Butterflies' diet impacts evolution of traits

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Why do some organisms within a single species have many offspring, while others have relatively few? A new study led by University of Minnesota researcher Emilie Snell-Rood finds that access to some nutrients may be a star player in shaping traits related to fitness such as fecundity and eye size over the long term. Given drastic increases in the
availability of many nutrients due to the widespread use of fertilizers and road salts, the finding has important implications for agriculture and ecology.

Snell-Rood and colleagues wanted to find out if different types of nutrients played a role in shaping the evolutionary history of five closely-related families of butterflies. "It's really hard to quantify diet," she says, noting that prior studies have provided coarse comparisons across animals—for instance, carnivores versus herbivores. "We wanted to test the idea that nutrition shapes life history evolution at a finer level."

To do that, researchers correlated the nutrition of 96 different butterfly species' food with a broad range of phenotypic features such as eye size. The researchers looked at three elements in the butterflies' diets: nitrogen, sodium, and phosphorus. Nitrogen is a necessary nutrient for protein building, sodium is critical for proper functioning of muscle and nervous systems, and phosphorous is thought to be important for growth rate.

They found that butterfly species with nitrogen-rich diets tended to have larger numbers of eggs, though the eggs themselves were relatively smaller. They also found that diets high in both nitrogen and sodium probably led to the evolution of larger eyes. In butterflies, the visual system is important for finding both food and mates, such that larger eyed individuals have an evolutionary advantage.

Human activity impacts the balance of nutrients in the environment. For example, heavy farm fertilization and increasing atmospheric deposition are both driving up nitrogen concentration in the soil, while road salts are similarly increasing sodium content in some places. "We are changing evolutionary selection pressures on traits," said Snell-Rood. "Pests might be evolving to be more fecund because, on average, their diet is of higher quality."
Emilie Snell-Rood is an associate professor in the College of Biological Sciences at the University of Minnesota. The paper was published in the *Proceedings of the Royal Society B*.


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