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commentary

The potential impact of land-use change on climate-driven animal migrations

Historically, many animals responded to changes in climate by migrating to new habitats in which they could survive. Today, a substantial number of species are expected to similarly alter their distributions in response to contemporary climate change (Botkin et al. 2007, Bellard et al. 2012). While some animals have already begun to shift their ranges (Walther et al. 2002), a recent manuscript by Lawler et al. (2013) identifies one of the key challenges facing these animals as they migrate.

Lawler et al. (2013) highlight the challenges that an animal may face as they attempt to track changing climates through a landscape that has been dramatically altered by human land-use. The authors analyze the potential for 2,903 species of amphibians, birds, and mammals in the western hemisphere to migrate to new habitats using 10 future climate-change projections. Because of the large number of species they analyzed, the authors utilized a course-resolution (50 km x 50 km grid cells) at which to map species ranges and their responses to climatic changes. Noting this resolution is important because recent research has suggested that coarse-scale analyses may actually overestimate the areas that species occupy (Hurlbert and Jetz 2007, Jetz et al. 2007) and in the case of climate change may have variable results in predicting their responses to shifting conditions. In this analysis, the author's address the issue to a degree and concur that finer-scale resolutions could provide more details about the specific migration routes that species may utilize in the future. However, they also suggest that the true benefit of this kind of study is to provide a continental perspective and to identify larger areas that many species may use as corridors in the future.

Using this continental-scale approach, the analyses conducted by the authors suggest two main things. First, nearly all of the species they analyzed were constrained in some manner by human land-use change. Second, and perhaps more importantly, the impact of land-use change on animal migration varied geographically and would likely disproportionately affect some taxa. In particular, they highlight the Atlantic Forests of Brazil and the southeastern United States as areas that will have substantial animal movements in response to climate change, but may be significantly constrained by land use change and development in the near future. It is important to note that recent papers have also suggested that the Atlantic Forests of Brazil (long considered a biodiversity hotspot) may be at risk from both development and climate change (Colombo and Joly 2010, Loiselle et al. 2010). However, an important caveat of the idea that this may be a migration hotspot is that the distribution of many South American taxa are not well documented (Jetz et al. 2012) and thus the climates in which they are known to persist may not accurately predict all of their future distribution.

The authors are not the first to suggest that human-domination of natural landscapes and changes in the availability of migration corridors may impact the survival of species in response to climate change (Jetz et al. 2007, Early and Sax 2011, Theobald et al. 2012). However, this study was one of the first to provide detailed locations for geographic regions of the world in which large numbers of animal taxa are expected to migrate. As is pointed out by Lawler et al. (2013) and a number of others (Peñuelas and Filella 2001, Wilcove and Wikelski 2008, Theobald et al. 2012), identifying these key regions may help nations around the world to develop complex conservation plans that may facilitate the survival of a variety of animal species in response to contemporary climate change. Furthermore, this work is likely to spark new questions about whether climate conservation efforts should focus on species-specific or larger-scale approaches.

Ultimately, Lawler et al. (2013) provides evidence for yet another threat that species may face in their responses to future climatic changes.

What is yet to be determined however, is how important land-use change may be relative to some of the other known factors that mediate species' responses to climate change including: phenological mismatches (Edwards and Richardson 2004) or increasing phenological isolation (Franks and Weis 2009, Heard et al. 2012), changes in biotic interactions (Araújo et al. 2011, Blois et al. 2013), potential lag-times in species' range shifts (LaSorte and Jetz 2012), and species' differential sensitivities to specific climate changes (Voigt et al. 2003, Middleton et al. 2013).

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