

Fairchild Tropical GARDEN BULLETIN

July 1987



Special Issue on Cycads

Fairchild Tropical Garden Bulletin

Volume 42

July 1987

Number 3

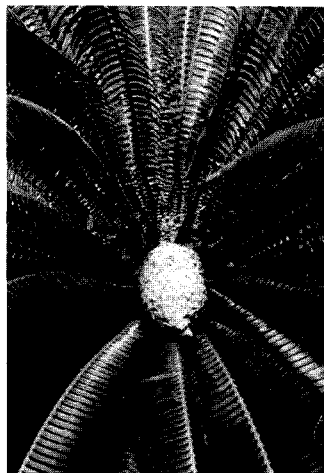
Contents

DEPARTMENTS

News of the Garden, <i>John Popenoe</i>	4
New Members	39

ARTICLES

Cycads: Propagation and Container Culture <i>Charles Hubbuck</i>	5
Current Cycad Research: An Introduction <i>Knut Norstog</i>	9
Research on Cycadales <i>Bijan Debgan</i>	10
Heat and Odor Production in Cycad Cones <i>William Tang</i>	12
African Cycads <i>Roy Osborne</i>	14
Mesoamerican Zamias <i>Bart Schutzman</i>	16
Cycad Hybridization Studies <i>Knut Norstog</i>	20
Again the West Indian Zamias <i>Dennis Wm. Stevenson</i>	23
International Protection of Cycads <i>Mary Collins</i>	28
Growing Cycads in the South Florida Landscape <i>Nancy Edmondson</i>	30
Cycads in the Garden <i>James B. Watson</i>	34
Special This Issue Fairchild Tropical Garden's Treasurer's Report <i>Charles B. Sacher</i>	38



John Popenoe, *Director*

Karen Nagle, *Editor*

Copyright© 1987 by Fairchild Tropical Garden. Published quarterly. Subscription included in membership dues. Others who are not members are invited to subscribe for \$6.00 per year.

Submit manuscripts or queries to Editor, Fairchild Tropical Garden, 10901 Old Cutler Road, Miami, FL 33156. ISSN 0014-6943.

CALENDAR OF COMING EVENTS

JULY

5 UNIVERSITY OF FLORIDA SUMMER COURSE begins, through August 1

SEPTEMBER

9 FRIENDS OF FAIRCHILD, meeting, 9:30 a.m.

9-11 VOLUNTEER ORIENTATION, 9:30 a.m., call 667-1651

12-13 HELICONIA SHOW AND SALE, 9:30 a.m. to 4:30 p.m.

26-27 AROID SHOW AND SALE, 9:30 a.m. to 4:30 p.m.

OCTOBER

14 FRIENDS OF FAIRCHILD, meeting, 9:30 a.m.

31 MEMBERS' DAY, plant distribution and sale

Again the West Indian *Zamia*s

Dennis Wm. Stevenson

The mean leaf dimensions of the second generation hybrids from the seven cones are statistically about the same as those of the F_1 plants. However, among second generation individuals, there is a complete range of shapes and sizes between the extremes exhibited by *Z. furfuracea* and *Z. spartea*. I assume this means that the genetics controlling these features is complex and involves several to many genes. The second generation plants, therefore correspond to what a population biologist might call a "hybrid swarm."

Are *Zamia furfuracea* and *Zamia spartea* good species? Yes, I think so. For one thing the F_1 plants are truly intermediate and are statistically distinct from either parent. For another thing, the range of individual variation of the second generation suggests, as noted above, that several to many genes control the leaf characteristics analyzed in this experiment. Furthermore, it suggests that there appears to be several to many gene differences (i.e., mutations) separating the two original species (note that there may also be many other genetic differences operational here for which I have no data).

References Cited

- Chamberlain, C.J. "Hybrids in cycads." *Bot. Gaz.*, Vol. 81 (1926), pp. 401-418.
- Helmsley, W.B. "Hybrid cycads." *Gard. Chron.*, Vol. 19 (1883) pp. 466-467.
- Norstog, K.J., D.W. Stevenson, and K.J. Niklas. "The role of beetles in the pollination of *Zamia furfuracea* L. fil. (Zamiaceae)." *Biotropica* Vol. 18 (1986), pp. 300-306.
- Vorster, P. "Hybridization in *Encephalartos*." *Excelsa*, Vol. 12 (1986), pp. 101-106.

(Dr. Knut Norstog has been a research associate at Fairchild Tropical Garden for the past nine years. His major interest is cycad reproductive biology.)

ALTHOUGH the nomenclature of *Zamia* spp. in the West Indies (I use the West Indies here as including Florida and the Bahamas) has in the past been at best confusing, the recent work of Eckenwalder (1980) has clarified and resolved the nomenclatural aspects of the genus in these areas and in this aspect is an extremely valuable piece of work. As can be seen from Eckenwalder's nomenclatural treatment, many names used for West Indian plants are either invalid or illegitimate. Moreover, any name that was not listed by Eckenwalder is a *nomen nudum* and as such has no status. I have no intention of presenting a long involved discussion on the nomenclatural aspects of the taxonomy of *Zamia* in the West Indies as I have already covered this ground in a recent article (Stevenson, 1987). Instead I will give a brief outline of my concept of the taxonomy of *Zamia* in this region.

As summarized by Eckenwalder, there are in his opinion two approaches. One would recognize numerous species, perhaps as many as 10 or 15, based primarily upon leaflet width and vein number. Another, that adopted by Eckenwalder, would consider leaflet width and vein number to be so arbitrary and unreliable that only one species would be recognized.

These two approaches obviously represent extremes. However, one of the outstanding features of Eckenwalder's work was the quantification of leaflet width and vein number. He clearly demonstrated that leaflet width is correlated with vein number. In other words, the wider the leaflet the more veins there are and the converse. Secondly, by analyzing leaflet width in various islands and regions he demonstrated that there was a continuum

for each island or region. Therefore, he concluded that leaflet width was an unreliable character because of the statistical overlap. For example, while he recognized that locally there are forms based on leaflet width associated with different islands in the Bahamas, he concluded this was unimportant in the context of total variability in the West Indies. This is fine as far as it goes.

However, Eckenwalder was concerned primarily with examining a quantifiable character, namely leaflet width. He apparently did not examine other characters such as leaflet shape, leaflet denticulation or strobilus shape and color. Had he done so, he certainly would have come to a different conclusion and I suspect found a statistical correlation between leaflet widths and the aforementioned characters. Moreover, he would have seen that these correlated entities had distinct distribution patterns within the West Indies. Although it is easy for me to criticize this aspect, it should be recognized that information on strobili was at that time quite sparse as most herbarium specimens are sterile. It was only by concerted effort that I was able to obtain the information given below concerning strobili.

Now let us consider some of these other characters. The principal vegetative characters I will discuss are leaflet shape and the denticulation of leaflet margins. The reproductive characters considered here are strobilus shape, strobilus color and seed color. There are three basic leaflet shapes — linear, oblong and obovate to ovate. Leaflets may be entire or denticulate. There are three forms of denticulation — one to three apical teeth, small callous teeth in the upper fourth and conspicuous teeth in the upper third. Strobilus shape varies from ovoid with a rather massive gradually tapering sterile apex, particularly in ovulate strobili, to cylindrical with an abruptly acuminate sterile tip or a truncate sterile tip. Two strobilus colors are present, those that are

grey to almost black and those that are red to red-brown. Seeds also come in two colors, blood red or orange to orange-red.

After considering the distribution of the above mentioned characters, I have come to the conclusion that there are six taxa in the West Indies which I recognize at the species level. One of these species, as hard as it is to believe, has not yet been described, probably as the result of a misleading specific epithet.

I would now like to discuss the distribution of the characters, give a brief synopsis of each species including its synonyms, and give a brief outline of the distribution of each species in the West Indies. There are two taxa with linear leaflets, but they differ from each other in strobilus and seed color, in denticulation and in distribution.

The first of these is *Z. angustifolia* Jacquin. This species has linear leaves that are usually from .08 to .2 inches (2 to 5 mm) wide with one to three small teeth at the leaflet apex. Most importantly, this species has strobili, both pollen-bearing and ovulate, that are dark grey to black in color when pollen is being shed and at pollination in the ovulate strobili. In fact, these strobili appear to have black and white vertical stripes when the sporophylls separate at pollination and pollen shedding. This feature is unique among *Zamia* in the West Indies. This can be seen in the male plants in Fairchild Tropical Garden. Ovulate strobili are cylindrical with a short acuminate sterile apex. The seeds at maturity are orange to orange-red. This species is found only on Eleuthera in the Bahamas and in eastern Cuba, chiefly in Oriente Province. Its synonyms are *Z. angustissima* Miq., *Z. guggenbeimina* Carabia, *Z. multifoliolata* A. DC., *Z. stricta* Miq., and *Z. yatesii* Miq.

The second species is *Z. portoricensis* Urban. It also has linear leaflets, but is the only West Indian taxon with truly entire leaflet margins. I would point out that occasionally one can find some widely

spaced bumps on the upper margin that appear to be reduced teeth. The strobili are typical for West Indian zamias in that they are reddish in color. Ovulate strobili are also cylindrical with a short acuminate sterile apex. The red to blood-red mature seeds are unique for the West Indies. This species is known only from Southwestern Puerto Rico in the region of the Susua Forest to the coast. There is some problem with the nomenclature in that the holotype (the original specimen upon which the species was described) was in Berlin and destroyed during World War II. The isotype (duplicate, but in this case a piece of the holotype) which is at the New York Botanical Garden consists of only a single basal leaflet. However, from the original description of the species, it is clear that plants from this region can be considered to be the same. There are no synonyms for this species.

There are two species, *Z. integrifolia* Willdenow and *Z. pumila* L., with oblong leaflets with parallel margins. These two species differ from each other in denticulation and strobilus morphology, in particular the nature of the sterile tip of the ovulate strobili. First, there is *Z. integrifolia*. This species has leaflets with marginal teeth that are generally inconspicuous and appear as small callous bumps in the upper quarter. The reddish ovulate strobili are cylindrical with a truncate or blunt sterile tip. The mature seeds are orange and sometimes orange-red. This species is somewhat widespread in the West Indies. It occurs on Andros, Grand Bahama Island, Great Abaco, Long Island and New Providence in the Bahamas. It also is the *Zamia* native to Florida and extreme southern Georgia. Additionally, it occurs sporadically in western Cuba, the Cayman Islands and South central Puerto Rico. I would like to point out that a very wide leafleted form occurs on Long Island in the Bahamas. These plants conform to *Z. lucayana* Britton. However, other than leaflet width, these plants are

in all aspects assignable to *Z. integrifolia*. Synonyms of *Z. integrifolia* are *Z. erosa* Cook & Collins, *Z. floridana* A. DC., *Z. lucayana* Britton, *Z. media* Jacq., *Z. silvicola* Small, *Z. tenuis* Willd., and *Z. umbrosa* Small.

The second species with parallel margined, oblong leaflets is *Z. pumila*. This species, which is the type for the genus, differs from *Z. integrifolia* in that it has well-defined teeth in the upper quarter of the margins and often has deeply cleft leaflets in vigorous plants. The reddish, cylindrical ovulate strobili have a pronounced acuminate sterile apex at maturity which is quite unlike the truncate apex of *Z. integrifolia*. In this sense, *Z. pumila* occurs in the Dominican Republic, where it is the sole species, in southern Puerto Rico and in central Cuba. Synonyms for this species are *Z. allison-armourii* Millsp., *Z. debilis* L. fil. (nom. illegit.), and *Z. latifoliolata* Prenl. It should be noted that the types of the last two synonyms are from the same locality in the Dominican Republic and this is probably the locality for the plant upon which Commelijn (1697) based his description. The illustration in Commelijn's work is the lectotype for *Z. pumila*. It is the synonym, *Z. latifoliolata*, that has contributed to confusion of West Indian zamias and is the reason that there is still an undescribed species in this area as discussed below.

There are two species in the West Indies that have obovate to ovate leaflets that are strongly toothed in the upper third. Moreover, both of these species have ovoid ovulate strobili with long gradually tapering sterile apices. The first of these species is *Z. pygmaea* Sims. This species is distinguished mainly by the overall size of the plants. They are quite small, indeed the smallest cycads known. The stems are usually less than 1.2 inches (3 cm) in diameter, the leaves usually less than 20 inches (50 cm) long, and leaflets less than 2.8 inches (7 cm) long. As pointed out by Eckenwalder (1980), these plants have

L. J. J.
7
L
Entomel

distinct leaflet width-to-length ratio that is lower (nearer to one) than that of other West Indian zamias. *Z. pygmaea* is restricted to central and western Cuba and the Isle of Pines. Synonyms of *Z. pygmaea* are *Z. kickxii* Miq., *Z. ottonis* Miq., and *Z. silicea* Britton. I would like to point out that the type of specimen of *Z. kickxii* has ovate leaflets that approach being lanceolate and are not really obovate. Apparently, dwarf zamias such as this usually have only one leaf or sometimes two in each leaf flush. The point is that more evidence is needed to determine whether or not this is a distinct element.

The second species with decidedly obovate to ovate leaflets and ovoid ovulate strobili with long tapering sterile apices is described below for the first time.

Zamia amblyphyllidia D. Stevenson, *sp. nov.* (Fig. 1)

Truncus hypogaeus; cataphylla lanata, triangularis, stipulata; folia usque 8, glabra, 7-1.5 m longa, 30-60 cm lata; petiolus inermis, 3-7 m longus; foliola obovata, 15-30 cm longa, 2-6 cm lata; strobilius O ovoideus, sterilis apex gradatim decrescens.

Species Zamia pygmaea affinis; planta grandis.

TYPE: PUERTO RICO. Bosque de Rio Abajo, Utuado. 30 Jan 1985 *P. Acevedo R. 576* (HOLOTYPE: NY; ISOTYPES: FTG, NY)

Basically, *Z. amblyphyllidia* (which means blunt in reference to the obovate leaflets) is a much larger plant than *Z. pygmaea*. That is, plants of the former are the same size and stature of the other species of *Zamia* in the West Indies, as discussed above. The distribution *Z. amblyphyllidia* is Jamaica, western Cuba and northern Puerto Rico. The reason this species has gone undescribed for so long is because plants conforming to this description have been thought to be *Z. latifoliolata* Prenl., mainly because this specific epithet literally means broad leaflets. The type of *Z. latifoliolata* is from the Dominican Republic and *Z. amblyphyllidia* does not occur in the Dominican

Republic. Moreover, the type of the former is identical to that of *Z. pumila* L. That *Z. amblyphyllidia* was not the same as *Z. latifoliolata* and was an undescribed species has been known for some time, as cogently pointed out by Read (1967).

It should be clear by now that even if one does not accept Eckenwalder's (1980) taxonomy for the West Indian cycads, the work itself represents significant progress in our understanding of *Zamia* in this region. Moreover, it makes an extremely valuable contribution to nomenclatural stability and establishes the nomenclatural tone for future interpretations. From this work one can see that it is possible to recognize 25 taxa of *Zamia* in the West Indies. It should be obvious from my preceding comments that this would be excessive.

On the other hand, it should be equally obvious that the recognition of only two taxa (one species with two subspecies) is, in my opinion, too conservative. I have attempted to demonstrate that if one evaluates several characters, one can come to a more reasonable, although middle ground, concept of the taxonomy of the West Indian zamias that is more in accord with the observations of botanists who have spent many years studying the West Indies. I fully realize that my concept does not include black and white descriptions, but then this is the essence of the *Zamia* problem in the West Indies. I have tried to reach a reasonable conclusion and am of the opinion that, although the issue could be discussed *ad nauseam*, this really is the best working solution.

Finally, together with colleagues at the University of Naples in Italy, I am now investigating the relationships of these species to each other, utilizing analyses of chloroplast genomes.

(Dr. Dennis Stevenson spent several productive postdoctoral years at Fairchild Tropical Garden. Currently he is a member of the research staff of the New York Botanical Garden. He has done ex-

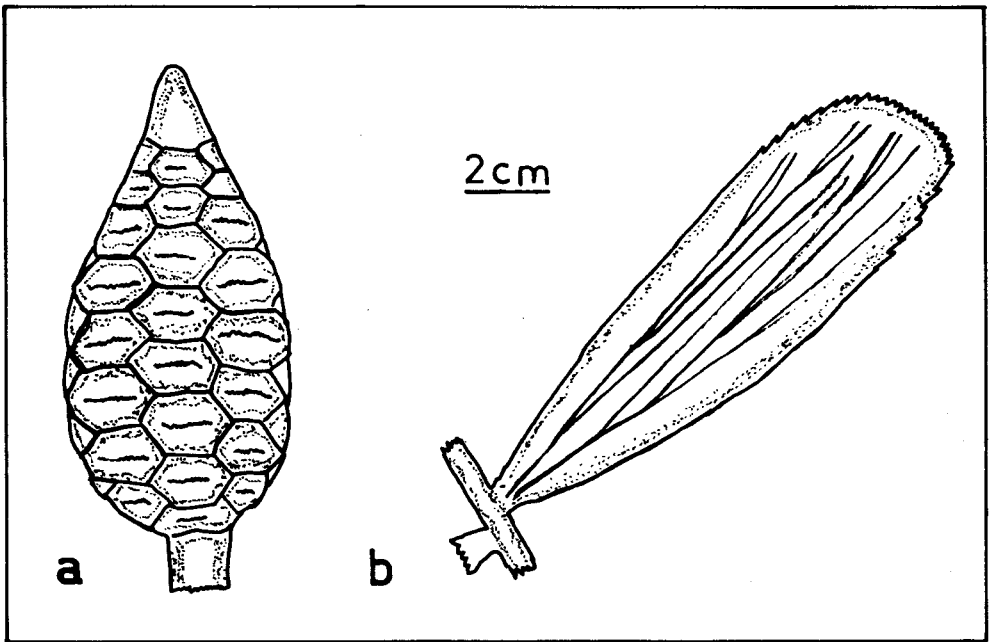


Fig. 1. *Zamia amblyphyllidia* a. Leaflet from middle region of leaf of the holotype. b. Ovulate strobilus.

tensive field studies of *Zamia* and *Ceratozamia* in Mexico, and *Zamia* in Central and South America.)

Literature Cited

Commelijn, J. *Horti Med. Amstelod.* Vol. 1 (1697), t. 58.
 Eckenwalder, J. "Taxonomy of the West Indian cycads." *Journ. Arnold Arbor.*, Vol. 61 (1980), pp. 701-722.

Read, R. "Taxonomy of the cycads of the West Indies and Florida." pp. III-1 to III-6 in Fifth Conference on Cycad Toxicity. 1967. Department of Biology, University of Miami, Miami, Florida.
 Stevenson, D. "Comments on character distribution, taxonomy, and nomenclature of the genus *Zamia* in the West Indies and Mexico." *Encephalartos*, No. 19 (1987), pp. 3-7.

KEY TO THE WEST INDIAN SPECIES OF ZAMIA

- 1. Leaflets obovate to ovate; ovulate strobilus ovoid, sterile apex gradually tapering - 2
- 1. Leaflets linear to oblong; ovulate strobilus cylindrical, sterile apex acuminate or truncate ----- 3
- 2. Leaflets less than 7 cm long, 3 cm wide ----- *Z. pygmaea* Sims
- 2. Leaflets greater than 10 cm long, 3 cm wide ---- *Z. amblyphyllidia* D. Stevenson
- 3. Leaflets entire or seemingly so ----- *Z. portoricensis* Urban
- 3. Leaflets with distinct or callous teeth in upper fourth ----- 4
- 4. Leaflets linear 1-3 (4) teeth at apex, 1-5 mm wide, margins often adaxially rolled; strobili gray to black - *Z. angustifolia* Jacq.
- 4. Leaflets oblong, with more than 10 distinct or callous teeth in upper fourth; strobili red to reddish-brown ----- 5
- 5. Leaflets with teeth reduced to callous bumps; ovulate strobilus with truncate sterile tip ----- *Z. integrifolia* Willd.
- 5. Leaflets with distinct teeth, often deeply cleft; ovulate strobilus with acuminate sterile tip ----- *Z. pumila* L.