# THE POPULATION DYNAMICS OF RODENTS AT PONGOLA, NORTHERN ZULULAND, EXPOSED TO DIELDRIN COVER-SPRAYING

BY

Pierre Swanepoel

Submitted in partial fulfilment of the requirements for the degree of

Master of Science

in the

Faculty of Science

University of Pretoria

PRETORIA

May 1972

To my wife

# ABSTRACT

# THE POPULATION DYNAMICS OF RODENTS AT PONGOLA, NORTHERN ZULULAND, EXPOSED TO DIELDRIN COVERSPRAYING.

BY

Pierre Swanepoel

| | |
|---|---|
| Supervisor: | Dr. J.A.J. Nel |
| Co-supervisor: | Prof. J.A.J. Meester |

DEPARTMENT OF ZOOLOGY

PRETORIA

M.Sc

Four grids, each 3,42 ha (4 morgen) in size, were live trapped from April 1967 through May 1969 in two soil and vegetation types (black turf: *Acacia nigrescens* community, and brown reddish soil: *Acacia tortilis* community) at Pongola, northern Zululand, to determine the effect of dieldrin coverspraying, at a dosage of 87,4 g/hectare (2,64 oz/morgen), on rodents. Low population numbers before and especially at the time of spraying made clear-cut conclusions impossible to reach. Rodent populations (mainly *Praomys* (*Mastomys*) *natalensis*, *Saccostomus campestris*, and *Lemniscomys griselda*) were apparently not adversely effected, although *L. griselda* numbers showed a decline which was not in correspondence with that on the control area. This might be ascribed to dieldrin spraying. Relatively higher numbers of *S. campestris* and *L. griselda* were observed during periods of lower *P.*( *M.*) *natalensis* numbers. Decreases in *P.*( *M.*) *natalensis* populations coincided with times of food scarcity. *Praomys* (*Mastomys*) *natalensis* are thus found in association with other rodents when abundant food is available, but seems to give way when competition due to food scarcity occurs.

Reproductive data obtained from the study were too meagre to allow any conclusions concerning the effect of spraying thereon.

The method involving the calculation of maximum distance between captures was used to express movement patterns of the species studied.

Population structure is expressed in terms of sex ratios, and frequency per mass class for each season.

The size of animals was investigated by measuring total length, tail length, and head and body length. Behavioural features of the species captured were also noted.

## Contents

Page

## 1. Introduction

Large tracts of land in Southern Africa are infested by harvester termites Hodotermes mossambicus (Hagen). Although the recommended treatment with sodium fluosilicate bait is effective, implementation of this method on a large scale proved to be impractical. This led to the temporary registration by the Department of Agricultural Technical Services in 1965 of dieldrin coverspraying at a dosage of 87,4 g/ha (2,64 oz per morgen). Due to worldwide concern about the use of organochlorines in general and dieldrin in particular, the permanent registration of dieldrin depended on the outcome of longterm investigations into all its effects on animal life.

In recent years the effect on mammals of pesticides in general and the persistent organochlorines in particular has received increased attention. Pesticides have on occasion been used for the control of rodents although usually at much higher concentrations than when used for insect control (Luckman, 1957; Schneider, 1966; Webb and Horsfall, 1967). More frequently, however, the effect of pesticides on mammals and other vertebrates is a secondary byproduct of attempts to eradicate insect pests.

The effect of persistent pesticides on mammals have been widely studied both in the laboratory and in the field. A field application of dieldrin (three pounds per acre) was reported to have virtually exterminated several species of mammals and birds (Scott, Willis, and Ellis, 1959). In a forest, however, sprayed with two pounds of DDT in oil per acre, no evidence of any adverse change in the rodent population was observed (Stickel, 1946).

Morris (1970) reports endrin, sprayed at 0,5 pounds/acre on an unenclosed field population, to illustrate an immediate decline in Microtus pennsylvanicus numbers. No long term toxicological effect was demonstrated in the Microtus population, which rapidly recovered, while a long term effect was demonstrated in Peromyscus maniculatus, indicating a different response by the two small mammal species to endrin. It was concluded that the Microtus population responded to endrin as it would to a local depopulation by removal trapping. Morris (1971) came to the same conclusion from a study on an enclosed Microtus populations, sprayed at the same dosage.

Resistance to organochlorines in insects is a widely known phenomenon. This resistance has, however, now also been illustrated in the Pine mouse, Pitymys pinetorum (Webb and Horsfall, 1967).

Most experimental work, however, has been done on laboratory rodents. Studies on the effect of exposure of mammals to organochlorines have been undertaken by various writers, e.g. Bernard and Gaetner, 1964; Hunter, Stevenson, and Ferrigan, 1964; Ware and Good, 1967; Morris, 1968; Deichmann, Keplinger, Dressler, and Sala, 1969; Good and Ware, 1969; and Murphy and Korschgen, 1970..

In South Africa, Wiese, Basson, and van der Merwe (1970) illustrated that livestock was not adversely effected by dieldrin coverspraying at the registered concentration.

The effect of organochlorine pesticieds on birds has been widely studied by various authors, especially in the United States of America (Robbins, Springer, and Webster, 1951; Genelly and Rudd, 1956; Clawson and Baker, 1959; Cross, King, and Haynes, 1962; Wurster, Wurster, and Strickland, 1965; Keith, 1966; Atkins and Linder, 1967; Labisky and Lutz, 1967; Baxter, Linder, and Dahlgren, 1969).

In South Africa Wiese and Basson (1967) concluded from a study on caged crowned guinea fowl, Numida meleagris, that it would be unlikely that acute intoxication would result from blanket treatment with dieldrin at a dosage of 2,64 oz per morgen. Wiese, Basson, van der Vyver, and van der Merwe (1969) report significantly higher egg production of crowned guinea fowl exposed to higher dieldrin dietary levels. The greater viability (weight gain and egg production) of the $F_1$ progeny of these birds was ascribed to a selection (resulting from dieldrin intoxication) for increased vigour.

Dieldrin and related compounds seem to be much more lethal to invertebrates and fish than to mammals and birds (Harrington and Bidlingmayer, 1958; Meeks, 1968).

In order to appreciate the ecological effects of pesticides, the ecology of the animals and areas studied should be known. In South Africa work on rodent ecology was initially undertaken mainly in connection with plague (Davis, 1939, 1946a, 1946b, 1948, 1953, 1963a, 1963b, 1964; Davis and Thomas, 1941; Oliff, 1953; Measroch, 1954; Johnston and Oliff, 1954; Allanson, 1958; Veenstra, 1958; Coetzee, 1965, 1967; Hallett, 1967; De Moor, 1969).

Work on rodent ecology in general has been undertaken, amongst others by Davis (1958, 1959), Meester (1958, 1960), De Graaff (1962), De Graaff and Nel (1965), Nel and Nolte (1965), Meester and Hallett (1970), and Davis (in press).

Against the background of this work the present study reports on the effect of dieldrin spraying on the general ecology of wild living rodents occurring on two soil and vegetation types 11 km SSE of Pongola (27°29'S, 31°42'E), in the northern Zululand lowveld, Natal.

The area was studied by means of live trapping from April 1967 through May 1969. In July 1968 it was aerially sprayed with dieldrin at 83,0 g/ha.

Several species of rodents, and particularly <u>Praomys</u> (<u>Mastomys</u>) <u>natalensis</u> which is one of the most important species for health and economic reasons, encountered during the study, are subject to periodic increases in numbers. <u>Praomys</u> (<u>Mastomys</u>) <u>natalensis</u> is a semi-commensal rodent which plays an important role in the transmission of plague, <u>Pasturella pestis</u>, from gerbils to man (Davis, 1946a; 1946b; 1948). Recently plague was reported from the Orange Free State during 1967/68, and from Lesotho at the end of 1968, which coincided with a rodent population outbreak which started and ceased sporadically at different localities in South Africa during the period late 1966 to early 1969. This outbreak, which caused considerable damage to maize and other crops, was observed over practically the whole of the Transvaal, the northern Cape near the Botswana border, the northern and central Orange Free State, and probably extended through Lesotho to the northeastern Cape Province. It also occurred in large parts of Natal and probably extended from there through Swaziland to the Transvaal lowveld (van der Merwe and Keogh, 1970; Hallett and Keogh, personal communication).

Wilson (1970) reports on a population explosion of Praomys (Mastomys) natalensis becoming evident in Rhodesia during January 1967 which steadily increased to a peak in July/August of the same year, after which numbers declined.

One of the main functions of ecological work on rodents in South Africa is to conduct surveys of those species that are involved directly or indirectly in vector-borne diseases of man (Davis, 1963a).

A secondary purpose of this study, therefore, was to try to obtain information about those aspects of the ecology of Praomys (Mastomys) natalensis and other species captured which would assist in understanding, and perhaps preventing, similar outbreaks and the plague epidemics which might accompany them.

## 2. Acknowledgements

The author wishes to express his sincere thanks to professor J.A J. Meester, University of Natal, for guidance and constructive criticism as project leader, until the final stages of this project; to Dr. J.A.J. Nel who took over from professor Meester after he had left for Natal University; to Dr. I.H. Wiese of the Plant Protection Research Institute without whose influence and inspiration this project would have been abandoned at an early stage; to Mr. C.G. Coetzee who made useful suggestions, and to whom the author owes his interest in rodents and other mammals; to Mr. P. Le S. Milstein who started the project; to my wife Rina who tirelessly helped with the fieldwork and analysis of data; to Mr. Stephen Mothlasedi for his help with the fieldwork; to other members of the staff of Plant Protection Institute who helped in many ways; and to the Department of Agricultural Technical Services for approving and financing this project.

## 3. Study area

### 3.1 Location

The study area is located on the farm Vergeval 644, district Ngotshe, northern Zululand, Natal (figs. 1 and 2), 11 km SSE of Pongola, at an altitude of approximately 360 m above sea level and at the coordinates 27°29'S, 31°42'E.

An area of 428,3 hectares (500 morgen) was selected for the dieldrin project. One half of this area was sprayed and the other half was used as a control area.

Trapping was conducted on two grids on each half of the study area. Grids P46 and P89 were the control grids, while grids P50 and P88 were sprayed. The position of each grid on the study area is shown in fig. 3. In each community (see section 3.3. below) the most uniform habitat where grid live trapping would be practical, was selected.

### 3.2 Climate

The climate of the area is subtropical, with a wet summer season followed by a dry winter. The temperature and relative humidity prevailing over the study area were determined by means of a thermohygrograph housed in a standard Stevenson screen.

The highest monthly maximum temperature, mean maximum, lowest minimum, mean minimum, and the monthly mean for the study area appear in table 1. The highest monthly maximum relative humidity, mean maximum, lowest minimum, mean minimum, and the monthly mean for the study area are shown in table 2.

Rainfall figures for the study area and for the Pongola Gorge (27°26'S, 32°4'E; 50 km ENE of the study area) are shown in table 3. Due to the fact that rainfall data for the study area were only available from September 1967 on, the Pongola Gorge rainfall figures (January 1966 to May 1969) and the average for Pongola Gorge area (657 mm per annum), were obtained from the Weather Bureau (Department of Transport, Pretoria) for comparison. The rainfall statistics for the nearby Pongola settlement (27°23'S, 31°37'E; alt. 274 m), available only for the period 1942 to 1950, can be summed up as follows:

Average over nine years: 718,8 mm
Max: 977,6 mm (1943)
Min: 497,6 mm (1947) (Weather Bureau, 1954).

When the total rainfall on the study area during 1968, viz. 327,4 mm (the only complete rainfall data for a full year available) and that on the Pongola Gorge during the same period (403,1 mm), are compared with the average over nine years (1942 to 1950) at the Pongola settlement (718,8 mm), it becomes apparent that 1968 was an extremely dry year, the nine-year average rainfall at the Pongola settlement being much higher than the 1968 figures observed on the study area and at the Pongola Gorge Weather Station. The 1968 rainfall on the study area, in fact, was even lower than the minimum of 497,6 mm observed at the settlement over the nine year period.

From January to May 1967 the rainfall on the study area was much higher than during the same period in 1968 (records from surrounding farmers). From July 1968 (the time of spraying) until February 1969, the rainfall was lower than during the same period the previous year. From March to May 1969 the rainfall exceeded that for the previous year (table 3).

## 3.3 Habitat

The study area, situated in the lowveld veld type (Acocks, 1953) and the Southern savannah biotic zone of Moreau (Davis, 1962), is composed of two plant communities viz. *Acacia tortilis*, and *A. nigrescens*. Two grids were situated in each community, grids P46 and P50 in the *A. tortilis* community and grids P88 and P89 in the *A. nigrescens* community. This means that a control and a sprayed grid occurred in each plant community.

The study area was grazed during the first three weeks of October, 1967 by approximately 1000 cattle, from 9 to 18 May 1968 by 300 cattle, and from 19 to 31 May 1968 by 170 cattle. Thereafter no grazing by cattle took place.

At least 100 Impala, *Aepyceros melampus*, were present on the area throughout the period of the study, although a much higher population presumably occurred most of the time. Other ungulates present on the area in low numbers were kudu, *Trage-*

*laphus strepsiceros*, bushbuck, *Tragelaphus scriptus*, steenbok, *Raphicerus campestris* and grey duiker, *Sylvicapra grimmia*.

The following small mammals were captured in the course of the study:

*Praomys* (*Mastomys*) *natalensis* (A. Smith, 1834) (Multimammate mouse)
*Saccostomus campestris* Peters, 1846 (Pouched mouse)
*Lemniscomys griselda* (Thomas, 1904) (Single-striped grass rat)
*Leggada minutoides* (Smith, 1834) (Pygmy mouse)
*Steatomys pratensis* (Peters, 1846) (Fat mouse)
*Aethomys* (*Aethomys*) *chrysophilus* (de Winton, 1897) (Red veld rat)
*Tatera brantsi* (A. Smith, 1834) (Highveld gerbil)
*Otomys angoniensis* Wroughton, 1906 (Vlei rat)
*Crocidura hirta* Peters, 1852 (Musk shrew)

The numbers of each species caught are shown in tables 4 to 7. For the distribution throughout Africa of the rodent species caught on the study area, see Davis (1962).

The mechanical and chemical analyses of eight soil samples, taken from the four grids at depths of 0 - 10 cm, are shown in tables 8 to 10, and the position where each sample was taken on the grids and study area is shown in fig. 3.

### 3.3.1 Grid P46

The position of this grid in the study area is shown in fig. 3 and described in section 4.1.

The general topography and nature of the habitat during November 1968 are indicated in fig 4. The soil colour varies from dark brown to brownish red (table 10). The area is flat and free of stones with *Acacia tortilis* and *A. karroo* the two most common tree species. The trees, shrubs, and grasses recorded from this grid are listed in table 11. The most common grass was *Sporobolus smutsii*. In the shade of the acacias, *Panicum maximum* and *P. deustum* were, however, the dominant species. These latter two species were those most damaged by termites through the winter months.

During April/May 1967 the grass cover was denser that at any other time during the study period. By the end of August (ie. the end of winter), however, the grass cover had been severely damaged by harvester termites, more than on any of the other three grids. During the winter of 1968 (June to August) much less termite activity was observed than during the previous winter.

At the end of the wet season in April/May 1968, the grass stand was far less than at the same time during the previous year. This was due mainly to the much lower rainfall during early 1968 (table 3).

The vegetation cover during late spring (November) of 1968 is shown in fig. 4. From this it can be seen that no new growth had taken place by the end of the spring. No substantial growth occurred before good rains fell in March 1969. This was, however, too late to enable any significant rodent population increase to take place before the termination of the study (see section 5.1).

### 3.3.2 Grid P50

The position of this grid in the study area is shown in fig. 3 and described in section 4.1.

The general topography and nature of the habitat during November 1968 are depicted in fig. 5. The soil colour is brown-red (table 10) and the area is flat and free of stones, with *A. tortilis* the most common tree. The trees, shrubs, and grasses recorded from this grid are listed in table 11.

*Panicum maximum* and *P. deustum* were less common than on grid P46. These two grass species seemed to be favoured by termites. The most common and less favoured species, *S. smutsii*, remained relatively dense even during winter.

During the 1968/69 rainy season this grid had a relatively better grass cover than did P46 (see figs. 4 and 5). The vegetation cover on this grid, however, was also poor during late spring of 1968 (November) and did not improve before March 1969.

### 3.3.3 Grids P88 and P89

The position of these two grids in the study area is shown in fig. 3 and described in section 4.1. They are situated on a slightly stony slope, sloping from west to east. The soil type is black turf (table 10).

The general topography and nature of the habitat during November 1968 are evident from fig. 6. The trees, shrubs, and grasses recorded from these two grids are listed in table 11 with *A. nigrescens* the most common tree.

*Heteropogon contortus* and *S. smutsii* were the most abundant grasses. *P. maximum* and *P. deustum* were sparsely distributed and are assumed to have played an insignificant role on these two grids.

Grids P88 and P89, on turf soil, and belonging to the *A. nigrescens* community, had a continuous grass cover (fig. 6) in contrast with the *A. tortilis* community (figs. 4 and 5), probably as a result of undergrazing of the *A. nigrescens* community, the conspicuous absence of termites or termite damage, and the soil type.

# 4. Material and methods

## 4.1 Trapping

Trapping was carried out in four grids, situated in two main plant communities (figs. 3 to 6). Grids P46 and P50 were situated in an *Acacia tortilis* plant community and the other two grids, P88 and P89, in an *Acacia nigrescens* community. In each community the most uniform habitat where live trapping on grids would be practical was selected.

The position of the four grids in relation to each other is shown in fig.3. Each grid was 3,42 ha (four morgen) in size. Grids P88 and P89 were adjacent to each other with a 182,9 metre (600 foot) communal boundary, and were situated approximately 0,8 km from the other two grids. Grid P89 was not sufficiently far from grid P88 to escape the effect of spraying on grid P88, but was chosen in order to study the interaction between the sprayed and unsprayed populations after spraying. Extremely low rodent population levels directly before and after spraying made this impossible.

The four grids were each trapped with 225 Chauvancy live traps (fig.7) spaced 13,1 metres (43 feet) apart, 15 rows with 15 trap stations each, and one trap per station, placed haphazardly within a 1 metre radius of the station marker.

The time and duration of trapping on the four grids are indicated in tables 4 to 7. Grids P46 (19 times) and P89 (16 times) were trapped from May 1967 through May 1969. Grid P88 (16 times) was trapped from April 1967 and grid P50 (18 times) from August 1967, both through May 1969. Each grid was trapped for four successive nights during each trapping period, with all 225 traps operating concurrently. Because of the low number of animals captured, grids P88 and P89 were sometimes trapped for only 3 nights during a trapping period.

A mixture of peanut butter and rolled oats was used as bait. No prebaiting was done.

During trapping operations traps were serviced early each morning. Sprung traps were investigated, and any mice caught were transferred from the trap to a large plastic bag (400 to 800 gauge plastic), approximately 375 mm x 250 mm (15 in. x

10 in.) in size, and from this bag to a smaller sized linen bag 200 mm x 125 mm (8 in. x 5 in.). The linen bag containing the animal was then taken to a light delivery truck used as a field station.

On first capture each rodent was marked by toe-clipping and/or ear-clipping (for method see fig. 8). In addition, the following data were recorded for each animal at every capture:

1) Species.
2) The mass of each animal to the nearest gram, obtained on a triple beam balance.
3) Sex.
4) Position of testes, whether scrotal or abdominal (males).
5) Vagina open or closed (females).
6) Pregnant females, as detected by palpation.
7) Total length in mm. Animals were stretched out on their backs on a ruler and measured from the tip of the nose to the end of the tail.
8) Tail length, by the vertebral method (Coetzee, 1967).
9) Trap number.

After the above data had been recorded the animals were released at their point of capture.

When an animal was caught more than once within a trapping period, the mass recorded at the first capture was taken to apply throughout. The total length, head and body length, and tail length were averaged for a particular trapping period to make measurements more accurate.

During all the trapping periods from 21 May, 1968 to November 1968, traps in grids P46 and P50 were serviced twice daily, in the early morning and again at sundown. This prevented mortality of the diurnal *Lemniscomys griselda*, which otherwise had to remain in the traps for a day and a night before release. Prior to 21 May, 1968 the numbers of *L. griselda* captured did not warrant this procedure, and their numbers in the other two grids were too low throughout the study to require traps to be serviced twice daily.

For the purpose of population density estimation the afternoon catches were added to those of the following morning.

The data thus accumulated were treated as if the traps had only been cleared in the mornings.

### 4.2 Spraying

Grids P50 and P88 were sprayed from the air on 2 July, 1968 with a solution of 13% (weight/weight) technical dieldrin (85 percent 1,2,3,4,10, 10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8, 8a-octahydro-exo-1,4-endo-5, 8-dimethanonaphthalene, Heod, and 15 percent related compounds) in a mixture of 70 percent xylene/styrene polymer and 30 percent Shellsol R, at the rate of 0,630 litres/hectare (0,95 pints/morgen; 83 g per ha). A rate of 0,663 l/ha (1,00 pints/morgen) is equal to 87,4 g active material per ha (2,64 oz/morgen). Therefore, slightly less dieldrin was sprayed than was intended. The insecticide was delivered by four two-blade rotary atomisers giving a distribution pattern of 5,77 droplets per $cm^2$ (37,2 droplets/$in^2$) (Wiese and Basson, unpublished data).

### 4.3 Sampling for residue analyses

At intervals of 10, 14, 20, and 60 days after spraying, small mammals were snap-trapped, and whole carcass samples taken for gas-chromatographic determination of dieldrin and photodieldrin (photoisomerization product of dieldrin) residues. As rodent populations were low at the time, all the species occuring were not sampled every time.

Three separate grass samples for analysis were taken from the sprayed area immediately after spraying and at one, two, seven, 14, 21, 30, 42, 56, 90, 146, 189, 258, and 380 days after spraying.

The gas-chromatographic method used for analysis is described by Wiese, Basson, and van der Merwe (1970).

### 4.4 Population density

The density for April/May 1967 was estimated by means of the capture-recapture method described by Davis (1956). This was adopted because the method of Jolly (1965), which was used for data from the rest of the study (see below), supplies no population estimate for the first sample.

From August 1967 to May 1969 densities were estimated by means of the stochastic capture-recapture model of Jolly (1965). These estimates are of the trappable population only. It is assumed that each sample from the population is random, and that the captured animals so distribute themselves after release that they have the same probablity as any other of being caught in the next sample. This model takes death and immigration into account.

A grid was trapped for four days in succession during each trapping period (section 4.1). The data for the four days were used as if they represented one capture. Therefore, if an animal was caught more than once within the four day trapping period, the captures after the first capture were ignored for population estimation purposes, as suggested by Jolly, in order to ensure that the assumptions of the method regarding randomness of trapping opportunity be met as far as possible. An animal caught on the first night might be more liable to be caught again on the second, either because it was still in the vicinity of the trap or for some other reason such as trap proneness. Animals on the second, third, and fourth nights could accordingly not be assumed to represent a random sample of the total.

## 4.5 Reproduction

The percentage of scrotal males and pregnant females per trapping period was calculated and breeding seasons for the different species were obtained.

## 4.6 Movements

Various methods for computing home range size have been suggested. The method of maximum distance between captures (M) was used in this study (Brant, 1962).

With this method the distance between the two furthest points of capture is measured, and computed for an animal after the second, third, ......, nth capture.

Maximum distance between captures (M) was calculated as follows in the example illustrated in fig. 9:

| No of captures | M in metres (feet) |
|---|---|
| After the 2nd capture | 13,1 (43) distance between first and 2nd capture |
| After the 3rd capture | 26,2 (86) longest distance between captures since the first. Therefore, the distance between 1 and 3 |
| After the 4th capture | 26,2 (86) distance between 1 and 4 |
| After the 5th capture | 29,5 (96,15) 4 to 5 |
| After the 6th capture | 29,5 (96,15) 4 to 5 |
| After the 7th capture | 29,5 (96,15) 4 to 5 |
| After the 8th capture | 47,3 (155,03) 7 to 8 |
| After the 9th capture | 47,3 (155,03) 7 to 8 |

The average maximum distance between captures (av. M) for a number of animals after, for example, the second capture can be calculated as follows:

| Animal number | M in metres (feet) after the 2nd capture |
|---|---|
| 1 | 0 (0) |
| 2 | 13,1 (43) |
| 3 | 18,6 (61) |
| 4 | 26,2 (86) |
| Total | 57,9 (190) |

The value of av. M = 57,9 ÷ 4 = 14,5 metres

Maximum distance between captures (M) was calculated for each animal captured more than once, provided that no more than half the captures were in the outermost two rows of a grid, and of these not more than half in the last row. An average maximum distance between captures (av. M) was then calculated for each sex of each species on each grid after each capture. The av. M for each species, sex and grid was plotted against the number of captures. Differences in the av. M between the species, sexes and grids were tested by means of the Mann Whitney - U test.

This test (which is the equivalent of the t-test for normally distributed data) is used to determine whether two independent samples were drawn from the same population when the data are assumed not be normally distributed.

The equation for the test is (Siegel, 1956):

$$U' = N_1N_2 + \frac{N_2\ (N_2 + 1)}{2} - R_2$$

$$U = N_1N_2 - U'$$

where $N_1$ = number of cases in smaller sample

$N_2$ = number of cases in larger sample

$R_2$ = sum of the rank numbers of the second sample

The smallest value of U' or U is used in the tables to determine significance. When calculated U values are smaller than or equal to $U_k$ values (table values), the two samples compared, differ significantly (Siegel, 1956: table K).

## 4.7 Sizes and mass

The mean, standard deviation, and standard error of the body mass, total length, head and body length, and tail length were calculated for each species and sex and for each season of the year. Spring was taken to include September, October, and November; summer included December, January, and February; autumn included March, April, and May; and winter included June, July, and August. The differences between mean values for the two sexes and different seasons were tested for significance by means of the t-test.

$$S = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N} ( x_i - \bar{x})^2}$$

S = standard deviation

N = sample size

$\bar{x}$ = mean of parameter

$\sum_{i=1}^{N}$ = sum overall data ($x_1$ to $x_N$)

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

$t$ = t-value

$\bar{x}_1$ = mean of first parameter

$\bar{x}_2$ = mean of second parameter

$S_1^2$ = variance of $\bar{x}_1$

$S_2^2$ = variance of $\bar{x}_2$

$n_1$ = sample size of first parameter

$n_2$ = sample size of second parameter

## 4.8 Population structure

The relative frequency of animals of different body mass during the four seasons of the year was used to divide the population into different age classes.

The sex structure of the different species for each season and grid was determined.

These ratios were tested by means of the $\chi^2$-test (Siegel, 1956) for a 1:1 ratio.

$$\chi^2 = \sum_{i=1}^{K} \frac{(O_i - E_i)^2}{E_i}$$

$O_i$ = observed number of cases in ith category

$E_i$ = expected number of cases in ith category

$\sum_{i=1}^{K}$ = sum over all (K) categories (two in the case of sex ratios).

## 4.9 Behaviour

Behaviour of the species encountered were noted during trapping, handling and release.

# 5. Results and discussion

## 5.1 Population densities

The rodent population density on each of the four grids is illustrated in figs. 10 to 19. The numbers of animals of each species and sex captured, the number of first captures, and the total number captured during each trapping period, appear in tables 4 to 7.

### 5.1.1 Comparison of population densities on the four grids

Throughout the study the *A. nigrescens* community (see section 3.3) usually had a denser grass cover than did the *A. tortilis* community, especially during drier periods. It is surprising, therefore, that grids P88 and P89, adjoining each other in the *A. nigrescens* plant community (see section 3), consistently supported a relatively much lower rodent population than did grids P46 and P50, situated in the *A. tortilis* community. During the rainy season the new growth in the *A. tortilis* community was better than in the *A. nigrescens* community. Dead grass was always present in the latter but never in the former, suggesting undergrazing in the *A. nigrescens* community.

#### 5.1.1.1 Total rodent population

During April/May 1967 grids P88, P89 and P46 supported the largest rodent population per grid observed at any time during the study, consisting mostly (52% and more) of *P.(M.) natalensis*. Grid P50 was not trapped during this period. Grid P46 supported the largest population: 153 *P.(M.) natalensis*, 18 *S. campestris*, and 6 *Lemniscomys griselda*. Grid P88 supported 17 *P.(M.) natalensis*, 3 *S. campestris*, 2 *L. griselda*, 1 *Leggada minutoides*, and 3 *A. chrysophilus*, while grid P89 supported 13 *P.(M.) natalensis*, 1 *S. campestris*, 2 *Steatomys pratensis*, 3 *Lemniscomys griselda* and 6 *Leggada minutoides*. This high rodent population during the late autumn of 1967 coincided with a rodent population outbreak observed through large parts of Southern Africa, extending from late 1966 to early 1969 in some localities (Van der Merwe and Keogh, 1970).

After autumn 1967, there was no evidence of the outbreak in the study area.

Of this population, only a small breeding stock still remained in August/September 1967 for the 1967/68 breeding season. This can be primarily ascribed to a considerable reduction in amount of vegetation and ground cover during the winter. Grid P46 in particular was largely laid bare by harvester termites between May and August 1967. This grid experienced its most marked decrease in rodent population density during this time (figs. 16 to 19).

The total population on both grids P88 (fig. 10) and P89 (fig. 11) declined steadily through the winter of 1967 and summer of 1967/68, reaching its lowest point (1 to 4 animals per grid) in April/May 1968. The population stayed at this low level until the termination of the study.

The population on grid P50 (fig. 12) peaked in the late spring (October to November) of 1967 at 34 animals. Thereafter, the population showed a progressive decrease to three in November 1968, followed by an increase to eight in February and 12 in May 1969, the latter consisting mostly of S. campestris.

On grid P46 (fig. 16) the high population (183) found in May 1967 declined through the winter, spring and early summer to 30 animals in November, whereafter it increased to a peak of 68 in February 1968, to decline to 18 in late June (just prior to spraying). During July (after spraying) the population stayed at about 17 but declined to four animals towards September 1968, staying at that level until February 1969. An increase to 16 animals, mostly S. campestris, was observed during April/May 1969.

Low numbers of all species on all grids after spraying, made a meaningful post-spraying evaluation of population structure impossible. According to Veenstra (1958) P.(M.) natalensis is found in association with other rodents (Rattus, Tatera, Mus and Rhabdomys) when abundant food is available, but when competition leads to food scarcity it gives way. In domestic habitats where Rattus or Mus musculus have established themselves P.(M.) natalensis seem to be driven away (Shortridge, 1934 citing Hewitt, 1918 and 1931). Delany and Neal (1966) report the same phenomenon, that is after the introduction of *Rattus rattus* in Uganda, *P.(M.) natalensis* was driven from its domestic habitat (native huts).

On both grids P50 (fig. 14) and P46 (fig. 18) *S. campestris* experienced a relatively large increase in numbers during the period January/February to early May 1968, before *P.(M.) natalensis* started to decline (see below). Although the sample was small, the fact that both grids showed more or less the same trend suggests that the relationship is a real one and not a result of sampling error.

Relatively higher numbers of *S. campestris* and *L. griselda* were observed during times of lower *P.(M.) natalensis* populations. The total population on grid P50 comprised from August 1967 to February 1968 (the time of a *P.(M.) natalensis* high) on the average 60% *P.(M.) natalensis*, 19% *S. campestris*, and 12% *L. griselda* of the 135 animals captured. Other species captured comprised the remaining 9% of the animals captured. During the subsequent period, towards late July 1968 (time of relative high *S. campestris* and *L. griselda* numbers), *P.(M.) natalensis* averaged 13% of the 110 animals captured, *S. campestris* 45%, and *L. griselda* 41% (table 6; fig. 20). During the following period, towards termination of the study in May 1969, the animals captured comprised 16% *P.(M.) natalensis*,75% *S. campestris*, and 3% *L. griselda* (fig. 20).

During April/May 1967, on grid P46, *P.(M.) natalensis* comprised 86% of the 177 animals captured, *S. campestris* 10%, and *L. griselda* 3%. From September 1967 to February 1968 *P.(M.) natalensis* comprised on the average 67% of the 219 animals captured, *S. campestris* 13%, and *L. griselda* 15%. During the subsequent period, towards late July 1968 (time of relatively high *S. campestris* and *L. griselda* numbers), *P.(M.) natalensis* averaged 28% of 163 animals captured, *S. campestris* 44% and *L. griselda* 22%. The trapping periods from July 1968 to May 1969 yielded 20% *P.(M.) natalensis*, 64% *S. campestris*, and 9% *L. griselda* (table 7; fig. 21). These lower *P.(M.) natalensis* numbers coincided with times of extreme food scarcity. During the autumn (April/May) of 1967 when the habitat was good, with abundant food, *P.(M.) natalensis* numbers were high while *S. campestris* and *L. griselda* numbers were relatively low. During the autumn of 1968 and 1969 *S. campestris* was present in relatively high numbers, coinciding with a time of food scarcity.

In spite of the fact that *P.( M.) natalensis* is a very successful rodent in terms of reproduction and distribution, the present data seem to favour the hypothesis that *P.( M.) natalensis* gives way during times of food scarcity in autumn and winter.

### 5.1.1.2 *Praomys* (*Mastomys*) *natalensis*

On grid P88 (fig. 10) and grid P89 (fig. 11) *P.( M.) natalensis* declined from 17 and 13 individuals per grid respectively in April 1967, through the winter of 1967 and summer of 1967/68 to a low in December 1967 on grid P88, and in April 1968 on grid P89, when only one animal was captured on each grid. Thereafter numbers remained low until the end of the study.

*Praomys* (*M.*) *natalensis* numbers on grid P50 (fig. 13) decreased from a peak (19 animals) in the beginning of December 1967, to nine in January and three in April 1968. It then remained at that low level until termination of the study.

On grid P46 the 1967/68 *P.( M.) natalensis* summer peak extended from December 1967 to February 1968 (fig. 17). The population decreased from 153 animals in May/June 1967 to 21 in November, then increased to 31 in December 1967, stayed at this level until February 1968 and thereafter, declined to two towards early June 1968. It remained at that low level until termination of the study.

The other species on both grids P50 and P46 did not decline during this period but in fact increased in numbers (see section 5.1.1.1 above, and 5.1.1.3 and 5.1.1.4 below).

### 5.1.1.3 *Saccostomus campestris*

While barely present on grids P88 (fig. 10) and P89 (fig. 11) from September to December 1967, *S. campestris* increased on both to a small peak (six animals) in February 1968. It disappeared from both grids prior to spraying in July 1968. On grid P88, which was sprayed, this species appeared again in July, just after spraying, but never more than one at a time, and on grid P89 (control) it did not appear until May 1969 (three animals).

A S. campestris population peak varying from 10 to 17 animals was observed on grid P50 (fig. 14) from February to late May 1968, whereafter it declined to six just prior to spraying and to zero in November 1968. Thereafter the population increased to 11 in May 1969. This shows a relatively large increase in the number of S. campestris compared to P.(M.) natalensis during the period February to late May 1968 (see section 5.1.1.1; fig. 20). The total number of S. campestris captured on this grid exceeded that of P.(M.) natalensis during all the trapping periods from April 1968 until the end of the study in May 1969, except during July 1968 when they were equal (one each) and November 1968 when there were no S. campestris against three P.(M.) natalensis captured (table 6).

On grid P46 a S. campestris population (fig. 18) of 18 (10% of the animals present) was estimated for May 1967. During subsequent trapping periods, from September to December 1967, a low population (one animal) was observed. In January 1968 a sudden increase to 10 was observed. It thereafter increased further towards April/May (18 to 24 animals). After this peak it declined steadily to zero in November and did not reappear before April/May 1969, when 16 animals were estimated to be present. The total number of S. campestris captured on this grid exceeded that of P.(M.) natalensis from April 1968 to late July 1968, except during early June when one S. campestris was observed against two P.(M.) natalensis (table 7).

During a period of relatively low rodent numbers, S. campestris, seemed, therefore, to comprise the largest proportion of the population. A relative much higher S. campestris population was present on grid P46 during February to May 1968, and during April/May 1969 than during April/May 1967, when total numbers (all species) were much higher. Grid P50 was not trapped during March to April 1967. During February to May 1968 and during the same time in 1969 relatively high numbers of S. campestris prevailed.

### 5.1.1.4 Lemniscomys griselda

Lemniscomys griselda numbers on grid P88 (fig. 10) and grid P89 (fig. 11) stayed consistently low and no clear trend could be discerned.

On grid P50 the numbers (fig. 15) exceeded those of the other species from just prior to spraying until just afterwards (early June to late July 1968), when they fluctuated between seven and 14. During this time the population (63 animals) consisted of approximately 56% L. griselda, 29% S. campestris and 10% P.( M.) natalensis (fig. 20). Thereafter numbers of L. griselda declined sharply to zero in November 1968 and remained so until the termination of the study.

On grid P46 a L. griselda peak (nine animals) was observed during late May 1968 (fig. 19). At the time of spraying (2 July, 1968) on grid P50 and P88, the population on grid P46 had already declined to four and subsequently declined more slowly to zero in February 1969. Lemniscomys griselda was more abundant than P.( M.) natalensis and S. campestris from late May to late July 1968, comprising 39% of 75 rodents captured during that time, with P.( M.) natalensis comprising only 12% and S. campestris 37% (fig. 21). Therefore, from early June to late July L. griselda populations on grids P50 and P46 exceeded those of both P.( M ) natalensis and S. campestris.

### 5.1.1.5 Other species

Aethomys chrysophilus, Leggada minutoides, and Steatomys pratensis were very infrequently present on grid P88 (fig. 10; table 4). Grid P89 (fig. 11; table 5), also supported low numbers of these species. During May and September 1967, however, a relatively high number of L. minutoides (three to six animals) was present on this grid.

Leggada minutoides and S. pratensis appeared sporadically on grid P50 (fig. 15; table 6). One Otomys angoniensis was captured on this grid, but A. chrysophilus was never observed. Steatomys pratensis was never captured on grid P46 while L. minutoides seemed to be present more regularly here than on grid P50. Aethomys chrysophilus was recorded on grid P46 during February 1968 and April 1969, while T. brantsi was recorded from this grid during February and May 1969 (table 7).

### 5.1.2 Effect of dieldrin coverspraying on rodent numbers

Grids P88 and P50 were sprayed with dieldrin on 2 July, 1968 while grids P89 and P46 were treated as controls.

The present study was conducted during times of below average rainfall and consequently poor habitat (see section 3). This resulted in low rodent populations just prior to and especially after the time of spraying, on both control and sprayed grids.

After the P.(M.) natalensis population declined in December 1967 (i.e., before spraying) on grid P88 (sprayed) and P89 (control), P.(M.) natalensis never again increased on these two grids to such a level as to supply either positive or negative evidence regarding the effect of spraying (figs. 10 and 11). On grid P46 (control) the population~~s~~ declined from its peak in December 1967 to zero in early July 1968 (the week of spraying), and thereafter stayed at a low level until the termination of the study (figs. 16 to 19). The number on grid P50 (sprayed), after its highest peak in October 1967, declined progressively to an extreme low just prior to spraying and thereafter showed no increase above this level. Again there is no evidence of a differential decline in numbers which could be ascribed to spraying (figs. 12 to 15).

This decline in P.(M.) natalensis numbers must therefore be ascribed to low rainfall and poor habitat as both sprayed and control grids declined to a similar extent.

On grid P88 (fig. 10) and grid P89 (fig. 11) Saccostomus campestris, after its peak in February 1968, decreased to zero just prior to spraying. It appeared again on grid P88 just after spraying in late July and thereafter stayed at an extremely low level. On the control grid P89, S. campestris did not appear again before May 1969. After a population peak in April 1968, the S. campestris population on grid P46 (control; fig. 18) decreased towards early July (the time of spraying). Thereafter it stayed low until a substantial increase occurred in May 1969. The population on grid P50 (sprayed; fig. 14) also showed a peak in April 1968, declined to a low in early

July (just after spraying), and thereafter stayed low until a similar increase as on grid P46 was observed in May 1969.

Lemniscomys griselda numbers on grids P88 (fig. 10) and P89 (fig. 11) stayed low and no clear trend was apparent. During late May 1968 a peak was observed on grid P46 (fig. 19). At the time of spraying the population had, however, already declined and thereafter declined still further to zero in February 1969. Grid P50 (sprayed; fig. 15) supported a high population from early June 1968 until after spraying in late July, whereafter it declined sharply to zero in November, not to increase again. Although L. griselda numbers on the sprayed grid P50 did not decline until after spraying, this was not evident on grid P46 (control), where a decline was already observed prior to spraying.

Low numbers of Leggada minutoides and Steatomys pratensis (figs. 11, 15, and 19) were captured throughout the study.

Although the numbers captured before and after spraying were too low for any clear-cut conclusions to be reached it seems from the present data that dieldrin coverspraying at the dosage applied had no visible influence on rodent population densities. The only possible exception is the suggestion that spraying might have influenced numbers of Lemniscomys griselda on grid P50.

## 5.2 Residue analysis

Dieldrin and photodieldrin residues (mean of three samples) found on the grass immediately after spraying and at 1, 2, 7, 21, 30, 42, 56, 90, 146, 189, 258 and 380 days after spraying are shown in table 12 (Wiese and Basson, unpublished data). These data correspond closely with those of Wiese, Basson, and van der Merwe (1970) for veld treated at the same dosage.

Immediately after spraying 15,08 ppm dieldrin were present on the grass and it thereafter declined to 4,34 ppm after seven days and 1,00 ppm after 30 days, while photodieldrin (photoisomerization product of dieldrin) increased from 0,12 ppm immediately after spraying to a peak of 8,37 ppm 14 days after spraying and thereafter declined to 1,4 ppm 90 days after spraying. No detectable amount of either dieldrin or photodieldrin was present 380 days after spraying.

Dieldrin and photodieldrin residues (in ppm) obtained from whole small mammal carcasses, are shown in table 13. The samples were obtained 10, 16, 20, and 60 days after spraying. As the rodent numbers were low, not all species were sampled on each occasion. Samples were obtained only from <u>Saccostomus campestris</u>, <u>L. griselda</u> and <u>Crocidura hirta</u>. <u>Lemniscomys griselda</u> carcasses (10, 20, and 60 days after spraying) and <u>S. campestris</u> (16 days after spraying) showed very low residues (< 1,0 ppm), while one shrew, <u>C. hirta</u> collected 60 days after spraying, showed 4,660 ppm dieldrin, and 0,206 ppm photodieldrin. This is an extremely high residue when compared with levels found in wethers at intervals of 30, 65, and 90 days after spraying, and in oxen 30 and 90 days after spraying (tables 14 and 15) during a similar experiment in the Lydenburg district (Wiese, Basson, and van der Merwe, 1970).

Unpublished data indicate that <u>Tatera leucogaster</u> males receiving 100 ppm dieldrin consistently in their diet lived up to 48 days after onset of exposure.

The present data, however, are too meagre for any meaningful conclusions to be reached.

## 5.3 Reproduction

### 5.3.1 Breeding season

The study covered two complete breeding seasons viz. 1967/68 and 1968/69, as well as the end (April/May) of the 1966/67 breeding season. Reproductive activity was observed only in P.( M.) natalensis, S. campestris, and L. griselda.

#### 5.3.1.1 Praomys (Mastomys) natalensis

Breeding data for grids P88 and P89 were combined because of the small samples obtained from each (table 16). At the end of the 1966/67 breeding season (during April/May 1967), scrotal males were observed but no pregnant females. While there was reproductive activity in the 1967/68 season, extending from September 1967 to February 1968 (69% of 29 females pregnant and 62% of 34 males scrotal), there was none in the 1968/69 season.

The breeding activity observed on grid P50 (sprayed) is shown in table 17. This grid was not trapped until after the end of the 1966/67 breeding season. Fifty-two percent of 29 females and 73% of 41 males were in breeding condition during the period September 1967 to April 1968. During the next breeding season no pregnant females amongst three captured and only one scrotal male (collected in November 1968) of two captured, were observed.

Reproduction, especially amongst the females, was much lower on grid P46 (control) than on the other grids (table 18). Pregnant females were observed only during September and October 1967 (seven of 10 animals captured) while from September 1967 to early May 1968 65% of 110 males observed were scrotal. No pregnant P.( M. ) natalensis females were observed on grids P46 and P50 during the 1968/69 season. Scrotal males were observed on both but in very low numbers (see above) (grid P46: one male observed during September 1968 not scrotal; one scrotal male of two observed in November 1968; and two scrotal males in February 1969).

When the data for the four grids are combined the observed breeding season for females was from September to February and for males from September to April.

Brambell and Davis (1941) found breeding females throughout the year in Sierra Leone with the greatest proportion present during October to November ( end of wet season/ beginning of dry season; autumn in northern hemisphere). Chapman, Chapman, and Robertson (1959) observed pregnant females in Rukwa, Tanzania from February to November with a peak during April and May (end of wet season/beginning of dry season; autumn in southern hemisphere). Pirlot (1954) found breeding in Katanga also to be at its highest during the autumn months. In Uganda during the period June to July 1958, Southern and Hook (1963) found three of seven females collected either pregnant or lactating. Material from Uganda (Delany, 1964a) indicates no pregnant or lactating females during August to December 1961. The same was observed in 19 females during the period 13 July to 13 September 1963 (Delany 1964b). Delany and Neal (1966 and 1969) observed pregnant females in Uganda during May to July and during October to December, while males with high sperm rating were observed throughout the year. Coetzee (1965 and 1967), studying the breeding season of _P._( _M._) _natalensis_ in the Roodepoort area near Johannesburg, reports breeding to be continuous through the spring and summer, reaching a peak in autumn (March to May; end of wet season/beginning of dry season). Thereafter no breeding was observed until July/ August (end of winter) in spite of abundant food being present in nearby maize lands.

An autumn reproductive peak at the end of the rainy season was not observed in the present study. Poor rainfall during the study is suspected to be the cause (see section 5.3.1.4 below).

### 5.3.1.2 _Saccostomus campestris_

Ten of the 14 males observed on grids P88 and P89 during the 1967/68 season were scrotal (table 16). In April 1967 there were a few observations, which included less than 5% scrotal animals. The only pregnant female observed on these grids during the study was encountered in May 1969 when one of four females captured proved to be pregnant.

On grid P50 (sprayed; table 17) pregnant females were observed in October 1967 (one of two animals), February 1968 (one of four animals) and May 1969 (two of four animals). On grid P46 (control; table 18) no pregnant females were observed throughout the study. Scrotal males (68% of 25 animals observed) were present on grid P50 from August 1967 to early May 1968, and from August 1968 to May 1969 (94% of 16 animals observed). Scrotal males were present on grid P46 from October 1967 to June 1968 (50% of 52 observed), in September 1968 (one of one), and during April/May 1969 (70% of 20 animals observed).

When the breeding data from all four grids are combined, the observed breeding season for males was from late August to June while females had a breeding season extending from October to February

A pregnant fema[illegible] [illegible]. <u>campestris</u> was observed in Uganda during November (Delany [illegible] Neal, 1966).

### 5.3.1.3 <u>Lemniscomys</u> <u>griselda</u>

On grids P88 and P89 (table 16) scrotal males were observed only during April/May 1967 (three of three animals) and during October 1967 (one of one). The only pregnant females encountered were during February 1968 (two of three animals observed).

Grid P50 (sprayed; table 17) supported breeding males and females prior to spraying but not afterwards (males: September 1967, the only one captured being scrotal; February to May 1968, all four animals captured scrotal; females: September 1967, all four females captured [illegible] pregnant; and January 1968, the only female captured [illegible] pregnant). No pregnant females were observed on grid P46 (control) during the study (table 18) and scrotal males were encountered only before spraying, from September 1967 to February 1968 (53% of the 17 animals observed were scrotal).

When the data for the four grids are combined the observed breeding season for females was from September to February and for males from September to May.

The reproductive data obtained from the present study were too meagre to allow any conclusions concerning the effect of dieldrin coverspraying on the reproductive activity of the animals present in the area.

### 5.3.1.4 Effect of rainfall on breeding

Because of the below average rainfall during the study period and the possible effect of this on the vegetation, the observed breeding seasons for the different species might be somewhat aberrant.

Reynolds (1960) reports two peaks of breeding in Merriam's Kangaroo rat, *Dipodomys merriami*, corresponding closely with the periods of new vegetation growth in spring and late summer. Bodenheimer and Sulman (1946) report that fresh vegetation has a stimulating effect upon breeding activity, and that the oestrous cycle of *Microtus guentheri* seems to be associated with a gonadotrophic factor found in fresh green plant material which is responsible for increased ovulation.

Bothma (1969) found high temperature and a too low or too high rainfall the apparent limiting factor of the breeding season of cottontails, *Sylvilagus floridanus*, in South Texas. He found reproductive peaks to correspond to increased growth of vegetation in the spring and autumn.

Stodart and Myers (1966) report green vegetation to be of importance to the maintenance of reproduction in the Australian wild rabbit. The same phenomenon has been observed in North American rabbits (Ingles, 1941; Fitch, 1947; Mossman, 1955; Bothma, 1969).

Bothma (1969) reports the onset of the cottontail breeding season to be closely correlated with the initial break in drought. Newsome (1966) reports this reaction to rainfall in the red Kangaroo *Megaleia rufus*, while Poole (1960) and Myers and Poole (1962) report it in the Australian rabbit. This response was attributed to estrogens in the growing tips of sprouting vegetation. Therefore the gonadotrophic factor mentioned by Bodenheimer and Sulman (1946) might be estrogen.

According to Measroch (1954) many animals from equatorial regions lack seasonal breeding periodicity. The results obtained by various workers (Brambell and Davis, 1941; Measroch, 1954; Pirlot, 1954; Allanson, 1958; Chapman et al., 1959; Delany, 1964a and 1964b; Coetzee, 1965 and 1967; Dieterlen, 1967; Delany and Neal, 1966 and 1969; and unpublished data), however, indicate that many species of small rodents have a restricted breeding season, in tropical and southern Africa corresponding more or less with the rainy season.

The appearance of green vegetation in the present study area was inhibited by the low rainfall prevailing during the period, and this might have resulted in reduced or delayed breeding activity.

During normal rainfall years on the study area, Praomys (M.) natalensis, S. campestris, and L. griselda breeding season is expected to be from the onset of good spring rains until after the end of autumn rains.

## 5.4 Movements

### 5.4.1 Maximum distance between captures

If animals are captured repeatedly, the maximum distance between captures (M) can be measured after the second, third, ....., nth capture for each animal. If the number of captures is placed on the abscissa of a graph, and the average length of M (av. M) for a number of animals on the ordinate, a curve can be plotted to illustrate the manner in which av. M increases with successive captures. It can be assumed that individual animals have stable movement patterns if the curve becomes asymptotic, thus approaching the limits of their movements (Stickel, 1954). If, however, the curve continues to rise, these animals are progressively occupying new areas. The av. M curves of two populations will consistently differ if the one population has distinctly larger or smaller movement patterns (home ranges) than the other (Brant, 1962). Unusual movements are not excluded from estimates of av. M, as they are in Burt's (1943) concept of home range. If progressive occupation of new areas becomes evident, av. M will be of limited value, since it will include areas no longer in use (Brant, 1962). The same limitation is, however, evident for other areal methods of calculating home range.

Trap spacing also seems to influence av. M values. Brant (1962) found that differences in trap spacing resulted in significant differences in the values of av. M obtained.

The Mann Whitney U-test was used for comparing av. M between the different grids, species and sexes. Where two or more observations per animal were available the data were used for calculating av. M values.

The average maximum distance travelled by P. (M.) natalensis between captures after the 2nd, 3rd, ....., nth captures is illustrated in fig. 22A and B (all grids combined, and grid P50), fig. 23A and B (grids P46, and P88+P89), and in table 19. Comparable data on S. campestris are illustrated in fig. 24A to D and table 20, on Lemniscomys griselda in fig. 25A to D and table 21, and on Leggada minutoides in table 22.

### 5.4.1.1 *Praomys* (*Mastomys*) *natalensis*

The av. M of males exceeded that of females significantly on all grids combined ($N_1 = 16$, $N_2 = 19$, $U_k = 92$, $U = 92$; $p < 0{,}05$), on grid P46 ($N_1 = 15$, $N_2 = 19$, $U_k = 75$, $U = 64$; $p < 0{,}02$), and on grid P50 ($N_1 = 10$, $N_2 = 11$, $U_k = 22$, $U = 12{,}5$; $p < 0{,}02$), but not on grids P88 + P89 ($N_1 = 13$, $N_2 = 15$, $U_k = 64$, $U = 82$), where no significant difference was observed ($p > 0{,}05$), but where female values tended to exceed those of males.

Male av. M values on the different grids did not differ significantly from one another. The female av. M for grids P88 + P89 exceeded that for grid P46 ($N_1 = 15$, $N_2 = 19$, $U_k = 55$, $U = 54$), and grid P50 ($N_1 = 10$, $N_2 = 15$, $U_k = 21$, $U = 17$) significantly ($p < 0{,}002$). The av. M values of sexes combined on grids P88 + P89 exceeded those for grid P46 ($N_1 = 18$, $N_2 = 19$, $U_k = 94$, $U = 79$; $p < 0{,}02$).

Grids P88 and P89, situated in the *A. nigrescens* community, consistently supported lower rodent numbers than did grids P46 and P50; av. M values on the former two tended to exceed those on the latter. This suggests that during low population levels animals cover larger areas, as is generally accepted.

Average M values of males (figs. 22 and 23; table 19) increased continuously while those of the females seem to reach an asymptote. It therefore seems that males progressively occupied new areas while females tended to occupy more fixed areas. On grids P88 + P89, where the small sample size makes a meaningfull conclusion difficult, this seems not to have been the case.

### 5.4.1.2 *Saccostomus campestris*

Average M values of the two sexes did not differ significantly from one another on any of the grids, or on all grids combined. No significant differences in av. M, of sexes both separated and combined, were observed between any of the grids.

Average M of *S. campestris* males ($N_1 = 13$, $N_2 = 16$, $U_k = 51$, $U = 36{,}5$), and of sexes combined ($N_1 = 16$, $N_2 = 20$, $U_k = 87$, $U = 82{,}5$) on all grids combined were exceeded significantly ($p < 0{,}02$) by comparable values of *P.* (*M.*) *natalensis*. The av. M of *Leggada minutoides* also exceeded that of *S. campestris* significantly ($N_1 = 6$, $N_2 = 14$, $U_k = 6$, $U = 3$; $p < 0{,}002$).

Average M curves (fig. 24A-D; table 20) tended to reach a plateau, suggesting that the animals did not continually occupy new areas, but remained in more or less fixed areas.

### 5.4.1.3 *Lemniscomys griselda*

Average M values of males on grid P46 ($N_1 = 5$, $N_2 = 10$, $U_k = 6$, $U = 3$; $p < 0{,}02$) and on all grids combined ($N_1 = 12$, $N_2 = 14$, $U_k = 25$, $U = 24$; $p < 0{,}002$) exceeded those of females significantly.

The male av. M values for grid P46 ($N_1 = 5$, $N_2 = 11$, $U_k = 7$, $U = 5$) exceeded those for grid P50 significantly ($p < 0{,}02$).

Average M values of females did not differ significantly from each other on the different grids, nor did the values for the sexes combined on the different grids. The number of observations, however, was very small in most cases.

Average M of *L. griselda* (sexes both separated and combined) was significantly exceeded by that of *P.(M.) natalensis* (males: $N_1 = 14$, $N_2 = 16$, $U_k = 56$, $U = 53$, $p < 0{,}02$; females: $N_1 = 12$, $N_2 = 19$, $U = 40$, $U = 34$, $p < 0{,}002$; sexes combined: $N_1 = 20$, $N_2 = 22$, $Z = -3{,}711$, $p < 0{,}001$).

Average M values of *S. campestris* and *L. griselda* did not differ significantly. *Leggada minutoides* av. M values exceeded those of *Lemniscomys griselda* highly significantly ($Z = -3{,}669$, $p < 0{,}001$).

The av. M curves of both male and female *L. griselda* (fig. 25A to D; table 21) tended to form a plateau, suggesting a more or less fixed range.

### 5.4.1.4 *Leggada minutoides*

*Leggada minutoides*, in spite of its small size, exhibited a greater maximum distance between captures than did any of the other species studied.

The av. M values of *Leggada minutoides* (table 22) exceeded those of *Lemniscomys griselda* ($N_1 = 6$, $N_2 = 22$, $Z = -3{,}669$; $p < 0{,}001$) and *S. campestris* ($N_1 = 6$, $N_2 = 14$, $U_k = 6$, $U = 3$; $p < 0{,}002$), significantly and those of *P.(M.) natalensis* ($N_1 = 6$, $N_2 = 20$, $U_k = 27$, $U = 49$) non-significantly ($p > 0{,}05$).

## 5.5 Sizes and mass

### 5.5.1 *Praomys* (*Mastomys*) *natalensis*

#### 5.5.1.1 Total length

Mean, standard deviation, and standard error of total length for each season (sexes both separated and combined) are illustrated in fig 26 (A-C), and given with range and sample size in table 23.

The highest mean total length ( ± 1 SE) was observed in the summer (males: 218,6 ± 2,8 mm; females: 206,9 ± 3,6 mm; both sexes: 213,2 ± 2,3 mm). The lowest for males (181,2 ± 7,8 mm) and sexes combined (181,5 ± 5,4 mm) was observed in autumn, while the lowest female mean total length was observed during winter (176,7 ± 7,8 mm). The summer mean total length of males and females exceeded that for all the other seasons highly significantly ($p < 0,01$; table 24). Autumn was the only season in which the female mean (181,8 ± 7,8 mm) exceeded that of the males (181,2 ± 7,8 mm) ($t = 0,057$, df 52), although not significantly. During spring and summer male means exceeded those of females significantly (spring: $t = 2,831$, df 1~~6~~58, $p < 0,01$; summer: $t = 2,570$, df 133, $p < 0,05$). Male mean total length for all seasons combined (201,2 ± 1,7 mm) exceeded that of females (192,2 ± 2,2 mm) highly significantly ($t = 3,242$, df 363, $p < 0,01$; table 25; fig 27).

#### 5.5.1.2 Head and body length

Summer mean head and body length of males (111,4 ± 2,0 mm), females (103,9 ± 1,6 mm), and sexes combined (108,0 ± 1,3 mm) exceeded those for all other seasons highly significantly (fig. 28 A-C; tables 23 and 26). None of the other seasons differed significantly from one another in this. Autumn was the only season in which the female mean head and body length (90,7 ± 3,7 mm) exceeded that of males (90,6 ± 3,8 mm), although again not significantly ($t = 0,021$, df 52). During spring and summer the male mean head and body length (spring: 93,3 ± 0,9 mm; summer: 111,4 ± 2,0 mm) exceeded that of the females (spring: 88,4 ± 0,9 mm; summer: 103,9 ± 1,6 mm) highly significantly ($p < 0,01$; spring: t= 3,879, df 158; summer: t= 2,951, df 133). Male mean head and body length for all seasons combined (99,5 ± 1,0 mm) exceeded that of females (94,8 ± 1,0 mm) highly significantly (t= 3,438, df 363, $p < 0,01$; table 25).

Delany and Neal (1966) found mean head and body length in Uganda to be 122,8 mm (N= 57; range: 90 mm to 154 mm) and female mean to be 125,1 mm (N= 53; range: 95 mm to 148 mm). Head and body length means of Uganda P.(M.) natalensis exceeded those of Pongola during all seasons by 12 mm to 32 mm in the case of males, and by 21 mm to 37 mm in the case of females.

In the Congo (Kivu lake area) P.(M.) natalensis head and body length was found to range between 105 mm and 150 mm (Dieterlen, 1967), while in the present study head and body length ranged from 59 mm to 126 mm ($\bar{x}$ = 97,4 mm).

### 5.5.1.3 Tail length

Summer mean tail length of both sexes, separately and combined, was significantly higher than the mean for spring and autumn, while during the winter the tails of only females and sexes combined were found to be significantly shorter (fig. 29; tables 23 and 27). Males (90,9 ± 4,1 mm) and sexes combined (91,0 ± 3,0 mm) showed the lowest mean during autumn, while for females the mean was lowest during winter (86,6 ± 2,1 mm). Autumn mean tail length of males and sexes combined was also significantly lower than the spring mean (males: t= 2,302, df 122, $p < 0,05$); sexes combined: t= 2,710, df 212, $p < 0,01$).

Female mean tail length (91,1 ± 4,3 mm) exceeded that of the males (90,9 ± 4,1 mm) only during autumn, although not significantly (t= 0,025, df 52). During summer (t= 2,173, df 133, $p < 0,05$) and winter (t= 3,071, df 14, $p < 0,01$) male mean tail length exceeded that of the females significantly. Male mean tail length for seasons combined (102,4 ± 1,0 mm) exceeded that of females (97,7 ± 1,3 mm) highly significantly (t= 2,917, df 363, $p < 0,01$; table 25).

Male mean tail length of P.(M.) natalensis in Uganda (Delany and Neal, 1966) was 112,3 mm (N= 57; range: 88 mm to 150 mm) and in females 114,0 mm (N=52; range: 95 mm to 135 mm). Uganda P.(M.) natalensis tail length means exceeded those of the present during all seasons by 3 mm to 21 mm in males and by 11 mm to 27 mm in females.

In the Kivu lake area (Congo), Dieterlen (1967) found tail length to range between 95 mm and 130 mm. He also observed that head and body length exceeded tail length by an average of 20 mm. In the present study tail length ranged from 40 mm to 150 mm ($\bar{x}$ = 100,3 mm).

### 5.5.1.4 Body Mass

Summer mean mass of sexes combined (38,3 ± 0,9 g), males (41,8 ± 1,2 g), and females (34,2 ± 1,4 g) was highly significantly greater than that observed during any other season (figs. 27 and 30; tables 23 and 28). The lowest mean mass of males (23,4 ± 2,6 g) was observed in the autumn, and that of females (19,8 ± 2,5 g), and sexes combined (22,3 ± 1,9 g) in winter. Mean mass of females exceeded that of males only during autumn (males: 23,4 ± 2,6 g; females: 24,7 ± 2,5 g) but not significantly (t= 0,358, df 52). During spring (t= 4,532, df 158, $p < 0,01$) and summer (t= 4,236, df 133, $p < 0,01$) male mean body mass exceeded that of females highly significantly. Male mean body mass for all seasons combined (32,5 ± 0,6 g) exceeded that of females (27,9 ± 0,7 g) highly significantly (t= 4,844, df 363, $p < 0,01$; table 25).

Mean body mass of P.(M.) natalensis in Uganda according to Delany and Neal (1966) was 48,0 g (N= 32; range: 23 g to 70 g) in males, and 44,6 g (N=34; range: 20 g to 60 g) in females. In contrast with head and body length and tail length the mean mass was slightly higher than that of females. In Uganda material, body mass means exceeded those of the present by 6 g to 25 g in males and by 11 g to 25 g in females.

All parameters (total length, tail length, head and body lenght, and body mass) exhibited their highest mean values during the summer (in sexes both separated and combined). In males the lowest mean values were observed during the autumn, in the females during the winter, except for female mean head and body length which was lowest during spring. In all the parameters studied, the female mean values exceeded those of males slightly during the autumn, but never significantly. Male mean values for all seasons combined exceeded those of the females highly significantly, in all the parameters.

### 5.5.1.5 Body mass relationship between the Pongola and Roodepoort areas.

The mean monthly mass of specimens from Roodepoort having a mass of more than 10 g (Coetzee, 1967: table 10), were grouped by season and means, standard deviations, and standard errors calculated (table 29). The comparison below of these data with the result of the Pongola study, will be affected by the fact that some of the specimens from Pongola, taken in the summer and autumn, had a mass of less than 10 g.

The highest mean body mass in the Roodepoort area was observed during the summer (males: 38,1 ± 3,9 g; females: 33,4 ± 2,0 g; both sexes: 35,6 ± 1,9 g). In the Pongola area the same trend was observed (males: 41,8 ± 1,2 g; females: 34,2 ± 1,4 g; both sexes: 38,3 ± 0,9 g) (fig. 30; tables 23 and 29).

The Roodepoort summer male mean body mass exceeded that for autumn ($t= 4,329$, df 565, $p < 0,01$) and winter significantly ($t= 3,747$, df 1197, $p < 0,01$; table 30) but not that of spring ($t= 1,821$, df 199). The Pongola summer male mean body mass exceeded ~~that~~ those for all other seasons highly significantly. (table 28; section 5.5.1.4). The lowest mean mass of females and sexes combined in both Roodepoort and Pongola areas were observed during winter. In Roodepoort males, females, and sexes combined, the winter mean body mass differed significantly from means for all the other seasons (table 30), while in the Pongola data, winter mean body mass of males, females, and both sexes combined was exceeded significantly only by the summer mean (table 28). The lowest mean body mass of males was observed during the autumn at both localities. In the Roodepoort area male mean body mass during all other seasons exceeded that for autumn highly significantly (table 30), while only the summer mean was significantly higher (t= 6,480, df 98, $p < 0,01$) than the autumn mean in the Pongola area (table 28).

At both localities autumn mean body mass of females exceeded that of males, but significantly only at Roodepoort (t= 5,026, df 1167, $p < 0,01$). Mean body mass of Roodepoort males exceeded that of females significantly during spring and winter while at Pongola, male mean mass exceeded that of females significantly during summer and spring (tables 25, 29, and 31). In contrast with Pongola material, Roodepoort male mean body mass for all seasons combined (23,7 ± 0,30 g) did not differ from that of females (23,7 ± 0,2 g; t= 0,030, df 4097, $p > 0,05$; tables 29 and 31).

Mean body mass of Roodepoort males, females and sexes combined during spring exceeded comparable Pongola values significantly, while for all seasons combined the Pongola mean body mass of males (t= 13,414, df 2122), females (t= 5,590, df 2338), and sexes combined (t= 13,172, df 4462) exceeded those for Roodepoort highly significantly ($p < 0,01$; table 32).

### 5.5.1.6 Relationship between head and body length and tail length

During summer and autumn, mean head and body length and mean tail length (table 23; figs. 28 and 29) were more or less equal regardless of sex (for t-values see table 33). During spring, however, mean tail length exceeded head and body length highly significantly (males: t= 5,045, df 192; females: t= 4,695, df 124; both sexes: t= 6,761, df 318; $p < 0,01$). No statistically significant difference was observed during winter. The seasonal ratio between mean head and body length and tail length did not deviate significantly from 1:1 (table 34). Mean tail length for all seasons combined exceeded mean head and body length (males: t= 2,120, df 404, $p < 0,05$; females: t= 1,829, df 322, $p > 0,05$; both sexes: t= 2,750, df 728, $p < 0,01$).

In contrast, Dieterlen (1967) found P.(M.) natalensis head and body length to exceed tail length in the Congo with an average of 20 mm. In Uganda, head and body length also tended to exceed tail length (Delany and Neal, 1966). When compared with data from Coetzee (1967: fig. 2) it seems that in Pongola material, animals with long tails were more frequent (fig. 31 A-D). Coetzee (1967) seldom found tail length to be longer than 110 mm, while this was common in Pongola specimens during all seasons except winter, when only a small sample was available. Animals with greater head and body length were more frequent in material from the Congo, Uganda, and Roodepoort (Transvaal) than in the present study. The Pongola material seldom included animals with head and body length exceeding 120 mm, while in the other areas this was frequently the case. The largest number of Pongola animals with head and body length above 120 mm was observed during the summer.

It seems, therefore, that P.(M.) natalensis from the Pongola area have relatively longer tails than do those from the Congo, Uganda and Transvaal, but that they are smaller in total length.

As Chapman et al. (1959) used the anus to tail tip method of measuring tail length, these lengths would be relatively shorter and head and body lengths relatively longer than the measurements obtained by the vertebral method. Therefore, no direct comparison between the present data and those of Chapman et al. (1959) is possible.

Coetzee (1967) states that the tails of very small and larger animals are relatively shorter than those of animals of intermediate size (weaned to subadults), of which a considerable number had tails longer than head and body length. He concluded that the tail undergoes a rapid elongation in the subadult stage, followed by a period of relatively slower growth in relation to head and body length.

The present data (fig. 31 A-D) show that most smaller animals (juveniles: with both tail length, and head and body length < 80 mm), had tails shorter than or equal to head and body length. In animals of intermediate size (subadults: both tail, and head and body length < 100 mm), tails were longer than head and body length, except during the summer when they were more often shorter than head and body length in subadults and as frequently longer or shorter in adults. In the Pongola population, therefore, unlike the Roodepoort population, the rapid elongation of the tail in subadults was sustained (except possible during summer), and not reversed by relative more rapid growth of the head and body length in adults.

### 5.5.2 Saccostomus campestris

The mean, standard deviation, and standard error of total length, head and body length, tail length, and body mass for each season (sexes both separated and combined) are illustrated in figs. 32 to 37 (A-D) and given with range and sample size in table 35.

The highest mean total length of both males (182,8 ± 4,8 mm) and females (172,8 ± 5,9 mm) was observed during the spring. Spring mean total length of males and sexes combined (178,6 ± 3,8 mm) exceeded those for all other seasons highly significantly, while the female spring mean total length (172,8 ± 5,9 mm) exceeded only the autumn mean (159,1 ± 1,9 mm) significantly (table 36). The lowest mean of males (153,1 ± 3,9 mm) was observed in summer, and was exceeded significantly by those for all other seasons except winter. In females (159,1 ± 1,9 mm) the lowest mean was observed in the autumn, but was exceeded significantly only by the spring mean ($t= 2,207$, df 67, $p < 0,05$). In both sexes a decrease in total length from spring to summer was observed. During summer ($t= 2,567$, df 60, $p < 0,05$) and winter ($t= 0,079$, df 34, $p > 0,05$) the female mean total length exceeded that of males, while the autumn male mean (167,9 ± 1,8 mm) exceeded that of females (159,1 ± 1,9 mm) highly significantly ($t= 3,393$, df 133, $p < 0,01$). The male mean total length for all seasons combined was 164,7 ± 1,5 mm and the female mean was 162,3 ± 1,4 mm ($t= 1,149$, df 257, $p > 0,05$; table 37).

The trend in mean head and body length during the different seasons was much the same as that for total length (table 38). Summer was the only season in which female mean head and body length (114,2 ± 0,5 mm) exceeded that of males (107,0 ±

2,9 mm), although not significantly (t= 1,898, df 60; table 37). Autumn was the only season in which the male mean (114,5 ± 1,3 mm) exceeded the female mean (109,4 ± 1,4 mm) highly significantly (t= 2,714, df 133, $p < 0,01$; table 37). The male mean head and body length for all seasons combined was 113,6 ± 1,1 mm and for females it was 111,8 ± 1,0 mm (t= 1,194, df 257, $p > 0,05$).

A male mean head and body length of 116,0 mm (N= 4; range: 94 mm to 130 mm) and female mean of 144,9 mm (N= 7; range: 127 mm to 157 mm) were observed in Uganda (Delany and Neal, 1966). These small sample sizes might have given aberrant values for the means.

The trend in mean tail length through the seasons of males and sexes combined, was the same as those of total length and head and body length (tables 35 and 39). Winter female mean tail length, however, was lower than that for autumn, in contrast with the other two parameters in which winter means were higher. During summer (t= 3,282, df 60, $p < 0,01$) and winter (t= 0,671, df 34, $p > 0,05$) female means exceeded those of males. Male mean tail length exceeded that of females highly significantly during the autumn (t= 2,719, df 133, $p < 0,01$; table 37). Male mean tail length for all seasons combined was 51,1 ± 0,6 mm and in females it was 50,4 ± 0,5 mm (t= 0,814, df 257, $p > 0,05$).

A male mean tail length of 45,3 mm (N= 4; range: 34 mm to 55 mm) and female mean of 53,9 mm (N= 7; range: 50 mm to 58 mm) were observed in Uganda (Delany and Neal, 1966). These means correspond closely with the means observed at Pongola for all seasons combined (males: 51,1 mm, range: 33 mm to 64 mm; females: 50,4 mm, range: 33 mm to 62 mm).

The tail length of S. campestris is the only parameter observed by Delany and Neal (1966) which compares favourably with that from the present study. The head and body of Uganda specimens seems to be longer than that for the present study, therefore S. campestris specimens from Pongola seem to be smaller with relatively longer tails than those from Uganda which were obtained from a small sample. however, Pongola, mean body mass (males: 70,7 ± 6,2 g: females: 57,5 ± 5,2 g; both sexes: 65,1 ± 4,3 g) was highest during spring. These spring means proved to be significantly higher than those for all other seasons, except that the female spring mean did not exceed the summer mean significantly (tables 35 and 40). The lowest mean body mass (males: 39,9 ± 1,9 g; females: 38,2 ± 1,5 g; both sexes: 39,0 ± 1,2 g) was observed during the winter. Female mean body mass (46,3 ± 2,7 g) exceeded male mean mass (40,4 ± 2,5 g) only during the summer (t= 1,604, df 60, $p > 0,05$). During autumn (t= 3,915, df 133, $p < 0,01$) male mean body mass exceeded that of females highly significantly. Male mean body mass (47,2 ± 1,2 g) for all seasons combined exceeded that of females (42,9 ± 1,0 g) highly significantly (t= 2,796, df 257, $p < 0,01$).

A male mean body mass of 29,0 g (N= 2; range: 24 g to 34 g) and a female mean of 65,2 g (N= 6; range: 41 g to 84 g) were observed in Uganda (Delany and Neal, 1966). The small male sample made comparison between Uganda and Pongola material difficult. Uganda S. campestris female mean body mass (65,2 g) clearly exceeded that from the study area (42,9 g) although the season(s) in which the sample was taken would considerably affect the mass.

All parameters studied showed their highest mean values during spring. In males and sexes combined lowest mean total length, head and body length, and tail length were observed during summer, while the lowest mean mass was observed during winter. Female mean total length and head and body length were lowest in autumn, while mean tail length and body mass were lowest in winter. Female mean body mass (t= 1,604, df 60, $p > 0,05$), total length (t= 2,567, df 60, $p < 0,05$), head and body length (t= 1,898, df 60, $p > 0,05$), and tail length (t= 3,282, df 60, $p < 0,01$) exceeded comparable values for males during summer. Female mean total length (t= 0,079, df 34, $p > 0,05$), and tail length (t= 0,671, df 34, $p > 0,05$) exceeded those of males during winter but not significantly. In all four parameters the male means exceeded those of females significantly during autumn.

Wrangham (1969), observing a S. campestris litter consisting of 4 animals from a female that conceived in the wild (Kafue National Park, Zambia) reports that at 18 days they had the appearance of adults except for size (mass 11 g; total length 82 mm), although two animals had their eyes still closed. On the 19th day all four had their eyes open but were still suckling frequently. It can therefore be assumed that animals of this species would be weaned at an age of 19 to 25 days, and at a mass of 11g to 15 g.

### 5.5.3 *Lemniscomys griselda*

The highest male mean total length (258,3 ± 3,6 mm) was found during the spring, while in females (247,4 ± 5,4 mm) and sexes combined (247,3 ± 5,9 mm) highest means were obtained in summer. For both males and sexes combined spring mean total length exceeded autumn and winter means significantly (figs. 38 and 39; tables 41 and 42). The female winter mean total length (238,9 ± 3,1 mm) was more or less equal to the spring mean (237,9 ± 3,5 mm) (t= 0,215, df 42, $p > 0,05$). Mean total length of males, females, and sexes combined was lowest during the autumn (males: 235,6 ± 7,7 mm; females: 231,5 ± 5,7 mm; sexes combined: 233,1 ± 4,5 mm). Female means exceeded those of the males (table 43) during the summer (t= 0,014, df 19) and winter (t= 0,008, df 46), although not significantly. Male spring mean total length (258,3 ± 3,6 mm) exceeded that of females (237,9 ± 3,5 mm) highly significantly (t= 4,050, df 27). The male mean total length for all seasons combined was 244,4 ± 2,7 mm and for females 239,0 ± 2,0 mm (t= 1,603, df 117, $p > 0,05$).

The highest male mean head and body length was found during the summer (118,3 ± 7,0 mm) and the lowest during the autumn (110,0 ± 3,0 mm) (t= 1,086, df 13, $p > 0,05$; figs. 40 and 41; tables 41 and 44). The highest female mean value was apparent during the summer (116,9 ± 2,5 mm) and the lowest occurred during the spring (108,7 ± 1,4 mm) (t= 2,843, df 29, $p < 0,01$). In sexes combined the highest mean head and body length was found during summer (117,3 ± 2,8 mm) and the lowest during autumn (109,8 ± 1,9 mm) (t= 2,247, df 40, $p < 0,05$). The winter mean head and body length of females (113, 2 ± 1,7 mm) exceeded that of males (112,5 ± 1,3 mm), although not significantly (t= 0,457, df 46). Spring male mean head and body length (117,2 ± 1,7 mm) exceeded that of females (108,7 ± 1,4 mm) highly significantly (t= 3,832, df 27, $p < 0,01$; table 43).

The male mean head and body length for all seasons combined was 114,1 ± 1,3 mm and for females, 112,2 ± 1,0 mm (t= 1,185, df 117, p > 0,05).

The highest mean tail length of males (141,1 ± 2,3 mm), females (130,5 ± 2,0 mm), and sexes combined (134,9 ± 1,8 mm) was observed in the spring, and the lowest in autumn (males: 125,6 ± 4,8 mm; females: 121,9 ± 3,3 mm; sexes combined: 123,3 ± 2,7 mm; figs. 40 and 42; table 41). The spring mean tail length of males, females, and sexes combined exceeded autumn and winter means significantly (table 45). Summer was the only season in which female mean tail length exceeded that of males, although not significantly (t= 0,191, df 19, p > 0,05; table 43). The spring male mean exceeded the female mean highly significantly (t= 3,464, df 27, p < 0,01). Male mean tail length for all seasons combined was 130,1 ± 1,6 mm and for females, 127,0 ± 1,1 mm (t= 1,575, df 117, p > 0,05).

The highest mean body mass of males (59,8 ± 3,1 g) was found during spring and the lowest (41,0 ± 3,0 g) in autumn (t= 4,442, df 18, p < 0,01). Sexes combined showed the same trend as the males. Spring mean body mass of both males and sexes combined exceeded the autumn and winter means highly significantly (figs. 38 and 43; tables 41 and 46). Summer mean body mass of sexes combined (51,1 ± 3,6 g) exceeded the winter mean (42,6 ± 1,0 g; t= 2,259, df 67, p < 0,05) significantly. The females, however, showed their highest mean mass (49,8 ± 3,9 g) in summer and their lowest (43,3 ± 1,6 g) during winter. No significant differences were observed between female body mass in the different seasons (table 46). Female mean body mass exceeded that of males during autumn (t= 0,560, df 19) and winter (t= 0,728, df 46), although not significantly. During spring the male mean body mass exceeded that of females highly significantly (t= 3,300, df 27 p < 0,01; table 43). The male mean body mass for all seasons combined was 47,9 ± 1,5 g and for females, 45,7 ± 1,2 g (t= 1,158, df 117, p > 0,05).

The highest mean values for all parameters studied were observed during spring or summer, and the lowest during autumn or winter, except that the lowest female mean head and body length was recorded in spring. Although the female means of all parameters studied usually exceeded those of males during summer and/or winter, the differences were never significant. On the other hand spring male means always exceeded those of females highly significantly.

### 5.5.4 *Leggada minutoides*

Highest values for mean total length (103,8 ± 2,6 mm), head and body length (59,6 ± 1,5 mm), and tail length (44,2 ± 1,5 mm) were observed during autumn, and in the case of mean body mass (7,0 ± 0,6 g) in summer. The lowest values of mean total length (93,9 ± 1,4 mm) and head and body length (52,7 ± 0,8 mm) were observed in spring, and of tail length (40,1 ± 0,9 mm), and body mass (5,1 ± 0,2 g) in winter (table 47; figs. 44 to 46). For all seasons combined mean body mass was 6,0 ± 0,2 g, mean total length, 97,4 ± 0,9 mm, mean tail length, 41,3 ± 0,5 mm, and mean head and body length, 56,1 ± 0,6 mm. Autumn mean total length exceeded those of spring (t= 3,331, df 13, $p < 0,01$) and winter (t= 2,536, df 12, $p < 0,05$) significantly, while spring mean head and body length was exceeded highly significantly by those of summer (t= 3,236, df 15, $p < 0,01$) and autumn (t= 4,454, df 13, $p < 0,01$). Autumn mean tail length exceeded that of winter significantly (t= 2,356, df 12, $p < 0,05$). Winter mean body mass was significantly exceeded by those of summer (t= 3,091, df 14, $p < 0,01$) and autumn (t= 2,719, df 12, $p < 0,05$; tables 47 and 48).

Delany (1964a) found Uganda *L. minutoides* male mean head and body length to be 61,8 mm (N= 6; range: 47 mm to 76 mm) and that of females to be 63,0 mm (N= 8; range: 49 mm to 77 mm). This corresponded closely with that observed by Delany and Neal (1966) also from Uganda (males: $\bar{x} = 60,6$ mm, N = 13, range: 45 mm to 76 mm; females: $\bar{x} = 60,8$ mm, N = 11, range: 49 mm to 77 mm). Dieterlen (1967) found head and body length to range from 55 mm to 70 mm in the Congo while the tail length range observed was 45 mm to 60 mm. Delany and Neal (1966) report male mean tail length to be 43,8 mm (N = 12, range: 35 mm to 54 mm) and that of females 45,5 mm (N = 11, range: 35 mm to 63 mm). Mean mass of males observed was 6,4 g (N = 7, range: 4 g to 10 g) and that of females 5,9 g (N = 9, range: 2,5 g to 10 g).

Length of specimens from the Congo and Uganda seems to exceed that of the present study somewhat.

## 5.6 Population structure

### 5.6.1 Age classes

#### 5.6.1.1 *Praomys (Mastomys) natalensis*

Coetzee (1967) assumes subadults to have a mass of 15 g to 25 g, adults above 25 g and designates mice of above 45 g as large adults. According to Dieterlen (1967) the juvenile stage ends when the animal reaches a mass of 10 to 20 g (25 days to 30 days old) and becomes adult when reaching a mass of more or less 40 g (70 days to 80 days old). The age classes of Coetzee (1967) are followed here.

The relative frequency of animals of different body mass during the four seasons (table 49; fig. 27) indicates that during spring (160 animals), all animals present in the population were subadults (47%), and adults (53%) of which 2% are designated as large adults. Males (97 animals) comprised 67% adults and 33% subadults. Three percent of the adult males were above 45 g in mass (large adults). In the females (63 animals) the opposite was apparent (32% adults, and 68% subadults). No large adult females were observed.

During summer most animals were adults (males: 94% of 73 animals; females: 86% of 62 animals; both sexes: 90% ). Juveniles (4%) appeared in the population and a substantial decrease in subadults from 47% to 5% was observed, probably as a result of the growth of subadults of the previous season to adulthood. In contrast with spring no obvious difference in age-class proportions of the sexes was apparent. This season showed the highest number of large adults (26% of 135 animals; males: 34% of 73 animals; females: 18% of 62 animals).

From summer (135 animals) to autumn (54 animals) there was a relative increase in number of juveniles (4% to 31%) and subadults (5% to 24%) with a decrease in number of adults, ( including large adults( 90% to 44%) and large adults (26% to 4%), indicating high mortality among the adults.

Far fewer observations (16 animals, comprising 18% juveniles; 43% subadults; 38% adults; 0% larger adults) during the winter made comparison more difficult, but indicated extensive mortality since the previous season.

Coetzee (1967) reports a comparatively high number of subadults during late autumn and spring. In the present study relatively high numbers of subadults were observed during the spring and winter, although during winter the small sample available could have been a source of error.

Juveniles were recorded throughout the year except during spring, while Coetzee (1967) found no juveniles in winter (July to early August). In both studies juveniles were most frequent during autumn.

The summer population seemed to consist of two mass groups viz. one with a body mass below 11 g (three males and three females) and another with a body mass of above 19 g ($>$ 23 g in 70 males; and $>$ 19 g in 59 females).

Coetzee (1967) found two mass groups during the autumn, one with a mass of below 25 g, the other above 35 g. In the present study two autumn groups are also apparent although very indistinct (males: $<$ 21 g, N = 16, and $>$ 24 g, N = 11; females: $<$ 21 g, N = 13, and $>$ 26 g, N = 14). No size groups were observed in the spring material, while the winter sample was too small to allow any meaningful conclusions to be reached.

In late winter and spring (August to October), Coetzee (1967) found apparently young animals, judging from fecundity and moult, with exceptionally heavy molar tooth wear. He suggests either that two species of multimammate mice occurred in the Roodepoort area, or that there was a difference in tooth wear rate during certain times of the year.

A possible alternative explanation may be retarded growth and sexual maturation during the winter and early spring, before the first rain of the season and the appearance of green growth (see section 5.3.1.4).

It is possible that animals born just prior to the winter may reach subadult stage, remain constant in mass and size until after the first spring rains, and then within a few weeks develop to breeding adults. The animals can, therefore, be as old as four or five months, with teeth correspondingly worn, and still be a subadult , while animals born just after the first spring rains could become breeding adults within two to four months, at which time teeth would be rather less worn. In laboratory studies of P. (M.) natalensis, Johnston and Oliff (1954) report age at first litter to be 130 days, and Coetzee (1967), citing records from the animal house of the Medical Ecology Centre, reports a mean age at first parturition of 94,1 ± 19,18 days with a range of 59 to 149 days. The youngest female to litter in a study by Meester (1960) was 77 days old.

### 5.6.1.2 Saccostomus campestris

Three mass classes are recognized, ie. $< 35$ g, 35 to 50 g, and $> 50$ g. These classes are not necessarily assumed to represent a particular age group although they possibly correspond roughly to juvenile, subadult, and adult classes. The body mass distribution during the four seasons (table 50; fig. 36) allows the conclusion that the spring sample consisted mostly (77% of 26 animals) of larger animals ($> 50$ g). During summer the three mass classes were more or less equally represented (N= 62; $< 35$ g: 29%; 35 g to 50 g: 39%; $> 50$ g: 32% ), while during autumn and winter, the intermediate size class (35 g to 50 g) comprised the largest proportion of the sample (autumn: 46% of 135 animals; winter: 58% of 36 animals). The relative number of smaller ($< 35$ g) and intermediate (35 g to 50 g) animals increased progressively from spring to winter, while the number of larger animals decreased.

### 5.6.1.3 Lemniscomys griselda

The relative frequency of animals of different body mass during the four seasons (fig. 38; table 51) allows the conclusion that smaller animals ($< 30$ g) occurred in low numbers, throughout (spring: 0% of 29 animals; summer: 10% of 21 animals; autumn: 10% of 21 animals; winter: 2% of 48 animals).

During spring (24% of 29 animals) and summer (19% of 21 animals), there were relatively fewer animals of intermediate size (30g to 45 g) than in autumn (62% of 21 animals) and winter (63% of 48 animals). During spring and summer, however, there was a higher number of larger animals ( $> 45$ g; spring: 76%; summer: 71%; autumn: 29%; and winter 35%).

### 5.6.2 Sex ratios

### 5.6.2.1 Praomys (Mastomys) natalensis

The observed overall male ratio (male: female) for all the animals trapped and sexed during the study was 0,573 (table 52). The highest ratio was observed during spring (0,625) and the lowest during autumn (0,491). Overall ratio (Chi square= 8,024, $p < 0,01$) and that for spring ($X^2 = 10,500$, $p < 0,01$) showed a highly significant preponderance of males over females. The autumn ratio (0,491, $X^2 = 0,018$) does not depart significantly from a 1:1 ratio.

The ratio for each grid is shown in table 52. Grid P46 showed a male ratio of 0,600 which is significantly ($X^2 = 8,00$, $p < 0,01$)

different from a 1:1 ratio. Male ratios of 0,594 on grid P50 ($X^2$= 3,574) and of 0,474 ($X^2$= 0,211) on grids P88 and P89 combined, do not depart significantly from a 1:1 ratio.

This preponderance of males corresponds with the following: Meester (1960) who found a 0,521 male ratio (76 males: 70 females; $X^2$= 0,247, $p > 0,05$) in the laboratory; Dieterlen (1967) who reports a male ratio of 0,611 (N= 190; $X^2$= 9,284, $p < 0,01$) from the Congo (Kivu lake area), and found during January to May a ratio of 0,638 (N= 58; $X^2$= 4,414, $p < 0,05$), during June to September 0,650 (N= 83; $X^2$= 7,530, $p < 0,01$), and during October to December 0,470 (N= 49; $X^2$= 0,184, $p > 0,05$); and de Wit (pers. comm.) who observed a male ratio of 0,544 (112 males: 94 females; $X^2$= 1,573; $p > 0,05$) while live trapping at Roodeplaat Agricultural Station near Pretoria.

In contrast with these findings, Oliff (1953) found in a laboratory study that the number of females (2039) exceeded that of males (1889) significantly ($p < 0,05$) at birth (female ratio: 0,519; $X^2$= 5,728) while after weaning they did not differ significantly (female ratio: 0,510; 2837 males: 2953 females; $X^2$= 2,324; $p > 0,05$).

Coetzee (1965; 1967) also reports a female preponderance (0,532; 2219 males: 2520 females; $X^2$= 19,118; $p < 0,001$). His material was obtained by capturing animals from excavated burrows. His monthly female ratios were as follows:

| | | | | |
|---|---|---|---|---|
| Jan.-Feb. | 0,481 | ( 41 males: | 38 females; | $X^2$= 0,114) |
| March | 0,517 | (112 males: | 120 females; | $X^2$= 0,276) |
| April | 0,531 | (246 males: | 279 females; | $X^2$= 2,074) |
| May | 0,521 | (367 males: | 399 females; | $X^2$= 1,337) |
| June | 0,512 | (467 males: | 489 females; | $X^2$= 0,506) |
| July | 0,528 | (399 males: | 447 females; | $X^2$= 2,723) |
| August | 0,523 | (325 males: | 356 females; | $X^2$= 1,411) |
| Sept. | 0,608 | ( 96 males: | 149 females; | $X^2$= 11,465; $p < 0,001$) |
| Oct. | 0,583 | ( 73 males: | 102 females; | $X^2$= 4,806; $p < 0,05$) |
| Nov. | 0,623 | ( 66 males: | 109 females; | $X^2$= 10,566; $p < 0,01$) |
| Dec. | 0,542 | (27 males: | 32 females; | $X^2$= 0,424) |

When divided into seasons the following female ratios were apparent:

| | | | | |
|---|---|---|---|---|
| Spring | 0,605 | ( 235 males: | 360 females; | $X^2$= 26,261; $p < 0,001$) |
| Summer | 0,507 | ( 68 males: | 70 females; | $X^2$= 0,029) |
| Autumn | 0,524 | ( 725 males: | 798 females; | $X^2$= 3,499) |
| Winter | 0,520 | (1191 males: | 1292 females; | $X^2$= 4,108; $p < 0,05$) |

These sex ratios indicate a seasonal fluctuation, with females being most abundant during spring (September to November).

Coetzee (1967) also reports unpublished data collected by Davis who, while kill trapping in Sierra Leone (1936 to 1937), encountered a female ratio of 0,514.

A 1:1 sex ratio can be expected according to Fisher's theory of the evolution of sex ratios (Myers and Krebs, 1971).

The sex ratio in a population can possibly be affected by some of the following factors (Tanton, 1965; Smith, 1967; Myers and Krebs, 1971):

1) Secondary sex ratio (sex ratio of new born animals).
2) Differential survival.
3) Differential movement.
4) Differential trappability.
5) Differential growth (recruitment of males and females as juveniles, subadults, or adults will be affected by the growth rate of the two sexes).
6) Population size .
7) Population structure (relative frequency of males and females as juveniles, subadults, and adults).
8) Genotype (which might affect 1 to 7 above).
9) Season of the year.
10) Method of collecting data.

The method of collecting data differed widely in the different studies cited above. Oliff (1953) and Meester (1960) obtained data from laboratory colonies, Coetzee (1965; 1967) from excavated burrows, Dieterlen (1967) and Davis (Coetzee, 1967) from kill trapping, and de Wit from live trapping. Data from the present study were collected by means of live trapping alone.

Therefore, no significant preponderance of female _P._( _M._) _natalensis_ has been found as yet, in either a live or kill trapping study, and judging from laboratory studies sex ratios appear to be equal at weaning, although females outnumber males significantly at birth.

The most conclusive data on sex ratios are expected from analysis of laboratory-reared animals, where most of the above-mentioned factors do not influence the number of each sex obtained.

If it is typical for _P._( _M._) _natalensis_ that more females than males are born (secondary sex ratio; Oliff, 1953) but that sexes at the time of weaning appear to be equal (Oliff, 1953; Meester, 1960), it can be assumed that differential mortality caused the ratio to be 1:1 at weaning. This is probably caused by some genetic factor.

Coetzee (1967), obtaining his material from excavating burrows, found a significantly higher number of females (0,532) in animals of all age classes. The ratios indicate a seasonal fluctuation, with females most abundant during spring (0,605) and least abundant during summer (0,507). Due to the method of collecting, the sex ratios obtained by Coetzee (1967) could not be attributed to differential movement, trappablity, or growth. As his method of collecting excluded the use of traps, differential movement and trappability of the animals can be assumed to be eliminated. Smith (1967) reports that while equal _Peromyscus polionotus_ numbers of both sexes were captured by hand from burrows, more males than females were captured in traps. As excavated burrows would yield all animals present, recruitment of males and females as juveniles, subadults, or adults at a differential rate (differential growth) are also assumed to be eliminated.

Therefore, according to the findings of Cliff (1953) and Meester (1960), Coetzee (1967) should have observed equal ratios. It is, however, possible that in his study area females did not exhibit a differential mortality rate after birth but sustained their preponderance, the extent of which was not consistent throughout his study.

Genotypically based differential survival and seasonally based population structure during different times of the year is the most probable explanation. Unweaned animals present in the sample however, might also have caused sex ratios to be in favour of females (secondary sex ratio).

Dieterlen (1967) found _P_( _M._) _natalensis_ males exhibiting their largest preponderance during June to September (0,650) and during October to December the lowest (0,470). The male ratio appears to suggest a negative correlation with the peak breeding activities and therefore does not sustain the assumption that males move further during the breeding season and are therefore more liable to be captured. However, Dieterlen (1967) observed little _P._( _M._) _natalensis_ breeding. All other species captured by Dieterlen (1967) included more males then females during October to December. If it is assumed that more femalas than males were born in the Congo, females experienced high mortality rates compared to males. This was, however, less apparent during October to December than during the rest of the year.

The female preponderance of 0,514 found by Davis in Sierra

Leone (Coetzee, 1967) is assumed to be not significant (sample size not known), while de Wit (pers. comm.) found a 0,544 male ratio in his live trapping study near Pretoria (112 males: 94 females; $X^2$= 1,573, $p > 0,05$). A 1:1 ratio is, therefore, assumed.

In the present study the observed male ratio was 0,573 ($X^2$= 8,024, $p < 0,01$). In contrast with the findings of Coetzee (1967) the most males were observed during spring (0,625; $X^2$= 10,500, $p < 0,01$). The most females were present in autumn (male ratio: 0,491; $X^2$= 0,018, $p > 0,05$).

If differences in sex ratio exist between the different age classes (Cliff, 1953), sex ratio will fluctuate from season to season as differential growth rate, population structure and survival rate differ from season to season. Therefore, during different stages of a population increase or decline, population size might indirectly be a factor causing sex ratios to differ during different times of the year. While Myers and Krebs (1971) found no evidence of this, the present data are to be inspected from this point of view in a further publication.

Home range size of a species might differ during different seasons and therefore might cause the sex ratio to differ from season to season. This was, however, not inspected in the present study.

Male P.( M.) natalensis home range size is shown in the present study to exceed that of females. Therefore, males would come in contact with more traps which might also have caused the observed ratio to deviate from 1:1 (differential movement). A further factor which could have caused the ratios to differ in a trapping situation, is that of differential trappablity of the sexes (Smith, 1967; see above).

On grids P46 (0,600 male ratio; $p < 0,01$) and on grid P50 (0,594, $p >$ P,05), a higher number of males than females was observed while on grid P88+P89 (0,474) this was not the case. The latter, however, being the only grid on which male home range size did not exceed that of females but where the opposite was apparent, although not significantly

De Wit (pers. comm.) found male P.( M.) natalensis home range to have exceeded that of females ($p < 0,05$), He, however, found no significant deviation from a 1:1 ratio (0,544 male ratio). Larger male home range size than that of females might also have played a role in the high male ratio observed by Dieterlen (1967).

So it appears that differential movement might have been a significant factor causing sex ratios to have been in favour of males in the present study and possibly in other studies. Furthermore differential survival of the different sexes in the present study could have caused the number of males to have exceeded that of females. Further studies, however, are required to determine the factors causing sex ratios to differ from a 1:1 ratio.

5.6.2.2 Saccostomus campestris

The observed overall male ratio was 0,575 (table 53). The highest male ratio was observed during autumn (0,597) and the lowest during winter (0,487). The overall ratio ($X^2 = 5,873$; $p < 0,05$) and that for autumn ($X^2 = 5,045$; $p < 0,05$) showed a significant male preponderance.

The male ratio for each grid is shown in table 53. Grid P46 showed a male ratio of 0,620, which deviates significantly from a 1:1 ratio ($X^2 = 7,450$; $p < 0,01$). The autumn ratio on this grid (0,642) also deviates significantly ($X^2 = 6,531$; $p < 0,05$

The overall male ratio of 0,541 ($X^2 = 0,653$) on grid P50 does not differ significantly from a 1:1 ratio. On grids P88+P89 the overall ratio was 0,500.

Saccostomus campestris male home range size did not exceed that of females according to the present method of expressing movement data, therefore differential movement could not have caused male numbers to exceed female numbers in the present study.

De Wit (pers. comm.) found a overall male ratio of 0,476 (10 males: 11 females).

Further data are needed for detailed analysis.

5.6.2.3 Lemniscomys griselda

The observed overall male ratio was 0,437 ($X^2 = 2,391$; $p > 0,05$) (table 54). The highest male ratio was observed in winter (0,484; $X^2 = 0,063$; $p > 0,05$) and the lowest during autumn (0,370; $X^2 = 1,815$; $p > 0,05$).

The male ratios for each grid and season are shown in table 54. Grid P46 showed a male ratio of 0,444 ($X^2 = 0,889$), grid P50 a ratio of 0,433 ($X^2 = 1,067$) and grids P88 and P89 combined a ratio of 0,421 ($X^2 = 0,474$). None of these represented a significant preponderance of females.

These female preponderances were observed in spite of the fact that male av. M (home range) exceeded that of females on all grids combined as well as on grid P46.

There appear to be fewer males than females, but the data are too meagre for further analysis.

De Wit (pers. comm.) found 0,500 male ratio (4 males: 4 females) at the Roodeplaat Agricultural Station near Pretoria.

### 5.6.2.4 *Leggada minutoides*

The observed male ratio was 0,500 (table 55). Due to the small sample observed the data were not separated by season.

A male ratio of 0,415 (17 males : 24 females) was observed at the Roodeplaat Agricultural Station near Pretoria (De Wit, pers. comm.) In contrast Dieterlen (1967) found a male ratio of 0,685 (N= 89; $X^2 = 12{,}236$, $p < 0{,}001$) in the Congo.

Further data are needed concerning the sex ratios of *L. minutoides* and the causative factors involved.

### 5.6.2.5 *Steatomys pratensis*

The observed male ratio was 0,857 (table 55). The sample was, however, too small for further analysis.

## 5.7 Behaviour

The following miscellaneous notes on the behaviour of the different species were accumulated in the course of the study.

### 5.7.1 Praomys (Mastomys) natalensis

Praomys ( M.) natalensis was observed utilizing natural holes in the ground and termite mounds. Shortridge (1934), Veenstra (1958), and Delany and Neal (1966) report that this species uses the deserted burrows of other animals whenever possible. If forced to do so, it will also burrow, but only when the soil is either soft or cracked (Veenstra, 1958). According the Delany and Neal (1966) animals of this species are good burrowers.

When transferred from the trap into a plastic bag animals were normally calm, in so far as that they did not jump about in the bag. When released at the trapping site, they would sit for a few seconds at the site of release and then unerringly move towards their holes without further delay. The speed of movement varied from one individual to the next.

They usually attempted to bite when handled unetherized, and did not seem to become tamer with repeated recaptures. When held by the nape and the base of the tail, a stream of air blown into the face caused them to respond with high-pitched squeaks. This was also observed by Veenstra (1958).

Measuring P.( M.) natalensis accurately when only half etherized or not etherized at all proved impossible, because stretching the animals to their maximum length resulted in rounding of their backs and kicking of their feet.

Veenstra (1958) reports P.( M.) natalensis to be nervous, quick te escape, conscious of danger, difficult to handle, and likely to bite without provocation.

Multiple captures of P.( M.) natalensis were observed twelve times on grid P46, but never on any of the other grids. Male/female and female/female multiple captures were each observed three times, while all-male multiple captures were found in six cases. In one of the male/female captures, the female had a mass of 45 g and the male 15 g. It could be that this was a mother with one of her recently weaned young. In the other two cases of male/female multiple captures the mass of the two animals were comparable, eg. male no. 96 and female no. 97 had a mass of 22 and 23 g respectively, and both male no. 113 and female no. 112 had a mass of 12 g. In the latter case the animals could have been siblings at an age of more or less three weeks (Meester, 1960) ie. both just weaned.

In both all-female and all-male multiple captures the two animals captured were normally of more or less the same size and mass. A mass of 28 g was never exceeded, suggesting that juveniles and subadults were involved in these multiple captures. Animals in a multiple capture, therefore, might have been of the same litter.

All but two multiple captures were in the trapping period 30 May, 1967 to 3 June, 1967, the period of extremely high population densities on grid P46. The other two multiple captures (all-male) were in May 1968 and coincided with a relatively high population density prevailing at that time, although not as high as that of May/June 1967 (see section 5.1).

The mechanism of the Chauvancy live traps used in this study renders it impossible to catch more than one animal at a time if they do not enter the trap almost simultaneously. Multiple captures could, therefore, indicate any of the following, either separately or in interaction:

1) The mice were travelling together and therefore some sort of social relationship existed between them;
2) a high degree of competition for food and living space occurred; and
3) the mice might have arrived separately at the trap seconds after each other and entered together, as when one chasing the other.

The presence of live and unscarred animals together in the traps would indicate mutual tolerance.

Praomys (M.) natalensis and S. campestris were the only species of which more than one animal was caught at a time. It seems that P.(M.) natalensis is tolerant of other rodents, both of its own and other species. Veenstra (1958) remarks that mixed or unisexual groups can live together without fighting and several families can live in one burrow. Shortridge (1934) reports that caged animals of this species are less quarrelsome than most other rodents.

Shortridge (1934), Roberts (1951), Delany and Neal (1966), and Delany and Kansiimeruhanga (1970) report *P.( M.) natalensis* to be omnivorous, with insects comprising about 50% of the diet.

According to Veenstra (1958), when abundant food is available, *P.( M.) natalensis* is found in association with other rodents (*Rattus*, *Tatera*, *Mus*, and *Rhabdomys*) but when competition leads to food scarcity, *P.( M.) natalensis* gives way. According to Shortridge (1934) *P.( M.) natalensis* were driven away where *Rattus* or *Mus musculus* have established themselves. Delany and Neal (1966) also report that after *Rattus rattus* was introduced in Uganda, *P.( M.) natalensis* was driven from its domestic habitat (native huts). In the present study it was observed that during *S. campestris* and *L. griselda* peaks, *P.( M.) natalensis* numbers were low (see section 5.1).

### 5.7.3 *Saccostomus campestris*

Holes in termite mounds as well as other natural holes were used as home sites in the present study. Roberts (1951) and Walker (1964) report *S. campestris* to dig burrows of their own.

When a storeroom near the study area was demolished in November 1968, a female *S. campestris* was found nesting in a hollow in the sand under the floor, together with a large quantity of *Balanites maughamii* seeds which the animal had most probably been storing there for food. Seeds of three *Acacia* species, *Acacia tortilis*, *A. nilotica* and *A. karroo*, were found in the cheek pouches of *S. campestris* from time to time during the study. An animal of this species was also observed eating the fruit of *Grewia monticola*. Roberts (19~~6~~51) reports *S. campestris* to feed on seeds, berries and termites.

These animals did not jump up and down when placed in a plastic bag after removal from the trap, but tried to run up against the side of the bag with characteristic, relatively slow, movements. This behaviour was exhibited for minutes on end if the animal was not released or etherized before then. Calm individuals were, however, also observed.

Saccostomus campestris were normally slow to seek cover when released, and seemed to find difficulty in orienting themselves in relation to their home sites, judging from the amount of time spent and the detours travelled before reaching their holes.

These animals are known to be extremely docile (Davis, 1963b; Walker, 1964; and Joubert, 1967).

If handled, however, even while partly etherized, they would attempt to bite.

Intraspecific aggression is reported by Davis (1963b), Joubert (1967), and Coetzee (pers. comm.). Females in oestrous or pro-oestrous have been observed to rip open the scrotum of males or even kill them.

Because of its slow movements S. campestris was easy to catch in enclosed areas. They were, however, not easily handled because of their extremely loose skin and their habit of trying to turn around and bite the handler.

One multiple capture of S. campestris was observed on 3 June, 1967 on grid P46. This included two males, both having a mass of 20 g, on the same grid and in the same trapping period as the multiple catches of P. (M.) natalensis during the population high of May/June 1967. Here again, as in P. (M.) natalensis, the large population size and consequent shortage of food and living space probably played an important role.

### 5.7.3 Lemniscomys griselda

Natural holes in the ground were used as home sites. No burrowing was observed.

When released from the trap into a plastic bag, L. griselda would frantically attempt to jump from the bag, bouncing up and down in it.

When released at the trapping site after handling, animals of this species immediately sought cover, many so fast that it was difficult to follow their movements clearly, so that they were easily lost from sight.

On the other hand, members of this species could be measured fairly accurately without being fully etherized, as they did not kick or round their backs as P.( M.) natalensis did. No attempt was ever made to bite when cautiously handled even when unetherized or only partly etherized.

Shortridge (1934) reports that all specimens from South West Africa were trapped in high grass near swamps or waterholes. In the present study this was not the case.

Lemniscomys griselda appears to feed mainly on vegetable matter and seeds (Shortridge, 1934).

### 5.7.4 Leggada minutoides

Attempts to bite the handler were observed. Animals of this species were twice observed taking refuge in scorpion (Cheloctonus jonesi) holes after release. However, several hundred scorpion holes dug up gave no evidence of Leggada minutoides inhabitating them. Delany (1964b) reports L. minutoides to be omnivorous.

## 6. Conclusion

Grids P88 and P89, adjoining each other in the A. nigrescens plant community, consistently supported a relatively much lower rodent population than did grids P46 and P50, situated in the A. tortilis community, although the A. nigrescens community usually had a better grass cover than did the A. tortilis community, especially during drier periods. During the rainy season the new growth in the A. tortilis community was better than that in the A. nigrescens community. Dead grass was always present in the latter but never in the former, suggesting undergrazing in the A. nigrescens community. This, together with the the vegetation type, probably had an influence on the rodent populations. However, further research is required to verify this. As the soil samples taken from the study area showed no clear-cut differences between the A. tortilis and A. nigrescens communities this factor is discarded as a cause of population differences.

Under the conditions which prevailed during the study, the A. tortilis community was preferred by P.(M.) natalensis, S. campestris, and Lemniscomys griselda. All the other species showed no clear preference for either of the two plant communities. Steatomys pratensis, however, seemed to appear more regularly in the A. nigrescens community (grids P88 and P89), and was never captured on grid P46 and only twice (one animal each time) during September and December 1967 on grid P50. The findings of Shortridge (1934), Veenstra (1958), and Delany and Neal (1966) regarding competition between P.(M.) natalensis and other species, sustain those of the present study. In spite of the fact, therefore, that P.(M.) natalensis is a very successful rodent, in terms of breeding success and distribution, the present data seem to favour the hypothesis that P.(M.) natalensis gives way during times of food scarcity such as autumn and winter. Whether this phenomenon will be found throughout the range of P.(M.) natalensis is impossible to say until further studies have been undertaken. The numbers of P.(M.) natalensis may, however, be affected by habitat and climate, depending on what the optimum environment is for this species.

The present study was conducted during times of below average rainfall and consequently poor habitat. This resulted in low rodent population numbers just prior to and especially after the time of spraying on both control and sprayed grids, which made it impossible to reach any finality concerning the influence of dieldrin spraying at a dosage of 83,0 g/ha.

Van Ark and Pretorius (1970), studying the effect of dieldrin coverspraying on night-flying insect populations in the same area, concluded that no significant differences could be found between populations before and after spraying. Wiese *et al*. (1969) report spraying at the same concentration as used in the present study to have had no adverse effects on exposed livestock. Wiese and Basson (1967) and Basson (1970a; 1970b; and 1971) found scorpions, *Cheloctonus jonesi*, millipedes, *Alloporus* spp., crowned guinea fowl, *Numida meleagris*, laughing dove, *Stigmatopelia senegalensis*, and cape sparrow, *Passer melanurus* not adversely affected at concentrations simulating that used in the field.

After spraying, *Lemniscomys griselda* and *S. campestris* showed very low dieldrin residues (< 1,0 ppm). One shrew, *Crocidura hirta*, collected 60 days after spraying, showed 4,660 ppm dieldrin, and 0,206 ppm photodieldrin. This is an extremely high level when compared with dieldrin levels found in wethers and oxen during a similar experiment in the Lydenburg district (Wiese *et al*., 1970). As shrews feed on insects and other invertebrate and vertebrate animals, they represent a higher level in the food chain than do more graminivorous rodents, and can therefore be expected to accumulate higher insecticide residues. The presence of a relatively high residue level in the insect-eating *Crocidura hirta* is an indication that these animals might possibly be adversely affected by spraying. However, whole carcass analyses of insect-eating birds from the same area after spraying did not produce clear evidence of higher residue levels (unpublished data). In any case, the sample was much too small for any meaningful conclusion, as it is known that residues in different animals treated alike may differ considerably (Wiese, pers. comm.).

There seems to be some suggestion that spraying might have influenced L. griselda numbers on grid P50, but the evidence for this is very tenuous, as the numbers captured were too low to allow a clear-cut conclusion to be reached. Furthermore it may be surmised that reproduction in the Pongola rodent population could have been affected by dieldrin coverspraying. Again, however, the reproduction data obtained were too meagre to allow any conclusions to be reached on this score.

It is concluded that dieldrin coverspraying at the dosage applied had no visible influence on rodent populations in the present study.

It has been recommended that spraying for harvester termites need not be done more than once every 10 years, and at the rate dieldrin and photodieldrin break down, as observed in the present study and in similar studies at Edenville in the Orange Free State, at Dendron in northern Transvaal (Wiese and Basson, unpublished data), and at Lydenburg in eastern Transvaal (Wiese et al., 1970), no accumulation of this pesticide under similar spraying conditions is expected in the environment.

In Praomys (Mastomys) natalensis average maximum distance between captures of males exceeded that of females significantly, suggesting that the area covered by males exceeded that of females significantly. Judging from the av. M curve of males which tended to increase continually while that of females tended to form a plateau, males progressively occupied new areas while females tended to occupy more fixed ranges.

Average M values and therefore ranges for the two sexes of S. campestris did not differ significantly from one another, and animals of both sexes stayed in more or less fixed areas, judging from av. M curves.

Average M values of Lemniscomys griselda males exceeded those of females significantly, suggesting a larger home range for males than for females. The animals also tended to stay in more or less fixed areas as shown by av. M curves.

Leggada minutoides, the smallest species studied, exhibited a greater av. M (both sexes combined) than did any of the other species, although not significantly greater than that of P.(M.) natalensis. This large home range is remarkable when the size of the animal is taken into account.

*Praomys* (*Mastomys*) *natalensis* home range size exceeded those of *S. campestris* (males and both sexes combined) and *L. griselda* (sexes both separated and combined) significantly, judging from av. M values; while the home ranges of *S. campestris* and *L. griselda* did not differ significantly from each other.

The relative frequency of *P.*( *M.*) *natalensis* of different body mass classes during the four seasons indicates that during spring most animals were subadults and adults, while large adults were present in very low numbers and juveniles were absent. During summer most animals captured were adults while few juveniles appeared in the population and a substantial decrease in subadults was observed. From summer to autumn there was a relative increase in number of juveniles and subadults with a decrease in number of adults and large adults, indicating high mortality among adults. Very few observations during winter made comparison difficult, but indicate extensive mortality in all age classes since the previous season. Coetzee (1967) concludes that a large number of mature animals died out at the end of the breeding season. He reports comparatively high numbers of subadults during late autumn and spring. In the present study relatively high numbers of subadults were observed during the winter and spring. Juveniles were recorded throughout the year except during spring, while Coetzee (1967) found no juveniles in winter (July to early August). In both studies juveniles were most frequent during autumn.

The *Praomys* (*Mastomys*) *natalensis* summer population seemed to consist of two mass groups viz. one with body mass below 11 g, and other with a mass of above 19 g. Coetzee (1967) found two mass groups during the autumn, one with a mass below 25 g, and the other above 35 g. In the present study two autumn groups were also apparent, although very indistinct (with mass < 21 g, and >24 g). No size groups were observed in spring material, while the winter sample was too small to allow any distinction of mass groups. In late winter and spring (August to October), Coetzee (1967) found apparently young animals, judging from fecundity and moult, with exceptionally heavy molar tooth wear. He suggests either that two species of multimammate mice occurred in the Roodepoort area, or that there was a difference in tooth wear rate during certain times of the year. A possible alternative explanation may be retarded growth and sexual maturation during winter and early spring, before the first rain of the season and the appearance of green growth. Perhaps animals born just prior to the winter may reach subadult stage, remain constant in mass and size until after the first spring rains, and then, within a few weeks, develop to breeding adults. An animal can, therefore, be as old as four to five months, with teeth correspondingly worn, and still be a subadult, while animals born just after the first spring rains could become breeding adults within two to four months, at which time teeth would still be rather less worn.

When the _Praomys_ (_Mastomys_) _natalensis_ breeding data for the four grids are combined the observed breeding season for females was from September to February and that for males from September to April.

Because of the below average rainfall during the study period and the possible effect of this on the vegetation and reproductive activity, the observed breeding season might be somewhat aberrant (Ingles, 1941; Bodenheimer and Sulman, 1946; Fitch, 1947; Mossman , 1955; Poole, 1960; Reynolds, 1960; Myers and Poole, 1962; Newsome, 1966; Stodart and Myers, 1966; Bothma, 1969).

An autumn reproductive peak at the end of the rainy season/beginning of the dry season (as observed by Brambell and Davis, 1941; Chapman _et al._, 1959; and Coetzee, 1965; 1967), was not observed in the present study. During normal rainfall years the breeding season of _P._ (_M._) _natalensis_ on the study area is expected to be from early spring to late autumn.

All _Praomys_ (_Mastomys_) _natalensis_ parameters studied (total length, tail length, head and body length, and body mass) exhibited their highest mean values during the summer (in sexes both separated and combined). This was also the season in which adults were most numerous. In males the lowest mean values were observed during autumn and in females during winter, except for female mean head and body length which was lowest during spring. In all the parameters studied, the female mean values exceeded those of males slightly during the autumn, but never significantly. This might be attributed to pregnant females being present during this season. Male mean values for all seasons combined exceeded those of the females highly significantly, in all parameters, suggesting that males ~~to~~ might be larger than females.

In the Pongola population, unlike that of Roodepoort (Coetzee, 1967) the elongation of the tail observed in subadults was sustained (except possibly during summer), and not reversed by relatively more rapid growth of the head and body length.

The body mass distrib~~t~~ution of Saccostomus campestris during the four seasons allows the conclusion that the spring sample consisted mostly of larger animals (> 50 g). During the summer the three mass classes were more or less equally represented, while during autumn and winter the intermediate group ( 35 g to 50 g) comprised the largest proportion of the sample. The relative number of smaller (< 35 g) and intermediate animals increased progressively from spring to winter, while the number of larger animals decreased towards winter.

Breeding data from all grids combined suggest a breeding season for males from late August to June, and from October to February for females. However, as for P.( M.) natalensis the low rainfall might have caused the breeding season to differ from the normal.

All Saccostomus campestris parameters studied showed their highest mean values during spring, the season in which most animals present were adults. In males, and sexes combined, lowest mean total length, head and body length, and tail length were observed during summer, while lowest mean mass was observed during winter. Female mean total length and head and body length were lowest in autumn, while mean tail length and body mass were lowest in winter. Female mean body mass ($p > 0{,}05$), total length ($p < 0{,}05$), head and body length ($p > 0{,}05$), and tail length ($p < 0{,}01$) exceeded comparable values for males during summer. Female mean total length, and tail length exceeded those of males also during winter but not significantly. In all four parameters the male means exceeded those of females significantly during autumn.

Male mean mass for all seasons combined exceeded that of females significantly, suggesting males to be heavier than females.

The relative frequency of Lemniscomys griselda of different body mass during the four seasons indicates that smaller animals (< 30 g) occurred in low numbers during all seasons of the year. During spring and summer, there was a relatively much lower number of animals of intermediate size (30 g to 45 g) than in autumn, and winter. During spring and summer, however, there was a higher number of larger animals (> 45 g).

The highest mean values for Lemniscomys griselda parameters studied were observed during spring or summer (most adults present), and the lowest during autumn or winter, except that the lowest female mean head and body length was recorded in spring. Although the female means of all parameters studied usually exceeded those of males during summer and/or winter, differences were never significant. On the other hand spring male means always exceeded those of females highly significantly. The parameter means for all seasons combined, however, indicate that the two sexes on the study area did not differ from each other in size and mass.

The seasonal variation in the parameters studied is caused by the population structure differing from season to season, and therefore the size and mass of the animal.

Breeding data for all grids combined suggest a breeding season for females from September to February and that of males from September to May.

The sex structure of the Praomys (Mastomys) natalensis population proved to be a 0,573 ratio in favour of males with the highest male ratio occuring during spring (0,625) and the lowest ratio during autumn (0,491).

No significant P. (M.) natalensis female preponderance has been found as yet, in a live or kill trapping study (Dieterlen, 1967; De Wit, pers. comm; present study), and according to laboratory studies sex ratios appear to be equal at weaning, but the number of females exceeds that of males at birth (Oliff, 1953; Meester, 1960). While sex ratios obtained from excavated burrows indicate females to exceed males significantly (Coetzee, 1965; 1967).

Home range size of P.(M.) natalensis males is shown in the present study to exceed that of females, with the result that males would come in contact with more traps which might also have caused sex ratios to differ from a 1:1 ratio in favour of males.

A male ratio of 0,575 was observed in the S. campestris population. The highest ratio was observed during autumn (0,597) and the lowest during winter (0,487). A male ratio of 0,476, was observed by de Wit (pers. comm.) for S. campestris. Male S. campestris home ranges do not exceed those of females according to the present method of expressing movement data, therefore home range size could not have caused male numbers to appear to exceed female numbers in the present study.

The L. griselda population indicates a 0,437 male ratio while the highest was observed in winter (0,484) and the lowest during autumn (0,370). De Wit (pers. comm.) reports a 0,500 male ratio. The female preponderance in the present study was observed in spite of the fact that male av. M (home range) exceeded that of females.

For Leggada minutoides a 0,500 male ratio and for S. pratensis a 0,857 ratio is illustrated, the latter representing a small sample. De Wit (pers. comm.) observed a 0,415 male ratio in L. minutoides, while Dieterlen (1967) found a male ratio of 0,685. Further studies are, however, needed for clear-cut conclusions concerning sex ratios of the animals captured in the present study.

## 7. Summary

Trapping of rodents was carried out in four grids situated in two main plant communities near Pongola, northern Zululand. Grids P46 and P50 are situated in an *Acacia tortilis* community and the other two grids, P88 and P89, in an *Acacia nigrescens* community. Grid P88 (16 times) was trapped from April 1967 and grid P50 (18 times) from August 1967, both through May 1969. Grids P46 (19 times) and P89 (16 times) were trapped from May 1967 through May 1969. Each grid (3,42 ha) was trapped for four successive nights during each trapping period for most of the trapping periods, with all 225 traps operating concurrently.

Grid P88 yielded 62 different animals comprising the following species: *Praomys* (*Mastomys*) *natalensis* (35), *Lemniscomys griselda* (5), *Saccostomus campestris* (14), *Leggada minutoides* (3), *Steatomys pratensis* (2), and *Aethomys chrysophilus* (3). Grid P89 yielded 91 different animals comprising the following species: *P.*( *M.*) *natalensis* (40), *Lemniscomys griselda* (14), *Saccostomus campestris* (15), *Leggada minutoides* (14), *Steatomys pratensis* (7), and *A. chrysophilus* (1). Grid P50 yielded 152 different animals comprising the following species: *P.*( *M.*) *natalensis* (52), *Lemniscomys griselda* (36), *Saccostomus campestris* (55), *Leggada minutoides* (7), *Steatomys pratensis* (1), and *Otomys angoniensis* (1). Grid P46 yielded 414 different animals comprising the following species: *P.*( *M.*) *natalensis* (254), *Lemniscomys griselda* (54), *Saccostomus campestris* (93), *Leggada minutoides* (8), *A. chrysophilus* (3), and *Tatera brantsi* (2).

The hypothesis that *P.*( *M.*) *natalensis* gives way during times of food scarcity (such as autumn and winter) is sustained by the present data.

*Lemniscomys griselda* carcasses (10, 20, and 60 days after spraying) and *Saccostomus campestris* (16 days after spraying) showed very low dieldrin residues (< 1,0 ppm). One shrew, *Crocidura hirta*, collected 60 days after spraying, showed

4,660 ppm dieldrin and 0,206 ppm photodieldrin.

The study was conducted during times of below average rainfall and consequently poor habitat. This resulted in low rodent numbers just prior to and especially after the time of spraying on both the control and sprayed grids, which made it difficult to reach meaningful conclusions concerning the influence of dieldrin spraying on the rodent populations and their reproduction. It is, however, concluded that dieldrin coverspraying at the dosage applied had no visible influence on rodent population densities and their reproduction.

Home ranges of P.(M.) natalensis males exceeded those of females significantly. Males progressively occupied new areas while females tended to occupy more fixed areas. Saccostomus campestris male and female home ranges did not differ significantly from one another. The size of male Lemniscomys griselda home range exceeded that of females significantly and both males and females tended to stay in more or less fixed areas. Leggada minutoides showed a significantly larger home range than did any of the other species. P.(M.) natalensis home range size exceeded that of S. campestris (males, and both sexes combined) and Lemniscomys griselda (sexes both separated and combined) significantly while home ranges of S. campestris and L. griselda did not differ significantly.

During spring most P.(M.) natalensis individuals present were subadults and adults, while large adults were present in very low numbers. No juveniles were observed during this season. During summer most animals were adults. A few juveniles appeared in the population and a substantial decrease in subadults was observed. From summer to autumn there was a relative increase in number of juveniles and subadults with a decrease in number of adults and large adults, indicating high mortality among adults. Very few observations during winter made comparison difficult, but indicate extensive mortality since the previous season. The *P.*( *M.*) *natalensis* summer population seemed to consist of two mass groups viz. one with body mass below 11 g, and the other with a mass of above 19 g. Two autumn groups were also apparent although very indistinct (with mass $<21$ g, and $>24$ g). When *P.*( *M.*) *natalensis* breeding data for the four grids are combined the observed breeding season for females was from September to February, and that for males from September to April.

All *P.*( *M.*) *natalensis* parameters studied (total length, tail length, head and body length, and body mass) exhibited their highest mean values during the summer (sexes both separated and combined). In males the lowest mean values were observed during the autumn and in females during the winter, except for female mean head and body length which was lowest during spring. In all parameters studied the female mean values exceeded those of males slightly during the autumn, but never significantly. Male mean values for all seasons combined exceeded those of females highly significantly, in all parameters.

The *S. campestris* spring sample consisted mostly of larger animals ( $>50$ g). During the summer the three mass classes were more or less equally represented, while during autumn and winter the intermediate class (35 g to 50 g) comprised the largest proportion of the sample. The relative number of smaller ( $<35$ g) and intermediate animals increased progressively from spring to winter, while the number of larger animals decreased towards winter.

When data for the four grids are combined the observed breeding season ~~for~~ of females was from October to February, and that of males from late August to June.

All *S. campestris* parameters studied showed their highest mean values during spring, the season in which most animals present were adults. In males and sexes combined lowest mean total length, head and body length, and tail length were observed during summer, while the lowest mean mass was observed during winter. Female mean total length and head and body length were lowest in autumn, while mean tail length and body mass were lowest in winter. Female mean body mass, total length, head and body length, and tail length exceeded comparable values for males during summer. Female mean total length, and tail length exceeded those of males also during winter but not significantly. In all four parameters the male means exceeded those of females significantly during autumn.

The relative frequency of <u>Lemniscomys griselda</u> body mass indicates that smaller animals ($<$30 g) occurred in low numbers during all seasons of the year. There were relatively fewer animals of intermediate size (30 g to 45 g) during spring and summer than during autumn and winter. During spring and summer, however, there was a higher number of larger animals ($>$45 g). When data for the four grids are combined the observed breeding season for females was from September to February, while males exhibited a season extending from September to May.

The sex structure of the <u>P.( M.) natalensis</u> population proved to be a 0,573 ratio in favour of males with the highest male ratio during spring (0,625) and the lowest ratio during autumn (0,491). In <u>S. campestris</u> the overall ratio was 0,575 in favour of males. The highest male ratio was observed in autumn (0,597) and the lowest during winter (0,487). The <u>L. griselda</u> population illustrates a 0,437 male ratio while the highest male ratio was observed in winter (0,484) and the lowest during autumn (0,370). A male ratio of 0,500 for <u>Leggada minutoides</u> and 0,857 for <u>Steatomys pratensis</u> was found.

Notes on behaviour in general indicate <u>P.( M.) natalensis</u> utilizing natutal holes in the ground or termite mounds. Burrowing was not observed in any of the species. They usually attempted to bite when handled unetherized, and did not seem to become tamer with repeated recaptures. When held by the nape and the base of the tail, a stream of air blown into the face caused them to respond with high pitched squeaks. Measuring the animals accurately when only half etherized proved to be impossible. Multiple captures of *P.( M.) natalensis* were observed 12 times, usually during periods of high population densities.

*Saccostomus campestris* utilized holes in termite mounds as well as other natural holes for home sites. Feeding habits for this species included seeds of *Acacia tortilis A. nilotica*, *A. karroo*, *Balanites maughamii* and fruit of *Grewia monticola*. These animals were normally slow to seek cover after release, and seemed to find difficulty in orientating themselves in relation to their home sites, judging from the amount of time spent and the detours travelled before reaching their holes. If handled even while partly etherized they would attempt to bite. One multiple capture was observed during a population high.

*Lemniscomys griselda* also used natural holes as as home sites. These animals sought cover after release so fast that it was difficult to follow their movements. Members of this species could be measured fairly accurately without being fully etherized, as they did not kick or round their backs as *P.( M.) natalensis* did. No attempt to bite was made when cautiously handled, even when unetherized or only partly so.

*Leggada minutoides* attempted to bite the handler. Animals of this species were twice observed taking refuge in scorpion (*Cheloctonus jonesi*) holes after release. Several hundred scorpion holes dug up, however, gave no evidence of *L. minutoides* inhabitating them.

## Samevatting

Knaagdiere is op vier persele in twee plantgemeenskappe naby Pongola in noord Zululand gevang. Persele P46 en P50 is in 'n *Acacia tortilis* gemeenskap geleë en die ander twee, P88 and P89, in 'n *Acacia nigrescens* gemeenskap. Op perseel P88 (16 keer) is vanaf April 1967 en op perseel P50 (18 keer) vanaf Augustus 1967, albei tot Mei 1969 knaagdiere gevang. Op persele P46 (19 keer) en P89 (16 keer) is vanaf Mei 1967 tot Mei 1969 knaagdiere gevang. Op elke perseel (3,42 hektaar) is vir vier agtereenvolgende nagte gedurende elke vangperiode, met 225 valle gevang.

Op perseel P88 is 62 verskillende knaagdiere gevang bestaande uit: *Praomys* (*Mastomys*) *natalensis* (35), *Lemniscomys griselda* (5), *Saccostomus campestris* (14), *Leggada minutoides* (3), *Steatomys pratensis* (2) en *Aethomys chrysophilus* (3). Op perseel P89 is 91 verskillende diere gevang bestaande uit die volgende: *P.*(*Mastomys*) *natalensis* (40), *Lemniscomys griselda* (14), *Saccostomus campestris* (15), *Leggada minutoides* (14), *Steatomys pratensis* (7) en *A. chrysophilus* (1). Op perseel P50 is 152 verskillende diere gevang: *P.*( *M.*) *natalensis* (52), *Lemniscomys griselda* (36), *Saccostomus campestris* (55), *Leggada minutoides* (7), *Steatomys pratensis* (1) en *Otomys angoniensis* (1). Op perseel P46 is 414 verskillende diere gevang bestaande uit die volgende: *P.*( *M.*) *natalensis* (254), *Lemniscomys griselda* (54), *Saccostomus campestris* (93), *Leggada minutoides* (8), *A. chrysophilus* (3) en *Tatera brantsi* (2).

Die hipotese dat *P.*( *M.*) *natalensis* gedurende 'n periode van voedselskaarste deur ander spesies uitgedruk word, word deur die huidige studie ondersteun.

*Lemniscomys griselda* karkasse (10, 20 and 60 dae na bespuiting) en *Saccostomus campestris* (16 dae na bespuiting) het lae dieldrin reste getoon($<$ 1,0 dpm). 'n Skeerbekkie, *Crocidura hirta*, wat 60 dae na bespuiting versamel is het 4,660 dpm dieldrin en 0,206 dpm fotodieldrin getoon.

Die studie is uitgevoer gedurende 'n periode van lae reënval en gevolglik 'n swak habitat. Dit het veroorsaak dat die aantal knaagdiere net voor en veral na bespuiting, beide op kontrole en bespuite persele baie laag was. Dit bemoeilik 'n betekenisvolle gevolgtrekking aangaande die invloed van dieldrin bespuiting op knaagdierpopulasies. Die gevolgtrekking kan egter gemaak word dat dieldrin dekbespuiting teen die konsentrasie wat gebruik is, geen sigbare invloed gehad het op knaagdierpopulasies en hul voortplanting nie.

Die loopgebiede van *P.*( *M.*) *natalensis* mannetjies was betekenisvol groter as die van die wyfies. Die mannetjies het ook geneig om voortdurend nuwe gebiede te betrek terwyl die wyfies geneig het om permanente areas te bewoon. Die loopgebiede van *Saccostomus campestris* mannetjies en wyfies het nie betekenisvol van mekaar verskil nie. Die grootte van die loopgebied van *Lemniscomys griselda* mannetjies was betekenisvol groter as die van wyfies terwyl beide geslagte geneig het on in 'n min of meer vaste gebiede te bly. *Leggada minutoides* het 'n betekenisvolle groter loopgebied as enige van die ander spesies behalwe *P.*( *M.*) *natalensis*. Die loopgebied van *P.*( *M.*) *natalensis* was betekenisvol groter as die van *Saccostomus campestris* (mannetjies en geslagte saam) en die van *Lemniscomys griselda* (geslagte saam en apart), terwyl die loopgebiede van *S. campestris* en *L. griselda* nie betekenisvol verskil het nie.

Gedurende lente was die meeste *P.*( *M.*) *natalensis* individue teenwoordig, half-volwassenes en volwassenes, terwyl groter volwassenes in baie lae getalle teenwoordig was. Geen onvolwassenes is waargeneem in hierdie seisoen nie. Gedurende somer was meeste diere volwassenes. Daar was 'n paar onvolwassenes in die populasie en 'n toename in half-volwassenes. Daar was 'n relatiewe toename in die getal onvolwassenes en half-volwassenes vanaf somer tot herfs, met 'n vermindering in die aantal volwassenes en groot volwassenes, wat 'n hoë mortaliteit onder volwassenes aandui. Die min waarnemings gedurende winter maak 'n vergelyking moeilik, maar dit dui op aansienlike mortaliteit sedert die vorige seisoen. Dit blyk dat die *P.*( *M.*) *natalensis* somer populasie uit twee massa groepe bestaan het nl., een met 'n massa van minder as 11 g en die ander met 'n massa van meer as 19 g. Twee herfs groepe is ook waargeneem alhoewel minder opvallend (massa < 21 g, en > 24 g). Wanneer die voortplantingsgegewens vir die vier persele van *P.( M.) natalensis* gekombineer word, het die voortplantingseisoen van wyfies vanaf September tot Februarie en die van mannetjies van September tot April gestrek.

Alle *P.( M.) natalensis* parameters wat bestudeer is (totale lengte, stertlengte, kop- en liggaamslengte en liggaamsmassa) het die hoogste gemiddelde waardes gedurende somer getoon (geslagte saam en apart). Vir mannetjies is die laagste gemiddeldes gedurende herfs waargeneem en vir wyfies gedurende winter, behalwe die gemiddelde kop- en liglaamslengte van wyfies wat laagste was in die lente. In alle parameters wat bestudeer is, het die gemiddelde waardes van wyfies die van mannetjies effens oorskry gedurende herfs, maar nooit betekenisvol nie. Gemiddelde waardes van mannetjies vir alle seisoene saam het die van die wyfies in alle parameters hoogs betekenisvol oorskry.

Die lente steekproef van *S. campestris* het meestal uit groter diere bestaan (> 50 g). Gedurende die somer was die drie massa klasse min of meer eweredig verteenwoordig, terwyl die middelklas (35 g tot 50 g) die grootste gedeelte van die diere uitgemaak het gedurende herfs en winter. Die relatiewe aantal kleiner (< 35 g) en middelklas diere het progressief vermeerder vanaf lente tot winter, terwyl die aantal groter diere verminder het gedurende die tyd. Wanneer die gegewens van die vier persele gekombineer word, blyk die voortplantingseisoen van wyfies van Oktober tot Februarie te wees, terwyl die van mannetjies dui op 'n seisoen wat gestrek het van laat Augustus tot Junie.

Al die *S. campestris* parameters wat bestudeer is, het hulle hoogste gemiddelde gedurende die lente getoon, die seisoen waarin die meeste volwasse diere opgemerk is. Die laagste gemiddelde totale lengte, kop- en liggaamslengte en stertlengte van die mannetjies en geslagte saam is gedurende die somer waargeneem, terwyl die laagste gemiddelde massa gedurende die winter waargeneem is. Die laagste gemiddelde totale lengte en kop- en liggaamslengte van wyfies is waargeneem in die herfs, terwyl die gemiddeld van die stertlengte en liggaamsmassa die hoogste in die winter was. Die gemiddelde liggamsmassa, totale lengte, kop- en liggaamslengte en stertlengte van die wyfies het ooreenstemmende waardes van mannetjies oorskry gedurende somer. Die gemiddelde totale lengte en stertlengte van wyfies het ook die van mannetjies oorskry gedurende die winter maar nie betekenisvol nie. In al vier die parameters het die gemiddeld van mannetjies die van die wyfies betekenisvol oorskry gedurende die herfs.

Die relatiewe frekwensie van die liggaamsmassa van Lemniscomys griselda dui aan dat kleiner diere ($<$ 30 g) in klein getalle voorgekom het dwarsdeur die jaar. Daar was relatief minder diere van die middelklas (30 g tot 45 g) gedurende lente en somer as gedurende herfs en winter. Gedurende lente en somer egter was daar 'n groter getal groter diere ($>$45 g). Wanneer voortplantingsgegewens vir die vier persele gekombineer word, blyk die voortplantingseisoen van die wyfies van September tot Februarie te wees en die van die mannetjies van September tot Mei.

Die geslagstruktuur van die P.( M.) natalensis populasie het uit 'n verhouding van 0,573 mannetjies bestaan. Gedurende lente was dit die hoogste (0,625) en gedurende die herfs (0,491) die laagste. Die mannetjie-wyfie verhouding van S. campestris was 0,575 ten gunste van die mannetjies, terwyl die hoogste mannetjie verhouding in die herfs (0,597) en die laagste gedurende winter (0,487) gevind is. Die L. griselda populasie het 'n verhouding van 0,437 mannetjies getoon, met die hoogste gedurende winter (0,484) en die laagste gedurende herfs (0,370). Leggada minutoides het 'n mannetjie verhouding van 0,500 getoon en Steatomys pratensis 'n 0,857 verhouding.

Gegewens aangaande die algemene gedrag van P.( M.) natalensis dui daarop dat hulle natuurlike gate in die grond asook termiethope as blyplek gebruik. Daar is nooit waargeneem dat hulle self grawe nie. Hulle het gewoonlik probeer byt gedurende hantering indien hulle nie aan die slaap gemaak is met eter nie. P.( M.) natalensis het nie makker geword met herhaaldelike hervangste nie. Wanneer 'n individu van die spesies in die hand gehou is en 'n stroom lug in sy gesig geblaas is, is daar met 'n hoë frekwensie piep geluid, gereageer. Om die diere akkuraat te meet wanneer hulle slegs half aan die slaap was het geblyk onmoontlik te wees. Veelvuldige vangste (die vang van meer as een dier tergelykertyd in 'n val) van *P.*( *M.*) *natalensis* is 12 keer gevind, gewoonlik gedurende periodes van hoë populasie digthede.

*Saccostomus campestris* het ook natuurlike gate in die grond, asook termiethope vir neste gebruik. Voedselsoorte het sade van die volgende plante ingesluit: *Acacia karroo*, *A. tortilis*, *A. nilotica* en *Balanites maughamii*, terwyl die vrug van *Grewia monticola* ook gevreet is. Die diere was gewoonlik stadig om hulle neste op te soek na vrylating. Wanneer hulle gehanteer is sonder dat hulle aan die slaap gemaak is, het hulle probeer byt. Een veelvuldige vangs gedurende 'n populasie piek is opgemerk.

*Lemniscomys griselda* het ook natuurlike gate in die grond as neste gebruik. Die diere het geweldig vinnig skuiling gesoek nadat hulle vrygelaat is. Individue van die spesies is redelik maklik gemeet wanneer hulle slegs half aan die slaap was. Geen poging om te byt is waargeneem wanneer hulle versigtig gehanteer is nie.

*Leggada minutoides* het probeer byt gedurende hantering. Daar is twee keer opgemerk dat hulle skuiling soek in skerpioengate (*Cheloctonus jonesi*) nadat hulle vrygelaat is. Die opgrawe van 'n paar honderd skerpioengate het egter geen bewys gelewer dat hulle dit wel bewoon nie.

## 7. Literature cited

Acocks, J.P.H. 1953. Veld types of South Africa. Botanical survey memoir No. 28. Government Printer, Pretoria.

Allanson, M. 1958. Growth and reproduction in the males of two species of gerbil, *Tatera brantsii* (A. Smith) and *Tatera afra* (Gray). Proc. zool. Soc. Lond. 130: 373 - 396.

Atkins, T.D., and R.L. Linder. 1967. Effects of dieldrin on reproduction of penned hen pheasants. J. Wildl. Mgmt. 31: 746 - 753.

Basson, N.C.J. 1970a. Toksisiteit van dieldrin teenoor die skerpioen, *Cheloctonus jonesi* Pocock. Phytophylactica 2: 171 - 176.

Basson, N.C.J. 1970b. Invloed van dieldrin op die duisendpoot *Alloporus* sp. (Juliformia: Spirostreptidae). Phytophylactica 2: 217 - 220.

Basson, N.C.J. 1971. Effect of dieldrin and its photoisomerization product, photodieldrin, on birds. Phytophylactica 3: 115 - 123.

Baxter, W.L., R.L. Linder, and R.B. Dahlgren. 1969. Dieldrin effects in two generations of penned hen pheasants. J. Wildl. Mgmt. 33: 96 - 102.

Bernard, R.F., and R.A. Gaetner. 1964. Some effects of DDT on reproduction in mice. J. Mammal. 45: 272 - 276.

Bodenheimer, F.S., and F. Sulman. 1946. The estrous cycle of *Microtus guentheri* D and A and its ecological implications. Ecology 27: 255 - 256.

Bothma, J. du P. 1969. Population ecology of the cottontail Rabbit, *Sylvilagus floridanus*, on the Welder Wildlife Refuge, South Texas. Unpublished Ph.D. thesis, Graduate College of Texas A & M University.

Brambell, F.W.R., and D.H.S. Davis. 1941. Reproduction of the multimammate mouse (*Mastomys erythroleucus* Temm.) of Sierra Leone. Proc. zool. Soc. Lond. Ser. B, 111: 1 - 11.

Brant, D H. 1962. Measures of the movements and population densities of small rodents. Univ. Calif. Publ. Zool. 62: 105 - 184.

Burt, W.H. 1943. Territoriality and home range concepts as applied to mammals. J. Mammal. 24: 346 - 352.

Chapman, B.M., R.F. Chapman, and I.A.D. Robertson. 1959. The growth and breeding of the multimammate rat, *Rattus* (*Mastomys*) *natalensis* (Smith) in Tanganyika Territory. Proc. zool. Soc. Lond. 133: 1 - 9.

Clawson, S.G., and M.F. Baker. 1959. Immediate effects of dieldrin and heptachlor on Bobwhites. J. Wildl. Mgmt. 23: 215 - 219.

Coetzee, C G. 1965. The breeding season of the multimammate mouse *Praomys* (*Mastomys*) *natalensis* (A. Smith) in the Transvaal Highveld. Zoologica Africana 1: 29 - 39.

Coetzee, C.G. 1967. The breeding season and population structure of the multimammate mouse *Praomys* (*Mastomys*) *natalensis* (A. Smith, 1834) in the Transvaal Highveld. Unpublished M.Sc. thesis, Univ. Pretoria.

Cross, D.L., H.L. King, and D.L. Haynes. 1962. The effects of DDT in the diet of Japanese quail. Q. Bull. Mich. St. Univ. agr. Exp. Stn. East Lansing 44: 688 - 696.

Davis, D.E. 1956. Manual for analysis of rodent populations. Edward Bros., Pennsylvania. 82 p.

Davis, D.H.S. 1939. Some ecological methods in research on bubonic plague. S. Afr. J. Sci. 36: 438 - 444.

Davis, D.H.S. 1946a. A plague survey of Ngamiland, Bechuanaland protectorate, during the epidemic of 1944 - 45. S. Afr. med. J. 20: 462 - 467.

Davis, D.H.S. 1946b. A plague survey of Ngamiland, Bechuanaland protectorate, during the epidemic of 1944 - 45. The rodent epizootic. S. Afr. med. J. 20: 511 - 515.

Davis, D.H.S. 1948. Sylvatic plague in South Africa: History of plague in man, 1919 - 43. Ann. trop. Med. Parasit. 42: 207 - 217.

Davis, D.H.S. 1953. Plague in South Africa: a study of the epizootic cycle in gerbils (Tatera brantsi) in the northern Orange Free State. J. Hyg., Camb. 51: 427 - 449.

Davis, D.H.S. 1958. Notes on small mammals in the Kalahari Gemsbok National Park, with special reference to those preyed upon by Barn owls. Koedoe 1: 184 - 188.

Davis, D.H.S. 1959. The Barn Owl's contribution to ecology and palaeoecology. Ostrich supll. 3: 144 - 153.

Davis, D.H.S. 1962. Distribution patterns of Southern African Muridae, with notes on some of their fossil antecedents. Ann. Cape Prov. Mus. II: 56 - 76.

Davis, D.H.S. 1963a. Ecology and vector control. Bull. wld. Hlth. org. 29 (suppl.): 127 - 133.

Davis, D H.S. 1963b. Wild rodents as laboratory animals and their contribution to medical research in South Africa. S. Afr. J. med. Sci. 28: 53 - 69.

Davis, D.H.S. 1964. Ecology of wild rodent plague, p. 301 - 314. In D.H.S. Davis (ed.), Ecological studies in Southern Africa. Dr. W. Junk, The Hague.

Davis, D.H.S., and A.D. Thomas. 1941. Gerbille control. Farming in South Africa Bull. No.233: 1 - 10.

Davis, R.M. (in press). Behaviour of the vlei rat, Otomys irroratus (Brants). Zoologica Africana.

De Graaff, G. 1962. On the nest of Cryptomys hottentotus in the Kruger National Park. Koedoe 5: 157 - 161.

De Graaff, G., and J.A.J. Nel. 1965. On the tunnel system of Brant's karroo rat, Parotomys brantsi in the Kalahari Gemsbok National Park. Koedoe 8: 136 - 139.

Deichmann, W.B., M. Keplinger, I. Dressler, and F. Sala. 1959. Retention of dieldrin and DDT in the tissues of dogs fed aldrin and DDT individually and as a mixture. Toxicol. appl. Pharmac. 14: 205 - 213.

Delany, M.J. 1964a. A study of the ecology and breeding of small mammals in Uganda. Proc. zool. Soc. Lond. 142: 347 - 370.

Delany, M.J. 1964b. An ecological study of the small mammals in the Queen Elizabeth Park, Uganda. Rev. zool. Bot. Afr. *LXX*: 129 - 147.

Delany, M.J., and B.R. Neal. 1966. A review of the Muridae (order Rodentia) of Uganda. Bull. Br. Mus. nat. Hist. Zoology B *13*: 297 - 355.

Delany, M.J., and B.R. Neal. 1969. Breeding season in rodents in Uganda. J. Reprod. Fert. (Suppl. 6): 299 - 236.

Delany, M.J., and W.D.K. Kansiimeruhanga. 1970. Observations on the ecology of rodents from a small arable plot near Kampala, Uganda. Rev. zool. Bot. Afr. LXXXI: 417 - 425.

De Moor, P.P. 1969. Seasonal variation in local distribution, age classes and population density of the gerbil *Tatera brantsi* on the South African Highveld. J. Zool., Lond. *157*: 399 - 411.

Dieterlen, F. 1967. Jahreszeiten und Fortpflanzungsperioden bei den Muriden des Kivusee-Gebietes (Congo). Z. Säugetierk. *32*: 1 - 44.

Fitch, H.S. 1947. Ecology of a cottontail rabbit (*Sylvilagus audaboni*) population in Central California. Calif. Fish Game *33*: 159 - 184.

Genelly, R.E., and R.L. Rudd. 1956. Effects of DDT, toxaphene, and dieldrin on pheasant reproduction. Auk *73*:529 - 539.

Good, E.E., and G.W. Ware. 1969. Effects of insecticides on reproduction in the laboratory mouse. IV. Endrin and dieldrin. Toxic. appl. Pharmac. 14: 201 - 203.

Hallett, A.F. 1967. An ecological study of the bush Karoo rat, Otomys unisulcatus. Zoological Society of South Africa, Symposium on Terrestrial ecology. Unpublished.

Harrington, R.W., and W.L. Bidlingmayer. 1958. Effects of dieldrin on fishes and invertebrates of a salt marsh. J. Wildl. Mgmt. 22: 76 - 82.

Hunter, C.G., D.E. Stevenson, and L.W. Ferrigan. 1964. Some effects of exposure of rats to dieldrin 75 ppm in their diet. "Shell Research Ltd., unpublished report.

Ingles, L.G. 1941. Natural history observations on the Audubon cottontail. J. Mammal. 22: 227 - 250.

Johnston, H.L., and W.D. Oliff 1954. The oestrous cycle of female Rattus (Mastomys) natalensis (A. Smith) as observed in the laboratory. Proc. zool. Soc. Lond. 124: 605 - 613.

Jolly, G.M. 1965. Explicit estimates from capture-recapture data with both death and immigration-stochastic model. Biometrika 52: 225 - 247.

Joubert, C.J. 1967. Total nutritive requirements for small laboratory rodents (including rodents indigenous to South Africa), p. 133 - 146. _In_ M.L. Conalty (ed.), Husbandry of laboratory animals. Academic Press inc., London.

Keith, J.A. 1966. Reproduction in a population of herring gulls (_Larus argentatus_) contaminated by DDT. J. appl. Ecol. _3_ (Suppl.) 57 - 70.

Labisky, R.F., and R.W. Lutz. 1967. Responses of wild pheasants to solid-block applications of aldrin. J. Wild. Mgmt. _31_: 13 - 24.

Luckman, W.H. 1957. Control of ground squirrels with ground sprays of dieldrin. Agron. J. _49_: 107.

Measroch, V. 1954. Growth and reproduction in the females of two species of gerbil, _Tatera brantsi_ (A. Smith) and _Tatera afra_ (Gray). Proc. zool. Soc. Lond. 124: 631 - 658.

Meeks, R.L. 1968. The accumulation of $^{36}$Cl ring-labeled DDT in a freshwater Marsh. J. Wildl. Mgmt. _32_: 376 - 398.

Meester, J. 1958. A litter of _Rattus namaquensis_ born in captivity. J. Mammal. _39_: 302 - 304.

Meester, J. 1960. Early post-natal development of multimammate mice _Rattus_ (_Mastomys_) _natalensis_ (A. Smith). Ann Transv. Mus. _24_: 35 - 52.

Meester, J.,and A.F. Hallett. 1970. Notes on early postnatal development in certain Southern African Muridae and Cricetidae. J. Mammal. _51_: 703 - 711.

Morris, R.D. 1968. Effects of endrin feeding on survival and reproduction in the deer mouse, *Peromyscus maniculatus*. Can. J. Zool. 46: 951 - 958.

Morris, R.D. 1970. The effects of endrin on *Microtus* and *Peromyscus*. 1. Unenclosed field populations. Can. J. Zool. 48: 695 - 708.

Morris, R.D. 1971. The effects of endrin on *Microtus* and *Peromyscus*. 11. Enclosed field populations. Unpublished MS.

Mossman, A.S. 1955. Reproduction of the brush rabbit in California. J. Wildl. Mgmt. 19: 177 - 184.

Murphy, D.A., and L.J. Korschgen. 1970. Reproduction, growth, and tissue residues of deer fed dieldrin. J. Wildl. Mgmt. 34: 887 - 903.

Myers, J., and C.J. Krebs. 1971. Sex ratios in open and enclosed vole populations: demographic implications. Amer. Nat. 105: 325 - 344.

Myers, K., and W.E. Poole. 1962. A study of the biology of the wild rabbit, *Oryctolagus cuniculus* (L.), in confined populations. III. Reproduction. Aust J. Zool. 10: 225 - 267.

Nel, J.A.J., and H. Nolte. 1965. Notes on the prey of owls in the Kalahari Gemsbok National Park, with special reference to the small mammals. Koedoe 8: 75 - 81.

Newsome, A.E. 1966. The influence of food on breeding in the red kangoroo in central Australia. CSIRO Wildl. Res. 11: 187 - 196.

Oliff, W.D. 1953. The mortality, fecundity and intrinsic rate of natural increase of the multimammate mouse Rattus (Mastomys) natalensis (Smith) in the laboratory. J. Anim. Ecol. 22: 217 - 226.

Pirlot, P.L. 1954. Percentage de jeunes et périodes de reproduction chez guelques rongeurs du Congo Belge. Annls Mus. r. Congo belge Sér. 4to. Zool. 1: 41 - 46.

Poole, W.E. 1960. Breeding of the wild rabbit, Oryctolagus cuniculus (L.), in relation to the environment. CSIRO Wildl. Res. 5: 21 - 43.

Reynolds, H.G 1960. Life history notes on Merriam's kangaroo rat in Southern Arizona. J. Mammal. 41: 48 - 58.

Robbins, C.S., P F. Springer, and C.G. Webster. 1951. Effects of five-year DDT application on breeding bird population. J. Wildl. Mgmt. 15: 213 - 216.

Roberts, A. 1951. The Mammals of South Africa. Trustees of "The Mammals of South Africa" Book Fund, Johannesburg. 700 p.

Schneider, F. 1966. Some pesticide-wildlife problems in Switzerland. J. appl. Ecol. 3 (Suppl.): 15 - 20.

Scott, T.G., Y.L. Willis, and J.A. Ellis. 1959. Some effects of a field application of dieldrin on wildlife. J. Wildl. Mgmt. 23: 409 - 427.

Shortridge, G.C. 1934. Mammals of South West Africa. vol. 1. Heineman, London.

Siegel, S. 1956. Nonparametric statistics for the behavioral sciences. McGraw-Hill, New York. 317 p.

Smith, M.H. 1967. Sex ratios in laboratory and field populations of the old-field mouse, Peromyscus polionotus. Res. Popul. Ecol. 1X: 108 - 112.

Southern, H.N., and O. Hook. 1963. A note on small mammals in East African forests. J. Mammal. 44: 126 - 129.

Stickel, L.F. 1946. Field studies of a Peromyscus population in an area treated with DDT. J. Wildl. Mgmt. 10: 216 - 218.

Stickel, L.F. 1954. A comparison of certain methods of measuring ranges of small mammals. J. Mammal. 35: 1 - 15.

Stodart, E., and K. Myers. 1966. The effects of different foods on confined populations of wild rabbits, Oryctolagus cuniculus (L.). CSIRO Wild. Res. 11: 111 - 124.

Tanton, M.T. 1965. Problems of live-trapping and population estimation for the wood mouse, Apodemus sylvaticus (L.). J. Anim. Ecol. 34: 1 - 22.

Van Ark, H., and L.M. Pretorius. 1970. The acute effect of dieldrin cover spraying on natural insect populations. Phytophylactica 2: 231 - 236.

Van der Merwe, G., and H. Keogh. 1970. Comprehensive report of the rodent population explosion in the Republic, 1966 to 1969. Unpublished report.

Veenstra, A.J.F. 1958. The behaviour of the multimammate mouse, Rattus (Mastomys) natalensis. Anim. Behav. 6: 195 - 206.

Walker, E.P. et al. 1964. Mammals of the world. vol II. Johns Hopkins Press, Baltimore.

Ware, G.W., and E.E. Good. 1967. Effects of insecticides on reproduction in the laboratory mouse. II. Mirex, telodrin, and DDT. Toxic. appl. Pharmac. 10: 54 - 61.

Weather Bureau. 1954. Climate of South Africa. I. Climate statistics. Goverment Printer, Pretoria.

Webb, R.E., and F. Horsfall. 1967. Endrin resistance in the pine mouse. Science 156: 1762.

Wiese, I.H., and N.C.J. Basson. 1967. The oral toxicity of dieldrin to the crowned guinea- fowl, Numida meleagris (L). S. Afr. J. agr. Sci. 10: 697 - 706.

Wiese, I.H., N.C.J. Basson, J.H. van der Vyver, and J.H. van der Merwe. 1969. Toxicology and dynamics of dieldrin in the crowned guinea-fowl, Numida meleagris (L). Phytophylactica 1: 161 - 176.

Wiese, I.H., N.C.J. Basson, and J.H. van der Merwe. 1970. Dynamics of dieldrin and its photoisomerization product, photodieldrin, on veld and in livestock exposed to dieldrin-treated veld. Phytophylactica 2: 33 - 48.

Wilson, V.J. 1970. Notes on the breeding and feeding habits of a pair of Barn owls, *Tyto alba* (Scopoli), in Rhodesia. Arnoldia *34*: 1 - 8.

Wrangham, R W 1969. Captivity, behaviour, and post-natal development of the Cape pouched rat, *Saccostomus campestris* Peters. Puku *5*: 207 - 210.

Wurster, D.H., C.F. Wurster, and W.N. Strickland. 1965. Bird mortality following DDT spray for Dutch elm disease. Ecology *46*: 488 - 499.

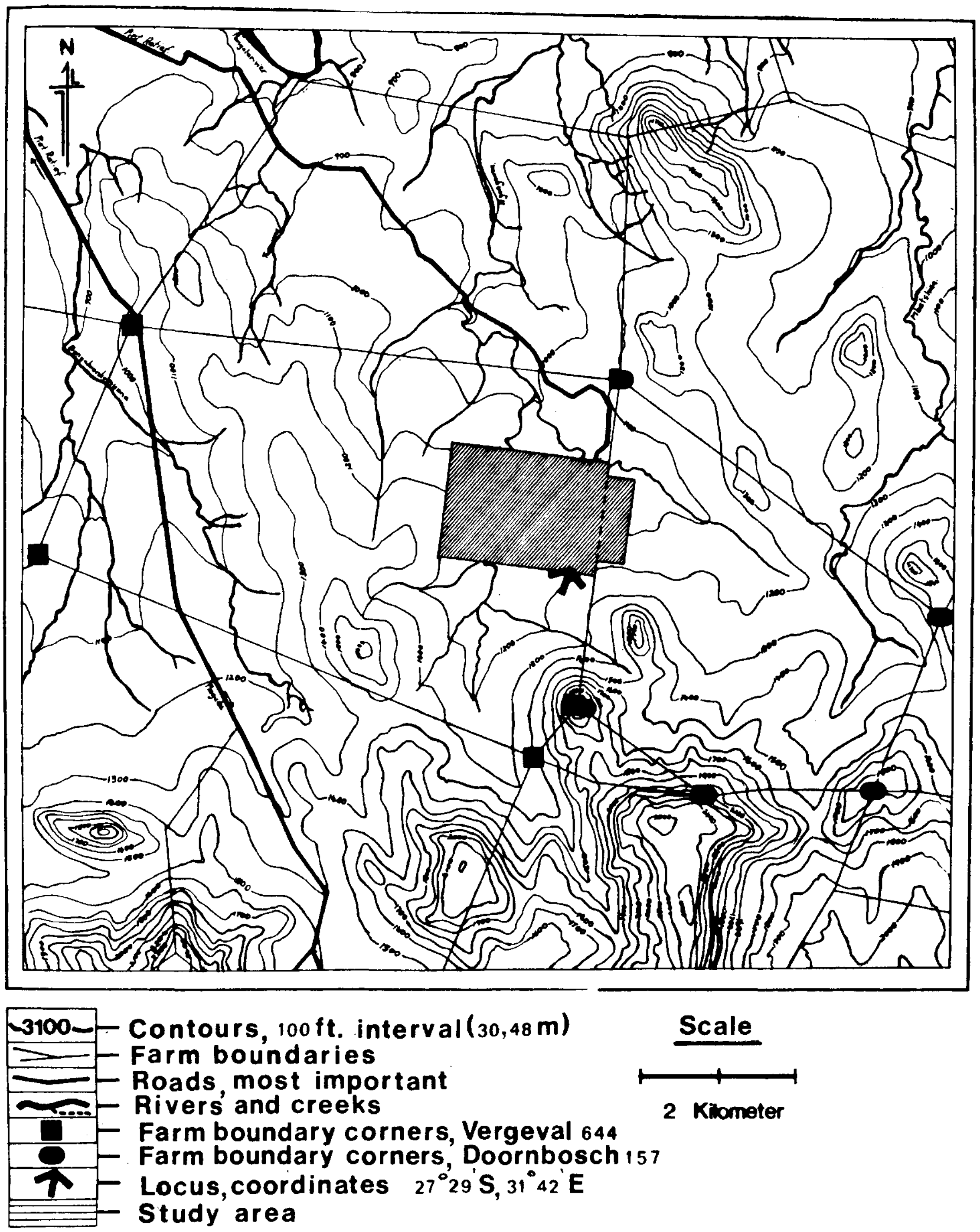
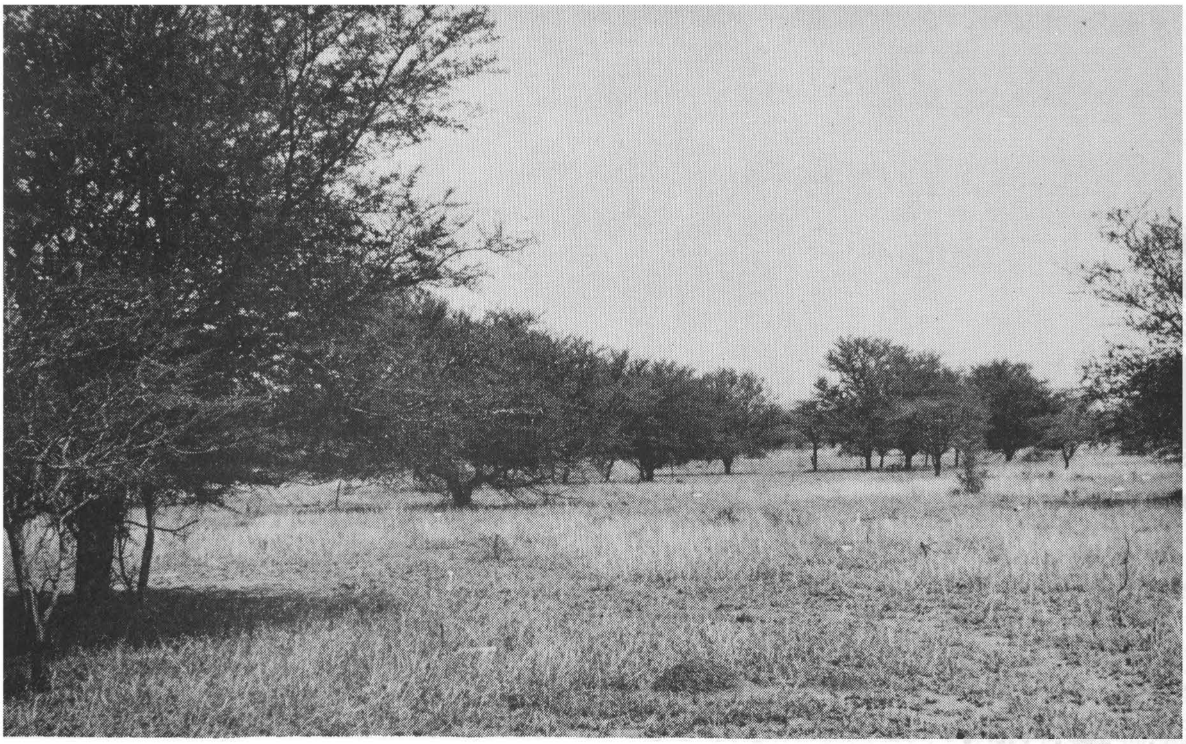


Fig. 1: General topography of the study area and surroundings.



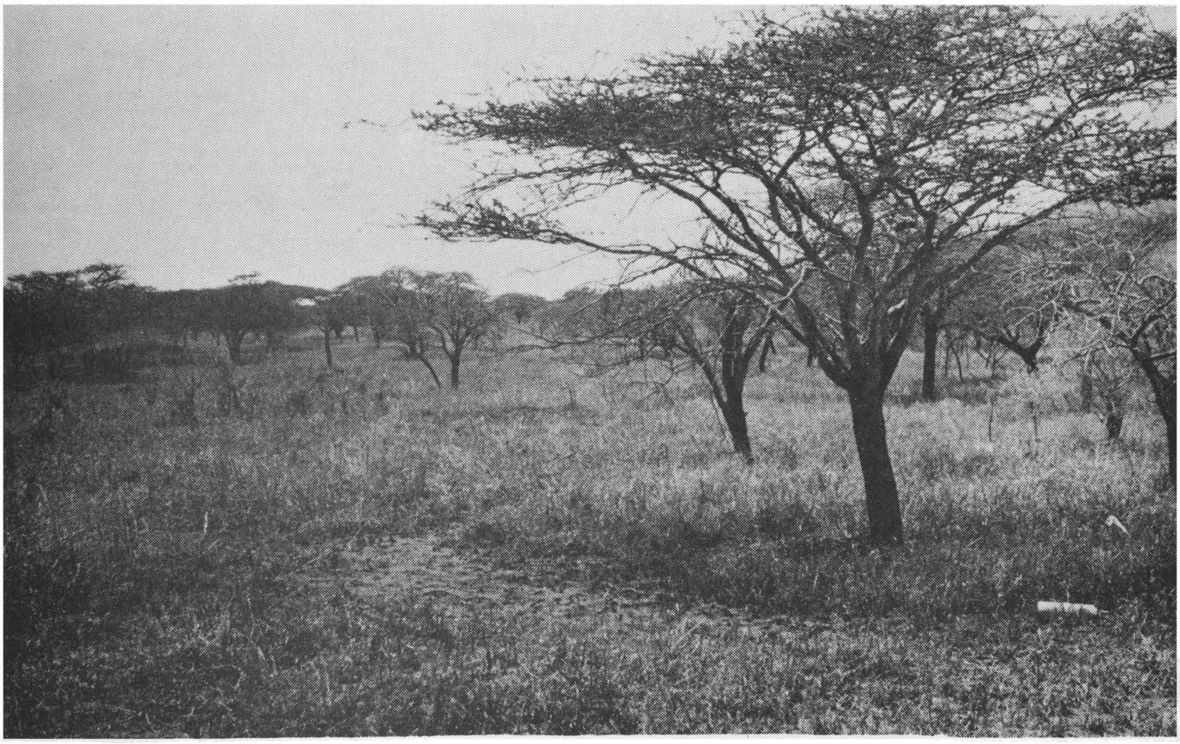


Fig. 5: The general topography and habitat of grid P50. The photos were taken in November 1968.

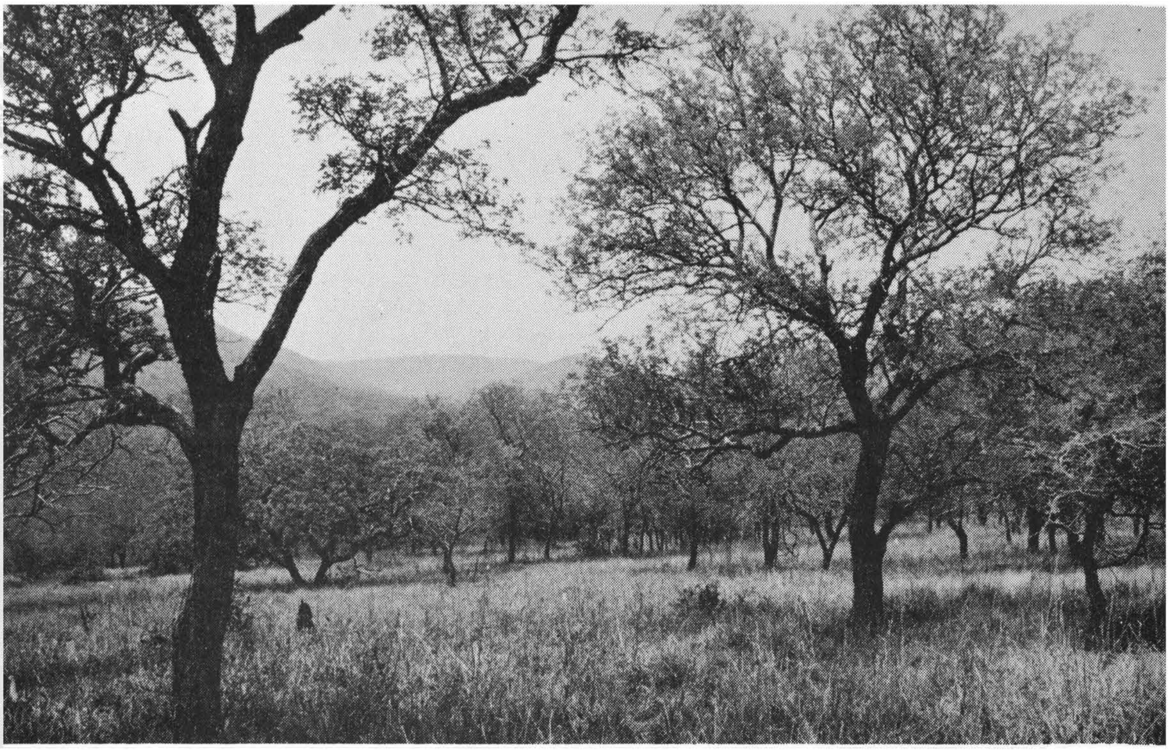


Fig. 6a: The general topography and habitat of grids P88 and P89. The photos were taken in November 1968.

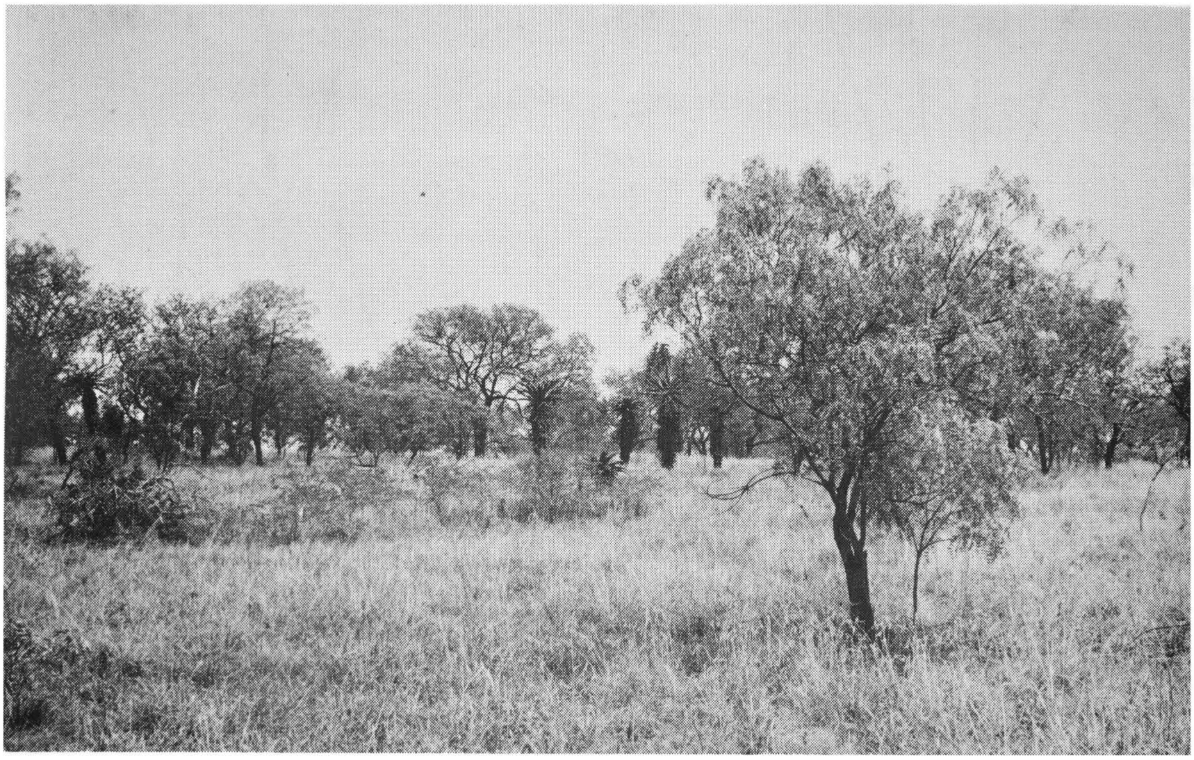


Fig. 6b: The general topography and habitat of grids P88 and P89. The photos were taken in November 1968.

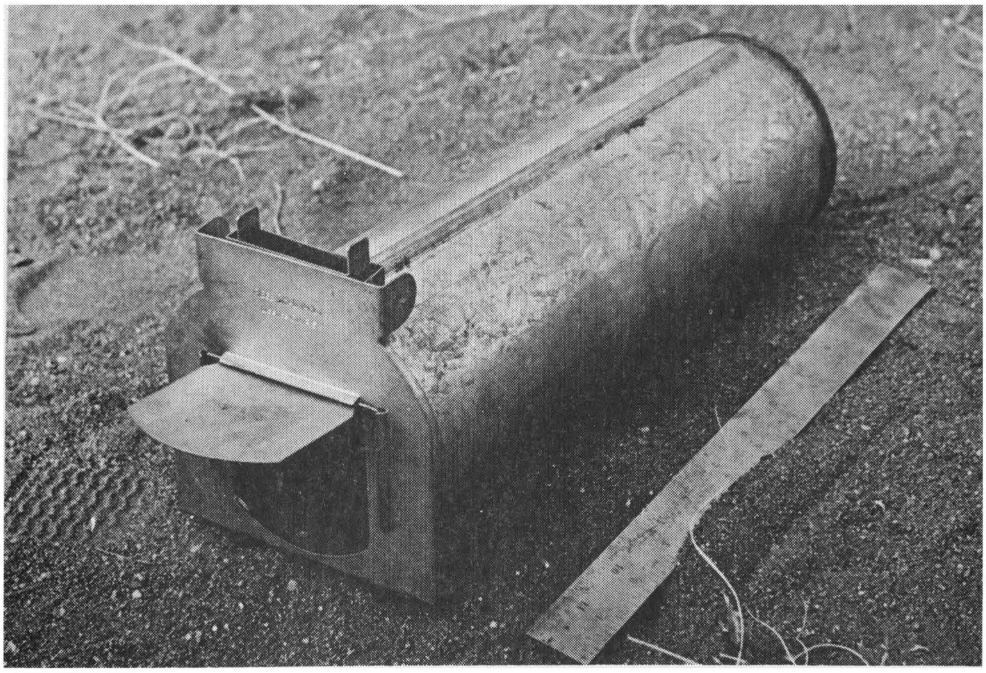


Fig. 7: A Chauvancy live trap, as used in the present study.

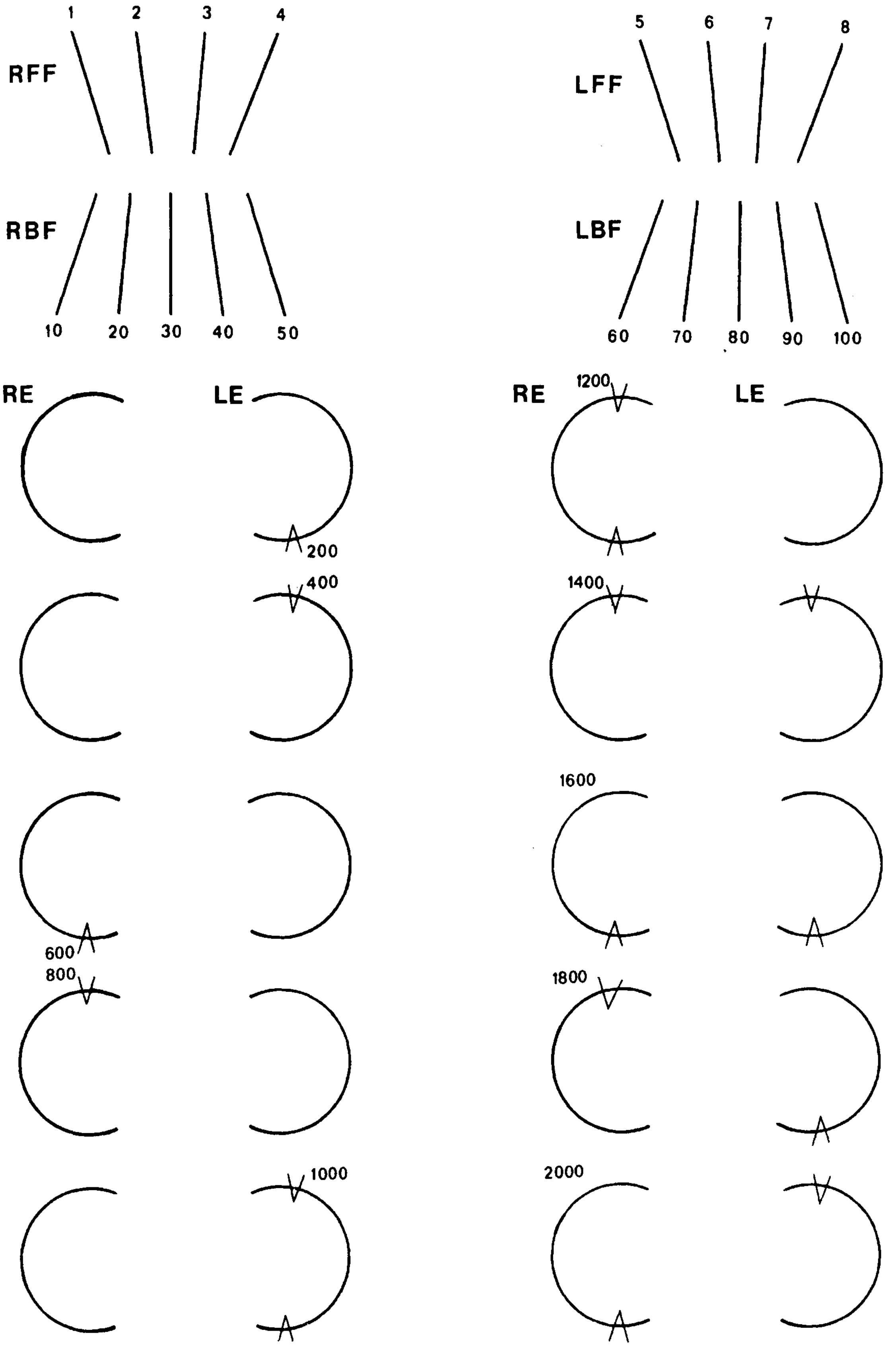


Fig. 8: Toe and ear-clipping combinations used for identifying individual animals (RFF =right front foot; RBF = right back foot; LFF = left front foot; LBF = left back foot; RE = right ear; LE = left ear).

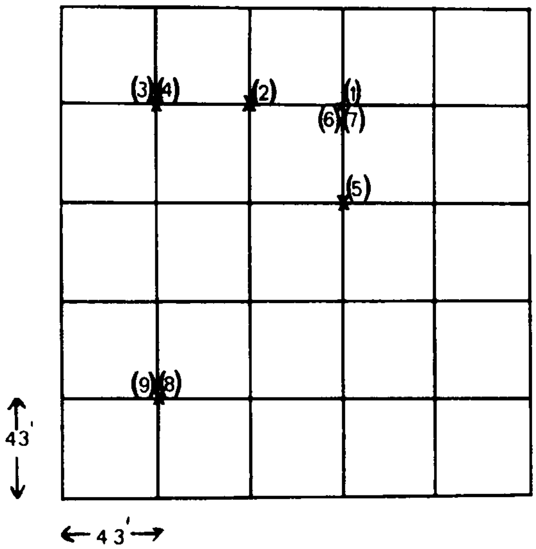


Fig. 9 Example of the method used for calculating the maximum distance between captures (M) after the 2nd, 3rd, . . . . 9th capture. Numbers 1 to 9 indicate position of capture at the different times of capture (43 ft = 13,1 m).

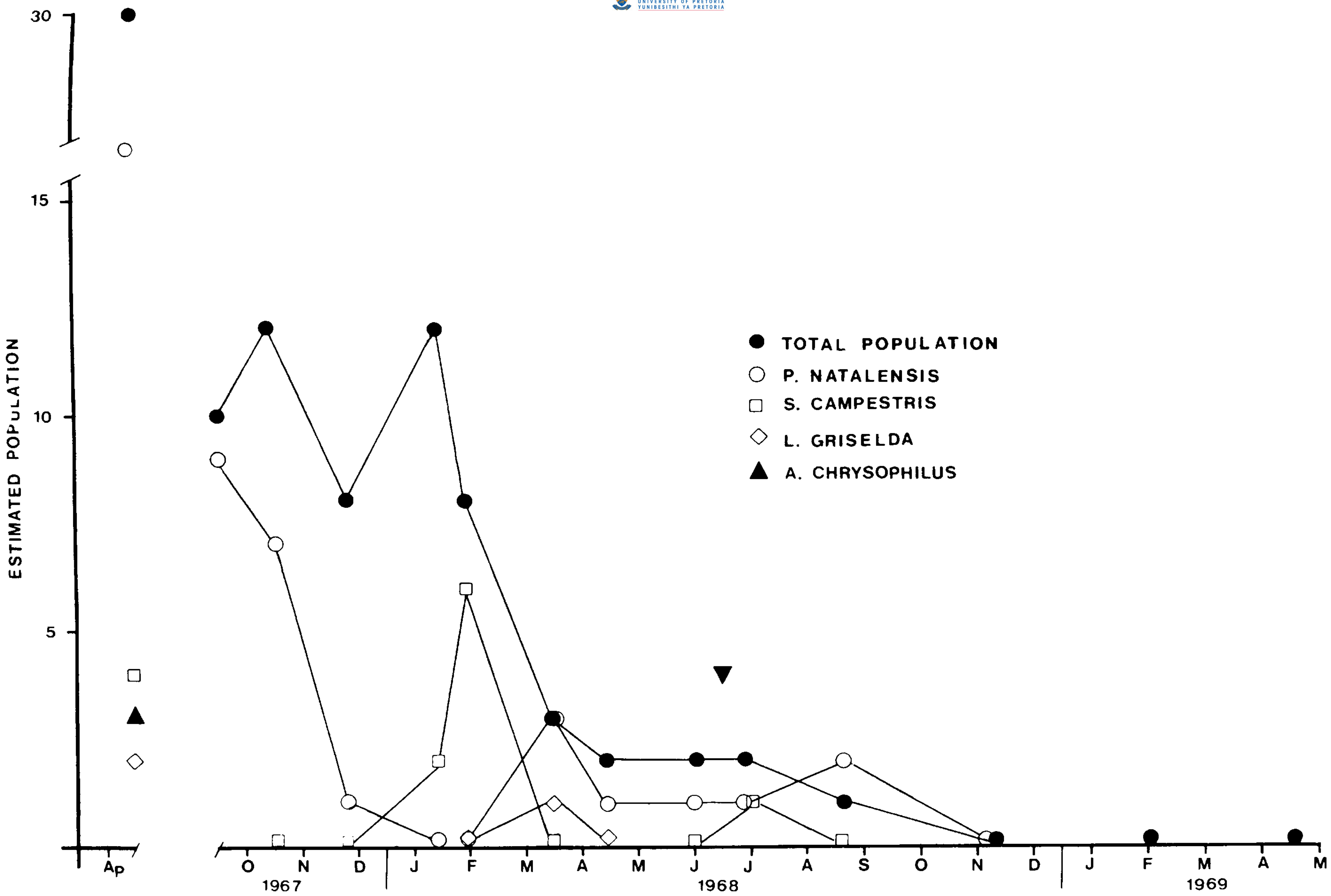


Fig. 10: The estimated total, Praomys (Mastomys) natalensis, Saccostomus campestris, Lemniscomys griselda, and Aethomys chrysophilus populations on grid P88. Time of spraying is indicated by an inverted triangle (2-7-68).

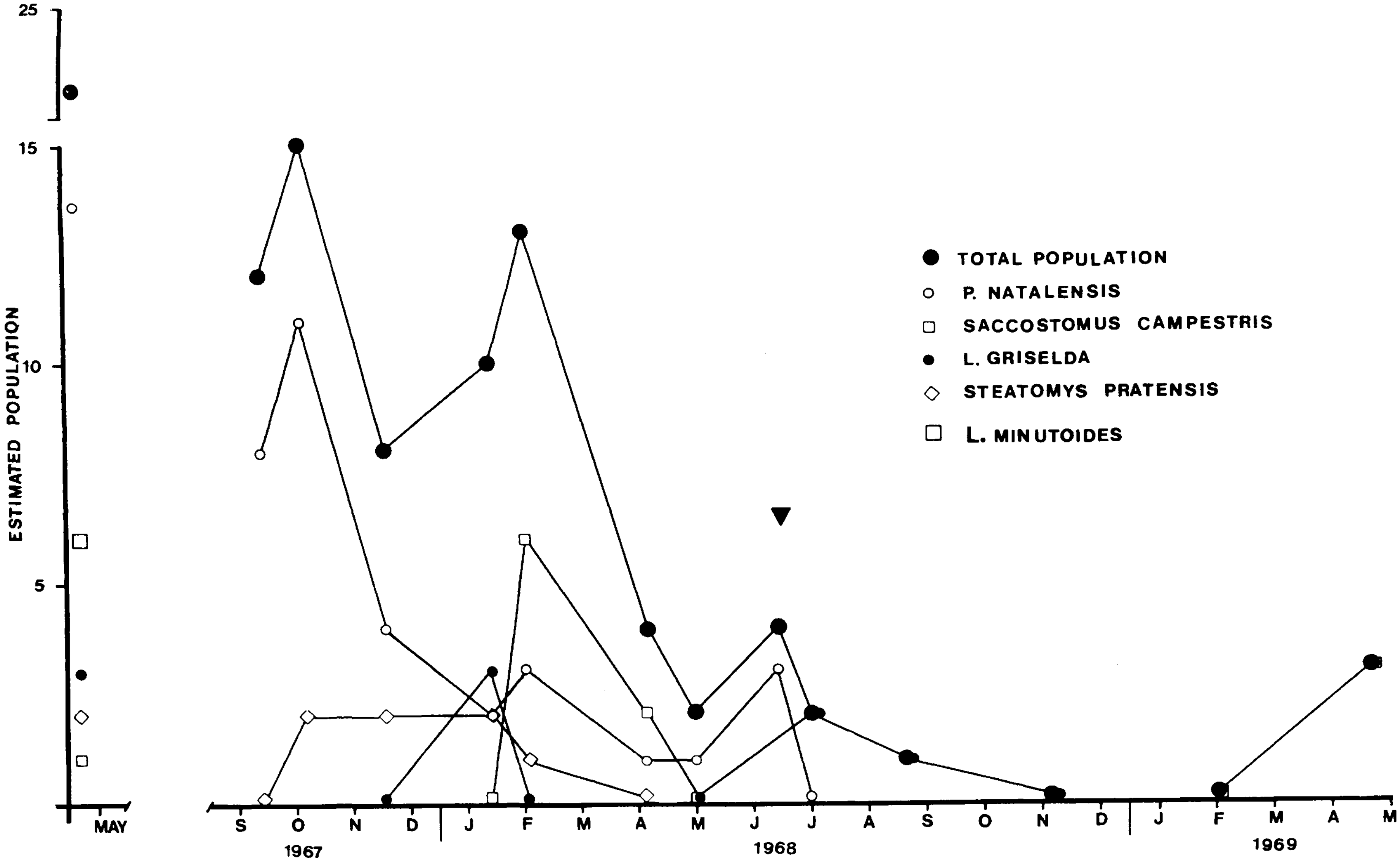


Fig. 11: The estimated total, Praomys (Mastomys) natalensis, Saccostomus campestris, Lemniscomys griselda, Steatomys pratensis, and Leggada minutoides populations on grid P89. The time of spraying on grids P50 and P88 is indicated by an inverted triangle.

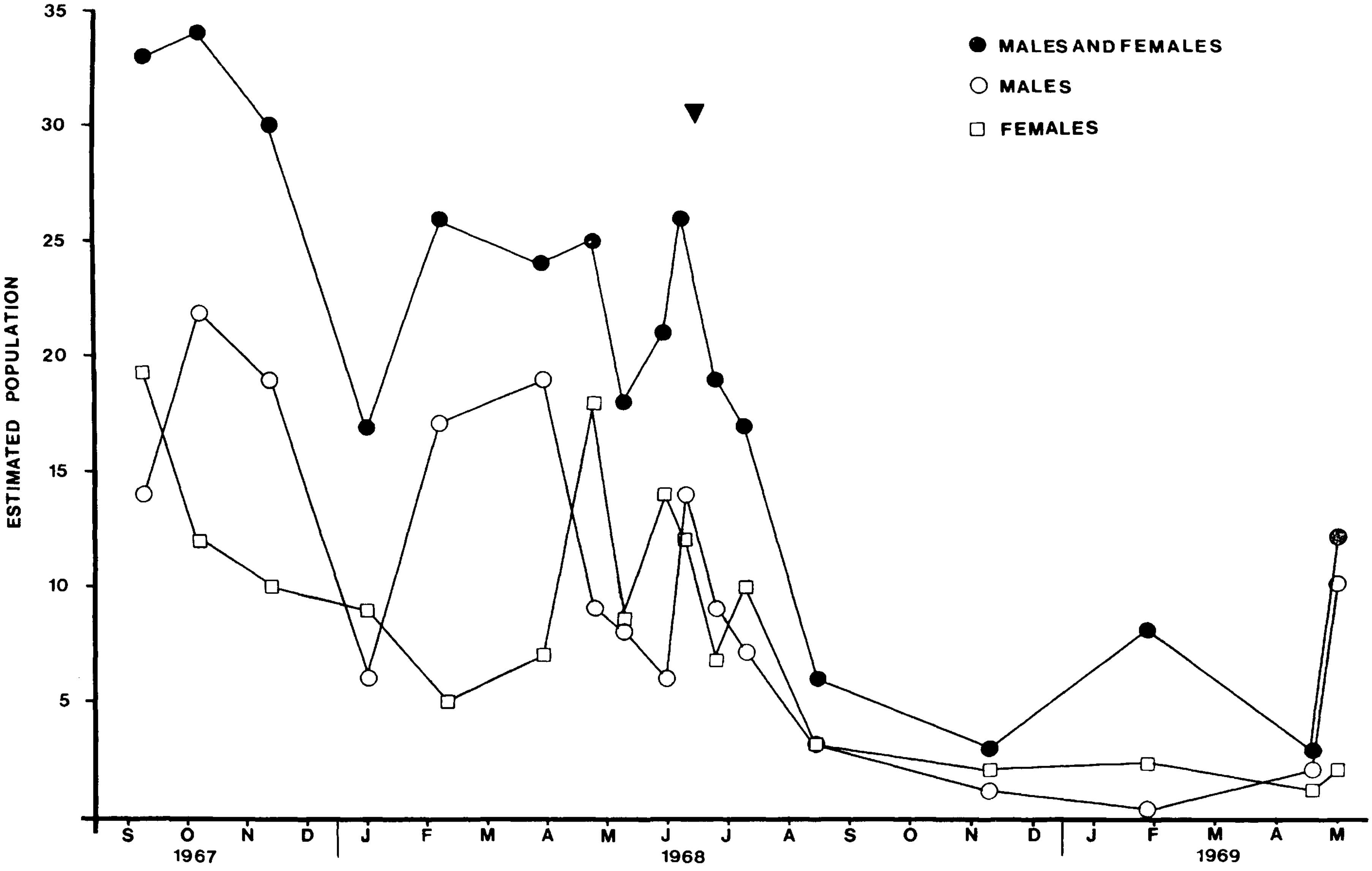


Fig. 12: The estimated total rodent population (with sexes both separate and combined) on grid P50. Time of spraying indicated by an inverted triangle.

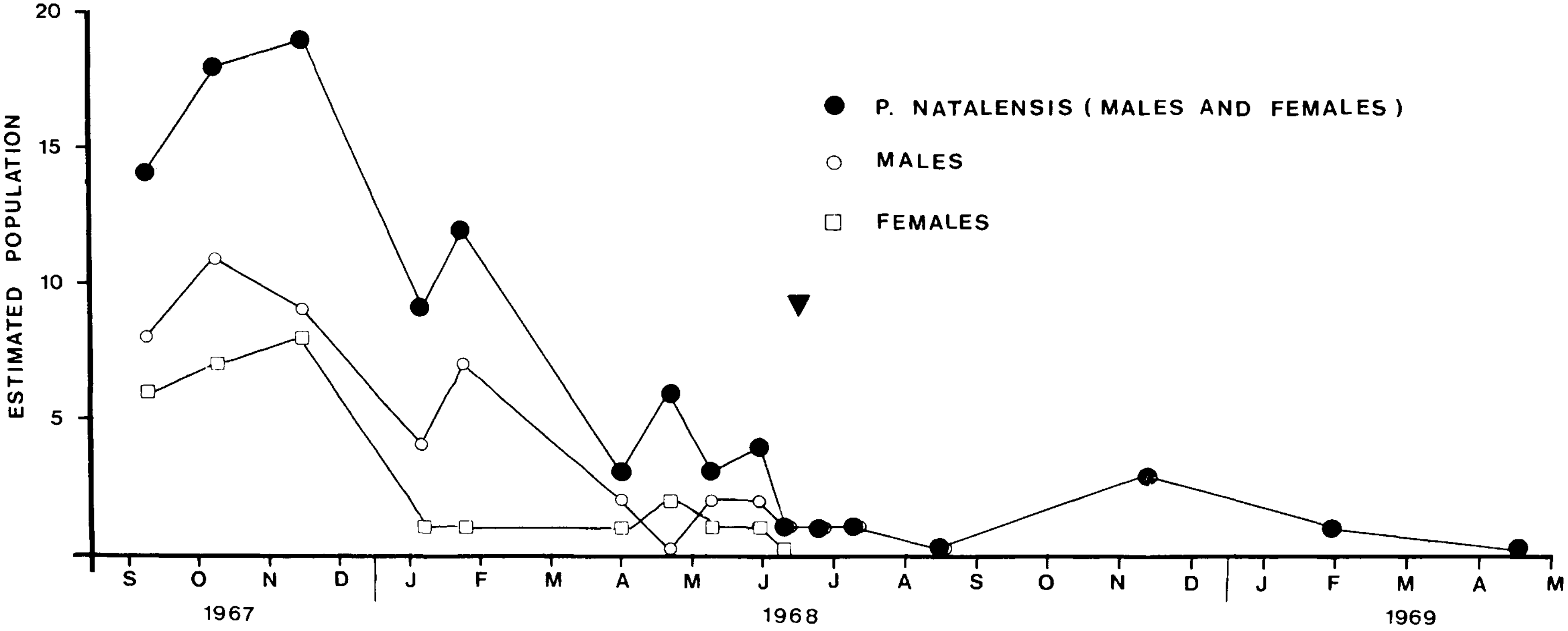


Fig. 13: The estimated population of Praomys (Mastomys) natalensis on grid P50. Time of spraying indicated by an inverted triangle.

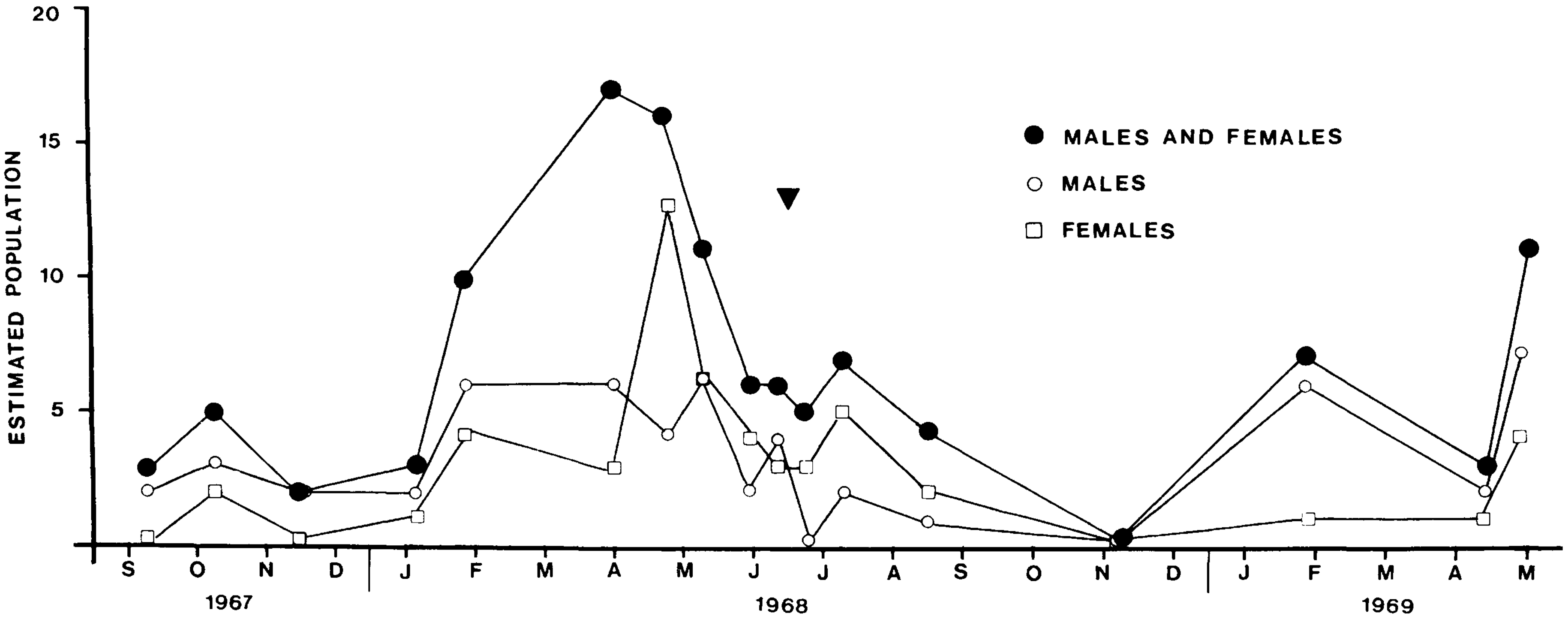


Fig. 14: The estimated population of Saccostomus campestris on grid P50 (with sexes both separate and combined). Time of spraying indicated by an inverted triangle.

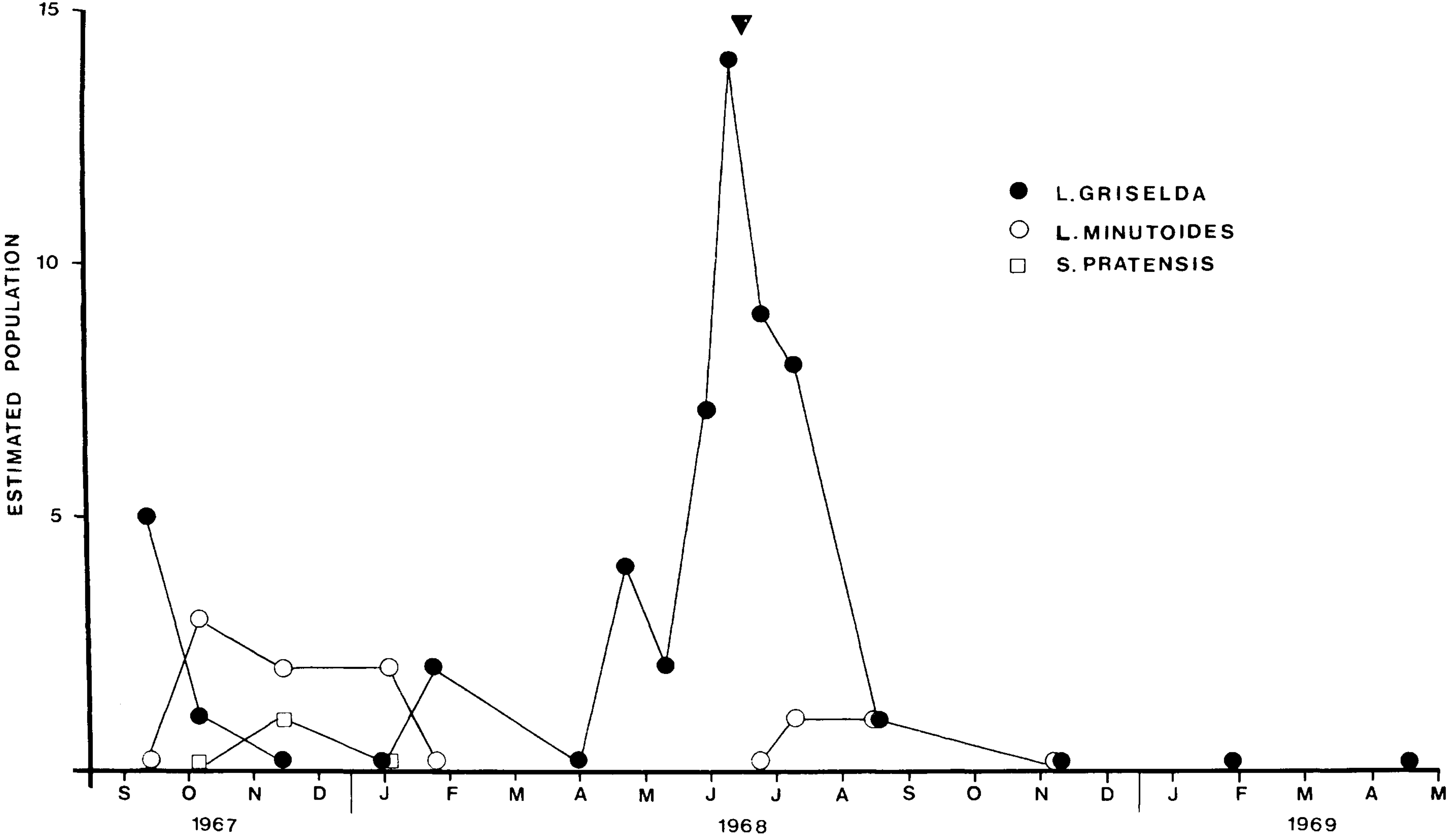


Fig. 15: The estimated population of Lemniscomys griselda, Leggada minutoides, and Steatomys pratensis on grid P50. Time of spraying indicated by an inverted triangle.

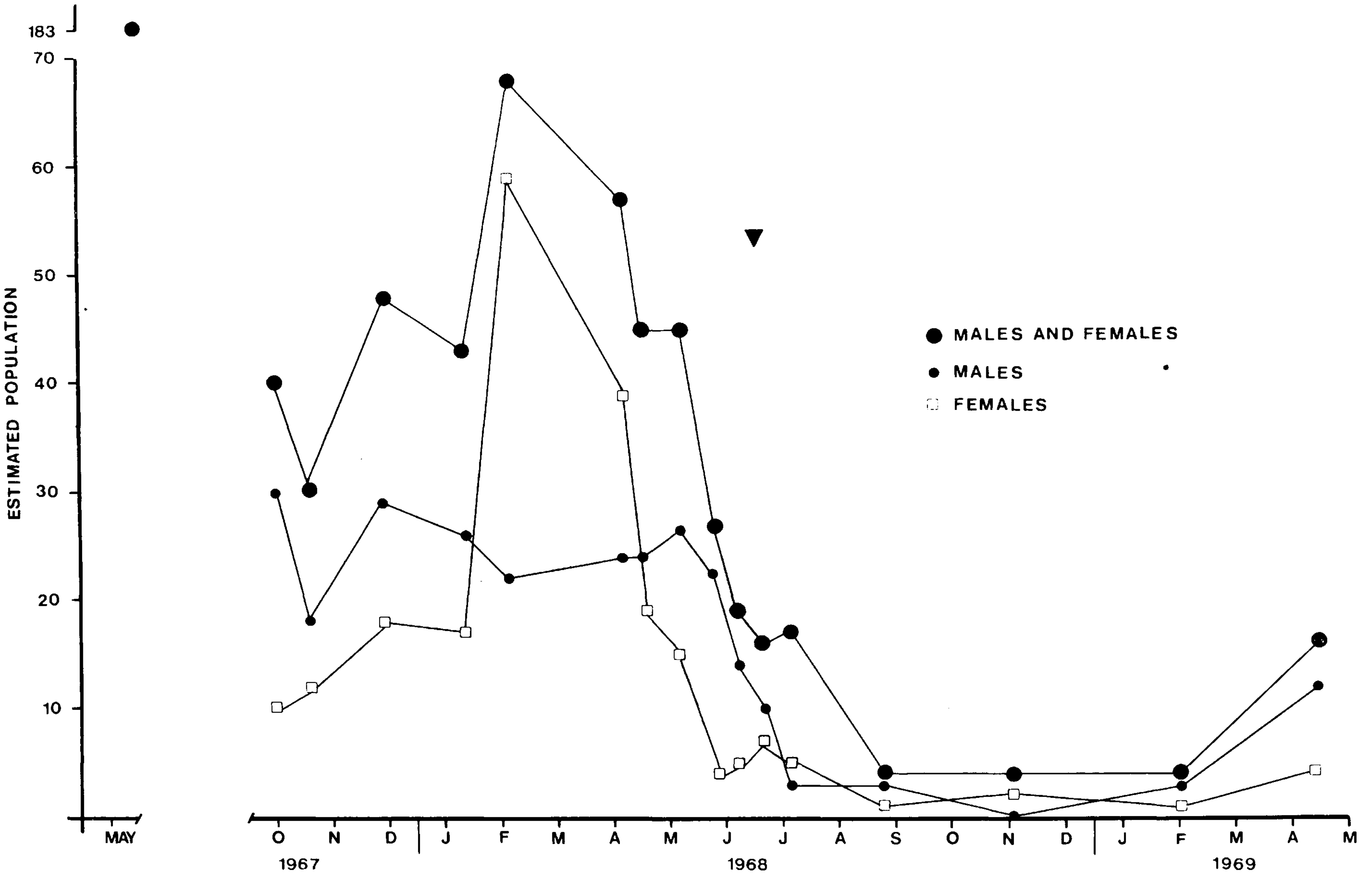


Fig. 16: The estimated total population on grid P46 (with sexes both separate and combined). Time of spraying on grids P50 and P88 is indicated by an inverted triangle.

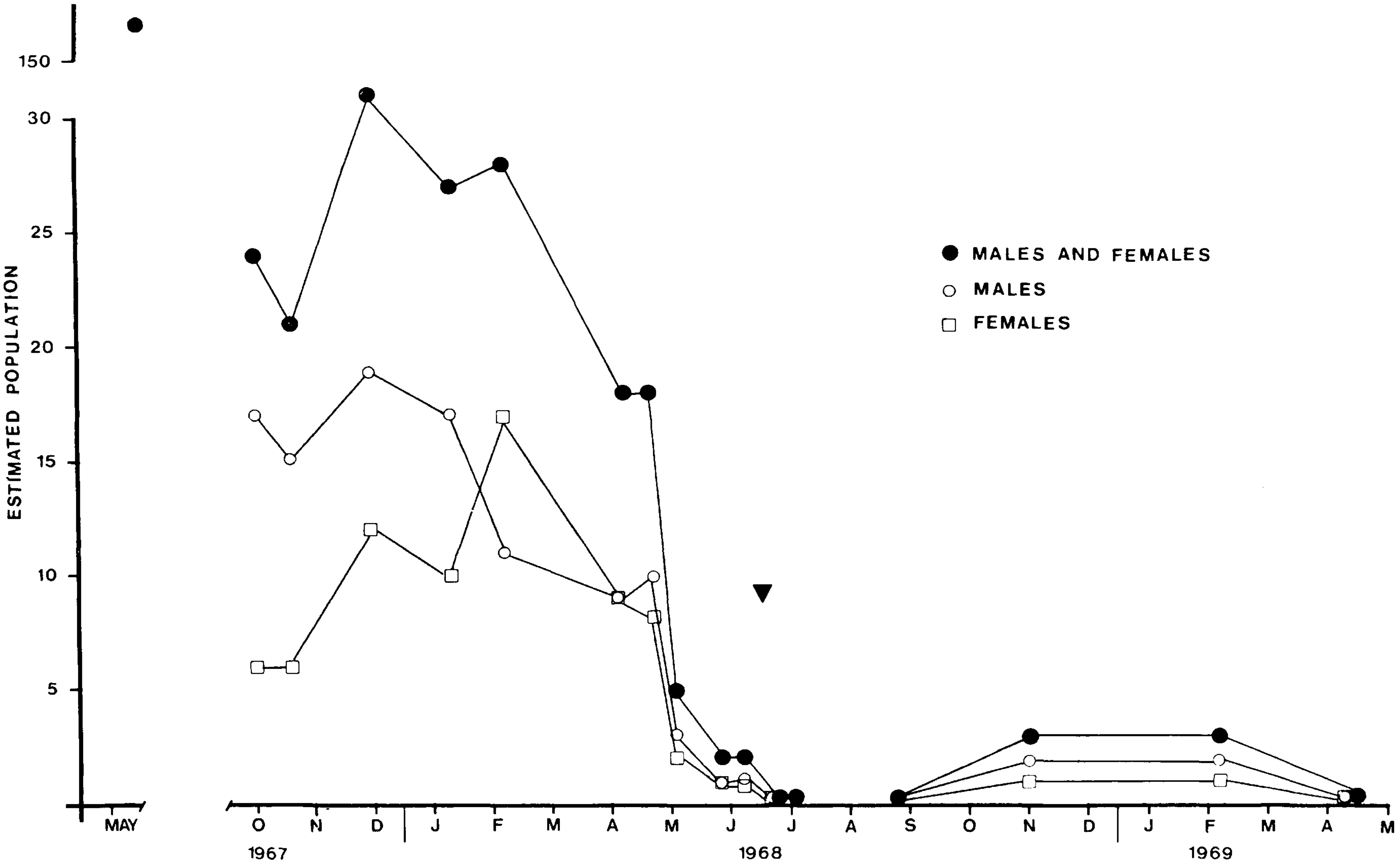


Fig. 17: The estimated Praomys (Mastomys) natalensis population on grid P46 (with sexes both separate and combined). Time of spraying on grids P50 and P88 is indicated by an inverted triangle.

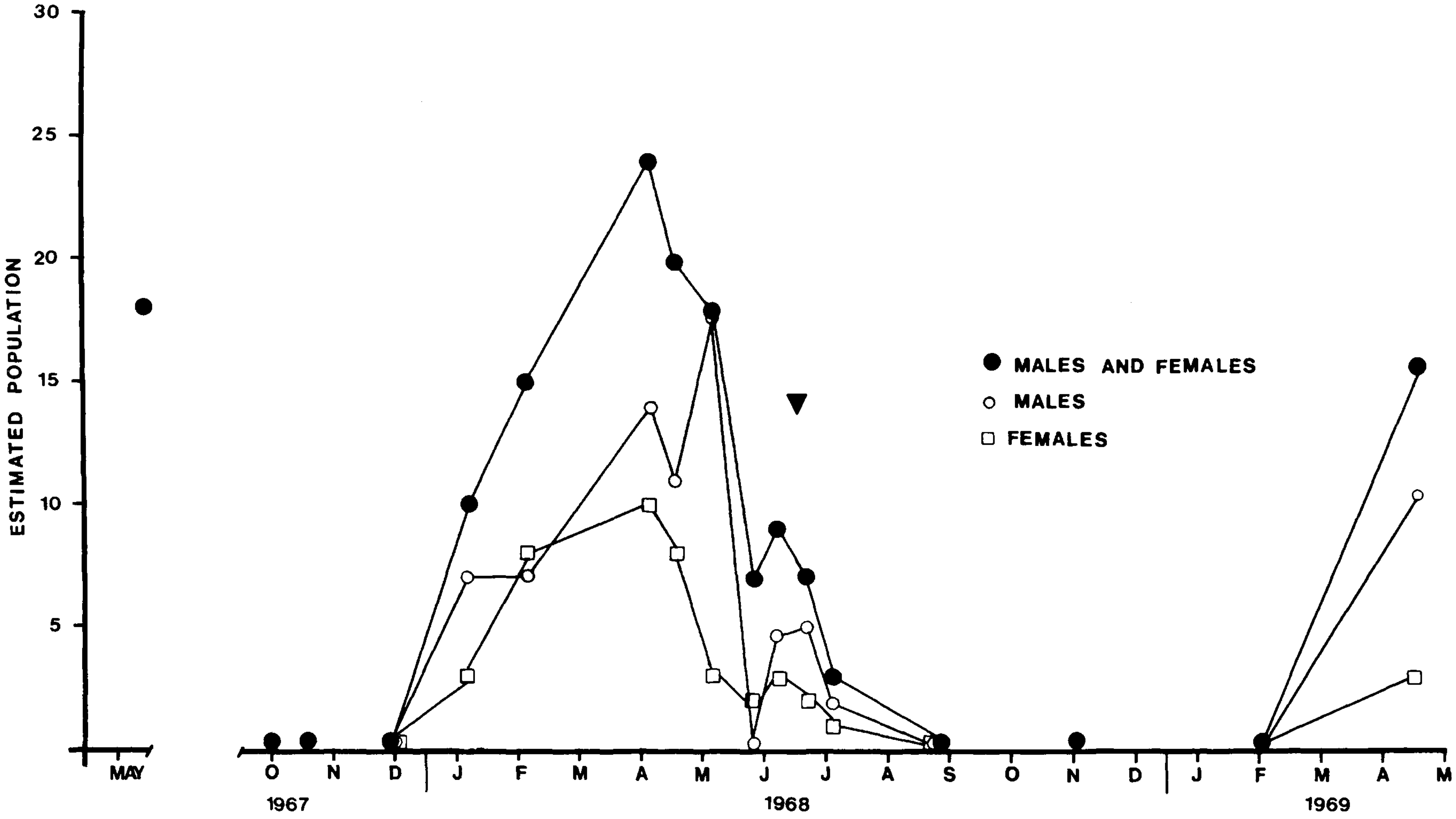


Fig. 18: The estimated Saccostomus campestris population on grid P46 (with sexes both separate and combined). Time of spraying on grids P50 and P88 is indicated by inverted triangle.

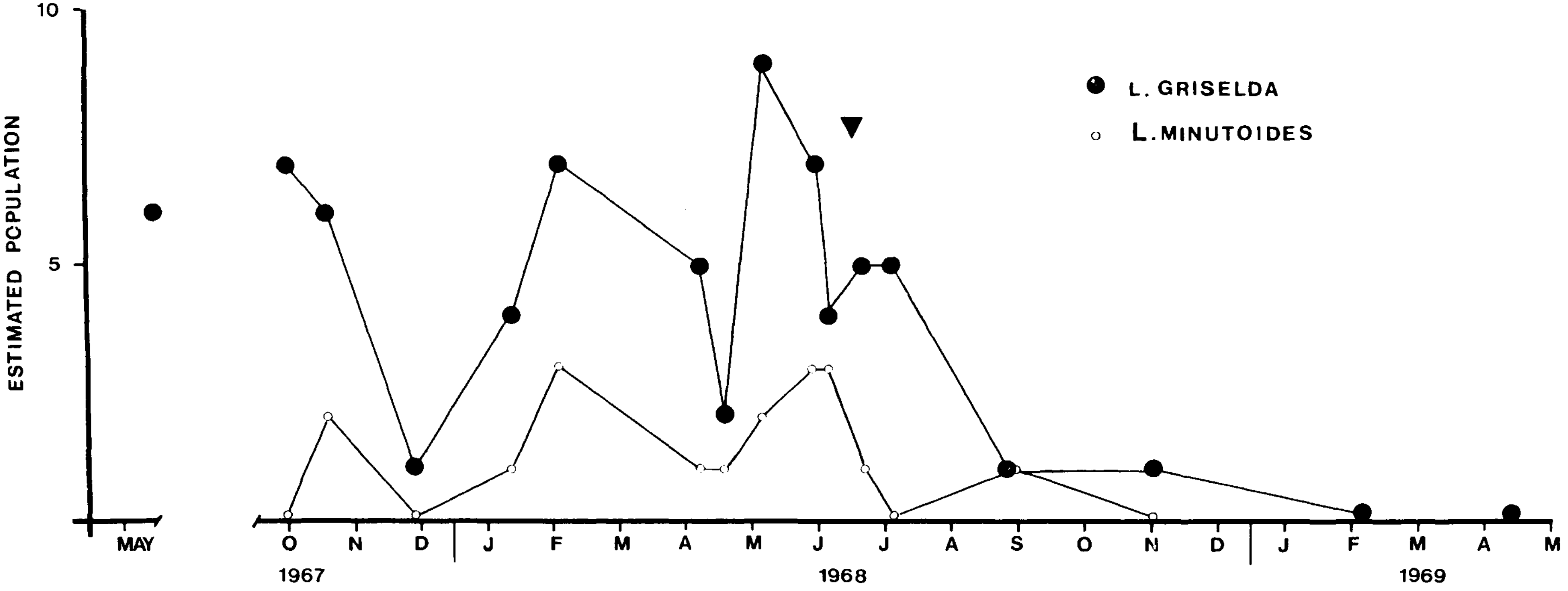


Fig. 19: The estimated population of Lemniscomys griselda and Leggada minutoides on grid P46. Time of spraying on grids P50 and P88 is indicated by an inverted triangle.

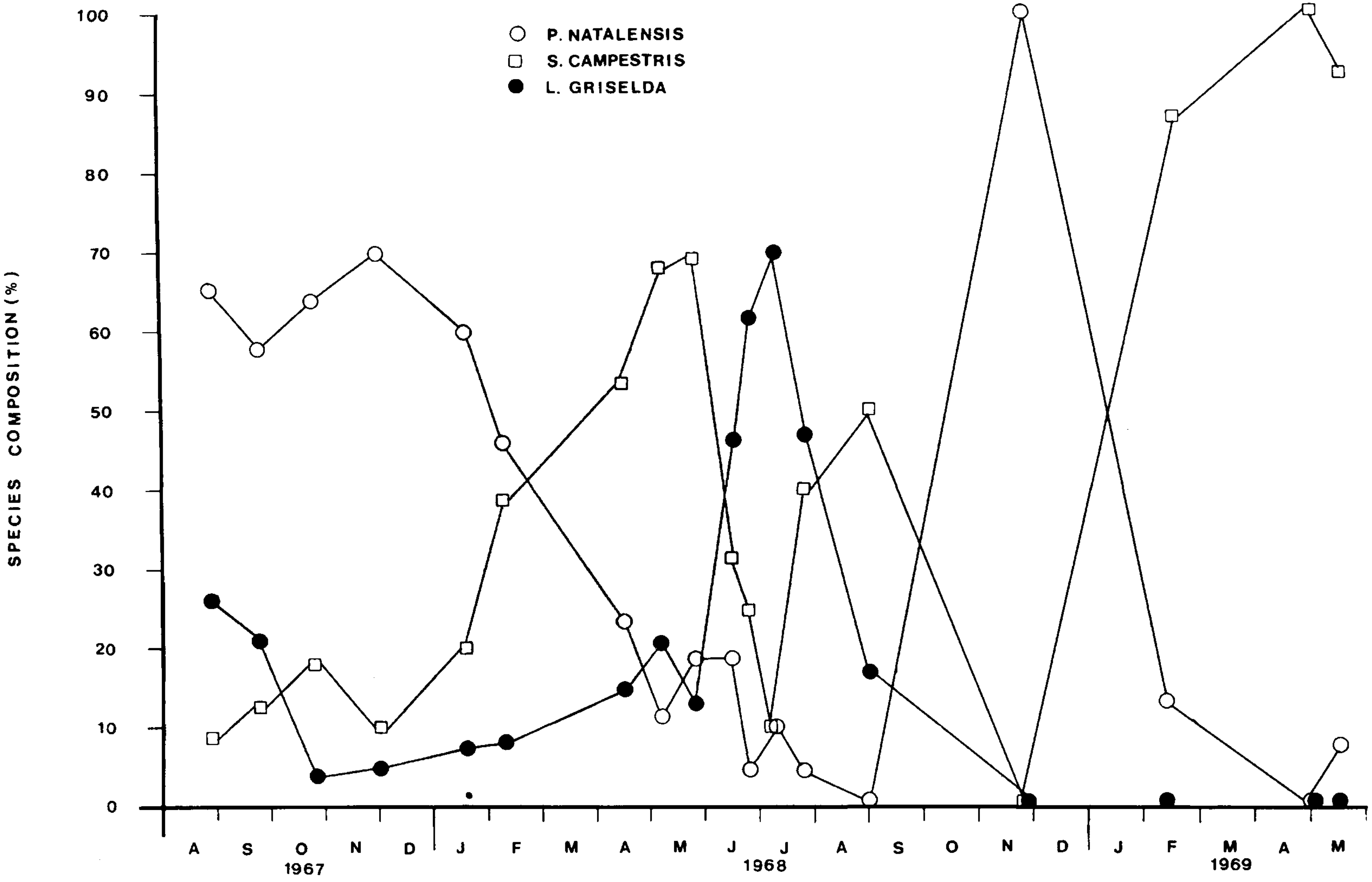


Fig. 20: Species composition (percentage) on grid P50 for each trapping period from August 1967 to May 1969.

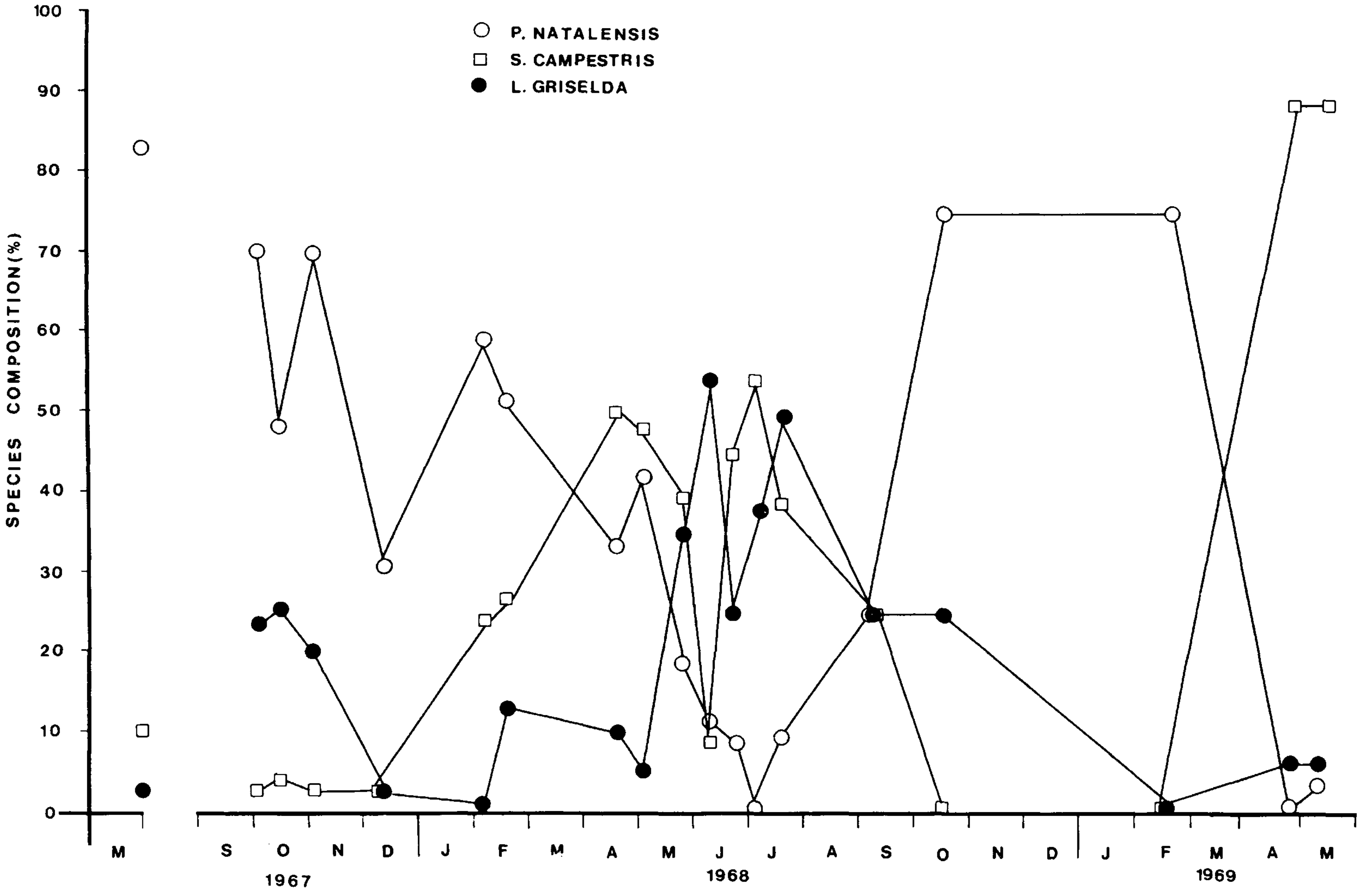


Fig. 21: Species composition (percentage) on grid P46 for each trapping period from May 1967 to May 1969.

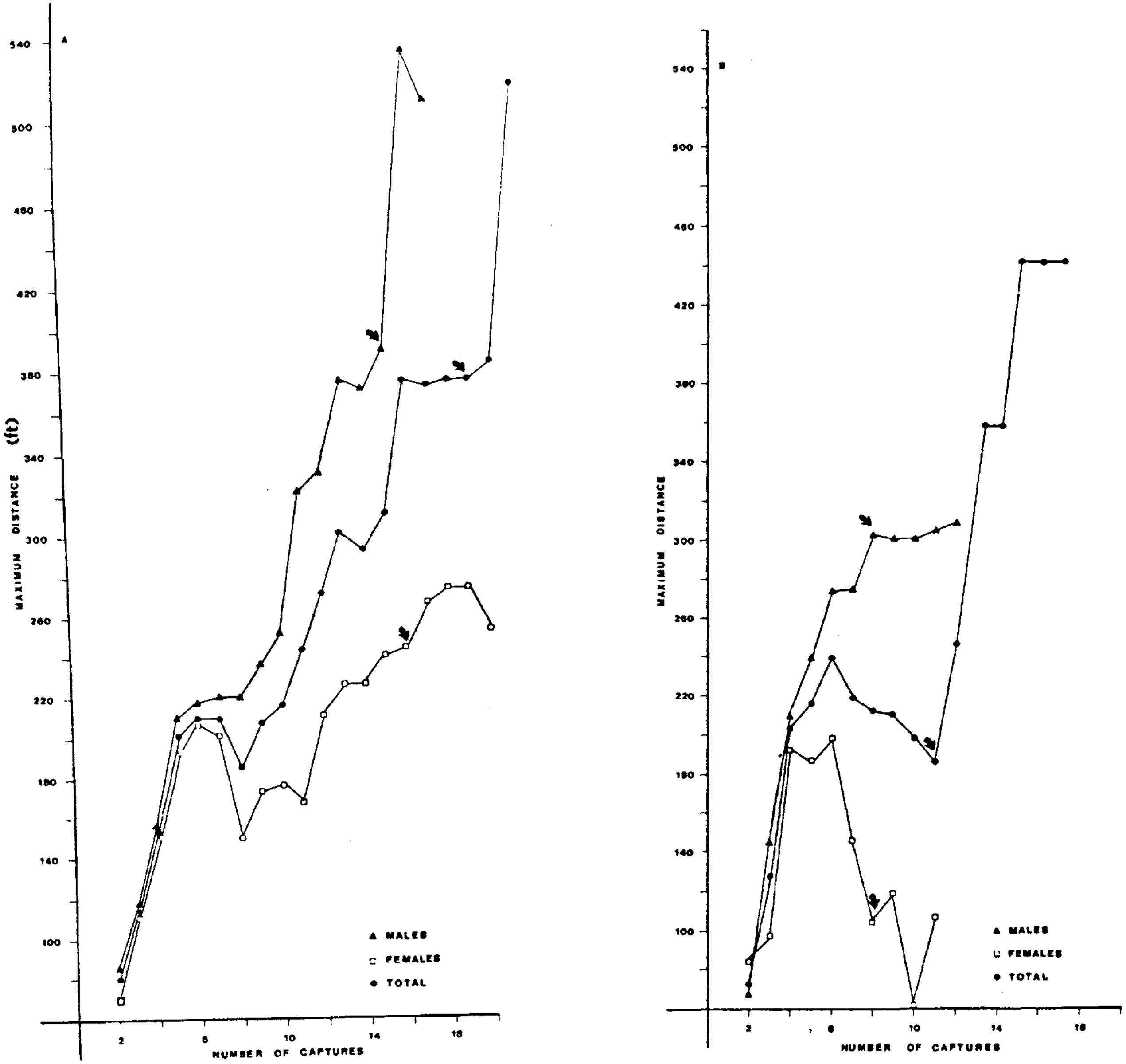


Fig. 22: Average maximum distance (ft) between points of capture (av. M) for Praomys (Mastomys) natalensis (A = all grids combined; B = grid P50). Arrows indicate the point beyond which the number of animals per capture was less than five (100 ft = 30,48 m).

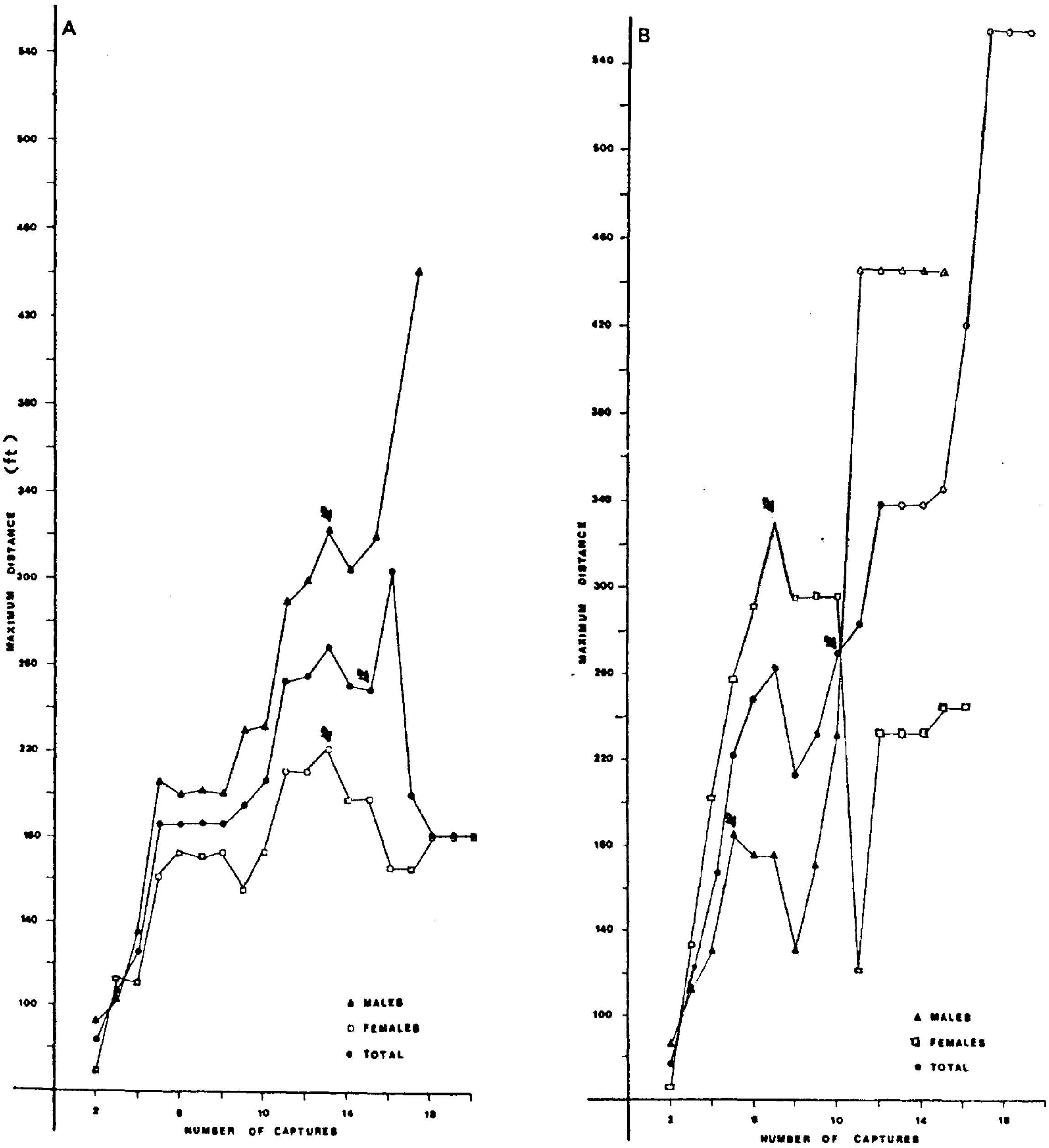


Fig. 23: Average maximum distance (ft) between points of capture (av. M) for Praomys (Mastomys) natalensis (A = grid P46; B = grid P88 + P89). Arrows indicate the point beyond which the number of animals per capture was less than five (100 ft = 30,48 m).

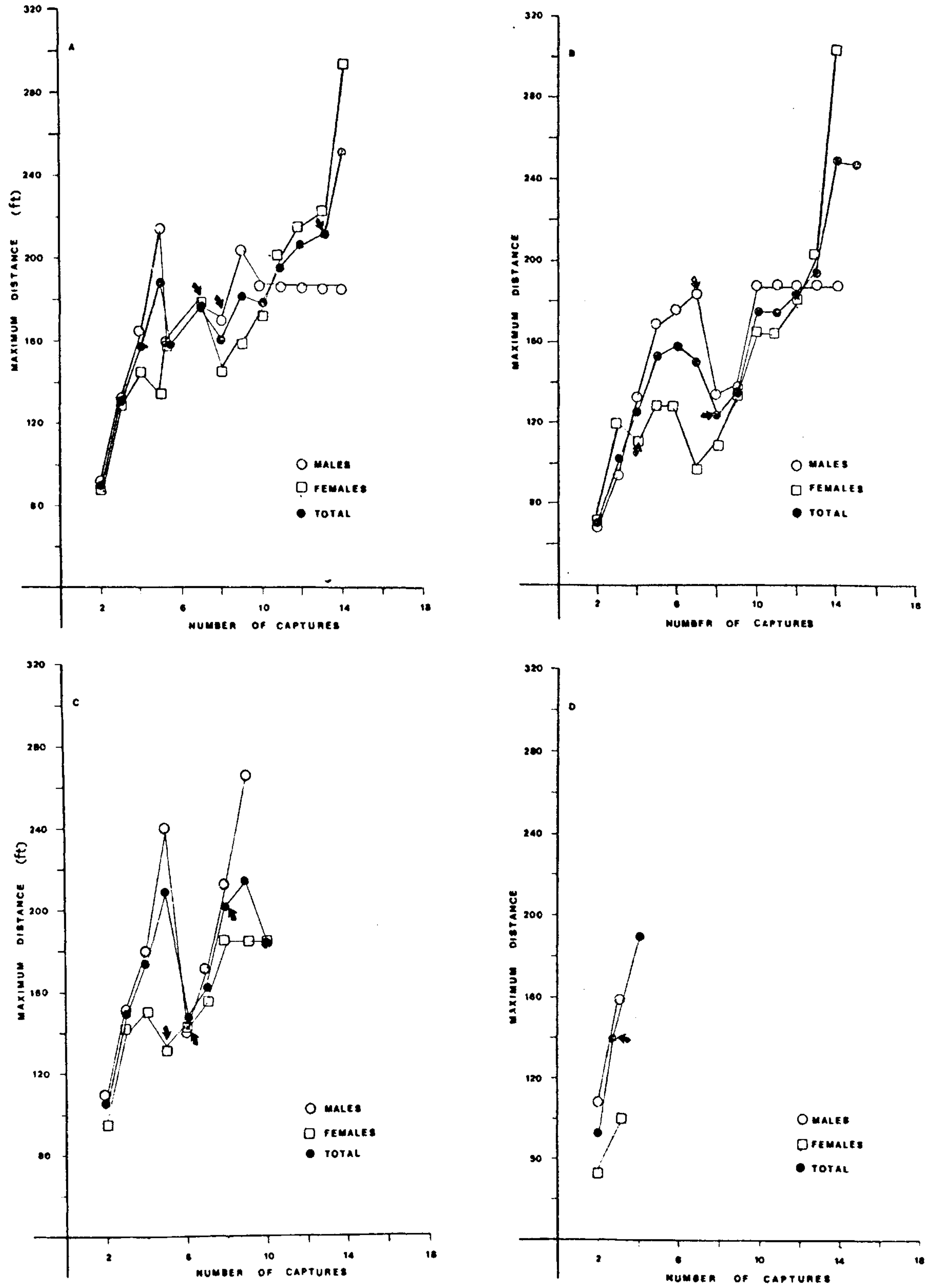


Fig. 24: Average maximum distance (ft) between points of capture (av. M) for Saccostomus campestris (A = all grids combined; B = grid P50; C = grid P46; D = grid P88 + P89). Arrows indicate the point beyond which the number of animals per capture was less than five (100 ft = 30,48 m).

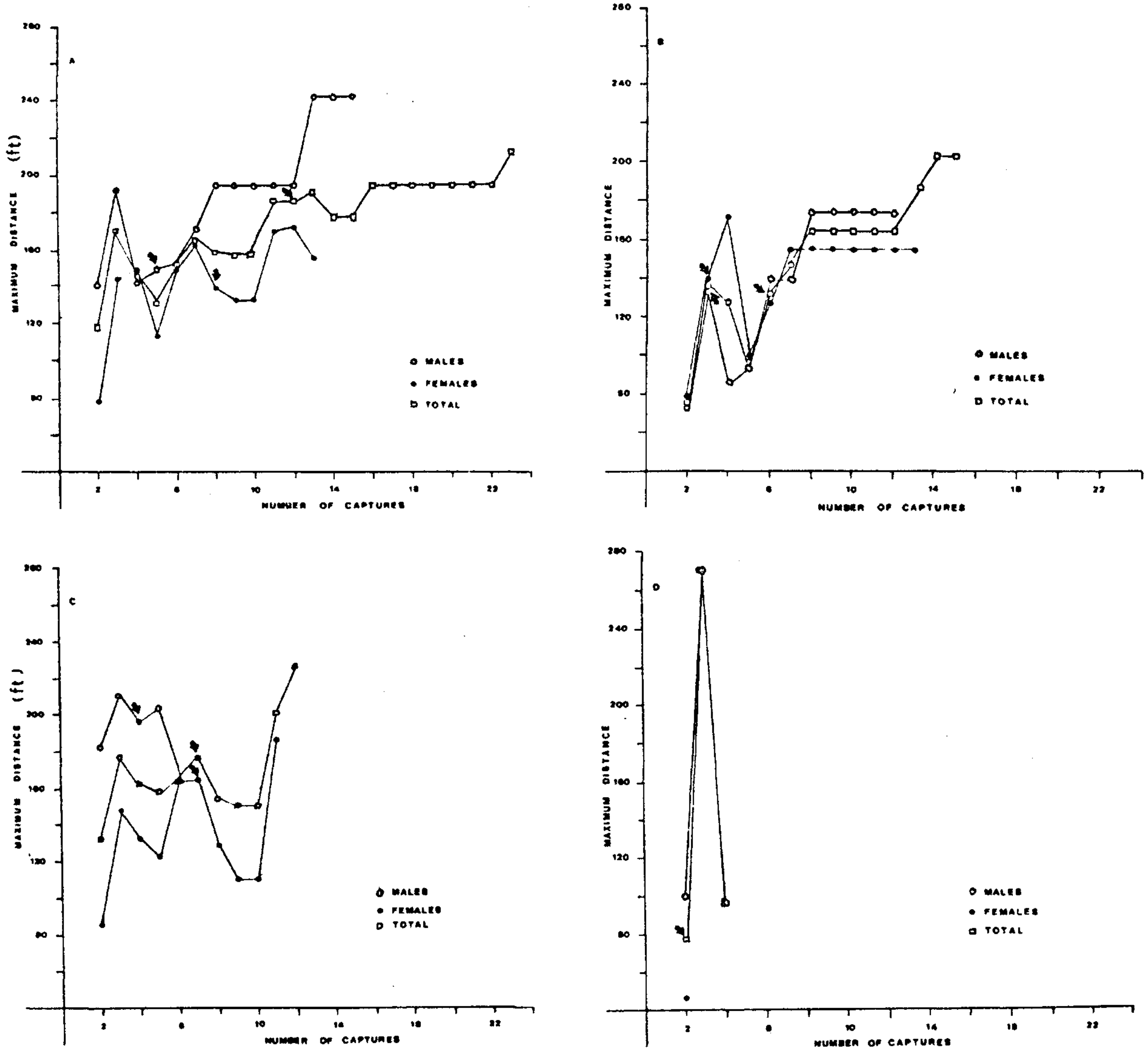


Fig. 25: Average maximum distance between points of capture (av. M) for Lemniscomys griselda (A = all grids combined; B = grid P50; C = grid P46; D = grid P88 + P89). Arrows indicate the point beyond which the number of animals per capture was less than five (100 ft = 30,48 m).

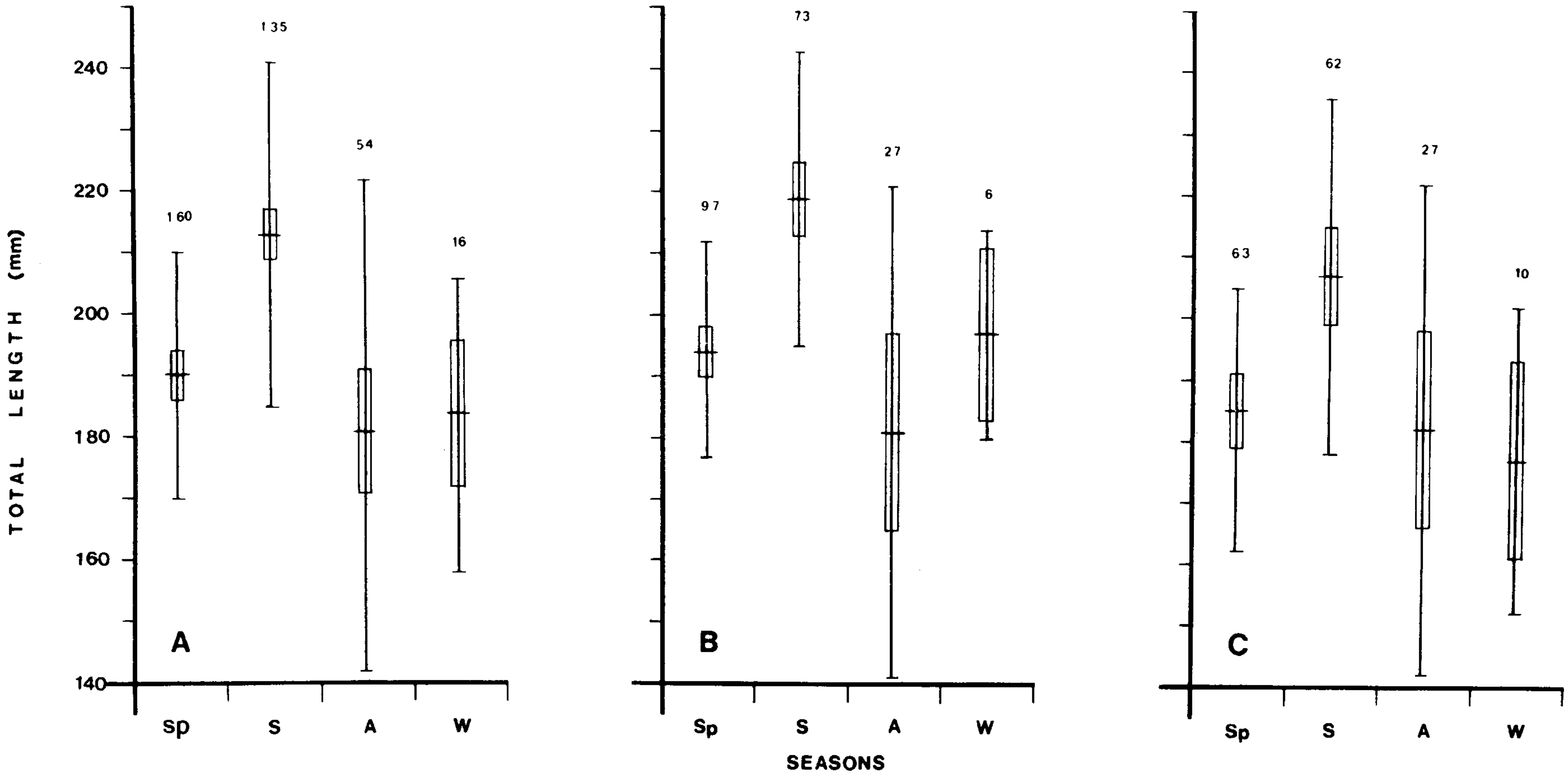


Fig. 26: Seasonal mean total length of *Praomys (Mastomys) natalensis* observed on the study area. A = both sexes; B = males; ₵ ≠ C =females; horizontal line = arithmetic mean; vertical line = mean ± one standard deviation; open bar = mean ± two standard errors. The sample size for each season is indicated above each vertical line.

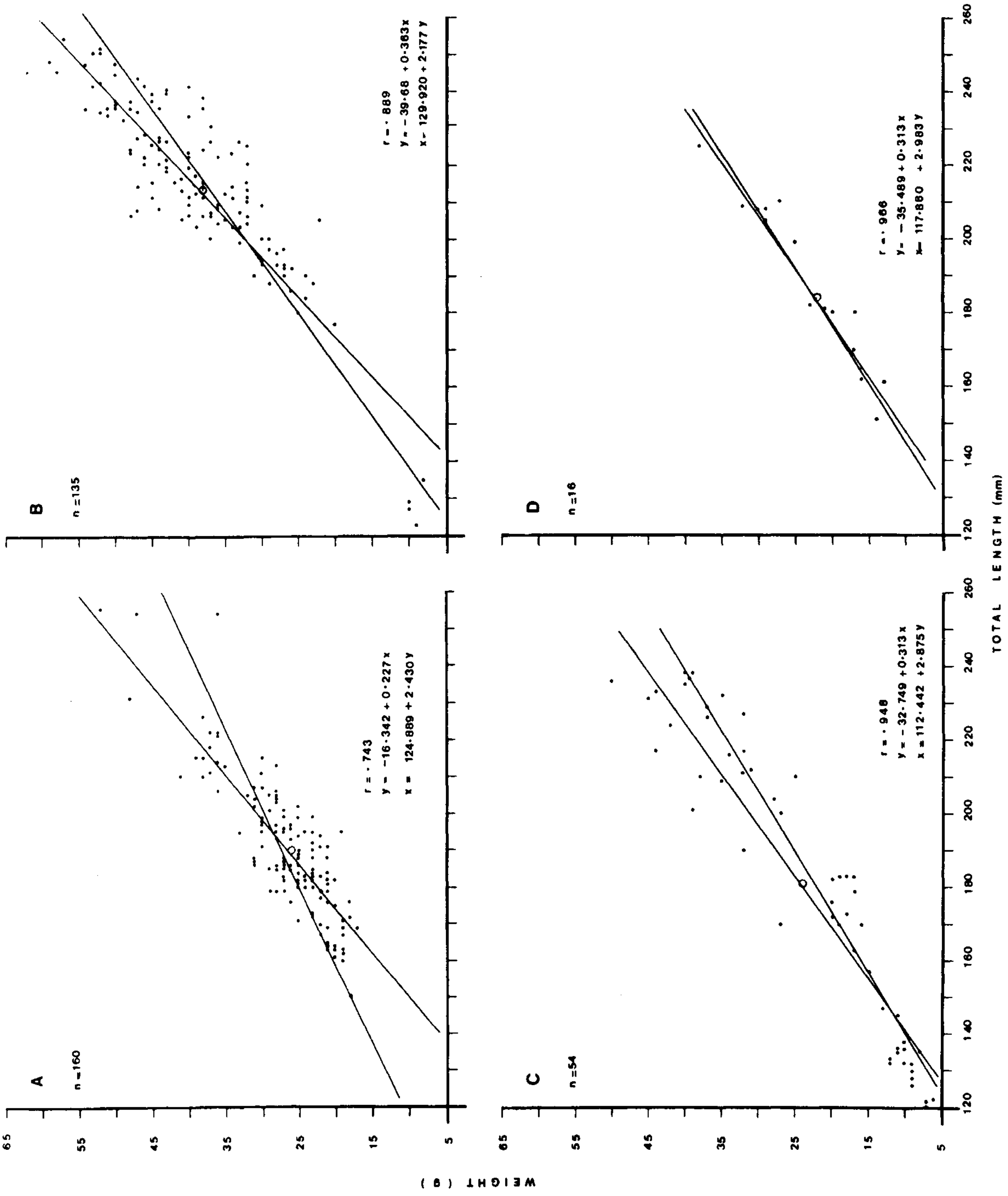


Fig. 27: Body mass (= weight in figure) of Praomys (Mastomys) natalensis on the study area, plotted seasonally against total length. Regression lines, equations and correlation coefficients (r) of the relationships for both sexes combined are indicated. (A = spring; B = summer; C = autumn; D = winter; O = mean of parameter). Two summer (female) measurements of below 120 mm were not plotted.

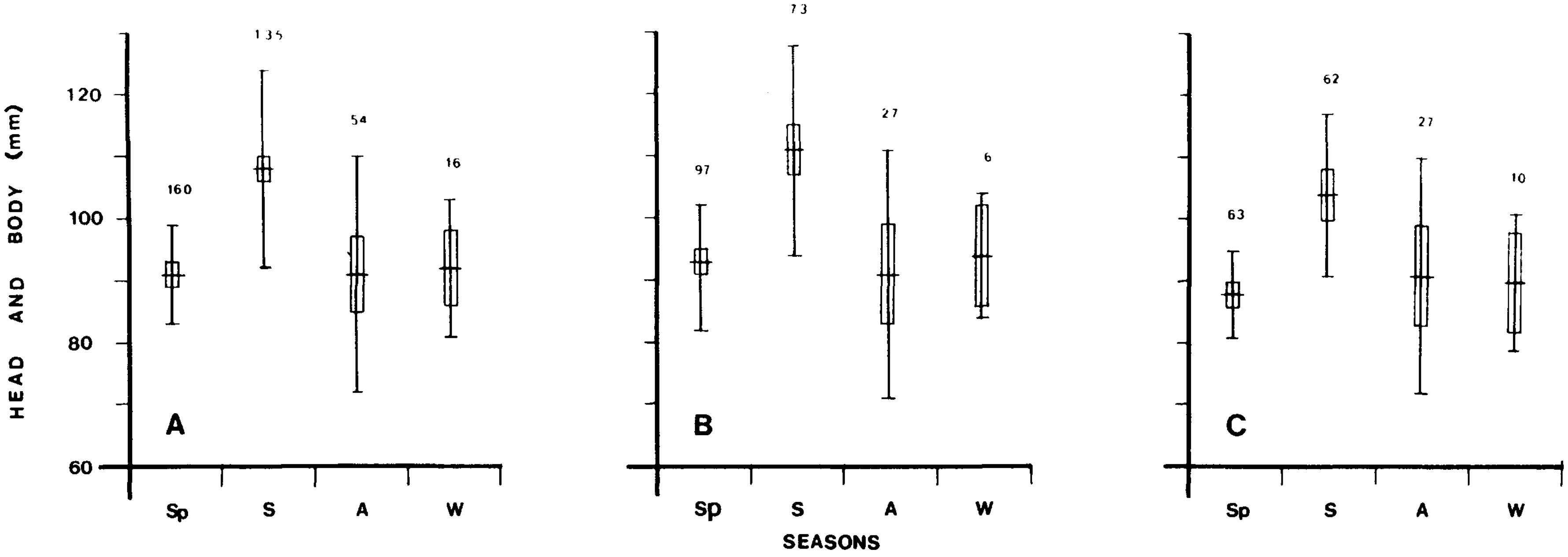


Fig. 28: Seasonal mean head and body length of *Praomys* (*Mastomys*) *natalensis* observed on the study area. A = both sexes; B = males; C = females; horizontal line = arithmetic mean; vertical line = mean ± one standard deviation; open bar = mean ± two standard errors. The sample size for each season is indicated above each vertical line.

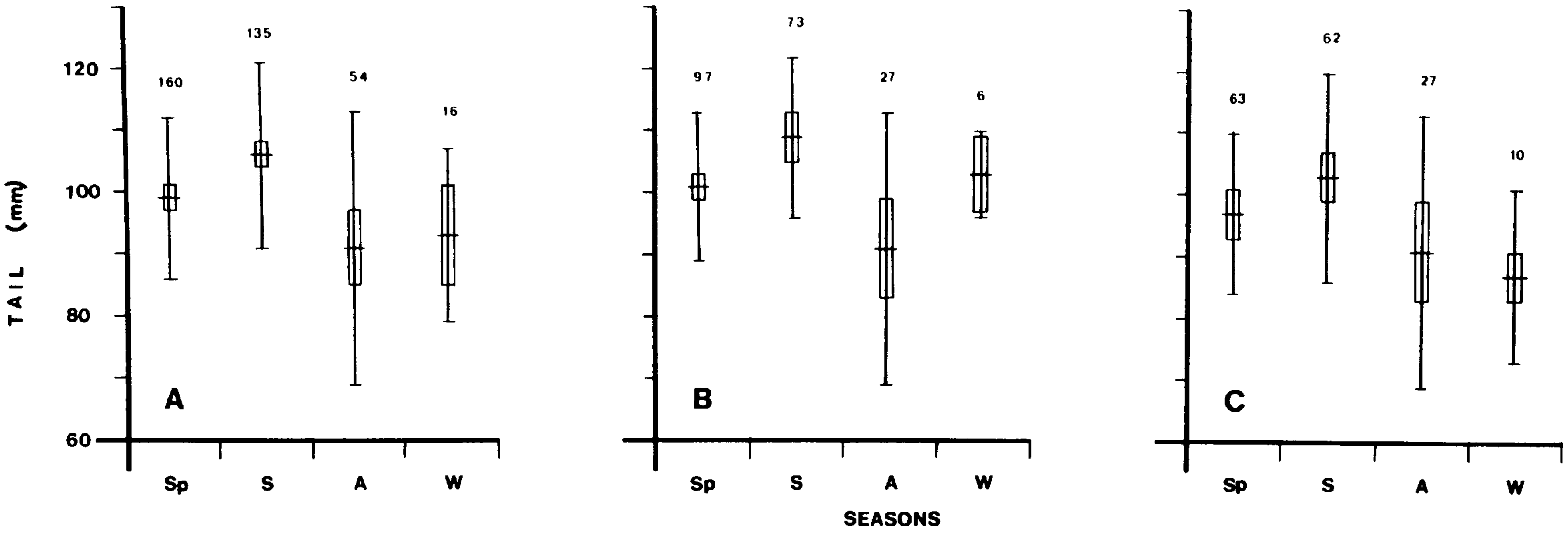


Fig. 29: Seasonal mean tail length of Praomys (Mastomys) natalensis observed on the study area. A = both sexes; B = males; C = females; horizontal line = arithmetic mean; vertical line = mean ± one standard deviation; open bar = mean ± two standard errors. The sample size for each season is indicated above each vertical line.

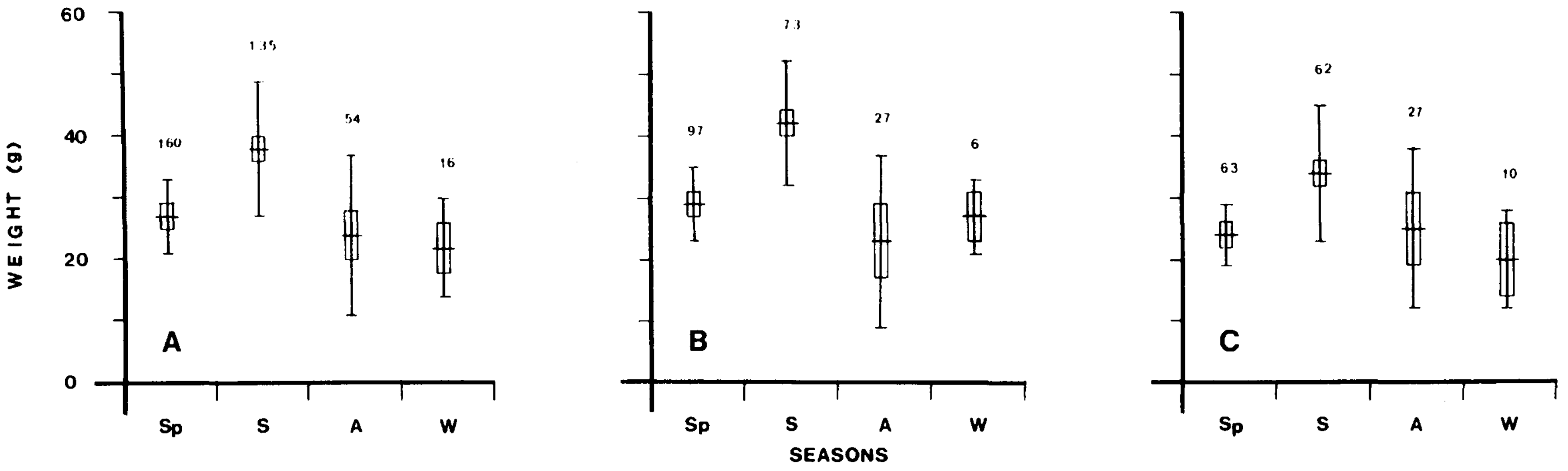


Fig. 30: Seasonal mean body mass (= weight in figure) of Praomys (Mastomys) natalensis observed on the study area. A = both sexes; B = males; C = females; horizontal line = arithmetic mean; vertical line = mean ± one standard deviation; open bar = mean ± two standard errors. The sample size for each season is indicated above each vertical line.

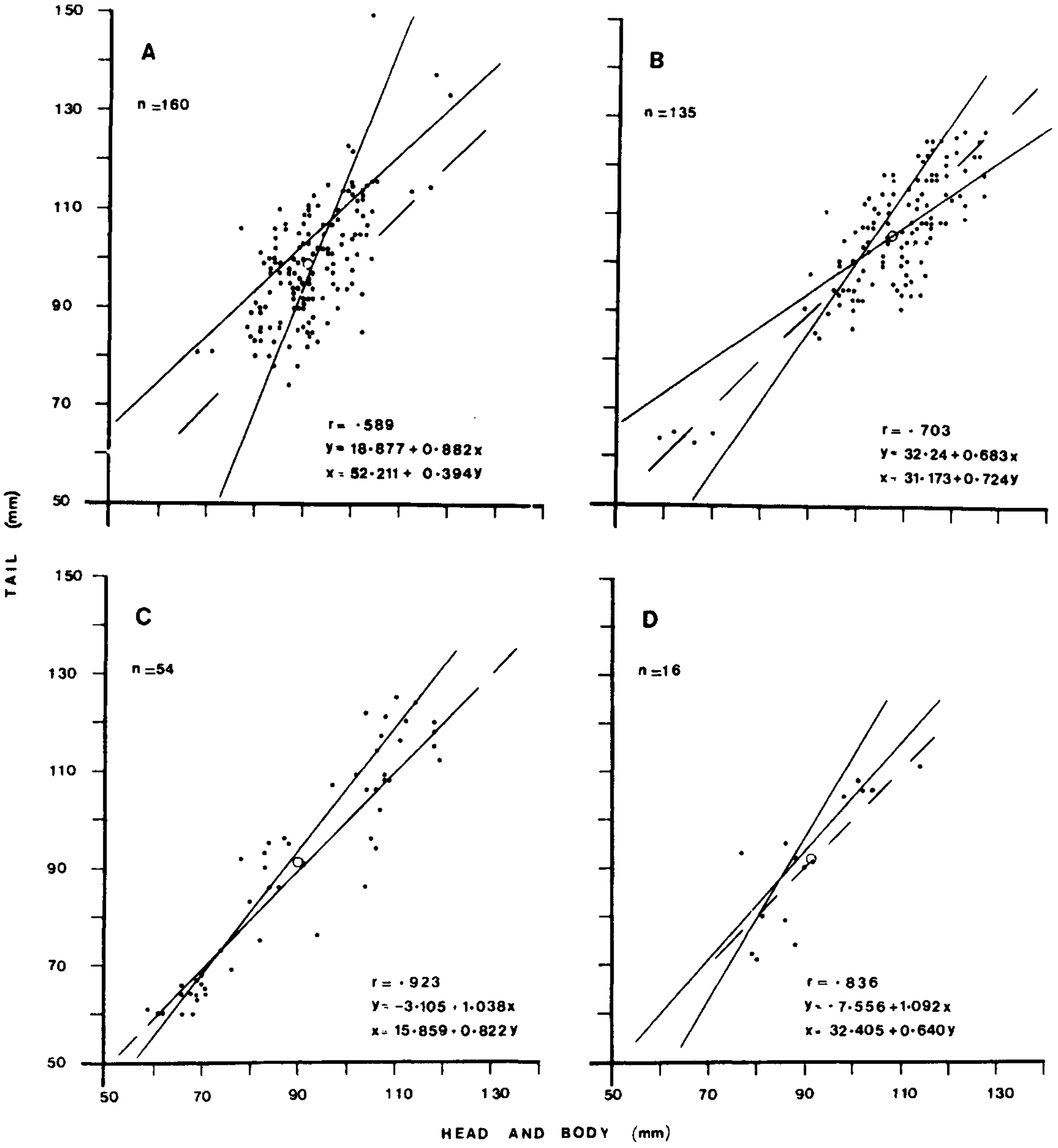


Fig. 31: Tail length of *Praomys (Mastomys) natalensis* on the study area, plotted seasonally against head and body length. Regression lines, equations and correlation coefficients (r) of the relationships for both sexes combined are indicated. (A = spring; B = summer; C = autumn; D = winter; O = mean of parameters). Broken lines indicate the point where tail length = head and body length.

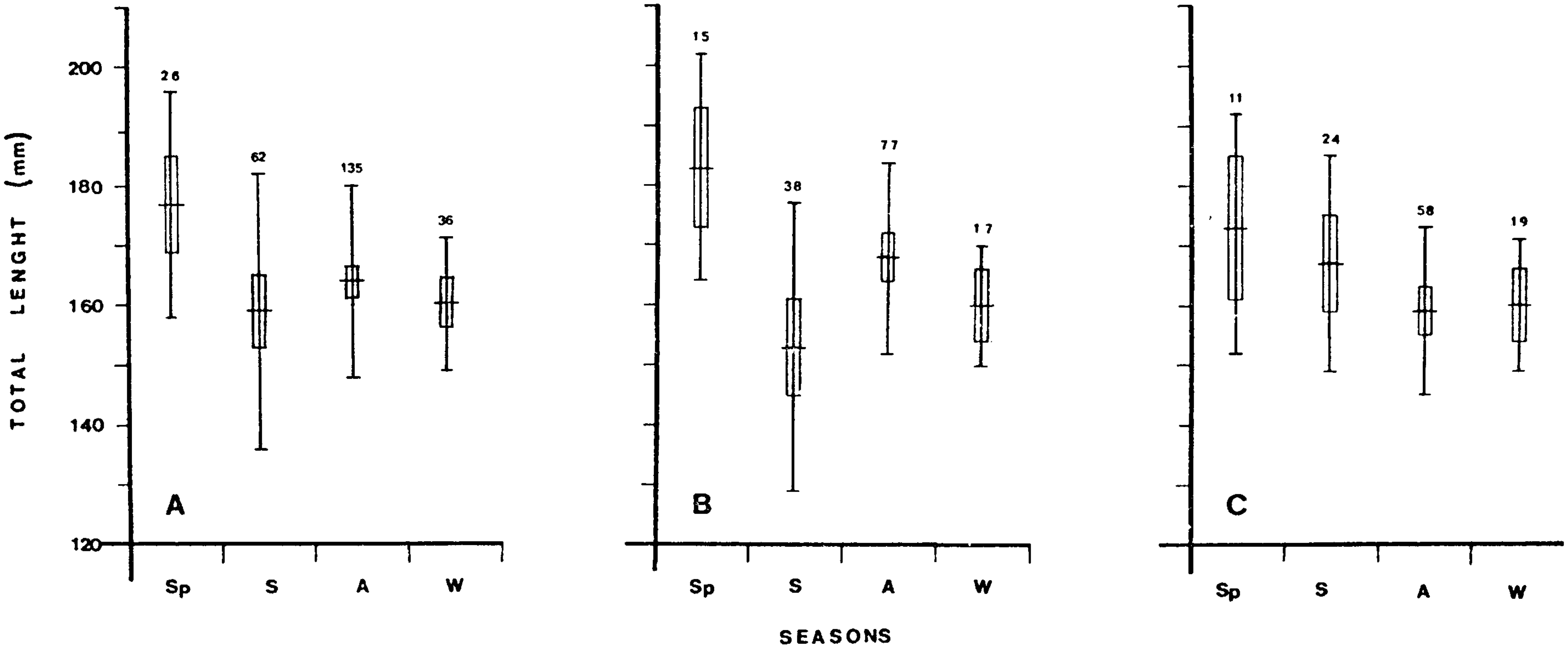


Fig. 32: Seasonal mean total length of Saccostomus campestris observed on the study area. A = both sexes; B = males; C = females; horizontal line = arithmetic mean; vertical line = mean ± one standard deviation; open bar = mean ± two standard errors. The sample size for each season is indicated above each vertical line.

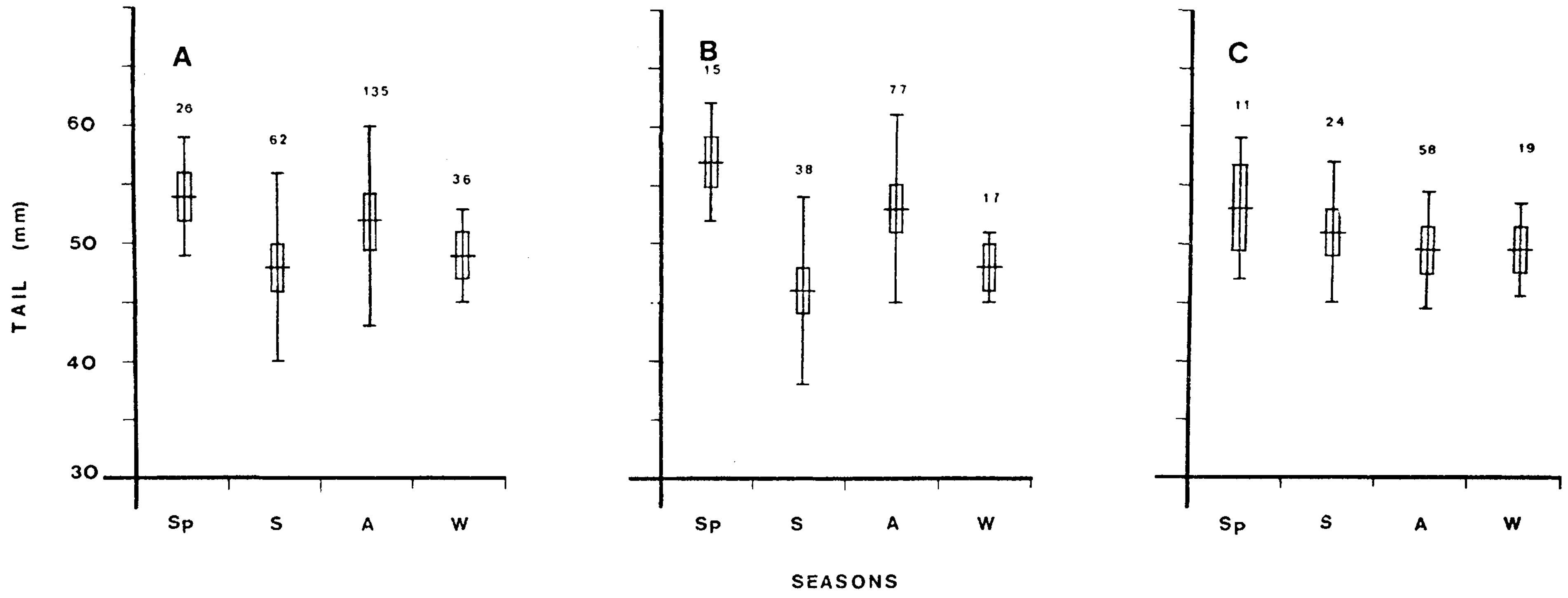


Fig. 33: Seasonal mean tail length of <u>Saccostomus campestris</u> observed on the study area. A = both sexes; B = males; C = females; horizontal line = arithmetic mean; vertical line = mean ± one standard deviation; open bar = mean ± two standard errors. The sample size for each season is indicated above each vertical line.

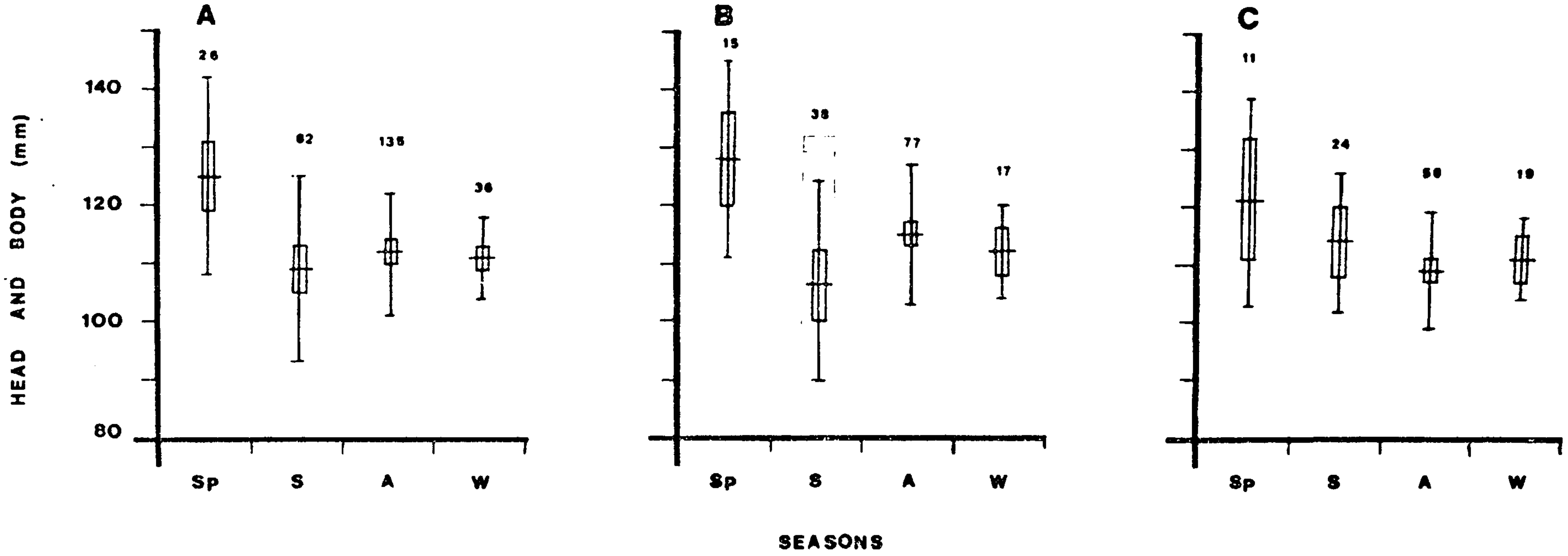


Fig. 34: Seasonal mean head and body length of Saccostomus campestris observed on the study area. A = both sexes; B = males; C = females; horizontal line = arithmetic mean; vertical line = mean ± one standard deviation; open bar = mean ± two standard errors. The sample size for each season is indicated above each vertical line.

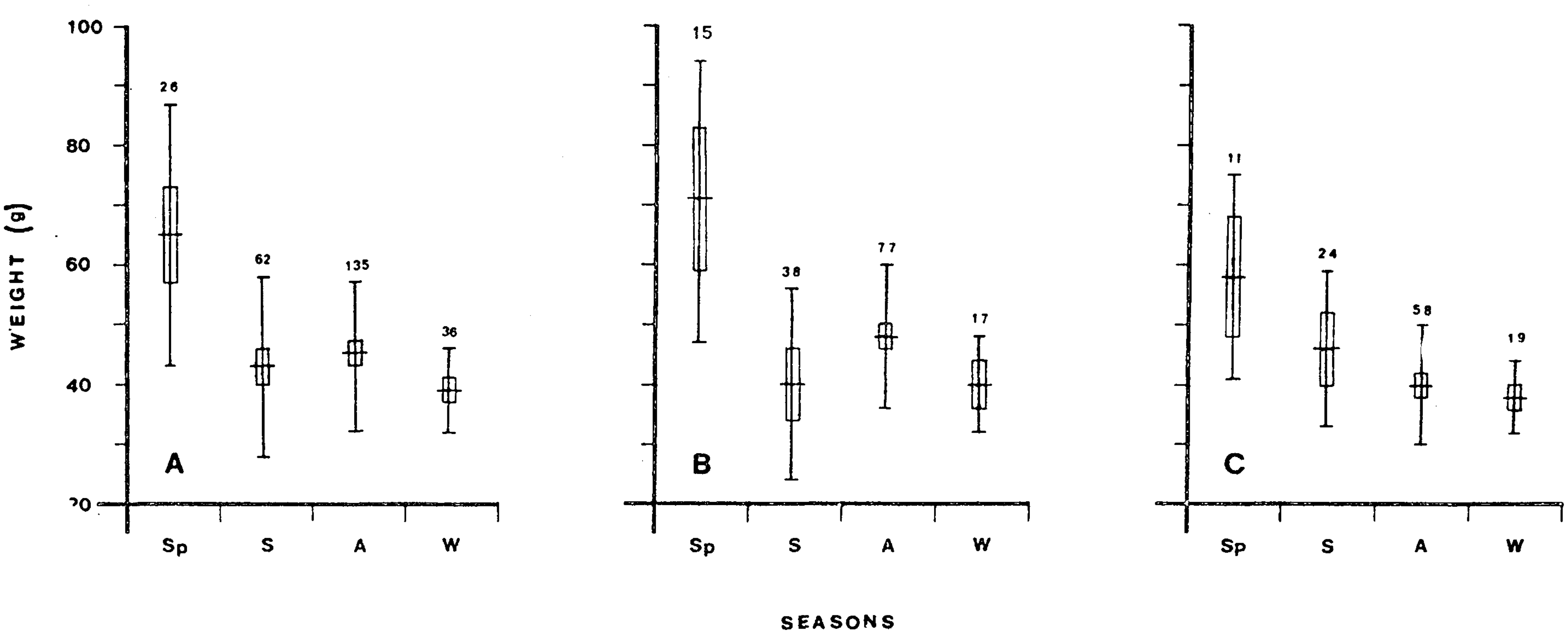


Fig. 35: Seasonal mean body mass (= weight in figure) of Saccostomus campestris observed on the study area. A = both sexes; B = males; C = females; horizontal line = arithmetic mean; vertical line = mean ± one standard deviation; open bar = mean ± two standard errors. The sample size for each season is indicated above each vertical line.

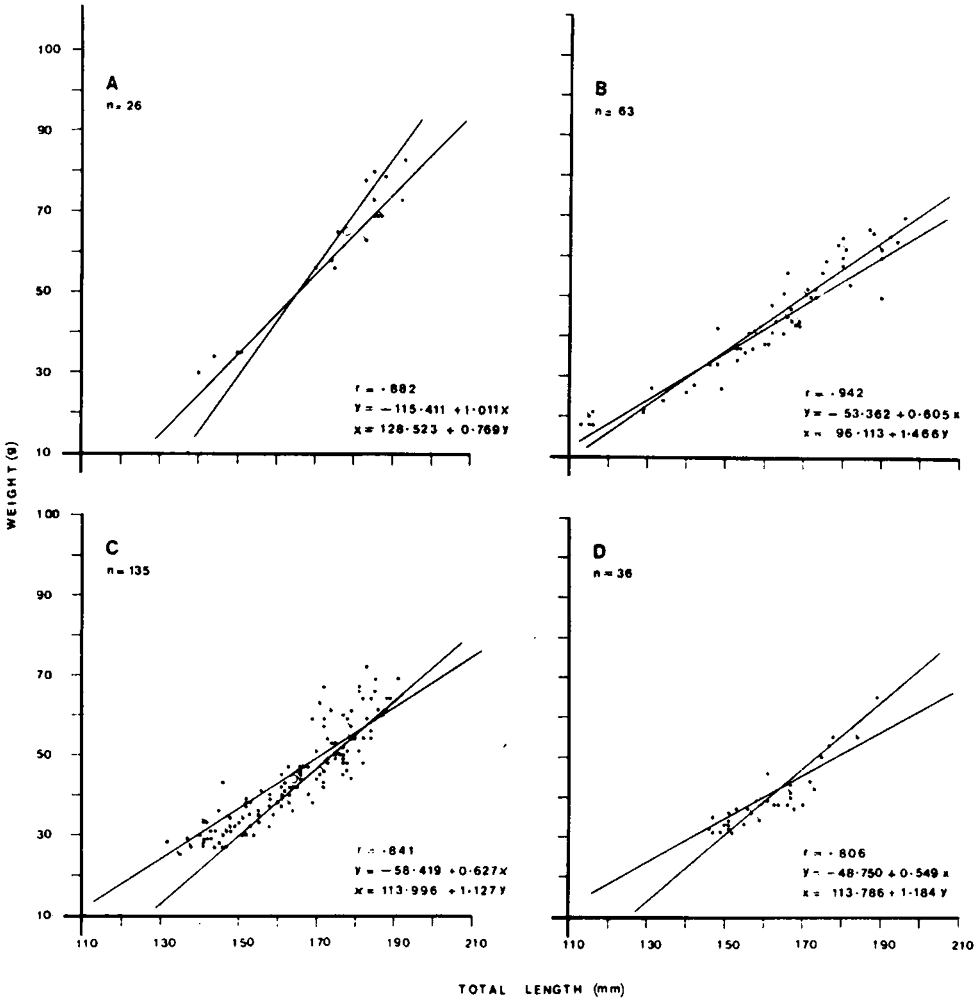


Fig. 36: Body mass (= weight in figure) of Saccostomus campestris on the study area, plotted seasonally against total length. Regression lines, equations and correlation coefficients (r) of the relationships for sexes combined are indicated (A = spring; B = summer; C = autumn; D = winter; O = mean of parameters; ● = males; ♀ = females).

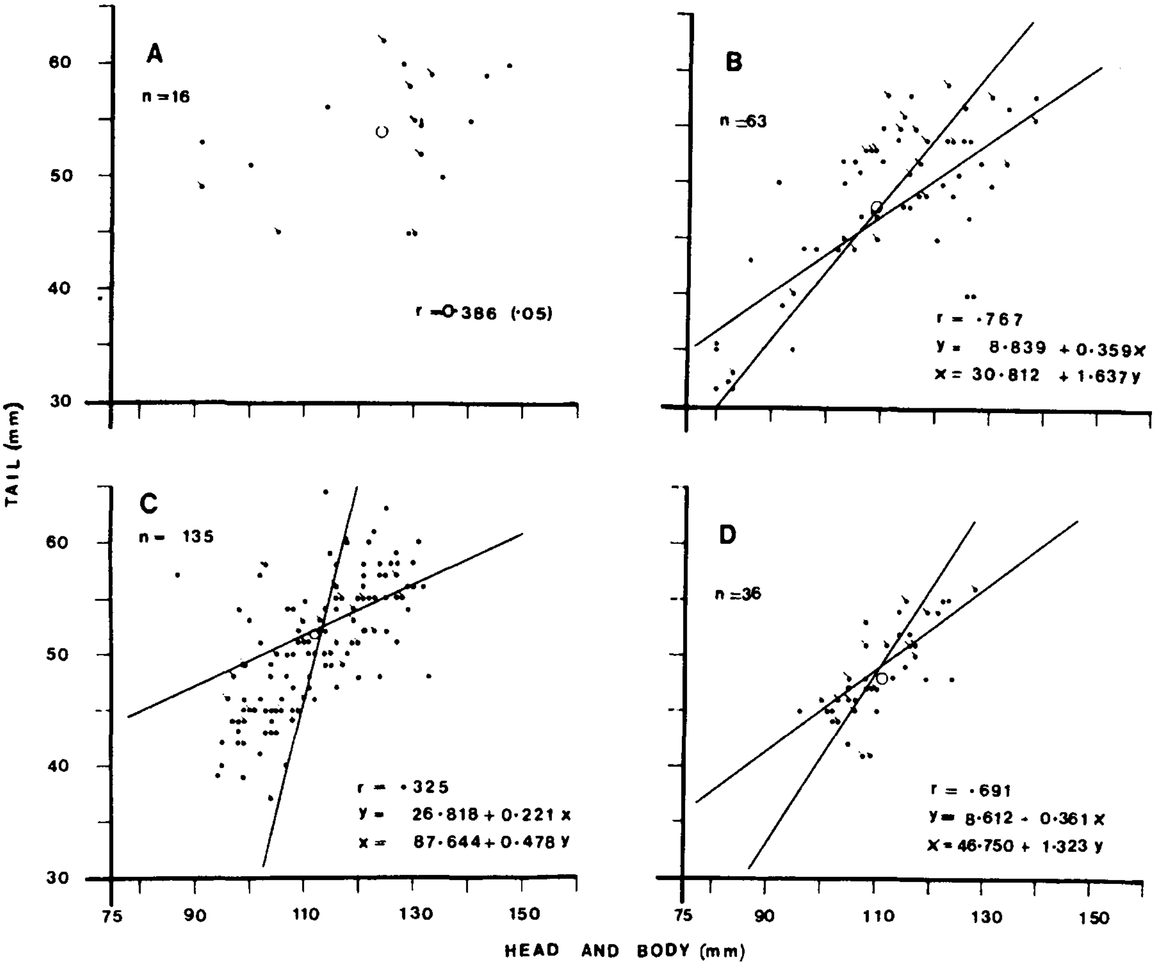


Fig. 37: Tail length of Saccostomus campestris on the study area, plotted seasonally against head and body length. Regression lines, equations and correlation coefficient (r) of the relationships for sexes combined are indicated (A = spring; B = summer; C = autumn; D = winter; O = mean of parameters; ● = males; ♦ = females).

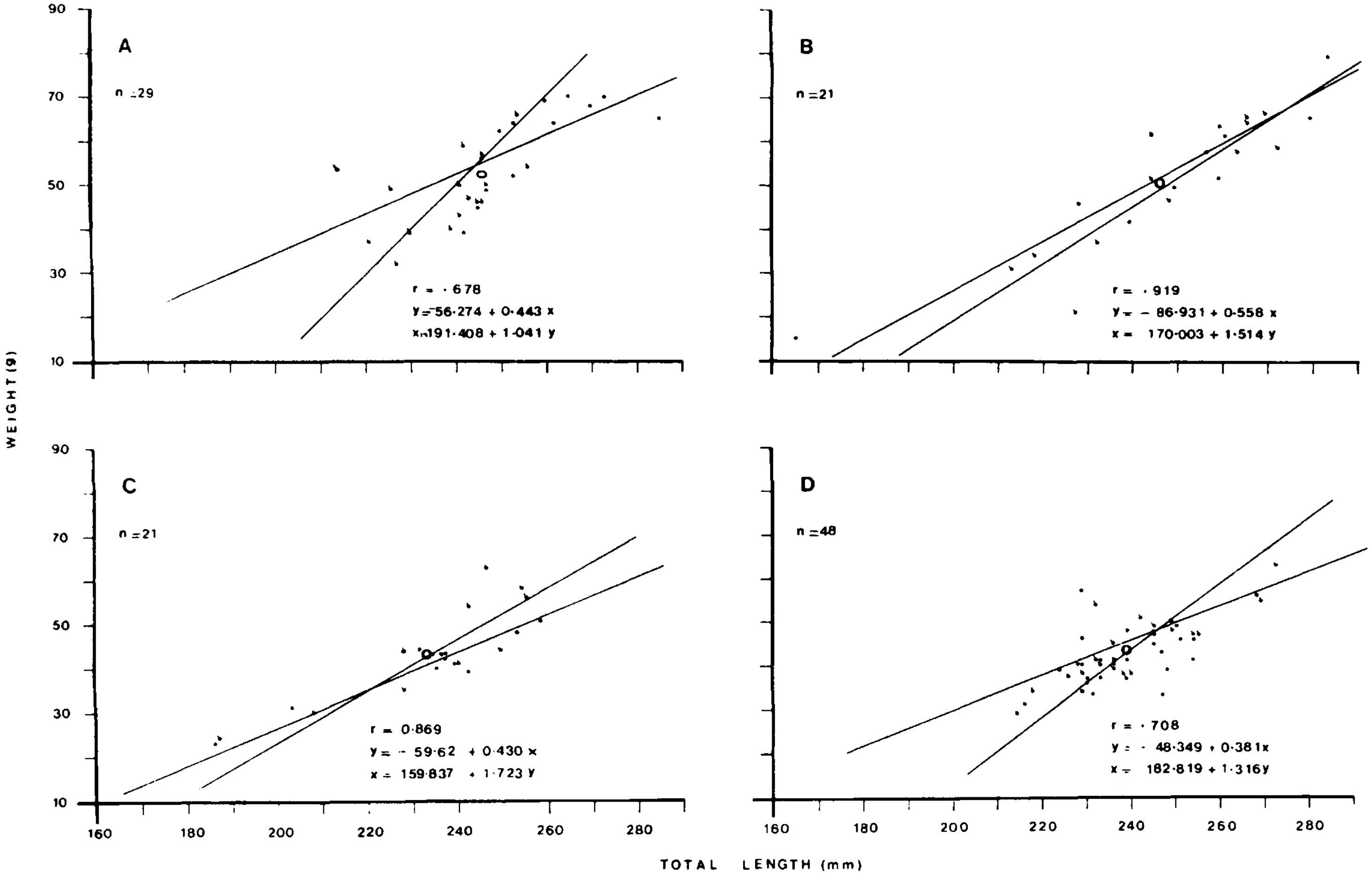


Fig. 38: Body mass (= weight in figure) of Lemniscomys griselda on the study area, plotted seasonally against total length. Regression lines, equations and correlation coefficients (r) of the relationships for sexes combined are indicated (A = spring; B = summer; C = autumn; D = winter; O = mean of parameters; ● = males; ◗ = females).

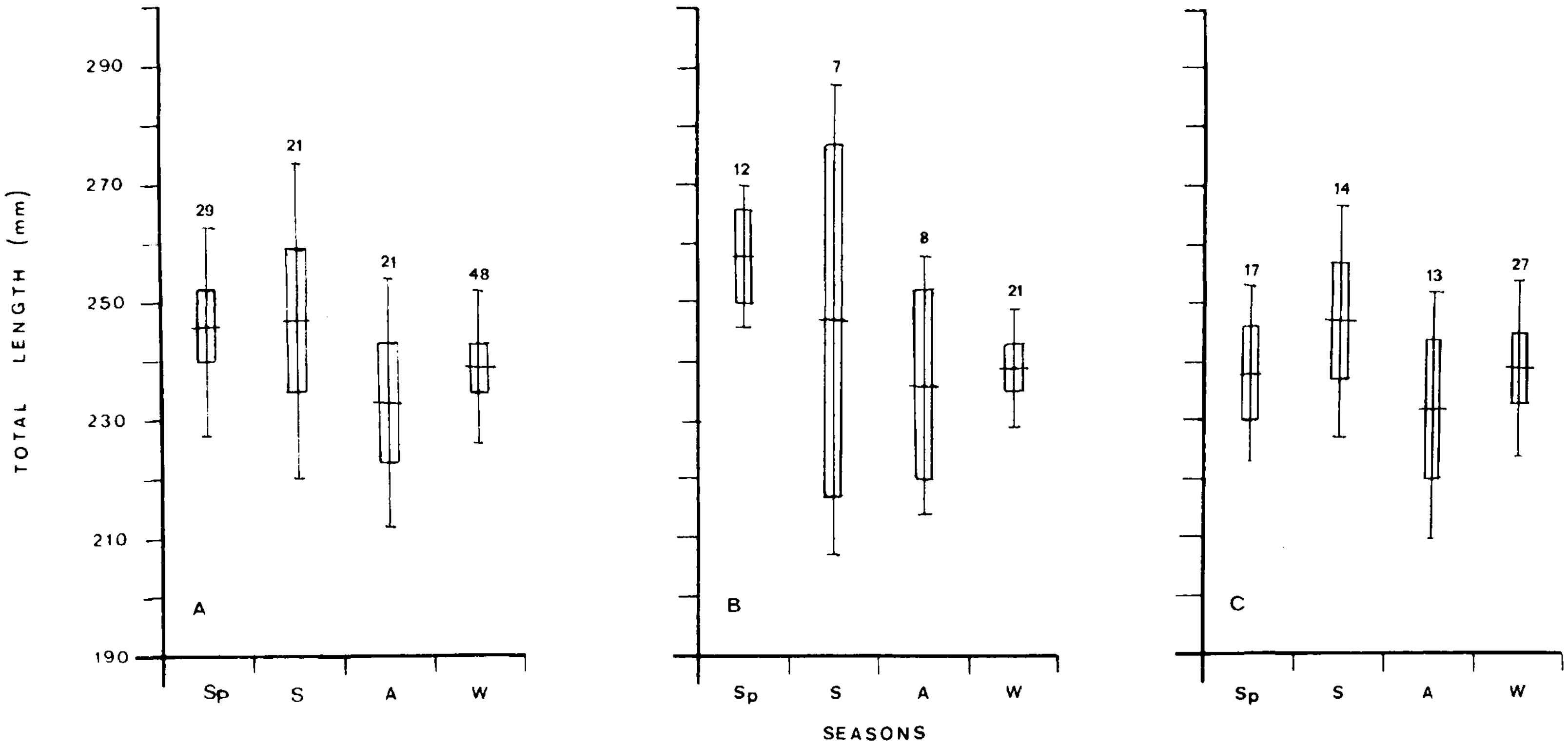


Fig. 39: Seasonal mean total length of *Lemniscomys griselda* observed on the study area. A = both sexes; B = males; C = females; horizontal line = arithmetic mean; vertical line = mean ± one standard deviation; open bar = mean ± two standard errors. The sample size for each season are indicated above each vertical line.

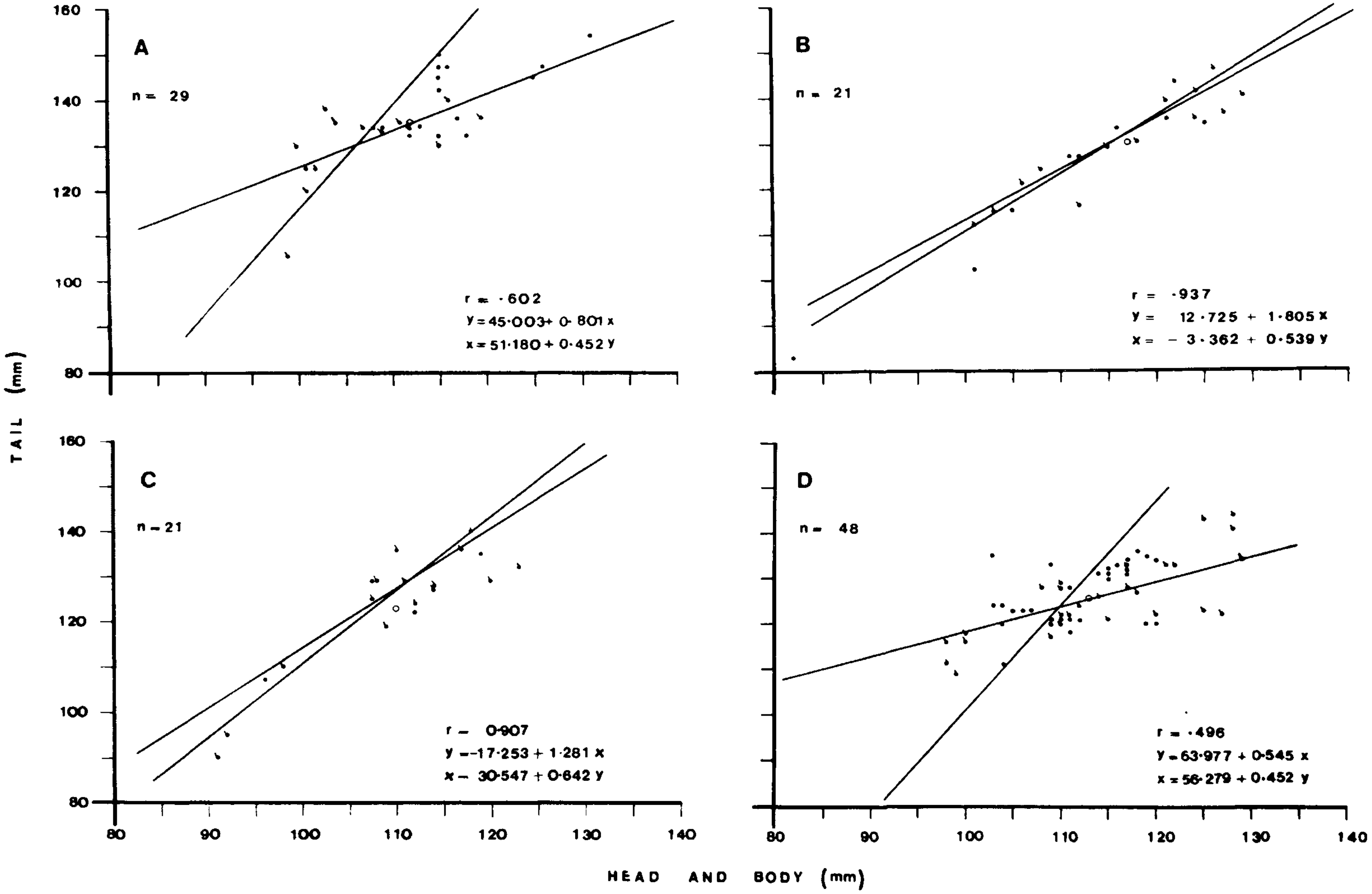


Fig. 40: Tail length of Lemniscomys griselda on the study area, plotted seasonally against head and body length. Regression lines, equations and correlation coefficients (r) of the relationships for sexes combined are indicated (A = spring; B = summer; C = autumn; D = winter; O = mean of parameters; ● = males; ♀ = females).

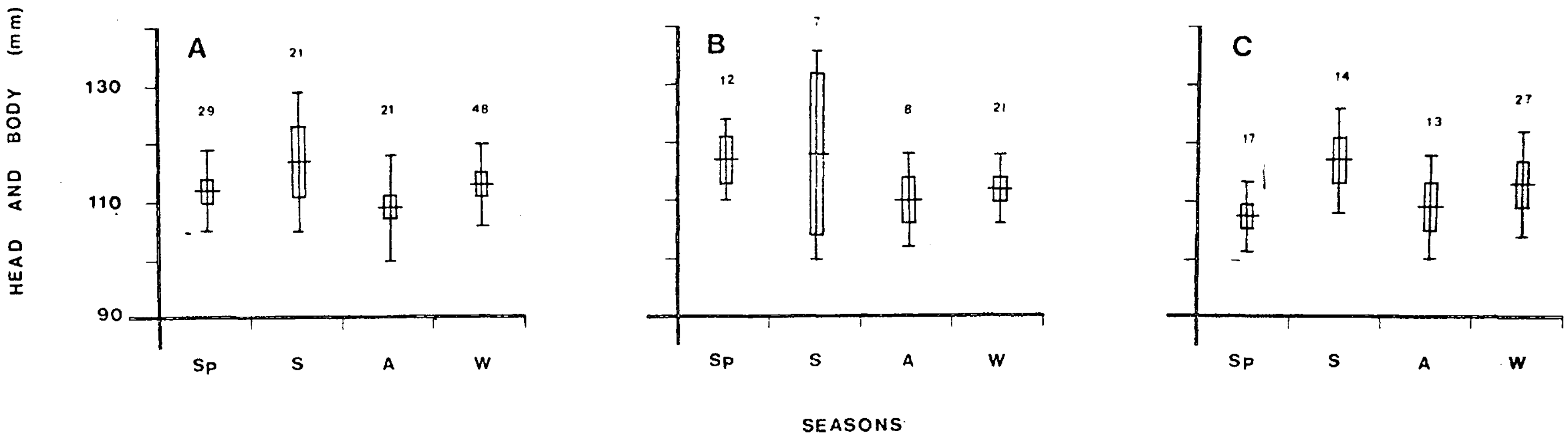


Fig. 41: Seasonal mean head and body length of Lemniscomys griselda observed on the study area. A = both sexes; B = males; C = females; horizontal line = arithmetic mean; vertical line = mean ± one standard deviation; open bar = mean ± two standard errors. The sample size for each season are indicated above each vertical line.

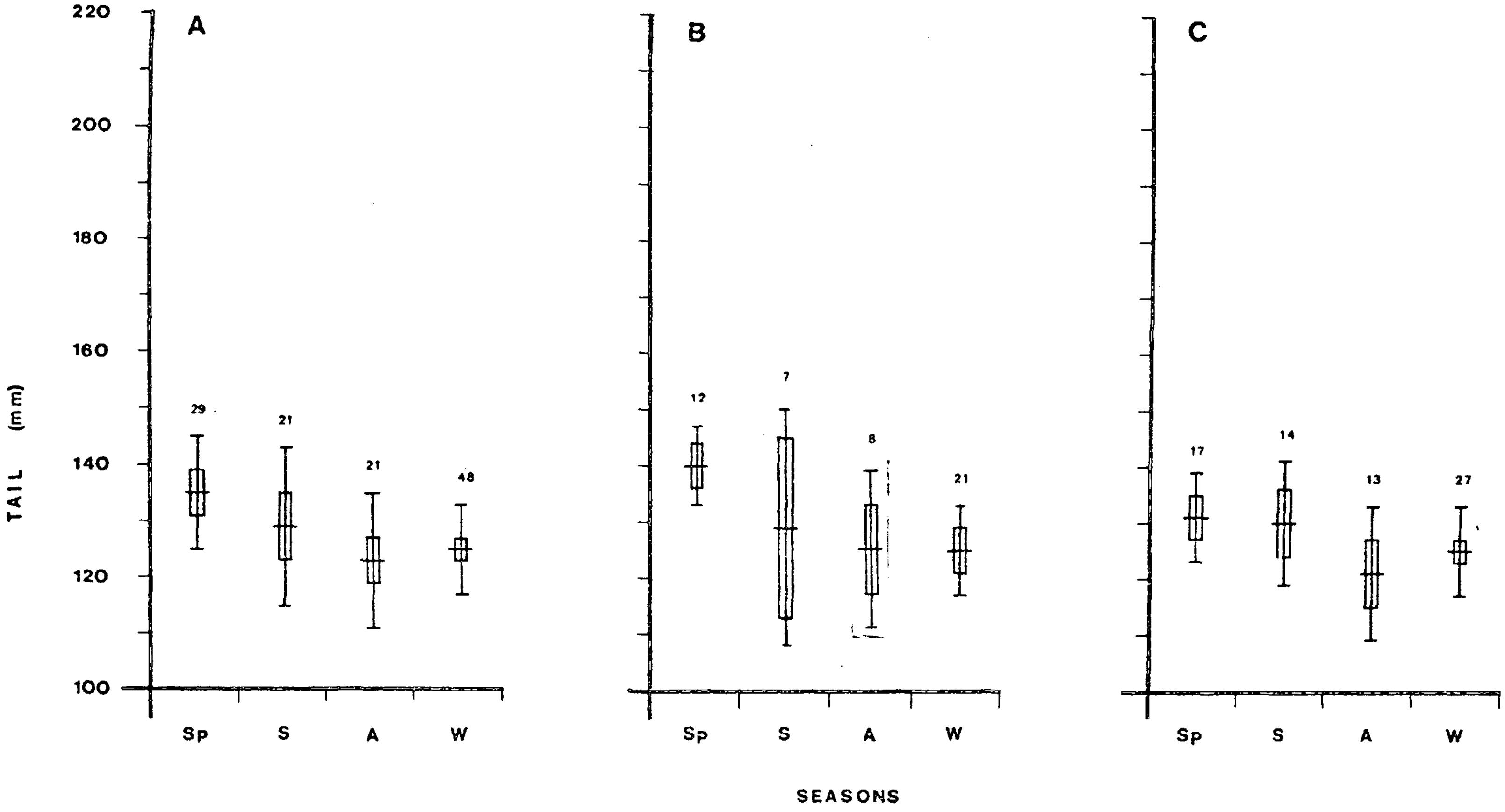


Fig. 42: Seasonal mean tail length of <u>Lemniscomys griselda</u> observed on the study area. A = both sexes; B = males; C = females; horizontal line = arithmetic mean; vertical line = mean ± one standard deviation; open bar = mean ± two standard errors. The sample size for each season are indicated above each vertical line.

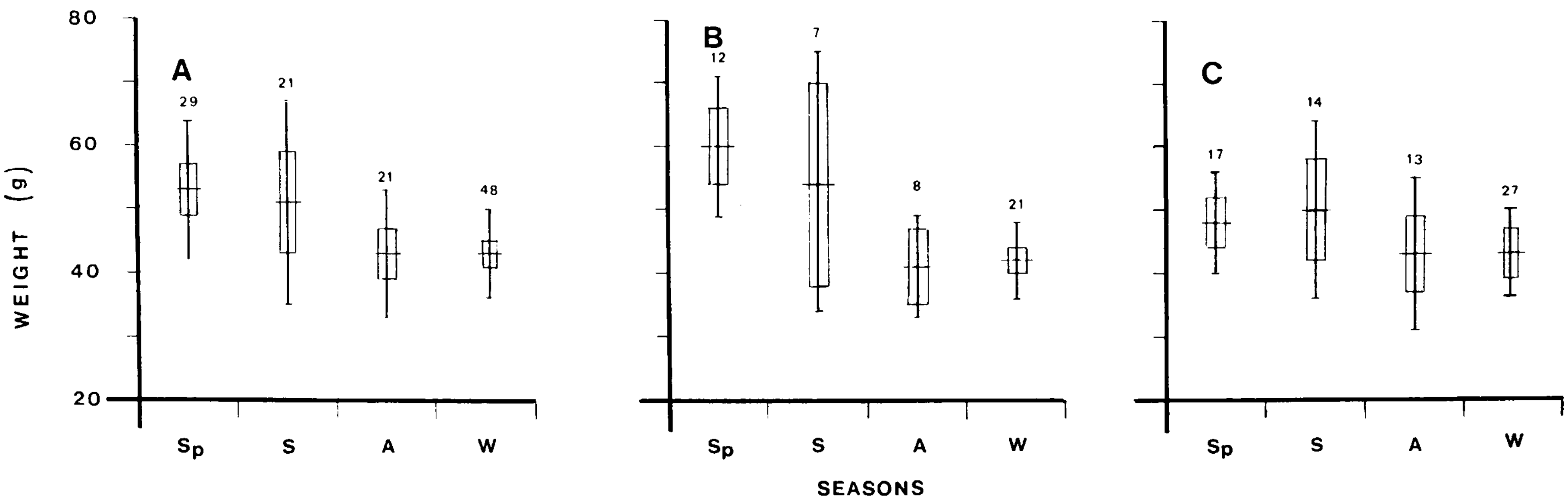


Fig. 43: Seasonal mean body mass (= weight in figure) of *Lemniscomys griselda* observed on the study area. A = both sexes; B = males; C = females; horizontal line = arithmetic mean; vertical line = mean ± one standard deviation; open bar = mean ± two standard errors. The sample size for each season are indicated above each vertical line.

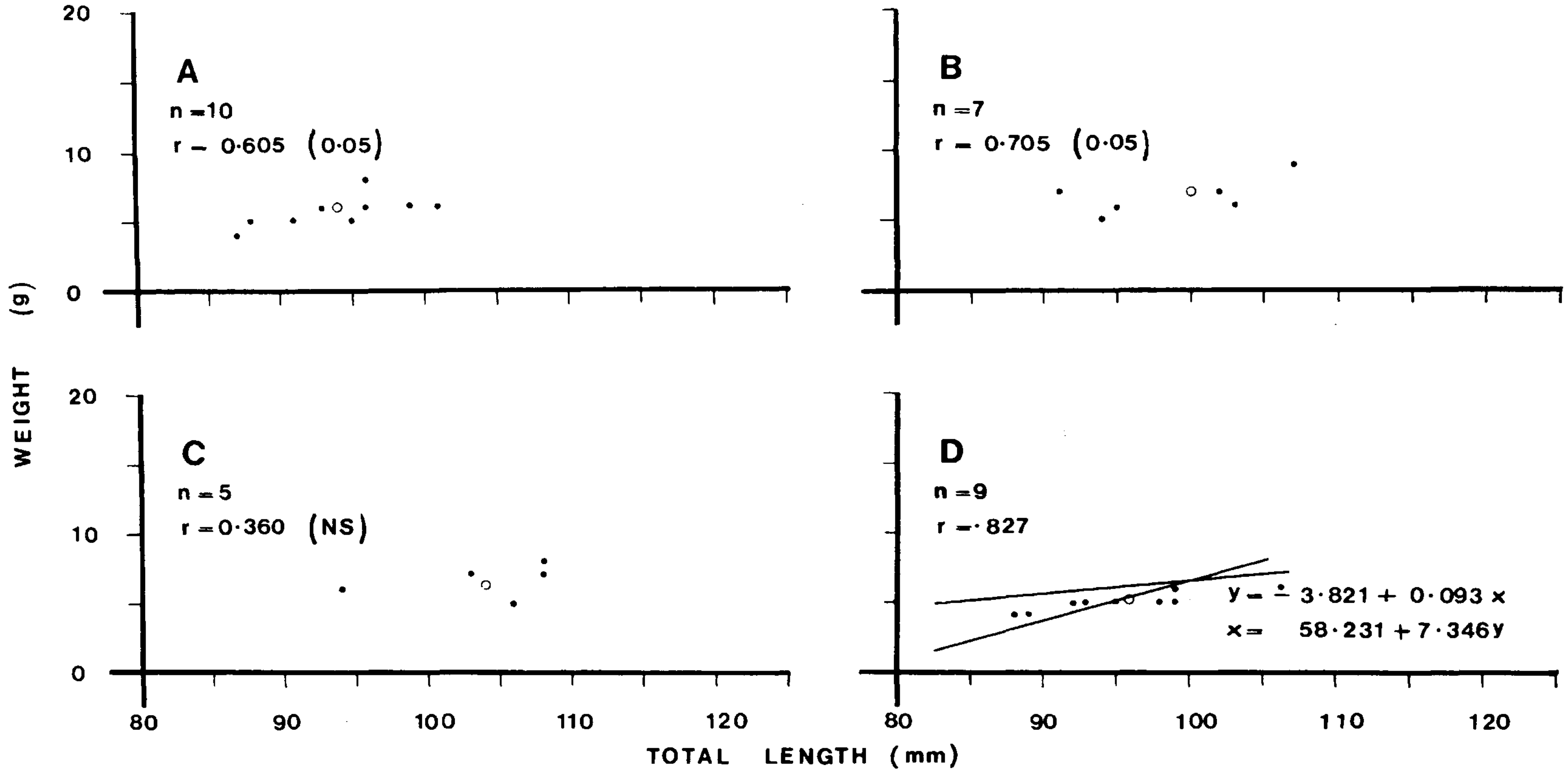


Fig. 44: Body mass (= weight in figure) of <u>Leggada minutoides</u> on the study area, plotted seasonally against total length. Regression lines, equations, and correlation coefficients (r) of the relationships for sexes combined are indicated (A = spring; B = summer; C = autumn; D = winter; O = mean of parameters).

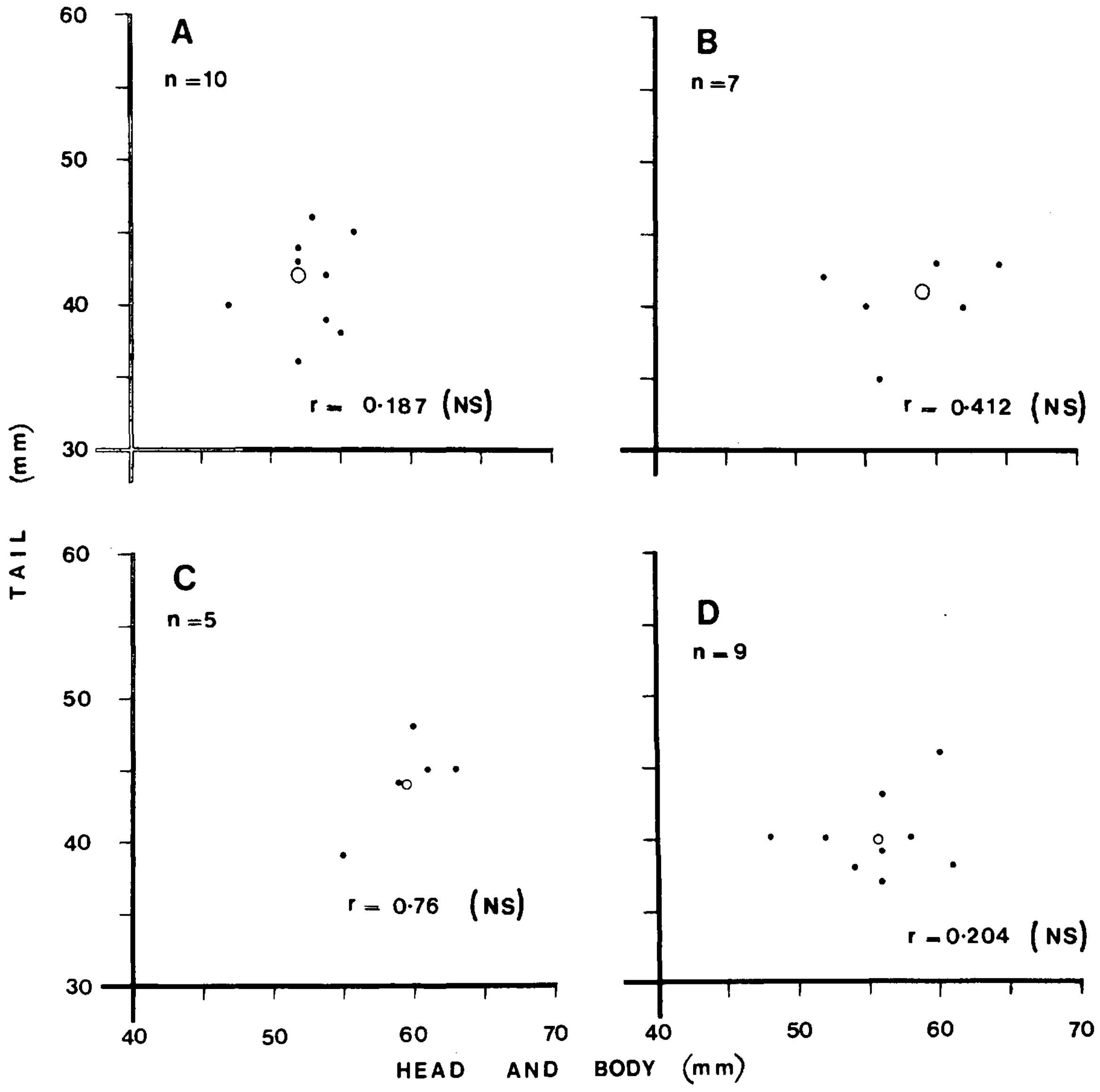


Fig. 45: Tail length of Leggada minutoides on the study area, plotted seasonally against head and body length. Regression lines, equations, and correlation coefficients (r) of the relationships for sexes combined are indicated (A = springs; B = summer; C = autumn; D = winter; O = mean of parameters).

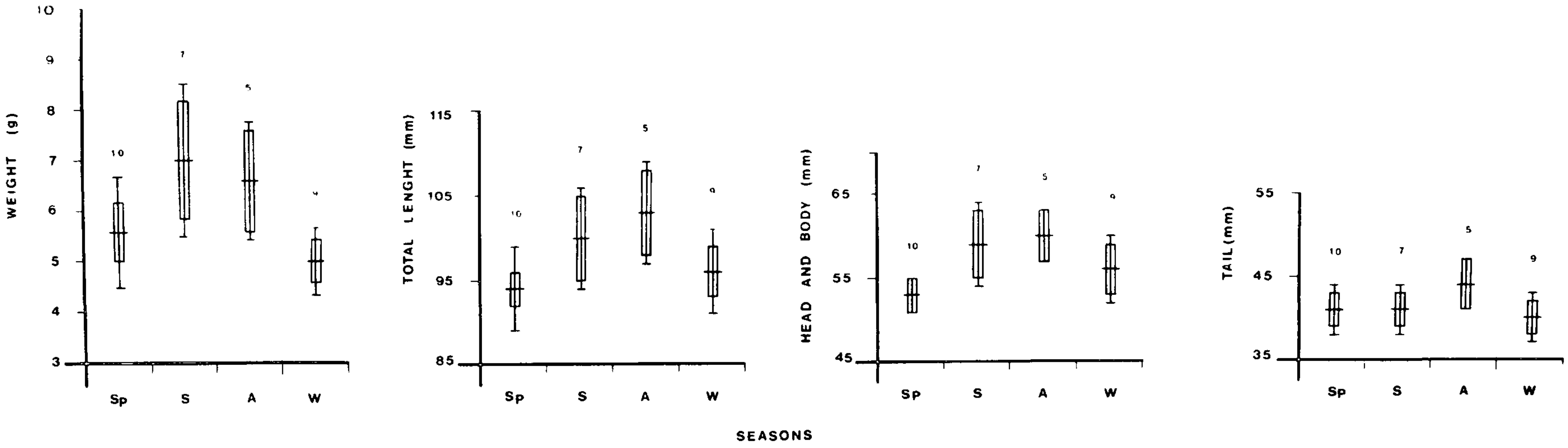


Fig. 46: Seasonal mean total length, tail length, head and body length, and body mass (= weight in figure) of *Leggada minutoides* (both sexes) observed on the study area. Horizontal line = arithmetic mean; vertical lines = mean ± one standard deviation; open bar = mean ± two standard errors. The sample size for each season is indicated above each vertical line.

Table 1 The highest monthly maximum, mean maximum, lowest minimum, mean minimum, and the monthly mean temperatures in degrees centigrade recorded on the study area between October 1966 and May 1969.

| Year | Month | Highest max.(°C) | Mean max.(°C) | Lowest min.(°C) | Mean min.(°C) | Mean Temp.(°C) |
|---|---|---|---|---|---|---|
| 1966 | Oct. | 32,2 | 28,4 | 10,7 | 14,8 | 19,8 |
| | Nov. | 34,8 | 29,6 | 14,5 | 16,6 | 22,5 |
| | Dec. | 33,2 | 29,3 | 15,2 | 17,7 | 22,7 |
| 1967 | Jan. | 34,0 | 26,7 | 14,5 | 17,6 | 22,5 |
| | Feb. | 34,8 | 29,7 | 16,6 | 18,6 | 23,5 |
| | March | 30,5 | 26,6 | 12,9 | 16,6 | 20,9 |
| | April | 31,6 | 28,2 | 11,1 | 13,2 | 19,8 |
| | May | 27,0 | 23,5 | 3,8 | 6,3 | 14,1 |
| | June | 27,7 | 23,8 | 0,8 | 4,2 | 13,2 |
| | July | 26,8 | 22,2 | -0,1 | 2,8 | 12,1 |
| | Aug. | 31,3 | 25,1 | 2,0 | 6,2 | 15,5 |
| | Sept. | 33,0 | 28,1 | 5,9 | 11,7 | 19,1 |
| | Oct. | 34,8 | 28,1 | 14,1 | 16,9 | 23,9 |
| | Nov. | 34,5 | 28,6 | 15,8 | 18,1 | 24,8 |
| | Dec. | 32,6 | 31,9 | 15,6 | 18,4 | 23,6 |
| 1968 | Jan. | 36,6 | 30,6 | 17,6 | 20,3 | 25,2 |
| | Feb. | 35,6 | 31,9 | 17,6 | 19,9 | 24,1 |
| | March | 30,6 | 27,1 | 16,8 | 18,6 | 23,9 |
| | April | 32,1 | 26,4 | 12,4 | 15,5 | 20,4 |
| | May | 30,2 | 26,2 | 8,8 | 11,8 | 18,3 |
| | June | 26,0 | 23,3 | 1,1 | 4,1 | 13,1 |
| | July | 30,6 | 25,9 | 2,6 | 5,4 | 15,0 |
| | Aug. | 31,6 | 25,8 | 3,9 | 9,2 | 18,1 |
| | Sept. | 34,2 | 26,8 | 9,2 | 13,0 | 19,5 |
| | Oct. | 36,1 | 28,3 | 11,1 | 14,1 | 20,4 |
| | Nov. | 35,3 | 27,0 | 12,3 | 17,4 | 20,4 |
| | Dec. | 38,9 | 33,6 | 17,9 | 19,8 | 25,7 |
| 1969 | Jan. | 40,5 | 33,6 | 18,0 | 19,7 | 25,9 |
| | Feb. | 38,3 | 33,9 | 18,7 | 21,4 | 26,3 |
| | March | 32,8 | 28,1 | 16,8 | 17,9 | 23,8 |
| | April | 30,8 | 26,4 | 13,0 | 15,3 | 19,4 |
| | May | 28,2 | 24,2 | 9,0 | 11,7 | 17,1 |

Table 2 The highest maximum, mean maximum, lowest minimum, mean minimum, and mean relative humidity recorded on the study area between October 1966 and May 1969.

| Year | Month | Highest max.(%) | Mean max.(%) | Lowest min.(%) | Mean min.(%) | Mean Rel. hum.(%) |
|---|---|---|---|---|---|---|
| 1966 | Oct. | 96,3 | 89,5 | 31,3 | 46,2 | 68,6 |
| | Nov. | 96,0 | 90,3 | 33,2 | 44,6 | 66,9 |
| | Dec. | 96,2 | 93,7 | 37,2 | 49,9 | 72,9 |
| 1967 | Jan. | 96,7 | 92,7 | 36,5 | 48,5 | 72,8 |
| | Feb. | 96,2 | 94,7 | 35,5 | 49,7 | 74,5 |
| | March | 97,7 | 96,2 | 44,0 | 56,5 | 80,6 |
| | April | 98,0 | 96,1 | 32,7 | 43,8 | 72,4 |
| | May | 97,5 | 95,8 | 26,0 | 38,0 | 70,8 |
| | June | 97,0 | 95,0 | 21,3 | 33,3 | 66,2 |
| | July | 96,7 | 93,4 | 21,2 | 32,9 | 63,9 |
| | Aug. | 96,2 | 91,8 | 21,7 | 33,2 | 62,8 |
| | Sept. | 94,0 | 89,8 | 21,0 | 31,2 | 61,3 |
| | Oct. | 92,2 | 88,2 | 23,0 | 40,1 | 65,3 |
| | Nov. | 96,4 | 72,7 | 32,4 | 45,9 | 69,4 |
| | Dec. | 99,2 | 95,0 | 35,4 | 45,3 | 70,3 |
| 1968 | Jan. | 100,0 | 95,6 | 33,7 | 45,6 | 71,5 |
| | Feb. | 99,2 | 94,5 | 35,4 | 46,3 | 72,3 |
| | March | 98,2 | 95,5 | 40,5 | 48,6 | 74,3 |
| | April | 98,2 | 93,8 | 28,5 | 41,0 | 68,8 |
| | May | 99,0 | 94,8 | 24,2 | 35,2 | 67,0 |
| | June | 99,0 | 90,5 | 20,7 | 28,9 | 58,0 |
| | July | 97,7 | 93,4 | 21,7 | 30,9 | 62,1 |
| | Aug. | 99,2 | 94,8 | 25,2 | 41,5 | 68,4 |
| | Sept. | 95,2 | 89,9 | 23,4 | 41,6 | 65,2 |
| | Oct. | 98,0 | 90,2 | 26,4 | 43,3 | 67,1 |
| | Nov. | 97,0 | 93,8 | 30,5 | 45,4 | 69,7 |
| | Dec. | 96,0 | 88,6 | 25,7 | 36,8 | 63,4 |
| 1969 | Jan. | 95,0 | 88,9 | 28,7 | 41,8 | 65,3 |
| | Feb. | 93,0 | 87,2 | 30,0 | 41,7 | 64,4 |
| | March | 95,0 | 92,3 | 39,0 | 54,1 | 72,2 |
| | April | 95,0 | 92,8 | 37,5 | 49,1 | 69,4 |
| | May | 95,0 | 93,0 | 42,0 | 43,8 | 70,6 |

Table 3 Monthly rainfall (in mm) on the study area between September 1967 and May 1969, and at Pongola Gorge (27°26'S,32°4'E), between January 1966 and May 1969.

| Year | Month | Study area | Pongola Gorge |
|---|---|---|---|
| 1966 | Jan. | - | 251,5 |
| | Feb. | - | 83,2 |
| | March | - | 19,5 |
| | April | - | 18,7 |
| | May | - | 21,6 |
| | June | - | 8,2 |
| | July | - | 0,0 |
| | Aug. | - | 17,7 |
| | Sept. | - | 5,5 |
| | Oct. | - | 15,5 |
| | Nov. | - | 60,8 |
| | Dec. | - | 55,2 |
| | Total | - | 563,4 |
| 1967 | Jan. | - | 86,1 |
| | Feb. | - | 204,8 |
| | March | - | 28,6 |
| | April | - | 76,4 |
| | May | - | 30,5 |
| | June | - | 1,4 |
| | July | - | 9,8 |
| | Aug. | - | 1,9 |
| | Sept. | 18,3 | 19,3 |
| | Oct. | 37,7 | 49,5 |
| | Nov. | 99,1 | 98,0 |
| | Dec. | 26,5 | 8,9 |
| | Total | - | 615,2 |
| 1968 | Jan. | 82,1 | 26,6 |
| | Feb. | 67,9 | 87,8 |
| | March | 40,1 | 105,6 |
| | April | 36,0 | 13,2 |
| | May | 1,7 | 3,0 |
| | June | 0,5 | 3,2 |
| | July | 0,0 | 23,2 |
| | Aug. | 16,9 | 14,4 |
| | Sept. | 2,9 | 1,2 |
| | Oct. | 24,3 | 28,4 |
| | Nov. | 45,1 | 52,0 |
| | Dec. | 9,9 | 44,5 |
| | Total | 327,4 | 403,1 |
| 1969 | Jan. | 69,8 | 73,7 |
| | Feb. | 12,7 | 22,9 |
| | March | 156,6 | 135,1 |
| | April | 59,0 | 76,9 |
| | May | 44,7 | 47,7 |
| | Total | 342,8 | 356,3 |

Table 4 The number of animals of each species and sex captured for the first time, and the total number captured during each trapping period from April 1967 to May 1969 in grid P88 on the study area near Pongola in northern Zululand. The % of the total population comprised by each species for each trapping period is indicated (M = males; F = females; T = both sexes).

| Trapping period | Total population | | | | | | *Praomys (M.) natalensis* | | | | | | | *Lemniscomys griselda* | | | | | | | *Saccostomus campestris* | | | | | | | *Leggada minutoides* | | | | | | | *Steatomys pratensis* | | | | | | | *Aethomys chrysophilus* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | First capt. | | | Total capt. | | | First capt. | | | Total capt. | | | | First capt. | | | Total capt. | | | | First capt. | | | Total capt. | | | | First capt. | | | Total capt. | | | | First capt. | | | Total capt. | | | | First capt. | | | Total capt. | | | |
| | M | F | T | M | F | T | M | F | T | M | F | T | % | M | F | T | M | F | T | % | M | F | T | M | F | T | % | M | F | T | M | F | T | % | M | F | T | M | F | T | % | M | F | T | M | F | T | % |
| 26. 4.67- 1. 5.67 | - | - | 26 | - | - | 26 | - | - | 17 | - | - | 17 | 65 | - | - | 2 | - | - | 2 | 8 | - | - | 3 | - | - | 3 | 12 | - | - | 1 | - | - | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - | 3 | - | - | 3 | 12 |
| 12. 9.67-15. 9.67 | 4 | 3 | 7 | 4 | 3 | 7 | 3 | 2 | 5 | 3 | 2 | 5 | 71 | 1 | 0 | 1 | 1 | 0 | 1 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.10.67- 4.10.67 | 3 | 3 | 6 | 5 | 4 | 9 | 3 | 3 | 6 | 5 | 4 | 9 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 29.10.67- 1.11.67 | 1 | 4 | 5 | 5 | 6 | 11 | 1 | 1 | 2 | 4 | 3 | 7 | 64 | 0 | 1 | 1 | 0 | 1 | 1 | 9 | 0 | 1 | 1 | 0 | 1 | 1 | 9 | 0 | 1 | 1 | 0 | 1 | 1 | 9 | 0 | 0 | 0 | 1 | 0 | 1 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6.12.67- 9.12.67 | 0 | 1 | 1 | 1 | 2 | 3 | 0 | 0 | 0 | 1 | 0 | 1 | 33 | 0 | 1 | 1 | 0 | 1 | 1 | 33 | 0 | 0 | 0 | 0 | 1 | 1 | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 27. 1.68-30. 1.68 | 2 | 1 | 3 | 2 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 2 | 0 | 2 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13. 2.68-16. 2.68 | 4 | 1 | 5 | 5 | 4 | 9 | 0 | 1 | 1 | 0 | 1 | 1 | 11 | 0 | 0 | 0 | 1 | 1 | 2 | 22 | 3 | 1 | 4 | 4 | 2 | 6 | 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26. 4.68-29. 4.68 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26. 5.68-29. 5.68 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16. 6.68-18. 6.68 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11. 7.68-13. 7.68 | 0 | 1 | 1 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3. 9.68- 6. 9.68 | 0 | 1 | 1 | 0 | 2 | 2 | 0 | 1 | 1 | 0 | 2 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19.11.68-22.11.68 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15. 2.69-17. 2.69 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4. 5.69- 6. 5.69 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7. 5.69- 9. 5.69 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 5 The number of animals of each species and sex captured for the first time, and the total number captured during each trapping period from May 1967 to May 1969 in grid P89 on the study area. The percentage of the total population comprised by each species for each trapping period is indicated (M = males; F = females; T = both sexes).

| Trapping period | Total Population | | | | | | *Praomys* (*M.*) *natalensis* | | | | | | | *Lemniscomys griselda* | | | | | | | *Saccostomus campestris* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | First capt. | | | Total capt. | | | First capt. | | | Total capt. | | | | First capt. | | | Total capt. | | | | First capt. | | | Total capt. | | | |
| | M | F | T | M | F | T | M | F | T | M | F | T | % | M | F | T | M | F | T | % | M | F | T | M | F | T | % |
| 4. 5.67- 8. 5.67 | - | - | 25 | - | - | 25 | - | - | 13 | - | - | 13 | 52 | - | - | 3 | - | - | 3 | 12 | - | - | 1 | - | - | 1 | 4 |
| 6. 9.67- 9. 9.67 | 9 | 11 | 20 | 9 | 11 | 20 | 6 | 6 | 12 | 6 | 6 | 12 | 60 | 1 | 1 | 2 | 1 | 1 | 2 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 27. 9.67-30. 9.67 | 6 | 2 | 8 | 8 | 5 | 13 | 3 | 1 | 4 | 4 | 4 | 8 | 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 0 | 2 | 15 |
| 25.10.67-28.10.67 | 6 | 3 | 9 | 9 | 6 | 15 | 4 | 2 | 6 | 6 | 5 | 11 | 73 | 1 | 1 | 2 | 1 | 1 | 2 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2.12.67- 5.12.67 | 0 | 0 | 0 | 4 | 2 | 6 | 0 | 0 | 0 | 2 | 2 | 4 | 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 27. 1.68-30. 1.68 | 2 | 4 | 6 | 5 | 5 | 10 | 0 | 0 | 0 | 1 | 1 | 2 | 20 | 1 | 1 | 2 | 1 | 2 | 3 | 30 | 2 | 1 | 3 | 2 | 1 | 3 | 30 |
| 13. 2.68-16. 2.68 | 4 | 5 | 9 | 5 | 7 | 12 | 1 | 0 | 1 | 2 | 1 | 3 | 25 | 0 | 2 | 2 | 0 | 2 | 2 | 17 | 3 | 2 | 5 | 3 | 3 | 6 | 50 |
| 22. 4.68-25. 4.68 | 3 | 1 | 4 | 3 | 1 | 4 | 1 | 0 | 1 | 1 | 0 | 1 | 25 | 0 | 1 | 1 | 0 | 1 | 1 | 25 | 2 | 0 | 2 | 2 | 0 | 2 | 50 |
| 14. 5.68-17. 5.68 | 0 | 2 | 2 | 0 | 2 | 2 | 0 | 1 | 1 | 0 | 1 | 1 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 27. 6.68-30. 6.68 | 1 | 2 | 3 | 1 | 3 | 4 | 0 | 2 | 2 | 0 | 3 | 3 | 75 | 1 | 0 | 1 | 1 | 0 | 1 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14. 7.68-17. 7.68 | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3. 9.68- 6. 9.68 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19.11.68-22.11.68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15. 2.69-17. 2.69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4. 5.69- 6. 5.69 | 1 | 1 | 2 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 50 |
| 7. 5.69- 9. 5.69 | 1 | 1 | 2 | 1 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 1 | 2 | 3 | 100 |

| Trapping period | *Leggada minutoides* | | | | | | | *Steatomys pratensis* | | | | | | | *Aethomys chrysophilus* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | First capt. | | | Total capt. | | | | First capt. | | | Total capt. | | | | First capt. | | | Total capt. | | | |
| | M | F | T | M | F | T | % | M | F | T | M | F | T | % | M | F | T | M | F | T | % |
| 4. 5.67- 8. 5.67 | - | - | 6 | - | - | 6 | 24 | - | - | 2 | - | - | 2 | 8 | - | - | - | - | - | - | - |
| 6. 9.67- 9. 9.67 | 0 | 4 | 4 | 0 | 4 | 4 | 20 | 2 | 0 | 2 | 2 | 0 | 2 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 27. 9.67-30. 9.67 | 2 | 1 | 3 | 2 | 1 | 3 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25.10.67-28.10.67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 0 | 2 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2.12.67- 5.12.67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 27. 1.68-30. 1.68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13. 2.68-16. 2.68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22. 4.68-25. 4.68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14. 5.68-17. 5.68 | 0 | 1 | 1 | 0 | 1 | 1 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 27. 6.68-30. 6.68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14. 7.68-17. 7.68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3. 9.68- 6. 9.68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19.11.68-22.11.68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15. 2.69-17. 2.69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4. 5.69- 6. 5.69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 50 |
| 7. 5.69- 9. 5.69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 6 The number of animals of each species and sex captured for the first time, and the total number captured during each trapping period from August 1967 to May 1969 in grid P50 on the study area. The percentage of the total population comprised by each species for each trapping period is indicated (M = males; F = females; T = both sexes).

| Trapping period | Total Population | | | | | | *Praomys (M.) natalensis* | | | | | | | *Lemniscomys griselda* | | | | | | | *Saccostomus campestris* | | | | | | | *Leggada minutoides* | | | | | | | *Steatomys pratensis* | | | | | | | *Otomys angoniensis* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | First capt. | | | Total capt. | | | First capt. | | | Total capt. | | | | First capt. | | | Total capt. | | | | First capt. | | | Total capt. | | | | First capt. | | | Total capt. | | | | First capt. | | | Total capt. | | | | First capt. | | | Total capt. | | | |
| | M | F | T | M | F | T | M | F | T | M | F | T | % | M | F | T | M | F | T | % | M | F | T | M | F | T | % | M | F | T | M | F | T | % | M | F | T | M | F | T | % | M | F | T | M | F | T | % |
| 26.8.67-29.8.67 | 16 | 7 | 23 | 16 | 7 | 23 | 10 | 5 | 15 | 10 | 5 | 15 | 65 | 4 | 2 | 6 | 4 | 2 | 6 | 26 | 2 | 0 | 2 | 2 | 0 | 2 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23.9.67-26.9.67 | 7 | 9 | 16 | 11 | 12 | 23 | 5 | 3 | 8 | 8 | 6 | 14 | 60 | 1 | 4 | 5 | 1 | 4 | 5 | 21 | 1 | 1 | 2 | 2 | 1 | 3 | 13 | 0 | 1 | 1 | 0 | 1 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21.10.67-24.10.67 | 8 | 5 | 13 | 16 | 12 | 28 | 5 | 3 | 8 | 11 | 7 | 18 | 64 | 0 | 0 | 0 | 0 | 1 | 1 | 4 | 1 | 1 | 2 | 3 | 2 | 5 | 18 | 1 | 1 | 2 | 1 | 2 | 3 | 11 | 1 | 0 | 1 | 1 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28.11.67-1.12.67 | 8 | 4 | 12 | 13 | 7 | 20 | 6 | 2 | 8 | 9 | 5 | 14 | 70 | 0 | 1 | 1 | 0 | 1 | 1 | 5 | 2 | 0 | 2 | 2 | 0 | 2 | 10 | 0 | 1 | 1 | 1 | 1 | 2 | 10 | 0 | 0 | 0 | 1 | 0 | 1 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17.1.68-20.1.68 | 1 | 4 | 5 | 6 | 9 | 15 | 0 | 1 | 1 | 4 | 5 | 9 | 60 | 0 | 1 | 1 | 0 | 1 | 1 | 7 | 1 | 2 | 3 | 1 | 2 | 3 | 20 | 0 | 0 | 0 | 1 | 1 | 2 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6.2.68 - 9.2.68 | 11 | 6 | 17 | 16 | 10 | 26 | 4 | 1 | 5 | 7 | 5 | 12 | 46 | 0 | 1 | 1 | 1 | 1 | 2 | 8 | 6 | 4 | 10 | 6 | 4 | 10 | 38 | 1 | 0 | 1 | 2 | 0 | 2 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14.4.68-17.4.68 | 6 | 2 | 8 | 8 | 4 | 12 | 1 | 0 | 1 | 2 | 1 | 3 | 25 | 1 | 1 | 2 | 1 | 1 | 2 | 17 | 4 | 1 | 5 | 5 | 2 | 7 | 58 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4.5.68 - 7.5.68 | 3 | 8 | 11 | 6 | 13 | 19 | 0 | 1 | 1 | 0 | 2 | 2 | 11 | 1 | 2 | 3 | 2 | 2 | 4 | 21 | 2 | 5 | 7 | 4 | 9 | 13 | 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22.5.68-25.5.68 | 2 | 1 | 3 | 8 | 8 | 16 | 1 | 0 | 1 | 2 | 1 | 3 | 19 | 0 | 1 | 1 | 0 | 2 | 2 | 13 | 1 | 0 | 1 | 6 | 5 | 11 | 69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12.6.68-15.6.68 | 2 | 5 | 7 | 6 | 9 | 15 | 0 | 0 | 0 | 2 | 1 | 3 | 20 | 2 | 5 | 7 | 2 | 5 | 7 | 47 | 0 | 0 | 0 | 2 | 3 | 5 | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23.6.68-26.6.68 | 7 | 2 | 9 | 12 | 9 | 21 | 0 | 0 | 0 | 1 | 0 | 1 | 5 | 6 | 2 | 8 | 8 | 5 | 13 | 62 | 0 | 0 | 0 | 2 | 3 | 5 | 24 | 1 | 0 | 1 | 1 | 1 | 2 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7.7.68 -10.7.68 | 0 | 1 | 1 | 5 | 5 | 10 | 0 | 0 | 0 | 1 | 0 | 1 | 10 | 0 | 0 | 0 | 4 | 3 | 7 | 70 | 0 | 0 | 0 | 0 | 1 | 1 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 10 |
| 21.7.68-24.7.68 | 1 | 2 | 3 | 7 | 10 | 17 | 0 | 0 | 0 | 1 | 0 | 1 | 6 | 1 | 0 | 1 | 3 | 5 | 8 | 48 | 0 | 2 | 2 | 2 | 5 | 7 | 41 | 0 | 0 | 0 | 1 | 0 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30.8.68- 2.9.68 | 1 | 0 | 1 | 3 | 3 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 17 | 0 | 0 | 0 | 1 | 2 | 3 | 50 | 1 | 0 | 1 | 2 | 0 | 2 | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23.11.68-26.11.68 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11.2.69-14.2.69 | 6 | 1 | 7 | 6 | 2 | 8 | 0 | 0 | 0 | 0 | 1 | 1 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 1 | 7 | 6 | 1 | 7 | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30.4.69- 3.5.69 | 2 | 1 | 3 | 2 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 3 | 2 | 1 | 3 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14.5.69-17.5.69 | 6 | 4 | 10 | 8 | 4 | 12 | 1 | 0 | 1 | 1 | 0 | 1 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 4 | 9 | 7 | 4 | 11 | 92 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 7 The number of animals of each species and sex captured for the first time, and the total number captured during each trapping period from May 1967 to May 1969 in grid P46 on the study area. The percentage of the total population comprised by each species for each trapping period is indicated.

| Trapping Period | Total Population | | | | | | *P. (M.) natalensis* | | | | | | | *Lemniscomys griselda* | | | | | | | *Saccostomus campestris* | | | | | | | *Leggada minutoides* | | | | | | | *Aethomys chrysophilus* | | | | | | | *Tatera brantsi* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | First capture | | | Total capture | | | First capture | | | Total capture | | | | First capture | | | Total capture | | | | First capture | | | Total capture | | | | First capture | | | Total capture | | | | First capture | | | Total capture | | | | First capture | | | Total capture | | | |
| | M | F | T | M | F | T | M | F | T | M | F | T | % | M | F | T | M | F | T | % | M | F | T | M | F | T | % | M | F | T | M | F | T | % | M | F | T | M | F | T | % | M | F | T | M | F | T | % |
| 30. 5.67 - 3. 6.67 | - | - | 177 | - | - | 177 | - | - | 153 | - | - | 153 | 86 | - | - | 6 | - | - | 6 | 3 | - | - | 18 | - | - | 18 | 10 | - | - | 0 | - | - | 0 | 0 | - | - | 0 | - | - | 0 | 0 | - | - | 0 | - | - | 0 | 0 |
| 19. 9.67 - 22. 9.67 | 22 | 8 | 30 | 22 | 8 | 30 | 17 | 4 | 21 | 17 | 4 | 21 | 70 | 4 | 3 | 7 | 4 | 3 | 7 | 23 | 0 | 1 | 1 | 0 | 1 | 1 | 3 | 1 | 0 | 1 | 1 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14.10.67 - 17.10.67 | 6 | 6 | 12 | 18 | 10 | 28 | 2 | 4 | 6 | 13 | 6 | 19 | 68 | 2 | 2 | 4 | 3 | 4 | 7 | 25 | 1 | 0 | 1 | 1 | 0 | 1 | 4 | 1 | 0 | 1 | 1 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2.11.67 - 5.11.67 | 8 | 5 | 13 | 19 | 11 | 30 | 5 | 2 | 7 | 15 | 6 | 21 | 70 | 3 | 1 | 4 | 4 | 2 | 6 | 20 | 0 | 1 | 1 | 0 | 1 | 1 | 3 | 0 | 1 | 1 | 0 | 2 | 2 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10.12.67 - 13.12.67 | 13 | 6 | 19 | 21 | 12 | 33 | 12 | 6 | 18 | 19 | 12 | 31 | 94 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 1 | 0 | 1 | 1 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23. 1.68 - 26. 1.68 | 19 | 6 | 25 | 27 | 15 | 42 | 10 | 2 | 12 | 17 | 10 | 27 | 64 | 2 | 1 | 3 | 3 | 1 | 4 | 10 | 7 | 3 | 10 | 7 | 3 | 10 | 24 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17. 2.68 - 20. 2.68 | 11 | 19 | 30 | 23 | 33 | 56 | 2 | 7 | 9 | 11 | 17 | 28 | 50 | 2 | 4 | 6 | 2 | 5 | 7 | 13 | 6 | 5 | 11 | 7 | 8 | 15 | 27 | 0 | 2 | 2 | 2 | 2 | 4 | 7 | 1 | 1 | 2 | 1 | 1 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18. 4.68 - 21. 4.68 | 18 | 20 | 38 | 24 | 24 | 48 | 8 | 7 | 15 | 9 | 9 | 18 | 38 | 1 | 3 | 4 | 1 | 4 | 5 | 10 | 9 | 10 | 19 | 14 | 10 | 24 | 50 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30. 4.68 - 3. 5.68 | 9 | 7 | 16 | 22 | 18 | 40 | 3 | 4 | 7 | 9 | 9 | 18 | 45 | 2 | 0 | 2 | 2 | 0 | 2 | 5 | 4 | 3 | 7 | 11 | 8 | 19 | 48 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18. 5.68 - 21. 5.68 | 5 | 5 | 10 | 15 | 11 | 26 | 0 | 0 | 0 | 3 | 2 | 5 | 19 | 3 | 5 | 8 | 4 | 5 | 9 | 35 | 1 | 0 | 1 | 7 | 3 | 10 | 38 | 1 | 0 | 1 | 1 | 1 | 2 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8. 6.68 - 11. 6.68 | 4 | 1 | 5 | 8 | 5 | 13 | 0 | 0 | 0 | 1 | 1 | 2 | 15 | 3 | 1 | 4 | 5 | 2 | 7 | 54 | 0 | 0 | 0 | 0 | 1 | 1 | 8 | 1 | 0 | 1 | 2 | 1 | 3 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19. 6.68 - 22. 6.68 | 2 | 2 | 4 | 9 | 7 | 16 | 0 | 0 | 0 | 1 | 1 | 2 | 13 | 1 | 1 | 2 | 1 | 3 | 4 | 25 | 0 | 1 | 1 | 4 | 3 | 7 | 44 | 1 | 0 | 1 | 3 | 0 | 3 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3. 7.68 - 6. 7.68 | 1 | 3 | 4 | 7 | 6 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 4 | 5 | 38 | 1 | 1 | 2 | 5 | 2 | 7 | 54 | 0 | 0 | 0 | 1 | 0 | 1 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17. 7.68 - 20. 7.68 | 2 | 0 | 2 | 3 | 4 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 3 | 4 | 57 | 0 | 0 | 0 | 2 | 1 | 3 | 43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7. 9.68 - 10. 9.68 | 2 | 0 | 2 | 3 | 1 | 4 | 1 | 0 | 1 | 1 | 0 | 1 | 25 | 0 | 0 | 0 | 0 | 1 | 1 | 25 | 1 | 0 | 1 | 1 | 0 | 1 | 25 | 0 | 0 | 0 | 1 | 0 | 1 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15.11.68 - 18.11.68 | 2 | 1 | 3 | 2 | 2 | 4 | 2 | 1 | 3 | 2 | 1 | 3 | 75 | 0 | 0 | 0 | 0 | 1 | 1 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18. 2.69 - 21. 2.69 | 1 | 0 | 1 | 3 | 1 | 4 | 0 | 0 | 0 | 2 | 1 | 3 | 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 25 |
| 26. 4.69 - 29. 4.69 | 11 | 5 | 16 | 11 | 5 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 6 | 11 | 3 | 14 | 11 | 3 | 14 | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10. 5.69 - 13. 5.69 | 4 | 3 | 7 | 9 | 8 | 17 | 0 | 1 | 1 | 0 | 1 | 1 | 6 | 0 | 0 | 0 | 0 | 1 | 1 | 6 | 4 | 1 | 5 | 9 | 5 | 14 | 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 6 |

Table 8 Results of chemical analyses of eight soil samples on an oven-dry basis taken from the four study grids. Values are indicated as percentages (The locations on the study area where the soil samples were taken are indicated in fig. 3).

| Grids | P50 | | P46 | | | | P88 and P89 | |
|---|---|---|---|---|---|---|---|---|
| Position of soil samples | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Depth in cm | 0-10 | 0-10 | 0-10 | 0-10 | 0-10 | 0-10 | 0-10 | 0-10 |
| pH | 5,7 | 6,0 | 6,5 | 6,2 | 5,6 | 5,9 | 6,3 | 6,6 |
| Resistance in ohms at 15.5°C | 810 | 810 | 380 | 420 | 590 | 590 | 449 | 370 |
| $CaCO_3$ | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| Phosphorus (as P) | 0,0007 | 0,0010 | 0,0012 | 0,0007 | 0,0015 | 0,0010 | 0,0014 | 0,0010 |
| Sodium (Na) | 0,006 | 0,005 | 0,007 | 0,006 | 0,009 | 0,012 | 0,006 | 0,007 |
| Potassium (K) | 0,034 | 0,029 | 0,036 | 0,047 | 0,041 | 0,060 | 0,019 | 0,038 |
| Calcium (Ca) | 0,075 | 0,136 | 0,279 | 0,225 | 0,110 | 0,152 | 0,320 | 0,272 |
| Magnesium (Mg) | 0,030 | 0,047 | 0,071 | 0,068 | 0,056 | 0,073 | 0,046 | 0,086 |
| Carbon (C) | 1,24 | 1,69 | 2,16 | 2,26 | 1,62 | 2,20 | 2,39 | 2,12 |
| Nitrogen (N) | 0,14 | 0,17 | 0,26 | 0,24 | 0,21 | 0,25 | 0,27 | 0,20 |
| C : N ratio | 8,86 | 9,94 | 8,31 | 9,42 | 7,71 | 8,80 | 8,85 | 10,60 |
| Incadescence loss | 5,65 | 6,67 | 7,18 | 7,83 | 5,99 | 7,35 | 7,37 | 12,27 |
| Humus | 2,15 | 2,82 | 3,74 | 3,91 | 2,80 | 3,81 | 4,03 | 3,67 |
| Org. Mat. | 2,36 | 3,11 | 4,11 | 4,30 | 3,08 | 4,19 | 4,44 | 4,03 |

Table 9 Analyses of eight soil samples taken from the four study grids. Water soluble cations and anions in 1 part soil + 5 parts water extract, as milliequavalents per 100 gram soil on an oven-dry basis (The locations on the study area where the soil samples were taken are indicated in fig. 3).

| Grids | P50 | | P46 | | | | P88 and P89 | |
|---|---|---|---|---|---|---|---|---|
| Position of soil samples | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Depth in cm | 0-10 | 0-10 | 0-10 | 0-10 | 0-10 | 0-10 | 0-10 | 0-10 |
| Cations $Na^+$ | 0,12 | 0,11 | 0,15 | 0,17 | 0,16 | 0,20 | 0,12 | 0,13 |
| $K^+$ | 0,09 | 0,09 | 0,12 | 0,18 | 0,13 | 0,19 | 0,04 | 0,09 |
| $Ca^{2+}$ | 0,08 | 0,14 | 0,37 | 0,26 | 0,14 | 0,17 | 0,40 | 0,33 |
| $Mg^{2+}$ | 0,02 | 0,00 | 0,04 | 0,07 | 0,00 | 0,00 | 0,04 | 0,09 |
| Sum of cations | 0,31 | 0,34 | 0,68 | 0,68 | 0,43 | 0,56 | 0,60 | 0,64 |
| Anions $Cl^-$ | 0,10 | 0,05 | 0,08 | 0,05 | 0,05 | 0,08 | 0,05 | 0,05 |
| $SO_4^{2+}$ | 0,05 | 0,00 | 0,00 | 0,05 | 0,10 | 0,00 | 0,16 | 0,16 |
| $CO_3^{2-}$ | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| $HCO_3^-$ | 0,10 | 0,21 | 0,27 | 0,27 | 0,16 | 0,16 | 0,27 | 0,31 |
| $NO_3^-$ | 0,10 | 0,07 | 0,29 | 0,32 | 0,18 | 0,24 | 0,22 | 0,19 |
| Sum of anions | 0,35 | 0,33 | 0,64 | 0,69 | 0,49 | 0,48 | 0,70 | 0,71 |

Table 10 Analyses of eight soil samples taken from the four study grids. Percentage particle size (in mm) calculated on an oven-dry basis (The locations on the study area where the soil samples were taken are indicated in fig. 3).

| Grids | P50 | | P46 | | | | P88 and P89 | |
|---|---|---|---|---|---|---|---|---|
| Position of soil samples | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Depth in cms | 0-10 | 0-10 | 0-10 | 0-10 | 0-10 | 0-10 | 0-10 | 0-10 |
| Colour (dry) | Brown Red | Brown Red | Dark Brown | Dark Brown | Brown Red | Red Brown | Black | Black |
| Stone > 2 (% particle size in mm) | 0,5 | 1,2 | 1,1 | 0,9 | 0,7 | 0,7 | 0,0 | 3,8 |
| Course sand (% particle size in mm) 2.0 - 0.5 | 9,6 | 9,6 | 6,5 | 6,4 | 8,0 | 6,6 | 7,7 | 5,8 |
| Medium sand (% particle size in mm) 0.5 - 0.2 | 14,9 | 12,4 | 9,1 | 8,6 | 10,3 | 9,1 | 13,8 | 9,3 |
| Fine sand (% particle size in mm) 0.20 - 0.02 | 28,3 | 26,4 | 22,5 | 21,3 | 24,1 | 21,4 | 30,1 | 30,9 |
| Silt (% particle size in mm) 0.02 - 0.002 | 3,7 | 8,2 | 9,9 | 8,7 | 12,3 | 15,6 | 6,5 | 4,5 |
| Clay (% particle size in mm) < 0.002 | 40,5 | 40,9 | 51,4 | 52,6 | 45,6 | 45,2 | 36,7 | 51,3 |
| Total | 97,5 | 98,7 | 100,5 | 98,5 | 101,0 | 98,6 | 94,8 | 105,6 |

Table 11 Trees, shrubs and grasses recorded from the study grids. Presence of a particular species in a grid is denoted as x.

| | Grids | | |
|---|---|---|---|
| | P46 | P50 | P88 & P89 |
| Trees and shrubs | | | |
| Acacia tortilis | x | x | |
| A. karroo | x | x | |
| A. nilotica | x | x | x |
| A. nigrescens | | x | x |
| A. senegal | | x | x |
| Aloe marlothi | x | x | x |
| Boscia albitrunca | x | | |
| Azima tetracantha | x | | |
| Nuxia congesta | x | x | |
| Ziziphus mucronata | | x | x |
| Maytenus senegalensis | | x | x |
| M. heterophyla | | x | x |
| Dichrostachys cinera | | x | |
| Spirostachys africana | | x | |
| Ormocarpum tricocarpum | | | x |
| Bolusanthus speciosus | | | x |
| Grewia spp. | | | x |
| Sclerocarya birrea | | | x |
| Commiphora pyrecanthoides | | | x |
| Grasses | | | |
| Panicum maximum | x | x | x |
| P. deustum | x | x | x |
| Sporobolus smutsii | x | x | x |
| Bothricocloa insculpta | x | x | x |
| Urocloa mosambicus | x | x | |
| Chloris virgata | x | x | |
| Digitaria spp. | | x | x |
| Eragrostis superba | | x | x |
| Aristida congesta | | x | x |
| Cenchrus ciliaris | | x | x |
| Diplachne eleusine | | | x |
| Fingerhutia spp. | | | x |
| Cymbopogon excavatus | | | x |
| Heteropogon contortus | | | x |
| Rhynchelytrum repens | | | x |
| Themeda triandra | | | x |

Table 12 Dieldrin and photodieldrin residues (in ppm) on the veld at increasing intervals after treatment (mean of three replicates) on the study area (From Wiese and Basson, unpublished data).

| Days | Dieldrin | Photodieldrin |
|---|---|---|
| 0 | 15,08 ± 1,14 | 0,12 ± 0,01 |
| 1 | 10,61 ± 1,24 | 1,67 ± 0,02 |
| 2 | 9,29 ± 1,09 | 4,05 ± 0,52 |
| 7 | 4,34 ± 0,17 | 7,3 ± 0,40 |
| 14 | 1,97 ± 0,37 | 8.37 ± 0,73 |
| 21 | 1,65 ± 0,45 | 6,65 ± 0,50 |
| 30 | 1,00 ± 0,30 | 4,57 ± 0,60 |
| 42 | 0,46 ± 0,17 | 4,26 ± 0,02 |
| 56 | 0,38 ± 0,15 | 3,20 ± 0,03 |
| 90 | 0,11 ± 0,02 | 1,40 ± 0,03 |
| 146 | 0,08 ± 0,02 | 0,67 ± 0,03 |
| 189 | 0,02 ± 0,02 | 0,35 ± 0,04 |
| 258 | 0,01 ± 0,01 | 0,20 ± 0,08 |
| 380 | < 0,01 | < 0,01 |

Table 13 Dieldrin and photodieldrin residues (in ppm) in carcasses of rodents exposed to treated habitat on the study area at increasing intervals after treatment. Sample sizes are shown in brackets.

| Time elapsed between dieldrin application and sampling (days) | Pesticide | *L. griselda* | *S. campestris* | *C. hirta* |
|---|---|---|---|---|
| 10 | Dieldrin<br>Photodieldrin | 0,010(5)<br>0,000 | -<br>- | -<br>- |
| 16 | Dieldrin<br>Photodieldrin | -<br>- | 0,015(2)<br>0,000 | -<br>- |
| 20 | Dieldrin<br>Photodieldrin | 0,054(6)<br>0,000 | -<br>- | -<br>- |
| 60 | Dieldrin<br>Photodieldrin | 0,102(3)<br>0,000 | -<br>- | 4,660(1)<br>0,206 |

Table 14 Dieldrin and photodieldrin residues (in ppm) in tissues of wethers exposed to treated grazing at increasing intervals after treatment (mean of two replicates) in the Lydenburg district (From Wiese et al. ~~and Basson~~, 1970).

| Time elapsed between dieldrin application and sampling(days) | Pesticide | Wethers | | |
|---|---|---|---|---|
| | | Muscle | Liver | Fat |
| 14 | Dieldrin<br>Photodieldrin | 0,645<br>0,090 | 3,800<br>0,215 | 13,000<br>1,500 |
| 30 | Dieldrin<br>Photodieldrin | 0,640<br>0,065 | 2,655<br>0,435 | 8,115<br>1,115 |
| 65 | Dieldrin<br>Photodieldrin | 0,435<br>0,020 | 0,870<br>0,040 | 7,000<br>0,140 |
| 90 | Dieldrin<br>Photodieldrin | 0,110<br>0,003 | 0,325<br>0,004 | 0,965<br>0,080 |

Table 15 Dieldrin and photodieldrin residues (in ppm) in tissues of oxen exposed to treated grazing after 30 and 90 days intervals (mean of two replicates) in the Lydenburg district (From Wiese et al. ~~and Basson~~, 1970).

| Time elapsed between dieldrin application and sampling(days) | Pesticide | Oxen | | |
|---|---|---|---|---|
| | | Muscle | Liver | Fat |
| 30 | Dieldrin<br>Photodieldrin | 0,265<br>0,013 | 1,700<br>0,060 | 6,700<br>0,295 |
| 90 | Dieldrin<br>Photodieldrin | 0,148<br><0,002 | 1,087<br>0,018 | 4,800<br>0,044 |

Table 16 Percentage~~s~~ pregnant females (P) and scrotal males (S) of *Praomys* (*Mastomys*) *natalensis*, *Saccostomus campestris*, and *Lemniscomys griselda* observed on grids P88 and P89 from September 1967 to May 1969 (M = males; F = females).

| Trapping Period | *P. natalensis* | | | | *S. campestris* | | | | *L. griselda* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. F | % P | No. M | % S | No. F | % P | No. M | % S | No. F | % P | No. M | % S |
| 6. 9.67 - 15. 9.67 | 8 | 25 | 9 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 |
| 27. 9.67 - 4.10.67 | 8 | 100 | 9 | 100 | 0 | 0 | 2 | 50 | 0 | 0 | 0 | 0 |
| 25.10.67 - 1.11.67 | 8 | 75 | 10 | 60 | 1 | 0 | 0 | 0 | 2 | 0 | 1 | 100 |
| 2.12.67 - 9.12.67 | 2 | 100 | 3 | 100 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 27. 1.68 - 30. 1.68 | 1 | 100 | 1 | 100 | 2 | 0 | 3 | 100 | 2 | 0 | 1 | 0 |
| 13. 2.68 - 16. 2.68 | 2 | 50 | 2 | 100 | 5 | 0 | 7 | 71 | 3 | 67 | 1 | 0 |
| 22. 4.68 - 29. 4.68 | 2 | 0 | 2 | 0 | 0 | 0 | 2 | 50 | 1 | 0 | 0 | 0 |
| 14. 5.68 - 29. 5.68 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16. 6.68 - 30. 6.68 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 11. 7.68 - 17. 7.68 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 3. 9.68 - 6. 9.68 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 19.11.68 - 22.11.68 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15. 2.69 - 17. 2.69 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4. 5.69 - 9. 5.69 | 0 | 0 | 0 | 0 | 4 | 25 | 2 | 100 | 0 | 0 | 0 | 0 |

Table 17 Percentage of pregnant females (P) and scrotal males (S) of *Praomys* (*Mastomys*) *natalensis*, *Saccostomus campestris*, and *Lemniscomys griselda* observed on grid P50 from August 1967 to May 1969 (M = males; F = females).

| Trapping Period | *P. natalensis* | | | | *S. campestris* | | | | *L. griselda* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. F | % P | No. M | % S | No. F | % P | No. M | % S | No. F | % P | No. M | % S |
| 26. 8.67 - 29. 8.67 | 5 | 0 | 10 | 0 | 0 | 0 | 2 | 100 | 2 | 0 | 4 | 0 |
| 23. 9.67 - 26. 9.67 | 6 | 67 | 8 | 38 | 1 | 0 | 2 | 100 | 4 | 100 | 1 | 100 |
| 21.10.67 - 24.10.67 | 7 | 29 | 11 | 64 | 2 | 50 | 3 | 100 | 1 | 0 | 0 | 0 |
| 28.11.67 - 1.12.67 | 5 | 60 | 9 | 89 | 0 | 0 | 2 | 100 | 1 | 0 | 0 | 0 |
| 17. 1.68 - 20. 1.68 | 5 | 60 | 4 | 75 | 2 | 0 | 1 | 100 | 1 | 100 | 0 | 0 |
| 6. 2.68 - 9. 2.68 | 5 | 60 | 7 | 100 | 4 | 25 | 6 | 83 | 1 | 0 | 1 | 100 |
| 14. 4.68 - 17. 4.68 | 1 | 0 | 2 | 100 | 2 | 0 | 5 | 20 | 1 | 0 | 1 | 100 |
| 4. 5.68 - 7. 5.68 | 2 | 0 | 0 | 0 | 9 | 0 | 4 | 25 | 2 | 0 | 2 | 100 |
| 22. 5.68 - 25. 5.68 | 1 | 0 | 2 | 0 | 5 | 0 | 6 | 0 | 2 | 0 | 0 | 0 |
| 12. 6.68 - 15. 6.68 | 1 | 0 | 2 | 0 | 3 | 0 | 2 | 0 | 5 | 0 | 2 | 0 |
| 23. 6.68 - 26. 6.68 | 0 | 0 | 1 | 0 | 3 | 0 | 2 | 0 | 5 | 0 | 8 | 0 |
| 7. 7.68 - 10. 7.68 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 3 | 0 | 4 | 0 |
| 21. 7.68 - 24. 7.68 | 0 | 0 | 1 | 0 | 5 | 0 | 2 | 0 | 5 | 0 | 3 | 0 |
| 30. 8.68 - 2. 9.68 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 100 | 1 | 0 | 0 | 0 |
| 23.11.68 - 26.11.68 | 2 | 0 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11. 2.69 - 14. 2.69 | 1 | 0 | 0 | 0 | 1 | 0 | 6 | 100 | 0 | 0 | 0 | 0 |
| 30. 4.69 - 3. 5.69 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 100 | 0 | 0 | 0 | 0 |
| 14. 5.69 - 19. 5.69 | 0 | 0 | 1 | 0 | 4 | 50 | 7 | 86 | 0 | 0 | 0 | 0 |

Table 18 Percentage of pregnant females (P) and scrotal males (S) of *Praomys* (*Mastomys*) *natalensis*, *Saccostomus campestris*, and *Lemniscomys griselda* observed on grid P46 from September 1967 to May 1969 (M= males; F = females).

| | *P. natalensis* | | | | *S. campestris* | | | | *L. griselda* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. F | % P | No. M | % S | No. F | % P | No. M | % S | No. F | % P | No. M | % S |
| 19. 9.67 - 22. 9.67 | 4 | 75 | 17 | 36 | 1 | 0 | 0 | 0 | 3 | 0 | 4 | 25 |
| 14.10.67 - 17.10.67 | 6 | 67 | 13 | 62 | 0 | 0 | 1 | 100 | 4 | 0 | 3 | 0 |
| 2.11.67 - 5.11.67 | 6 | 0 | 15 | 80 | 1 | 0 | 0 | 0 | 2 | 0 | 4 | 75 |
| 10.12.67 - 13.12.67 | 12 | 0 | 19 | 100 | 0 | 0 | 1 | 100 | 0 | 0 | 1 | 100 |
| 23. 1.68 - 26. 1.68 | 10 | 0 | 17 | 71 | 3 | 0 | 7 | 57 | 1 | 0 | 3 | 67 |
| 17. 2.68 - 20. 2.68 | 17 | 0 | 11 | 91 | 8 | 0 | 7 | 43 | 5 | 0 | 2 | 100 |
| 18. 4.68 - 21. 4.68 | 9 | 0 | 9 | 33 | 10 | 0 | 14 | 44 | 4 | 0 | 1 | 0 |
| 30. 4.68 - 3. 5.68 | 9 | 0 | 9 | 22 | 8 | 0 | 11 | 91 | 0 | 0 | 2 | 0 |
| 18. 5.68 - 21. 5.68 | 2 | 0 | 3 | 0 | 3 | 0 | 7 | 0 | 5 | 0 | 4 | 0 |
| 8. 6.68 - 11. 6.68 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 5 | 0 |
| 19. 6.68 - 22. 6.68 | 1 | 0 | 1 | 0 | 3 | 0 | 4 | 25 | 3 | 0 | 1 | 0 |
| 3. 7.68 - 6. 7.68 | 0 | 0 | 0 | 0 | 2 | 0 | 5 | 0 | 4 | 0 | 1 | 0 |
| 17. 7.68 - 20. 7.68 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 3 | 0 | 1 | 0 |
| 7. 9.68 - 10. 9.68 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 100 | 1 | 0 | 0 | 0 |
| 15.11.68 - 18.11.68 | 1 | 0 | 2 | 50 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 18. 2.69 - 21. 2.69 | 1 | 0 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26. 4.69 - 29. 4.69 | 0 | 0 | 0 | 0 | 3 | 0 | 11 | 55 | 1 | 0 | 0 | 0 |
| 10. 5.69 - 13. 5.69 | 1 | 0 | 0 | 0 | 5 | 0 | 9 | 89 | 1 | 0 | 0 | 0 |

Table 19 Average maximum distance (in feet) between points of capture (av. M) for <u>Praomys</u> (<u>Mastomys</u>) <u>natalensis</u> on grids P46, P50, and P88 & P89. n indicates the number of observations after each capture (100 ft = 30,48 m).

| Frequency of captures | Grid P46 | | | | | | Grid P50 | | | | | | Grids P89 & P88 | | | | | | All grids | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Males | | Females | | Total | | Males | | Females | | Total | | Males | | Females | | Total | | Males | | Females | | Total | |
| | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M |
| 2 | 53 | 93 | 33 | 69 | 86 | 84 | 27 | 67 | 12 | 84 | 39 | 72 | 14 | 86 | 13 | 65 | 27 | 76 | 94 | 85 | 58 | 71 | 152 | 80 |
| 3 | 42 | 103 | 24 | 113 | 66 | 107 | 20 | 145 | 11 | 97 | 31 | 128 | 14 | 112 | 10 | 133 | 24 | 121<br>~~116~~ | 76 | 116 | 45 | 112 | 121 | 115<br>~~147~~ |
| 4 | 28 | 136 | 21 | 111 | 49 | 126 | 15 | 209 | 8 | 192 | 23 | 203 | 12 | 131 | 10 | 203 | 22 | 164 | 55 | 156 | 39 | 151 | 94 | 154 |
| 5 | 20 | 205 | 16 | 161 | 36 | 186 | 9 | 239 | 7 | 187 | 16 | 216 | 7 | 185 | 7 | 258 | 14 | 222 | 36 | 210 | 30 | 190 | 66 | 200 |
| 6 | 16 | 199 | 15 | 172 | 31 | 186 | 8 | 274 | 7 | 199 | 15 | 239 | 4 | 176 | 6 | 291 | 10 | 245<br>~~284~~ | 28 | 217 | 28 | 204 | 56 | 211 |
| 7 | 12 | 200 | 12 | 172 | 24 | 186 | 8 | 274 | 6 | 145 | 14 | 219 | 4 | 176 | 5 | 332 | 9 | 263 | 24 | 220 | 23 | 199 | 47 | 209 |
| 8 | 12 | 200 | 12 | 172 | 24 | 186 | 6 | 302 | 5 | 104 | 11 | 212 | 3 | 130 | 3 | 296 | 6 | 213 | 21 | 220 | 20 | 149 | 41 | 185 |
| 9 | 9 | 230 | 8 | 155 | 17 | 195 | 4 | 300 | 4 | 119 | 8 | 210 | 3 | 169 | 3 | 296 | 6 | 232 | 16 | 236 | 15 | 174 | 31 | 206 |
| 10 | 8 | 231 | 6 | 173 | 14 | 206 | 4 | 300 | 3 | 61 | 7 | 198 | 2 | 232 | 3 | 296 | 5 | 270 | 14 | 251 | 12 | 176 | 26 | 216 |
| 11 | 7 | 290 | 6 | 211 | 13 | 253 | 2 | 304 | 3 | 107 | 5 | 186 | 2 | 446 | 2 | 121 | 4 | 283 | 11 | 321 | 11 | 166 | 22 | 243 |
| 12 | 6 | 300 | 6 | 211 | 12 | 255 | 2 | 308 | 1 | 122 | 3 | 246 | 2 | 446 | 2 | 233 | 4 | 339 | 10 | 331 | 9 | 205 | 19 | 271 |
| 13 | 5 | 323 | 5 | 221 | 10 | 272 | 1 | 486 | 1 | 232 | 2 | 359 | 2 | 446 | 2 | 233 | 4 | 339 | 8 | 374 | 8 | 225 | 16 | 300 |
| 14 | 4 | 305 | 4 | 198 | 8 | 252 | 1 | 486 | 1 | 232 | 2 | 359 | 2 | 446 | 2 | 233 | 4 | 339 | 7 | 371 | 7 | 225 | 14 | 292 |
| 15 | 3 | 320 | 4 | 198 | 7 | 250 | 1 | 486 | 1 | 396 | 2 | 441 | 2 | 446 | 2 | 245 | 4 | 346 | 6 | 390 | 7 | 240 | 13 | 309 |
| 16 | 2 | 442 | 2 | 166 | 4 | 304 | 1 | 486 | 1 | 396 | 2 | 441 | 1 | 775 | 2 | 245 | 3 | 422 | 4 | 536 | 5 | 244 | 9 | 374 |
| 17 | 1 | 272 | 2 | 166 | 3 | 201 | 1 | 486 | 1 | 396 | 2 | 441 | 1 | 775 | 1 | 336 | 2 | 556 | 3 | 511 | 4 | 266 | 7 | 371 |
| 18 | | | 2 | 180 | 2 | 180 | | | 1 | 396 | 1 | 396 | 1 | 775 | 1 | 336 | 2 | 556 | 1 | 775 | 4 | 273 | 5 | 373 |
| 19 | | | 2 | 180 | 2 | 180 | | | 1 | 396 | 1 | 396 | 1 | 775 | 1 | 336 | 2 | 556 | 1 | 775 | 4 | 273 | 5 | 373 |
| 20 | | | 2 | 180 | 2 | 180 | | | 1 | 396 | 1 | 396 | 1 | 775 | | | 1 | 775 | 1 | 775 | 3 | 252 | 4 | 383 |
| 21 | | | 1 | 262 | 1 | 262 | | | | | | | 1 | 775 | | | 1 | 775 | 1 | 775 | 1 | 262 | 2 | 519 |
| 22 | | | | | | | | | | | | | 1 | 775 | | | 1 | 775 | 1 | 775 | | | 1 | 775 |
| 23 | | | | | | | | | | | | | 1 | 775 | | | 1 | 775 | 1 | 775 | | | 1 | 775 |

Table 20 Average maximum distance (in feet) between points of capture (av.M) for <u>Saccostomus campestris</u>, on grids P46, P50, and P88 & P89. n indicates the number of observations after each capture (100 ft = 30,48 m).

| Frequency of captures | Grid P46 | | | | | | Grid P50 | | | | | | Grids P89 & P88 | | | | | | All Grids | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Males | | Females | | Total | | Males | | Females | | Total | | Males | | Females | | Total | | Males | | Females | | Total | |
| | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M |
| 2 | 26 | 111 | 16 | 96 | 42 | 106 | 21 | 67 | 11 | 75 | 32 | 70 | 5 | 109 | 4 | 74 | 9 | 93 | 52 | 93 | 31 | 86 | 83 | 90 |
| 3 | 23 | 152 | 13 | 141 | 36 | 149 | 17 | 94 | 8 | 119 | 25 | 102 | 3 | 159 | 2 | 99 | 5 | 135 | 43 | 132 | 23 | 130 | 66 | 131 |
| 4 | 19 | 180 | 8 | 156 | 27 | 173 | 10 | 132 | 5 | 112 | 15 | 125 | 1 | 177 | 1 | 192 | 2 | 185 | 30 | 164 | 14 | 143 | 44 | 157 |
| 5 | 13 | 239 | 5 | 132 | 18 | 209 | 7 | 168 | 4 | 127 | 11 | 153 | | | 1 | 192 | 1 | 192 | 20 | 214 | 10 | 136 | 30 | 188 |
| 6 | 8 | 140 | 3 | 143 | 11 | 141 | 7 | 175 | 4 | 127 | 11 | 157 | | | 1 | 327 | 1 | 327 | 15 | 156 | 8 | 158 | 23 | 157 |
| 7 | 4 | 170 | 3 | 155 | 7 | 163 | 5 | 182 | 3 | 98 | 8 | 150 | | | 1 | 327 | 1 | 327 | 9 | 176 | 7 | 177 | 16 | 176 |
| 8 | 3 | 212 | 2 | 184 | 5 | 201 | 3 | 134 | 2 | 109 | 5 | 124 | | | | | | | 6 | 171 | 4 | 146 | 10 | 161 |
| 9 | 2 | 264 | 2 | 184 | 4 | 224 | 2 | 140 | 2 | 138 | 4 | 139 | | | | | | | 4 | 202 | 4 | 161 | 8 | 182 |
| 10 | | | 2 | 184 | 2 | 184 | 2 | 187 | 2 | 164 | 4 | 175 | | | | | | | 2 | 187 | 4 | 174 | 6 | 178 |
| 11 | | | 1 | 272 | 1 | 272 | 2 | 187 | 2 | 164 | 4 | 175 | | | | | | | 2 | 187 | 3 | 200 | 5 | 195 |
| 12 | | | 1 | 272 | 1 | 272 | 2 | 187 | 2 | 182 | 4 | 185 | | | | | | | 2 | 187 | 3 | 212 | 5 | 202 |
| 13 | | | 1 | 272 | 1 | 272 | 2 | 187 | 2 | 204 | 4 | 195 | | | | | | | 2 | 187 | 3 | 227 | 5 | 211 |
| 14 | | | 1 | 272 | 1 | 272 | 2 | 187 | 2 | 304 | 4 | 250 | | | | | | | 2 | 187 | 3 | 293 | 5 | 251 |
| 15 | | | 1 | 272 | 1 | 272 | 1 | 304 | 1 | 192 | 2 | 248 | | | | | | | 1 | 304 | 2 | 232 | 3 | 256 |
| 16 | | | 1 | 272 | 1 | 272 | 1 | 304 | | | 1 | 304 | | | | | | | 1 | 304 | 1 | 272 | 2 | 288 |
| 17 | | | 1 | 272 | 1 | 272 | 1 | 304 | | | 1 | 304 | | | | | | | 1 | 304 | 1 | 272 | 2 | 288 |
| 18 | | | | | | | 1 | 304 | | | 1 | 304 | | | | | | | 1 | 304 | | | 1 | 304 |

Table 21 Average maximum distance (in feet) between points of capture (av.M) for Lemniscomys griselda on grids P46, P50, and P88 & P89. n indicates the number of observations after each capture (100 ft = 30,48 m).

| Frequency of captures | Grid P46 | | | | | | Grid P50 | | | | | | Grids P89 & P88 | | | | | | All Grids | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Males | | Females | | Total | | Males | | Females | | Total | | Males | | Females | | Total | | Males | | Females | | Total | |
| | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M | n | av.M |
| 2 | 16 | 182 | 17 | 85 | 33 | 132 | 7 | 73 | 10 | 77 | 17 | 75 | 4 | 100 | 3 | 46 | 7 | 77 | 27 | 141 | 30 | 78 | 57 | 118 |
| 3 | 11 | 210 | 12 | 148 | 23 | 177 | 7 | 133 | 6 | 136 | 13 | 134 | 3 | 272 | | | 3 | 272 | 21 | 193 | 18 | 144 | 39 | 170 |
| 4 | 6 | 196 | 7 | 132 | 13 | 162 | 4 | 86 | 4 | 171 | 8 | 128 | 2 | 96 | | | 2 | 96 | 12 | 143 | 11 | 146 | 23 | 144 |
| 5 | 4 | 203 | 5 | 122 | 9 | 158 | 3 | 95 | 3 | 98 | 6 | 96 | 1 | 96 | | | 1 | 96 | 8 | 149 | 8 | 113 | 16 | 131 |
| 6 | 2 | 164 | 5 | 164 | 7 | 164 | 2 | 139 | 3 | 127 | 5 | 132 | | | | | | | 4 | 151 | 8 | 150 | 12 | 150 |
| 7 | 1 | 232 | 5 | 164 | 6 | 176 | 2 | 139 | 2 | 155 | 4 | 147 | | | | | | | 3 | 170 | 7 | 162 | 10 | 164 |
| 8 | 1 | 232 | 3 | 128 | 4 | 154 | 2 | 174 | 2 | 155 | 4 | 164 | | | | | | | 3 | 193 | 5 | 139 | 8 | 159 |
| 9 | 1 | 232 | 2 | 109 | 3 | 150 | 2 | 174 | 2 | 155 | 4 | 164 | | | | | | | 3 | 193 | 4 | 132 | 7 | 158 |
| 10 | 1 | 232 | 2 | 109 | 3 | 150 | 2 | 174 | 2 | 155 | 4 | 164 | | | | | | | 3 | 193 | 4 | 132 | 7 | 158 |
| 11 | 1 | 232 | 2 | 185 | 3 | 200 | 2 | 174 | 2 | 155 | 4 | 164 | | | | | | | 3 | 193 | 4 | 169 | 7 | ~~185~~ 179 |
| 12 | 1 | 232 | 1 | 219 | 2 | 225 | 2 | 174 | 2 | 155 | 4 | 164 | | | | | | | 3 | 193 | 3 | 171 | 6 | ~~185~~ 182 |
| 13 | 1 | 232 | | | 1 | 232 | 1 | 251 | 2 | 155 | 3 | 187 | | | | | | | 2 | 241 | 2 | 155 | 4 | 190 |
| 14 | 1 | 232 | | | 1 | 232 | 1 | 251 | 1 | 155 | 2 | 203 | | | | | | | 2 | 241 | 1 | 155 | 3 | 177 |
| 15 | 1 | 232 | | | 1 | 232 | 1 | 251 | 1 | 155 | 2 | 203 | | | | | | | 2 | 241 | 1 | 155 | 3 | 177 |
| 16 | 1 | 232 | | | 1 | 232 | | | 1 | 155 | 1 | 155 | | | | | | | 1 | 232 | 1 | 155 | 2 | 194 |
| 17 | 1 | 232 | | | 1 | 232 | | | 1 | 155 | 1 | 155 | | | | | | | 1 | 232 | 1 | 155 | 2 | 194 |
| 18 | 1 | 232 | | | 1 | 232 | | | 1 | 155 | 1 | 155 | | | | | | | 1 | 232 | 1 | 155 | 2 | 194 |
| 19 | 1 | 232 | | | 1 | 232 | | | 1 | 155 | 1 | 155 | | | | | | | 1 | 232 | 1 | 155 | 2 | 194 |
| 20 | 1 | 232 | | | 1 | 232 | | | 1 | 155 | 1 | 155 | | | | | | | 1 | 232 | 1 | 155 | 2 | 194 |
| 21 | 1 | 232 | | | 1 | 232 | | | 1 | 155 | 1 | 155 | | | | | | | 1 | 232 | 1 | 155 | 2 | 194 |
| 22 | 1 | 232 | | | 1 | 232 | | | 1 | 155 | 1 | 155 | | | | | | | 1 | 232 | 1 | 155 | 2 | 194 |
| 23 | 1 | 232 | | | 1 | 232 | | | 1 | 192 | 1 | 192 | | | | | | | 1 | 232 | 1 | 192 | 2 | 212 |
| 24 | | | | | | | | | 1 | 192 | 1 | 192 | | | | | | | | | 1 | 192 | 1 | 192 |
| 25 | | | | | | | | | 1 | 192 | 1 | 192 | | | | | | | | | 1 | 192 | 1 | 192 |
| 26 | | | | | | | | | 1 | 192 | 1 | 192 | | | | | | | | | 1 | 192 | 1 | 192 |

Table 22 Average maximum distance (in feet) between points of capture (av.M) for Leggada minutoides (sexes combined) on all grids combined (100 ft = 30,48 m).

| Frequency of captures | n | av.M |
|---|---|---|
| 2 | 7 | 196 |
| 3 | 6 | 285 |
| 4 | 5 | 333 |
| 5 | 3 | 330 |
| 6 | 3 | 330 |
| 7 | 2 | 359 |
| 8 | 1 | 262 |

Table 23 *Praomys* (*Mastomys*) *natalensis* seasonal mean total head and body length, tail length and body mass of male, female, and sexes combined on the study area.

| Season | MALES | | | | | FEMALES | | | | | TOTAL | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | SE | range | n | $\bar{X}$ | SD | SE | range | n | $\bar{X}$ | SD | SE | range | n |
| | BODY MASS (g) | | | | | | | | | | | | | | |
| Spring | 28,515 | 6,134 | 0,623 | 17-52 | 97 | 24,444 | 5,139 | 0,647 | 17-38 | 63 | 26,913 | 6,083 | 0,481 | 17-52 | 160 |
| Summer | 41,753 | 9,786 | 1,145 | 8-62 | 73 | 34,177 | 10,817 | 1,383 | 6-57 | 62 | 38,274 | 10,912 | 0,939 | 6-62 | 135 |
| Autumn | 23,370 | 13,485 | 2,593 | 7-52 | 27 | 24,667 | 13,121 | 2,523 | 6-44 | 27 | 24,019 | 13,195 | 1,782 | 6-52 | 54 |
| Winter | 26,333 | 5,922 | 2,417 | 17-32 | 6 | 19,800 | 7,772 | 2,459 | 13-38 | 10 | 22,250 | 7,655 | 1,914 | 13-38 | 16 |
| Total | 32,527 | 8,734 | 0,613 | 7-62 | 203 | 27,920 | 9,256 | 0,727 | 6-57 | 162 | 30,483 | 9,368 | 0,490 | 6-62 | 365 |
| | TOTAL LENGTH (mm) | | | | | | | | | | | | | | |
| Spring | 193,887 | 18,377 | 1,866 | 169-255 | 97 | 184,730 | 20,967 | 2,646 | 148-254 | 63 | 190,281 | 19,887 | 1,572 | 148-255 | 160 |
| Summer | 218,644 | 23,906 | 2,798 | 123-250 | 73 | 206,855 | 28,615 | 3,634 | 102-254 | 62 | 213,230 | 26,732 | 2,301 | 102-254 | 135 |
| Autumn | 181,185 | 40,359 | 7,761 | 121-238 | 27 | 181,815 | 40,414 | 7,771 | 122-238 | 27 | 181,500 | 40,005 | 5,442 | 121-238 | 54 |
| Winter | 196,833 | 16,940 | 6,914 | 170-209 | 6 | 176,700 | 24,522 | 7,760 | 151-225 | 10 | 184,250 | 23,618 | 5,905 | 151-225 | 16 |
| Total | 201,187 | 24,103 | 1,692 | 121-255 | 203 | 192,216 | 27,873 | 2,190 | 102-254 | 162 | 197,206 | 26,303 | 1,377 | 102-255 | 365 |
| | TAIL LENGTH (mm) | | | | | | | | | | | | | | |
| Spring | 100,876 | 12,127 | 1,231 | 85-138 | 97 | 97,206 | 12,987 | 1,636 | 74-150 | 63 | 99,431 | 12,562 | 0,993 | 74-150 | 160 |
| Summer | 108,603 | 13,103 | 1,534 | 64-128 | 73 | 102,935 | 16,610 | 2,111 | 40-128 | 62 | 106,000 | 15,029 | 1,293 | 40-128 | 135 |
| Autumn | 90,925 | 21,535 | 4,141 | 60-121 | 27 | 91,074 | 22,202 | 4,269 | 60-125 | 27 | 91,000 | 21,664 | 2,948 | 60-125 | 54 |
| Winter | 102,500 | 6,656 | 2,717 | 93-108 | 6 | 86,600 | 13,938 | 2,107 | 71-111 | 10 | 92,563 | 13,947 | 3,486 | 71-111 | 16 |
| Total | 102,379 | 13,852 | 0,972 | 60-138 | 203 | 97,722 | 16,123 | 1,267 | 40-150 | 162 | 100,312 | 15,114 | 0,791 | 40-150 | 365 |
| | HEAD AND BODY LENGTH (mm) | | | | | | | | | | | | | | |
| Spring | 93,289 | 8,504 | 0,863 | 68-120 | 97 | 88,381 | 7,343 | 0,925 | 71-104 | 63 | 91,356 | 8,395 | 0,664 | 68-120 | 160 |
| Summer | 111,411 | 16,667 | 1,951 | 59-126 | 73 | 103,887 | 12,925 | 1,642 | 60-126 | 62 | 107,956 | 15,475 | 1,332 | 59-126 | 135 |
| Autumn | 90,630 | 19,879 | 3,821 | 61-119 | 27 | 90,741 | 19,050 | 3,663 | 59-118 | 27 | 90,685 | 19,284 | 2,623 | 59-119 | 54 |
| Winter | 94,333 | 10,444 | 4,263 | 77-102 | 6 | 90,100 | 11,050 | 3,496 | 79-114 | 10 | 91,688 | 10,682 | 2,671 | 77-114 | 16 |
| Total | 99,483 | 13,673 | 0,960 | 59-126 | 203 | 94,815 | 12,227 | 0,961 | 59-126 | 162 | 97,411 | 13,334 | 0,698 | 59-126 | 365 |

Table 24 Values of t and degrees of freedom (d f) for a comparison of total length between samples of P. (M.) natalensis observed during different seasons on the study area (x - significant, $p < 0.05$; xx - highly significant, $p < 0.01$).

| | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Total | d f |
| Spring - Summer | 7,3616$^{xx}$ | 168 | 4,9247$^{xx}$ | 123 | 8,2358$^{xx}$ | 293 |
| Spring - Autumn | 1,5901 | 122 | 0,3549 | 88 | 1,5497 | 212 |
| Spring - Winter | 0,4113 | 101 | 0,9802 | 71 | 0,9870 | 174 |
| Summer - Autumn | 4,5374$^{xx}$ | 98 | 2,9168$^{xx}$ | 87 | 5,3688$^{xx}$ | 187 |
| Summer - Winter | 2,9236$^{xx}$ | 77 | 3,5212$^{xx}$ | 70 | 4,5732$^{xx}$ | 149 |
| Autumn - Winter | 1,5047 | 31 | 0,4657 | 35 | 0,3424 | 68 |

Table 25 Values of t and degrees of freedom (d f) for comparison of P. (M.) natalensis male and female mean body mass, total length~~s~~, tail length , and head and body length , on the study area (x - significant, $p < 0.05$; xx - highly significant, $p < 0.01$).

| Season | Values of t | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Body mass | d f | Total length | d f | Tail length | d f | Head and Body length | d f |
| Spring | 4,5319$^{xx}$ | 158 | 2,8314$^{xx}$ | 158 | 1,7923 | 158 | 3,8786$^{xx}$ | 158 |
| Summer | 4,2357$^{xx}$ | 133 | 2,5704$^{x}$ | 133 | 2,1733$^{x}$ | 133 | 2,9513$^{xx}$ | 133 |
| Autumn | 0,3582 | 52 | 0,0573 | 52 | 0,0250 | 52 | 0,0209 | 52 |
| Winter | 1,8950 | 14 | 1,9377 | 14 | 3,0708$^{xx}$ | 14 | 0,7679 | 14 |
| Total | 4,8439$^{xx}$ | 363 | 3,2420$^{xx}$ | 363 | 2,9165$^{xx}$ | 363 | 3,4379$^{xx}$ | 363 |

Table 26 Values of t and degrees of freedom (d f) for a comparison of head and body length between samples of *P.* (*M.*) *natalensis* observed during different seasons on the study area (x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$).

| | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Total | d f |
| Spring - Summer | $8,4952^{xx}$ | 168 | $8,2295^{xx}$ | 123 | $11,1559^{xx}$ | 293 |
| Spring - Autumn | 0,6780 | 122 | 0,6242 | 88 | 0,2479 | 212 |
| Spring - Winter | 0,2400 | 101 | 0,4756 | 71 | 0,1207 | 174 |
| Summer - Autumn | $4,8392^{xx}$ | 98 | $3,2728^{xx}$ | 87 | $5,8689^{xx}$ | 187 |
| Summer - Winter | $3,6424^{xx}$ | 77 | $3,5712^{xx}$ | 70 | $5,4514^{xx}$ | 149 |
| Autumn - Winter | 0,6464 | 31 | 0,1266 | 35 | 0,2679 | 68 |

Table 27 Values of t and degrees of freedom (d f) for a comparison of tail length between samples of *P.* (*M.*) *natalensis* observed during different seasons on the study area (x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$)

| | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Total | d f |
| Spring - Summer | $3,9289^{xx}$ | 168 | $2,1460^{x}$ | 123 | $4,0283^{xx}$ | 293 |
| Spring - Autumn | $2,3017^{x}$ | 122 | 1,3402 | 88 | $2,7102^{xx}$ | 212 |
| Spring - Winter | 0,5444 | 101 | $2,2559^{x}$ | 71 | 1,8944 | 174 |
| Summer - Autumn | $4,0005^{xx}$ | 98 | $2,4891^{x}$ | 87 | $4,6594^{xx}$ | 187 |
| Summer - Winter | 1,9560 | 77 | $3,3430^{xx}$ | 70 | $3,6132^{xx}$ | 149 |
| Autumn - Winter | $2,3357^{x}$ | 31 | 0,7288 | 35 | 0,3423 | 68 |

Table 28 Values of t and degrees of freedom (d f) for a comparison of body mass between samples of *P.* (*M.*) *natalensis* observed during different seasons on the study area (x - significant, $p < 0.05$; xx - highly significant, $p < 0.01$).

| | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Total | d f |
| Spring - Summer | 10,1542$^{xx}$ | 168 | 6,4092$^{xx}$ | 123 | 10,7677$^{xx}$ | 293 |
| Spring - Autumn | 1,9278 | 122 | 0,0855 | 88 | 1,5569 | 212 |
| Spring - Winter | 0,8740 | 101 | 1,8273 | 71 | 2,3632$^{x}$ | 174 |
| Summer - Autumn | 6,4804$^{xx}$ | 98 | 3,3083$^{xx}$ | 87 | 7,0350$^{xx}$ | 187 |
| Summer - Winter | 5,7641$^{xx}$ | 77 | 5,1064$^{xx}$ | 70 | 7,5170$^{xx}$ | 149 |
| Autumn - Winter | 0,8354 | 31 | 1,3812 | 35 | 0,6741 | 68 |

Table 29 Seasonal *Praomys* (*Mastomys*) *natalensis* body mass in the study and Roodepoort areas (Roodepoort data from Coetzee, 1967: Table 10).

| Season | PONGOLA | | | | ROODEPOORT | | | |
|---|---|---|---|---|---|---|---|---|
| | $\bar{x}$ | SD | SE | n | $\bar{x}$ | SD | SE | n |
| | MALES | | | | | | | |
| Spring | 28,515 | 6,134 | 0,623 | 97 | 30,790 | 12,816 | 0,961 | 178 |
| Summer | 41,753 | 9,786 | 1,145 | 73 | 38,085 | 18,651 | 3,889 | 23 |
| Autumn | 23,370 | 13,485 | 2,593 | 27 | 21,104 | 11,808 | 0,506 | 544 |
| Winter | 26,333 | 5,922 | 2,417 | 6 | 23,485 | 7,954 | 0,231 | 1176 |
| Total | 32,527 | 8,734 | 0,613 | 203 | 23,670 | 10,760 | 0,245 | 1921 |
| | FEMALES | | | | | | | |
| Spring | 24,444 | 5,139 | 0,647 | 63 | 27,972 | 10,498 | 0,655 | 257 |
| Summer | 34,177 | 10,817 | 1,383 | 62 | 33,385 | 12,792 | 1,998 | 41 |
| Autumn | 24,667 | 13,121 | 2,523 | 27 | 24,829 | 13,533 | 0,541 | 625 |
| Winter | 19,800 | 7,772 | 2,459 | 10 | 21,883 | 7,727 | 0,218 | 1255 |
| Total | 27,920 | 9,256 | 0,727 | 162 | 23,660 | 10,660 | 0,299 | 2178 |
| | TOTAL | | | | | | | |
| Spring | 26,913 | 6,083 | 0,481 | 160 | 29,110 | 10,967 | 0,526 | 435 |
| Summer | 38,274 | 10,912 | 0,939 | 135 | 35,628 | 14,954 | 1,869 | 64 |
| Autumn | 24,019 | 13,195 | 1,782 | 54 | 23,099 | 12,904 | 0,377 | 1169 |
| Winter | 22,250 | 7,655 | 1,914 | 16 | 22,648 | 8,050 | 0,163 | 2431 |
| Total | 30,483 | 9,368 | 0,490 | 365 | 23,660 | 10,710 | 0,167 | 4099 |

Table 30 Values of t and degrees of freedom (d f) for a comparison of body mass between seasons in samples of *P. (M.) natalensis* in the Roodepoort area, Transvaal highveld. (Calculated from Coetzee, 1967; x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$).

| | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Total | d f |
| Spring - Summer | 1,8206 | 199 | 2,5748$^{x}$ | 296 | 3,3567$^{xx}$ | 497 |
| Spring - Autumn | 8,9206$^{xx}$ | 720 | 3,6998$^{xx}$ | 880 | 9,2877$^{xx}$ | 1602 |
| Spring - Winter | 7,3922$^{xx}$ | 1352 | 8,8221$^{xx}$ | 1510 | 11,7363$^{xx}$ | 2864 |
| Summer - Autumn | 4,3294$^{xx}$ | 565 | 4,1337$^{xx}$ | 664 | 6,9179$^{xx}$ | 1231 |
| Summer - Winter | 3,7470$^{xx}$ | 1197 | 5,7235$^{xx}$ | 1294 | 4,9009$^{xx}$ | 2493 |
| Autumn - Winter | 4,2762$^{xx}$ | 1718 | 5,0480$^{xx}$ | 1878 | 1,0968 | 3598 |

Table 31 Values of t and degrees of freedom (d f) for comparison of Roodepoort P. (M.) _natalensis_ male and female mean body mass (x - significant, $p < 0.05$; xx - highly significant, $p < 0.01$; calculated from Coetzee, 1967).

| Seasons | Values of t | d f |
|---|---|---|
| | Body mass | |
| Spring | $2,4241^{x}$ | 433 |
| Summer | 1,0744 | 62 |
| Autumn | $5,0263^{xx}$ | 1167 |
| Winter | $5,0314^{xx}$ | 2429 |
| Total | 0,0298 | 4097 |

Table 32 Values of t and degrees of freedom (d f) for a comparison of P. (M.) natalensis body mass from Roodepoort, and the study area for each season (x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$).

| Season | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Total | d f |
| Spring | $1,9872^{x}$ | 273 | $3,8315^{xx}$ | 318 | $3,0831^{xx}$ | 593 |
| Summer | 0,9053 | 94 | 0,3267 | 101 | 1,2649 | 197 |
| Autumn | 0,8570 | 569 | 0,0627 | 650 | 0,5014 | 1221 |
| Winter | 1,1726 | 1180 | 0,8442 | 1263 | 0,2072 | 2445 |
| Total | $13,4136^{xx}$ | 2122 | $5,5898^{xx}$ | 2338 | $13,1718^{xx}$ | 4462 |

Table 33 Values of t and degrees of freedom (d f) for a comparison of P. (M.) natalensis head and body length and tail length observed during different seasons on the study area (x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$).

| Season | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Both Sexes | d f |
| Spring | $5,0452^{xx}$ | 192 | $4,6951^{xx}$ | 124 | $6,7607^{xx}$ | 318 |
| Summer | 1,1317 | 144 | 0,3562 | 122 | 1,0535 | 268 |
| Autumn | 0,0523 | 52 | 0,0591 | 52 | 0,0798 | 106 |
| Winter | 1,6153 | 10 | 0,6223 | 18 | 0,1992 | 30 |
| Total | $2,1201^{x}$ | 404 | 1,8286 | 322 | $2,7500^{xx}$ | 728 |

Table 34 $X^2$ test for significance of deviation from 1:1 ratio between head and body length and tail length of *P.* (*M.*) *natalensis* from the study area during different seasons.

|  | Males | Females | Both Sexes |
|---|---|---|---|
| Season | $X^2$ | $X^2$ | $X^2$ |
| Spring | 0,2898 | 0,4172 | 0,3354 |
| Summer | 0,0356 | 0,0048 | 0,0186 |
| Autumn | 0,0004 | 0,0008 | 0,0005 |
| Winter | 0,3416 | 0,0735 | 0,0034 |
| Total | 0,0416 | 0,0438 | 0,0427 |

Table 35 *Saccostomus campestris* seasonal mean total length, [illegible]ody length, tail length and body mass of male, female, and sexes combined on the study area.

| Season | MALES | | | | | FEMALES | | | | | TOTAL | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | SE | range | n | $\bar{X}$ | SD | SE | range | n | $\bar{X}$ | SD | SE | range | n |
| | BODY MASS (g) | | | | | | | | | | | | | | |
| Spring | 70,667 | 24,088 | 6,225 | 34-106 | 15 | 57,455 | 17,276 | 5,203 | 30-73 | 11 | 65,077 | 22,105 | 4,333 | 30-106 | 26 |
| Summer | 40,368 | 15,555 | 2,524 | 18-70 | 38 | 46,250 | 13,034 | 2,661 | 20-66 | 24 | 42,619 | 14,764 | 1,876 | 18-70 | 62 |
| Autumn | 47,675 | 12,137 | 1,383 | 28-72 | 77 | 40,241 | 9,907 | 1,298 | 25-63 | 58 | 44,481 | 11,787 | 1,016 | 25-72 | 135 |
| Winter | 39,882 | 7,999 | 1,941 | 31-56 | 17 | 38,211 | 6,373 | 1,462 | 31-55 | 19 | 39,000 | 7,131 | 1,188 | 31-56 | 36 |
| Total | 47,231 | 14,165 | 1,168 | 18-106 | 147 | 42,875 | 10,912 | 1,031 | 20-66 | 112 | 45,341 | 13,340 | 0,829 | 18-106 | 259 |
| | TOTAL LENGTH (mm) | | | | | | | | | | | | | | |
| Spring | 182,800 | 18,475 | 4,773 | 144-207 | 15 | 172,818 | 19,712 | 5,937 | 140-192 | 11 | 178,577 | 19,284 | 3,782 | 140-207 | 26 |
| Summer | 153,079 | 24,198 | 3,928 | 113-196 | 38 | 167,041 | 18,442 | 3,763 | 116-194 | 24 | 158,587 | 22,977 | 2,919 | 113-196 | 62 |
| Autumn | 167,922 | 15,795 | 1,801 | 131-191 | 77 | 159,052 | 14,443 | 1,895 | 135-184 | 58 | 164,111 | 15,800 | 1,361 | 131-191 | 135 |
| Winter | 159,824 | 10,345 | 2,519 | 145-178 | 17 | 160,105 | 10,878 | 2,494 | 146-184 | 19 | 159,972 | 10,479 | 1,746 | 145-192 | 36 |
| Total | 164,667 | 17,964 | 1,482 | 113-207 | 147 | 162,295 | 15,225 | 1,439 | 116-194 | 112 | 163,666 | 17,476 | 1,086 | 113-207 | 259 |
| | TAIL LENGTH (mm) | | | | | | | | | | | | | | |
| Spring | 56,667 | 4,952 | 1,270 | 45-60 | 15 | 53,273 | 5,764 | 1,730 | 45-62 | 11 | 54,077 | 5,245 | 1,020 | 45-62 | 26 |
| Summer | 45,947 | 7,519 | 1,220 | 33-58 | 38 | 51,720 | 6,208 | 1,267 | 33-59 | 24 | 48,238 | 7,534 | 0,957 | 33-59 | 62 |
| Autumn | 53,090 | 8,633 | 0,984 | 41-64 | 77 | 49,690 | 5,880 | 0,772 | 37-60 | 58 | 51,630 | 7,735 | 0,665 | 37-64 | 135 |
| Winter | 48,353 | 3,481 | 0,844 | 42-55 | 17 | 49,211 | 4,184 | 0,956 | 41-56 | 19 | 48,806 | 3,838 | 0,636 | 41-56 | 36 |
| Total | 51,061 | 7,537 | 0,622 | 33-64 | 147 | 50,396 | 5,619 | 0,531 | 33-62 | 112 | 50,671 | 7,011 | 0,436 | 33-64 | 259 |
| | HEAD AND BODY LENGTH (mm) | | | | | | | | | | | | | | |
| Spring | 128,133 | 16,638 | 4,260 | 91-147 | 15 | 120,363 | 16,415 | 4,940 | 91-133 | 11 | 124,850 | 16,677 | 3,270 | 91-147 | 26 |
| Summer | 106,974 | 17,814 | 2,891 | 80-138 | 38 | 114,208 | 12,177 | 2,485 | 83-138 | 24 | 109,778 | 16,091 | 2,040 | 80-138 | 62 |
| Autumn | 114,532 | 11,607 | 1,323 | 74-133 | 77 | 109,362 | 10,442 | 1,378 | 95-128 | 58 | 112,311 | 11,375 | 0,980 | 74-133 | 135 |
| Winter | 111,471 | 7,803 | 1,891 | 96-124 | 17 | 111,211 | 7,130 | 1,636 | 101-128 | 19 | 111,333 | 7,348 | 1,225 | 96-138 | 36 |
| Total | 113,612 | 13,556 | 1,118 | 74-147 | 147 | 111,795 | 10,919 | 1,032 | 83-138 | 112 | 112,827 | 12,755 | 0,793 | 74-147 | 259 |

Table 36 Values of t and degrees of freedom (d f) for a comparison of total length between samples of *Saccostomus campestris* observed during different seasons on the study area (x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$).

| | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Total | d f |
| Spring - Summer | $4,8810^{xx}$ | 51 | 0,8212 | 33 | $4,1848^{xx}$ | 86 |
| Spring - Autumn | $2,9181^{xx}$ | 90 | $2,2066^{x}$ | 67 | $3,5995^{xx}$ | 159 |
| Spring - Winter | $4,2629^{xx}$ | 30 | 1,9722 | 28 | $4,4662^{xx}$ | 60 |
| Summer - Autumn | $3,4372^{xx}$ | 113 | 1,8953 | 80 | 1,7159 | 195 |
| Summer - Winter | 1,4478 | 53 | 1,5357 | 41 | 0,4073 | 96 |
| Autumn - Winter | $2,6225^{x}$ | 92 | 0,3359 | 75 | 1,8700 | 169 |

Table 37 Values of t and degrees of freedom (d f) for a comparison between *Saccostomus campestris* male and female mass, total length, tail length, and head and body length on the study area (x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$).

| | Values of t | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Mass | d f | Total Length | d f | Tail Length | d f | Head and Body Length | d f |
| Spring | 1,6286 | 24 | 1,3098 | 24 | 1,5731 | 24 | 1,1856 | 24 |
| Summer | 1,6041 | 60 | $2,5672^{x}$ | 60 | $3,2824^{xx}$ | 60 | 1,8978 | 60 |
| Autumn | $3,9153^{xx}$ | 133 | $3,3925^{xx}$ | 133 | $2,7189^{xx}$ | 133 | $2,7138^{xx}$ | 133 |
| Winter | 0,6879 | 34 | 0,0794 | 34 | 0,6712 | 34 | 0,1039 | 34 |
| Total | $2,7955^{xx}$ | 257 | 1,1490 | 257 | 0,8136 | 257 | 1,1944 | 257 |

Table 38 Values of t and degrees of freedom (d f) for a comparison of head and body length between samples of *S. campestris* observed during different seasons on the study area (x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$).

| | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Total | d f |
| Spring - Summer | $4,0868^{xx}$ | 51 | 1,1113 | 33 | $3,9082^{xx}$ | 86 |
| Spring - Autumn | $3,0259^{xx}$ | 90 | $2,1421^{x}$ | 67 | $3,6728^{xx}$ | 159 |
| Spring - Winter | $3,5494^{xx}$ | 30 | 1,7557 | 28 | $3,8705^{xx}$ | 60 |
| Summer - Autumn | $2,3782^{x}$ | 113 | 1,7072 | 80 | 1,1179 | 195 |
| Summer - Winter | 1,3019 | 53 | 1,0072 | 41 | 0,6527 | 96 |
| Autumn - Winter | 1,3257 | 92 | 0,8663 | 75 | 0,6238 | 169 |

Table 39 Values of t and degrees of freedom (d f) for a comparison of tail length between samples of *S. campestris* observed during different seasons on the study area (x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$).

| | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Total | d f |
| Spring - Summer | $6,0668^{xx}$ | 51 | 0,7221 | 33 | $4,1565^{xx}$ | 86 |
| Spring - Autumn | $2,2173^{x}$ | 90 | 1,8842 | 67 | 1,9972 | 159 |
| Spring - Winter | $5,4265^{xx}$ | 30 | $2,0460^{x}$ | 28 | $4,3515^{xx}$ | 60 |
| Summer - Autumn | $4,5584^{xx}$ | 113 | 1,3681 | 80 | $2,9101^{xx}$ | 195 |
| Summer - Winter | 1,6219 | 53 | 1,5783 | 41 | 0,4935 | 96 |
| Autumn - Winter | $3,6540^{xx}$ | 92 | 0,3889 | 75 | $3,0589^{xx}$ | 169 |

Table 40 Values of t and degrees of freedom (d f) for a comparison of body mass between samples of S. campestris observed during different seasons on the study area (x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$).

| | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Total | d f |
| Spring - Summer | $4,5143^{xx}$ | 51 | 1,9157 | 33 | $4,7548^{xx}$ | 86 |
| Spring - Autumn | $3,6086^{xx}$ | 90 | $3,2063^{xx}$ | 67 | $4,6260^{xx}$ | 159 |
| Spring - Winter | $4,8975^{xx}$ | 30 | $3,5570^{xx}$ | 28 | $5,8012^{xx}$ | 60 |
| Summer - Autumn | $2,5394^{x}$ | 113 | $2,0290^{x}$ | 80 | 0,8734 | 195 |
| Summer - Winter | 0,1527 | 53 | $2,6481^{x}$ | 41 | 1,6303 | 96 |
| Autumn - Winter | $3,2708^{xx}$ | 92 | 1,0374 | 75 | $3,5078^{xx}$ | 169 |

Table 41 Lemniscomys griselda seasonal mean total length, body length, tail length and body mass of males, females, and sexes combined on the study area.

| Season | MALES | | | | | FEMALES | | | | | TOTAL | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | SE | range | n | $\bar{X}$ | SD | SE | range | n | $\bar{X}$ | SD | SE | range | n |
| | BODY MASS (g) | | | | | | | | | | | | | | |
| Spring | 59,833 | 10,564 | 3,053 | 39-70 | 12 | 47,706 | 8,454 | 2,052 | 32-66 | 17 | 52,724 | 11,029 | 2,046 | 32-70 | 29 |
| Summer | 53,571 | 20,880 | 7,877 | 15-80 | 7 | 49,786 | 14,460 | 3,866 | 21-65 | 14 | 51,048 | 16,433 | 3,588 | 15-80 | 21 |
| Autumn | 41,000 | 8,332 | 2,955 | 23-51 | 8 | 43,462 | 11,752 | 3,260 | 24-63 | 13 | 42,524 | 10,424 | 2,290 | 23-63 | 21 |
| Winter | 41,762 | 5,924 | 1,293 | 33-57 | 21 | 43,259 | 8,305 | 1,600 | 29-63 | 27 | 42,604 | 7,325 | 1,015 | 29-63 | 48 |
| Total | 47,875 | 10,346 | 1,493 | 15-80 | 48 | 45,648 | 10,221 | 1,213 | 21-66 | 71 | 46,546 | 10,697 | 0,981 | 15-80 | 119 |
| | TOTAL LENGTH (mm) | | | | | | | | | | | | | | |
| Spring | 258,250 | 12,367 | 3,570 | 242-285 | 12 | 237,882 | 14,607 | 3,454 | 215-256 | 17 | 246,310 | 16,918 | 3,138 | 215-285 | 29 |
| Summer | 247,143 | 39,448 | 14,886 | 165-283 | 7 | 247,357 | 20,224 | 5,408 | 213-272 | 14 | 247,286 | 29,069 | 5,910 | 165-283 | 21 |
| Autumn | 235,625 | 21,738 | 7,681 | 186-258 | 8 | 231,538 | 20,723 | 5,740 | 187-255 | 13 | 233,095 | 20,669 | 4,542 | 186-258 | 21 |
| Winter | 238,857 | 10,219 | 2,231 | 228-254 | 21 | 238,888 | 15,962 | 3,060 | 214-272 | 27 | 238,875 | 13,616 | 1,888 | 214-272 | 48 |
| Total | 244,375 | 18,689 | 2,698 | 165-285 | 48 | 238,963 | 17,117 | 2,031 | 187-272 | 71 | 241,149 | 18,905 | 1,733 | 165-285 | 119 |
| | TAIL LENGTH (mm) | | | | | | | | | | | | | | |
| Spring | 141,083 | 7,971 | 2,300 | 132-154 | 12 | 130,529 | 8,232 | 1,990 | 105-140 | 17 | 134,890 | 9,570 | 1,770 | 105-154 | 29 |
| Summer | 128,857 | 21,279 | 8,050 | 83-147 | 7 | 130,500 | 11,257 | 3,009 | 112-146 | 14 | 129,952 | 14,793 | 3,260 | 83-147 | 21 |
| Autumn | 125,625 | 13,522 | 4,781 | 95-140 | 8 | 121,923 | 11,968 | 3,319 | 95-136 | 13 | 123,333 | 12,383 | 2,702 | 95-140 | 21 |
| Winter | 125,906 | 8,179 | 1,785 | 118-136 | 21 | 125,296 | 8,389 | 1,613 | 109-144 | 27 | 125,563 | 8,215 | 1,139 | 103-144 | 48 |
| Total | 130,084 | 11,330 | 1,635 | 83-154 | 48 | 126,952 | 9,472 | 1,124 | 95-146 | 71 | 128,217 | 10,568 | 0,969 | 83-154 | 119 |
| | HEAD AND BODY LENGTH (mm) | | | | | | | | | | | | | | |
| Spring | 117,167 | 5,906 | 1,700 | 109-131 | 12 | 106,647 | 5,884 | 1,420 | 100-119 | 17 | 112,174 | 7,192 | 1,330 | 100-131 | 29 |
| Summer | 118,286 | 18,590 | 7,015 | 82-140 | 7 | 116,857 | 9,396 | 2,512 | 101-127 | 14 | 117,333 | 12,710 | 2,775 | 82-140 | 21 |
| Autumn | 110,000 | 8,435 | 2,982 | 91-118 | 8 | 109,615 | 9,305 | 2,580 | 92-123 | 13 | 109,762 | 8,769 | 1,913 | 92-123 | 21 |
| Winter | 112,476 | 5,980 | 1,305 | 103-120 | 21 | 113,231 | 8,559 | 1,645 | 98-128 | 27 | 113,042 | 7,483 | 1,037 | 98-128 | 48 |
| Total | 114,083 | 8,837 | 1,276 | 82-140 | 48 | 112,186 | 8,146 | 0,967 | 92-127 | 71 | 113,009 | 8,660 | 0,794 | 82-140 | 119 |

Table 42 Values of t and degrees of freedom (d f) for a com= parison of total length between samples of L. griselda observed during different seasons on the study area (x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$).

| | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Total | d f |
| Spring - Summer | 0,7245 | 17 | 1,3949 | 29 | 0,1379 | 48 |
| Spring - Autumn | 2,6699$^{x}$ | 18 | 0,9396 | 28 | 2,4042$^{x}$ | 48 |
| Spring - Winter | 4,6073$^{xx}$ | 31 | 0,2145 | 42 | 2,0064$^{x}$ | 75 |
| Summer - Autumn | 0,6866 | 13 | 2,0051 | 25 | 1,8232 | 40 |
| Summer - Winter | 0,5496 | 26 | 1,3622 | 39 | 1,2666 | 67 |
| Autumn - Winter | 0,4039 | 27 | 1,1278 | 38 | 1,1748 | 67 |

Table 43 Values of t and degrees of freedom (d f) for a com= parison of male and female body mass, total length, tail, and head and body length from the study area (x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$).

| Season | Values of t | | | | |
|---|---|---|---|---|---|
| | Mass | Total Length | Tail Length | Head and Body Length | d f |
| Spring | 3,3001$^{xx}$ | 4,0497$^{xx}$ | 3,4644$^{xx}$ | 3,8321$^{xx}$ | 27 |
| Summer | 0,4307 | 0.0135 | 0,1913 | 0,1915 | 19 |
| Autumn | 0,5604 | 0,4259 | 0,6361 | 0,0976 | 19 |
| Winter | 0,7283 | 0,0082 | 0,2535 | 0,4569 | 46 |
| Total | 1,1575 | 1,6027 | 1,5753 | 1,1853 | 117 |

Table 44 Values of t and degrees of freedom (d f) for a comparison of head and body length between samples of L. griselda observed during different seasons on the study area (x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$).

| | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Total | d f |
| Spring - Summer | 0,1548 | 17 | $2,8425^{xx}$ | 29 | 1,6759 | 48 |
| Spring - Autumn | 2,0864 | 18 | 0,3282 | 28 | 1,0336 | 48 |
| Spring - Winter | $2,1850^{x}$ | 31 | $2,1033^{x}$ | 42 | 0,5054 | 75 |
| Summer - Autumn | 1,0855 | 13 | 2,0112 | 25 | $2,2469^{x}$ | 40 |
| Summer - Winter | 0,8130 | 26 | 1,2074 | 39 | 1,4417 | 67 |
| Autumn - Winter | 0,7606 | 27 | 1,1811 | 38 | 1,4927 | 67 |

Table 45 Values of t and degrees of freedom (d f) for a comparison of tail length between samples of L. griselda observed during different seasons on the study area (x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$).

| | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Total | d f |
| Spring - Summer | 1,4615 | 17 | 0,0080 | 29 | 1,3401 | 48 |
| Spring - Autumn | $2,9135^{xx}$ | 18 | $2,2218^{x}$ | 28 | $3,5735^{xx}$ | 48 |
| Spring - Winter | $5,2119^{xx}$ | 31 | $2,0381^{x}$ | 42 | $4,3660^{xx}$ | 75 |
| Summer - Autumn | 0,3454 | 13 | 1,9146 | 25 | 1,5723 | 40 |
| Summer - Winter | 0,3582 | 26 | 1,5242 | 39 | 1,2763 | 67 |
| Autumn - Winter | 0,0551 | 27 | 0,9138 | 38 | 0,7557 | 67 |

Table 46 Values of t and degrees of freedom (d f) for a comparison of body mass between samples of *L. griselda* observed during different seasons on the study area (x - significant, $p < 0,05$; xx - highly significant, $p < 0,01$).

| | Values of t | | | | | |
|---|---|---|---|---|---|---|
| | Males | d f | Females | d f | Total | d f |
| Spring - Summer | 0,7401 | 17 | 0,4755 | 29 | 0,4059 | 48 |
| Spring - Autumn | 4,4417$^{xx}$ | 18 | 1,1016 | 28 | 3,3325$^{xx}$ | 48 |
| Spring - Winter | 5,4559$^{xx}$ | 31 | 1,7106 | 42 | 4,3908$^{xx}$ | 75 |
| Summer - Autumn | 1,4923 | 13 | 1,2509 | 25 | 2,0073 | 40 |
| Summer - Winter | 1,4767 | 26 | 1,5607 | 39 | 2,2587$^{x}$ | 67 |
| Autumn - Winter | 0,2369 | 27 | 0,0559 | 38 | 0,0319 | 67 |

Table 47 Leggada minutoides seasonal mean total length, head and body length, tail length, and body mass of sexes combined on the study area.

| Season | Body Mass (g) | | | | | Total Length (mm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | SE | range | n | $\bar{X}$ | SD | SE | range | n |
| Spring | 5,700 | 1,059 | 0,335 | 4-8 | 10 | 93,900 | 4,458 | 1,410 | 87-101 | 10 |
| Summer | 7,000 | 1,528 | 0,577 | 5-9 | 7 | 99,857 | 6,492 | 2,449 | 91-107 | 7 |
| Autumn | 6,600 | 1,140 | 0,509 | 5-8 | 5 | 103,800 | 5,850 | 2,610 | 94-108 | 5 |
| Winter | 5,111 | 0,601 | 0,200 | 4-6 | 9 | 95,778 | 5,333 | 1,778 | 88-106 | 9 |
| Total | 5,968 | 1,036 | 0,186 | 4-9 | 31 | 97,387 | 5,162 | 0,925 | 87-108 | 31 |

| Season | Tail Length (mm) | | | | | Head and Body Length (mm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SD | SE | range | n | $\bar{X}$ | SD | SE | range | n |
| Spring | 41,200 | 3,293 | 1,030 | 36-46 | 10 | 52,700 | 2,45 | 0,770 | 47-56 | 10 |
| Summer | 40,857 | 2,911 | 1,098 | 35-43 | 7 | 59,000 | 4,726 | 1,780 | 52-64 | 7 |
| Autumn | 44,200 | 3,270 | 1,450 | 39-48 | 5 | 59,600 | 3,000 | 1,467 | 55-63 | 5 |
| Winter | 40,111 | 2,803 | 0,934 | 37-46 | 9 | 55,667 | 4,000 | 1,300 | 48-61 | 9 |
| Total | 41,290 | 2,910 | 0,521 | 35-48 | 31 | 56,097 | 3,426 | 0,615 | 47-64 | 31 |

Table 48 Values of t and degrees of freedom (d f)for a comparison of total length, head and body length, tail length, and body mass between samples of <u>Leggada minutoides</u> (sexes combined) observed during different seasons on the study area (x - significant, xx - highly significant).

| | Values of t | | | | |
|---|---|---|---|---|---|
| | Body Mass | Total Length | Tail Length | Head and Body Length | d f |
| Spring - Summer | 1,9473 | 2,1051 | 0,2264 | 3,2357$^{xx}$ | 15 |
| Spring - Autumn | 1,4754 | 3,3313$^{xx}$ | 1,6711 | 4,4539$^{xx}$ | 13 |
| Spring - Winter | 1,5095 | 0,8278 | 0,7784 | 1,9240 | 17 |
| Summer - Autumn | 0,5193 | 1,0993 | 1,8268 | 0,2686 | 10 |
| Summer - Winter | 3,0906$^{xx}$ | 1,3462 | 0,5168 | 1,4953 | 14 |
| Autumn - Winter | 2,7186$^{x}$ | 2,5362$^{x}$ | 2,3564$^{x}$ | 2,0793 | 12 |

Table 49 Seasonal frequency per mass class in *P.* (*M.*) *natalensis* males, females, and sexes combined, from the study area (M = males; F = females).

| Mass classes | Spring | | | | | | Summer | | | | | | Autumn | | | | | | Winter | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M | % | F | % | M+F | % | M | % | F | % | M+F | % | M | % | F | % | M+F | % | M | % | F | % | M+F | % |
| < 15 (g) | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 3 | 4 | 6 | 4 | 8 | 30 | 9 | 33 | 17 | 31 | 0 | 0 | 3 | 30 | 3 | 18 |
| 15-25 (g) | 32 | 33 | 43 | 68 | 75 | 47 | 1 | 1 | 6 | 10 | 7 | 5 | 9 | 33 | 4 | 15 | 13 | 24 | 2 | 33 | 5 | 50 | 7 | 43 |
| 26-45 (g) | 62 | 64 | 20 | 32 | 82 | 51 | 44 | 60 | 42 | 68 | 86 | 64 | 8 | 30 | 14 | 52 | 22 | 40 | 4 | 67 | 2 | 20 | 6 | 38 |
| > 45 (g) | 3 | 3 | 0 | 0 | 3 | 2 | 25 | 34 | 11 | 18 | 36 | 26 | 2 | 7 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 97 | | 63 | | 160 | | 73 | | 62 | | 135 | | 27 | | 27 | | 54 | | 6 | | 10 | | 16 | |

Table 50 Seasonal frequency per mass class in *S. campestris*, males, females, and sexes combined, from the study area.

| Mass classes | Spring | | | | | | Summer | | | | | | Autumn | | | | | | Winter | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M | % | F | % | M+F | % | M | % | F | % | M+F | % | M | % | F | % | M+F | % | M | % | F | % | M+F | % |
| < 35 (g) | 1 | 7 | 2 | 18 | 3 | 12 | 14 | 37 | 4 | 17 | 18 | 29 | 13 | 17 | 19 | 33 | 32 | 24 | 5 | 29 | 6 | 32 | 11 | 31 |
| 35-50 (g) | 2 | 13 | 1 | 9 | 3 | 12 | 12 | 32 | 12 | 50 | 24 | 39 | 32 | 42 | 30 | 52 | 62 | 46 | 9 | 53 | 12 | 63 | 21 | 58 |
| > 50 (g) | 12 | 80 | 8 | 73 | 20 | 77 | 12 | 32 | 8 | 33 | 20 | 32 | 32 | 42 | 9 | 16 | 41 | 30 | 3 | 18 | 1 | 5 | 4 | 11 |
| Total | 15 | | 11 | | 26 | | 38 | | 24 | | 62 | | 77 | | 58 | | 135 | | 17 | | 19 | | 36 | |

Table 51 Seasonal frequency per mass class in Lemniscomys griselda males, females, and sexes combined, observed on the study area (M = males; F = females).

| Mass classes | Spring |  |  |  |  |  | Summer |  |  |  |  |  | Autumn |  |  |  |  |  | Winter |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | M | % | F | % | M+F | % | M | % | F | % | M+F | % | M | % | F | % | M+F | % | M | % | F | % | M+F | % |
| < 30 g | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 14 | 1 | 7 | 2 | 10 | 1 | 13 | 1 | 8 | 2 | 10 | 0 | 0 | 1 | 4 | 1 | 2 |
| 30-45 g | 1 | 8 | 6 | 35 | 7 | 24 | 1 | 14 | 3 | 21 | 4 | 19 | 5 | 63 | 8 | 62 | 13 | 62 | 15 | 72 | 15 | 56 | 30 | 63 |
| > 45 g | 11 | 92 | 11 | 65 | 22 | 76 | 5 | 71 | 10 | 71 | 15 | 71 | 2 | 25 | 4 | 31 | 6 | 29 | 6 | 29 | 11 | 41 | 17 | 35 |
| Total | 12 |  | 17 |  | 29 |  | 7 |  | 14 |  | 21 |  | 8 |  | 13 |  | 21 |  | 21 |  | 27 |  | 48 |  |

Table 52 Praomys (Mastomys) natalensis sex ratios for each season and grid during the period August 1967 to May 1969 on the study area. $X^2$ values for testing a 1:1 ratio are indicated ($x = p < 0,05$; $xx = p < 0,01$; $xxx = p < 0,001$; M = male; F = female).

| Season | Grid P46 |  |  | Grid P 50 |  |  | Grids P88 & P89 |  |  | Total |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | M:F | M ratio | $X^2$ | M:F | M ratio | $X^2$ | M:F | M ratio | $X^2$ | M:F | M ratio | $X^2$ |
| Spring | 48:17 | ,739 | 14,785$^{xxx}$ | 29:20 | ,592 | 1,653 | 28:26 | ,519 | 0,074 | 105:63 | ,625 | 10,500$^{xx}$ |
| Summer | 49:40 | ,551 | 0,910 | 11:11 | ,500 | 0,000 | 6:5 | ,546 | - | 66:56 | ,541 | 0,820 |
| Autumn | 21:21 | ,500 | 0,000 | 5:4 | ,556 | - | 2:4 | ,333 | - | 28:29 | ,491 | 0,018 |
| Winter | 2:2 | ,500 | - | 15:6 | ,714 | 3,857$^{x}$ | 0:5 | - | - | 17:13 | ,567 | 0,533 |
| Total | 120:80 | ,600 | 8,000$^{xx}$ | 60:41 | ,594 | 3,574 | 36:40 | ,474 | 0,211 | 216:161 | ,573 | 8,024$^{xx}$ |

Table 53 Saccostomus campestris sex ratios for each season and grid during the period August 1967 to May 1969. $\chi^2$ values for testing a 1:1 ratio are indicated ($x = p < 0{,}05$; $xx = p < 0{,}01$; $xxx = p < 0{,}001$; M = male; F = female).

| Season | Grid P46 | | | Grid P50 | | | Grids P88 & P89 | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M:F | M ratio | $\chi^2$ | M:F | M ratio | $\chi^2$ | M:F | M ratio | $\chi^2$ | M:F | M ratio | $\chi^2$ |
| Spring | 2:2 | 0,500 | - | 8:5 | 0,615 | - | 2:2 | 0,500 | - | 12:9 | 0,571 | 0,429 |
| Summer | 15:11 | 0,577 | 0,615 | 13:7 | 0,650 | 1,800 | 10:9 | 0,526 | 0,053 | 38:27 | 0,585 | 1,862 |
| Autumn | 52:29 | 0,642 | 6,531$^{x}$ | 24:21 | 0,533 | 0,200 | 4:4 | 0,500 | - | 80:54 | 0,597 | 5,045$^{x}$ |
| Winter | 11:7 | 0,611 | 0,889 | 8:12 | 0,400 | 0,800 | 0:1 | - | - | 19:20 | 0,487 | 0,026 |
| Total | 80:49 | 0,620 | 7,450$^{xx}$ | 53:45 | 0,541 | 0,653 | 16:16 | 0,500 | 0,00 | 149:110 | 0,575 | 5,873$^{x}$ |

Table 54 Lemniscomys griselda sex ratios for each season and grid during the period August 1967 to May 1969. The $\chi^2$ values for testing a 1:1 ratio are indicated ($x = p < 0{,}05$; $xx = p < 0{,}01$; $xxx = p < 0{,}001$; M = male; F = female).

| Season | Grid P46 | | | Grid P50 | | | Grids P88 & P89 | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M:F | M ratio | $\chi^2$ | M:F | M ratio | $\chi^2$ | M:F | M ratio | $\chi^2$ | M:F | M ratio | $\chi^2$ |
| Spring | 11:11 | 0,500 | 0,000 | 1:7 | 0,125 | - | 4:3 | 0,571 | - | 16:21 | 0,432 | 0,676 |
| Summer | 6:6 | 0,500 | - | 1:2 | 0,333 | - | 2:6 | 0,250 | - | 9:14 | 0,391 | 1,087 |
| Autumn | 7:11 | 0,389 | 0,889 | 3:5 | 0,375 | - | 0:1 | - | - | 10:17 | 0,370 | 1,815 |
| Winter | 8:12 | 0,400 | 0,800 | 21:20 | 0,512 | 0,024 | 2:1 | 0,667 | - | 31:33 | 0,484 | 0,063 |
| Total | 32:40 | 0,444 | 0,889 | 26:34 | 0,433 | 1,067 | 8:11 | 0,421 | 0,474 | 66:85 | 0,437 | 2,391 |

Table 55 *Leggada minutoides* and *Steatomys pratensis* sex ratios during the period August 1967 to May 1969. $X^2$ value for testing a 1:1 ratio in the case of *L. minutoides* is indicated (M = male; F = female).

| *Leggada minutoides* | | |
|---|---|---|
| M:F | M ratio | $X^2$ |
| 23:23 | 0,500 | 0,00 |
| *Steatomys pratensis* | | |
| 12:2 | 0,857 | - |