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Review Paper

Biases in wildlife and conservation research, using felids and canids as a case study

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ABSTRACT

With limited funds available for research and conservation, resources should primarily be focussed on taxa that need it the most. Although some consider all species equal, others argue that research prioritization should depend on a species' role in the ecosystem, taxonomic uniqueness, limited geographic range, or high risk of extinction. This study aimed to quantitatively compare scientific output to species characteristics in order to assess potential bias in research and conservation prioritization. The Felidae and Canidae families were used as case studies, and all peer-reviewed articles that were published between 2013 and 2017 were included. Articles were divided into topics, and research output was compared to species' body size, conservation status, keystone effect, geographic range, and evolutionary distinctiveness. Research allocation varied greatly among species, from zero to 579 publications. Overall, the best predictors for research allocation were body size and keystone effect. No significant correlation was found between research output and the conservation status, geographic range size and evolutionary distinctiveness of species. The average number of publications was the same for felid and canid species ($N = 60$), yet a notable difference was that studies on felids mainly focussed on conservation and wildlife management, whereas canid studies most often involved diseases and other health issues. This study affirms that research effort are not yet focussed on species that need it the most. An attempt should be made to allocate research funds towards species that are understudied, endangered, and taxonomically unique, or have a small geographic range.

1. Introduction

Scientific research in wildlife biology, ecology and management has greatly advanced species conservation, though it is claimed that research allocation not yet matches conservation priorities (Fazey et al., 2005; Lawler et al., 2006). With limited funds available for research and conservation, resources should primarily be focussed on taxa that need it the most (Wilson et al., 2006). Although some consider all species equal, others argue that conservation prioritization should depend on a species' role in the ecosystem, taxonomic distinctiveness, limited geographic range, or high risk of extinction (Restani and Marzluff, 2002; Dickman et al., 2015). Keystone species play an important role in ecosystem functioning and govern the well-being of other species, as such they should be important targets for conservation management (Simberloff, 1998).

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Taxonomic distinctiveness is a measure of how much a species contributes to overall phylogenetic diversity (Dickman et al., 2015). When the focus is to maintain overall genetic diversity across species, a monotypic genus, which consists of only one representative, should receive more conservation and research attention (Isaac et al., 2007; Martín-López et al., 2009). Another argument is that species with a limited distribution should receive more conservation effort because they are more prone to extinction (Payne and Finnegan, 2007; Pimm et al., 2014). In an attempt to rank species for effective conservation prioritization, an EDGE (Evolutionary Distinct and Globally Threatened) metric has been developed, which incorporates the evolutionary history as well as extinction risk of species (Gumbs et al., 2018).

In reality, prioritization schemes are often little related to conservation need. To begin with, there is a research-implementation gap in which scientific research does not primarily aim to assist in conservation management (Knight et al., 2008). For instance, research funding is often allocated to species that are of economic benefit or concern to humans, instead to species that are threatened with extinction (Restani and Marzluff, 2002). Furthermore, local governance and economic wealth are major determinants for the conservation likelihood of species (Dickman et al., 2015). Countries in which biodiversity is highest or under most threat are generally underrepresented in scientific literature due to deficient funding (Wilson et al., 2016). Foremost, charismatic species with high public appeal generally receive most research and conservation attention, while other species are completely overlooked (Lawler et al., 2006; Brodie, 2009; Dickman et al., 2015; Macdonald et al., 2015).

Carnivores have often received much attention from scientists and conservationists due to their charisma and threatened status globally (Karanth and Chellam, 2009; Dickman et al., 2011; Winterbach et al., 2013). Not all carnivores are charismatic or at risk however, and for many other species the conservation status is largely unknown (Brodie, 2009; Macdonald et al., 2015). Conservation of carnivores is important as they comprise a critical part of our biodiversity and play an important role in ecosystems by regulating numbers of their prey (Berger et al., 2001; Miller et al., 2001; Ostfeld and Holt, 2004). Research is mainly allocated to large carnivores, whilst some species, areas and topics remain severely understudied (Ray et al., 2005; Brodie, 2009; Pérez-Irineo and Santos-Moreno, 2013).

It is important to know what trends occur in scientific research and what factors influence the allocation of funds. This study aimed to quantitatively compare scientific output to species characteristics in order to assess potential bias in research and conservation prioritization. Two families of the order Carnivora were compared for this study, namely the Felidae (hereafter felids; 38 species) and Canidae (hereafter canids; 36 species). These two families were chosen because they are very diverse, and encompass well-studied and charismatic species as well elusive and poorly known species (Dickman et al., 2015). All scientific literature published between 2013 and 2017 was included and categorized into topics and subtopics. Previous studies that have been conducted on research prioritization in carnivore species (Brodie, 2009; Pérez-Irineo and Santos-Moreno, 2013) allow for the inclusion of a temporal trend. Even though the number of peer-reviewed articles does not directly translate to conservation management (Ray et al., 2005; Greggor et al., 2016), it is a valuable indicator of conservation allocation (Clark and May, 2002; Fazey et al., 2005; Lawler et al., 2006; Knight et al., 2008; Wilson et al., 2016).

2. Methodology

2.1. Literature search

Literature searches were conducted in Scopus, EBSCO and Google Scholar to optimize the yield of scientific articles (Wu et al., 2012). While it is possible that these search engines may overlook some relevant articles, it was expected that this risk is equal among species and would therefore be of negligible influence on the results. Common and scientific species names (IUCN, 2017) were used as search strings in the electronic databases, for instance: cheetah OR *Acinoyx jubatus*. All peer-reviewed articles that were published between 2013 and 2017 were included to reflect only recent biases in scientific research. Furthermore, this allowed the inclusion of the latest recognized member of the Felidae family, the southern tigrina *Leopardus guttulus*, described in 2013 (Trigo et al., 2013). Subspecies were not investigated separately in this study, and domesticated animals were excluded. Observational notes or replies to previous publications were also excluded from the database, as well as articles for which no English abstract was available. Articles were listed for species only if the animal in question was the main research topic or among a maximum of three.

2.2. Research topics

All scientific articles were subdivided into the following research topics: (1) ecology and behaviour, (2) conservation and wildlife management, (3) anatomy and physiology, (4) diseases and other health issues, (5) captive housing and artificial reproduction, (6) genetic diversity and phylogenetic structure, and (7) taxonomy and palaeoecology.

Research topics 2 and 6 were suspected to most likely relate to conservation and as such they were further divided into subtopics to allow for a more detailed comparison. 'Conservation and wildlife management' papers were divided into the following subtopics: (a) trophy hunting and illegal poaching, (b) livestock predation and human-wildlife conflict, (c) effects of urbanisation and human disturbance, (d) habitat fragmentation and connectivity, (e) population estimates and threats, (f) management efforts and conservation outcomes, (g) impact of climate change, (h) hybridization with other species, (i) human attitude and traditional beliefs, (j) research methodology, (k) illegal wildlife trade, and (l) impact as an invasive species. 'Genetic diversity and phylogenetic structure' papers were divided into the following subtopics: (m) habitat connectivity and