Study finds link between global warming and frog susceptibility to fungal disease

August 13 2012, by Bob Yirka

A chytrid-infected frog. From Riders of a Modern-Day Ark. Gewin V. PLoS Biology Vol. 6, No. 1, e24 doi:10.1371/journal.pbio.0060024

(Phys.org) -- A lot of studies are underway to try to find out what the impact of changing temperatures due to global warming will be on plants and animals. But few so far have been done to study the impact of the likely increase in the variability of weather patterns that are also expected to occur as the planet heats up. Once such group however, has been focusing on the impact of variable temperatures on amphibians and a fungal skin disease that has been killing a lot of them. The researchers, from Oakland University and the University of South Florida, have, as they write in their paper published in *Nature Climate Change*, found that Cuban tree frogs appear to be more susceptible to the fungal disease chytridiomycosis when temperatures vary, than when temperatures remain relatively constant.

Chytridiomycosis is a skin disease that occurs when frogs and other amphibians are attacked by the fungus Batrachochytrium dendrobatidis. The result is generally death as the frogs develop cysts under their skin and eventually die of cardiac arrest. The disease is believed to be responsible for the deaths of billions of amphibians worldwide and has led to the extinction of some species and has put others at risk.

Suspecting that global warming is possibly accelerating the death toll of amphibians infected with mold spores from the fungus, the team tested 80 Cuban frogs in the lab. There they subjected both frogs and the fungus to various temperature tests.

In one test, temperatures were held constant. In another, temperatures were set to correspond to the normal highs and lows that occur in the natural world. Then, to mimic what the researchers believe global warming has wrought, they caused unexpected highs and lows, creating a chaotic, variable temperature zone.

The team found that when existing by itself, the fungus did best when exposed to cool even temperatures or when the temperature changes were regular. The frogs did best, of course, when temperatures mimicked their natural environment. What was different however was when the fungus was present on the frog's skin. Under those conditions, the fungus did better and the frogs did worse when the temperature was varied and unpredictable. This suggests, the researchers say, that it's possible that global warming, and associated temperature volatility, is accelerating the rate of amphibian deaths from Chytridiomycosis.

They also suggest the reason frogs become more susceptible to Chytridiomycosis during times of unpredictable temperature changes is because the fungus is a simpler organism that can respond faster than frogs, meaning they can acclimate faster.

More information: Disease and thermal acclimation in a more variable and unpredictable climate, *Nature Climate Change* (2012) doi:10.1038/nclimate1659

Abstract
Global climate change is shifting the distribution of infectious diseases of humans and wildlife with potential adverse consequences for disease control. As well as increasing mean temperatures, climate change is expected to increase climate variability, making climate less predictable. However, few empirical or theoretical studies have considered the effects of climate variability or predictability on disease, despite it being likely that hosts and parasites will have differential responses to climatic shifts. Here we present a theoretical framework for how temperature variation and its predictability influence disease risk by affecting host and parasite acclimation responses. Laboratory experiments conducted in 80 independent incubators, and field data on disease-associated frog declines in Latin America6, support the framework and provide evidence that unpredictable temperature fluctuations, on both monthly and diurnal timescales, decrease frog resistance to the pathogenic chytrid fungus Batrachochytrium dendrobatidis. Furthermore, the pattern of temperature-dependent growth of the fungus on frogs was opposite to the pattern of growth in culture, emphasizing the importance of accounting for the host–parasite interaction when predicting climate-dependent disease dynamics. If similar acclimation responses influence other host–parasite systems, as seems likely, then present models, which generally ignore small-scale temporal variability in climate7, might provide poor predictions for climate effects on disease.