

Lepraria normandinoides, a New Widespread Species from Eastern North America

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ABSTRACT. – *Lepraria normandinoides*, a new species found to be widely distributed in eastern North America, USA is described.

INTRODUCTION

For some time we have been aware of the occurrence of a species of *Lepraria* in eastern North America, comparable to *L. nivalis* J.R. Laundon in chemistry, but quite different in morphology and ecology. The second author encountered this taxon when he began studying *Lepraria* in the late 1970's and at first annotated specimens as "*L. lobificans* Nyl. s. lat." because of a perceived similarity to French material identified by Nylander as *L. lobificans* but differing in chemistry. We have referred to the species in previous publications as "*Lepraria* sp." or, more recently as "*Lepraria normandinoides* ined.", the latter name having been derived from the resemblance of the lobes of the thallus to the squamules of *Normandina pulchella* (Borr.) Nyl. We have now had the opportunity to compare material of this species to a paratype of *L. nivalis*, and have collected abundant material to serve as types. The description of this new species adds to our growing knowledge of North American *Lepraria* (Knudsen et al. 2006, 2007; Knudsen and Elix in press., Lendemer 2005).

METHODS

During field work throughout North America we have actively collected all material potentially referable to the genus *Lepraria*, hundreds of collections, and have routinely encountered *Lepraria normandinoides* in eastern North America. The chemistry of our specimens has routinely been studied with thin layer chromatography (TLC) using solvents A, C, and G following the standardized methods of Culberson and Kristinsson (1970) and Culberson et al. (1981). A representative (see discussion of chemistry) specimen of *L. normandinoides* was also studied using HP-TLC by Jack Elix. The morphology of specimens has been examined using standard light microscopy. Measurements were obtained from hand cut sections of the thallus mounted in water. Illustrations were prepared using a Nikon CoolPix 950 digital camera with the aid of Adobe Photoshop CS2.

TAXONOMIC SECTION

***Lepraria normandinoides* Lendemer and R.C. Harris sp. nov.**

Thallus leprosus stratosus robustus lobatus lacteus tenuis, rhizohyphis brunneolis ad substratum laxae affixus, acidum atranoricum, roccellicum, et protocetraricum vel fumaprotocetraricum continens.

TYPE: **USA.** NORTH CAROLINA. TRANSYLVANIA CO.: Nantahala National Forest, Shower Falls, along Cold Mountain Road, south slope of Panthertail Mountain, Lake Toxaway Quad., elev. 3500 ft., 35° 09' 34"N, 82° 58' 26"W, small roadside waterfall over gneiss, on gneiss overhang, 29.v.2006, J.C. Lendemer et al. 7001 (NY!, holotype; isotypes to be distributed in *Lichens of Eastern North America V*: 221).

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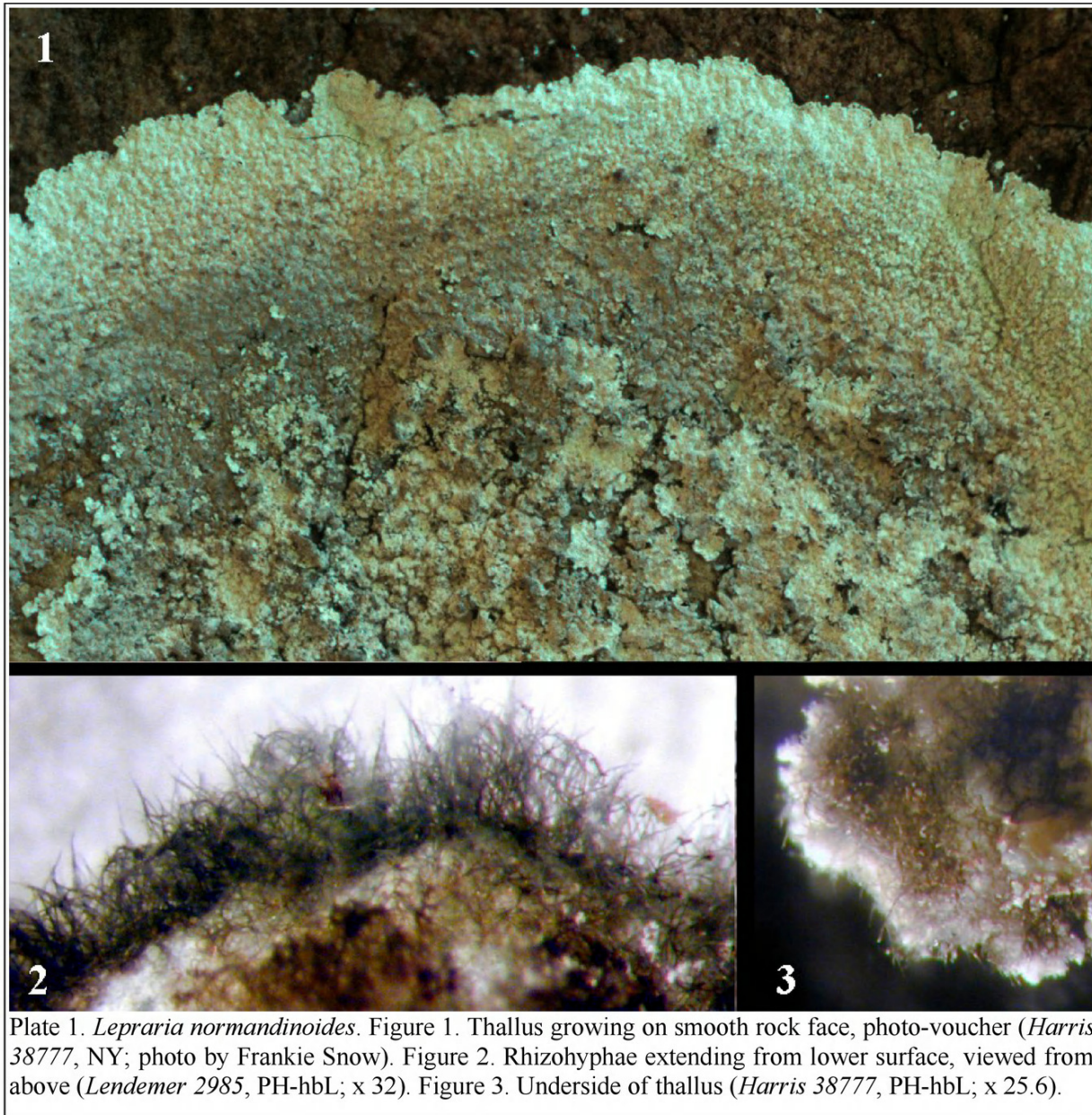


Plate 1. *Lepraria normandinoides*. Figure 1. Thallus growing on smooth rock face, photo-voucher (Harris 38777, NY; photo by Frankie Snow). Figure 2. Rhizohyphae extending from lower surface, viewed from above (Lendemer 2985, PH-hbL; x 32). Figure 3. Underside of thallus (Harris 38777, PH-hbL; x 25.6).

DESCRIPTION. — **Thallus** saxicolous or corticolous, crustose, weakly anchored to the substrate by rhizohyphae, easily detached in large pieces, distinctly bluish-white, to greenish-blue when growing in shaded situations, forming scattered isolated thalli consisting of isolated lobes or a continuous well developed crust with marginal lobes resembling *Normandina pulchella* in overall aspect (having thickened margins); **upper surface** continuous, composed of $\pm$ globose soredia held together by a network of gelatinized hyphae; **medulla** prosoplectenchymatous, composed of anticlinal hyaline hyphae coated with irregular POL+ crystals; **lower surface** pale, underlain by rhizohyphae; **rhizohyphae** branching, extending from the medulla to anchor the thallus to the substrate; **soredia** 30-60 μ m in diameter, without projecting hyphae; **hyphae** 3-5 μ m wide, septate, branching, hyaline above (upper surface, medulla, lower surface) and brown in the rhizohyphae; **crystals** calcium oxalate[?], small, irregular, coating hyphae of the upper surface and medulla, POL+, not dissolving in KOH; **photobiont** green, coccoid, 7-10 μ m in diameter.

CHEMISTRY. — Three chemotypes of *Lepraria normandinoides* have been observed in North America. HP-TLC of a specimen of chemotype I (Lendemer 2182, UCR!) revealed a trace of virensic acid, this substance was not routinely detected by our TLC.

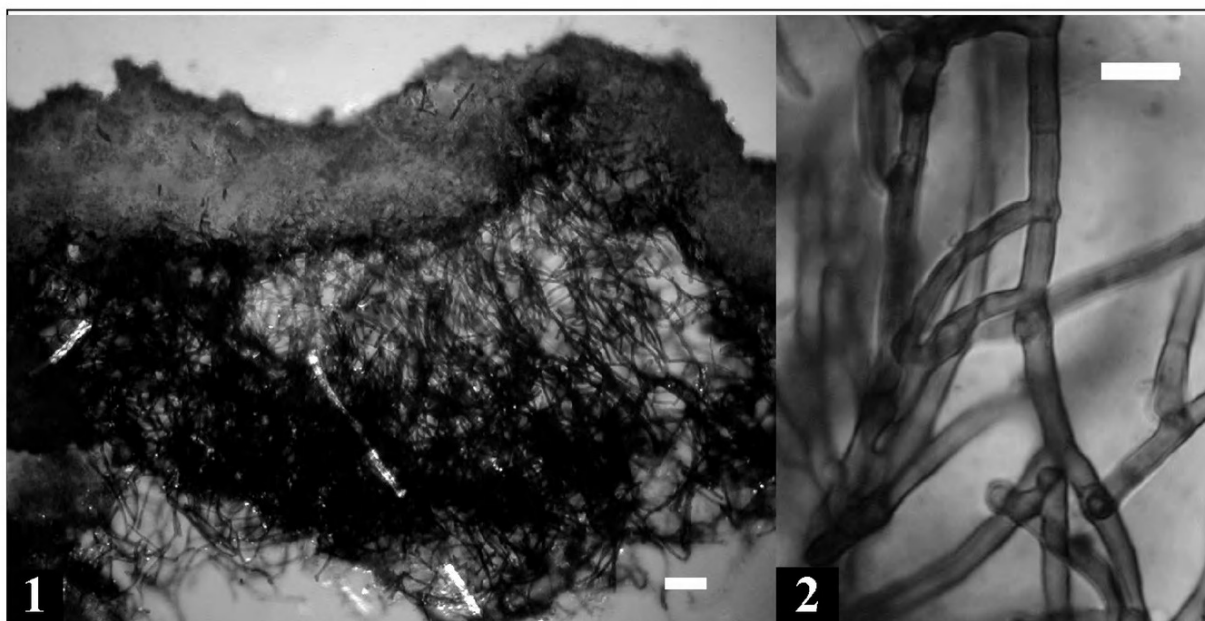


Plate 2. *Lepraria normandinoides*. Figure 1. Section through thallus illustrating well developed rhizohyphae extending from medulla (Lendemer 2985, PH-hbL; scale = 50um). Figure 2. Detail of rhizohyphae (Lendemer 2985, PH-hbL; scale = 10um).

CHEMOTYPE I – TLC: atranorin, protocetraric acid (major), roccellic/angardianic acid; spot tests: K+ yellow, C–, KC+ yellowish, PD+ orange/red.

CHEMOTYPE II – TLC: atranorin, fumarprotocetraric acid (major), protocetraric acid (minor), roccellic/angardianic acid; spot tests: K+ yellow, C–, KC+ yellowish, PD+ orange/red.

CHEMOTYPE III – TLC: atranorin, roccellic/angardianic acid; spot tests K+ yellow, C–, KC+ yellowish, PD–.

DISTRIBUTION. – *Lepraria normandinoides* is widely distributed in eastern North America, having a primarily Appalachian distribution (cf. Brodo et al. 2001) with a disjunct population in the Ozarks. Scattered collections are also known from the Coastal Plain, Great Lakes, and Piedmont Regions. The fumarprotocetraric acid and protocetraric acid chemotypes are widely distributed. As is illustrated by the distribution maps and cited specimens the protocetraric acid chemotype, represented by 127 of 155 specimens examined, is considerably more common than the fumarprotocetraric acid chemotype. The fumarprotocetraric and protocetraric acid deficient chemotype is rare and only known from the northern edge of the range of the species where it occurred as an admixture with the protocetraric acid chemotype

ECOLOGY. – *Lepraria normandinoides* occurs on the bark of hardwood trees and on acidic rocks in semi-shaded sites with moderate to high humidity. When growing on rocks the species is most often found on vertical faces and, as in the type collection, on the exposed (not fully shaded) portions of massive rock overhangs. While showing a preference for wet rocks and seepage faces the species is not found in drainages where water is constantly flowing but rather, in adjacent areas that are not continuously wet.

DISCUSSION. – The presence of atranorin and protocetraric (or chemically related fumarprotocetraric acid) in *Lepraria normandinoides* would clearly lead one to compare the new species to the chemically similar *L. nivalis* J.R. Laundon. The new species is easily separated from *L. nivalis* by the presence of rhizohyphae, smaller soredia, the production of roccellic/angardianic acid in addition to atranorin and protocetraric or fumarprotocetraric acid, and preference for acidic rocks and the bark of hardwoods. As may be inferred from the above, *L. nivalis* lacks well developed rhizohyphae, has large soredia, does not produce fatty acids, and is a species primarily of calcareous rocks (Laundon 1992).

In eastern North America *L. normandinoides* cannot easily be confused with any other species as the combination of a lobed thallus, production of atranorin and protocetraric/fumarprotocetraric acid, and rhizohyphae are distinctive. In the field *L. lobificans* Nyl. can be confused with the new species, *L. lobificans* is easily recognized by the green color of the thallus, different chemistry (atranorin, zeorin, stictic acid syndrome), and the absence of rhizohyphae.

As noted by Laundon (1992) the type of *L. nivalis* lacks the fatty acid present in *L. normandinoides*. Considering the chemical and morphological similarities between *L. nivalis* s. str. (as typified and described by Laundon) and *L. normandinoides* it is likely that most reports of *L. nivalis* from North America belong to *L. normandinoides*. Further study is required to determine if *L. nivalis* s. str. occurs in North America. The morphological, ecological, and chemical differences between *L. nivalis* s. str. and *L. normandinoides* however, readily serve to separate the species.

SELECTED SPECIMENS EXAMINED. **CHEMOTYPE I – CANADA.** QUEBEC. HAUT SAINT MAURICE Co.: *Anselm* 11296 (NY!). **USA.** ALABAMA. CLAY Co.: Talladega National Forest, *Harris* 28390 (NY!). JACKSON Co.: Pisgah, *Harris* 43351 (NY!). ARKANSAS. FRANKLIN Co.: Ozark National Forest, Boston Mountain Ranger District, *Harris* 49274 (NY!). NEWTON Co.: Ozark National Forest, *Lendemer* 6557 (NY!). CONNECTICUT WINDHAM Co.: Town of Ashford, *Harris* 46109 (NY!). GEORGIA. APPLING Co.: Along Co. Rd. 341, *Harris* 36403 (NY!). COFFEE Co.: Broxton Rocks Ecological Preserve, *Harris* 32707 (NY!). DEKALB Co.: DeSoto State Park, *Buck* 34741 (NY!). EMANUEL Co.: 1.5 miles N of US 80 on Foskey Rd., *Harris* 36299 (NY!). JEFF DAVIS Co.: 0.4 mi E of Coffee County Line, *Harris* 38777 (NY!). JOHNSON Co.: 2 miles N of Adrian, *Harris* 36287 (NY!). LAURENS Co.: *Harris* 36346 (NY!). PUTNAM Co.: Oconee National Forest, *Harris* 38707 (NY!). RABUN Co.: Lake Burton Wildlife Management Area, *Lendemer* 7547 (NY!). WALKER Co.: Chattahoochee National Forest, Keown Falls, *Harris* 28273 (NY!). WASHINGTON Co.: ~3 miles N of Harrison, *Harris* 36270 (NY!). ILLINOIS. GALLATIN Co.: Shawnee National Forest, Indian Wall Recreation Area, *Buck* 35936 (NY!). JACKSON Co.: Shawnee National Forest, *Skorepa* 2247 (NY!). POPE Co.: Shawnee National Forest, Burden Falls, *Phillippe* 28777 (NY!). RANDOLPH Co.: Piney Creek Ravine Nature Preserve, *Harris* 50566 (NY!). KENTUCKY. BATH Co.: Daniel Boone National Forest, *Harris* 36882 (NY!). LETCHER Co.: Bad Ranch Nature Preserve, *Harris* 27023 (NY!). MAINE. HANCOCK Co.: N. of ME 182, 8 mi W of junct. Of Unionville Rd., *Harris* 53043 (NY!). OXFORD Co.: Berry Ledge, *Parlin* 9897 (NY!). MARYLAND. BALTIMORE Co.: Harford Road Bridge, Gunpowder Falls, *Plitt* 328 (NY!). CECIL Co.: Rock Creek Rd. off Rt. 273, *Reed* 126440 (NY!). MASSACHUSETTS. BERKSHIRE Co.: Bartholomew's Cobble, NW of Ashley Falls, *Harris* 13540 (NY!). MINNESOTA. SAINT LOUIS Co.: Voyageurs National Park, *Wetmore* 39989p.p. (NY!). MISSISSIPPI. TISHOMINGO Co.: Tishomingo State Park, *Harris* 28584 (NY!). MISSOURI. CARTER Co.: Bluff on E. side of Current River, *Harris* 25660 (NY!). DADE Co.: Bona Glade Natural Area, *Harris* 50888 (NY!). IRON Co.: E slope of Royal Gorge, *Harris* 21781 (NY!). LAWRENCE Co.: Fall Hollow Gorge, *Lendemer* 6183 (NY!). MADISON Co.: Amadon State Forest, *Ladd* 12951 (NY!). NEWTON Co.: Wildcat Glade Natural Area, *Buck* 42997 (NY!). REYNOLDS Co.: St. Francis Mountains, Johnson Shut-Ins State Park, *Harris* 31254 (NY!). SAINT GENEVIEVE Co.: S of Sprott, *Wilhelm* 13676 (NY!). NEW YORK. DUTCHESS Co.: Town of Red Hook, *BF100* (NY!). ESSEX Co.: Town of Keene, *Harris* 50039 (NY!). GREENE Co.: Catskill Park, Devil's Path, *Harris* 38516 (NY!). JEFFERSON Co.: Wellesley Island State Park, *Harris* 16746 (NY!). ORANGE Co.: Harriman State Park, *Harris* 42144 (NY!). ROCKLAND Co.: Bear Mountain State Park, *Harris* 13385 (NY!). ULSTER Co.: Catskill Mountains, *Harris* 30497 (NY!). WARREN Co.: Crane Mountain, *Harris* 30578 (NY!). WESTCHESTER Co.: Croton Dam Rd., *Prince* 75-65 (NY!). NORTH CAROLINA. CLAY Co.: Standing Indian Wildlife Management Area, *Lendemer* 7909 (NY!). JACKSON Co.: Nantahala National Forest, Panthertown Valley, *Lendemer* 6977 (NY!). MACON Co.: Ravenel Park, *Lendemer* 7003 (NY!). MITCHELL Co.: Pisgah National Forest, Roan High Bluff, *Harris* 30914 (NY!). SWAIN Co.: Great Smoky Mountains National Park, Hughes Ridge Trail, *Harris* 10795 (NY!). TRANSYLVANIA Co.: Gorges State Park, *Lendemer* 4566 (NY!). OHIO. GALLIA Co.: Wayne National Forest, *Lendemer* 7437 (NY!). SCIOTO Co.: Shawnee State Forest, *Lendemer* 7173 (NY!). OKLAHOMA. CHEROKEE Co.: J.T. Nickel Family Nature and Wildlife Preserve, *Harris* 44331 (NY!). PENNSYLVANIA. BUCKS Co.: Nockamixon State Park, *Lendemer* 1964 (NY!). MONTGOMERY Co.: Fulshaw Craig Preserve, *Lendemer* 1868 (NY!). PIKE Co.: Delaware Water Gap National Recreation Area, *Lendemer* 2464 (NY!). SULLIVAN Co.: Worlds End State Park, *Lendemer* 5277 (NY!). RHODE ISLAND. PROVIDENCE Co.: Town of Lincoln, *Harris* 53210 (NY!). SOUTH CAROLINA. GREENVILLE Co.: Along US 276, 0.2 mi downhill of Bald Rock, *Harris* 43449 (NY!). LANCASTER Co.: Forty Acer Rock Heritage Preserve, *Harris* 43457 (NY!). LEXINGTON Co.: Peachtree Rock Nature Preserve, *Harris* 39954 (NY!). TENNESSEE. MONROE Co.: Cherokee National Forest, *Harris* 32915 (NY!). SCOTT Co.: Big South Fork National River, *Harris* 32967 (NY!). VIRGINIA. PATRICK Co.: Blue Ridge Parkway, Rock Castle Gorge Loop, *Harris* 36656 (NY!). WEST VIRGINIA. GRANT Co.: Greenland Gap, *Harris* 44846 (NY!). GREENBRIER Co.: Wades Draft, *Harris* 44035 (NY!). MORGAN Co.: Rte. 8, S of Cacapon, *Reed* 11125 (NY!). POCAHONTAS Co.: Watoga State Park, *Harris* 43957 (NY!). TUCKER Co.: Monogahela National Forest, Fernow Experimental Forest, *LaGreca* 805 (NY!).

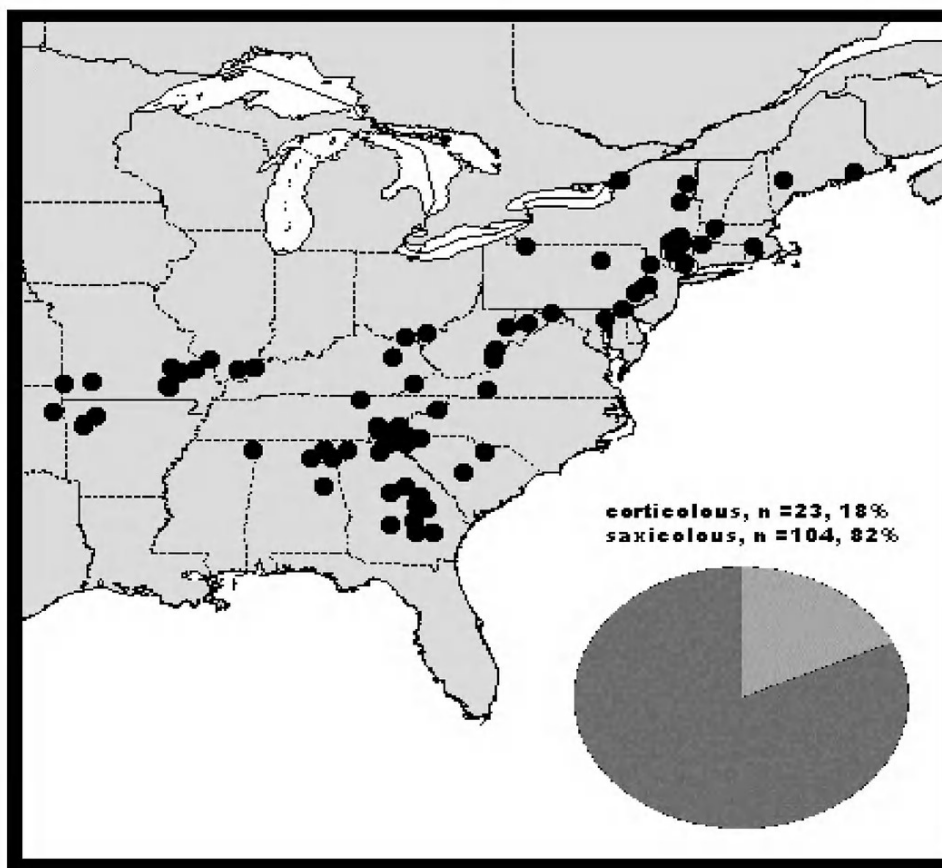
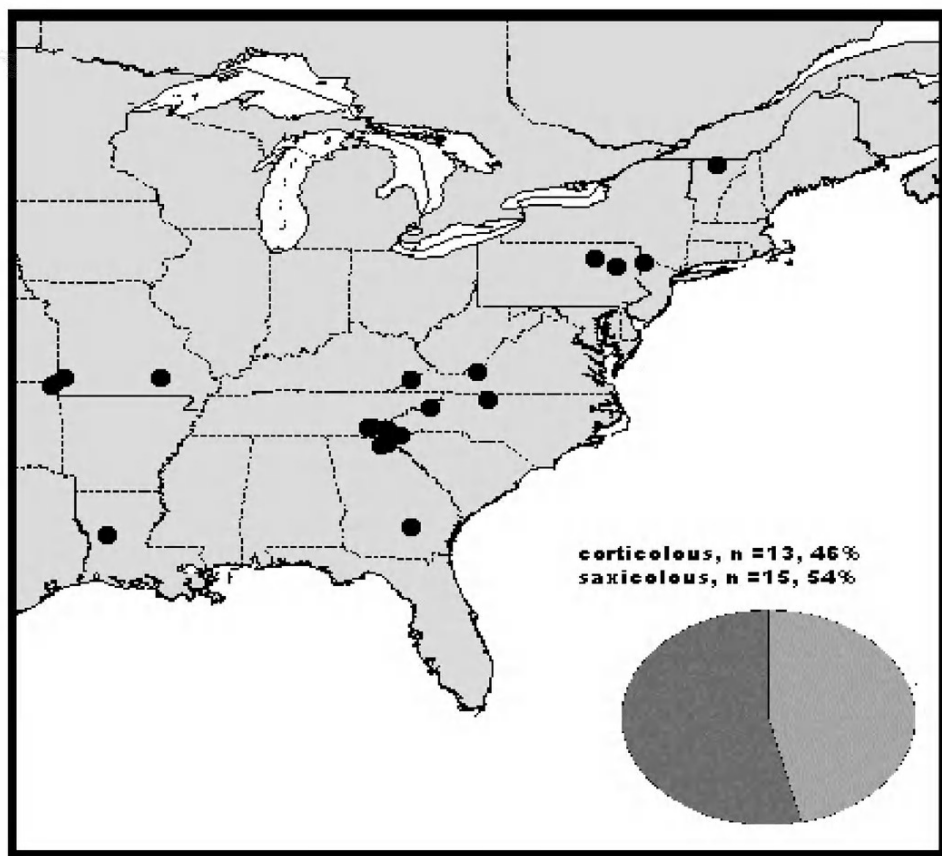


Plate 3. *Lepraria normandinoides*. Distribution of the protocetraric acid chemotype (bottom) and the fumarprotocetraric acid chemotype (top) in eastern North America.

SELECTED SPECIMENS EXAMINED. **CHEMOTYPE II. – USA.** ARKANSAS. STONE CO.: Ozark National Forest, City Rock Bluff Special Interest Area, *Harris 51247* (NY!). GEORGIA. COFFEE CO.: Pond Drain, *Harris 36683* (NY!). KENTUCKY. LETCHER CO.: Bad Branch Nature Preserve, *Harris 27016* (NY!). LOUISIANA. NATICHITOCHES PARISH.: Kisatchie National Forest, *Pruski 2472* (NY!). MISSOURI. NEWTON CO.: Wildcat City Park, S edge of Joplin, *Harris 46781* (NY!). SHANNON CO.: Ozark National Scenic Riverways, Rocky Falls, *Harris 25576* (NY!). NEW YORK. GREENE CO.: Catskill Mountains, Mink Hollow Trail, *Harris 32861* (NY!). NORTH CAROLINA. GRAHAM CO.: Nantahala National Forest, Cherohala Skyway, *Harris 41007* (NY!). HAYWOOD CO.: Great Smoky Mountains National Park, 3 miles SE of Waterville, *Lendemer 8188* (NY!). MACON CO.: Nantahala National Forest, Wayah Bald, *Harris 40970* (NY!). STOKES CO.: Hanging Rock State Park, *Harris 30709* (NY!). OKLAHOMA. OTTAWA CO.: N of E0060 Rd., *Harris 44436* (NY!). PENNSYLVANIA. PIKE CO.: Delaware Water Gap National Recreation Area, *Lendemer 3421* (NY!). SULLIVAN CO.: Worlds End State Park, *Lendemer 5289* (NY!). LUZERNE CO.: Nescopeck State Park, *Lendemer 3999* (NY!). TENNESSEE. CARTER CO.: Roan Mountain, *Harris 18359* (NY!). TEXAS. LLANO CO.: sine loc., *Whitehouse 48* (NY!). VERMONT. ORLEANS CO.: Town of Westfield, *Harris 51347* (NY!). VIRGINIA. GILES CO.: Mountain Lake Biological Station, *Harris 36718* (NY!).

SPECIMENS EXAMINED. **CHEMOTYPE III. – MINNESOTA.** SAINT LOUIS CO.: Voyageurs National Park, *Wetmore 39989p.p.* (NY!). NEW YORK. ESSEX CO.: Chapel Pond, *Lendemer et al. 2985pp.* (PH-HBL!).

SPECIMENS OF *LEPRARIA NIVALIS* EXAMINED. **ENGLAND. NORTH-WEST YORKSHIRE:** Muker, Keld, West Wood, dominant on shaded vertical limestone in gorge, growing over *Dermatocarpon miniatum* in places, 3.viii.1979, *Laundon 3076* (NY!, PARATYPE). **IRELAND.** Fermanagh, Marlbank, on vertical limestone cliff, on mosses, 1992, *Fox s.n.* (NY!).

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