



The informative nature of unexpected results: reply to Tellería and Yapu-Alcázar

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Introduction

Predictive modeling in conservation science is a powerful tool to inform decision making, especially when data are scarce. Predictions offer an opportunity to develop proactive strategies that may alleviate pressures on species (Cardillo & Meijard 2012). On such grounds, we advanced the most likely population trends of poorly known species of Bolivian mammals as an input to setting conservation priorities (Peñaranda & Simonetti 2015). Tellería and Yapu-Alcázar (2016) qualify some outcomes of our trait-based models as “drawbacks” (Tellería & Yapu-Alcázar) and suggest that they may lead to sub-optimal resource allocation when setting conservation priorities. We welcome criticisms but believe those of Tellería and Yapu-Alcázar arise from a misunderstanding of the modeling approach we used and our results and conclusions. Further, they appear uncomfortable with our unexpected results because our results “do not agree with theoretical expectations” or with “what is apparent for the species” we studied. Here, we address Tellería and Yapu-Alcázar’s misinterpretations and call for thought on the application of conventional wisdom in ecology and species conservation.

Misinterpretations

Tellería and Yapu-Alcázar assert that we reclassified the population trends of 22% of all Bolivian mammals. This is not correct. Rather, our trait-based analysis shows that 22% of the species we considered in our study sample are expected to have population trajectories different from what is known. That is, we expect the trajectories of 41 rather than 86 species to differ.

Tellería and Yapu-Alcázar state that our reclassification of the vicuña (*Vicugna vicugna*) as a declining species (i.e., relatively high risk of extinction) is inaccurate because the species was removed from the Bolivian Red List

due to its current abundance (Tarifa & Aguirre 2009). This contention stems from a misunderstanding of the analysis. Our trait-based predictive model of the risk of decline aims to elucidate the intrinsic biological vulnerability of a species in the absence of conservation actions rather than to reclassify species’ conservation status. Vicuña populations have recovered from near extinction in the 1960s due to long-term management (Tarifa & Aguirre 2009; MMAyA 2012). This recovery is largely due to populations inside protected areas; however, illegal hunting is still a threat, particularly outside parks and reserves (Lichtenstein & Vilá 2003). Counterfactual analyses reveal that conservation actions improve the status of species under management, especially ungulates (Hoffmann et al. 2010, 2015). Absence of current multinational, targeted conservation efforts would result in the species being classified as threatened, as it was in the 1960s (Lichtenstein et al. 2008). Hence, classifying the vicuña as a declining species is correct because its current status inside protected areas is management dependent (Hoffmann et al. 2015). This fact could result in vicuñas being classified as near threatened (Mace et al. 2008).

Tellería and Yapu-Alcázar claim that we reclassified the Andean fox (*Lycalopex culpaeus*) as a declining species, which we did not. In fact, we used data on the Andean fox among other species to train our predictive model. Hence, the fox was excluded from the classification process (Supporting Information in Peñaranda & Simonetti [2015]). The declining status of this species in Bolivia was proposed by local scientists and managers in the national workshop for the categorization of the Bolivian threatened vertebrates (Tarifa & Aguirre 2009).

Informative Nature of Unexpected Results

Tellería and Yapu-Alcázar further claim that the Andean fox is unlikely to be declining because it is regarded as a habitat generalist. Unfortunately, while habitat loss and

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transformation may not be a threat to the Andean fox, it is primarily threatened by persecution. Retaliatory killing to reduce predation on domestic animals reduces their population size (Ripple et al. 2014). In fact, extinction risk due to persecution is not related to the degree of habitat specialization but to large body size (Owens & Bennett 2000), which is the case for the Andean fox. As advanced by local scientists and managers, Andean fox populations from the highlands and the Inter-Andean dry valleys are diminishing mainly due to hunting (e.g., Romero-Muñoz & Perez-Zubieta 2008) and persecution to reduce livestock predation (Wallace et al. 2010). Andean foxes also appear to be negatively affected by feral dogs (Aliaga-Rossel et al. 2012). If hunting is reduced, Andean fox populations usually recover rapidly (Jiménez et al. 2008).

For widely distributed species such as the Andean fox, vulnerability may not be evident because significant changes in population or geographic distribution may occur slowly and be difficult to detect (Collen et al. 2011). Frequently, the decline of common species may be so slow that it goes unrecognized by listing bodies such as the International Union for Conservation of Nature (IUCN). For example, the IUCN lists the carnivores *Nasua nasua* (Emmons & Helgen 2008), *Leopardus pardalis* (Paviolo et al. 2015), and *Puma concolor* (Nielsen et al. 2015) in the Neotropics as of least concern, despite that their populations are declining. The potential risk of decline of common or widely distributed species should not be neglected or underestimated (Gaston & Fuller 2007; Gaston 2010).

Unlike Tellería and Yapu-Alcázar, who argue that the species most likely to decline are ecological generalists, we did not mention generalists sensu lato; rather, we pointed out that diet generalization appears to be associated with high risk of decline, especially among small- and medium-sized mammals (figure 4 in Peñaranda & Simonetti [2015]). The threatening factor for these species is not food supply but hunting or persecution.

Overall, a common factor behind Tellería and Yapu-Alcázar's perspective is their discomfort with unexpected results, such as some habitat or diet generalist species exhibiting a higher risk of decline than some specialist species (see Pimm [1991] for other unexpected findings such as a high risk of decline in small-bodied, fast-growing species). To protect Bolivian mammals, or any taxon in any region, robust proposals to inform management decision making must be developed. To advance hypotheses regarding the status of species for which data are largely unavailable, reliance on trait-based models developed with data from known species is a potent approach, where unexpected results may be critically informative and lead to questioning of the status quo of current assessments and perhaps to attention and conservation action for species that otherwise would have been neglected.

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