

Chinquapin

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Southern Appalachian Botanical Society Newsletter

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Hornworts in the eastern US Part Two

Taxonomy

Included within the liverworts by early authors, hornworts were eventually elevated to a separate phylum, though its placement was difficult to discern. Morphological and early molecular phylogenies found support for almost every possible placement, with a bryophyte grade and hornworts sister to either all land plants or all vascular

Taxonomy has been no less complicated within the hornwort phylum Anthocerotophyta. Hornworts often show minor, usually microscopic, variation that can be overinterpreted by taxonomists. Without knowing whether the variation was due to phenotypic plasticity, random assortment within a species, or genetically fixed in separate



Anthoceros punctatus with sporophytes. White specks are pine pollen. 26 March 2023 Southampton Co., VA.



Nothoceros aenigmaticus on a rock submerged in a creek (removed for photograph). 12 December 2019 Cocke Co., TN



Phaeoceros carolinianus, flat sandy riverbank, Anthony Creek, WV (left) and an undercut riverbank among roots, Blackwater River, VA (right). Photographed 4 September 2021 and 26 November 2021, respectively.



Example of hornworts with lamellate (left, *Anthoceros fusiformis*) and non-lamellate thallus (right, *Paraphymatoceros pearsonii*). 1 May 2023 Marin Co., CA.

plants, or a monophyletic clade of mosses, liverworts, and hornworts with various topologies within the clade. In the last few years, new genomic datasets have converged on a single topology: reciprocally monophyletic non-vascular and vascular plants, with hornworts sister to mosses + liverworts (Li et al. 2020).

lineages, repeated nomenclatural changes have led to some current names with dozens of synonyms. Proskauer (1958), quoting Lund (1956), summarized the problem: “having reached a viewpoint similar to that of a shepherd who sees marked differences between sheep in his flock ... a new taxon is made for each isolation”. Unsurprisingly,

(continued on page 3)

Hornworts *(continued from page 1)*

molecular phylogenetics clarified many relationships between the lineages, leading to a classification consisting of two classes, five orders, five families, and eleven to twelve genera (Söderström et al. 2016). Estimates for the total number of species generally range from 100–300. In the eastern US today, we recognize four genera containing about nine species. A new treatment for the Bryophyte Flora of North America is forthcoming (J.C. Villarreal Aguilar, pers. comm.). Here I provide some brief notes to help you identify specimens at least to genus:

Anthoceros — The only genus with multiple widespread species in the eastern US, identification to species is often difficult, relying on microscopic examination of multiple characters. But *Anthoceros* spp. are usually separable from other genera by outgrowths of lamellae on the upper thallus surface, mucilage-filled schizogenous cavities in the interior of the thallus, and dark brown-black spores at maturity. Two of our *Anthoceros* are made distinctive by their relatively short, stubby sporophytes: *A. macounii*, found in Ontario, Quebec, and adjacent US, and *A. adscendens* (= *Sphaerosporoceros a.*) found broadly across the Southeast. Other species of our region are: *A. agrestis*, *A. lamellatus*, *A. punctatus*, and *A. scariosus*. The genera *Folioceros* and *Sphaerosporoceros* are also recognized as subgenera of *Anthoceros* (Cargill et al. 2022).

Phaeoceros — *Phaeoceros carolinianus* is likely the only member of the genus occurring in the eastern US (Stotler and Crandell-Stotler 2005). Many older collections called *P. laevis* (= *Anthoceros l.*) were identified prior to recognition of *P. laevis* as strictly dioicous and *P. carolinianus* as monoicous. Because the production of male and female gametangia is often temporally separated, single collections can lack the necessary features for identification. Most likely, *P. laevis sensu stricto* occurs only in Eurasia. Spores of *P. carolinianus* are yellow at maturity with a finely echinate distal surface and variably echinate to smooth proximal surface. There may be unrecognized diversity within our *P. carolinianus*. Plants I've germinated from spores collected across the eastern US show consistently different thallus morphologies after one year in axenic culture, and two *P. carolinianus* genomes we've sequenced show noticeable size and structural variations. See Proskauer (1958) for more about variation within *P. carolinianus* and *P. laevis*.

Notothylas — This genus is easily distinguished from our other hornworts by its horizontally-oriented sporophytes that largely remain inside the involucre at maturity. Plants tend to be flat and rosette-shaped. The only species that is widespread in the eastern US is *N. orbicularis*. The tropical *N. breutelii* is sometimes included (Stotler and Crandell-Stotler 2005), but this seems to be based on only two natural observations made in southern Louisiana in the late 1800s to early 1900s (Howe 1898, Schuster 1992). The species are easily separated by mature spore color: black (*N. breutelii*) vs. yellow-brown (*N. orbicularis*).

Nothoceros — Represented by *N. aenigmaticus* (= *Megaceros a.*) in our flora, this dioicous species exists as isolated male and female populations in creeks and rivers of the southern Appalachians, and thus reproduces only clonally. The nearest sexually reproductive populations in Mexico have an estimated divergence time of 0.6–0.8 mya, pointing to extensive isolation of the Southern Appalachian populations (Alonso-García et al. 2020). Plants form dense mats on rocks, tree roots, or other solid surfaces, growing either completely submerged or near the waterline.

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Hemlock Bluffs

Two hundred miles east of the Appalachians, one of the south's most distinctive montane trees clings to steep bluffs among the rolling hills of North Carolina's piedmont. At Hemlocks Bluffs Nature Preserve in Cary, North Carolina's easternmost population of *Tsuga canadensis* thrives on north-facing bluffs carved by Swift Creek, a tributary of the Neuse River. Distributed in the center of Raleigh's southern suburban sprawl, these bluffs provide a fascinating view of the changes that have occurred in our southeastern ecosystems over glacial and human time scales.



Tsuga canadensis at Hemlock Bluffs

Widely distributed across most of southeastern North America during the Pleistocene, *T. canadensis* followed retreating glaciers north, and is now found mainly along the spine of the Appalachians and in relictual populations in the piedmont, coastal plain, and interior low plateau. During this retreat, the steep north-facing cliffs along Swift Creek offered *T. canadensis* a refugia in the piedmont like the cool mountain slopes supporting the species from Alabama to Canada. *Tsuga canadensis* was not alone in finding refugia along Swift Creek. It is joined

by *Galax urceolata*, also more commonly found in montane and northern regions.

The land around the bluffs has a long history of human activity. Until the 1940s, small farms were established above and below the bluffs. *Tsuga* and *Galax* persisted as the steep slopes were not able to be cultivated. The land above the bluffs is now dominated by *Carya tomentosa*, *Quercus montana*, *Q. alba*, and *Pinus taeda*. Below the bluffs, remnants of agricultural fields are still present among vernal ponds that provide home for native amphibians. The Hemlock Bluffs Preservation Society was established in the 1970s to raise awareness of the unique biota of the area. Colonel William Walton Stevens, a local nature enthusiast and geologist, noted the importance of this ecosystem in the quickly developing community of Cary. Colonel Stevens worked with local land developers and the State of North Carolina to secure the land along Swift Creek as a Nature Preserve. Formally established in 1991, Hemlock Bluffs Nature Preserve is a North Carolina State Nature Preserve managed by the Town of Cary. This unique partnership is responsible for maintaining the diverse communities on and around the bluffs as well as providing an educational resource to the community of Cary. Preserve staff work closely with experts at the North Carolina Forest Service, North Carolina State Parks, and North Carolina State University to monitor the health of the *Tsuga* population. As the population is so small, it is possible to monitor the woolly adelgid and mitigate this threat to *Tsuga* populations in North America.

Hemlock Bluffs Nature Preserve is currently a 140-acre ecological

landmark. Beyond gates designed to look like Hemlock boughs resides a welcoming Visitor's Center, classrooms, and several miles of trails along uplands, bottomlands, and the bluffs themselves. The Colonel William Walton Stevens and Emily Stevens Nature Center contains interactive exhibits highlighting the human and natural history of the region. Morgan Burns, the Interim Site Supervisor and Program Specialist at Hemlock Bluffs, is incredibly excited about the role that Hemlock Bluffs plays in the local area. Burns sees Hemlock Bluffs as a "beacon of environmental education in Cary". She envisions Hemlock Bluffs Nature Preserve as an area where "the public can witness and engage in natural areas in a way that is safe for them and for nature". The preserve hosted over 100,000 visitors in 2023 and Burns expects larger numbers in the upcoming years. As the range of southern taxa continues become fragmented due to anthropogenic factors, preserves like Hemlock Bluffs will allow the public to learn about the fragile habitats that maintain our southeastern taxa, and their role in helping to preserve them for future generations.

Hemlock Bluffs Nature Preserve is located at 2616 Kildaire Farm Rd, Cary, NC. To donate, or become a member of Friends of Hemlock Bluffs, please visit: www.hemlockbluffs.org

Acknowledgements:

Information for this article came from educational displays at Hemlock Bluffs and from a conversation with Morgan Burns, Interim Site Supervisor and Program Specialist at Hemlock Bluffs Nature Preserve. Photos by Bill Stice.

J. Christopher Harvan



The Colonel William Walton Stevens and Emily Stevens Nature Center at Hemlock Bluffs Nature Preserve.

Botanical Brainteasers

By Joe Pollard and Janie Marlow

Our Brainteasers in the last issue [Chinquapin 30(1)] were: (A) *Tradescantia obiensis*, smooth spiderwort; (B) *Persicaria pensylvanica*, pinkweed or Pennsylvania smartweed; (C) *Pinus virginiana*, Virginia pine; (D) *Carpinus caroliniana*, American hornbeam; and (E) *Quercus montana*, chestnut oak. What we were going for here relates to a superficial similarity in the scientific names. They all seem to reference American states or colonies: Ohio, Pennsylvania, Virginia, Carolina, and Montana. But wait... why Montana? Chestnut oak is primarily a tree of the Appalachian Mountains, and while its distribution extends westward, it ends around Missouri, where forests give way to prairies. The species doesn't naturally occur in the western state of Montana at all. A little more digging makes it even less likely that it was named for the state, given that the name *Quercus montana* was published by Willdenow in 1805, whereas Montana didn't become a territory until 1864 and gained statehood in 1889. So while the names of A through D are toponyms, based on place-names, the epithet "montana" is merely an adjective describing the species' habitat, based on Spanish/Latin roots meaning mountain. Therefore, answer E is the odd one out.

We received three entries. Of course, all it takes is one or two mistakes in identification or nomenclature to break up that "state name" pattern, which makes the puzzle potentially challenging. Many people still know chestnut oak as *Quercus prinus*, but that name was officially rejected as ambiguous (see Weakley's *Flora of the Southeastern U.S.* for more information). Some players struggled a little, but everybody got at least partial credit. The answer that came closest to what we were seeking came from David Morgan, so we declare him to be the winner of the first Brainteaser of 2024. Congratulations, David!

Now here's our second Brainteaser of the year. Five southeastern trees are pictured. For some of them we've pasted some images together, to make them more recognizable. (Note that in B and D, the scale ruler applies only to the leaves, not the fruits.) As usual, we want you to identify all five species, including both their scientific and common names, and then tell us which one doesn't really belong with the others. Like the last issue, this puzzle also relates to the names of the plants, but in a very different way. Which is the odd one out?

Winners for each Brainteaser are based on accuracy of identifications, correct solution of the puzzle, and speed of reply. At the end of the year, we'll total up the score, so playing repeatedly is a big advantage. We'll award a prize (TBD) to the winner.

IMPORTANT CHANGE IN EMAIL:

Email your answers to joe.pollard@furman.edu. (Please do not rely on the previous AT&T email address, as it may be discontinued soon.) Color photos that you can enlarge for a closer look are posted online at <https://sabs.us/publications/#chinquapin>.



Photo credits:

A(left), B, C, D(right), E(right)
by J K Marlow;
A(right) by Ron Lance;
D(left) by Joe Pollard;
E(left) by Keith Bradley

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Fairey Scholarship Report

Editor's note: Reports from three recipients appeared in *Chinquapin* 30(1). Here is the fourth and final report for 2023

Forest Ecosystems at Highlands Biological Station

Nestled in WNC Highlands is a geographically beautiful location, with steep changes in elevation and aspect it offers a home for many different species! I just spent two weeks at the highlands biological research station where I studied Forest Ecosystems led by Steph Jefferies of NCSU, Alan Weakly of UNC Chapel Hill and Julie Tuttle.

The facilities were top notch, from the residential cottages to the common rooms, beds, bathrooms and communal kitchen, it was all great! There happened to be another group visiting the station for a part of our stay studying the fleshy fungi of the southeast, which was great for networking with other ecologically minded people.



bogs and high elevation grass lands, so that we could discuss the hows and whys that some of these ecosystems still exist. We also discussed some of the more broad ecosystems like rich coves, acidic coves, and high alpine forests.

Each student was assigned a special topic that we would study and then present and discuss to the class when we visited that ecological area. I personally was assigned bogs and fens which was a very interesting topic to get to learn about! I spent some time reading over Michael Schafales classification of natural communities (fourth approximation) in order to get to know the framework of these ecosystem types.

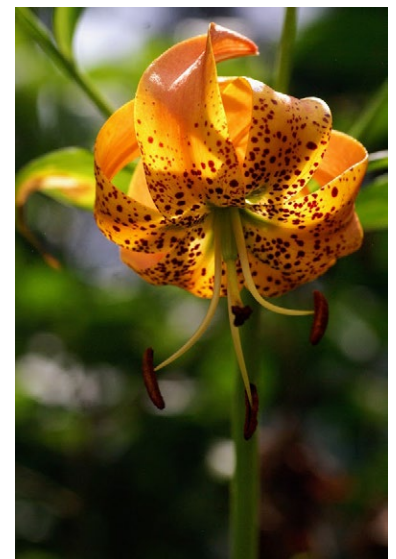
Nestled in WNC Highlands is a geographically beautiful location, with steep changes in elevation and aspect, highlands offers a home for many different species and with it Highlands biological research station is a great facility led by good people like our instructors, Steph Jefferies, Alan Weakly and Julie Tuttle. I don't think I could have asked for a better team, geographical area or facilities. Thank you again *Chinquapin* and the Fairey scholarship for this astounding opportunity!

P.S - Bring your hiking boots and rain gear! It only rains when you forget to bring'em!

J. Oliver Watts



For our course, we visited many beautiful locations like, the great smoky mountains, panther town, Pisgah national forest, white side mountain, Roan highlands, dulaney bog, buck creek serpentine barrens, bull pen, trillium gap trail, black balsam knob and many more! The instructors took us to many locations that exemplified rare and special ecosystems like boulder fields, spray cliffs,



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In this issue:

- Spectacular images of overlooked plants
- Fairey tale
- Brainbuster
- Misplaced hemlocks

Awards

Conference Support (Travel) Awards

Alan Huff, Appalachian State University
Aspen Warrillow, Appalachian State University
Cameron Tinsley, Appalachian State University
Clara Minnich, Marshall University
E.G. Postal, Appalachian State University
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Kaya Rosselle, North Carolina State University
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Lauren Willhite, North Carolina State University
Leigha Henson, Appalachian State University
Sam Cleary, University of North Carolina Asheville
Sarah Durham, Old Dominion University
Skyler Fox, Georgia Southern University
Sydney Svoboda, Appalachian State University

Earl Core Awards

Kate Loughran, MS Student at Appalachian State University. Title:
Secrets of the Swamp: Uncovering the genetic diversity of a federally
threatened wetland species, swamp pink (*Helonias bullata*)

Skyler Fox, MS Student at Georgia Southern University, Title:
Evaluating trampling effects on plant communities in a restored sand
dune ecosystem

Bartholomew Award

Joey Shaw, University of Tennessee—Chattanooga

Announcement

Book reviewers needed for *Castanea*. Titles are diverse and reviewers get to keep the book they review. This is an excellent opportunity for a graduate student to gain experience in reviewing—and a free book to boot. Contact the Book Review Editor at lmusselm@odu.edu for more information.