

Gene studies lead to kissing cousins

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To look at the tobacco budworm moth and its close cousin, you wouldn't be able to tell the fuzzy-looking, fingertip-size moths apart. But put males of each species as far as six car-lengths away from females, and even in the darkness of midnight they easily find their way to mates from their own species while ignoring females from the other species. Today, the genes that keep the species sexually isolated are no longer a mystery, thanks to research from North Carolina State University and the University of Utah.

NC State entomologist Dr. Fred Gould says the study, published today in the online edition of the [Proceedings of the National Academy of Sciences](#), gives scientists a better understanding of how [moths](#) descended from a [common ancestor](#) and evolved distinctly different ways of communicating with mates.

Biologists have long been fascinated by the intricate way moths communicate through airborne chemicals known as sex pheromones. There are more than 100,000 species of moths, with each relying on its own unique pheromone blend, different in terms of the chemicals that make it up and the ratio of those chemicals. Females produce these precisely blended perfumes, and only males of their species respond to that sexual cue. Until now, scientists had a long list of potential genes and cellular molecules that could be responsible for each male finding only females of its own species.

In the PNAS paper, Gould and his collaborators explain how, through breeding, they moved a number of hypothesized sexual communication

genes from *Heliothis virescens*, the budworm, into *Heliothis subflexa*, its close relative. They found that when they moved one specific small set of odorant receptor genes, the hybrid males understood and responded to the female budworm's pheromones in the same way that true male budworms respond.

The scientists cross-bred the related moths in their Raleigh laboratory and studied the moths' behavior in Utah wind tunnels, watching to see which pheromone blends attracted and repelled which offspring.

Then they inserted tiny electrodes into cells of the moths' antennae and measured how neurons in the antennae responded to the pheromones of the two species. They found that in each male the antennae neurons' response was largely controlled by which of the species' receptor genes it had inherited.

"In the end, the finding that big changes in the moths' responses to pheromones are controlled by such a small genetic change is a first step toward understanding how the thousands of moth species evolved," Gould says.

The puzzle, or evolutionary paradox, has been that within each moth species "natural selection constantly acts against any female that makes a novel pheromone blend that isn't recognized by males of its species," Gould says. "And males that have a mutated receptor gene that recognizes an as-yet-unevolved pheromone will have a hard time finding a mate."

This has led some to assume that a new moth species could evolve only if genetic changes occurred in the male and female at the same instant in evolutionary time - which is highly unlikely.

"In the narrow sense, the research is about the evolution of sexual

communication and speciation," Gould says. "But in a broader sense, it is about the evolution of what are sometimes called characteristics with irreducible complexity. Irreducible complexity is the idea that some traits are so complicated that there's no way for them to have evolved by natural selection.

"Moths seem to possess an irreducibly complex mating system," he says, "but perhaps the puzzle of how this system evolved has simply been difficult to solve."

Gould and his colleagues hope that, armed with a new understanding of the male sexual communication genes plus knowledge of the female genes from previous studies, they may now be in a position to recreate the evolutionary events involved in moth speciation. That would finally solve the puzzle.

More information: "Sexual isolation of male moths explained by a single pheromone response QTL containing four receptor genes"
Authors: Fred Gould, Marie Estock, Bekah Powell, Astrid T. Groot, Catherine M. Ward, Jennifer L. Emerson and Coby Schal, North Carolina State University; N. Kirk Hillier and Neil J. Vickers, University of Utah, Published: April 12, 2010, in the online version of Proceedings of the National Academy of Sciences.

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