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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 laxe 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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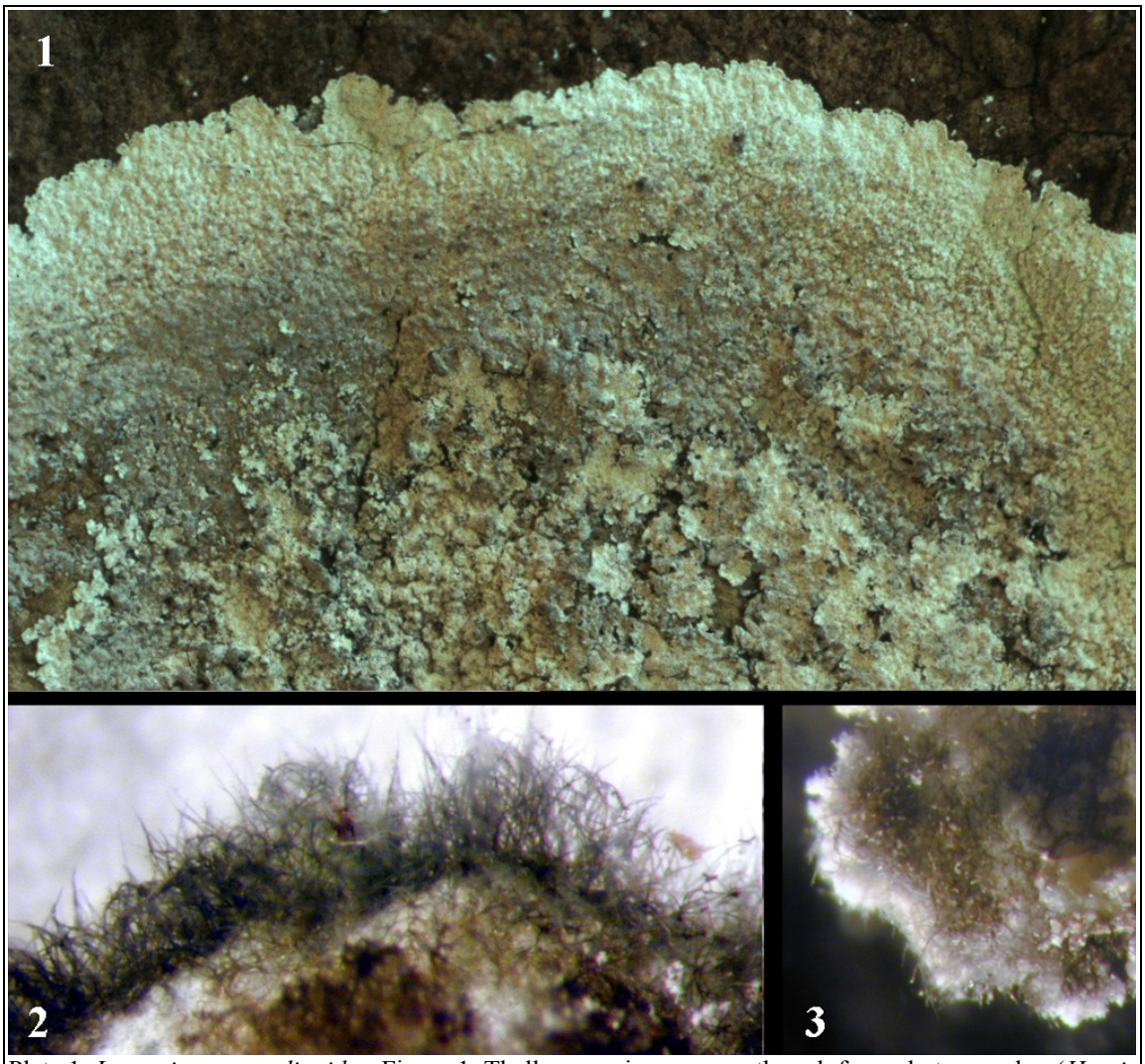


Plate 1. *Lepraria normandinoides*. Figure 1. Thallus growing on smooth rock face, photo-voucher (*Harris 38777*, NY; photo by Frankie Snow). Figure 2. Rhizohyphae extending from lower surface, viewed from above (*Lendemer 2985*, PH-hbL; x 32). Figure 3. Underside of thallus (*Harris 38777*, PH-hbL;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

Descrpition. – **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 ± 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** 30-60µm in diameter, without projecting hyphae; **hyphae** 3−5µm 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, 7-10µm 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.

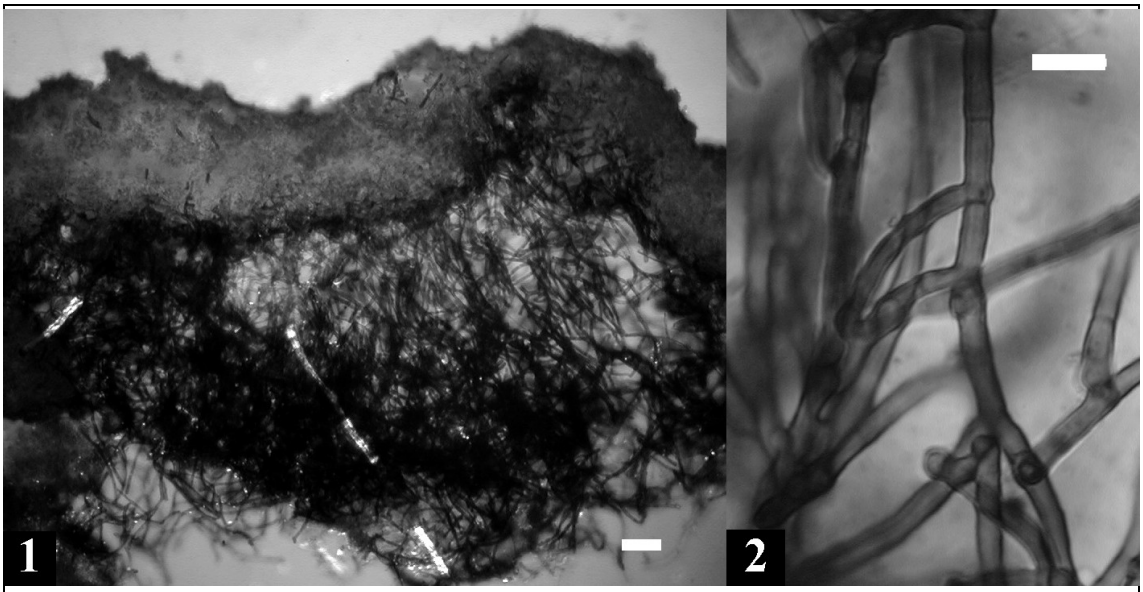


Plate 2. *Lepraria normandinoides*. Figure 1. Section through thallus illustrating well developed rhizohyphae extending from medulla (*Lendemer 2985*, PH-hbL; scale = 50um). Figure 2. Detail of rhizohyphae (*Lendemer 2985*, PH-hbL; scale = 10um).

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

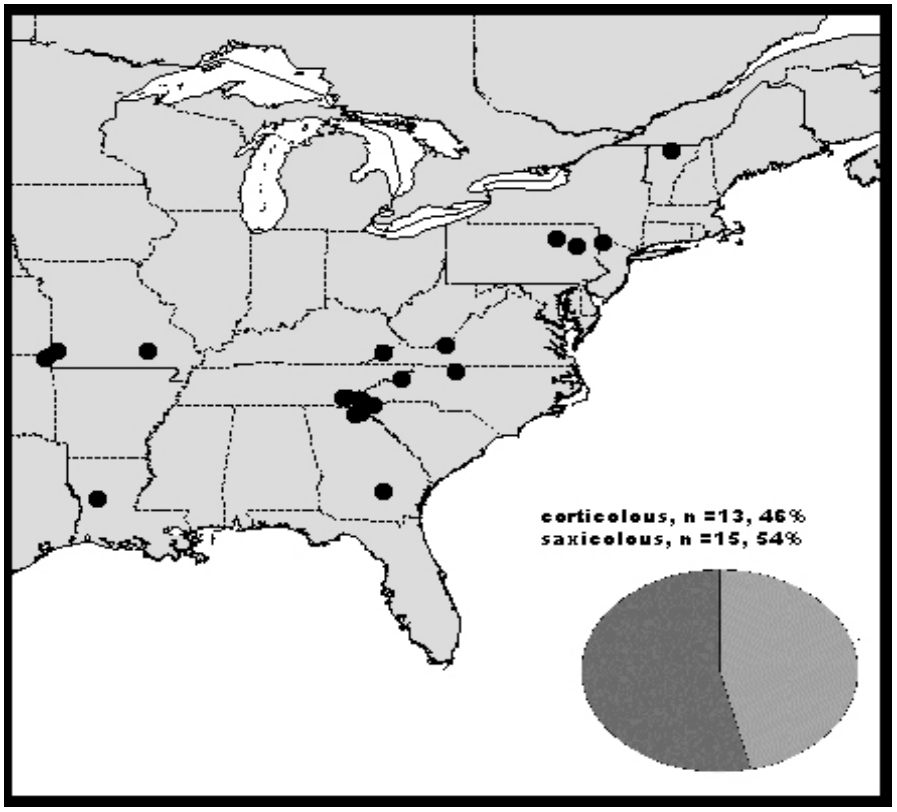
Ecology. – *Lepraria normandinoides* occurs on the bark of hardwood trees and on acidic rocks in semi-shaded sites with moderate to high humidity. When growing on rocks the species is most often found on vertical faces and, as in the type collection, on the exposed (not fully shaded) portions of massive 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 by 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!).



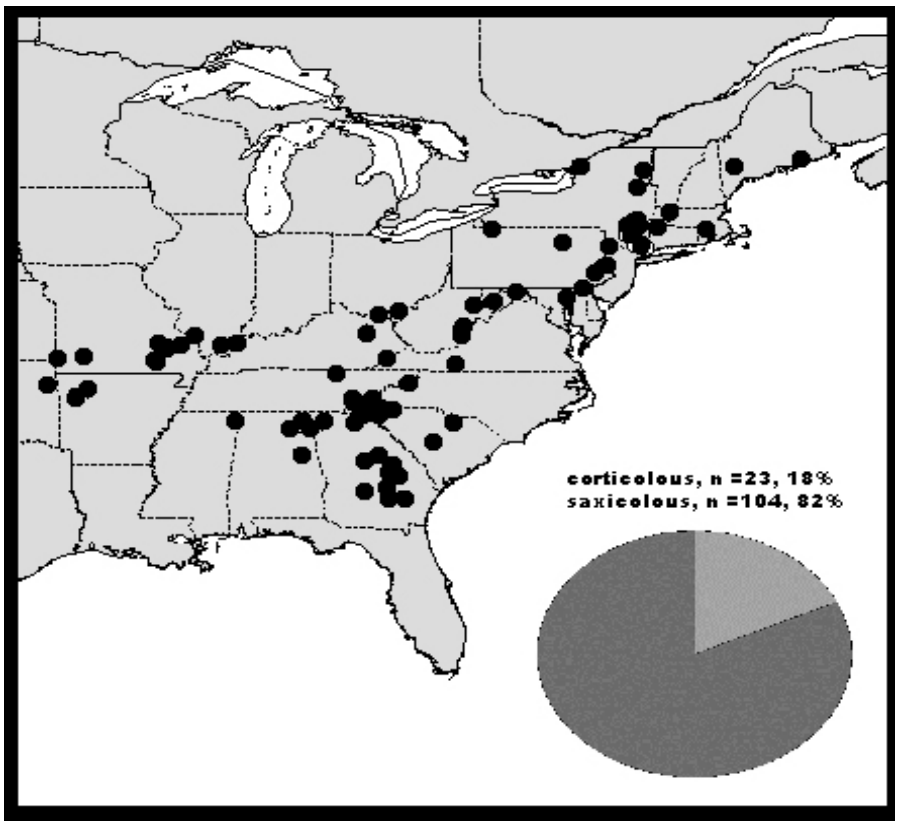


Plate 3. *Lepraria normandinoides.* Distribution of the protocetraric acid chemotype (bottom) and the fumarprotocetraric acid chemotype (top) in eastern North America.

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!).

Acknowledgements

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