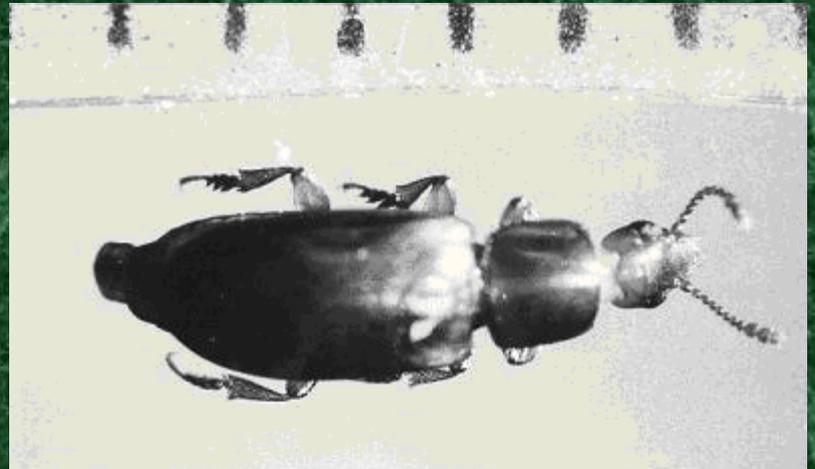


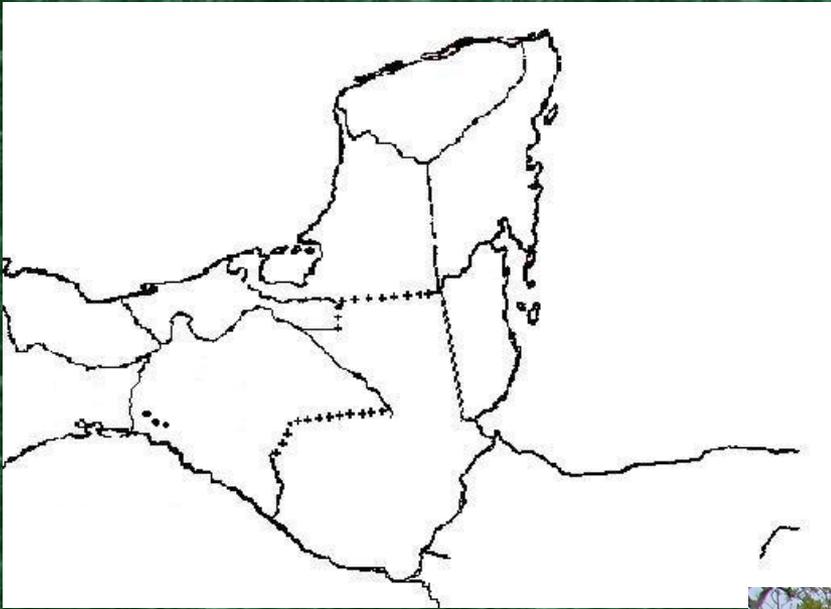
# Ceratozamia mirandae

Miguel A. Pérez-Farrera



*Ceratozamia mirandae* is a medium to large sized with trunks up to one meter long which are erect or prostrate topped with an ascending to spreading crown of up to 23 pinnate leaves approximately. It is entomophilous which accords with that reported by De La Cruz (1999) and only langurid beetles have been observed





*Ceratozamia mirandae* is endemic to the Sepultura Biosphere Reserve along the west of Sierra Madre of Chiapas. It grows in Oak forest and evergreen cloud forest between altitudinal ranges from 900 to 1,200 meters above sea level





The pine-oak forests that are the cycads 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 have affected the cycad populations, including the locality studied within the La Sepultura Biosphere Reserve





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

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Received April 2000; accepted for publication February 2001

*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* Mq.) in Guatemala and Belize. Recently a *Ceratozamia* species has been reported from Honduras (Whitelock, 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 Balducci, 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 *Microcyces* 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, 82–106 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 linearis-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.

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## Systematic studies



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

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Received March 2000; accepted for publication November 2000

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 amend 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.

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**ADDITIONAL KEY WORDS:** *Ceratozamia kuesteriana* – *Ceratozamia saragozoi* – Chiapas – Cycadales – Mesoamerica – Oaxaca.

### INTRODUCTION

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 saragozoi* 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:

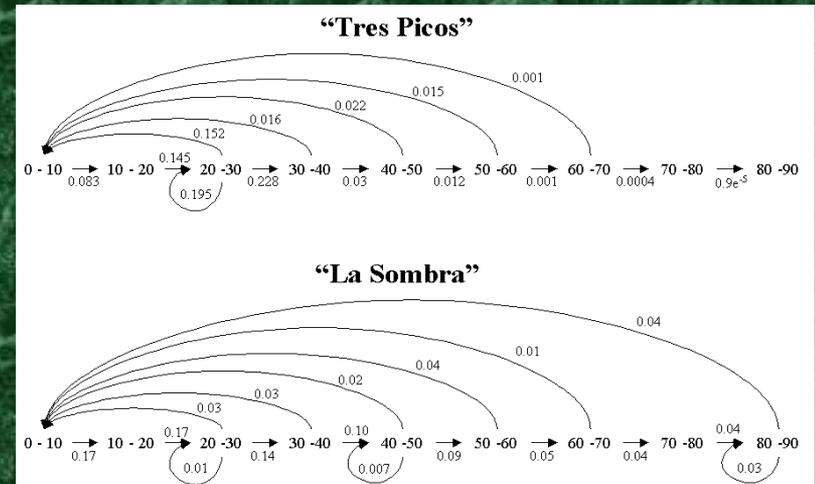
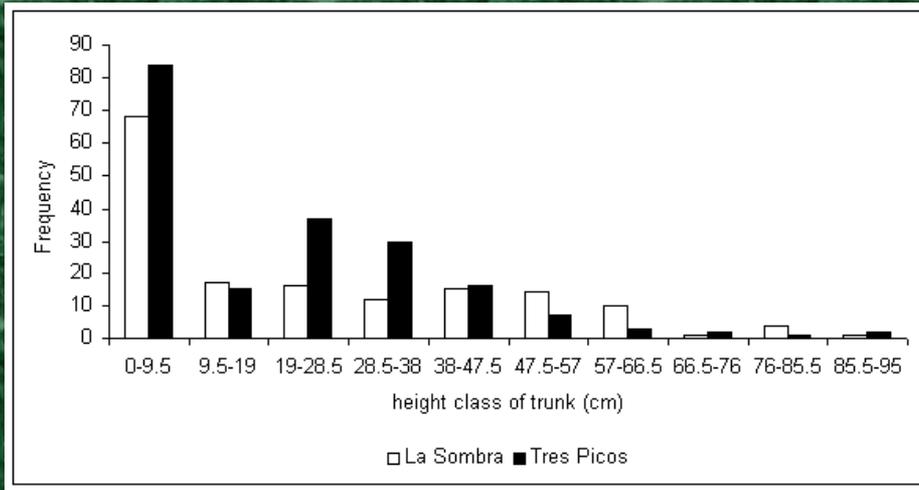
Holotype cited (Stevenson, 1982): CHIAPAS: leaves and megasporophylls with immature ovules, C.A. Purpus 61 iii–iv, 1925 (US) isotype US, F. The following paratypes were also cited: CHIAPAS: Purpus 1800/81 24, 11, 1932 (UC); UNITED STATES: CALIFORNIA: (cultivated material) Chamberlain s/nl 13, 11, 1937 (F); FLORIDA: (cultivated material) a male cone collected by Stanley E. Koenig s/nl 14, vi, 1971 and leaves added at a later date to this voucher by J. Watson s/nl 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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# Demographic studies



Mortality is high during the seedling stages of the life history due to the prolonged droughts and fires in its habitats

Table 1. Demographic parameters of the two populations of *C. mirandae* in the *Sepultura Biosphere Reserve*.  $r$ : intrinsic population growth rate;  $R_0$ : net rate of population turnover;  $\lambda$ : finite population growth rate estimated from life table data;  $V_x$ : reproductive value (individuals per female);  $Ex$ : life expectancy.

Population	$r$	$R_0$	$\lambda$	$V_x$	$Ex$
"La Sombra"	0.57	5.85	1.77	20 - 30 cm = 11.27	10 - 20 cm = 4.95
"Tres Picos"	0.84	8.2	2.33	10 - 20 cm = 13.18	10 - 20 cm = 4.06

Height	Mean	Increment	Mean	Residence	Age
Class	total		leaves		(year)
(cm)	bases		/year		
0–10	42.6		1.44	30	30
10–20	123.07	80.5	1	80.5	110.5
20–30	565.68	442.61	2.5	117	227.5
30–40	985.71	420.03	3.67	114	341.5
40–50	1408.2	422.46	7	60.4	401.9
50–60	1721.2	313.05	7.8	40.1	442
60–70	1985	263.77	12	22	464
70–80	1996.1	11.15	16	0.7	464.7
80–90	2523.5	538.48	21.6	24.9	489.6

The sex ratio is approximately 9:1 male/female respectively but this can be deceiving since male plants cone more frequently than females

Mortality is high during the seedling stages of the life history due to the prolonged droughts and fires in its habitats

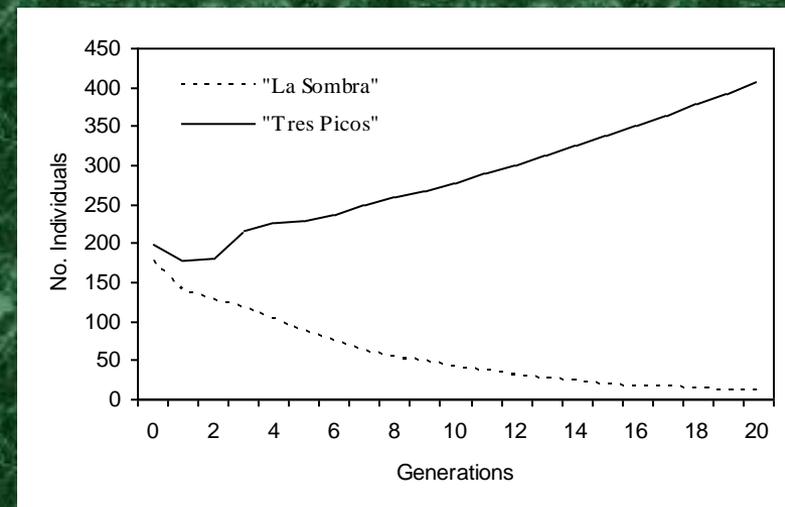


Figure 4. Population projection of two the populations of *Ceratozamia mirandae* in the *Sepultura Biosphere Reserve*

## Genetic studies

Cuadro 10. Valores de alelos por locus, diversidad genética, heterocigocidad y porcentaje de loci polimórficos por especie. Los números en negritas corresponden a los valores más altos y bajos.

Sp/Población	n	na		A		h		H		P
		M	D.S	M	D.S	M	D.S	M	D.S	
<i>C. alvarezii</i>	11	1.65	0.48	1.28	0.32	0.18	0.18	0.28	0.25	61.80
<b><i>C. mirandae</i> Champerico</b>	<b>10</b>	<b>1.75</b>	<b>0.43</b>	<b>1.32</b>	<b>0.30</b>	<b>0.21</b>	<b>0.17</b>	<b>0.33</b>	<b>0.24</b>	<b>75.20</b>
<b><i>C. mirandae</i> Sierra Morena</b>	<b>10</b>	<b>1.59</b>	<b>0.49</b>	<b>1.24</b>	<b>0.30</b>	<b>0.15</b>	<b>0.15</b>	<b>0.25</b>	<b>0.24</b>	<b>59.20</b>
<i>C. norstogii</i>	15	1.75	0.43	1.31	0.32	0.19	0.17	0.31	0.24	75.20
<b>C. Chimalapas</b>	<b>15</b>	<b>1.92</b>	<b>0.27</b>	<b>1.34</b>	<b>0.27</b>	<b>0.22</b>	<b>0.15</b>	<b>0.36</b>	<b>0.20</b>	<b>92.00</b>
Media	61	1.73	---	1.29	---	0.19	---	0.30	---	72.68



Training with farmers or campesinos or ejidatarios of communities of Sepultura Biosphere reserve







Upon cone dehiscence the seeds are collected. The female cone cycle is one year since female cone emerging until that it is dehiscent. The seeds are then stored for a further 9-12 months pending embryo maturity

Seed production and recruitment is relatively high with over 80% germination of seeds and the female cones produce from 74 to 170 seeds.

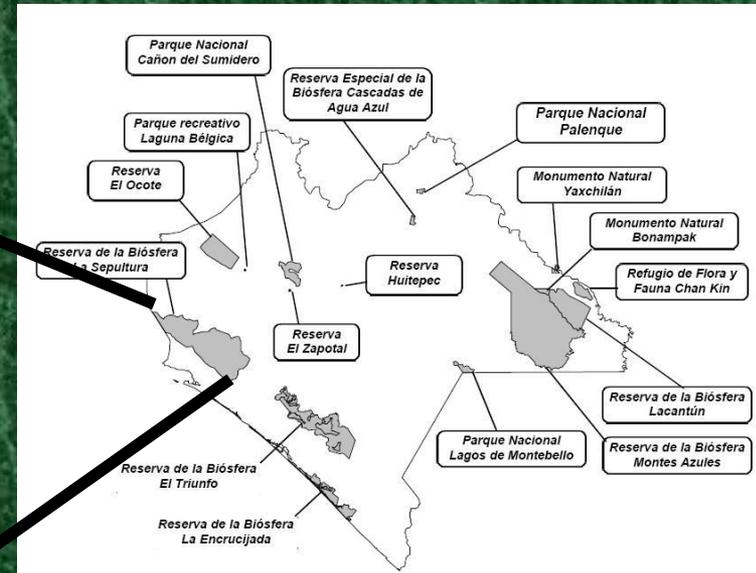
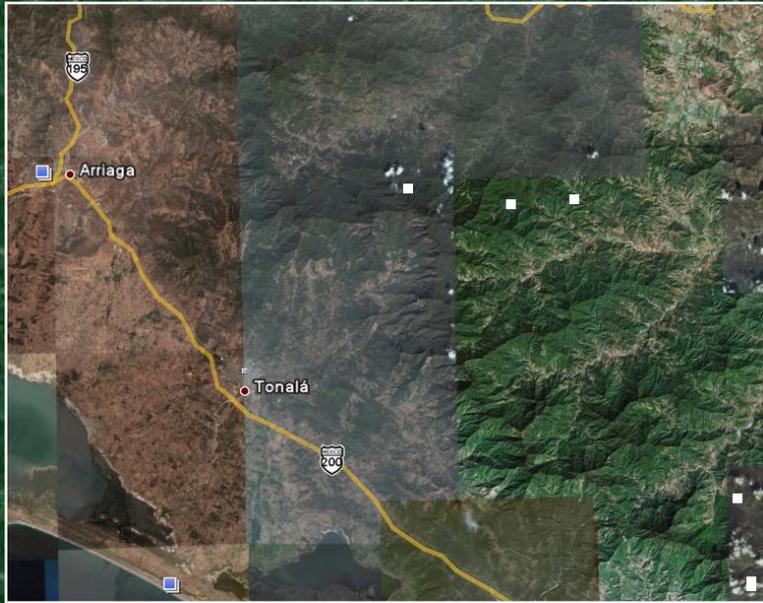


The farmers are organized through small group (5 to 8 persons). Each farmer collect seeds in their “Predio” or land but they all collect together. Originally when the project began each farmer established his nursery in his “patio”.





The SEMARNAT authority requires a management plan where nursery area is specified, availability of water and other infrastructure.



We have observed that this species is distributed on both the Pacific and inland slopes of the Sierra Madre de Chiapas in five municipalities. generally throughout the state of Chiapas. We estimate between 1000 to 2000 plants. We recommend an IUCN Red List category of Vulnerable (VU C, 2a), largely due to difficult-to-control destructive annual forest fires that occur in this Reserve

A condition set by SEMARNAT special permission, they must reintroduce 5 to 10% of the seedlings produced back into habitat and to establish one ejidal nursery.



Seedling for sale

Nurseries *in situ*



The original idea is to harvest seed from mother plant, sow and cultivate the plants in order to provide an additional alternative income for the farmers and at the same time the farmers are obliged to protect the habitat from poachers and loggers

Natural populations

Reintroduction



Seedling for reintroduction



The nurseries have produced about 15,000 seedlings. They have made a sale to *Cycadmania* in the USA. Also they have made some national events such as national flower exhibitions in Mexico City with sales of about \$ 30,000 pesos during sales at 2001. However, sales are not constant. During the period 1998 to 2000 they collected about 5,000 seeds per year. No exports have occurred recently, nor do we have details on illegal trade.