

# *Hypotrachyna oprah* (Parmeliaceae, Lichenized Ascomycota), a new foliose lichen with lichexanthone from southeastern North America

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## ABSTRACT

*Hypotrachyna oprah* is described as new to science from collections made at locations in southeastern North America (Alabama, Florida, North Carolina). The species is considered rare and was potentially confused with *H. osseoalba* in the past. It differs from *H. osseoalba* in having capitate soralia and producing echinocarpic acid, together with related substances, in the medulla. The specific epithet was chosen to honor Dr. Oprah Winfrey for her performances, media presence, and generous philanthropy that have substantially improved humanity.

**Key words:** Appalachian Mountains, biodiversity hotspot, Coastal Plain, conservation, endemism, lichenized diaspores, Talladega National Forest.

## INTRODUCTION

Southeastern North America is a global hotspot of biodiversity, hosting countless unique species of plants, animals and fungi, as well as ecosystems that occur nowhere else on Earth (Braun 1950, Lydeard and Mayden 1995, Petranks 1998, Manos and Meireles 2015, Noss et al. 2015). Throughout the dynamic natural communities of the region, from the coast to the mountains, lichens are a particularly conspicuous and important component of the vegetation (DePriest 1984, Harris 1995, Lücking et al. 2011, Lendemer et al. 2013, 2016, Seavey et al. 2017). As is the case for other organisms, many lichens are endemic to different ecoregions within the southeastern United States (Lendemer et al. 2013, 2016, Allen and Lendemer 2016, Allen et al. 2017). Despite being macroscopic organisms that are widely noticed by both scientists and non-specialists alike, lichens are now at the forefront of scientific discovery in temperate eastern North America and new species continue to be documented and described at a remarkable rate (Lendemer et al. 2016, Seavey et al. 2017). Here we describe a charismatic foliose lichen that appears to be rare, but widely distributed throughout the biodiversity hotspot of southeastern North America. The species is instantly recognizable by its capitate soralia and bright, luminous yellow fluorescence in long wave ultraviolet light.

## MATERIALS AND METHODS

This study is based on specimens deposited in the herbarium of The New York Botanical Garden (NY) supplemented by material from MAF and US. Thalli were observed in the field at the type locality in Talladega National Forest, Alabama, U.S.A. to determine growth direction, lobe arrangement and thallus shape. Macroscopic vegetative and reproductive structures were studied and measured from herbarium specimens using a StereoZoom 7 dissecting microscope (Bausch & Lomb, Laval, Quebec). Soredia were measured using an DP72 digital camera and CellSens imaging software attached to an Olympus BX53 compound microscope (Olympus, Center Valley, Pennsylvania).

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Micrographs were taken with a Nikon SMZ1500 camera (Nikon, Melville, New York) mounted on an Olympus SZ-STB dissecting microscope. The chemistry of thalli was studied with both standard spot tests (e.g., K, C, P.) following Brodo et al. (2001) and thin layer chromatography using solvent C following Culberson and Kristinsson (1970) as modified by Lendemer (2011).

### The New Species

*Hypotrachyna oprah* Lendemer & J.L. Allen sp. nov. Figure 1.

Mycobank #829268.

**Common Name:** Oprah's Sunshine Lichen

**Diagnosis:** Similar to *Hypotrachyna osseoalba* but differing chemically in the production of the echinocarpic acid aggregate (vs. lividic acid aggregate) and morphologically in the production of capitate soralia (vs. pustules).

**TYPE: U.S.A. ALABAMA. Chilton Co.:** Talladega National Forest, E slopes of Perry Mountain, Blue Branch of Boggles Creek, FSR307 ~5.5 mi S of jct w/ AL183, 143 m., mixed hardwood (*Acer*, *Carya*, *Quercus*)–pine (*Pinus*) forest with riparian *Magnolia virginiana*-*Acer* forest and *Arundinaria* understory, 29 Mar 2017, on *Quercus*, J.C. Lendemer 50712 (NY!, holotype, COLO!, isotype).

### Description

**Thallus** foliose, irregular to circular in outline, small to medium, 3.0-8.0 cm in diameter, loosely adnate, sorediate; **upper surface** blue-gray but with a distinct yellow hue, dull, epruinose, maculate with conspicuous white maculae concentrated on the younger lobes; **medulla** white with unevenly distributed patches of light yellow pigment; **lower surface** smooth, shiny, black throughout except for a narrow brown zone near the lobe tips; **lobes** narrow, plane to slightly revolute, 1.5-3.0 mm wide, irregularly organized, with subsympodial to irregular branching; **rhizines** +/- uniformly distributed across the lower surface, black, dichotomously branched, 0.2-0.7 mm long; **soralia** capitate on the upper surface of the lobes and lobe tips, 0.5-1.5 mm in diameter, initiating as +/- ovoid patches of cortical tissue that erode to form soredia, eventually expanding through further erosion of the cortex and medulla, becoming weakly to strongly convex, often merging with adjacent soralia to form extensive sorediate masses that dominate the terminal portions of the lobes; **soredia** fine, 25-50  $\mu\text{m}$  in diameter, often forming aggregations of multiple soredia, remaining the same color as the medullary tissue throughout the development of the soralia; **apothecia** unknown; **pycnidia** unknown.

### Chemistry

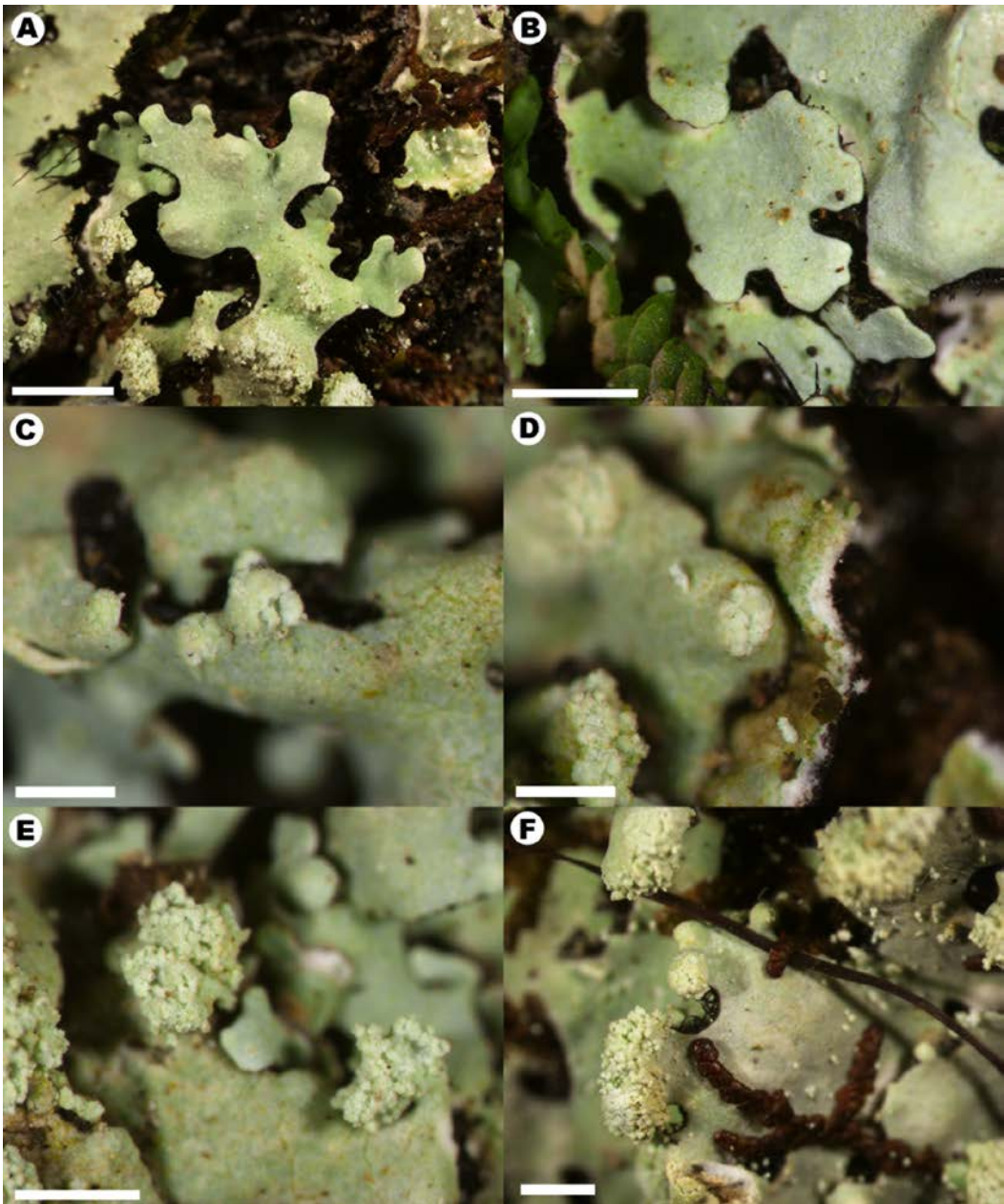
Lichexanthone and compounds of the echinocarpic acid aggregate. Spot tests: cortex: K-, C-, KC-, P-, UV+ bright yellow; medulla: K-, C-, KC-, P+ orange-red, UV-.

### Etymology

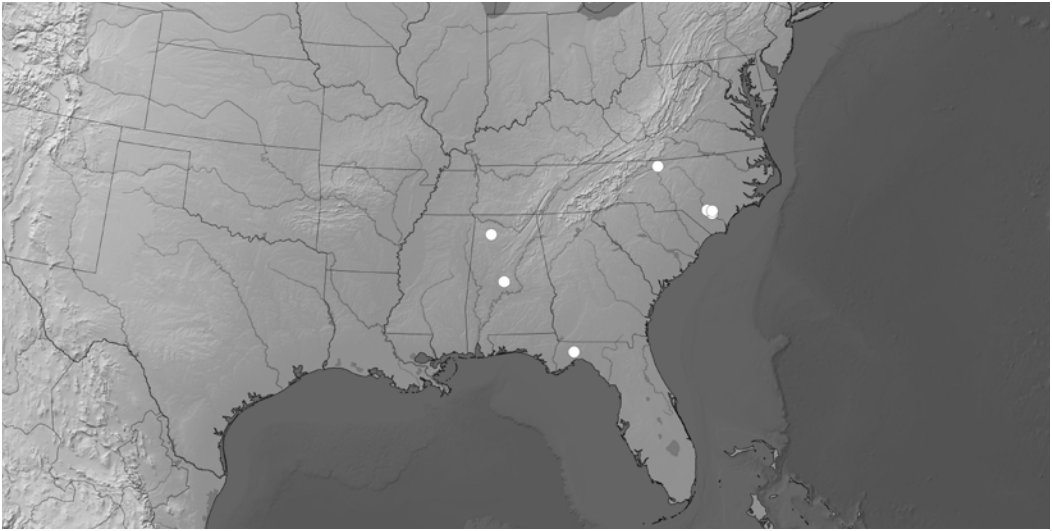
The new species honors Dr. Oprah Winfrey, widely considered to be the world's most influential woman, to commemorate her lifelong accomplishments and contributions in the realms of media and philanthropy. Oprah was born in the town of Kosciusko (known locally as 'the Beehive of the Hills'), Mississippi in the biodiversity hotspot of southeastern North America. From a young age Oprah used her nascent talent and drive to advance efforts in media. She began the highly influential Oprah Winfrey Show in 1986, and her media contributions subsequently expanded to manifold formats and ever broader, more diverse audiences (Illouz 1999, Lowe 2001, Young 2001). In addition to philanthropic work that spans the globe, she received the Presidential Medal of Freedom in 2013 from then President Barack Obama, along with honorary doctorates from Duke and Harvard Universities. The species epithet "oprah" is treated as a noun in apposition (i.e., lacking a termination of -iae or -iana; Art. 23.5) to both preserve euphony and honor her unique presence.

### Ecology and distribution

*Hypotrachyna oprah* is known from scattered locations throughout the Coastal Plain of southeastern North America (Figure 2) with a distribution that extends into the interface between the Coastal Plain and the foothills of the Appalachian Mountains in Alabama. The type locality is an example of one such location where the lichen communities include a mixture of typically temperate



**Figure 1.** Morphology of *Hypotrachyna oprah* (A and F, from *Lendemer 48443*; B-E from *Lendemer 48532*). **A.** macroscopic morphology of the thallus. **B.** detail of lobe tip. **C.** detail of soralia in early stages of development as the upper cortex begins to disintegrate. **D.** detail of soralia in early stages of development as they form soredia and begin to expand. **E.** and **F.** detail of capitulate soralia in later stages of development as they become convex and cause the lobe surface to curl and become reflexed. Scales = 2.0 mm in A; 1.0 mm in B, E and F; 0.5 in C and D.



**Figure 2.** Geographic distribution of *Hypotrachyna oprah* based on specimens examined for this study

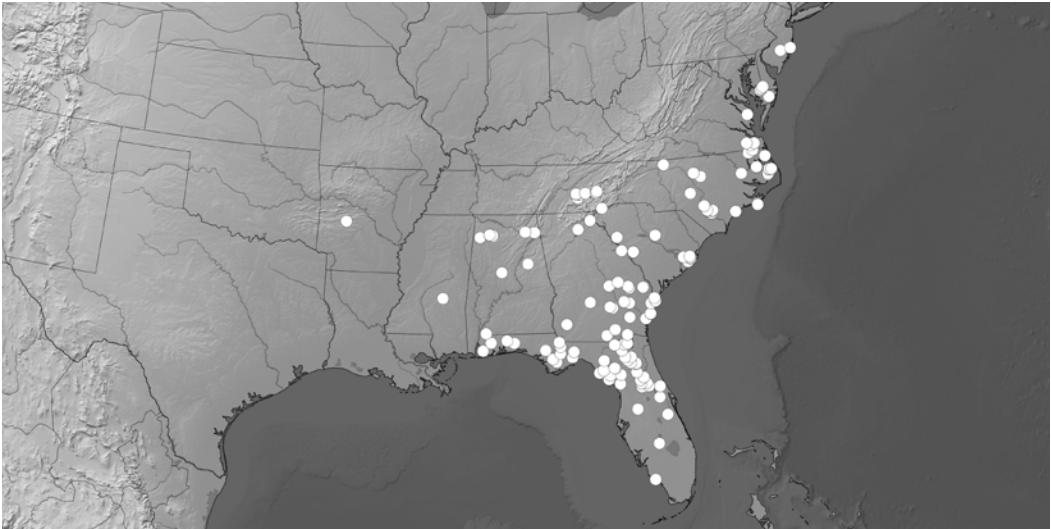
or Appalachian species (e.g., *Anzia colpodes* (Ach.) Yoshim., *Fuscopannaria leucosticta* (Tuck.) P.M. Jørg. and *Heterodermia speciosa* (Wulfen) Trevis.) and Coastal Plain species (e.g., *Arthonia albovirescens* Nyl., *Brigantiaea leucoxantha* (Spreng.) R. Sant. & Hafellner, *Bulbothrix scortella* (Nyl.) Hale, *Byssoloma meadii* (Tuck.) S.Ekman, *Fissurina insidiosa* C. Knight & Mitten, *Heterodermia albicans* (Pers.) Swinsc. & Krog, *Lecanora louisianae* de Lesd., *Lobaria ravenelii* (Tuck.) Yoshim., *Minutoexcipula miniattoexcipula* R.C. Harris & Lendemer, *Parmotrema praesorediosum* (Nyl.) Hale, *Parmotrema rampoddense* (Nyl.) Hale, *Polymeridium quinquesepatum* (Nyl.) R.C. Harris, *Pyrenula cruenta* (Mont.) Vain., *Thelotrema defectum* R.C. Harris and *Trichothelium americanum* Lendemer) (Lendemer unpublished data).

Throughout its range, the species occurs on the bark of hardwoods in humid habitats, such as pocosins and stream ravines. Given the small number of known occurrences of *Hypotrachyna oprah*, we suspect that species is rare throughout its range. However, it is possible that, despite its distinctive morphology and brightly fluorescent cortex, *H. oprah* has been overlooked in the field and confused with *H. osseoalba* which is much more common and widely distributed (Figure 3; Harris 1995, Lendemer and Noell 2018).

## DISCUSSION

*Hypotrachyna oprah* is a very distinctive member of the genus *Hypotrachyna* on account of its capitate soralia, production of lichexanthone in the cortex, and production of the echinocarpic acid aggregate in the medulla. The species has been collected since at least the 1970's and was recognized as unusual by Johnathan Dey whom noted the distinctive chemistry of specimens in his herbarium and tentatively identified it as a new species. The first author, together with Richard Harris, encountered that material while processing Dey's herbarium for inclusion in NY. Although the chemistry and morphology did not match any known species (see e.g., Hale 1975, Sipman et al. 2009) the available material was limited in size and insufficient to serve as an adequate type specimen. Thus, it was filed amongst the undetermined specimens at NY pending further study. Subsequently we located it in the Coastal Plain of North Carolina, where it was frequent at several sites but present only as scattered individuals. Eventually we discovered two much larger populations in the Appalachian Mountain-Coastal Plain interface of Alabama, which permitted collection of ample material to serve as a type.





**Figure 3.** Geographic distribution of *Hypotrachyna osseoalba* in eastern North America based on specimens at NY examined for this study.

Given the presence of lichexanthone in the cortex of *Hypotrachyna oprah* it is almost certain that the species has been previously confused with *H. osseoalba* (Vain.) S.Y. Park & Hale in North America. *Hypotrachyna osseoalba* is the only other member of the genus that occurs in eastern North America and produces lichexanthone in the cortex (see e.g., Hale 1958, Moore 1968, Harris 1995). Although it differs considerably in having pustules rather than capitate soralia, specimens of *H. oprah* would likely have been referred to *H. osseoalba* if the chemistry had not been studied in detail. Confusion with *H. osseoalba* is particularly likely given that the species is widespread and common throughout much of southeastern North America (Figure 3, see also the appendix) and its range is entirely sympatric with *H. oprah*.

Other than *H. osseoalba*, there are relatively few species that occur with *H. oprah* and have capitate soralia. *Hypotrachyna cryptochlora* (Vain.) D. Hawksw. & A. Crespo is one such species that is similar in having capitate soralia. Nonetheless it differs in lacking lichexanthone in the cortex and producing gyrophoric acid together with members of the hiassic acid aggregate in the medulla (Harris 1995, Lendemer et al. 2016). *Hypotrachyna pseudosinuosa* (Asahina) Hale also occurs at low elevations of the southern Appalachian Mountains (Lendemer et al. 2013) and has capitate soralia (Asahina 1951, Hale 1975, Sipman et al. 2009). However it differs from *H. oprah* in lacking lichexanthone in the cortex and producing protocetraric acid in the medulla (Hale 1975, Sipman et al. 2009).

Outside of North America, there are few species that could be confused with *Hypotrachyna oprah* given that it combines distinctive capitate soralia with a thallus chemistry that is unusual within the genus. In fact, the vast majority of *Hypotrachyna* species with lichexanthone in the cortex lack lichenized propagules and instead are frequently fertile (Hale 1975). *Hypotrachyna subformosana* Hale ex Elix, T.H. Nash and Sipman from Brazil is similar in having capitate soralia and producing lichexanthone in the cortex, but differs in having lividic acid instead of echinocarpic acid in the medulla (Sipman et al. 2009, Gerlach and Eliasaro 2012). *Hypotrachyna protoformosana* Elix, T.H. Nash and Sipman might also be confused with *H. oprah* because it produces lichexanthone in the cortex, but that species has laminal pustules and produces protocetraric acid in the medulla (Sipman et al. 2009, Gerlach and Eliasaro 2012).

**Additional specimens examined**

**U.S.A. FLORIDA.** Apalachicola National Forest, N of Leon Springs, US319 1.7 mi N of jct w/ CR2204, Dec 1990, on deciduous tree, *J.P. Dey 21492* (NY). **NORTH CAROLINA. Bladen Co.:** Jones Lake State Park, Salters Lake Natural Area, S of Ruskin Rd., 1 Oct 2016, on *Quercus*, *J.C. Lendemer et al. 48443* (NY); Bay Tree Lake State Park, sand ridge 0.6 mi SE of NC41, 0.3 mi W of shore of Bay Tree Lake, 1 Oct 2016, on *Quercus* base, *J.C. Lendemer et al. 48362* (NY); Singletary Lake State Park, just E of Camp Ipecac, 2 Oct 2016, on *Quercus*, *J.C. Lendemer et al. 48532* (NY). **Surry Co.:** Pilot Mountain, 1973, on deciduous tree, *J.P. Dey 7139* (NY).

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## APPENDIX

### Specimens of *Hypotrachyna osseoalba* used for comparison

**U.S.A. ALABAMA. Baker Co.:** Ichauway Plantation/Jones Ecological Research Center, CR 124, ca. 1.25 miles northwest of Mimsville. 2007, J.C. Lendemer 9569 (NY). **Baldwin Co.:** Fish River, 1924, *A.W. Evans* 96 (NY); Baldwin Co., Splinter Hill Bog Preserve, S of CR 47, 0.3 mi WNW of Dyas Creek, 2007, *R.C. Harris* 53337 (NY). **Bibb Co.:** Bibb County Glades TNC Preserve, E-facing slopes above the W shore of the Little Cahaba River, 2017, *J.C. Lendemer* 50816 (NY). **Clay Co.:** Talladega National Forest, Cheaha Wilderness, Chinnabee Silent Trail from Lake Chinnabee to Devil's Den, 1992, *R.C. Harris* 28353 (NY). **DeKalb Co.:** Little River National Preserve, Bear Creek 0.16 mi S of AL176/Little River Canyon Parkway, ~2.8 mi N of jct w/ DeKalb CR148, 2016, *J.C. Lendemer* 49153 (NY). **Lawrence Co.:** Bankhead National Forest, Sipsey Wilderness Area, slopes above tributary to Quillan Creek, 2016, *E.A. Tripp* 6548 (NY). **Marion Co.:** North Fork Glade, vicinity of confluence of Gin Creek and North Fork Creek, 2017, *J.C. Lendemer* 52030 (NY). **Talladega Co.:** Talladega National Forest, slopes above E shore of Talladega Creek, FSR310 0-0.2 mi N of jct w/ Skyway Parkway, 2017, *J.C. Lendemer* 50467 (NY). **Winston Co.:** Bankhead National Forest, Sipsey Wilderness Area, N-facing slopes above S shore of the Sipsey River, 2.0 mi S of Sipsey River Recreation Area, 2017, *J.C. Lendemer* 52257 (NY). **ARKANSAS. Garland Co.:** Ouachita National Forest, NE-facing slope along W side of North Fork Ouachita River, 2010, *J.C. Lendemer* 26118 (NY). **DELAWARE. Sussex Co.:** along Nanticoke River, 3-4 mi SW of Blades, 1962, *C.F. Reed* 55221 (NY). **FLORIDA. Alachua Co.:** O'Leno State Park, 1974, *J.P. Dey* 7604 (NY). **Baker Co.:** Along C.R. 127 at Moccasin Creek, ~2 mi NNW of FL2 at Baxter, 1996, *R.C. Harris* 39282 (NY). **Bay Co.:** N of Fla. Hwy 20, 1.2 mi E of US 231, 1994, *R.C. Harris* 35736 (NY). **Bradford Co.:** Lake Butler Wildlife Management Area, Raiford Tract, 1994, *R.C. Harris* 35876 (NY). **Clay Co.:** Gold

Head Branch State Park, along Florida Trail near park entrance, 1992, *R.C. Harris 29088* (NY). **Collier Co.:** Collier-Seminole State Park, along beginning of Florida Trail on W side of US 41, 1992, *W.R. Buck 22897* (NY). **Columbia Co.:** Osceola National Forest, W of FSR237, 0.3 mi S of FSR263, 1993, *R.C. Harris 32532A* (NY). **Dixie Co.:** Big Bend Wildlife Management Area, Jena Unit, 1996, *R.C. Harris 39635* (NY). **Gadsden Co.:** Chattahoochee, "Brickyard Glade", W of W end of River Rd. off FL269, 1994, *R.C. Harris 35646* (NY). **Gilchrist Co.:** Waccasassa Flats, along CR232 ca. 3 mi E of US129, 1993, *R.C. Harris 31687* (NY). **Gulf Co.:** N of Lake Grove Rd./FL22), 1.5 mi E of FL71 at Wewahitchka, 1993, *R.C. Harris 32177* (NY). **Hamilton Co.:** Bee Haven Bay, N of Co. Rd. 6, 5.5 mi W of US 441, 1993, *R.C. Harris 32513* (NY). **Highlands Co.:** Archbold Biological Station, on Old SR 8, SE Tract, 1998, *R.C. Harris 41757* (NY). **Lafayette Co.:** along CR355A, 1.4 mi SE of FL51, 1994, *R.C. Harris 35800A* (NY). **Lake Co.:** Ocala National Forest, along FSR538-A from FSR538 to Alexander Springs Creek, ca. 2 mi SE of Alexander Springs, 1988, *J.C. Harris 23499* (NY). **Leon Co.:** Apalachicola National Forest, N of Leon Springs, 1.7 mi N on US319 from jct w/ CR2204, 1990, *J.P. Dey 21515* (NY). **Levy Co.:** along FL24 ~6 mi NE of jct w/ US Alt 27 at Bronson, at microwave tower, 1992, *R.C. Harris 29285* (NY). **Liberty Co.:** Apalachicola National Forest, near jct of FL67 and FSR-F13, 1990, *J.P. Dey 21390* (NY). **Marion Co.:** along CR316, 0.5 mi E of Oklawaha River Bridge at Eureka and 0.2 mi W of FSR67, 1995, *J.P. Dey 25449* (NY). **Okaloosa Co.:** along Antioch Rd./CR4 1.2 mi W of FL85, ca. 4 mi S of Crestview, 1990, *R.C. Harris 25189* (NY). **Osceola Co.:** Bull Creek Wildlife Management Area, along Interpretive Drive, 1.5 mi ESE of Check-in Station, 1996, *R.C. Harris 37548* (NY). **Putnam Co.:** along CR 21, 2.7 mi S of Johnson at jct of CR 20A, 1996, *R.C. Harris 39900* (NY). **Santa Rosa Co.:** Blackwater River State Forest, along Jackson Red Ground Trail N from Red Rd. just E of Big Juniper Creek, 1993, *R.C. Harris 32049* (NY). **Seminole Co.:** along Willingham Rd., 0.5 mi N of Co. Rd. 419 at Econlockhatchee River, on W border of Flying Seminole Ranch, 1996, *R.C. Harris 37762* (NY). **Sumter Co.:** Green Swamp Wildlife Management Area, Cross Creek Swamp, 1998, *R.C. Harris 41624* (NY). **Union Co.:** Lake Butler Wildlife Management Area, along Co. Rd. 231A, 1994, *R.C. Harris 36012* (NY). **Volusia Co.:** Blue Spring State Park along hiking trail, 1988, *R.C. Harris 23795* (NY). **Wakulla Co.:** Apalachicola National Forest, Bradwell Bay Wilderness, along Apalachicola Trail at jct. with Forest Serv. Rd. 314, 1988, *R.C. Harris 23464* (NY). **GEORGIA. Appling Co.:** Moody Bryant Natural Area, 0-0.5 mi E of head of River Trail on Miller Landing Rd., 2009, *J.C. Lendemer 21089* (NY). **Bryan Co.:** Richmond Hill Wildlife Management Area, 2012, *M.F. Hodges 7932* (NY). **Candler Co.:** Charles Harold TNC Preserve, 0-0.25 mi N of Salem Church Rd., W side of Stocking Head Creek, 2009, *J.C. Lendemer 21785* (NY). **Charlton Co.:** Okefenokee National Wildlife Refuge, E side of Chase Prairie along boat trail, 1989, *C.M. Wetmore 66173* (NY). **Chatham Co.:** Wormsloe State Historic Site, 2011, *M.F. Hodges 7591* (NY). **Clinch Co.:** 1628 Shiloh Rd., 2011, *M.F. Hodges 7723* (NY). **Coffee Co.:** Broxton Rocks Ecological Preserve, Ricketson Tract, 1996, *R.C. Harris 38798* (NY). **Columbia Co.:** Burks Mountain, ca. 3.5 mi E of US 221 from Pollards Corner on road through Rosemont, 2010, *J.C. Lendemer 21912* (NY). **Echols Co.:** Alapaha River at Howell Rd., 2014, *M.F. Hodges 11162* (NY). **Effingham Co.:** Craig Barrow farm, 2012, *M.F. Hodges 8297* (NY). **Emanuel Co.:** Ohoopee Dunes Natural Area, GA80 tract, 2009, *J.C. Lendemer 21272* (NY). **Glynn Co.:** Hofwyl-Broadfield Plantation Historical Site, 2013, *R.D. Rosentreter 17725* (NY). **Habersham Co.:** Chattahoochee National Forest, Panther Creek Trail, 2014, *M.F. Hodges 11560* (NY). **Co.,** Young tract, Murrayville, 2014, *M.F. Hodges 11463* (NY). **Jeff Davis Co.:** 0.4 mi E of Coffee County line on GA 107, ca. 11 mi NE of Broxton, along "Mill Creek", 1996, *R.C. Harris 38779* (NY). **Laurens Co.:** River Bend Wildlife Management Area, 2012, *M.F. Hodges 8464* (NY). **McIntosh Co.:** Sapelo Island, West Perimeter Rd. 0.5 mi N of Kenan Fields, 2009, *J.C. Lendemer 20853* (NY). **Pierce Co.:** Little Satilla Wildlife Management Area, Knight Rd. ca. 1 mi E of Offerman, 2009, *J.C. Lendemer 21475* (NY). **Tattnall Co.:** Big Hammock Natural Area, ~1 mi E of jct of CR 441 & GA 121/144/169, 2009, *J.C. Lendemer 21167* (NY). **Wilcox Co.:** US280 roadside, 2016, *M.F. Hodges 13861* (NY). **MARYLAND. Wicomico Co.:** Nanticoke River TNC Preserve, Owens/Plum Creek Tract, *J.C. Lendemer 31866* (NY). **Worcester Co.:** Nassawango Creek TNC Preserve, Dickerson/Quillen Tract, 2012, *J.C. Lendemer 33603* (NY). **MISSISSIPPI. Smith Co.:** Bienville National Forest, Marathon Lake Recreation Area, 1992, *R.C. Harris 28779* (NY). **NEW JERSEY. Burlington Co.:** Wharton State Forest, Batsto Natural Area, E of Atsion, ~0.5 mi N of Quaker Bridge, along the E shore of Batsto River, 2003, *J.C. Lendemer 964* (NY). **Ocean Co.:** without location, 1932, *G.P. Anderson s.n.* (NY). **NORTH CAROLINA. Bladen Co.:** Singletary Lake State Park, just E of Camp Ipecac, 0.2 mi SE of shore of Singletary Lake, 0.2 mi NE of NC53, 2016, *J.C. Lendemer 48524* (NY); Singletary Lake State Park, 1973, *J.P. Dey 7295* (NY); Bay Tree Lake State Park, sand ridge 0.6 mi SE of NC41, 0.3 mi W of shore of Bay Tree Lake, 2016, *J.C. Lendemer 48361* (NY); Jones Lake Park, midpoint of Campground Loop at spur to Group Camping Area, 0.5 mi W of NC242, 0.2 mi S of Shore of Jones Lake, 2016, *J.C. Lendemer 48495* (NY); Jones Lake State Park, 1973, *J.P. Dey 7379* (NY); S of NC 41 along N shore of Bay Tree Lake, 2002, *R.C. Harris 46066* (NY); **Bladen Co.:** Jones Lake State Park, Salters Lake Natural Area, 2016, *J.C. Lendemer 48403* (NY). **Camden Co.:** North River Game Land, E end of Indian Island, N of Indian Island Rd./Sassafras Lane, 3 mi E of Sandy Hook Rd., 2012, *J.C. Lendemer 31293* (NY); Dismal Swamp State Park, S side of Kim Saunders Ditch, at 5 mi marker, 2009, *J.C. Lendemer 20199* (NY). **Carteret Co.:** Harker's Island, 1973, *J.P. Dey 6874* (NY). **Cumberland Co.:** Suggs Mill Pond Game Land, 0.1-0.2 mi E of NC53 0.4 mi N of Jessups Pond, 2013, *J.C.*



*Lendemer 39543* (NY). **Dare Co.:** Alligator River National Wildlife Refuge, W of Milltail Rd., 0.4 mi N of bridge at Milltail Creek, 6 mi S of jct w/ US642012, *J.C. Lendemer 34248A* (NY); Alligator River National Wildlife Refuge, SE of jct of Butler Road and Sandy Ridge Road, 0.6 mi NW of jct w/ Milltail Rd., 2014, *J.C. Lendemer 42880* (NY); Alligator River National Wildlife Refuge, W of US264, 1 mi N of jct w/ Borrow Pit Rd., 4 mi S of jct w/ US64, 2013, *J.C. Lendemer 36706* (NY). **Gates Co.:** Rt. 158, 2 mi E of Sunbury, 1964, *C.F. Reed 139521* (NY). **Haywood Co.:** Great Smoky Mountains National Park, W-facing slopes above Caldwell Fork, Caldwell Fork Trail 0.3 mi S of jct w/ McKee Branch Trail, 2017, *J.C. Lendemer 53109* (NY); Great Smoky Mountains National Park, Cataloochee School Foot Bridge area, 2000, *J.P. Dey 29620* (NY); Great Smoky Mountains National Park, Cataloochee, road to Sterling Gap, 2010, *J. Hollinger 20100411.7* (NY). **Hyde Co.:** Alligator River National Wildlife Refuge, Chip Rd. 2 mi SW of jct w/ Whipping Creek Rd, 2014, *J.C. Lendemer 43128* (NY). **Lee Co.:** 11 mi S of Sanford on US1, 1973, *J.P. Dey 7038* (NY). **Martin Co.:** Rt. 17, 3 mi S of Williamston, 1964, *C.F. Reed 139820* (NY). **Onslow Co.:** Stones Creek Game Land, Deer Lane 0.7 mi W of NC17, between NC172 and NC2102013, *J.C. Lendemer 39104* (NY). **Orange Co.:** Concrete Bridge Rd. off Mt. Sinai Rd. in Duke Forest, 1972, *J.P. Dey 362* (NY). **Stokes Co.:** Hanging Rock State Park, 1973, *J.P. Dey 7237* (NY). **Swain Co.:** Great Smoky Mountains National Park, Wolf Ridge Trail, S of jct w/ Twentymile Loop Trail but N of jct w/ Twentymile Trail, 2010, *E.A. Tripp 1415* (NY); Great Smoky Mountains National Park, Tunnel Bypass Trail at terminus of Lakeview Drive, 2011, *J.C. Lendemer 29570* (NY). **Transylvania Co.:** Gorges State Park, Bearwallow Fields, 2005, *J.C. Lendemer 4601* (NY). **Wake Co.:** William B. Umstead State Park, vicinity of lower Sycamore Lake, ca. 1 mi SW of Ebenezer Church, 2007, *J.C. Lendemer 8352* (NY). **Washington Co.:** Bull Neck Swamp, Deep Creek Rd., N of jct w/ Bear Lane, 2013, *J.C. Lendemer 36378* (NY). **SOUTH CAROLINA. Abbeville Co.:** Sumter National Forest, Parsons Mountain, from jct of FSR515 and 515B to summit, 1997, *R.C. Harris 40317* (NY). **Aiken Co.:** The Hitchcock Woods, just SW of city of Aiken, along Tea Cottage Path from entrance on Dibble Road to Barton's Pond Bridge, 2010, *J.C. Lendemer 22122* (NY). **Berkeley Co.:** Francis Marion National Forest, vicinity of FS 212 and FS 5216, 2.4 mi SW of jct of FS 212 and FS 204, 2013, *J.C. Lendemer 40838* (NY); Berkeley Co., Francis Marion National Forest, FS 110/Walleye Rd., 1.0 mi NW jct w/ FS 118/Strawberry Rd., *R.C. Harris 59938* (NY); Francis Marion National Forest, FS 204F 0.25 mi S of McConnel's Landing, S of the South Santee River, 2013, *J.C. Lendemer 40876* (NY). **Charleston Co.:** Francis Marion National Forest, Wambaw Swamp, ~0.1 mi W of Elden Rd./FS C-10-217, 2013, *R.C. Harris 59430* (NY); Francis Marion National Forest, Little Wambaw Swamp, E of terminus of FS 217B, 2013, *R.C. Harris 59457* (NY); Francis Marion National Forest, 0.5 mi E of Wambaw Creek, 0.25 mi W of Mill Branch Rd./FS 211, 0.8 mi N of jct w/ FS 211-D and FS 2102013, *J.C. Lendemer 40519* (NY). **Richland Co.:** Fort Jackson Army Base, Skyline Drive Scenic Area, 1997, *R.C. Harris 40002* (NY). **TENNESSEE. Blount Co.:** Great Smoky Mountains National Park, Rabbit Creek Trail bottomland on E side of Abrams Creek near Abrams Creek Range Station, 2004, *J.P. Dey 32656* (NY); Great Smoky Mountains National Park, ridge N of summit of Pine Mountain, along Rabbit Creek Trail, 2004, *J.P. Dey 32720* (NY), *J.P. Dey 32738* (NY); Great Smoky Mountains National Park, Cooper Road Trail from Abrams Creek Campground along Abrams Creek and then Kingfisher Creek, 1998, *J.P. Dey 30632* (NY). **Sevier Co.:** Great Smoky Mountains National Park, Oliver Branch stream area, 0.3 mi E of Tipton Place on Cades Cove Loop Rd., 2004, *J.P. Dey 32874* (NY); Great Smoky Mountains National Park, Sea Branch stream area, 0.3 mi E of Sparks Lane on Cades Cove Loop Rd., 2004, *J.P. Dey 32904* (NY). **VIRGINIA. Cheasapeake City, Deep Creek, 1935, G.P. Anderson s.n.** (NY). **Lancaster Co.:** Merry Point, 1962, *C.F. Reed 57549* (NY). **Suffolk City:** near Myrtle, 1964, *C.F. Reed 66569* (NY). Great Dismal Swamp National Wildlife Refuge, Jericho Ditch, 1 mi S of jct with Lynn Ditch, 2009, *B.P. Hodkinson 11212* (NY)