

**Light Signal Preference of *Robopus lutzi* (Coleoptera: Lampyridae) in
Primary Rainforest in the Commonwealth of Dominica**

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Abstract

This experiment was conducted in the Commonwealth of Dominica in the primary rainforest around Emerald Pool, Morne Trois Pitons National Park. The light preference of *Robopus lutzi* (Leng and Mutchler) (Coleoptera: Lampyridae) was observed using six variations of light signals: solid red, flashing red, solid yellow, flashing yellow, solid green, and flashing green. Two trials were completed on separate nights, 10-VI-2015 and 13-VI-2015, from approximately 8:30 P.M. to 11:00 P.M. *Robopus lutzi* were captured most often by the use of solid patterned lights and red colored lights. Although fewer were captured when compared to the use of red light (620-750 nm), yellow light (570-590 nm) resulted in more observed *R. lutzi*. Because the emission range for lampyrids is 548-575 nm, it is notable that fewer *R. lutzi* were captured with the use of yellow light than with red light.

Keywords. *Robopus lutzi*, Lampyridae, Coleoptera, Dominica, bioluminescence

This study analyzed the effectiveness of various light colors and light patterns on attracting *Robopus lutzi* (Leng and Mutchler) (Coleoptera: Lampyridae). Yellow, red, and green light colors were tested using two patterns, solid glow and rapid flash. *Robopus lutzi* (Fig. 1-3) is endemic to the island of Dominica (Peck 2006). Few research projects have been conducted on *R. lutzi*, so little is known about the behavior of this species.

Lampyrids are known for their bioluminescent abilities. The light-producing organs are located on the ventral and posterior sides of the abdomen. In the presence of magnesium ions, adenosine triphosphate (ATP), and oxygen, luciferase oxidizes luciferin to release cold light energy. The pattern of light emitted primarily functions to attract members of the opposite sex for mating, and as a result the pattern is typically specific to individual species (Triplehorn 2005).

Light emitting diodes (LEDs) have been used to mimic and attract bioluminescent beetles in previous studies (Branham 2003, Reyes and Lee 2010). Fireflies are generally attracted to lights in the range of 560 to 575 nm, although the emission range of fireflies can be from 548 to 575 nm (Branham 2015, personal communication).



Fig. 1. Dorsal view of *Robopus lutzi*.



Fig. 2. Ventral view of the posterior sternites of *Robopus lutzi*, showing light-producing organs.



Fig. 3. Anterioventral view of *Robopus lutzi*.

Materials and Methods

Samples of lampyrids were collected from a primary rainforest habitat at Emerald Pool, Morne Trois Pitons National Park, on 6-VI-2015, 10-VI-2015, and 13-VI-2015. In the initial sample, which was conducted on 6-VI-2015 from approximately 8:30 P.M. to 10:00 P.M., the collected lampyrids were identified by Dr. Marc Branham as *R. lutzi* (personal communication). The specimens were kept in separate 20 mL disposable scintillation vials, each of which had a mesh cover secured in place with a small rubber band. Data collection for Trial 1 occurred on 10-VI-2015 and Trial 2 on 13-VI-2015 from approximately 8:30 P.M. to 11:00 P.M. each night of collection. Three sources of light were used to attract lampyrids: a red head lamp, a green head lamp, and an artificial firefly. The artificial firefly was constructed with one yellow diode, two 1.5 V AA batteries, one paint stirring stick, electric tape, alligator clips, one button, and wiring (Fig. 4). Samples were collected using solid red, flashing red, solid green, flashing green, solid yellow, or flashing yellow lights at different locations. Three repetitions were completed for each of the six lights used, and each repetition was conducted for three minutes. The first sample was taken using a randomly selected light signal at the locality of DOMINICA: St. Paul Parish: Emerald Pool, Morne Trois Pitons National Park, 15.3954000°N, -61.3106500°W, 410 m. The samples were collected 50 paces from each previous sampling location until the last sample was taken at the end point of DOMINICA: St. Paul Parish: Emerald Pool, Morne Trois Pitons National Park, 15.39672°N, -61.31418°W, 453 m. The lampyrids that flew within range of capture were collected using insect nets or by hand capture and stored in separate vials. The collected specimens were either pinned, point mounted, or preserved in 95% alcohol for further analysis.

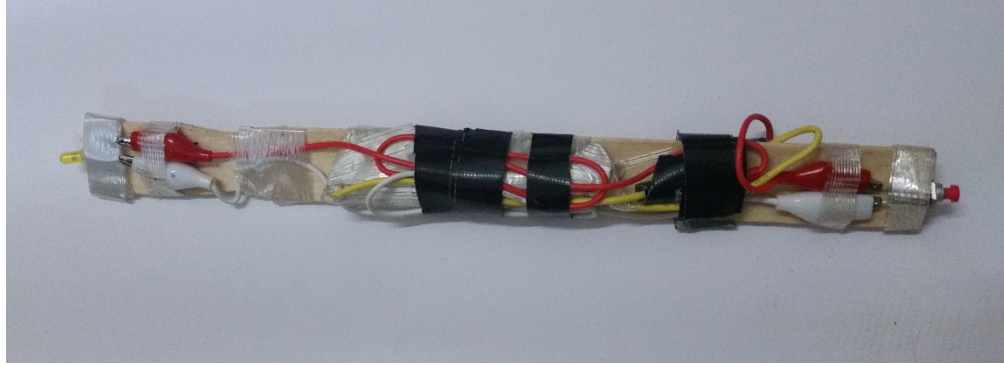


Fig. 4. Artificial firefly for production of yellow light.

Results

During Trial 1, a total of five *R. lutzi* were captured and seven were observed (Fig. 5). The solid red light resulted in the capture of three *R. lutzi*. None were captured using the flashing red light, but one was observed. Using the solid yellow light, one *R. lutzi* was captured and three were observed. Only one *R. lutzi* was observed for Trial 1 using the flashing yellow light. No *R. lutzi* were captured or observed with the solid green light. Use of the flashing green light resulted in one capture and two observations.

During Trial 2, a total of five *R. lutzi* were captured and 40 were observed (Fig. 5). The use of solid red light resulted in the capture of four *R. lutzi* and seven observations. Using solid yellow light, one *R. lutzi* was captured and 11 were observed. *Robopus lutzi* were observed while using each of the six types of light signals. Four were observed with the use of flashing red light, seven with flashing yellow light, five with solid green light, and six with flashing green light.

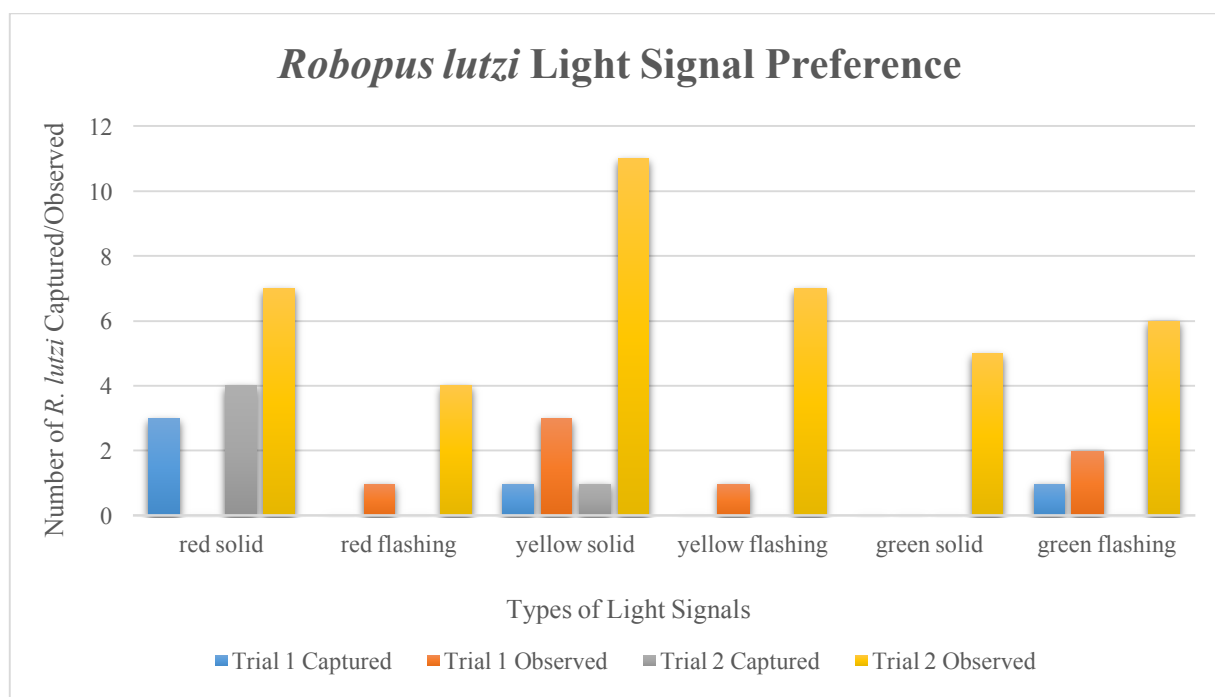


Fig. 5. The number of *Robopus lutzi* captured or observed for each of the light signals used.

Trial 1 was conducted on 10-V-2015 and Trial 2 on 13-VI-2015. Trial 1 Captured is shown in blue, Trial 1 Observed in orange, Trial 2 Captured in grey, and Trial 2 Observed in yellow.

Discussion

Based on the results of this experiment, *R. lutzi* preferred solid red light (620-750 nm) over the other types of light signals used. The highest number of captured *R. lutzi* corresponded with the use of solid red light, although solid yellow light (570-590 nm) resulted in the highest number observed. Based on information provided by Dr. Marc Branham (personal communication), fireflies generally emit light in the range of 548-575 nm. Because yellow light is within their emission range, more *R. lutzi* may have initially been attracted to the light source. It is unusual that red light resulted in the capture of the most *R. lutzi* since one would not expect them to be attracted to wavelengths outside of their emission range. The use of green light (495-570 nm),

both flashing and solid, appeared to be the least attractive to *R. lutzi*. This could be due to the high intensity of the green light used during this experiment. For further studies, light intensity could be standardized to reduce variation.

The flashing light signals of the three colors used appeared to be less attractive to *R. lutzi* than the solid light signals of each color. The only exception was seen while using the green flashing light, with which one *R. lutzi* was captured. This could be due to the *R. lutzi* already being within close proximity of the sampling location at the start of the repetition. Based on both field observations during this study and comments from Dr. Marc Branham, the genus *Robopus* emits either a constant or slowly modulating glow (personal communication). Their limited emission capabilities could explain why *R. lutzi* appeared to be more attracted to the solid light signals than the flashing light signals.

Because more *R. lutzi* were observed than captured, repetition time should be increased from three minutes to a minimum of six minutes. Due the limited amount of time available to conduct this experiment, only two trials were completed. Additional trials are required to expand the data set, which would allow for statistical analysis. Future studies could be conducted on the behavior of *R. lutzi* to further the understanding of this endemic Dominican lampyrid. The behavior of *R. lutzi* could be studied in other habitats, such as secondary rainforest, elfin forest, and dry forest, to test for variations in light color and pattern attraction. Further studies could be performed using shorter and longer wavelengths of light, as well as increased variation in light emission patterns. Another aspect of this experiment that could be expanded upon is changes in behavior during different times of the day, such as sampling at dusk and dawn. Due to limited understanding of *R. lutzi*, there are many opportunities to further knowledge about this species.

Acknowledgments

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