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The Lady-Slipper

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Tulip-poplar: Douglas-Fir of the East?

A Tall Tree Tale By Neil Pederson, Bob Leverett, Will Blozan, Jess Riddle and Josh Kelly

Given the attempts of past Tall Tree Tales to present new or striking information, you might wonder why there is a column here dedicated to the state tree of Kentucky. We mean, you know this species, correct? Fast growing, shade-intolerant, needs large gaps and major canopy disturbance for successful recruitment into the tops of Kentucky's majestic canopies. Tulip-poplar or yellow-poplar or tuliptree, but always *Liriodendron tulipifera*, a tree such as this by any other name is considered a classical early-successional species as it is a prolific seeder and not thought to be particularly long-lived. In fact, tuliptree (we'll stick to this name because we can!) seems to fit in nicely with other classic r-selected species; rats, cockroaches and bunnies are good examples of r-selected species. So, why are we kind of comparing it to Douglas-fir (*Pseudotsuga menziesii*) or even trying to tell you something new about a 'well-known' tree?

Because we have new attributes regarding tuliptree and they are not Tall Tales!

In this column I (Neil) am joined by Bob Leverett, a co-founder and Executive Director of the Eastern Native Tree Society (ENTS), Will Blozan, a co-founder and President of ENTS and Jess Riddle and Josh Kelly, old-growth researchers and active ENTS members. Around the same time my students and I were discovering new attributes about tuliptree longevity and radial growth patterns, ENTS as a group, but lead by these folks, was making similar discoveries regarding tuliptree's height and volume. The more I thought about what my lab was finding out and what ENTS was discovering, the more and more I had visions of Douglas-fir dance in my head. See, Douglas-fir is an early successional species that recruits after disturbance, has rapid growth and can reaches large sizes. A really interesting thing about Douglas-fir, however, is its longevity. There is a report of a 1,350 year old tree on Vancouver Island and there is a cross-dated individual (all rings are accurately accounted for that makes it better than a ring count) that was 1275 years old. I believe there are reports of a stand in Oregon with many 700-1000+ year old Douglas-fir. Unlike bunnies, Douglas-fir can live a long time for a tree (which shows why trees are so cool – they can be quite plastic in their growth habits & patterns). What we are finding for tuliptree can match these attributes for Douglas-fir. Of course, tuliptree is an angiosperm, which makes it even cooler than Douglas-fir.

Longevity & Growth Patterns

A little over seven years ago a US Forest Service forester pointed me towards an old-growth patch of forest just below the Blue Ridge Parkway. There were some nice tuliptrees in the forest that certainly looked old, but nothing to write home about [or a column about]. However, of the 22 tuliptrees cored, seven were older than 275 years old and one, eked out the best-documented age for this species by Dr. David Stahle of the University of Arkansas (327 years). The new maximum age was set at 337 years. Another was a close 328 years of age. This was exciting! …. for a few days…. Sometime after I put this information on the ENTS forum and Will Blozan quickly wrote in and told me of 400 yr old tuliptrees in the Smoky Mountains. This was extraordinary for science. So, you know, extraordi-

Image 1 – The oldest documented tuliptree to date. Dated in 2007 to 509 years of age. Oh yeah, it is hollow, too. Image by Neil Pederson.

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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:

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For all other business please contact an appropriate officer or board member.

The President's Message

By Alan Nations

Greetings! I hope this finds you all well and enjoying the warm, dry weather. I want to thank all who attended Wildflower Weekend at Natural Bridge State Park. It was a festive gathering, with great weather for enjoying the many guided hikes and programs. It was my pleasure to host our 25th Anniversary program on Saturday night. Dr. Ron Jones, a founding member and the first president, presented a history of the Society, including many interesting photographs of events and people. We unveiled the new official logo and presented framed prints to Dr. Jones and to Natural Bridge State Park for their support and partnership over the last 25 years. Cake and coffee were served during intermission, with a photo session and a collage of photos from the past provided by the membership. Our board and officers did a great job of planning and coordinating the weekend. I'd like to extend a special note of thanks to our guest speakers, Michael Gaige, Alice Mandt and Tyler Smith, and also to the many hike and program leaders for an outstanding job. The weekend ended with some smiling, wet faces as hikers returned Sunday afternoon. The warm showers did not seem to dampen their spirits. It was a great weekend, it always is….

I have chosen the subject of public education as it pertains to our mission for this message. Herbert Spencer, a controversial philosopher and biologist of the Victorian era, once said, "The great aim of education is not knowledge but action". I agree. An educated person is not only more likely to take action, but is also able to make informed decisions concerning those actions. The Society's mission is to promote education, preservation, and protection of Kentucky's native plants and ecological systems. That mission mandates leadership in education, and our first priority must be to develop quality programs that compel others to action.

Our native plants and ecological systems have never seen more perilous times. This is due mainly to increased areas of disturbance and growing numbers of nonnative invasive species. These problems are compounded by weak or nonexistent laws that allow continued importation, growing and sale of invasive species in Kentucky. Only through education can we expect to bring about changes necessary to reverse this process and save our native plants and ecological systems.

Our first six-month Stewardship Certification Program ended in June and was a great success. After some review and fine tuning, we plan to hold two classes each year. The next one is scheduled to begin in January 2012. We also hope to complete a revision of the Native Plant Certification Program and begin holding classes next year.

For our educational programs to be successful we need your support. We need more qualified instructors and more options for class locations and field trips. We would also appreciate tax deductible donations, earmarked for educational programs. Soon we'll be preparing next year's budget and we want to ensure there is adequate funding for quality programs. (Once the programs are up and running, they will be fully supported by student tuition. Tuition cost is yet to be determined.)

Please give some thought to the future of Kentucky's native plants and ecological systems and the Society's mission. I hope you will be inspired to become a part of the solution to this serious problem. Future generations will thank you, just as we thank those who saved the Red River Gorge not so long ago.

Upcoming Kentucky Native Plant Society Field Trips 2011

July 30—Hike at Beaver Creek Wilderness Area in the Daniel Boone National Forest in Pulaski County with Tara Littlefield (KSNPC botanist). We will explore old growth forests and search for new populations of rare plants in one of the few wilderness areas in Kentucky. A checklist will be handed out to all participants. Hike is from 10:00 AM to 3:00 PM. Hike is difficult; bring lunch, water and wear sturdy boots. Limit 10 people. Registration is required, please call 502-573-2886 (ask for Tara) or email info@knps.org to register.

August 13—Hike at Red River Gorge in Powell County to explore rockhouse vegetation and help protect the federally listed White Haired goldenrod by weeding invasive grasses around populations. Hike will be lead by Rita Wehner (Backcountry ranger) and David Taylor (Botanist for the DBNF). Hike is from 10:00AM to 2:00 PM. Bring lunch, water, gloves, and sturdy boots. Registration is required, please call 502-573-2886 (ask for Tara) or email info@knps.org to register.

Save the Date!

2011 KNPS Fall Meeting is set for

Saturday, October 1st at

Cumberland Falls State Park!

Details will be posted at **www.knps.org**...stay tuned!

2010 Field Trip to Roundstone Seed by Tara Littlefield

Mary Delany-Force of Nature

By Raymond Cranfill

Passionflower by Mary Delany

Not many people commence an artistic career at the age of 72, but then again Mary Delany was no ordinary woman. Born into a time and society that treated women more like property than human beings, Mrs. Delany's life would be immediately recognizable to any fan of Jane Austin.

Born Mary Granville in 1700, a minor branch of an aristocratic family (in fact MY family, the american Granvilles changing the surname to Cranfill after the Revolution), she spent much of her childhood being trained and educated for an eventual position at Court. This was sadly not to be as her uncle and benefactor had backed the wrong heir to the throne after the death of Queen Anne. To rescue falling family fortunes (yes, we were broke), she was married off to the elderly Alexander Pendarves, a man poor Mary positively loathed. In the despairing voice of a seventeen year old girl she wrote " I was married in great pomp. Never was dressed out in greyer colours, and when I was led to the alter, I wished from my soul I had been led, as Iphigenia, to be sacrificed." And things didn't much change after the nuptials. Mrs. Delany would confide to her diary in heart-breaking detail that her new husband was “disgusting,” “excessively fat” and had “a dirty look.” She had lost “all that makes life desirable.” He was, she wrote, “my gaoler.”

For seven years, she endured the tortures and humiliations that befell most women of class married off for political or financial advantage, bereft of their own free will or indeed any legal rights whatsoever. It was then a great relief when Pendaerves' death seven years later released her from her "walking death."

Although she had many suitors, she wisely chose to remain "unencumbered," making friends, attending concerts and becoming a keen observer of the aristocratic life of her times. She made many friends and had many acquaintances in the arts world of her times. Her love of music precipitated a close but platonic relationship with Handel. Her interest in literature brought her in contact with Jonathan Swift, of whom she wrote: “he is a very odd companion (if that expression, is not too familiar for so extraordinary a genius); he talks a great deal and does not require many answers.” She surrounded herself with the society of women similarly situated as she once was, often bound up in loveless marriages with little freedom to do as they pleased. It was during this time she became a close confidant of the Duchess of Portland who would become one of her closest lifelong friends.

At 43, she met and married the anglo-irish pastor, Patrick Delany, and moved to his estates in Dublin. There she would live by all accounts a very happy marriage in which she enjoyed considerable freedom of action for her times. She devoted herself to the practical and poetic matters of the household. When she was not gardening (“Our garden is now a wilderness of sweets. The violets, sweet briar, and primroses perfume the air, and the thrushes are full of melody”), she was acquiring new skills: plastering, quilting, sketching, gilding, decoupaging. She began to affix shells to every available surface: “I am making festoons with shell flowers chained up with silver bells.” Martha Stewart, eat your heart out!

In fact, Mrs. Delany shared many of these interests with her husband, the two spending long hours together in the garden, collecting "curiosities," or simply "taking the air" on agreeable walks and carriage rides in the green hills surrounding Dublin. She was, accordingly, devastated by her second husband's death. At the age of 72, her life seemed over.

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Then one day, as Andrea Wulf recounts in article in the New York Times:

> "She happened to be watching as the petal of a geranium fall onto the dark surface of a table. Nearby was a bit of paper of a similar color. Inspired, she began her first collage. 'I have invented a new way of imitating flowers,' she explained. And she continued to do so, mixing pigments, dissecting plants and occasionally adding parts of them to her compositions, ultimately cutting and gluing together tens of thousands of 'the tiniest dots, squiggles, scoops, moons, slivers, islands and loops of brightly colored paper."

"Asphodel Lilly" by Mary Delany

Delany was not just making pretty pictures. The duchess, who championed Delany's creations, had one of the greatest natural history collections in the country. Delany also received specimens from the Royal Botanic Gardens at Kew, and had seen the floral spoils that came back from Australia on Captain Cook's Endeavor.

These hundreds of botanical collages, productions she called "mosaicks," would be produced regularly over the next ten years until her eyesight began to fail and she could no longer deftly observe her quarries or wield her scissors to produce the numerous pieces of colored paper necessary to her art. Eventually these several thousand works were carefully gathered together into four substantial, leather-bound volumes, which were ultimately bequeathed by her great-great niece to the British Museum in 1895, where they remain today.

"Winter Cherry" by Mary Delany

The photographs reproduced here are but the tiniest sampling of her exquisitely detailed and scientifically accurate work. You see, late in life, Mrs. Delany had become a devotee of the new botanical science as practiced by Count Karl von Linné (aka Linnaeus) and his sexual system of classification. Linnaeus in his day received considerable resistance from many in the botanical community and in society as a whole, for his "needlessly prurient interest" in the naughty bits of the plant kingdom. As such, his sexual system was considered wholly inappropriate for study by women, particular the genteel, upper class subspecies. Nothing, however, would stop Mrs. Delany when she had decided to set her mind to something. She carefully studied flowers with Linnaeus as her guide to ensure her works of art were also works of science. So faithful are her renderings that in most cases her works can be identified to species. They are are exquisite examples of botanical illustration and deserve to be more widely appreciated.

Further reading, as well as reproductions of her works, can be found in two recent books:

"Mrs. Delany and Her Circle" Mark Laird and Alicia Weisberg-Roberts. Yale University Press, 2009.

"The Paper Garden: Mrs. Delany Begins Her Life's Work at 72". Molly Peacock McClelland and Stewart 2010

First of It's Kind: Only Book Dedicated Solely to Kentucky Wildflower Photography

By Mary Carol Cooper, KNPS board

How to Find and Photograph Kentucky Wildflowers

Thomas Barnes

University of Kentucky Press

256 pp., $29.95

Thomas G. Barnes, Ph.D, full professor in the Department of Forestry at the University of Kentucky, has done it again! His newest literary endeavor, *How to Find and Photograph Kentucky Wildflowers* is yet another unique wildflower book with a creative theme in mind. Tom's new book stands out/sets up as a "sort of" field guide that focuses on finding, appreciating and photographing wildflowers in Kentucky. So…what better way to enjoy "wildflowers" than to photograph them?

If you are a wildflower enthusiast and a photographer, this is the book for you. If you are neither a wildflower enthusiast nor a photographer but have always thought that you might like to learn more about both photography and wildflowers, *How to Find and Photograph Kentucky Wildflowers* will certainly inspire you to get a move on with it.

The first section of this book covers "how to photograph" and the second section covers "where" to do it. Tom discusses all points from finding wildflowers to his own thoughts on equipment, how to use this equipment in the field, and the elementary principles of visual design. He encourages you to begin thinking more creatively about how to photograph the wildflowers you find. The book begins with an introduction to macro and micro photography and moves on to terminology, shutter speed, aperture, and all the basics. Next he covers color, light and visual design elements of photographs (form shape and space). He then moves on to composition. This is my downfall, being a point and shoot junkie and not paying the least bit of attention to what is really going to be in the photo—thus, this is the book for me! We point and shooters can learn loads from this insightful book. You more serious photographers can add to your knowledge and pick up new ideas and ways of looking at your own photography. The remainder of the first section covers all of the equipment needed and, even the equipment to leave at home. The wrap up gives pointers on how to control variables like wind and background in the field, and he offers ideas on saving and storing files. There is also a nice section that gives pointers on how to be "photographically " prepared when you happen to be lucky enough to come upon a wonderful creature such as a butterfly or tree frog. One of the wonderful benefits of photographing and searching out wildflowers is the other critters that go along with them. The first section gives an enormous amount of information, all illustrated with many, many beautiful photographs which also serve as examples of good photos made exceptional by using Tom's techniques.

In the second section, Tom lists his favorite places to find wildflowers. He starts, as he did in his *Kentucky's Last Great Places*, in Eastern Kentucky then travels to Central Kentucky and on to Western Kentucky. This is a wonderful resource for all of us who travel the state looking for wildflowers. Areas are set up according to name of place, what wildflowers one would find there, about when they bloom, how to get there, the trails available and whether they are easy, moderate or strenuous. This is a wonderful guide for any outdoor enthusiast, whether you plan to photograph or not. Tom concludes with the idea that maybe the last (or maybe that should be the "first") best place to photograph is your own backyard. Wildflowers are very easy to grow and give hours and years of pleasure to homeowners. Those of you who have sun and shade can grow many types of wildflowers. The wonderful part is that you know when they bloom, you know where the sun will be and you can simply walk out your front or back door with your camera and there you are —taking beautiful, breathtaking photographs!

How to Find and Photograph Kentucky Wildflowers is a "must have for all wildflower enthusiasts. I imagine, after reading Tom's newest book, you will look at photographing wildflowers in a different light (no pun intended)! You will, at least, think about and implement many of his ideas the next time you look through your lens.

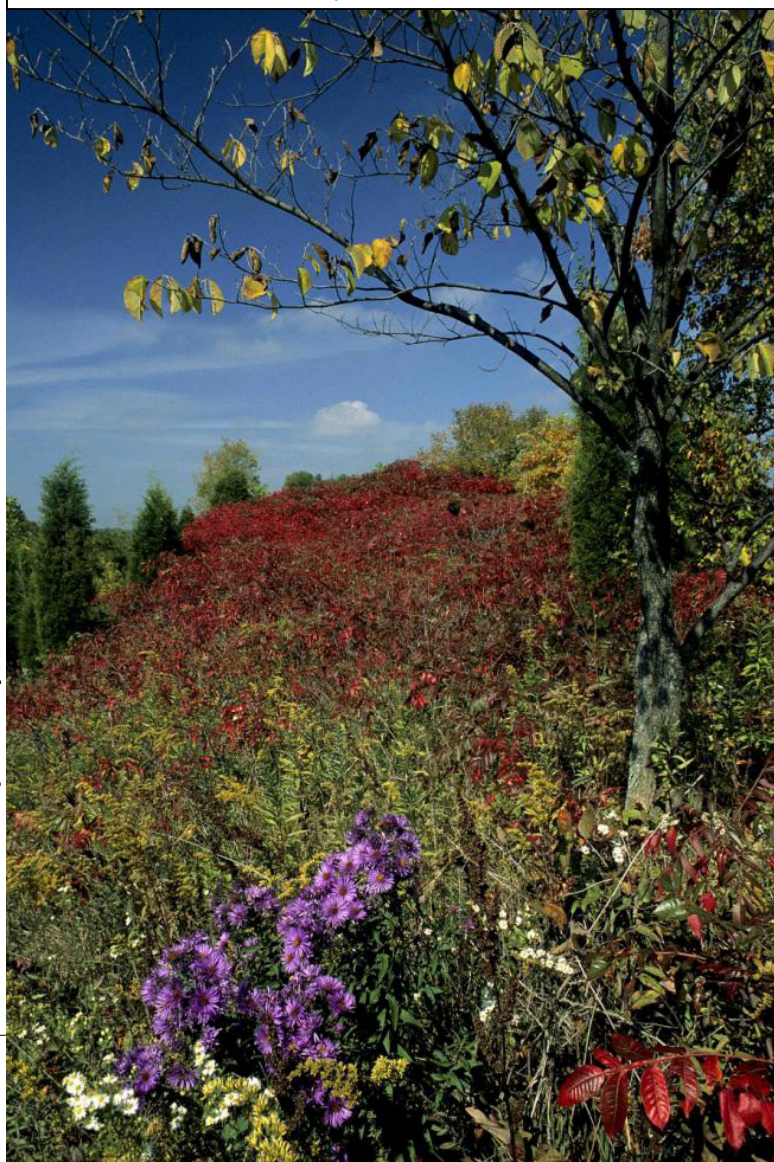
Excerpt from *How to Find and Photograph Kentucky Wildflowers* by Dr. Thomas G. Barnes

Photo courtesy of Dr. Thomas G. Barnes

One of the simplest ways to create a sense of depth is to overlap parts of your objects such as in the case of overlapping flowers, leaves or stems. In the photo of jack-in-the pulpits and yellow violets below, a sense of depth was created by the overlapping leaves and petals. It is easy to identify those with petals in front of the first Jack are closer than those whose petals by the second Jack in the background.

Another easy, and often used technique, is to change the size and placement of an object in the image. This is most often seen in landscape images where a flower or groups of flowers are placed in focus in the front of an image while the remaining forms and shapes appear in the distance and still remain in focus. The third most commonly used technique to create a sense of depth is to use leading lines or linear perspective. Lines that converge can imply depth and distance because the illusion is that objects appear smaller and come together to some "point" on the horizon line, either real or imagined. Finally, color can affect depth perception. This concept will be expanded in the color section. In general, warm colors appear closer than do cool colors, and stronger hues (red) come forward more than do less saturated hues (pink).

Photo courtesy of Dr. Thomas G. Barnes



Perhaps the best way to achieve the perception of depth is to use all of the above techniques in combination with one another to alter how we perceive an image. For instance, light objects come forward, and dark objects recede, and when there is a large amount of contrast, a small area of differing tone will come forward. Where you place the subject and its size is also important. Larger objects come forward, and objects in the lower half of the image come forward, or command more of our attention. One rule of thumb to improve your images is if you can't make it good, make it *big*! Of course, this stuff all sounds good in theory, and you can break every single rule, and still achieve your desired effect. I try to stick to the basics, which usually keeps me out of trouble.—*Thomas G. Barnes*

Kentucky Rain Garden Plant Selections:

First Year Field Observations

By Jim Lempke, Curator of Native Plants and Natural Ecosystems, UK Arboretum

Urban storm water runoff has become a major issue in Kentucky and across the United States. Flooding, erosion, and movement of pollutants during rain events have all been shown to place serious environmental and economic burdens on local communities. Recently, the "rain water garden" concept has become a common topic in many horticultural magazines and professional journals. Well designed wetland gardens have been shown to offer significant relief for urban storm water runoff, especially when installed in significant numbers. From individual homeowners to city engineers, Americans are looking at these strategies to slow down, filter, and infiltrate rain water runoff, while creating aesthetically pleasing spaces.

As interest and demand increases, designers and consumers will need access to accurate information about plant performance under alternating flooding and drying conditions. Successful implementation will depend on an understanding of local soils, local plant "communities" and local natural processes.

In 2006 The Arboretum (The State Botanical Garden of Kentucky), the Lexington-Fayette Urban County Government, and a private design firm, Parsons-Brinkerhoff, joined into a partnership to solve a longstanding flooding problem in a Lexington neighborhood. The design process that ensued became an example of cooperation among several stakeholders resulting in the construction of a 5 acre wetland exhibit in 2007. This paper outlines the initial efforts to vegetate a man-made, artificial wetland.

Plant Selection Guidelines

A major component of the plan included the use of native Kentucky wetland plant species which fit the following criteria: 1) plants were selected to provide a diversity of structure (roots and foliage), 2) species were selected that are listed as *common* or *abundant* in Kentucky (Jones, 2005), and 3) species that would be "easy to grow". Careful study of local ecosystem patterns, compatibility with engineering specifications, and aesthetic appeal were also considerations that helped guide plant selection.

Photo of The Arboretum by Jim Lemke

Seed was collected for all herbaceous plants in the fall and winter of 2006, and submitted to cold-moist stratification for approximately 90 days. Plants were grown in deep-well flats to allow for development of large root system. (Note: Plants were grown by Dropseed Nursery, Louisville, Ky) Six thousand plugs were transplanted into the field during the months of April, May, and June. Planting was made difficult by compacted soil left behind by heavy equipment traffic. After installation, plant care was further complicated by a severe summer drought, which necessitated water rationing. In spite of the difficult growing conditions, all herbaceous species planted had a 90% or greater survival rate.

Wetland Category Descriptions

Wetland plants were categorized using the system described by Reed (1988) and used by Jones (2005) in The Plant Life of Kentucky. The wetness ratings help ecologists determine whether a plant has an affinity for growing in wet soils. 3 zones were created (based on relative elevation) within the wetland basin to match plants to moisture requirements.

OBL= Obligate wetland (the plant species is almost always found in wetlands)

FACW=Facultative wetland (usually in wetlands but sometimes in nonwetland habitats)

FAC=Facultative (just as likely to occur in wetlands as in nonwetland habitats)

FACU=Facultative Upland (usually in nonwetlands but sometimes in wetlands)

UPL= Upland (nearly always in nonwetland habitats, hardly ever in wetlands)

Performance ratings

Tables 1 and **2** list herbaceous species planted in the first year of the Arboretum Wetland Project, corresponding wetland category descriptions and performance ratings. (Key to ratings: **v**=plants achieved vigorous vegetative growth; **f**=plants flowered during growing season; **s**=plants ripened seed)

Table 3 lists woody plant species that were planted from nursery stock purchased at Kentucky nurseries or dug from Arboretum collections.

Additional species will be added and monitored during the 2nd growing season of the Arboretum Wetland Project. (2008)

Table 1. Grass and Sedge Species

Wetland category	Common name	Scientific name	Rating
FAC	Bottlebrush grass	*Hystrix patula*	v, f, s
FACU	River oats	*Chasmantheum latifolium*	v
FACU	Greasy grass	*Tridens flavus*	v
FACW	Straw-colored sedge	*Cyperus strigosus*	v
FACW	Stream bank Wild rye	*Elymus riparius*	v
FACW	Eastern gamagrass	*Tripsacum dactyloides*	v
FACW	Giant cane	*Arundinarea gigantea*	v
FACW+	Plume-grass	*Saccharum giganteum*	v
FAU-	Silky wild rye	*Elymus villosus*	v
OBL	Fox sedge	*Carex vulpinoidea*	v
FACW+	Soft rush	*Juncus effusus*	v

Table 2. Wildflower Species

Wetland category	Common name	Scientific name	Rating
FAC	Blue mistflower	*Conoclinum coelestinum*	v,f,s
FAC	Foxglove beardtongue	*Penstemon digitalis*	v
FAC	Yellow wingstem	*Verbesina alternifolia*	v,f,s
FAC	Illinois bundleflower	*Desmanthus illinoensis*	v
FAC	Ironweed	*Vernonia gigantea*	v,f,s
FAC+	Dense blazing star	*Liatris spicata*	v
FACW	Joe-pye weed	*Eupatorium fistulosum*	v,f,s
FACW	Slender mountain mint	*Pycnanthemum tenuifolium*	v
FACW+	Sneezeweed	*Helenium autumnale*	v,f,s
FACW+	Blue vervain	*Verbena hastata*	v,f,s
FACW+	Rattlebox	*Ludwigia alternifolia*	v,f,s
FACW+	Cardinal flower	*Lobelia cardinalis*	v,f
FACW+	Great blue lobelia	*Lobelia siphilitica*	v,f
OBL	Swamp milkweed	*Asclepias incarnata*	v,f,s
OBL	Nodding bur marigold	*Bidens cernua*	v,f,s
OBL	Water horehound	*Lycopus americanus*	v,f,s
OBL	Wild hibiscus	*Hibiscus militaris*	vf,s

Table 3. Woody Plant Species

Wetland	Common name	Scientific name	Rating
OBL	Bald cypress	*Taxodium distichum*	v
OBL	Swamp-privet	*Forestiera acuminata*	v
OBL	Water locust	*Gleditsia aquatica*	v
OBL	Buttonbush	*Cephalanthus occidentalis*	v,f,s
FACW+	Black willow	*Salix nigra*	v
OBL	Water elm	*Planera aquatica*	v
FAC	Black gum	*Nyssa sylvatica*	v
FACW	Silky dogwood	*Cornus ammomum*	v
FACW	False Indigo bush	*Amorpha fruticosa*	v

Implications for the Industry

As new technology develops requiring the use of native plant species in design solutions, research on plant performance will become essential to the success of storm water projects and wetland restoration in Kentucky. Effective species recommendations, including functional, ecological and aesthetic considerations are not currently available to address local needs. Continued monitoring of projects currently under construction and improved communication by professionals could be a valuable resource for Kentucky land owners.

Jones, R.L. 2005. Plant Life of Kentucky: An Illustrated Guide to the Vascular Flora. The University Press of Kentucky.

Reed, P.B. 1988. National list of plant species that occur in wetlands: Kentucky. National Wetlands Inventory, U.S. Fish and Wildlife Service, St. Petersburg, Fl.

Photo of The Arboretum by Jim Lemke

(Continued from page 1)

nary claims need extraordinary proof (at the time, I didn't know how much I could depend on Will's word…slinks away quickly). Will told me the samples were in storage in the Great Smoky Mountains National Park archives and gave me permission to borrow them and attempt to cross-date them. Sure enough. Will's ages were correct. Will currently has three of the oldest-documented tuliptrees to date. The youngest of his ages is 377 years while the oldest is 424 years old; his next oldest was just behind at 420 years. This is something because the Silvics Manual of North America says tuliptree might reach 300 years. However, a funny thing happened by happenstance that reveals how little we know about our forests.

In 2007 I was teaching at the North American Dendroecological Fieldweek in the Smoky Mountains. I joined with another group to study growth rates and ecology of an old-growth forest not too far from Cades Cove. Luckily Jess Riddle was in this other group and I was able to work with Jess in the forest. Our groups put in plots and cored some nice trees within these plots. At the end of the first day, we got the feeling we were in an old stand of tuliptrees. So, for Day Two, a bunch of us decided to focus solely on the tuliptrees outside these plots. It was a joyful day. We found a tulip 1.5 meters in diameter, roughly 5 feet, with a broken top that is a good characteristic of an old tuliptree. So, of course, we cored it. It was around lunchtime when we finished coring and many in the group decided to eat. Jess and I decided to core the spindly, 1 m diameter tuliptree next door. Unfortunately, it was hollow. Well, it was a nice try…..ha!....until we got that sample under a microscope about 2 days later. A student thought that perhaps he had counted 350 or more rings…*What? No way! Couldn't be possible!* So, I re-sanded the sample (you can never sand enough) and sat down at a good microscope. I could hardly contain myself as I started seeing rings that seem to be the early-1500s. By serendipity [and a good work ethic? Who needs food!?], we had just discovered the oldest-documented tuliptree (Image 1). Oh yeah, you recall how I wrote that it was hollow? We estimated that we recovered only about ½ of the tree's radius. As the final age stands at 509 years, there is good reason to think that this tree is at least 600 years old, and, perhaps, closer to 650 or 700. Like Douglas-fir, this extraordinary age does not fit the longevity we think of for early-successional trees in humid, moist environments like the eastern US.

Since then, through the work of my students in Kentucky and Josh Kelly in North Carolina as well as assistance on other old tuliptree sites in north Georgia from Jess Riddle, we have regularly found tuliptrees 330-475 years old. Kacie Tackett found and cross-dated the oldest tuliptree in Kentucky. The maximum age in Kentucky, based upon this tree, currently stands at 375 years of age. I hear a rumor, however, that an older one in Kentucky has been ring counted to nearly 400 years. This, too, will require extraordinary proof.

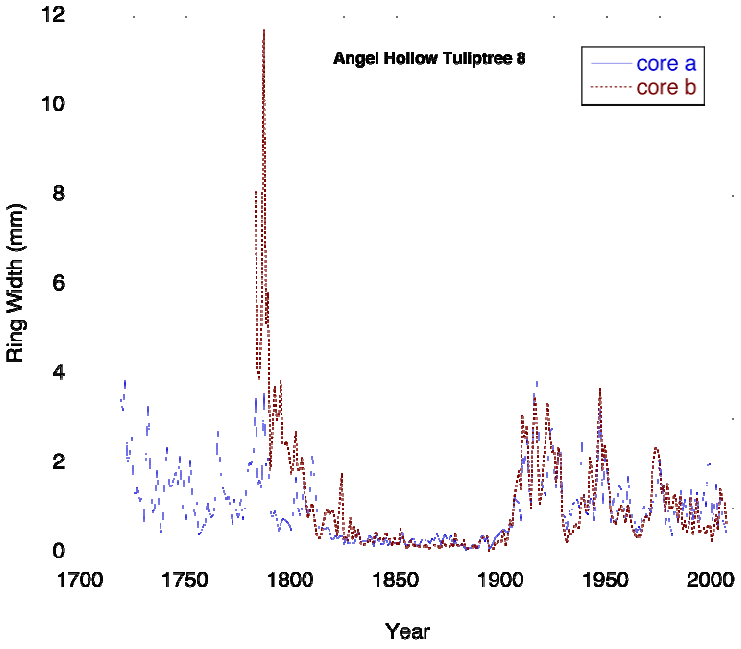


Image 2 – Extended suppression and then release from competition of the AH008 tuliptree. Adrienne Cooper, unpublished data.

As we have explored the ages and growth histories of tuliptree, we have also found patterns that we would not associate with a tree that recruits in large gaps and is often managed for through the implementation of large cuts. The Silvics Manual of North America notes that tuliptree can handle small gaps for recruitment and tolerates competition by out-reproducing and growing competitors. It also notes that thinning up at various stand ages, "*even in stands as old as 80 years*", results in increased growth. However, the Manual also notes that growth "*seldom, if ever, stagnates*" and that "*at 20 to 30 years of age, the peak rates of growth*" is hit and diameter growth slows considerably. We are finding over and over that this doesn't seem to hold true for many tuliptrees in mature and old-growth forests. Take Adrienne Cooper's tuliptree, AH008. Radial growth in the early-1700s is high, as expected for this species, and then declines (Image 2). There is suddenly an increase in growth in the late-1700s, when the tree is roughly 80 years old, as the Silvics Manual would expect. However, growth drops to very low levels in the early-1800s. In fact, radial growth averages 0.285 mm/yr from 1820-1902. In

other words, radial increment was just creeping above zero for much of that time. However, at 186 years of age, growth is 1.281 mm/yr from 1904-2007, an increase in radial increment of ~350% over the 1820-1902 mean (Image 2). AH008 indicates, and we've seen it in other individuals, that tuliptrees can stagnate and then respond positively with improved conditions at nearly 200 years of age. In fact, when we convert radial growth to biomass production, we see that this tree and the oldest-documented tuliptree are growing faster today than they ever have. This does not surprise us too much as we and ENTS researchers have noticed that crowns continue to enlarge substantially after the first 100 years, so growth should also accelerate. While we know tuliptrees to be among the straightest tree in the forest, we've seen many that defy that categorization. The twisty towers indicate that they have had to deal with much competition to live two centuries or more (Image 3).

Height & Volume (led by Bob Leverett and ENTS Fellows)

Tree dimensions are commonly quoted in tree identification guides, silvics manuals, forestry websites, and in popular literature. Often a height range is given along with a maximum for a species. Since tree heights have been measured for serious purposes over several centuries, it is reasonable to believe that maximum heights of important timber species are well known. In the eastern United States, maximums for most commercially valuable species would seem to be firmly established by a combination of forest scientists, forestry professionals, nurserymen, arborists, and big tree hunters. In a general sense, this is true. But, there are surprising differences in quoted maximums among what is commonly assumed to be authoritative sources. Consider *Liriodendron tulipifera*. The following table provides a sample of maximum heights as given in the identified sources (Table 1).

In researching height maximums for the tuliptree, only a few of the sources we consulted are specific about where the maximums occur, and only one explained how the measurements were made, e.g. of standing or downed trees. Interestingly, the averages often understate what the species commonly achieves, which casts doubt on the maximums. There is one fact that most sources agree on, and that is the stature of *Liriodendron*. About half the sources quote 190 – 200 feet as the maximum height of *Liriodendron*. Unfortunately, none of these sources explain how the range was determined. These omissions scream out for explanation. It appears to us that this frequently quoted and extraordinary height range is merely being repeated by author after author without qualification or citations.

From our literature search, it appears that a very small number of newspaper reports of isolated trees are the primary source of 190-200 foot range combined with one scholarly account of maximum heights from naturalist Robert Ridgeway who measured trees in the 1870s. Ridgeway measured lengths of downed tuliptrees near the Wabash River on the border of Illinois and Indiana, getting an

Image 3 – A tuliptree with a sinuous stem reflecting past battles for light with neighboring trees. Image Neil Pederson.

average of 143 feet and a maximum of 165 feet. We consider his numbers credible. Ridgeway apparently triangulated a lone tuliptree standing in a field at 182 feet and speculated about 200-foot tall trees. We don't know if he used the method of similar triangles or attempted to establish a baseline and shoot the angle to the top of the tree, employing right triangle trigonometry. Even if he used the latter method, many sizable errors have been documented by ENTS, errors made by presumably qualified measurers using the baseline and angle to crown method. For example, the champion *Liriodendron* in Kentucky is listed at 174'. However, when directly measured by a tape drop by Duane Hook, Landon Smith and Tom Robison, the height turns out to be 168' (Image 4). Of course, wind, snow, drought or ice could have caused some height lost between measurements. Nonetheless, we often find purported heights of tall trees to be in significant error. A tuliptree in a famous park in Delaware was stated to be nearly 200 feet tall, but when accurately measured was just over 150 feet. In researching newspaper accounts of extraordinary tuliptree heights, several tall tree stories stand out. One account features the famous Reems Creek Poplar and states:

> *Yellow poplar tree 144' high, 28.7' in circumference at breast height on the contour. Reems Creek, Pisgah National Forest, North Carolina, 1932. (From C.A. Abell. ☐U.S. Forest Service Southern Research Station Collection, D.H. Ramsey Library, Special Collections, University of North Carolina at Asheville 28804).*

Table 1 – Sources and listing of maximum height for *Liriodendron tulipifera*.

Source	Maximum
Identifying Trees	exceeding 120 feet
The Complete Trees of North America	98-165 ft, rarely to 200
Eastern Forests	over 100 feet
Trees of Pennsylvania	approaching 200 feet
Trees of Eastern and Central North America	up to 200 feet
The Sibley Guide to Trees	max 200
Trees of New England	approaching 200 feet
Michigan Trees	60 meters
Our Native Trees	190 feet
A Field Guide to Trees and Shrubs	190
Trees	******
Woody Plants of Maryland	to 60 meters
Simon & Schuster's Guide to Trees	150 feet
Trees and Shrubs of Virginia	190 feet
Trees of North America	150 feet
Handbook of The Trees of New England	50-70 feet
New England Natives	******
Forest Trees of Massachusetts	50-80 feet
The Complete Guide to North American Trees	******
Field Book of American Trees and Shrubs	190 feet
The World of Trees	150 to 190 feet
Trees	150-180 feet
New England Trees in Winter	nearly 200 feet
Trees of the Great Smoky Mountains NP	******
Trees of Arkansas	150 feet or more
Silvics of North America	*****
Virginia Department of Foresty	nearly 200 feet
Ohio Department of Natural Resources	well over 100 feet
Trees and Shrubs of Massachusetts	140 feet
Common Trees of Pennsylvania	*****

However, other images of the Reems Creek Poplar have listed in the captions heights of anywhere from 150 to 198 feet. It is likely that these heights have reinforced the perception of 200-foot tall tuliptrees. Another tree purportedly in the quoted height range is shown in NPS archived images for the Great Smoky Mountains. A tuliptree is shown that purportedly was 190 feet tall and 7 feet in diameter. Again, we do not know how the measurement was taken, but there is a chance it was determined after the tree was cut. We could cite other examples of dubious reports on great heights for not only tuliptrees but other species as well, which brings us to an important point - quoting from or citing past sources on the maximum heights of trees does not prove the listed maximums for *Liriodendron*. And it doesn't matter if the sources are popular or scientific. Citations of the work of others are fundamental to scientific research and publication. Yet, when it comes to confirming species height maximums, this workhorse technique fails us completely for the tuliptree, and all other species we've studied. How can this be?

A point that is often overlooked is that traditional tree height measurement methods used by lumbermen approximate heights, and are not intended for high accuracy levels. Anecdotal citations from newspaper and magazine articles obfuscate rather than elucidate. To further compound the problem, tree height maximums are often not relevant in scientific research, so they go unrecorded by researchers fully capable of applying advanced measurement techniques. And lastly, serious researchers often adopt the approximating measurement techniques of lumbermen, dooming themselves to committing the errors of timber professionals.

Given the interest in big trees from the general public, the lack of authoritative height information from conventional sources continues to be surprising, but nonetheless, has left a gap in our formal understanding of what the maximums actually are, where they are

Image 4 – State champion tuliptree in Kentucky. While listed at 174', the most recent measurement, via a tape drop from the top by Duane Hook, Landon Smith and Tom Robison, puts the tree's height at 168'. Images courtesy of Duane Hook.

reached, under what conditions and ages, and with what probabilities. For example, assuming the maximum for the tuliptree is between 190 and 200 feet, can that extreme height range be achieved in many regions native to the tuliptree? The probability of *Liriodendron* reaching a height above 150 feet anywhere in say Massachusetts, the northeastern natural range limit of the species, is remote. Yet, measurement data obtained by ENTS in the lower Hudson River corridor and on Long Island suggests that at least on occasion, the species approaches 160 feet along narrow corridors above the river where soils are deepest and protections are at a maximum. Our current, though admittedly limited data, suggest that by the time 42.5 degrees latitude has been reached, the maximum height or *Liriodendron* is around 145 feet, with only the rarest exceptions. Going northward, beyond 42.5 degrees, maximum heights drop dramatically as the species become primarily a yard tree. Moving south from the 42.5-degree parallel, maximum heights jump to near 160 feet at 41.5 degrees latitude. The 160-foot threshold holds to at least the latitude of Atlanta, GA, or around 33.5 degrees latitude. Farther south and westward, maximums appear to drop to around 135 and below.

Within the latitude band of 33.5 to 41.5 degrees, we have measured tuliptree to over 160 feet on many sites. We conclude that the tuliptree reaches heights of 160 feet over a very large geographical area. On highly favorable sites, *Liriodendron* can reach heights of 160 feet or more over a geographical area of at least half a million square miles. But this isn't the end of the story. In the southern Appalachians, multiple sites have been confirmed with tuliptrees over 170 feet and a scattering of sites exists with trees over 180 feet. A single tree has recently been confirmed to 191.9 feet in western North Carolina, which interestingly agrees with the tree guides that claim a maximum between 190 and 200 feet. But as previously stated, few of the sources explained where trees in this height range had been confirmed and by what measurement methods.

With a growing body of extremely accurate height measurements, courtesy of ENTS, tall tree hot spots are being investigated. We are gradually piecing together the growth behavior of *Liriodendron*. As mentioned, several pockets in the southern Appalachian Mountains contain a good number of tall *Liriodendron*. For example, Barkers Creek in the Cowee Mountains and Welch Branch in the Great Smoky Mountains have loads of tall trees. Barkers Creek has a tree over 184' and 16 over 170'. Welch Branch has about 27 over 170' and one at 187'. Both sites are second growth and not much over 100 years old. Elsewhere, the Santeetlah Poplar reaches 179.7 feet in height and 15 feet in girth, and likely in the neighborhood of 250-300 years old. Other examples could be given. However, much work remains to be done before the picture is complete. One reason is that *Liriodendron*'s growth characteristics vary greatly with climate, soil texture and fertility, terrain, and frequency of damaging storms.

Image 5 – A voluminous tuliptree in the Smoky Mountains (lft). Jess Riddle stands at the base. The Three Amigos, a cluster of tall tuliptrees in western North Carolina. Images by Will Blozan and Jess Riddle.

Our long-term challenge is to determine height maximums for *Liriodendron* on favorable sites across the full geographical range of the species. Ideally, the trees on a site would be mature, but not too old. If a site possesses extremely old trees, their crowns are often broken, and many if not most very old trees have lost height from their maximums. Sites with very young trees obviously distort downwardly the site's full growth potential. So, stand age must be factored into the data.

A lot more tree measuring must take place before we can profile the species full growth potential with high confidence, but what has been learned thus far suggests that *Liriodendron* maintains the significant height of 140 feet or more over at least a span of 11 degrees of latitude. It reaches its absolute maximums in the southern Appalachians, where it has the potential of exceeding 200 feet. Our conclusion is that 200-feet would be extremely rare, certainly now, and probably historically, but the possibility definitely exists. However, we have found no evidence to believe that *Liriodendron* can exceed 200 feet outside of the southern Appalachians. That perception may change, but stands for now. However, the latitude range over which *Liriodendron* can exceed 150 feet spans at least 7 degrees. By comparison, this is less than that for the white pine, which can reach to over 150 feet in height across a span of at least 12 degrees latitude. However, the number of 150-foot tulips literally dwarfs the number of white pines above 150-feet. In addition, the tulip reaches significant heights over a much greater geographical area than does the white pine. Growth rates for both species are extremely rapid, and maximum ages appear comparable.

We note that not only confirmed *Liriodendron* to currently reach the greatest documented height in the eastern U.S. for native species, and 6th oldest species in the East, but it is proving to be one of the most voluminous species. The tallest *Liriodendron* is estimated to have 2,844 cubic feet of total volume, which translates to a lot of carbon being stored in this particular tree, approximately 35,550 pounds. The other few individuals that have been measured through a telescopic eyepiece at several points along the tree profile or directly from climbing range from 1787 to 4,013 cubic feet of biomass. Tuliptree falls behind some exceptional baldcypress (*Taxodium distichum*) and live oak (*Quercus virginiana*) trees in terms of most voluminous eastern tree.

So, to circle back around. Despite being an icon of the woods and the state of Kentucky, Indiana, and Tennessee, and an important and charismatic tree in every state in which it grows, our full knowledge of tuliptree is still incomplete. Perhaps it will never be complete. But, the ability of a few dedicated individuals to improve 100+ years knowledge of this tree in just a few years indicates there is much new natural history to discover. Specifically, this new information of the tuliptree makes us think it as more of the great Douglas-fir, a fast-growing species with a partial, late-successional persona. Tuliptree soars even taller in our minds now because of what we have learned. What is most exciting is what there is left to learn in our magnificently diverse woods. Will we soon see the 600+ year old black tupelo (*Nyssa sylvatica*) as the eastern bristlecone pine (*Pinus longevea*)? Time, research and, perhaps, another column might tell.

2011 Wildflower Weekend Photo Contest Winners!

1st Place - Melodie Cunningham (Indigo Bunting)

2nd Place - Melodie Cunningham (Blue Columbine)

3rd Place - Holly Robinson (White Violet)

Kentucky Native Plant Society
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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.