Cryptogamie, Bryologie, 2003, 24 (2): 173-180

Entosthodon productus Mitt. (Funariaceae) on Marion Island – the first record in the Subantarctic

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(Received 16 January 2003, accepted 18 March 2003)

Abstract – *Entosthodon productus* Mitt. is recorded for the first time from the Subantarctic, from Marion Island in the Prince Edward Islands archipelago. The species is widespread and locally frequent on the island. The island's *E. productus* plants are described and illustrated and their ecology and local distribution are discussed. Global distribution of *E. productus* is reviewed and mapped.

Bryophyta / Musci / Funariaceae / *Entosthodon* / Subantarctica / Prince Edward Islands / Marion Island / Kerguelen Province / distribution

INTRODUCTION

Although the family Funariaceae has an essentially cosmopolitan distribution it exhibits its greatest diversity in temperate and tropical regions. It is poorly represented in cold temperate and polar regions of the Southern Hemisphere, where only five or six species of *Entosthodon* Schwägr., two species of *Funaria* Hedw. and three species of *Physcomitrium* (Brid.) Fuernr. occur, none being particularly abundant. In fact, the above mentioned taxa have not yet been critically assessed taxonomically. The Subantarctic region comprises six highly isolated islands or small archipelagoes scattered throughout the vast Southern Ocean that surrounds the Antarctic continent. There, Funariaceae is exceedingly poorly represented; hitherto only two species belonging to two closely related genera, *Entosthodon* and *Funaria,* have been recorded. Of these, only *E. laxus* (Hook. f. & Wilson) Mitt. appears to be indigenous to the Subantarctic and it occurs on the Prince Edward Islands, Îles Crozet, Îles Kerguelen and Macquarie Island (Fife, 1986). The other species, *Funaria hygrometrica* Hedw., has been recorded from Macquarie Island (Selkirk *et al.,* 1990) and South Georgia, where it is probably a recent, transient introduction because it has not been found there since it was originally collected in 1961 and 1977 (Ochyra *et al.,* 2002).

Entosthodon productus Mitt. is a third funariaceous species reported from the Subantarctic (from Macquarie Island), as *Funaria producta* (Mitt.) Broth.

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by Seppelt (1981). This proved to be a misidentification and re-examination of the voucher collection showed that the material represented *Entosthodon subattenuatus* (Broth.) Paris (Selkirk *et al.*, 1990), which was subsequently shown to be conspecific with *E. laxus* (Fife & Seppelt, 2001).

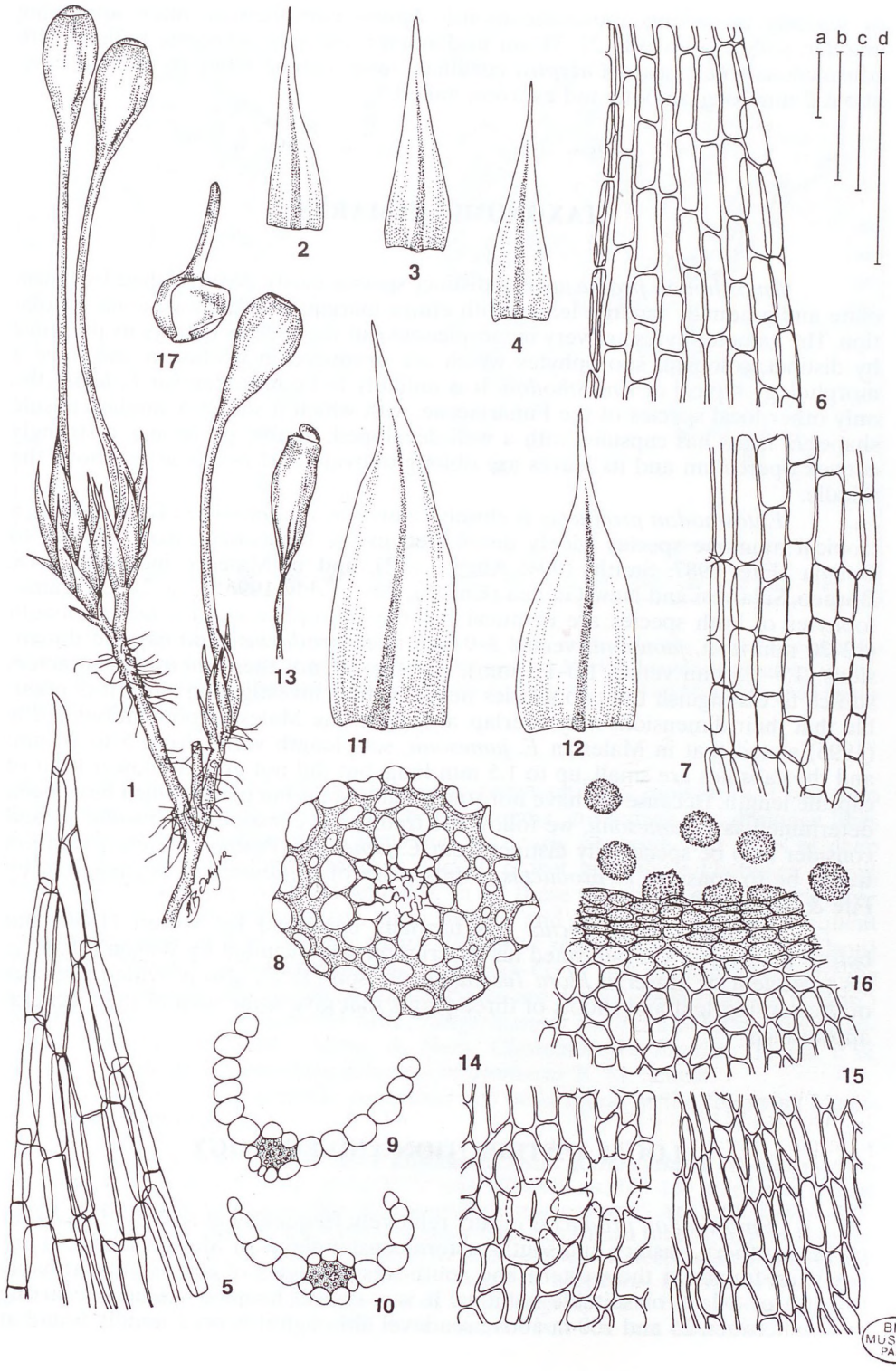
Here, we show that *E. productus* does in fact occur in the Subantarctic; we collected it at a number of localities on Marion Island, one of two islands of the Prince Edward Islands archipelago in the Kerguelen Province of the Subantarctic.

DESCRIPTION OF MARION ISLAND PLANTS

Entosthodon productus Mitt. *in* Wilson *in* Hook. f., *Fl. Tasm.* 2: 197, *pl. 175, f. 1.* 1859 (Fig. 1)

Plants small, gregarious to loosely or densely caespitose, yellow- to brownish-green. ***Stems*** erect, up to 5 mm tall, sparsely branched by subperigonial innovation, radiculose at base with reddish-brown, smooth rhizoids, in cross-section with a distinct single-layered hyalodermis of large cells with thin outer walls, 1(–2)-stratose sclerodermis of larger, thick-walled cells, mostly bistratose medulla of large, hyaline, thin-walled cells and a large, well-developed central strand. ***Leaves*** more or less evenly disposed, not markedly clustered toward stem apices, erect when dry, not (or only slightly) altered on wetting, lanceolate to triangular- or ovate-lanceolate, concave to subtubulose, non-decurrent; lower leaves 0.7–1.1 mm long, 0.2–0.3 mm wide; upper leaves conspicuously larger, 1.4–1.9 mm long, 0.4–0.8 mm wide; ***margins*** entire throughout, plane to narrowly incurved above, plane below; ***costa*** single, subpercurrent, 25–40 μm wide near base, pale yellowish-brownish, subconcolorous with the laminal cells, round in cross-section, consisting of a large central stereid band surrounded by one layer of large, thin-walled epidermal cells; ***laminal cells*** smooth, often lax, thin- to firm-walled, bulging, oblong to rectangular, (30–)40–90(–110) μm long, 14–20 μm wide, not differentiated at the margins or toward the base; ***alar cells*** not differentiated. ***Autoecious***. ***Seta*** erect, straight to slightly flexuose, smooth, sinistrorse, 3–8 mm long, reddish-brown. ***Capsule*** erect or variously inclined to horizontal, symmetric, smooth, reddish-brown at maturity, narrowly to broadly obloid-pyriform, 1.0–1.3 mm long, 0.5–0.8 mm wide, weakly constricted below the mouth, abruptly tapering to a wrinkled neck about half the capsule length; ***annulus*** simple; ***operculum*** plano-convex, somewhat paler at the margin; ***exothecial cells*** mostly irregularly shaped, fusiform-rectangular, oblong-hexagonal to irregularly angular in the mid-urn, 30–70 μm long, 12–20 μm wide, thin-walled, becoming transversely rectangular, thick-walled and orange-brown pigmented in 3–5 tiers at the orifice; ***stomata*** numerous at the apophysis, composed of a single guard cell with a central, elongate pore; ***peristome teeth*** absent or vestigial, reduced to irregular membrane, not

Fig. 1. *Entosthodon productus* Mitt. — **1.** Habit. **2–4.** Lower leaves. **5.** Leaf apex. **6.** Mid-leaf cells. **7.** Basal cells. **8.** Cross-section of stem. **9–10.** Cross-sections of leaves. **11–12.** Upper leaves. **13.** Capsule, dry. **14.** Exothecial cells in apophysis and stoma. **15.** Exothecial cells in mid-urn. **16.** Exothecial cells at mouth, vestigial peristome teeth and spores. **17.** Calyptra. [All from *Ochyra & V.R. Smith 2486/99,* KRAM]. Scale bars: a – 1 mm (1, 13, 17); b – 100 mm (5–7, 14–16); c – 100 μm (8–10); d – 1 mm (2–4, 11–12).



or scarcely projecting above the mouth. ***Spores*** subspherical, often appearing angular, yellow-brownish, 27–34 μm in diameter, coarsely verrucate-bullate, with conspicuous trilete scars. ***Calyptra*** cucullate, long-rostrate from an inflated base, about 2 mm long, smooth and lustrous, naked.

TAXONOMIC REMARKS

Entosthodon productus is a distinct species easily distinguished by lanceolate and gradually tapered leaves with entire margins and homogeneous areolation. The gametophytes are very inconspicuous but the species betrays its presence by distinct, colourful sporophytes which are produced in profusion and have a morphology typical of *Entosthodon*. It is unlikely to be mistaken for *E. laxus,* the only other local species of the Funariaceae, with which it shares a similar capsule shape. *E. laxus* has capsules with a well-developed, double peristome, a strongly convex operculum and its leaves are oblong-obovate and widest at or above the middle.

Entosthodon productus is closely related to *E. jamesonii* (Taylor) Mitt., a tropical montane species widely distributed in the Neotropics, from Mexico to Bolivia (Fife, 1987; Smith, 1994; Allen, 2002), and in Malesia, including Java, Borneo, Sulawesi and New Guinea (Enroth, 1991; Eddy, 1996) (Fig. 2). The gametophytes of both species are identical but the sporophytes differ in seta length (12–20 mm in *E. jamesonii* versus 3–9 mm in *E. productus*) and capsule dimensions (1.5–2.5 mm versus 1.0–1.3 mm). Whether or not these metrical characters suffice to distinguish the two species needs further investigation since it is possible that their dimensions may overlap, at least in the Malesian populations. Eddy (1996) stated that in Malesian *E. jamesonii,* seta length varies from 5 to 20 mm and the capsules are small, up to 1.5 mm long, but did not give the lower limit of capsule length. Because we have not studied any Malesian plants which have been determined as *E. jamesonii,* we follow the traditional concept of *E. productus* and consider it to be specifically distinct from *E. jamesonii*. Perhaps, a better solution would be to consider *E. productus* a subspecies of *E. jamesonii,* as suggested by Fife & Seppelt (2001).

Entosthodon productus was formally described by Mitten (1860) but before that paper was published his description was included by Wilson (1859) in his treatment of Musci in *Flora Tasmaniae*. Wilson (1859) also provided sketches of the capsule, leaf and shoots of three plants that give some idea of their general appearance.

LOCAL DISTRIBUTION AND ECOLOGY

Entosthodon productus occurs relatively frequently at scattered localities on the northern, eastern and south-eastern coastal plains of Marion Island. It has not been found on the western and south-western sides of the island, probably because of a lack of suitable habitats. It is a typical lowland species, occurring mostly between 25 and 100 m above sea level although it is occasionally found at

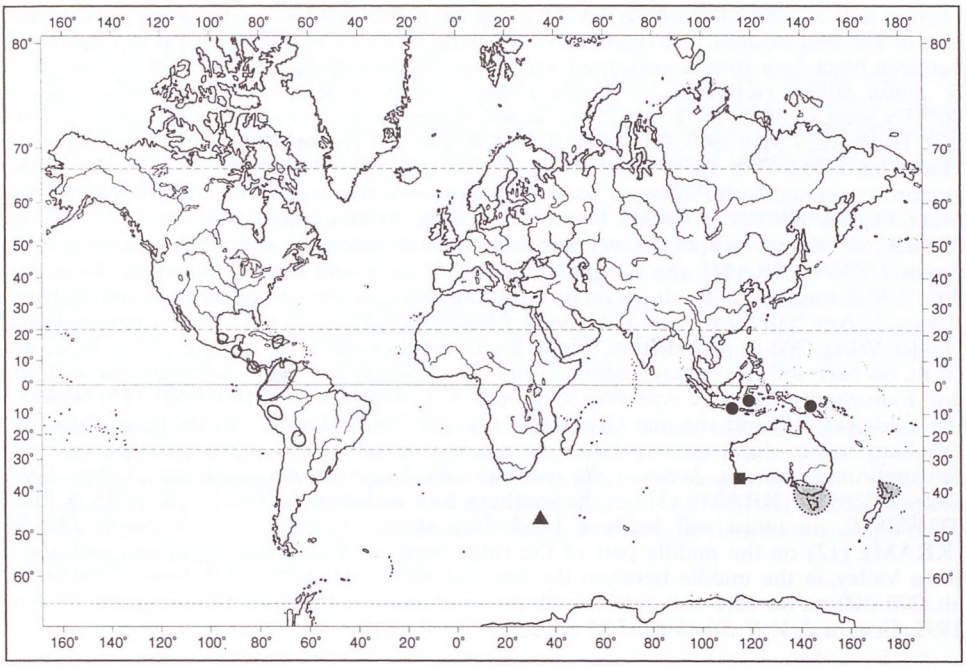


Fig. 2. Global distribution of *Entosthodon productus* Mitt. marked by the dotted line and the square in Western Australia; the Subantarctic occurrence on Marion Island is marked by the triangle. The distribution of the closely related species *E. jamesonii* (Taylor) Mitt. is marked by the solid line and black dots.

higher elevations (up to 300 m). It usually grows on bare, moist to wet soil onto which water is dripping or over which it is seeping, in seepage and drainage lines on slopes, at the margins of streams and on nearly perpendicular sides of deep ravines. It is also sometimes found on pockets of wet, gravelly soil between stones, boulders and rocks in lowland fellfields. In all these situations it may form large patches or be scattered between other mosses and liverworts. Its most frequent moss associates are *Entosthodon laxus, Philonotis scabrifolia* (Hook. f. & Wilson) Braithw., *Notoligotrichum tristaniense* (Dixon) G. L. Sm., *Breutelia integrifolia* (Taylor) A. Jaeger, and its liverwort associates are *Jamesoniella colorata* (Lehm.) Schiffn., *Fossombronia australis* Mitt., *Jungermannia coniflora* Schiffn., *Symphyogyna podophylla* (Thunb.) Mont. & Nees, *Clasmatocolea humilis* (Hook. f. & Taylor) Grolle and *Austrofossombronia marionensis* R. M. Schust.

Hitherto, *Entosthodon productus* has been found at the following localities in the Subantarctic.

SUBANTARCTICA. **Prince Edward Islands.** ***Marion Island:*** (1) stream at the east foot of Repetto's Hill, lat. 46°50'35"S, long. 37°45'E, alt. 100–180 m, on wet soil on steep stream banks, associated with *Notoligotrichum tristaniense;* 29 Apr 1999, *Ochyra & V. R. Smith 2486/99 & 2487/99* (KRAM); (2) Goney Plain, the stream running to Prinsloomeer from Gordon's Hill, lat. 46°50'50"S, long. 37°47'E, on wet soil on steep banks of the stream, associated with *Blindia magellanica* and a variety of liverworts; 29 Apr 1999, *Ochyra 2413/99* (KRAM); (3) north-eastern slope of Long Ridge opposite Fairy Prion Valley, lat. 46°51'30"S, long. 37°48'15"E, alt. 150 m, on wet soil between lava blocks; 24 Apr 1999,

Ochyra & V. R. Smith 1837/99 (KRAM); (4) at the north-east foot of Tafelberg on the right side of Van den Boogaard River, lat. 46°53'S, long. 37°49'10"E, alt. 250 m, on wet peaty soil between black lava stones, associated with *Breutelia integrifolia;* 13 Apr 1999, *Ochyra & V. R. Smith 803/99* (KRAM); (5) Nellie Humps, south of Meteorological Station, lat. *ca* 46°53'S, long. *ca* 37°51'30"E, alt. 25 m, on wet mineral soil compacted by trampling in lowland feldmark, 7 May 1997, *Gremmen 97/7* (KRAM); (6) Trypot stream near Tom, Dick and Harry, lat. 46°53'45"S, long. 37°50'45"E, alt. 100 m, on bare earth on steep banks of the stream, associated with *Philonotis scabrifolia, Jungermannia coniflora* and *Jamesoniella colorata, Ochyra 1040/99* (KRAM); (7) northern slope of Stony Ridge, lat. 46°54'30"S, long. 37°52'E, alt. 100 m, on spots of wet bare soil between stones, 22 Apr 1999, *Ochyra & V. R. Smith 1718/99* (KRAM); (8) Kerguelen Rise, 500 m inland from Killerwhale Cove, lat. 46°55'30"S, long. 37°52'E, alt. 70 m, forming extensive patches on moist bare soil between stones, 22 Apr 2002, *Ochyra & V. R. Smirh 1494/99* (KRAM); (9) in the lower part of Black Haglet Valley, 300 m inland from Whale Bird Point, lat. 46°57'08"S, long. 37°51'30"E, alt. 60 m, on bare soil in seepage, together with *Jamesoniella colorata, Fossombronia australis* and *Entosthodon laxus;* 22 Apr 1999, *Ochyra & V. R. Smith 1412/99* (KRAM); (10) between the Kildalkey Bay hut site and Green Hill, lat. 46°57'06"S, long. 37°51'05"E, alt. 70 m, on wet bare soil in depressions between stones, associated with *Symphyogyna podophylla, Fossombronia australis, Jamesoniella colorata* and *Jungermannia coniflora;* 21 Apr 1999, *Ochyra 1266/99* (KRAM); (11) at the southern foot of Johnny's Hill, lat. 46°57'15"S, long. 37°49'25"E, on moist soil between black lava stones, *Ochyra & V. R. Smith 1386/99* (KRAM); (12) on the middle part of the ridge between Water Tunnel Stream and Santa Rosa Valley, in the middle between the hut and Sfinks, lat. 46°57'10"S, long. 37°44'50"E, alt. 200–300 m, on bare soil between black lava blocks in the fellfield vegetation; 27 Apr 1999, *Ochyra & V. R. Smith 2247/99 & 2256/99* (KRAM).

REVIEW OF GLOBAL DISTRIBUTION

The discovery of *Entosthodon productus* on Marion Island in the Kerguelen Province is the first reliable record of the species in the Subantarctic and represents a major extension of its geographical range (Fig. 2). *E. productus* is considered to be an Australasian endemic species, widely distributed in southern Australia including Victoria, South Australia and Western Australia (Fife & Seppelt, 2001), Tasmania (Rodway, 1914; Dalton *et al.,* 1991) as well as from North Island of New Zealand (Sainsbury, 1955).

The distribution pattern exhibited by *Entosthodon productus* is exceptional amongst mosses. The prevailing westerlies means that migration of mosses to Marion Island should be from regions west of the island, i.e. from southern South America. A migration in the opposite direction, i.e. from Australasia to Marion Island, might be expected to be an exception and, in fact, the proportion of species in the Marion Island moss flora that occurs elsewhere only eastward of the island is low. According to Zanten (1971) only 22% of the island's moss bryoflora showed such a distribution but he suggested that this value might be too high because of an inadequate knowledge of the taxonomy of Southern Hemisphere mosses and a poor understanding of their distributions. This suggestion has been repeatedly confirmed; later taxonomic studies have shown several species to have different distributions than those suggested by the information available in 1971. For example, *Campylopus arboricola* Cardot & Dixon appears to be identical to the Patagonian *C. purpureocaulis* Dusén which consequently was established as an amphipacific south-temperate species penetrating into the Subantarctic (Frahm, 1988). *Blindia contecta* Hook. f. & Wilson was incorrectly

reported from Îles Kerguelen and Heard Island (Bartlett & Vitt, 1986) and from the Prince Edward Islands (Ochyra & Hertel, 1990). The latter record was based on an incorrect taxonomic conclusion of the conspecificity of *Blindia microcarpa* Mitt. and *B. contecta.* In fact, they are distinct taxa, the former belonging to a separate genus *Valdonia* Ochyra (Ochyra, 2003) and the latter remaining an endemic to the Campbell and Auckland Islands in the New Zealand sector of the cool temperate zone.

It would appear that of the Marion Island moss flora, apart from *Entosthodon productus,* only *Philonotis tenuis,* which is widespread in Australia and New Zealand and also found on Tristan da Cunha (Dixon, 1960), shows an Australasian-Tristan da Cunha disjunction. However, it is possible that *P. tenuis* may merge into one of southern South American species and, as was pointed out above, a detailed study might place the Australasian *E. productus* as a subspecies of the Andean-Malesian *E. jamesonii.*

Acknowledgements — Logistical support from the South African Department for Environmental Affairs and Tourism for the field work on the Prince Edward Islands is gratefully acknowledged. This study has also gained financial support from the Polish State Committee for Scientific Research through grant No. 6 P04C 002 18. Halina Bednarek-Ochyra designed the plate and Katarzyna Biłyk generated the distribution map and their assistance is gratefully acknowledged.

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