Friends of Plant Conservation, Inc.

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Editor: Katherine Schlosser

Three Rivers Land Trust adds 15 acres to N.C. Plant Conservation Program's Eastwood Preserve

Three Rivers Land Trust, soon to be a merged organization with the Sandhills Area Land Trust, is excited to announce the addition of 15 acres to the North Carolina Department of Agriculture & Consumer Services Plant Conservation Program's Eastwood Preserve in Moore County. This site is a significant natural heritage area as identified by the North Carolina Natural Heritage Program, known primarily for its occurrence of the state endangered Sandhills lily, which occurs only in the Sandhills of North Carolina, South Carolina, and Virginia. The Sandhills lily is a relatively new species, discovered by long-time Moore County resident and botanist, Bruce Sorrie, around 20 years ago.

Three Rivers Land Trust worked with the landowners, Andy and Heather Kiser, to purchase the tract using Clean Water Management Trust Fund dollars, and then transferred the tract to the state. This property brings the total acreage of land in the Eastwood Preserve to 392 acres.

"Three Rivers Land Trust appreciates the opportunity given to us by the Kiser's to add this important property to the Plant Conservation Program's Eastwood Preserve," states Executive Director Travis Morehead. "Conserving our state's significant and rare species and ecosystems has been a primary goal of the Land Trust since our inception, and we are pleased to continue these efforts in our newly expanded region."

The mission of the NC Plant Conservation Program is to conserve the native plant species of North Carolina in their natural habitats, now and for future generations. "The addition of this tract to the existing Plant Conservation Preserve is an important part of protecting the habitat that this plant requires," states Plant Ecologist with NC Plant Conservation Program Lesley Starke.

As with all NC Plant Conservation Program preserves, due to the sensitive nature of the species found on site, the site is only open to the public through workdays and guided tours offered by the NC Plant Conservation Program through a partnership with the Friends of Plant Conservation. Workdays are announced on the FoPC website ncplantfriends.org.

Crystal Cockman, Three Rivers Land Trust

Message from the President

NORTH CAROLINA Museum of Natural Sciences
celebrating nature | advancing science

A 4 1/2 year retirement from the NC Museum of Natural Sciences has led Alvin to new places...and back to a very familiar one. He was recently called back to the Museum to serve as Acting Interim Director as they conduct a search for a new director. With strong loyalties to the Museum, and lots of friends there, he accepted the challenge. He is now working a regular 8-5 job and says that FOPC, still high on his list of priorities, will have his attention on weekends.

The board of directors is ready to step up when needed, and all activities will continue as normal, though not with quite as much input from Alvin as we have had. Still, he is on top of things as usual and always available in an emergency.

We understand that the folks at the Museum were "jumping with joy" as they learned about Alvin's return, and we understand that completely. He anticipates that a new director can be found and installed within a 6 to 8 month timeframe. We wish him well and look forward to his second retirement, when we, too, will be jumping with joy!

In the meantime, he will of course respond to emails and such, but if it takes him a few days, please be patient.

Annual Meeting: Picture Creek & Picnic October 26th

DETAILS WILL BE SENT SOON—**SAVE THE DATE!**

Looking for A Way to Help??

Olivia has a plan for you!

"Help us this fall to remove non-native invasive grasses and monitor rare sunflowers on the Plant Conservation Program Preserves across the state. Visit our website to sign up for a workday near you."

www.ncplantfriends.org/workdays.html

Saying Good-bye

Hi Friends,

I have been working for PCP for almost five years during which time I've had the privilege to get to know and work alongside many of you. Your dedication to plant conservation is inspiring and the countless hours you spend to keep FoPC and PCP running do not go unnoticed! Plus, you all do things like buy us weed-eaters and leaf blowers and pay for us to go to weed conferences and help us survive our mandatory months off as technicians. I mean, those things alone score you some major cool points.

I can't think of any job that is more diverse than this one. Where else do you get to save plants and kill plants, set fires and put out fires, rake leaves up and rake them back out, dig holes and fill holes, cut trees and plant trees? Or travel all over the state, see tons of rare plants, explore all kinds of natural communities, write management plans that prioritize plant protection and conservation, work with volunteers, kill a whole bunch of plants and then kill them again, collaborate with a host of partners and agencies, actively contribute to the conservation of nature, witness the success of restoration first hand, or spend all day in the woods AND get paid for it?!

As some of you may know, last fall the funding for my position was tenuous. The annual grant that pays my salary lapsed and it wasn't clear if it would come through at all. Had it not been for the Redlair Foundation, which generously stepped in and paid my salary for over a month, I would have been laid off in October. Thankfully, the funding for this year did eventually come through, but it was a wakeup call that this job is not a guarantee. As much as I love working here, I am ready for more stability and a career that allows me to put down roots.

In April I interviewed for a Field Botanist position with the Virginia Natural Heritage Program in Richmond. You guys, Field Botanist is LITERALLY the job title I have dreamed of having for the last ten years. That type of job doesn't come around often, so I knew I had to throw my hat in the ring even if it was a long shot. Long story short, to my flabbergastion (totally a word), they offered me the job, and I have accepted. PCP's former program coordinator Rob Evans currently works for their program, so PCP will be well represented!

So many stories, so many amazing experiences, so many passionate people. I am certainly sad to be leaving PCP and North Carolina, but I am also excited to explore a new state with new plants and new people…but mostly the plants .

I will miss you all! I will not, however, miss writing permits!

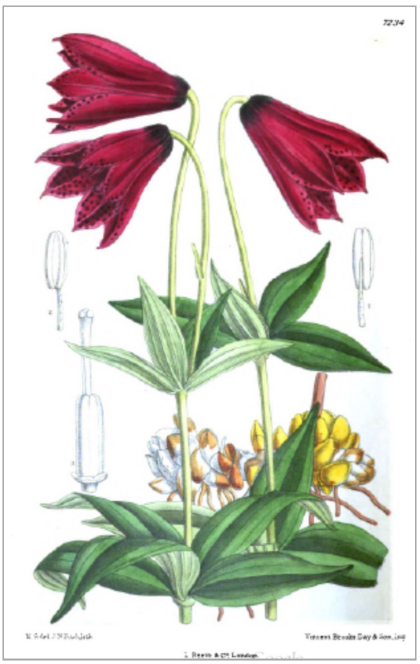
Jenny Stanley

More photos from Jenny...

Best wishes to Jenny....

and Congratulations to VA.NHP for snagging another great NCPCP employee!

Threatened: *Lilium grayi*



Lilium grayi illustration from Curtis Botanical Magazine, 1892.

A brisk walk around the top of Roan Mountain twenty years ago, with a damp mist softening the view and gusty winds that made us pull our coats even closer on this June day, soon brought me to my first glimpse of Gray's lily. From a distance, it was the nodding bud that caught my attention.

One hundred and sixty years earlier, Asa Gray had been here and noticed the same species that, even with the differences he noted, he assumed was *Lilium canadense*. Preserving a specimen in his herbarium at Cambridge, he would later learn that it was indeed a different species.

Roan Mountain has long been a popular spot for botanizing. Andre Michaux reported its beauty and botanical diversity in 1789 and it has continued to attract botanists and naturalists, including Asa Gray in 1841.

In 1876, led by M. E. Hyams of Statesville, NC, and accompanied by George Engelmann, William Canby and J.H. Redfield, Gray repeated his earlier visit. It was on this trip that he finally found the long sought *Shortia brevistyla* (it has recently been declared a species rather than a varietas of *S. galacifolia*), Several days later the group reached Roan Mountain where Gray again found the lily, "a lily which Watson has recently named *Lilium Grayi*, probably too near to *L. canadense*." Watson had studied the specimen left at Cambridge in 1841 and recognized it as a species. (J.H.R., 1879)

Taken in 2009 on Roan Mountain, there appears to be a Lily leaf spot on the

Botanists still regularly visit the area, most recently with a new purpose. Never an abundant species (see box), it suffers from many of the same threats as so many others: trampling by hikers, non-native species invasion, encroachment of woody species, hydrology alteration, elimination of native grazers, and poaching by wildflower collectors. There is now a new threat: lily leaf spot disease, *Pseudocrecosporella inconspicua.*

***Lilium grayi* Distribution**		
STATE	**# COUNTIES W/ POPULATION**	**THREAT STATUS**
North Carolina	7	THREATENED
Tennessee	2	ENDANGERED
Virginia	6?	S-2 RARE

In the 1990s Moni Bates noticed tan lesions on the leaves of some Gray's lily plants on Roan Mountain. For the next six years she kept track of her observations and progression of the disease. She made annual reports to the NC Plant Conservation Program which remain unpublished but are available in the PCP office. The early senescence—prior to seed set—of the affected plants and their failure to successfully reproduce—and when they do, the capsules and seeds show sign of lily leaf spot—led Bates to suggest a fungal problem. Her reports ended in 1998, but the work of students and botanists continued.

Early evidence of the disease came from examination of herbarium specimens. Russell Ingram reviewed 500 specimens dating from the mid-1900s, finding one *L. grayi* from Roan Mountain in 1947 and two *L. canadense* showing disease symptoms. It appears the disease originated in the northeastern U.S. and has spread to the southern Appalachians.

In 2011 Joe Powell, a student at East Tennessee State University (ETSU), submitted an undergraduate Honor's Thesis, the purposes of which was to:

describe the demography of adult plants,
compare browsed and non-browsed plots,

...continued on p. 6

Gray's lily with severe lily leaf spot disease. Taken by Cheryl Gregory, June 20, 2017.

> and determine the extent to which disease may impact survival and reproduction of *L. grayi* on Roan Mountain. There were no significant differences between browsed and control plots in measures of plant morphology, vigor, or reproductive output, but browsed plots had significantly more juvenile plants compared to controls. Along a transect, spatial analyses uncovered clusters of diseased and healthy plants and showed that plants in close proximity tended to be alike in disease status and those distant were more unalike. A pathogenic fungus, *Pseudocercosporella inconspicua*, may be the disease pathogen. (Powell, 2011)

In 2013, Ingram, also of ETSU, prepared a Thesis on Gray's lily concluding that the impact of the disease is severe with "59% of mature and 98% of adolescent plants undergoing early senescence. Only 32% of mature plants produced seed capsules and they were frequently diseased." He also warned that lily leaf spot disease is capable "of causing sequential annual epidemics of unknown long-term consequences to the stability of the host population." (Ingram, 2013)

He also points out that *L. grayi* and *L. candense* are known to hybridize, yet *L. canadense* generally shows less susceptibility to the disease. *L. grayi* is a high elevation plant while *L. canadense* generally grows below 2600', an elevation at which *Pseudocercosporella inconspicua* cannot survive. Since then lily leaf spot has appeared in *L. canadense*, to a lesser extent, on Roan Mountain, making it a host.

In October 2018 Ingram published another study in which he states:

> this infectious disease poses conservation and management difficulties because increases in plant density can be expected to lead to enhanced disease transmission. Lily leaf spot of L. grayi is best characterized as an annually recurring epidemic because of high prevalence rates, strong impacts on all life stages, and reductions in seed production and viability. (Ingram, 2018).

Cindy Barrett (ETSU) is conducting a study of lily leaf spot in *Gray's lily, Turk's Cap lily, and L. michauxii* as a part of her Masters' Thesis, which will not be available for a while yet. In the meantime, she is addressing interested groups and individuals and sharing her studies. Thus far, she has identified *L. superbum* as an additional host which may also "act as disease reservoir, further complicating the outlook for *L. grayi*. The disease should be considered an epidemic because of its impact on individual plants, its commonness within populations, and its ubiquity across the geographical range."

Sign posted by Southern Appalachian Highlands Conservancy, FWS, and Appalachian Trail

As an infectious disease, spore transmission of lily leaf spot is exacerbated by human activity. The Appalachian Trail Association, US Forest Service and Southern Appalachian Highlands Conservancy have posted signs on Roan Mountain urging

...*continued on p. 7*

visitors not to touch the plants. That may help and should be honored, but it is not the full answer. That is yet to come for this recurring epidemic. With a small overall population size, limited distribution range, and susceptibility to lily leaf spot disease, an "extinction vortex" could be in place. (Ingram, 2018)

The prospects for *Lilium grayi* do not currently look good. However, a host of agencies and associations, including NCPCP, botanists, and a stream of bright students from ETSU continue their work.

Katherine Schlosser

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2019

Friends of Plant Conservation

Annual Meeting

October 26, 2019

Raleigh NC

and

Picture Creek

- *A Fall Visit to Picture Creek*
- *Picnic*
- *Speakers on topics of interest*

Details available soon.

SAVE THE DATE!

References con't.:

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Cheryl 'outstanding' in her field

When Cheryl Gregory heard that Lesley and team were headed for Bat Fork Bog recently, she called and asked if she could go along. While she was with PCP, managing the *Phalaris arundinacea* (reed canary grass) invasion became her particular interest and challenge. If you will recall, she worked to rid the pest from the preserve during the summers of 2017 and 2018. She also managed last year to get the Forest Service to use their drone to provide visuals of the problem and the results of treatment.

As you can see from the photo above from July 2019, sent by Lesley who also added the caption, the work they did last year made a huge difference. Most of the *Phalaris* in the foreground is growing in the ruts of the equipment used as the work was beginning, where it was flattened and did not receive the full brunt of the herbicide. The task now, that Cheryl is helping with, is spot treatment of clumps that return.

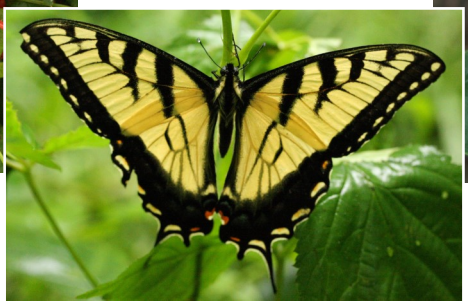
We are grateful for Cheryl's continued commitment to the project and to NCDOT for allowing her to devote time to the task.

Phalaris is a native plant that grows to 9' tall and has a tendency to weediness, being banned in some areas. It is especially a hazard to wetlands, displacing desirable vegetation.

As a matter of curiosity, the plant is named for Phalaris, the "tyrant of Acragas [ancient city of Sicily], who died in 554BCE. Made a general, he was given absolute power. With that power he made a cruel despot of himself across the island. He was finally overthrown in an uprising of the people for his atrocities. He was said to have been burned in "his own brazen bull," a bronze figure used for torture.

Seems an appropriate name for such a difficult weed, but the plant does have many useful attributes.

Signs of Summer



Signs of Summer photo credits

**Lilium grayi*, Gray's lily (Cheryl Gregory)

Rhododendron calendulaceum, Flame azalea (C. Gregory)

Papilio glaucus, Eastern Tiger Swallowtail (C. Gregory)

Clitoria mariana, Butterly pea (K. Schlosser)

Matelea decipiens, Oldfield or Deceptive Milkvine (Jenny Stanley)

***Scutellaria leonardii*, Shale-barren Skullcap (Jenny Stanley)

**Platanthera grandiflora*, Greater Fringed Purple Orchid (C. Gregory)

*Threatened

**Endangered

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Ten Commandments of Wildflower Conservation

"Thou shalt not pick, bend or break, trample, dig, poach, let pets run free, set fires, [or] alter the environment. Thou shalt enjoy and preserve and educate."

J. Anthony Alderman , Wildflowers of the Blue Ridge Parkway, University of North Carolina Press; 1st edition (May 12, 1997).

Pest Removal

The Callery or Bradford pear (*Pyrus calleryana*) was introduced as an ornamental tree in 1964 by the US Department of Agriculture. Even at that time, it was known that the tree has the weakest branch structure in nature. Bradford pears seldom survived more than 20 years before they split and lose branches in breezes, especially if wet or covered with snow.

We all know what happened: after growing for a number of years, these trees started to spread, usually unnoticed by most. Now they are a major pest and invading our forests and fields. They are everywhere.

South Carolina is asking property owners to cut their trees down. Ohio lawmakers are giving nurseries until 2023 to stop selling them. The City of Champaign, Illinois, no longer allows them to be planted in city rights-of-way. Indiana is working to ban the sale of the trees. The list goes on.

The trees appear on various "pest" lists, but it appears little formal action has been taken to stop the sale of the trees in N.C.

Journal Articles of Interest

Full copies of the articles below can be accessed on the FOPC website:

www.ncplantfriends.org or via the links provided

Plant functional traits and climate influence drought intensification and land–atmosphere feedbacks

William R. L. Anderegga,1, Anna T. Trugmana, David R. Bowlinga , Guido Salvucci b, and Samuel E. Tuttle c
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Edited by Benjamin D. Santer, Lawrence Livermore National Laboratory, Livermore, CA, and approved May 31, 2019 (received for review March 19, 2019). Published June 24, 2019

Terrestrial vegetation can affect climate extremes such as severe drought by mediating fluxes of energy and water from the land surface to the atmosphere. Declines in plant transpiration due to low soil moisture during drought, which is fundamentally determined by plant functional traits, can intensify drought, but this process is not well understood. We examine ecosystem-level eddy flux and satellite remote-sensing estimates of drought intensification and find that both mean climate and plant functional traits, particularly those related to water transport, explain drought intensification patterns across sites. Our findings highlight that plant physiology and water transport functional traits are likely crucial to include in earth system models for capturing land–atmosphere feedbacks and climate extremes.
https://www.pnas.org/lookup/suppl/doi:10.1073/pnas.1904747116/-/DCSupplemental

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Shifting avian spatial regimes in a changing climate

Caleb P. Roberts 1,2*, Craig R. Allen2, David G. Angeler3,4 and Dirac Twidwell1

In the present era of rapid global change, development of early warnings of ecological regime shifts is a major focus in ecology. Identifying and tracking shifts in spatial regimes is a new approach with potential to enhance understanding of ecological responses to global change. Here, we show strong directional non-stationarity of spatial regimes identified by avian community body mass data. We do this by tracking 46 years of avian spatial regime movement in the North American Great Plains. The northernmost spatial regime boundary moved >590 km northward, and the southernmost boundary moved >260 km northward. Tracking spatial regimes affords decadal planning horizons and moves beyond the predominately temporal early warnings of the past by providing spatiotemporally explicit detection of regime shifts in systems without fixed boundaries.

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Nature Climate Change | VOL 9 **562** | JULY 2019 | 562–566 | **www.nature.com/natureclimatechange**

https://doi.org/10.1038/s41558-019-0517-6

When the dinosaurs died, lichens thrived

Field Museum Press Release
June 28, 2019

Usnea spp.?? Beard lichen on Roan Mountain
K. Schlosser

When an asteroid smacked into the Earth 66 million years ago, it triggered mass extinctions all over the planet. The most famous victims were the dinosaurs, but early birds, insects, and other life forms took a hit too. The collision caused clouds of ash to block the sun and cool the planet's temperature, devastating plant life. But a new study in Scientific Reports shows that while land plants struggled, some kinds of lichens—organisms made of fungi and algae living together—seized the moment and evolved into new forms to take up plants' role in the ecosystem.

"We thought that lichens would be affected negatively, but in the three groups we looked at, they seized the chance and diversified rapidly," says Jen-Pan Huang, the paper's first author, a former postdoctoral researcher at the Field Museum now at Academia Sinica in Taipei. "Some lichens grow sophisticated 3D structures like plant leaves, and these ones filled the niches of plants that died out."

The researchers got interested in studying the effects of the mass extinction on lichens after reading a paper about how the asteroid strike also caused many species of early birds to go extinct. "I read it on the train, and I thought, 'My god, the poor lichens, they must have suffered too, how can we trace what happened to them?'" says Thorsten Lumbsch, senior author on the study and the Field Museum's curator of lichenized fungi.

You've seen lichens a million times, even if you didn't realize it. "Lichens are everywhere," says Huang. "If you go on a walk in the city, the rough spots or gray spots you see on rocks or walls or trees, those are common crust lichens. On the ground, they sometimes look like chewing gum. And if you go into a more pristine forest, you can find orange, yellow, and vivid violet colors—lichens are really pretty." They're what scientists call "symbiotic organisms"—they're made up of two different life forms sharing one body and working together. They're a partnership between a fungus and an organism that can perform photosynthesis, making energy from sunlight—either a tiny algae plant, or a special kind of blue-green bacterium. Fungi, which include mushrooms and molds, are on their own branch on the tree of life, separate from plants and animals (and actually more closely related to us than to plants). The main role of fungi is to break down decomposing material.

During the mass extinction 66 million years ago, plants suffered since ash from the asteroid blocked out sunlight and lowered temperatures. But the mass extinction seemed to be a good thing for fungi—they don't rely on sunlight for food and just need lots of dead stuff, and the fossil record shows an increase in fungal spores at this time. Since lichens contain a plant and a fungus, scientists wondered whether they were affected negatively like a plant or positively like a fungus.

"We originally expected lichens to be affected in a negative way, since they contain green things that need light," says Huang.

To see how lichens were affected by the mass extinction, the scientists had to get creative—there aren't many fossil lichens from that time frame. But while the researchers didn't have lichen fossils, they did have lots of modern lichen DNA.

From observing fungi growing in lab settings, scientists know generally how often genetic mutations show up in fungal DNA—how frequently a letter in the DNA sequence accidentally gets switched during the DNA copying process. That's called the mutation rate. And if you know the mutation rate, if you compare the DNA sequences of two different species, you can generally extrapolate how long ago they must have had a common ancestor with the same DNA.

The researchers fed DNA sequences of three families of lichens into a software program that compared their DNA and figured out what their family tree must look like, including estimates of how long ago it branched into the

groups we see today. They bolstered this information with the few lichen fossils they did have, from 100 and 400 million years ago. And the results pointed to a lichen boom after 66 million years ago, at least for some of the leafier lichen families.

“Some groups don’t show a change, so they didn’t suffer or benefit from the changes to the environment,” says Lumbsch, who in addition to his work on lichens is the Vice President of Science and Education at the Field. “Some lichens went extinct, and the leafy macrolichens filled those niches. I was really happy when I saw that not all the lichens suffered.”

The results underline how profoundly the natural world we know today was shaped by this mass extinction. “If you could go back 40 million years, the most prominent groups in vegetation, birds, fungi—they’d be more similar to what you see now than what you’d see 70 million years ago,” says Lumbsch. “Most of what we see around us nowadays in nature originated after the dinosaurs.”

And since this study shows how lichens responded to mass extinction 66 million years ago, it could shed light on how species will respond to the mass extinction the planet is currently undergoing. “Before we lose the world’s biodiversity, we should document it, because we don’t know when we’ll need it,” says Huang. “Lichens are environmental indicators—by simply doing a biodiversity study, we can infer air quality and pollution levels.”

Beyond the potential implications in understanding environmental impacts and mass extinctions, the researchers point to the ways the study deepens our understanding of the world around us.

“For me, it’s fascinating because you would not be able to do this without large molecular datasets. This would have been impossible ten years ago,” says Lumbsch. “It’s another piece to the puzzle to understanding what’s around us in nature.”

“We expect a lot of patterns from studying other organisms, but fungi don’t follow the pattern. Fungi are weird,” says Huang. “They’re really unpredictable, really diverse, really fun.”

This study was contributed to by researchers from the Field Museum, Kasetsart University, Brigham Young University, and Academia Sinica.

Full Article:

Jen-Pan Huang, Ekaphan Kraichak, Steven D. Leavitt, Matthew P. Nelsen, H. Thorsten Lumbsch. Accelerated diversifications in three diverse families of morphologically complex lichen-forming fungi link to major historical events. Scientific Reports, 2019; 9 (1) DOI: **10.1038/s41598-019-44881-1**

Or: FOPC website: **www.ncplantfriends.org**

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