

Have Traits, Will Travel: Some Butterflies Travel Farther, Reproduce Faster

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The Glanville fritillary. Credit: Howard Fescemyer, Pennsylvania State University

Researchers have uncovered physiological differences among female Glanville fritillary butterflies that allows some to move away from their birth place and establish new colonies. These venturesome butterflies are stronger fliers and reproduce more quickly compared to their less mobile female relatives.

The study is a window to how genetic differences influence behavior and how the environment influences genetic change by favoring individuals with certain traits, said lead author Howard W. Fescemyer. The new study found significant physiological differences that may account for

the more adventuresome behavior of certain of the females.

The work is important because human activity is disrupting many animal habitats, forcing more and more species to do what the fritillary has long done in its naturally fragmented environment. Scientists want to know how this fragmentation influences a species' evolution.

“We may be selecting for genes that enhance the dispersal or migratory capability of animals when we fragment the landscape,” Fescemyer said. The animals best able to migrate are more likely to survive and reproduce. “What we learn could apply to any organism that has to move to find food,” he added

Åland Islands are natural laboratory

The study, “Population history-dependent reproductive physiology in a butterfly metapopulation,” will be presented on Oct. 10 at Comparative Physiology 2006: Integrating Diversity, Oct. 8-11, Virginia Beach, Virginia. Howard W. Fescemyer and James H. Marden of Pennsylvania State University, Ilkka Hanski of the University of Helsinki and A. Daniel Jones of Michigan State University carried out the study. Marden was the senior researcher.

The researchers studied the Glanville fritillary butterfly (*Melitaea cinxia*) on the Åland Islands of Finland, located between Finland and Sweden in the Baltic Sea. The research team was composed of a population biologist, molecular biologist, physiologist and chemist. The study built on the work of Hanski who has recorded changes in the butterfly population on the islands for years.

It's in the genes

The fritillary live in distinct patches -- rocky outcroppings containing plants that serve as food and provide a hospitable home for the butterfly larvae to spend the winter. There are about 4,000 such patches on the Ålands, with about 500 patches occupied in a given season, Hanski has found. Some of the patches are farther apart than most individual butterflies can migrate, Fescemyer said.

Each year, new populations begin in some patches while others go extinct because of parasites, disease and the disappearance of plants that serve as food and shelter. Populations established on an isolated patch may require a good flier to reach a new patch to start a new population.

Flight capability varies quite a lot among females, who carry the eggs and establish new populations. For those reasons, natural selection on flight and reproductive capability acts primarily on the females.

Travelers reproduce more quickly

This study examined whether there is a difference in physiology between the females in the newly established populations and females in the older populations. The researchers found out there are.

The study looked at seven patches which had not been colonized the year before and six old populations, Fescemyer said. Hanski's group collected larvae from the seven new patches and reared them on host plants in the laboratory, where they moved to the pupae stage.

Fescemyer recorded when the pupa emerged to become butterflies and periodically collected individual butterflies to determine the number of mature eggs they carried.

“The females from the new patches develop very quickly,” Fescemyer said. They developed mature eggs sooner (three days after emerging

from the pupa) which could enable them to mate and lay eggs sooner. Females from older populations took an additional day to mature their eggs.

What's in a day? A lot. The butterflies live between two and three weeks after emerging from the pupa, so they have to produce eggs quickly. In the fragile world of a butterfly, a day can make all the difference between reproducing and not.

The physiological difference

The researchers delved into what was behind these differences in egg production and development. They obtained blood samples from butterflies from old populations and new populations. Compared to females in the established patches, the females in these newly colonized patches had more

- total protein
- vitellogenin
- juvenile hormone

Juvenile hormone appears to be a key. It plays an important role in regulating egg and larval development and also regulates reproduction, particularly egg maturation, in adults, Fescemyer said. Vitellogenin is the protein precursor to egg yolk, which the embryo uses for food. Total protein is the most important nutrient for egg maturation, he said.

Adds to previous study

Previous studies had found other physiological differences between these more robust butterflies and their status quo sisters and brothers. They found that individuals that established new populations mate

sooner, lay more eggs and have a different form of an enzyme important to flying, phosphoglucose isomerase. They also found they have a higher metabolic rate.

Future research will try to further uncover more physiological and molecular differences that account for the differences in reproduction and in flight, Fescemyer said. The researchers also hope to see what part host plant nutrition plays in these differences.

Source: American Physiological Society

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