

## CONTRIBUTION TO THE KNOWLEDGE OF THE LICHEN BIOTA OF BOLIVIA. 6

ADAM FLAKUS<sup>1</sup>, HARRIE J. M. SIPMAN, PAMELA RODRIGUEZ FLAKUS, ULF SCHIEFELBEIN,  
AGNIESZKA JABŁOŃSKA, MAGDALENA OSET & MARTIN KUKWA

**Abstract.** This paper presents new data on the geographic distribution of 84 lichen species in Bolivia. *Bulbothrix chowoensis* (Hale) Hale is new to South America. Twenty-five species are new national records: *Chaenotheca confusa* Tibell, *Cora bovei* Speg., *C. reticulifera* Vain., *Dictyonema obscuratum* Lücking, Spielmann & Marcelli, *Gassicurtia ferruginascens* (Malme) Marbach & Kalb, *Haematomma subinnatum* (Malme) Kalb & Staiger, *Malmidea badimoides* (M. Cáceres & Lücking) M. Cáceres & Kalb, *Maronea constans* (Nyl.) Hepp, *Menegazzia subsimilis* (H. Magn.) R. Sant., *Myelochroa lindmanii* (Lynge) Elix & Hale, *Parmotrema commensuratum* (Hale) Hale, *P. conformatum* (Vain.) Hale, *P. disparile* (Nyl.) Hale, *P. machupicchuense* Kurok., *P. mordenii* (Hale) Hale, *P. praesorediosum* (Nyl.) Hale, *P. submarginale* (Michx.) DePriest & B. W. Hale, *P. viridiflavum* (Hale) Hale, *P. wainioi* (A. L. Sm.) Hale, *P. xanthinum* (Müll. Arg.) Hale, *P. yodae* (Kurok.) Hale, *Protoparmelia multifera* (Nyl.) Kantvilas, Papong & Lumbsch, *Ramboldia haematites* (Fée) Kalb, Lumbsch & Elix, *Solorina spongiosa* (Ach.) Anzi and *Stigmatochroma metaleptodes* (Nyl.) Marbach. Notes on distribution and chemistry are provided.

**Key words:** biodiversity, biogeography, lichenized fungi, Neotropics, South America

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

Harrie J. M. Sipman, Botanischer Garten & Botanisches Museum Berlin Dahlem, Königin-Luise-Strasse 6–8, D-14191 Berlin, Germany; e-mail: h.sipman@bgbm.org

Pamela Rodriguez Flakus, Department of Botany and Molecular Evolution, Senckenberg Forschungsinstitut und Naturmuseum, Senckenberganlage 25, D-60325, Frankfurt am Main, Germany; Herbario Nacional de Bolivia, Instituto de Ecología, Universidad Mayor de San Andrés, Calle 27, Cota Cota, Casilla 10077, La Paz, Bolivia; e-mail: pamelarodriguez@senckenberg.de  
Ulf Schiefelbein, Blücherstr. 71, D-18055 Rostock, Germany; e-mail: ulf.schiefelbein@gmx.de

Agnieszka Jabłońska, Martin Kukwa & Magdalena Oset, Department of Plant Taxonomy and Nature Conservation, University of Gdańsk, Wita Stwosza 59, 80-308 Gdańsk, Poland; e-mail: dokmak@ug.edu.pl

### INTRODUCTION

Based on the experience gained during our lichenological research in Bolivia, we can confidently state that this biologically unique country has one of the richest lichen biota in South America. This richness is due mainly to its geographic situation, diverse physiography and very high vegetation diversity (Josse *et al.* 2003; Ibsch & Mérida 2004; Lücking *et al.* 2009). However, the diversity and distribution of lichenized fungi are still largely unknown. Efforts in recent years have doubled the number of species known from this country to ca 1100. This is only about 25% of the 4000 spe-

cies expected to occur in the country (Rodriguez Flakus *et al.* 2014).

In this sixth part of our contributions to the Bolivian lichens based on our recent collections and revision of herbarium material, we present new records of 84 species, including 26 species reported for the first time for the country.

### MATERIAL AND METHODS

Specimens are housed at B, KRAM, LPB, UGDA (acronyms after Thiers 2012) and the private herbaria of A. Flakus and U. Schiefelbein; some duplicates were donated to other herbaria. Thin-layer chromatography (TLC) was used to identify the secondary lichen metabo-

<sup>1</sup> Corresponding author

lites necessary for recognition of some groups of lichens; methods follow Culberson and Kristinsson (1970) and Orange *et al.* (2001). Some specimens of *Parmotrema* were also analyzed by high-performance liquid chromatography (HPLC; methods according to Söchting 1997). The symbol ( $\pm$ ) indicates that a particular substance was absent in some specimens. In some cases the fluorescence of the thallus under ultraviolet light (UV) was checked, and spot tests were made using K (10% water solution of potassium hydroxide) and C (commercial bleach).

Notes on general distribution are presented for species reported as new for Bolivia; for other species only the distribution in Bolivia is commented. New national records are asterisked (\*) and those new to South America bear two (\*\*).

The following abbreviations are used: *AF* – A. Flakus; *JQ* – J. Quisbert; *KB* – K. Bach; *MK* – M. Kukwa; *OP* – O. Plata; *PR* – P. Rodríguez Flakus; *US* – Ulf Schiefelbein; *NP* – National Park; *AMBORÓ* – Parque Nacional y Área Natural de Manejo Integrado Amboró; *APOLO-BAMBA* – Área Natural de Manejo Integrado Nacional Apolobamba; *CARRASCO* – Parque Nacional Carrasco; *COTAPATA* – Parque Nacional y Área Natural de Manejo Integrado Cotapata; *E. B. BENI* – Reserva de la Biosfera Estación Biológica del Beni; *KAA-IYA* – Parque Nacional y Área Natural de Manejo Integrado Kaa-Iya del Gran Chaco; *NOEL KEMPF* – Parque Nacional Noel Kempff Mercado; *SAJAMA* – Parque Nacional Sajama; *TARIQUÍA* – Reserva Nacional de Flora y Fauna Tariquia; *TUNI CONDORIRI* – Parque Nacional Tuni Condoriri (abbreviations of protected areas according SERNAP Bolivia; <http://www.sernap.gob.bo>).

## RESULTS

### *Acarospora ramosa* K. Knudsen & Flakus

Known so far only from the type locality in Bolivia (Knudsen & Flakus 2009).

CHEMISTRY. Rhizocarpic and gyrophoric acids.

SPECIMEN EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Murillo, TUNI CONDORIRI, Comunidad Tuni, a 15 minutos de la cabaña de la represa Tuni, cima Condor Pustaña, 16°13'27.7"S, 68°16'03.4"W, 4874 m, high Andean vegetation, on siliceous rock, 17 March 2009, *PR s.n.* (LPB).

### \*\**Bulbothrix chowoensis* (Hale) Hale

Previously known only from Africa (Mozambique, Zambia) (Hale 1972, 1976a).

CHEMISTRY. Atranorin, protocetraric acid,  $\pm$  pigments.

SPECIMEN EXAMINED. BOLIVIA. DEPT. BENI. Prov. Ballivan, 12 km por carretera maderera al SW del km 12 Yucumo – Rurrenabaque, 15°06'S, 67°07'W, alt. 600 m, bosque siemprevverde, corticolous, 31 July 1997, *KB 363b et al.* (B).

### \**Chaenotheca confusa* Tibell

In South America previously known from Argentina, Chile (Tibell 1998) and Brazil (Aptroot 2002).

SPECIMENS EXAMINED. BOLIVIA. DEPT. SANTA CRUZ. Prov. Andrés Ibáñez, AMBORÓ, on road to San Mateo de Toresilla, old road between Cochabamba and Comarapa, 17°48'11"S, 64°39'28"W, 2250 m, Yungas cloud forest, tree by road, corticolous, 9 June 2011, *MK 9974* (LPB, UGDA).

### *Cladonia aleuropoda* Vain.

Quite common in the Bolivian Andes but still under-collected (Flakus 2008; Flakus *et al.* 2012).

CHEMISTRY. Fumarprotocetraric acid and related substances.

SPECIMEN EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Saavedra, near Charazani, 15°10'39"S, 68°56'36"W, 2237 m, Yungas montane forest, on soil, 18 May 2011, *US s.n.* (LPB).

### *Cladonia ceratophylla* (Sw.) Spreng.

Known from several localities in Bolivia and especially common in humid Andean forests (Nylander 1859, 1860; Rusby 1895; Ahti 2000; Flakus 2008; Flakus *et al.* 2012).

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Ayopaya, 10 km de Cocapata hacia Cotacajes, 16°38'S, 66°41'W, 2700–2850 m, bosque húmedo, epiphytic and terricolous, 10 & 11 May 1997, *KB et al.* 15, 28, 38, 43 & 55 (B, LPB); ibidem, 16°38'S, 66°41'W, 3150 m, SW-exposición, epiphytic, 13 May 1997, *KB et al.* 72 (B, LPB); comunidad de Saila Pata, 16°54'S, 66°55'W, 3450 m, Puna, terricolous, 23 Nov. 1997, *KB 919* (B, LPB); DEPT. LA PAZ. Prov. Bautista Saavedra, 15 km de Camata hacia Apolo, 15°13'S, 68°41'W, 1300 m, bosque semi-deciduo, on rock, 24 June 1997,

*KB et al.* 209 (B, LPB); 15 km de Charazani hacia Apolo, 15°11'S, 68°52'W, 2400 m, bosque húmedo secundario, terricolous, 2 July 1997, *KB et al.* 292 (B, LPB); Prov. Nor Yungas, between Coroico and La Paz, 16°13'09"S, 67°49'32"W, 2600 m, open place by road in Yungas cloud forest, on ground, 4 Aug. 2008, *MK 7177* (LPB, UGDA).

### *Cladonia confusa* R. Sant.

A common lichen in Bolivia but still under-recorded (Feuerer *et al.* 1998; Ahti 2000; Flakus 2008; Flakus *et al.* 2012). It comprises two forms, *C. confusa* s. str. and *C. confusa* f. *bicolor* (Müll. Arg.) Ahti & DePriest.

CHEMISTRY. Perlatolic acid (*C. confusa* f. *bicolor*) or usnic and perlatolic acids (*C. confusa* f. *confusa*).

SPECIMENS OF *C. CONFUSA* F. *BICOLOR* EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Murillo, Valle del Zongo, 16°07'41"S, 68°05'55"W, 2450 m, Yungas cloud forest, among bryophytes, 29 May 2011, *MK 9591* (LPB, UGDA); Prov. Nor Yungas, near Chuspipata, on road between Coroico and La Paz, 16°17'09"S, 67°51'00"W, 3228 m, Yungas cloud forest with Ericaceae, among mosses, 24 May 2011, *MK 9283* (LPB, UGDA).

SPECIMENS OF *C. CONFUSA* F. *CONFUSA* EXAMINED. BOLIVIA. DEPT. SANTA CRUZ. Prov. Caballero, El Lago, Cochabamba–Santa Cruz road, 17°50'16"S, 64°43'56"W, 2960 m, open Yungas cloud forest, on ground, 17 Aug. 2012, *MK 11641* (LPB, UGDA).

### *Cladonia corniculata* Ahti & Kashiw.

Appears to be common in Bolivia (Ahti 2000; Flakus 2008; Flakus *et al.* 2012) but still under-recorded.

CHEMISTRY. Fumarprotocetraric acid and related substances.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Nor Yungas, near Unduavi, 16°17'29"S, 67°51'43"W, 3200 m, Yungas cloud forest, on soil, 25 May 2011, *US 2926* (LPB, herb. Schiefelbein).

### *Cladonia dactylota* Tuck.

Few localities reported from Bolivia previously (Flakus 2008; Flakus *et al.* 2012).

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Carrasco, CARRASCO, near Sehuencas, 17°26'14"S, 65°15'20"W, 2150 m, Yungas cloud forest, on soil, 18 Aug. 2012, *MK 11748* (LPB, UGDA); DEPT. LA PAZ. Prov. Nor Yungas, between Coroico and La Paz, 16°13'09"S, 67°49'32"W, 2600 m, open place by road in montane cloud forest, on ground, 4 Aug. 2008, *MK 7175a* (LPB, UGDA); 2 km del camino principal de Chuspipata hacia Coroico, 16°22'S, 67°49'W, 2900 m, pared rocosa en el borde de camino, on rock and terricolous, 17 Sept. 1997, *KB et al.* 534 (B, LPB); San Vicente, ca 1 km al este de Chuspipata, 16°21'S, 67°49'W, 3000 m, on decaying wood, 21 Sept. 1997, *KB et al.* 583 (B, LPB).

### *Cladonia meridensis* Ahti & S. Stenroos

Only rarely reported from Bolivia (Ahti & Stenroos 1986; Stenroos 1989; Ahti 2000; Flakus *et al.* 2012).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Bautista Saavedra, Cerro Asunta Pata, 15°05'S, 68°29'W, 1500 m, bosque siempreverde, on decaying wood, 21 June 1997, *KB et al.* 188 (B, LPB); Prov. Nor Yungas, Coscapa, senda al oeste del camino principal ca 4 km de Cotapata hacia La Paz, 16°23'S, 67°53'W, 3500 m, bosque siempreverde, epiphytic, 9 Sept. 1997, *KB et al.* 471 (LPB).

### *Cladonia rappii* Tuck.

Only a few records of this species published from Bolivia (Feuerer *et al.* 1998; Ahti 2000; Flakus 2008; Flakus *et al.* 2012).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Bautista Saavedra, 15 km de Charazani hacia Apolo, 15°11'S, 68°52'W, 2400 m, pastos con arbustos al lado del Río Camata, terricolous, 1 July 1997, *KB et al.* 281 (B, LPB); Prov. Nor Yungas, between Coroico and La Paz, 16°13'09"S, 67°49'32"W, 2600 m, open place by road in montane cloud forest, on ground, 4 Aug. 2008, *MK 7187* (LPB, UGDA).

### *Cladonia signata* Vain.

Previously reported in Bolivia from four localities (Ahti 2000; Flakus *et al.* 2012).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Nor Yungas, Serranía Bellavista, 43 km por el camino de Caranavi hacia Sapecho, 15°40'S, 67°27'W,

1300 m, pared rocosa, on rock, 29 Aug. 1997, *KB et al.* 427 (B, LPB).

***Cladonia squamosa* (Scop.) Hoffm.**

Reported from only a few localities in Bolivia (Herzog 1922; Flakus 2008; Flakus *et al.* 2012).

SPECIMENS EXAMINED. BOLIVIA. DEPT. BENI. PROV. Ballivan, 16 km por carretera maderera al SW del km 12 Yucumo – Rurrenabaque, 15°06'S, 67°07'W, 700 m, bosque siempreverde primario, terricolous, 1 Aug. 1997, *KB et al.* 367 (B, LPB); DEPT. COCHABAMBA. PROV. Ayopaya, 10 km de Cocapata hacia Cotacajes, 16°38'S, 66°41'W, 2800–2850 m, bosque húmedo, terricolous, 10 May 1997, *KB et al.* 5 (B, LPB, as admixture to specimen of *Cladonia didyma*); DEPT. LA PAZ. PROV. Bautista Saavedra, Cerro Asunta Pata, 15°05'S, 68°29'W, 1500 m, pared lodosa, terricolous, 21 June 1997, *KB et al.* 174 & 189 (LPB); 15 km de Charazani hacia Apolo, 3500 m, 15°11'S, 68°52'W, bosque húmedo, terricolous, 4 July 1997, *KB et al.* 350 (B, LPB, as admixture to *C. subradiata*); 3 km de Pauji–Yuyo hacia Charazani, 15°02'S, 68°29'W, 1300 m, bosque siempreverde primario, epiphytic, 5 June 1997, *KB et al.* 138 (B, LPB, as admixture to *C. didyma*); Prov. Nor Yungas, Serranía Bellavista, ca 43 km por camino de Caranavi hacia Sapecho, 15°40'S, 67°27'W, 1300 m, pared rocosa, on rock, 29 Aug. 1997, *KB et al.* 428 (B, LPB).

***Cladonia subradiata* (Vain.) Sandst.**

Apparently common in Bolivia but still under-recorded (Ahti 2000; Flakus *et al.* 2012).

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. PROV. Ayopaya, 10 km de Cocapata hacia Cotacajes, 16°38'S, 66°41'W, 2800–2850 m, bosque húmedo, terricolous, 10 May 1997, *KB et al.* 3 (LPB); 5 km al sur de Saila Pata, 16°55'S, 66°56'W, 3050 m, bosque siempreverde, epiphytic, 10 Nov. 1997, *KB 861 & I. Jiménez* (B, LPB); Prov. Chapare, CARRASCO, 130 km del camino antiguo de Cochabamba a Villa Tunari, 17°07'S, 65°36'W, 2200 m, bosque húmedo, terricolous, 10 Oct. 1997, *KB et al.* 691 (B, LPB, as admixture to *Cladonia subsquamosa*); DEPT. LA PAZ. PROV. Bautista Saavedra, 15 km de Charazani hacia Apolo, 15°11'S, 68°52'W, 3500 m, bosque húmedo, terricolous, 4 July 1997, *KB et al.* 350 (B, LPB); 6 km de Pauji–Yuyo hacia Charazani, 15°02'S, 68°29'W, 1350 m, bosque siempreverde, on decaying wood, 14 June 1997, *KB et al.* 160, 161 & 164 (B, LPB); Prov. Nor Yungas, Serranía Bellavista, ca 43 km por el camino de Caranavi hacia Sapecho,

15°41'S, 67°30'W, 1400 m, al borde del camino, on decaying wood, 27 Aug. 1997, *KB et al.* 424 (B, LPB); DEPT. SANTA CRUZ. PROV. Florida, Refugio Los Volcanes, 18°06'S, 63°36'W, 1000 m, bosque semi-deciduo, on decaying wood, 3 Oct. 1997, *KB et al.* 626 (B, LPB).

***Cladonia subsquamosa* Kremp.**

Apparently a common species in Bolivia, especially in Andean humid forests (Ahti 2000; Flakus 2008; Flakus *et al.* 2012).

CHEMISTRY. Fumarprotocetraric acid and related substances.

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. PROV. Ayopaya, 10 km de Cocapata hacia Cotacajes, 16°38'S, 66°41'W, 2800–2850 m, bosque húmedo, terricolous, 10 May 1997, *KB et al.* 3 (LPB, as admixture to *Cladonia subradiata*); ibidem, 16°38'S, 66°41'W, 2750 m, pared rocosa en el borde del camino, terricolous, 12 May 1997, *KB et al.* 42 (LPB); 20 km de Cocapata hacia Cotacajes, 16°46'S, 66°44'W, 2000 m, bosque semideciduo intervenido, on rock, 15 May 1997, *KB et al.* 104 (B, LPB); comunidad de Saila Pata, 16°55'S, 66°56'W, 3050 m, borde del sendero adentro de un matorral, terricolous, 13 Nov. 1997, *KB 894 & I. Jiménez* (B, LPB); 5 km al sur de Saila Pata, 16°55'S, 66°56'W, 3050 m, bosque siempreverde, 10 Nov. 1997, *KB 861 & I. Jiménez* (B, LPB, as admixture to *C. subradiata*); Prov. Carrasco, CARRASCO, between Sehuencas and Monte Punku, 2650 m, montane cloud forest, on humus or rocks, 22 July 2008, *MK 6576* (LPB); Prov. Chapare, CARRASCO, a 130 km del camino antiguo de Cochabamba a Villa Tunari, 17°07'S, 65°36'W, 2200 m, bosque húmedo con paredes rocosas, terricolous, 10 Oct. 1997, *KB et al.* 691 (B, LPB); DEPT. LA PAZ. PROV. Bautista Saavedra, 3 km de Pauji–Yuyo hacia Charazani, 15°02'S, 68°29'W, 1300 m, bosque siempreverde primario, epiphytic, 5 June 1997, *KB et al.* 138 (B, LPB, as admixture to specimen of *C. didyma*); 10 km de Charazani hacia Apolo, 15°11'S, 68°52'W, 2550 m, pared rocosa, on rock, 31 May 1997, *KB et al.* 130 (LPB); 15 km de Charazani hacia Apolo, 15°11'S, 68°52'W, 3500 m, bosque húmedo, terricolous, 4 July 1997, *KB et al.* 349 (B, LPB); ibidem, 2400 m, pastos con arbustos al lado del Río Camata, terricolous, 1 July 1997, *KB et al.* 276, 277 & 278 (B, LPB); ibidem, 2450 m, bosque húmedo secundario, at base of trunk, 2 July 1997, *KB et al.* 312 (LPB); Cerro Asunta Pata, 15°05'S, 68°29'W, 1500 m, pared lodosa, terricolous, 21 June 1997, *KB et al.* 175 (B, LPB); Prov. Franz Tamayo, Río Bilipisa,

ca 10 km NW de Apolo, 14°36'S, 68°27'W, 1100 m, bosque semideciduo intervenido, terricolous, 4 July 1997, *KB 234* (B, LPB); Prov. Nor Yungas, between Coroico and La Paz, 16°13'09"S, 67°49'32"W, 2600 m, open place by road in montane cloud forest, on ground, 4 Aug. 2008, *MK 7177a* (LPB); Coscapa, senda al oeste del camino principal ca 4 km de Cotapata hacia La Paz, 16°23'S, 67°54'W, 3200–3350 m, bosque siempreverde, terricolous, 11 Sept. 1997, *KB et al. 498* (LPB); ibidem, 16°23'S, 67°53'W, 3500 m, bosque siempreverde, epiphytic, 9 Sept. 1997, *KB et al. 460* (B, LPB); San Vicente, ca 1 km al oeste de Chuspipata, 16°21'S, 67°49'W, 3000 m, on saxicolous bryophytes, 21 Sept. 1997, *KB et al. 582* (B, LPB); Serrania Bellavista, ca 43 km por camino de Caranavi hacia Sapecho, 15°41'S, 67°30'W, 1400 m, borde del camino, on decaying wood, 27 Aug. 1997, *KB et al. 424* (B, LPB, as admixture to *C. subradiata*); DEPT. SANTA CRUZ. Prov. Florida, Refugio Los Volcanes, 18°06'S, 63°36'W, 1000 m, bosque semideciduo, on decaying wood and rock, 3 & 4 Oct. 1997, *KB et al. 627 & 642* (B, LPB).

### *Cora arachnoidea* J. E. Hern. & Lücking

A Neotropical species with only one record from Bolivia (Lücking *et al.* 2013).

The Bolivian records of this and other *Cora* species were previously included in the broad concept of *C. glabrata* [syn. *Dictyonema glabratum* (Spreng.) D. Hawksw.] and/or *C. minor* (syn. *D. minor* Lücking, E. Navarro & Sipman) by Flakus *et al.* (2012, 2013). After revision of the material previously assigned to these two taxa we conclude that both are known from only a few records in Bolivia.

SPECIMENS EXAMINED. BOLIVIA. DEPT. SANTA CRUZ. Prov. Manuel María Caballero, near Siberia, 17°49'34"S, 64°43'14"W, 2800 m, Yungas cloud forest, 16 Aug. 2012, *MK 11481* (LPB, UGDA).

### *Cora aspera* Wilk, Lücking & E. Morales

A recently described species reported in Bolivia from four localities (Lücking *et al.* 2013). The records given below were assigned erroneously to *C. glabrata* by Flakus *et al.* (2012, 2013).

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Chapare, CARRASCO, near Incachaca, 17°15'10"S, 65°48'51"W, 2330 m, disturbed montane cloud forest, on bark of tree, 23 July 2008, *MK 6690*

(LPB, UGDA); DEPT. LA PAZ. Prov. Nor Yungas, near Pacallo, 16°12'10"S, 67°50'39"W, 1360 m, montane forest, on bark of tree, 3 Aug. 2008, *MK 7140* (LPB, UGDA); COTAPATA, between Tunkini and Chairó, 16°11'S, 67°52'W, 2400 m, Yungas montane forest, on epiphytic bryophytes, 22 May 2011, *MK 9099* (LPB); by Sillu Tincara pre-Columbian route, 16°17'22"S, 67°53'29"W, 3520 m, transition Páramo Yungueño–Yungas montane cloud forest, on ground, 25 May 2011, *MK 9457* (GMUF, LPB, UGDA); DEPT. SANTA CRUZ. Prov. Manuel María Caballero, near Siberia, 17°49'38"S, 64°44'45"W, 3950 m, open Yungas cloud forest, on ground, 16 Aug. 2012, *MK 11459* (LPB, UGDA).

### \**Cora bovei* Speg.

Previously known only from Argentina (Lücking *et al.* 2013). The records below were erroneously published as *Dictyonema glabratum* and *D. minus* by Flakus *et al.* (2012).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Larecaja, Titilaya, 15°39'55"S, 68°42'51"W, 2773 m, transition Yungas forest–Valles Secos vegetation, on bryophytes, 14 May 2011, *MK 8442* (LPB, UGDA); la Cumbre de Sorata, 15°53'06"S, 68°38'55"W, 4787 m, high Andean open vegetation, on soil, 13 May 2011, *MK 8416* (LPB, UGDA).

### *Cora glabrata* (Spreng.) Fr.

The only records for the species in Bolivia are those given below.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Larecaja, la Cumbre de Sorata, 15°53'06"S, 68°38'55"W, 4787 m, high Andean open vegetation, on mosses over stone, 13 May 2011, *MK 8418* (LPB, UGDA); Prov. Nor Yungas, between Coroico and La Paz, 16°13'09"S, 67°49'32"W, 2600 m, open place by road in montane cloud forest, on ground, 4 Aug. 2008, *MK 7201b* (UGDA); DEPT. SANTA CRUZ. Prov. Florida, AMBORÓ, above la Yunga, senda Los Helichos, 18°03'30"S, 63°54'36"W, 2330 m, Yungas cloud forest, on soil, 7 June 2011, *MK 9732* (UGDA, as admixture to *Cladonia ceratophylla*).

### *Cora minor* (Lücking, E. Navarro & Sipman) Lücking

Records published erroneously as *Dictyonema glabratum* by Flakus *et al.* (2013)

SPECIMENS EXAMINED. BOLIVIA. DEPT. SANTA CRUZ. Prov. Manuel María Caballero, near Siberia, 17°49'38"S, 64°44'45"W, 3950 m, open Yungas cloud forest, on bark, 16 Aug. 2012, *MK 11462* (LPB, UGDA); DEPT. COCHABAMBA. Prov. Carrasco, CARRASCO, between Sehuencas and Monte Punku, ca 2650 m, Yungas cloud forest, on humus, 22 July 2008, *MK 6578* (LPB).

### *Cora pavonia* (Sw.) Fr.

Reported from Bolivia by Parmasto (1978). The record below was erroneously published under the name *Dictyonema glabratum* by Flakus *et al.* (2012).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Nor Yungas, between Coroico and La Paz, 16°13'09"S, 67°49'32"W, 2600 m, open place by road in montane cloud forest, on ground, 4 Aug. 2008, *MK 7181* (BILAS, GPN, LPB, UGDA, herb. Schiefelbein).

### \**Cora reticulifera* Vain.

Described from Brazil (Lücking *et al.* 2013). Published from Bolivia erroneously as *Cora glabrata* and *Dictyonema glabratum* by Flakus *et al.* (2012, 2013).

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Carrasco, CARRASCO, near Sehuencas by Río López Mendoza, 17°30'26"S, 65°16'55"W, 2226 m, Yungas cloud forest, on bark of tree, 22 July 2008, *MK 6634* (LPB, UGDA); near Phaqcha, 20 km of Monte Punku, 17°27'13"S, 65°16'44"W, 2850 m, Yungas cloud forest, close to river, among mosses, 20 July 2008, *MK 6237* (LPB, UGDA); DEPT. LA PAZ. Prov. Franz Tamayo, near Correo, 14°59'06"S, 68°26'09"W, 1630 m, Yungas montane forest, open area near path, on soil, 17 May 2011, *MK 8782* (LPB, UGDA); Prov. Murillo, Valle del Zongo, 16°08'38"S, 68°06'59"W, 2910 m, Yungas cloud forest, on bryophytes, 29 May 2011, *MK 9564* (LPB, UGDA); Prov. Nor Yungas, between Coroico and La Paz, 16°13'09"S, 67°49'32"W, 2600 m, open place by road in montane cloud forest, on ground, 4 Aug. 2008, *MK 7182, 7190* (LPB, UGDA); COTAPATA, Santa Catalina, 16°11'12"S, 67°52'07"W, 2700 m, Yungas montane forest, on ground, 22 May 2011, *MK 9059* (LPB, UGDA); km 62 on road between Coroico and La Paz, 16°14'30"S, 67°49'58"W, 2850 m, Yungas secondary cloud forest, on ground, 23 May 2011, *MK 9206* (GMUF, LPB, UGDA).

### *Cora squamiformis* Wilk, Lücking & Yáñez-Ayabaca

Recently described from Bolivia and Ecuador by Lücking *et al.* (2013). The records below were assigned erroneously to *Dictyonema minus* in Flakus *et al.* (2012).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Camacho, cerca Villa Cala, 15°25'53"S, 69°05'07"W, 4250 m, high Andean vegetation, tertricolous, 19 May 2011, *AF 21186, 21220, MK 8966 & OP* (GMUF, KRAM, LPB, UGDA); Prov. Larecaja, la Cumbre de Sorata, 15°53'06"S, 68°38'55"W, 4787 m, high Andean open vegetation, on soil, 13 May 2011, *MK 8427* (LPB, UGDA); Prov. Murillo, below Potosí, on road between La Paz and Valle del Zongo, 16°17'43"S, 68°07'42"W, 4720 m, high Andean vegetation, on soil, 28 May 2011, *MK 9498* (LPB, UGDA).

### *Cratiria obscurior* (Stirt.) Marbach & Kalb

Previously reported from a single locality in Bolivia by Marbach (2000).

SPECIMENS EXAMINED. BOLIVIA. DEPT. SANTA CRUZ. Prov. Cordillera, between Tucavaca and Roboré, 18°36'11"S, 59°53'06"W, 320 m, transition Chiquitano–Chaqueño forest, corticolous, 4 Dec. 2011, *AF 23533.1* (LPB, herb. Flakus); 350 km on road from Tucavaca to Roboré, 18°37'56"S, 59°36'50"W, 370 m, transition Chiquitano–Chaqueño forest, corticolous, 4 Dec. 2011, *AF 23407* (KRAM, LPB); KAA-IYA, near Peto Blanco, park guards' station, 18°51'36"S, 60°18'00"W, 310 m, transition Chiquitano–Chaqueño forest, corticolous, 5 Dec. 2011, *AF 23728* (KRAM, LPB, herb. Flakus); DEPT. TARIJA. Prov. Aniceto Arce, Papachacra, 21°41'36"S, 64°29'33"W, 2195 m, Tucumano-Boliviano montane forest with *Alnus acuminata*, corticolous, 26 Nov. 2010, *AF 19891 & JQ* (LPB).

### *Cratiria saltensis* (H. Magn.) Marbach

Previously reported from Bolivia by Marbach (2000).

SPECIMENS EXAMINED. BOLIVIA. DEPT. SANTA CRUZ. Prov. Cordillera, between Tucavaca and Roboré, 18°36'11"S, 59°53'06"W, 320 m, transition Chiquitano–Chaqueño forest, corticolous, 4 Dec. 2011, *AF 23533* (KRAM, herb. Flakus); PNAN KAA-IYA, Charrata, 18°28'05"S, 62°05'43"W, 307 m, Chaqueño forest, corticolous, 2 Dec. 2010, *AF 20196 & JQ* (LPB).

**\**Dictyonema obscuratum*** Lücking, Spielmann & Marcelli

Recently described from Brazil by Lücking *et al.* (2013). Erroneously published from Bolivia as *D. sericeum* (Sw.) Berk. f. *schenkianum* (Müll. Arg.) Parm. and f. *membranaceum* P. Metzner by Flakus *et al.* (2012, 2013).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Bautista Saavedra, Calzada, 15°09'06"S, 68°30'24"W, 835 m, Preandean Amazon secondary forest, on plant remains, 17 May 2011, *MK 8798* (LPB, UGDA); Prov. Nor Yungas, near Pacallo, 16°12'10"S, 67°50'39"W, 1360 m, montane forest, on bark of tree, 3 Aug. 2008, *MK 7169a* (LPB); DEPT. SANTA CRUZ. Prov. Manuel María Caballero, near Siberia, 17°49'34"S, 64°43'14"W, 2800 m, Yungas cloud forest, on epiphytic bryophytes, 16 Aug. 2012, *MK 11480* (LPB, UGDA).

***Everniastrum subplanum*** Sipman

Previously known from Bolivia from only a single locality (Flakus *et al.* 2011b).

CHEMISTRY. Atranorin, salazinic and protolicheterinic acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Larecaja, Jocollone, 15°37'35"S, 68°41'21"W, 3545 m, Páramo Yungueño, open disturbed area, on twigs, 14 May 2011, *MK 8498* (LPB, UGDA).

***Flavopunctelia flaventior*** (Stirt.) Hale

A rather common species but reported from only a few localities in Bolivia (Feuerer *et al.* 1998; Canseco *et al.* 2006; Flakus *et al.* 2011b).

CHEMISTRY. Usnic and lecanoric acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Cercado, Cochabamba, 17°22.0'S, 66°08.5'W, 2500 m, vegetación de los valles secos interandinos, corticolous on *Jacaranda*, 27 Sept. 2006, *M. Canazas MC-71* (B, BOLV); DEPT. LA PAZ. Prov. Bautista Saavedra, near Charazani, 15°10'39"S, 68°56'36"W, 2730 m, Yungas montane forest, on rocks, 18 May 2011, *MK 8817* (LPB, UGDA); 10 km de Charazani hacia Apolo, 15°11'S, 68°52'W, 2550 m, pared rocosa, on rock, 31 May 1997, *KB et al. 131* (B, LPB); DEPT. LA PAZ. Prov. Murillo, Jupapina, 16°34'S, 68°05'W, 3400 m, matorral seco y abierto, on bark, 12 Feb. 1987, *S. Stab LB-11* (B); Prov. Murillo, La Paz, parque Día

Internacional del Niño, 16°31.2'S, 68°05.1'W, 3300 m, área verde recreacional, corticolous on *Acacia dealbata*, 4 July 2008, *Yapu-Alcázar G. 253* (B, LPB); La Paz, plaza Adela Zamudio, zona de Sopocachi, 16°30,9'S, 68°07,6'W, 3608 m, área verde, corticolous on *Acacia dealbata*, 28 June 2008, *G. Yapu-Alcázar 111* (B, LPB); La Paz, plaza Mundial, 16°31.8'S, 68°04.4'W, 3355 m, área verde recreacional, corticolous on *Acacia dealbata*, 4 July 2008, *G. Yapu-Alcázar 245* (B, LPB).

***Flavopunctelia praesignis*** (Nyl.) Hale

Previously reported from only two localities in Bolivia (Flakus *et al.* 2011b).

CHEMISTRY. Usnic and lecanoric acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Murillo, Valle de la Luna near Mallasa district, 16°34'03"S, 68°05'38"W, 3350 m, open semi-desert high Andean area, on twigs, 17 Nov. 2009, *AF 14659* & *PR* (KRAM, LPB).

**\**Gassicurtia ferruginascens*** (Malme) Marbach & Kalb

Known from a few localities in South America (Brazil, Venezuela) and Hawaii (Marbach 2000; Neuwirth 2008).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Nor Yungas, near Pacallo, 16°12'10"S, 67°50'39"W, 1360 m, Yungas montane forest, corticolous, 3 Aug. 2008, *AF 11749* & *MK* (LPB, KRAM).

**\**Haematomma subinnatum*** (Malme) Kalb & Staiger

An endemic South American lichen known from several localities in Gran Chaco in Brazil, Paraguay and Uruguay (as *Haematomma puniceum* var. *subinnatum*) (Osorio 1980; Staiger & Kalb 1995).

SPECIMENS EXAMINED. BOLIVIA. DEPT. SANTA CRUZ. Prov. Cordillera, KAA-IYA, Charrata, 18°28'05"S, 62°05'43"W, 307 m, Chaqueño forest, corticolous, 2 Dec. 2010, *AF 20141.1* & *JQ* (LPB); near Peto Blanco, park guards' station, 18°56'26"S, 60°22'39"W, 340 m, Chiquitano forest, corticolous, 5 Dec. 2011, *AF 23653* (LPB, KRAM, herb. Flakus); near Peto Blanco, park guards' station, 18°51'36"S, 60°18'00"W, 310 m, transition Chiquitano–Chaqueño forest, corticolous, 5 Dec. 2011, *AF 23694* (LPB, KRAM).

***Heterodermia comosa*** (Eschw.) Follmann & Redón

Reported several times from Bolivia but only a few records are recent (Nylander 1859, 1860, 1861; Herzog 1922; Lyngge 1924; Kurokawa 1962; Trass 1992; Moberg 2011; Flakus *et al.* 2012).

CHEMISTRY. Not tested by TLC; two specimens had spots of pale salmon pigment on lower surface of thallus.

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Ayopaya, 20 km de Cocapata hacia Cotacajes, 16°46'S, 66°44'W, 2000 m, bosque semi-deciduo intervenido, epiphytic, 15 May 1997, *KB et al.* 92 (B, LPB); comunidad de Saila Pata, 16°54'S, 66°56'W, 2800 m, bosque semi-siempreverde, epiphytic, 17 Nov. 1997, *KB et al.* 918A (B, LPB); DEPT. LA PAZ. Prov. Bautista Saavedra, 15 km de Camata hacia Apolo, 15°13'S, 68°41'W, 1400 m, bosque semi-deciduo, epiphytic, 27 June 1997, *KB et al.* 226 (B, LPB); Prov. Nor Yungas, COTAPATA, between Tunkini and Chairros, above Tunkini, 16°11'S, 67°52'W, 2400 m, on bark, 22 May 2011, *MK 9118* (LPB, UGDA); Coroico, Sol y Luna hotel, 1870 m, 16°11'56"S, 67°43'26"W, gardens with trees, on bark, 13 Dec. 2011, *MK 10745* (LPB, UGDA); DEPT. SANTA CRUZ. Prov. Cordillera, KAA-IYA, near Peto Blanco, 18°51'36"S, 60°18'00"W, 310 m, transition Chiquitano-Chaqueño forest, on twigs, 5 Dec. 2011, *MK 10653* (LPB, UGDA); Prov. Florida, Refugio Los Volcanes, 1000 m, 18°06'S, 63°36'W, bosque semi-deciduo, epiphytic, 2 Oct. 1997, *KB et al.* 609 & 611a (B, LPB); DEPT. TARIJA. Prov. O'Connor, near San Diego, 21°26'28"S, 64°14'37"W, 1620 m, Tucumano-Boliviano altimontane forest, on twig, 9 Aug. 2012, *MK 11172* (LPB, UGDA).

***Heterodermia fertilis*** Moberg

A Neotropical taxon previously reported from Bolivia from nine localities (Moberg 2011; Flakus *et al.* 2012).

CHEMISTRY. Not tested by TLC; specimens possessed spots of brownish or pinkish pigment on lower surface of thallus, which did not react with K.

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Carrasco, along road to valley of S Wencas, 2600 m, rocky slope, near stream, 1987, *R. Guillén 9* (B); CARRASCO, Ch'iqta rumi, 17°28'44"S, 65°17'06"W, 2120 m, montane cloud forest, on bark of tree, 21 July

2008, *MK 6272* (LPB); Prov. Chapare, CARRASCO, 137 km del camino antiguo de Cochabamba a Villa Tunari, 17°06'S, 65°35'W, 1600 m, bosque siempreverde, epiphytic, 11 Oct. 1997, *KB et al.* 763 (B, LPB); DEPT. LA PAZ. Prov. Nor Yungas, near Nogalani, 16°12'57"S, 67°49'15"W, 2168 m, Yungas secondary cloud forest, on corticolous bryophytes, 23 May 2011, *MK 9162* (LPB); near Siniari colony, km 74 on road between Coroico and La Paz, 16°13'20"S, 67°50'37"W, 2190 m, Yungas secondary cloud forest, on mosses, 24 May 2011, *MK 9254* (LPB); DEPT. SANTA CRUZ. Prov. Caballero, El Camino de Orquideas, 17°49'20"S, 64°42'31"W, 2340 m, Yungas cloud forest, on bark, 17 Aug. 2012, *MK 11570* (LPB, UGDA); el Camino de Orquideas, 17°49'50"S, 64°42'11"W, 2415 m, Yungas cloud forest, on bark, 17 Aug. 2012, *MK 11608* (LPB, UGDA).

***Heterodermia galactophylla*** (Tuck.) W. L. Culb.

Recently reported from six localities in Bolivia (Flakus *et al.* 2012).

CHEMISTRY. Atranorin and zeorin.

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Chapare, CARRASCO, Incachaca, 17°14'59"S, 65°49'36"W, 2560 m, Yungas cloud forest, on twigs, 19 Aug. 2012, *MK 11815* (LPB, UGDA); 145 km del camino antiguo de Cochabamba a Villa Tunari, 17°07'S, 65°34'W, 1200 m, bosque húmedo, epiphytic, 10 Oct. 1997, *KB et al.* 662 (LPB); 123 km del camino antiguo de Cochabamba a Villa Tunari, 17°06'S, 65°37'W, 2100 m, borde de camino con arbustos y paredes rocosas, epiphytic, 10 Oct. 1997, *KB et al.* 751 (LPB); 137 km del camino antiguo de Cochabamba a Villa Tunari, 17°06'S, 65°35'W, 1600 m, bosque siempreverde, epiphytic, 11 Oct. 1997, *KB et al.* 764 (LPB); DEPT. LA PAZ. Prov. Nor Yungas, near Siniari colony, 16°13'20"S, 67°50'37"W, 2190 m, Yungas secondary cloud forest, on bark, 24 May 2011, *MK 9251* (LPB, UGDA); DEPT. SANTA CRUZ. Prov. Florida, AMBORÓ, above la Yunga, 18°03'30"S, 63°54'36"W, 2330 m, Yungas cloud forest, on bark, 7 June 2011, *MK 9782b* (LPB).

***Heterodermia leucomela*** (L.) Poelt

One of the commonest members of the genus in Bolivia (Nylander 1859, 1861; Rusby 1896; Herzog 1922, 1923; Lyngge 1924; Feuerer *et al.* 1998; Moberg 2011).



CHEMISTRY. Atranorin, zeorin and salazinic acid.

SPECIMENS OF *HETERODERMIA LEUCOMELA* S. STR. EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Ayo-paya, 10 km de Cocapata hacia Cotacajes, 16°38'S, 66°41'W, 2750–2850 m, bosque húmedo, epiphytic, 10 May 1997, *KB et al.* 2, 35, 11a (LPB); 20 km de Cocapata hacia Cotacajes, 16°46'S, 66°44'W, 2000 m, bosque semideciduo intervenido, epiphytic, 15 May 1997, *KB et al.* 106 (B, LPB); 5 km al sur de Saila Pata, 16°55'S, 66°56'W, 3050 m, S-exposición, bosque siempreverde con *Podocarpus*, epiphytic, 10 Nov. 1997, *KB & I. Jiménez* 848 (B, LPB); 6 km al sur de Saila Pata, 16°55'S, 66°56'W, 3050 m, cresta en bosque siempreverde, epiphytic, 11 Nov. 1997, *KB & I. Jiménez* 885 (B, LPB); comunidad de Saila Pata, 16°54'S, 66°56'W, 2600 m, matorral intervenido, epiphytic, 25 Nov. 1997, *KB et al.* 923 (B, LPB); Prov. Chapare, CARRASCO, 132 km del camino antiguo de Cochabamba a Villa Tunari, 17°06'S, 65°35'W, 1950 m, borde de camino en bosque húmedo, epiphytic, 10 Oct. 1997, *KB et al.* 675 (B, LPB); 139 km del camino antiguo de Cochabamba a Villa Tunari, 17°07'S, 65°34'W, 1450 m, bosque siempreverde, epiphytic, 12 Oct. 1997, *KB et al.* 803 (LPB); 145 km del camino antiguo de Cochabamba a Villa Tunari, 17°07'S, 65°34'W, 1200 m, bosque húmedo, epiphytic, 10 Oct. 1997, *KB et al.* 661 (LPB); 148 km del camino antiguo de Cochabamba a Villa Tunari, 17°07'S, 65°34'W, 1050 m, bosque húmedo, epiphytic, 10 Oct. 1997, *KB et al.* 655 (LPB); 156 km del camino antiguo de Cochabamba a Villa Tunari, 17°05'S, 65°32'W, 850 m, bosque siempreverde, epiphytic, 12 Oct. 1997, *KB et al.* 841 (LPB); DEPT. LA PAZ. Prov. Bautista Saavedra, 15 km from Charazani, 15°11'02"S, 68°53'43"W, 2560 m, transition Yungas montane forest–cloud forest, on twigs, 18 May 2011, *MK 8953* (LPB); 10 km de Charazani hacia Apolo, 15°11'S, 68°52'W, 2550 m, pared rocosa, terricolous, 31 May 1997, *KB et al.* 129 (B, LPB); 15 km de Charazani hacia Apolo, 15°11'S, 68°52'W, 2400 m, pastos con arbustos al lado del Río Camata, terricolous, 1 July 1997, *KB et al.* 259 (LPB); *ibidem*, N-exposición, bosque húmedo secundario, epiphytic, 3 July 1997, *KB et al.* 333 (B, LPB); Prov. Nor Yungas, Serranía Bellavista, 36 km por camino de Caranavi hacia Sapecho, 15°41'S, 67°30'W, 1500 m, bosque siempreverde primario, epiphytic, 23 Aug. 1997, *KB et al.* 404 (B, LPB); DEPT. TARIJA. Prov. O'Connor, TARIQUÍA, near Salinas, 21°49'15"S, 64°12'44"W, 1400 m, Tucumano-Boliviano montane forest, on bark, 10 Aug. 2012, *MK 11210* (LPB); near San Diego, 21°26'28"S, 64°14'37"W,

1620 m, Tucumano-Boliviano altimontane forest, on tree, 9 Aug. 2012, *MK 11188* (LPB, UGDA).

SPECIMENS OF *HETERODERMIA LEUCOMELA* SUBSP. *BORYI* EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Carrasco, CARRASCO, near Phaqcha, 20 km from Monte Punku, 17°27'13"S, 65°16'44"W, 2850 m, montane cloud forest, close to river, on rock, 20 July 2008, *MK 6167a* (LPB); DEPT. LA PAZ. Prov. Larecaja, Jocollone, 15°37'35"S, 68°41'21"W, 3545 m, Páramo Yungueño, open disturbed area, on corticolous bryophytes, 14 May 2011, *MK 8469a* (LPB).

### *Heterodermia lutescens* (Kurok.) Follmann

Reported from Bolivia only by Moberg (2011) and Flakus *et al.* (2012).

CHEMISTRY. Atranorin and zeorin; yellow pigment present on of thallus.

SPECIMENS EXAMINED. BOLIVIA. DEPT. BENI. Prov. José Ballivián, 12 km por la carretera maderera al SW del km 12 Yucumo – Rurrenabaque, 15°05'S, 67°07'W, 550 m, bosque siempreverde primario, epiphytic, 30 July 1997, *KB et al.* 361 (B, LPB); DEPT. LA PAZ. Prov. Nor Yungas, near Nogalani, 16°12'57"S, 67°49'15"W, 2168 m, Yungas secondary cloud forest, on tree, 23 May 2011, *MK 9125* (LPB, UGDA); Prov. Franz Tamayo, between Apolo and Mapiri, 14°41'50"S, 68°25'07"W, 1510 m, savannah with scattered trees, on tree, 22 Nov. 2011, *MK 10206* (LPB, UGDA); Prov. Nor Yungas, Cotapata a 3 horas caminando desde la comunidad de Yucupi, 16°11'06"S, 67°49'30"W, 1490 m, bosque muy denso, corticolous, 14 May 2006, *PR et al.* 108 (B, LPB); Cotapata, desde Sandillani hacia Bajo Hornuni, 16°11'06"S, 67°49'30"W, 1520 m, bosque muy húmedo, corticolous, 13 Oct. 2006, *PR et al.* 131 & 132 (B, LPB); DEPT. TARIJA. Prov. O'Connor, TARIQUÍA, near Salinas, 21°49'15"S, 64°12'44"W, 1400 m, Tucumano-Boliviano montane forest, on tree, 10 Aug. 2012, *MK 11227* (LPB, UGDA).

### *Heterodermia podocarpa* (Bél.) D. D. Awasthi

A few localities known from Bolivia (Herzog 1922; Lynge 1924; Moberg 2011; Flakus *et al.* 2012).

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Chapare, CARRASCO, 130 km del camino antiguo de Cochabamba a Villa Tunari, 17°07'S, 65°36'W, 2200 m, bosque húmedo, epiphytic, 10 Oct. 1997, *KB*

*et al.* 699 & 699a (B, LPB); 139 km del camino antiguo de Cochabamba a Villa Tunari, 17°07'S, 65°34'W, 1450 m, bosque siempreverde, epiphytic, 12 Oct. 1997, *KB et al.* 804 (B, LPB); 156 km del camino antiguo de Cochabamba a Villa Tunari, 17°05'S, 65°32'W, 850 m, bosque siempreverde, epiphytic, 12 Oct. 1997, *KB et al.* 838 (LPB); DEPT. LA PAZ. Prov. Nor Yungas, Comunidad Cultural Unidos, 36 km por camino de Caranavi hacia Sapecho, 15°41'S, 67°30'W, 1300 m, plantación de café, epiphytic, 22 Aug. 1997, *KB et al.* 399 (B, LPB); CO-TAPATA, Santa Catalina, above Tunkini, 16°11'12"S, 67°52'07"W, 2700 m, Yungas montane forest, on bark, 22 May 2011, *MK 9014* (LPB).

### *Heterodermia vulgaris* (Vain.) Follmann & Redón

A few localities reported from Bolivia (Herzog 1922; Kurokawa 1962; Trass 1992; Feuerer 2010; Moberg 2011; Flakus *et al.* 2012).

CHEMISTRY. Atranorin, zeorin and leycotylin; orange pigment present on lower surface (reacting K<sup>+</sup> violet).

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Ayopaya, 10 km de Cocapata hacia Cotacajes, 16°38'S, 66°41'W, 2600 m, NW-exposición, bosque húmedo, epiphytic, 14 May 1997, *KB et al.* 68 (LPB); 20 km de Cocapata hacia Cotacajes, 16°46'S, 66°44'W, 2000 m, bosque semideciduo intervenido, epiphytic, 15 May 1997, *KB et al.* 93 (LPB); Prov. Carrasco, CARRASCO, near Phaqcha, 17°27'13"S, 65°16'44"W, 2850 m, montane cloud forest, close to river, on rock, 20 July 2008, *MK 6167* (LPB, UGDA); DEPT. LA PAZ. Prov. Bautista Saavedra, 15 km de Charazani hacia Apolo, 2400 m, 15°11'S, 68°52'W, bosque húmedo secundario con rocas, epiphytic, 2 & 3 July 1997, *KB et al.* 301 & 332a (LPB); Prov. Franz Tamayo, between Apolo and Mapiri, 14°41'50"S, 68°25'07"W, 1510 m, savannah with scattered trees, corticolous, 22 Nov. 2011, *MK 10207* (LPB); Prov. Nor Yungas, Coscapa, senda al oeste del camino principal ca 4 km de Cotapata hacia La Paz, 16°23'S, 67°54'W, 3200–3350 m, bosque siempreverde, epiphytic, 11 Sept. 1997, *KB et al.* 496 (B, LPB); Hacienda Sacramento, ca 8 km del camino principal de Chuspipata hacia Co-roico, 16°24'S, 67°47'W, 2500 m, bosque siempreverde, epiphytic, 20 Sept. 1997, *KB et al.* 556 (LPB); Serranía Bellavista, 36 km por camino de Caranavi hacia Sapecho, 15°41'S, 67°30'W, 1500 m, bosque siempreverde primario, epiphytic, 23 Aug. 1997, *KB et al.* 404b (B, LPB); DEPT. TARIJA. Prov. O'Connor, TARIQUÍA, near

Salinas, 21°49'15"S, 64°12'44"W, 1400 m, Tucumano-Boliviano montane forest, on bark, 10 Aug. 2012, *MK 11210a* (LPB, UGDA).

### *Hypotrachyna microblasta* (Vain.) Hale

Known from several localities in Bolivia (Sipman *et al.* 2009; Flakus *et al.* 2011a; Divakar *et al.* 2013).

CHEMISTRY. Usnic, galbinic, norstictic and salazinic acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Larecaja, SW of Itubaya, 15°32'37"S, 68°39'49"W, 2813 m, Yungas forest, on rocks, 14 May 2011, *MK 8543a* (LPB, UGDA).

### *Hypotrachyna rockii* (Zahlbr.) Hale

In Bolivia reported from several localities (Feuerer *et al.* 1998; Sipman *et al.* 2009; Flakus *et al.* 2011b; Divakar *et al.* 2013).

CHEMISTRY. Atranorin, lecanoric and evernic acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Larecaja, Jocollone, 15°37'35"S, 68°41'21"W, 3545 m, Páramo Yungueño, open disturbed area, on *Polylepis* sp., 14 May 2011, *MK 8528* (LPB, UGDA).

### *Lepraria finkii* (B. de Lesd.) R. C. Harris

*L. lobificans* auct.

A cosmopolitan species common throughout South America, previously also published as *L. lobificans* (Flakus & Kukwa 2007; Flakus *et al.* 2011a, b, 2012; Bungartz *et al.* 2013).

CHEMISTRY. Atranorin, zeorin and stictic acid complex.

SPECIMENS EXAMINED. BOLIVIA. DEPT. TARIJA. Prov. Aniceto Arce, Papachacra, 21°41'54"S, 64°29'28"W, 2056 m, Tucumano-Boliviano montane forest, corticolous, 27 Nov. 2010, *AF 20040* & *JQ* (KRAM, LPB).

\**Malmidea badimioides* (M. Cáceres & Lücking) M. Cáceres & Kalb

A Neotropical species known from several localities in lowland rain forests of Brazil, Ecuador

and Guyana, and also from Mexico (Cáceres 2007; Lücking 2008; Kalb *et al.* 2012).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Iturrealde, near San Pedro, 13°44'35"S, 68°00'04"W, 230 m, Preandean Amazon forest, corticolous, 29 July 2008, *AF 11241* & *MK* (KRAM, LPB).

\**Maronea constans* (Nyl.) Hepp

Widespread in humid areas all over the world except Antarctica (Magnusson 1934; Kalb 1988, Wolseley *et al.* 2002; Aptroot & Sparrius 2003; Harada & Katsurayama 2003; Kantvilas 2004; Galloway 2007). For South America previously reported from Ecuador (Kalb 1988) and Chile (pers. comm. Z. Palice).

CHEMISTRY. Sekikaic acid (major) or 4'-*O*-demethylsekikaic acid (major in sample 24156.1).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Murillo, Valle del Zongo, 16°10'15"S, 68°08'02"W, 3375 m, Páramo Yungueño, corticolous, 29 May 2011, *AF 21928* & *OP* (KRAM, LPB); Prov. Nor Yungas, km 69 on Coroico-La Paz road, 16°13'33"S, 67°49'20"W, 2600 m, Yungas secondary cloud forest, corticolous, 23 May 2011, *AF 21482* & *OP* (LPB); DEPT. SANTA CRUZ. Prov. Caballero, el Rincón, 17°49'33"S, 64°38'50"W, 2670 m, Yungas cloud forest, corticolous, 17 Aug. 2012, *AF 24435* (KRAM); DEPT. TARIJA. Prov. O'Connor, Lomas de la Soledad, road between Entre Ríos and Chiquiacá, 21°39'38"S, 64°07'31"W, 1670 m, Tucumano-Boliviano altimontane forest, corticolous, 10 Aug. 2012, *AF 24156.1* (LPB, herb. Flakus).

\**Menegazzia subsimilis* (H. Magn.) R. Sant.

A cosmopolitan species reported in South America from only a few localities in Ecuador and Peru (Bjerke 2003; Bjerke & Obermayer 2005).

CHEMISTRY. Atranorin, stictic acid complex (including menegazziaic acid), and unknown substance of Rf class 6 (minor) found only on plate in solvent C.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Nor Yungas, on road between La Paz and Chulumani, 16°14'10"S, 67°44'20"W, Yungas secondary cloud forest, corticolous, 24 May 2011, *MK 9338* (LPB, UGDA).

\**Myelochroa lindmanii* (Lynge) Elix & Hale

A Neotropical species known from a number of localities in Argentina, Brazil, Colombia, Mexico, Paraguay, Uruguay and Venezuela (Osorio 1970; Hale 1976b).

CHEMISTRY. Atranorin and 4 unknown pigments.

SPECIMENS EXAMINED. BOLIVIA. DEPT. SANTA CRUZ. Prov. Florida, AMBORÓ, la Yunga, 18°03'S, 63°54'W, 2250 m, trees in village, on lemon tree, 8 June 2011, *MK 9834* (LPB, UGDA).

*Normandina pulchella* (Borrer) Nyl.

Previously known from only a few records in Bolivia (Feurerer *et al.* 1998; Flakus & Wilk 2006; Flakus 2008; Flakus *et al.* 2011a).

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Carrasco, CARRASCO, near Sehuencas, 17°30'12"S, 65°16'30"W, 2220 m, montane cloud forest, on bark of tree, 21 July 2008, *MK 6381* (LPB, UGDA); by Río López Mendoza, 17°30'26"S, 65°16'55"W, 2226 m, Yungas cloud forest, corticolous, 22 July 2008, *AF 10675*, *MK* & *PR* (KRAM, LPB); La Cumbre, El Camino de las Nubes, 17°17'46"S, 65°43'56"W, 4100 m, Páramo Yungueño, on saxicolous *Umbilicaria* sp., 19 Aug. 2012, *MK 11785* (LPB, UGDA); Prov. Chapare, near Incachaca, 17°12'54"S, 65°49'30"W, 2028 m, Yungas cloud forest near road, on epiphytic bryophytes, 7 July 2009, *AF 13007* (LPB); DEPT. LA PAZ. Prov. Nor Yungas, Serranía Bellavista, 15°41'S, 67°30'W, 1500 m, bosque siempreverde primario, epiphytic, 23 Aug. 1997, *KB et al. 411* (LPB); between Coroico and La Paz, 16°13'09"S, 67°49'32"W, 2600 m, open place by road in montane cloud forest, on dead fern leaf and ground, 4 Aug. 2008, *MK 7191*, *7194* (LPB, UGDA); near Nogalani, on Coroico-La Paz road, 16°12'57"S, 67°49'15"W, 2168 m, Yungas secondary cloud forest, on corticolous bryophytes, 23 May 2011, *MK 9162*, *9163* (LPB, as admixture to *Heterodermia fertilis* and *Coccocarpia palmicola*); near Siniari colony, 16°13'20"S, 67°50'37"W, 2190 m, Yungas secondary cloud forest, on tree, 24 May 2011, *MK 9242* (LPB, UGDA); Prov. Nor Yungas, between Coroico and La Paz, 16°13'09"S, 67°49'32"W, 2400 m, open area near Yungas cloud forest, on soil, 4 Aug. 2008, *AF 11841* & *MK* (KRAM, LPB); near Chuspipata, 16°17'09"S, 67°51'00"W, 3228 m, Yungas cloud forest, on bark and epiphytic bryophytes, 24 May 2011, *AF 21591* & *OP*

(KRAM, LPB); COTAPATA, by Sillu Tincara pre-Columbian route, 16°17'22"S, 67°53'29"W, 3520 m, transition Páramo Yungueño–Yungas cloud forest, on corticolous bryophytes, 25 May 2011, *MK 9453* (LPB, UGDA); near Pongo, near Coroico-La Paz road, 16°19'28"S, 67°57'21"W, 3822 m, Páramo Yungueño, on saxicolous bryophytes, 26 Nov. 2011, *MK 10452* (LPB, as admixture to *Peltigera* sp.); DEPT. SANTA CRUZ. Prov. Caballero, El Rincón, 17°49'33"S, 64°38'50"W, 2670 m, Yungas cloud forest, on bark and epiphytic bryophytes, 17 Aug. 2012, *MK 11535* (LPB, UGDA); DEPT. TARIJA. Prov. Aniceto Arce, Filo de Sidras, 22°14'50"S, 64°33'28"W, 1064 m, Tucumano-Boliviano submontane forest, on bark and epiphytic bryophytes, 22 Nov. 2010, *AF 18536, 18495.1* (LPB); Papachacra, 21°41'41"S, 64°29'35"W, 2170 m, Tucumano-Boliviano montane forest, on bark, 7 Aug. 2012, *MK 11055* (LPB); ibidem, 21°41'52"S, 64°29'15"W, 1900 m, on thalli of *Leptogium* sp. and tree bark, 8 Aug. 2012, *MK 11033* (LPB, UGDA); Lomas de la Soledad, road between Entre Ríos and Chiquiacá, 21°39'38"S, 64°07'31"W, 1670 m, Tucumano-Boliviano altimontane forest, on tree, 10 Aug. 2012, *MK 11296* (LPB, as admixture to *Coccocarpia stellata*); Prov. O'Connor, Lomas de la Soledad, 21°39'38"S, 64°07'31"W, 1670 m, Tucumano-Boliviano altimontane forest, on bark and epiphytic bryophytes, 10 Aug. 2012, *MK 11276* (LPB, UGDA).

### *Ochrolechia africana* Vain.

Reported from Bolivia by Flakus & Kukwa (2012) and Kukwa *et al.* (2013).

CHEMISTRY. Gyrophoric, lecanoric and 5-*O*-methylhiassic acids; cited specimen represents chemotype 6.

SPECIMENS EXAMINED. BOLIVIA. DEPT. SANTA CRUZ. Prov. Cordillera, KAA-IYA, near Peto Blanco, park guards' station, 18°51'36"S, 60°18'00"W, 290 m, transition Chiquitano–Chaqueño forest, on bark, 5 Dec. 2011, *AF 23714.1* (KRAM, LPB).

### *Ochrolechia austroamericana* (Räsänen) Räsänen

Only recently reported from Bolivia by Kukwa *et al.* (2013).

CHEMISTRY. Gyrophoric and lecanoric acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Franz Tamayo, cerca del campamento de guardaparques del APOLOBAMBA, Puntani, 15°01'50.26"S, 69°11'08.89"W, 4770 m, vegetación altoandina, on

rock, 23 Apr. 2008, *PR 528* (LPB); APOLOBAMBA, near Puyo Puyo, 15°56'55"S, 69°07'58"W, 4888 m, high Andean open vegetation, on rock, 5 July 2010, *AF 17592 & PR* (KRAM, LPB); Prov. Murillo, below Potosí, on road between La Paz and Valle del Zongo, 16°17'43"S, 68°07'42"W, 4720 m, high Andean vegetation, on rock, 28 May 2011, *AF 21880* (KRAM, LBP); DEPT. URURO. Prov. Sajama, SAJAMA, Huincurata near Sajama, 18°07'01"S, 68°58'00"W, 4301 m, Puna Sureña, *Polylepis* vegetation, on rock, 19 June 2010, *AF 16538 & PR* (KRAM, LPB, UGDA); Jecha K'ala 25 km of Sajama, 18°09'52"S, 68°49'08"W, 4184 m, Puna Sureña, pajonales vegetation, on rock, 20 June 2010, *AF 16634 & PR* (KRAM; LPB).

### *Parmotrema aberrans* (Vain.) Canêz & Marcelli

Previously reported from Bolivia from only one locality (Kukwa *et al.* 2012).

CHEMISTRY. Usnic, gyrophoric and fatty acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. TARIJA. Prov. Burnet O'Connor, TARIQUÍA, near Salinas, 21°49'15"S, 64°12'44"W, 1400 m, Tucumano-Boliviano montane forest, on tree, 10 Aug. 2012, *MK 11241* (LPB, UGDA); Lomas de la Soledad, road between Entre Ríos and Chiquiacá, 21°39'38"S, 64°07'31"W, 1670 m, Tucumano-Boliviano altimontane forest, on tree, 10 Aug. 2012, *MK 11315* (LPB, UGDA).

### *Parmotrema affluens* (Hale) Hale

Previously known from Bolivia from only three localities (Kukwa *et al.* 2012).

CHEMISTRY. Atranorin, usnic acid, echinocarpic acid, protocetraric acid, 4 pigments; skyrin by HPLC.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Bautista Saavedra, cerro Asunta Pata, 15°05'S, 68°29'W, 1500 m, bosque siempreverde en la cresta con *Dictyocaryum*, corticolous, 21 June 1997, *KB et al. 206* (LPB); DEPT. SANTA CRUZ. Prov. José Miguel de Velasco, NOEL KEMPF, near Florida, 14°35'50"S, 61°50'46"W, 220 m, Cerrado, on branches, 15 Dec. 2009, *AF 15743 & PR* (KRAM, LPB),

### *Parmotrema arnoldii* (Du Rietz) Hale

Previously known from Bolivia from only two localities (Kukwa *et al.* 2012).

CHEMISTRY. Atranorin, alectorialic acid and  $\alpha$ -collatolic acid.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Bautista Saavedra, km 202 on road from Apolo to Charazani, 20 km from Charazani, 15°12'35"S, 68°51'30"W, 2260 m, transition Yungas montane forest–cloud forest, corticolous, 18 May 2011, *MK 8924* (LPB, UGDA); km 196 on road from Apolo to Charazani, 15 km from Charazani, 15°11'02"S, 68°53'43"W, 2560 m, transition Yungas montane forest–cloud forest, corticolous, 18 May 2011, *MK 8950* (LPB, UGDA).

### *Parmotrema betaniae* Hale

Previously known from Bolivia from only a single locality (Flakus *et al.* 2012).

CHEMISTRY. Atranorin, protocetraric acid, fatty acids, and additional unidentified substances (traces).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Abel Iturralde, by Tumupasa, 350 m, in forest, on bark, 17 March 1987, *S. Stab LB48b* (B).

### \**Parmotrema commensuratum* (Hale) Hale

In the Neotropics known from Colombia, Haiti, Honduras, Uruguay and Venezuela (Hale 1971a; López-Figueiras 1986; Osorio 1995; Sipman *et al.* 2008) and elsewhere from North America and South Africa (Dey 1974; Brusse 1991).

CHEMISTRY. Atranorin, norlobaridone and loxodine.

SPECIMENS EXAMINED. BOLIVIA. DEPT. TARIJA. Prov. Aniceto Arce, Papachacra, 21°41'36"S, 64°29'33"W, 2195 m, Tucumano-Boliviano montane forest with *Alnus acuminata*, corticolous, 26 Nov. 2010, *AF 19818* & *JQ* (KRAM, LPB).

### \**Parmotrema conformatum* (Vain.) Hale

Widely distributed, reported from several countries in the Neotropics (Brazil, Colombia, Dominican Republic, Ecuador, Guyana, Haiti, Jamaica, Mexico, Venezuela) (Hale 1965; Nöske & Sipman 2004; Neuwirth 2008; Sipman *et al.* 2008).

CHEMISTRY. Usnic, protocetraric and malon-protocetraric acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Bautista Saavedra, cerro Asunta Pata, 15°05'S, 68°29'W, 1500 m, bosque siempreverde en la cresta, corticolous, 21 June 1997, *KB 205 et al.* (B).

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

Reported from several localities in Bolivia (Feuerer *et al.* 1998; Flakus *et al.* 2011a, 2012).

CHEMISTRY. Atranorin, stictic acid complex and hypostictic acid.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Bautista Saavedra, near Charazani, 15°10'39"S, 68°56'36"W, 2730 m, Yungas montane forest, corticolous, 18 May 2011, *MK 8825*, *8834* & *8836* (LPB, UGDA); DEPT. SANTA CRUZ. Prov. Manuel María Caballero, Siberia region near La Palma, 17°49'12"S, 64°40'28"W, 2582 m, Yungas cloud forest, corticolous, 13 Dec. 2004, *AF 4669* (KRAM, LPB).

### *Parmotrema dilatatum* (Vain.) Hale

Previously reported from two localities in Bolivia (Hale 1965; Kukwa *et al.* 2012).

CHEMISTRY. Atranorin, usnic (trace), protocetraric and echinocarpic acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. BENI. Prov. Ballivan, 12 km por la carretera maderera al SW del km 12 Yucumo – Rurrenabaque, 15°05'S, 67°07'W, 350 m, bosque siempreverde, epiphytic, 21 July 1997, *KB et al. 359* (B); DEPT. LA PAZ. Prov. Larecaja, near Achiquiri, on road to Apolo, 15°13'31"S, 68°13'49"W, 1070 m, Yungas lower montane secondary forest, corticolous, 16 May 2011, *MK 8668* (LPB, UGDA); Prov. Nor Yungas, COTAPATA, between Tunkini and Chairó, 16°11'S, 67°52'W, 2400 m, Yungas montane forest, corticolous, 22 May 2011, *MK 9072* (LPB, UGDA).

### \**Parmotrema disparile* (Nyl.) Hale

Known in the Neotropics from Brazil and Mexico. Also reported from Congo, Madagascar and India (Hale 1965; Divakar & Upreti 2005).

CHEMISTRY. Atranorin, protocetraric acid, fatty acids, additional unidentified substances (traces).

SPECIMENS EXAMINED. BOLIVIA. DEPT. BENI. Prov. Ballivan, 20 km por la carretera maderera al SW del km 12 Yucumo–Rurrenabaque, 15°07'S, 67°08'W,

900–950 m, bosque siempreverde primario, corticolous, 6 Aug. 1997, *KB et al.* 385 (B, LBP).

***Parmotrema gardneri*** (C. W. Dodge) Sérus.

A Pantropical species previously recorded from scattered localities in Bolivia (Kukwa *et al.* 2012).

CHEMISTRY. Atranorin, protocetraric acid and additional unidentified substances (traces).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Sud Yungas, Alto Beni Sapecho, Colonia, Tupiza, bosque siempreverde a semideciduo, corticolous on *Spondias mombin*, 2 July 1999, *A. Acebey* 962 (LPB).

**\**Parmotrema machupichuense*** Kurok.

Previously known only from Peru (Kurokawa & Moon 1998).

CHEMISTRY. Atranorin, usnic and protocetraric acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Nor Yungas, Coroico, 16°11'10"S, 67°43'16"W, 1550 m, Yungas montane forest, corticolous, 6 June 2010, *AF 16421* & *PR* (KRAM, LPB, UGDA).

***Parmotrema merrillii*** (Vain.) Hale

Previously reported from only a few localities in Bolivia (Hale 1965; Flakus *et al.* 2011a, 2012).

CHEMISTRY. Atranorin, protocetraric acid, fatty acid ( $\pm$ ), and additional unidentified substances (traces).

SPECIMENS EXAMINED. BOLIVIA. DEPT. TARIJA. Prov. Aniceto Arce, Filo de Sidras, near guards' camp, 22°14'50"S, 64°33'28"W, 1064 m, Tucumano-Boliviano submontane forest, corticolous, 22 Nov. 2010, *AF 18401*, *18413*, *18467*, *18473*, *18509*, *18510*, *18533*, *18552*, *18556*, *18599*, *18605*, *18605*, *18609* (KRAM, LPB, UGDA, herb. Flakus).

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

Previously reported from only a few localities in Bolivia (Hale 1965; Flakus *et al.* 2012).

CHEMISTRY. Atranorin, constipatic acid complex, some additional substances (traces); no pigments detected by HPLC.

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Ayopaya, 20 km de Cocapata hacia Cotacajes, 16°46'S, 66°4'W, 2000 m, bosque semideciduo intervenido, corticolous, 15 May 1997, *KB et al.* 84a (B); DEPT. LA PAZ. PROV. Bautista Saavedra, 15 km de Camata hacia Apolo, 15°13'S, 68°41'W, elev. 1400 m, bosque semi-deciduo con *Anadenanthera*, corticolous, 27 June 1997, *KB et al.* 231 (B, LPB); Prov. Franz Tamayo, Río Bilipisa, ca 10 km NW de Apolo, 14°36'S, 68°27'W, 1100 m, bosque semideciduo intervenido con *Anadenanthera*, on bark, 4 July 1997, *KB 240* (B); DEPT. SANTA CRUZ. Prov. Cordillera, KAA-IYA, Charrata, 18°28'05"S, 62°05'43"W, 307 m, Chaqueño forest, corticolous, 2 Dec. 2010, *AF 20191*, *20213*, *20218* & *JQ* (KRAM, LPB, herb. Flakus); Prov. Florida, Refugio 'Los Volcanes' 18°06'S, 63°36'W, 1000 m, bosque semideciduo, epífita, 2 & 4 Oct. 1997, *KB et al.* 618, 639 (B, LPB).

**\**Parmotrema mordenii*** (Hale) Hale

Known from Brazil, Dominica, the USA and Venezuela (Hale 1971b; Jackson & Hopkins 1980; Lopez-Figueiras 1986; Gerlach & Eliasaro 2012).

CHEMISTRY. Atranorin and constipatic acid complex; medulla K+ yellow.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Nor Yungas, near Pacallo, 16°12'10"S, 67°50'39"W, 1360 m, Yungas montane forest, on rock, 3 Aug. 2008, *MK 7158* (LPB, UGDA).

***Parmotrema perlatum*** (Huds.) M. Choisy

Known since early explorations but only recently reported for Bolivia in contemporary records (Nylander 1859; Schmidt 1909; Herzog 1922; Flakus *et al.* 2011a).

CHEMISTRY. Atranorin and stictic acid complex.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Bautista Saavedra, km 196 on road from Apolo to Charazani, 15 km from Charazani, 15°11'02"S, 68°53'43"W, 2560 m, transition Yungas montane forest, corticolous, 18 May 2011, *MK 8950a* (LPB); km 202 on road from Apolo to Charazani, 20 km from Charazani, 15°12'35"S, 68°51'30"W, 2260 m, transition Yungas montane forest, corticolous, 18 May 2011, *MK 8917* (LPB, UGDA); Prov. Larecaja, Titilaya, 15°39'55"S, 68°42'51"W, 2773 m, transition Yungas forest – Valles

Secos vegetation, on soil over rocks, 14 May 2011, *MK 8448* (LPB, UGDA).

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

A cosmopolitan lichen reported from several localities in South America (Argentina, Brazil, Chile, Colombia, French Guyana, Venezuela) (Hale 1965, 1971; Hekking & Sipman 1988; Elix 1994; Calvelo & Liberatore 2002; Sipman et al. 2008).

CHEMISTRY. Atranorin, praesorediosic acid complex and unknown fatty acid (with low Rf in solvents A and C).

SPECIMENS EXAMINED. BOLIVIA. DEPT. BENI. Prov. Yacuma, E. B. BENI, near la Estación Biológica, 14°51'07"S, 66°20'23"W, 175 m, island of lowland Amazon forest among savanna, on twigs, 6 Nov. 2010, *AF 17928* & *F. Saavedra* (KRAM, LPB, UGDA).

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

Previously reported from a number of localities in Bolivia (Nylander 1859, 1861; Herzog 1922; Feuerer et al. 1998; Flakus et al. 2011b, 2012).

CHEMISTRY. Atranorin, salazinic and con-salazinic acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Murillo, below Potosí, on road between La Paz and Valle del Zongo, 16°17'43"S, 68°07'42"W, 4720 m, high Andean vegetation, on rock, 28 May 2011, *MK 9505* (LPB, UGDA); Valle del Zongo, 16°10'15"S, 68°08'02"W, 3375 m, Páramo Yungueño, on terricolous bryophytes, 29 May 2011, *MK 9516* (LPB, UGDA); Prov. Nor Yungas, near Nogalani, on Coroico–La Paz road, 16°12'57"S, 67°49'15"W, 2168 m, Yungas secondary cloud forest, corticolous, 23 May 2011, *MK 9133* (LPB, UGDA).

***Parmotrema robustum*** (Degel.) Hale

A widespread species previously reported from a few localities in Bolivia (Kukwa et al. 2012).

CHEMISTRY. Atranorin, protocetraric acid, unidentified fatty acid (±).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Franz Tamayo, near Yuyo, 15°07'05"S,

68°20'22"W, 1150 m, Preandean Amazon forest, corticolous, 16 May 2011, *MK 8697* (LPB, UGDA). Prov. Larecaja, near Consata, 15°20'46"S, 68°29'16"W, 1240 m, Yungas lower montane secondary forest, on rock, 15 May 2011, *MK 8592* (LPB, UGDA).

***Parmotrema simulans*** (Hale) Hale

Previously known from a few localities in Bolivia (Kukwa et al. 2012; Flakus et al. 2013).

CHEMISTRY. Atranorin and caperatic acid.

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Chapare, CARRASCO, near Incachaca, 17°14'13"S, 65°49'02"W, 2294 m, Yungas cloud forest, corticolous, 10 June 2006, *AF 8174.1* (KRAM, LPB).

**\**Parmotrema submarginale*** (Michx.) DePriest & B. W. Hale

*P. michauxianum* (Zahlbr.) Hale

Previously known only from Brazil, Costa Rica, Thailand and the USA (Hale 1969; Marcelli 1991; Umaña Tenorio et al. 2002; Wolseley et al. 2002).

CHEMISTRY. Atranorin and protocetraric acid.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Abel Iturralde, forest above Tumupasa, 14°08'51"S, 67°53'34"W, 350 m, Subandean Amazon forest, on bark of tree, 31 Aug. 2008, *MK 7042* (LPB, UGDA).

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

A widely distributed and easily distinguishable lichen only recently reported from Bolivia (Kukwa et al. 2012).

CHEMISTRY. Not tested by TLC; thallus reacting C+ red.

SPECIMENS EXAMINED. BOLIVIA. DEPT. TARIJA. Prov. O'Connor, Lomas de la Soledad, road between Entre Ríos and Chiquiacá, 21°39'38"S, 64°07'31"W, 1670 m, Tucumano-Boliviano altimontane forest, on rock, 10 Aug. 2012, *MK 11277* (LPB, UGDA).

**\**Parmotrema viridiflavum*** (Hale) Hale

Known in the Neotropics from Colombia, the Dominican Republic, Ecuador, Haiti, Mexico

and Venezuela (Hale 1965; Lopez-Figueiras 1986; Nöske & Sipman 2004; Sipman *et al.* 2008).

CHEMISTRY. Usnic acid, malonprotocetraric acid and related substances.

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Carrasco, CARRASCO, near Sehuencas, 17°30'12"S, 65°16'30"W, 2220 m, montane cloud forest, with some rocks in open place, on bark of tree, 21 July 2008, *MK 6500* (LPB, UGDA).

**\**Parmotrema wainioi*** (A. L. Sm.) Hale

A widely distributed species previously known from Brazil in the Neotropics and elsewhere from Congo, Nigeria and Oceania (Hale 1965; Spielmann & Marcelli 2009).

CHEMISTRY. Atranorin, alectoronic and  $\alpha$ -collatolic acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Bautista Saavedra, 15 km de Charazani hacia Apolo, 15°11'S, 68°52'W, 2400 m, pastos con arbustos al lado del Río Camata, saxicolous, 1 July 1997, *KB et al.* 269 (B).

**\**Parmotrema yodae*** (Kurok.) Hale

Previously reported from Argentina, Brazil and Nepal (Kurokawa 1967; Spielmann 2006; Adler & Calvelo 2010; Baniya *et al.* 2010).

CHEMISTRY. Atranorin, norlobaridone and loxodine.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Nor Yungas, Coroico, 16°11'10"S, 67°43'16"W, 1550 m, Yungas montane forest, on twig, 6 June 2010, *AF16395.1* & *PR* (KRAM, LPB, UGDA).

***Physcia biziana*** (A. Massal.) Zahlbr.

Previously reported from Bolivia only by Feuerer & Sipman (2005).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Murillo, La Paz, laguna de Cota Cota, 16°32.4'S, 68°04.0'W, 3750 m, Puna, corticolous on *Populus balsamifera*, 8 Febr. 2002, *A. Canseco 124* (B, LPB); La Paz, Cota Cota, campus universitario, 16°32.3'S, 68°04.1'W, 3582 m, Puna y vegetación altoandina, on *Schinus molle*, 8 Febr. 2002, *A. Canseco 139* (B, LPB).

**\**Protoparmelia multifera*** (Nyl.) Kantvilas, Pong & Lumbsch

*Maronia multifera* (Nyl.) Hafellner & R. W. Rogers

A Neotropical lichen known from several localities in Brazil, Colombia, Uruguay and Venezuela (Magnusson 1934; Hafellner & Rogers 1990; Sipman *et al.* 2008).

CHEMISTRY. Unknown substance with appearance of a fatty acid (UV + ice blue, after spraying and heating on TLC plates) and Rf class similar to "Ma 2" substance reported by Hafellner & Rogers (1990).

SPECIMEN EXAMINED. BOLIVIA. DEPT. SANTA CRUZ. Prov. Cordillera, KAA-IYA, gasoducto Bolivia-Brasil KP 164, 60 km from Tucavaca colony, 18°27'29"S, 61°23'01"W, 292 m, Chaqueño forest, corticolous, 3 Dec. 2010, *AF 18954* & *JQ* (LPB, herb. Flakus).

***Ramalina celastri*** (Spreng.) Krog & Swinscow

Still under-collected, recorded a number of times from Bolivia (Nylander 1859, 1861; Herzog 1922, 1923; Feuerer & Sipman 2005; Flakus 2008; Flakus *et al.* 2012).

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Ayopaya, 10 km de Cocapata hacia Cotacajes, 16°38'S, 66°41'W, 2800–2850 m, bosque húmedo, corticolous, 10 May 1997, *KB et al. 11b* (LPB); 20 km de Cocapata hacia Cotacajes, 16°46'S, 66°44'W, 1850–2100 m, bosque semideciduo intervenido, epiphytic, 15 & 17 May 1997, *KB et al. 89* & *121c* (B, LPB); 5 km al sur de Saila Pata, 16°55'S, 66°56'W, 3050 m, bosque siempreverde, epiphytic, 10 Nov. 1997, *KB* & *I. Jiménez 849* (B, LPB); DEPT. LA PAZ. Prov. Bautista Saavedra, 10 km de Charazani hacia Apolo, 15°11'S, 68°52'W, 2550 m, pared rocosa, epiphytic, 31 May 1997, *KB et al. 127, 127a* (B, LPB); Prov. Sud Yungas, Cienequillas, 16°35'S, 67°26'W, 1300 m, bosque deciduo, epiphytic, 14 Dec. 1997, *KB 931* (LPB); DEPT. TARIJA. Prov. O'Connor, TARIQUÍA, near Salinas, 21°49'15"S, 64°12'44"W, 1400 m, Tucumano-Boliviano montane forest, on tree, 10 Aug. 2012, *MK 11238* (LPB, UGDA).

**\**Ramboldia haematites*** (Fée) Kalb, Lumbsch & Elix

A Pantropical species known from several localities in South America (Argentina, Brazil,



Guiana, Paraguay, Uruguay, Venezuela) (Kalb *et al.* 2008).

SPECIMENS EXAMINED. BOLIVIA. DEPT. SANTA CRUZ. Prov. Cordillera, KAA-IYA, near Peto Blanco, park guards' station, 18°56'26"S, 60°22'39"W, 340 m, Chiquitano forest, 5 Dec. 2011, *AF 23588* (LPB).

***Ramboldia russula*** (Ach.) Kalb, Lumbsch & Elix

Probably common but still under-collected in Bolivia (Nylander 1859; Kalb *et al.* 2008; Flakus *et al.* 2012).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Franz Tamayo, Río Bilipisa, ca 10 km NW de Apolo, 14°36'S, 68°27'W, 1100 m, bosque semideciduo intervenido, on bark, 4 July 1997, *KB 238* (LPB); Prov. Nor Yungas, near Yucupi, 16°11.1'S, 67°50'W, 1482 m, bosque muy denso, on bark, 13 May 2006, *PR et al. 105* (B, LPB).

***Siphula fastigiata*** (Nyl.) Nyl.

Known previously from two records in Bolivia (Kantvilas 1998; Kantvilas & Elix 2002).

CHEMISTRY. Baeomycetic and squamatic acids.

SPECIMEN EXAMINED. BOLIVIA, DEPT. LA PAZ, Prov. Murillo, below Potosí, on road between La Paz and Valle del Zongo, 16°17'43"S, 68°07'42"W, 4720 m, high Andean vegetation, terricolous, 28 May 2011, *MK 9486* (LPB, UGDA).

***Siphula pteruloides*** Nyl.

Previously reported in Bolivia from three localities (Feuerer *et al.* 1998; Feuerer & Sipman 2005).

CHEMISTRY. Siphulin and thamnolic acid.

SPECIMENS EXAMINED. BOLIVIA, DEPT. LA PAZ, Prov. Nor Yungas, COTAPATA, by Sillu Tincara pre-Columbian route, 16°17'22"S, 67°53'29"W, 3520 m, transition Páramo Yungueño–Yungas montane cloud forest, terricolous, 25 May 2011, *MK 9470* (LPB, UGDA).

**\**Solorina spongiosa*** (Ach.) Anzi

A widespread species known from only a few localities in South America (Argentina, Colombia) (Calvelo & Liberatore 2002; Sipman *et al.* 2008).

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Saavedra, km 162 on road from Apolo to Charazani, La Cruz Charazani-Pelechuco, 15°15'00"S, 69°02'51"W, 4545 m, high Andean vegetation with limestone rock, on terricolous bryophytes, 19 May 2011, *AF 21152* & *OP* (LPB).

**\**Stigmatochroma metaleptodes*** (Nyl.) Marbach

A Pantropical species reported in the Neotropics from only a few localities (Brazil, Costa Rica, Puerto Rico) (Marbach 2000).

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Chapare, near Bulo Bulo, near Río Chimoré, 16°58'19"S, 65°21'11"W, 283 m, lowland Amazon forest, corticolous, 9 Dec. 2010, *AF 19498* & *JQ* (KRAM); DEPT. LA PAZ. Prov. Franz Tamayo, between Apolo and Mapiro, 14°41'50"S, 68°25'07"W, 1510 m, savannah with scattered trees, corticolous, 22 Nov. 2011, *AF 22928* (LPB).

***Thamnolia vermicularis*** (Sw.) Schaer.

A common species at high altitudes in open Andean vegetation (Nylander 1861; Herzog 1923; Menhofer 1992; Feuerer *et al.* 1998; Flakus & Wilk 2006; Flakus 2008; Flakus *et al.* 2012).

CHEMISTRY. Thamnolic acid.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Franz Tamayo, APOLOBAMBA, near Puyo Puyo, 15°56'55"S, 69°07'58"W, 4888 m alt., high Andean open vegetation, on soil, 5 July 2010, *AF 17643* & *PR* (KRAM, LPB, as admixture to specimen of *Hypogymnia subphysodes*); Prov. Larecaja, la Cumbre de Sorata, 15°53'06"S, 68°38'55"W, 4787 m, high Andean open vegetation, on soil, 13 May 2011, *MK 8404* (LPB, UGDA); Prov. Murillo, Valle del Zongo, Laguna Viscachani, 16°11'54"S, 68°07'33"W, 3860 m, Páramo Yungueño, on soil, 30 May 2011, *MK 9661* (LPB, UGDA).

***Xanthoparmelia mougeotii*** (Schaer.) Hale

Previously reported from Bolivia by Nylander (1861), Nash *et al.* (1995) and Flakus *et al.* (2012).

CHEMISTRY. Usnic, stictic, constictic, cryptostictic and norstictic (trace) acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. PROV. Bautista Saavedra, APOLOBAMBA, near Taypi

Cañuma, 15°03'20"S, 69°09'07"W, 4506 m, high Andean open vegetation, on sandstone, 5 July 2010, *AF 17542 & PR* (KRAM, LPB, herb. Flakus); Prov. Franz Tamayo, APOLOBAMBA, near Puyo Puyo, 14°56'55"S, 69°07'58"W, 4888 m, high Andean open vegetation, on schist rock, 5 July 2010, *AF 17593, 17634 & PR* (LPB, herb. Flakus); Socondori Chico near Ulla Ulla, 15°00'38"S, 69°13'48"W, 4479 m, high Andean open vegetation, saxicolous, 4 July 2010, *AF 17485, 17446 & PR* (KRAM, LPB); DEPT. URURO. Prov. Sajama, SAJAMA, Jecha K'ala, 18°09'52"S, 68°49'08"W, 4184 m, Puna Sureña, pajonales vegetation, saxicolous, 20 June 2010, *AF 16706.1 & PR* (LPB).

### *Xanthoparmelia taractica* (Kremp.) Hale

Previously reported from not many localities in Bolivia (Hale 1990; Nash *et al.* 1995; Feuerer *et al.* 1998; Flakus *et al.* 2011b).

CHEMISTRY. Usnic, salazinic, norstictic ( $\pm$ , trace) and consalazinic ( $\pm$ ) acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Murillo, Río Abajo, La Paz, Jupapina, colina frente del pueblo, 3500 m, on soil and rocks, 12 Feb. 1987, *S. Stab LB17* (B, LPB); Prov. Aroma, Huaraco, ca 160 km del camino La Paz – Oruro, 3780 m, on soil and rocks, 15 Feb. 1981, *M. Liberman 364* (LPB).

### *Xanthoparmelia ulcerosa* (Zahlbr.) Hale

Previously recorded from Bolivia only by Hale (1990) and Nash *et al.* (1995).

CHEMISTRY. Usnic, salazinic, consalazinic ( $\pm$ ), norstictic ( $\pm$ ) and stictic ( $\pm$ , trace) acids.

SPECIMENS EXAMINED. BOLIVIA. DEPT. COCHABAMBA. Prov. Quillacollo, area of Incarraya-Sipesipe, 17°28'39"S, 66°21'43"W, 2846 m, semi-desert open area, on siliceous rock, 17 Dec. 2004, *AF 4920 & 4921.1* (LPB); DEPT. LA PAZ. Prov. Bautista Saavedra, APOLOBAMBA, near Taypi Cañuma, 15°03'20"S, 69°09'07"W, 4506 m, high Andean open vegetation, saxicolous, 5 July 2010, *AF 17549 & PR* (KRAM, LPB); DEPT. URURO. Prov. Sajama, SAJAMA, Jecha K'ala, 18°09'52"S, 68°49'08"W, 4184 m, Puna Sureña, pajonales, on volcanic rock, 20 June 2010, *AF 16671, 16677, 16709 & PR* (KRAM, LPB); Huincurata near Sajama, 18°07'01"S, 68°58'00"W, 4301 m, Puna Sureña, *Polylepis* forest, saxicolous, 19 June 2010, *AF 16598 & PR* (LPB); near Sajama, 18°07'49"S, 68°56'54"W,

4437 m, Puna Sureña, tholares vegetation, saxicolous, 18 June 2010, *AF 16464 & PR* (KRAM, LPB); DEPT. POTOSÍ. Prov. Daniel Campos, by Puerto Chuvica near Salar Uyuni, 20°36'06"S, 67°35'50"W, 3670 m, open semi-desert high Andean area, on volcanic rock, 4 Dec. 2009, *AF 14696 & PR* (KRAM, LPB); Prov. Nor Lipez, Pinturas Rupestres near Mallku Villamar, 21°46'20"S, 67°29'05"W, 4038 m, open semi-desert high Andean area, on volcanic rock, 6 Dec. 2009, *AF 14751, 14747 & PR* (KRAM, LPB).

ACKNOWLEDGEMENTS. We are greatly indebted to Rosa I. Meneses Q., Director of Herbario Nacional de Bolivia, Universidad Mayor de San Andrés and Museo Nacional de Historia Natural La Paz, for her generous cooperation, Ulrik Søchting (Copenhagen) for hospitality during the SYNTHESYS visit of M. Kukwa and for valuable help with interpretation of HPLC results, the curators of herbaria B and LPB for the loan of specimens, and our colleagues for their kind help during the field work. We thank Dr. Zdenek Palice (Průhonice) and the anonymous reviewer for their very useful comments on the manuscript. This research received support from the Polish National Centre for Research and Development (NCBiR) under the LIDER Programme for 2010–2013 (No. 92/L-1/09), from the University of Gdańsk, and from the W. Szafer Institute of Botany, Polish Academy of Sciences through its statutory funds. The HPLC analyses were supported by a grant from the European Commission's (FP 6) Integrated Infrastructure Initiative programme, SYNTHESYS (DK-TAF-3060).

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Received 24 April 2013