



On the overlap between scientific and societal taxonomic attentions – Insights for conservation



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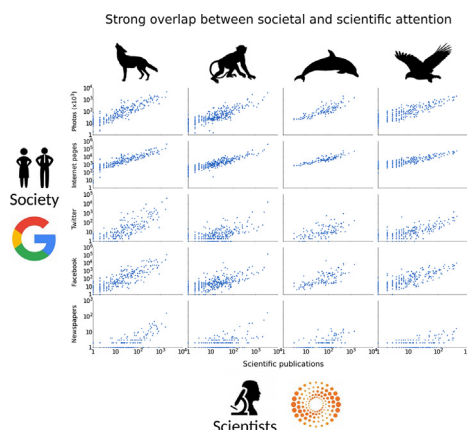
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HIGHLIGHTS

- High concordance revealed between scientific and societal taxonomic attention.
- Overlap was consistent among assessed species groups and online media sources.
- Top-ranked species by societal and scientific focus overlapped in all groups.
- Science is connected with societal interests but with potential to generate new ones.

GRAPHICAL ABSTRACT



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ABSTRACT

Attention directed at different species by society and science is particularly relevant within the field of conservation, as societal preferences will strongly impact support for conservation initiatives and their success. Here, we assess the association between societal and research interests in four charismatic and threatened species groups, derived from a range of different online sources and social media platforms as well as scientific publications. We found a high level of concordance between scientific and societal taxonomic attention, which was consistent among assessed species groups and media sources. Results indicate that research is apparently not as disconnected from the interests of society as it is often reproached, and that societal support for current research objectives should be adequate. While the high degree of similarity between scientific and societal interest is both striking and satisfying, the dissimilarities are also interesting, as new scientific findings may constitute a constant source of novel interest for the society. In that respect, additional efforts will be necessary to draw scientific and societal focus towards less charismatic species that are in urgent need of research and conservation attention.

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1. Introduction

Species receive uneven attention in terms of scientific research (Clark and May, 2002; Proenca et al., 2008; De Lima et al., 2011; Murray et al., 2015; Donaldson et al., 2016; Fleming and Bateman, 2016). This uneven scientific focus is driven by diverse factors, such as geographic location, species accessibility, suitability for use as model species, conservation status, and researchers' own personal interests (Jarić et al., 2015). Society, however, can also influence research focus through policy and funding agendas, while science in turn influences societal attention through scientific communication and media representation. Contrastingly, choices of studied species are sometimes criticized as leading to a waste of societal resources when they do not appear to match the immediate interest of taxpayers.

Based on the main drivers of societal and scientific taxonomic attention identified so far in the literature, we suggest that there are at least three general categories of drivers of societal and scientific taxonomic attention: 1) intrinsic, species-related factors, which can also be considered as elements of species charisma, 2) population-level or spatial factors, and 3) socio-economic factors. Major intrinsic factors include body size, unique morphology, distinctive coloration patterns, anthropomorphism, behavior, social structure and neotenic features (Moustakas and Karakassis, 2005; Stokes, 2007; Wilson et al., 2007; Martín-Forés et al., 2013; Žmihorski et al., 2013; Kim et al., 2014). Other recognized proxies for scientific and societal taxonomic preferences are phylogenetic distance from humans and structural complexity (Proenca et al., 2008; Martín-López et al., 2011; Martín-Forés et al., 2013), although both are associated with already listed factors such as anthropomorphism and body size. Population-level or spatial factors include abundance, range size, range proximity to or overlap with developed nations, extinction risk, and habitat accessibility (Wilson et al., 2007; Brooks et al., 2008; Sitas et al., 2009; Trimble and van Aarde, 2010; Fisher et al., 2011; Žmihorski et al., 2013; Dos Santos et al., 2015; Jarić et al., 2015; Zhang et al., 2015). Socio-economic factors are represented by the species economic value (e.g. as an object of trade or tourism), its pest status, potential threat to humans (e.g. venomous or aggressive species), presence of key ecological values or ecosystem services, and various cultural values (i.e. traditional, religious, etc.) (Moustakas and Karakassis, 2005; Wilson et al., 2007; Proenca et al., 2008; Jarić et al., 2015; Zhang et al., 2015; Donaldson et al., 2016; Roll et al., 2016).

While previous research has addressed the factors underlying uneven taxonomic attention, the actual level of overlap between societal and scientific attention has been poorly quantified. In the current information age, society has access to and produces much more content than any previous generation. Due to the sheer amount of accessible information, it becomes necessary to make choices regarding the attention scope. Consequently, it may be interesting to compare the species chosen by scientists and by the rest of the society. This question was previously addressed in the seminal work of Wilson et al. (2007), however this was based on a rather limited sample. While it has not received further attention so far, this issue remains highly relevant, particularly within the field of conservation biology. As stated by Stokes (2007), societal preferences are just as important for the success of conservation efforts and survival of many endangered species as are common ecological determinants, such as minimum population size and habitat requirements. Societal preferences can play a wide range of roles. People express their views and interests using various widespread media, and not all have the opportunity to express their interest in a more active way, such as engagement in conservation non-profit organizations. Societal attention towards particular species can be beneficial if it helps society to understand the need for conservation action and to support it. Approaches that aim to attract societal attention towards conservation goals, such as flagship species concept, have proven to be successful in attracting societal support and funding (Verissimo et al., 2011; Verissimo et al., 2017). On the other hand, increased attention might sometimes lead people to exert increasing negative pressure on the

species they are interested in, akin to the Anthropogenic Allee Effect (Courchamp et al., 2006), or alternatively to contest actions against invasive alien species (Courchamp et al., 2017).

Here we take advantage of emerging culturomic techniques (Michel et al., 2011; Ladle et al., 2016; Sutherland et al., 2018) to assess the similarities and differences in the societal and scientific interests in different species, based on scientific publications and a range of different online sources and social media. We assessed the relationship between the scientific and societal taxonomic attention within four species groups that predominantly consist of charismatic and threatened animals: carnivorans, primates, marine mammals and birds of prey. We discuss the drivers of observed relationships and overlaps, and address their implications for conservation planning and management.

2. Methods

Data retrieval was based on the approach proposed by Jarić et al. (2016) and Correia et al. (2017). Species lists, comprising diurnal birds of prey (orders Accipitriformes, Falconiformes and Cathartiformes), Carnivora, Primates and marine mammals (cetaceans and pinnipeds), were obtained from the IUCN Red List database (IUCN, 2017). Extinct species and those described after 1995 were excluded from the analysis, which resulted in a total of 1058 species in the dataset (318 birds of prey, 252 carnivorans, 370 primates and 118 marine mammals). Search of scientific publications and online media sources was conducted by using both species scientific names and scientific synonyms, each placed in parentheses, within a same search query (i.e., ["species name" OR "synonym #1" OR "synonym #2" OR ...]). This resolved the problem of potential double entries, and the results were thus expressed as the number of unique records per species. Scientific names represent a reliable proxy and preferable alternative to vernacular names, due to a strong and culturally independent association between their representation in digital corpora (Jarić et al., 2016; Correia et al., 2017, 2018). At the same time, search based on scientific names avoids numerous problems related to vernacular language, such as frequent vernacular synonyms and homonyms (Roll et al., 2018), differing names among languages, as well as lack of vernacular names for some species (Jarić et al., 2016). Accounting for taxonomic synonyms is also critical, as they can strongly affect the accuracy of species data retrieval (Correia et al., 2018).

Research attention was defined as the number of scientific articles indexed within the Web of Knowledge (available at www.isiknowledge.com) for a given species. The search was conducted within titles, abstracts, and keywords of referenced publications published during 1996–2016. Keywords that are automatically assigned by the Web of Knowledge (i.e. Keywords Plus) were not considered in the analysis, due to their low reliability (Wilson et al., 2007; Fisher et al., 2011).

Media coverage for each species was estimated based on the following five online sources: Internet pages containing the species name, online articles in selected major international newspapers (The New York Times, The Guardian, Le Monde, Washington Post, and Asahi Shimbun), Twitter, Facebook, and pictures posted on the Internet for each of the studied species (Jarić et al., 2016). Media coverage data collection was performed in line with the approach by Correia et al. (2017), by using the Google's Custom Search Engine API. Searches were carried out during June 2017, with search queries for each of the online sources based on Jarić et al. (2016): 1) Internet pages – ["species name"], 2) Twitter – ["species name" site:twitter.com], 3) Facebook – ["species name" site:facebook.com], 4) Newspapers – ["species name" (site:nytimes.com OR site:theguardian.com OR site:lemonde.fr OR site:washingtonpost.com OR site:asahi.com)], and 5) Photographs – ["species name" (filetype:png OR filetype:jpg OR filetype:jpeg OR filetype:bmp OR filetype:gif OR filetype:tif OR filetype:tiff)].

The resulting dataset features the number of records per species and per assessed sources. Since the variables were not normally distributed (Kolmogorov-Smirnov test, $p < 0.001$), nonparametric tests were applied. Relationship between the number of scientific publications and

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