Polarized light guides cholera-carrying midges that contaminate water supplies

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Cholera is a major killer and since the first pandemic in the early 19th century it has claimed millions of lives. According to Amit Lerner from The Hebrew University of Jerusalem, Israel, the lethal infection is harboured by an equally infamous insect: chironomids (midges). Lerner explains that the females contaminate water sources with the deadly bacteria when laying their eggs.

He adds that his colleagues Nikolay Meltser and Meir Broza had found that females actively choose the body of water where they lay their eggs, but it wasn't clear what drives a female to select a particular pond. Meltser and Broza had noticed that the tormenting insects prefer patches of water that reflect little light, and when they heard that dark water reflects more polarized light than brightly lit water the pair wondered whether the insects were basing their choice on the amount of polarized light reflected by water or the brightness of the reflection. Broza contacted animal polarization vision expert Nadav Shashar and his student Lerner to find out whether polarization or intensity was the guiding factor for midges.

The team publish their discovery that midges are attracted to polarized reflections in The *Journal of Experimental Biology* on 31st October 2008 at http://jeb.biologists.org .

First Lerner and Meltser had to prove that the insects could use polarized light to select egg-laying sites. Tempting the irritating insects into a tent at dusk, they offered them a choice of four trays of tap water to lay their

eggs in. Two trays were illuminated with polarized light, one at high intensity and the other at low intensity. The remaining two trays were illuminated with bright and dim unpolarized light. Returning to the tent the next day, the duo counted the numbers of egg clusters laid in each tray, and found that over 60% of the females chose to lay their eggs in trays emitting polarized light, with more than 40% of the females opting for the water with the highest intensity polarization.

Having found that the insects responded strongly to polarized light, the team next tested the midges' preferences under more natural circumstances. Knowing that cloudy water reflects much more polarized light than clear tap water, they offered midges four more choices of bright and dark water, this time varying the degree of reflected polarization by using either tap or cloudy pond water. The results were even more clear cut. Virtually no midges laid their eggs in the unpolarized tubs of clear water, while the number of eggs laid in the tubs of cloudy water reflecting polarized light was proportional to the percentage of polarized light reflected, regardless of the intensity.

So why are midges so strongly attracted to polarized reflections? According to Lerner, polarization is a reliable cue at sunset. This is particularly important for short-lived female midges that only have a matter of hours to find water and lay their eggs when the light is fading.

And there could be another reason for the midges' polarization preference. Lerner explains that the reflections from cloudy water are highly polarized. Could a high level of polarization in reflections be related to the amount of nutritious organic matter in the water? By measuring the polarization of reflections from increasingly cloudy water samples, it was clear that the cloudiest water produced the most polarized reflections, suggesting that the water offers the best start in life to the midges' larvae, and their cholera bacteria hitchhikers.

The team are also keen to point out that their discovery could help control midge numbers and minimise cholera transmission. They suggest that by reducing the proportion of polarized light reflected by water supplies and offering midges cloudy, polarized light reflecting alternatives to lay their eggs in, we could limit the spread of future cholera epidemics.

Citation: Lerner, A., Meltser, N., Sapir, N., Erlick, C., Shashar, N. and Broza, M. (2008). Reflected polarization guides chironomid females to oviposition sites. J. Exp. Biol. 3536-3543.

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