Harvard University Gazette Online

May 7, 2009

Nectar nurtures pitcher plant's eating habits

By Alvin Powell
Harvard News Office

New research helps explain how the pitcher plant, Sarracenia purpurea, attracts prey.
Courtesy of Katherine Bennett

Elementary school teacher Katherine Bennett conducted research into the pitcher plant.
Photo by Primrose Boynton

New research from the Harvard Forest shows that carnivorous pitcher plants use sweet nectar to attract ants and flies to their water-filled traps, not color, as earlier research had indicated.

The work, which was among the first to experimentally examine the role of nectar in attraction by pitcher plants in the field, not only served to advance understanding of insect-eating plants, it also helped to improve science education at local schools. It was conducted as part of a National Science Foundation-funded program to enrich science training of local schoolteachers.

The research, published Wednesday (May 6) in the journal Biology Letters, was conducted by Katherine Bennett, a fourth- and fifth-grade math and science teacher at J.R. Briggs Elementary School in Ashburnham, Mass., under the guidance of Aaron Ellison, senior ecologist and senior research fellow at Harvard Forest.

Ellison, who has worked on carnivorous plants for more than a decade, said the work was spurred in part by Bennett's interest and in part by a journal article Ellison had seen that concluded that color was the main prey attractant in a group of pitcher plants studied in a greenhouse in Germany. That study, which didn't control for the presence of sweet nectar in the plants and which found that flies were the major prey, didn't agree with the observations Ellison had made over his years studying the plants in the field. Ants, not flies, are the plants' main prey, he said, and ants can't see color, two facts that made him suspicious of the earlier results.

Bennett meanwhile, was working at the Harvard Forest in a National Science Foundation-funded citizen-scientist program. She spent a season working with Ellison on ant inventories, and, in her second season, her initial idea for an independent project fell through, so Ellison set her to work studying pitcher plant prey attraction.

Pitcher plants live in boggy areas where their carnivorous habits help compensate for the nutrient-poor soil. They are called "pitcher" plants because they are shaped like a slender pitcher or vase whose base is filled with rainwater spiked with digestive enzymes. The sweet nectar is produced on the pitcher's outside and on its lip, where it not only attracts insects, but it also serves as a lubricant, helping prey slip inside. The pitcher's inside surface is slick and waxy, and covered with tiny, downward-facing hairs that serve to keep prey from escaping the water below.

Once an ant or fly falls into the trap, it drowns and sinks to the bottom where it decomposes, making its nutrients available to the plant.

To find out what was going on with the plants, Bennett and Ellison created 70 artificial pitcher plants using 50 milliliter tubes. They painted them red and green, the colors found on natural plants, but varied the coloration from all red to all green, with different proportions in between. They filled the artificial pitchers with ethanol, a liquid commonly used in insect capture, and spread thickened sweet corn syrup in patterns on some of the fake pitcher plants. They then planted the artificial plants near real pitcher plants in Tom Swamp, a bog that is part of Harvard Forest in Petersham, Mass.

They compared the results from the artificial pitchers with 25 natural plants that had had their liquid suctioned out and replaced with distilled water to control for the possibility that prey were attracted by the scent of decaying insects inside.

The results, Ellison said, were about as clear as they get. Natural pitcher plants caught 357 insects while the pseudo-pitchers with the sweet syrup caught 344. The pseudo-pitchers without the sweetener, by contrast, caught only 62 insects.

"The results showed that plastic pitchers with sugar catch the same amount of ants and flies as natural pitcher plants, and if you take the sugar away, nothing gets captured," Ellison said.

The work, Ellison said, furthers an argument that has continued for 100 years over how pitcher plants attract their prey. Despite those clear-cut results, however, the argument isn't yet entirely settled. Because the plants' coloration occurs in elaborate patterns of red veins — patterning that was not explored in the current work — experts in the field have suggested the need for further exploration of the interplay between nectar and color.

Thus, Ellison and Bennett will focus this summer on the exact location of the nectar on the plants to see if the red vein pattern serves some yet unseen purpose.

In the meantime, Bennett and her students continue to reap the benefits of her involvement. Bennett said she got involved in research at Harvard Forest to improve her science teaching, but said the work was also personally rewarding. Though moving through the bog was challenging, she said the quiet days there were peaceful.

"I wanted to get involved because I love teaching science, but I felt I was lacking in science knowledge," Bennett said.

Since she began working at the Harvard Forest four years ago, Bennett has taught units on ants and on forest ecology, aided by advice from Ellison.

"Anytime I have a question, we know where the experts are," Bennett said. "This has made me a much better a science teacher."