Fireflies blink in synch to send a uniform message (w/ Video)

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A male firefly, *Photinus carolinus*, searches for females in the Great Smoky Mountains National Park. Credit: Andrew Moiseff

For decades, scientists have speculated about why some fireflies exhibit synchronous flashing, in which large groups produce rhythmic, repeated flashes in unison - sometimes lighting up a whole forest at once. Now, the first experiments on the function of this phenomenon suggest that synchronous flashing preserves female fireflies' recognition of suitable mates. The results are reported in the July 9 issue of *Science*.

"There have been lots of really good observations and hypotheses about firefly synchrony," says lead author Andrew Moiseff of the University of Connecticut. "But until now, no one has experimentally tested whether synchrony has a function."

Fireflies - which are actually a type of beetle - produce bioluminescence as a mating tool, in which males display a species-specific pattern of flashes while "cruising" through the air, looking for females, says Moiseff. These patterns consist of one or more flashes followed by a characteristic pause, during which female fireflies, perched on leaves or branches, will produce a single response flash if they spot a suitable male.

Of the roughly 2,000 species of fireflies around the world, scientists estimate that about 1 percent synchronize their flashes over large areas. In their study, Moiseff and his coauthor Jonathan Copeland of Georgia Southern University tested the idea that the males of these species synchronize to facilitate the females' ability to recognize the particular flashing pattern of their own species.

The researchers collected females of the synchronous species *Photinus carolinus* from the Smoky Mountains National Park in Tennessee. In the laboratory, they exposed the females to groups of light-emitting diodes (LEDs), meant to mimic male fireflies. Each individual LED produced the species-specific pattern of flashes for P. carolinus, but the experimenters varied the degree to which the flashes were in synch with one another.

"We had the technology to design something that we thought would create a virtual world for these females," says Moiseff.

Their results showed that females responded more than 80 percent of the time to flashes that were in perfect unison or in near-perfect unison. But when the flashes were out of synch, the females' response rate was 10 percent or less.

Since synchronous species are often observed in high densities, Moiseff and Copeland concluded that their results suggest a physiological

problem in the females' information processing. Male fireflies are typically in flight while searching for females, so their flashes appear in different locations over time. Therefore, says Moiseff, females must be able to recognize visual cues over a wide range of space.

A male firefly, *Photinus carolinus*, perches on a leaf in the Great Smoky Mountains National Park. Credit: Andrew Moiseff

But, he points out, this behavior presents a problem in areas crowded with male fireflies. Instead of seeing a single flying male, the female would see a cluttered landscape of unrecognizable flashes.

"When males are flashing in high densities, the female's inability to focus on just one male would make it very difficult for her to detect her species-specific pattern," Moiseff says. "So if the males synchronize, it can maintain the fidelity of the signal in the presence of many other males."

Whether the females can't or simply choose not to discriminate spatial information on small scales is unclear, says Moiseff. His future research will focus on questions that address whether physiological constraints or

behavioral decisions are driving the evolution of synchrony.

Overall, says Moiseff, he is interested in the role that animal physiology plays in shaping evolution.

"Animals have evolved to solve unique problems in many different ways, and I'm interested in how they do that," he says. "Fireflies have these tiny heads and these tiny brains, but they can do some complex and amazing things."

Provided by University of Connecticut