

Selaginella ayitiensis and S. brigitteana (Selaginellaceae): two new species from Hispaniola Island

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IVÁN A. VALDESPINO¹

Selaginella ayitiensis and *S. brigitteana* (*Selaginellaceae*): two new species from Hispaniola Island

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Abstract: Two new species of *Selaginella* (i.e. *S. ayitiensis* and *S. brigitteana*) from Hispaniola Island are described. Illustrations are provided for both new species and their affinities are discussed. *Selaginella ayitiensis* was collected in the Massif de la Hotte, Haiti, and is characterized by its long-creeping stems, corrugate to bumpy leaf upper surfaces, broadly acute to obtuse or apiculate median leaf apices, and white megaspores. It is morphologically related to the “*Selaginella flexuosa* group”. *Selaginella ayitiensis* differs chiefly from *S. denudata* and *S. krugii* (the only two other members of the “*Selaginella flexuosa* group” in the Greater and Lesser Antilles) by the shape of the median and lateral leaves apices. *Selaginella brigitteana* is known from different localities in the Dominican Republic and Haiti; it can be distinguished by its long-creeping, 2–4-branched stems, coriaceous leaves with the upper surfaces glossy, the median leaves with broadly hyaline, long-ciliate margins, and short-acuminate apices tipped by 2 or 3 cilia, and light yellow to cream megaspores. *Selaginella brigitteana* differs from *S. leonardii*, with which it has been confused in the past, by its broadly ovate median leaves with rounded, non-auriculate, and glabrous outer bases, submarginal and marginal stomata along proximal ½ of outer halves of the laminae, and with the upper surfaces glossy, comprising rounded and rectangular to elongate cells, many of which are papillate.

Resumen: Dos nuevas especies de *Selaginella* (i.e. *S. ayitiensis* y *S. brigitteana*) procedentes de la isla de La Española son descritas. Ambas nuevas especies son ilustradas y sus posibles afinidades son discutidas. *Selaginella ayitiensis* proviene del Massif de la Hotte, Haití, y se caracteriza por sus tallos largamente rastreros, superficie superior de las hojas arrugadas o con pequeñas proyecciones, hojas mediales con ápices agudos a obtusos o apiculados y megásporas blancas. Ésta especie se relaciona morfológicamente con aquellas pertenecientes al “grupo de *Selaginella flexuosa*”. *Selaginella ayitiensis* difiere marcadamente de *S. denudata* y *S. krugii* (las otras dos especies del “grupo de *Selaginella flexuosa*” en la región de las Antillas) por la forma de los ápices de las hojas mediales y laterales. *Selaginella brigitteana* es originaria de varias localidades tanto de Haití como de República Dominicana y se distingue por sus tallos largamente rastreros y 2–4-ramificados, hojas coriáceas con sus superficies superiores lustrosas, hojas mediales con los márgenes anchamente hialinos y largamente ciliados, ápices cortamente acuminados que terminan en 2 o 3 cilios y megásporas amarillo claro a crema. *Selaginella brigitteana* ha sido confundida en el pasado con *S. leonardii*, de la que difiere por sus hojas mediales anchamente ovadas con las bases externas redondeadas, sin aurículas y glabras, estomas submarginales y marginales a lo largo de la ½ proximal de las mitades externas de la láminas y por las superficies superiores de las láminas lustrosas, conformadas por células cuadrangulares a alargadas, muchas de las cuales son papiladas.

Key words: Dominican Republic, Haiti, Hispaniola, idioblasts, new species, *Selaginella*, *Selaginellaceae*, stomata

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Introduction

Alston (1952) prepared the only comprehensive revision of *Selaginella* in the Greater and Lesser Antilles presently available. It includes a key to species, synonymy, distribu-

tion and exsiccatae for each taxon, but provides no taxon descriptions. Since that work, Greater and Lesser Antilles *Selaginella* species were treated in geographically defined floristic accounts that include species descriptions such as those of Jamaica (Proctor 1985) and Puerto Rico and the

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Virgin Islands (Proctor 1989). More recently, new species of *Selaginella* were added for Cuba either in the context of putative species group reports (i.e. Caluff & Shelton 2003, 2009) or as independent taxa (Shelton & Caluff 2003; Caluff & Shelton 2014; Valdespino & al. 2014). Within the Greater and Lesser Antilles, Hispaniola Island is the second largest island of the region and its *Selaginella* flora has received slight attention over the more than six decades since Alston (1952) recognized 13 species to be present there. Recently, though, Caluff & Shelton (2015) reported a second collection of *S. fuertesii* Hieron., a little-known endemic, articulate species, from the Dominican Republic.

In connection with the IX Latin American Botanical Congress held in Santo Domingo, Dominican Republic in 2006, my colleagues John Pruski and Rosa Ortíz (MO), Rita Besana and I conducted fieldwork in the central mountainous region of that country and collected an intriguing *Selaginella* species along wet road banks. Further examination of that collection and revision of additional herbarium specimens representing species from the Greater and Lesser Antilles, as well as relevant published taxonomic literature on *Selaginella*, has revealed it to be an undescribed species and has revealed an additional new taxon from Hispaniola. Accordingly, herein they are formally named and established as *S. ayitiensis* Valdespino from Haiti and *S. brigitteana* Valdespino from Dominican Republic and Haiti.

Material and methods

This study is based on examination of herbarium specimens from B, F, GH, JBSD, MO, NY, PMA, UC and US (herbarium codes follow Thiers 2019+) and fieldwork conducted in 2006 in La Vega province, Dominican Republic. Samples for Scanning Electron Microscopy (SEM) to document upper and lower surfaces of stem sections and leaves, and to determine sculpturing patterns and diameter of the spores of the new taxa and possible related species were taken from selected representative herbarium specimens. SEM samples were prepared following standard techniques as described by Valdespino (1995) and Valdespino & al. (2014) and were examined and imaged at different magnifications using a Zeiss Model Evo 40 at 10–15 kV. Digitized SEM images were post-processed with Adobe Photoshop and assembled according to species in multipart figures.

Descriptions of the new species follow the pattern and methods utilized by Valdespino (2017) and Valdespino & al. (2014, 2018), complemented by terminology found in general botanical glossaries (e.g. Beentje 2016) and those specialized for pollen and spores (e.g. Punt & al. 2007; Halbritter & al. 2018). Furthermore, when describing cell surface projections the terms “*mammilla* (pl. *mammillae*) / *mammillate* (with *mammillae*)” and “*papilla* (pl. *papillae*) / *papillate* (with *papillae*)” regardless of their com-

position and consistency may be considered equivalent. Therefore, herein these structures are defined as a nipple-shaped structure or single, discrete, round and small, nipple-like, cell surface projection, where the “*mammilla*” is less than 1 µm in diam., while the “*papilla*” is usually 1–2 µm in diam. Finally, the conservation status was assessed according to the IUCN Red List categories and criteria version 3.1, second edition (IUCN 2012).

Results and Discussion

Selaginella ayitiensis Valdespino, **sp. nov.** – Fig. 1A–H, 2A–H.

Holotype: Haiti, Dept. Sud-Grand’Anse, Massif de la Hotte, Geffrard, 18 km N of Camp Perrin, on road to Beaumont and Jérémie, [c. 18°23’N, 73°48’W], 850 m, 11 Mar 1983, J. Mickel, T. Zanoni, M. Mejía & J. Pimentel 9308 (NY!; isotype: PMA!).

Diagnosis — *Selaginella ayitiensis* resembles *S. denudata* (Willd.) Spring but differs from it by its median leaf apices broadly acute to obtuse or apiculate, in latter case each apiculum 0.05–0.1 mm long (vs short- aristate, each arista $\frac{1}{4}$ – $\frac{1}{3}$ the length of the leaf lamina, 0.2–0.4 mm long), lateral leaf apices obtuse (vs acute), and ventral (vs axillary) rhizophores, which are filiform, each 0.1–0.3 mm in diam. (vs stout, each 0.6–1.5 mm in diam.).

Description — *Plants* terrestrial or epipetric. *Stems* long-creeping, stramineous, 6–15 cm long, 0.3–0.5 mm in diam., non-articulate, not flagelliform or stoloniferous, 2- or 3-branched. *Rhizophores* ventral, throughout stems, filiform, 0.1–0.3 mm in diam. *Leaves* dimorphic, chartaceous, both surfaces glabrous, upper surfaces green and corrugate to bumpy, lower surfaces silvery green and smooth or slightly corrugate on lateral leaves. *Lateral leaves* distant, ascending, ovate, broadly ovate or ovate-elliptic, 1–2.5 × 0.7–1.5 mm; bases rounded, acroscopic bases overlapping stems, basicopic bases free from stems; acroscopic margins on upper surfaces narrowly hyaline along proximal $\frac{1}{2}$ or throughout and comprising an obscure band 2–4 cells wide, each cell elongate and papillate, idioblast-like, papillae in one row on each cell lumen, or greenish along distal $\frac{1}{2}$ and comprising rounded to rectangular, sinuate-walled cells, dentate to serrulate, basicopic margins on upper surfaces greenish and comprising rounded to rectangular, sinuate-walled cells, entire along proximal $\frac{2}{3}$, otherwise sparsely dentate distally, margins on lower surfaces hyaline and comprising a band 2–4 cells wide, cells elongate and papillate, idioblast-like, papillae in one row on each cell lumen; apices obtuse, tipped by 1–4 teeth; upper surfaces consisting of rounded, rectangular to elongate or irregular, sinuate-walled cells, some laevigate and others papillate, papillae 8–25 on each cell lumen, without idioblasts or

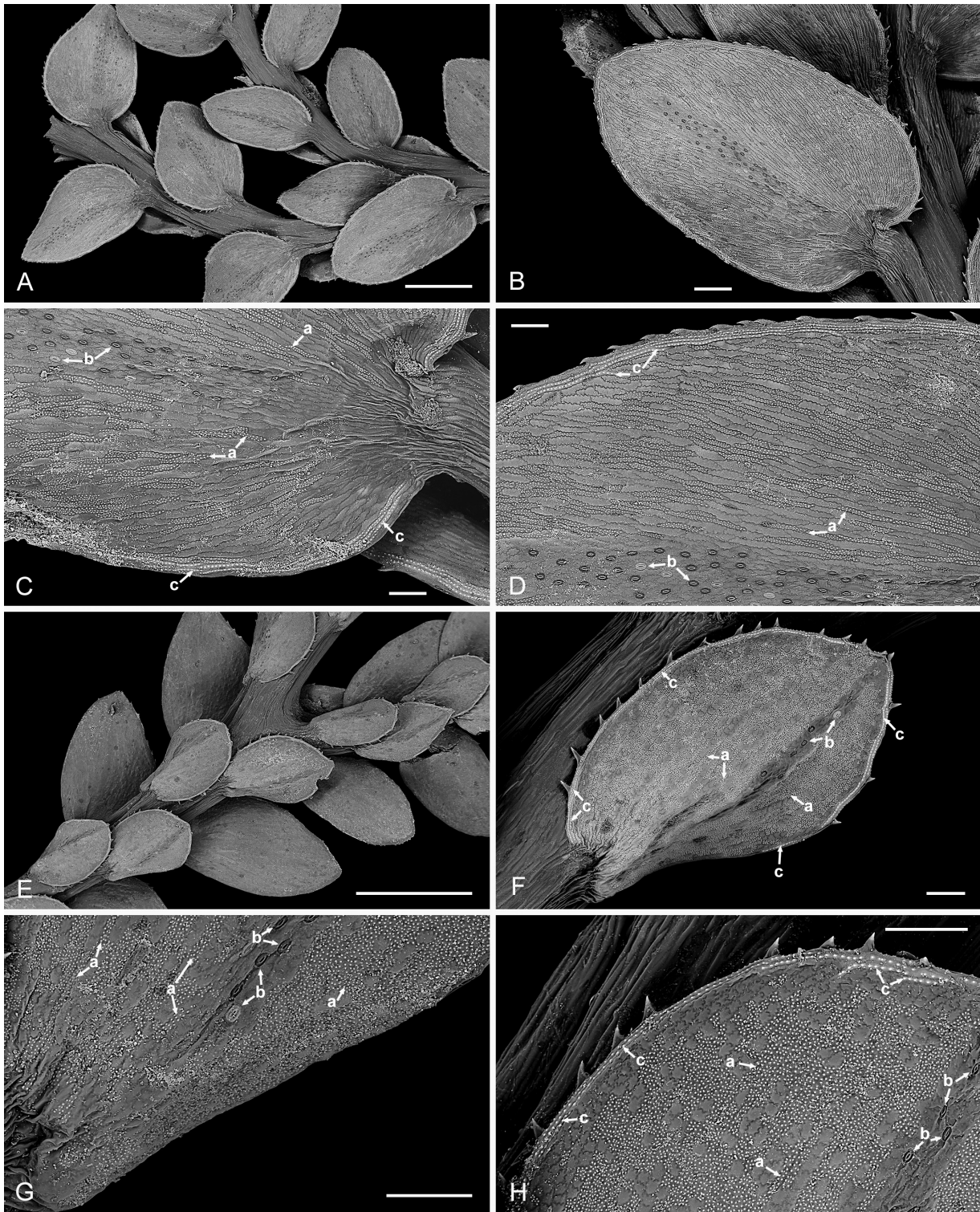


Fig. 1. *Selaginella ayitiensis* – A: section of lower surface of stem branch showing lateral leaves and portions of median leaves; B: close-up of lateral leaf from stem branch, lower surface; C: close-up of proximal, basicopic portion of lateral leaf (same leaf shown in B); note, elongate and papillate, idioblast-like cells on lamina (a), stomata along midrib (b), and elongate and papillate, idioblast-like cells on basicopic margin (c); D: close-up of central-distal, acroscopic portion of lateral leaf (same leaf shown in B); note, elongate and papillate, idioblast-like cells on lamina (a), stomata along midrib (b), and elongate and papillate, idioblast-like cells on acroscopic margin (c); E: section of upper surface of stem branch showing lateral and median leaves; F: close-up of median leaf from stem branch, upper surface; note, elongate and papillate cells on lamina (a), stomata along midrib (b), and elongate and papillate, idioblast-like cells on margin (c); G: close-up of proximal portion of median leaf (same leaf shown in F); note, elongate and papillate cells on lamina (a) and stomata along midrib (b); H: close-up of inner, distal ½ portion of median leaf (same leaf shown in F); note, elongate and papillate cells on lamina (a), stomata along midrib (b), and elongate and papillate, idioblast-like cells on inner margin (c). – Scale bars: A, E = 1 mm; B = 200 µm; C, D, F–H = 100 µm. – A–H taken from the holotype, *Mickel & al. 9308* (NY).

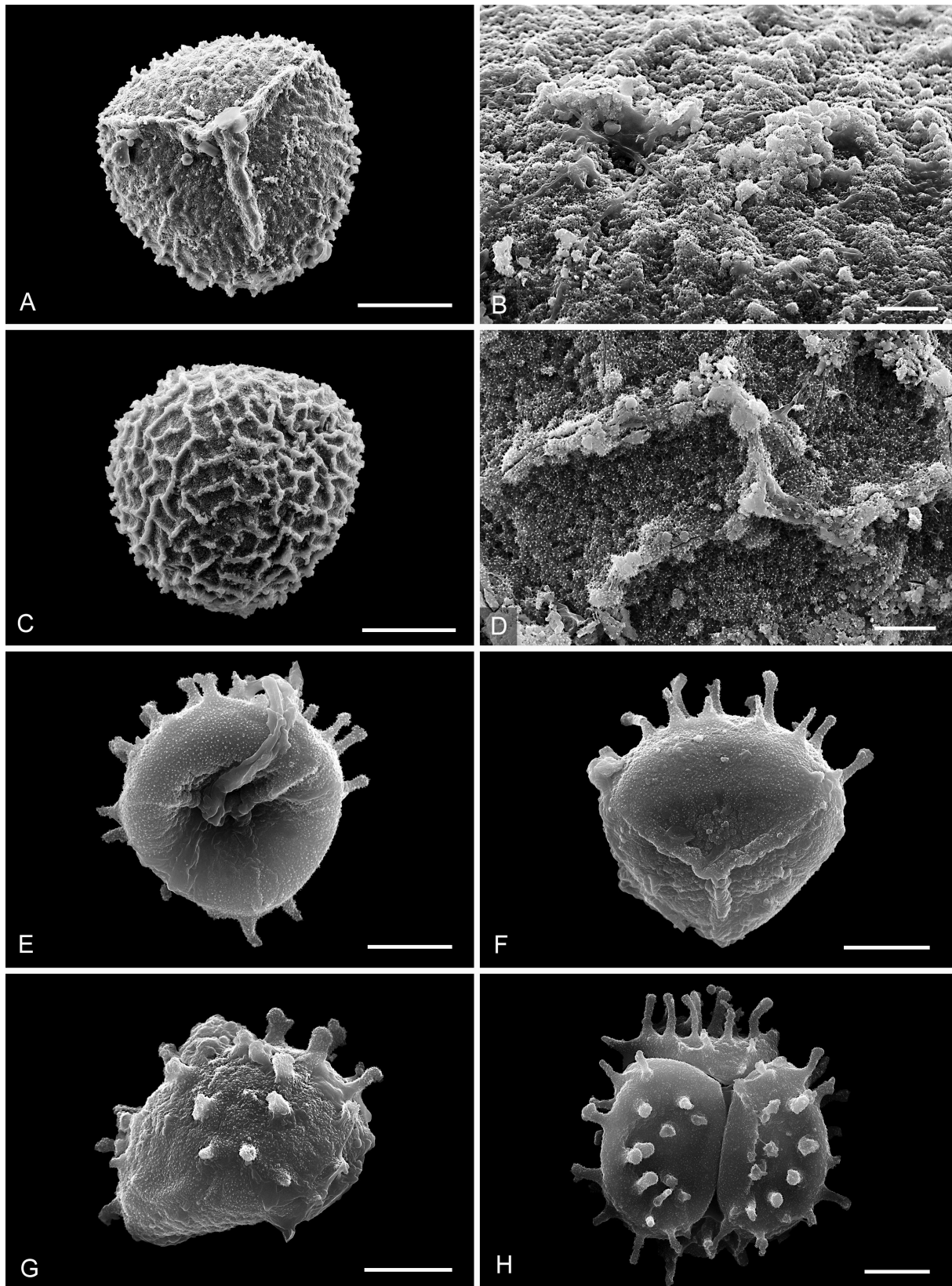


Fig. 2. Scanning electron micrographs of megaspores and microspores of *Selaginella ayitiensis* – A: megaspore proximal face; B: close-up of megaspore proximal face; C: megaspore distal face; D: close-up of megaspore distal face; E: microspore proximal face (with a smooth line of contamination running from spore centre to margin on upper, right side); F: microspore proximal-equatorial face, showing capitate and baculate projections; G: microspore proximal equatorial-distal face, showing capitate and baculate projections; H: microspore tetrad, showing capitate and baculate projections on collapsed distal and equatorial faces. – Scale bars: A, C = 100 μm ; B, D–H = 10 μm . – A–H taken from the holotype, *Mickel & al. 9308* (NY).

stomata, lower surfaces consisting of elongate, sinuate-walled cells, some laevigate and others papillate, idioblast-like, papillae 30–65 in 2 rows on each cell lumen, with stomata in 2–4 rows along central $\frac{1}{6}$ portion of midribs. *Median leaves* distant to slightly imbricate, ascending, broadly obovate, broadly ovate-oblong or broadly ovate-elliptic, 1–1.4 × 0.5–0.8 mm; bases oblique, inner bases rounded to truncate, outer bases rounded, ventricose; inner margins narrowly hyaline and comprising a band of 2 or 3 cells wide, each cell elongate and papillate, idioblast-like, papillae in one row on each cell lumen, dentate, outer margins conspicuously hyaline along distal $\frac{1}{2}$ and obscurely so (because margins folding inward) on proximal $\frac{1}{2}$ and comprising a band 2–4(–6) cells wide, cells as in inner margins; apices broadly acute to obtuse or apiculate, if latter, apiculae 0.05–0.1 mm long and often breaking off; both surfaces without idioblasts, upper surfaces consisting of rounded, rectangular to elongate or irregular, sinuate-walled cells, some laevigate, most papillate, papillae 8–25 over each cell lumen, with stomata in 1–3 rows along distal $\frac{3}{4}$ of midribs, lower surfaces consisting of elongate, sinuate-walled, laevigate cells, except for those on incurved, outer submarginal to marginal region along proximal $\frac{1}{4}$, where cells are elongate, sinuate-walled and papillate, papillae 15–35 in 1 or 2 rows over each cell lumen, without stomata or few submarginal on incurved portion of outer margins and bases. *Axillary leaves* similar to lateral leaves or oblong-elliptic, with both margins hyaline and dentate. *Strobili* terminal and single on branch tips, quadrangular, 2.5–15 mm long. *Sporophylls* monomorphic, without a laminar flap, ovate, 0.8–1.2 × 0.4–0.7 mm, with a slightly developed keel distally on upper surfaces along midribs; bases rounded; margins hyaline, dentate; apices acute; *dorsal sporophylls* upper surfaces green with cells as in median leaves, except for halves that overlap ventral sporophylls, where they are hyaline and have elongate, slightly sinuate-walled cells, lower surfaces greenish-hyaline consisting of elongate, sinuate-walled cells; *ventral sporophylls* with both surfaces hyaline to greenish-hyaline, consisting of elongate, sinuate-walled cells. *Megasporangia* on proximal $\frac{1}{2}$ of two ventral rows; *megaspore* white, rugulate and slightly reticulate marginally on proximal faces with granulate-foveolate microstructure, reticulate with open reticulae on distal faces with granulate-echinate microstructure, 230–280 μm in diam. *Microsporangia* in two dorsal rows and on distal $\frac{1}{2}$ of two ventral rows; *microspores* deep orange, granulate-rugulate on proximal faces, capitate or baculate (if tips broken off) on distal faces, with echinulate microstructure on both faces, 25–30 μm in diam.

Distribution and ecology — *Selaginella ayitiensis* is known only from the type collection made in Geffrard in the vicinity of the Massif de la Hotte in Haiti, where it may be a local endemic; it grows on limestone rocks at c. 850 m.

Conservation status — *Selaginella ayitiensis* seems to be an element of remnant patches of primary to secondary, wet, limestone forests in and around the Massif de la Hotte in Haiti, which is an important centre of plant endemism and dispersal and one of the most biologically diverse regions of Hispaniola (Judd 1986; Peguero & al. 2006). This region is highly threatened by human encroachment resulting in vegetation loss due to the expansion of subsistence agriculture, harvest of wood for diverse uses (e.g. construction and charcoal production), and small-scale ranching (Judd 1986; Peguero & al. 2006). Based on these threats, *S. ayitiensis* is considered Endangered; EN A1c; B2ab(i–iv).

Etymology — The species epithet derives from the aboriginal Taino word “Ayiti”, meaning land of the high mountains, which was one of the pre-Columbian names for Hispaniola and that is still used in Haitian creole to refer to the country of Haiti.

Remarks — *Selaginella ayitiensis* is characterized by its long-creeping stems, corrugate to bumpy leaf upper surfaces, broadly acute to obtuse or apiculate median leaf apices, and white megaspores. Some of these features are also shared with a group of Neotropical species of *Selaginella*, here informally called the “*Selaginella flexuosa* group”, which includes *S. alampeta* M. Kessler & A. R. Sm., *S. barnebyana* Valdespino, *S. chiapensis* A. R. Sm., *S. corrugis* Mickel & Beitel, *S. denudata*, *S. flexuosa* Spring, *S. guatemalensis* Baker, *S. huehuetenangensis* Hieron., *S. idiospora* Alston, *S. krugii* Hieron., *S. macrostachya* (Spring) Spring and *S. subrugosa* Mickel & Beitel. All these taxa, except *S. denudata* and *S. krugii*, are restricted to the mainland of the Neotropics and have acuminate to long-aristate median leaf apices, except for *S. corrugis* that could have apiculate median leaf apices as in the newly described *S. ayitiensis*. *Selaginella ayitiensis*, however, is a more robust plant than *S. corrugis* and has larger median leaves, 1–1.4 × 0.5–0.8 mm (vs 0.4–0.6 × 0.2–0.4 mm). In the Greater and Lesser Antilles region, *S. denudata* from Jamaica and *S. krugii* from Puerto Rico are morphologically close (including also having white megaspores) to *S. ayitiensis*. In fact, *S. ayitiensis* will key out to *S. denudata* in Alston (1952) but the former differs from the latter by the characters listed under the diagnosis and by having broadly obovate, broadly ovate-oblong or broadly ovate-elliptic (vs elliptic) median leaves with the upper surfaces of the apices glabrous (vs with tooth-like projections on aristae), and hyaline (vs greenish) basispic margins on lower surfaces of lateral leaves, composed of elongate and papillate cells (vs cells without papillae). *Selaginella ayitiensis* is set aside from *S. krugii* by its median leaf apices broadly acute to obtuse or apiculate, if the latter, apiculae 0.05–0.1 mm long (vs apices long-aristate, arista at least $\frac{2}{3}$ or more the length of the leaf lamina, each 1.5–2 mm long) with the upper surfaces glabrous (vs with tooth-

like projections on upper surfaces of aristae), and dentate (vs short-ciliate) margins, obtuse (vs acute) lateral leaves, and filiform (vs stout) rhizophores, each 0.1–0.3 mm (vs 0.4–1.2 mm) in diam.

Selaginella brigitteana Valdespino, **sp. nov.** – Fig. 3A–H, 4A–F.

Holotype: Dominican Republic, La Vega, Cordillera Central, along DR Carretera Secundaria 12, c. 3 km E of El Río on road to Arroyo Prieto, c. 23 km E of Constanza, 19°01'N, 70°31'W, 1150 m, 25 Jun 2006, *J. Pruski, R. Ortíz, I. Valdespino & R. Besana 4045* (PMA!; isotypes: B!, JBSD!, MO!, NY!, UC!, US!).

Diagnosis — *Selaginella brigitteana* differs from *S. leonardii* O. C. Schmidt by its 2–4- (vs 1- or 2-) branched stems, broadly ovate (vs ovate-oblong to ovate-deltate) median leaves with the outer bases rounded, slightly prominent, non-auriculate and glabrous (vs with a prominent, distinct, linear, terete and hirsute outer auricle that curves inward towards the stems), upper surfaces with some cell lumina papillate (vs papillate and mammillate), and with (vs without) submarginal stomata on upper surfaces along proximal ½ of outer halves, and leaves upper surfaces glossy (vs dull) comprising rounded and rectangular to elongate (vs quadrangular to rectangular) cells.

Description — *Plants* terrestrial or epipetric. *Stems* creeping, stramineous, 10–35 cm long, 0.3–1 mm in diam., non-articulate, not flagelliform or stoloniferous, 2–4-branched. *Rhizophores* axillary-ventral, throughout stem, filiform, 0.1–0.3 mm in diam. *Leaves* dimorphic, chartaceous, both surfaces glabrous, upper surfaces green, smooth or slightly corrugate, and glossy, lower surfaces silvery green, smooth, slightly glossy. *Lateral leaves* distant or slightly imbricate at branches, ascending, ovate or ovate-deltate, 1–2.5 × 0.7–1.5 mm; bases rounded to subcordate, acroscopic bases overlapping stems, basicopic bases free from stems; acroscopic margins on upper surfaces hyaline along proximal ⅔ and comprising a band 3–6 cells wide, cells elongate and papillate, idioblast-like, papillae in one row over each cell lumen, otherwise greenish on distal distally ⅓ and comprising rounded to rectangular, sinuate-walled cells, long-ciliate along proximal ⅔–¾, otherwise short-ciliate on distal ¼–⅓, basicopic margins on upper surfaces greenish and comprising rounded to rectangular and elongate, sinuate-walled cells, both margins on lower surfaces as in acroscopic margins, long-ciliate along proximal ¼–⅓, otherwise short-ciliate distally; apices acute, tipped by 1–3 short cilia; upper surfaces consisting of rounded to rectangular, sinuate-walled cells, some of these cells laevigate, others papillate, papillae 10–35 over each cell lumen, without idioblasts, with some marginal stomata on distal ⅓ of acroscopic and basicopic margins and along proximal ⅓ of basicopic margins, lower surfaces consisting of elongate, sinuate-walled cells, some of these papillate and idioblast-like,

papillae in 2 or 3 rows over each cell lumen, with stomata in 1–4 rows along central ⅕–⅙ portion of midribs. *Median leaves* distant or slightly imbricate at branches, ascending, broadly ovate, 1.1–1.5 × 0.5–1.3 mm; bases oblique or subcordate, inner bases rounded to truncate, outer bases rounded or both bases rounded; inner margins hyaline and comprising a band 2–4 cells wide, cells elongate and papillate, idioblast-like, papillae in one or occasionally two rows over each cell lumen, long-ciliate, outer margins green along proximal ⅓–½ and comprising rounded to rectangular, sinuate-walled cells, long-ciliate throughout or long-ciliate near bases and becoming entire up to proximal ½ and then long-ciliate along distal ½, greenish along proximal ⅓–½ and comprising obscurely rectangular to elongate cells, hyaline along distal ½–⅔ and comprising a band 2–4 cells wide, cells as in inner margins, long-ciliate along distal ½–⅔; apices short-acuminate to short-aristate, each acumen or arista hyaline and 0.1–0.4 mm long, tipped by 1–3 often divergent cilia; both surfaces without idioblasts, upper surfaces consisting of rounded and rectangular to elongate, sinuate-walled cells, some of these laevigate or papillate, others elongate, sinuate-walled and papillate, idioblast-like, papillae 10–35 over each cell lumen, with stomata in 2 or 3 rows on distal ½ along midribs and submarginal and marginal along proximal ½ of outer halves of lamina, lower surfaces laevigate, consisting of elongate, sinuate-walled cells, without stomata. *Axillary leaves* shape, bases, margins (except for both margins long-ciliate) and apices similar to lateral leaves. *Strobili* terminal, single on branch tips, quadrangular, 2.5–15 mm long. *Sporophylls* monomorphic, without a laminar flap, ovate, 0.8–1.2 × 0.4–0.7 mm, with a slightly developed keel distally along midribs on upper surfaces; bases rounded; margins hyaline, dentate; apices acute; *dorsal sporophylls* with upper surfaces green with cells as in median leaves, except for halves that overlap ventral sporophylls where cells are hyaline, elongate, slightly sinuate-walled, lower surfaces greenish-hyaline, composed of elongate, sinuate-walled cells; *ventral sporophylls* with both surfaces hyaline to greenish, composed of elongate, sinuate-walled cells. *Megasporangia* in two ventral rows; *megaspores* light yellow to cream, rugulate-reticulate on proximal and distal faces with verrucate, echinulate and perforate microstructure, 320–360 µm in diam. *Microsporangia* in two dorsal rows; *microspores* deep orange, slightly rugulate to smooth on proximal and distal faces, 25–40 µm in diam.

Distribution and ecology — This species grows in seepages on steep roadside banks, limestone rocks or clay soil in humid broad-leaved forests at 300–2140 m; it is known from the Massif de la Selle in southeastern Haiti and in the central and northeastern mountainous region of the Dominican Republic.

Conservation status — This species has a wide distribution in Hispaniola and may be more common than here

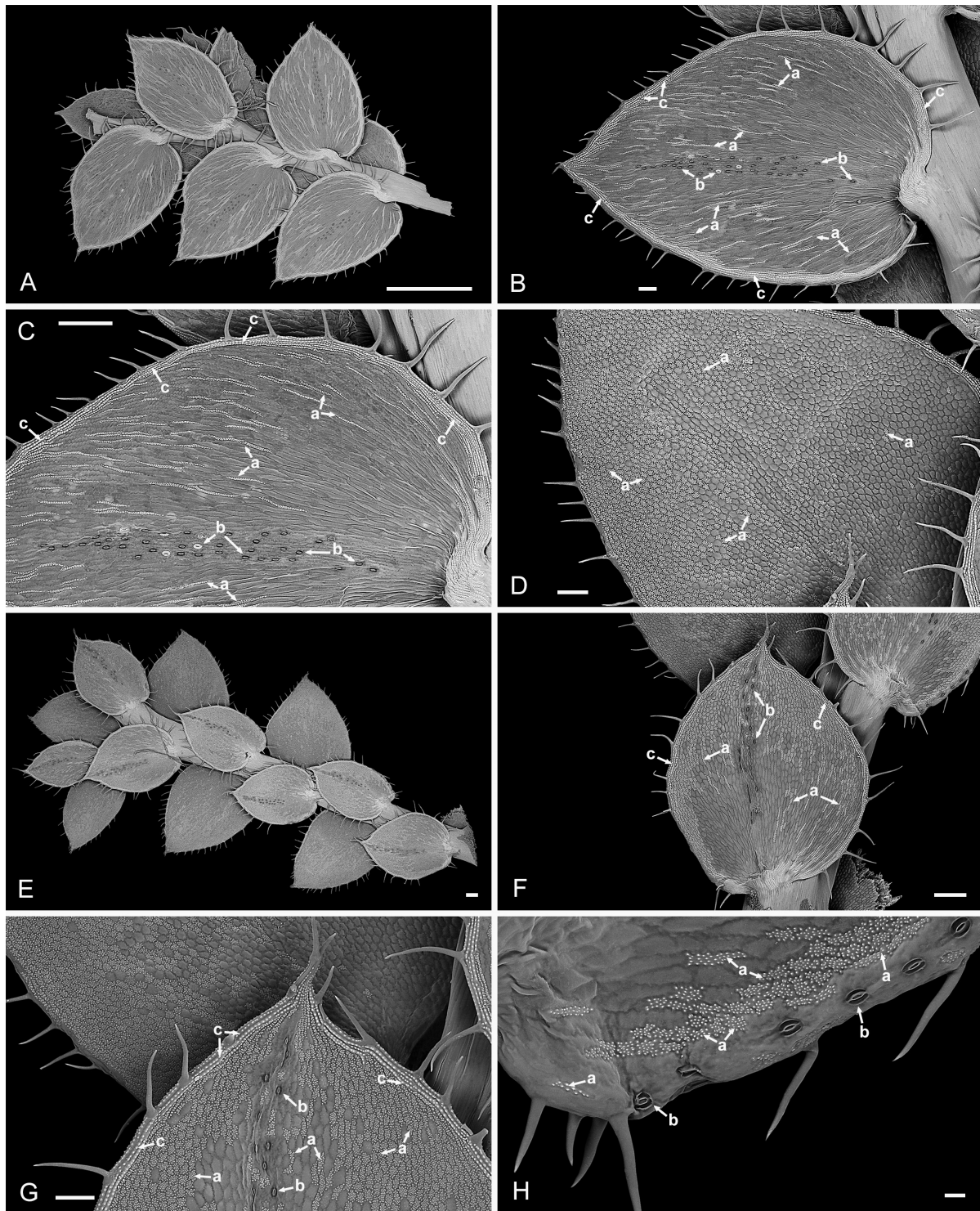


Fig. 3. *Selaginella brigitteana* – A: section of lower surface of stem branch showing lateral leaves and portions of median leaves; B: close-up of lateral leaf from stem branch, lower surface; note, elongate and papillate, idioblast-like cells on lamina (a), stomata along midrib (b), and marginal, elongate and papillate, idioblast-like cells (c); C: close-up of proximal, acropscopic portion of lateral leaf (same leaf shown in B); note, elongate and papillate, idioblast-like cells on lamina (a), stomata along midrib (b), and marginal, elongate and papillate, idioblast-like cells (c); D: close-up of lateral leaf, upper surface; note, papillate cells on lamina (a); E: section of upper surface of stem branch showing lateral and median leaves; F: close-up of median leaf from stem branch, upper surface; note, elongate and papillate, idioblast-like cells on lamina (a), stomata along midrib (b), and marginal, elongate and papillate, idioblast-like cells (c); G: close-up of distal portion of median leaf (same leaf shown in F); note, rounded and rectangular to elongate and papillate cells on lamina (a), stomata along midrib (b), and marginal, elongate and papillate, idioblast-like cells (c); H: close-up of proximal, outer margin of median leaf, upper surface; note, submarginal papillate cells (a) and submarginal and marginal stomata (b). – Scale bars: A = 1 mm; B, D, G = 100 µm; C, E, F = 200 µm; H = 20 µm. – A–H taken from the holotype, Pruski & al. 4045 (PMA).

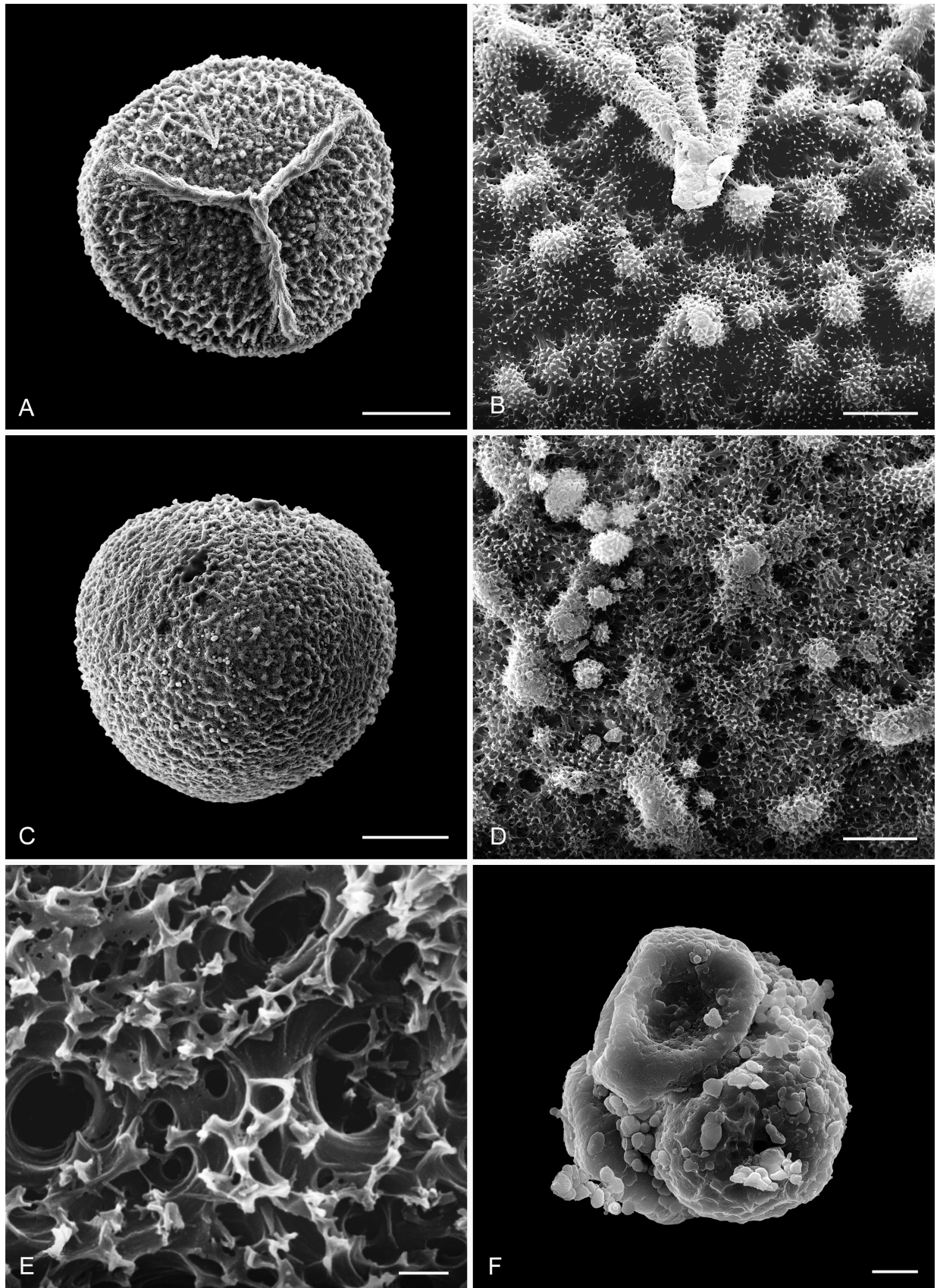


Fig. 4. Scanning electron micrographs of megaspores and microspores of *Selaginella brigitteana* – A: megaspore proximal face; B: close-up of megaspore proximal face; C: megaspore distal face; D: close-up of megaspore distal face; E: close-up of megaspore distal face; F: microspore tetrad, showing collapsed distal and equatorial faces. – Scale bars: A, C = 100 μm ; B, D, F = 10 μm ; E = 1 μm . – A–F taken from the holotype, *Pruski & al.* 4045 (PMA).

recorded. However, the localities where it has been collected are imperilled do to human encroachment into natural forest remnants, resulting in increased deforestation. Therefore, according to IUCN (2012) categories and criteria, it is tentatively considered Vulnerable: VU A1c; B1ab(iii).

Eponomy — *Selaginella brigitteana* is dedicated to my colleague and friend Brigitte Zimmer (b. 1943) from the Botanic Garden and Botanical Museum Berlin; a specialist on *Adiantum* and whose skilled dedication to the curation, including databasing and imaging of the lycophyte and fern collections at B has been outstanding, thereby making systematic and taxonomic studies on these groups more accessible and efficient for pteridologists.

Remarks — *Selaginella brigitteana* is distinguished by its long-creeping, 2–4-branched stems, glossy and chartaceous leaves, broadly hyaline and long-ciliate median leaves tipped by a short acumen or short arista tipped by 1–3 often divergent cilia, with leaf laminae upper surfaces with some cell lumina papillate. It may be confused with *S. leonardii* and *S. plumieri* Hieron., both also found in Hispaniola. In fact, Caluff & Shelton (2009) cited two of the paratypes of this new taxon (i.e. *Abbott 2137* and *Judd & al. 4467*) under *S. leonardii*. *Selaginella brigitteana* differs from *S. leonardii* by the characters of median leaves overall laminae and outer bases shape, and upper surface cell types and stomata distribution listed under the diagnosis. It is separated from *S. plumieri*, which is an ill-defined species, by its short-acuminate to short-aristate (vs long-aristate) median leaf apices, the acumen or arista hyaline (vs the arista greenish) and $\frac{1}{12}$ (vs $\frac{1}{2}$ or more) the length of the leaf laminae, each 0.1–0.4 (vs 0.5–1) mm long, tipped by 1–3 often divergent cilia (vs tipped by teeth), outer margins long-ciliate near bases (vs entire), and lateral leaf apices acute (vs acuminate).

Additional specimens examined (paratypes) — HAITI: Dép. Ouest, Port-au-Prince, Massif de la Selle, near Roberjot, northern slope of Morne Cabaio, 1700 m, 28 Aug 1924, *Ekman H1691* (B, F, GH, US); Parc National Morne La Visite, ravine of Riviere Blanche, W of point where crossed by road from Seguin to Furcy, SW of Park Headquarter, 1700–1800 m, 10 May 1984, *Judd & al. 4467* (NY, S n.v.). — DOMINICAN REPUBLIC: La Vega, between Constanza and main highway Santo Domingo–Santiago, c. 300 m, 21 Dec 1964, *Jones & Norris 1011* (NY); Cordillera Central, Constanza, Río del Medio, c. 1150 m, 28 Oct 1929, *Ekman H13952* (B, GH, U); Arroyo La Sal, SE of town of La Sal, between Loma La Sal and Loma La Golondrina, 19°03.5'N, 70°34'W, 14 Apr 1982, *Zanoni & al. 20040* (NY); Loma La Golondrina, S of Jarabacoa, near La Sal, Paso Bajito, 19°04'N, 70°33'W, 2 Jul 1986, *Zanoni & al. 36763* (NY); 13.3 km N of El Río and 10 km from La Sal and la Palma towns,

19°04'N, 70°34'W, 3000–3300 ft [914–1006 m], 29 Apr 1982, *Zanoni & al. 20293* (NY); 12 km road Duarte (Santo Domingo–Santiago), on road to El Río and Constanza, Casabito, valley of Río Jalubey, 19°03'N, 70°30'W, 900 m, 2 Sep 1982, *Zanoni & al. 23024* (NY); 4 km W of La Culata de Constanza, Loma El Campanario, 18°57'N, 70°48'W, 1800–2140 m, 8 Sep 1982, *Zanoni & al. 23247* (NY); Subida al Casabito, Bonao, 600–700 m, 4 May 1975, *Liogier & Liogier 22868* (NY 2 sheets); Reserva Científica Ebano Verde, sendero (nuevo) de El Cajón (ladera de Loma La Sal), en ladera Norte Loma La Sal a Río Camú, 19°04'N, 70°33'W, 1200–1300 m, 6 May 1992, *Zanoni & al. 45759* (NY); cima de Loma La Sal, 19°04'N, 70°34'W, 1350–1440 m, 27 May 1992, *Zanoni & al. 45970* (NY); Pacificador [Duarte], vicinity of San Francisco de Macorís, 400–1000 m, *Abbott 2137* (B, BM n.v., GH).

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References

- Alston A. H. G. 1952: A revision of the West Indian species of *Selaginella*. – Bull. Brit. Mus. (Nat. Hist.), Bot. **1**: 27–47.

- Beentje H. 2016: The Kew plant glossary: an illustrated dictionary of plant terms, ed. 2. – Kew: Royal Botanic Gardens, Kew.
- Caluff M. G. & Shelton G. 2003: The musciform *Selaginella* species (*Selaginellaceae*) with broad lateral leaves in the West Indies. – *Willdenowia* **33**: 425–437.
- Caluff M. G. & Shelton G. 2009: Review of hairy species of *Selaginella* (*Selaginellaceae*) of the West Indies, with description of two new species from Cuba. – *Willdenowia* **39**: 109–119.
- Caluff M. G. & Shelton G. 2014: Two new species and a new hybrid species of *Selaginella* (*Selaginellaceae*) from W Cuba. – *Willdenowia* **44**: 311–319.
- Caluff M. G. & Shelton G. 2015: *Selaginella fuerstii* Hieron. (*Selaginellaceae*, *Lycophyta*), un raro endémico dominicano redescubierto en la provincia de Barahona. – *Moscsoa* **19**: 158–162.
- Halbritter H., Ulrich S., Grímsson F., Weber M., Zetter R., Hesse M., Buchner R., Svojtka M. & Frosch-Radivo A. 2018: Illustrated pollen terminology, ed. 2. – Cham: Springer.
- IUCN 2012: IUCN Red List categories and criteria. Version 3.1, ed. 2. Prepared by the IUCN Species Survival Commission. – Gland & Cambridge: International Union for Conservation of Nature.
- Judd W. S. 1986: Floristic study of La Visite and Macaya National Parks, Haiti. – Gainesville: University of Florida.
- Peguero B., Clase T. & Hilaire J. V. 2006: Plants observed during the scientific expedition to Massif de La Hotte, Haiti. – Pp. 58–73 in: Société Audubon Haïti (ed.), Macaya biodiversité. Expédition scientifique dans la Réserve de la Biosphère de Macaya / 2006. – Haiti: Société Audubon Haïti.
- Proctor G. R. 1985: Ferns of Jamaica: a guide to the pteridophytes. – London: British Museum (Natural History).
- Proctor G. R. 1989: Ferns of Puerto Rico and the Virgin Islands. – *Mem. New York Bot. Gard.* **53**: 1–389.
- Punt W., Hoen P. P., Blackmore S., Nilsson S. & Le Thomas A. 2007: Glossary of pollen and spore terminology. – *Rev. Palaeobot. Palynol.* **143**: 1–81.
- Shelton G. & Caluff M. G. 2003: Three new species of *Selaginella* (*Selaginellaceae*) from Cuba. – *Willdenowia* **33**: 159–166.
- Thiers B. 2019+ [continuously updated]: Index herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's virtual herbarium. – Published at <http://sweetgum.nybg.org/science/ih/> [accessed 6 Feb 2019].
- Valdespino I. A. 1995: A monographic revision of *Selaginella* P. Beauv. subgenus *Heterostachys* Baker in Central and South America. – New York: Doctoral Thesis, The City University of New York.
- Valdespino I. A. 2017: Novel fern- and centipede-like *Selaginella* (*Selaginellaceae*) species and a new combination from South America. – *PhytoKeys* **91**: 13–38.
- Valdespino I. A., López C. & Góes-Neto L. A. A. 2014: Additions to Cuban *Selaginella* (*Selaginellaceae*). – *Phytotaxa* **184**: 235–244.
- Valdespino I. A., López C., Sierra A. M. & Ceballos J. 2018: From the Guiana Highlands to the Brazilian Atlantic forest: four new species of *Selaginella* (*Selaginellaceae* – *Lycopodiophyta*: *S. agioneuma*, *S. magnaforneensis*, *S. ventricosa*, and *S. zartmanii*). – *PeerJ* **6**: e4708.

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