No map, no problems for monarchs

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This is a monarch butterfly. Monarchs are plentiful in the spring in Canada and the U.S. Research from the University of Guelph has revealed new details on how they migrate thousands of miles. Credit: University of Guelph - Jessica Linton

Monarch butterflies have long been admired for their sense of direction, as they migrate from Canada and the United States to Mexico. According to new findings from a team of scientists, including researchers from the University of Guelph, the winged insects fly without a map, and use basic orientation and landmarks to find their way

to their wintering sites, thousands of miles away.

Recently published in the *Proceedings of the National Academy of Sciences*, the study examined the insects' flight patterns and whether those patterns changed when the butterflies were displaced.

The team, which included researchers from Queen's University, Germany and Denmark, also analyzed more, also analyzed more than 50 years' worth of migration data to learn how monarchs find their way for the first time to their wintering habitat in Mexico.

A monarch flies the full migration route just once during its life cycle.

The flight patterns and data suggest that, when butterflies are blown off course, they likely use major geographic landmarks to funnel them to their destination.

Monarch butterflies are plentiful in Canada and the U.S. each spring. Here, two monarchs are resting. New research from the U of Guelph reveals details of their

migration journey from Mexico north. Credit: University of Guelph / Jessica Linton

Looking at the distances that these insects fly each year, scientists had long thought that monarchs were "true navigators."

"To be a true navigator, you need both a compass and a map," explained Prof. Ryan Norris, Department of Integrative Biology. "We've know for some time that monarchs use external cues, such as the sun and magnetic field, as a built-in compass that can indicate their latitude. But having an internal map requires knowledge of both latitude and longitude."

To test whether monarchs could detect longitude displacements, the team, led by U of G undergraduate student Rachael Derbyshire, examined the butterflies' flight patterns in a funnel on the University of Guelph campus. They then tested the same monarchs in Calgary.

"The monarchs we tested in Guelph flew southwest, in the general direction of Mexico," said Derbyshire. "When we tested them in Calgary, they flew in the same general direction as if they were in Ontario, suggesting that they did not know they had been displaced 2,500 kilometres."

Researchers at the U of Guelph tested monarchs' flight path in a funnel on the university campus. Credit: University of Guelph / Ryan Norris

Studying data from monarchs tagged and recaptured throughout North America from 1952 to 2004, the team found that migrating monarchs do not use an internal map to reach Mexico. Instead, they use landmarks, such as coastlines and the Rocky and Appalachian mountains.

"Given the challenge of this migratory journey and the fact that these

insects are less than a gram, it is a remarkably simple system they used to travel thousands of kilometres to a site they have never seen," said Norris.

Monarchs use the same sites in the highlands of central Mexico each year. One mystery remains: how do they pinpoint these exact locations in Mexico?

Derbyshire said, "One possibility we think is likely, and would need to be tested, is that they—like some other migratory animals—use smell to guide them to their final destination."

More information: "An experimental displacement and over 50 years of tag-recoveries show that monarch butterflies are not true navigators," by Henrik Mouritsen et al. *PNAS*, 2013.

Provided by University of Guelph