

Entosthodon kroonkurk (Bryophyta: Funariaceae), a new species from the Iberian Peninsula and Macaronesia

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SUMMARY

A new species *Entosthodon kroonkurk* sp. nov. is described and figured. It is most similar to *E. pulchellus* (Philibert) Brugués, from which it differs in duller and squarrosely recurved leaves when dry, a narrower nerve, and spores which are discoid and collapse when dry. It is very rare in the Iberian Peninsula (Cataluña, Gerona) but common in the Canary Islands, where it occurs mainly below 400 m alt. in S parts of Gran Canaria, Hierro, La Palma, Tenerife. A key to related Canarian species is provided.

KEYWORDS: *Entosthodon*, taxonomy, Macaronesia, Canary Islands.

INTRODUCTION

During bryological work in the Canary Islands (1984–2009), GMD gathered and studied some 800 collections of Funariaceae, among which 529 collections of *Entosthodon* Schwägr. Of these, 147 collections of *Entosthodon* subgenus *Plagiodus* (Fife, 1985) resisted identification with known species (Loeske, 1929; Luisier, 1931; Ochi, 1968; Flowers & Holmgren, 1973; Gangulee, 1974; Agnew & Vondráček, 1975; Crum & Anderson, 1981; Fife, 1985; Magill, 1987; Noguchi & Iwatsuki, 1988; Dirkse, Bouman & Losada-Lima, 1993; Smith, 1994; Cano *et al.*, 1999; Ros, Cano & Guerra, 1999; Fife & Seppelt, 2001; Li, He & Zhang, 2003; Casas *et al.* 2006; Hill *et al.*, 2006; Smith, 2006; McIntosh, 2007). For several years, the collections remained without a name. Then MB discovered identical specimens in the NE of the Iberian Peninsula. The collections form a homogeneous set, so they represent a species. This we describe as new. Names of vascular plants follow Acebes Ginovés *et al.* (2004) or Bolòs *et al.* (2005).

MATERIAL AND METHODS

The material studied was collected in the Canary Islands (1984–2008) and kept air-dried as herbarium vouchers at room temperature. The gametophytes and sporophytes were microscopically studied in a 2% KOH solution. Spores were studied in water, in 2% KOH and in glycerine. Description of spores applies to mature spores, seen under

the light microscope. SEM images were taken from air dried, gold-sputtered material and prepared at the National Herbarium Nederland, branch Leiden.

DESCRIPTION

Entosthodon kroonkurk Dirkse & Brugués **sp.nov.** (Figs. 1–5).

Autoica; gregaria vel laxe caespitosa. Caulis erectus 1–2(5) mm altus. Folia erecto-patentia, 1.3–2.1 mm longa, concava, obovata vel oblonga, acuminata, marginibus integra, nervo ante apicem evanido. Annulum nullum. Peristomium duplum. *E. pulchellum* (H.Philib.) Brugués aemulans differt sporis laevibus.

Type: SPAIN, Canary Islands, Gran Canaria, Montaña de los Perros, 2 km NW of Sardina UTM 26R 450–3080. 16 February 1996, *Dirkse 8588* (holotype L; isotypes *Herb. Dirkse, BCB*).

Plants annual, gregarious or in loose patches, often partly buried in soil, dull green, 1–2(5) mm high; *stem*, apart from basal male branch, unbranched, in cross section with a one-layered hyalodermis, 1–2 stereid layers, 3–4 layers of medullary cells, and a distinct central strand; rhizoids brown, smooth; *axillary hairs* hyaline, composed of three cells, end cell elongated, straight or curved. *Leaves* of female branch crowded at top, erecto-patent, obovate to oblong, abruptly acuminate, largest outer leaves 1.3–2.1 mm long (without acumen), 0.7–1.2 mm wide at widest part, concave; acumen green to yellowish, often

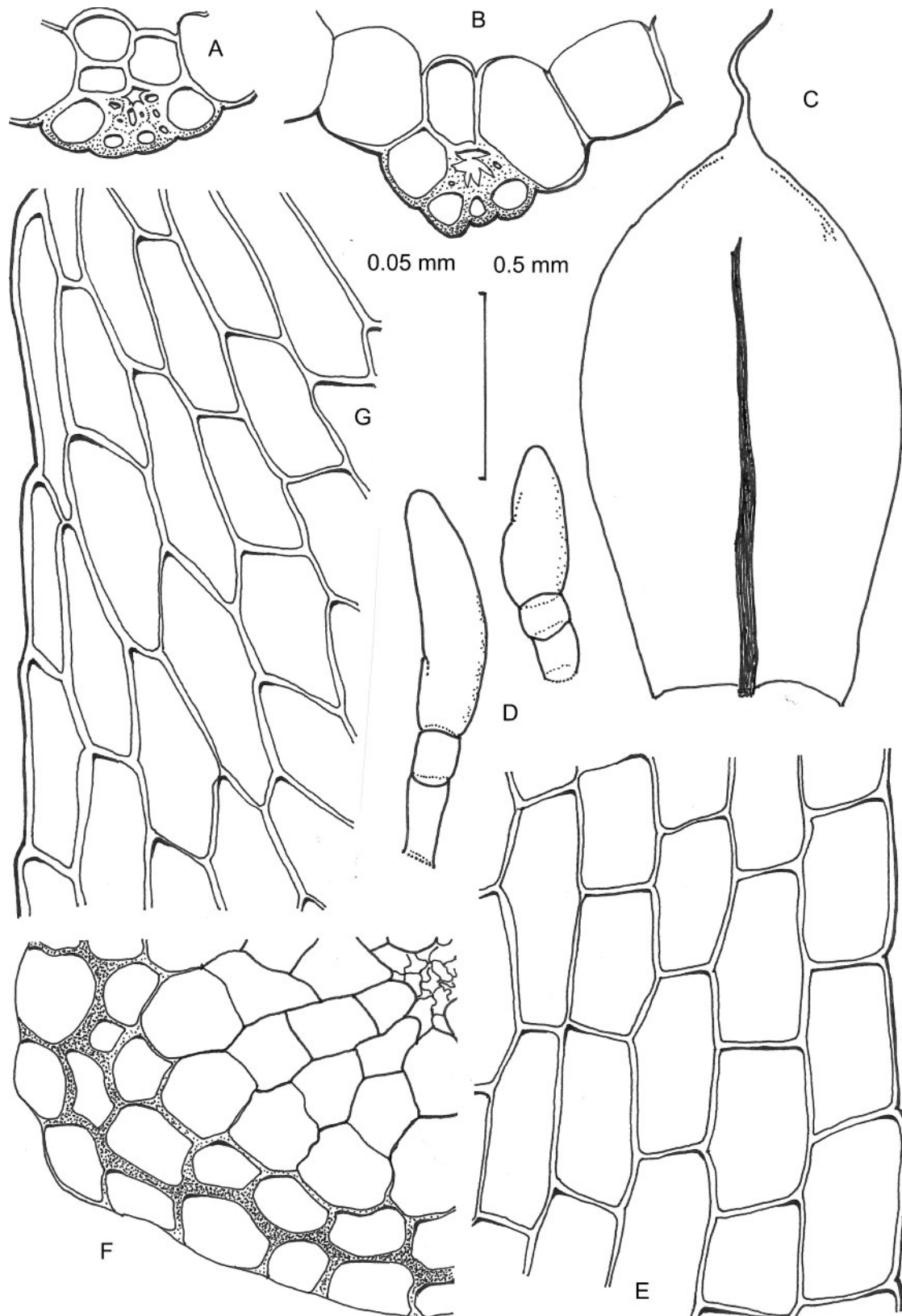


Figure 1. *Entosthodon kroonkurk* Dirkse & Brugués. (A and B) Nerve cross-sections; (C) leaf; (D) axillary hairs; (E) marginal cells at base of leaf; (F) cross-section of stem; (G) marginal cells in upper part of leaf. 0.5 mm bar applies to C; 0.05 mm bar to A, B, and D-G. A-D & F drawn from Dirkse 8658; E from Dirkse 8586; G from Dirkse 8609.

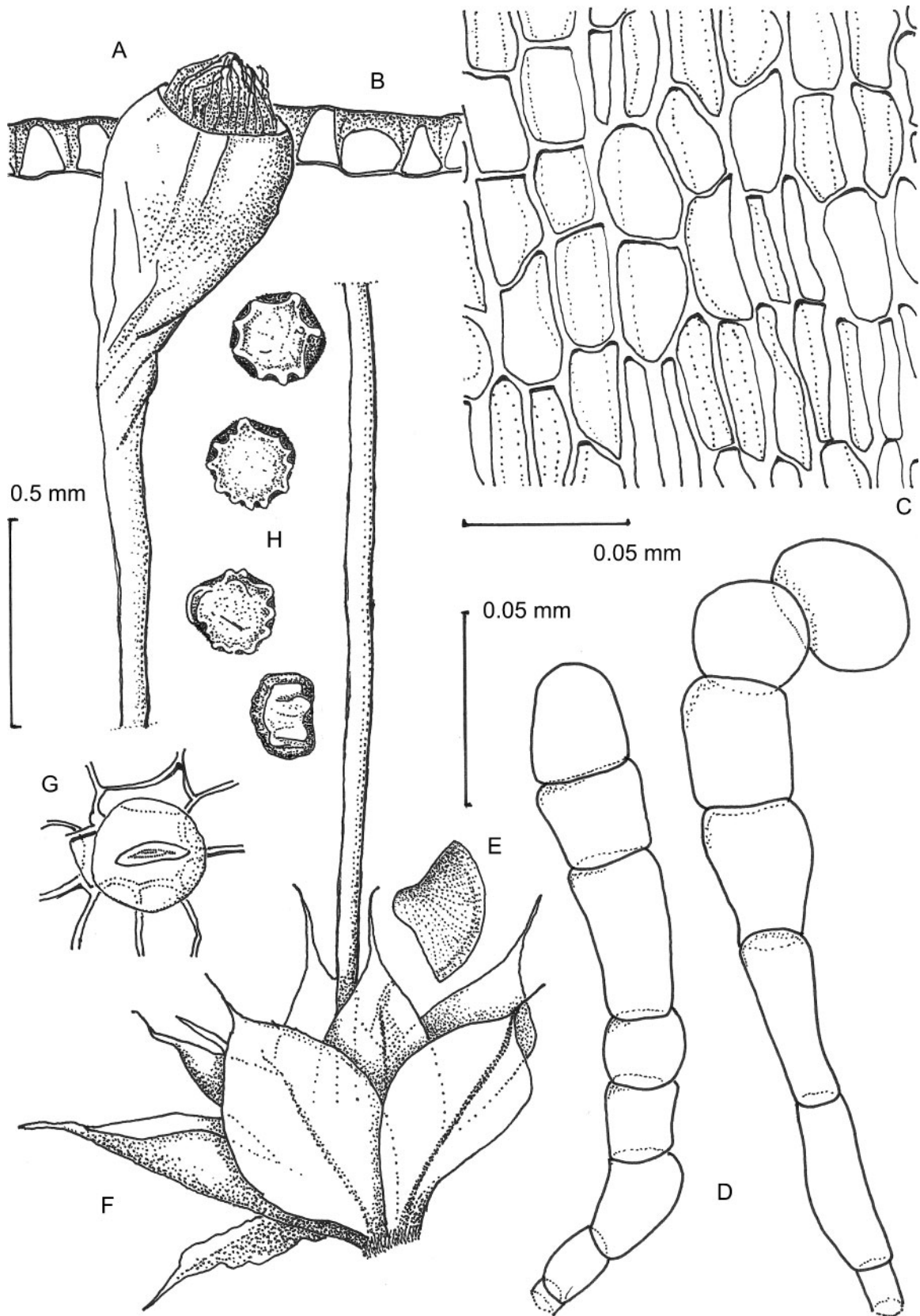


Figure 2. *Entosthodon kroonkurk* Dirkse & Brugués. (A) Wet capsule; (B) exothecial cells cross-section; (C) exothecial cells; (D) perigonial paraphyses; (E) operculum; (F) wet gametophyte with seta; (G) stoma; (H) spores proximal side, one in side-view (proximal side to the right). 0.5 mm bar applies to A, E and F; 0.05 mm horizontal bar to B, C and G; 0.05 mm vertical bar to D and H. A–H Drawn from Dirkse 8588.

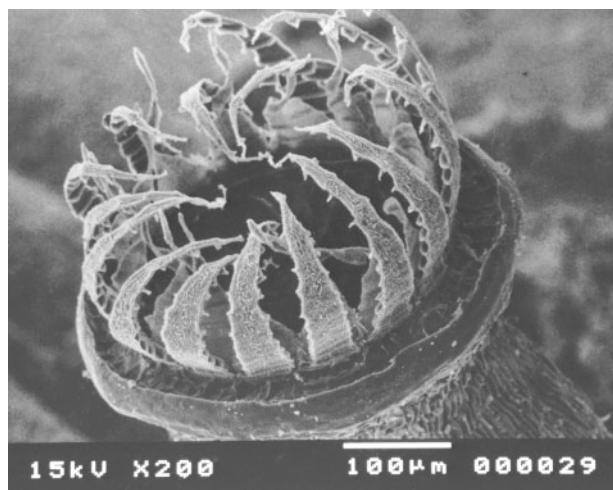


Figure 3. *Entosthodon kroonkurk* Dirkse & Brugués. SEM image of capsule mouth with peristome. Form Dirkse 8711.

hyaline at tip, to 0.5 mm long, smooth; margin entire, plane or erect in upper half; dry leaves very concave, with margins erect to slightly incurved, leaf tips usually recurved squarrosely; *nerve* to 3/4 of length of leaf, rarely ending just below apex, often slightly forked in upper part, 40–70 µm wide near base, in cross-section with thick-walled dorsal epidermal cells, to two layers of sub-stereids, a distinct group of hydroids, 0–2 guide cells, and 1–2 large ventral epidermal cells; *basal lamina cells* rectangular, 50–120(160) µm long, (15)20–30(40) µm wide, thin-walled; median and upper lamina cells quadrate-rectangular or polygonal, rhombic near apex, (25)30–70 µm long, (14)20–30(35) µm wide, thin-walled; marginal cells only differentiated near apex (if at all), 70–90 µm long, (5)10–15 µm wide, slightly thick-walled, distal cell ends somewhat protruding, but seldom forming distinct teeth, rarely with some jagged teeth at extreme apex; innermost leaves usually much smaller, narrower, with nerve less developed or absent. *Autoicous*, perigonia apical on basal branch, outer perigonial leaves *ca* 1.5 mm long, 0.5 mm wide, costate, acuminate, margin smooth, tips usually spreading; inner perigonial leaves much smaller, ecostate; antheridia numerous, to 100 µm long; paraphyses numerous, much longer than antheridia, composed of 7–8 cells, distal cells globose; perichaetia terminal on main shoot, largest vegetative leaves gradually passing into smaller, but otherwise little differentiated, inner perichaetial leaves. *Sporophyte* 5.0–10.0 mm long, capsule erect-inclined, neck 1/2–2/3 of capsule. *Exothecial cells*, 5–6 rows near mouth 5–10 µm high, 15–20 µm wide, transverse walls thickened, median cells elongate to isodiametric, 5–25 µm wide, 20–50 µm long, longitudinal walls radially thickened, thickenings tapering inwards, towards base of capsule isodiametric cells prevail, stomata at base of capsule, phaneropore. *Peristome* double, peristomial formula 4–2–4; exostome 400 µm long, brownish-orange, whitish at tips, 40–60 µm wide at base, outer face longitudinally striate, papillose at tips, teeth sometimes cleft; endostome hyaline.

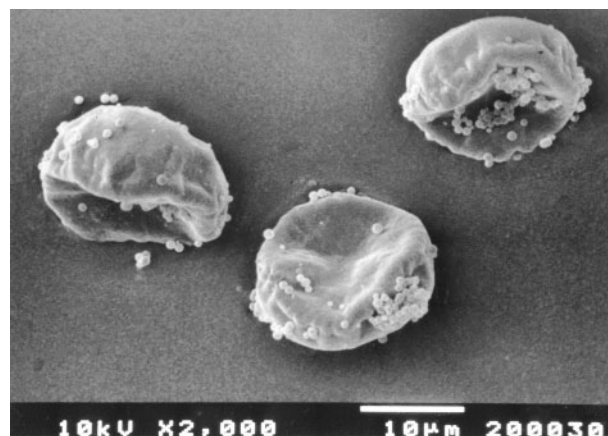


Figure 4. *Entosthodon kroonkurk* Dirkse & Brugués. SEM image of spores, proximal side turned downwards. Form Dirkse 8711.

Annulus absent. *Operculum* conical to mammillate. *Calyptra* cucullate. *Spores* 18–28 µm in diameter, smooth, very rarely faintly papillose, discoid, angularly collapsed, with appearance of a crown cap under light microscope. On SEM images, spores appear as smooth discs.

Etymology

The specific epithet is a Latinization of the Dutch expression for crown cap, referring to the spores which, when seen under the light microscope, look like crown caps or bottle tops.

Selected specimens examined (paratypes): SPAIN: Cataluña. *Gerona*, Cadaqués, Faro de Cala Nans, *Casas* (BCB17658). **Canary Islands.** *Gran Canaria*: Barranco de la Fuentes, 1996, *Herb.* Dirkse 8575, 8578, 8590 (Duplicates at TFCBry); Barranco de la Aldea, 1989, *Herb.* Dirkse 8627; Barranco del Taurito, 1998, *Herb.* Dirkse 8626, 8656, 8658; Barranco de Arguineguín, 1989, *Herb.* Dirkse 8609; NW of Mogán, 1989, *Herb.* Dirkse 8635; Montaña Arguineguín, 1996, *Herb.* Dirkse 8583; Barranco del Taurito S of Mogán, 1989, *Herb.* Dirkse 8626; W slope of Los Alares, 1989, *Herb.* Dirkse 8635; Montaña de Ojeda, 1989, *Herb.* Dirkse 8649; Barranco de la Data NNW of Maspalomas, 1989, *Herb.* Dirkse 8706; Barranco Bordona E of Santa Lucia, 1989, *Herb.* Dirkse 8619; Barranco de los Melosos, 1989, *Herb.* Dirkse 8790; Barranco de la Fuentes, 1996, *Herb.* Dirkse 8586; Barranco Berriel, W of Presa de Berriel, 1996, *Herb.* Dirkse 8593; small barranco 1 km W of Aldea Blanca, 1996, *Herb.* Dirkse 8599. *Fuerteventura*: Malpaís de Arena, 3 km NW of La Oliva, 2000, *Herb.* Dirkse 10725; Morro de la Degollada del Frontón & Morro del Chupadero 8 km W of Caleta de Fustes, 2000, *Herb.* Dirkse 10645. *Hierro*: near Montaña de los Cardillos 4 km W of Taibique, 1991, *Herb.* Dirkse 8680; Hoya del Morro 4 km S of Taibique, 1991, *Herb.* Dirkse 8676; 5 km S of Puerto Estacos, Ladera del Bosque, 1991, *Herb.* Dirkse 8683; Barranco de Honduras, near Roque de los Morenos,

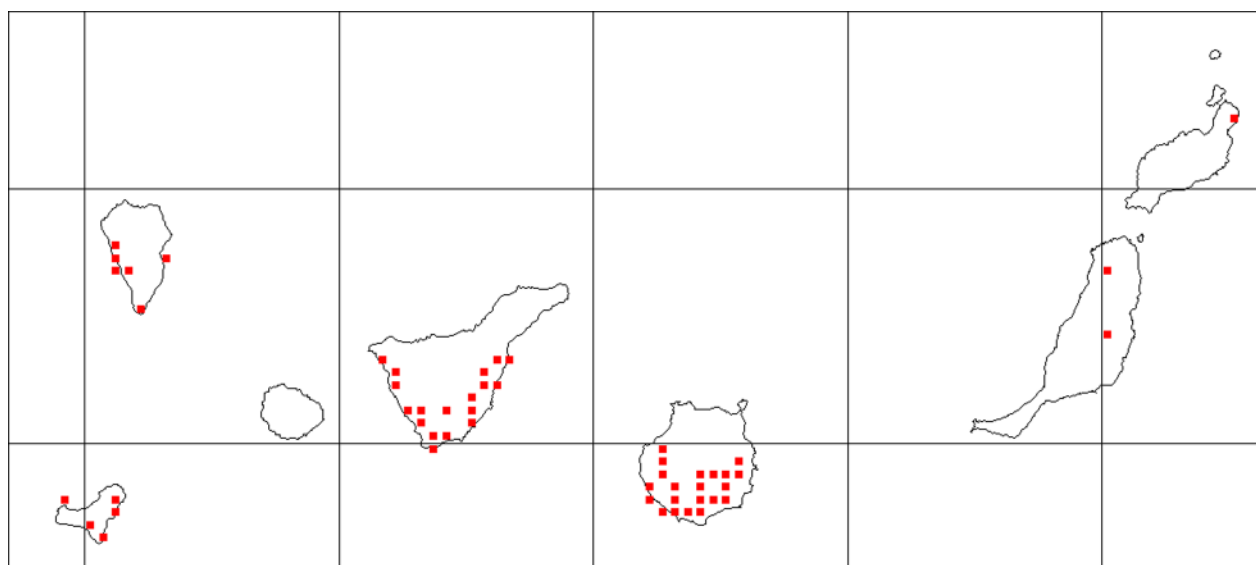


Figure 5. In the Canary Islands, *Entosthodon kroonkurk* Dirkse & Brugués is common in the southern parts of Hierro, La Palma, Tenerife, and Gran Canaria. It is rare in Fuerteventura and Lanzarote. It has not yet been found on Gomera. Distance of grid coordinates 100 km.

1.5 km SW of Puerto Estacos, 1991, *Herb.* Dirkse 8774.

Lanzarote: S part of Malpais de Corona, between Jameo del Agua and Cueva de los Verdes, 1994, *Herb.* Dirkse 8645. *La Palma*: Tazacorte, W part of Montaña Todoque, 4 km S of Los Llanos de Aridana, 2008, *Herb.* Dirkse 25141; Laderas de Amagar NW of Los Llanos de Aridane, 1990, *Herb.* Dirkse 8638; Barranco de Los Hombres just E of Puerto Naos, 1990, *Herb.* Dirkse 8602; Montaña de Mago S of Fuencaliente de La Palma, 1990, *Herb.* Dirkse 8604; near Los Cancajos, between Santa Cruz de La Palma and the aeropuerto, 1990, *Herb.* Dirkse 8615. *Tenerife*: Barranco del Marito, 1991, *Herb.* Dirkse 8711; Malpais de Güímar 4 km E of Güímar, between Punta de los Altillos o de los Picos and Morra del Cocho, 2003, GMD 23644; Teno, Barranco de Masca, 1984, *Herb.* Dirkse 4399; La Ladera S of Güímar, 1985, *Herb.* Dirkse 4109; Barranco de Arena SW of Arona, 1988, *Herb.* Dirkse 8613; Barranco del Infierno NE of Adeje, 1988, *Herb.* Dirkse 8701; Montaña de Chó 7 km E of Los Christianos, 1991, *Herb.* Dirkse 8678; Barranco de Gambuesa ca 1 km S of Fasnia, 1991, *Herb.* Dirkse 8652; Barranco del Alphonso just N of Arico Viejo, 1991, *Herb.* Dirkse 8712; 7 km W of El Médano SE of El Guincho, along the road to San Isidro, 1991, *Herb.* Dirkse 8608; Barranco del Marito ca 3.5 km SE of Fasnia, 1991, *Herb.* Dirkse 8653; Barranco de Herques ca 1 km W of Fasnia, 1991, *Herb.* Dirkse 8785; 1 km SE of Montaña de los Riscos, 4 km N of El Médano, 1993, *Herb.* Dirkse 8643; small barranco between Armeñime and La Caleta 4 km W of Adeje, 1993, *Herb.* Dirkse 8762; between Punta Blanca and Callao Chico 1.5 km NNW of Alcalá, 1993, *Herb.* Dirkse 8749; Punta Negra 1 km W of Las Galletas, 1993, *Herb.* Dirkse 8759; Barranco del Infierno above Adeje, 1993, *Herb.* Dirkse 8662; dry barranco SW of Arona, 2001, *Herb.* Dirkse 11595; lower part of Barranco del Rio 6 km S of Arico, 2001, *Herb.* Dirkse 11456.

DISTRIBUTION

In Cataluña, Gerona, in mainland Spain the species is very rare in the northwest on schists under mediterranean shrub vegetation of *Cistus salviifolius* L., *Pistacia lentiscus* L., and *Juniperus oxycedrus* L. In the Canary Islands, it is common below 400 m alt. (extending to 600 m alt.) in the southern parts of Gran Canaria, Hierro, La Palma and Tenerife, rarely at a higher altitude (Gran Canaria: Mont. Ojeda, 900 m alt.; Barr. Bordona, 825 m alt.; Barr. Fataga, 700 m alt.). Rare in Fuerteventura (Jandía, 300 m alt., Malpais de Arena, 180 m alt.). It is very rare in Lanzarote (Malpais de Corona, 50 m alt.) and unknown from Gomera, but there probably overlooked. In the Canary Islands, it is most common on gravelly, sandy or loamy soil on dry, usually SW-facing, sometimes grassy slopes with xerophytic vegetation: *Euphorbia* spp., *Plocama pendula* Aiton, *Periploca laevigata* Aiton, *Laumaea arborescens* (Batt.) Murb., *Kleinia neriifolia* Haw., *Asphodelus ramosus* subsp. *distalis* Z. Díaz & Valdés, *Rumex lunaria* L., *Lycium intricatum* Boiss. *Entosthodon kroonkurk* also grows on thin soil among lava or on basaltic ledges on steep slopes with *Lavandula* species, *Ceropegia fusca* Bolle, *Campylanthus salsoloides* (L.f.) Roth, *Reseda scoparia* Brouss. ex Willd., *Opuntia dillenii* (Ker-Gawl.) Haw. It is less common in areas sown with *Patellifolia patellaris* (Moq.) A.J.Scott, Ford-Lloyd. & J.T.Williams. and grazed by goats, and rare under xerophytic shrubs (*Euphorbia balsamifera* Aiton, *Justicia hyssopifolia* L., *Salsola divaricata* Masson ex Link in Buch, *Schizogyne sericea* (L.f.) DC.) on sandy soil on higher parts of coastal areas. Associated bryophytes include: *Microbryum starckeanum* (Hedw.) R.H.Zander, *Tortula atrovirens* (Sm.) Lindb., *Goniomitrium seroi* Casas, *B. argenteum* Hedw., *Bryum radiculosum* Brid., *B. dichotomum* Hedw., *B. gemmilucens* R.Wilczek & Demaret, *Aloina aloides* (D.J.Koch ex Schultz) Kindb., *Mannia androgyna*

(L.) A. Evans, *Funariella curviseta* (Schwägr.) Sérgio, and *Targionia hypophylla* L.

TAXONOMIC NOTES

The annual *Entosthodon kroonkurk* with the peristomial formula 4–2–4, wide smooth lamina cells, axillary hairs with a long-cylindric distal cell, and large perigonal paraphyses with spherical end cells clearly belongs to the *Funariaceae* (Fife, 1985; Schwartz, 1994; Frey, Stech & Fischer, 2009). According to a key to the genera, provided by Fife (1985), *E. kroonkurk* belongs to *Entosthodon* subgenus *Plagiodus* (Mitten) Fife which is characterized by small size, asymmetric capsules, a well-developed double peristome, and no annulus (Fife, 1985). This group includes, among others, *Entosthodon convexus* (Spruce) Brugués, *E. pulchellus* (Philibert) Brugués, *E. muhlenbergii* (Turner) Fife and *E. schimperii* Brugués (Loeske, 1929; Crundwell & Nyholm, 1974; Brugués, Dirkse & Sérgio, 2001; Casas *et al.*, 2006). Within subgenus *Plagiodus*, *E. kroonkurk* is morphologically closest to *E. pulchellus* with which it shares plant size, leaf shape and the arid habitat. *E. pulchellus* differs in having the leaves more or less glossy and more shrivelled when dry, a wider nerve (60–90 μm near the base) and warty spores remaining spherical when dry. *E. kroonkurk* is separated by its usually dull leaves when dry, its leaf points more or less squarrosely recurved when dry, its narrower nerve (40–70 μm wide near base of largest leaves), and its mature spores smooth, discoid and angularly collapsed. The spores of both species remain different as indicated, whether soaked in water, 2% KOH or glycerine. The spores always allow a distinct separation of *E. kroonkurk* from its morphologic relative *E. pulchellus*. The gametophytic characters alone do not always suffice for certain differentiation between these two species. However, poor gametophytic distinctness of species is common within the Funariaceae (Loeske, 1929; Fife, 1985).

E. apiculatopilosus (Card.) Fife, *E. acutifolius* Hamp. and *E. attenuatus* (Dicks.) Bryhn also produce smooth discoid spores but clearly differ from *E. kroonkurk* in peristome and leaf characters (Loeske, 1929; Fife, 1985; McIntosh, 2007). The other European and N African *Entosthodon* species (*E. durieui* Mont., *E. fascicularis* (Hedw.) Müll.Hall., *E. mouretii* (Corb.) Jelenc, *E. longicolle* (Trab.) Ros & M.J. Cano, *E. commutatus* Durieu & Mont. (= *E. krausei* Besch.), *E. obtusus* (Hedw.) Lindb. differ in having a more or less straight capsule when dry and a peristome that is either single or lacking (Loeske, 1929; Luisier, 1931; Casas *et al.*, 2006; Ros & Cano, 2008; Brugués & Sérgio, 2009).

In the Canary Islands, nine species of *Entosthodon* are currently recognized (González-Mancebo *et al.*, 2008). Since we have not been able to confirm the occurrence of *E. muhlenbergii* (Turner) Fife on these islands, we consider it a doubtful member of the local flora and prefer to exclude it from the local list. The remaining Canarian representatives of subgenus *Plagiodus* can be identified with the following key, which applies to female shoots only.

KEY TO CANARIAN REPRESENTATIVES OF *ENTOSTHODON* SUBGENUS *PLAGIODUS*

- 1 Leaf margin in upper part smooth or finely and irregularly sinuose; operculum conic or mammillate; largest leaves 1.3–2.5(2.8) mm long.....2
- 2 Leaf margin in upper part serrate or partly so; operculum flat or mammillate; largest leaves 1.5–3.0(3.5) mm long.....3

- 2 Spores smooth, rarely faintly papillose, discoid, angularly collapsed; nerve of largest leaves 40–70 μm wide near base; dry plants bud-like, at least some leaves with recurved leaf points.....*E. kroonkurk*

Spores warty or roughly papillose, spherical; nerve of largest leaves 60–90 μm wide near base; dry plants shrivelled with the leaf points straight or incurved.....*E. pulchellus*

- 3 Leaves shrivelled or incurved but not twisted when dry, concave when wet, 1.0–1.8 mm wide, obovate, suddenly tapered at apex; nerve ending below apex; spores 13–25 μm in diameter.....*E. convexus*

Leaves spirally twisted when dry, more or less flat when wet, 0.7–1.1 mm wide, ovate-lanceolate, gradually acute or acuminate; nerve excurrent in stout point; spores 20–38 μm in diameter.....*E. schimperii*

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TAXONOMIC ADDITIONS AND CHANGES: *Entosthodon kroonkurk* Dirkse & Brugués sp. nov.

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