

The *Lecanora varia* Group in Spain: Species with Amphithecial Cortex

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Abstract. *Lecanora burgaziae*, a new epiphytic species, is described from central Spain. It belongs to the *Lecanora varia* group with amphithecial cortex, and is closely related to *L. densa* and *L. varia* by the presence of psoromic acid and a distinctly thickened amphithecial cortex. The major differences are in thallus color, apothecia appearance and shape, and spore size. *Lecanora burgaziae* has a green thallus and greenish to slightly brown apothecial disc. Additionally, it has a thin apothecial margin and average spore size interval that does not overlap with other species in the group. We also included the first report of *Lecanora coniferarum*, *L. densa*, and *L. laxa* in Europe. A synopsis of the species of *Lecanora varia* group with amphithecial cortex in Spain is presented. Descriptions, notes on the ecology and distribution, and a key to the 10 species recognized in Spain are included.

Keywords. *Lecanora burgaziae* n. sp., *Lecanora varia* group, lichen, new species, Spain.

Lecanora Ach. is a large cosmopolitan genus represented by ca 800 species (Martínez et al. 1999). Several groups have been studied within this morphologically and anatomically heterogeneous genus by different authors (see Printzen 2001). The *Lecanora varia* group is well characterized by the presence of usnic acid as the main substance and the lack of atranorin.

Śliwa and Wetmore (2000) presented a systematic treatment of this group for North America and described two new subspecies that include the variability of *Lecanora varia* (subsp. *densa*, *laxa*, and *varia*), based on differences in thallus development, apothecial margin appearance, amphithecial cortex thickness, spore size, and chemistry. Recently, Printzen (2001) proposed two new combinations at the species rank scaling up the previously proposed names (*Lecanora laxa*, *L. densa*, and *L. varia*). This author also described a few additional species of the group including *L. coniferarum*. Additionally, Laundon (2003) presented results of six species of the *Lecanora varia* group, where *L. laxa* is placed under *L. densa*, and *L. varia* is confined to Europe, and replaced in North America by *L. densa*. We agree with the systematic and nomenclatural treatment of Printzen (2001) for *L. densa* and *L. laxa* and that treatment is followed here.

The main subject of this paper is to present the species of the *L. varia* group with amphithecial cortices that occur in Spain. This research arose due to the large collection of *L. varia s.lat.* obtained during field studies in the forested areas of the Iberian Peninsula. Some of the collected specimens indicated conspicuous morphological differences

when compared with known taxa. As a consequence, a new species is here described. Some of the specimens were recognized as species known only from North America.

MATERIAL AND METHODS

This study is based on more than 150 specimens collected recently in different localities in Spain and deposited in MA. Additionally, material from BCC, BIO, GDA, LEB, MA, MACB, MAF, and SANT were revised. Reference specimens from MIN were also examined.

Thalli and apothecia were sectioned at a thickness of 14–16 µm using a freezing microtome and stained with lactophenol cotton blue. Sections of apothecia for preliminary observations were mounted in distilled water. All light microscopy measurements were made in water mounts, with an oil-immersion lens. Maximum spore length and width, and length/width ratio were measured in each specimen. Twenty-five measurements of randomly selected mature spores were made for each specimen. Chemical analyses of acetone extracts were carried out by thin-layer chromatography (TLC) according to White and James (1985). Bibliographic information from Spain was not incorporated into the study due to the high number of misidentifications.

KEY TO SPECIES OF THE *LECANORA VARIA* GROUP WITH AMPHITHECIAL CORTEX IN SPAIN

- 1 Thallus and apothecial margin partially sorediate.
Fumarprotocetraric acid present. *L. conizaeoides*
- 1 Soredia absent. Fumarprotocetraric acid lacking 2
- 2 Paraphysis tips black, N+ violaceous
- *L. mughicola*
- 2 Paraphysis tips never black color, N- 3
- 3 Amphithecial cortex ± uniform in thickness 4
- 3 Amphithecial cortex basally distinctly thickened
- 6
- 4 Thallus well-development, areolate. Apothecia light beige to yellowish ochre. Spores 5.0–6.5

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- μm wide. Saxicolous. Usnic acid, zeorin -----
----- *L. polytropa*
- 4 Thallus of dispersal warts or endosubstratal.
Apothecia orange-brown to dark red-brown.
Spores 3–5 μm wide. On bark. Isoousnic or both
isousnic and usnic acids ----- 5
- 5 Apothecial disc orange brown. Epihymenium or-
ange-brown. Spores 8–11 × 4–5 μm. Usnic and
isousnic acids present ----- *L. albellula*
- 5 Apothecial disc dark red-brown. Epihymenium
brown to dark-brown. Spores 7–13 × 3–5 μm. Iso-
ousnic acid present ----- *L. saligna*
- 6 Psoromic acid present ----- 7
- 6 Psoromic acid lacking ----- 9
- 7 Margin of apothecia strongly prominent when
young, thick, and in two layers from above. Am-
phithecial cortex > 60 up to 150 μm wide near
base. Spore length to width ratio averaging 2.1:2.5
----- *L. varia*
- 7 Margin of apothecia weakly prominent, thin, and
not distinctly two-layered. Amphithecial cortex <
60 μm wide near base. Spore length to width ratio
averaging < 2.0 ----- 8
- 8 Thallus endosubstratal or of dispersed warts,
up to 1 mm diam. Apothecial disc greenish to
slight brown, epruinose. Spores 10–13 × 5.0–
7.5 μm ----- *L. burgaziae*
- 8 Thallus warted-areolate; individual areoles 0.1–
0.4 mm. Apothecial disc beige to orange-brown,
pruinose. Spores 8–11 × 4–6 μm ----- *L. densa*
- 9 Apothecia flexuose; disc concave, beige to ochre.
Spores 7–11 × 4–7 μm -----
----- *L. laxa*
- 9 Apothecia not flexuose; disc flat, never concave,
reddish brown. Spores 9–13 × 4.5–6.0 μm -----
----- *L. coniferarum*

LECANORA ALBELLULA Nyl.

Thallus endosubstratal or sometimes of dispersed warts, esorediate, yellowish to ochre; individual areoles up to 0.2 mm diam. *Apothecia* rounded, 0.3–0.6 mm diam., mostly densely arranged, sessile with constricted base; disc orange-brown, finely whitish pruinose, flat; margin persistent and ± level with disc yellowish to ochre. Amphithecium corticate, laterally 40–80 μm, basally 45–85 μm, medulla hyphae with lumina of 1.5–2.0 μm wide, cortex 7–20 μm wide; hypothecium 50–85 μm high, colorless to yellowish; hymenium 40–55 μm; epihymenium 3–12 μm, orange-brown; paraphyses simple to weakly branched, 1.0–1.5 μm wide; spores colorless, simple, 8–11 × 4–5 μm. *Pycnidia* not seen.

Chemistry.—Thallus C–, K–, P–. Secondary metabolites: isousnic acid and traces of usnic acid.

Ecology and distribution.—The only specimen of this species examined and clearly identifiable was growing on bark of *Pinus sylvestris* in central Spain. Bibliographic references were not considered, because most specimens were misidentified. Circumboreal in the Northern Hemisphere (Nimis 1993).

Distinguishing features.—Orange-brown apothecia,

amphithecial cortex ± uniform in thickness, spores < 5 μm wide, and presence of usnic and isousnic acids.

Remarks.—Only one Spanish specimen in the MA herbarium was recognized as *L. albellula*. The sample was collected in 1922, and morphological and anatomical characters were in agreement with those in Printzen (2001). Recently, Printzen (2001) pointed out that *L. piniperda* Körb. is an illegitimate name, and proposed the oldest available name for the taxon - *L. albellula* Nyl. This species is similar to *L. coniferarum* and *L. saligna*, both of which can be differentiated by the chemistry and spore size. Spores of *L. saligna* are narrower and longer than those of *L. albellula*, and the thallus has only isousnic acid. On the other hand, *L. coniferarum* has slightly wider spores, wider amphithecium, and amphithecial cortex basally broader (Printzen 2001). Another taxon containing usnic and isousnic acids is *L. laxa*, which differs from *L. albellula* in thallus appearance, flexuose apothecia, amphithecial cortex broadened basally, and wider spores.

Specimen examined.—SPAIN. SEGOVIA. Sierra de Guadarrama, San Rafael, 1922, *Sampaio* (MA 1669).

LECANORA BURGAZIAE Martínez & Aragón, sp. nov.

FIG. 1

Thallus Lecanorae salignae similis, esorediate. Prothallus non evolutus. Apothecia sessilia vel basi constricta, (0.3)0.4–0.7(1.0) mm in diametro, discis epruinosis. Apothecia margine thallino distincte corticato cincta. Cortex marginis apicaliter 10–23 μm, basim 50–60 μm latus. Ascospora ellipsoidea, 10.8–12.3 × 5.4–6.8 μm. Thallus plerumque acida usnicum, psoromicum et 2'-O-demethylpsoromicum continens.

TYPE: SPAIN. CIUDAD REAL. Horcajo de los Montes, Montes de Toledo, Las Llanas, 30SUJ6972, 900 m, on fallen pine cone, *Pinus pinaster* forest, 9–October–2002, Aragón 2200/02 & Martínez (holotype and isotype, MA). PARATYPES: SPAIN. CIUDAD REAL. Horcajo de los Montes, Sierra del Chorito, Cuerda de Cabañeros, 30SUJ7162, 920 m, 2002, Aragón 505/02 (MA); 30SUJ7562, 1,000 m, Aragón 558/02 (MA). Horcajo de los Montes, Montes de Toledo, Sierra de Valdefuertes, 30SUJ6768, 825 m, 2002, Aragón 2251/02, 2252/02 & Martínez (MA). Alcoba, Sierra del Chorito, cerca del Morro de la Fragua, 30SUJ8156, 980 m, 2002, Aragón 1050/02 (MA). Alcoba, Sierra del Chorito, cerro del Romeral, 30SUJ8156, 980 m, 2002, Aragón 1075/02 (MA). Navas de Estena, Montes de Toledo, los Acebuches, 30SUJ6671, 800 m, 2002, Aragón 960/02 (MA). El Bullaque, Sierra de la Ventilla, collado de Macheros, 30SUJ8556, 890 m, 2002, Aragón 450/02 (MA). TOLEDO PROV. Los Navalucillos, Montes de Toledo, arroyo del Chorro, 30SUJ5978, 950 m, 2002, Aragón 473/02 (MA).

Thallus of dispersed warts or often endosubstratal, causing a greenish discoloration of the substratum, esorediate; warts ± rounded, 0.03–0.10 mm in diam., convex, surface green, matt. *Apothecia* rounded, rarely flexuose, single to crowded, sessile, when older slightly constricted at base, but re-

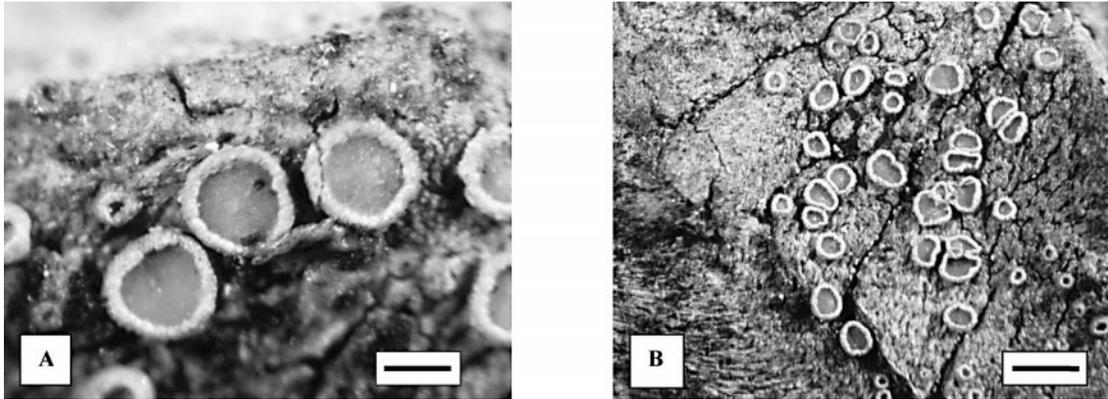


FIGURE 1. Morphology of *Lecanora burgaziae* (holotype). Scales: A = 0.4 mm; B = 1 mm.

mained sessile, (0.3)0.4–0.7(1.0) mm in diam.; disc greenish to slightly brown, flat to moderately concave when old, epruinose; margin weakly prominent, persistent, \pm granular-knobby, matt, slightly lighter in color than thallus. Amphithecium corticate, laterally 70–110 μ m, basally 80–123 μ m wide, medulla with irregularly entangled, short-celled hyphae with lumina ca 1.0 μ m wide, cortex 10–23 μ m above, 50–60 μ m near base of apothecia, colorless within, outer part with granules epihymenium like, of strongly gelatinized, anticlinally arranged hyphae with lumina of 0.5–1.0 μ m; parathecium 8–15 μ m wide; hypothecium 40–50 μ m high; subhymenium 13–22 μ m high; hymenium 39–48 μ m high, colorless; epihymenium 6–10 μ m high, slightly brown, ochre to brown, granular; paraphyses weakly branched and anastomosing below, 1.0–1.5 wide, apically 1.5–2.0 μ m wide; spores colorless, simple, (10.0)10.8–12.3(13.0) \times (5.0)5.4–6.8(7.5) μ m. *Pycnidia* not seen.

Chemistry.—Thallus C⁻, K⁻, P⁺ yellow; secondary metabolites: usnic, psoromic and 2'-O-demethylpsoromic acids.

Ecology.—*Lecanora burgaziae* was found in two different ecological conditions: on fallen pine cones in *Pinus pinaster* forests and on branches of *Cistus ladanifer* in Mediterranean shrub formations. Both communities are widely distributed in Montes de Toledo, at elevations ranging from 800 to 1,000 m. Montes de Toledo is a relative old mountainous range similar in elevation to "Appalachian relief" (600 to 1,450 m elevation). The substrate of the mountains is composed of granites, quartzites, siliceous, and clayey slates. The climate is typically Mediterranean, with annual rainfall varying from 500 to 800 mm, but always with an extreme drought during the summer. Annual mean monthly temperature varies from 12.5 to 15.5°C. *Lecanora burgaziae* is usually accompanied by other pioneer lichens such as *Buellia iberica* Giralt, *B. triseptata*

A. Nordin, *Caloplaca holocarpa* (Hoffm.) H. Magn., *Lecanora chlarotera* Nyl., *Lecanora umbriana* (Ach.) A. Massal., *Lecidea exigua* Chaub., *Lecidella elaeochroma* (Ach.) M. Choisy, and *Rinodina sophodes* (Ach.) A. Massal. on *Cistus ladanifer* branches, whereas it grew alone on pine cones.

Distribution.—Central Spain.

Etymology.—The specific epithet refers to Ana Rosa Burgaz who has contributed significantly to the development of Spanish lichenology.

Remarks.—*Lecanora burgaziae* is externally similar to *L. saligna*, but it can be separated by differences in the amphithecial cortex and by chemistry. Moreover, *L. burgaziae* is closely related to *L. densa* and *L. varia* by the presence of psoromic acid in the thallus, and apothecial margin and amphithecial cortex distinctly thickened at the base of the apothecia. The new species has; however, several differences of thallus and apothecia appearance, amphithecium anatomy, spore size, and ecology (Table 1). Typical specimens of *L. burgaziae* develop an endosubstratal thallus or dispersed warts around the apothecia that are green, while *L. densa* and *L. varia* have a warted-areolate thallus, that is beige to ochre. However, when the material is fresh, the last two taxa might also have a thallus with a greenish or yellowish tint. *Lecanora densa*, for comparison, has a gray hypothallus between the areoles; this never appears in the Iberian species (the character might also not always be obvious in all North American specimens). *Lecanora burgaziae* and *L. densa* are similar in having sessile young apothecia that are slightly constricted at the base with age and by margins weakly prominent to \pm level with the disc. On the contrary, apothecia of *L. varia* are soon strongly constricted at the base, with prominent and thick margins. *Lecanora burgaziae* has greenish to slightly brown apothecial discs without pruina, whereas *L. densa* has beige to

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TABLE 1. Main differences between *L. burgaziae*, *L. densa*, and *L. varia*. Mean \pm standard deviation and extreme values (in parentheses) of spores in μm .

Character	<i>L. burgaziae</i>	<i>L. densa</i>	<i>L. varia</i>
Thallus morphology	Endosubtratal or dispersal warts, to 0.1 mm diam. Green	Warted-areolate; areoles 0.15–0.37 mm diam. Yellowish beige to ochre	Warted-areolate; areoles 0.2–0.5 mm diam. Beige to ochre
Apothecia	Young sessile, when older slightly constricted at base Disc greenish to slightly brown; epruinose	Young sessile, when older slightly constricted at base Disc beige to orange-brown; pruinose	Young sessile, soon strongly constricted at base Disc ochre to orange-brown; pruinose
Hypothallus	Inconspicuous	Ash-gray to dark gray, between areoles	Inconspicuous
Apothecial margin	Thin, weakly convex or at same level at disc and uniform	Thin, weakly convex or at same level at disc and uniform	Strongly prominent when young, thick and in two-layered
Amphithecial	Cortex 10–23 μm laterally, 50–60 μm near base; hyphae lumina < one wide Medulla hyphae ca one wide	Cortex 5–20 laterally, 35–65 near base; hyphae lumina 1.5–2.5 wide Medulla hyphae 1.0–1.5 wide	Cortex 25–80 laterally, 90–150 near base hyphae lumina 1.5–2.5 wide Medulla hyphae < one wide
Spores	(10.0)10.8–12.3(13.0) (5.0)5.4–6.8(7.5) (1.6)1.7–1.9(2.2)	(8.0)8.3–9.7(11.0) (4.0)4.7–5.4(6.0) (1.5)1.6–1.9(2.5)	(10.0)10.5–12.0(12.5) (4.0)4.6–5.4(5.5) (2.0)2.1–2.5(2.7)
Habit	Fallen pine cones and branches of <i>Cistus ladani-fer</i>	On bark of <i>Pinus pinaster</i>	On hard lignum of different phorophytes

orange-brown and pruinose disc, and *L. varia* has ochre discs with pruina. Amphithecia are similar in *L. burgaziae* and *L. densa*, but those of *L. varia* have a wider cortex, both laterally and basally. Furthermore, some differences in the width and lumina of medullar hyphae between the species were detected (Table 1). *Lecanora burgaziae* can also be easily distinguished from *L. densa* and *L. varia* by the presence of wider spores in the former. Apart from the anatomical and morphological differences, there is also a remarkable ecological difference, at least in Central Spain, where the three species are widely distributed. *Lecanora burgaziae* grows on fallen pine cones and branches of *C. ladani-fer*, *Lecanora densa* is found on bark of *Pinus pinaster*, and *L. varia* occurs on hard lignum.

LECANORA CONIFERARUM Printzen

Thallus warted areolate to endosubtratal, esorediate, greenish yellow to ochre; individual areoles 0.1–0.4 mm diam. *Apothecia* rounded, 0.4–1.0 mm diam., single or in groups, sessile with constricted base; disc reddish-brown, finely whitish pruinose, flat; margin prominent in young apothecia, persistent. Amphithecium corticate, laterally 75–110 μm wide, basally 100–140 μm wide, medulla hyphae with lumina of 1–2 μm wide, cortex 5–20 μm wide above, 16–40 μm wide below; hypothecium 40–90 μm high, colorless to yellowish; hymenium 40–60 μm , colorless to yellowish; epihymenium 5–15 μm , reddish brown; paraphyses simple to weakly

branched, one μm wide; spores colorless, simple, 9–13 \times 4.5–6.0 μm . *Pycnidia* not seen.

Chemistry.—Thallus C⁻, K⁻, P⁻. Secondary metabolites: isousnic and usnic acids.

Ecology and distribution.—This species has been collected in pine forests (*Pinus pinaster*) in the Montes de Toledo, Serranía de Cuenca, and Sierra de Segura, which are impressive mountains located in central and southern Spain. The associates of this species are *Buellia griseovirens* (Turner & Borrer) Alm., *B. iberica*, *Lecanora densa*, *Micarea synotheoides* (Nyl.) Coppins, *Pyrrhospora lusitanica* (Räsänen) Hafellner, *Rinodina archaea* (Ach.) Arnold, and *Scoliciosporum umbrinum* (Ach.) Arnold, *Lecanora coniferarum* was known from Arizona, California, Colorado, New Mexico, and Guadalupe Island (Printzen 2001). These new records from central and southern Spain have significantly increased the known distribution.

Distinguishing features.—Reddish-brown apothecia, amphithecial cortex basally broad, and presence of usnic and isousnic acid.

Remarks.—*Lecanora coniferarum* is similar in appearance to *L. saligna*; however, the latter develops broader spores, amphithecial cortex \pm uniform in thickness, and contains only isousnic acid. *Lecanora coniferarum* occurs in similar habitat as *L. densa*, from which it may be separated by thallus appearance, wider amphithecial cortex, shorter spores, and the presence of psoromic acid. *Lecanora laxa* may be distinguished from *L. conifera-*

rum by flexuose apothecia with strongly constricted base and shorter spores. *Lecanora albellula* has distinctly wider spores and amphithecial cortex \pm uniform in thickness. *Lecanora burgaziae* is separated from *L. coniferarum* by slightly broader ascospores, thallus containing psoromic acid, apothecial disc greenish to slightly brown, and epruinose, and its different habitat.

Specimens examined.—SPAIN. CIUDAD REAL. Horcajo de los Montes, Montes de Toledo, Las Llanas, 30SUJ6972, 900 m, 2002, *Aragón 2203/02, 2202/02, 2207/02, 2211/02, 2214/02, 2212/02 & Martínez* (MA). Horcajo de los Montes, Sierra del Chorito, Cuerda de Cañeros, 30SUJ7162, 920 m, 2002, *Aragón 501/02, 502/02* (MA); 30SUJ7562, 1,000 m, *Aragón 552/02, 553/02, 554/02* (MA). CUENCA. Boniches, Serranía de Cuenca, sobre *Pinus pinaster*, 30TXK1428, 940 m, 2002, *Aragón 2281/02* (MA). JAÉN PROV. Cazorla, Sierra de Segura, Rio-gazas, 30SWG0094, 1,230 m, 1997, *Aragón 4271/97 & Martínez* (MA). TOLEDO PROV. Hontanar, Montes de Toledo, arroyo del Gatillo, 30SUJ7384, 1,090 m, 2002, *Aragón 240/02* (MA).

Reference material examined.—NORTH AMERICA. ARIZONA. Saguaro Nat. Mon. Rincon Peak, elev. 2,260 m, *Wetmore 55191* (MIN). Apache National Forest, Mt. Baldy, ca 3,000 m, *Ryan & Nash 26877* (MIN).

LECANORA CONIZAEOIDES Crombie

Thallus coarsely granular, greenish to grayish-green, partially or whole sorediate; soredia farinose to minutely granular, grayish-yellow. *Apothecia* numerous, rounded, 0.5–1.5 mm diam., flat, sessile, narrowed at base; margin persistent, crenulate, partially sorediate; disc yellowish to brownish. Amphithecium corticate (without cortex in sorediate margin), laterally 60–100 μ m, basally 80–130 μ m, medulla hyphae with lumina of 1.5–2.0 μ m wide; hypothecium 45–55 μ m high, colorless; hymenium 45–65 μ m high; epihymenium 5–13 μ m high, brown; paraphyses simple, 1.5 μ m wide; spores colorless, simple, 10–15 \times 4–6 μ m. *Pycnidia* not seen.

Chemistry.—Thallus and apothecial margin P+ (orange to red), K \pm (weakly yellowish), C $-$. Secondary metabolites: usnic and fumarprotocetraric acids.

Ecology and distribution.—The species mainly grows on acid bark and lignum of *Pinus nigra* and *Pinus sylvestris* together with *Hypogymnia physodes* (L.) Nyl., *Lecanora expallens* Ach., and *Rinodina archaea*, at elevations ranging between 750 and 1,800 m. It appears inside forested but managed areas, historically dedicated for timber production.

Distinguishing features.—*Lecanora conizaeoides* is the only species treated here with thallus and apothecial margin partially sorediate and containing fumarprotocetraric acid.

Specimens examined.—SPAIN. BARCELONA. Sant Martí

de Tous, Coll del Guix, 31TCG79, Guixos, 400 m, 1972, *Llimona* (BCC 8286). Vilada, ctra. a Borredà, 31TDG16, 750 m, *Pinus sylvestris*, 1981, *Gómez-Bolea*, (BCC 11459). CUENCA. Tragacete, Cerro de San Felipe, 30TWK9772, 1,780 m, 2002, *Aragón 2313/02* (MA). Huerta del Marquesado, Sierra de Valdemeca, arroyo de la Hoz, 30TXK0647, 1,520 m, 1998, *Aragón & Martínez* (MA 10693). GERONA. Collada, La Molina, Cerdanya, DG18, corticícola, sobre *Pinus uncinata*, 1982, *Gómez-Bolea* (BCC 3089). GUADALAJARA. Checa, Sierra del Tremedal, cerca del cerro del Moro, 30TXK0377, 1,600 m, 1998, *Aragón & Martínez* (MA 10872). JAÉN. Segura de la Sierra, Sierra de Segura, río Madera, 30SWH3436, 1,250 m, 1997, *Aragón 1875/97 & Martínez* (MA). Segura de la Sierra, Sierra de Segura, río Madera, 30SWH3537, 1,270 m, 1996, *Aragón 1127/96 & Martínez* (MA). MADRID. Canencia, Sierra de Guadarrama, Puerto de Canencia, 30TVL3624, 1,500 m, 2002, *Aragón 2464/02 & Martínez* (MA). NAVARRA. Campo de la Contienda, Anielarra, Osa, corticícola, sobre *Pinus uncinata*, 1973, *Llimona & Clauzade* (BCC 2543). LA RIOJA. Sierra Cebollera, pista continuación de la Ermita hacia el castillo, 1,700 m, 1993, *Breuss & Etayo* (MA 5837). TERUEL. Orihuela del Tremedal, Sierra del Tremedal, El Castillejo, 30TXK1185, 1,730 m, 1998, *Aragón & Martínez* (MA 10796). Villar del Cobo, barranco de la Melchora, cerca de La Cañada, 30TXK0868, 1,700 m, 1998, *Aragón & Martínez* (MA 10884).

LECANORA DENSA (Śliwa & Wetmore) Printzen

Thallus warted-areolate, esorediate, yellowish beige to ochre, hypothallus ash gray to dark gray (not always well developed); individual areoles 0.15–0.37 mm diam. *Apothecia* rounded, 0.3–0.6 mm diam., single to densely crowded, sessile with constricted base; disc beige to orange brown, pruinose, flat; margin weakly prominent when young, persistent. Amphithecium corticate, laterally 60–120 μ m wide, basally 65–130 μ m wide, medulla hyphae with lumina of 1.0–1.5 μ m wide, cortex 5–20 μ m wide above, 35–65 μ m wide below; hypothecium 40–60 μ m high, colorless to yellowish; hymenium 40–65 μ m, colorless to yellowish; epihymenium 7–18 μ m, ochre to orange-brown; paraphyses simple to weakly branched, one μ m wide; spores colorless, simple, 8–11 \times 4–6 μ m. *Pycnidia* not seen.

Chemistry.—Thallus C $-$, K $-$, P+ (yellow). Secondary metabolites: usnic acid, psoromic acid and \pm 2'-O-demethylpsoromic acid.

Ecology and distribution.—The species grows in central, southern, and northwestern Spain on bark of *Pinus pinaster*, at elevations from 800 to 1,000 m. It is usually associated with *Buellia griseovirens*, *B. iberica*, *Lecanora coniferarum*, *Micarea synotheoides*, *Pyrrhospora lusitanica*, *Rinodina archaea*, and *Scoliciosporum umbrinum*. *Lecanora densa* was formerly considered restricted to Arizona and Colorado (Printzen 2001), and here it is reported from Spain.

Distinguishing features.—Hypothallus ash gray,

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disc beige to orange-brown, amphithecial cortex basally broader, and presence of psoromic acid.

Remarks.—Spanish specimens have pruinose apothecial disc. In relation to this character, Printzen (2001) pointed out the presence of pruina in this taxon, although Śliwa and Wetmore (2000) wrote that the apothecia of *L. densa* are never pruinose.

The main differences between the other two species containing psoromic acid (*L. burgaziae* and *L. varia*) are provided in Table 1. Spores of *L. albellula* and *L. coniferarum* are similar in shape and size to those of *L. densa*. However, the amphithecial cortex of *L. albellula* is \pm uniform in thickness and the thallus contains isousnic and usnic acids, whereas *L. coniferarum* differs from *L. densa* due to thallus appearance, broader amphithecial cortex, slightly larger spores, and absence of psoromic acid.

Specimens examined.—SPAIN. CIUDAD REAL. Horcajo de los Montes, Sierra del Chorito, Cuerda de Cabañeros, 30SUJ7562, 1,000 m, 2002, *Aragón 556/02, 557/02*, (MA). Horcajo de los Montes, Montes de Toledo, Las Llanas, 30SUJ6972, 900 m, 2002, *Aragón 2204/02, 2205/02, 2206/02 & Martínez* (MA). JAÉN. Santiago-Pontones, Sierra de Segura, río Aguamulas, 30SWH1810, 820 m, 1997, *Aragón 3406/97 & Martínez* (MA). MADRID. Chamartín, Madrid, 1900 (MA). ZAMORA. Galende, Parque Natural "Lago de Sanabria", cerca del río Tera, 29TPG9065, 1,000 m, 1996, *Aragón, Castillo & Herrero* (MA).

Reference material examined.—NORTH AMERICA. ARIZONA. Saguaro Nat. Mon. Rincon Mt., elev. 2,510 m, *Wetmore 54367* (MIN). Saguaro Nat. Mon. Rincon Mt. E of Mica Mt., elev. 2,300 m, *Wetmore 55078* (MIN). COLORADO. Boulder Co., Green Mountain ca 2,300 m, *Shushan & Weber* (MIN).

LECANORA LAXA (Śliwa & Wetmore) Printzen

Thallus endosubstratal or sometimes of few areoles, moderately convex, yellowish beige. *Apothecia* flexuose, 0.3–0.6 mm diam., single or densely crowded, sessile with strongly constricted base; disc beige to ochre, concave or rarely flat, whitish pruinose; margin strongly prominent when young, persistent, thick, yellowish to beige. Amphithecium corticate, laterally 40–120 μ m wide, basally 65–160 μ m wide, medulla hyphae with lumina of 1.5–2.0 μ m wide, cortex 10–30 μ m laterally, 23–50 μ m near base; hypothecium colorless to yellowish, 30–60 μ m high; hymenium colorless, 40–70 μ m high; epihymenium ochre, 6–13 μ m, finely granular; paraphyses simple to weakly branched, up to 1.5 μ m wide; spores colorless, simple, 7–11 \times 4–7 μ m.

Chemistry.—Thallus C⁻, K⁻, P⁻: usnic and isousnic acids.

Ecology and distribution.—It is a corticolous and lignicolous species growing on bark of *Pinus pinaster* and lignum (*Quercus* spp. and *Juniperus thurifera*) at elevations of 900–1,300 m. It shares habitats with *Lecidea botryosa* (Fr.) Th. Fr., *Mica-*

rea misella (Nyl.) Hedl., *Placynthiella uliginosa* (Schr.) Coppins & P. James, and *Trapeliopsis granulosa* (Hoffm.) Lumbsch. So far, *L. laxa* has been collected in California at elevations between 1,250–2,100 m, appearing on different phorophytes (Printzen 2001). In Spain, it is central in distribution, being known from 'Sierra Madrona' (Ciudad Real prov.), 'Montes de Toledo' (Toledo and Ciudad Real provs.), and 'Serranía de Cuenca' (Cuenca prov.).

Distinguishing features.—Apothecia flexuose with a strongly constricted base, amphithecial cortex basally broader, and presence of usnic and isousnic acids.

Remarks.—Previously to the studies of Śliwa and Wetmore (2000) and Printzen (2001), many specimens currently named *L. laxa* and lacking psoromic acid, flexuose apothecia, and small spores were identified as *L. varia*. The apothecial discs of *L. saligna* and *L. coniferarum* are mainly flat, not flexuose, and with an indistinctly constricted base, whereas *L. laxa* has apothecial discs mainly concave, with markedly constricted bases. Also, the spores are shorter in *L. laxa* than these other two species.

Specimens examined.—SPAIN. CIUDAD REAL. Fuencaliente, Peña Rodrigo, ladera NE, 30SUH85, 1990, *Sarrión, Burgaz & Fuertes* (MACB). Horcajo de los Montes, Montes de Toledo, Las Llanas, 30SUJ6972, 900 m, 2002, *Aragón 2213/02, 2208/02, 2209/02 & Martínez* (MA). Horcajo de los Montes, Sierra del Chorito, Cuerda de Cabañeros, 30SUJ7162, 920 m, 2002, *Aragón 503/02* (MA); Fuencaliente, Sierra de Dormideros, ladera Norte, 30SUH95, 1,200 m, 1990, *Sarrión* (MACB). CUENCA. Buenache de la Sierra, Serranía de Cuenca, Barranco de los Charcos, 30TWK8744, 1,275 m, 1998, *Aragón & Martínez* (MA). TOLEDO. Los Navalucillos, Montes de Toledo, Las Becerras, arroyo del Chorro, 30SUJ5978, 1,070 m, 1995, *Aragón, Herrero & Martínez* (MA).

Reference material examined.—NORTH AMERICA. CALIFORNIA. Kings Canyon National Park. Redwood Canyon. *Blakeman 203* (MIN). Los Padres National Forest, town of Frazier Park, elev. 1,370 m, *Wetmore 14777* (MIN).

LECANORA MUGHICOLA Nyl.

Thallus \pm warted-areolate, flat to moderately convex, yellowish beige to ochre; individual areoles 0.3–1.0 mm in diam. *Apothecia* rounded to irregular, 0.3–0.8 mm diam., mostly densely crowded, sessile with weakly constricted base dark brown, dark grayish to black, flat; margin persistent, slightly crenulate. Amphithecium corticate, laterally 30–110 μ m, basally 80–138 μ m, medulla hyphae with lumina of 1–2 μ m wide, cortex 10–35 μ m laterally, 32–60 μ m near base; hypothecium 40–85 μ m high, yellowish epihymenium 8–15 μ m, blackish brown with blackish apical cells of paraphyses and brown granules; paraphyses simple to

weakly branched, 1.0–1.5 μm wide; spores colorless, simple, 8–13 \times 3.5–5.0 μm ; conidia 4–5 \times 1.0–1.5 μm .

Chemistry.—Thallus C⁻, K⁻, P⁻. Secondary metabolites: isousnic acid.

Ecology and distribution.—This species grows on hard lignum of different phorophytes (*Juniperus thurifera*, *Pinus nigra*, and *Pinus sylvestris*) together with *Buellia cedricola* Werner, *Cyphelium tigillare* (Ach.) Ach. and sometimes with *L. varia*. It often occurs in open areas from the supra- to oromediterranean belts (1,430 to 1,900 m elevation) in central-eastern and southeastern Spain. The species is apparently confined to upland areas of central Europe (Nimis 1993) and western North America (Printzen 2001).

Distinguishing features.—*Lecanora mughicola* is the only species treated here with paraphysis tips often black, N⁺ violaceous. For an extended discussion of the species see Printzen (2001).

Specimens examined.—SPAIN. CUENCA. Serranía de Cuenca, Tierra Muerta, Cerro de la Sabina, 30TWK9646, 1,430 m, 2002, *Aragón 2050/02* (MA). Tragacete, Cerro de San Felipe, 30TWK9772, 1,780 m, 2002, *Aragón 2308/02* (MA). JAÉN. Santiago-Pontones, Sierra de Segura, Cordillera de las Banderillas, 30SWH2107, 1,700 m, 1997, *Aragón 3651/97 & Martínez* (MA). Pozo Alcón, Sierra del Pozo, cerro Cabañas, 30SWG0484, 1,900 m, 1997, *Aragón* (MA). NAVARRA. Larra, 1,700 m, lignícola, sobre branques mortes de *Pinus uncinata*, 1986, *Etayo* (BCC 3224). TARRAGONA. Baix Ebre, Tortosa, Mola de Catí (Serra dels Ports), 31TBF7021, 1,200 m, fusta, 1992, *Boqueras, Canals & Gómez-Bolea* (BCC 6081).

LECANORA POLYTROPA (Hoffm.) Rabenh.

Thallus areolate, esorediate, yellowish or greenish-ochre; individual areoles 0.1–0.4 mm diam. *Apothecia* \pm polygonal, 0.4–1.0 mm diam., densely crowded, sessile, without constricted base; disc light beige to yellowish ochre, indistinctly pruinose, flat; margin weakly prominent when young, persistent. Amphithecium corticate, laterally 50–100 μm wide, basally 60–110 μm wide, medulla hyphae with lumina of 1–2 μm wide, cortex 15–40 μm wide; hypothecium 50–230 μm high, yellowish; hymenium 45–60 μm , colorless to yellowish; epihymenium 7–23 μm , ochre; paraphyses weakly branched, 1.0–1.5 μm wide; spores simple, 10–12 \times 5.0–6.5 μm . *Pycnidia* not seen.

Chemistry.—Thallus C⁻, K⁻, P⁻. Secondary metabolites: usnic acid and zeorin.

Ecology and distribution.—This species grows on siliceous rocks at elevations of 500 to 2,500 m, in open and exposed areas of northern Spain. There was a single record from southern Spain, in Sierra Nevada, at 2,500 m. A species with bipolar, circum-boreal-montane distribution in the Northern Hemisphere (Nimis 1993).

Distinguishing features.—*Lecanora polytropa* is a saxicolous taxon of the *Lecanora varia* group occurring in the Iberian Peninsula. The species is well-differentiated by its densely crowded, light beige to yellowish ochre apothecia with a slightly lighter margin (Printzen 2001).

Remarks.—*Lecanora polytropa* is similar to *L. intricata*; however, the latter develops an areolate thallus that is \pm continuous and with crenulate margins, and apothecia mainly immersed with blackish green discs. Spanish specimens examined of *L. intricata* all belonged to *L. polytropa*.

Selected specimens examined.—ANDORRA. Sota Sant Julià per la ctra. de Fontaneda, 31TCH70, 900 m, alzar encarat a l'Est, esperó rocós amb. *Q. pubescens*, 1978, *Llimona* (BCC 7067). Coma de Port de Rat, 31TCH82, 2,360–2,650 m, blocs al prat alpí, cara N roques erosionades per l'antiga glacera, 1978, *Llimona* (BCC 7099). SPAIN. BARCELONA. Montseny, Catiu d'Or, 31TDG52, extaplomo orientado al SE, 1,350 m, 1979, *Hladun* (BCC 6851). Fogars de Montclus, mirador a prop de Can Penyacanyes, 31TDG52, 1,200 m, rocas esquitosas al límit del hayedo, 1981, *Hladun* (BCC 6937). Fogars de Montclus, Torrent de la roca d l'Escala, 31TDG52, 1,350 m, sobre granito, inclinat 10° al NW, en un clar de hayedo, sotobosque de *Calluna vulgaris*, 1978, *Hladun* (BCC 6738). A 500 m al N del Turó Catiu d'Or en la carena hacia les Agudes, 31TDG5326, 1,670 m, 1975, *Hladun* (BCC 6421). LA CORUÑA. Caaveiro, 350–400 m, 1986, *Carballal & López de Silanes* (SANT 2691). Península de Bares, 1996, *Paz Bermúdez* (SANT 9876). A Capelada, Ortigueira, 29TNJ7937, 529 m, 1991, *Sánchez-Biezma* et al. (SANT 9095). GERONA. Arbucies, Puig de Sa Carbassa, cara mira a Coll ses Basses, 31TDG52, 1,660 m, orientació N, 1976, *Hladun* (BCC 6695). GRANADA. Sierra Nevada, Peñones de San Francisco, 2,400 m, 1977, *Casares* (GDA 2050). HUESCA. Campo de Troya, Panticosa, pista del Corral de Mulas, barranco de la Mina, 2,150 m, 1993, *Etayo & Gómez-Bolea* (MA 4249). LEÓN. Mascariel, 29TQG1490, 1,700 m, 1988, *Terrón* (LEB 1675). El Lagarelló, 29TQG1590, 1,800 m, 1989, *Terrón* (LEB 653). Arroyo de las Rubias, 29TQG1289, 1,350 m, 1989, *Terrón* (LEB 648). La Pasada de Mascariel, 29TQG1291, 1,690, 1988, *Terrón* (LEB 1352). Alto de el Palo, 29TQG1293, 1,650 m, 1987, *Terrón* (LEB 1420). Alto de el Palo, 29TQG1192, 1,900 m, 1988, *Terrón* (LEB 1668). Collado de el Palo-Sierra del Teleno, 29TQG1292, 1,900 m, 1988, *Terrón* (LEB 2115). Peña de la Serna, 29TQG1594, 1,350 m, 1989, *Terrón* (LEB 655). Peña Negra, 29TQG1790, 1,900 m, 1989, *Terrón* (LEB 650). Las Majadotas, 29TQG1789, 1,700 m, 1989, *Terrón* (LEB 430). LÉRIDA. Bellver de Cerdanya, Gréixer, Prop del Poble, 31TDG36, orientat al SE, incl. 80°, substrat esquistós, 1,400 m, 1990, *Llimona* (BCC 12883). LUGO. Consagrada, Puebla de Burón, 1987, *Valcárcel* (SANT 7767). ORENSE. Sierra de Invernadeiro, 29TPG3472, 1988, *Carballal* (SANT 8945). PALENCIA. Pico Curavacas, 30TUN66, 1,950 m, 1990, *Terrón* (LEB 1512).—PONTEVEDRA. La Fracha, *Crespi* (MA 1672, MA 1033).

LECANORA SALIGNA (Schrad.) Zahlbr.

Thallus of dispersed warts, yellowish; individual warts up to 0.2 mm diam. *Apothecia* rounded, 0.3–1.0 mm diam., single, sessile, with constricted base; disc dark red-brown, flat; margin prominent in

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young apothecia, persistent. Amphithecium corticate, laterally 55–100 μm wide, basally 60–120 μm wide, medulla hyphae with lumina of 1–2 μm wide, cortex 5–22 μm wide; hypothecium 40–75 μm high, yellowish brown, sometimes with conspicuous orange-brown patches; hymenium 37–70 μm , colorless; epihymenium 5–20 μm , brown to dark-brown; paraphyses weakly branched, 1.0–1.5 μm wide; spores simple, 7–13 \times 3–5 μm . *Pycnidia* not seen.

Chemistry.—Thallus C–, K–, P–. Secondary metabolites: isousnic acid.

Ecology and distribution.—This species grows on lignum of different phorophytes together with *Lecidea botryosa*, *Calicium salicinum* Pers., and *Trapeliopsis flexuosa*. It mainly appears from the meso- to supramediterranean belts at elevations of 700 to 1,300 m.

Distinguishing features.—Apothecia dark red-brown, amphithecial cortex \pm uniform in thickness, spores < 5 μm wide, and presence of isousnic acid.

Remarks.—*Lecanora albellula* is the other epiphytic taxon with amphithecial cortex \pm uniform in thickness; however, it is distinguished from *L. saligna* by different apothecial disc color (orange-brown in *L. albellula*), hypothecium colorless, and amphithecium narrower than that of *L. saligna*. The species is similar in appearance to *L. coniferarum* that has a basally thickened amphithecial cortex, broader spores, and usnic acid as main lichen substance.

Specimens examined.—SPAIN. JAÉN. Orcera, Sierra de Segura, río Madera, 30SWH3537, 1,270 m, 1997, *Aragón 2702/97* (MA). Santo Tomé, Sierra de las Villas, subida al cerro Vilchetes, 30SWH0209, 1,150 m, 1998, *Aragón 997/98 & Martínez* (MA). LEÓN. Priaranza del Bierzo, 29TPH90, 700 m, 1988, *Etayo & Terrón* (LEB 2176). TARAGONA. Baix Ebre, Tortosa, Mola de Catí (serra dels Ports), 31TBF7021, 1,200 m, fusta de pi, 1992, *Boqueras, Canals & Gómez-Bolea* (BCC 6080).

LECANORA VARIA (Hoffm.) Ach.

Thallus crustose, warted-areolate, continuous, beige to ochre. Apothecia 0.5–1.5 mm diam., single or in groups, sessile with constricted base; disc ochre to orange-brown, flat, whitish pruinose; margin strongly prominent when young, persistent, thick and two layered. Amphithecium corticate, amphithecial cortex 25–80 μm laterally, 90–150 μm near base, hyphae lumina 1.5–2.5 μm wide; hypothecium colorless to yellowish, 30–40 μm high; hymenium colorless, 50–80 μm high; epihymenium ochre, 6–13 μm ; paraphyses simple to weakly branched, 2 μm wide; spores colorless, simple, 10.0–12.5 \times 4.0–5.5 μm .

Chemistry.—Thallus C–, K–, P + yellow; secondary metabolites: usnic, psoromic and 2'-O-demethylpsoromic acids.

Ecology and distribution.—*Lecanora varia* mainly grows on acid bark or lignum of different phorophytes, in lowland sites as well as mountainous areas, in subhumid conditions, and it frequently appears together with *Cyphelium tigillare*, *Lecidea botryosa*, *Mycocalicium subtile*, or *Trapeliopsis flexuosa*. Our specimens originated mostly from the Mediterranean Region, at elevations of 700 to 2,000 m. Widespread in Europe (Printzen 2001).

Distinguishing features.—Apothecial margin strongly prominent when young, thick and in two layers, amphithecial cortex > 100 μm wide basally, and presence of psoromic acid.

Remarks.—*Lecanora varia* is easily identified by the prominent margin (when young) that is two layered—greenish or brownish on the outer part and yellowish on the inner part, spores narrowly ellipsoid, and the presence of psoromic acid. This species has been confused with *L. laxa*, which can be distinguished by the absence of psoromic acid, flexuose apothecia, and slightly smaller spores. *Lecanora varia* is related to *L. densa* and *L. burgaziae* through the presence of psoromic acid in the thallus and apothecial margin and amphithecial cortex distinctly thickened (with the base significantly broader). The main differences between these three species are given in Table 1.

Selected specimens examined.—ANDORRA. Ordino, Coll d'Ordino, 31TCH82, 1,930 m, Més amunt del Coll, *Llimona*, (BCC 7296). SPAIN. ALBACETE. Bienservida, Sierra de Alcaraz, Padrón de Bienservida, 30SWH3961, 1,600 m, *Aragón 1022/97, Herrero & Martínez* (MA). Paterna del Madera, Sierra de Alcaraz, Calar de la Osera, 30SWH5167, 1,550 m, 1997, *Aragón & Martínez* (MA). BARCELONA. Collada de les set Fonts, Pedreforca, Bergudà, CG97, 2,100 m, sobre *Pinus uncinata* mort., 1979, *Gómez-Bolea* (BCC 3350). CIUDAD REAL. Navas de Estena, Montes de Toledo, collado de Acebuches, 30SUJ6671, 975 m, 2002, *Aragón 954/02* (MA). CUENCA. Buenache de la Sierra, Serranía de Cuenca, cerro de la Menta, 30TWK9044, 1,424 m, 2002, *Aragón 2400/02* (MA). Serranía de Cuenca, Cotillas, 30TWK8738, 1,200 m, 1998, *Aragón & Martínez* (MA). JAÉN. La Iruela, Sierra de Segura, valle del río Borosa, 30SWH1305, 850 m, 1997, *Aragón 3205/97 & Martínez* (MA). Villacarrillo, Sierra de las Villas, arroyo de las Aguascebas, 30SWH1017, 1,200 m, 1998, *Aragón 1100/98, 1117/98 & Martínez* (MA). Aldeaquemada, Sierra Morena, cascada de La Cimbarra, 30SVH6749, 760 m, 1994, *Sarrión* (MA). LEÓN PROV. Sierra del Teleno, 29TQG2187, 1,550 m, 1993, *Terrón* (LEB 2071). Tabuyo del Monte, 29TQG2586, 1,220 m, 1993, *Terrón* (LEB 2077). Suertes de Ancares, 29TPH8546, 925 m, 1995, *Terrón* (LEB 3370). Guímar, 29TPH8752, 1,170 m, 1995, *Terrón* (LEB 3373). LÉRIDA. Alins, Vall Ferrera, 31TCH60, 1,900 m, *Pinus uncinata*, 1981, *Gómez-Bolea* (BCC 11770). SEGOVIA. Riofrío de Riaza, valle del río Riaza, Majada Larga, 30TVL6564, 1,500 m, 1994, *Aragón, Martínez & Rojas* (MA). Riofrío de Riaza, valle del río Riaza, barranco que sube hacia Las Vegas, 30TVL6465, 1,450 m, 1994, *Aragón & Martínez* (MA). SORIA. Recuerdo, Corral de la Losa, 30TVL9988, 1,000 m, 1995, *Aragón 1128/95* (MA). Dehesa de Cuevas de Agreda, Moncayo, WM92, lignícola, 1984, *Gómez-Bolea* (BCC 3537).

TOLEDO. Real de San Vicente, ascenso a los Pelados, vert. S, 30TUK5345, 1995, *Vázquez & Burgaz* (MACB). Hontanar, Montes de Toledo, río Estena, 30SUJ6280, 950 m, 2002, *Aragón 364/02* (MA). ZAMORA. Presa Puente Porto, 29TPG7965, 1,700 m, 1997, *Salegui & Andrés* (LEB 4821).

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