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Georychus capensis.

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Georychus Illiger, 1811

Mus: Pallas, 1778:172. Part, not *Mus* Linnaeus, 1758.
Georychus Illiger, 1811:87. Type species *Mus capensis* Illiger, 1811, by monotypy.
Georhychus Wagner, 1843:369. Incorrect subsequent spelling of *Georychus* Illiger, 1811:87.
Fossor Lichtenstein, 1844:364. Type species *Fossor leucops* Lichtenstein, 1844, by monotypy.

CONTEXT AND CONTENT. Order Rodentia, suborder Hystricognathi, infraorder Phiomorpha, family Bathyergidae, subfamily Georychinae. *Georychus* is monotypic.

Georychus capensis (Pallas, 1778)

Cape Mole-rat

Mus capensis Pallas, 1778:172. Type locality "Cape of Good Hope," South Africa.
Georychus capensis: Smith, 1833–1835:170. First use of current name combination.
[*Mus*] *buffoni* Cuvier, 1834:196. Type locality "Cape of Good Hope," South Africa.
Fossor leucops Lichtenstein, 1844:364. Type locality "Cape of Good Hope," South Africa.
Georychus capensis canescens Thomas and Schwann, 1906:165. Type locality "Knysna, southern Cape Province," South Africa.
Georychus yatesi Roberts, 1913:92. Type locality "Belfast, eastern Transvaal," South Africa.

CONTEXT AND CONTENT. Context as above. *G. capensis* is monotypic.

DIAGNOSIS. In size, *G. capensis* resembles the Damaraland mole-rat (*Cryptomys damarensis*, ca. 160 g), but *G. capensis* has distinctive white facial markings around the eyes (Fig. 1) not present in *C. damarensis* and lacks guard hairs projecting from pelage that are present in *C. damarensis*.

GENERAL CHARACTERISTICS. *Georychus capensis* is a medium-sized bathyergid (ca. 181 g) with distinctive white markings on the face and head. Pelage is thick and woolly, russet, often with brownish tinge while ventral pelage is silvery white. Body is cylindrical with a low-slung carriage. Limbs are short and stout, and feet relatively large with leathery soles. Head is large and blunt with a horseshoe-shaped nose. Head is a black, charcoal, or deep russet with white markings. Muzzle and lips are white. Eyes are small and black in color with a large white eye-ring. Opening to auditory meatus is raised slightly and external pinnae are absent. A large white patch of fur occurs around the ear meatus. Forefeet and hind feet are usually white. Tail is short (ca. 13% of length of head and body) and pink with a number of coarse white hairs radiating from it. Facial whiskers are longer than pelage (1–2 cm). Short stiff hairs border the mouth, short tail, and outer edges of feet. No sexual dimorphism is present.

Skull (Fig. 2) is dorsoventrally flattened and adults have sagittal and nuchal crests. Extrabuccal incisors are white, ungrooved, and rooted behind the pterygoid region. Zygomatic arch is strongly bowed out. Infraorbital foramen is small and rounded. Molariform teeth are present. Upper molariform teeth with 1 narrow inner and outer fold persist in adults. Mandibles are not ankylosed, permitting separation of tips of incisors.

Body measurements (mean ± *SD* in mm, *n*) of wild-caught males and females, respectively, are: length of head and body, 158.3 ± 73.3, 51, 156.2 ± 25.0, 38; length of tail, 20.6 ± 2.5, 52, 20.5 ± 3.2, 38; length of hind foot (sine unguis), 28.1 ± 3.0, 52, 27.6 ± 3.3, 38. Cranial measurements (mean ± *SD* in mm, *n*) of males and females, respectively, are: greatest length of skull, 43.6 ± 5.8, 49, 44.4 ± 7.4, 34; zygomatic width, 31.3 ± 5.0, 48, 31.3 ± 6.0, 34; cranial breadth, 16.9 ± 1.0, 51, 16.9 ± 1.21, 34; length of mandible, 36.0 ± 5.3, 50, 35.6 ± 6.4, 38; height of mandible at coronoid process, 13.9 ± 1.5, 51, 13.9 ± 1.5, 34 (Taylor et al. 1985). Body mass (mean ± *SD* in g, *n*) of wild-caught adult males and adult females, respectively, is: 181.8 ± 73.3, 51, 180.0 ± 92.3, 37.

DISTRIBUTION. *Georychus capensis* occurs in South Africa from Cape Peninsula in Western Cape Province northward to Citrusdal and Niewoudtville and eastward from Cape Town to Port Elizabeth and eastern Cape Province (Fig. 3). Isolated populations occur in KwaZulu Natal Province near the border with Lesotho, at Belfast, Wakkerstroom, and Ermelo in Mpumalanga Province, formerly Transvaal (Bennett and Faulkes 2000; Bronner 1990; Nanni 1988).

FOSSIL RECORD. The oldest fossils that resemble *Georychus* closely enough to be considered ancestral are in the Swartkrans member 1–3 (lower Pleistocene) in the "Cradle of Humankind" sites (Avery 1998, 2000). *Georychus* occurs in middle Pleistocene deposits at Elandsfontein on the Western Cape coast, within the distributional range of the extant species of the genus (Hendey 1969).

FORM AND FUNCTION. Dental formula is i 1/1, c 0/0, p1/1, m 3/3, total 20 (De Graaff 1964; Taylor et al. 1985). Incisors of the Cape mole-rat grow continuously. In the wild, incisors are worn down as the animals dig by chiseling through the soil to excavate tunnels. Teeth of captive animals are honed or sharpened.

FIG. 1. Two color phases of the Cape mole-rat (*Georychus capensis*) from Cape Town. Used with the permission of the photographer, N. C. Bennett.

FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of an adult male *Georychus capensis* from Impendle, KwaZulu Natal (30°40′S, 29°57′E; Durban Natural Science Museum, DM 4830). Greatest length of cranium is 44.0 mm. Used with the permission of the photographer, Peter Taylor.

When doing so, the Cape mole-rat braces itself with its forepaws and adopts a tooth-sharpening posture. Forward and backward and side-to-side actions of the lower jaw file upper and lower incisors against each another. Short forward thrusts of lower incisor against upper ones sharpen upper incisors. During the process flakes of chipped incisor are periodically flicked out of the mouth by the tongue. When jaws are fully open during digging, stiff oral bristles push soil particles aside and restrict soil entering buccal cavity.

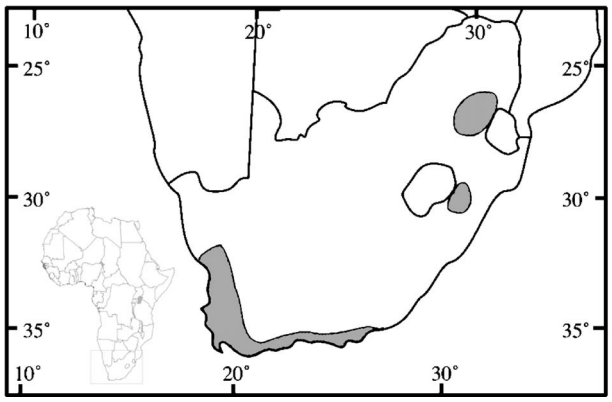

FIG. 3. Geographical distribution of *Georychus capensis* in South Africa. Map from De Graaff (1981).

Two flaps of skin behind extrabuccal incisors restrict entry of soil into esophagus and thus prevent choking. Forefeet scoop loosened soil backward and under the animal to be collected by the hind feet. Once a pile has accumulated behind an animal it reverses down the tunnel using its small tail, with fan of stiff hairs, to move the soil along like a plow. Soles of hind feet are leathery in texture but soft with a fringe of stiff hairs along their outer edges.

Burrow systems of *G. capensis* are 50–130 m long with a microclimate that is slightly hypoxic (20.4% O_2), mildly hypercapnic (1.2–12% CO_2), and highly humid (>95%—Roper et al. 2001). *G. capensis* is homeothermic and maintains a stable body temperature (36°C) over an ambient temperature range of 12–32°C (Lovegrove 1987). Basal metabolic rate is 0.59 ml O_2 g^{-1} h^{-1}.

Cape mole-rats do not drink free water and obtain all fluid requirements from a diet of geophytes (plants with underground storage organs) and aerial vegetation that is undermined. Geophytes have high moisture contents of 70–80% (Bennett and Jarvis 1995) with many bulbs and corms having digestibility coefficients in excess of 90% (Bennett and Jarvis 1995). Geophytes typically possess a fibrous outer husk that must be removed when feeding. These are held between the forefeet, the bulb is chewed around the base, and layers of the husk are peeled down toward the tip, in much the same way as a banana is peeled by humans. During removal of the husk, rapid vibratory movements of the forepaws are made while the bulb is held in the incisors.

Hindgut and cecum are large and contain large numbers of cellulose-digesting endosymbionts including protozoa, bacteria, and fungi. Cape mole-rats use the digesta from these symbionts by means of coprophagy and by absorbing amino acids through the gut wall (Buffenstein 2000).

Males have abdominal testes and a penis within a sheath. Females have a small Y-shaped split between the vagina and anus and 3 paired mammae (4 pectoral and 2 inguinal).

ONTOGENY AND REPRODUCTION. Cape mole-rats are solitary, aggressive, and highly territorial. Seismic signaling, which differs from territorial drumming, occurs at the onset of reproduction. Males and females drum at different frequencies. Onset of courtship by seismic signaling in males is accompanied by raised urinary testosterone concentrations, and enlargement of the testes and accessory reproductive glands. Hind-foot seismic signaling by males is extremely fast, each drum pulse in males lasts 2 min with a beat length of 0.035 s. Drumming can be heard aboveground 10 m from the source. Females do not drum as fast, with a beat length of 0.05 s. Courtship is usually initiated by the male and copulation is brief, involving multiple intromissions of 2 or 3 thrusts per second, interspersed by short periods during which the animals are involved in bouts of grooming, particularly around the genitalia (Bennett and Jarvis 1988; Narins et al. 1992).

Reproduction is seasonal with the young born in summer (August–December). A female produces a maximum of 2 litters per summer. Gestation length is ca. 44–48 days. Mass of a pregnant female may increase by 39%. Two litters were born 55 days apart to the same captive female. Mean litter size is 6 (range 3–10; n = 19). Litter sex ratio is biased toward males (2:1). Newborn pups are 3–4 cm long, weigh 5–12 g, and are altricial. At birth, young

are naked and blind. Pelage with the distinctive markings is apparent on day 7. Eyes open on day 9. First solid foods are eaten ca. day 17. Pups are weaned ca. day 28. Intersibling aggression begins ca. day 35, and young disperse (either below or aboveground) at ca. day 50 (Bennett and Jarvis 1988).

Growth of pups over the first 80 days is 1.23 g/day (Bennett et al. 1991). While in the maternal burrow, the pups are able to draw from the food store of geophytes and therefore will expend little energy in finding their food (Lovegrove and Jarvis 1986) and channel much energy into growth. Assuming a mean adult body mass of 181 g and a mean body mass of 6 g at birth, the projected time to reach average adult body mass is ca. 143 days in laboratory-reared animals. Cape mole-rats take 1.5 years to attain sexual maturity and have a life span of 5 years (Bennett and Faulkes 2000).

ECOLOGY. The Cape mole-rat occurs in mesic regions of South Africa characterized by moderate temperatures (25°C) with a mean annual rainfall of 500–800 mm. They occur in sandy loams, alluvium, and clay soils. The habitat is typically coastal and montane fynbos, forest, and savanna grassland (Low and Rebelo 1998).

When excavating tunnels, Cape mole-rats push up cores of soil with the same diameter of the burrow, which in turn dry and crumble to form a characteristic dome-shaped mound. Burrow system can exceed 130 m in length, and burrow diameter is typically 100 mm. Burrow system has a central nest, a food store, and a toilet area located away from the nest area. Food store consists of geophytes packed with soil; stored geophytes are debudded when they sprout. Mounds are thrown up after rain when the soil is moist. Most extensions to the burrow occur after rainfall when the costs of burrowing are lowest (Lovegrove 1989). The burrow system is completely sealed from the surface and is hypoxic and hypercapnic, with high humidity and moderate temperatures (12°C in winter and 26°C in summer), much muted from the conditions on the surface (Bennett et al. 1988; Roper et al. 2001). Cape mole-rats occasionally occur aboveground, particularly after dusk. In mountainous regions, where pockets of soil are interspersed with rocky barriers, Cape mole-rats may disperse aboveground.

The Cape mole-rat is herbivorous. Individuals find food as they excavate superficial (5- to 25-mm-deep) foraging tunnels of diameter 7–8 cm. The diet is predominately geophytes (bulbs, corms, and tubers) but also ca. 6% vegetation growing aboveground. Geophytes include species of Hyacinthaceae (*Albuca*, *Lachenalia*, and *Ornithogalum*), Iridaceae (*Homeria*, *Micranthus*, and *Romulea*), and Oxalidaceae (*Oxalis*). A number of these contain cardiac glycosides that are toxic to livestock but not to Cape mole-rats. Cape mole-rats selectively store larger-sized geophytes of many species and food stores may exceed 5,000 items. Food in the store is eaten when the female has young or during unfavorable periods when soils are difficult to excavate (Lovegrove and Jarvis 1986).

Cape mole-rats risk predation during mound formation and when moving aboveground. They are especially preyed upon by mole snakes (*Pseudapsis cana*), which wait at freshly extruded mounds with their heads pushed into the soil. When a Cape mole-rat passes, the snake will seize it from behind, constrict, and kill it. The Cape cobra (*Naja nivea*) enters open holes and breaks into Cape mole-rat burrows. Cape mole-rats dispersing aboveground are vulnerable to owls and small carnivores such as black-backed jackals (*Canis mesomelas*) and small mongooses (*Galerella pulverulenta* and *Herpestes ichneumon*). Grey herons (*Ardea cinerea*) will take Cape mole-rats after very heavy rains have flooded burrow systems and Cape mole-rats are forced onto the surface. Few parasites are associated with Cape mole-rats. Ectoparasites includes 4 species of mites (*Haemolaelaps capensis*, *H. cryptomius*, *H. lawrencei*, and *Listrophoroides zumpti*), a tick (*Ixodes alluaudi*), and a flea (*Cryptoctenopsyllus ingens*). Endoparasites include a tapeworm (*Echinococcous*) and a nematode (*Trichurus*). Cape mole-rats are susceptible to bubonic plague in the wild (De Graaff 1981) and infection by *Escherichia coli* in captivity.

HUSBANDRY. Cape mole-rats should be maintained individually, preferably in Perspex (Plexiglas) tunnel systems provided with a nest area, food chamber, and toilet area with wood shavings. Paper toweling or corn husks suffice as nesting material. Tunnel system should be cleaned weekly so that odor in the toilet area is present. Captive Cape mole-rats eat a variety of chopped vegetables, including apple, carrots, pumpkin, sweet corn, sweet potato, and yams. Because they do not drink free water, food should be provided daily. Temperature should be 25–27°C with a relative humidity of 50–60% (Bennett et al. 1988). Cape mole-rats should ideally be kept under red light.

BEHAVIOR. Wild and captive Cape mole-rats are more active during at night. In some animals, activity occurs before dawn and after dusk. *G. capensis* readily entrains to a 12L:12D light cycle (Oosthuizen 2002; Oosthuizen et al. 2003). Under constant dark the Cape mole-rats exhibit a distinct circadian rhythm of locomotory activity (Lovegrove and Papenfus 1995; Oosthuizen 2002; Oosthuizen et al. 2003).

Individuals are xenophobic and territorial. Over much of the year a single adult Cape mole-rat occupies a single burrow system. Burrow systems may come to within 1–2 m of each other. In captivity, fighting ensues when unfamiliar adult *G. capensis* of either sex are put together in the same cage. Captive individuals use seismic signaling to inform conspecifics of their presence and sex. If alarmed, an individual will throw the head back with its eyes open and mouth fully agape; its forefeet are placed firmly in front of the body and its hind limbs are widely spaced laterally, and thus it is braced for a rapid advance or retreat. The Cape mole-rat snorts and chatters its teeth periodically, maintaining a firm and rigid posture while making short jerks or jumps toward the agonistic source.

The Cape mole-rat also exhibits a characteristic pumping behavior when the tunnel system is breached. It moves cautiously towards the source of the threat, repeatedly sniffing the air, with its forelegs and hind legs splayed laterally, its head stretched out forward, and its body flattened dorsoventrally. Periodically it moves its body up and down in a series of wave like motions, pumping its hind region (legs and sacral region) up and down.

GENETICS. *Georychus* is monotypic, although allozyme and mitochondrial DNA analyses of disjunct populations of *Georychus* from Cape Town and southeastern KwaZulu Natal suggest separate species (Honeycutt et al. 1987, 1991; Nevo et al. 1987). Sequence data support high levels of genetic divergence: 13.7% at the cytochrome-*b* gene (Faulkes et al. 2004) between populations around Cape Town and those from the north, including Wakkerstroom (Ingram et al. 2004). Chromosome number is 2n = 54 and autosomal FN = 100 (Nevo et al. 1986; Taylor et al. 1985).

CONSERVATION STATUS. The 2004 Red List of Threatened Species lists *G. capensis* in the Least Concern category (International Union for the Conservation of Nature and Natural Resources 2001). Cape mole-rats are occasionally an agricultural pest, and they can cause problems for horticulturists and green keepers. The species is protected in several South African nature reserves. In Western Cape Province it is present in the West Coast National Park in Langebaan and in KwaZulu Natal it is found in the Kamiesberg and Mgeni Vlei protected areas.

REMARKS. The generic name *Georychus* means earth mover. The specific name *capensis* is derived from its original capture locality and does not accurately represent its distribution.

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