

## Aggressive Mimicry in Photuris:

### Firefly Femmes Fatales

**Abstract.** Firefly females of the genus *Photuris*, long known to be carnivorous, attract and devour males of the genus *Photinus* by mimicking the flash-responses of *Photinus* females. Although suspected, this behavior had not been observed previously.

While observing firefly behavior, several naturalists have noted that females of the genus *Photuris* are carnivorous. Many, including myself, have discovered this by trying to keep groups of fireflies alive overnight in the same container. In the morning one usually finds one *Photuris* female and bits and pieces of all the rest. Barber (1) observed *Photuris* females in spider webs eating glowing fireflies that had been captured and wrapped by spiders. He also observed courting males of the genus *Photinus* receiving flashed responses from perched *Photuris* females. He asked: "Does she lure him to serve as her repast?" During the past three summers while working in the field on flash-communication in the firefly genus *Photinus*, I have made several observations which have a bearing on Barber's question.

In order to study the flash-communicative systems of fireflies it is essential to have females of the species being studied. Unfortunately, these are usually at a premium. An hour or two of searching may yield but one, more frequently none. The best method is to walk about the area flashing a pocket flashlight in a manner which simulates the flash-pattern of the males of that particular species. Although in competition with dozens or hundreds of male fireflies, the flashlight will often draw flash-responses from females 6 to 12 m away, while male fireflies are seldom answered at distances greater than 3 m. While searching in this manner for female *Photinus* fireflies, I have on five occasions received flash-responses from *Photuris* females.

1) *Fife, Goochland County, Virginia, 13 June 1963.* While searching in the site of *Photinus ignitus* Fall, I received a single flash-response to a quick flash of the flashlight after a delay of 5.5 seconds at 14°C. This is the delay time and flash of *P. ignitus* females. When collected after several more similar flash-responses, this female was found to be *Photuris* (2).

2) *Red Hills State Park, Lawrence County, Illinois, 24 July 1963.* During the early period of activity of *Photinus pyralis* (Linné) I located a *Photuris* female in a *P. pyralis* site by her flash given 2.2 seconds after a flash from my flashlight at 21°C. This is the time delay Buck (3) found for *P. pyralis*.

3) *Gainesville, Alachua County, Florida, 24 May 1964.* In the site of a large population of a species in the *Photinus collustrans* LeConte complex, two *Photurjs* females repeatedly answered my single flash with a single long pulse, I second in duration after a delay of about 1 second (the flash-and-delay-characteristics of this *Photinus* species). No *Photuris* males were seen.

4) *Gainesville, Florida, 6 April 1965.* The flash pattern of males in one species of the *Photinus consanguineus* LeConte complex consists of two short pulses separated by about 2 seconds. This phrase is repeated every 4 to 7 seconds. While searching for females I received a response from the direction of a low weed along a stream. The flash appeared greener and brighter than usual and upon investigation I found a large (14 mm), black *Photuris* female. One li-mm black *Photuris* male was later caught which emitted single, ragged, flickering flashes at intervals from 3 to 5 seconds in duration. I watched this female for the next half-hour, and during that time she responded to twelve passing males of the *Photinus* species with a single flash-response similar to that of the females of this species—a single pulse about 1 second after the second male pulse. All of these males were at least partially attracted to her. One flew into the stream. Two flew into the grass below her and then she stopped answering them; presumably she couldn't see their flashes. Eight of the males were attracted to within 1 m of her and then she stopped answering them. While answering, she would occasionally flash after the first male pulse and then again after the second pulse. Usually she answered only after the second pulse. I also noted that, as the males neared her, she greatly reduced the intensity of her flashes. The last male attracted, after three or four flash-exchanges, landed about 7 cm from her. After another flash sequence I turned on my light and found him 15 cm from her. Following the next flash exchange, after a pause of 10 to 15 seconds, I checked and found she was clasping him and chewing on his pronotum.

5) *Gainesville, Florida, 15 April 1965.* The flash pattern of the males in one species in the *Photinus cognizans* Green complex consists of two or three pulses delivered at 1.2- to 1.4-second intervals; the flash pattern is repeated every 10 to 14 seconds. Being unable to find females of this species, I tried unsuccessfully to attract the males, using a variety of different flashlight techniques. Later, while again searching for females, I received a response at 5.0 seconds delay after the last stimulus pulse at about 22°C. The response flash consisted of two, long, single pulses about two seconds apart. This female responded with a similar tlelay several times and, when collected, was found to be a *Photuris*. Using this flash-response I was able to attract several, although not all, of the *Photinus* males tested.

The answer to Barber's question has precipitated a deluge of new questions, not the least of which concerns the males of the genus *Photuris*. Is the female *Photuris* predaceous before she has mated? If so, how does her mate avoid the fate of attracted

*Photinus* males? Also of interest is the question of how this interspecific signaling developed in 'evolution. The most logical beginning would have the female *Photuris* preying on *Photinus* males of species with signal systems similar to their own. Finally, can a single *Photuris* species prey upon more than one *Photinus* species with different signal systems? In other words, how many flash patterns do *Photuris* females have in their "repertoires," and is predation on *Photinus* fireflies in any sense obligatory? Certainly, this kind of predation must have had effects on the evolution of the signal systems and other behavior of members of the genus *Photinus*.

JAMES E. LLOYD

*Department of Entomology,  
Cornell University, Ithaca, New York*

#### References and Notes

1. Barber, *Smithsonian Inst. Misc. Collections* 117 (1), 10 (1951).
2. No attempt was made to identify the *Photuris* specimens because of the confused taxonomic situation which exists in this genus.
3. Buck, *Physiol. Zool.* 10, 414 (1937).
4. This investigation was supported by USPI{S predoctoral fellowship No. I -F1-GM-22, 196-01, the Sigma Xi—RESA research fund, and the Bache Fund, grant No. 481. I thank Thomas I. Walker of the University of Florida, and Richard D. Alexander of the University of Michigan for their helpful suggestions and criticisms of the manuscript.

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