

Revealing the Bryophytes of Shenandoah National Park

At first glance, a moss-covered rock may not seem remarkable. But in Shenandoah National Park, those small green patches can contain rare species found in only a few places. They can also help stabilize soils, retain moisture, recycle nutrients, and provide habitat for other organisms.



Ontario rhodobryum moss (Rhodobryum ontariense).

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Bryophytes—a plant group that includes mosses and liverworts—grow throughout the park on rocks, wood, and soil. Despite their importance, many of Shenandoah’s bryophytes had never been carefully documented. Vegetation surveys in the park have focused mostly on trees, wildflowers, and other vascular plants, and most bryophyte specimens housed in the park herbarium were collected about 90 years ago. As a result, park staff had limited information about the bryophyte species living there today.

Park staff also began noticing signs of trampling in heavily visited areas, especially near waterfalls, overlooks, swimming holes, and climbing sites. A recent project set out to better

understand the park's bryophyte communities and determine whether recreation may be impacting them.

Surveying Shenandoah's Mosses and Liverworts

Shenandoah staff partnered with researchers from the University of Tennessee to carry out bryophyte surveys at sites throughout the park. Researchers studied 36 sites in 2023, including waterfalls, streams, wetlands, and rock outcrops. They returned to sites with rare bryophytes in 2025 for more detailed surveys.



Researchers surveyed bryophytes across a variety of habitats.

Photos courtesy of Aspen Mazzatta

The surveys spanned a range of habitats and visitor use levels to better understand both bryophyte diversity and the potential effects of disturbance. Researchers studied sites popular for hiking, climbing, and swimming alongside less-visited areas with similar habitat conditions.

At each site, researchers searched carefully for bryophytes growing on different surfaces and recorded how much bryophyte cover was present. While some species could be identified in the field using a hand lens and field guide, others required closer examination

under a microscope. For example, one of the rare liverworts documented during the study was less than a millimeter wide and grew hidden among larger mosses.



Graduate student Eric Shershen and principal investigator Jessica Budke examine bryophytes using hand lenses.

Photo courtesy of Isabel Hildesheim

Key Findings

The surveys documented 247 bryophyte species, including 76 that had never before been recorded in the park. Researchers discovered four species considered rare at the state or global level. This included one species never before recorded in Virginia, and another with only two known populations in the state, both in Shenandoah.

The study highlighted how much remains unknown about these communities. Even well-visited areas still contained undocumented species. “This was a relatively small project,” Shenandoah botanist Wendy Cass said. “There is more to be discovered.”



Research technician Aspen Mazzatta collects field data beneath the forest canopy. Canopy cover helps maintain the cool, moist conditions many bryophytes depend on.

Photo courtesy of Jessica Budke

Researchers found that heavily visited sites generally had similar levels of bryophyte cover and similar numbers of species compared to less disturbed sites, suggesting that many bryophytes can persist even in popular recreation areas. However, disturbed and undisturbed sites often supported different bryophyte communities.



Aneura sharpii, a rare liverwort documented during the study.

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Beyond recreation, environmental conditions played an important role in shaping bryophyte communities. The team observed this at Dry Run Falls, where a rare liverwort (*Aneura sharpii*) documented in 2023 could not be relocated during follow-up surveys in 2025. Between surveys, tree mortality caused by the invasive Emerald Ash borer beetle had opened the canopy and altered the cool, moist conditions the species depended on. Researchers believe the species likely persists as microscopic spores that could grow new plants if conditions improve. As tree mortality increases across the park due to stressors like drought, insects, and disease, findings like these provide another reminder of the importance of protecting healthy forest canopy.

Guiding Future Management and Research

The study is already helping inform management decisions in the park. At Dry Run Falls, park staff are considering shifting search-and-rescue training activities away from the area where a rare bryophyte was documented. At Little Stony Man, park staff are evaluating whether slight adjustments to current climbing regulations may help protect sensitive bryophytes while still allowing recreation. Initial efforts may focus on education, signage, and encouraging visitors to avoid sensitive areas.

The project also created lasting resources for future bryophyte research and conservation. The team developed a guide to help park staff identify rare bryophytes and recognize habitats where they may occur elsewhere in the park. Staff hope to incorporate bryophyte monitoring into future rare plant surveys every few years.

Additionally, the project improved access to the park's bryophyte collections. Hundreds of specimens were digitized and added to the [Consortium of Bryophyte Herbaria](#) database, making these records publicly accessible to researchers, naturalists, and anyone interested in exploring Shenandoah's bryophyte diversity.

Looking Closer

Cass hopes the project encourages visitors to slow down and notice the smaller details around them. “You can really appreciate bryophytes when you get in close on your hands and knees with a magnifying hand lens—a whole world will open up to you that you could have just stepped over and never noticed. I’ve made some of my most interesting discoveries by sitting still, looking carefully around me,” Cass reflected.

Visitors can help protect these fragile communities by staying on designated trails, respecting climbing closures and signage, and practicing [Leave No Trace](#) principles.

Learn More

- Dive into the study's survey methods, discoveries, and management implications in the [full report](#).
- Explore resources about mosses, liverworts, and other bryophytes from the [Bryophyte Conservation Alliance](#).
- Learn more about bryophyte research in the [Budke Lab](#) at the University of Tennessee.

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