Insect attraction to different colored lights near Lake Itasca State Park.

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Ecological light pollution has a major impact on millions of insects throughout the world. The flight-to-light response occurs when nocturnal insects fly towards an artificial light. We tested if insects would show equal flight-to-light response towards red, blue, and white light. This was done by hanging a light for 15 minute intervals with different colored bulbs and counting the number of insects that were near the light. We found insects in the order lepidoptera were significantly more attracted to the white light.

Introduction

Humans have been searching for ways to illuminate the night for millennia. Until the invention of electric lights, the affect of the light on the ecosystem was fairly small. However, in the present day, artificial light has completely altered the nighttime environment throughout much of the world. The altering of the environment from artificial light sources is known as ecological light pollution. Ecological light pollution has a major effect on the behavior and population of many organisms. Overall, these effects come from changes in orientation and the attraction or repulsion from the artificial light. This can affect reproduction, communication, foraging, and migration (Longcore & Rich 2004).

It is well known that a wide variety of insects are affected by artificial light. One of the most known affects is the flight-to-light response. This is when organisms are attracted to light even at their peril. There are two hypotheses for this response. The first is the compass theory. This theory states nocturnal insects use celestial light to orient themselves in order to fly in a straight line. The divergent beams from the artificial light cause the insect to spiral ever closer to the light. The other hypothesis is the open space theory. This theory assumes insects fly to open space for their nightly actions. Open spaces are generally brighter because trees are not blocking the celestial light. Insects mistake artificial lights for open spaces and then fly to them (Altermatt et al. 2009).

Like all animals, insect's sensitivity to light varies by wavelength. However, most species of insect have a very similar sensitivity curve when it comes to different wavelengths. Their range of vision goes from less than 340nm to more than 700nm (Langer et al. 1978). The maximum responses have been obtained within the green band around 520nm. The responses dropped sharply toward the red band and less sharply toward the violet (Weiss 1994). We are testing which color of light will attract the largest number of insects. We predict white light with all the wavelength will attract the most, the blue light attracting slightly less, and the red light attracting the least.

Materials and Methods

For this experiment, a light was hung 1.25m above the ground. It was approximately 50m from the shore of Lake Itasca in Minnesota. Three different light bulbs were used. There was a red bulb, a blue bulb, and a white bulb, and all three bulbs were 25W. They were all manufactured by Sylvania. Behind the light, a white bed sheet was hung, and a 50cm×28cm rectangle was taped off with the light in the center. Every 15 minutes the number of insects were counted and categorized by order within the rectangle. The light was then turned off and the sheet shaken of all insects. The light bulb was then changed to one of the other colors, and turned on after one minute of darkness.

Measurements were taken on four different nights from June 17 to June 21. The first night I went from 22:40h to 24:37h. The second night I went from 21:53h to 4:46h the next day. The third night was from 22:13h to 4:19h, and the last night was from 21:45h to 23:15h.

Results

There was no significant difference between the amount of diptera attracted to the different colored lights (F=0.56, df=59, P=0.58). There was also no significant difference in the amount of trichoptera (F=0.59, df=59, P=0.56) or ephemeroptera (F=0.42, df=59, P=0.66) attracted to the lights. There was a significant difference in the amount of lepidoptera attracted to the different colored lights (F4.13 df=59, P=0.02).

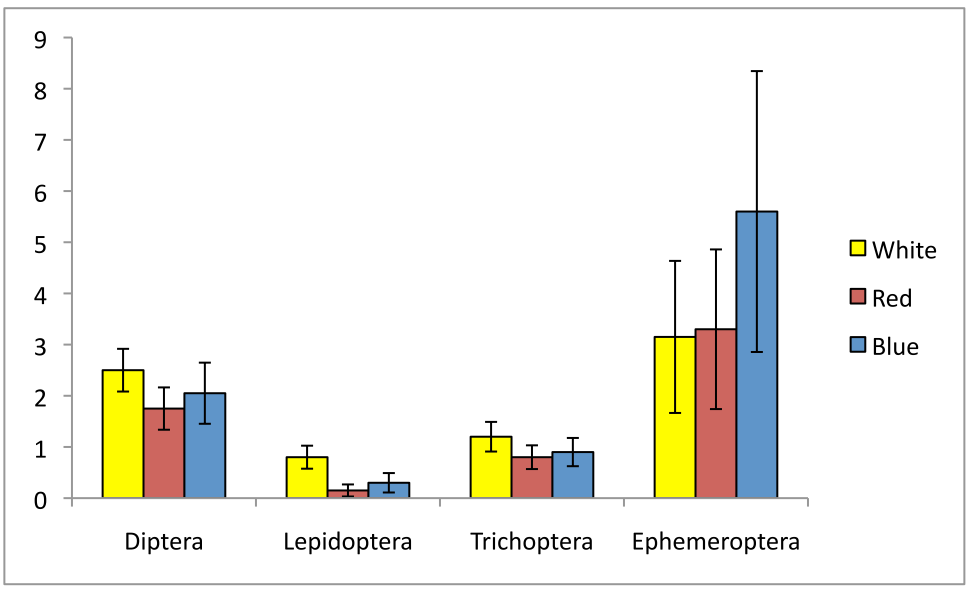

Figure 1: Mean ± SE average number insects attracted to the light in a 15 minute period categorized by order.

The lights also attracted a few hymenoptera. However, there were not enough of them to analyze.

Discussion

Our experiment showed no significant difference between the different colored lights for most insect orders. The only group with a significant difference was the order lepidoptera were more attracted to the white light. However, even though we did not find a significant difference our data does follow the trend we expected. I feel with more data we would find our hypotheses to be correct. In experiments with 15,000 insects, it was found over and over again that they're vision follows this pattern of sensitivity (Weiss 1944).

Further research is needed in this area. First we would to attempt the experiment with a green light used. Insect's eyes are most sensitive to light in this area, so we except green will draw more insects than either blue or red. We would also like to attempt this study in other locations. We believe if conducted further from the water we may get different results. In our study, we also noticed a trend with different insect orders appearing at different times. We feel this phenomenon should be investigated further. Lastly, we would like to provide information to end the debate between the open space theory and the compass theory of flight-to-light response. According to open space theory the insects should fly straight towards, and compass theory says they should spiral ever closer. We would like to watch individual marked insects to find their path to the light.

References

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