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The problem of subspecies and biased taxonomy in conservation lists: the case of mammals

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A b s t r a c t . The scientific and political communities must be aware of our bias in the knowledge of the taxonomy of the various living organisms. Although the effects of species concepts on conservation have received considerable attention, usage of the subspecies category in conservation lists have received insufficient scientific scrutiny, at least for most taxonomic groups and geographic regions. Here we draw from the class Mammalia to show that discrepancies in the inclusion of subspecies in the IUCN Red List often reflect uneven taxonomic knowledge and the differential scientific and public interest raised by different kinds of mammals, which together can produce a biased picture of mammalian endangerment worldwide.

Key words: biodiversity, mammals, IUCN Red List, subspecies

Introduction

International agreements, such as the Convention on Biological Diversity (CBD), advocate a 'significant reduction' in biodiversity loss by 2010. Despite the broad definition of biodiversity adopted by the CBD, taxonomic entities at the species level are usually the preferred target of conservation policies and biodiversity monitoring programmes (P e r e i r a & C o o p e r 2006).

Yet one influential review has recently argued that ideally "whether the mountain gorilla *Gorilla gorilla beringei* is classified as a species, subspecies or local population" should make little difference to conservationists (I s a a c et al. 2004). These seemingly conflicting views on conservation targets are probably borne of the diversity of aims and practices in the conservation movement as well as the astonishing variety of different living organisms involved. However, given the simple fact that resources available for biological conservation are finite (M a s t e r 1991), and our knowledge of biodiversity around the planet is limited and biased (W i l s o n 2000), it is imperative to continue discussions regarding which levels of taxonomic distinctness are most worth conserving and how resources might be allocated accordingly.

Subspecies in conservation assessments

Current recognition of species, subspecies and population-level variability within taxa reflects the level of refinement of our knowledge of the biology and systematics of different groups of organisms. Better-known, highly charismatic taxa are more commonly subdivided taxonomically, both among mammals (e.g. W a n et al. 2005) and non-mammals

(R u s s e l l o et al. 2005), for various reasons, both scientific and otherwise. For example, cases of species recognition driven by political and economical considerations more than biological reasons have been reported (e.g. K a r l & B o w e n 1999). In some cases lesser taxonomic categories, such as subspecies and populations are recognized as important conservation foci (O ' B r i e n & M a y r 1991); even cultural diversity can be the target of conservation planning, as in the case of the western chimpanzee *Pan troglodytes verus* (K o r m o s et al. 2003). Well-studied and highly charismatic species, such as African apes or big cats, may receive a larger amount of conservation attention and funds when they are found to consist of several taxonomic distinct populations, some of which consist of only a few hundred individuals (S t a n f o r d 2001, O a t e s 2006, K i t c h e n e r et al. 2006). Still, even within such a high-interest taxonomic group as the primates, some subspecies may escape IUCN categorization even if the little available information indicates a pessimistic scenario (i.e. *Cercopithecus mitis mitis* from Angola, cf. K i n g d o n 1997 or *Cercopithecus albogularis zammaranoi* from Somalia, cf. G i p p o l i t i 2006). It is clear that little-known (particularly subspecific) taxa can easily be neglected in conservation assessments if they lack a 'scientific lobby' interested in studying and protecting them. An end result of this situation could be that researchers' interests will drive conservation priorities and not *vice versa* as we suggest should be the case.

In our opinion, consequences of differences in attitude and knowledge about intraspecific taxonomy in the allocation of conservation funding have been insufficiently explored in the conservation biology literature. In this review, we analysed the IUCN Red List (IUCN 2004) to investigate patterns of conservation assessment for mammalian subspecies. The 2004 IUCN Red List includes 2209 species and 718 subspecies among the evaluated mammal taxa (Categories EX, EW, CR, EN, VU, LR/cd, NT, DD) apart from those classified as LC (Least Concern). Of the 26 mammalian orders (W i l s o n & R e e d e r 2005), 12 have subspecies recognized in the list. The order Primates has the highest number of subspecies listed (229) while orders such as Chiroptera and Insectivora have none. Perissodactyla has most of its recognised subspecific taxa (28) included, while no subspecies of elephants (order Proboscidea) are listed despite the strong phylogeographic structure found in the living species (F l e i s c h e r et al. 2001, E g g e r t et al. 2002, F e r n a n d o et al. 2003). Geographically, North America is the region with the greatest number of recognized subspecies on the Red List (179). This geographic bias is indicated best amongst rodents, where 151 out of 164 rodent subspecies recognized in the Red List (92 %) are from North America. Similarly, Australia has 50 listed subspecies (mostly marsupials) compared to only one in neighboring Papua New Guinea. There is little doubt that such biases reflect the uneven knowledge of biodiversity in some areas of the planet. Clearly, these taxonomic categories may also correspond to particular national priorities, political concerns, and legislation, such as the Endangered Species Act in the United States (H a i g et al. 2006). It seems that current taxonomic knowledge does not allow for confident recognition of subspecies in conservation lists for most mammals, for instance among Chiroptera and Rodentia outside North America, in which species and subspecies diversity is undoubtedly underestimated substantially in current classifications (e.g. C o t t e r i l l 2002, A m o r i & G i p p o l i t i 2003, J e n k i n s et al. 2004, M u s s e r & C a r l e t o n 2005). Interestingly, while the Primates provide a prime example of 'taxonomic inflation' (in which many former subspecies have recently been raised to the species level) according to I s a a c et al. (2004) (cf. G r o v e s 2001, 2005), this order still has the highest number of recognized subspecies in the 2004 IUCN Red List, a fact confirmed in the 2006 Red List (IUCN 2006).

A serious complication thus emerges from the fact that authoritative reference works listing recognized species, even for well-known groups such as mammals, usually say nothing about valid subspecies (although this has been partially corrected in Wilson & Reeder 2005). This implies that while conservation assessments by IUCN is obligatory for species, the inclusion of subspecies depends on the attitude and knowledge of specialists on different taxa in different regions. Given the intent to make the IUCN Red List a quantitative and comprehensive indicator of biodiversity status worldwide (Rodrigues et al. 2006), it seems appropriate that the subspecies category should be utilised with greater consistency among taxa and geographic regions. Otherwise, the IUCN Red List may inadvertently justify disproportionate resources being directed toward study and conservation of slightly differentiated populations belonging to well-studied and highly charismatic large-bodied species, such as tigers *Panthera tigris* (Cracraft et al. 1998, Luo et al. 2004), while the nature and severity of conservation threats among the majority of organisms in most parts of the world, including most small mammals (Brito 2004, Amori et al. 2007), remain unknown and undefended. In fact, while the taxonomic validity of many described subspecies is regularly questioned (e.g. for birds; Zink 2004), there is mounting evidence that an astounding amount of taxonomic diversity among mammals has been overlooked; many recognised subspecies may deserve to be considered full species according to evolutionary species concepts (Cotteril 2005, Baker & Bradley 2006) and many clearly distinct taxa remain undescribed (e.g. Musser & Carleton 2005). As a case in point, we highlight the conservation status of eastern populations of the European beaver *Castor fiber*, whose genetic distinctiveness has been only recently established while some of these 'subspecies' have been reduced to a few tens or hundreds of individuals threatened by *Castor* populations introduced from other regions (Durka et al. 2005). It should also be noted that of the 787 species newly recognized in the latest edition of the Mammal checklist (Wilson & Reeder 2005), 260 are newly described while 527 (nearly 10% of all mammal species) represent taxa formerly considered synonyms or subspecies. This revised checklist offers us the opportunity to highlight exemplary taxonomic changes in particular groups. For example, the chiropteran family Pteropodidae is a moderately diverse family within a speciose mammal order that has been previously assessed by IUCN only at the species level. The number of recognised species has been raised by twenty since the last edition of the 1993, reaching a total of 186 valid species. Only six however represent new discoveries, meaning that 14 specific names have been raised from synonymy to the species level. Simmons (2005) also recognise 143 valid subspecies, almost doubling the number of taxa recognised in the family. We can easily speculate that consideration of these many additional taxa in conservation assessment coupled with rapid ongoing taxonomic status changes (e.g. Helgen 2005), will importantly influence overall impressions of the number of threatened taxa and the degree of threat within the Pteropodidae. But it remains unknown to what extent similar future changes will influence geographic priority-setting or estimates of species vulnerability or extinction rates among mammals, which often utilise present checklists and IUCN Red List for their analyses (i.e. Cardillo et al. 2005, Ceballos et al. 2005).

In according with the precautionary principle, we suggest that it should be advisable, at the moment, to pay greater attention to mammal subspecies especially in poorly known orders and families, exactly the contrary of what is usually done, even if this may create hot debates (e.g. Ramey et al. 2005, Vignieri et al. 2006).

Monitoring the status of biodiversity on the planet, even of the small most well-known part constituted by vertebrates, is hampered by our limited taxonomic knowledge and

controversies over species concepts (H e y et al. 2003). We should thus be careful that current attempts to census and assess biodiversity for conservation do not distract societies from the need to increase and expedite taxonomic research as the only serious basis for conservation policies.

On the other hand, conservation organizations are requested to seriously consider all measures to make conservation assessments and projects the less influenced possible by economic, political and moral bias. Perhaps, they should create adequate tools to direct more attention and resources toward the study of neglected taxa and geographical regions.

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