Photobehavioral Responses of Daphnia magna to Selected Light Cues

Thomas Maher, Daniel Zaccariello, Dr. Donald Stearns
Wagner College Department of Biological Sciences

Abstract

Photobehavioral responses of the freshwater crustacean Daphnia magna were recorded at selected combinations of wavelength and light intensity. The daphnid shows negative phototaxis to 430 nm light at an intensity of 1.6 µE-2s-1. When the wavelength was changed to 450 nm or 590 nm, however, the response was a positive phototaxis, even though the light intensity was not changed. In addition, the daphnid showed negative phototaxis at 430 nm, 450 nm, and 590 nm when tested at a light intensity of 0.01 µEm-2s-1. These results indicate that the direction and degree of phototaxis depends on the unique combination of wavelength and light intensity for this crustacean.

Materials and Methods

Each individual was dark adapted for 1 h in a light-tight box in the experimental room. After dark adaptation, each daphnid was exposed to a specific light stimulus. Each animal was tested using the same setup (Figure 2). It included a light source, interference filters for wavelength selection (Omega Optical), neutral density filters for light intensity selection, a transparent plastic trough, and removable partitions. The light source was a Kodak Medalist AF Carousel Projector covered with a box that was draped with black felt to eliminate light leaks. A hole was cut to allow the selected light beam to shine through. The wavelength and neutral density filters were inserted so as to test the organisms with selected light cues. The plastic trough contained five equally sized cells with removable separating partitions. The wavelengths used in this experiment were 430, 450, and 590 nm. The light intensities used were 1.6, 0.58, 0.40, 0.03, and 0.01 µEm-2s-1. The light intensity was measured in complete darkness using a quantum light meter (Licol model Li-250A). The intensity was measured every time a new combination of filters was placed in front of the light source. The light source projector was connected to a constant voltage regulator (Solis) to maintain constant voltage output from the projector. By doing this, any significant fluctuation of power that may influence a varying light intensity was eliminated.

Discussion

The present research showed that the daphnids displayed negative phototaxis to 430 nm light at an intensity of 1.6 µEm-2s-1. However, at the same intensity, the daphnid, when exposed to 450 nm and 590 nm light, showed positive phototaxis. At the light cue moved towards the longer wavelengths of the spectrum, the phototactic response became positive to that same intensity. However, at the lower light intensity of 0.01 µEm-2s-1, responses to all three tested wavelengths resulted in negative phototaxis.

Smith and Beyer (1953) found that Daphnia magna displayed positive phototaxis when exposed to longer wavelengths (redder) and negative phototaxis when exposed to shorter (bluer) wavelengths. The results of this research are supported by these findings by Smith and Beyer (1953). This research also shows that the daphnids are negatively phototactic to 430 nm light at an intensity of 1.6 µEm-2s-1.

To summarize, these results corroborate those of other researchers and indicate that the effect of light on the photobehavior of Daphnia magna depends on the unique combination of wavelength and light intensity.

References


