

Notes on small mammals on the Springbok Flats, Transvaal

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Small mammals were trapped at three-month intervals on six trap-lines on the Springbok Flats, Transvaal during 1977 and 1978. Trapping success varied considerably (average 18,5%) during 5 760 trap-nights. Nine rodent and four shrew species were recorded in the area. Species composition and abundance differed on black turf and red clay. *Praomys natalensis*, *Rhabdomys pumilio* and *Otomys angoniensis* were the dominant rodents, and *Crocidura hirta* the commonest shrew. Trapping success was greatest in late spring and autumn to mid-winter. *O. angoniensis* probably bred throughout the year, but *P. natalensis* and *R. pumilio* produced most young in spring and autumn.

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Klein soogdiere is met tussenposes van drie maande in ses rye valle op die Springbokvlakte, Transvaal gedurende 1977 en 1978 gevang. Vangsukses het aansienlik gevarieer (gemiddeld 18,5%) oor 5 760 vangnagte. Nege knaagdier- en vier skeerbekmuisspesies is in die gebied opgeteken. Spesiesamestelling en digthede het verskil op swart turf en rooi kleigrond. *Praomys natalensis*, *Rhabdomys pumilio* en *Otomys angoniensis* was die volopste knaagdierspesies en *Crocidura hirta* die algemeenste skeerbekmuissort. Vangsukses was hoogste in die laat lente en in die herfs tot die middel van die winter. *O. angoniensis* het waarskynlik dwarsdeur die jaar aangeteel, maar *P. natalensis* en *R. pumilio* het in die lente en herfs die meeste kleintjies afgewerp.

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Although small mammals form important components of many ecosystems in southern Africa, few studies have provided more than lists of the species occurring in an area. In addition, rodent densities are often said to fluctuate widely and unpredictably, thereby having possible important effects on disease transmission and agriculture (e.g. Choate 1972; De Graaff 1981). There is, however, little published information on the magnitude and timing of these changes in density. Furthermore, little is known of environmental factors and reproductive events causing demographic changes.

This paper attempts to describe the basic composition and dynamics of a small mammal community. The study formed part of a wider investigation into the effects of the availability, as prey, of small mammals on blackshouldered kites *Elanus caeruleus* (Mendelsohn 1981). My primary interest was therefore in the overall dynamics of small mammal populations.

Study area

The study was in a 6900-ha area at Settlers (28°33'E/24°57'S) on the Springbok Flats. The topography was flat with a 60-m drop over 12 km from north to south. Substrates consisted of black turf soil (64% of the area) or red clay (36%). Cultivation accounted for 72% of the area, with six predominant crops: wheat (38%), sunflowers (33%), maize (9%), millet (9%), sorghum (7%) and manna (5%). Wheat was usually planted in February and March and harvested between July and September. Other crops were planted between September and November and harvested between March and August. Other major habitats in the area were: grassland (5%), woodland (17%), road and field verges (5%) and farmyards (1%).

The whole area was on Springbok Flats Turf Thornveld (Acocks 1975). The indigenous plant communities varied according to soil conditions. On black turf *Acacia tortilis*, *A. nilotica*, *A. flecki* and *Rhus pyroides* accounted for about 98% of the trees, while grasses consisted mainly of *Setaria woodii*, *Ischaemum glaucostachyum*, *Bothriochloa insculpta*, *Sorghum versicolor* and *Sehima galpini*. There was a more diverse flora on red clay where *Acacia tortilis*, *A. nilotica*, *A. robusta*, *A. caffra*, *A. karroo* and *Zizyphus mucronata* formed woodlands, and *Themeda triandra*, *Hyparrhenia hirta*, *Bothriochloa insculpta*, *Eragrostis* spp., *Heteropogon contortus*, *Fingerhuthia africana* and

Panicum coloratum were the commonest grasses.

The mean annual rainfall at Settlers was 601 mm ($n = 41$ yrs), of which about 90% fell between October and March (Figure 1). Much of the rain fell in localized thunderstorms, often resulting in marked differences in rainfall between areas. Winter temperatures seldom reach

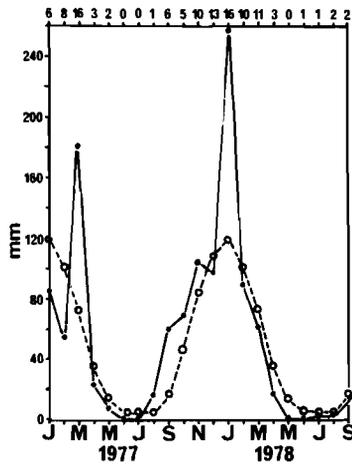


Figure 1 Observed (—) and average (----) rainfall at Towoomba (28°20'E/24°54'S), the nearest weather station to Settlers. The average annual rainfall at Towoomba was 621 mm. Figures above each month show the number of days on which rain was recorded at Towoomba during 1977 and 1978.

ed 0° C, but frost occurred on about 20% of the days in June and July. Maximum temperatures in summer often rose to 35–38° C — for details of the geography of the Springbok Flats *vide* Van der Riet (1974).

Trapping was conducted at three-month intervals from April 1977 to September 1978. At five sites, 20 trap-stations were spaced 10 m apart along a line, with one masonite live-trap (Meester 1970) and two Museum Special snap traps set at each station. At a sixth site, started in October 1977, 30 masonite traps were placed 10 m apart along a line. These traps were set in runways to catch as many *Otomys angoniensis* as possible. This species is not normally attracted to baited traps (Taylor & Green 1976; pers. obs.). All traps were baited with a peanut-butter-syrup-oatmeal mixture (Dippenaar 1974). Trapping sessions lasted 72 h. All catches were removed and bait renewed if necessary late in the morning of each day. Specimens were weighed on a triple beam balance. From June 1978 all rodents were examined for reproductive activity.

Weight and reproductive activity data from animals trapped at scattered localities and times were included with those obtained from trapping sessions on the six trap-lines.

Although *Praomys natalensis* has been found to consist of two sibling species with different karyotypes (Hallet 1979), the karyotype(s) of these rodents at Settlers has not been determined; I shall therefore continue using the name *P. natalensis*.

Table 1 Habitat features and rodent trapping successes at six trap-lines. Grass species listed in order of dominance were *Ischaemum glaucostachyum*, *Setaria woodi*, *Cynodon dactylon*, *Hyparrhenia hirta*, *Bothriochloa insculpta*, *Themeda triandra* and *Panicum coloratum*

	Trap line					
	1	2	3	4	5	6
Soil type	Black turf	Black turf	Black turf	Black turf	Red clay	Red clay
Habitat	Woodland edge	Woodland	Woodland	Field verge	Road verge	Woodland edge
Dominant grasses	<i>Ischaemum</i> <i>Setaria</i>	<i>Setaria</i> <i>Ischaemum</i>	<i>Setaria</i> <i>Ischaemum</i>	<i>Ischaemum</i> <i>Setaria</i> <i>Cynodon</i>	<i>Hyparrhenia</i> <i>Bothriochloa</i> <i>Themeda</i>	<i>Themeda</i> <i>Bothriochloa</i> <i>Panicum</i>
No. of trap-nights	360	1080	1080	1080	1080	1080
No. of captures	107	236	186	167	203	166
% Trap success						
All species	29,7	21,8	17,2	15,5	18,8	15,4
<i>Otomys angoniensis</i>	5,6	1,3	1,7	2,2	0,6	0,6
<i>Rhabdomys pumilio</i>	8,1	10,9	7,4	4,3	1,2	2,1
<i>Praomys natalensis</i>	12,8	8,1	6,9	8,0	15,9	10,9
<i>Dendromys melanotis</i>	0	0	0	0	0,3	0
<i>Lemniscomys griselda</i>	0	0	0	0	0	0,4
<i>Saccostomus campestris</i>	0	0	0	0	0	0,7
<i>Rattus</i> sp.	0	0,1	0	0	0	0
<i>Mus minutoides</i>	0	0	0	0	0	0,1
<i>Crociodura hirta</i>	3,3	1,4	1,2	1,0	0,8	0,5
<i>C. cyanea</i>	0	0	0	0	0	0,1

Results

In a total of 5 760 trap-nights, 1 065 small mammals were caught (Table 1), i.e. 18,5% trap-success. Sixty-six (6,5%) were shrews (65 *Crocidura hirta* and one *C. cyanea*) and the rest rodents. *Otomys*, *Praomys* and *Rhabdomys* together formed 92% of all captures. Capture rates of *Otomys* were, however, low (Table 1) because they were probably not attracted to the bait used. Thus, only 89 (8,4%) of all captures were *Otomys* compared with a frequency of 27,6% in 2 573 pellets regurgitated by blackshouldered kites (Mendelsohn 1982). The proportion of *Praomys* trapped (54,9%) was higher than their incidence in kite pellets (29,8%); as nocturnal rodents they were probably under-represented in the prey of diurnal blackshouldered kites. The corresponding figures for diurnal *Rhabdomys* (Choate 1972) were 28,9% trapped and 29,5% in pellets. *Steatomys pratensis*, *Crocidura bicolor* and *Suncus infinitesimus* were recorded in blackshouldered kite pellets, but were not trapped.

Otomys and *Rhabdomys* were more abundant on black turf than on red clay (Table 1). However, there was only a marginal difference in the trapping success of all species on the two soils, with better success on black turf ($\chi^2 = 3,7; p < 0,1$).

There were similar changes in trapping success at the six trap-lines during the study (Figure 2). At most lines trap-

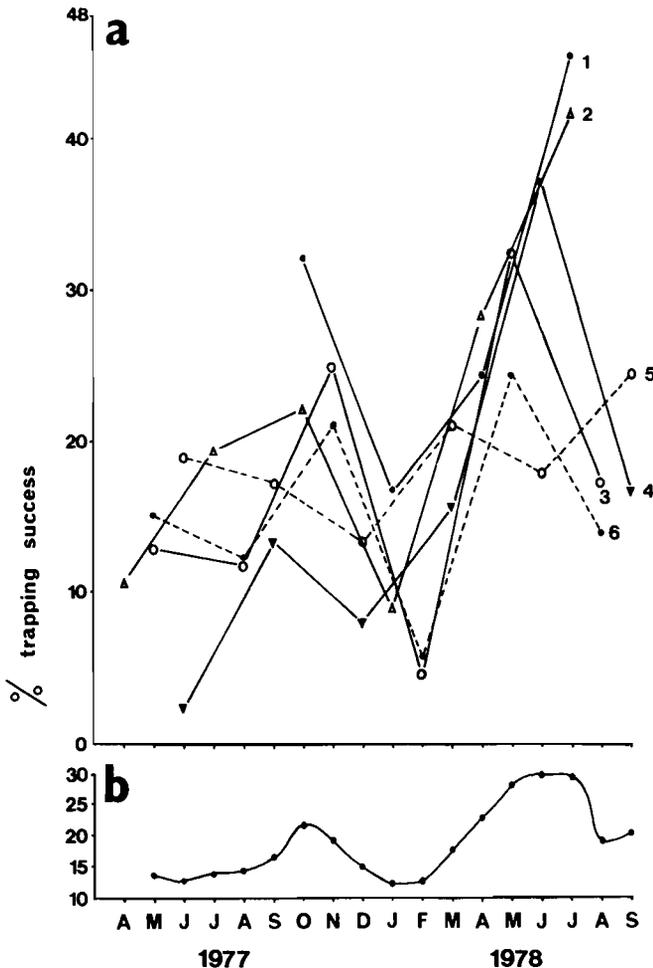


Figure 2 Observed (a) and mean (b) trapping success rates at six trap-lines, numbered as in Table 1. Mean values for each month (b) were calculated by averaging monthly observed trapping rates and interpolated rates (read off curves in (a)) for trap-lines at which there was no trapping.

ping success changed 2–4 times. Numbers increased in spring and autumn, and decreased during early summer and late winter. As a result, peaks in trapping success occurred in late spring and the first half of winter. The only prominent trough occurred in the middle of summer. Differences in trapping success between the winters of 1977 and 1978 were possibly related to differences in rainfall during the preceding summers. There was a much higher rainfall during summer 1977–78 than in the previous summer (Figure 1). Several authors have demonstrated a positive relationship between rodent breeding activity and rainfall (Perrin 1980; Taylor & Green 1976).

Only *Praomys* and *Rhabdomys* were caught in sufficient numbers to show seasonal changes in trapping rates (Figure 3). Although the two species showed similar changes in numbers during most of the study period, *Praomys* numbers changed more than those of *Rhabdomys*.

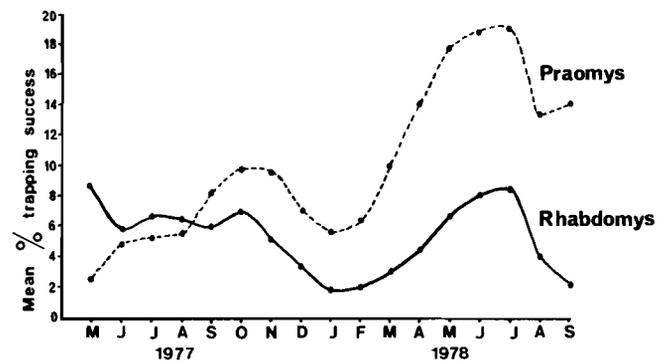


Figure 3 Seasonal changes in trapping success for *Praomys natalensis* and *Rhabdomys pumilio*. The mean trapping rates were calculated in the same way as those in Figure 2b.

Seasonal changes in the proportion of juveniles in trapped samples of *Otomys*, *Rhabdomys* and *Praomys* are shown in Figure 4. Specimens weighing less than 50 g (*Otomys*), 20 g (*Rhabdomys*) and 15 g (*Praomys*) were considered juvenile and less than a month old (Brooks 1974; Coetzee 1967; Davis 1973). *Otomys* samples were small, but suggested that young were produced year-round. For *Rhabdomys* and *Praomys* greater numbers of juveniles trapped during spring and autumn suggested that there were two peaks of breeding activity (Figure 4). In particular, there was an absence of young during the summer months. Between October 1977 and February 1978 there were no juveniles in a total sample of 104 *Praomys*, and between November and March only one juvenile *Rhabdomys* was caught in a sample of 33. Figure 4 also shows an increase in breeding activity for all three species with the onset of the 1978 spring.

The following weights of trapped animals were recorded; means, standard deviations and sample sizes are given where more than ten animals were weighed. *Otomys* — $83,2 \pm 25,4$ g; $n = 128$; *Praomys* — $31,0 \pm 12,5$ g; $n = 503$; *Rhabdomys* — $34,4 \pm 11,0$ g; $n = 240$; *Saccostomus campestris* — 40,5; 43,5; 49,0, 56,5; 65,0; 66,5; 81,0 g; *Lemniscomys griselda* — 18,5; 29,5; 36,5 g; *Dendromus melanotis* — 5,5; 7,5; 9,5 g; *Mus minutoides* — 4,0 g; *Crocidura hirta* — $13,6 \pm 2,8$ g; $n = 52$; *C. cyanea* — 9,0 g.

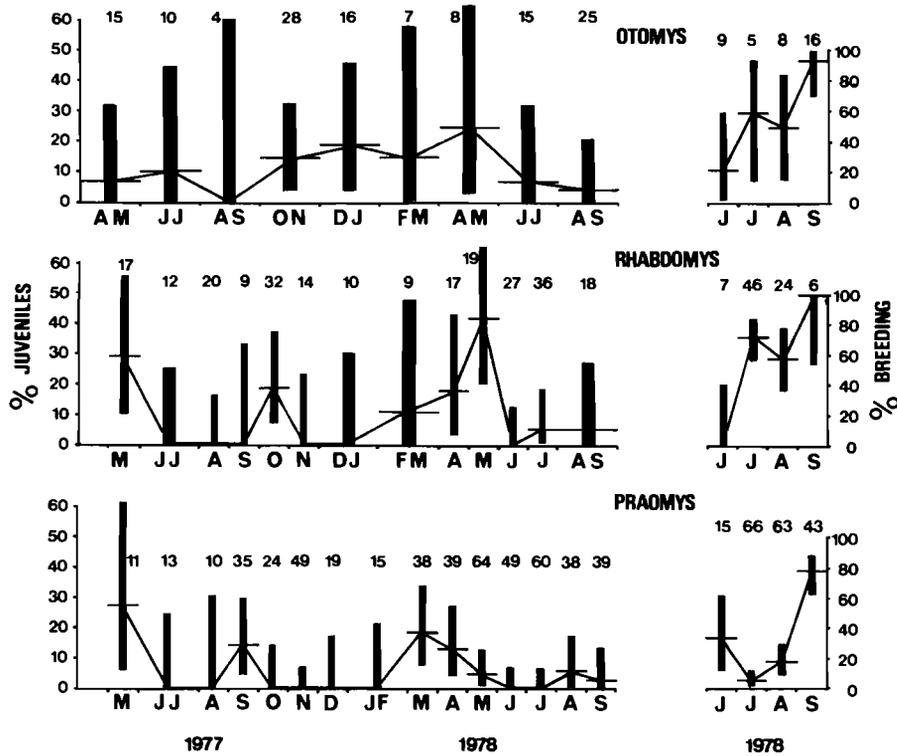


Figure 4 Seasonal breeding activity in *Otomys angoniensis*, *Rhabdomys pumilio* and *Praomys natalensis* as determined by the frequency of juveniles (left) and reproductively active animals (right) in trapped samples. Means, 95% confidence intervals and sample sizes are shown. Small samples were pooled into two-month periods. Reproductive activity in late 1978 was identified by scrotal males and pregnant or lactating females.

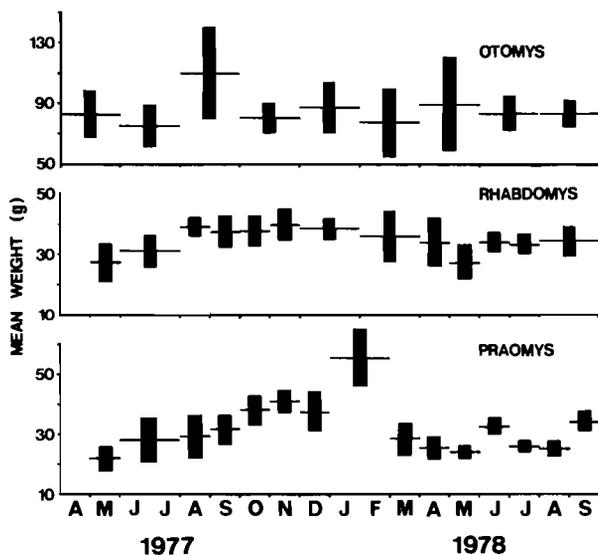


Figure 5 Mean weights of monthly or two-monthly samples of *Otomys angoniensis*, *Rhabdomys pumilio* and *Praomys natalensis*. Means and 95% confidence intervals are shown.

The small samples of *Otomys* showed no seasonal changes in weight (Figure 5). Larger numbers of *Rhabdomys* and *Praomys* indicated that weights of trapped animals increased from a low point in early winter to a peak in late summer.

Discussion

Lines 1–4 set on black turf (Table 1) were in climax communities, and these were seldom disturbed by grazing. In contrast, cattle grazed heavily on the more palatable grasses

on red clay communities. Most red clay areas were overgrazed with either pioneer (unpalatable) communities (line 5) or a sparse grass cover (line 6). These differences in vegetation probably explain the greater abundance of *Otomys* and *Rhabdomys* on black turf (Table 1). Both species were active diurnally and probably favoured the dense grass cover on black turf (Brooks 1974; Choate 1972; Davis 1973; pers. obs.).

The soil at line 6 was slightly sandy, unlike other parts of the study area. There was an associated greater plant diversity at this line and certain species, e.g. *Acacia karroo* and *A. gerrardii* were found only in this area. This diversity was apparently linked to a more varied mammal community (Table 1).

Although I did not attempt to trap in fields, the hunting activity of blackshouldered kites, greater kestrels *Falco rupicoloides* and marsh owls *Asio capensis* (regular small mammal predators (pers. obs.)) indicated that there were few mammals in most crops. Exceptions were wheat and manna and, during winter, bare black turf fields. Wheat and manna, particularly when well-grown, probably provided cover for small mammals, and birds of prey regularly hunted over these areas. Similarly, birds of prey often hunted over bare black turf during the dry winter when large crevices (25–100 cm deep and 5–10 cm wide) formed. These crevices probably also provided cover, because during the wet summer there were no crevices and birds of prey did not hunt over these areas.

There were no small burrowing mammals (e.g. *Tatera* spp., *Cryptomys hottentotus*, *Pedetes capensis*) in the clay soils at Settlers. The soils were probably too hard when dry and too clayey when wet for burrowing. Burrowing

species mentioned above were all common in surrounding sandy, Mixed Bushveld (Acocks 1975) areas (Dean 1973; Jacobsen 1977; pers. obs.).

The average trapping success rate during the study (Figure 2b) was highly significantly correlated with two measures of feeding success in blackshouldered kites (Mendelsohn 1982). This suggests that changes in trapping success closely matched changes in actual mammal density. These large changes in trapping rate resemble those found by other studies; (De Moor 1969; De Wit 1972; Davis 1973; Brooks 1974; David 1980; Perrin 1980). Although some changes occur regularly as a result of seasonal breeding, others are irregular with marked differences between years. Populations studied by Davis (1973), Brooks (1974), and David (1980) showed peak densities in late summer and autumn, but the peaks varied 2–4 times in magnitude between years.

While some rodents in southern Africa breed throughout the year, most breed during summer (De Graaff 1981). Breeding usually starts in early summer, reaches a peak in mid and late summer, and may continue into autumn if the summer rainfall is high. Juvenile recruitment boosts densities until they peak between late summer and early winter. Numbers then decline and reach a minimum in spring before breeding resumes.

The peak densities observed during autumn and early winter at Settlers (Figure 2) were therefore probably owing to similar summer breeding. However, the other population peak in spring and the low numbers of juvenile *Praomys* and *Rhabdomys* produced during summer (Figure 4) suggest that breeding did not occur in one continuous season. Most studies demonstrating summer breeding activity did so by noting adults in reproductive condition. However, results using this method do not always agree with those obtained by recording the presence of juveniles in trapped samples. This is shown by the results of several studies that were similar to those obtained in my study. Davis (1973) and Perrin (1980) observed lower numbers of juvenile *Otomys irroratus* and *Rhabdomys* during midsummer than during early and late summer, and Brooks (1974) and Chidumayo (1980) found that populations of *Rhabdomys* and *Tatera leucogaster* decreased during summer. Adult rodents sampled during these studies nevertheless continued to show reproductive activity throughout the summer, suggesting that environmental conditions were not always suitable for the actual production, or survival, of young.

These observations therefore suggest that rodent populations may not always breed throughout summer, and that densities may not always show single peaks during late summer and autumn. They also suggest that the peak numbers found in spring (Figure 2) resulted from the production of juvenile *Rhabdomys* and *Praomys* (Figure 4). Similarly, low densities recorded during midsummer were probably caused by the low rates at which juveniles were then recruited.

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