

Surviving the Desert: Phylogenomics and Evolution of Arid-Adapted Darkling Beetles (Tenebrionidae: Blaptinae)

Covering around 20% of Earth's continental surface, deserts constitute one of the largest terrestrial biomes on the planet. Despite their extreme climatic conditions, deserts are home to a surprisingly rich variety of flora and fauna—including many highly specialized species that are remarkably well-adapted to arid environments. For this reason, deserts have long attracted the interest of biologists. Today, in the face of accelerating desertification in many regions of the world, research on desert-dwelling organisms is gaining renewed relevance. The results of such studies help us better understand past climatic processes, forecast the impact of global change, and inspire the development of modern technologies based on nature's solutions (so-called biomimicry).

Darkling beetles (Tenebrionidae) are renowned for their ability to thrive under extremely dry conditions. Interestingly, their species richness often increases with aridity. To survive in such harsh habitats, these beetles have evolved a wide range of unique strategies, including fog harvesting, secretion of protective wax layers, respiratory and metabolic adaptations, ovoviviparity, extended adult longevity, burrowing behavior, and even parental care. Unfortunately, despite numerous field observations, our understanding of these adaptations remains incomplete—mainly due to a lack of phylogenetic data, which are essential for interpreting evolutionary relationships and patterns.

The goal of this project is to investigate the adaptive strategies of desert-dwelling beetles from the subfamily Blaptinae—one of the most diverse and cosmopolitan lineages within Tenebrionidae, comprising over 4,000 species across nearly 300 genera. Members of this group inhabit major deserts such as the Gobi, Kalahari, Namib, and the Great Basin. Using state-of-the-art DNA sequencing technologies, the research team will reconstruct the evolutionary history of Blaptinae and explore the pathways through which they colonized arid ecosystems. The study will also include the analysis of selected anatomical (e.g., body shape) and molecular traits (notably the evolution of heat shock proteins—Hsp40) that contribute to their survival in extreme desert climates.

An important outcome of the project will be the development of richly illustrated, open-access identification keys, along with the release of genetic data in major international databases (e.g., GenBank, BOLD). This will enable rapid and reliable species identification, even by non-specialists such as border inspectors or agricultural authorities. The project also includes an educational component: a doctoral student will be trained in modern systematics, including bioinformatics, morphometric analyses, and museum-based research.

In summary, the project will generate original data on one of the least understood groups of desert animals, contributing to a better understanding of evolutionary and adaptive processes, and providing a solid foundation for future research in the context of global climate change.



Selected members of the subfamily Blaptinae.