Climate-Linked Epidemic Hypothesis Confirmed?

New scientific research finds that the extinction of amphibians associated with epidemic diseases is tied to global warming. The authors suggest that temperatures in many highland regions are shifting towards the optimum growth conditions for amphibian pathogens, thus encouraging disease outbreaks.

One of the predicted outcomes of the climate change is the extinction of many species as a result of the alteration of living systems. Seventeen years ago, the Monteverde harlequin frog and the golden toad disappeared from the mountains of Costa Rica, and it is believed that a pathogenic fungus was implicated in their loss. Although, it is known that pathogens play an important role in the disappearance of amphibians, the mechanism and their relation to environmental changes is not well understood.

Recently, scientists have tested the “climate-linked epidemic” hypothesis, which predicts a decline of amphibian species in unusually warm years, as temperature shifts influence disease dynamics. The study examines the overall biological pattern by analysing available data regarding the year of disappearance of different species of toads endemic to the American tropics, including Monteverde frog and golden toad, in relation to altitude and selected temperature signals.

After considering determinants of the local climate in the case of the Monteverde harlequin frog and the golden toad disappearances, the authors propose that the sea surface and air temperatures in the tropics are the large-scale temperature signals that best capture the temperature shifts influencing ecological processes. These parameters are strongly related to the timing of the widespread extinction of these species. The episodic loss of amphibians occurred in years that were unusually warm across the tropics. Moreover, this strong association is not related to altitude, latitude or range size.

Theoretically, the pathogenicity of the fungus involved in the amphibians extinction increases at lower temperatures and it is associated with host mortality in highlands and during winter season. This seems to be in contradiction with the predicted amphibian extinction-warm years association. In order to find a solution to this paradox, the study assesses the large-scale altitudinal patterns of extinction risk and examines the favorable conditions for this pathogenic fungus. Contrary to the prevailing idea, the results show that the percentage of extinct or threatened species is larger in middle elevations (1 000-2 400m), suggesting that both high and low temperatures may limit the effect of the pathogenic fungus. On the other hand, global warming accelerates evaporation and raises the air’s capacity to hold water. This translates into enhanced cloud formation, which decreases solar radiation during the day and reduces heat loss at night. The result is daytime cooling, and night time warming. These local or microscale conditions favor and accelerate pathogen development.

The present study proves that the global warming is affecting disease dynamics, favoring the optimum growth conditions for pathogens, thus threatening amphibians’ survival. In a more general context, these findings illustrate how global warming could affect life and ecological interactions leading to important losses of biodiversity.


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