

EDITORIAL

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BMC Zoology – a home for all zoological research in the *BMC* series

Dirk Krüger^{1*}, Laurence Packer², Thomas Flatt³, Herbert Hoi⁴, Serge Morand⁵, Bernhard Lieb⁶, Luiz R. Malabarba⁷ and M. Brock Fenton⁸

Abstract

This editorial accompanies the launch of *BMC Zoology*, a new open access, peer-reviewed journal within the *BMC* series that considers manuscripts on all aspects of zoology. *BMC Zoology* will increase and disseminate zoological knowledge through the publication of original research, methodology, database, software and debate articles. With the launch of *BMC Zoology*, the *BMC* series closes a gap in its portfolio of subject-specific research journals and is now able to cover all aspects of animal research together with *BMC Ecology*, *BMC Evolutionary Biology* and *BMC Veterinary Research*.

Introduction

“It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change” (Charles Darwin). When Charles Darwin published his book ‘*On the Origin of Species*’ [1] in 1859 many members of the scientific community as well as the general public considered it controversial. Today, Darwin’s evolutionary theory of natural selection is well established and influenced many of the early researchers that laid the foundation for modern zoology.

Zoology, from the Greek words *zoon* meaning *animal* and *logos* meaning *to study*, is the study of animals. More than 2000 years ago, Aristotle took notes on animal observations and even established classifications. As humans, we have always had great interest in the other species we share our world with, past and present. Some we have domesticated and even formed very special bonds with over the centuries.

We do not know how many million species co-exist with us on our planet, but we do know that most remain to be described and that they are becoming extinct faster than we are describing them. Due to this variety of animals, zoology is a very broad field and many zoologists specialize in the study of a particular functional, structural or ecological aspect by specializing in one particular group of animals, or both. About 1.5 million species

have been named and described to date. Vertebrates account for less than 5 % of all species [2]. While insects, which play a crucial part in our ecosystems (e.g. pollination, biological control), might dominate on land, members of completely different taxa with far greater phylogenetic diversity dominate in the oceans. *BMC Zoology* serves as an outlet for the scientific study of all components of this rich diversity.

With the launch of *BMC Zoology*, the *BMC* series aims to complement its current portfolio of animal research to better serve the global research communities. With *BMC Ecology*, *BMC Evolutionary Biology*, *BMC Veterinary Research* and now *BMC Zoology*, the *BMC*-series portfolio can offer authors a home for all original research manuscripts that report scientifically valid results on animal research. *BMC Zoology* aims to be an all-inclusive zoological journal that will disseminate new findings about the world’s fauna, ranging from the discovery of new species through knowledge about how the latest research is used in animal conservation to understanding the complex interplay between evolution, ecology and earth geological history to understand the current distribution of animals. *BMC Zoology* will serve as a resource for researchers, students, organizations and charities with an interest in zoology and conservation. The Journal will be identified as a home for valid zoological research, freely, openly and permanently accessible to all biologists and all those with an interest in zoological findings.

* Correspondence: dirk.krueger@biomedcentral.com

¹BioMed Central, 236 Gray’s Inn Road, London WC1X 8HB, UK
Full list of author information is available at the end of the article

Aims and scope

BMC Zoology considers articles on all aspects of zoological research. As the Journal aspires to be as broad as the subject discipline itself, we welcome submissions on all animals.

BMC Zoology is part of the *BMC* series, which publishes subject-specific journals focused on the needs of individual research communities across all areas of biology and medicine. We offer an efficient, fair and friendly peer review service and do not make editorial decisions on the basis of the interest of a study or its likely impact. Studies must be scientifically valid; for research articles this includes a scientifically sound research question, the use of suitable methods and analysis, and following community-agreed standards relevant to zoological research.

BMC Zoology has seven editorial sections:

- Biotic interactions
- Cognition, sensory biology, signaling and communication
- Conservation and wildlife monitoring
- Life history
- Comparative physiology and morphology
- Sociobiology, parental and sexual behavior
- Systematics and biogeography

We are delighted to welcome Serge Morand, Brock Fenton, Thomas Flatt, Herbert Hoi and Laurence Packer as Section Editors for the Journal along with an expanding international team of Associate Editors [3]. Together with the in-house Editor, they will provide academic leadership and expertise. As the Journal grows and develops, we will continue to recruit academic editors to the Board in order to adapt to the changing and growing nature of the field.

BMC Zoology requires that experimental research on animals must comply with institutional, national, or international guidelines, and where available should have been approved by an appropriate ethics committee. The Basel Declaration [4] outlines fundamental principles to adhere to when conducting research on animals. Manuscripts that describe new taxa must follow the guidelines set by the International Commission on Zoological Nomenclature [5]. We require the new taxon name and the article it is published in to be registered with ZooBank [6].

BMC Zoology aims to publish work that, after a thorough peer review process by appropriate independent experts, is deemed to be a coherent and valid addition to the scientific knowledge. *BMC Zoology* will provide an open access platform to allow the effective dissemination of this knowledge, and to allow readers to explore and understand the most important developments,

trends and practices in zoology. As the pioneering and original open access publisher, we believe that open access and the Creative Commons Attribution License [7] are essential in this, allowing universal and free access to all articles published in the Journal and allowing them to be read and the data re-used without any restrictions.

BMC Zoology will work closely with the rest of the journals in the *BMC*-series portfolio [8] to help authors find the right home for their research in the field of zoology. High impact submissions of outstanding merit will be brought to the attention of our flagship journal *BMC Biology*. We will highlight selected journal content through various marketing channels to ensure the research reaches its target audience and receives the attention it deserves.

Biotic interactions section

The development of molecular tools and phylogenetic methods have contributed to the explosion of taxonomic and phylogenetic investigations. Parasite diversity appears considerable although often cryptic. In a parallel way, the studies of host–parasite interactions and parasitism have influenced many scientific disciplines from biogeography to evolutionary ecology by using various comparative methods based on phylogenetic information. Indeed, hosts and their parasites interact over both relatively long evolutionary and relatively short ecological time. Studies are still needed to investigate the co-diversification and co-interactions of hosts and their parasites in time and space [9].

Theoretical and empirical contributions on host–parasite (and host–symbiont) interactions are various from ecological immunity, to community ecology and health ecology. However, important questions remain regarding the host factors that may explain the diversity and diversification of parasites, and correlatively the effects of parasitism and symbiosis on the diversity and diversification of their hosts including the evolution of their life history traits.

The biotic interactions section of *BMC Zoology* welcomes submissions on comparative studies of host–parasite and host–symbiont interactions such as the analyses of co-adaptation taking into account history depicting by phylogenetics. Furthermore, *BMC Zoology* invites studies at the level of populations and communities that investigate biotic interactions in the context of biological invasion and biological conservation. There is a strong interest for publishing studies that investigate biotic interactions in the context of ecosystem regulating services and their implementation. Finally, we also welcome manuscripts that contribute to science-policy dialog for which the debate article type might be the ideal forum.

Cognition, sensory biology, signaling and communication section

This general area of zoology covers a large spectrum both in terms of topics and endeavors across a huge variety of animals. For me, bats symbolize the diversity of, and connectivity among topics in this area, so I will explore them as an example.

Many of the ~800 species of insectivorous bats use echolocation to detect, track and identify their prey e.g., [10]. In a sense, these animals communicate with themselves, adjusting the design and timing of their echolocation signals to ensure that they obtain accurate information about their prey and the setting in which it is operating. The recent discovery [11] that a Japanese bat (*Pipistrellus abramus*) begins to track a second target while still closing on the first one is exciting because of the neuroscience and behavior that is involved. Neurobiology underlying echolocation has revealed the elegance, complexity, and accuracy of this form of behavior [10].

We also know that echolocating big brown bats (*Eptesicus fuscus*) use sensory hairs to collect information about air flow across their wing membranes [12]. Input from these hairs is fundamental to the maneuverability of flying bats. Still to be determined, however, is how most bats integrate information obtained by echolocation and by vision, because bats are not blind and some have acute eyesight. This is supported by work with Egyptian fruit bats (*Rousettus aegyptiacus*) which have a mental map of their home ranges [13].

On the other side of the coin, many species of insects, notoriously moths, lacewings, orthopterans, beetles and mantids, have bat detectors, ears allowing them to detect the echolocation calls of marauding bats e.g., [14]. Insects with bat-detecting ears are much less likely to be captured by hunting bats. Some species of tiger moths (Arctiidae) use acoustic displays as aposematic signals or to jam bats' echolocation [15].

The vampire bat (Fig. 1) emerging from its day roost, adds thermal sensors [16] to its sensory array that includes vision, echolocation, acute hearing, and a high level of olfactory sensitivity. In vampire bats, individual recognition of group members is mediated by at least acoustic and olfactory cues [17]. Other bats also use echolocation calls of conspecifics to locate roosts and concentrations of prey.

Individual vampire bats can beg blood from familiar roost mates that may or may not be genetic relatives. This adds an additional layer of behavior and social interactions to the mix of cognition, sensory biology, signaling and communication. The possibilities are greatly enhanced by recurring evidence of bats learning foraging tasks and identification of prey by watching experienced conspecifics.

I chose bats as an example of the importance of cognition, sensory biology, signaling and communication in the lives of animals and in studies of zoology.

The cognition, sensory biology, signaling and communication section of *BMC Zoology* will particularly welcome manuscripts that present valid theoretical developments



Fig. 1 Vampire bat (*Desmodus rotundus*) emerging from its day roost in a looters' tunnel dug into a Maya ruin in Belize. Photo by M.B. Fenton

as well as rigorous empirical studies that draw together different aspects of cognition and sensory biology. Making connections to similar studies with other subject species will enhance the readership and impact of the articles. *BMC Zoology* is an ideal journal to present analyses drawing on large, long-term data sets. The online nature of the Journal makes it well suited to presenting large amounts of data.

Conservation and wildlife monitoring section

Our planet is entering the 6th mass extinction as a result of human impacts on all aspects of the world's biota. Human survival depends upon the maintenance of biological diversity in ways that are often complex and poorly understood. Yet it is precisely this understanding that is required to permit conservation of as much of our remaining biological diversity as possible. Conservation research is a diverse field with numerous exciting new theoretical and methodological advances. However, none of these approaches will find successful practical application in the absence of the accurate monitoring of wildlife populations.

Through its conservation and wildlife monitoring section, *BMC Zoology* is interested in publishing scientifically valid research in all areas related to animal conservation and wildlife monitoring. The Journal considers the term *wildlife* to encompass all animal life. Of particular interest will be novel theoretical developments, rigorous empirical studies that illuminate conservation principles whether or not the target organisms are actively threatened, methodological advances that increase our ability to assess the status of wildlife populations and science-based commentary aimed at influencing policy makers. The Journal is also interested in publishing analyses that make use of the presentation of large, long term datasets. The online nature of the Journal is particularly suitable for the presentation of such large amounts of data.

Life history section

The field of life history evolution seeks to explain how natural selection '*designs*' organisms to achieve and optimize reproductive success under specific environmental conditions and given intrinsic organismal constraints [18–20]. Life history traits (e.g., age and size at maturity, number, size and sex ratio of offspring, age-specific schedules of fecundity and survival, lifespan) are the major phenotypic components of Darwinian fitness and thus direct targets of natural selection. Since natural selection can be defined as heritable variation in fitness components, understanding the causes and consequences of life history variation is of central importance for our understanding of adaptation [19, 20]. Life history traits are often connected to each other via constraining

genetic, physiological and developmental relationships [21, 22]. Given these constraining relationships, the interactions among life history traits determine fitness. The study of life histories thus also illuminates our understanding of evolutionary trade-offs and constraints. Broadly defined, the field of life history evolution deals with all facets of life histories and fitness components, including evolutionary, ecological as well as mechanistic aspects [20, 22, 23].

The life history section of *BMC Zoology* is committed to publishing original research articles in all areas of animal life history including experimental, observational and descriptive studies, and covering the whole range of approaches, including evolutionary ecology, evolutionary demography, field observations, laboratory-based experimental approaches (e.g., phenotypic manipulations and assays, experimental evolution and artificial selection, breeding and quantitative genetic experiments), genetics and genomics, phylogenetics, physiology (including metabolism and endocrinology) and development. Subjects of particular interest also include the evolution and proximate mechanisms of life history plasticity, trade-offs, and constraints, as well as the evolution of life cycles.

Comparative physiology and morphology section

In order to understand the physiological functions, adaptations or correlations of animals, we are studying the structure and functionality of subcellular compartments e.g. nuclei, mitochondria, chloroplasts or even smaller cellular parts. To fully understand and characterize an animal, one must also look at the structures and functions of cells, tissues, organs, organisms, habitats and behavioral patterns.

Both disciplines, comparative physiology and morphology, are multi- and interdisciplinary fields. To study them together means understanding evolution, ecosystems, environmental changes and circumstances and analyzing behavior. Looking into how cells, organs and organisms communicate by understanding the informational flow within and between cells, tissues, organs and organisms is a key part. A major research topic in animal physiology, summarizing all its sub disciplines remains the question on how homeostasis is achieved. Homeostasis means to keep you *comfortable and constant* which for animals mean the ability to explore new '*worlds*' and '*niches*'.

The last centuries provided fundamental insights and this was achieved by methods sometimes considered old-fashioned and simple. But these methods are still indispensable, valuable and precise providing us with fundamental insights. We now complement these findings, theories and rules by new, modern and exciting methods and possibilities to strengthen and deepen our

knowledge. Next generation sequencing (NGS), life-imaging, 4D-fluorescence microscopy, high resolution light microscopy, laser scan microscopy (LSM), single cell analyses and measurements among others are examples of tools and techniques that will provide new insights and possibilities.

Modern zoologists will be able to combine the scientific results coming from different levels of organizations (i.e. population studies, organismal and cellular studies) and integrate it into a whole entity in our field, the integrative and modern disciplines of comparative physiology and morphology.

The comparative physiology and morphology section of *BMC Zoology* welcomes submissions with a focus on comparative studies at different levels as they exist between different species, populations, individuals, organs, tissues or cells within species. We particularly welcome manuscripts which focus on the special needs of specific organisms providing hints on their evolutionary relationship or convergent evolutionary background.

Sociobiology, parental and sexual behavior section

The first and most sensitive response of an organism to changes in its environment are behavioral changes. Environment and climate change, reduction and fragmentation of habitats and the loss of resources; investigations on how animals adapt to new conditions is timely and important.

We can imagine that children who consume large amounts of unhealthy food and grow up without forming social bonds through the interaction with other children may display unwanted behavioral traits as adults. In non-human animals, increasing or decreasing population densities, rapid changes in physical and social environments, human disturbance and rapid changes in their parasite community or disease risk have an impact on behavior. Behavioral studies are therefore an important area of zoological research.

The sociobiology, parental and sexual behavior section of *BMC Zoology* welcomes manuscripts about the social, sexual or reproductive behavior of animals. Studies can be correlative, experimental, methodological or theoretical. We are particularly interested in research that focuses on the influence of environmental impact on behavioral patterns but also on the genetic background influencing behavioral adaptation and plasticity. *BMC Zoology* further invites manuscripts describing mechanistic research on personality or behavioral organization of animal systems including complex statistical approaches such as social network analyses.

Systematics and biogeography

Systematics is the branch of biology that deals with classification and nomenclature. Biogeography seeks to understand the patterns of distribution of taxa over

space and time. Both incorporate phylogenetic analysis to form the basis for our comprehension of all aspects of our planet's biological diversity. There has been an increase in the diversity of tools available for the study of both systematics and biogeography: including both means of data acquisition and analysis. The identification and description of existing species as well as the georeferencing of their locality data are particularly important in comparatively underexplored regions of the world. However, the use of new integrative studies in the analysis of species' distribution and diversity is also generating important new insights in well studied faunas.

The systematics and biogeography section in *BMC Zoology* embraces studies related to the description of new zoological taxa and their phylogenetic interrelationships and biogeographic histories at all levels. Articles incorporating any rigorously applied methods are welcome. These may range from simple new species descriptions to new phylogeny-based classifications; or they may deal with the impact of newly explored characters on our understanding of the evolution and distribution of any taxonomic group of animals. The online nature of the Journal provides the possibility of publishing very long, copiously illustrated papers should be particularly attractive to those wishing to publish thorough taxonomic revisions, extensive molecular taxonomic treatments, or the results of large scale biogeographic analyses.

Conclusion

The rationale for the launch of *BMC Zoology* is to provide a community-driven, all-encompassing, unbiased and fully open access zoological research journal. As editors, we are committed to ensure that *BMC Zoology* will be a home for all sound manuscripts from all areas of zoology. Authors, reviewers, editors, the zoological research community as well as the general public can be sure that as part of the established *BMC* series of BioMed Central as a reputable, well respected open access publisher, the Journal is managed with integrity and set up to serve its community long term. We welcome and encourage sound research from all areas of zoology and are looking forward to working closely with reviewers and editors to provide high quality zoological research to the community.

We would like to encourage all future readers and those with an interest in the Journal to get in touch with the editor, provide us with feedback and suggestions on how to improve the Journal as we continuously strive to better serve the community. We hope you will find the first set of articles a pleasant and worthwhile read and we look forward to working with you all to disseminate zoology and conservation research.

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Authors' contributions

DK wrote the introduction, aims and scope and conclusion section. SM wrote the biotic interactions section. MBF wrote the cognition, sensory biology, signaling and communication section. LP wrote the conservation and wildlife monitoring section. TF wrote the life history section. BL wrote the comparative physiology and morphology section. HH wrote the sociobiology, parental and sexual behavior section. LRM wrote the systematics and biogeography section. All authors read and approved the final version of the manuscript.

Competing interests

All authors have read the final version of the manuscript and declare that they have no financial or non-financial competing interests.

Consent for publication

Not applicable.

Ethics approval and consent to participate

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Author details

¹BioMed Central, 236 Gray's Inn Road, London WC1X 8HB, UK. ²Department of Biology, York University, 4700 Keele St., Toronto, ON M3J 1P3, Canada. ³Department of Ecology and Evolution, Université de Lausanne, UNIL Sorge, Biophore Building, CH-1015 Lausanne, Switzerland. ⁴Department of Integrative Biology and Evolution, Konrad-Lorenz Institute of Ethology, University of Veterinary Medicine, Savoyenstrasse 1a, 1160 Vienna, Austria. ⁵Institut des Sciences de l'Évolution, CNRS, Université de Montpellier II, Montpellier, France. ⁶Institute of Zoology, Johannes Gutenberg-Universität, Müllerweg 6, 55099 Mainz, Germany. ⁷Department of Zoology, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil. ⁸Department of Biology, University of Western Ontario, London, ON N6A 5B7, Canada.

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References

- Darwin C. On the origin of the species, vol. 5. 1859.
- Arthur W. Evolving animals: the story of our kingdom. Cambridge University Press; 2014. 344. ISBN: 9781107627956.
- BMC Zoology Editorial Board. [Online]. Available: <https://bmczool.biomedcentral.com/about/editorial-board>.
- Basel Declaration A call for more trust, transparency and communication on animal research. 2010.
- International Commission on Zoological Nomenclature. International Code of Zoological Nomenclature. 4th edition. International Trust for Zoological Nomenclature; 1999. ISBN:0 85301 006 4.
- ZooBank. [Online]. Available: <http://www.zoobank.org>.
- Creative Commons Attribution License, Creative Commons Attribution License. [Online]. Available: <http://creativecommons.org/licenses/by/4.0/>.
- BMC-series journals. In [<http://www.biomedcentral.com/p/the-bmc-series-journals#journalist>].
- Clayton DH, Bush SE, Johnson KP. Coevolution of life on hosts: integrating ecology and history. University of Chicago Press; 2016. p. 320. ISBN:9780226302270.
- Fenton MB, Grinnell AD, Popper AN, Fay RR. Bat bioacoustics. Springer Verlag; 2016. ISBN:9781493935253.
- Fujioka E, Aihara I, Sumiya M, Aihara K, Hiryu S. Echolocating bats use future-target information for optimal foraging. PNAS. 2016;113:4848–4852.
- Sterbing-D'Angelo S, Chadha M, Chui C, Falk B, Xian W, Barcelo J, Zook JM, Moss CF. Bat wing sensors support flight control. PNAS. 2011;108:11291–11296.
- Tsoar A, Nathan R, Baratan Y, Vyssotski A, Dell'Omo G, Ulanovsky N. Large-scale navigational map in a mammal. PNAS. 2011;108:E718–E724.
- ter Hofstede H, Ratcliffe J. Evolutionary escalation: the bat–moth arms race. J Exp Biol. 2016;219:1589–1602.
- Dowdy N, Conner W. Acoustic Aposematism and Evasive Action in Select Chemically Defended Arctiine (Lepidoptera: Erebidae) Species: Nonchalant or Not? PLoS One. 2016;11(4): e0152981. doi:10.1371/journal.pone.0152981.
- Gracheva E, Cordero-Morales J. Ganglion-specific splicing of TRPV1 underlies infrared sensation in vampire bats. Nature. 2011;476:88–92.
- Carter G, Wilkinson G. Food sharing in vampire bats: reciprocal help predicts donations more than relatedness or harassment. Proc R Soc B. 2013;280:2–122573.
- Roff DA. The evolution of life histories: theory and analysis. 1992.
- Stearns S. The evolution of life histories. 1992.
- Stearns S. Life history evolution: successes, limitations, and prospects. Naturwissenschaften. 2000;87:476–486.
- Zera A, Harshman L. The physiology of life history trade-offs in animals. Annu Rev Ecol Syst. 2001;32:95–126.
- Flatt T, Heyland A. Mechanisms of life history evolution: the genetics and physiology of life history traits and trade-offs. 2011.
- Roff D. Contributions of genomics to life-history theory. Nat. Rev. Genet. 2007;8: 116–125.

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