

Loss assessment: Amphibians of the Western Hemisphere

NOWHERE TO RUN, NOWHERE TO HIDE. AS CLIMATE change raises the surface temperatures of lakes, ponds, and streams and alters the seasonal precipitation of adjacent land-masses, a class of animal that relies on freshwater habitats—amphibians—is intensely threatened. Because of their physiological sensitivity to temperature, water-permeable skin, and migration and breeding behavior tied to precipitation patterns, amphibians,

according to Lawler et al. (2010), are likely to be “highly sensitive” to climatic shifts toward warmer, drier regimes in freshwater ecosystems.

Amphibians occur in three orders: anurans (frogs and toads), caudates (newts and salamanders), and the lesser-known gymnophonia (caecilians), and their numbers already are reported to be suffering. The International Union for Conservation of Nature lists more than 32% of the world’s amphibians as vulnerable, endangered, or critically endangered. Also, estimates suggest that 122 species have gone extinct since 1980. The leading cause of these population declines is generally considered to be habitat loss. But before a prognosis can be given, the question must be asked: Where does it hurt the most? By zeroing in on the geographic vulnerability of amphibians relative to climate change, the authors provide broad-scale guidance for directing conservation efforts.

Using bioclimatic models, species distribution data, and future climate change simulations, the authors map areas in the Western Hemisphere where amphibians are “particularly likely to be affected by climate change.” Bioclimatic models provide a general indication of future climate-driven shifts in amphibian habitats. The scientists ran 20 future climate simulations based on 37 bioclimatic variables, including scenarios for low and high amounts of greenhouse gas emissions, to determine changes in temperature and precipitation. These model simulations were then overlaid with the distributions of 1,099 amphibian species that could not be modeled accurately because of their limited ranges.

Collectively, future climate changes projected by the authors showed that amphibian species in the Western Hemisphere exhibited larger range contractions than range expansions. A net loss in total range area was projected for 85% of all species. Specifically, species turnover—the percentage change in species in an area—will be highest in the Andes Mountains and parts of Central America and Mexico. Also, much of Mexico, and Central and South America were projected to experience decreases in precipitation in at least one season, with likely consequences for amphibians. Most of the 79 ecoregions modeled were projected to experience at least a 30% turnover in amphibian species. In the eastern United States, a 50% turnover was projected. A minor finding of the study is that range increases may occur for a few species, presumably because warmer areas may be suitable where the environment had heretofore been too cold.

The authors translate this information into management strategies based on the likelihood of range contractions and expansions and the relative sizes of each. For most species (where range contractions are likely to be larger than range expansions), simply focusing on preserving the populations in areas that are projected to

experience less change may be an option. For species with limited dispersal capabilities, small populations, or where range contractions and expansions are likely to be large, translocations to new habitat may be necessary.

Disease is another factor that affects amphibians and works in tandem with climate change, though the interactions are complex. Additionally, climate change may result in the movement of amphibian predators, prey, and competitors, affecting the suitability of any given habitat. Unfortunately for amphibians, the hits will keep coming.

It is worth noting, however, that bioclimatic models have a number of limitations. They cannot account for pure adaptability of species, which can lead to overestimating range shifts. Plus, they are only as good as the data. In this application, the data reflect known niches of amphibians and may miss areas that could be habitable. Also, species that have been extirpated locally because of factors other than climate change are not represented. These factors and other biotic interactions that are not considered could have a large effect. Thus, while they can provide broad approximations of climatic effects, models “cannot necessarily accurately predict the future location of a given species,” according to the authors.

Despite these limitations, Lawler et al. (2010) argue that the results of their study demonstrate that over the coming century there will be major shifts in the various ranges of amphibians. These results provide a solid case for increasing analyses of range shifts and other complementary evaluations, such as scenarios for precipitation change and greenhouse gas emissions.

Reference

Lawler, J. J., S. L. Shafer, B. A. Bancroft, and A. R. Blaustein. 2010. Projected climate impacts for the amphibians of the Western Hemisphere. *Conservation Biology* 24(1):38–50.

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