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The cycad *Ceratozamia norstogii* D.W. Stev. (Zamiaceae) from southern Mexico: new information on distribution, habitat and vegetative morphology

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The type locality in Chiapas of the rare and endangered Mexican cycad *Ceratozamia norstogii* D.W. Stev., originally collected by C. A. Purpus in 1925, has been found. This enabled us to emend and illustrate the description of *C. norstogii*, thus clearing up some confusion surrounding the concept of this species. We believe the confusion arose owing to a composite herbarium voucher consisting of unrelated material from apparently different physiographic regions of Chiapas. Two further localities for *C. norstogii* have also been discovered, one in the neighbouring state of Oaxaca. Additional information on its habitat and distribution is presented.

ADDITIONAL KEY WORDS: *Ceratozamia kuesteriana* *Ceratozamic zaragozae* Chiapas ycadales Mesoamerica – Oaxaca.

INTRODUC ION

While preparing a revision of the genus *Ceratozamia* in the state of Chiapas, we encountered some difficulty with the species concept of *C. norstogii sensu* Stevenson (1982). Stevenson had reported the distinctive characters of this species as being short stemmed (less than 50 cm), leaflets strongly rolled, parallel to the longitudinal plane and with straight petioles and rachis. He related it to *Ceratozamia zaragozae* Medellín, which has a spirally twisted rachis with flat, straight to falcate leaflets and is restricted to the state of San Luis Potosí in north-eastern Mexico. From this description we find little affinity between the two taxa. However, his description of *C. norstogii* appears to be more applicable to *C. kuesteriana* Regel from Tamaulipas.

Unfortunately, Stevenson (1982) based his description on herbarium specimens and, at best, on cultivated plants. He was hampered by not being able to examine the plants in their natural habitat, especially that of the type cited below:

Holotype cited (Stevenson, 1982): CHIAPAS: leaves and megasporophylls with immature ovules, *C.A. Purpus 6*! iii–iv. 1925 (US) isotypes US, F. The following paratypes were also cited: CHIAPAS; *Purpus 10006*! 24. ix. 1932 (UC); UNITED STATES. CALIFORNIA; (cultivated material) *Chamberlain s/n*! 13. ix. 1937 (F). FLORIDA; (cultivated material) a male cone collected by *Stanley K. Kiem s/n*! 14. vi. 1971 and leaves added at a later date to this voucher by *J. Watson s/n*! 26. vi. 1981 (FTG); A female cone and seed from a cultivated plant at FTG was also cited (access no. 69-421B) that is no longer available.

REVISION OF MATERIAL AND FIELD STUDIES

During this study the above mentioned vouchers were examined and also extensive field studies carried out, especially at the type locality and surrounding areas. We came to the conclusion that the description in Stevenson (1982) was based upon various herbarium vouchers of distinct taxa and populations, thus giving rise to a confusion in the species definition of *C. norstogii*. The leaf voucher of *J. Watson s/n* corresponds

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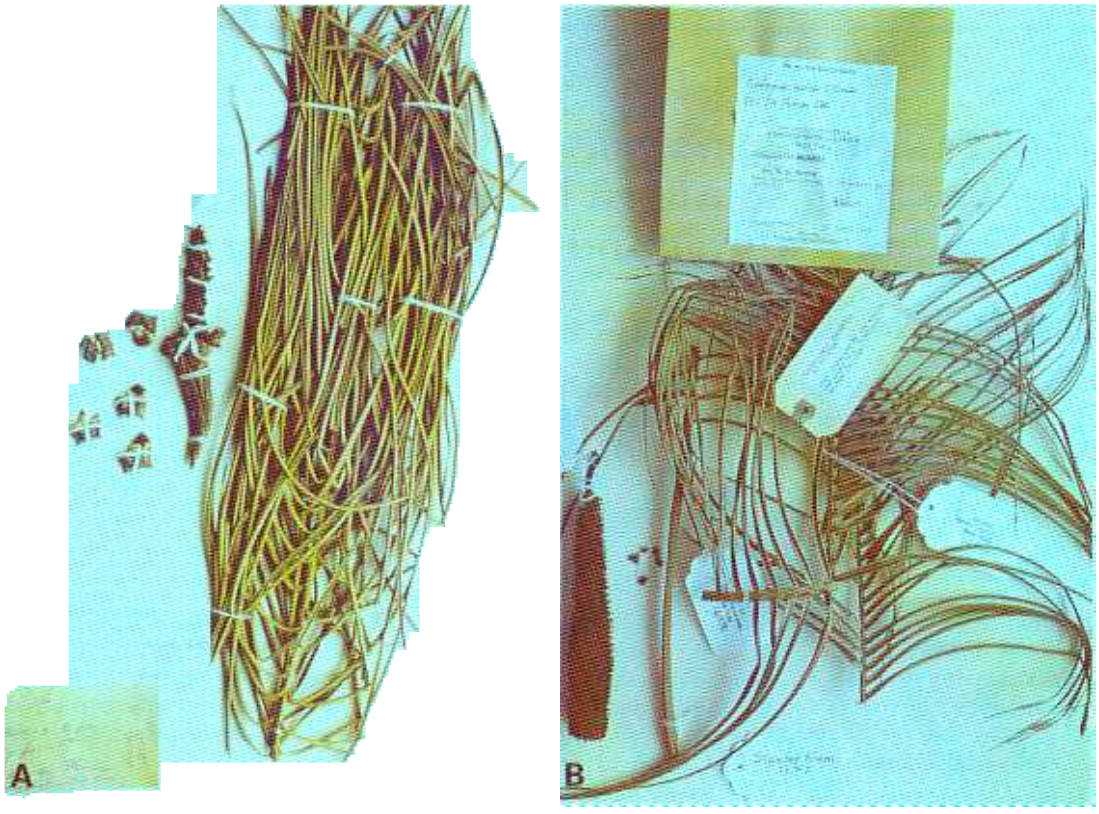

Figure 1. A and B, *Ceratozamia norstogii*; type voucher *C.A. Purpus 6* (US); B, *Ceratozamia* sp. voucher *Stanley K. Kiem s/n*! 14. vi. 1971 and leaves added at a later date to this voucher by *J. Watson s/n*! 26. vi. 1981 (FTG).

to a *Ceratozamia* whose principal characteristics are a straight petiole and rachis (Fig. 1B), whilst the designated type voucher of *C.A. Purpus 6* (Fig. 1A) and paratype *C.A. Purpus 10006* correspond to a *Ceratozamia* with twisted petiole and rachis. In order to verify this, the type locality was visited at "Ejido El Fenix" (reported by Stevenson [1982] as "Rancho Fenia"). This locality was known, at the time of Purpus, as "Rancho Fenix" and was in fact one of Purpus's classical collecting localities (Sousa-Sánchez, 1969). The Spelling "Fenia" of Stevenson (1982) for this locality was a transcription error due to the label on a voucher Purpus sent to Dr Rose where the letter "x" in Fenix appears as an "a" (Fig. 1A). The *Ceratozamia* population found at this locality indeed corresponds to the specimen of *C.A. Purpus 6* in having twisted petioles and rachis.

We therefore present the following description of our concept of *C. norstogii* based upon field studies and material collected at the type locality.

DESCRIPTION

Ceratozamia norstogii D.W. Stev. Brittonia 34: 181–184 (1982) (Figs 2, 3)

Trunk partially subterranean, unbranched, subglobose becoming cylindrical with age 12–130 cm tall, 13.7–22 cm diameter. Leaves pinnate, up to 15 or more forming an erect crown 69.5–134.7 cm long, 52–95 cm wide. Petiole and rachis spirally twisted, petiole 9.5–38.5 cm long. Rachis 43–84.5 cm long, petiole and rachis armed with short prickles 0.1–0.5 cm long, diminishing in frequency toward the rachis. Leaflets 33–65 pairs, linear, subfalcate to undulate, heavily channelled, olive-green on adaxial surface, light green on abaxial; alternate along the base of the rachis, alternate to subopposite toward mid region and leaf apex; coriaceous, apex acute, base attenuate; margin entire, subrevolute, 22.8–57 cm long, 0.3–0.5 cm wide, veins 4–7, distance between veins 0.5–1 mm. Microstrobilus conical, olive-green to light green upon emergence, creamy-yellow to pale yellow when mature, 25–36 cm long, 3.8–5.1 cm diameter, peduncle tomentose 4.5 cm long 1.5–1.7 cm diameter. Microsporophylls indefinite, inserted spirally on axis forming apparent vertical rows, cuneiform, bicornate on distal sterile portion, 1–1.4 cm long, 0.8–1.1 cm wide. Megastrobilus cylindrical to barrel shaped, olive-green at emergence, dark brown upon maturity, 21–37 cm long, 9.1–13.1 cm diameter, peduncle tomentose, 6–10 cm long, 0.8–1.9 cm diameter, megasporophylls peltate, distal face hexagonal bicornate, distal to proximal

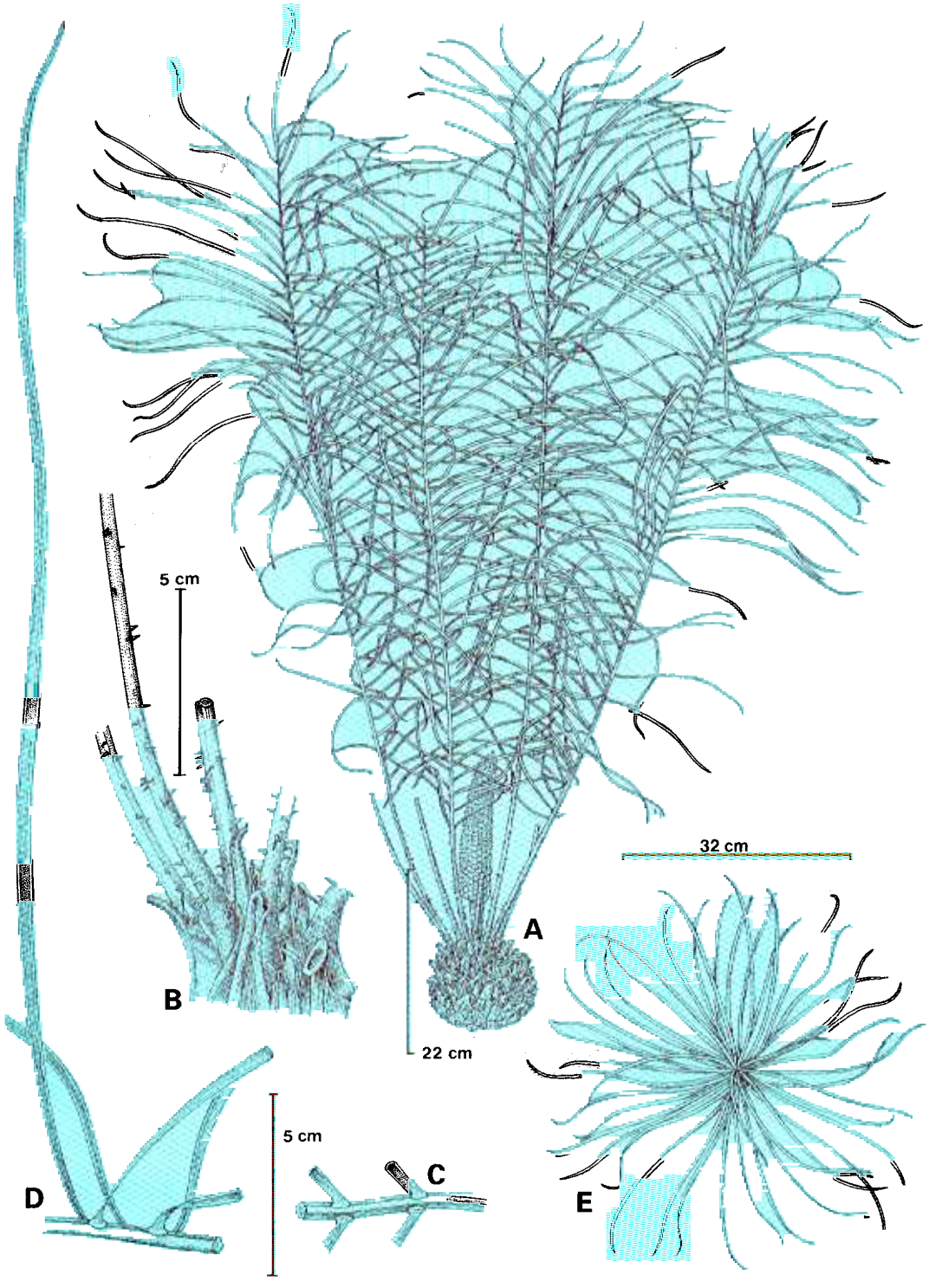

Figure 2. *Ceratozamia norstogii*. A, plant habit; B, detail of cataphylls and petioles; C, adaxial view of leaflet articulations; D, detail of leaflet; E, view of leaf from top emphasizing the twisted rachis.

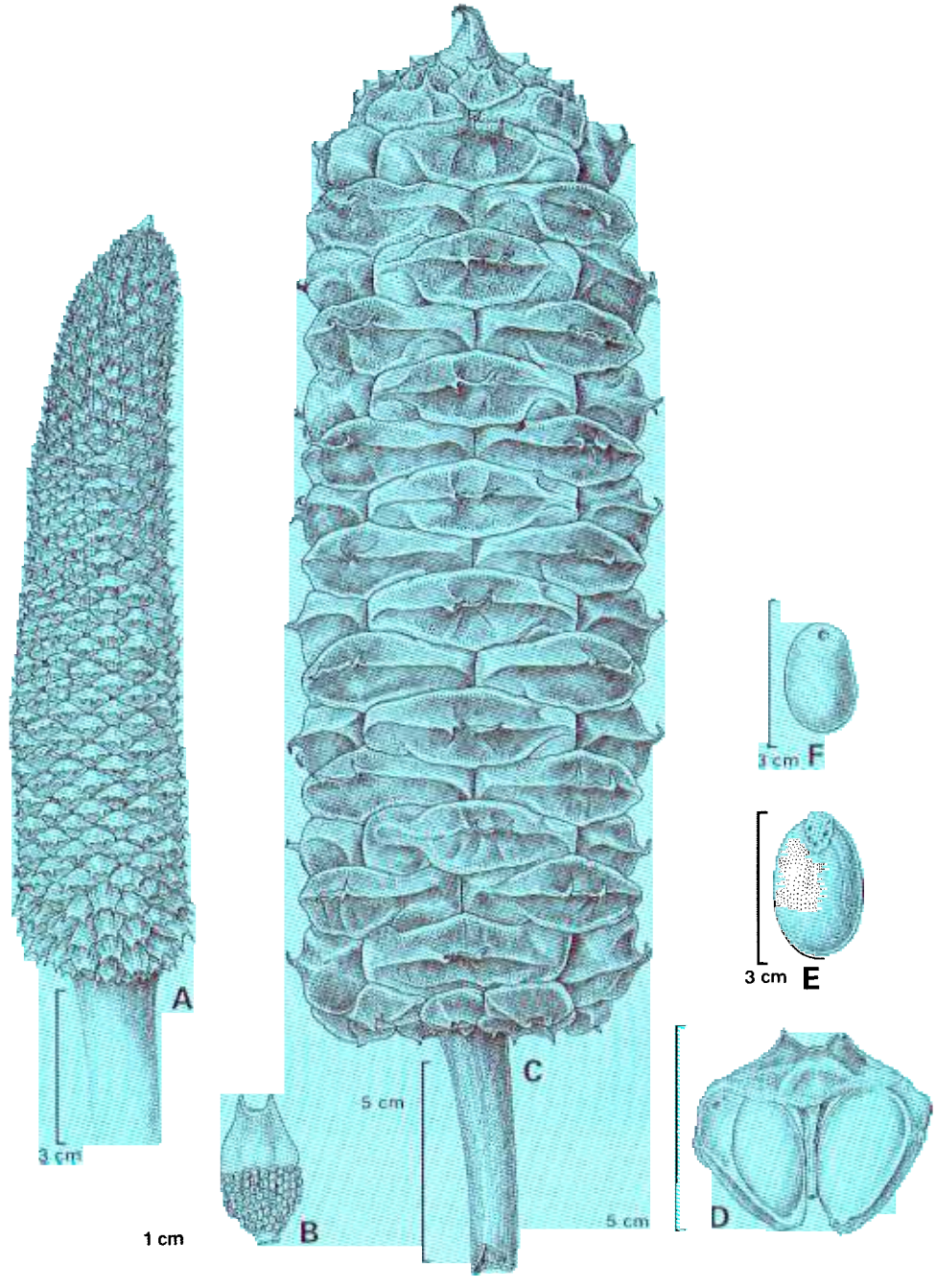

Figure 3. *Ceratozamia norstogii*. A, microstrobilus; B, microsporophyll, abaxial view showing microsporangia; C, megastrobilus; D, megasporophyll with ovules; E and F, detail of seed.

dimension 4.1–5.5 cm, long axis of face 3.8–5.2 cm, short axis 1.1–2.2 cm, distance between horns 0.7–1.2 cm. Seed ovoid-angular, sarcotesta yellowish-white when immature, light brown upon maturity, sclerotesta creamy-beige 2.4–2.9 cm long, 1.5–2.1 cm diameter with 6–11 lines radiating from the micropile. Chromosome count $2n = 16$.

The outstanding characteristics of this species are the twisted rachis and the narrow undulate-channeled leaflets.

Table 1. Morphological differences between *C. norstogii* and *C. zaragozae*

Characters	*C. norstogii*	*C. zaragozae*
Trunk	Unbranched, 12–130 cm long	Branched, 9–20 cm long
Leaflets	Channeled olive-green	Plane dark green
Microstrobilus	25–36 cm long, 3.8–5 cm diameter	10–20 cm long, 2–3 cm diameter
Megastrobilus	Erect 21–37 cm long, 9–13 cm diameter	Decumbent 8–12 cm long, 6–7 cm diameter

Other vouchers examined: *C. norstogii*: Chiapas; *Pérez-Farrera, M.A. 71, 775* (CHIP); *Vovides, A.P 1230* (XAL); *Palacios E. 375* (CHIP); *Breedlove 4431*, (CAS); *Breedlove & Smith 21813, Breedlove 24709*, (CAS). Oaxaca; *S. Salas E; Torres H. Morales 1173* (SERBO).

Not in Index Herbariorum; Sociedad para el Estudio de los Recursos Bióticos de Oaxaca, A.C. (SERBO). Address: Porfirio Díaz 211, A.P. 533, Oaxaca, Oax. 68000 Mexico.

HABITAT

The vegetation of the type locality is principally oak forest in the geographical province of the northern mountains of Chiapas (Müllerried, 1957). The predominant species are *Quercus magnoliifolia* Née, *Quercus elliptica* Née, *Pinus oocarpa* Schiede, *Calliandra houstoniana* (Mill.) Standl., *Canavalia hirsuta* (M. Martens & Galeotti) Standl., *Anthurium cerrobaulense* Matuda, and *Elaphoglossum latifolium* (Sw.) J. Sm.

DISTRIBUTION

Ceratozamia norstogii has also been found at a further locality in the same physiographic province in Chiapas in a higher rainfall area, forming cloud forest according to Rzedowski (1978). The predominant species here are *Liquidambar styraciflua* L. var. *mexicana* Oerst., *Ulmus mexicana* Liebm., *Zinoweiwia integerrima* Turcz., *Weinmannia pinnata* L., *Styrax argenteus*, C. Presl. and *Quercus* spp. Recent explorations have also shown that *C. norstogii* also occurs in one locality in the neighbouring state of Oaxaca between 800 and 1600 m elevation.

DISCUSSION

The German botanist C. A. Purpus, resident in Mexico in the early 1900s, explored Chiapas during the period 1913–1925 and collected material from and around the Hacienda Monserrat which included the type locality of *C. norstogii* known then as Finca (Rancho) Fénix (Miranda, 1952; Sousa-Sánchez, 1969; Breedlove, 1981). This locality has been converted into Ejido Fénix (after the Mexican Agrarian Reform). The majority of Purpus's collections were deposited at the following herbaria – DS, MEXU BM and US (Miranda, 1952).

Ceratozamia norstogii shares some vegetative characteristics with *C. zaragozae*, especially petiole morphology and twisted rachis, but differs in leaflet form, trunk and cone morphology; the outstanding features are illustrated in Table 1.

We have deduced that the confusion associated with *C. norstogii* as described by Stevenson (1982) has largely been due to the composite vouchers of Kiem and Watson (Fig. 1B). These vouchers consist of material from apparently different physiographic regions of Chiapas (specimens characterized in having a straight petiole and rachis) to the type assigned (*C.A. Purpus 6*). It appears that the description by Stevenson (1982) was hampered by both the lack of precise locality information on the Kiem and Watson vouchers and knowledge of the physiographic regions of the state of Chiapas. This, quite understandingly, led him to consider a much wider and polymorphic species concept of *C. norstogii*.

The plants examined from the new localities reported during this study are morphologically similar to *Purpus 6*. No appreciable variation from that of plants at the type locality has been seen within or between these newly discovered populations. This leads us to reject a polymorphic species concept of *C. norstogii*. Specimens collected by us that correspond to the Kiem and Watson vouchers are a separate taxon (see companion paper, pp. 81–86) from a distinct mountain system of Chiapas: the Sierra Madre del Sur, according to Müllerried (1957).

Precise locality information of the new populations discovered during this study has been purposely omitted in order to avoid commercial collecting of the cycads leading to their decimation. This has already happened at the type locality and a nearby habitat where heavy commercial collecting took place soon after the species publication in 1982 (Dehgan, 1983). Very few plants now survive.

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