DBA 366	310	50	145	50	126	77 N
DBA 432	353	60	174	50	144	83 N
DBA 568	318	59	163	53	129	75 N
DBA 521	320	53	160	55	125	81 N
DBA 527	309	51	155	51	122	71 N
FEMALES						
DBA 342	313	50	161	50	133	75 N
DBA 349	325	53	163	50	133	82 N
DBA 345	340	56	171	51	130	87 N
DBA 607	298	50	151	49	120	70 N
DBA 526	317	55	169	49	114	80 N
FEMALE (Botletle River)						
P 137 M	329	54	—	53	126	82 N
JUVENILES						
DBA 479	273	50	139	50	106	65 F
DBA 350	273	50	138	49	98	68 F

Genus DASYMYS Peters, 1875

Dasymys incomtus

Water Rat

D. i. nudipes (Peters, 1870)

Distribution

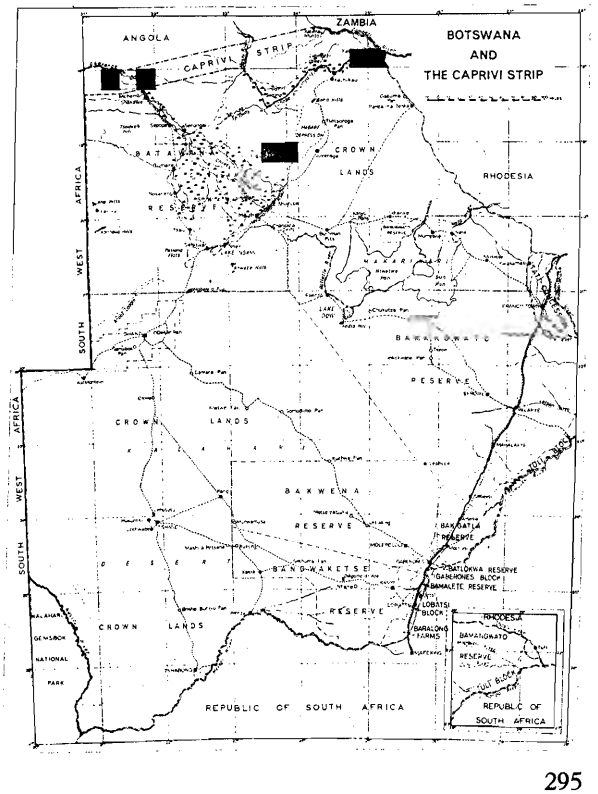
Confined to the extreme northern parts of the territory on the Okavango River, in the border area near Mohembo; on the Chobe River from Kasane west to about Kabulabula and in the northern parts of the Okavango delta. Shortridge (1934) confines the distribution of the species to the northern parts of South West Africa.

Habitat

Reed-beds and other semi-aquatic vegetation on the fringes of rivers and swamp.

Habits

Nocturnal and to some extent diurnal (specimens were shot at Kasane during the day) semi-aquatic, terrestrial. They live under the mass of fallen leaves and other frass at the base of reed-beds which are standing in shallow water, or in wet places or under matted semi-aquatic grasses and sedges or the fringes of swamp or swamp islands. Domed nests are built of cut grass and other vegetable matter at ground-level



with a short refuge tunnel running into the ground about a metre long from them. Distinct runs are formed radiating from the nest to feeding areas, where the remains of cut fresh reeds and grass stems on which they have been feeding are found. Appear to be as at home in the water as on firm ground, the runs often inundated.

They are more strictly confined to wet areas than *Otomys angoniensis*, alongside which they occur on the Chobe River. Like *O. angoniensis* the flesh of the species appears to be palatable to other rodents and shrews as specimens get badly chewed in traps unless they are cleared regularly.

Food

The stems of semi-aquatic grasses, new shoots of *Phragmites* sp. reeds and other vegetable matter. Traces of insects were noted in some stomachs.

Breeding

Gravid females were taken in August, October and December and a nest of seven juveniles at an average weight of 4 g in March. These appear to be nearly newborn.

Distribution of non-gravid and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	–	1	–	1	–	–	5	4	9	10	1	4
Non-gravid	–	1	–	–	–	–	5	3	9	8	1	3
Gravid	–	–	–	–	–	–	–	1	–	2	–	1

Juveniles were obviously common at Kasane in September, October and December as there are 20 in the collection.

Indications from the present meagre data are that the young are born from about August through to March.

Females breed at quite a small size, C888 at 118·8 g and PCL 65/106 at 89·4 g.

The juveniles lack the warm brown suffusion on the upperparts and are generally darker, greyer with a soft woolly pelage as opposed to the coarser pelage of the adults.

The average number of foetuses at a birth appears to be about five.

Foetuses

Number $\bar{X} = 5{\cdot}3$; $N = 4$; Obs. range 2-9.

Sizes and Weights

MALES

TL	$\bar{X} = 325$;	$N = 11$;	Obs. range 301-350
T	$\bar{X} = 164$;	$N = 11$;	„ „ 146-178
Hf c/u	$\bar{X} = 40$;	$N = 11$;	„ „ 36- 44
E	$\bar{X} = 20$;	$N = 11$;	„ „ 16- 22
Weight	$\bar{X} = 128{\cdot}5$ g;	$N = 11$;	„ „ 107·3-164·1 g

FEMALES

TL	$\bar{X} = 329$;	$N = 8$;	Obs. range 309-352
T	$\bar{X} = 163$;	$N = 7$;	„ „ 152-180
Hf c/u	$\bar{X} = 39$;	$N = 8$;	„ „ 35- 41
E	$\bar{X} = 21$;	$N = 8$;	„ „ 20- 22
Weight	$\bar{X} = 127{\cdot}0$ g;	$N = 6$;	„ „ 102·3-161·2 g

Genera MUS Linnaeus, 1758
LEGGADA Gray, 1837

1. Size larger; general colour brown, hands and feet brownish, underparts light brown . . *Mus*
   Size smaller; general colour reddish, hands and feet whitish, underparts white . . *Leggada*

Taxonomic Notes

Misonne (1968) states that recent developments in the study of chromosomes have shown that *Mus* is different from *Leggada*, the status of the two genera being extremely complex and confusing.

In Botswana the genus *Mus* is represented by the house mouse, *Mus musculus*, so far known from a single specimen from Francistown.

The genus *Leggada* is represented by a group of species which I am at the moment unable to place satisfactorily. Within a series of 90 specimens from Kasane, 38 are darker browner in colour than the remaining 52, which are brighter and redder. This does not appear to correlate with age, sex, or the season of the year in which they were taken.

A series of 11 specimens from the extreme north-west from Shakawe, Mohembo and points west to the South West African border and eastwards to Seronga on the eastern bank of the Okavango River, where it spreads out to its broadening delta, are also clearly recognizable. In these 11 specimens, six males and five females, the ears are larger, averaging 13·6 as opposed to 11 in the remainder of the series, the white of the underparts extending upwards on to the rump above the tail forming a clearly defined broad white patch. The upperparts are a light ochraceous

buff, the white of the underparts extending on the sides of the face to the level of the eyes and narrowly across the muzzle, immediately behind the rhinarium.

These occurred on the same ground and were taken in the same trap-line as specimens with smaller ears (11), and lacking the white above the tail and across the muzzle.

There does not appear to be a category into which these specimens might be readily placed. *Leggada callewaerti* (Thomas) appears to be the only species with large ears, Hill and Carter (1941) record a specimen, AMNH 86671, with an ear length of 14. *L. callewaerti*, however, like *L. triton*, has pearl-grey underparts, the upperparts hair brown and chaetura drab, whereas in the Botswana series, with an ear length of 14, the upperparts are light ochraceous buff, the underparts pure white.

Until such time as a revision of the species has been undertaken I follow Roberts (1951), including in the subspecies *L. minutoides induta*, Thomas, 1910, the whole series including those specimens in which the white of the underparts is carried broadly above the level of the hindlimbs (*L. deserti*, Thomas, 1910). At the same time I exclude those from the extreme north-western parts of the territory with large ears (Av. 13·6) for which, at the moment, no taxa appear to be available.

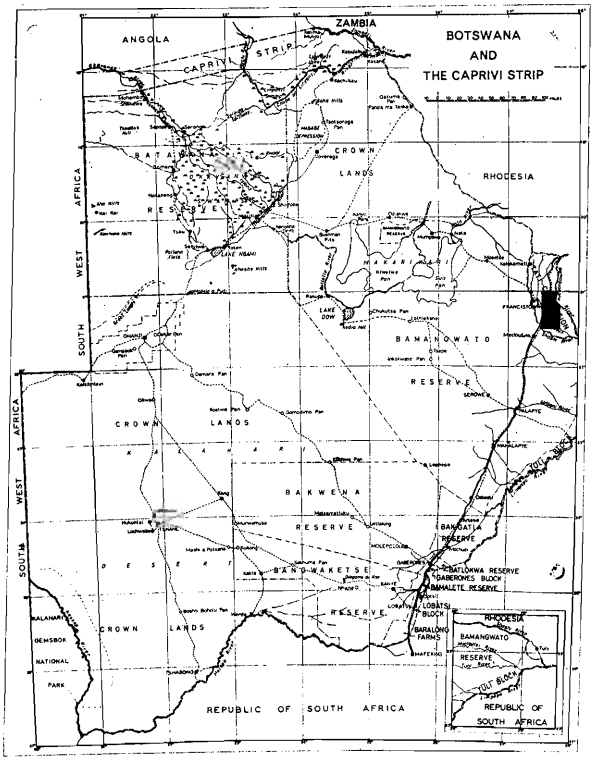
Genus MUS Linnaeus, 1758

Mus musculus House Mouse

M. musculus Linnaeus, 1758

Distribution

This introduced species has settled in most of the built-up areas on the line of rail in Rhodesia and, although it has so far only been taken at Francistown, it should be looked for in other towns southwards.



Habitat

Houses, kraals, grain stores, railway sheds, etc., lives as a commensal with man. The Francistown specimen was taken on Francistown kopje within the town limits.

Habits

Nocturnal, terrestrial, solitary or in pairs and family parties. Constructs small nests of any available material such as paper, rags, grass, etc., in crevices, under floors, or in any available hidden shelter.

Food

Graminivorous but will take a wide range of household foods.

Breeding

No data available.

Sizes and Weights

No data available.

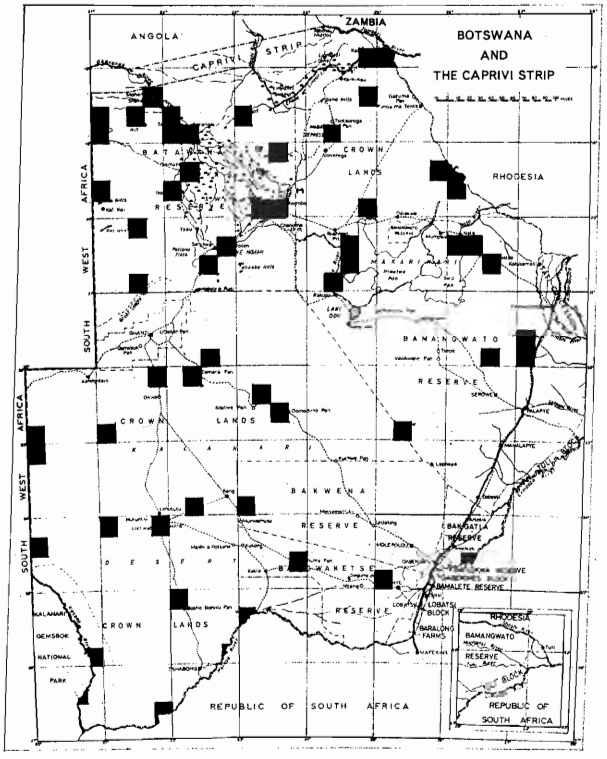
Leggada minutoides

Pygmy Mouse

L. m. induta (Thomas, 1910)

Distribution

Widely distributed throughout the territory although, at the moment, only recorded east of the line of rail from Sequane.



Habitat

Specimens were taken in a wide variety of habitats, from the arid shrub savannah of the extreme south-western parts of the Kalahari, an area with a mean annual rainfall of 200 mm, to the rich riverine forests of the Chobe River at Kasane, in an area of a mean annual rainfall of over 700 mm.

Habits

Nocturnal, terrestrial, lie up during the day in any sort of cover, under stones, debris, fallen logs, under the bark of trees and, as well, dig shallow burrows in soft soils. Prone to use the cover provided by sacks, tarpaulins, etc., left lying on the ground overnight, under the floor covering of tents, etc. Several specimens were taken from the bedding of members of the survey parties sleeping on the ground. The nests are constructed under any type of cover and consist of a ball of soft grass, or other fibres, in which the young are born.

Like the multimammate mouse, *P. natalensis*, subject to population explosions (Khumaga, 1967).

Food

Graminivorous.

Breeding

Distribution of non-gravid and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	9	19	6	16	84	43	34	30	21	20	2	6
Non-gravid	9	16	4	12	84	41	34	30	21	15	2	5
Gravid	–	3	2	4	—	2	—	—	—	5	–	1

Although the sample indicates that the young are born during the summer months, the two records of gravid females from June suggest that they may breed throughout the year.

The number of foetuses carried by pregnant females is as follows:

Foetuses

Number $\bar{X} = 4{\cdot}9$; $N = 17$; Obs. range 2-8.
Implantation is irregular.

Sizes and Weights

Kasane series

TL	$\bar{X} = 96$;	$N = 90$;	Obs. range 76-118
T	$\bar{X} = 42$;	$N = 90$;	,, ,, 30- 52
Hf c/u	$\bar{X} = 14$;	$N = 90$;	,, ,, 13- 16
E	$\bar{X} = 11$;	$N = 90$;	,, ,, 8- 12
Weight	$\bar{X} = 5{\cdot}4$ g;	$N = 85$;	,, ,, 2·5-7·5 g

Kalahari series

TL	$\bar{X} = 100$;	$N = 46$;	Obs. range 87-116
T	$\bar{X} = 43$;	$N = 46$;	,, ,, 31- 49
Hf c/u	$\bar{X} = 14$;	$N = 47$;	,, ,, 13- 15
E	$\bar{X} = 11$;	$N = 44$;	,, ,, 9- 13
Weight	$\bar{X} = 6{\cdot}9$ g;	$N = 35$;	,, ,, 4·0-11·0 g

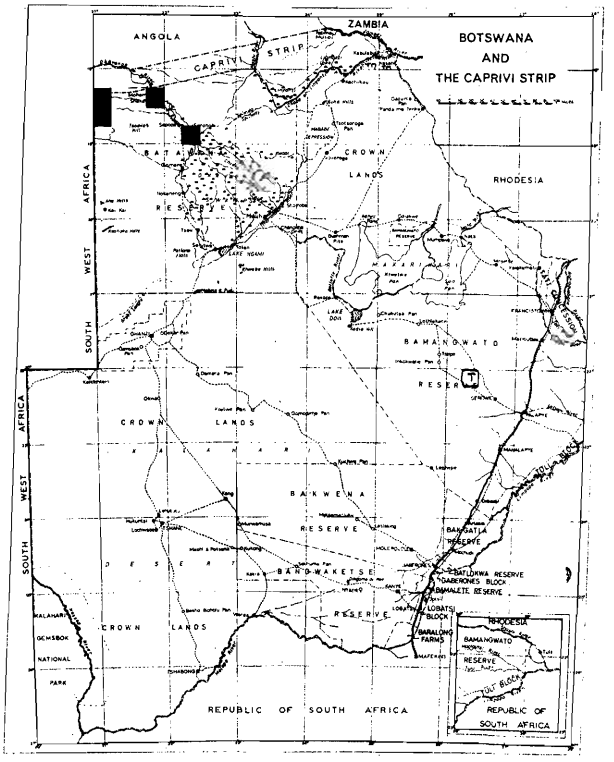
Leggada sp.

Among the Botswana material there is a series of 11 specimens which, on account of their length of ears, I retain separate from the remainder.

These come from the extreme north-west from Seronga, on the eastern side of the Okavango River, where it broadens out to the delta, from Shakawe and the Caprivi border area, west of Shakawe and Mohembo.

These specimens, in body colour, conform to the description of *L. deserti* in that the white of the underparts comes broadly over the rump above the tail and high on the face to the eyes and across the top of the muzzle, the hindlimbs white above and below. Seven of the eleven specimens have an ear length of 14, the average being 13·6.

I am unable to place these specimens at the moment.



Sizes and Weights

TL	$\bar{X} = 90$;	$N = 9$;	Obs. range 82-97
T	$\bar{X} = 36$;	$N = 9$;	,, ,, 31-48
Hf c/u	$\bar{X} = 14$;	$N = 11$;	,, ,, 13-15
E	$\bar{X} = 13{\cdot}6$;	$N = 11$;	,, ,, 13-14
Weight	$\bar{X} = 6{\cdot}8$ g;	$N = 11$;	,, ,, 5·0-9·0 g

Genus **PRAOMYS** Thomas, 1915

1. Mammae 12 or more, not in pairs or divided into pectoral or inguinal groups; pterygoids narrow; anterior palatal foramen reaches beyond the inner root of M^1; colour of the upperparts brown or grey brown . . . . . *P. natalensis*

   Mammae 10, 5—5 = 10; pterygoids wider; anterior palatal foramen shorter than in *P. natalensis;* colour of the upperparts darker, dark brown or blackish-brown . . . *P. shortridgei*

Praomys natalensis Multimammate Mouse

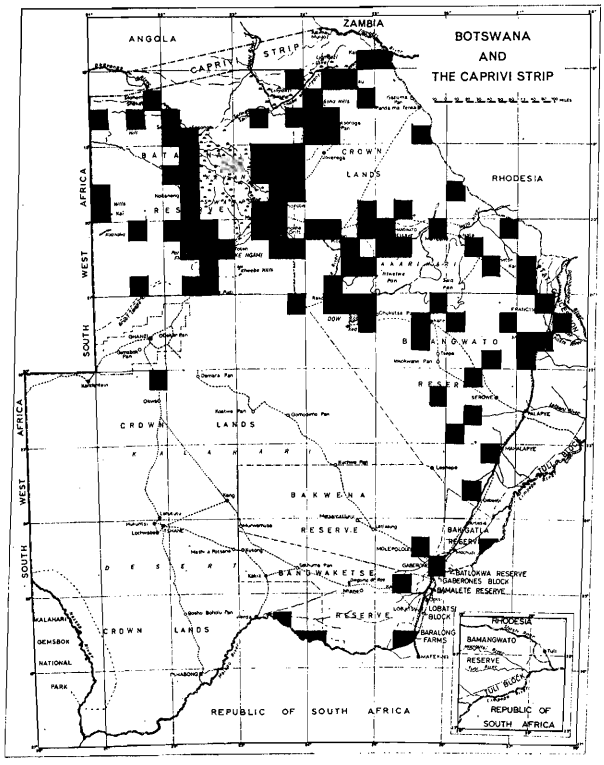
P. n. microdon (Peters, 1852)

Taxonomic Notes

Within a population from any one locality (Kasane) there is a wide variation in the colour of the upperparts. Adults of either sex, with heavily worn teeth, may be dark grey, lacking any tinge of brown (C 2197), or predominantly brown (C453). The juveniles appear to fall into two distinct groups, the first cold dark grey, the second a warm brown. Such variations in colour do not appear to be correlated with season or age for they are apparent in material collected in the same months of the year, at widely different times of the year, and throughout the series in varying size groups.

Within populations from other localities (Maun) there are individuals matching those from Kasane in colour, but including others that are much paler and redder, others paler and greyer. In general those from the environs of the Makgadikgadi, more especially Nxai Pan, are palest of all, a pale reddish-buff, outstandingly different from the remainder of the Botswana series.

In juveniles that are dark grey on the upperparts this colour blends through to the grey of the underparts, in those that are warm brown there is a distinct junction between the colour of the upperparts and the lighter colour of the underparts.



Distribution

Widely distributed throughout Ngamiland south to 21° S.; the north-eastern sector, excluding the central area, south to include Makgadikgadi Pan, Lake Dow, the Botletle River and their environs and throughout the eastern sector south to the Baralong Farms and westwards along the Molopo River to near Werda.

In the central part of the eastern sector extends westwards, in the Kalahari, to Moyabana and the Lebung some 40 miles west of Serowe.

No material is at present available from the eastward extension of the Bamangwato Reserve but they are likely to occur as they are found in the north-western Transvaal and adjacent parts of Rhodesia.

Absent from the central and south-western Kalahari, although there are records from 35 miles south of Ghanzi on the Okwa road. Not so far recorded from the Ghanzi farms but there seems reason to expect that they will eventually be found in this area, as they occur in adjacent areas northwards and Shortridge (1934) states that they are 'plentiful' in the Gobabis area in South West Africa to the west.

Habitat

They have a wide habitat tolerance; in arid areas (Groot Laagte; 35 miles south of Ghanzi and Molopo River) often found in association with dry watercourses. A commensal with man, abundant in Ngamiland on the fringes of the swamp, where human population concentrations are high, and where they freely enter huts and settle, breeding under the floors, in the thatch or in holes in the walls.

Habitats include *Acacia* and mopane scrub and woodland, *Terminalia* scrub, particularly associated with scrub fences erected round cultivated lands, and the fringes of pans, especially where there are calcareous outcrops, although they also occur on sandy ground with some scrub and grass (Lebung).

Will use any available cover such as fallen logs, rock crevices, piles of stones or debris, holes in antheaps or will excavate their own burrows where there is soft ground.

To some extent dependent on water, they appear commoner in areas where this is available, but are by no means dependent on it, as is shown by their occurrence in such areas as the Groot Laagte, Kuki-Makalamabedi fence, Lebung, Nxai Pan, etc.

Common in and on the fringes of cultivated lands with crops such as peanuts, mealies, sorghums and other small grains where, in times when their numbers are high, they can be a pest.

Habits

Nocturnal, terrestrial.

Food

Under field conditions subsist mainly on grass and other seeds, including *Acacia* seeds and dried pods and the dry pulpy exterior of wild fruits. When populations reach high levels will eat dry grass stems and bark and become cannibalistic. As a commensal, omnivorous, and few household edibles are safe from them unless protected.

Breeding

Gravid females have, over a five-year period, been taken in every month of the year except June. The number of non-gravid and gravid females against a total sample of 775 females through the months of a five-year period is as follows:

	Total	*Non-gravid*	*Gravid*	% *Gravid Total*
January	12	9	3	20·0
February ..	41	29	12	31·6
March	30	15	15	50·0
April	224	197	27	12·0
May	131	129	2	1·5
June	109	109	—	—
July	57	52	5	7·4
August	43	40	3	6·9

	Total	Non-gravid	Gravid	% Gravid Total
September ..	52	51	1	1·9
October	24	18	6	25·0
November ..	26	25	1	3·8
December ..	11	8	3	27·0

The highest percentages of gravid females in the sample appears to occur from October to March with a decided peak about March. This would mean that the highest peak of dropping the young would coincide with the ripening of grass and other seeds, which peak might be expected to vary with the vagaries of the seasons. There is a very definite drop off in the number of gravid females during the colder drier months of the year from May to September.

During the whole of the first two years of the survey, the last two years of the four-year drought, the total number of pregnant females taken during the whole year was only four in 1964 and six in 1965.

Although the sample is small the average number of foetuses per female over the years 1964-67 was as follows:

Foetuses

1964 No.	$\bar{X}$ = 9·7;	N = 4;	Obs. range 8-10
1965 „	$\bar{X}$ = 7·1;	N = 6;	„ „ 6-10
1966 „	$\bar{X}$ = 8·2;	N = 16;	„ „ 6-14
1967 „	$\bar{X}$ = 15·8;	N = 8;	„ „ 7-22 (Maun)

Sizes and Weights

MALES (Kasane series, medium and heavy tooth wear)

TL	$\bar{X}$ = 239;	N = 13;	Obs. range 216-268
T	$\bar{X}$ = 115;	N = 12;	„ „ 102-125
Hf c/u	$\bar{X}$ = 27;	N = 14;	„ „ 24- 30
E	$\bar{X}$ = 18;	N = 14;	„ „ 18- 20
Weight	$\bar{X}$ = 64·5 g;	N = 14;	„ „ 51·3-77·1 g

FEMALES (Kasane series, medium and heavy tooth wear)

TL	$\bar{X}$ = 234;	N = 19;	Obs. range 202-268
T	$\bar{X}$ = 111;	N = 17;	„ „ 100-123
Hf c/u	$\bar{X}$ = 26;	N = 19;	„ „ 22- 28
E	$\bar{X}$ = 19;	N = 19;	„ „ 17- 20
Weight	$\bar{X}$ = 56·8 g;	N = 16;	„ „ 38·3-74·5 g

General

The first two years of the Survey 1964 and 1965 marked the last two years of an unprecedented drought which affected not only Botswana but most of the southern part of Africa. Rodent populations generally were at a low level, a position which is reflected in the percentage catches on the basis of 100-unit trap-lines in the western Okavango in February 1964.

It will be seen from the tables (p. 302) that, in this area, where at a later date rodent populations exploded to an unprecedented high level, catches were small, averaging 3%, the highest catch in February 1964 being nine in 100 traps, seven of these being *P. natalensis*. On a number of occasions 120 trap-lines yielded no material at all which if taken into account would have reduced the average figure of 3% considerably.

This four-year drought was broken by heavy rains which fell rather patchily throughout Botswana in October and November 1965. By February 1966 areas such as the northern crown land and in particular the south-western part of Ngamiland in the Lake Ngami area benefited as they had not done for some four years. These favourable conditions were reflected in the lush growth of grasses and annuals which formed a thick thigh-deep cover over great areas.

As might be expected these favourable conditions did not immediately affect rodent populations as during this month in 10 days in the Toten-Kwebe Hills sector, only eight specimens were taken during the whole period operating 120 traps per night.

By July 1966 populations in the Lake Ngami area were building up, a high percentage of females being pregnant and juveniles being in evidence. In August 1966 populations at Chukutsa Pans remained low, while at Tamafupi in September 1966 in the northern crown lands the populations of *Tatera* spp. were already at a high level. In the western parts of the Makarikari, as reflected by catches at Gweta and Gutsa Pan areas in November, rodents were far more numerous than had been experienced during the drought years.

At Kumaha on the Botletle River 100 miles east of Lake Ngami in September 1966 populations, especially of *P. natalensis*, had already reached extraordinarily high levels. Soon after dark they swarmed everywhere even entering the tents, making it necessary to securely pack all soft goods and provisions and to place them out of reach. This explosion of *P. natalensis* was paralleled to a lesser degree by the bushveld gerbil, *Tatera leucogaster*, and the pygmy mouse, *Leggada* spp.

At this stage trapping was to a large extent unnecessary for as much material could be taken with a branch whisk and a torch as could be processed. Trap-lines were overrun by *P. natalensis* and *T. leucogaster*, masking the possibility of catching other species. Travelling at night rodents were nearly always in view in the lights in the spoor.

However, in the following month, October 1966, populations of *T. leucogaster* and *G. paeba* in the south-western Kalahari appeared normal.

Between April and August 1967 in the north-western and western Okavango, *P. natalensis* populations had reached explosive levels, again masking the position as far as other species were concerned, although *Leggada* spp. were obviously very plentiful. Towards the end of this period many of the *P. natalensis* taken were diseased, showing swollen lumps on the feet, the reproductive tract and scrotal sacs, the uterus often grossly deformed. This was noticed as well in *T. leucogaster* and *Z. woosnami* but not in other species.

This situation was paralleled in the eastern Okavango on the fringes of the swamp the patchy nature of the population explosion, however, being illustrated by the fact that in the Savuti area north of the swamps, in a relatively dry area, populations remained low.

At the beginning of July 1967, however, in the Mababe area east of the swamp there were unmistakable signs that the peak had been passed. Here catches consisted mainly of immature individuals, with no signs of pregnancy in females. There were signs of cannabalism in the form of fur and dried portions of the bodies of *P. natalensis* lying outside *P. natalensis* burrows. Individuals caught in traps were often destroyed as specimens, through being eaten.

During July 1967, populations on the Botletle River remained at very high levels and it was impossible to set a 100 trap-line from 5.30 p.m. onwards for, on 15 or 20 traps being set, those at the start of the line were already being set off. On one occasion on the twelfth trap being set a return visit down the line of 12 produced seven *P. natalensis*. At this time cannabalism was particularly rife and rodents left in the traps from about 6 p.m. till the late pick-up at 10.30 p.m., or from this time till early morning, were almost invariably destroyed as identifiable specimens through being chewed.

In order to obtain some sort of a figure on the catch, a line of 100 traps was set on the 1st July, 1967, without regard to the catch which was already taking place, at about 6 p.m. and left till morning, resulting in 97 rodents being taken, 87 of these *P. natalensis*. In two cases there were two *P. natalensis* in one trap. Very few of these were in a fit state to process, being chewed, in some cases only limbs or other portions of the body remaining in the traps. During other nights at this camp 30-50 traps only were set and providing they were kept clear and reset, a catch of several times the number of traps was secured.

In an endeavour to avoid these high levels of catch the trap-lines were set deep in the reed-beds bordering the river in very wet conditions which still produced *P. natalensis*. Under the conditions prevailing very distinct runs were seen through the grass from the fringing scrub bush to the edge of the water, and at night *P. natalensis* were observed using these.

The figures given in the following table represent the total catch from a line of 100 'Museum specials' from about 6 p.m. to about 7 a.m. As a routine the traps were cleared and reset at about 10 p.m., the total catch being the number of rodents collected at 10 p.m., plus the number at 7 a.m. The comparisons are made on trap-lines set on level ground, except where specifically stated, and no cognizance is taken of the different ecological situations covered by the lines which might vary from, e.g. mopane woodland to the fringes of vlei areas, the figures being presented simply to illustrate whether rodents were abundant or scarce in the area in general.

The number of traps set varied from 120 to 300, the catches are calculated on the basis of 100 traps for purposes of convenience of comparison. Only the species *P. natalensis* and *Tatera* spp. are specially listed and the numbers quoted are calculated to the nearest whole number when reducing to the basis of the 100-trap unit.

Although a proper evaluation of the changing position in relation to rodent populations could only have been provided by intensive work in a single area, over the period 1964-68 it was, unfortunately, impossible to settle to do this. In spite of this, the figures provide a broad picture of the great change which took place from the position during these drought years (No. 1), to the position two years after the break of the drought in 1965 (No. 8 and text), and the patchy nature of the population explosion.

Percentage Catch on the Basis of a 100-trap Line c. 6 p.m.-c. 7 a.m.

P. n. = *Praomys natalensis*
T. spp. = *Tatera* spp.

1. *Western Okavango*, 1964

	Date	*P. n.*	*T. spp.*	*Other*	% *Catch*
Nokaneng	6/2		2	1	3
	8/2		1		1
	9/2		3		5
	10/2		2		2
Gomare	13/2	2		1	3
	14/2	2			2
	15/2	1			1
	16/2	2	1	1	4
	17/2	2		1	3
	18/2	1			1
Shakawe	20/2	4		1	5
	21/2	7		2	9

2.	*Debeeti-Lephepe*, 1965					
	Debeeti	4/10		2	3	5
		7/10		1	2	3
		13/10			2	2
	4 m. W. Lechua	14/10		2	1	3
3.	*Baralong Farms*, 1966					
	Baralong Farms	9/6	1		1	2
		10/6		2	2	4
		11/6	(no breakdown)			8
	Matebe	13/6		16	2	18
4.	*Gweta*, 1966					
	Gweta	26/11	4	5	1	10
	Gutsa Pan	27/11	3	5	1	9
	Gutsa Pan	29/11		35	1	36
	Serowe	2/12	3	1	4	8
5.	*SW. Kalahari*, 1967					
	Kang	19/2	—	—	30	30
	Tshane	20/2	—	—	16	16
	Tshane	21/2	—	1	19	20
		22/2	—	1	9	10
		23/2	—	—	20	20
	Tshane	27/2	—	3	45	48
6.	5 *m. W. Gaborones*, 1967					
		5/3	—	1	13	14
		6/3	—	—	1	1
		6/3		1	3	4
7.	*Selinda-Sevuti*, 1967					
	Selinda Spillway	24/2	5	10	6	21
		25/2	4	1	3	8
		26/2	2	5	2	9
8.	*Botletle River*, 1967					
	Botletle River	1/7	87	8	2	97
9.	*Serowe*, 1968					
	Moyabana	27/3	12	8	12	32
	Moyabana	28/3		5	10	15
	Lebung	29/3		4	4	8
	Lebung	30/3	4	8	8	20
10.	*Macloutsie-Shashi*, 1968					
	Macloutsie Siding	6/4	5	2	5	12
	Shashi	7/4	—	3	2	6
11.	*Gomoti River-Maun*, 1968					
		29/7	1	2	1	4
		30/7		1	1	2
	Maun	31/7	13	1	3	17
		2/8	2	4	2	8
		3/8	3	4	6	13
		4/8	1	4	7	12
	Island at Maun	5/8	27	6	1	34
		6/8	6	2	3	11

Praomys shortridgei Shortridge's Mouse

P. shortridgei (Thomas & Hinton, 1927)

Taxonomic Notes

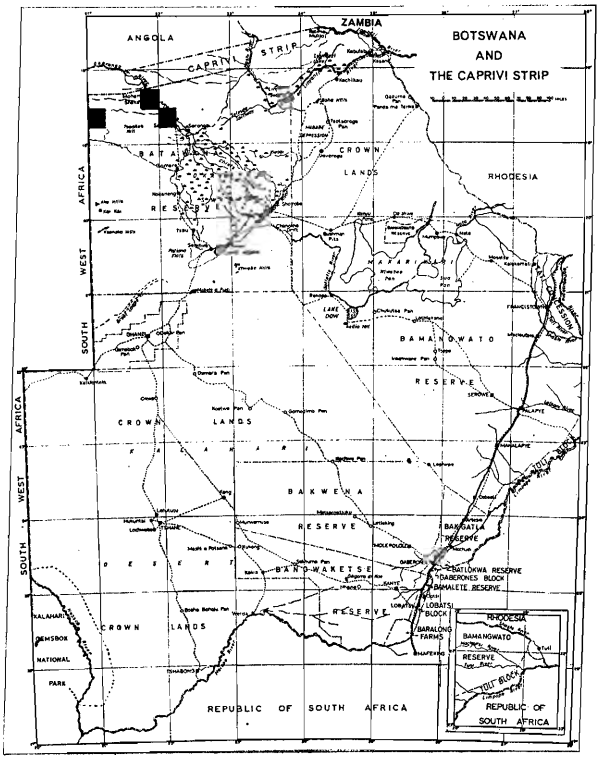
The pelage on the upperparts of this species is, in series, much darker than *P. natalensis*, some specimens being nearly black. This is, however, variable, some (TNL 4013) being nearly black, others (SWG 408) browner with black patches on the head between the ears and on the sides of the muzzle. The mammary formula is 5—5 = 10 not separated into pectoral and inguinal pairs.

Distribution

Confined to the extreme north-western corner of the territory as far south as Sepopa and west to the South West African border.

Habitat

Occurred in the W.N.L.A. garden, around the houses and in rocky terraces on the raised bank of the Okavango River at Shakawe; on the banks of the same river at Sepopa in dry underbush and around buildings and on the fringes of wet vleis on the South West African border. Occurred on the same ground as *P. natalensis*, which was the commoner of the two species in the three localities in which *P. shortridgei* was taken.



Habits

Terrestrial, nocturnal, their occurrence round buildings suggesting that like *P. natalensis* will live as a commensal with man.

Food

Gramnivorous, but probably omnivorous.

Breeding

The only material available was taken in April and May, there being no signs of breeding in any of the 18 females collected. BPR37, a tiny juvenile which is believed to be a *P. shortridgei*, was taken at Shakawe in February.

Sizes and Weights

MALES

TL	$\bar{X}$ = 217;	N = 16;	Obs. range 202-241
T	$\bar{X}$ = 104;	N = 15;	„ „ 96-114
Hf c/u	$\bar{X}$ = 27;	N = 15;	„ „ 25- 28
E	$\bar{X}$ = 18;	N = 14;	„ „ 17- 19
Weight	$\bar{X}$ = 45 g;	N = 15;	„ „ 35- 67 g

FEMALES

TL	$\bar{X}$ = 222;	N = 10;	Obs. range 205-255
T	$\bar{X}$ = 106;	N = 10;	„ „ 99-111
Hf c/u	$\bar{X}$ = 26;	N = 9;	„ „ 24- 27
E	$\bar{X}$ = 19;	N = 9;	„ „ 17- 20
Weight	$\bar{X}$ = 48 g;	N = 10;	„ „ 36- 74 g

Genus THALLOMYS Thomas, 1920

Thallomys paedulcus — Tree Rat

T. p. kalaharicus (Dollman, 1911)
T. p. herero Thomas, 1926
T. p. stevensoni Roberts, 1933

Taxonomic Notes

In a series of 28 adult males and 31 adult females from Maun distributed over the months as follows:

	J	F	M	A	M	J	J	A	S	O	N	D
Males	4	8	–	1	–	2	–	2	7	1	1	2
Females	1	1	1	4	–	1	4	2	7	6	4	–
Total	5	9	1	5	–	3	4	4	14	7	5	2

there is a distinct difference in the length of the hair and the general weight of the pelage between those from the warm wet as opposed to the cold dry months of the year. Specimens taken in November through to about April have a much lighter, shorter pelage than those from June to October, in which the coat is long and woolly, with a dense undercoat.

While there is a wide variation in the colour of the upperparts of individual specimens from within the same months, there is a trend for material from November to January to be darker than that from June to September, these being on the whole lighter and yellower or redder.

The tails of this series from Maun are dark but not nearly as distinctly so as those from the Kalahari, where the tail has a much denser coating of black hairs, this coating obscuring the scaling on the tail.

The tails of the series from the Kalahari Gemsbok National Park, Tshane, Tshabong, Sekoma Pan, the Hanahai, Kang and Mamuno, all have a thick covering of shiny black hair, either covering the whole tail (TNL 4776, Tshane) or three-quarters of it, the basal quarter with a line of black hairs on the dorsal surface and white on the sides and underparts (K 62, Tshane). The dark marking round and in front of the eye is distinct in all this material.

It is possible, however, to recognize within this south-western material two colour forms. The first from the extreme south-west, in the area of the Kalahari Gemsbok National Park, Tshane and Tshabong, has a wash of yellow on the upperparts. In the second from Kang and the Hanahai the shoulders and mid-back at shoulder level, are distinctly grey, the yellow wash confined to the rump, giving a greyer overall appearance. Further east on Sekhoma Pan specimens are even lighter grey overall than either of the above series, although still with the wash of yellow, narrowly on the upperparts at shoulder level, more pronouncedly and more broadly on the rump. This Sekoma Pan, Kang and Hanahai material agrees well in respect of colour with the description of *T. p. kalaharicus* Shortridge, the material from the Gemsbok National Park, Tshane and Tshabong appears intermediate between this and *T. p. nigricauda* Thomas of Great Namaqualand.

According to Roberts (1951) key *T. p. nigricauda* has an upper molar toothrow length of 4·7-5·2 mm;

T. p. kalaharicus over 5·2. In this respect the Sekoma Pan, Kang and Hanahai material, referred to *T. p. kalaharicus*, averages 5·6, the Kalahari Gemsbok National Park, Tshane and Tshabong being slightly smaller at 5·4, which is longer than the limits given by Roberts, suggesting that they may, in this respect, as well as colour, be intermediate between *T. p. kalaharicus* and *T. p. nigricauda*.

In the colour of the upperparts, material from the north-west, the Okavango delta (Maun) and Botletle River is very different from the material from the Kalahari, the upperparts being overall more buffy-brown, the sides darker, less grey and generally lacking the greyness of the Kalahari material. The dark marking round the eye is indistinct, and in some cases (RN 196, RN 474) near absent, the hair of the tail lacks the profuse covering of shiny black hair, the hair being sparser and lighter in colour allowing the scaling of the tails to be seen right to the tip. This material is referred to *T. p. herero* Thomas (cf. Roberts, 1951, who suggested that material from the Grootfontein district, South West Africa, might represent an undescribed subspecies). The material from northern Botswana may well be more closely allied to the Grootfontein material than to *T. p. herero* which was described from Ondongua, Ovamboland, northern South West Africa.

In a small series from Francistown the colour of the upperparts is similar to material from northern Botswana, but in two specimens the feet have dark brown patches on the upperparts on which basis they are referred to *T. p. stevensoni* Roberts.

The distribution of the three recognizable subspecies is as follows:

T. p. kalaharicus (Dollman, 1911).

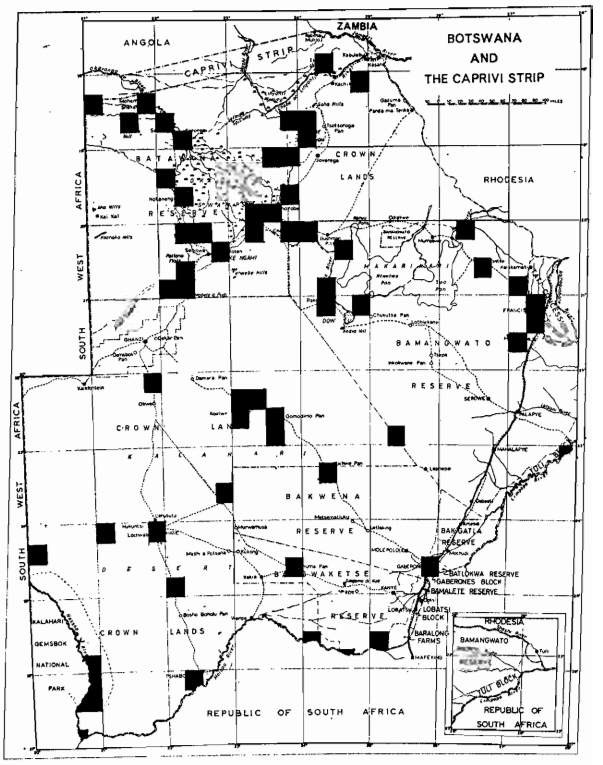
Occurs in the south-east, through the central Kalahari to the South West African border at Mamuno. Intergrades in the extreme south-west with *T. p. nigricauda* (Thomas, 1882) of southern South West Africa and in the eastern sector with *R. p. paedulcus* Sundervale, 1846, of the Transvaal. Replaced northwards in the Okavango delta and Botletle River by *T. p. herero* Thomas, 1926.

T. p. herero Thomas, 1926.

Occurs throughout the Okavango delta and on the Botletle River intergrading eastwards with *T. p. stevensoni* Roberts, 1933, in the area of the Tati Concession.

T. p. stevensoni Roberts, 1933.

Only so far recorded from the Francistown area.



Distribution

The species is widely distributed throughout the territory from the very driest areas, with a mean rainfall of less than 200 mm, to the higher rainfall area of over 750 mm. Although they have not so far been recorded from the eastward extension of the Bamangwato Reserve they probably occur there, as they have been taken in adjacent parts of Rhodesia and the Transvaal.

Habitat

Acacia woodland or other types of woodland providing *Acacia* spp. are present.

Habits

Arboreal, living in the hollow trunks and branches and under the loose bark of trees into which large accumulations of grass, leaves and sticks may be dragged. If the holes are situated near a fork of a tree the accumulation may, by continual collecting, overflow from it and form large piles sometimes as much as 30 cm deep (Savuti). In some situations there are no external accumulations of debris, the entrances to the hollows being open and clean.

Shortridge (1934) records their building conspicuous nests of interlaced sticks among the outer

branches of trees and quotes Bradfield who states that 'they make nests like those of the Buffalo weaver' (*Bubalornis niger*). Such nests have not been observed in Botswana, although their use of disused Buffalo weavers' nests would not be discounted, but it is questioned if they build such structures themselves. Shortridge also records their building a nest under the roof of an old native hut.

Where hollow trees are large a number of adults may be found occupying the nest, in smaller ones a pair only.

At the Savuti and Maun, the nests were found in large camelthorn, *Acacia giraffae*, trees in the riverine association, but they will use holes in any type of tree, nests being found in *Boschia albitrunca* (Chukutsa Pan), *Combretum imberbe* (Botletle River), and *Colophospermum mopane* (Kalakamati). In the case of the last two named they were associated with stands of *Acacia* spp.

They are nocturnal, emerging from the nests at sundown, running quickly up the branches to the outermost twigs of the *Acacia* trees. Where they were found nesting in *C. imberbe* and *C. mopane* they proceeded up to the higher branches making their way from tree to tree until they settled to feed on *Acacia*. In moving up the trunks they do so very quickly and are difficult to see against the trunks, unless they move on the skyline against the light. Once in the outer twigs, however, they can easily be seen from below, with the aid of a dazzling light, the white bellies reflecting the light. They are not easily trapped and are best taken under these conditions with the aid of a ·22 or ·410 shotgun and dust-shot.

On occasion they may be trapped at the bases of trees where they may be searching on the ground for seed pods. It has been stated that they are easily smoked out (Shortridge, 1934), by setting fire to the nesting material, but this has not been found to be the case as they appear reluctant to leave its shelter and they perish in the blaze rather than leave it.

Food

Vegetarian, feeding on the fresh leaflets of *Acacia* spp., the green outer coating of the pods (*A. tortilis*), or this outer coating when it is dry. At Chukutsa Pans feeding on the young leaves of *Boschia albitrunca*. On the banks of the Shashi River a pair, occupying an *A. tortilis* in camp, were seen to crop short lengths of the outermost twigs with green seed pods attached and to carry them to the hole where they were eaten at the entrance, the remains eventually dragged into the hole. They have also been seen to eat the green outer coating of the fruits of *Ziziphus mucronata* (Foley).

Breeding

Gravid females were taken during the months of October, February, March and April.

Distribution of non-gravid and gravid females through the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	5	8	3	17	8	11	7	11	12	11	1	1
Non-gravid	5	7	2	16	8	11	7	11	12	9	1	1
Gravid	–	1	1	1	–	—	–	—	—	2	–	–

While the data are scanty they appear to drop the young from about October through to May.

In a sample of five gravid females the average number of foetuses was as follows:

Foetuses

Number $\bar{X} = 3{\cdot}6$; $N = 5$; Obs. range 2-5.

Juveniles were taken in August, November, February and April.

Sizes and Weights

MALES (Maun)

TL	$\bar{X} = 311$;	$N = 25$;	Obs. range 280-357
T	$\bar{X} = 164$;	$N = 25$;	„ „ 144-186
Hf c/u	$\bar{X} = 27$;	$N = 27$;	„ „ 24- 30
E	$\bar{X} = 22$;	$N = 26$;	„ „ 21- 25
Weight	$\bar{X} = 81$ g;	$N = 5$;	„ „ 64-100 g

FEMALES (Maun)

TL	$\bar{X} = 307$;	$N = 32$;	Obs. range 275-330
T	$\bar{X} = 163$;	$N = 31$;	„ „ 144-180
Hf c/u	$\bar{X} = 27$;	$N = 31$;	„ „ 24- 29
E	$\bar{X} = 23$;	$N = 31$;	„ „ 19- 27
Weight	$\bar{X} = 80$ g;	$N = 5$;	„ „ 63- 91 g

Genus AETHOMYS Thomas, 1915

Size larger; first lower molar without an anterior medium cusp, but often with a small tubercle or cingulum; molar toothrow subequal to the greatest diameter of the bullae or up to 1 mm shorter; tail subequal to length of head and body . . . . *A. chrysophilus*

Size smaller; first lower molar with an anterior medium cusp; molar toothrow longer than the greatest diameter of the bullae; tail normally clearly longer than head and body . . . . *A. namaquensis*

Aethomys chrysophilus

Red Veld Rat

A. chrysophilus (de Winton, 1897)

Taxonomic Notes

In a series from the vicinity of the type locality Mazoe, Rhodesia, there is considerable variation in the colour of the upperparts from the 'bright reddish fawn', as originally given by de Winton, to individuals in which the colour is much yellower, or others in which the flanks are yellower. In all the specimens there is a liberal sprinkling of black hairs on the upperparts, the cheeks and sides of the face usually, but not always, paler. The base of the hairs of the underparts are slate-coloured, at least on the chest and upper belly, although in some cases this is not so well defined on the lower belly where the hairs are almost wholly white.

A similar colour variation is seen in a series from Gaborone and the Tati Concession. Taking the Botswana series as a whole, the palest individuals come from the area just south of the Makgadikgadi, on the cordon fence at Makoba, those from the north-western Okavango being distinctly redder and those from north of the swamp (Selinda Spillway) paler and yellower than any of the remainder of the series.

All the Botswana material has grey bases to the hairs of the underparts except that from the area just south of the Makgadikgadi where at 7 miles west west of the Makoba Gate (21 25 C_1) and Nthane (21 26 A_3) there are, within the series of grey-bellied individuals, some with pure white hair on the underparts. At Matebe (25 25 A_4) in the south-east and at Moyibana west of Serowe (22 26 C_1) the same state of affairs rules, although here the hairs are not pure white, but the grey base is so faint as to be scarcely discernible.

It is noticeable that individuals with pure white or nearly pure white underparts are occurring on the fringes on the Kalahari.

A. c. pretoriae Roberts is recorded as occurring at Gaborone (Ellerman *et al.*, 1953) and a number of other subspecies could occur in the territory but until these are reviewed, no attempt to place the Botswana material subspecifically is made.

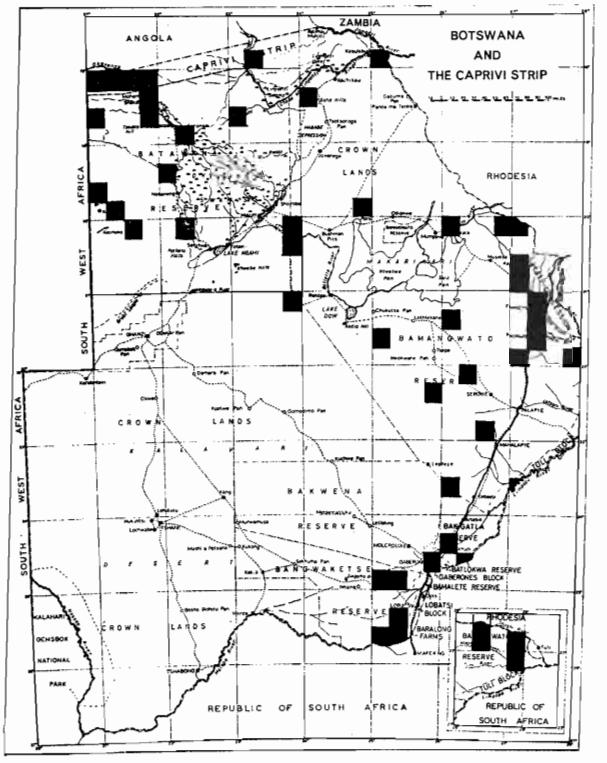
Distribution

Occurs throughout the northern parts of the territory south to the Aha Hills, Botletle River and round the western and southern parts of the Makgadikgadi, south to the Dukwe cordon fence and Moyabana, west of Serowe, and throughout the eastern sector from the Nata River to the Baralong farms. There are no records from the north-eastern sector from the Nata River to Pandamatenga along the Rhodesian border although they occur sparsely in the Wankie National Park to the east. They may have been overlooked in this area as it appears ecologically suitable.

As they have been taken in South West Africa, near Mamuno (MEC, 22 19 B4), their distribution in the west may in time be shown to extend southwards from the Aha Hills, through the Ghanzi area at least as far south as Mamuno.

Habitat

Grassland with open scrub associations, open woodland, frequently occurring on the fringes of pans.



Taken both in areas of sandy ground or sandy alluvium and where the ground is hard, as for example in the Tati Concession where they occur in mopane woodland. In areas with rocky kopjes they may occur on the lower levels of these then occupying the same ground as *A. namaquensis* but not particularly associated with this type of habitat. It would appear that some type of cover is an essential requirement of the species for they seem to be particularly associated with the thorn fences round agricultural lands or piles of debris.

Occasionally found as a commensal with man (Francistown).

Habits

Nocturnal, terrestrial, excavate their burrows under the cover of bushes, under rocks, or will use crevices in rocks or holes in termite mounds.

Food

Graminivorous.

Breeding

Gravid females were taken in January, March, April, June, October and November, indicating that the young are born during the summer months.

Distribution of non-gravid and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	11	1	2	22	26	18	1	4	1	2	7	2
Non-gravid	10	1	1	19	26	17	1	4	1	–	5	2
Gravid	1	–	1	3	—	1	–	–	–	2	2	–

The average number of foetuses was as follows:

Foetuses

Number $\bar{X} = 3{\cdot}9$; $N = 10$; Obs. range 3-6.
Implantation is irregular.

Sizes and Weights

MALES

TL	$\bar{X} = 306$;	$N = 9$;	Obs. range 293-331
T	$\bar{X} = 161$;	$N = 9$;	„ „ 150-180
Hf c/u	$\bar{X} = 30$;	$N = 9$;	„ „ 27- 33
E	$\bar{X} = 21$;	$N = 9$;	„ „ 20- 24
Weight	$\bar{X} = 89$ g;	$N = 4$;	„ „ 76-116 g

FEMALES

TL	$\bar{X} = 300$;	$N = 21$;	Obs. range 290-321
T	$\bar{X} = 159$;	$N = 21$;	„ „ 145-177
Hf c/u	$\bar{X} = 30$;	$N = 20$;	„ „ 27- 31
E	$\bar{X} = 20$;	$N = 17$;	„ „ 15- 23
Weight	$\bar{X} = 77$ g;	$N = 7$;	„ „ 70- 99 g

Aethomys namaquensis

Namaqua Rock Rat

A. namaquensis (A. Smith, 1834)

Taxonomic Notes

Meester *et al.* (1964) retain *A. n. namaquensis* for populations with grey bases to the hair of the underparts, *A. n. arborarius* for those with pure white hair. In Botswana specimens with grey bases to the hair occur north of the Okavango delta from the Tsodilo Hills and Goha (Gubatsa) Hills and from the eastern sector from the Tati Concession and the Masetsi area to the hills south of Lobatse and west to Dikgomodikae. All the material from the Kalahari and the southern parts of the north-eastern sector through to the Rhodesian border has pure white hairs on the underparts.

In parts of the eastern sector (Kalakamati, Macloutsie, Serowe and Mahalapye) the populations are mixed, some individuals have grey bases, others pure white.

The white-bellied forms use trees in which to build their nests, as indeed no rocks are generally available to them, whereas the populations with grey bases to the hair, from the north and from the eastern sector, and the mixed populations, are generally but not always associated with a rocky habitat.

The series from the Tshane area is the palest of all, the colour of the upperparts greyish with a faint tinge of red, some specimens showing more of this reddish tinge than others. These might well be referred to as *A. n. calarius* Thomas which Roberts (1951) remarks is a 'pallid subspecies'. The variation in colour of populations from limited areas is demonstrated in material from 30 miles south of Tshane where individuals, while still pale, are tinged yellow rather than red.

Material from the Maun area is pale in colour but yellower than that from Tshane, more closely approaching the colour of the material from 30 miles south of Tshane.

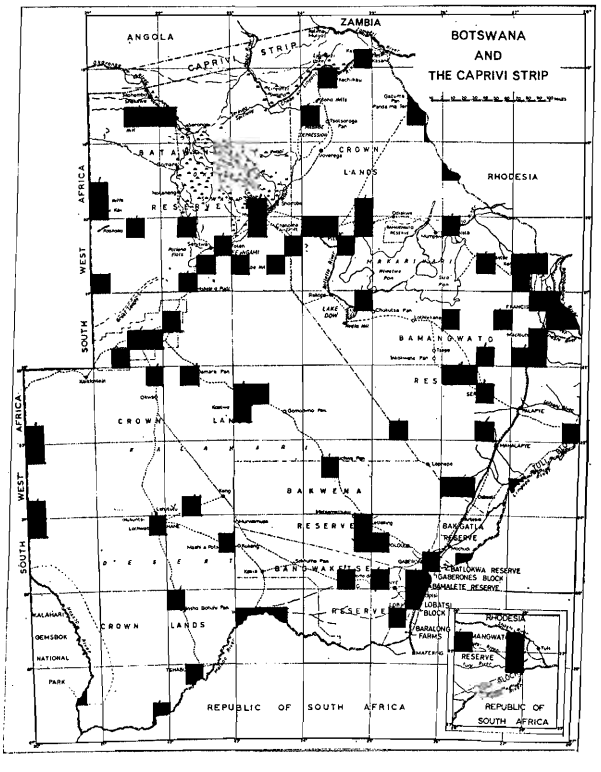
Material from the southern part of the eastern sector (Gaborone, Lobatse) is, in contrast, much darker more especially on the mid-back and closely agrees with the description of *A. n. lehocla* A. Smith.

Plate 15 Grass and stick nest of the Namaqua Rock Rat, *A. namaquensis*. Tonoto **Photo:** Author

Material from the Tati Concession and the northern parts of the eastern sector are much brighter and redder than that from further south and might more appropriately be referred to *A. n. lehochloides* (Roberts) which he describes as a 'small brightly coloured form with a large admixture of black-tipped hairs over the upper parts of the head and body'.

Proportionately those from the Tati Concession have the longest tails in relation to the length of the head and body at 140% for males, 148% for females, those from the Maun area the shortest at 118% for males, 123% for females. The Tshane and Dikgomodikae material is intermediate at 134% for males and 138% for females and 127% for males and 131% for females respectively.

The species is in need of revision on a wide basis, and until this is undertaken no subspecies are recognized.



Distribution

Widely distributed and common throughout the territory, although not so far recorded from the Caprivi Strip. Taken on the fringes of the Okavango delta but not within the delta itself.

Habitat

The species has a wide habitat tolerance. In areas of rocky kopjes, such as are found in the eastern sector, they are particularly associated with this rocky habitat, although not confined to it. They also occur in open scrub country where there are scattered trees (south-western Kalahari), open woodland (north-eastern sector), riverine woodland (Botletle and Nata rivers), the fringes of pans where there are trees, bushes or calcareous outcrops (Tshane).

Habits

Communal, nocturnal, terrestrial and to some extent arboreal. Small colonies occupy rock crevices, or burrows under rocks, holes in living trees, hollow fallen logs or under piles of debris or bushes. The nests are easily recognized by the accumulation of grass stems, twigs and other debris dragged to them which may form huge piles (Plate 15). These may be in the forks of trees, usually *Acacia* where the trunks are hollow or under sheltering rocks. These piles of grass and debris are perforated by tunnels giving access usually to some more substantial type of hiding place such as the hollows in the tree-trunk or the crevices in the rocks.

At Tshane these nests were often constructed under the cover of bushes, the domed pile of grass and debris concealing burrows into the sandy soil underneath.

Where the nests are in trees they are seldom over two to three metres from the ground, normally up to two metres and not higher.

Food

Graminivorous.

Breeding

Gravid females were taken in the months of October and January to May, there being no signs of breeding during the dry cold months of the year from June to September.

Distribution of non-gravid and gravid females throughout the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	10	9	36	100	34	99	9	27	12	17	14	11
Non-gravid	9	5	21	83	32	99	9	27	12	16	14	11
Gravid	1	4	15	17	2	—	—	—	—	1	—	—

The average number of foetuses is as follows:

Foetuses

Number $\bar{X} = 3{\cdot}1$; $N = 42$; Obs. range 2-7.
Implantation not following any regular pattern.

Sizes (*no weights available*)

Tati Concession

MALES

TL	$\bar{X} = 257$;	$N = 24$;	Obs. range 234-279
T	$\bar{X} = 150$;	$N = 24$;	„ „ 138-166
HB	$\bar{X} = 107$;	$N = 24$;	$\frac{T}{HB} \times 100 = 140\%$

FEMALES

TL	$\bar{X} = 261$;	$N = 35$;	Obs. range 242-274
T	$\bar{X} = 156$;	$N = 21$;	„ „ 142-177
HB	$\bar{X} = 105$;	$N = 21$;	$\frac{T}{HB} \times 100 = 148\%$

Tshane

MALES

TL	$\bar{X} = 251$;	$N = 9$;	Obs. range 232-278
T	$\bar{X} = 144$;	$N = 8$;	„ „ 134-156
HB	$\bar{X} = 107$;	$N = 8$;	$\frac{T}{HB} \times 100 = 134\%$

FEMALES

TL	$\bar{X} = 236$;	$N = 7$;	Obs. range 201-263
T	$\bar{X} = 137$;	$N = 6$;	„ „ 133-147
HB	$\bar{X} = 99$;	$N = 6$;	$\frac{T}{HB} \times 100 = 138\%$

Dikgomodikae

MALES

TL	$\bar{X} = 243$;	$N = 6$;	Obs. range 217-280
T	$\bar{X} = 136$;	$N = 6$;	„ „ 121-157
HB	$\bar{X} = 107$;	$N = 6$;	$\frac{T}{HB} \times 100 = 127\%$

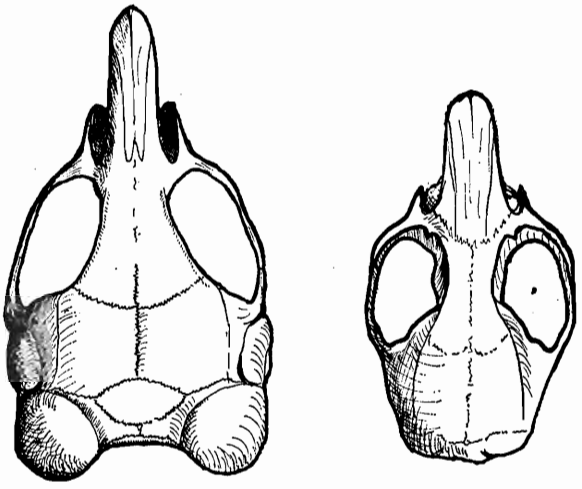
FEMALES

TL	$\bar{X} = 243$;	$N = 9$;	Obs. range 214-270
T	$\bar{X} = 138$;	$N = 9$;	„ „ 127-156
HB	$\bar{X} = 105$;	$N = 6$;	$\frac{T}{HB} \times 100 = 131\%$

Subfamily GERBILLINAE

1. Bullae enlarged, showing on the dorsal surface of the skull (fig. 23 (*a*)) . . . *Desmodillus*
   Bullae not showing on the dorsal surface of the skull 2
2. Soles of hindfeet haired; zygomatic plate normal; cheekteeth sub-laminated . . . . *Gerbillurus*
   Soles of hindfeet naked; zygomatic plate projecting far forwards, molars laminated . . *Tatera*

Fig. 23 Skulls of Muridae



(*a*) Namaqua Gerbil, *D. auricularis*

(*b*) Pouched Mouse, *S. campestris*

Genus DESMODILLUS Thomas and Schwann, 1904

Desmodillus auricularis — Namaqua Gerbil

D. auricularis (A. Smith, 1834)

(Skull, fig. 23 (*a*).)

Taxonomic Notes

Individuals from the same locality taken on the same date exhibit a wide variation in colour. In 30 specimens from the Tshane area, taken in the same month, the colour of the upperparts varies from an even rich cinnamon buff to an overall brownish-buff, to individuals with the rump and hindquarters grey-brown, the anterior parts lighter and tinged cinnamon-buff. In the darker species the tails tend to be broadly dark tipped, in the lighter specimens the tails are cinnamon-buff like the body, or white with a cinnamon-buff tinge. K 166 is particularly outstanding in having a broad longitudinal band of greyish-buff down the centre of the back, the remainder of the upperparts cinnamon-buff. These colour variations do not appear to be correlated with sex or season. Juveniles are as variable in colour as the adults, being either cinnamon-buff, although never to the same intensity (9R34) as in adults, or greyer (C2784).

In the whole series the underparts are pure white, the white patch behind the ears a distinctive character.

Taking the two areas from which fair samples of adults are available, the tails of the males in the Ghanzi-Mamuno sample are longer than in those from Tshane (*see* Sizes and Weights). There does not appear to be any other differences in the measurements of the two series which fall within the minimum and maximum limits given by Roberts (1951) which, although it is not stated, are presumably in the main based on material from the Republic of South Africa.

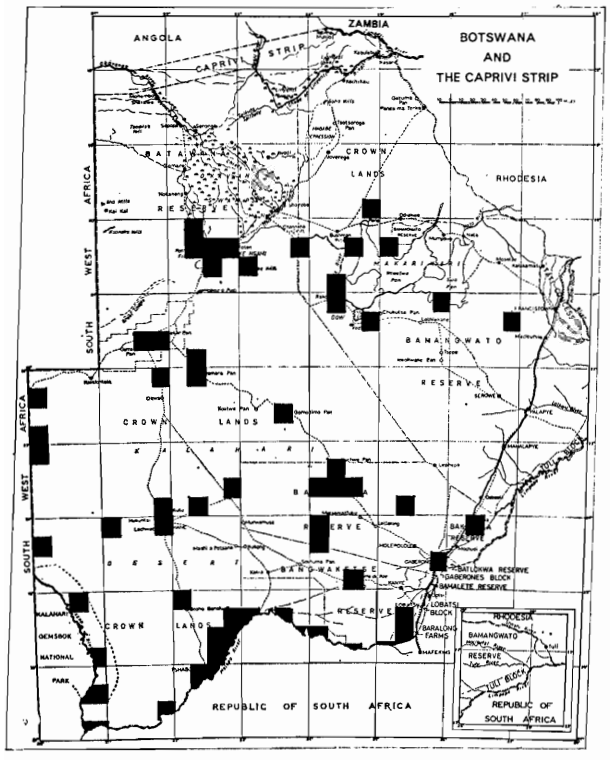
Several subspecies have been described, none of which have generally been accepted (Ellerman *et al.*, 1953; Roberts, 1951; Meester *et al.*, 1964). Lundholm (1955*a*) described *D. a. shortridgei* and *D. a. robertsi*, the former on a greyish-brown specimen from Port Elizabeth, the latter on a cinnamon-buff specimen from Sesfontein, Kaokoveld, South West Africa, the colours of which are within the range of variation demonstrated by Botswana material from within a circumscribed range. The availability of this wide

range of Botswana material appears to reinforce the view that no subspecies can be accepted.

Distribution

Widely distributed throughout the central and south-western Kalahari as far north as Tsau; the Botletle River; Nxai Pan and, south of the Makgadikgadi, throughout the north-eastward extension of the Kalahari association to within 40 miles of Francistown. Not so far recorded in the Lothlekane, Lephepe, Serowe triangle and adjacent areas, although in parts the terrain seems suitable. In the south-east extending eastwards to Artesia on the line of rail and, within the range of the Kalahari association, to some five miles west of Gaborone and, south of the hills in the Lobatse area, in the Baralong farms.

The Tsau record may well represent their northernmost limit in Botswana as, in the adjacent eastern parts of South West Africa Shortridge (1934) gives their northernmost limit as latitude 20° S., although in the western areas they have been taken as far north as Sesfontein *c.* 19° S.



Habitat

Open hard ground with some cover of grass or karroid bushes or hard sand with similar cover. Particularly associated with calcareous ground on the fringes of pans or calcareous pans with some low cover of grass or karroid bush.

Habits

Nocturnal. Although there may be many burrows within short distances of each other, does not form warrens. Burrows may be in quite open ground or at the base of a clump of grass or low bush, a small ramp of loose sand at the lip. In the vicinity of the entrance there are often considerable accumulations of seed cases, calyx of grass seeds, discarded stems of the seeding tops of grasses, etc., dragged there, the food material cropped from them.

There appears to be another entrance to the underground shelter, this often nearly vertical with no sign of excavated material and with no food remains at the entrance.

The species is difficult to trap and, in the initial stages of the survey, was predominantly taken at night by hand with the aid of dazzling lights. Peanuts are seldom, if ever, touched. A more effective bait was later found to be a mixture of oats with 'Purity' vegetable purée, or oats moistened with the liquid from tinned peas or other vegetables.

Food

Graminivorous, including the seeds of grasses and annuals. A common item of diet appears to be the seeds of the 'dubbeltjie', *Tribulus terrestris*, the remains of which are found among the debris at the entrance to the holes. Accumulations of these are also found in the burrows. Davis (*pers. comm.*) states that they are stored in side issues of the burrows.

Breeding

The distribution of gravid females over the months of the year, although the number available is small, suggests that the young may be born throughout the year. Gravid females were taken both in the warm wet (February) and the cold dry months of the year (June to August). Further evidence of a wide breeding season is provided by the presence of juveniles of weights between 14 and 20 g during the months of January, May, July, August, October and November.

Distribution of non-gravid and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	–	18	7	2	13	5	28	8	1	6	–	–
Non-gravid	–	16	7	2	13	4	21	6	1	3	–	–
Gravid	–	2	–	–	—	1	7	2	–	3	–	–

The number of foetuses carried by females was as follows:

Foetuses

Number $\bar{X} = 3{\cdot}9$; $N = 13$; Obs. range 3-7 the pattern of implantation showing no regularity.

Sizes and Weights

MALES (Tshane)

TL	$\bar{X} = 200$;	$N = 18$;	Obs. range 186-221
T	$\bar{X} = 90$;	$N = 18$;	,, ,, 84- 99
Hf c/u	$\bar{X} = 27$;	$N = 18$;	,, ,, 25- 28
E	$\bar{X} = 12$;	$N = 16$;	,, ,, 11- 13
Weight	$\bar{X} = 53{\cdot}3$ g;	$N = 18$;	,, ,, 39- 70 g

FEMALES (Tshane)

TL	$\bar{X} = 204$;	$N = 19$;	Obs. range 190-214
T	$\bar{X} = 91$;	$N = 19$;	,, ,, 81-100
Hf c/u	$\bar{X} = 27$;	$N = 19$;	,, ,, 26- 28
E	$\bar{X} = 12$;	$N = 19$;	,, ,, 11- 13
Weight	$\bar{X} = 51{\cdot}3$ g;	$N = 19$;	,, ,, 40- 60 g

MALES (Ghanzi—Mamuno)

TL	$\bar{X} = 214$;	$N = 9$;	Obs. range 194-221
T	$\bar{X} = 97$;	$N = 8$;	,, ,, 91-104
Hf c/u	$\bar{X} = 26$;	$N = 9$;	,, ,, 25- 27
E	$\bar{X} = 13$;	$N = 9$;	,, ,, 12- 14
Weight	$\bar{X} = 63$ g;	$N = 9$;	,, ,, 60- 70 g

FEMALES (Ghanzi—Mamuno)

TL	$\bar{X} = 205$;	$N = 9$;	Obs. range 201-232
T	$\bar{X} = 89$;	$N = 9$;	,, ,, 82-103
Hf c/u	$\bar{X} = 26$;	$N = 9$;	,, ,, 25- 28
E	$\bar{X} = 12$;	$N = 9$;	,, ,, 11- 14
Weight	$\bar{X} = 54$ g;	$N = 9$;	,, ,, 37- 66 g

Gerbillurus paeba

South African Pygmy Gerbil

G. p. paeba (A. Smith, 1836)

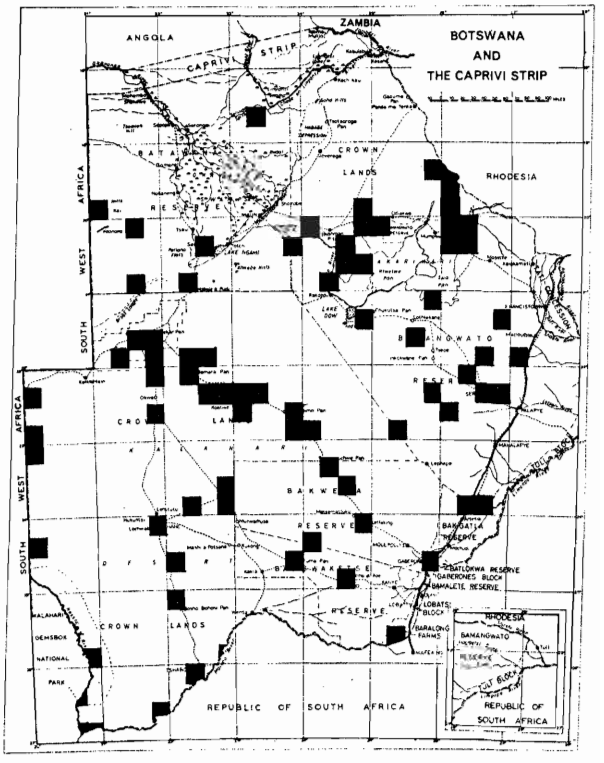
Taxonomic Notes

Davis (1968) includes *G. p. kalaharicus* (Roberts, 1932) as a synonym.

Distribution

Occur widely throughout the southern parts of the territory, in the west as far north as the Aha Hills on the South West African border, eastwards to Lake Ngami, the Botletle River and the northern parts of the Makgadikgadi (including Nxai Pan) to Tamafupi on the Rhodesian border. Not occurring in the eastern sector from the Nata River, the Tati Concession and the eastern parts of the Bamangwato Reserve south to Lobatse, except in the eastern extension of the Kalahari association in the Debeeti area. At Gaborone they occur five miles west of the town and in the extreme south-east in the Baralong farms area.

There are isolated records on the Selinda Spillway, north of the Okavango delta, with no apparent connection with the southern populations. They may in time be shown to occur up the eastern fringe of the Okavango delta but, so far, intensive collecting in this area has not revealed their presence and the habitat generally is unsuitable. This Selinda Spillway records may be connected with their occurrence in parts of southern Angola (Hill and Carter, 1941).



Habitat

Confined to areas of sandy ground or sandy alluvium with a grass, scrub or light woodland cover.

Habits

Nocturnal, terrestrial, lives in small warrens with many entrances, those in use characterized by the ramp of loose soil at the entrance, similar to *T. leucogaster* but the diameter of the burrows smaller. The entrances to the burrows are often concealed under a tuft of grass or at the base of bushes. Independent of water.

Food

Grass seeds and the seed of bushes and trees (*Acacia* spp.).

Breeding

Gravid females were taken in December to March, June to August, and in October, indicating that the young may be born at any time throughout the year.

Distribution of non-gravid and gravid females throughout the months of the year:

	J	F	M	A	M	J	J	A	S	O	N	D
Total	15	61	18	2	15	63	46	19	19	30	9	7
Non-gravid	13	52	13	2	15	58	40	16	19	22	9	5
Gravid	2	9	5	–	—	5	6	3	—	8	–	2

In a sample of 39 gravid females the average number of foetuses was as follows:

Foetuses

Number $\bar{X} = 3{\cdot}7$; $N = 39$; Obs. range 2-5.

Implantation is irregular.

Sizes and Weights

North-east; Serowe, Seruli, 45 miles south-west Francistown

MALES

TL	$\bar{X} = 204$;	$N = 20$;	Obs. range 192-214
T	$\bar{X} = 110$;	$N = 20$;	,, ,, 95-120
Hf c/u	$\bar{X} = 27$;	$N = 20$;	,, ,, 26- 28
E	$\bar{X} = 17$;	$N = 18$;	,, ,, 15- 17
Weight	$\bar{X} = 28{\cdot}1$;	$N = 18$;	,, ,, 25·0-34·0 g

FEMALES

TL	$\bar{X} = 203$;	$N = 17$;	Obs. range 185-216
T	$\bar{X} = 110$;	$N = 18$;	,, ,, 102-117
Hf c/u	$\bar{X} = 27$;	$N = 17$;	,, ,, 25- 28
E	$\bar{X} = 16$;	$N = 17$;	,, ,, 15- 17
Weight	$\bar{X} = 26{\cdot}9$ g;	$N = 17$;	,, ,, 22·0-31·0 g

South-west Kalahari

MALES

TL	$\bar{X} = 210$;	$N = 20$;	Obs. range 187-230
T	$\bar{X} = 113$;	$N = 20$;	,, ,, 102-125
Hf c/u	$\bar{X} = 27$;	$N = 20$;	,, ,, 26- 29
E	$\bar{X} = 17$;	$N = 20$;	,, ,, 17- 19
Weight	$\bar{X} = 25{\cdot}6$ g;	$N = 20$;	,, ,, 21·0-37·0 g

FEMALES

TL	$\bar{X} = 209$;	$N = 20$;	Obs. range 197-220
T	$\bar{X} = 113$;	$N = 20$;	,, ,, 104-121
Hf c/u	$\bar{X} = 27$;	$N = 20$;	,, ,, 26- 28
E	$\bar{X} = 17$;	$N = 21$;	,, ,, 16- 18
Weight	$\bar{X} = 25{\cdot}2$ g;	$N = 21$;	,, ,, 20·0-30·0 g

The material from the south-west Kalahari appears to have slightly longer tails than that from the north-east (Serowe, Seruli, 45 miles south-west of Francistown) and to average lighter in weight.

Genus TATERA Lataste, 1882

Key after Davis (1968)

1. Colour of upperparts brighter reddish, texture of fur sleek, silky; tail dark on the upperside, dark tipped; pads of hindfeet dark; mammary formulae 2—2 = 8 . . . . . *T. leucogaster*

   Colour of upperparts duller, lighter, less reddish, texture of fur fluffy, or somewhat harsh, tail less dark line on the upperside, white-tipped; pads of hindfeet lighter; mammary formulae 1—2 = 6 . . . . . *T. brantsi*

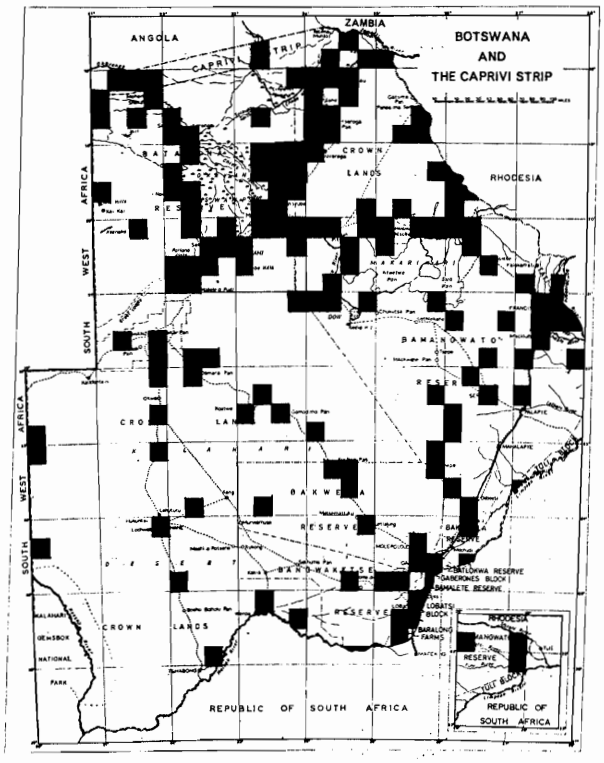
Tatera leucogaster — Bushveld Gerbil

T. leucogaster (Peters, 1852)

Taxonomic Notes

Davis (1968) states 'there is remarkably little discontinuity in distribution and populations appear to integrate fairly evenly throughout the range of the species. Hence valid subspecies cannot readily be picked out . . . Kalahari and fringes harbour the lightest coloured and the western Transvaal the darkest individuals.'

The very large series from Botswana demonstrates



the correctness of Davis' remarks as far as colour is concerned, material from the eastern, north-eastern sectors and the Okavango delta being distinctly darker, redder than that from the Kalahari. Material from the Makarikari is, in series, as light in colour, if not lighter, than that from the Kalahari. Within any population there is a considerable variation in the general colour.

Distribution

Widely distributed throughout except in the extreme south-west where, so far, it is not recorded west of the Tshabong-Tshane road or south of 24°30′ S. on the South West African border in the area of less than 250 mm mean annual rainfall. The status of the species in the eastern parts of the Central Kalahari Game Reserve and the adjacent parts of the Bamangwato Reserve is not known. No specimens, however, were taken on the cordon fence 10 miles west of Makoba (south-west of Lothlekane) or 40 miles north-west of Lephepe on the eastern border fence of the Central Kalahari Game Reserve.

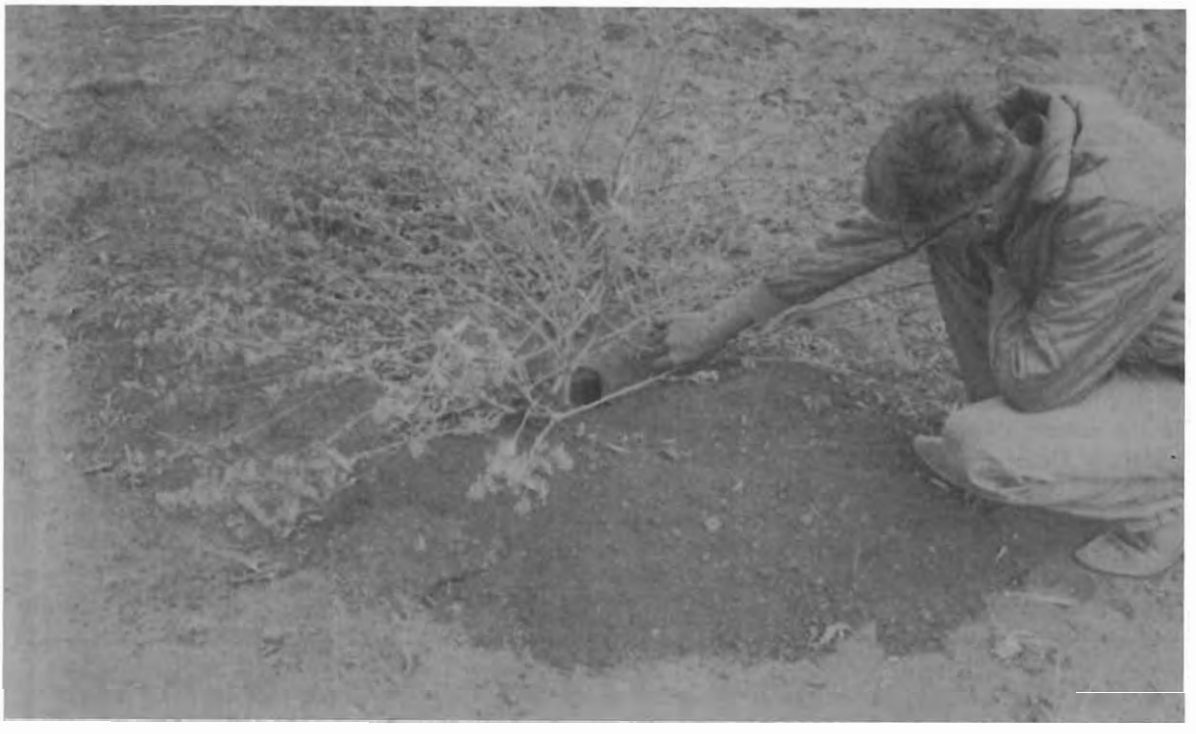


Plate 16 Active burrow of Peter's Gerbie *T. leucogaster*. Tonoto **Photo:** Author

Habitat

While the great majority of specimens were taken on sandy ground or sandy alluvium, they have also been taken on hard ground, as for example in parts of Tati Concession where they occur in mopane woodland, although in this latter situation they are less common.

The species appears independent of the type of vegetational cover present, being taken on open grassland (Gweta), the open sandy fringes of pans (Tshane), *Acacia* woodland and scrub (Tsau), *Terminalia-Combretum* scrub (Tamafupi) and on sandy islands in the Okavango delta with a rich cover of evergreen trees such as *Ficus* spp., *Kigelia pinnata*, etc., and palms, H. *ventricosa*. In the eastern sector they are absent from the rocky hills but occur in the valleys.

Habits

Nocturnal, terrestrial, communal, living in warrens, although sometimes solitary burrows found, the entrances to the burrows usually situated under a bush or tuft of grass, or at least with some adjacent cover (Plate 16). The burrows presently being used are easily traced by the spoor and freshly dug out sand which they throw out with their back feet and forms long ramps at the entrances. These burrows appear to be cleared out nightly, fresh sand being found at the entrances in the morning. Solitary burrows are found usually with at least two entrances, these housing not more than a pair of gerbils. The entrances are from 40-45 mm in diameter, the burrows running considerable distances underground in sandy ground. In areas of hard ground, such as in mopane woodland, the species will use holes at the bases of trees, holes in termite mounds or shallow excavations under fallen logs.

No evidence of the formation of runs, except between burrows in warrens, has been found, the individuals apparently scattering from the burrows to feed. Very sensitive and difficult to keep under observation at night, as a light or ground vibration will send them scurrying for the shelter of the burrows.

In the eastern Okavango burrows were found in the Mababe Depression in the season of low flood which would certainly have to be evacuated when the flood reached them. In such areas there must be some local movement to accommodate this situation.

A species subject to population explosions. Independent of water.

Food

Seeds of grasses, bushes and trees, grass rhizomes, bulblets.

Breeding

The data indicate that the young are born throughout the year, gravid females being taken in every month except September.

Distribution of non-gravid and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	6	17	20	36	22	71	90	75	19	15	38	21
Non-gravid	2	11	10	32	16	65	85	68	19	9	33	18
Gravid	4	6	10	4	6	6	5	7	—	6	5	3

In a sample of 53 gravid females, the average number of foetuses was as follows:

Foetuses

Number $\bar{X} = 4{\cdot}5$; $N = 53$; Obs. range 2-9

Implantation not following any regular pattern.

Sizes and Weights

Western Okavango

MALES

TL	$\bar{X} = 281$;	$N = 20$;	Obs. range 235-314
T	$\bar{X} = 146$;	$N = 20$;	„ „ 127-158
Hf c/u	$\bar{X} = 36$;	$N = 20$;	„ „ 34- 37
E	$\bar{X} = 22$;	$N = 20$;	„ „ 21- 24
Weight	$\bar{X} = 72{\cdot}9$ g;	$N = 20$;	„ „ 50·0-96·0 g

FEMALES

TL	$\bar{X} = 273$;	$N = 20$;	Obs. range 243-316
T	$\bar{X} = 143$;	$N = 20$;	„ „ 123-166
Hf c/u	$\bar{X} = 36$;	$N = 20$;	„ „ 32- 38
E	$\bar{X} = 22$;	$N = 20$;	„ „ 20- 23
Weight	$\bar{X} = 71{\cdot}3$ g;	$N = 20$;	„ „ 50·0-110·0 g

Kasane

MALES

TL	$\bar{X} = 264$;	$N = 12$;	Obs. range 248-289
T	$\bar{X} = 148$;	$N = 12$;	„ „ 138-160
Hf c/u	$\bar{X} = 35$;	$N = 12$;	„ „ 34- 36
E	$\bar{X} = 21$;	$N = 12$;	„ „ 20- 23
Weight	$\bar{X} = 58{\cdot}2$ g;	$N = 12$;	„ „ 46·1-79·4 g

FEMALES

TL	$\bar{X} = 259$;	$N = 12$;	Obs. range 235-293
T	$\bar{X} = 146$;	$N = 12$;	„ „ 129-164
Hf c/u	$\bar{X} = 35$;	$N = 12$;	„ „ 34- 36
E	$\bar{X} = 21$;	$N = 12$;	„ „ 19- 22
Weight	$\bar{X} = 53{\cdot}7$ g;	$N = 12$;	„ „ 46·2-77·9 g

Tatera brantsi

Brants' Gerbil

T. b. griquae Wroughton, 1906

Taxonomic Notes

All the Botswana material has pure white underparts and is generally pallid in coloration. A series from Serowe is distinctly darker on the upperparts than from any other part of the territory. Davis (1968) remarks on the reddish tinge in the colour of the upperparts of material from the Kalahari Gemsbok National Park which is borne out by the series from Vloorskop, but this feature is apparently narrowly confined to populations from this area as this reddish tinge is not present in material from Tshabong further east.

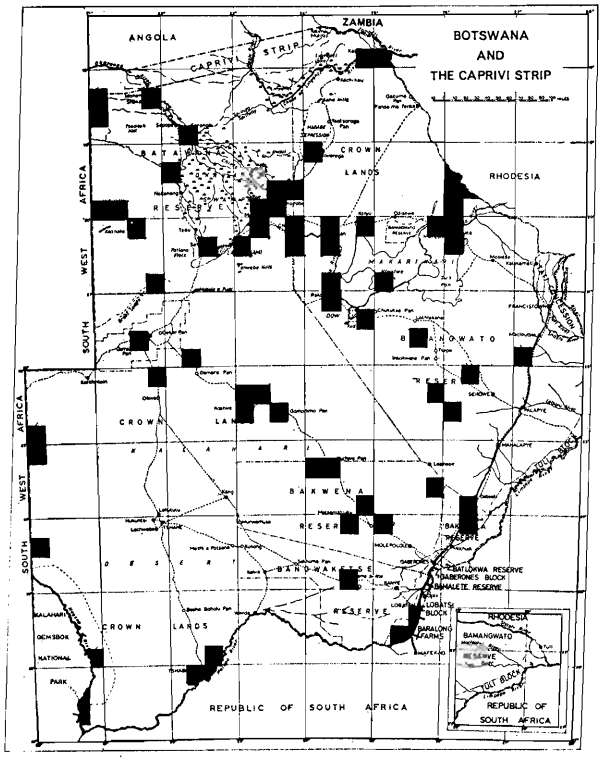
MSS 271, 272 and 277 from Maun are aberrants, having white patches of hair on the nape.

Distribution

Widely distributed throughout, although absent in the eastern sector from the Nata River to Debeeti east of the railway. Absent locally in areas where the ground is hard, as for example between Francistown and the Makgadikgadi in mopane, and on the basalt soils of the Pandamatenga area.

Habitat

Sandy ground or sandy alluvium, irrespective of the type of vegetational cover (*see T. leucogaster*). The species appears to be able to tolerate drier conditions than *T. leucogaster*, occurring in the extreme south-west in areas of mean annual rainfall of less than 250 mm, where *T. leucogaster* is absent, although elsewhere occurring on the same ground.



Habits

Similar to *T. leucogaster*.

Food

Similar to *T. leucogaster*.

Breeding

Gravid females were taken during the months of March, May to August, and in December, the average number of foetuses in a sample of 12 being as follows:

Foetuses

Number $\bar{X} = 3{\cdot}3$; $N = 12$; Obs. range 1-5.

Implantation is irregular.

Distribution of non-gravid and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	3	3	7	11	22	62	13	23	14	9	1	3
Non-gravid	3	3	7	11	20	61	9	21	14	9	1	2
Gravid	–	–	–	—	2	1	4	2	—	–	–	1

There are too few specimens available from the months of October through to March to be certain that there is not some breeding during these months. Juveniles were taken in March, June, July, September, October and December, which suggests that the species may breed throughout the year but further data are required to substantiate this.

Sizes and Weights (*Maun series*)

MALES (Maun series)

TL	$\bar{X} = 278$;	$N = 20$;	Obs. range 240-310
T	$\bar{X} = 122$;	$N = 20$;	„ „ 116-150
Hf c/u	$\bar{X} = 36$;	$N = 20$;	„ „ 33- 37
E	$\bar{X} = 22$;	$N = 20$;	„ „ 18- 24
Weight	$\bar{X} = 95{\cdot}7$ g;	$N = 13$;	„ „ 82·0-125·0 g

FEMALES (Maun series)

TL	$\bar{X} = 275$;	$N = 20$;	Obs. range 229-315
T	$\bar{X} = 137$;	$N = 20$;	„ „ 129-157
Hf c/u	$\bar{X} = 36$;	$N = 20$;	„ „ 34- 37
E	$\bar{X} = 22$;	$N = 20$;	„ „ 19- 24
Weight	$\bar{X} = 89{\cdot}3$ g;	$N = 12$;	„ „ 74·0-105·0 g

Subfamilies DENDROMURINAE and CRICETOMYINAE

Key after Misonne (1968)

1. Upper incisors grooved 2
   Upper incisors plain ..... *Saccostomus*
2. Tail length 90% of head and body length . . . . . *Dendromus*
   Tail length 60% of head and body length . 3
3. Pterygoid fossae far behind tooth-rows . . . . . *Malacothrix*
   Pterygoid fossae not behind tooth-rows . . . . . *Steatomys*

Saccostomus campestris

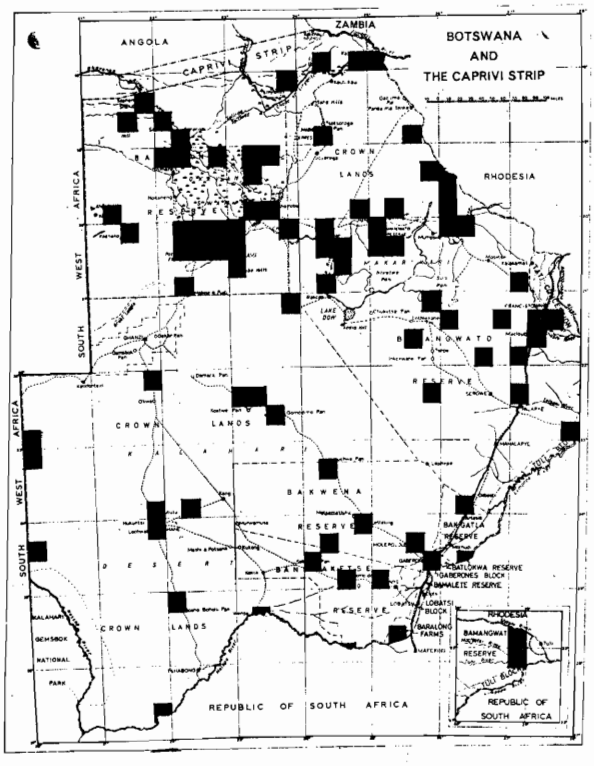
Pouched Mouse

S. campestris (Peters, 1846)

(Skull, fig. 23 (*b*).)

Taxonomic Notes

No subspecies are admitted (Meester *et al.*, 1964), although in the past at least six were listed for the southern part of the continent (Ellerman *et al.*, 1953). The colour is very variable, from the very pale grey populations of the south-west Kalahari to the much darker grey, or grey tinged with brown, populations of the Okavango delta and northern parts of the territory. Colour also varies with the age groups.



Distribution

Widely distributed throughout, occurring in the driest areas (Khuis, Molopo River), within the 250 mm mean annual rainfall area, to the well-watered higher rainfall areas of 700 mm and over of the northern parts of the territory.

It is of similar widespread occurrence in all surrounding territories.

Habitat

The species appears to have a very wide habitat tolerance being found in sandy as well as rocky kopje country. It has been taken on open short grass on the fringes of pans (Tshane); in dry river-beds (Khuis, Molopo River); in grassland with *Acacia* and other types of scrub (Tamafupi); on the fringes of swamp (Okavango delta); in mopane, *Acacia* and *Baikiaea* and other types of woodland (north-eastern sector) and rocky kopjes (Tati Concession).

Habits

Terrestrial, nocturnal, occurring singly, in pairs or family parties. The species wanders widely from its burrows to feed. At Gutza Pan an individual was followed for some 200 metres on open hard ground before it entered a hole in an antheap.

The burrows are dug in open ground or under the cover of a bush, whether it is soft and sandy or hard pan or stony or in rocky places, and they also appear to use other holes such as disused antbear, *O. afer*, or spring hare, *P. capensis*, burrows or holes in antheaps, under the roots of trees, under fallen logs or in piles of rock.

They are slow movers and, judging from the frequency with which they are taken in the stomachs of small predators, frequently fall prey to them.

Food

In the course of their nocturnal wanderings they fill their cheek pouches with seeds, returning to their burrows to consume them. A plentiful scattering of hard seed cases, etc., were found near the entrance to these burrows as well as in the nesting chamber.

The food consists predominantly of a wide variety of seed including grass seed; the seeds of *Acacia* spp., including *Acacia giraffae*, which is found widely throughout the major part of the country; *Grewia* spp.; *Combretum* spp.; and *C. mopane*.

Both Roberts (1951) and Shortridge (1934) record the finding of termites and other insects in the cheek pouches.

Breeding

Gravid females were taken in January to April and juveniles in September, October and February, suggesting a time of dropping the young during the warm wet months of the year.

Distribution of non-gravid and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total No.	17	30	18	27	9	8	3	–	6	6	5	4
Non-gravid	15	26	17	25	9	8	3	–	6	6	5	4
Gravid	2	4	1	2	–	–	–	–	–	–	–	–

In a sample of eight gravid females the average number of foetuses was as follows:

Foetuses
Number $\bar{X} = 7{\cdot}4$; $N = 8$; Obs. range 5-10.
Implantation is irregular.

Sizes and Weights

MALES

TL	$\bar{X} = 156$;	$N = 20$;	Obs. range 138-178
T	$\bar{X} = 44$;	$N = 20$;	,, ,, 37- 55
Hf c/u	$\bar{X} = 20$;	$N = 20$;	,, ,, 18- 21
E	$\bar{X} = 18$;	$N = 20$;	,, ,, 16- 19
Weight	$\bar{X} = 48{\cdot}5$ g;	$N = 20$;	,, ,, 33·0-68·0 g

FEMALES

TL	$\bar{X} = 155$;	$N = 20$;	Obs. range 134-174
T	$\bar{X} = 46$;	$N = 20$;	,, ,, 34- 54
Hf c/u	$\bar{X} = 20$;	$N = 20$;	,, ,, 19- 21
E	$\bar{X} = 18$;	$N = 20$;	,, ,, 16- 21
Weight	$\bar{X} = 42{\cdot}2$ g;	$N = 20$;	,, ,, 30·0-54·0 g

Genus DENDROMUS A. Smith, 1829

1. Fifth hind toe with a nail . . . *D. melanotis*
   Fifth hind toe with a claw 2
2. Larger, skull over 22 . . . . *D. mesomelas*
   Smaller, skull under 22 . . . *D. mystacalis*

Dendromus melanotis

Grey Pygmy Climbing Mouse

D. m. shortridgei St. Leger, 1930

Distribution

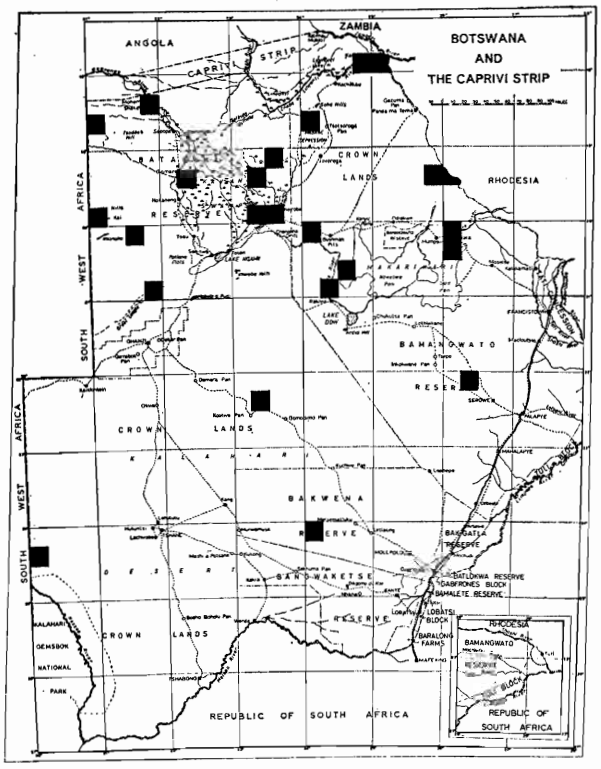
Widely distributed throughout the northern parts of the territory, with scattered records from the Kalahari. Not so far recorded from the eastern sector from the Nata River southwards, but, as it has been taken in parts of the Transvaal (Pretoria, Middelburg; Roberts, 1951), may be taken in this area in due course.

Habitat

Grassland, either in dry areas or on the fringes of swamps and rivers. At the Gomoti River, Okavango delta, taken in thick grass over water alongside *D. mesomelas*. Has a preference for thick stands of high (2 m) grass (e.g. *Hyparrhenia* sp.) especially if this is thickened up by the presence of shrubs or annuals. At Kasane taken under carpets of dry *Salvinia* sp. on the river fringe, in riverine woodland and floodplain, on swamp islands and in dry *Baikiaea* woodland adjacent to the river.

Habits

Nocturnal, climbs around in the tall grass and shrubs



in search of its food but, at the same time, to some extent terrestrial. The long tail is not truly prehensile, but is used to steady them in their climbing activities, the tip twining round the grass stems when pausing to feed. Small round nests are constructed, about 4-6 cm in diameter, with a single entrance, made of shredded grass or fibres, hung between three or four grass stems at from near ground-level to about a metre high. These nests are only used in the breeding season and are thereafter deserted, when presumably they make use of other types of cover. Shortridge (1934) and Roberts (1951) both state that they use burrows.

The species is not easily trapped and they are most easily secured during the breeding season by locating the nests or taken at night with a dazzling light.

Territorial in habits, if strange individuals are introduced near the nests, they fight and, if restricted in captivity, they will fight to the death.

Food

Granivorous and insectivorous. In captivity will take a wide range of insects, including Isoptera.

Breeding

The only information on the time of dropping the young is given by a single female from Kasane, *c.* 1232, taken in December with four foetuses, 3R 1L. In Mashonaland, Rhodesia, the young are born during the months of December to March.

Sizes and Weights

MALES (Okavango)			
TL	$\bar{X} = 136$;	$N = 21$;	Obs. range 123-151
T	$\bar{X} = 76$;	$N = 21$;	„ „ 67- 84
Hf c/u	$\bar{X} = 18$;	$N = 22$;	„ „ 17- 21
E	$\bar{X} = 17$;	$N = 21$;	„ „ 14- 18
Weight	$\bar{X} = 7{\cdot}4$ g;	$N = 11$;	„ „ 6·0-10·0 g
FEMALES (Okavango)			
TL	$\bar{X} = 129$;	$N = 9$;	Obs. range 119-157
T	$\bar{X} = 73$;	$N = 9$;	„ „ 68- 80
Hf c/u	$\bar{X} = 18$;	$N = 10$;	„ „ 16- 20
E	$\bar{X} = 16$;	$N = 10$;	„ „ 14- 18
Weight	$\bar{X} = 7{\cdot}0$ g;	$N = 6$;	„ „ 4·0-12·0 g
MALES (Kasane)			
TL	$\bar{X} = 142$;	$N = 22$;	Obs. range 125-162
T	$\bar{X} = 77$;	$N = 19$;	„ „ 70- 85
Hf c/u	$\bar{X} = 19$;	$N = 24$;	„ „ 17- 22
E	$\bar{X} = 16$;	$N = 24$;	„ „ 14- 18
Weight	$\bar{X} = 7{\cdot}8$ g;	$N = 22$;	„ „ 5·1-9·9 g
FEMALES (Kasane)			
TL	$\bar{X} = 134$;	$N = 17$;	Obs. range 121-150
T	$\bar{X} = 73$;	$N = 17$;	„ „ 61- 82
Hf c/u	$\bar{X} = 19$;	$N = 19$;	„ „ 16- 21
E	$\bar{X} = 16$;	$N = 19$;	„ „ 14- 17
Weight	$\bar{X} = 6{\cdot}9$ g;	$N = 15$;	„ „ 5·1-9·3 g

Dendromus mesomelas Chestnut Climbing Mouse

D. m. major (St. Leger, 1930)

So far only recorded from the Gomoti River where two males were taken in thick matted grass, over water 50 cm deep, near the edge of the swamp, where they occurred alongside *D. melanotis*. Shortridge (1934) records the species from Mbambi and the Popa Falls on the Okavango River in the western Caprivi Strip and they might be expected to occur in other parts of the north-western Okavango delta and along the Okavango River.

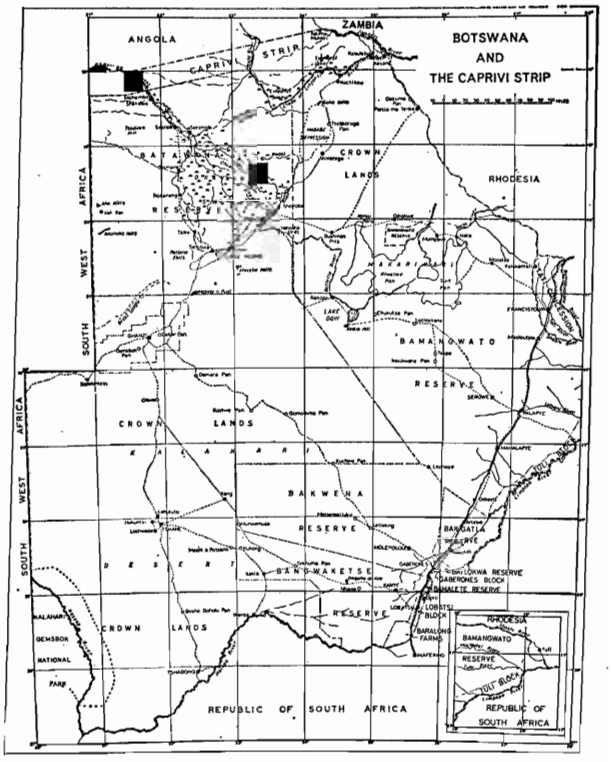
Nocturnal, the two specimens were trapped at night and another individual was seen in the beam of a dazzling light moving in the matted grass after dark. The stomach of one specimen showed scraps of chitin indicating that at least a proportion of the food consisted of insects.

Sclater (1901) states that they construct nests among trees and shrubs and 'at other times occupy those of small birds' there being three specimens in the collection of the South African Museum taken from the deserted nest of a weaver bird, *Ploceus* sp.

The sizes of the two specimens are as follows:

MALES

No.	*TL*	*T*	*Hf c/u*	*E*
RB 43	183	105	26	15
RB 7	165	91	26	15



Dendromus mystacalis

D. m. whytei Wroughton, 1909

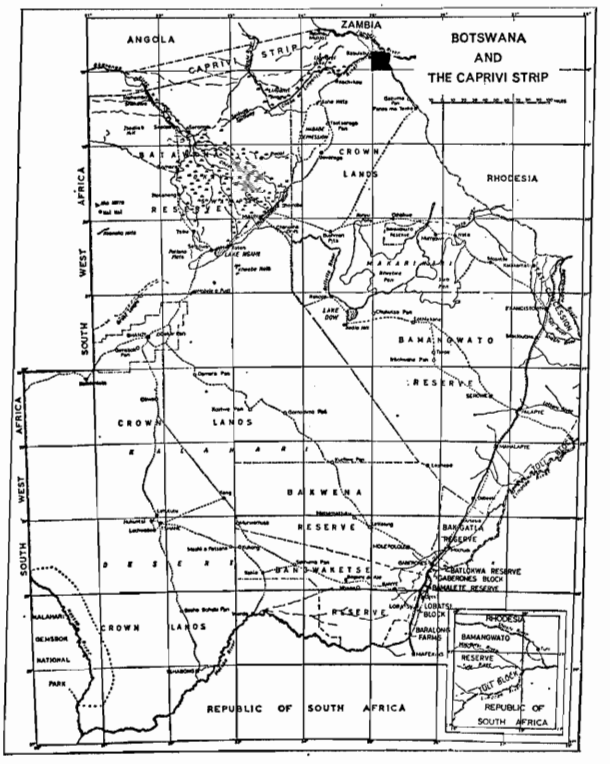
Lesser Climbing Mouse

So far only recorded from a single specimen taken in floodplain grassland on a swamp island near Kasane. Nothing further is known of the ecology of the species in Botswana.

The size of the single specimen is as follows:

MALE

No.	*TL*	*T*	*Hf c/u*	*E*	*Weight*
C 815	187	102	25	13	10·8 g



Malacothrix typica

Long-eared Desert Mouse

M. t. molopensis Roberts, 1933
M. t. kalaharicus Roberts, 1932

Taxonomic Notes

Two clearly recognizable subspecies occur in the territory:

M. t. molopensis Roberts, 1933, and *M. t. kalaharicus* Roberts, 1932.

1. Hairs on chest and belly with greyish bases; ground colour of upperparts buffy-grey, markings on upperparts black . . . *M. t. molopensis*
   Hairs on chest and belly pure white, ground colour of upperparts warm reddish-buffy, markings brownish . . . . . *M. t. kalaharicus*

There is a gradual lessening in the intensity of the ground colour of the upperparts from *M. t. typica* (A. Smith) of the Graaff Reinet area, C.P., which is pale reddish-brown, north-westwards through the reddish-buffy of *M. t. kalaharicus* to the pale drab of *M. t. egeria* Thomas of Ovamboland, northern South West Africa. Parallel with this there is a lessening in the intensity of the dorsal markings; all the western subspecies have pure white hairs on the chest and belly.

In the east, including the material from the Baralong farms, the loss of the reddish colour is more marked, the dorsal markings more intense, features that *M. t. molopensis* shares with *M. t. fryi* of the southern Transvaal, albeit to a lesser degree. The hairs of the chest and belly of these two subspecies in both cases have grey bases.

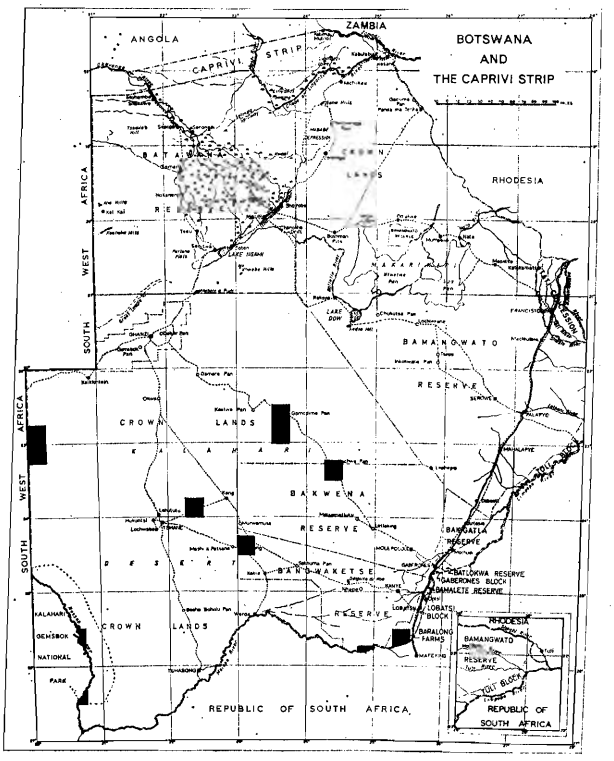
In the young of *M. t. molopensis* from the Baralong farms the dark transverse markings on the hind back are distinct from an early age, the remainder developing more strongly as the adult stage is reached.

In the young of *M. t. kalaharicus* from the Tshane area, because of the lighter general colour, the markings are distinct, although less intense.

M. t. molopensis appears to be confined to the extreme south-east in the area of the Baralong farms, *M. t. kalaharicus* having a wider distribution from the south-western parts of the Kalahari, along the South West Africa border north to *c.* 27° S. and in the central Kalahari to Gomodimo and Kuchwe Pans. To date the species has not been taken between the Baralong farms and the Kuchwe Pan-Kukong areas, although intensive collecting has been undertaken in the intermediate zone. The reason for their absence here is not apparent as the ecological conditions appear suitable.

Distribution

Occurs throughout the central, south-western and southern parts of the Kalahari as far north as 45 miles south of Mamono on the South West Africa border, Gomodimo and Kuchwe Pans in the Central Kalahari Game Reserve. In the extreme south-east they occur in the vicinity of the Baralong farms. Roberts (1951) records their occurrence in the northern Orange Free State and southern Transvaal as far north as Krugersdorp and west to southern Botswana. Westwards the distribution extends much further north. Shortridge (1934) lists two records, one from Gobabis, the other from Ondonga, Ovamboland, and Hill and Carter (1941) a single record from southern Angola.



Habitat

The species is particularly associated with short grass on hard ground, occurring on the fringes of pans or on pans with a cover of karroid bush, or on hard calcareous ground. They are difficult to trap and, although they have been taken on a bait of oats and vegetable juices, most of the specimens collected were taken with the aid of dazzling lights, being caught by hand. Roberts (1923) records that the entrance to the deep burrow, which leads to the resting chamber, opens cleanly to the surface with no ramp of loose material at the entrance, this being used to fill the original excavated burrow which is thus closed. On hard ground in the Baralong farms these small burrows, 20-25 mm in diameter, were nearly vertical. In captivity, where deep burrows cannot be made, domed nests are neatly constructed with any available material, such as soft grass, which is cut into small pieces for the purpose.

Habits

The species appears to wander widely from its burrows at night for, on several occasions, individuals were chased for distances up to 100 m before disappearing down holes. They are easily handled and not prone to bite. On capture they call loudly, *dziss-dziss*, repeatedly, a similar noise being heard when, in captivity, a strange individual is introduced to the cage of another.

Food

The food appears to consist entirely of green vegetable matter although an individual was trapped with what appeared to be grass seed in its mouth. Stomach contents are frequently green tinged, indicating that green vegetable matter formed at least part of the food. In captivity from an original stock of two females and three males, seven litters of from three to six young were produced on a diet of lettuce, fresh lucerne and munga (finger millet) seed, an individual from the original stock living for two and a half years.

Breeding

No signs of breeding were noted in a series taken in June from the Baralong farms or from the Tshane area in February. In the latter case, however, a number of juveniles were trapped at 6-8 g which, on the basis of material born in captivity, might be placed as somewhere between 2-4 weeks old, giving a time of birth as approximately January.

From three pairs taken in June 1966 from the Baralong farms and kept together as from that date, litters were born on the following dates:

	Litter No.	*Young Born*	*No. Young*	*Gestation in Days*
1. *Female A*	1	22.8.66	5	—
	2	10.11.66	3	25
2. *Female B*	1	5.10.66	6	—
	2	9.11.66	5	34-35
3. *Female C*	1	16.10.66	3	25
4. *Female E* (bred in captivity 1966)	1	7.3.67	3	22-24
5. *Female F* (bred in captivity 1966)	1	10.4.67	4	23-26
6. *Female G* (bred in captivity 1966)	1	18.4.67	*c.* 2	27-30
7. *Male and female from Female A, Litter No.* 1 Ages at mating 51 days	1	8.12.66	3	—
8. *Male and female from Female B, Litter No.* 1 Ages at mating 72 days	1	29.12.66	5	—

Under these artificial conditions, in spite of the fact that in Nos. 1-3 adult males and females had been together since June, no breeding took place until the onset of the warmer weather in August and in the case of Nos. 4-6 none after April.

In an endeavour to establish the gestation period, males were introduced to females for periods of from one to three days, litters being born from a minimum of 22 to a maximum of 26 days. In a further case, a period of 27-30 days elapsed. When litter No. 1 was born from Female B on the 5th October, 1966, the male was removed on the following day, this female producing a further litter on the 9th November, 1966, 34-35 days later. Fertilization of this female must have taken place very soon after the young were born.

Birth weights of individuals from Female B litter No. 1 and Female B litter No. 2 were 1·1 and 1·15 gm, the young being born pink and naked.

The species is apparently capable of producing more than one litter during the season and of breeding at an age of 51 days and more.

In the light of the above and the presence of juveniles in February at Tshane, the breeding season appears to fall during the warmer wetter months of the year from about August to March.

Females in captivity bred at weights of 13·2-18·8 gm.

Sizes and Weights

Baralong Farms (*M. t. molopensis*)

MALES

TL	$\bar{X} = 111$;	$N = 5$;	Obs. range	107-117
T	$\bar{X} = 35$;	$N = 5$;	„ „	34- 35
Hf c/u	$\bar{X} = 19$;	$N = 5$;	„ „	19- 20
E	$\bar{X} = 19$;	$N = 5$;	„ „	19- 20

South-west Kalahari (M. t. kalaharicus)

MALES				FEMALES			
TL	$\bar{X}$ = 112;	N = 8;	Obs. range 104-120	TL	$\bar{X}$ = 107;	N = 6;	Obs. range 102-116
T	$\bar{X}$ = 36;	N = 9;	„ „ 34- 40	T	$\bar{X}$ = 35;	N = 5;	„ „ 32- 39
Hf c/u	$\bar{X}$ = 19;	N = 8;	„ „ 18- 20	Hf c/u	$\bar{X}$ = 18;	N = 5;	„ „ 18- 19
E	$\bar{X}$ = 20;	N = 9;	„ „ 19- 20	E	$\bar{X}$ = 20;	N = 5;	„ „ 18- 22
Weight	$\bar{X}$ = 16·4 g;	N = 9;	„ „ 12·0-20·0 g	Weight	$\bar{X}$ = 10·4 g;	N = 5;	„ „ 7·0-13·0 g

Genus STEATOMYS Peters, 1846

Taxonomic Notes

Ansell (1960) and Meester *et al.* (1964) recognize three species, *S. pratensis* Peters; *S. krebsii* Peters and *S. minutus* Thomas and Wroughton, keying them out on the number of mammae, the multimammate group with 5-7 down each side *S. pratensis;* 2—2 = 8 in the case of *S. krebsii* and *S. minutus.*

S. minutus in its smaller size HB 60-80; skull TL 21-23 and its pure white tail, is immediately recognizable in the series.

The remainder consisting of 62 males and 49 females are difficult to place as, with the exception of nine females, it was impossible in the field to ascertain the number of mammae present, either because they were juvenile or the mammae undeveloped.

In the nine specimens it was possible to count the mammae as the females were either gravid or suckling young.

These were from the following localities and appeared, in the multimammate group, to represent *S. pratensis* and in the group with 2—2 = 8 mammae *S. krebsii* and *S. minutus:*

No.	*Locality*	*H.B.*	*Skull T.L.*
Multimammate, 5-7 each side: *S. pratensis*			
R 85	Tamafupi	86	232
MS 128	Maun	91	239
MS 205	Maun	88	—
RN 580	Maun	93	245
SWG 352	Sepopa	89	240
C 2870	Goha Pan	100	239
HJH 1272	Shorobe	85	—
Mammae, 2−2 = 8 (tail bicolor): *S. krebsii*			
MS 68	Kabulabula	86	230
Mammae, 2−2 = 8 (tail white): *S. minutus*			
9R16	Gutsa Pan	88	229

The female MS 68 from Kabulabula, with 2—2 = 8 mammae, two males from the same locality and a male from the Kwando River are, in the colour of the upperparts, colder, greyer than the remainder of the series. Ansell (1960) records this as a feature of *S. krebsii* as opposed to *S. pratensis.* On the basis of the number of mammae and their colour these four specimens are assigned to *S. krebsii.*

Within the remainder of the series there are a number of juveniles of both sexes which it is impossible, with certainty, to place, leaving a range of adults which, including the six multimammate females, are redder on the upperparts, especially on the sides of the face, which are assigned to *S. pratensis.* Further study of this genus is required in the hope that other characters may be found to clarify the status of the three species now listed.

1. Smaller, skull TL 20-23, HB 69-80; tail white . . . . . *S. minutus*

   Larger, skull TL 23·5-24·5, HB over 80; tail dark above white below 2

2. Multimammate, 5-7 down each side not necessarily paired; upperparts tinged reddish . . . . . *S. pratensis*

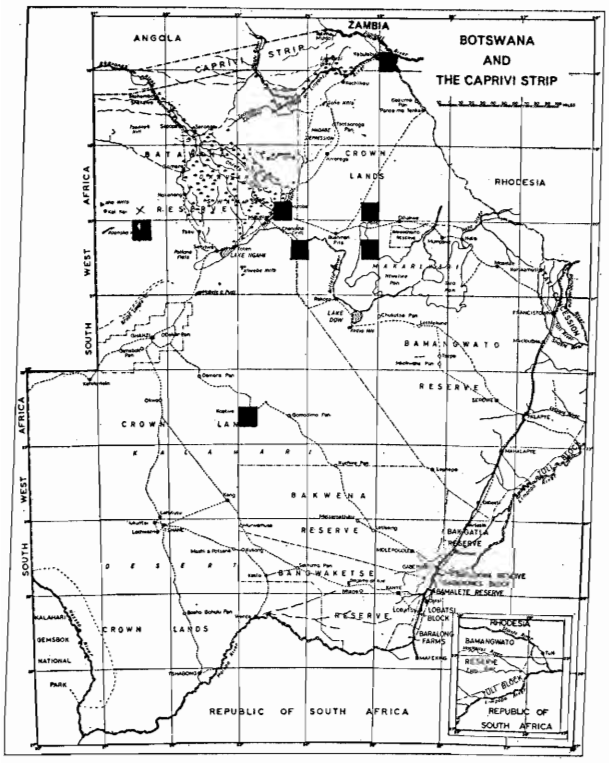
   Mammae 2—2 = 8; upperparts greyish . . . . . *S. krebsii*

Steatomys minutus Tiny Fat Mouse

S. m. swalius Thomas, 1926

Distribution

There are too few records to allow of a proper assessment of the distribution of the species. To date there are records from Kasane; the Aha Hills; Maun; Makalamabedi; Nxai Pan; Gutsa Pan; the Botletle



River (2024 C2) and Camp 3 (2123 A3). Roberts' (1935) specimen from 25 miles west of Damara Pan which he states is 'a small form related to *S. k. swalius* Thomas of north-western Ovamboland' described by him as *S. k. kalaharicus* is assigned to this species. It has a whitish tail and is of small size Skull TL 22·0.

Habitat

They appear to have a wide habitat tolerance, being taken in riverine floodplain and woodland (Chobe River and Botletle River) as well as in dry open scrub (Kaotwe Pan), in areas of mean annual rainfall from over 700 mm (Chobe River) to 400 mm (Kaotwe Pan). Three of the records are from the fringes of pans (Kaotwe, Gutsa and Nxai) where they were taken in dry scrub or on the associated grassland.

Habits

No data. They occur on the same ground as *S. pratensis* at Kasane and Maun and as *S. krebsii* at Kasane.

Food

No data.

Breeding

The female taken in November at Gutsa Pan was lactating. No gravid females were collected.

Sizes and Weights

TL	$\bar{X} = 121$;	$N = 7$;	Obs. range 110-137
T	$\bar{X} = 43$;	$N = 7$;	„ „ 34- 49
Hf c/u	$\bar{X} = 16$;	$N = 7$;	„ „ 14- 17
E	$\bar{X} = 15$;	$N = 7$;	„ „ 12- 18
Weight	Only three available: 11, 14 and 15 g		
Skull TL	$\bar{X} = 22{\cdot}1$;	$N = 7$;	Obs. range 21·3-22·9

Steatomys pratensis — Fat Mouse

S. p. maunensis Roberts, 1932

Distribution

Occur throughout the northern part of the territory south to the Hanahai Depression (south of Ghanzi), the Botletle River, Mabitwane and Tamafupi on the Rhodesian border. Shortridge (1934) restricts their distribution to the extreme northern part of South West Africa stating 'probably occurs in the Central and Eastern Caprivi, its range, in that region extends from Ngamiland to Northern Rhodesia'.

Habitat

The majority of the specimens were taken either on sandy ground in scrub (Nunga) or in sandy alluvium on the fringes of swamp or rivers (Okavango delta and Chobe River).

Habits

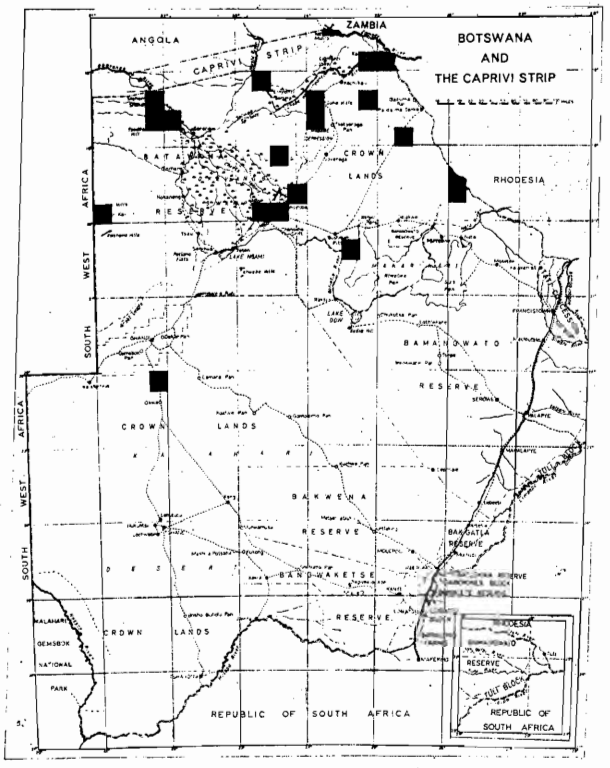
Nocturnal, terrestrial, occurring singly or in pairs. Two pairs were dug out of grass-lined nests on the fringe of the swamp at Savuti, the nest 20 cm below ground. These pairs, when picked out of the nest, were torpid and at first made no attempt to escape but soon recovered their normal activity.

Food

Graminivorous.

Breeding

There are only two records of gravid females, RN 580



Maun with two foetuses and HJH 1272 Shorobe with seven.

Distribution of non-gravid, lactating and gravid females through the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Total	2	4	1	40	11	4	1	–	–	3	1	9
Non-gravid	2	2	–	38	11	4	1	–	–	2	1	7
Lactating	–	1	1	2	—	–	–	–	–	1	–	1
Gravid	–	1	–	—	—	–	–	–	–	–	–	1

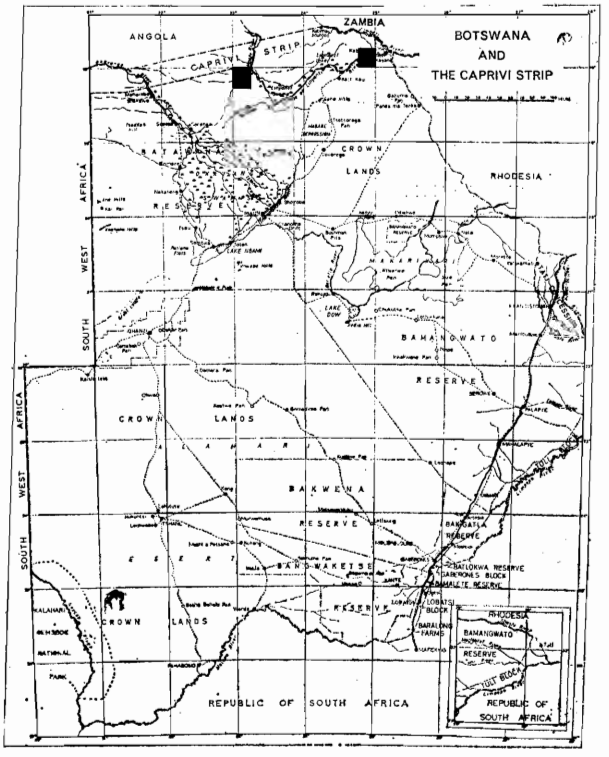
Sizes and Weights

TL	$\bar{X} = 133$;	$N = 40$;	Obs. range 115-150
T	$\bar{X} = 44$;	$N = 40$;	„ „ 31- 54
Hf c/u	$\bar{X} = 18$;	$N = 40$;	„ „ 16- 20
E	$\bar{X} = 16$;	$N = 40$;	„ „ 15- 19
Weight	$\bar{X} = 26$ g;	$N = 13$;	„ „ 20- 47 g
Skull TL	$\bar{X} = 23{\cdot}5$;	$N = 20$;	„ „ 22·3-25·4

Steatomys krebsii

Peters' Fat Mouse

S. krebsii (Peters, 1852)



Distribution

So far only recorded from the extreme northern part of the country from Kabulabula and the Kwando River (1923AI) and Kabuta in the eastern Caprivi Strip, only nine specimens being certainly identified as referable to this species.

Habitat

All nine specimens were taken in sandy alluvium on the fringes of the Chobe and Kwando rivers.

Habits

Terrestrial, nocturnal.

Food

No data.

Breeding

No data.

Sizes and Weights

TL	$\bar{X} = 130$;	$N = 9$;	Obs. range 118-146
T	$\bar{X} = 51$;	$N = 9$;	„ „ 44- 61
Hf c/u	$\bar{X} = 17$;	$N = 9$;	„ „ 14- 19
E	$\bar{X} = 17$;	$N = 8$;	„ „ 16- 18
Weight	Only one available: 24 g		
Skull TL	$\bar{X} = 23{\cdot}9$;	$N = 9$;	„ „ 22·9-24·9

List of species not recorded but which may occur

Order CHIROPTERA
Family PTEROPODIDAE
Genus EPOMOPHORUS Bennett, 1836

Epomophorus gambianus — Gambian Epauletted Fruit Bat

Koopman (1966) records *E. g. parvus* from Nampini, Zambezi River, Rhodesia (17 25 C_4), some three miles from the Botswana border. Similar ecological conditions exist on the Chobe River, within Botswana limits, and it may in time be shown to occur, although at present no material is available.

Epomophorus wahlbergi — Wahlberg's Epauletted Fruit Bat

This species has been taken in southern Angola (Hill and Carter, 1941) and western Rhodesia (National Museums of Rhodesia) on which basis they might be expected to occur in the northern parts of Botswana, although there are no material records to date.

Order RODENTIA
Family MURIDAE
Genus RATTUS Fischer, 1803

Rattus rattus — Alexandra Rat
R. r. alexandrinus (Geoffroy, 1803)

The introduced Alexandra Rat is firmly established in and around the larger centres on the line of rail throughout Rhodesia, in goods yards, grain stores, houses and farm outbuildings. Within recent years they appear to have extended their distribution to other areas where there is human activity—a specimen being taken at the site of the Kariba Dam in 1966. On this basis they might be expected to occur on the extension of this line of rail into Botswana, but, to date, have not been recorded in the territory.

Order ARTIODACTYLA
Family BOVIDAE
Genus PELEA Gray, 1851

Pelea capreolus

Vaal Rhebok

Although Shortridge (1934) records the species from eastern Botswana and Ellerman *et al.* (1953) quotes Shortridge as recording them from 'Gaberones near the Transvaal border of southern Botswana', there does not appear to be any material evidence to support this. Kettlitz (1962) states that they still occur in the Rustenburg district of the Transvaal, the nearest locality from which they have been collected.

Bryden (1893) did not contact them himself but records that 'Mr. James Nicolls (joint author of 'The Sportsman in South Africa') stated that they were to be found in the hills of the Protectorate (Botswana). Hodson (1912) records that they are to be found in the 'vicinity of Lobatse'.

Shortridge's (1934) statement is based on an unpublished record by Neale (1930).

The evidence of either their occurrence in historical times or today is based too much on hearsay and it is not considered that the species is worthy of being listed even as a 'possible'.

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