

*FISSIDENS LUISIERII* P. VARDE (FISSIDENTACEAE, MUSCI),  
A NEGLECTED SPECIES FROM MACARONESIA

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ABSTRACT. *Fissidens luisierii* was described by Potier de la Varde in 1955 from the Azores. But no study of this species has been made since the original description. This species is compared and contrasted with *F. adianthoides* Hedw., the Asiatic *F. nobilis* Griff., *F. polyphyllus* Wils. ex B. S. G., and *F. serrulatus* Brid. A description of *F. luisierii* and illustrations of *F. luisierii*, and *F. serrulatus* are provided.

INTRODUCTION

*Fissidens luisierii*, described by Potier de la Varde (1955) from the Azores (São Miguel), is based on material collected in 1940 by A. Luisier. In the original description Potier de la Varde referred this species to sect. *Serridium* (sensu Brotherus) and compared it with *F. polyphyllus* Wils. ex B. S. & G. and *F. adianthoides* Hedw. *Fissidens luisierii* is listed in current Macaronesian checklists, such as by Eggers (1982), Corley et al. (1981) and Düll (1984, 1992), but no recent study of this species has been made.

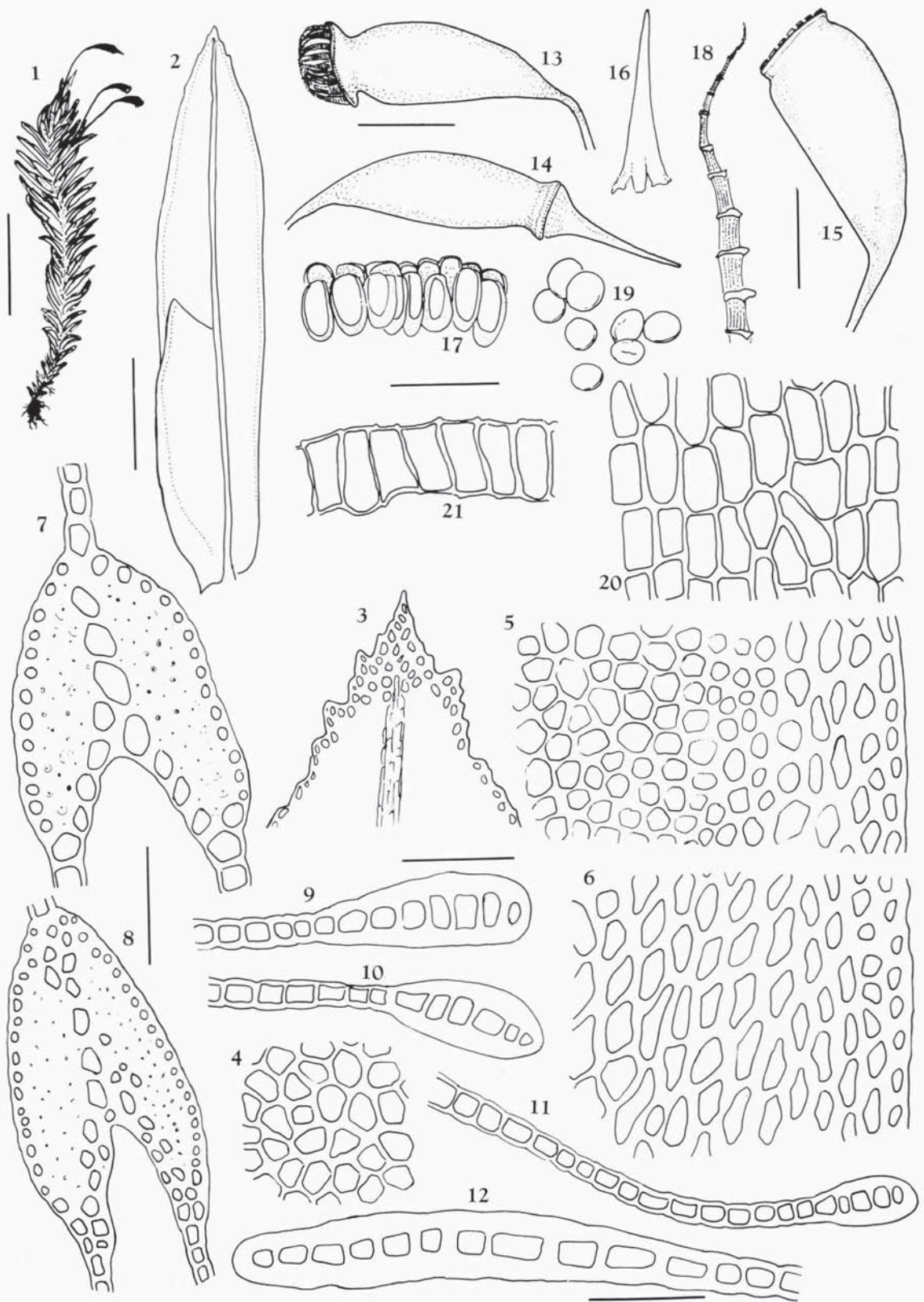
Several years ago the first author made a number of collections of *Fissidens* on Madeira that appeared to be related to *F. serrulatus* Brid. but lacked the characteristic mammillose laminal cells. In the course of a revision of *Fissidens* from the Azores these specimens were seen to be identical with *F. luisierii*, a species known only from the Azores. Our examination of collections in European herbaria revealed that there is difficulty in recognizing *F. luisierii*. Some specimens had been annotated as "*F. adianthoides*?", "similar to *F. polyphyllus*", and "*F. serrulatus* with no mammillose cells". Moreover, three specimens from the Canary Islands (Agua Garcia, 1833, BM, G, PC) were named *F. denticulatus* Brid., a nomen nudum.

The purpose of the present paper is to provide a modern description and illustrations of *Fissidens luisierii*, and to distinguish it from species with which it has been confused, *F. adianthoides*, *F. polyphyllus*, and *F. serrulatus*. *Fissidens luisierii* also has characteristics shared with the Asiatic *F. nobilis*. All of these species belong to section *Serridium* as defined by Iwatsuki and Inoue (1984), and have a similar type of peristome (Allen 1980, Bruggeman-Nannenga and Berendsen 1990) and similar costa (Bruggeman-Nannenga 1990).

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*Fissidens luisierii* P. de la Varde

Figs. 1–39 &amp; 64–69

Mitteil. Thüring. Bot. Ges. 1 (2–3): 15, 1995.

Type: Archipel des Azores, île San Miguel, Tameyal (Tafsmujal), III 1940, leg. A. Luisier (PC).

Plants large, tufted, pale green to dark green, brownish red when old; stems simple, 2–9 cm long, 0.4–1 cm wide with leaves, erect, rhizoidous generally only at base, with central strand, axillary hyaline nodules not differentiated, cortical stem-cells thick-walled; leaves in 15–40 pairs, regularly and more or less densely arranged, erect-patent with stem when wet; middle and upper leaves lanceolate to linear-lanceolate, (4.5) 5–8 mm long, (0.5) 0.7–1.2 (1.3) mm wide; acute to obtusely acute, base of dorsal lamina rounded or decurrent; vaginant lamina about 1/2 the leaf length; costa stout, ending below apex; margin at leaf apex irregularly dentate to sparsely and faintly denticulate; margin bordered throughout by a darker to lighter colored band (yellow or orange brown), 4–6 (8) cells wide (Fig. 9, 10, and 11), at base of vaginant lamina a wide band of 8–20 (22) differentiated cells (Fig. 12); median cells of apical and dorsal laminae quadrate to hexagonal, thinner-walled compared with marginal cells, smooth (not mammillose), 10–16 (20)  $\mu\text{m}$  long; cells of vaginant lamina elongate to base and almost prosenchymatous, 2–6 as long as wide; lamina in cross-section 1 cell thick, in a regular arrangement (Fig. 10 and 11), rectangular to quadrangular.

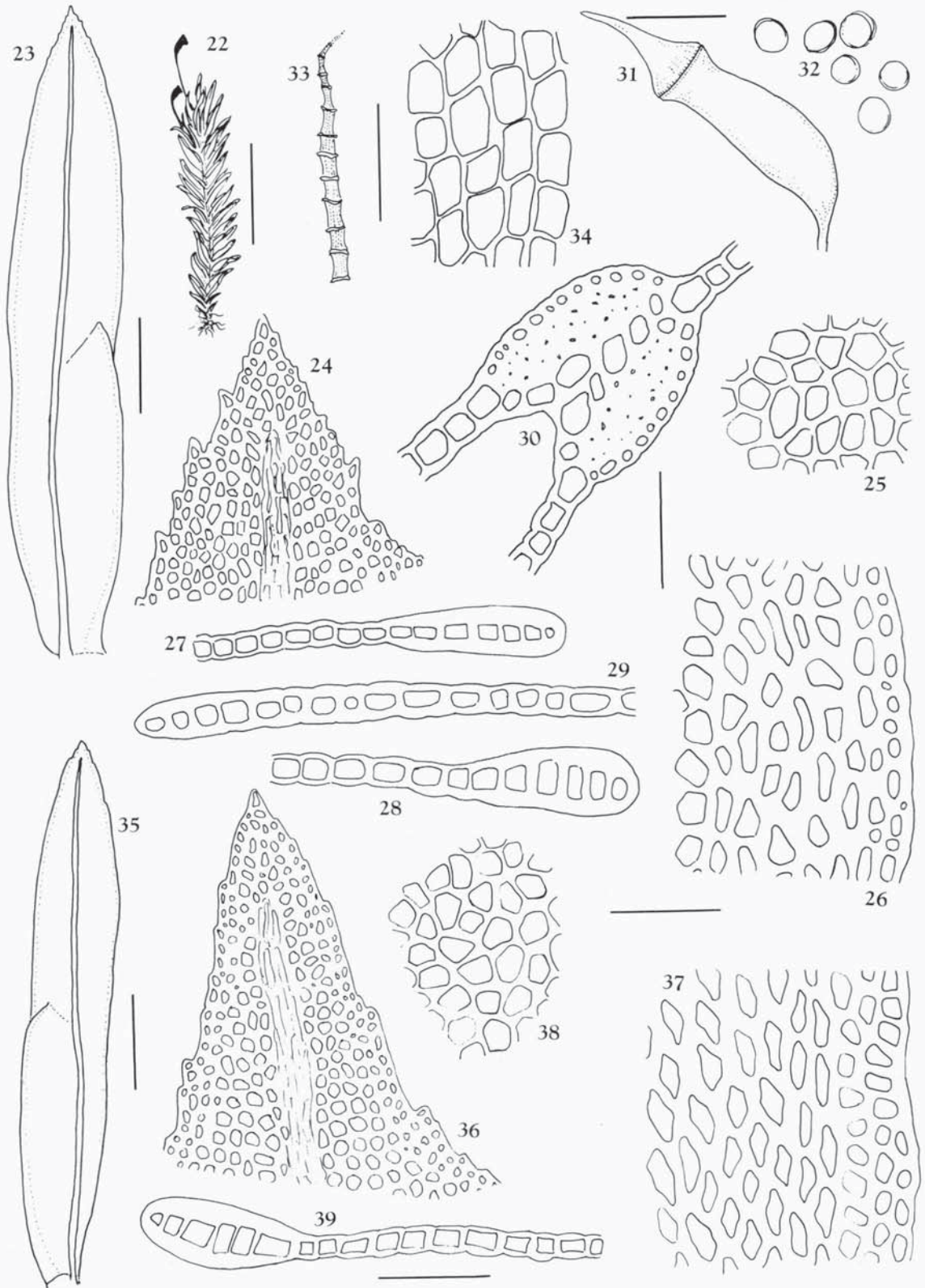
Dioicous; male inflorescences bud-like in axils of median leaves (usually 4–5 to 20 per plant), with small perigonal leaves and few paraphyses; antheridia 20–30 per perigonium; female inflorescences terminal, on main stems and on short lateral branches, with narrow perichaetial leaves; innovations of small female inflorescences often below the terminal inflorescence; setae terminal (1–2 per perichaetium) or appearing lateral, 0.8–1.5 (1.8) mm long, brown to orange brown, smooth; capsules inclined and asymmetrical, usually constricted below the mouth; 0.8–1.2 mm large to 1.5–2.3 mm long; exothecial cells quadrate to hexagonal, 20–30  $\times$  25–40 (50)  $\mu\text{m}$  (Fig. 20 & 21); annulus present with 2 rows of cells (Fig. 17); opercula very long rostrate, 1.3–1.7 mm long; capsule perimeter with 115–140 cells; peristome teeth red or brick-red, erect when wet, 500–650  $\mu\text{m}$  long, 100–130  $\mu\text{m}$  wide at base, with smooth, thickened articulations, with papillae linearly arranged in lower half of lamellae and nodose filaments (Fig. 66 and 67); spores 12–16 (18)  $\mu\text{m}$  in diameter, nearly smooth (Fig. 68); calyptra campanulate, smooth, 1.5–2.0 mm long.

## DISCUSSION

The features distinguishing *F. luseirii*, *F. nobilis*, and *F. serrulatus* are listed in Table 1.

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Figs. 1–21. *Fissidens luisierii* P. Varde. 1. Habit (dry). 2. Vegetative leaf. 3. Leaf apex. 4. Cells in median part of apical lamina. 5. Marginal cells in median part of vaginant lamina. 6. Marginal cells in lower vaginant lamina. 7, 8. Cross-sections in median part of leaf. 9, 10. Cross-sections of margin in median part of leaf. 11. Cross-section in median part of dorsal lamina. 12. Cross-section in base of vaginant lamina. 13. Capsule (dry). 14. Capsule with operculum. 15. Old capsule. 16. Calyptra. 17. Annulus. 18. Filament of peristome. 19. Spores from one capsule. 20. Exothecial cells. 21. Cross-section of exothecial cells. [All figs. from Sérgio 9448 and 9456 (LISU)]. Scale bar: 1=1.5 cm; 2 and 13–16=1 mm; 3, 17 and 20–21=60  $\mu\text{m}$ ; 4–12 and 18–19=40  $\mu\text{m}$ .



### 1. Distinctions between *Fissidens luisierii* and *F. serrulatus*

The smooth, less obscure laminal cells of *F. luisierii* are the primary difference from *F. serrulatus* in which the laminal cells are highly mammillose [holotype B; isotype BM, PC; Fig. 56, 57–61 & 63]. Further, in *F. luisierii* the leaf border is more distinctly differentiated. The leaf border of *F. luisierii* is translucent, yellow to orange or brown in older leaves, and consists, in the upper half of the leaf of 3–6 (8) rows of larger cells that are more or less prosenchymatous. In the base of the leaves this band consists of about 13 rows of prosenchymatous cells that are quite evident in cross-section (Figs. 9–12, 27–29 and 39). On the other hand, the leaf border in *F. serrulatus* is rarely coloured, and consists of 3–5 rows of short rhomboidal cells that are less evident in cross-sections (Figs. 45–47, 59–61).

These two species also differ in cross-sections of their leaves. In *F. luisierii*, the cells in the median part of the leaf are more or less regularly quadrate, smooth or with slightly convexly thickened walls (Fig. 10–11, 27–29, 39, 64, & 65). In *F. serrulatus*, the laminal cells are more or less polygonal and irregularly arranged, with high mammillae often more evident on one side of the leaf (Figs. 46, 47, 58, 59, 70, 72 and 73). Laminal cells of *F. luisierii* are generally larger [(8) 10–16 (20)  $\mu\text{m}$ ] than of *F. serrulatus* [(6) 8–14(16)  $\mu\text{m}$ ].

There is considerable variation in the marginal denticulations of the apical and dorsal laminae in all specimens studied. In some specimens, including the type of *F. luisierii*, the denticulation is reduced and irregular (Fig. 36), while in other specimens, e.g., those of *F. denticulatus* Brid., nom. nud. (Fig. 24) the leaf apex is conspicuously dentate. Specimens with weak dentations at the leaf apex (as seen in the type of *F. luisierii*) are identical to the Madeiran plants known under the name *F. serrulatus* fo. *subintegrifolius* P. Varde.

We confirmed that *F. serrulatus* from Canary Islands (Teneriffe), is not distinct from the material of the type locality of *F. langei* De Not. [Holotype RO, Italy, Ad Cape Penaggi] a species included in the synonymy of *F. serrulatus*.

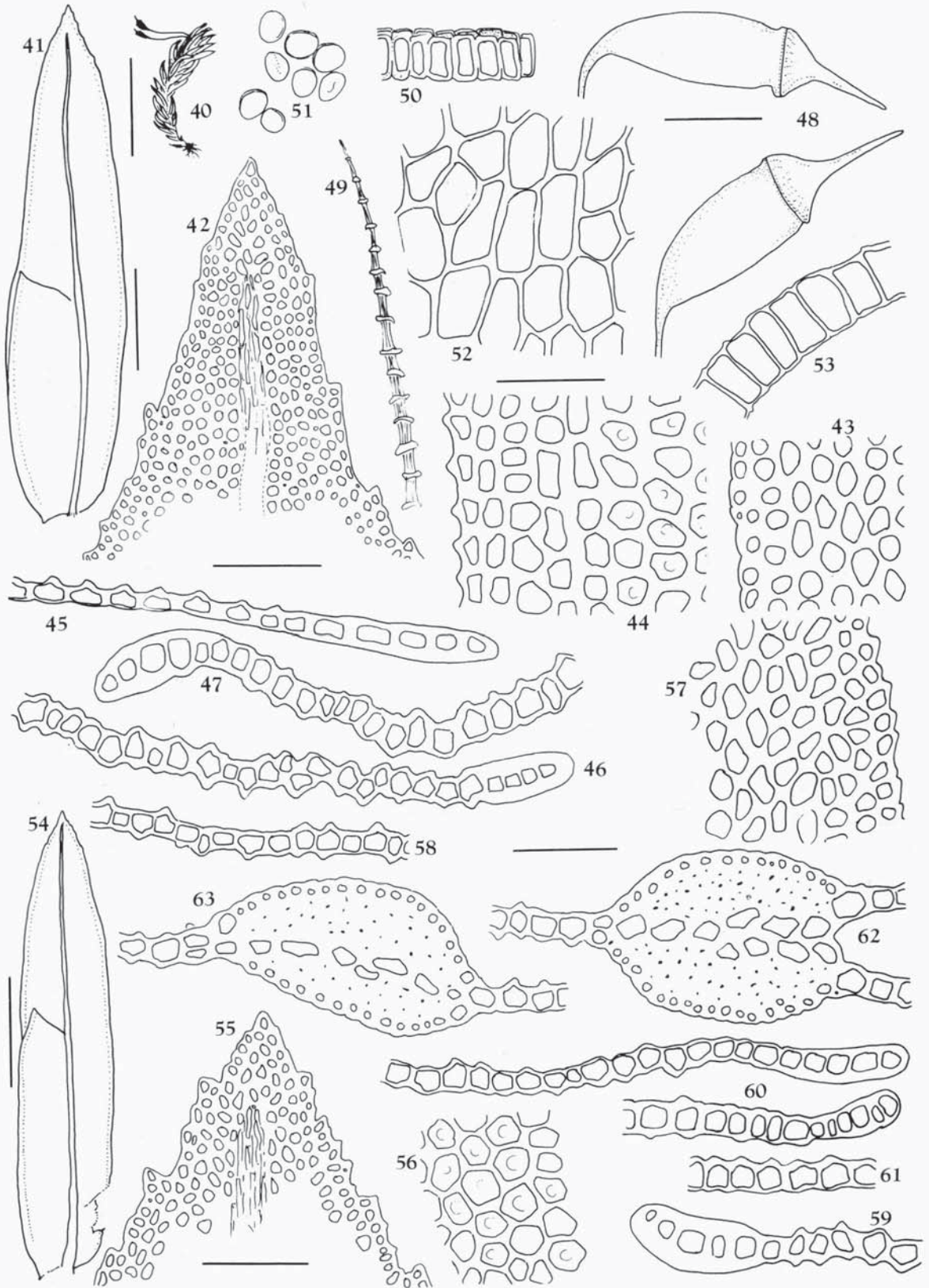
Bruggeman-Nannenga (1990) considered the number of exothecial cells in the circumference of the capsule to be an important characters in the taxonomy of *Fissidens*. The number of exothecial cells is larger in *F. luisierii* (115–140) than in *F. serrulatus* (80–100). (Table 1)

### 2. Distinctions between *Fissidens luisierii* and *F. nobilis*

Both the apical and vaginant laminae of *F. nobilis* are bordered throughout by a dark band of cells, 2–4 layers in thickness (Abramova & Abramov 1968; Iwatsuki & Suzuki 1982; Li 1985). In both *F. luisierii* and *F. serrulatus* this marginal band is just 1 cell thick. As seen in cross-sections, cells in the apical lamina of *F. nobilis* and *F. serrulatus* cells are

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Figs. 22–39. *Fissidens luisierii* P. Varde. 22. Habit (dry). 23, 35. Vegetative leaves. 24, 36. Cells at leaf apex. 25, 38. Median cells of apical lamina. 26, 37. Marginal cells in median part of vaginant lamina. 27, 28 and 39. Cross-sections of margin in median part of leaf. 29. Cross-section of margin in base of vaginant lamina. 30. Cross-section in median part of leaf. 31. Capsule with operculum. 32. Spores from one capsule. 33. Filament of peristome. 34. Exothecial cells. Figs. 23–34 from *F. denticulatus* Brid.(nom. nud.) [Canary Island, Tenerife Agua Garcia, 1833 (PC and BM); 35–39 from isotype (PC, Herb)]. Scale bar: 22=1,5 cm; 23, 31 and 35=1 mm; 24,34 and 36=60  $\mu\text{m}$ .; 25–30, 32–33 and 37–39=40  $\mu\text{m}$ .



mammillose to highly mammillose, and often, in part, bistratose and irregularly arranged (Figs. 45–47, 58, 61; see Iwatsuki & Suzuki 1982; Abramova & Abramov 1968). On the other hand, the cells of the apical and vaginant laminae of *F. luisierii* are always unistratose and regularly arranged. The cells of the vaginant laminae of *F. nobilis* are always unistratose and mammillose on the outer surface, while those of *F. luisierii* are unistratose and smooth.

### 3. Distinctions between *F. luisierii* and *F. polyphyllus*

*Fissidens polyphyllus* is a species large for the genus and usually grows in or nearer to streams than does *F. luisierii*. Morphologically, *F. polyphyllus* is difficult to mistake for any other species of subgenus *Serridium*. Unlike *F. luisierii*, there is no coloured marginal band of thickened marginal cells in *F. polyphyllus*. Leaves of *F. polyphyllus* are long and narrowly ligulate-lanceolate and the leaf apices have only a few obscure denticulations. The laminal cells are thickened, smooth, and decrease in size from costa to margin. By nature of its aquatic habitat and aspects of costa structure, *F. polyphyllus* is closer to *F. grandifrons* Brid. (Casares 1919).

### 4. Distinctions between *F. luisierii* and *F. adianthoides*

Leaf shape in *F. luisierii* is lanceolate to linear-lanceolate (Fig. 23 & 35), while that of *F. adianthoides* is broadly oblong to ovate. In addition to leaf shape, marginal border cells of these two species are quite different. Both species have a few rows of cells differentiated from other laminal cells: marginal cells of *F. luisieri* are distinctly prosenchymatous while those of *F. adianthoides*, however, are thin walled. In cross-section of the apical lamina of *F. luisierii*, cells of the marginal border are much thicker-walled than laminal cells. The marginal cells of *F. adianthoides* are not thicker than laminal cells in cross-sections. Another difference between these two species is of spore size. Spores of *F. luisierii* are 12–16  $\mu\text{m}$  (Fig. 68), while those of *F. adianthoides* are larger, 18–26  $\mu\text{m}$ .

In keys to European *Fissidens*, specimens of *F. luisierii* often “key out” to *F. adianthoides*.

### 5. Distinctions between *Fissidens serrulatus* and *F. nobilis*

*Fissidens serrulatus* and *F. nobilis* are distinct from one another, based on the morphological features listed in Table 1. The most important distinguishing character, however

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Figs. 40–63. *Fissidens serrulatus* Brid. 40. Habit (dry). 41, 54. Vegetative leaves. 42, 55. Cells at leaf apex. 43, 44, 57. Marginal cells of apical and dorsal laminae. 45, 61. Cross-sections of leaf margin in median part of vaginant lamina. 46, 47, 58–60. Cross-sections of margin in median part of dorsal lamina. 48. Capsules with opercula. 49. Filament of peristome. 50. Annulus. 51. Spores from one capsule. 52. Exothecial cells. 53. Cross-section of exothecial cells. 56. Median cells of apical lamina. 62. Cross-section in median part of leaf. 63. Cross-section in median part of apical lamina. Figs. 40–53. from *F. serrulatus* Brid. [From Bussaco, Sérgio 6071 (LISU); 54–56 and 62–63 from the isotype (BM); 57–61 from the holotype (B)]. Scale bar: 40=1.5 cm; 41, 48 and 54=1 mm; 42, 50, 52, 53 and 55=60  $\mu\text{m}$ .; 43–47, 49, 51 and 56–63=40  $\mu\text{m}$ .

Table 1. Diagnostic characters of *Fissidens luisierii* P. Varde, *F. serrulatus* Brid. and *F. nobilis* Griff.

	<i>Fissidens luisierii</i>	<i>Fissidens serrulatus</i>	<i>Fissidens nobilis</i>
Number of leaf pairs	(10) 15-36 (40)	(10) 15-25 (30)	18-46
Leaf shape and length	lanceolate to linear-lanceolate 0.5-1.2×(4.5) 5.0-8.0 mm 6-9 times as long as irregularly dentate to sparsely and remotely denticulate	ovate to lanceolate 0.8-1.3×4.0-6.5 mm 4-6 times as long as wide irregularly denticulate to coarsely dentate	lanceolate 1.0-1.6×4.5-8.7 mm wide 4.5-8.7 times as long as wide irregularly dentate to coarsely serrate
Leaf apices	smooth or slightly bulging 1 cell thick smooth or slightly bulging	highly mammillose 1 cell thick highly mammillose on external side	highly mammillose usually 2 cells thick highly mammillose on external side
Cells of apical laminae	smooth, glossy, generally colored, colored, 2 rows of smaller and 3-6 rows of usually long prosenchymatous cells	smooth, glossy, rarely colored, 1 row of smaller cell and 3-4 rows of usually short rhomboid cells	smooth, thick-walled, generally colored
Cross-section of apical lamina	1 cell thick	1 cell thick	2-4 cells thick
Marginal border of vaginant lamina	entire, not serrulate	usually serrulate	almost entire to weakly serrulate
Shape or laminal cells in cross-sections	Quadrangular to rectangular, regularly arranged	Quadrangular to polygonal (pentagonal), irregularly	Quadrangular to polygonal irregularly arranged
Size of laminal cells (in $\mu\text{m}$ )	(8) 10-16 (20)	(6) 8-14 (16)	6-13
Number of exothelial cells in capsule perimeter	(115) 120-140	80-100 (115)	120-131 from one specimen only
Size of spores (in $\mu\text{m}$ )	12-16 (20)	10-14	15-19



is the thick (2–4 cell layers) margin of *F. nobilis*.

#### GEOGRAPHICAL DISTRIBUTION

*Fissidens luisierii* is restricted to Macaronesia (Madeira, the Canary Islands, and the Azores), while *F. serrulatus* has a broader distribution in the Mediterranean-Atlantic region (Macaronesia, Portugal, Italy, France, Corse, Spain, Greece, England, and northern Africa). *F. luisierii* seems to be more abundant than *F. serrulatus* in the Canary Islands, but both species are present in the same area (Agua Garcia). On the other hand, *F. serrulatus* is more widely distributed in the Azores than *F. luisierii*. We could not examine any material of *F. serrulatus* from Madeira Island.

*Fissidens polyphyllus* is found in Europe, Macaronesia, and disjunct in South Africa (Düll 1984), and has a strong oceanic affinity.

*Fissidens nobilis* is known from Asia and Oceania, and *F. adianthoides* has wide distribution range in the world.

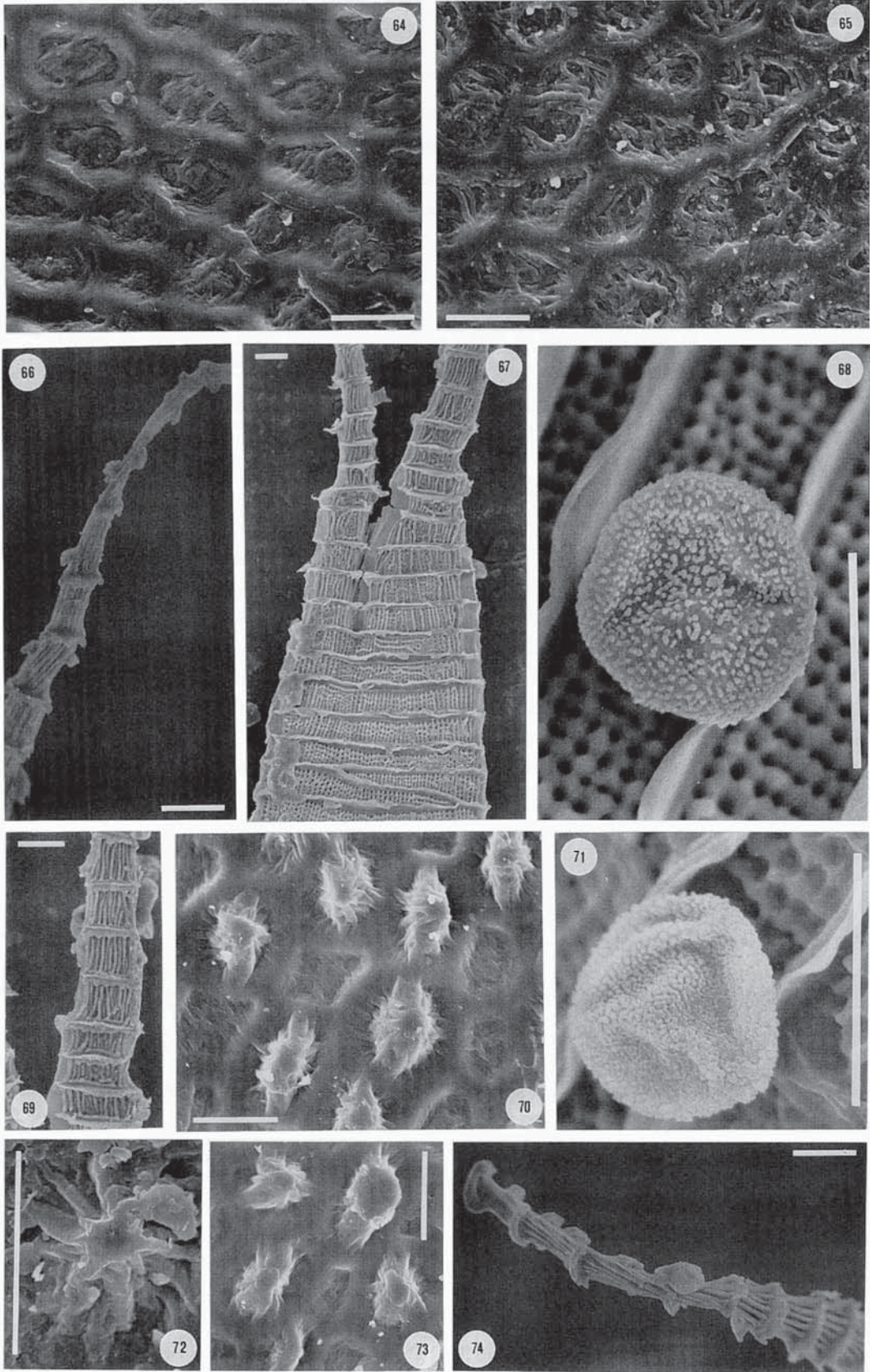
#### SPECIMENS STUDIED

*FISSIDENS LUISIERII* P. VARDE (\* specimens with sporophytes)

AZORES. FAIAL: Lomba, 1982 Sérgio 4376 (LISU). S. MIGUEL: Tamujal, 1940 Luisier (PC-Herb. P. Varde) (Holotype); Lagoa das Furnas, 1837 Persson (PC); Lameiro, 1898, Carreiro 645 (LISU 66503 ex.p.); Sete Cidades, 1980 Sérgio 2624 (LISU); Pico da Vara, 1937 Persson (BM). TERCEIRA: Furnas do Cabrito, 1982 Sérgio 4558 (LISU).

CANARY. TENERIFE: Agua Garcia, Pitard (PC-ex. Herb. Corbier); \*Cumbre de Las Mercedes, 1855 H. Perraudière (BM); \*Las Mercedes, Krause 21 (BM-Herb. Warnstorff); \*Las Mercedes, 1928 Bequaert (PC-Herb. Bizot); \*Tenerife, ad rupes Agua Garcia, 1844 E. Bourgeau, Pl. Canarienses (BM) [Type of *F. denticulatus* Brid. (nom. Nud.)]; ibidem 38 (PC); \*Agua Garcia, 1866 Husnot 160 (PC-Herb. P. Varde); \*Anaga, 1855 H. Perraudière (BM); \*Las Mercedes, 1908 Bryhn (Herb. Muñoz 2642); Las Yedras, 1987 Losada (Briotheca Hispanica 1109, BCB 931, NAU 4117, VABbrio 1813 and TFCbry 1754); \*Monte de Agua Garcia y Cerro del Lomo, 1983 Losada et al. (BCB 21664 and TFCbry 2081); Las Mercedes, 1965 Dorta (BCB 13868); \*Madre del Agua, Agua Garcia, 1971 Acuña (Briotheca Hispanica 339, NAU 250 and TFCbry 193); \*Monte de Agua Garcia, 1971 Acuña (BCB 2159); Tacoronte, Monte de Agua Garcia y Cerro del Lomo, 1995 Ederra (NAU 6703); \*El Pijaral, Anaga, 1995 Ederra (NAU 67036); \*Las Mercedes, 1974 Rodriguez & Ron (TFCbry 249); Monte de las Mercedes, Llano de los Loros, 1981 Beltrán & Losada (TFCbry 842). GOMERA: Cumbre del Carbonero, 1954 J. Lid (PC-Herb. P. Varde). La Palma: \*Barranco del Agua, 1954 J. Lid (PC-Herb. P. Varde); \*Barranco del Agua, 1978 Duell (LISU); Bosco de la Galga, 1978 Duell (LISU).

MADEIRA. \*Chão de Louros, 1982 Sérgio & Nóbrega 3792 (LISU); Encumeada de S. Vicente, 1970 Koppe (LISU 162159); from Monte to Terreiro da Luta, 1951 Tavares (LISU 149113); from Queimadas to Caldeirão Verde, 1951 Tavares (LISU 149116); \*Ribeiro Frio, Lamaceiros, 1992 Sérgio & Fontinha 7952, 7911, 7946 (LISU); \*Faldas do Pico Jorge, Ribeira do Bonito, 1988 Sérgio & Nóbrega 6128, 6175 (LISU); Fanal de Baixo, 1992 Sérgio & Fontinha 8037 (LISU); \*Fanal, Ribeiro Alto, 1994 Nóbrega (LISU); \*Funduras, to Pico da Coroa, 1992 Sérgio & Fontinha 7958 (LISU); \*Lamaceiros, 1886 Mandon (BM-Herb. Schimper); Levada do Furado, Cabeço do Pessegueiro, 1957 Romariz 744 (LISU 43576); Levada do Ribeiro Frio to Santo da Serra, 1951 Tavares (LISU 149115); Machico, Groute do Cavalo, 1936 Barreto 73 (BM-Herb. Dixon); \*Palheiro, Funchal, 1909 Armitage (BM-Herb. Dixon); Pico Grande, 1847 Love (BM); Poiso, 1937 Persson



(PC- Herb. P. Varde); Poiso, pr. Casa do Poiso, 1970 Koppe (LISU 66448 ex.p.); Encumeada de S. Vicente, 1951 Tavares (LISU 149114); Rabaçal, Levada do Risco, 1949 Romariz (LISU); Ribeira de S. Vicente, 1970 Koppe (LISU 66448 ex.p.); \*Ribeiro Frio, Mandon 5 (BM-Herb. Bescherelle and Herb. Schimper); \*Ribeiro Frio, 1890 Menezes 97 (PC); Ribeiro Frio, 1970 Koppe (LISU 162160); Ribeiro Frio, 1979 Sérgio 2366 (LISU); Ribeiro Frio, 1990 Thorn (Herb. Werner 5066); Ribeiro Frio, Levada do Furado, 1991 Fontinha (LISU); Levada do Ribeiro Frio to Balcões, 1990 Sauer et al. (SAAR and LISU); Vereda do Posto da Encumeada to Ribeira Grande de S. Vicente, 1982 Sérgio & Nóbrega 3819 (LISU); \*Queimadas to Caldeirão Verde, 1995 Sérgio & Fontinha 9448, 9456 (LISU).

*FISSIDENS SERRULATUS* BRID. (Selected specimens) (\*specimens with sporophytes)

AZORES. FAIAL: Ribeira das Cabras, 1937 Palhinha & Sobrinho (LISU 64545 p.p.); Faial, 1929 Tutin & Warburg (BM). PICO: \*Canada do Moio, 1937 Palhinha & Sobrinho (LISU 64545 p.p.); 1929 Tutin & Warburg 157 (BM); \*Serra Madalena, 1967 Botelho Gonçalves 300 (LISU 66504 ex. part); Cueva de Henrique Maciel, 1989 Hernández Mancebo (TFCbry 9608). S. JORGE: From Ribeira da Areia to Norte Pequeno, 1939 Palhinha & Sobrinho 250 (LISU 66502 p.p.); Pico da Bagacina, 1938 Gonçalo da Cunha & Sobrinho (LISU 64545 p.p.); Ribeira das Duas, Pico da Falca, 1968 Ormonde 370 (LISU 66513 ex. part). S. MIGUEL: Lameiro, 1898 Carreiro 645 (LISU 66503 p.p.); Nove Janelas, 1898 Carreiro 644 (LISU 66502 ex. part). TERCEIRA: Agualva, 1937 Palhinha & Sobrinho (LISU 64545 p.p.).

CANARY. GOMERA: La Gomera, 1978 Brugués (BCB 23382); La Zarza, 1978 Wildpret & Rodriguez (TFCbry 777 and TFCbry 778); Parque Nacional de Garajonay, Las Mimbreras, 1987 Losada & Beltrán (TFCbry 7125, 7137). LA PALMA: \*La Palma, 1985 Brugués (BCB 23383); \*El Canal y Los Tiles, 1990 Losada, González & Leon (TFCbry 7818); \*El Canal y Los Tiles, 1989 Losada & Gonzalez (TFCbry 7430). TENERIFE: Holotype, 1803 Bory (B, Herb Briedel 995); Bory (BM) Isotype; Bory de St. Vincent (PC) Isotype; Sierra de Anaga, 1975 Redfearn & Crosby 30376 (PC-Herb. Bizot); Carboneras, 1975 Crosby 9562 (PC-Herb. Bizot); Agua García y Cerro Lomo, 1995 Ederra (NAU 6702); Tacoronte, Monte de Agua Garcia y Cerro del Lomo, 1995 Ederra (NAU 6702); Las Mercedes, 1971 Varo & Zafra (GDAC 9009); El Pijaral, Anaga, 1995 Ederra (NAU 6707 and NAU 6705).

FRANCE. Estérel, Le Mal Inferent, 1958? Delon (PC-Herb. P. Varde); Pas de Roland, Basses-Pyrénées, 1910 Douin (Herb. Muñoz 2556).

CORSICA. La Piana, Calanehes, 1894 Fleisher (BM); Bonifaso pro Calvi, 1901 Camus (PC).

GREAT BRITAIN. Devon, Hembrory Wood, M. Buckfastleigh, 1982 Gardinier (BM); Hartor Bridge, 1950 Norkett; Penzance, 1879 Curnow, Castle Horneck, Penzance, 1868 Curnow and 1886 Dixon & Curnow. (BM).

ITALY. Ad Cape Penaggi prope Arenzano, 1856 De Notaris (RO) Holotype of *F. langei* De Not.;

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Figs. 64–69. Scanning electron micrographs of *Fissidens luisierii* P. Varde. 64–65. Aspects of the foliar texture in median part of dorsal lamina. 66. Filament of peristome. 67. Outer surface of undivided part and bifurcation of a peristome tooth. 68. A spore and outer surface of peristome tooth. 69. Outer surface of the peristome tooth at the bifurcation.

Figs. 70–74. Scanning electron micrographs of *Fissidens serrulatus* Brid. 70, 72, 73. Aspects of the foliar texture in median part of dorsal lamina. 71. A spore and outer surface of a peristome tooth. 74. Filament of peristome [Fig. 64 from Madeira, Sauer et al. (LISU); 65–69. from Madeira, Sérgio 9448 (LISU); 70 and 73 from Monchique, Solms (BM); 71, 72 and 74 from Bussaco, Sérgio 6071 (LISU)]. Scale bar=10 µm.

Base della Alps Apuane, Toscana Sena, 1882 Bottini (PC); Monte Pisano ad Asciano, Toscana, 1887 Bottini (PC); Monte Pisano, 1903 Bottini (BM).

MAROCOCO. Gebel Kebui, 1934 Richards (PC).

PORTUGAL. MINHO: \*Gerês, Caldas, 1908 Luisier (LISU 53346 p.p.); Rio Mouro, 1908 Luisier (LISU 53346); Cabeceiras de Basto, 1878 Henriques ? (LISU 53338). BEIRA LITORAL: \*Bussaco, 1911 Dixon & Nich. 141 (BM); Coimbra, 1880 A. Moller (BM) Herb. S.O. Lindberg; \*Bussaco, Fonte Fria, 1988 Sérgio 6071 (LISU); Coimbra, Zombaria 1879 Henriques (LISU 53338 ex.part.); Louzã, 1911 Nicholson 141 (BM); Silva Escura, Cascata da Cabreira, 1982 Sérgio 4654 (LISU). ALGARVE: Monchique, 1866 Solms (BM-Flor. Lusit. Algar.); Picota, 1911 Dixon & Nicholson (BM-Herb. Dixon); ESTREMADURA: Serra de Sintra, Welwitsch 27 (BM-Herb.H. Mitten); Serra de Sintra, 1841 Welwitsch 267 (BM).

SPAIN. ASTURIAS: Soto do los Infentes to Cangas de Narcea, 1972 Vigón (Briotheca Hispanica 1306, FCO s/n, BCB 1339, NAU 5841 and VABbrio 988). ANDALUCIA: \*Arroyo de la Miel, Algeciras, 1979 Varo, Gil & Guerra (GDAC 7845). CANTABRIA: Entrambasmestas, 1988 Brugués & Schumacker (BCB 25713). GALICIA: Budián, 1926 Casares Gil (BM-Herb. Dixon, MA 8404); Pontevedra, 1960 Pierrot (BCB 16172); \*Caaveiro, Puentedeume, 1981 Reinoso (BCB 2160, BCB 2161, SANT 2728 and SANT 2729). EXTREMADURA: Gata, Rivera de Gata, 1986 Cros & Brugués (BCB 21663). NAVARRA: \*Endarlaza, 1927 Allorge (Bryoth.Ibér. 19B, PC, MA 3047 and 11407).

TUNISIA. Aïn Drahan, 1945 Call. Labbe 278 (PC-Herb. P. Varde). Type of *F. serrulatus* Brid. var. *africanus* Besch.

*FISSIDENS NOBILIS* GRIFF. (Selected specimens)

JAPAN. HOKKAIDO. Isl. Rishiri, 500 m. alt., Iwatsuki 15453 (NICH). HONSHU: Hiroshima, Ryuzukyo Gorge, River Ota, 1983 Sérgio & Seki 4839 (LISU). SHIKOKU. Tokushima-ken, Kaifu-gun, Kainan-cho, 5 m alt., Iwatsuki 5779 (NICH). KYUSHU. Miyazaki-shi, Kaeda Valley, 1983 Sérgio 4894 (LISU). Kagoshima-ken, Isl. Yakushima, 1000 m alt., Iwatsuki (Fissidentaceae Asiaticae 1 : 5, 1980) (NICH).

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