

## A new species of *Ceratozamia* (Zamiaceae) from Tabasco and Chiapas, Mexico

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*Ceratozamia becerrae* sp. nov. is described and illustrated. This species from Tabasco and Chiapas has affinity with *C. miqueliana* H. Wendl. from Veracruz and Chiapas, but differs in morphology and habit of leaves, leaflets, male and female strobili and trunk. *Ceratozamia becerrae* is considered part of the *C. miqueliana* species complex that includes *C. miqueliana*, *C. euryphyllidia* Vázq. Torres, Sabato & Stevenson and *C. zoquorum* Pérez-Farrera, Vovides & Iglesias. The geographical range of this species complex is southern Veracruz, Tabasco and northern Chiapas in tropical rain forests. © 2004 The Linnean Society of London, *Botanical Journal of the Linnean Society*, 2004, **146**, 123-128.

**ADDITIONAL KEYWORDS:** cycad — floristic refuges - Mesoamerica - Pleistocene — species complex.

### INTRODUCTION

When Professor Marcos E. Becerra carried out a floristic study in the mountainous zone of southern Tabasco and northern Chiapas during the period 1914-15, he discovered and collected an interesting *Ceratozamia*, which he identified as *C. miqueliana* H. Wendl. During a taxonomic revision of the genus for the *Flora Mesoamericana* and *Flora de Chiapas* projects, we examined Becerra's voucher (s/n) and noted that there were wider and fewer leaflet pairs with greater distances between the leaflet articulations than in *C. miqueliana*. We considered this taxon to be part of the *C. miqueliana* species complex.

During a botanical exploration into the karstic hills of southern Tabasco during 1985 we found Becerra's

*Ceratozamia* to be sympatric with *Zamia cremnophila* Vovides, Schutzman & Dehgan and *Z. splendens* Schutzman. We treated this *Ceratozamia* as *C. miqueliana* at the time, but we collected several individuals and cultivated them at the Francisco J. Clavijero Botanic Garden of the Instituto de Ecología, A.C. (accession no. 85-011). Further collections of this taxon were made from Tabasco and Chiapas in April 1996 and further living specimens were brought to the Botanic Garden and to the greenhouse of the School of Biology of the Universidad de Ciencias y Artes de Chiapas (accession no. 02-96). We observed these specimens in cultivation for more than six years under similar growing conditions used for other species of the genus including *C. miqueliana* and compared the observations with the plants in habitat. We also noted differences in strobili, leaves and leaflets, arriving at the conclusion that this is a new species to science.

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## DESCRIPTION

*CERATZAMIA BECERRAE* PÉREZ-FARRERA, VOVIDES,  
& SCHUTZMAN SP. NOV. AFFINIS *C. MIQUELIANA*.  
(FIG. 1)

*Diagnosis:* Plantae rupestrae, caule hypogaeo vel partim epigaeo, globoso, parvo, humili; foliis 2-5, descendentibus, petiolis et rachidibus linearibus; foliolis 4-13-jugatis, coriaceis, oblongis vel oblanceolatis, subfalcatis, planis, 5.4-12.9 cm disjunctis, articulis luteis vel aurantiacis.

*Holotype:* MEXICO, Tabasco viii.2003 AP. *Vovides 1458* (XAL).

*Paratype:* i.2001, M.A. Pérez-Farrera 2457 TABASCO; iv 1996, M.A. Pérez-Farrera 901 CHIAPAS (UNICACH, CHIP, MEXU, MO).

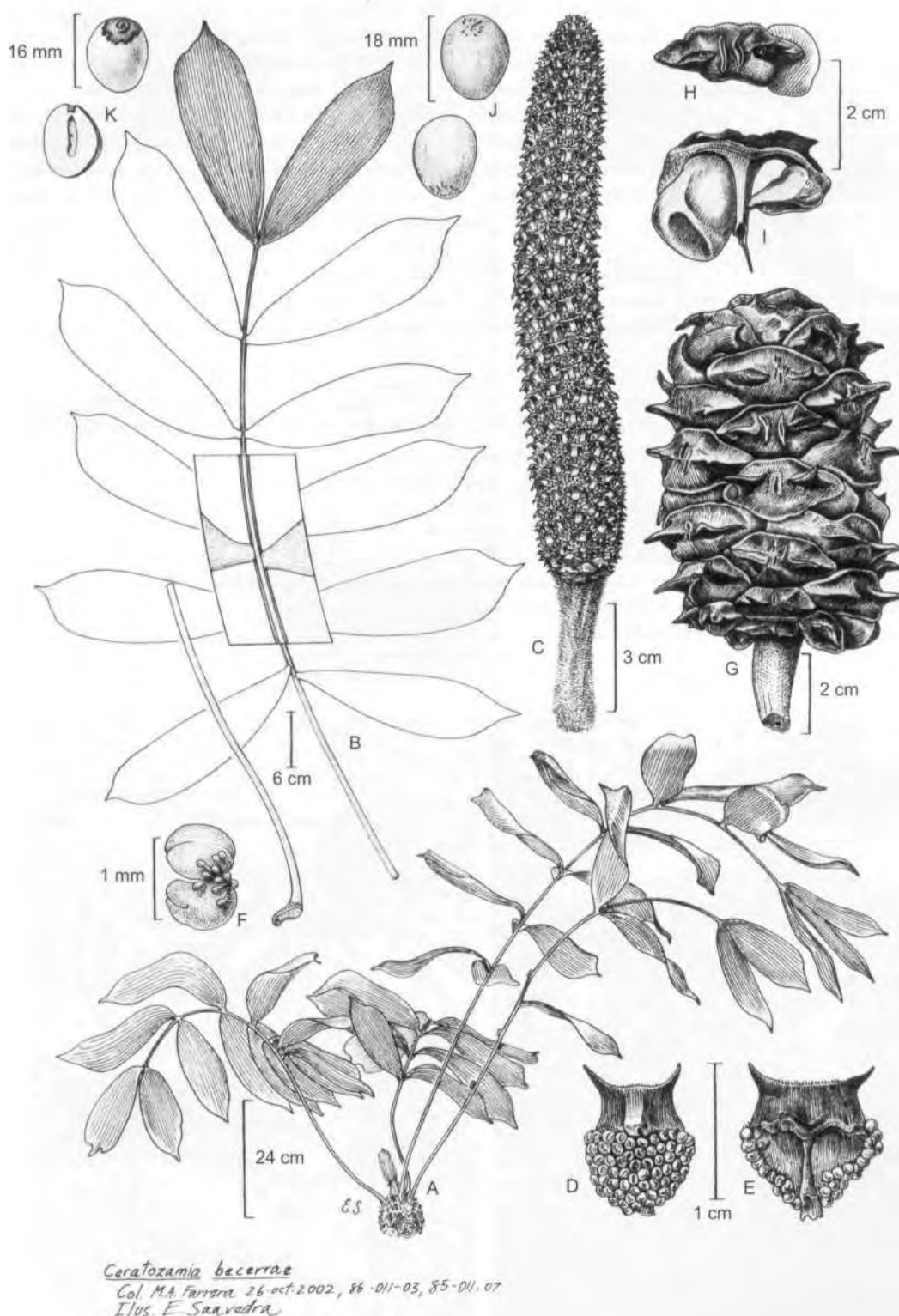
*Description:* Rupicolous plants with globose trunks, subterranean or partially so, protected by reddish brown, persistent petiole bases and cataphylls, 10.34-31 cm long, 5.48-10.47 cm in diameter. Cataphyll triangular, tomentose on basal part, 2.3-3.5 cm long, 2.2-5 cm wide, reddish. LEAVES 2-5 descending to decumbent, pinnate, olive-green upon emergence, forming an open crown, 55-178 cm long, 21.5-45 cm wide; petiole and rachis linear, terete with two parallel adaxial canals at leaflet articulations on rachis, unarmed or with few distantly spaced fine prickles, petiole 15.5-79 cm long, rachis 17-80 cm long; leaflets coriaceous, flat, 4-13 pairs, oblong to oblanceolate, subfalcate, asymmetrical towards acuminate apex, opposite to subopposite along apical portion of leaf, alternate to subalternate along mid and basal portion of leaf, margins subrevolute, entire, proximal margin more curved than the distal, giving the leaflet a subfalcate appearance, olive green on adaxial surface, light green on abaxial surface, articulation yellow to orange inserted at an oblique angle to the rachis, 17-30 cm long, 5.2-10 cm wide, 32-54 veins visible on adaxial surface, intervein distance 0.17-0.24 cm, distance between leaflets 5.4-12.9 cm. MICROSTROBILI erect, conical, light to olive green at emergence, beige to creamy yellow at maturity, 14-14.5 cm long, 1.7-2.2 cm in diameter; peduncle tomentose, light brown at emergence to brown at cone maturity, 3.8-5 cm long, 2.3-2.5 cm in diameter; microsporophylls numerous, cuneiform, inserted spirally at an angle of c. 45° with respect to cone axis forming apparent vertical rows, tomentulose, bicornate on distal surface, fertile portion covering 2/3 of abaxial surface excluding the horns, 1-1.4 cm long, 0.4-0.6 cm wide; microsporangia numerous in sori of 3-4 microsporangia, dehiscence by longitudinal slit. MEGASTROBILI cylindrical or barrel-shaped, erect,

beige at emergence, light to olive-green at maturity, 11-13.5 cm long, 4-5.1 cm in diameter; peduncle heavily tomentose, 2-3 cm long, 1-1.5 cm in diameter; megasporophylls numerous, peltate, spirally inserted along cone axis, distal face hexagonal, bicornate, with olive-green tomentulum on lobulate portion near the horns, long axis 1.8-3.3 cm, short axis 0.6-1.4 cm, 3-4 crests near base of the horns. SEEDS ovate, sarcotesta white when immature turning creamy yellow at maturity, sclerotesta smooth, beige to light-beige with 7-10 visible rays radiating from the micropyle, 1.1-2.1 cm long, 1.1-1.4 cm in diameter. Chromosome number  $2n = 16$ .

*Etymology:* We have assigned the specific epithet of this species in honour of Professor Marco E. Becerra, who collected this taxon for the first time. Professor Becerra (1870-1940) made important historical, linguistic, ethnological and archaeological contributions, as well as carrying out botanical (floristic) and faunistic research throughout his native State of Tabasco. His intellectual life is considered one of the most inquiring and fruitful in its history. He also explored northern Chiapas and made archaeological and botanical discoveries in the Sumidero canyon.

*Other specimen examined:* Tabasco; iv.1914, Becerra s/n (MEXU).

*Habitat:* *Ceratozamia becerrae* grows on karstic rocks in evergreen tropical rainforest or *bosque tropical perennifolio* of Rzedowski (1978) predominated by three strata. In the first stratum, the dominant emergent tree species, between 20 and 40 m tall, are: *Alibertia edulis* A. Rich. ex DC, *Pouteria campechiana* (H. B. & K.) Baehni, *Dialium guianense* (Aubl.) Sandwith, *Ceiba pentandra* (L.) Gaertn., *Trophis racemosa* (L.) Urban, *Sterculia mexicana* R. Br., *Manilkara zapota* (L.) van Royen, *Pouteria sapota* (Jacq.) H.E. Moore & Stearn, *Bernoullia flammea* Oliver, and *Pterocarpus rohrii* Vahl. In the middle stratum, trees between 10 and 20 m tall are commonly found: *Pseudolmedia oxyphyllaria* J. D. Smith, *Alchornea latifolia* Klotzsch, *Casearia nitida* Jacq., *Pouteria campechiana* (H. B. & K.) Baehni, *Nectandra* sp., and *Guarea* sp. The lower stratum contains trees, shrubs and herbaceous plants 1-10 m tall and are represented by: *Astrocaryum mexicanum* Liebm. ex Mart., *Dendropanax arboreus* (L.) Decne. & Planch., *Chamaedorea tepejilote* Liebm., *C. ernesti-augusti* H. Wendl., *Reinhardtia gracilis* (H. Wendl.) Burret, *Geonoma oxycarpa* Mart., *Calathea lutea* G. F. W. Met., *Spathiphyllum blandura* Schott, *Heliconia* sp. (López-Hernández, 1994), and the cycads *Zamia cremnophila* Vovides, Schutzman & Dehgan and *Z. splendens* Schutzman.



**Figure 1.** *Ceratozamia becerrae* sp. nov. A, habit of young male plant; B, leaf highlighting detail of articulation and leaflet veins; C, mature male strobilus; D & E, detail of microsporophyll, abaxial and adaxial surfaces, respectively; F, detail of microsporangia and associated reddish brown tomentum; G, mature female strobilus (vertical scars between sporophyll horns are caused by squirrels); H & I, detail of megasporophyll and ovules (one ovule aborted); J, seed; K, long section of seed showing embryo.

The habitat presents an irregular topography with slopes of up to 70% and cliff faces. The geology of this region comprises Eocene continental marine strata with Oligocene marine inclusions. Its limestone rock has eroded to form a karst topography (López-Mendoza, 1980; López-Hernández, 1994), and the soil is a shallow tropical rendzina. *Ceratozamia becerrae* grows within an altitudinal range of 400-600 m a.s.l.

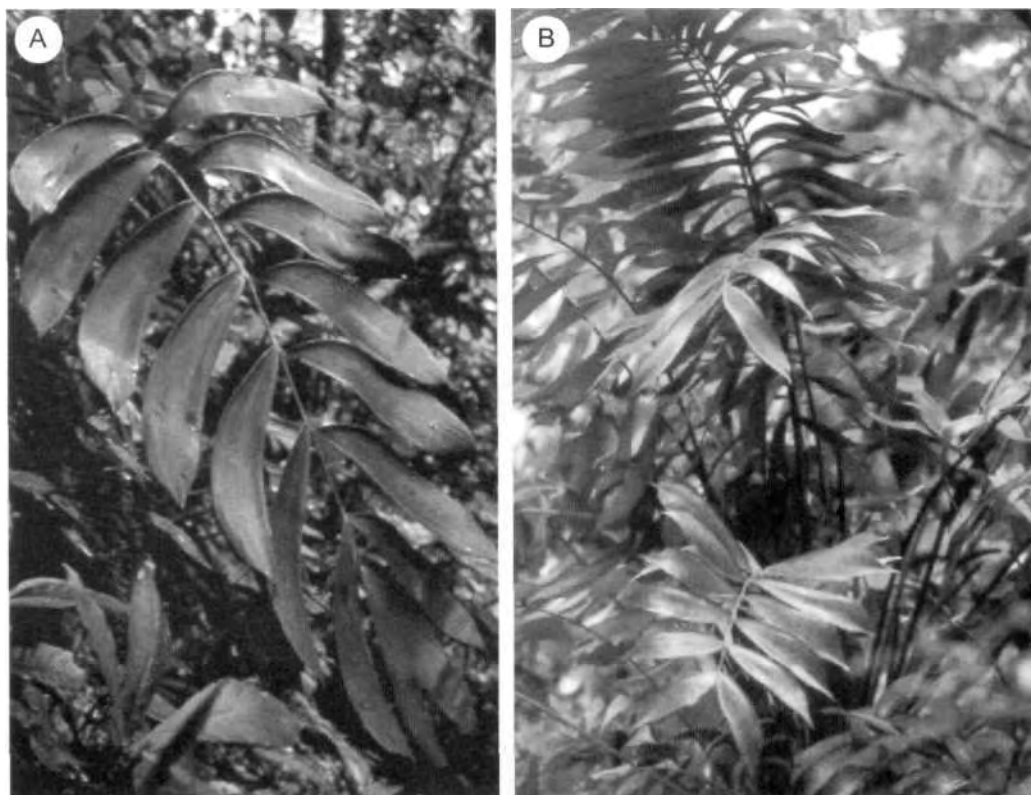
## DISCUSSION

*Ceratozamia becerrae* sp. nov. has affinity with *C. miqueliana* but differs in growth habit of the

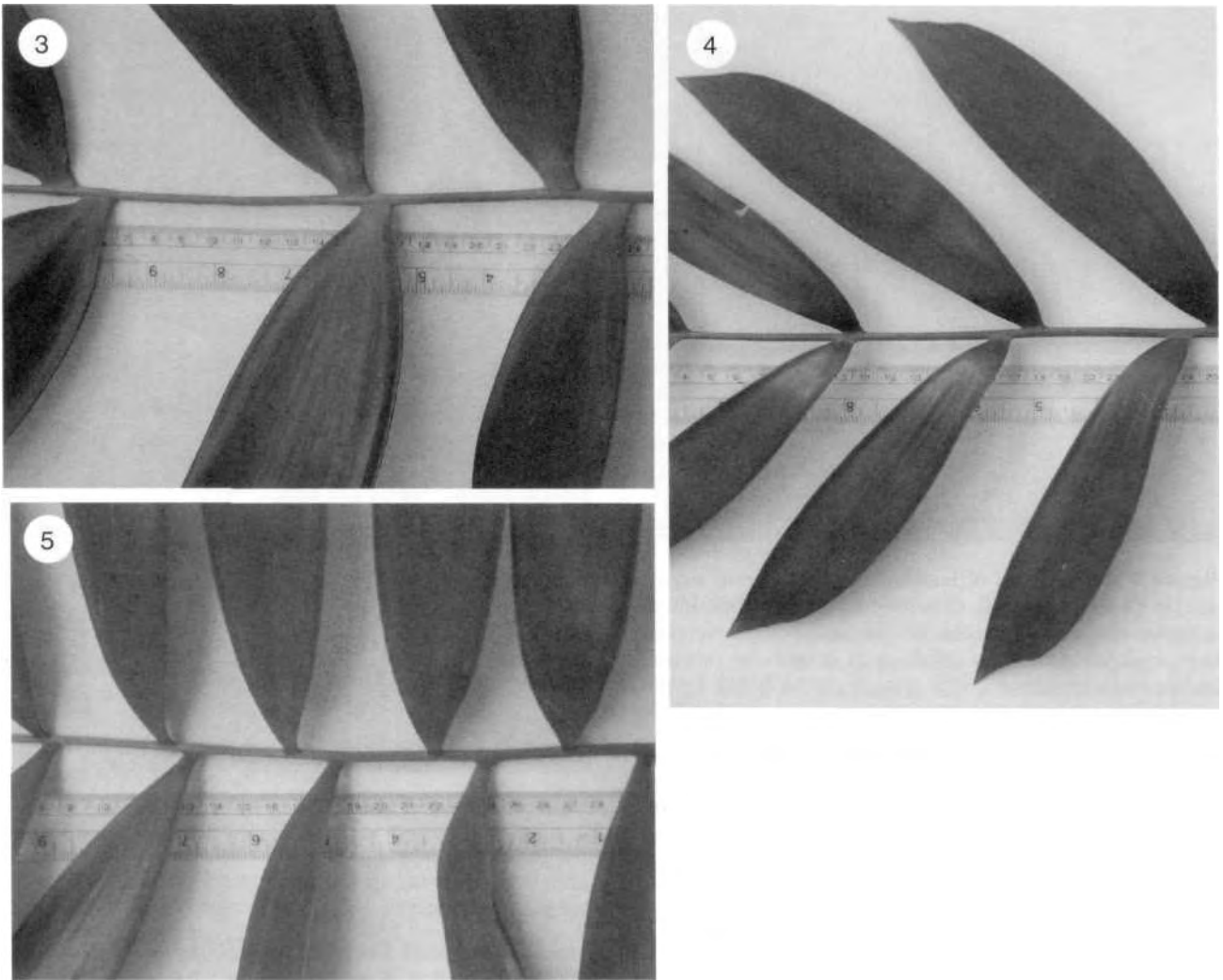
leaves, trunk and petioles. The leaf crown in *C. miqueliana* is erect with a heavily armed petiole, and the trunks become curved with age. The leaf crown in *C. becerrae* consists of fewer leaves (Fig. 2), which are descendent to decumbent and have a greater interleaflet distance when compared to those of *C. miqueliana* and *C. zoquorum* (Figs 3-5). The leaflet shapes in *C. miqueliana* and *C. zoquorum* are long oblanceolate but in *C. becerrae* they are comparatively wider; the articulation in both *C. zoquorum* and *C. becerrae* is similar in that the angle of insertion to the rachis is oblique, but not so in *C. miqueliana* (Fig. 6). The petioles are unarmed and

### KEY SEPARATING *CERATOZAMIA BECERRAE* FROM *C. MIQUELIANA*, *C. ZOQUORUM* AND *C. EURYPHYLLIDIA*

1. Petioles unarmed or very few prickles. Leaflets coriaceous
  2. Leaf 42-75 cm wide, leaflets pruinose, often long oblanceolate, leaflets 3.2-6.5 cm wide, distance between leaflets 1.7-2.4 cm.....*C. zoquorum*
  - 2'. Leaf 21.5-45 cm wide, leaflets glossy, often oblong rarely oblanceolate, leaflets 5.2-9 cm wide, distance between leaflets 5.3-12.8 cm.....*C. becerrae*
- 1'. Petiole heavily armed with prickles. Leaflets papyraceous to moderately membraneaceous
  3. Leaflets not translucent, 4-6.5 cm wide.....*C. miqueliana*
  - 3'. Leaflets translucent 9-16 cm wide.....*C. eurphyllidia*



**Figure 2.** Habitat photos. A, habit of mature *Ceratozamia becerrae* sp. nov.; note descending to decumbent leaf with few leaflets. B, habit of *C. miqueliana*; note ascending leaves with many more leaflets in comparison.

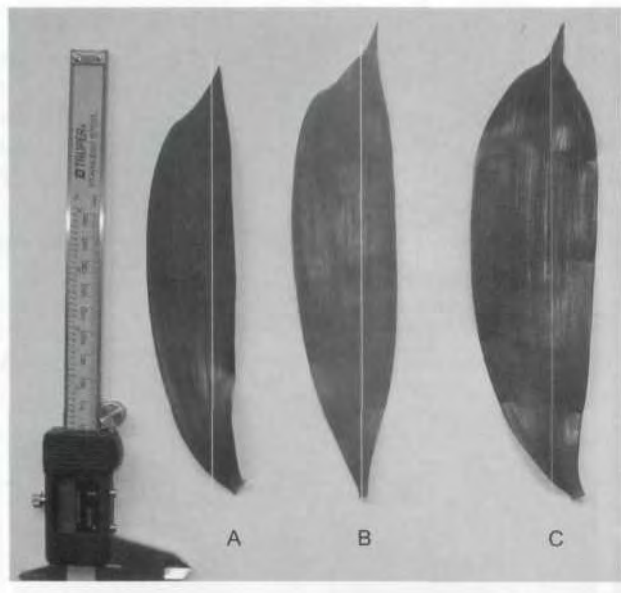


**Figures 3-5.** Detail of leaflet insertion along rachis of *Ceratozamia becerrae* (Fig. 3), *C. zoquorum* (Fig. 4) and *C. miqueliana* (Fig. 5); note the greater distance between leaflets of *C. becerrae* articulation width and angle of insertion.

rarely present prickles, which when present are light, whilst the trunks are globose to subglobose in *C. becerrae*. Although both species bear erect cones, they differ in size and colour: at emergence the megastrobili of *C. miqueliana* are olive-green, whilst those of *C. becerrae* are a light yellowish green (Fig. 7). Both species occur in similar vegetation types, inhabiting the herbaceous layers of tropical evergreen rain forests; however, *C. miqueliana* occurs on basaltic substrate in Veracruz, or on humus rich clay soils in Chiapas, while *C. becerrae* is found only on calcareous rocks forming karst topography. These rain forests form part of the Pleistocene floristic refuges south of the Mexican Trans-volcanic Mountain Range (González & Vovides, 2002) and both these cycad species, along with *C. zoquorum*, *Zamia cremnophila* and *Z. splendens*, appear to be endemic to the

region, which has the highest precipitation in lowland Mexico. This region specifically comprises the 'arc refuge' area of Wendt (1987, 1993), which extends from northern Oaxaca, southern Veracruz and southern Tabasco to northern Chiapas c. 350 km long (east-west) and 75 km (north-south) at its widest. This area is rich in endemics and includes other Pleistocene refuges described by Toledo (1982). These refuge areas of southern México have been postulated as the probable centre of origin for the genus *Ceratozamia* (González & Vovides, 2002).

*Ceratozamia becerrae* is native to the mountains of northern Chiapas and the southern Sierras of Tabasco. Specific locality information has been omitted on purpose in order to discourage illegal commercial collecting of this critically endangered species. Owing to recent expanding agricultural activities and



**Figure 6.** Comparison of leaflets. A, *Ceratozamia zoquorum*; B, *C. miqueliana*; C, *C. becerrae*. Note the differences in leaflet shape and articulation placement (white vertical line as guide); in (B) the articulation is opposite to apex, whereas in (A) and (C), the articulation is offset to the right.

coffee plantations, as well as a forest fire during 1998 that affected severely one of its two known populations, we recommend its inclusion in IUCN Red List Category CRB2 (a-e) (IUCN (1994).

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**Figure 7.** *Ceratozamia becerrae* ripening female strobilus in habitat (vertical scratch marks between sporophyll horns are caused by squirrels).

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