



Another new species of *Ceratozamia* (Zamiaceae) from Chiapas, Mexico

ANDREW P. VOVIDES^{1*}, MIGUEL A. PÉREZ-FARRERA² and CARLOS IGLESIAS¹

¹Instituto de Ecología, A.C., Apartado Postal 63, 91000, Xalapa, Veracruz, México

²Escuela de Biología, Universidad de Ciencias y Artes del Estado de Chiapas, Calzada Samuel León Brindis 151, C.P. 29,000, Tuxtla Gutiérrez, Chiapas, México

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Ceratozamia mirandai sp. nov. from the Sepultura Biosphere reserve of Chiapas, Mexico, is described and illustrated. Its closest affinities are with *C. kuesteriana* Regel from Tamaulipas of north-east Mexico, but differs in male and female cone and trunk morphology.

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ADDITIONAL KEY WORDS: biosphere reserves - *Ceratozamia kuesteriana* - Chiapas - Cycad - Mesoamerica - Pleistocene refuges.

INTRODUCTION

The genus *Ceratozamia* or 'horned *Zamia*' as the name suggests, is largely restricted to Mexico, with an outlying species (*C. robusta* Miq.) in Guatemala and Belize. Recently a *Ceratozamia* species has been reported from Honduras (Whitlock, pers. comm.). Much of our knowledge of the distribution of *Ceratozamia* in its native Mexico is due to the early exploratory work of Chamberlain (1919). In recent years information on the genus has been greatly expanded by workers from Mexico and Italy (Norstog & Nicholls, 1997; see also Balduzzi, De Luca & Sabato, 1981-82 and Moretti & Sabato, 1988). The genus is found mainly in dense moist tropical woodlands, such as cloud-forests, evergreen tropical rain-forests and also in mid-elevation oak/pine forests. *Ceratozamia* is much like some robust species of *Zamia* and according to Crane (1988) *Ceratozamia*, *Zamia* and the Cuban endemic *Microcycas* are phylogenetically related. Some *Ceratozamia* species are basically arborescent with stems rarely more than about 1 m tall, often leaning or curved and rarely branching. Others are semi-hypogeous and often branching.

During botanical explorations and conservation studies in the recently established Biosphere Reserve

of the Sierra Madre (Chiapas) we collected a *Ceratozamia* specimen with a thick, arborescent, branched trunk with large leaves and cones. We first considered that this taxon formed part of the wide species concept of *Ceratozamia norstogii* of Stevenson (1982) and Jones (1993). However, further explorations at the type of locality of *C. norstogii* and other populations of this species in the states of Chiapas and Oaxaca, as well as examination of the type of *C. norstogii* (see preceding paper pp. 77-80) we came to the conclusion that we had collected an unrelated new *Ceratozamia* species.

SPECIES DESCRIPTION

Ceratozamia mirandai Vovides, Pérez-Farrera & Iglesias sp. nov.
(Figs 1, 2)

Truncus primum semiglobosus demum cylindricus, grandis, ramosus, humilis, 32-105 cm altus; cataphylla lanata, triangularia, stipulata; folia pinnata; petiolus 22-59 cm longus; rachis 70-115 cm longa, petiolus et rachis recta; foliola opposita ad subopposita, 49-82-juga, linearia; strobilus masculinus lineari-cylindricus 26.5-57 cm longus, pedunculus tomentosus 3-11.5 cm longus; strobilus femininus 26-48 cm longus, pedunculus tomentosus, 5.5-14 cm; semina 2.3-2.7 cm longa. Affinis *Ceratozamia kuesteriana* Regel.

* Corresponding author. E-mail: vovidesa@ecologia.edu.mx

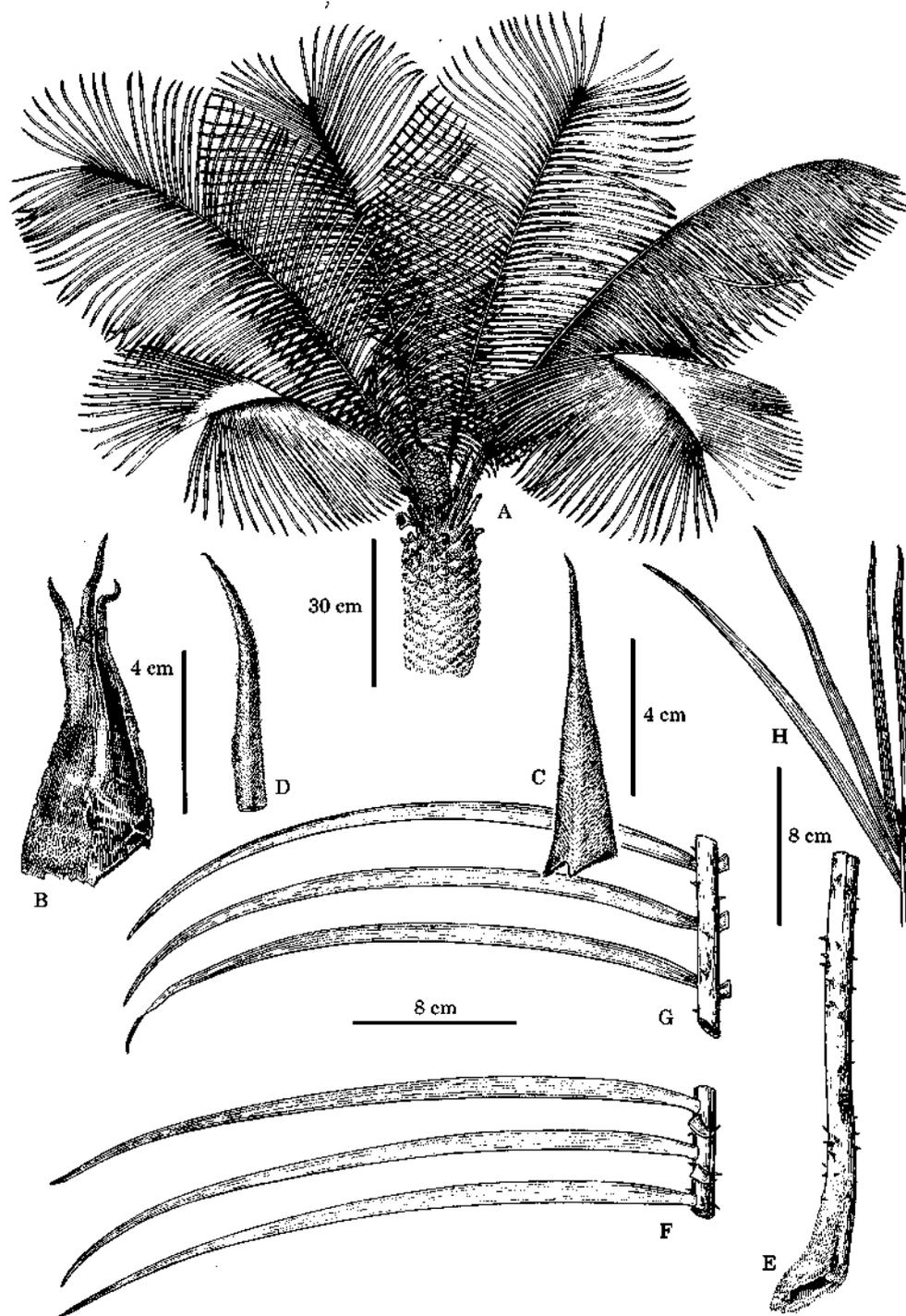


Figure 1. A-E, *Ceratozamia mirandai* sp. nov. A, habit of plant; B, leaf cataphyll; C & D, cone cataphylls; E, detail of petiole and base; F-H, leaf detail; proximal, median and distal portions respectively.

Holotypus. MÉXICO, CHIAPAS, Sierra Madre de Chiapas 20. ix. 1997, *De La Cruz. R.* 66 female (CHIP).

Isotypes. MÉXICO, CHIAPAS, Sierra Madre de Chiapas, *De la Cruz. R.* 20. ix. 1997, 67 (female); 24. ix. 1998,

De La Cruz. R. 75 (male), 76 (female); 23. iv. 1998, *De La Cruz. R.* (male), (CHIP, XAL, MEXU, MO, CAS, F).

Cycads with subglobose trunks when young, brown, becoming cylindrical, erect to prostrate with age, branched, protected by persistent petiole and cataphyll

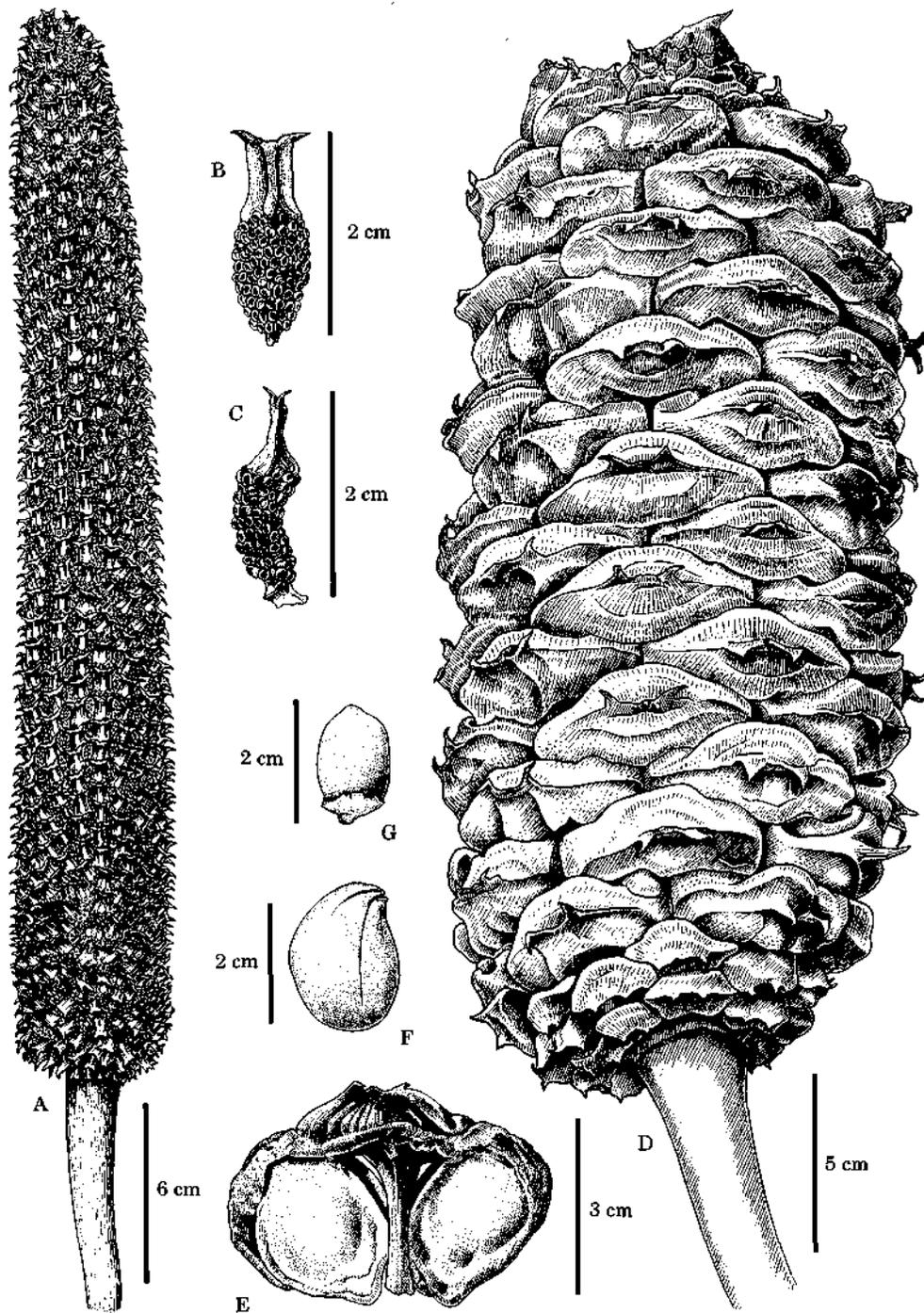


Figure 2. A–G *Ceratozamia mirandai* sp. nov. Strobili. A, microstrobilus; B, microsporophyll, abaxial view showing sporangia; C, lateral view; D, megastrobilus; E, megasporophyll with ovules; F, detail of seed; G, detail of young ovule.

bases, 32 (58.2) 105 cm long ($n = 30$), 19.4 (22.7) 28 cm diameter ($n = 30$); Cataphylls stipulate tomentose 3 (5.7) 8 cm long, 1.2 (2.8) 3.8 cm wide. Leaves 6–23, pinnate, ascending to spreading forming an apical crown, 115 (151.8) 189 cm long, 51 (69.3) 87 cm wide; petiole erect, base tomentose 22 (40) 59 cm long; rachis

erect rarely curved, 70 (93.3) 115 cm long, petiole and rachis armed with short stout prickles diminishing or absent toward apex of rachis. 0.3 (0.5) 0.6 cm long; leaflets 49–82 pairs, coriaceous, linear to sub-falcate, opposite to subopposite, channelled to slightly channelled, apex acute, base attenuate margin subrevolute

KEY SEPARATING *C. MIRANDAI* SP. NOV. *C. KUESTERIANA* AND *C. NORSTOGII*.

1. Rachis straight, leaflets more than 0.6 cm wide:
 2. Petiole and rachis armed with numerous prickles, leaflets 49-82 pairs, linear:.....*C. mirandai*
 2. Petiole and rachis unarmed, leaflets 30-50 pairs, linear-lanceolate:.....*C. kuesteriana*
1. Rachis twisted, leaflets less than 0.5 cm wide:
 - 3.....*C. norstogii*

entire, shining dark-green on adaxial surface, light-green on abaxial 26.5 (36) 45 cm long, 0.8 (0.97) 1.2 cm wide; (all measurements $n = 30$); veins visible on adaxial surface 6-13, distance between veins 0.1-0.15 cm. Microstrobili cylindrical to conical, light to olive-green at emergence, light to creamy-yellow at maturity 26.5 (47.7) 57 cm long ($n=10$), 4.2 (5.7) 7.7 cm diameter ($n = 30$); peduncle tomentose, 3 (7.1) 11.5 cm long ($n = 30$), 2 (2.6) 3 cm diameter ($n=12$); microsporophylls numerous, spirally inserted on cone axis forming apparent vertical rows, cuneiform, bicornate on distal face, fertile portion covering 1/2-2/3 of abaxial surface excluding horns 1.3 (1.7) 2 cm long ($n = 12$) 0.5 (0.8) 1 cm wide ($n = 12$); microsporangia numerous in sori of 3-4, longitudinally dehiscent. Megastrobili barrel shaped, olive-green when immature, brown-ochre at maturity 26 (37.3) 48 cm long, 8.2 (10.7) 12.7 cm diameter; peduncle tomentose, 5.5 (9.5) 14 cm long, 1.4 (2) 2.2 cm diameter (all measurements $n = 6$). Megasporephylls numerous, spirally inserted on cone axis forming apparent vertical rows, peltate, bicornate, face hexagonal, with light brown-ochre tomentum on lobulate part near horns, proximal to distal dimension 5.3 (5.6) 5.8 cm, face long axis, 1.9 (2.1) 2.5 cm short axis 2 (2.4) 2.8 cm (all measurements $n = 6$). Seeds ovate, sarcotesta whitish when immature, creamy-yellow when ripe, sclerotesta smooth, beige to light beige with 9-11 visible lines radiating from the micropyle 2.3 (2.5) 2.7 cm long, 1.7 (1.8) 1.9 cm diameter (all measurements $n = 5$). Chromosome count $2n = 16$.

Etymology. In honour of Dr Faustino Miranda, an untiring and eminent Mexican botanist whose contributions to the flora of Chiapas have been unequalled.

Other vouchers examined. A. R. López, F. A. Espejo & A. Flores 507 (UAMI); M.A. Pérez Farrera 26A, 37, 126, 129, 163, 352, 465; J.J. Castillo Hdez 230, 548, 595 (all CHIP); Chamberlain s.n. (F); S. K. Kiem s.n. (FTG); J. Watson s.n. (FTG); Breedlove 23999 (CAS); Ursula Bachem y & C. Ricardo Rojas 819 (CAPA).

HABITAT ECOLOGY

The vegetation type of this cycad's habitat is mainly oak/pine forest as described by Rzedowski (1978), with

an open forest canopy (72-89% cover) on a 40% slope at an elevation of 950 m, dominated by *Quercus elliptica* Née and *Pinus oocarpa* Schiede, together with less common species such as *Rapanea myricoides* (Schltdl.) Lundell and *Ternstroemia tepezapote* Cham. & Schltdl. The shrub layer is dominated by *Miconia glaberrima* (Schltdl.) Naudin, *Calliandra hirsuta* (G. Don) Benth., *Canavalia hirsuta* Standl. and the herbaceous layer by *Begonia* sp., *Callisia gentlei* Matuda, *Elaphoglossum latifolium* (Sw.) J. Sm., *Elephantopus* sp., *Euphorbia graminea* Benth. *Hyptis* sp., *Lasiacis procerrima* (Hackel) Hitchc. and *Salvia rubiginosa* Benth. Lianas are absent but epiphytes such as *Tillandsia* spp., *Catopsis montana* L.B.Sm., *Billergia* sp., *Peperomia* spp., *Maxillaria* spp. are present as well as an abundance of Spanish moss (*Tillandsia usneoides* L.).

The soil type of this habitat is an acid grey-brown humic cambisol (Cmu) consisting of a loamy-sandy clay texture with abundant surface humus. The bedrock consists of a complex of Precambrian granites and heavily folded laminated metamorphic rocks (Bachen & Rojas-Cruz, 1994).

Botanical explorations in other parts of the Sierra Madre de Chiapas have encountered other populations of *Ceratozamia mirandai* in other vegetation types such as semi-deciduous tropical rain-forest, deciduous tropical forest and cloud-forest as described by Rzedowski (1978). These habitats are all within a range of altitude between 910 and 1300 m.

DISCUSSION

Ceratozamia mirandai shares some vegetative characteristics with *C. kuesteriana* found in the state of Tamaulipas of north-east Mexico north of the neovolcanic belt. Both have channelled leaflets, erect petioles and straight rachis but differ in growth habit of the trunk and male cone colour. The trunk of *C. mirandai* is arborescent, branched and thicker than that of *C. kuesteriana*. Male cone colour at maturity in *C. mirandai* is creamy-yellow but dark brown in *C. kuesteriana*. Owing to the leaflet characteristics of *C. mirandai*, we consider this to be a member of the second group of *Ceratozamia* species *sensu* Stevenson *et al.* (1986) which are characterized by narrow leaflets;

this includes *C. mexicana* Brongn., *C. zaragozae* Meddellin, *C. matudai* Lundell, *C. kuesteriana* Regel, *C. mexicana* var. *robusta* (Miq.) Dyer, *C. alvarezii* Pérez Farrera, Vovides & Iglesias and *C. sabatoi* Vovides, Vázq. Torres, Schutzman & Iglesias.

Precise locality information has been purposely omitted in order to avoid illegal commercial collecting leading to the decimation of the populations of this cycad. We have observed that this species is distributed on both the Pacific and inland slope of the Sierra Madre de Chiapas in five municipalities. However, the oak/pine forests that form the cycad's principal habitat are rapidly being transformed by slash-and-burn agriculture techniques by subsistence farmers. This activity, though of a lesser extent within the Biosphere Reserve, is rendering the cycad an endangered species. During the exceptional drought of 1998, forest fires affected the cycad populations, including the locality studied within the La Sepultura Biosphere Reserve, and biodiversity generally throughout the state of Chiapas. We consider the Sepultura Reserve to be within the influence of the Soconusco Pleistocene refuge zone of Toledo (1982) mentioned by Schutzman, Vovides & Dehgan (1988) for the cycad *Zamia soconuscensis* Schutzman, Vovides & Dehgan of the Triunfo Reserve. The Sepultura Reserve is highly diverse and Villaseñor (1991) considers this a centre of endemism for the Asteraceae. Other endemic taxa registered in this Reserve are: *Chamaedorea benziei* Hodel and *C. keeleriorum* Hodel & Castillo (Hodel (1992), *Asplenium breedlovei* A. R. S., *Ctenis baulensis* A. R. Sm. (Smith, 1981), *Anthurium cerrobaulense* Matuda (Croat, 1983) and *Ceratozamia alvarezii* Pérez Farrera, Vovides & Iglesias (Pérez-Farrera, Vovides & Iglesias, 1999).

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Erratum

Another new species of *Ceratozamia* (Zamiaceae) from Chiapas, Mexico

ANDREW P. VOVIDES^{1*}, MIGUEL A. PÉREZ-FARRERA,² and CARLOS G. IGLESIAS¹

¹*Instituto de Ecología, A.C., Apartado Postal 63, 91000, Xalapa, Veracruz, México*

²*Escuela de Biología, Universidad de Ciencias y Artes del Estado de Chiapas, Calzada Samuel León Brindis 151, C.P. 29,000, Tuxtla Gutiérrez, Chiapas, México*

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Specific epithet should be changed to *mirandae* throughout.

Page 82, for *Isotypes* read *Paratypes*.