A New Endemic *Zamia* from Honduras (Cycadales: Zamiaceae)

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ABSTRACT

Zamia bussellii, an arborescent and highly localized Honduran endemic cycad most similar to *Z. tuerckheimii* Donn Sm. (incl. *Z. monticola* Chamb.) from Guatemala, is described. We consider *Zamia bussellii* one of a group of arborescent *Zamia* species including *Z. elegantissima* Schutzman, R.S. Adams & Vovides from central Panama, *Z. fairchildiana* L.D.Gómez (incl. *Z. pseudomonticola* L.D. Gomez) from southwestern Costa Rica and adjacent Panama and *Z. tuerckheimii* from Guatemala. *Zamia bussellii* is geographically closest to *Z. tuerckheimii* but morphologically most similar to *Z fairchildiana*.

Key words: Zamia, Honduras, Mesoamerica, cycad, arborescent

INTRODUCTION

Prior to 2006, only two endemic cycad species had been described from Honduras: *Dioon mejiae* Standl. & L.O. Williams and *Zamia standleyi* Schutzman. Unconfirmed anecdotes (*sensu* Whitelock, 2002) also claimed that the distribution of the Salvadoran *Z. herrerae* Calderón & Standl. extended into Honduras (Jones, 1993; Norstog & Nicholls, 1997; Pant, 2002). This third species has since been described as *Z. oreillyi* C. Nelson.

In January 1994, plant enthusiast Robert Alonzo visited a Honduran nursery to identify *Codiaeum* species and cultivars. He noticed a unique, beautiful cycad growing in the nursery, which he photographed and brought to the attention of authors Adams and Schutzman (Fig.1).

Alonzo returned to Honduras with associate Allen Whittington July 13-18th of the same year to observe plants in habitat. Photographs and herbarium specimens were collected and brought to Adams and Schutzman. Mr. Alonzo asked that this new *Zamia* species be named in honor of Larry Bussell, a well-known plant explorer in Mexico and Central America during the 1970s and 80s. In 1995, they revisited the population and joined Loran Whitelock to observe two other cycads, another unknown *Zamia* (since described as *Z. sandovalii* C. Nelson), and *Ceratozamia hondurensis* Haynes *et al.* (2008 - this issue pp.10-15).

In 2003, Montgomery Botanical Center sponsored an expedition to Honduras to study these new taxa. Co-sponsored and organized by Mark Bonta and author Haynes, this expedition yielded substantial morphometric data, specimens, seeds, and photos (Haynes & Bonta, 2003) of the new species. Even though plants of this new species had been collected some ten years earlier, it existed only in a few collections in the US, and was mistakenly referred to as the "giant *fischeri*" due to somewhat papyraceous leaflets. Additionally, even though photographs were published on the website of the Palm and Cycad Societies of Australia by Kyburz (n.d.), others suggested that these distinctive plants represent a disjunct population of *Z. tuerckheimii* (*e.g.*, Jones, 1993). As is commonplace with little-known and undescribed taxa, common names and misconceptions reflect the lack of study of a species until its formal description has been published and knowledge of it widespread.

The aforementioned expeditions by the authors and their associates yielded enough data to enable this formal description. Specific locality data has been omitted to aid in the conservation of this narrow endemic cycad.

DESCRIPTION

Zamia bussellii Schutzman, R.S. Adams, J.L. Haynes, & Whitelock. *sp. nov.* (Figs. 1-19).

Haec species *Zamia fairchildiana* et *Z. tuerckheimii* affinis sed foliis emergentibus tomentibus niveus. A *Z. tuerckheimii* dentibus foliolorum usque ad medium et folioliis longe acuminates differt, et a *Z. fairchildiana* paginis distalis microsporophyllorum sine microsporangiis distinguenda.

Plant an arborescent shrub. **Stem** to 2 m tall, 5.1-15.9 cm diam., solitary; pale, glossy, yellowish-brown in color, lacking persistent leaf bases but covered in numerous small bumps and creases. **Leaves** arching to spreading, 67-151 cm long, to 44 per crown; **rachis** 41.5-122 cm long, terete, armed with small prickles in lower half to two-thirds; 13-31 leaflet pairs, opposite to subopposite, evenly spaced, non-overlapping; basally keeled, medially and apically flat to slightly declinate; **petiole** 17.5-40.5 cm long, 0.5-1.3 cm diam., terete, lightly to moderately armed; mean petiole-to-rachis ratio = 0.4; **leaf base** 2-3.3 cm wide, light brown, glabrous; **leaflets** 15.5-36 cm long, 3-4.4 cm wide (median), ovate-lanceolate to oblong-lanceolate, glossy medium green, papyraceous, undulating, margins evenly serrulate in the distal half, with raised longitudinal ridge and acuminate apex; mean length:width ratio of median leaflets 7.0; **eophyll** with [1-]2-3[-4] leaflet pairs, leaflets similar in shape, color, and orientation to those of mature leaves. **Microsporangiate strobilus** 27.5 cm long, 3.8 cm diam., light brown to tan, puberulent, occurring singly or in groups of three or more, cylindrical, erect to slightly leaning; **peduncle** 8.5 cm long, 1.6 cm diam., greenish-brown to tan, puberulent, erect; **microsporophylls** 6 mm long, 4 mm wide, hexagonal to oblong-hexagonal; **microsporangia** on proximal microsporophyll surface. **Megasporangiate strobilus** 22.4-25.2 cm long, 10-11.2 cm diam., solitary, cylindrical to barrel-shaped, emerging light brown and tomentose, later losing tomentum and maturing dark green to grayish-green, erect at maturity with large conical sterile apex; **peduncle** 4-4.5 cm long, 2.4-4.5 cm diam., tan, tomentulose; **megasporophylls** 4.5-5 cm long, 4.3-4.6 cm wide, oblong hexagonal, spirally arranged; **seeds** 200 or more per strobilus, elongate ovoid, with red sarcotesta at maturity.

Type. Honduras. Dep't. Cortés. Holotype: R. Alonzo & A. Whittington June 2003, *Whittington 200301* (FLAS). Paratypes: 30 July 2003, *J. Haynes, M. Bonta, G. Sandoval, C. O'Reilly, I. Zúñiga & J. Mendoza JLH03-044A*, *JLH03-044B*, *JLH03-045* (TEFH).

Etymology. This species is named for Larry Bussell, a well known plantsman whose endeavors have led to a greater understanding of Mesoamerican cycads, and enhanced many public as well as private collections throughout the world.

Distribution and habitat. This highly localized endemic appears restricted to only two steep hillsides in Departmento Cortés in northwestern Honduras. Further fieldwork is necessary whether its distribution range extends into neighboring Guatemala. Plants grow as understory plants in heavy shade in tropical deciduous forest from 700-1,300 meters above sea level (masl). The soil is dark brown, highly organic, and covered in thick leaf litter. Associated species include large tropical trees (*Quercus* and *Liquidambar* spp.), *Anthurium* and other aroids, and palms such as *Chamaedorea* and *Geonoma* spp.

Population structure. Plants occur in all sizes throughout both known populations. The two populations, totaling approxi-

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mately 10,000 plants, are approximately equal in number of plants and land area, and collectively occupy roughly 7.5 ha, (density approx. 1,350 plants·ha^{-1}). Observations of numerous seedlings together with the fact that many plants possess cones in a given year is an indication that the two known populations are actively and successfully reproducing.

Climate. The climate is tropical, with a distinct bimodal rainy season in the summer months (May-June and July-August) and a dry season in the winter months (Haynes & Bonta, 2003).

Taxonomic relationships. Though reproductive features are also useful,

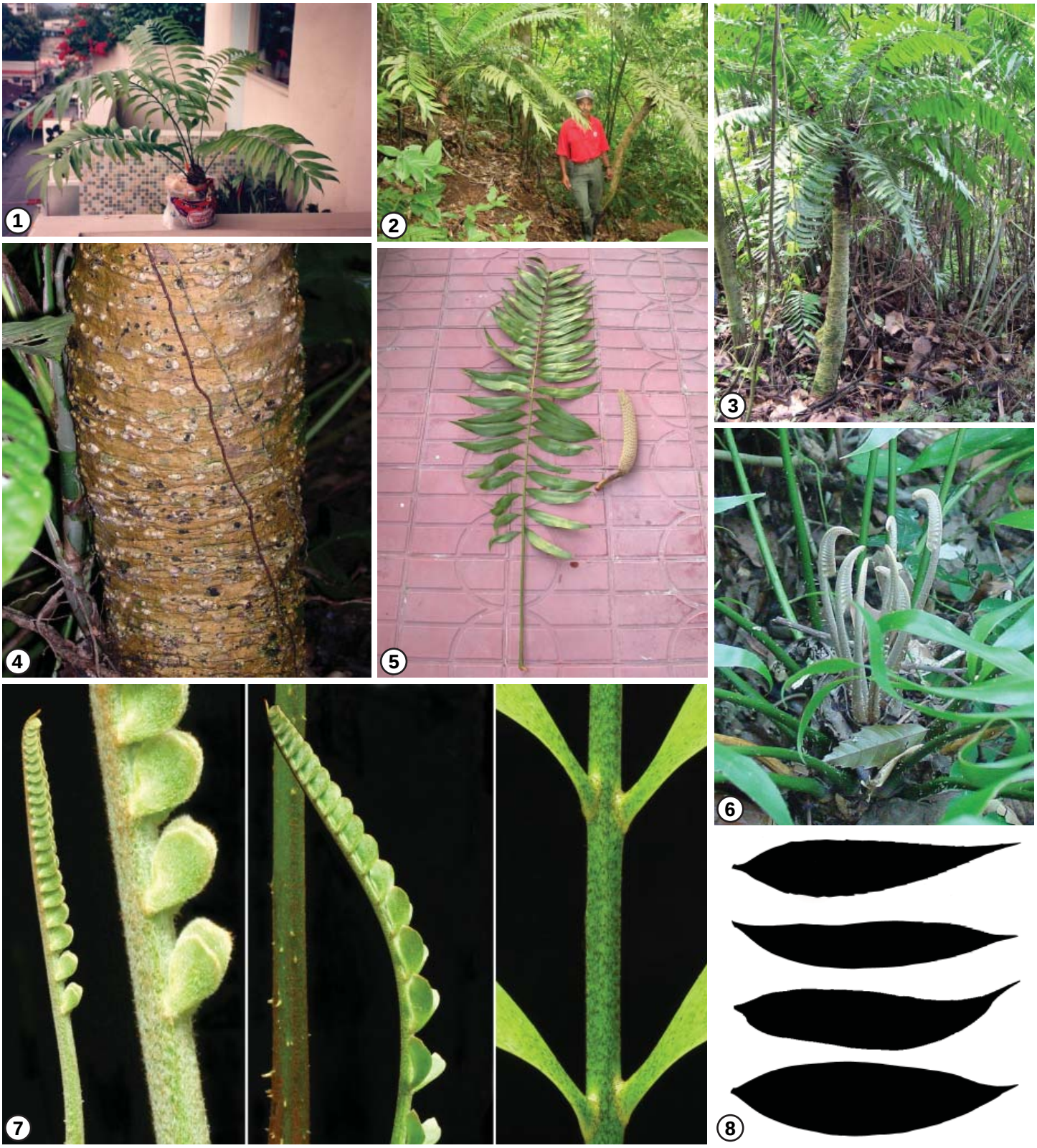
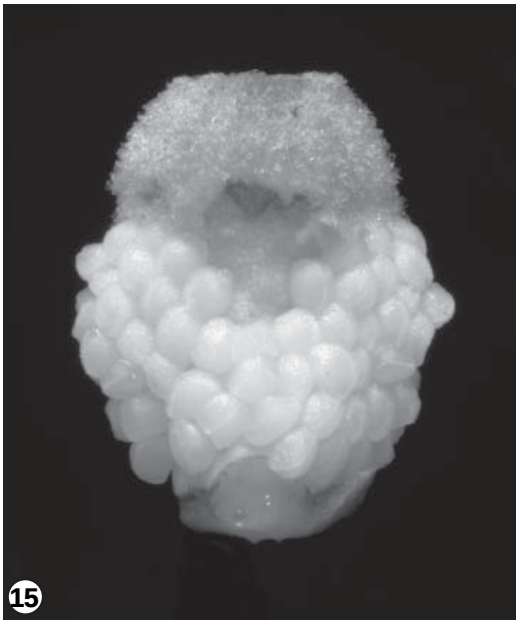


Fig. 1. Original plant of Zamia bussellii *first observed in Honduran nursery (Photo: Robert Alonzo). Fig. 2. Guide Rigoberto ("Rigo") standing among large arborescent plants of* Zamia bussellii *in habitat. Fig. 3. Habit of* Zamia bussellii. *Fig. 4. Closeup of* Zamia bussellii *trunk illustrating typical texture and coloration. Fig. 5. Leaf of* Zamia bussellii *with microstrobilus. Fig. 6. Newly emerging leaf flush of* Zamia bussellii *showing dense white covering of trichomes. Fig. 7. Closeup of* Zamia bussellii *leaves showing three stages in trichome coloration; white immature trichomes at left, reddish-brown immature stage, and black mature stage. Fig. 8. Comparison of leaflets of related arborescent species, from top to bottom:* Zamia bussellii, Z. elegantissima, Z. fairchildiana, Z. tuerckheimii.



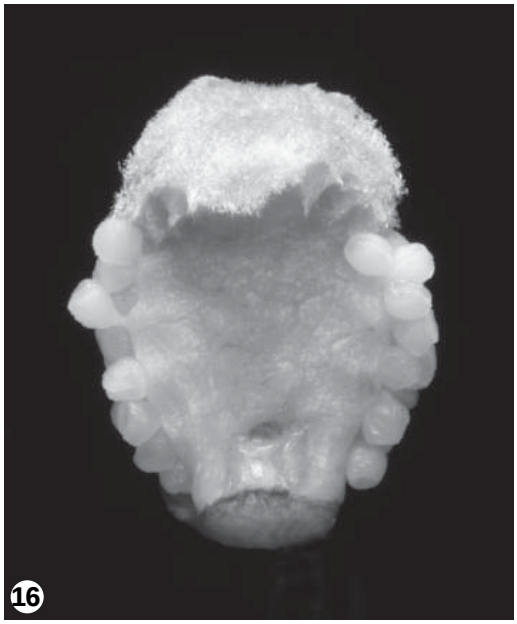


Fig. 9. Zamia bussellii *plant in habitat with emerging immature megastrobilus. Fig. 10.* Zamia bussellii *plant in habitat with mature megastrobilus. Fig. 11. Megastrobilus of cultivated* Zamia bussellii *plant. Fig. 12.* Zamia bussellii *plant in habitat with several microstrobili. Fig. 13. Microstrobilus of cultivated* Zamia bussellii *plant. Fig. 14. Transverse section through* Zamia bussellii *microstrobilus showing arrangement of microsporophylls. Fig. 15. Adaxial view of* Zamia bussellii *microsporophyll. Fig.16. Abaxial view of* Zamia bussellii *microsporophyll. Fig. 17. Putative pollinator of* Zamia bussellii *(photo by M. Thomas, Florida State Collection of Arthropods).*

Zamia busselIii can be distinguished solely by vegetative features from the three related Central American arborescent species *Z. elegantissima*, *Z. fairchildiana* and *Z. tuerckheimii*. Its emerging leaf flush is unique both because of its densely white puberulence and its asynchronous leaf expansion. The latter feature is especially interesting because of its rarity in mature plants of this genus. Most leaves of a mature *Zamia* plant's developing leaf flush develop synchronously.

Leaflet features are particularly useful in distinguishing the arborescent Central American species. Both *Zamia busselIii* and *Z. elegantissima* have leaflets with prominent teeth in the lower half of the margin. *Zamia fairchildana* and Z. *tuerckheimii* have few if any teeth, which are much less prominent and restricted to the apical end of the leaflet. Leaflets of *Z. busselIii*, *Z. fairchildana,* and to a lesser extent, *Z. tuerckheimii* have a raised longitudinal crease that is absent in *Z. elegantissima*. Median leaflets of *Z. busselIii* most closely resemble those of *Z. fairchildiana* but are only about half the length of *Z. fairchildana* leaflets and lack their typical long acuminate tip. Leaflets of *Z. busselIii* are relatively papyraceous, the other three species more coriaceous, *Z. elegantissima* possessing the thickest leaflets. Emergent leaves of *Z. busselIii* are green and covered with trichomes which begin white, maturing through reddish-brown to their final black color. *Zamia fairchildiana* has green-emergent leaves covered with a dense brown tomentum that wears off with age. Emergent leaves of *Z. tuerckheimii* are green-emergent, those of *Z. elegantissima* are light green to white, and leaves of both species lack tomentum.


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Fig. 18 . Seeds of Zamia bussellii *with (left) and without (right) sarcotesta, illustrating typical size, shape, and coloration.*


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Fig. 19. Zamia bussellii *seedling with eophyll.*

Armament of petiole and rachis is also a distinguishing character within this group. Prickles are most prominent and numerous on both the petiole and rachis of *Zamia fairchildiana*. Those of *Z. busselIii* are smaller and less prominent on the petiole and grade to smooth along the rachis. Prickles of *Z. elegantissima* are fewer and smaller than those of *Z. busselIii*, and rachis and petiole of *Z. tuerckheimii* are sparsely armed or unarmed.

Eophylls may also be used to distinguish between the species of this group. Those of *Zamia busselIii* have the most leaflets (up to four pairs), those of *Z. elegantissima* and *Z. fairchildiana* typically have two or three pairs, and *Z. tuerckheimii* usually only has one pair. Mature plants of *Z. busselIii* tend to hold many more leaves (up to 40) than the other species, which typically hold fewer than twenty.

Differences in reproductive features are difficult to describe due to extreme plasticity of strobilar size, shape and color. Size differences can be related to overall size of the reproductive plant and environmental conditions under which it grows, as discussed by Schutzman (2004).

Reproductive phenology. Elongating and dehiscing male cones have been observed in July, and mature female cones have been observed in both July and January. Based on the latter observation, this species may exhibit a bimodal or possibly even a continuous reproductive cycle. More work is necessary for a better ecological understanding of this species.

Pollination. Mature pollen cones collected in 2003 harbored numerous individuals of an unknown species of clavicorn beetle in the genus *Pharaxonotha* (Coleoptera: Erotylidae) (formerly Languriidae; Leschen, 2003). Samples of this beetle have been sent to the Florida State Collection of Arthropods in Gainesville, FL, where they will be described as a new species (M. Thomas, pers. comm.).

Ethnobotanical uses and vernacular names. No human uses or names are known for this particular species, although other *Zamia* species in Honduras are called 'camotillo' (little sweet potato) or 'yuca de ratón' (cassava of the mouse) and are known to be extremely poisonous (Bonta, 2007).

Threats. Although this species seems restricted to two adjacent hillsides, both known populations occur within a protected area. Nevertheless, potential threats have been discussed by Haynes & Bonta (2003) and include poaching, inadequate governmental protection, agricultural encroachment, and natural disasters that could endanger this narrowly endemic species. Barring these threats, the populations appear robust with apparent excellent seedling recruitment.

Conservation status. At the present time there are several thousand plants growing within two populations in a protected area, and they appear to be relatively safe. Nonetheless, this species should be listed as Critically Endangered (CR) based on its extremely restricted extent of occurrence and area of occupancy—per the most recent IUCN Red List categories and criteria (IUCN, 2001). The complete Red List assessment for *Zamia busselIii* is CR B1a+2a.

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Table I. Key to *Zamia busselIii* and related species

1a. Leaflets denticulate beyond apex 2
2a. Leaflets papyraceous with median raised longitudinal ridge; leaf trichomes numerous, color changing from white through reddish-brown to black..... *Z. busselIii*
2b. Leaflets coriaceous, lacking median raised longitudinal ridge; leaf trichomes rare or absent ..... *Z. elegantissima*
1b. Leaflets untoothed or with few teeth only at apex..... 3
3a. Microsporangia present on both proximal and distal microsporophyll surfaces, leaflet shape sigmoidal, apex long acuminate..... ..... *Z. fairchildiana* (incl. *Z. pseudomonticola*)
3b. Microsporangia present only on proximal microsporophyll surfaces, leaflet shape elliptic-lanceolate, apex abrupt-acuminate ....*Z.tuerckheimii* (incl. *Z. monticola*)

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