

CONTRIBUTION TO THE KNOWLEDGE OF THE LICHEN BIOTA OF BOLIVIA. 2

ADAM FLAKUS

Abstract. The paper presents new records of 57 lichenized fungi from Bolivia collected recently from lowland and montane rain forests and from open high Andean habitats. Of the taxa, 23 species are reported for the first time from the country: *Calicium salicinum* Pers., *Cladonia aleuropoda* Vain., *C. lepidophora* Ahti & Kashiw., *C. macilentoides* Ahti & Fleig, *Coccocarpia filiformis* Arv., *Coenogonium congense* C. W. Dodge, *C. luteocitrinum* Rivas Plata, Lücking & Umaña, *C. subdentatum* (Vězda & G. Thor) Rivas Plata, Lücking, Umaña & Chaves, *C. tuckermanii* Mont., *Cresponea melanocheioides* (Vain.) Egea & Torrente, *Dichosporidium nigrocinctum* (Ehrenb.) G. Thor, *Graphis chrysocarpa* (Raddi) Spreng., *Lobaria fendleri* (Tuck. ex Mont.) Lindau, *Lobariella crenulata* (Hook.f.) Yoshim., *Lopezaria versicolor* (Fée) Kalb & Hafellner, *Malcolmiella piperis* (Spreng.) Kalb & Lücking, *M. rhodopsis* (Tuck.) Kalb & Lücking, *Megalospora sulphurata* Meyen, *Ocellularia viridis* Hale, *Phaeographis haematites* (Fée) Müll. Arg., *Porina leptalea* (Durieu & Mont.) A. L. Sm., *Tremolecia atrata* (Ach.) Hertel and *Tylophoron crassiusculum* Tibell.

Key words: lichenized fungi, new records, biogeography, Neotropics, Bolivia, South America

Adam Flakus, Laboratory of Lichenology, W. Szafer Institute of Botany, Polish Academy of Sciences, Lubicz 46, PL-31-512 Kraków, Poland; e-mail: a.flakus@botany.pl

INTRODUCTION

Bolivia is a large country characterized by great biodiversity and diverse geography. About 20 different ecoregions are distinguished in the country – from lowland rain forest up to high mountain vegetation (Navarro & Maldonado 2002; Ibisch & Mérida 2004). On the basis of studies on other neotropical areas, we can assume that its lichen biota is also rich and contains many interesting species. Knowledge of the diversity and distribution of Bolivian lichens is still insufficient. All data delivered by previous lichenological investigations of the country up to 1998 were summarized for the first time by Feuerer *et al.* (1998). Up to now, based on a preliminary checklist of lichens and lichenicolous fungi compiled by Feuerer (2008) and recent papers (e.g. Flakus & Lücking 2008; Flakus *et al.* 2008) about 500 species are known from the country.

This paper is the next of a series presenting new data on the diversity and distribution of lichenized fungi (excluding foliicolous species) of Bolivia (see Flakus & Wilk 2006). The main aim of the study is to update our knowledge of Bolivian

lichens. In this part of the series, new records of 57 species are provided, of which 23 are reported for the first time from the country.

MATERIAL AND METHODS

The data are based on specimens collected by the author (numbers in brackets refer to the author's collection number) in Bolivia during scientific expeditions in 2004–2006. The specimens are housed in KRAM-L and LPB as well as in my private herbarium. Identification of some groups of lichens (mainly *Cladonia* spp.) was supported by thin-layer chromatography analysis done according to Orange *et al.* (2001). Annotations on detected secondary products are provided under species, because the chemistry of Bolivian lichens is still poorly known. In the text the following symbols are used: Dept. – Department, Prov. – Province, alt. – altitude.

The localities are indicated in the species list and on the map (Fig. 1) by numbers corresponding with the list below:

1. DEPT. BENI. PROV. BALLIVIAN, by Lake Copaiba near Reyes, 14°17'56"S, 67°14'06"W, alt. 189 m, lowland Amazon forest surrounded by savanna vegetation.

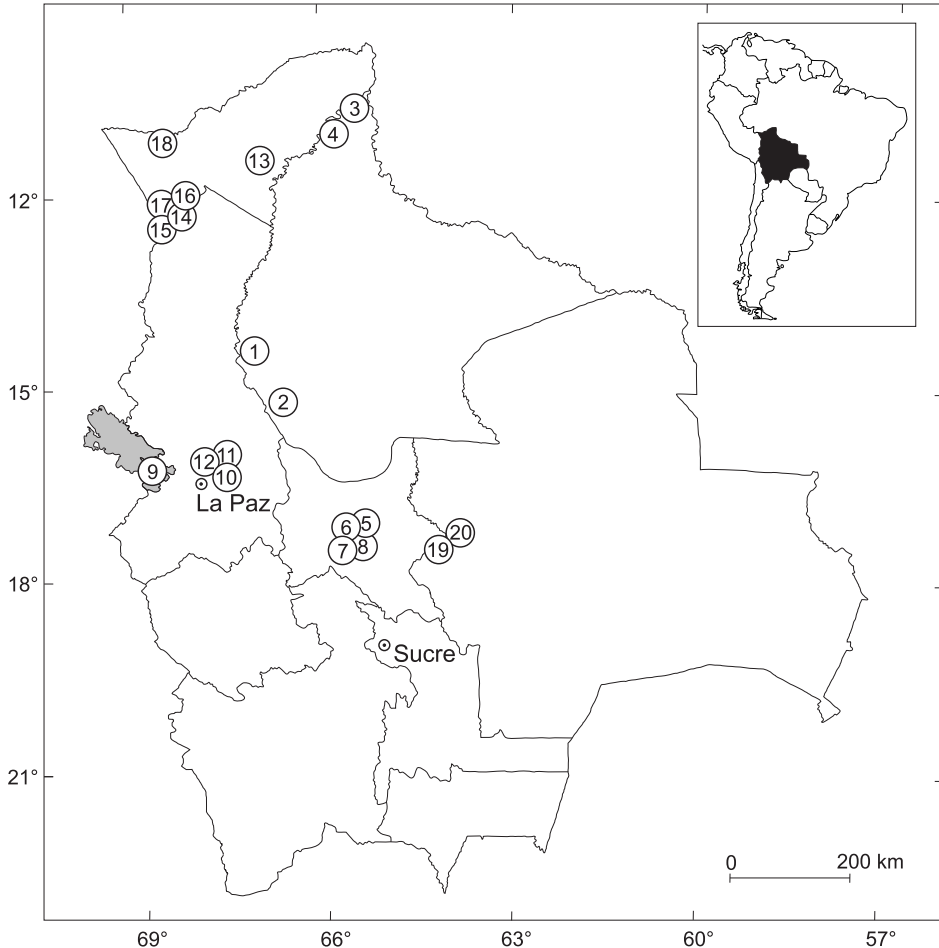


Fig. 1. Map of Bolivia showing lichen sampling locations.

2. DEPT. BENI. PROV. BALLIVIAN, near Yucumo village, $15^{\circ}09'40''\text{S}$, $67^{\circ}01'55''\text{W}$, alt. 254 m, lowland Amazon forest.

3. DEPT. BENI. PROV. VACA DIEZ, Cachuela Esperanza village, $10^{\circ}32'09''\text{S}$, $65^{\circ}34'55''\text{W}$, alt. 128 m, lowland Amazon forest.

4. DEPT. BENI. PROV. VACA DIEZ, Riberalta village, Mercado Central, $10^{\circ}59'49''\text{S}$, $66^{\circ}04'28''\text{W}$, alt. 152 m, city park.

5. DEPT. COCHABAMBA. PROV. CHAPARE, near Incachaca village, $17^{\circ}14'09''\text{S}$, $65^{\circ}48'51''\text{W}$, alt. 2198 m, montane cloud forest.

6. DEPT. COCHABAMBA. PROV. CHAPARE, near Incachaca village, $17^{\circ}14'13''\text{S}$, $65^{\circ}49'02''\text{W}$, alt. 2294 m, montane cloud forest.

7. DEPT. COCHABAMBA. PROV. CHAPARE, near Incachaca village, $17^{\circ}14'11''\text{S}$, $65^{\circ}49'02''\text{W}$, alt. 2317 m, *Pinus* plantation near montane cloud forest.

8. DEPT. COCHABAMBA. PROV. CHAPARE, near Incachaca village, $17^{\circ}14'17''\text{S}$, $65^{\circ}48'54''\text{W}$, alt. 2400 m, montane cloud forest.

9. DEPT. LA PAZ. PROV. MANCO CAPAC, near Copacabana village, Mt. Horca del Inca, $16^{\circ}10'15''\text{S}$, $69^{\circ}05'05''\text{W}$, alt. 3974 m, high Andean puna vegetation.

10. DEPT. LA PAZ. PROV. MURILLO, near Cumbre pass, $16^{\circ}19'18''\text{S}$, $68^{\circ}04'42''\text{W}$, alt. 4550 m, high Andean puna vegetation.

11. DEPT. LA PAZ. PROV. MURILLO, near Cumbre pass, $16^{\circ}21'59''\text{S}$, $68^{\circ}02'37''\text{W}$, alt. 4604 m, high Andean puna vegetation.

12. DEPT. LA PAZ. PROV. MURILLO, near Cumbre pass, 16°20'14"S, 68°02'20"W, alt. 4672 m, high Andean puna vegetation.

13. DEPT. PANDO. PROV. MADRE DE DIOS, near Puerto Madre de Dios village by Rio Madre de Manupare, 11°31'37"S, 67°17'29"W, alt. 155 m, lowland Amazon forest.

14. DEPT. PANDO. PROV. MANURIPI, Bajada colony near Chive village by Madre de Dios river, 12°24'03"S, 68°26'45"W, alt. 170 m, lowland Amazon forest.

15. DEPT. PANDO. PROV. MANURIPI, Metale colony near Chive village by Madre de Dios river, 12°20'38"S, 68°20'40"W, alt. 170 m, lowland Amazon forest.

16. DEPT. PANDO. PROV. MANURIPI, Chive village, 12°23'19"S, 68°35'28"W, alt. 179 m, lowland Amazon forest.

17. DEPT. PANDO. PROV. MANURIPI, Chive village, 12°23'19"S, 68°34'39"W, alt. 157 m, lowland Amazon forest.

18. DEPT. PANDO. PROV. NICOLAS SUAREZ, near Cobija village, 11°02'16"S, 68°45'31"W, alt. 191 m, lowland Amazon forest.

19. DEPT. SANTA CRUZ. PROV. CABALLERO, Siberia region near La Palma village, 17°49'12"S, 64°40'28"W, alt. 2582 m, montane cloud forest.

20. DEPT. SANTA CRUZ. PROV. CABALLERO, Siberia village, 17°49'38"S, 64°45'14"W, alt. 3480 m, open area near montane forest.

LIST OF TAXA

Calicium salicinum Pers.

The species is new to Bolivia.

SPECIMEN EXAMINED: locality 6; on hard wood (8282).

Chrysothrix xanthina (Vain.) Kalb

This common tropical species was previously reported from Bolivia from only three localities (Flakus *et al.* 2006).

SPECIMEN EXAMINED: locality 4; on bark (7487).

Cladia aggregata (Sw.) Nyl.

According to Feuerer *et al.* (1998) the species is very common in montane rain forest of Bolivia, from where it was recorded by Herzog (1922), Feuerer *et al.* (1998), Ahti (2000) and Flakus and Wilk (2006).

SPECIMEN EXAMINED: locality 6; on soil among bryophytes (8173).

Cladonia aleuropoda Vain.

The species is new to Bolivia.

Substances detected by TLC: fumarprotocetraric acid.

SPECIMEN EXAMINED: locality 10; on humus (8568).

Cladonia cf. *borbonica* Nyl.

The specimen represents untypical material of the species found for the first time and discussed by Flakus *et al.* (2008).

Substances detected by TLC: fumarprotocetraric acid.

SPECIMEN EXAMINED: locality 6; on humus among bryophytes (8213).

Cladonia ceratophylla (Sw.) Spreng.

It appears to be rather common in montane cloud forest of Bolivia, but so far reported from only a few localities (Ahti 2000; Flakus *et al.* 2008).

Substances detected by TLC: atranorin and fumarprotocetraric acid.

SPECIMEN EXAMINED: locality 6; on humus among bryophytes (8212/1).

Cladonia chlorophaea (Flörke ex Sommerf.) Spreng.

This cosmopolitan species was recorded in Bolivia by Feuerer *et al.* (1998), Ahti (2000) and Flakus *et al.* (2008).

Substances detected by TLC: fumarprotocetraric acid.

SPECIMEN EXAMINED: locality 5; on humus soil among bryophytes (7847/3).

Cladonia confusa R. Sant.

It is a widely distributed species in the Neotropics (Ahti 2000) which was reported from Bolivia only by Feuerer *et al.* (1998), Ahti (2000) and Flakus *et al.* (2008).

Substances detected by TLC: perlatolic (with satellites) and usnic acids.

SPECIMEN EXAMINED: locality 6; on humus soil among bryophytes (8246).

Cladonia dactylota Tuck.

This distinct species, characterized generally by production of peculiar tuberculate and cottony soralia and the presence of psoromic acid, was previously reported from Bolivia from only a single locality (Flakus *et al.* 2008).

Substances detected by TLC: psoromic and consporomic acids.

SPECIMEN EXAMINED: locality 5; on soil (7847/1).

Cladonia didyma (Fée) Vain.

The species was recently reported from Bolivia by Feuerer *et al.* (1998), Ahti (2000) and Flakus *et al.* (2008).

Substances detected by TLC: barbatic and thamnolic acids with didymic acid complex (first chemotype), or thamnolic acid with didymic acid complex (second chemotype).

SPECIMENS EXAMINED: locality 6; on rotting bark and humus soil (8185, 8245, 8294).

Cladonia lepidophora Ahti & Kashiw.

The species is new to Bolivia.

Substances detected by TLC: squamatic and usnic acids.

SPECIMEN EXAMINED: locality 10; on terricolous bryophytes and humus soil (8570).

Cladonia macilentoides Ahti & Fleig

The species is new to Bolivia.

Substances detected by TLC: thamnolic acid.

SPECIMEN EXAMINED: locality 6; on humus among bryophytes (8215).

Cladonia pyxidata (L.) Hoffm.

The species has not been reported from Bolivia recently. According to Feuerer (2008) its only localities were published by Rusby (1896).

Substances detected by TLC: fumarprotoctaric acid.

SPECIMENS EXAMINED: localities 10 and 12; on terricolous bryophytes and humus soil (5717, 8569).

Cladonia rappii A. Evans

It was recently reported from Bolivia by Feuerer *et al.* (1998), Ahti (2000) and Flakus *et al.* (2008).

Substances detected by TLC: fumarprotoctaric acid.

SPECIMENS EXAMINED: locality 6; on humus and rotting bark (8191, 8242).

Cladonia subsquamosa Kremp.

The species is known so far from only three localities in Bolivia (Ahti 2000; Flakus *et al.* 2008).

Substances detected by TLC: fumarprotoctaric acid.

SPECIMEN EXAMINED: locality 8; on rotting bark (7874).

Coccocarpia erythroxyli (Spreng.) Swinscow & Krog

It was recorded from Bolivia previously by Feuerer and Sipman (2005).

SPECIMEN EXAMINED: locality 7; on bark of *Pinus* sp. (8317).

Coccocarpia fliformis Arv.

The species is new to Bolivia.

SPECIMENS EXAMINED: locality 7; on bark of *Pinus* sp. (8333, 8335).

Coccocarpia palmicola (Spreng.) Arv. & D. J. Galloway

This very common species (Lücking *et al.* 2007) has been reported from Bolivia from only a single locality (Feuerer & Sipman 2005).

SPECIMEN EXAMINED: locality 7; on bark of *Pinus* sp. (8316).

Coenogonium congense C. W. Dodge

The species is new to Bolivia.

SPECIMEN EXAMINED: locality 18; on bark (6435).

Coenogonium* cf. *linkii Ehrenb.

This pantropical species (Rivas Plata *et al.* 2006) has not been reported from Bolivia for about 80 years (see, e.g., Herzog 1922; Feuerer 2008).

SPECIMENS EXAMINED: localities 1 and 14; on bark (3672, 6089).

Coenogonium luteocitrinum Rivas Plata, Lücking & Umaña

The species is new to Bolivia.

SPECIMENS EXAMINED: locality 7; on bark (8302, 8358).

Coenogonium subdentatum (Vězda & G. Thor) Rivas Plata, Lücking, Umaña & Chaves

The species is new to Bolivia.

SPECIMEN EXAMINED: locality 16; on bark (5814).

Coenogonium tuckermanii Mont.

The species is new to Bolivia.

SPECIMEN EXAMINED: locality 8; on bark (7893).

Cresponia melanocheioides (Vain.) Egea & Torrente

The species is new to Bolivia.

SPECIMEN EXAMINED: locality 16; on bark (5826).

Cryptothecia rubrocincta (Ehrenb.) G. Thor

This species appears to be rather common in montane rain forests of Bolivia (Flakus unpubl.), but so far it has been reported from only a few localities (Thor 1991; Flakus & Wilk 2006).

SPECIMENS EXAMINED: locality 6; on bark and corticolous bryophytes (8201, 8278).

Cystocoleus ebeneus (Dillwyn) Thwaites

This species was reported from Bolivia from only a single locality by Flakus and Wilk (2006).

SPECIMENS EXAMINED: localities 11 and 12; on tercolous bryophytes (5721, 5765, 5771, 5773).

Dichosporidium nigrocinctum (Ehrenb.)

G. Thor

The species is new to Bolivia.

SPECIMENS EXAMINED: localities 13, 14 and 16; on bark (5816, 5823, 5828, 6090, 6701).

Dictyonema glabratum (Spreng.) D. Hawksw.

This species appears to be common from montane rain forest up to open high Andean vegetation (see, e.g., Parmasto 1978; Feuerer *et al.* 1998; Flakus & Wilk 2006; Feuerer 2008).

SPECIMENS EXAMINED: localities 6, 8, 9 and 10; on bark, soil and corticolous or saxicolous bryophytes (7891, 8217, 8578, 8633).

Dictyonema sericeum (Sw.) Berk.

Both of the following forms were found in the examined material: *f. sericeum* (specimen 7900) and *f. schenckianum* (Müll. Arg.) Parm. (specimen 8233) The second one is easily distinguished from the typical form of the species by its crustose thallus, which is often fertile (see Chaves *et al.* 2004). The species was reported from Bolivia for the first time by Parmasto (1978).

SPECIMENS EXAMINED: localities 6 and 8; on bark and corticolous bryophytes (7900, 8233).

Diorygma epiglaucum (Müll. Arg.) Kalb, Staiger & Elix

This species was recently reported from Bolivia by Kalb *et al.* (2004).

SPECIMEN EXAMINED: locality 17; on bark (6372).

Dyplolabia afzelii (Ach.) A. Massal.

This common tropical species has been recorded from Bolivia by Kalb and Staiger

(2000), Staiger (2002), and Flakus and Wilk (2008).

SPECIMENS EXAMINED: localities 14 and 15; on bark (6092/2, 6108, 6113, 6115, 6129, 6137/1, 6140, 6144, 6151, 6162, 6169/1).

Graphis chrysocarpa (Raddi) Spreng.

The species is new to Bolivia.

SPECIMENS EXAMINED: localities 16 and 17; on bark (5846, 6373).

Leprocaulon arbuscula (Nyl.) Nyl.

It was previously reported from only one locality in Bolivia (Flakus & Wilk 2006).

SPECIMEN EXAMINED: locality 8; on rotting bark (7885).

Leprocaulon gracilescens (Nyl.) I. M. Lamb & A. Ward

This species was recorded in Bolivia only by Flakus and Wilk (2006).

SPECIMEN EXAMINED: locality 9; on soil among bryophytes (8661).

Lobaria fendleri (Tuck. ex Mont.) Lindau

The species is new to Bolivia.

SPECIMEN EXAMINED: locality 6; on bark (8262).

Lobariella crenulata (Hook.f.) Yoshim.

The species is new to Bolivia.

SPECIMEN EXAMINED: locality 7; on bark (8319).

Lopezaria versicolor (Fée) Kalb & Hafellner

The species is new to Bolivia.

SPECIMEN EXAMINED: locality 7; on bark (8357).

Malcolmiella piperis (Spreng.) Kalb & Lücking

The species is new to Bolivia.

SPECIMENS EXAMINED: localities 2 and 14; on bark (6087, 7716).

Malcolmiella rhodopsis (Tuck.) Kalb & Lücking

The species is new to Bolivia.

SPECIMENS EXAMINED: localities 2 and 14; on bark (6087/1, 7721, 7722).

Megalospora sulphurata Meyen
subsp. *sulphurata*

The species is new to Bolivia.

SPECIMENS EXAMINED: locality 19; on bark (4650, 4556, 4779).

Megalospora tuberculosa (Fée) Sipman

The species was reported from Bolivia by Sipman (1983) and Feuerer *et al.* (1998).

SPECIMENS EXAMINED: localities 6 and 19; on bark (4564, 4631, 8163).

Normandina pulchella (Borrer) Nyl.

It is known from a few localities in Bolivia (e.g., Feuerer *et al.* 1998; Flakus & Wilk 2006).

SPECIMENS EXAMINED: locality 5; on corticolous and terricolous bryophytes, and moribund thallus of lichens (7810, 7840, 7851).

Ocellularia viridis Hale

The species is new to Bolivia.

SPECIMEN EXAMINED: locality 15; on bark (6118).

Phaeographis haematites (Fée) Müll. Arg.

The species is new to Bolivia.

SPECIMEN EXAMINED: locality 15; on bark (6164).

Phaeographopsis neotropica Kalb

This recently described species is characterized by small ascospores and the production of norstictic acid as a major lichen substance (Kalb 2004). The presented record is the second locality in South America and Bolivia (Flakus & Wilk 2006).

Substances detected by TLC: norstictic acid (major).

SPECIMENS EXAMINED: locality 16; on bark (5817, 5845).

Phyllobaeis imbricata (Hook.) Kalb & Gierl

It is considered a rather common species in Bolivia, especially in montane rain forests, but reported only from several documented localities (e.g., Herzog 1922; Flakus & Wilk 2006; Feuerer 2008).

SPECIMENS EXAMINED: localities 6 and 8; on soil and small stones (7899, 8165).

Placynthiella icmalea (Ach.) Coppins & P. James

This is the second record from Bolivia. The previous ones were reported by Flakus and Wilk (2006). The species is probably frequent in the montane part of the area and most likely under-collected.

SPECIMEN EXAMINED: locality 6; on moribund bryophytes (8294/1).

Placynthiella uliginosa (Schrad.) Coppins & P. James

It was previously reported from only one locality (Flakus & Wilk 2006).

SPECIMEN EXAMINED: locality 10; on plant debris and moribund bryophytes (8578/1).

Porina leptalea (Durieu & Mont.) A. L. Sm.

The species is new to Bolivia. It has rarely been reported from South America and neighboring islands (McCarthy 1993; Aptroot 2002; McCarthy & Palice 2003). Despite its antitropical distribution (McCarthy 1998), the species is probably more common in mountain areas but overlooked.

SPECIMEN EXAMINED: locality 11; on schist (5801/1).

Porina mastoidea (Ach.) Müll. Arg.

According to McCarthy (2008) the species was reported from Bolivia only as *Verrucaria mastoidea* (Ach.) Nyl., by Nylander (1859).

SPECIMENS EXAMINED: locality 3; on siliceous rock (7524, 7543).

Ramalina celsa (Spreng.) Krog & Swinsc.

It was recently reported from Bolivia by Feuerer and Sipman (2005).

SPECIMENS EXAMINED: localities 6 and 20; on twigs of shrub and bark of tree (4506, 8259/1).

Tephromela atra (Huds.) Hafellner

The present records of the species are most likely the only modern ones originating from Bolivia (see Feuerer 2008).

SPECIMENS EXAMINED: localities 10 and 12; on schist (5709, 8574).

Thamnomia papelillo R. Sant.

Both known varieties (see Santesson 2004), var. *papelillo* and var. *subsolida* (Sato) R. Sant., were found during this study. Previously the species was recorded in Bolivia by Santesson (2004).

Substances detected by TLC: thamnolic acid (var. *papelillo*; 5770, 5782) and baecomycetic acid (var. *subsolida*; 5782/1).

SPECIMENS EXAMINED: locality 11; on soil (5770, 5782, 5782/1).

Thamnomia vermicularis (Sw.) Schaer.
var. *vermicularis*

The montane species appears to be common in open high Andean areas of Bolivia (see, e.g., Feuerer 2008; Flakus unpubl.).

Substances detected by TLC: thamnolic acid.

SPECIMENS EXAMINED: locality 10; on soil among bryophytes (8563, 8572).

Trapeliopsis flexuosa (Fr.) Coppins & P. James

This is the second published locality of the species in Bolivia (Flakus & Wilk 2006).

SPECIMENS EXAMINED: locality 6; on hard wood (8211, 8279, 8287).

***Tremolecia atrata* (Ach.) Hertel**

The species is new to Bolivia.

SPECIMEN EXAMINED: locality 10; on siliceous rock (8553).

***Tylophoron crassiusculum* Tibell**

The species is new to Bolivia.

SPECIMEN EXAMINED: locality 8; on bark (8373).

ACKNOWLEDGEMENTS. I wish to cordially thank Dr. Stephan G. Beck and Mrs. Rosa Isela Moneses Q. (La Paz, Herbario Nacional de Bolivia, Instituto de Ecología, Universidad Mayor de San Andrés) for their generous cooperation. Thanks are also due to Mr. Vincente Chura Palli (Cobija), Director of Reserva Nacional de Vida Silvestre Amazonica Manuripi, for granting permission to carry out lichenological research in the reserve, and to Mr. Celso Bismarck Ruiz (Chivé) for his kind help during the field work. I also to thank the anonymous reviewer for valuable comments on the manuscript.

REFERENCES

- AHTI T. 2000. Cladoniaceae. Flora Neotropica Monograph 78. Organization for Flora Neotropica and New York Botanical Garden, Bronx, New York.
- APTROOT A. 2002. New and interesting lichens and lichenicolous fungi in Brazil. *Fungal Diversity* **9**: 15–45.
- CHAVES J. L., LÜCKING R., SIPMAN H. J. M., UMAÑA L. & NAVARRO E. 2004. A first assessment of the Ticolichen biodiversity inventory in Costa Rica: the genus *Dictyonema* (Polyporales: Atheliaceae). *Bryologist* **107**: 242–249.
- FEUERER T. (ed.) 2008. Checklists of lichens and lichenicolous fungi. Hamburg University, Hamburg. [Version 1 April 2008]. <http://www.checklists.de>.
- FEUERER T. & SIPMAN H. J. M. 2005. Additions to the lichenized and lichenicolous fungi of Bolivia. *Herzogia* **18**: 139–144.
- FEUERER T., AHTI T. & VITIKAINEN O. 1998. Lichenological investigations in Bolivia. In M. P. Marcelli & M. R. D. Seaward (eds), *Lichenology in Latin America: history, current knowledge and applications*, pp. 71–86. CETESB, São Paulo.
- FLAKUS A. & LÜCKING R. 2008. New and additional records of foliicolous lichenized fungi from Bolivia. *Lichenologist* **40**(5): 423–436.
- FLAKUS A. & WILK K. 2006. Contribution to the knowledge of the lichen biota of Bolivia. *J. Hattori Bot. Lab.* **99**: 307–318.
- FLAKUS A., KUKWA M. & CZARNOTA P. 2006. Some interesting records of lichenized and lichenicolous Ascomycota from South America. *Polish Bot. J.* **51**(2): 209–215.
- FLAKUS A., AHTI T., KUKWA M. & WILK K. 2008. New and interesting records of *Cladonia* and their lichenicolous fungi from the Andean cloud forest in Bolivia. *Ann. Bot. Fenn.* **45**(6) (in press).
- HERZOG T. 1922. Beiträge zur Flechtenflora von Bolivia. *Hedwigia* **63**: 263–268.
- IBISCH P. L. & MÉRIDA G. (eds) 2004. Biodiversity: the richness of Bolivia. State of knowledge and conservation. Ministry of Sustainable Development. Editorial FAN, Santa Cruz de la Sierra, Bolivia.
- NAVARRO G. & MALDONADO M. 2002. Geografía ecológica de Bolivia: vegetación y ambientes acuáticos. Centro de Ecología Difusión Simón I. Patiño, Santa Cruz, Bolivia.
- KALB K. 2004. New or otherwise interesting lichens II. *Biblioth. Lichenol.* **88**: 301–329.
- KALB K., STAIGER B. 2000. *Dyplolabia* Massalongo. Monographie einer vergessenen Flechtengattung. *Hoppea, Denkschr. Regensb. Bot. Ges.* **61**: 409–422.
- KALB K., STAIGER B. & ELIX J. A. 2004. A monograph of the lichen genus *Diorygma* – a first attempt. *Symb. Bot. Ups.* **34**(1): 133–181.
- LÜCKING R., APTROOT A., CHAVES J. L., SIPMAN H. J. M. & UMAÑA L. 2007. A first assessment of the Ticolichen biodiversity inventory in Costa Rica: the genus *Coccocarpia* (Peltigerales: Coccocarpiaceae). *Biblioth. Lichenol.* **95**: 429–457.
- MCCARTHY P. M. 1993. Saxicolous species of *Porina* Müll. Arg. (Trichotheliaceae) in the Southern Hemisphere. *Biblioth. Lichenol.* **52**: 1–134.
- MCCARTHY P. M. 2008. Catalogue of Porinaceae. Australian Biological Resources Study, Canberra. Version 29 July 2008. <http://www.anbg.gov.au/abrs/lichenlist/PORINACEAE.html>.
- MCCARTHY P. M. & PALICE Z. 2003. A new species of *Trichothelium* and new records of Porinaceae from Ecuador. *Lichenologist* **35**(3): 237–240.
- NYLANDER W. 1859. Lichenes in regionibus exoticis quibusdam vigentes. Exponit synoptice enumerationibus. *Annales des Sciences Naturelle. Botanique, sér. 4* **11**: 205–264.
- ORANGE A., JAMES P. W. & WHITE F. J. 2001. Microchemical methods for the identification of lichens. British Lichen Society, London.
- PARMASTO E. 1978. The genus *Dictyonema* ('Thelephorolichenes'). *Nova Hedwigia* **29**(1–2): 99–144.
- RIVAS PLATA E., LÜCKING R., APTROOT A., SIPMAN H. J. M., CHAVES J. L., UMAÑA L. & LIZANO D. 2006. A first assess-

- ment 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.
- RUSBY H. H. 1895. On the collections of Mr. Miguel Bang in Bolivia. Part II. *Mem. Torrey Bot. Club* **4**: 203–274.
- SANTESSON R. 2004. Two new species of *Thammolia*. *Symb. Bot. Ups.* **34**(1): 393–397.
- SIPMAN H. J. M. 1983. A monograph of the lichen family Megalosporaceae. *Biblioth. Lichenol.* **18**: 1–241.
- STAIGER B. 2002. Die Flechtenfamilie Graphidaceae. Studien in Richtung einer natürlicheren Gleiderung. *Biblioth. Lichenol.* **85**: 1–526.
- THOR G. 1991. The placement of *Chiodecton sanguineum* (syn. *Chiodecton rubrocinctum*), and *Cryptothecia striata* sp. nov. *Bryologist* **94**(3): 278–283.

Received 9 September 2008