

Late-Season Patrolling Behavior and Flash Patterns of Female *Photuris lucicrescens* Barber (Coleoptera: Lampyridae)

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Late-season Patrolling Behavior and Flash Patterns of Female *Photuris lucicrescens* Barber (Coleoptera: Lampyridae)

Christopher M. Heckscher*

Abstract - Female fireflies in the genus *Photuris* are predatory on males of other firefly genera and are known to lure unsuspecting prey by mimicking female flash patterns. From 2004–2012, late-season (2 July–10 August) female *Photuris lucicrescens* were captured while emitting variable atypical signals on the wing and flying in loose associations in non-breeding habitat in Delaware and Pennsylvania. These observations corroborate those recognized by Herbert S. Barber in his description of the species over sixty years ago. I report these atypical flash patterns (single and multiple weak and bright flashes) and hypothesize that late-season *P. lucicrescens* might be patrolling non-breeding habitat in an effort to locate sedentary females who would respond to their variable male-like flash patterns. This hypothesis differs from traditional “femmes fatales” firefly models in that late-season female *P. lucicrescens* appear to be mimicking signaling males, rather than sedentary females, to locate prey.

The behavior of the firefly *Photuris lucicrescens* Barber has been a topic of interest since the species was described by Barber (1951). In the very first sentence of the species’ description, Barber notes: “... much remains to be learned of its behavior”. He continues his narrative with several atypical behavioral observations. Most puzzling are the various flash patterns reported by Barber. Flash patterns are assumed to represent a reproductive isolating mechanism in which each species has a species-specific pattern that can be recognized by potential mates. The typical flash pattern of *P. lucicrescens* is a single, rather long, crescendo that begins dim but rapidly increases in luminosity becoming brilliant then terminating abruptly (Barber 1951). That signal is usually given from among low vegetation sometimes by poising individuals and sometimes by individuals giving a zig-zag flight (Barber 1951). Barber (1951) also noted a rapid single flash given from tree canopies and a rare vibrato flash. The flash color has variously been described as green, yellow, greenish-white, and blue-green (Barber 1951; L. Faust, Knoxville, TN, pers. comm.; C.M. Heckscher, pers. observ.; McDermott 1967). Many photurids give multiple flash patterns, but no other mid-Atlantic or northeastern *Photuris* has such variable signal combinations.

My collection of Lampyridae from the mid-Atlantic and northeastern states includes several *P. lucicrescens* that exhibited atypical flash patterns. Upon examination of my specimens, early season (16 Jun–2 Jul) individuals usually have emitted the typical crescendo flash, but late season (6 Jul–10 Aug) individuals have showed far more variation, and the typical crescendo has not been observed in collected specimens after 2 July (Table 1). Further, females were always the late-season atypical flashers. I have not encountered males after 2 July. Barber (1951) also notes that late season *P. lucicrescens* are usually females. Examination of my field notes from collection sites indicates that atypical-flashing late-season females have usually been captured while moving through forest in small, apparently isolated yet cohesive, social groups (i.e., one following another). For example, while I was surveying for nocturnal Noctuidae in a Delaware xeric oak-pine woodland (atypical habitat for *P. lucicrescens*) on 12 July 2007, two females appeared moving toward my location, and both were emitting periodic single brilliant flashes with no discernible crescendo. This

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behavior of female *P. lucicrescens* begs an explanation.

Female *Photuris* of several species use a flash repertoire to exploit the signal system of male fireflies of various genera (Lloyd 1975). The mimicking of interspecific female flash patterns lures unsuspecting males, at which time they are captured and consumed (Lloyd 1990). Female *Photuris* consume male fireflies of other genera to obtain lucibufagins, which are compounds necessary for chemical defense (Eisner et al. 1997). Female *P. lucicrescens* are large *Photuris* and can be assumed to be among the predatory species (see Lloyd 1984). Because late-season females are not found in the presence of conspecific males it is unlikely these late season signals are intended for mating or otherwise targeted toward conspecific male prey. Nor is it likely these dispersing females are using their flash patterns primarily to illuminate the surrounding vegetation (e.g., Lloyd 1969), considering they use flashes of varying luminosity and pattern. Rather, I suggest that late-season females may leave breeding habitat (usually moist floodplain forest; Heckscher 2010) to disperse and patrol the surrounding forests in search of prey and possibly new breeding sites. The single and multiple flash patterns used by late-season patrolling *P. lucicrescens* are similar to those emitted by males of several other species in this region including some *Photinus* (e.g., *Photinus consimilis* Green, *Ph. marginellus* LeConte). By moving through various ecosystems, females could be “probing” for unsuspecting prey that may inadvertently respond to their flash attempts. This hypothesis differs from traditional interpretations of *Photuris* predatory mimicking behavior (e.g., Faust et al. 2012; Lloyd 1965, 1990) in that female *P. lucicrescens* may be mimicking male signals in an attempt to prey on responding sedentary females rather than lying in wait and signaling to passing males (e.g., Lloyd 1975). Male and female *Photinus* do not differ in their lucibufagin content (Eisner et al. 1997), so there is no reason why *Photuris* species, such as *P. lucicrescens*, should not exploit both male and female firefly prey to obtain that resource. If so, further investigation should reveal late-season female *P. lucicrescens* feeding on females. However, due to the unpredictable temporal and spatial nature of the patrolling behavior, we will likely have to wait for a serendipitous confirmation event.

I have compiled new information regarding the late-season flash patterns and behavior of

Table 1. *Photuris lucicrescens* Barber caught on the wing with flash voucher information in the private collection of C.M. Heckscher. The gender of individuals cannot be ascertained on the wing; therefore, the exclusive capture of females after 2 July is considered biologically meaningful.

Date	Flash description	General location	Sex
16 Jun 2004	Typical crescendo	New Castle County, DE	2♂
16 Jun 2011	Typical crescendo	New Castle County, DE	1♂, 1♀
28 Jun 2005	Typical crescendo	New Castle County, DE	♂
29 Jun 2012	Typical crescendo	Perry County, PA	♂
29 Jun 2012	Single rapid weak flash	Perry County, PA	2♀
1 Jul 2004	Single bright flash	New Castle County, DE	♂
2 Jul 2004	Typical crescendo	New Castle County, DE	♂
6 Jul 2005	Single rapid weak flash	Sussex County, DE	2♀
10 Jul 2008	Multiple bright flashes	Sussex County, DE	3♀
12 Jul 2005	Multiple weak flashes	Sussex County, DE	3♀
12 Jul 2007	Single bright flash	Sussex County, DE	2♀
16 Jul 2008	Multiple bright flashes	Sussex County, DE	2♀
19 Jul 2007	Single and multiple bright flashes	Kent Co., DE	2♀
29 Jul 2004	Single bright flash	Sussex County, DE	♀
10 Aug 2008	Multiple bright flashes	Sussex County, DE	♀

P. lucicrescens from the Middle-Atlantic states. These heretofore unpublished observations complement those reported by Barber (1951) and should assist in the field identification of this enigmatic species. The hypothesis presented to explain this species' variable signal patterns differ from published "femme-fatale" *Photuris* mimicking behavior in that I suggest female *P. lucicrescens* are mimicking male signals to locate sedentary female prey rather than remaining sedentary and signaling to passing males. However, the hypothesis will need field verification if its validity is to be determined.

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