

Behavior of Male *Ignelator luminosus*

Abstract:

Ignelator luminosus is a luminescent click beetle of the family Elateridae. A study was performed to measure the responses of males towards electronic beetles where two variables were manipulated: intensity of light and color of light. There was no significant difference between intensities. There was a significant difference among responses to colors.

Introduction:

Ignelator luminosus is a luminescent click beetle of the family Elateridae. *I. luminosus* is an extremely conspicuous insect in Dominica. A previous study done by Edith Kretsch (2000) provided many observations and ideas about the courtship behavior of *I. Luminosus*. This project expands upon her observations and ideas.

Male beetles fly in search of females, which wait on the ground. Edith Kretsch determined that females pulse their lights at two-second intervals to attract the males. Males turn on a ventral light that may serve as a spotlight as they approach the females. Edith Kretsch developed a method of observing the males by building an electronic female to lure the males to the ground.

My experimental design was based upon her observations. I made two electronic beetles to test male *I. Luminosus* responses to peak pulse intensity. I also used these devices to test the affect that a change in color of the dorsal lights would have on the male beetles. Research is being conducted on color polymorphisms of other luminescent Elaterids in Jamaica (Stoltz, Personal communication). My hypothesis is that the higher the intensity of the lights, the stronger the males response.

Materials:

I constructed the electronic beetle using copper wire, alligator clips, a 24 ohm resistor, a battery pack of two 1.5 volt AA batteries, two 2v, 20ma light emitting diodes, and a rheostat (Figure 1). The apparatus was set up so that a wire ran from the battery pack where it split into two wires. These two wires were attached to different light emitting diodes (LED). The unattached parts of the LED's were wound together and another wire was attached to them on one end and the rheostat on the other. This rheostat allowed me to pulse the LED's with varying intensity. Another wire was attached to the rheostat and to a resistor. A final wire was stretched between the resistor and the battery pack. The LED's were placed right next to the light emitting organs on the pronotum of a dead female beetle. The beetle was then pinned to Styrofoam and the whole apparatus was taped to a larger piece of Styrofoam.

Methods:

Two of the electronic beetles were made to be used simultaneously in the field. Initially a live female control was attempted, but this became unfeasible and was abandoned. I began the experiment with initial observations conducted on the nights of May 31 and June 1, 2002. The electronic beetles were taken to one of two spots: the trail from Springfield Station to the Check Hall river or the Bee House at Springfield Station. I placed the electronic beetles at the Bee House next to two groves of trees, a pond, and a field. The trail to the Check Hall is surrounded by forest.

Electronic beetles were placed one to two meters apart on the trail. Male responses were recorded as landing, low flyovers (within one foot), and mid level flyovers (within 4 feet of the beetle). The LED's were left on the brightest settings until

males approached. At this time the pulse intensity was varied with one apparatus being pulsed from low to medium intensity and the other from medium to high intensity. Pulse intensities for the color phase were low to medium, because low to medium pulses elicited the most responses.

Observations for the pulse intensity phase were conducted between June 2, 2002 and June 9, 2002 for a total of 3 hours and 55 minutes. Observations for the color phase were conducted between June 10, 2002 and June 15, 2002 for a total of 2 hours and 35 minutes.

Results:

Table 1. Behavioral responses of male *Ignelator luminosus* to different model females.

	Low to medium green pulse	Medium to high green pulse	red pulse	Orange pulse	pooled red and orange
Number of landings	6	6	1	3	4
Number of low flyovers	14	12	7	10	17
Number of mid level flyovers	28	20	0	4	4

Table 2. Statistical Analysis

	Intensity	Color
Degrees of Freedom	2	2
Chi Square	.329	12.705
Chi Square p-value	.8484	.0017

Discussion:

Data from all experiments is presented in Table 1 and results of contingency table analysis of selected results are shown in Table 2. For the second set of experiments, trials with red and orange LED's were pooled to provide expected cell values of at least 5.0. Intensity comparisons in Table 2 are between different intensities of green LED's. Color comparisons in Table 2 represent totals for low to medium green pulses compared with the pooled red and orange LED totals.

Male *I. luminosus* did not show a clear preference towards the brighter intensity. As table 2 shows, there was not a significant difference between the low to mid intensity and the mid to high intensity. The hypothesis was based on the assumption that the greater the stimulus, the more interested the males would be. It may be possible that a mixture of different intensities is necessary for the male to be fully interested. There may be a more complex signaling system.

Male *I. luminosus* did show a significant difference in their reaction to the red and orange LED's as compared to the more natural (to our eyes) green light (see table 2). The largest change in behavioral response was an increased number of low level flyovers

and decreased number of mid level flyovers compared with green LED's. There are various possible explanations for this fact. *I. luminosus* may perceive colors differently. Therefore the different colors may even appear brighter or closer to a real beetle. There might also be an aspect of curiosity in the males, since they are presumably seeing these colors for the first time.

I obtained several interesting observations in *I. luminosus*. Initially a female was followed to observe natural conditions. I watched many males circle and investigate her. The female pulsed as Edith Kretsch previously determined, at a pulse close to a one second interval. The female pulsed at different intensities, but when copulation actually occurred she was pulsing brightly.

I obtained other observations during the course of the experiment. The beetles tend to fly in groups. Many times during the experiment, three to five males would fly around the apparatus for several minutes. Afterwards, I would not have any flyovers for many minutes. While at the Bee House, I noticed that many males would fly low over the field, many would fly low over the pond, and many would wait in the trees. I could not determine if the low flying males had seen females and descend from the trees, or if they were initially flying low in search of females. Females were observed on surface plants on the ponds. On June 8, I was able to set up next to a live female. I noticed a male who was near the female, but left quickly and approached the electronic beetles instead. I also had a firefly land on the red lighted electronic beetle.