Testing how species respond to climate change

January 10 2017

Predicting how species will respond to climate change is a critical part of efforts to prevent widespread climate-driven extinction, or to predict its consequences for ecosystems.

Usually, the current climatic range of a species is used to predict where it will occur under future climate change scenarios.

However, this approach overlooks two important factors that may affect species' responses to climate change:

- Species may be able to change the climatic range they can inhabit through evolution
- Species within an ecological community may respond differently to climate change, meaning the competitors, predators, pathogens and parasites that a given species encounters under the new climatic conditions may also change.

In a new study, published today in *Global Change Biology*, scientists from the Universities of Bristol, James Cook University, and Melbourne University in Australia tested the response of the tropical rainforest fly *Drosophila birchii* to a changing climate by transplanting flies in hundreds of cages along mountain gradients in north-eastern Australia, and measuring their reproductive success at different elevations.

Mountains are useful for exploring the effects of climate change because they show predictable changes in temperature and humidity with

elevation: In general, sites at low elevations are warmer and drier than higher elevation sites.

By testing the success of many *D. birchii* families transplanted along elevation gradients, the team were able to measure genetic variation in responses to the thermal environment, which indicates the potential for thermal tolerances to evolve. They found that all families showed similar responses, indicating low levels of genetic variation in temperature sensitivity, and therefore little potential for climatic tolerances to evolve.

The team also compared the response of flies in cages (which experienced the local temperature and humidity, but not interactions with other species) with the abundance of *D. birchii* in wild populations at the same sites along mountain gradients (where other species were also present), to test whether interactions among species affect responses to climate change.

The reproductive success of *D. birchii* in cages was lowest at cold, high elevation sites and increased at warmer sites towards the bottom of mountains. Of particular interest however, was that the change in abundance of *D. birchii* in wild populations along mountain gradients differed from that of *D. birchii* success in cages. *D. birchii* was most common at intermediate elevations, with abundance declining at colder sites towards the summit, but also at warmer sites towards the bottom of mountains, where flies in cages thrived.

This suggests that different factors restrict the distribution of *D. birchii* at either end of its range. Low temperatures prevent expansion of *D. birchii* at higher elevations, whereas it appears that other species, which were absent from the transplant cages, limit the spread of *D. birchii* into warmer sites in nature.

Understanding how interactions among species in ecological

communities will change as a consequence of climate change is a critical part of predicting the consequences for ecosystem function, and will be a focus of the team's future work.

Provided by University of Bristol