Sneezing sponges suggest existence of sensory organ

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(Phys.org) —When Danielle Ludeman decided to leave her hometown of Vancouver to study evolutionary biology at the University of Alberta, she knew she was in for a challenge that would help her discover things about science and, in turn, herself.

What she didn't count on were the hours, days and months she'd spend watching sponges in mid-sneeze.

It sounds like a strange way to pass time, but sneezing sponges have become a major part of Ludeman's studies at the U of A, including a new paper that points to the sneeze as evidence of a sensory organ in one of the most basic multicellular organisms on Earth.

"The sneeze can tell us a lot about how the sponge works and how it's responding to the environment," said Ludeman, a master's student in the Faculty of Science. "This paper really gets at the question of how sensory systems evolved. The sponge doesn't have a nervous system, so how can it respond to the environment with a sneeze the way another animal that does have a nervous system can?"

Ludeman started the work as part of an undergraduate research honours project, working under the supervision of Sally Leys, Canada Research Chair in Evolutionary Developmental Biology. It was Leys and a former graduate student who first discovered that sponges do in fact sneeze.

The sponge is a filter feeder that relies totally on water flow through its body for food, oxygen and waste removal. Sneezing, a 30- to 45-minute process that sees the entire body of the sponge expand and contract, allows it to respond to physical stimuli such as sediment in the water.

Time-lapse sneezes

For their study, Ludeman and Leys used a variety of drugs to elicit sneezes in freshwater sponges and observed the process using fluorescent dye—all recorded using time-lapse video. Their efforts focused on the sponge's osculum, which controls water exiting the organism, including water expelled during a sneeze.

Through a series of lab experiments, the pair discovered that ciliated cells lining the osculum play a role in triggering sneezes. In other animals, cilia function like antennae, helping cells respond to stimuli in a co-ordinated manner. In the sponge, their localized presence in the osculum and their sensory function suggest the osculum is in fact a sensory organ.

"For a sponge to have a sensory organ is totally new. This does not appear in a textbook; this doesn't appear in someone's concept of what sponges are permitted to have," said Leys.

Leys said the discovery raises new questions about how sensory systems may have evolved in the sponge and other animals, including ones with nervous systems. It's possible this sensory system is unique to the sponge, she said, evolving over the last 600 million years. Or it may be evidence of a common mechanism shared among all animals, and retained over evolutionary history, as demonstration of its essential function.

For Ludeman, the paper represents the latest chapter in her studies at the U of A, which also included a year-long exchange in Australia and several months at the Bamfield Marine Sciences Centre on Vancouver Island (where, it just so happens, she also studied sponges). Having the flexibility to study abroad was part of the appeal of the U of A, she said.

"Those two experiences were huge during my undergrad. The Faculty of Science at the U of A gave me those opportunities."

Despite all the hours filming and observing sneezes, Ludeman says she's still not sick of sponges.

"We know so little about how a sponge works, and there are so many cool questions you can ask."

More information: "Evolutionary origins of sensation in metazoans: functional evidence for a new sensory organ in sponges." Danielle A Ludeman, Nathan Farrar, Ana Riesgo, Jordi Paps, Sally P Leys. *BMC Evolutionary Biology* 2014, 14:3 DOI: 10.1186/1471-2148-14-3

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