

ON THE MOLE-RAT (*CRYPTOMYS HOTTENTOTUS DAMARENSIS*) (RODENTIA) IN THE KALAHARI GEMSBOK NATIONAL PARK

by

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Abstract – Aspects of the ecology and distribution of the Damara mole-rat (*Cryptomys hottentotus damarensis*) are discussed relative to its life in the arid Kalahari Gemsbok National Park. The value of coat colour as a taxonomic criterion for the subspecies is discussed. Notes are also presented on reproduction, aspects of behaviour such as: habitat, nests, orientation, activity, locomotion, voice, food, feeding and social life, symbiosis, commensalism, parasites and predators.

Introduction

Zoogeographically, the mole-rats (order Rodentia, family Bathyergidae) are typical Ethiopian animals. They all show suppressed development of the eyes, enlarged incisors and/or claws adapted for digging, pinnae of the ears reduced to a fringe of skin surrounding the external auditory meatus, short legs and tail. A tendency for reduction in the hair covering the body occurs, reaching its culmination in the nearly naked sand-puppy *Heterocephalus*, presently known only from Somalia and Kenya. Furthermore, all the genera (*Bathyergus*, *Heliophobius*, *Georychus*, *Cryptomys* and *Heterocephalus*) are fossorial, while the incisors tend to jut out conspicuously from the closed lips.

In southern Africa only the genera *Bathyergus*, *Georychus* and *Cryptomys* are encountered. The fossorial nature of these creatures partially explains the dearth in knowledge that we have about them. In this paper aspects of the ecology of Damara mole-rats (*Cryptomys hottentotus damarensis*) from the Kalahari Gemsbok National Park are discussed.

History and Taxonomy

The Damara mole-rat was first collected by Captain Alexander, probably during his 1837 travels into Damaraland near the South West African coast, and exhibited to the Zoological Society in London in January, 1838. The type specimen was collected somewhere in Damaraland.

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land, and no specific type locality was given for *damarensis*. According to Roberts (1951) Alexander did not penetrate north of Damaraland proper during his explorations.

The type specimen was purchased by the British Museum during the same year and described as a new species *damarensis* by Ogilby (1838). Ellerman, Morrison-Scott and Hayman (1953) treat this bathyergid as a subspecies of *Cryptomys hottentotus* and this interpretation is accepted in this paper, while Roberts (1951) treats *damarensis* as a separate species.

Distribution

This subspecies has a wide geographical distribution in southern Africa, especially in the drier western areas (Fig. 1). It occurs abundantly in the Kalahari Gemsbok National Park (excluding the beds of the Auob and Nossob rivers and their calcrete banks (Fig. 2)) and ranges northwards and westwards to South-West Africa as far north as Ovamboland. It is also encountered eastwards through Ngamiland and the Kalahari Desert in Botswana, into Rhodesia and Barotseland in Zambia.

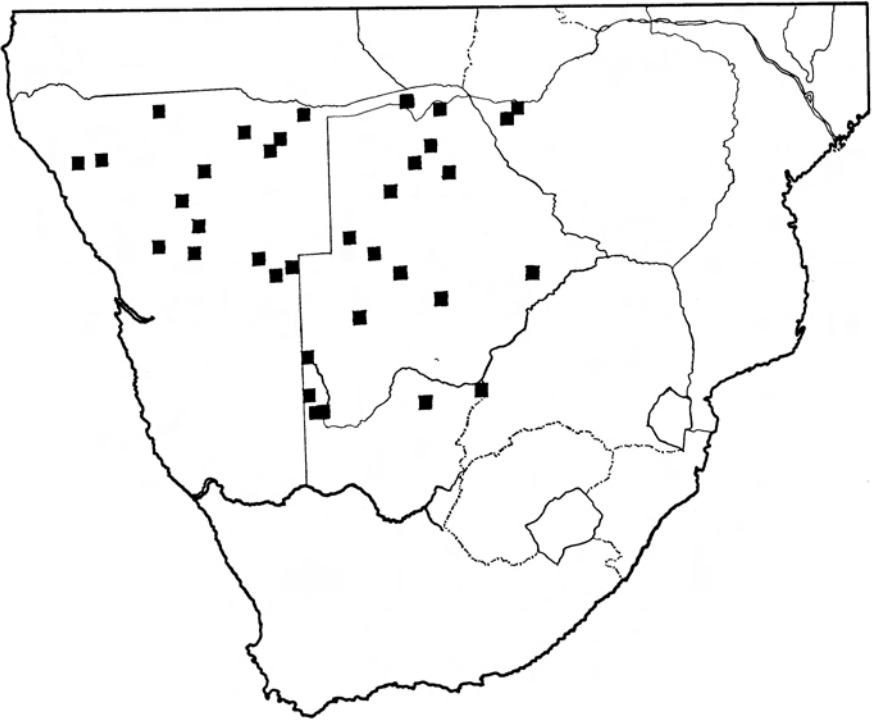


Fig. 1. Distribution of *C. h. damarensis* in southern Africa.

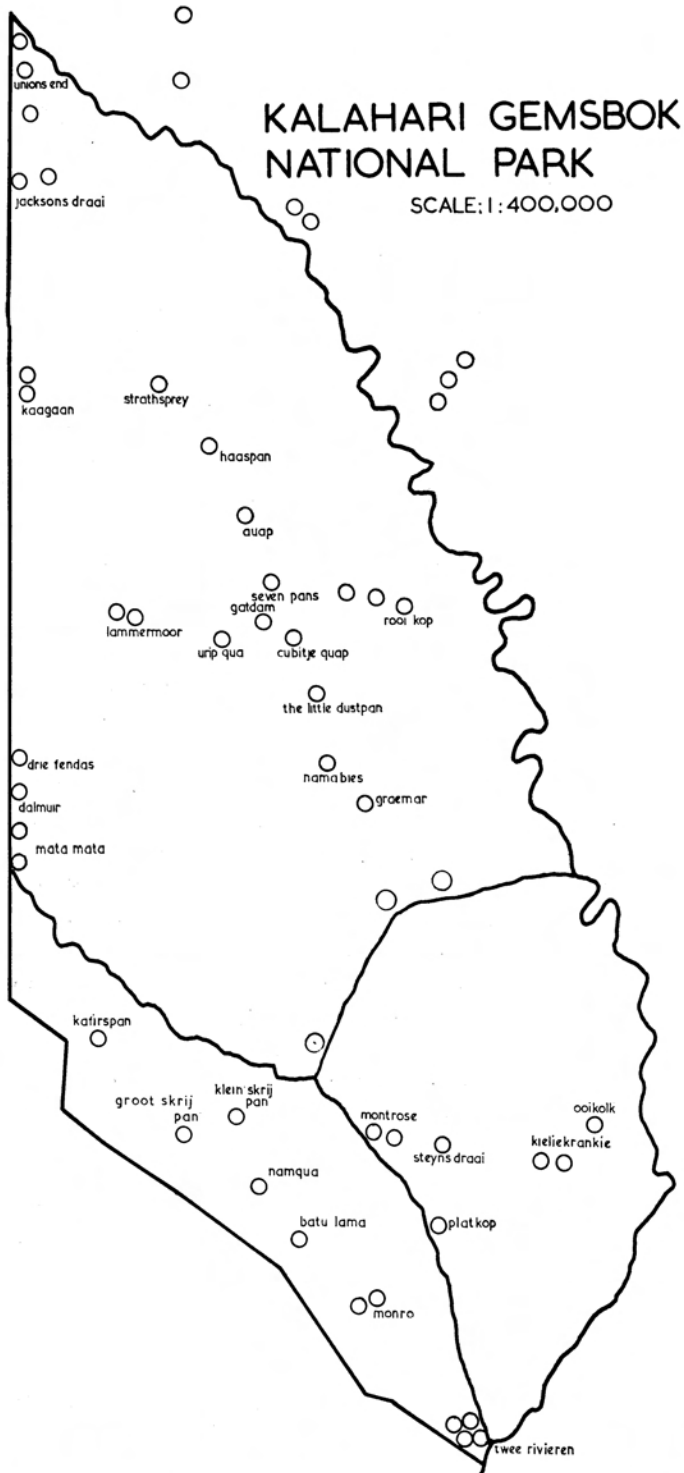


Fig. 2. Distribution of *C. h. damarensis* in the Kalahari Gemsbok National Park

Colour

The majority of specimens are uniformly dark slaty-grey in colour, while some are virtually black. On the other hand, reddish-brown specimens may occasionally be encountered and in some instances both the dark and brown colour phases occur simultaneously in a single burrow (e.g. at Mata Mata). A white occipital patch, varying in size and shape, is present in all individuals. It may be limited to the occipital region of the head or may extend as a white stripe along the mid-dorsal and mid-ventral line. The juvenile pelage is not markedly darker than that of adult specimens.

The colour of the pelage of the Damara mole-rat has contributed considerably to the taxonomic confusion that has ensued over the years. In the type specimen of *damarensis*, Ogilby (1838) described the colour as a uniform reddish-brown, both dorsal and ventral, with a large irregularly shaped white patch in the occipital region. White patches were also present on each side of the neck just below the ears, meeting on the throat which was thus covered with a dirty dullish white, while the tail was covered with coarse reddish-brown bristles with the paws similarly coloured.

Gray (1864) stated the type to be a uniform grey-brown, while Sclater (1899) again followed Ogilby's description. This led to an element of doubt as to the precise colour.

De Winton (1898) on the other hand, described the colour of the synonym *lugardi* as seal-brown, while Thomas (1927) commented that all specimens from Sandfontein and Gobabis were a uniform dark slaty colour. Chubb (1909) described the synonymic *micklemei* specimens collected by Micklem from the Kataba river in the upper Zambesi as a bluish-black including the limbs and tail.

St. Leger (1932) reported on specimens collected in north-western Damaraland by Shortridge's 6th Percy Sladen and Kaffrarian Museum Expedition. At the different localities where *C. damarensis* was collected the specimens were all black or dark-brown in colour. Similarly, skins from Ondongwa (central Ovamboland) (collected by Shortridge on one of his former expeditions) were pale-brown in colour while others were dark-brown. St. Leger thus suggested that three colour phases can be expected in *damarensis*, i.e. dark-(reddish)-brown, pale-(seal)-brown and black.

Confirmation of this is afforded by a series of skins (housed in the Transvaal Museum, Pretoria) from the Molopo river, which in addition to black and dark brown skins, contains a skin which integrates so perfectly between brown and pale-brown specimens that it is difficult to decide to which colour phase it belongs. St. Leger furthermore commented that *damarensis* is a reddish-brown species slightly more red in colour than the paler colour phase of *lugardi*, while the skin of the type of *micklemei* is in the black colour phase. Both black and pale-(seal)-brown specimens have been trapped in a single tunnel system at Mata Mata on the western

border of the Kalahari Gemsbok National Park. This confirms the fact that both the blacker *micklei* and the paler *lugardi* should be treated as synonyms while the brown specimens also occur in a lighter or darker hue. The name *damarensis* was originally attached to the darker (reddish)-brown specimens and in terms of priority, *damarensis* should therefore be used. As far as I am aware, this is the only known instance of pronounced colour polymorphism, within the genus *Cryptomys*.

The black colour encountered in *C. h. damarensis*, a typical desertlike animal, presents a curious anomaly. Animals occurring in the dry west of southern Africa usually present a pallid coloration, while the colour usually darkens in the moister, more easterly regions. Roberts (1951) postulated that one could only conclude that in this case the blackness in colour, specific to many animals of the Congo region, has been retained in this mole-rat as a specific character, even after the animals radiated into and were overtaken by desert conditions of the present times. Retention of the black coloration would be aided by the fossorial nature of the animals, so that its colour would not be affected by dry conditions as in other forms. What adaptive significance can be attached to this phenomenon and phenotype (i.e. black specimens under desert conditions) is not clear.

Biology

Habitat

In South-West Africa the southern limit of the range of *C. h. damarensis* coincides with the southern limit of the red Kalahari sand at about the latitude of Rehoboth station in the Rehoboth district. This also applies to the distribution of many large bulbous plants (e.g. *Pseudogaltonia* sp.), and the possibility of a correlation of distribution pattern of both animal and plants exists. Shortridge (1934) states that the area south of Rehoboth is a 'hard-veld' region, "... sparsely clothed with a Karroo type of vegetation, largely consisting of succulent-leaved plants". In the Kalahari Gemsbok National Park, *C. h. damarensis* is known to subsist largely on the deeply rooted tubers of the gemsbok cucumber *Citrullus naudinianus*, constructing its tunnels past these tubers and gnawing off enough to satisfy its hunger at each visit. Roberts (1951) mentions that they doubtless lay up stores of bulbs in some places although actual proof of this is still lacking.

Generally they are associated mostly with fairly open sand plains, but do not avoid bush or thin forests as long as the soil is sandy and soft. They do not frequent rocky or stony regions and in mountainous parts they extend along flat, sandy valleys. The distribution of local populations is thus often interrupted and disconnected (Shortridge, 1934).

Reproduction

Very little is known about the breeding habits of this subspecies. Two females collected in the Grootfontein district (S.W.A.) during the end of

April each contained five foetuses. Shortridge (1934) suspects that these mole-rats have a fixed breeding season although definite evidence is still lacking.

In *C. h. damarensis* there is some sexual dimorphism in body size as the males are slightly larger than the females. Embryological data about the species are not available and there is no indication of the length of the gestation period. This also applies to the post-natal development and aspects of parental care.

The testes of the male usually descend during the breeding season as in rats, and the females often start breeding before reaching maturity. It is not known how long the young remain in the nests.

There are six mammae present in *C. h. damarensis* individuals, thus making it a member of the *hottentotus* species. The pectoral mammae are nearly always longer (apparently more in use) than the inguinal mammae, the latter usually undeveloped in immature breeding females but coming into use with age when full litters are produced.

Behaviour

General

Like the other genera of the family, *C. h. damarensis* individuals are all rather short-tempered. This is especially noticeable when they are captured in the field or when housed in cages in captivity. According to Eloff (1951), this aggressiveness has been noted by other observers as a marked characteristic of all blind moles. When on the surface of the soil, there is random movements but no real fleeing.

They are very sensitive to air currents and a violent reaction is evoked when one blows into the face of a captured specimen. It reacts with snapping movements of its large incisors, accompanied by a snorting type of grunt while the animal retreats backwards rapidly for a distance of 5–10 cm keeping its head and snout directed at the source of irritation.

When captured alive they are usually unsettled and agitated but after a while soon calm down when caged. However, they remain vicious and are not easily handled with bare hands.

Digging

In view of the fact that these animals are fossorial, it stands to reason that burrowing is an important activity. *C. h. damarensis* employ their incisors during digging activities, while the fore-feet are used mainly to clear the passages of loosened soil. This is in contrast to the large *Bathyergus* (occurring in the South-western Cape) which digs mainly with the enlarged claws of the front paws).

The burrows are permanent constructions, i.e. they are used over and over again. The main incentive for the extension of these burrows appears to be the acquisition of new feeding grounds where new and untapped food resources are available. The direction of tunneling is therefore

determined by the geographical distribution of the food supply as well as by the prevailing conditions, especially texture, humidity, etc., of the soil.

The diameter of the tunnels average 5 to 8 centimetres. The excavated earth from the tunnels is heaped up in the direction of the tunnel. It is not always easy to determine this direction because of sharp turns to the left or right. In such cases the distribution of the mole-hills often present a confusing picture. Closer inspection will reveal that these mounds are pushed up more or less in two parallel rows with the actual main tunnel lying approximately between them. The distances between these hills are not constant and the hills are irregularly spaced either to the left or to the right of the main tunnel. The main tunnel has side branches leading at an angle of approximately 45° to the surface of the soil through which the excavated soil is pushed out. The excavated soil within the side tunnel immediately below the mole-hill is usually tightly packed, making the tunnel system airtight at that point.

The mole-hills are large, measuring approximately 30–35 cm in diameter and usually 20 cm high in the case of *C. h. damarensis*. When damp, the soil is pushed out from the side tunnel in the shape of bundles equivalent to the diameter of the tunnel, reminding one somewhat of toothpaste as squeezed out of a tube. The actual construction of these side tunnels by *Cryptomys* has been excellently described by Eloff (1951).

It is not known whether the juveniles are as efficient at tunneling or digging as the adult specimens. Occasionally there are smaller mole-hills interspersed with the larger ones which may represent the excavatory activities of the young.

It may be assumed that digging or tunneling is an instinctive adaptation in the bathyergids, but this activity does not commence before the animals attain a certain minimum age. Eloff (1952) has found that juvenile specimens of *C. hottentotus hottentotus* only develop an inclination for boring into the surface of the soil after approximately six weeks, and such activity was not observed earlier. This implies that even in the absence of parents who could thus not condition their offspring as far as digging is concerned, they did so on their own at a certain age.

The rate of burrowing is determined by soil conditions, as is the length of the tunnel system, as well as by the geographical position of the nest, the distance between the nest and feeding grounds and by the physical nature of the soil. A tunnel system of *C. h. damarensis* which was opened in the Kalahari Gemsbok National Park attained a length of 19 m, not considering the various side tunnels or parallel tunnels.

Nests

Very often nests occur at one end of a tunnel system and all other tunnels leading from such nests usually converge at the feeding grounds. No further generalizations can, however, be made concerning the geographical position of the nests. The nests are usually constructed entirely from vegetable matter utilizing roots, leaves, bracts etc., com-

pletely entwined so that a round structure is obtained which fits more or less snugly in a surrounding nest chamber.

Orientation

The orientation of these animals below the surface of the soil has been investigated by Eloff (1951, 1952) and the main orientation mechanism occurs by means of echo-localization. This implies that they must have a well developed sense of hearing. It is doubtful whether the sense of sight is of any importance as far as orientation is concerned, in view of the fact that the animals live in pitch dark tunnels and have diminished eyesight. Furthermore, the snout region and the cornea of the eye are highly sensitive to air currents and this probably explains how the virtually blind animal so correctly detects perforations of its burrows or nests.

According to Eloff (1952) the sense of smell in the mole-rat is poorly developed and the animal does not locate food or members of its colony by this means.

The sense of touch is apparently delicately adapted to its mode of eating and it is possible that the sense of touch together with other senses play an important part in connection with the animals' easy movements within the tunnel system. Facilitating the sense of touch, mention must be made of the well developed vibrissae which all the genera possess, together with stiffened bristle-like hairs which are found on the outer lateral surfaces of the front and hind feet. Added to this one also finds longer hairs in the dorsal pelage in *Cryptomys* which may also serve a tactile function, so that it seems as if the tactile sense is well developed. The vibrissae in conjunction with the incisors are employed during the localization of bulbs for feeding. Similarly it is stated that mates are also recognized by the sense of touch rather than by the sense of smell. Tactile stimuli which are applied to the body of the mole-rat in a careful and calm way evokes no reaction (Eloff, 1952).

Activity and locomotion

Mole-rats are more active after rainfall, when the soil is usually softer and easier to manipulate. In addition, tunnels are often damaged by flooding or by sagging of roofs which may induce the animals to greater activity. During drier periods this is not the case and therefore less activity may be expected.

The daily activity rhythm is not known. Instances have been observed in the Kalahari Gemsbok National Park where the animals walk around on the surface of the soil in broad daylight. The reason why the animal leaves its tunnel system is unknown. They are either ejected by other individuals after fights or they are collecting nesting material. There are indications which indicate increased activity, i.e. burrowing etc., at dawn and sunset, which may imply that they are quieter during the warmer periods of day. Differences in temperature, humidity etc. occurring within the tunnel system are expected, however, to be of a low order.

Within the tunnel system the animals are exceedingly agile. On the

surface of the soil, however, the animals walk stuntily with a wobbly motion. They do not walk long distances uninterrupted, i.e. they stop often, perhaps every 25 cm or so, to investigate their surroundings. This frequent stopping may also be correlated with the fact that the animals use echo-localization for orientation.

Vocal

When these animals are captured they often utter a series of grunts accompanied by a savage and threatening attitude. In captivity specimens often communicate by means of a series of high-pitched squeaks.

Food and Feeding

Food is predominantly located by searching within the soil by means of tunneling (and thereby extending their ranges) or by foraging on the surface of the soil, especially at night. The localization of food by means of extension of the tunnel systems is probably facilitated by the sense of touch. Eloff (1952) maintains that the food is detected by tooth pressure in addition to the tactile sense which is apparently well developed in the snout and sub-mental vibrissae region.

The depth of the tunnels is correlated with the depth of the bulbs in the soil. When food is located (under captive conditions on the surface) it assumes a sitting or squatting position, hind feet wide apart, the stumpy tail used as a small stilt. The food is often conveyed to the mouth with the aid of the front paws accompanied by quick vibrations. These vibratory movements shake off additional particles of grit or sand clinging onto the food or to the soles or between the fingers of the hand. Shortridge (1934) states that he has never found sand in the mouth of *Cryptomys* and nor are the teeth worn in the manner that might be expected if the teeth were habitually used for biting through grit.

Eloff (1952) states that food is stockpiled, especially during the winter months. These bulbs are carried between the upper and lower incisors (the lower ones being free to move, because the symphysis between the jaws is not ankylosed) ensuring a better grip. The question of storing food in special chambers has been mentioned as a characteristic of *Cryptomys* by various authors. *C. h. damarensis* consumes mainly bulbs, tubers and other roots.

An important aspect of feeding is the animals' water requirements. In captivity they do not seem to show any interest in water even if it is freely available. FitzSimons (1919–1920) states that these mole-rats even occur in the centre of the Kalahari Desert where their mounds may be found at least 160 km from water. A feasible explanation is that these animals obtain their necessary water from ingested food.

The possible influence of the nature of the diet on the animals has been mentioned by Roberts (1951). In southern Africa *C. h. damarensis* has a wide distribution with little local variation in phenotype. "The habits of the species are such as to confine them to small areas where food is plentiful and when this food differs, new forms have evolved, whereas where the

food remains much the same over great tracts, such as the Karoo or the Kalahari Desert, little change takes place.”

Social

The animals live in small colonies consisting of four or more individuals sharing a communal nest. Individuals coming from different tunnel systems act very aggressively towards each other and are instantly ready to fight, whether they are of the same or opposite sex. On the other hand, on capturing specimens from the same tunnel system, these specimens get on well with each other in captivity.

Roberts (1951) has raised a number of interesting points about the social organization of *Cryptomys*. It appears that the younger animals are usually first to be trapped, but when the traps are left in the same places for several days, older animals are also caught. This implies that the older animals drive out the younger ones to forage and bring back food to the nest chamber so that they can subsist without the labour of burrowing. On the other hand, on some occasions only males are trapped in certain colonies which seem to point to segregation of the sexes at certain times of the year.

Symbiosis and Commensalism

Little is known about this aspect of *C. h. damarensis*. In the Kalahari Gemsbok National Park lizards (*Mabuya striata*) and scorpions (*Opisthothalmus pictus*, *O. wahlbergi*, *O. cavinatus* and *Parabuthus granulatus*) are encountered in or near the tunnel systems of *C. h. damarensis*.

Parasites and Predators

Information concerning parasites associated with *C. h. damarensis* is meagre. Shortridge (1934) states that no external parasites were observed on any South West African *Cryptomys* specimens although he collected widely in that area. Similarly, on handling dissected specimens, I have gained the impression that *C. h. damarensis* is conspicuously free of external and internal parasitic infection.

As far as predators are concerned, virtually nothing is known about this aspect of its life-cycle. It is surprising that this mole-rat was not found in analysis of owl pellets of the barn owl *Tyto alba* from the Kalahari Gemsbok National Park (Nel and Nolte, 1965).

Conclusion

From the available literature and the data presented here, it is clear that *Cryptomys hottentotus damarensis* is well adapted to a predominantly fossorial habit in an arid area. The subspecies consequently offers a wide field for rewarding research. Recent development of radio-telemetry and radioactive tagging techniques offers exciting possibilities of exploring some of the questions raised in this paper. These techniques should greatly contribute to unravelling the intricate ecology of this interesting animal.

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