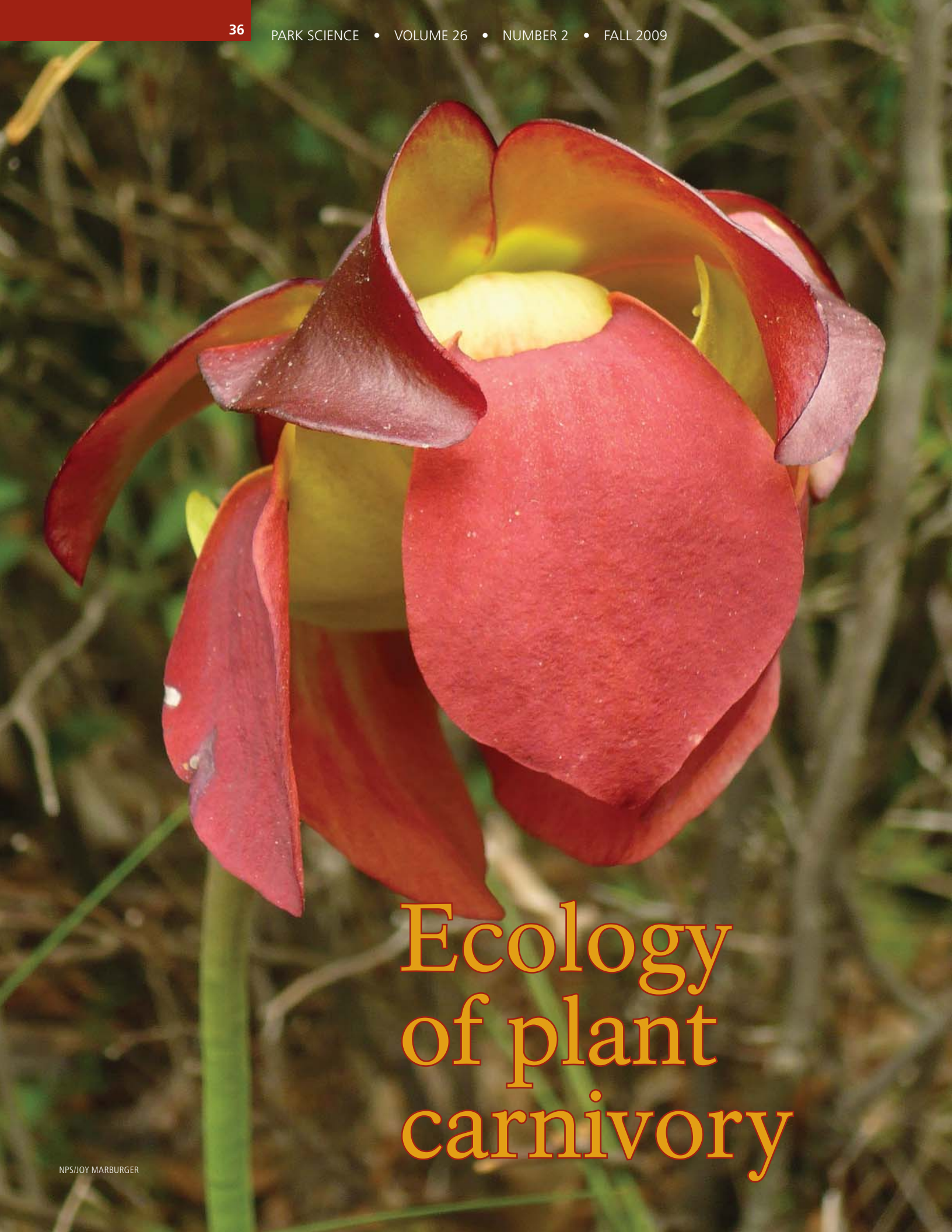

Ecology of plant carnivory

NPS/JOY MARBURGER

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THE PLANT KINGDOM HOSTS A VARIETY OF particularly adapted species, each with unique responses to the stresses of its habitat. For example, wetland plants growing in standing water can pump oxygen from the atmosphere down to feed their air-starved roots. Epiphytes (aerial plants living in forest canopies with no root system) gather rainfall in cupped leaves and extract nutrients from falling leaves, rainwater, and their host plants. Within the world of unique plant adaptations, one of the most intriguing is carnivory.

Carnivorous plants have fascinated researchers and the general public since the time that Charles Darwin first described their behavior in 1875 (Darwin, C. 1908. Insectivorous plants. Revised by Francis Darwin. John Murray, London, UK). Those who have seen the original movie version of the *Little Shop of Horrors* starring Jack Nicholson, or the musical version with Rick Moranis, can appreciate the human fascination with the macabre associated with carnivorous plants.

Carnivorous plants inhabit extremely low-nutrient ecosystems. Metabolic growth in these plants is hypothesized to be limited primarily by low concentrations of nitrogen and phosphorus. Consequently, carnivorous plants consume insects, spiders, and small amphibians to gain nutrients necessary for growth and reproduction.

With more than 600 species in 12 genera, carnivorous plants have evolved a variety of clever trapping mechanisms. Prey may fall or be sucked into pools of digestive enzymes, stick to droplets of goo, get snapped by fast-moving leaves, or be forced toward a digestive organ by inward-pointing hairs. These adaptations have allowed carnivorous plants to colonize and thrive in nutrient-poor ecosystems throughout the world.

The most common style of plant carnivory in North America is practiced by the pitcher plant. The leaves of these plants are modified into pitchers or hollow cups with a closed bottom, facilitating the collection of rainwater and potential prey (see photos). The pitcher structure acts as a passive form of carnivory, luring insects into a trap designed to capture them within the pitcher structure. The lip of each pitcher contains sweet-smelling nectaries that attract insects, which then land on the slippery plant leaf, fall into the pitcher and are prevented from climbing out by downward-facing hairs on the inside pitcher wall. In some pitcher plant species, the plants secrete digestive juices to break down prey; in others a suite of bacteria and microorganisms in the fluid digests prey and releases nutrients available for plant uptake. The plant absorbs the nutrients, particularly nitrogen and phosphorus, through the leaf wall, and transports them throughout the plant to where they are most needed.

Another interesting adaptation of the pitcher plant is its ability to modify leaves depending on the availability of nutrients. When nutrients are high, pitcher leaves are altered to perform more photosynthesis; when nutrients are low, pitcher leaves increase their carnivorous effort.

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Despite its colorful and showy flowers, the northern pitcher plant may rely on asexual reproduction for a large part of its reproductive effort, according to molecular genetics. Pollen and seed dispersal between populations can often be limited by the plant's isolated habitat. Lack of sexual reproduction further segregates the species and can possibly reduce genetic diversity in the population and increase genetic differences between isolated populations.

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Tubelike modified leaves trap prey through backward-pointed hairs that prevent escape. Digestion of prey occurs through bacterial enzymes and enzymes secreted by the plant to extract nutrients needed for plant growth.

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