ISSN (print) 0093-4666  ISSN (online) 2154-8889

MYCOTAXON

http://dx.doi.org/10.5248/121.385

*Volume 121, pp. 385–392* *July–September 2012*

# New records of *Lecanora* for Bolivia

Lucyna Śliwa[1], Karina Wilk[1],
Pamela Rodriguez Flakus[2,3] & Adam Flakus[1]

[1]*Laboratory of Lichenology, W. Szafer Institute of Botany, Polish Academy of Sciences, Lubicz 46, PL–31–512 Kraków, Poland*
[2]*Department of Botany and Molecular Evolution, Senckenberg Forschungsinstitut und Naturmuseum, Senckenberganlage 25, D-60325 Frankfurt am Main, Germany*
[3]*Herbario Nacional de Bolivia, Instituto de Ecología, Universidad Mayor de San Andrés, Calle 27, Cota Cota, Casilla 10077, La Paz, Bolivia*
Correspondence to: *l.sliwa@botany.pl, a.flakus@botany.pl*

Abstract — *Lecanora cavicola*, *L. laxa*, *L. stenotropa,* and *L. subaurea* are reported as new to South America, and *L. flowersiana* and *L. semipallida* as new to Bolivia. Distributions of the species are discussed and information on their chemistry and diagnostic characters are provided.

Key words — lecanoroid lichens, *Lecanoraceae*, secondary metabolites, Neotropics

## Introduction

Although Bolivia is thought to have one of the largest biodiversities worldwide (Ibisch & Mérida 2004), knowledge of its lecanoroid lichens is still underexplored (Nylander 1861, Ryan & Nash 1993, Feuerer et al. 1998, Lumbsch et al. 1996, Guderley 1999, Messuti & Vobis 2003, Feuerer & Sipman 2005, Quilhot et al. 2007). Several of its natural ecosystems are undoubtedly rich in lichen diversity (Flakus & Kukwa 2007, Flakus et al. 2008, 2011, 2012), but these may soon become endangered as in neighbouring countries. Therefore, studies aimed at establishing an inventory of this diversity are fundamental to lichen knowledge and conservation in this part of South America (Flakus 2010).

Only 14 *Lecanora* species were recorded from Bolivia (Rodriguez Flakus et al. 2012), as compared with, for example, 124 known from the comprehensively investigated Greater Sonoran Desert Region in North America (Ryan et al. 2004). The present survey, focused on *Lecanora* and based on part of material collected from various biogeographic regions of Bolivia, has revealed 6 species new to Bolivia, of which 4 are newly reported from South America.

## Material & methods

Morphology was studied using standard techniques, with preparations mounted in water or a c. 25% solution of potassium hydroxide (K). Tissue measurements were made in water, and ascospores in K. Granulations were observed in polarized light (pol). The solubility of granules or/and crystals was tested with K and 65% nitric acid (N). Lichen substances were studied by thin-layer chromatography (TLC) using the methods of Culberson & Kristinsson (1970) and Orange et al. (2001). Spot-test reactions with C, K and P were applied to determine the location of secondary metabolites in some specimens.

Voucher specimens are available at KRAM, LPB and herb. Flakus.

Abbreviations used: ANMIN Apolobamba – Área Natural de Manejo Integrado Nacional Apolobamba.

## The species

***Lecanora cavicola*** Creveld, Biblioth. Lichenol. 17: 273. 1981.

The species was studied in detail by Poelt & Leuckert (1984) who also provided the first records of fertile individuals of *L. cavicola* from Central Europe. The authors discussed the taxonomic position of this species and concluded it holds an isolated position within the genus. They also chemically proved that the species only produces atranorin and alectorialic acid, although in the original description by Creveld (1981) the species was presented as also containing thamnolic acid (see also Ryan et al. 2004). Flakus (2007) noted the lack of this substance in *L. cavicola* in a west Carpathian population. No thamnolic acid was found in Bolivian material, but traces of the protocetraric complex in addition to atranorin and alectorialic acid (with related compounds) were detected. A revision of the secondary metabolites content based on worldwide sampling is necessary to evaluate the true chemical variation in *L. cavicola*. Detailed descriptions are presented in Poelt & Leuckert (1984) and Ryan et al. (2004).

*Lecanora cavicola* is widespread but rare in Europe (Creveld 1981, Poelt & Leuckert 1984, Nimis & Martellos 2003, Santesson et al. 2004, Flakus 2007, Edwards et al. 2009); it has also been reported from Asia (central Siberia; Zhurbenko 1996), North America (Nash et al. 1998, Ryan et al. 2004), Greenland (Alstrup et al. 2000), and New Zealand (Galloway 2007). It occurs on hard siliceous rocks in alpine areas. In Bolivia it was found in moist Puna and subnival Andean vegetation. New to South America.

Specimens examined — **BOLIVIA. Dept. La Paz.** Prov. Bautista Saavedra, ANMIN Apolobamba, near Villa Amarca village, 4643 m, 15°16′47″S 69°01′47″W, 2010, Flakus 17347 & Rodriguez (KRAM, LPB); Prov. Franz Tamayo, ANMIN Apolobamba, near Puyo Puyo village, 4888 m, 15°56′55″S 69°07′58″W, 2010, Flakus 17563 & Rodriguez (KRAM, LPB); Pelechuco municipality, Cañuhuma village, near Puntani mountain, 4760 m, 15°01′51″S 69°11′98″W, 2008, Rodriguez 526, 532/2, 541, 549 (LPB); Prov. Murillo, below Potosi near campamento de mineros, on the road La Paz – Valle del

Zongo, 4716 m, 16°17′43″S 68°07′42″W, 2011, Flakus 21851 & Plata (KRAM, LPB); Paso Cumbre near La Paz city, 4405 m, 16°19′6″S 68°02′09″W, 2011, Flakus 22130 & Plata (KRAM, LPB).

***Lecanora flowersiana*** H. Magn., Acta Horti Gothob. 19(2): 38. 1952.

The species, a member of the *L. dispersa* group, is characterized by its sessile apothecia with brown disc and thin, white crenate thalline margin. Anatomically it is distinguished by paraphyses that are simple, thick, agglutinated (coherent in K), and apparently submoniliform and expanded up to 4–5 µm in the uppermost part. The epihymenium (up to 1/3 of the upper hymenium) is deeply pigmented brown or reddish. *Lecanora flowersiana* produces no secondary metabolites. Detailed characteristics are presented in Śliwa (2007a) and de la Rosa et al. (2012).

The monograph of the *L. dispersa* complex in North America (Śliwa 2007a) considers *L. flowersiana* to be a western temperate element confined the central and western regions of the continent. However, later it was recorded in the Canary Islands (van den Boom 2010) and Iran (Valadbeigi & Sipman 2010). De la Rosa et al. (2012) reported *L. flowersiana* for the first time from South America (Argentina), and we now report it from Bolivia. It was found in the semi-desert Inter-Andean Valley in a sunny location on a shrubby rocky slope.

Specimen examined — **BOLIVIA. Dept. Cochabamba**. Prov. Quillacollo, East Cordillera, area of Inkarraya-Sipesipe, dry Inter-Andean Valleys, 3146 m, 17°29′25″S 66°22′09″W, 2004, Wilk 3218 (KRAM, LPB).

***Lecanora laxa*** (Śliwa & Wetmore) Printzen, Bryologist 104: 395. 2001.

The species is characterized by large flexuose and basally constricted apothecia, whitish pruinose discs, broadly ellipsoid ascospores, and production of usnic acid, ± isousnic acid and ± 1–5 terpenoids (incl. zeorin). Detailed descriptions are presented in Śliwa & Wetmore (2000) and Printzen (2001).

*Lecanora laxa* is most similar to *L. subviridis* de la Rosa & Messuti, recently described from Argentina (de la Rosa et al. 2010). The authors distinguish *L. subviridis* mainly by somewhat smaller apothecia and ascospores, but the characters seem to overlap in both taxa.

When *L. laxa* was described, it was known only from the western part of North America (Śliwa & Wetmore 2000, Printzen 2001), but Martínez & Aragón (2004) reported it from Europe (Spain), and we have now found it in Bolivia. The Bolivian voucher specimen was collected from twigs of a single exposed roadside tree on a S-facing slope covered with montane Yungas forest. New to South America.

Specimen examined — **BOLIVIA. Dept. La Paz.** Prov. Bautista Saavedra, San Juan Piquendo between villages Chullina and Mataro, 3298 m, 15°10′19″S 68°55′05″W, 2006, Wilk 4266 (LPB).

Additional specimen examined — **U.S.A. Wyoming.** Big Horn Co., Near Dayton on U.S. 14 in foothills of Big Horn Mts, on *Pinus ponderosa* on steep S facing hill with scattered pines and juniper, elev. 5300 ft. (1615 m), 1 Aug. 1965, Wetmore 12911 (KRAM; isotype of *L. laxa*).

***Lecanora semipallida*** H. Magn., Lichens from Central Asia 1: 89. 1940.

This distinctive member of the *L. dispersa* group seems to be well circumscribed based on the following phenotypic evidence: sessile apothecia with yellow, yellow-orange to pale brown epruinose to moderately pruinose apothecial discs and thick white entire or crenate margins, epihymenial granules that are soluble in K, and the presence of vinetorin (5-chloro-3-O-methylnorlichexanthone) (Śliwa 2007a,b). Detailed characteristics are presented in Śliwa (2007a) and de la Rosa et al. (2012).

*Lecanora semipallida* was shown to be a monophyletic species, but this is only partly supported on the basis of phylogenetic inferences from the ITS region (Śliwa et al. 2012). Part of the South American material reminiscent of *L. semipallida* showing some morphological, chemical, and genetic differences is not included here and will be treated elsewhere.

The species is new to Bolivia but has been noted previously in South America in Argentina (de la Rosa 2012) and Peru (Śliwa et al. 2012). The species is frequent worldwide. It is known from North America, Europe, Asia, Australia, and New Zealand (Śliwa 2007b, 2009a,b, and literature cited therein; Valadbeigi & Sipman 2010). *Lecanora semipallida* occupies predominately calcareous rocks but also occurs on concrete or overgrowing other lichens; it is occasionally corticolous. In Bolivia it was collected on rocks in Puna and subnival Andean vegetation.

Specimens examined — **BOLIVIA. Dept. La Paz.** Prov. Bautista Saavedra, ANMIN Apolobamba, near Taypi Cañuma village, 4506 m, 15°03′20″S 69°09′07″W, 2010, Flakus 17533 & Rodriguez (KRAM, LPB); Prov. Franz Tamayo, ANMIN Apolobamba, near Puyo Puyo village, 4795 m, 15°56′55″S 69°07′58″W, 2010, Flakus 17688 & Rodriguez (KRAM, LPB); Prov. Murillo, near Cumbre pass, 4604 m, 16°21′59″S 68°02′37″W, 2006, Flakus 5811 (KRAM, LPB). **PERU. Dept. Arequipa.** Prov. Caylloma, Valle del Colca valley, near Soccoro village, 3349 m, 15°38′32″S 71°43′22″W, 2006, Flakus 9423 & Cykowska (KRAM).

***Lecanora stenotropa*** Nyl., Flora 55: 251. 1872.

The species can be separated from the superficially similar *L. polytropa* (Ehrh.) Rabenh. by the ascospore shape, which is narrowly ellipsoid in *L. stenotropa* (8–14 × 2.5–4.5 µm; in Bolivian material 9–14 × 3–4 µm) and broadly ellipsoid in *L. polytropa* (10–14 × 5–7 µm) (Edwards et al. 2009, see also Śliwa & Flakus 2011). Both species usually produce fatty acids in addition to usnic acid and zeorin; however, *L. polytropa* contains rangiformic acid, contrasting with isorangiformic acid in *L. stenotropa* (Huneck 1982, Ryan et al. 2004, Edwards

et al. 2009). It should be noted that no fatty acids were detected in the Bolivian *L. stenotropa* population. Detailed descriptions are presented in Ryan et al. (2004) and Edwards et al. (2009).

The species is known from Europe (e.g. Crespo et al. 2003, Nimis & Martellos 2003, Santesson et al. 2004, Flakus 2007, Edwards et al. 2009), North America (LaGreca & Lumbsch 2001), and New Zealand (Galloway 2007). It is probably much more widespread but overlooked due to its morphological similarity to *L. polytropa.* The two species also share the same substrate preference (hard siliceous rocks); however, *L. stenotropa* has to date been recorded only from alpine habitats. In Bolivia the species was found in high Andean open vegetation and in an open area near Yungas montane cloud forest. New to South America.

Specimens examined — **BOLIVIA. Dept. La Paz.** Prov. Bautista Saavedra, ANMIN Apolobamba, near Taypi Cañuma village, 4506 m, 15°03′20″S, 69°09′07″W, 2010, Flakus 17517, 17518 & Rodriguez (KRAM, LPB); San Juan Piquendo between villages Chullina and Mataro, 3298 m, 15°10′19″S 68°55′05″W, 2006, Wilk 4179 (KRAM, LPB); **Dept. Santa Cruz.** Prov. Caballero, East Cordillera, Siberia village, 3480 m, 17°49′38″S 64°45′14″W, 2004, Flakus 4813, 4814 (KRAM, LPB, herb. Flakus); Wilk 3105 (KRAM, LPB); Prov. Franz Tamayo, ANMIN Apolobamba, Pelechuco municipality, near Socondori mountain, 4600 m, 15°05′20″S 68°13′9″W, 2007, Rodriguez 238, 245, 250 (LPB); Cañuhuma village, near Puntani mountain, 4760 m, 15°01′51″S 69°11′98″W, 2008, Rodriguez 518, 587 (LPB).

***Lecanora subaurea*** Zahlbr., Cat. Lich. Univers. 5: 547. 1928.

Having yellow-green areolate sorediate usually sterile thalli, *L. subaurea* resembles *L. epanora* (Ach.) Ach. Although superficially similar, the two species differ in morphology, anatomy, chemistry, and habitats (Earland-Bennett 1975). Most frequently they can be distinguished by the soralia, which are mainly marginal in *L. subaurea* and laminal in *L. epanora*. Chemical constituents are also used to determine the species, since *L. subaurea* contains pannarin, rhizocarpic acid, and zeorin (Earland-Bennett 1975, Obermayer 2009), whereas *L. epanora* produces epanorin, rhizocarpic, and zeorin (Earland-Bennett 1975). However, chemical study of the Bolivian *L. subaurea* collection showed the presence of the following secondary metabolites: pannarin, rhizocarpic acid, and traces of epanorin and zeorin. Therefore, only a high concentration of epanorin can be considered as reliable for distinguishing *L. epanora,* although the presence/absence of pannarin remains diagnostic for the two species. The detailed description is presented by Edwards et al. (2009).

In Europe *L. subaurea* is commonly found on rocks rich in heavy metals, especially iron, such as in the mining regions of central Europe, from where it was originally described (Earland-Bennett 1975). It has also been reported as growing on an old leather shoe (Tønsberg 1987). It favours sunny situations. A broad account of the species distribution and ecology is provided by Follmann

(1985). Besides Europe, the species is known from North America (Esslinger & Egan 1995) and Asia (Urbanavichus & Andreev 2010). In Bolivia the species was found in high Andean Puna vegetation. New to South America.

Specimen examined — **BOLIVIA. Dept. La Paz.** Prov. Murillo, near Cumbre pass, 4672 m, 16°20′14″S, 68°02′20″W, 2006, Flakus 5743 (KRAM, LPB).

**Acknowledgments**

We are very grateful to Prof. Mark R.D. Seaward (Bradford) and Dr. Martin Kukwa (Gdańsk) for reviewing the manuscript and providing important suggestions and improvements. Rosa I. Meneses Q. (La Paz), the Director of Herbario Nacional de Bolivia, Universidad Mayor de San Andrés is thanked for her valuable cooperation. This research received support from the National Centre for Research and Development (NCBiR) in Poland under the LIDER Programme for the years 2010–2013 (no. 92/L-1/09), and from the W. Szafer Institute of Botany, Polish Academy of Sciences thorough a statutory fund.

**Literature cited**

Alstrup V, Hansen ES, Daniëls FJA. 2000. Lichenized, lichenicolous and other fungi from North and North East Greenland. Folia Cryptogamica Estonica 37: 1–20.

Crespo A, Barreno E, Sancho LG, Pintado A, Lumbsch HT. 2003. Four species new to Spain. Lazaroa 24: 3–5.

Creveld M. 1981. Epilithic lichen communities in the alpine zone of southern Norway. Bibliotheca Lichenologica 17: 1–288.

Culberson CF, Kristinsson H. 1970. A standardized method for the identification of lichen products. Jour. Chromatogr. 46: 85–93. http://dx.doi.org/10.1016/S0021-9673(00)83967-9

de la Rosa IN, Messuti MI, Lumbsch HT. 2010. *Lecanora subviridis* (*Lecanoraceae*, *Lecanorales*), a new corticolous lichen species from south-western Argentina. Lichenologist 42: 301–306. http://dx.doi.org/10.1017/S0024282909990673

de la Rosa IN, Messuti MI, Śliwa L. 2012. The *Lecanora dispersa* group (*Lecanoraceae*) in Argentina. Lichenologist 44: 101–114. http://dx.doi.org/10.1017/S0024282911000594

Earland-Bennett PM. 1975. *Lecanora subaurea* Zahlbr., new to the British Isles. Lichenologist 7: 162–167. http://dx.doi.org/10.1017/S0024282975000229

Edwards B, Aptroot A, Hawksworth DL, James PW. 2009. *Lecanora* Ach. in Luyken (1809). 465–502, in: CW Smith et al. (eds). The Lichens of Great Britain and Ireland. London, British Lichen Society.

Esslinger TL, Egan RS. 1995. A sixth checklist of the lichen-forming, lichenicolous, and allied fungi of the continental United States and Canada. Bryologist 98: 465–549. http://dx.doi.org/10.2307/3243586

Feuerer T, Sipman HJM. 2005. Additions to the lichenized and lichenicolous fungi of Bolivia. Herzogia 18: 139–144.

Feuerer T, Ahti T, Vitikainen O. 1998. Lichenological investigations in Bolivia. 71–86 in: MP Marcelli, MRD Seaward (eds). Lichenology in Latin America: History, current knowledge and applications. Sao Paulo, CETESB.

Flakus A. 2007. Lichenized and lichenicolous fungi from mylonitized areas of the subnival belt in the Tatra Mountains (Western Carpathians). Annales Botanici Fennici 44: 427–449.

Flakus A. 2010. Lichens and lichenicolous fungi from Bolivia. W. Szafer Institute of Botany, Polish Academy of Sciences, Krakow. http://botan.botany.pl/lichens-bolivia

Flakus A, Kukwa M. 2007. New species and records of *Lepraria* (*Stereocaulaceae*, lichenized *Ascomycota*) from South America. Lichenologist 39: 463–474. http://dx.doi.org/10.1017/S0024282907007116

Flakus A, Ahti T, Kukwa M, Wilk K. 2008. New and interesting records of *Cladonia* and their lichenicolous fungi from the Andean cloud forest in Bolivia. Annales Botanici Fennici 45: 448–454.

Flakus A, Elix JA, Rodriguez P, Kukwa M. 2011. New species and records of *Lepraria* (*Stereocaulaceae*, lichenized *Ascomycota*) from South America. Lichenologist 43: 57–66. http://dx.doi.org/10.1017/S0024282910000502

Flakus A, Rodriguez Saavedra P, Kukwa M. 2012. A new species, new combinations and new records of *Hypotrachyna* and *Remototrachyna* from Bolivia. Mycotaxon 119: 157–166. http://dx.doi.org/10.5248/119.157

Follmann G. 1985. Vorkommen und Vergesellschaftung der Krustenflechte *Lecanora subaurea* Zahlbr. (*Lecanoraceae*) im Hessischen Bergland. Hessische Floristische Briefe 34: 42–46

Galloway D. 2007. Flora of New Zealand lichens. Revised second edition including lichen-forming and lichenicolous fungi. Volumes 1 and 2. Manaaki Whenua Press, Lincoln, New Zealand.

Guderley R. 1999. Die *Lecanora subfusca*-Gruppe in Süd- und Mittelamerika. Journal of the Hattori Botanical Laboratory 87: 131–257.

Huneck S. 1982. (+)-Isorangiformic acid, a lichen substance from *Lecanora stenotropa*. Phytochemistry 21: 2407–2408. http://dx.doi.org/10.1016/0031-9422(82)85218-7

Ibisch PL, Mérida G. (eds) 2004. Biodiversity: The richness of Bolivia. State of knowledge and conservation. Editorial FAN, Santa Cruz de la Sierra, Bolivia.

LaGreca SA, Lumbsch HT. 2001. Three species of *Lecanora* new to North America, with notes on other poorly known lecanoroid lichens. Bryologist 104: 204–211. http://dx.doi.org/10.1639/0007-2745(2001)104[0204:TSOLNT]2.0.CO;2

Lumbsch HT, Guderley R, Elix JA. 1996. A revision of some species in *Lecanora* Sensu Stricto with a dark hypothecium (*Lecanorales*, *Ascomycotina*). Bryologist 99: 269–291. http://dx.doi.org/10.2307/3244300

Martínez I, Aragón G. 2004. The *Lecanora varia* group in Spain: species with amphithecial cortex. Bryologist 107: 222–230. http://dx.doi.org/10.1639/0007-2745(2004)107[0222:TLVGIS]2.0.CO;2

Messuti MI, Vobis G. 2003. Additions to the Lichen Flora of Tierra del Fuego. Bryologist 106: 596–598. http://dx.doi.org/10.1639/0007-2745(2003)106[596:ATTLFO]2.0.CO;2

Nash TH III, Ryan BD, Davis WC, Breuss O, Hafellner J, Lumbsch HT, Tibell L, Feuerer T. 1998. Additions to the lichen flora of Arizona IV. Bryologist 101: 93–99.

Nimis PL, Martellos S. 2003. A second checklist of the lichens of Italy with a thesaurus of synonyms. Monografie del Museo Regionale di Scienze Naturali, 4, Museo Regionale di Scienze Naturali Saint-Pierre - Valle d'Aosta, Aosta.

Nylander W. 1861. Additamentum ad lichenographiam Andium Boliviensium. Annales des Sciences Naturelles 15: 365–382.

Obermayer W. 2009. Dupla Graecensia Lichenum (2009, nos 581-680). Fritschiana 65: 7–32.

Orange A, James PW, White FJ. 2001. Microchemical methods for the identification of lichens. London, British Lichen Society.

Printzen C. 2001. Corticolous and lignicolous species of *Lecanora* (*Lecanoraceae, Lecanorales*) with usnic and isousnic acid in the Sonoran Desert region. Bryologist 104: 382–409. http://dx.doi.org/10.1639/0007-2745(2001)104[0382:CALSOL]2.0.CO;2

Poelt J, Leuckert C. 1984. *Lecanora cavicola* Creveld, ihre Apothecien, ihr Chemismus und ihre systematische Stellung. Herzogia 6: 411–418.

Quilhot W, Rubio C, Cuellar M. 2007. Comparative studies between the lichen flora from Chile and Antarctica. Bibliotheca Lichenologica 95: 479–488.

Rodriguez Flakus P, Flakus A, Kukwa M, Lücking R, Meneses RI, Rivas Plata E, Stanton D, Truong C, Vargas R. 2012. Preliminary catalogue of lichens and lichenicolous lichens from Bolivia. Version 1.2. W. Szafer Institute of Botany, Polish Academy of Sciences, Krakow. http://botan.botany.pl/lichens-bolivia

Ryan BD, Nash TH. 1993. *Lecanora* section *Placodium* (Lichenized *Ascomycotina*) in North America: new taxa in the *L. garovaglii* [sic] group. Bryologist 96: 288–298. http://dx.doi.org/10.2307/3243856

Ryan BD, Lumbsch HT, Messuti MI, Printzen C, Śliwa L, Nash III TH. 2004. *Lecanora* Ach., 176–286, in: TH Nash III et al. (eds). Lichen Flora of the Greater Sonoran Desert Region. vol. 2. Tempe, Arizona, Lichens Unlimited, Arizona State University.

Santesson R, Moberg R, Nordin A, Tønsberg T, Vitikainen O. 2004. Lichen-forming and lichenicolous fungi of Fennoscandia. Uppsala, Museum of Evolution, Uppsala University.

Śliwa L. 2007a. A revision of the *Lecanora dispersa* complex in North America. Polish Botanical Journal 52: 1–70.

Śliwa L. 2007b. *Lecanora semipallida*, the correct name for *L. xanthostoma*, and a reappraisal of *L. flotoviana* (*Lecanoraceae*, *Ascomycotina*). Polish Botanical Journal 52: 71–79.

Śliwa L. 2009a. First records of *Lecanora semipallida* (lichenized fungi) from Romania. Acta Mycologica. Acta Mycologica 44: 173–178.

Śliwa L. 2009b. *Lecanora semipallida* (lichenized *Ascomycota*) in Poland. Polish Botanical Journal 54: 31–36.

Śliwa L, Flakus A. 2011. *Lecanora microloba*, a new saxicolous species from Poland. Lichenologists 43: 1–6. http://dx.doi.org/10.1017/S0024282910000551

Śliwa L, Wetmore CM. 2000. Notes on the *Lecanora varia* group in North America. Bryologist 103: 475–492. http://dx.doi.org/10.1639/0007-2745(2000)103[0475:NOTLVG]2.0.CO;2

Śliwa L, Miądlikowska J, Redelings BD, Molnar K, Lutzoni F. 2012. Are widespread morphospecies from the *Lecanora dispersa* group (lichenized *Lecanoromycetes*, *Pezizomycotina*) monophyletic? Bryologist 115: 265–277. http://dx.doi.org/10.1639/0007-2745-115.2.265

Tønsberg T. 1987. *Lecanora subaurea* new to Norway. Graphis Scripta 1: 51.

Urbanavichus G, Andreev M. 2010. A checklist of the lichen flora of Russia. St Petersburg, Nauka.

Valadbeigi T, Sipman HJM. 2010. New records of lichens and lichenicolous fungi from Iran and their biogeographical significance. Mycotaxon 113: 191–194. http://dx.doi.org/10.5248/113.191

van den Boom PPG. 2010. New or interesting lichens and lichenicolous fungi of Gran Canaria (Canary Islands, Spain). Willdenowia 40: 359–367. http://dx.doi.org/10.3372/wi.40.40215

Zhurbenko M. 1996. Lichens and lichenicolous fungi of the northern Krasnoyarsk Territory, central Siberia. Mycotaxon 58: 185–232.