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Entosthodon balansae (Funariaceae) is excluded from the Chilean bryophyte flora

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Abstract – A reexamination of specimens of *Entosthodon balansae* Besch. from Chile reveals that they represent either *Entosthodon obtusifolius* Hook.f., *Funaria chilensis* (Thér.) Thér. or *Physcomitrium sp. (aff. badium* Broth.). *Entosthodon balansae* should therefore be excluded from the Chilean bryophyte flora. *Entosthodon obtusifolius* and *Funaria chilensis* are reported as new to the flora of the Provinces of Llanquihue and Ñuble, respectively.

Résumé – Un réexamen des spécimens d'*Entosthodon balansae* Besch. du Chili révèle qu'ils représentent *Entosthodon obtusifolius* Hook.f., *Funaria chilensis* (Thér.) Thér. ou *Physcomitrium sp. (aff. badium* Broth.). *Entosthodon balansae* doit dès lors être exclu de la flore des mousses chiliennes. *Entosthodon obtusifolius* Hook.f. et *Funaria chilensis* (Thér.) Thér. sont rapportés pour la première fois, respectivement des Provinces de Llanquihue et Ñuble.

Bryophytes / Funariaceae / *Entosthodon* / *Funaria* / *Physcomitrium* / Chile

INTRODUCTION

Entosthodon Schwägr. contains about 20 species distributed across both Hemispheres (Miller & Miller, 2007). This number is in contrast with the number of accepted names in Crosby *et al.* (1999): 83, of which 44 refer to well known taxa. In his checklist of the mosses of Chile, He (1998) lists seven taxa and one variety of *Entosthodon* that are confined to the central and southern portions of the country: *E. balansae* Besch., *E. bonplandii* (Hook.f.) Mitt., *E. chiloensis* Mitt., *E. laevis* (Mitt.) Fife, *E. laxus* (Wilson *et* Hook.f.) Mitt., *E. mathewsii* var. *integer* (Müll. Hal.) Müll. Hal. and *E. obtusifolius* Hook.f. Ireland *et al.* (2006) recently added *E. apophysatus* (Taylor) Mitt. to the Chilean bryoflora. Thériot (1927) provided the only taxonomic treatment of the genus in Chile, but his treatment lacks three of the eight currently recognized taxa.

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Enthostodon balansae is known from only a handful of collections from Chile. As part of our taxonomical and nomenclatural revision of historical collections of bryophytes from the Chilean territory, housed in diverse European herbaria, we first studied a specimen collected by the German naturalist Dr. E. Schwabe in Calbuco (Province of Llanquihue) and kept in JE. This specimen is here shown to belong to *E. obtusifolius*. The only other collections known of this species from Chile were made by Ireland & Bellolio (Province of Ñuble, Bío-Bío Region) and are kept in CONC and US were examined. These specimens are, however, here considered to represent *Funaria chilensis* (Thér.) Thér. or in one case, potentially, *Physcomitrium badium* Broth. Consequently *E. balansae* should be deleted from the Chilean flora.

Here we present an updated description for *E. balansae* based on the study of type material housed in PC and a critical examination of all known specimens from Chile initially assigned to this species.

MATERIALS

We studied all collections of *E. balansae* reported from Chile and contrasted these to type specimens of this species from Paraguay (PC) or to type and non-type collections of other species know to occur in Chile. In particular the following specimens were studied:

***Entosthodon balansae* Besch.** Paraguay, Región Oriental, Asunción: L'Assomption, *Balansa* 1227, 14 Août 1874 (Syntype, PC); *idem*, *Balansa 1228*, Août 1876 (Syntype, PC); Región Oriental, Villarica, *Balansa 1233*, Septembre 1874 (Syntype, PC); Guarapi, *Balansa 1226*, Juin 1877 (Syntype, PC). Chile, Llanquihue, Calbuco, *Schwabe 131*, 11.9.37 (JE, Herbarium Theodor Herzog); Ñuble, Road to garbage dump, 6 km E of Quirihue, *R.R. Ireland & G. Bellolio 32333*, 36°17'S/72°28'W, ca. 570 m alt., Oct. 8, 2001 (CONC); Termas de Chillán & environs, *R.R. Ireland & G. Bellolio 30578*, 36°55'S/71°42'W, ca. 1660 m alt., Dec. 5-7, 2002 (CONC); *idem*; *R.R. Ireland & G. Bellolio 30551*, 36°55'S/71°42'W, ca. 1660 m alt., Dec. 5-7, 2002 (US).

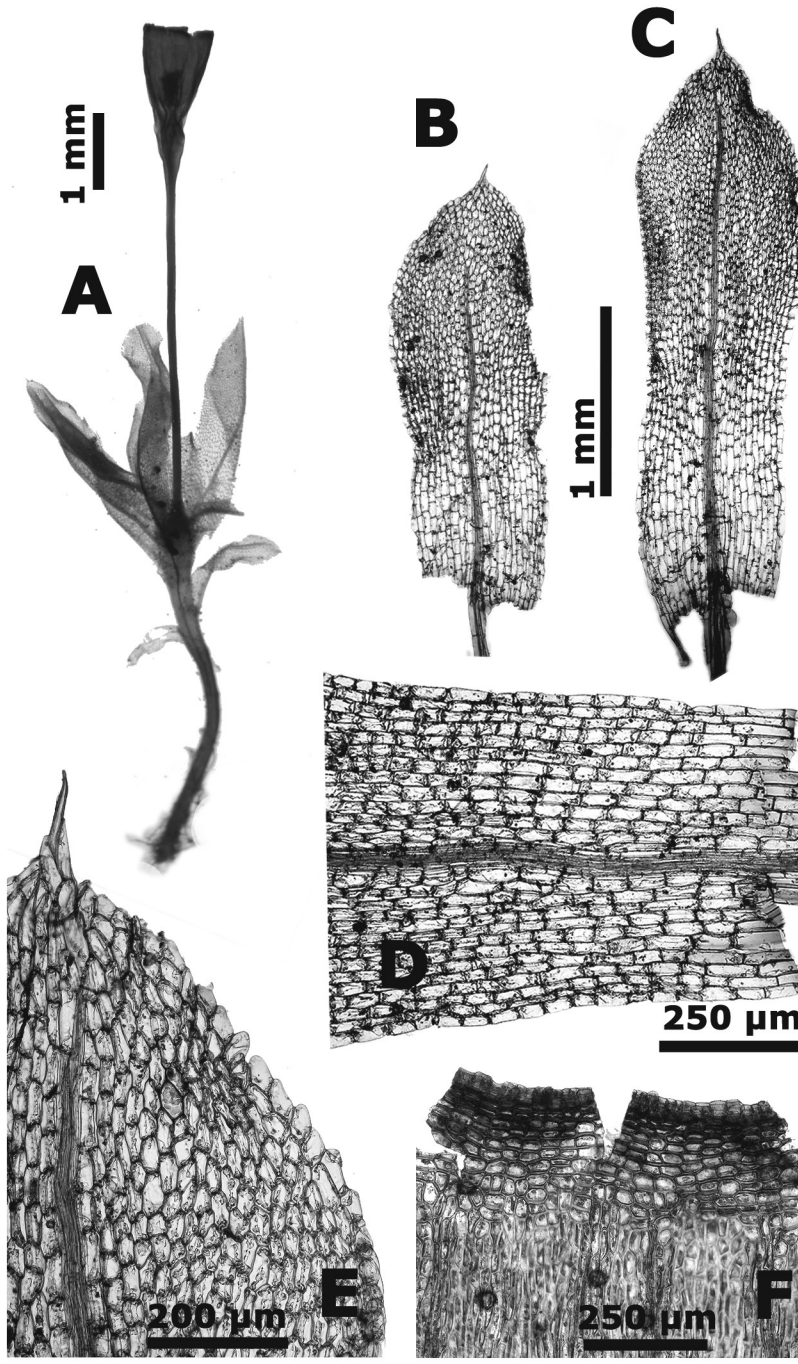
***Funaria acutifolia* (C. M.) Broth.** Chile, Concepción, Puchacay, Lonco, *Bertho*, Oct. 1925 (PC, Herbier Thériot).

***Funaria chilensis* (Thér.) Thér.**, Chile, Concepción, Puchacay, Lonco, *Bertho*, Oct. 1925 (S).

***Physcomitrium badium* Broth.** (n. 60), Brazil, Rio Grande do Sul, Porto Alegre, *Lindman*, 25.9.1892 (Holotype, S).

RESULT AND DISCUSSIONS

Entosthodon balansae was described by Bescherelle (1877) based on material Dr. B. Balansa collected in Paraguay. The protologue refers to four syntypes and these are kept in PC. The species was diagnosed by the red-purplish, clavate-pyriform and gymnostomous capsule with a long neck, the 5-7 mm long seta, the elongate, ovate lanceolate leaves with crenulate-dentate apices, the sub-quadrate upper laminal cells, and the reddish costa (Fig. 1). Other characters useful in distinguishing this species from similar species (Table 1) include: percurrent costa, 45-65 (– 88) µm at base, apical leaf cells *ca* 33-44 × 17-32 µm,



Figs 1-6. *Entosthodon balansae* Besch. **A.** Entire plant. **B.** Outer leaf. **C.** Intermediate leaf. **D.** Basal laminal cells. **E.** Apical laminal cells. **F.** Portion of capsule mouth (pictures from specimen *Balansa 1228* and taken by Dr. Jacques Bardat).

rectangular to subquadrate marginal basal leaf cells (25-) 38-60 (-100) × (19 -) 23-37 (– 44) μm, capsule 1.5-2.5 mm long with exothecial cells elongate, *ca* 33-55 × 11-15 μm and thick cuneate walls.

***The identity of the collection by* Schwabe (#131) from Calbuco:**

Herzog *et al.* (1939) reported *E. balansae* from Chile based on the specimen from Calbuco. Herzog identified the specimen solely based on the original description from Bescherelle as he noted on the specimen label (ex descriptione). The specimen differs from type material of *E. balansae* by the longer seta (7.5-12.5 mm), shorter and gold-brown (immature) capsules (18 mm), obovate leaves, yellowish sub-percurrent costa, 33-44 μm at base and cerise rhizoids.

Entosthodon obtusifolius was described by W. J. Hooker (1840) based on material collected by A. Mathews in the surroundings of Lima, Peru. Fife (1987) mentioned the following traits for *E. obtusifolius*: erect, symmetric and pyriform capsule less than 2 mm long, with a plano-convex operculum, a single peristome, elongated exothecial cells, cuneate anticlinal exothecial cell-walls and a seta 10-20 mm in length, brown rhizoids, concave entire obovate leaves with a broadly acute or obtuse apex that is occasionally mucronate, a costa ending 2 to 5 cells below apex and no differentiated marginal cells. The Chilean material from Calbuco matches all these traits, except for the sinuate margin of the leaf apex and cerise-colored rhizoids.

Fife (1987) treated *E. acutifolius* as a synonym of *E. obtusifolius*. The observation of one specimen of *E. acutifolius* collected in Lonco (Chile) in 1925 and kept in PC (Herbier Thériot), confirms the incorrect identity of the specimen of *E. balansae* from Calbuco, particularly by the similarity of the marginal cells of leaves, leaf apex and rhizoids. The specimen from Lonco exhibits the following features: leaves obovate with mucronate apex; apical cells 37-50 × 12-25 μm, elongated below; marginal cells scarcely inflated, shorter above (*ca* 38 μm), longer below (*ca* 95 μm) and narrow throughout (about 20-28 μm); costa yellowish sub-percurrent, *ca* 40 μm at base; rhizoids cerise; setae 7-12 mm long; capsules symmetric, pyriform, about 2 mm long, cuneate anticlinal exothecial cell walls; peristome single; spores 21-25 μm. *Entosthodon acutifolius* was treated by Thériot (1927) under *Funaria acutifolia* (Hampe) Broth. and this author referred to the specimen from Lonco as differing from the type of *F. acutifolia* (Mt. Galipano, Caracas, Venezuela) only by the scarcely larger leaves. Thériot's and our own observations lead us to consider the specimen Schwabe 131 as representing *E. obtusifolius*. This species was hitherto not known from the Province of Llanquihue.

Entosthodon obtusifolius has an extensive synonymy and it is widespread in the mountains of Central and South America, Mexico, and is disjunct in Jamaica (Fife, 1986). In Chile it has been recorded in the Provinces of Concepción, Arauco, Valdivia, and now also in Llanquihue.

***The identity of the collection by* Ireland & Bellolio (#32333) from Ñuble:**

This specimen differs from type material of *E. balansae* by the shorter seta (2 mm), bigger capsule (2.0-3.5 mm long) with a mouth *ca* 1/3 of the diameter of the capsule, median exothecial cells short (40-50 × 15-23 μm) and thin-walled, leaves with sub-percurrent costa, longer marginal cells in the upper and basal

Table 1. Summary of characters distinguishing *E. balansae* from similar species based on personal observations and published descriptions.

	Entosthodon balansae Besch. (Bescherelle 1877; Syntypes)	*Entosthodon obtusifolius* Hook.f (Fife 1986, 1987)	*Entosthodon acutifolius* Hampe (specimen Lonco, Chile)	*Funaria chilensis* (Thér.) Thér. (Thériot 1924, 1926; specimen Lonco, Chile)	*Physcomitrium badium* Broth. (Brotherus 1900; Holotype)
Leaves shapes	Elongate, lanceolate, slightly spathulate	Obovate with obtuse, acute or mucronate apex	Obovate with mucronate apex	Ovate-lanceolate	Obovate-spathulate
Leaves margins	Crenulate-dentate in apical portions	Entire	Sinuate, with scarcely inflated cells 38 × 20-28 µm	Entire	Serrate in apical half and short-celled (31-74 µm long)
Apical leaf cells	Polygonal elongated to rectangular 33-44 × 17-32 µm	Short rectangular to irregularly hexagonal 30-60 x 18-25 µm	Irregular shape: short rectangular, hexagonal, rhomboidal 12-25 × 37-50 µm	Short rectangular-hexagonal 44 × 29 µm	Hexagonal-rhomboidal 21-50 × 10-23 µm
Basal leaf cells at margins	Rectangular to sub-quadrate (25-) 38-60 (-100) × (19-) 23-37 (-44) µm	Elongated	Rectangular 95 × 20-28 µm	Rectangular 46-90 × 21-32 µm	Rectangular 62-84 × 21-32 µm
Costa diameter at base	45-65 (-88) µm	50-60 µm	± 40 µm	(55-) 75-90 µm	42-63 µm
Costa extention	Percurrent	Ending 2 – 5 cells bellow apex	Sub-percurrent	Sub-percurrent	Sub-percurrent
Costa color	Yellow-reddish	Yellowish	Yellowish	Concolorous, yellowish, sometimes reddish	Concolorous, yellowish, sometimes orange
Rhizoids color	Red-brown	Brown	Cerise	Brown-reddish	Brown-reddish
Seta length	4-7 mm	10-20 mm	7-12 mm	1.5-2.0 mm	5-10 mm

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Capsule shape	Clavate-Pyriform	Pyriform	Pyriform	Clavate	Short pyriform
Capsule length	1.5-2.5 mm	1.5-2 mm	± 2 mm	2.0-3.5 mm	1.0-1.7 mm
Capsule diameter	0.7-1.2 mm	0.7 mm	0.8-1.3 mm	0.8-1.2 mm	± 1 mm
Mouth diameter/ capsule diameter ratio	± 1	Not given in litterature	± 2/3	± 1/3	± 3/4
Peristome	None	Single	Single	None	Rudimentary
Exothecial cells	Elongate, thick-cuneate walled 33-55 × 11-15 µm	Elongate, cuneate-anticlinal walls	Cuneate-anticlinal walls	Short, thin-walled 40-50 × 15-23 µm	Irregular shape: ± isodiametric to rectangular, sinuous, slightly thick-walled (32-) 42-84 × 20-25 µm
Spore diameter	21-32 µm	(27-) 30-40 µm	21-25 µm	30-35 µm	21-30 µm
Spore ornamentation (under LM)	Smooth with trilete scars	Minutely papillose-lirate	Papillose	Minutely papillose with trilete scars	Spinate
Operculum	Plano-convex	Plano-convex	Plano-convex	Plane, tiny	Short conical

parts, entire margins and scarcely bigger upper leaf cells (*ca* 44 × 29 µm). All these characters fit well with those of *F. chilensis* (Thér.) Thér. and the comparison with type material confirms this too.

Funaria chilensis was firstly treated as a variety of *F. clavellata* (Mitt.) Broth. by Thériot (1924) on the basis of a specimen collected by Bertho in Viña del Mar. Thériot (1926) later argued for elevating this variety to species rank after the observation of one specimen from Lonco also collected by Bertho. *Funaria chilensis* is diagnosed by its short, 1.5-2.0 mm long seta, clavate 2.0-3.5 mm long capsule with a long neck and tiny 0.2-0.3 mm wide operculum. Other distinguishing characters include: ovate-lanceolate leaves, sub-percurrent costa, (55-) 75-90 µm at base, trilete spores 30-35 µm diameter, minutely papillose.

The specimen *Ireland & Bellolio 32333*, erroneously assigned to *E. balansae*, is in fact *F. chilensis*, a new addition to the flora of the Province of Ñuble. *Funaria chilensis* is endemic to Chile, where it is known only from the Provinces of Petorca, Valparaiso, San Antonio, Concepción and now Ñuble.

The identity of the collections by Ireland & Bellolio (#30551 and 30578) from Ñuble:

The specimens, bearing inmature sporophytes, present the following features: Leaves obovate from attenuate bases with acute apex, cells of lamina quadrate or short-rectangular in middle part becoming hexagonal or rhomboidal toward the apex where they measure 27-53 × 15-25 µm, marginal cells projecting into fine teeth 48-126 µm long, longer basal leaf cells that occupy the basal third of leaf area, sub-percurrent costa, 52-63 µm wide at base; seta 5-6 mm long, capsules short pyriform ± 1.5 mm long with short-conical opercula, exothecial cells *ca* 26-40 × 12-25 µm with sinuous scarcely thickened walls not obscuring the lumina.

These characters match the description of *Physcomitrium badium* described from Brazil (Brotherus, 1900), but also known from Chile (Herzog, 1954; Ireland *et al.*, 2006). By contrast, the comparison with type material of *Physcomitrium badium* (see Table 1) reveals some differences in leaves shape, basal leaf cells area that mostly occupies the basal half of leaves in the type. The most conspicuous difference concerning leaves is in the margins of the upper half that are serrate and short-celled in the type (31 up to 74 µm), whereas in specimens 30551 and 30578 the leaves are dentate and are composed of longer cells that become shorter and hence closer to those in the type just under the tip, but with values not wholly overlapped (48-74 µm *vs* 31-50 µm in the type). A meaningful comparison of the sporophytes is not possible given the immature stage of them in the Chilean specimens, but a first observation shows similarities in capsule shape, exothecial cells shape, distribution of stomata and operculum shape to the type material. Differences in sporophyte essentially concern seta length and exothecial cells dimensions.

Taking into account the similarities and differences mentioned above, we consider specimens *Ireland & Bellolio 30551* and *30578* clearly belonging to *Physcomitrium* and related to *Physcomitrium badium*. We can argue for regional environmental conditions as a factor of variation, however further analyses based on mature specimens and the examination of other available collections should be done to establish whether we can confer to the Chilean populations of the species a varietal or a different taxonomic status.

CONCLUSION

Entosthodon balansae is listed in the Checklist of Mosses of Chile (He, 1998) on the basis of the sole specimen reported by Herzog *et al.* (1939). This collection should be treated as *E. obtusifolius*. Recent collections from Ñuble should be treated as *F. chilensis* and *Physcomitrium* (*aff. badium*!). Hence *E. balansae* should be excluded from the list of Chilean bryophytes.

Entosthodon balansae is at the moment known from central-south Paraguay, however, Fife & Seppelt (2001) mention that *Entosthodon smithhurstii* (Broth. *et* Geh.) Paris from Australia and *E. balansae* could be referable to a single species.

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