

**MACROLICHENS OF THE BIG THICKET NATIONAL PRESERVE AND  
SURROUNDING PINEY WOODS REGION OF SOUTHEAST TEXAS**

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# MACROLICHENS OF THE BIG THICKET NATIONAL PRESERVE AND SURROUNDING PINEY WOODS REGION OF SOUTHEAST TEXAS

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## Abstract

Southeast Texas is an area of rich biodiversity including lichen populations. A floristic survey of the area was conducted in which 100 species in 25 genera of macrolichens were collected and identified (88 species in 24 genera from the Big Thicket National Preserve). Several new records were found including new reports for Texas of *Bulbothrix isidiza*, *Heterodermia crocea*, *Pseudoparmelia uleana*, *Pyxine coralligera*, and *Usnea subscabrosa*. New records from the Big Thicket Region include *Candelaria concolor*, *Cladonia parasitica*, *Cladonia sobolescens*, *Cladonia subcariosa*, *Collema subflaccidum*, *Dirinaria confluens*, *Heterodermia speciosa*, *Leptogium chloromelum*, *Parmelinopsis spumosa*, *Phaeophyscia rubropulchra*, *Physcia millegrana*, *Punctelia graminicola*, *Ramalina complanata*, *Teloschistes chrysophthalmus*, and *Usnea trichodea*. Pre-1980 and post-2005 collections from the region are summarized and compared.

## Acknowledgements

I would like to thank first and foremost Dr. Robert Egan for all the help he endlessly gave to see my thesis completed. He provided the inspiration, expertise, and practicality that allowed this project to be a success. I am truly grateful for all he has taught me and feel honored to be his final thesis student before retirement.

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I owe many thanks to the other collectors whose specimens I have included in this study. The late Cynthia Troxell made many of the historic collections, including the Texas record *Usnea subscabrosa*. Previous graduate students Rob Harms and Todd Widhelm did the bulk of the collecting in 2006, and several hundred of their collections were identified for this study. Rebecca Moshman and Kelley Penney also collected from the area and a few of their collections were included.

Finally, I would like to express my appreciation for the financial assistance I received from the UNO Biology Department in the form of graduate research funds and travel reimbursement. I am also grateful to the Big Thicket Association for partial funding of the project and use of the field station in Saratoga, Texas, during my field work, and to the National Parks Service for collection permits.

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## Introduction

Lichens are an association of fungi and a photosynthetic partner. Most lichenized fungi, or lichen-forming fungi, are members of the Ascomycota or “sac fungi,” and almost half of all ascomycete fungi form lichens (Brodo et al. 2001). Algal partners in lichens are most often green algae and occasionally cyanobacteria. They tend to be members of just a few genera that can often be found free-living as well as associated with lichen-forming fungi. Because these same algal genera may be present in many lichens, the name of the lichen is also the name of the fungal partner, and the alga retains its own name. Unlike the photobiont (algal partner), the fungal partner cannot survive free-living. It requires a photosynthetic partner which provides carbohydrates for metabolism. These two very different organisms come together to form a composite thallus that is unlike either partner.

Lichens have different growth forms that are often useful when separating genera. This study includes only the macrolichens, those lichens with either fruticose or foliose growth forms. Fruticose lichens are usually described as shrubby or bushy, sometimes drooping from trees (pendulous). They do not have distinct upper and lower surfaces. Foliose lichens are relatively flat and have lobes that are somewhat leaf-like. They are loosely attached to a substrate at multiple points and are described as having distinct upper and lower surfaces. The third common lichen growth form, crustose lichens (microlichens), with their thin, non-lobed, crust-like thalli were not included in this survey.

Sexual reproductive structures called apothecia produce spores and are sometimes present in macrolichens in this region. They are disk or cup-like and vary in size and color. There are two main types, lecanorine apothecia and lecideine apothecia.

Lecanorine apothecia have a distinct rim or margin (exciple) with a cortical covering that is often a different color than the center (disk). Lecideine apothecia lack such rim and are a single color. Other characters are sometimes important in identification such as the presence of cilia on the apothecial margin and whether or not the apothecia are perforate (with a hole through the middle). Details of the asci and ascospore morphology are useful in the identification of crustose lichens but are generally not required for identification of macrolichens.

Asexual reproductive structures are also common in many species. There are two main types, soredia and isidia. Both types are composed of both lichen partners (fungal hyphae and algal cells) and can thus form a new lichen thallus when distributed. Isidia are finger-like projections from the surface and have a cortical covering that is contiguous with the cortex. Soredia occur on the surface (laminally) or along the edges (marginally). They burst through the cortex as masses of coarse granules and lack the cortical covering formed in isidia. Distinguishing between isidia and soredia takes practice, since in some taxa isidia break down and may appear as soredia on older parts of the thallus.

Cilia are hair-like extensions that occur on the edges of the lobes. They vary in color, length, and abundance. Rhizines are attachment structures on the lower surface. They may be branched or unbranched and vary in color, abundance, and placement.

Lichen-forming fungi produce an array of unique chemical substances known as lichen acids. These substances are referred to as secondary metabolites, since they are not involved directly in metabolic activity. They are found in the medulla or the cortex, deposited outside the hyphal cell walls as metabolic waste products. Some lichen acids are pigments that give certain genera and species their characteristic colors, but most are depsides and depsidones which are built from phenolic rings. In many genera, lichen chemistry has become an important character in identification of species and is sometimes the sole grounds for distinguishing one species from another.

## **The Study Area**

The piney woods region of southeast Texas (see Figure 1) is an area of rich biodiversity including lichen populations. The Big Thicket National Preserve is at the center of this floristic area of Texas, and its diversity is the result of its geologic and climatic history. Many different plant communities and ecosystems converge here due to glacial movements of the last ice age which created a shared home for an unlikely combination of fauna and flora (Watson 2006). The Big Thicket National Preserve (BTNP) was established by congress in 1974 and was the first preserve in the National Parks system. It is comprised of nine separate land units (see Figure 2), six water corridors, and covers 97,500 acres (The National Biological Information Infrastructure). We have included the land around the official units in this study, as well as several national forests and other sites in the following counties: Angelina, Hardin, Jasper,

Jefferson, Liberty, Newton, Orange, Polk, Sabine, San Augustine, San Jacinto, and Tyler  
(see Figure 3).



**Figure 1.** Typical piney woods in southeast Texas. Photo by the author.



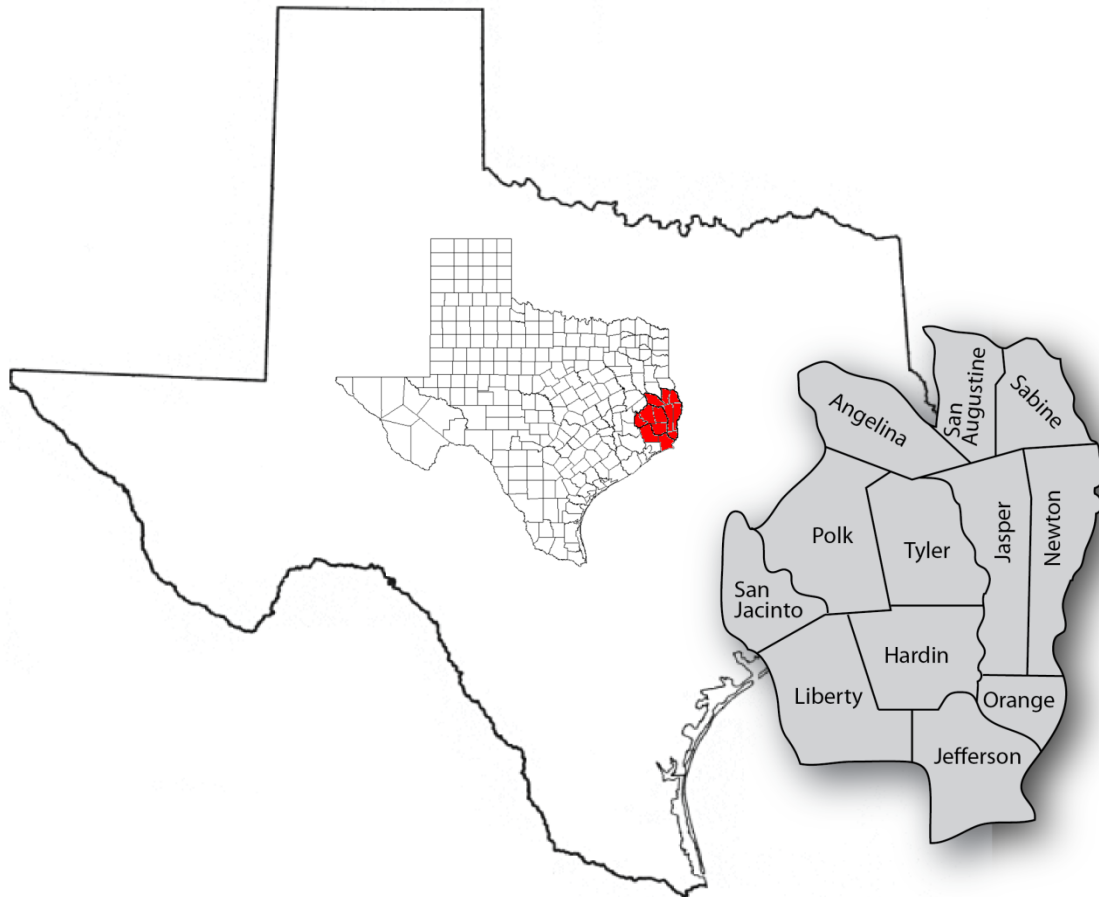


**Figure 3.** Southeast Texas region and counties.

Plant communities in the Big Thicket include cypress swamps (see Figure 4), acidic savannah wetlands, palmetto-hardwood flats (see Figure 5), arid sandylands, and upland forests (see Figure 6). These communities are in an ecological succession cycle. The original climax community in the Thicket uplands was longleaf pine forest. However, because of fire suppression, the climax community we see today is a mixed forest of magnolia, loblolly pine, and beech (Watson 2006).

The common forest vegetation of this region includes: ash (*Fraxinus* spp.), bald cypress (*Taxodium distichum* (L.) Rich.), beech (*Fagus grandiflora* Ehrh.), laurel cherry (*Prunus caroliniana* (Mill.) Ait.), hackberry/Texas sugarberry (*Celtis laevigata* Willd.),

hawthorn (*Crataegus* spp.), shagbark hickory (*Carya ovata* (Mill.) K. Koch.), American holly (*Ilex opaca* Ait.), yaupon (*Ilex vomitoria* Ait.), blueberry (*Vaccinium* spp.), ironwood (*Carpinus caroliniana* Walt.), honey locust (*Gleditsia tricanthos* L.), maple (*Acer* spp.), oak (*Quercus* spp.), common persimmon (*Diospyros virginiana* L.), pine (*Pinus* spp.), and sweetgum (*Liquidambar styraciflua* L.).



**Figure 4.** Cypress swamp. Photo by the author.



**Figure 5.** Palmetto-hardwood flats. Photo by the author.

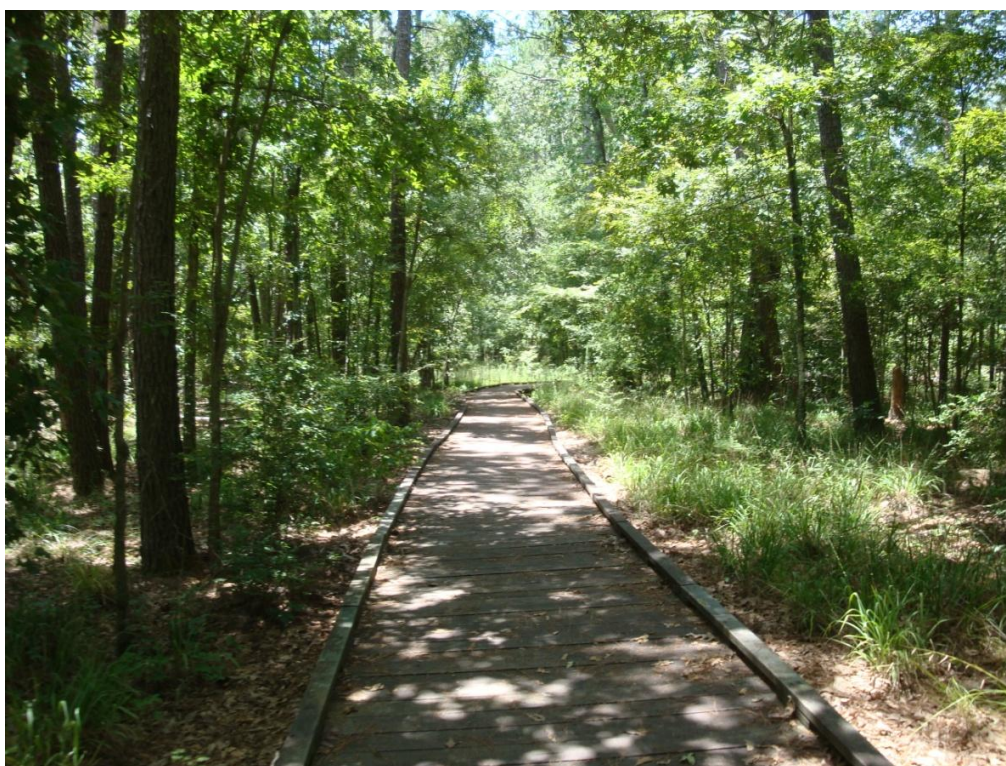


**Figure 6.** Upland forest. Photo by the author.

## **Lichen Biodiversity in Texas and the East Texas Piney Woods Region**

Early work on Texas lichen diversity dates to the mid-1800s when Charles C. Wright and other naturalists began lichen collections. Edward Tuckerman studied Wright's collections and named several new species in the late 1800s. After these initial surveys, few new species were reported until the 1930s. Collections were made from numerous localities by Mason Hale in the 1950s and more recently by Clifford Wetmore and Robert Egan. Other lichenologists who made collections and expanded our knowledge of the lichen flora in Texas include William Weber, Sam Shushan, Roger Anderson, and Shirley Tucker (Egan 1978).

Surveys of lichen diversity in the Big Thicket and the surrounding region began in the mid 1970s soon after the creation of the Big Thicket National Preserve. Dr. Robert Egan, then a faculty member at Texas A&M University, and Cynthia Troxell (an undergraduate student at Louisiana State University under the direction of Dr. Shirley Tucker) made most of the early collections from the region included in this study. In early 2011 the UNO Herbarium received a gift of several hundred specimens from the estate of Cynthia Troxell, primarily her collections from the 1970s while studying at LSU. Her unpublished undergraduate thesis dealt with lichen diversity in the Big Thicket area. After sorting out boxes of specimens and piecing together information from her notebooks to generate labels, we were able to add more than 200 hundred specimens to our current study. These specimens are now deposited and databased in the UNO Lichen Herbarium (OMA).

My thesis work continues the effort to document the abundant lichen diversity of the area. Data from this work will also expand on the original Texas lichen checklist (Egan 1978, Tucker & Egan 2009) and numerous Texas flora papers (Egan 1976, 1977, 1982; Egan et al. 2005). These data will serve as baseline survey information for the National Parks Service and U.S. Forest Service for future monitoring projects dealing with air pollution and climate change. Macrolichens are the focus of the survey, in part, because they are better indicators of air pollution and/or climate change than crustose species (Huckaby 1993). Species keys along with short descriptions and comments will help other botanists and ecologists studying in the region to include the more common lichens in their datasets.

The primary goal of this study was to make a biodiversity survey of lichen populations by collecting, documenting, and describing lichen species from the Big Thicket National Preserve and from neighboring Angelina, Sabine, Sam Houston, and Davy Crockett National Forests. As the data were compiled, comparisons between historic collections and recent collections were made to point out possible changes in the lichen flora that have taken place in the past 30+ years since the BTNP was established. It is a challenge to protect and preserve all of this diversity, and there are many threats to the unique biodiversity of the BTNP and surrounding natural areas including long-term climate change, logging and oil/gas drilling, and human population expansion.

## Methods

Field work was done by the author July 30-August 1 (2008), July 12-15 (2010), and May 24-25 (2011). Specimens from the area were collected at other times during the last six years by Dr. Robert Egan, Rob Harms, Todd Widhelm, and Rebecca Moshman. Historic collections by Cynthia Troxell from the mid 1970s have been included in the study. Field collections were made according methods outlined in Brodo et al. (2001). Identification of specimens made use of keys by Brodo et al. (2001), Harris (1990, 1995), and Harris & Ladd (2005). Thin layer chromatography (TLC) was employed for chemical analysis according to standard procedures (Culberson 1972, Orange et al. 2001), where lichen compounds are extracted in acetone, spotted on a silica coated plate, and run in a solvent system. Solvent system A (toluene-dioxane-acetic acid) was used for all specimens except for those in the genus *Ramalina*, which were tested with solvent system B (hexane-formic acid-ether).

All specimens collected for this study are deposited at the University of Nebraska at Omaha Herbarium (OMA), which is the designated herbarium by the National Park Service as the repository for lichen collections from the Big Thicket National Preserve. All specimen records in the UNO Lichen Herbarium as well as records from other herbaria may be searched online at <http://symbiota.org/nalichens>.

## Recent Collection Localities by Texas County

### Angelina

Angelina National Forest; Cassells–Boykin County Park on Sam Rayburn Reservoir; 6 miles NE of Zavalla; 31°12'48.3" N, 94°20'56.4" W. On fallen tree branches.

July 21, 2006. Collectors: Todd Widhelm & Robert S. Egan

### Hardin

**Big Thicket National Preserve**, Neches Bottom and Jack Gore Baygall Unit; along Timber Slough Road just W of the Neches River off FM 2937; 30°29'29" N, 94°06'35" W. Mixed swamp forest with pine, oaks, bald cypress, sweetgum, and magnolia.

December 15, 2006. Collectors: Todd Widhelm & Robert Harms

**Big Thicket National Preserve**, Beaumont Unit; N of Beaumont along South Canal Road, E of US 287; 30°11'04" N, 94°08'29" W. Pine forest with oaks and hurricane-downed trees. December 16, 2006. Collectors: Todd Widhelm & Robert Harms

**Big Thicket National Preserve**, Turkey Creek Unit; off the Gore Store Road along the Turkey Creek Trail, NE of Village Mills; 30°31'17" N, 94°20'30" W. Mixed oak, beech, holly, pine, and bald cypress woods along Turkey Creek. December 18, 2006.

Collectors: Todd Widhelm & Robert Harms

**Big Thicket National Preserve**, Turkey Creek Unit; NW of the Kirby Nature Trail off FM 420 near BTNP Visitor Center; 30°27'27" N, 94°21'05" W. Mixed oak, magnolia, beech, and pine forest. December 18, 2006. Collectors: Todd Widhelm & Robert Harms

**Big Thicket National Preserve**, Lance Rosier Unit; along Teel Road toward the cemetery; 30°15'59" N, 94°30'54" W. Swampy hardwood forest with *Quercus*, *Acer*, *Liquidambar*, *Ilex*, and *Pinus*. January 5, 2008. Collector: Robert S. Egan

**Big Thicket National Preserve**, Turkey Creek Unit; Kirby Nature Trail off FM 420 east of the BTNP Visitor Center; 30°27'42.7" N, 94°21'04" W. Mixed deciduous forest with *Quercus*, *Magnolia*, *Fagus*, *Carpinus*, and *Pinus*. January 6, 2008.

Collector: Robert S. Egan

Roy E. Larsen Sandyland Sanctuary (The Nature Conservancy), along Village Creek west of Silsbee off FM 327; 30°20'54" N, 94°14'11" W. Mixed sandy upland forest with *Pinus*, *Quercus*, *Carya*, *Magnolia*, *Taxodium*, and *Liquidambar*. July 31, 2008.

Collectors: Lacey LeGrand & Robert S. Egan

**Big Thicket National Preserve**, Lower Neches River Corridor Unit; 1 mile west of Evadale just south of US Route 96, on the west side of the Neches River; 30°21'19" N, 94°14'11" W. Mixed hardwood forest with *Quercus*, *Carpinus*, *Acer*, *Betula*, *Liquidambar*, and other hardwoods. July 31, 2008. Collectors: Lacey LeGrand & Robert S. Egan

**Big Thicket National Preserve**, Lance Rosier Unit; at the end of Cotton Road; 30°14'21" N, 94°28'41" W. Mixed hardwood forest with *Quercus*, *Pinus*, *Acer*, *Ilex*, *Liquidambar*, and *Platanus*. August 1, 2008. Collectors: Lacey LeGrand & Robert S. Egan

**Big Thicket National Preserve**, Village Creek Corridor Unit; just off of US Route 96, 1.5 miles N of Lumberton; 30°17'09" N, 94°11'28" W. Riparian hardwood forest along Village Creek. July 14, 2010. Collectors: Lacey LeGrand & Robert S. Egan

Village Creek State Park; just E of Lumberton; 30°15'17" N, 94°10'15.2" W. Pine and hardwood forest. July 14, 2010. Collectors: Lacey LeGrand & Robert S. Egan

### **Liberty**

**Big Thicket National Preserve**, Loblolly Unit; at the end of FM 2071, NE of Moss Hill; 30°17'08" N, 94°40'10" W. Swampy forest with oak, pine, and bald cypress. December 19, 2006. Collectors: Todd Widhelm & Robert Harms

**Big Thicket National Preserve**, Menard Creek Corridor Unit; along Bird Watchers Trail off FM 2610; NW of Rye; 30°29'10" N, 94°50'07" W. Oak, sweetgum, pine, and bald cypress woods along Menard Creek near the Trinity River. December 19, 2006. Collectors: Todd Widhelm & Robert Harms

**Big Thicket National Preserve**, Menard Creek Corridor Unit; along Bird Watchers Trail off FM 2610; NW of Rye; 30°29'10" N, 94°50'07" W. Oak, sweetgum, pine, and bald cypress woods along Menard Creek near the Trinity River. January 4, 2008.

Collector: Robert S. Egan

### **Newton**

Along FM 1416; about 1.2 miles E of junction with Texas Route 87; 6.5 miles SE of Kirbyville; 30°36'30" N, 93°46'37.6" W. Roadside with hardwood trees and sandy soil. July 13, 2010. Collectors: Lacey LeGrand & Robert S. Egan

Wild Azalea Canyon trail, about 9 miles ENE of Newton, 30°53'58" N, 93°36'03" W. Forest slopes with *Quercus*, *Liquidambar*, *Magnolia*, *Ilex*, *Acer*, *Carpinus* and *Pinus*. July 13, 2010. Collectors: Lacey LeGrand & Robert S. Egan

E. O. Siecke State Forest, about 4 miles SE of Kirbyville off FM 82; 30°37'59" N, 93°49'46.5" W. Picnic area with live oak (*Quercus*) trees. July 13, 2010. Collectors: Lacey LeGrand & Robert S. Egan

### **Orange**

**Big Thicket National Preserve**, Beaumont Unit; Four Oaks Fishing Point at the end of Four Oaks Road, N of Beaumont off FM 1131; 30°11'12" N, 94°06'06" W. Mixed forest with oaks, bald cypress, and pine along the Neches River. December 16, 2006. Collectors: Todd Widhelm & Robert Harms

**Polk**

**Big Thicket National Preserve**, Big Sandy Creek Unit; along the Big Sandy Trail off Sunflower Road, 2 miles WSW of Dallardsville; 30°36'53.3" N, 94°40'14.8" W.

Elevation about 250 ft. (75 m); dry upland forest with *Juniperus*, *Pinus*, *Quercus*, *Ilex*, *Liquidambar*, and other hardwoods. March 13, 2007. Collector: Robert S. Egan

**Big Thicket National Preserve**, Big Sandy Creek Unit; along the Beaver Slide Trail near Big Sandy Creek; 2.5 miles E of Segno off FM 943; 30°34'23.3" N, 94°38'33.1" W.

Elevation about 150 ft. (46 m); wet forest with *Carpinus*, *Taxodium*, *Fagus*, *Magnolia*, *Ilex*, *Quercus*, and *Pinus*. March 13, 2007. Collector: Robert S. Egan

**Big Thicket National Preserve**, Menard Creek Corridor Unit; dirt road to Holly Grove at the junction with Menard Creek; 30°30'13.2" N, 94°41'19.6" W. Elevation about 130

ft. (40 m); mixed hardwood-conifer forest with *Taxodium*, *Fagus*, *Magnolia*, *Ilex*, *Quercus*, *Pinus*, and *Betula*. March 14, 2007. Collector: Robert S. Egan

**Big Thicket National Preserve**, Big Sandy Creek Unit, along the Woodlands Trail off FM 1276; 5 miles NW of Dallardsville; 30°40'46.4" N, 94°41'58.1" W. Elevation 225 ft.

(69 m); mixed forest with *Pinus*, *Quercus*, *Liquidambar*, *Acer*, *Carpinus*, and other hardwoods. March 14, 2007. Collector: Robert S. Egan

**Big Thicket National Preserve**, Big Sandy Creek Unit; along the Woodlands Trail off FM 1276; 5 miles NW of Dallardsville; 30°40'46.4" N, 94°41'58.1" W. Elevation 225 ft. (69 m); mixed forest with *Pinus*, *Quercus*, *Liquidambar*, *Acer*, *Carpinus*, and other hardwoods. August 1, 2008. Collectors: Lacey LeGrand & Robert S. Egan

**Big Thicket National Preserve**, Big Sandy Creek Unit; along Lily Road; about 3.5 miles W of Dallardsville; 30°37'40" N, 94°41'10" W. Forest of *Pinus*, *Quercus*, *Carya*, *Liquidambar*, and other hardwoods. July 12, 2010. Collectors: Lacey LeGrand & Robert S. Egan

Lake Livingston State Park, along the Pineywoods Nature Trail; about 6.5 miles SW of Livingston; 30°39'52.5" N, 95°00'18.3" W. *Pinus*, *Quercus*, *Liquidambar*, and *Ulmus* forest. July 15, 2010. Collectors: Lacey LeGrand & Robert S. Egan

### **Sabine**

Sabine National Forest, Willow Oak Recreation Area on Toledo Bend Reservoir; 14 miles S of Hemphill off Texas State Hwy. 87; 31°12'40" N, 93°44'01" W. *Taxodium*, *Pinus*, and hardwood forest. July 13, 2010. Collectors: Lacey LeGrand & Robert S. Egan

Sabine National Forest, Lakeview Recreation Area on Toledo Bend Reservoir; about 10 miles SE of Hemphill; 31°15'40.45" N, 93°40'45.7" W. Mixed forest with *Quercus*, *Pinus*, *Liquidambar*, and *Taxodium*. May 24, 2011. Collectors: Kelley Penney & Robert S. Egan

### **San Augustine**

Angelina National Forest, Jackson Hill Park off FM 2851; on the eastern shore of Sam Rayburn Reservoir; 31°16'23.8" N, 94°19'12.6" W. Hardwood and pine woods. July 12, 2010. Collectors: Lacey LeGrand & Robert S. Egan

### **San Jacinto**

Sam Houston National Forest, Big Creek Scenic Area; about 6 miles WNW of Shepherd; 30°30'21.3" N, 95°05'17.6" W. *Pinus*, *Liquidambar*, *Fagus*, *Magnolia*, *Ilex*, and fern forest. July 15, 2010. Collectors: Lacey LeGrand & Robert S. Egan

### **Tyler**

**Big Thicket National Preserve**, Beech Creek Unit; along the Beech Woods Trail; NW of Spurger off FM 2992; 30°43'10" N, 94°13'16" W. Beech-magnolia forest with scattered oaks. December 15, 2006. Collectors: Todd Widhelm & Robert Harms

**Big Thicket National Preserve**, Turkey Creek Unit; N end of the Turkey Creek Trail off FM 1943; E of Warren; 30°36'24" N, 94°20'26" W. Mixed oak-pine forest. December 17, 2006. Collectors: Todd Widhelm & Robert Harms

**Big Thicket National Preserve**, Hickory Creek Savannah Unit; on the Sundew Trail, off FM 1910, S of Warren; 30°32'31" N, 94°24'28" W. Open mixed pine-hardwood forest. December 17, 2006. Collectors: Todd Widhelm & Robert Harms

Just north of John Henry Kirby State Forest on US Route 287; 13 miles S of Woodville; 30°34'51.4" N, 94°24'12.3" W. Elevation 40 m; on fallen trees. July 21, 2006. Collectors: Todd Widhelm & Robert S. Egan

Martin Dies Jr. State Park, Cherokee Unit just N of US Route 190 on B. A. Steinhagen Lake; 23 miles ENE of Woodville; 30°51'15.3" N, 94°12'53.8" W. Elevation about 85 ft. (26 m); mixed lake margin forest with *Taxodium*, *Acer*, *Ilex*, *Quercus*, *Liquidambar*, *Carpinus*, *Pinus*, and shrubs. March 11, 2007. Collector: Robert S. Egan

**Big Thicket National Preserve**, Canyonlands Unit; 4 miles NNE of Spurger of CR 4415; on forested bluffs along the Neches River; 30°43'45.3" N, 94°08'32.8" W. Elevation about 175 ft. (53 m); mixed forest with *Pinus*, *Fagus*, *Ilex*, *Magnolia*, and *Quercus*. March 12, 2007. Collector: Robert S. Egan

**Big Thicket National Preserve**, Turkey Creek Unit; junction of Turkey Creek and County Road 4825 along the Turkey Creek Trail; approximately 30°33'11" N, 94°19'49" W. Mixed deciduous forest with *Quercus*, *Pinus*, *Fagus*, *Ilex*, *Liquidambar*, and *Carpinus*. July 30, 2008. Collectors: Lacey LeGrand & Robert S. Egan

## Results

Comments made in genera and species descriptions concerning distribution and habitat were taken from Brodo et al. (2001). Brackets are used in some keys and refer to species that may occur in the area but to date have not been found. Collections are listed by county with the number of specimens collected in parentheses. Readers may access an online database at <http://symbiota.org/nalichens> where they can search all UNO lichen herbarium records based on taxon or collector(s) name(s), and various geographic parameters.

### Key to the Genera

1. Thallus fruticose..... 2
1. Thallus foliose..... 6
2. Thallus bushy or pendant..... 3
2. Thallus composed of primary squamules and upright podetia..... *Cladonia*
3. Thallus bright orange..... *Teloschistes*
3. Thallus not orange..... 4
4. Branches hollow..... *Cladonia*
4. Branches solid..... 5
5. Branches without a central cord; usually flattened..... *Ramalina*
5. Branches with a central cord; usually round..... *Usnea*

- 6. Thallus bright yellow; cortex K–..... *Candelaria concolor*
- 6. Thallus not yellow (if yellow-orange, then K+ purple)..... 7
- 7. Thallus orange; cortex K+ purple..... *Xanthomendoza weberi*
- 7. Thallus not orange..... 8
- 8. Lower surface tomentose..... 9
- 8. Lower surface not tomentose (individual rhizines may be present)..... 11
- 9. Photobiont cyanobacteria..... *Coccocarpia*
- 9. Photobiont green algae..... 10
- 10. Lobes narrow (<3 mm), appearing inflated; lower surface black..... *Anzia*
- 10. Lobes wide (>3 mm), not appearing inflated; lower surface pale brown.....  
..... *Lobaria ravenelii*
- 11. Thallus jelly-like when wet (gelatinous)..... 12
- 11. Thallus not jelly-like when wet (not gelatinous)..... 13
- 12. Thallus lacking both an upper and lower cortex; dark brown or greenish-black to  
black..... *Collema*
- 12. Thallus with an upper and usually lower cortex; slate gray to brownish.....  
..... *Leptogium*
- 13. Marginal cilia with a bulb at the base..... *Bulbothrix*
- 13. Marginal cilia, if present, not bulbous..... 14
- 14. Lower surface always lacking rhizines..... *Dirinaria*
- 14. Lower surface with rhizines..... 15
- 15. Pseudocyphellae present..... 16
- 15. Pseudocyphellae absent..... 17

16. Pseudocyphellae present on the lower surface..... *Pseudocyphellaria aurata*
16. Pseudocyphellae present on the upper surface..... *Punctelia*
17. Rhizines dichotomously branched; lobe tips squared and truncated.....  
 ..... *Hypotrachyna*
17. Rhizines, if branched, not dichotomously branched; lobe tips not squared or  
 truncated..... 18
18. Lobes broad (>5 mm); lower surface black in the center..... *Parmotrema*
18. Lobes narrower (< 5 mm); lower surface variable..... 19
19. Lobes very narrow, usually <2 mm; spores (if present) brown and 2-celled..... 20
19. Lobes broader, usually >2 mm; spores (if present) simple and hyaline..... 23
20. Lobe tips finely pruinose; medulla often pigmented..... *Pyxine*
20. Lobe tips not pruinose; medulla usually white..... 21
21. Cortex K+ yellow (atranorin present)..... 22
21. Cortex K- (atranorin absent)..... *Phaeophyscia*
22. Upper cortex of parallel, elongate hyphae; underside often ecorticate.....  
 ..... *Heterodermia*
22. Upper cortex of crisscrossed hyphae; underside usually corticate..... *Physcia*
23. Medulla pale yellow..... 24
23. Medulla white..... *Canoparmelia*
24. Cortex with eroding soredia; underside black..... *Myelochroa aurulenta*
24. Cortex lacking soredia; underside brown..... *Pseudoparmelia uleana*

## Annotated Catalogue with Keys

### ***Anzia*** Stizenb.

*Anzia* species are medium sized gray-green foliose lichens. The lower surface has a thick and spongy black hypothallus that is very distinctive. There are no recent collections of this genus from SE Texas; our records are from the 1970s. Only three species occur in North America, and two have been found in the area.

- 1. Thallus lacking isidia and soredia..... *Anzia colpodes*
- 1. Thallus isidiate..... *Anzia ornata*

#### ***Anzia colpodes*** (Ach.) Stizenb.

The lobes are small with pycnidia appearing as black dots embedded in the tips. Apothecia are common; soredia and isidia are absent. At first glance this species looks similar to *Hypogymnia*, because the thick hypothallus below makes the lobes appear inflated.

Collections: Liberty (1), Tyler (1)

#### ***Anzia ornata*** (Zahlbr.) Asahina

In this species isidia occur on the margins of the lobes. It is found on hardwoods on the southern coastal plain and is not very common.

Collections: Hardin (3), Tyler (2)

## ***Bulbothrix*** Hale

The narrow lobes in this foliose genus have marginal cilia that are bulbous at the base (see Figure 7), and most (three of four North American) species are isidiate. This is a tropical to subtropical genus occurring on bark.



**Figure 7.** Bulbate cilia. Source: Benatti (2011).

1. Medulla K+ yellow to red; salazinic acid..... *Bulbothrix isidiza*
1. Medulla K-..... 2
2. Lower surface jet black; lecanoric acid..... *Bulbothrix laevigatula*
2. Lower surface pale to brown; gyrophoric acid..... *Bulbothrix goebelii*

### ***Bulbothrix goebelii*** (Zenker) Hale

This isidiate lichen is pale to brown below and contains gyrophoric acid but is otherwise very similar to *Bulbothrix laevigatula*. It was collected from a variety of hardwood trees, especially holly, and pine.

Collections: Angelina (1), Hardin (6), Jasper (1), Liberty (2), Newton (1), Orange (1), Polk (3), Tyler (7)

***Bulbothrix isidiza*** (Nyl.) Hale

This species contains salazinic acid but is otherwise similar to *Bulbothrix goebelii*. It is a **new Texas record**, previously known only from Florida, Louisiana, and North Carolina (Dey 1987). The specimen cited below was collected on pine bark (see Figure 8).

Collection: Hardin County on pine. Roy E. Larsen Sandyland Sanctuary (The Nature Conservancy) along Village Creek off FM 327, W of Silsbee; 30°20'54" N, 94°14'11" W. Egan & LeGrand 42. July 13, 2008.



**Figure 8.** *Bulbothrix isidiza* thallus with isidia. Photo by the author.

***Bulbothrix laevigatula*** (Nyl.) Hale

This *Bulbothrix* species has a jet black lower surface and contains lecanoric acid but is otherwise similar to *Bulbothrix goebelii*.

Collections: Hardin (1), Tyler (1)

***Candelaria*** A. Massal.***Candelaria concolor*** (Dickson) Stein

One of only two North American species of *Candelaria*, this species is a new record for the BTNP. The edges of the small, bright yellow lobes have granules or granular soredia. Rhizines are present and apothecia are rare. It is very common and widespread across the U.S. and Canada. The other North American species, *Candelaria fibrosa*, has apothecia but no soredia and has a narrower range that covers the eastern U.S.

Collection: Tyler (1)

***Canoparmelia*** Elix & Hale

These medium sized foliose pale gray lichens have no marginal cilia. They have pale unbranched rhizines and often have a network of white maculae on the surface. Pseudocyphellae are absent. The upper cortex usually contains atranorin (K<sup>+</sup> yellow).

1. Thallus isidiate; perlatolic acid present..... *Canoparmelia caroliniana*
1. Thallus sorediate..... 2
2. Soredia in spherical soralia on lobe tips; cryptochlorophaeic acid present.....  
..... *Canoparmelia cryptochlorophaea*
2. Soredia coarse, laminal along wrinkles in the thallus; divaricatic acid present.....  
..... [*Canoparmelia texana*]

***Canoparmelia caroliniana*** (Nyl.) Elix & Hale

The surface is wrinkled and appears cracked due to the presence of white maculae. This extremely common isidiate species very much resembles *Punctelia rudecta* but has maculae instead of pseudocyphellae (eruptions in the cortex) and perlatolic (UV+ white) rather than lecanoric acid. It is common on pine bark in SE Texas, a substrate unsuitable for most lichens because it is shed fairly quickly and is more acidic than other types of bark (see Figure 9).

Collections: Hardin (33), Jasper (1), Liberty (11), Newton (4), Orange (1), Polk (17), Sabine (2), San Jacinto (3), Tyler (21)



**Figure 9.** *Canoparmelia caroliniana* on pine. Photo by the author.

***Canoparmelia cryptochlorophaea* (Hale) Elix & Hale**

This species contains cryptochlorophaeic acid and has soralia on the lobe tips in distinct, often spherical mounds but is otherwise similar to *Canoparmelia texana*. It is found on the southern coastal plain and is relatively common throughout the BTNP and SE Texas. Collections were made from assorted hardwoods.

Collections: Hardin (22), Jasper (2), Jefferson (1), Liberty (3), Newton (4), Orange (2), Polk (6), San Jacinto (2), Tyler (7)

## ***Cladonia*** P. Browne

Lichens in this fruticose genus usually have a primary thallus composed of squamules from which erect, hollow podetia develop often with apothecia at the top. Species grow directly on the ground or on rotting wood often with mosses. Because of the presence of diverse chemical compounds produced in many species and used in the systematics of this genus, TLC analysis is required for accurate identification of most collections.

1. Primary squamules present..... 3
1. Primary squamules absent..... 2
2. Podetia with a cortex, thick and much branched; not brittle.....  
..... *Cladonia leporina*
2. Podetia without a cortex, slender and extensively branched; brittle.....  
..... *Cladonia subtenuis*
3. Squamules and/or podetia sorediate..... 4
3. Squamules and/or podetia not sorediate..... 8
4. Fumarprotocetraric acid present..... *Cladonia subradiata*
4. Fumarprotocetraric acid absent..... 5
5. Thamnolic acid present..... 6
5. Thamnolic acid absent..... 7
6. Thamnolic acid only..... *Cladonia parasitica*
6. Thamnolic and didymic acids..... *Cladonia ravenelii*

- 7. Soredia granular..... *Cladonia didyma*
- 7. Soredia farinose..... *Cladonia macilenta* var. *bacillaris*
- 8. Squamules extensively divided; podetia, when present, extremely short.....  
..... *Cladonia caespiticia*
- 8. Squamules not extensively divided; podetia, when present, about 10-20 mm tall...  
..... 9
- 9. Podetia split along the sides, topped with pale brown or tan apothecia much  
broader than the podetia..... *Cladonia peziziformis*
- 9. Podetia not split along the sides; topped with darker brown apothecia barely wider  
than the podetia..... 10
- 10. Fumarprotocetraric acid present..... *Cladonia sobolescens*
- 10. Fumarprotocetraric acid absent..... 11
- 11. Atranorin present..... 12
- 11. Atranorin absent (norstictic acid only)..... *Cladonia polycarpoides*
- 12. Stictic acid present..... *Cladonia polycarpha*
- 12. Stictic acid absent (atranorin and norstictic acid)..... *Cladonia subcariosa*

***Cladonia caespiticia* (Pers.) Flörke**

Primary squamules are divided extensively and appear lacy but not sorediate.

Podetia are extremely short (< 4 mm) and always topped with large brownish apothecia.

This species produces fumarprotocetraric acid. Many specimens we called *Cladonia caespiticia* had tiny primary squamules and fumarprotocetraric acid but were sterile.

Collections: Hardin (4), Tyler (2)

***Cladonia didyma* (Fée) Vainio**

Primary squamules in this species are lobed and somewhat divided. Podetia are unbranched or branch only near the tips. Both the squamules and podetia have granular soredia. Podetia are usually fertile with red apothecia. Two chemical varieties occur, but all our collections had barbatic and didymic acids. It is similar to *Cladonia macilenta*, which can also produce red apothecia but has farinose soredia and thicker, less divided squamules. This species is common on rotting wood.

Collections: Hardin (1), Liberty (1), Polk (2), Tyler (3)

***Cladonia leporina* Fr.**

In this species primary squamules are absent. The large podetia are yellowish-green, branched extensively and non-sorediate. Bright red apothecia may be present. Chemistry varies with geography, and it occurs on sandy soil.

Collections: Hardin (3), Newton (1)

***Cladonia macilenta* var. *bacillaris* (Genth) Schaerer**

Primary squamules are small and thick. Podetia are slender with fine (farinose) soredia, pointed or blunt tipped, and with or without red apothecia. Barbatic acid is produced in our specimens usually along with didymic acid. It was collected from rotting wood and burned pine stumps.

Collections: Hardin (1), Tyler (4)

***Cladonia parasitica* (Hoffm.) Hoffm.**

Primary squamules are very granular and form mats, often over rotting wood. Podetia are uncommon and short (3-10 mm), topped with reddish-brown apothecia. This species produces thamnolic acid. *Cladonia macilenta* also produces thamnolic acid, but the podetia are taller and apothecia, when present, are red.

Collections: Hardin (1), Newton (1)

***Cladonia peziziformis* (With.) J. R. Laundon**

Primary squamules are small, rounded, and thick in this common species. Podetia are split along the sides and topped with large, pale brown apothecia many times the diameter of the podetia (like a turban). It produces fumarprotocetraric acid. Other *Cladonia* species are similar, but the apothecia in this species are much larger and paler brown or tan. This species is most often found on sandy soil and occasionally on rotting wood.

Collections: Hardin (8), Jefferson (1), Liberty (2), Newton (2), Polk (3), Tyler (8)

***Cladonia polycarpia* G. Merr.**

This species is in the *Cladonia subcariosa* group and it produces atranorin, norstictic, and stictic acids. Podetia tend to be slightly shorter than in *Cladonia polycarpoides*, and it is widespread in the southeastern U.S.

Collections: Hardin (2), Polk (1)

***Cladonia polycarpoides* Nyl.**

This species is in the *Cladonia subcariosa* group, and it produces norstictic acid. Podetia become broader at the top, and brown apothecia often occur in clusters. It is found on open, sandy soil in the entire eastern half of the U.S. except the Florida panhandle.

Collection: Orange (1)

***Cladonia ravenelii* Tuck.**

Primary squamules are small and dissolve into a soresiate mass. Podetia are often branched and topped with red apothecia. This species produces thamnolic and didymic acids (Harris 1995), and in the Big Thicket area it occurs exclusively on bark and rotting wood. Most of our material is sterile, but the distinctive chemistry makes identification possible. Our collections were made almost exclusively from pine bark.

Collections: Hardin (5)

***Cladonia sobolescens* Nyl. ex Vainio**

This species is in the *Cladonia subcariosa* group and it produces fumarprotocetraric acid. It occurs in sunny habitats on sandy soil or rotting wood. *Cladonia peziziformis* also produces fumarprotocetraric acid and occupies similar habitats but has much broader and paler brown apothecia.

Collections: Hardin (1), Orange (1), Tyler (2)

***Cladonia subcariosa* Nyl.**

Primary squamules may be lobed but are not finely divided. Podetia are non-sorediate and topped with brown apothecia. This species produces atranorin and norstictic acid. Ahti (2000) lumped the so-called “peg lichens” *Cladonia polycarpia*, *Cladonia polycarpoides*, and *Cladonia sobolescens* together under the species *Cladonia subcariosa*. We, however, separate these species based on chemical differences according to Culberson (1969). Collections were made from sandy soil.

Collections: Newton (4)

***Cladonia subradiata* (Vainio) Sandst.**

The primary squamules of this species are small, finely divided, and often granular. Podetia are cylindrical, covered with powdery soredia above and granules near the base. The tips are pointed or blunt often with very tiny brown apothecia. This species produces fumarprotocetraric acid, and its range hugs the coast from Texas up through Virginia. It occurs on sandy soil, wood, and bark.

Collections: Hardin (10), Liberty (2), Newton (2), Polk (1), Tyler (1)

***Cladonia subtenuis* (Abbayes) Mattick**

The thallus lacks primary squamules and is pale yellowish-green to gray. The branches are smooth, slender, and dichotomously forked. It forms large mats on sandy soil (see Figure 10) and is one of the so-called “reindeer lichens.” Usnic and fumarprotocetraric acids are produced. This species was previously placed in a different

genus (*Cladina*), because it lacks both a primary thallus and a continuous, smooth outer cortex.

Collections: Hardin (1), Newton (2), Tyler (1)



**Figure 10.** *Cladonia subtenuis* on sandy soil. Photo by the author.

### ***Coccocarpia*** Pers.

These small, bluish-gray foliose lichens have a cyanobacterial photobiont (*Scytonema*) and thick, blue-gray tomentum underneath that resembles steel wool. The grayish color of the thallus is similar to species of *Leptogium*, but that genus has a different photobiont (*Nostoc*) and becomes jelly-like when wet.

- 1. Isidia absent; apothecia present..... *Coccocarpia erythroxyli*
- 1. Isidia present; apothecia absent or rare..... *Coccocarpia palmicola*

***Coccocarpia erythroxyli*** (Sprengel) Swinscow & Krog

Apothecia are brown, convex, and common. The lobes are shell-like and the thallus may have ridges. The tomentum on the lower surface is blue-green to blue-black. This species is very similar to *Coccocarpia palmicola*, which lacks apothecia and reproduces asexually by isidia. Both species are common on bark in tropical to subtropical forests. In SE Texas collections were made from oak trees.

Collections: Hardin (2), Tyler (1)

***Coccocarpia palmicola*** (Sprengel) Arv. & D. J. Galloway

The thallus is dark blue-gray with cylindrical to globular isidia. The tomentum, which is grayer in color when compared to *Coccocarpia erythroxyli* often shows at the edges of the lobes. It is found on bark in shady areas often growing with mosses.

Collections: Angelina (1), Hardin (9), Liberty (4), Polk (2), Tyler (3)

***Collema*** F. H. Wigg.

These are “jelly lichens” which become gelatinous when wet. The thallus is black to very dark olive/brown and lacks both an upper and lower cortex. The photobiont is *Nostoc*, a very common genus of cyanobacteria that does not form a distinct layer within the thallus. These lichens can look very similar to species of *Leptogium*, another genus of jelly lichens, which differ slightly in color and are corticate.

- |                        |   |
|------------------------|---|
| 1. Isidia absent.....  | 3 |
| 1. Isidia present..... | 2 |

- 2. Thallus not pustulate; isidia globular..... *Collema subflaccidum*
- 2. Thallus pustulate; isidia cylindrical..... *Collema furfuraceum*
- 3. Apothecia not pruinose..... [*Collema nigrescens*]
- 3. Apothecia usually pruinose..... *Collema pulcellum*

***Collema furfuraceum*** (Arnold) Du Rietz

The thallus has conspicuous pustules and ridges. Isidia are cylindrical and concentrated on the ridges. Apothecia are rare. This species is similar to *Collema subflaccidum*, which has a non-pustulate thallus and globular isidia. Our collection was from ash.

Collection: Hardin (1)

***Collema pulcellum*** Ach.

The thallus is black and has broad lobes with pustules and ridges. Apothecia may be pruinose or not and may or may not have a cortex. Three different varieties have been recognized by some authors. *Collema nigrescens* (Hudson) DC. is virtually indistinguishable from *Collema pulcellum* var. *pulcellum*. The only difference is the shape of the cells in the exiple, which are elongate in *Collema nigrescens* and round in *Collema pulcellum* var. *pulcellum*. Apothecia in both are without pruina. If apothecia are pruinose, the specimen is one of two other varieties of *Collema pulcellum*. We refer to all specimens in this group collected from the study area as *Collema pulcellum*. Collections were made from hardwood bark.

Collections: Hardin (2), Polk (1), San Jacinto (1)

***Collema subflaccidum* Degel.**

The thallus is folded slightly but not pustulate, and globular isidia are abundant on the surface, at least in older areas. Another isidiate species, *Collema furfuraceum*, is similar, but the thallus is pustulate and the cylindrical isidia are confined mostly to the pustules and ridges. This species occurs on the bark of hardwoods.

Collections: Polk (1), Tyler (1)

***Dirinaria* (Tuck.) Clem.**

These small lichens are foliose but very tightly appressed, thus sometimes appearing crustose. The upper surface is gray and contains atranorin. The lower surface is black and always lacks rhizines. Other similar genera have rhizines on the lower surface. Most species occur on bark.

1. Soredia present..... 2
1. Soredia absent; apothecia present..... 3
2. Soredia coarse and granular, from the breakdown of  
pustules..... *Dirinaria aegialita*
2. Soredia farinose (fine, powdery) and produced in hemispherical  
mounds..... *Dirinaria picta*
3. Divaricatic acid present..... *Dirinaria confluens*
3. Sekikaic acid present..... *Dirinaria confusa*

***Dirinaria aegialita* (Afz.) B. Moore**

The thallus is greenish-gray and pruinose with soredia developing from the breakdown of pustules. It produces divaricatic acid and is similar to *Dirinaria picta*, except that the soredia are coarse and pustulate. It may also resemble *Physcia americana*, but that species has a different chemistry and the lower surface is rhizinate and not black. It is common on the bark of oak, sweetgum, beech, and other hardwoods.

Collections: Hardin (16), Jasper (1), Liberty (1), Orange (2), Polk (2), Sabine (1), Tyler (7)

***Dirinaria confluens* (Fr.) D. D. Awasthi**

This species is very similar to *Dirinaria confusa* but contains divaricatic acid (medulla UV+ blue-white) and has slightly smaller lobes. It is not common in the area. Our collection was from sweetgum.

Collection: Hardin (1)

***Dirinaria confusa* D.D. Awasthi**

The lobes are broad for the genus and have narrow folds radiating outward. Apothecia are common with black disks and pale rims (exiples). This species produces sekikaic acid and is very similar to *Dirinaria confluens*, which produces divaricatic acid. Of the two species, *Dirinaria confusa* is much more common in SE Texas. It occurs on the bark of hardwoods and bald cypress.

Collections: Hardin (3), Jefferson (1), Liberty (4), Newton (1), Orange (4), Polk (1), Sabine (2), Tyler (2)

***Dirinaria picta* (Sw.) Clem. & Shear**

The thallus is pale gray-green and flat with small lobes. Hemispherical mounds of farinose sores occur on the thallus surface. This species produces divaricatic acid in the medulla. It is similar to *Physcia americana*, differing in chemistry and the lower surface, which in *Physcia americana* is white and rhizinate. It occurs on hardwoods, often oak or holly.

Collections: Hardin (6), Jasper (2), Liberty (3), Newton (1), San Augustine (1), Tyler (4)

***Heterodermia* Trevisan**

These are pale gray foliose lichens with narrow lobes that are sometimes fringed with cilia and that broaden slightly at the tips. The thallus has the appearance of flowing outward due to the arrangement of fungal hyphal tissue in the upper cortex. Atranorin is produced in the cortex (K+ yellow). Assistance in identification of species in this genus was generously provided by Dr. Ted Esslinger.

- 1. Soredia absent..... 2
- 1. Soredia present..... 3
- 2. Isidia absent..... *Heterodermia echinata*
- 2. Isidia present..... *Heterodermia crocea*

3. Medulla K+ yellow to red (salazinic acid); soredia marginal.....  
..... *Heterodermia albicans*
3. Medulla K– or K+ yellow (salazinic acid absent); soredia on the underside of the  
lobe tips..... 4
4. Lower surface yellow to orange in spots (K+ purple) .....  
..... *Heterodermia obscurata*
4. Lower surface white or tan..... *Heterodermia speciosa*

***Heterodermia albicans*** (Pers.) Swinscow & Krog

Coarse marginal soredia line the thallus lobes. The lower surface is tan with pale rhizines. It resembles the other sorediate species *Heterodermia speciosa* and *Heterodermia obscurata* but contains salazinic acid (medulla K+ yellow to red). Several specimens that have extremely narrow lobes (<1 mm), but otherwise fit with the species description, are grouped here for now. This is a common species that occurs on a variety of hardwoods.

Collections: Hardin (18), Jasper (1), Jefferson (3), Liberty (9), Newton (1), Orange (3), Polk (10), Sabine (1), San Augustine (1), Tyler (9)

***Heterodermia crocea*** R. C. Harris

This species was first described by Harris and was reported only from Florida (Harris 1990). It is a **new Texas record** (Tucker and Egan 2009) and is the only isidiate *Heterodermia* known from SE Texas. The lower surface is orange and reacts K+ purple (similar to *Heterodermia obscurata*). Our collection was made from oak (see Figure 11).

Collection: Hardin County on oak. Big Thicket National Preserve, Turkey Creek Unit; off the Gore Store Road along Turkey Creek Trail, NE of Village Mills; 30°31'17" N, 94°20'30" W. Widhelm & Harms 928. December 18, 2006.



**Figure 11.** *Heterodermia crocea*. Photo by the author.

***Heterodermia echinata*** (Taylor) Culb.

Ascending lobes give this lichen an almost fruticose look, and they are fringed with abundant, long cilia. The apothecial margins are toothed, and the lower surface lacks a cortex thus appearing webby. Soredia are absent. This species commonly grows on small branches and twigs.

Collections: Hardin (6), Liberty (2), Tyler (1)

***Heterodermia obscurata*** (Nyl.) Trevisan

Soredia are on the underside of the lobe tips. The lower surface is deep yellow to orange in spots (K+ purple) and sometimes lacks a cortex. Cilia and rhizines are black, and sometimes the rhizines form a mat. *Heterodermia speciosa* is similar, but the lower surface is white in that species. *Heterodermia crocea* is another species with an orange lower surface, but it is isidiate rather than sorediate. This species occurs on bark.

Collections: Hardin (2), Jefferson (1), Liberty (3), Tyler (3)

***Heterodermia speciosa*** (Wulfen) Trevisan

Lobes broaden at tips producing crescent-shaped soralia with powdery soredia on the underside. White or tan branched cilia are abundant. The lower surface is white or tan and smooth or slightly fibrous but not webby. This species produces atranorin, zeorin and other terpenes. It is similar to *Heterodermia albicans* (atranorin and salazinic acid) but differs in chemistry and the type of soredia. Our collections were made from oak.

Collections: Hardin (2)

***Hypotrachyna*** (Vainio) Hale

This genus is characterized by narrow lobes with square or truncated tips (not rounded) and a black lower surface with dichotomously branched (forked) rhizines.

1. Thallus UV–; soredia absent..... *Hypotrachyna livida*
1. Thallus UV+ gold; soredia present..... *Hypotrachyna osseoalba*

***Hypotrachyna livida*** (Taylor) Hale

Apothecia are abundant and have slightly toothed margins; black pycnidia are often present as well. Atranorin and the lividic acid complex are produced. This species is very common on deciduous trees mainly in the southeastern U.S. A very similar species, *Hypotrachyna pulvinata* (Fée) Hale, contains lecanoric acid and is found further west.

Collections: Angelina (1), Hardin (19), Jasper (1), Liberty (10), Orange (2), Polk (6), Sabine (5), Tyler (6)

***Hypotrachyna osseoalba*** (Vainio) Park & Hale

The black, forked rhizines that characterize this genus form a mat under the lobes. Coarse soredia or schizidia from pustules are present on the thallus. It produces lichexanthone (UV+ gold) and the lividic acid complex. Other sorediate species of *Hypotrachyna* have different chemistries but have not been found in the area. This species occurs on bark.

Collections: Hardin (2), Tyler (2)

***Leptogium*** (Ach.) Gray

These are foliose jelly lichens similar to *Collema* but are slate gray to brownish rather than greenish-black. Unlike *Collema*, these lichens have an upper and usually a lower cortex. The species found in SE Texas are commonly collected from bark, especially at the base of hardwoods, often growing together with mosses. North American species of *Leptogium* were monographed by Sierk (1964).

1. Thallus brown or olive when dry; lobes branched and anastomosing..... 2
1. Thallus slate gray when dry; lobes not anastomosing..... 3
2. Isidia present; apothecia rare..... *Leptogium milligranum*
2. Isidia absent; apothecia present..... *Leptogium chloromelum*
3. Isidia present..... 4
3. Isidia absent; apothecia usually present..... 6
4. Thallus minutely wrinkled..... *Leptogium austroamericanum*
4. Thallus smooth..... 5
5. Isidia cylindrical..... *Leptogium cyanescens*
5. Isidia flattened and lobulate ..... *Leptogium denticulatum*
6. Thallus smooth; apothecia laminal..... *Leptogium azureum*
6. Thallus wrinkled; apothecia primarily along the margins.....  
..... *Leptogium marginellum*

***Leptogium austroamericanum*** (Malme) C. W. Dodge

This species is isidiate and appears very similar to *Leptogium cyanescens*, but the thallus is minutely wrinkled. It frequently occurs on the bark of oak trees.

Collections: Hardin (9), Liberty (6), Polk (1), San Jacinto (1), Tyler (3)

***Leptogium azureum*** (Sw. ex Ach.) Mont.

Lobes in this species are usually broad (unlike the similar *Leptogium marginellum*), and isidia are absent. Apothecia are produced on the thallus surface and

have reddish-brown disks. The thallus is smooth as in *Leptogium cyanescens*, but that species is isidiate. This species occurs on bark.

Collections: Hardin (7), Liberty (1), Orange (1), Polk (5), San Jacinto (1), Tyler (3)

***Leptogium chloromelum* (Ach.) Nyl.**

The thallus is olive to yellowish-brown when dry and lobes are anastomosing. It lacks isidia, but apothecia are abundant on the folds of the lobes. Apothecial margins are often wrinkled. This species is similar in color to *Leptogium milligranum*, which is also anastomosing, but that species is isidiate. Our collection was from bark.

Collection: Tyler (1)

***Leptogium cyanescens* (Rabenh.) Körber**

The thallus is slate gray and smooth without wrinkles. Cylindrical isidia are abundant on the surface and lobe margins. It intergrades somewhat with *Leptogium denticulatum*, a species with flattened or lobulate isidia. *Leptogium cyanescens* is common in SE Texas and occurs on the bark of a variety of hardwoods.

Collections: Hardin (22), Jefferson (1), Liberty (5), Orange (1), Polk (7), Tyler (9)

***Leptogium denticulatum* Nyl.**

This species is very similar to *Leptogium cyanescens* (and they intergrade), but isidia are flattened and lobulate rather than cylindrical. It is known primarily from the

tropics and occurs less frequently in the area than *Leptogium cyanescens*. Collections were made from hardwood bark.

Collections: Hardin (9), Liberty (5), Newton (1), Polk (6), Tyler (6)

***Leptogium marginellum*** (Sw.) Gray

The thallus is bluish-gray and the upper surface is wrinkled. Small, globular apothecia with lobulate rims are produced abundantly along the lobe margins. The wrinkled surface and unusual apothecia make this species easy to identify. Our collection was from hickory.

Collection: Hardin (1)

***Leptogium milligranum*** Sierk

The thallus is wrinkled and anastomosing. Isidia are present and mainly marginal, varying from spherical and granular to cylindrical and branched. This species resembles the genus *Collema* because of the dark olive color of the thallus. In *Leptogium chloromelum* the thallus is a similar olive to yellowish-brown color, but it lacks isidia and produces apothecia. This species occurs on hardwood bark.

Collections: Hardin (3), Newton (1), Polk (1), Tyler (1)

***Lobaria*** (Schreber) Hoffm.

***Lobaria ravenelii*** (Tuck.) Yoshim.

This is the only *Lobaria* species that occurs in SE Texas. Its range extends eastward along the coast through North Carolina. It occurs on bark. Apothecia with red-

brown disks are laminal (on the thallus surface) and common. Pycnidia are also common, buried in the thallus, which is greenish-gray or olive-brown and relatively smooth. Cephalodia (pockets of cyanobacteria) occur on the upper surface. The lower surface is finely hairy tomentose. As is characteristic of the genus, lobes are broad and squarish. It produces gyrophoric and 4-*O*-methylgyrophoric acids.

Collections: Hardin (2), Polk (4), San Jacinto (1), Tyler (3)

### ***Myelochroa*** (Asahina) Elix & Hale

#### ***Myelochroa aurulenta*** (Tuck.) Elix & Hale

This is the only *Myelochroa* species that we have record of from the area, though other species are known from the surrounding region. This species has coarse soredia developing from the breakdown of the cortex, and as is characteristic of the genus, a yellowish medulla especially near or under the soredia. Cilia are present though often confined to the axils of the lobes. This is a common species that is easily identified by its yellow medulla and coarse soredia. It produces leucotylic acid. *Myelochroa galbina* (Ach.) Elix & Hale, known from Texas (though not this area), is similar but produces galbinic acid and lacks soredia. *Myelochroa aurulenta* was commonly found on the bark of magnolia and oak.

Collections: Hardin (8), Liberty (5), Newton (2), Polk (7), Sabine (2), San Augustine (1), Tyler (4)

## ***Parmelinopsis*** Elix & Hale

These are pale gray lichens with small lobes, black cilia, and a black lower surface with unbranched rhizines. The medulla is usually white but can be slightly yellowish.

- 1. Isidia present..... 2
- 1. Isidia absent; schizidia/soredia present..... *Parmelinopsis spumosa*
- 2. Gyrophoric acid present..... *Parmelinopsis minarum*
- 2. Gyrophoric acid absent; hiascic acid complex present.....  
..... *Parmelinopsis horrescens*

### ***Parmelinopsis horrescens*** (Taylor) Elix & Hale

Isidia are abundant and often have cilia coming out of the tips. This species is very similar to *Parmelinopsis minarum*, which has non-ciliate isidia and a different chemistry. The hiascic acid complex that *Parmelinopsis horrescens* produces is a distinct chemistry for North American lichen species.

Collections: Hardin (2), Tyler (1)

### ***Parmelinopsis minarum*** (Vainio) Elix & Hale

This species is heavily isidiate. It produces gyrophoric acid, 5-O-methylhiascic acid, and sometimes a UV+ unknown. It is similar to *Parmelinopsis horrescens*, but the isidia do not become ciliate and the chemistry is different. At first glance it is similar to other small gray isidiate lichens that occur in the area including *Canoparmelia*

*caroliniana*, which has white maculae and perlatolic acid, and *Bulbothrix goebelii*, which produces marginal, bulbate cilia. This species is found on the bark of oaks and other hardwoods.

Collections: Hardin (5), Liberty (1), Newton (4), Orange (1), Polk (6), Tyler (5)

***Parmelinopsis spumosa*** (Asahina) Elix & Hale

The thallus surface is slightly shiny with abundant, irregular pustules breaking down into coarse, granular particles (schizidia) that resemble sores. Cilia are very short, and the medulla is faintly yellow. It produces atranorin, gyrophoric acid, and unknowns. *Hypotrachyna osseoalba* also has pustules, but its rhizines are forked and it produces lichexanthone in the cortex (UV+ gold) along with the lividic acid complex in the medulla.

Collections: Newton (1), Polk (1)

***Parmotrema*** A. Massal.

This foliose genus is characterized by broad lobes with ruffled margins, frequently with marginal cilia. The thallus is gray to greenish-gray. The lower surface is black except for a marginal zone in most species. Rhizines are usually present but may be absent from the marginal zone. This is a very commonly encountered genus in the piney woods usually occurring on the bark of various deciduous trees.

- |                         |    |
|-------------------------|----|
| 1. Soredia absent.....  | 2  |
| 1. Soredia present..... | 14 |

|                                                                                      |                                  |
|--------------------------------------------------------------------------------------|----------------------------------|
| 2. Isidia present.....                                                               | 3                                |
| 2. Isidia absent.....                                                                | 9                                |
| 3. Cilia present.....                                                                | 4                                |
| 3. Cilia absent.....                                                                 | 8                                |
| 4. Medulla yellow.....                                                               | <i>Parmotrema sulphuratum</i>    |
| 4. Medulla white.....                                                                | 5                                |
| 5. Lower surface with rhizines present to the margin.....                            | <i>Parmotrema subsidiosum</i>    |
| 5. Lower surface with rhizines absent from a marginal zone.....                      | 6                                |
| 6. Medulla UV+ yellow (lichexanthone present).....                                   | <i>Parmotrema ultralucens</i>    |
| 6. Medulla UV+ white or UV– (lichexanthone absent).....                              | 7                                |
| 7. Medulla UV–; medulla K+ yellow (stictic acid present, alectoronic acid absent)... |                                  |
| .....                                                                                | <i>Parmotrema crinitum</i>       |
| 7. Medulla UV+; medulla K– (stictic acid absent, alectoronic acid present).....      |                                  |
| .....                                                                                | <i>Parmotrema mellissii</i>      |
| 8. Medulla yellow, C+ red-orange (gyrophoric acid present).....                      |                                  |
| .....                                                                                | <i>Parmotrema endosulphureum</i> |
| 8. Medulla white, C+ blood red (lecanoric acid present).....                         |                                  |
| .....                                                                                | <i>Parmotrema tinctorum</i>      |
| 9. Lower surface with rhizines present to the margin.....                            | <i>Parmotrema cetratum</i>       |
| 9. Lower surface with rhizines absent from a marginal zone.....                      | 10                               |
| 10. Lower surface with white marginal zone.....                                      | 12                               |
| 10. Lower surface without white areas.....                                           | 11                               |
| 11. Medulla K+ yellow to red (salazinic acid present).....                           | <i>Parmotrema eurysacum</i>      |

- 11. Medulla K– (protocetraric acid present)..... *Parmotrema submarginale*
- 12. Medulla UV+ (alectoronic acid present)..... *Parmotrema subrigidum*
- 12. Medulla UV– (alectoronic acid absent)..... 13
- 13. Stictic and norstictic acids present..... *Parmotrema preperforatum*
- 13. Stictic acid absent; norstictic acid present..... *Parmotrema perforatum*
- 14. Lower surface with rhizines present to the margin..... *Parmotrema reticulatum*
- 14. Lower surface with rhizines absent from a marginal zone..... 15
- 15. Lower surface with white marginal zone..... 18
- 15. Lower surface without white areas..... 16
- 16. Medulla UV+ (alectoronic acid present)..... *Parmotrema rampoddense*
- 16. Medulla UV– (alectoronic acid absent)..... 17
- 17. Medulla K+ yellow to red (salazinic acid present)..... *Parmotrema cristiferum*
- 17. Medulla K– (salazinic acid absent)..... *Parmotrema praesorediosum*
- 18. Medulla UV+ white (alectoronic acid present)..... *Parmotrema louisianae*
- 18. Medulla UV– (alectoronic acid absent)..... 19
- 19. Stictic and norstictic acids present..... *Parmotrema hypoleucinum*
- 19. Stictic acid absent; norstictic acid present..... *Parmotrema hypotropum*

***Parmotrema cetratum* (Ach.) Hale**

Cilia are short and often sparse; the lower surface is brown close to the margins with rhizines extending to the edges. Salazinic acid is produced. This species resembles *Parmotrema perforatum* because of the perforated apothecia, but the lower surface has rhizines to the edges, no white margin, and the chemistry is different. Along with

*Parmotrema reticulatum* and *Parmotrema subsidiosum*, this species was previously placed in the genus *Rimelia* because of the distribution of rhizines to the margin and the presence of reticulate maculae.

Collections: Hardin (3), Jefferson (1), Tyler (1)

***Parmotrema crinitum*** (Ach.) M. Choisy

Isidia cover the upper surface and can become ciliate. Cilia are present on the lobe margins, and the lower surface has a broad zone without rhizines near the margin. This species produces atranorin and the stictic acid complex. It is similar to *Parmotrema ultralucens* which has a different chemistry and isidia that are not ciliate.

Collections: Hardin (6), Liberty (6), Polk (2), Sabine (1), Tyler (3)

***Parmotrema cristiiferum*** (Taylor) Hale

Fine soralia occur on the margins of older lobes, cilia are absent or very sparse, and the lower surface has a broad, brown, bare edge. This species produces atranorin and salazinic acid and is similar to several other *Parmotrema* species with different chemistries. Another sorediate species, *Parmotrema praesorediosum*, also lacks cilia but contains atranorin and fatty acids.

Collections: Hardin (1), Tyler (1)

***Parmotrema endosulphureum*** (Hillm.) Hale

Marginal cilia are absent in this species. Isidia cover the thallus surface. The medulla is dark yellow and produces gyrophoric acid. The lobes are somewhat smaller

than *Parmotrema tinctorum* which has a white medulla and produces lecanoric acid.

*Parmotrema sulphuratum* also has a yellow medulla, but it is a brighter yellow (different pigment) and the margins have cilia.

Collections: Hardin (5), Liberty (1)

***Parmotrema eurysacum* (Hue) Hale**

This species is similar to *Parmotrema cetratum* producing medullary salazinic acid, but the underside has a bare margin and the upper cortex lacks reticulate cracking. Our collections were from hardwood bark.

Collections: Hardin (1), Tyler (2)

***Parmotrema hypoleucinum* (Steiner) Hale**

The lobes are broad and ascending. Soralia and long cilia are present on the lobe margins. The lower surface is brown with a broad white marginal zone. This species produces the stictic acid complex, atranorin, and norstictic acid. It is identical to *Parmotrema hypotropum* which produces norstictic acid but lacks the stictic acid complex.

Collections: Hardin (1), Liberty (1)

***Parmotrema hypotropum* (Nyl.) Hale**

This species has long cilia, white maculae, marginal soralia, and produces atranorin and norstictic acid. The lower surface is white near the edges and black in the

center. It is identical to *Parmotrema hypoleucinum* which produces stictic acid in addition to norstictic acid. It is common on bald cyress, oak, and dead branches.

Collections: Angelina (1), Hardin (11), Liberty (5), Newton (1), Orange (3), Polk (4), Sabine (2), Tyler (8)

***Parmotrema louisianae* (Hale) Hale**

This species, like *Parmotrema hypoleucinum*, is a chemical variant of *Parmotrema hypotropum*. It produces alectoronic acid and is known from only a few localities in SE Texas and eastward along the Gulf Coast.

Collections: Hardin (2), Polk (3), Sabine (3), San Augustine (2), Tyler (2)

***Parmotrema mellissii* (C. W. Dodge) Hale**

This species is found in the southeastern U.S. and is very similar to *Parmotrema crinitum*. It differs in chemistry, being UV+ white (alectoronic acid), and the isidia often break down into granular soredia in this species.

Collections: Hardin (3), Polk (1)

***Parmotrema perforatum* (Jacq.) A. Massal.**

This species has perforate apothecia with a hole at the center of each disc. It produces atranorin and norstictic acid. The lower surface is black with a white marginal zone and the lobes are ascending. A number of chemical relatives exist including *Parmotrema subrigidum* (alectoronic acid) and *Parmotrema preperforatum* (norstictic and stictic acids). It is common on hardwood bark and fallen branches.

Collections: Angelina (1), Hardin (13), Jasper (2), Liberty (6), Orange (3), Polk (3), Tyler (4)

***Parmotrema praesorediosum*** (Nyl.) Hale

This species has relatively narrow (<10 mm), rounded, smooth lobes. The margins lack cilia, but crescent shaped soralia are present on the older lobes in the center of the thallus. It produces only atranorin and fatty acids. It often occurs in full sun on fallen branches and bark including pine and bald cypress.

Collections: Angelina (1), Hardin (5), Jasper (1), Jefferson (2), Liberty (6), Newton (1), Polk (5), Sabine (4), San Augustine (1), Tyler (10)

***Parmotrema preperforatum*** (W. L. Culb.) Hale

This species is a chemical variant of *Parmotrema perforatum*, producing norstictic acid and the stictic acid complex. It is most common from central Texas to Louisiana.

Collections: Angelina (2)

***Parmotrema rampoddense*** (Nyl.) Hale

In this species, marginal cilia are very long, the lower surface is black, and the medulla fluoresces (alectoronic acid). Marginal soralia are present on the main lobes, similar to *Parmotrema praesorediosum*, but this species has larger, broader lobes. It is commonly found on oak and other hardwoods.

Collections: Hardin (19), Jasper (1), Liberty (3), Newton (2), Orange (1), Polk (6), Sabine (1), San Jacinto (1), Tyler (7)

***Parmotrema reticulatum*** (Taylor) M. Choisy

The thallus is often folded slightly with white maculae in a reticulate pattern developing into cracks on the surface. Mounds of coarse soredia are present close to the margins or at the tips of elongated lobes. Rhizines extend to or almost to the edge of the lower surface. Salazinic acid is produced. This species could be considered the sorediate counterpart of *Parmotrema cetratum*. It occurs on various types of bark and fallen branches.

Collections: Angelina (1), Hardin (17), Jefferson (1), Liberty (6), Orange (3), Polk (3), Sabine (2), Tyler (10)

***Parmotrema subisidiosum*** (Müll. Arg.) Hale

Reticulate maculae and cracks are visible on the thallus surface. Isidia are present, sometimes intergrading with soredia, and can become ciliate at the tips. The lower surface is black with a brown marginal zone, and rhizines occur to the edge. Salazinic acid and atranorin are produced. This species could be considered the isidiate counterpart of *Parmotrema cetratum*.

Collections: Angelina (1), Hardin (5), Jasper (1), Liberty (9), Polk (2), Sabine (2), San Augustine (1), Tyler (7)

***Parmotrema submarginale*** (Michaux) DePriest & B. Hale

This species lacks soredia, isidia, and maculae but has abundant black pycnidia on the lobe tips. Apothecia are usually present and are not perforate. It produces protocetraric acid and atranorin. It is the only *Parmotrema* species in SE Texas that produces protocetraric acid. It is common on bark and twigs.

Collections: Angelina (1), Hardin (13), Jasper (2), Liberty (3), Newton (1), Orange (1), Polk (4), Sabine (1), Tyler (8)

***Parmotrema subrigidum*** Egan

Long cilia are present on the margins, and perforate apothecia are common. It is similar to *Parmotrema perforatum* but produces alecronic acid. It was recently separated from *Parmotrema rigidum* because of different spore measurements and chemistry, as well as being known only from North America, not South America where *Parmotrema rigidum* occurs (Egan et al. 2005). It is common on a variety of hardwood trees and fallen branches.

Collections: Angelina (1), Hardin (16), Jasper (1), Liberty (3), Orange (1), Polk (4), Sabine (2), San Augustine (2), Tyler (12)

***Parmotrema sulphuratum*** (Nees & Flotow) Hale

The medulla is bright yellow, and the thallus is yellowish-green/gray becoming wrinkled and cracked with long, thin cilia present on the margins. Isidia are cylindrical or slightly branched, and the lower surface is black with brown margins. Atranorin and

vulpinic acid are produced. It is similar to *Parmotrema endosulphureum*, another species with a yellow medulla, but that species lacks cilia and has a different medullary pigment.

Collections: Hardin (2)

***Parmotrema tinctorum*** (Delise ex Nyl.) Hale

This is the single most-collected species in the area. It has broad lobes and is covered with isidia. The medulla contains lecanoric acid and reacts C+ blood red. It is similar to *Parmotrema endosulphureum* which is also isidiate but has a yellow medulla and produces gyrophoric acid. This species occurs on many types of hardwoods as well as pine and fallen branches (see Figure 12).

Collections: Angelina (1), Hardin (39), Jasper (1), Jefferson (2), Liberty (8), Newton (5), Orange (4), Polk (15), Sabine (3), San Augustine (1), San Jacinto (1), Tyler (22)



**Figure 12.** *Parmotrema tinctorum*. Photo by the author.

***Parmotrema ultralucens* (Krog) Hale**

This species has marginal cilia, abundant isidia, and the medulla is UV+ gold due to the presence of lichexanthone. Atranorin and salazinic acid are also produced. It is similar to *Parmotrema crinitum*, differing in chemistry and the isidia which do not become ciliate in this species. It is found on beech, oak, other hardwoods, and downed limbs.

Collections: Angelina (1), Hardin (15), Liberty (6), Polk (8), Sabine (1), San Augustine (3), San Jacinto (1), Tyler (11)

***Phaeophyscia* Moberg**

In this genus the lobes are small to medium in width, the lower surface is black, and the thallus is pale olive/brown in color. These species are similar to species of *Physcia* but lack atranorin in the cortex (K–). Assistance in identification of species in this genus was generously provided by Dr. Ted Esslinger.

1. Medulla white; soredia absent..... *Phaeophyscia ciliata*
1. Medulla red-orange; soredia present..... *Phaeophyscia rubropulchra*

***Phaeophyscia ciliata* (Hoffm.) Moberg**

The lower surface has abundant black rhizines that are sometimes visible at the margins of the lobes. Apothecia are also abundant often with rhizines growing from the lower margin. This species occurs on bark mainly in the eastern half of the U.S. It contains no lichen substances.

Collections: Hardin (4), Liberty (5), Polk (1), San Jacinto (1), Tyler (1)

***Phaeophyscia rubropulchra*** (Degel.) Essl.

The bright red-orange medulla distinguishes this species whose name (*rubropulchra*) translates “red beautiful.” Coarse soredia are present and are usually marginal but also sometimes laminal. Rhizines are short and black with white tips. Our collection was from ironwood.

Collection: Tyler (1)

***Physcia*** (Schreber) Michaux

These are foliose lichens with narrow to medium sized lobes, greenish-gray to white, often spotted with white maculae. The lower surface is usually pale often with pale rhizines. Atranorin is produced in the cortex (K+ yellow). Other genera, including *Phaeophyscia*, *Dirinaria*, *Heterodermia*, and *Pyxine*, have some species that are very similar to certain species of *Physcia* and are also placed in the family Physciaceae. Assistance in identification of species in this genus was generously provided by Dr. Ted Esslinger.

- |                           |                          |
|---------------------------|--------------------------|
| 1. Soredia absent.....    | 2                        |
| 1. Soredia present.....   | 3                        |
| 2. Medulla K+ yellow..... | <i>Physcia aipolia</i>   |
| 2. Medulla K—.....        | <i>Physcia stellaris</i> |

- 3. Lower surface black except for a white border.....  
..... *Physcia solediosa*
- 3. Lower surface not black..... 4
- 4. Soredia entirely laminal..... *Physcia americana*
- 4. Soredia marginal..... 5
- 5. Lower surface appearing fibrous, streaked with darker lines (striate).....  
..... *Physcia atrostriata*
- 5. Lower surface not appearing fibrous or streaked with darker lines .....  
..... *Physcia millegrana*

***Physcia aipolia*** (Ehrh. ex Humb.) Fűrnr.

The thallus lacks soredia and isidia but is spotted with white maculae. The lower surface is white to pale brown with abundant rhizines. Apothecia are common and typically have white pruina. Atranorin and zeorin are produced. This species is very similar to *Physcia stellaris*, but the medulla in this species reacts K<sup>+</sup> yellow (K<sup>-</sup> in *Physcia stellaris*).

Collection: Hardin (1)

***Physcia americana*** G. Merr.

Soredia are produced in laminal soralia. The lower surface is white with white rhizines. Atranorin and unknown terpenes are produced. This species is very much like *Dirinaria picta* expect for the white lower surface and chemistry. It is found on twigs and bark.

Collections: Hardin (4), Jefferson (1), Polk (1), Tyler (4)

***Physcia atrostriata*** Moberg

The lower surface is fibrose, appearing to lack a cortex, streaked with gray/black lines radiating outward; it is white near the edges and gets darker until it is almost black in the center. The lobe tips are pruinose giving a frosty appearance around the edges. It is similar to species of *Heterodermia*, but lacks cilia, has the unique lower surface, and the fungal tissue in the upper cortex is structured differently than in *Heterodermia*. This species occurs on various types of hardwood bark in the Gulf Coast region up to North Carolina.

Collections: Hardin (14), Liberty (4), Newton (1), Polk (6), San Augustine (1), San Jacinto (1), Tyler (5)

***Physcia millegrana*** Degel.

Maculae are present and narrow lobe margins become finely divided and dissolve into fine, granular soredia. The lower surface is white with pale rhizines. This is a common and widespread species in the eastern U.S. mostly north of the Gulf Coast. Our collection was from willow.

Collection: Sabine (1)

***Physcia solediosa*** (Vainio) Lynge

Soredia are produced in mounds along the lobe margins, encroaching on the thallus surface, and appearing laminal in older parts of the lichen. The lower surface is

black except for a white border, and black rhizines are present. It produces atranorin, zeorin and other terpenes and is easily mistaken for species of *Dirinaria* or *Pyxine*, because the black lower surface is not typical of *Phycia* species. The similar *Phycia americana* has truly laminal soredia and a white lower surface. This species occurs on oaks and other hardwoods.

Collections: Jefferson (1), Liberty (3), Polk (1), Sabine (1), San Augustine (1), Tyler (1)

***Phycia stellaris* (L.) Nyl.**

The lobes seem to radiate outward and apothecia are common, but soredia and isidia are absent. Rhizines are abundant on the lower surface which is pale but varies in color. It produces atranorin and is similar to *Phycia aipolia*, but that taxon has a different chemistry (K<sup>+</sup> yellow medulla) and white maculae. This species occurs on bark and twigs and its range covers nearly the entire U.S. and extends into Canada.

Collections: Hardin (4), Tyler (1)

***Pseudocyphellaria* Vainio**

***Pseudocyphellaria aurata* (Ach.) Vainio**

This is the only species of *Pseudocyphellaria* reported from the area, and there are no recent collections. The thallus is grass-green when wet and olive/brownish when dry. Lobes are large with marginal, yellow, powdery soredia. The medulla is dark yellow. The lower surface is tan to yellowish and has bright yellow pseudocyphellae characteristic of the genus. Cephalodia (pockets of cyanobacteria) occur on the thallus surface appearing

as bumps. The only other *Pseudocyphellaria* with yellow sores is *Pseudocyphellaria crocata*, but its sores are coarse and laminal as well as marginal, and it has a cyanobacterial photobiont and a more northern range.

Collections: Hardin (2)

## ***Pseudoparmelia*** Lynge

***Pseudoparmelia uleana*** (Mull. Arg.) Elix & T.H. Nash

One of only three North American species, it is a **new record for Texas**. There is another unpublished record from Aransas County, Texas, but we have not examined that specimen (Tucker and Egan 2009). In this species, the thallus is similar in color to *Punctelia* and often has maculae but no pseudocyphellae (see Figure 13). Cilia are absent. The medulla is pale lemon yellow. The lower surface is pale/olive brown with abundant short rhizines. Apothecia are often present (though not in our specimens), and the disks are reddish brown. It produces secalonin acid and lacks atranorin.

*Canoparmelia* is a closely related genus with atranorin, a white medulla, and a dark lower surface.

Collections: Polk (1), Tyler (2)

Polk County on hardwood. Big Thicket National Preserve, Menard Creek Corridor Unit; dirt road to Holly Grove at junction with Menard Creek; 30°30'13" N, 94°41'19" W.

Moshman 71. March 14, 2007.

Tyler County on bark. Big Thicket National Preserve, Turkey Creek Unit; N end of Turkey Creek Trail off FM 1943, E of Warren; 30°36'24" N, 94°20'26" W.

Widhelm & Harms 2331, 2351. December 17, 2006.



**Figure 13.** *Pseudoparmelia uleana*. Photo by the author.

### ***Punctelia*** Krog

These foliose lichens are medium sized, gray, and have conspicuous white pseudocyphellae. They are common on bark in SE Texas.

- 1. Isidia present..... *Punctelia rudecta*
- 1. Isidia absent..... *Punctelia graminicola*

***Punctelia graminicola* (B. de Lesd.) Egan**

This species lacks soredia and isidia. The lower surface is pale brown. It produces atranorin and lecanoric acid and usually occurs on rocks in other areas of North America (Egan 2003). Our collection was from bark.

Collection: Liberty (1)

***Punctelia rudecta* (Ach.) Krog**

This species is locally very common, and its range covers the eastern U.S. and extends into Canada. It is isidiate with white pseudocyphellae. The lower surface is pale tan with rhizines. The white medulla reacts C<sup>+</sup> red (lecanoric acid). It looks very similar to *Canoparmelia caroliniana* but has a different chemistry and pseudocyphellae rather than white maculae. The two species often grow together in SE Texas. *Punctelia rudecta* occurs on a variety of hardwoods and conifers as well as fallen branches (see Figure 14).

Collections: Angelina (2), Hardin (18), Jasper (1), Jefferson (1), Liberty (7), Newton (2), Orange (1), Polk (12), Sabine (3), San Augustine (3), San Jacinto (1), Tyler (15)



**Figure 14.** *Punctelia rudecta*. Photo by the author.

### ***Pyxine*** Fr.

These are foliose lichens with narrow lobes that grow closely appressed, usually on bark. The lower surface is black with rhizines. The medulla is often pigmented. The cortex contains lichexanthone and/or atranorin. Species resemble other small foliose lichen genera, especially *Dirinaria*, but that genus lacks rhizines and never contains lichexanthone. *Pyxine* produces lecideine apothecia, while other genera of the Physciaceae produce lecanorine apothecia.

- |                                                    |                              |
|----------------------------------------------------|------------------------------|
| 1. Thallus UV+.....                                | 2                            |
| 1. Thallus UV–.....                                | 3                            |
| 2. Medulla yellow; K– or K+ yellowish.....         | <i>Pyxine subcinerea</i>     |
| 2. Medulla orange or yellow-orange; K+ purple..... | <i>Pyxine caesiopruinosa</i> |

- 3. Medulla mostly white; soredia/dactyls laminal..... 4
- 3. Medulla yellow-orange; soredia marginal..... *Pyxine sorediata*
- 4. Dactyls immediately breaking down into soredia.....  
.....*Pyxine eschweilerli*
- 4. Dactyls coarse, almost isidia-like, not becoming sorediate.....  
..... *Pyxine coralligera*

***Pyxine caesiopruinosa*** (Nyl.) Imshaug

In this species the medulla is orange, and it reacts K<sup>+</sup> purple (anthraquinones). Soredia are yellow and in patches, and the cortex is UV<sup>+</sup> gold (lichexanthone). It is similar to *Pyxine subcinerea* which produces different medullary pigments that are K<sup>–</sup> or K<sup>+</sup> yellowish. It occurs on the bark of hardwoods.

Collections: Hardin (6), Newton (1), Orange (1), Polk (1), Tyler (8)

***Pyxine coralligera*** Malme

This **new Texas record** was previously reported from only a few counties in Florida (Harris 1995). Rather than having typical soredia, it has dactyls on the surface which are coarse and resemble isidia because of the cortical covering (see Figure 15). Aside from that difference, it is very similar to *Pyxine eschweilerli*, and both species are found on hardwood bark.

Collections: Hardin (2), Tyler (2)

Hardin County on fallen limb. Big Thicket National Preserve, Turkey Creek Unit; Kirby Nature Trail off FM 420, E of the BTNP Visitor Center; 30°27'42.7" N, 94°21'04" W.

Egan 18,815. January 6, 2008.

Hardin County on bark. Big Thicket National Preserve, Turkey Creek Unit; NW of Kirby Nature Trail off FM 420, near BTNP Visitor Center; 30°27'27" N, 94°21'05" W.

Widhelm & Harms 2528. December 18, 2006.

Tyler County on bark. Big Thicket National Preserve, Turkey Creek Unit; N end of the Turkey Creek Trail off FM 1943, E of Warren; 30°36'24" N, 94°20'26" W.

Widhelm & Harms 2345. December 17, 2006.

Tyler County on bark. Big Thicket National Preserve, Beech Creek Unit; along the Beech Woods Trail off FM 2992, NW of Spurger; 30°43'10" N, 94°13'16" W.

Widhelm & Harms 2124. December 15, 2006.



**Figure 15.** *Pyxine coralligera*. Photo by the author.

***Pyxine eschweileri*** (Tuck.) Vainio

The thallus is pale gray/greenish-gray and lacks lichexanthone. The medulla can be white or yellowish. Lobe tips may be pruinose. Laminar soredia originate from dactyls bursting/breaking down. In *Pyxine coralligera* the dactyls do not break down into soredia. This species is found on bark in the Gulf Coast states from Texas to South Carolina.

Collections: Hardin (4), Liberty (1), Orange (1), Tyler (6)

***Pyxine sorediata*** (Ach.) Mont.

The thallus is bluish-gray, lacks lichexanthone, and is pruinose at lobe tips which are often up-turned. Granular soredia are produced along the lobe margins. The medulla is deep yellow, and the lower surface has black rhizines that are pale at the tips and forked. It is common throughout the eastern U.S. on hardwoods.

Collections: Hardin (2), Liberty (2), Tyler (2)

***Pyxine subcinerea*** Stirton

Marginal soredia are present and apothecia are common as well. The medulla is yellowish, and the lower surface is black with pale margins. It produces lichexanthone and terpenes. This species is very similar to *Pyxine caesiopruinosa* but is easily distinguished by the K– or K+ yellow (rather than K+ purple) medullary spot test. It occurs on deciduous trees and bald cypress.

Collections: Angelina (1), Liberty (1), Polk (2), Sabine (3), San Augustine (1), Tyler (2)

## ***Ramalina*** Ach.

This fruticose genus produces usnic acid and is similar to the genus *Usnea* which is also found in the area. Thalli are pendant or shrubby, branches are stiff and often flattened, and lack the central cord that is characteristic of *Usnea* species. These lichens are often found growing as tufts on tree trunks and branches.

There are several *Ramalina* specimens that remain unidentified. They are similar in morphology to *Ramalina montagnei* or *Ramalina stenospora*, but they lack lichen substances.

- 1. Soredia present..... *Ramalina peruviana*
- 1. Soredia absent..... 2
- 2. Spiny side branches present; salazinic acid present (rarely norstictic or protocetraric acids)..... *Ramalina willeyi*
- 2. Spiny side branches absent; salazinic acid absent..... 3
- 3. Branches nearly round in cross-section..... *Ramalina montagnei*
- 3. Branches wide and flattened..... 4
- 4. Branches covered with tubercles (whitish warts)..... *Ramalina complanata*
- 4. Branches not covered with tubercles..... *Ramalina americana*

### ***Ramalina americana*** Hale

White pseudocyphellae are present on the branches which are often ridged with large flat apothecia near the branch tips. This species is usually found growing in full

sun. As in *Ramalina montagnei*, there is chemical variation in this species. *Ramalina complanata* is similar, but its branches are covered with whitish warts.

Collections: Tyler (2)

***Ramalina complanata* (Sw.) Ach.**

Branches in this species are broad, ridged, and covered with tubercles (appearing as whitish warts) and pseudocyphellae. Large apothecia are usually common at the lobe tips. It typically produces divaricatic acid. *Ramalina americana* is a similar species, but it lacks tubercles.

Collections: Liberty (2)

***Ramalina montagnei* De Not.**

Branches are terete with white striations and pseudocyphellae. Apothecia are abundant. The sekikaic acid complex is produced in most of our collections. Stenosporic and divaricatic acids have also been reported. This species intergrades somewhat with *Ramalina stenospora* which usually has perlatolic acid and more flattened branches. It occurs on twigs and dead branches as well as bark.

Collections: Hardin (8), Liberty (8), Orange (1), Polk (3), San Jacinto (1),

Tyler (2)

***Ramalina peruviana* Ach.**

Branches are flattened to nearly terete, usually striate, with small soralia produced along the branch margins. The soralia are round or elliptical and sometimes give rise to

isidia-like outgrowths. The sekikaic acid complex is produced. This species is similar to *Ramalina dendriscoides* which produces salazinic acid, and the soralia are confined to the branch tips. It occurs on branches and the bark of hardwoods and bald cypress.

Collections: Hardin (8), Newton (1), Orange (3), Polk (1), Sabine (2), Tyler (3)

***Ramalina willeyi*** R. Howe

In this species, branches are nearly round except at the base where they are flattened. Side branches that resemble spines are common. Pseudocyphellae are white and slightly raised, and apothecia are common. It produces salazinic acid (or rarely norstictic or protocetraric acids). It occurs on hardwoods.

Collections: Hardin (3), Liberty (1), Orange (1)

***Teloschistes*** Norman

These fruticose lichens are usually bright orange and tufted or shrubby.

1. Apothecia without cilia on margins..... *Teloschistes exilis*
1. Apothecia with marginal cilia..... *Teloschistes chrysophthalmus*

***Teloschistes chrysophthalmus*** (L.) Th. Fr.

Appearing very similar to *Teloschistes exilis*, this species has branches that are somewhat broader and flatter, and they end in ciliate apothecia. Thalli are often smaller as well. Our collection was from hardwood branches.

Collection: Liberty (1)

***Teloschistes exilis*** (Michaux) Vainio

Branches are more or less terete (round) ending in long, fine cilia. Apothecia are orange, scattered along the branches, and lack cilia on the margins. This species is often found on branches of hardwood trees in open woodlands.

Collections: Hardin (4), Liberty (2), Polk (1), Tyler (1)

***Usnea*** Dill. ex Adans.

These fruticose lichens are shrubby or pendant (hanging) and yellow-green due to the presence of usnic acid. Branches are round in cross section with a central cord (axis). Another fruticose genus found in the area is *Ramalina*, but those lichens lack a central cord, and the branches are usually more flattened in cross section.

1. Isidia or isidia-like papillae or fibrils present..... 2
1. Isidia absent..... 5
2. Axis hollow at the base; norstictic acid present..... *Usnea baileyi*
2. Axis not hollow at the base; norstictic acid absent..... 3
3. Thallus reddish; stictic acid present..... *Usnea rubicunda*
3. Thallus not reddish; stictic acid absent..... 4
4. Cortex thick and hard; protocetraric acid present.....  
..... *Usnea subscabrosa*
4. Cortex thinner and brittle; protocetraric acid absent (usnic acid only).....  
..... *Usnea mutabilis*

- 5. Thallus shrubby with numerous side branches..... *Usnea strigosa*
- 5. Thallus pendant; branches segmented..... *Usnea trichodea*

***Usnea baileyi*** (Stirton) Zahlbr.

Branches are stiff, tapering, and form papillae (small cortical bumps) and isidia. The medulla is usually red and very thin. There is a large, hollow central axis filling most of the branch near the base. Norstictic acid is produced. *Usnea perplectata* also has a hollow axis and red medulla but is found in Florida and produces diffractaic acid. Our collection was from bald cypress.

Collection: Hardin (1)

***Usnea mutabilis*** Stirton

This species is shrubby and isidiate with a brittle cortex. The medulla and axis are dull red, and it produces usnic acid only. *Usnea strigosa* can have a red medulla, but that species lacks isidia and usually contains norstictic acid (but can have psoromic or usnic acid only). *Usnea subscabrosa* looks similar but produces protocetraric acid.

Collections: Hardin (5), Tyler (5)

***Usnea rubicunda*** Stirton

The thallus in this species is red-orange due to pigmentation in the cortex. Branches are papillate and isidiate. It produces the stictic acid complex in addition to usnic acid. The distinctive color of the thallus makes this species easy to identify. Our collections were from oak.

Collections: Hardin (2)

***Usnea strigosa*** (Ach.) Eaton

The thallus in this species is shrubby, and the main branches are covered with side branches giving it a bristly look. It lacks isidia and soredia, and papillae are inconspicuous. The medulla is red or white, the axis is white or pink, and large apothecia are common. There are five chemical varieties; the most common one in SE Texas contains norstictic acid. Other chemical varieties in the area contain psoromic and conpsoromic acids or usnic acid only. This is a very common species and is typically found on fallen branches and twigs.

Collections: Hardin (22), Liberty (7), Newton (1), Orange (2), Polk (9), Sabine (1), San Jacinto (1), Tyler (9)

***Usnea subscabrosa*** Nyl. ex Motyka

This species is a **new Texas record**. The cortex is very thick relative to the medulla. The medulla is white, thin, and only half the width of the cortex. This species is isidiate and produces protocetraric acid (see Figure 16). It resembles *Usnea mutabilis*, but that species has a thinner cortex, a red medulla, and produces usnic acid only.

Collection: Hardin County on bark. E side of Village Creek, 6 miles N of Kountze. Troxell 821A. January 1, 1977.



**Figure 16.** *Usnea subscabrosa*. Photo by the author.

***Usnea trichodea* Ach.**

The thallus in this species is pendent and branches in uneven dichotomies with slender main branches divided into articulating segments by swollen white cracks. It lacks isidia, soredia, and papillae. The medulla is white and dense, and the axis is reddish to brown. It produces diffractaic acid or constictic acid and sometimes barbatic acid. Our collections had diffractaic acid as the primary chemical product and were found on bald cypress.

Collections: Liberty (2)

***Xanthomendoza*** S. Kondr. & Kärnefelt

***Xanthomendoza weberi*** (S. Kondr. & Kärnefelt) L. Lindblom

This bright orange foliose lichen has very narrow, tiny lobes with soredia on the underside. It is the only representative of this genus in the area, and previous records of *Xanthoria fulva* are likely to be *Xanthomendoza weberi*. It occurs on bark.

Collections: Hardin (1), Sabine (1)

## Discussion

The table below is an alphabetical listing of all the species collected in this study. An “x” indicates the presence of a species from the time period listed at the top of the table and “number collected” indicates how many collections were made of that species. Empty cells indicate the absence of a species from our collections, and species absent from recent collections are indicated by a dash (–). Bolded species are new records for the Big Thicket region and species followed by an asterisk (\*) are new Texas records.

**Table 1.** Macrolichen species present in historic and recent collections.

| <b>Taxon</b>                          | <b>1967–1980</b> | <b>Number collected</b> |  | <b>2005–2011</b> | <b>Number collected</b> |
|---------------------------------------|------------------|-------------------------|--|------------------|-------------------------|
| <i>Anzia colpodes</i> –               | x                | 2                       |  |                  |                         |
| <i>Anzia ornata</i> –                 | x                | 5                       |  |                  |                         |
| <i>Bulbothrix goebelii</i>            | x                | 12                      |  | x                | 13                      |
| <b><i>Bulbothrix isidiza</i>*</b>     |                  |                         |  | x                | 1                       |
| <i>Bulbothrix laevigatula</i>         | x                | 1                       |  | x                | 1                       |
| <b><i>Candelaria concolor</i></b>     |                  |                         |  | x                | 1                       |
| <i>Canoparmelia caroliniana</i>       | x                | 34                      |  | x                | 59                      |
| <i>Canoparmelia cryptochlorophaea</i> | x                | 15                      |  | x                | 34                      |
| <i>Cladonia caespiticia</i>           | x                | 1                       |  | x                | 5                       |
| <i>Cladonia didyma</i>                | x                | 2                       |  | x                | 5                       |
| <i>Cladonia leporina</i>              | x                | 3                       |  | x                | 1                       |

| <b>Taxon</b>                       | <b>1967–1980</b> | <b>Number collected</b> |  | <b>2005–2011</b> | <b>Number collected</b> |
|------------------------------------|------------------|-------------------------|--|------------------|-------------------------|
| <i>Cladonia macilenta</i>          | x                | 1                       |  | x                | 4                       |
| <b><i>Cladonia parasitica</i></b>  |                  |                         |  | x                | 2                       |
| <i>Cladonia peziziformis</i>       | x                | 12                      |  | x                | 12                      |
| <i>Cladonia polycarpia</i>         | x                | 2                       |  | x                | 1                       |
| <i>Cladonia polycarpoides</i> –    | x                | 1                       |  |                  |                         |
| <i>Cladonia ravenelii</i> –        | x                | 5                       |  |                  |                         |
| <b><i>Cladonia sobolescens</i></b> |                  |                         |  | x                | 4                       |
| <b><i>Cladonia subcariosa</i></b>  |                  |                         |  | x                | 4                       |
| <i>Cladonia subradiata</i>         | x                | 2                       |  | x                | 14                      |
| <i>Cladonia subtenuis</i>          | x                | 1                       |  | x                | 3                       |
| <i>Coccocarpia erythroxyli</i> –   | x                | 3                       |  |                  |                         |
| <i>Coccocarpia palmicola</i>       | x                | 8                       |  | x                | 11                      |
| <i>Collema furfuraceum</i> –       | x                | 1                       |  |                  |                         |
| <i>Collema pulchellum</i>          | x                | 1                       |  | x                | 3                       |
| <b><i>Collema subflaccidum</i></b> |                  |                         |  | x                | 2                       |
| <i>Dirinaria aegialita</i>         | x                | 12                      |  | x                | 18                      |
| <b><i>Dirinaria confluens</i></b>  |                  |                         |  | x                | 1                       |
| <i>Dirinaria confusa</i>           | x                | 4                       |  | x                | 14                      |
| <i>Dirinaria picta</i>             | x                | 5                       |  | x                | 12                      |
| <i>Heterodermia albicans</i>       | x                | 13                      |  | x                | 43                      |
| <b><i>Heterodermia crocea</i>*</b> |                  |                         |  | x                | 1                       |

| <b>Taxon</b>                        | <b>1967–1980</b> | <b>Number collected</b> |  | <b>2005–2011</b> | <b>Number collected</b> |
|-------------------------------------|------------------|-------------------------|--|------------------|-------------------------|
| <i>Heterodermia echinata</i>        | x                | 5                       |  | x                | 4                       |
| <i>Heterodermia obscurata</i>       | x                | 6                       |  | x                | 3                       |
| <b><i>Heterodermia speciosa</i></b> |                  |                         |  | x                | 2                       |
| <i>Hypotrachyna livida</i>          | x                | 25                      |  | x                | 25                      |
| <i>Hypotrachyna osseoalba</i>       | x                | 3                       |  | x                | 1                       |
| <i>Leptogium austroamericanum</i>   | x                | 3                       |  | x                | 17                      |
| <i>Leptogium azureum</i>            | x                | 11                      |  | x                | 7                       |
| <b><i>Leptogium chloromelum</i></b> |                  |                         |  | x                | 1                       |
| <i>Leptogium cyanescens</i>         | x                | 23                      |  | x                | 22                      |
| <i>Leptogium denticulatum</i>       | x                | 11                      |  | x                | 16                      |
| <i>Leptogium marginellum</i> –      | x                | 1                       |  |                  |                         |
| <i>Leptogium milligranum</i>        | x                | 3                       |  | x                | 3                       |
| <i>Lobaria ravenelii</i>            | x                | 7                       |  | x                | 3                       |
| <i>Myelochroa aurulenta</i>         | x                | 15                      |  | x                | 14                      |
| <i>Parmelinopsis horrescens</i> –   | x                | 3                       |  |                  |                         |
| <i>Parmelinopsis minarum</i>        | x                | 4                       |  | x                | 18                      |
| <b><i>Parmelinopsis spumosa</i></b> |                  |                         |  | x                | 2                       |
| <i>Parmotrema cetratum</i>          | x                | 3                       |  | x                | 2                       |
| <i>Parmotrema crinitum</i>          | x                | 11                      |  | x                | 7                       |
| <i>Parmotrema cristiferum</i> –     | x                | 2                       |  |                  |                         |
| <i>Parmotrema endosulphureum</i>    | x                | 3                       |  | x                | 3                       |

| <b>Taxon</b>                            | <b>1967–1980</b> | <b>Number collected</b> |  | <b>2005–2011</b> | <b>Number collected</b> |
|-----------------------------------------|------------------|-------------------------|--|------------------|-------------------------|
| <i>Parmotrema eurysacum</i> –           | x                | 3                       |  |                  |                         |
| <i>Parmotrema hypoleucinum</i>          | x                | 1                       |  | x                | 1                       |
| <i>Parmotrema hypotropum</i>            | x                | 11                      |  | x                | 24                      |
| <i>Parmotrema louisianae</i>            | x                | 5                       |  | x                | 7                       |
| <i>Parmotrema mellissii</i>             | x                | 3                       |  | x                | 1                       |
| <i>Parmotrema perforatum</i>            | x                | 18                      |  | x                | 14                      |
| <i>Parmotrema praesorediosum</i>        | x                | 13                      |  | x                | 23                      |
| <i>Parmotrema preperforatum</i>         | x                | 1                       |  | x                | 1                       |
| <i>Parmotrema rampoddense</i>           | x                | 21                      |  | x                | 20                      |
| <i>Parmotrema reticulatum</i>           | x                | 22                      |  | x                | 21                      |
| <i>Parmotrema subsidiosum</i>           | x                | 19                      |  | x                | 9                       |
| <i>Parmotrema submarginale</i>          | x                | 17                      |  | x                | 17                      |
| <i>Parmotrema subrigidum</i>            | x                | 11                      |  | x                | 31                      |
| <i>Parmotrema sulphuratum</i>           | x                | 1                       |  | x                | 1                       |
| <i>Parmotrema tinctorum</i>             | x                | 44                      |  | x                | 58                      |
| <i>Parmotrema ultralucens</i>           | x                | 20                      |  | x                | 26                      |
| <i>Phaeophyscia ciliata</i>             | x                | 4                       |  | x                | 8                       |
| <b><i>Phaeophyscia rubropulchra</i></b> |                  |                         |  | x                | 1                       |
| <i>Physcia aipolia</i> –                | x                | 1                       |  |                  |                         |
| <i>Physcia americana</i>                | x                | 7                       |  | x                | 3                       |
| <i>Physcia atrostriata</i>              | x                | 10                      |  | x                | 22                      |

| <b>Taxon</b>                        | <b>1967–1980</b> | <b>Number collected</b> |  | <b>2005–2011</b> | <b>Number collected</b> |
|-------------------------------------|------------------|-------------------------|--|------------------|-------------------------|
| <i>Physcia millegrana</i>           |                  |                         |  | x                | 1                       |
| <i>Physcia solediosa</i>            | x                | 1                       |  | x                | 7                       |
| <i>Physcia stellaris</i> –          | x                | 5                       |  |                  |                         |
| <i>Pseudocyphellaria aurata</i> –   | x                | 2                       |  |                  |                         |
| <i>Pseudoparmelia uleana</i> *      |                  |                         |  | x                | 3                       |
| <i>Punctelia graminicola</i>        |                  |                         |  | x                | 1                       |
| <i>Punctelia rudecta</i>            | x                | 20                      |  | x                | 46                      |
| <i>Pyxine caesiopruinosa</i>        | x                | 3                       |  | x                | 14                      |
| <i>Pyxine coralligera</i> *         |                  |                         |  | x                | 4                       |
| <i>Pyxine eschweileri</i>           | x                | 4                       |  | x                | 8                       |
| <i>Pyxine soledata</i>              | x                | 5                       |  | x                | 1                       |
| <i>Pyxine subcinerea</i>            | x                | 3                       |  | x                | 7                       |
| <i>Ramalina americana</i> –         | x                | 2                       |  |                  |                         |
| <i>Ramalina complanata</i>          |                  |                         |  | x                | 2                       |
| <i>Ramalina montagnei</i>           | x                | 5                       |  | x                | 18                      |
| <i>Ramalina peruviana</i>           | x                | 3                       |  | x                | 15                      |
| <i>Ramalina willeyi</i>             | x                | 3                       |  | x                | 2                       |
| <i>Teloschistes chrysophthalmus</i> |                  |                         |  | x                | 1                       |
| <i>Teloschistes exilis</i>          | x                | 4                       |  | x                | 3                       |
| <i>Usnea baileyi</i> –              | x                | 1                       |  |                  |                         |
| <i>Usnea mutabilis</i>              | x                | 5                       |  | x                | 5                       |

| <b>Taxon</b>                | <b>1967–1980</b> | <b>Number collected</b> |  | <b>2005–2011</b> | <b>Number collected</b> |
|-----------------------------|------------------|-------------------------|--|------------------|-------------------------|
| <i>Usnea rubicunda</i> –    | x                | 2                       |  |                  |                         |
| <i>Usnea strigosa</i>       | x                | 17                      |  | x                | 35                      |
| <i>Usnea subscabrosa</i> *– | x                | 1                       |  |                  |                         |
| <i>Usnea trichodea</i>      |                  |                         |  | x                | 2                       |
| <i>Xanthomendoza weberi</i> | x                | 1                       |  | x                | 1                       |
| <b>TOTAL</b>                | <b>81</b>        | <b>604</b>              |  | <b>83</b>        | <b>883</b>              |

In total, 1487 specimen collections were recorded and analyzed in this study. Within these collections there are 100 different macrolichen species representing 25 genera. In the official units of the BTNP we recorded 88 macrolichen species in 24 genera (see Table 2). Several new records were collected and identified in this study. Overall, five species are new to Texas and 15 species are new to just the Big Thicket region (see Table 1). **Records for the state of Texas** include *Bulbothrix isidiza*, *Heterodermia crocea*, *Pseudoparmelia uleana* [there is one other unpublished record of this species (Tucker & Egan 2009)], *Pyxine coralligera* and *Usnea subscabrosa*.

**New records for the Big Thicket region** (the BTNP and surrounding areas based on OMA collections) include *Candelaria concolor*, *Cladonia parasitica*, *Cladonia sobolescens*, *Cladonia subcariosa*, *Collema subflaccidum*, *Dirinaria confluens*, *Heterodermia speciosa*, *Leptogium chloromelum*, *Parmelinopsis spumosa*, *Phaeophyscia rubropulchra*, *Physcia millegrana*, *Puntelia graminicola*, *Ramalina complanata*, *Teloschistes chrysophthalmus* and *Usnea trichodea*. These taxa have been recorded from

Texas (Tucker & Egan 2009), but we cannot determine if the reports are based on collections from the Big Thicket area.

Two distinct collection periods are represented in this study, one “historic” and one recent. Collection dates range from 1967 to 1980 for the historic collections and from 2005 to 2011 for the recent collections. All Egan collections with a date of 1980 or earlier, as well as all Troxell collections, are considered the historic collections.

According to the data compiled in Table 1, the abundance of some species has changed markedly over time, with some species represented only from historic collections. For example, our records of both *Anzia ornata* and *Anzia colpodes* from the area were collected before 1980. Other species for which we have only historic collections (ranging from a single collection up to five collections) include: *Cladonia polycarpoides*, *Cladonia ravenelii*, *Coccocarpia erythroxyli*, *Collema furfuraceum*, *Leptogium marginellum*, *Parmelinopsis horrescens*, *Parmotrema cristiferum*, *Parmotrema eurysacum*, *Physcia aipolia*, *Physcia stellaris*, *Pseudocyphellaria aurata*, *Ramalina americana*, *Usnea rubicunda*, and *Usnea subscabrosa*. These species may no longer be present in the flora, or they were somehow overlooked during recent field work. All of the recent collections were made after hurricane Rita (Category 5) struck the area in September 2005. Many trees were downed as a result of the storm, and it is possible that the fallen trees represent a loss of habitat for certain species. Other factors could play a role in the decline or loss of species such as climate change and/or increasing regional air pollution. Unfortunately, it is largely speculation at this point as to why these species are present in the historic but not recent collections. An area for

future investigation might include confirming that species richness and/or abundance are in fact changing and determining the reasons for such population shifts.

Some species, on the other hand, have remained relatively abundant. For example, *Hypotrachyna livida* is very common, and we have an equal number of historic and recent collections. *Bulbothrix goebelii*, *Cladonia peziziformis*, *Leptogium cyanescens*, *Myelochroa aurulenta*, *Parmotrema rampoddense*, *Parmotrema reticulatum*, and *Parmotrema submarginale* are all nearly equal in collection numbers from both periods. A few species remain consistently uncommon or rare: *Leptogium milligranum*, *Parmotrema endosulphurem*, *Parmotrema hypoleucinum*, *Parmotrema preperforatum*, *Parmotrema sulphuratum*, *Teloschistes exilis*, *Usnea mutabilis*, and *Xanthomendoza weberi*. The most commonly collected species in the area from both collection periods is *Parmotrema tinctorum*.

The changes detected from these data may be due to actual changes in abundance and/or extinction of some species, or they may reflect the human element inherent in field collecting. While we made an effort to survey all units of the BTNP and the various national forests and surrounding areas, we collected from certain selected. Also, when working in the field, it is virtually impossible to sample every microhabitat present. Consequently, it is impossible to be sure if new records for the region represent actual range extensions for various species, or whether they were present in the past and simply overlooked. However, combining both historic and recent records, we now have a more complete dataset for the macrolichens of the BTNP and the surrounding areas of SE Texas.

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## **Appendix A**

### **Macrolichen Records from Units of the Big Thicket National Preserve**

As seen in Figure 2, the Big Thicket National Preserve is divided into 15 officially designated units. Using the databased information in the OMA herbarium, the table below lists the identified species of macrolichens from these BTNP units indicating the number of collections of each taxon from each of the 13 units sampled thus far. We have no records from the Big Sandy Creek Corridor Unit or the Pine Island-Little Pine Island Corridor Unit. In the table below, the names for the BTNP units are abbreviated as follows:

|            |                                          |
|------------|------------------------------------------|
| <b>B</b>   | Beaumont Unit                            |
| <b>BC</b>  | Beech Creek Unit                         |
| <b>BSC</b> | Big Sandy Creek Unit                     |
| <b>C</b>   | Canyonlands Unit                         |
| <b>HCS</b> | Hickory Creek Savannah Unit              |
| <b>L</b>   | Loblolly Unit                            |
| <b>LNC</b> | Lower Neches River Corridor Unit         |
| <b>LR</b>  | Lance Rosier Unit                        |
| <b>MCC</b> | Menard Creek Corridor Unit               |
| <b>NB</b>  | Neches Bottom and Jack Gore Baygall Unit |
| <b>TC</b>  | Turkey Creek Unit                        |

**UNC** Upper Neches River Corridor Unit

**VCC** Village Creek Corridor Unit

Of the 1,487 specimen records from this study, 994 collections were made in the official units of the BTNP (see Table 2). These records represent 88 macrolichen species in 24 genera. So far, only *Parmotrema tinctorum* has been collected in every investigated unit. The total number of macrolichen species found in each of the units is not necessarily a reflection of the actual diversity but probably more a reflection of the number of individual sites visited within that unit.

**Table 2.** Macrolichen species present in the units of the BTNP.

| Taxon                                             | B | BC | BS<br>C | C | HC<br>S | L | LN<br>C | LR | M<br>CC | NB | TC | UN<br>C | VC<br>C |
|---------------------------------------------------|---|----|---------|---|---------|---|---------|----|---------|----|----|---------|---------|
| <i>Anzia colpodes</i>                             |   |    |         |   |         |   |         |    | 1       |    | 1  |         |         |
| <i>Anzia ornata</i>                               |   |    |         |   |         |   |         | 3  |         |    | 2  |         |         |
| <i>Bulbothrix goebelii</i>                        | 2 | 1  | 3       |   | 4       | 1 | 1       |    |         | 1  | 2  | 1       |         |
| <i>Bulbothrix lavigatula</i>                      |   |    |         |   |         |   |         | 1  |         |    |    |         |         |
| <i>Candelaria concolor</i>                        |   | 1  |         |   |         |   |         |    |         |    |    |         |         |
| <i>Canoparmelia caroliniana</i>                   | 5 | 11 | 14      | 1 | 6       | 7 | 1       | 6  | 2       | 7  | 11 | 1       | 2       |
| <i>Canoparmelia<br/>cryptochlorophaea</i>         | 3 |    | 4       |   | 3       |   | 2       | 8  | 2       | 1  | 6  |         | 2       |
| <i>Cladonia caespiticia</i>                       | 1 | 1  |         |   | 1       |   |         |    |         |    | 2  |         |         |
| <i>Cladonia didyma</i>                            |   | 2  | 2       |   |         | 1 |         |    |         |    |    |         |         |
| <i>Cladonia leporina</i>                          |   |    |         |   |         |   |         |    |         |    | 2  |         |         |
| <i>Cladonia macilenta</i> v.<br><i>bacillaris</i> |   | 1  |         |   |         |   |         |    |         |    | 3  |         |         |
| <i>Cladonia parasitica</i>                        |   |    |         |   |         |   |         |    |         | 1  |    |         |         |
| <i>Cladonia peziziformis</i>                      |   | 2  | 3       | 3 | 2       | 1 |         |    | 1       |    | 1  |         |         |
| <i>Cladonia polycarpia</i>                        |   |    | 1       |   |         |   |         |    |         |    | 1  |         |         |
| <i>Cladonia polycarpoides</i>                     | 1 |    |         |   |         |   |         |    |         |    |    |         |         |
| <i>Cladonia subolescens</i>                       | 1 | 2  |         |   |         |   |         | 1  |         |    |    |         |         |
| <i>Cladonia subradiata</i>                        |   |    | 1       | 1 |         | 2 | 1       | 1  |         | 2  | 2  |         | 2       |
| <i>Cladonia subtenuis</i>                         |   |    |         | 1 |         |   |         |    |         |    |    |         |         |
| <i>Coccocarpia erythroxili</i>                    |   |    |         |   |         |   |         |    |         |    | 1  |         |         |
| <i>Coccocarpia palmicola</i>                      |   | 1  | 2       | 1 | 1       | 3 |         | 3  |         |    | 3  |         |         |
| <i>Collema pulchellum</i>                         |   |    | 1       |   |         |   |         |    |         |    | 2  |         |         |
| <i>Collema subflaccidum</i>                       |   |    | 1       |   |         |   |         |    |         |    |    |         |         |
| <i>Dirinaria aegialita</i>                        | 2 | 2  | 2       |   | 1       | 1 | 2       | 6  |         | 3  | 8  | 1       |         |
| <i>Diriniaria confluens</i>                       |   |    |         |   |         |   | 1       |    |         |    |    |         |         |
| <i>Diriniaria confusa</i>                         | 4 |    |         |   |         | 2 |         |    | 2       | 1  |    |         |         |
| <i>Dirinaria picta</i>                            | 3 |    |         |   | 2       | 1 | 2       | 1  | 2       |    | 1  | 1       | 1       |
| <i>Heterodermia albicans</i>                      | 9 |    | 7       |   | 3       | 3 | 3       | 4  | 7       |    | 4  | 1       | 1       |

| Taxon                             | B | BC | BS<br>C | C | HC<br>S | L | LN<br>C | LR | M<br>CC | NB | TC | UN<br>C | VC<br>C |
|-----------------------------------|---|----|---------|---|---------|---|---------|----|---------|----|----|---------|---------|
| <i>Heterodermia crocea</i>        |   |    |         |   |         |   |         |    |         |    | 1  |         |         |
| <i>Heterodermia echinata</i>      |   |    |         |   |         |   |         |    | 2       | 1  | 2  |         |         |
| <i>Heterodermia obscurata</i>     |   | 1  |         |   | 1       | 1 |         |    |         |    | 1  |         |         |
| <i>Heterodermia speciosa</i>      |   |    |         |   |         |   |         | 1  |         |    |    |         |         |
| <i>Hypotrachyna livida</i>        | 3 | 2  | 5       |   | 2       | 4 | 1       | 3  | 4       | 2  | 5  |         | 1       |
| <i>Hypotrachyna osseoalba</i>     |   | 1  |         |   |         |   |         |    |         |    | 1  |         |         |
| <i>Leptogium austroamericanum</i> | 1 |    | 1       |   |         | 3 | 2       | 1  | 3       |    | 6  |         |         |
| <i>Leptogium azureum</i>          | 1 | 2  | 4       |   |         | 1 | 1       | 1  | 1       | 3  | 2  |         |         |
| <i>Leptogium chloromelum</i>      |   |    |         | 1 |         |   |         |    |         |    |    |         |         |
| <i>Leptogium cyanescens</i>       | 1 | 2  | 7       |   | 1       | 1 | 1       | 3  | 2       | 4  | 8  |         |         |
| <i>Leptogium denticulatum</i>     |   | 2  | 5       | 1 | 1       | 2 | 1       | 3  | 1       |    | 4  |         | 1       |
| <i>Leptogium milligranum</i>      |   |    | 1       |   |         |   |         | 2  |         |    |    |         |         |
| <i>Lobaria ravenelii</i>          |   | 3  | 1       |   |         |   |         |    | 3       |    | 2  |         |         |
| <i>Myelochroa aurulenta</i>       |   | 2  | 7       |   |         | 5 |         | 1  |         |    | 4  | 1       |         |
| <i>Parmelinopsis horrescens</i>   |   | 1  |         |   |         |   |         |    |         |    |    |         |         |
| <i>Parmelinopsis minarum</i>      | 1 | 1  | 5       |   | 2       | 1 |         |    |         |    | 4  |         |         |
| <i>Parmelinopsis spumosa</i>      |   |    | 1       |   |         |   |         |    |         |    |    |         |         |
| <i>Parmotrema cetratum</i>        |   |    |         |   |         |   |         |    |         |    | 1  |         |         |
| <i>Parmotrema crinitum</i>        |   | 1  | 2       | 2 |         | 1 | 1       | 1  | 4       | 1  | 3  |         |         |
| <i>Parmotrema cristiferum</i>     |   |    |         |   |         |   |         |    |         |    |    | 1       |         |
| <i>Parmotrema endosulphureum</i>  |   |    |         |   |         |   | 1       | 2  |         |    |    |         |         |
| <i>Parmotrema eurysacum</i>       |   |    |         |   |         |   |         |    |         |    |    | 2       |         |
| <i>Parmotrema hypoleucinum</i>    |   |    |         |   |         |   |         |    | 1       |    |    |         |         |
| <i>Parmotrema hypotropum</i>      | 6 | 1  | 4       |   | 1       |   |         |    | 4       |    | 2  | 1       | 2       |
| <i>Parmotrema louisianae</i>      |   |    | 1       |   |         |   |         |    | 1       |    |    |         |         |
| <i>Parmotrema mellissii</i>       |   |    |         |   |         |   |         | 2  | 1       |    |    |         |         |
| <i>Parmotrema perforatum</i>      | 4 |    | 3       |   | 1       | 1 | 2       | 2  | 5       |    | 4  | 2       |         |
| <i>Parmotrema praesorediosum</i>  |   | 1  | 3       |   | 5       |   | 1       | 1  | 6       | 1  | 1  |         |         |

| Taxon                               | B | BC | BS<br>C | C | HC<br>S | L | LN<br>C | LR | M<br>CC | NB | TC | UN<br>C | VC<br>C |
|-------------------------------------|---|----|---------|---|---------|---|---------|----|---------|----|----|---------|---------|
| <i>Parmotrema rampoddense</i>       | 1 | 2  | 6       |   | 1       | 2 | 1       | 3  | 1       |    | 8  |         |         |
| <i>Parmotrema reticulatum</i>       | 4 | 3  | 3       | 2 | 1       | 4 | 1       | 5  |         | 1  | 5  | 2       | 1       |
| <i>Parmotrema subsidiosum</i>       |   | 2  | 2       | 1 | 1       | 3 | 1       | 1  | 2       | 1  | 1  | 1       |         |
| <i>Parmotrema submarginale</i>      | 1 | 3  | 3       |   | 1       |   | 2       | 2  | 3       |    | 2  | 2       | 2       |
| <i>Parmotrema subrigidum</i>        | 2 | 3  | 3       |   | 5       |   | 2       | 1  | 3       | 3  | 2  |         | 1       |
| <i>Parmotrema sulphuratum</i>       |   |    |         |   |         |   |         | 1  |         |    | 1  |         |         |
| <i>Parmotrema tinctorum</i>         | 7 | 8  | 12      | 2 | 3       | 3 | 3       | 8  | 4       | 2  | 17 | 1       | 1       |
| <i>Parmotrema ultralucens</i>       |   | 8  | 5       | 1 |         | 2 | 2       | 3  | 4       | 1  | 6  | 1       |         |
| <i>Phaeophyscia ciliata</i>         |   |    | 1       |   |         |   |         | 1  | 5       |    | 1  |         |         |
| <i>Phaeophyscia rubropulchra</i>    |   |    |         |   |         |   |         |    |         |    | 1  |         |         |
| <i>Physcia americana</i>            |   |    |         |   | 2       |   |         |    |         |    | 2  |         |         |
| <i>Physcia atrostriata</i>          | 2 | 1  | 3       |   | 2       |   |         | 1  | 4       | 3  | 9  |         |         |
| <i>Physcia solediosa</i>            |   |    |         |   |         |   |         |    | 4       |    | 1  |         |         |
| <i>Pseudocyphellaria aurata</i>     |   |    |         |   |         |   |         |    |         |    | 2  |         |         |
| <i>Pseudoparmelia uleana</i>        |   |    |         |   |         |   |         |    | 1       |    | 2  |         |         |
| <i>Punctelia graminicola</i>        |   |    |         |   |         |   |         |    | 1       |    |    |         |         |
| <i>Punctelia rudecta</i>            | 2 | 3  | 9       | 1 | 1       | 1 | 1       | 2  | 5       | 1  | 12 |         | 1       |
| <i>Pyxine caesiopruinosa</i>        | 1 | 4  | 1       | 1 | 1       |   |         |    |         |    | 5  |         | 1       |
| <i>Pyxine coralligera</i>           |   | 1  |         |   |         |   |         |    |         |    | 3  |         |         |
| <i>Pyxine eschweileri</i>           | 1 | 3  |         |   |         |   | 1       | 2  | 1       |    | 3  | 1       |         |
| <i>Pyxine soledata</i>              |   | 1  |         |   |         |   |         |    |         |    | 1  | 1       |         |
| <i>Pyxine subcinerea</i>            |   | 1  | 1       |   |         | 1 |         |    |         |    | 1  |         |         |
| <i>Ramalina americana</i>           |   |    |         |   | 1       |   |         |    |         |    |    |         |         |
| <i>Ramalina complanata</i>          |   |    |         |   |         |   |         |    | 2       |    |    |         |         |
| <i>Ramalina montagnei</i>           | 1 |    | 2       |   |         | 2 | 2       | 1  | 6       |    |    |         |         |
| <i>Ramalina peruviana</i>           | 3 | 1  | 1       |   |         |   |         | 1  |         | 1  | 3  |         | 1       |
| <i>Ramalina willeyi</i>             | 1 |    |         |   |         |   |         |    | 1       |    |    |         |         |
| <i>Teloschistes chrysophthalmus</i> |   |    |         |   |         |   |         |    | 1       |    |    |         |         |

| <b>Taxon</b>               | <b>B</b>  | <b>BC</b> | <b>BS<br/>C</b> | <b>C</b>  | <b>HC<br/>S</b> | <b>L</b>  | <b>LN<br/>C</b> | <b>LR</b> | <b>M<br/>CC</b> | <b>NB</b> | <b>TC</b> | <b>UN<br/>C</b> | <b>VC<br/>C</b> |
|----------------------------|-----------|-----------|-----------------|-----------|-----------------|-----------|-----------------|-----------|-----------------|-----------|-----------|-----------------|-----------------|
| <i>Teloschistes exilis</i> |           |           |                 |           |                 |           |                 |           | 1               |           |           |                 |                 |
| <i>Usnea baileyi</i>       |           |           |                 |           |                 |           |                 | 1         |                 |           |           |                 |                 |
| <i>Usnea mutalilis</i>     |           |           |                 |           | 1               |           |                 | 1         |                 | 2         | 2         |                 | 1               |
| <i>Usnea strigosa</i>      | 4         | 3         | 8               |           | 3               | 2         |                 | 1         | 5               | 3         | 7         | 1               | 1               |
| <i>Usnea trichodea</i>     |           |           |                 |           |                 |           |                 |           | 2               |           |           |                 |                 |
| <b>TOTAL COLLECTIONS</b>   | 78        | 91        | 151             | 19        | 60              | 62        | 40              | 92        | 111             | 46        | 200       | 22              | 22              |
| <b>TOTAL NO. SPECIES</b>   | <b>30</b> | <b>39</b> | <b>42</b>       | <b>14</b> | <b>30</b>       | <b>29</b> | <b>27</b>       | <b>40</b> | <b>41</b>       | <b>23</b> | <b>58</b> | <b>18</b>       | <b>17</b>       |

## Appendix B

### Macrolichen Records from Southeast Texas Counties in the Big Thicket Region

As seen in Figure 3, the Big Thicket Region includes the SE Texas counties of Angelina, Hardin, Jasper, Jefferson, Liberty, Newton, Orange, Polk, Sabine, San Augustine, San Jacinto, and Tyler. Collections were made from the counties in both the official BTNP units and from various state parks and national forests and other localities. Using the databased information in the OMA herbarium, the table below lists the identified species of macrolichens from these 12 SE Texas counties indicating the number of collections of each taxon from each county. The names for the counties are abbreviated as follows:

**AN** Angelina

**HA** Hardin

**JA** Jasper

**JE** Jefferson

**LI** Liberty

**NE** Newton

**OR** Orange

**PO** Polk

**SB** Sabine

**SA** San Augustine

**SJ** San Jacinto

**TY** Tyler

The 1,487 specimen records from this study are sorted based on the SE Texas counties from which they were collected (see Table 3). These records represent 100 macrolichen species in 25 genera. So far, only *Parmotrema tinctorum* and *Punctelia rudecta* have been collected in every surveyed county. The total number of macrolichen species found in each of the counties is not necessarily a reflection of the actual diversity but probably more a reflection of the number of individual sites visited within that county.

**Table 3.** Macrolichens species present in SE Texas counties.

| <b>Taxon</b>                          | <b>AN</b> | <b>HA</b> | <b>JA</b> | <b>JE</b> | <b>LI</b> | <b>NE</b> | <b>OR</b> | <b>PO</b> | <b>SB</b> | <b>SA</b> | <b>SJ</b> | <b>TY</b> |
|---------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <i>Anzia colpodes</i>                 |           |           |           |           | 1         |           |           |           |           |           |           | 1         |
| <i>Anzia ornata</i>                   |           | 3         |           |           |           |           |           |           |           |           |           | 2         |
| <i>Bulbothrix goebelii</i>            | 1         | 6         | 1         |           | 2         | 1         | 1         | 3         |           |           |           | 7         |
| <i>Bulbothrix isidiza</i>             |           | 1         |           |           |           |           |           |           |           |           |           |           |
| <i>Bulbothrix laevigatula</i>         |           | 1         |           |           |           |           |           |           |           |           |           | 1         |
| <i>Candelaria concolor</i>            |           |           |           |           |           |           |           |           |           |           |           | 1         |
| <i>Canoparmelia caroliniana</i>       |           | 33        | 1         |           | 11        | 4         | 1         | 17        | 2         |           | 3         | 21        |
| <i>Canoparmelia cryptochlorophaea</i> |           | 22        | 2         | 1         | 3         | 4         | 2         | 6         |           |           | 2         | 7         |
| <i>Cladonia caespiticia</i>           |           | 4         |           |           |           |           |           |           |           |           |           | 2         |
| <i>Cladonia didyma</i>                |           | 1         |           |           | 1         |           |           | 2         |           |           |           | 3         |
| <i>Cladonia leporina</i>              |           | 3         |           |           |           | 1         |           |           |           |           |           |           |
| <i>Cladonia macilenta</i>             |           | 1         |           |           |           |           |           |           |           |           |           | 4         |
| <i>Cladonia parasitica</i>            |           | 1         |           |           |           |           |           |           |           |           |           | 1         |
| <i>Cladonia peziziformis</i>          |           | 8         |           | 1         | 2         | 2         |           | 3         |           |           |           | 8         |
| <i>Cladonia polycarpia</i>            |           | 2         |           |           |           |           |           | 1         |           |           |           |           |
| <i>Cladonia polycarpoides</i>         |           |           |           |           |           |           | 1         |           |           |           |           |           |
| <i>Cladonia ravenelii</i>             |           | 5         |           |           |           |           |           |           |           |           |           |           |
| <i>Cladonia sobolescens</i>           |           | 1         |           |           |           |           | 1         |           |           |           |           | 2         |
| <i>Cladonia subcariosa</i>            |           |           |           |           |           | 4         |           |           |           |           |           |           |
| <i>Cladonia subradiata</i>            |           | 10        |           |           | 2         | 2         |           | 1         |           |           |           | 1         |

| <b>Taxon</b>                      | <b>AN</b> | <b>HA</b> | <b>JA</b> | <b>JE</b> | <b>LI</b> | <b>NE</b> | <b>OR</b> | <b>PO</b> | <b>SB</b> | <b>SA</b> | <b>SJ</b> | <b>TY</b> |
|-----------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <i>Cladonia subtenuis</i>         |           | 1         |           |           |           | 2         |           |           |           |           |           | 1         |
| <i>Coccocarpia erythroxyli</i>    |           | 2         |           |           |           |           |           |           |           |           |           | 1         |
| <i>Coccocarpia palmicola</i>      | 1         | 9         |           |           | 4         |           |           | 2         |           |           |           | 3         |
| <i>Collema furfuraceum</i>        |           | 1         |           |           |           |           |           |           |           |           |           |           |
| <i>Collema pulchellum</i>         |           | 2         |           |           |           |           |           | 1         |           |           | 1         |           |
| <i>Collema subflaccidum</i>       |           |           |           |           |           |           |           | 1         |           |           |           | 1         |
| <i>Dirinaria aegialita</i>        |           | 16        | 1         |           | 1         |           | 2         | 2         | 1         |           |           | 7         |
| <i>Dirinaria confluens</i>        |           | 1         |           |           |           |           |           |           |           |           |           |           |
| <i>Dirinaria confusa</i>          |           | 3         |           | 1         | 4         | 1         | 4         | 1         | 2         |           |           | 2         |
| <i>Dirinaria picta</i>            |           | 6         | 2         |           | 3         | 1         |           |           |           | 1         |           | 4         |
| <i>Heterodermia albicans</i>      |           | 18        | 1         | 3         | 9         | 1         | 3         | 10        | 1         | 1         |           | 9         |
| <i>Heterodermia crocea</i>        |           | 1         |           |           |           |           |           |           |           |           |           |           |
| <i>Heterodermia echinata</i>      |           | 6         |           |           | 2         |           |           |           |           |           |           | 1         |
| <i>Heterodermia obscurata</i>     |           | 2         |           | 1         | 3         |           |           |           |           |           |           | 3         |
| <i>Heterodermia speciosa</i>      |           | 2         |           |           |           |           |           |           |           |           |           |           |
| <i>Hypotrachyna livida</i>        | 1         | 19        | 1         |           | 10        |           | 2         | 6         | 5         |           |           | 6         |
| <i>Hypotrachyna osseoalba</i>     |           | 2         |           |           |           |           |           |           |           |           |           | 2         |
| <i>Leptogium austroamericanum</i> |           | 9         |           |           | 6         |           |           | 1         |           |           | 1         | 3         |
| <i>Leptogium azureum</i>          |           | 7         |           |           | 1         |           | 1         | 5         |           |           | 1         | 3         |
| <i>Leptogium chloromelum</i>      |           |           |           |           |           |           |           |           |           |           |           | 1         |
| <i>Leptogium cyanescens</i>       |           | 22        |           | 1         | 5         |           | 1         | 7         |           |           |           | 9         |

| <b>Taxon</b>                     | <b>AN</b> | <b>HA</b> | <b>JA</b> | <b>JE</b> | <b>LI</b> | <b>NE</b> | <b>OR</b> | <b>PO</b> | <b>SB</b> | <b>SA</b> | <b>SJ</b> | <b>TY</b> |
|----------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <i>Leptogium denticulatum</i>    |           | 9         |           |           | 5         | 1         |           | 6         |           |           |           | 6         |
| <i>Leptogium marginellum</i>     |           | 1         |           |           |           |           |           |           |           |           |           |           |
| <i>Leptogium milligranum</i>     |           | 3         |           |           |           | 1         |           | 1         |           |           |           | 1         |
| <i>Lobaria ravenelii</i>         |           | 2         |           |           |           |           |           | 4         |           |           | 1         | 3         |
| <i>Myelochroa aurulenta</i>      |           | 8         |           |           | 5         | 2         |           | 7         | 2         | 1         |           | 4         |
| <i>Parmelinopsis horrescens</i>  |           | 2         |           |           |           |           |           |           |           |           |           | 1         |
| <i>Parmelinopsis minarum</i>     |           | 5         |           |           | 1         | 4         | 1         | 6         |           |           |           | 5         |
| <i>Parmelinopsis spumosa</i>     |           |           |           |           |           | 1         |           | 1         |           |           |           |           |
| <i>Parmotrema cetratum</i>       |           | 3         |           | 1         |           |           |           |           |           |           |           | 1         |
| <i>Parmotrema crinitum</i>       |           | 6         |           |           | 6         |           |           | 2         | 1         |           |           | 3         |
| <i>Parmotrema cristiferum</i>    |           | 1         |           |           |           |           |           |           |           |           |           | 1         |
| <i>Parmotrema endosulphureum</i> |           | 5         |           |           | 1         |           |           |           |           |           |           |           |
| <i>Parmotrema eurysacum</i>      |           | 1         |           |           |           |           |           |           |           |           |           | 2         |
| <i>Parmotrema hypoleucinum</i>   |           | 1         |           |           | 1         |           |           |           |           |           |           |           |
| <i>Parmotrema hypotropum</i>     | 1         | 11        |           |           | 5         | 1         | 3         | 4         | 2         |           |           | 8         |
| <i>Parmotrema louisianae</i>     |           | 2         |           |           |           |           |           | 3         | 3         | 2         |           | 2         |
| <i>Parmotrema mellissii</i>      |           | 3         |           |           |           |           |           | 1         |           |           |           |           |
| <i>Parmotrema perforatum</i>     | 1         | 13        | 2         |           | 6         |           | 3         | 3         |           |           |           | 4         |
| <i>Parmotrema praesorediosum</i> | 1         | 5         | 1         | 2         | 6         | 1         |           | 5         | 4         | 1         |           | 10        |
| <i>Parmotrema preperforatum</i>  | 2         |           |           |           |           |           |           |           |           |           |           |           |
| <i>Parmotrema rampoddense</i>    |           | 19        | 1         |           | 3         | 2         | 1         | 6         | 1         |           | 1         | 7         |

[illegible]

| <b>Taxon</b>                        | <b>AN</b> | <b>HA</b> | <b>JA</b> | <b>JE</b> | <b>LI</b> | <b>NE</b> | <b>OR</b> | <b>PO</b> | <b>SB</b> | <b>SA</b> | <b>SJ</b> | <b>TY</b> |
|-------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <i>Pyxine eschweileri</i>           |           | 4         |           |           | 1         |           | 1         |           |           |           |           | 6         |
| <i>Pyxine soreliata</i>             |           | 2         |           |           | 2         |           |           |           |           |           |           | 2         |
| <i>Pyxine subcinerea</i>            | 1         |           |           |           | 1         |           |           | 2         | 3         | 1         |           | 2         |
| <i>Ramalina americana</i>           |           |           |           |           |           |           |           |           |           |           |           | 2         |
| <i>Ramalina complanata</i>          |           |           |           |           | 2         |           |           |           |           |           |           |           |
| <i>Ramalina montagnei</i>           |           | 8         |           |           | 8         |           | 1         | 3         |           |           | 1         | 2         |
| <i>Ramalina peruviana</i>           |           | 8         |           |           |           | 1         | 3         | 1         | 2         |           |           | 3         |
| <i>Ramalina willeyi</i>             |           | 3         |           |           | 1         |           | 1         |           |           |           |           |           |
| <i>Teloschistes chrysophthalmus</i> |           |           |           |           | 1         |           |           |           |           |           |           |           |
| <i>Teloschistes exilis</i>          |           | 4         |           |           | 2         |           |           | 1         |           |           |           | 1         |
| <i>Usnea baileyi</i>                |           | 1         |           |           |           |           |           |           |           |           |           |           |
| <i>Usnea mutabilis</i>              |           | 5         |           |           |           |           |           |           |           |           |           | 5         |
| <i>Usnea rubicunda</i>              |           | 2         |           |           |           |           |           |           |           |           |           |           |
| <i>Usnea strigosa</i>               |           | 22        |           |           | 7         | 1         | 2         | 9         | 1         |           | 1         | 9         |
| <i>Usnea subscabrosa</i>            |           | 1         |           |           |           |           |           |           |           |           |           |           |
| <i>Usnea trichodea</i>              |           |           |           |           | 2         |           |           |           |           |           |           |           |
| <i>Xanthomendoza weberi</i>         |           | 1         |           |           |           |           |           |           | 1         |           |           |           |
| <b>TOTAL COLLECTIONS</b>            | 17        | 554       | 19        | 17        | 191       | 48        | 46        | 193       | 47        | 19        | 17        | 317       |
| <b>TOTAL NO. SPECIES</b>            | 15        | 82        | 15        | 13        | 49        | 26        | 26        | 48        | 24        | 13        | 14        | 70        |