

## **Two new species and a new hybrid species of *Selaginella* (Selaginellaceae) from W Cuba**

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MANUEL G. CALUFF<sup>1</sup> & GUSTAVO SHELTON<sup>1</sup>**Two new species and a new hybrid species of *Selaginella* (*Selaginellaceae*) from W Cuba****Abstract**

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Two new species and a new hybrid species of *Selaginella* (*Lycophyta*: *Selaginellaceae*), from Pinar del Río and Artemisa Provinces in W Cuba, are described and illustrated. The new species are *S. cavernaria*, an erect plant growing on calcareous rocks and cliffs in mogote vegetation, and *S. striata*, a prostrate plant occurring in the same ecosystems and sometimes growing together with *S. cavernaria*. The new hybrid species is *S. x dualis* (*S. serpens* × *S. striata*), with intermediate morphology, growing together and sometimes mixed with the postulated parent species. All three new taxa are representatives of *S.* subg. *Stachygynandrum*.

Additional key words: Caribbean, West Indies, *Lycophyta*, taxonomy, *Selaginella* subg. *Stachygynandrum*

Studies carried out in *Selaginella* P. Beauv. (*Lycophyta*: *Selaginellaceae*) of the West Indies revealed some new endemic species from Cuba (Caluff & Shelton 2003, 2009; Shelton & Caluff 2003). In this paper two further new species of *Selaginella* and a new hybrid species, from Pinar del Río and Artemisa Provinces in W Cuba, are described and illustrated. They all belong to *S.* subg. *Stachygynandrum* (P. Beauv. ex Mirb.) Warb. The terminology used to describe the spore ornamentation follows Lellinger & Taylor (1997).

***Selaginella cavernaria* Caluff & Shelton, sp. nov.** – Fig. 1.

Holotype: Cuba, Prov. Pinar del Río, Sierra de Los Órganos, Cueva de las Avispas, Caverna de Santo Tomás, Sierra de Quemados, Pinar del Río, 400 m, mogote vegetation, on humid calcareous [cave] floor under opening in roof where sun enters, mixed with *Selaginella eatonii* Hieron. and *S. wilsonii* Hieron., 17 Mar 2003, Caluff,

Shelton & Urquiola 4575 (BSC; isotypes: B, HAC, HAJB, JBSD).

**Diagnosis** — *Selaginella cavernaria* is similar and perhaps related to *S. subcaulescens* Baker but differs principally in the following characteristics: stem erect with alternate dormant buds on both sides and imbricate leaves (vs without dormant buds and distant leaves in *S. subcaulescens*); lateral leaves on branched stems and branches with aristate apex (vs merely acute apex in *S. subcaulescens*); and megaspores orange (vs cream-coloured in *S. subcaulescens*). The two species also differ in distribution and habitat: *S. cavernaria* is apparently confined to W Cuba, usually growing on vertical calcareous rocks and cliffs in mogote vegetation, whereas *S. subcaulescens* is found in E Cuba, growing on horizontal non-calcareous rocks in gallery forests.

**Description** — Plants erect, 12–25 cm tall, not flabelliform at apex, at first a creeping stem with spaced rudi-

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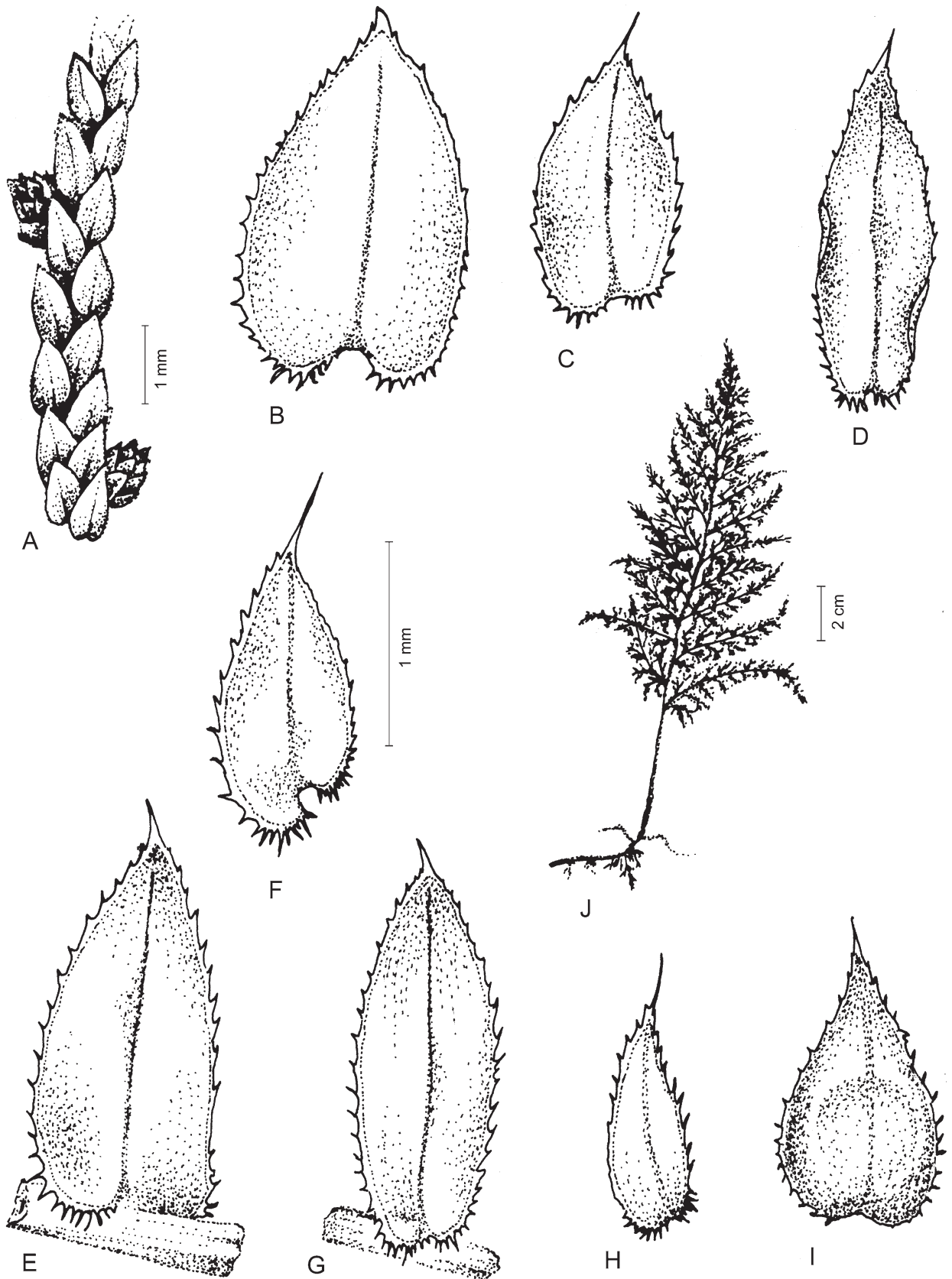


Fig.1. *Selaginella cavernaria* – A: erect main unbranched stem with lateral leaves and buds, underside (“abaxial”) view; B: lateral leaf of main unbranched stem; C: medial leaf of main unbranched stem; D: axillary leaf; E: lateral leaf of main branched stem; F: medial leaf of main branched stem; G: lateral leaf of branches; H: medial leaf of branches; I: sporophyll; J: habit. – From Caluff, Shelton & Novo 6286 (BSC). – Drawn by Manuel G. Caluff.

mentary leaves and rhizophores, with roots at short intervals, then curving upward and producing numerous roots and leafy stolons; next portion an erect dorsiventral stem without branches and finally a branched stem like a frond. *Main unbranched stem* 5–15 cm long, 0.5–0.7(–1) mm in diam. without leaves, to 1.2 mm wide with leaves, straight, monostelic, not articulate, simple to rarely bifurcate, usually ridged, clear brown toward base and stramineous above, producing near base short rhizophores 0.1–0.2 mm in diam. and latent alternate small leafy buds on both sides. *Main branched stem* (“frond”) lanceolate in young plants, deltoid in adult plants, inequilateral; *branches* alternate, ascending, branched 1–3 times, 3–12 × 1–4 cm, without rhizophores. *Leaves* dimorphic, ascending, herbaceous, papyraceous on unbranched stem, dark green, dull on adaxial side, paler and shinier abaxially, without ideoblasts, margin differentiated beneath into 3–7 rows of papillose enlarged cells and some longitudinal rows of dark papillose cells on surface. *Lateral leaves on main unbranched stem* more openly ascending, nearly appressed, ovate-attenuate, 1.2–2.1 × 0.6–1.2 mm, base truncate, rounded to cordate, margin wide, clear brown, denticulate on outer side, entire on inner side or with few teeth, ciliate toward base, apex acute. *Medial leaves on main unbranched stem* strongly ascending, appressed, cordate-attenuate, 0.6–2.1 × 0.8–1.1 mm, base auriculate on outer side, auricle rounded, with a tuft of cilia, margin wide, pale green, denticulate on outer side, nearly entire to denticulate on inner side, apex aristate, arista 0.1–0.2 mm long. *Lateral leaves on main branched stem* deltoid-oblong-attenuate to deltoid-ovate-attenuate, 1.5–2.8 × 0.9–1.7 mm, slightly inequilateral, acroscopic side widest, midvein evident, ending abruptly 0.2–0.4 mm from apex, base narrowed, truncate, rounded to nearly cordiform, acroscopic auricle partially overlapping stem, margin thin, pale green, both sides denticulate, teeth on basiscopic side smaller and more spaced, shortly ciliate on base, cilia 0.1–0.15 mm long, apex acute to shortly aristate, arista 0.1–0.2 mm long. *Medial leaves of main branched stem* ovate-lanceolate, 0.6–2.1 × 0.3–0.8 mm, base oblique, auriculate on outer side, auricle short, rounded, with a tuft of cilia, margin thin, pale green, shortly ciliate toward base, denticulate on inner side, with few spaced teeth on outer side, apex shortly aristate, arista 0.1–0.2 mm long. *Lateral leaves of branches* similar to those of main stem but narrower, oblong-attenuate, 1.7–2.3 × 0.6–1.1 mm, arista to 0.3 mm long. *Medial leaves of branches* ovate-lanceolate to oblong-attenuate, 0.8–0.9 × 0.3–0.7 mm, midvein inconspicuous, arista to 0.3 mm long. *Axillary leaves* oblong-attenuate, 1.5–2 × 0.6–1 mm, placed in middle of bifurcation, slightly inequilateral, base truncate to shortly biauriculate, ciliate, margin pale green, denticulate on both sides, apex acute. *Strobili* relatively short, 1.8–4.3 × 1–2.5 mm, at first quadrangular. *Sporophylls* nearly appressed when living, more open when dried, oblique to stem, uniform, ovate-attenuate, 0.8–1.2 × 0.6–1 mm, some translucent, margin ciliolate on both sides, keel en-

tire to slightly denticulate toward apex, apex aristate, arista 0.1–0.15 mm long, slightly recurved. *Megasporangia* purse-shaped; *megaspores* orange, 300–350 µm in diam., surface reticulate. *Microsporangia* ovoid; *microspores* deep orange, 15–20 µm in diam., surface gemmulate, gemmulae hemispheric, large.

*Distribution and ecology* — *Selaginella cavernaria* is endemic to Sierra del Rosario and Sierra de Los Órganos in Pinar del Río and Artemisa Provinces of westernmost Cuba. It is uncommon in mogote vegetation on vertical or inclined locations, cliffs, large rocks and cave entrances, rarely growing on rocky ground, at altitudes of 150–720 m. It never forms very large populations, and grows in shaded places mixed with bryophytes and other calciphilous *Selaginella* species such as *S. armata* Baker, *S. eatonii* Hieron., *S. heterodonta* (Desv.) Hieron., *S. serpens* (Desv.) Spring, *S. striata* Caluff & Shelton and *S. wilsonii* Hieron.

*Additional specimens seen* — CUBA: PINAR DEL RÍO PROVINCE: foot of La Sierra, Valle de Ancón, Pinar del Río, 4 Feb 1956, *H. Alain, C. V. Morton & J. Acuña* 5260 (HAC); Minas de Matahambre, Mogote de La Punta, NW side and summit, 590 m, 19 Dec 1978, *J. Bisse, M. Díaz, Y. Randel, H. Dietrich & A. Claro* 38818 (B, HAJB [2 sheets], JE n.v.); Las Vírgenes, Pinar del Río, 11 Nov 1972, *Bobrov & A. Cárdenas* 29380 (HAC [2 sheets]); overhang of Salón de los Gigantes, Sierra San Carlos, Pinar del Río, 150 m, mogote vegetation, on calcareous stones and cliffs, 22 Jan 2007, *Caluff, Shelton & Novo* 6286 (BSC); overhang of Salón de los Gigantes, Sierra San Carlos, Pinar del Río, 150 m, on a stalactite at 3 m from floor, mixed with *Selaginella wilsonii*, mogote vegetation, 22 Jan 2007, *Caluff, Shelton & Novo* 6293 (BSC); Hoyo de los Helechos, Salón de los Gigantes, San Carlos, Pinar del Río, 150 m, mogote vegetation, on a stalagmite at 3 m from floor, abundant there, 22 Jan 2007, *Caluff, Shelton & Novo* 6303 (BSC); Viñales, Sierra Sitio del Infierno, from Abra de Boquerón to Hoyo de los Cimarrones, mogote vegetation, Feb 1992, *C. Sánchez* 3475 (BSC); Sierra del Infierno, Hoyo de los Cimarrones, Viñales, Pinar del Río, mogote vegetation, mogote cliffs, growing perpendicular to rock face, 21 Jul 1991, *C. Sánchez* 69951 (HAJB [5 sheets]). — ARTEMISA PROVINCE: La Palma, Pan de Guajaibón summit, 720 m, 28 Dec 1969 [“1970”], *J. Bisse* 15606 (HAJB, JE n.v.).

*Selaginella striata* Caluff & Shelton, **sp. nov.** – Fig. 2. Holotype: Cuba, Pinar del Río Province, overhang Salón de los Gigantes, Sierra de San Carlos, Pinar del Río, 150 m, mogote vegetation, calciphilous, on cliffs, stalagmites and on the humid floor forming carpets, 22 Jan 2007, *Caluff, Shelton & Novo* 6307 (BSC; isotypes: B, HAC, HAJB, JBSD).

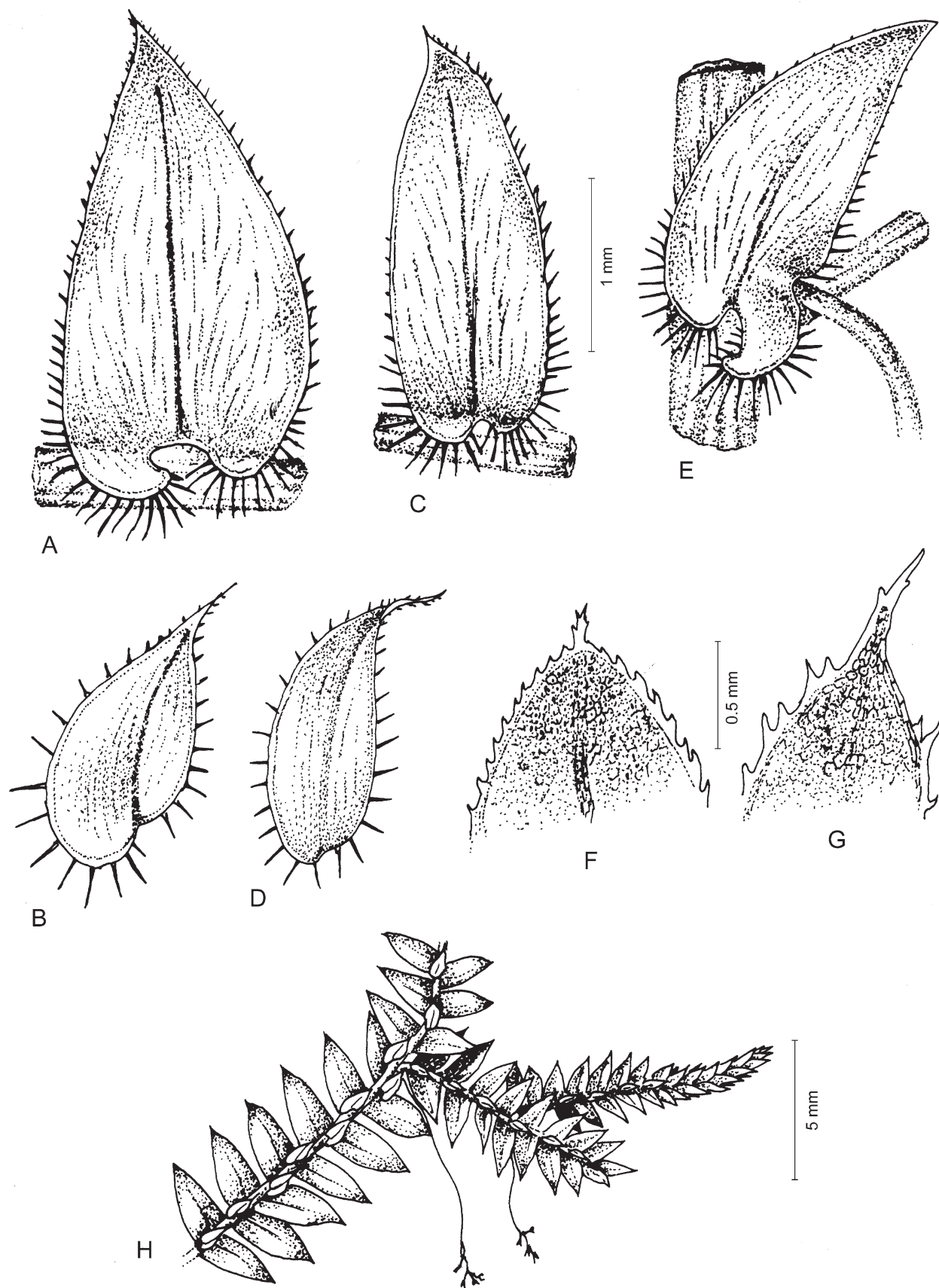


Fig. 2. *Selaginella striata* – A: lateral leaf of main stem; B: medial leaf of main stem; C: lateral leaf of branches; D: medial leaf of branches; E: axillary leaf; F: apex of lateral leaf; G: apex of medial leaf; H: habit, showing a strobilus. – From Bobrov & A. Cárdenas 29383 (HAC). – Drawn by Manuel G. Caluff.

**Diagnosis** — *Selaginella striata* resembles *S. heterodonta* (Desv.) Hieron. and *S. serpens* (Desv.) Spring. It differs from *S. heterodonta* mainly in being larger, with stems to 43 cm long, (vs 8–15(–33) cm long in *S. heterodonta*); in its non-flagelliform and non-proliferous apex (vs flagelliform and proliferous in *S. heterodonta*); in its conspicuously striate leaves (vs nearly smooth in *S. heterodonta*); in its calliculate megaspores (vs clavate in *S. heterodonta*); and in its rugate microspores (vs cristate in *S. heterodonta*). *Selaginella striata* differs from *S. serpens* in having lateral leaves always with apex acute, mucronate to shortly aristate (vs rounded to obtuse in *S. serpens*). *Selaginella striata* is apparently restricted to Pinar del Río and Artemisa Provinces of westernmost Cuba, whereas both *S. heterodonta* and *S. serpens* grow in nearly all of Cuba.

**Description** — Plants prostrate, caespitose, with stems to 43 cm long, never flagelliform or proliferous at apex. *Main stem* usually cylindrical, or if ridged then central ridge straight, 0.6–0.8 mm in diam. without leaves, to 5–6 mm wide with leaves, monostelic, stramineous, not articulate, alternately branched 1 or 2 times, 9–11 × 2.8–3.5 cm. *Rhizophores* axillary, filiform, 0.1–0.2 mm in diam., descending between branches of bifurcation. *Leaves* herbaceous, dark green, dull on adaxial surface, clear green and sometimes shiny on abaxial surface, cells with a central protuberant papilla, striate with rows of dark cells parallel and oblique to midvein, more notable on adaxial surface, present in living plants also; midvein evident, running to apex. *Lateral leaves of main stem* patent to slightly ascending, spaced 0.5–2 mm apart, deltoid-attenuate to ovate-attenuate, 2.4–2.6 × 1–1.3 mm, base cordiform to occasionally rounded, acroscopic auricle more developed, recurved and imbricate over stem, base strongly ciliate on both sides, cilia 0.2–0.25 mm long, occasionally some cilia grouped forming a tuft on auricle base, 2 or 3 cilia emerging from laminar tissue, margin clear green, with 2 or 3 rows of enlarged cells, ciliate throughout, sometimes denticulate to serrulate in distal 1/3, cilia of acroscopic side largest, apex acute, mucronate to shortly aristate, arista to 0.3 mm long, denticulate. *Medial leaves of main stem* adjacent to imbricate, ovate-lanceolate, base oblique, strongly auriculate on outer side, auricle wide, rounded and strongly ciliate, margin broad, of 4 or 5 rows of enlarged cells, whitish, with spaced cilia, largest on outer side, apex aristate, arista to 0.2 mm long, denticulate, incurved. *Lateral leaves of branches* slightly ascending, adjacent to slightly imbricate, narrowly deltoid-ovate-attenuate, base narrowly cordiform, imbricate to stem, apex acute, incurved. *Medial leaves of branches* similar to those of main stems but smaller, 1.5–1.6 × 0.6–0.7 mm. *Axillary leaves* placed on middle of bifurcation, ovate-oblong with attenuate apex, base biauriculate, inner auricle small, rounded, outer one conspicuous, descending, incurved, very strongly

ciliate, cilia to 0.35 mm long, apex acute. *Strobili* at first quadrangular, 10–15 × 1–1.3 mm. *Sporophylls* ovate-lanceolate, to 2.4 × 0.8 mm, uniform, margin and keel ciliolate, margin differentiated, cartilaginous, apex acute, shortly aristate. *Megasporangia* purse-shaped; *megaspores* cream-coloured, 400–600 µm in diam., surface calliculate. *Microsporangia* ovoid; *microspores* orange-coloured, 30–50 µm in diam., surface rugate.

**Distribution and ecology** — *Selaginella striata* is endemic to Sierra del Rosario and Sierra de los Órganos in Pinar del Río and Artemisa Provinces of westernmost Cuba. The species is locally common in mogote vegetation, evergreen forests, gallery forests and secondary forests at altitudes of 100–500 m. It grows on cliffs, river banks, between mogotes, at cave entrances and on waysides, often over old stone walls of the French coffee plantations, especially on the mortar between the stones, sometimes growing on earth, humus or decayed leaves forming great mats, usually in shaded places or with filtered sun, mixed with bryophytes and other calciphilous *Selaginella* species such as *S. armata*, *S. cavernaria*, *S. eatonii*, *S. heterodonta*, *S. prasina* Baker, *S. serpens*, and *S. wilsonii*.

**Additional specimens seen** — CUBA: [sine loco], 1865, *Fraser* 8, 17, 12 & 38 (B); in Cuba orientali [?], 1860. *Wright* 940 (B). — PINAR DEL RÍO PROVINCE: Pan de Azúcar cliffs, Viñales, 5 Feb 1956, *J. Acuña & C. V. Morton* 20097 (HAC); Valle de Ancón cliffs, Viñales, 4 Feb 1956, *J. Acuña, H. Alain & C. V. Morton* 0096 (HAC); Valle del Ruiseñor cliffs, Viñales, 4 Feb 1956, *J. Acuña, H. Alain & C. V. Morton* 20098 (HAC); Viñales, Valle del Ruiseñor, 27 Feb 1972, *J. Bisse* 21584 (HAJB); Viñales, Valle de San Vicente, near El Indio Cave, 150 m, 13 Feb 1983, *J. Bisse, G. Proctor & C. Sánchez* (HAC); Las Vírgenes, 1 Nov 1972, *Bobrov & A. Cárdenas* 29383 (HAC); Paso de La Estechura, Sierra de San Carlos, Pinar del Río, 150 m, mogote vegetation, on calcareous cliffs, 2 Jan 2007, *Caluff, Shelton & Novo* 6285 (BSC); overhang Salón de los Gigantes, Sierra San Carlos, Pinar del Río, 150 m, mogote vegetation, forming a carpet on floor, mixed with *Selaginella cavernaria*, 22 Jan 2007, *Caluff, Shelton & Novo* 6305 (BSC); Hoyo de Los Helechos, Salón de Los Gigantes, Sierra de San Carlos, Pinar del Río, 150 m, mogote vegetation, on calcareous cliffs and stalagmites, 22 Jan 2007, *Caluff, Shelton & Novo* 6291 (BSC); cliffs on base of Sierra de La Guacamaya, 100 m, mogote vegetation, 21 Jan 2007, *Caluff, Shelton, Urquiola & Novo* 6281 (BSC); prope Viñales, ad Mogote de La Mina, in rupibus arduis umbrosis, 7 Nov 1923, *E. Ekman* 17960 (B); Pan de Azúcar, 200–400 m, 8 Feb 1954, *C. V. Morton* 9848 & 79452 (JBSD); vicinity of Sumidero, 18 Jan 1984, *Nikolai* 40220 (HAC); Viñales, *Ponce de León s.n.* (HAC); Viñales, 1941, *Ponce de León s.n.* (HAC); Viñales, 1943, *Ponce de León s.n.* (HAC); Mogote de

La Jagua, Consolación del Sur, 17 Jun 1923, *J. T. Roig 8145* (HAC); Pico Chico, Los Órganos, 500 m, mogotes, 14 Feb 1997, *C. Sánchez & L. Regalado 72793* (BSC); Sierra del Infierno, Hoyo de los Cimarrones, Viñales, on calcareous cliffs in mogotes, 21 Jul 1991, *C. Sánchez 69953* (HAJB); Río Sumidero, Minas de Matahambre, Pinar del Río, mogotes, 17 Jan 1984, *C. Sánchez 991* (BSC); Poza de Los Venados, Sierra Sitio del Infierno, from Abra de Boquerón to Hoyo de los Cimarrones, mogote vegetation, Feb 1992, *C. Sánchez 3476* (BSC); near Sumidero, Aug 1972, *Shafer 13646* (HAC [2 sheets]); near Sumidero, Aug 1912, *Shafer & León 13668* (HAC); El Caliente, Sierra de Sumidero, Pinar del Río, 400 m, in a deep hole, hanging from humid calcareous cliffs, 17 Mar 2003, *Shelton & Urquiola 4572 A-B* (BSC); Hoyo de los Cimarrones, Viñales, 300 m, mogote vegetation, hanging from humid calcareous cliffs, 18 Mar 2003, *Shelton, Caluff & Urquiola 4576* (BSC). — ARTEMISA PROVINCE: Las Terrazas, Sierra del Rosario, Pinar del Río, 200–250 m, rivulets and humid forests, forming great colonies on river banks, 26 Jan 2007, *Caluff & Shelton 6313* (BSC); Orquideario Soroa, 300 m, on large rocks and on calcareous floor, scarce there, 19 Feb 2007, *Caluff 6225* (BSC); river banks of Arroyo La Unión, Casa del Campesino, Sierra del Rosario, 200 m, gallery forest, abundant on river sides, in shade, growing together with *S. heterodonta* and *S. serpens*, 25 Feb 2007, *Caluff 6240* (BSC); French ruins of Mongo Pérez coffee plantation, 200 m, abundant on ruin walls, ruderal, growing together with *S. heterodonta* and *S. serpens*, 25 Jan 2007, *Caluff & Shelton 6316* (BSC); Arroyo La Unión, Las Terrazas, Sierra del Rosario, 200 m, gallery forest, growing together with *S. heterodonta*, 25 Jan 2007, *Caluff & Shelton 6317* (BSC); Candelaria, Reserva de la Biosfera, El Salón Hill, Pinar del Río, near Las Terrazas town, ascending to Station House, 23 Feb 1990, *C. Sánchez & C. Zavaro 68580* (HAJB); Río Bayate, Soroa, Pinar del Río, 100–200 m, gallery forest, on decayed leaves and humus, 22 Oct 1997, *Shelton & Caluff 4363 & 4367* (BSC); Arroyo Manantiales, near Soroa, Sierra del Rosario, Pinar del Río, 300 m, gallery forest, common on river banks following river, 30 Oct 1998, *Shelton & Caluff 4468, 4469, 4470 & 4471* (BSC).

***Selaginella* *xdualis*** Caluff & Shelton, **nothosp. nov.** (postulated parents: *S. serpens* (Desv.) Spring and *S. striata* Caluff & Shelton) – Fig. 3.

Holotype: Cuba, Artemisa Province, Pedernales river, behind CITMA Station, Las Terrazas, Sierra del Rosario, 130 m, gallery forest, 2 Feb 2013, *Caluff 6536* (BSC; isotypes: B, HAC, HAJB, JBDS).

**Diagnosis** — *Selaginella* *xdualis* is intermediate between the postulated parents, *S. serpens* and *S. striata*. Some individuals are more similar to one or the other species, and

frequently morphological characters of both species occur mixed in one individual. Table 1 provides a detailed comparison of the characteristics of the hybrid and its postulated parents.

**Distribution and ecology** — *Selaginella* *xdualis* is endemic to the Sierra del Rosario, Sierra de los Órganos and Alturas de Cajalbana in Pinar del Río and Artemisa Provinces of westernmost Cuba. It is uncommon in gallery forests and secondary vegetation near rivers, less commonly on serpentine, at altitudes of 100–300(–400) m. It is found on river banks and river cliffs, growing on humid rocks, earth, humus and decaying leaves, in shaded places or with filtered sun, mixed with bryophytes and other calciphilous *Selaginella* species such as *S. armata*, *S. heterodonta*, *S. prasina*, *S. serpens* and *S. striata*.

**Additional specimens seen** — CUBA: [sine loco], *Wright 941* p.p. (HAC); “Oriente”, *Wright 1821* p.p. (HAC [2 sheets]). – PINAR DEL RÍO PROVINCE: Caja de Agua rivulet, Cajalbana, N side, La Palma, 300 m, gallery forest, 11 Sep 2011, *L. Regalado, L. González & H. Hernández 6511* (BSC [2 sheets]). — ARTEMISA PROVINCE: Pedernales river, behind CITMA Station, Las Terrazas, Sierra del Rosario, 130 m, gallery forest, 2 Feb 2013, *Caluff 6533, 6535, 6539, 6544 & 6545* (BSC); Bayate River, Soroa, near place where river meets autopista, 100–200 m, gallery forest, 22 Oct 1997, *Shelton & Caluff 4364* (BSC); Bayate River, Soroa, Pinar del Río, 100–200 m, gallery forest, on limestone, 22 Oct 1997, *Shelton & Caluff 4365* (BSC); Naranjal Viejo, Soroa, Pinar del Río, 300 m, gallery forest, mixed with *S. heterodonta*, 25 Oct 1997, *Caluff & Shelton 4371* (BSC); Naranjal Viejo, Soroa, Pinar del Río, 300 m, gallery forest, mixed with *S. serpens*, *S. heterodonta* and *S. striata*, 25 Oct 1997, *Caluff & Shelton 4372* (BSC); El Salto, Soroa, Pinar del Río, 200 m, gallery forest, on cliffs near cascade, mixed with *S. armata*, 27 Oct 1997, *Shelton & Caluff 4376* (BSC); Naranjal Viejo, Soroa, Pinar del Río, Las Terrazas, Sierra del Rosario, 250 m, gallery forest, 25 Oct 1997, *Shelton & Caluff 4636* (BSC); Rangel, rocks in mountain woods, *Wright 1821* p.p. (HAC).

**Remarks** — The gathering *Wright 1821* p.p. is represented at HAC by three sheets, which include several *Selaginella* species, including *S. xdualis*, and cite different localities. One of the sheets states the locality as “Oriente”, but this is presumably a mistake because the hybrid is otherwise known exclusively from Pinar del Río and Artemisa Provinces in westernmost Cuba.

The megaspores of *Selaginella* *xdualis* are cream-coloured, with different sizes in one sporangium, ranging from 200–500 µm in diam., with the surface irregularly rugate. The microspores are variable in colour, from colourless to pale or deep orange; they are very small, dissimilar in shape and size, and sometimes joined in pairs, with the ornamentation also variable and irregular:

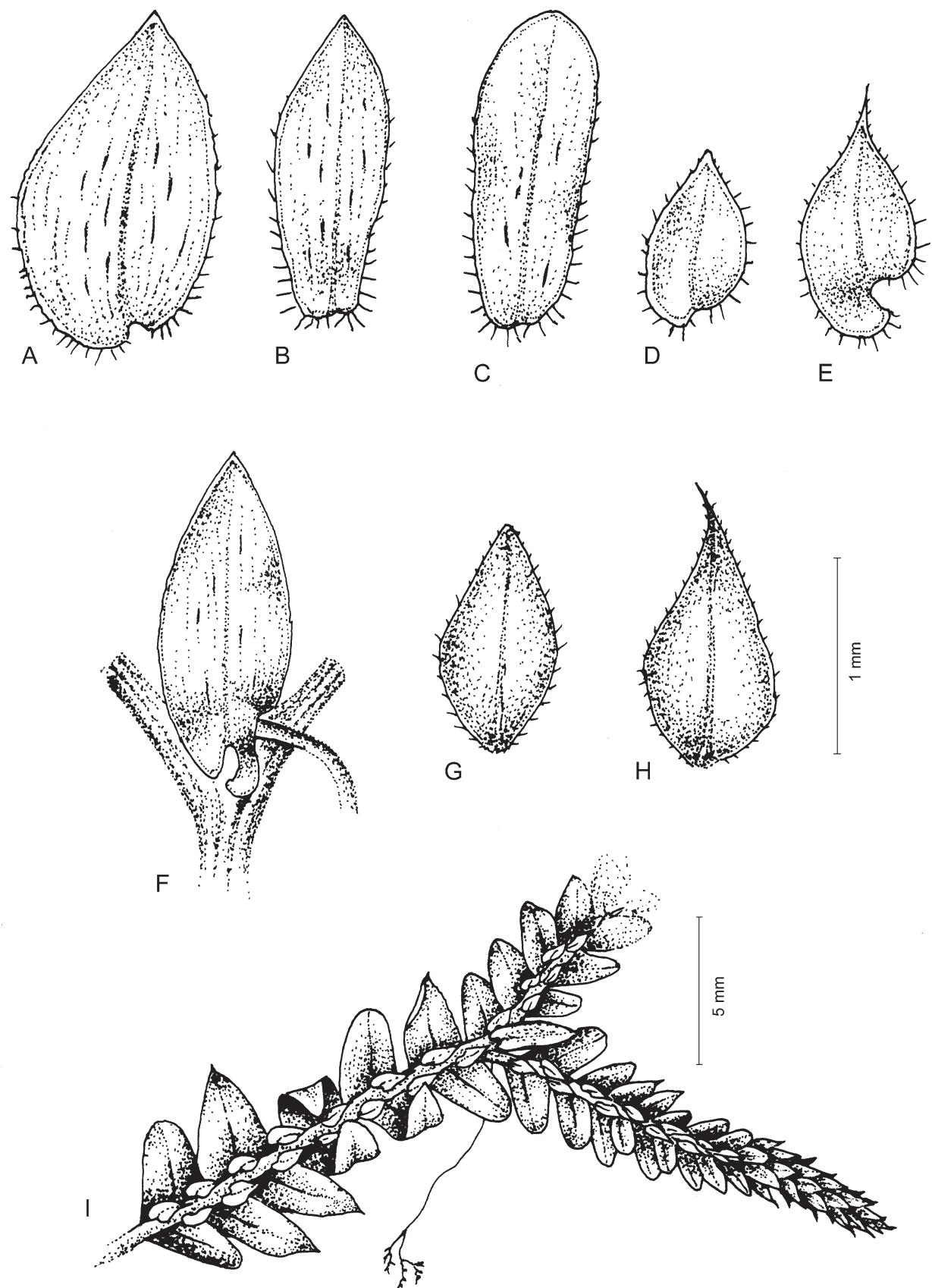


Fig. 3. *Selaginella x dualis* – A: lateral leaf of main stem; B & C: lateral leaves of branches; D & E: medial leaves; F: axillary leaf; G: sporophyll similar to that of *S. serpens*; H: sporophyll similar to that of *S. striata*; I: habit, showing a strobilus. – From Caluff 6545 (BSC). – Drawn by Manuel G. Caluff.

Table 1. Comparative morphology between *Selaginella striata*, *S. serpens* and *S. x dualis*.

|                                   | <i>Selaginella striata</i>                                                                            | <i>Selaginella serpens</i>                                                              | <i>Selaginella x dualis</i>                                                                                                          |
|-----------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| <b>Main stem</b>                  |                                                                                                       |                                                                                         |                                                                                                                                      |
| diameter [mm]                     | 0.6–0.8                                                                                               | 0.4–0.5                                                                                 | 0.3–0.5                                                                                                                              |
| width including leaves [mm]       | 5–6                                                                                                   | 3–4.3                                                                                   | 2.4–4.6                                                                                                                              |
| central ridge                     | straight                                                                                              | sinuous                                                                                 | straight to sinuous                                                                                                                  |
| <b>Lateral leaves</b>             |                                                                                                       |                                                                                         |                                                                                                                                      |
| inclination relative to main stem | patent to slightly ascending                                                                          | strongly ascending                                                                      | patent to strongly ascending                                                                                                         |
| colour and texture                | dark green, herbaceous                                                                                | usually pale green, membranous                                                          | usually pale green, membranous, sometimes dark green and herbaceous                                                                  |
| length × width [mm]               | to 2.6 × 1.3                                                                                          | to 2.1 × 1.7                                                                            | to 2.5 × 1.4                                                                                                                         |
| striae                            | always present, abundant, conspicuous                                                                 | sometimes present, inconspicuous                                                        | present or not, inconspicuous                                                                                                        |
| spicular ideoblasts               | absent                                                                                                | present                                                                                 | occasional, very thin and short                                                                                                      |
| cilia length [mm]                 | to 0.25                                                                                               | to 0.4                                                                                  | to 0.3                                                                                                                               |
| base                              | cordiform to occasionally rounded, acroscopic auricles more developed, recurved and imbricate on stem | truncate, rounded to cordiform, auricles of similar size, usually not imbricate on stem | truncate, rounded to cordiform, auricles inconspicuous, sometimes acroscopic one more developed, recurved and imbricate on stem      |
| apex                              | acute, mucronate to shortly aristate                                                                  | rounded to obtuse                                                                       | rounded, obtuse or subacute, mucronate to shortly aristate                                                                           |
| <b>Axillary leaves</b>            |                                                                                                       |                                                                                         |                                                                                                                                      |
| base                              | biauriculate, inner auricles small, rounded, outer one conspicuous, descending, incurved              | auricles, if present, similar, small, rounded                                           | rounded to biauriculate, auricles similar, small, rounded, or inner auricle smallest and outer one conspicuous, descending, incurved |
| apex                              | acute                                                                                                 | obtuse                                                                                  | acute to rounded and obtuse                                                                                                          |
| <b>Strobili</b>                   |                                                                                                       |                                                                                         |                                                                                                                                      |
| length × width [mm]               | to 15 × 1.3                                                                                           | to 10 × 1.1                                                                             | to 11 × 2                                                                                                                            |
| <b>Sporophylls</b>                |                                                                                                       |                                                                                         |                                                                                                                                      |
| shape                             | long acuminate                                                                                        | shortly acuminate                                                                       | shortly to long acuminate                                                                                                            |
| length × width [mm]               | to 2.4 × 0.8                                                                                          | to 1.4 × 0.9                                                                            | to 1.4 × 0.8                                                                                                                         |
| apex                              | shortly aristate                                                                                      | narrowly obtuse to rarely acute                                                         | narrowly obtuse to shortly aristate                                                                                                  |
| <b>Megaspores</b>                 |                                                                                                       |                                                                                         |                                                                                                                                      |
| colour                            | cream                                                                                                 | cream                                                                                   | cream                                                                                                                                |
| diameter [µm]                     | 400–600                                                                                               | 300–400                                                                                 | 200–500                                                                                                                              |
| surface ornamentation             | calliculate                                                                                           | rugate                                                                                  | irregularly rugate                                                                                                                   |
| <b>Microspores</b>                |                                                                                                       |                                                                                         |                                                                                                                                      |
| colour                            | orange                                                                                                | orange                                                                                  | variable, from colourless to pale or deep orange                                                                                     |
| diameter [µm]                     | 30–50                                                                                                 | 60–70                                                                                   | dissimilar                                                                                                                           |
| surface ornamentation             | rugate                                                                                                | rugate                                                                                  | variable and irregular, nearly smooth, rugate or in some spores partially clavate                                                    |

nearly smooth, rugate or in some spores partially clavate. Sexual abnormalities in lycophytes and ferns are usually evidence of hybridization, and the hybrids have abortive spores with some dissimilarity in colour, shape, size and ornamentation, e.g. Somers & Buck (1975) referred to strong differences between megaspores and microspores in one sporangium of a presumed *Selaginella* hybrid. This is the case with *S. x dualis*. Moreover, *S.*

*x dualis* grows together with its postulated parents and, like *S. striata*, is confined to westernmost Cuba.

Comparison with similar species

*Selaginella x dualis*, *S. heterodonta*, *S. serpens* and *S. striata* are similar in some characteristics, such as size,

prostrate growth and outline of the median leaves. These four taxa can be distinguished with the following key:

1. Main stem and sometimes apical branches flagelliform and proliferous at apex; nearly all of Cuba . . . . . *S. heterodonta*
- Main stem and apical branches neither flagelliform nor proliferous at apex . . . . . 2
2. Lateral leaves dissimilar in orientation, colour, outline, size and apex, with characters of *S. striata* and *S. serpens* frequently mixed in one individual; W Cuba . . . . . *S. x dualis*
- Lateral leaves uniform in orientation, colour, outline, size and apex . . . . . 3
3. Lateral leaves on main stem patent or nearly so, dark green, deltoid-attenuate to ovate-attenuate, to 2.6 mm long, apex acute, mucronate to shortly aristate; W Cuba . . . . . *S. striata*
- Lateral leaves in main stem ascending, usually pale green, broadly ovate, to 2.1 mm long, apex rounded to subobtusate, entire; nearly all of Cuba . . . . . *S. serpens*

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