PHYTOGEOGRAPHICAL ANALYSIS OF THE PTERIDOPHYTES OF VERACRUZ, MÉXICO

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Abstract

The objective of this study is to present a phytogeographical analysis of the pteridophytes of the state of Veracruz, located along the coast of the Gulf of México. Based on a review of literature and specimens in various herbaria, and a database from the herbarium XAL (Instituto de Ecología, A.C., these species were compared with the pteridophyte species from other Mexican states, and with the fern floras of other countries or geographical regions. The highest pteridophytic richness in Veracruz is located in areas with mean temperatures between 12 C and 27 C, humid and subhumid environments, elevations between 500 and 2,900 m, and uneven topography. Currently, the pteridophyte flora of México is known for the following states or regions: Baja California, Campeche, Chiapas, Chihuahua, Estado de México, Guanajuato, Guerrero, Michoacán, Nueva Galicia, Nuevo León, Oaxaca, Querétaro, Quintana Roo, Tabasco, Valle de México, Veracruz, and Yucatán. Veracruz is the third richest state for pteridophytes. When the fern species of ten of the above states are compared a clear division is observed, depending on where the state is located (i.e. Neartic or Neotropical floristic province). Chiapas, Oaxaca, and Veracruz have a high number of species and a high number of species in common. This is not surprising because the three states share characteristics that allow for great species richness (high precipitation a wide range of temperatures and elevations, and a diverse topography). Tabasco and the states in the Yucatan Peninsula, even though they are also located in the warm, humid, southeastern part of México, present a relatively low species richness, due to the lack of topographic and elevation diversity, and the distance to other floristic provinces. About 27% of the pteridophyte species in Veracruz are species distributed from México to South America and the Caribbean Islands; 6.2% are species with an even wider distribution (New and Old World); and 6.1% are species restricted to México and Guatemala. The information presented here, should be very useful as a basis for future studies on a wide range of topics: taxonomic, floristic, biosystematic, and ethnobotanic.

Objective

The purpose of this study is to present a phytogeographical analysis of the pteridophytes in the State of Veracruz, México, and categorize their distribution patterns with ferns present in other Mexican states, and other countries or regions of the world.

Introduction

Currently, the pteridophyte flora of México is known for the following states or regions: Baja California, Campeche, Chiapas, Chihuahua, Estado de México, Guanajuato, Guerrero, Michoacán, Nueva Galicia, Nuevo León, Oaxaca, Querétaro, Quintana Roo, Tabasco, Valle de México, Veracruz, and Yucatán (Table 1). Veracruz is the third state in richness of pteridophyte species (Table 1).

Phytogeographical aspects

Because of its geographical position (part Neartic, part Neotropical), Veracruz has marked phytogeographical importance in México. It includes three floristic provinces: Mesoamerican Mountain Forests, Mexican Xerophytic, and Caribbean. Within these regions, the following floristic provinces converge (Rzedowski 1978).

SIERRA MADRE ORIENTAL. This includes part of northeastern Veracruz. Limestone rocks predominate, *Quercus* forests are widespread, but some *Pinus* forests and other plant communities are present.

MERIDIONAL HILL RANGE. Within this province we find the Eje Volcánico Transversal (running from Jalisco and Colima to Veracruz), the Sierra Madre del Sur, and the mountainous complex of northern Oaxaca. The latter includes México's highest elevations, for Veracruz the Pico de Orizaba and Cofre de Perote. *Pinus* and *Quercus* forests are widespread and, because of the high elevations, there are many isolated areas that favour endemism.

NORTHEASTERN COASTAL PLAIN. It includes the northernmost part of Veracruz where the climate is extreme, hot and semiarid. Vegetation is mostly tropical dry forest and xerophytic scrub, with few endemics but many species with narrow distribution. There is influence from Caribbean floras.

TEHUACÁN-CUICATLÁN VALLEY. A small portion of Veracruz belongs to this floristic province. The climate is dry but it is isolated from the arid areas of the central highlands of México. The vegetation has certain similarities to that of the Balsas Depresion province in the Central México.

COAST OF THE GULF OF MÉXICO. This floristic province includes coastal lowlands and occupies a considerable portion of the state. The climate is mostly warm and humid, and the main vegetation is tropical deciduous forest. Other areas are covered by *Quercus* forests, different hydrophyte communities, and mountain cloud forest. A large number of elements of this province are present also in Central and South America.

Description of the study site

The State of Veracruz is located along the east coast of México (between 17°00' – 22°20' N) and has an area of 71,954 km^2, including islands (Figure 1). Topography is diverse, with elevation from sea-level to nearly to 6,000 m (Pico de Orizaba, 5,747 m); nevertheless, most areas are below 300 m. The climate is also diverse as a result of the latitudinal and topographic variations (Gómez-Pompa 1977). The climatic types present include: A, (A)C, A(C), BS, BW, C, E, ETH, EFH, with their variations (Soto 1969, 1986). The topographic variations, combined with latitudinal position, climatic factors, and the confluence of the Neartic and Neotropical regions, results in a diversity of vegetation associations, favouring the presence

and abundance of species. Southern México (Oaxaca, Tabasco, Chiapas, and southern Veracruz) is the region with the highest species richness and the northern limit for the distribution of many neotropical species (Palacios-Rios 1986).

The richest areas for pteridophytes in Veracruz are located in areas with mean temperatures between 12°C and 27°C, in humid and subhumid environments, at elevations between 500 and 2,900 m, and in areas with uneven topography. Nevertheless, pteridophytes can be found from sea level (mangrove forest) to elevations well over 4,000 m. This rich and diverse flora includes aquatic (rooted emergents or floating), terrestrial, epiphytic, hemiepiphytic, epipetric, and arborescent ferns.

Methods

The results and analyses presented here are based on a survey of the literature (see Table 1 and Table 2). The computarized floristic data base of Instituto de Ecología, A.C. was also used, checking localities, altitude, type of vegetation, uses, common names, etc. Direct communications were made with many specialists.

TABLE 1. Main references of Mexican pteridophytes used in this study.

State	Species	Reference
Baja California	71	Wiggins, 1980
Campeche	18	Palacios-Rios 1993c; Palacios-Rios in progress
Chiapas	609	Smith 1975, 1981, 1986
Chihuahua	127	Knobloch and Correll 1962
Edo. de México	244	Matuda 1956b; Tejero-Díez 1990
Guanajuato	63	Díaz-Barriga and Palacios-Rios 1992, Palacios-Rios 1993a, 1993b, 1994a
Guerrero	355	Lorea, 1990
Isla Socorro	14	Johnston 1931; Levin and Moran 1989; Flores-Palacios and Palacios-Rios 1994
Michoacán	226	Díaz-Barriga and Palacios-Rios 1992; Palacios-Rios 1993a, 1993b, 1994a
Morelos	159	Pacheco *et al.* 1993
Nueva Galicia	281	Mickel 1992
Nuevo León	109	Aguirre-Claverán 1983; Arreguín-Sánchez and Aguirre-Claverán 1985, 1986
Oaxaca	690	Mickel and Beitel 1988
Querétaro	155	Díaz-Barriga and Palacios-Rios, 1992; Argüelles *et al.* 1991; Palacios-Rios 1993a, 1993b, 1994a
Quintana Roo	27	Palacios-Rios and Cortés 1990; Palacios-Rios 1993c; Palacios-Rios in progress
Sinaloa	ca. 50	Vega Aviña *et al.* 1989
Tabasco	90	Rovirosa 1909; Cowan, 1983
Valle de México	95	Arreguín-Sánchez 1987; Matuda 1956a
Veracruz	ca. 572	Palacios-Rios 1987a, 1987b, 1988a, 1988b, 1990a, 1990b, 1990c, 1990d, 1992a, 1992b, 1994b; Palacios-Rios and Gómez-Pompa 1993
Yucatán	30	Palacios-Rios 1993c; Palacios-Rios in progress

TABLE 2. Main references used to compare the pteridophytes of Veracruz to other areas.

Area	Reference
Africa	Kornas 1990, pers. comm.
America	Tryon and Tryon 1982
Argentina	de la Sota 1977
Australia	Jones and Clemesha 1981
Canada	Lellinger 1985
Chile	Duek and Rodríguez 1987; Rodríguez R. 1974
Colombia	Lellinger 1989; Murillo-Pulido and Harker-Useche 1990
Costa Rica	Lellinger 1989
Cuba	Sánchez and Caluff 1993b
Ecuador	Smith 1983; Øllgaard 1988; Stolze 1986; Stolze *et al.* 1994; Tryon 1986
El Salvador	Standley and Calderón 1927; Seiler 1980; Pfeiffer-Berendsohn 1989
Great Britain	Jermy and Camus 1991
Greater Antilles	Sánchez and Caluff 1993a
Guatemala	Stolze 1976, 1981 1983
Guyana Francesa	Cremers and Hoff 1990
Jamaica	Proctor 1985
Lesser Antilles	Proctor 1977
México	Palacios-Rios 1994c
Panamá	Lellinger 1989
Paraguay	Hassler 1928; Salvo and España L. 1987a, 1987b.
Perú	Tryon 1964; Tryon and Stolze 1989, 1990, 1991, 1993, 1994
Puerto Rico	Kepler 1975; Proctor 1989
Texas	Correll 1956
Trinidad	Mickel 1987
North America	Morin 1993
Uruguay	Herter 1930; Legrand and Lombardo 1958
Venezuela	Vareschi 1969; Ortega 1982, 1991; Ortega and Rivero 1986; Smith 1985

Results and discussion

Results

Veracruz has a relatively large number of pteridophytes, some are not well collected and studied. A preliminary analysis considers ca. 1,000 pteridophytes for all of México (Mickel *et al.* ined.). In Veracruz we find 57.2% of these, in 31 families, 104 genera, 572 species, plus 14 hybrids (Table 3).

The largest families in Veracruz are: Pteridaceae, Polypodiaceae, Dryopteridaceae, Aspleniaceae, and Thelypteridaceae. The genera with the most species, are: *Asplenium*, *Thelypteris*, *Polypodium*, *Selaginella*, *Elaphoglossum*, *Cheilanthes*, *Adiantum*, and *Trichomanes*. Sixteen of the 104 genera of ferns in Veracruz, those with ten or more species, comprise 59.9% (343 species) of the total (Table 4). Of the 572 pteridophyte species in Veracruz, 45 (8%) are fern-allies: 28 species in *Selaginella*, 10 in *Huperzia*, 1 in *Lycopodiella*, 2 in *Lycopodium*, and 4 in *Equisetum*.

TABLE 3. Pteridophyte families present in the State of Veracruz, and number of genera, species and hybrids.

Family	Genera	Species	Hybrids
1. ASPLENIACEAE	4	48	
2. ATHYRIACEAE	5	25	
3. AZOLLACEAE	1	3	
4. BLECHNACEAE	2	21	6
5. CYATHEACEAE	4	14	
6. DENNSTAEDTIACEAE	6	15	
7. DICKSONIACEAE	2	2	
8. DRYOPTERIDACEAE	13	47	1
9. EQUISETACEAE	1	4	2
10. GLEICHENIACEAE	3	7	
11. GRAMMITIDACEAE	5	13	
12. HYMENOPHYLLACEAE	2	36	
13. LINDSAEACEAE	2	6	
14. LOMARIOPSIDACEAE	4	34	
15. LOPHOSORIACEAE	1	1	
16. LYCOPODIACEAE	3	13	
17. MARATTIACEAE	2	5	
18. MARSILEACEAE	1	4	
19. OLEANDRACEAE	2	13	
20. OPHIOGLOSSACEAE	2	7	
21. OSMUNDACEAE	1	2	
22. PARKERIACEAE	1	2	1
23. PLAGIOGYRIACEAE	1	2	
24. POLYPODIACEAE	8	68	2
25. PSILOTACEAE	1	2	
26. ADIANTACEAE	18	89	2
27. SALVINIACEAE	1	2	
28. SCHIZAEACEAE	3	12	
29. SELAGINELLACEAE	1	28	
30. THELYPTERIDACEAE	2	39	
31. VITTARIACEAE	2	8	
TOTAL	104	572	14

TABLE 4. Genera of pteridophytes in Veracruz with 10 or more species.

Asplenium	45	*Blechnum*	18
Thelypteris	38	*Diplazium*	18
Polypodium	31	*Hymenophyllum*	15
Selaginella	28	*Pteris*	14
Elaphoglossum	24	*Ctenitis*	13
Adiantum	22	*Nephrolepis*	12
Cheilanthes	22	*Pleopeltis*	12
Trichomanes	21	*Huperzia*	10

Ferns endemics in Veracruz

There are only eight fern species endemic to Veracruz, 1.4% of the total. This low total is a consequence of the wider distribution of spores compared to most seed plants; consequently, there are fewer fern endemics than seed plant endemics (Smith, 1990) in the area. The ferns endemics are:

Elaphoglossum obscurum	*Polystichum ordinatum* × *muricatum*
Pecluma sursumcurrens	*Selaginella orizabensis*
Pleopeltis × *melanoneuron*	*Thelypteris lanosa*
Pleopeltis × *sordidula*	*Thelypteris rhachiflexuosa*

Species like *Blechnum danaeaceum*, *Diplazium hahnii*, *Polypodium arthropodium*, *P. hahnii*, and *P. lesourdianum*, are often cited as Veracruz endemics. They have not been listed here because they may be synonyms and their type specimens have not been examined by the author.

Endemic species of México

Even though México is not island, it has a high proportion of taxa with narrow distribution patterns (Rzedowski, 1991). There are 51 fern species endemic to México, that occur in Veracruz. They account for 8.57% of the pteridophyte species in the state. Some of the species are:

Anemia munchii	*Huperzia cuernavacensis*
Asplenium minimum	*Marattia laxa*
Astrolepis crassifolia	*Phanerophlebia gastonyi*
Bolbitis hastata	*Phlebodium araneosum*
Bommeria ehrenbergiana	*Plagiogyria truncata*
Cheilanthes allosuroides	*Polypodium eatonii*
Cnemidaria apiculata	*Selaginella pulcherrima*
Diplazium puberulentum	*Thelypteris albicaulis*
Elaphoglossum monicae	*Trichomanes bucinatum*
Holodyctium ghiesbreghtii	*Woodwardia martinezii*

Distribution of ferns per vegetation type

Fern species are not evenly distributed throughout the vegetation types present in Veracruz. More ferns are present in the mountain cloud forest, oak forest and tropical rain forest (see Table 5). A given species may occur in more than one vegetation type.

TABLE 5. Number of fern species per type of vegetation in Veracruz.

Type of Vegetation	Number of Species
Mountain Cloud Forest	372
Quercus Forest	201
Tropical Rain Forest	197
Tropical Deciduous Forest	120
Pinus-Quercus Forest	119
Pinus Forest	98
Matorral	59
Tropical Dry Forest	57
Liquidambar Forest	55
Alnus Forest	12
Grassland	13
Abies Forest	10
Palms	7
Popal (fresh water swamp)	5
Mangrove Forest	4

When the fern species of ten of the above states are compared (Table 6), a clear division is observed depending on where is the state located (i.e., Neartic or Neotropical floristic province). Chiapas, Oaxaca, and Veracruz have a higher number of species and a high number of species in common. This is not surprising, because the three states share characteristics that allow for great species richness (high precipitation, wide range of temperature and elevation, and diverse topography). Tabasco and the states in the Yucatán Peninsula, even though they are also located in the warm, humid southeastern part of México, present a relatively low species richness, due to the lack of topographic and elevation diversity.

TABLE 6. Species similarity (Sørensen Similarity Index) between the ferns of Veracruz and other Mexican states.

	BC	CAM	CH	CHS	MEX	NL	OAX	QR	TAB	**VER**	YUC
BC	—	0.0%	31%	3.9%	14.9%	16.8%	5.4%	0.0%	0.0%	**5.6%**	2.0%
CAM		—	1.4%	5.4%	7.4%	8.8%	4.9%	53.7%	23.5%	**6.15%**	65.2%
CH			—	15%	22%	48%	15.7%	1.3%	1.9%	**17.2%**	2.5%
CHS				—	2%	12.4%	72.3%	5.7%	22.4%	**73.9%**	7.1%
MEX					—	14%	21.2%	7.1%	10.3%	**23.7%**	5.1%
NL						—	14%	8.4%	6.7%	**14.9%**	9.7%
OAX							—	5.4%	18.2%	**74%**	6%
QR								—	26.2%	**7.2%**	47%
TAB									—	**24.6%**	25%
VER										—	7.8%
YUC											—

In contrast, the states of México, Baja California, Chihuahua, and Nuevo León, even though they have a variety of vegetation types, elevation and topographic diversity, have relatively low numbers of species. This is the result of extreme temperatures and low precipitation. Large areas are covered with xerophytic vegetation, and the climatic conditions do not favour the presence of a great number of fern species.

Mexican States and Territories

Ags. Aguascalienties	DF. Distrito Federal	Mich. Michoacán	QR. quintana Roo	Ver. Veracruz
BC. Baja California	Dgo. Durango	Mor. Morelos	SLP. San Luis Protosí	Yuc. Yucatán
Camp. Campeche	Gto. Guanajuato	Nay. Nayarit	Sin. Sinaloa	Zac. Zacatecas
Chis. Chiapas	Gro. Guerrero	NL. Nuevo León	Son. Sonora	
Chih. Chihuahua	Hgo. Hidalgo	Oax. Oaxaca	Tab. Tabasco	
Coah. Coahuila	Jal. Jalisco	Pue. Puebla	Tam. Tamaulipas	
Col. Colima	Mex. México	Qro. Queretaro	Tlax. Tlaxcala	

FIG. 1. Location of the State of Veracruz in México.

Phytogeographic affinities and distribution

A description of the distribution and phytogeographic affinities of the pteridophytes of Veracruz follows.

1.- Species distributed from Canada southward

Of species confined to Canada, the United States, and México, two are present in Veracruz: *Pellaea atropurpurea* and *Selaginella apoda*.

Of the species confined to Canada, the United States, México, Central America, and South America, excluding the Antilles, only one is present in Veracruz: *Botrychium virginianum*.

2.- Species distributed from the United States southward

Of species confined to the United States, and México, four are present in Veracruz: *Dryopteris cinnamomea*, *Ophioglossum pycnostichum*, *Selaginella wrightii*, and *Woodsia mexicana*.

Astrolepis integerrima and *Notholaena schaffneri* are present in Veracruz, the United States, México, and the Antilles. *Asplenium monodon* is present in Veracruz, the United States (Florida), México, Guatemala, and the Antilles.

Of taxa distributed in the southeastern United States, México, and Guatemala, two are present in Veracruz: *Pleopeltis polypodioides* var. *michauxiana* and *Trichomanes petersii*. Of the species confined to the United States, México and Central America, four are present in Veracruz: *Adiantum tricholepis*, *Notholaena candida*, *Thelypteris ovata* var. *lindheimeri*, and *T. pilosa*. *Blechnum serrulatum* and *Pecluma ptilodon* var. *bourgeana* are present in Veracruz, the United States (Florida), México, Central America, and the Antilles.

Of species confined to the United States (Florida), southeast México, Guatemala, the Antilles, and South America, two are present in Veracruz: *Asplenium trichomanes-dentatum* and *Dennstaedtia bipinnata*. *Cheilanthes bonariensis*, *C. lendigera*, *C. microphylla*, *C. tomentosa*, and *Pleopeltis thyssanolepis*, are present in Veracruz, southwestern United States, México, the Antilles and South America.

There are six species present in Veracruz, the United States and South America: *Cheilanthes kaulfussii*, *C. notholaenoides*, *Thelypteris kunthii*, *T. patens* var. *patens*, *T. tetragona*, and *T. serrata*.

Of the species distributed from the United States to South America, and the Antilles, 20 (3.5%) are found in Veracruz, including:

Anemia adiantifolia
Asplenium resiliens
Azolla caroliniana
Blechnum glandulosum
Campyloneurum angustifolium
Ctenitis submarginalis
Dicranopteris flexuosa
Hypolepis repens
Pecluma plumula
Phlebodium pseudoaureum
Pleopeltis thyssanolepis
Pteridium caudatum
Salvinia minima

Azolla filiculoides, is the only species for Veracruz that is also distributed from the United States to South America, the Antilles, Hawaii, and New Zealand.

3.- Species confined to México, parts of Central America, and Cuba

There are three fern species in Veracruz with distribution in México, parts of Central America and Cuba: *Cyathea myosuroides*, *Huperzia pithyoides* and *Schaffneria nigripes*.

4.- Species confined to México and Central America

Of species ocurring only in México and Guatemala, there are 31 (5.42%) in Veracruz. Examples are:

Argyrochosma formosa
Blechnum stoloniferum
Campyloneurum tenuipes
Cheilanthes cucullans
Cyathea bicrenata
Cystopteris membranifolia
Diplazium drepanolobium
Elaphoglossum gratum
Huperzia pringlei
Lavea cordifolia
Notholaena galeottii
Plagiogyria pectinata
Polypodium rhachipterygium
Polystichum ordinatum
Selaginella reflexa
Thelypteris meniscioides

Of species only distributed in México, Guatemala, and Belize, three are present in Veracruz: *Ctenitis salvinii*, *Thelypteris paucipinnata*, and *T. toganetra*.

Of species with a distribution from México to El Salvador, there are six (1.05%) in Veracruz.

Campyloneurum ensifolium
Cheilanthes complanata
Cheiloplecton rigidum var. *rigidum*
Pleopeltis peltata var. *interjecta*
Polypodium hartwegianum
Polypodium hispidulum

Of species with a distribution ranging from México to Honduras, Veracruz has 19 (3.33%). Examples are:

Adiantum wilesianum
Blechnum varians
Cibotium schiedei
Cnemidaria decurrens
Ctenitis interjecta
Elaphoglossum guatemalense
Huperzia tuerckheimii
Lellingeria prionodes
Lomariopsis recurvata
Marattia weinmanniifolia
Odontosoria schlechtendalii
Pecluma atra
Polypodium colysoides
Polystichum mickelii
Selaginella delicatissima
Thelypteris resiliens

There are 14 species (2.45%) in Veracruz with a distribution ranging from México to Nicaragua:

Alsophila salvinii
Alsophila tryoniana
Asplenium sphaerosporum
Cyathea divergens var. *tuerckheimii*
Diplazium ternatum
Pleopeltis mexicana
Polypodium cryptocarpon
Polypodium echinolepis
Polypodium fraternum
Pteris orizabae
Selaginella schizobasis
Sphaeropteris horrida
Woodwardia spinulosa
Woodsia mollis

The are 24 species (4.2%) in Veracruz with a distribution pattern from México to Costa Rica. Examples are:

Adiantum feei
Bommeria pedata
Ctenitis melanosticta
Diplazium lonchophyllum
Elaphoglossum setosum
Lygodium heterodoxum
Pecluma alfredii
Pleopeltis crassinervata
Pleopeltis fallax
Polypodium puberulum
Thelypteris imbricata

The are 30 species (5.2%) in Veracruz with a Mesoamerican distribution (southeast México to Panama). Examples are:

Adiantum decoratum
Antrophyum ensiforme
Asplenium miradorense
Ctenitis hemsleyana
Cyathea costaricensis
Danaea cuspidata
Diplazium urticifolium
Elaphoglossum sartorii
Loxogramme mexicana
Phanerophlebia macrosora
Pityrogramma dealbata
Polypodium rhodopleuron
Polystichum speciosissimum
Pteris paucinervata
Selaginella martensii
Thelypteris ghiesbreghtii

The Antilles, being an archipelago, have been an important center of plant evolution but, as with México, the main body of their flora is clearly neotropical. The direct influence of Antillean elements in the Mexican flora is mainly reflected in the Yucatan Peninsula but it can be seen in other regions as well (Rzedowski, 1991). There are 18 species (3.5%) in Veracruz with a clear Antillean distribution, i.e., México, at least one of the Central American countries, and at least one Antillean Island.

Adiantum trapeziforme
Anemia speciosa
Argyrochosma incana
Asplenium heterochroum
Cheilanthes jamaicensis
Ctenitis excelsa
Ctenitis grisebachii
Cyathea myosuroides
Dennstaedtia distenta
Hymenophyllum ectocarpon
Lellingeria delitescens
Microgramma nitida
Pteris longifolia
Selaginella microdendron
Sticherus palmatus
Terpsichore delicatula
Thelypteris obliterata
Trichomanes godmanii

Of the species found only southeastern México (Guerrero, Hidalgo, Puebla, Veracruz, Tabasco, Oaxaca, and Chiapas) to South America, including the Antilles, there are 114 (20%) present in Veracruz. Examples are:

Adiantopsis radiata
Adiantum wilsonii
Anemia hirsuta
Asplenium feei
Blechnum gracile
Bolbitis hemiotis
Campyloneurum amphostenon
Cochlidium rostratum
Cyathea microdonta
Cyclopeltis semicordata
Danaea elliptica
Dennstaedtia obtusifolia
Dicranopteris pectinata
Didymochlaena truncatula
Diplazium plantaginifolium
Diplopterygium bancroftii
Elaphoglossum revolutum
Hemidictyum marginatum
Hemionitis palmata
Huperzia linifolia
Hymenophyllum undulatum
Hypolepis nigrescens
Lastreopsis effusa subsp. *divergens*
Lindsaea portoricensis
Lonchitis hirsuta
Lophosoria quadripinnata
Lycopodium thyoides
Lygodium volubile
Megalastrum pulverulentum
Microgramma lycopodioides
Nephrolepis occidentalis
Niphidium crassifolium
Oleandra articulata
Olfersia cervina
Pecluma consimilis
Peltapteris peltata
Phlebodium decumanum
Polystichum platyphyllum
Psilotum complanatum
Pteris propinqua
Saccoloma inaequale
Salvinia auriculata
Schizaea elegans
Sticherus bifidus
Stigmatopteris longicaudata
Tectaria incisa
Terpsichore semihirsuta
Trichomanes crispum

Veracruz has 44 species (7.7%) of plants ocurring in México, Central America, South America, and the Antilles. Examples are:

Acrostichum danaeifolium
Adiantum concinnum
Anemia pastinacaria
Anogramma chaerophylla
Asplenium myapteron
Asplenium serra
Blechnum occidentale
Campyloneurum serpentinum
Cheilanthes myriophylla
Dennstaedtia cicutaria
Diplazium cristatum
Diplazium induratum
Huperzia myrsinites
Lygodium venustum
Pellaea ternifolia
Pityrogramma ebenea
Pteridium arachnoideum
Tectaria heracleifolia
Lastreopsis effusa subsp. *dilatata*
Melpomene xiphopteroides
Pleopeltis astrolepis
Sticherus brevipubis
Tectaria transiens
Trichomanes galeottii

There are 24 species (4.2%) in Veracruz with a distribution pattern ranging from México (at least one of Guerrero, Hidalgo, Puebla, Veracruz, Tabasco, Oaxaca, Chiapas) to South America, but not in the Antilles.

Asplenium otites
Asplenium palmeri
Asplenium achilleifolium
Blechnum ensiforme
Bolbitis bernoullii
Campyloneurum serpentinum
Cyathea fulva
Dicksonia gigantea
Diplazium striatastrum
Elaphoglossum lindenii
Elaphoglossum squamipes
Hymenophyllum myriocarpum
Hymenophyllum pulchellum
Lindsaea klotzschiana f. *klotzschiana*
Microgramma percussa
Pecluma divaricata
Phanerophlebia juglandifolia
Polypodium furfuraceum
Stigmatopteris sordida
Tectaria panamensis
Tectaria incisa f. *vivipara*
Trichomanes collariatum
Trichomanes diaphanum
Trichomanes diversifrons

Veracruz has 27 species (4.7%) that are distributed from México (various states) to South America, excluding the Antilles. The most important species, are:

Adiantum braunii
Aleuritopteris farinosa
Alsophila firma
Asplenium castaneum
Azolla mexicana
Blechnum falciforme
Botrychium schaffneri
Cheilanthes marginata
Diplazium werckleanum
Doryopteris pedata var. *palmata*
Dryopteris patula
Elaphoglossum muelleri
Equisetum myriochaetum
Hymenophyllum trapezoidale
Polypodium plesiosorum
Pteris muricella
Pteris pulchra
Tectaria mexicana
Terpsichore heteromorpha

Arachniodes denticulata, *Asplenium salicifolium* and *Micropolypodium trichomanoides*, are present in Veracruz, and distributed from southeast México to Nicaragua or Costa Rica, the Caribbean Islands, and northern South America.

5.- Species with a wide distribution pattern

There are 36 species (6.2%) in Veracruz that exhibit a wide distribution pattern, i.e., New and Old World.

Acrostichum aureum
Adiantum capillus-veneris
Adiantum poiretii
Anogramma leptophylla
Asplenium monanthes
Asplenium praemorsum
Athyrium filix-femina
Cochlidium serrulatum
Cystopteris fragilis
Doryopteris concolor
Dryopteris wallichiana
Elaphoglossum petiolatum
Equisetum hyemale subsp. *affine*
Histiopteris incisa
Hymenophyllum tunbrigense
Lycopodiella cernua
Lycopodium clavatum
Macrothelypteris torresiana (introduced)
Nephrolepis biserrata
Nephrolepis cordifolia
Nephrolepis exaltata
Nephrolepis multiflora cultivated
Ophioglossum nudicaule
Ophioglossum petiolatum
Ophioglossum reticulatum
Osmunda regalis
Psilotum nudum
Pteris biaurita
Pteris cretica
Pteris quadriaurita
Thelypteris dentata introduced
Thelypteris hispidula
Thelypteris interrupta
Trichomanes pyxidiferum
Trichomanes radicans
Trichomanes rigidum

Conclusions

The information presented here, which is the result of an extensive and representative review, should be very useful as a framework and basis for future studies on a wide range of topics: taxonomic, floristic, biosystematic and ethnobotanic. Rzedowski (1991) argues that the consequence of the clear relationship of the Mexican flora to southern floras is that most of the country should be considered Neotropical. A large number of species could have originated in what is now Central and South America (Raven and Axelrod 1974; Rzedowski 1991). Rzedowski (1991) also discusses the possibility that several species could have originated in México and then migrated south, or that certain species originated elsewhere in the world and are now extinct in their place of origin.

It is quite clear that more research is needed on the ecology and biosystematics of the different species mentioned; a detailed analysis of the hybrids is needed; an analysis to the distribution of species throughout the state of Veracruz should be done; research should be done on the relationship of spore production and development and establishment of gametophytes and sporophytes; an analysis of the sexual and vegetative reproduction of certain species should be made. Finally research should be focused on the cultivation and propagation of species considered rare, threatened or endangered.

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