



The Lady-Slipper

Winter 2015/2016 Issue

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www.knps.org

Life History and Status of the Appalachian Gametophyte Fern

By David D. Taylor

A region of erosion resistant limestone, sandstone, conglomerate, and or quartzite cliffs of Mississippian or Pennsylvanian- age stretches along the western edge of the Appalachian Plateaus from Massachusetts to northern Alabama. Other areas with cliffs include the Interior Low Plateaus and Ozark Plateaus physiographic provinces. These cliffs are best developed along the Red River and Cumberland River drainages on the Cumberland Plateau, roughly eastern-central Kentucky south to northern Alabama. They most often are found along stream valleys, sometime close to the stream, sometimes well upslope. The cliffs are commonly punctuated with recesses, often, but not always, found at the base of the



Photo B: Cluster of plants. Photo by David D. Taylor.

cliff. The largest of the recesses are usually

found at or near the heads of narrow stream valleys. Locally known in Kentucky as rockhouses or rockshelters, the recesses were used frequently by prehistoric humans for shelter, and historically for shelter for both humans and livestock. Even today, there is a house in Jackson County partially built into one of these large recesses. An excellent review of rockhouses may be found in Walck et al. (1996).

Many of these rockhouses are deep, extending 32 m (105 ft) or more under the cliff. Some are cave-like with dark zones. While many are very dry and dusty, others have a continual source

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Photo A: Habitat. *Vittaria* in the dark green at the back. Photo taken 30 ft inside shelter. Photo by David D. Taylor

KNPS President's Message by Zeb Weese

Another great year for the KNPS is ahead of us, and we'd love to have you on board. First of all, make plans to attend the 2016 Wildflower Weekend at Natural Bridge in April. Our tentative agenda is on page 4 of this newsletter. Bring your family and friends who might just barely be thinking about native plants but love hiking in the Gorge. Next, encourage a student to apply for a KNPS research grant. Education is a priority at KNPS, we need to encourage the next generation of biologists to get out in Kentucky's natural areas. If you know any students that could use free money, the information is on page 5. Finally, another Native Plant Certification class is forming in the Lexington area now, details on page 4. If you would like to get on the waiting list for the 2016 class please contact certification@knps.org.

See you all at Natural Bridge! Zeb

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The Lady-Slipper is intended to be published by the Kentucky Native Plant Society [IRC 501(c)(3)] in March, June, Sept., and Dec. Deadlines are the 10th of the prior months, but Editorial Committee members welcome article submissions at any time. Send dues and membership status inquiries to:

Kentucky Native Plant Society Membership, 801 Schenkel Lane, Frankfort, KY 40601

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KNPS Wildflower Weekend 2016

April 29– May 1 at Natural Bridge State Park

Spring will once again find us enjoying the native plants and trails at Natural Bridge State Park. As usual our field trips will travel all over Natural Bridge and the Red River Gorge National Geologic Area, including hikes along the Rock Garden Trail, Whittleton Arch Trail, Sheltolee Trace, and many others. Our trips are led by some of Kentucky's most prominent biologists, both professional and amateur, and range from general wildflower hikes to specialized hikes focusing on woody plants, geology, ecology, and invasive plants.

Friday, April 29: Field Trips—8:30 am, 1:30 pm, 4:00 pm

7:00 PM—John Snell – Basics of Wildflower Photography

John Snell is well known for his photographs of the Red River Gorge. On Friday night he'll give you some tips on improving your own nature photography, and on Saturday morning he'll join us for a hike in search of subjects. Be sure to bring your cameras and your questions! Check out John's website at www.johnsnellphoto.com

8:00 PM—John MacGregor—Natural History of Kentucky

John MacGregor has been one of Kentucky's premier field biologists for decades, and an accomplished photographer in his own right. His presentation will feature native plants from the area, as well as salamanders, reptiles, bats, and just about everything else found in the woods. You can count on John to be entertaining as well as informative.

Saturday, April 30: Field Trips—8:30 am, 9:00 am, 1:30 pm, 2:00 pm

6:00 PM – Kentucky Native Plant Society's 30th Anniversary Celebration

Join us for some fellowship and cake!

6:45 PM—Find out about our plans for 2016!

7:00 PM – Tom Patrick—Trilliums of the South

Tom Patrick is a botanist with the Georgia Department of Natural Resources. He studies the rare flowering plants of Georgia and conducts inventories of native plants in natural areas through Georgia. He is particularly interested in trilliums, orchids, and pitcher plant bogs. A native of upstate New York, he received his M.S. in Botany from Cornell University, continued graduate studies at the University of Tennessee, and has been a part of the Georgia Natural Heritage Program since 1986.



Sunday, May 1st: Field Trips—8:30 am, 9:00 am

The cost is \$10 for adults, \$3 for ages 13-17 and free for ages 12 and under. Discounted KNPS memberships will be available for \$10 for registrants.

To reserve a lodge or cabin at Natural Bridge please call 1-606-663-2214, and make sure to tell them you are coming for Wildflower Weekend!

2016 KNPS Native Plant Stewardship Certification

Planning is underway for the 2016 KNPS Native Plant Stewardship Certification program! This year's program will be held in the Lexington area and will run from around April to September of 2016. Registration will be opened soon, in the next few weeks, after all the class dates and locations have been confirmed.

To be placed on the waiting list and receive updates about the 2016 program, email certification@knps.org.

The goals of the KNPS Native Plant Stewardship Certification Program are to provide:

- Background knowledge about Kentucky's native plant resources
- Knowledge about threats to native plant resources
- Experience managing for and restoring native plant resources

The full certification program consists of six one-day sessions, one course each month. It is intended that participants will complete the program in one calendar year. Cost is \$110 per person and includes educational materials. Our instructors include some of Kentucky's most experienced botanists and land managers.

2016 Classes (dates to be determined):

Native Plant Identification 101 - Robert Paratley (Herbarium Curator, University of Kentucky)

Kentucky's Native Plant Communities and Rare Plant Monitoring –
Tara Littlefield and Martina Hines (Kentucky State Nature Preserves Commission)

Threats to Ecological Communities & Biodiversity of Kentucky -
Jody Thompson, (Eco-Tech Consultants, Inc.), Zeb Weese (Kentucky Heritage Land Conservation Fund)

Enhancing Biodiversity in Your Own Backyard – Growing Native Plants –
Mary Carol Cooper (Kentucky Fish and Wildlife, Native Plant Program (retired))

Invasive Species – Field Identification and Management Techniques - Beverly James (Preserve Manager, Floracliff)

Habitat Management/Graduation Event - Clare Sipple (Preserve Manager, Lower Howard's Creek)

2016 class locations:

Lower Howards Creek Nature and Heritage Preserve,
Raven Run Nature Sanctuary, and
Floracliff Nature Sanctuary

Lower Howard's Creek; photo by Zeb Weese



2016 KNPS STUDENT RESEARCH GRANTS

KNPS is pleased to announce the student research grant program, a funding source to support botanical knowledge and understanding in Kentucky. We are pleased to offer awards of \$500 for graduate student projects, and \$250 for undergraduate projects. Awards will be given for field-based botanical project(s) which contribute to the knowledge of Kentucky's flora or natural communities (with students preferably attending a Kentucky college or university). The grant may be used to purchase consumable supplies and materials such as rebar, herbarium paper, label stock, and topographic maps. The grant may also be used to cover travel expenses. It may not be used to pay time (e.g., labor) for any party. Applications are due by **April 8, 2016**. Applications will be evaluated and recipients will be announced at the 2016 Wildflower Weekend. Funding amount may vary depending on the applicant pool (and may include no grants given). Proposals will be reviewed by the KNPS Grant Committee.

Proposals must include:

1. A current resume/curriculum vitae;
2. A proposal (not to exceed two single-spaced typed pages) identifying the research as either graduate or under-graduate, and describing the proposed research and the role the grant would play in the research;
3. An itemized budget;
4. One letter of recommendation from a faculty member.

Applicants are encouraged to become members of the KNPS, but membership is not required to be awarded a grant. Grant recipients are required to provide KNPS with a short summary of the funded research suitable for publishing in KNPS's newsletter, *The Lady-Slipper*, within one year of receiving the grant. Grant recipients are also expected to present their work at the KNPS Fall or Spring meeting, and we encourage presenting their work at the annual Kentucky Academy of Sciences meeting within one year of completion of their research.

Submit electronic copies (as Word or PDF attachments) of all items listed above including letter of recommendation (sent separately by faculty member) to:

dtaylor02@fs.fed.us

The KNPS's goals:

- To serve as the Kentucky native plant education resource;
- To support native plant research;
- To support efforts to identify and protect endangered, threatened, and rare native plant species;
- To promote appreciation of the biodiversity of native plant ecosystems;
- To encourage the appropriate use of native plants.



Vittaria appalachiana
showing gemmae

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of moisture from ground water seepage through the sandstone that may form the head of small streams. They are usually shaded, and compared to the surrounding environment have local climates cooler and more humid in summer and warmer and more humid in winter. Within the rockhouses, ledges, crevices, secondary and tertiary rockhouses, and small to large cavities (tafoni) can be found on the back wall and ceiling, all contributing to a variety of microhabitats. In Kentucky and elsewhere, tafoni may form honeycomb patterns on the rockhouse walls. In general,

rockhouses, at least the larger and more complex ones, have more stable temperatures and humidity than habitat immediately outside of the shelters. This is beneficial to many plants and animals. Eleven species of vascular plants in the eastern United States are endemic or nearly so to sandstone rockhouses (Walck et al 1996). This article will feature one of those plants, a fern with a nonstandard approach to reproduction.

Appalachian gametophyte or shoestring fern (*Vittaria appalachiana* Farrar & Mickel) belongs to the family Vittariaceae (Shoestring fern family) whose members are tropical or subtropical in distribution with the exception of this fern. The only other members of the family known from the continental U.S. are shoestring fern (*V. lineata*), which occurs typically on palm trunks in south Florida, and another location in southeastern Georgia, and grass fern (*V. graminifolia*), which is known only from a single parish in southeastern Louisiana (Farrar 1993).

Appalachian gametophyte fern is found at the back of rockhouses (very rarely on tree bases in dark, humid gorges). Within these rockhouses, it occupies dark, humid crevices, ledges and tafoni where it can create a carpet on the substrate (Photo A). Individual plants are seldom over 3 mm (0.12 in), but up to 1 cm (0.4 in) long, and about 3 mm (0.12 in) wide, at least at the base. The plants usually occur in dense overlapping clusters, making it difficult to view an entire single plant (Photos B and C). They are usually only a few cells thick and quickly dry out when removed from the sheltered locations. Plants have a bubbly appearance (Photo D). The plants may have few to many branches and frequently

Photo E: Plant through microscope showing gemmae. ©Paul G. Davidson, University of North Alabama. Used with permission.

have very small filaments at the end of branches (see photo D). These filaments are gemmae, asexual reproductive structures. Each, consisting of 2-12 cells, can form a new plant when in the correct growing conditions.

The small plants are easily overlooked and they are commonly mistaken for liverworts or even mosses by those who see them. In fact, some of the first scientific reference to the species (1824) referred to it as a liverwort (see Farrar and Mickel 1991). It was recognized as a fern gametophyte around 1930, but thought to be a species of *Hymenophyllum* (see Farrar 1978, Farrar and Mickel 1991), another fern genus known for persisting as a gametophyte. Its relationship to other ferns was not identified until much later when Wagner and Sharp (1963) determined it was a species of *Vittaria*. It was thought to be *V. lineata*, until shown a distinct species (Farrar and Mickel 1991) and the name *Vittaria appalachiana* was proposed. Other work suggests that its origin might be the result of hybridization of other *Vittaria* species (Farrar 1990). Farrar (1990, 1998) suggests that the sporophyte generation may have been eliminated during the Pleistocene, only the gametophytes surviving in rockhouse refugia (see discussion below).

Typical ferns exhibit alternation of generations, one generation (gametophyte) with half the normal amount ($1n$) of genetic material, and one generation (sporophyte) with the normal amount ($2n$). The gametophyte generation produces egg and sperm, each $1n$. When egg and sperm fuse, the resulting zygote now is $2n$. The zygote develops into the typical fern plant with which readers are familiar. Sporophyte plants produce spores, each $1n$, that germinate into gametophytes starting the cycle over.

As the common name implies, Appalachian gametophyte fern exists as a gametophyte; sporophytes are rarely produced. The few tiny sporophytes that have been observed do not fully develop and do not produce spores. The plant reproduces entirely by asexual means, either through gemmae, or movement of gametophytes from one location to another by animals such as the eastern woodrat (*Neotoma floridana*). This is the only fern known to reproduce exclusively by asexual reproduction. All other ferns so far examined produce sporophyte plants capable of producing spores at least sometimes.

So why is this fern in rockhouses? Farrar (1998) discussed three hypotheses that could answer the question: 1) tropical element species can survive in rockhouses because of the specific conditions of the habitat, 2) the small size of the plants and other characteristics of these plants allow them to survive in rockhouse habitats, and 3) rockhouses served as refugia for species that were once more widespread during a warmer climate. A short summary is presented here.

This fern and five others found exclusively or primarily in rockhouses or in rockhouses outside of the tropics belong to families that are almost entirely tropical or subtropical in distribution. A number of mosses and liverworts that occur

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Vittaria appalachiana

primarily or exclusively in rockhouses in eastern North America are otherwise tropical or subtropical in distribution. Tropical ferns, mosses, and liverwort frequently grow shaded by multiple layers of canopy and receive low levels of light. They occur in areas of nearly constant high humidity. They are also subjected to relatively narrow changes in temperature on a daily basis and temperatures that rarely, if ever, drop below freezing. These conditions are largely met in rockhouses. Researchers have investigated the microclimate of rockhouses and other protected areas (see Farrar 1998). In multiyear research, temperatures were logged in rockhouses and outside of them. Temperatures in summer were

as much as 30° F (16° C) lower in the shelters than outside on adjacent ridges. Winter temperatures in rockhouses were as much as 34° F (19° C) warmer than on adjacent ridges, reaching below 32° F (0° C) only a few times, and by then only a few degrees. Daily changes are not great and although seasonal changes of temperature range over 80 Fahrenheit degrees or more, the change is gradual allowing acclimatization. Humidity remained high except in the worst droughts.

Farrar (1998) investigated photosynthesis response of a related, evergreen and sporophyte-producing fern, *Trichomanes boschianum*, (filmy fern or Appalachian bristle fern) that is also a rockhouse denizen. He determined that the fern was capable of photosynthesis at very low light levels and over a range of temperatures. Peak photosynthesis occurred between 59° and 77° F (15° and 25° C), temperatures experienced in spring and fall in eastern Kentucky. Light levels were highest in winter and lowest in summer due to leaf cover of the deciduous trees around the rockhouse. Photosynthesis appears to be limited in winter by low temperature and in summer by light, but nonetheless probably occurs throughout the year. This is important for evergreen species in low light. The plant must continually produce sugar to support itself. Appalachian gametophyte fern, and mosses and liverworts also evergreen, must produce sugars throughout the year to maintain themselves and reproduce, but as they are much smaller than the filmy fern, require less energy to do so.



Photo C: Plants through dissecting scope (left) and in wild (right). ©Paul G. Davidson, University of North Alabama. Used with permission.)

Investigations into the genetic structure of Appalachian gametophyte fern indicate that genetic structure is fixed among populations, that is, there is no genetic exchange occurring between populations (Farrar 1998). Populations close to the center of distribution such as those in eastern Kentucky show greater genetic diversity than those at the outer extent of the fern's range. This helps to support the idea that the fern retreated to rockhouses as climate became harsher during Pleistocene glaciation. During the Eocene and Miocene, Kentucky was in a subtropical to tropical climate favorable to many species that might today be found in the tropics. Appalachian gametophyte fern will survive temperatures of 12° F (-11° F), but sporophytes of related species of *Vittaria* do not survive freezing (Farrar 1998). Under harsh, but survivable conditions¹, sporophytes, which are more temperature sensitive, may well have ceased to develop over time. Without sexual reproduction, gametophytes became isolated and lost the ability to produce sporophytes. Since rockhouses are long lasting features, habitat would have been available to support species as they evolved to adapt to new climatic conditions. In essence, rockhouses acted as refugia allowing Appalachian gametophyte ferns to survive in less than ideal conditions. The fern continues to survive today in temperate North America in conditions that are still not ideal for a tropical fern.

Appalachian gametophyte fern is not rare, but is frequently overlooked or mistaken for a liverwort or moss. It is found



from extreme southwestern New York south through the Appalachians to northern Alabama, Georgia and South Carolina, west through eastern Ohio, eastern and western Kentucky, and southern Illinois (Farrar 1993). The PLANTS Database (NRCS, USDA 2015) adds southern Indiana and Louisiana. It is also reported from Mississippi (MNHP 2015). The range corresponds to areas with appropriate habitat: noncalcareous rockshelters or otherwise sheltered crevices, ledges and tafoni.

¹ *Appalachian gametophyte fern occurs north of the glacial boundary in only a few places within 50 mi (80 km) of the boundary, apparently post glacial migration. It is also thought based on studies such as, for example,*

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Delcourt and Delcourt (1993), that prevailing winds probably kept areas not far south of the glacial boundary much warmer than would be expected at the edge of a glacier allowing some plants the opportunity to migrate northward.

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Kentucky Conservation Committee

The Kentucky Native Plant Society is an official Affiliate of the Kentucky Conservation Committee!

The KCC is the state's only organization dedicated solely to providing a non-partisan voice for Kentucky's environmental community in Frankfort. KCC works to make sound environmental stewardship a priority for elected officials and voters. For more information on KCC's activities, just go to:

www.kyconservation.org



Kentucky Native Plant Society
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Detach and send to: Kentucky Native Plant Society / 801 Schenkel Lane / Frankfort, KY 40601

Note: To pay by credit card or PayPal account, please visit the website www.knps.org.

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The Kentucky Native Plant Society was founded in 1986 for everyone interested in the native plants, trees, and wildflowers of Kentucky. Plants are essential to both the well-being of our Commonwealth's natural ecosystems and our enjoyment of its unique environment. With members in Kentucky and neighboring states, the Kentucky Native Plant Society is a leader in promoting education about, appreciation for, and conservation of the native flora of our Commonwealth.