frontiers | Frontiers in Ecology and Evolution

TYPE Editorial
PUBLISHED 06 September 2022
DOI 10.3389/fevo.2022.1017185

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to
Behavioral and Evolutionary Ecology,
a section of the journal
Frontiers in Ecology and Evolution

RECEIVED 11 August 2022
ACCEPTED 22 August 2022
PUBLISHED 06 September 2022

CITATION
Braude S, Holtze S, Bennett NC and
Begall S (2022) Editorial: Recent
advances in the ecology and evolution
of the Bathyergidae.
Front. Ecol. Evol. 10:1017185.
doi: 10.3389/fevo.2022.1017185

Editorial: Recent advances in the ecology and evolution of the Bathyergidae

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KEYWORDS

ecology, evolution, Bathyergidae, mole-rat, fossorial

Editorial on the Research Topic
Recent advances in the ecology and evolution of the Bathyergidae

Thirty or more species of bathyergid mole-rats exist across sub-Saharan Africa, from naked mole-rats (*Heterocephalus glaber*) in the Horn of East Africa to Cape dune mole-rats (*Bathyergus suillus*) and blesmols (genus *Georychus, Fukomys, Cryptomys, Heliphobus, Bathyergus*) in the Western and Southern Cape at the southern tip of Africa. The family exhibits a broad spectrum of social organization ranging from strictly solitary to eusocial representatives (Bennett and Faulkes, 2000). Early research on the Bathyergidae focused on describing and understanding the social behavior and basic ecophysiology of a few species (e.g., McNab, 1966; Jarvis and Sale, 1971) and subsequently the discovery of eusociality in naked mole-rats (Jarvis, 1981) attracted even more attention and paved the way for an explosion of studies (Begall et al., 2007). In particular, biomedical, behavioral, and ecological research across the bathyergid mole-rats has expanded exponentially in recent years, again with attention focused primarily on naked mole-rats with exceptional findings on their extreme longevity (Buffenstein, 2005) and unusual physiological properties such as the ability to survive relatively long periods of anoxia (Park et al., 2017).

Although their subterranean habitat may protect bathyergid mole-rats from a hostile environment and many types of predators, the constraints of that subterranean environment have led to a host of morphological, physiological and behavioral adaptations which are discussed in these articles. These studies of the Bathyergidae and their adaptations, may also help us understand naked mole-rats by placing them in an evolutionary and ecological context. The broad goal of understanding the Bathyergidae is advanced in part by multi-species comparative analyses (of which we have included six) as well as examining some of the mole-rat species other than *Heterocephalus* (i.e., Damaraland, Ansell's and Highveld mole-rats). The breadth of work represented in this collection also includes six studies on wild animals in the field and six laboratory based studies.

Some of these articles have benefitted from new experimental technologies (such as Finn, van Vuuren et al.'s and Zöttl et al.'s with the use of RFIDs to quantify underground activity patterns) that we predict will be applied broadly to behavioral work on multiple bathyergid species. Others draw on established techniques and published results to explore particular biological processes across the family, such as Oosthuizen and Bennett's review of biological clocks and Hart et al.'s comparison of metabolic function across the Bathyergidae. Burda has also looked back on published results from 30 years of work with Zambian mole-rats (genus *Fukomys*) to frame a trove of unanswered questions that will keep the next generation of bathyergid researchers busy.

One challenge of studying the behavior of any fossorial animal is that their underground burrows make behavioral observations difficult. While Finn, van Vuuren, et al.'s and Zöttl et al.'s RFID method may change some of this, much of our current understanding of the behavior of these species has come from laboratory observations, which themselves are limited by short artificial burrow systems that provide little opportunity to dig or disperse. Nonetheless, Hite et al.'s modification of the Hebb-Williams maze to assess spatial learning in burrowing species is likely to be repeated on other bathyergid species, and even in two other families of subterranean rodents represented by the genera *Spalax* and *Ctenomys*.

Our characterization of mating system and population structure, in bathyergids and many other taxa, is often based on behavioral observation and inference from findings such as Finn, Thorley, et al.'s discovery that Damaraland mole-rats can disperse more than 4 km from their natal burrows. However, Szafranski et al. went further and used microsatellites to confirm that their captive naked mole-rats are monogamous, whereas Hess et al. used nested clade analysis of mitochondrial genes to explore the role of rivers in gene flow and fragmentation in this species, and they reported the surprising discovery that the current size of a river is not a direct predictor of the divergence between populations separated by the river. Lutermann et al. looked at how parasites can affect how mates are chosen in the Highveld mole-rat (*Cryptomys hottentotus hottentotus*) and Lutermann also took a step back and reviewed the broader role of parasites in a potential scenario on the evolution of social behavior in animals that are both protected and restricted to an underground burrow.

Anatomical phenotypes, and adaptations to the fossorial niche, were studied by Montoya-Sanhueza et al. who compared limb development across a broad spectrum of bathyergid mole-rats. Begall et al. and Toor et al. examined the behavioral phenotypes or personalities of Ansell's mole-rats (*Fukomys anselli*) and task specialization in naked mole-rats respectively; while the size of the white head patch does not correlate with differences among Ansell's mole-rats, partner preference tests are predictive of social roles in naked mole-rats.

This collection of papers on the behavior, ecophysiology, anatomy and genetics across the Bathyergidae may appear to be an eclectic collection, but it highlights the diversity of adaptations to the subterranean niche in the African mole-rats. It further supports the argument that in order to fully understand the amazing adaptations of naked mole-rats, we must also know how their fellow bathyergid relatives have adapted to a life underground.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

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