Snaring bigger bugs gave flytraps evolutionary edge

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(PhysOrg.com) -- Carnivorous plants defy our expectations of how plants should behave, with Venus flytraps employing nerve-like reflexes and powerful digestive enzymes to capture and consume fresh meat.

The evolutionary history of these botanical oddities is now a bit clearer, thanks to new work.

In a paper in the August issue of the journal New Phytologist, UW-Madison botanist Don Waller and ecologist Thomas Gibson explored the evolution of the so-called “snap trap” carnivorous plants, including the rare but familiar Venus flytrap.

Using a combination of ecological data, published reports, and modeling, they concluded that the ability to catch larger — and therefore more nutritious — insects drove the evolution of the Venus flytrap’s characteristic hinged, jaw-like leaves, complete with teeth and digestive glands.

Many other carnivorous plants, like sundews, use a “sticky trap” strategy, exuding a gooey adhesive to snare small creatures that touch the plant. This strategy is mechanistically much simpler than the snap trap but has its limitations, says Waller.

“Sticky traps are great for tiny insects,” he says. “As the insects get larger, you have to change your tactics. The snap trap is one way to do that.”

The nutritional content of insects rises sharply with increasing size, so bigger bugs provide better returns on the plant's energy investment and offer a selective edge to any plant that can hang on to larger meals. The insects supply crucial minerals that are hard to come by in the boggy, acidic, nutrient-poor environments these plants typically call home.

Waller and Gibson determined that the advantage of being able to catch and digest larger insects may have driven the evolution of the snap traps' many specializations, including sensitive trigger hairs on the inside surface of each leaf and the ability to respond quickly to a potential meal — a Venus flytrap can snap a leaf shut in a fraction of a second.

The Venus flytrap displays several adaptations suitable for catching larger prey, Waller says. The hinged leaf helps immobilize bigger insects without the need for stronger adhesives, while also sealing in nutrients and protecting the meal from passing scavengers. The row of spiky "teeth" rimming each leaf keeps larger prey in while allowing smaller insects to escape — an adaptation that allows the plant to ensure high nutritional returns on its outlay of digestive energy. The digestive glands are recessed into the leaf's surface to protect them from the destructive thrashings of a trapped victim.

Fortunately for us, carnivorous plants don't come as big as the blood-hungry Audrey II in "The Little Shop of Horrors." The physiological demands of capturing and digesting larger and larger prey limits how big the plants can get — even the largest leaves on an average Venus flytrap are quite small, an inch or less across.

According to work by Ken Cameron, director of the Wisconsin State Herbarium, snap traps evolved from sundews. This divergence around 65 million years ago was the "one and only time snap traps evolved," Waller says. Today there are only two living species, the Venus flytrap and an aquatic plant called a waterwheel that eats tiny invertebrates.