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# A Taxonomic Study of the Lichen Genera Canomaculina, Canoparmelia and Rimelia in the Great Smoky Mountain National Park

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## ABSTRACT

The 1997 National Park Service checklist of lichen species in the Great Smoky Mountains National Park (GSMNP) included only two *Rimelia* species (*R. reticulata* and *R. subisidiosa*), two *Canoparmelia* species (*C. caroliniana* and *C. crozalsiana*) and one *Canomaculina* species (as *Rimeliella subtinctorium*). Previous field and laboratory work by Jonathan Dey, often with Illinois Wesleyan University undergraduate student assistants, pointed to the presence of additional species of *Rimelia* in the GSMNP. Thus, we examined all specimens of *Rimelia*, *Canoparmelia* and *Canomaculina* previously collected in the GSMNP and deposited in the lichen herbarium at Illinois Wesleyan University in order to update the species list for the park for these three genera.

As a result of this study, five species of *Rimelia* are now known to occur in the GSMNP. *R. commensurata* and *R. simulans* are newly reported in the park to go with *Rimelia cetrata* (noted in the 2005 version of the checklist) and the previously known *R. reticulata* and *R. subisidiosa*. *Rimelia diffractaica* occurs in the Southern Appalachian Mountain regions but has not yet been found in the park. *Canoparmelia amabilis* is tentatively added to the species checklist for the park bringing the total *Canoparmelia*

species to three—*C. amabilis*, *C. caroliniana* and *C. crozalsiana*. *Canomaculina subtinctoria* remains the only *Canomaculina* species reported in the park.

Descriptions of the genera, keys to the species in each genus, and species descriptions are presented. Data include morphological characters, secondary product chemistry, local ecology, general distribution, GSMNP distribution map, and a list of specimens examined for each species. Data from IWU herbarium specimens of related species that occur in the southeastern United States are also presented. Some of these species might one day be found in the park.

This study is a part of the All Taxa Biodiversity Inventory (ATBI) of the GSMNP, a large endeavor where scientists and educators are working collaboratively to determine all the organisms that can be found in the park.

## WHAT ARE LICHENS?

Lichens are fungi that form unique composite thalli that resemble neither the fungus nor its photosynthetic partner. Lichens consist of a mycobiont (fungus) and a photobiont (green algae or cyanobacteria) that are in a symbiotic relationship with each other. The mycobiont provides shade and protection for the photobiont, and the photobiont provides organic and inorganic nutrients for the mycobiont. This symbiotic relation allows lichenized fungi to live on and in substrates that often are not hospitable for free-living fungi.

Lichens exhibit extremely diverse morphologies that can be lumped into three broad categories of growth forms--foliose, fruticose, and crustose. Select foliose lichens will be the main focus of this research investigation. Foliose lichens are often termed "leaf like" in that

they have flattened lobes that have distinctive upper and lower surfaces. This growth form usually lays flat on a substrate such as bark or a rock and may be loosely attached to strongly adnate via holdfast structures (rhizines or holdfasts). Foliose thalli usually can be removed from their substrate without severe damage to the lichen. In contrast fruticose lichens are often shrub-like or beard-like thalli with limited points of attachment to their substrates. Crustose lichens often look like paint splotches on trees and rocks and cannot be removed from the substrate without also taking part of the substrate with the specimen.

Foliose lichens can be differentiated from each other based on their morphology including thallus and lobe dimensions and shape; upper and lower cortex color and characteristics such as the presence or absence of cilia, rhizines, and sexual and asexual reproductive structures; and internal anatomy. These lichens can also be differentiated based on chemical spot test reactions, the underlying secondary product chemicals produced, local ecology, and general distribution information.

Approximately 20,000 species of lichens have been described worldwide. Lichenologists are working to identify and determine the diversity and occurrence of these organisms in various parts of the world. One such lichen biodiversity inventory is being conducted in the Great Smoky Mountains National Park (GSMNP). This particular lichen inventory is a small part of a much larger inventory of the GSMNP, called the All Taxa Biodiversity Inventory (ATBI). Scientists and educators are working collaboratively to examine the estimated 100,000 species of living organisms that can be found in the park (www.dlia.org). This ATBI of the park is a collaborative effort between US Park Service

GSMNP and a nonprofit organization called Discover Life in America. Besides determining the biodiversity of the GSMNP, a second goal is to encourage other organizations to start up their own ATBI projects all over the world. Thus, the purpose of this study is to contribute information regarding lichen genera and species that can be found in the park to the US Park Services, GSMNP. The study reported here is a subset of Jonathan Dey's ongoing work in the GSMNP.

## *CANOMACULINA, CANOPARMELIA* AND *RIMELIA*—THREE LICHEN GENERA

*Canomaculina, Canoparmelia and Rimelia* are members of the family *Parmeliaceae,* and all three were at one time included within the genus *Parmelia.* Mainly as a result of Mason Hale's influence in the 1970s to 1990s, the genus *Parmelia* was reexamined with great scrutiny, and eventually other genera were differentiated from *Parmelia* based on differences in thallus morphology, anatomy and secondary metabolites. In 1974, Hale segregated several species of *Parmelia* into the genera *Parmotrema* and *Pseudoparmelia. Parmotrema* is characterized as has having broad rotund lobes, simple rhizines and a distinct bare erhizinate zone towards the margins of the lower cortex. *Pseudoparmelia* has more narrow, eciliate lobes with simple rhizines.

In 1987, Elix and Hale separated several species of *Parmotrema* into the genus *Canomaculina* based on the latter's maculate cortex, ridging, cracking, and dimorphous rhizines found on the lower surface and extending to the lobe margins. In 1990, Hale and Fletcher separated several more species of *Parmotrema* into the genus *Rimelia. Rimelia* is

characterized as having reticulate-patterned maculae (see figure 1) with a similar cracking pattern and the presence of simple to squarrosely branched rhizines on the lower surface and extending to the lobe margins. Whereas *Parmotrema* is characterized as having no (or weak) maculae or cracking, only simple rhizines, and a broad, bare erhizinate zone near the lobe margins. In 1991, Kurokawa assigned several species of *Parmelia* to the genus *Rimeliella* based on the presence of distinct maculae on the upper surface and rhizines extending to the lobe margins on the lower surface. It was later determined that several of these *Rimeliella* species greatly overlapped with the genera description of *Canomaculina*, and therefore, these *Rimeliella* species were reassigned to the genus *Canomaculina.*

*Pseudoparmelia* was so named by Lynge in 1914 because he thought some *Parmelia* specimens had pseudocyphellate on their lower cortices (Elix et al.,1986). However, many specimens had artifacts caused by rhizines simply being broken off the lower cortex (Elix et al., 1986). As mentioned previously Hale (1974) recognized *Pseudoparmelia* as distinct from *Parmelia*. After further investigation, it became clear that the genus *Pseudoparmelia* was a mix of several different species from several different genera. Therefore, the genus *Canoparmelia*, along with two other genera, were segregated from *Pseudoparmelia* by Elix and Hale (Elix et al.,1986). The genera were differentiated based on difference in chemical properties of the upper cortex and medulla, distributional information, substrate and habitat requirements, and size of conidia and spores. Those specimens assigned to the genus *Canoparmelia* have a white medullary layer, black lower cortex, and shorter conidia (7-10um). Those assigned to *Pseudoparmelia* have a yellow pigmented medulla, brown to pale brown lower cortex, and longer conidia (12-20um).

The three genera being examined in this study can be differentiated from one another based on upper cortex characteristics and rhizine distribution. Genus *Rimelia* can be differentiated from *Canoparmelia* because *Rimelia* has a strongly reticulately maculate upper cortex, marginal cilia, and rhizines present from the center to the lobe apices of the lower cortex. Whereas, *Canoparmelia* does not have a reticulately maculate upper cortex, nor does it have marginal cilia, and the rhizines are only present in the center of the lower cortex leaving a narrow erhizinate zone at the margins. The genus *Canomaculina* can be distinguished from the other two genera by the presence of effigurate maculae (not in a reticulate pattern) on the upper cortex, marginal cilia, and a narrow erhizinate zone at the margins of the lower cortex.

## THE STUDY

The 1997 National Park Service checklist of lichen species in the GSMNP included only two *Rimelia* species (*R. reticulata* & *R. subisidiosa)*. Field and laboratory work by Dey and IWU undergraduates (Rebecca Rincker and Holly Grey in 1998; Jana Rose and Adrianne Gagnon in 2000; Emily Richter and Sarah Mick in 2003) pointed to the presence of additional species of *Rimelia* in the GSMNP. As a result, all specimens of *Rimelia* previously collected in the GSMNP and deposited in the IWU herbarium were reexamined to update the current species list in the park and to produce a key and species descriptions to all *Rimelia* species in the park.

Two other genera, *Canoparmelia & Canomaculina*, which are related to *Rimelia* were also examined. *Canoparmelia caroliniana*, *C. crozalsiana* and *Canomaculina subtinctoria* (as *Rimeliella subtinctoria*) were known from the park in 1997. These species and all additional species of each of these genera found in areas near the park were examined to better understand those species that might one day also be discovered in the park. Other goals of this study are to prepare genera and species descriptions and a key to these species.

## METHODS

A total of 370 specimens of *Canomaculina, Canoparmelia, & Rimelia* found in the GSMNP or in the southeastern United States were examined. All specimens examined were collected by Jonathan Dey, often with the assistance of IWU undergraduates, and deposited in the Illinois Wesleyan University lichen herbarium unless otherwise noted. Select specimens collected by H. Phillips and deposited in the Austin Peay State University Herbarium (APSU) were also available for examination. Unidentified specimens were identified and identifications of other specimens were verified and corrected if necessary. A combination of morphological and chemical characters was utilized in identifying the specimens.

Chemical spot testing (to look for color changes in the cortex and medulla) and thin layer chromatography were used to assist in specimen identification and to characterize the secondary product chemistry of specimens. Chemical spot testing techniques utilized potassium hydroxide (K), chlorine (C), and paraphenylenediamine (Pd) and are described in

Brodo, et al. (2001). Thin layer chromatography followed the standardized method described by Culberson (1972).

Once all specimens were keyed to genus and species, the specimens were used to construct species and genera descriptions. Once all information was complete, dichotomous keys were prepared, along with distribution information and maps.

# TAXONOMIC TREATMENT

## GENUS *CANOMACULINA*

**Thallus** foliose, 2-10 cm broad, loose to adnate. **Lobes** 5-20 mm wide, rotund to subirregular to elongate becoming crenate. **Marginal cilia** black, simple, to 2.0 mm long. **Upper cortex** gray to gray-green, maculate, wrinkled to ridged, some cracking. **Isidia or Soredia** present. **Medulla** white. **Lower cortex** dark brown to black, typically becoming lighter in color toward apices. **Rhizines** black, centrally located, bare toward apices, dimorphous, to 3 mm long. **Apothecia** present but rare. **Pycnidia** not seen.

**Spot tests:** cortex K + yellow; medulla K+ or K-, C-, KC+ or KC-, Pd+ or Pd-

**Secondary Chemistry:** cortex with atranorin; medulla with various chemicals.

**Local ecology** Found on hardwood trees.

**General Distribution** Found in tropical and temperate regions throughout the world, North America, Europe, Asia, and East Africa.

**Comments:** A few of the key characters of this genus listed by Elix (1997) include: upper cortex that is effigurate-maculate, gray or yellow-gray, containing atranorin or lichexanthone; thallus with ciliate margins; lower surface black in the center and commonly paler near

margin; rhizines dimorphous (short, simple or long, coarse and more or less grouped); apothecia laminal, sometimes perforate; ascospores ellipsoid and conidia filiform; medullary fatty acids or depsidones present.

References: Brodo et al., 2001; Elix, 1997; Flenniken, 1999; Nash et al., 2002

## *CANOMACULINA* KEY TO SPECIES

1. Soredia present.....(***C. subsumpta***)
1. Isidia present.....2

2. (1) Medulla K+ yellow turning red, Pd+ orange.....3
2. Medulla K-, C-, KC+ pink, Pd-, norlobaridone present.....(***C. haitiensis***)

3. (2) Salazinic acid and norlobaridone present.....***C. subtinctoria***
3. Salazinic acid present.....(***C. neotropica***)

***Canomaculina haitiensis*** (Hale) Elix, Mycotaxon 65: 477 (1997)

*Parmelia haitiensis* Hale, Bryologist, 62: 20 (1959)

*Parmotrema haitiensis* Hale, Phytologia, 28: 336 (1974)

**Thallus** foliose, 2-10 cm broad, adnate. **Lobes** 7-20 mm wide, elongate with rotund tips, becoming crenate. **Marginal cilia** black, simple, to 1.5 mm long. **Upper cortex** gray green, wrinkled to ridged, random maculae, some cracking. **Isidia** abundant, simple to branched. **Medulla** white. **Lower cortex** black, typically becoming brown toward apices. **Rhizines** moderate, black, dimorphous, to 1.5 mm long. **Apothecia** not seen. **Pycnidia** not seen.

**Spot tests:** cortex K+ yellow; medulla K-, C-, KC+ pink, Pd-.

**Secondary metabolites:** cortex with atranorin; medulla with norlobaridone.

**Local ecology:** Found on hardwood trees.

**General distribution:** Found in southeastern United States and in tropic and subtropical areas throughout the world.

Not yet reported from the Great Smoky Mountains National Park.

**Comments:** *Canomaculina haitiensis* can be differentiated from *C. subtinctoria* and *C. neotropica* morphologically and chemically. All three species produce isidia and have a

brown to tan lower cortex. *Canomaculina haitiense* has simple to branched isidia, whereas *C. subtinctoria* is characterized as having simple isidia. *Canomaculina haitiensis* produces norlobaridone in the medulla (K- C- KC+ pink Pd-); *C. subtinctoria* produces both salazinic acid and norlobaridone in the medulla (K+ yellow turning red, C-, PD+ orange); *C. neotropica* produces only salazinic acid in the medulla (K+ yellow turning red, C-, PD+ orange). Thin layer chromatography would be required to distinguish *C. subtinctoria and C. neotropica* from each other. *Canoparmelia subsumpta* differes from all three of the above species because it produces marginal soredia rather than isidia.

Esslinger (1997) now consider *Canomaculina haitiensis* to be a chemotype of *Canomaculina subtinctoria* rather than a separate species.

**ILLUSTRATIONS: See figure 2**

**SPECIMENS EXAMINED (3)**

**Southern United States**

**NORTH CAROLINA. Orange Co.:** Concrete Bridge Rd off Mt Sinai Rd in Duke Forest, 397.

**TENNESSEE. Lawrence Co.:** David Crockett State Park, off US Hwy 64 just W of Lawrenceville, 17783. **Stewart Co.:** Old field on St Mary's Cemetery Rd (LBL Rd 401) off of Ft. Henry Rd (LBL Rd 231) in Land Between the Lakes National Recreation Area, 24134.

***Canomaculina subsumpta*** (Zahlbr.) Elix, Mycotaxon 65: 477 (1997)

*Parmelia subsumpta* Nyl, Flora, Jena 52:117 (1869)

*Rimeliella subsumpta* (Hale) Kurok., Tsukuba Bot. Gard. 10 (1991)

*Parmotrema subsumptum* Nyl. Hale, Mycotaxon 5: 434 (1977).

**Thallus** foliose, 2-9 cm broad, loose to adnate. **Lobes** 7-20 mm wide, subirregular, rotund to crenate, some becoming revolute. **Marginal cilia** sparse, black, simple to 2.0 mm long. **Upper cortex** gray-green, shiny, maculate, random cracking, ridged. **Soredia** marginal, rarely laminal, linear to labriform. **Medulla** white. **Lower cortex** dark brown, typically becoming lighter brown toward apices. **Rhizines** abundant, black, dimorphous, to 3.0 mm long. **Apothecia** not seen, reported to be rare, and 10-13 mm wide (Hale, 1960). **Pycnidia** present.

**Spot tests:** Cortex: K+ yellow. Medulla: K+ yellow turning red, C-, Pd+ orange.

**Secondary metabolites**: cortex with atranorin; medulla with norlobaridone, loxodin, and salazinic acid.

**Local ecology:** Found on hardwood trees.

**General distribution:** Found in tropical America, East Africa, and tropical and warm regions throughout the world (Hale, 1960; Swinscow & Krog, 1988).

**Comments:** *C. subsumpta* can be differentiated from *C. subtinctoria & C. haitiensis* because of the presence of soredia where the *subtinctoria* and *haitiensis* both have isidia. *C. subsumpta & C. haitiensis* also differ in regards to chemical reactions. *C. subsumpta* reacts positively with both KOH (K+ yellow turning red) and paraphenylenediamine (Pd+ orange) where *haitiensis* only reacts positively with a combination of KOH and chlorine (KC+ pink). Furthermore, *subsumpta* contains loxodin, salazinic, and norlobaridone in the medulla, where *subtinctoria* contains only salazinic and norlobaridone, and *haitiensis* contains only norlobaridone.

**SPECIMENS EXAMINED (1)**

**Southern Appalachian Mountains**

**ALABAMA. Clay Co.:** Horn Mt 16 mi SE of Talladega , 8084.

***Canomaculina subtinctoria*** (Zahlbr.) Elix, Mycotaxon 65: 477 (1997)

*Parmelia subtinctoria* Zahlbr. Symb. Sin. 3: 193 (1930)

*Rimeliella subtinctoria* (Hale) Kurok., Tsukuba Bot. Gard. 10 (1991)

*Parmotrema subtinctoria* (Zahlbr.) Hale, Phytologia 28: 339 (1974)

**Thallus** foliose, 3-10 cm broad, loose to adnate. **Lobes** 5-20 mm wide, round, some lobe tips recurving up or down. **Marginal cilia** black, simple, sparse, to 1.5 mm long. **Upper cortex** gray green, maculate, wrinkled to ridged, and random cracking. **Isidia** abundant, mostly simple with some occasional branching. **Medulla** white. **Lower cortex** dark brown, typically becoming lighter toward lobe apices. **Rhizines** black, centrally located, becoming sparse toward lobe apices, dimorphous, to 3.0mm long. **Apothecia** not seen, reported to be rare and 3-8 mm wide (Nash et al., 2002). **Pycnidia** not seen.

**Spot tests:** cortex K+ yellow; medulla K+ yellow becoming red, C-, Pd+ orange.

**Secondary metabolites:** cortex with atranorin (major); medulla with salazinic acid (major), and norlobaridone (minor).

**Local ecology:** Found on hardwood trees.

**General distribution:** Found in East Africa, North America, Europe, Asia, and other tropical and temperate regions throughout the world (Nash et al., 2002).

**Comments:** See comments under *Canoparmelia haitiense.*

**ILLUSTRATIONS: See figure 3**

**SPECIMENS EXAMINED (55)**

**Great Smoky Mountains National Park (See Map 1)**

**TENNESSEE. Blount Co.:** Cades Cove Visitor Center at SE end of Cades Cove, 24700; Rich Mtn. Trailhead from Cades Cove Loop Road to Crooked Arm Ridge Trailhead at Crooked Arm Branch, (35° 36' 33"N, 83° 46' 58"W), 30812, 30855.

**Mammoth Cave National Park**

**KENTUCKY. Edmonson Co.:** Joppa Ridge cemetery off US Hwy 70 above the head of Smith Valley on the Joppa Ridge Top, 14764.

**Southern United States**

**ALABAMA. Colbert Co.:** Limestone Sink Hole Nature Trail area at Mile 323.8 on the Natchez Trace Parkway, near Cherokee, 17978. **Lauderdale Co.:** Rock Springs Nature Trail area near Mile Post 330 on the Natchez Trace Parkway, N of Colbert Ferry and Tennessee River, 18004.

**GEORGIA. Catoosa Co.:** Chickamauga Battlefield area of the Chickamauga & Chattanooga National Military Park S of Fort Oglethorpe, Cedar glade, 18234.

**KENTUCKY. Lyon Co.:** At the junction of The Trace (LBL Rd 100) and LBL Rd 130 to Smith Creek in Land Between the Lakes National Recreation Area, 24473; Campground area on N shore of Cravens Bay on LBL Rd 118 E from Old Ferry Rd (LBL Rd 117) in Land Between the Lakes National Recreation Area, 24364, 24375, 24382, 24385; Lee Cemetery, 3D2, in Land Between the Lakes, Phillips 1110, Phillips 1116; N bank of Duncan Creek near 4P2, in Land Between the Lakes, Phillips 1088; N bank of Moss Creek Dock near 3D3, in Land Between the Lakes, Phillips 1104; 1/2 mi SW of 4E2, north shore Duncan creek in Land Between the Lakes, Phillips 1290; 1/4 mi SW of 5D2, in Land Between the Lakes, Phillips 1069; 4E1, near Smith Bay Dock, in Land Between the Lakes, Phillips 1081; **Trigg Co.:** Along Hematite Trail on shores of Hematite Lake from parking lot at end of LBL Road 176 in Land Between the Lakes National Recreation Area, 24270, 24273, 24277, 29292, 24294; Forest along the Trace (LBL Rd 100) near junction with Redd Hollow Lake Access Rd (LBL Rd 171) in Land Between the Lakes National Recreation Area, (LLL), 24188; GordonHill Spring Area on Lick Creek Rd (LBL Rd 165) at junction with LBL Rd 342 in Land Between the Lakes National Recreation Area, 24212, 24216; Higgens Cemetery #2 off LBL road 141 near Rhodes Creek in Land Between the Lakes National Recreation Area, 24490, 24495; Redd Hollow Lake Access Area at the end of LBL Rd 171 from The Trace (LBL Rd 100) in Land Between the Lakes National Recreation Area, 24547, 24555; Turner Cemetery on LBL Road 162 off US Hwy 68 W of Golden Pond in the Land Between the

Lakes National Recreation Area, 24819; 1/4 mi W of 5F4, in Land Between the Lakes, Phillips 1046; 1/2 mi W of 5F4 in Land Between the Lakes, Phillips 1042; 1/4 mi S of 7F4, Crooked Creek in Land Between the Lakes, Phillips 1370; 1/4 mi W of 7E4, Northside of Hematite Lake in Land Between the Lakes, Phillips 1004; 1 mi N of 6K3, E shore of Ky. Lake, in Land Between the Lakes, Phillips 1273; 8H in Land Between the Lakes, Phillips 1353, Phillips 1355; 8K4 in Land Between the Lakes, Phillips 1364; 200 yds SW of 8J6 in Land Between the Lakes, Phillips 1151.

**TENNESSEE. Lawrence Co.:** David Crockett State Park off US Hwy 64 just W of Lawrenceville, 17715. **Stewart Co.:** Area N along LBL Road 376 from Barrow Cemetery LBL Road 206 in Land Between the Lakes National Recreation Area, 24580; Ginger Ridge on LBL Road 208 near junction with LBL Road 206 in Land Between the Lakes National Recreation Area, 24566, 24568A; Hill on LBL Rd 100 at Junction with LBL rd 227, approx. 1.2 mi N of South Welcome Station to Land Between the Lake National Recreation Area, 24055; 1/4 mi W of 8P6, Boyd cemetery in Land Between the Lakes, Phillips 1243; 1/2 mi W of 9P1, Blue Spring Rd, in Land Between the Lakes, Phillips 1212; 7L2, Hendon Cemetery, Land Between the Lakes, Phillips 1298; 7R1 in Land Between the Lakes, Phillips 1452; 8P4, Blue Spring Rd, in Land Between the Lakes, Phillips 1238; 300 yds W of 6L2, E short Kentucky Lake, in Land Between the Lakes, Phillips 1327.

**WEST VIRGINIA. Grant Co.:** 0.3 mi E of Dolly Sods Picnic Area on FS Road 19 (just E of Randolph Co. line), adjacent to Dolly Sods Wilderness Area and ca. 0.5 mi W of FS Road

75, 22799. **Pendleton Co.:** Smoke Hole Picnic Area along South Branch Potomac River in Spruce Knob-Seneca Rocks National Recreation Area, N on County Rd 2 off US Hwy 220, 22640, 22673, 22701.

## GENUS *CANOPARMELIA*

**Thallus** foliose, 3 to 11 cm broad, adnate. **Lobes** 2 to 15 mm wide, subirregular, to rotund, to linear, to crenate. **Marginal cilia** absent. **Upper cortex** mineral gray to gray-green, wrinkled to ridged, some with cracking, some with maculae. **Soredia or Isidia** present. **Medulla** white. **Lower cortex** black to brown, typically with lighter color at lobe apices. **Rhizines** abundant but becoming erhizinate at lobe apices, black, brown, or tan, mainly simple but some branching, to 2.0mm long. **Apothecia** present but rare, 1-5 mm wide, discs orangish brown to brown in color. **Pycnidia** present reported to be laminal or rarely marginal (Elix et al., 1986).

**Spot tests:** cortex K+ yellow; medulla K+ or K-, C-, KC+ or KC-, Pd+, or Pd-.

**Secondary metabolites:** cortex with atranorin; medulla with various other compounds.

**Local ecology:** Found on hardwood trees.

**General distribution:** North America, Central America, South America, Eastern and Southern Africa, Thailand, India, Italy, and France.

**Comments**: The genus *Canoparmelia* was recently segregated by Elix and Hale (along with two other genera) from the genus *Pseudoparmelia* (Elix et al., 1986). Chemical properties of the upper cortex and medulla, the centers of distribution, the substrate and habitat

requirements and the size of conidia and spores were used to differentiate the genera. Species assigned to the genus *Canoparmelia* have white medullas, black lower surfaces, and shorter conidia (7-10 um) while those assigned to *Pseudoparmelia* have yellow pigmented medullas, brown to pale brown lower surfaces and longer conidia (12-20 um) (Elix, et al., 1986).

Genus *Rimelia* can be differentiated from *Canoparmelia* because *Rimelia* have reticulate-maculate upper surfaces, have marginal cilia, and have rhizines from the center of the thallus to the lobe margins while *Canoparmelia* are not reticulate-maculate, lack marginal cilia and have a narrow erhizinate zone at the margins. *Canomaculina* can be distinguished from the other two genera by their effigurate maculae (not reticulate-maculate) upper surface, their marginal cilia, and having a narrow erhizinate zone at the margins.

References: Brodo et al., 2001; Elix et al., 1986; Flennike, 1999; Nash et al., 2002; Thomson, 2003.

## *CANOPARMELIA* KEY TO SPECIES

1. Soredia present.....2
1. Isidia present.....4

2. (1) Medulla K+ yellow, Pd+ orange, stictic acid present.....***C. crozalsiana***
2. Medulla K-, Pd-, stictic acid absent.....3

3. (2) Soralia laminal; medulla K-, KC+ pinkish, divaricatic acid present.....(***C. texana***)
3. Soralia mainly marginal; medulla K-, KC+ pink/purple, cryptochlorophaic acid present.....(***C. cryptochlorophaea***)

4. (2) Medulla K-, Pd+ orange or K+ yellow turning red, Pd+ orange .....5
4. Medulla K-, Pd- perlatolic and stenosporic acids present.....6

5. (4) Medulla K-, C-, KC+ pinkish, Pd+ orange, protocetraric acid present.....(***C. amazonica***)
5. Medulla K+ yellow turning red, C-, Pd+ orange, salazinic acid present.....(***C. salacinifera***)

6. (4) Lower cortex black typically turning brown at apices.....***C. carolinana***
6. Lower cortex brown typically turning tan or off white at apices.....***C. amabilis***

***Canoparmelia amabilis*** Elix & Heiman, Mycotaxon 70: 163 (1999).

**Thallus** foliose, 3-8 cm broad, adnate. **Lobes** 2-15 mm wide, subirregularly rotund to crenate, some lobe margins curved downward. **Marginal cilia** absent. **Upper cortex** gray green, wrinkled to slightly ridged, reticulately maculae, and some cracking. **Isidia** abundant, branched. **Medulla** white. **Lower cortex** brown, typically becoming tan to off white toward lobe apices. **Rhizines** moderate, centrally located, absent toward lobe apices, to 1.5mm long. **Apothecia** present but rare, to 8 mm broad, discs orangish brown to brown. **Pycnidia** not seen, reported to be laminal or rarely marginal (Elix et al., 1986).

**Spot tests:** **c**ortex K+ yellow; medulla K-, C-, KC-, and Pd-.

**Secondary metabolites:** cortex with atranorin; medulla with perlatolic and stenosporic acids.

**Local ecology:** Found on hardwood trees.

**General distribution:** Found in the SE United States, Central America, South America, Azores, Western and Southern Africa, and Thailand (Hale, 1976; Swinscow & Krog, 1988)

**Comments:** Elix and Heiman (1999) described this as a new species. It was segregated from *Canoparmelia caroliniana*, a very common, widely distributed species in the southeastern United States. According to them, "Although the two species are chemically

identical [producing both perlatoic and stenosporic acids], they differ in the color of the lower surface and in the nature of the isidia" (Elix & Heiman, 1999). They report that "*Canoparmelia caroliniana* has a black to black-brown lower surface with a paler, brown marginal zone whereas *C. amabilis* has a pale brown to brown lower surface with an ivory to pale tan marginal zone. Further, the isidia are fragile, narrow (to 0.07 mm in diameter) and mainly simple in *C. caroliniana*, but are denser, more robust (to 0.12 mm in diameter) and densely branched to coralloid in *C. amabilis*" (Elix & Heiman, 1999).

Based on our examination of 47 specimens of *Canoparmelia caroliniana sensu lato* from the southeastern United States, we observe a range of variation in the color of the lower cortex and the size and shape of the isidia. We are tentative in our recognition of *Canoparmelia amabilis*. The lower surfaces of specimens that were lighter brown were not uniformly lighter and tended to be more mottled with some darker areas. Often specimens with tan to whitish lower surfaces have isidia that vary in thickness and ranged from unbranched to highly branched. Thus, the specimens listed below have tan to whitish lower surfaces and morphologically variable isidia. Specimens with black to dark brown lower surfaces that would be assigned to *C. caroliniana sensu stricto* were not consistently uniformly dark either and have morphologically variable isidia. We do not see the lower surface and isidia differences mentioned by Elix and Heiman between the species. Maybe we have not seen any true *Canoparmelia amablis* specimens.

**ILLUSTRATIONS: See Figure 3**

**SPECIMENS EXAMINED: (5)**

**Great Smoky Mountains National Park. (See Map 2)**

**TENNESSEE. Blount Co.:** Hillside behind Tipton Oliver Place, 2.3 mi E of Cable Mill Visitor Center on Cades Cove Loop Road, (35° 35' 15"N, 83° 48' 42"W), 30332; Ridge to north of Pine Mountain Summit, along Rabbit Creek Trail, (35° 36' 24"N, 83° 55' 30"W), 32727, 32730.

**Southern United States.**

**FLORIDA. Alachua Co.:** Behind Northern Florida Regional Hospital near Fla. Hwy 26 and Interstate 75, Gainsville, 309.

**NORTH CAROLINA. Bladen Co.:** Jones Lake State Park, 7437.

***Canoparmelia amazonica*** Elix & Hale, Mycotaxon 27: 278 (1986).

*Parmelia amazonica* Nylander, Flora, Jena 68: 611 (1885)

*Pseudoparmelia amazonica* (Nylander) Hale, Phytologia 28: 189 (1974)

**Thallus** foliose, 1-8 cm broad, closely adnate. **Lobes** 3-10 mm wide, subirregularly rotund to crenate. **Marginal cilia** absent. **Upper cortex** gray green, wrinkled to ridged with some cracking. **Isidia** abundant, simple, branching in rare occasions. **Medulla** white. **Lower cortex** dark brown to black, typically lighter brown toward apices. **Rhizines** moderate, centrally located, with a bare zone toward apices, black, to 2.0mm long. **Apothecia** rare, 1-3 mm wide, disc are organish brown to dark brown in color, edges rounded inward. **Pycnidia** not seen, reported to be laminal or rarely marginal (Elix et al., 1986).

**Spot tests:** cortex K+ yellow; medulla K-, C-, KC+ pinkish, Pd+ orange.

**Secondary metabolites:** cortex with atranorin; medulla with protocetraric acid.

**Local ecology:** Found on hardwood trees.

**General distribution:** Found in the SE United States, Central America, South America, West Indies, Guinea, West Africa, and Taiwan (Hale, 1976; Swinscow & Krog, 1988).

This species occurs in the coastal plain and has not been reported in the Great Smoky Mountains National Park.

**Comments:** *Canoparmelia amazonica* can be differentiated from all other local isidiate species of *Canoparmelia* by the presence of protocetraric acid in the medulla (K-, C-, KC-, Pd+ orange). Another isidiate species, *Canoparmelia salacinifera,* produces salazinic acid in the medulla (K+ yellow turning red, C-, PD+ orange).

**SPECIMENS EXAMINED: (6)**

**Southern United States.**

**FLORIDA. Franklin Co.:** At communications Antenna on hill south along Fla Hwy 370 from its junction with US Hwy 94, 4mi. E of St. Teresa Beach, 24283. **Levy Co.:** Along Florida Hwy 24, 0.9 mi SE of Alachua County Line, near abandon microwave tower, *Ceratola/Quercus laevis* scrub on sand hill, 25581; Approx. 3 mi NW of Bronson on US Hwy Alternate. 27, along edge of a small cypress swamp, 7601B. **Marion Co.:** County Road 314 at FS Road 67, ca. 3.5 mi E of Cedar Creek, in Ocala National Forest, 25561; Grass and pine tree road bank community at eastern end of Oklawnaha River Bridge on County Road 316 at Eureka, in Ocala National Forest, 25691.

**LOUISIANA, Livingston Parish:** Rest area near mile post 12 on east bound Interstate Hwy 12, approx 13 mi W of Hammond, 25383.

***Canoparmelia caroliniana*** Elix & Hale, Mycotaxon 27: 278 (1986).

*Parmelia caroliniana* Nylander, Flora, 68: 614 (1885).

*Pseudoparmelia caroliniana* (Nylander) Hale, Phytologia, 28: 189 (1974).

**Thallus** foliose, 3-8 cm broad, adnate. **Lobes** 2-15 mm wide, subirregularly rotund to crenate, some lobe margins curved downward. **Marginal cilia** absent. **Upper cortex** gray green, wrinkled to slightly ridged, strongly maculae along wrinkles, and some cracking. **Isidia** abundant, cylindrical to branched. **Medulla** white. **Lower cortex** black to black-brown, typically broad brown band toward lobe apices. **Rhizines** moderate, centrally located, naked toward lobe apices, to 1.5mm long. **Apothecia** present but rare, mainly 2-5(-8) mm wide, discs orangish brown to brown. **Pycnidia** not seen, reported to be laminal or rarely marginal (Elix et al., 1986).

**Spot tests:** cortex K+ yellow; medulla K-, C-, KC-, Pd-.

**Secondary metabolites:** cortex with atranorin; medulla with perlatolic and stenosporic acids.

**Local ecology:** Found on hardwood trees.

**General distribution** Found in the SE United States, Central America, South America, Azores, Western and Southern Africa, and Thailand (Hale, 1976; Swinscow & Krog, 1988)

**Comment:** Specimens with a lighter brown to tan lower cortex were recently segregated and described as a new species, *Canoparmelia amabilis*. See the discussion under *C. amabilis* for further comments.

**ILLUSTRATIONS: See Figure 5**

**SPECIMENS EXAMINED: (42)**

**Great Smoky Mountains National Park (See Map 3)**

**NORTH CAROLINA. Swain Co.:** Area of Towstring Horse Camp and along Oconaluftee River, ca. 1mi S of Smokemont Campground opp. US Hwy 441, (35° 32.6'N, 83° 18' W), 29456; Road to Paynetown Cemetery, 1 mi NW of Fontana Dam, (35° 27' 41.7"N, 83° 43' 58.1"W), 31931; Trail W of Tunnel at end of Lakeside Dr., Fontana Road, (35° 27' 40.2"N, 83° 32' 42.1"W), 31448.

**TENNESSEE. Blount Co.:** Chilhowee Reservoir, 1.4 mi N on US Hwy 129 from Takcat Creek, (35° 32' 36"N, 83° 59' 37"W), 30588; Oliver Branch Stream area, 0.3 mi E of Tipton Place on Cades Cove Loop Rd in Cades Cove, (35° 35' 18"N, 83° 48' 26.5"W), 32872.

**Mammoth Cave National Park**

**KENTUCKY. Edmonson Co.:** Along Houchins Ferry Road approx 2 km NE of Temple Hill Cemetery, along ridge top, 10916; Joppa Ridge, in an area approx 2 km W of the Sloans Crossing junction of Hwy 70 and the paved road to visitor Center, along ridge top above Woolsey Valley, 10741; Ridge above Cubby Cove and Nolin River, along ridge above cliff, 11312B.

**Southern United States**

**ALABAMA. Clay Co.:** Horn Mt. 16mi SE of Talladega, 8063, 8094; **Cleburne Co.:** Talladega National Forest, 3 mi west of Heflin, 7922.

**FLORIDA. Alachua Co.:** Behind hospital near Fla. Hwy 26 and Interstate 75, Gainsville, 306, 307, 308, 310. **Citrus Co.:** 4 mi south of Inverness on FLA Hwy 581, 8202, 8176. **Clay Co.:** Mike Roess Gold Head Branch State Park, 7731, 7779. **Columbia Co.:** O'Leno State Park, (LLL), 7609. **Levy Co.:** Manatee Springs State Park, 7692, 7704; Three miles NW of Bronson on US Hwy Alt 27, 7595, 7599. **Putnam Co.:** 1 mi west of Johnson on FLA Hwy 21, 8147.

**GEORGIA. Catoosa Co.:** Chickamauga Battlefield area of Chickamauga & Chattanooga National Military Park South of Fort Oglethorpe, Cedar glade, 18225, 18258. **Rabun Co.:** Pine Forest approx. 12.2 mi. west of Calhoun on US Hwy 76 along ridge top, 13787; FHM Plot # 3108186, FHM 3108186-11, FHM 3108186-12; FHM Plot # 3308582, FHM 3308582-2.

***Canoparmelia crozalsiana*** Elix & Hale, Mycotaxon 27: 278 (1986).

*Parmelia crozalsiana* Harm., Lich. Fr. 4: 555 (1909).

*Pseudoparmelia crozalsiana* Hale, Phytologia 28: 189 (1974).

**Thallus** foliose, 3-10 cm broad, adnate. **Lobes** 5-15 mm wide, subirregular, rotund, apically subrotund. **Marginal cilia** absent. **Upper cortex** gray green, wrinkled to reticulately ridged, with some cracking. **Soredia** soralia present along ridges, some are laminal, often circular. **Medulla** white. **Lower cortex** black, typically brown toward lobe apices. **Rhizines** moderate, black, simple, to 1.5 mm long. **Apothecia** extremely rare, but when present on a specimen they are numerous on that specimen, 1-3 mm wide, orangish brown in color. **Pycnidia** not seen, reported to be rare (Swinscow & Krog, 1988) reported to be laminal or rarely marginal (Elix et al., 1986).

**Spot tests:** cortex K+ yellow; medulla K+ yellow, C-, Pd+ orange

**Secondary metabolites:** cortex with atranorin; medulla with stictic acid.

**Local ecology:** Found on hardwood trees.

**General distribution:** Found in the southeastern United States, Mexico, South America, France, Italy, India, Zaire, and South Africa (Hale, 1976; Swinscow & Krog, 1988)

**Comments:** *Canoparmelia crozalsiana* can be differentiated from all other sorediate species of *Canoparmelia* due to the presence of stictic acid in the medulla (K+ yellow, C-, Pd+ orange). Two other sorediate *Canoparmelia* species—*C. cryptochlorophaea* and *C. texana*—do not produce stictic acid and are both K-, Pd-. See *C. cryptocholorphaea* for more comments.

**SPECIMENS EXAMINED (63)**

**Great Smoky Mountains National Park (See Map 4)**

**TENNESSEE. Cocke Co.:** Laurel Springs Road edge of GSMNP opposite Laurel Spring Church, 1 mi S of E junction of road with U.S. Hwy 321, (35° 46' 20.3"N, 83° 15' 29.2"W), 31965.

**Mammoth Cave National Park**

**KENTUCKY. Barren Co.:** Near Baptist Church approx 0.5 km from the Sand Cave Entrance to the Park on the Cave City Pike, on ridge top, 10002, 10007, 10008, 10029, 10035, 10077, 10088, 10105; Near Frozen Niagara Entrance to Mammoth Cave, from floor to Doyle Valley to ridge top, 10103. **Edmonson Co.:** Along gravel road to Great Onyx Cave approx 1.3 km from Flint Ridge paved rd, along ridge top, 12055; Along Houchins Ferry Rd. approx 2 km NE of Temple Hill Cemetery, along ridge top, 10914, 10946B, 10956B; Along side of Flint Ridge above Eaton Valley approx 2-2.5 km from Visitor Center on Flint Ridge

road, 12113; Approx 0.5 km S from Sloans Crossing Pond along Hwy 70, along ridge top, 12743, 12749, 12783, 12787, 12791; Approx 1 km N of main southern entrance to Park along Hwy 70 (Old Union City area) along ridge top, 10675; Approx 3 km from Hwy 70 on Joppa ridge Motor Nature Trail along side of Jim Lee Ridge above Bruce Hollow, along slope up to ridge top, 12249; Area around Little Jordan Cemetery along northern boundary of Park, along ridge top, 11683; Area between Crumps Knob and Brooks Knob, along slopes of the two knobs, 10891; Area from France Cemetery on ridge top down slope into Woolsey Valley, from valley floor to ridge top, 12481, 12498; Around Sloans Crossing Pond, on ridge top, 12712; Double Spring area along Stockholm-Mammoth Cave Ferry Road just N of side rd to Maple Springs Ranger Station, along ridge top, 11764B, 11795; Gravel rd N of Sal Hollow and Fishtrap Hollow, along ridge, 11384; Hickory Cabin Fire Tower approx 1 km S of N entrance to Park near Stockholm, along side of hill to the top, 11735; Houchins Ferry Rd from ridge top near SW entrance to Park (by Edmonson County High School) down to the ferry crossing, from Green River to ridge top, 11092; Joppa Ridge in an area approx 2 km W of the Sloans Crossing junction of Hwy 70 and the paved rd to the Visitors Center, along ridge top above Woolsey Valley, 10718; Near Adwell Cemetery off Flint Ridge paved rd, along ridge top, 11833; Ridge above Cubby Cove and Nolin River, along ridge above cliff, 11304, 11333; Ridge along N boundary of Park above First Creek about 1.2 km SW of Ollie and 1 km due W of Jaggers Cemetery, along ridge top, 11267; Trail between Good Springs Cemetery and Waterfall Campsite above Dry Prong of Buffalo Creek, from creek bed to ridge top, 11649; Turnhole Bend Trail off Hwy 70, from slope above Green River to ridge top, 12387, 12411B. **Hart Co.:** Along gravel rd along E boundary of the Park approx

3.2km from its junction with the Cave City Pike, along ridge top between Strawberry Valley and Hamilton Valley, 10531, 10563, 10624.

**Southern United States**

**GEORGIA. Catoosa Co.:** Chickamauga Battlefield area of Chickamauga & Chattanooga National Military Park South of Fort Oglethorpe, Cedar glade, 18255; **Rabun Co.:** West of Clayton, FHM Plot # 3408421, FHM 3408421-26.

**KENTUCKY. Lyon Co.:** At the junction of Trace (LBL Rd 100) and LBL Road 130 to Smith Creek in Land Between the Lakes National Recreation Area, 24467, 24470; Canal Overlook on Kentucky Lake Road 101 near N end of Land Between the Lakes National Recreation Area near Grand Rivers, 23895; Sardis-Lady Cemetery on LBL Road 126 near LBL Road 125 south of Davenport Bay in Land Between the Lakes National Recreation Area, 24459; 0.25 mi NE of Pisgah Point Lake Access on Lee Cemetery Road (LBL Rd 111) in Land Between the Lakes National Recreation Area, 24418. **Trigg Co.:** Black gum & Mt. Chestnut oak, Phillips 1189. Forest along the Trace (LBL Rd 100) near junction with Redd Hollow Lake Access Road (LBL Rd 171) in Land Between the Lakes National Recreation Area, 24202; 200 yds. SW of 8J6 in Land Between the Lakes, Phillips 1157.

**SOUTH CAROLINA. Oconee Co.:** Park at Issaqueena Falls, N of Walhalla, 0.5 mi E of SC Hwy 28 on Stumphouse Rd, 28587.

**TENNESSEE. Carter Co.:** Along abandoned railroad tracks and along Doe River in Doe River Gorge off US Hwy 19E south of Hampton, (LLL), 25159. **Coffee Co.:** Old Stone Fort State Archeological Area, near Manchester off US Hwy 41 at the Duck River, (LLL), 17555, 17576. **Lincoln Co.:** Approx 2-3 mi E of Boonshill (and 9 mi W of Fayetteville) on US Hwy 64, (LLL), 17632. **Stewart Co.:** Area along Fort Henry Rd (LBL Rd 231) above Wofford Hollow in Land Between the Lakes National Recreation Area, (LLL), 24027; Area N along LBL Rd 376 from Barrow Cemetery on LBL Rd 206 in Land Between the Lakes National Recreation Area, (LLL), 24581; Pettit Cemetery opposite the junction of LBL Road 211 with the Trace (LBL Road 100) in the Land Between the Lakes National Recreation Area, (LLL), 24857. Rushing Creek Campground area towards end of LBL Rd 172 near Rushing Bay in Land Between the Lakes National Recreation Area, (LLL), 24557; 9P2 Hwy 49 in Land Between the Lakes, (LLL), Phillips 1257. **Wilson Co.:** Cedars of Lebanon State Park, S of Bairds Mills off US Hwy 231, Cedar Forest Trail area opposite the park office, (LLL), 17408.

**NORTH CAROLINA. Bladen Co.:** Singletary Lake State Park, 7263, 7297. **Carteret Co.:** W of Emerald Isle on Bogue Bank, 6984. **Lee Co.:** 11 mi. S of Sanford on US 1 near county line, Turkey oak-pine sandhill, 7039, 7041, 7048. **Pender Co.:** Holly Shelter Game Land, just EW of Shaw Hwy (NC State Road 1523) at Lodge Road, 5.3 mi S of NC Hwy 53, (34° 33' 7.0"N, 77° 48' 41"W), 29250.

**SOUTH CAROLINA. Oconee Co.:** Yellow Branch Picnic Area off SC Hwy 28, north of Walhalla near junction with Yellow Branch Road, (34° 48.4'N, 83° 7.6'W), 28566.

**TENNESSEE. Stewart Co.:** Area at Fort Henry Road (LBL Rd 231) Entrance to Land Between the Lakes National Recreation Area at US Hwy 79, 23982; Cedar bluff near 6L3 in Land Between the Lakes, Phillips 1463. **Wilson Co.:** Cedars of Lebanon State Park, off US Hwy 231 south of Bairds Mill, Limestone Sink Trail area, 17254.

***Canoparmelia cryptochlorophaea*** Elix & Hale, Mycotaxon 27: 278 (1986).

*Parmelia cryptochlorophaea* Hale, The Bryologist 62: 18 (1959).

*Pseudoparmelia cryptochlorophaea* (Hale) Hale, Phytologia 28: 189 (1974)

**Thallus** foliose, 4-10 cm broad, adnate. **Lobes** 3-10 mm wide, subirregular to rotund. **Marginal cilia** absent. **Upper cortex** gray green, shiny, abundant ridging, maculae, with some cracking. **Soredia** abundant, soralia marginal, rounded to labriform, some are erect. **Medulla** white. **Lower cortex** dark brown to black, with typically lighter brown toward lobe apices. **Rhizines** moderate, white to tan or darker brown, centrally located, absent toward apices, to 1.5 mm long. **Apothecia** not see, but reported to be rare and up to 3mm wide (Hale, 1976). **Pycnidia** not seen, reported to be laminal or rarely marginal (Elix et al., 1986).

**Spot tests:** cortex K+ yellow; medulla K-, C-. KC+ pink/purple, Pd-.

**Secondary metabolites:** cortex with atranorin; medulla contains cryptocholorphaeic acid and caperatic acid.

**Local ecology:** Found on hardwood trees.

**General distribution:** Found in the southern United States predominantly in coastal plain, Mexico, the Caribbean, West Indies, Venezuela, and Brazil (Hale, 1976).

In the southern United States, it occurs predominantly in the coastal plain, but it is also known from the lower mountains of the Southern Appalachians (see Georgia specimens cited below from Rabun County.) Not reported from the Great Smoky Mountains National Park yet.

**Comments:** *Canoparmelia cryptochlorophaea* can be differentiated from all other local sorediate species of *Canoparmelia* by soralia that are mainly marginal and the presence of cryptocholorphaeic acid in the medulla (K-, C-, KC+ pink/purple, Pd-). *Canoparmelia texana* has only laminal soralia and produces divaricatic acid (K-, C-, KC+ pink, Pd-).

**ILLUSTRATIONS: See Figure 6**

**SPECIMENS EXAMINED (20)**

**Southern United States**

**FLORIDA. Alachua Co.:** Behind hospital near FLA Hwy 26 and Interstate 75, Gainesville, 301, 313, 314; Nature Center in east Gainesville, 25288; 8 mi E of Gainesville on Hwy 20, 8114. **Citrus Co.:** 4 mi S of Inverness on FLA Hwy 581, 8203. **Franklin Co.:** 5 mi W of St. Teresa Beach on US Hwy 98 at its junction with US Hwy 319, 21336. **Leon Co.:** North of Leon Springs in Apalachicola National Forest, 1.7 mi N on US Hwy 319 from its junction with County Rd 2204, 21496, 21524, 21543; Southwood/Woodside area, 1.2 mi S of junction of FLA Hwy 61 with US Hwy 319, S of Tallahassee, 21668, 21677, 21689, 21727.

**Levy Co.:** Northern end of Gulf Hammock, along Florida Hwy 24, 7.5 mi SW of US Hwy 1998 at Otter Creek, Hardwood *Taxodium* swamp, 25647; S of Fowler's Bluff along County Rd 347, just S of the northern boundary of Lower Suwanee Wildlife Refuge and due N of Cedar Key, 25747, 25760. **Marion Co.:** Along County Rd 316, 0.5 mi E of Oklawnaha River Bridge at Eureka and 0.2 mi W of FS Rd 67, oak-heath scrub forest, 25473, 25487; Floodplain forest near boat ramp beneath eastern end of Oklawnaha River Bridge on County Rd 316 at Eureka in Ocala National Forest, 25652.

**GEORGIA. Rabun Co.:** West of Clayton, FHM Plot #3108182, FHM 3108182-23; FHM Plot # 3208345, FHM 3208345-13.

**MISSISSIPPI. Hancock Co.:** Rest area near mile post 11 on E bound Interstate Hwy 10 near Bay St. Louis, 25403, 25408, 25412.

**NORTH CAROLINA. Pender Co.:** Pocosin along Lodge Rd 1.2 mi E of Shaw Hwy (NC State Rd 1523) at Lodge Rd 5.3 mi S of NC Hwy 53, Holly Shelter Game Land, 29269

***Canoparmelia salacinifera*** Elix & Hale, Mycotaxon 27: 279 (1986)

*Parmelia salacinifera* Hale in Hale & Kurok., Contrib. U.S. Natl. Herb 36: 157 (1964).

*Pseudoparmelia salacinifera* (Hale) Hale, Phytologia 28: 191 (1974).

**Thallus** foliose, 4-10 cm broad, adnate. **Lobes** 3-8 mm wide, subirregular to rotund. **Marginal cilia** absent. **Upper cortex** grayish white to gray, dull, some ridging, reticulately white-maculate, and finely cracked. **Isidia** moderate, cylindrical, branching on rare occasions. **Medulla** white. **Lower cortex** dark brown to black, typically becoming lighter brown toward apices. **Rhizines** moderate, centrally located, bare zone at apices, tan to brown, simple, to 1.5mm long. **Apothecia** not seen, reported to be rare and 2-4 mm wide (Hale, 1976). **Pycnidia** not seen, reported to be laminal or rarely marginal (Elix et al., 1986).

**Spot tests:** cortex K+ yellow; medulla K+ yellow turning red, C-, and Pd+ orange.

**Secondary metabolites:** cortex with atranorin; medulla with salazinic acid.

**Local ecology:** Found on hardwood trees.

**General distribution:** Found in the SE United States, Central America, South America, West Indies, and Thailand (Hale, 1976).

This species occurs in the southeastern coastal plain. It is not known from the Great Smoky Mountains National Park, and it not likely to be found there.

**Comment:** See the *Canoparmelia amazonica* for discussion.

**SPECIMENS EXAMINED (12)**

**Southern United States**

**FLORIDA. Clay Co.:** Magnolia Lake State Park, (LLL), 7789; Mike Roess Gold Head Branch State Park, 7735, 7736, 7745, 7761. **Leon Co.:** North of Leon Springs in Apalachicola National Forest, 1.7 mi N on US Hwy 319 from its junction with County Rd 2204, 21467, 21525. **Levy Co.:** Along Florida Hwy 24, 0.9 mi SE of Alachua County Line, near abandon microwave tower, *Ceratola/Quercus laevis* scrub on sandhill, 25589; Along trail E of Shell Mound in County Park at the end of County Rd 326 W from CR 347, due N of Cedar Key, 25741; One mile NE of Bronson on FLA Hwy 24, 7579; South of Fowler's Bluff along County Rd 347, just S of the northern boundary of Lower Suwanee wildlife Refuge and due N of Cedar Key, 25778. **Putnam Co.:** 1 mi W of Johnson on FLA Hwy 21, 8155.

***Canoparmelia texana*** Elix & Hale, Mycotaxon 27: 279 (1986)

*Parmelia texana* Tuckerman, Am. J. Sci. Arts, Ser 2, 25: 424 (1858).

*Pseudoparmelia texana* Hale, Phytologia 28: 191 (1974).

**Thallus** foliose, 4-11 cm broad, adnate. **Lobes** 3-10 mm wide, subirregular, rotund to linear, crowded, twisting occurs where not attached. **Marginal cilia** absent. **Upper cortex** gray green, maculate, ridging, and cracking, some lobe tips pruinose. **Soredia** abundant, laminal in partially capitate to pustulate soralia. **Medulla** white. **Lower cortex** dark brown to black, typically becoming light brown toward apices. **Rhizines** centrally located, becoming sparse toward apices, tan white to dark brown, simple, to 1.5mm long. **Apothecia** rare, 2-4 mm wide, discs orangish brown. **Pycnidia** not seen.

**Spot tests:** cortex K+ yellow; medulla K-, C-, KC+ faint pinkish to purple, Pd-, and UV+ blue.

**Secondary metabolites:** cortex with atranorin; medulla with divaricatic acid.

**Local ecology:** Found on hardwood trees.

**General distribution:** Found in the SE United States, Mexico, Europe, Pantropic and Pantemperate areas (Hale, 1976; Swinscow & Krog, 1988).

Occurs in coastal plain and piedmont in the southeastern United States. Not yet reported from the Great Smoky Mountains National Park.

**Comments:** See *Canoparmelia cryptochlorophaea* for a discussion.

**ILLUSTRATIONS: See Figure 7**

**SPECIMENS EXAMINED (22)**

**Mammoth Cave Park**

**KENTUCKY. Edmonson Co.:** Approx 0.5 km S from Sloans Crossing Pond along Hwy 70, along ridge top, 12754; Ridge above Cubby Cove and Nolin River, along ridge above cliff, 11315A, 11314A, 11314, 11316, 11319A, 11348, 11350C; Trail from Jaggers Cemetery to Wet Prong of Buffalo Creek via Blue Springs, from creek bottom to ridge top, 11129.

**Southern United States**

**FLORIDA. Leon Co.:** Southwood/Woodside area, 1.2 mi S of junction of FLA Hwy 61 with US Hwy 319, S of Tallahassee, 21665.

**KENTUCKY. Lyon Co.:** Moss Creek area on LBL Rd 106 as it approaches Kentucky Lake in Land Between the Lakes National Recreation Area, 23949; O'Brien Cemetery area off of

Rd 101 (Kentucky Lake Drive) at N end of Land Between the Lakes National Recreation Area, 23915, 23922; Sardis-Lady Cemetery on LBL Rd 126 near LBL Rd 125 S of Davenport Bay in Land Between the Lakes National Recreation Area, 24460. 1/4 mi SW of 5D2 in Land Between the Lakes, Phillips 1064. **Trigg Co.:** Forest along the Trace (LBL Rd 100) near junction with Redd Hollow Lake Access Rd (LBL Rd 171) in Land Between the Lakes National Recreation Area, 24185A, 24189, 24208; Ridge along LBL Rd 343 towards Turkey Bay from LBL Rd 168 in the Land Between the Lakes National Recreation Area, 24843.

**NORTH CAROLINA. Pender Co.:** Pocosin along Lodge Rd 1.2 mi E of Shaw Hwy (NC State Rd 1523) at Lodge Rd 5.3 mi S of NC Hwy 53, Holly Shelter Game Land, 29275.

**TENNESSEE. Stewart Co.:** Area N along LBL Rd 376 from Barrow Cemetery on LBL Rd 206 in Land Between the Lakes National Recreation Area, 24588; Old field on St. Mary's Cemetery Rd (LBL Rd 401) which is off Ft. Henry Rd (LBL Rd 231) in Land Between the Lakes National Recreation Area, 24155.

## GENUS *RIMELIA*

**Thallus** foliose, 4-20 cm broad, medium to large lobes, loosely adnate to adnate. **Lobes** 3-30 mm wide, rounded to irregular to sublinear to lacinate, elongate. **Marginal cilia** black, simple to branched, ciliate lobe apices become subrotund to rotund. **Upper cortex** gray to dark gray to gray-green to pale green, strongly reticulate maculae often with reticulate cracking to margins. **Soredia/Isidia** present or absent. **Medulla** white. **Lower cortex** black, typically brown (or rarely white) at lobe apices. **Rhizines** typically present and extending to margins, black, unbranched to squarrosely branched, 0.5-3.5 mm in length.. **Apothecia** present or absent. **Pycnidia** present, Hale and Fletcher (1990) reported that they were immersed.

**Spot tests:** cortex K+ yellow; medulla K+ or K-, C- KC+ or KC-, CK+ or CK-, Pd+ or Pd- and rarely UV+ orange-yellow.

**Secondary metabolites:** cortex with atranorin; medulla has a combination of depsides, xanthone, or aliphatic acids.

**Local ecology:** Typically grows on trees but can also be found on rock.

**General distribution:** Wide distribution in temperate and subtropical areas with major center of diversity in South America. There are at least sixteen reported species in the world, and there are at least seven species in North America north of Mexico.

**Comments:**

At one time *Rimelia* species were included in the genus *Parmotrema* in that they were both broad lobed and typically had marginal cilia. Hale & Fletcher (1990) segregated *Rimelia* from *Parmotrema* on the basis that the former species were strongly maculate in a reticulate pattern and were often reticulately cracked to the lobe margins while the *Parmotrema* species may be maculate but are never reticulate maculate. Additionally *Rimelia* species are typically rhizinate to the lobe margins while *Parmotrema* species have a broad, bare erhizinate zone at the margins of the lobes.

**ILLUSTRATIONS: See Figures 8 & 9**

References: Brodo et al., 2001, Dey 1973, Esslinger 1972, Flenniken, 1999, Hale & Fletcher, 1990; Nash et al., 2002.

## *RIMELIA* KEY TO SPECIES

1. Soredia or isidia present.....2
1. Soredia, and isidia absent; lobes sometimes becoming lacinate.....**R. cetrata**

2. (1) Isidia present; medulla K+ yellow turning red, salazinic acid present.....**R. subisidiosa**
2. Soredia present, medulla K+ yellow turning red or K-.....3

3. (2) Medulla K+ yellow turning red, salazinic acid present.....**R. reticulata**
3. Medulla K-, salazinic acid absent.....4

4. (3) Medulla UV+ orange, K-, C-, KC-, CK+, Pd- lichexanthone and diffractaic acid present.....(**R. diffractaica**)
4. Medulla UV-, K-, C-, KC+ red or KC-, CK-, Pd- lichexanthone and diffractiaic acid absent,.....5

5. (4) Medulla C-, KC+ red, norlobaridone present.....**R. commensurata**
5. Medulla C-, KC-, fatty acid present.....**R. simulans**

***Rimelia cetrata*** (Ach.) Hale & A. Fletcher, Bryologist 93: 26 (1990)

*Parmelia cetrata* (Ach.), Syn. Lich. 198 (1814)

*Parmotrema cetratum* (Ach.) Hale, Phytologia 28: 335 (1974)

**Thallus** foliose, 3.0-15.0 cm broad, loose to adnate. **Lobes** 2.0 to 15.0 mm wide, recurved and rounded to irregularly elongate to lacinate. **Marginal cilia** black, simple, to 2.0 mm long. **Upper cortex** grey-green, smooth and dull, strongly maculate in reticulate pattern, with reticular cracking or ridging along maculae, lobe tips may be pruinose. **Soredia/Isidia** absent. **Medulla** white. **Lower cortex** black, typically brown (rarely white on a few lobes) toward lobe apices. **Rhizines** abundant, extending to margins, black, simple to squarrously branched, 2.0 mm in length. **Apothecia** abundant. **Pycnidia** present, Hale and Fletcher (1990) reported that they were immersed.

**Spot tests:** cortex K+ yellow; medulla K+ yellow turning red, C-, Pd+ orange.

**Secondary metabolites:** upper cortex with atranorin, medulla with salazinic acid (major) and consalazinic acid (minor).

**Local ecology:** Typically found on trees and rocks.

**General distribution:** Pantemperate, pansubtropical; especially common in SE United States and Southern Africa (Hale & Fletcher 1990).

**Comments:** *Rimelia cetrata* can be differentiated from all other species of *Rimelia* occurring in the southeastern United States because it lacks both isidia and soredia.

**ILLUSTRATIONS: SEE FIGURE 10**

**SPECIMENS EXAMINED: (3)**

**Great Smoky Mountain National Park. (See Map 5)**

**NORTH CAROLINA. Swain Co.:** Trail W of tunnel at end of Lakeside Dr from Fontana Road west of Bryson City, (35° 27' 40.2"N, 83° 32' 42.1"W) 31374.

**TENESSEE. Sevier Co.:** Sugarlands Visitor Center area near Gatlinberg at junction of US Hwy 441 and Little River Road, (35° 41' 8.2"N, 83° 32' 15.2"W) 31867, 31874.

***Rimelia commensurata*** (Hale) Hale & Fletcher, Bryologist 93: 27 (1990)

*Parmelia commensurata* Hale, Phytologia 23: 31. (1971)

*Parmotrema commensuratum* (Hale) Hale, Phytologia 28: 335. (1974)

**Thallus** foliose, 4.5 to 6.0 cm broad, loose to adnate. **Lobes** 0.3 to 2.0 cm wide, rounded to laciniate, descending recurved edges. **Marginal cilia** sparse to absent, black, simple, to 1.3mm long. **Upper cortex** mineral gray to gray green, smooth, strongly maculate to margins in reticulate pattern, reticulate cracking concentrated in the center of the lobes. **Soredia** granular, soralia marginal to submarginal, mainly on laciniate lobes, sorediate lobes becoming revolute. **Medulla** white. **Lower cortex** black, typically brown toward lobe apices **Rhizines** abundant, black, simple to sparingly branched, 0.3 to 1.3mm long. **Apothecia** not seen in specimens examined. **Pycnidia** present, Hale and Fletcher (1990) reported that they were immersed.

**Spot tests:** cortex K+ yellow; medulla K-, C-, KC+ red, Pd-

**Secondary metabolites:** cortex with atranorin; medulla with norlobaridone (major) and loxodin (minor).

**Local ecology:** Found on hardwood trees.

**General distribution:** Found mainly in tropical America and East Africa (Hale & Fletcher 1990). In North America north of Mexico, only known from the Southern Appalachian Mountains.

**Comments:** *Rimelia commensurata* can be differentiated from all other local species of *Rimelia* by the presence of norlobaridone and loxodin (KC+ red) in the medulla. This is the first report of the species in the Great Smoky Mountains National Park.

**ILLUSTRATIONS: See Figure 11**

**SPECIMENS EXAMINED: (4)**

**Great Smoky Mountains National Park. (Map 6)**

**TENNESSEE. Sevier Co.**: Sugarlands Visitors Center area near Gatlinberg at junction of US Hwy 441 and Little River Road, (35° 41' 8.2"N, 83° 32' 15.2"W), 31605.

**Southern Appalachian Mountains and Piedmont.**

**NORTH CAROLINA. Surry Co.:** Pilot Mtn. State Park along trail from upper parking lot, (36° 20' 26"N, 80° 28' 42"W), 7146, 7148.

**NORTH CAROLINA. Wilkes Co.:** Tompkins Knob along the Blue Ridge Parkway, (36° 14' 39"N, 81° 28' 04"W), 513.

***Rimelia diffractaica*** (Essl.) Hale & Fletcher, Bryologist 93: 27 (1990)

*Parmelia diffractaica* Essl., The Bryologist 75: 80. (1972)

*Parmotrema diffractaicum* (Essl.) Hale, Phytologia 28: 335. (1974)

**Thallus** foliose, 3.0 to 12.0 cm broad, loose to adnate. **Lobes** 2.0 to 20.0 mm wide, rounded, with poorly developed lacinae. **Marginal cilia** abundant, simple or with occasional unique branching pattern (one branch being directed upward and the other being directed downward), to 2.0 mm long. **Upper cortex** smooth, weakly maculate in reticulate pattern to indistinctly maculate, reticulately cracked at the center of the lobes.. **Soredia** abundant, white and granular, soralia marginal to submarginal, sorediate lobes becoming revolute. **Medulla** white. **Lower cortex** black, typically brown toward lobe apices. **Rhizines** abundant at center, becoming sparse towards lobe tips , black, simple or with some dichotomous branching, to 2.5mm long. **Apothecia** not seen. **Pycnidia** present, Hale and Fletcher (1990) reported that they were immersed.

**Spot tests:** cortex K+ yellow; medulla K-, C-, KC-, CK+ orange, Pd-, UV+ orange.

**Secondary metabolites:** cortex with atranorin; medulla with diffractaic acid and lichexanthone.

**Local ecology:** Found on trees.

**General distribution:** Southeastern United States including Southern Appalachian Mountains and adjacent piedmont; Brazil (Kurokawa, 1985).

This species has not yet been reported from the GSMNP.

**Comments:** *Rimelia diffractaica* can be differentiated from all other local species of *Rimelia* by the presence of diffractaic acid and lichexanthone in the medulla (CK+ orange) and ultraviolet light (UV+ orange).

**ILLUSTRATIONS: See Figure 12**

**SPECIMENS EXAMINED: (4)**

**Southern Appalachian Mountains and Piedmont.**

**GEORGIA. Rabun Co.:** FHM plot # 3408374, off U.S. Hwy 76 west of Clayton, FHM 3408374-65.

**NORTH CAROLINA. Stokes Co.:** Hanging Rock State Park, (36° 23' 45"N, 80° 15' 22"W), 7213.

**NORTH CAROLINA. Surry Co.:** Pilot Mountain State Park, along trail from upper parking lot, (36° 20' 26"N, 80° 28' 42"W), 7154.

**NORTH CAROLINA. Transylvania Co.:** Pink Beds Recreation Area—Cradle of Forestry in America on US Hwy 276, 4 mi S of Blue Ridge Parkway in Pisgah National Forest, (35° 21' 09"N, 82° 46' 49"W), 24961.

***Rimelia reticulata*** (Taylor) Hale & A. Fletcher, Bryologist 93: 28 (1990)

*Parmelia reticulata*, Taylor, Fl. Hibern. 148 (1836)

*Parmotrema reticulatum* (Taylor) M. Choisy, Soc. Bot. Lyon 21: 148 (1952)

**Thallus** foliose, 3-20 cm broad, loosely adnate to adnate. **Lobes** 4-20 mm wide, elongate and rounded to subirregular, with deeply crenate margins which can sometimes be subascending. **Marginal cilia** abundant, black, simple, to 3 mm long. **Upper cortex** green-gray to white-gray, dull, strongly maculate in reticulate pattern, often reticulately cracked to the margins. **Soredia** granular, in laminal to marginal circular to pustulate soralia, sorediate lobe tips often revolute. **Medulla** white. **Lower cortex** black, typically brown (or very rarely white and brown splotched) toward lobe apices. **Rhizines** abundant, extending to margins, black, unbranched to sparingly squarrosely branched, to 3.5 mm long. **Apothecia** not common in Southern Appalachian specimens, to 4.5 mm broad, the disc brown, the exciple sorediate (Dey, 1975). **Pycnidia** present, Hale and Fletcher (1990) reported that they were immersed.

**Spot tests:** Cortex K+ yellow; medulla K+ yellow turning red, C-, PD+ orange.

**Secondary metabolites:** cortex with atranorin; medulla with salazinic acid (major) and consalazinic acid (minor).

**Local ecology:** Common; on hardwood trees and on rock, rarely on conifer trees.

**General distribution:** Wide spread in tropical and temperate areas (Hale & Fletcher 1990) including parts of North and South America, Europe, Africa, Asia, Australia, and New Zealand. In the United States it has an Eastern Deciduous Forest distribution.

**Comments:** The soredia of *Rimelia reticulata* are quite variable from powdery to very coarsely granular on different thalli. Additionally there may be considerable variation in the soredia on different lobes of the same thallus. Some thalli may even have granular to coarsely granular soredia that become partially corticate and verge on becoming granular isidia. We have chosen to recognize such specimens as *Rimelia reticulata*. Another local *Rimelia* species—*R. subisidiosa*—has well defined cylindrical to coralloid isidia that may occasionally have apical cilia.

Typical *Rimelia reticulata* specimens are broad lobed and grow to produce medium-to-large thalli. Many dicotomous keys use broad lobes as a useful character in the identification process. Some thalli of *R. reticulata* only have narrow lobes even though the thalli may be fairly large. The upper cortex of the lobes is strongly maculate in a reticulate pattern and the lower cortex is rhizinate to the tips of their lobes as is characteristic of the genus.

*Rimelia reticulata* can be differentiated from all other local sorediate *Rimelia* species by its production of salazinic acid and consalazinic acid in the medulla (K+ yellow turning red, C-Pd+ orange). *Rimelia simulans* produces fatty acids in the medulla (K-, C-, KC-, CK-, Pd-) and *R. diffractaica* produces diffractaic acid and lichexanthone in the medulla (K-C-, KC-,

CK+ orange, Pd-, UV+). *Rimelia subisidiosa* has isidia and *R. cetrata* lacks both soredia and isidia.

**ILLUSTRATIONS: See Figure 13**

**SPECIMENS EXAMINED: (93)**

**Great Smoky Mountain National Park. (See Map 7)**

**NORTH CAROLINA. Haywood Co.:** Along Cataloochie Trail from McKee Branch Trail Head to knob adjacent to Purchase Knob Education Center, (35° 35' 5.0-18.0"N, 83° 4' 36.4-37.9"W), 31210, 31241; Big Cataloochie (35° 40' 2.0"N, 83° 40' 1.0"W), 3621; Cataloochie School Foot Bridge area, (35° 37.5'N, 83° 6.8'W), 29597; Inadu Knob along the Appalachian trial in Fire Cherry Community (35° 43' 34"N, 83° 14' 27"W), 3721, 3723; Mt. Sterling deciduous ectone (35° 41' 57"N, 83° 7.0' 29"W), 3555; Near Big Creek Campground/Picnic area on Big Creek, 1 mi SW of Mt. Sterling cross roads, (35° 45.8'N, 83° 6.5'W), 30234, 30245; Rough Fork Creek Trail Head, Cataloochie Valley, (35° 37.0'N, 83° 7.2'W), 29627, 29637, 29646, 29648, 29712**;. Upper McKee Branch Trail to junction with Cataloochie Trail, (35° 35' 5.0"N, 83° 4' 37.9"W), 31172.

**NORTH CAROLINA. Swain Co.:** Alluvial flood plain adjacent to Oconaluftee River (ATBI Reference Plot A18), (35° 30' 33"N, 83° 18' 06"W), 30065, 30074, 30085, 30131; Appalachian Trail, above parking area 0.2 mi N from Fontana Dam (35° 27' 35.1"N, 83° 48'

38.5"W), 31878, 31899, 31920, 31922; Balsam Mountain Campground, 8.6 mi N of Blue Ridge Parkway on Heintooga Road and 5 mi N of Black Camp Gap (35° 33' 59"N, 83° 10' 30"W), 31742; Collins Creek Picnic Area off US Hwy 441, 4.8 mi N of Oconaluftee Visitors Center, (35° 34' 2.5"N, 83° 20' 9.1"W), 31781, 31791; Forney Ridge below the Clingmans Dome parking lot in Fire Cherry Community (35° 33' 21"N, 83° 29' 51"W), 6758; Indian Gap (ATBI Reference Plot A06), (35° 36' 40"N, 83° 26' 36"W), 29910; Round Bottom Horse Camp area on Round Bottom Road, 3.4 mi NE of GSMNP boundary, via Big Cove Road, (35° 37.0'N, 83° 12.6'W), 29430; Trail N from Towstring Horse Camp N along Oconaluftee River, 1 mi S of Smokemont Campground opp. US Hwy 441, (35° 32.6' N, 83° 18.0"W), 29489; Trail W of tunnel at end of Lakeside Dr. from Fontana Road, (35° 27' 40.2"N, 83° 32' 42.1"W), 31394,* 31396, 31427, 31319 31370, 31345, 31393, 31405.

**TENNESSEE. Blount Co.:** Area Along Sea Branch stream at Cades Cove Loop Road, 0.3 mi E of Sparks Lane (35° 35' 39.6"N, 83° 47' 27.8"W) 32887, 32900; Cades Cove grassland pasture (ATBI Reference Plot A03), (35° 35' 34"N, 83° 50' 16"W), 30153, 30157, 30148, 30176; Cades Cove Picnic Area, (35° 36' 21.7"N, 83° 46' 21.9"W), 32804; Cades Cove Visitor Center area at SE end of Cades Cove, (35° 35' 08"N, 83° 50' 34"W), 24701; Cold Spring Gap on Cades Cove Mtn., 3.6 mi N on Rich Mtn. Road from Cades Cove Loop Road, (35° 37' 32"N, 83° 49' 24"W), 30480; Dorsey Branch cove forest at Tremont, (ATBI Reference Plot A18), tulip poplar forest, (35° 38' 20"N, 83° 41' 55"W), 29968; Forest opposite Cades Cove Missionary Baptist Church near intersection of Rich Mtn. Road and Cades Cove Loop Road, (35° 36' 32"N, 83° 49' 36"W), 32839; Forge Creek, 2.3 mi S on

Parson's Branch Road from Cades Cove Loop Road at Cable Mill Visitor Center, (35° 33' 46"N, 83° 50' 50"W), 30254, 30258 30295; Hillside behind Tipton Oliver Place, 2.3 mi E of Cable Mill Visitor Center on Cades Cove Loop Road, (35° 35' 15"N, 83° 48' 42"W), 30330; Hyatt Lane, 0.6 mi N of Cades Cove Loop Road (35° 35' 49.7"N, 83° 49' 26.2"W), 32854; Parson Branch Road at Trailheads of Hannah Mountain Trail and Gregory Bald Trail, (35° 32.6'N, 83° 53.7'W), 29745, 29776; Rabbit Creek Trail bottomland on E side of Abrams Creek near Abrams Creek Ranger Station, (35° 36' 22"N, 83° 56' 01"W), 32645, 32660, 32686, 32701; Rich Mtn. Trailhead from Cades Cove Loop Road to Crooked Arm Ridge Trailhead at Crooked Arm Branch, (35° 36' 33"N, 83° 46' 58"W), 30862; Ridge to North of Pine Mountain Summit along Rabbit Creek Trail, (35° 36' 24"N, 83° 55' 30"W), 32729, 32737; Ridge to north of Pine Mountain along Rabbit Creek Trail, (35° 36' 24" N, 83° 55' 30" W), 32736; School House Gap Trail along Spence Branch, 3.2 mi SW on Laurel Creek Road from Little River Road, (35° 37' 44"N, 83° 43' 43"W), 30404; SW slope of Rich Mtn. at feeder creek of Horse Creek, 6.4 mi N on Rich Mtn. Road from Cades Cove Loop Road, (35° 38' 15"N, 83° 48' 18"W), 30549; 0.2 mi N on Sparks Lane from S section of Cades Cove Loop Road, (35° 35' 51"N, 83° 47' 41"W), 30416, 30428.

**TENNESSEE. Cocke Co.:** Cosby Picnic Area near Cosby Creek, (35° 45' 13"N, 83° 16' 21"W), 31091, 31092; Laurel Springs Road edge of GSMNP opposite Laurel Spring Church, 1 mi S of E junction of road with U.S. Hwy 321, (35° 46' 20.3"N, 83° 15' 29.2"W), 31958, 31977; Maddron Bald Trail Head off Laurel Spring Road to Willis Baxter Cabin along trail (35° 45-46' 45.8"N, 83° 16' 15.5"W), 31027**, 31052***.

**TENNESSEE. Sevier Co,:** Above loop in US 441 SE of Gatlinburg, (35° 37' 58"N, 83° 27' 40"W), 7830; Along Little Pigeon River, 0.7 mi N of Greenbrier Ranger Station on Greenbrier Road, 0.4 mi S of U.S. Hwy 321, (35° 44' 6.0"N, 83° 24' 47.2"W), 32967, 32976; Along Little River near Rattlebox Branch, 1.65 mi W on Little River Road from Elkmont Campground Road, (35° 39' 46"N, 83° 37' 15"W), 30566; Along Wear Cove Road, 0.4 mi S of Wear Cove Gap and GSMNP boundary, (35° 41' 20"N, 83° 38' 45"W), 32761, 32775, 32778, 32779; Greenbrier Cove at Settlers Trail head near junction of Porters Creek Road and Ramsey Cascades Road, 3.1 mi S of Greenbrier Ranger Station, (35° 42' 29.1"N, 83° 22' 48.1"W) 32948, 32955; Road bank, 1 mi N of U.S. Hwy 411 on Gatinburg By-pass Road, (35° 42' 20"N, 83° 31' 52"W), 29582; Roadside stop #1 on Little River Road (TN Hwy 73) less than 0.5 mi west of Visitors Center, (35° 41' 04"N, 83° 32' 38"W), 24670, 24679; S of Goshen Prong trail and Fish Camp Prong, 1.0 mi SW of Junction with Little River Trail "Goshen Prong" (ATBI plot A04), (35° 36' 40"N, 83° 32' 36"W) , 32985, 31000, 33006; Sugarlands Visitors Center Area near Gatlinberg at Junction US Hwy 441 and Little River Road, (35° 41' 8.2"N, 83° 32' 15.2"W), 31858; Twin Creeks adjacent to Uplands Research Lab (ATBI Reference Plot A18), tulip poplar forest, (35° 38' 20"N, 83° 41' 55"W), 30003, 30005.

* Narrow lobed thallus

** Compare favorably with ***Rimelia*** **reticulata**

***Rimelia simulans*** (Hale) Hale & A. Flecher, Bryologist 93: 29 (1990)

*Parmelia simulans* Hale, Phytologia 22:32. (1971)

*Parmotrema simulans* (Hale) Hale Phytologia 28: 339 (1974)

**Thallus** foliose, 2.0 to 15.0 cm broad, loose to adnate. **Lobes** 1.0 to 11 mm wide, round, to lacinate in the center of the thallus. **Marginal cilia** rare to abundant, black, simple, to 2.0 mm in length. **Upper cortex** mineral gray to grayish green, smooth and dull, strongly maculate to the margins in reticulate pattern, reticulate cracking concentrated in the center of the lobes. **Soredia** abundant, coarse and granular in submarginal to marginal sorelia, mainly on lacinate lobes, sorediate lobe tips becoming revolute. **Medulla** white. **Lower cortex** black typically brown at lobe apices. **Rhizines** dense at center, sparser to margins, black, simple or squarrosely branched, to 1.5mm long. **Apothecia** not seen. **Pycnida** present, Hale and Fletcher (1990) reported that they were immersed.

**Spot tests:** cortex K+ yellow; medulla K-, C-, KC-, Pd-, UV-

**Secondary metabolites:** cortex with atranorin; medulla with caperatic acid (major)

**Local ecology:** Found on trees and rock in open habitats.

**General distribution:** North and Tropical America (Hale & Fletcher 1990). In the United States found in Arizona, Tennessee, North Carolina, & Georgia

**Comments:** *See comments under Rimelia reticulata.*

**ILLUSTRATIONS: See Figure 14**

**SPECIMENS EXAMINED: (7)**

**Great Smoky Mountain National Park. (See Map 8)**

**NORTH CAROLINA. Swain Co.:** Collins Creek picnic area off US Highway 441, (35° 34' 2.5"N, 83° 20' 9.1"W) 31803.

**TENNESSEE. Blount Co.:** Forge Creek, 2.3 mi S on Parson's Branch Road from Cades Cove Loop Road at Cable Mill Visitor Center, (35° 33' 46"N, 83° 50' 50" W) 30267; Forest opposite of Cades Coves Missionary Baptist Church near intersection of Rich Mtn. Road and Cades Cove Loop Road, (35° 36' 32"N, 83° 49' 36"W) 32822.

**Southern Appalachian Mountains.**

**GEORGIA. Rabun Co.:** FHM plot # 3408374, off U.S. Hwy 76 west of Clayton, FHM 3408374-27, 3408374-15.

**NORTH CAROLINA. Burke Co.:** Linville Falls off Blue Ridge Parkway, (35° 56' 57"N, 81° 55' 41"W), 6955.

**TENESSEE. Monroe Co.**: Double Camp Campgrounds on Citico Creek, approx. 17 mi NE of Tellico Plains, (35° 26' 28"N, 84° 06' 26"W) 7910.

***Rimelia subisidiosa*** (Mull. Arg.) Hale & A. Fletcher, Bryologist 93: 29 (1990)

*Parmelia cetrata* var. *subisidiosa* Mull. Arg., Engler Bot. Jahrb. 20: 256 (1894)

*Parmelia subisidiosa* (Mull. Arg.) C. W. Dodge, Mo. Bot. Garden 46:87 (1959)

*Parmotrema subisidiosum* (Mull. Arg.) Hale, Phytologia 28:339. (1974)

**Thallus** foliose, 3.0 to 12.0 cm broad, loose to adnate. **Lobes** are 3-15 mm wide, subirregular, rounded to elongate, crenate. **Marginal cilia** sparse to abundant, black, simple or sparingly branched, to 3.0 mm long. **Upper cortex** mineral gray to green-gray, smooth and dull, strongly maculae to the edges in reticulate pattern, and reticular cracking along the maculae with age. **Isidia** abundant, laminal and marginal, cylindrical, simple or branched, often with apical cilia . **Medulla** white. **Lower cortex** black, typically brown toward lobe apices. **Rhizines** abundant in center becoming sparse towards margins, black, simple or squarrosely branched, to 2.0mm long. **Apothecia** not seen. **Pycnidia** present, Hale and Fletcher (1990) reported that they were immersed.

**Spot tests:** cortex K+ yellow: medulla K+ yellow turning red, C-, and Pd+ orange.

**Secondary Metabolites:** cortex with atranorin; medulla with salazinic acid (major) and consalazinic acid (minor).

**Local ecology:** Found on trees.

**General distribution:** Tropical America and Africa (hale & Fletcher 1990). Southeastern United States and southwestern United States (Arizona and southern California).

**Comments:** The identification of some *Rimelia* specimens with coarse granular soredia that in part are corticated and isidioid are problematic. We are placing such specimens with soredia and isidioid soredia in *Rimelia reticulata*. *Rimelia subisidiosa* specimens are clearly isidiate. The isidia are cylindrical or coralloid in shape and often have apical cilia.

**ILLUSTRATIONS: See Figures 15 & 16**

**SPECIMENS EXAMINED: (30)**

**Great Smoky Mountain National Park. (See Map 9)**

**NORTH CAROLINA. Haywood Co.:** Inadu Knob along the Appalachian trial in Fire Cherry community (35° 43' 34"N, 83° 14' 27"W), 3722; Mt Sterling, (35° 41' 57"N, 83° 7.0' 29"W), 3583. Rough Fork Creek Trail Head, Cataloochie Valley, (35° 37.0' N, 83° 7.2'W), 29710, 29692.

**NORTH CAROLINA. Swain Co.:** Collins Creek Picnic Area off US Hwy 441, 4.8 mi N of Oconaluftee Visitor Center, (35° 34' 2.5"N, 83° 20' 9.1"W), 31788, 31800; Forney Ridge along Andrews Bald trial (35° 33' 8.0"N, 83° 29' 35"W), 2749; Heintooga Overlook Picnic area at Blue Ridge Parkway Extension (Heintooga Road) turnaround, (35° 34' 24.4"N, 83°

10' 48"W), 31275; Trail at end of tunnel on Lakeside Dr. from Fontana Road, (35° 27' 40.2"N, 83° 32' 42.1"W), 31347, 31403, 31431; Trail N from Towstring Horse Camp along Oconaluftee River, 1 mi S of Smokemont Campground opp. US Hwy 441, (35° 32.6' N, 83° 18.0'W), 29491; Balsam Mountain Campground, 8.6 mi N from Blue Ridge Parkway on Heintooga Road, (35° 38' 15"N, 83° 48' 18"W), 31729, 31744;

**TENNESSEE. Blount Co.:** Cades Cove grassland pasture (ATBI Reference Plot A03), (35° 35' 34"N, 83° 50' 16"W), 30146**, 30175**, 30187**; Cold Spring Gap on Cades Cove Mtn., 3.6 mi N on Rich Mtn. Road from Cades Cove Loop Road, (35° 37' 32"N, 83° 49' 24"W), 30524; Forest opposite Cades Cove Missionary Baptist Church near intersection of Rich Mtn Road and Cades Cove Loop Road, (35° 36' 32"N, 83° 49' 36"W), 32820; Forge Creek, 2.3 mi S on Parson's Branch Road from Cades Cove Loop Road at Cable Mill Visitor Center (35° 33' 46"N, 83° 50' 50"W), 30256; Rabbit Creek Trail bottomland on E side of Abrams Creek near Abrams Creek Ranger Station, (35° 36' 22"N, 83° 56' 01"W), 32688**; Sea Branch area 0.3 mi E of Sparks Lane on S section of Cades Cove Loop Road, (35° 35' 39"N, 83° 47' 28"W), 30455; Turkey Pen Ridge Trail in Big Spring Cove area, 1.6 mi E on Laurel Creek Road from Cades Cove Campground, (35° 36' 33"N, 83° 44' 46"W), 30734, 30782; 0.2mi N on Sparks Lane on S section of Cades Cove Loop Road, (35° 35' 51"N, 83° 47' 41"W), 30429.

**TENNESSEE. Cocke Co.:** Cosby Picnic Area near Cosby Creek, (35° 45' 25"N, 83° 12' 31.1"W), 31102; Maddron Bald Trail between Willis Baxter Cabin to Gales Mtn. Trail junction, (35° 45' 19.5" N, 83° 16' 18.1" W), 31061.

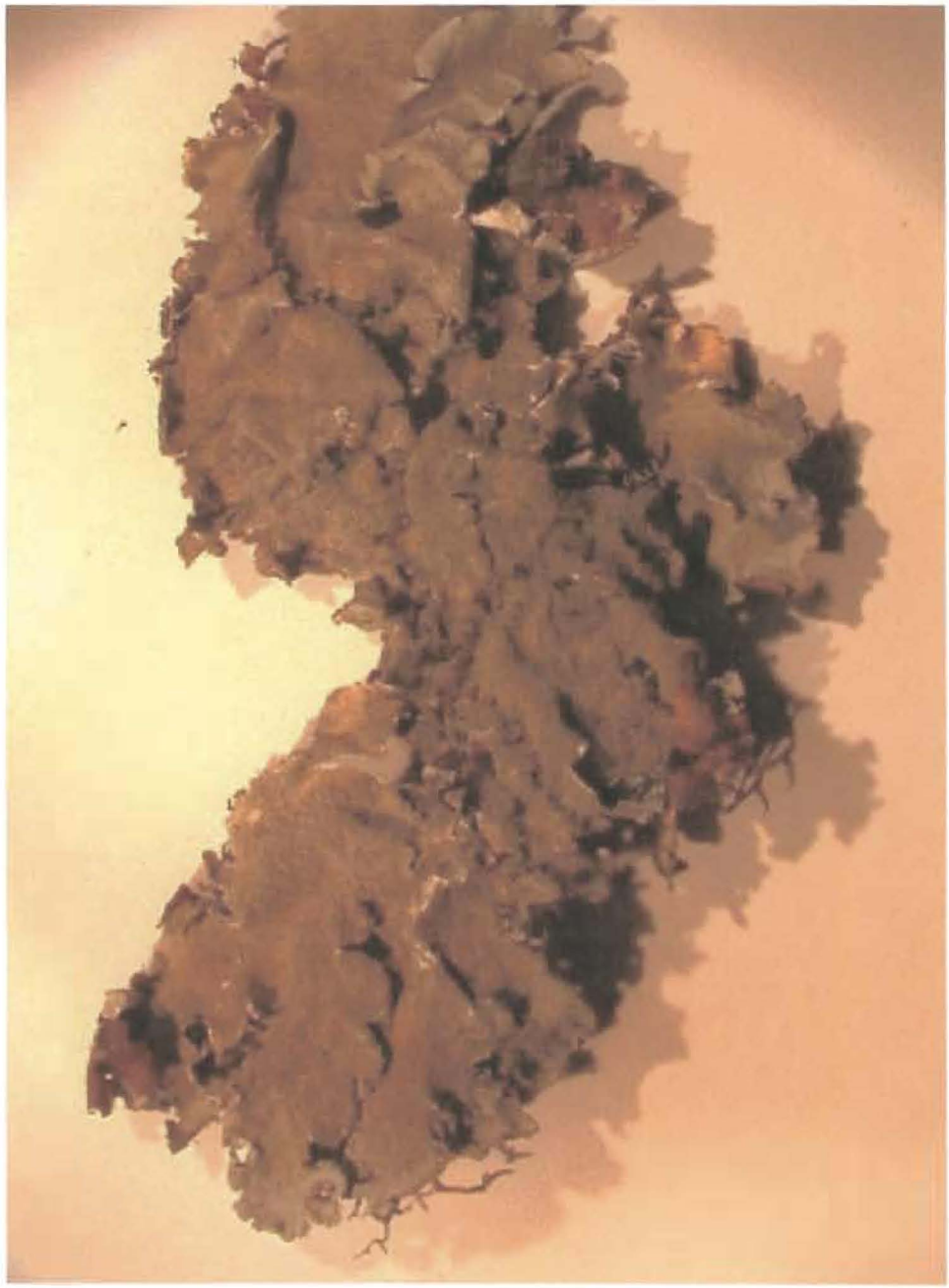
**TENNESSEE. Sevier Co.:** Along Little Pigeon River, 0.7 mi N of Greenbrier Ranger Station on Greenbrier Road, 0.4 mi S of US Hwy 321, (35° 44' 6.0"N, 83° 24' 47.2"W), 33017; Roadside stop #2 on Little River Road (TN Hwy 73) less than 0.9 mi west of Visitors Center, (35° 40' 46"N, 83° 33' 15"W), 24681; Twin Creeks (ATBI Reference Plot A18) adjacent to Uplands Research Lab, (35° 38' 20"N, 83° 41' 55"W), 30004.

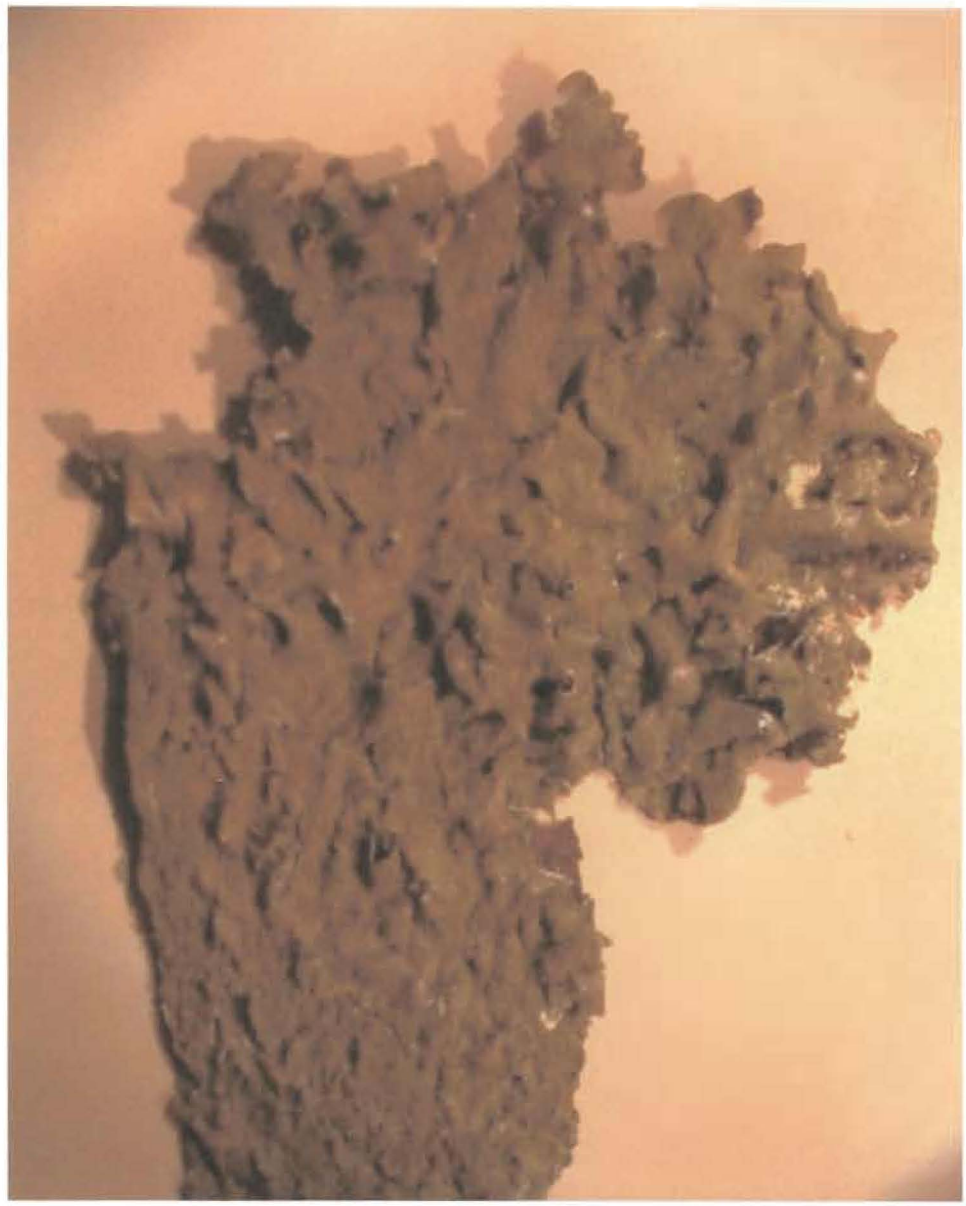
** Compare favorably with ***Rimelia subisidosa***

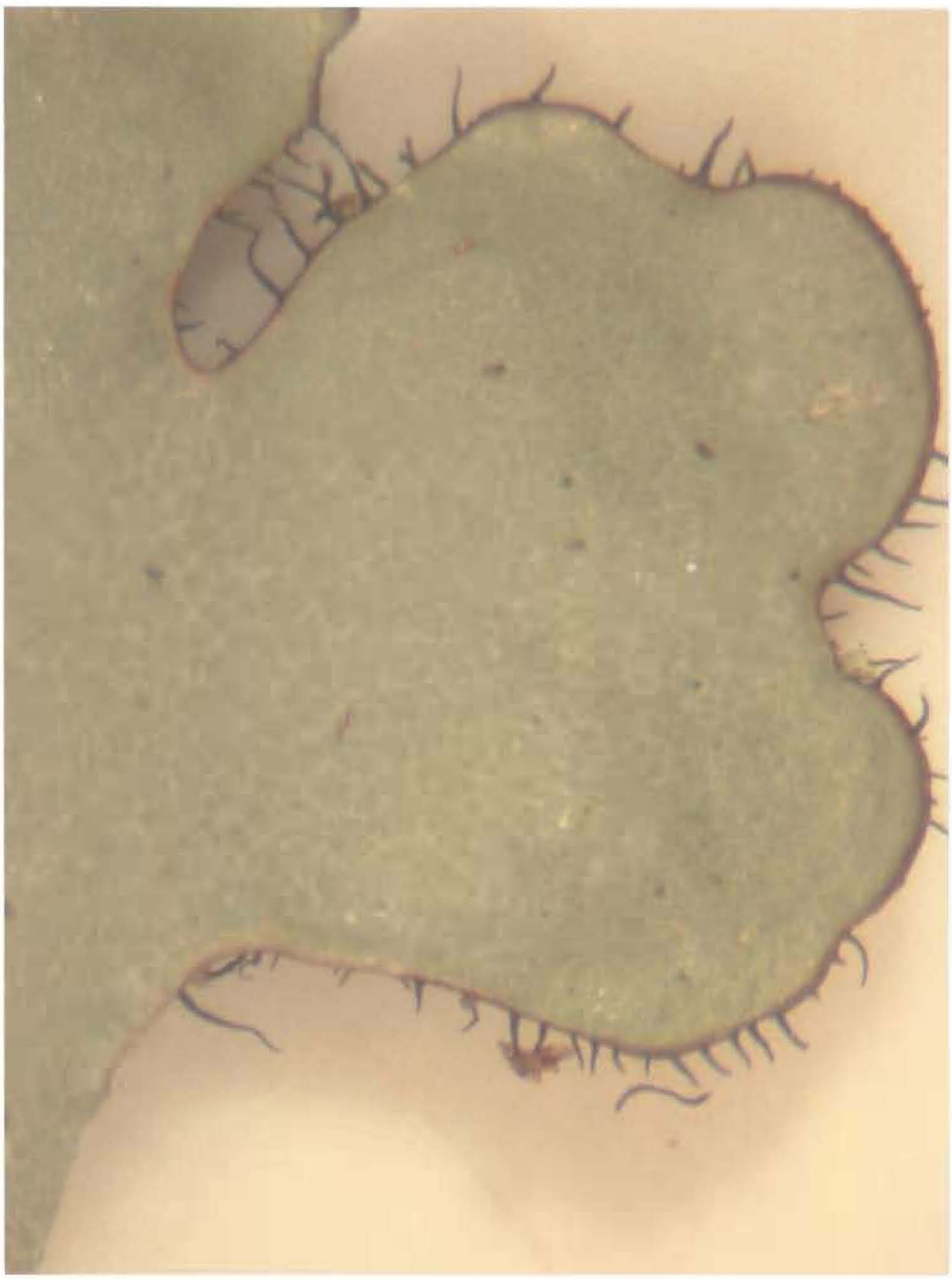
## Table of Figures

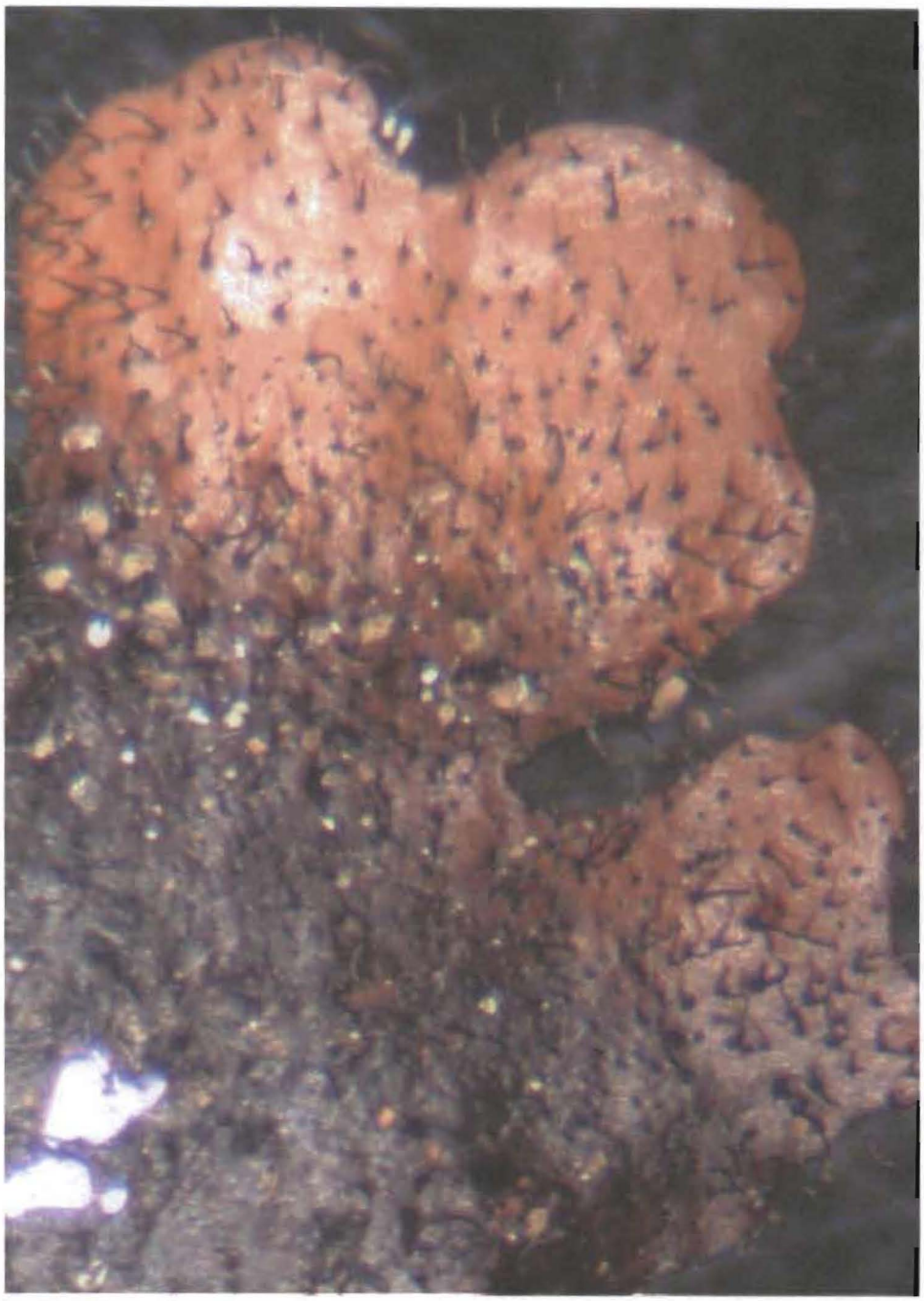


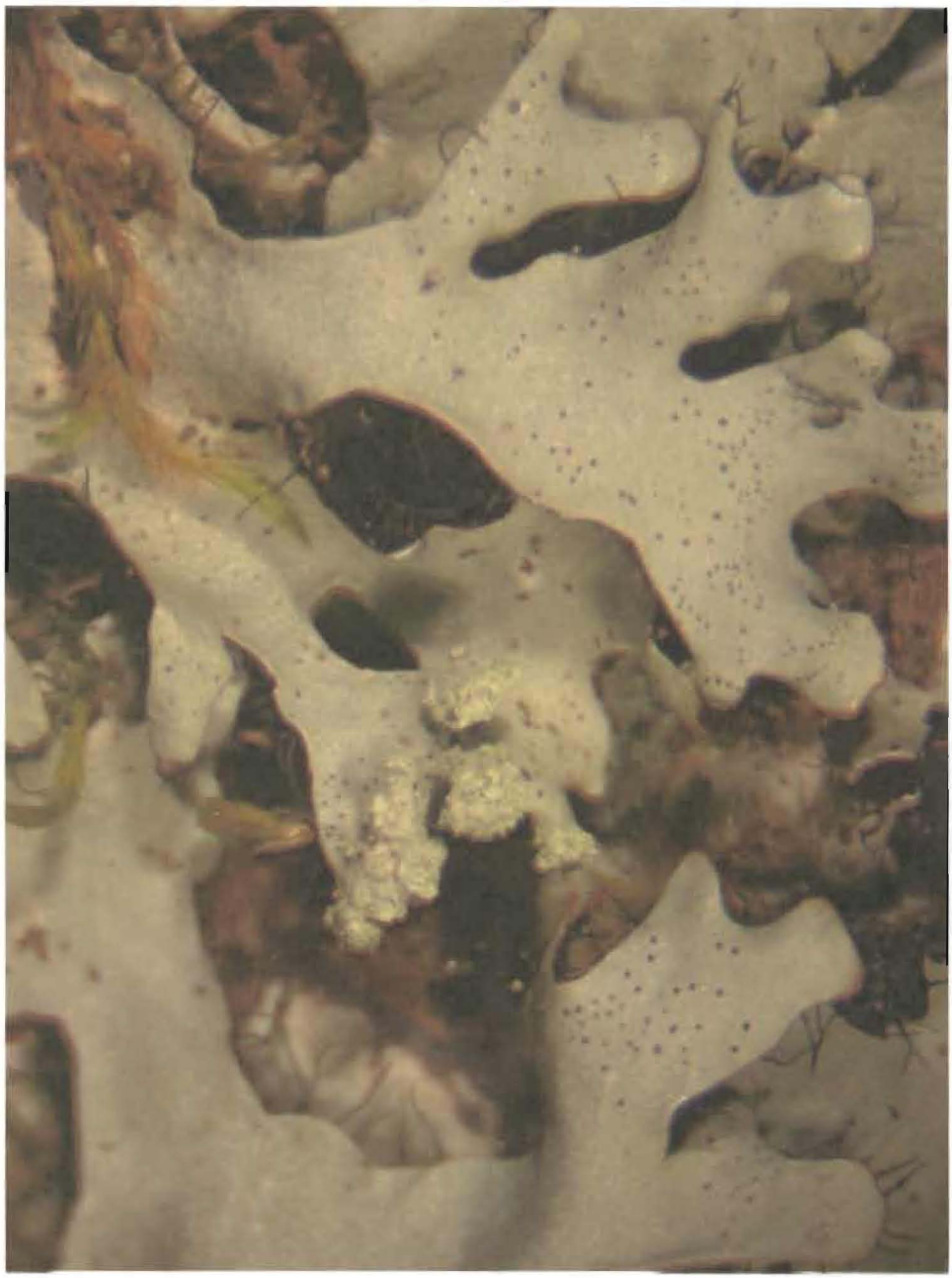
*All photographs taken by Dr. J. Dey

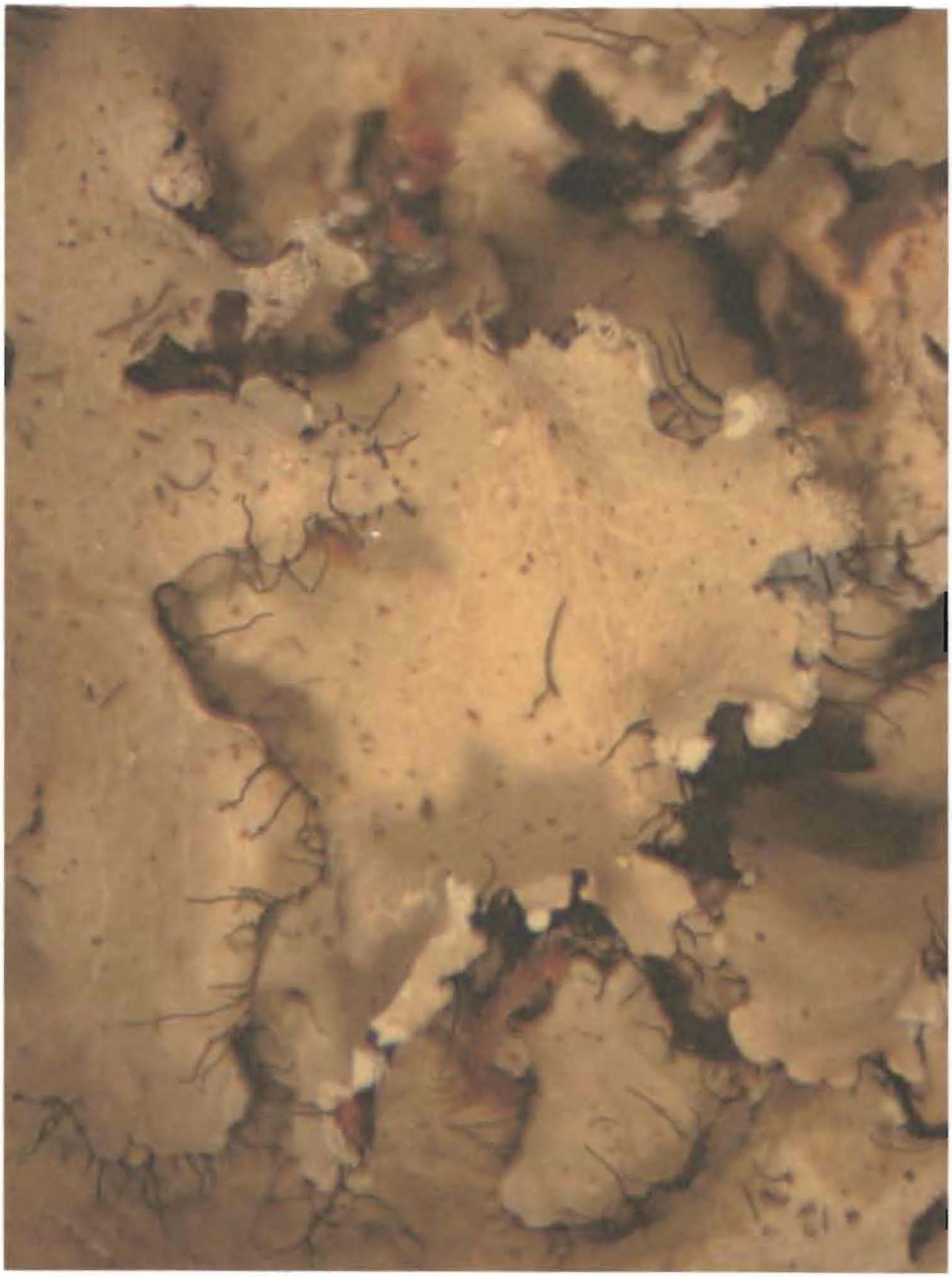


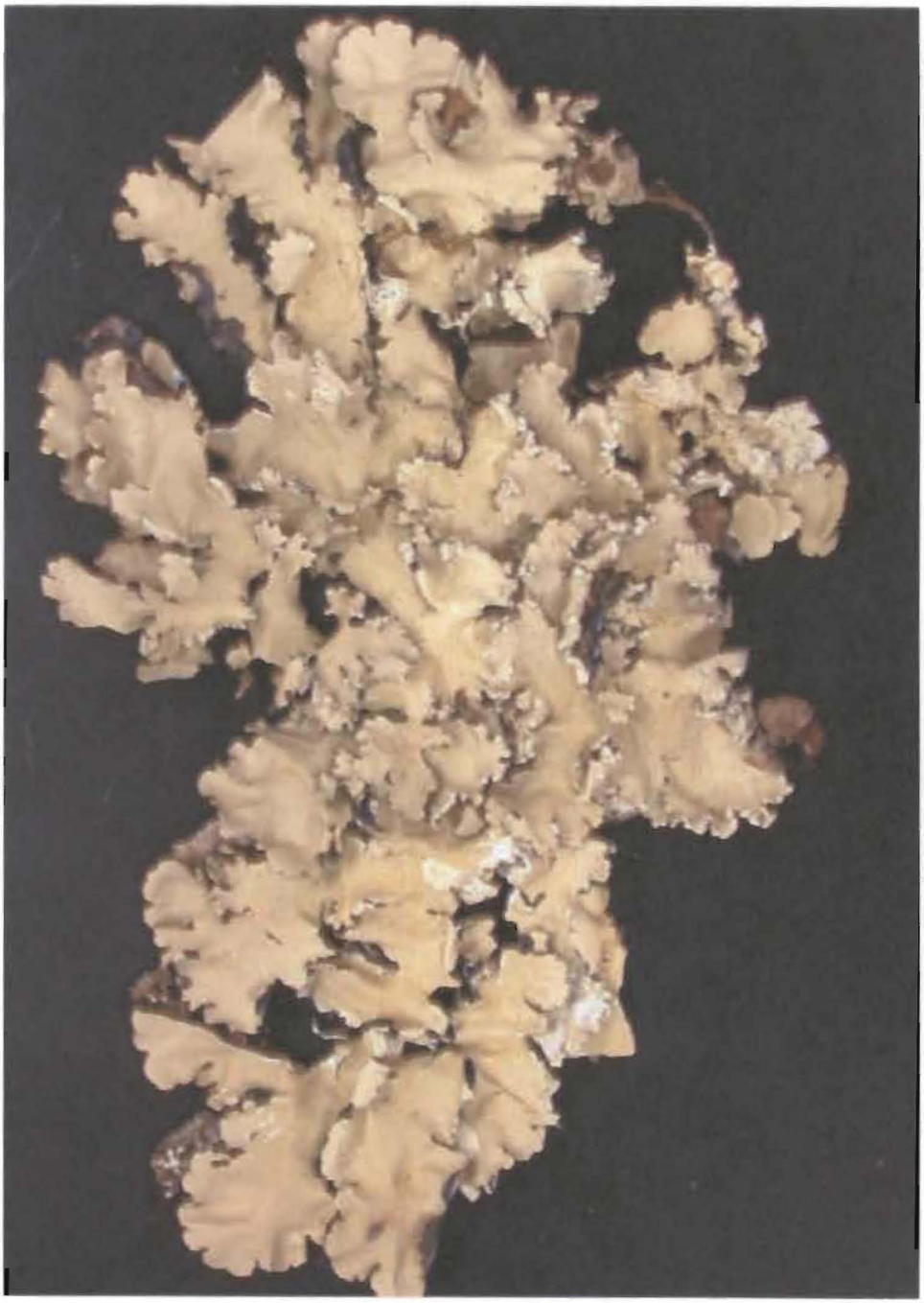


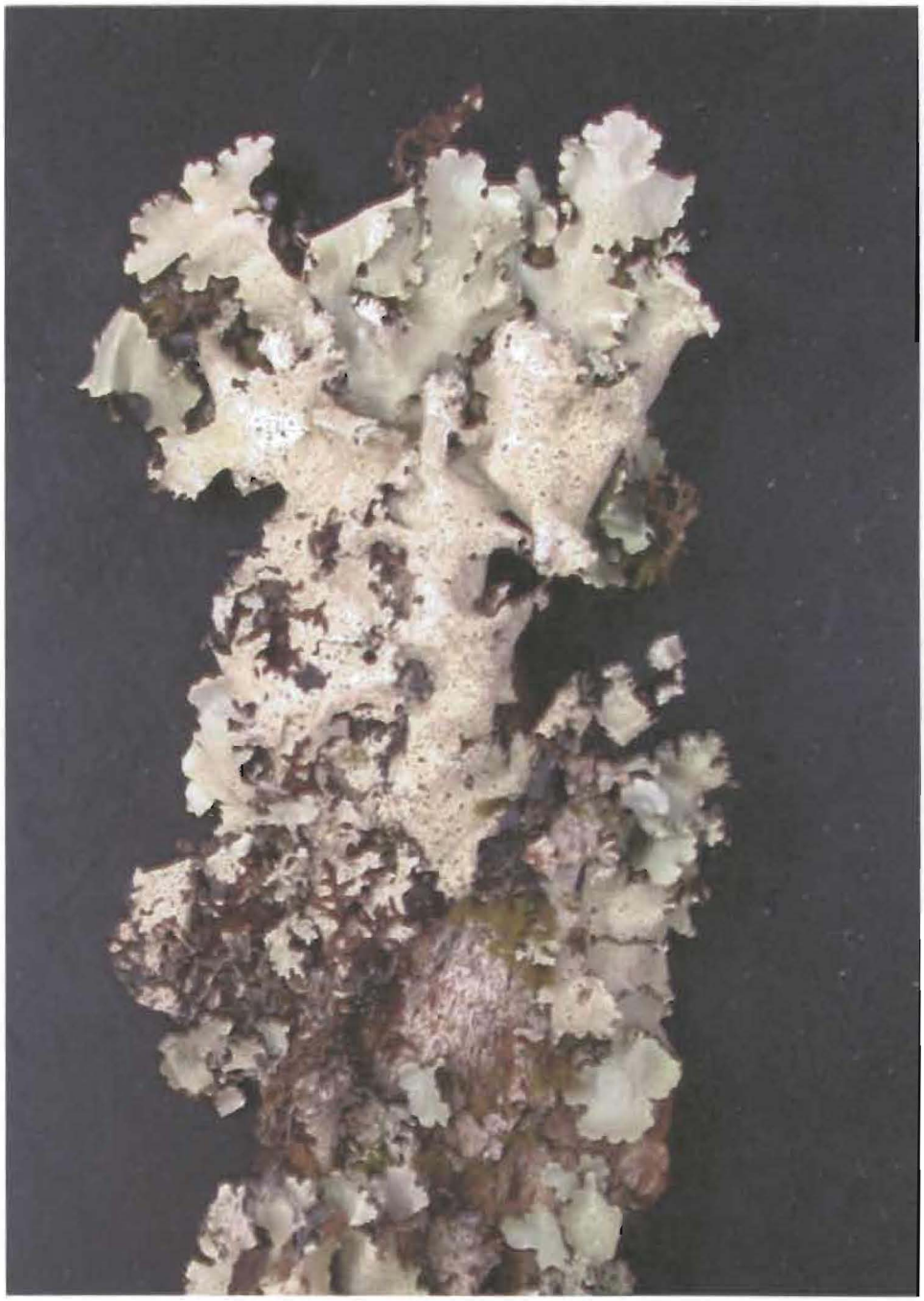












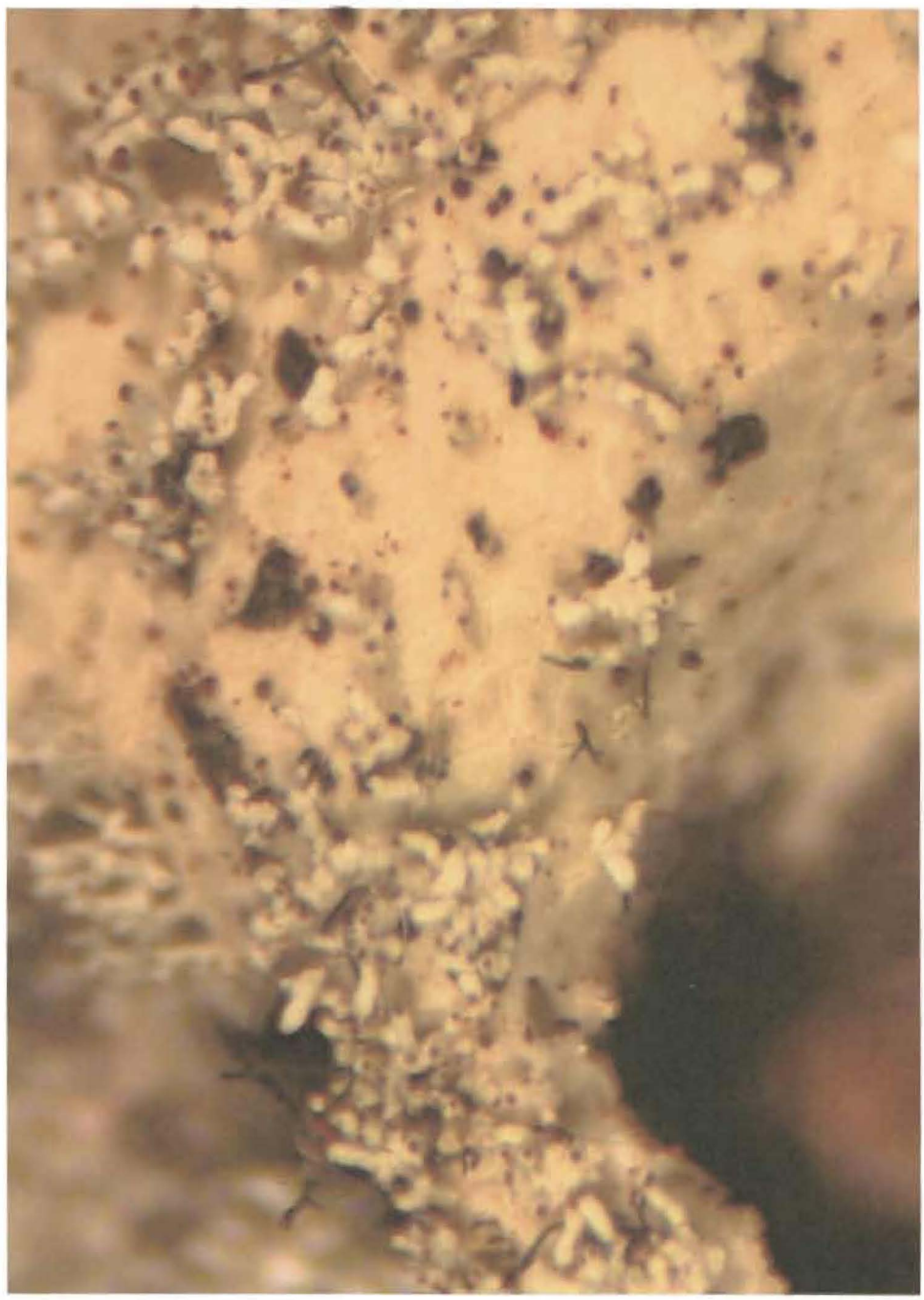
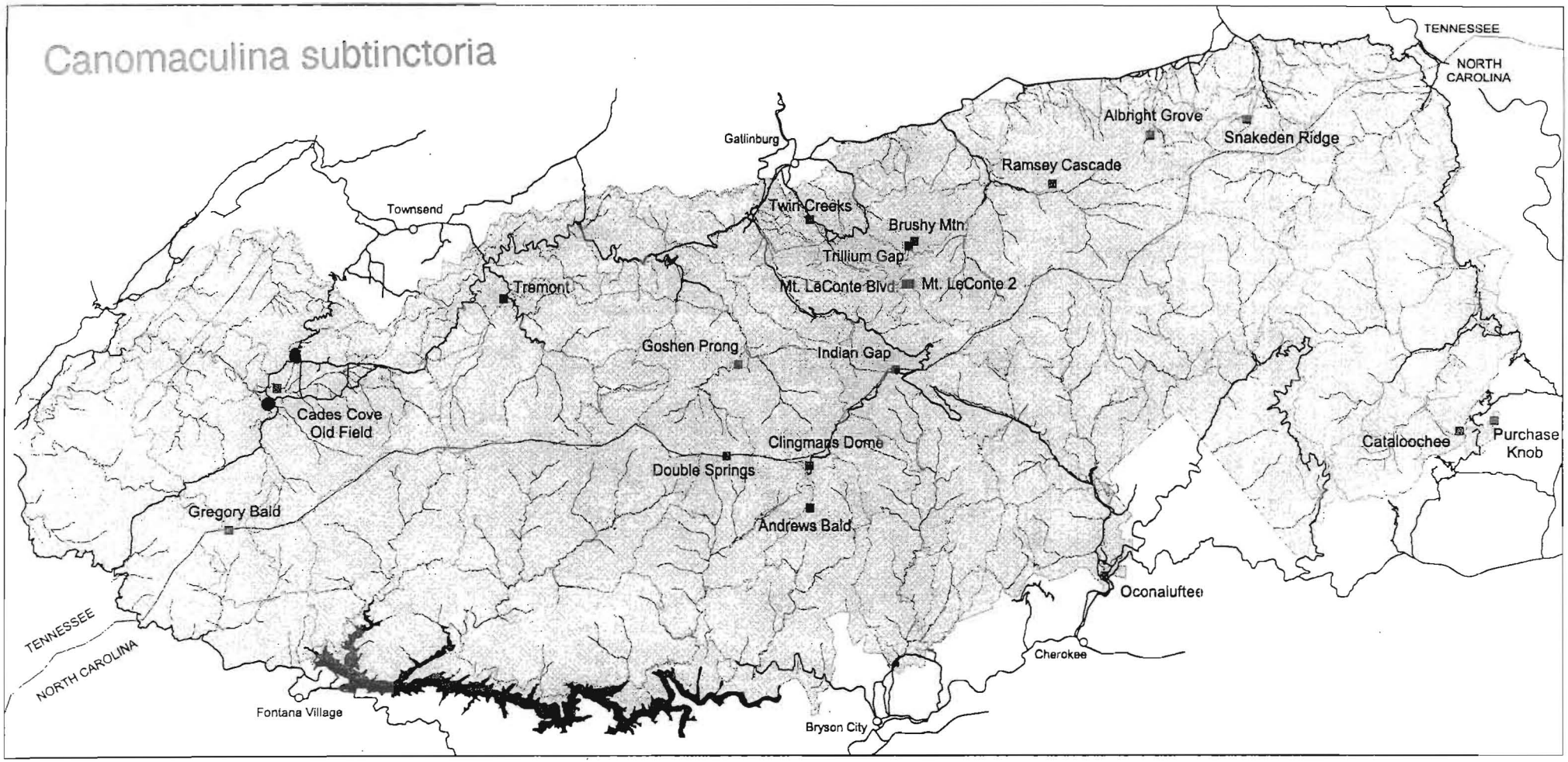


**Table of Distribution Maps of Specimens in the Great Smoky Mountains National Park**

| # on Map | Genus and Species Represented on Map |
|---|---|
| 1 | *Canomaculina subtinctoria* |
| 2 | *Canoparmelia amabilis* |
| 3 | *Canoparmelia caroliniana* |
| 4 | *Canoparmelia crozalsiana* |
| 5 | *Rimelia cetrata* |
| 6 | *Rimelia commensurata* |
| 7 | *Rimelia reticulata* |
| 8 | *Rimelia simulans* |
| 9 | *Rimelia subisidiosa* |

Map 1

# ATBI Plot Locations - Great Smoky Mountains National Park




5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

## Legend

- ATBI Plots
- Great Smoky Mts. NP
- Fontana Lake
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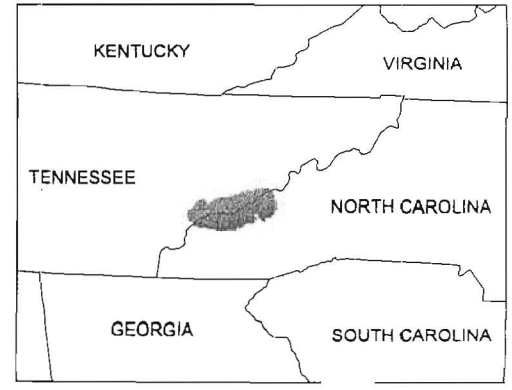
| ATBI PLOT NAME | ELEV. | VEGETATION TYPE | ATBI PLOT NAME | ELEV. | VEGETATION TYPE |
|---|---|---|---|---|---|
| Albright Grove | 3,390' | Montane Cove | Mount LeConte Blvd. | 6,010' | Spruce - Fir |
| Andrews Bald | 5,760' | Grassy Bald | Mount LeConte 2 | 6,430' | Spruce - Fir |
| Brushy Mountain | 4,810' | Heath Bald | Oconaluftee | 2,010' | Bottomland Hardwood |
| Cades Cove Old Field | 1,710' | Treeless | Purchase Knob | 5,020' | Northern Hardwood |
| Cataloochee | 4,530' | Mesic Oak | Ramsey Cascade | 2,950' | Xeric Oak |
| Clingmans Dome | 6,380' | Spruce - Fir | Snakeden Ridge | 3,260' | Hemlock |
| Double Springs | 5,600' | Beech Gap | Tremont | 1,500' | Tulip Poplar |
| Goshen Prong | 2,940' | Cove Hardwood | Trillium Gap | 4,600' | Beech Gap |
| Gregory Bald | 4,940' | Grassy Bald | Twin Creeks | 1,950' | Tulip Poplar - Hemlock |
| Indian Gap | 5,490' | Beech Gap | | | |

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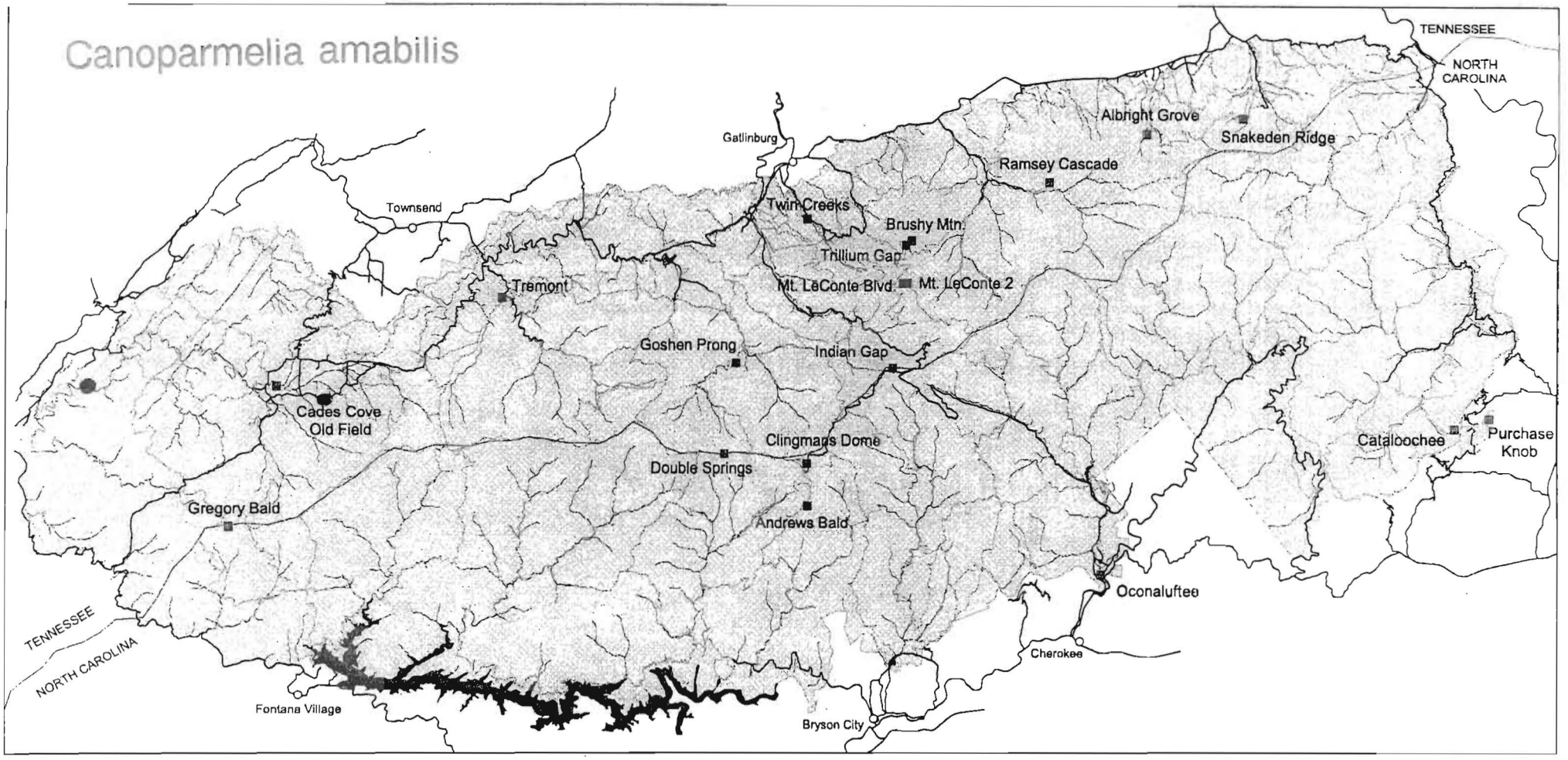
# Map 2 ATBI Plot Locations - Great Smoky Mountains National Park




5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

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| Mount LeConte 2 | 6,430' | Spruce - Fir |
| Oconaluftee | 2,010' | Bottomland Hardwood |
| Purchase Knob | 5,020' | Northern Hardwood |
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| Snakeden Ridge | 3,260' | Hemlock |
| Tremont | 1,500' | Tulip Poplar |
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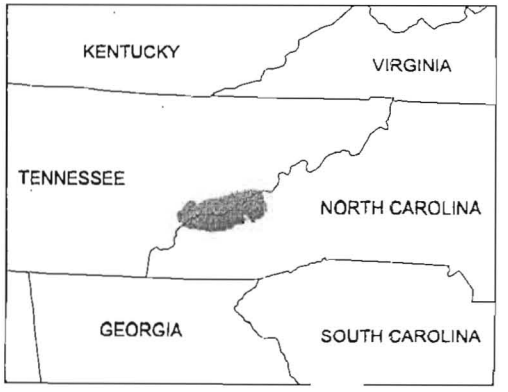
| Twin Creeks | 1,950' | Tulip Poplar - Hemlock |

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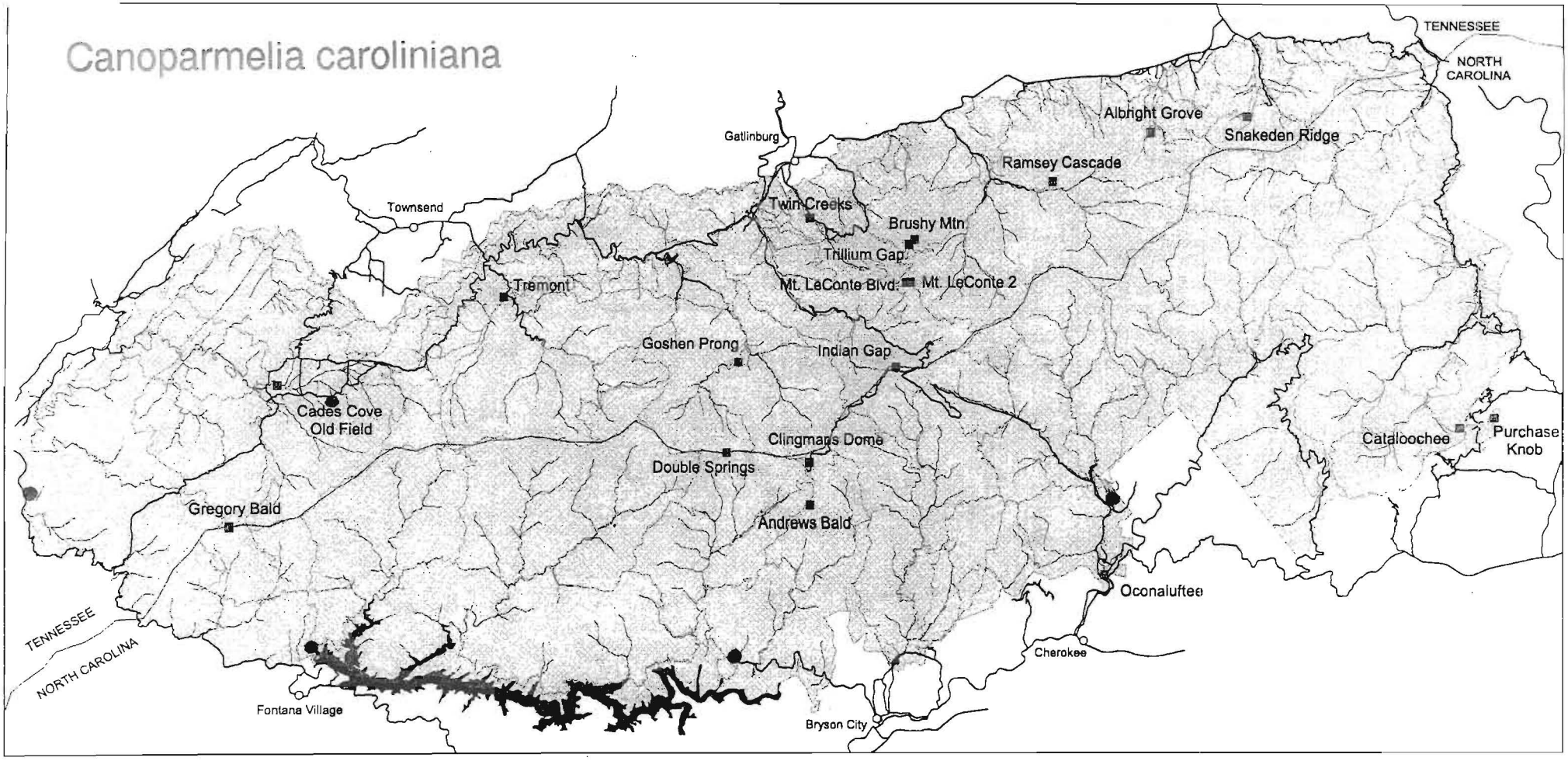
# Map 3 ATBI Plot Locations - Great Smoky Mountains National Park




5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

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| Albright Grove | 3,390' | Montane Cove |
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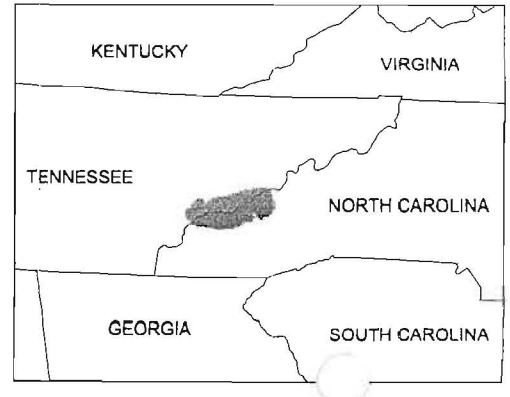
| Mount LeConte 2 | 6,430' | Spruce - Fir |
| Oconaluftee | 2,010' | Bottomland Hardwood |
| Purchase Knob | 5,020' | Northern Hardwood |
| Ramsey Cascade | 2,950' | Xeric Oak |
| Snakeden Ridge | 3,260' | Hemlock |
| Tremont | 1,500' | Tulip Poplar |
| Trillium Gap | 4,600' | Beech Gap |
| Twin Creeks | 1,950' | Tulip Poplar - Hemlock |

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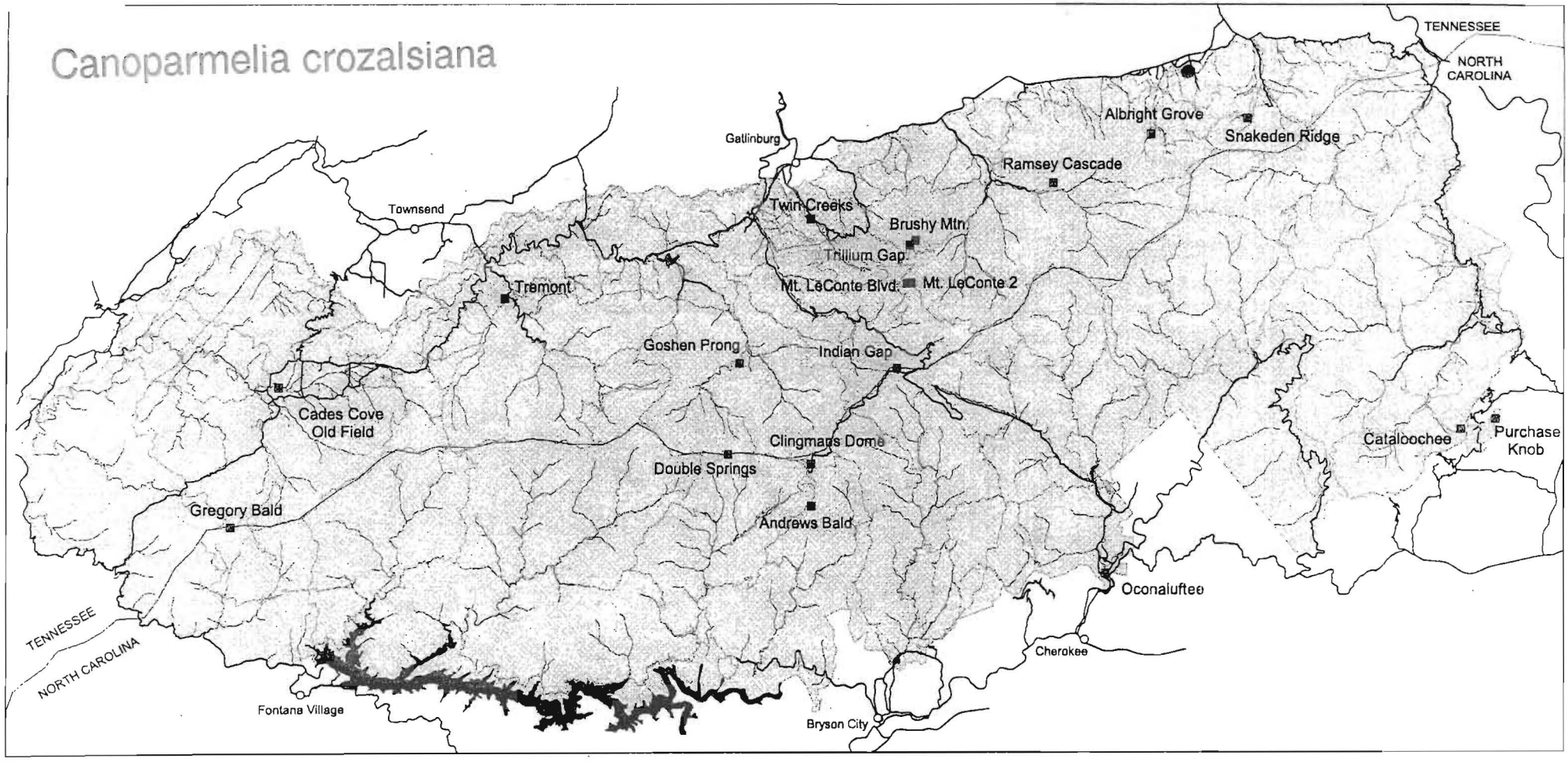
Map 4

# ATBI Plot Locations - Great Smoky Mountains National Park




5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

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| ATBI PLOT NAME | ELEV. | VEGETATION TYPE |
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| Albright Grove | 3,390' | Montane Cove |
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| ATBI PLOT NAME | ELEV. | VEGETATION TYPE |
|---|---|---|
| Mount LeConte Blvd. | 6,010' | Spruce - Fir |
| Mount LeConte 2 | 6,430' | Spruce - Fir |
| Oconaluftee | 2,010' | Bottomland Hardwood |
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| Tremont | 1,500' | Tulip Poplar |
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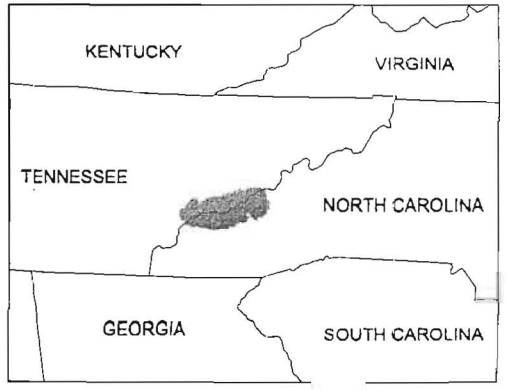
| Twin Creeks | 1,950' | Tulip Poplar - Hemlock |

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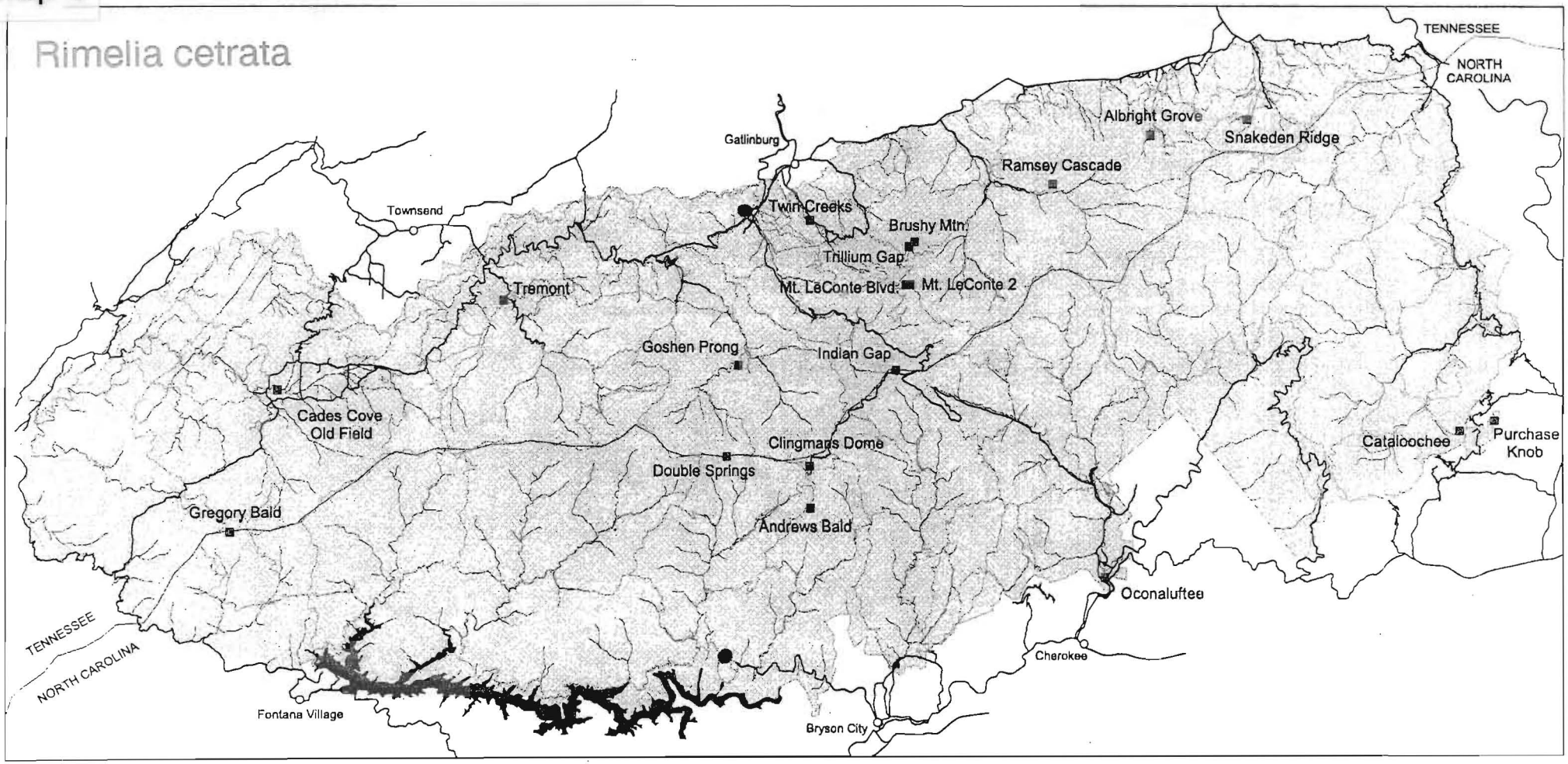
Map 5

# ATBI Plot Locations - Great Smoky Mountains National Park




5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

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| ATBI PLOT NAME | ELEV. | VEGETATION TYPE |
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| Tremont | 1,500' | Tulip Poplar |
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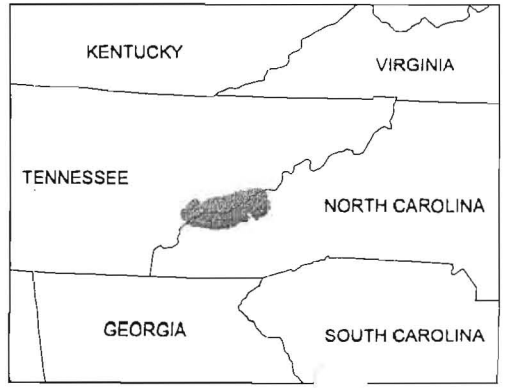


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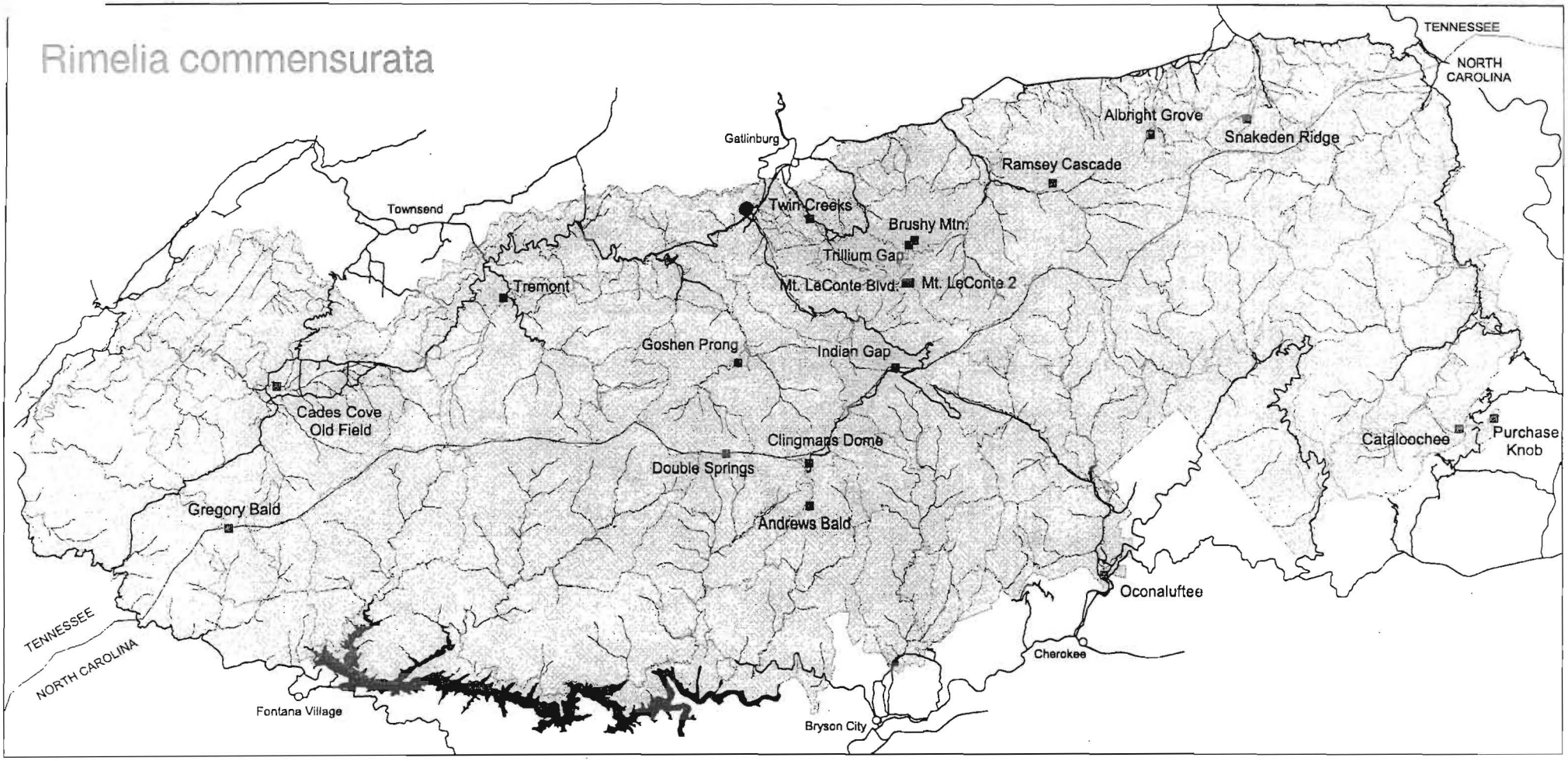
# Map 6 ATBI Plot Locations - Great Smoky Mountains National Park




5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

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| Tremont | 1,500' | Tulip Poplar |
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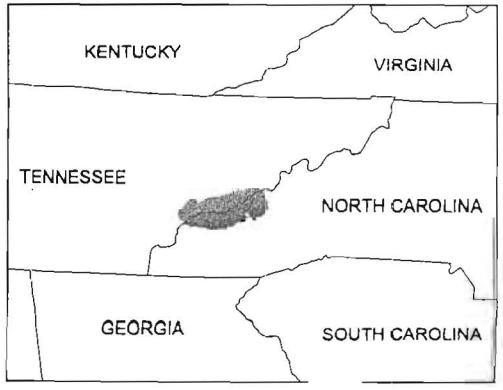
| Twin Creeks | 1,950' | Tulip Poplar - Hemlock |

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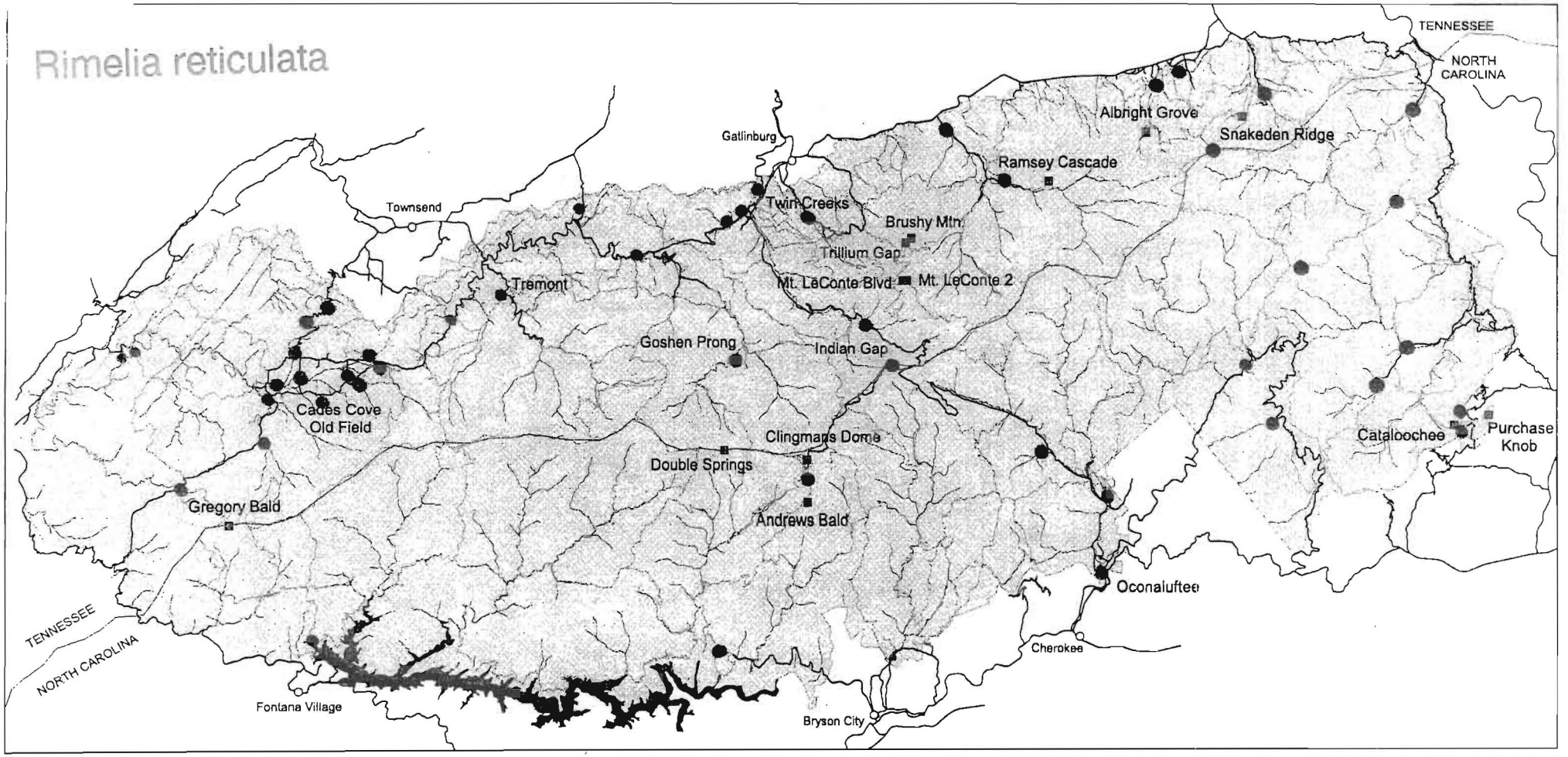
# Map 7 ATBI Plot Locations - Great Smoky Mountains National Park




5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

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| Snakeden Ridge | 3,260' | Hemlock |
| Tremont | 1,500' | Tulip Poplar |
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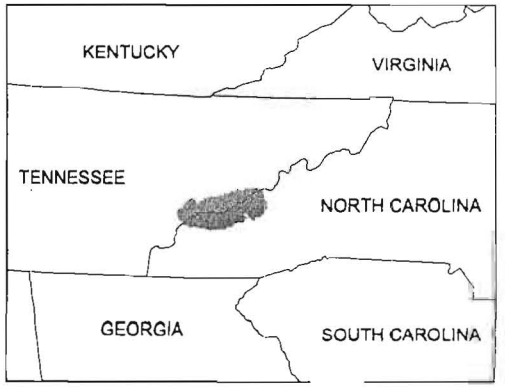


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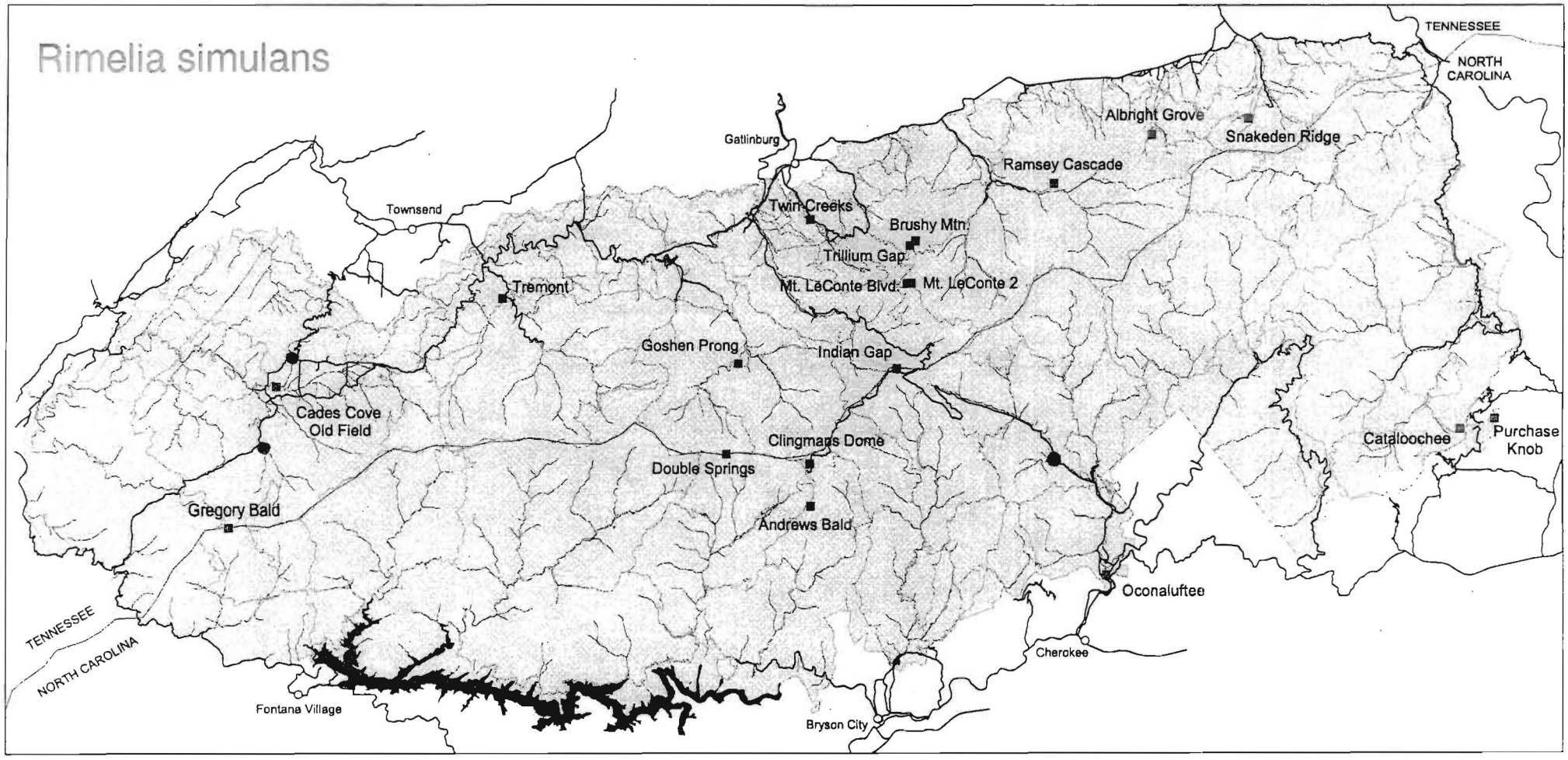
Map 8

# ATBI Plot Locations - Great Smoky Mountains National Park




5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

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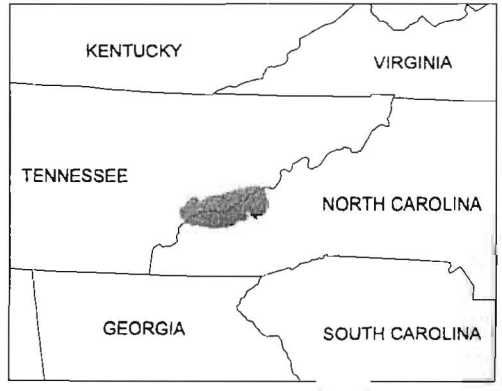


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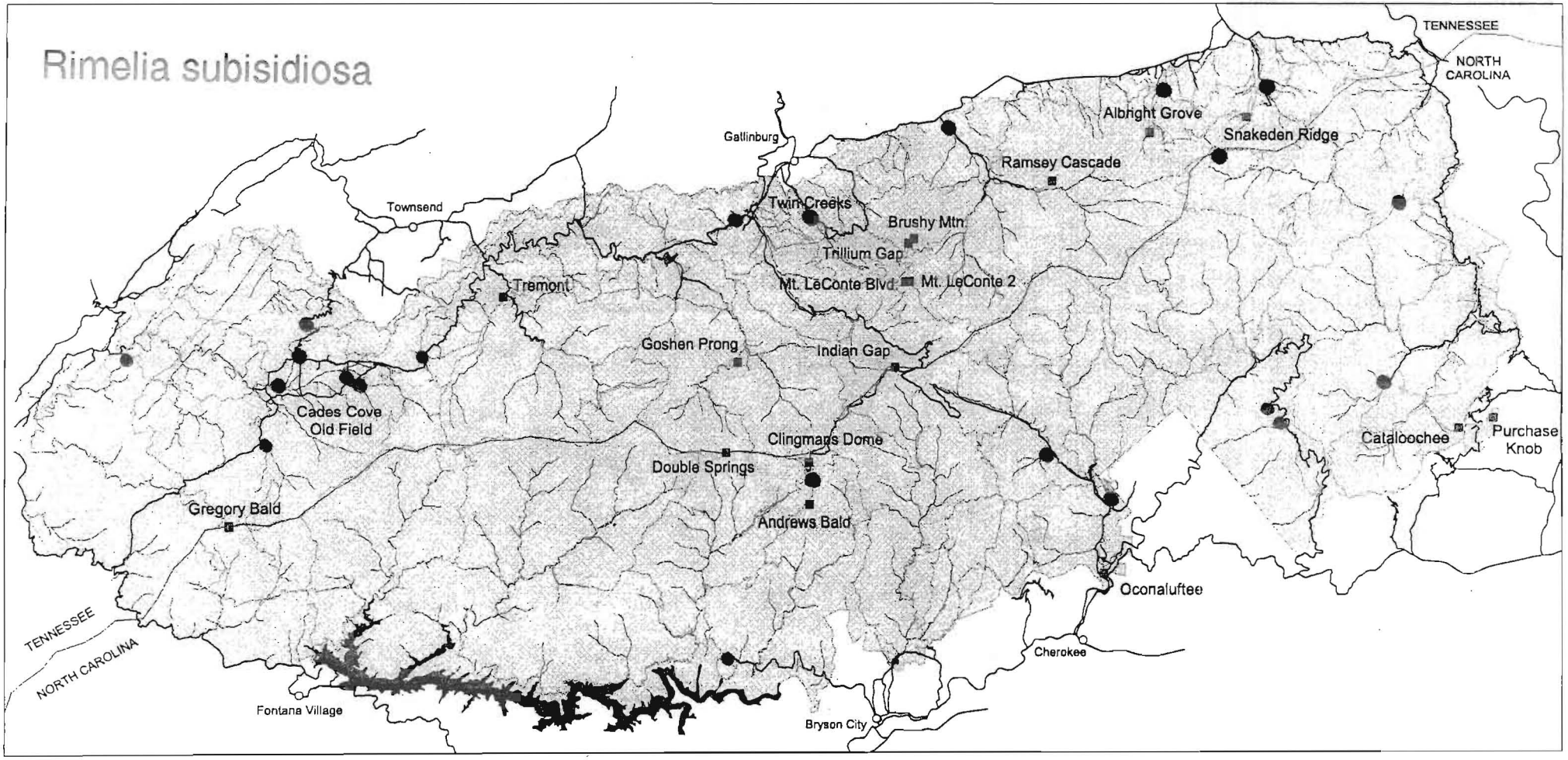
Map 9

# ATBI Plot Locations - Great Smoky Mountains National Park




5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

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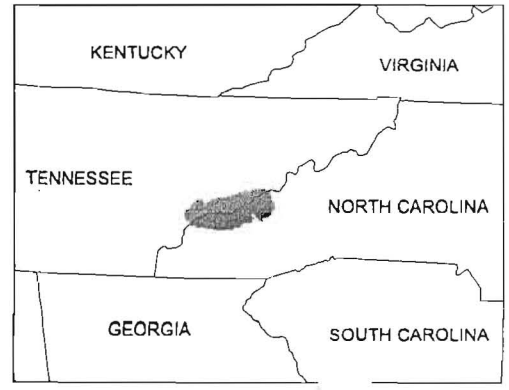


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