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Fissidens bryoides var. *gymnandrus* and *F. celticus* (Bryophyta, Fissidentaceae) in the Iberian Peninsula

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Abstract – *Fissidens bryoides* Hedw. var. *gymnandrus* (Buse) R. Ruthe and *Fissidens celticus* Paton are reported new to Spain, based on collections from the Basque Country in the northern part of the Iberian Peninsula. A description and illustrations of each taxon based on Iberian samples are provided. *Fissidens bryoides* var. *gymnandrus* is lectotypified.

Bryophyta / *Fissidens* / Iberian Peninsula / new records / Spain

INTRODUCTION

In the preparation of a monograph of the genus *Fissidens* for **Flora Briofitica Ibérica** by the first author (J.G.), numerous collections from the northern part of the Iberian Peninsula have been critically examined. The purpose of this report is to record and discuss the presence of *F. bryoides* Hedw. var. *gymnandrus* (Buse) R. Ruthe and *F. celticus* Paton, in the bryoflora of Spain. The descriptions and illustrations provided are based on Iberian specimens.

MATERIALS AND METHODS

The present study is based on a revision of around 400 samples of *Fissidens* deposited in VIT (Vitoria), PAMP (Pamplona), MUB (Murcia) and FCO (Oviedo). Microscopic examination was made with an Olympus-BH2 light microscope, while microphotographs were obtained with a Spot insight QE camera mounted on that microscope.

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RESULTS AND DISCUSSION

Fissidens bryoides Hedw. var. **gymnandrus** (Buse) R. Ruthe, *Hedwigia* 9: 178. 1870. **(Figs 1-4)**

Basionym: *Fissidens gymnandrus* Buse, *Hedwigia* 8: 55. 1869.
Ind. loc.: "Bisher nur bei Renikli in der Provinz Geldern in Holland an einem Bache beobachtet...".
Lectotype: L, designated here. [The Netherlands] "In het najaar met rijpe vrucht, bij Renkom, ontdekt en verzameld door", *L.H. Buse legit* (L 0059987).

Plants 3-7 mm tall. *Stems* simple or sparingly branched; *central strand* well-developed. *Rhizoids* basal and axillary, brownish to brown-orange, slightly papillose to almost smooth. *Leaves* erect to erect-patent, usually incurved, sometimes slightly curled when dry, 5-12(14) pairs, oblong-lanceolate to oblong-lingulate, 0.9-1.7 × 0.3-0.5 mm; *laminae* unistratose; *apex* acute to shortly acuminate, more rarely obtuse-apiculate; *margins* entire, sometimes sinuose at the apex; *limbidium* present in all laminae, rarely absent in the dorsal lamina, with (1)2-3 row of cells, confluent with the nerve (Fig. 3), 1-2 stratose, 7.5-12.5(14) µm wide in the dorsal lamina, 12-25(30) µm wide in the vaginant lamina. *Costa* percurrent or shortly excurrent in an apiculus, 40-50 µm wide at mid-leaf. *Dorsal laminae* slightly decurrent; *vaginant* laminae 1/2-2/3 the leaf length. *Upper and median* lamina cells irregularly quadrate to hexagonal, sometimes rectangular, (7)12-15 × 7.5-12 µm, plane, smooth (Fig. 4). *Paroicous. Perichaetia* terminal, perichaetial leaves slightly longer and narrower than the vegetative ones, limbidium sometimes absent on the dorsal laminae. *Perigonia* absent, antheridia naked in the leaf axils below perichaetia (Figs 1-2). *Seta* 1 per perichaetium, more or less straight, sometimes slightly sinuose or twisted at base, 5-6(7) mm long, brownish to yellow, smooth. *Capsule* immature. *Calyptra* cucullate, *ca* 0.5 mm long.

Distribution – Known from Austria (Grims, 1999), Netherlands and Belgium (Siebel & During, 2006), Great Britain (Smith, 2004), Italy (Cortini Pedrotti, 2001), Montenegro (Erzberger & Papp, 2007), Germany, Iceland, Switzerland, Poland (Düll, 1992), Czech Republic (Kučera & Váňa, 2003), Sweden (Hallingbäck *et al.*, 2008), Slovenia, Kroatia, Bosnia and Hercegovina (Düll *et al.*, 1999), Greece (Sabovljević *et al.*, 2008), and Russia (Ignatov & Afonina, 1992); also reported from Japan and North America (Podpěra, 1954).

Iberian sample – Spain, Vizcaya, Orozco, Usotegieta, Gorbeia Natural Park. 30TWN1466, 1120 m a.s.l., *Heras*, 31-08-1985 (VIT 7125).

On calcareous walls in the bottom of a karstic depression, on a north facing slope with beeches. Growing with *Lejeunea cavifolia* (Ehrh.) Lindb., *Leiocolea bantriensis* (Hook.) Jörg., *Jungermannia atrovirens* Dumort., *Trichostomum brachydontium* Bruch and *Orthothecium rufescens* (Dicks. ex Brid.) Schimp.

The genus *Fissidens*, subgenus *Fissidens*, as described in Pursell & Bruggeman-Nannenga (2004), comprises 12 species in the Iberian Peninsula (*cf.* Casas *et al.*, 2006). Among them, the group of *F. bryoides* and *F. viridulus* cover

a set of morphologically very variable taxa, so much that several American authors have considered them in a wide sense, synonymising both species (Pursell, 2007a; Pursell, 2007b). In recent European floras (Smith, 2004; Cortini-Pedrotti, 2001) or checklists (Hill *et al.*, 2006), *F. bryoides* and *F. viridulus* have been considered distinct species that can be differentiated by several characteristics, among them and more importantly, their reproductive systems, that is the distribution of antheridia and archegonia on the plants.

European authors consider that *F. viridulus* includes autoicous plants, with antheridia on the basal stems, perhaps rhizoautoicous, or dioicous plants. Meanwhile, *F. bryoides*, in a strict sense, includes mainly autoicous (gonioautoicous) and, rarely, paroicous plants. Bruggeman-Nannenga (1982) confirmed that, as far as the European samples she had studied were concerned, the sexual condition of *F. viridulus* was the one here is described, that is to say it never presents axilar antheridia. In addition, several relevant morphological characteristics served to separate both species. *Fissidens viridulus* includes small plants of (2.5)3-7 mm, with 1-2 stratified limbidium that generally does not reach the leaf apex, and therefore is not usually confluent with the costa. In contrast, *F. bryoides* shows somewhat larger plants, generally 5-15 mm long, limbidium 1-3 stratified, reaching the leaf apex and clearly confluent at the leaf apex with the percurrent to short-excurrent costa.

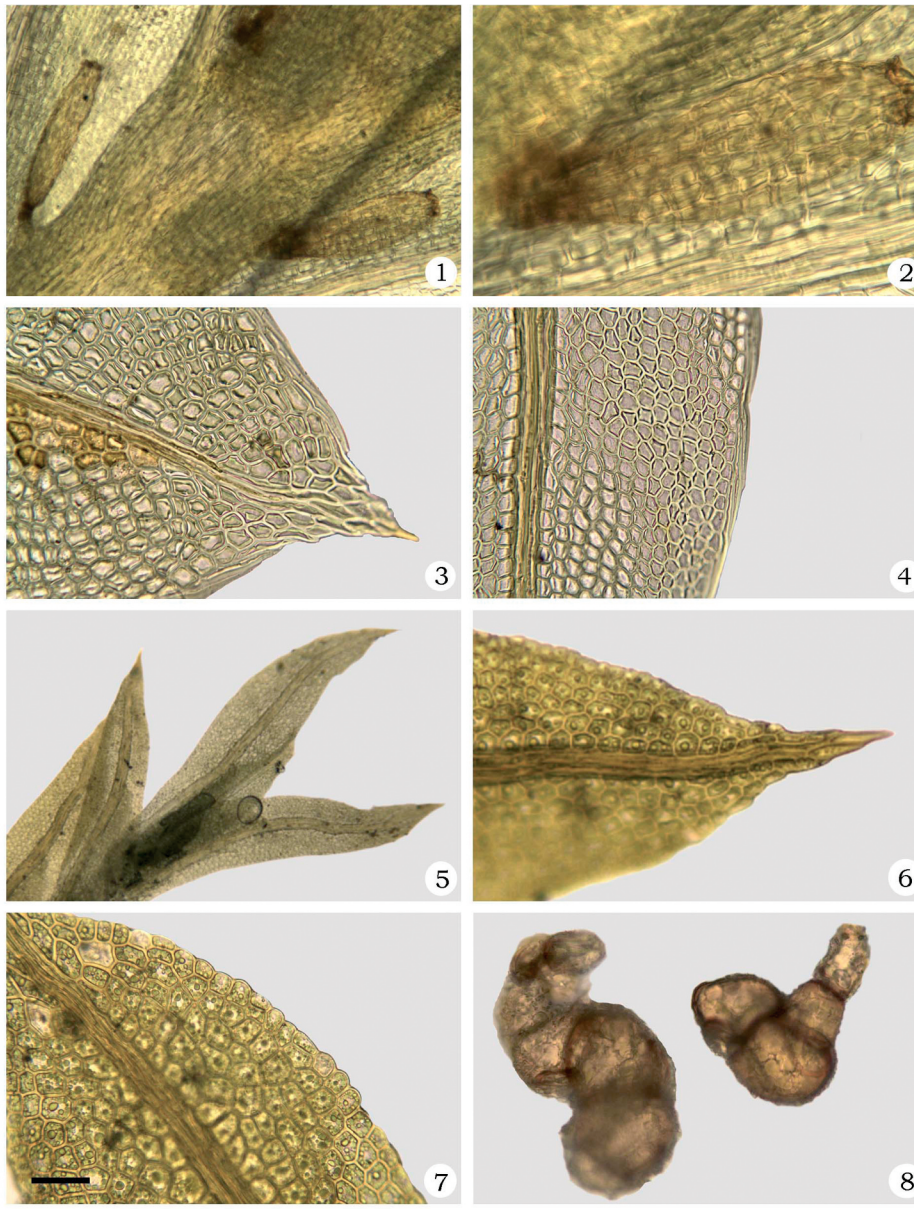
Fissidens bryoides is one of the most frequently collected species of subgenus *Fissidens* in the north of the Iberian Peninsula. It is mainly represented by var. *bryoides*, which is gonioautoicous and has brown rhizoids, followed by var. *caespitans* Schimp., also gonioautoicous, but with violet-red rhizoids. Among the more than 250 specimens examined, only one was found to be *F. bryoides* var. *gymnandrus*, which is paroicous, with naked antheridia (without perigonial leaves) in the leaf axils, below the perichaetia (Figs 1-2). The taxonomic category of this taxon has varied in recent years from being considered by some authors a synonym of *F. bryoides* (Ignatov & Afonina, 1992), to a variety (Hallingbäck *et al.*, 2008) or a distinct species (Hill *et al*., 2006). It is clear that only a comparative molecular study including other close species (e.g., *F. monguillonii* Thér.) will provide a more or less firm support regarding its taxonomic status.

Fissidens bryoides var. *gymnandrus* is recorded here for the first time in the Iberian Peninsula. The previous account of this species in Spain from Muniellos Nature Reserve (Asturias) by Fernández & Collado (2003) was based on an erroneous determination of a specimen of *F. ovatifolius* R. Ruthe.

Fissidens celticus Paton, *Trans. Brit. Bryol. Soc.* 4: 780. 1965. **(Figs 5-8)**

Ind. loc.: "Cornwall, Husty Wood, St Breock near Wadebridge, shaded bank above stream". Holotype: [Great Britain] "Shaded bank above stream, Husty Wood, St. Breock, Wadebridge, Cornwall", 8.8.1963, *J.A. Paton* (OXF !).

Plants (2)3-4(6) mm tall. *Stems* simple or sometimes branched in the axils of upper leaves or near the base; *central strand* well-developed. *Rhizoids* basal and axillary, deep red to brown-red, papillose; *rhizoidal gemmae* multicellular, moniliform, 70-200 µm long, brown (Fig. 8). *Leaves* erect to patent, incurved when dry, 5-16(18) pairs, lanceolate to oblong-lanceolate, 0.5-0.8 × 0.1-0.2 mm; *laminae* unistratose, usually narrowing at the junction of the vaginant and apical laminae; *apex* acute, acuminate, apiculate; *margins* entire at the base, sinuose-crenulate to denticulate at the apex; *limbidium* absent. *Costa* 25-30 µm wide at mid-leaf, distinctly bent half-way along its length, percurrent or shortly excurrent in a short



Figs 1-8. **1-4.** *Fissidens bryoides* var. *gymnandrus* (VIT 7215). **1.** antheridia, **2.** detail of antheridium. **3.** leaf apex. **4.** median cells. **5-8.** *Fissidens celticus* (VIT 35020). **5.** perichaetial leaves. **6.** leaf apex. **7.** median and marginal cells. **8.** rhizoidal gemmae. Scales. 1 = 50 µm; 2 = 20 µm; 3, 4, 7 = 25 µm; 5 = 100 µm; 6 = 30 µm; 8 = 20 µm.

apiculus of 3-5 cells (Fig. 6). *Dorsal laminae* not decurrent, sometimes ending slightly above the insertion; *vaginant* laminae 1/2 the leaf length. *Upper and median* lamina cells irregularly hexagonal, sometimes slightly rectangular near the

costa, 14-20 × 12-15 μm, plane to slightly convex, smooth, with one or more oil globules, cell walls incrassate (Fig. 7). *Dioicous*(?). *Perichaetium* apical; perichaetial leaves slightly longer and narrower than the vegetative ones, 0.8-1 mm long (Fig. 5). *Perigonia* absent. *Sporophyte* absent.

Distribution – Described originally from England (Paton, 1965), *Fissidens celticus* has been reported from Belgium, France, Germany and Scotland (Stirling, 1967; Sotiaux *et al*., 1991; Vanderpoorten & Sotiaux, 2002; Lüth, 2008). A previous report of the species in Alicante (Spain) by Casas *et al.* (2001) was based on an erroneous identification in Cano *et al*. (1996), and was therefore not included in Casas *et al.* (2006).This report is the first for the species in the Iberian Peninsula.

Iberian sample – Spain, Guipúzcoa, Oiartzun, Oieleku, Aiako Harriak Natural Park, 30TWN9589, 575 m a.s.l., *Infante & Heras*, 16-05-2006 (VIT 35020).

Saxicolous with *Fissidens viridulus* (Sw. *ex anon.*) Wahlenb., on a rocky granitic talus of a stream bank, in the bottom of a shady ravine under an acidophilous beech forest.

Fissidens celticus belongs to subgenus *Aloma* Kindb. (Hill *et al.*, 2006), in which most species are tropical and subtropical. Another species belonging to this subgenus and found in continental Europe, is *F. exilis* Hedw., an annual plant that usually does not exceed 1.2 mm in length, has 2-4 pairs of leaves, a straight costa, upper and median lamina cells 8-10(12) μm wide, eguttulate, and a short poorly differentiated intralaminal limbidium on the vaginant laminae. The plants are usually found with sporophytes, but lack rhizoidal gemmae.

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