Courtship Behavior of *Ignelater luminosus*

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Study Abroad Dominica 2000

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Introduction

One of the most conspicuous and interesting insects on Dominica is the bioluminescent click beetle. Using Costa (1975), it was concluded that the Dominican Elateridae is *Ignelater luminosus*. The male antennae is elongate and surpasses the hind angles of the prothorax. The pronotal luminous spots are slightly convex and visible above and beneath the proepisternum. The ventral light producing organ is on the base of the first abdominal sternite, facing the posterior face of the metasternum under the hind coxae.

Many entomological scientists have based their whole lives on the study of insect behavior, however bioluminescent Elateridae behaviors have not been well studied. Entomologists are not sure of the function of the two pronotal thoracic light organs. There is debate concerning whether or not the lights are used as aposematic coloration or for mate recognition. A few very general statements have been made about Dominican *I. luminosus* concerning the use of its lights in mating. The research that follows concerns *I. luminosus*. The goal of the study concerned the use of the thoracic lights to communicate mating information and whether their copulation is pheromone or light induced.

Materials and Methods

The research was conducted over a 20 day period. First general field observations on *I. luminosus* mating behaviors were made. Then an artificial light producing beetle ("robo-beetle) was built in an effort to simulate the hypothesized beetle mating ritual. This would determine if male *I.* luminosus could be attracted to the model in which no pheromones would be present. Robo-beetle was constructed by inserting 2v, 20MA green, light-emitting diodes in appropriate position in the pronotum of a dead male beetle. Robo-beetle was powered by 2AA cell batteries (3v total) with a 25ohm resistor in the circuit

(Figure 1). Based upon preliminary field observations, two further modifications were necessary. First, a button-switch was installed to interrupt the circuit when depressed. (1, Figure 1) Then a rheostat was attached that allowed variation in the intensity of light production.(2, Figure 1) Observations were initially done using constant light production on the prototype.. After observing these interactions between males and females, robo-beetle was altered to manually blink in order to better lure male beetles. The altered robo-beetle was placed with captive live females in the field where observations and comparisons were made. Finally, robo-beetle with varying intensity rheostat and four live females were alternately and comparatively utilized and final observations were recorded.

Observed Results

The first field observations (May 21) revealed that *I. luminosus* emerges in the evening around 7:15 p.m. The males fly actively while the females stay on the ground. The next observations (May 23) were made with the robo-beetle. As the males fly down from above to investigate a female, or robo-beetle, they turn off their pronotal lights and turn on a type of ventral spotlight. This spotlight is located just under the plates on the first abdominal segment. When the males came in to investigate robo-beetle they did not land. The males briefly flew in low circles shining their ventral light. This light seemed to flicker slightly. Then they flew away. This happened continually until around 8:30. Then the males flew up into the canopy. The next observations (May 24) were conducted with the altered manual blinking robo-beetle. Again the beetles emerged around 7:15 p.m. Many males flew in circles as the robo-beetle was keyed to blink. Eight beetles landed and 7 them were caught. All were males. None of the males that landed copulated with the robo-beetle. Some females were caught along the trail and put into plastic jars with mesh lids. They were then placed some distance away. The males did not fly over to the females but continued to fly around the robo-beetle. However, when comparing the captured females and males it was noticed that the females are much larger and more robust than the

males (Figure 2). The females also have brighter lights that are spaced farther apart than the males. The next two days (May 29 and 30) of observation were done up on Mount Joy. These days were very windy with intermittent rain showers. There was not much beetle activity. The next night of observation (June 1) was conducted back down at the Check Hall River. After the males came out robo-beetle was turned on and the lights were made to flicker. Twenty or more males came to investigate but none landed. After about thirty minutes one of the captured female beetles began to glow. She was released. The female did not fly off, but instead crawled up on a log and started to glow. It was noticed that the females do not flicker as previously thought. Their pronotal lights slowly fade in and out in about two second intervals. Another one of the captured females began to glow; hence, she was released as well. This female also began to fade her pronotal lights in and out slowly. She also began to oscillate from side to side slowly. The first female also began to swivel. Eight males began to fly around them. One came in very close, turned off his pronotal lights, and turned on his ventral light. As he was observed it was noticed that the males do not flicker; the appearance of flickering is caused by the way the way their wings shadow their ventral light. The male flew in a circle spot-lighting the ground around the first female. He landed beside her and crawled up on her. The male then lowered his abdomen and the two copulated for about five seconds. This happened two other times with the first female. Then copulation happened two times with the other female. The next night of observation (June 2) was conducted with another alteration to robo-beetle. A rheostat was inserted in order to make the lights fade in and out at two second intervals. Again the males started flying about around 7:30 p.m. Three males flew in circles around the robo-beetle while spotlighting. Then two flew off while one landed and tried to copulate with robo-beetle. During the rest of the observation time, around fifteen more males circled and one more tried to copulate with robo-beetle.

Discussion

The May 23 observations that used the robo-beetle showed that the males turn on a ventral light. Because the ventral light producing organ is on the base of the first abdominal sternite and faces the posterior face of the metasternum under the hind coxae, the only way one can see that light could be emitted is if they lifted and flexed their abdomen in some way. It was also noticed throughout that the males spotlight the area around a female, or robo-beetle, while flying in circles. This may be to scan for predators such as *Gegacarcinus sp.* or *Leptodactylus fallax*. The observation on May 24 had the robo-beetle and some females in mesh lid jars. Mesh was used to release any pheromones produced by the females. The robo-beetle attracted all the males in the area and none of the live females attracted the males. The observations on Mount Joy revealed that *I. luminosus* prefer areas protected from high winds and rain. They seem to prefer hot muggy nights with no wind. On June 1 the captured females began to glow and it was observed that they fade their lights in and out slowly. The rheostat allowed me to mimic this behavior. This led to the two copulations with robo-beetle on the night of June 2. These copulations show that the lights can be used for mating and that copulatory pheromones are not necessary to induce copulation.

Conclusion

Insect biology and behavior are very interesting subjects; however, it takes patience and tenacity in order to obtain good results. Even though I was only able to observe *I. luminosus* courting behavior for three weeks I believe that it consists of the following behaviors:

1. The beetles emerge from their diurnal hiding spots around 7:15.
2. The females are on the ground alternately fading in and out their pronotal lights.
3 The males fly around with their pronotal lights on until they see a female.
4. The males turn on their ventral spotlight and fly in circles around the female while searching and spot-lighting the area.
5. The males land next to the female and crawl up on her to copulate.

6. The above goes on until around 8:30 when the males fly up into the canopy.

Copulation by *I. luminosus* does not require the emission of mating pheromones by the female. This beetles reproductive ritual makes use of light signals to identify potential mating partners. Hopefully, further studies will be done on nesting behavior and brood care of females. It would also be interesting to discover if the larvae also have bioluminescent capabilities.

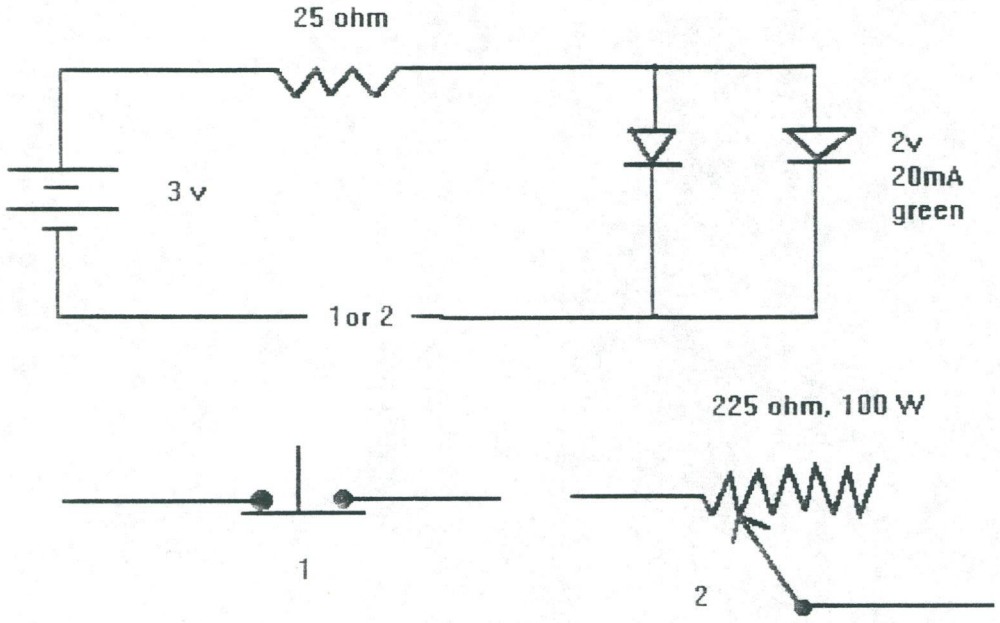
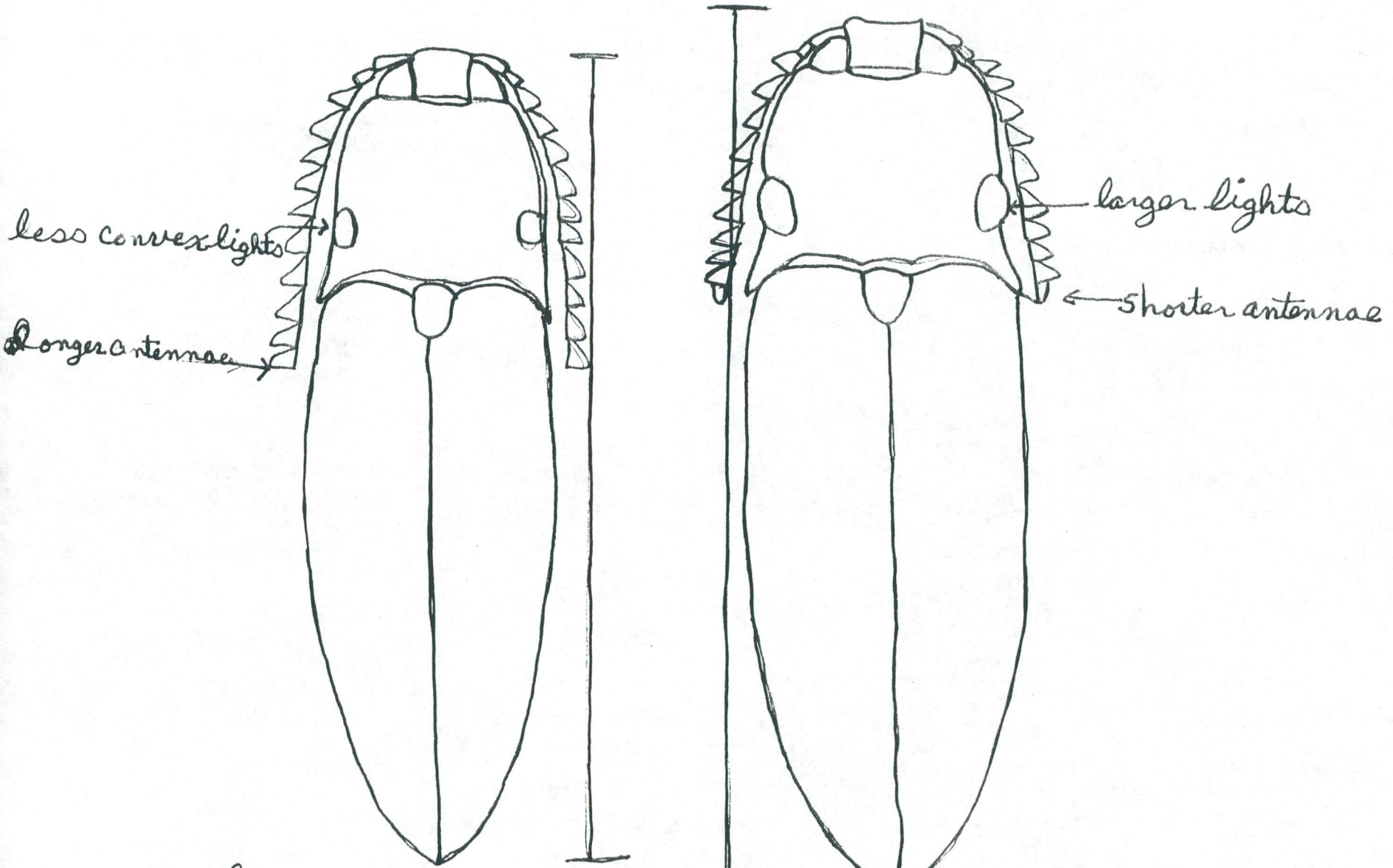


Figure #1

Figure #2

* figure from p. 220
Costa, C. 1972.



Male ♂

I. luminosus

♀ female

I. luminosus

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Dr. Woolley and Dr. Lacher, Brilliant Minds of Our Time (*H. sapien*). Frontal lobes (sense of humor).