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Notes on *Fissidens* (Fissidentaceae) in tropical Australia: *Fissidens darwinianus*

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Notes on *Fissidens* (Fissidentaceae) in tropical Australia: *Fissidens darwinianus*. – Acta Mus. Siles. Sci. Natur., 68: 151-155, 2019.

Abstract: Recent collections of the Tropical to Subtropical Australian endemic species *Fissidens darwinianus* with good fruiting material have enabled an elaboration of the type diagnosis with a complete description of the sporophyte and updated anatomical details. The peristome is of the *bryoides*-type. *Fissidens darwinianus* appears closely related morphologically to *F. bogoriensis*, a species known from China, Japan, the Malay Peninsula and most of the large islands of the Indo-Pacific as far east as New Guinea. The relationships of *F. darwinianus* to the globally widespread and morphologically diverse *F. curvatus* are being further investigated.

Key words: Fissidentaceae, *Fissidens*, *Fissidens darwinianus*, Australia, Indonesia, Papua New Guinea

Introduction

The genus *Fissidens* contains around 440 recognised species worldwide but has its greatest diversity in Tropical and Subtropical regions (Pursell 2007). In their recent molecular phylogenetic study of *Fissidens*, Suzuki et al. (2018) have suggested that the evolutionary history of the genus lies in adaptation and diversification in the tropical regions.

Until relatively recently *Fissidens* had been little studied in Australia, a country offering a great diversity of habitats and climatic options for diversification. An assessment of the *Fissidens* flora of the country began with the pioneering work of Stone (1983a, b) and continued in a series of publications (Stone 1984, 1985, 1987, 1989, 1990a, b, c, 1991, 1992, 1994a, b; Stone & Beever 1996; Stone & Catcheside 1993). In the most recent revision, Seppelt & Stone (2016) included some 70 taxa (58 species and 12 varieties) in the Australian flora. However, most collections from the Australian tropics and subtropics remain only provisionally studied. Many anomalous forms have been collected and any floristic or phytogeographic evaluation of similarities with the *Fissidens* floras of the Indo-Malaysian region (Iwatsuki & Haji Mohamad 1987; Eddy 1988), Indonesia and Papua New Guinea (Norris & Koponen 1987; Suzuki & Iwatsuki 2011), as well as the islands of Pacific Oceania (e.g., Bartram 1933a, b, 1957; Whittier & Miller 1967; Iwatsuki 1982; Iwatsuki & Suzuki 1989, 1995, 1996), is not only difficult but not sensible at the present time. New Zealand is perhaps the most completely documented locality in the region (Beever & Stone 1992, 1998, 1999a, b; Beever 2014; Beever *et al*. 2018), with some 34 taxa recognised. However, differences and difficulties in taxonomic interpretation, difficulties in locating vouchers from previously reported taxa, and recent taxonomic re-evaluations make any biogeographic comparisons tenuous at best.

Fissidens darwinianus revisited

Some recent collections of *Fissidens* from the wet tropics and south-east bioregions of Queensland have resulted in a better understanding and circumscription of a number of species. One such species is *F. darwinianus* Catches. & I.G.Stone which, when first described (Catcheside & Stone 1988), lacked a description of the complete sporophyte. Recent collections from Eungella National Park, Queensland included both immature and mature sporophytes and an amended description and illustration of the species is provided here.

Fissidens darwinianus Catches. & I.G.Stone, J. Adelaide Bot. Gardens 11(1): 3, f.1, 2. (1988)

Type: AUSTRALIA: Northern Territory: Rapid Creek, Darwin. Holo: MEL 1023242 (!). Para: Queensland, South of Cooktown, 19.vi.1982, *I.G.Stone 19232 p.p.* (MEL) (!).
Illustrations: D.G.Catcheside & I.G.Stone, Jl. Adelaide Bot. Gardens 11(1): 4, fig. 1, 5; fig. 2. (1988). R.D.Seppelt & I.G.Stone, Flora Australia Mosses On-line. Fissidentaceae. Fig. 1.

Plants green, on shaded soil. **Stems** short, 1.0-2.5 mm long, arising from a persistent protonema; rhizoids basal on stems, dark brown; in section with a central region of relatively large thin-walled cells occupying ca. 1/3 diameter of stem surrounded by thin-walled cells and an outer cortical layer of 1-2 rows of smaller thicker-walled cells. **Leaves** small, cultriform below, ±lanceolate above, in up to 5 pairs, (0.6-)1.0-1.4 mm long, 0.3-0.4 mm wide, widest about mid leaf; **apex** acute, **limbidium** on all laminae, of 1-3 rows of elongate, thicker-walled cells and 1-2 cells thick, the lowest outermost cells 15-20(-25) μm long, 10-15 μm wide, the inner cells longer and narrower, 30-60(-80) μm long and 4-6 μm wide; margins weakly crenulated; **vaginant laminae** 1/2-3/5(-2/3) leaf length, closed and joined at the margins or part open with the minor lamina joining part way between margin and costa; **dorsal lamina** broad above, tapering gradually to the base, ending slightly above or at the insertion, or occasionally shortly decurrent; **lamina cells** thin-walled, ±hexagonal, 1-3:1, 10-20 μm long, 8-15 μm wide, ±oblong in proximal part of vaginant laminae and 20-30(-50) μm long, (12-)15-18 μm wide; **costa** of *bryoides*-type, joining with marginal limbidia in leaf apex, percurrent to barely excurrent.
Dioicous. **Perigonia** terminal; antheridia clustered at apex; perigonial leaves mostly elimbate. **Perichaetia** terminal; perichaetial leaves similar to vegetative leaves. **Setae** 4-5 mm long, geniculate at base. **Capsules** inclined, asymmetric, 0.15-0.6 mm long, 0.4 mm wide, slightly narrowed at the mouth; **exothecial cells** quadrate to short rectangular, 20-30 μm long, 10-20 μm wide, ±collenchymatous, the longitudinal walls appearing thicker than transverse walls, in ca. 58 columns around the circumference of urn, outer surface ±bulging. **Operculum** conical, ca. 1/2 length of urn. **Peristome** of *bryoides*-type; teeth ca. 350 μm long, split to 1/3 from base into two narrow filaments, the filaments irregularly spirally thickened, basal membrane ca. 120 μm high, outer surface trabeculate, finely punctate in horizontal rows between the trabeculae; teeth 30-40 μm wide at the base. **Calyptra** cucullate. **Spores** pale brown, 11-16 μm in diameter, surface very finely papillose but appearing ±smooth.

Distribution: Apparently endemic to northern Australia, known from Northern Territory and tropical north east Queensland.

Specimens examined: AUSTRALIA: NORTHERN TERRITORY: Rapid Creek, Darwin, i.1965, *V.Pederson* (MEL). QUEENSLAND: Kirama State Forest, Cardwell, *I.G.Stone 15001 p.p.* (MEL); Helenvale, 25 km S of Cooktown, *I.G.Stone 19232 p.p.* (MEL); Eungella National Park, Mount Dalrymple, 30.vi.2014, *G.Bell 2, 4* (BRI).

The holotype specimen includes mature capsules but only remnants of the basal membrane of the peristome teeth. The recent Mount Dalrymple, Queensland, collections (*Bell 2, 4*) contain both immature and mature (Fig. 1a, b) sporophytes, calyptrae (Fig. 1b) and opercula (Fig. 1c) and intact peristomes (Fig. 1a, d, e), thus permitting a complete description of the sporophyte. The peristome (Fig. 1d, e) is of the *bryoides*-type (*fidé* Bruggeman-Nannenga & Berendsen 1990). Between the trabeculae on the outer surface of the basal undivided part of the peristome the ornamentation appears as lines of very fine papillae ("minutely dotted" of Bruggeman-Nannenga & Berendsen 1990) together with interconnected horizontal ridges. Above the bifurcation of the teeth the ornamentation appears as a combination of oblique to more or less vertically arranged ridges and papillae. Bruggeman-Nannenga & Berendsen (1990) describe the upper filament ornamentation (compared to that of the basal membrane) of the *bryoides*-type peristome as being "equally high having a similar ornamentation; trabeculae obscure, lamellar ornamentation of oblique, rather wide-spaced riblets which distally may become horizontal, … together giving the impression of spiral ornamentation".

In the specimens studied, the peristome teeth are ca. 350 μm in length, split to 1/3 from the base into two narrow filaments, with a basal membrane ca. 120 μm high, and the teeth 30-40 μm wide at the base. The calyptra is cucullate. Although under the light microscope the spore surface appears almost smooth, careful observation reveals that the exine is very finely papillose. The spores are pale brown with a diameter range of 11-16 μm (mean 12.98, n = 50).

When described, *F. darwinianus* was considered as being similar to *F. bogoriensis* M. Fleisch., but that species is autoicous and the apical laminal cells larger at 30-45 x 20-25 μm (10-20 x 8-15 μm in *F. darwinianus*), and the cells of the basal part of the vaginant laminae up to 80 μm long (20-50 x 12-18 μm in *F. darwinianus*).

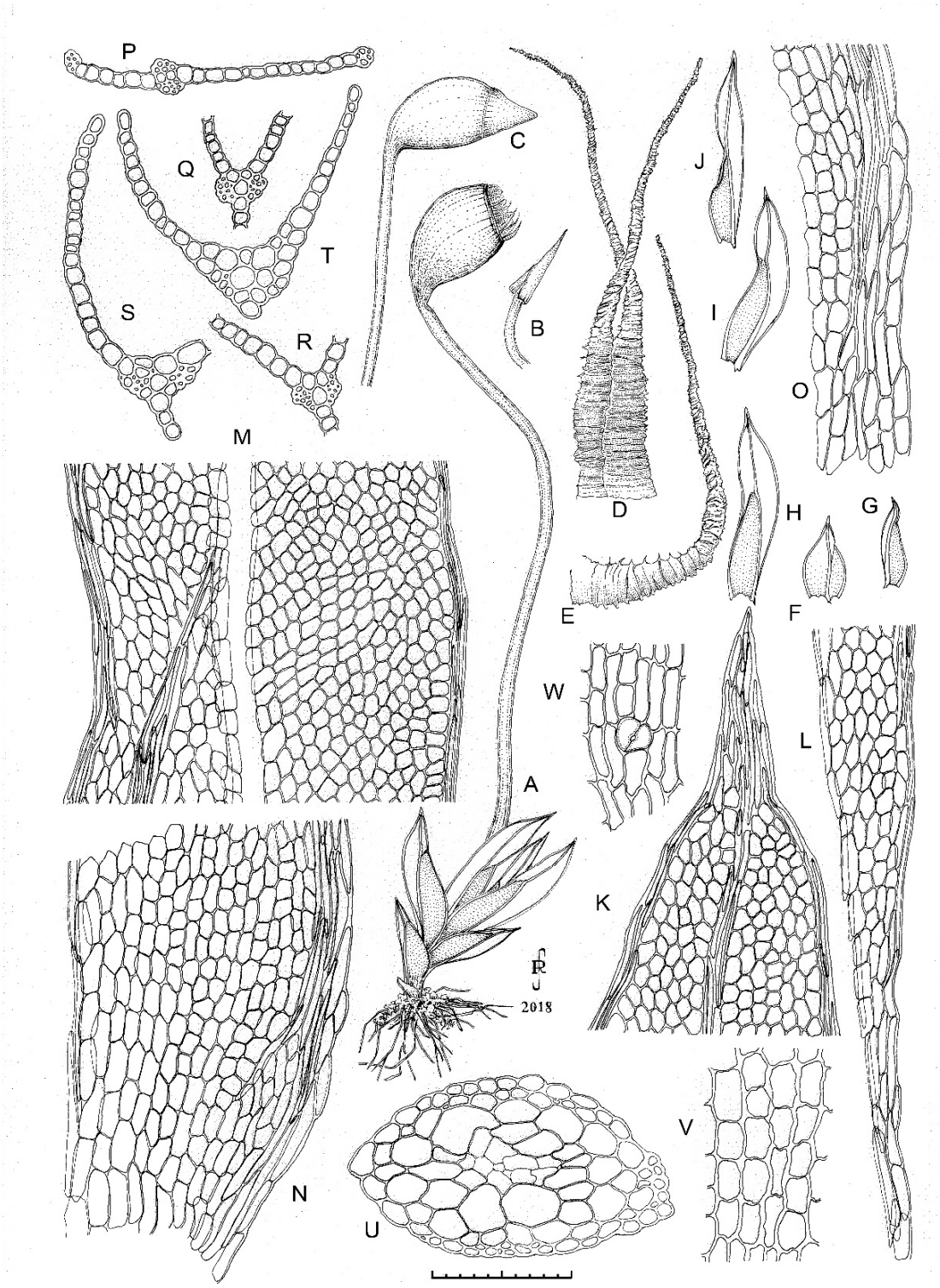

Fig 1: *Fissidens darwinianus* Catches. & I.G.Stone. Drawn from *Bell 2, 4* : Eungella National Park, Mount Dalrymple, 21°02'07.9"S, 148°35'46.6"E, 990 m alt. (BRI). **A**: Habit of fruiting plant. **B**: Immature sporophyte with cucullate calyptra. **C**: Operculate capsule. **D**: Peristome tooth, outer surface. **E**: Peristome tooth, lateral view. **F, G**: Lower stem leaves. **H**: Subperichaetial leaf. **I, J**: Perichaetial leaves. **K**: Cells of leaf apex. **L**: Cells of proximal part of dorsal lamina. **M**: Cells of vaginant and dorsal laminae at level of junction of vaginant laminae. **N, O**: Cells of basal part of vaginant laminae with limbidia. **P**: Section of apical lamina with bistratose limbidia. **Q-S**: Sections of leaf and costa below junction of vaginant laminae. **T**: Section of leaf at level of insertion on stem. **U**: Stem section showing presence of the weakly defined central strand. **V**: Exothecial cells from mid capsule. **W**: Stomate from base of urn.
Scale bar: = 1.0 mm for plant, leaves, capsule, immature sporophyte with calyptra; = 100 μm for cells, sections, peristome.

Iwatsuki & Suzuki (1982) noted that for *F. bogoriensis* the limbidium was weak and consisted of 1-3 rows of elongate and more or less thicker-walled cells, although the leaves often also lacked a limbidium. Variability in the limbidium is not an uncommon phenomenon with many species, compounding identification. They did note that near its proximal end the limbidium was often intra-laminar, as also seen in the Mount Dalrymple collections of *F. darwinianus* (Fig 1n, o). They also noted that the costa usually ended well below the apex of stem leaves but in perichaetial leaves the costa often terminated near to the apex of the leaf. In *F. darwinianus* the costa consistently terminates in the apex where it conjoins the marginal limbidia (Fig. 1k).

The operculum of *F. bogoriensis* is long-rostrate, 0.3-0.6 mm in length, while in *F. darwinianus* it is conical to short-rostrate, 0.3-0.35 mm in length (Fig. 1. c). Spores are of similar size and ornamentation in both species: 8-14(-16) μm in *F. bogoriensis*, 11-16 μm (mean = 12.98 μm) in *F. darwinianus*.

Fissidens darwinianus is also morphologically similar to *F. zollingeri* Mont. However, the latter species in synoicous, it has prominent axillary hyaline nodules, there are sometimes septate propagulae borne on the protonema or in leaf axils on the stem, the capsules are erect, and the peristome is of the *scariosus*-type (*fidé* Bruggeman-Nannenga & Berendsen 1990), correlating with (28-)32(-40) columns of exothecial cells around the circumference of the theca.

The morphological relationship of *F. darwinianus* to *F. curvatus* Hornsch. also merits further assessment. The latter species is polyoicous but its anatomical characteristics are close to those of *F. darwinianus*. *Fissidens curvatus* is often dimorphic, with sterile stems having smaller and more numerous and more uniformly sized leaves; fertile stems are shorter with the subperichaetial and perichaetial leaves larger than lower stem leaves. *Fissidens curvatus* is a widespread and common species worldwide and within Australia some eight taxa having an Australian type (including two *nomina nuda* and a *nomen invalidum*) have been included in its synonymy (Seppelt & Stone 2016).

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