



BULLETIN

THE LICHENS OF FAKAHATCHEE STRAND PRESERVE STATE PARK, FLORIDA: PROCEEDINGS FROM THE 18th TUCKERMAN WORKSHOP

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THE LICHENS OF FAKAHATCHEE STRAND PRESERVE STATE PARK, FLORIDA: PROCEEDINGS FROM THE 18th TUCKERMAN WORKSHOP

Robert Lücking^{1,20}, Frederick Seavey², Ralph S. Common³, Sean Q. Beeching⁴, Othmar Breuss⁵, William R. Buck⁶, Lee Crane⁷, Malcolm Hodges⁸, Brendan P. Hodkinson⁹, Elisabeth Lay¹⁰, James C. Lendemer¹¹, R. Troy McMullin¹², Joel A. Mercado-Díaz¹³, Matthew P. Nelsen^{1, 14}, Eimy Rivas Plata^{1, 15}, William Safranek¹⁶, William B. Sanders¹⁷, Harold P. Schaefer Jr.¹⁸, and Jean Seavey¹⁹

ABSTRACT

Fakahatchee Strand Preserve State Park is located in Collier County at the extreme southwestern corner of Florida, close to Everglades National Park and Big Cypress National Preserve. The 18th Tuckerman Workshop, an annual gathering of professional and amateur lichenologists and mycologists from the United States and Canada, this time with additional participants from Puerto Rico, Peru, and Austria, was held at this locality from March 1–7, 2009. Lichens were collected over a five day span from four sites within the Preserve. Together with previously made collections, the survey produced a total of 432 taxa, 18 of which are new to science and 89 are additions to the North America checklist, six of which are also new to the New World. The new species are: *Calopadia floridana* Hodges & Lücking, *Calopadia imshaugii* Common & Lücking, *Cryptothecia miniata* Vain. ex Lücking, *Diorygma microsporum* M. Cáceres & Lücking (formally described in a separate paper), *Fissurina aggregatula* Common & Lücking, *Fissurina analphabetica* Common & Lücking, *Fissurina confusa* Common & Lücking, *Fissurina inspersa* Common & Lücking, *Fissurina pseudostromatica* Lücking & Rivas Plata, *Fissurina subcomparimuralis* Common & Lücking (formally described in a separate paper), *Fissurina tuckermaniana* Common & Lücking, *Fissurina varieseptata* Common & Lücking, *Graphis appendiculata* Common & Lücking, *Halegrapha floridana* Common & Lücking (formally described in a separate paper), *Heiomasia seaveyorum* M. P. Nelsen & Lücking (formally described in a separate paper), *Phaeographis delicatula* Common & Lücking, *Tapellaria floridensis* Common & Lücking, and *Tapellaria granulosa* Lücking & Rivas Plata. Further, the following three new combinations are proposed: *Chapsa platycarpoides* (Tuck.) Breuss &

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Lücking, *Fissurina intercludens* (Nyl.) Lücking & Rivas Plata, and *Fissurina mexicana* (Zahlbr.) Lücking & Rivas Plata. Six species are for the first time reported for the New World: *Arthonia interveniens* Nyl., *Arthonia simplicascens* Nyl., *Chapsa subpatens* (Hale) Mangold, *Fissurina crassilabra* Mont. & Bosch, *Stirtonia dubia* A. L. Sm., and *Stirtonia macrocarpa* Makhija & Patw. Further 83 species are additions to the North American lichen checklist: *Amandinea endachroa* (Malme) Marbach, *Anisomeridium subnexam* (Nyl.) R. C. Harris, *Arthonia antillarum* (Fée) Nyl., *Aspidothelium cinerascens* Vain., *Aspidothelium geminiparum* (Malme) R. Sant., *Aspidothelium scutellarpum* Lücking, *Astrothelium diplocarpoides* Müll. Arg., *Byssoloma chlorinum* (Vain.) Zahlbr., *Calopadia editae* Vězda ex Chaves & Lücking, *Calopadia lecanorella* (Nyl.) Kalb & Vězda, *Calopadia perpallida* (Nyl.) Vězda, *Calopadia subcoerulescens* (Zahlbr.) Vězda, *Chapsa chionostoma* (Nyl.) Rivas Plata & Mangold, *Chapsa platycarpoides* (Tuck.) Breuss & Lücking, *Coenogonium congense* C. W. Dodge, *Coenogonium geralense* (P. Henn) Lücking, *Coenogonium luteocitrinum* Rivas Plata, Lücking & Umaña., *Coenogonium subdentatum* (Vězda & G. Thor) Rivas Plata, Lücking, Umana & Chaves., *Coenogonium subfallaciosum* (Vězda & Farkas) Lücking, Aptroot & Sipman., *Coniarthonia wilmsiana* (Müll. Arg.) Grube, *Cryptolechia nana* (Tuck.) D. Hawksw. & Dibben, *Cryptothecia effusa* (Müll. Arg.) R. Sant., *Cryptothecia punctosorediata* Sparrius., *Dictyonema phyllogenum* (Müll. Arg.) Zahlbr., *Dictyonema sericeum* f. *phyllophilum* Parm., *Echinoplaca leucotrichoides* (Müll. Arg.) R. Sant., *Eugeniella leucocheila* (Tuck.) Lücking, Sérus. & Kalb, *Fissurina cingalina* (Nyl.) Staiger, *Fissurina egena* (Nyl.) Nyl., *Fissurina mexicana* (Zahlbr.) Lücking & Rivas Plata, *Fissurina radiata* Mont., *Fissurina tachygrapha* (Nyl.) Staiger, *Glyphis atrofusca* (Müll. Arg.) Lücking, *Graphis argentata* Lücking & Umaña., *Graphis assimilis* Nyl., *Graphis caesiocarpa* Redinger, *Graphis caribica* Lücking, *Graphis conferta* Zenker., *Graphis cupei* Vain. ex Lücking, *Graphis disserpens* Nyl., *Graphis handelii* Zahlbr., *Graphis longula* Kremp., *Graphis oshioi* M. Nakan., *Graphis pseudocinerea* Lücking, *Graphis sauroidea* Leight., *Graphis stellata* M. Cáceres & Lücking, *Graphis subflexibilis* Lücking & Chaves., *Graphis xanthospora* Müll. Arg., *Gyalectidium ulloae* Herrera-Campos & Lücking, Lücking & G. Thor, *Herpothallon echinatum* Aptroot, Lücking & Will-Wolf., *Lecanora achroa* Nyl., *Lecanora elapheia* Stizenb., *Leucodecton compunctellum* (Nyl.) A. Frisch., *Malmidea fuscella* (Müll. Arg.) Kalb & Lücking, *Malmidea gyalectoides* (Vain.) Kalb & Lücking, *Malmidea leptoloma* (Müll. Arg.) Kalb & Lücking, *Malmidea piperis* (Spreng.) Kalb, Rivas Plata & Lumbsch, *Malmidea rhodopis* (Tuck.) Kalb, Rivas Plata & Lumbsch, *Malmidea variabilis* Kalb, *Malmidea vinosa* (Eschw.) Kalb, Rivas Plata & Lumbsch, *Myriotrema pycnoporellum* (Nyl.) Hale, *Ocellularia auberianoides* (Nyl.) Müll. Arg., *Ocellularia obturascens* (Nyl.) Hale, *Pertusaria paratuberculifera* Dibben, *Phaeographis flavescens* Dal Forno & Eliasaro., *Phaeographis inconspicua* (Fée) Müll. Arg., *Phaeographis leiogrammodes* (Kremp.) Müll. Arg., *Phaeographis major* (Kremp.) Lücking, *Phaeographis nylanderi* (Vain.) Zahlbr., *Phaeographis scalpturata* (Ach.) Staiger, *Phaeographis schizoloma* (Müll. Arg.) Müll. Arg., *Phyllopsora lacerata* Timdal, *Pseudopyrenula subgregaria* Müll. Arg., *Pseudopyrenula subnudata* Müll. Arg., *Psoroglaena costaricensis* Henssen, *Pyrenula brunnea* Fée, *Pyrenula sexocularis* (Nyl.) Müll. Arg., *Sporopodium marginatum* Lücking & Lumbsch, *Strigula orbicularis* Fr., *Strigula schizospora* R. Sant., *Tapellaria albomarginata* Lücking, *Tapellaria malmei* R. Sant., and *Thelotrema pachysporum* Nyl. The high number of species found within a relatively small area, which corresponds to almost 10% of all lichens currently known in North America, is put into perspective by comparing it with other protected areas in the United States. It is explained by the high carrying capacity of (sub-)tropical vegetation for epiphytic and particularly crustose lichens. Keytables and image plates are presented to facilitate the identification of species in larger crustose genera.

Key Words: Ascomycota; lichens; new species; biodiversity; biogeography; Florida

TABLE OF CONTENTS

Introduction.....	129
Materials and Methods.....	132
Results and Discussion	137
New or Otherwise Interesting Species.....	138
<i>Calopadia floridana</i> Hodges & Lücking, new species	138
<i>Calopadia imshaugii</i> Common & Lücking, new species	139
<i>Chapsa platycarpoides</i> (Tuck.) Breuss & Lücking, new combination.....	140
<i>Cryptothecia miniata</i> Vain. ex Lücking, new species.....	140
<i>Fissurina aggregatula</i> Common & Lücking, new species	141
<i>Fissurina analphabetica</i> Common & Lücking, new species.....	142
<i>Fissurina confusa</i> Common & Lücking, new species	142
<i>Fissurina inspersa</i> Common & Lücking, new species	143
<i>Fissurina mexicana</i> (Zahlbr.) Lücking & Rivas Plata, new combination (with remarks on <i>Fissurina intercludens</i> (Nyl.) Lücking & Rivas Plata, new combination).....	144
<i>Fissurina pseudostromatica</i> Lücking & Rivas Plata, new species	145
<i>Fissurina tuckermaniana</i> Common & Lücking, new species.....	145
<i>Fissurina varieseptata</i> Common & Lücking, new species.....	146
<i>Graphis appendiculata</i> Common & Lücking, new species	147
<i>Phaeographis delicatula</i> Common & Lücking, new species.....	148
<i>Tapellaria floridensis</i> Common & Lücking, new species.....	149
<i>Tapellaria granulosa</i> Lücking & Rivas Plata, new species	149
Annotated Checklist of Lichen Species from Fakahatchee Strand Preserve State Park	150
Acknowledgements.....	178
Literature Cited	178

INTRODUCTION

Lichens have long been believed to be most abundant and speciose in cool-temperate areas, a notion supported by a recently published survey from Alaska and its global comparison with other published inventories (Spribille et al. 2010). However, these figures are misleading, as they compare areas of very different size (of more than two orders of magnitude) and also include heterogeneous accounts of lichenicolous fungi. At smaller scales, e.g. looking at uniform area sizes of 100 km², 10 km², 1 km², or even one hectare, lichen species richness clearly increases towards lower latitudes, like that of many other organisms, a fact realized only recently. This is particularly true for crustose epiphytic microlichens which, for many groups, have their highest diversity in the

tropics (Aptroot 1997; Aptroot & Sipman 1997; Sipman & Aptroot 2001; Feuerer & Hawksworth 2007; Lücking et al. 2009). Lücking et al. (2009) estimated that about half of the predicted global 26,000–28,000 lichen species occur in the tropics, even considering that the tropics cover less than 25% of the Earth's land surface. Our ongoing surveys in the Neotropics, particularly in Mexico (Los Tuxtlas Biosphere Reserve), Costa Rica (Las Cruces and La Selva Biological Stations, Corcovado National Park), Venezuela (Henry Pittier National Park), and Peru (Los Amigos Biological Station) suggest numbers of 500–600 or more species per km² of rain forest vegetation, about half of them foliicolous (Lücking 1999; Herrera-Campos et al. 2004; Lücking, unpubl. data). In quantitative studies, inventories revealed totals of

approximately 150 corticolous lichen species on 50 trees in the forest understory (Cáceres et al. 2008), as many as 250 corticolous species on less than ten trees in the forest canopy (Komposch & Hafellner 1999, 2000), as many as 173 corticolous species on a single tree from top to bottom (Aptroot 1997) and as many as 300 foliicolous species on 100 trees and shrubs (Lücking 1999); as many as 49 foliicolous species were found on a single leaf (Lücking & Matzer 2001).

Extratropical sites with similarly high or higher species numbers (excluding lichenicolous fungi) listed in Spribille et al. (2010) are either very large in size, such as Cévennes National Park (France) with 973 lichen species (2297 km²), the Bavarian Forest (Germany) with 841 species (over 9000 km²), Pechoro-Ilychiskiy Nature Reserve (Russia) with 790 species (7213 km²), the Gurktaler Alps (Austria) with 774 species (2950 km²), the d'Aosta Valley (Italy) with 631 species (3262 km²), and Isle Royale National Park (U.S.A.) with 596 species (2314 km²), or include a heterogeneous and diverse geography, such as Tatra National Park (Poland) with 864 species (211 km²), Berchtesgaden National Park (Germany) with 813 species (210 km²), Klondike Gold Rush National History Park (U.S.A.) with 668 species (53 km²), and Vega Island (Norway) with 649 species (163 km²). None of these areas maintain such large numbers at the small scale, but rather they are the result of combining different vegetation and substrate types with substantial beta diversity. For example, the figure of 766 species for the Klondike Gold Rush National History Park (Spribille et al. 2010) is composed of 668 lichen species and 98 lichenicolous fungi, which were sampled from two different units within the park. The larger unit, Chilkoot Trail, harbored 510 lichen species within an area of 35 km². Considering that these include lichens from all substrata (rock, soil, bark, bryophytes), that number is substantially lower than 500–600 species of lichens that can be found solely epiphytic within 1 km² of tropical rain forest.

The high species richness in the tropics is attributed to several different factors (Shmida &

Wilson 1985; Stocker et al. 1985; Linsenmair 1990), including the absence of frost and the generally near-optimal conditions for photosynthesis, the strategy of 'escaping' competition by being rare and having effective reproductive mechanisms, a tendency for tropical communities to have a high level of entropy or 'disorder' by dispersion of populations, high dynamics with frequent intermediate disturbances (Connell 1978; Huston 1979; Schupp 1992; Burkey 1994; Hubbell et al. 1999) which, along with biological feed-back mechanisms (Janzen 1970; Becker et al. 1985; Pirozynski & Hawksworth 1988; Armstrong 1989; Waterman & McKey 1989; Wills et al. 1997) prevent competitive species from becoming dominant and instead create a mosaic of successional stages within communities, and the notion that diversity begets diversity in an 'autocatalytic' fashion. Some of these hypotheses have also been tested in tropical lichens (Lücking & Bernecker-Lücking 2000, 2002; Lücking 2008).

The continental United States covers an area ranging from the Arctic in the north to the subtropical deserts and subtropical coastal swamp forests in the south. Accordingly, the number of lichen species estimated to occur within this area is large, possibly close to 5,000 species. Most areas and ecosystems are comparatively well-studied with regard to their lichen biota (Harris 1990, 1995; Bennett & Wetmore 1999, 2005a, b; Brodo et al. 2001; Bennett 2006; Thomson 2003; Esslinger 2010), especially the Southwest and specifically the Greater Sonoran Desert Region, with about 1,800 species included in a recent monographic treatment (Nash et al. 2002, 2004, 2007). Other lichen-rich regions that have been partially inventoried are the Ozarks and part of the Appalachians in eastern North America (e.g. Hale 1957; Dey 1978; Peck et al. 2004; Harris & Ladd 2007, 2008; Knudsen et al. 2007; Amtoft et al. 2008; Harris 2009; Harris & Lendemer 2009; Lendemer 2009a, b, c).

The chiefly wet, (sub-)tropical parts of North America are mostly restricted to the peninsula of Florida extending westward along the coast through Alabama, Mississippi, Louisiana, and Texas. But some usually tropical elements that can tolerate more temperate conditions, including

some foliicolous lichens, also extend northward into coastal Georgia and the Carolinas and in some cases the Delmarva Peninsula and southern New Jersey (Lücking et al. 2007; Lendemer & Knapp 2007; Lendemer & Yahr 2004). Recently disjunct populations of typically tropical taxa have also been uncovered at middle and low elevations of the southern Appalachian Mountains (Lendemer 2009; Lendemer & Tripp 2008, and unpubl. data).

Many treatments on tropical lichens are available for these areas (Moore 1966, 1968; Skorepa 1968; Reese & Tucker 1970; Sérusiaux 1979; Tucker 1979, 1981; Tucker & Harris 1980; Smith 1986; Harris 1987, 1988, 1990, 1995; Thor 1988; Harris & Wheeler, 1988; Griffin et al. 1995; Lumbsch et al. 1995; Ekman 1996; Staiger & Kalb 1999; Marbach 2000; Buck & Sérusiaux 2000; Grube 2001), including the classic works by Calkins (1885, 1886, 1889; Eckfeldt & Calkins 1887a, b), Müller Argoviensis (1895), Rolfs (1901), Merrill (1913), Bouly de Lesdain (1933), and Herre (1942). Despite the large amount of lichen diversity documented in these works,

which span over a century, previously unknown and unreported taxa continue to be found in the region at a remarkable rate (Lücking & Cáceres 2004; Safranek & Lücking 2005; Perlmutter 2006; DeBolt et al. 2007; Lücking et al. 2007; Lendemer & Knudsen 2008; Lendemer & Lumbsch 2008; Grube & Lendemer 2009; Lendemer et al. 2009a–d; Seavey 2009; Seavey & Seavey 2009; Tucker 2010; Nelsen et al. 2010; Tripp et al. 2010).

These papers document the extraordinary diversity of the region's lichens, especially of crustose epiphytic microlichens, suggesting that many more species await discovery and could provide substantial additions to the North American Lichen Checklist (Esslinger 2010). With this in mind, the 2009 Tuckerman workshop (Fig. 1), as part of the annual lichen workshops organized by the Eastern Lichen Network (<http://www.nybg.org/bsci/lichens/elc>) was held at Fakahatchee Strand Preserve State Park, which together with Everglades National Park, Big Cypress National Preserve and Collier-Seminole State Park, form a large protected area covering the southern and



Figure 1. Group photograph of the 2009 Tuckerman workshop. Standing from left to right: Lee Crane, Sean Beeching, Frederick Seavey, Malcolm Hodges, Richard Fagan, William Buck, Elisabeth Lay, Mike Owen, Harold Schaefer, Matthew Nelsen, William Sanders, Troy McMullin, and Brendan Hodkinson. Kneeling from left to right: Jean Seavey, Bob Nesmith, Alicia Campanella, James Lendemer, William Safranek, Ottmar Breuss, Joel Mercado-Díaz, Eimy Rivas Plata, Natasha Lücking Rivas Plata, and Robert Lücking. Color version available online at <http://www.flmnh.ufl.edu/bulletin/vol49no4/figures1-2.pdf>.

southwestern part of Florida peninsula.

The workshop was organized as part of an ongoing NSF workshop project towards an inventory of neotropical crustose epiphytic microlichens (Lücking et al. 2009; <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0715660>) and served several objectives: extending the area covered by the annual Tuckerman workshops to southern Florida and thus the most tropical part of the continental United States; document in more detail the tropical element of the lichen biota of the continental United States; train participating colleagues and students in tropical lichen taxonomy, with emphasis on crustose epiphytic microlichens; and produce a guide to crustose epiphytic microlichens found in the area to be used by the park personnel and ecotourists.

MATERIALS AND METHODS

STUDY AREA

Fakahatchee Strand Preserve State Park, a narrow strip of land oriented north to south, is located in Collier County, Florida, and is about 3–5 miles (4.5–8 km) wide and 20 miles (36 km) long (Fig. 2). Hydrologically, it is a shallow and narrow drainage basin channeling the waters from low-lying terrains to the north and east into the Ten Thousand Island zone of the Gulf of Mexico (Petuch & Roberts 2007). The name Fakahatchee is derived from the Seminole Indian language which, roughly translated, means ‘muddy creek.’ During the summer rainy season from May to October, which provides about 42 of the annual 53 inches of precipitation, most of the Preserve is inundated to varying depths. This is reversed in winter months

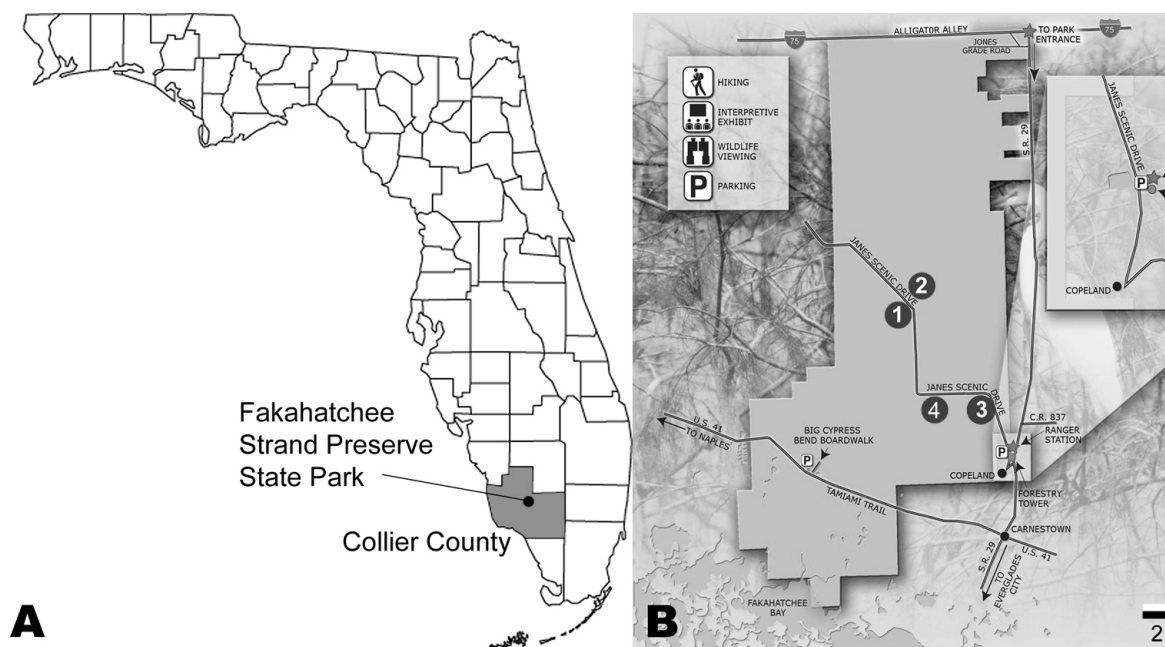


Figure 2. A, County map of Florida showing Collier County and the study site. B, Map of Fakahatchee Strand Preserve State Park, straddling the Tamiami Trail (Route 41) within Collier County; the four main collection sites described in the text are indicated by numerals 1 to 4. Map reprinted with permission of the Florida Department of Environment Protection, Tallahassee, Florida. Color version available online at <http://www.flmnh.ufl.edu/bulletin/vol49no4/figures1-2.pdf>.

as ground water recedes and in drier years much of the Preserve may lack surface water.

Winter temperatures are mild, ranging normally from 10°C to 18°C. The mean January low temperature is slightly below 12° which, in the strict definition, would place the Preserve slightly outside the subtropical zone. Occasional cold fronts may bring mild frosts. Summer months are very humid with overnight lows rarely dropping below 18°C and daytime highs around 32°C. The rock substrate is predominately of biogenetic limestone (Petuch & Roberts 2007) but outcrops projecting sufficiently above ground and water levels to support lichen colonization are rare. Although logged extensively during the 1940s and 1950s, relatively mature secondary forests now cover a large portion of the Preserve. In the north and central part, the major tree species include *Taxodium distichum* (bald cypress), *Ilex cassine* (dahoon), *Fraxinus caroliniana* (Carolina ash), *Roystonea elata* (royal palm), *Sabal palmetto* (cabbage palm), *Acer rubrum* (red maple) and *Quercus virginiana* (live oak). The mangrove zone to the south supports *Rhizophora mangle* (red mangrove), *Avicennia germinans* (black mangrove), *Laguncularia racemosa* (white mangrove) and, on higher ground, *Conocarpus erectus* (buttonwood).

Situated between a West Indian-dominated flora of subtropical Florida to the south and a more temperate flora to the north, Fakahatchee is known for its vascular plant diversity by sharing both floral types (Robertson 1955; Austin et al. 1990). Encompassing only a little over 85,000 acres (34,000 hectares), at least 524 vascular plant species have been recorded from the Preserve (Institute for Regional Conservation online database: http://regionalconservation.org/ircs/reports_database.asp). Outside South Florida, many of these are found nowhere else in North America and some are endemic to the park (Avery & Loope 1980; Austin et al. 1990). By comparison, Everglades National Park, with its northwest boundary located just five miles to the southeast, has recorded about 1,200 plant species, although it occupies nearly 1.4 million acres (560,000 hectares) (Olmstead & Loope 1984; Avery & Loope 1996).

Even though the plant flora at the Preserve has been effectively inventoried, the lichen biota has not. Due to its climate and geological history, southern Florida, including the Preserve, possesses a flora and fauna unlike the rest of the continental United States (Beard 1938; Robertson 1955; Olmstead et al. 1981). It is then logical to assume the lichen biota should also be different. The most extensive lichen collections from the Preserve were made in 1992 by Richard Harris and William Buck and in 1997 by Ralph Common. These forays produced collections of several hundred species. A few collections were also taken by Sylvia and Stephen Sharnoff while accumulating photos for the book *Lichens of North America* coauthored with Dr. Irwin Brodo in 2001 (Brodo et al. 2001). Undoubtedly, other unpublished and unrecorded collections have been made but, if maintained at all, they appear to be scattered. Currently, no single database or inventory dedicated to the lichens of the Preserve is maintained (R. Rau, Park Manager at Fakahatchee Strand Park Preserve, pers. comm. 2009). The collections previously made by others plus those gathered during the 2009 Tuckerman Workshop now document over 400 species and can be considered representative. This publication should provide the Preserve with the framework on which to build a lichen checklist which will, we hope, be as comprehensive as that of vascular plants.

COLLECTION SITES

Although small in relation to its giant neighbors Big Cypress National Preserve and Everglades National Park, the Preserve contains many distinct ecological communities including mangrove forests, prairies of grasses and sedges, nearly monotypic cypress stands and a variety of broad leaf forest types. However, due to the limited collecting time allotted (two full days in addition to time assigned for laboratory work), only four sites were selected for sampling. The chosen sites featured ease of access, a close proximity to one another and a generous lichen flora.

At Site 1 (Figs. 2B, 3A–B), a lowland forest is dominated by a unique canopy mix of royal

palms and bald cypress. Dahoon and Carolina ash are common in the subcanopy while the understory varies from dense to open. In most places at least moderate sunlight reaches the forest floor. Site 2 features a raised tram road once used by logging companies to extract cut trees (Fig. 3C–D). Lichens are abundant along the margins of the road, particularly foliicolous species on cabbage and saw palm leaves (*Sabal palmetto*, *Serenoa repens*). Collectors also wandered off into the short canopy forests on either side of the road. Species of *Tapellaria*, *Sporopodium* and *Strigula* are common at this site. Site 3 straddles the main road through the Preserve. It encompasses a nearly monospecific bald cypress stand on the east side of the road and an upland hammock (tree island) on the west. The latter is dominated by live oak, dahoon, cypress and red maple (Fig. 3E–F). Judging by the large number of bald cypress stumps and cypress knees, Site 4 was once a cypress swamp forest (Fig. 3G–H). Although some cypress has regenerated since logging days, the site today is dominated by dahoon, Carolina ash, red maple, and swamp dogwood (*Cornus foemina*). The understory was open during the time of our survey and filtered sunlight reached the lower strata of the community. During summer months, site 4 is inundated to various depths but at the time of collecting ground water was absent except for a few scattered ponds.

SPECIES IDENTIFICATIONS

Specimens were studied using standard techniques of light microscopy and thin-layer chromatography, first during the workshop at Edison State College in Naples, Florida and subsequently at the institutions of the participants. The information was compiled by Rick and Jean Seavey and Robert Lücking and each reported taxon was critically revised to ensure correct identification. In many cases, specimens were compared with authentic type material, particularly for the Graphidaceae (including Thelotremaaceae), Porinaceae, Pyrenulaceae, and Trypetheliaceae. Specimens were studied using a diverse array of optical equipment at Edison State College and subsequently at the institutions of each participant. For spot reactions and microscopic

staining, we used 10–20% potassium hydroxide solution (K), commercial bleach containing 6% sodium hypochloride (CHLOROX), para-phenyldiamine crystals dissolved in 95% ethanol, and Lugol solution (FLUKA 62650). Standard thin-layer chromatography (TLC; Arup et al. 1993; Lumbsch 2002) was applied to a large number of specimens to confirm spot reactions and to elucidate more complex chemical patterns. Most images were taken from freshly collected material at Edison State College using a NIKON Coolpix 5400 digital camera mounted on one ocular of a stereomicroscope.

SPECIES RICHNESS

In order to put the number of lichen species found here into a wider context, we compared the data to those published for other nature preserves in the continental United States (Bennett & Wetmore 2005a; Spribille et al. 2010) and extracted the most recent data of the NPLichen database for national parks and other nature preserves (Bennett & Wetmore 2005b, Bennett 2006; <http://www.nbi.gov/portal/server.pt/community/lichens/1555>). We also used these authors' estimates of relative completeness of the lichen inventories in these parks and preserves to account for missing data, knowing that this can only be an approximation and that many parks require more detailed studies to assess their lichen diversity accurately. It should be noted that recent surveys of several parks considered 90–99% known in the NPLichen database (e.g. the Santa Monica Mountains and the Great Smoky Mountains; Knudsen & 2010; Lendemer et al., unpubl. data) exhibit undiscovered lichen species richness that was higher than previously estimated. However, this applies likely to other parks and preserves, including Fakahatchee, and therefore the level of uncertainty is partially balanced out and the relative comparisons remain valid at this point.

Assuming that lichen species richness depends more or less logarithmically on area and rather linearly on habitat diversity (McGuinness 1984; Nilsson et al. 1988; Rosenzweig 1995; Ney-Nifle & Mangel 2000; McCune & Grace 2002; Lücking et al. 2009a), in our analysis we used the

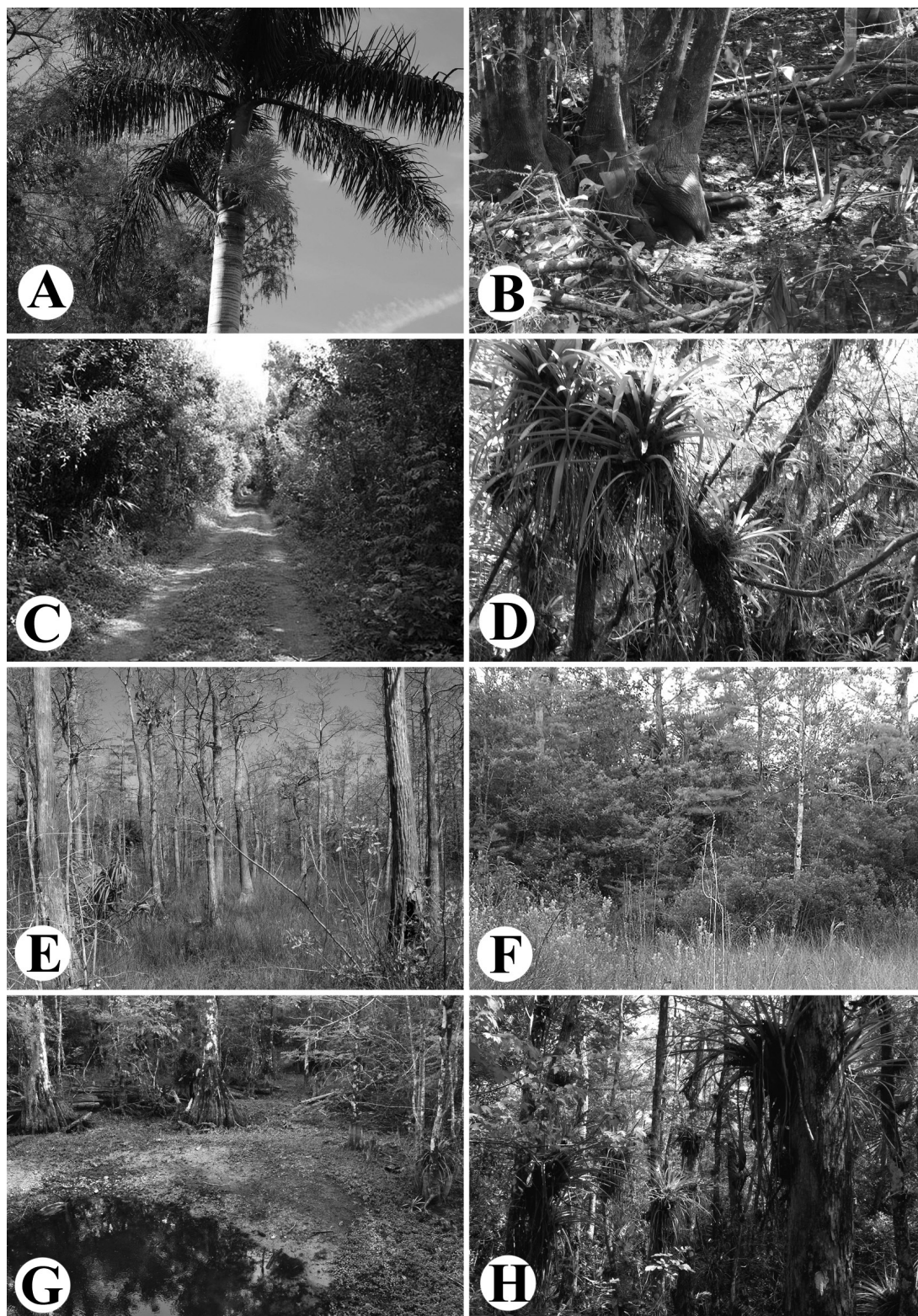


Figure 3. Habitat photographs of the four collection sites at Fakahatchee Strand Preserve State Park. First row: site 1, showing royal palm canopy and understory with bald cypress. Second row: site 2, showing side road along old tram with dense vegetation and aspect of understory with bromeliads. Third row: site 3, showing open bald cypress prairie hammock and dense regrowth. Fourth row: site 4, showing closed bald cypress forest and aspect of forest understory. Photographs by R. Lücking (A, B, G), Matthew Nelsen (D, E, H), Frederick Seavey (F), and Jean Seavey (C). Color version available online at <http://www.flmnh.ufl.edu/bulletin/vol49no4/figure3.pdf>.

Table 1. Lichen species richness of selected North American national parks and other preserves (after Bennett & Wetmore 2005a, b; Bennett 2006; Spribille et al. 2010; <http://www.nbii.gov/portal/server.pt/community/lichens/1555>). SPE = currently known species richness; COMP = estimate of completeness range; EST = estimated species richness using mean from estimate of completeness range (mean value; the range would be $\pm 5\%$); SIZE = area cover (excluding water surfaces); ALT = altitudinal range; VEG = number of vegetation categories present (using simplified classification following Grossman et al. 1998); SPE/area = species per area; SPE/log = species per log-area; SPE/veg = species per log-area per vegetation categories. For further explanation see text. *For these parks, species versus log-area relationships have a steeper slope due to small area size and hence comparison with larger areas does not apply and SPE/area, SPE/log, and SPE/veg calculations are not given. **Figures updated according to list maintained by park; further 90 species are to be added and hence the lichen species richness of that park will surpass Kondike (Lendemer, pers. comm. 2010).

PARK NAME	SPE	COMP	EST	SIZE [km ²]	ALT [m]	VEG	SPE/ area	SPE/ log	SPE/ veg
Klondike (Alaska)*	668	91–99%	703	53	—	—	—	—	—
Isle Royale (Michigan)	613	91–99%	645	540	180–425	6	1.14	2.24	0.37
Great Smoky Mountains (North Carolina)**	589	91–99%	620	2100	265–2025	7	0.28	1.77	0.30
Voyageurs (Minnesota)	498	91–99%	525	250	335–430	5	1.99	2.08	0.42
Glacier (Montana)	480	91–99%	505	3830	960–3190	7	0.13	1.34	0.19
Everglades (Florida)	450	76–90%	540	6000	0–10	5	0.08	1.19	0.24
Acadia (Maine)*	444	91–99%	465	140	—	—	—	—	—
Gates of the Arctic (Alaska)	441	91–99%	465	39000	85–2525	6	0.01	0.96	0.16
Fakahatchee Strand (Florida)	432	76–90%	519	320	0–10	5	1.35	1.72	0.43
Yellowstone (Wyoming)	421	76–90%	505	8500	1610–3460	7	0.05	1.07	0.15
Rocky Mountain (Colorado)	419	91–99%	440	1050	2325–4350	6	0.40	1.39	0.23
Keweenaw (Michigan)*	354	91–99%	375	8	—	—	—	—	—
Olympic (Washington)	353	76–90%	425	3700	0–2430	7	0.10	0.99	0.14
Delaware Water Gap (New Jersey)	333	91–99%	350	265	90–500	6	1.26	1.37	0.23
Santa Monica Mountains (California)	333	91–99%	350	620	0–950	7	0.54	1.19	0.17
Chiricahua (Arizona)*	325	91–99%	340	120	—	—	—	—	—
Apostle Islands (Wisconsin)	323	91–99%	340	160	N/A	5	2.02	1.47	0.29
Saint Croix (Minnesota)	308	91–99%	325	350	N/A	5	0.88	1.21	0.24
Saguaro (Arizona)	299	91–99%	315	370	665–2640	7	0.81	1.16	0.17
Big Bend (Texas)	289	91–99%	305	3200	520–2385	8	0.09	0.82	0.10
Channel Islands (California)	273	91–99%	285	500	0–550	7	0.55	1.01	0.14
Pictured Rocks (Michigan)	263	91–99%	275	290	N/A	5	0.91	1.07	0.21
Denali (Alaska)	259	51–75%	410	20183	70–6195	6	0.01	0.60	0.10
Sequoia (California)	256	91–99%	270	1600	415–4420	9	0.16	0.80	0.09
Grand Canyon (Arizona)	255	51–75%	405	4900	780–2515	7	0.05	0.69	0.10
Theodore Roosevelt (North Dakota)	251	91–99%	265	280	590–870	5	0.90	1.03	0.21
Redwood (California)	251	76–90%	300	450	N/A	7	0.56	0.95	0.14
Blue Ridge (North Carolina/Virginia)	246	51–75%	390	370	200–1845	8	0.66	0.96	0.12
Mount Rushmore (South Dakota)*	222	76–90%	265	5	—	—	—	—	—
Grand Teton (Wyoming)	221	51–75%	350	1250	1900–4200	7	0.18	0.71	0.10
Shenandoah (Virginia)	218	76–90%	265	800	180–1235	6	0.27	0.75	0.13
Hot Springs (Arkansas)*	214	91–99%	225	22	—	—	—	—	—
Bandelier (New Mexico)*	211	91–99%	220	130	—	—	—	—	—
Costa Rica Las Cruces	550	91–99%	580	2.7	1200–1400	1	203.70	12.75	12.75
Costa Rica La Selva	598	91–99%	630	28	200–400	1	21.36	4.13	4.13
Costa Rica Tortuguero	523	76–90%	630	190	0–200	1	2.75	2.30	2.30
Costa Rica Hitoy Cerere	485	76–90%	585	200	200–500	1	2.43	2.11	2.11
Costa Rica Corcovado	511	76–90%	615	420	0–200	1	1.22	1.95	1.95

following parameters: total number of species, species per area, species per log-area, and species per log-area per habitats. For each preserve, the total area was corrected to the area covered by land. To assess the number of principal vegetation types (suitable for lichen growth) in each preserve, we applied a simplified classification following Grossman et al. (1998). In addition to principal vegetation types, the number of altitudinal belts was taken into consideration, using a relative assessment depending on latitude, since the tree line and hence the potential substrate for epiphytic lichens decreases with higher latitudes.

RESULTS AND DISCUSSION

Together with previous collections gathered at Fakahatchee Strand Preserve State Park by R. Common, W. R. Buck, and R. C. Harris, the total number of species currently documented for the Preserve amounts to 432, most of which were collected during the 2009 Tuckerman workshop. All species are listed below, together with representative voucher specimens, and most of the crustose epiphytic lichens are documented with color images. The 432 species represent over 100 genera in 35 families and approximately 2,000 collections in total. Fourteen species new to science are described below (plus four others in three separate papers; Nelsen et al. 2010; Lumbsch et al. 2011; Lücking et al. 2011) and we also report 89 species new to the North American Lichen Checklist (Esslinger 2010).

Although South Florida lies entirely north of the Tropic of Capricorn, its floristics are extremely similar to those of the Caribbean (Tomlinson 1980). Tomlinson also stated that the 12°C January mean temperature isotherm for the state was most likely the result of oceanic influence and the part of Florida between the shoreline and this isotherm would be where the concentration of Caribbean species would be found. With minor exceptions, this has proved to be the case (Olmstead et al. 1993). Fakahatchee Strand Preserve State Park narrowly misses being within this zone, but still has some elements of the Caribbean tree flora such as *Sideroxylon foetidissimum* (mastic), *Chrysophyllum*

oliviforme (satinleaf) and *Randia aculeata* (indigoberry). Conversely, several arboreal species common at Fakahatchee apparently have reached their southern limits and become scarce or absent only a few miles to the south of the site. These include *Fraxinus caroliniana* (Carolina ash), *Acer rubrum* (red maple), and *Quercus laurifolia* (laurel oak). The complete botanical checklist of the Preserve reveals essentially the same type of distributional composition and demonstrates that it is a geographical ecotone between temperate and tropical biomes.

The 432 lichen species found at Fakahatchee show a similar mixture of temperate and tropical taxa, with a distinct bias towards tropical species, and this certainly accounts for the richness of the preserve's lichen biota. The majority of the species recorded here as new to the North American lichen checklist have tropical affiliations. Some species, including *Pyrenula brunnea*, *Stirtonia macrocarpa*, and *S. dubia*, have been known so far only from the Old World tropics. Others are essentially tropical but have been collected beyond tropical latitudes under favorable conditions, such as foliicolous species (Lendemer & Tripp 2008).

The high percentage of species found to be new to North America within the preserve's newly created checklist can in part be attributed to the paucity of previous systematic lichen explorations at this location, as only few collections have been studied and published before (Harris 1990, 1995). Several lichenologists have collected at Fakahatchee but there is no record of any lichen foray equaling the present one. The list below also includes some taxa that keyed imperfectly or would not key at all and require further study, most of them lacking ascomata.

The checklist consists mostly of corticolous and foliicolous collections with only a few from lignum or on moss over bark. The lack of saxicolous specimens is accounted for by the nature of the geology of the collection site and South Florida in general. For many million years the area has been formed by successive layers of biogenic marine carbonates, mostly limestone (Randazzo & Jones 1997; Petuch & Roberts 2007). It has been

covered by peat and calcareous marls following its emergence above sea level early in the Pleistocene. Although limestone outcrops are common, many of these are inundated nearly half the year by summer rains. Siliceous rocks are absent from the region. For the most part, only the higher *Muhlenbergia* prairies (Orzell & Bridges 2006) contain exposed calcareous outcrops potentially capable of supporting a lichen flora. This plant community was not sampled during this foray.

Although Fakahatchee is a small park, being 22nd in size of all parks with more than 200 lichen species reported and compared here (Table 1) and only 10% of the average size of these parks, it currently ranks 9th in lichen species richness. By far the largest numbers of species have been documented for Klondike Gold Rush National History Park and Isle Royale National Park, with 668 and 613 taxa, respectively (Table 1). Several other parks have between 400 and 500 species, including Everglades National Park (Seavey & Seavey, unpubl. data). In addition to the parks and preserves listed in Table 1, further inventories are currently under way. Tucker (2010) recently reported 296 lichen species from Burden Research Plantation in Louisiana, another subtropical site that has been monitored for over 25 years. Hodkinson (2010) and Hodkinson et al. (2009, 2010) found 220 lichen species at Mount Rogers National Recreation Area.

Excluding parks of less than 200 km² (because the log-area approximation does not directly compare between small and large area sizes due to changes in the slope parameter; McGuinness 1984; Nilsson et al. 1988; Rosenzweig 1995; Ney-Nifle & Mangel 2000), Fakahatchee Strand Preserve State Park ranges among the top three parks for species per log-area and is first in species per log-area per habitat indices (Table 1). The latter index surpasses that of much larger parks with comparable vegetation, such as the nearly twenty times larger Everglades National Park, and underlines the carrying capacity of (sub-)tropical vegetation to support high small-scale diversity, especially for epiphytic crustose microlichens.

The North American lichen checklist currently comprises more than 4500 lichen species (Esslinger 2010), which means that Fakahatchee supports almost 10% of the lichen species richness reported for the entire North America, although it is only a fraction of its size (0.00015%). This corresponds to a 60000-fold increase in species density. This phenomenon of concentrated, high small-scale species richness comes to its extreme in the tropics, such as in Costa Rica, where the species per log-area per habitat indices are five to ten times larger than in any species-rich park found in the continental United States, including the (sub-)tropical parts of Florida (Table 1).

NEW OR OTHERWISE INTERESTING SPECIES

In the following account, we present taxonomic novelties found during this and previous lichen surveys at Fakahatchee. Other new species are described in separate papers (Nelsen et al. 2010; Lumbsch et al. 2011; Lücking et al. 2011). The taxa are listed in alphabetical order.

Calopadia floridana Hodges & Lücking, new species

Figure 14D–G¹

Mycobank #518000

Diagnosis.—Sicut *Calopadia puiggarii* apotheciis pruinosis maioribusque differt.

Description.—Thallus corticolous, 1–3 cm diam., 30–50 µm thick, centrally continuous but towards the margin with dispersed, irregular patches; surface uneven, white to pale gray. Photobiont chlorococcoid. Apothecia sessile, rounded, 0.6–1.2 mm diam. and 250–350 µm high; disc plane to slightly convex, dark gray to brownish gray, coarsely white-pruinose; margin thin, pale gray to cream-colored. Excipulum paraplectenchymatous, 50–70 µm broad, colorless. Hypothecium 30–50 µm high, dark brown. Apothecial base aeruginous. Epithecium thin, 5–10 µm high, pale grayish

¹Figures 4–58 are available on-line at <http://www.flmnh.ufl.edu/bulletin/vol49no4supplmats.htm>

brown. Hymenium 120–150 μm high, colorless. Paraphyses unbranched to slightly branched. Asci 100–120 \times 25–30 μm . Ascospores single, ellipsoid, muriform, 50–80 \times 17–25 μm , 3–4 times as long as broad, colorless. Campylidia sessile, 0.6–1.2 mm broad, 1–1.5 mm long; lobe well-developed, hood-shaped, dark gray with paler apex, white-pruinose; socle not apparent. Conidia filiform with clavate apex, 5–7-septate, 50–70 \times 1.5–2 μm . Secondary chemistry: no substances detected by TLC.

Type.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Janes Scenic Drive 6.5 mi NNW of ranger station, west of old tram, *Taxodium-Sabal* hardwood hammock, slough and strand, on *Taxodium* branch, March 2009, *Hodges s.n.* (F, holotype).

Etymology.—Referring to its discovery in Florida.

Distribution and Ecology.—This species is known from two well-developed collections from Fakahatchee Strand Preserve State Park and Sumpter County, growing on the smooth part of the bark of small *Taxodium* branches and partly on exposed areas of the wood bare of periderm, as well as on hardwood bark.

Remarks.—*Calopadia floridana* belongs in a group of species that have single, muriform ascospores less than 100 μm long. All species so far known in this group, except the recently described *C. editae* (see below in the species list), have non-pruinose apothecia which are also distinctly smaller, usually not exceeding 0.8 mm diam. *Calopadia editae* also has pruinose apothecia but the disc is lighter brown and yellowish pruinose and the pruina also covers the apothecial margin. Except for the pruina on the apothecial disc, the new species comes closest to *C. puiggarii*, also present in the park, which shares the dark brown hypothecium and aeruginous apothecial base and a gray-brown apothecial disc, but differs in its smaller, non-pruinose apothecia. Another species with pruinose apothecia and single-spored asci is *C. perpallida*, which has longer ascospores (> 100 μm) and the apothecia, as in *C. editae*, are yellow-brown with pale yellow-white pruina (Lücking 2008). The holotype of *C. floridana*

bears only mature apothecia, all heavily pruinose, whereas an additional collection from Sumpter County (*Common 5320K*) has younger apothecia with scarce pruina only, suggesting that the pruina develops with age.

Additional Specimens Examined.—U.S.A. Florida. Sumpter Co.: Rt. 471 along Withlacooche River, at boundary with Polk Co., Apr 1992, *Common 5320K* (hb. Common).

***Calopadia imshaugii* Common & Lücking, new species**

Figure 15A–F

Mycobank #560000

Diagnosis.—Sicut *Calopadia fusca* sed apotheciis maioribus pruinosis et ascosporis 1–3 in ascis differt.

Description.—Thallus corticolous, 0.5–3 cm diam., 30–50 μm thick, centrally continuous but towards the margin with dispersed, irregular patches; surface uneven, white to pale gray. Photobiont chlorococcoid. Apothecia sessile, rounded, 0.4–0.8 mm diam. and 200–325 μm high; disc plane to slightly convex, brown, coarsely white-pruinose; margin conspicuous, pale gray to cream-colored. Excipulum paraplectenchymatous, 50–100 μm broad, colorless. Hypothecium 20–40 μm high, (dark) brown. Apothecial base sordid brown. Epithecium thin, 5–10 μm high, pale grayish brown. Hymenium 100–130 μm high, colorless. Paraphyses unbranched to slightly branched. Asci 90–100 \times 20–30 μm . Ascospores (1–)2(–3) per ascus, ellipsoid, muriform, 50–80 \times 15–23 μm , 3–4 times as long as broad, colorless. Campylidia sessile, 0.5–1 mm broad, 1–1.5 mm long; lobe well-developed, hood-shaped, dark gray with paler apex, white-pruinose; socle not apparent. Conidia filiform with clavate apex, 7–15-septate, 70–90 \times 1.5–2 μm . Secondary chemistry: all spot tests negative.

Type.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Scenic Drive (CR 837) just past bend near gate 14, second growth, Apr 1997, *Common 7322F* (MSC, holotype; hb. Common, isotype).

Etymology.—We dedicate this new species

to the late Henry Imshaug for his contributions to lichenology.

Distribution and Ecology.—This species is known from several collections in Florida, growing on the bark of small twigs on unidentified trees.

Remarks.—*Calopadia imshaugii* is unusual within the genus in having more than one ellipsoid ascospore per ascus. Most species of the genus have single-spored asci, and in the few taxa with more than one ascospore per ascus, the ascospores are narrow and oblong rather than ellipsoid, being $70\text{--}120 \times 8\text{--}14\ \mu\text{m}$ (Lücking 2008). The ascospores of the new species have the same shape and dimensions as those in species with single-spored asci related to *C. fusca*. Morphologically, the new species is similar to *C. floridana* (described above), but the latter has single-spored asci.

Additional Specimens Examined.—U.S.A. Florida. Dade Co.: SW 388th St., 1.2 miles east of Old Dixie Hwy., near Homestead, May 1992, *Common* 5889I, 5892E (all hb. Common).

***Chapsa platycarpoides* (Tuck.) Breuss & Lücking, new combination**

Figure 17D

Mycobank #517995

Basionym.—*Thelotrema platycarpoides* Tuck., Proc. Am. Acad. Arts Sci. 6:270 (1866); *Phaeotrema platycarpoides* (Tuck.) Müll. Arg., Flora 69:311. (1886).

Type.—Cuba, *Wright 157* (FH!; lectotype, fide Hale 1981:265).

Remarks.—This species is closely related to *Chapsa platycarpa*, with which it co-occurs in the same microhabitats, mostly on swamp dogwood. The species was originally separated from *C. platycarpa* because of the smaller apothecia and larger ascospores with more numerous septa. However, while the two species do differ in apothecial size, the ascospores are practically identical, as already noted by Hale (1981). We found two other distinctive features of *Chapsa platycarpoides*: the outer thallus margin is more or less entire compared to the distinctly lobulate and recurved margin of *C. platycarpa*, and the apothecial margin is UV+ yellow (sometimes

only weakly so), indicating the presence of lichexanthone. The species somewhat resembles *Thelotrema porinoides*, which also contains stictic acid, but has much longer, multiseptate, hyaline ascospores (Rivas Plata et al. 2010).

Additional Specimens Examined: U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Off James Scenic Drive west of Tram Rd. 6.5 mi NNW of Ranger Station, Taxodium-Sabal-hardwood hammock, slough, and strand; March 2009, *Breuss* 28665 (LI, USF), *Lücking & Rivas Plata* 26571 (F, USF).

***Cryptothecia miniata* Vain. ex Lücking, new species**

Figure 20E–F

Mycobank #560001

Diagnosis.—*Cryptothecia* speciei medulla cinnabarinadiffert. Thallusecorticatus, virido-albus. Ascomata desunt. Acido 2-*O*-methylperlatolico continens.

Description.—Thallus corticolous, to 10 cm diam., $25\text{--}50\ \mu\text{m}$ thick, continuous; surface uneven, minutely farinose-bysoid, pale green to almost white, with mottled areas of pure white, sterile but potentially ascigerous areas; streaks of medulla frequently exposed, bright orange to cinnabar-red. Photobiont trentepohlioid. Thallus in section lacking upper cortex, with irregular algal layer and areas of concentrated crystalline orange pigments. Asci and ascospores not observed. Secondary chemistry: 2-*O*-methylperlatolic acid and unknown substance close to gyrophoric in solvent C, unidentified anthraquinone pigment detected by TLC (paratype); unpigmented thallus parts C–, K–, P–, I+ light blue (especially white areas), pigmented parts K+ dark purple-violet.

Type.—Guyana. Vryheid Plantation, no date or collector given (TUR-Vainio 28367, holotype).

Etymology.—The epithet refers to the strongly pigmented parts of the thallus, *miniata* meaning cinnabar-red color (not to be confused with small).

Distribution and Ecology.—This species is known from the type material from Guyana and from several collections from Fakahatchee Strand

Preserve State Park, where it was found on bark of *Taxodium* and hardwood in shaded situations.

Remarks.—The material of this taxon found in TUR suggests that Vainio intended to describe this species under the generic name *Chiodecton*, but never published it. It does not seem to have been mentioned in the literature. However, the Florida collections suggest that this is a widespread, well-defined taxon, even if asci and ascospores are absent. The general habit, the sterile white areas dispersed over the thallus showing a light blue reaction with iodine, and the secondary chemistry including 2-*O*-methylperlatolic acid, support inclusion within *Cryptothecia*. However, the pigmented thallus parts are quite unique in the genus. Thus far, pigments appear to be restricted to the related genus *Herpothallon* (Aptroot et al. 2009), where they usually occur in the hypothallus and prothallus, as well as the isidioid outgrowths. Since the name coined by Vainio was available, we decided to validate this name rather than using a new one; therefore, Vainio's material was selected as holotype. We also specified an epitype from the Florida material which is then available for molecular studies.

Additional Specimens Examined.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, off James Scenic Drive 6.5 mi NNW of ranger station at gate 12 along old tram road, *Taxodium-Sabal* hardwood hammock, strand and swamp, on *Taxodium* bark, March 2009, Lay 09-0063 (hb. Lay), Lücking & Rivas Plata 26678, 26679 (F).

***Fissurina aggregatula* Common & Lücking,**

new species

Figure 23E

Mycobank #560002

Diagnosis.—Sicut *Fissurina insidiosa* sed lirellis minoribus aggregatibusque differt.

Description.—Thallus corticolous, 1–3 cm diam., 40–80 μ m thick, continuous; surface uneven to verrucose-bullate, yellowish green to olive-brown. Photobiont trentepohlioid. Thallus in section with prosoplectenchymatous upper cortex, irregular algal layer and scattered clusters

of crystals. Lirellae densely aggregate in small clusters, straight to curved, unbranched to sparsely branched, erumpent, with lateral thalline margin, 0.3–0.7 mm long, 0.15–0.2 mm wide, 0.12–0.15 mm high; disc concealed; labia conspicuous, thick, yellowish-white; thalline margin olive-brown. Excipulum entire, apically dark brown, 25–50 μ m wide; laterally covered by corticate algiferous thallus including clusters of crystals; hypothecium prosoplectenchymatous, 5–10 μ m high, colorless to pale yellowish; hymenium 60–80 μ m high, colorless, clear; epithecium granulose, 5–10 μ m high, brown. Paraphyses unbranched, glabrous; periphysoids not observed; asci fusiform, 60–70 \times 10–13 μ m. Ascospores 8 per ascus, ellipsoid, transversely 3-septate, 14–20 \times 7–9 μ m (including 1–1.5 μ m thick wall), 2 times as long as wide, with comparatively thin septa and angular-rounded lumina, colorless to pale gray-brown, I–. Secondary chemistry: no substances detected by TLC.

Type.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, K2 trail among royal palms, second growth area, Apr 1997, *Common* 7356A (MSC, holotype; hb. *Common*, isotype).

Etymology.—The epithet refers to the small clusters of aggregate lirellae.

Distribution and Ecology.—This species is known from several small collections from Fakahatchee Strand Preserve State Park, from bark of branches of unidentified hardwood.

Remarks.—This material is characterized by erumpent, fissurine lirellae with thick labia which are clearly aggregate, as well as 3-septate, non-amyloid ascospores. It comes closest to *F. insidiosa* (Harris 1995; Staiger 2002; Archer 2009), but the lirellae are much more delicate and form small clusters. *Fissurina radiata* is another species with aggregate lirellae and 3-septate ascospores (see below), but in that species, the labia are inconspicuous, the lirellae are gaping, and the clusters are much larger and almost pseudostromatic.

Additional Specimens Examined.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, K2 trail among royal palms, second

growth area, Apr 1997, *Common* 7368C-2 (hb. Common), 7380C-2 (hb. Common).

***Fissurina analphabetica* Common & Lücking,
new species**

Figure 23F–G

Mycobank #560003

Diagnosis.—Sicut *Fissurina illiterata* sed thallo corticato et ascosporis typo tryptethelio differt. Thallus corticatus. Lirellae fissurinae, 0.3–0.5 mm longae, 0.1 mm latae. Ascosporae 3-septate, $13\text{--}18 \times 7\text{--}9\ \mu\text{m}$, I–. Acidi lichenum desunt.

Description.—Thallus corticolous, 0.5–1 cm diam., $30\text{--}60\ \mu\text{m}$ thick, continuous; surface smooth to uneven, pale greenish white. Photobiont trentepohlioid. Thallus in section with prosoplectenchymatous upper cortex, irregular algal layer and clusters of crystals. Lirellae straight to curved, unbranched to irregularly branched, erumpent, fissurine, with thick complete thalline margin, 0.3–0.5 mm long, 0.1 mm wide, 0.1 mm high; disc concealed; labia inconspicuous to slightly bulging, brown along the slit; thalline margin white. Excipulum entire, apically dark brown, $10\text{--}15\ \mu\text{m}$ wide; laterally covered by corticate algiferous thallus including clusters of crystals; hypothecium prosoplectenchymatous, $5\text{--}10\ \mu\text{m}$ high, colorless to pale yellowish; hymenium $70\text{--}80\ \mu\text{m}$ high, colorless, clear; epithecium granulose, $5\text{--}10\ \mu\text{m}$ high, colorless. Paraphyses unbranched, glabrous; periphysoids not observed; asci fusiform, $60\text{--}70 \times 12\text{--}15\ \mu\text{m}$. Ascospores 8 per ascus, ellipsoid, transversely 3-septate, $13\text{--}18 \times 7\text{--}9\ \mu\text{m}$ (including $1\text{--}1.5\ \mu\text{m}$ thick wall), 2 times as long as wide, with tryptethelioid to thin septa and tryptethelioid to angular-rounded lumina, colorless, I–. Secondary chemistry: no substances detected by TLC.

Type.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, K2 trail among royal palms, second growth area, Apr 1997, *Common* 7356N (MSC, holotype; hb. Common, isotype).

Etymology.—The name is a word play corresponding to the superficially similar *F. illiterata*.

Distribution and Ecology.—This species

is known from several rich collections, from Fakahatchee Strand Preserve State Park and other parts in Florida. It grows on bark of hardwood.

Remarks.—*Fissurina analphabetica* belongs in a complex of species with 3-septate, non-amyloid ascospores and lacking lichen substances, centered around *F. dumastii*. Within this complex, the new species is clearly set apart by its extremely small and delicate lirellae, which are the smallest known among all described species. *Fissurina tachygrapha* (see below) agrees in the delicate lirellae with apically dark brown excipulum, as well as the non-amyloid ascospores with tryptethelioid septa, but has an endoperidermal, ecorticate thallus. *Fissurina illiterata* is also superficially similar, but its thallus is mostly ecorticate and the ascospores have more rounded lumina and are frequently weakly amyloid. We also observed conspicuously thickened paraphyses in that species but not in *F. analphabetica*.

Additional Specimens Examined.—U.S.A. Florida. Baker Co.: Osceola National Forest near Ocean Pond, Dec 1975, *Common* 3673K, 3684H, 3786G (all hb. Common). Collier Co.: Fakahatchee Strand Preserve State Park, K2 trail among royal palms, second growth area, Apr 1997, *Common* 7356I, 7377E, 7380L (all hb. Common). Hillsborough Co.: Hillsborough River State Park, Dec 1990, *Common* 4667, 4929C (all hb. Common). CR 581, 3.2 mi S of I-75, Nov 1995, *Common* 6601A, 6864A, 6880D (all hb. Common). Polk Co.: CR 54, 0.1 mi E of CR 557, Apr 1996, *Common* 6868P (hb. Common).

***Fissurina confusa* Common & Lücking, new
species**

Figure 24B

Mycobank #560004

Diagnosis.—Sicut *Fissurina instabile* sed acido psoromico differt. Thallus corticatus. Lirellae labiatae, 0.5–1 mm longae, 0.2 mm latae. Ascosporae muriformes, $25\text{--}35 \times 12\text{--}20\ \mu\text{m}$, I+ caeruleae. Acido psoromico continens.

Description.—Thallus corticolous, 1–3 cm diam., $50\text{--}100\ \mu\text{m}$ thick, continuous; surface uneven to verrucose-bullate, yellowish green to

olive-brown. Photobiont trentepohlioid. Thallus in section with prosoplectenchymatous upper cortex, irregular algal layer and scattered clusters of crystals. Lirellae straight to curved, unbranched to sparsely branched, erumpent to prominent, with lateral thalline margin, 0.5–1 mm long, 0.15–0.2 mm wide, 0.15–0.2 mm high; disc partially exposed, gray-pruinose; labia conspicuous, thick, white; thalline margin olive-brown. Excipulum entire, colorless to apically orange-brown, 25–50 μm wide; laterally covered by corticate algiferous thallus including clusters of crystals; hypothecium prosoplectenchymatous, 5–10 μm high, colorless to pale yellowish; hymenium 80–100 μm high, colorless, clear; epithecium granulose, 5–10 μm high, brown. Paraphyses unbranched, glabrous; periphysoids not observed; asci fusiform, 80–90 \times 25–35 μm . Ascospores 8 per ascus, ellipsoid, muriform with 5–7 \times 1–3 septa, 25–35 \times 12–20 μm (including 1–2 μm thick wall), 2 times as long as wide, with comparatively thin septa and angular-rounded lumina, colorless, I+ violet-blue. Secondary chemistry: psoromic acid (major), subpsoromic acid (minor), 2'-O-demethylpsoromic acid (major), medulla P+ yellow.

Type.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, K2 trail among royal palms, second growth area, Apr 1997, *Common 7380D* (MSC, holotype; hb. Common, isotype).

Etymology.—The epithet refers to the fact that this species was previously confused with *F. instabilis*.

Distribution and Ecology.—Known from several collections from Fakahatchee Strand Preserve State Park and also reported from Brazil by Staiger (2002; under *F. instabilis*). The species is usually found on branches of hardwood.

Remarks.—The Florida material agrees well with the description of *Fissurina instabilis* given by Staiger (2002), including the verrucose-bullate thallus and the erumpent to prominent lirellae with slightly gaping disc and thick, white labia. Staiger (2002) accepts forms with and without psoromic acid in the same species, but we consider this premature until molecular data clarify the

situation. In other genera of Graphidaceae, such as *Ocellularia* s.lat., psoromic acid is accepted as a species-diagnostic character. Since the type of *F. instabilis* has no substances, we introduce here the name *Fissurina confusa* for the psoromic-acid containing specimens. All Florida material contains psoromic acid. *Fissurina* presently contains four species with muriform (and amyloid) ascospores and psoromic acid chemistry. Among these, *Fissurina globulifica* (Nyl.) Staiger is set apart by the very small, almost globose ascospores (about 10 \times 10 μm), whereas *Fissurina streimannii* (A. W. Archer) A. W. Archer has more elongate ascospores (about 18 \times 10 μm); both have closed, labiate lirellae with white upper surface. The other two species have comparatively large ascospores (about 30 \times 15 μm) and differ from each other morphologically: *Fissurina columbina* (see below) has erumpent, fissurine lirellae with inconspicuous labia, whereas *Fissurina psoromica* (A. W. Archer) A. W. Archer has labiate lirellae with concealed disc which are brown-black along the slit due to a weakly carbonized excipulum; in addition, that species differs in having 2-methoxy-psoromic acid, a substance that can be distinguished from psoromic acid only by HPLC (Archer 2001). The new species, *F. confusa*, also has labiate lirellae but with partially exposed disc and white labia, thus clearly different from both *F. columbina* and *F. psoromica*.

Additional Specimens Examined.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, K2 trail among royal palms, second growth area, Apr 1997, *Common 7356A* (hb. Common), *7356F* (hb. Common), *7368G* (hb. Common).

***Fissurina inspersa* Common & Lücking, new species**

Figure 25B

Mycobank #560005

Diagnosis.—Sicut *Fissurina tachygrapha* sed hymenio insperso et acido stictico differt. Thallus pro parte ecorticatus. Lirellae fissurinae, 0.5–1 mm longae, 0.1 mm latae. Ascosporae 3-septatae, 12–18 \times 6–9 μm , I–. Acido stictico continens.

Description.—Thallus corticolous, 0.5–1 cm diam., 30–60 µm thick, continuous; surface smooth to uneven, yellowish to pale greenish white. Photobiont trentepohlioid. Thallus in section with partly prosoplectenchymatous, partly irregular and loose upper cortex, irregular algal layer and scattered clusters of crystals. Lirellae straight to curved, unbranched, immersed, fissurine, with thick complete thalline margin, 0.5–1 mm long, 0.1 mm wide, 0.1 mm high; disc partially exposed, dark gray-pruinose; labia inconspicuous; thalline margin yellowish white. Excipulum entire, brown to apically dark brown, 10–15 µm wide; laterally covered by corticate algiferous thallus including clusters of crystals; hypothecium prosoplectenchymatous, 5–10 µm high, colorless to pale yellowish; hymenium 50–60 µm high, colorless, strongly and densely inspersed (inspersion persistent in K); epithecium granulose, 5–10 µm high, brown. Paraphyses unbranched, glabrous; periphysoids not observed; asci fusiform, 50–60 × 10–12 µm. Ascospores 8 per ascus, ellipsoid, transversely 3-septate, 12–18 × 6–9 µm (including 1–1.5 µm thick wall), 2 times as long as wide, with tryptethelioid septa and lumina, colorless, I–. Secondary chemistry: stictic acid (major), constictic acid (trace), thallus section with K+ yellow efflux under the microscope.

Type.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Scenic Drive (CR 837) just past bend near gate 14, second growth, Apr 1997, *Common* 7323C (MSC, holotype; hb. Common, isotype).

Etymology.—The name refers to the strongly inspersed hymenium, an unusual character in *Fissurina* (Staiger 2002).

Distribution and Ecology.—This species is known from several rich collections, all from Fakahatchee Strand Preserve State Park, on hardwood.

Remarks.—*Fissurina inspersa* is a typical *Fissurina* with an unusual character: a strongly inspersed hymenium. The inspersion resembles that of *Graphis cinerea* and allies (Lücking 2009), in that it makes the paraphyses, asci, and ascospores barely discernible, but contrary to the latter, in

Fissurina inspersa it does not dissolve in K. Thus far, no species of *Fissurina* with inspersed hymenium appears to be known (Staiger 2002). Apart from the inspersion and the darkened excipulum, *Fissurina dumastoides* Fink comes closest, as it shares the fissurine lirellae of type I according to Staiger (2002), has the same ascospore type, and also produces stictic acid. *Fissurina tachygrapha* (see below) looks superficially similar and also has a weakly carbonized excipulum and the same ascospore type, but lacks inspersion and its thallus is endoperidermal and completely ecorticate.

Additional Specimens Examined.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Scenic Drive (CR 837) just past bend near gate 14, second growth, Apr 1997, *Common* 7276F (hb. Common); *ibid.*, K2 trail among royal palms, second growth area, Apr 1997, *Common* 7356O (hb. Common), 7368J (hb. Common).

***Fissurina mexicana* (Zahlbr.) Lücking & Rivas Plata, new combination**

Figure 25C

Mycobank #517999

Basionym.—*Enterodictyon mexicanum* Zahlbr., Ann. Mycol. 19:233 (1921); *Graphina mexicana* (Zahlbr.) M. Wirth & Hale, Contr. US Natl. Herb. 36:82 (1963).

Type.—Mexico, Pringle 20 (W).

Remarks.—This species is usually identified with *Fissurina leuconephela* Nyl. (Harris 1995). Staiger (2002) noted that *F. leuconephela* was described as sterile, and indeed, no ascospores are present in the type (indicated on Mason Hale's Index Cards at US). The application of this name is therefore uncertain. There are two other species with similar thallus and lirellae morphology: *Graphis egena* f. *intercludens* Nyl. and *Graphina mexicana* (Zahlbr.) Wirth & Hale. Ascospores are present in both types, being 20–25 µm long in *intercludens* and 25–40 µm long in *mexicana*. The first was listed as a synonym of *Fissurina egena* by Staiger, but differs in the pseudostromatic lirellae and therefore is recombined in *Fissurina*: ***Fissurina intercludens* (Nyl.) Lücking & Rivas Plata, new combination and status** [Mycobank #517996;

Basionym.—*Graphis egena* f. *intercludens* Nyl., Bull. Soc. Linn. Normandie, Sér. 2, 2:121 (1868). Type.—New Caledonia, *Viellard s.n.* (H-NYL 7455!; lectotype, fide Staiger 2002:128)]. In the material from Fakahatchee, ascospores are mostly 30–45 μm long and fit *Graphina mexicana*. Since the type of *F. leuconephela* is from SE Asia (Bengal), we consider it highly unlikely that *F. leuconephela* is conspecific with *G. mexicana*. Harris (1995) gave the ascospore size for *Fissurina leuconephela* as 35–78 \times 18–36 μm . We have not seen ascospores of such a size and they seem to be highly unusual for a *Fissurina*; probably there is a further species belonging to a different genus involved. The collection *Common 7323H* bears pycnidia with bacillar conidia about 5 μm in size.

Additional Specimens Examined.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Scenic Drive (CR 837) just past bend near gate 14, second growth, Apr 1997, *Common 7323H*). Along James Scenic Drive, 3.2 mi NNW of Ranger Station; *Taxodium*-hardwood strand, swamp and slough, Mar 2009, *Lücking & Rivas Plata 26513**, 26514, 26515 (all F).

***Fissurina pseudostromatica* Lücking & Rivas
Plata, new species**

Figure 25D

Mycobank #560006

Diagnosis.—Sicut *Fissurina aggregatula* sed lirellis immersis albis et ascosporis angustioribus differt. Thallus corticatus. Lirellae fissurinae, 0.3–0.7 mm longae, 0.15–0.2 mm latae. Ascosporae 3-septatae, 14–20 \times 7–9 μm , I–. Acidi lichenum desunt.

Description.—Thallus corticolous, 1–3 cm diam., 40–60 μm thick, continuous; surface smooth to uneven, olive-green. Photobiont trentepohlioid. Thallus in section with prosoplectenchymatous upper cortex, irregular algal layer and scattered clusters of crystals. Lirellae densely aggregate in pseudostromatic, white clusters, straight to curved, unbranched, immersed, with thin thalline margin, 0.1–0.3 mm long, 0.1 mm wide, 0.1 mm high; disc concealed to slightly gaping; labia inconspicuous, white; thalline margin yellow-

white. Excipulum entire, orange-brown, 15–20 μm wide; laterally covered by corticate algiferous thallus including clusters of crystals; hypothecium prosoplectenchymatous, 5–10 μm high, colorless to pale yellowish; hymenium 60–80 μm high, colorless, clear; epithecium granulose, 5–10 μm high, orange-brown. Paraphyses unbranched, glabrous; periphysoids present, glabrous; asci fusiform, 60–80 \times 10–15 μm . Ascospores 8 per ascus, ellipsoid, transversely 3-septate, 15–20 \times 5–7 μm (including 1 μm thick wall), 3 times as long as wide, with comparatively thin septa and angular-rounded lumina, colorless to pale gray-brown, I–. Secondary chemistry: no substances detected by TLC.

Type.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Janes Scenic Drive 6.5 mi NNW of ranger station, west of old tram, *Taxodium-Sabal* hardwood hammock, slough and strand, March 2009, *Lücking & Rivas Plata 26512* (F, holotype).

Etymology.—The epithet refers to the pseudostromatic clusters of aggregate lirellae.

Distribution and ecology.—This species is known from a single collection from Fakahatchee Strand Preserve State Park, found on branches of hardwood.

Remarks.—This material was first considered to represent *Fissurina mexicana*, another species with pseudostromatic clusters of lirellae (see above). However, *F. mexicana* has muriform ascospores and its thallus is lighter, with a less conspicuous contrast between thallus and pseudostromatic clusters. *Fissurina pseudostromatica* appears to be the only species known in the genus with pseudostromatic clusters and transversely septate ascospores.

***Fissurina tuckermaniana* Common & Lücking,
new species**

Figure 26B

Mycobank #560007

Diagnosis.—Sicut *Fissurina comparile* sed ascosporis maioribus et paraphysoidis spinulosis differt. Thallus corticatus. Lirellae fissurinae, 1–3 mm longae, 0.25 mm latae. Ascosporae muriformes, 15–25 \times 6–8 μm , I–. Acidi lichenum desunt.

Description.—Thallus corticolous, 1–2 cm diam., 30–50 μm thick, continuous; surface smooth, yellowish-brown to olive-brown. Photobiont trentepohlioid. Thallus in section with prosoplectenchymatous upper cortex, irregular algal layer and scattered clusters of crystals. Lirellae straight to curved, unbranched to sparsely branched, immersed to erumpent, fissurine, with complete thalline margin, 1–3 mm long, 0.3–0.5 mm wide, 0.15–0.2 mm high; disc concealed; labia conspicuous but not thickened, grayish black to brown-black below corticate thalline margin; thalline margin olive-brown. Excipulum entire, brown-black, 25–50 μm wide; covered by corticate algiferous thallus including clusters of crystals; hypothecium prosoplectenchymatous, 5–10 μm high, colorless to pale yellowish; hymenium 80–100 μm high, colorless, clear; epithecium granulose, 5–10 μm high, gray-brown. Paraphyses unbranched, apically spinulose; periphysoids present, apically spinulose; asci fusiform, 80–90 \times 20–25 μm . Ascospores 2–4 per ascus, ellipsoid, transversely 3-septate, 25–40 \times 11–14 μm (including 1–1.5 μm thick wall), 2–3 times as long as wide, with \pm tryptethelioid septa and lumina, colorless, I+ violet-blue. Secondary chemistry: no substances detected by TLC.

Type.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Scenic Drive (CR 837) just past bend near gate 14, second growth, Apr 1997, *Common 7323D* (MSC, holotype).

Etymology.—We honor Edward Tuckerman for his contributions to North American lichenology with this new species.

Distribution and Ecology.—This species is known from two rich collections on hardwood from Fakahatchee Strand Preserve State Park.

Remarks.—*Fissurina tuckermaniana* externally resembles *Fissurina comparilis* (Nyl.) Nyl. and *Fissurina comparimuralis* Staiger (Staiger 2002) in the corticate, smooth, olive-brown thallus and the fissurine, carbonized lirellae. Anatomically, however, the species is quite unique in having unusually large, albeit 3-septate ascospores in numbers of 2–4 per ascus and apically spinulose paraphyses and periphysoids. Spinulose

paraphyses do occur in a few other species in *Fissurina* (Staiger 2002), but not in combination with carbonized lirellae (except for the new species *Fissurina subcomparimuralis* (formally described in Lumbsch et al. 2011). The ascospores are the largest 3-septate ascospores thus far known in *Fissurina*. Staiger (2002) gives *Fissurina tachygrapha* (Nyl.) Staiger as species similar to *F. comparilis*, but with larger ascospores; however, *F. tachygrapha* clearly differs in the largely endoperidermal, pale yellowish-gray thallus and the only weakly and apically carbonized lirellae; it also lacks spinulose paraphyses and periphysoids and is thus quite distinct from *F. tuckermaniana*.

Additional Specimens Examined.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Scenic Drive (CR 837) just past bend near gate 14, second growth, Apr 1997, *Common 7266* (hb. Common).

***Fissurina varieiseptata* Common & Lücking,
new species**

Figure 26C

Mycobank #560008

Diagnosis.—Sicut *Fissurina illiterata* sed ascospores 7-septatis differt. Thallus pro parte ecorticatus. Lirellae fissurinae, 0.5–1 mm longae, 0.1 mm latae. Ascosporae 5–7-septate, 12–18 \times 4–5 μm , I–. Acidi lichenum desunt.

Description.—Thallus corticolous, 1–5 cm diam., 40–70 μm thick, continuous; surface smooth to uneven, yellowish white. Photobiont trentepohlioid. Thallus in section with irregular and loose upper cortex, irregular algal layer and clusters of crystals. Lirellae straight to curved, unbranched to sparsely branched, immersed, fissurine, with complete thalline margin, 0.5–1 mm long, 0.1 mm wide, 0.1 mm high; disc \pm concealed; labia inconspicuous; thalline margin yellowish white but yellow-brown along the slit. Excipulum entire, colorless to apically orange-brown, 15–25 μm wide; laterally covered by corticate algiferous thallus including clusters of crystals; hypothecium prosoplectenchymatous, 5–10 μm high, colorless to pale yellowish; hymenium 60–80 μm high, colorless, clear; epithecium granulose, 5–10 μm

high, gray-brown. Paraphyses unbranched, \pm glabrous; periphysoids not observed; asci fusiform, $60\text{--}70 \times 10\text{--}15 \mu\text{m}$. Ascospores 8 per ascus, ellipsoid, transversely (3-)5–7-septate, $12\text{--}18 \times 4\text{--}5 \mu\text{m}$ (including $0.5\text{--}1 \mu\text{m}$ thick wall), 3–4 times as long as wide, with tryptethelioid septa and lumina, colorless, I–. Secondary chemistry: no substances detected by TLC.

Type.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Big Cypress Bend, old growth Cypress swamp, Apr 1997, *Common 7413A* (MSC, holotype).

Etymology.—The name refers to the transversely multiseptate ascospores.

Distribution and ecology.—This species is known from a single collection, growing on hardwood, from Fakahatchee Strand Preserve State Park.

Remarks.—*Fissurina varieseptata* is superficially similar to *Fissurina illiterata* and perhaps closely related to that species. It differs, however, in the mostly 5–7-septate ascospores, a highly unusual trait in the genus, where the species known to date have either 3-septate or (sub-) muriform ascospores (Staiger 2002). In spite of careful search, we have not found any indication in the literature or studied type specimens that suggest a previous description of a multiseptate species that would belong in *Fissurina*. On the other hand, most species with muriform ascospores have 5–7 transverse primary septa.

***Graphis appendiculata* Common & Lücking,
new species**

Figure 27D–E

Mycobank #560009

Diagnosis.—Sicut *Graphide olivacea* sed ascosporis minoribus et thallo albo-cinereo differt.

Description.—Thallus corticolous, 1–3 cm diam., $50\text{--}100 \mu\text{m}$ thick, continuous; surface smooth, white to pale gray. Photobiont trentepohlioid. Thallus in section with prosoplectenchymatous upper cortex, irregular algal layer and large clusters of crystals. Lirellae flexuose, irregularly branched but often in radiating lines, immersed to erumpent, with lateral to apically thin complete thalline margin,

3–7 mm long, 0.1–0.2 mm wide (abruptly thinner at the ends), 0.15–0.2 mm high; disc concealed; labia finely but distinctly striate, black or dark gray (when covered by thin thalline margin); thalline margin white to pale gray. Excipulum crenulate, apically carbonized and laterally and basally orange-brown, $30\text{--}50 \mu\text{m}$ wide and basally to $25 \mu\text{m}$ high; laterally covered by corticate algiferous thallus including clusters of crystals; hypothecium prosoplectenchymatous, $10\text{--}15 \mu\text{m}$ high, colorless to pale yellowish; hymenium $100\text{--}150 \mu\text{m}$ high, colorless, clear; epithecium granulose, $5\text{--}15 \mu\text{m}$ high, gray-brown. Paraphyses unbranched; asci fusiform, $80\text{--}120 \times 30\text{--}40 \mu\text{m}$. Ascospores 8 per ascus, oblong, transversely 9–13-septate, $40\text{--}60 \times 9\text{--}13 \mu\text{m}$, 4–6 times as long as wide, colorless, I+ violet-blue. Secondary chemistry: no substances detected by TLC.

Type.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Scenic Drive (CR 837) just past bend near gate 14, second growth, Apr 1997, *Common 7313A* (MSC, holotype; hb. Common, isotype).

Etymology.—The name refers to the peculiar shape of the lirellae, which become abruptly narrow and with entire labia towards the ends and hence appear appendiculate.

Distribution and Ecology.—Surprisingly this new species is one of the most commonly collected graphids at Fakahatchee but not yet known from outside the area, making it a possible local endemic. It mostly grows on small branches of hardwoods in partially exposed microhabitats.

Remarks.—With a number of over 300 accepted taxa and well over 1000 described names, describing new species in the genus *Graphis* is problematic. Nevertheless, in spite of careful search, we have not found a name for this taxon, which is represented by abundant material. With the immersed-erumpent lirellae with striate labia and apically carbonized excipulum, together with the clear hymenium, transversely septate ascospores, and no chemistry, it comes closest to *Graphis subalbostrata* Lücking, *Graphis olivacea* Redinger, *Graphis subtenella* Müll. Arg., and *Graphis proserpens* (Lücking et al. 2009).

However, both *G. subalbostrata* and *G. olivacea* have ascospores over 80 μm long, whereas in *G. subtenella* and *G. proserpens*, they are 20–40 μm long. The often present thin cortex covering the labia apically is also found in *G. olivacea*, but besides the larger ascospores, that species also differs by its dark, olive-gray thallus. *Graphis appendiculata* can be considered a further species in the difficult *G. proserpens*-*subtenella* complex. *Graphis appendiculata* is the most abundant *Graphis* at Fakahatchee. The collections made during the Tuckerman workshop in March 2009 are almost without exception sterile, whereas those made by R. Common in Apr 1997 are abundantly fertile, suggesting not just a seasonality in ascospore production but periodicity that could span more than a year's cycle. The species does not key out in Harris (1995); the most similar species there is *Graphis subelegans* Nyl., which has prominent to sessile lirellae and smaller ascospores, but it too is listed by Harris (1995) as frequently sterile.

Additional Specimens Examined.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Scenic Drive (CR 837) just past bend near gate 14, second growth, Apr 1997, *Common* 7318K (hb. Common); *ibid.*, K2 trail among royal palms, second growth area, Apr 1997, *Common* 7368L, 7380I (all hb. Common). U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, off James Scenic Drive 6.5 mi NNW of ranger station at gate 12 along old tram road, *Taxodium-Sabal* hardwood hammock, strand and swamp, on *Taxodium* bark, March 2009, *Lay* 09-0068 (hb. Lay), *Lücking & Rivas Plata* 26657, 26659, 26660, 26668 (all F, USF).

***Phaeographis delicatula* Common & Lücking,
new species**

Figure 44D

Mycobank #560010

Diagnosis.—Sicut *Phaeographide brasiliense* sed acidum sticticum continente differt.

Description.—Thallus corticolous, 1–3 cm diam., 50–100 μm thick, continuous; surface uneven-verrucose, pale yellow-gray to olive-yellow. Photobiont trentepohlioid. Thallus in section with prosoplectenchymatous upper cortex,

irregular algal layer and large clusters of crystals. Lirellae flexuose, aggregate in dense clusters but not pseudostromatic, stellately branched, erumpent, with indistinct labia and thin thalline margin, 1–3 mm long (but sometimes secondarily divided into shorter segments), 0.1 mm wide, 0.12–0.15 mm high; disc exposed, chocolate-brown, sometimes with thin gray pruina; labia indistinct, dark brown; thalline margin yellow-white. Excipulum divergent, dark brown, 10–20 μm wide; laterally covered by corticate algiferous thallus with clusters of crystals between individual lirellae; hypothecium prosoplectenchymatous, 10–15 μm high, colorless to pale yellowish; hymenium 50–60 μm high, colorless, clear; epithecium granulose, 5–10 μm high, gray-brown. Paraphyses unbranched; asci fusiform to clavate, 45–55 \times 10–12 μm . Ascospores 8 per ascus, oblong, transversely 3-septate, 13–18 \times 5–7 μm , 2–3 times as long as wide, colorless, I+ vine-red to red-purple. Secondary chemistry: stictic acid (major), constictic acid (trace), thallus section with K⁺ yellow efflux under the microscope.

Type.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, K2 trail among royal palms, second growth area, Apr 1997, *Common* 7367C (MSC, holotype; hb. Common, isotype).

Etymology.—The name refers to the delicate lirellae.

Distribution and Ecology.—Known from three collections from Fakahatchee Strand Preserve State Park, all on branches of hardwood.

Remarks.—The clear hymenium, aggregate-stellate lirellae, and small ascospores indicate this new species to belong in the *Phaeographis intricans* aggregate (Staiger 2002). Most species in this aggregate have norstictic acid; thus far only one species, *Phaeographis flavescens*, is known with stictic acid (Dal Forno & Eliasaro 2010). The latter has more robust, distinctly pruinose lirellae and larger, usually 5-septate ascospores.

Additional Specimens Examined.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, K2 trail among royal palms, second growth area, Apr 1997, *Common* 7355J (hb. Common), 7381D (hb. Common).

***Tapellaria floridensis* Common & Lücking, new species**

Figure 56C

Mycobank #560011

Diagnosis.—Sicut *Tapellaria malmei* sed apotheciis marginibus pruinosis et ascosporis minoribus differt.

Description.—Thallus corticolous, 1–2 cm diam., 30–50 µm thick, continuous; surface uneven, white to pale gray. Photobiont chlorococcoid. Apothecia sessile, rounded, 0.3–0.7 mm diam. and 170–270 µm high; disc at first concave, eventually plane to slightly convex in old apothecia, black; margin thick, prominent, evanescent in old apothecia, thickly gray-pruinose especially in younger apothecia. Excipulum paraplectenchymatous, 30–50 µm broad, dark purplish-brown. Hypothecium 30–60 µm high, dark purplish brown, K+ purplish. Apothecial base dark purplish brown. Epithecium 10–15 µm high, blackish brown. Hymenium 100–120 µm high, colorless or light purplish in upper parts. Paraphyses branched and anastomosing. Asci 90–110 × 18–25 µm. Ascospores 4–8 per ascus, ellipsoid, muriform with 3–5 transverse and 0–2 longitudinal septa per segment, 20–25 × 9–12 µm, 2–2.5 times as long as broad, colorless. Campylidia sessile, 0.4–0.5 mm broad, 0.6–0.8 mm long; lobe well-developed, hood-shaped, black; base not thickened. Conidia filiform, curved, 7–13-septate, 80–90 × 2–2.5 µm. Secondary chemistry: no substances detected by TLC.

Type.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Scenic Drive (CR 837) just past bend near gate 14, second growth, Apr 1997, *Common* 7322A (MSC, holotype, USF, hb. Common, isotypes).

Etymology.—Refers to the state of Florida.

Distribution and Ecology.—This species is known from two, well-developed collections from Fakahatchee Strand Preserve State Park, growing on branches and trunks of hardwood.

Remarks.—*Tapellaria* is a chiefly foliicolous genus characterized by lecideine apothecia, *Byssoloma*-type asci, anastomosing, net-like paraphyses, thin-walled, transversely septate to muriform ascospores, and campylidioid

conidiomata producing filiform, multiseptate conidia (Lücking 2008). The species are distinguished chiefly by their ascospore septation and size and the absence or presence of pruina on the apothecial margin. Thus far, only one species, *Tapellaria malmei*, was known to produce small, muriform ascospores in numbers of 4–8 per ascus (Lücking 2008). *Tapellaria floridensis* species agrees with *T. malmei* in ascospore type, but the young apothecia are epruinose in *T. malmei* and thickly gray-pruinose in the new species; in addition, the ascospores are larger in *T. malmei* (25–35 × 14–20 µm).

Additional Specimen examined.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Scenic Drive (CR 837) just past bend near gate 14, second growth, Apr 1997, *Common* 7315D (hb. Common).

***Tapellaria granulosa* Lücking & Rivas Plata, new species**

Figure 56D

Mycobank #560012

Diagnosis.—Sicut *Tapellaria malmei* sed thallo granuloso differt.

Description.—Thallus corticolous, 2–5 cm diam., 30–50 µm thick, continuous; surface finely and densely granulate-isidiate, pale green; granules ('isidia') formed by agglomerated algal cells wrapped in fungal hyphae. Photobiont chlorococcoid. Apothecia sessile, rounded to irregular in outline, 0.5–1 mm diam. and 180–270 µm high; disc plane becoming convex, black to brownish black; margin thin but distinct, not prominent, persistent, black. Excipulum paraplectenchymatous, 30–50 µm broad, gray-brown. Hypothecium 50–100 µm high, dark purplish brown, K+ purplish. Apothecial base dark purplish brown. Epithecium 10–20 µm high, blackish brown. Hymenium 100–130 µm high, colorless or light purplish in upper parts. Paraphyses branched and anastomosing. Asci 90–120 × 18–28 µm. Ascospores 4–8 per ascus, ellipsoid, muriform with 3–5 transverse and 1–2 longitudinal septa per segment, 20–25 × 10–15 µm, 1.8–2 times as long as broad, colorless. Campylidia sessile, 0.4–0.6

mm broad, 0.7–1 mm long; lobe well-developed, hood-shaped, dark gray to black with white-gray base; base not thickened. Conidia filiform, curved, 5–7-septate, $40\text{--}50 \times 2 \mu\text{m}$. Secondary chemistry: no substances detected by TLC.

Type.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Janes Scenic Drive 1.8 mi NNW of ranger station, *Taxodium-Sabal* hardwood prairie hammock, March 2009, *Lücking & Rivas Plata 26810* (F, holotype; USF, isotype).

Etymology.—The epithet refers to the finely and densely granulose thallus, an unusual feature in the genus *Tapellaria*.

Distribution and Ecology.—This species is known from two well-developed collections from Fakahatchee Strand Preserve State Park, growing on *Taxodium* bark.

Remarks.—This is a second new species related to *Tapellaria malmeyi*, which is also found at the type locality. Like the preceding species, *Tapellaria granulosa* shares with *T. malmeyi* the small, muriform, broadly ellipsoid ascospores occurring in numbers of 4–8 per ascus. However, the finely and densely granulose-isidiate thallus differs from all *Tapellaria* species known to date. It is unlikely that these granules serve as isidia; rather they should be interpreted as increasing the thallus surface. A similar interspecific variation in thallus surface structure is known from the related genus *Lasioloma* (Lücking & Sérusiaux 2001).

Additional Specimen Examined.—U.S.A. Florida. Collier Co.: Fakahatchee Strand Preserve State Park, Janes Scenic Drive 1.8 mi NNW of ranger station, *Taxodium-Sabal* hardwood prairie hammock, March 2009, *Lay 09-0013* (hb. Lay), *Lücking & Rivas Plata 26697* (F), *Mercado-Díaz 394* (UPR).

ANNOTATED CHECKLIST OF LICHEN SPECIES FROM FAKAHATCHEE STRAND PRESERVE STATE PARK

In the following list, genera and species are listed in alphabetical order. Brief taxonomic and nomenclatural annotations are given for selected taxa. Selected and representative specimens are

cited for each taxon in parentheses after the species name. Herbaria are not indicated in the list but are as follows: DUKE (B. P. Hodkinson), F (R. Lücking & E. Rivas Plata, M. P. Nelsen), FTU (W. Safranek), ILLS (L. Crane), LI (O. Breuss), MSC (R. Common, types and new records for United States), NY (S. Q. Beeching p.p., W. R. Buck, R. C. Harris, J. C. Lendemer), OAC (T. McMullin), UPR (J. A. Mercado-Díaz), and the private herbaria of S. Q. Beeching, R. Common, M. Hodges, E. Lay, W. B. Sanders, H. P. Schaefer, and R. & J. Seavey. Where the material allowed, selected duplicate specimens are deposited at the University of Southern Florida in Tampa (USF); these are marked with an asterisk (*) after the collection number. Most crustose species are illustrated by color photographs in a series of plates in the supplemental online appendix (Figs 4–58; <http://www.flmnh.ufl.edu/bulletin/vol49no4supplmats.htm>); for a few taxa for which the Fakahatchee material did not allow to produce good images, we replaced these by images taken from specimens from other regions. For selected genera that are either not treated in detail in Harris (1990, 1995) or more recent publications (Ekman 1996; Staiger & Kalb 1999; Marbach 2000; Lücking et al. 2007; Lendemer et al. 2009; Seavey 2009; Seavey & Seavey 2009; Tripp et al. 2010) or for which many new records are cited, we provide brief keytables that summarize the characters of each species and allow their identification and differentiation. In these keytables, species are arranged in taxonomic order by column characters from left to right; to key out a species, one would therefore start with the first column and then use subsequent columns to narrow down the identification. Species new to the North American lichen checklist are marked with an asterisk (*) before the species name; some of these have already been known to occur in North America but have either not been reported in the literature or not yet added to the checklist. Species newly reported to the New World are preceded by two asterisks (**) and new species (described above or in separate papers) with three asterisks (***) .

Acanthothecis peplophora (M. Wirth & Hale)
E. A. Tripp & Lendemer—Figure 4A–B

(Beeching 7582, Common 7323G, Crane ILLS 60431, Lay 09-0038, Lendemer 15673, Lücking & Rivas Plata 26500*, 26503*, Mercado-Díaz 406, Seavey & Seavey 11007*). Material from Florida was sequenced and clusters with *Graphina* aff. *peplophora* from Cuba (Staiger et al. 2006; Rivas Plata et al., unpubl. data). Thus far, no other species of *Acanthothecis* have been sequenced, but based on the available data, the genus is distinct from other lirellate Graphidaceae and unrelated to *Fissurina* and instead close to *Carbacanthographis*.

***Acanthothecis poitaeoides* (Nyl. ex Tuck.) E. A. Tripp & Lendemer**—Figure 4C (Seavey & Seavey 10843). Species of *Acanthothecis* are recognized by their non-carbonized lirellae, warty paraphysis tips and usually non-amyloid ascospores. A taxonomic treatment of North American species is given by Tripp et al. (2010).

***Actinoplaca* spec.**—Figure 4D (Sanders 10504.1, 10504.6). This material represents an undescribed foliicolous species most probably belonging in *Actinoplaca* (Lücking 2008). It produces abundant, very shortly stalked hyphophores that carry a rounded mass of agglutinated diahyphae interspersed with algal cells. No apothecia were found in the material.

****Amandinea endachroa* (Malme) Marbach**—Figure 4E (Breuss 28936*). Species of *Amandinea* are treated in Marbach (2000). The genus is probably heterogeneous and needs a revision using molecular methods.

***Amandinea punctata* (Hoffm.) Coppins & Scheid.**—Figure 4F (Seavey & Seavey 10712*).

***Anisomeridium ambiguum* (Zahlbr.) R. C. Harris**—(Harris & Buck s.n.).

***Anisomeridium aureopunctatum* R. C. Harris**—(Buck 54428). Harris (1995) provided a key to *Anisomeridium* species, both for Florida and world-wide.

***Anisomeridium phaeospermum* R. C. Harris**—(Lendemer 15538).

****Anisomeridium subnexum* (Nyl.) R. C. Harris**—Figure 4G (Lücking & Rivas Plata 26616).

***Anisomeridium subprostans* (Nyl.) R. C. Harris**—Figure 4H (Beeching 7706, Seavey & Seavey 10700).

***Anisomeridium terminatum* (Nyl.) R. C. Harris**—(Lendemer 15516).

***Anisomeridium* spec.**—Figure 5A (Lücking & Rivas Plata 26598*, 26614). The material agrees with *Harris* 29392A in Harris (1995) and probably represents an undescribed species. Unfortunately the material is not abundant enough for a formal description.

***Anthracotheceum nanum* (Zahlbr.) R. C. Harris**—(Harris & Buck s.n.). Species of *Anthracotheceum* are treated in Harris (1995).

***Anthracotheceum prasinum* (Eschw.) R. C. Harris**—Figure 5B–D (Beeching 7583, Lay 09-0036, Lücking & Rivas Plata 26591*, 26595*, Mercado-Díaz 389, Nelsen 4095, Seavey & Seavey 10602).

****Arthonia antillarum* (Fée) Nyl.**—Figure 5E–F (Common 7327E, Mercado-Díaz 449). The genus *Arthonia* is not well-understood and the present study revealed several additions to the North American lichen checklist; some of these are widespread in the coastal plain but have not yet been reported in the literature. The taxonomy of the species found here is summarized in Table 2. Compare also *Coniarthonia*.

***Arthonia cinnabarina* (DC.) Wallr.**—Figure 5G–H (Common 7421C, Crane ILLS 60432, Seavey & Seavey 10611*). As pointed out by Grube (2007), this is a difficult species complex with variation in ascomata morphology and ascospore size and septation. In our material, *Common* 7421C has few marginal pruina and the ascospores are mostly 4-septate and 20–25 × 6–8 µm.

***Arthonia complanata* Fée**—Figure 6A (Lay 09-0041, Seavey & Seavey 10542).

***Arthonia ilicina* Taylor**—Figure 6B (Mercado-Díaz 410). The material fits well with the description given in Grube (2007), particularly the apothecia being first immersed and covered with remnants of bark tissue resembling a

Table 2. Simplified keytable to identify species of *Arthonia* cited in this work (only lichenized species included). Septa = number of ascospore septa: muri = muriform; Shape = ascospore shape: iso = isolocular (cells \pm equal or middle cell sometimes slightly enlarged), macro = macrocephalic (upper and sometimes also lower end cell enlarged), submacro = submacrocephalic (second upper cell enlarged); Ascomata = shape of ascomata: irreg = irregular; Color = color of ascomata; Pruina = pruinose cover of ascomata; Emergence = emergence of ascomata; Chemistry = secondary thallus chemistry (not including ascomata pigments): lichexan = lichexanthone, psor = psoromic acid; Other = other characters: inspersed = inspersed hymenium, K+ pigments = crystallized pigments present in excipulum, epithecium and/or hymenium, segmented = lirellae divided into segments; Size = ascospore size in μm (typical upper range for length and size; the typical lower range is about 30% less). Detailed hymenial and ascus reactions with iodine solution are not given for lack of space (consulting specialized literature for *Arthonia* species is highly recommended; e.g. Grube 2007).

Species of <i>Arthonia</i>	Septa	Shape	Ascomata	Color	Pruina	Emergence	Chemistry	Other	Size
<i>A. antillarum</i>	3	submacro	irreg-lirellate	pale	—	adnate	lichexan	—	18 \times 5
<i>A. aff. pruinata</i>	3	submacro	rounded-irreg	pale	pruinose	erumpent	—	—	28 \times 10
<i>A. redingeri</i>	3	macro	irreg-lirellate	cinnabar	pruinose	erumpent	—	K+ pigment	18 \times 6
<i>A. rubrocincta</i>	3–4	macro	irreg-lirellate	cinnabar	pruinose	erumpent	psor	K+ pigment	22 \times 6
<i>A. cinnabarina</i>	4–7	macro	irreg	cinnabar	pruinose	erumpent	—	K+ pigment	28 \times 8
<i>A. speciosa</i>	4	macro	lirellate	brown-orange	—	erumpent	—	K+ pigment	20 \times 8
<i>A. wilmsiana</i>	3	submacro	irreg	dark red	—	adnate	—	K+ pigment	25 \times 12
<i>A. pyrrhuliza</i>	3–4	macro	lirellate	brown	—	adnate	—	segmented	18 \times 6
<i>A. rubella</i>	4–7	macro	lirellate-stellate	brown	—	adnate	—	—	30 \times 12
<i>A. pruinoseella</i>	3	submacro	irreg	black	pruinose	adnate	—	—	15 \times 5
<i>A. simplicascens</i>	5–7	submacro	irreg-lirellate	black	—	adnate	—	—	15 \times 6
<i>A. complanata</i>	5	macro	rounded-irreg	black	—	adnate	—	—	25 \times 8
<i>A. ilicina</i>	5–7	macro	rounded-irreg	brown-black	bark tissue	erumpent	—	—	35 \times 12
<i>A. platygraphidea</i>	11–17	\pm iso	rounded-irreg	black	—	adnate	—	—	70 \times 20
<i>A. cyrtodes</i>	11–13	\pm iso	rounded-irreg	black	—	adnate	—	inspersed	60 \times 15
<i>A. interveniens</i>	muri	\pm iso	rounded-irreg	black	—	adnate	—	—	30 \times 10
<i>A. macrotheca</i>	muri	iso	rounded-irreg	black	—	adnate	—	inspersed	70 \times 30
<i>A. mesoleuca</i>	muri	iso	rounded-irreg	black	—	adnate	—	K+ pigment	50 \times 20
<i>A. mirabilis</i>	muri	iso	irreg-lirellate	brown-black	—	adnate	—	K+ pigment	55 \times 20

coarse pruina and later becoming erumpent to almost sessile and *Arthothelium*-like.

*****Arthonia interveniens* Nyl.**—Figure 6C–D (*Common* 7303A, 7382A).

***Arthonia macrotheca* Fée**—Figure 6E–F (*Beeching* 7597, *Lendemer* 15515, *Seavey & Seavey* 10167*).

***Arthonia mesoleuca* Nyl.**—(*Lendemer* 15544). The description for the North American material of this species in Lendemer et al. (2009b) is reminiscent of another, recently described species, *A. mirabilis* Grube, which was also identified from Fakahatchee material. The main difference is in ascospore size (less than 50 μm long in *A. mesoleuca* versus more than 50 μm long in *A. mirabilis*) and the often more lirellate ascomata in *A. mirabilis*; however, it is possible that both are conspecific, in which case *A. mesoleuca* would be the older name.

***Arthonia mirabilis* Grube**—Figure 6G–H (*Common* 7265).

“*Arthonia*” *montagnei* (Tuck.) R. C. Harris—(*Buck* 54466). This name is here applied to a species that apparently belongs in the genus *Cryptothecia* (and therefore not included in Table 2), with 8-spored asci and 2-*O*-methylperlatolic and confluent acids. This taxon has been confused with the recently described *Cryptothecia evergladensis* (Seavey 2009), which also has 8-spored asci but smaller ascospores and contains psoromic acid and lichexanthone. The name *Chiodecton montagnei* Tuck. (Tuckerman 1872) is apparently based on material that Montagne (1842) first identified as atypical *Chiodecton lacteum* Fée, based on an Auber collection from Cuba. We have not yet seen that material and in the light of the chemical diversity of *Cryptothecia* species, it is possible that the Auber material is not conspecific with the taxon from southeastern North America named here *Arthonia montagnei*, in which case a new species name would be required. For this reason, we have refrained at this time from simply transferring *Arthonia montagnei*

to *Cryptothecia*.

***Arthonia* aff. *pinastri* Anzi**—Figure 7A (*Lay* 09-0042A). We have not yet found a definite name for this taxon which has macrocephalic, 3-septate ascospores about $15 \times 5 \mu\text{m}$ in size and abundant pycnidia and appears to be related to the bulk of foliicolous taxa (Lücking 2008). The material fits *A. pinastri* in most details, including the abundant pycnidia (Grube 2007), except that it is lichenized.

***Arthonia platygraphidea* Nyl.**—Figure 7B (*Lücking & Rivas Plata* 26583*, 26584*, *Seavey & Seavey* 10584).

***Arthonia* aff. *pruinata* (Pers.) Steud. ex A. L. Sm.**—Figure 7C–D (*Common* 7372A). This material deviates from typical *A. pruinata* (Grube 2007) by its larger ascospores (24–30 μm).

***Arthonia pruinosa* Nyl.**—Figure 7E–F (*Common* 7327A).

***Arthonia pyrroliza* (Fée) Nyl.**—Figure 7G–H (*Lay* 09-0017A, *Mercado-Díaz* 438b).

***Arthonia redingeri* Grube**—Figure 8A–B (*Common* 7259U).

***Arthonia rubella* (Fée) Nyl.**—Figure 8C (*Lücking & Rivas Plata* 26586*).

***Arthonia rubrocincta* G. Merr. ex Grube & Lendemer**—Figure 8D (*Buck* 54444, *Lay* 09-0042B, *Lendemer* 15611, *Lücking & Rivas Plata* 26582*, *Nelsen* 4010, *Seavey & Seavey* 11001). This name was recently validated (Grube & Lendemer 2009).

*****Arthonia simplicascens* Nyl.**—Figure 8E–F (*Common* 7291D). We apply this name as it fits the type specimen from Sri Lanka rather well in ascomata morphology and anatomy and ascospore type. However, it is likely that there are additional names available for this relatively non-descript taxon.

***Arthonia speciosa* (Müll. Arg.) Grube**—Figure 8G–H (*Common* 7291I, *Lücking & Rivas Plata* 26622).

Arthonia spec.—(*Lay* 09-0191). This is an unnamed, yet characteristic taxon. The ascomata are black, rather plane, and irregular in shape; the hamathecium is slightly interspersed with oil

droplets and reacts K– (no crystalline pigments present); ascospores are muriform, about $35\text{--}40 \times 10\text{--}15\text{ }\mu\text{m}$ in size and become brown when mature. *Arthonia macrothecia* is most similar but has much larger, hyaline ascospores. The African *A. bessalis* Nyl. also resembles this material but its ascospores are persistently hyaline and have an enlarged distal cell.

***Arthopyrenia cinchonae* (Ach.) Müll. Arg.**—Figure 9A (*Lendemer 15615A*). Species of *Arthopyrenia* are keyed out in Harris (1975, 1995).

***Arthopyrenia lyrata* R. C. Harris**—Figure 9B (*Harris & Buck s.n.*).

***Arthopyrenia planorbis* (Ach.) Müll. Arg.**—Figure 9C (*Seavey & Seavey 10165*).

***Arthopyrenia* aff. *planorbis* (Ach.) Müll. Arg.**—Figure 9D (*Lücking & Rivas Plata 26787b*). This material agrees with *A. planorbis* in ascospore type but has consistently excentric (lateral) ostioles. We have not found a name for this taxon but refrain from describing it as new, since the genus is in further need of revision and possible epithets might be hidden among other generic names.

***Arthothelium spectabile* A. Massal.**—Figure 9E (*Breuss 28770**, *Lücking & Rivas Plata 26576**, *26581*). This species strongly resembles an *Arthonia* with muriform ascospores, but differs in the strongly compacted, stromatic structure of the hymenium in which the asci are formed in locules and surrounded by a delicate network of anastomosing paraphysoids. The entire hymenium in the present material appears interspersed.

***Arthothelium* spec.**—(*Lücking & Rivas Plata 26500*). The scanty material does not fit any of the described species in the genus.

****Aspidothelium cinerascens* Vain.**—Figure 9F (*Harris & Buck s.n.*). For key to species of *Aspidothelium*, see Lücking (2008).

****Aspidothelium geminiparum* (Malme) R. Sant.**—Figure 9G (*Lendemer 26576*, *Lücking & Rivas Plata 26600c*).

****Aspidothelium scutellarpum* Lücking**—Figure 9H (*Breuss 28787**).

***Astrothelium confusum* Müll. Arg.**—Figure 10A (*Lücking & Rivas Plata 26691*, *Seavey & Seavey 10187*). This genus is treated in Harris (1995). Molecular data suggest that the genus concept is artificial and most probably Harris' (1995) idea of including the bulk of species of *Astrothelium*, *Campylothelium*, *Cryptothelium*, *Laurera*, and *Trypethelium* within a single genus *Laurera* (or *Bathelium*) is correct (Nelsen et al. 2009). In addition, the species concept in the *Astrothelium variolosum* / *Trypethelium nitidiusculum* aggregate needs revision. We do not agree with Harris (1995) that species with either fused or separate ostioles should be lumped, as there are substantial differences in other morphological features as well. In addition, hymenial inspersion has not yet been explored as a taxonomic character in this complex, even if its use is accepted for other genera.

****Astrothelium diplocarpoides* Müll. Arg.**—Figure 10B (*Lücking & Rivas Plata 26627**, *26630**). This species is quite distinctive due to its very large ascospores ($70\text{--}85 \times 17\text{--}22\text{ }\mu\text{m}$) which, however, have only 5–7 septa with distinctly diamond-shaped lumina, thus looking like gigantic ascospores of the *Trypethelium*-type. The thallus and especially the perithecial warts, which contain 3–6 aggregate perithecia with fused ostioles, are UV+ golden-yellow (lichexanthone). The species was described from Cuba (Müller Argoviensis 1885), so its presence in Florida is not a surprise.

***Astrothelium diplocarpum* Nyl.**—Figure 10C (*Beeching 7626*, *Buck 54444*, *Lay 09-0044*, *Nelsen 4012*, *Seavey & Seavey 10087*).

***Astrothelium galbineum* Kremp.**—Figure 10D (*Crane ILLS 60455*, *Lücking & Rivas Plata 26596*, *Nelsen 4013*).

***Astrothelium variolosum* Müll. Arg.**—Figure 10E–F (*Beeching 7640*, *Breuss 28962**, *Lay 09-0128*, *Lücking & Rivas Plata 26691**, *26771**, *Nelsen 4085*, *Seavey & Seavey 10092*). This taxon is supposed to have a clear hymenium, but Harris (1995) also included specimens with interspersed hymenia. We found one collection with an interspersed hymenium

(Breuss 28964) and suspect that this represents a separate taxon, but no name appears to be available for this form.

***Aulaxina microphana* (Vain.) R. Sant.**—Figure 10G (Sanders 10521.1). Lücking (2008) provided a key to species of *Aulaxina*.

***Aulaxina quadrangula* (Stirt.) R. Sant.**—Figure 10H (Sanders 10521.7).

***Bacidia aggregatula* Malme.**—Figure 11A (Seavey & Seavey 10095*). Species of *Bacidia* can be identified using Ekman (2006).

***Bacidia campalea* (Tuck.) S. Ekman & Kalb**—Figure 11B (Breuss 28735*, 28829*, Seavey & Seavey 10045).

***Bacidia heterochroa* (Müll. Arg.) Zahlbr.**—Figure 11C (Lay 09-0046, Lücking & Rivas Plata 26621*, Seavey & Seavey 10234).

***Bacidia* aff. *heterochroa* (Müll. Arg.) Zahlbr.**—Figure 11D (Lücking & Rivas Plata 26610). This material differs from *Bacidia heterochroa* in the gray-black apothecia with flat disc and gray margin.

***Bacidia hostheleoides* (Nyl.) Zahlbr.**—Figure 11E (Lücking & Rivas Plata 26605, 26606, 26607*, 26608, 26609).

***Bacidia* aff. *hostheleoides* (Nyl.) Zahlbr.**—Figure 11F (Lücking & Rivas Plata 26600b). This material keys to *B. hostheleoides* in Ekman (1996) but differs in the dark apothecia without orange tinge and the persistent margin.

***Bacidia medialis* (Tuck.) Zahlbr.**—Figure 11G (Buck 54433, Lücking & Rivas Plata 26601*, 26603*, Mercado-Díaz 433).

***Bacidia* aff. *medialis* (Tuck.) Zahlbr.**—Figure 11H (Lücking & Rivas Plata 26606). This material resembles *Bacidia medialis* but has darker apothecia and the internal parts (excipulum) have an orange, K+ purple band. The material is also similar to *B. hostheleoides* in which the excipulum is pale orange and not K+ purple.

***Bacidia mutabilis* Malme.**—Figure 12A (Lücking & Rivas Plata 26603, 26604*, Seavey & Seavey 10129).

***Bacidia russeola* (Kremp.) Zahlbr.**—Figure 12B (Breuss 28828*, Lay 09-0019, Mercado-Díaz 460).

***Bacidia schweinitzii* (Fr. ex E. Michener) A. Schneid.**—Figure 12C (Seavey 13331*).

***Bacidia* aff. *schweinitzii* (Fr. ex E. Michener) A. Schneid.**—Figure 12D (Lücking & Rivas Plata 26602a). This material covers the taxon with brown apothecia and brown epithecium included by Ekman (1996) in *Bacidia schweinitzii*. In our view, this is a taxon separate from *B. schweinitzii* s.str. with black apothecia and red-black hypothecium, but there appears to be no alternative name available. The type material of all synonyms cited under *B. schweinitzii* by Ekman (1996) seem to represent the typical form with black apothecia. We have refrained from formally describing the taxon with brown apothecia since our material is moderately developed and segregating this taxon requires restudy of the many specimens cited by Ekman (1996).

***Bacidia* spec. 1**—Figure 12E (Lücking & Rivas Plata 26611). This material does not key to any species in Ekman (1996). The apothecia are large, brown and irregular in outline, with an orange excipulum and hypothecium. The ascospores are 40–50 × 4–5 µm and thus unusually broad, with 5–11 septa. Most similar in ascospore type are *B. insularis* Zahlbr. and *B. subincompta* (Nyl.) Arnold, which have black apothecia with different apothecial pigments internally (Ekman 1996).

***Bacidia* spec. 2**—(Lay 09-0213). The taxonomic status of this material is unclear. The granular, green thallus and the more or less emarginate, turbinate to convex, dark gray-brown apothecia, together with the 3-septate ascospores, suggest a species of *Biatora* or *Mycobilimbia*, but none of these two genera includes anything similar. *Biatora tetramera* (De Not.) Coppins agrees in general morphology but has larger ascospores. Since the ascospores of the present material are rather narrow (to 13 × 2.5 µm) and the excipulum consists of parallel hyphae, *Bacidia* is a likely home, but no matching species was found in the key provided by Ekman (1996).

***Bacidina varia* S. Ekman**—Figure 12F (Lay 09-0004).

- Bactrospora denticulata* (Vain.) Egea & Torrente**—Figure 12G (Lücking & Rivas Plata 26737b, Seavey & Seavey 10325). The two species of *Bactrospora* found at Fakahatchee are characterized by cylindrical ascospores lacking constrictions and a K/I–, rather thick excipulum (Egea and Torrente 1993). *Bactrospora denticulata* has a denticulate apothecial margin and ascospores to 130 µm long, whereas *B. myriadea* has a smooth margin and ascospores less than 100 µm long.
- Bactrospora myriadea* (Fée) Egea & Torrente**—Figure 12H (Buck 54426, Lay 09-0045, 09-0212, Seavey & Seavey 10326).
- Baculifera curtisii* (Tuck.) Marbach**—Figure 13A (Seavey & Seavey 10432). Marbach (2000) provided a key to *Baculifera* species.
- Baculifera imshaugiana* (R. C. Harris) Marbach**—Figure 13B (Breuss 28890*).
- Bathelium carolinianum* (Tuck.) R. C. Harris**—Figure 13C (Lücking & Rivas Plata 26617, Nelsen 4149). Species of *Bathelium* are treated in Harris (1995).
- Bathelium madrepuriforme* (Eschw.) Trevis.**—Figure 13D (Lay 09-0047).
- Brigantiaea leucoxantha* (Spreng.) R. Sant. & Hafellner**—Figure 13E (Breuss 28981*, Hodgkinson 10553, Nelsen 4079).
- Buellia stillingiana* J. Steiner**—(Beeching 7615).
- **Byssoloma chlorinum* (Vain.) Zahlbr.**—Figure 13F (Nelsen 4078, Safranek 135). Lücking (2008) provided a key to neotropical *Byssoloma* species including those found in Florida.
- Byssoloma leucoblepharum* (Nyl.) Vain.**—Figure 13G (Lücking & Rivas Plata 26692*, Seavey & Seavey 10246).
- Byssoloma meadii* (Tuck.) S. Ekman**—Figure 13H (Buck 54387, Lay 09-0172, Lendemer 15572, Lücking & Rivas Plata 26693, Seavey & Seavey 10054).
- Byssoloma subdiscordans* (Nyl.) P. James**—(Safranek 131).
- Calicium hyperelloides* Nyl.**—Figure 14A–B (Harris & Buck s.n.).
- **Calopadia editae* Vězda ex Chaves & Lücking**—Figure 14C (Common 7322B). This recently described species (Lumbsch et al. 2011) is closely related to *C. fusca* but differs in the heavily pruinose apothecia. In contrast to *Calopadia floridana*, the apothecia disc is orange-brown and the pruina yellowish, and also the apothecial margins are pruinose.
- ****Calopadia floridana* Hodges & Lücking**—Figure 14D–G (Hodges s.n.). See p. 138 for description of this new species. The species of *Calopadia* currently known from Florida are summarized in Table 3.
- Calopadia fusca* (Müll. Arg.) Vězda**—Figure 14H (Lay 09-0186, Safranek 72, 73, Seavey & Seavey 10365*).
- ****Calopadia imshaugii* Common & Lücking**—Figure 15A–F (Common 7322F). See p. 139 for description of this new species.
- **Calopadia lecanorella* (Nyl.) Kalb & Vězda**—Figure 15G–H (Lay 09-0219, Lücking & Rivas Plata 26696, Nelsen 4071).
- **Calopadia perpallida* (Nyl.) Vězda**—Figure 16A (Nelsen 4072a).

Table 3. Simplified keytable to identify species of *Calopadia* cited in this work. Ascospore length in µm.

Species of <i>Calopadia</i>	Disc color	Pruina	Hypothecium color	Ascospore number	Ascospore length
<i>C. imshaugii</i>	orange-brown	white-gray	brown	(1–)2(–3)/ascus	50–80
<i>C. perpallida</i>	orange-brown	yellowish	light brown	single	80–110
<i>C. editae</i>	orange-brown	yellowish	light brown	single	50–80
<i>C. floridana</i>	gray-brown	white-gray	dark brown	single	70–80
<i>C. fusca</i>	orange-brown	—	light brown	single	60–85
<i>C. puiggarii</i>	gray-brown	—	dark brown	single	55–85
<i>C. lecanorella</i>	black	—	dark brown	single	60–80
<i>C. subcoerulescens</i>	black	—	aeruginous	single	55–85

***Calopadia puiggarii* (Müll. Arg.) Vězda**—Figure 16B (*Beeching* 7659, *Crane* ILLS 60444, *Lay* 09-0005, *Lendemer* 15616, *Lücking & Rivas Plata* 26695*, 26695, *Safranek* 76, 81, *Seavey & Seavey* 10367).

****Calopadia subcoerulescens* (Zahlbr.) Vězda**—Figure 16C (*Buck* 54382).

***Calopadia* spec.**—(*Common* 7399D). This material bears only campylidia and cannot be identified to species level but is distinctive due to its conspicuously verrucose thallus, a feature uncommon in *Calopadia* and the related genus *Tapellaria*. The campilidioconidia associate with photobiont cells, a feature more commonly observed in the genus *Tapellaria* (Lücking 2008).

***Caloplaca camptidia* (Tuck.) Zahlbr.**—Figure 16D (*Lücking & Rivas Plata* 26568b). This is one of the brown *Caloplaca* species, characterized by the pruinose apothecia resembling those of a *Gyalideopsis* (Wetmore 1994).

***Caloplaca epiphora* (Taylor) C. W. Dodge**—Figure 16E (*Beeching* 7688, *Buck* 54398, *Common* 7310, *Lay* 09-0052, *Lendemer* 15576, *Seavey & Seavey* 10543*). This species is characterized by the orange and densely isidate thallus.

***Caloplaca holocarpa* (Hoffm.) A. E. Wade**—Figure 16F (*Lücking & Rivas Plata* 26698). This material features mostly deformed apothecia with brownish color, but some apothecia with orange color and flat discs are present corresponding to those typically found in this species.

***Canoparmelia cryptochlorophaea* (Hale) Elix & Hale**—(*Beeching* 7612, *Mercado-Díaz* 409, *Seavey & Seavey* 10056).

***Canoparmelia salicinifera* (Hale) Elix & Hale**—(*Harris & Buck* s.n.).

***Catillochroma endochroma* (Fée) Kalb**—Figure 16G (*Beeching* s.n.*). This material was first believed to represent a new species in *Malcolmiella*, since the ascospores appeared to lack septa. However, some 1-septate ascospores were eventually found, and the apothecial anatomy, with the outer excipulum consisting of radiating cell rows, the inner excipulum being

of medullary structure, and the hypothecium being pale, as well as the aeruginous epithecium, characterize the material as *Catillochroma* (Kalb 2007). Species of *Malcolmiella* can be remarkably similar in appearance, especially as *Malcolmiella granifera* and related taxa also have a medullary excipulum, but apart from the non-septate ascospores, these species differ in the outer paraplectenchymatous excipulum and the brown-black hypothecium. *Catillochroma* and *Lopezaria* have been synonymized with *Megalaria* (Fryday & Lendemer 2010). We do agree that the limits between the three genera are not clearcut but differences between the type species, including in ascus structure, exist. Unfortunately, no sequence data are available for *Catillochroma*; analysis of the available sequences of the large subunit of the nuclear ribosomal DNA (nuLSU) of one specimen of *Megalaria grossa* and two specimens of *Lopezaria versicolor* (Lücking, unpubl. data) show that both are in the same clade within Ramalinaceae, but on very long branches each, which supports a close relationship but not congenerity, considering that nuLSU is a relatively conserved gene partition and hence species within the same genus are expected to appear on short branches. Therefore, we maintain the genera separate pending further studies. The overlap of anatomical and chemical features between species assigned to the different genera documented by Fryday & Lendemer (2010) is not necessarily evidence to merge them, since phylogenetic studies show that genetically distinctive clades can evolve similar phenotypic characters in parallel (Rivas Plata et al. 2011).

***Celothelium aciculiferum* (Nyl.) Vain.**—Figure 16H (*Common* 7396D, *Lay* 09-0194).

***Chaenotheca brunneola* (Ach.) Müll. Arg.**—Figure 17A (*Beeching* 7613, *Buck* 54451, *Lay* 09-0049, *Lendemer* 15630, *Seavey & Seavey* 10058*).

***Chaenotheca floridana* R. C. Harris**—(*Beeching* 7663, *Crane* ILLS 60436, *Seavey & Seavey* 10435*).

****Chapsa chionostoma* (Nyl.) Rivas Plata &**

Mangold—Figure 17B (*Common* 7321A). The material agrees perfectly with the type of this species in the morphology of the thallus and apothecia, which are somewhat intermediate between *Chapsa* and *Thelotrema*, as well as the brown excipulum and hardly discernable periphysoids. The ascospores are, however, larger than in the type and material from Costa Rica (25–30 μm versus 15–20 μm) and with more numerous septa (9–13 versus 5–9). Since only few specimens are known, we refrain from considering the Florida material a separate taxon, until the variational amplitude of the Florida populations has been established in comparison with the material from Costa Rica and Panama (Hale 1978).

***Chapsa platycarpa* (Tuck.) A. Frisch**—Figure 17C (*Beeching* 7691, *Lay* 09-0053, *Lendemer* 15646, *Lücking & Rivas Plata* 26573*, 26574*, *Seavey & Seavey* 10394*). This species is commonly found on the thin trunks and branches of swamp dogwood.

****Chapsa platycarpoides* (Tuck.) Breuss & Lücking**—Figure 17D (*Breuss* 28665*, *Lücking & Rivas Plata* 26571*). See p. 140 for new combination and discussion.

*****Chapsa subpatens* (Hale) Mangold**—(*Common* 7400A). The material fits the type from Sri Lanka well in the endoperidermal, pale thallus, the irregular apothecia, the amyloid ascospores with rather thin septa, and the lack of secondary substances. Previously known from Sri Lanka and Australia (Hale 1981; Mangold et al. 2009); new for the New World.

***Chrysothrix xanthina* (Vain.) Kalb**—Figure 17E (*Beeching* 7591, *Crane* ILLS 60463, *Buck* 54437, *Lay* 09-0055, *Lendemer* 15592, *Nelsen* 4005, *Seavey & Seavey* 10060).

***Cladonia beaumontii* (Tuck.) Fink**—(*Harris & Buck* s.n.).

***Cladonia chlorophaea* (Flörke ex Sommerf.) Spreng.**—(*Beeching* 7712, *Lay* 09-0056, *Lücking & Rivas Plata* 26699*, *Mercado-Díaz* 415, *Seavey & Seavey* 10193).

***Cladonia didyma* (Fée) Vain.**—(*Crane* ILLS 60476, *Lendemer* 15673, *Seavey & Seavey* 10063).

***Cladonia didyma* var. *vulcanica* (Zoll. & Moritz) Vain.**—(*Harris & Buck* s.n.).

***Cladonia ravenelii* Tuck.**—(*Lendemer* 15665).

***Cladonia subradiata* (Vain.) Sandst.**—(*Beeching* 7710, *Buck* 15641, *Crane* ILLS 60453, *Hodkinson* 10541, *Lendemer* 15600, *Lücking & Rivas Plata* 26700*, *Mercado-Díaz* 414, *Seavey & Seavey* 10185*).

***Clathroporina isidiifera* R. C. Harris**—Figure 17F (*Beeching* 7662, *Lücking & Rivas Plata* 26768, *Nelsen* 4124, *Seavey & Seavey* 10239). *Clathroporina* comprises species of *Porina* s.lat. with thallus-dominated perithecial verrucae and shiny thallus and (dark) prothallus; the Florida species are treated in Harris (1995).

***Clathroporina subpungens* (Malme) R. C. Harris**—Figure 17G (*Lay* 09-0129, 09-0228, *Lücking & Rivas Plata* 26758, *Seavey & Seavey* 10241*).

***Clathroporina tetracerae* (Ach.) R. C. Harris**—Figure 17H (*Lücking & Rivas Plata* 26767, *Seavey & Seavey* 10242).

***Coccocarpia domingensis* Vain.**—Figure 18A (*Harris & Buck* s.n.).

***Coccocarpia erythroxyli* (Spreng.) Swinscow & Krog**—Figure 18B (*Lendemer* 15508, *Nelsen* 4080, *Seavey & Seavey* 10382).

***Coccocarpia palmicola* (Spreng.) Arv. & D. J. Galloway**—Figure 18C–D (*Crane* ILLS 60441, *Lay* 09-0057, *Lendemer* 15632, *Lücking & Rivas Plata* 26701, *Seavey & Seavey* 10383*).

****Coenogonium congense* C. W. Dodge**—Figure 18E (*Lay* 09-0134). The genus *Coenogonium* (including *Dimerella*) is treated with a world-wide key including all Florida species by Rivas Plata et al. (2006).

****Coenogonium geralense* (P. Henn) Lücking**—Figure 18F (*Lay* 09-0135, *Lücking & Rivas Plata* 26702).

***Coenogonium interplexum* Nyl.**—Figure 18G (*Lay* 09-0132).

***Coenogonium linkii* Ehrenb.**—Figure 18H (*Lay* 09-0002, *Nelsen* 4014).

****Coenogonium luteocitrinum* Rivas Plata, Lücking & Umaña.**—Figure 19A (*Lay* 09-0131).

***Coenogonium luteum* (Dicks.) Kalb & Lücking**—

- Figure 19B (*Beeching* 7614, *Lendemer* 15589, *Seavey & Seavey* 10130).
- **Coenogonium subdentatum* (Vězda & G. Thor) Rivas Plata, Lücking, Umana & Chaves.—Figure 19C (*Lay* 09-0130).
- **Coenogonium subfallaciosum* (Vězda & Farkas) Lücking, Aptroot & Sipman.—Figure 19D (*Lücking & Rivas Plata* 26703*).
- Collema furfuraceum* (Arnold) Du Rietz—(*Harris & Buck s.n.*).
- Collema pulchellum* Ach.—(*Beeching* 7713, *McMullin* 3015).
- **Coniarthonia wilmsiana* (Müll. Arg.) Grube—Figure 19E (*Beeching* 7702, *Common* 7291G).
- Cratiria lauricassiae* (Fée) Marbach—Figure 19F (*Common* 7287E, 7329C).
- Crocynia gossypina* (Sw.) A. Massal.—Figure 19G (*Seavey & Seavey* 10473*).
- Crocynia pyxinoides* Nyl.—Figure 19H (*Beeching* 7592, *Crane ILLS* 60454, *Lay* 09-0058, *Lücking & Rivas Plata* 26705*, *Nelsen* 4045, *Seavey & Seavey* 10064).
- **Cryptolechia nana* (Tuck.) D. Hawksw. & Dibben—Figure 20A (*Breuss* 28711).
- **Cryptothecia effusa* (Müll. Arg.) R. Sant.—Figure 20B (*Lücking & Rivas Plata* 26683). The otherwise well-developed material has mostly sterile ascigerous parts but in two specimens a few young asci where found with eight undeveloped ascospores per ascus.
- Cryptothecia evergladensis* Seavey—Figure 20C–D (*Lay* 09-0012, *Lücking & Rivas Plata* 26670).
- ****Cryptothecia miniata* Vain. ex Lücking—Figure 20E–F (*Lay* 09-0063, *Lücking & Rivas Plata* 26678, 26679*). See p. 140 for description of this new species.
- **Cryptothecia punctosorediata* Sparrius.—Figure 20G (*Beeching* 7641, *Lücking & Rivas Plata* 26680, *Nelsen* 4038). In this material and other specimens from the Neotropics, the entire thallus contains gyrophoric acid and reacts C+ red, not just the soralia as in the paleotropical populations (Sparrius & Saipunkaew 2005).
- Cryptothecia striata* G. Thor—Figure 20H (*Beeching* 7678, *Crane ILLS* 60439, *Lay* 09-0009, *Lendemer* 15640, *Lücking & Rivas Plata* 26685*, 26687, *Mercado-Díaz* 388, *Seavey & Seavey* 10066). This species is often misinterpreted in the literature as having isidia. Isidiate with a chemistry similar to that of *C. striata* (gyrophoric acid) must be referred to *Herpothallon philippinum* (Vain.) Aptroot & Lücking (Aptroot et al. 2009). *Cryptothecia striata* is one of the most common and widespread species of the genus in the Neotropics and consistently fertile, always lacking isidia.
- **Dictyonema phyllogenum* (Müll. Arg.) Zahlbr.—Figure 21A (*Common* 7363D).
- **Dictyonema sericeum* f. *phyllophilum* Parm.—Figure 21B (*Harris & Buck s.n.*).
- Diorygma junghuhnii* (Mont. & Bosch) Kalb, Staiger & Elix—Figure 21C (*Common* 7418D, 7425A, *Lendemer* 15639). This genus has been monographed by Kalb et al. (2004) and North American species are treated in Tripp et al. (2010).
- ****Diorygma microsporum* M. Cáceres & Lücking—Figure 21D (*Lay* 09-0040, *Lücking & Rivas Plata* 26504). This species, described in a separate paper (Lumbsch et al. 2011), was previously misidentified as *Anomomorpha aggregans* (Nyl.) Staiger (Cáceres 2007), with which it agrees in the small ascospores and norstictic acid but differs in the absence of hymenial inspersion and the indistinctly corticate thallus. Sequencing data showed that the species belongs in *Diorygma* instead, with which it agrees in the thallus and ascomata morphology (Lumbsch et al. 2011).
- Diorygma poitaei* (Fée) Kalb, Staiger & Elix—Figure 21E (*Crane ILLS* 60430, *Seavey & Seavey* 10548*).
- Dirinaria aegialita* (Afz.) B. J. Moore—Figure 21F (*Beeching* 7593, *Lendemer* 15606, *Seavey & Seavey* 10621*).
- Dirinaria confusa* D. D. Awasthi—Figure 21G (*Beeching* 7619).
- Dirinaria leopoldii* (Stein) D. D. Awasthi—Figure 21H (*Seavey & Seavey* 10632*).
- Dirinaria papillulifera* (Nyl.) D. D. Awasthi—Figure 22A–B (*Beeching* 7617).
- Dirinaria picta* (Sw.) Schaer. ex Clem.—Figure

22C (*Crane* ILLS 60462, *Lendemer* 15561, *Nelsen* 4039, *Seavey & Seavey* 10633).

***Dirinaria purpurascens* (Vain.) B. Moore**—Figure 22D (*Seavey & Seavey* 10636*).

***Dyplolabia afzelii* (Ach.) A. Massal.**—Figure 22E–F (*Buck* 54397, *Common* 7356L, 7380E, *Crane* ILLS 60427, *Lay* 09-0176, *Lendemer* 15521, *Lücking & Rivas Plata* 26505, *Mercado-Díaz* 443, *Seavey & Seavey* 10681).

***Echinoplaca areolata* Lücking & W. R. Buck.**—Figure 22G (*Common* 7285B, *Lay* 09-0020, *Lendemer* 15701).

***Echinoplaca* cf. *epiphylla* Fée**—(*Sanders* 10504.6b). The material is sterile but suggests this species based on the verrucose thallus, white setae and acute white hyphophores with subapically inserted diahyphal bunches.

****Echinoplaca leucotrichoides* (Müll. Arg.) R. Sant.**—(*Beeching* 7660).

***Echinoplaca* aff. *leucotrichoides* (Müll. Arg.) R. Sant.**—Figure 22H (*Crane* s.n.). This material represents an undescribed species, but the single thallus is too small to describe it formally. It agrees with the pantropical *E. leucotrichoides* in the short hyphophores with brown-black upper part, but contrary to the latter, the diahyphal bunches include numerous small algal cells with are dispersed with the diahyphae. This appears to be the first species in *Echinoplaca* with this mode of joint dispersal of mycobiont and photobiont (Lücking 2008).

***Echinoplaca lucernifera* Kalb & Vězda**—Figure 23A (*Sanders* 10504.1b).

***Echinoplaca similis* Kalb & Vězda**—Figure 23B (*Breuss* 28922*).

***Enterographa anguinella* (Nyl.) Redinger**—Figure 23C (*Seavey & Seavey* 10429*).

****Eugeniella leucocheila* (Tuck.) Lücking, Sérus. & Kalb**—Figure 23D (*Buck* 54463, *Lendemer* 15558).

******Fissurina aggregatula* Common & Lücking**—Figure 23E (*Common* 7356A3). See p. 141 for description of this new species. *Fissurina* sensu Staiger (2002) is a rather large genus, with over 60 species (Lücking, unpubl. data). Species concepts have so far been confusing

and the delimitation of species found in Florida is summarized in Table 4.

******Fissurina analphabetica* Common & Lücking**—Figure 23F–G (*Common* 7356I, 7356N, 7377E, 7380L). See p. 142 for description of this new species.

****Fissurina cingalina* (Nyl.) Staiger**—Figure 23H (*Common* 7323F).

***Fissurina columbina* (Tuck.) Staiger**—Figure 24A (*Buck* 54399, *Common* 7323I, *Lendemer* 15512).

******Fissurina confusa* Common & Lücking**—Figure 24B (*Common* 7356F, 7368G, 7380D). See p. 142 for description of this new species.

*****Fissurina crassilabra* Mont. & Bosch**—Figure 24C–D (*Common* 7356C, 7368F, 7380N). This species closely resembles *Fissurina insidiosa* C. Knight and Mitt., but differs in the strongly amyloid ascospores. *Fissurina insidiosa* has been reported for Florida (Harris 1995), but the specimens have to be rechecked for ascospore amyloidity. Archer (2009) synonymized *Fissurina subcontexta* under *F. insidiosa*, whereas Galloway (2007) kept them separate but instead listed *Fissurina comparilis* (Nyl.) Nyl. and *Fissurina rugosa* C. Knight & Mitt. as synonyms of *F. insidiosa*. This suggests some confusion about species concepts and the corresponding type material. *Fissurina insidiosa* has labiate lirellae ('swollen lips'), clearly seen in the picture of the type (Hayward 1977), whereas in *F. comparilis* and *F. rugosa* they are fissurine with inconspicuous labia; in addition, *F. comparilis* has a carbonized excipulum and blackened lirellae. The confusion about *F. comparilis* probably stems from Staiger (2002), who used the example of *F. comparilis* to denote carbonized lirellae in her scheme of classifying lirellae types in *Fissurina* and also correctly depicted the excipulum as apically carbonized in the lectotype of *F. comparilis* (Staiger 2002:133, fig. 30), but in the description of the species gave the excipulum as non-carbonized. The type material of *F. rugosa*, on the other hand, agrees well with *Fissurina dumastii* and

Table 4. Simplified keytable to identify species of *Fissurina* cited in this work and otherwise reported from Florida. Septa = number of ascospore septa; muri = muriform; iodine = ascospore amyloidity; chemistry = secondary chemistry; inspersion = hymenium inspersion; excipulum = excipulum carbonization; lirellae = lirellae shape; other = other characters: verrucose = thallus verrucose, endoperidermal = thallus endoperidermal; size = ascospore size in μm (typical upper range for length and size; the typical lower range is about 30% less).

Species of <i>Fissurina</i>	Septa	Iodine	Chemistry	Inspersion	Excipulum	Lirellae	Other	Size
<i>F. varieseptata</i>	7	—	—	—	—	fissurine	cortex loose	15 × 5
<i>F. inspersa</i>	3	—	—	inspersed	—	fissurine-gaping	cortex loose	15 × 6
<i>F. subnitidula</i>	3	I+	—	—	carbonized	roof-like	—	13 × 5
<i>F. humilis</i>	3	I+	—	—	carbonized	roof-like	—	20 × 8
<i>F. tuckermaniana</i>	3	I+	—	—	carbonized	roof-like	—	35 × 12
<i>F. rufula</i>	3	—	—	—	—	labiate	—	20 × 10
<i>F. insidiosa</i>	3	—	—	—	—	labiate-gaping	verrucose	18 × 9
<i>F. crassilabra</i>	3	I+	—	—	—	labiate-gaping	verrucose	18 × 8
<i>F. aggregatula</i>	3	—	—	—	—	labiate-aggregate	—	15 × 6
<i>F. pseudostromatica</i>	3	—	—	—	—	pseudostromatic	—	18 × 6
<i>F. radiata</i>	3	(I+)	—	—	—	fissurine-radiate	—	15 × 7
<i>F. illiterata</i>	3	—	—	—	—	fissurine	cortex loose	16 × 6
<i>F. analphabetica</i>	3	(I+)	—	—	—	fissurine	—	15 × 7
<i>F. tachygrapha</i>	3	—	—	—	(carbonized)	fissurine-gaping	endoperidermal	20 × 9
<i>F. cypressi</i>	muri	—	—	—	—	fissurine-gaping	ecorticate	100 × 25
<i>F. columbina</i>	muri	I+	psoromic	—	—	roof-like	—	30 × 15
<i>F. confusa</i>	muri	I+	psoromic	—	—	labiate-gaping	verrucose	30 × 18
<i>F. subcomparimuralis</i>	muri	—	—	—	carbonized	erumpent-fissurine	—	22 × 8
<i>F. nitidescens</i>	muri	(I+)	—	—	—	chroodiscoid	—	18 × 8
<i>F. aff. elaiocarpa</i>	muri	—	—	—	—	labiate-gaping	verrucose	25 × 15
<i>F. scolecitis</i>	muri	I+	—	—	—	labiate	—	28 × 12
<i>F. mexicana</i>	muri	—	—	—	—	pseudostromatic	—	35 × 12
<i>F. cingalina</i>	muri	—	—	—	—	fissurine-gaping	—	30 × 15
<i>F. egena</i>	muri	(I+)	—	—	—	fissurine-gaping	—	20 × 10
<i>F. incrustans</i>	muri	(I+)	—	—	—	labiate-gaping	—	20 × 9

should be considered a synonym of the latter, thus adding *F. dumastii* to the lichen biota of New Zealand. The main differences between *F. insidiosa* and *F. dumastii* are the labiate versus fissurine lirellae and the verrucose-bullate versus smooth to uneven thallus.

***Fissurina cypressi* (Müll. Arg.) Lendemer**—(*Beeching 7643, Common 7268C, Seavey & Seavey 10456*). This species is most certainly not a genuine *Fissurina*, on the basis of its large ascospores and general habit. It fits better into the *Diorygma-Thalloloma* complex but is set apart by its I– ascospores. Molecular data are required to clarify the systematic position of this taxon.

****Fissurina egena* (Nyl.) Nyl.**—Figure 24E (*Common 7276B, 7368Q*). This species is close to *Fissurina incrustans*, which differs in the erumpent lirellae with distinct labia and gaping disc, resembling *Platythecium* rather than *Fissurina* (Staiger 2002). *Fissurina egena*, in contrast, has immersed lirellae with roof-like margins and concealed to slightly exposed disc. However, intermediate forms do occur and in fact this intermediate lirellae type is quite common in several species of *Fissurina*, such as *Fissurina dumastii*. North American material with this type of lirellae has also been identified as *Fissurina nitidescens* (Nyl.) Nyl. However, this is based on misinterpretation of the type material (Staiger 2002). *Graphis nitidescens* Nyl. is validly described in Tuckerman (1888), who cited a collection from Cuba (*Wright 68*) as the only collection (based on Nylander 1886). Three collections with the name are present in Nylander's herbarium: Cuba, *Wright 267b* (H-NYL 7459!), U.S.A., *Calkins 31* (H-NYL 7460!), and Cuba, *Wright 69* (H-NYL 7461!). *Calkins 31* was cited as type by Wirth & Hale (1978), but cannot be the type as it is not in geographical accordance with the protologue and also was collected one year after the description (Staiger 2002). This material is conspecific with *Fissurina incrustans*, as already established by Wirth & Hale (1978). *Wright 267b* is a different

Fissurina with similar ascospores, but olive-brown thallus and very short and broad, widely open, almost chroodiscoid lirellae with white, erect margins. This specimen is the same taxon as *Graphina olivaceoalbida* Fink from Puerto Rico (Fink 1927), described as having closed lirellae, but in the type clearly showing short and wide open lirellae with erect, white margins. Finally, *Wright 69* is yet another species with lirellae of the *comparilis*-type, i.e. roof-shaped and distinctly carbonized. This material appears to be conspecific with the new species *Fissurina subcomparimuralis* (formally described in Lumbsch et al. 2011). None of the three specimens can conclusively be designated as lectotype, since they all deviate from the protologue either in morphological or label details; on the other hand, it is unlikely that there are further specimens of this series which we have not seen, since the collections were checked directly in hb. Nylander and at that time only *Calkins 31* was on loan to Bettina Staiger. Conceivably, the listing of number 68 in the protologue (based on Nylander 1886) could be an error for number 69; however, *Wright 69* deviates strongly in its lirellae type from the description given in Tuckerman (1888), which on the other hand fits *Wright 267b* rather well. Tuckerman (1888) obviously based his description on North American material (Florida, *Ravenel s.n.*) and stated that he had not seen an original description of Nylander's species. In that case, the validity of the description can certainly be questioned. Presently, we apply the name *F. nitidescens* in the sense of *Wright 267b*, pending further information.

***Fissurina* aff. *elaiocarpa* (A. W. Archer) A. W. Archer**.—Figure 24F (*Common 7356T, 7425F*). This material can be considered the muriform counterpart of *Fissurina insidiosa*. It agrees well with the description and types of *Fissurina elaiocarpa* (synonym *F. marginata* Staiger), except that the ascospores are consistently I–. Given the taxonomic importance of this character in the family, the Florida material

likely represents an undescribed taxon (the non-amyloid counterpart of *F. elaiocarpa*), but the material is too scanty to allow for a formal description.

***Fissurina humilis* (Vain.) Staiger**—Figure 24G–H (*Common* 7276I, 7356M, 7368H).

***Fissurina illiterata* (R. C. Harris) Lendemer**—Figure 25A (*Lücking & Rivas Plata* 26618). The paraphyses in this species are often thickened at the apex, a feature not observed in the newly described *F. analphabetica*.

******Fissurina inspersa* Common & Lücking**—Figure 25B (*Common* 7276F, 7323C, 7356O, 7368J, *Lücking & Rivas Plata* 26510). See p. 143 for description of this new species.

****Fissurina mexicana* (Zahlbr.) Lücking & Rivas Plata**—Figure 25C (*Common* 7323H, *Common* 7418G, *Harris & Buck s.n.*, *Lücking & Rivas Plata* 26513*, 26514, 26515).

******Fissurina pseudostromatica* Lücking & Rivas Plata**—Figure 25D (*Lücking & Rivas Plata* 26512). See p. 145 for description of this new species.

****Fissurina radiata* Mont.**—Figure 25E (*Common* 7356A–2, 7418E, *Lücking & Rivas Plata* 26619b).

***Fissurina rufula* (Mont.) Staiger**—Figure 25F (*Breuss* 28769*, *Seavey & Seavey* 10457). The concept of this species is not clear. We have not been able to study the type, but according to Harris (1995), the labia are striate and ascospores to 24 µm long. The material from Fakahatchee includes both specimens with striate and entire labia, and the latter are usually identified with the name *Fissurina subcontexta* (= *Graphis subparilis* Nyl. in Harris 1995), supposedly also with shorter ascospores (15–20 µm). Mason Hale's Index Cards in US indicate a syntype of *Fissurina rufula* in UPS as striate, but with ascospores 13–20 µm long. Tuckerman (1888) gave the ascospores of *F. rufula* (the striate form) as 14–18 µm, and Staiger (2002) included *Graphis robustior* Müll. Arg. as synonym of *F. subcontexta*; the type of that species has robust, partly striate labia and ascospores about 15–18 µm long.

The situation is complicated by Archer's (2009) synonymization of *F. subcontexta* and *G. robustior* with *F. insidiosa*, also suggested by Staiger (2002), who in addition suggests *F. rufula* to be the oldest name for this complex. On the other hand, Harris (1995) maintained *insidiosa*, *rufula*, and *subparilis* (= *subcontexta*) separate on account of lirellae morphology and ascospore size. A further problem is the fact that, while most forms in this complex have I– ascospores, there is *Fissurina crassilabra* with distinctly amyloid ascospores. As a consequence of our findings, we distinguish species in this complex as follows: (1) Lirellae short, erumpent-labiate, thallus uneven-verrucose, usually yellowish brown = *Fissurina insidiosa* (ascospores I–) or *F. crassilabra* (ascospores I+ violet-blue). *Graphis interversa* Nyl. and *G. beaumontii* Tuck. are synonyms of either species, but the types have to be checked for ascospore amyloidity. (2) Lirellae long, prominent-labiate, entire or becoming striate, thallus smooth to uneven, usually olive-green, ascospores I– = *Fissurina rufula*. Since there is no apparent difference in ascospore size, the distinction between entire and striate forms cannot be maintained, which is also supported by specimens like the type of *G. robustior*, which bears both entire and striate lirellae. Synonyms of *F. rufula* thus include: *Graphis subcontexta* Nyl., *G. subparilis* Nyl., *G. robustior* Müll. Arg., and *G. rufula* var. *comirana* Vain.

******Fissurina subcomparimuralis* Common & Lücking**—Figure 25G (*Common* 7276A, 7323A). This new species is formally described in a separate paper (Lumbsch et al. 2011).

***Fissurina subnitidula* (Nyl.) Staiger**—Figure 25H (*Common* 7356B, 7368B, 7380A, 7418H, *Lücking & Rivas Plata* 26511, *Seavey & Seavey* 10458). The concept of this species in the literature is not accurate. Harris (1995) and Staiger (2002) described it as having a non-carbonized excipulum and non-amyloid ascospores. However, as Tuckerman (1888) correctly noted, the type shows apical

carbonization and this is also seen in all our collections. The ascospores are persistently small, not exceeding $15 \times 5 \mu\text{m}$ and usually about 11–13 μm long, and are weakly to strongly amyloid. The species thus agrees with *Fissurina comparilis* (Nyl.) Nyl. in having lirellae of type II according to Staiger (2002), but the latter has larger ascospores about 13–23 μm long.

**Fissurina tachygrapha* (Nyl.) Staiger—Figure 26A (*Common* 7276E, 7413C, 7418A).

****Fissurina tuckermaniana* Common & Lücking—Figure 26B (*Common* 7266, 7323D). See p. 145 for description of this new species.

****Fissurina varieoseptata* Common & Lücking—Figure 26C (*Common* 7413A). See p. 146 for description of this new species.

Flakea papillata O. E. Erikss.—Figure 26D (*Lay* 09-0062). This species was included in *Agonimia* (Aptroot et al. 1997) but molecular phylogenetic analysis suggests that it represents a separate lineage (Muggia et al. 2009).

**Glyphis atrofusca* (Müll. Arg.) Lücking—Figure 26E (*Lay* 09-0015). This earlier name replaces *Glyphis montoensis* (Archer) Staiger (Lücking et al. 2009b). The taxon is identical with *Graphina* sp. 1271 in Harris (1995:10), as already noted by Staiger (2002). *Graphis mesoleucodes* Nyl. is also conspecific and antedates *Graphina atrofusca* Müll. Arg. by one year, but was published as a nomen nudum only (Nylander 1886).

Glyphis cicatricosa Ach.—Figure 26F–G (*Beeching* 7600, 7685, *Buck* 54438, *Common* 7259C, 7277B, 7292E, *Hodkinson* 10549, *Lay* 09-0073, *Mercado-Díaz* 412, *Lücking & Rivas Plata* 26619*, *Seavey & Seavey* 10067). The abundant material includes both forms with stroma bearing numerous rounded to slightly elongate lirellae, as well as forms with stroma bearing a single, radiately branched lirella. The stroma are uniform within a given individual, but thalli with intermediate forms have also been found, although they are rare. Possibly two distinct taxa are involved here and DNA

studies will be needed to solve the issue.

Glyphis scyphulifera (Ach.) Staiger—Figure 26H (*Common* 7292D). In the checklist (Esslinger 2010) as *Gyrostomum scyphuliferum* (Ach.) Nyl.

Graphis cf. *acharii* Fée—Figure 27A (*Lücking & Rivas Plata* 26521*). The material is unfortunately sterile but agrees in the thallus and lirellae morphology as well as the clear hymenium with *Graphis acharii*, which has muriform ascospores. Other likely alternatives would be the less common *Graphis angustata* Eschw. (ascospores transversely septate) and *Graphis vestitoides* (Fink) Staiger (ascospores terminally muriform). The genus *Graphis* was keyed out with over 300 species world-wide by Lücking et al. (2009b); molecular phylogenetic analysis suggests that it actually includes two distantly related lineages (Rivas Plata et al. 2011).

Graphis anfractuosa Eschw.—Figure 27B (*Beeching* 7644, *Lay* 09-0070, *Seavey & Seavey* 10319). *Graphis anfractuosa* forms part of a misunderstood complex of species with completely carbonized excipulum and interspersed hymenium (Table 5). Specimens with small ascospores and norstictic acid represent either *G. desquamescens* (disc concealed) or *G. aperiens* (disc exposed), whereas specimens with larger ascospores and lacking secondary substances are either *G. anfractuosa* (ascospores 30–40 μm long) or *G. cupei* (ascospores 40–60 μm long).

Graphis aperiens Müll. Arg.—Figure 27C (*Common* 7425D).

****Graphis appendiculata* Common & Lücking—Figure 27 D–E (*Common* 7313A, 7368L, 7380I, 7418K, *Lay* 09-0024, 09-0068, *Lücking & Rivas Plata* 26657*, 26659*, 26660*, 26668*, *Mercado-Díaz* 411). See p. 147 for description of this new species.

**Graphis argentata* Lücking & Umaña.—Figure 27F (*Breuss* 28825*).

**Graphis assimilis* Nyl.—Figure 27G (*Common* 7259O, 7276K, 7346I).

Graphis caesiella Vain.—Figure 27H (*Buck*

Table 5. Simplified keytable to identify species of *Graphis* cited in this work. Septa = number of ascospore septa; muri = muriform; excipulum = excipulum carbonization; inspersion = hymenium inspersion; labia = labia striation; chemistry = secondary chemistry; lirellae = lirellae emergence; margin = thalline margin of lirellae; other = other characters: exposed = exposed disc; green = green thallus; pruinose = pruinose labia; verrucose = verrucose thallus; size = ascospore size in μm (typical upper range for length and size; the typical lower range is about 30% less).

Species of <i>Graphis</i>	Septa	Excipulum	Inspersion	Labia	Chemistry	Lirellae	Margin	Other	Size
<i>G. oshioi</i>	5–9	absent	—	entire	norstictic	prominent	complete	—	30 × 7
<i>G. xanthospora</i>	7–9	apical	—	entire	—	erumpent	lateral	pruinose	35 × 8
<i>G. appendiculata</i>	9–13	apical	—	striate	—	erumpent	comp thin	—	55 × 12
<i>G. caribica</i>	9–15	apical	—	striate	—	prominent	absent	green	60 × 12
<i>G. caesiella</i>	5–9	lateral	—	entire	norstictic	erumpent	lateral	pruinose	35 × 7
<i>G. lucifica</i>	5–7	lateral	—	striate	lichexanth	erumpent	absent	—	30 × 8
<i>G. leptocarpa</i>	7–11	lateral	inspersed	entire	stictic	erumpent	lateral	—	35 × 7
<i>G. handelii</i>	7–9	lateral	inspersed	entire	norstictic	erumpent	lateral	exposed	40 × 8
<i>G. sauroidea</i>	7–15	complete	—	entire	lichexanth	prominent	basal	—	50 × 12
<i>G. assimilis</i>	7–11	complete	—	entire	norstictic	erumpent	lateral	—	40 × 8
<i>G. caesiocarpa</i>	7–11	complete	—	entire	norstictic	erumpent	comp thin	pruinose	35 × 8
<i>G. conferta</i>	7–11	complete	—	entire	—	sessile	absent	—	40 × 8
<i>G. oxyclada</i>	7–11	complete	—	entire	—	prominent	lateral thick	—	40 × 8
<i>G. stellata</i>	5–7	complete	—	entire	—	prominent	lateral	verrucose	25 × 7
<i>G. rimulosa</i>	7–11	complete	—	striate	—	erumpent	absent	—	50 × 12
<i>G. longula</i>	11–17	complete	—	striate	—	erumpent	lateral	—	65 × 12
<i>G. desquamescens</i>	5–9	complete	inspersed	entire	norstictic	erumpent	basal	—	25 × 7
<i>G. aperiens</i>	5–9	complete	inspersed	entire	norstictic	erumpent	lateral	exposed	30 × 8
<i>G. anfractuosa</i>	7–11	complete	inspersed	entire	—	prominent	absent	—	35 × 8
<i>G. cupei</i>	13–17	complete	inspersed	entire	—	prominent	basal	—	55 × 8
<i>G. disserpens</i>	muri	apical	—	striate	—	erumpent	lateral	—	40 × 20
<i>G. xylophaga</i>	muri	lateral	—	entire	—	erumpent	lateral	—	80 × 25
<i>G. acharii</i>	muri	complete	—	striate	—	prominent	comp thin	—	120 × 20
<i>G. subflexibilis</i>	term	complete	inspersed	striate	—	prominent	comp thin	—	120 × 18
<i>G. pseudocinerea</i>	muri	complete	inspersed	striate	—	prominent	comp thin	—	60 × 12
<i>G. argentata</i>	muri	complete	inspersed	striate	—	prominent	comp thin	—	100 × 20

- 54439, *Common* 7413B, 7425B, Lücking & Rivas Plata 26524*, Seavey & Seavey 10362).
- ****Graphis caesiocarpa* Redinger**—Figure 28A (Breuss 28718*).
- ****Graphis caribica* Lücking**—Figure 28B (*Common* 7356G). This species was already discussed in Lücking et al. (2008) for Costa Rica and is formally described in a separate paper (Lumbsch et al. 2011).
- ****Graphis conferta* Zenker**—Figure 28C (Beeching 7602, *Lay* 09-0016, Mercado-Díaz 441).
- ****Graphis cupei* Vain. ex Lücking**—Figure 28D (*Common* 7380H, Lücking & Rivas Plata 26526*).
- Graphis desquamescens* (Fée) Zahlbr.**—Figure 28E (*Common* 7368O, *Lay* 09-0064, Seavey & Seavey 10377*). We are uncertain about the correct application of the name *Graphis desquamescens*. The Florida material has very small ascospores to 25 µm and the outer wall of the end cells is amyloid, a feature rarely observed in other *Graphis* species. The lectotype has ascospores 25–35 µm long and other material from the Neotropics fits this size range; the end cell walls are usually not amyloid. It is possible that different species are involved here, but we want to await more detailed studies on ascospore morphology and chemistry in a wide range of *Graphis* species before using this character formally.
- ****Graphis disserpens* Nyl.**—Figure 28F–G (*Lay* 09-0224, Lücking & Rivas Plata 26656*).
- ****Graphis handelii* Zahlbr.**—Figure 28H (*Common* 7292G).
- Graphis leptocarpa* Fée**—(*Common* 7346E).
- ****Graphis longula* Kremp.**—Figure 29A (*Common* 7380B, Lücking & Rivas Plata 26527).
- Graphis lucifica* R. C. Harris**—Figure 29B (*Lay* 09-0065).
- ****Graphis oshioi* M. Nakan.**—Figure 29C (Breuss 28706*, *Common* 7292C, 7313H, *Lay* 09-0076, Lücking & Rivas Plata 26612). This species would be classified as a *Hemithecium* in the concept of Staiger (2002), because of the absence of excipulum carbonization. However, molecular data show that species of *Hemithecium* are nested within *Graphis*, and the differences in excipulum carbonization are merely gradual (Rivas Plata et al. 2011). *Graphis oshioi* is similar to the widespread tropical *Graphis implicata* Fée and differs mainly in the presence of norstictic acid.
- Graphis oxyclada* Müll. Arg.**—Figure 29D (*Common* 7368M, 7380J, Hodges s.n., *Lay* 09-0017C, 09-0173, Lendemer 15683, Lücking & Rivas Plata 26528a).
- ****Graphis pseudocinerea* Lücking**—Figure 29E–G (Beeching 7630, Breuss 28987*, Lendemer 15547, Lücking & Rivas Plata 26533*, 26537*, Mercado-Díaz 392, Seavey & Seavey 10337).
- Graphis rimulosa* (Mont.) Trevis.**—Figure 29H (Lücking & Rivas Plata 26534).
- ****Graphis sauroidea* Leight.**—Figure 30A (Breuss 28890*, Lendemer 15546).
- ****Graphis stellata* M. Cáceres & Lücking**—Figure 30C–F (Breuss 28889*, *Lay* 09-0067, Seavey & Seavey 10321). This find represents an interesting disjunction, as the species was previously only known from northeastern Brazil (Cáceres 2007). The Florida material agrees well with the type, except that the ascospores are 5-septate rather than 7-septate and at the lower side of the size range (20 µm versus 20–30 µm). As in other cases, we expect this species to be also found in the Caribbean and/or parts of Central America.
- ****Graphis subflexibilis* Lücking & Chaves.**—Figure 30B (*Common* 7356H, 7368E, 7380G).
- ****Graphis xanthospora* Müll. Arg.**—Figure 30G (Breuss 28825*, Lendemer 15537, Lücking & Rivas Plata 26535*).
- Graphis xylophaga* (R. C. Harris) Lendemer**—Figure 30H (Crane ILLS 60442, Seavey & Seavey 10359).
- Gyalectidium appendiculatum* Lücking & Lendemer**—Figure 31A–B (Sanders 10504.4, 10504.6a).
- Gyalectidium catenulatum* (Cavalc. & A. A. Silva) L. I. Ferraro, Lücking & Sérus.**—Figure 31C (Sanders 10504.8).
- Gyalectidium floridense* Safranek & Lücking**—Figure 31D–E (Sanders 10504.5, 10521.4).
- Gyalectidium imperfectum* Vězda**—Figure 31F

(Lücking & Rivas Plata 26808b, Mercado-Díaz 419d, Sanders 10504.7).

****Gyalectidium ulloae* Herrera-Campos & Lücking**—Figure 31G (Sanders 10504.10).

***Gyalectidium* aff. *yahriae* W. R. Buck & Sérus.**—Figure 31H (Sanders 10521.2, 10521.3). This material resembles *Gyalectidium yahriae* in the more or less radially symmetrical hyphophores with a crater-like base and the irregularly incised appendages, but differs clearly in that the diahyphae form a compact mass embedded in a gelatinous matrix. *Gyalectidium denticulatum* Lücking is somewhat similar but has a verrucose instead of smooth thallus and the hyphophores have a thinner margin and more delicate appendages. Unfortunately, the material is too scanty to allow for a formal description.

***Haematomma flexuosum* Hillm.**—Figure 32A (Nelsen 4045).

***Haematomma guyanense* Kalb & Staiger**—Figure 32B (Harris & Buck s.n., Mercado-Díaz 429b).

***Haematomma persoonii* (Fée) A. Massal.**—Figure 32C (Seavey & Seavey 10070).

***Hafellia bahiana* (Malme) Sheard.**—Figure 32D–E (Harris & Buck s.n.).

***Hafellia curatellae* (Malme) Marbach**—Figure 32F (Lendemer 15542A, Seavey & Seavey 10615).

***Hafellia pleiotera* (Malme) Marbach**—Figure 32G (Breuss 28936*).

******Halegrapha floridana* Common & Lücking**—Figure 32H (Common 7410C). This new genus and species is described by Lücking et al. (2011). The genus is characterized by combining a *Graphis*-like whitish thallus and carbonized, labiate lirellae with a *Phaeographis*-like in-spersed hymenium and gray-brown, *Phaeographis*-type ascospores (short with rounded ends and thick walls compared to longer with tapering ends and thinner walls in *Graphis*). It is phylogenetically distinct from both *Graphis* and *Phaeographis* s.str., although more closely related to the latter.

******Heiomasia seaveyorum* M. P. Nelsen &**

Lücking—Figure 33A–B (Beeching s.n., Lücking & Rivas Plata 26850, Nelsen 4076). This new genus, with two new species, was described by Nelsen et al. (2010). It is a genus of two sterile taxa based on *Herpothallon sipmanii* Aptroot et al. from the Palaeotropics (Aptroot et al. 2009). The North American species has sausage-shaped isidia and an unusual chemistry of 5-hydroxy-4-O-demethylnotatic acid and 4-O-demethylnotatic acid.

***Herpothallon antillarum* (Vain.) Aptroot, Lücking & G. Thor**—Figure 33C–D (Nelsen 4037).

****Herpothallon echinatum* Aptroot, Lücking & Will-Wolf.**—Figure 33E (Lay 09-0008, Lücking & Rivas Plata 26681*).

***Herpothallon rubrocinctum* (Ehrenb.) Aptroot, Lücking & G. Thor**—Figure 33F–G (Buck 54478, Hodgkinson 10555, Lay 09-0075, Lendemer 15624, Lücking & Rivas Plata 26707, 26708*, Nelsen 4006, Seavey & Seavey 10725).

***Herpothallon rubroechinatum* A. Frisch & G. Thor**—Figure 33H (Lücking & Rivas Plata 26682). This species was recently established based on material from southern Florida (Frisch et al. 2010).

***Heterodermia albicans* (Pers.) Swinscow & Krog.**—Figure 34A (Breuss 28763*, Lay 09-0077).

***Heterodermia pseudospeciosa* (Kurok.) W. L. Culb.**—Figure 34B (Breuss 29020*).

***Laurera megasperma* (Mont.) Riddle**—Figure 34C–D (Beeching 7682, Crane ILLS 60461, Lay 09-0080, Lendemer 15580, Lücking & Rivas Plata 26709, 26710a*, Nelsen 4015, Seavey & Seavey 10072).

****Lecanora achroa* Nyl.**—Figure 34E (Seavey & Seavey 10144).

***Lecanora achroides* Vain.**—Figure 34F (Seavey & Seavey 10624*).

***Lecanora allophana* Nyl.**—Figure 34G (Lücking & Rivas Plata 26639).

***Lecanora argentata* (Ach.) Malme**—Figure 34H (Lay 09-0136, Lücking & Rivas Plata 26632a*, 26636*, Seavey & Seavey 10631).

- Lecanora caesiorubella* ssp. *glaucomodes* (Nyl.) Imshaug & Brodo—Figure 35A (Seavey & Seavey 10077*).
- **Lecanora elapheia* Stizenb.—(Buck 54405, Lendemer 15577).
- Lecanora floridula* Lumbsch—Figure 35B–C (Beeching 7675, Buck 54384, Lay 09-0083, Lendemer 15528, Seavey & Seavey 10648*).
- Lecanora hybocarpa* (Tuck.) Brodo—Figure 35D (Lay 09-0138).
- Lecanora leprosa* Fée—Figure 35E (Breuss 28936*, Lendemer 15550, Seavey & Seavey 10079*).
- Lecanora pseudargentata* Lumbsch—Figure 35F (Lücking & Rivas Plata 26642, Seavey & Seavey 10081).
- Lecanora strobilina* (Spreng.) Kieffer—Figure 35G (Lücking & Rivas Plata 26637*, 26638*, Seavey & Seavey 10082).
- Lecanora spec.*—(Mercado-Díaz 399). This material is characterized by beige apothecia with thin margin, much as in *Lecanora helva* Stizenb., but has numerous small crystals in the amphithecium that dissolve in K and lacks crystals in the epithecium. The only species matching this apothecial anatomy is *L. epibryon* (Ach.) Ach., which has apothecia with much darker discs and thicker margin.
- Leiorreuma exaltatum* (Mont. & Bosch) Staiger—Figure 35H (Common 7355I, 7424A).
- Leiorreuma explicans* (Fink) Lendemer—(Beeching 7637).
- Leiorreuma sericeum* (Eschw.) Staiger—Figure 36A (Beeching 7625, Common 7313F, 7355E, 7424G, Lendemer 15557, Seavey & Seavey 10823).
- Leptogium cyanescens* (Rabenh.) Körb.—(Beeching 7586, Lay 09-0086, Lendemer 15614, Seavey & Seavey 10480*).
- Leptogium denticulatum* Nyl.—(Hodkinson 10557, Seavey & Seavey 10222*).
- Leptogium isidiosellum* (Riddle) Sierk.—(Beeching 7638, Hodkinson 10542).
- Leptogium marginellum* (Sw.) Gray—(Beeching 7721, Buck 54450, Crane ILLS 60460, Hodkinson 10542, Lay 09-0089, Lendemer 15631, Seavey & Seavey 10491*).
- Leptogium microstictum* Vain.—(Seavey & Seavey 10493).
- Leptogium milligranum* Sierk.—(Mercado-Díaz 462, Seavey & Seavey 10224).
- Letrouitia domingensis* (Pers.) Hafellner & Bellem.—Figure 36B (Beeching 7587, Common 7379, Hodkinson 10548, Lay 09-0093, Lücking & Rivas Plata 26717*, 26718, Nelsen 4083b, Seavey & Seavey 10225*).
- Letrouitia vulpina* (Tuck.) Hafellner & Bellem.—Figure 36C–D (Crane ILLS 60449, Lay 09-0094, Lendemer 15621, Lücking & Rivas Plata 26723*, Mercado-Díaz 390, Nelsen 4083a, Seavey & Seavey 10539*).
- **Leucodecton compunctellum* (Nyl.) A. Frisch.—Figure 36E (Lücking & Rivas Plata 26566b, Seavey & Seavey 10228). The genus *Leucodecton* is treated with a key to all accepted species by Rivas Plata et al. (2010).
- Leucodecton glaucescens* (Nyl.) A. Frisch.—Figure 36F–G (Beeching 7588, Lücking & Rivas Plata 26538, 26539*, Nelsen 4182, Seavey & Seavey 10230).
- Leucodecton occultum* (Eschw.) A. Frisch.—Figure 36H (Common 7321B).
- Lithothelium microsporum* R. C. Harris—(Harris & Buck s.n.).
- Malmidea furfurosa* (Tuck. ex Nyl.) Kalb & Lücking—Figure 37A (Lay 09-0098, Seavey & Seavey 10232). Species of this genus were until recently treated under the name *Malcolmiella* (Cáceres 2007), but molecular phylogenetic analysis showed that the type species of *Malcolmiella* is unrelated to the remaining taxa placed in that genus, and the new genus *Malmidea* was erected for this group (Kalb et al. 2011). Most species can be keyed out using the treatment under *Malcolmiella* in Cáceres (2007) plus the key to Thai species of *Malmidea* provided by Kalb et al. (2011). *Malmidea furfurosa* is currently listed as *Lecidea furfurosa* Tuck. ex Nyl. in the North American lichen checklist (Esslinger 2010).
- **Malmidea fuscella* (Müll. Arg.) Kalb & Lücking—Figure 37B (Breuss 28711*).

***Malmidea granifera* (Ach.) Kalb, Rivas Plata & Lumbsch**—Figure 37C (*Beeching* 7632, *Breuss* 28711*, *Buck* 54400, *Crane* ILLS 60478, *Lücking & Rivas Plata* 26725*, *Seavey & Seavey* 10314).

****Malmidea gyalectoides* (Vain.) Kalb & Lücking**—Figure 37D (*Lücking & Rivas Plata* 26727, 26728*, *Nelsen* 4017).

****Malmidea leptoloma* (Müll. Arg.) Kalb & Lücking**—Figure 37E (*Lendemer* 15564, *Lücking & Rivas Plata* 26730).

****Malmidea piperis* (Spreng.) Kalb, Rivas Plata & Lumbsch**—Figure 37F (*Lay* 09-0090).

****Malmidea rhodopis* (Tuck.) Kalb, Rivas Plata & Lumbsch**—(*Breuss* 28687*).

****Malmidea variabilis* Kalb**—Figure 37G (*Beeching* 7585). This taxon was recently described from Thailand (Kalb et al. 2011), being somewhat similar to *M. granifera* but differing chiefly in the papillose apothecial margin. Similar collections have been reported from Brazil (Cáceres 2007) but were left unnamed. Our identification is tentative because in the Neotropics apparently two species with slightly different chemistry are involved which need further study.

****Malmidea vinosa* (Eschw.) Kalb, Rivas Plata & Lumbsch**—Figure 37H (*Breuss* 28658*, 28690*, *Lay* 09-0099, *Lücking & Rivas Plata* 26731).

***Megalospora porphyritis* (Tuck.) R. C. Harris**—Figure 38A–B (*Harris & Buck* s.n., *Hodges* s.n.).

***Megalotremis* spec.**—(*Lay* 09-0227, *Lücking & Rivas Plata* 26809). This material is very characteristic because of its comparatively large (35–50 × 10–14 µm), distally pointed, ornamented ascospores with markedly submedian septum. The thallus is endoperidermal and white and patchily UV+ yellow (lichexanthone). The perithecia are prominent, black, and slightly irregular although with more or less apical ostiole. It does not key out to any of the species of *Anisomeridium* s.lat. in Harris (1995); because of its large, ornamented ascospores, it seems to belong in *Megalotremis*

sensu Aptroot (1991), but none of the species currently accepted in that genus comes close. The recently described *M. lateralis* Aptroot has perithecia with markedly excentric ostiole and much broader ascospores with the distal end rounded (Aptroot et al. 2008).

***Micarea prasina* Fr.**—Figure 38C (*Lay* 09-0088).

***Micarea* spec.**—Figure 38D–G (*Lay* 09-0051). This unidentified material bears numerous apothecia and tubular pycnidia and probably represents an undescribed species.

***Mycocalicium subtile* (Pers.) Szatala.**—Figure 38H (*Buck* 54471, *Lay* 09-0097).

***Mycomicrothelia modesta* (Müll. Arg.) D. Hawksw.**—Figure 39A (*Lücking & Rivas Plata* 26588a*).

***Mycomicrothelia subfallens* (Müll. Arg.) D. Hawksw.**—Figure 39B (*Lücking & Rivas Plata* 26772*, *Seavey & Seavey* 10821).

***Mycomicrothelia willeyana* (Müll. Arg.) D. Hawksw.**—Figure 39C–D (*Lücking & Rivas Plata* 26597*, 26599, 26733*, *Mercado-Díaz* 444). The species resembles an *Anisomeridium*, especially as the ascospores are often pale to hardly pigmented at all. *Mycomicrothelia* (at least the three species sequenced to date) has recently been shown to belong in Trypetheliaceae (Nelsen et al. 2009), which is supported by the thin, distinct, anastomosing, loosely net-like interascal hyphae. *Anisomeridium* has a similar type of hamathecium and also belongs in Dothideomycetes, but in a separate clade distant from Trypetheliaceae (Nelsen et al. 2009). If ascospore pigmentation is variable in both *Anisomeridium* and *Mycomicrothelia*, some species currently placed in *Anisomeridium* could belong in *Mycomicrothelia*, and vice versa. The situation is complicated by similar looking species of *Strigula* (another clade in the Dothideomycetes) with branched and anastomosing interascal hyphae (Nelsen et al. 2009).

***Mycoporum buckii* R. C. Harris**—(*Harris & Buck* s.n.).

***Mycoporum eschweileri* (Müll. Arg.) R. C. Harris**—(*Beeching* 7581, *Buck* 54403).

Mycoporum lacteum (Ach.) R. C. Harris—Figure 39E–F (Lücking & Rivas Plata 26732).

Mycoporum sparsellum Nyl.—Figure 39G–H (Lücking & Rivas Plata 26613).

Myriotrema erodens R. C. Harris—Figure 40A–B (Beeching 7611, Lendemer 15687A, Lay 09-0102, Lücking & Rivas Plata 26541, Mercado-Díaz 436, Nelsen 4183, Seavey & Seavey 10811*). Thalli with the coarse, somewhat diffuse soralia typical of *Myriotrema erodens* were found quite abundantly at Fakahatchee. Molecular analysis of some sorediate specimens (Rivas Plata et al., unpubl. data) showed that they are very similar to apotheciate specimens identified as *Ocellularia auberianoides* (see below). The latter agrees in most features with fertile *Myriotrema erodens* except for the distinctly smaller ascospores and more open apothecia with irregular columella structures. *Myriotrema erodens* is based on material from Cuba and so far only the type and an additional specimen from Panama (Harris 29645) have been found with apothecia. Coincidentally, a sorediate species with small ascospores, *Ocellularia sorediigera* Kalb, was recently described from the Neotropics (Kalb 2009), which corresponds to forms with apothecia of the *O. auberianoides* type and soralia of the *Myriotrema erodens* type. Kalb (2009) indeed suggested *O. sorediigera* to be the sorediate counterpart of *O. auberianoides*. In the present material, we have not found any specimen with apothecia and soralia on the same thallus; we therefore used *Ocellularia auberianoides* for apotheciate material and *Myriotrema erodens* for sorediate specimens, but molecular analysis of a large number of specimens could well reveal the presence of up to three taxa, *Myriotrema erodens* s.str., *O. auberianoides*, and *O. sorediigera*. It is also possible that all sorediate North American material hitherto identified as *Myriotrema erodens* belongs to *Ocellularia sorediigera* or even that that *O. auberianoides* and *O. sorediigera* are conspecific, in which case only one taxon would be recognized.

Myriotrema peninsulae R. C. Harris—Figure 40C (Lücking & Rivas Plata 26542*, Nelsen 4181, Seavey & Seavey 10847).

**Myriotrema pycnoporellum* (Nyl.) Hale—Figure 40D (Beeching 7666, Common 7359A, 7371B, 7377B, Lay 09-0228, Lücking & Rivas Plata 26544*, Seavey & Seavey 10133).

Nadvornikia hawaiiensis (Tuck.) Tibell—Figure 40E (Breuss 28889).

Nadvornikia sorediata R. C. Harris—Figure 40F (Lendemer 15540).

**Ocellularia auberianoides* (Nyl.) Müll. Arg.—Figure 40G (Lay 09-0027, Lücking & Rivas Plata 26548*). This taxon has been synonymized with *O. bonplandii* (Fée) Müll. Arg., but differs in the larger apothecia with irregular-reticulate pseudocolumella; both are also genetically different. *Ocellularia auberianoides* closely resembles *O. obturascens* but can be readily distinguished by the hyaline, transversely septate ascospores (brown and muriform in *O. obturascens*).

**Ocellularia obturascens* (Nyl.) Hale—Figure 40H (Beeching 7720, Lay 09-0103, Lendemer 15551, 15627, Lücking & Rivas Plata 26552*, 26554*, 26555*, Mercado-Díaz 381, Seavey & Seavey 10136*). The material of this taxon from southeastern United States is usually identified as *Myriotrema bahianum* (Ach.) Hale, recently recombined as *Ocellularia bahiana* (Ach.) A. Frisch (Frisch & Kalb 2006). However, that species lacks a columella or very rarely has a rudimentary pseudocolumella, whereas the Florida material is without exception distinctly columellate. The name *Ocellularia obturascens* is available for the columellate taxon; this name is listed as synonym of *O. bahiana* in the North American lichen checklist (Esslinger 2010) but should be restored and *O. bahiana* be deleted.

Ochrolechia africana Vain.—Figure 41A (Seavey & Seavey 10752*).

Ochrolechia antillarum Brodo—(Lendemer 15642).

Opegrapha astraia Tuck.—Figure 41B–C (Lücking & Rivas Plata 26734*, Mercado-Díaz 440, Seavey & Seavey 10741).

- Opegrapha atra* Pers.**—Figure 41D (Lücking & Rivas Plata 26737a*).
- Opegrapha candida* Müll. Arg.**—Figure 41E (Seavey & Seavey 10628*).
- Opegrapha cypressi* R. C. Harris**—Figure 41F (Breuss 28715*, Lendemer 15588, Seavey & Seavey 10791).
- Opegrapha longissima* Müll. Arg.**—Figure 41G (Harris & Buck s.n., Lücking & Rivas Plata 26736, 26815).
- Opegrapha spec.***—Figure 41H (Mercado-Díaz 450). This material is the same as Britton 652 cited in Harris (1995: 7). It is characterized by robust, sessile lirellae with basally closed excipulum and slit-like disc, inspersed hymenium, and 7-septate ascospores $40\text{--}45 \times 5\text{--}7 \mu\text{m}$ in size with the two median cells slightly enlarged. Most similar appear to be *O. varia* Pers., with smaller, usually 5-septate ascospores and non-inspersed hymenium, and the paleotropical *O. ugandensis* Ertz, with non-inspersed hymenium, more delicate lirellae, and smaller, 6-septate ascospores.
- Parmeliella stylophora* (Vain.) P. M. Jørg.**—Figure 42A–B (Lücking & Rivas Plata 26738).
- Parmotrema austrosinense* (Zahlbr.) Hale**—(Beeching 7647).
- Parmotrema crinitum* (Ach.) M. Choisy**—(Seavey & Seavey 10644).
- Parmotrema cristiferum* (Taylor) Hale**—(Beeching 7714, Hodkinson 10544, Lendemer 15644, Seavey & Seavey 10639).
- Parmotrema dilatatum* (Vain.) Hale**—(Lendemer 15691, Seavey & Seavey 10156*).
- Parmotrema endosulphureum* (Hillm.) Hale**—(Lendemer 15555, Seavey & Seavey 10559*).
- Parmotrema gardneri* (C. W. Dodge) Sérus.**—(Lendemer 15672).
- Parmotrema hypoleucinum* (Steiner) Hale**—(Breuss 28653*, Seavey & Seavey 10544).
- Parmotrema perforatum* (Wulfen) A. Massal.**—(Crane ILLS 60443).
- Parmotrema sulphuratum* (Nees & Flot.) Hale**—(Beeching 7670, Lay 09-0105, Lendemer 15654).
- Parmotrema tinctorum* (Delise ex Nyl.) Hale**—(Crane ILLS 60446, Seavey & Seavey 10158*).
- Pertusaria commutata* Müll. Arg.**—(Lendemer 15637).
- Pertusaria epixantha* R. C. Harris**—Figure 42C–D (Lücking & Rivas Plata 26666c).
- Pertusaria expolita* R. C. Harris**—Figure 42E–F (Lücking & Rivas Plata 26650*). The whitish, sterile sorediate thallus containing stictic acid and coronatone characterize this species.
- Pertusaria aff. expolita* R. C. Harris**—Figure 42G–H (Lücking & Rivas Plata 26649). This material agrees with *P. expolita* in the sorediate thallus and chemistry; however, the soralia are much smaller and discrete, resembling goniocystangia, and the thallus is greenish rather than whitish.
- Pertusaria floridana* Dibben**—(Harris & Buck s.n.).
- Pertusaria leioplaca* DC.**—Figure 43A–B (Lücking & Rivas Plata 26623c, Seavey & Seavey 10147*).
- **Pertusaria paratuberculifera* Dibben**—Figure 43C (Breuss 28965*, Lücking & Rivas Plata 26623b, 26645*).
- Pertusaria sinismexicani* Dibben**—Figure 43D (Lendemer 15682, Lücking & Rivas Plata 26652*, 26654).
- Pertusaria tetrathalamia* (Fée) Nyl.**—Figure 43E (Harris & Buck s.n., Seavey & Seavey 13332*).
- Pertusaria texana* Müll. Arg.**—Figure 43F (Lücking & Rivas Plata 26643, Seavey & Seavey 10215).
- Pertusaria virensica* R. C. Harris**—Figure 43G (Lay 09-0141).
- Pertusaria xanthodes* Müll. Arg.**—Figure 43H (Lendemer 15568, Lücking & Rivas Plata 26647*, 26651*, Seavey & Seavey 10218).
- Phaeographis asteroides* (Fink) Lendemer**—Figure 44A (Beeching 7665, Lay 09-0145, Lücking & Rivas Plata 26739*, Seavey & Seavey 10216). Species of *Phaeographis* found in Florida are summarized in Table 6.
- Phaeographis brasiliensis* (A. Massal.) Kalb & Matthes-Leicht.**—Figure 44B–C (Common 7245A, 7355M, 7424C, Lay 09-0149A, Seavey & Seavey 10266). Some of the specimens

Table 6. Keytable to identify species of *Phaeographis* and allied genera (*Leiorreuma*, *Platygramme*, *Sarcographa*) cited in this work or otherwise reported from Florida. Septa = number of ascospore septa; muri = muriform; insp = hymenium inspersion; chem = secondary chemistry: pigm = quinone pigment (K+ green), lichx = lichexanthone; exci = excipulum carbonization; hypo = hypothecium (or basal part of excipulum) carbonization; lirellae = lirellae shape; disc = disc color and/or pruina; other = other characters: ecorticate = ecorticate thallus, lobulate = lobulate lirellae margin, orange = orange hymenium, striate = striate labia; size = ascospore size in μm (typical upper range for length and size; the typical lower range is about 30% less).

Species	Septa	Insp	Chem	Exci	Hypo	Lirellae	Disc	Other	Size
<i>Phaeographis</i>									
<i>P. haematites</i>	5–9	—	pigm	—	—	elongate-stellate	dark red	—	30 × 8
<i>P. inconspicua</i>	3	—	norst	—	—	elongate	grey-pruinose	—	13 × 6
<i>P. subfulgurata</i>	3	—	norst	—	—	elongate	grey-pruinose	lobulate	20 × 9
<i>P. major</i>	5	—	norst	—	—	elongate	grey-pruinose	—	22 × 8
<i>P. brasiliensis</i>	3	—	norst	—	—	pseudostromatic	grey-pruinose	—	17 × 6
<i>P. intricans</i>	5	—	norst	—	—	pseudostromatic	grey-pruinose	—	22 × 6
<i>P. schizoloma</i>	3–5	—	stictic	—	—	elongate	brown (pruinose)	striate	25 × 10
<i>P. flavescens</i>	5	—	stictic	—	—	pseudostromatic	grey-pruinose	—	25 × 6
<i>P. delicatula</i>	3	—	stictic	—	—	stellate	brown	—	25 × 9
<i>P. aff. schizoloma</i>	5–7	—	—	—	—	elongate	brown (pruinose)	striate	30 × 10
<i>P. punctiformis</i>	5	insp	lichx	thin	thin	round-oval	brown-black	—	25 × 8
<i>P. nylanderii</i>	3–5	insp	norst	—	—	oval-elongate	brown-black	—	20 × 6
<i>P. dendritica</i>	5–11	insp	norst	thin	thin	elongate-stellate	brown-black	ecorticate	40 × 10
<i>P. lindigiana</i>	3	insp	—	—	—	elongate	brown-black	lobulate	18 × 8
<i>P. inusta</i>	3–5	insp	—	thin	thin	elongate	brown	—	25 × 7
<i>P. erumpens</i>	5–7	insp	—	thin	thin	elongate	brown-black	lobulate	30 × 8
<i>P. lobata</i>	5–11	insp	—	thick	thin	round	brown (pruinose)	lobulate	40 × 10
<i>P. leiogrammodes</i>	muri	—	norst	—	—	elongate-stellate	grey-pruinose	—	20 × 8
<i>P. asteroides</i>	muri	—	—	—	—	stellate	grey-pruinose	—	35 × 12
<i>P. multicolor</i>	muri	insp	norst	thin	—	elongate	brown-black	orange	35 × 10
<i>P. scalpturata</i>	muri	insp	—	—	—	elongate	brown (pruinose)	—	100 × 30
<i>P. aff. scalpturata</i>	muri	insp	—	thin	thin	elongate	brown (pruinose)	—	100 × 20
<i>Platygramme</i>									
<i>P. praestans</i>	9–17	insp	—	thick	—	elongate	bluish pruinose	striate	70 × 13
<i>P. pachnodes</i>	muri	insp	norst	thick	—	elongate	white-pruinose	—	35 × 10
<i>P. caesiopruinosa</i>	muri	insp	—	thick	—	elongate	bluish pruinose	—	90 × 20
<i>P. aff. caesiopruinosa</i>	muri	insp	—	thick	—	elongate	brown (pruinose)	—	90 × 20
<i>Leiorreuma</i>									
<i>L. sericeum</i>	3	insp	—	thin	thick	stellate	brown-black	—	18 × 7
<i>L. exaltatum</i>	5–9	insp	—	thin	thick	elongate	brown-black	—	30 × 8
<i>L. explicans</i>	muri	insp	—	thin	thick	elongate	brown-black	—	28 × 11
<i>Sarcographa</i>									
<i>S. labyrinthica</i>	3	insp	stictic	thin	thick	stromatic	grey-pruinose	—	20 × 6
<i>S. tricola</i>	3	insp	—	thin	thin	stellate	(pruinose)	—	20 × 6

exhibited a negative K-reaction of thallus and lirellae, although TLC showed the presence of norstictic acid. Apparently, either the substance is concentrated in certain parts of the thallus or occurs in concentrations too low to be reliably detected by 10% KOH solution. The specimen supposedly devoid of lichen substances, *Harris 23697* in Harris (1995), was tested TLC negative and might represent a separate taxon. Specimens with stictic acid belong to *P. flavescens*.

****Phaeographis delicatula* Common & Lücking—Figure 44D (Common 7355J, 7367C, 7381D, Lay 09-0151). See p. 148 for description of this new species.

Phaeographis erumpens (Nyl.) Müll. Arg.—Figure 44E (Breuss 28734*, Common 7277A, 7367E).

**Phaeographis flavescens* Dal Forno & Eliasaro.—Figure 44F (Common 7355K, 7367J, 7424I).

**Phaeographis inconspicua* (Fée) Müll. Arg.—Figure 44G (Lay 09-0149B). This appears to be the correct name for the species commonly identified as *P. subtigrina* (Harris 1995). The latter is now considered a synonym of *P. brasiliensis* (Archer 2009).

Phaeographis intricans (Nyl.) Staiger—Figure 44H (Common 7355A, Seavey & Seavey 10295).

**Phaeographis leiogrammodes* (Kremp.) Müll. Arg.—Figure 45A (Common 7277C, 7355F, 7424E). This is the same taxon as *Harris 18150B* in Harris (1995). There are two other species in Florida (not yet found at Fakahatchee) with small, muriform ascospores and norstictic acid, but with inspersed hymenium: *Phaeographis multicolor* R. C. Harris (with orange hymenium) and *Phaeographis quadrifera* (Nyl.) Staiger, which in Harris (1995) keys out as *Small 10114*. There also seems to be an undescribed species from Florida with clear hymenium and smaller ascospores which requires further study.

Phaeographis lobata (Eschw.) Müll. Arg.—Figure 45B (Common 7423V).

**Phaeographis major* (Kremp.) Lücking—Figure

45C (Common 7355B, 7367J).

**Phaeographis nylanderi* (Vain.) Zahlbr.—Figure 45D (Common 7346A, Lay 09-0220).

**Phaeographis sculpturata* (Ach.) Staiger—Figure 45E (Common 7264A, Seavey & Seavey 10297).

Phaeographis aff. sculpturata (Ach.) Staiger—Figure 45F (Common 7381B, Lücking & Rivas Plata 26740, 26741). We have not found a name for this taxon which resembles *Phaeographis sculpturata* but has a completely carbonized excipulum.

**Phaeographis schizoloma* (Müll. Arg.) Müll. Arg.—Figure 45G (Common 7355C, 7367J, 7381C, Lay 09-0146, Lücking & Rivas Plata 26742).

Phaeographis aff. schizoloma (Müll. Arg.) Müll. Arg.—Figure 45H (Common 7262, Lay 09-0175, Lücking & Rivas Plata 26744*, 26746). This material is the same as *Wilson 1259* in Harris (1995). It agrees with *Phaeographis schizoloma* in all details except the lack of lichen substances and larger ascospores. No name was found for this taxon, but revision of types of *Phaeographis* has not yet been concluded.

Phaeographis subfulgurata (Nyl.) Zahlbr.—(Buck 54432).

Phaeographis spec.—(Beeching 7624, Hodges s.n.). We have not found a name for this species. It is intermediate between *P. brasiliensis*, in having much branched lirellae with non-carbonized base, 3-septate ascospores, and norstictic acid, and *Sarcographa tricola*, in having an inspersed hymenium.

Phyllopsora confusa Swinscow & Krog—Figure 46A (Lay 09-0209, 09-0210, Nelsen 4068).

Phyllopsora furfuracea Zahlbr.—Figure 46B (Lendemer 15699).

Phyllopsora isidiotyla (Vain.) Riddle—Figure 46C (Crane ILLS 60437, Lay 09-0106, Lücking & Rivas Plata 26748, Seavey & Seavey 10444).

Phyllopsora kalbii Brako—Figure 46D (Lücking & Rivas Plata 26750*).

**Phyllopsora lacerata* Timdal—Figure 46E (Sanders s.n.). This species was recently

described from Peru and is also known from Cuba, Tobago, and Ecuador (Timdal 2008), so its presence in subtropical Florida is not a surprise. It somewhat resembles *Eschatogonia* but differs in thallus anatomy.

***Phyllopsora santensis* (Tuck.) Swinscow & Krog.**—Figure 46F (*Lay* 09-0211).

***Physcia atrostriata* Moberg**—Figure 46G (*Beeching* 7711, *Buck* 54441, *Lendemer* 15661, *Lücking & Rivas Plata* 26751*, 26752, 26753*, *Nelsen* 4056, *Seavey & Seavey* 10298).

***Physcia undulata* Moberg**—Figure 46H (*Lendemer* 15655).

***Platygramme caesiopruinosa* (Fée) Fée**—Figure 47A (*Beeching* 7627, *Common* 7313G; *Lay* 09-0107, *Lendemer* 15693, *Lücking & Rivas Plata* 26624*, 26826b). The species of *Platygramme* are treated in Staiger (2002) and Tripp & Lendemer (2010).

***Platygramme* aff. *caesiopruinosa* (Fée) Fée**—Figure 47B (*Common* 7259E, 7292A, 7367K, 7410F, *Lay* 09-0148). This material differs from *P. caesiopruinosa* in the brown, thinly pruinose disc (bluish pruinose in *P. caesiopruinosa*) and the usually pale to almost white thallus.

***Platygramme pachnodes* (Fée) E. Tripp & Lendemer**—Figure 47C (*Seavey & Seavey* 10300*). Not in checklist but reported by Tripp & Lendemer (2010).

***Platygramme praestans* (Müll. Arg.) Staiger**—Figure 47D (*Lücking & Rivas Plata* 26628*, *Seavey & Seavey* 10586). Not in checklist but reported by Tripp & Lendemer (2010).

***Platythecium floridanum* (Tuck.) Lendemer**—Figure 47E (*Common* 7368P).

***Platythecium grammitis* (Fée) Staiger**—Figure 47F (*Lendemer* 15626).

***Polymeridium albocinereum* (Kremp.) R. C. Harris**—Figure 47G (*Lay* 09-0143).

***Polymeridium catapastum* (Nyl.) R. C. Harris**—(*Harris & Buck* s.n.).

***Polymeridium proponens* (Nyl.) R. C. Harris**—Figure 47H (*Seavey & Seavey* 10302*).

***Porina heterospora* (Fink ex J. Hedrick) R. C. Harris**—Figure 48A (*Buck* 54414, *Lendemer* 15562). This species is similar to *P. nucula*,

but differs in the larger ascospores with more numerous septa (9–13) which are distinctly tapering towards the proximal end; ascospores in *P. nucula* are consistently 7-septate and symmetrically fusiform (Harris 1995).

***Porina nucula* Ach.**—Figure 48B–F (*Beeching* 7689, *Lay* 09-0155, *Lücking & Rivas Plata* 26761*, 26762*, *Mercado-Díaz* 438a, *Nelsen* 4157, *Seavey & Seavey* 10482*).

***Pseudoparmelia uleana* (Müll. Arg.) Elix & T. H. Nash**—(*Beeching* 7704, *Buck* 54389, *Hodkinson* 10552, *Lendemer* 15563, *Seavey & Seavey* 10304*).

****Pseudopyrenula subgregaria* Müll. Arg.**—Figure 48G (*Lücking & Rivas Plata* 26770, *Nelsen* 4082b, *Seavey & Seavey* 10153). Reinstated for the North American checklist. This taxon differs from *P. diluta* (Fée) Müll. Arg. in the smaller ascospores (20–25 µm versus 25–32 µm) and the yellow interspersed hymenium (clear in *P. diluta*). The thallus is also more compact and the perithecia flatter than in *P. diluta*.

****Pseudopyrenula subnudata* Müll. Arg.**—Figure 48H (*Lendemer* 15656). Reinstated for the North American checklist. This taxon differs from *P. diluta* in the smaller ascospores and the largely endoperidermal thallus.

***Pseudosagedia cestrensis* (E. Michener) R. C. Harris**—(*Lay* 09-0187).

***Pseudosagedia* aff. *cestrensis* (E. Michener) R. C. Harris**—(*Lay* 09-0225, *Lücking & Rivas Plata* 26757). This material has longer ascospores with more numerous septa than typical *P. cestrensis* (ascospores regularly 7-septate).

“*Psorella*” spec.—Figure 49A–B (*Lay* 09-0033, 09-0218, *Lücking & Rivas Plata* 26829*). In spite of careful search we have not yet found a name for this diminutive but characteristic taxon. The thallus consists of very small (0.1–0.3 mm diam.), discrete, adnate squamules and bears abundant, orange-brown to red-brown apothecia with darker, persistent margin. Ascospores are non-septate or 1-septate and 12–20 × 1.5–2 µm large, resembling those of *Phyllopsora*. Eventually the squamules break up to produce large, pale yellow-green soralia.

The taxon comes closest to *Psorella pertexta* (Nyl.) Müll. Arg. in the key given by Ekman (1996: 56), but that species has much longer ascospores and a *Phyllopsora*-like prothallus and lacks soralia (Swinscow & Krog 1981). Another superficially similar species is the sorediate, microsquamulose *Biatora fallax* Hepp (Printzen 1995), which differs in having *Biatora*-type apothecia with evanescent margin and much broader, ellipsoid ascospores. The species is here tentatively filed under *Psorella* since the type of that genus appears to belong in *Bacidia* (S. Ekman, pers. comm. 2011).

****Psoroglaena costaricensis* Henssen**—Figure 49C–D (*Common* 7363D).

***Punctelia rudecta* (Ach.) Krog.**—(*Beeching* 7652).

***Pyrenula acutalis* R. C. Harris**—Figure 49E (*Breuss* 28797*, *Seavey & Seavey* 13333*). The genus *Pyrenula* is keyed out for Florida in Harris (1995).

***Pyrenula anomala* (Ach.) Vain.**—Figure 49F (*Beeching* 7654, *Lay* 09-0153, *Lücking & Rivas Plata s.n.*, *Mercado-Díaz* 431, *Nelsen* 4073, *Seavey & Seavey* 10317*).

***Pyrenula aspistea* (Ach.) Ach.**—Figure 49G (*Breuss* 28679*, *Lay* 09-0154).

***Pyrenula astroidea* (Fée) R. C. Harris**—Figure 49H (*Lücking & Rivas Plata* 26774*, *Seavey & Seavey* 10322).

****Pyrenula brunnea* Fée**—Figure 50A (*Lücking & Rivas Plata* 26777, *Seavey & Seavey* 10391).

***Pyrenula concatervans* (Nyl.) R. C. Harris**—Figure 50B (*Beeching* 7686, *Breuss* 28993*, *Buck* 54427, *Lay* 09-0157, *Lücking & Rivas Plata* 26778, *Seavey & Seavey* 13334*).

***Pyrenula confinis* (Nyl.) R. C. Harris**—Synonym *Pyrenula corticata* (Müll. Arg.) R. C. Harris—Figure 50C (*Common* 7281G, 7326M).

***Pyrenula cruenta* (Mont.) Vain.**—Figure 50D (*Beeching* 7649, *Lay* 09-0158, *Lendemer* 15519, *Lücking & Rivas Plata* 26781, *Seavey & Seavey* 10151*).

***Pyrenula cubana* (Müll. Arg.) R. C. Harris**—Figure 50E (*Beeching* 7664, *Lay* 09-0160, *Lücking & Rivas Plata* 26783*, 26784*,

Seavey & Seavey 10388).

****Pyrenula dermatodes* (Borrer) Schaer.**—(*Lücking & Rivas Plata* 26509c). This species is characterized by a corticate, UV+ yellow thallus (lichexanthone), immersed perithecia covered mostly by a thalline layer except for the ostiolar area, non-inspersed hymenium, and ascospores $14\text{--}20 \times 5\text{--}6 \mu\text{m}$ with well-developed endospore and the terminal lumina separated from the exospore by an endospore layer. The species is regularly found in tropical montane situations and is also known from Europe; it is therefore surprising that it had not been reported before from North America.

***Pyrenula duplicans* (Nyl.) Aptroot**—Figure 50F (*Lücking & Rivas Plata* 26785a).

***Pyrenula falsaria* (Zahlbr.) R. C. Harris**—Figure 50G (*Lay* 09-0161, *Lücking & Rivas Plata* 26786).

***Pyrenula globifera* (Eschw.) Aptroot**—Figure 50H (*Breuss* 28709*).

***Pyrenula leucostoma* Ach.**—Figure 51A (*Crane* ILLS 60469, *Lay* 09-0162, *Lendemer* 15688, *Lücking & Rivas Plata* 26789, 26790*, 26791, *Nelsen* 4087, *Seavey & Seavey* 10307*).

***Pyrenula mamillana* (Ach.) Trevis.**—Figure 51B (*Lay* 09-0163, *Lücking & Rivas Plata* 26792, 26795*).

***Pyrenula microtheca* R. C. Harris**—Figure 51C (*Common* 7326B, *Lay* 09-0109, *Seavey & Seavey* 10364).

***Pyrenula mucosa* (Vain.) R. C. Harris**—Figure 51D (*Lücking & Rivas Plata* 26797*, 26798*, 26812, *Nelsen* 4096).

***Pyrenula ochraceoflava* (Nyl.) R. C. Harris**—Figure 51E (*Beeching* 7590, *Crane* ILLS 60479, *Mercado-Díaz* 429a, *Nelsen* 4089, *Seavey & Seavey* 10309).

***Pyrenula ochraceoflavens* (Nyl.) R. C. Harris**—Figure 51F (*Seavey & Seavey* 10311).

***Pyrenula punctella* (Nyl.) Trevis.**—Figure 51G (*Lücking & Rivas Plata* 26801).

***Pyrenula quassiiicola* Fée**—Figure 51H (*Beeching* 7599, *Lay* 09-0166, *Lendemer* 15689, *Lücking & Rivas Plata* 26803, *Mercado-Díaz* 432, *Seavey & Seavey* 10519).

- Pyrenula santensis* (Nyl.) Müll. Arg.**—Figure 52A (Lay 09-0170, Lücking & Rivas Plata 26785, 26804, 26805, Seavey & Seavey 10536).
- Pyrenula aff. santensis* (Nyl.) Müll. Arg.**—Figure 52B (Mercado-Díaz 442). This material is the same as the one cited in Harris (1995: 106) for Collier County under the collection number Harris 30313. It agrees with *P. santensis* in the large perithecia covered by a thin thalline layer and the non-inspersed hymenium, but has smaller ascospores ($14\text{--}15 \times 4.5\text{--}5.5 \mu\text{m}$ in the present material). We agree with Harris (1995) that this might represent a taxon distinct from *P. santensis* s.str.
- Pyrenula septicollaris* (Eschw.) R. C. Harris**—(Nelsen 4083c, Seavey & Seavey 13335*).
- **Pyrenula sexocularis* (Nyl.) Müll. Arg.**—Figure 52C (Lücking & Rivas Plata 26780, Seavey & Seavey 10256). This taxon has almost invariably been included in *P. concatervans*, a species with 3-septate ascospores (Harris 1995). Considering that ascospores with more than three transverse septa are extremely rare within *Pyrenula*, and the material seen by us has either 3-septate or 5-septate mature ascospores, we propose to recognize the taxon with 5-septate ascospores as separate species.
- Pyrenula thelomorpha* Tuck.**—Figure 52D (Lücking & Rivas Plata 26658b, Seavey & Seavey 10802).
- Pyrgillus javanicus* (Mont. & Bosch) Nyl.**—Figure 52E (Beeching 7604, Lay 09-0110, Lendemer 15583).
- Pyxine cocoes* (Sw.) Nyl.**—Figure 52F (Lücking & Rivas Plata 26806).
- Pyxine eschweileri* (Tuck.) Vain.**—Figure 52G–H (Breuss 28655*, Lay 09-0060, Lücking & Rivas Plata 26563b, Mercado-Díaz 448).
- Ramalina complanata* (Sw.) Ach.**—(Hodkinson 10547, Seavey & Seavey 10426).
- Ramalina dasypoga* Tuck.**—(Lay 09-0111, Seavey & Seavey 10579*).
- Ramalina dendriscoides* Nyl.**—(Lendemer 15690).
- Ramalina denticulata* Nyl.**—(Lay 09-0112, Seavey & Seavey 10427).
- Ramalina montagnei* De Not.**—(Beeching 7610, Breuss 28694*, McMullin 3018).
- Ramalina peruviana* Ach.**—(Beeching 7634, Seavey & Seavey 10414).
- Ramalina stenospora* Müll. Arg.**—(Crane ILLS 60451, Lay 09-0113, Seavey & Seavey 10835).
- Ramalina usnea* (L.) R. Howe**—(Beeching 7616, Crane ILLS 60438, Hodkinson 10556, Lay 09-0116, Lendemer 15593, Seavey & Seavey 10484*).
- Ramalina willeyi* R. Howe.**—(Beeching 7719).
- Reimnitzia santensis* (Tuck.) Kalb**—Figure 53A–B (Lücking & Rivas Plata 26558*, Nelsen 4179).
- Sarcographa labyrinthica* (Ach.) Müll. Arg.**—Figure 53C–H (Beeching 7635, Buck 54461, Common 7355G, 7367A, 7381A, Crane ILLS 60450, Lay 09-0119, Lendemer 15678, Lücking & Rivas Plata 26559*, 26560*, Seavey & Seavey 10799*). *Sarcographa labyrinthica* is possibly a collective species. The shape and arrangement of the lirellae within the stromata is very different across samples (Figure 53C–H) and this appears to correlate with thallus morphology.
- Sarcographa tricola* (Ach.) Müll. Arg.**—Figure 54A (Common 7346H, 7367F, 7410D, Crane ILLS 60428, Hodges 9304.7, Lay 09-0147).
- Segestria leptalea* (Durieu & Mont.) R.C. Harris**—Figure 54B (Breuss 28722*).
- **Sporopodium marginatum* Lücking & Lumbsch**—Figure 54C (Lücking & Rivas Plata 26808a, Safranek 86, 87, 90, 91).
- Stegobolus auberianus* (Mont.) A. Frisch & Kalb**—(Beeching 7690).
- Stegobolus emersus* (Kremp.) A. Frisch & Kalb**—Figure 54D (Harris & Buck s.n.). In the checklist as *Ocellularia emersa*.
- Stegobolus granulatus* (Tuck.) A. Frisch.**—Figure 54E–H (Lay 09-0028, Lendemer 15602, Mercado-Díaz 400, Nelsen 4180, Seavey & Seavey 10837).
- Sticta beauvoisii* Delise**—(Beeching 7655, Lay 09-0121).
- ***Stirtonia dubia* A. L. Sm.**—Figure 55A–B (Common 7421D). The genus *Stirtonia* was revised by Aptroot (2009), who stated that the

genus is almost absent from the Neotropics. Surprisingly, two species previously known only from the Paleotropics were found in our material, indicating that this genus is probably undercollected in the Neotropics or misidentified in herbarium collections.

*****Stirtonia macrocarpa* Makhija & Patw.**—Figure 55C–D (*Common* 7327C).

****Strigula orbicularis* Fr.**—Figure 55E (*Seavey & Seavey* 10510).

***Strigula phaea* (Ach.) R. C. Harris**—Figure 55F (*Buck* 54474, *Lendemer* 15531, *Lücking & Rivas Plata* 26589*).

****Strigula schizospora* R. Sant.**—Figure 55G (*Lay* 09-0208A, *Mercado-Díaz* 419a, *Safranek* 109).

***Strigula smaragdula* Fr.**—Figure 55H (*Lay* 09-0208B, *Lücking & Rivas Plata* 26694b, *Mercado-Díaz* 419b, *Nelsen* 4077, *Seavey & Seavey* 10531).

***Syncesia byssina* (Vain.) Tehler**—Figure 56A (*Breuss* 28938*, *Lendemer* 15619, *Lücking & Rivas Plata* 26831*, *Seavey & Seavey* 10781).

****Tapellaria albomarginata* Lücking**—Figure 56B (*Common* 7285F, 7322H, *Seavey & Seavey* 10571). This species is described in a recent paper (Lumbsch et al. 2011) based on material from Costa Rica. It is anatomically similar to *T. bilimbioides* R. Sant. but differs in the distinct white pruina covering the apothecial margin. The ascospores are predominantly 3-septate but occasionally, ascospores with up to four or five septa might occur. In the North American checklist, this name should replace *T. bilimbioides*, which is with certainty only known from the Paleotropics.

******Tapellaria floridensis* Common & Lücking**—Figure 56C (*Common* 7315D, *Common* 7322A). See p. 149 for description of this new species.

******Tapellaria granulosa* Lücking & Rivas Plata**—Figure 56D (*Lay* 09-0013, *Lücking & Rivas Plata* 26697, 26810*, *Mercado-Díaz* 394). See p. 149 for description of this new species.

****Tapellaria malmei* R. Sant.**—Figure 56E (*Lay* 09-0017B, *Lücking & Rivas Plata* 26811).

***Tapellaria nana* R. Sant.**—Figure 56F (*Seavey & Seavey* 10618).

Tapellaria spec.—Figure 56G–H (*Hodges s.n.*). This material is characterized by a coarsely verrucose-bullate thallus; the hypothecium and excipulum are dark gray-brown reacting K+ sordid green, a reaction unusual for the genus (normally K+ purple). While campylidia are abundant in the material, only one apothecium was found and it lacked ascospores. Thus, while this taxon is certainly not identical with any known species of *Tapellaria*, it cannot be formally described at this point, but further collections must be awaited to get ascospore data.

***Tephromela atra* (Hudson) Hafellner**—Figure 57A (*Seavey & Seavey* 10574*).

***Thalloloma anguinum* (Mont.) Trevis.**—Figure 57B (*Common* 7356K, 7367B, 7380M).

***Thalloloma hypoleptum* (Nyl.) Staiger**—Figure 57C (*Lücking & Rivas Plata* 26564*).

***Thecaria quassiiicola* Fée**—Figure 57D (*Beeching* 7661, *Buck* 54477, *Common* 7313B, 7366, *Crane* ILLS 60440, *Lay* 09-0117, *Lücking & Rivas Plata* 26615*, 26626*, *Seavey & Seavey* 10603). The species is extremely variable in producing both perfectly round and distinctly lirellate ascomata on the same thallus (Harris 1995). Exactly the same variation was observed in material from the Philippines and the specimens cluster together in molecular phylogenetic analyses (*Rivas Plata et al.*, unpubl. data).

***Thelotrema lathraeum* Tuck.**—Figure 57E (*Common* 7359B, 7371A, *Harris & Buck s.n.*). This species was synonymized with *T. defossum* (Müll. Arg.) Mangold (*Rivas Plata et al.* 2010), but is actually set apart by the distinctly corticate thallus and extremely small apothecia. It frequently grows together with *Fissurina analphabetica*, which has the same thallus type.

****Thelotrema pachysporum* Nyl.**—Figure 57F (*Beeching* 7628, *Lücking & Rivas Plata* 26569*, *Seavey & Seavey* 10812).

***Thelotrema porinoides* Mont. & Bosch.**—Figure

57G (Lücking & Rivas Plata 26570).

***Thelotrema subtile* Tuck.**—(Beeching 7723).

***Tricharia subumbrosa* Lücking & W. R. Buck.**—(Beeching 7700).

***Tricharia vainioi* R. Sant.**—Figure 57H (Crane ILLS 60435, Lücking & Rivas Plata 26808c, Mercado-Díaz 419c).

***Trypethelium aeneum* (Eschw.) Zahlbr.**—Figure 58A (Beeching 7639, 7696, Buck 54430, Crane ILLS 60459, Lendemer 15695, Lücking & Rivas Plata 26814*, Nelsen 4091, Seavey & Seavey 10514*).

***Trypethelium eluteriae* Spreng.**—Figure 58B (Beeching 7680, Mercado-Díaz 434, 452, Seavey & Seavey 10532*).

***Trypethelium marcidum* (Fée) Aptroot**—Figure 58C Synonym *T. floridanum* (Zahlbr. ex Choisy) R. C. Harris—(Beeching 7694, Buck 54393, Lendemer 15543, Mercado-Díaz 479, Nelsen 4090, Seavey & Seavey 10587). As *Trypethelium floridanum* in the North American checklist.

***Trypethelium nitidiusculum* (Nyl.) R. C. Harris**—Figure 58D (Beeching 7692, Crane ILLS 60466, Lay 09-0122, Lücking & Rivas Plata 26816*, Nelsen 4002a, Seavey & Seavey 10418).

***Trypethelium ochroleucum* (Eschw.) Nyl.**—Figure 58E (Beeching 7709, Crane ILLS 60452, Lay 09-0144, Lücking & Rivas Plata 26822*, 26824*, Mercado-Díaz 417, Nelsen 4081, Seavey & Seavey 10161*).

***Trypethelium tropicum* (Ach.) Müll. Arg.**—Figure 58F (Beeching 7695, Buck 54448, Lay 09-0125, Lendemer 15581, Lücking & Rivas Plata 26827, 26828*, Nelsen 4143, Seavey & Seavey 10401*).

***Tylophoron moderatum* Nyl.**—Figure 58G–H (Harris & Buck s.n.).

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LITERATURE CITED

- Amtoft, A., F. Lutzoni, & J. Miadlikowska 2008. *Dermatocarpon* (Verrucariaceae) in the Ozark Highlands, North America. *The Bryologist* 111:1–40.
- Aptroot, A. 1991. A monograph of the Pyrenulaceae (excluding *Anthracotheceum* and *Pyrenula*) and the Requienellaceae, with notes on

- the Pleomassariaceae, the Trypetheliaceae and *Mycomicrothelia* (lichenized and non-lichenized Ascomycetes). *Bibliotheca Lichenologica* 44:1–178.
- Aptroot, A. 1997. Lichen biodiversity in Papua New Guinea, with the report of 173 species on one tree. *Bibliotheca Lichenologica* 64:203–213.
- Aptroot, A. 2009. A revision of the lichen genus *Stirtonia*. *The Lichenologist* 41:615–625.
- Aptroot, A., & H. J. M. Sipman 1997. Diversity of lichenized fungi in the tropics. Pp. 93–106 in K. D. Hyde (ed.). *Biodiversity of Tropical Microfungi*. University Press, Hong Kong.
- Aptroot, A., P. Diederich, E. Sérusiaux, & H. J. M. Sipman 1997. Lichens and lichenicolous fungi from New Guinea. *Bibliotheca Lichenologica* 64:1–220.
- Aptroot, A., R. Lücking, H. J. M. Sipman, L. Umaña, & J. L. Chaves 2008. Pyrenocarpous lichens with bitunicate asci: A first assessment of the lichen biodiversity inventory in Costa Rica. *Bibliotheca Lichenologica* 97:1–162.
- Aptroot, A., G. Thor, R. Lücking, J. A. Elix, & J. L. Chaves. 2009. The lichen genus *Herpothallon* reinstated. *Bibliotheca Lichenologica* 99:19–66.
- Archer, A. W. 2001. The lichen genus *Graphina* (Graphidaceae) in Australia: new reports and new species. *Mycotaxon* 77:153–180.
- Archer, A. W. 2009. Graphidaceae. *Flora of Australia* 57:84–194.
- Armstrong, R. A. 1989. Competition, seed predation, and species coexistence. *Journal of Theoretical Biology* 141:191–196.
- Arup, U., S. Ekman, L. Lindblom, & J. E. Mattsson 1993. High performance thin layer chromatography (HPTLC), an improved technique for screening lichen substances. *Lichenologist* 25:61–71.
- Austin, D. F., J. L. Jones, & B. C. Bennett 1990. Vascular plants of the Fakahatchee Strand State Preserve. *Florida Scientist* 53:89–117.
- Avery, G. N., & L. L. Loope 1980. Endemic taxa in the flora of South Florida. National Park Service, South Florida Research Center Report T-558, Homestead, Florida. 39 p.
- Avery, G. N., & L. L. Loope 1996. Plants of Everglades National Park: a preliminary checklist of vascular plants. 3rd Edition edited by R. G. Reimus. National Park Service, South Florida Research Center Report T-574, Homestead, Florida.
- Beard, D. B. 1938. Everglades National Park Project: Wildlife Reconnaissance. U.S. Department of the Interior, National Park Service, Washington, D.C.
- Becker, P., L. W. Lee, E. D. Rothman, & W. D. Hamilton 1985. Seed predation and the coexistence of tree species: Hubbell's models revisited. *Oikos* 44:382–390.
- Bennett, J. P. 2006. NPLichen Version 3 is now available. *Evansia* 23:21.
- Bennett, J. P., & C. M. Wetmore. 1999. Covariance of lichen and vascular plant floras. *Rhodora* 101:277–297.
- Bennett, J. P., & C. M. Wetmore. 2005a. Lichens of the U.S. national parks. *The Bryologist* 108:544–553.
- Bennett, J. P., & C. M. Wetmore. 2005b. NPLichen: a database of lichens in the U.S. national parks. *Evansia* 22:39–42.
- Bouly de Lesdain, M. 1933. Lichens de la Louisiane recueillis par les frères G. Arsène et Néon. *Annales de Cryptogamie Exotique* 6:49–58.
- Brodo, I. M., S. Duran-Sharnoff, & S. Sharnoff 2001. *Lichens of North America*. Yale University Press, New Haven & London.
- Buck, W. R., & E. Sérusiaux. 2000. *Gyalectidium yahriae*, sp. nov. (lichenized Ascomycetes, Gomphillaceae) from Florida and Papua New Guinea. *The Bryologist* 103:134–138.
- Burkey, T. V. 1994. Tropical tree diversity: A test of the Janzen-Connell model. *Oecologia* 97:533–540.
- Cáceres, M. E. S. 2007. Corticolous crustose and microfoliose lichens of northeastern Brazil. *Libri Botanici* 22:1–168.
- Cáceres, M. E. S., R. Lücking, & G. Rambold 2008. Efficiency of sampling methods for accurate estimation of species richness of corticolous microlichens in the Atlantic

- rainforest of northeastern Brazil, *Biodiversity and Conservation* 17:1285–1301.
- Calkins, W. W. 1885. Notes on Florida lichens. *Botanical Gazette* 10:369–370.
- Calkins, W. W. 1886. Catalogue of lichens collected in Florida in 1885. With notes. *Journal of Mycology* 2:112–114.
- Calkins, W. W. 1889. Florida lichens. *Bulletin of the Torrey Botanical Club* 16:330.
- Connell, J. H. 1978. Diversity in tropical rainforests and coral reefs. *Science* 199:1302–1310.
- Dal-Forno, M., & S. Eliasaro. 2010. Two new species of Graphidaceae (lichenized Ascomycota) from Brazil. *Mycotaxon* 112:15–20.
- DeBolt, A. M., R. Rosentreter, & E. P. Martin. 2007. Macrolichen diversity in subtropical forests of north-central Florida. *The Bryologist* 110:254–265.
- Dey, J. P. 1978. Fruticose and foliose lichens of the high-mountain areas of the southern Appalachians. *The Bryologist* 81:1–93.
- Eckfeldt, J. W., & W. W. Calkins 1887a. The lichen-flora of Florida. Catalogue of species, with notes, and also notices of new species. *Journal of Mycology* 3:121–126.
- Eckfeldt, J. W., & W. W. Calkins 1887b. The lichen-flora of Florida. Catalogue of species, with notes, and also notices of new species. *Journal of Mycology* 3:133–137.
- Egea, J. M., & P. Torrente. 1993. The Lichen Genus *Bactrospora*. *The Lichenologist* 25:211–255.
- Ekman, S. 1996. The corticolous and lignicolous species of *Bacidia* and *Bacidina* in North America. *Opera Botanica* 127:1–148.
- Esslinger, T. L. 2010. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada. North Dakota State University, Fargo, North Dakota. <http://www.ndsu.edu/pubweb/~esslinge/chcklst/chcklst7.htm> [First posted 1 December 1997, most recent version (#16) 18 June 2010].
- Feurerer, T., & D. L. Hawksworth. 2007. Biodiversity of lichens, including a world-wide analysis of checklist data based on Takhtajan's floristic regions. *Biodiversity and Conservation* 16:85–98.
- Fink, B. 1927. New species of lichens from Porto Rico I. Graphidaceae. *Mycologia* 19:206–221.
- Frisch, A., & K. Kalb 2006. A monograph of Thelotremaaceae with a complex structure of the columella. *Bibliotheca Lichenologica* 92:371–516.
- Frisch, A., G. Thor, & J. A. Elix. 2010. *Herpothallon rubroechinatum* (Arthoniaceae), a new species from tropical and subtropical America. *The Bryologist* 113:144–148.
- Fryday, A. M., & J. C. Lendemer 2010. Reassessment of the genus *Catillochroma* (lichenized Ascomycota, Ramalinaceae). *The Lichenologist* 42:587–600.
- Galloway, D. J. 2007. Flora of New Zealand Lichens. Revised Second Edition Including Lichen-Forming and Lichenicolous Fungi. Volumes 1 and 2. Manaaki Whenua Press, Lincoln, New Zealand.
- Griffin III, D., R. C. Harris, & W. R. Buck. 1995. The bryophytes and lichens of Rock Hill Preserve, Florida. *Evansia* 12:31–39.
- Grossman, D. H., D. Faber-Langendoen, A. S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K. D. Patterson, M. Pyne, M. Reid, & L. Sneddon. 1998. International Classification of Ecological Communities: Terrestrial Vegetation of the United States. Volume I. The National Vegetation Classification System: Development, Status, and Applications. The Nature Conservancy, Arlington, Virginia, USA.
- Grube, M. 2001. *Sporostigma*, a new calicioid genus in Arthoniales. *Lichenologist* 33:387–391.
- Grube, M. 2007. *Arthonia*. Pp. 39–61 in T. H. Nash III, C. Gries, & F. Bungartz (eds.). Lichen Flora of the Greater Sonoran Desert Region. Volume 3. Lichens Unlimited, Arizona State University, Tempe.
- Grube, M., & J. C. Lendemer. 2009. *Arthonia rubrocincta*: belated validation of a name for a common species endemic to *Sabal palmetto* in the southeastern United States. *Opuscula Philolichenum* 7:7–12.
- Hale Jr., M. E. 1957. Corticolous lichen flora of the

- Ozark Mountains. Transactions of the Kansas Academy of Sciences 60:155–160.
- Hale Jr., M. E. 1978. A revision of the lichen family Thelotremaaceae in Panama. Smithsonian Contributions to Botany 38:1–60.
- Hale Jr., M. E. 1981. A revision of the lichen family Thelotremaaceae in Sri Lanka. Bulletin of the British Museum (Natural History), Botany Series 8:227–332.
- Harris, R. C. 1975. A taxonomic revision of the genus *Arthopyrenia* Massal. s. lat. (Ascomycetes) in North America. Ph.D. Dissertation, Michigan State University, East Lansing.
- Harris, R. C. 1987. Four lichens new to North America collected on the 1985 ABLS Foray in Florida. *Evansia* 4:26–27.
- Harris, R. C. 1988. *Buellia* in north and central Florida or the virtues and rewards of collecting. *Evansia* 5:37–45.
- Harris, R. C. 1990. Some Florida Lichens. Published by the author, Bronx, NY.
- Harris, R. C. 1995. More Florida Lichens Including the 10 ¢ Tour of the Pyrenolichens. Published by the author, Bronx, NY.
- Harris, R. C. 2009. Four novel lichen taxa in the lichen biota of eastern North America. *Opuscula Philolichenum* 6:149–156.
- Harris, R. C., & D. Ladd. 2007. New taxa of lichens and lichenicolous fungi from the Ozark ecoregion. *Opuscula Philolichenum* 4:57–68.
- Harris, R. C., & D. Ladd. 2008. The lichen genus *Chrysothrix* in the Ozark ecoregion, including a preliminary treatment for eastern and central North America. *Opuscula Philolichenum* 5:29–42.
- Harris, R. C., & E. M. Wheeler. 1988. *Gyalideopsis vainioi* new to North America. *Evansia* 5:22.
- Harris, R. C., & J. C. Lendemer. 2009. The *Fellhanera silicis* group in eastern North America. *Opuscula Philolichenum* 6:157–174.
- Hayward, G. C. 1977. Taxonomy of the lichen families Graphidaceae and Opegraphaceae in New Zealand. *New Zealand Journal of Botany* 15:565–584.
- Herre, A. W. 1942. Some notheworthy lichens from Florida. *The Bryologist* 45:180.
- Herrera-Campos, M. A., R. Lücking, R.-E. Pérez Pérez, A. Campos, P. Martínez Colín, & A. Bárcenas Peña. 2004. The foliicolous lichen flora of Mexico. V. Biogeographical affinities, altitudinal preferences, and an updated checklist of 293 species. *The Lichenologist* 36:309–327.
- Hodkinson, B. P. 2010. A first assessment of lichen diversity for one of North America's 'Biodiversity Hotspots' in the Southern Appalachians of Virginia. *Castanea* 75:126–133.
- Hodkinson, B. P., R. C. Harris, & M. A. Case. 2009. A Checklist of Virginia Lichens. *Evansia* 26:64–88.
- Hodkinson, B. P., R. C. Harris, & M. A. Case. 2010. A Checklist of Virginia Lichens. <http://www.duke.edu/~bph8/VirginiaLichens/checklist.html> [updated: 01 December 2010].
- Hubbell, S. P., R. B. Foster, S. T. O'Brien, K. E. Harms, R. Condit, B. Wechsler, S. J. Wright, & S. Loo de Lao. 1999. Light-gap disturbances, recruitment limitation, and tree diversity in a neotropical forest. *Science* 283:554–557.
- Huston, M. 1979. A general hypothesis of species diversity. *American Naturalist* 113:81–101.
- Janzen, D. H. 1970. Herbivores and the number of tree species in tropical forests. *American Naturalist* 104:501–528.
- Kalb, K. 2007. New or otherwise interesting lichens. *Bibliotheca Lichenologica* 95:297–316.
- Kalb, K., B. Staiger & J. A. Elix. 2004. A monograph of the lichen genus *Diorygma* – a first attempt. *Symbolae Botanicae Upsalienses* 34(1):133–181.
- Kalb, K., E. Rivas Plata, R. Lücking, & H. T. Lumbsch. 2011. The phylogenetic position of *Malmidea*, a new genus for the *Lecidea piperis*- and *Lecanora granifera*-groups (Lecanorales, Malmideaceae), inferred from nuclear and mitochondrial ribosomal DNA sequences, with special reference to Thai species. *Bibliotheca Lichenologica* 106:137–163.
- Knudsen, K., & J. Kocourková. 2010. Lichens, lichenicolous and allied fungi of the Santa Monica Mountains, Part 5: Additions and

- Corrections to the Annotated Checklist. *Opuscula Philolichenum* 8:83–100.
- Knudsen, K., J. A. Elix, & J. C. Lendemer. 2007. *Lepraria adherens*: a new species from North America. *Opuscula Philolichenum* 4:5–10.
- Komposch, H., & J. Hafellner 1999. List of lichenized fungi so far observed in the tropical lowland rain forest plot Surumoni (Venezuela, Estado Amazonas). *Fritschiana* 19:1–10.
- Komposch, H., & J. Hafellner 2000. Diversity and vertical distribution of lichens in a Venezuelan tropical lowland rain forest. *Selbyana* 21:11–24.
- Lendemer, J. C. 2009a. A synopsis of the lichen genus *Heterodermia* (Physciaceae, lichenized Ascomycota) in eastern North America. *Opuscula Philolichenum* 6:1–36.
- Lendemer, J. C. 2009b. *Opegrapha moroziana* (Roccellaceae, lichenized Ascomycetes), a new sorediate saxicolous species from eastern North America. *Opuscula Philolichenum* 6:51–54.
- Lendemer, J. C. 2009c. *Pertusaria andersonii* (Pertusariaceae, lichenized Ascomycetes), a new species from high elevations of the southern Appalachian Mountains of eastern North America. *Opuscula Philolichenum* 6:55–58.
- Lendemer, J. C. 2009d. A synopsis of the lichen genus *Heterodermia* (Physciaceae, lichenized Ascomycota) in eastern North America. *Opuscula Philolichenum* 6:1–36.
- Lendemer, J. C. 2010. Notes on the genus *Graphis* (Graphidaceae: lichenized Ascomycetes) in the coastal plain of southeastern North America. *Journal of the Torrey Botanical Society* 137:312–317.
- Lendemer, J. C., & J. A. Elix. 2010. Two new species of *Chrysothrix* from eastern North America. *Opuscula Philolichenum* 8:51–58.
- Lendemer, J. C., & W. M. Knapp, 2007. Contributions to the lichen flora of Maryland: recent collections from the Delmarva Peninsula. *Opuscula Philolichenum* 4:23–40.
- Lendemer, J. C., & K. Knudsen 2008. Studies in lichens and lichenicolous fungi: further notes on North American taxa. *Mycotaxon* 103:75–86.
- Lendemer, J. C., & H. T. Lumbsch 2008. *Protoparmelia capitata* sp. nov., and *P. isidiata* Diederich, Aptroot and Sérus., two species of *Protoparmelia* (Lecanorales, Ascomycota) from south-eastern North America. *Lichenologist* 40:329–336.
- Lendemer, J. C., & C. A. Morse. 2010. *Caloplaca yuchiorum* (Teloschistaceae, lichenized Ascomycota), a new sorediate species from North America. *Journal of the Torrey Botanical Society* 137:327–332.
- Lendemer, J. C., & E. A. Tripp 2008. Contributions to the lichen flora of North Carolina: a preliminary checklist of the lichens of Gorges State Park. *The Bryologist* 111:57–67.
- Lendemer, J. C., & R. Yahr. 2004. A checklist of the lichens collected during the Tuckerman workshop #12, Outer Banks, North Carolina, USA. *Evansia* 21:118–136.
- Lendemer, J. C., J. Kocourková, & K. Knudsen 2009a. Studies in lichen and lichenicolous fungi: more notes on taxa from North America. *Mycotaxon* 108:491–497.
- Lendemer, J. C., J. Kocourková, & K. Knudsen 2009b. Studies in lichens and lichenicolous fungi: More notes on taxa from North America. *Mycotaxon* 110: 373–378.
- Linsenmair, K. E. 1990. Tropische Biodiversität: Befunde und offene Probleme. *Verhandlungen der Deutschen Zoologischen Gesellschaft* 83:245–261.
- Lücking, R. 1999. Líquenes foliícolas de la Estación Biológica La Selva, Costa Rica: Inventario, comunidades y comparación florística de tipos de vegetación. *Revista de Biología Tropical* 47:287–308.
- Lücking, R. 2008. Foliicolous lichenized fungi. *Flora Neotropica Monograph* 103:1–866.
- Lücking, R. 2009. The taxonomy of the genus *Graphis* sensu Staiger (Ascomycota: Ostropales: Graphidaceae). *Lichenologist* 41:319–362.
- Lücking, R., & A. Bernecker-Lücking 2000. Lichen feeders and lichenicolous fungi: Do they affect

- dispersal and diversity in tropical foliicolous lichen communities? *Ecotropica* 6:23–41.
- Lücking, R., & A. Bernecker-Lücking 2002. Distance, dynamics, and diversity in tropical rain forests: An experimental approach using lichens on artificial leaves. *Ecotropica* 8:1–13.
- Lücking, R., & M. E. S. Cáceres. 2004. Corticolous species of *Trichothelium* (Ascomycota: Porinaceae). *Mycological Research* 108:571–575.
- Lücking, R., & M. Matzer 2001. High foliicolous lichen alpha-diversity on individual leaves in Costa Rica and Amazonian Ecuador. *Biodiversity and Conservation* 10:2139–2152.
- Lücking, R., & E. Sérusiaux. 2001. *Lasioloma stephanellum* comb. nov. (Lichenized Ascomycetes: Ectolechiaceae). *Mycotaxon* 77:301–304.
- Lücking, R., W. R. Buck, & E. Rivas Plata. 2007. The lichen family Gomphillaceae (Ostropales) in eastern North America, with notes on hyphophore development in *Gomphillus* and *Gyalideopsis*. *The Bryologist* 110:622–672.
- Lücking, R., J. L. Chaves, H. J. M. Sipman, L. Umaña, & A. Aptroot 2008. A first assessment of the Ticolichen Biodiversity Inventory in Costa Rica: the genus *Graphis*, with notes on the genus *Hemithecium* (Ascomycota: Ostropales: Graphidaceae). *Fieldiana Botany, New Series* 46:1–126.
- Lücking, R., E. Rivas Plata, J. L. Chaves, L. Umaña, & H. J. M. Sipman. 2009a. How many tropical lichens are there... really? *Bibliotheca Lichenologica* 100:399–418.
- Lücking, R., A. W. Archer, & A. Aptroot 2009b. A world-wide key to the genus *Graphis* (Ostropales: Graphidaceae). *The Lichenologist* 41:363–452.
- Lücking, R., E. Rivas Plata, K. Kalb & R. Common. 2011. *Halegrapha* (Ascomycota: Graphidaceae), an enigmatic new genus of tropical lichenized fungi dedicated to Mason Hale Jr. *The Lichenologist* (in press).
- Lumbsch, H. T. 2002. Analysis of phenolic products in lichens for identification and taxonomy. Pp. 281–295 in I. Kranner, R. P. Beckett, & A. K. Varma (eds.). *Protocols in Lichenology. Culturing, Biochemistry, Ecophysiology and Use in Biomonitoring*. Springer, Berlin, Germany.
- Lumbsch, H. T., T. Ahti, S. Altermann, G. Amo De Paz, A. Aptroot, U. Arup, A. Bárcenas Peña, P. A. Bawingan, M. N. Benatti, L. Betancourt, C. R. Björk, K. Boonpragob, M. Brand, F. Bungartz, M. E. S. Cáceres, M. Candan, J. L. Chaves, P. Clerc, R. Common, B. J. Coppins, A. Crespo, M. Dal-Forno, P. K. Divakar, M. V. Duya, J. A. Elix, A. Elvebakk, J. D. Fankhauser, E. Farkas, L. Itatí Ferraro, E. Fischer, D. J. Galloway, E. Gaya, M. Giralt, T. Goward, M. Grube, J. Hafellner, J. E. Hernández M., M. De Los Angeles Herrera Campos, K. Kalb, I. Kärnefelt, G. Kantvilas, D. Killmann, P. Kirika, K. Knudsen, H. Komposch, S. Kondratyuk, J. D. Lawrey, A. Mangold, M. P. Marcelli, B. Mccune, M. Ines Messuti, A. Michlig, R. Miranda González, B. Moncada, A. Naikatini, M. P. Nelsen, D. O. Øvstedal, Z. Palice, K. Papong, S. Parnmen, S. Pérez-Ortega, C. Printzen, V. J. Rico, E. Rivas Plata, J. Robayo, D. Rosabal, U. Ruprecht, N. Salazar Allen, L. Sancho, L. Santos De Jesus, T. Santos Vieira, M. Schultz, M. R. D. Seaward, E. Sérusiaux, I. Schmitt, H. J. M. Sipman, M. Sohrabi, U. Söchting, M. Zeuthen Søgaard, L. B. Sparrius, A. Spielmann, T. Spribille, J. Sutjaritturakan, A. Thammathaworn, A. Thell, G. Thor, H. Thüs, E. Timdal, C. Truong, R. Türk, L. Umaña Tenorio, D. K. Upreti, P. Van Den Boom, M. Vivas Rebuelta, M. Wedin, S. Will-Wolf, V. Wirth, N. Wirtz, R. Yahr, K. Yeshitela, F. Ziemmeck, T. Wheeler & R. Lücking. 2011. One hundred new species of lichenized fungi: a signature of undiscovered global diversity. *Phytotaxa* 18:1–127.
- Lumbsch, H. T., G. B. Feige, & J. A. Elix. 1995. A revision of the usnic acid containing taxa belonging to *Lecanora* sensu stricto (Lecanorales: lichenized Ascomycotina). *The Bryologist* 98:561–577.
- Mangold, A., J. A. Elix & H. T. Lumbsch 2009. Thelotremataceae. *Flora of Australia* 57: 195–420.

- Marbach, B. 2000. Corticole und lignicole Arten der Flechtengattung *Buellia* sensu lato in den Subtropen und Tropen. *Bibliotheca Lichenologica* 74:1–384.
- McCune, B., & J. B. Grace. 2002. Analysis of Ecological Communities. MjM Software, Gleneden Beach, Oregon.
- McGuiness, K. A. 1984. Equations and explanations in the study of species-area curves. *Biological Review* 59:423–440.
- Merrill, G. K. 1913. Florida lichens. *The Bryologist* 16:30–41.
- Montagne, C. 1842. Troisième centurie de plantes cellulaires exotiques nouvelles, *Décades V–VIII*. *Annales des Sciences Naturelles* 18:241–282.
- Moore, B. J. 1966. The chemistry of the *Parmelia perforata* group in Florida. *The Bryologist* 69:353–356.
- Moore, B. J. 1968. The macrolichen flora of Florida. *The Bryologist* 71:161–266.
- Müller Argoviensis, J. 1885. *Pyrenocarpeae Cubenses a cl. C. Wright lectae*. *Englers Botanische Jahrbücher* 6:375–421.
- Müller Argoviensis, J. 1895. *Graphideae Eckfeldtianae in Louisiana et Florida lectae additis observationibus in Graphideas Calkinsianas ejusdem regionis*. *Bulletin de l'Herbier Boissier* 3:41–50.
- Muggia, L., C. Gueidan, G. Perlmutter, O. E. Eriksson, & M. Grube 2009. Molecular data confirm the position of *Flakea papillata* in the Verrucariaceae. *The Bryologist* 112:538–543.
- Nash III, T. H., B. D. Ryan, C. Gries, & F. Bungartz (eds). 2002. Lichen Flora of the Greater Sonoran Desert Region, Volume 1. Lichens Unlimited, Arizona State University, Tempe.
- Nash III, T. H., B. D. Ryan, P. Diederich, C. Gries, & F. Bungartz (eds). 2004. Lichen Flora of the Greater Sonoran Desert Region, Volume 2. Lichens Unlimited, Arizona State University, Tempe.
- Nash III, T. H., C. Gries, & F. Bungartz (eds). 2007. Lichen Flora of the Greater Sonoran Desert Region, Volume 3. Lichens Unlimited, Arizona State University, Tempe.
- Nelsen, M. P., R. Lücking, M. Grube, J. S. Mbatchou, L. Muggia, E. Rivas Plata & H. T. Lumbsch. 2009. Unravelling the phylogenetic relationships of lichenized fungi in Dothideomyceta. *Studies in Mycology* 64:135–144.
- Nelsen, M. P., R. Lücking, E. Rivas Plata, & J. S. Mbatchou 2010. *Heiomasia*, a new genus in the lichen-forming family Graphidaceae (Ascomycota: Lecanoromycetes: Ostropales) with disjunct distribution in southeastern North America and southeast Asia. *Bryologist* 113:742–751.
- Ney-Nifle, M., & M. Mangel. 2000. Habitat loss and changes in the species–area relationship. *Conservation Biology* 14:893–898.
- Nilsson S. G., J. Bengtsson, & S. As. 1988. Habitat diversity or area per se? Species richness of woody plant, carabid beetles, and land snailson islands. *Journal of Animal Ecology* 57:685–704.
- Nylander, W. 1886. *Graphidei Cubani novi*. *Flora* 69:103–104.
- Olmsted, I. C., & L. L. Loope 1984. Plant communities of Everglades National Park. Pp. 167–184 in P. J. Gleason (ed.). *Environments of South Florida: Present and Past II*. Miami Geological Society, Coral Gables, Florida.
- Olmstead, I. C., L. L. Loope, & R. P. Russell 1981. Vegetation of southern coastal region of Everglades National Park between Flamingo and Joe Bay. National Park Service, South Florida Research Center Report T–620, Homestead, Florida. 18 p.
- Olmsted, I. C., H. Dunevitz, & W. J. Platt 1993. Effects of freezes on tropical trees in Everglades National Park Florida, USA. *Tropical Ecology* 34:17–34.
- Orzell, S. L., & E. L. Bridges 2006. Floristic composition and species richness of subtropical seasonally wet *Muhlenbergia sericea* prairies in portions of central and south Florida. Pp. 136–175 in R. F. Noss (ed.). *Land of Fire and Water: The Florida Dry Prairie Ecosystem*. Proceedings of the Florida Dry Prairie Conference, Painter, DeLeon Springs.

- Peck, J. E., J. Grabner, D. Ladd, & D. R. Larsen. 2004. Microhabitat affinities of Missouri Ozarks lichens. *The Bryologist* 107:47–61.
- Perlmutter, G. B. 2006. *Flakea papillata* in North America. *The Bryologist* 109:566–569.
- Petuch, E. J., & C. Roberts 2007. *The Geology of the Everglades and Adjacent Areas*. CRC Press, Taylor & Francis Group, Boca Raton, Florida.
- Pirozynski, K. A., & D. L. Hawksworth (eds.) 1988. *Coevolution of Fungi with Plants and Animals*. Academic Press, London.
- Printzen, C. 1995. Die Flechtengattung *Biatora* in Europa. *Bibliotheca Lichenologica* 60:1–275.
- Randazzo, A. F., & D. S. Jones (eds.) 1997. *The Geology of Florida*. University of Florida Press, Tallahassee.
- Reese, W. D., & S. Tucker. 1970. The 1967 foray of the American Bryological and Lichenological Society in Louisiana and Texas. *The Bryologist* 73:692–701.
- Rivas Plata, E., R. Lücking, A. Aptroot, H. J. M. Sipman, L. Umaña, J. L. Chaves, & D. Lizano 2006. A first assessment of the Ticolichen biodiversity inventory in Costa Rica: the genus *Coenogonium* (Ostropales: Coenogoniaceae), with a world-wide key and checklist and a phenotype-based cladistic analysis. *Fungal Diversity* 23:255–321.
- Rivas Plata, E., R. Lücking, H. J. M. Sipman, A. Mangold, K. Kalb, & H. T. Lumbsch 2010. A world-wide key to the thelotremoid Graphidaceae, excuding the *Ocellularia-Myriotrema-Stegobolus* clade. *The Lichenologist* 42:187–189.
- Rivas Plata, E., J. E. Hernández M., R. Lücking, B. Staiger, K. Kalb, & M. E. S. Cáceres 2011. *Graphis* is two genera – A remarkable case of parallel evolution in lichenized Ascomycota. *Taxon* 60 (in press).
- Robertson, W. B. Jr. 1955. *An Analysis of Breeding-bird Populations in Tropical Florida in Relation to the Vegetation*. Ph.D. Dissertation, University of Illinois, Urbana, Illinois.
- Rolfs, P. H. 1901. Florida lichens. *Transactions of the Academy of Sciences of St. Louis* 11:25–39.
- Rosenzweig, M. L. 1995. *Species Diversity in Space and Time*. Cambridge University Press, Cambridge.
- Safranek, W. W., & Lücking, R. 2005. *Gyalectidium floridense*, a new foliicolous lichen from the southeastern United States. *The Bryologist* 108:295–297.
- Schupp, E. W. 1992. The Janzen-Connell model for tropical tree diversity: population implications and the importance of spatial scale. *American Naturalist* 140:526–530.
- Seavey, F. 2009. *Cryptothecia evergladensis* sp. nov. (Arthoniaceae), a new lichen species from Everglades National Park, Florida. *Opuscula Philolichenum* 7:49–54.
- Seavey, F., & J. Seavey. 2009. Subtropical Florida lichens. <http://www.seaveyfieldguides.com/Lichens/default.htm> (accessed May 2009).
- Sérusiaux, E. 1979. Follicolous lichens from southeastern United States. *The Bryologist* 82:88–93.
- Shmida A., & E. O. Wilson 1985. Biological determinants of species diversity. *Journal of Biogeography* 12:1–20.
- Sipman, H. J. M., & A. Aptroot 2001. Where are the missing lichens? *Mycological Research* 105:1433–1439.
- Skorepa, A. C. 1968. Lichens from the Okefenokee Swamp, Georgia. *Castanea* 33:248–253.
- Smith, C. W. 1986. Three foliicolous lichens new to the United States. *The Bryologist* 89:232–233.
- Sparrius, L. B. & W. Saipunkaew. 2005. *Cryptothecia punctosorediata*, a new species from northern Thailand. *Lichenologist* 37:507–509.
- Spribille, T., S. Pérez-Ortega, S., T. Tønsberg, & D. Schirokauer 2010. Lichens and lichenicolous fungi of the Klondike Gold Rush National Historic Park, Alaska, in a global biodiversity context. *The Bryologist* 113:439–515.
- Staiger, B., & K. Kalb. 1999. *Acanthothecis* and other graphidioid lichens with warty periphysoids or paraphysis-tips. *Mycotaxon* 73:69–134.
- Staiger, B. 2002. Die Flechtenfamilie Graphidaceae. Studien in Richtung einer natürlicheren

- Gliederung. *Bibliotheca Lichenologica* 85:1–526.
- Staiger, B., K. Kalb, & M. Grube 2006. Phylogeny and phenotypic variation in the lichen family Graphidaceae (Ostropomycetidae, Ascomycota). *Mycological Research* 110:765–772.
- Stocker, G. C., G. L. Unwin, & P. W. West 1985. Measures of richness, evenness and diversity in tropical rainforest. *Australian Journal of Botany* 33:131–137.
- Swinscow, T. D. V., & H. Krog 1981. The genus *Phyllopsora*, with a report on the East African species. *The Lichenologist* 13:203–247.
- Thomson, J. W. 2003. Lichens of Wisconsin. Wisconsin State Herbarium, Department of Botany, University of Wisconsin, Madison.
- Thor, G. 1988. Three calicialian lichens new to the continental United States. *The Bryologist* 91:367.
- Timdal, E. 2008. Studies on *Phyllopsora* (Ramalinaceae) in Peru. *The Lichenologist* 40:337–362.
- Tomlinson, P. B. 1980. *The Biology of Trees Native to Tropical Florida*, 2nd Edition. Published by the author, printed by the Harvard University Printing Office, Petersham, Massachusetts.
- Tripp, E. A. & J. C. Lendemer. 2010. The genus *Platygramme* in North America. *Castanea* 75:388–393.
- Tripp, E. A., J. C. Lendemer, & R. C. Harris. 2010. Resolving the genus *Graphina* Müll. Arg. in North America: new species, new combinations, and treatments for *Acanthothecis*, *Carbacanthographis*, and *Diorygma*. *Lichenologist* 42:55–71.
- Tucker, S. C. 1979. New or noteworthy records of lichens from Louisiana. *The Bryologist* 82:125–140.
- Tucker, S. C. 1981. Checklist of Louisiana lichens. *Proceedings of the Louisiana Academy of Sciences* 44:58–70.
- Tucker, S. C. 2010. Lichens of Burden Research Plantation, Baton Rouge, Louisiana. *Evansia* 27:121–140.
- Tucker, S. C., & R. C. Harris. 1980. New or noteworthy pyrenocarpous lichens from Louisiana and Florida. *The Bryologist* 83:1–20.
- Tuckerman, E. 1872. *Genera Lichenum: an arrangement of the North American lichens*. Amherst.
- Tuckerman, E. 1888. A synopsis of the North American lichens. Part. II. Comprising the Lecideacei, and (in part) the Graphidacei. New Bedford, Massachusetts.
- Waterman, P. G., & D. McKey. 1989. Herbivory and secondary compounds in rainforest plants. Pp. 513–536 in H. Lieth & M. J. A. Werger (eds.). *Tropical Rain Forest Ecosystems. Biogeographical and Ecological Studies [Ecosystems of the World 14B]*. Elsevier, Amsterdam.
- Wetmore, C. M. 1994. The lichen genus *Caloplaca* in North and Central America with brown or black apothecia. *Mycologia* 86:813–838.
- Wills, C., R. Condit, R. B. Foster, & S. P. Hubbell. 1997. Strong density- and diversity-related effects help to maintain tree species diversity in a neotropical forest. *Proceedings of the National Academy of Sciences of the USA* 94:1252–1257.
- Wirth, M., & M. E. Hale Jr. 1978. Morden-Smithsonian Expedition to Dominica: the lichens (Graphidaceae). *Smithsonian Contributions to Botany* 40:1–64.

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