The Texas butterfly effect

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MSU's Sarah Saunders and Elise Zipkin know that to better understand summer monarch butterfly populations in the Midwest, scientists need to check spring weather in Texas. Credit: G.L. Kohuth

How can scientists better understand summer monarch butterfly populations in the Midwest? Check spring weather in Texas.

This information is just one of many insights that researchers from Michigan State University gleaned from developing a new model to forecast ecological responses to climate change. The model, featured in the current issue of *Global Ecology and Biogeography*, focuses on estimating monarch populations in Ohio and Illinois via their migration through Texas.

"Spring weather conditions in Texas primarily drive summer abundance of monarchs in Ohio and Illinois, as opposed to localized climate effects in the summer breeding areas," said Elise Zipkin, MSU integrative biologist and co-author. "This suggests that the climate experienced by monarchs during their annual migration from overwintering sites in Mexico to their northern summer breeding grounds has a significant impact on population growth."

There are myriad issues that can affect wildlife populations, especially those that migrate. Monarch butterflies, for example, winter in Mexico and spend summers as far north as Canada. Deforestation in Mexico, violent storms and flooding in Texas, fewer milkweed plants in the Midwest on which to lay eggs can all critically impact this threatened population.

Recent evidence from the wintering colonies in Mexico suggests that the eastern migratory monarchs have declined precipitously over the last decade, leading the U.S. Fish and Wildlife Service to consider listing them under the Endangered Species Act.

So forecasting future monarch numbers in response to climate change is especially crucial. Yet, year-specific counts are notoriously difficult to predict, specifically when spring weather is outside the range of typical regional conditions, Zipkin said.

The new model effectively showed that populations in Illinois and Ohio,

separated by at least 140 miles and the state of Indiana, exhibit spatio-temporal synchrony. Simply stated, the populations mirror each other in many ways despite spending their summers separately.

Higher populations in both states were associated with average to above average precipitation and cooler than average temperatures in Texas during the spring, Zipkin said.

"Forecasting ecological responses to climate change is a common objective, but it's equally important to evaluate confidence in such predictions," said Sarah Saunders, MSU integrative biologist and lead author. "Our results demonstrate the relative importance of annual weather patterns in driving abundances of a migratory species and the difficulties in producing reliable predictions of animal populations in the face of climate change."

So what happens when the preferred climate gets upended in epic scale?

"This is the first-ever model that has accurately predicted annual monarch abundance using environmental variables," Zipkin said. "However, our predictions were fairly poor in years with extreme weather, highlighting how tough it will be to develop conservation strategies for monarchs. We'll continue to study methods to quantify uncertainty in model predictions so that we can better assess how climate change is likely to impact wildlife populations."

Researchers from the National Socio-environmental Synthesis Center, the University of Maryland and the University of Minnesota contributed to this study.

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