Cycads of the Sand: The Beach-dwelling Zamias of Bocas del Toro, Panama

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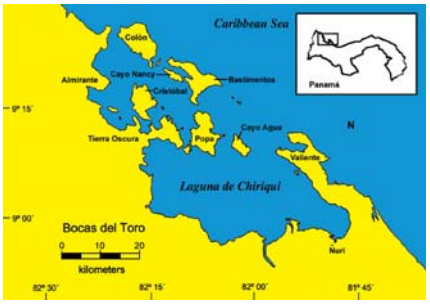

Fig. 1. Map of Bocas del Toro showing the major islands and place names on the mainland (after Fig. 1a of Anderson & Handley, 2002; used with permission).

Cycad expeditions tend to take on a life of their own once the players commit to the objective. This year the objective was to assess populations of the *Zamia skinneri*/Z. *neurophyllidia* complex of western Panama. Misunderstood and mysterious, these plants are among the most beautiful and wondrous of all Central American cycads.

Jody Haynes, Gregg Hamann, and Greg Holzman were to meet up with Dr. Alberto Taylor of the University of Panama on an expedition sponsored by the Montgomery Botanical Center(MBC) to investigate reports of cycads growing on beaches and near salt water on several islands in the Bocas del Toro Archipelago. None of us had ever seen a reference to salt tolerance in *Z. neurophyllidia* or *Z. skinneri*, yet these were the only cycads known in that part of Panama. The idea that an arborescent cycad could be growing on a Caribbean island's white sand beach was just too enticing to resist a look!

After months of extensive and careful planning, we set out to Bocas del Toro during a time of the year when we hoped the weather would allow us to reach our stated island objectives. It rains most of the year in this part of the world, and strong winds can create horrendous sea conditions. None of us wanted any part of rainy and stormy oceans, so the timing of the expedition was selected with help from Gregg, who has sailed the area often, and from Capt. Louis Anciaux, owner and operator of Panama Jet Boat Explorer and new inductee into the wonderful world of cycads. Weather was never a problem for us; instead, we were blessed with the best conditions of the year—light winds and no rain—for the entire 10-day trip.

Our primary goal was to assess the habitat, morphology, ecology, phenology, and conservation status of as many island populations as possible. Soil samples were to be taken and cones collected. What we discovered at one locality were perfect white sand beaches with literally tens of thousands of *Zamia* "trees" growing on them—in areas where waves are known to roll right through the populations three or four times a year and where winds blow 20-30 knots onshore, sending salt spray up the hills behind the beaches. Sometimes dreams do come true…and in this case, success was in every step we left on those beaches!

This is the story of the cycads of the sand…

Overview of the "Groove-leaved" Zamias

The genus *Zamia* currently contains seven named species with veins that are prominently sunken on the upper surface of the leaflets and protruding below, resulting in a corrugated appearance and texture that is technically referred to as "plicate." Two of these "groove-leaved" zamias, *Z. amplifolia* hort. Bull ex Mast. (1878) and *Z. wallisii* A. Braun (1875), are Colombian endemics, while *Z. roezlii* Linden (1873) occurs in Colombia and adjacent Ecuador, and *Z. urep* Walln. (1996) is restricted to central Peru. The other three represent a group of closely-related species from Panama (and possibly Costa Rica?), the oldest known being *Z. skinneri* Warsz. ex Dietrich (1851) and the newest named species being *Z. dressleri* D.W. Stev. (1993) and *Z. neurophyllidia* D.W. Stev. (1993). Even though *Z. skinneri* was discovered and named more than 150 years ago, it is remarkable that it is still

Fig. 2. Gregg Hamann (left) and the first author (right) try to contain their excitement in the midst of the Zamia neurophyllidia *colony on Playa Primera (a.k.a., Wizard Beach), Isla Bastimentos, Panama.*

Fig. 3. Female (A) and male (B) cones of Zamia neurophyllidia *at Wizard Beach.*

Fig. 4. The authors (left and right, respectively) and Gregg Hamann (center) next to a 4 m specimen of Zamia neurophyllidia *at Wizard Beach.*

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so incompletely known (Whitelock, 2002). Unfortunately, rather than clarify the confusion, the paper that described the two newest species in this group (Stevenson, 1993) and other subsequent reports have contributed to it.

The Central American "groove-leafed" zamias are often confused, particularly in cultivation and especially as seedlings. The following brief descriptions of the three species were compiled from Whitelock (2002), A. Taylor (pers. comm.), and personal observations.

The "true" *Z. skinneri*, as it is often called, is arborescent with trunks to 2+ m tall, and has broad leaflets (to 50+ cm long by 20+ cm wide) and red-emergent leaves to 2 m in length; adult plants in habitat typically hold 3-6 leaves; female cones densely red-brown tomentose and quite large, measuring 20-40 cm long, 8-12 cm in diameter, with a peduncle 2-7 cm long; male cones usually number 1-4, are red-brown tomentose, and measure 4-15 cm long, 1-2.5 cm in diameter, with a peduncle 2-12 cm long.

Seedlings and juveniles of *Z. dressleri* are sometimes confused with *Z. skinneri* because of their relatively large leaflets (although not as broad as *Z. skinneri*) and red-emergent leaves, but the former species is completely acaulescent and usually holds only a single erect leaf (rarely two to three leaves) in habitat; female cones are relatively small, wine-red to rust-red tomentose, 10-15 cm long, 3-4 cm in diam., with peduncles 4-6 cm long; male cones usually solitary, cream to rust-red colored, 5-8 cm long, 1-2 cm in diam., with a prominently pointed apex (not found in the other two species) and peduncle 3 cm long.

Zamia neurophyllidia is similar to *Z. skinneri* in stature, being arborescent with trunks over 2m tall, but the leaves are green emergent, the leaflets are much smaller and typically more numerous, and mature plants in habitat often hold 20 or more leaves; female cones tan to greenish brown, are often covered with brown to reddish-brown tomentum, may be erect to leaning or pendulous at maturity, and measure 21-27cm long, 6.5-7.5cm diam., with peduncle 7.5-20cm long (much longer than the other two species); male cones 2-10 in number, cream or light brown in color, 8-9cm long, 1.5-2.0cm diam., peduncle 5.5-7.0cm long.

Zamia neurophyllidia is by far the most common of the three species in cultivation, with *Z. skinneri* and *Z. dressleri* following at a far distant second and third, respectively. Ironically, with but a few exceptions, published reports and unpublished anecdotes suggest that *Z. neurophyllidia* is the most difficult of the three species to grow in cultivation. It is our hope that some of the discoveries summarized in this article will illuminate improved horticultural practices for this species.

The Cycads of Isla Bastimentos

Physical Environment

The Bocas del Toro Archipelago consists of six large islands and many smaller islets (Fig. 1). Isla Bastimentos is the third largest island, measuring approximately 52 km^2. It and Isla Colón guard the mouth of a large bay, Laguna de Chiriquí, containing the four other main islands—Isla Popa, Isla San Cristóbal, Cayo Nancy, and Cayo Agua. This island group is geologically recent, having been formed by sea level rise beginning around 5,200 ybp (Isla Colón) and continuing until around 1,000 ybp (Isla Popa and Isla San Cristóbal) (Anderson & Handley, 2002).

Bastimentos was definitely our favorite island in the group. As mere visitors, we were enveloped in its charm the minute we stepped off the water taxi. The inhabitants of Bastimentos are of African descent and are remnants of the banana trade that dominated the area in the early 20th century. They now make their living as subsistence farmers and fishermen, or from the tourism that is slowly making its way to their idyllic tropical paradise.

There are no roads on Bastimentos—which means no cars either, only walkways and boats for transportation—and we found this very calming upon our arrival to the island. For years, Bastimentos has been a backpacker's low-key getaway. Unfortunately, developers have recently made their way to the island and now see money to be made in subdividing the land, especially the beaches along the northern side of the island.

Population Characteristics

After a 20-minute walk through a cemetery and past several houses on top of the island (located on a hill that separates the south side, where the islanders prefer the protection from the unforgiving Caribbean waters, from the much harsher north side), we reached our destination: Playa Primera (also known as Wizard Beach), a white sand beach half a mile long adjacent to the most inviting aquamarine Caribbean water one could ever hope to see. Shaded by large trees was a low-lying beach strand vegetation, just above the high-tide line containing what could only be described as a "lawn" of *Z. neurophyllidia* seedlings and small plants (Fig. 2). Straight away, Alberto commented that many large cycads he had seen near the trail-head three years prior had been cut down to make room for a shack that operated as a bar and restaurant during peak tourist season.

As we made our way eastward down the beach, the cycads got larger, some with two-meter trunks sticking out of the tropical vegetation. It was here that the first cones came into view (Fig. 3). Both female and male cones were present, but not in great quantities, though there were literally thousands of zamias in this one colony!

We were elated over our "find" until we came upon the second sign of cycad destruction. A large house was in the

Fig. 5. Leaf spot fungus, possibly Mycoleptodiscus indicus*, on a plant at Wizard Beach.*

Fig. 6. Larvae (A) and adult (B) of Eumaeus godartii*, an insect predator of* Zamia *species throughout Panama.*

process of being built right in the center of this amazing colony. No one was around that day, and construction was incomplete. But the most surprising thing was the size of the house; it was massive by even Florida or Hawaii standards. This was no villager's modest home, but rather the home of a person with money—and lots of it! The cycads had been cleared throughout the property, and we strolled by in utter silence as we were slammed with a huge dose of reality.

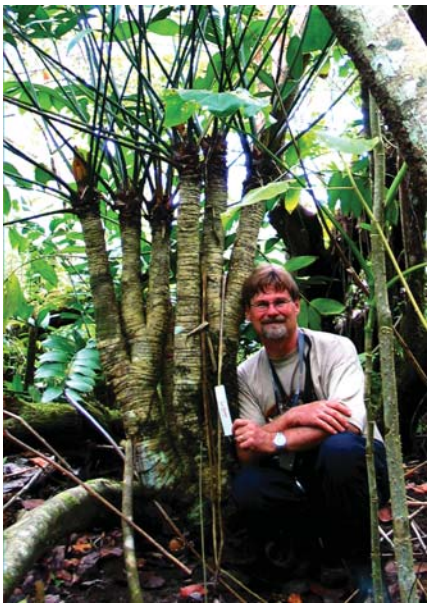

Fig. 7. Gregg Hamann posing next to a spectacular seven-headed male plant of Zamia neurophyllidia *at Wizard Beach; the multiple apices resulted from generations of being chopped by Bastimentos islanders.*

Fig. 8. Examples of the regenerative abilities of Zamia neurophyllidia *at Wizard Beach in response to human-induced damage: A) cut top rerooting in the sand, and B) cut trunk base resprouting leaves.*

We quickly realized that this population is threatened and that, unless something changes very quickly, we may never again see it in all its glory. Alberto was also feeling the pain, as he could no longer locate some of the more interesting specimens he wanted to show us. One plant, in particular, had become procumbent and had wrapped around a tree like a giant boa with leaves; but it was nowhere to be seen. We found more plants further down the beach where the vegetation became thicker and denser. Here, the plants were even more elegant, with darker green leaves and taller trunks—some reaching nearly four meters in overall height (Fig. 4)!

Another thing that became evident was that this population was growing in pure white sand covered with composted leaf matter. As soon as we walked 100 meters into the vegetation behind the high tide line—at the point where the sand stopped and the true soil started—the cycads abruptly ended their domination. In fact, not a single cycad could be seen growing further inland in the heavy, wet, clay-based soil.

We were also a bit surprised by the amount of seedling recruitment present in this colony—especially considering that *Z. neurophyllidia* was thought to be primarily a forest dweller of rich, lowland soils. The assumption was that this species grows in acidic, organically rich soil in nature—but nothing could be further from the truth in this population, as the calcareous-based sand is very low in organic content and is almost certainly alkaline. As propagators and growers of cycads, we realized that we had been trying to grow these plants in a soil mix that was too organically rich and too acidic. We had both had problems growing this species from seed—whereby large percentages of seedlings would die over time. The plants that did survive and were then potted up into "real" soil grew well enough, producing trunks and coning in ten years time. But it seems as though better results might be had by growing seedlings and small plants (at the very least) in an alkaline, sand-based medium.

Ecology

The beach strand habitat where *Z. neurophyllidia* grows on Bastimentos was dominated by sea grapes (*Coccoloba uvifera*) and coconut palms (*Cocos nucifera*) above and by a yellow-flowering "wedelia" groundcover (*Sphagneticola trilobata*) below. But from the perspective of their sheer numbers and imposing presence, the cycads were obviously the dominant plants in the area.

As we moved through the colony, we noticed a leaf spot fungus that looked like *Mycoleptodiscus indicus* (Fig. 5)—a new pest reported on zamias at Fairchild Tropical Botanic Garden just a couple of years ago (Tang, 2002) and occasionally observed on *Z. neurophyllidia* and other tropical zamias in cultivation. At times, this fungus can destroy entire sets of leaves in larger plants and can weaken young seedlings until they finally perish. Amazingly, it appeared as though this pest was having no significant impact on the health of the plants at Wizard Beach. It seemed to only affect plants in open situations that received more sunlight, so perhaps stress from excess sunlight plays a role in the susceptibility to this disease. It is also possible that seedlings that survive to reproduce in the wild are able to pass on some level of resistance to their offspring.

We also observed some minor leaf damage from a caterpillar, and we photographed larvae and adults of *Eumaeus godartii* (Fig. 6)—a relative of *E. atala*, the atala butterfly that feeds on coonties in Florida. The latter species has been problematic at MBC in recent years, where it has significantly broadened its host range to include more than 20 species of *Zamia* as well as species in several other cycad genera. Although obviously present on Bastimentos, *E. godartii* did not seem to be causing any noticeable adverse effects on the population.

Ethnobotany

In addition to the plants that had been killed or completely removed to make way for "progress," numerous other plants had been cut and had regrown. Some had been cut in the distant past and had regrown large trunks; others had been cut numerous times and developed into some really strange multi-headed creations. One plant to which we took a liking was a seven-headed male that possessed multiple scars as evidence of having been chopped by a machete or some type of axe. Four of the seven apices on this plant were in the middle of coning. Of course, we all wanted a picture next to this freak of "nature" (Fig. 7).

Some plants had been chopped fairly recently and their "tops" left on the

ground to re-root and continue their quest for survival (Fig. 8A), while the cut bases had sealed themselves and were beginning to re-sprout leaves (Fig. 8B). In one of the last areas on the beach that we checked, there was a path cut not long before through a large stand of plants, leaving only stumps and freshly cut tops of green leaves in the wake. It appeared as though a kind of harvesting was going on as all the trunks had been removed. By now, we were pretty sure that the people of Bastimentos were either directly involved or, at the very least, would know why the plants were being harvested. By this time, the steam seemed to come bellowing out of the jungle. So, with cold refreshments on our minds, we decided to head back to the bar where we started.

Upon our arrival at the little bar on the water, we sat down and ordered a cold beer. After some small talk with some of the locals, we took out a few photos of *Z. neurophyllidia* and asked the lady working at the bar about the use(s) of the plants. She had never seen the plants before, but she showed the photos to a few men at one of the other tables. We could not hear what was being said but they were all laughing and joking with the woman, who seemed quite amused by their answers. We continued to enjoy our beer, hoping for some sort of answer that could be of benefit to our trip. We had heard previously from Alberto that the Indians in other areas of Panama used the mucilage of *Z. skinneri* as glue in making folk guitars. But what we learned that day on Bastimentos was about as far from our wildest expectations as the hot sun would allow!

Our bartender came back with a great big smile on her face, and we ordered another round of beer in anticipation. She then told us that the plant was used to "make men strong," using her fist and arm for emphasis. We took another swig of our beer and said, "so it helps their muscles?" She shook her head and laughed, emphasizing the fist in the groin area. "No way!" we thought, as we looked over at the men who were by now quite interested in our reactions. We looked at them as though they must be kidding, but they didn't look like they were joking anymore. So we raised our beers in a toast and asked for more information.

To our astonishment, we learned that the trunks of the plant—which is known locally as 'guade teet'—are ground up and brewed into a tea, which is then drunk by the men for the purpose of prolonging erections. Needless to say, that was a great day for the expedition and for cycads in general! We all had some great laughs over how and who would investigate this on a scientific level. Graphs, charts, and "before and after" photos flashing on a screen in front of the peer review at the cycad conference in Mexico had us laughing until our stomachs hurt.

But we were still not completely convinced that the men of Bastimentos were telling the truth, even though they seemed sincere. On another island we observed plants bearing the same types of scars, but this time the Indians were reluctant to say any more than that the plants were used for the occasional headache and fever. It was on the island of Popa several days later that our apprehension in believing the "male sexual enhancement" story was shattered. An Indian man who called himself "Mama-Tata" (which literally means "mother and father") and who looked like Jesus—complete with a full beard and a white robe with a red cross on the sleeve—told us (after being paid $20.00 for his knowledge) that the plant is known as 'tadowa' by the Ngöbe-Bugle Indians and that both the men and women of Popa drink a tea made from ground up trunks as an aphrodisiac and sexual stimulant. Alas, we were convinced that the inhabitants of Bastimentos were telling the truth!

We feel it is important to note here that, "you should ***not*** try this at home!" Nearly every part of every cycad that has ever been tested has been shown to contain highly neurotoxic compounds like cycasin and BMAA (De Luca *et al.*, 1980, Charlton *et al.*, 1992, Audhali & Stevenson, n.d.). There was no apparent evidence of Parkinson's disease-like symptoms among the men of Bastimentos—similar to the cumulative symptoms that have been reported from Guam following long-term ingestion of *Cycas micronesica* seeds—but there was certainly evidence of long-term use, as many of the largest plants had been cut numerous times. We are currently working with a researcher at the Harvard Medical School to determine what kinds and how much of the toxins are present in *Z. neurophyllidia* stem tissue and if simply boiling the ground up trunk neutralizes the known toxins. Much more work needs to be done on cycad ethnobotany and on the possible medicinal uses of compounds associated with cycads.

Conservation

We are aware that *Z. neurophyllidia* occurs on many of the other islands and on the mainland in Bocas del Toro Province, but the population on Bastimentos is not only one of the largest populations of zamias we have ever seen but also one of the prettiest localities (see cover). It is also one of the most threatened populations, as we learned toward the end of the trip that there are new plans being made to develop the beaches all along the north shore of the island (similar colonies exist at both Long Beach and Red Frog Beach to the east of Wizard Beach).

One of our hopes in writing this article and sharing the locality information with other cycad enthusiasts is so that others might go to Bastimentos and enjoy the plants and, while there, reach out and educate the island's community regarding the importance of the cycads to ecotourism and to the heritage of the people of Panama in general. Much thought has gone into how to best protect this area for the future, and it is our firm belief that it best serves the cycads to have this area protected through education as a form of conservation.

Not all populations of cycads would benefit from this approach, but in this case it is our hope that we will see these plants protected through a multi-layered approach focusing on education and awareness. We all need to do our part to preserve and protect cycads in the wild. This was the main reason for writing this article in the *Cycad Newsletter*.

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