Comment

Translating large-scale prioritization models for vultures to local-scale decision making

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Introduction

Santangeli et al. (2019) present an extensive analysis that aims to answer one of the most important questions in conservation: where should we target conservation efforts? They try to answer this question of resource allocation for Old World vulture conservation, a group of species of great importance because of their unique functional role in most ecosystems, significance to many human cultures, and recent rapid decline worldwide (Markandya et al. 2008; Ogada et al. 2012; O’Bryan et al. 2018). A prioritization map for the conservation of Old World vultures could assist ongoing conservation efforts directed at halting, and even reversing, these species declines internationally. Furthermore, as demonstrated by the authors, a global analysis is important for this group because of the shared threats throughout most of its global distribution. For these reasons, we highly appreciate Santangeli et al.’s work, and believe it is of great importance to the conservation of Old World vultures. However, such large-scale analyses typically require generalizations that exclude relevant data for smaller scale conservation efforts. We believe it is of crucial importance to be aware of the assumptions and limitations of such generalizations when attempting to implement large-scale prioritization maps at the local scale.

We acknowledge that “all models are wrong, some are useful” (Box 1979) and that when performing large-scale analyses, it is impossible to consider all factors that are relevant for the entire region (Mouquet et al. 2015). Therefore, our goal is not to look for flaws in the original model, but rather to complement it with notes regarding important factors that should be considered at the local scale. We used scientific evidence from throughout the range of Old World vultures as examples of important information that was not used by Santangeli et al. and could affect local-scale conservation efforts of these species.

Long-Range Movements

Santangeli et al. modeled prioritization according to breeding and resident ranges and ignored areas vultures use outside their regular ranges. For some species, this may be a negligible area because at a large spatiotemporal scale many Old World vultures probably can be found in their resident and breeding home range. However, conservation at the local scale may be impaired by ignoring areas in which vultures are found only during long-range movements. Some vulture species migrate long distances, especially before reaching adulthood, and most tend to move through large areas outside what is usually referred to as their resident distribution (Mundy et al. 1992). Long-range movements such as migration and dispersal are critical stages for the survival of individuals; thus, such periods of movement may have a disproportionate effect on long-term population viability through direct mortality events and carryover effects (Klaassen et al. 2014; Marra et al. 2015; Oppel et al. 2015).

Large numbers of both Egyptian (Neophron percnopterus) and Griffon (Gyps fulvus) vultures migrate through parts of the Middle East and North and West Africa that were not included in the analysis (Mundy et al. 1992; Camiña 2004; Phipps et al. 2019).

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Additionally, vultures may move large distances away from their resident range regularly, for example, Cinereous Vulture (*Aegypius monachus*) in East Asia, the Caucasus, and Turkey (Gavashelishvili et al. 2012; Yamaç & Bilgin 2012; Kang et al. 2019); Ruppell’s Vulture (*Gyps rueppelli*) in North Africa and the Iberian Peninsula (Ramírez et al. 2011); Lappet-faced (*Torgos tracheliotus*) and White-backed (*Gyps africanus*) Vultures in southern Africa; and Griffon Vulture in the Middle East (Spiegel et al. 2015). These long-range movements often end far from the breeding range. For example, the Middle East is the winter residence of juvenile and immature Griffon and Cinereous Vultures originating from a large breeding range that extends from the Balkans to the Caucasus (O.H., personal observation). Considering long-range movements can have a significant effect at the local scale when one prioritizes the conservation of vultures in areas that may not have been included in a large-scale model because no vulture species breed there.

**Inaccuracy of Large Data Sets**

The use of large data sets and global analyses is an increasing and positive trend in science. However, in conservation there is often a large gap between acquired knowledge and its dissemination in the field, and large data sets are often biased toward areas with better data availability (Sutherland et al. 2004). We considered a few examples of missing data that resulted from the simplifications required for large-scale analyses but are vital for local-scale conservation planning. Although these and other examples can theoretically be randomly distributed and thus may not affect a large-scale model, any small-scale variation can have significant effects for local conservation priorities.

First, the distribution maps Santangeli et al. used are coarse, whereas local distribution maps can provide greater accuracy for the relevant prioritization areas. For example, Griffon and Egyptian Vultures’ breeding and resident ranges in the Middle East (Mayrose et al. 2017) are larger than the range presented by Santangeli et al. Second, they calculated the threat of poisoning based on livestock densities and carnivore presence, whereas more fine-scale factors that actually determine conflict and the use of poison in conflict resolution should be considered at a local scale. For example, socioeconomic level and the existence of protected areas influence the probability of poisoning in Spain (Mateo-Tomás et al. 2012). Third, the wind turbine potential map Santangeli et al. used is based on a simplistic model derived from wind measurements that allows a generalization to fit a global model (Pogson et al. 2013). However, many other factors not related to wind conditions are also considered when planning wind farms at the local scale, such as population density (Lu & McElroy 2017), cultural, political, or financial incentives (Sturje et al. 2014; González et al. 2016), and ecological challenges (Katzner et al. 2019). Finally, the assumption that vultures are safe in protected areas should be made with care because the ability of these areas to protect animals varies at a local scale. For example, substantial declines in vulture populations were observed in protected areas in East and West Africa (Ogada et al. 2016). We suggest that assuming protected areas are safe for vultures should be done only following an analysis of the actual threats for vultures in each of these areas and after determining whether the protected status of the area effectively alleviates these threats.

**Summary**

In the face of the dramatic decline of Old World vultures, the effort made by Santangeli et al. is an important and impressive first step toward global prioritization efforts. However, we believe that implementing the results of such large-scale analyses should be done with caution (Mouquet et al. 2015). Specifically, we call on stakeholders and decision makers who wish to conserve their local vulture populations to consider not only the results of large-scaled generalized models, but also data that are available for their area. We hope that the examples we provided clarify the potential importance of local data in changing the required investment in vulture conservation locally and that it will encourage more fine-scale research of different vulture populations. Finally, the promising new trend of large-scale collaborations to incorporate data from many resources (Phipps et al. 2019) will surely allow for more accurate models to be produced in the near future.

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**Literature Cited**


