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Calliergonella (Bryopsida) in the Iberian Peninsula

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Abstract: Oliván, G.; Fuertes, E. & Acón, M. 2006. *Calliergonella* (Bryopsida) in the Iberian Peninsula. *Bot. Complut.* 30: 71-85.

The genus *Calliergonella* Loeske is revised for the Iberian Peninsula, based mainly on specimens kept in PC and the main Iberian herbaria. The occurrence of *C. cuspidata* (Hedw.) Loeske and *C. lindbergii* (Mitt.) Hedenäs in the studied area is confirmed. *C. cuspidata* is widely distributed in all kind of wet habitats in the Iberian Peninsula, especially in the mountainous areas of the northern half (30-2000 m a.s.l.). *C. lindbergii* is restricted to moist ant wet habitats in the Eurosiberian Region, growing from 1200 to 2200 m a.s.l. in the Pyrenees and at lower altitudes (50-100 m a.s.l.) in the Cantabrian Range. A key, descriptions, illustrations and distribution maps of the species of *Calliergonella* in the Iberian Peninsula are provided.

Key words: *Calliergonella*, Bryopsida, taxonomy, ecology, chorology, Iberian Peninsula.

Resumen: Oliván, G.; Fuertes, E. & Acón, M. 2006. *Calliergonella* (Bryopsida) in the Iberian Peninsula. *Bot. Complut.* 30: 71-85.

Se ha llevado a cabo la revisión del género *Calliergonella* Loeske en la Península Ibérica basada principalmente en material de herbario procedente de PC y de los más importantes herbarios ibéricos. Se confirma la presencia de *C. cuspidata* (Hedw.) Loeske y *C. lindbergii* (Mitt.) Hedenäs en el área de estudio. *C. cuspidata* se distribuye ampliamente en todo tipo de terrenos encharcados y húmedos de la Península Ibérica, especialmente en las zonas montañosas de la mitad norte (30-2000 m s.n.m.). *C. lindbergii* está restringida a medios húmedos de la Región Eurosiberiana, de manera que crece entre 1200 y 2200 m s.n.m. a lo largo de los Pirineos y a bajas altitudes (50-100 m) en la Cordillera Cantábrica. Se aportan clave, descripciones, iconografía y mapas de distribución para las especies de *Calliergonella* en la Península Ibérica.

Palabras claves: *Calliergonella*, Bryopsida, taxonomía, ecología, corología, Península Ibérica.

INTRODUCTION

The genus *Calliergonella* was described by Loeske (1911) to place the single species *C. cuspidata* (Hedw.) Loeske and has been mainly treated in modern floras and monographs as a distinct and monotypic genus belonging to the *Amblystegiaceae* G. Roth (e.g. Nyholm 1965, Kanda 1976, Tuomikosky & Koponen 1979, Crum & Anderson 1981), although some exceptions exist. Thus, Boros (1968), Karczmarz (1971) and Smith (1978) included *Calliergonella cuspidata* in the genus *Calliergon* (Sull.) Kindb., following the old treatments by Kindberg (1896), Loeske (1910) and Mönkemeyer (1927), while Richards & Wallace (1950) and Scott & Stone (1976) included it in *Acrocladium* Mitt., in accordance with Lindberg (1879), Brotherus (1923) and Dixon (1927).

Tuomikoski & Koponen (1979) and later Hedenäs (1989, 1992) definitively established *Calliergonella* as a genus distinct from *Calliergon* and *Acrocladium*. Their results were based on morphological and anatomical characters that had been neglected before by most taxonomists of pleurocarpous mosses. Tuomikoski & Koponen (1979) suggested that the three genera could even belong to different families, retaining only *Calliergon* in the *Amblystegiaceae*, although they did not place *Calliergonella* and *Acrocladium* in any other family. Nishimura *et al.* (1984) and Hedenäs (1989) placed *Calliergonella* in the *Hypnaceae* Schimp., and the latter also moved *Acrocladium* to the *Plagiotheciaceae* (Broth.) M. Fleisch., a result that was recently confirmed by phylogenetic studies based on molecular and morphological data (Pedersen & Hedenäs 2002). Hedenäs (1992, 1995, 1998) was unable to place *Calliergo-*

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nella with certainty either in the *Amblystegiaceae* or in the temperate *Hypnaceae*, since the limits between both families were badly defined at that point. However, recent phylogenetic analyses based on molecular data (Vanderpoorten *et al*. 2001) and on molecular and morphological data (Vanderpoorten *et al*. 2002a, 2003; Hedenäs *et al*. 2005) have better circumscribed the *Amblystegiaceae*, and it is now established that there are at least two families within it, the *Amblystegiaceae s.str.* and the *Calliergonaceae* (Kanda) Vanderpoorten *et al*. (see new classification in Vanderpoorten *et al*. 2002b). It seems now clear that *Calliergonella* belongs neither to the re-circumscribed family *Amblystegiaceae s.str.* nor to the *Calliergonaceae*, and its closest relatives seem to be among the temperate *Hypnaceae*. Ignatov & Ignatova (2004) have just resurrected the family *Pylaisiaceae* Schimp. to place *Calliergonella* together with *Breidleria*, *Pseudohygrohypnum* (*Hygrohypnum eugyrium* and *H. subeugyrium*), *Calliclad*ium, *Stereodon*, *Ptilium*, *Homomallium* and *Pylaisia*.

Calliergonella had been traditionally considered a monotypic genus (*C. cuspidata*) until Hedenäs (1992) transferred *Hypnum lindbergii* Mitt. to it. A few species were earlier described under *Calliergonella* or transferred to it. Grout (1931) included *Pleurozium schreberi* (Willd. ex Brid.) Mitt. in the genus *Calliergonella*, nowadays generally accepted to belong to the *Hylocomiaceae* (Rohrer 1985a, 1985b; Hedenäs 2004). Lawton (1971) described a new species in the genus, *Calliergonella conardii* E. Lawton, which was later synonymized with *Fontinalis hypnoides* Hartm. (Tuomikoski & Koponen 1979).

Calliergonella lindbergii (Mitt.) Hedenäs was first clearly defined as a species separate from *Hypnum pratense* Koch ex Spruce (currently *Breidleria pratensis* (Koch ex Spruce) Loeske) by Lindberg (Ångström 1861). Hitherto, both these species had been confused in the descriptions, or the first was treated merely as variety «*β*» (Wilson 1855; Schimper 1860). However, Lindberg made an unfortunate choice of an already used name, *Hypnum arcuatum*. Therefore, the name was an illegitimate homonym, and Mitten (1864) proposed a new name for this species, *Hypnum lindbergii* Mitt., honouring Lindberg. *Calliergonella lindbergii* had traditionally been considered to belong to *Hypnum* (Nyholm 1965, Ando 1973, Smith 1978) or to *Breidleria* (Loeske 1910) and had always been placed in the *Hypnaceae*, until Hedenäs (1992) circumscribed the genera *Calliergonella* and *Breileria* based on many morphological and anatomical characters never used before for this group.

Nowadays it is usually accepted that *Calliergonella* includes two species, *C. cuspidata* and *C. lindbergii*, especially since the circumscription of the genus suggested by Hedenäs (1992) has also been supported by phylogenetic analyses based on molecular (Tsubota *et al*. 2002) or molecular and morphological data (Vanderpoorten *et al*. 2002a), which showed both species belonging to a very well supported clade (100% bootstrap support).

History of *Calliergonella* in the Iberian Peninsula

Calliergonella cuspidata was reported from the Iberian Peninsula since the middle of the nineteenth century (Bory de Saint-Vicent (1820), Spruce (1849), Colmeiro (1889) and Röll (1897) in Spain, and Henriques (1889) and Luisier (1907, 1910) in Portugal). At the beginning of the twentieth century *C. cuspidata* was already well-known as a widely distributed moss in Spain and Portugal (Casares 1915; Machado 1918, 1931). *Calliergonella lindbergii* was first cited in the Iberian Peninsula (in the Pyrenees) by Jeanbernat & Renauld (1885) as *Hypnum arcuatum* Lindb. Only a few records of this species have been reported since then, most of them in the Pyrenees (Casas 1986, Ruiz & Brugués 1997) and only one in the Cantabrian Range (Fuertes & Martínez-Conde 1989).

Recent floras and checklists of the Iberian Peninsula still place *Calliergonella lindbergii* under *Hypnum* (Casas 1991, Ruiz & Brugués 1997, Casas *et al*. 2001) and keep *Calliergonella* as a monotypic genus containing only *C. cuspidata*. In view of the old-fashioned taxonomic treatment of the genus *Calliergonella* in the Iberian Peninsula, and since there is not a complete Iberian bryophyte flora, the present work was considered to be needed in order to: (1) assess the taxonomic status of the Iberian specimens of *Calliergonella* in the light of modern taxonomic works, (2) determine the current distribution and ecology of the species of *Calliergonella* in the studied area, (3) provide descriptions and illustrations specific for the Iberian specimens of *Calliergonella*. This study is part of a larger one containing all the genera traditionally placed under *Amblystegiaceae s.l.*

MATERIALS AND METHODS

This revision is based mainly on herbarium material from PC and the main Iberian herbaria (BCB, FCO, GDAC, LISU, MA,

MACB, MAF, MUB, PAMP, SALA, VAB, VIT). Many specimens were also collected by the authors in the studied area; these are now deposited in MACB. Due to the large number of Spanish herbarium specimens belonging to *Calliergonella cuspidata*, only a selection of these were studied (see Appendix 1), while all the available Spanish specimens belonging to *Calliergonella lindbergii* have been revised. About 300 specimens were checked. 110 morphological and anatomical characters have been studied (Appendix 2). The descriptions of the gametophytic characters and sexual branches, as well as the habitat descriptions and illustrations are based on Iberian specimens. Nevertheless, since there were no sporophytes in any of the studied Iberian specimens, the sporophytic characters were described from non-Iberian specimens, kept at S and BM, during stays of one of the authors in these institutions. The type specimens kept at S and BM was checked. Nomenclature follows Crosby *et al*. (1999) and Hedenäs (1992). Names of authors are abbreviated according to Brummit & Powell (1992).

RESULTS

Calliergonella Loeske, Hedwigia 50: 248, 1911.

Calliergon sect. *Calliergonella* (Loeske) Mönk., Laubm. Eur. 744, 1927. Type: *Calliergonella cuspidata* (Hedw.) Loeske, Hedwigia 50: 248, 1911. – *Hypnum cuspidatum* Hedw., Sp. Musc. Frond. 254, 1801 (basionym).

Calliergon subgen. *Pseudacrocladium* Kindb., Eur. N. Amer. Bryin. 1: 80, 1897. – *Hypnum* sect. *Pseudacrocladium* (Kindb.) Paris, Index Bryol. Suppl. 285, 1900. – *Acrocladium* sect. *Pseudacrocladium* (Kindb.) Broth. Nat. Pflanzenfam. I(3): 1038, 1908. Type: *Calliergon cuspidatum* (Hedw.) Kindb., Canad. Rec. Sci. 6(2): 72, 1894. – *Hypnum cuspidatum* Hedw., Sp. Musc. Frond. 254, 1801 (basionym).

Plants forming loose or dense tufts or mats, green or shiny yellowish, medium-sized to large. **Stem** erect or prostrate, usually branched in one plane, pinnately or irregularly branched; stem transverse section round-oval, with central strand, large and thin-walled medullar cells and 3-5 layers of yellowish-brown, thick-walled cortical cells enclosed by a well developed hyalodermis; axillary hairs abundant, medium-sized, with 1-5 hyaline or brownish apical cells and 1 quadrate to shortly rectangular and brownish basal cell; pseudoparaphyllia foliose, broad; paraphyllia absent. **Rhizoids** in bundles, below leaf costa insertion, on ventral surface of stem in prostrate plants, red-brown, scarcely branched, smooth. **Stem leaves** ± concave, either straight, oblong-ovate with abruptly acute or obtuse and apiculate or rounded apex, or falcate, ovate to oblong-ovate with gradually and shortly to longly acuminate apex; erect-spreading to imbricate, usually complanate; margin plane, entire or slightly denticulate near apex; costa short and double, occasionally absent; median lamina cells linear-flexuose, becoming shorter and wider towards apex and slightly shorter, wider and porose towards base; marginal cells similar or slightly shorter and wider than adjacent median lamina cells; alar cells numerous, hyaline, inflated, forming a well delimited group, slightly or longly decurrent. **Branch leaves** narrower and smaller than stem leaves or only slightly smaller. **Dioicous**. **Perigonia** lateral on stem, perigonial leaves ovate, abruptly acuminate, margin entire, ecostate. **Perichaetia** lateral on stem; inner perichaetial leaves straight, plicate, lanceolate, erect, margin entire, apex acuminate, costa absent or sometimes short and single, cells fusiform to linear, thin-walled and smooth; vaginula with paraphyses. **Seta** long (3,5-5,0 cm), reddish, slightly twisted, smooth. **Capsule** inclined to horizontal, curved, broadly cylindrical, inflated, brownish, furrowed when dry. **Exothecial cells** irregular, rounded, hexagonal or quadrate in ventral part, longer and rectangular in dorsal part; stomata at base of capsule, phaneropore. **Separating annulus** present, consisting of 3-4 rows of cells, cells of marginal rows rectangular to shortly rectangular and cells of central rows quadrate to rounded. **Peristome** well developed; exostome yellowish, brownish towards base, lower outside ornamentation cross-striolate, upper outside ornamentation papillose, border broad, widened where ornamentation changes from cross-striolate to papillose; endostome hyaline to yellowish, basal membrane high, about 35-40% of endostome height, segments perforated, papillose, cilia 2-3, long, appendiculate at least in upper part of cilia, otherwise nodose. **Lid** conical, obtuse and apiculate. **Calyptra** cucullate, naked. **Spores** 12,5-20,0 μm, brownish, finely papillose.

The genus *Calliergonella* includes two species, both present in the Iberian Peninsula.

1.- Leaves straight, oblong-ovate; apex abruptly acute or obtuse and apiculate or rounded. Apices of stems and branches usually straight, acute and stiff .....1. *C. cuspidata*

1.- Leaves falcate, ovate to oblong-ovate; apex gradually and shortly to longly acuminate. Apices of stems and branches usually hooked.....2. *C. lindbergii*

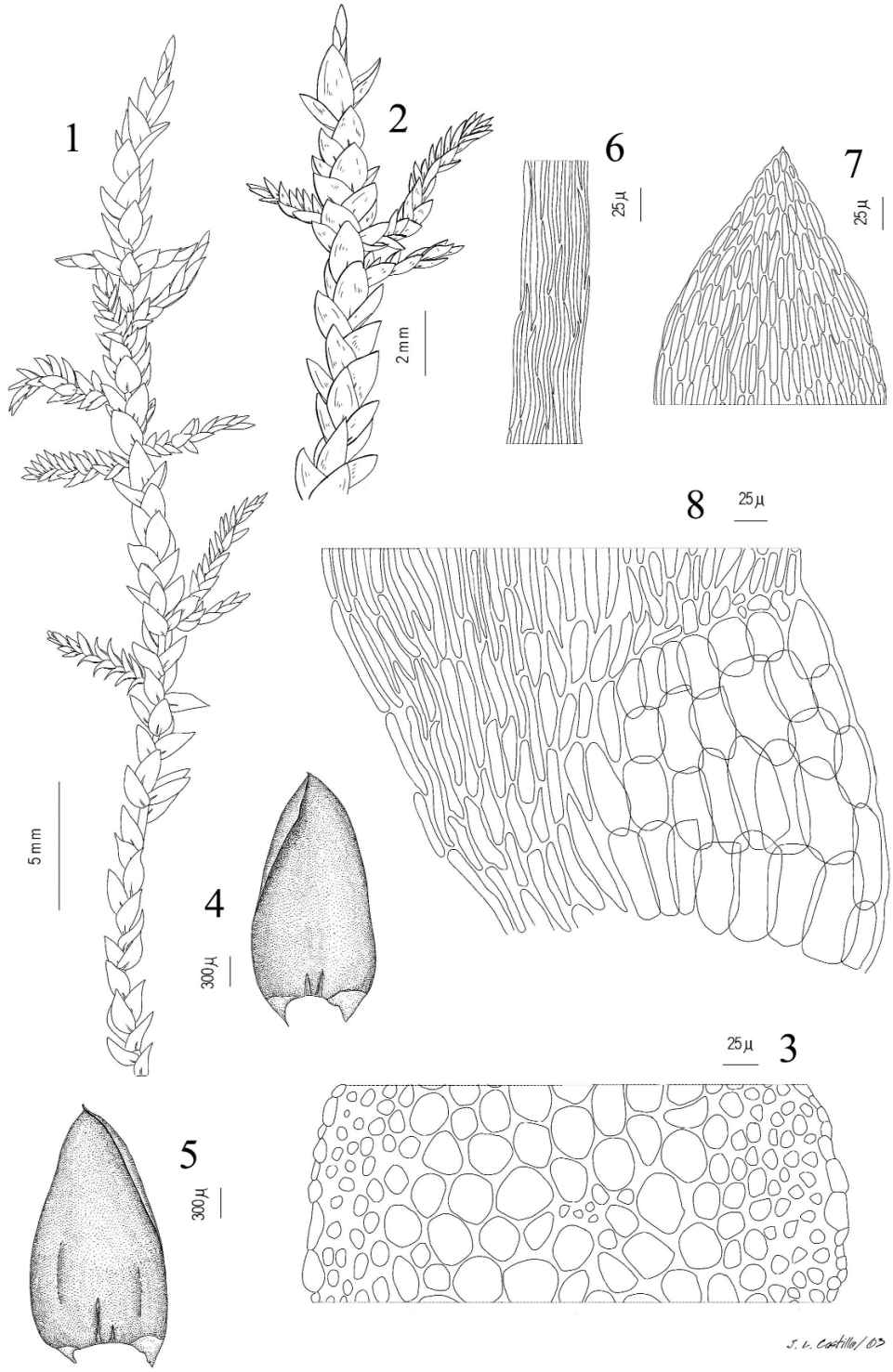

Fig. 1— *Calliergonella cuspidata*. 1, shoot; 2, shoot apex; 3, stem transverse section; 4-5 stem leaves; 6, median lamina cells; 7, apical cells; 8, alar cells.

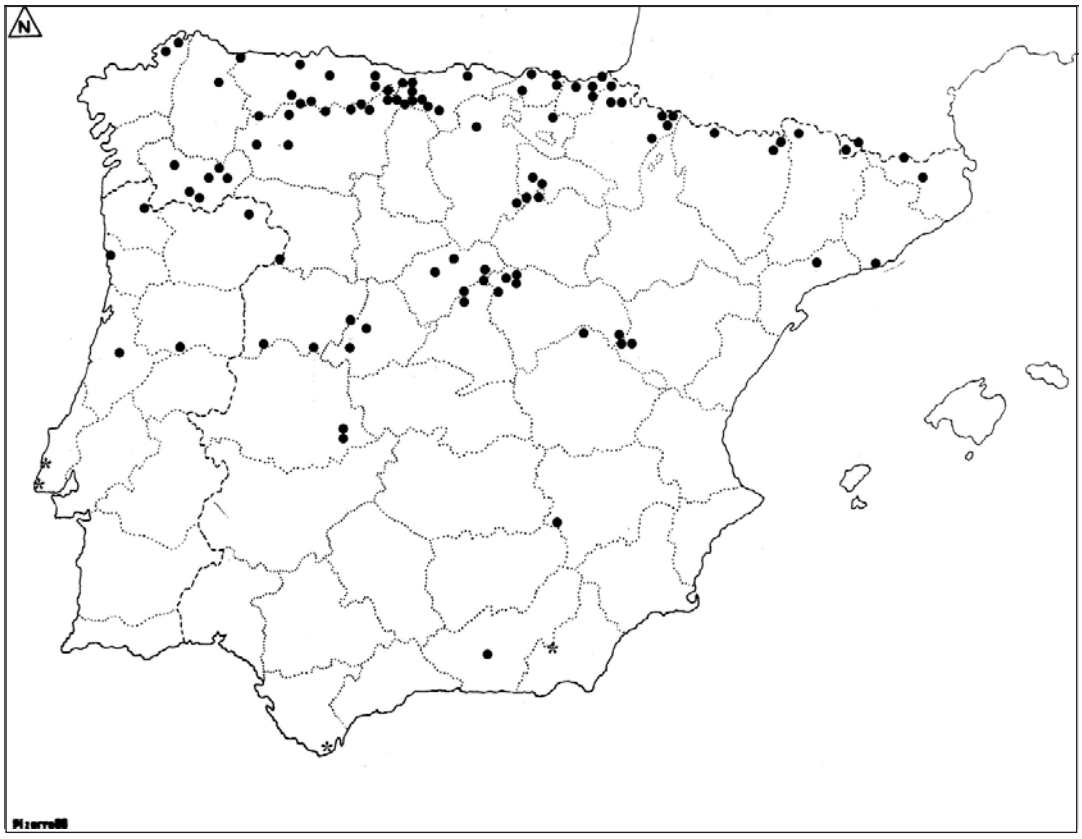

Fig. 2— Distribution map of *Calliergonella cuspidata* in the Iberian Peninsula. ● confirmed occurrence (10 x 10 Km square); ✱ literature report.

1. **Calliergonella cuspidata** (Hedw.) Loeske, Hedwigia 50: 248, 1911. (Fig. 1).

Hypnum cuspidatum Hedw., Sp. Musc. Frond. 254. 1801 (basionym). – *Stereodon cuspidatus* (Hedw.) Brid., Bryol. Univ. 2: 824, 1827. – *Amblystegium cuspidatum* (Hedw.) Mitt., Nat. Hist. Azores 312, 1870. – *Acrocladium cuspidatum* (Hedw.) Lindb., Musci Scand. 39, 1879. – *Calliergon cuspidatum* (Hedw.) Kindb., Canad. Rec. Sci. 6(2): 72, 1894. **Lectotype**: «*Hypnum cuspidatum*. Lipsiae lectus. Hedwig», G, selected by Hedenäs (1992).

Plants forming loose or dense tufts, green or shiny greenish-yellow to brownish, 5-10(12) cm. **Stem** often erect, sometimes prostrate, occasionally julaceous, ± pinnately branched, branches 1-2 cm; stem transverse section round-oval, with central strand, large and thin-walled medullar cells and 4-5 layers of yellowish-brown, thick-walled cortical cells enclosed by a well developed hyalodermis; axillary hairs abundant (4-7 per leaf axil), with 3-5 hyaline or brownish apical cells; pseudoparaphyllia foliose, broad, ± quadrate with irregular margin. **Rhizoids** scarce in erect plants, more abundant on ventral surface of stem in prostrate plants. **Stem leaves** straight, slightly concave, oblong-ovate, 1,2-1,3 mm wide x 1,8-2,2 mm long; erect-spreading to imbricate, usually strongly appressed and inrolled towards apices of stem and branches, forming straight, acute and stiff tips, usually complanate; leaf margin plane, entire, sometimes slightly denticulate near apex; apex abruptly acute or obtuse and apiculate or rounded; costa short and double (up to 25% of length leaf); median lamina cells linear-flexuose, 3,7-5,0(6.2) μm wide x 60-120(130) μm long, becoming shorter and wider towards apex and slightly shorter, wider and porose towards base; marginal cells similar to adjacent median lamina cells; alar cells rectangular to shortly rectangular, hyaline, strongly inflated, thin-walled, forming a very well delimited group, triangular or ± quadrate, usually excavate and decurrent. **Branch leaves** smaller and narrower than stem leaves, lanceolate, 0,4-0,8 mm wide x 1,3-2,1 mm

long. **Dioicous**. **Perichaetia** lateral on stem; inner perichaetial leaves straight, plicate, lanceolate, erect, margin entire, apex acuminate, costa absent or sometimes short and single, cells fusiform to linear, thin-walled and smooth; vaginula with paraphyses. **Sporophyte** typical for genus. Sporophytes not known from Iberian specimens and rare in non-Iberian specimens.

Habitat: All kinds of wet and nutrient rich habitats. Rich fens, swampy meadows, moist soil in woods and bushy areas with *Erica* sp., beside eutrophic pools, brooks, etc., on acid or basic substrates. It has been found occasionally submerged in ponds (Peñuelas & Comelles 1984).

General distribution: Eurasia, North and South America, Macaronesia, northern and north-eastern Africa, New Zealand and Australia (Hedenäs 2003a, 2003b).

Distribution in the Iberian Peninsula (Fig. 2): *Calliergonella cuspidata* is most abundant in the northern half of the Iberian Peninsula, where it is only absent in the dry areas of the Northern Sub-plateau, while in the southern half this species is restricted to mountainous areas above 1200 m a.s.l. In the Eurosiberian Region *C. cuspidata* grows from the low montane to alpine belts (30-2000 m a.s.l.), in the north-western coasts of Portugal (Douro Litoral and Beira Litoral) and Spain (Coruña, Lugo), from the Galician-Portuguese Massif (Orense, Minho, Trás-Os-Montes and Alto Douro) to the Cantabrian Range (Lugo, Asturias, León, Zamora, Palencia, Cantabria and Basque Mountains (Guipúzcoa, Vizcaya)) and the Pyrenees (Navarra, Huesca, Andorra, Lérida and Gerona). In the Mediterranean Region, it grows in higher altitudes, in the supra-oromediterranean belts of the high mountains (700-2200 m a.s.l.) in the Central Range (Guadalajara, Madrid, Ávila, Segovia, Salamanca and Beira Alta), Mountains of Toledo (Cáceres) and the Iberian Range (Burgos, La Rioja, Soria, Guadalajara, Cuenca and Teruel). In contrast, in the southern half of the peninsula, which is much dryer, *C. cuspidata* is restricted to the Penibetic Ranges (Sierra de los Filabres (García-Zamora *et al*. 1999) and Sierra Nevada in Granada) and Sub-Betic Ranges (Sierra de Cazorla, Segura y Las Villas).

Selected specimens examined: Appendix 1.

Specimens erroneously identified as Calliergonella cuspidata: Appendix 3.

2. **Calliergonella lindbergii** (Mitt.) Hedenäs, Lindbergia 16: 167, 1992 («1990»). (Fig. 3).

Hypnum lindbergii Mitt., J. Bot. 2: 123, 1864 (basionym).. - *Hypnum curvifolium* subsp. *lindbergii* (Mitt.) Kindb., Canad. Rec. Sci. 6: 74, 1894. - *Stereodon lindbergii* (Mitt.) Braithw., Brit. Moss Fl. 3: 157, 1902.. - *Drepanium lindbergii* (Mitt.) G. Roth, Eur. Laubm. 2: 628, 55 f. 5, 1904.. - *Breidleria lindbergii* (Mitt.) W. Schultze-Motel, Nova Hedwigia 5: 88, 1963. **Lectotype**: «270. *Hypnum arcuatum* Lindb. In terra argillaceae circa Holmian. Leg. S. O. Lindberg», S!, selected by Hedenäs (1992). **Isolectotype**: BM!: BM000851575.

Hypnum arcuatum Lindb., Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 18: 371, 1861, illegitimate, later homonym. **Original material**: S!, BM!: BM000851575.

Hypnum pratense var. *arcuatum* Molendo, Ber. Naturhist. Vereins Augsburg 18: 184, 1865. - *Breidleria arcuata* (Molendo) Loeske, Stud. Morph. Syst. Laubm. 172, 1910. Type not seen (cf. Ignatov & Afonina, 1992). Full synonymy in Hedenäs (1992).

Plants forming quite dense tufts or carpets, green, shiny yellowish or brownish, 3-8 cm. **Stem** usually erect, irregularly branched, branches 1,0-2,5 cm; stem transverse section round-oval, with central strand, large and thin-walled medullar cells and 3-4 rows of yellowish-brown thick-walled cortical cells enclosed by a well developed hyalodermis; axillary hairs abundant (4-6 per leaf axil), with 1-4 hyaline or brownish apical cells; pseudoparaphyllia foliose, very broad, transversally rectangular with irregular margin. **Rhizoids** (abundant on ventral surface of stem in prostrate plants. **Stem leaves** falcate, hooked at stem apices, concave, ovate to broadly ovate, 0,5-0,8 mm wide x 1,5-2,2 mm long; erect-spreading, usually complanate; leaf margin plane, entire or slightly denticulate near apex; apex gradually and shortly to longly acuminate; costa short and double (up to 35% of length leaf), occasionally absent, seldom single; median lamina cells linear, flexuose, 5-7 μm wide x 50-110(125) μm long, becoming shorter and wider towards apex and shorter, wider and porose towards base; marginal cells slightly shorter and wider than adjacent median lamina cells; alar cells rectangular to shortly rectangular, hyaline, inflated, thin-walled, forming a very well delimited group, triangular, sometimes excavate and not or slightly decurrent. **Branch leaves** slightly smaller than stem ones. **Dioicous**. **Perichaetia** lateral on stem; inner perichaetial leaves straight, plicate, lanceolate, erect, margin entire, apex acuminate, costa absent or sometimes short and single, cells fusiform to linear, thin-walled and smooth; vaginula with paraphyses. **Sporophyte** typical for genus. Sporophytes not known from Iberian specimens and rare in non-Iberian specimens.

Habitat: Wet and nutrient-rich habitats. Wet or moist meadows, pool or brook shores, moist and loamy soils in woods and beside paths, on basic or acid substrates.

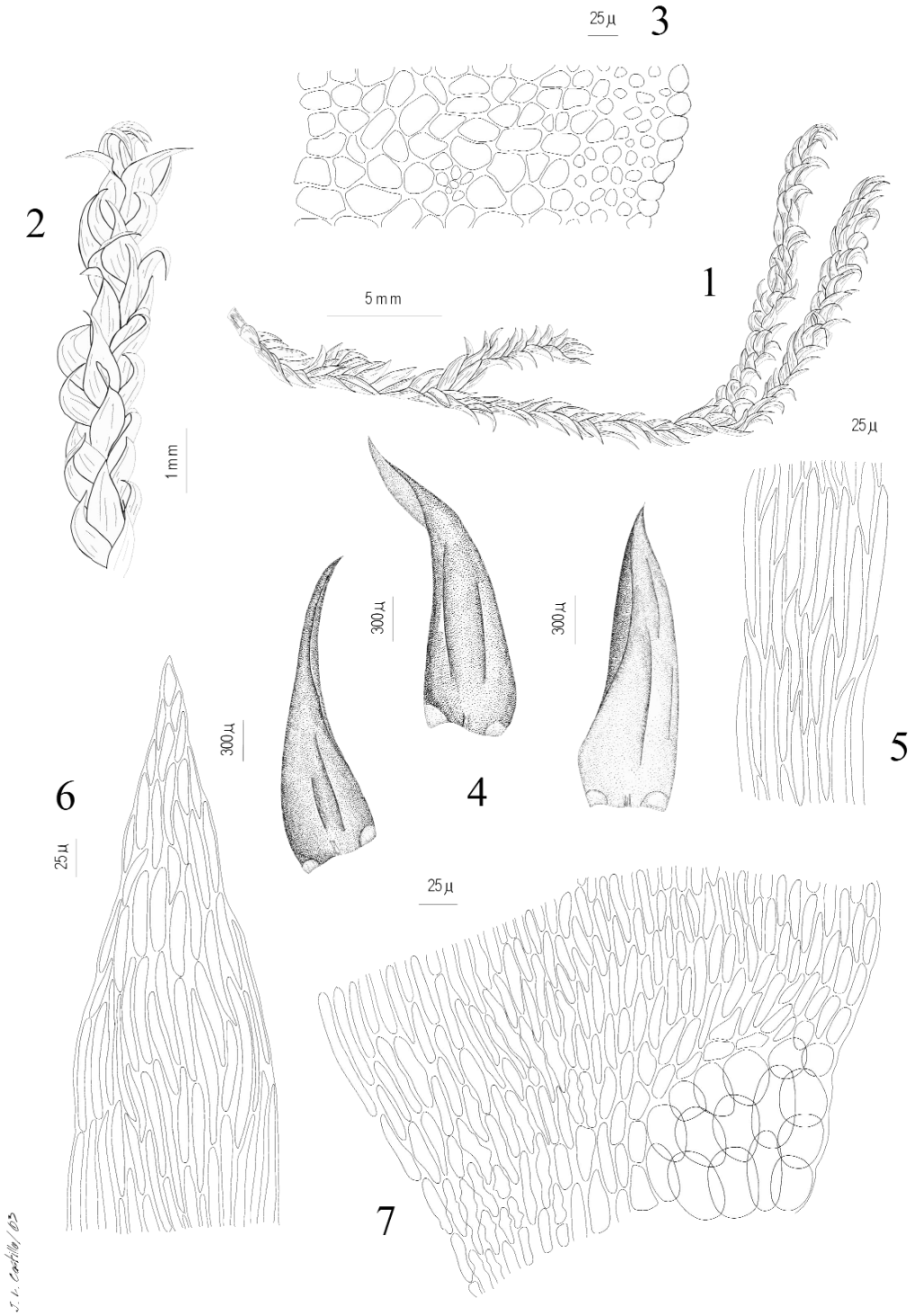

Fig. 3— *Calliergonella lindbergii.* 1, shoot; 2, shoot apex; 3, stem transverse section; 4, stem leaves; 5, median lamina cells; 6, apical cells; 7, alar cells.

General distribution: Eurasia, North America, and a few localities in Brazil (Hedenäs, 2003a, 2003b).

Distribution in the Iberian Peninsula (Fig. 4): *Calliergonella lindbergii* is restricted to the Eurosiberian Region, along the Pyrenees (Navarra, Huesca, Lérida and Gerona) and Cantabrian Range (Asturias and Cantabria). In the Pyrenees it grows in the high-montane to alpine regions (1200-2200 m a.s.l.), while in the Cantabrian Range it has been collected at lower altitudes, from 50 to 100 m a.s.l.

Specimens examined: Appendix 1.

DISCUSSION

Calliergonella cuspidata and *C. lindbergii* are very similar in almost all the characters except in the shape and symmetry of the stem leaves and sometimes in leaf orientation. It seems now surprising that they had never been thought to be closely related until Hedenäs (1992) placed them together in the same genus. However, considering that for a long time the classifications of bryophytes were based on a few key characters, such as those mentioned above, maybe it is not so strange that the similarity in many other characters of *Calliergonella cuspidata* and *C. lindbergii* were disregarded for a long time. This stresses the importance of using the highest possible number of characters, either morphological or molecular, in order to get accurate taxonomies based on well-resolved phylogenies.

Calliergonella cuspidata is easily distinguished from other related or similar taxa by the stem with hyalodermis, oblong-ovate leaves, usually obtuse-rounded and apiculate apex, costa short and double, and alar cells inflated and hyaline, forming a well delimited group. These diagnostic characters are constant in all the plants

Fig. 4— Distribution map of *Calliergonella lindbergii* in the Iberian Peninsula. ● confirmed occurrence (10 x 10 Km square).

belonging to this taxon. Nevertheless, some other features can vary considerably, which has resulted in the description of a high number of varieties (Karczmarz 1971). It seems that the variability depends on habitat conditions, and many aquatic and terrestrial forms and varieties have been distinguished. Iberian specimens that had been referred to two varieties of *Calliergonella cuspidata* were found in the collections that were checked for the present work, *C. cuspidata* var. *pungens* (Schimp.) Latzel and *C. cuspidata* var. *fluitans* (H. Klinggr.) Riehm. All of them were re-identified as *Calliergonella cuspidata*, since we consider that they fit perfectly within the variability of the species, and their differences are only due to habitat conditions. Karczmarz (1971) reported *Calliergonella cuspidata* var. *caespitosum* (H. Whitehouse) Jansen & Wacht. for Spain, but we have seen no Spanish specimens under this name in the revised herbaria.

During this study we found that plants of *Calliergonella cuspidata* growing in dry and exposed habitats, forming carpets and presenting julaceous stems with acute and stiff apices and yellow-brownish colour, had sometimes been confused with *Pleurozium schreberi* (Willd. ex Brid.) Mitt. (see Appendix 3). Their appearance in the field may be very similar, but they can be easily differentiated when observed with a microscope. *P. schreberi* has very different alar cells, rectangular and thick-walled, never hyaline and inflated, and a stem without hyalodermis. *C. cuspidata* has also occasionally been confused with *Scorpidium revolvens* (Sw. ex Anonymo) Rubers (Fuertes *et al*. 2005), probably due to the presence of a hyalodermis on the stem in both species. However, they can easily be separated because *S. revolvens* has falcate stem leaves and a single costa reaching midleaf or beyond.

Calliergonella lindbergii is easily distinguished from other related or similar taxa by the stem with hyalodermis, ovate to oblong-ovate leaves, gradually and shortly to longly acuminate apex, costa short and double and alar cells inflated and hyaline, forming a well delimited group.

Habitat and distribution in the Iberian Peninsula

In the Iberian Peninsula *Calliergonella cuspidata* is basically present in all the wetlands with not too poor soils. Since wetlands are more abundant in the northern half of the Iberian Peninsula, this is where *C. cuspidata* is most abundant. It seems that *C. cuspidata*'s distribution is only determined by the availability of water, and neither any other climatic factor, nor altitude, nor the kind of substrate, seem to affect it. The presence of *Calliergonella cuspidata* in Sintra (Casares 1915), Mafra (Machado 1918), Algarve (Solms-Laubach 1868) and Valle de la Miel (Allorge & Allorge 1946) could not been confirmed since no material from those localities was found in the revised herbaria (see Fig. 3).

Although the first record for *Calliergonella lindbergii* in Spain was given by Jeanbernat & Renauld (1885), Spruce had gathered it in the Pyrenees before, although it was distributed by Schleicher as *Hypnum circinatum* (Mitten 1864). Spruce (1849) reported *Hypnum pratense* in Bagneres de Bigorre, in the French Pyrenees. Also Wilson (1855) affirmed that *Hypnum pratense* «var. α» was common in the Pyrenees. However, *Breidleria pratensis* has not been reported from the Spanish Pyrenees, while *Calliergonella lindbergii* is relatively common in that area (Ruiz & Brugués 1997, Casas 1986). Taking into account that both species were not well defined until Lindberg (in Ångström 1861) described *Hypnum arcuatum*, it is possible that the preceding references to *Hypnum pratense* correspond either to *Calliergonella lindbergii* or to *Breidleria pratensis*.

Ruiz & Brugués (1997), in a revision of the genus *Hypnum* for peninsular Spain, affirmed that *Calliergonella lindbergii* (*Hypnum lindbergii* in their treatment) is restricted to the Pyrenees. However, they ignored that a record of this taxon for the Cantabrian range had already been published (Fuertes & Martínez-Conde 1989). We confirm the distribution of this species along the Pyrenees and Cantabrian Range. *Calliergonella lindbergii* grows in the Pyrenees from 1200 to 2200 m a.s.l., whereas in the Cantabrian Range it has been collected at low altitudes (50 m a.s.l.). This difference in altitude preferences could be due to the humidity conditions. Since the south slope of the Pyrenees is quite continental, mosses with high requirements of humidity have to grow at high altitudes, where the dryness of the summer cannot affect them. The Cantabrian Range has a more Atlantic influence, which provides higher humidity conditions, allowing *C. lindbergii* and many other mosses to grow at lower altitudes than they do in the Pyrenees.

Although the habitat preferences of *Calliergonella cuspidata* and *C. lindbergii* seem to be very similar, the latter is restricted to the Eurosiberian region, while *C. cuspidata* has a wider distribution. It is likely that *C. lindbergii* is more dependent on the environmental humidity than *C. cuspidata*, since it usually grows in more exposed habitats, and consequently it is more sen-

sitive to dry periods. However, it is also possible that the distribution of *C. lindbergii* is affected by other climatic factors that restrict its growth to the Eurosiberian Region.

Besides these considerations, *Calliergonella cuspidata* is a since long very well-known taxon and easy to identify in the field, while *C. lindbergii* has been known only later, in part because it was described later as a separate species from *Hypnum pratense*. In addition, it is not so easy to recognize this species in the field, and it could have been confused with *Hypnum* species. Consequently, the distribution area of *C. lindbergii* in the Iberian Peninsula could be larger than known at present.

Conservation

Calliergonella cuspidata can be considered as a common moss of wet and moist habitats in Andorra, Portugal and Spain. Machado (1931) already made similar observation about *C. cuspidata* in Portugal: *«Uno de los musgos más vulgares y característicos de terrenos encharcados»*.

In contrast, *Calliergonella lindbergii* is considered as a vulnerable species in Spain and the Iberian Peninsula (Sérgio *et al*. 1994), but not throughout Europe (Schumacker & Martiny 1995). According to Hallingbäck *et al*. (1998) a species is Vulnerable (VU) when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to E) shown in that work. There is only information to assess the threat category of *C. lindbergii* in the Iberian Peninsula under criterion B (species recently recorded in twenty or fewer 10 km x 10 km squares and found in ten or fewer localities/severely fragmented and in decline). So far *C. lindbergii* has been reported in sixteen 10 km x 10 km squares and in 19 localities, agreeing only with the first part of criterion B. On the other hand, it occurs in eutrophic habitats, such as roadsides, a circumstance that seems to indicate that *C. lindbergii* bears quite well the anthropogenic pressure, which is probably the main threat for the wet habitats in the Iberian Peninsula. In our opinion this species, although rare in the Iberian Peninsula, is not menaced.

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Appendix 1. Specimens examined.

Calliergonella cuspidata

ANDORRA. **31TCH71**, Pal. Pla de Borrás, *Casas*, 13-07-78, BCB 10671; **31TCH91**, Vall d´Inclés, Pont de l´Orry, *E. Fuertes & G. Oliván*, 17-10-2001, MACB.

PORTUGAL. **Beira Alta**: **29TPE16**, Serra da Estrela, *Fuertes, Acón & Oliván*, 2000. **Beira Litoral**: **29TNE45**, Penedo da Meditaçao. Coimbra, *P. Allorge*, 1928, PC. **Douro Litoral**: **29TNF26**, Boa-Nova, *V. Allorge*, 1950, PC. **Minho**: **29TNG62**, Caldas de Gerez, *P. Allorge*, 1931, PC. **Trás-os-Montes e Alto Douro**: **29TPG82**, Serra Nogueira sobre Rabordaos, *P. Allorge*, 1931, PC.

SPAIN. **Albacete**: **30SWH46**, Campamento de San Juan, Riópar, *Ros*, 1984, MACB 62114. **Asturias**: **29TPJ52**, Ribadeo, *P. Allorge*, 1956, PC; **30TUP30**, Entre Cangas de Onís y Covadonga, *P. Allorge*, 1933, PC; **30TTP80**, Siero, El Plano, *H. S. Nava*, 1986, MA-Musci 15988; **29TQH27,** Parque Natural de Somiedo, *E. Fuertes & A. R. Burgaz*, 1994, MACB s/n; **29TQJ3219**, Pravia, Cañedo, *J. Muñoz*, 1988, MA-Musci 15986; **30TUN7499**, Peñamellera Baja; Narganes, *J. Muñoz*, 1987, MA-Musci 15990; **30TTN6067**, Lena, Ubiña, vega del Meicín, *C. Aedo*, 1990, MA-Musci 17327; **30TUN39**, Covadonga, camino a las minas, *Simó*, 1970, MACB 62316. **Ávila**: **30TUK07**, Sierra de Gredos, Puerto de la Peña Negra, *Brugués, Cros & Lloret*, 1993, BCB 41895; Peña Negra, Herguijuela, *Costa,* MACB 62111; **30TUK291656**, Puerto del Pico, Cuevas del Valle, *Soria & Ron*, 1984, MACB 13841; **30TUK0568**, Sierra de Gredos, Laguna del Cervunal, *Granzow, Ortiz & Ron*, 1983, MACB 11261; **30TUK26**, Sierra de Gredos, Puerto del Pico, prope Cuevas del valle, *E. Fuertes*, 1985, MACB. **Barcelona**: **31TDF07**, Garraf Olivella, Can Suniol, *F. Lloret*, 1993, BCB 50376. **Burgos**: **30TWM05**, Neila. Refugio de Villavelayo, *Casas*, 1988, BCB 25353; **30TVM94**, Quintanar de la Sierra, *Casas*, 1988, BCB 33419; **30TVN43**, Huidrobo, *Fuertes*, 1988, MACB 29915. **Cáceres**: **30STJ9784**, Navalvillar de Ibor. Garganta Salóbriga, *Casas*, 1995, BCB 49309; **30STJ9875**, Río Ibor, *M. C. Viera*, 1980, MA-Musci 5093. **Cantabria**: **30TUN87**, Peña Sagra, *Oliván & Fuertes*, 1997, MACB 75705; *Ibidem*, *Fuertes*, 1985, MACB 20652; **30TUN57**, Fuente Dé, MA-Musci 6978, *Fuertes*, 1981, MACB 28692; **30TUN6166**, Vega de Liébana; Puertos de Río Frío, *J. Muñoz*, 1988, MA-Musci 15989; *Ibidem*, Fuertes & Acón, 1996, MACB 64277; **30TVN06**, Hermandad de Campoo de Suso, Serna, *J. Muñoz*, 1995, MA-Musci 19744; **30TUN9364**, Hermandad de Campoo de Suso, Abiada, *J. Muñoz*, 1987, MA-Musci 15987; **30TVP3307**, Camargo; Maliaño, «El Carmen», *J. Muñoz*, 1988, MA-Musci 15991; **30TUN7474**, Cabezón de Liébana, La Tenada de Montecillo, pr. Perrozo, *C. Aedo*, 1991, MA-Musci 17328, 12220; **30TUN7580**, Cabezón de Liébana; supra Cahecho, *J. Muñoz*, 1996, MA-Musci 21307; **30TUN5975**, Cosgaya, *Viera & Ron*, 1979, MACB 31390; **30TUN69**, Urdón, *Fuertes & Martínez-Conde*, 1981, MACB 22187. **Coruña**: **29TNJ71**, Caaveiro, Puentedeume, *J. Reinoso*, 1979, BCB 7417; **29TNJ83**, Sierra de Capelada, *Fuertes, Oliván & Sallent*, 2000, MACB. **Cuenca**: **30TWK79**, Hoz de Beteta, *E. Fuertes & A. Silva*, 1982, MA-Musci 276; *Ibidem*, *E. Fuertes & M. Alonso*, 1979, MA-Musci 7572; *Ibidem*, *Fuertes & Alonso-Silva*, 1980, MACB 10599. **Gerona**: **31TDG49**, Vall Llobre, *Lloret*, 1985, BCB 25286; **31TDG6166**, Carretera de Olot a Sta Pau, Km 6, *Solé*, 1984, BCB 32192. **Granada**: **30SVG61**, Barranco del Genil, *Varo*, 1974, MACB 62315. **Guadalajara**: **30TVL9969**, Sierra de Bulejo, *Álvarez & Ayala*, 1985, MACB 20046; **30TVL74**, Prados de Campillejo,

Ladero & Demetrio, 1970, MACB 62314; **30TVL95**, Sierra del Alto Rey, arroyo Pelagallinas, *Gómez, Pajarón & Ron*, 1976, BCB 24530; **30TVL86**, Hayedo de Cantalojas, río Lillas, *Riestra*, 1985, MACB 14541. **Guipúzcoa**: **30TWN89**, Pasajes, *P. & V. Allorge*, 1932, PC; **30TWN69**, Entre Zarauz y Guetaria, *P. Allorge*, 1933, PC; **30TWP90**, Irún, *P. Allorge*, 1927, PC; Monte Jaizquibel, cerca de Irún hacia el océano, *P. Allorge*, 1930, PC; **30TWN69**, Zarauz, *P. & V. Allorge*, 1933, PC; **30TWN88**, Cuevas de Landarbaso, *V. Allorge*, 1968, PC; **30TWN35**, Puerto de Arlabán, *Gandoger*, 1910, PC. **Huesca**: **31TBH91**, Hospital de Benasque, subiendo al Pla dels Estanys, *Casas*, 1962, MACB 2707; **31TCH02**, Benasque, Plan d´Estan, *M. Infante & P. Heras*, 2002, VIT 29322; **30TYN23**, Panticosa, El Bozuelo, *Casas*, 1965, MACB 3219. **La Rioja**: **30TWM27**, El Rasillo de Cameros, *Zubía,* MA-Musci 3676; Orillas del Ebro, *Zubía,* MA-Musci 3648; Orillas del Ebro, *Zubía,* MA-Musci 6090-3; **30TWM18**, Sierra de la Demanda. Peñas en la carretera forestal a San Millán de la Cogolla, *Casas*, 1979, BCB 1002. **León**: **30TUN17**, Puerto de las Señales, *Fuertes, Acón & Oliván*, 17-05-2002, MACB; Laguna de Isoba, *Fuertes, Acón & Oliván,* MACB; **30TUN07**, Puerto de San Isidro, *Fuertes, Acón & Oliván*, 2002, MACB; **30TUN4580**, Posada de Valdeón; pr. Cordiñanes, *J. J. Aldasoro,* 1994, MA-Musci 19254; **30TTN76**, Puerto de Pajares, *P. Allorge*, 1928, PC; **29TQH3366**, Cabrillanes; Laguna de las Verdes de Babia, *J. J. Aldasoro*, 1994, MA-Musci 19249; **29TPH84**, Valle del Cuiña de León, *Casas & Cros*, 1984, BCB 25263; **29TQH21**, Manzanal del Puerto. Brañuelas, *P. Allorge*, 1927, PC; **30TUN4580**, Posada de Valdeón, pr. Cordiñanes, *J. J. Aldasoro*, 1995, MA-Musci 13336; **30TUN26**, Picos de Mampodre, supra Acevedo, *Gandoger*, 1905, PC; **29TQH25**, subida al Puerto de La Magdalena, *E. Fuertes, M. Acón, E. Munín & G. Oliván*, 1999, MACB; **30TUN4173**, Posada de Valdeón, monte Gildar, Horcada del Oro, pr. Caldevilla, *J. Muñoz*, 1994, MA-Musci 15993; **29TPH81**, Toral de los Vados, *P. Allorge*, 1927, PC. **Lérida**: **30TCH23**, Vall d'Arán, camino a Artiga, *Casas*, 1966, MACB 2187. **Lugo**: **29TPH38**, Carretera de Oviedo a Lugo, cerca de Meira, Sierra de Meira, *V. Allorge*, PC; **29TPJ52**, Ribadeo, *P. Allorge*, 1933, PC. **Madrid**: **30TVL36426**, Puerto de Canencia, *Vicente & Ron*, 1984, MACB 27797; **30TVL55**, Hayedo de Montejo, *Fuertes*, 1980, MACB 7963; **30TVL32**, Sierra de Guadarrama, Puerto de Canencia, *Fuertes et al*., 2000, MACB 75172; Puerto de Canencia, camino de la Tejera, *J. Vicente & E. Ron*, 1984, MACB 27796 pp.; **30TVL33**, Sierra de Guadarrama. Puerto de Navafría, fuente del Reajo Bajo, *Fuertes & Acón*, 20-06-2001, MACB; **30TVL55**, Dehesa Boyal de Somosierra, *Fuertes & Oliván*, 2001, MACB; Dehesa Boyal de Robregordo, *Fuertes & Oliván*, 2001, MACB; **30TVL55**, Montejo de la Sierra, *E. Fuertes*, 1980, MA-Musci 153. **Navarra**: **30TXN52**, Sierra de Leyre, barranco de Fuente Fría, *Simó*, 28-09-1972, BCB 37228; **30TXN74**, Valle del Roncal. Uztarroz, *Casas*, 1960, BCB 15095; **30TXN16**, Camino de Sayoa, junto al convento, *Fuertes*, 1974, MACB 62112; **30TXN09**, Endarlaza, *P. Allorge*, 31-05-1927, PC; **30TXN65**, Larrau, *P. Allorge*, 1938, PC; **30TXN07**, Santesteban, *P. Allorge*, 1930, PC; **30TXN7055**, Isaba, pr. Isaba, Mintxate, *A. Ederra*, 1996, MA-Musci 21318; Isaba, Belabarce, *A. Ederra*, 1996, MA-Musci 21313. **Orense**: **29TPG37**, Sierra de Queija, *Gandoger*, 1898, PC; **29TPG57**, Viana del Bollo, margen del río Bibey, *P. Allorge*, 1933, PC; **29TPG24**, Verin, *P. Allorge*, 1933, PC; **29TNH80**, Piñor *P. Allorge*, 1933, PC; **29TNG98**, Laguna de Antela, cerca de Ginzo de Limia, *P. Allorge*, 1928, PC; **29TPG5383**, O Bolo, *C. Aedo*, 1991, MA-Musci 17218. **Palencia**: **30TUN66**, Curavacas, *Fuertes & Acón*, 2003, MACB. **Salamanca**: **30TTK67**, Carretera cerca de Béjar, *V. Allorge*, 1956, PC; **29TQE17**, Puerto Descargamaría, *Casas, Cros & Brugués*, 1985, BCB 21404. **Segovia**: **30TVL28**, San Miguel de Bernúy, prob. *E. Guinea*, 1940, MA-Musci 6868; **30TVL66**, Riofrío de Riaza, Macizo de Ayllón, Pto. de la Quesera, *Fuertes & Bermejo*, 1982, MACB 56621; *Ibidem*, *Fuertes & Oliván*, 2001, MACB; **30TVL06**, Zarzuela del Pinar. Borde del rio Cega, *P. Allorge*, 1931, PC. **Soria**: **30TWM25**, Sierra de Cebollera, *E. Fuertes & E. Munín*, 1999, MACB. **Tarragona**: **31TCF37,** Montes de Prades, *F. 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ANDORRA. **31TCH71**, Grau Roig. Pleta de Morató, Casas, 1975, BCB.

SPAIN. **Asturias**: **30TUP1914**, Colunga, Santiago de Gobiendas, Obaga, *J. Muñoz*, 1986, MA-Musci 17527. **Cantabria**: **30TUN68**, Sierra de Beges, *E. Fuertes & Martínez-Conde*, 1983, MACB 22159. **Gerona**: **31TDG18**, La Molina, *Casas*, 1950, BCB 16651; *Ibidem*, *C. Casas*, 1948, BCB; La Molina, Torrent de la Molina, *Casas*, 1956, BCB 25833; **31TDG48**, Torrent del Rodá, Faitús Llanars, *F. Lloret*, 1984, BCB 23609; **31TDG49**, Riera de Catllar, Vilallonga del Ter, *F. Lloret*, 1983, BCB 23610; Setcases, *Casas*, 1955, BCB 16649; **31TDG29**, Nuria, camino a la Font Alba, *Casas*, 1968, MACB 61835; *Ibidem*, *Casas*, 1949, BCB 16648; Nuria, hacia el Coll de Finestrelles y cerca del Santuario, *Casas*, 1949, BCB 14899; **31TDG4384**, Lels Adous d'Abella, LLamars, *F. Lloret*, 1984, BCB 25837; **31TDG57**, Vall de Bianya, *Casas*, 1952, BCB 14900. **Huesca**: **31TBH51**, Valle de Añisclo, Casas, 1955, BCB 47976. **Lérida**: **31TCH12**, Hospital de Vielha, *Casas*, 1961, BCB 43662; **31TCH21**, Boi, Estany Llebreta, *Casas*, 1991, BCB 43649; **31TCH90**, Maranges, *Casas*, 1958, BCB; **31TCH31**, Boi. Sobre el Estany de Colomers, *Casas*, 1994, BCB 39867; **31TCG99**, Montmalús, Viella, *P. Monserrat*, 1950, BCB 16650. **Navarra**: **30TXN2482**, Arizcun, *Ederra*, 1985, MACB 61835.

Appendix 2. Morphological and anatomical characters studied.

GAMETOPHYTE

Plant

1. Habit
3. Colour
4. Size

Stem

4. Orientation in relation to the substrate
9. Branching pattern
10. Size of branches

Anatomy

11. Shape of the transverse section
12. Central strand
13. Basic tissue
14. Cortex
15. Hyalodermis

Axillary hairs

16. Number hairs/leaf axil
17. Number of apical cells
18. Colour of apical cells
19. Description of basal cells

Pseudoparaphyllia

20. Present/absent. Shape

Paraphyllia

21. Present/absent. Shape

Rhizoids

22. Position
23. Colour
24. Branching
25. Ornamentation
26. Abundance

Stem leaves

27. Symmetry
28. Rugosity/ presence of undulations/ concavity
29. Shape
30. Size

Orientation in relation to the stem

31. Wet condition
32. Dry condition (if different)

Margin

33. Curvature
34. Denticulation

Apex

35. Description

Costa

36. Length, double, single, etc
37. Surface cells
38. Proration/papillosity?

Areolation

Mid-leaf cells

39. Shape
40. Size
41. Cell walls
42. Papillosity

Apical cells

43. Shape
44. Size
45. Cell walls

Basal cells

46. Shape
47. Cell walls

Marginal cells

48. Shape
49. Size

Alar cells

50. Appearance
51. Cell walls
52. Alar group appearance
53. Alar group decurrency

Initial cells of rhizoids

54. Position
55. Appearance

Branch leaves (if different)

56. Symmetry
57. Shape
58. Size

Sexuality

59. Sexual condition

Perigonia

60. Position
61. Leaf shape
62. Leaf margin
63. Leaf costa

Perichaetia

64. Insertion
65. Paraphyses

Inner perichaetial leaves

66. Symmetry
67. Plication
68. Shape
69. Orientation
70. Margin
71. Apex
72. Costa

Areolation

Upper cells

73. Shape
74. Cells walls
75. Papillosity/proration

Lower cells

76. Shape
77. Cell walls
78. Papillosity/proration

Vaginula

79. Description

SPOROPHYTE

Seta

80. Length
81. Colour
82. Twisting
83. Ornamentation

Capsule

84. Orientation
85. Shape
86. Size
87. Colour
88. Ornamentation (wet/dry)

Exothecial cells
- 89. Shape
- 90. Size
- 91. Papillosity/mammillosity
- 92. Differentiation (apophysis to mouth)

Stomata
- 93. Number
- 94. Position
- 95. Structure

Separating annulus
- 96. Absent/present. Description

Peristome

Exostome
- 97. Colour
- 98. Orientation (wet/dry)
- 99. Lower outside ornamentation
- 100. Upper outside ornamentation
- 101. Margin
- 102. Border

Endostome
- 103. Colour
- 104. Basal membrane height (%)

Segments
- 105. Perforation
- 106. Ornamentation

Cilia
- 107. Number
- 108. Development
- 109. Appendiculate/nodose

Lid
- 110. Description

Calyptra
- 111. Shape
- 112. Ornamentation

Spores
- 113. Size
- 114. Ornamentation

Appendix 3: Specimens erroneously identified as *Calliergonella cuspidata*.

SPAIN: Ávila: **UK0477**, Puerto de la Peña Negra, Piedrahita, MACB 11260 is *Pleurozium schreberi*. **León**: **29TPH74**, Tejedo de Ancares, MACB 17491, MA-Musci 4165 is *Pleurozium schreberi*. **Madrid**: **30TVL54**, Montejo de la Sierra, MACB 19953 is *Pleurozium schreberi*. **Navarra**: **30TXN64**, Urzainqui, PC is *Pleurozium schreberi*. **Segovia**: **30TVL66**, Riofrío de Riaza, Puerto de la Quesera, MACB 53238 is *Pleurozium schreberi*; *Ibidem*, MA-Musci 13377 is *Pleurozium schreberi*.