The Green Beneath O

Bryophytes were the first plants to occupy terrestrial habitats.

Story By Ray Stotler and Barbara Crandall-Stotler
Photos By Li Zhang and Barbara Crandall-Stotler

The green beneath our feet is not always grass.

As we hike through the woods, stroll through a park or, to the dismay of some homeowners, walk through our yard, we may be stepping on green clumps, mats or even springy carpets of moss. Because of their small stature, these plants, even though ubiquitous, tend to be an inconspicuous part of the landscape and typically go unnoticed by most. Every patch is made up of hundreds or thousands of individual plants, each with a stem and spirally arranged leaves.

Mosses are part of a section of the plant world called bryophytes. Numbering about 16,000 species, bryophytes comprise three groups or phyla of the Kingdom Plantae and are second only to flowering plants (about 250,000 species) in the number of plant species known to exist. Mosses (Phylum Bryophyta) are the most abundant of the three bryophyte categories worldwide, with nearly 10,000 species. Liverworts (Phylum Marchantiophyta) account for approximately 6,000 species, and hornwort (Phylum Anthocerotophyta) species number about 200. Liverworts are the most ancient group of land plants, with

Pear-shaped urn moss
Physcomitrium pyriforme

The spore-bearing capsules of the pear-shaped urn moss look like upside-down pears. When ripe, they become urn-shaped cups.

their fossils dating back to more than 475 million years ago.

Illinois' rich flora includes an outstanding array of bryophytes, with approximately 350 species of mosses, 140 species of liverworts and four species of hornworts. These plants occupy an assortment of habitats, including disturbed ones, like plowed fields and roadside banks, as well as native woodlands and grasslands. They commonly grow on trees, logs, rocks and soil, and some may even be submerged in or floating on water. The greatest diversity of our state's bryoflora occurs in woodlands and canyons, where small, specialized environments, known as microhabitats, exist. Most bryophyte species are found in only one microhabitat, although some species are adapted to a broad range of habitats.

The three groups of bryophytes can be distinguished if examined with care. This can easily be done by using a magnifying lens and, once a person has observed the structural differences, it becomes fairly straightforward. All mosses and most liverworts are made up of cylindrical stems with either spirally arranged leaves (mosses) or leaves arranged in two or three rows (liverworts). Some mosses grow erect, forming turfs or tight cushions, while other species form compacted mats or loose wefts. Liverworts and hornworts typically grow prostrate and appressed to their substrates. With rare exception, the leaves of mosses are evenly spaced all around the stem, while leafy liverworts are bilaterally symmetric (mirror images halves), with distinctly different dorsal and ventral surfaces. In mosses, the insertion of the leaves on the stem is transverse and the leaves are undivided, long and often tapered to a pointed tip. The leaves of liverworts lie flat against the substrate and can be divided into two or more parts, or if undivided are generally a rounded shape. In mosses, all of the leaves of a shoot are similar. But in liverworts, the two rows of leaves that can be seen from the upper side are larger and different from the smaller, hidden leaves on the underside surface. Overall, liverworts are much smaller than mosses.

Look for Carolina hornwort in the spring, growing on the compact soil along trails in Illinois woodlands. In the fall it can be found on river banks exposed by receding water.

Carolina hornwort
Phaeoceros carolinianus

Great scented liverwort
Conocephalum conicum

Rivulet liverwort
Pellia epiphylla

Common feather liverwort
Plagiochila porelloides

Liverworts are the most ancient family of green plants. Scientists have examined chemical compounds produced by liverworts and found that they can inhibit the growth of certain bacteria and tumor cells.

Although all mosses and most liverworts are leafy plants, in some liverworts and all hornworts the plant is a flattened, ribbon-like thallus. The thallus in complex liverworts is differentiated into a ventral zone of storage tissue and an upper zone of air chambers that open to the outside by elevated pores. These chambers impart a patterned appearance on the thallus surface. In contrast, in simple thalloid liverworts and all hornworts the air chambers and pores are lacking so that the thallus has a very smooth texture.

Bryophytes reproduce by means of microscopic, one-celled spores. These spores germinate and grow into populations of sexually mature plants. Each bryophyte population consists of countless gametophytes, individual plants that produce sex cells or gametes, i.e., sperm or eggs. A male sperm will fertilize a female egg and the spore-generating period of the life-cycle has begun.

The spore-producing phase remains attached to the plant by embedded tissue; it is through this tissue that nutrients move from the green plant to nurture the spore-developing process.

Spore-producing structures are frequently seen emerging from mosses and hornworts. In mosses this consists of a leafless stalk that bears an enlarged spore-producing capsule at its tip. Hornworts produce elongate, often green, horn-like capsules. The liverwort

Hairy Grimmia moss
Grimmia laevigata

A pioneer species, hairy Grimmia moss grows on rocks. The species can be identified by the long, white, hair-like tips on each leaf.

Compact peat moss
Sphagnum compactum

This species of Sphagnum moss grows in "hanging bogs," found draped over the tops of southern Illinois canyons.

spore phase is rarely seen, but can be recognized by their fragile, white stalks tipped with shiny black capsules.

When the capsules are mature they dry and open, dispersing the spores in breezy weather, and the cycle then repeats. In most of our bryophytes, spore release occurs in February to April in southern Illinois on into May or June in the northern parts of the state.

Bryophytes grow in practically every kind of habitat with the exception of hot springs and salty ocean waters.

Teaching About Bryophytes?

The DNR Division of Education produced an Illinois Bryophytes poster to assist teachers with their lessons about these unique organisms. Along with images of 25 bryophyte species indigenous to the state, life history information and other items of interest are included. Order the poster at www.idnrteachkids.com.

On March 28, 2008, Ray Stotler and Barbara Crandall-Stotler will lead an Illinois Bryophytes workshop for teachers at Giant City State Park in Makanda as part of the DNR ENTICE (Environment and Nature Training Institute for Conservation Education) program. Registration is required. For the workshop description and to register, visit www.ilcf.org/Workshop/Courses.asp. Continuing Professional Development Units are available.

They flourish particularly well in moist, humid forests like the fog forests of the Pacific northwest or the rain forests of the southern hemisphere. Their ecological roles are many. They provide seedbeds for the larger plants of the community, they capture and recycle nutrients that are washed with rainwater from the canopy and they bind the soil to keep it from eroding.

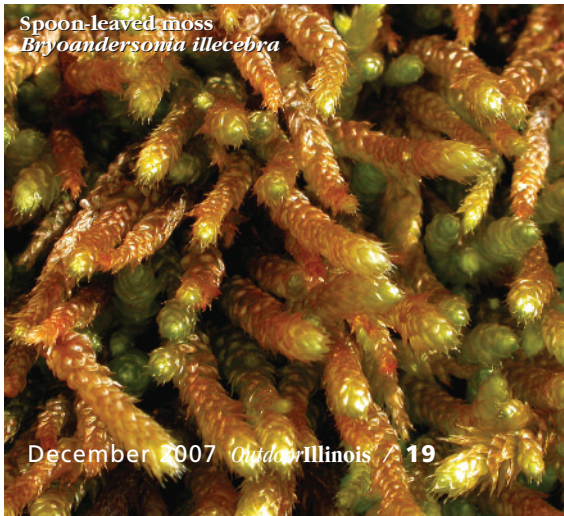
In Illinois the greatest diversity of mosses is found in woodlands, especially mid-slope to upland sites where they occur on exposed soil, rocks, logs and tree trunks. Most liverworts, in contrast, require a more mesic habitat and so are found on shaded soil, rocks, logs and tree bases in bottomland woods, ravines, and in canyons where water seeps through the rocks. The hornworts that occur in Illinois are most commonly found growing on disturbed, compacted soil. This habitat may be found in farm fields before they are plowed in the spring or along the edge of dirt paths in forests. In the fall, look for hornworts and liverworts in drawdown areas where the water has receded along river banks, lake shores and streams banks.

Mosses and liverworts grow on all continents—including Antarctica. Most Illinois species grow throughout the year, even during harsh winter months.

Because so few biologists study these plants, few data have been collected regarding the need for bryophyte conservation in Illinois. As of 2007, no bryophytes have been listed as either endangered or threatened in our state. To conserve the diversity of bryophytes, as well as associated organisms, it is essential to preserve the diversity of natural habitats that they occupy.

Drs. Ray Stotler and Barbara Crandall-Stotler are Emeriti Professors of Plant Biology at Southern Illinois University-Carbondale. Dr. Li Zhang was a Post-Doctoral Fellow at SIU-C and has returned to his native China as a research scientist at the Fairylake Botanical Garden in Guangdong.

Juniper moss
Polytrichum juniperinum



Spoon-leaved moss
Bryoandersonia illecebra