The bush Karoo rat *Otomys unisulcatus* on the Cape West coast

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In the Postberg Nature Reserve, coastal Western Cape Province, bush Karoo rats *Otomys unisulcatus* build dome-shaped stick shelters or lodges, with a mean height of 1,45 m and a mean volume of 0,61 m^3, usually with *Exomis microphylla* var. *axyrioides* as a supporting shrub. Sticks and twigs utilized are from 10 to 517 mm long, 3,5 mm thick, and with a mean length up to 117 mm per lodge, interwoven to form intricate structures. These are criss-crossed with passages and contain two nests and two latrines each. More than 13 000 sticks can be used to build a lodge; this involves travelling total distances of up to 16,5 km to gather building material. A network of paths interconnects lodges and leads to shrubs providing sticks and food. Most lodges are inhabited by one or two individuals. The species is diurnal and crepuscular.

In die Postberg-Natuurreservaat op die Kaapse Weskus bou boskaroorotte *Otomys unisulcatus* koepelvormige stokhuise met 'n gemiddelde hoogte van 1,45 m en 'n gemiddelde volume van 0,61 m^3, gewoonlik met 'n hondebossie *Exomis microphylla* var. *axyrioides* ter ondersteuning. Stokkies en takkies 10 tot 517 mm lank, 3,5 mm dik, en met gemiddelde lengtes tot 117 mm per stokhuis word gebruik om ingewikkelde strukture, deurkruis met gangetjies, en met twee neste en twee latrines elk te bou. Meer as 13 000 stokkies word gebruik om 'n huis mee te bou; dit behels versameling van boumateriaal oor totale afstande van tot 16,5 km. Paadjies verbind stokhuise en lei na bossies wat boumateriaal en voedsel voorsien. Die meeste stokhuise word deur een of twee individue bewoon. Die spesies is dag- en skemeraktief.

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The bush Karoo rat *Otomys unisulcatus* (Muridae: Otomyinae) is endemic and widespread in the semi-arid Karoo and West Coast regions of South Africa. Currently eight species of Otomyinae (six *Otomys* spp. and two *Parotomys* spp.) are recognized as occurring in southern Africa (Meester, Rautenbach, Dippenaar & Baker 1986). These inhabit habitats ranging from mesic to xeric, and in places two or more species occur sympatrically (Shortridge 1942; Rautenbach & Nel 1980). In this large and widespread assemblage and indeed amongst all southern African rodents *O. unisulcatus* is unique in constructing and inhabiting characteristic stick shelters or lodges (hereafter referred to as lodges) on the ground. Despite this visual and unmistakable sign of its presence, however, little is known of the ecology, behaviour or life history of this species apart from its parasites (De Graaff 1981).

In its habit of constructing lodges *O. unisulcatus* parallels the woodrats (*Neotoma* spp.) of North America and the stick-nest rats (*Leporillus* spp.) of Australia — both genera that favour more arid regions. In the drier parts of southern Africa tree rats (*Thallomys paedulcus*) can construct stick nests in forks of trees, while the Namaqua rock mouse *Aethomys namaquensis* builds shelters from grass. None, however, have the definitive structure of *O. unisulcatus* lodges.

The present study focussed on the distribution, density, and construction of *O. unisulcatus* lodges on a peninsula along the Cape West Coast, and thus largely under a maritime regime. Incidental observations on other aspects of its biology were also recorded.

Study area

Lodge occurrence and construction was studied on the Postberg Nature Reserve (33°05'S / 18°W), an area of *ca* 2700 ha on the peninsula west of the Langebaan Lagoon (Figure 1). Altitude varies from sea level to 193 m; the substrate comprises calcareous sand on granite and chalk, and the topography varies from flats to low hills. Vegetation is classified as West Coast Strandveld of the Fynbos Biome (Boucher & Jarman 1977) and dominant plant species include *Zygophyllum cordifolium*, *Z. flexuosum*, *Z. morgsana*, *Atriplex semibaccata*, *Ruschia geminiflora*, *Ehrharta calycina*, *Muraltia dumosa*, *Rhus glauca*, *Limonium perigrinum*, *Exomis microphylla* var. *axyrioides*, *Restio oleocharis* and *Euclea racemosa* (Boucher & Jarman 1977; Moll, Campbell, Cowling, Bossi, Jarman & Boucher 1984). The study area is situated in the winter rainfall region, with a mean annual precipitation, usually in the form of a soft drizzle, of 253 mm (Boucher & Jarman 1977). Southerly and especially south-westerly winds off the cold Benguella current are common throughout the year, although north-westerlies predominate from May to August. Advective fog commonly occurs.

Materials and Methods

Fieldwork lasted from March through September 1985. *Otomys unisulcatus* were trapped with collapsible aluminium Sherman live traps 230 × 75 × 90 mm, baited with fresh pieces of apple, sliced potatoes or orange peel, set in paths between or around lodges, and checked at dawn, midday, and dusk. Captured animals were weighed, sexed, measured, reproductive condition noted (females: perforate or not, lactating; males: abdominal or scrotal and enlarged testes), toe-clipped for subsequent identification, and released at point of capture.

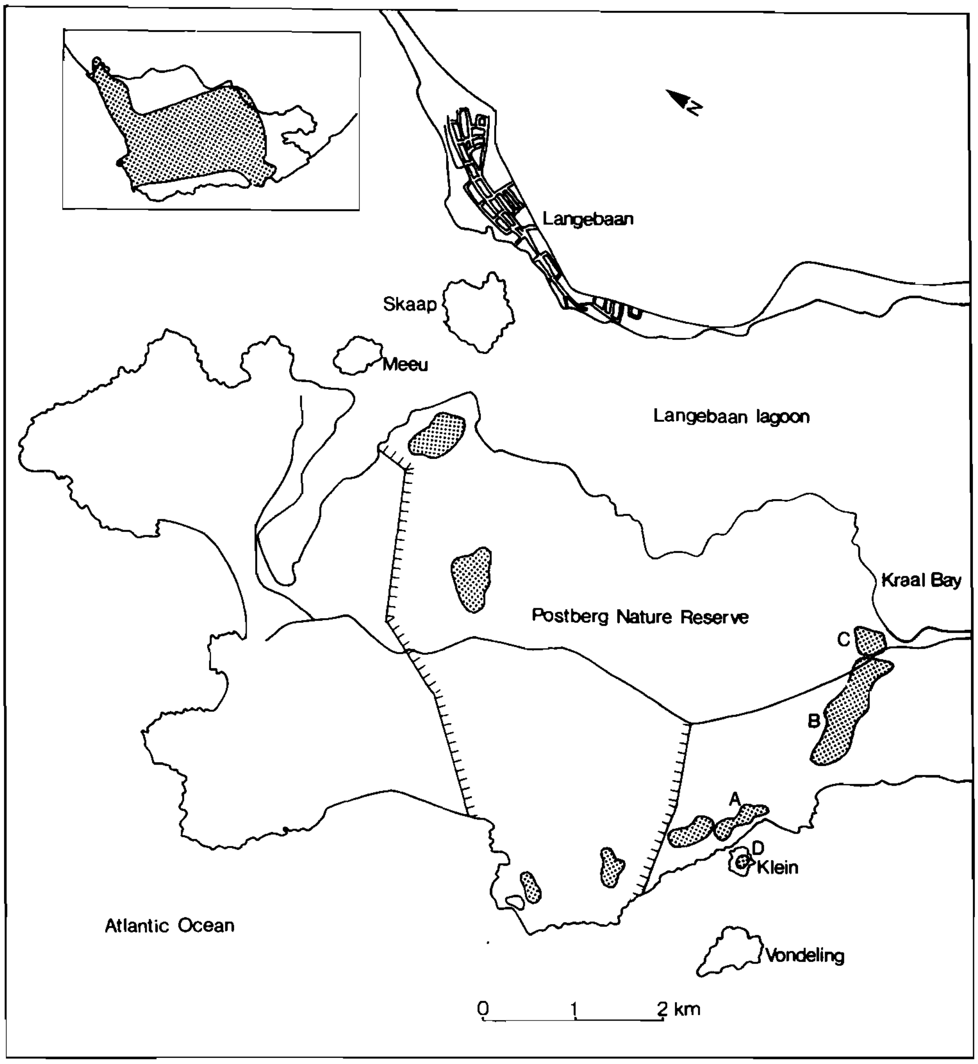

Figure 1 Map of the Postberg Nature Reserve, showing location of lodges (stippled areas) and study areas (A–D). Insert: distribution of *O. unisulcatus* (from Smithers 1983 and Coetzee, *in litt.*); dot indicates study area.

Eight specimens were sacrificed and ecto- and endoparasites collected, preserved in 70% alcohol, and later identified. Females were examined for the presence of embryos or foetuses.

For detailed analysis of lodge density four localities in the Postberg Nature Reserve were selected (Figure 1). Locality A was just inland of coastal dunes, *ca* 300 m from the sea; locality B, on the neck of land between Kraal Bay in the lagoon, and the sea; locality C adjacent and NW of Kraal Bay, with locality D being Klein Eiland, just offshore and accessible only at spring low tide. In each locality a sampling plot was delineated, and all lodges therein marked with numbered flags and their position mapped. Two diameters ('length' and 'breadth'), and the height of each lodge were measured, as well as the between-lodge distance and the length and width of the paths linking lodges. Nine lodges were completely dismantled to note construction; all sticks used were collected and weighed. The formula for a paraboloid 2π r. c^2 was used to calculate the volumes of lodges. Measurements of openings into the lodges, nests, latrines, and passages inside or underneath the lodges were taken and associated fauna inside the lodges and nests collected and preserved in 70% alcohol. Fresh plant material used in constructing the lodges was collected, identified in the field after the method of Kidd (1983) and the shortest distance from the lodges to such plants measured. Identification of fresh plant material was later verified in the laboratory.

In the laboratory sticks from two dismantled lodges were sorted into length classes (0–100; 101–200; 201–300; > 300 mm), as well as in plant species represented, and the thickness of sticks measured with vernier calipers.

Results

Habitat selection

Bush Karoo rats and their lodges were not distributed uniformly but occurred in patches (Figure 1) situated mainly on low-lying sandy areas where *Exomis microphylla* var. *axyrioides* were common, and where a large variety of evergreen fynbos vegetation of different heights occurred. Shrubs were mostly sclerophylous and some were xerophytic (Boucher & Jarman 1977). At most localities lodges were well protected by dunes or low hills from the prevailing SW wind. Most lodges were situated on more or less level ground (88%, n = 43) with only five found on slopes of up to 20°.

Klein Eiland (locality D — Figure 1) contained many lodges even though little protection against wind existed on this islet of *ca* 7000 m^2. However, additional building material in the form of shells of black mussels *Choromytilus meridionalis* were here piled on top of the lodges (Figure 2).

Lodges

Distribution and density (Figure 1 and Table 1)

In each locality examined there was no set pattern in the distribution of lodges or obvious correlation with topographical features, apart from lodges being in the lee of any nearby dunes. Locality A had some lodges in the vegetation on the slopes of the 4 m high dune. A sample plot 50 × 10 m, with the long axis parallel to the dune, contained 19 lodges, nearly all in *E. microphylla* and a few in *Z. flexuosum* shrubs. Locality B, again in the lee of a vegetated dune, had 24 lodges in a sample plot 50 × 50 m. Plant cover here was much sparser and shrubs generally lower than in locality A, with few *E. microphylla* in which all houses were constructed. Some lodges here were occupied only by numbers of striped mice *Rhabdomys pumilio*. Locality C had a thick, tall fynbos vegetation with relatively few *E. microphylla*. On a 30 × 20 m sample plot on a northerly slope five lodges occurred — four in *E. microphylla*, one in *Z. flexuosum*.

Locality D (Klein Eiland) differed from the others in being windswept and exposed to salt spray. The vegetated area measured 100 × 50 m; maximum elevation is 10 m above sea level. *Exomis microphylla* were absent and lodges were built in *Z. flexuosum* and *Lycium ferocissimum*. All 32 lodges, as noted above, had greater or lesser numbers of black mussel *Choromytilus meridionalis* shells piled on top (Figure 2).

Figure 2 Lodges on Klein Eiland. Note profusion of black mussel *Choromytilus meridionalis* shells piled on top.

Table 1 Comparison between *O. unisulcatus* lodges at localities A–D, Postberg Nature Reserve. Numbers in parenthesis denote numbers of lodges in sample plots

Locality		Size of lodges L	W	H	Volume (m^3)	Distance between lodges (m)	Density lodges/ 1000 m^2)	Presence of *E. microphylla*	Vegetation
A						n = 22			
	Min	0,92	0,84	0,15	0,06	1,14			Dense, tall
(n = 19)	$\bar{x}$	1,67	1,28	0,44	0,74	3,78	38	Very numerous	shrubs common
	Max	2,74	2,13	0,71	3,86	8,23			
B						n = 31			
	Min	0,68	0,63	0,13	0,03	1,62			Dense, few
(n = 24)	$\bar{x}$	1,24	1,03	0,31	0,34	6,75	10	Numerous	tall shrubs
C						n = 4			
	Min	1,02	0,88	0,29	0,25	2,31			
(n = 5)	$\bar{x}$	1,47	1,14	0,38	0,59	9,15	8	Scarce	Dense, many
	Max	1,82	1,31	0,49	1,18	16,83			tall shrubs
D						n = 33			
	Min	0,86	0,71	0,22	0,12	2,51			Fairly dense,
(n = 32)	$\bar{x}$	1,58	1,24	0,40	0,70	8,62	6	Absent	little variety
	Max	2,59	1,77	0,49	1,65	19,23			
	$\bar{X}$ =	1,49	1,70	0,38	0,61	7,08 n = 90	15,5		

Size

Within one locality the dimensions and volumes of lodges differed greatly (Table 1). Plotting volumes of lodges against the mass of the sticks used to construct them, yielded no significant relationship (r = 0,785), according to the null hypothesis. Mean mass of the sticks used to construct a lodge was 5,95 kg (range 2,25–8,3 kg) with a mean volume for these particular lodges of 0,41 m^3 (n = 6).

Lodge construction and paths

Most lodges had a parabolic shape with a somewhat flattened top, especially where supported by a living shrub, usually *E. microphylla*. When unsupported (i.e. the shrub 'backbone' having died) they tended to be flatter. The grey colour of the lodges, resulting from the dead sticks and twigs used to construct them, and the branches of the supporting shrub tend to camouflage the lodges.

Lodges consisted of intricately intertwined sticks and twigs, forming a strong structure interlaced by the branches of the supporting shrub. Sticks and twigs were in various stages of decomposition, especially the dense mass on top. After rain only the top part of a lodge was wet, with the lower portion being merely damp. Fresh green plant material on top of lodges usually indicated occupancy by *O. unisulcatus*. Each lodge (n = 17) had a number of openings ($\bar{x}$ = 9, range 6 to 11), located at or above ground level, with dimensions of 60 mm wide × 50 mm high (n = 21). Usually two burrows, up to 30 cm below soil surface, extended from a lodge to open on the surface some 20 cm distant from the periphery (Figure 3). These burrows (n = 10) had the same dimensions (width and height) as the openings.

Lodges were criss-crossed by passages and tunnels leading to nests, latrines or openings (Figure 3). These passages were *ca* 60 mm wide (n = 10), with faecal pellets and green plant material, especially leaves, scattered in them. Underneath lodges the soil was damp and loose.

All lodges dismantled (n = 9) contained two nests close together but on different levels. One was usually in the centre, close to the thickest and presumably strongest part of the supporting shrub, and often underneath a thick branch, with the other one at ground level. Nests had only one opening (50 mm diameter), were spherical in shape with approximate outside dimensions of 180 × 160 mm, and with an open space inside of 140 × 140 mm (n = 6). Nest material weighed 63–158 g ($\bar{x}$ = 103 g, n = 10), was usually damp when removed from a lodge, and consisted mainly of grasses from the vicinity. Some nests had a woolly appearance, owing to the use of the leaves and stems of *Helichrysum helianthemifolium*. Most grasses used were so finely shredded that identification without microscopic examination proved impossible; these shreds were finely intertwined to form a thick fibrous mat. Composition of nests was approximately 70% grass, 18% shrub leaves, and 12% stems (n = 10). Strands of *O. unisulcatus* hairs commonly occurred in nests, with one nest containing feathers of a kelp gull *Larus dominicanus*.

Each lodge usually had two latrines, near and above the nests (Figure 3). Dampness from accumulation of faeces, and probably from urine as well, caused extensive rotting of sticks in the vicinity. Latrines were usually 150 mm long and 100 mm thick (n = 6).

A network of paths connected the lodges, with a path encircling each lodge (Figure 3). Paths also extended to shrubs (often *E. microphylla*) where food or building material was collected (Figure 4). Average length of paths was 3,0 m (range 0,96–5,33 m; n = 16) with average width 72 mm (range 62–83 mm; n = 12). On average seven paths radiated from individual lodges (n = 14), with a maximum of 16. Paths were always clear of obstructions.

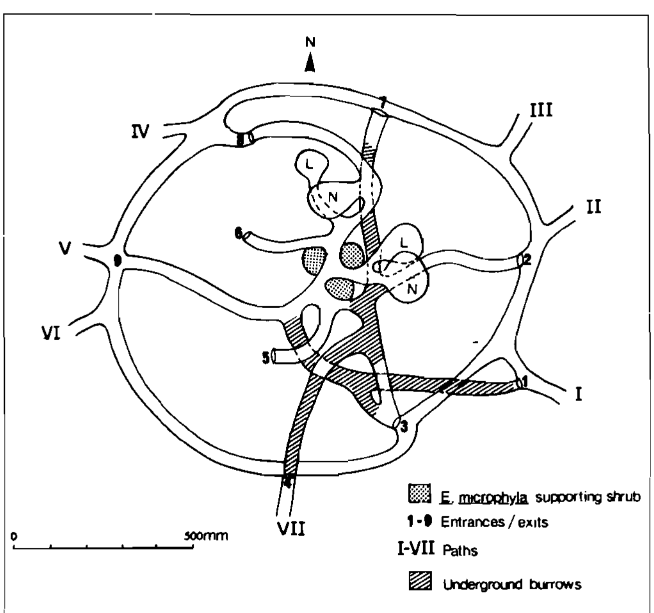

Figure 3 Schematic representation of the passages, nests (N) and latrines (L) in a lodge, the openings to the passages, and the network of paths around the lodge.

Building material

One lodge in locality A and one in locality B were dismantled and all sticks collected. The number of sticks or twigs per length class from the lodge in locality A is given in Figure 5, and origin of sticks, height of parent plant, and thickness in Table 2. Mass of all above-ground sticks was 8,3 kg. This lodge contained 13 329 sticks or twigs between 10 and 517 mm long, with an average mass of 0,62 g per stick. Sticks longer than 300 mm (n = 93) had an average mass of 5,5 g. Total length of all sticks and stems was *ca* 1 200 m, giving a mean stick length of 91 mm with a mean thickness of 3,5 mm per stick (n = 280). The longest stick used (517 mm long, 2,5 mm thick) came from *H. helianthemifolium*.

Average height of shrubs providing building material was 0,58 m (n = 14), with average distance from a lodge being 1,87 m (n = 14) (Table 2). To gather building material individual *O. unisulcatus* would have to travel to and fro between the lodge and shrubs yielding material. If we assume that on all occasions only one stick at a time is transported (see 'Activity' below) and that on average a stick or twig used in the construction of a lodge had been divided once, either by biting it through at the lodge, before using it as building material or from natural causes (e.g. rotting), then approximately 16,5 km were travelled to collect all sticks (13 329 ÷ 2) originating from different plant species (Table 3).

The lodge in locality B (Figure 6, Tables 4 & 5) was constructed of far fewer parts (4 323) but these also had a mean stick thickness of 3,5 mm (n = 140). Average distance to a shrub providing building material was 1,15 m (n = 7). These shrubs had a mean height of 0,4 m

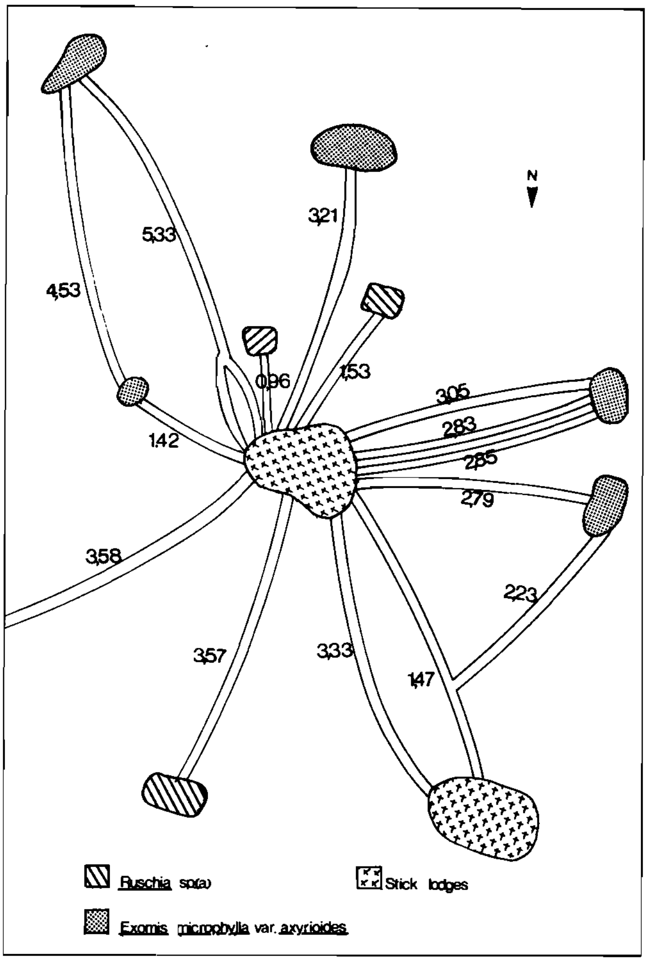

Figure 4 Schematic representation of the network of paths radiating from a lodge to nearby lodges or shrubs. Lengths of paths given in metres.

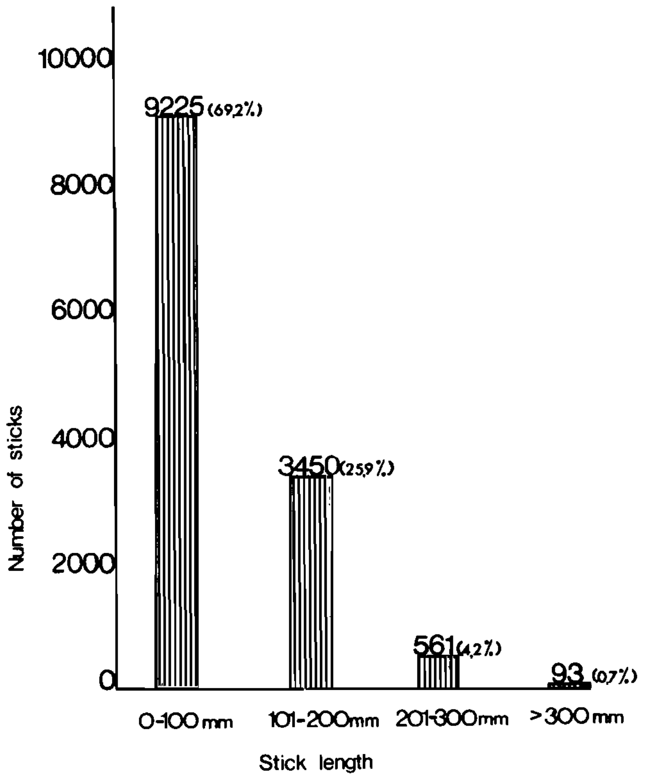

Figure 5 The numbers of sticks of different length classes used to construct a lodge in locality A containing 13 329 sticks.

Table 2 Type, number and percentage of plant species used in constructing an *O. unisulcatus* lodge in locality A including distance from the lodge examined, height and diameter of sticks used in constructing the lodge

Plant species	Type	Number	%	Distance from lodge (m)	Height (m)	Stick diameter Range (mm)	Stick diameter $\bar{x}$ (mm)
Exomis microphylla var. *axyrioides*	stick	4351	32,6	0–0,3	0,8	1-13	6
Chrysocoma sp.	stem	2680	20,1	1,93	0,4	0,0–1,5	1
Helichrysum helianthemifolium	stick & stem	2048	15,4	0,38	0,35	1–5	2,5
Ruschia sp. (a)	stem	1638	12,3	3,02	0,2	0,5–3	1
Zygophyllum flexuosum	stick	676	5,1	0,73	1,45	2–6	4,5
Pelargonium gibbosum	stick	518	3,9	2,31	0,95	2,5–7	4
Grass, unidentified	–	516	3,9	0,60	0,3	0,5–4	2
Limonium scabrum	stick & stem	344	2,6	6,30	1,3	3–8	4
Lycium ferocissimum	stick	190	1,4	0,68	1,15	1–3	2
Ruschia sp. (b)	stick	149	1,1	1,10	0,25	1,5–9	6
Ruschia macowanii	stem	115	0,9	3,16	0,25	1–3	2
Rhus mucronata	stick	57	0,4	2,94	1,25	1–4	2,5
Asparagus capensis	stick	43	0,3	1,20	0,55	1–4	3
Asparagus sp.	stem	4	0,003	1,64	0,03	1–3	2
		13329		$\bar{x}$ = 1,87	$\bar{x}$ = 0,58		$\bar{x}$ = 3,5

(n = 7). Again if one individual *O. unisulcatus* built the lodge it would have had to travel 3,4 km to collect all the sticks or stems (4 323 ÷ 2). The mass of all above-ground sticks was 2,25 kg ($\bar{x}$ = 0,52 g per stick) with the total length of all sticks being 507 m ($\bar{x}$ = 117 mm per stick).

On Klein Eiland shells of black mussels *Choromytilus meridionalis* (each approximately 130 mm long, mass 60 g) and occasionally of *Patella argenvillei* (each approximately 80 mm long, mass 45 g) were placed on top of the lodges.

Associated fauna

Associated fauna from lodges were mostly invertebrates, predominantly arthropods. Of these most were Insecta (11 orders) and Arachnida (five orders), with fewer myriapods, crustaceans, and molluscs. The only vertebrates utilizing the lodges were *Mabuya capensis* and *Phyllodactylus lineatus*. Associated fauna in nests were all invertebrates. Six orders of insects, one crustacean, and three of arachnids were represented. On a numerical basis mites predominated.

Otomys unisulcatus inhabiting the lodges

During the study period 45 individuals were trapped — 24 males and 21 females. Cut apples proved the most successful bait. Most lodges harboured only one individual, although on one occasion two adult males were trapped simultaneously, and on another a female and two young.

At locality A, 11 *O. unisulcatus* were trapped (six males and five females). One male, seemingly the only occupant, was trapped four times over a two-month period at the same lodge. In locality B, with 24 lodges in the sample plot, 19 individuals (11 males and 8 females) were trapped at seven different lodges. At one lodge, in a month, three adult males and a subadult female were trapped; at another lodge 3,08 m distant two males and a female were trapped. At locality C a total of 15 individuals were trapped (seven males and eight females). One lodge yielded six animals in one month, of which three were young. Mean total length and mean mass for 33 adults of both sexes were slightly less than the figures given by De Graaff (1981). Of the other animals caught, nine were subadult and three young.

Possible predators included the small grey mongoose *Galerella pulverulenta*, water mongoose *Atilax paludinosus*, yellow mongoose *Cynictis penicillata*, small spotted genet *Genetta genetta*, Cape fox *Vulpes chama*, bat-eared fox *Otocyon megalotis*, mole snake *Pseudaspis cana*, 'sweepslang' *Psamophis notostictus*, Cape cobra *Naja nivea*, boomslang *Dispholidus typus*, and black eagle *Aquila verreauxi*.

Food of *O. unisulcatus*

Fresh, half-eaten leaves on top of lodges were common. Most leaves came from *E. microphylla*, *Z. flexuosum*, and *Ruschia* sp. (a). Many paths led to *Ruschia*, sugges-

Table 3 Distance covered by *O. unisulcatus* to gather 13 329 sticks for building a lodge examined in locality A, assuming one twig at a time is carried, and that every twig brought to a lodge has been divided once through rotting or gnawing. Distance from the nearest shrub of a particular plant species providing building material, and total distance covered to gather all sticks of that species are given in metres

Plant species	Calculation (distance to and from nearest shrub × no. of twigs from shrub ÷ 2 (division due to rotting or gnawing)	Rank order (distance covered)
Chrysocoma sp.	3,86 m × 2680 ÷ 2 = 5172 m	1
Ruschia sp. (a)	6,04 m × 1638 ÷ 2 = 4915 m	2
Limonium scabrum	12,06 m × 344 ÷ 2 = 2167 m	3
Pelargonium gibbosum	4,62 m × 518 ÷ 2 = 1197 m	4
Helichrysum helianthemifolium	0,76 m × 2048 ÷ 2 = 778 m	5
Exomis microphylla var. *axyrioides*	0,3 m × 4351 ÷ 2 = 653 m	6
Zygophyllum flexuosum	1,46 m × 676 ÷ 2 = 493 m	7
Ruschia macowanii	6,32 m × 115 ÷ 2 = 360 m	8
Grass, unidentified	1,20 m × 516 ÷ 2 = 310 m	9
Ruschia sp. (b)	2,02 m × 149 ÷ 2 = 165 m	10
Rhus mucronata	5,88 m × 57 ÷ 2 = 165 m	11
Lycium ferocissimum	1,36 m × 190 ÷ 2 = 129 m	12
Asparagus capensis	2,04 m × 43 ÷ 2 = 50 m	13
Asparagus sp.	3,28 m × 4 ÷ 2 = 7 m	14
	Total distance = 16,5 km	

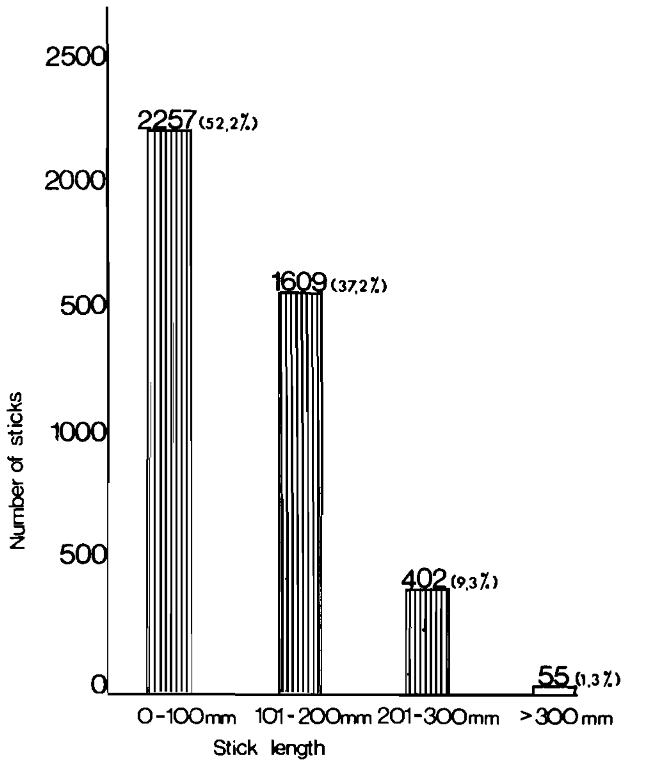

Figure 6 The number of sticks of different length classes used to construct a lodge in locality B containing 4323 sticks.

Table 4 Type, number and percentage of plant species used in constructing an *O. unisulcatus* lodge in locality B, distance from the lodge examined, height, and the diameter of the sticks used in constructing the lodge

Plant species	Type	Number	%	Distance from lodge (m)	Height (m)	Stick diameter Range (mm)	Stick diameter $\bar{x}$ (mm)
Chrysocoma sp.	stem	1755	40,6	0,82	0,4	0,5–1,5	1
Ruschia sp. (b)	stick	1104	25,5	0,38	0,1	1,5–9	6
Exomis microphylla var. *axyrioides*	stick	665	15,4	0–0,3	0,8	1–13	6
Unidentified	stick	550	12,7	2,15	0,65	1–6	3
Ruschia sp. (a)	stem	140	3,2	1,38	0,18	0,5–3	1
Grass, unidentified	–	94	2,1	0,35	0,3	0,5–3	2
Emex sp.	stick & stem	15	0,5	2,64	0,4	1–3	2
		4323		$\bar{x}$ = 1,1	$\bar{x}$ = 0,4		$\bar{x}$ = 3,5

Table 5 Distance covered by *O. unisulcatus* to gather 4323 sticks for building a lodge examined in locality B. Actual number of sticks used are halved to allow for subdividing of original twigs by gnawing or rotting. Distance from nearest shrub of a particular plant species, and total distance covered to gather all sticks of that species are given in metres

Plant species	Calculation (distance to and from nearest shrub × no. of twigs from shrub ÷ 2 (division due to rotting or gnawing)	Rank order (distance covered)
Chrysocoma sp.	1,64 m × 1755 ÷ 2 = 1436 m	1
Unidentified	4,03 m × 550 ÷ 2 = 1182 m	2
Ruschia sp. (b)	0,76 m × 1104 ÷ 2 = 420 m	3
Ruschia sp. (a)	2,76 m × 140 ÷ 2 = 193 m	4
Exomis microphylla var. *axyrioides*	0,03 m × 665 ÷ 2 = 98 m	5
Emex sp.	5,28 m × 15 ÷ 2 = 40 m	6
Grass, unidentified	0,07 m × 94 ÷ 2 = 32 m	7
	Total distance = 3,4 km	

ting that they could function as common food sources. All three species have soft, fleshy, sclerophylous leaves. Stomach content analyses (n = 8) indicated that on average 70% leaves and 30% stems were eaten, but no insects.

Parasites

Virtually all *O. unisulcatus* examined had fleas, sucking lice and ticks on the skin and between the fur. In the eight individuals sacrificed and dissected three contained a tapeworm *Paranoplocephala omphalodes* (= *P. acanthocirrosa*) in the lower portions of the duodenum, and ileum and caecum. One rat harboured three tapeworms. This is the furthest west this tapeworm has been found, and is a considerable range extension from Uitenhage (Collins 1972).

Reproduction

During early May a pregnant female, containing a single fetus in the right uterine horn, was trapped. This fetus, with measurements TL = 81 mm, T = 23 mm, E = 6 mm, HF (c/u) = 14 mm and mass = 12,3 g was possibly approaching full term as hair covered the dorsum (but not ventrum and ears) and the nails were uncovered. Young *O. unisulcatus* were trapped towards the end of July (a female caught at the same lodge on the same date was lactating, and probably the mother), while chirping noises, possibly from young, were heard at this lodge in June and at other lodges during June and July. The heaviest female (168 g) was trapped at the end of June, and could have been pregnant.

At the beginning and end of June, and end of July, a total of five males was trapped at different lodges, all with descended and enlarged testes.

Activity

Individuals were active throughout the day, but activity increased just before sunset and at sunrise. To some extent *O. unisulcatus* are thus also crepuscular. Individuals moved quickly along paths between shrubs, paused briefly at a shrub, and then dashed to the next shrub, or at any sign of danger, back to a lodge. Some individuals moved from one lodge to another; but most movements were restricted to the immediate environs of a particular lodge. After an *O. unisulcatus* had entered a lodge a characteristic flapping noise could be heard, persisting for *ca* 3 s, and repeated up to four times a minute.

Sticks for building a lodge were first gnawed off at the parent plant and then carried in the mouth, one stick at a time. A captive female used grass from a field nest to construct a round nest with a central hollow using her nose, mouth, and front feet to position grasses.

Discussion

According to De Graaff (1981) and Smithers (1983) *O. unisulcatus* prefer dry habitats, e.g. rock sheets or stony soil with shrub or karroid vegetation. Our study area on the Cape West coast obviously was more mesic than their typical habitat, although stick lodges invariably occurred on sandy or rocky terrain providing good drainage. Most lodges occurred where conditions are wetter but the vegetation more lush e.g. on the ocean side of the Langebaan Peninsula. Further north along the coast, lodges also occur close to the sea in the fog belt (unpubl. data). On Klein Eiland lodges were exposed to the full force of the SW wind; here the plant species richness was less than on the mainland, and food sources thus scarcer. A xeric environment therefore is no prerequisite for the occurrence of *O. unisulcatus*, and judging from the density of stick lodges on the Postberg Nature Reserve (including Klein Eiland) bush Karoo rat density is also fairly high. However, as no data exist on their density elsewhere the effect of habitat on density remains conjectural.

The selection of *E. microphylla* shrubs for supporting lodges of *O. unisulcatus* was obvious in the present study. In the sample plots nearly all mature shrubs of this species contained a lodge, and where *E. microphylla* was absent few or no lodges were found, except for Klein Eiland. Locality A, with the highest density of *E. microphylla* had the highest density of lodges and presumably also of *O. unisulcatus*. The occurrence of lodges and thus *O. unisulcatus* on Postberg Nature Reserve would therefore seem to be profoundly influenced by the presence or absence of *E. microphylla*. Even though *Z. flexuosum* are common and widespread on the reserve few lodges are built in them, except at Klein Eiland where it and *L. ferocissimum* provide the only suitable shrubs to support lodges. In most places on the reserve lodges were well protected against the predominant SW winds.

To some extent the size of a lodge is dictated by the size of the supporting shrub, especially *E. microphylla* (height = 0,8 m). Although *Z. flexuosum* (1,45 m) and *L. ferocissimum* (1,15 m) grow somewhat taller, they are more straggly with fewer branches resulting (on Klein Eiland) in lower lodges. The shape of lodges also follows the contours of the supporting shrubs. Optimum stick length for carrying and/or building could be obtained through gnawing through sticks, a habit also recorded for *Leporillus conditor* (Aslin 1972), but not *Neotoma lepida* (Bonaccorso & Brown 1972). The selectivity shown by *O. unisulcatus* for sticks to use in constructing lodges on the Postberg Nature Reserve was unexpected, especially if our calculations of the distance travelled to collect all the sticks are correct. This would place a high energetic drain on an individual, or individuals, and can perhaps only be afforded where food plants are plentiful, and remain lush throughout the year owing to the moist conditions.

Many factors obviously contribute to the size of a lodge — supporting shrub used, age of lodge, amount of building material, state of decay of sticks, and the number of passages and latrines. This could explain the poor correlation found between the volume and mass of the two lodges analysed.

The numerous passages, openings, paths, and tunnels in, around, and underneath a lodge could provide a choice of escape routes from terrestrial predators, e.g. snakes. As nests are connected to most passages leading to exits they can be reached quickly and, being centrally situated, are well protected from mammalian predators such as jackals, foxes or mongooses. Another advantage of a nest centrally placed could be less fluctuation in temperature, and a more constant humidity. The reason for the presence of two nests per lodge is, however, not clear. Nests could be used alternately as they become contaminated by fleas, mites, and ticks, or being located at different levels could play a thermoregulatory role. Alternatively, as *Otomys unisulcatus* are fairly large rodents and the small size of a nest precludes sheltering more than two rats at a time, a number of rats inhabiting the same lodge would need at least two nests.

The network of paths circling and radiating from a lodge to shrubs, and linking lodges, provides ample opportunity to collect food and building material and to escape predators. Paths are fairly straight and link up adjacent shrubs so that exposure to raptors would be minimized.

On Postberg Nature Reserve *E. microphylla* shrubs are the major suppliers of building material not only in the form of twigs and sticks, but also as a 'backbone' around which to construct a lodge. Although not quantified, lodge density seemed much lower where *E. microphylla* was scarce (e.g. locality B as compared to locality A). It is tempting to suggest that in this general area *O. unisulcatus* density is correlated with the occurrence and density of suitable *E. microphylla* shrubs (see Table 1). This same correlation between the occurrence of *O. unisulcatus* lodges and a particular shrub species has been found in the Tankwa Karoo National Park, where lodges nearly invariably occur in *Lycium* sp. (unpubl. data). The second most common plant used for lodge construction at Postberg was *Chrysocoma* sp. although twigs, commonly on top of lodges and forming a fine web which could act to weatherproof the lodge somewhat, had to be carried far. On Klein Eiland the piling of shells from black mussels on top of lodges probably reflects the more exposed site and the necessity for extra weight in the face of strong winds. This same habit of adding weight on top of lodges in windy surroundings is prevalent in the Tankwa Karoo; here pieces of shale are added to lodges. However, this habit of adding non-vegetable material to lodges also occurs in the ecologically equivalent *Neotoma lepida* in North America (Cameron & Rainey 1972).

Our data suggest that up to 1 000 individuals of 65 associated species can occur per lodge. Insects as a group were the most common, especially beetles (Coleoptera). Most numerous as individuals, however, were mites — up to 250 per nest, but also in some cases only 50.

Owing to the few *O. unisulcatus* captured in our study, the number of permanent inhabitants or even occupancy of a lodge remain conjectural. Our limited data suggest that from one to six individuals, although usually one or two, inhabit a lodge at a given time.

Stomach samples analysed point to a strictly herbivorous diet for *O. unisulcatus*, in common with other members of the Otomyinae (Smithers 1983). The soft, juicy leaves eaten (70% of the diet) would, in an arid environment, be an effective strategy for obtaining water. Even in the present study area, with precipitation through fog a common event, this habit persists. No hoarding of food was evident in the nine lodges dismantled, probably because food plants were close by. This contrasts with most *Neotoma* spp. and *Leporillus* spp.; however *N. lepida* occurring in cactus gardens where food is plentiful also do not have larders (Cameron & Rainey 1972).

Our limited data suggest that on the Cape West coast *O. unisulcatus* breed in winter (the rainy season).

The flapping or drumming noise emanating from lodges into which *O. unisulcatus* has fled is also made by other members of the Otomyinae, e.g. *Parotomys brantsii* (Nel & Rautenbach 1974), where the tail is rapidly drummed on the ground to give alarm. The same applies to *Neotoma floridana* (Rainey 1956).

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