

# *Zygodon bistratus* sp. nov. (Orthotrichaceae) from the Iberian Peninsula

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**ABSTRACT.** *Zygodon bistratus*, a new species from Spain in the Iberian Peninsula is described. The small size, partially bistratose leaf lamina and the upper laminal cells with tall, forked papillae are distinctive features for this species.

**KEYWORDS.** *Zygodon bistratus*, Orthotrichaceae, Spain.



While examining material of Iberian Peninsula *Zygodon* for the taxonomic treatment of the genus in this area, some distinctive specimens with bistratose leaves were found. Most of them had been named *Zygodon rupestris* Schimp. ex Lorentz, while others were identified as *Z. baumgartneri* Malta (a synonym of *Z. rupestris*, cf. Karttunen 1984). However, they show a combination of characters not found in any other *Zygodon*, and therefore are here described as a new species.

***Zygodon bistratus*** Calabrese & J. Muñoz, sp. nov.

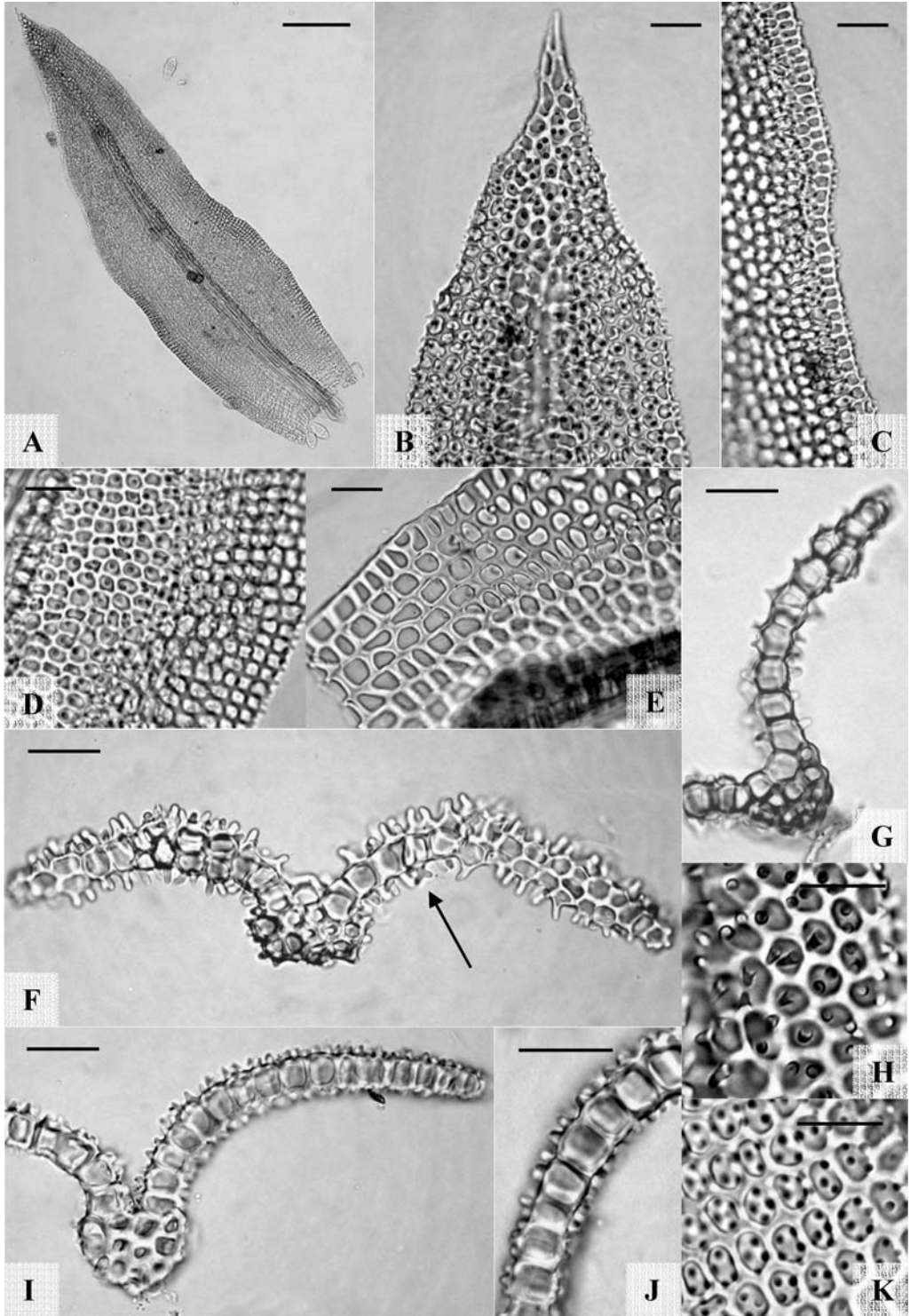
**Figs. 1A–H, 2**

*Differt a Zygodon viridissimus et Z. rupestris statura minore, folia bistrata, papillae altae, simplices aut bifurcatae, gemmae fusiformes aut claviformes, 3–5-cellularis, cum parietibus tantum transversalibus.*

TYPE: SPAIN. BADAJOZ: La Morera, Sierra de María Andrés, pr. La Morera, 460 m, MGRS Coord. 29SQC06, corteza de *Quercus ilex* L. subsp. *ballota* Samp., 22-IV-1992, Muñoz s.n. (holotype: MA 20460; isotype: NY).

**Description.** Plants to 0.6 cm tall, in loose turfs, green above, reddish-brown to brown below. Stems erect, sometimes branched, pentagonal in cross-section, central strand absent, cortex of 2(–3) layers of small

and thick-walled cells. Rhizoids reddish-brown to yellowish-brown, roughened to papillose, at the base of stem. Leaves erect and somewhat contorted when dry, erect-spreading when moist, increasingly larger to the stem apex, lanceolate, keeled, (0.80–)1.00–1.47 mm long, 0.20–0.32 mm wide, slightly decurrent, apex acute, occasionally with small denticulations; margins plane, entire, papillose throughout or papillose above and smooth towards leaf base; lamina partially or almost entirely bistratose in the upper half, partially bistratose to unistratose in the lower half; upper leaf cells isodiametric, rounded-hexagonal to subquadrate, thick-walled, 6–10 µm in diameter, papillose, 1–2(–3) papillae per cell, towards the margins perfectly aligned, the papillae tall, simple or forked; basal cells subquadrate to short-rectangular, longer toward the costa and shorter towards the margins, thick-walled, sometimes nodulose, 10.0–24.5(–42.7) µm long, 7.5–12.5 µm wide, usually smooth; costa ending below the apex, 25–38 µm wide in lower 1/3, in a deep furrow, dorsally smooth in the lower half and papillose above, ventrally smooth throughout, in cross-section with 2 ventral guide cells and thick-walled, smaller dorsal cells. Propagula usually abundant in leaf axils, fusiform to fusiform-clavate, with hyaline to yellowish-brown or brown walls, 3–5-celled, 32–70 µm long, (15–) 20–33 µm wide, with only transverse or somewhat oblique septa. Dioicous. Perigonia term-



**Figure 1.** A–H. *Zygodon bistratus*. A. Leaf. B. Leaf apex. C. Leaf margin. D. Upper leaf cells. E. Basal leaf cells. F. Leaf cross-section in the upper half, the arrow points to a bifurcate papilla. G. Leaf cross-section in the lower third. H. Details of upper leaf cells showing 1–2 papillae per cell. I–K. *Zygodon rupestris*. I. Leaf cross-section in the upper half. J. Details of leaf cells and papillae. K. Details of upper leaf cells showing 3–6 papillae per cell. A–E, H from *J. Muñoz s. n.* (MA 20460); F from *Ederra s. n.* (PAMP 7195); G from *Ederra s. n.* (PAMP 7208); I–K from *J. Muñoz s. n.* (MA 18054). Scale: A = 0.1 mm; B–K = 20  $\mu$ m.

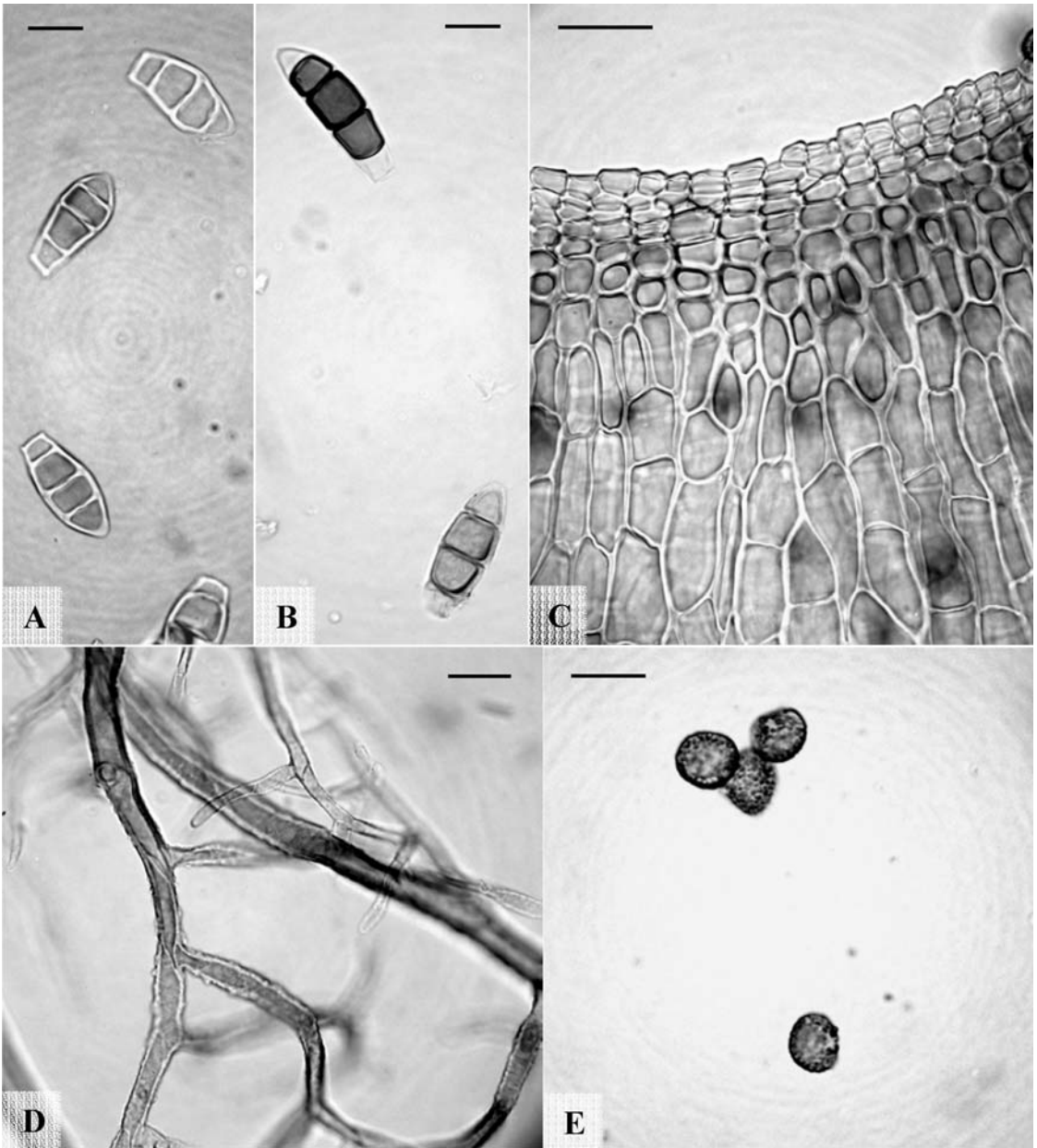


Figure 2. *Zygodon bistratus*. A–B. Propagula. C. Capsule mouth. D. Rhizoids. E. Spores. A–B from *Fuertes s.n.* (MA 35098); D from *Ederra s.n.* (PAMP 7179); C, E from *Fuertes s. n.* (MACB 44420). Scale: A, B, D, E = 20  $\mu$ m; C = 45  $\mu$ m.

inal, perigonal leaves ovate. Perichaetial leaves undifferentiated, slightly larger than vegetative leaves. Vaginula pilose, hairs uniseriate, smooth. Seta ca. 2.5 mm long, yellowish-brown, dextrorse above, sinistrorse below; capsule erect, ellipsoidal, 1.0–1.2 mm long, with 8 longitudinal ribs; exothecial cells slightly differentiated in longitudinal bands 3–4 cell rows wide, with 5–6 rows of smaller cells around capsule mouth; operculum conic at base, obliquely rostrate,

yellowish, reddish at base; peristome none. Spores papillose, 12–15  $\mu$ m in diameter, with weak trilete mark. Calyptra not seen.

**Etymology.** The specific epithet “*bistratus*” refers to bistratose leaf lamina.

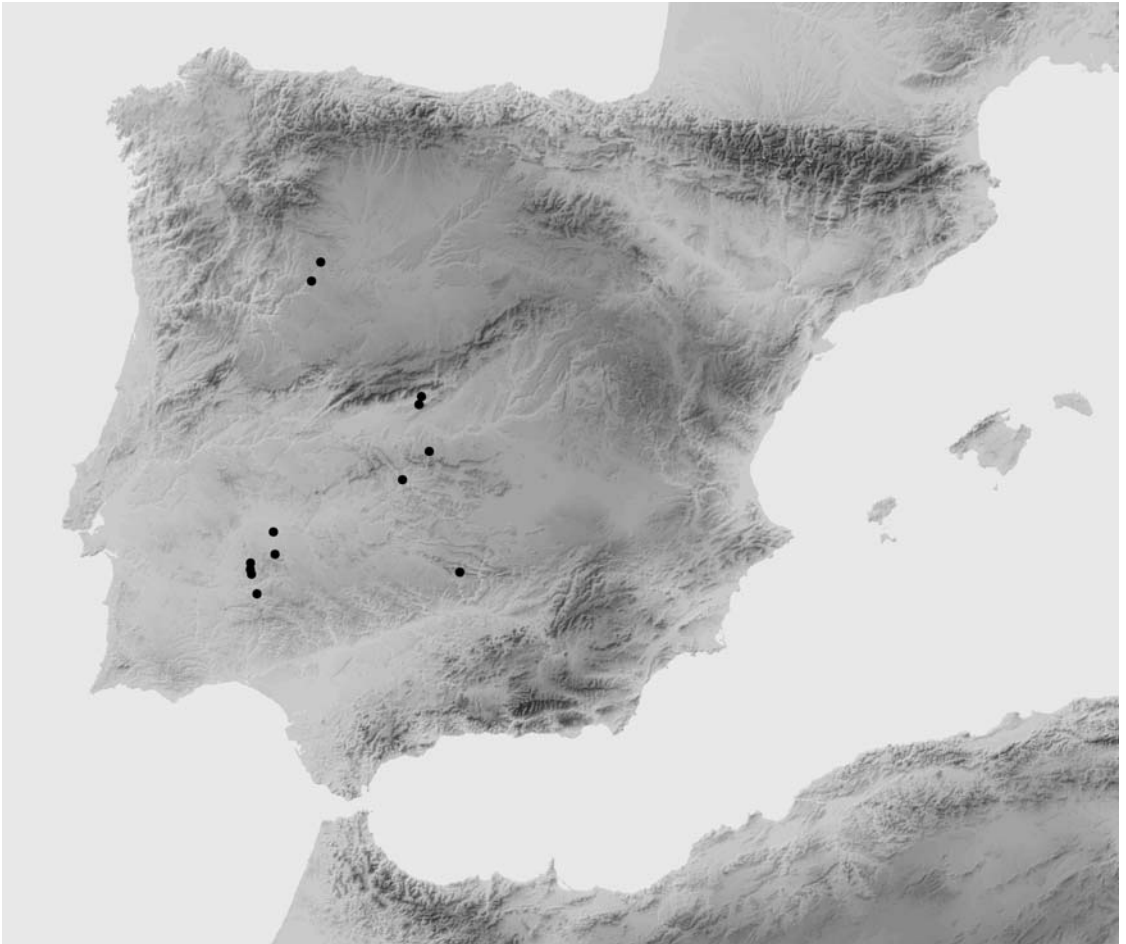
**Ecology and distribution.** Typically epiphytic, most specimens were collected on bark of *Quercus rotundifolia* Lam., except some collections from Toledo that were on *Q. pyrenaica* Willd. It usually

grows mixed with *Zygodon rupestris*. **Fig. 3** shows the known distribution of the new species.

**Differentiation.** This small *Zygodon* can be distinguished from *Z. rupestris* and *Z. viridissimus* mainly by its bistratose leaf lamina and the tall, occasionally bifurcate laminal papillae. Leaf laminae of the new species are bistratose in the upper half (**Fig. 1F**), with bistratose portions variable in area in the lower half but always with at least some double cells (**Fig. 1G**). In contrast, *Z. viridissimus* and *Z. rupestris* have completely unistratose leaf laminae, which has been so far considered diagnostic for the genus but only explicitly reported by Limpricht (1895). *Zygodon bistratus* usually has 1–2 tall papillae per cell, while the other two species typically have (2–)3–5(–6) low papillae per cell (**Fig. 1I–K**; Castaldo-Cobianchi & Giordano 1984). In addition, *Z. bistratus* is a smaller

plant with leaves always lanceolate, never linear-lanceolate, while the European plants of *Z. rupestris* often have narrowly lanceolate leaves, and *Z. viridissimus* has more widely lanceolate and flexuose leaves. Cross-sections of the costa show more stereids, and with thicker walls, in *Z. rupestris* and *Z. viridissimus*. Propagula of *Z. bistratus* and *Z. rupestris* are similar, although in *Z. rupestris* they are larger, have more cells, and occasionally have longitudinal septa. Propagula of *Z. viridissimus* have transverse and longitudinal septa, which immediately separates both taxa. Sporophytically, *Z. bistratus* agrees with the description of *Z. viridissimus* in Vitt (1994) or Allen (2003). Unfortunately, no Iberian Peninsula specimen of *Z. viridissimus* or *Z. rupestris* studied so far has sporophytes.

The new species is also similar in size to the North American species *Z. apiculatus* Redfearn, but



**Figure 3.** Known distribution of *Zygodon bistratus*.

the latter has distal laminal cells that are thin-walled and pluripapillose on both sides, oblong-lanceolate to oblong-ovate leaves with recurved tips when moist (Redfearn 1967). Vitt (1994, 2003) included *Z. apiculatus* and *Z. rupestris* under a broadly defined *Z. viridissimus*.

**Additional specimens seen.** SPAIN. BADAJOZ:

Cuenca del río Godolid, carretera de Jerez de los Caballeros a Higuera de Vargas, 23-IV-1992, *Fuertes s.n.* (as *Zygodon baumgartneri*) (MACB 56491); Jerez de los Caballeros, Rivera Godolid, pr. Zahinos, 350 m, 23-IV-1992, *Ederra s.n.* (as *Zygodon rupestris*) (PAMP 7195); Jerez de los Caballeros, arroyo de Bujardo, pr. Zahinos, 350 m, 23-IV-1992, *Ederra s.n.* (as *Zygodon rupestris*) (PAMP 7205) La Morera, Sierra María Andrés, pr. La Morera, 460 m, 22-IV-1992, *Ederra s.n.* (as *Zygodon rupestris*) (PAMP 7208). CIUDAD REAL: Sierra Madrona, Peña Rodrigo, prope Fuencaliente, 825 m, 29-I-1990, *Fuertes s.n.* (MACB 44420). HUELVA: Encinasola, pr. Encinasola, arroyo Cabá, 380 m, 24-IV-1992, *Muñoz s.n.* (MA-Musci 20462), *Ederra s.n.* (both as *Zygodon rupestris*) (PAMP 7179). TOLEDO: Pico Rocigalga, cerca del Chorro, 750 m, 16-III-1988, *Fuertes s.n.* (as *Zygodon baumgartneri*) (MACB 35098; Cuenca alta del río Estena, 790 m, 19-II-1988, *Fuertes s.n.* (as *Zygodon baumgartneri*) (MACB 35975); Navamorcuende a La Iglesiasuela, Sierra de San Vicente, 62 m, 24-III-2005, *Mateo & Cezón 56* (MA 29503), *Mateo & Cezón 99* (MA 29501, NY); La Iglesiasuela "Zoológico de Piedra," 520 m, 24-III-2005, *Mateo & Cezón 95* (MA 29502). ZAMORA: Arribes del Duero, encinar-enebral entre Mámoles y el río Duero, 640–480 m, 20-III-

1999, *Fernández 104* (as *Zygodon rupestris*) (MACB 081035); Arribes del Duero, camino entre Castro de Alcañices (cementerio) y el ribeiro do Prateira, 660 m, 31-III-1999, *Fernández 243* (as *Zygodon rupestris*) (MACB 081034).

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