

A new species of *Zamia* (Zamiaceae) from Costa Rica

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ABSTRACT. *Zamia gomeziana* sp. nov. is described from material collected from Fila de Matama, in Limón Province, Costa Rica. It is distinguished from *Zamia fairchildiana* L.D. Gómez by its straighter leaflets with longer tips, longer megastrobilus peduncle and thicker megastrobilus with a shorter sterile apex. A discussion about the possible relationships of this new taxon with other existing *Zamia* species is briefly outlined. Most aspects of the biology of this species are unknown.

RESUMEN. *Zamia gomeziana* sp. nov. se describe a partir de material recolectado en la fila de Matama, en la provincia de Limón, Costa Rica. Se distingue de *Zamia fairchildiana* L.D. Gómez por sus folíolos más rectos y con ápices más largos, así como por los pedúnculos de los megaestróbilos más largos y megaestróbilos más gruesos con el ápice estéril más corto. Se discuten brevemente las relaciones de este taxon con otras especies de *Zamia*. La mayor parte de los aspectos de la biología de esta especie se desconocen.

KEY WORDS. *Zamia*, new species, Costa Rica, Fila de Matama, Limón Province

Zamia L. is the second most speciose genus in Cycadales Pers. ex Bercht. & J. Presl, 69 species have been recognized as valid by the world's leading cycadologists in the latest edition of the world list of cycads (Haynes 2009), and it is likely that some others still await either discovery (because they inhabit poorly botanically inventoried areas) or have already been collected but require to be diagnosed to be separated from similar looking taxa (Schutzman 2004). *Zamia* is the only living genus of Cycadales native to Costa Rica (Haynes 2009) and it is distributed in the humid lowlands and mid elevations from sea level up to about 1300 m in the Caribbean slope and up to 1600 m in the Pacific slope. Recent revisions for this genus include Stevenson (1993) for Panama, Stevenson (2001a) for Colombia, Stevenson (2001b) for Nicaragua, Merello (2004) for Costa Rica and Stevenson (2004) for Ecuador, Peru and Bolivia. However, Merello's revision on Costa Rican species is outdated and over simplifies the real situation of the taxa (D.W.Stevenson, M.A.Calonje com. pers.). The specimen G. Herrera & A. Chacón 2865 currently deposited at CR and INB was traditionally considered as *Z. fairchildiana* L.D. Gómez, from an aberrant collection location. However a detailed examination of that specimen indicates that leaflet and megastrobilus morphologies differ from

the related *Z. fairchildiana* L.D. Gómez and *Z. pseudomonticola* L.D. Gómez. The latter differences, coupled with the geographic isolation of this specimen justify the description of a new taxon.

Zamia gomeziana R. Acuña, sp. nov. Type: COSTA RICA, Limón, fila de Matama, 1350 m. G. Herrera & A. Chacón 2865 (Holotype CR, Isotype INB). Fig. 1.

Species haec ab Zamia fairchildiana differt foliola proportione longiora angustataque. Megastrobilus apicem sterilis indistinctis, pedunculus longioribus.

Stem arborescent 100-200 cm tall. Peridermis not described. *Cataphylls* unknown. *Leaves* 105-175 cm. Petiole 30-80 cm with large, sparse prickles, its base expanded, flat on the upper surface. Rachis 70-100 cm, straight or slightly arched, prickled 1.5-2.2 times longer than the petiole, with 13-24 pairs of leaflets inserted at angles of 50-70°. *Leaflets* almost straight, narrowly falcate to lanceolate, asymmetrical, smooth surfaced, median leaflets 32-38 cm long, 3-4 cm wide. Leaflet margins entire, upper margin convex basally, straight distally, lower margin almost straight. Tip acute, straight, long (25% of leaflet length). *Microstobili* unknown. *Megastrobili peduncle* 11 cm, long, cylindrical, with dense brown tomentum. *Megastrobili* barrel shaped, 20 cm long, 8

cm wide (when dry, very likely bigger when fresh), sterile conic apex small and inconspicuous (less than 5 mm long), seven rows and eight columns of sporophylls. Sporophylls hexagonal covered by brown tomentum, diameters (when dry) 23-35 mm. Seeds orange, 1 cm long.

Similar species. This species is morphologically related to *Zamia fairchildiana*. However both species have several differences (Table 1). In *Z. gomeziana* the leaflets are almost straight, with entire margins and their tips are longer and narrower (more than 25% of leaflet length), while in *Z. fairchildiana* leaflets are curved or sigmoid, often with denticles in the lower margin near the tip which is shorter than in *Z. gomeziana* (less than 20% of leaflet length). There are also important differences in the megastrobili. *Z. gomeziana* megastrobilus is thicker, with the sterile apex shorter and with a longer peduncle than *Z. fairchildiana* megastrobili (Table 2).

Zamia gomeziana is also similar to *Z. pseudomonticola*; however, the leaflets of the former species are ten times longer than wide, while in the *Z. pseudomonticola* they are, at the most, seven times longer than wide. Also the lower margins of the leaflets in the latter species of the latter are convex and their tips shorter (up to 20% of leaflet length). The megastrobili of *Z. pseudomonticola* are greenish, and the peduncles are much shorter (up to 5 cm) than in *Z. gomeziana*.

Another superficially similar species is *Zamia chigua* Seem. (here including *Z. lindleyi* Warsz. ex A. Dietr. from Western Panama and *Z. chigua* from Western Colombia, neither reported for Costa Rica); but this species has thicker petioles and rachises (these with a pair of grooves along most of the rachis length, on the leaflet insertion points). The leaflets in *Z. chigua* are incurved and overlap each other, due to the short inter-leaflet distance. Also in *Z. chigua*, the megastrobilus peduncles are usually shorter than 3 cm.

Etymology. This species' name is dedicated to the Costa Rican botanist Luis Diego Gómez Pignataro (1944-2009).

Distribution and habitat. The only known specimen of this species was collected in premontane rainforest understory at 1350 m.a.s.l., in Fila de Matama, a region of irregular topography, with little human intervention and where there still are large remnants of primary forest.

Climate. The middle elevations of the Caribbean

slope of Talamanca mountain range have no definite dry season and it rains most of the year. The presence of epiphyllous bryophytes on the leaflets laminae and the petioles of the leaves is also evidence of humid conditions in the plant's habitat.

Vegetative characters. The stems of mature plants of this species can attain heights of 2 m. The leaves' lengths range 1-2 m and have more than 20 pairs of long but narrow leaflets, the longest attaining lengths of more than 40 cm. The leaflet width diminishes towards the very long and narrow tips.

Reproductive characters. The microstrobili of this species are unknown. The megastrobili have peduncles longer than in any species of *Zamia* native to Costa Rica and Western Panama, excluding those of the *Z. skinneri* species complex. The megastrobili have less than 100 seeds and they have relatively few sporophylls, and a very short sterile, conic apex.

Reproductive phenology. The only known specimen of this species is a fertile female plant. It was collected with strobili in April.

Threats. Fila de Matama is sparsely populated by humans and most of the vegetation in this section of Talamanca mountain range is constituted by primary forest and it has been scarcely affected by recent human activities. Due to the difficult access to this area it seems likely that this species is not under serious direct threats due to human activities.

Conservation status. This species is found in one of the least botanically surveyed regions in Costa Rica, far removed from the most important human settlements, so it is likely that this species is not heavily threatened. However it is to be expected that this species has a relatively slow life cycle and population replacement rates, like other species of *Zamia*. Also, so far, it is only known from the type location so I consider that, preventively, this species should be considered vulnerable (VU B2a) by the IUCN (IUCN 2001).

Additional notes. *Zamia gomeziana* is only known from the type specimen, which was identified as *Z. fairchildiana* both in CR and INB and considered as unusual due to the collection locality (Merello 2004). However both species differ from each other in the morphological traits pointed out above and in their distribution ranges. *Z. gomeziana* inhabits premontane rainforests in the Caribbean slope of Talamanca mountain range. No plants have been

observed by botanists since the collection year, and I consider it necessary to survey the area and search for more individuals and populations. As it was indicated above, this species has been overlooked by the cycadologists, mostly because of its rarity in the collections and the difficult access to the region of Fila de Matama. Also it would be convenient to collect cataphylls and microstrobili. This species could be closely related to *Z. fairchildiana* y *Z. pseudomonticola* considering the rather similar morphologies of these species. If we consider the climatic and geologic history of Talamanca mountain range, it is feasible that the populations of this newly described species have been isolated for thousands of years from their closest living relatives in the wet Pacific slope of southern Costa Rica and southwestern Panama.

The cycadologists have not agreed on a single concept of species for Cycadales (Walters *et al.* 2004). Walters *et al.* (2004) point out that the "morphogeographic" species concept is the most widely accepted nowadays by the group specialists. This concept recognizes the importance of both morphology and geographic isolation. Since nineteenth century, cycadologists decisions have been influenced by geographic distribution of the taxa. In this concept the isolated populations are seen as units with independent identities and with a particular evolutionary story, affected by the unique physical conditions of each region (Walters *et al.* 2004).

There are no reliable records of *Zamia* at elevations above 1600 m.a.s.l. in Costa Rica nor in Panama (the continental division is above 2000 m.a.s.l. in Talamanca mountain range). According to paleobotanic, paleoclimatic and palynologic information from other elements of the flora in different regions of the neotropics, the colder and drier conditions during most of the Quaternary, caused the montane elements to extend down the mountains slopes, so they occupied a lower elevation than they do today. The temperature depression made the main biotas decrease their altitudinal ranges while lower elevation biotas got their altitudinal ranges compressed even closer to sea level (Colinvaux *et al.* 1996, Kerr 1996, Piperno & Jones 2003, Rull *et al.* 2005). This suggests that *Z. gomeziana* could have diverged from its relatives in the Pacific slope due to vicariance.

The habitat changes and isolation between the populations, even in relatively short periods

of time, such as a few tens of thousands of years, could lead to divergence between populations and, eventually, speciation. Phenomena in such short periods of time seem to be responsible of the speciation of *Ceratozamia* in México (Pérez-Farrera *et al.* 2004), *Encephalartos* in southern Africa (Vorster 2004) and *Zamia* in northwestern Panamá (Taylor *et al.* 2008).

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Table 1. Average values per species (standard deviations in parentheses) for morphological foliar traits. *Zamia gomeziana* has no standard deviations for some variables because they come from a single herbarium specimen.

Species	<i>Z. fairchildiana</i>	<i>Z. gomeziana</i>	<i>Z. pseudomonticola</i>
Leaf length (cm)	155.53 (+33.87)	105.7	130.27 (+25.55)
Number of leaflet pairs	20.78 (+5.92)	13	15.94 (+4.29)
Petiole length (cm)	58.7 (+15.64)	34.5	54.28 (+12.88)
Rachis length (cm)	96.84 (+21.52)	71.2	75.56 (+18.69)
Rachis:petiole ratio	1.8 (+0.63)	2.06	1.46 (+0.44)
Middle leaflets length (cm)	26.91 (+3.90)	35.1 (+3.00)	21.98 (+2.88)
Middle leaflets width (cm)	3.89 (+0.81)	3.6 (+0.50)	4.22 (+0.73)
Middle leaflets length:width ratio	7.15 (+1.60)	9.86 (+1.00)	5.36 (+1.13)
Middle leaflet horizontal angle (degrees)	64.03 (+10.26)	65.0 (+5.00)	75.14 (+14.64)

Table 2. Average values per species (standard deviations in parentheses) for morphological megastrobilar traits. *Zamia gomeziana* has no standard deviations because only one strobilus was measured.

Species	<i>Z. fairchildiana</i>	<i>Z. gomeziana</i>	<i>Z. pseudomonticola</i>
Megastrobili length (cm)	14.83 (+3.82)	17	22.00 (+12.53)
Megaestrobili diameter (cm)	6.33 (+0.58)	8	9.83 (+1.76)
Number of horizontal sporophyll rows	7.67 (+0.58)	7	10.33 (+2.31)
Number of vertical sporophyll columns	7.33 (+1.15)	8	9.33 (+1.53)
Megastrobili peduncle length (cm)	5.83 (+1.26)	11	4.33 (+0.58)

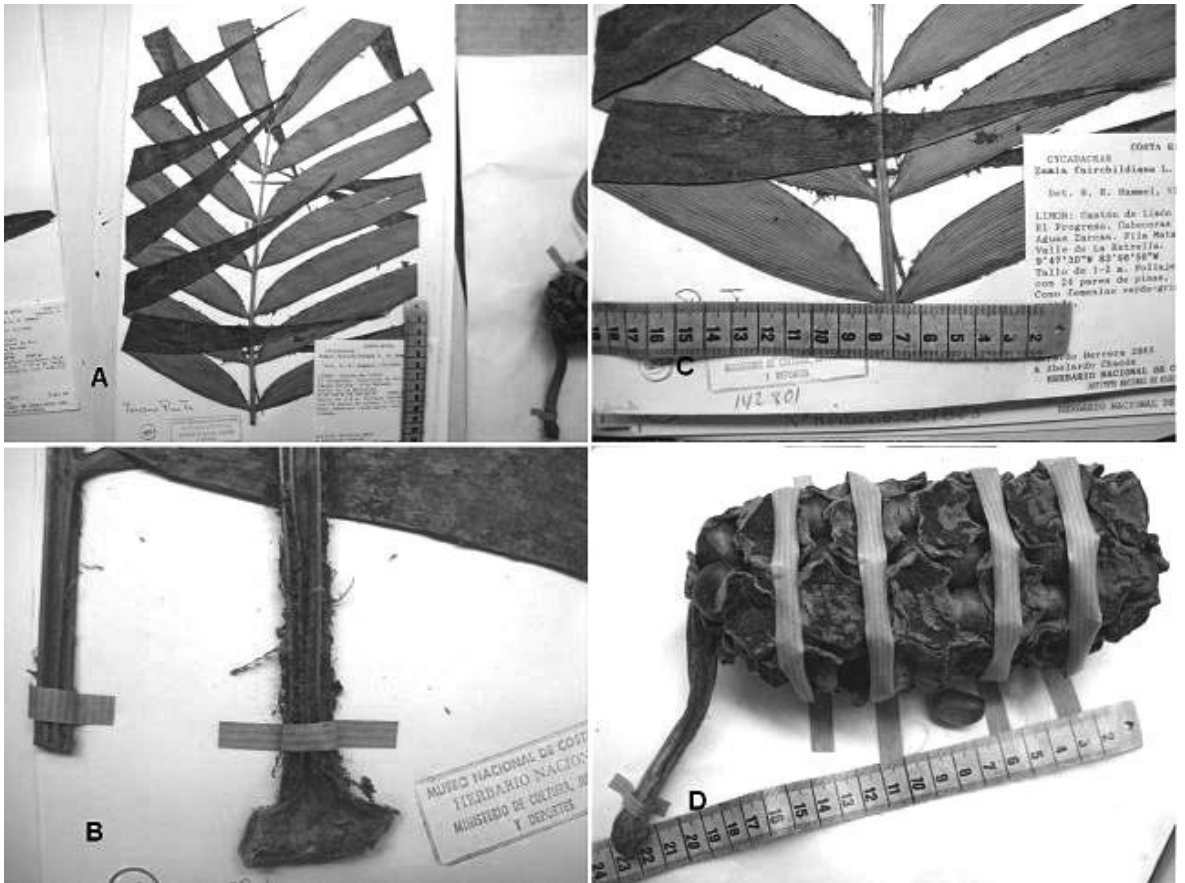


Figure 1. Some traits of *Zamia gomeziana*: A. Blade terminal portion. B. Petiole base detail. C. Middle leaflets detail. D. Megastrobilus. All pictures taken from the holotype (G. Herrera & A. Chacón 2865, CR).