

Light Pollution's Impact on the Synchronous Lighting Behavior of *Photuris frontalis*

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Hypothesis

It is hypothesized that there is a negative relationship between light pollution and the synchronous lighting behavior of *Photuris frontalis*.

Intended analysis

- Number of deviations from standard flash pattern is our continuous dependent variable
- Intensity of light pollution is categorical
- We will use a t-test to analyze our results
- T-test will help us determine how closely related level of light pollution and *Photuris frontalis* bioluminescent flash deviations are

Predictions

- It's predicted from this study that as light pollution intensity increases, the bioluminescent synchrony of *Photuris frontalis* will decrease and thus deviations will increase
- Caused by the artificial light inhibiting the important light-producing enzyme, luciferase, and thus proper bioluminescent communication with other *Photuris frontalis* (Gould et al., 1988)

Motivations

- Although often neglected in conservation efforts fireflies have a unique cultural significance across the globe which has led them to hold an economic value as an eco-tourist attraction in diverse habitats (Copeland, 2004).
- Fireflies are important to biodiversity; they contribute in keeping slug and snail populations at bay and act as pollinators to various plant species (AMNH, 2012).

Background

- Light pollution is a significant threat since fireflies rely on bioluminescent courtship signals to locate their mates (Lewis et al., 2020).
- Studies show that artificial light at night can lead to issues such as a decrease in female response to courtship signals, and general reduction in mating success (Guarino, 2020).
- *Photuris frontalis* a firefly species native to North America performs synchronous flashing that specifically occurs while in flight. However, there are few studies on how light pollution effects this special species (Copeland, 2004).

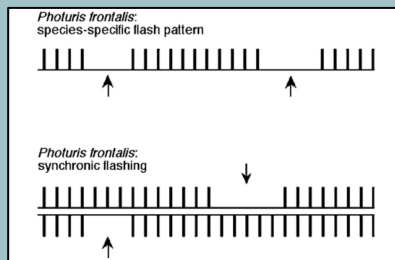


FIGURE 2. Visual of photuris frontalis synchronized flash precision and patterns, arrows indicate breaks in flashing of an individual, the bottom figure is representative of two individuals (Copeland, 2004).

Study design

Species: *Photuris frontalis*

When: May 14th to June 14th from 8 - 10pm

Location: Congaree National Park, SC

Identification: Given that the fireflies will remain in their natural habitats in an effort to maintain natural behavior patterns, identification will solely take place based on particular bioluminescent color of flash and flash patterns. Flash patterns demonstrated in figure 2 will be thoroughly studied till they can be distinguished among others. The presence of other species will ensure the continued use of unique synchronous flashing to attract particular mates.

Research plots: 20 x 20ft research plots with similar vegetation across all sites. Three sites, each 1 km apart. Sites will differ in light pollution, Site 1; high light pollution, Site 2; medium levels of light pollution, Site 3; low levels of light pollution. Light pollution levels will range from high values of 22 SQM to low levels of 20 SQM.

Data collection: Data will be collected twice a week. Thirty observations will be collected in total, 10 for each site.

Parameters: Data can only be collected between 70-80 degrees Fahrenheit, if not ideal temperature data collection will have to be moved to another day.

Quantifying light intensity: A portable spectrophotometer will be used to record light pollution values during data collection periods, providing a reading in magnitudes per square-arc-second. This will simply be used as an observation variable to ensure that low, medium, high site classification remains accurate. Numerical values will be known and recorded but categorical (high, low, medium) will be used in data representation.

Quantifying synchronicity: Synchronicity will be quantified using video recordings of the firefly activity to detect the deviation from synchronicity. The number of deviations is the true specified dependent variable of interest. Furthermore, using video footage a rough estimate of firefly numbers can be counted and used to assess statistical error.



FIGURE 3. Map of Congaree National Park, SC depicting research site locations. Sites are distanced 1 km away from one another, totalling three site locations with differing light pollution intensity. Map provided by: Congaree Maps | NPMaps.com