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Towards a better understanding of life history strategies and the implications of habitat destruction on future mammal conservation

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Mammals first appeared on planet Earth approximately 200 million years ago and have undergone significant and diverse phylogenetic radiations across the continents (Pickrell, 2019). The fossil record reveals a number of extinction events that have led to the appearance and disappearance of a great diversity of species which we know of only by their presence in the fossil record. Overall, we have very little information on a large proportion of the world's extant mammals (Handbook of the Mammals of the World edited by Wilson et al., 2009-2019), our current knowledge on the majority of species being scant, and it is possible that we may never know much about many species as they become endangered and their habitat becomes destroyed. The Anthropocene, leading to the sixth major extinction, arising from the loss of biodiversity hotspots and climate change, poses the most significant threat to mammals since the end of the Cretaceous (65 MYA) – the event that led to the demise of the dinosaurs (Fortey, 1997). Humans have been responsible for the decimation of many iconic species such as the white and black rhinoceros, the African elephant, the tiger and lion, as well as many primates, all for the trade in animal products such as rhino horn, tiger and lion bone for herbal medicines and the ivory trade for carvings, trinkets, and bracelets. Indeed, entire ecosystems have been destroyed as a consequence of human gluttony, Madagascar being one very sad example of this destruction as a consequence of deforestation (McConnell and Kull, 2014a; McConnell and Kull, 2014b). In South-east Asia deforestation has brought the orangutan, the slow loris and tarsier to the brink of extinction as the demand for palm oils and exotic rainforest timber accelerates (Vijay et al., 2016; Winaarni et al., 2017; Supriatna et al., 2020). Pangolins across Africa and Asia are in crisis as a consequence of the demand for their scales for herbal medicines (e.g., Challender et al., 2020). In South America, the great Amazonian rainforest is under threat from logging, mining, and cattle farming, human activities that put pressure on many mammal species as well as other vertebrates and invertebrates, but soil erosion is also a major issue in the land once occupied by tropical rainforest. Indeed, it has been estimated that less than 35% of the natural terrestrial environment is still pristine and this area is reduced annually (Davidson et al., 2012; Nobre et al., 2016).

Knowledge of the life history of most mammals is still fragmentary, this is particularly true for many small mammals occurring in the tropics and subtropics, known biodiversity hotspots (Ceballos and Erhlich, 2006). Life history theory attempts to understand how natural selection acts upon organisms to maximize reproductive success, using knowledge concerning the selective factors operating in the environment (i.e., extrinsic mortality) and

factors intrinsic to the organism (i.e., trade-offs and constraints) and how this ultimately affects survival and reproduction. Knowledge of life history is closely linked to population ecology, which deals with the dynamics of species populations and how these populations interact with the environment, such as birth and death rates, as well as immigration and emigration between populations. A thorough knowledge of life history is essential when developing strategies to conserve and maintain populations in their natural environments.

In the last two to three decades many previously unknown mammals have been discovered, predominantly in tropical regions that have been poorly explored. In Africa, a primate, the Lesula (*Ceropithecus lomaniensis*), was discovered in the Democratic Republic of Congo (Hart et al., 2012), and in 2005 Goodman's mouse lemur, (*Microcebus lehilahytsara*) was recorded in Madagascar (Roos and Kappeler, 2006). In South America Milton's titi monkey (*Plecturocebus miltoni*) was discovered in Brazil in 2011 (Dalponte et al., 2014), and the pygmy three-toed sloth (*Bradypus pygmaeus*) in Panama in 2001 (Kaviar et al., 2012). While we have a moderately good understanding of the life history and needed conservation actions for many of the iconic mammal species, there are numerous small mammal species about which we have fragmentary information and this is an area of research that requires intensive effort. As with the larger mammals there are still a number of small mammal species being discovered such as the Cyprus mouse (*Mus cypriacus*) reported in 2006 (Cacchi et al., 2006), and the Toothless, or Edented Sulawesi, rat (*Paucidentomys vermidax*) found in Sulawesi in 2011 (Esselstyn et al., 2012).

The speciality section encompassing life history, ecology and conservation has been specifically designed to encourage the publication of papers that will add to the paucity of information on poorly studied mammalian taxa in these designated disciplines. By increasing our knowledge of the life history traits such as growth, reproductive strategies, survivorship and fecundity of mammal species and their populations in both small and large mammals we will be in a better position to put forward recommendations for potential conservation strategies to protect populations that are vulnerable. An understanding of the basic biology of reproduction is essential for the proposing future conservation scenarios for species that have very restricted distributions or are on the brink of extinction (Mace et al., 2008). In turn an understanding of the ecology of a species is imperative to implement conservation actions to protect species that are already threatened with extinction. The relationship that mammals have with their physical environment can be considered at the individual, population, and community level. It is a broad encompassing discipline that investigates how mammals interact with their habitat as well as other organisms in the environment. A knowledge of the life history traits of mammals and population size is important for implementing well informed conservation strategies to protect species listed in the various IUCN threatened categories (Mace et al., 2008). Even species currently considered as of least concern merit study, as it is quite possible that in the near future these species may unfortunately be IUCN listed.

The discipline of ecology has several practical applications with conservation biology, which is an increasingly important theme in the Anthropocene. Many mammal species are under threat due to

habitat destruction and climate change, as well as poaching and the illegal trade in animals (Davidson et al., 2012; McConnell and Kull, 2014a; McConnell and Kull, 2014b; Nobre et al., 2016; Supriatna et al., 2020). Climate change is having a drastic effect on the ecosystems around the planet, the rising temperatures and changes in rainfall patterns have resulted in an imbalance in many habitats that in turn has affected the trophic levels in the ecosystem. Such imbalances can bring about a cascade of changes that results in species extinctions, or in the case of some mammal species irruptions that can upset the balance of the food web (e.g., David et al., 2017). Habitat destruction in the form of logging or mining in forests and woodlands, or the changing of the vegetation due to farming and planting of monocultures of grain can threaten the populations of numerous small mammal species that require specific habitat requirements. Scientific studies and analyses focusing on these topics are of importance to the survival of mammalian biodiversity across the planet. Studies involving the conservation of mammals involving captive breeding programmes and the subsequent reintroduction, or rewilding of species are important for the future of several species that have become threatened by habitat destruction or for use of their wildlife products. In particular, studies on iconic mammals and conservation successes arising as a result of human intervention are particularly important (such as the American Bison being brought back from the brink of extinction in the early 1900's when only 1100 were left and the humpback whale where less than 10% of the population were left prior to a hunting moratorium being issued by the IUCN). As much as the conservation of the iconic species are important, so too are studies on the lesser-known species, particularly the small mammals that are often overlooked in conservation programmes. Many small mammals are under threat due to habitat fragmentation and destruction. In South Africa, numerous species of golden mole are either vulnerable, threatened or endangered and the same is true of some of the tenrecs of Madagascar, all as a result of habitat transformation (Bronner and Bennett, 2005; Stephenson et al., 2021). Global warming could be particularly harmful to many small mammal species that occupy arid regions, such as the Middle East that regularly experiences temperatures exceeding 45°C. Unusual heat waves arising from prolonged periods of elevated temperatures have resulted in birds literally falling from the skies in large numbers (McKechnie and Wolf, 2010).

We know little about the small mammal species from the Neotropics and Asia, thus contributions from these regions are particularly encouraged, especially those from the tropics and subtropics that are historically under-represented in the scientific literature. Mammals are susceptible to disease from a number of zoonotic organisms that usually have little or no effect on the host, but if these small mammals come in close proximity to human dwellings diseases can jump the species barriers. Thus, studies at the wildlife-disease interface are important and shed light on how to mitigate future losses and local extinctions arising from infectious organisms. Many bat species have become prone to white nose syndrome, a fungal infection that is spreading across the globe at an alarming rate (Cryan et al., 2013), to name but one disease that is decimating this mammalian order.

In this speciality section contributions should be hypothesis driven and present novel findings that are suitable to a broad audience. Papers that are interdisciplinary or transdisciplinary, that bridge or interface the speciality theme, are particularly encouraged. This speciality theme sets out to investigate various life history traits such as growth, reproductive strategies, survivorship and fecundity of mammal species and their populations in both small and large mammals.

Many mammal species are under threat due to habitat destruction and climate change, as well as poaching and the animal trade. Articles focusing on these topics are of importance to the future survival of the mammalian biodiversity on the planet. In particular the speciality section seeks contributions on mammalian wildlife that is currently under represented in the literature and for which novel and fascinating research questions are directed towards increasing our knowledge in these areas of mammal biology.

The life history of mammals and particularly those aspects dealing with the patterns of growth, the reproductive strategies operational in mammals as well as studies on longevity or survivorship in monitored populations are particularly encouraged. Case studies on how populations are shaped by ecological changes and both positive and negative effects of conservation strategies are important for future survival scenarios of species and ecosystems alike. Studies on mammal conservation involving captive breeding programmes and the subsequent reintroduction or rewilding of species of concern are

important for the future survival of several species that have become threatened by habitat destruction or for use of their wildlife products.

Author contributions

The author confirms he solely conceptualized and wrote this work.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The handling editor [PM] declared a past co-authorship with the author.

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