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MÓNICA PALACIOS-RIOS[1, 2*] & MARCELO D. ARANA[3]

A synopsis of *Woodwardia* (*Blechnaceae*) in Veracruz State, Mexico, and typification of *W. spinulosa*

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Abstract: A synopsis of species belonging to the genus *Woodwardia* Sm. (*Blechnaceae*) from Veracruz State, Mexico, is presented. Three species (including one hybrid species) are recognized as inhabiting Veracruz: the widespread *W. spinulosa* M. Martens & Galeotti, which grows in montane rain forests; the Mexican endemic *W. martinezii* Maxon ex Weath., growing in mesic woods; and *W.* ×*semicordata* Mickel & Beitel (*W. martinezii* × *W. spinulosa*), found in both deciduous and evergreen forests. An identification key to the three species is provided and the name *W. spinulosa* is lectotypified.

Key words: *Blechnaceae*, ferns, identification key, Mesoamerica, Mexico, pteridophytes, taxonomy, typification, Veracruz, *Woodwardia*, *Woodwardioideae*

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Introduction

Mexico has one of the most diverse fern floras of the world, comprising some 1063 taxa belonging to 146 genera, of which 187 species are endemic (Palacios-Rios 2016a, 2016b). The state of Veracruz, with 572 species (Palacios-Rios 1992), is the third-richest in terms of total fern diversity, after Oaxaca (690 species; Mickel & Beitel 1988) and Chiapas (609 species; Smith 1981, 1986).

The woodwardioid ferns (*Woodwardioideae*, *Blechnaceae*) comprise 15 species treated in one genus, *Woodwardia* Sm., or distributed among three genera: *Anchistea* C. Presl, *Lorinseria* C. Presl, and *Woodwardia*. We adopt the latter taxonomy, following the classification proposed by Gasper & al. (2016) and PPG I (2016). The former two genera are monotypic and are confined to E North America, whereas the more diverse genus *Woodwardia* is found throughout the warm-temperate and subtropical regions of the N hemisphere in a classic Arcto-Tertiary distribution pattern, with E Asia as the centre of diversity of the genus (Kramer & al. 1990). *Woodwardia* can be distinguished from the other genera in the subfamily *Woodwardioideae* by the monomorphic leaves and the usually shortly creeping to suberect rhizomes (Gasper & al. 2016). So far, 13 or 14 taxa have been recognized, of which three or four are reported from Mexico.

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The most widespread species, which also occurs in some Central American countries to the south of Mexico, is *Woodwardia spinulosa* M. Martens & Galeotti, a species variable in lamina and pinna size and shape, as well as in width and lobing of pinnules and density of indumentum on the abaxial surface of the blades (Mickel & Smith 2004).

During the preparation of both a taxonomic account of the genus *Woodwardia* in Veracruz State and the treatment of the family *Blechnaceae* for the Flora de Veracruz project, it became apparent that the widespread species *W. spinulosa* had never been formally typified. According to Turland (2013), untypified names are of uncertain application and are thus potentially unstable. In order to avoid any ambiguity regarding the application of the name *W. spinulosa*, we here present a nomenclatural study of the untypified name and designate a lectotype. Also we present here a first synopsis of the genus *Woodwardia* in Veracruz State, based on data compiled from field work carried out in Veracruz by the first author, herbarium material, literature, and collections from the main herbaria of Mexico, the United States and Europe.

Material and methods

The present study is based on revisions of herbarium collections from Veracruz, Mexico, consulted in the course of preparing a taxonomic treatment of the fern flora of the state, started in 1983. Specimens from the following herbaria were surveyed: B, BM, BR, BRIT, CAS, CHAPA, CHIP, CORU, CR, DS, ENCB, F, FCME, GH, IEB, K, M, MA, MEXU, MICH, MO, NY, P, RB, SI, UAMIZ, UC, US, WIS, XAL and XALU (herbarium codes according to Thiers 2017+).

Results and Discussion

Key to the species of *Woodwardia* in Veracruz State

1. Leaves with 4 or 5 pairs of free pinnae below pinnatifid apex; pinnae with rounded, shortly decurrent bases; spores 64 per sporangium .... ***W. spinulosa***
– Leaves with only 1 pair of free pinnae below pinnatifid apex; pinnae shortly decurrent to cuneate; spores 32 per sporangium, or spores abortive **2**
2. Sori on distal ⅓–½ of pinna, remote; rhizome scales 10–20 mm long; spores abortive .. ***W. ×semicordata***
– Sori along entire length of pinna, approximate to confluent; rhizome scales 6–10 mm long; spores 32 per sporangium ..... ***W. martinezii***

Woodwardia martinezii Maxon ex Weath. in Amer. Fern J. 39: 88. 1949 ≡ *Chieniopteris martinezii* (Weath.) Pic. Serm. in Webbia 31: 254. 1977. – Holotype: Mexico, Hidalgo, near Zacualtipán, 1800 m, 15 Apr 1940, *M. Martinez 27* (US! [accession no. 1791178, barcode US00067459]; isotypes: ARIZ, B!, BR!, CAS!, COL, DAO, DUKE [2 sheets], E, ENCB!, FI, LL, MEXU!, RB, RSA, TEX, U, UC!, WIS [3 sheets], WTU).

Distribution and ecology — Endemic to Mexico (states of Hidalgo, Puebla and Veracruz); terrestrial, in mesic woods, often in ravines, from 1500–1900 m.

Remarks — The species may be apomictic, given that it differs from its allies in having 32 spores per sporangium instead of 64.

Additional specimens examined — Mexico: Veracruz State: Mun. Huayacocotla: El Salto en Helechales, *Ballesteros & Ballesteros 410* (XAL); Agua de la Calabaza, *Ballesteros & Morales 22* (ENCB, IEB, XAL); Arroyo Helechales, *Ramírez 562* (XAL). Mun. Misantla: Pas de Enrique cloud forest, 15 km S of Misantla, *Bohs & al. 1808* (F); 10 km W de Misantla, carretera Xalapa-Misantla, *Dorantes & Acosta 2373* (XALU). Mun. Nautla: Teziutlán-Nautla road, 12 km from Teziutlán, *Sánchez 339* (US). Mun. Texcatepec: entre El Baldo y Agua Linda, *Turra 2766* (ENCB).

Woodwardia ×semicordata Mickel & Beitel in Mem. New York Bot. Gard. 46: 403. 1988. – Holotype: Mexico, Veracruz, Orizaba, 1855, *Müller 1485bis* (NY! [barcode NY00179355]).

Distribution and ecology — Endemic to Mexico (states of Chiapas, Estado de México, Hidalgo, Oaxaca, Puebla and Veracruz); in forests of *Liquidambar*, *Pinus* and *Pinus-Quercus*, from 1000–2360 m.

Remarks — *Woodwardia ×semicordata* is an abortive-spored hybrid of *W. martinezii* and *W. spinulosa*.

Additional specimens examined — Mexico: Veracruz State: Mun. Altotonga: 1.5 km W of Orilla del Monte, 14 km (by air) NW of town of Perote, *Nee 23471* (F, NY, XAL); 15 km N of town of Perote on road to Altotonga, *Nee 23542* (F, NY, XAL). Mun. Banderilla: Rancho "La Mesa", *Palacios-Rios 3296* (XAL); carretera Xalapa-Perote, cerca de un reservorio de agua, *Palacios-Rios 3403* (XAL); carretera Xalapa-Perote, cerca de un reservorio de agua, *Pérez-García 317* (XAL); al NE de Banderilla, rancho "La Martinica", *Calzada 7882* (IEB, XAL). Mun. Chiconquiaco: Cañada del Huérfano, *Gómez-Pompa & Riba 385* (MEXU). Mun. Huayacocotla, El Salto Helechales, camino a Las 3 Cascadas, *Ballesteros*, & *al. 272* (XAL); cerca de Agua de La Calabaza, camino a Las 3 Cascadas, 17 km NE de Huayacocotla, *Juárez & Vázquez 32* (F, XAL); Rancho Quemado, 3 km al SE de Huayacocotla, *Vázquez 1227* (XAL). Mun. Las Vigas, "El Volcan-

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cillo", *Dorantes & al. 5104* (XAL). Mun. Xalapa, Jalapa, *A. S. Hitchcock s.n.* (US); Rancho Guadalupe, 3 km W de Xalapa, carretera vieja Xalapa-Coatepec, *Calzada & al. 1939* (MEXU, MO, XAL); camp near Jalapa, *Halsted 9* (NY); about 2 miles S of Jalapa, on road to Coatepec, *Correll & Correll 28759* (LL, MEXU, TEX); entre Xalapa y Coatepec, *Sánchez-Mejorada 943* (MEXU); Jalapa, *Smith 2154* (F, UC); Jalapa, *Smith s.n. b* (MO accession no. 1877896, MO accession no. 1877897, UC). Mun. Yecuatla, 12 km S of Misantla, *Bohs & al. 1696* (GH, XAL).

Woodwardia spinulosa M. Martens & Galeotti in Nouv. Mém. Acad. Roy. Sci. Bruxelles 15 [Mém. Foug. Mexique]: 64. 1842. – **Lectotype (designated here):** Mexico, Veracruz, Orizaba, 3400 m, *H. Galeotti 6255* (RB! [register no. 215617, barcode RB00603390]). – Fig. 1.

Typification — In the protologue of *Woodwardia spinulosa* (Martens & Galeotti 1842: 64), the authors cited two localities on Pico de Orizaba, Veracruz, Mexico: "la caverne del Temascal, sur le versant oriental du pic d'Orizaba, et près des ruisseaux de la Vaqueria del Jacal, situés à 3000 pieds plus bas que la caverne"; they also cited the gathering *H. Galeotti 6255*. The second locality, the Vaqueria del Jacal, was described under *Pteris orizabae* M. Martens & Galeotti (l.c.: 52–53), as "vacherie située sur le versant méridional du pic d'Orizaba".

Mickel & Beitel (1988) and Mickel & Smith (2004) suggested that the collecting number given for *Woodwardia spinulosa* by Martens & Galeotti was likely an error and should have been *H. Galeotti 6573* because the only specimens known to them of *W. spinulosa* collected by Galeotti were nine sheets in BR, five of them from Cerro San Martin, three from Veracruz, and one from Oaxaca, all specimens with the number 6573. However, none of these sheets is annotated with either of the localities cited in the protologue, and one of the sheets, from Cerro San Martin (barcode BR0000006985356), bears the date "Mai 1845", i.e. three years later than the protologue. Therefore, these sheets cannot be regarded as original material for the name. In 1995, one of us (M.P.-R.) annotated the sheet BR0000006985356 as the lectotype, but this cannot be followed because the specimen is not eligible as the lectotype and the type designation was not effectively published (McNeill & al. 2012: Art. 7.9).

Mickel & Smith (2004) stated that "The BR specimen of *Galeotti 6255* is *Cochlidium serrulatum*, Veracruz, 8000'", but after an exhaustive search we were unable to find such a specimen, or indeed any specimen in BR labelled as *H. Galeotti 6255*. However, we wonder if Mickel & Smith might have erroneously cited the number 6255 in connection with *C. serrulatum* (Sw.) L. E. Bishop (*Polypodiaceae*). In the same work as the protologue of *W. spinulosa*, Martens & Galeotti (1842: 29) recorded *C. serrulatum* (as *Xiphopteris serrulata* (Sw.) Kaulf.) from pic d'Orizaba, citing the gathering *H. Galeotti 6455*.

During the course of a review of specimens in different herbaria, we have located only one specimen of *Woodwardia spinulosa* with the collector and number *H. Galeotti 6255*, conserved in the Fée herbarium in RB with the collection locality "Mexique, Orizaba, à 3.400 metres". McNeill (2014) stated "In situations in which no type is designated but reference is made to only a single specimen or gathering, there will be a holotype only if it can be established that no additional elements were used". The locality, collector and number of the specimen in RB all correspond with those cited in the protologue of *W. spinulosa*; we are therefore confident that this specimen is part of the original material of the name *W. spinulosa* and we designate it here as the lectotype. We do not regard this specimen as the holotype because we cannot be sure that this was the only element used by Martens & Galeotti in preparing the protologue of *W. spinulosa*. They mentioned two localities, so there could be other gatherings, or duplicates of *H. Galeotti 6255* in other herbaria, and possibly some specimens have been lost or destroyed.

Distribution and ecology — El Salvador, Guatemala, Honduras, Mexico (Chiapas, Chihuahua, Distrito Federal, Durango, Estado de México, Guanajuato, Guerrero, Hidalgo, Jalisco, Michoacán, Morelos, Nayarit, Nuevo León, Oaxaca, Puebla, San Luis Potosí, Sinaloa and Veracruz) and Nicaragua; terrestrial, usually in ravines or on steep banks near streams in montane rain forests, forests of *Liquidambar*, *Pinus*, *Pinus-Quercus* and *Quercus*, from (1200–)1850–2350(–3400) m.

Remarks — *Woodwardia spinulosa* is the most widespread species of *Woodwardia* in Veracruz; It is distinguished from *W. fimbriata* Sm., known from the Pacific coast of North America (from British Columbia south to México), by having abaxial costae, veins and lamina with fibrillose scales, and distal pinnae with shortly decurrent bases, but lacking numerous large, pale yellow resin glands on the abaxial surface. *Woodwardia spinulosa* is variable in size and shape of the lamina and pinnae, as well as in width and lobing of the pinnules and density of indumentum abaxially on the lamina (Mickel & Smith 2004).

Additional specimens examined — Mexico: Oaxaca State: Oaxaca, *H. Galeotti 6573* (BR). — Veracruz State: prov^{ce} Veracruz, *H. Galeotti 6573* (BR [3 sheets]); Veracruz, *Mohr 36* (B, US); Veracruz, *Müller s.n.* (NY); probably Veracruz, *Schaffner 268* (K); probably Veracruz, *Uhde 36* (B). Mun. Altotonga, 5 km SW of Altotonga along road to Champilico, *Taylor & Nee 330* (F, NY, XAL). Mun. Atzalan, La Florida, *F. Ventura 189* (ENCB, NY). Mun. Banderilla, adelante de Jalapa, km 315 (Jalapa-Perote), *Herrera & al. JB-1264* (MEXU); a 2 km de Banderilla, carretera Xalapa-Perote, cerca de un reservorio de agua, *Palacios-Rios 3403* (XAL). Mun. Calcahualco, 1 km al E de Calcahualco, Barranca de Jamapa, *Martínez & Acosta P.* (XAL); 500 m al SW de

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Fig. 1. Lectotype of *Woodwardia spinulosa* H. Martens & Galeotti: *H. Galeotti 6255* (RB [register no. 215617, barcode RB00603390]). – Reproduced with permission of the Herbarium of the Jardim Botânico do Rio de Janeiro (RB).

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Maquistla, camino a Jacal, *J. L. Martínez & F. Vázquez 539* (IEB, XAL). Mun. Chocamán, puente sobre el Río Jamapa, adelante de Chocamán, *Herrera & al. JB-1211* (MEXU). Mun. Coscomatepec, Coscomatepec, *Kempton & Collins s.n.* (US). Mun. Huatusco, Huatusco, *Liebmann s.n.* (K). Mun. Huayacocotla, El Salto, en Helechales, por la Vereda Tzimentey, *Ballesteros & Ballesteros 347* (XAL); Vereda Tzimentey, cerca del límite al SE de la reserva propuesta, *Ballesteros & Ballesteros 419* (XAL); 1 km E of Viborillas, 4 km S of Huayacocotla, 21 Jul 1982, *Diggs & Nee 2907* (F, XAL); El Paraje, *Hernández & Cedillo 814* (MEXU, XAL); Palo Bendito, *Hernández 1531* (F, MEXU); 2 km de Huayacocotla a Viborillas, *Nevling & Gómez-Pompa 1938* (MEXU); Helechales, barranca paralela a las cascadas, *Ramírez 523* (XAL); cañada de Las 3 Cascadas, *Ramírez 620* (XAL). Mun. Ixhuacán de Los Reyes, 2 km (by road) W of Ixhuacán de Los Reyes and 2.2 km (by road) E of Ayahualulco, *Nee & Taylor 25959* (F [2 sheets], NY, XAL). Mun. Jalacingo, 10 km adelante de Jalacingo, rumbo a Perote, *Nevling & Gómez-Pompa 1063* (MEXU). Mun. La Perla, La Perla, *Copeland 53a* (B, BM, MICH, UC, US). Mun. Las Minas, al SE de Rinconada por el Cerro La Tolva, *Durán & Burgos 575* (IEB, XAL). Mun. Maltrata, Maltrata, *Matuda 1364* (MEXU). Mun. Misantla, "montagnes prés Misantla", *Hahn s.n.* (B, K, NY, US [2 sheets]). Mun. Orizaba, Lomogrande, Mt Orizaba, 8900 ft., growing in deep barrancas, in moist shade, under trees and shrubs, fronds to 6 ft long, *Balls B4375* (K, UC, US). Mun. Perote, above Los Molinos, Perote, *Balls 4558* (K); Monte San Cristobal, Orizava, 6000', damp woods, *Botteri s.n.* (US); Monte Azul, Región d'Orizaba, monte Azoul, *Bourgeau 3151* (BR, US); Orizaba, *Lemmon 330* (UC). Mun. San Rafael, San Rafael, *Guillemin 3151* (NY). Mun. San Andrés Tuxtla, Volcán Tuxtla, *H. Galeotti 6573* (BR); pied du cratère du C°. S. [Cerro San] Martin, *H. Galeotti 6573* (BR, XAL). Mun. Xalapa Salto del Gato, W de Xalapa, *Acosta & Dorantes 203* (ENCB); near Jalapa, *Barnes & al. 76* (F); Rancho Guadalupe, 3 km W de Xalapa, carretera vieja Xalapa-Coatepec, *Calzada & al. 1939* (MEXU, MO); Salto del Gato, along Río Sedeño, about 3 km NE of Xalapa, *Conant 805 & al.* (GH, MEXU); Salto del Gato, *Dorantes 455* (F, MEXU); in Monte Gacho bei Jalapa, *Endlich 1706* (B); Parque Clavijero, antes Rancho Guadalupe, *Ortega 1350* (F). Mun. Xico, cascadas de Texolo, *Frías 14* (XALU); Xico, 2500 m, *Johnson s.n.* (US); gorge below Teocelo Falls, *Johnson 529* (NY); fondo de la Barranca "El Caracol", *Narave & Vázquez 418* (XAL). Mun. Vigas de Ramírez, Pedregal Las Vigas, carretera Xalapa-Perote, *Dorantes & M. Acosta 2397* (XALU); Las Vigas, El Volcancillo, *Dorantes & al. 5104* (ENCB, F, MEXU, NY, XAL); Las Vigas, cráter "El Volcancillo", *Ortega & al. 131* (ENCB, F, IEB, MEXU, NY, XAL, XALU); Las Vigas (Rafael Ramírez), Dos Veredas, *Ventura 7545* (ENCB). Mun. Zongolica, km 18 carretera Orizaba-Zongolica, *Palacios-Rios & Hernández M. 532* (ENCB, UAMIZ).

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