As monarch butterflies vanish, researchers investigate road salt as culprit and cure

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A monarch butterfly had just emerged from its chrysalis when Emilie Snell-Rood reached into its cage, grabbed it carefully to take measurements and photographs, then placed it inside a tall and breezy

tent. There it would strengthen its wings for a day or two in relative safety before being released in time to begin a 2,000-mile trek to southern Mexico.

This monarch in particular, a female, may have a better chance than most to survive the migration. It all depends on how her body reacts to varying levels of road salt.

In an effort to understand why monarch populations are plummeting, researchers at the University of Minnesota are investigating road salt as both a culprit and an unlikely solution. Across the country, the butterfly's numbers have fallen by more than 90% since the early 1990s, and now the U.S. Fish and Wildlife Service is considering adding the butterfly to its list of endangered and threatened species.

In Minnesota, the northern end of a key monarch migration route, researchers believe that road salt is playing an outsized role. That's because many of the state's remaining significant concentrations of milkweed—the food source for monarch caterpillars—run alongside roads and highways.

When winter road salt is kicked up and ground into dust by traffic, the sodium seeps into nearby soil. The milkweed growing in that soil keeps the sodium within its leaves, said Snell-Rood, an ecology professor at the U who is leading the research.

Too much sodium is toxic for butterflies and can delay or hinder their muscle development, she said.

But smaller amounts may prove beneficial.

"Every animal needs sodium for proper growth," Snell-Rood said during a recent interview at her lab on the St. Paul campus. "But the options are

fairly limited for herbivores because plants don't like sodium and tend to have very little of it."

In the wild, animals resort to various, often strange, behaviors to get that sodium. It's why deer are so attracted to salt licks, why moose seek out aquatic plants and why butterflies have been known to suck up mud, Snell-Rood said.

"The question is," she said, "is this sodium translating to performance effects in monarchs during migration?"

Monarchs are just beginning what is perhaps the greatest annual migration in North America. Tens of millions of the orange-and-black butterflies will spend the next few months fluttering thousands of miles from every corner of the country and parts of Canada to just a handful of locations west of Mexico City, where the tiny creatures will mass in numbers so big that their weight can collapse tree branches.

One of the busiest routes runs down the center of the United States, following Interstate 35 from Duluth to the Texas border.

To test the role of road salt, Snell-Rood and her team have been raising thousands of monarch caterpillars since the insects first returned north this spring. They've split the bugs into three groups: One is fed milkweed sprayed with high concentrations of sodium, one gets lower levels of sodium and one gets no extra sodium at all. The higher levels are set to mimic the amount of salt that leaks into the soil along major urban highways, such as the I-35 corridor in Minneapolis. The lower levels roughly equal the amount of sodium kicked up along less-trafficked rural roads.

When each caterpillar emerges as a butterfly, it is measured, tagged with a sticker on its wing and put into a tent for a few days to grow and get

used to its surroundings. Then it is released.

The female butterfly Snell-Rood photographed on a recent afternoon had been treated with lower levels of sodium. Her brain may be a little bigger, eyesight a little better and flight muscles stronger than those of a typical monarch butterfly. Snell-Rood's team has found that those treated with higher levels of sodium take longer to develop. They're expected to be weaker and more vulnerable to frosts, predators and the countless perils they'll face during the great migration.

Researchers will track the butterflies to see how many from each group make it to Mexico, by working with various partners and possibly sending a team south to try to spot the stickers.

Lab studies have already shown that modest levels of sodium supplements can increase muscle growth as well as brain and eye size, all of which are critical for migrating, Snell-Rood said. Higher levels can outright poison monarchs or hinder their muscle development.

This will be the first field test of its kind to see how sodium levels actually affect survival rates outside the lab.

The Minnesota Department of Transportation (MnDOT) will be following the results closely. The agency has already begun to design major road projects, such as the reconstruction of I-35W in Minneapolis, with monarch butterflies in mind by adding more diverse plantings of clovers, grasses and milkweed, as long stretches of highway have become one of the butterfly's primary remaining habitats.

The U's monarch study comes amid heightened scrutiny of road salt and the environmental damage it can cause. In the Twin Cities area, where roads, sidewalks and parking lots are treated with an estimated 349,000 tons of road salt a year, dozens of lakes have already been impaired by

chloride contamination, according to the Minnesota Pollution Control Agency.

Many of those lakes are becoming so salty they will not be able to support native life within the next three decades, according to a 2017 study from the University of Wisconsin.

Fortunately for the monarch, however, solving their sodium problem is likely to be much easier than fixing Minnesota's long-term addiction to salt.

If lower concentrations of sodium prove helpful for monarchs, then Minnesota would need to make just a few changes to salting and plowing practices, Snell-Rood said.

"If you look at just a profile of roadsides across Minnesota, most have low to moderate traffic, which is good," she said.

It's the busiest corridors that are probably toxic to monarchs. And even along those major highways, she said, fixes could be relatively simple and cheap. The most toxic plants are right next to the road, she said, so the easiest solution would be to mow that strip consistently and remove the milkweed.

Forcing the caterpillars to move even just a few yards away from the road could mean the difference between strong monarchs and weak ones.

Snell-Rood and her team will present MnDOT with a series of recommendations once their study is complete this winter.

"Depending on what we find, I really think we're going to be able to have a discussion and come up with ideas that are feasible," she said.