Understanding the Role of Climate Change and Land Use Modifications in Facilitating Pathogen Invasions and Declines of Ectotherms

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Invasive parasites of humans and wildlife are arising at an unprecedented rate and are debilitating our ecosystems. For instance, pathogens have been implicated in many amphibian declines that are triggering state changes and impairing ecosystem functions. Climate change and land use modifications might elicit disease emergence, but few generalizations have materialized for how these factors facilitate parasite invasions. The investigators recently documented immunosuppression in amphibians associated with agrochemical exposure and temporal climatic variability, stimulating the agrochemical spread and climatic variability hypotheses. These hypotheses predict that proximity to agriculture (a global land-use modification) and elevated temporal variability in temperature (due to climate change), respectively, compromise host immunity and facilitate parasite invasions. In preliminary work, both temperature increases and decreases caused suboptimal immunity, but drastic seasonal drops in temperature caused the longest periods of suboptimal immunity, stimulating the hypothesis that cold-tolerant parasites will benefit most from elevated climatic variability driven by global climate change. The investigators propose to test these hypotheses on multiple parasites and ectothermic taxa, but intentionally focus on the invasive *Batrachochytrium dendrobatidis* and amphibians because this emerging chytrid fungus is cold-tolerant and implicated in many of the global amphibian declines.

The investigators will test these hypotheses by: (1) examining whether the timing of apparently disease-induced amphibian extinctions in Central and South America are related to climatic variability, proximity to agriculture, or alternative factors; (2) testing whether the distribution of extinct and threatened ectothermic species worldwide is positively associated with the spatial pattern of climatic variability and agriculture across the globe; and (3) conducting a series of manipulative experiments in which numerous ectothermic hosts and cold- and warm-tolerant parasites will be exposed to constant and variable temperatures (across a temperature range) and quantify subsequent host immunity and parasite infections.

This research project is expected to reveal general mechanisms by which climate change and specific land use modifications facilitate parasite invasions. This will enhance risk assessment and management by allowing decision makers to prioritize regions, localities, and species that are at risk for potentially debilitating parasite invasions.

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