Researchers find natural section favors parasite fitness over host health

Why do parasites harm their hosts? Classic evolutionary theory predicts that parasites become more virulent because they must transmit themselves between hosts, yet scientists have found little data to support this idea, until now.

Led by Emory University researcher Jacobus de Roode, PhD, a team of scientists has uncovered evidence that natural selection selects for harmful parasites by maximizing parasite fitness.

De Roode and co-authors Andrew Yates, PhD, Emory University; and Sonia Altizer, PhD, University of Georgia, studied monarch butterflies Danaus plexippus infected with parasite Ophryocystis elektroscirrha and observed that higher levels of replication within the host resulted in both higher virulence and greater transmission of the parasite.

The study will be published online in the *Proceedings of the National Academy of Sciences*.

"A fundamental evolutionary question is why parasites that depend on their hosts for their own survival and fitness hurt or even kill them," says de Roode. "According to theory, parasites face a trade-off between the benefits of increased replication, the transmission to new hosts and the costs of host mortality, resulting in the highest fitness at intermediate parasite replication. During the past 30 years there has been very little experimental evidence that this trade-off actually exists. This is one of the first demonstrations that really shows that this trade-off model applies.

"These findings support the idea that selection for parasite transmission can favor parasite genotypes that cause substantial harm," he says.

In natural populations, D. plexippus become infected as caterpillars after they ingest spores of O. elektroscirrha that are scattered onto eggs or host plant leaves by adult butterflies. The parasites then penetrate the gut wall and replicate, forming spores around the scales of the developing butterflies.

"Greater parasite replication reduced host survival to the adult stage, with fewer monarchs emerging successfully from their pupal cases," says de Roode. "Among female monarchs that survived to the adult stage, higher parasite loads reduced mating success, in part by reducing the female lifespan.

"Harmful effects from the parasites on the host may appear maladaptive," says de Roode. "But high parasite loads were necessary to increase transmission."

Because the parasites affect the butterflies' lifespan, their ability to fly, and whether they can migrate and reproduce, de Roode says he and his colleagues are now studying how the parasites' virulence level varies among monarch populations and whether migration patterns and length affect the parasites' virulence level.

Source: Emory University