# The reproductive biology of *Cryptomys hottentotus pretoriae* (Rodentia: Bathyergidae).

by

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- Philippians 4: 13.

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# Summary

The subterranean mole-rat, *C. h. pretoriae* occurs on the verdant grasslands of the highveld regions of South Africa. The highveld mole-rat is a co-operatively breeding rodent that exhibits seasonal breeding and a reproductive division of labour. Evidence from reproductive tract morphometrics, ovarian histology and plasma oestrogen and progesterone concentrations strongly support that the highveld mole-rat is a seasonal breeder. Although the birth of the offspring is confined to the months of May through to November, qualitative analysis of ovarian histology revealed that females retained reproductive function during the summer non-breeding period (December – March). Seasonal differences were found in ovarian morphometrics in addition to progesterone and oestrogen concentrations which are associated with enhanced follicular activation in April and May and subsequent conceptions from May through to November during the breeding period.

The non-breeding period coincides with the period of maximal dispersal opportunities in the summer rainfall areas inhabited by the highveld mole-rat. Non-reproductive females exhibited follicular development but failed to ovulate in the confines of the colony, as evidenced by a lack in the production of corpora lutea. The endocrinological data supports the lack of ovulation in these socially suppressed non-reproductive females.

Reproductive tract morphometrics, testicular histology and plasma testosterone concentrations for the males suggests that there is a gradual increase in testicular mass and volume with increasing proximity to the breeding season, but after September, the testicular parameters begin to fall. Seminiferous tubule diameter are significantly greater in reproductive males but there is no obvious change with season. In general, testosterone concentrations are higher in the reproductive males, with the highest titres occurring around July and August. All available evidence supports a continuance of reproductive activity during the non-breeding season. It is speculated that reproductive activation in

the non-reproductive males may facilitate inter-sexual recognition and hence facilitate bond formation for independent reproduction.

Bimonthly sampling of males to investigate sperm motility, revealed no significant difference between the sperm kinematics of reproductive (n = 14) and non-reproductive males (n = 17).

Both the follicular and testicular parameters studied indicate that there are two main periods of reproductive activity, these being May/July and September. It is possible that for an animal with an estimated gestation of two months, that the reproductive potential of producing two litters during the breeding season arise with pups being born at the end of May through to November.

The non-breeding season for the highveld mole-rat coincides with the summer rainfall period on the highveld regions of South Africa. Moist, workable soils facilitate the dispersal of previously non-reproductive animals from their natal colonies and subsequent colony genesis arises from previously suppressed females and males.

Examining the age structure within colonies, it was expected that the founding animals would be the oldest animals within the confines of the colony. The age structure within colonies were examined, where all individuals were assigned to nine relative age classes. The reproductive animals were amongst the oldest as well as the heaviest members of the colony. Males tended to be the heavier in the colony as a whole. There was a positive relationship between body mass and increasing age for all the mole-rats studied.

In addition to age determination, morphometric measurements of skulls were performed. Morphometric analyses showed an absence of sexual dimorphism. Cluster, principal components and discriminant analyses revealed two distinct groupings amongst the nine relative age classes. The results of the morphometric data together with the age determination data exhibited a clear pattern. The young individuals were assigned to age classes 1 to 4, no reproductive animals were present within this group. The older individuals, including all the reproductive animals, were grouped in age classes 6 to 9. Age class 5 acted as an intermediate age class, that consisted of both reproductive and non-reproductive individuals. The statistical analysis of the morphometric data form different geographic localities indicated no distinct differences between them.

Melatonin secretion in mammals has a circadian rhythm, the period of which is dependent on the daylength. Circannual changes in the period of the melatonin rhythm can be used as a neurochemical index of season in order to time reproduction. Due to their subterranean nature, mole-rats are exposed to little light on an infrequent basis, if ever. Yet these animals exhibit a rhythm of melatonin secretion similar to that of other mammals. However, it is not known whether the melatonin rhythm effectively reflects different daylengths.

The highveld mole-rat was used to compare the pattern of melatonin secretion in two different photoperiodic regimes, namely long days (LD, 14L:10D) and short days (SD, 10L:14D). Blood samples collected in the dark period yielded significantly higher melatonin secretion, compared to blood samples collected in daylight. However, the circadian pattern of melatonin secretion in LD did not differ from the pattern observed in SD. Thus, while a circadian rhythm of melatonin secretion exists in *C .h. pretoriae,* the secretion of melatonin cannot be used as a means of distinguishing between different daylengths. It is postulated that in this subterranean rodent mole-rat, other factors such as seasonal changes in temperature and precipitation patterns may be the ultimate cues that the mole-rats respond to for the timing of reproduction.

Thus, in conclusion I suggest that the highveld mole-rat is a seasonal breeder, with the proposed breeding period lasting from May through to November. Evidence suggest that these animals are capable of producing two litters per breeding season. Increased reproductive activities of the males coincides with that of the females, although the males tend to keep their testes functional out of the breeding period.

It is suggested that the highveld mole-rat cannot effectively utilise the photoperiodic signal and thus may use other seasonal *zeitgebers* such as temperature changes or seasonal rainfall as cues for dispersal and the onset of reproduction.

The small colony size (12 individuals) of this species of *Cryptomys* is probably the result of frequent dispersals. The founding animals of a colony become the reproductive force and it is proposed that these individuals are the oldest or amongst the oldest individuals in a colony. Males tend to be heavier than females, but no sexual dimorphism occurs between the sexes with regard to their skull morphometrics. Definite

age groupings are evident within the colony structure, placing the reproductive animals in the oldest age classes.