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Non-native plants show a greater response than native wildflowers to climate change

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Warming temperatures in Ohio are a key driver behind changes in the state's landscape, and non-native plant species appear to be responding more strongly than native wildflowers to the changing climate, new research suggests.

This adaptive nature demonstrated by introduced species could serve them well as the climate continues to warm. At the same time, the non-natives' potential ability to become even more invasive could threaten the survival of native species already under pressure from land-use changes, researchers say.

The research combines analyses of temperature change and blooming patterns of 141 species of Ohio wildflowers since 1895. Overall, the average temperature increased 1.7 degrees Fahrenheit (0.9 degrees Celsius) in Ohio between 1895 and 2009. And 66 wildflower species – or 46 percent of the 141 studied – flowered earlier than usual in response to that warming.

This change in flowering patterns not only alters the landscape, but affects the availability of food for insects and birds and can influence the reproductive success of the plants themselves.

This kind of wildflower data is difficult to come by because historical observations of flowering trends simply don't exist in most states.

Ohio State University graduate student Kellen Calinger collected her flowering pattern data from the university's herbarium, which contains more than 500,000 plant specimens. Accessing this treasure trove of specimens complete with data on their location and the date they were harvested has led her to produce one of the six largest such datasets in the world tracking the history of the wildflower life cycle in response to climate change.

"This is a new way of assessing conservation. Not only are the results important, but so is the method that allowed me to produce these results," said Calinger, a Ph.D. candidate in the Department of Evolution, Ecology and Organismal Biology at Ohio State.

"I hope not only to look at climate change impacts and predict potential species extinctions as a result of climate change in Ohio, but also hope my methods will allow people throughout the country to assess impacts in their areas and allow us all to make informed decisions about protecting these areas," she said.

Calinger described her research in a talk Friday (10/5) at EcoSummit 2012, an international conference held in Columbus.

Calinger documented temperature change in Ohio with data kept since 1895 by 26 weather stations located throughout the state as part of the U.S. Historical Climatology Network.

"This is a really excellent record of temperature change for climate change studies because these stations have been constant in terms of location since 1895. There are no latitudinal or elevation shifts to affect temperatures, and they're also located away from urban heat areas, so any increase seen at these stations is likely a result of changes in climate," Calinger said.

In addition to the overall warming trend across Ohio, the data showed more dramatic localized increases, such as a 3.7 degree Fahrenheit (2 degree Celsius) increase in Trumbull County.

Calinger compiled data on species of flowering patterns by using Ohio State's herbarium, which contains a half-million historic specimens of plants and fungi collected by faculty, students, affiliated researchers and citizen scientists since its founding in 1891.

For this presentation, Calinger had analyzed 141 species. Her final dataset will include analysis of a total of 207 species.

"I tried to get a fairly even sampling of a really large number of different plant families so I could include a lot of evolutionary lineages and see how each of them is responding," she said.

For comparison purposes, Calinger analyzed wildflowers at their maximum flowering point, when 50 percent or more of their buds were open. Information cards accompanying each specimen outline the date of the harvest and location of the plant. To track how each species responded to temperatures, Calinger crossed that information with temperature data for the same date and place. Though the collection rate varies per species, she estimates she analyzed an average of 40 specimens of each type of wildflower.

Forty-six percent of the 141 species showed significant advancement in flowering in response to increased temperatures. And more of this advancement was seen in introduced species than in native plants.

While the response to temperature change suggests adaptability, the timing shift can also produce problems in the rest of the ecosystem and even function as a threat to the plants' livelihood. For example, if flowers bloom early based on warm air temperatures but the ground remains cool, their insect pollinators hibernating underground might not wake up in time to do their jobs – a significant reproductive issue for the plants. In addition, migrating birds relying on nectar sources on their route could find less food during their travels.

"There are a lot of effects that cascade up the food chain to birds and insects," Calinger said.

Frost is also a significant threat, especially to the most sensitive of flowers. When temperatures soar earlier than usual and are followed by a freeze, flowers that respond to the false weather cues and bloom could then succumb for the entire season if a frost kills their buds.

That being said, the responsiveness of non-native species to the warming trend suggests they might have an advantage over their native counterparts and crowd out native species that are less able to adapt to change. Non-native annuals were especially responsive among this group of species.

What's a potential conservationist to do to protect biodiversity among these species? Calinger said preservation of wild areas could go a long way toward protecting native wildflowers, and that assessments such as hers could help identify areas housing at-risk species that should be left undeveloped. Some tender species could be moved to more favorable locations, but there is no consensus among scientists that this strategy would work, she said.

Calinger co-authored the presentation with Peter Curtis, professor and chair, and Simon Queenborough, professor, both in the Department of Evolution, Ecology and Organismal Biology at Ohio State.

Provided by The Ohio State University