Journal of Animal Diversity
Online ISSN 2676-685X
Volume 4, Issue 3 (2022)
Book Review
http://dx.doi.org/10.52547/JAD.2022.4.3.2

Voles and Lemmings (Arvicolinae) of the Palaearctic Region. Boris Kryštufek and Georgy I. Shenbrot. 2022. University of Maribor, University Press. 436 pp.

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Citation: Maul, L. C. (2022). Voles and Lemmings (Arvicolinae) of the Palaearctic Region. Boris Kryštufek and Georgy I. Shenbrot. 2022. University of Maribor, University Press. 436 pp. *Journal of Animal Diversity*, 4 (3): 7–9. http://dx.doi.org/10.52547/JAD.2022.4.3.2

Received: 20 August 2022
Accepted: 4 September 2022
Published online: 30 September 2022

The book by Boris Kryštufek and Georgy I. Shenbrot, published a few weeks ago, is an encyclopaedic masterpiece and up-to-date standard work on the rodent group of Arvicolinae Gray, 1821 (voles and lemmings) belonging to the family Cricetidae Fischer, 1817 (hamsters). The authors are two experts on these mammals, and are known worldwide by scientists working in mammalogy for their publications. In addition to countless individual articles, B. Kryštufek is best known for his monograph on the 'Mammals of Turkey and Cyprus', which he published together with Vladimír Vohralík (Kryštufek and Vohralík, 2001; 2005; 2009). Georgy Shenbrot wrote, among many other books and papers, mainly devoted to desert and steppe rodents, 'An Atlas of the Geographic Distribution of the Arvicoline Rodents' in co-operation with Boris Krasnov (Shenbrot and Krasnov, 2005). It is certainly no exaggeration to call the present book, reviewed here, a worthy, up-to-date successor to Hinton's classic 'Monograph of Voles and Lemmings' (Hinton, 1926) and Gromov and Polyakov's volume on 'Voles (Microtinae)' (Gromov and Polyakov, 1977) in the framework of the 'Fauna SSSR' series (which actually always represented the entire group worldwide). So, one can say that a fundamental work on voles appears about every 50 years.

Outsiders may ask if a monograph of this kind make any sense at all nowadays, in a time when so much - including taxonomy - is constantly changing every day? To anticipate the answer right away: Yes, of course it makes sense.

When I started this book review, I found that the abstract of Kryštufek and Shenbrot's book actually already summarised all the important statements, which includes: 'the most species-rich group of Palaearctic rodents; frequently used in various research; this work integrates achievements of the genomic era with the traditional taxonomy; provides an authoritative and up-to-date taxonomic guide; 331 illustrations; over one thousand references; skull and dentition of each of the 128 species are depicted, and their distributions are mapped in detail'.

I doubted that I could possibly add to this.

As the authors note in the summary, the potentially interested parties include not only representatives of the various fields of recent zoology but also researchers who are 'concerned with biostratigraphy.... [and] evolutionary research', i.e. palaeontologists. This is where I felt addressed, because I belong to this latter group. What distinguishes a palaeontologist's view of voles from that of a zoologist?

Voles play a crucial role for all palaeontologists dealing with fossil small mammal faunas of the latest Miocene, Pliocene and Quaternary of the Northern Hemisphere (Holarctic), because here vole TEETH (and more or less ONLY them) represent the majority of all finds in terms of species and individual numbers. Due to their - compared to other groups - much faster evolution (e.g., Triant and DeWoody, 2005), they are the most important biostratigraphic key fossils in the terrestrial realm. Therefore, a single (vole) mouse tooth is often more

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[DOI: 10.52547/JAD.2022.4.3.2]

informative for the dating of a site than most of the large mammal remains of that locality.

In the previous 140 years, many new and improved phylogenies of voles have been established on the basis of dental morphology by palaeontologists. Researchers who have worked intensively on the evolution of voles and their biostratigraphic (fossil-based) dating include such eminent personalities as Newton, Forsyth Major, Hinton, Kormos, Heller, Kretzoi, Fejfar, Heinrich, Kowalski, Gromov, Koenigswald (Newton, 1882; Forsyth Major, 1902; Hinton, 1926; Kormos, 1934; Heller, 1936; Kretzoi, 1956; Kowalski, 1960; Gromov and Polyakov, 1977; Koenigswald, 1980; Fejfar and Heinrich, 1981) and many others. For the period from the late Miocene to the Quaternary, the total number of sites in different regions of the Holarctic is currently well over 1,000.

Based on the investigations of this extensive material, it soon became clear that certain fundamental processes had taken place in all evolutionary lineages of the Arvicolinae: the most primitive forms have root-toothed molars, which develop after successive increases in crown height (hypsodonty) rootless molars in some of the evolutionary lineages. Within the phylogenetic lineage of *Microtus* Schrank, 1798 *sensu lato* (s. l.), the occlusal pattern of the first lower molar shows in the most primitive representatives, typical *Allophaiomys* Kormos, 1933 morphotypes (comparable to the occlusal surface in *Arvicola* Lacépède, 1799), which in further evolutionary stages are replaced by *Pitymys* McMurtrie, 1831 morphotypes (characterised by the *Pitymys*-rhomb) and finally by *Microtus* morphotypes. However, palaeontologists have always been aware that due to the obviously numerous parallel developments and convergences, phylogenetic reconstructions based solely on morphology have strict limitations.

Since the reconstruction of phylogenetic trees can draw on the tools of molecular biology, serious changes have also taken place in the study of the phylogeny of voles. An initially widespread competitive thinking between palaeontologists ('only the fossils provide evidence of what really existed') and recent mammalogists ('DNA alone is the key to phylogenetic relationship analyses') is giving way to the realisation that only cooperation between the two disciplines will uncover the truth. On the one hand, the fossil finds must be interpreted in the context of the latest DNA phylogenies and DNA phylogeographies. On the other hand, the fossils alone can verify the DNA phylogeny – to date the branching events and determine the direction of the dispersal events.

In my 'daily business' of excavating fossils, identifying them and interpreting their phylogenetic and biogeographical position, I need the results of the recent zoologists and check whether they agree with the fossil findings. The encyclopaedia of the Arvicolinae by Kryštufek and Shenbrot is ideal for this work. I would like to briefly mention the technical details of the book. It is divided, as usual, into a general and a specialized part, the species description. The general part outlines and defines the geographical framework, explanations of the morphological characteristics (including external features, skin, penis, baculum, sperm head, skull, dentition and karyotype). The larger part of the book is devoted to species descriptions. This includes the taxonomy, from family to species groups, subgroups, species and (where applicable) subspecies, taking into account the latest phylogenetic relationships between taxa. A key to the species is provided in the genus chapter. In addition to the scientific name and authorship, the common name, the original type name with its reference and the type locality, are given. This is followed by a discussion on the taxonomic history, the differentiation of the species and notes on nomenclature. For all species, illustrations of skulls and molar patterns, in some cases tails, feet (palm and sole) and whole bodies of living animals, cadavers or skin preparations are included. Karyotypes and measurements are also given. The distribution maps are supplemented by descriptions of the distribution areas and their size in square kilometres. A comprehensive bibliography (29 pages) and a taxonomic index conclude the work.

Given the wealth of information found in the work, it might be easier for the reader to know what is NOT included. As stated in the title, only Palaearctic species are included. Although no illustrations of phylogenetic trees are provided, the most recent analyses of DNA-based phylogenies (Robovský et al., 2008; Martinkova and Moravec, 2012; Mahmoudi et al., 2017, and many others; Mahmoudi et al., 2020; Abramson et al., 2021) are of course reflected - in the taxonomic order of the species of Arvicolinae as applied in this book. Fossil taxa are not explicitly and individually documented and systematically treated - as was the case with Hinton (1926) and Gromov and Polyakov (1977). However, they are mentioned in important places with the corresponding recent taxa. This omission is intentional, as the treatise would otherwise be 'overflowing'.

Does this monograph make sense in a time when everything changes every day? It is an excellent work and will be the standard (even if individual views on taxonomy etc. change) for some time - in a time when everything changes every day.

Acknowledgements

Last but not least, I wish to thank the anonymous referees for their valuable comments.

Conflict of interest

The author declares that there are no conflicting issues related to this book review.

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[DOI: 10.52547/JAD.2022.4.3.2]