Ecological adaptation likely to influence impacts of climate change

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Animals' capacity to adapt is a factor in how they are likely to respond to changing climate conditions.

This conclusion of a new study published March 2 in the Proceedings of the Royal Society B is not especially surprising, says author Brandon Barton, but confirms the importance of accounting for local adaptation when determining the likely ecological effects of climate change.

The work shows that the ability of the top predator in a well-studied food web to adapt to local temperatures can preserve the ways the species in the web influence one another across a range of climate conditions. Barton, a postdoctoral fellow at the University of Wisconsin-Madison, completed the work while a graduate student at Yale University.

Barton focused on a food web composed of a predatory spider, a grasshopper, and the plants the grasshopper eats. The spider's predatory behavior is temperature-sensitive: if things get too warm, it retreats to the shade and does not hunt, freeing the grasshoppers to eat more plants. Thus, in warm weather the spiders exert a larger — though indirect — effect on the plants.

This much was known. But Barton found that the temperature-dependence is relative. The warmer the usual conditions in a spider's home turf, the better it is able to tolerate warm temperatures. For example, at the same temperature that would drive a cool-adapted spider

into the shade, a warm-adapted spider would still be on the hunt.

The new work overcomes a common limitation of many climate change experiments, in which an organism is suddenly exposed to a new set of conditions to see how it fares. Such an experimental design does not account for the ability of the species to adapt to changing conditions gradually over time.

Instead, Barton studied populations that already live in different climes. The spiders and grasshoppers he studies thrive along most of the eastern seaboard, so he compared populations in Vermont, Connecticut and New Jersey, using the warmer temperatures farther south as a proxy for the changing conditions expected in Vermont over the next 100 years as projected by common global climate models.

By comparing spider-grasshopper-plant communities in the three states, he was able to look at the same ecosystem under three different sets of environmental conditions. He found that the New Jersey spiders are better able to function at warmer temperatures.

"A Vermont spider at home in Vermont and a New Jersey spider in New Jersey function the same in terms of how much the predator influences the plants," Barton explains. "But if you take that Vermont spider and move it to New Jersey — basically a warming experiment — you increase the effect on the plants." Interestingly, moving Jersey spiders to Vermont had no effect.

"This shows experimentally that these predators are locally adapted — in the south, they're used to the higher temperatures," he adds.

That flexibility suggests that this food web will withstand a warming climate in Vermont, but the implications go well beyond spiders and grasshoppers. Similar principles are likely to apply to many other species

as well, and adapting to changing conditions over time may buffer some ecological impacts.

However, species will probably only adapt within certain ranges and those limits will vary species to species. So we're not completely off the hook as far as climate change goes, Barton says, but it's important that ecologists have a realistic understanding of all the factors at play when forecasting the possible effects of regional changes.

"Species do adapt to their local environment, and in this system that all worked out okay," he says. "But that does not mean that adaptation will completely eliminate the negative effects of climate change."

Provided by University of Wisconsin-Madison

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