Learning from habitat 'haves' to help save a threatened rattlesnake

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The study suggests that a collection of six relatively closely situated but isolated populations of Eastern massasauga rattlesnakes in northeast Ohio could grow their numbers if strategic alterations were made to stretches of land between their home ranges. Credit: Scott Martin

Comparing the genetics and relocation patterns of habitat "haves" and

"have-nots" among two populations of threatened rattlesnakes has produced a new way to use scientific landscape data to guide conservation planning that would give the "have-nots" a better chance of surviving.

The study suggests that a collection of six relatively closely situated but isolated populations of Eastern massasauga rattlesnakes in northeast Ohio could grow their numbers if strategic alterations were made to stretches of land between their home ranges. The findings have contributed to the successful application for federal funding of property purchases to make some of these proposed landscape changes happen.

Reconnecting these populations could not only help restore Eastern massasaugas to unthreatened status, but establish a thriving habitat for other prey and predator species facing threats to their survival—satisfying two big-picture conservation concerns, researchers say.

"We aren't just protecting massasaugas—we're protecting everything else that's there," said H. Lisle Gibbs, professor of evolution, ecology and organismal biology at The Ohio State University and senior author of the study. "Even though we are focused on this species, protection of the habitat has all these collateral benefits."

The research was published recently in the journal *Ecological Applications*.

Eastern massasauga rattlesnakes live in isolated spaces in midwestern and eastern North America and were listed as threatened under the Endangered Species Act in 2016 because of loss and fragmentation of their wetland habitat.

This study involves two known groups of Eastern massasaugas in Ohio:

The Killdeer Plains Wildlife Area in north central Ohio, home to one of the most genetically diverse and largest populations in the country, numbering in the thousands, and six small, separate populations of Eastern massasaugas clustered near each other in Ashtabula County.

Study co-author Gregory Lipps, a field biologist at Ohio State, has studied the northeast Ohio groups for years. Federal officials once told him the populations are too small in number to be viable—but the genetics portion of this study showed that the populations had once been connected and deserve a second chance to rebuild.

"So now we are working on trying to reconnect them, to get them back to a viable population large enough to sustain itself even when disturbances happen that cause populations to fluctuate," Lipps said.

First author Scott Martin, who completed this work as a Ph.D. student in Gibbs' lab, had previously sequenced genomes of 86 snakes from the six fragmented sites in northeast Ohio. For a genetic comparison in this new study, the team captured and collected blood samples from 109 snakes living together in the Killdeer Plains site. The genetic analysis, combined with where snakes were located at the time of capture, showed that the snakes living in fragmented sites in northeast Ohio were very distantly related, having stopped mingling at least three generations ago.

"Once we knew that they didn't seem to be moving around, the real question is why aren't they moving? It's not that big of a distance—so we focused on finding out what was stopping them from being connected," Martin said.

Previous research had indicated how far a male Eastern massasauga snake could safely travel to find a mate and establish a family in a new location. GPS and genetic data from the Killdeer Plains and northeast Ohio population samples showed how much movement was common

among related snakes in a successful group, and how uncommon relocation was among snakes living in fragmented habitats. Martin came up with the idea to combine all the data to see what was different about the landscapes in the two regions—and what could be interfering with snake relocation in the Ashtabula County groups.

"It seemed to be about specific features of the habitat," Martin said. "If the snakes in northeast Ohio were moving as far as we would expect them to based on how the Killdeer snakes move and data on the species' range, they should be able to move between these little sites. And yet when we look at the genetics and use pedigrees to see if there is any breeding between the sites, there's just not."

Using landscape maps, the researchers created models from the data that detailed the "resistance value" of various landscape features that would either help or hinder the northeast Ohio snakes' movement to find mates. Wooded areas, cropland, and roads and housing developments—also called impervious surfaces—were found to be the main obstacles to snake relocation. Wet prairies are the ideal habitat for Eastern massasaugas.

"You can imagine two snakes in the same habitat that are probably likely very genetically similar because they can move easily. And then in this other region you have two snakes near each other, but on either side of a four-lane highway, and they will be genetically different because snakes don't move across that highway, and over time they've diverged," Martin said.

"That means a highway would have a high resistance value and an open field would have a very low resistance value."

These findings, and Lipps' longtime work with northeast Ohio landowners and numerous conservation agencies, helped Ohio and

Michigan collaborate on applying for and receiving a $2.3 million grant from the U.S. Fish and Wildlife Service to acquire land to benefit Eastern massasaugas in both states.

"To me, this is a clear example of where Ohio State basic research has produced practical results that have then been directly used to help conserve wildlife in Ohio—in other words, achieving one of the goals of a land-grant institution, which is to provide useful, practical knowledge of value to the citizens of the state," Gibbs said.

William Peterman, School of Environment and Natural Resources at Ohio State, was also a co-author on this study.

More information: Scott A. Martin et al, Inferring population connectivity in Eastern Massasauga Rattlesnakes (Sistrurus catenatus) using landscape genetics, *Ecological Applications* (2022). DOI: 10.1002/eap.2793

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