This plant sucks! (But how?)

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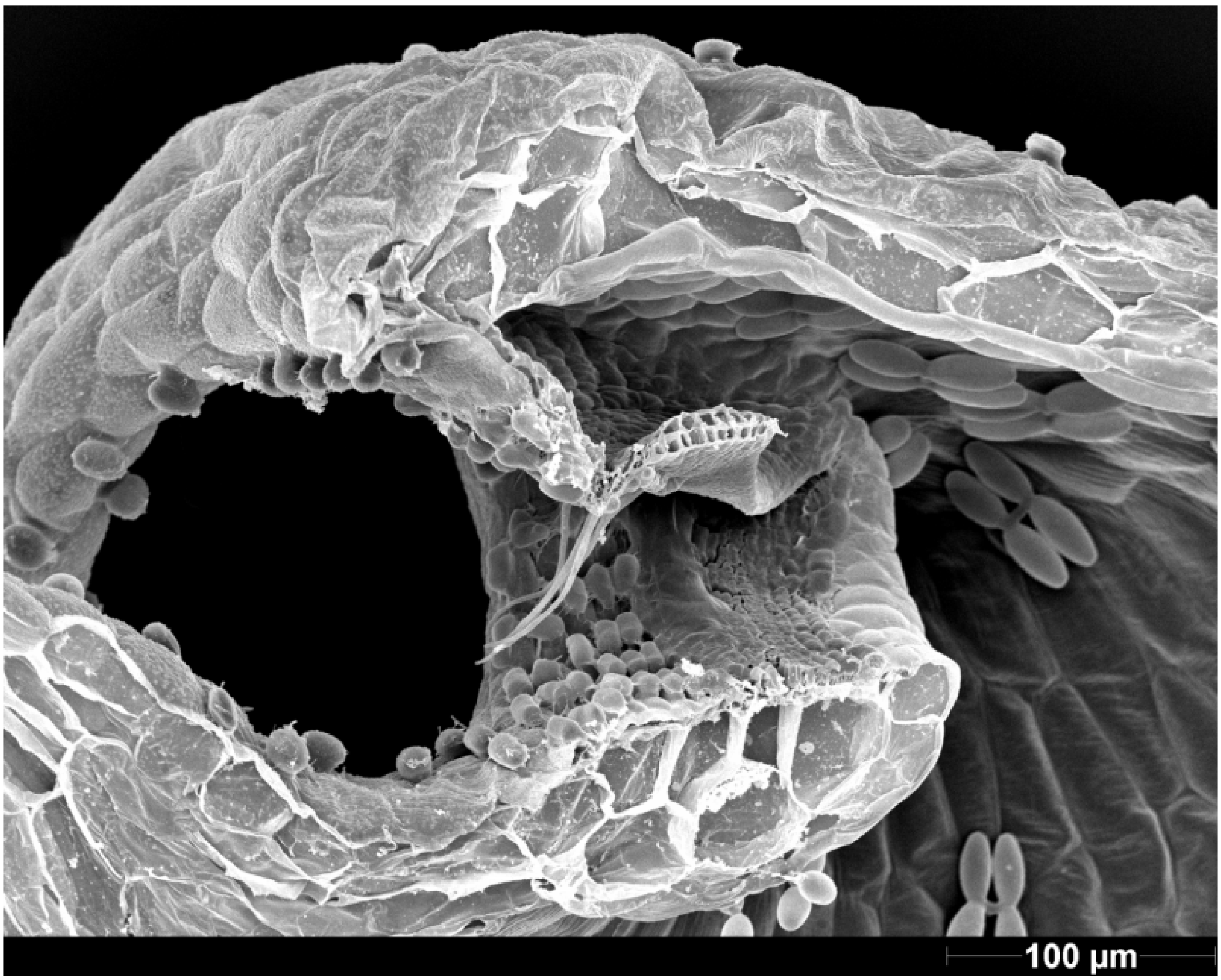

A bladderwort trap. Credit: SEM

The bladderwort has a trap faster than the blink of an eye. It uses powerful suction to snatch its prey. A recently published review is helping reveal exactly how a plant can suck so much.

When comes to catching prey, carnivorous plants have a variety of techniques. The sundew slowly curls around its victim, while the Venus flytrap snaps shut around it. But the fastest carnivorous plant on the planet is the bladderwort. When it opens its trap, whatever was outside is inside a bladder faster than the blink of an eye. The bladderwort's trap is so fast that, until recently, botanists have struggled to see it in action at all. Now faster cameras are revealing its secrets, but a review recently published in *AoB Plants* by Poppinga et al. shows that the closer you look at a bladderwort the more mysteries you find.

The way a bladderwort catches its prey is to wait for prey animals (mainly small crustaceans) to touch trigger hairs situated on the trapdoor which closes the trap watertight. Once this happens, it has a bladder snap open. The inside of the bladder is empty, so water, and anything nearby in it, is sucked in with an acceleration over 600 times the force of gravity. Getting water to flow rapidly into the trap is the key to the bladderwort's success, but understanding how these traps exactly work is not easy.

Simon Poppinga of the research team said: "The bladderwort traps are considered as some of the most complex structures in the plant kingdom. They are tiny, they are ultrafast in their sucking motion and they are complicated to investigate. Though being intensively studied not only since Darwin's benchmark book about carnivorous plants, there are still many mysteries about how these devices function. With our review we aimed at putting all relevant biophysical and structural information together and to inspire further research on these enigmatic devices."

Recent advances include using scanning electron microscopes that are capable of seeing far more detail than a standard light microscope.

While reviewing studies of bladderwort traps, Poppinga and coworkers noted that not all bladderworts are alike.

Poppinga said: "You might think that if the selective pressure on the traps is just about an optimized water flow, then the traps would look more or less identical. But when we looked closely into trap architecture during our experimental studies we found that different plants have different structural arrangements, which has also been noted by earlier authors. This is probably caused by the fact that different species of bladderwort live in different environments and, hence, might show structural adaptations to the respective habitat - for example, terrestrial bladderworts often have, in contrast to aquatic species, to cope with seasonal dryness which would make the traps functionless. We think this might also mean the traps are adapted to lure and to catch different kinds of prey, and this is something botanists need to test."

Despite the variety of architecture, the traps all share a similar method of operating. First water is pumped out of the bladders and the walls of the bladder store elastic energy ready to snap back into shape. This happens when prey triggers the trap. In an instant the trap door opens, the walls pop to open up space in the bladder to suck in a meal, then the trap door shuts before the prey can escape. It's a complex sequence of events, and by using advanced microscopy techniques it should be possible to make new discoveries.

Poppinga added: The great advantage of using modern microscopes like TEM, FIB-SEM and others is that we could get a very close look at fine structures that are crucial for trap functioning. By slicing and scanning the traps we could get architectural information in more detail than anyone has seen before. That's great for learning about the plant - for example this could possibly help in elucidating whether the trigger hairs possess structural and functional features similar to those in Venus flytraps. But the research could have other applications too. If we can work out how the bladderwort can grab food so quickly, it could also have applications in other fields by helping us develop tools that can rapidly capture small samples of fluids. Finding out how a bladderwort sucks could possibly also lead to biomimetic technical innovations.

More information: Simon Poppinga et al. Fastest predators in the plant kingdom: functional morphology and biomechanics of suction traps found in the largest genus of carnivorous plants, *AoB Plants* (2016). [DOI: 10.1093/aobpla/plv140](https://doi.org/10.1093/aobpla/plv140)

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