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COLOR DETECTION IN FRESHWATER AMPHIPODS (*GAMMARUS MINUS*)

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ABSTRACT

This study tested whether different lighting affected the color preference of the aquatic amphipod *Gammarus minus*. These amphipods were given choices between residing above either a green or blue floor under differing light conditions. Amphipods were counted on each side in a given time interval. After analyzing data, it was concluded that different lighting did affect the color preference of *Gammarus minus*. In red light, *Gammarus minus* preferred a green floor color. In soft white light, *Gammarus minus* preferred a blue floor color. The results were statistically significant $p<0.05$. Future implications for this research could include testing additional floor and light colors to see which ones the amphipods are able to detect.

Keywords: amphipods, Gammarus minus*, preference*

INTRODUCTION

The *Gammarus minus*, or the Amphipod, is a crustacean-like macroinvertebrate found in fresh waters. Locally, these can be found in springs. A topic of interest for us was their eyesight, specifically the way they perceive color. According to Smithsonian Magazine, “While the vision was blurry, these eyes allowed the crustacean to see nearly 360 degrees save for a small blindspot directly behind its head. The larger eyes at the top of its head were much more focused and powerful, allowing the amphipod to see surprisingly far in the dark.” However, not much is known about their ability to see color. Another species that is similar to the amphipod is the isopod. It is worth noting that isopods potentially have the ability to perceive color to a degree. Aurora Nelson from The University of Washington states “This species is highly likely to have color sensing abilities as a way of adjusting their chromatophores, so they may use those abilities to search for a substrate that they can match. I placed isopods in containers where they had access to three different colors of algae.” when performing an experiment on *Lirceus* , a marine isopod species. We decided to test the ability of color recognition and preference in amphipods. Using the referenced literature, we felt that giving the amphipods the choice between a blue and a green floor would be best to test whether they had a preference in color. We tested under both direct white light and red light. We predicted that under the soft white amphipods will prefer blue, but under the red light, they will have no preference.

MATERIAL AND METHODS

In this experiment, our lab group used an array of different materials that aided us in getting the necessary results. The amphipods used during this experiment were collected from Linden Hall in State College, PA and were housed in a large container in an environmental control room.. This fridge was ten degrees Celcius consistently during this experiment and none of the amphipods were taken out of said environment. There were hundreds of amphipods in this large container, but only 300 random individuals

were chosen for the entire experiment. For the main setup, a cardboard box is placed on a cart with a lamp hovering and is placed in the fridge. The lamp housed a red light bulb (60 watt) and a soft white light bulb (incandescent, 60 watt) which was used in the hope that amphipods acted differently under different light stimuli. To house the amphipods during the trial runs, they were placed in one of three flat petri dishes (3.5 in x 3.5 in). Under each tank was a sheet of paper that was half blue (dark color) and half green (bright color) to monitor color preference of the amphipods. A few other materials used in this experiment include a stopwatch, materials to record observations (pen/notebook), a plastic pipette to move/transfer amphipods, and tape (attach paper to tanks/label each tank).

In addition to materials, this experiment had several methods that were followed and never changed throughout the entire experiment. Before running each trial, the thirty amphipods in the trial runs were acclimated to both lights (red and white) for ten minutes before data was recorded in their designated tanks. Once acclimated, the number of amphipods on each color (blue/green) was recorded every thirty seconds for a total of ten minutes in each tank. Once each trial run was concluded, amphipods were released back into their original holding tank and thirty random amphipods were chosen for the next run. In total, five runs were completed under each light condition and 300 amphipods were sampled over several days.

RESULTS

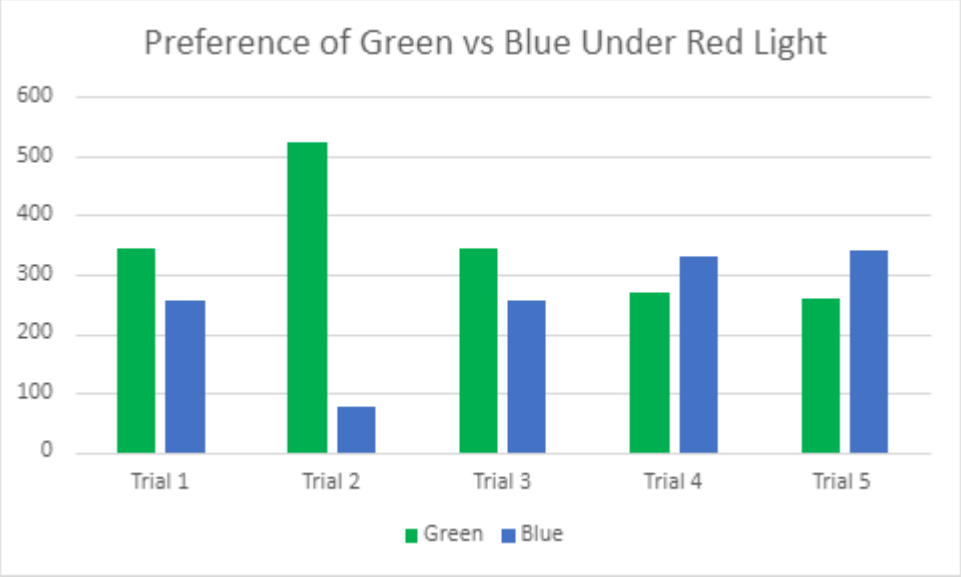

Figure 1. Bar graph showing amphipod preference under soft white light (60W).

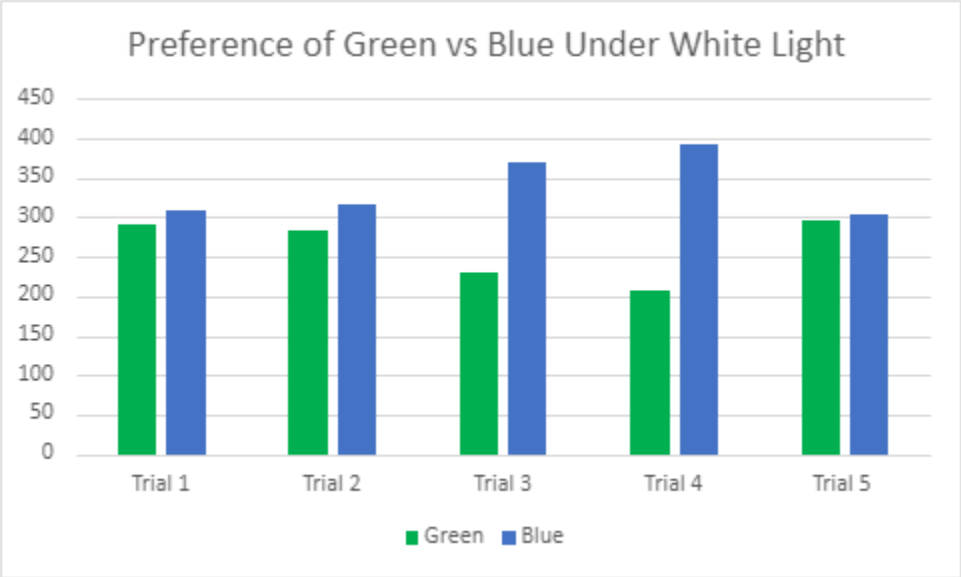

Figure 2. Bar graph showing total amphipod color preference under red light (incandescent, 60W).

Results						
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	*Row Totals*
Green	344 (348.80) [0.07]	525 (348.80) [89.01]	344 (348.80) [0.07]	271 (348.80) [17.35]	260 (348.80) [22.61]	1744
Blue	256 (251.20) [0.09]	75 (251.20) [123.59]	256 (251.20) [0.09]	329 (251.20) [24.10]	340 (251.20) [31.39]	1256
Column Totals	600	600	600	600	600	**3000 (Grand Total)**

The chi-square statistic is 308.3648. The *p*-value is < 0.00001. The result is significant at $p < .05$.

Figure 3. Red light (incandescent 60W) Chi Square of Independence to look at goodness of fit in green versus blue preference. Chi square statistic = 308.3648. p<0.05.

Results						
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	*Row Totals*
Green	291 (261.40) [3.35]	283 (261.40) [1.78]	229 (261.40) [4.02]	207 (261.40) [11.32]	297 (261.40) [4.85]	1307
Blue	309 (338.60) [2.59]	317 (338.60) [1.38]	371 (338.60) [3.10]	393 (338.60) [8.74]	303 (338.60) [3.74]	1693
Column Totals	600	600	600	600	600	**3000 (Grand Total)**

The chi-square statistic is 44.8708. The *p*-value is < 0.00001. The result is significant at $p < .05$.

Figure 4. Soft white light (60W) Chi Square of Independence to look at goodness of fit in green versus blue preference. Chi square statistic = 44.8708 p<0.05

Results						
	Green	Blue				*Row Totals*
Red	1744 (1525.50) [31.30]	1256 (1474.50) [32.38]				3000
White	1307 (1525.50) [31.30]	1693 (1474.50) [32.38]				3000
Column Totals	3051	2949				6000 (Grand Total)

The chi-square statistic is 127.3495. The *p*-value is < .00001. The result is significant at $p < .05$.

Figure 5. Chi Square of Independence comparing soft white light (60W) to red light (incandescent 60W) in green versus blue preference. Chi square statistic = $p<0.05$

DISCUSSION

Our hypothesis was incorrect. Although there was a smaller preference under white light, the preference under white light was blue. There was a stronger preference under soft red light, and the preference was green. It was expected that there would be little to no preference under red light, and a preference for blue under soft white light. There was a preference for blue under soft white light, so we were partially correct.

The expected column totals were 3000. In comparison, there was a clear blue preference under white light. The amphipods had a greater color preference overall in soft white light than in red light, possibly signifying that they are better able to discern between red and blue in soft white light than in red light.

Although our hypothesis was incorrect, we were on the right track in predicting that the amphipods would have a statistically different preference under soft white light than under red light. This leads to future discussions and potential experiments. Is it more likely that the white or red light preference better reflects the amphipods preference in nature? If the amphipods seem to prefer blue under soft white light, which is similar to daylight, how would this compare to other colors? Finding a statistically significant preference is a great starting point in researching other similar topics in amphipods.

We could have looked to do more than five runs and potentially incorporated the color red in one of the trays. It would also be helpful to get a camera that snaps every 10 to 30 seconds instead of counting the Gammarus minus by eye.

ACKNOWLEDGMENTS

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