Monarchs' white spots shown to aid migration

June 21 2023

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If you've ever wondered how the monarch butterfly got its spots, University of Georgia researchers may have just found the answer.

The new study, published in *PLOS ONE* suggests that the butterflies with more white spots are more successful at reaching their long-distance wintering destination. Although it's not yet clear how the spots aid the species' migration, it's possible that the spots change airflow patterns around their wings.

"We undertook this project to learn how such a small animal can make such a successful long-distance flight," said lead author Andy Davis, an assistant researcher in UGA's Odum School of Ecology. "We actually went into this thinking that monarchs with more dark wings would be more successful at migrating because dark surfaces can improve flight efficiency. But we found the opposite."

The monarchs with less black on their wings and more white spots were the ones that made it to their ultimate destination, nearly 3,000 miles away in south and central Mexico.

"It's the white spots that seem to be the difference maker," Davis said.

Migration selects for butterfly spots

The researchers analyzed nearly 400 wild monarch wings collected at different stages of their journey, measuring their color proportions. They found the successful migrant monarchs had about 3% less black and 3% more white on their wings.

An additional analysis of museum specimens that included monarchs and six other butterfly species showed that the monarchs had significantly larger white spots than their nonmigratory cousins.

The only other species that came close to having the same proportion of white spots on its wing was its semi-migratory relative, the southern monarch.

Monarchs use solar energy to improve flight

The authors believe the butterflies' coloring is related to the amount of radiation they receive during their journey. The monarchs' longer journey means they're exposed to more sunlight. As a result, they have evolved to have more white spots.

"The amount of solar energy monarchs are receiving along their journey is extreme, especially since they fly with their wings spread open most of the time," Davis said. "After making this migration for thousands of years, they figured out a way to capitalize on that solar energy to improve their aerial efficiency."

But as temperatures continue to rise and alter the solar radiation reaching Earth's surface, monarchs will likely have to adapt to survive, said Mostafa Hassanalian, co-author of the study and an associate professor at the New Mexico Institute of Mining and Technology.

"With greater solar intensity, some of that aerial efficiency could go away," Davis said. "That would be yet one more thing that is hindering the species' fall migration to Mexico."

Monarch breeding population is stable

But it's not all bad news for the flying insects.

Davis' previous work showed that summer populations of monarchs have remained relatively stable over the past 25 years. That finding suggests that the species' population growth during the summer compensates for butterfly losses due to migration, winter weather and changing environmental factors.

"The breeding population of monarchs seems fairly stable, so the biggest hurdles that the monarch population faces are in reaching their winter destination," Davis said. "This study allows us to further understand how monarchs are successful in reaching their destination."

More information: How the monarch got its spots: long-distance migration selects for larger white spots on monarch butterfly wings, *PLoS ONE* (2023). DOI: 10.1371/journal.pone.0286921

Provided by University of Georgia

Citation: Monarchs' white spots shown to aid migration (2023, June 21) retrieved 6 May 2024 from https://phys.org/news/2023-06-monarchs-white-shown-aid-migration.html

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