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# CYCADS

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CYCAD 2018, South Africa



Feature Articles  
Research & Conservation News  
Reports: Cycad 2018, South Africa & CSG Meeting 2018  
Cycad Horticulture Workshop Announcement





The Cycad Specialist Group (CSG) is a component of the IUCN Species Survival Commission (IUCN/SSC). It consists of a group of volunteer experts addressing conservation issues related to cycads, a highly threatened group of land plants. The CSG exists to bring together the world's cycad conservation expertise, and to disseminate this expertise to organizations and agencies which can use this guidance to advance cycad conservation.

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Front: *Encephalartos lanatus*  
Back: *Encephalartos middelburgensis*  
Both in natural habitat in Middelburg,  
Mpumalanga, South Africa.  
Photos by Michael Calonje

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# MESSAGE

Dear Friends,

**CONGRATULATIONS!** Let us all join in saying that word to Piet Vorster, Wynand van Eeden, and all the great people that worked tirelessly to bring us together this past summer for CYCAD 2018! Page 12 details the wonderful event, which gathered experts from 18 nations to move cycad science and conservation forward. An amazing job!

Our Cycad Specialist Group is doing wonderful work! Getting together in August was great inspiration for what lies ahead. New collaborations and opportunities came forward from our discussions. Personally, I was deeply impressed with the breadth and expertise of cycad conservation projects featured at the meeting. It is so clear that cycad conservation is a *multidisciplinary endeavor* – so many kinds of information, skills, and tasks are needed, and a great diversity of experts is required to bring all of this to the table. I am glad to see we all work together so well – worldwide collaboration in service of cycads is what our mission is all about.



Pictured: Dr. Griffith with *Encephalartos middelburgensis*, during CYCAD 2018; See also the back cover.

I am inspired, also, by the growing numbers of experts we include in that mandate. At our CSG meeting, we brought forward nine cycad scientists, cultivators, and educators, all of whom will help move our efforts forward. Their diversity of skills is exactly what we need, as I note above. Please see page 27 for examples of the enthusiasm and ability these great people provide. Our next issue will continue profiling those new members – it is great to have our group represent so many places and so many projects.

JS Khuraijam, our tireless editor, has again compiled and presented the very latest in cycad conservation in this issue. Again, what clearly jumps out from these pages is the need for *every kind of skill* and *every kind of person* in our efforts – horticulturists, geneticists, entomologists, anatomists, botanists, and botanic garden professionals all play a role to ensure that no cycad goes extinct!

Sincerely,

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*Encephalartos lehmannii* at Eastern Cape, South Africa.

Photo by Michael Calonje





Seedlings of *Encephalartos lebomboensis* at the Mlambo village nursery.

Photo by T. Steyn

## Village nursery projects for cycads: Review and assessment

William Tang, Andrew P. Vovides, Miguel Angel Pérez-Farrera,  
Tommie Steyn, Dennis Kamoga & JS Khuraijam

### Introduction and history

With few exceptions cycad populations occur near human inhabitants. In most of the tropics these inhabitants are people living in villages who farm for a living. In the foreseeable future human populations in the tropics will continue to grow and therefore there will be a continuing need from cycad conservation workers to have an approach, or tool if you will, to work with these local peoples. Why? Because people living nearby cycads can either be a first line of defense against poaching or they can be the poachers themselves and the attitude they adopt may depend on the messages that outsiders bring. That outsider may be a plant collector

wanting to pay a villager to dig up plants or it can be a cycad biologist. Also, the farmer may simply want to clear the land for agriculture. How can the field biologist begin interacting with villagers living nearby his or her cycad study site and what can he or she do to shift the opinion of villagers toward conservation? This is a question that all the authors of this article have faced as we strove to protect a cycad population. The solution we chose was the village-based nursery project.

Yes, there are other approaches, such as the formation of fenced-in reserves, as the one established for a wild population of

*Encephalartos heenani*. That “protected” population in a reserve was collected to extinction, no doubt with the assistance of locals who knew how to navigate the local terrain. This example shows that establishing reserves is not enough. Local peoples must also be part of the solution or they will be part of the problem. Why did we choose the village-based nursery approach instead of another kind of arrangement? First, rural peoples are farmers. When you approach them and say you want them to start a nursery they understand immediately: you’re asking them to farm a crop. Second, it is a time and labor intensive activity which many members of the community will observe and



participate in: this allows the message of conservation to sink in over many months or years to all people in the village. There is a third aspect and a costly one to the manager who proposes the project: it requires commitment, however, the villager will know that the manager is serious and will understand that he or she must reciprocate. It is difficult to find another conservation approach which villagers will grasp immediately and which they are able to participate in without a great deal of training.

Given the inherent attractiveness of the village-based conservation approach it is understandable that village-based cycad nurseries have been started in many parts of the world. The earliest may be the Modjadji nursery for *Encephalartos transvenosus* in South Africa (Fig. 1, Table 1) which has been operating continuously since the early 1980's. In this project seeds are collected from the nearby reserve of some 14,000 wild plants. These seeds are germinated, potted, irrigated under shade houses and the resultant seedlings are sold to visitors to the reserve. The objective was to provide a source of income and employment to local people while simultaneously making seedlings available to the general public where there was already a high demand for this plant as an ornamental. Local peoples are educated to understand that the jobs and income from the nursery are tied to the continuing existence of the wild population. Over some 35 years, while under the supervision of several managers

appointed by the local conservation authorities, this nursery is conservatively estimated to have produced over 200,000 seedlings while the natural population remained intact. A similar record of achievement occurred at the Mananga village nursery project for *E. lebomboensis*, also in South Africa, where 185,000 seedlings were produced from 1997-2009 (Fig. 2, Table 1).



**Figure 1.** A worker at the Modjadji nursery in 2018, with seedlings of *Encephalartos transvenosus*. Photo by W. Tang

The village nursery concept has also been applied in Mexico beginning in 1991 by Andrew Vovides for the Monte Oscuro nursery for *Dioon edule* in the state of

Veracruz (Fig. 3). As in the South African nurseries the villagers were educated to understand the importance of preserving the wild population as a source of seeds. The concept was attractive enough that other conservation workers set up similar nurseries in other parts of Mexico for other species of cycads and some villagers were inspired to start village cycad nurseries on their own initiative (Pérez-Farrera, 2008, see Table 1). The history of these efforts in Mexico have been documented (Vovides *et al.*, 2002, 2010, 2016) and show that after 10 years or less many of these nurseries closed and those that survived longer struggled from the lack of revenue for the farmers (Fig. 4). The lack of revenue starts after initial startup funds (eg. from short-term grants) have been used up, and these nurseries must then come to grips with the problem of developing a market where they can sell their product. In Mexico managers of the cycad nursery projects have arranged occasional sales to commercial landscapers or through a botanic garden gift shop, but this has not been adequate. At this point the manager for a nursery faces a dilemma: how to market cycad seedlings without encouraging the growth of domestic collectors and therefore poaching pressure. For South African cycad nurseries this is not a big issue because public demand and poaching pressures are already high and selling seedlings would likely reduce demand for wild-collected plants rather than increase it.



**Figure 2.** Wild seed harvest for the *Encephalartos lebomboensis* village nursery project at Mlambo. Photo by T. Steyn



**Table 1.** Global list of village-based nursery projects for cycads, arranged alphabetically by country and within each country by province/state and start date within each country.

Location (registry #)	Project coordinators/institutions	Species grown	Start date, # village participants	# plants grown	Plants sold: value	End date	Reasons for decline	Comment
<b>CHINA</b>								
Guangxi: Fuping	W. Tang, N. Liu, A. Lindstrom/ Zhongkai Univ., Nong Nooch Bot. Gard.	<i>Cycas debaoensis</i>	2001, 3 participants	~1000	0	Project dormant, plants still in ground at nursery	Sales not possible	Nursery coupled with school construction and conservation education project
<b>COSTA RICA</b>								
Talamanca	Sr. Ocampo/Tropical Agricultural Research and Higher Education Center (CATIE)	<i>Zamia neurophyllidia</i>	1990, one family, 2- 3 participants			~1995	Funding ended after 5 years	Due to infrequent coning, propagated was by rerooting stem cuttings
<b>INDIA</b>								
Manipur: Uran Chiru	JS Khuraijam	<i>Cycas pectinata</i>	2014, 5 participants	~500	0	Active		This nursery is operated by villagers and still in initial stage.
<b>MEXICO</b>								
Veracruz: Monte Oscuro, (DGAERN/MX/VEV- CO.CON-015-VER)	A. Vovides/Jardín Botánico Francisco Javier Clavijero	<i>Dioon edule</i> , <i>Zamia furfuracea</i> , <i>Beaucarnea recurvata</i>	1990, 27 participants, down to 5 in 1992-2001 and 3 in 2009	15,000 as of 1998	\$20,075 up through 2009	1 current active participant, 2 dormant	Low demand for plants, Sporadic funding	In 1997, 300 plants reintroduced into habitat; due to low demand 2000 plants currently in the nursery may be plowed under
Veracruz: Cienega del Sur	M. Vazquez Torres/University Veracruzana	<i>Zamia furfuracea</i>	1991, 25 participants down to 9 in 1994	28,000 as of 2002, 2,500 between 1998- 1999		Late 1990s-Early 2000s	Funds diverted to finance students instead of growers	2000 plants reintroduced into coastal habitat
Veracruz: several nurseries in the Los Tuxtlá region initiated independently as a response to the one at Cienega del Sur	Some guidance requested from the team at University Veracruzana, otherwise unsupervised	<i>Zamia furfuracea</i>	Mid 1990s	600,000		Ended, date unknown		
Veracruz: Tlachinola	M. Vazquez Torres/University Veracruzana	<i>Ceratozamia tenuis</i>	1995	4,700 as of 2000		Active in 2005, but completely abandoned well before 2018		Many plants still growing in abandoned nursery
Chiapas: 3 nurseries at:Ejido Nueva Independencia, Ejido Tres Picos Ejido La Sombra,	Miguel Pérez-Farrera (MPF)/Universidad de Ciencias y Artes de Chiapas (UNICACH)-CONANP	<i>Ceratozamia mirandae</i> ,  <i>C. mirandae</i> <i>C. mirandae</i> & <i>D. merolae</i>	1995-1996, groups of 5-8 participants	15,000 C. mirandae as of 2008, 1500 D. merolae as of 2000	1998-2000: sale of 400 plants of both species from combined nurseries to US by coordinator (MPF), US\$2800, \$830 from 2000- 2008	12 participants as of 2000	SEMARNAT did not renew permits	Within the Biosphere Reserve La Sepultura, 10% of initial crop planted into habitat
Chiapas: Ejido San Andrés	Miguel Pérez-Farrera	<i>Dioon merolae</i>	1995, 7 participants	1000 as of 2000	\$1050 from 2000- 2008	12 participants as of 2000	SEMARNAT did not renew	This nursery was operated by ejidatarios



Quintana Roo Chiapas: Las Golondrinas	Miguel A. Pérez-Farrera- CONANP	<i>Ceratozamia matudae</i> , <i>Zamia sconuscensis</i> , <i>Chamaedorea quezalteca</i>	1996, 26 participants	600 <i>Z. sconuscensis</i> , 100 <i>C. matudae</i> , 730 <i>Chamaedorea quezalteca</i> as of 2002	\$780 <i>C. matudae</i> &\$830 <i>Z. sconuscensis</i> from 2000-2008	Inactive, plants still in nursery as of 2013	permits SEMARNAT did not renew permits, infighting among villagers	This nursery was operated by villagers and supervised by reserve staff
Puebla: San Luis Atolotitlán	Tehuacan-Cuicatlan Biosphere Reserve	<i>Dioon caputoi</i> , + other native species	Mid 1990s	No sales permitted, excessive bureaucracy		Inactive	Champion of nursery died, no replacement came forward; infighting among villagers Probably still active	Farmers paid through reserve authority for cultivation and reintroduction
Oaxaca: San Miguel Soyaltepec in Cerro Tepezcuintle	Centro de Estudios para el Manejo Sustentable de los Recursos Naturales (CEMASREN), an NGO Roberto Pedraza	<i>Dioon spinulosum</i>	Late 1990s			?		
Queretaro: Sierra Gorda biosphere reserve		<i>Dioon edule</i>	Early 2000s			Still active?		
Sonora: Ejido Choquincahui, Alamos, Sonora	CONANP	<i>Dioon sonorensis</i>	August 2010, 18 participants	2000 plants		December 2014	The director of Alamos reserve stopped the project for unknown reason	This nursery was operated by ejidatarios of ejido Choquincahui. The director of Alamos reserve granted the funds to establish the nursery
SOUTH AFRICA								
Limpopo: Modjadji	Modjadji Kloof National Park	<i>Encephalartos transvenosus</i>	Early 1980's	200,000+	R1000 000+	Active	Continuously active,	Demand high enough to sustain operations
Mpumalanga: Mlambo community near Mananga	Tommie Steyn	<i>Encephalartos lebomboensis</i>	1997	185,000	R925000	2009	Village champion of nursery died, no replacement came forward	Partnership between Mpumalanga Parks Board and Braaks Envionmental Products to market seedlings
UGANDA								
Near Thruston Bay, Lake Victoria	Dennis Kamoga	<i>Encephalartos equatorialis</i>	~2016	0	0	Active	Still in establishment phase	Attempts to pollinate and collect viable seeds not yet successful
Mpanga River:2 nurseries at Kalere (Ntarama) and Kanara (Kagurugumana)	Dennis Kamoga	<i>Encephalartos whitelockii</i>	~2010	6752	0?	Active	Active funding & management	All seedlings reintroduced back into habitat





**Figure 3.** Farmed *Dioon edule* plants in the village nursery at Monte Oscuro, Mexico; due to lack of sales the farmer plans to plow these cycad under so that another crop can be grown. Photo by A. Vovides.

In a place like Mexico there is currently little domestic demand for cycads, so where plants should be marketed to produce sufficient revenue on a consistent basis, while preventing increase in poaching? The answer may be to seek an overseas market where there is already interest for these plants, such as California or Florida, where these plants can be grown outdoors. Access to overseas markets is hampered by the remoteness of many of these villages and the transport problems they face over unpaved, rutted or mountainous roads. But more importantly, experience in Mexico has shown that village farmers do not have the expertise to navigate the red tape necessary to obtain phytosanitary certificates and permits that are required to send a shipment of cycad plants overseas. Much of this red tape originates with endangered species legislation, such as CITES (Convention on the International Trade in Endangered Species). CITES was created to control the international trade in endangered species and to its credit has greatly reduced the export of large wild-collected cycads over international borders

(Donaldson, 2003). It has, however, created a bureaucracy of officials and regulations that negatively impact the potential of the village-nursery to succeed. For example, in Mexico officials of various regulatory agencies such as SEMARNAT require the farmers to provide a management plan for operating a nursery with requirements that are excessive and complicated to deal with. Officials often fail to understand the purpose of village nursery projects and actively block sales. Clearly conservation officials are trained to delay and hinder on the premise that all cycads are wild collected and often do not understand that conservation can be achieved by encouraging nurseries and facilitating sales. As a result some village nurseries have failed or been abandoned.

Other cycad nursery projects have been started in Costa Rica and China (Fig. 4) and more recently in India and Uganda based on inspiration from these South African and Mexican examples (Table 1). In China the senior author has experienced similar barriers to marketing cycads, not only internationally,

but also domestically within the country, and no plants or seeds have been officially marketed from that project (Tang, 2011).

### Assessment

It is important to view village-based cycad nurseries in a large picture. It is one tool among several options for conducting cycad conservation. At Modjadji, for instance, this concept is coupled with a reserve and they function together. In the *Cycas debaoensis* project in China, a cycad nursery was coupled with an education project and the construction of a school (Tang, 2008a, 2008b, 2011, 2012; Tang *et al.*, 2018). Nursery projects have two distinct phases that require very different skills. The first phase is about procuring funding and setting up infrastructure including land, shade houses and irrigation and collecting seeds from the wild population. The second phase is about marketing the plants, keeping villagers interested and dealing with village politics. Resentments often arise when some villagers feel they have not been treated fairly and this may lead participants to drop out.



People skills are important in a manager, but in perspective village politics is no more complex or exotic than those we face in a factory or office job or which we may encounter at home in our own families. While a nursery project may wind down and end, the conservation message that it delivered may remain imbedded in the culture of the community for many years, perhaps generations. For children it may be the only message they are taught about the plant. Experience shows that attention and respect from outside institutions and authorities, brought in through the nursery project, in themselves have a tremendous positive impact on conservation. In the *Cycas debaoensis* project in China, for example, reports in newspapers and TV or visits from an authority figure were interpreted by villagers that poaching and other inappropriate behavior will not go unnoticed. In the broadest perspective, when a nursery project ends, it does not mean that the commitment and effort invested failed. The

project must be judged on whether the decline in the cycad population slowed down or stopped and how effectively it contributed to conservation education. Visits to wild cycad populations adjoining nursery projects, years after they have become inactive, indicate that cycad populations remain essentially intact, without the levels of destruction prior to the establishment of the nursery project.

The subject of long term funding must be addressed for every conservation project. Conservation is an ongoing issue and never ends as long as people live nearby a threatened cycad population. Unfortunately funding for conservation is almost always structured as short term grants (see IUCN SOS for examples). If the subject of long term funding or self-sustaining arrangements are neglected then the “No more extinctions” objective for cycads (Gregory & Lopez Gallego, 2018) remains just a dream. In its broadest sense conservation is also a

business and village-based nurseries are businesses run by villagers who need to be paid. The ideals of conservation may motivate the mind and spirit for a short time, but they will ultimately fail when they cannot fill the belly.

### Recommendations

Professional businessmen have a role to play in village nurseries either as brokers who assists the villager in marketing the seedlings they grow and negotiating complex regulations they may encounter. When conservation activities are viewed as businesses, then appropriate business models can be applied to increase their chances of success. For example, Rainforest Alliance has developed a certification program for organic produce and sustainable agriculture. In such programs representatives from the certifying organization visit nurseries or farming operations and if they meet stringent requirements they are certified by the



**Figure 4.** The *Cycas debaoensis* nursery in Fuping China; cycad specialist group member Michael Calonje greets nursery worker on a winter day in 2011. Photo by W. Tang



organization as being organic, environmentally friendly or beneficial to the health of the communities where they operate. Such certified produce can command higher prices and attract purchases from a significant segment of the population that believe in socially and environmentally friendly farming practices. Starbucks Coffee and Whole Foods are examples where this type of marketing has succeeded. One of the best examples of cooperation between village nursery, government agencies and businessmen that can serve as a model was the project for *Encephalartos lebomboensis* at Mlambo (Fig. 2, Table 1), where the Mpumalanga Parks Board partnered with Braaks Environmental Products to market seedlings produced in the Mlambo nursery at garden centers throughout South Africa. CITES certificates were issued for the seedlings and seedlings were even shipped overseas. As in the case for the *E. transvenosus* nursery, tens of thousands of seedlings were distributed to the public over a period of 10 years, while the wild population remained intact.

The reformulation of the village nursery concept is not complete unless we address its function within larger overall goals of cycad conservation (see Donaldson, 2018). The plants produced in village nurseries can be used for other purposes besides education and alleviating demand from collectors. For example, in the village project for *Encephalartos whitelockii* (Table 1) over 6000 seedlings have been used for reintroduction back into habitat. Unlike seedlings produced in botanic gardens or commercial nurseries, seedlings produced in local villages have a much lower chance of being hybrids and therefore have a lower potential for introducing genetic contamination to the population. Also, seedlings in village nurseries are exposed to native soil and climate and therefore experience selection for traits similar to those in nearby wild plants rather than the artificial selection of traits

likely to occur in plants domesticated in botanic gardens. Reintroduced seedlings from botanic gardens and commercial nurseries also run the risks of introducing insect pests, diseases and weeds that can harm the wild population that they intend to bolster. Finally, for these same reasons village nurseries are an ideal source of plants if an assurance colony of a cycad species needs to be established elsewhere within the country or overseas.

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# CYCAD 2018: A report

Piet Vorster & Wynand van Eeden



CYCAD 2018: the participants.

Photo by Piet Vorster

CYCAD 2018, the 11<sup>th</sup> International Conference on Cycad Biology, hosted by the Cycad Society of South Africa, took place from 20 to 23 August at the Ingwenyama Lodge outside White River. This venue was chosen because it is in a rural part of South Africa, with cycad habitat close by, with a splendid collection of cycads at the Lowveld Botanical Garden at Nelspruit, being close to the essence of the African Bush at the Kruger National Park, and the absence of the disrupting attractions of a city or town.

The Conference hosted about 100 participants, from Australia, Brazil, China, Colombia, France, Indonesia, Hungary, Japan, Mexico, Netherlands, New Zealand, Panama, Portugal, Scotland, U.S.A. including Hawaii, Uganda, Zimbabwe and South Africa.

To start the conference, a day trip was undertaken on Sunday, 19 August, to show participants two *Encephalartos* species, *E. middelburgensis* and *E. lanatus*, in habitat. An unexpected surprise was the game seen whilst driving to the cycads. Red hartebeest,

ostriches and a giraffe caused great excitement! Seeing a majestic specimen of *E. middelburgensis* was a highlight but as with all plant people, they soon dispersed and people could be seen far and wide photographing various other plants in genera like *Haemanthus*, *Gladiolus*, *Euphorbia* and *Aloe*. The population of *E. lanatus* we visited was spectacular. Many plants had new flushes of leaves and cones emerging. Lots of fertile seed and seedlings were present in this population.

Some 36 papers were presented over three and a half days, and it is noteworthy that no less than 20 of these were read in the symposium on Conservation. Particularly interesting was the application of DNA in a range of disciplines, including conservation, taxonomy, evolutionary relationships, endophytic organisms, and pollinating insects. Arguably the most startling paper was read by Boglarka Erdei on the first fossil seedling cycad. Student participants delivered really good papers and it is encouraging to

see these young scientists rising up and doing excellent work.



**Figure 1.** Michael Calonje with a beautiful clump of *E. middelburgensis*. This specimen has 5 stems of various sizes and produces pollen cones.

Photo by Wynand van Eeden





**Figure 2.** *Encephalartos lanatus* in typical grassland habitat. Note that the cycads occur in the rocky part of the ridge, sheltered from fires started by lightning in the rainy season after the long very dry winter. Photo by Wynand van Eeden



**Figure 3.** Isabel Velásquez de la Cruz (left) and Karina Gutierrez-Garcia surrounded by *E. lanatus*. Photo by Wynand van Eeden.

To keep with tradition, Wednesday, 22 August, was spent visiting the Lowveld Botanical Garden. The delegates saw the collection of cycads in the garden, which included mostly *Encephalartos* species but also a few *Macrozamia* from Australia. Members of the Cycad Specialist Group had the opportunity to visit the gene bank maintained by the garden. This collection comprises many threatened species which are almost extinct in habitat. M

any delegates made use of the opportunity to visit Kruger National Park. They departed long before sunrise and returned late afternoon after a very successful if exhausting day. Everybody reported seeing the "Big Five" and one couple even saw a pangolin, a rare occurrence indeed.

The Cycad Specialist Group had its general meeting on Thursday evening, 23 August, where Tim Gregory explained his vision of



**Figure 4.** Alberto Taylor receiving his painting from Patrick and Cristina.

"No More Extinctions", a plan to have all species represented in *ex-situ* collections at Botanical Gardens all over the World. Plans are also afoot to start reserves where threatened species could be protected and monitored for the future. Some of these plans promoted and managed by Cristina Lopez-Gallego in Colombia, are already proving to work.

The morning of Friday, 24 August, was spent enjoying a private collection where the original specimen of *Encephalartos relictus* could be seen.

Three prizes were awarded at this conference to presenting participants. The first was a "Young Scientist" award which went to José Said Gutiérrez Ortega for his work on the genetics of *Dioon*. The second award was given to Vanessa Handley. Vanessa is an



**Figure 5.** Alberto Taylor with Piet Vorster and Cristina Lopez-Gallego.





Figure 6. Albeto Taylor with his South African pinup!





**Figure 7.** José Said Gutiérrez Ortegareceiving his award, a US\$1000 grant, from Patrick and Cristina.



**Figure 8.** Vanessa Handley receiving her award, a signed copy of *Cycads of Africa* by Douglas Goode, from Patrick and Cristina.

established researcher and delivered an excellent paper on the conservation work done



at UC Botanical Garden, Berkeley. Alberto Taylor received the "Lifetime Contribution to Cycad Science" award. Douglas Goode specially made a painting of *E. dolomiticus* for this award. Patrick Griffith and Cristina Lopez-Gallego presented the prizes to the winners.

A special word of thanks must go to The Cycad Society, Montgomery Botanical Center and the Colombian Cycad Society for donating funds to support student participation.

The international cycad community is a tightly knit group of scientists, researchers,

botanists, horticulturists and enthusiasts. Many have been friends for a long time.

Judging by the number and intensity of discussions after sessions, many good projects were thought of for the next three years.

See you all in Cuba in 2021!

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*Encephalartos longifolius* in South Africa.

Photo by Michael Calonje





## Report

# Cycad Specialist Group Meeting

## August 23, 2018

The Cycad Specialist Group met on Thursday Evening, August 23, 2018, as part of the Cycad 2018 conference in South Africa. Discussion centered on revitalizing the central focus of the group on conservation. New thinking about integrated habitat conservation and offsite assurance colonies was advanced at the meeting. Considerations of genetic diversity were highly emphasized, and the Specialists present offered a deep discussion of the best approaches to maximize conservation outcomes.

Additionally, new funding opportunities were presented, as seen in the August 2018 issue of CYCADS. The new program from Rainforest Trust was explained and CSG members were encouraged to submit proposals for consideration. This is a rare and incredible opportunity for our Group, and I am encouraged to see how new funding is leading to new conservation projects and initiatives in Africa and elsewhere.

The Group made recommendations and nominations for new expert members, continuing the recent push to include emerging leaders in cycad research and conservation efforts worldwide. Please see

pages 27 and 28 for profiles on some of our new members, and see page 29 for a complete roster. This professionalization, strategic recruitment, and robust networking continues to move forward, and is probably the most important characteristic of the modern CSG.

Finally, it was with great reluctance that the CSG accepted the retirement of Dr. Piet Vorster, *World Expert* on African Cycads. Piet was involved with the CSG since its earliest efforts, and has been instrumental to advancing the knowledge of these living

treasures. Our group will miss Piet's experience and perspectives. Piet's dedicated leadership was essential to the wonderful success of Cycad 2018 (see page 12), and that conference is a fitting capstone to Piet's dedicated career as an expert member of the Cycad Specialist Group.

**M. Patrick Griffith**

CSG Co-Chair

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## ***Ceratophila*, new genus of cycad beetle described, probable pollinator of *Ceratozamia***

Willie Tang

As part of the ongoing effort to identify and describe insect pollinators of cycads in the northern hemisphere, a new genus of cycad beetles has been described. Cycad Specialist Group members Willie Tang and Miguel Angel Pérez-Farrera in collaboration with erotylid beetle specialist Paul Skelley described the genus *Ceratophila* in the journal *Zootaxa* (Tang et al. 2018a). This genus consists of two subgenera, *Ceratophila* and *Vovidesa*, with a total of seven species (Fig. 1). This work is a culmination of more than 25 years of field work beginning with specimens collected by Andrew Vovides in 1989 and Ydelia Sánchez-Tinoco in 1995. This new genus belongs in the subfamily Pharaonothinae along with related cycad beetle genera *Cycadophila* and *Pharaxonotha* (Skelley et al. 2017; Tang 2016, 2107; Xu et al. 2015) and is distinguished from these based on morphology as well as DNA analysis (Tang et al. 2018b). In the cones of many species of *Ceratozamia*, species of *Ceratophila* are often found together with species of *Pharaxonotha*. One such co-inhabiting *Pharaxonotha* is in the process of being described by another group of workers as *P.*

*tenuis* (Santiago-Jiménez et al. 2019). Another species of *Pharaxonotha* being described by these authors in the same article appears to be a synonym of one of the newly described *Ceratophila* species.

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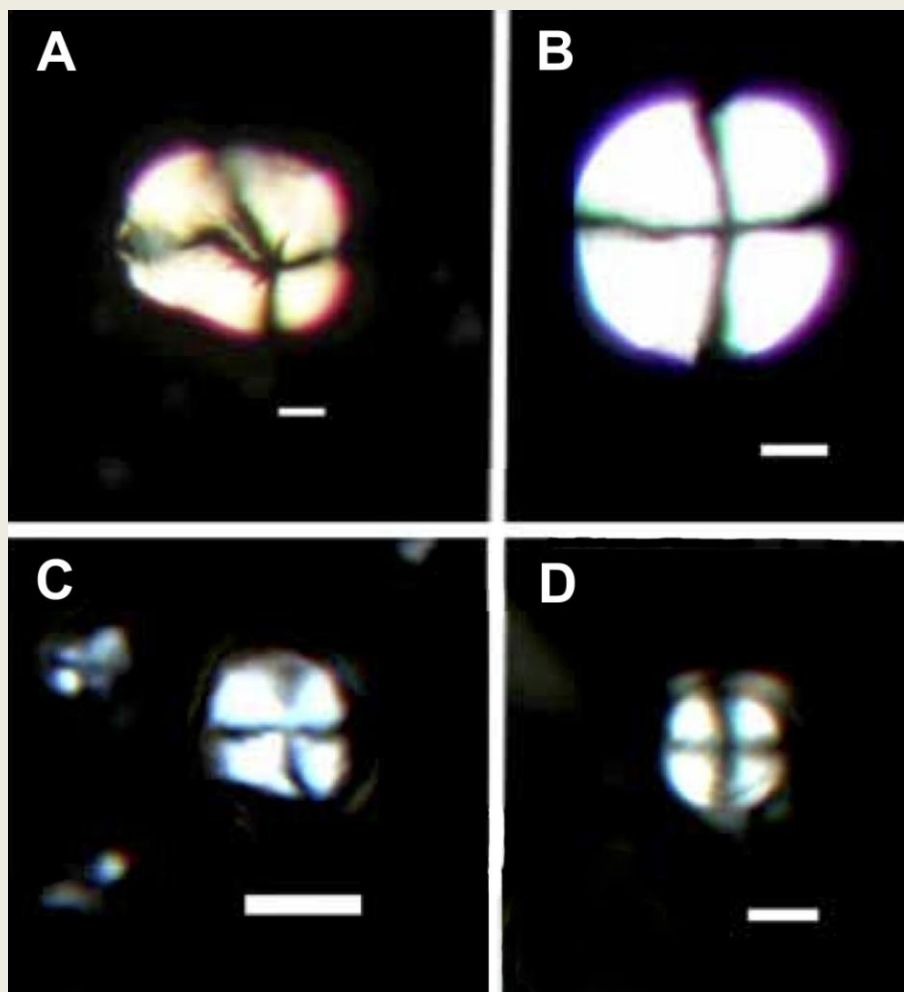
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# A brief survey of cycad starch grains

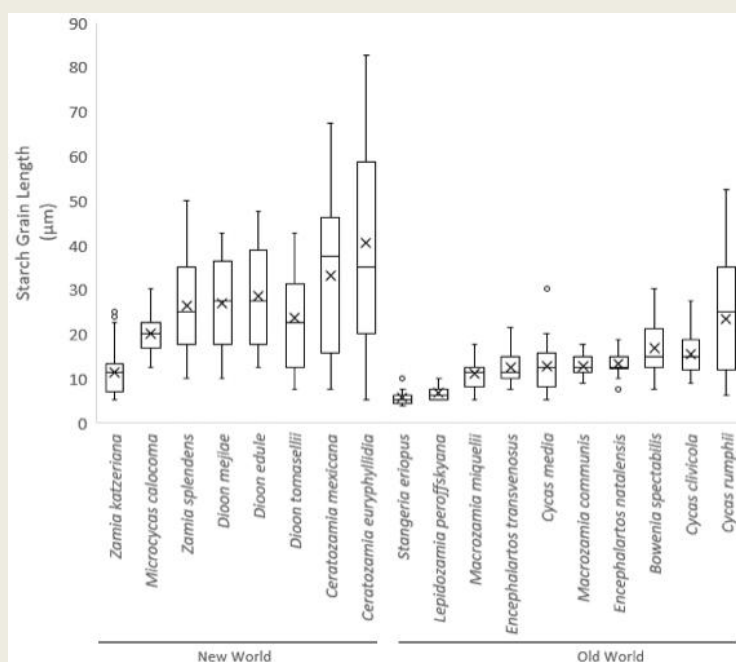
Andrew P. Vovides & Sonia Galicia

Starch grains are made up of glucose units formed into well-packed long chains known as polysaccharides. These are the end products of photosynthesis and are found in the parenchyma of plant storage organs such as roots, tubers, bulbs, corms, rhizomes, stems and some fruits such as bananas. Starch is an important energy carbohydrate source in our diets and is found in major cereal crops such as wheat, barley, rice, maize, sorghum and millet. All starch grains have a hilum, which is the point around which the polysaccharide layers are deposited in the form of growth rings. In some organs such as potato this hilum is often off-center, with growth rings emanating outward from the hilum giving a sea shell-like the appearance of the starch grain, yet in others, such as cereal grains it is perfectly spherical. One of the main properties of a starch grain is birefringence. Birefringence is the property of anisotropic materials to split light by polarization into two different rays. Nichol prisms or nowadays Polaroid is used in the polarizing microscope to detect birefringence. When starch grains are observed under the polarizing microscope the grains have a set of black arms that come together at the hilum called the extinction cross, and this resembles a Maltese cross when the hilum is perfectly centered or an early anaphase chromosome pair when off centered by the starch grain being of ovoid or mussel shell shape (Fig. 1).



**Figure 1.** Cycad starch grains under polarizing microscopy: A. *Ceratozamia euryphyllidia*, B. *Dioon edule*, C. *Stangeria eriopus*, D. *Lepidozamia peroffskyana*. A and B bar= 10µm, C and D bar= 5µm.

Cycads store starch in the thick cortex of their stems, in male cone sporophylls and to a far lesser or nil extent in female sporophylls, this has much to do with the cycads' pollination syndrome whereby in the male cone the sporophylls are starch-rich that serve as a food source for the pollinator beetles whereas the opposite is true of the female sporophylls. The stem starch grains are extremely variable in size and shape and mostly isodiametric in shape, seen clearly by the centered hilum and Maltese cross under polarizing microscopy. Other starch grains are ovoid or mussel shell shaped. By and large, the New World cycads examined exhibit larger starch grains than the Old World species with *Ceratozamia euryphyllidia* around 50% isodiametric starch grains and having the largest with a mean of 40.4 µm and the smallest shown by the South



**Figure 2.** Comparison of relative size of starch grains from Old and New World cycads.



**Table 1.** Starch grain shape per species

Species	Starch grain shape
<i>Bowenia spectabilis</i>	Isodiametric
<i>Ceratozamia euryphyllidia</i>	Variable
<i>Ceratozamia mexicana</i>	Variable
<i>Cycas clivicola</i>	Mostly isodiametric
<i>Cycas media</i>	Isodiametric
<i>Cycas rumphii</i>	Mostly isodiametric
<i>Dioon edule</i>	Mostly isodiametric
<i>Dioon mejiae</i>	Mostly isodiametric
<i>Dioon tomasellii</i>	Mostly isodiametric
<i>Encephalartos transvenosus</i>	Mostly isodiametric
<i>Encephalartos natalensis</i>	Isodiametric
<i>Lepidozamia peroffskyana</i>	Isodiametric
<i>Macrozamia communis</i>	Mostly isodiametric
<i>Macrozamia miquelii</i>	Isodiametric
<i>Microcycas calocoma</i>	Isodiametric
<i>Stangeria eriopus</i>	Isodiametric
<i>Zamia katzeriana</i>	Isodiametric
<i>Zamia splendens</i>	Isodiametric

The mostly isodiametric category is given when 50% + grains are isodiametric.

African *Stangeria eriopus* with wholly isodiametric starch grains with a mean of 5.5  $\mu\text{m}$  (Fig. 2). Table 1 shows the shape of starch grains among the cycad species examined. Further research into cycad starch grains and comparison between storage organs might be of taxonomic value in cycads.

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*Dioon mejiae* in natural habitat at Olancho, Honduras.

Photo by Chip Jones





Largest *Zamia* population encountered in Jamaica, in understory of coastal Caribbean forest 45-200 m on the north coast.

Photo by Alan W. Meerow

## Adaptive Convergence in Caribbean *Zamia*

Meerow AW, D Salas-Leiva, M Calonje, J Francisco-Ortega, MP Griffith, K Nakamura, F Jiménez-Rodríguez, J Lawrus & A Oberli

In paper in the November/December issue of International Journal of Plant Sciences (IJPS), Meerow *et al.* (2018) tested the following hypotheses about the *Zamia pumila* complex across six islands of the Greater Antilles [Hispaniola (Dominican Republic, DR), Jamaica (JAM), and Puerto Rico (PR), and the three Cayman Islands (CAY)] using both microsatellites (SSRs) and single copy nuclear genes (SCNGs): (i) Dominican Republic (DR) and JAM fit evolutionary models of panmixis and isolation, respectively; (ii) historical gene flow has occurred between PR and DR, and admixture between the Caymans (CAY) and JAM; and (iii) vegetative morphological characters in common to populations on different islands do not conform to genetic relationships. We genotyped a total of 30 populations from CAY, DR, JAM and PR with 21-28SSRs, and

haplotypes from ten SCNGs. By using two different sets of molecular markers with very different mutation rates (SSR and SCNGs), we sought to capture two distinct time slices of evolutionary history in the populations of each island. Diversification of Caribbean *Zamia* follows a different path on each island after migration or vicariance from ancestors putatively originating in Cuba. DR and PR evolved from a common ancestral gene pool. DR fits a model of panmixis, while PR fits a vicariance model of semi-speciation. Northern and western populations in JAM represent separate introductions to the island. Overall, JAM shows minimal levels of gene flow among populations, and apparent admixture with CAY. We conclude that niche adaptation and associated vegetative morphological character states evolve convergently among different islands in

response to environmental and other stochastic variables. We present a model of how these dioecious gymnosperms diversified in the Greater Antilles.



**Figure 1.** Young plant in littoral population of *Zamia* on Jamaica's west coast. Photo by Alan W. Meerow.





**Figure 2.** Patrick Griffith with *Zamia* on the Cayman Islands.

Photo by Michael Calonje

Meerow, A. W., D. Salas-Leiva, M. Calonje, J. Francisco-Ortega, M.P. Griffith, K. Nakamura, F. Jiménez-Rodríguez, J. Lawrus, and A. Oberli. 2018. Contrasting demographic history and population structure of *Zamia* (Cycadales: Zamiaceae) on six islands of the Greater Antilles suggests a model for population diversification in the Caribbean clade of the genus. *International Journal of Plant Sciences* 179: 730–757.

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Rita Singh with a young plant of *Cycas orixensis* in Odisha, India.

## Threats to populations of *Cycas orixensis*, an endangered species endemic to Odisha, India: A report

Rita Singh, JS Khuraijam & P Radha

It took almost 100 years to solve the taxonomic status of this Eastern Ghats species. *Cycas orixensis* was identified as a variety of *Cycas circinalis*, by Haines (1924). Critical revision of Indian cycads over last decade or more has established that *Cycas circinalis* is an endemic species of South Kerala in the Western Ghats (Singh *et al.* 2015). Like the species, several species of *Cycas* which were described previously either as a variety or subspecies of *Cycas circinalis* were raised as separate species in the last few decades. *Cycas orixensis* was also erroneously synonymised by many authors under *Cycas sphaerica*, an unresolved species described from cultivated plants brought from Moluccas (Lindstrom & Hill 2007, Ramana *et al.* 2018). *Cycas orixensis* with its characteristic variously forked tips of microsporophylls and tall, slender trunk is unique among Indian cycads. After extensive surveys in Odisha extending to more than a decade, the natural populations of this interesting species were identified and their range of distribution was demarcated to be up to Odisha, the northern Eastern Ghats. We have been regularly monitoring the identified

populations of the species to study its phenology and reproductive biology.



**Figure 1.** Cycad locality after selective removal of *Cycas orixensis* plants in northern Odisha, 2018. Photo by Rita Singh.



Till 2015, all the populations of *Cycas orixensis* were more or less intact despite of temporal harvesting of leaves, seeds, leafy trunks for food, customs, beliefs and other uses by indigenous people since time immemorial. We have always believed that abundant *Cycas* populations of Odisha will remain intact as people have been using them sustainably and are interwoven with their traditional and cultural practices. However, our belief got immensely shattered during our visit to northern and central Odisha in 2017 March to do observations on their phenology and reproductive biology, all the populations in the region were gone..... except for some individuals at the higher reaches. On pursuance with our friends among indigenous people (who were guilty that they could not save cycads), we were told how people have selectively decimated cycad populations to earn some money to meet the two ends. The trunks were cut into pieces, dried and sold to some unknown middle man from some pharmaceutical company from Kolkata, West Bengal at the rate of Rs.20/Kilogram!!!! The same modus operandi was followed throughout northern and central Odisha.



**Figure 2.** Remnants of a hacked tree trunk of *Cycas orixensis*. Photo by JS Khuraijam.

Cycads which survived geological upheavals and passed on to us by nature itself could not endure the wrath of Anthropocene. But...cycads are survivors and have tenacity to flourish again, evident from our 2018 visit to the same localities as some of them have started sprouting. It may take decades if sincere efforts are initiated NOW to revive some of these populations, at least those which are in the vicinity of Protected Areas. Time has come to fix the responsibility of the State Forest Department, officials to take cognizance of the decimated populations of *Cycas* in their areas of jurisdiction, through Ministry of the Environment, Forest and Climate Change, Government of India. This can only be achieved through involvement of IUCN/SSC Cycad Specialist Group at the international level and by the involvement of local indigenous people in a community based conservation action plan which should be associated with their livelihood.



**Figure 3.** Young leaves sprouting from the ill fate plant. Photo by Rita Singh.

The conservation status of *Cycas orixensis* was 'Endangered', it needs to be revised now. Moreover sincere efforts are required by cycad specialist group to update the long due cycad redlist. As we are aware that IUCN Red List of Threatened Species plays an important role in directing limited conservation resources to the species that need it the most. The Red List is an important tool for funding allocation, as many funding agencies prefer to support projects on species listed as threatened on the Red List. *Cycas orixensis*, an endemic to Odisha, which has recently been devastated by humans need and greed, definitely needs timely conservation attention.



**Figure 4.** JS Khuraijam with a tall *Cycas orixensis* in northern Odisha, 2009. Photo by Rita Singh.

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# Conservation through collaboration: a pilot project with *Encephalartos hirsutus*

Vanessa Handley & Nathalie Nagalingum

In mid-2000, roughly one thousand illegally imported cycads were intercepted by the United States Fish and Wildlife Service—the result of an elaborate sting operation dubbed “Operation Botany”. The University of California Botanical Garden at Berkeley (UCBG), through its role as a designated Plant Rescue Center, was asked to accept many of these confiscated plants. Though a monumental undertaking, UCBG agreed to accommodate the plants, first shouldering the task of nursing them back to health (most were seriously compromised by the smuggling process) and then investing in staff and infrastructure to steward the collection permanently. However, this significant commitment set the stage for UCBG to become a member of the Multisite Cycad Collection (a botanical garden collaboration dedicated to this taxonomic group), and to make an institutional commitment to cycad conservation.

The UCBG cycad collection currently comprises almost 700 accessions representing 113 taxa, and includes numerous species of conservation concern including *Encephalartos hirsutus*, *Cycas ophiolitica*, and *Dioon spinulosum*. While UCBG generally mandates that accessions be of permitted wild-origin, a broad exception was made when incorporating these confiscated cycads. Particularly for Critically Endangered (CR) taxa, determining location of origin and characterizing genetic variation of “data-free” accessions is of utmost importance. To this end, a pilot project focused on *E. hirsutus* has been initiated, led by Vanessa Handley at UCBG and Nathalie Nagalingum at California Academy of Sciences.

Described in 1995 by Hurter & Glen and also known as the “Venda cycad”, *E. hirsutus* is a beautiful blue cycad with a striking tomentum on the flushing leaves (Fig. 1). This feature helps distinguish it from other taxa in the so-called “Transvaal blue” complex, a group of species considered closely related: *E. eugene-maraisii*, *E. hirsutus*, *E. middenburgensis*, *E. dolomiticus* and *E. dyerianus*. *Encephalartos hirsutus* was originally known from three populations in Limpopo Province, South Africa, but by the time it was described it was

already on a fast track toward extinction. Last assessed as CR, *E. hirsutus* is now functionally extinct in the wild.



Figure 1. *Encephalartos hirsutus*, leaf flush.

Unfortunately, there are very few botanical garden holdings of this taxon—in fact, UCBG is the only *ex situ* collection within the 1000+ institutions in the Botanical Garden Conservation International database. Accordingly, UCBG has made *E. hirsutus* a conservation priority and the plants are held away from public view in a safe facility to prevent poaching. However, the genetic relationships among the UCBG accessions are unclear—do they represent multiple, unique plants or clones?

To address this question, we have adopted a state-of-the-art genomic approach called restriction-site associated DNA sequencing (RADseq). Given that *Encephalartos* species have large genomes (exceptional even amongst cycads), RADseq is ideal because it provides a reduced, yet still informative, representation of the genome. This approach has been successfully utilized in the Nagalingum lab across many species of *Cycas* (see December 2016 issue). We have already completed our pilot RADseq analysis of the UCBG accessions alongside private holdings of *E. hirsutus* and other taxa in the “Transvaal blue” species complex. Thus far we have

obtained DNA sequences from 24 individuals for a total of 63 GB of data. Our preliminary results indicate that RADseq provides resolution of relationships among the *E. hirsutus* individuals.

In the long term, our hope is that these data will be used to inform breeding efforts and reciprocal pollen/seed/offset exchange with our partners (Fig. 2). The ultimate goal is to establish reproducing populations (analogous to assurance colonies in animal conservation) of *E. hirsutus*...and eventually for allied CR taxa. Preliminary molecular results suggest that the UCBG *E. hirsutus* accessions lack significant diversity to create a genetically representative breeding population. Moreover, due to extirpation of wild plants, we have no reference populations. Given the parallel dearth of public holdings, this will necessitate bridge building and, over time, exchange with private collectors—by far the most significant repository for this taxon.



Figure 2. *Encephalartos hirsutus*

This project on *E. hirsutus* serves as an important pilot for future public-private collaboration around a CR taxon and is a platform we hope to see replicated across other *Encephalartos* species. Together with South African colleagues we are beginning to quantify and assess private holdings.



Accordingly, the Cycad Specialist Group and regional societies, such as the Cycad Society of South Africa, can most effectively serve as points of liaison for stakeholders growing CR taxa.

We are currently soliciting additional *E. hirsutus* samples (comprising small amounts of leaflet tissue, Fig. 3) to integrate into a future expanded RADseq analysis. Broader sampling is vital for us to develop an accurate molecular snapshot of the taxon and will potentially allow us to reconstruct provenance of public and private holdings. We gladly welcome contributions, queries, and recommendations.



Figure 3. *Encephalartos hirsutus*

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*Encephalartos horridus* in natural habitat at Uitenhage, Eastern Cape, South Africa.

Photo by Michael Calonje





NongNooch Cycad Horticulture Workshop 2016

## Announcement

# 2019 NongNooch Cycad Horticulture Workshop



The 2019 Cycad Horticulture workshop starts (Day I) on Sunday, 13th October, 2019 and will be a 7-day, 6-night Cycad extravaganza ending Saturday, 19<sup>th</sup> October, 2019. There will be 2 Invited speakers each evening and half day indoor workshop on hand-pollination, potting media, pollen storage and other horticulture issues.

Double share: US\$1,700/person  
Single room: US\$ 1,900/person  
Latest payment is the 15th of August 2019.

There will also be a POST TOUR to visit and see 6 Thai *Cycas* species in habitat. The post tour will start directly after the Workshop on the 19<sup>th</sup> October, 2019. The tour will take you through the Northeast and Central Thailand (6 days, 5 nights). The post-tour is not included in the Workshop fee and will be charged extra.



Information on registration and online secure payment will be posted on [www.nongnoochtropicalgarden.com](http://www.nongnoochtropicalgarden.com)

Any questions can be sent to  
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## New CSG Members (2018)



**Wynand van Eeden**

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Wynand first became interested in cycads in 1998 and, given his academic interest in cycads, was appointed as editor of *ENCEPHALARTOS*, the official journal of the Cycad Society of South Africa, in 2003 – a position he still holds. After participation in many CYCAD conferences, he organised the CYCAD 2018 conference recently held.

Much of Wynand's knowledge was acquired through his own cultivation of most genera and visits to habitats globally. He strives to be in a position where he can contribute even more to conservation of especially the cycad species indigenous to South Africa. With help from members of the CSG, he is currently in the process of registering a non-profit company with which to acquire land specifically for cycad preservation. *Ex situ* assurance populations also need to be established and managed for many species - he is currently sourcing and acquiring specimens for this program. A primary aim of this initiative is to ensure genetic diversity of the gene pool in surviving plants, even if only in cultivation. By these endeavours and through working with cycad researchers – whom he actively supports – Wynand believes we can gain valuable insight which may inform on strategies to ensure better habitat survival.



**Vanessa Handley**

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While I have benefited from many botanical mentors, the most seminal influences were my grandmother and father – both avid horticulturists. Both are South African so my earliest awareness of cycads was in fact through photos in family albums and books. After my grandmother immigrated to Canada, she kept a lovely assortment of plants in her backyard greenhouse (with South African flora featuring prominently). While she didn't have an appropriate space to cultivate *Encephalartos*, she nonetheless intrigued me with these iconic plants from her homeland.

I currently serve as Director of Collections & Research at the University of California Botanical Garden at Berkeley (UCBG) and as a Research Associate at the California Academy of Sciences. My research interests center on plant evolution and conservation and current projects include population genetics of cycads and diversification of Malagasy melastomes. Before joining UCBG, I enjoyed a decade as a biology professor at a liberal arts university where I also served as Chair of Math and Science. During this time, I was proud to reinvigorate the institution's plant science curriculum and to see my students pursue their own botanical careers. Sharing my love of botany – and inspiring the next generation to study and conserve plants – continues to be my passion.



**Rosane Segalla**

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My great interest in Cycads began in 2012, when I first visited a population of *Zamia boliviana* in its habitat and I became fascinated by its dioecious reproductive system and its rarity. However, I also became concerned about the neglected state of its conservation. In the last six years I have done extensive fieldwork with populations of *Z.*

*boliviana* while studying the phenology and biotic interactions as the subject of my doctoral thesis. More recently, I have begun doing research on with Amazonian species. During the course of my fieldwork I was able to study and evaluate the conservation status of many populations. The total or partial destruction of habitats remains the major concern for Brazilian cycads. Despite the difficulties in keeping my self-funded research going, the plans to develop conservation programs for Zamiaceae of Brazil and adjacent countries are ongoing. I am grateful to the Instituto Federal de Educação, Ciência e Tecnologia de Mato Grosso (IFMT), for the salary maintenance license, from which I am able to develop my PhD and associate research.

Graduated in Biological Sciences, Master in Tropical Agriculture and PhD student in Plant Biology - University of São Paulo (UNESP), Institute of Biosciences, Postgraduate Program in Biological Sciences (Plant Biology), São Paulo, Brazil.



**Chip Jones**

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Chip Jones lives in Fort Lauderdale, Florida. His business is Jones Landscaping with operations in horticulture, garden design, and landscape construction. For the last decade he has also operated a rare plant nursery ([www.cycadflorida.com](http://www.cycadflorida.com)) growing cycads commercially and working to make cycads known and available to the public. Chip works on the Fairchild Tropical Garden cycad collection for pollination and propagation. He has developed a new significant public garden collection of cycads at Flamingo Gardens in Broward County, Florida. Particularly fond of new world species, Chip has studied many cycad species *in situ*.





**Brian Dorsey**

*The Huntington Library, Art Collections and Botanical Gardens*

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I am the Research Botanist at The Huntington Botanical Gardens in southern California,

USA, where my research focuses on the phylogeny, speciation, phylogeography, and conservation genetics of the genus *Dioon*. Before beginning my current position I did my graduate work on the giant genus, *Euphorbia*, investigating the phylogeny, taxonomy, and morphological evolution of a *E.* subg. *Euphorbia*. However, like most botanists I have always been fascinated by the odd and resilient cycads and, as a graduate student, I was inspired by Nathalie Nagalingum's *Science* paper dating the living genera. So, when I started at the Huntington I was immediately impressed with the collection of cycads and jumped at the chance to build my research program around it. Tim Gregory

introduced me to the genus *Dioon* and since then I have worked with Tim and others at UC Berkeley to establish divergence dates within the genus, and with Silvia Salas-Morales and Gonzalo Juárez García from SERBO, to build a comprehensive population-level genetic data set for *Dioon*. Our hope is to use these data to characterize the history of speciation and the phylogeography of each species in order to inform conservation efforts and improve our understanding of evolutionary processes in the genus.



*Ceratozamia euryphyllidia* in natural habitat at Oaxaca, Mexico.

Photo by Chip Jones



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Mature female plant of *Cycas pectinata* clinging to the roots of other trees in foothills of Himalayas (Bihar, India). Photo by JS Khuraijam



*Encephalartos middelburgensis*  
Middelburg, Mpumalanga, South Africa



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