
***Megalospora imshaugii* sp. nov. and *M. caraibica* sp. nov. from Jamaica (Ascomycota: Teloschistales: Megalosporaceae) increase the number of American *Megalospora* species to ten**

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Examination of lichen collections housed at MSC made by Henry A. Imshaug in the Caribbean revealed two new species of *Megalospora* from Jamaica: *M. imshaugii* sp. nov., with muriform ascospores and large pruinose apothecia, and *M. caraibica* sp. nov., with muriform ascospores and large apothecia producing a K⁺ red pigment in the subhypotheecium. Eight species and one variety of *Megalospora* are now recognized for the Neotropics: *M. admixta* (Nyl.) Sipman, *M. coccodes* (Bél.) Sipman, *M. foersteri* Kalb, *M. imshaugii* sp. nov., *M. caraibica* sp. nov., *M. pachycheila* (Tuck.) Sipman, *M. sulphurata* Meyen var. *sulphurata*, *M. sulphurata* var. *nigricans* (Müll. Arg.) Riddle, *M. tuberculosa* (Fée) Sipman. In addition, *M. porphyritis* (Tuck.) R.C. Harris is known from North America and *M. kalbii* Sipman from Argentina (Valdivia). A key is provided to all ten American species of *Megalospora*.

Key words: Imshaug, Jamaica, *Megalospora*, Neotropics

Introduction

Megalospora is a mid-size genus of crustose apothecial lichens consisting of about 30 species (Sipman, 1983, 1986; Harris, 1984, 1986; Kalb, 1990; Kantvilas, 1994). The *Megalosporaceae* were associated with different lineages in the past, including *Lecideaceae*, *Lecanoraceae*, *Physciaceae*, and *Teloschistaceae*, but have recently been confirmed to belong in *Teloschistales* (Helms *et al.*, 2003). Among other features, the main character identifying *Megalospora* species is the heavily inspersed hymenium, in combination with the often large apothecia. Species with transversely septate ascospores can also be recognized by their large size, while taxa with muriform ascospores are easily confused with genera such as *Calopadia* in the *Pilocarpaceae*. Indeed, the two new species described here, together with two collections of

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Megalospora admixta (Nyl.) Sipman, were all labelled as *Calopadia fusca* (Müll. Arg.) Vězda, a common foliicolous and sometimes corticolous species, but the large apothecia with reddish to purplish brown disc and the heavily inspersed hymenium, together with other characters such as excipulum structure and asci, place them in *Megalospora*.

Sipman (1983) distinguished two species of *Megalospora* with muriform ascospores, *M. lopadioides* Sipman and *M. kalbii* Sipman, both described as new in his monograph. Later, two neotropical species were added, *M. admixta* (Nyl.) Sipman (Sipman, 1986) and *M. foersteri* Kalb (Kalb, 1990). The four species have more or less the same apothecial anatomy and thallus chemistry (pannarin, zeorin) and are chiefly distinguished by apothecial morphology, such as size, shape, and pruinosity. While *M. admixta* (small, plane apothecia) and *M. foersteri* (large, turbinate apothecia) are neotropical montane, *M. kalbii* (small, convex apothecia with pruina when young) is restricted to southern South America (Valdivia) and *M. lopadioides* (large, plane apothecia) has so far been reported from Australia and New Zealand (Sipman, 1983, 1986; Kalb, 1990; West and Polly, 1999). The two species found in the Jamaican material collected by Imshaug cannot be identified with any of these four taxa and are here described as new.

The species

The two species of *Megalospora* described here increase the number of species known from America to ten plus one variety (Table 1). The two taxa are described below in detail and their taxonomic affinities are discussed.

Sipman (1983: 70ff.) discussed the problems of delimiting species within *Megalospora*, problems that certainly apply to many other lichen groups. He favored the biological species concept, a view which is shared by the author of this paper, but concludes that biological species can only be predicted by at least two independent characters. This view has been used by a variety of authors but is, surprisingly, mostly applied to chemical characters only. For example, it is rarely questioned that statistically significant differences in ascospore size, as a single character, should be recognized taxonomically at species level. Also, forms with consistently 1-septate versus consistently 3-septate ascospores are usually separated at species level without questioning. While the presence of two independent, differentiating characters is certainly good evidence to separate species, the presence of only one such character (or merely our lack of ability to detect more differences) does not preclude forms from representing different species. Without any other evidence, there is no a priori criterion to favor uniting forms with only one differentiating character

into a single species or separating them at species level, and they should preferably be kept separate until evidence demonstrates the contrary, for the sake of maintaining as much information detail as possible. Sipman's (1983) concept of infraspecific taxa (subspecies, variety) based on different distribution patterns, similar to that outlined by Lücking (2002), provides a practicable solution to the problem but cannot recognize potentially different entities when distribution patterns are the same or largely overlap.

Species of *Megalospora* provide several characters that occur as single differences between entities, in particular thallus chemistry, epitecium pigmentation, and presence of vegetative reproduction (isidia, soralia). While the author of the present paper agrees with the assessment of vegetative propagules as potentially not species-specific, thallus chemistry, in particular cortical substances, is usually accepted as species-specific and has been confirmed so in molecular studies (Tehler and Källersjö, 2001). The most common and most widely distributed species of *Megalospora*, *M. tuberculosa* (Fée) Sipman, is circumscribed by Sipman (1983, 1986) as including 'chemotypes' with either usnic acid or pannarin, while no such variation is documented for other species of the genus. Unless proven by molecular data, it seems unlikely that the same species is capable of facultatively producing two such chemically different substances as usnic acid and pannarin or carrying corresponding genetic alleles. The alternative view of both 'chemotypes' representing different species is supported by the fact that the two substances never occur together in single specimens and that the two 'chemotypes' have strongly differentiated distribution patterns (Sipman, 1983): the usnic acid 'chemotype' is tropical-subtropical and the pannarin 'chemotype' subtropical-extratropical. Sipman (1983) assumes that the chemical differences reflect ecological variation due to colder climate at higher latitudes, but there is no evidence in the literature for such variation and one would expect that high altitude tropical specimens would then display pannarin as thallus substance, which is not the case. Harris (1984, 1986) argues that the eastern North American temperate populations with pannarin, soralia, pruinose apothecia, and smaller ascospores, are specifically different from the subtropical-tropical populations, and Sipman (1986) and Tønsberg (1992) indicate similarities in this respect with European, Japanese, and Australian extratropical populations. Harris (1984, 1986) is therefore followed here in distinguishing *M. porphyritis* (Tuck.) R.C. Harris from *M. tuberculosa* s. str., but reexamination of all pannarin-containing specimens cited by Sipman (1983, 1986) is required to determine whether they all represent a single or perhaps even several different taxa.

Table 1. Species of *Megalospora* known from America.

<i>Megalospora admixta</i> (Nyl.) Sipman
<i>Megalospora coccodes</i> (Bél.) Sipman
<i>Megalospora foersteri</i> Kalb
<i>Megalospora imshaugii</i> Lücking sp. nov.
<i>Megalospora caraibica</i> Lücking sp. nov.
<i>Megalospora kalbii</i> Sipman
<i>Megalospora pachycheila</i> (Tuck.) Sipman
<i>Megalospora porphyritis</i> (Tuck.) R.C. Harris
<i>Megalospora sulphurata</i> Meyen
<i>Megalospora sulphurata</i> Meyen var. <i>sulphurata</i>
<i>Megalospora sulphurata</i> var. <i>nigricans</i> (Müll. Arg.) Riddle
<i>Megalospora tuberculosa</i> (Fée) Sipman

***Megalospora imshaugii* Lücking sp. nov.**

(Fig. 1A-B)

Mycobank: 511204

A *Megalospora admixta* apotheciis maioribus pruinosis differt.

Type: JAMAICA, Portland Parish, Ridge NW of Murdock's Gap, 3600 ft, 15 March 1953, Imshaug 15311 (MSC-0013899, **holotype**).

Thallus crustose, corticolous, 20-30 mm across and 30-50 µm thick, continuous, smooth to uneven-rugulose, with cartilaginous cortex, white. *Photobiont* chlorococcoid. *Apothecia* round, sessile, (0.5-)1-1.5(-2) mm diam., 0.3-0.5 mm high; disc plane (convex in old apothecia), purplish brown with white pruina; margin distinct, slightly prominent, 0.1 mm wide, brown-black to black. *Excipulum* prosoplectenchymatous with radiating cell rows, 50-100 µm wide, colorless in inner parts to (orange-)brown externally, laterally covered by a colorless, corticiform layer, K–; medullary excipulum nubilous by strong incrustation with small, colorless crystals, partly dissolving in K except for lateral pockets; subhypotheceum dark grey-brown, K–; hypotheceum prosoplectenchymatous, 40-60 µm high, colorless to pale yellow; hymenium 150-200 µm high, colorless, densely interspersed with small oil droplets. *Epitheceum* diffuse-granulose, orange-brown. *Asci* clavate, 120-180 × 25-35 µm. *Ascospores* 1 per ascus, ellipsoid to oblong, muriform, 80-130 × 20-30 µm, 4-5 times as long as wide, colorless. *Secondary chemistry:* pannarin and zeorin in thallus; no apothecial substances detected.

This new species is dedicated to Henry A. Imshaug, pioneering North American lichenologist of the 20th century (Fryday and Prather, 2001). *Megalospora imshaugii* resembles *M. admixta* and *M. kalbii* in apothecial anatomy and chemistry, but has larger, persistently pruinose apothecia. Also, the ascospores are longer on average, being mostly over 100 µm. *Megalospora kalbii* has thinly pruinose apothecia when young but the pruina soon disappears

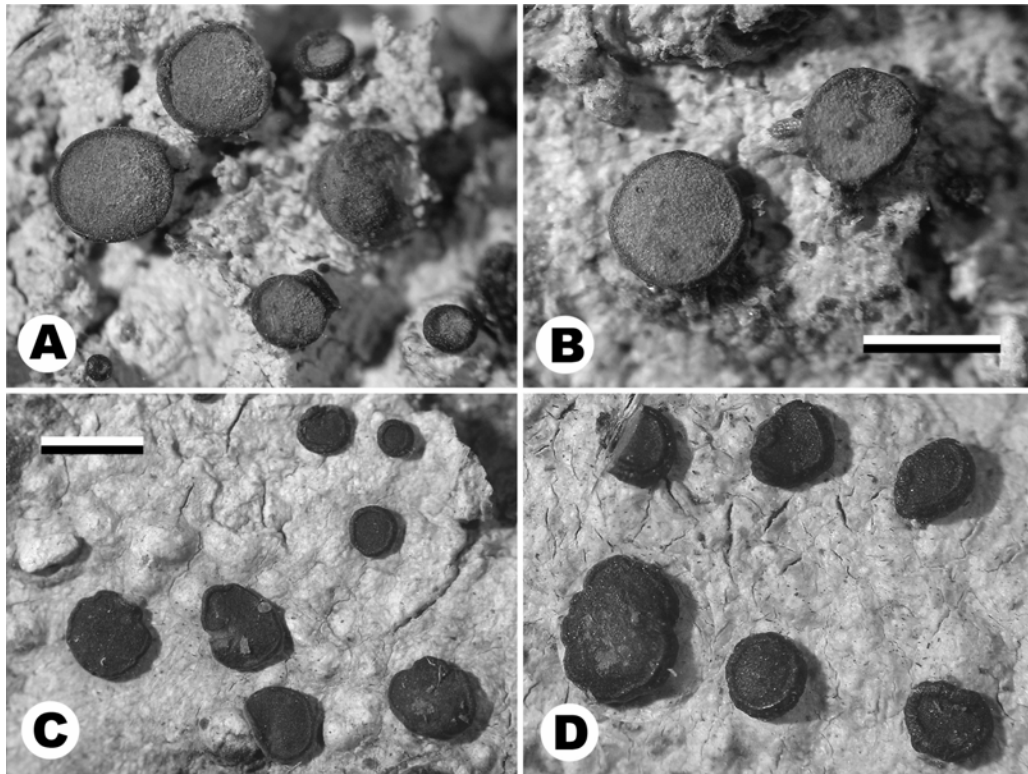


Fig. 1. Habit of the new species. **A-B.** *Megalospora imshaugii*. **C-D.** *Megalospora caraibica*. Scale = 10 μm (scale for A and D is the same as for B).

and mature apothecia are non-pruinose and become convex (Sipman, 1983). *Megalospora admixta* has consistently smaller, non-pruinose apothecia with shorter ascospores being usually less than 100 μm long (Sipman, 1986). Several specimens of the latter species from Central and South America and the Caribbean housed in B, F, INB, and MSC [Jamaica, St. Andrew Parish, Gap SE of Catherines Pk., 4500 ft, Imshaug 13869 (MSC-0013897). St. Andrews Parish, Bellevue to mt. Rosanna, 3800 ft, Imshaug 14503 (MSC-0013898)], were studied and compared to *M. imshaugii*, and the differences were found to be constant. The new species *M. caraibica* described below is similar to *M. imshaugii* in apothecial size but has non-pruinose apothecia with K⁺ blood-red subhypotheceum and slightly shorter ascospores.

***Megalospora caraibica* Lücking sp. nov.**

(Fig. 1C-D)

Mycobank: 511203

A *Megalospora lopadioides* epithecio aurantiaco-fusco et subhypotheceio K⁺ sanguineo differt.

Type: JAMAICA, St. Thomas Parish, S slope of Mossmans Park, 5000 ft, 19 February 1953, Imshaug 14660 (MSC-0013900, **holotype**).

Thallus crustose, corticolous, 10-30 mm across and 30-50 µm thick, continuous, smooth to uneven-rugulose, with cartilaginous cortex, white. Photobiont chlorococcoid. *Apothecia* round, sessile, (0.5-)1-2 mm diam., 0.3-0.5 mm high; disc plane, purplish brown, non-pruinose; margin distinct, slightly prominent, 0.1-0.15 mm wide, brown-black to black. *Excipulum* prosoplectenchymatous with radiating cell rows, 50-100 µm wide, orange-brown to dark brown, laterally covered by a colorless, corticiform layer, K⁻; medullary excipulum and subhypotheceum brown-black, K⁺ blood-red; hypotheceum prosoplectenchymatous, 40-70 µm high, pale yellow to orange; hymenium 130-180 µm high, colorless, densely interspersed with small oil droplets. *Epitheceum* diffuse-granulose, orange-brown. Asci clavate, 100-150 × 25-35 µm. *Ascospores* 1 per ascus, ellipsoid to oblong, muriform, 70-110 × 20-30 µm, 3-4 times as long as wide, colorless. Secondary chemistry: pannarin and zeorin in thallus; unknown apothecial substance in subhypotheceum and medullary excipulum reacting K⁺ blood red, on TLC plate forming pale olive-brown spot at RF = 18 in solvent C.

Megalospora caraibica was first identified with the Australian *M. lopadioides* Sipman, with which it agrees in apothecial morphology and ascospores size. However, the latter has an olive-green epitheceum and lacks the K⁺ red apothecial pigment; instead the unknown substance B is found (Sipman, 1983). The neotropical *M. foersteri* Kalb differs from *M. caraibica* in the same way as *M. lopadioides* and also has larger, turbinate apothecia and a colorless hypotheceum (Kalb, 1990). The subhypotheceal pigment of *M. caraibica* remains unidentified but might be related to the hypotheceal pigment boryquinone found in *Lecanora hypocrocina* Nyl. and *L. hypocrocinoidea* Lumbsch (Lumbsch *et al.*, 1996). Both the location and K⁺ reaction, as well as the RF value in solvent C, are the same, but boryquinone produces a purple spot after developing the TLC plate (tested by simultaneous analysis with *Lecanora hypocrocina*), while that of the unknown substance detected in *M. caraibica* is olive-green. No such pigment is known from other species of *Megalospora*.

The distinctive characters of the six *Megalospora* species with muriform ascospores are summarized in Table 2.

Key to American species of *Megalospora*

- 1a. Ascospores transversely septate 2
- 1b. Ascospores muriform 7
- 2a. Ascospores 1-septate (*Megalospora sulphurata*) 3
- 2b. Ascospores 5-11-septate 4

3a. Epithecium (orange-)brown..... *Megalospora sulphurata* var. *sulphurata*
 3b. Epithecium olive-green to olive-brown..... *Megalospora sulphurata* var. *nigricans*

4a. Ascospores 1 per ascus..... 5
 4b. Ascospores 2-8 per ascus 6

5a. Ascospores mostly 5-septate; apothecia usually pruinose; soredia frequent; pannarin
 *Megalospora porphyritis*
 5b. Ascospores 7-11-septate; apothecia non-pruinose; soredia absent or rare; usnic acid
 *Megalospora tuberculosa*

6a. Hymenium 100-200 µm high; ascospores 3-5-septate; lichexanthone
 *Megalospora pachycheila*
 6b. Hymenium 200-300 µm high; ascospores 5-7-septate; pannarin *Megalospora coccodes*

7a. Apothecia 0.5-1 mm diam. when mature..... 8
 7b. Apothecia 1-2(-3) mm diam. when mature 9

8a. Apothecia convex when mature, disc and margin brown *Megalospora kalbii*
 8b. Apothecia remaining plane; disc (red-)brown, margin brown-black.....
 *Megalospora admixta*

9a. Apothecia turbinate, up to 3 mm diam.; hypothecium colorless; epithecium olive-green.....
 *Megalospora foersteri*
 9b. Apothecia sessile, up to 2 mm diam.; hypothecium orange-brown; epithecium orange-brown 10

10a. Apothecia white-pruinose; subhypothecium K-..... *Megalospora imshaugii*
 10b. Apothecia non-pruinose; subhypothecium K+ blood-red..... *Megalospora caraibica*

Table 2. Taxonomically important characters of species of *Megalospora* with muriform ascospores.

Species	Apothecial diam. (mm)	Apothecial shape	Epithecium pruina	Epithecium color	Subhypothecium color	Ascospore K-reaction	Ascospore Size (µm)	Thallus chemistry	Apothecial chemistry
<i>kalbii</i>	0.5-1	convex	young only	orange-brown	orange-brown	—	80-90 × 25-30	pannarin zeorin	—
<i>admixta</i>	0.5-1	plane	—	orange-brown	orange-brown	—	65-105 × 20-35	pannarin zeorin	—
<i>imshaugii</i>	1-2	plane	present	orange-brown	grey-brown	—	80-130 × 20-30	pannarin zeorin	—
<i>caraibica</i>	1-2	plane	—	orange-brown	dark brown	K+ red	70-110 × 20-30	pannarin zeorin	unknown pigment
<i>lopadioides</i>	1-2	plane	—	olive-green	orange-brown	yellowish	60-90 × 25-35	pannarin zeorin	substance B
<i>foersteri</i>	1.5-3	turbinate	—	olive-green	colorless	—	80-110 × 25-30	pannarin zeorin	—

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References

- Fryday, A.M. and Prather, L.A. (2001). The lichen collection of Henry Imshaug at the Michigan State University Herbarium (MSC). *The Bryologist* 104: 464-467.
- Harris, R.C. (1984). *Megalospora porphyritis* in eastern North America. *Evansia* 1: 24.
- Harris, R.C. (1986). *Megalospora porphyritis* again: a reply to Sipman. *Evansia* 3: 30.
- Helms G., Friedl T. and Rambold G. (2003). Phylogenetic relationships of the *Physciaceae* inferred from rDNA sequence data and selected phenotypic characters. *Mycologia* 95: 1078-1099.
- Kalb, K. (1990). Lichenes Neotropici ausgegeben von Klaus Kalb. Fascikel XI (No. 451-475). Neumarkt/OPf.
- Kantvilas, G. (1994). Additions to the family *Megalosporaceae* in Tasmania and mainland Australia. *Lichenologist* 26: 349-366.
- Lücking, R. (2002). [Review] P. M. McCarthy (ed.). *Flora of Australia Volume 58A, Lichens* 3. xviii + 242 pp. CSIRO Publishing, Canberra. 2001. *The Bryologist* 105: 296-297.
- Lumbsch, H.T., Guderley, R. and Elix, J.A. (1996). A revision of some species in *Lecanora* sensu stricto with a dark hypothecium (*Lecanorales, Ascomycotina*). *The Bryologist* 99: 269-291.
- Sipman, H.J.M. (1983). A monograph of the lichen family *Megalosporaceae*. *Bibliotheca Lichenologica* 18: 1-241.
- Sipman, H.J.M. (1986). Additional notes on the lichen family *Megalosporaceae*. *Willdenowia* 15: 557-564.
- Tehler, A. and Källersjö, M. (2001). *Parmeliopsis ambigua* and *P. hyperopta* (*Parmeliaceae*): species or chemotypes? *Lichenologist* 33: 403-408.
- Tønsvberg, T. (1992). The sorediate and isidiate, corticolous, crustose lichens in Norway. *Sommerfeltia* 14: 1-331.
- West, C. J. and Polly, B. (1999). Additional lichen records from New Zealand 29. *Megalospora lopadioides* from Campbell Island. *Australasian Lichenology* 44: 8.

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