Burrow system characteristics of seven small mammal species (Mammalia: Insectivora; Rodentia; Carnivora)

G. N. BRONNER
Department of Mammals, Transvaal Museum, P. O. Box 413, Pretoria, 0001 Republic of South Africa.

Koedoe 35/1 (1992): 125-128. Pretoria. ISSN 0075-6458.

The burrows excavated by small mammals provide not only refuge from predators, but also relatively constant microclimates which reduce their susceptibility to climatic extremes and habitat disturbances (Bennett, Jarvis & Davies 1988, *South African Journal of Zoology* 23:189-195; McNab 1966, *Ecology* 47:712-733). However, burrow conditions also impose ecophysiological constraints (including hypoxia and high humidity) which their occupants must overcome in order to survive (Nevo 1979, *Annual Review of Ecology and Systematics* 10:269-308). The burrow structures of small mammals may therefore be considered adaptive (Hickman 1990, *In*: Nevo & Reig (eds.), *Evolution of subterranean mammals at the organismal and molecular levels*, New York: Alan R. Liss), and knowledge thereof may contribute to a better understanding of their physiology, behaviour and ecology (Buffenstein 1984, *Journal of Thermal Biology* 9:235-241; Lovegrove & Painting 1987, *Koedoe* 30:149-163).

Although the burrow architecture of fossorial mammals has been extensively studied (Hickman 1979, *Zeitschrift für Säugetierkunde* 44:153-162; Hickman 1984, *Säugetierkundliche Mitteilungen* 31:243-249; Davies & Jarvis 1986, *Journal of Zoology, London* 209:125-147; Jarvis & Sale 1971, *Journal of Zoology, London* 163:451-479; amongst others), little attention has hitherto been paid to the burrow systems of some of the common terrestrial species in southern Africa. This study describes the burrow characteristics of two soricid, four rodent and one viverrid species, and briefly examines factors underlying variation in burrow topographies.

Small mammals were trapped at burrow entrances in a reservoir enclosure in Bankenveld (Acocks 1988, *Memoirs of the Botanical Survey of South Africa* 57:1-146; Veld Type 61) at Komati Power Station (26°06'S; 29°29'E), situated 37 km north of Bethal on the eastern Transvaal highveld of South Africa. Species captured were identified with keys in Meester, Rautenbach, Dippenaar & Baker (1986, *Transvaal Museum Monograph* 5:1-359), and by karyotypic analyses performed using the *in-vitro* method of Green, Keogh, Gordon, Pinto & Hartwig (1980, *Journal of Zoology, London* 192:17-23). Eleven burrows (occupied by a total of seven species) were carefully excavated with shovels and trowels, and the following data recorded for each system (= group of interconnected tunnels): number and diameter(s) of burrow entrances; direction(s) and depth(s) of tunnels; distance(s) between turning points; tunnel diameter(s) at each turning points; number and dimensions of chambers; and nest contents. Burrow system dimensions were quantified in terms of: total tunnel length; maximum depth; and total volume (V_B), which was calculated using the equation

$$V_B = \pi(\tfrac{1}{2}D)^2L + \Sigma(l_n \times w_n \times h_n)$$

where D = mean tunnel diameter
L = total length of tunnel system
l_n = length of nest/chamber
w_n = width of nest/chamber
h_n = height of nest/chamber

The dimensions and topographies of the burrow systems analysed are shown in Table 1 and Fig. 1. Two disused slender mongoose (*Galerella sanguinea*) burrows were inhabited by other species at the time of study: one by a breeding pair of vlei rats (*Otomys irroratus*); and the other by a multimammate mouse (*Mastomys coucha*; identified on basis

Table 1
Dimensions of the 11 small mammal burrows analysed

Species	No. of entrances	No. chambers	Mean diameter	Total length (+ chambers)	Total length (- chambers)	Total volume	Maximum depth
Myosorex varius	2	1	4,8 ±0,4cm	0,42m	0,42m	0,83dm³	36cm
Crocidura mariquensis	3	1	4,1 ±0,7cm	1,65m	1,52m	2,71dm³	35cm
Rhabdomys pumilio	2	2	5,5 ±0,7cm	0,59m	0,26m	3,43dm³	22cm
Rhabdomys pumilio	3	1	5,9 ±1,1cm	3,25m	3,07m	10,88dm³	44cm
Mastomys coucha	8	1	5,4 ±0,9cm	9,19m	8,99m	24,42dm³	60cm
Tatera brantsii	8	1	6,1 ±1,2cm	6,64m	6,44m	18,82dm³	22cm
Tatera brantsii	4	1	4,6 ±0,7cm	5,34m	5,24m	9,51dm³	20cm
Galerella sanguinea	1	1	7,5 ±0,7cm	0,90m	0,38m	16,66dm³	59cm
Galerella sanguinea	1	1	10,5cm	0,82m	0,20m	26,70dm³	60cm
Joint burrow systems							
Galerella sanguinea	1	1	9,0 ±1,8cm	1,33m	0,69m	16,65dm³	75cm
+							
Mastomys coucha) *Myosorex varius*)	3	6	5,5 ±1,4cm	4,79m	3,82m	16,24dm³	75cm
Galerella sanguinea	1	1	9,0cm	0,88m	0,10m	59,45dm³	50cm
+							
Otomys irroratus	3	1	6,8 ±1,8cm	6,03m	5,74m	24,79dm³	50cm

of diploid chromosome number = 36) and a forest shrew (*Myosorex varius*). This suggests that multi-species usage of the same burrow system (either concurrently or at different times) may be a common phenomenon. The measurements in Table 1 may, therefore, include biases introduced by different species modifying the same tunnel system.

The four slender mongoose burrows studied displayed similar, simple topographies characterised by single entrances connected to single, large chambers (mean dimensions: 39,8 ±21,2 cm long x 32,7 ±17,2 cm wide x 13,5 ±5,4 cm high) via short passages (Fig. 1). None of the chambers contained any nesting materials, although prey remains (millipedes, crushed crustacean fragments) occurred in two chambers. These results indicate that slender mongooses do not rely exclusively on natural holes, hollow logs and burrows made by other species (see Jacobsen 1982, *Säugetierkundliche Mitteilungen* 30:168-183; Skinner & Smithers 1990, *The Mammals of the Southern African Subregion* (New Edition). Pretoria: University of Pretoria Press), and that even though they may not possess strong claws, they are adept diggers which can capably excavate their own burrow systems if the need arises.

The various rodent burrows excavated displayed more complex topographies than those of slender mongooses. Two striped mouse (*Rhabdomys pumilio*) burrows studied were characterised by two to three entrances that proceeded downwards (at an angle of 15°-20°) and sideways to connect with single nesting chambers (mean dimensions: 17,5 ±0,7 cm long x 12,0 ±4,2 cm wide x 8,0 ±1,4 cm high). These chambers contained round nests of shredded grass— mainly kikuyu (*Pennisetum* sp.). One system contained another bare chamber, the purpose for which was not clear. The disparity in the dimensions of the two systems may have resulted from differences in soil moisture content (which were 4,4 % and 15,4 %, for the shorter and longer burrows respectively) which probably affected substrate friability.

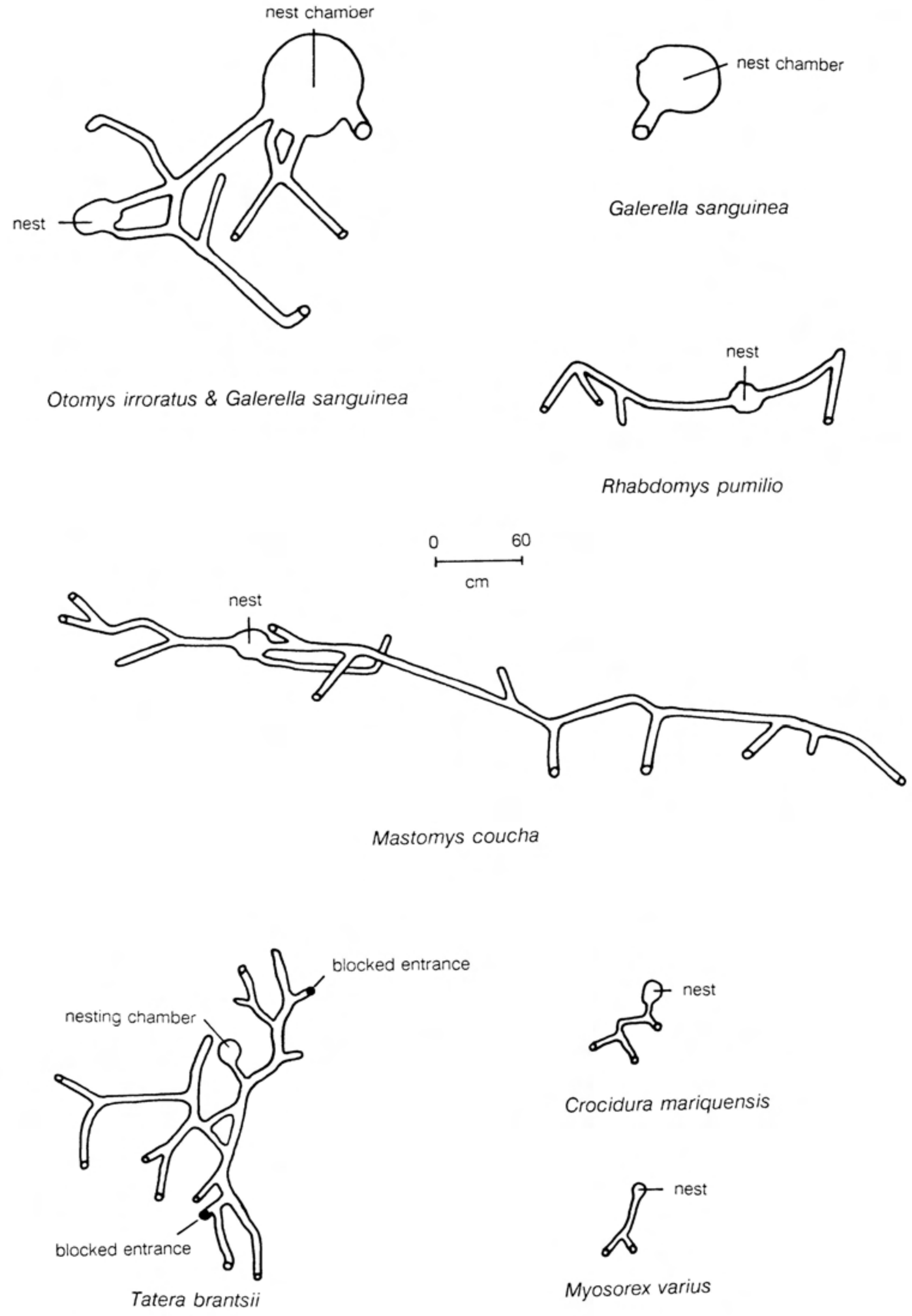

Fig. 1. Schematic topographies of small mammal burrows excavated during the study.

The single *M. coucha* burrow excavated had an elongate configuration with eight entrances which connected to a main tunnel with four blind side-tunnels. The single nesting chamber was lined with shredded grass, and joined to a twisting tunnel which proceeded downwards (at an angle of ca. 10°) to reach a dead-end after 95 cm. This presumably was used as a bolt-hole during danger.

A breeding pair of *O. irroratus* was captured in a burrow system (which merged with a disused slender mongoose burrow) situated below a thick clump of grass (*Hyparrhenia hirta*). The single nesting chamber contained a bowl-shaped, shredded grass nest with a diameter of ca. 29 cm, and connected to the main burrow system via two tunnels, one of which joined with a cul-de-sac that proceeded downwards (at an angle of ca. 45°) after approximately 20 cm. These results conflict with previous reports that *O. irroratus* is a terrestrial species which usually nests above ground, and which seldom burrows (Davis 1972, *Zoologica Africana* 7:119-140; FitzSimons 1920, *The natural history of South Africa. Vol 4: Mammals*. London: Longmans and Green; Roberts 1951, *The Mammals of South Africa*. Johannesburg: Trustees of the Mammals of South Africa Book Fund). Davis (1973, *The ecology and life history of the vlei rat,* Otomys irroratus *(Brants, 1827), on the Van Riebeeck Nature Reserve, Pretoria*, unpublished M.Sc. thesis, University of Pretoria) concluded that this species excavates short, simple burrows only in dry or exposed situations, whereas the data reported here suggest that this species may construct extensive and complex burrows even in moist habitats with good vegetative cover. Burrowing by this species may be a facultative, adaptive response to habitat instability (the area studied, like much of the Transvaal highveld, is subjected to veld fires every dry season) which allows the vlei-rats to survive transient, man-induced habitat destruction.

The two highveld gerbil (*Tatera brantsii*) burrow systems studied were located three metres apart in loose, sandy soil amidst short grass at the edge of a vlei. Both systems were extensive and intricate, with four to seven open entrances (characterised by mounds of freshly excavated soil) and several blocked entrances) which connected with single, bare nesting chambers via mazes of shallow tunnels. The entrances to the nesting chambers were plugged with loose sand, presumably to provide relatively constant microclimates within the chambers. The mean total length of the systems was 5,99 ±0,9 m, which is in close agreement with that reported for *T. robusta* in Tanzania (Senzota 1984, *Mammalia* 48:185-195). Such shallow, intricate burrow systems were also reported for *T. robusta* (Senzota 1984, *ibid.*), *Gerbillurus paeba* (De Graaff & Nel 1966, *Koedoe* 8:136-139) and *Desmodillus auricularis* (Nel 1967, *Koedoe* 10:118-121), and appear to be characteristic of many gerbil species. These labyrinthine tunnel systems are probably necessitated by gerbils' preferences for sandy soils, which makes their burrows vulnerable to excavation by predators. The role of the anastomosing tunnels is probably to slow-down or confuse predators, whereas the abundant entrances presumably serve as quick escape routes during danger.

The burrows excavated by *Myosorex varius* and *Crocidura mariquensis* were considerably shorter than those of rodents, and had simpler topographies with two to three entrances which converged to form single main tunnels with terminal nesting chambers (mean dimensions: 9,0 ±5,7 cm long x 8,0 ±5,7cm wide x 3,8 ±1,1 cm high) lined with shredded vegetation. Similar burrow topographies were reported by Goulden & Meester (1978, *Mammalia:* 197-207), although these authors found that *M. varius* is usually a more active burrower than *C. mariquensis*.

Acknowledgements

This study was commissioned by the Electricity Supply Commission of South Africa (ESKOM), whose financial input is gratefully acknowledged. Messrs. L. Viviers, M. Bunton, E. Coertzen, S. Mothlasedi and A. Mathiba assisted with fieldwork. Dr. I. L. Rautenbach, and two reviewers, kindly commented on the draft manuscript.