

NEW RECORDS OF *LECANORA* FOR BOLIVIA. II

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Abstract. Members of the lichen genus *Lecanora* Ach. are important but still poorly known components of almost all vegetation types in Bolivia. In this paper, seven species new for Bolivia are presented: *Lecanora bicincta* Ramond, *L. fulvastra* Kremp., *L. hagenii* (Ach.) Ach., *L. muralis* (Schreb.) Rabenh., *L. percrenata* H. Magn., *L. stramineoalbida* Vain. and *L. strobilina* (Spreng.) Kieff. Their distributions are described and information on their diagnostic characters and chemistry is given.

Key words: biodiversity, lichenized *Ascomycota*, *Lecanoraceae*, secondary metabolites, Neotropics, South America

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INTRODUCTION

A recent advanced lichenological survey in Bolivia revealed the remarkable diversity of its lichens and lichenicolous fungi, which includes a large number of newly described species (Flakus & Kukwa 2007, 2012; Flakus 2009; Flakus *et al.* 2011a, 2012a; Knudsen *et al.* 2012; Kukwa *et al.* 2012a, 2013; Etayo *et al.* 2013a, b; Lücking *et al.* 2013) as well as hundreds of new national records, many of which are also new for South America (Flakus & Wilk 2006; Flakus *et al.* 2008, 2011b, 2012b, 2013; Krzewicka & Flakus 2010; Wilk 2010; Kukwa *et al.* 2012b; Śliwa *et al.* 2012a; Flakus 2013). Nevertheless, various taxonomic groups in this region are far from being fully described. Lecanoroid lichens, especially the largest genus *Lecanora* Ach., are the best example of this, with only 20 species recorded from the country (Rodriguez Flakus *et al.* 2014), in contrast with the more than 100 *Lecanora* species known from the Greater Sonoran Desert Region in North America (Ryan *et al.* 2004) or the 63 representatives of the *Lecanora subfusca* group exclusively reported from South and Central America (Guderley 1999).

The rich collection of *Lecanora* we collected from diverse biogeographic regions of Bolivia over the past decade is a source of many new discoveries, some of which have been published (Śliwa *et al.* 2012a). Here we present the second in a series of new national records for species of the genus representing several informal groups circumscribed according to morphological, anatomical and chemical characters: the *L. dispersa* group, *L. rupicola* group, *L. subfusca* group and *L. varia* group. One species of subgenus *Placodium* is also included.

MATERIAL AND METHODS

Morphology and anatomy were studied by standard techniques, with preparations mounted in water or ca 25% solution of potassium hydroxide (K). Tissues were measured in water, ascospores in K, and granulations were observed in polarized light (pol). The solubility of granules and/or crystals was tested with K and 65% nitric acid (N). Lichen substances were studied by thin-layer chromatography (TLC) using the methods of Culberson and Kristinsson (1970) and Orange *et al.* (2001); note: the presence of chloroatranorin was not tested in this study.

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Voucher specimens are deposited in KRAM and LPB.

Abbreviations: APOLOBAMBA – Área Natural de Manejo Integrado Nacional Apolobamba; CARRASCO – Parque Nacional Carrasco; COTAPATA – Parque Nacional y Área Natural de Manejo Integrado Cotapata; SAJAMA – Parque Nacional Sajama (abbreviations of protected areas according to SERNAP Bolivia; <http://www.sernap.gob.bo>).

THE SPECIES

Lecanora bicincta Ramond

Mém. Mus. Hist. Nat. 13: 248. 1825.

This species is a member of the *Lecanora rupicola* group, which Leuckert and Poelt (1989) studied in detail. Its phylogenetic position was clarified by Grube *et al.* (2004) and Blaha and Grube (2007). *Lecanora bicincta* is easily distinguished from other saxicolous species with pruinose apothecial discs by its apically pigmented parathecium. The dark ring that lines the outer edge of the hymenium may also occur in *L. bicinctoidea* Blaha & Grube, but the latter species differs in having a thallus composed of comparatively small areoles, broadly sessile apothecia, and the development of a eucortex. Moreover, *L. bicinctoidea* contains an additional lichen compound – methyl 3 α -hydroxy-4-O-demethylbarbatate (Blaha & Grube 2007). A similar species reported from Bolivia (Nylander 1861; Flakus *et al.* 2013) is *L. farinacea* Fée, but it lacks pigmentation of the parathecium and is also easily distinguished by the C– reaction of the thallus due to the absence of sordidone.

Lecanora bicincta is widespread but rare, occurring in Africa, Asia, Australasia, Europe, North America, and South America (Ryan *et al.* 2004) where it was recorded in Argentina (Calvelo & Liberatore 2002). In Bolivia it was found in high mountain open vegetation.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Bautista Saavedra, APOLOBAMBA, near Villa Amarca village, 15°16'47"S, 69°01'47"W, 4643 m, 3 July 2010, Flakus 17364 & Rodriguez (KRAM), 17397 (KRAM, LPB); Prov. Franz Tamayo, cerca del campamento de guardaparques del APOLOBAMBA,

cerro Puntani, 15°01'50"S, 69°11'09"W, 4770 m, 23 April 2008, Rodriguez 545, 550 (LPB).

Lecanora fulvastra Kremp.

Fig. 1

Vidensk. Meddel. Naturhist. Foren. Kjøbenhavn 5: 17. 1874.

The species is a distinctive representative of the *Lecanora subfusca* group, having yellowish pruinose apothecial discs. By the presence of yellow pruina, which is rare in the genus *Lecanora*, the species resembles usnic acid-containing *L. cupresii* Tuck. The two species differ in apothecial anatomy, with a *pulicaris*-type amphithecium in *L. fulvastra* and the absence of large crystals in the amphithecium of *L. cupresii*. In *L. fulvastra* the yellowness of the pruina is caused by the presence of calycin; it also contains atranorin, chloro-atranorin and zeorin. Calycin was not detected by TLC in the Bolivian specimen, possibly due to the small amount of material used for analysis, since the collection bore only a few apothecia.

According to Lumbsch (1994), *L. fulvastra* is an undercollected Pantropical species. To date it has been reported only from China (Lumbsch 1994) and Central and South America: Argentina, Brazil, Columbia, the Dominican Republic and Ecuador (Guderley 1999). In Bolivia it was found in the Tucumano-Boliviano forest.

SPECIMEN EXAMINED. BOLIVIA. DEPT. TARIJA. Prov. Aniceto Arce, near park guards' station, 2 hours' drive

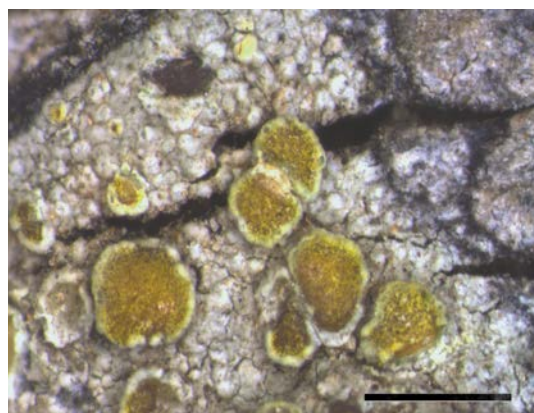


Fig. 1. *Lecanora fulvastra* Kremp. (Flakus 18352, LPB). Scale bar = 1 mm.

by car from Tarija, 22°14'56"S, 64°32'55"W, 883 m, 21 Nov. 2010, *Flakus 18352* (LPB).

***Lecanora hagenii* (Ach.) Ach.**

Lichenogr. Universalis: 367. 1810.

This member of the *Lecanora dispersa* group seems well circumscribed on the basis of the following phenotypic characters: small apothecia with brown, usually pruinose discs; thin, white, entire to incised margins; epihymenium indistinctly granular (pol±, insoluble in K, soluble in N); and the lack of any lichen substances (Śliwa 2007). A similar species previously reported from the country is *L. flowersiana* H. Magn. (Śliwa et al. 2012a), which differs from *L. hagenii* in having larger, epruinose apothecia, paraphyses strongly expanded apically and coherent in K, and longer ascospores. Detailed characteristics of *L. hagenii* and its affinities were given by Śliwa (2007) and De la Rosa et al. (2012). Despite the current circumscription of *L. hagenii* by Śliwa (2007), proper delimitation of the taxon is still problematic and requires resolution, as members of this morphospecies appear to be distributed across the first phylogeny of the *L. dispersa* group (Śliwa et al. 2012b).

The species is widespread in Europe and North America; it is also known from Asia (Śliwa 2007). In South America it was previously reported from Argentina (De la Rosa 2012). It is also on the lichen checklist of Chile (http://www.biologie.uni-hamburg.de/checklists/lichens-pro/south-america/chile_1.htm). In Bolivia it occurs both in lowland Amazon forest and in high Andean open vegetation.

SPECIMENS EXAMINED. BOLIVIA. DEPT. BENI. PROV. José Ballivián, Laguna colony, 14°15'46"S, 67°28'24"W, 190 m, 2 Dec. 2004, *Flakus 4908* (LPB). DEPT. COCHABAMBA. PROV. Quillacollo, East Cordillera, area of Inkaraya-Sipesipe, dry inter-Andean valleys, 17°29'25"S, 66°22'09"W, 3146 m, 17 Dec. 2004, *Wilk 3225* (KRAM, LPB), *3284* (KRAM). DEPT. LA PAZ. PROV. Murillo, near Cumbre pass, 16°21'59"S, 68°02'37"W, 4604 m, 13 May 2006, *Flakus 5810* (KRAM).

***Lecanora muralis* (Schreb.) Rabenh.**

Deutschl. Krypt.-Fl. 2: 42. 1845.

It is the commonest and most widely distrib-

uted member of the subgenus *Placodium*, reported from Africa, Asia, Australasia, Europe, Macaronesia, North and South America and Oceania (Ryan et al. 2004). In South America *L. muralis* occurs in Argentina (Calvelo & Liberatore 2002), Chile (Pereira & San Martín 1998) and Peru (Pavlich et al. 2005). *Lecanora muralis* differs from the other placodioid *Lecanora* known from Bolivia, *L. garovaglioii* (Körb.) Zahlbr., in having a much thinner, flattened thallus and lobes that are not sinuous-plicate. *Lecanora muralis* also lacks placodiolic acid, which was detected in addition to usnic acid and zeorin in all Bolivian samples of *L. garovaglioii*. For the full characteristics of the species refer to Ryan and Nash (1993), Ryan et al. (2004) and Edwards et al. (2009).

This saxicolous species was found in Bolivia in high Andean open vegetation (up to 4437 m) and in the Yungas forest.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. PROV. Bautista Saavedra, APOLOBAMBA, near Taypi Cañuma village, 15°03'20"S, 69°09'07"W, 4506 m, 5 July 2010, *Flakus 17530 & Rodriguez* (LPB); PROV. Franz Tamayo, cerca de la comunidad de Ulla Ulla, en el cerro Socondori Grande, 15°02'43"S, 69°11'30"W, 4600 m, 3 Dec. 2007, *Rodriguez 206* (LPB); PROV. Nor Yungas, COTAPATA, near Urpuma colony, 16°13'20"S, 67°52'34"W, 1989 m, 30 June 2010, *Flakus 17320 & Rodriguez* (KRAM, LPB). DEPT. ORURO. PROV. Sajama, SAJAMA, near Sajama village, 18°07'49"S, 68°56'54"W, 4437 m, 18 June 2010, *Flakus 16469 & Rodriguez* (KRAM), *16513* (KRAM, LPB). DEPT. POTOSÍ. PROV. Daniel Campos, by Puerto Chuvica village near Salar Uyuni, 20°36'06"S, 67°35'50"W, 3670 m, 4 Dec. 2009, *Flakus 14691 & Rodriguez* (KRAM); PROV. Nor Lipez, Pinturas Rupestres near Mallku Villamar village, 21°46'20"S, 67°29'05"W, 4038 m, 6 Dec. 2009, *Flakus 14778, 14781 & Rodriguez* (KRAM, LPB).

***Lecanora percrenata* H. Magn.**

Lichens from Central Asia I, in S. Hedin (ed.), Reports Scientific Exped. North-west. Provinces of China (the Sino-Swedish expedition). 13, XI. Botany, 1. Aktiebolaget, Thule & Stockholm: 88. 1940.

The species is well distinguished by its white, distinctly cracked apothecial margin and dark disc, paraphyses with distinctly enlarged end cells that are coherent in K, and narrowly ellipsoid

ascospores. These characters make *L. percrenata* superficially resemble *L. flowersiana* but it differs from the latter by having a very dark to black apothecial disc, a brown, olive or bluish-green (not reddish) epihymenium, and usually a more prominent thallus. *Lecanora percrenata* also resembles the saxicolous form of *L. hagenii* but the latter differs in having a brownish and often pruinose apothecial disc, paraphyses that are only slightly capitate at the tips and usually free in K, and considerably shorter spores. Śliwa (2007) characterized the species in detail.

Muchnik and Śliwa (2011) gave the known world distribution of *L. percrenata*, including Asia (Afghanistan, China, Iran, Kazakhstan, Kyrgyzstan, Tajikistan), Europe (western Russia) and central and western parts of North America. The Bolivian record below extends its geographic range to South America. In Bolivia it was found in high Andean open vegetation above 4500 m a.s.l.

This is the first record of the species for South America.

SPECIMEN EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Bautista Saavedra, km 162 on the road from Apolo to Charazani villages, la Cruz Charazani-Pelechuco, 15°15'00"S, 69°02'51"W, 4545 m, 19 May 2011, *Flakus 21169 & Plata* (KRAM, LPB).

***Lecanora stramineoalbida* Vain.** Figs 2 & 3
J. Bot. 34: 35. 1896.

Previously this characteristic *Lecanora* with a dark reddish-brown hypothecium was rarely reported. Morphologically the species is distinguished by its large apothecia up to 1.3 mm in diameter with yellowish to orange-brown discs (that may also become dark grey) and a prominent, entire, flexuose to verrucose margin. The major lichen substances detected by TLC are atranorin and 2'-*O*-methylperlatolic acid. As reported by Lumbsch *et al.* (1996), minor substances produced by the species are chloroatranorin and 2'-*O*-methylstenosporic acid. In this work we detected, for the first time in this lichen traces of usnic acid in addition to atranorin and 2'-*O*-methylperlatolic acid in the majority of the Bolivian collections. Due to the pale color of its

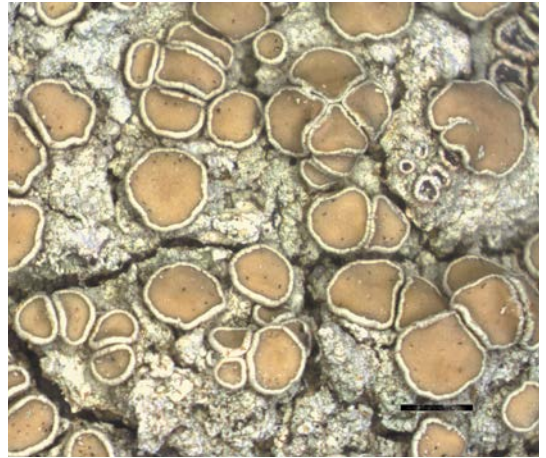


Fig. 2. *Lecanora stramineoalbida* Vain. (*Flakus 23034*, KRAM). Scale bar = 1 mm.

apothecial discs and its chemistry, *L. stramineoalbida* may be confused with *L. helva* Stizenb, but the latter differs in having a hyaline hypothecium. Lumbsch *et al.* (1996) gave detailed characteristics of the species.

Lecanora stramineoalbida was previously recorded from two localities on the Antilles in Central America, Saint Vincent (*locus classicus*) and Guadeloupe (Lumbsch *et al.* 1996), and from Georgia (Sapelo Island) in North America (Lendamer & Knudsen 2011) and Western China (Lv 2012). In Bolivia it appears to be scattered across a few departments and several provinces (Fig. 1), occurring in sub-Andean Amazon forest, the Yungas cloud forest and Tucumano-Boliviano forest as well as in savannah, at elevations between 400 and 2544 m a.s.l.; although known to be corticolous it was also noted on lignum and once on a rocky substrate.

This is the first record of the species for South America.

SPECIMENS EXAMINED. BOLIVIA. DEPT. BENI. Prov. José Ballivián, Yucumo village, 15°12'13"S, 67°01'50"W, 400 m, 2 Aug. 2008, *Flakus 11743 & Kukwa* (KRAM, LPB), 11744 (LPB). DEPT. COCHABAMBA. Prov. Carrasco, CARRASCO, near Sehuencas village, 17°30'12"S, 65°16'30"W, 2220 m, 21 July 2008, *Flakus 10426 & Kukwa, Rodriguez* (LPB); Prov. Chapare, CARRASCO, near Incachaca village,

17°14'13"S, 65°49'02"W, 2294 m, 10 June 2006, *Flakus 8143* (LPB), *Flakus 8150,1* & *8157* (KRAM). DEPT. LA PAZ. Prov. Abel Iturralde, near Tumupasa village, 14°08'51"S, 67°53'34"W, 500 m, 31 July 2008, *Flakus 11722* & *Kukwa* (KRAM, LPB), *11731* (KRAM); Prov. Franz Tamayo, between Apolo and Mapiri villages, 14°41'50"S, 68°25'07"W, 1490 m, 22 Nov. 2011, *Flakus 22990* (LPB); between Apolo and Mapiri villages, 13 km from Apolo, 14°50'51"S, 68°21'38"W, 1530 m, 23 Nov. 2011, *Flakus 23034*, *23035.1*, *23061* (KRAM, LPB); Prov. Muñecas, above Camata, NE slope, 15°15'06"S, 68°46'14"W, 2544 m, 15 May 2006, *Wilk 4370b* (KRAM); Prov. Nor Yungas, near Pacallo village, 16°12'10"S, 67°50'39"W, 1360 m, 3 Aug. 2008, *Flakus 11752* & *Kukwa* (KRAM, LPB); Coroico village, 16°11'10"S, 67°43'16"W, 1550 m, 6 June 2010, *Flakus 16394*, *16397*, *16408* & *Rodriguez* (KRAM), *16418*, *16427*, *16444* (LPB); COTAPATA, near Urpuma colony, 16°13'20"S, 67°52'34"W, 1989 m, 30 June 2010, *Flakus 17156* & *Rodriguez* (KRAM), *17303* (LPB). DEPT. TARIJA. Prov. Aniceto Arce, Serranía de Propiedad Arnold, 22°13'19"S, 64°33'41"W, 1309 m, 24 Nov. 2010, *Flakus 18763* (LPB); Prov. Burnet O'Connor, Lomas de la Soledad, road between Entre Ríos and Chiquiaca, 21°39'38"S, 64°07'31"W, 1670 m, 10 Aug. 2012, *Flakus 24174* (LPB); Papachacra, 21°41'36"S, 64°29'33"W, 2195 m, 26 Nov. 2010, *Flakus 19939* & *Quisbert* (KRAM).



Fig. 3. American distribution of *Lecanora stramineoalbida* Vain.

Lecanora strobilina (Spreng.) Kieff.

Bull. Soc. Hist. Nat. Metz **19**: 74. 1895.

This member of the *Lecanora varia* group is characterized by numerous small apothecia (up to 0.8 mm in diam.) with a yellowish, plane to convex disc and a thin, ecorticate thalline margin concolorous with the thallus. The presence of terpenoid crystals on the thallus and thalline margin in older specimens is also characteristic. The species is closely related to *L. confusa* Almb., *L. perconfusa* Printzen and *L. substrobilina* Printzen, from which it differs by the lack of xanthonenes; often these may also be absent in *L. perconfusa* but that species has considerably larger apothecia (up to 0.9–1.3 mm in diam.; Printzen 2001). Surprisingly, no decarboxysquamatic acid was detected in the Bolivian material of *L. strobilina*, although it was reported by Printzen (2001) as a characteristic constituent of it. *Lecanora strobilina* is also considered to be similar to *L. symmicta* (see LaGreca & Lumbsch 2013); detailed descriptions of these species are also presented in Śliwa and Wetmore (2000) and Printzen (2001).

Lecanora strobilina is widely distributed in North America and also occurs in some parts of Europe and North Africa where it is rare (Printzen 2001). Pereira and San Martín (1998) reported it from South America (Chile). In Bolivia it was found in savannah and in the Tucumano-Boliviano forest at elevations above 1000–2000 m a.s.l.

SPECIMENS EXAMINED. BOLIVIA. DEPT. LA PAZ. Prov. Franz Tamayo, between Apolo and Mapiri villages, 14°41'50"S, 68°25'07"W, 1490 m, 22 Nov. 2011, *Flakus 22953,1* (LPB), *22986* (KRAM, LPB). DEPT. TARIJA. Prov. Aniceto Arce, Papachacra, 21°41'36"S, 64°29'33"W, 2195 m, 26 Nov. 2010, *Flakus 19773* & *Quisbert* (LPB), *19855* (KRAM).

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