
A New Species of *Ceratozamia* (Zamiaceae) from Veracruz, Mexico

Mario Vázquez-Torres

Instituto de Investigaciones Biológicas, Universidad Veracruzana,
Apdo. Postal 294 Xalapa, Veracruz, 9100 Mexico

Andrew P. Vovides

Instituto de Ecología, A.C., Apdo. Postal 63, Xalapa, Veracruz, 91000 Mexico

ABSTRACT. *Ceratozamia morettii* is described from a cloud-forest environment in Veracruz, Mexico. The main morphological characters are illustrated, and comments on related species are made. The new species differs from others in the genus by the near prostrate habit, circinate vernation of the leaves, and wide leaflets with translucent venation. This taxon is apparently related to a group of species that are relatively small trunked, branched, produce few leaves, and have relatively small strobili. The non-sympatric species of the group also inhabit moist to very moist habitats, as in the case of *C. miqueliana*, *C. microstrobila*, and *C. mexicana* var. *robusta*.

Ceratozamia morettii Vázquez-Torres & Vovides, sp. nov. TYPE: Mexico. Veracruz: 7 Jan. 1992, M. Vázquez-Torres & H. Barney 4097 (holotype, CIB; isotypes, CIB, MEXU, XAL). Figure 1.

Truncus semihypogaeus. humilis ad 30 cm altus; *folia* vernata circinata, pauca. usque 10, glabra. *Foliola* subopposita vel alterna, 12-25 juga, remota, linearis vel falcata. translucida, tenuia. basicuneata.

Plant palm-like, *trunk* erect to procumbent, short, globose to cylindrical, semihypogeous up to 30 cm long, 8 cm diam., typically with 1-4 branches covered with persistent cataphyll and leaf bases; *cataphylls* triangular, 2 cm wide at base, 2.6 cm long; *vernation* circinate; *leaves* light green, pubescent when juvenile, decurrent to prostrate forming an open crown with a maximum of 10(4-7) leaves per crown, 1-1.4 m long, 40-65 cm wide; *leaflets* 12-25 pairs, ovoid when immature, becoming linear to falcate upon maturity, chartaceous, venation parallel, translucent, pale yellow, dichotomous principally in the lower third of leaflet, 25-35 cm long at median position of leaf, distal portion unevenly sinuous, apex acute, base attenuate, 2.7-4.8 cm wide, petiole terete or subterete, 45-60 cm long, armed with short stout prickles; *microstrobilus* typically coniform, elongate, yellowish green, 10-15 cm long, 2.5-4 cm diam.; *peduncle* terete, 5-7

cm long, 1 cm diam., reddish brown tomentum; *microsporophylls* cuneate, 10-12 mm long, 8-9 mm wide, distal end with two erect to curved prominent coniform protuberances; *microsporangia* numerous, generally in sori of three covering $\frac{1}{2}$ to $\frac{2}{3}$ of abaxial surface, dehiscence longitudinal; *megasporobilus* coniform, green when juvenile turning brown at maturity, 12-16 cm long, 4.5-5 cm diam.; *peduncle* terete, dark brown tomentose, 5-7 cm long, 1 cm diam.; *megasporophylls* peltate, reddish brown, distal end almost hexagonal with two erect or curved coniform protuberances; *ovules* ovoid, two per megasporophyll; *seeds* irregularly ovoid without any defined faces, sarcotesta yellowish white when immature turning to gray brown, delicately papery and transparent when mature, sclerotesta hard, light gray, 1.5-1.8 cm long, 1.2 cm diam.; *chromosome number* $2n = 16$.

CHROMOSOMAL STUDIES

The chromosome number and karyotype of *Ceratozamia morettii* were determined from three established specimens held at the Jardín Botánico Fco. J. Clavijero (Botanic Garden of the Instituto de Ecología) under the accession numbers 81-397, 81-857, and 81-852; vouchers are deposited at XAL. The root tip mitosis technique used was that described by Vovides (1983), and the chromosome classification based on centromere position was that of Levan et al. (1964) modified by Schlarbaum and Tsuchiya (1984). The diploid idiogram (Fig. 2) was constructed by taking the average arm lengths of the best three metaphase cells examined (Fig. 3). Photomicrography was done on a Zeiss photomicroscope (Fomi III) equipped with phase contrast optics and planapochromatic objectives. Prints were made using Kodak bromide paper. Arm lengths, total chromosome length, chromosome index (short arm divided by long arm), and symmetry index (length of longest pair divided by length of shortest pair) were computed using the average arm lengths from the three metaphase cells (Table 1). The

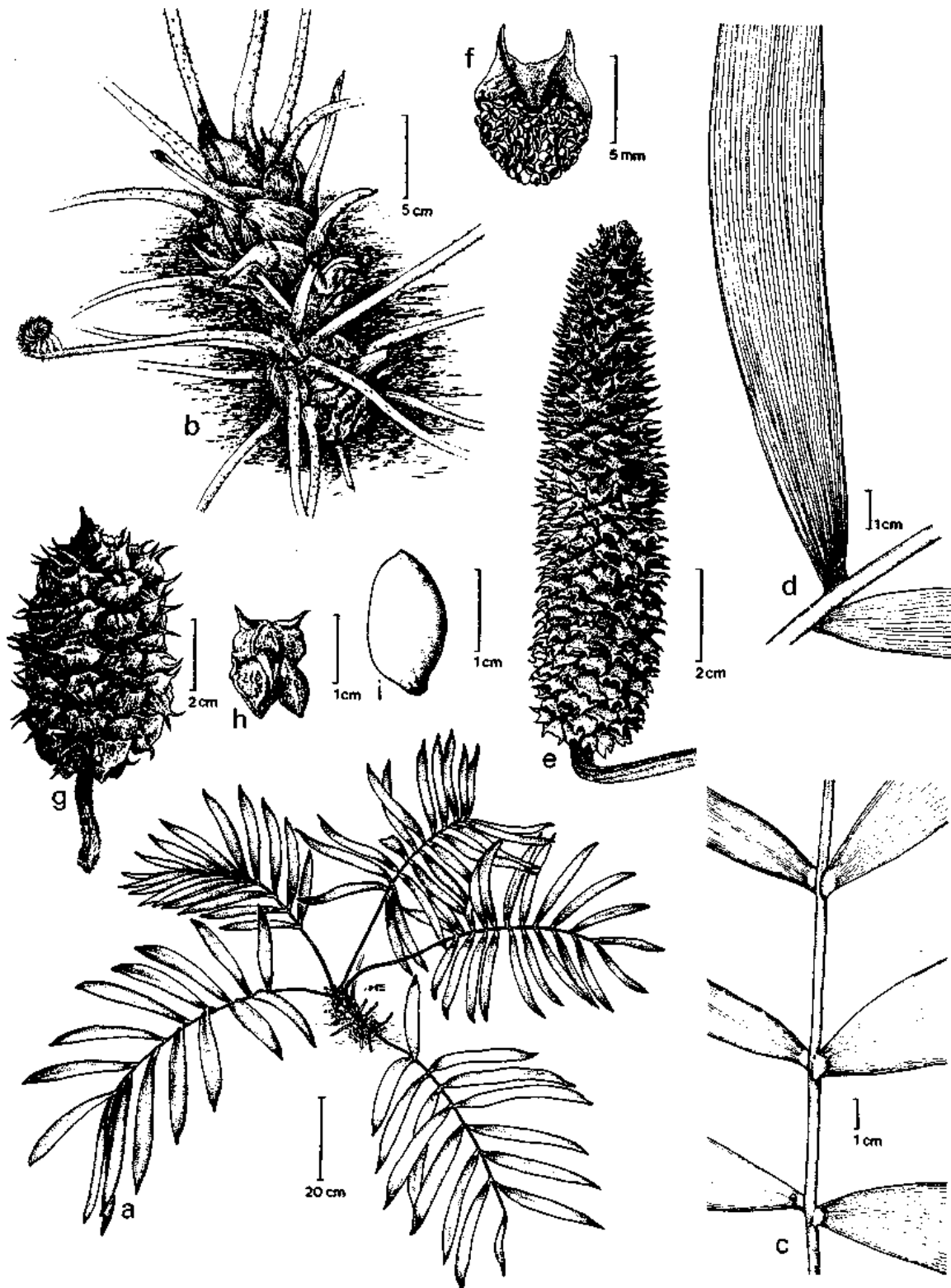


Figure 1. a–i, *Ceratozamia moretii* Vázquez-Torres & Vovides. —a. Habit of plant. —b. Circinate vernation of leaf, petiole, and trunk. —c. Leaflet articulations and rachis. —d. Detail of leaflet veins. —e. Non-expanded male strobilus. —f. Abaxial view of microsporophyll showing dehiscent sporangia. —g. Female strobilus. —h. Megasporophyll with immature ovules. —i. Seed.



Figure 2. Diploid idiogram of *Ceratozamia morettii* ($2n = 16$). bar = 2 μm .

karyotype shows 12 median region (m) chromosomes, 1 submedian (sm), 1 sub-terminal region (st) chromosome, and 2 terminal point (T) chromosomes. A maximum of 5 satellites were recorded but were not considered in the calculations.

HABITAT

This cycad occurs in cloud forest on humus-rich grayish yellow clay soil of volcanic origin. The plants are found on steep 45–60° slopes or on vertical rocky walls of loose, weathered basalt, at an elevation of 1200 to 1400 m. The closest climatological station to this habitat has recorded an average temperature of 17.3°C and over 1900 mm annual precipitation.

Other vascular plants associated with the cycad in this vegetation type are typical of cloud-forest species distributed on the windward slopes of the Sierra Madre Oriental facing the Gulf of Mexico. These are: *Alnus jorullensis* Kunth, *Clethra mexicana* DC, *Dendropanax arboreus* (L.) Decaisne & Planchon, *Dicksonia gigantea* Maxon, *Ilex discolor* Hemsley, *Liquidambar macrophylla* Oersted, *Mag-*

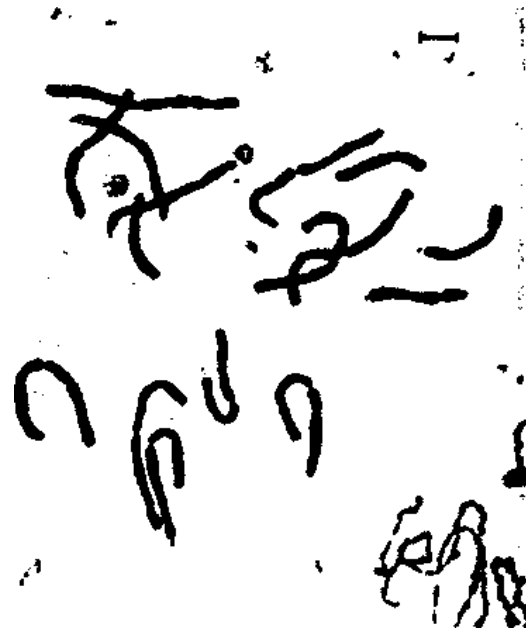


Figure 3. Mitotic metaphase cell of *Ceratozamia morettii*, bar = 4 μm .

nolia schiedeana Schlechtendal, *Marattia laxa* Kunze, *Oreopanax capitatus* (Jacquin) Decaisne & Planchon, *Ostrya virginiana* (Miller) K. Koch, *Podocarpus guatemalensis* Standley, *Quercus germana* Chamisso & Schlechtendal, *Q. laurina* Humboldt & Bonpland, *Q. xalapensis* Humboldt & Bonpland,

Table 1. Karyotypic data at metaphase in root-tip mitosis of *Ceratozamia morettii* (mean of three metaphase cells).

Pair	Arm length (μm)		Total	Index (S/L)	r Value	Centromere position*
	Long (L)	Short (S)				
1	12.86	11.28	24.14	0.88	1.14	m
	11.13	10.17	21.30	0.91	1.09	m
2	11.07	9.94	21.01	0.90	1.11	m
	10.83	9.87	20.70	0.91	1.10	m
3	10.81	9.27	20.08	0.86	1.17	m
	10.48	9.22	19.70	0.88	1.14	m
4	10.21	9.21	19.42	0.90	1.11	m
	9.77	8.49	18.26	0.87	1.15	m
5	9.19	8.07	17.26	0.88	1.14	m
	9.22	7.69	16.91	0.83	1.20	m
6	9.17	7.51	16.68	0.82	1.22	m
	8.38	7.66	16.04	0.91	1.09	m
7	7.22	2.88	10.10	0.40	2.51	sm
	8.76	2.63	11.39	0.30	3.33	st
8	10.95	0.00	10.95	0.00	0.00	T
	10.77	0.00	10.77	0.00	0.00	T
Total 274.71			Symmetry index = 0.48			

* m = median, msm = median-submedian, sm = submedian, st = subterminal, T = terminal. Average chromosome index = 0.70.

Turpinia insignis (Kunth) Tulasne, and *Ulmus mexicana* (Liebmann) Planchon.

DISCUSSION

The specific epithet was chosen in recognition of the scientific contributions of Aldo Moretti in the field of cycad biology. Prof. Moretti is a researcher of the Orto Botanico of the University of Naples, Italy.

Ceratozamia morettii differs from the rest of its congenere by the circinate vernation of its leaves. Like *C. microstrobila*, *C. morettii* has few nearly prostrate leaves per crown and profuse branching of the trunk. *Ceratozamia morettii* belongs to the group of species having wide leaflets: i.e., *C. euryphyllidia* Vázquez-Torres, Sabato & Stevenson, *C. microstrobila* Vovides & Rees, *C. hildae* Landry & Wilson, *C. miqueliana* H. Wendland, *C. latifolia* Miquel, *C. mexicana* var. *robusta* (Miquel) Dyer, and *C. whitelockiana* Chemnick & Gregory. With the exception of *C. microstrobila*, *C. hildae*, and perhaps *C. mexicana* var. *robusta*, the other taxa are distributed south of the neovolcanic belt of Mexico in moist habitats.

The following key separates *Ceratozamia morettii* from other *Ceratozamia* species with wide leaflets.

DIACNOSTIC KEY

- 1a. Emerging leaves presenting circinate vernation, leaves spreading, leaflets ovoid when immature, linear, falcate to subfalcate, not greater than 5 cm wide. *C. morettii*
- 1b. Emerging leaves not presenting circinate vernation, leaves ascending or spreading, leaflets lanceolate, elliptic, obovate, or broadly oblanceolate.
 - 2a. Persistent leaf bases dark brown, not appressed to trunk.
 - 3a. Leaflets coriaceous.
 - 4a. Leaflets lanceolate, less than 4 cm wide. *C. mexicana* var. *robusta*
 - 4b. Leaflets not lanceolate.
 - 5a. Leaflets obovate to broadly oblanceolate, greater than 4 cm wide. *C. miqueliana*
 - 5b. Leaflets elliptic to oblanceolate, less than 4.5 cm wide *C. latifolia*
 - 3b. Leaflets papyraceous.
 - 6a. Leaflets linear lanceolate, less than 4 cm wide *C. whitelockiana*
 - 6b. Leaflets broadly oblanceolate, greater than 8 cm wide *C. euryphyllidia*

- 2b. Persistent leaf bases light brown, tightly appressed to trunk.
 - 7a. Leaflets pinnate, elliptic to lanceolate *C. microstrobila*
 - 7b. Leaflets fasciculate, lanceolate *C. hildae*

The chromosome count and karyotype are consistent with that reported for the genus ($2n = 16$) by Marchant (1968), Vovides (1983, 1985), Vovides et al. (1993), and Moretti (1990). The karyotype of *C. morettii* ($12m + 1sm + 1st + 2T$) is nearly typical for the genus *Ceratozamia* ($12m + 2sm + 2T$) and appears to be stable within the genus (Vovides et al., 1993; Moretti, 1990). Satellite number and position appear to vary with cells observed and much care is needed in recording them. A maximum of five were recorded and many cells showed three.

The precise locality has been intentionally omitted to discourage indiscriminate commercial collecting of this endangered species, which could result in its extinction. The common names of this species are "tepetmaizte," or "tepemaizte" (forest maize), because of a similarity between the corn-cob and the cycad cones.

Acknowledgments. We thank Manuel Escamilla for the botanical illustration of this species. This research was partially funded by CONACyT projects No. 0063-N9106 and 1837P-N9507, LE. Sistemática Vegetal project No. 904-14 and U.V. F641-M940.

Literature Cited

- Levan, A., K. Fredga & A. A. Sandberg. 1964. Nomenclature for centromeric position on chromosomes. *Hereditas* 52: 201-220.
- Marchant, C. J. 1968. Chromosome patterns and nuclear phenomena in the cycad families Stangeriaceae and Zamiaceae. *Chromosoma (Berl.)* 24: 100-134.
- Moretti, A. 1990. Karyotypic data on north and central American Zamiaceae (Cycadales) and their phylogenetic implications. *Amer. J. Bot.* 77: 1016-1029.
- Schlarbaum, S. E. & T. Tsuchiya. 1984. The chromosomes of *Cunninghamia konishi*, *C. lanceolata* and *Taiwania cryptomeroides* (Taxodiaceae). *Pl. Syst. Evol.* 145: 169-181.
- Vovides, A. P. 1983. Systematic studies on the Mexican Zamiaceae I. Chromosome numbers and karyotypes. *Amer. J. Bot.* 70: 1002-1006.
- . 1985. Systematic studies on the Mexican Zamiaceae II. Additional notes on *Ceratozamia kuesleriana* from Tamaulipas, Mexico. *Brittonia* 37: 226-231.
- , M. Vázquez-Torres, B. Schutzman & C. G. Iglesias. 1993. A new species of *Ceratozamia* (Zamiaceae) from Querétaro and Hidalgo, Mexico. *Novon* 3: 502-506.