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A first assessment of the Ticolichen biodiversity inventory in Costa Rica and adjacent areas: the thelotremoid Graphidaceae (Ascomycota: Ostropales)

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Abstract

In a continuation of our biotic inventory of lichenized fungi in Costa Rica and adjacent areas, we present a treatment of the thelotremoid Graphidaceae, that is the genera and species formerly included in Thelotremataceae. A total of 186 species in 23 genera are reported for Costa Rica, plus an additional 30 taxa for adjacent areas (El Salvador, Nicaragua, Panama) that are expected to occur in Costa Rica. This is the highest number of thelotremoid Graphidaceae reported for any country in the world thus far, followed by Australia (173 species), Sri Lanka (130 species), and Panama (110 species). Together with our previous treatment of the genus *Graphis*, a total of 293 species of Graphidaceae have now been reported for Costa Rica in revised monographic works, with revisions of larger genera such as *Phaeographis* still pending, suggesting that the total number of Graphidaceae in Costa Rica is over 400. In the present monograph, the following genus and 40 species taxa are described as new to science: *Enigmotrema* Lücking *gen. nov.*, *Acanthotrema bicellularis* Sipman & Lücking, *spec. nov.*, *A. kalbii* Lücking, *spec. nov.*, *Chapsa defecta* Lücking, *spec. nov.*, *C. defectosorediata* Lücking, *spec. nov.*, *C. farinosa* Lücking & Sipman, *spec. nov.*, *C. perdissuta* Sipman & Lücking, *spec. nov.*, *C. sublilacina var. cyanea* Lücking, *spec. nov.*, *C. thallotrema* Lücking & N. Salazar, *spec. nov.*, *Clandestinotrema analorenae* Lücking, *spec. nov.*, *Enigmotrema rubrum* Lücking, *spec. nov.*, *Gyrotrema aurantiacum* Sipman, Lücking & Chaves, *spec. nov.*, *G. papillatum* Lücking, *spec. nov.*, *Leucodecton album* Sipman & Lücking, *spec. nov.*, *Myriotrema*

aggregans Sipman & Lücking, *spec. nov.*, *M. clandestinoides* Sipman & Lücking, *spec. nov.*, *M. classicum* Lücking, *spec. nov.*, *M. endoflavescens* Hale ex Lücking, *spec. nov.*, *M. frondosolucens* Lücking & Aptroot, *spec. nov.*, *Ocellularia albobullata* Lücking, Sipman & Grube, *spec. nov.*, *O. cocosensis* Lücking & Chaves, *spec. nov.*, *O. flavoperforata* Lücking, *spec. nov.*, *O. gerardii* Sipman, *spec. nov.*, *O. globifera* Kalb & Lücking, *spec. nov.*, *O. inspersata* Kalb & Lücking, *spec. nov.*, *O. inspersula* Lücking & Aptroot, *spec. nov.*, *O. isohypocrellina* Lücking & Kalb, *spec. nov.*, *O. laevigatula* Kalb & Lücking, *spec. nov.*, *O. laeviusculoides* Sipman & Lücking, *spec. nov.*, *O. praestantoides* Sipman, *spec. nov.*, *O. pseudopyrenuloides* Lücking, *spec. nov.*, *O. psorbarroensis* Sipman, *spec. nov.*, *O. subcarassensis* Sipman & Lücking, *spec. nov.*, *O. subpyrenuloides* Lücking, *spec. nov.*, *O. supergracilis* Kalb & Lücking, *spec. nov.*, *O. terrabensis* Kalb & Lücking, *spec. nov.*, *O. zamorana* Sipman, Lücking & Chaves, *spec. nov.*, *Thelotrema gomezianum* Lücking, *spec. nov.*, *T. submyriocarpum* Lücking, *spec. nov.*, *T. wilsonii* Sipman & Lücking, *spec. nov.*, and *Wirthiotrema duplomarginatum* Lücking, Mangold & Lumbsch, *spec. nov.* In addition, the following 19 new combinations are proposed: *Ampliotrema dactylizum* (Hale) Sipman, Lücking & Grube, *comb. nov.* [bas.: *Ocellularia dactyliza* Hale], *A. panamense* (Hale) Sipman & Lücking, *comb. nov.* [bas.: *Leptotrema panamense* Hale], *C. discoides* (Stirt.) Lücking, *comb. nov.* [*Graphis discoides* Stirt.], *C. esslingeri* (Hale) Sipman, *comb. nov.* [bas.: *Ocellularia esslingeri* Hale], *C. hiata* (Hale) Sipman, *comb. nov.* [bas.: *Thelotrema hiatum* Hale], *C. pseudoschizostoma* (Hale) Sipman, *comb. nov.* [bas.: *Ocellularia pseudoschizostoma* Hale], *C. referta* (Hale) Lücking, *comb. nov.* [bas.: *Ocellularia referta* Hale], *C. stellata* (Hale) Sipman, *comb. nov.* [bas.: *Leptotrema stellatum* Hale], *Fibrillithecis pachystoma* (Nyl.) Sipman, *comb. nov.* [bas.: *Thelotrema pachystomum* Nyl.], *Leucodecton bisporum* (Nyl.) Sipman & Lücking, *comb. nov.* [bas.: *Thelotrema bisporum* Nyl.], *L. dactyliferum* (Hale) Lücking, *comb. nov.* [bas.: *Ocellularia dactylifera* Hale], *L. sordidescens* (Fée) Lücking & Sipman, *comb. nov.* [bas.: *Trypethelium sordidescens* Fée], *Ocellularia carassensis* (Vain.) Sipman, *comb. nov* [bas.: *Thelotrema carassense* Vain.]., *O. maxima* (Hale) Lumbsch & Mangold, *comb. nov.* [bas.: *Thelotrema maximum* Hale], *R. vulcani* (Hale) Lücking, *comb. nov.* [bas.: *Phaeotrema vulcani* Hale], *Stegobolus anamorphoides* (Nyl.) Lücking, *comb. nov.* [bas.: *Thelotrema anamorphoides* Nyl.], *Stegobolus lankaensis* (Hale) Lücking, *comb. nov.* [bas.: *Ocellularia lankaensis* Hale], *Thelotrema jugale* (Müll. Arg.) Lücking, *comb. nov.* [bas.: *Ocellularia jugalis* Müll. Arg.], and *Wirthiotrema desquamans* (Müll. Arg.) Lücking, *comb. nov.* [bas.: *Anthracothecium desquamans* Müll. Arg.]. All species are described and discussed in detail and illustrated by photographic plates, and keys are provided to genera and species.

Key words: *Amazonotrema*, *Ampliotrema*, Australia, *Chroodiscus*, *Cruentotrema*, *Diploschistes*, *Leptotrema*, *Melanotopelia*, *Melanotrema*, *Myriotrema*, *Nadvornikia*, *Pycnotrema*, *Reimnitzia*, *Rhabdodiscus*, *Schizotrema*, *Stegobolus*, *Topeliopsis*.

Introduction

The lichen family Graphidaceae, as currently circumscribed, was traditionally divided into five separate families: Graphidaceae and Thelotremataceae, as well as Asterothyriaceae, Gomphillaceae, and Solorinellaceae (Wirth & Hale 1963, 1978; Hale 1974, 1978, 1981; Lücking 1997, 2008; Archer 1999, 2000, 2001a-e, 2002, 2003a, b, 2005, 2006; Staiger 2002; Henssen & Lücking 2002; Frisch *et al.* 2006a). Molecular data, however, suggested that these families had to be merged (Staiger *et al.* 2006; Mangold *et al.* 2008a; Rivas Plata & Lumbsch 2011); in a strict monophyletic view, they are now recognized in a single family Graphidaceae, with three subfamilies (Rivas Plata *et al.* 2012a): Fissurinoideae (including parts of the former Graphidaceae and Thelotremataceae), Gomphilloideae (including the former Asterothyriaceae, Gomphillaceae, and Solorinellaceae), and Graphidoideae (including the bulk of the former Graphidaceae and Thelotremataceae). Subfamily Graphidoideae is divided into three tribes: Graphideae (corresponding to the bulk of the former Graphidaceae), Thelotremateae (corresponding largely to the genus *Thelotrema* sensu Hale 1980), and Ocellularieae (corresponding largely to the genera *Myriotrema* and *Ocellularia* sensu Hale 1980). The thus emended Graphidaceae has become the largest family of lichenized fungi together with Parmeliaceae, with probably over 2,000 species worldwide.

The inclusion of Gomphillaceae within Graphidaceae is perhaps not as counterintuitive as it appears at first glance. Typical Gomphillaceae are separated from typical Graphidaceae by the chlorococcoid versus trentepohlioid photobiont, the anastomosing versus unbranched paraphyses, the thin-walled and non-amyloid