Researchers quantify effect of global warming on fungal disease in frogs and toads for the first time

October 24 2016, by Caroline Brogan

Credit: Imperial College London

At high altitudes, frogs and toads are being infected by a deadly chytrid

fungus at increasingly high rates in the Pyrenees Aspe Valley, France. The spike in mortality of these toads is blamed on warming in these mountains, which drives fungal infection in frogs and toads, and is expected to get worse.

Following years of speculation that climate change was driving deaths by chytrid, this eight-year study by researchers at Imperial College London and ZSL (Zoological Society of London), published in *Philosophical Transactions of the Royal Society B*, is the first to compare temperature with amounts of disease in order to infer future patterns at high altitudes. The fungus Batrachochytrium dendrobatidis (Bd) has severely affected over 700 amphibian species worldwide causing more extinction events than any other infectious disease known to science.

From analysing lake melt and amphibian infection rates over eight years, the researchers found that the earlier that the valley's lakes melted in the springtime, the higher were the rates of infection for both frogs and toads.

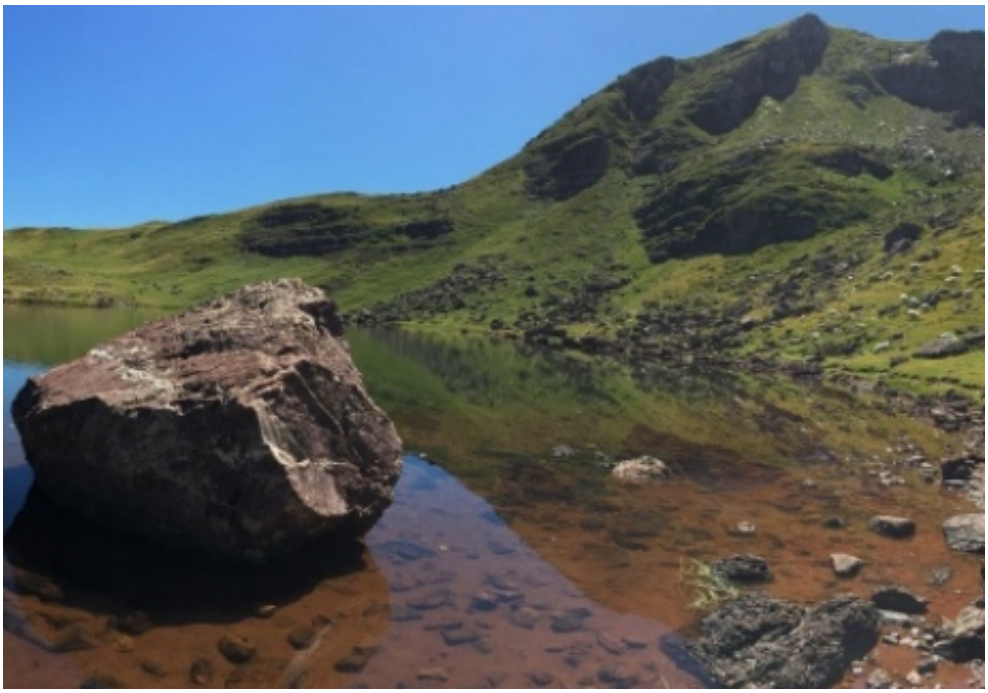
They then created predictive climate models that focused on regional temperatures across this part of the Pyrenees mountains. This research predicted that the region will continue to warm significantly and that frozen lakes will become increasingly rare, meaning that the midwife toad tadpoles in these lakes will spend increasingly less time under ice, with the effect that they multiply the effects of Bd infection in other species of frogs and toad.

Although the link between lake melt and rates of Bd infection is clear, it isn't known why temperature has this effect. Theories range from whether warmer lakes provide the ideal temperatures for chytrid growth, to whether predators of chytrid fungal zoospores are less active in warmer lakes.

The lakes in this region of the Pyrenees traditionally stay frozen for up to half of the year, and although Bd infection is normally very common in the long-lived midwife toad tadpoles, it's kept in check by low temperatures and frozen lakes. However, rising temperatures cause the lakes to melt earlier in the year, meaning that other species of amphibians are exposed to an increasingly warming climate with fewer frozen lakes, and are less able to cope with the spillover effects of infection from the midwife toads.

Declines in amphibian species can be seen as indicator of environmental degradation, and chytridiomycosis' responsibility for mass extinctions makes it an example of an Anthropocene extinction - the ongoing extinction event of species mainly due to human activity.

Professor Matthew Fisher from the School of Public Health at Imperial and co-author of the study, said: "These findings show yet another devastation of species thanks to human activity. Thankfully, it's unlikely the midwife toads will suffer extinction, largely because temperature is altitude dependant and so the toads in lower areas will survive."



Lac Arlet in the Pyrenees. Credit: Imperial College London

"The rapid decline of midwife toads in these regions will affect the whole local ecosystem in ways we can only guess at present. Food webs are likely to become less stable – and we are losing an Eden-like biodiversity in these mountains thanks to humanity's impact on the natural environment."

At present, researchers at Imperial College London and ZSL (Zoological Society of London) are able to cure the Bd infection on a small scale in a lab (see video), but their methods so far haven't been translated to the large scale of the Aspe Valley.

Professor Fisher added: "Until we know why this happens, it will be difficult to find a solution. Further research should aim to explain why warming temperatures are driving these deaths in midwife toads."

More information: Climate forcing of an emerging pathogenic fungus across a montane multi-host community. *Philosophical Transactions of the Royal Society B*, DOI: 10.1098/rstb.2015.0454

Provided by Imperial College London