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Authors: Prado, Jefferson, Hirai, Regina Y., Smith, Alan R., and Tuomisto, Hanna

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JEFFERSON PRADO^{1*}, REGINA Y. HIRAI¹, ALAN R. SMITH² & HANNA TUOMISTO³

Novelties in *Adiantum* (*Pteridaceae*) from South America

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Abstract: We describe two new species of *Adiantum* (*Pteridaceae*): *A. nodosum* and *A. pseudocajennense*. These species occur in the lowland rainforests of the Amazon Basin at 100–350 m in elevation. Both species have laminae 2-pinnate and grow on waterlogged soil in tall swamp forests, but they differ in the rhizome diameter and degree of incision of the pinnule margins. Currently available information suggests that *A. pseudocajennense* may be endemic to Ecuador, whereas *A. nodosum* has a wider distribution and is known from Brazil, Colombia and Peru. For both species we present descriptions, distribution statements, comments and illustrations.

Key words: *Adiantum*, Amazonia, Brazil, Colombia, Ecuador, ferns, Neotropics, new species, Peru, *Pteridaceae*, pteridophytes, South America

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Introduction

Adiantum L. is a large genus described by Linnaeus (1753) with a worldwide distribution (Mickel & Smith 2004). The genus is monophyletic (Rothfels & Schuettpelz 2014; Pryer & al. 2016; PPG I 2016) and has about 225 species. It is characterized by terete, blackish to castaneous petioles, rachises and costae, and sporangia borne on the false indusium (i.e. not on the abaxial laminar surface below it). The rhizomes are short- to long-creeping, usually horizontal, but sometimes compact and suberect, with scales. Laminae are monomorphic or nearly so, pinnate (rarely undivided) to 5-pinnate, sometimes pedate with free or rarely anastomosing veins without included free veinlets and with or without linear epidermal idioblasts (false veins) between the true veins. Sori are formed on the veins of the recurved laminar margins (false indusia), and paraphyses are absent.

Our recent studies and those of others have revealed several new *Adiantum* species for South America in the last 11 years, e.g.: Peru, one species (Prado 2006); Bolivia, one species (Prado 2006); Argentina, one species (Sundue & al. 2010); Ecuador, one species (McCarthy & Hickey 2011); Brazil, one species (Prado & Hirai 2013); French Guiana, one species (Zimmer 2007); Guyana, one species; and French Guiana, three species (Boudrie & al. 2017).

The two new species described here represent one more step in the process to understand the diversity of *Adiantum* in the Amazon region.

Material and methods

This study is based on specimens from the following herbaria: AMAZ, COAH, CUZ, INPA, NY, QCA, QCNE, SP, TUR, UC, US and USM. Species recognition was

1 Instituto de Botânica, Herbarium SP, C.P. 68041, CEP 04045-972 São Paulo, SP, Brazil; *e-mail: jprado.01@uol.com.br (author for correspondence); regina.hirai@gmail.com

2 University Herbarium, 1001 Valley Life Sciences Building #2465, University of California, Berkeley, CA 94720-2465, U.S.A.; e-mail: arsmith@berkeley.edu

3 University of Turku, Department of Biology, FI-20014 Turku, Finland; e-mail: hanna.tuomisto@utu.fi

based on morphological characters such as rhizomes, scales, laminar dissection, indumentum and pseudindusia. We have illustrated the most distinctive characters for each species.

Bracketed geographic coordinates were estimated based on the closest localities, when that information was not given on the specimen label.

The dot-distribution maps are based on all specimens studied for a given species.

Results and Discussion

***Adiantum nodosum* J. Prado, R. Y. Hirai & A. R. Sm., sp. nov.** – Fig. 2.

Holotype: Peru, Loreto, Mariscal Ramon Castilla, Río Yaguasyacu, 2–5 km SW from the village of Puerto Izango, primary upland rain forest on a sandy terrace of Río Amazonas, 03°18'S, 72°01'W, 100–150 m, 23 May 1997, *H. Tuomisto, K. Ruokolainen, V. Vargas & J. Vormisto 11250* (UC barcode UC1788281; isotypes: AMAZ, SP, TUR 3 sheets, USM).

Morphological description — *Plants* terrestrial. *Rhizomes* short-creeping, (1.5–)3–5 mm in diam., scaly, with stipes (1–)5–10 mm apart, scales light to dark brown, shiny, lanceolate, margin entire to sparingly denticulate. *Fronds* (25–)60–76 cm long; *stipe* black, c. 0.6 ×

as long as frond, adaxially sulcate, sparsely scaly, scales appressed throughout, dark brown, concolorous, linear, (1–)1.5–2 mm long, base with several processes, margin entire, apex filiform; also with some arachnoid scales c. 0.5 mm long; *lamina* 2-pinnate, not reduced at base, 15–28 cm wide; *rachis* with indumentum similar to that of stipe; *pinnae* elliptic, slightly narrowed at base, tapering at apex, (8–)11–20 × 2–4 cm, indumentum of pinna rachis like that of stipe and main rachis; *lateral pinnae* in (1 or)2–4(–6) pairs (3–6 pairs in fertile fronds, fewer than 4 in sterile fronds), alternate, ascending; *terminal pinna* conform, almost as long as or 1–1.2 × as long as subtending pinnae; *pinnules* in 10–32 pairs, not articulate, conspicuously oblique to pinna rachis, 2–3 × as long as wide, chartaceous, adaxial surface glabrous, abaxial surface sparsely scaly, scales borne on veins, light brown, 0.5–1 mm long, base pectinate, apex filiform and tortuous; pinnules free-veined, without evident midrib, veins slightly prominulous, with oblique idioblasts between veins on both surfaces; proximal pairs of pinnules reduced, somewhat rounded to deltate, medial pairs dimidiate, trapeziform, acroscopic base rectangular, sterile margins irregularly denticulate or serrate, sterile apices obtuse, straight or curved toward pinna apex, fertile apices angular; distal pinnules c. ½ or less length of medial pinnules; terminal pinnule on each pinna broadly rhombic, similar in size or usually longer than distal ones. *Sori* mostly 5–7(or 8) per pinnule, lunate, oblong; *indusia*

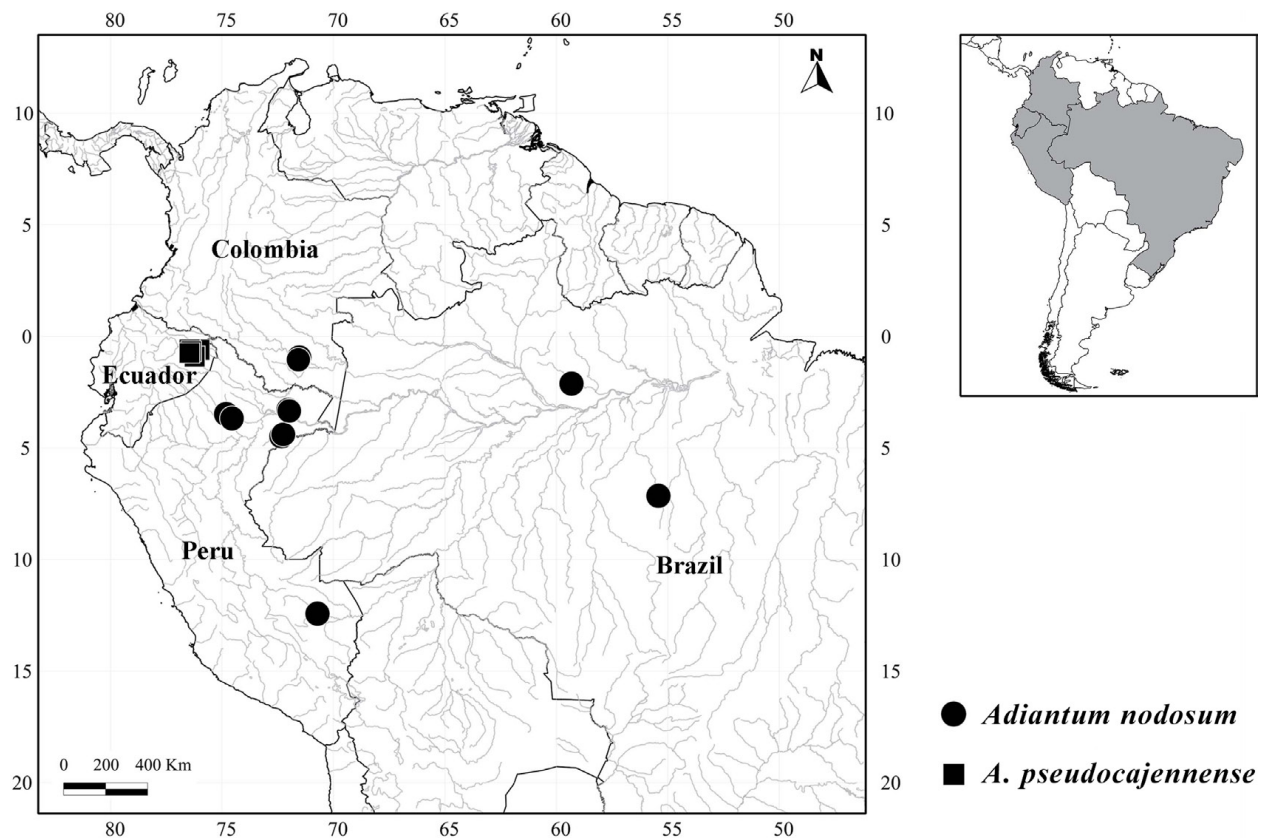


Fig. 1. Distribution of *Adiantum nodosum* and *A. pseudocajennense*.

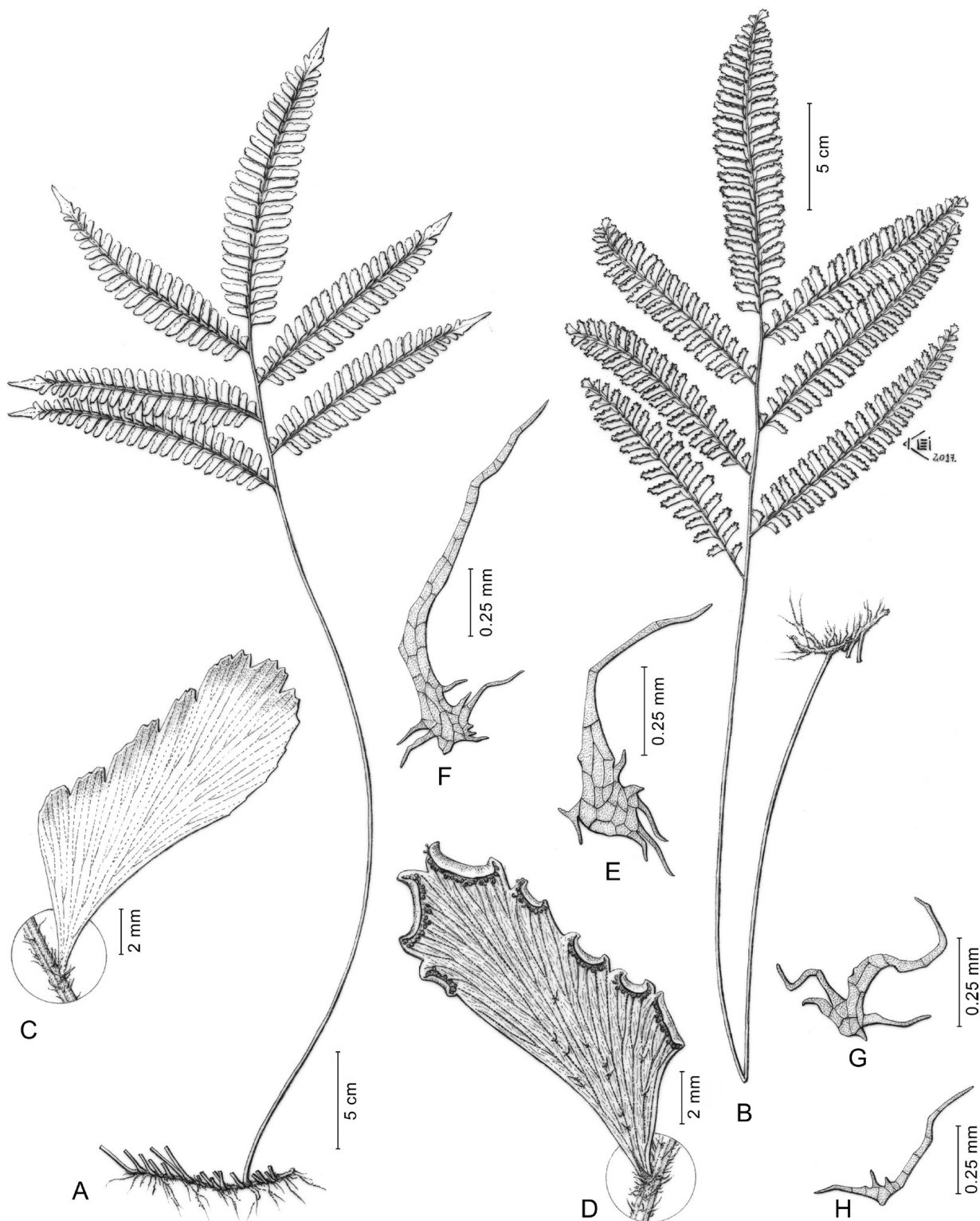


Fig. 2. *Adiantum nodosum* – A, B: habit; C: sterile pinnule; D: fertile pinnule; E, F: scales from rachis; G, H: scales from abaxial pinnule surface. – A, C, E, G from Tuomisto & al. 12684 (UC); B, D, F, H from Tuomisto & al. 11250 (UC). – Drawn by Klei Sousa.

light brown to dark brown, lunate, glabrous, margin entire; spores light brown, trilete.

Distribution and ecology — Amazonian forests in Colombia, Peru and Brazil (Fig. 1). Growing in the floodplains and banks of creeks on waterlogged and often

muddy sites, at 100–350 m. Usually terrestrial, but can also grow on the bases of tree trunks.

Etymology — The specific epithet is based on the morphology of the rhizome, with approximate stipes, leading to a nodose appearance of the rhizomes. This feature

is more evident on small specimens where the stipes are 1–1.5 mm apart.

Additional specimens examined — BRAZIL: AMAZONAS: Presidente Figueiredo, Distrito de Balbina, margem direita da estrada de acesso à Vila de Balbina, Ramal da Morena, margem do Rio Uatumã, [02°07'06"S, 59°19'07"W], 100 m, 3 Feb 2008, J. Prado & al. 1873 (NY, SP, TUR, US). PARÁ: Novo Progresso, Fazenda Sr. Sérgio, 15 km Sul de NP pela BR-163, 07.15012°S, 55.41845°W, 8 Dec 2009, F. O. Figueiredo & al. 1372 (INPA). — COLOMBIA: AMAZONAS: Río Caquetá, 0.5 km E of Estrecho (9 km E of confluence of Río Metá and Caquetá), 00°57'S, 71°32'W, 150–250 m, 28 Apr 1998, H. Tuomisto & al. 12232 (COAH, TUR 4 sheets); idem, close to mouth of Río Sábalo but on opposite shore of Caquetá, 01°03'S, 71°34'W, 150–250 m, 22 May 1998, H. Tuomisto & al. 12391 (COAH, TUR 2 sheets). — PERU: LORETO: Mariscal Ramon Castilla, Río Yaguasyacu, 2–5 km SW from village of Puerto Izango, 03°18'S, 72°01'W, 100–150 m, 23 May 1997, H. Tuomisto & al. 11264 (AMAZ, BM, SP, TUR 2 sheets, USM); idem, 03°18'S, 72°01'W, 100–150 m, 23 May 1997, H. Tuomisto & al. 11251 (AMAZ, TUR, USM); idem, 03°18'S, 72°01'W, 100–150 m, 23 May 1997, H. Tuomisto & al. 12624 (TUR 2 sheets); idem, 2 km S from village of Puerto Izango, Río Yaguasyacu, 03°18'S, 72°00'W, 100–150 m, 21 Aug 1998, H. Tuomisto & al. 12684 (AMAZ, NY, TUR 2 sheets, UC, US, USM); idem, 1 km NE from village of Nueva Esperanza, 03°20'S, 71°59'W, 100–150 m, 23 Aug 1998, H. Tuomisto & al. 12717 (AMAZ, TUR 2 sheets, USM); idem, Río Ampiyacu, 3 km SW from village of Nueva Esperanza, 03°21'S, 72°00'W, 100–150 m, 24 Aug 1998, H. Tuomisto & al. 12722 (AMAZ, SP, TUR 2 sheets, USM); idem, Río Yavarí-Mirín, Bosque primario, 04°29'S, 72°20'W, 100–200 m, 13 Apr 2002, G. Cárdenas & K. Salovaara 1374 (AMAZ, TUR); idem, Río Yavarí-Mirín, bosque primario, 04°24'S, 72°15'W, 100–200 m, 21 Mar 2002, G. Cárdenas & K. Salovaara 1280 (AMAZ, TUR 2 sheets, USM); idem, Río Tigre, 2.5 km SW of village 28 de Julio W of river, 03°29'S, 74°49'W, 100–200 m, 5 Feb 2005, H. Tuomisto & al. 14942 (AMAZ, TUR); idem, Tierra firme 1 km E of river, 03°41'S, 74°33'W, 100–200 m, 8 Feb 2005, H. Tuomisto & al. 14966 (AMAZ, TUR 2 sheets, USM). MADRE DE DIOS: Manu, Río Madre de Dios, S of river and 15 km W from mouth of Río Azul, 12°26'S, 70°43'W, 250–350 m, 30 Oct 1998, H. Tuomisto & al. 13558 (CUZ, TUR).

Diagnostic features — *Adiantum nodosum* is characterized by having rhizomes nodose (i.e. with stipes approximate, 1–1.5(–10) mm apart); lamina 2-pinnate, with (1 or) 2 or 4(–6) pairs of lateral pinnae (3–6 pairs in fertile fronds, fewer than 4 in sterile fronds); margin of sterile pinnules irregularly denticulate or serrate; pinnules abaxially with sparse scales on veins at base; scales light brown, 0.5–1 mm long, base pectinate, apex filiform; and indusia glabrous, margin entire.

Adiantum nodosum resembles *Adiantum tetraphyllum*, but the latter differs in having thicker rhizomes (> 5 mm in diam.), sterile pinnules with acute apices that are curved toward the pinna apices, and rachises with filiform scales adaxially and lanceolate scales abaxially. Additionally, in *A. tetraphyllum* the terminal pinnule of each pinna is long-linear (vs. broadly rhombic), and the indusia are shortly oblong and pubescent (vs. lunate and glabrous).

Adiantum nodosum grows in similar swampy sites as *A. pseudocajennense*. The two resemble each other in general appearance in the field, being relatively large but delicate in structure. They differ in that the rhizome of *A. nodosum* is more compact and the pinnule margins less deeply crenate than those of *A. pseudocajennense*.

Cárdenas & al. (2007) referred to *Adiantum nodosum* as "*Adiantum* sp. 2".

Adiantum pseudocajennense J. Prado, R. Y. Hirai & A. R. Sm., **sp. nov.** — Fig. 3.

Holotype: Ecuador, Napo, Yasuní National Park, km 32 of oil road, mature forest in the floodplain of Río Tiputini, a swamp dominated by *Mauritia* palms, 00°36'S, 76°27'W, 200–300 m, 14 Apr 1997, H. Tuomisto, S. Markkanen, K. Ruokolainen & R. Montufar 10591 (UC barcode UC1788278; isotypes: QCA 2 sheets, QCNE 2 sheets, SP, TUR 3 sheets).

Morphological description — Plants terrestrial. Rhizomes long-creeping, slender, 1–2 mm in diam., sparsely scaly, with stipes 2–3.3 cm apart, scales light brown, shiny, linear-lanceolate, base pectinate, margin entire. Fronds 23–66 cm long, maximally to 1.3 m; stipe black, 0.5–1 × as long as frond, adaxially sulcate, very sparsely scaly, scales appressed throughout, light brown, concolorous, filiform, c. 1 mm long, base with several processes, margin ciliate near base; also with arachnoid scales c. 0.5 mm long; lamina 2-pinnate, not reduced at base, 20–40 cm wide; rachis with indumentum similar to that of stipe, but more dense; pinnae elliptic, slightly narrowed at base, tapering at apex, 9–25 × 2.5–3 cm, indumentum of pinna rachis like that of main rachis; lateral pinnae in 1–7 pairs (5–7 pairs in fertile fronds, fewer than 5 in sterile fronds), alternate, oblique; terminal pinna conform, 1–1.2 × as long as subtending pinnae; pinnules in 11–35 pairs, not articulate, oblique to pinna rachis, 2–3 × as long as wide, papyraceous, adaxial surface glabrous, abaxial surface very sparsely scaly, scales borne on veins at pinnule base, light brown, 0.5–1 mm long, base pectinate, apex filiform; pinnules free-veined, without evident midrib, veins slightly prominulous, with oblique idioblasts present between veins adaxially; proximal pairs of pinnules reduced, somewhat deltate; medial pairs dimidiate, almost trapeziform, acroscopic base rectangular, sterile margins irregularly crenately lobed, sterile apices obtuse, straight or curved toward pinna apex, fertile apices angular; distal pinnules c. ½ or

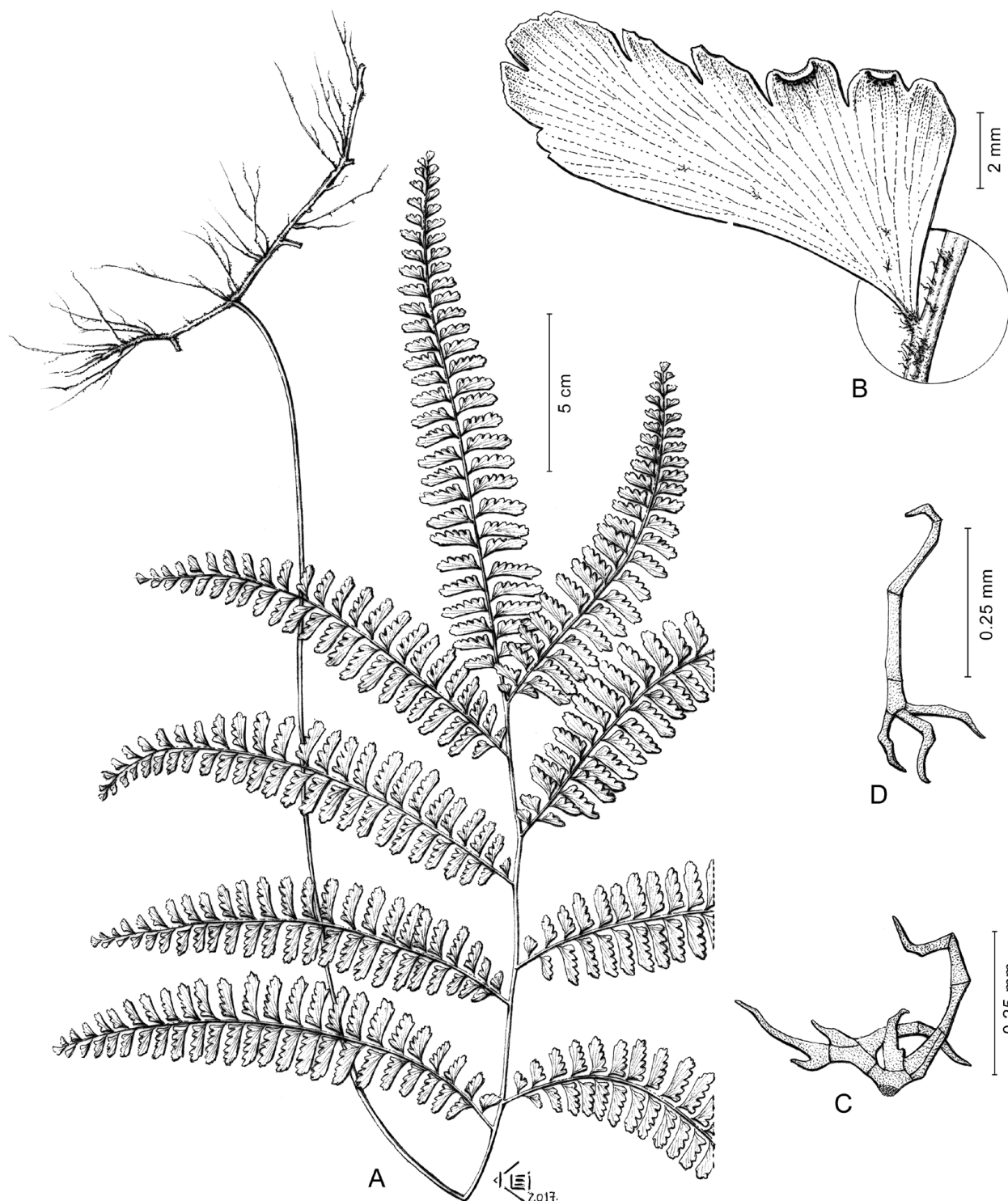


Fig. 3. *Adiantum pseudocajennense* – A: habit; B: fertile pinnule; C: scale from rachis; D: scale from abaxial pinnule surface. – All from Tuomisto & al. 10591 (UC). – Drawn by Klei Sousa.

less length of medial pinnules; terminal pinnule on each pinna slightly pinnatifid, larger than distal ones. *Sori* mostly 1–3 per pinnule, oblong; *indusia* light brown, glabrous, margin entire; *spores* not seen.

Distribution and ecology — Endemic to Amazonian Ecuador (Fig. 1). Occurring in swamp forests dominated

by *Mauritia* L. f. palms and in floodplain forests, usually on muddy sites, at 200–300 m.

Etymology — The specific epithet is based on the morphological similarity between the pinnules of this new species and those of *Adiantum cajennense* Willd. ex Klotzsch.

Additional specimens examined — ECUADOR: NAPO: Laguna de Yuturi, Bosque húmedo tropical, sendero hacia el moretal, 00°36'S, 76°01'W, 220 m, *J. Jaramillo & E. Grijalva* 11308 (QCA); idem, Yasuní National Park, 94.9 km along oil road, 00°54'S, 76°13'W, 200–300 m, 24 Feb 1998, *H. Tuomisto & K. Ruokolainen* 11476 (QCA 3 sheets, QCNE, SP, TUR 3 sheets); idem, Yasuní National Park, km 32 of oil road, mature forest in floodplain of Río Tiputini, 00°36'S, 76°27'W, 200–300 m, 13 Apr 1997, *H. Tuomisto & al.* 10589 (QCA, QCNE, SP, TUR); idem, Yasuní National Park, about 1.5 km E of bridge over Río Tiputini E of biological station, 00°40'S, 76°23'W, 200 m, 11 Apr 1996, *R. C. Moran & al.* 6089 (TUR 2 sheets); idem, Parque Nacional Yasuní, 3 km E of bridge over Río Tiputini E of research station, 00°45'S, 76°27'W, 200 m, 19 Apr 1996, *R. C. Moran & al.* 6239 (TUR).

Diagnostic features — *Adiantum pseudocajennense* is easily recognized by having rhizomes long-creeping, slender, 1–2 mm in diam., with fronds 2–3.3 cm apart; margins of sterile pinnules irregularly crenately lobed; pinnules almost glabrous abaxially; laminar scales concentrated near base of pinnules, petioles and rachises, with few sparse, filiform plus arachnoid scales; and indusia glabrous.

Adiantum pseudocajennense typically grows on very wet soil in floodplain and swamp forests, and the long-creeping rhizomes allow it to spread vegetatively such that it often sparsely covers relatively large patches.

The most similar species is *Adiantum cajennense*, which occurs widely in the Amazon Basin. The similarity is indicated by the sterile margins of the crenately lobed pinnules in both species. However, *A. cajennense* differs by its short-creeping and stout rhizomes (5–8 mm in diam.) and pubescent indusia. Additionally, in *A. cajennense* the stipes and rachises are generally densely scaly. Ecologically the two species are clearly distinct, as *A. cajennense* grows in well-drained sites rather than in swamps.

Tuomisto & al. (2002) referred to *Adiantum pseudocajennense* as “*Adiantum* sp. 2”.

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