

**A NEW SPECIES OF CERATUZAMIA (ZAMIACEAE) FROM OAXACA,
MEXICO WITH COMMENTS ON DISTRIBUTION, HABITAT, AND
RELATIONSHIPS**

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ABSTRACT

Ceratozamia whitelockiana spec. nov., from Oaxaca, México is described and illustrated. The species differs from others in the genus in the upright habit of its few, large, glaucous, pea-green leaves with comparatively long petioles and relatively small megastrobili and microstrobili. It is most closely related to *Ceratozamia miqueliana* Wendland (Vovides *et al.* 1983; Stevenson *et al.* 1986); having similar cones, caudex, and leaf color but differs in the habit, size, and shape of the leaves. *Ceratozamia whitelockiana* is known only from the drainage of the Río Valle Nacional, at elevations from 335 to 975 m.

KEY WORDS: *Ceratozamia*, México, Oaxaca, Zamiaceae, systematics

CERATUZAMIA WHITELOCKIANA Chemnick & Gregory, *spec. nov.* TYPE: MEXICO. Oaxaca: Vicinity of Metates, south of Valle Nacional, May 1995, *Chemnick & Gregory 5* (HOLOTYPE: HNT; Isotypes: to be distributed to FTG & XALU. Cultivated specimens at GannaWalska Lotusland, Santa Barbara, California; Mildred Mathias Botanic Garden, UCLA, California; and UCSB Greenhouse, Santa Barbara, California.

Truncus semihypogaeus, ad 30 cm altus; cataphylla lanata, triangularia, 5 cm longa basi 5 cm lata; folia pauca, usque 5, glauca; petiolus teresve, 2.0-2.5 m longus, parte infima dilatatus, pauca spinis armatus; rachis subteres, supra bisulcata, in dimido inferiore, paucis spinis armata, supra fere inermis vel inermis, in cuspidem 10-25 mm longam excurrans; foliola opposita vel subopposita, 30-40 juga, lanceolata vel falcata, 30-50 cm longa, 30-38 mm lata, papyracea, pisacea, tenuia, basi attenuata, apicem attenuata, margine integerrima, revoluta; 22-27 nervis moderata; strobilus microsporangiatiss linearis-cylindricus, 26-28 cm longus, 15-28 mm latus; pedunculus tomentosus, 20-30 mm longus, 11-15 mm latus; strobilus megasporangiatiss cylindricus, apice mucronatus, 14-18 cm longus, 7.5-10.0 cm latus; pedunculus 1-2 cm longus.

MORPHOLOGY

Stem solitary, semihypogeous, moderately short (20-30 cm), cylindric (12-18 cm in diameter), covered by rough, irregular persistent leaf and cataphyll bases, brownish-red; cataphylls wrinkled, stipulate, triangular, densely white hairy at crown, irregularly arranged on lower portions of stem, 5 cm wide and 5 cm long; leaves 2.0-2.5 m long, usually in whorls of 2-4, recently-emerged and juvenile leaves glaucous on both surfaces, light pea-green, older leaves glabrous, uniformly medium-green on both surfaces, adult plants with up to 2 previous whorls of leaves; petiole 1.00-1.25 m long, terete with an expanded base, 15 mm in diameter at base and tapering gradually to 8 mm at the first leaflet, sparsely armed with simple spines (1-3 mm), spines more densely distributed proximally and becoming sparse distally; rachis nearly straight, subterete, very sparsely armed on proximal 25%, ending in conical-linear apex 10-25 mm long and unarmed; adaxial surface is flattened and shallowly bisulcate with leaflets inserted in the paired grooves up to 5 mm apart, the paired grooves arising distally to the first pair of leaflets; leaflets linear lanceolate to falcate, papyraceous, the median leaflets 30-50 cm in length, gradually attenuate, 30-38 mm in width with 22-27 veins slightly raised on abaxial surface, 30-40 "pairs" inserted on 25-50 mm centers, opposite to sub-opposite, 9-12 mm wide at point of attachment on rachis, margins are slightly revolute and turned upward, basal 25-30% of leaf keeled becoming flattened distally, leaflets gradually reduced in length towards apex; microsporangiate strobilus elongate-conical, solitary, 26-28 cm in length, 28 mm in diameter at base, 15 mm in diameter distally, mucronate, peduncle 20-30 mm in length and 11-15 mm in diameter, tomentose to wooly; microsporophylls 8 mm wide and 3 mm long, sporangia in a single patch, olive green; megasporangiate strobilus cylindrical to ovoid with a large apiculum, solitary, overall length 14-18 cm and diameter 7.5-10.0 cm at maturity, apiculate cap 1.5-3.0 cm in length and 3-5 cm in width, megastrobilus borne on a short peduncle 30-38 mm long and 18-20 mm wide; megasporophyll length 2.5-3.0 cm, sporophyll face 3.5-5.0 cm wide and 17-23 mm long, inner face somewhat glabrous except for the moderately rolled margins which are gray tomentose; sporophyll horns divergent to either side of the sporophyll up to 10 mm long, only slightly raised from the sporophyll face, outer edges grey and tomentose, horns joined by a wrinkled raised edge; megastrobilus with short purple hairs sparsely scattered on sporophyll face and sarcotesta where exposed between megasporophylls which are widely separated at maturity by the fully-developed seeds; sarcotesta white, soon turning brown as it ripens; 31-33 mm long, 25-27 mm wide; sclerotesta irregular, ovoid, tan, 24-26 mm long, 18-20 mm wide, smooth with 8-9 indistinct longitudinal ridges.

Etymology: The species is named to honor Mr. Loran Whitelock of Los Angeles, CALIFORNIA for his remarkable dedication and contribution to cycad biology and awareness throughout the world.

DISTRIBUTION AND HABITAT

Ceratozamia whitelockiana is known only from the drainage of the Río Valle Nacional in montane tropical forest within the range of 335-973 m, but occurs more commonly at lower elevations (335-600 m). Habitat consists of very steep slopes

with small pockets of remnant primary forest now covered mostly by coffee and banana groves and secondary growth. The patchy canopy consists of emergent trees to 40 m covered with epiphytes. *Ceratozamia whitelockiana* occurs on heavily shaded east- and west-facing slopes in primary forest with *Chamaedorea* sp., *Geonoma* sp., *Melastoma* spp., *Acanthus* sp., *Ficus* sp., *Begonia* sp., *Selaginella* sp. Soil is light-colored crumbly, rocky clay with outcroppings of sedimentary rock. *Ceratozamia whitelockiana* growing in exposed, deforested areas have extremely bleached, yellow leaves. The entire locality is rapidly being cleared and burned and thus this cycad must be considered endangered. In our most recent survey of the locality in May, 1995 we found approximately 250 plants during 3 days of field work. The same areas were visited several times in 1979, 1980, and 1981 and the population of *Ceratozamia whitelockiana* was considerably larger then, perhaps by twice as many individuals. Since this cycad is seldom seen in collections, it appears that habitat destruction is the greatest threat to its existence. The more inaccessible reaches of the Rio Valle Nacional drainage are likely to contain many pocket populations of *Ceratozamia whitelockiana* but the rapid rate of deforestation will soon reach areas that are currently inaccessible. In May 1995, the smoke from clearing fires was intense and recently cleared fields, as evidenced by still fresh, charred remains, were spread throughout the drainage like a patchwork quilt. This cycad does not seem to persist in open situations or in second growth forest for very long. The only plants we found in cleared areas were artificially maintained by local farmers and appeared bleached and chlorotic.

RELATIONSHIP TO OTHER SPECIES OF *CERATOZAMIA* AND DISCUSSION

The current state of taxonomy within the genus *Ceratozamia* is confused, ambiguous, and incomplete. Three of the most widespread taxa, both in the wild and in cultivation, *C. mexicana* Brongniart (Vovides *et al.* 1983; Stevenson *et al.* 1986), *C. robusta* Miquel (Vovides *et al.* 1983; Stevenson *et al.* 1986), and *C. latifolia* Miquel (Vovides *et al.* 1983; Stevenson *et al.* 1986) are based on vague and obscure descriptions and neotypifications. Locality information is either non-existent or too generalized. Important morphological data such as male and female cone descriptions are incomplete or omitted. When considered from historical perspective, the neotypifications assign the above specific epithets to localities of *Ceratozamia* which do not necessarily correspond to the most likely localities where the original authors and collectors might have been in the mid 1800's when access into México was much more restricted than today. The many isolated populations, forms, ecotypes, and varieties of the large-leaved *Ceratozamia* have been treated within the above three taxa with apparently little regard for valid character differences that in some cases might suggest separation at the species level.

Ceratozamia whitelockiana is distinguished from the other large-leaved *Ceratozamia* as follows: *C. mexicana* has smooth, dark brown, globose stems to 1 m tall and 20 cm in diameter; numerous, glabrous, dark-green, arching leaves which are heavily armed with numerous spines; megastrobili which are on average 35 cm long and 12 cm in diameter borne on a peduncle 10 cm long; microstrobili which are on average 38-43 cm long and 7-8 cm in diameter borne on a peduncle 8-10 cm long and 2.5 cm in diameter. *Ceratozamia whitelockiana* has rough, cylindrical reddish stems that are much smaller than *C. mexicana* and its few, sparsely-armed, upright, glaucous, pea-green leaves with long petioles are strikingly different than the leaves of *C. mexicana* as are the much smaller male and female cones of *C. whitelockiana*.

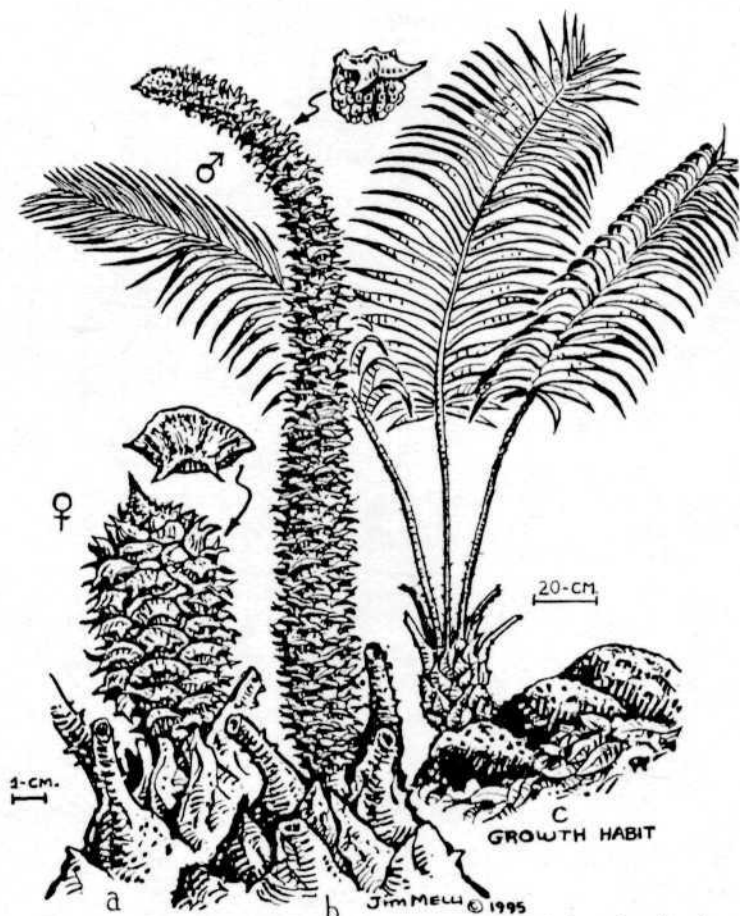


FIG. 1 - *Ceratozamia whitelockiana*. a, megasporangiate strobilus at pollination. b, microsporangiate strobilus after shedding pollen. c, growth habit.

Ceratozamia latifolia stems are globose, light brown, and frequently sucker, especially in cultivation; leaves are 90-150 cm; leaflets are coriaceous, unequally attenuate, slightly overlapping, 20-30 cm long and 33-43 mm wide. *Ceratozamia whitelockiana* stems are solitary, even in cultivation; leaves are 2.0-2.5 m long; leaflets are papyraceous, 30-50 cm long, 30-38 mm wide, and not overlapping.

Ceratozamia robusta has very large stems to 1.5 m, numerous, heavily-armed, glabrous dark-green leaves to 2.25 m, megastrobili on average 38 cm long and 15.25 cm in diameter borne on a peduncle 7.5 cm long and 28 mm in diameter, microstrobili 45 cm long and 8 cm in diameter. *Ceratozamia whitelockiana* is a much different plant than *C. robusta* based on many characteristics, but especially in the detail of the male and female cones which, as reproductive structures, are characters of the highest weight.

We stress the differences between these two taxa because in Stevenson *et al.* (1986), figure 7, indicates three populations of *Ceratozamia robusta* in north central Oaxaca. One of these populations appears to occur in the drainage of the Río Valle Nacional. Similarly, in their paper on the distribution of *Ceratozamia*, Moretti *et al.* (1980), figure 1, identifies several populations in northern Oaxaca belonging to the *C. mexicana* complex. The localities are not described in the detailed text that precedes the illustration but the placement of one of those populations would appear to be in the Río Valle Nacional drainage. We have searched extensively for other *Ceratozamia* in the drainage of the Río Valle Nacional, from the municipality of Valle Nacional up to 2,200 meters but have only found *C. whitelockiana*.

It is noteworthy that *Ceratozamia whitelockiana*, *C. robusta*, and *C. mexicana* retain their respective phenotypes even when cultivated for many years under varying conditions. We have grown all three taxa for over fourteen years and found that cultivated individuals are easily distinguished. We make this observation with respect to remarks in Stevenson *et al.* (1986a) regarding the validity of *C. microstrobila* Vovides & Rees. Stevenson *et al.* (1986a) assert that *C. latifolia* and *C. microstrobila*, are the same because "when cultivated in conditions of high moisture and deep shade, plants assignable to *C. microstrobila* 'turn into' plants of *C. latifolia*. Conversely, when plants assignable to *C. latifolia* are exposed to conditions that are dry with high light intensity, they 'turn into' plants of *C. microstrobila*. In our opinion, the plants that have been referred to *C. microstrobila* are nothing more than forms of *C. latifolia* that are phenotypical expressions of environmental conditions. Therefore, we recognize only *C. latifolia* and consider *C. microstrobila* to be a synonym." However, a careful character examination of these two taxa reveals a host of differences that justify separation at the species level. We have similarly cultivated both taxa for seventeen years and have observed cultivated specimens of numerous individuals of both taxa in other gardens and collections, and have never seen the alleged change of phenotypic expression whereby one taxon "turned into" the other, regardless of whether the individuals were grown in full sun, heavy shade, or even in the greenhouse. Therefore we reject the assertion that *C. latifolia* and *C. microstrobila* are synonymous but rather that each is a distinct species. Similarly, we reject any *ad hoc* hypothesis that *C. whitelockiana* is merely an ecotype of *C. robusta* or *C. mexicana*.

Ceratozamia miqueliana has 7-10 leaves that are distinctively different from those of *C. whitelockiana*. The leaflets are fewer (about 15 pairs), wider (60-65 mm),

unequally and abruptly attenuate. The petiole is heavily armed with long, curved spines which is in stark contrast to that of *C. whitelockiana*, which is much longer overall and sparsely armed with much shorter spines. However, there are many similarities between *C. whitelockiana* and *C. miqueliana* that suggest an affinity between the two taxa. Both species have subterranean to shortly arborescent stems of similar size, shape, and color; each with rough, wrinkled, irregular leaf bases and brownish-red cataphylls. Both species have juvenile and adult emergent foliage which is a very distinctive glaucous, pea-green color which matures into papyraceous, slightly revolute leaflets. The mature foliage retains the glaucous coating for some time, eventually giving way to a more glabrous, medium green color in old age. Male and female cones of both taxa are of similar size. The megastrobilus in *C. miqueliana* averages 11 cm long and 6.5 cm wide and is borne on a short peduncle 30 mm long. In *C. whitelockiana*, it averages 15 cm long and 8 cm wide and is borne on a short peduncle 30-38 mm long. The microstrobilus is 20 cm long and 4.5 cm wide in *C. miqueliana* and 26 cm long and 25 mm wide in *C. whitelockiana*. The closest population of *C. miqueliana* to *C. whitelockiana* is approximately 150 km.

Since cytological and genetic evidence currently does not yield any measurable character differences upon which to base species differentiation within the genus (Walters *et al.* 1991), classic taxonomic consideration of characters and weighting of those characters is our basis for conferring specific status to *Ceratozamia whitelockiana* and assigning it to the "*miqueliana* group" which also includes the various forms of *C. miqueliana* and *C. euryphyllidia* Vazquez Torres, Sabato, & Stevenson. It is our hope that workers will continue to investigate *Ceratozamia* in detail to determine the disposition of the many populations and types currently being lumped into vaguely conceptualized and incompletely described taxa that generate confusion and uncertainty rather than create the order, predictability, and sense that responsible taxonomy is supposed to serve.

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LITERATURE CITED

- Moretti, A., M. Vazquez-Torres, & S. Sabato. 1980. The distribution of *Ceratozamia* Brongn. (Zamiaceae). *Delpinoa* 21:13-21.
- Stevenson, D.W., S. Sabato, & M. Vazquez-Torres. 1986a. A new species of *Ceratozamia* (Zamiaceae) from Veracruz, Mexico with comments on species relationships, habitats, and vegetative morphology in *Ceratozamia*. *Brittonia* 38:17-26.

- Stevenson, D.W. & S. Sabato. 1986. Typification of names in *Ceratozamia* Brongn., *Dion* Lindl., and *Microcycas* A. DC. (Zamiaceae). *Taxon* 35:578-584.
- Vovides, A.P., J.D. Rees, & M. Vazquez-Torres. 1983. Zamiaceae in Flora de Veracruz., Fasciculo 26, INIREB, Xalapa, Veracruz, México.
- Walters, T.W. & D.S. Decker-Walters. 1991. Patterns of allozyme diversity in the West Indies cycad *Zamia pumila* (Zamiaceae). *Amer. J. Bot.* 78:436-445.