

Novelties in *Campyloneurum* (Polypodiaceae) from Mesoamerica

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Abstract

Three new species are described and another is recognized in *Campyloneurum*. Two species occur in Mexico to El Salvador and the others two are present in Nicaragua, Costa Rica and Panama. The new species are *Campyloneurum acutum* A. Rojas, *C. leoniae* A. Rojas and *C. madreense* A. Rojas. The first species differs from *C. xalapense* by broader rhizome scales, acute to attenuate blade apex, commonly two series of areoles between parallel veins, commonly one sori per areole and hydathodes absent or few evident. *Campyloneurum leoniae* differs from *C. irregulare* by more compact and non-pruinose rhizomes, thinner stipes, relatively broader, thinner and more opaque laminae, and distribution at lower elevations. *Campyloneurum madreense* is different to *C. angustifolium* because it has narrower and darker rhizome scales with denticulate margin, long scales cells and distributed at lower elevations. Finally, *Campyloneurum pittieri* is here recognized as valid species and it differs from the similar *C. amphostenon* by longer rhizomes with appressed scales that have a patent, long acuminate apices, relative broader laminae, veins evident and distribution at higher elevations.

Keywords

Campyloneurum amphostenon Complex, *Campyloneurum angustifolium* Complex, *Campyloneurum xalapense*, Lectotype Designed, New Species, Ferns, Species Recognized

1. Introduction

Campyloneurum C. Presl is a Neotropical genus with about 50 species [1]. This genus is recognized by having sterile and fertile monomorphic leaves, single, entire and glabrous blades or with few scales on the rachis, sori in 2 - 4 rows between the main lateral veins and they born on the tips of included veinlets [2].

In the *Campyloneurum angustifolium* (Sw.) Fée complex, Lellinger described

C. centrobrasilianum Lellinger, *C. cooperi* Lellinger and *C. irregulare* Lellinger. The first species was compared with *C. angustipaleatum* (Alston) M. Mey. ex Lellinger, the second one with *C. rigidum* J. Sm. and the third with *C. amphostenon* (Kunze ex Klotzsch) Fée. Also he made a new combination from *Polypodium angustifolium* f. *densifolium* Hieron. as *C. densifolium* (Hieron.) Lellinger [3]. Of the species previously mentioned, Lellinger registered from Costa Rica to *Campyloneurum cooperi* and *C. irregulare* [3]. However, León synonymized this species joining to *C. angustifolium* s. l. and mentioned that the group require more studies. Additionally, León registered to *C. angustipaleatum* (Alston) M. Mey. ex Lellinger and *C. densifolium* from Costa Rica [4].

Lellinger mentioned two distributional ranges from *Campyloneurum irregulare* in Costa Rica, between 800 - 1500 m and between 2200 - 3300 m [5]. Rojas found that really are two entities with different geographic and altitudinal distribution. Since the plants with the northernmost distribution between Costa Rica and Nicaragua present a non-farinosous rhizome, rhizome scales are with basal cells less markedly irregular and distribute to (700-) 1200 - 1700 m, while the typical form with pruinose rhizome and basal cells of the rhizome scales markedly irregular is located to (1200-) 1700 - 2500 m. Rojas also mentioned that lowland plants need to merit consideration of variety or species [6].

Mickel & Smith made difference between *C. angustifolium* and *C. ensifolium* (Willd.) J. Sm., principally referring to rhizome scales, the first with long acuminate apex and with oblong cells, the other with rounded to short acute apex and the cells rounded to squarish [7].

Respect to *Campyloneurum xalapense* Fée, León mentioned that this taxon has differences in the blade form and variation in rhizome scales between lanceolate to linear, related with populations but not between characters [8]. Mickel & Smith mentioned different chromosome number between Oaxaca (=74) and Costa Rica (=148) [7], probably due because they are different taxa.

León defined to *Campyloneurum amphostenon* (Kunze ex Klotzsch) Fée as plants with long-creeping rhizome with dark brown and ovate scales, they are appressed at base, with patent apex [4] [8]. Respect to same species, Rojas found two different entities and separated them in his **Table 2**, [6], relating entity 1 to the entity proposed by León [4] [8] and entity 2 as a possible hybrid that has short-creeping rhizome with scales 1.5 - 3 times longer than wide and brown-yellowish, fronds relatively shorter and narrower, veins few evident and distributed at low elevation.

León [8] mentioned 18 species of *Campyloneurum* from Mesoamerica, but Rojas with the publication of *C. gracile* and the recognition of *C. cooperi* and *C. irregulare* [6], the inclusion of *Hyalotrichopteris anetioides* (Christ) W.H. Wagner in *Campyloneurum* [9] and four species that are included in this work; the current number of species for the region arrives to 26.

2. Materials and Methods

The new species here considered are the result of comparisons with specimens of

other Mexican and Central American species, and a review of related species and keys from the neotropical ferns by Gómez & Arbeláez [1], Lellinger [5], Mickel & Smith [7], Mickel & Beitel [10], Smith [11] and Stolze [12] and other papers in the *Campyloneurum* genus [3] [6]. The examined specimens are deposited in the following herbaria CHAPA, CR, MEXU, MO, UC and XAL [13]. To ensure the correct application names, original type material or digital type images were examined as available (Jstor Global Plants (<http://plants.jstor.org/>)), and the new names were corroborated with International Plant Name Index (<http://www.ipni.org/ipni/plantname-searchpage.do>).

3. Results

3.1. New Species

3.1.1. *Campyloneurum acutum* A. Rojas, Sp. Nov. (Figure 1)

TYPE: MEXICO. Guerrero: Mpio. Atoyac, a 8 km al SW de Puerto del Gallo, camino a Atoyac, 2140 m, 16 jun 1982, E. Martínez 982 (holotype: MEXU).

Diagnoses: *Campyloneurum acutum* differs from *C. xalapense* by lanceolate and broader rhizome scales, acute blade apex and parallel veins with commonly two series of areoles.

Description: Epiphytic; rhizome 3 - 6 mm in diameter, short-creeping, fronds 2 - 5 mm distant between them, not pruinose, brown to blackish when dry; rhizome scales 3 - 6 × 0.5 - 1.5 mm, lanceolate, brown to yellowish-brown, clathrate or scarcely so with transparent lumina, marginally entire and acute at tip; fronds (20-) 45 - 93 cm long, moderately decumbent; stipe (3-) 5 - 9 cm long, 1/12 - 1/9 of the frond length, strawish to pale brown, glabrous, phyllopodia 2 - 3 mm long; blade (17-) 40 - 84 × (2-) 3 - 4.3 (-5.5) cm, narrowly elliptic to linear-oblong, gradually reduced at base, long acute to attenuate at apex, chartaceous, lustrous; hydathodes absent or small; rachis strawish to pale brown, glabrous; veins few evident, commonly forming 2 series of areoles between parallel veins, included veinlets one (rarely 2) per areole; sori rounded, in 4 - 6 rows between costa and margin.

Etimology: The name of the new species refers to the acute blade apex.

Distribution: Known from Mexico and El Salvador at 1000 - 2700 m elevation.

Additional revised specimens (paratypes): MEXICO. Chiapas: Municipio San Andrés Larrainzar, near the summit of Chuchil Ton, NE of Bochil, 2700 m, 3 Aug 1972, D. Breedlove 26780-A (MEXU); Municipio Motozintla de Mendoza, 45 - 50 km NE of Huixtla along road to Motozintla, 1900 m, 17 Nov 1971, D. Breedlove & A. Smith 22658 (MEXU); SE side of Volcán Tacaná above Talquian, 2200 m, 16 Jan 1973, D. Breedlove & A. Smith 31631 (MEXU); to 22 km E of Lagunas de Monte Bello, over the trail to Santa Elena, 22 Nov 1982, E. Cabrera & H. de Cabrera 3687 (MEXU); above El Rosario, 8 mi S of Motozintla, 1800 m, 10 Jul 1977, T. Croat 40731 (MEXU, MO), ibidem, T. Croat 40732 (MEXU, MO); Municipio Jaltenango, El Triunfo Reserve, trail NNW from El Triunfo camp towards Palo Gordo camp, 1 - 3 km from El Triunfo camp, 15°39'N, 92°50'W,

2000 m, 21 Feb 1990, *R. Hampshire et al.* 530 (MEXU); Municipio Jaltenango, Reserva El Triunfo, 1 polygon, HQ camp, 15°39'N, 92°48'W, 1850 m, 13 Jun 1990, *M. Heath & A. Long* 976 (MEXU); Municipio La Concordia, Cerro Cebú, polygon, Core zone 5, 15°49'24.4"N, 93°02'44"W, 2200 m, 17 Jul 2005, *J. López* 49 (MEXU); Municipio Mapastepec, Triunfo-Tomatal camp, 15°38'N, 92°50'W, 1728 m, *M. López* 85 (MEXU); Municipio Unión de Juárez, between Toniná and Talquián, 1700 - 2700 m, 10 May 1987, *E. Martínez* 20884 (MEXU); Municipio Ziltepec, Pico de Loro range, 8 km S of Nueva Argentina, 15°28'50"N, 92°36'20"W, 2000 m, 27 Jan 1999, *M. Pérez* 1739 (MEXU); Municipio Monte Cristo, trail to San Luis, 2 km from Laguna El Cofre, buffer zone, 15°37'33.8"N, 92°37'45.1"W, 2010 m, 15 Jun 2005, *M. Reynoso* 209 (MEXU); Municipio Tapa-chula, El Dormitorio, hillside W from Volcán Tacaná, 22 May 1984, *P. Tenorio et al.* 5913 (MO). Guerrero: Municipio Atoyac, 8 km SW from Puerto del Gallo, trail to Atoyac, 2140 m, 16 Jun 1982, *E. Martínez* 980A (MEXU); Reserva El Triunfo, 1900 m, 1 Jun 1987, *E. Martínez et al.* 21547 (MEXU); Municipio La Independencia, Colonia Francisco Madero, near the road, 14 Mar 1981, *M. Sousa et al.* 1935 (MEXU); Municipio Yajalón, Surroundings of Ejido Lázaro Cárdenas, 17.21463°N, 92.6059°W, 1152 m, 11 abr 2010, *G. Salazar et al.* 8904 (MEXU); in Las Golondrinas, 29 km NE from Paraíso, trail to Puerto del Gallo, 1810 m, 5 Jun 1983, *J. Soto et al.* 5188 (MEXU); Municipio Zihuatanejo, 86 km NE from Zihuatanejo, by road Zihuatanejo-Ciudad Altamirano, 1530 m, 21 May 1982, *P. Tenorio et al.* 422 (MEXU). Oaxaca: Municipio Santiago Comaltepec, 2.8 km in a straight line to S (225°) from La Esperanza, 17°36'32"N, 96°24'14"W, 1600 m, 10 Jan 1995, *C. Gallardo et al.* 1323 (MEXU); Municipio San Felipe Usila, on the periphery of the community of Santa Cruz Tepetotutla, 1000 m, 07 May 1995, *M. Romero* 2926 (MEXU); Distrito Ixtlán, Municipio Comaltepec, Vista Hermosa, 26.6 km SW from Valle Nacional, road Tuxtepec-Oaxaca, 17°43'N, 96°20'W, 1460 m, 26 Jan 1988, *R. Torres & E. Martínez* 11417 (MEXU). Queretaro: Municipio Jalpan, 2 - 3 km N from La Parada, 1250 m, 08 Mar 1991, *B. Servín* 868 (MEXU). Tabasco: Municipio Tacotalpa, Sunú and Patostal, 16 Feb 2000, *G. Gaspar & G. Ocaña* 94 (MEXU). Veracruz: Municipio San Andrés Tuxtla, Ejido Barrio Lerdo, slopes of Volcán San Martín Tuxtla, 18°34'N, 95°10'W, 1000 m, 11 Aug 2005, *T. Krömer & A. Acebey* 2474 (MEXU); Municipio San Andrés Tuxtla, Ejido Ruiz Cortines, sidewalk near the town that connects with dirt road, 18°31'59"N, 95°08'59"W, 1100 m, 25 May 2001, *A. Rincón et al.* 2427 (MEXU); Municipio Chocaman, Tepejilotla, 1300 m, 29 Jun 1979, *F. Ventura* 16285 (MEXU).

EL SALVADOR. Santa Ana: Cerro Montecristo, ca. 14 mi NE of Metapán, 1950 - 2000 m, 31 Jul 1977, *T. Croat* 42399 (MEXU, MO).

Campyloneurum acutum differs from *C. xalapense* by lanceolate (vs. linear or at less with long and narrow apex) and broader apex (0.5 - 1 mm vs. 0.2 - 0.5 mm) rhizome scales, acute to attenuate (vs. long acuminate to cuspidate) blade apex, hydathodes absent or small (vs. markedly evident), commonly two (vs. one) series of areoles between parallel veins and commonly one sori per areola

(vs. 2). Also the new species is related to *C. tenuipes* but differs of it by longer (1/12 - 1/9 of the frond length vs. ca. 1/3) stipe, narrower ((2-) 3 - 4.3 (-5.5) vs. 4 - 9 cm) blade, acute to attenuate (vs. long acuminate to cuspidate) blade apex and 4 - 6 (vs. 6 - 10) sori rows between costa and margin (see **Figure 1** and **Table 1**).

3.1.2. *Campyloneurum leoniae* A. Rojas, Sp. Nov. (Figure 2)

TYPE: COSTA RICA. Guanacaste: Cordillera de Tilarán, 1 km N of Las Nubes de Río Chiquito, Zona Monteverde, Atlantic slope, 10°22'N, 84°51'W, 1300 m, 4 Sep 1988, *W. Haber & W. Zuchowski* 8691 (holotype: CR!; isotype: MO?).

Diagnoses: *Campyloneurum leoniae* differs from *C. irregulare* by more compact and non pruinose (vs. pruinose) rhizomes, relatively broader, thinner and more opaque (vs. lustrous) laminae, and distribution at lower elevations.

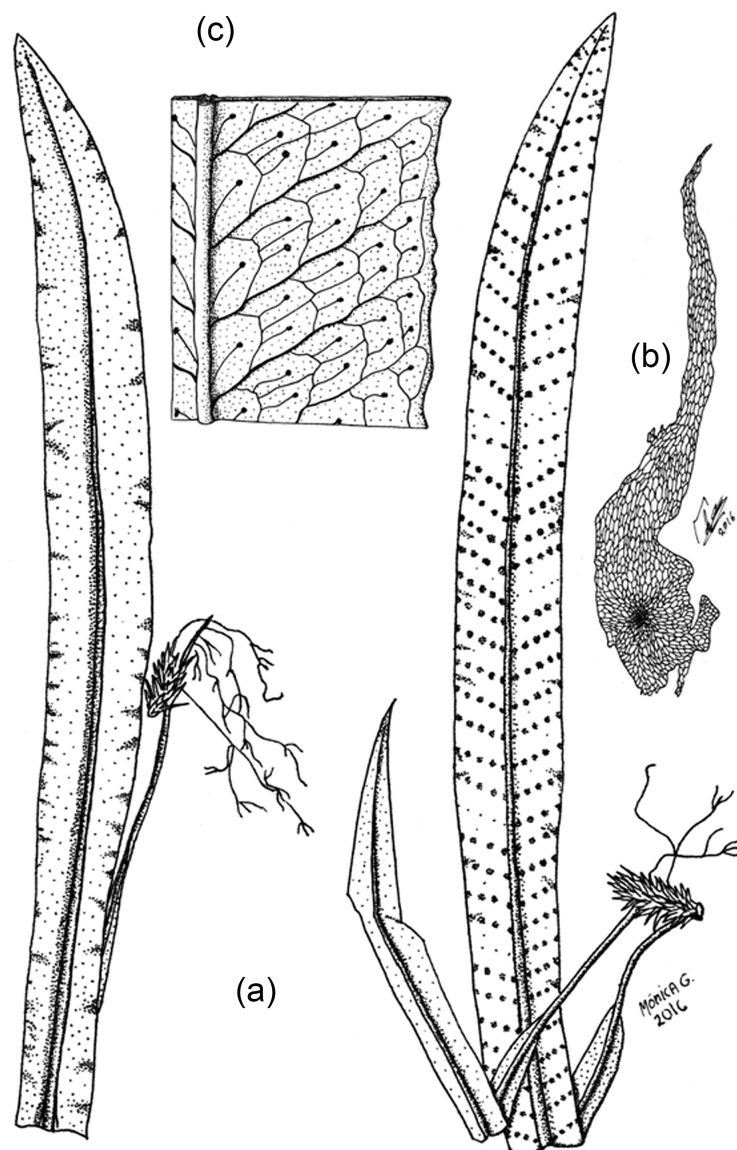


Figure 1. (a)-(b). Type material of *Campyloneurum acutum* A. Rojas (*E. Martínez 982*, MEXU). (a) Habit; (b) Rhizome scales; (c) Blade detail.

Table 1. Comparison of morphological characteristics among three species of *Campyloneurum*: *C. acutum*, *C. tenuipes* and *C. xalapense*.

Character	<i>C. acutum</i>	<i>C. tenuipes</i>	<i>C. xalapense</i>
Long of rhizome scales	3 - 6 mm	5 - 8 mm	3 - 5 mm
Broad of rhizome scales	0.5 - 1.5	1 - 1.5	0.2 - 0.5
Color of rhizome scales	yellowish-brown to brown	brown	dark brown to blackish
Lumen color of rhizome scales	translucid	translucid	brown
Size of fronds	(20-) 45 - 93 cm	30 - 80 cm	(20-) 30 - 60 cm
Long of stipe	1/12 - 1/9 of the frond length	1/3 of the frond length	1/10 of the frond length
Broad of blade	(2-) 3 - 4.3 (-5.5) cm	4 - 9 cm	3 - 5.5 cm
Blade apex	acute to attenuate	acuminate to cuspidate	acuminate to cuspidate
Rows of areoles between parallel veins	commonly two	two	one
Rows of sori between midvein and margin	4 - 6	6 - 10	4 - 7
Altitudinal distribution	1000 - 2700 m	1000 - 2300 m	500 - 1700 (-2300) m

Description: Epiphytic; rhizome 3 - 5 mm in diameter, short-creeping, fronds approximate to distant to 3 mm, not pruinose, blackish and glabrescent with age; rhizome scales 1.5 - 3.5 (-4) × 0.8 - 1.5 mm, ovate-lanceolate to lanceolate, dark brown, clathrate, dense, cordiform at base, cells with irregular base, with the cells at scale apex 1.5 - 3 times longer than wide, lumen pale brown; fronds (8-) 15 - 35 (-45) cm long; stipe 0.5 - 4 (-5) cm long, 1/12 - 1/8 of the frond length, 1 - 1.5 mm wide (to 2 mm with wing), slight to strongly flattened, strawish to pale brown, winged throughout, glabrous or sparsely scaly, the scales 0.5 - 1.5 x ca. 0.5 mm, ovate, brown; phyllopodia 0.5 - 1 (-2) mm long; blade (7-) 13 - 30 (-40) × (0.5-) 1 - 2 (-2.3) cm, linear-elliptic, attenuate on both sides, coriaceous, opaque, with commonly revolute margin; rachis strawish to brown, glabrous or sparsely scaly at base; lateral veins few evident; sori rounded, in 1 - 3 (-4) irregular rows between costa and margin.

Etimology: This new species is dedicated to Blanca León, Peruvian pteridologist, who has made several contributions to *Campyloneurum* studies.

Distribution: Known from Nicaragua and Costa Rica at 700 - 1800 (-2000) m elevation.

Additional revised specimens (paratypes): NICARAGUA. Estelí: Cerro Quiabú, NW of Estelí, 13°07'N, 86°26'W, 1600 m, 24 Jul 1980, *P. Moreno* 1330 (CR, HNMN); foothill of Quiabú, side N, 13°06'N, 86°25'W, 1460 - 1480 m, 2 Jul 1982, *P. Moreno* 16775 (CR, HNMN). Granada: Volcán Mombacho, 1345 m, 31 Jan 1980, *M. Araquistain & P. Moreno* 1206 (CR, HNMN). Jinotega: Santa Gertrudis, 30 km E of Jinotega, 1000 m, 20 Jan 1980, *M. Araquistain & P. Moreno* 867 (CR, HNMN); ca. 23.5 km (by road) NE of hwy. 1 at Estelí and ca. 2.8 km SE of Laguna Miraflores, ca. 13°14'N, 86°14'W, 1400 m, 11 Jun 1981, *J. Henrich & W. Stevens* 408 (CR, MO); ibidem, *J. Henrich & W. Stevens* 410 (CR,

MO); along hwy 3, ca. 1.9 km NW of Aranjuez, road to entrance, ca. 13°02'N, 85°56'W, 1460 - 1480 m, 24 Dec 1977, *W. Stevens & B. Krukoff* 5537 (CR, MO); ca. 0.6 km from hwy 3 on road to Aranjuez, ca. 13°01'N, 85°55'W, ca. 1430 m, 9 Apr 1978, *W. Stevens & B. Krukoff* 7543 (CR, MO); along hwy 3, ca. 1 km NW of La Fundadora entrance, unnamed peak ca. 500 m W of hwy, ca. 13°01'N, 85°56'W, 1450 - 1520 m, 24 May 1981, *W. Stevens et al.* 20391 (CR); Miraflores, Aug 1975, *J. Villa s.n.* (CR). Madriz: Cerro Pataste, ca. 20 km SW of Somoto city, ca. 1700 m, 28 Aug 1982, *A. Grijalva* 897 (CR, HNMN). Matagalpa: La Carlota, road Matagalpa-Tuma, 1400 - 1500 m, Oct 1975, *L. Gómez et al.* 6298 (CR); Fuente Pura, Santa María de Ostuma, between Matagalpa and Jinotega, 1400 m, 26 Aug 1982, *E. Martínez et al.* 1731 (MEXU); trail to Cerro La Carlota, 2 km of the trail to Tuma, 12°58'N, 85°52'W, 1040 - 1100 m, 5 Mar 1982, *P. Moreno* 15618 (CR, HNMN); Santa María de Ostuma estate, 10 km N of Matagalpa, 1300 m, 17 Jul 1978, *P. Vincelli* 755 (CR).

COSTA RICA. Alajuela: Piedades Norte (Los Ángeles) of San Ramón, 6 Mar 1929, *A. Brenes* 6724 (CR); La Palma of San Ramón, 2 Nov 1929, *A. Brenes* 7396 (145) (CR); San Pedro of San Ramón, 31 Jan 1936, *A. Brenes* 21558 (8) (CR); San Carlos, 14 km NE of Ciudad Quesada, 1250 m, 22 Jul 1963, *A. Jiménez* 950 (CR); above Angel Falls, Río La Paz Grande, on road to Sarapiquí, 1460 m, 23 Mar 1969, *R. Lent* 1501 (CR); above Río Toro, 10°12'N, 84°19'W, 1550 m, 3 Sep 1972, *R. Lent* 2812 (CR); La Palma of San Ramón, 3 - 10 Aug 1935, *M. Quirós* 259 (CR); Carrillos de Poás, 23 Aug 1936, *M. Quirós* 569 (CR); San Ramón, Reserva Forestal San Ramón, Cordillera de Tilarán, Los Ángeles, banks of the road between Los Ángeles and Río Cataratas, 10°12'15"N, 84°32'15"W, 900 - 1250 m, 2 May 1996, *A. Rojas & J. Morales* 2589 (CR). Cartago: Pacayas, near of bridge over the Río Turrialba, trail to Turrialba (between Santa Teresa and Santa Cruz), 9°57'20"N, 83°46'20"W, 1670 m, 27 Oct 1995, *A. Cascante et al.* 847 (CR); 10 km S of Cartago by air, along confluence of río Empalme and Río Estrella, 1 km S of Palo Verde by road, Palo Verde is 1 km S of Panamerican hwy on road to La Estrella, 9°46'N, 83°57'W, 1450 m, 21 Apr 1983, *R. Liesner & E. Judziewicz* 14587 (MO); Paraíso, Cordillera de Talamanca, Estación de Biología Tropical Río Macho and surroundings, Orosi, 09°46'N, 83°52'W, 1550 - 1580 m, 30 Sep 1993, *A. Rojas* 480 (CR, INB, MO); Guadalupe (Arenilla), Zona Protectora La Carpintera, slope of hill of La Carpintera, with view to Coris, 9°52'39.2"N, 83°58'17.6"W, 1710 m, 19 Mar 2007, *A. Ruiz et al.* 1179 (CR); 0.8 km down (W) road to San Cristobal Norte, 1850 m, 21 Set 1979, *K. Walter* 79498 (CR). Guanacaste: La Cruz, Parque Nacional Guanacaste, 9 km S of Santa Cecilia, Estación Pitilla, 10°59'26"N, 85°25'40"W, 700 m, 28 Sep 1990, *C. Chávez et al.* 188 (CR, MO); Monteverde, 3.4 km N of Santa Elena on road to Las Nubes, 10°22'N, 84°49'W, 1500 m, 14 Aug 1988, *W. Haber & W. Zuchowski* 8547 (CR, MO); Monteverde, 3.5 km N of Santa Elena on road to San Gerardo, 0.5 km N of junction road and Río Negro, 10°21'N, 84°48'W, 1540 m, 20 Aug 1988, *W. Haber & W. Zuchowski* 8579 (CR); Cordillera de Tilarán, 1 km N of Las Nubes de Río Chiquito, Monteverde zone, Atlantic slope, 10°22'N, 84°51'W, 1300 m, 4 Sep 1988, *W. Haber & W. Zuchowski* 8689 (CR, MO); Tilarán, Cordillera de Tilarán, Río San Lucas,

10°22'50"N, 84°54'20"W, 800 - 900 m, 27 Jun 1995, *G. Rodríguez & A. Rojas* 357 (CR); La Unión, San Rafael, Zona Protectora Cerros La Carpintera, Iztarú camp, between the road and the top of the mountain, 9°53'11"N, 83°58'16"W, 1750 - 1850 m, 17 Jul 2007, *A. Rojas et al.* 7599 (CR). Heredia: Vara Blanca, 1700 - 1900 m, 27 Oct 1979, *C. Todzia* 929 (CR). Limón: Talamanca, trail ca. 5 km up Alto Lari, 9°24'15"N, 83°05'05"W, 1300 m, 27 Feb 1992, *J. Bittner* 1338 (CR); Talamanca, Bratsi, Amubri, Alto Lari, Kivut, 9°24'15"N, 83°05'15"W, 1300 m, 6 Mar 1992, *G. Herrera* 5174 (CR). Puntarenas: Coto Brus, Parque Internacional La Amistad, Cordillera de Talamanca, Estación Pittier, Río Gemelo trail, 9°01'30"N, 82°57'40"W, 1680 m, 29 Jan 1995, *F. Alvarado et al.* 12 (INB, CR); upper río Burú, 2010 m, 19 Aug 1983, *L. Gómez et al.* 21431 (CR); Ojo de Agua, Monteverde, Méndez estate, Río Aranjuez, 10°17'N, 84°46'W, 1550 m, 14 Nov 1987, *W. Haber & E. Bello* 7731a (CR); La Pitahaya, Arancibia, Rincón, headers of Río Aranjuez, 10°15'10"N, 84°41'20"W, 1200 m, 27 May 1996, *G. Herrera* 9024 (CR); Monteverde Reserve, 1 km SW station, 10°18'N, 84°48'W, 1500 - 1550 m, 20 Feb 1992, *S. Ingram & K. Ingram* 1361 (CR); Monteverde, 1520 m, 13 Nov 1979, *S. Koptur* 223 (CR); Monteverde, 1 Dec 1979, *S. Koptur* 246 (CR); Monteverde, Cordillera de Tilarán, 1350 m, 30 Jul 1981, *D. Neill* 5067 (CR); Monteverde, Cordillera de Tilarán, 4500 ft [=1372 m], Mar 1959, *C. Palmer* 110 (CR); Coto Brus, Zona Protectora Tablas, Cordillera de Talamanca, Sabalito, Las Alturas de Cotón, Estación Biológica Las Alturas, surroundings of the station, 8°57'15"N, 82°50'10"W, 1580 m, 23 Dec 1993, *A. Rojas* 765 (INB, MO); Monteverde Cloud Forest Reserve, road to station from community, 10°06'N, 83°26'W, 1500 m, 23 Aug 1987, *J. Smith* 563 (CR). San José: Pérez Zeledón, Cordillera de Talamanca, Las Nubes de Santa Elena, 9°23'30"N, 83°35'50"W, 1210 m, 8 Sep 1995, *E. Alfaro* 395 (CR, INB); Desamparados, Patarrá, Cerro El Espino (Mata de Caña-Azahar), 1600 - 1800 m, 13 Nov 1983, *I. Chacón & G. Herrera* 1564 (CR); ibídem, *I. Chacón & G. Herrera* 1569 (CR); Coronado, Las Nubes, 29 Dec 1956, *F. Chisaki* 1004 (CR); surroundings S of San José, trail more than 1 km NE of Tarbaca to Joya, which deviates from the road no. 4 Aserri-Tarbaca,

1750 m, 29 Apr 1990, *P. Döbbeler* 112 (MEXU); Tarrazú, San Carlos, trail to San Josecito, 9°37'20"N, 84°07'30"W, 1400 m, 23 set 1997, *A. Estrada* 1177 (CR); Escazú, cerros de Escazú, to Alto Tapezco by Bebedero, 9°55'00"N, 84°10'00"W, 1100 - 1700 m, 3 Oct 1993, *B. Hammel et al.* 19070 (CR); Dota, Peor es Nada, NW from the foothills of Cerro Lira, 9°31'30"N, 83°51'40"W, 1800 m, 8 Dec 1994, *G. Herrera & S. Martén* 7410 (CR); Dota, Copey, Providencia, Zapotal, path on the right after the river, 9°31'50"N, 83°49'49"W, 1800 m, 20 Aug 2003, *S. Lobo & A. Ruiz* 507 (CR); Aserri, Cerros de Escazú, Tarbaca, 9°49'10"N, 84°07'30"W, 1850 m, 12 Oct 1993, *J. Morales* 1871 (CR); Parque Nacional Braulio Carrillo, ca. 1 km along road from entrance, 1500 m, 19 Jul 1983, *R. Moran* 3294 (CR, F); Dota, Copey, Zapotal de Providencia, of the Montaña Fría farm 0 - 1 km to Providencia, 9°32'05"N, 83°50'19"W, 1720 m, 26 Aug 2004, *A. Rojas & H. Gómez* 5975 (CR, MO); Tarrazú, San Carlos, Cerro Cura, trail to San Marcos, 9°36'17"N, 84°06'39"W, 1730 m, 21 Sep 2004, *A. Rojas & S. Lobo* 6096 (CR);

Aserrí, Cerros de Escazú-La Carpintera, Tarbaca, El Cedral, trail to Pico Alto, 9°49'35"N, 84°06'50"W, 1770 - 2000 m, 16 Jun 1996, *A. Rojas & M. Obando* 2628 (CR); Acosta, Palmichal, Zona Protectora Cerros de Escazú, side of Río Tabarcia, 9°50'32"N, 84°10'21"W, 1450 m, 23 Jun 2004, *A. Rojas & A. Quesada* 5789 (CR); along Río Zurquí, (downstream from Guápiles hwy), Cordillera Central, 10°03'N, 84°0'W, ca. 1400 - 1500 m, 18 Jan 1986, *A. Smith et al.* 1731 (CR, UC); Escazú, Piedra Blanca, 1900 m, 20 Jan 1935, *F. Solís* 149 (CR); San Vicente, La Justa, 1170 m, Sep 1925, *M. Valerio* 124 (CR).

Campyloneurum leoniae separates from *C. irregulare* because has not pruinose rhizome (vs. pruinose); fronds approximate to 3 (-5) mm distant (vs. (approximate-) 2 - 5 mm distant); rhizome scales with the apical cells 2 - 5 times longer than wide (vs. 1.5 - 3.5 times); phyllopodia relatively shorter (0.5 - 1 (-2) mm vs. 1 - 3 mm); adaxial blade surface opaque (vs. lustrous (rarely opaque)) and distributed to lower elevation ((700-) 1000 - 1850 (-2000) m vs. (1700-) 190 - 2500 m) (See **Figure 2** and **Table 2**).

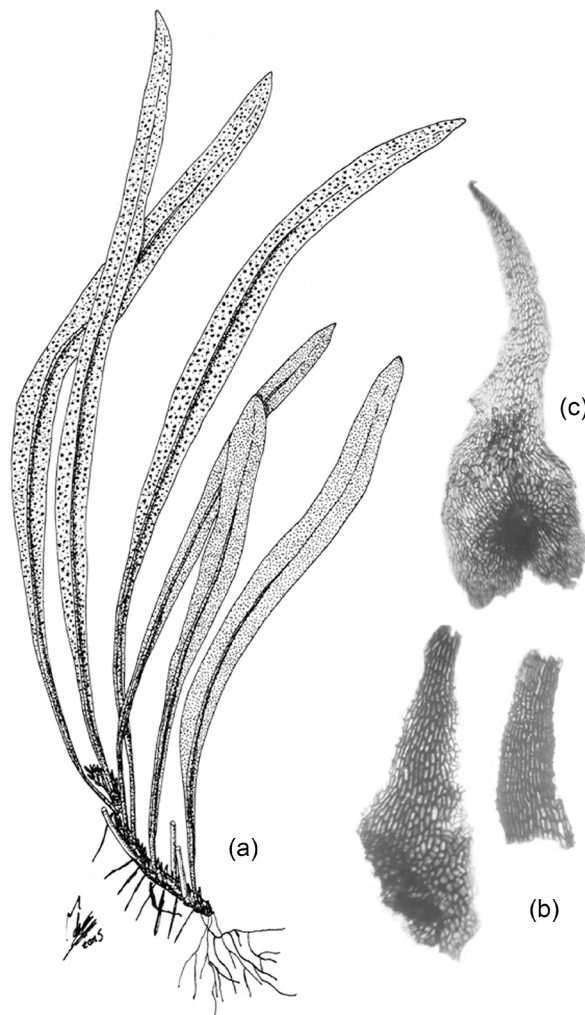


Figure 2. (a) (b). Type material of *Campyloneurum leoniae* A. Rojas (W. Haber & W. Zuchowski 8691, CR). (a) Habit; (b) Rhizome scales; (c) Rhizome scales of *Campyloneurum irregulare* Lellinger (A. Rojas et al. 6229, CR).

Table 2. Comparison of morphological characteristics among four species of *Campyloneurum*: *C. amphostenon*, *C. irregulare*, *C. leoniae* and *C. pittieri*.

Character	<i>C. amphostenon</i>	<i>C. irregulare</i>	<i>C. leoniae</i>	<i>C. pittieri</i>
Rhizome glaucous	yes	yes	no	No or scarcely
Distance between fronds	2 - 15 mm	(approximate-) 2 - 5 mm distant	Approximate to 3 (-5) mm distant	5 - 30 (-50) mm
Long of rhizome scales	4 - 8 mm	3 - 5 mm	1.5 - 4.0 mm	2 - 5 mm
Color of rhizome scales	yellowish-brown to grayish-brown	brown to dark brown	brown to dark brown	brown to dark brown
Form of basal cell of rhizome scales	triangular to hexagonal, isodiametric	poligonal, irregular	poligonal, irregular	Rounded to poligonal, isodiametric
Long of apical cells of rhizome scales	1.5 - 3.0 times longer than wide	1.5 - 3.5 times longer than wide	2 - 5 times longer than wide	1 - 2 times longer than wide
Lumen cells color of rhizome scales	translucid	brown	brown	translucid to grayish-brown
Fronds size	30 - 55 (-65) cm	20 - 45 cm	(10-) 20 - 35 (-50) cm	(35-) 45 - 60 (-80) cm
Long of phyllopodia	1.5 - 3 mm	1 - 3 mm	0.5 - 1 (-2) mm	2 - 4 mm
Long of stipe	4 - 10 (-20) cm	0.5 - 3.0 (-5.0) cm	(0.5-) 1 - 5.0 cm	8 - 25 cm
Diameter of stipe	2 - 3 mm	(1-) 1.5 - 2 mm	1 - 1.5 mm	2 - 3 mm
Broad of blade	1.0 - 3.5 cm	(0.4-) 0.6 - 1.2 cm	(0.5-) 1 - 2 (-.3) cm	(1.3-) 2.0 - 5.0 cm
Brightness of abaxial blade surface	middle to markedly lustrous	lustrous (rarely opaque)	opaque	middle lustrous
Highlighted veins	few or not	not	not	yes
Altitudinal distribution	(1800-) 2100 - 2900 (-3200) m	(1700-) 1900 - 2500 m	(700-) 1000 - 1850 (-2000) m	(1900-) 2700 - 3400 (-3550) m

3.1.3. *Campyloneurum madrense* A. Rojas, Sp. Nov. (Figure 3).

TYPE: MEXICO. Chiapas: Mpio. Ocosingo, 6.35 km NW of San Javier cruise, 16°50'34"N, 91°23'W, 391 m, 15 Nov 2003, *D. Álvarez et al.* 6960 (holotype: MEXU).

Diagnoses: *Campyloneurum madrense* differs from *C. angustifolium* by not pruinose rhizome or scarcely so, linear rhizome scales with sparsely denticulate margin; they dark gray to blackish, inside with narrow oblong cells and distributed at lower altitudinal distribution.

Description: Epiphytic; rhizome 2 - 5 mm in diameter, compact to short-creeping, fronds approximate to distant to 2 mm, not pruinose, brown to blackish when dry; rhizome scales 3 - 6 × 0.4 - 0.8 mm, linear to linear-lanceolate, dark gray to blackish, clathrate, dense, apically long acute to attenuate, marginally sparsely denticulate, cells oblong to narrowly oblong, 2 - 5 times longer than wide, lumen gray; fronds (18-) 30 - 65 cm long; stipe 2 - 5 (-8)

cm long, 1/12 - 1/8 of the frond length, 1 - 1.5 mm wide (to 2 mm with wing), slight to strongly flattened, strawish to pale brown, winged throughout, glabrous or sparsely scaly, the scales 0.5 - 1.5 x ca. 0.5 mm, ovate, brown; phyllopodia 0.5 - 1 (-2) mm long; blade (16-) 27 - 48 × (0.5-) 0.8 - 1.5 cm, linear, attenuate on both sides, chartaceous to subcoriaceous, opaque to lustrous, with commonly revolute margin; rachis strawish to brown, glabrous or sparsely scaly at base; lateral veins few evident; sori rounded, in 1 - 2 (-3) irregular rows between costa and margin.

Etimology: The name of its species make reference to geographical distribution in Sierra Madre Oriental and Sierra Madre del Sur.

Distribution: Actually known only from Mexico at 25 - 940 m elevation.

Additional revised specimens (paratypes): MEXICO. Chiapas: Municipio Ocosingo, 2 km S of Nuevo Guerrero, 16°59'02"N, 91°17'07"W, 248 m, 31 Jan 2003, *G. Aguilar* 5371 (MEXU); Municipio Ocosingo, 0.83 km SE of Nuevo Guerrero village, 16°58'51"N, 91°16'44"W, 222 m, 4 Nov 2003, *G. Aguilar* 8347 (MEXU); Municipio Ocosingo, 4.2 km E of Nuevo Francisco León, 16°19'43"N, 91°16'57"W, 180 m, 13 Oct 2002, *G. Aguilar & D. Álvarez* 3443 (MEXU); Municipio Ocosingo, 6.37 km SE of Nuevo Guerrero, trail of Lancanjá-Tzeltal, 16°55'57"N, 91°15'43"W, 456 m, 15 Oct 2002, *G. Aguilar & D. Álvarez* 3575 (MEXU) Municipio Ocosingo, 1.3 km S of El Paraíso, 16°57'05"N, 91°15'43"W, 483 m, 16 Oct 2002, *G. Aguilar & D. Álvarez* 3642 (MEXU); Municipio Ocosingo, 0.09 km SO of Lacanjá Chansayab community, 16°45'39"N, 91°07'47"W, 325 m, 15 Nov 2003, *G. Aguilar & C. Chancayun* 8425 (MEXU); Municipio Ocosingo, waterhole of San Javier, 16°50'25"N, 91°08'32"W, 390 m, 2 Dec 2002, *G. Aguilar & A. Cortés* 4504 (MEXU); Municipio Ocosingo, Chansayab community, 16°45'16"N, 91°07'55"W, 362 m, 19 Oct 2002, *G. Aguilar et al.* 3830 (MEXU), *ibídem*, *G. Aguilar et al.* 3832 (MEXU); Municipio Ocosingo, 4.8 km SE of Nuevo Guerrero, 16°57'26"N, 81°15'02"W, 338 m, 23 May 2002, *D. Álvarez & G. Aguilar* 1420 (MEXU); Municipio Ocosingo, 4.5 km SE of Bonampak archaeological zone, 16°40'33"N, 91°02'05"W, 256 m, 10 Feb 2003, *D. Álvarez & A. Chambor* 3720 (MEXU); Municipio Ocosingo, 7.5 km SW of Bonampak, 16°39'51"N, 91°00'59"W, 25 m, 28 Nov 2002, *D. Álvarez et al.* 2743 (MEXU) Municipio Ocosingo, 6.35 km NW of the cruise of San Javier, 16°34'N, 91°08'43"W, 391 m, 15 Nov 2003, *D. Álvarez et al.* 6960 (MEXU); Municipio Ocozocoautla de Espinoza, 26 - 28 km N of Ocozocoautla, along road to Mal Paso, 700 m, 15 Nov 1971, *D. Breedlove & A. Smith* 22445 (MEXU); 13 mi N of Ocozocoautla, on gravel road to Apitpac, near km 21 marker, 900 m, 9 Jul 1977, *T. Croat* 40605 (MEXU, MO); along dirt road between San Fernando and Moravillas (near Lago Malpaso), 4 - 66 mi NW of San Fernando, 16°53'N, 93°16'W, 840 - 940 m, 15 Feb 1987, *T. Croat & D. Hannon* 65024 (MEXU, MO); along hwy 197, between Chiapa de Corzo and Pichucalco, 0.6 mi N of Tapulula, 35.6 mi SSE of Pichucalco, vicinity of km 124 marker, 17°16'N, 93°01'W, 750 m, 18 Feb 1987, *T. Croat & D. Hannon* 65272 (MEXU, MO); Municipio Ocosingo, 4 km SE of Nuevo Guerrero, trail to Boca Lacantum, 560 m, 24 Jan 1986, *E.*

Martínez 16764 (MEXU); Municipio Ocozacoautla, Reserva Ecológica “El Ocote”, 750 m, 17 Feb 1986, *M. Palacios* 2884 (MEXU, UC, XAL); Municipio Ocosingo, Río Cedro, W of Lacanja Chansayab, 300 m, 15 Jan 1984, *F. Vázquez & S. Avendaño* 1514 (MEXU, XAL). Oaxaca: Municipio San Pedro Ixcatlan, In the village of Cerro Quemado, road entrance Ojitlán-Xalapa de Diaz, 230 m, 8 Feb 1984, *J. Calzada* 10263 (UC, XAL); Municipio Soyaltepec, Distrito Tuxtepec, spillway of the Temascal dam, 18°12'N, 96°20'W, 70 m, 21 Oct 1987, *L. Cortes & R. Torres* 1092 (MEXU); along road from Valle Nacional to Arriba Tortuga and Armadillo, via Rancho Grande and Loma San Rafael, 5 - 6 km NW of Valle Nacional Center (Hotel del Valle), 17°47'25"N, 96°17'55"W, 474 - 476 m, 2 Mar 2008, *T. Croat* 100128 (MO, XAL); Municipio Santa María Chimalapa, near of Arroyo Sangre, ca. 2 km E de Santa María, 16°54'30"N, 94°40'30"W, 280 m, 27 Aug 1984, *H. Hernández* 369 (CHAPA, MEXU); Chiltepec, Tuxtepec, 7 Aug 1965, *G. Martínez* 174 (MEXU); Sierra de Juárez, Municipio Valle Nacional, Yetla, km 154 of trail Tuxtepec-Oaxaca, 800 m, 15 Jun 1966, *G. Martínez* 879 (MEXU, XAL); Distrito Tuxtepec, Municipio Valle Nacional, along hwy México 175, 21 km (by road) N of Vista Hermosa and 4 km SW of Valle Nacional, 17°44'N, 96°21'W, 450 m, 15 Dec 1985, *M. Nee* 32158 (NY, UC, XAL); Municipio Putla, Distrito Putla, ca. 4 km NE of San Pedro, 800 m, 11 Jul 1988, *E. Solano* 429 (CHAPA); Municipio Santa María Jacatepec, Distrito Tuxtepec, trail to Cosolapa San Antonio, Ejido San Felipe Tilpa, 13.3 km SW of La Reforma, 17°51'N, 96°03'W, 300 m, 20 Feb 1988, *R. Torres & L. Cortes* 11439 (MEXU); Municipio Matías Romero, hills between Río Verde and Arroyo Hamaca, near Río Verde, 10 km SE from the La Foresta sawmill (abandoned), ca. 24 km S of Esmeralda, 17°01'N, 94°44'W, 300 m, 27 Sep 1982, *T. Went et al.* 4007 (CHAPA, UC); Santa María Chimalapa, Arroyo Sangre, ca. 1 - 2 km W of Santa María, 16°54'30"N, 94°40'W, 250 m, 27 Jul 1985, *T. Went et al.* 5132 (MEXU). Puebla: Municipio Hueytamalco, 1 km NE of Campo Experimental “Las Margaritas” facilities, Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP), 20°00'25"N, 97°18'45"W, 490 m, 16 Jun 2007, *G. Ibarra et al.* 5333 (MEXU). Tabasco: Municipio Tacotalpa, Cerro del Madrigal, km 7 of Tacotalpa station to Tapijulapa, 13 Apr 1980, *C. Cowan* 2908 (MEXU); 13 mi N of Ocozacoautla on gravel road to Apitac, near km 21 marker, 900 m, 9 Jul 1977, *T. Croat* 40619 (MEXU, MO); Municipio Teapa, surroundings of Centro Regional Puyacatengo, 16 Jan 1982, *S. Zamudio* 180 (XAL). Veracruz: Municipio Atoyac, Ejido Esperanza, 18°52'00"N, 96°44'00"W, 750 m, 21 Jun 1985, *R. Acevedo & G. Castillo* 281 (XAL); Municipio Atoyac, Miraflores, 18°57'00"N, 96°49'00"W, 750 m, 22 Jun 1985, *R. Acevedo & G. Castillo* 286 (MEXU); Municipio San Andrés Tuxtla, Estación de Biología Tropical Los Tuxtlas, 150 m, 5 Oct 1974, *J. Calzada* 1547 (XAL); Municipio Catemaco, hills S of Cerro Jegal, N of Los Naranjos Ranch, road entrance Catemaco-Dos Amates, 21 May 1985, *J. Calzada* 11575 (XAL); Municipio Sotepan, Ejido Piedra Labrada to N, 17 May 1985, *J. Calzada et al.* 11518 (XAL); Municipio Catemaco, El Naranjillo, El Naranjillo Ranch, road Catemaco-Sontecomapan, 18°25'N, 95°06'W, 7 Aug 1993, *G. Carmona* 60

(XAL); Municipio San Andrés Tuxtla, El Bastonal, 18 Sep 1985, *R. Cedillo* 3402 (MEXU, XAL); Municipio Jesús Carranza, km 6 from trail Cedillo-Río Alegre, 17°10'N, 94°40'W, 150 m, 18 Jan 1975, *J. Dorantes* 3916 (XAL); Municipio Catemaco, Coyame, near Catemaco, 18°27'N, 95°05'W, 180 m, 22 Jan 1972, *R. Hernández* 1386 (MEXU, XAL); Municipio Catemaco, Ejido Balzapote, ca. 3 km N of the Los Tuxtlas Biological Station, 15 Oct 1992, *P. Hietz & U. Seifert* 562 (MEXU); Municipio San Andrés Tuxtla, Laguna Escondida, 5 km NE of Estación de Biología Tropical Los Tuxtlas, 18°34' - 36'N, 95°04' - 09'W, 250 m, 12 Sep 1982, *G. Ibarra* 307 (MEXU); Municipio Montepio, Estación de Biología Tropical Los Tuxtlas, 18°34'N, 94°05'W, ca. 140 m, 29 Jul 1976, *H. Kennedy & C. Horvitz* 3676 (MEXU); 33 km NE of Catemaco, Biological Station, 200 m, 30 Apr 1973, *K. Kramer* 1974 (MEXU); Municipio San Andrés Tuxtla, Estación de Biología Tropical Los Tuxtlas, Cerro Vigía 5, lot 67, 18°34'N, 95°04'W, 450 m, 12 Apr 2005, *T. Krömer et al.* 1924 (MEXU); Municipio San Andrés Tuxtla, Colegio Agrícola Militar, Montepio "Rancho Pouchoulen", 18°34'N, 95°08'W, 740 m, 28 Apr 2005, *T. Krömer et al.* 2029 (MEXU, XAL); Municipio Catemaco, La Palma, Don Fidel plot, 18°33'N, 95°04'W, 35 m, 8 Aug 2005, *T. Krömer et al.* 2465 (MEXU); Municipio Catemaco, 5 km E of Tebanca course to Bastonal, N slope of Sierra de Santa Marta, 830 m, 10 Dec 1980, *R. Lira* 170 (XAL); Municipio Las Choapas, "El Milagro" Ranch, 5 km in a straight line to SW (202°) of Nueva Tabasqueña colony, 17°31'48"N, 94°01'44"W, 115 m, 27 Aug 2002, *E. López* 241b (XAL); Municipio San Andrés Tuxtla, Estación de Biología Tropical Los Tuxtlas, between Montepio and Sontecomapan, 150 m, 12 Jun 1981, *D. Lorence* 3477 (XAL); Municipio Catemaco, ca. 8 km after Coyame course to Adolfo López Mateos, 18°26'22"N, 95°00'11"W, 650 m, 3 May 2002, *A. Mendoza et al.* 617b (MEXU); Municipio Pajapan, 5 km NW of Pajapan, SE slopes of Cerro San Martín Pajapan, 18°17'30"N, 94°43'W, 700 m, 3 Nov 1981, *M. Nee & J. Calzada* 22768 (MEXU, XAL); gravel Cliff 1 mi W of Fortín, 4 Aug 1947, *J. Paxson et al.* 17M680 (MEXU, UC); Municipio San Andrés Tuxtla, Colegio Agrícola Militar, Montepio, Huber Ranch, 18°36'N, 95°05'W, 70 m, 7 Sep 2005, *A. Pérez et al.* 11 (MEXU); Municipio San Andrés Tuxtla, Estación de Biología Tropical Los Tuxtlas, 28 Oct 1981, *T. Ramamoorthy* 2613 (MEXU); Municipio San Andrés Tuxtla, Estación de Biología Tropical Los Tuxtlas, 19 Jan 1982, *T. Ramamoorthy & G. Ibarra* 3268 (MEXU); Municipio Catemaco, Península de Moreno, tral Coyame-Península de Moreno, 18°27'N, 95°00'W, 200 m, 18 Aug 1980, *F. Ramírez* 1382 (XAL); Municipio Catemaco, trail Tebanca-El Bastonal, 18°24'N, 94°59'W, 400 m, 27 mar 1980, *F. Ramírez & F. Vázquez* 704 (XAL); Municipio Catemaco, Santa Rosa, 18 km S of Catemaco, 450 m, 10 Apr 1973, *R. Riba et al.* 705 (MEXU); San Pedro Soteapan, Arroyo Soteapan, 1 km W of San Fernando, S slope of Sierra de Santa Marta, 600 m, 13 Aug 1980, *R. Riba et al.* 1135 (MEXU); Municipio Catemaco, Península de Moreno, ca. 4 km E of Coyame, 300 m, 17 ago 1980, *R. Riba et al.* 1223 (MEXU); Municipio Coetzala, hillside E of Coetzala, 18°46'50"N, 96°54'52"W, 650 m, 4 Nov 2001, *A. Rincón & C. Durán* 2819 (XAL); Municipio Catemaco, Cerro Jegal, 8 km N of Catemaco, 18°29'05"N,

95°03'53"W, 940 m, 4 nov 2000, *A. Rincón et al.* 2137 (MEXU, XAL); some km before Montepio, 18°38'N, 95°05'W, 2 May 1988, *J. van Rooden* 810 (MEXU); Municipio Catemaco, Dos Amates de Sontecomapan, 4 Aug 1965, 500 m, *J. Rzedowski* 20356 (MEXU); Municipio Amatlán, Cerro Cruztitlán, near the cave chapel of La Virgen, in front of Peñuelas, E of Amatlán, 18.84704°N, 96.88715°W, 743 m, 30 Jan 2015, *G. Salazar et al.* 9376 (MEXU); Municipio Catemaco, at highest point on road from Catemaco to Sontecomapan, 5 km N of junction with road around Lago Catemaco, 8 km (by air) NE of Catemaco, 18°29'N, 95°04'W, 510 m, 14 Jan 1981, *G. Schatz & M. Nee* 227 (XAL); Municipio Catemaco, Dos Amates, Cerro Chochobi, 720 m, 20 Dec 2006, *B. Senterre & M. Parvais* 4379 (XAL); Municipio San Andrés Tuxtla, Estación de Biología Tropical Los Tuxtlas, 18°34'N - 18°36'N, 95°04'W - 95°09'W, 700 m, 10 Sep 1986, *S. Sinaca* 921 (MEXU); Municipio San Andrés Tuxtla, Ejido Balzapote, 5 km N of Estación de Biología Tropical Los Tuxtlas, 18°34'N - 18°36'N, 95°04'W - 95°09'W, 180 m, 16 Feb 1989, *S. Sinaca & P. Ventura* 1490 (MEXU); 3 km N of Catemaco, along dirt road, 18°30'N, 95°10'W, 400 m, 15 Jun 1982, *S. Solheim & V. Powers* 848 (XAL); Municipio Catemaco, Estación de Biología Universidad de Veracruz, 500 - 650 m, 14 Sep 1998, *A. Torrez & A. Campos* 18 (MEXU); Municipio Hidalgotitlán, E of Campamento Hermanos Cedillo to La Laguna, 1 km of camp, 11 Apr 1974, *P. Valdivia* 212 (XAL); Municipio Hidalgotitlán, 2, 5 km of Campamento Hermanos Cedillo in front of Paso Moral, N side, 17°15'30"N, 94°36'W, 150 m, 18 Apr 1974, *P. Valdivia* 324 (XAL); Municipio Hidalgotitlán, to Álvaro Obregón, 6 km of Campamento Hermanos Cedillo, 17°18.7'N, 94°39'W, 149 m, 23 Apr 1974, *P. Valdivia* 416 (XAL); Municipio Hidalgotitlán, hacia Álvaro Obregón, 6 km of Campamento Hermanos Cedillo, 17°18.7'N, 94°39'W, 150 m, 23 Apr 1974, *P. Valdivia* 426 (XAL); Municipio Hidalgotitlán, to Álvaro Obregón, 300 m of Campamento Hermanos Cedillo, by Plan de Arroyo, W direction, 17°16'N, 94°37'W, 149 m, 24 Apr 1974, *P. Valdivia* 452 (XAL); Municipio Hidalgotitlán, 6.5 km of Campamento Hermanos Cedillo to La Laguna, 17°16.6'N, 94°33.4'W, 159 m, 23 May 1974, *P. Valdivia* 615 (XAL); Municipio Hidalgotitlán, in km 6.06 and to 200 m of N side course to La Laguna, 17°16.3'N, 94°35.2'W, 160 m, 28 May 1974, *P. Valdivia* 760 (XAL); Municipio Hidalgotitlán, 1.7 km of Campamento Hermanos Cedillo to La Escuadra, 17°17'N, 94°36.5'W, 156 m, 22 Jun 1974, *P. Valdivia* 915 (XAL); Municipio Hidalgotitlán, 1.5 km of Campamento Hermanos Cedillo to La Escuadra, 17°16.5'N, 94°35.3'W, 156 m, 24 Jun 1974, *P. Valdivia* 943 (XAL); Municipio Hidalgotitlán, 800 m of Campamento Hermanos Cedillo to La Escuadra, 17°15'N, 94°37'W, 156 m, 22 Jul 1974, *P. Valdivia* 995 (XAL), *ibidem*, 24 Jul 1974, *P. Valdivia* 1075 (XAL); Municipio Hidalgotitlán, 1 km of Campamento Hermanos Cedillo to La Escuadra, 17°15'N, 94°37'W, 156 m, 29 Jul 1974, *P. Valdivia* 1164 (XAL); Municipio Hidalgotitlán, 2 km of Campamento Hermanos Cedillo to La Escuadra, 17°17.3'N, 94°36.5'W, 156 m, 31 Jul 1974, *P. Valdivia* 1202 (XAL), *ibidem*, 01 Aug 1974, *P. Valdivia* 1229 (XAL), *ibidem*, *P. Valdivia* 1242 (XAL); Municipio Hidalgotitlán, 1.5 km of Campamento

Hermanos Cedillo to La Escuadra, 17°15.5'N, 94°37'W, 150 m, 2 Aug 1974, *P. Valdivia* 1259 (XAL); Municipio Hidalgotitlán, 6 km of Campamento Hermanos Cedillo to La Escuadra, 17°18.7'N, 94°39'W, 150 m, 06 Aug 1974, *P. Valdivia* 1292 (XAL); Municipio Hidalgotitlán, La Escuadra, 17°19'N, 94°38.5'W, 160 m, 07 Aug 1974, *P. Valdivia* 1325 (XAL); Municipio Hidalgotitlán, 500 m of Campamento Hermanos Cedillo to La Escuadra, 17°14'N, 94°37'W, 156 m, 09 Oct 1974, *P. Valdivia* 1380 (XAL); Municipio Hidalgotitlán, 6 km of Campamento Hermanos Cedillo to La Laguna, 17°16'N, 94°32.5'W, 156 m, 12 Aug 1974, *P. Valdivia* 1440 (XAL); Municipio Hidalgotitlán, 500 m of Campamento Hermanos Cedillo to La Escuadra, 17°16.5'N, 94°37.5'W, 156 m, 14 ago 1974, *P. Valdivia* 1469 (XAL); Municipio Hidalgotitlán, a 1.5 km of Campamento Hermanos Cedillo to La Escuadra, 17°15.5'N, 94°37'W, 156 m, 13 Dec 1974, *P. Valdivia* 1600 (XAL); Municipio Hidalgotitlán, 4.5 km of Campamento Hermanos Cedillo to La Escuadra, 17°16.5'N, 94°38'W, 149 m, 19 Dec 1974, *P. Valdivia* 1706 (XAL); Municipio Hidalgotitlán, 3 km of Campamento Hermanos Cedillo to La Escuadra, 17°16.5'N, 94°37.8'W, 155 m, 21 Jan 1975, *P. Valdivia* 1776 (XAL); Municipio Hidalgotitlán, 7 km going Río Alegre, 17°12'N, 95°04'W, 120 m, 26 Jan 1975, *P. Valdivia* 1888 (XAL); Municipio Hidalgotitlán, 4 km of Campamento Hermanos Cedillo to La Laguna, 17°16'N, 94°35'W, 160 m, 28 Jan 1975, *P. Valdivia* 1904 (XAL); Municipio Jesús Carranza, 10 km S of Hermanos Cedillo, road to Río Alegre, 17°12'N, 94°41'W, 150 m, 30 May 1974, *M. Vázquez* 708 (XAL); Estación de Biología Tropical Los Tuxtlas, 19 mi (by road) NW of Catemaco, 18°35'N, 95°04'W, 400 ft [=122 m], 17 Aug 1976, *G. Webster & W. Armbruster* 20888A (MEXU); Municipio Jesús Carranza, hills S of Pob. 2, (near 3 km S Of the junction of the earth trail La Laguna-Sarabia with the trail N to Pob. 2, 17°12'N, 94°39'W, 250 m, 14 Jul 1984, *T. Went & A. Villalobos* 4454 (CHAPA, MEXU); Municipio Hidalgotitlán, N of La Laguna camp, near and N Of the rubber plantation and the W of Río Cuevas, 17°17'15"N, 94°30'45"W, 125 m, 25 Sep 1980, *T. Went et al.* 2739 (CHAPA, MEXU).

Campyloneurum madrense differs from *C. angustifolium* by not pruinose (vs. pruinose) rhizome or scarcely so, linear (vs. lanceolate) and narrower (0.4 - 0.8 mm vs. 1.0 - 1.7 mm) rhizome scales with sparsely denticulate (vs. entire) margin, they dark gray to blackish (vs. yellowish-brown to grayish-brown), inside with narrow oblong (isodiametric) cells and present at lower (25 - 940 m vs. (700-) 1200 - 1600 (-2000) m) altitudinal distribution. Also the new species differs from *C. gracile* A. Rojas by thicker (2 - 5 mm vs. 1.5 - 2.5 mm) rhizome, longer (3 - 6 mm vs. 1.5 - 3.0 (-4.0) mm) rhizome scales with longer (2 - 5 times longer than wide vs. 1-2 times) cells and relative longer ((18-) 30 - 65 cm vs. (10-) 18 - 40 (-55) cm) fronds (see **Figure 3** and **Table 3**).

Studies on the type material of *Campyloneurum angustifolium* (*Swartz s.n.*, holotype: S!; isotype: BM!), particularly on the isotype in BM is evident that this species has pruinose rhizome and yellowish-brown to brown rhizome scales, and also the material identified as *C. ensifolium* in Mexico not is significantly different, only in shorter and obtuse rhizome scales (present in the northernmost

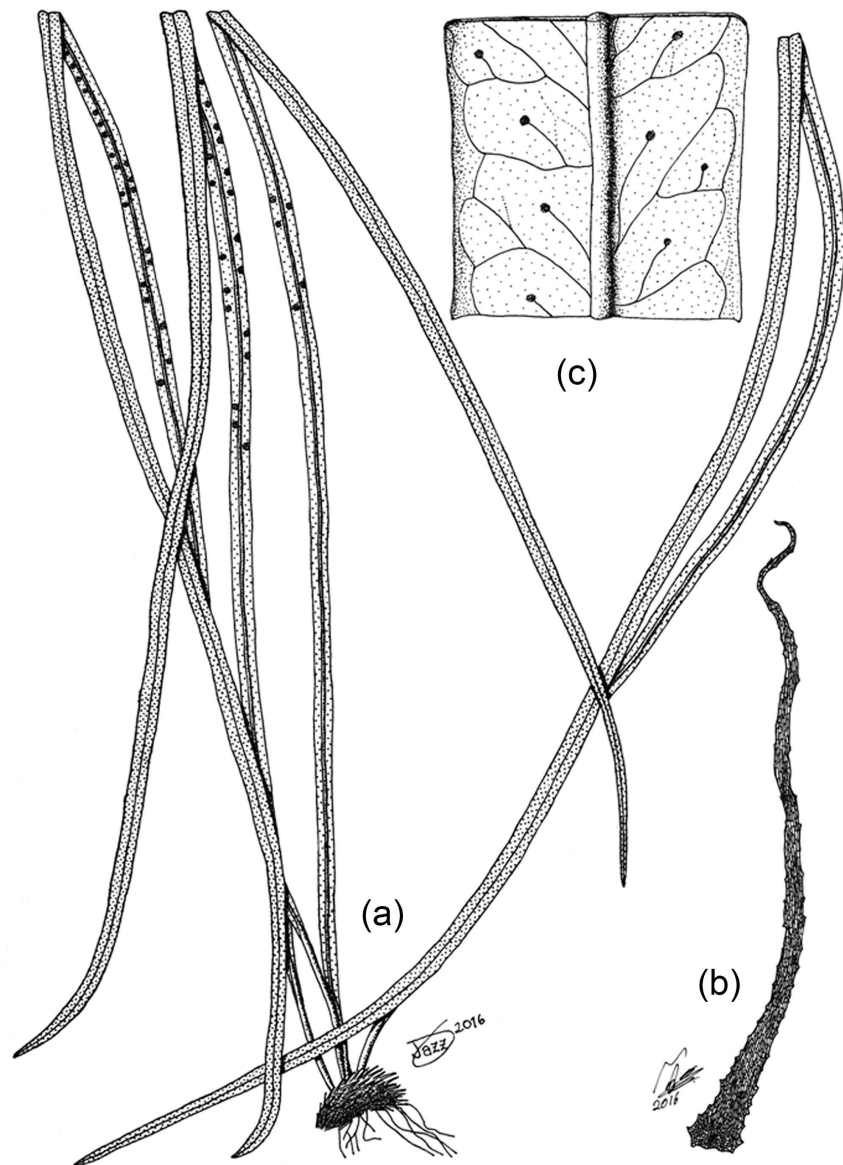


Figure 3. (a) (b). Type material of *Campyloneurum madrense* A. Rojas (*D. Álvarez et al.* 6960, MEXU). (a) Habit; (b) Rhizome scales; (c) Blade detail.

populations in Mexico), but this parameter is variable in the species gradually changing to South. However, Mickel & Smith mentioned in the key and description of *C. angustifolium* from Mexico with oblong cells in rhizome scales and they twice or more longer than wide, characters more related with *C. madrense*, but also they mentioned populations of *C. angustifolium* in South of Mexico that are present at lower elevation and that have narrow rhizome scales with small cell lumen, and they associated this entity with *C. angustipaleatum* [7], a species present in Costa Rica to Bolivia at high elevations.

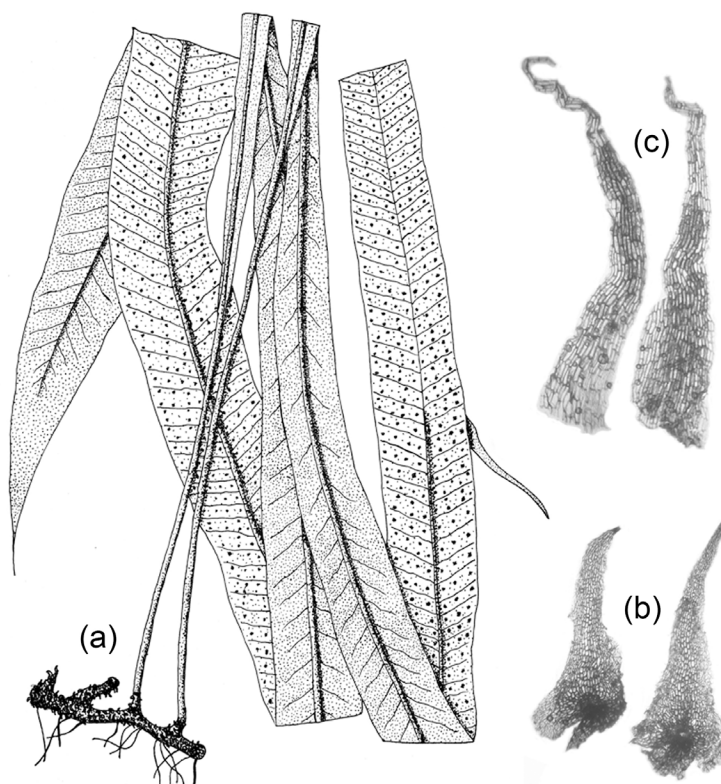
3.2. Accepted Name and Lectotype Designed

Campyloneurum pittieri

(Christ) Ching, *Sunyatsenia* 5: 263. 1940 (**Figure 4**).

Table 3. Comparison of morphological characteristics among three species of *Campyloneurum*: *C. angustifolium*, *C. gracile* and *C. madrense*.

Character	<i>C. angustifolium</i>	<i>C. gracile</i>	<i>C. madrense</i>
Diameter of rhizome	2 - 5 mm	1.5 - 2.5 mm	2 - 5 mm
Pruinose rhizome	yes	not	not or scarcely so
Distance between fronds	approximate to 5 mm distant	approximate	approximate to 2 mm distant
Long of rhizome scales	3 - 5 mm	1.5 - 3.0 (-4.0) mm	3 - 6 mm
Broad of rhizome scales	1.0 - 1.7 mm	0.5 - 1.0 mm	0.4 - 0.8 mm
Margin of rhizome scales	entire	entire to denticulate	denticulate
Color of rhizome scales	yellowish-brown to grayish-brown	brown to dark brown	dark gray to blackish
Form of apical cells of rhizome scales	poligonal, elongate	poligonal, isodiametric	rectangular to oblong
Long of cell of rhizome scales	1.5 - 3.0 times longer than wide	1 - 2 times longer than wide	2 - 5 times longer than wide
Lumen color of rhizome scales	translucid	brown	gray
Frond size	20 - 45 (-75) cm	(10-) 18 - 40 (-55) cm	(18-) 30 - 65 cm
Diameter of stipe	1 - 2 mm	0.7 - 1.0 mm	1 - 1.5 (-2) mm
Broad of blade	0.4 - 1.5 (-2.0) cm	0.3 - 1.5 (-2.0) cm	(0.5-) 0.8 - 1.5 cm
Altitudinal distribution	(700-) 1200 - 1600 (-2000) m	0 - 900 (-1200) m	25 - 940 m

**Figure 4.** (a) (b). Representative specimen of *Campyloneurum pittieri* (Christ) Ching (A. Rodríguez & L. Vargas 3152, CR). (a) Habit; (b) Rhizome scales; (c) Rhizome scales of *Campyloneurum amphostenon* (Kunze ex Klotzsch) Fée (J. Bittner 109, CR).

Polypodium pittieri Christ, Prim. Fl. Costaric. 3(1): 16. 1901. Tipo: COSTA RICA. San José: El Páramo, E side of Cerro Buena Vista, 3000 m, Jan 1897, *H. Pittier* 10479 (lectotype designed here: CR!; isolectotypes: BM (photo, GH), BR, P!, US).

Description: Terrestrial; rhizome 2 - 5 mm in diameter, creeping, fronds 5 - 30 (-50) mm distant between them, pruinose; rhizome scales 2 - 5 × 0.7 - 1.5 mm, ovate-lanceolate, clathrate, grayish-brown, sparse, peltate or with overlapping base, cells rounded to polygonal, lumen translucent; fronds 40 - 80 (-100) cm long, moderately decumbent; stipe 1/3 - 1/6 of the frond length, strawish to pale brown, glabrous, phyllopodia 2 - 5 mm long; blade 30 - 60 (-80) × 2.5 - 3 (-5) cm, narrowly elliptic, long acuminate at apex, gradually reduced at base, coriaceous, lustrous; rachis glabrous, pale brown, pale as lamina, principally with immersed lateral veins or inconspicuous; sori rounded, in 3 - 7 rows between costa and margin.

Distribution: Known from Costa Rica and Panama at 700 - 1800 (-2000) m elevation.

Additional revised specimens: COSTA RICA. Cartago: Cerro Asunción, ca. 0.5 km NE of the Interamerican Hwy (km 90 - 91), 6 Mar 1986, 3080 m, *M. Kappelle* 1414 (CR); Volcán Turrialba, outside the crater, 3200 - 3300 m, 16 Jun 1993, *K. Mehltreter* 432 (CR); El Guarco, Reserva Forestal Los Santos, Savegre basin, over Interamerican road, rute to Cerro de La Muerte, between km 78 and 79. 9°37'05"N, 83°49'0"W, 2960 m, 28 Jan 1998, *A. Rodríguez et al.* 2971 (INB, CR, MO); Volcán Turrialba, high part of the hill, 31 ene 1957, *R. Rodríguez* 98 (CR); Paraíso, Valle del Reventazón, Cerros Sákira, Sábila and Zacatales, 9°35'20"N, 83°45'40"W, 3300 - 3420 m, 16 Jul 1996, *A. Rojas & M. Coto* 2764 (INB, MO); Cerros Cuericí, 2940 m, 9 Nov 1988, *Y. Widmer* 395 (CR). Cartago-San José: ca. 22 km SE of El Empalme, along Interamerican Hwy, 2500 - 2600 m, 9°40'N, 83°50'W, 27 Nov 1969, *W. Burger & R. Liesner* 6501 (CR, F); just below of highest point on the Interamerican hwy, NW of La Asunción, 9°34'N, 83°45'W, 3000 - 3200 m, 5 Feb 1982, *W. Burger & K. Barringer* 11506 (CR, F); Cordillera de Talamanca, upper slopes, W ridge of Cerros Cuericí, ca. 9°34'N, 83°40'W, 3160 m, 15 Sep 1983, *G. Davidse* 24661 (CR, MO); Cordillera de Talamanca, Cerros Cuericí, Parque Nacional Chirripó, continental divide, 9°35'N, 83°38'30"W, 3200 m, 16 Sep 1983, *G. Davidse* 24813 (CR, MO); Villa Mills, 2 Aug 1961, *D. Knight s.n.* (CR). Heredia: Parque Nacional Braulio Carrillo, volcán Barva station, path and forest between park office and crater, 10°07'20"N, 84°06'00"W, 2700 - 2900 m, 13 Jul 1991, *H. Gay et al.* 1511 (CR); hills SW of Volcán Barba, 2700 - 2900 m, Apr 1971, *L. Gómez & W. Wagner s.n.* (CR); slopes and ridges above Laguna del Barva and Summit of Volcán Barva, 10°08'N, 84°06'5"W, 2840 - 2900 m, 27 Apr 1986, *M. Grayum & F. Quesada* 7424 (CR, MO); Volcán Barva, trail to Laguna Copey, 2700 - 2800 m, 24 Jun 1993, *K. Mehltreter* 467 (CR); Barva, Parque Nacional Braulio Carrillo, Tárcoles basin, Estación Barva, Sendero Secreto, 10°08'00"N, 84°07'15"W, 2600 m, 24 Mar 1998, *A. Rodríguez & L. Vargas* 3152 (CR, INB, MO); Barva, Parque Nacional Braulio Carrillo, Sarapiquí basin, surroundings of the path that goes to the viewpoint,

10°08'10"W, 84°06'25"W, 1900 m, 2 Jun 1998, *A. Rodríguez & L. Vargas* 3456 (CR, INB, MO); road from Cartago to San Isidro del General, (Pan American Hwy, Rte 2), km 87 - 88, ca. 1 km NW of Asunción, 3200 m, 29 Jan 1986, *A. Smith & T. Béliz* 2022 (CR, UC); Aromal del Volcán Barba, 2700 m, 8 May 1927, *M. Valerio* 64 (CR). Limón: Cordillera de Talamanca, Atlantic slope, Kámuk massif, paramo NE of the main Kámuk peak, 9°16'N - 9°17'N, 83°00'W - 83°02'W, 3000 - 3300 m, 17 - 18 Sep 1984, *G. Davidse & G. Herrera* 29328 (CR, MO); cordillera de Talamanca, peak of Cerro Kámuk, 9°16'30"N, 83°02'W, 3350 - 3549 m, 25 Mar 1984, *G. Davidse et al.* 26019 (CR, MO); Chirripó National Park, N end of Loma Larga, ca. 3350 m, 15 Feb 1983, *N. Garwood et al.* 1263 (CR). Limón-Puntarenas: Cordillera de Talamanca, between Cerro Kasir and Cerro Nai, continental divide, 9°12'N - 9°13'N, 83°03'30"W - 83°04'30"W, 2900 - 3050 m, 22 Mar 1984, *G. Davidse et al.* 25837 (CR, MO). San José: Pérez Zeledón, Interamerican hwy (km 82) in the near of the Cerro de La Muerte border, 9°34'20"N, 83°45'30"W, 3000 m, 12 Jun 1991, *J. Bittner* 1097 (CR); along the trail from Canaán to Chirripó, via Los Ángeles, above (N of) the Río Talari, 9°30'N, 83°32'W, 3100 - 3200 m, 24 Aug 1971, *W. Burger* 8323 (CR, F); along Interamerican Hwy, 9°40'N, 83°50'W, 2840 m, 23 Nov 1986, *E. Hennipman et al.* 7131 (CR, U); Cerro Las Vueltas, between Cruces and Alto Indio, 3020 m, 11 Mar 1986, *M. Kappelle* 1622 (CR); Parque Nacional Chirripó, Monte Sin Fé, 3250 m, 20 Sep 1988, *M. Kappelle* 2674 (CR); Parque Nacional Chirripó, Palmito Morado, 2910 m, 20 Jan 1989, *M. Kappelle & M. Monge* 4902 (CR); San Gerardo de Dota, 2800 m, Jun-Jul 1989, *H. Van Velzen & T. Genze* 62 (CR).

PANAMÁ. Bocas del Toro: Cordillera de Talamanca, 2 airline km NW of the main peak of cerro Fábrega, along the NW ridge of the massif, 9°08'N, 82°53'W, 3150 - 3200 m, 7 - 8 Mar 1984, *G. Davidse et al.* 25333 (CR, MEXU, MO); between Itamut & Bine peaks, Fabrega massiff, 3200 m, 5 - 9 Mar 1984, *L. Gómez et al.* 22547 (CR); 1 - 2 km SWW of Itamut camp, 3175 m, 6 - 7 Mar 1984, *L. Gómez et al.* 22615 (CR).

Campyloneurum pittieri differs from *C. amphostenon* because has not pruinose or scarcely pruinose (vs. pruinose); rhizome scales longer (4 - 8 mm vs. 2 - 5 mm), ovate with a long acuminate tip (vs. lanceolate with acute tip), they are with brown to dark brown color (vs. yellowish-brown to grayish-brown) and with the apical cells 1 - 2 times longer than wide (vs. 1.5 - 3 times); fronds relatively longer ((35-) 45 - 60 (-80) cm vs. 30 - 55 (-65) cm); stipe longer (8 - 25 cm vs. 4 - 10 (-20) cm); blade relatively broader ((1.3-) 2 - 5 cm vs. 1 - 3.5 cm); veins prominently marked (vs. not marked or scarcely so) and distributed to relative higher elevation ((1900-) 2700 - 3400 (-3550) m vs. (1800-) 2100 - 2900 (-3200) m) (see **Figure 4** and **Table 2**).

Detailed studies on the type of *Campyloneurum amphostenon* (*Moritz* 120*b*, B!, BK!, K!) demonstrated that this material coincides with the second entity proposed by Rojas (2005), while the first corresponds to *C. pittieri* (Christ) Ching (*H. Pittier* 10479, CR!), so the recognition and validation of this species are necessary.

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References

- [1] Gómez, L.D. and Arbeláez, A.L. (2009) Flora de Nicaragua, Helechos (Tomo IV). In: Stevens, W.D., Montiel, O.M. and Pool, A., Eds., *Monographs in Systematic Botany from the Missouri Botanical Garden*, The Missouri Botanical Garden Press, St. Louis, Vol. 116, 34-36.
- [2] Moran, R.C. (2011) Géneros Neotropicales de helechos y licófitas. Organización para Estudios Tropicales, San José, 407 p.
- [3] Lellinger, D.B. (1988) Some New Species of *Campyloneurum* and a Provisional Key to the Genus. *American Fern Journal*, **78**, 14-35. <https://doi.org/10.2307/1547598>
- [4] León, B. (1993) A Taxonomic Revision of the Fern Genus *Campyloneurum* (Polypodiaceae). Doctoral Thesis, Afdelingen for Systematisk-Biologisk Institut, Aarhus Universitet, Aarhus, 104 p.
- [5] Lellinger, D.B. (1989) The Ferns and Fern-Allies from Costa Rica, Panama, and the Chocó: Psilotaceae through Dicksoniaceae (Pteridologia). *American Fern Society*, 255-264.
- [6] Rojas, A.F. (2005) El complejo de *Campyloneurum agustifolium* (Sw.) Fée (Polypodiaceae) en Costa Rica. *Lankesteriana*, **5**, 41-48.
- [7] Mickel, J.T. and Smith, A.R. (2004) The Pteridophytes of Mexico (Memoirs of the New York Botanical Garden). NYBG Press, Bronx, Vol. 88, 165-172 and 467-468.
- [8] León, B. (1995) *Campyloneurum*. In: Moran, R.C. and Riba, R., Eds., *Flora Mesoamericana. Psilotaceae a Salviniaceae*, Universidad Nacional Autónoma de México, México, Vol. 1, 333-338. http://www.mobot.org/mobot/tropicos/meso/homep_sp.htm
- [9] Krier, H.P., Rojas, A.F., Smith, A.R. and Schneider, H. (2007) *Hyalotrichopteris* Is Indeed a *Campyloneurum* (Polypodiaceae). *American Fern Journal*, **97**, 127-135. [https://doi.org/10.1640/0002-8444\(2007\)97\[127:HIACP\]2.0.CO;2](https://doi.org/10.1640/0002-8444(2007)97[127:HIACP]2.0.CO;2)
- [10] Mickel, J.T. and Beitel, J.M. (1988) Pteridophyte Flora of Oaxaca, México. *Memoirs of the New York Botanical Garden*, Bronx, Vol. 46, 96-99 and 470.
- [11] Smith, A.R. (1981) Flora of Chiapas, Part 2. Pteridophytes. The California Academy of Sciences. San Francisco.
- [12] Stolze, R.G. (1981) Ferns and Fern Allies of Guatemala. Part II. Polypodiaceae. *Fiediana Botany*, New Series, Vol. 6, 1-522.
- [13] Thiers, B. (2016) Index Herbariorum: A Global Directory of Public Herbaria and Associated Staff. New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/science/ih/>

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