NEBS Meeting News

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NEBS MEETING NEWS

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President Matt Charpentier welcomed all to the 1168th meeting of the New England Botanical Society on April 1, 2023, at Clark Center, Smith College, Northampton, Massachusetts. Jesse Bellemare introduced the speaker, Dr. Jessica Stephens, assistant professor in the Biology Department at Westfield State University in Westfield, Massachusetts. Dr. Stephens gave a presentation called "Complex Interactions in *Sarracenia*: Implications for Plant and Ecosystem Health," based on her research in the southeastern United States.

Plant microbiomes, the microbic organisms that colonize around plants, are divided into anthosphere (flower), phyllosphere (leaves), and rhizosphere (roots tissue). Recent research has shown that anthosphere microbes can influence pollinator behavior, phyllosphere microbes can be species-specific and prevent pathogen colonization, and rhizosphere microbes can increase nutrient availability, tolerance to biotic stress, and potentially health and fitness of the plant. Carnivorous plants live in low-nutrient habitats, where they gain nitrogen and phosphorus from prey items. Nine independent evolutionary events gave rise to 580 species of carnivorous plants with a diversity of forms and strategies. Some carnivorous plants actively trap their prey. *Drosera* species have modified leaf structures with sticky mucilage (flypaper traps) that fold over prey when triggers are touched. *Utricularia* species have triggers that cause the suction of prey into bladder-like structures (suction traps) with the fastest motion known in plants. Other carnivorous plants, such as *Nepenthes*, have passive traps with diverse structures that do not always include trapping prey for nutrients. For example, *N. hemsleyana* attracts bats that roost in the pitcher and excrete nitrogen-rich guano, which is used by the plant. *Nepenthes lowii* provides nectar for shrews and benefits from shrew feces.

Dr. Stephens studies North American pitcher plants (genus *Sarracenia*), which have a center of diversity in the southeastern United States. The pitchers of *Sarracenia* species are pitfall traps evolved from leaves that attract, trap, and digest prey, with an associated microbiome that helps digest prey and gains nutrients in the process. The pitcher has a hood (attractive zone) with downward pointing hairs to direct insects into the orifice to a slippery lip and a tube lined with downward pointing trichomes (conductive zone), an area with digestive enzymes (glandular zone), and a narrow base (detention zone) to hold prey while digestion is completed. The outside of the pitcher may have a wing (called the ayla) and tiny trichomes pointing upward to direct prey toward the top of the pitcher.

Research was conducted on prey specialization in two pitcher plant varieties, *Sarracenia minor* and *S. minor* var. *okefenokeensis*, that share the same habitat in the Okefenokee Swamp in Georgia. Electron microscopic examination of these two species revealed that *S. minor*, which is shorter, has tiny, upward trichomes on the pitchers. *Sarracenia*

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minor pitchers examined contained mainly ants, while *S. minor* var. *okefenokeensis* pitchers contained mainly flies, beetles, moths, and butterflies, with relatively few ants. Dr. Stephens then looked at other species to see if they have suites of covarying trapping traits and if the suites of traits associate with the prey captured. This would decrease competition between species occupying the same habitat.

The Atlanta Botanical Garden in Gainesville, Georgia, has 15 species of *Sarracenia* in garden beds in one area, presumably having the same prey available to them. Dr. Stephens conducted a study in which she dissected eight pitchers from each species in spring and fall for two years, identifying prey to order and measuring leaf traits. She found that leaf traits were covariant and that suites of traits were strongly correlated to types of prey. Small species had many trichomes on the outside of the pitcher, a smaller opening, and a wider wing. The small species captured predominantly crawling prey, especially ants. Taller species had a larger opening, few trichomes on the outside of the pitcher, and no wing. These captured mainly flying prey, such as bees, flies, and moths. Mid-sized species had a mix of traits and caught both crawling and flying prey. These findings provide evidence of prey specialization within North American species of *Sarracenia*. None of the species was found to trap its own pollinators.

Dr. Stephens also investigated the microbial diversity of pitcher plants through a sampling of eight pitchers per species in 15 species; measuring water volume, prey biomass, and percentage of rotifers and protozoans present; and identifying bacteria. The bacterial community varied across species, with host species explaining about 12% of the variation. Year, season, prey biomass, and protozoans also played a role, explaining 1–3% of bacterial variation. There was a similar outcome for eukaryotes, with host species explaining 12% of the variation, and year and season explaining about 3% of the variation. These findings show a pattern of plant host influence on bacterial and eukaryote microbial communities, sug-gesting phylosymbiosis between *Sarracenia* species and their microbiomes. *Sarracenia purpurea* and *S. psittacina* had diverse communities of eukaryotes, while several other species were dominated by fungi. Future investigations could look at how the plants interact with their microbial communities and possible benefits for host health, for instance, in helping to digest prey and make nutrients available to the host.

Sarracenia are also hosts to many species of arthropods, some of which are obligate pitcher plant species. *Exyra semicrocea*, one of three species of pitcher plant moth, relies on *Sarracenia* for its entire lifecycle. The female moths lay their eggs inside newly developed pitchers at dusk. The larva hatches out and eats a ring around the pitcher, causing the top to fold over, protecting it while it feeds; then it migrates to another pitcher, where it lives attached to a silk thread and weaves a web around the top to keep water and predators out while it completes its lifecycle. Dr. Stephens sampled pitcher plant moths in bogs across the southeastern United States. A comparison of one gene showed a 2.5% difference in the DNA between populations in eastern Texas and populations east of the Mississippi River, suggesting speciation in the Texas populations. Mississippi and Louisiana populations were genetically similar but differed from the gulf species east of the Apalachicola River and the Atlantic Coastal Plain species. This pattern of genetic variation is also seen in *Sarracenia* and other species of the Southeast.

Four isolated bogs with rare species had no pitcher plant moths. Many bogs in the Southeast are growing in and need prescribed burns to maintain the bog habitats. However, the pitcher plant moth overwinters as a caterpillar and may be wiped out by winter burns. The isolated bogs with no pitcher plant moths had been burned in the winter, possibly extirpating the moths at those sites. Dr. Stephens advises conservation managers to leave refugia for arthropods when burning bogs in winter.

—Karen Hirschberg, *Recording Secretary*