

## New records of Parmeliaceae from Bolivia

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**ABSTRACT.** – New records of 43 species of Parmeliaceae from Bolivia are presented. Fourteen species are new to the country: *Bulbothrix cinerea*, *Canoparmelia cryptochlorophaea*, *Flavocetraria nivalis*, *Hypotrachyna ectypa*, *H. everniiformis*, *H. osseoalba*, *H. polydactyla*, *Parmotrema eitenii*, *P. hypermaculatum*, *P. muelleri*, *P. virescens*, *Punctelia jujensis*, *P. riograndensis* and *P. rudecta*. *Hypotrachyna ectypa* is also reported for first time from South America. New records of twenty-eight species rarely reported from Bolivia are presented, as are many first records for various Bolivian departments and provinces.

**KEYWORDS.** – Biodiversity, floristics, lichenized fungi, neotropics, new records, new species, taxonomy.

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### INTRODUCTION

Bolivia is among the South American countries considered to have one of the highest lichen biodiversities on the continent due to the existence of numerous rich and biologically diverse ecosystems (Feuerer et al. 1998). Lichens, however, are still understudied there. Until quite recently, only approximately 150 lichen species were reported from Bolivia (Feuerer et al. 1998), but extensive investigation multiplied this number almost by ten and at present approximately 1400 species are known from the country (Guzow-Krzemińska et al. 2019a, 2019b; Rodriguez Flakus et al. 2016). However, this number still represents only approximately 35% of the total species expected to occur in Bolivia (Rodriguez Flakus et al. 2016).

The family Parmeliaceae F. Berchtold & J. Presl contains species which are among the most iconic lichens as many possess large and luxuriant thalli (Crespo et al. 2010). Nevertheless, species of this family are still understudied in many regions of the world and sometimes known only from the type localities where they originally described (e.g., *Bulbothrix cinerea* reported in this paper; Benatti 2012a, 2014; Marcelli & Ribeiro 2002). The Bolivian lichen checklist contains numerous species of Parmeliaceae, however many of them were reported from the country only during the last 20 years and often from single records (Feuerer et al. 1998; Flakus et al. 2011, 2012a, 2012b, 2013, 2014, 2015, 2016; Kukwa et al. 2012; Sipman et al. 2009). For example, the speciose genus *Parmotrema* A. Massal. contains 300 species (Lücking et al. 2017), but until 2012 only 13 species were known from Bolivia. Kukwa et al. (2012) added 39 *Parmotrema* species and an additional 19 species were reported in later works raising the total number to 68 (Rodriguez Flakus et al. 2016). More species are expected (three are added here) and the diversity is probably comparable to that from Brazil, where 90 species of *Parmotrema* are known (Kukwa et al. 2012).

The aim of this contribution is to increase the knowledge of Parmeliaceae in Bolivia and document their distribution in this country.

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## MATERIALS AND METHODS

This study is based on material deposited in LPB and UGDA. Specimens were collected during four field investigations in the years 2014–2017 from the wide range of elevations (465–4650 m. a.s.l.) and habitats (high open Andean vegetation, Boliviano-Tucumano forest, Yungas forest, Chaceño-Amazon forest, savanna). Morphology was studied under the stereomicroscope. Lichen secondary metabolites were studied using standard spot test (K, C, KC and PD), UV light and thin layer chromatography (TLC) in solvents A, B', C and/or G (only in case of the fumarprotocetraric acid complex) following methods of Culberson and Kristinsson (1970) and Orange et al. (2001).

## RESULTS

New records of 42 species of Parmeliaceae from Bolivia are presented, of which 14 are reported as new to the country (these entries are marked with asterisk) and one as new to South America (this entry marked with two asterisks). The remaining species are known only from a few records in the country and are in most cases here newly reported for different departments or provinces of Bolivia. The morphology and secondary chemistry of specimens studied for this paper agreed in most cases with the available descriptions, however some discrepancies are discussed under the entries for *Hypotrachyna ectypa*, *H. everniiformis*, *Parmotrema conformatum*, *P. hypermaculatum*, *P. pilosum*, *P. virescens*, *P. yodae*, *Punctelia hypoleucites* and *P. riograndensis*.

### \**Bulbothrix cinerea* Marcellii & Kalb

#### FIGURE 1A.

NOTES. – The species is characterized by tightly adnate thalli; the presence of black and bulbate cilia with apices that are curved downwards; a pale brown (rarely dark at the margins) lower surface; simple rhizines; isidia (apices are often broken after collection) darker than the thallus and the production of atranorin, norstictic and connorstictic acids (Benatti 2012a, 2014; Marcelli & Ribeiro 2002). *Bulbothrix cinerea* has been so far found on rocks (Marcelli & Ribeiro 2002), but it was known only from type locality in Brazil and its substrate range apparently has not been known. This species is here reported for the first time from Bolivia where was found on bark rather than rock.

*Specimens examined.* – **BOLIVIA. LA PAZ DEPT.** FRANZ TAMAYO PROV.: between Mapiri and Apollo, 14°40'31"S, 68°25'05"W, elev. 1500 m, savanna with shrubs and some trees, 18.xi.2016, corticolous, *M. Kukwa 18926* (LPB, UGDA).

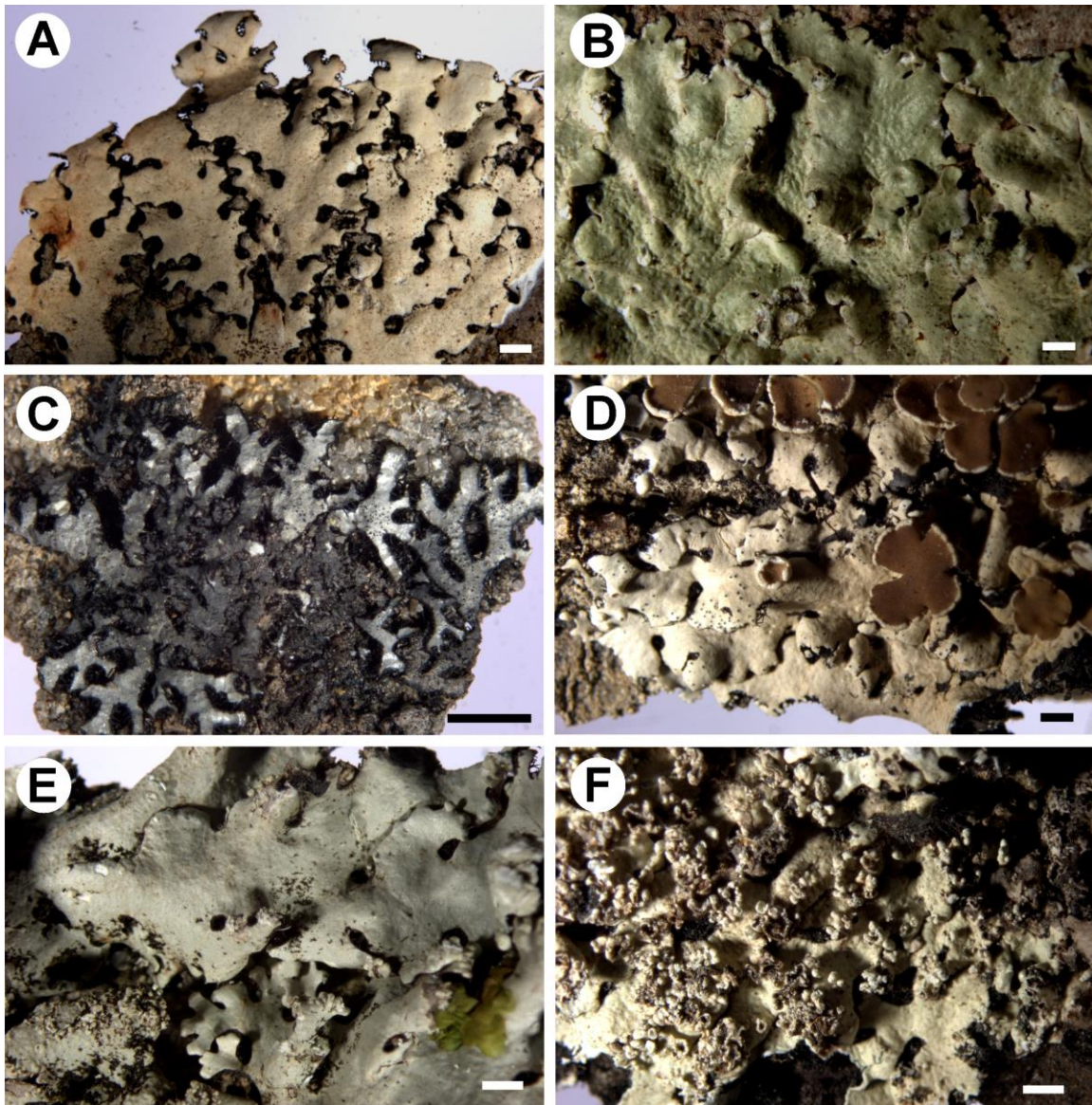
### *Bulbothrix coronata* (Fée) Hale

NOTES. – *Bulbothrix coronata* can be distinguished from other similar species that lack isidia or soredia by the 0.5–1.0 mm wide laciniae; furcate to dichotomously branched cilia and rhizines; coronate margin of the apothecia; ellipsoid ascospores measuring 5.0–10.0 × 3.0–6.0 µm and the production of atranorin, gyrophoric (major) and lecanoric (minor) acids (Benatti 2012a, 2014; Hale 1976a). This species has been reported from Argentina, Bolivia, Brazil, Costa Rica, Jamaica, Paraguay, Peru, the U.S.A. and Venezuela (Calvelo & Liberatore 2002; Flakus et al. 2011, 2016; Hale 1976a; Neuwirth 2008). In Bolivia it was known previously from three localities, two of which were from La Paz Department (Flakus et al. 2011, 2016). The third Bolivian record from La Paz Department is reported here.

*Specimens examined.* – **BOLIVIA. LA PAZ DEPT.** FRANZ TAMAYO PROV.: between Mapiri and Apollo, 14°40'31"S, 68°25'05"W, elev. 1500 m, savanna with shrubs and some trees, 18.xi.2016, corticolous, *M. Kukwa 18924* (LPB, UGDA).

### *Bulbothrix laevigatula* (Nyl.) Hale

NOTES. – *Bulbothrix laevigatula* can be distinguished by its short, marginal bulbate cilia with simple or furcate apices; eciliate isidia, upper cortex and apothecial margin; cylindrical, sometimes branched isidia and the production of atranorin and lecanoric acid (Benatti 2014, Hale 1976a). It is a widely distributed species reported from Africa, Asia, North America and South America (Benatti 2014, Hale 1976a, Sipman et al. 2008). In the latter region it was reported from Bolivia, Brazil, Colombia, Ecuador, French Guiana, Peru and Venezuela (Benatti 2014, Flakus et al. 2016, Hale 1976a, Sipman et al. 2008). In Bolivia it was reported by Flakus et al. (2016) who cited two localities. This is the first report from Franz Tamayo Province.



**Figure 1.** Morphology of selected species reported as new to Bolivia. **A**, *Bulbothrix cinerea* (Kukwa 18926). **B**, *Canoparmelia cryptochlorophaea* (Kukwa 19312). **C**, *Hypotrachyna ectypa* (Kukwa 16899). **D**, *H. everniiformis* (Kukwa 18909). **E**, *H. osseoalba* (Kukwa 19139). **F**, *H. polydactyla* (Kukwa 18581). All scale bars = 1 mm.

*Specimens examined.* – **BOLIVIA. LA PAZ DEPT. FRANZ TAMAYO PROV.:** between Mapiri and Apollo, 14°38'51"S, 68°24'44"W, elev. 1520 m, remnants of forest on savanna, 18.xi.2016, corticolous, *M. Kukwa 18875* (LPB, UGDA).

***Bulbothrix leprieurii* Aubel**

**NOTES.** – This species can be distinguished from other soresiate-pustulate *Bulbothrix* taxa by its narrow lobes (up to 0.7 mm wide); capitate to subplane and laminal or subapical soralia; branched cilia and rhizines; eciliate upper cortex and the presence of atranorin, gyrophoric (major) and lecanoric (minor) acids (Benatti 2014, Sipman & Aubel 1992). It is known from Bolivia, Brazil, Colombia and Guyana (Benatti 2014, Flakus et al. 2016, Sipman & Aubel 1992, Sipman et al. 2008) and was reported from Bolivia from a single locality by Flakus et al. (2016). The record cited below is the first from Cochabamba Department.

*Specimens examined.* – **BOLIVIA. COCHABAMBA DEPT.** CARRASCO PROV.: Parque Nacional Carrasco, Sehuencas, 17°29'57"S, 65°16'30"W, elev. 2235 m, Yungas forest of *Alnus acuminata*, 6.xi.2016, on *Alnus acuminata*, *M. Kukwa 18227* (LPB, UGDA).

**\**Canoparmelia cryptochlorophaea* (Hale) Elix & Hale**

**FIGURE 1B.**

NOTES. – *Canoparmelia cryptochlorophaea* has subirregular, branched lobes up to 5 mm wide; often reticulately maculate, plane to rugose upper surface; laminal, initially orbicular and often coalescing soralia; black lower surface with lighter marginal zone; moderately abundant, simple to tufted rhizines and produces atranorin together with cryptochlorophaeic acid (due to the presence of this latter substance, the medulla reacts KC+ rose) and minor or trace amounts of caperatic acid (Hale 1976b, Pérez-Pérez & Nash 2010). So far the species has been reported from North and Central America (Dominican Republic, Jamaica, Mexico, Trinidad and Tobago, USA) and South America (Argentina, Brazil, Venezuela) (Hale 1976b, Esslinger 2021, Lendemer & Ruiz 2015, Michlig 2014, Pérez-Pérez & Nash 2010). The record below is the first one from Bolivia.

*Specimens examined.* – **BOLIVIA. SANTA CRUZ DEPT.** ICHILO PROV.: Parque Nacional y Área Natural de Manejo Integrado Amboró, Macuñucu, 17°43'38"S, 63°35'38"W, elev. 465 m, secondary transition Chaceño-Amazon forest, 12.v.2017, corticolous, *M. Kukwa 19312* (LPB, UGDA).

***Cetraria aculeata* (Schreb.) Fr.**

NOTES. – This species is characterized by its fruticose thallus, which often forms shrubby tufts, with elongated pseudocyphellae in pits on the main branches (Smith et al. 2009, Thell & Kärnefelt 2011). *Cetraria aculeata* always produces lichesterinic and protolichesterinic acids (Smith et al. 2009, Thell & Kärnefelt 2011). This widely distributed species was reported from Bolivia by Fernández-Mendoza and Printzen (2013) and Flakus et al. (2016). Here, we report a second record from Cochabamba Department.

*Specimens examined.* – **BOLIVIA. COCHABAMBA DEPT.** TIRAQUE PROV.: Parque Nacional Carrasco, Camino de los Nubes, 17°17'28"S, 65°44'05"W, elev. 4146 m, open high Andean vegetation, 2.xii.2014, terricolous, *M. Kukwa 15326* (LPB, UGDA).

***Cetraria ericetorum* Opiz**

NOTES. – *Cetraria ericetorum* differs from similar fruticose *Cetraria* species by the presence of pseudocyphellae on the margin of the lower lobe surface and the strongly channeled and curved lobes (Smith et al. 2009, Thell & Kärnefelt 2011). The species produces lichesterinic and protolichesterinic acids (Thell & Kärnefelt 2011). This is a widespread species; in South America it was found in Argentina, Bolivia and Chile (as *C. ericetorum* ssp. *patagonica* Kärnefelt) (Bjerke & Elvebakk 2004, Flakus et al. 2012a, Kärnefelt 1979). It was previously reported from Bolivia only in the La Paz Department (Flakus et al. 2012a). The first record from Cochabamba Department is presented here.

*Specimens examined.* – **BOLIVIA. COCHABAMBA DEPT.** TIRAQUE PROV.: Parque Nacional Carrasco, Diente del Diablo, 17°16'55"S, 65°44'14"W, elev. 4335 m, open high Andean vegetation, 2.xii.2014, terricolous, *M. Kukwa 15300* (LPB, UGDA).

**\**Flavocetraria nivalis* (L.) Kärnefelt & Thell**

NOTES. – Thallus lobes in *Flavocetraria nivalis* are pale yellow, plane, never canaliculate or subtubular; with reddish-violet necrotic basal parts; wrinkled and foveolate surface and wavy margins (Randlane & Thell 2011). Pseudocyphellae are present on the lower surface as white spots and the species produces usnic, lichesterinic and protolichesterinic acids (Randlane & Thell 2011, Smith et al. 2009). This widely distributed species was previously known in South America from Argentina, Chile and Peru (Bjerke & Elvebakk 2004). It is here reported as new to Bolivia.

*Specimens examined.* – **BOLIVIA. COCHABAMBA DEPT.** TIRAQUE PROV.: Parque Nacional Carrasco, Diente del Diablo, 17°16'55"S, 65°44'14"W, elev. 4335 m, open high Andean vegetation, 2.xii.2014, saxicolous, *M. Kukwa 15303* (LPB, UGDA).

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

NOTES. – The black lower surface and the lack of soredia distinguish *Flavopunctelia praesignis* from other species of the genus (Egan 2004). The lobes are linear to sublinear, rarely with small laciniae and always with white, punctiform pseudocyphellae (Egan 2004). Apothecia are frequent and were also

found in Bolivian material. The species always produces usnic and lecanoric acids (Egan 2004). *Flavopunctelia praesignis* is known from Argentina, Bolivia, Mexico, Peru, Venezuela, the U.S.A. and East Africa (Kenya) (Calvelo & Liberatore 2002, Egan 2004, Esslinger 2021, Flakus et al. 2011). The third Bolivian record is presented here and it is also the first for the Chuquisaca Department. The species was previously known from Santa Cruz and Cochabamba Departments (Flakus et al. 2011).

*Specimens examined.* – **BOLIVIA. CHUQUISACA DEPT. ZUDAÑEZ PROV.:** Área Natural de Manejo Integrado El Palmar, Lomán, Salviatójo, 18°45'51"S, 64°50'09"W, elev. 2836 m, disturbed Boliviano-Tucumano forest with *Podocarpus* and shrubs, 14.vii.2015, corticolous, *M. Kukwa 16089* (LPB, UGDA).

***Flavopunctelia soledica* (Nyl.) Hale**

NOTES. – The diagnostic features of this species are the undulating lobe margins with abundant crescent-shaped soralia (rarely soralia are rounded and laminal); the dark brown to black lower surface and the presence of usnic and lecanoric acids (Egan 2004). Pseudocyphellae are absent or rare, very small and punctiform (Egan 2004). This species is widely distributed and reported from Asia, Europe, North America, South America and Oceania (Calvelo & Liberatore 2002; Divakar & Upreti 2005; Egan 2004; Elix & McCarthy 1998; Esslinger 2021; Flakus et al. 2012a, 2015; Galloway & Quillhot 1998). Flakus et al. (2012a, 2015) reported only two Bolivian localities of the species. The first record from Chuquisaca Department is presented here.

*Specimens examined.* – **BOLIVIA. CHUQUISACA DEPT. ZUDAÑEZ PROV.:** Área Natural de Manejo Integrado El Palmar, Lomán, Salviatójo, 18°45'53"S, 64°49'57"W, elev. 2875 m, Boliviano-Tucumano forest with *Podocarpus* and shrubs, 14.vii.2015, corticolous, *M. Kukwa 16128* (LPB, UGDA).

**\*\**Hypotrachyna ectypa* (Brusse) Divakar, A. Crespo, Sipman, Elix & Lumbsch**

**FIGURE 1C.**

NOTES. – *Hypotrachyna ectypa* has narrow lobes, up to 1.5 mm wide (in Bolivian material up to 1 mm wide); laminal isidia with black tips (in Bolivian material tips are very dark brown almost black); simple cilia and produces atranorin together with gyrophoric acid (Benatti 2012b, Brusse 1991). It is here reported for the first time from Bolivia and South America. The species was previously known only from the type locality in South Africa (Benatti 2012b, Brusse 1991). The material from Bolivia has lobes, that are more separated and isidia are shorter than in the photographs presented by Brusse (1991), however all the other characters fit the description of the species. As the species has been known only from the type collection, we suspect that the original description does not fully account for the morphological variation in the taxon and refer the Bolivian collection to this species.

*Specimens examined.* – **BOLIVIA. CHUQUISACA DEPT. ZUDAÑEZ PROV.:** Área Natural de Manejo Integrado El Palmar, Muy Orquo, on road from El Palmar to Loman, 18°47'46"S, 64°51'31"W, elev. 2879 m, open area, table mountain of sandstone, 14.vii.2015, saxicolous, *M. Kukwa 16899* (LPB, UGDA).

**\**Hypotrachyna everniiformis* (Zahlbr.) Elix, T. H. Nash & Sipman**

**FIGURE 1D.**

NOTES. – *Hypotrachyna everniiformis* is characterized by subirregular to sublinear-elongate and canaliculate lobes; the lack of vegetative propagules; rhizines which are sparse to moderately dense and cilia-like along lobe margins; and small ascospores measuring 11–15 × 8–9 μm (in Bolivian material they are a bit narrower and measure 11–12 × 6–7 μm) (Sipman et al. 2009). The species produces atranorin and ovoic acid with minor to trace amounts of gyrophoric and lecanoric acids (Sipman et al. 2009). Previously the species was known only from Brazil (Sipman et al. 2009) and is here reported new to Bolivia.

*Specimens examined.* – **BOLIVIA. LA PAZ DEPT. FRANZ TAMAYO PROV.:** between Mapiri and Apollo, 14°40'31"S, 68°25'05"W, elev. 1500 m, savanna with shrubs and some trees, 18.xi.2016, corticolous, *M. Kukwa 18909* (LPB, UGDA).

***Hypotrachyna nigrociliata* (B. de Lesd.) Divakar, A. Crespo, Sipman, Elix & Lumbsch**

NOTES. – This species was formerly included in the genus *Everniastum* Hale and is characterized by elongate lobes; marginal rhizines and the presence of gyrophoric acid in addition to atranorin, and protolichesterinic acid (the latter substance is absent in Bolivian material) (e.g., Culberson & Culberson 1981, Hale 1976c, Sipman 1980). *Hypotrachyna nigrociliata* is morphologically diverse and specimens

from Central America have broad lobes and long and robust rhizines, while those from South America have lobes that are narrow and rhizines that are short and slender (Culberson & Culberson 1981, Hale 1976c, Sipman 1980). The latter were previously separated as *E. imitatum* (B. de Lesd.) W. Culb. & C. Culb.; see Hale (1976c). In material from Bolivia the lobes are up to 1 mm wide with slender and branched marginal rhizines. This is a Neotropical species known from Bolivia, Costa Rica, Ecuador, Guatemala, Mexico and Venezuela (Culberson & Culberson 1981, Flakus et al. 2011, Sipman 1980). It was reported from Bolivia as a *Everniastrum nigrociliatum* (Taylor) Hale ex Sipman from a single locality (Flakus et al. 2011). Here, we present the first record from Tarija Department.

*Specimens examined.* – **BOLIVIA. TARIJA DEPT. MÉNDEZ PROV.:** Cuesta de Sama, near Las Antenas, 21°29'53"S, 64°54'57"W, elev. 3880 m, open high Andean vegetation, 21.vii.2015, terricolous, *M. Kukwa 16514* (LPB, UGDA).

**\**Hypotrachyna osseoalba* (Vain.) Park & Hale**

**FIGURE 1E.**

NOTES. – *Hypotrachyna osseoalba* differs from other *Hypotrachyna* species with lichexanthone in the upper cortex by the presence of laminal to submarginal pustules forming granular soredia; a white medulla with yellow-orange patches and the presence of colensoic, 4-O-methylphysodic, lividic and oxyphysodic acids (Sipman et al. 2009). The species is widely distributed and has been reported from Asia, Australia, North America and South America (Elix 1994a, Esslinger 2021, Hale 1975, Sipman et al. 2009). In the Neotropics it was reported from Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, Guyana, Guatemala, Haiti, Mexico, Panama, and Venezuela (Hale 1975, Sipman et al. 2009). It is here reported as new to Bolivia.

*Specimens examined.* – **BOLIVIA. COCHABAMBA DEPT. CARRASCO PROV.:** Parque Nacional Carrasco, Sehuencas, 17°29'57"S, 65°16'30"W, elev. 2235 m, Yungas forest of *Alnus acuminata*, partly grazed, 6.xi.2016, on *Alnus* sp., *M. Kukwa 18223* (LPB, UGDA). **LA PAZ DEPT. NOR YUNGAS PROV.:** Coroico, 16°11'36"S, 67°43'21"W, elev. 1890 m, shrubs and small trees, 23.xi.2016, corticolous, *M. Kukwa 19139* (LPB, UGDA).

**\**Hypotrachyna polydactyla* (Krog & Swinscow) T.H. Nash**

**FIGURE 1F.**

NOTES. – The taxon differs from other similar *Hypotrachyna* species with atranorin in the cortex by the presence of sublinear lobes; inflated to crescent-shaped, epicorticate dactyls with abrading apices and the presence of the lividic acid chemosyndrome in the medulla, which reacts K<sup>-</sup>, C<sup>-</sup> and KC<sup>+</sup> red (Sipman et al. 2009). This species is known from Africa (Kenya) and South America where it was reported only from Argentina and Brazil (Adler & Calvelo 2007, Sipman et al. 2009). Here it is reported as new to Bolivia.

*Specimens examined.* – **BOLIVIA. COCHABAMBA DEPT. CARRASCO PROV.:** Carrasco National Park, near Sehuencas village, 17°30'12"S, 65°16'30"W, alt. 2220 m, montane cloud forest, corticolous, 21.vii.2008, *M. Kukwa 6517* (LPB, UGDA). **SANTA CRUZ DEPT. MANUEL MARÍA CABALLERO PROV.:** near Siberia, Monte Empalme, 17°49'43"S, 64°39'58"W, elev. 2545 m, semi-natural Yungas forest, 8.xi.2016, corticolous, *M. Kukwa 18581* (LPB, UGDA).

***Hypotrachyna protochlorina* Sipman, Elix & T.H. Nash**

NOTES. – The diagnostic features of *Hypotrachyna protochlorina* are the presence of flaking cortex, which expose a pale yellow to yellow (due to the presence of secalonic acid A) medulla; K<sup>+</sup> and C<sup>+</sup> yellow medulla due to the production of barbatic acid and related substances; and the development of sublinear lobules forming in the central part of thalli (Sipman et al. 2009). This Neotropical species is known only from Bolivia and Brazil (Flakus et al. 2016, Sipman et al. 2009). Flakus et al. (2016) reported one locality from Tarija Department. Here, we present the first record from Cochabamba Department.

*Specimens examined.* – **BOLIVIA. COCHABAMBA DEPT. CARRASCO PROV.:** Parque Nacional Carrasco, river Phaqcha, 17°26'12"S, 65°15'21"W, elev. 2130 m, rocks near the cascade, 5.xi.2016, on saxicolous bryophytes, *M. Kukwa 18090* (LPB, UGDA).

***Hypotrachyna pulvinata* (Fée) Hale**

NOTES. – *Hypotrachyna pulvinata* is characterized by dichotomously branched, sublinear to subirregular lobes; the lack of vegetative propagules; a white-maculate upper surface and the presence of

atranorin, lecanoric and evermic acids (Sipman et al. 2009). This is a widespread species in the Neotropics and outside of that region it is known only from the Azores (Sipman et al. 2009). In Bolivia it was reported from several localities by Sipman et al. (2009) and Flakus et al. (2011). Here, we provide the first locality from Santa Cruz Department.

*Specimens examined.* – **BOLIVIA. SANTA CRUZ DEPT.** MANUEL MARÍA CABALLERO PROV.: near Siberia, Monte Empalme, 17°49'43"S, 64°39'58"W, elev. 2545 m, semi-natural Yungas forest, 8.xi.2016, corticolous, *M. Kukwa 18589* (LPB, UGDA).

***Hypotrachyna subformosana* Hale ex Elix, T. H. Nash & Sipman**

NOTES. – *Hypotrachyna subformosana* has lichexanthone in the upper cortex, and is characterized by the presence of laminal to subapical, capitate to orbicular soralia (pustules absent) and the lividic acid complex in the medulla (Sipman et al. 2009). This species was reported in the Neotropics from Bolivia, Brazil, Dominican Republic, Guatemala, Jamaica, Mexico and Venezuela (Flakus et al. 2012b, Sipman et al. 2009). It was also reported from Fiji (Sipman et al. 2009). Previously only one locality was known from Bolivia (Flakus et al. 2012b). Two new Bolivian records are added here, including the first for the Tarija Department.

*Specimens examined.* – **BOLIVIA. LA PAZ DEPT.** FRANZ TAMAYO PROV.: between Mapiri and Apollo, 14°38'51"S, 68°24'44"W, elev. 1520 m, remnants of forest on savanna, 18.xi.2016, corticolous, *M. Kukwa 18875a* (LPB, UGDA). **TARIJA DEPT.** ANICETO ARCE PROV.: close to Coyabuyo, between Padcaya and Bermejo, 22°17'23"S, 64°28'50"W, elev. 942 m, Sub-Andean Tucumano-Boliviano forest, 26.vii.2015, corticolous, *M. Kukwa 16735* (LPB, UGDA).

***Parmotrema austrosinense* (Zahlbr.) Hale**

NOTES. – *Parmotrema austrosinense* is characterized by gray, wide and eciliate lobes; marginal and sinuate soralia; and lower surface that is black and sparsely rhizinate in the center, transitioning to light brown, mottled, ivory or white and erhizinate in a broad marginal zone. It also produces atranorin and lecanoric acid (Benatti & Marcelli 2009, Hale 1965a, Kukwa et al. 2012). This Pantropical species is known from Africa, Asia, Australia, North and South America and Oceania (Calvelo & Liberatore 2002, Divakar & Upreti 2005, Elix 1994b, Esslinger 2021, Hale 1965a, Kukwa et al. 2012, Spielmann & Marcelli 2009). In Bolivia the species was reported from a single locality in Cochabamba Department (Kukwa et al. 2012). Here, we report it from the Chuquisaca Department.

*Specimens examined.* – **BOLIVIA. CHUQUISACA DEPT.** BELISARIO BOETO PROV.: close to Padilla between Nuevo Mundo and Santa Rosa, 18°57'12"S, 64°16'37"W, elev. 1790 m, transition between Boliviano-Tucumano forests and dry interandean vegetation, 16.vii.2015, on twig, *M. Kukwa 16232* (LPB, UGDA).

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

NOTES. – The upper surface of *Parmotrema conformatum* is greenish-yellow with granular to cylindrical, rarely branched, laminal to marginal isidia. Cilia are absent or sparse. The lower surface is black and sparsely rhizinate in the center, transitioning to brown and naked near the margins (Bungartz & Spielmann 2019, Hale 1965a, Sipman 2005). The species produces usnic acid, and according to Hale (1965a) and Bungartz and Spielmann (2019) also protocetraric and fumarprotocetraric acids; however, Sipman (2005) reported only protocetraric acid. Bolivian material contains usnic and protocetraric acids. This species was reported from many countries in the Neotropics (Bungartz & Spielmann 2019, Flakus et al. 2014, Hale 1965a). Here, we present the fifth record of the species from Bolivia (Flakus et al. 2014, 2016).

*Specimens examined.* – **BOLIVIA. LA PAZ DEPT.** FRANZ TAMAYO PROV.: between Mapiri and Apollo, 14°40'31"S, 68°25'05"W, elev. 1500 m, savanna with shrubs and some trees, 18.xi.2016, corticolous, *M. Kukwa 18905* (LPB, UGDA).

**\**Parmotrema eitenii* Marcelli & Benatti**

**FIGURE 2A.**

NOTES. – Diagnostic features of *Parmotrema eitenii* are marginal soralia with granular soredia, which may develop into corticate, isidia-like structures (although true isidia are absent); eciliate lobe margins; the lower surface that is black and mostly rhizinate in the center and brown, naked at the marginal zone. The species produces atranorin and lecanoric acid (Benatti & Marcelli 2009, Marcelli et al. 2007).

Previously the species was known only from Brazil (Benatti & Marcelli 2009, Marcelli et al. 2007). It is here reported for the first time from Bolivia.

*Specimens examined.* – **BOLIVIA. TARIJA DEPT.** ANICETO ARCE PROV.: close to la Mamora, between Tarija and Bermejo, 22°09'51"S, 64°40'03"W, elev. 1320 m, disturbed Tucumano-Boliviano forest, 27.vii.2015, corticolous, *M. Kukwa 16780* (LPB, UGDA).

#### ***Parmotrema flavomedullosum* Hale**

NOTES. – *Parmotrema flavomedullosum* is characterized by gray thalli with a yellow medulla; eciliate lobe margins; black, sparsely rhizinate lower surface with a wide, brown, erhizinate marginal zone; submarginal to laminal soralia and the production of atranorin, gyrophoric and lecanoric acids and secalonic acid A (Hale 1974, Kukwa et al. 2012, Sipman 2005). The species is known from Bolivia, Brazil, Panama, Paraguay and Venezuela (Flakus et al. 2016, Kukwa et al. 2012, Hale 1974, Spielmann & Marcelli 2009). In Bolivia it was previously reported from only five localities (Flakus et al. 2016, Kukwa et al. 2012).

*Specimens examined.* – **BOLIVIA. TARIJA DEPT.** ANICETO ARCE PROV.: close to Coyabuyo, between Padcaya and Bermejo, 22°17'23"S, 64°28'50"W, elev. 942 m, Sub-Andean Tucumano-Boliviano forest, 26.vii.2015, corticolous, *M. Kukwa 16709* (LPB, UGDA).

#### **\**Parmotrema hypermaculatum* Marcelli, Benatti & Elix**

**FIGURE 2B.**

NOTES. – The species produces atranorin, salazinic and consalazinic acids. Morphologically it is characterized by hypermaculate upper surface; usually simple, up to 2.6 mm long cilia present along lobe margins; lower surface that is black and rhizinate in the center and brown and naked in the marginal zone; imperforate and shortly stipitate apothecia with eciliate thalline margin (apothecia absent in Bolivian material); ascospores measuring 10–14 × 6.5–9 µm and conidia measuring (7–)9–14 × 1 µm (Benatti et al. 2008). Although the material from Bolivia lacks apothecia, the hypermaculate upper surface and the size of conidia (9–12 µm long in studied samples) allowed us to distinguish it from other similar taxa (Benatti et al. 2008). This species is reported from Bolivia for the first time. Previously it was known only from two collections made in Brazil (Benatti et al. 2008).

*Specimens examined.* – **BOLIVIA. TARIJA DEPT.** ANICETO ARCE PROV.: Reserva Nacional de Flora y Fauna Tariquía, close to la Cumbre, between Padcaya and campamento los Alisos, 22°00'00"S, 64°36'29"W, elev. 3158 m, open area, 24.vii.2015, saxicolous, *M. Kukwa 16619* (LPB, UGDA).

#### **\**Parmotrema muelleri* (Vain.) Blanco, Crespo, Divakar, Elix & Lumbsch**

**FIGURE 2C.**

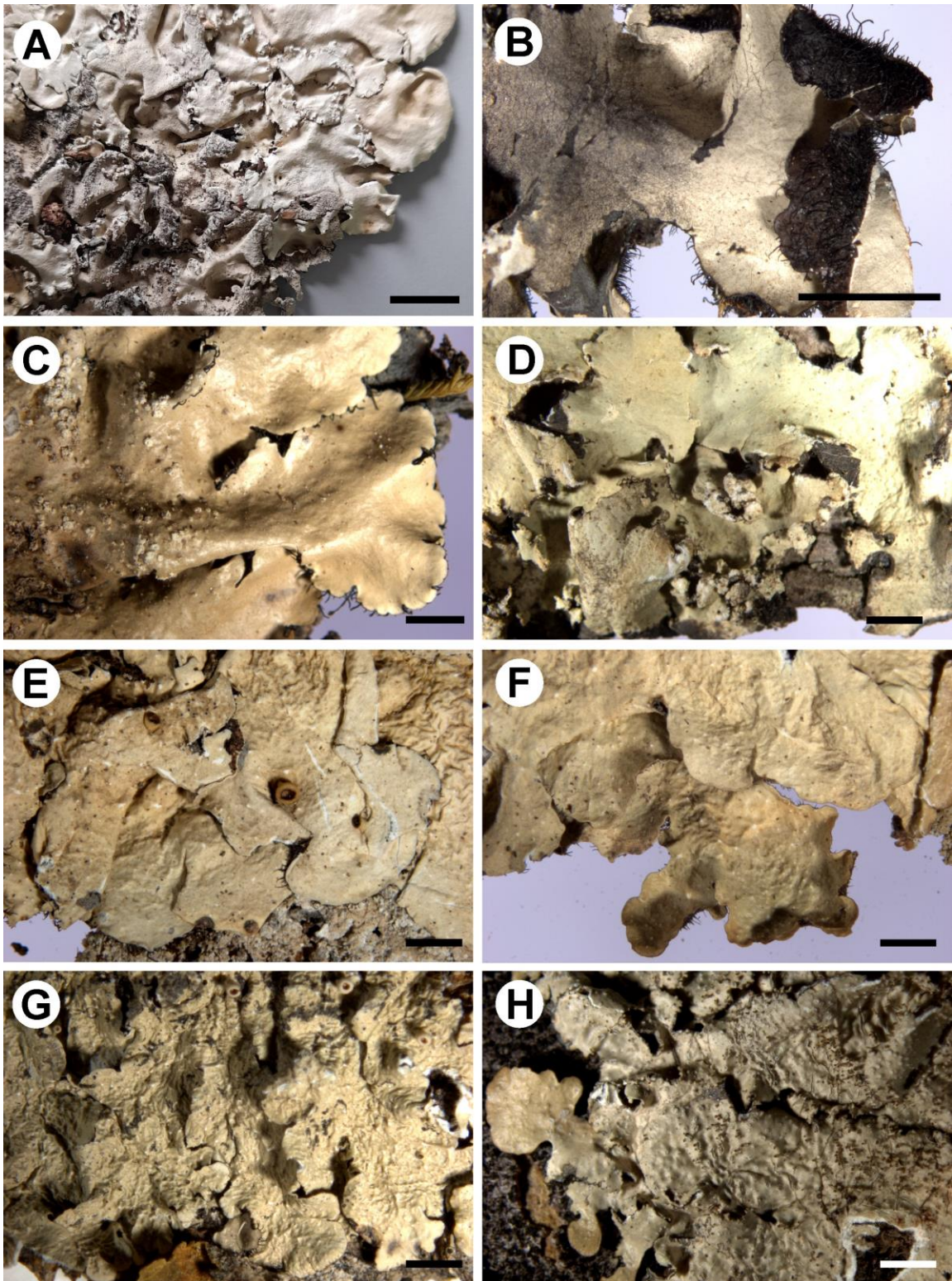
NOTES. – The soralia in *Parmotrema muelleri* are capitate and laminal, although they also extend to the lobe margins. Maculae are laminal, punctate to irregular. The margins of the lobes are covered by black, simple to furcate or irregularly branched cilia. The lower surface is black, rhizinate almost to the margins, with simple to irregularly branched and short rhizines mixed with long ones. The species always produces atranorin and the stictic acid complex (Hale 1976d, Sipman 2005, Spielmann & Marcelli 2009). This species was previously reported from North and South America (Argentina, Brazil, Mexico, Peru, Uruguay and Venezuela) as well as from Asia (Calvelo & Liberatore 2002, Hale 1976d, Spielmann & Marcelli 2009). This is the first record from Bolivia.

*Specimens examined.* – **BOLIVIA. CHUQUISACA DEPT.** LUIS CALVO PROV.: Parque Nacional y Área Natural de Manejo Integrado Serranía del Iñaño, close to Ticucha, 19°37'26"S, 63°50'55"W, elev. 1040 m, disturbed Sub-Andean Boliviano-Tucumano forests with *Acacia*, 18.vii.2015, corticolous, *M. Kukwa 16354* (LPB, UGDA).

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

NOTES. – This species is characterized by the presence of submarginal, linear soralia soon eroding and causing lobes to be strongly revolute; sparse cilia; a lower surface that is black and moderately rhizinate in the center and brown and naked along marginal zone; and the production of atranorin and the stictic acid complex (Hale 1965a, Jabłońska et al. 2009, Sipman 2005). It is widely distributed in many regions of the world (Hale 1965a, Flakus et al. 2011, Jabłońska et al. 2009). In Bolivia it has previously been reported from several localities (Flakus et al. 2011, 2014). The record presented here is the first one from Burnet O'Connor Province and the second one from Tarija Department.





**Figure 2.** Morphology of selected species reported as new to Bolivia. **A**, *Parmotrema eitenii* (Kukwa 16780). **B**, *P. hypermaculatum* (Kukwa 16619). **C**, *P. muelleri* (Kukwa 16354). **D**, *P. virescens* (Kukwa 18919). **E-F**, *Punctelia jujensis* (Kukwa 16857c). **G**, *P. riograndensis* (Kukwa 16028). **H**, *P. rudecta* (Kukwa 16946). Scale bars = 10 mm in A; 5 mm in B; 2 mm in C-H.

*Specimens examined.* – **BOLIVIA. TARIJA DEPT.** BURNET O'CONNOR PROV.: between Tarija and Entre Ríos, 21°28'52"S, 64°17'41"W, 1837 m, Boliviano-Tucumano forest with *Podocarpus* and small epiphytic orchids exposed SE, 28.vii.2015, corticolous, *M. Kukwa 16933* (LPB, UGDA).

***Parmotrema pilosum* (Stizenb.) Krog & Swinscow**

NOTES. – The thallus of *Parmotrema pilosum* is gray, with ciliate lobes; a lower surface rhizinate to the margins, black in the center and brown in the marginal zone and rhizines are dimorphous (Hale 1976d, Krog & Swinscow 1981, Sipman 2005). Hale (1976d) and Sipman (2005) reported only atranorin in this species, but Krog and Swinscow (1981) also detected an unidentified fatty acid. In Bolivian samples fatty acids were also found, however only on plates developed in solvent C. This species is known from South America from Argentina, Bolivia, Chile, Ecuador and Uruguay, and has also been reported from Africa (Calvelo & Liberatore 2002, Flakus et al. 2016, Hale 1976d, Krog & Swinscow 1981). Only one locality was previously known in Bolivia from La Paz Department (Flakus et al. 2016). Here report the species for the first time from Tarija Department.

*Specimens examined.* – **BOLIVIA. TARIJA DEPT.** BURNET O'CONNOR PROV.: between Entrerios and Tarija, 21°29'13"S, 64°11'42"W, 1535 m, Boliviano-Tucumano forest, 31.vii.2015, corticolous, *M. Kukwa 16956* (LPB, UGDA). **SANTA CRUZ DEPT.** FLORIDA PROV.: road to la Yunga de Mairana, 18°06'04"S, 63°55'58"W, 1905 m, transition dry-Yungas forest 16.v.2017, corticolous, *M. Kukwa 19516* (LPB, UGDA).

***Parmotrema recipiendum* (Nyl.) Hale**

NOTES. – *Parmotrema recipiendum* can be recognized by the absence of vegetative propagules; maculate upper surface; usually simple cilia present along lobe margins; dark brown lower surface; dimorphic rhizines distributed up to the edge of the thallus; perforate apothecia; filiform conidia measuring 10–16 × 1 µm (12–14 µm long in Bolivian material) and the production of atranorin, norlobaridone and loxodin (the latter in trace amount in Bolivian material) (Spielmann & Marcelli 2009). This species is known only from South America where it has been reported from Argentina, Bolivia, Brazil, Colombia and Paraguay (Calvelo & Liberatore 2002, Flakus et al. 2016, Hale 1965a, Sipman et al. 2008, Spielmann & Marcelli 2009). To date only a single Bolivian record was known from Cochabamba Department (Flakus et al. 2016). Here it is reported as new to Chuquisaca Department.

*Specimens examined.* – **BOLIVIA. CHUQUISACA DEPT.** BELISARIO BOETO PROV.: close to Padilla between Nuevo Mundo and Santa Rosa, 18°57'12"S, 64°16'37"W, elev. 1790 m, transition between Boliviano-Tucumano forests and dry interandean vegetation, 16.vii.2015, corticolous, *M. Kukwa 16239* (LPB, UGDA).

***Parmotrema sancti-angelii* (Lynge) Hale**

NOTES. – *Parmotrema sancti-angelii* has a ciliate thallus; mainly marginal and linear soralia; a centrally black and sparsely rhizinate lower surface with erhizinate paler marginal zone; and white medulla sometimes with some orange patches. It contains atranorin, gyrophoric (major) and lecanoric (trace) acids and skyrin in orange patches (Hale 1965a, Kukwa et al. 2012). The species has a Pantropical distribution and is known from Africa, Australia, Asia, North America, South America and Oceania (e.g., Benatti & Marcelli 2009, Calvelo & Liberatore 2002, Hale 1965a, Krog & Swinscow 1981, Kukwa et al. 2012, Louwhoff & Elix 1999). In Bolivia it was previously reported only from two localities (Flakus et al. 2016, Kukwa et al. 2012). Here two new records are presented, including the first one from Franz Tamayo Province.

*Specimens examined.* – **BOLIVIA. LA PAZ DEPT.** FRANZ TAMAYO PROV.: between Mapiri and Apollo, 14°38'51"S, 68°24'44"W, elev. 1520 m, remnants of forest on savanna, 18.xi.2016, corticolous, *M. Kukwa 18896* (LPB, UGDA). **NOR YUNGAS PROV.:** Coroico, 16°11'36"S, 67°43'21"W, elev. 1890 m, shrubs and small trees, 23.xi.2016, corticolous, *M. Kukwa 19123* (LPB, UGDA).

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

NOTES. – The diagnostic features of *Parmotrema simulans* are the lacinate thallus; cracked, reticulately white-maculate and strongly upper surface; coarse soralia developing laciniae; dark brown lower surface with dense, simple to squarrosely branched rhizines and the production of atranorin and caperatic acid (Hale 1971, Kukwa et al. 2012, Sipman 2005). This species has been reported from the Neotropics (Bolivia, Brazil, Dominican Republic, Haiti, Mexico, Uruguay), U.S.A. and Africa (South

Africa, Uganda) (Flakus et al. 2013, 2014; Esslinger 2021; Hale 1971; Krog & Swinscow 1981, as *Parmelia reticulata* Taylor; Kukwa et al. 2012). In Bolivia it was reported from three localities (Flakus et al. 2013, 2014; Kukwa et al. 2012). Here the first record from La Paz Department is reported.

*Specimens examined.* – **BOLIVIA. LA PAZ DEPT. FRANZ TAMAYO PROV.:** between Mapiri and Apollo, 14°40'31"S, 68°25'05"W, elev. 1500 m, savanna with shrubs and some trees, 18.xi.2016, corticolous, *M. Kukwa 18930* (LPB, UGDA).

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

NOTES. – The features that distinguish *Parmotrema tinctorum* from other species of the genus are the presence of laminal, abundant, cylindrical, simple to sparsely branched isidia; broad lobes (up to 14 mm wide) that are eciliate; a lower surface that is light to dark brown with naked erhizinate margins, but that becomes blackened centrally with sparse, short, simple rhizines; and the production of atranorin and lecanoric acid (Bungartz & Spielmann 2019, Kukwa et al. 2012). This species is widely distributed in tropical and subtropical regions of the world (Bungartz & Spielmann 2019, Calvelo & Liberatore 2002, Divakar & Upreti 2005, Elix 1994b, Hale 1965a, Krog & Swinscow 1981, Kukwa et al. 2012, Louwhoff & Elix 1999, Esslinger 2021). In Bolivia it has previously been reported from several localities (Flakus et al. 2014, 2016; Kukwa et al. 2012). Here the first records from Chuquisaca Department are reported.

*Specimens examined.* – **BOLIVIA. CHUQUISACA DEPT. LUIS CALVO PROV.:** Parque Nacional y Área Natural de Manejo Integrado Serranía del Iñaño, close to Ticucha, 19°37'26"S, 63°50'55"W, elev. 1040 m, disturbed Sub-Andean Boliviano-Tucumano forests, 18.vii.2015, corticolous, *M. Kukwa 16338* (LPB, UGDA), Parque Nacional y Área Natural de Manejo Integrado Serranía del Iñaño, close to Ticucha, between Tranqua and Monte Agudo, 19°39'50"S, 63°49'14"W, elev. 1022 m, disturbed area with shrubs, 18.vii.2015, corticolous, *M. Kukwa 16391* (LPB, UGDA).

#### **\**Parmotrema virescens* Hale**

**Figure 2D.**

NOTES. – This species is characterized by a light greenish-yellow thallus with abundant soredia at the margins; soralia that are initially concolorous with the thallus, later often with a brownish tinge; scarce to abundant marginal cilia; black and densely rhizinate lower surface in center and erhizinate and dark brown to black marginal zone; and the presence of atranorin (not detected in Bolivian material probably due to small concentration), usnic and protocetraric acids (Bungartz & Spielmann 2019, Sipman 2005). The species was reported from Colombia, Ecuador (including the Galapagos Islands) and Venezuela (Bungartz & Spielmann 2019, Hale 1986, Marcano et al. 1996, Sipman et al. 2008). Here it is reported for the first time from Bolivia.

*Specimens examined.* – **BOLIVIA. LA PAZ DEPT. FRANZ TAMAYO PROV.:** between Mapiri and Apollo, 14°40'31"S, 68°25'05"W, elev. 1500 m, savanna with shrubs and some trees, 18.xi.2016, corticolous, *M. Kukwa 18919* (LPB, UGDA).

#### ***Parmotrema warmingii* (Vain.) Spielmann & Marcelli Spielmann**

NOTES. – *Parmotrema warmingii* has a lacinate thallus with long, simple or rarely branched cilia; hypermaculate upper surface without soredia and isidia; and dark brown to black lower surface with rhizines present up to the margins. The species produces atranorin and salazinic acid, and has been only recently separated from other similar member of the genus with salazinic acid (Spielmann & Marcelli 2020). It is known from Bolivia, Brazil and South Africa (Flakus et al. 2015, 2016; Spielmann & Marcelli 2020). In Bolivia it was reported from three localities as *Parmelia warmingii* Vain. (Flakus et al. 2015, 2016). Here two new records are presented, including the first one from Tarija Department.

*Specimens examined.* – **BOLIVIA. LA PAZ DEPT. LARECAJA PROV.:** la Cumbre Ancoruma, close to Sorata-Mapiri road, 14°43'09"S, 68°35'55"W, elev. 4650 m, open high Andean vegetation, 21.xi.2014, saxicolous, *M. Kukwa 15010* (LPB, UGDA). **TARIJA DEPT. MÉNDEZ PROV.:** Cuesta de Sama, near Las Antenas, 21°28'42"S, 64°55'28"W, elev. 4020 m, open high Andean vegetation, 21.vii.2015, terricolous, *M. Kukwa 16491* (LPB, UGDA).

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

NOTES. – *Parmotrema yodae* has narrow lobes (up to 1 cm wide) with or without cilia (found in Bolivian material); an emaculate upper surface; marginal to submarginal soralia; black lower surface that transitions to brown or white near the margins; dimorphic rhizines and produces atranorin and

norlobaridone and loxodin (the latter was absent in our material) (Adler & Calvelo 2010, Flakus et al. 2014, Kurokawa 1967). This species is known from Argentina, Bolivia, Brazil and Nepal (Adler & Calvelo 2010, Baniya et al. 2010, Flakus et al. 2014, Kurokawa 1967, Spielmann 2006). Flakus et al. (2014) reported only a single Bolivian locality from La Paz Department. Here, we report a second occurrence, this time from the Chuquisaca Department.

*Specimens examined.* – **BOLIVIA. CHUQUISACA DEPT. BELISARIO BOETO PROV.:** close to Padilla between Nuevo Mundo and Santa Rosa, 18°57'12"S, 64°16'37"W, elev. 1790 m, transition between Boliviano-Tucumano forests and dry interandean vegetation, 16.vii.2015, on twig, *M. Kukwa 16231* (LPB, UGDA).

#### ***Psiloparmelia diffractaica* Elix & T. H. Nash**

NOTES. – *Psiloparmelia diffractaica* has a small rosette-forming thallus without isidia and soredia; lobes that are narrow, subirregular and branched; an erhizinate lower surface that is black to dark gray towards the margin. The species produces atranorin, usnic and diffractaic acids as the main secondary lichen metabolites (Elix & Nash 1992). This species was reported from Argentina and Bolivia (Elix & Nash 1992, Flakus et al. 2013). In Bolivia it has been reported from only two localities (Flakus et al. 2013). The record cited below is the first one from Tarija Department.

*Specimens examined.* – **BOLIVIA. TARIJA DEPT. MÉNDEZ PROV.:** Cuesta de Sama, near Las Antenas, 21°29'52"S, 64°54'06"W, elev. 3842 m, open high Andean vegetation, 2.viii.2015, saxicolous, *M. Kukwa 16872a* (LPB, UGDA).

#### ***Punctelia hypoleucites* (Nyl.) Krog**

NOTES. – *Punctelia hypoleucites* is characterized by a thallus with distinct pseudocypbellae; marginal lacinae; unciform conidia that measure 3–8 µm long; the lack of isidia and soredia; the light brown, opaque lower surface with a smooth or slightly papillate marginal zone; and the presence of atranorin and lecanoric acid (Canêz 2009; Culberson & Culberson 1980, as *Parmelia semansiana* W. Culb. & C. Culb.). Culberson and Culberson (1980) distinguished *Punctelia semansiana* (W.L. Culb. & C.F. Culb.) Krog from *P. hypoleucites* on the basis of having shorter conidia (average length 5.2 µm in *P. semansiana* versus 10.7 µm or 11.8 µm depending on the material in *P. hypoleucites*). However they did not find conidia in the type of *Parmelia hypoleucites* Nyl. and their assumptions were based on the differences in material they studied. Canêz (2009), who restudied the type collection of the latter, reported the conidia to be unciform and 3–5 µm long and therefore, as no differences were found, *Punctelia semansiana* was included in the synonymy of *P. hypoleucites*. Egan and Lendemer (2016) reported conidia to be 10–13 µm long in *P. hypoleucites*, but this is not in agreement with the data reported by Canêz (2009), who stated that the material with longer conidia may refer to *Parmelia azulensis* B. de Lesd. (a formal transfer to *Punctelia* has not yet been made for this epithet). Also Hale (1965b) and Culberson and Culberson (1980) suggested, that this latter name can be applied to the species with long conidia, but it was listed as synonym of *Parmelia hypoleucites* recognized at that time as having long conidia. Here we follow the concept of Canêz (2009).

Egan (2003) synonymized *P. semansiana* with *Punctelia graminicola* (B. de Lesd.) Egan, however the latter was treated as distinct species by Canêz (2009) and differs from *P. hypoleucites* in subtle or inconspicuous pseudocypbellae and thallus with smooth or crenate margins (Canêz 2009).

*Punctelia hypoleucites* as characterized by Canêz (2009) is known from Argentina (as *Punctelia semansiana*), Bolivia, Brazil, Mexico (type collection) and U.S.A. (as *P. semansiana*) (Calvelo & Liberatore 2002, Canêz 2009, Culberson & Culberson 1980, Esslinger 2021, Flakus et al. 2011). Flakus et al. (2011, 2013) published two records from Bolivia. Here, we reported it for the first time from Chuquisaca Department.

*Specimens examined.* – **BOLIVIA. CHUQUISACA DEPT. ZUDAÑEZ PROV.:** Cerro Pothulo close to Icla, 19°34'29"S, 64°37'44"W, elev. 4150 m, open high Andean vegetation, 12.vii.2015, on soil, *M. Kukwa 15985* (LPB, UGDA), Área Natural de Manejo Integrado El Palmar, Lomán, Salviatójo, 18°45'51"S, 64°50'09"W, elev. 2836 m, disturbed Boliviano-Tucumano forest, 14.vii.2015, on *Podocarpus* sp., *M. Kukwa 16022* (LPB, UGDA). **BELISARIO BOETO PROV.:** close to Padilla between Nuevo Mundo and Santa Rosa, 18°57'12"S, 64°16'37"W, elev. 1790 m, transition between Boliviano-Tucumano forests and dry interandean vegetation, 16.vii.2015, corticolous, *M. Kukwa 16217 & 16218* (LPB, UGDA).

**\**Punctelia jujensis* Adler**

**FIGURE 2E-F.**

NOTES. – This species is characterized by subtle, abundant and mainly punctiform pseudocyphellae; the lack of soredia and isidia; the presence of few lobules in central part of the thallus; a black, slightly shiny, smooth to papillate lower surface with brown marginal zone; filiform conidia measuring 11–14 µm in length; and the presence of gyrophoric acid and atranorin (Adler 1989, Canêz 2009, Canêz & Marcelli 2010). Previously the species was known from Argentina and Brazil (Adler 1989, Canêz 2009, Canêz & Marcelli 2010). Here we report it as new to Bolivia.

*Specimens examined.* – **BOLIVIA. TARIJA DEPT.** ANICETO ARCE PROV.: Reserva Nacional de Flora y Fauna Tariquía, between la Cumbre and campamento los Alisos, 22°00'41"S, 64°36'02"W, elev. 2560 m, Boliviano-Tucumano forest, 22.vii.2015, corticolous, *M. Kukwa 16526* (LPB, UGDA). **BURNET O'CONNOR PROV.:** close to los Pinos, 21°25'07"S, 64°18'50"W, 2190 m, Boliviano-Tucumano forest, 29.vii.2015, corticolous, *M. Kukwa 16857c* (LPB, UGDA).

**\**Punctelia riograndensis* (Lynge) Krog**

**FIGURE 2G.**

NOTES. – The characteristic features of *Punctelia riograndensis* are frequently rugose to scrobiculate thallus; subtle pseudocyphellae, which are mostly laminal (rarely marginal) with a tendency to be on the tops of the thallus ridges and conspicuous on amphithecial margins; the lack of isidia and soredia; a mostly smooth, black to dark brown lower surface that is brown in the marginal zone; ascospores measuring 21–24 × 13–16 µm; unciform conidia measuring 5–7(–8) µm long and the presence of atranorin, unidentified fatty acids and a trace of gyrophoric acid (Canêz 2009, Canêz & Marcelli 2010). In the Bolivian material gyrophoric acid was found in minor amounts together with a trace of lecanoric acid. The species was reported from Brazil and Africa (Canêz 2009, Canêz & Marcelli 2010, Sérusiaux 1983). The record cited below is the first one from Bolivia.

*Specimens examined.* – **BOLIVIA. CHUQUISACA DEPT.** ZUDAÑEZ PROV.: Área Natural de Manejo Integrado El Palmar, Lomán, Salviatójo, 18°45'51"S, 64°50'09"W, elev. 2836 m, disturbed Boliviano-Tucumano forest, 14.vii.2015, on twigs, *M. Kukwa 16028* (LPB, UGDA).

**\**Punctelia rudecta* (Ach.) Krog**

**FIGURE 2H.**

NOTES. – *Punctelia rudecta* is an isidiate species with an adnate to loosely adnate thallus; conspicuous laminal pseudocyphellae; cylindrical to coralloid and branching isidia with brown apices; tan to brown lower surface and the presence of atranorin and lecanoric acid (Canêz 2009, Egan & Lendemer 2016). This species is widely distributed and has been reported from North America, Africa, Asia (India, Siberia) and South America (Aptroot 2016, Divakar & Upreti 2005, Egan & Lendemer 2016, Esslinger 2021, Swinscow & Krog 1988). In South America it has been reported from Argentina, Brazil, Colombia and Venezuela (Calvelo & Liberatore 2002, Canêz 2009, Marcano et al. 1996, Sipman et al. 2008, Spielmann 2006). Here we report the species as new to Bolivia.

The material from India, Japan and Kenya previously referred to *P. rudecta* was recently distinguished as *P. ruderata* (Vain.) Canêz & Marcelli ex. Alors et al. (Alors et al. 2016). Additional samples from Chile were placed in a sister clade to *P. ruderata* and may represent a cryptic species (Alors et al. 2016). The Bolivian material was referred to *P. rudecta* according to the determination key in Canêz (2009), nevertheless, these specimens and other records from Argentina, Brazil, Colombia and Venezuela reported by Canêz (2009) may belong to an unnamed cryptic species from Chile resolved as separate clade from *P. rudecta* s.str. and *P. ruderata* in Alors et al. (2016). However this needs confirmation by molecular data.

*Specimens examined.* – **BOLIVIA. CHUQUISACA DEPT.** BELISARIO BOETO PROV.: close to Padilla between Nuevo Mundo and Santa Rosa, 18°57'12"S, 64°16'37"W, elev. 1790 m, transition between Boliviano-Tucumano forests and dry interandean vegetation, 16.vii.2015, corticolous, *M. Kukwa 16214* (LPB, UGDA). **TARIJA DEPT.** BURNET O'CONNOR PROV.: old road between Entrerios and Tarija, 21°29'13"S, 64°11'42"W, 1535 m, Boliviano-Tucumano forest, 31.vii.2015, corticolous, *M. Kukwa 16946* (LPB, UGDA). **SANTA CRUZ DEPT.** MANUEL MARÍA CABALLERO PROV.: near Siberia, Monte Empalme, 17°49'43"S, 64°39'58"W, elev. 2545 m, semi-natural Yungas forest, 8.xi.2016, corticolous, *M. Kukwa 18599* (LPB, UGDA).

***Remototrachyna singularis* (Hale) Flakus, Kukwa & Sipman**

NOTES. – The species is characterized by thalli with subirregular lobes, which are lobulate towards the center (especially along the lobe margins); the lack of vegetative propagules and the presence of atranorin and the constipatic acid chemosyndrome (Sipman et al. 2009). It is known from Bolivia, Colombia, Ecuador and Peru (Flakus et al. 2012b, Hale 1975, Sipman et al. 2009). In Bolivia it was reported from a single locality in Cochabamba Department (Flakus et al. 2012b). Here we report it for the first time from La Paz Department.

*Specimens examined.* – **BOLIVIA. LA PAZ DEPT.** FRANZ TAMAYO PROV.: Área Natural de Manejo Integrado Nacional APOLOBAMBA, near Rio Pelechuco, below Pelechuco close to new road to Apolo, 14°46'39"S, 69°00'35"W, elev. 2550 m, lower montane Yungas cloud forest, 16.xi.2014, corticolous, *M. Kukwa 14759a* (LPB, UGDA).

***Remototrachyna sipmaniana* Kukwa & Flakus**

NOTES. – *Remototrachyna sipmaniana* is characterized by large thalli, up to 20 cm wide; subirregular lobes usually with a black rim and abundant, branched marginal cilia; laminal isidia and the presence of atranorin and protocetraric acid in the thallus and additional gyrophoric acid in isidia (Flakus et al. 2012b). So far it has been found only in Carrasco National Park in Bolivia (Flakus et al. 2012b, 2015). This is the third record of the species.

*Specimens examined.* – **BOLIVIA. COCHABAMBA DEPT.** CARRASCO PROV.: Parque Nacional Carrasco, Wayra Mayu close to Monte Punku, 17°32'27"S, 65°16'14"W, elev. 2553 m, lower montane Yungas cloud forest, saxicolous, 28.x.2014, *M. Kukwa 15152* (LPB, UGDA).

***Xanthoparmelia mexicana* (Gyeln.) Hale**

NOTES. – *Xanthoparmelia mexicana* has a yellowish-green thallus; with dense, syncorticate isidia that do not form pustules and are subglobose; a light brown lower surface; pale, simple rhizines and the presence of usnic, salazinic and consalazinic acids (Hale 1990, Nash et al. 1995). This species is known from Argentina, Bolivia, Chile, Dominican Republic, Mexico, Venezuela and the U.S.A (Esslinger 2021, Feurerer et al. 1998, Hale 1990, Nash et al. 1995). In Bolivia it was reported only by Feurerer et al. (1998) from a single locality in La Paz Department. Here we report it for the first time from Tarija Department.

*Specimens examined.* – **BOLIVIA. TARIJA DEPT.** MÉNDEZ PROV.: Cuesta de Sama, near Las Antenas, 21°28'39"S, 64°55'31"W, elev. 4025 m, open high Andean vegetation, 21.vii.2015, saxicolous, *M. Kukwa 16501* (LPB, UGDA).

***Xanthoparmelia microspora* (Müll. Arg.) Hale**

NOTES. – *Xanthoparmelia microspora* differs from other species in the genus by the presence of orbicular to irregular soralia; a lower surface that is brown along the margin and black in the center; black, unbranched rhizines and the production of usnic, salazinic and consalazinic acids (Hale 1990, Nash et al. 1995). This species is known from Argentina, Bolivia, Chile, Columbia, Ecuador, Peru, Venezuela and Gough Island (Hale 1990, Nash et al. 1995, Flakus et al. 2013). It was previously reported several times from Bolivia (Hale 1990, Nash et al. 1995, Flakus et al. 2013). Here we report it for the first time Tarija Department.

*Specimens examined.* – **BOLIVIA. TARIJA DEPT.** MÉNDEZ PROV.: Cuesta de Sama, near Las Antenas, 21°28'42"S, 64°55'28"W, elev. 4020 m, open high Andean vegetation, 21.vii.2015, saxicolous, *M. Kukwa 16493* (LPB, UGDA); Cuesta de Sama, near Las Antenas, 21°29'03"S, 64°53'35"W, elev. 3622 m, open high Andean vegetation, 2.viii.2015, saxicolous, *M. Kukwa 16877a* (LPB, UGDA).

***Xanthoparmelia substenophylloides* Hale**

NOTES. – This species is characterized by cylindrical, shiny, simple or sparsely branched, brownish isidia with syncorticate apices; sublinear, elongate and dichotomously branched lobes, which become marginally lacinate with age; a lower surface that is dark brown at the margins and black in the center and the presence of usnic, stictic (major) and norstictic (minor) acids (Hale 1990, Nash et al. 1995). It has previously been reported from Argentina, Bolivia, Brazil, Colombia, Panama Peru, Paraguay, Uruguay, Venezuela, the U.S.A and South Africa (Esslinger 2021, Flakus et al. 2016, Hale 1990, Nash et al. 1995, Sipman et al. 2008). Here we report the second record of the species from Bolivia, where it was previously reported from La Paz Department (Flakus et al. 2016). This is the first report from the Tarija Department.

*Specimens examined.* – **BOLIVIA. TARIJA DEPT.** ANICETO ARCE PROV.: Reserva Nacional de Flora y Fauna Tariquía, close to la Cumbre de Tariquía, road between Padcaya and Cerro Tariquía, 21°59'21"S, 64°36'42"W, elev. 3114 m, open area with shrubs and rocks, 25.vii.2015, saxicolous, *M. Kukwa 16674* (LPB, UGDA).

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