MAMMALIAN SPECIES 828:1–7

Bathyergus suillus (Rodentia: Bathyergidae)

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Abstract: *Bathyergus suillus* (Schreber, 1782) is a bathyergid commonly known as the Cape dune mole-rat. A solitary-dwelling and sexually dimorphic species, it is the largest in body size of the African mole-rats, and 1 of 2 species within the genus. It is endemic to sandy soils of the southeastern and northwestern coastal regions of South Africa and the southwestern coast of Namibia. It is currently not of special conservation concern. DOI: 10.1644/828.1

Key words: Africa, African mole-rat, bathyergid, Cape dune mole-rat, subterranean rodent

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Bathyergus Illiger, 1811

Mus: Schreber, 1782:715. Part, not *Mus* Linnaeus, 1758.
Marmota: Thunberg, 1788:293. Part, not *Marmota* Blumenbach, 1779.
Bathyergus Illiger, 1811:89. Type species *Mus maritimus* Gmelin, 1788 [= *Mus suillus* Schreber, 1782] by original designation.
Orycterus Cuvier, 1829:481. Type species *Mus maritimus* Gmelin, 1788 [= *Mus suillus* Schreber, 1782] by original designation.

CONTEXT AND CONTENT. Order Rodentia, infraorder Hystricognathi, family Bathyergidae, subfamily Bathyerginae. *Bathyergus* is polytypic. Two species are currently recognized (Woods and Kilpatrick 2005).

Bathyergus suillus (Schreber, 1782)
Cape Dune Mole-rat

Mus suillus Schreber, 1782:715. Type locality "Cape of Good Hope," South Africa.
Mus maritimus Gmelin, 1788:140. Type locality "Cape of Good Hope," South Africa.
Marmota africana Thunberg, 1788:293. Type locality "Cape of Good Hope," South Africa.
Georychus maritimus: Smith, 1826:28. Name combination.
Orycterus maritimus: Cuvier, 1829:481. Name combination.
Bathyergus maritimus: Smuts, 1832:48. Name combination.
Bathyergus suillus intermedius Roberts, 1926:261. Type locality "Klawer, Cape Province," South Africa.
Bathyergus suillus: Roberts, 1926:261. First use of current name combination.

CONTEXT AND CONTENT. Context as for genus. *B. suillus* is considered monotypic (De Graff 1981).

NOMENCLATURAL NOTES. The generic name *Bathyergus* (Greek), means deep digger. The specific name *suillus* derived from the Latin *sus* describes the pig-like appearance

Fig. 1.—An adult male Cape dune mole-rat (*Bathyergus suillus*) from Cape Town, South Africa. Used with the permission of the photographer J. Jarvis.

of the nose. In Afrikaans (the local language of South Africa), the mole-rat is known as the duin mol (dune mole).

DIAGNOSIS

Adults of *Bathyergus suillus* are distinguishably larger (about 775–950 g) than *B. janetta* (about 750 g). Also, *B. suillus* has cinnamon-brown–colored pelage rather than the gray-black pelage of *B. janetta* and a skull that is more robust with defined sagittal crests than that of *B. janetta* (Skinner and Smithers 1990).

GENERAL CHARACTERS

Bathyergus suillus is the largest (up to 2 kg) of all bathyergids in Africa. Dorsal pelage is cinnamon-brown, sometimes with a darker middorsal band; ventral pelage is slate gray and flanks are paler. Individual hairs are black or gray at the base becoming cinnamon at the tip. Pelage is thick and woolly, with longer, pale-colored sensory hairs interspersed throughout. The head is similar in color to the dorsum, with buff to white areas on the muzzle, under the chin, and around eyes and ears (Fig. 1). Some specimens have a white fleck on the back of the head. Eyes are small and black. The torso of *B. suillus* is cylindrical with short, stout limbs, and relatively large leathery-soled feet. Forelimbs are short with strong curved digging claws (largest on digits 2, 3, and 4), and a clawless, digitlike projection above digit 1. Its head is large, broad, and blunt with a horseshoe-shaped nose. Openings to the auditory meatus are raised slightly but external pinnae are absent. The tail is short and broad (about 18% of head–body length) and fringed with stiff, pale bristles. Short, stiff hairs also border the mouth and outer edges of feet. Facial whiskers are longer (1–2 cm) than the tail bristles (Skinner and Smithers 1990).

The skull of *B. suillus* (Fig. 2) is robust and dorsoventrally flattened; older specimens possess distinctive sagittal and occipital crests. Bullae are not markedly swollen and the zygomatic arches are strongly bowed outward. The palate extends posteriorly beyond M3. Each upper incisor has a deep vertical groove on the anterior surface and premolars and molars are simple with reentrant folds present in juveniles. Testes are abdominal and the penis is sheathed. The clitoris has a small Y-shaped split. *B. suillus* has 6 paired mammae, 4 pectoral and 2 inguinal (Skinner and Smithers 1990).

Mean body measurements (± *SD* in mm, *n* in parentheses) of wild-caught male and female *B. suillus*, respectively, are: length of head and body, 310.8 ± 42.9 (87), 304.9 ± 25.0 (100); length of tail, 36.3 ± 5.6 (204), 33.8 ± 4.5 (124); length of hind foot (sine unguis), 50.3 ± 5.3 (87), 48.4 ± 3.3 (100). Mean cranial measurements (± *SD* in mm, *n* in parentheses) for male and female *B. suillus*, respectively, are: greatest length of skull, 61.8 ± 10.7 (87), 56.8 ± 8.6 (100); zygomatic width, 30.5 ± 3.6 (87), 29.3 ± 1.9 (100); maximum width of cranium, 21.4 ± 0.9 (87), 20.8 ± 0.8 (100); length of mandible, 44.5 ± 7.1 (87), 41.9 ± 4.9 (100); height of mandible at coronoid process, 20.9 ± 1.5 (11), 19.2 ± 1.6 (9—Hart et al. 2007).

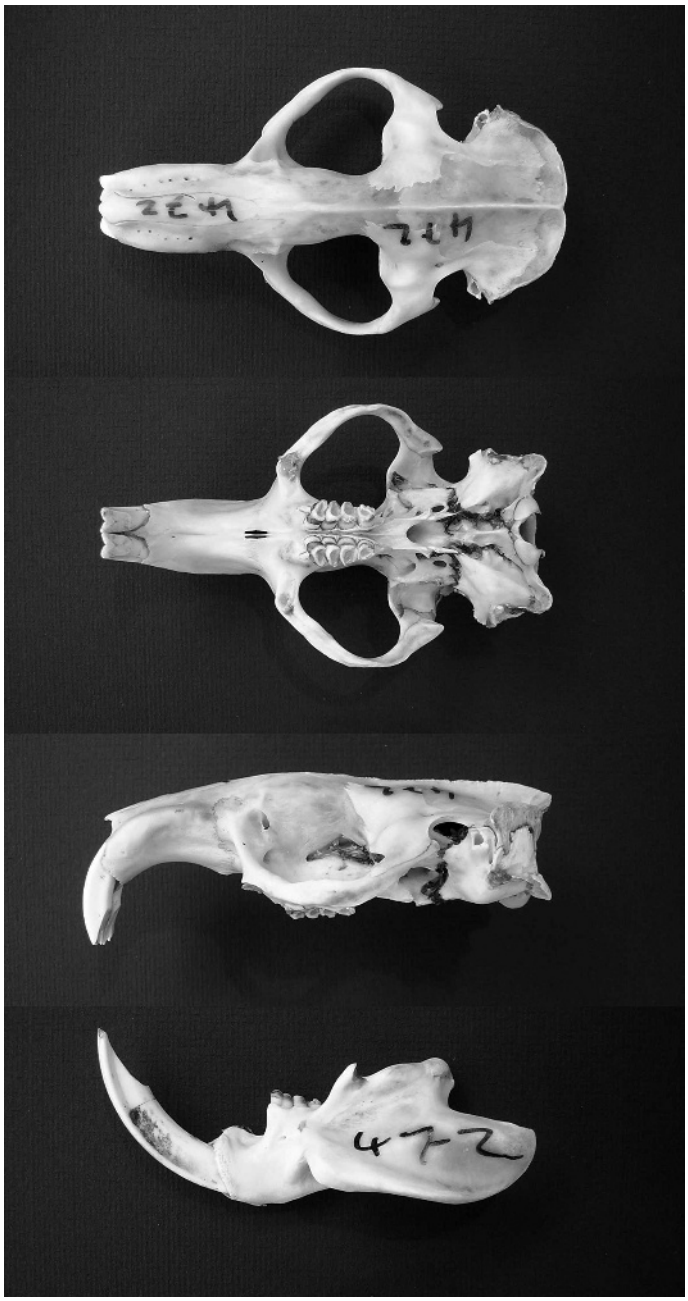

Fig. 2.—Dorsal, ventral, and lateral views of cranium and lateral view of mandible of an adult male *Bathyergus suillus* (body mass: 1,416 g) from Cape Town International Airport, Western Cape Province, South Africa (33°58′S, 18°37′E). Greatest length of cranium is 84.0 mm. Used with the permission of the photographer C. Faulkes.

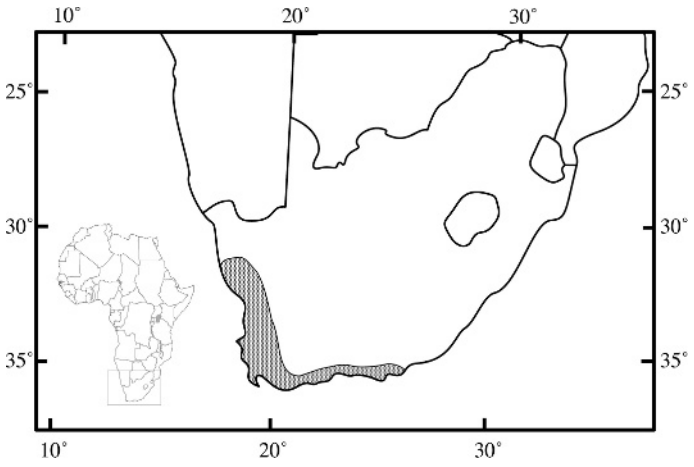

Fig. 3.—Geographical distribution of *Bathyergus suillus* in South Africa. Map redrawn with modifications from Bennett and Faulkes (2000).

Mean body mass (± *SD*) of wild-caught adult male *B. suillus* is 955.2 ± 384 g ($n = 87$) and of adult females is 778.5 ± 189.3 g ($n = 100$). Distinct sexual dimorphism also is evident in the very thick skin layer (up to 100 mm thick) on the ventral surface of the neck (Hart et al. 2007).

DISTRIBUTION

Bathyergus suillus is endemic to South Africa (Fig. 3). It occurs in mesic regions with sandy soils from Cape Peninsula in southwestern Western Cape Province, north to near Vanrhynsdorp and Rondawel, and east from Cape Town to Port Elizabeth, in Eastern Cape Province (Skinner and Smithers 1990).

FOSSIL RECORD

The oldest fossil representative of the genus *Bathyergus* so far discovered has been recorded at Langebaanweg 'E' Quarry, southwestern Western Cape Province, South Africa. This Pliocene site is dated at about 5–4.5 million years of age (Hendy 1981). Two extinct bathyergids are present, *B. hendeyi* and *Cryptomys broomi*, a fossil species of the extant genus *Cryptomys* (Denys 1998; Matthews et al. 2006, 2007). *B. hendeyi* was smaller than *B. suillus*, and is estimated to have had a similar, or slightly larger, body size to *B. janetta*, although with slightly different skull proportions (Denys 1998; Matthews et al. 2006, 2007). Thus, *B. hendeyi* would appear to be a good candidate as a common ancestor for *B. suillus* and *B. janetta*. The large accumulation at Langebaanweg of fossil material of *B. hendeyi* relative to *Cryptomys* (all extant species of which are social) has led to speculation that this species, unlike extant *Bathyergus*, may have been social (Denys 1998; Matthews et al. 2006). It also could be argued that the greater accumulation of *B. hendeyi* could be due to selective predation because extant *Bathyergus* is known to come from the protection of its burrow to the surface more frequently than *Cryptomys*. Furthermore, the incisors from more than one-half of the specimens of *B. hendeyi* bear signs of digestion by a predator (Matthews et al. 2006).

More recent Plio–Pleistocene breccias in cave deposits at Makapansgat and Taung in South Africa also contain fossils of a giant mole-rat, *Gypsorychus*, in association with the hominin *Australopithecus* (Broom 1934, 1939, 1948; De Graaff 1961). However, its affinities with other bathyergids remain unclear. Although the skull of *Gypsorychus* is as large as that of *B. suillus*, comparison of tooth morphology suggests that *Gypsorychus* does not share characteristics in common with either *B. hendeyi* or *Cryptomys* (Denys 1998). *Gypsorychus* was contemporary with *C. robertsi* (De Graaff 1981), although more recently it has been suggested that *C. robertsi* should be referred to as *Georychus capensis*, another extant solitary-dwelling mole-rat sympatric with *Bathyergus* and *Cryptomys* today (Avery 1998).

Fossils of *B. suillus* are found at almost all archeological sites within its historic range (Henshilwood 1997, 2001; Matthews et al. 2005). The earliest incidence is from at least 200,000–300,000 years ago at Hoedjiespunt 1, a fossilized hyena lair in Western Cape Province of South Africa, where fossils of *C. hottentotus* also are present (Matthews et al. 2005). Often they are the most abundant species represented, and depending on the site and time, have been preyed upon and accumulated by both humans, the aforementioned hyenas, and predatory raptors such as the Cape eagle-owl (*Bubo capensis*—Klein and Cruz-Uribe 2000).

FORM AND FUNCTION

Bathyergus suillus excavates tunnels using its clawed forefeet and to a lesser extent its large procumbent incisors. When the jaws are fully open during excavation, 2 flaps of skin close behind the incisors, effectively restricting entry of soil into the mouth. Stiff oral bristles also function to push soil particles aside, inhibiting entry into the buccal cavity (Skinner and Smithers 1990).

Bathyergus suillus is homeothermic and maintains a stable but low body temperature (35.3°C) over an ambient temperature range of 12–30°C. Its basal metabolic rate is low compared to other nonfossorial rodents of a similar size but comparable to that of other bathyergids (0.48 ml $O_2\ g^{-1}\ h^{-1}$) within a thermoneutral zone of 25–31°C. Thermal conductance is high (0.045 $cm^3\ O_2\ g^{-1}\ h^{-1}\ °C^{-1}$); thus, *B. suillus* has little resistance to cold (Lovegrove 1986).

Bathyergus suillus does not drink free water; it satisfies its fluid requirements from a diet of highly digestible geophytes (>90% digestibility coefficient and water content of 70–80%) and aerial vegetation (Bennett and Jarvis 1995). The hindgut and cecum of *B. suillus* are capaceous and

contain large numbers of symbiotic cellulose-digesting protozoa, bacteria, and fungi. Some products of their metabolic activities become available to *B. suillus* after coprophagy; amino acids are directly absorbed through the gut wall (Buffenstein 2000).

The dental formula for *B. suillus* is i 1/1, c 0/0, p 1/1, m 3/3, total 20 (De Graaff 1964). Incisors of *B. suillus* grow continuously. They are worn down continually as individuals dig and chew through roots and are honed or sharpened by filing the upper and lower incisors against one another. During this process flakes of chipped incisor are periodically flicked out of the mouth by the tongue (Bennett and Faulkes 2000).

ONTOGENY AND REPRODUCTION

At birth, young weigh 27–52 g ($n = 10$). Eyes open on day 7 and solid foods are eaten by about day 15. Intersibling sparring begins at day 12 and soon escalates to fighting. Weaning occurs at about day 30. Young disperse either above or below ground at about day 60–65, at a time when young weigh about 300 g (Bennett et al. 1991).

While in the maternal burrow young eat food collected by their mother, thus they expend little energy finding food. They can, therefore, channel energy into growth. Assuming a mean adult body mass of 780 g and a mean body mass of 30 g at birth, the projected time to reach average adult body mass is about 227 days based on growth rates derived from laboratory-reared animals (Bennett et al. 1991).

Sexual size dimorphism is evident at 1 year of age when body mass is 420–638 g ($n = 4$). Sexually active individuals as small as 529 g (male) and 494 g (female) have been captured (M. J. O'Riain, in litt.). Growth in *B. suillus* may continue for several years and individuals can live >6 years. The sex ratio in free-living populations is equal (M. J. O'Riain, in litt.)

Reproduction is seasonal, occurring during the wet winter and spring (April–November), with numbers of pregnancies peaking in August. During the reproductive season, testes change from abdominal to inguinal, but there is no real development of a scrotum. Gestation lasts about 2 months. Litters average 3.3 (range 1–6, $n = 99$). There is usually 1 litter/season (Hart et al. 2006; Jarvis 1969).

ECOLOGY

Bathyergus suillus inhabits areas characterized by moderate temperatures (25°C) with a mean annual rainfall of 500–800 mm. It occurs predominantly in sandy or sandy loam soils along the coast and on banks of rivers close to the coast. It favors sandveld vegetation where grasses, herbs, and restionaceous sedges abound (Davies and Jarvis 1986). Densities of *B. suillus* range from 0.9 individuals/ha in coastal fynbos (Davies and Jarvis 1986) to >300 individuals/ha in grasslands and wheat fields, at which densities the entire ground surface can be covered by their large mounds. Average home range of adults at 1 site in coastal fynbos was 0.27 ha (0.14–0.35—Davies and Jarvis 1986).

Individual adults of *B. suillus* occupy the same burrow system for much of the year. Burrow systems contain 50–420 m of tunnels constructed in patterns that are not typically as branched as those of other bathyergids (Davies and Jarvis 1986). The burrow system is completely sealed from the surface and develops a microclimate that is characteristically hypoxic (20.4% O_2), hypercapnic (1.2–12% CO_2), and humid (>95%), but of a moderate temperature (12°C in winter and 26°C in summer), much ameliorated from the surface extremes of 36°C and 15°C in summer and 12°C and 5°C in winter (Bennett et al. 1988; Roper et al. 2001). The burrow system consists of foraging burrows that are 150–220 mm in diameter excavated at a subsurface depth of 350–650 mm. Nest chambers often are deeper than foraging burrows. Nests are lined with grass and twigs and often are associated with blind-ended "bolt holes" (>2 m deep) into which *B. suillus* retreats if alarmed, blocking the burrow with soil behind it. Blind-ended toilet chambers also occur near the nest chamber, and food caches are located close to the nest (Davies and Jarvis 1986).

Burrow configuration may change constantly but individuals of *B. suillus* tend to remain in one area (Davies and Jarvis 1986). One of us (JUMJ) has observed that vacated burrows are quickly taken over by neighboring conspecifics. Males seem to have longer burrows with fewer side branches than do the burrows of neighboring females, the greater length possibly providing access to several females (Davies and Jarvis 1986). At one of our study sites, it was observed (JUMJ) that individuals of *B. suillus* in neighboring burrow systems communicate through soil by simultaneously drumming both hind feet on the ground (2 beats, pause, 2 beats, etc.). During courtship, males and females drum to one another more frequently and also move soil in unison. Then, once in physical contact, males and females lock incisors, the female raises her tail and vocalizes while the male follows and attempts to mount. Burrows may overlap with those of *G. capensis* and *C. h. hottentotus* but the burrows of each species are located at distinctly different depths (Jarvis and Bennett 1991; Skinner and Smithers 1990).

Bathyergus suillus excavates with its forefeet and its incisors. While digging, it pushes excavated soil with its forefeet backwards under its torso to its hind feet, which then propel it further to the rear. Once a pile of soil accumulates, it reverses its direction and pushes the soil ahead of it through tunnels to the surface, where it forms the characteristic dome-shaped mound of the molehill (Bennett and Faulkes 2000). Extensions of burrow systems occur mainly after rainfall when the soil is moist and the energetic costs of burrowing are lowest (Lovegrove 1989). During these times an individual *B. suillus* can excavate up to 0.5 tonne of soil/month (Davies and Jarvis 1986).

The diet of *B. suillus* consists predominately (60%) of aboveground vegetation (herbs, grasses, and sedges of the family Restionaceae), which is harvested by digging under a plant and pulling it into the burrow. Individual plant parts are held by the incisors and brushed clean with the forefeet, then rapidly drawn into the mouth as small pieces are bitten off with the incisors, chewed, and swallowed. Geophytes (bulbs, corms, and tubers) also are eaten after they are dehusked. These include species of Hyacinthaceae (*Albuca*, *Lachenalia*, and *Ornithogalum*), Iridaceae (*Homeria*, *Micranthus*, and *Romulea*), and Oxalidaceae (*Oxalis*), a number of which contain cardiac glycosides and are toxic to livestock but not to *B. suillus* (Davies and Jarvis 1986).

Bathyergus suillus is at risk of predation when active on the surface, particularly during mound formation. Mole snakes (*Pseudapsis cana*) push their heads into freshly formed soil mounds and await *B. suillus* bringing the next load of soil. The snake then seizes the rat from behind and kills by constriction. Cape cobras (*Naja nivea*) enter open holes and break into burrows of *B. suillus*. Individuals of *B. suillus* dispersing above ground are particularly vulnerable to small carnivores such as black-backed jackals (*Canis mesomelas*), caracals (*Caracal caracal*), African wild cats (*Felis silvestris*), and domestic dogs (De Graaff 1981). One of us (JUMJ) observed that during the Cape winter, individuals of *B. suillus* inhabiting low-lying areas such as temporary vleis, sometimes get flooded out of their burrow systems, at which time they are heavily preyed upon and vulnerable to the cold. Both wild and captive *B. suillus* are intermittently active year-round. One of us (JUMJ) determined through telementry that burrowing activity occurs throughout the 24 h but peak activity is between 1200 h and 1600 h.

Ectoparasites of *B. suillus* include laelaptid mites (*Haemolaelaps bathyergus* and *Macronyssus bacoti*), listrophorid mites (*Listrophoriodes bathyergians*), fleas (*Dinopsyllius ingens*), lice (*Proenderleinellus lawrensis*), and ticks (*Ixodes alluandi* and *Haemaphysalis leachii*). Endoparasitic nematode worms include *Longistriata bathyergi*, *Libyostrongylus bathyergi*, and *Heterakis macrospiculum* (De Graaff 1964, 1981). Close to human habitations, *B. suillus* often is infested with the cysts of the dog tapeworm *Echinococcus cani*. *B. suillus* harbors the liver bacterium *Bartonella*, which may be transmitted to humans (Van Sandwyk 2007).

HUSBANDRY

Bathyergus suillus does not adjust well to captivity. Members of this species should be maintained individually either in large tanks or in Perspex (Plexiglas) tunnel systems provided with a nest area, food chamber, and toilet area. Wood shavings are preferable to soil in these chambers and paper toweling, hay, or cornhusks can serve as nesting material. The tunnel system should be cleaned weekly and the toilet area daily. *B. suillus* will eat a variety of chopped vegetables, including sweet potato, apple, carrot, pumpkin, yam, and sweet corn, but the diet must be supplemented with fresh grass and herbs daily. *B. suillus* does not drink, thus it should be fed daily. Room temperature should be 25–26°C and relative humidity 50–60% (Bennett and Jarvis 1988).

GENETICS

Bathyergus suillus and *B. janetta* have been reported to have different karyotypes. Nevo et al. (1986) reported diploid numbers (2n) of 56 and 54 and fundamental numbers (FN) of 102 and 104 for *B. Suillus* and *B. janetta*, respectively. However, 2 recent independent studies (Deuve et al. 2008; work by 2 of us [CGF and NCB]) suggest that in both species the diploid number is 54. Furthermore, although morphologically and genetically (although maybe not karyotypically) these 2 species are distinctly different, Faulkes et al. (2004) found relatively low levels of cytochrome-*b* sequence divergence between *B. suillus* and *B. janetta* (mean ± *SEM* uncorrected *p*-distance: 4.1% ± 0.19% [$n = 7$], up to a maximum of 5.6%). This divergence is the smallest recorded among bathyergid species. Comparisons within *B. suillus* across its geographic range revealed cytochrome-*b* sequence divergences of 2.1% ± 0.38% ($n = 4$). Molecular phylogenies constructed from samples collected across the ranges of species of *Bathyergus* resolved 2 distinct monophyletic clades for *B. suillus* and *B. janetta* (Faulkes et al. 2004). However, Ingram et al. (2004) do not support monophyly and suggest that there may be more variability within populations of *B. suillus* than currently suspected, possibly warranting the recognition of additional taxa. Another explanation could be hybridization between the species. Although *B. suillus* and *B. janetta* are generally allopatric (Honeycutt et al. 1987, 1991; Nevo et al. 1987), Faulkes et al. (2004) suggest that there is a hybrid zone in an area of sympatry around Groenrivier and Rondawel, South Africa, where some specimens display an intermediate phenotype. At this study site we have observed animals that are larger than a typical *B. janetta* but smaller than *B. suillus*. Their pelage also is lighter than that of *B. suillus* and more silvery, like that of *B. janetta*. We have conducted a preliminary phylogenetic analysis of cytochrome-*b* sequence data and the results indicate that 2 of these intermediate individuals collected from Groenrivier cluster in a clade with *B. janetta*, suggesting that if hybridization is occurring, it is between male *B. suillus* and female *B. janetta*.

CONSERVATION

Bathergus suillus is listed by the International Union for the Conservation of Nature and Natural Resources (IUCN) as Lower Risk /Least Concern (LR/LC—IUCN 2001). *B.*

suillus is considered as a pest species by some. Their large mounds damage combine harvesters, their burrows undermine roads and damage earthen dam walls, and they chew through underground communication cables and irrigation pipes. *B. suillus* is trapped extensively and eaten by local people.

REMARKS

The abundance of *B. suillus* was noted by Europeans as early as 1660. Van Riebeeck, in his journals, referred to the Berg River region as "the kingdom of the moles." He commented that horse riders were forced to keep to rhinoceros trails to prevent the horses from stumbling and throwing their riders or breaking their legs when they stumbled into the mole-rats' burrows (Bennett and Faulkes 2000).

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