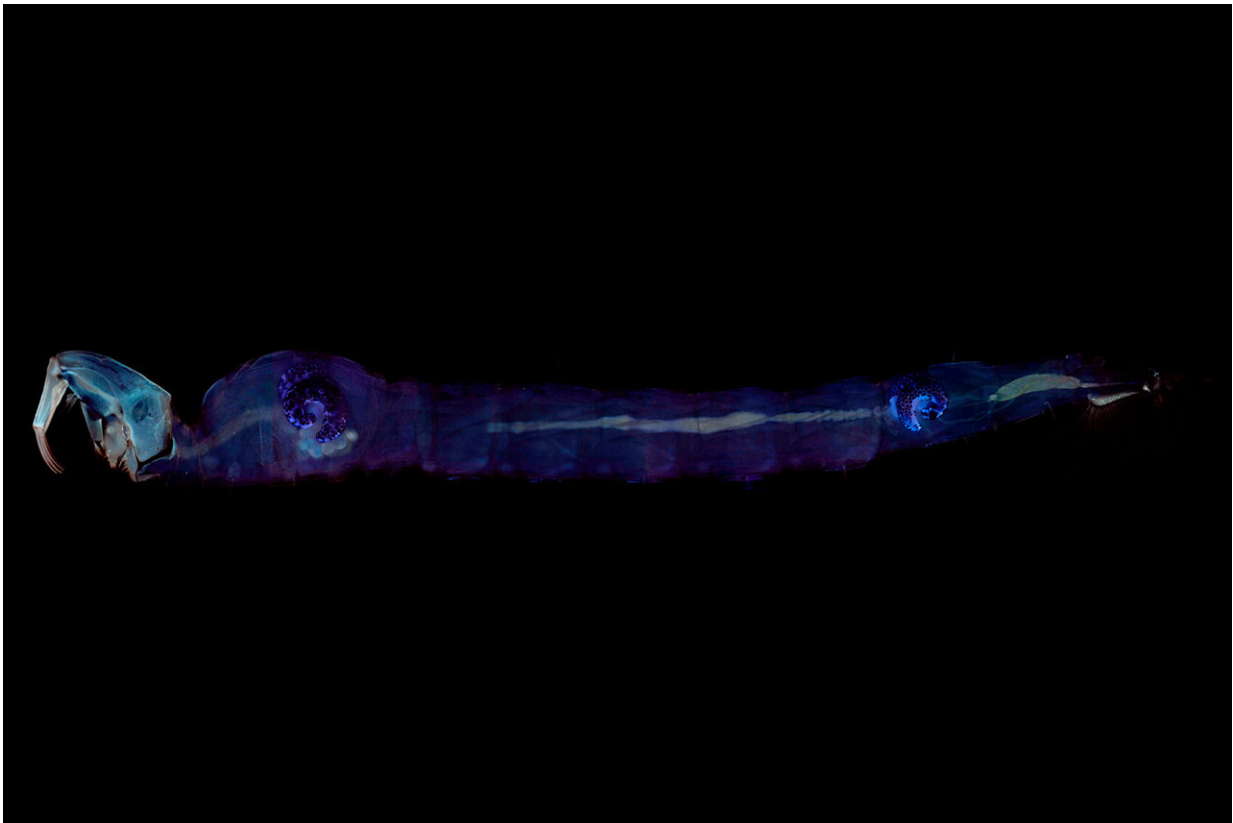


Zoologist solves the 100-year-old mystery of the floating phantom midge

January 26 2022



When researchers mounted the air-sacs of the larvae on a microscope that just happened to have ultraviolet light illuminating the microscope's stage, the air-sacs started glowing blue. Credit: Evan McKenzie

In spring 2018, Dr. Philip Matthews spent a typical afternoon capturing

dragonflies in the University of British Columbia's (UBC) experimental ponds. Little did the zoologist know he was about to embark on a journey to solve a century-old entomological mystery involving a much smaller but equally intriguing insect. As he worked in the ponds, larvae floating in rainwater in a nearby cattle tank caught his eye.

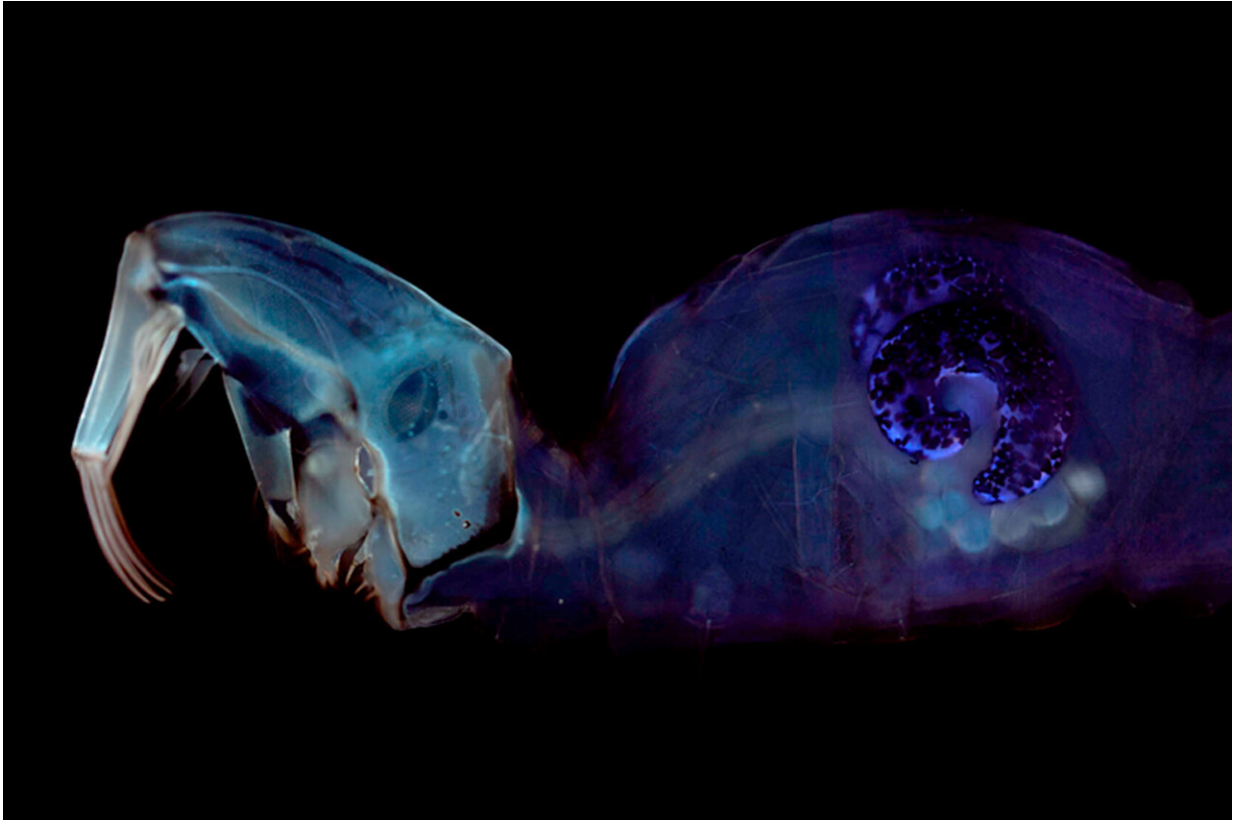
The insects were the freshwater aquatic larvae of the Chaoborus midge, also called the 'phantom midge' due to its near transparency. The transparency makes the larvae resemble tiny ghosts as they move through lakes, ponds and puddles.

"These bizarre insects were floating neutrally buoyant in the water, which is something you just don't see insects doing," said Dr. Matthews. "Some insects can become neutrally buoyant for a short time during a dive, but Chaoborus larvae are the only insects close to being neutrally buoyant."

Solving a 100-year-old mystery with a Nobel connection

Some fish regulate their buoyancy by inflating a swim bladder with oxygen unloaded from the hemoglobin in their blood. In 1911, Nobel laureate August Krogh discovered Chaoborus larvae use a completely different mechanism, regulating their buoyancy using two pairs of internal air-filled sacs. But he never figured out how the insects adjusted the volume of their sacs without having blood or hemoglobin like vertebrates do.

A serendipitous discovery



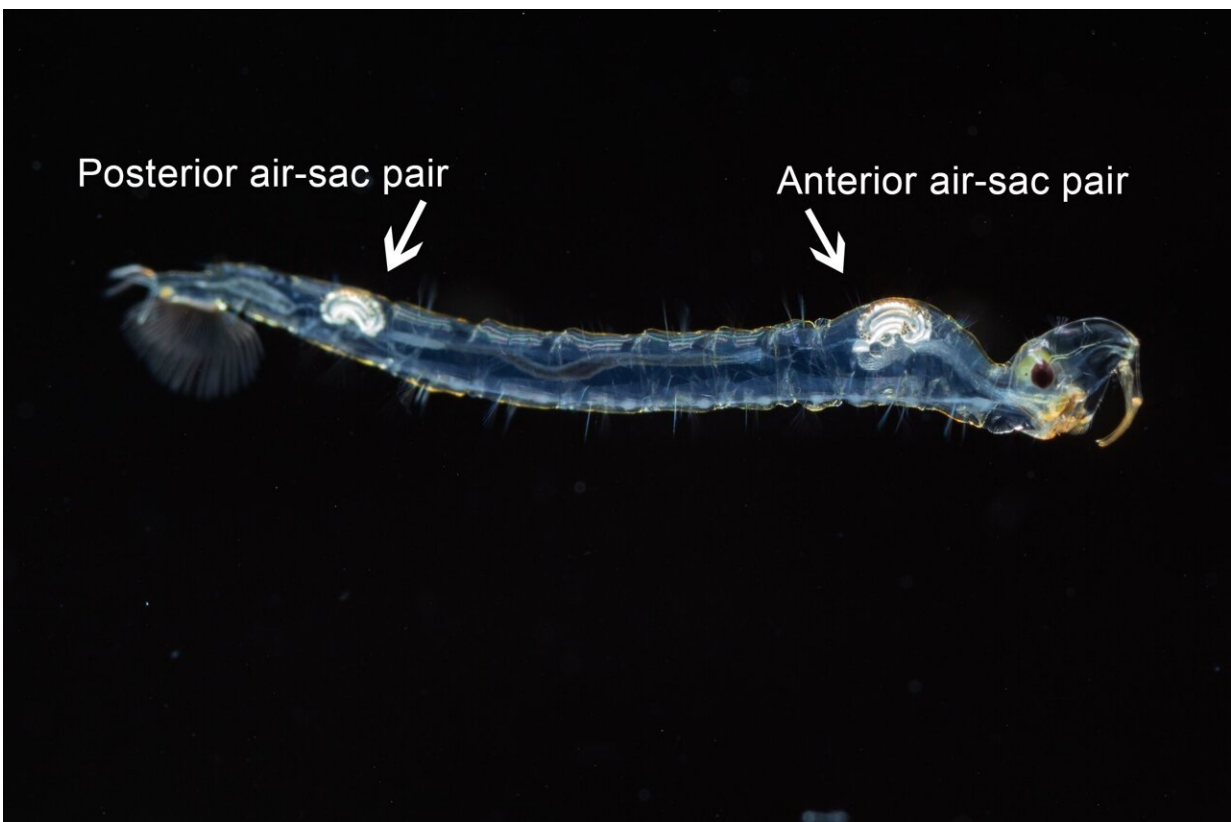
The head and anterior air-sac pair illuminated by UV light. Researchers discovered that the insect doesn't secrete gas into their air-sacs to make them expand. Instead, they change the pH level of the air-sac wall, the bands of resilin within the air-sac wall swell or contract in response, and the volume of the sac adjusts. Credit: Evan McKenzie

Back in the lab after his coffee, Dr. Matthews mounted the air-sacs of the larvae from the cattle tank on a microscope that just happened to have ultraviolet light illuminating the microscope's stage. The air-sacs started glowing blue.

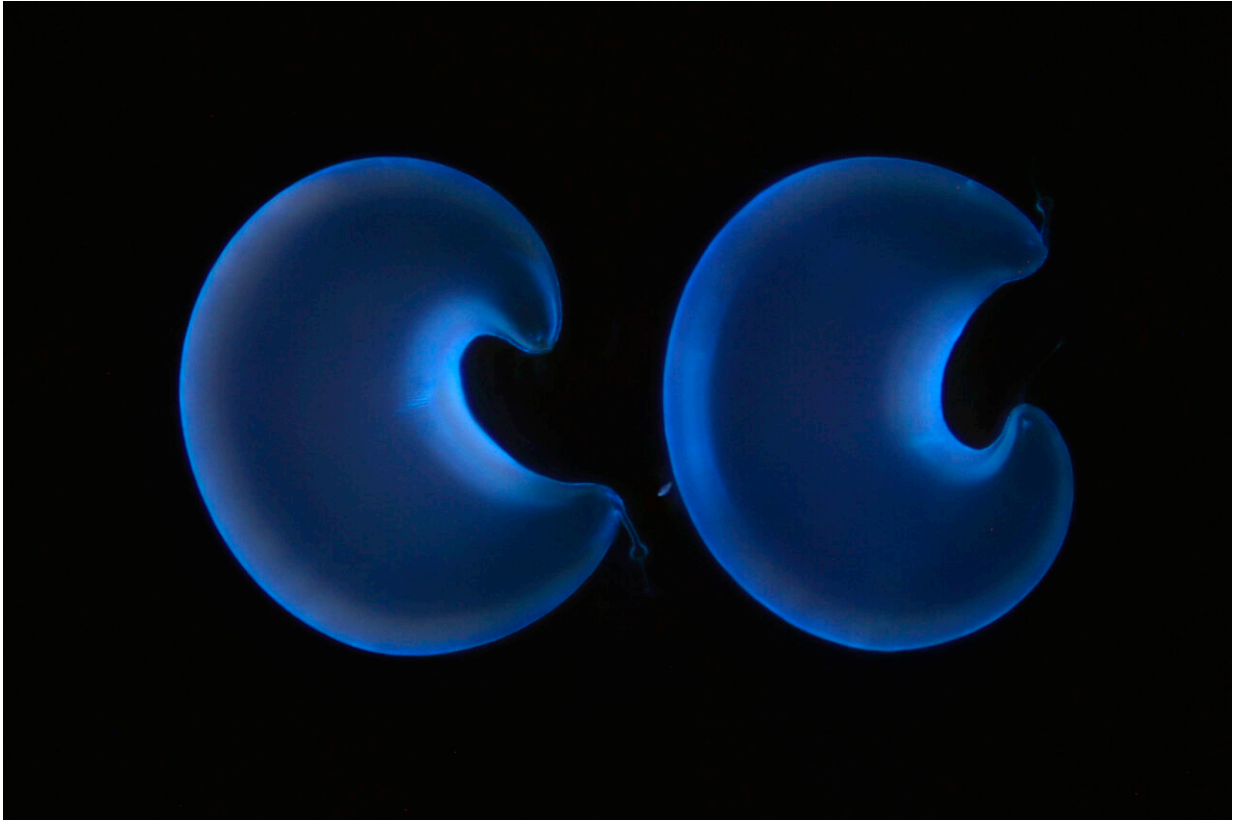
The blue fluorescence was due to [resilin](#)—an almost perfect rubber found in parts of insects where elasticity is key, as in the elastic energy that powers a flea's incredible jump.

"The weird thing about resilin is that not only is it really elastic. It will swell if you make it alkaline and contract if you make it acidic."

With Ph.D. student Evan McKenzie driving experimental investigations, the researchers discovered that the insect doesn't secrete gas into their air-sacs to make them expand. Instead, they change the pH level of the air-sac wall, the bands of resilin within the air-sac wall swell or contract in response, and the volume of the sac adjusts.



Aquatic Chaoborus midge larvae are the only insect that can control their buoyancy. Their tracheal air-sacs act as a pH-powered mechanochemical engine. Credit: Philip Matthews



The blue fluorescence of the air-sac was due to resilin—an almost a perfect rubber found in parts of insects where elasticity is key, as in the elastic energy that powers a flea’s incredible jump. Credit: Philip Matthews

The Chaoborus air-sacs function as mechanochemical engines, converting changes in chemical potential energy into mechanical work.

"This is a really bizarre adaptation that we didn't go looking for," says Dr. Matthews. "We were just trying to figure out how they can float in water without sinking."

More information: Evan K.G. McKenzie et al, A pH-powered mechanochemical engine regulates the buoyancy of Chaoborus midge larvae, *Current Biology* (2022). [DOI: 10.1016/j.cub.2022.01.018](https://doi.org/10.1016/j.cub.2022.01.018)

Provided by University of British Columbia

Citation: Zoologist solves the 100-year-old mystery of the floating phantom midge (2022, January 26) retrieved 12 May 2024 from <https://phys.org/news/2022-01-zoologist-year-old-mystery-phantom-midge.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.