Field Notes

Newsletter of the Friends of Plant Conservation
Support group of the NC Plant Conservation Program, NC Department of Agriculture and Consumer Services, Raleigh, NC

Vol. II, Issue 2, Summer 2010
Editor: Kathy Schlosser

Protected: Pellaea wrightiana, cliffbrake fern

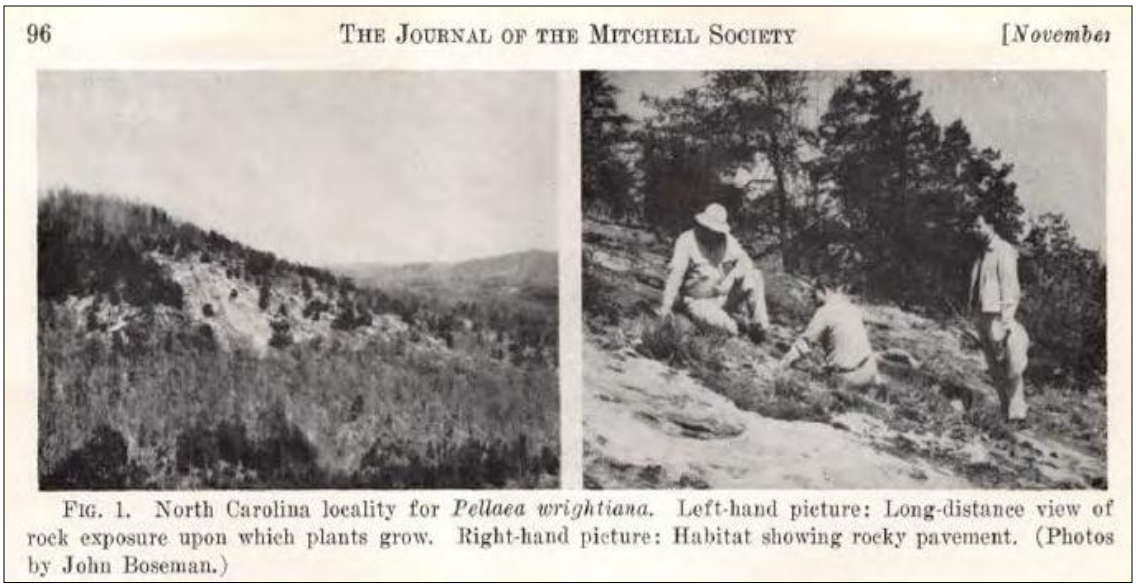

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FIG. 1. North Carolina locality for *Pellaea wrightiana*. Left-hand picture: Long-distance view of rock exposure upon which plants grow. Right-hand picture: Habitat showing rocky pavement. (Photos by John Boseman.)

On a sunny July day in 1956, A. E. Radford stepped out onto the face of a granite outcrop in Alexander County, NC to conduct a floristic survey. Among the plants collected were four specimens of what he thought was *Pellaea glabella* Mett. Ex Kuhn, at the time the only eastern cliffbrake fern that was similar. (The only other Pellaea on the east coast is *P. atropurpurea*, purple cliffbrake.) This collection, of what was ultimately decided to be *Pellaea wrightiana* Hooker*, brought about decades of debate and generated questions about the nature and means of fern dispersal.

There is something terrifyingly wonderful about granitic outcrops, those wide open bald rock faces found throughout our mountains and into the Piedmont. From a mountaintop outcrop you can reach for the skies, touch the clouds floating by, feel free from the entanglements of life below, or be scared to death by a fast moving storm racing up the side of the mountain. Either way, it's exhilarating—that is, unless you have just finished a sweaty climb up a steep slope. Getting to many of these sites is for the young among us, or hardy older hikers who have the time and patience to pace themselves.

It's exhilarating, too, to know that you are standing on top of the inner core of what once was a molten mass of magma.

We have two basic types of outcrops in North Carolina, high and low elevation, both with steep to gently sloping exposures of "smooth, exfoliating granite or similar massive igneous or metamorphic rock such as granitic gneiss." [i] These are plutons formed of igneous rock once far below the surface. During mountain building processes eons ago, molten magma slowly began to cool, crystallizing under tremendous overhead pressure. As pressure was reduced the resulting granite rose and overlying rock was eroded away. As the granite further expanded, fractures and sheet joints formed parallel to the surface. Rounded areas of rock, called exfoliation domes, are exposed—what we call granite outcrops. Now fully exposed, the granite further erodes as these layers, somewhat like the

Continued on page 3

*Status: Endangered

From The President…

May 15, 2010

Later this week, I plan a kayak trip into the swamps of Brunswick County to look for a small orchid (Greenfly Orchid). My travels this spring have taken me halfway around the world, from the Republic of Georgia to Pensacola Florida. My travels have made me realize how fortunate we are to have such a diverse population of protected native wildflowers. In some parts of Eastern Europe, plants have been overharvested or left unprotected. I visited a small protected prairie in western Moldova, one ranger was responsible for protecting a huge (hundreds of acres) native area. Trees are invasive into the area and wood is so valuable that every fallen limb is used for fuel; the forest more resembles what we would call a park. Burning is prohibited in the prairie areas and it appears to me that lack of prescribed burning (of the steppes) will soon mean the loss many plants native to those areas. Only the ditches and waste areas will serve as habitat for future plant populations. Nearly all the forested areas are owned by government since private land owners cannot afford the taxes and other costs associated with long term forestry. Forests take a back seat (in regards to funding) to human needs in most countries and you know what that means for imperiled plants.

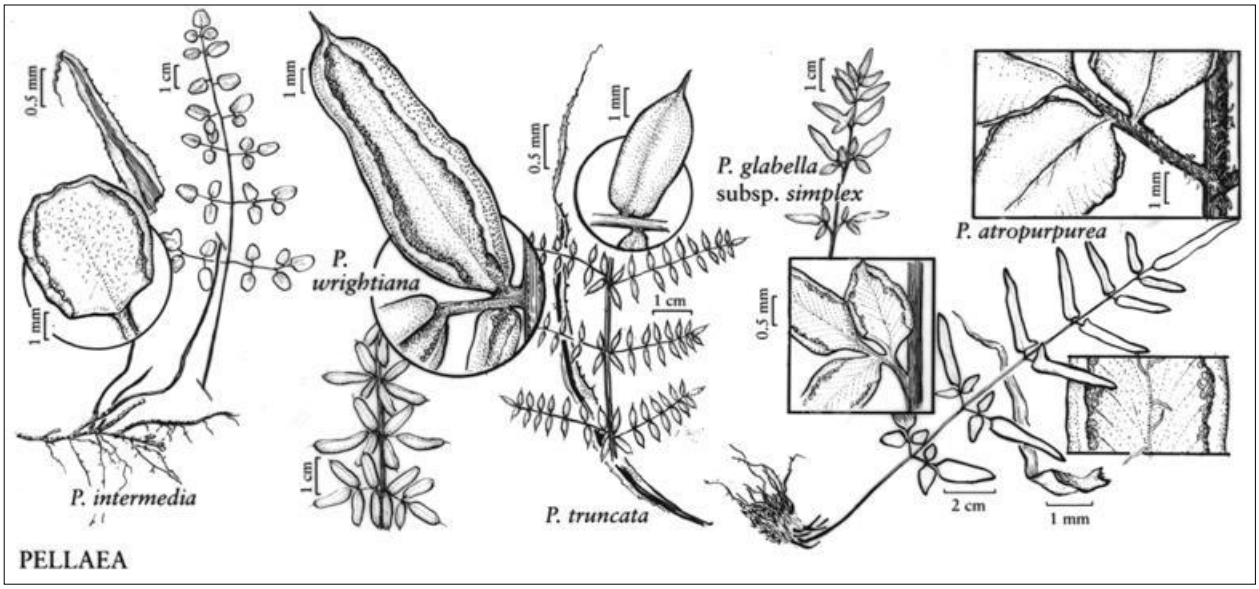
I feel comforted to know that we have places in North Carolina, like the Green Swamp in Brunswick County, that provide a habitat for numerous plant species and remain accessible to the public to see some nature's true precious "plant gems". Please help us save and preserve the plant species in all of North Carolina that are special and unique, support (or join!) North Carolina Friends of Plant Conservation!

Greenfly orchid, *Epidendrum magnoliae* Muhl. var. *magnolia.* Photo courtesy David McAdoo (Friends of Plant Conservation member)

Bruce

Field Notes

Pellaea wrightiana continued...



Windham, Michael D. Pellaea wrightiana. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 16+ vols. New York and Oxford. Vol. 2 http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=124283

layers of an onion, separate and break away. Many times, you can find areas of "sandy" soil at the bottom of granite slopes, the result of the flaking away of those granite layers.[ii]

The plant species found on high and low elevation outcrops are slightly different, the result of elevation, exposure, erosion, climate, and surrounding communities. Of interest in this article is *Pellaea wrightiana* Hook., collected in New Mexico by Charles Wright in 1851 and described by W. J. Hooker. The specimen collected in North Carolina by Radford was on a low elevation dome in a plant community including *Juniperus virginiana* L. and *Pinus virginiana* Miller as dominant woody species. Common flowering herbs included *Andropogon* sp., *Crotonopsis elliptica* Willd., *Hypericum gentianoides* (L.) BSP., *Opuntia compressa* (Salisb.) MacB., and *Talinum teretifolium* Pursh. Other pteridophytes include *Asplenium platyneuron* (L.) BSP., *Cheilanthes lanosa* (Michaux) D.C. Eaton, *C. tomentosa* Link, and *Selaginella rupestris* (L.) Spring.

In 1957 Alice F. Tryon published an article in the *Annals of the Missouri Botanical Garden* in which she described *Pellaea wrightiana* Hook. as a variatas of *P. ternifolia* (*Pellaea ternifolia* (Cav.) Link var. *wrightiana* (Hook.) A. Tryon), a "northern extension of the species having quantitative differences not sufficient for specific separation." The range for this variety was given as Oklahoma to Arizona and into northern Mexico.[iii]

In 1963, unaware of the discovery by Radford of *Pellaea wrightiana* in North Carolina, Irving Knobloch and D. M. Britton published a paper on "The Chromosome Number And Possible Ancestry of Pellaea wrightiana."[iv] Specimens were collected and analyzed of *P. wrightiana, P. ternifolia,* and *P. longamucronata*. Knobloch and Britton determined that "Meiotic and somatic chromosome number determinations show that *Pellaea wrightiana* Hook. is a triploid (2n =87) of hybrid origin. *P. ternifolia* (Cav.) Link (4x) and *P. longimucronata* Hook. (2x) (2n = 58) are considered to be the probable parents."[v]

Morphological examination shows that *P. ternifolia* is "once pinnate and without pinnae rachides, that *P. longimucronata* is bipinnate (rarely tripinnate) almost throughout the blade and with long pinnae rachides, and that the blade of *P. wrightiana* is usually bipinnate only on the lowest pinnae and has a short rachis in that region. …[*P. wrightiana* exhibits] 2 examples of variation in degree of pinnation of the fronds of the same plant. It can be noted…that the fronds of *P. wrightiana* are more triangular than those of *P. ternifolia*, but less so than those of *P. longimucronata*. Accordingly, there is morphological evidence for hybridity in regard to the shape of the frond and the degree of pinnation."[vi]

Assessing the reproductive characteristics of *P. wrightiana*, Knobloch and Britton suggest:

> *Pellaea wrightiana* is listed as a sexual species (Tryon and Britton, 1958) because 64 spores occur in each sporangium. Attempts by the senior author to grow the prothallia of this triploid have not been successful, so that it is not yet possible to say whether or not P. wrightiana might be able to reproduce apogamously.

Pellaea wrightiana continued...

> Apogamy is of frequent occurrence in this genus and *P. glabella* var. *glabella, P. glabella* var. *simplex, P. sagittata* var. *sagittata* and *P. ovata* are known to produce fertile spores by a pre- meiotic doubling of the chromosomes (Tryon and Britton, 1958). However, since only the sexual type of development has been observed (i.e., 64 spores per sporangium) in *P. wrightiana,* it is possible that *P. wrightiana* is a sterile triploid hybrid similar to many ferns (e.g. *Dryopteris spinulosa* X *intermedia*). Dr. Irene Manton (personal communication) has suggested that the tendency to form 8 spore mother cells per sporangium vs. 16 spore mother cells varies with the environment. Certainly the frequency of one type over the other can be most marked for certain taxa of Pellaea. It is for this reason that it would be unwise to say that *P. wrightiana* produces only aborted spores and apogamy is not present. The widespread range of this taxon in the Southwest would suggest that it may be able to reproduce by fertile spores. If this is true, then it is cytologically similar to *P. atropurpurea* and *P. sagittata* var. *sagittata*; if it is not, then it is unique among the Pellaeas studied so far. The genus Pellaea would be a worthwhile one in which to study the inheritance of apogamy and its relationship to polyploidy and hybridization because of the frequent occurrence of apogamy and also diploids, triploids and tetraploids. The evidence presented suggests that *P. wrightiana* (No. 1624) is a triploid hybrid of diploid *P. longimucronata* and a tetraploid race of *P. ternifolia*.[vii]

W. H. Wagner, Jr. (Dept. of Botany, Univ. of Michigan) in 1965, having learned of Radford's discovery, checked the spore numbers, finding 64 uniform spores per sporangium "rather than the 32-spored condition of the common eastern form of *P. glabella*."[viii] Wagner visited the site of Radford's discovery, finding that, as is typical of plant communities on granite outcrops, and especially for Pellaea, the 15-20 degree slope faced due south, indicating summer extremes of temperature and paucity of water. Dr. Radford considered the population natural, not the result of intentional or unintentional introduction, and Wagner agreed for the following reasons:

(1) The area in which is (sic) was found is a poorly collected one, and it is not surprising that the fern was overlooked until 1956. (2) The habitat itself is remarkably similar to those in which *P. wrightiana* exits in the western United States. (3) The species in not one which would ordinarily be selected for cultivation or transplantation. (4) The associated plants are all natives. And (5) the existence of *P. wrightiana* here and in the western United States parallels, at least in part, the patterns of such related ferns as *P. atropurpurea, Cheilanthes alabamensis, C. lanosa*, and *C. tomentosa.*[ix]

Major fern population disjunctions are not uncommon—Wagner cites several examples—and coupled with his reasoning above and the existence of the closest population being New Mexico, he concurs with Radford that this is a natural population. Microscopic spores are easily carried great distances by air currents, but to establish, must be fertile.

Wagner's further study, including chromosome numbers, led him to a different conclusion than Knobloch and Britton:

> 1. Taxon *wrightiana* should be given specific rank and not placed as a variety with either *P. ternifolia* or *P. longimucronata*.
> 2. It is an intermediate between these species, and no closer to the one than the other.
> 3. It seems unlikely that *P. wrightiana* is a half-way point in a linear pattern of evolution between *P. ternifolia* and *P. longimucronata*. More likely, this taxon arose as a sterile diploid hybrid between these species which doubled its chromosome number and became an amphidiploid sexual species. Earlier reports of a sterile triploid "*P. wrightiana*" probably refer to a backcross hybrid.
> 4. The known facts support the view that the North Carolina population originated in the southwestern United States. Introduction by man is unlikely. *Pellaea wrightiana* was probably established in North Carolina by natural means.[x]

A second North Carolina population was found in 1978 by L. N. Hood at the Rocky River Morgan's Bluff Natural Area in Stanly County.[xi] That population was estimated to include 500 individuals. By 1995, Kerry D. Heafner (Miami Univ.) estimated the population had declined to 250 individuals, and personal communication between Heafner and Larry Mellichamp, PhD indicated a likely further decline in the future.[xii]

A part of Heafner's study was to determine if the introduction of *P. wrightiana* into N.C. was the result of two separate dispersal events or one introduction with that population giving rise to a second. (A third population was reported from Pickens, S.C., but that was later determined to be *P. ternifolia* spp. *arizonica* Windham.)

Heafner's work revealed "no genetic variation…either within or between the two North Carolina populations of *Pellaea wrightiana*…. Therefore, the two North Carolina *P. wrightiana* populations appear to be the result of a single dispersal event from the Southwestern primary range, the Alexander County

Pellaea wrightiana continued...

population most similar to a Jeff Davis County, Texas population.[xiii]

Fifty plus years after Radford's collection of what turned out to be *Pellaea wrightiana* in North Carolina, we now claim two Pellaea species:

> ***Pellaea atropurpurea*** (Linnaeus) Link, Purple Cliff-brake. Mt, Pd, Cp (GA, NC, SC, VA): outcrops of limestone and other rocks (usually either calcareous or mafic), rarely on masonry walls (Wieboldt 1995); common only in the Ridge and Valley of VA, otherwise uncommon to rare (SC Rare). May-September. This species is an apogamously-reproducing triploid, either an allopolyploid derived from the hybridization of a sexually-reproducing diploid species and sexually-reproducing tetraploid, or an autopolyploid of an undiscovered or extinct species. Gastony, Yatskievych, & Dixon (1992) provide convincing evidence that modern *P. glabella* is not one of the parental taxa, as indicated by Lellinger (1985). *P. atropurpurea* is widespread in e. North America, from VT, NY, MN, SD, Saskatchewan, and Alberta south to FL, AL, TN, AR, TX, NM, AZ, and Mexico; also in Guatemala.
> [= RAB, C, F, FNA, K, S, W ; = *P. atropurpurea* var. *atropurpurea* -- G; = *P.* ×*atropurpurea*]

> ***Pellaea wrightiana*** Hooker, Wright's Cliff-brake. Pd (NC): south-facing outcrops of Carolina slate or granitic rock with infrequent nutrient-rich seepage; rare (NC Endangered). May-September. OK west to se. CO and sw. UT, south to TX, AZ, and Mexico, with a few, remarkable disjunct occurrences in c. NC. *P. wrightiana* is apparently a sexually-reproducing allotetraploid derivative of hybridization between P. ternata (Cavanilles) Link and P. truncata Goodding.
> [= RAB, FNA, K][xiv]

Pellaea wrightiana remains on the Endangered list of the N. C. Plant Conservation Program.

Katherine Schlosser
June 2010

Pellaea wrightiana. Photo courtesy of Patrick J. Alexander, USDA Plants Database. Photo taken in southern New Mexico.

References

[i]Schafale, Michael P. and Alan S. Weakley. *Classification of the Natural Communities of North Carolina (Third Approximation)*, N.C. Natural Heritage Program,1990.
[ii]For a far better explanation of plutions than given here, see Steven A. Nelson, Tulane University, *Magmas, Igneous Rocks, Volcanoes, and Plutons* http://www.tulane.edu/~sanelson/geol111/igneous.htm (accessed 06-26-2010).
[iii]Tryon, Alice G. "Revision of the Gern Genus Pellaea Section Pellaea," *Annals of the Missouri Botanical Garden*. Vol 44, No. 2 (May 1957), pp 125-193. Accessed May 13, 2010, 22:17 from JSTOR, http://www.jstor.org/stable/2394577, p. 153.
[iv]Knobloch, Irving W., Britton, D.M. "The Chromosome Number And Possible Ancestry of Pellaea Wrightiana," *American Journal of Botany,* Vol. 50, No. 1 (Jan. 1963) pp 52-55. Botanical Society of America. Accessed May 13, 2010, http://www.jstor.org/stable/2349860
[v]Ibid 53.
[vi]Ibid 55
[vii]Ibid 55
[viii]Wagner, W. H. "*Pellaea wrightiana* in North Carolina and the Question of Its Origin," *The Journal of the Mitchell Society,* Vol. 81, pt 2, 1965, p. 95-103 (UNC Digital Collections, http://www.lib.unc.edu/dc/jncas/?CISOROOT=/jncas)
[ix]Ibid 96
[x] Ibid 102.
[xi]Hood, L.N. 1978. *Description and classification of Rocky River Morgan's Bluff Natural Area, Stanly County, North Carolina*. M.S. thesis, University of North Carolina at Charlotte.
[xii]Heafner, Kerry D. "*Pellaea wrightiana* Hooker (Pteridaceae) in North Carolina Revisited with a New Record for Eastern North America and a Key to Pellaea Species in the Carolinas." *Castanea*, Vol. 66, No. 4 (Dec., 2001), pp. 319-326. Accessed 5-13-2010 from JSTOR, http://www.jstor.org/stable/4033921
[xiii]Ibid 324.
[xiv]Weakley, A. S. *Flora of the Carolinas, Virginia and Georgia*. UNC Chapel Hill, p. 48-49.

Board news...

Note from Tom Harville:

Remember the 800 Venus flytrap's rescued from a poacher last year? This photo is in the approximate location where we got out of the cars and Rob briefed us on the replanting effort. Each of those white things are VFT blooms!

Tom Harville (Membership chair)
Photo taken end of May.

Check our newly updated and re-vamped website !

www.ncplantfriends.org

More News:

...Watch your email Inbox for monthly e-Notes from the Board. We want you fully informed of our activities, news from around the state and beyond, anything that we think will be of interest. We will continue our quarterly newsletter, and the website should become a useful resource. Monthly e-Notes will be one more way for us to stay in touch.

...in a time and energy-saving move, the board will begin conducting some of its meetings via Skype, the internet tele-conference program.

...Kurt Schlimme (Eno River Association Stewardship Director and FoPC Treasurer) arranged for the Friends organization to participate in the 31st Annual Eno River Festival. Kurt, Kathy Schlosser, Rob Evans and wife Emily and their children all helped to greet visitors to the Friends information booth. **Next year we will invite each of you to participate, too!**

...SAVE THE DATE 3rd Annual Meeting: Wednesday, November 3rd, Wilmington, NC. Plans are still in the development stage, but we do have a block of rooms reserved at the Marriot Courtyard Inn in Carolina Beach. Put the date on your calendar, reserve a room, and we'll send details as soon as we have them.

Help Needed...

We could use a little help, and because we have shared interests, we thought you might be willing to lend a hand.

We have several committees in need of assistance. If you have skills, interests, or knowledge in any of the areas listed, please contact the committee chair.

If you have other skills or talents you are willing to share, contact Bruce Williams (cbw.3@earthlink.net)

Note: you will notice that we no longer have a Legislative committee. The FoPC board decided that committee had completed its work, and that a greater need existed for a separate Education committee.

Thank you!

Try it—and send us comments/ suggestions!

www.ncplantfriends.org

Education: Tom Baugh (springmountain1@att.net) and Andy Woods (awood@audubon.org) Providing educational opportunities for members and the public at large.

Development: Marsh Smith (marsh@marshsmithlaw.com) Putting together a plan for generating income for the purchase of imperiled plant habitats.

Membership: Tom Harville (tomhar@bellsouth.net) Creating and conducting a membership campaign.

Program Planning: Mike Kunz (mkunz@email.unc.edu) Planning the program and securing speakers for the FoPC Annual Meeting

Communication: Kathy Schlosser (kathyschlosser@triad.rr.com) and David Blevins (david@blevinsphoto.com). Soliciting and/or writing articles for the newsletter and website, updating website periodically, developing outreach materials (brochures, powerpoint programs), and other means of spreading the word about FoPC.

Preserve Stewards Needed

Do you have some time to spare? Are you willing to donate that time?

- Are you a biologist, environmental scientist, trained in a related field, or willing learn a few new skills ?
- Are you interested in...
  - -exotic vegetation control?
  - -plant inventories
  - -community outreach
  - -land acquisition
  - -site maintenance
  - -and a number of things necessary to protect and maintain North Carolina's Plant Conservation Preserves
- Would you like to hone or develop the above skills , or simply gain a better understanding of day to day Preserve management issues ?
- Training provided!

If so, contact Bruce Williams at cbw.3@earthlink.net

Staff Report — Rob Evans

Volunteer steward program off to running start! Tom Baugh, http://ncplantfriends.org/People.aspx, also a Board member, has begun working with staff at the Bat Fork Bog Preserve in Hendersonville. Tom has begun expanding relationships with neighboring landowners and has been gaining familiarity with the plant species and ecological make-up of the Preserve. The expanded team has been tackling invasive species on site, including the cursed Reed Canary Grass.

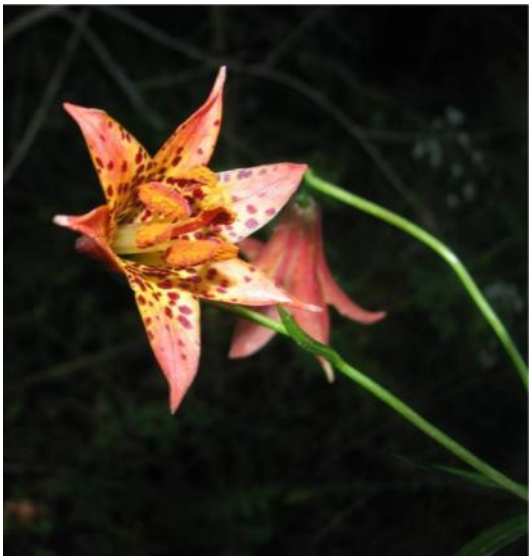
The Ochlawaha Bog Preserve recently expanded with purchase of 3 tracts totaling approx 30 acres. This Preserve expansion was made possible by willing landowners, tremendous assistance provided by the Carolina Mountain Land Conservancy, and funding from the Natural Heritage Trust Fund.

Plant Conservation Board approves a statewide comprehensive plan outlining the sites most in need of protection, management, and acquisition for the imperiled plant species.

List of 422 imperiled species in NC moves one step closer to official adoption. With this process species, including the Venus Fly Trap may be afforded more protection.

American Ginseng harvest data completed. Last year, ginseng harvest exceeded 10,000 pounds for the 3rd straight year.

PCP staff recently found a new site for a "vulnerable" species, Savanna Milkweed, *Asclepias pedicellata*, and a contractor working for the Program on a coastal Preserve may have located a species of grass not previously recorded in NC.



Lilium canadense. Photo by Tom Baugh, taken in Bat Fork Bog Preserve.

Asclepias pedicellata, Savannah milkweed. Photo taken in Green Swamp, courtesy Jim Fowler, http://www.flickr.com/photos/22032600@N04/4636393024/

Preserve Steward Report

"…some folks from DENR [are] coming by on Wednesday (weather permitting) to see the work at BFB and to talk about the Preserve Steward program. We are killing a lot of reed canary grass at BFB, opening up some minimalist trails, cataloging species, and playing in the mud. What fun!!!"

Tom Baugh, Bat Fork Bog

Plant Conservation Program awarded $679,000 by Natural Heritage Trust Fund

Lilium pyrophilum, Sandhills lily.
Photo from NCDAG&CS

The N.C. Natural Heritage Trust Fund recently awarded four grants totaling $679,380 to the N.C. Department of Agriculture and Consumer Services to support the expansion or establishment of plant conservation preserves in the state. Plant conservation preserves are designed to protect imperiled plants and their natural habitats.

We asked Rob Evans, plant ecologist with the department's Plant Conservation Program, about the four preserves that will benefit from the NHTF grants. The grant amounts and project descriptions are below:

- $210,000 for Tater Hill Preserve in Watauga County. This funding will be used to purchase an additional 40 acres for the preserve, which is the largest in the North Carolina mountains. Evans says the preserve is considered a nationally significant site containing a number of imperiled plants, including tall larkspur, bent avens and long-stalked holly.

- $230,880 for Hebron Road Preserve in Durham County. The grant will make it possible for the program to purchase an additional 40 acres for the preserve, which is home to the imperiled smooth coneflower and narrow-leaf aster. The addition will help protect one of the highest-ranking parcels identified to protect the Raleigh water supply.

- $110,000 to add 43 acres to the Eastwood Preserve in Moore County, which aims to protect the endangered sandhills lily.

- $128,500 to purchase 16 acres to establish the Rocky River/Morgans Bluff Preserve in Stanly County. The land is known to harbor three imperiled plant species. One of these, Wright's cliffbrake, is found in only two sites east of the Mississippi River.

The Natural Heritage Trust Fund was established in 1987 to provide supplemental funding to select state agencies for the acquisition and protection of important natural areas, preserve the state's ecological diversity and cultural heritage, and inventory the natural heritage resources of the state. The trust fund is supported by 25 percent of the state's portion of the tax on real estate deed transfers and a portion of the fees for personalized license plates. The trust fund is housed within the Department of Environment and Natural Resources.

Source: In The Field Blog of the NCDAG&CS
http://info.ncagr.com/blog/?p=5846