Journal of the Cycad Society of South Africa

ENCEPHALARTOS

Tydskrif van die Broodboom Vereniging van Suid-Afrika

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BROODBOOM VERENIGING VAN SUID-AFRIKA

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ON THE COVER:

Cover: *Encephalartos dyerianus* in habitat in Limpopo Province. This picture was taken in August 2019 while on an expedition to collect DNA of our endangered species from this province, as well as Mpumalanga. Unfortunately no DNA could be collected on this visit from any of the plants in habitat. Around 300 mature stems have been counted but there are fewer plants. Many specimens have two, three or even more stems and are huge. Picture: Wynand van Eeden

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FROM THE COUNCIL / VAN DIE RAAD

VAN DIE REDAKTEUR / FROM THE EDITOR

Die lys van redakteurs van ENCEPHALARTOS kan amper op een hand getel word. Mense soos Maans Kemp en al sy opvolgelinge het uitstekende werk gedoen in die begin jare van die vereniging. Dr Isabella Claassen was die langste in die pos en het 35 uitgawes die lig laat sien.

Nommer 138 van ENCEPHALARTOS is my laaste uitgawe as redakteur. Baie dankie aan almal, plaaslik en internasionaal, wat bydraes gelewer het oor die jare. Soms was dit moeilik om artikels te vind, maar iemand het altyd 'n artikel gestuur as die nood hoog was. Dit was 'n voorreg om saam te werk.

Ek het as redakteur die voorreg gehad om broodboom vriende te maak reg oor die wêreld, van New Zealand tot in Kalifornië. Dit is net een van die vele voordele wat die vereniging inhou vir lede.

Hierdie uitgawe het nuus oor tak aktiwiteite en 'n nuwe bewaringspoging vir broodbome. Hopelik inspireer die artikel oor Lillie Flora ons lede om 'n noodsaaklike projek te ondersteun en 'n bydrae te lewer vir bewaring van ons broodbome. Lees meer op bladsy 17.

Geniet hierdie uitgawe en dra asseblief by tot ENCEPHALARTOS!

Beste groete
Wynand van Eeden

One can almost count the editors of ENCEPHALARTOS on one hand. People like Maans Kemp and his successors did outstanding work in the early years of the society. Dr Isabella Claassen was the longest serving editor and 35 journals saw the light under her editorship.

Number 138 of ENCEPHALARTOS is my last edition as editor. I want to thank all local and international members that contributed over the years. At times material was difficult to find but somebody always contributed when it was needed. It was a great privilege working with you.

As editor I had the privilege to make friends across the world, from New Zealand to California. This is but one of the benefits of our society. These friendships last a lifetime, just ask some of the older members!

This edition has news about branch activities as well as a new effort to conserve cycads. The article on Lillie Flora will hopefully inspire our members to support a worthwhile project and contribute to the conservation of our cycads. Read more about it on page 17.

Enjoy this edition and please contribute to ENCEPHALARTOS!

Kind regards
Wynand van Eeden

NEWS FROM THE CENTRAL BRANCH

VISIT TO THE ALOE FARM, NORTH WEST PROVINCE

Christo Page

Figure 1. Andy de Wet explaining their selective breeding and propagation programme for aloe hybrids.

Members of the Central Branch were scheduled to visit a cycad garden in North West Province and The Aloe Farm near the Hartbeespoort Dam on the 13th of July 2019. The first mentioned visit had to be cancelled due to unforeseen circumstances, however, the visit to the Aloe Farm more than made up for it. Although strictly speaking not strictly cycad related, we had a very informative and enjoyable day. The Aloe Farm is the premises of De Wet Plant Breeders where horticulturally superior aloes, *Agapanthus*, *Tecomaria*, *Gazania*, *Cotyledon* and other plant varieties are developed. The aloes and other succulents are excellent companion plants for landscaping with cycads, either as fill-in between the cycad plants or the tall growing aloes as accent plants. This is particularly applicable now and in the future with the extreme heat and dry weather we are experiencing. Many of the selected, mostly patented plants are available for purchase at the retail nursery on the property. There is also a good selection of *Encephalartos* cycads for sale.

Figure 2. Some of the many commercially available aloe hybrids in the garden at the Aloe Farm: the tall growing Aloe Koeleman's Orange and A. Koeleman's Red, the shorter growing, bi-coloured yellow and orange-red Aloe Havenga's Pride on left, and white and red Aloe Tazzy on the right of Andy.

Figure 3. A kaleidoscope of aloes in bloom with *Aloidendron* (Aloe) barberae as accent plants in background.

Figure 4. Ennobled *Osteospermum* daisies bred by De Wet Plant Breeders to be more tough in the dry, hot South African climate.

We were welcomed at the nursery by Andy de Wet, founder of De Wet Plant Breeders, who proceeded to give us a conducted tour of the aloe garden and an insight in their aloe breeding programme. He started by showing us the difference between aloes pollinated by sunbirds and those pollinated by other birds and bees. Aloes with long, narrow tubular flowers are pollinated by sunbirds with long, curved beaks and those with more open and shorter tubular flowers are pollinated by other birds and bees. The long tubular flowers generally hang down nearly parallel to the inflorescences so that the sunbirds can insert their bills from below while clinging to the inflorescence. The short tubes flowers hang at an angle nearer to ninety degrees away from the inflorescence.

During the aloe flowering season from autumn to early spring at the nursery many sunbirds flit among the aloes for nectar affording bird photographers a field day taking photos. At the time of our visit in middle July,

Figure 5. Discussing the rigorous selection process for *Agapanthus* seedlings.

Figure 6. A selected white and intense dark blue *Agapanthus* seedling.

Figure 7. One of the very striking blue *Agapanthus* cultivars selected for further evaluation and possible propagation.

however, very few sunbirds were present due to the many *Aloe davyana* plants in flower in the veld in the flat-laying area between Pretoria and Rustenburg.

After this introduction, Andy discussed the whole process of artificially pollinating selected aloe plants with others in the process to enhance specific positive traits in their offspring like ease of culture and flowering, increased disease resistance, holding properties of the flowers, etc. The seed are sown, and seedlings grown to flowering stage. The plants are then evaluated over several years according to certain very strict criteria including the factors mentioned above. The culled plants are destroyed and only the very best (about one to two percent) are propagated by means of tissue culture to be introduced to the local and overseas markets.

At the conclusion of the tour of the aloe garden, some of us had the opportunity to visit the propagation area, closed to the public, where the seedlings of aloes, *Agapanthus* and other selected plants are grown on to maturity and flowering stage. This is also the area where the plans are evaluated to the strict criteria mentioned above and discards disposed of.

Some of us explored the wildflower garden laid out between natural bushveld trees, while others selected plants in the commercial nursery to take home. The visit to the Aloe Farm was concluded by the customary braai and social interaction. A special word of thanks is due to Andy de Wet for allowing us to visit his nursery and the very informative talk on their selective plant propagation. A word of thanks is also due to John Evert for the arrangement to make everything happen.

Figure 8. Cycad Society members Derek Minnaar, Hermann Böhm, John Evert and Johan Britz around the BBQ fire.

WESTERN CAPE BRANCH CALENDAR 2020

Date	Venue/Activity	Time
29 February	Garden Visits Vink's Garden and Dr Adriaan and Karin van Zyl	13:30 for 14:00
21 March	Retief Du Toit, Deux Freres Wyne, R44, Between and Klapmutz, Stellenbosch	14:00
4–5 April	Kirstenbosch Annual Plant Sale	details to follow
18 April	Cultivation Workshop, Brackenfell High School	09:00 for 09:30–12:30
11 Julie	Wynand van Eeden, Cycad Conservation Needs and Cycad ID Workshop (WC Branch Committee), Brackenfell High School	09:00 for 09:30–12:30
19–28 September	Cycad Tour, Nong Nooch Thailand	details to follow
26 September	Garden Visit Cycads and Clivias, Gideon van Zyl, Kuilsrevier	14:00
31 October	Annual Plant Sale, Exclusive Plants, 1 Krisant Rd, Tara, Durbanville	09:00–15:00
21 November	Year End Function	details to follow

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TYPE

A VISIT TO THE CAIRNS BOTANIC GARDENS

Roy Osborne*

Figure 1. Cairns Botanic Gardens signage on the Captain Cook Highway, framed on each side by coning specimens of *Encephalartos whitelockii*.

My wife and I had a spare morning during a recent visit to Far North Queensland, and we were privileged to spend the time renewing our acquaintance with the deservedly-popular Cairns Botanical Garden (CBG).

The CBG is a complex of several areas. The older tropical garden stems back to 1886 when plant collector Eugene Fitzalan established a nursery garden which he opened to the public. In the mid 1900s, the North Queensland Naturalist Club initiated a Native Botanical Preservation Society that constructed a garden near Fitzalan's original site in 1971. The attraction was

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Figure 2. The main entrance gates to Cairns Botanic Gardens on Collins Avenue.

Figure 3. Coning *Zamia skinneri*, with *Cycas deboaensis* behind, in the CBG Watkins Munro conservatory.

Figure 4. One of many coning specimens of *Zamia pseudoparasitica* in the CBG conservatory.

named Flecker Botanic Gardens in recognition of the contribution of Hugo Flecker, founder of the North Queensland Naturalist Club. In the past 20 years, the area has been greatly extended to include a Gondwanan Heritage Garden, a Visitor Centre incorporating a gift shop and interactive displays, the Centenary Lakes, a Rainforest Boardwalk, a Lowland Swamp Forest, the Mount Whitefield Conservation Park and the Tanks Art Centre. In 2007, the precinct as a whole was rebranded as the Cairns Botanic Gardens.

Figure 5. A collection of tassel ferns is a special feature in the Watkins Munro conservatory.

Figure 6. The characteristic foliage of *Cycas apoa*, a tropical cycad species from Indonesia and Papua New Guinea, in the CBG Flecker Gardens.

Figure 7. *Stangeria eriopus* with emerging male cones in the Flecker Gardens.

The older section of the CBG, now referred to as the Flecker Gardens, boasts sections of lush rainforest vegetation, numerous impressive and important trees, large grassy lawns, water features, an Aboriginal ethnobotanical section, tropical fruit trees, a spice garden, a display of beverage plants, a "Friends" office and library, and a cafeteria. The tropical and diverse collections in the Flecker Gardens include aroids, bromeliads, orchids, palms, vines and many other plants. A highlight is the Watkins Munro Martin Conservatory, built in 2015 in the profile of a *Licuala* palm leaf. This houses some of the most tender and valuable plants including aroids

Figure 8. The lush glossy foliage of *Zamia fairchildiana* in the Flecker Gardens.

(especially a significant *Amorphophallus* display), numerous bromeliads, cycads, ferns (especially a fine collection of tassel ferns), palms, orchids and many other important tropical specimens. The conservatory also functions as a delightful butterfly house where one encounters Ulysses, Cairns Birdwing, Red Swallowtail, Ambrax and Lurcher butterflies.

Of particular interest to our readers is the Gardens' cycad collection, which comprises approximately 250 specimens in 110 species with nine genera represented. The conservatory has magnificent specimens of *Cycas deboaensis*, *Zamia skinneri* and *Zamia pseudoparasitica*; in the general garden areas one finds well-tended examples of *Bowenia,Dioon*, *Encephalartos, Lepidozamia, Stangeria, Zamia* and other cycads.

The Cairns Botanic Gardens are located on Collins Avenue, only 4 kms from the city centre are open daily throughout the year. Admission is free although donations are welcome. This popular facility is a "must see" for any cycad enthusiast visiting Australia.

I thank David Paschetto, Botanic Reserve and Conservation Park Supervisor, for kindly proof-reading this article.

Figure 9. Numerous male cones of this specimen of *Zamia fairchildiana* in the Flecker Gardens.

CYCAD TOXICITY: HITS AND MYTHS

Roy Osborne[1], Piet Vorster[2] & Wynand van Eeden[3]

INTRODUCTION

If you Google "cycad toxins" you come up with several hundred thousand "hits", many of them authoritative, informative and useful, but some of them obscure, irrelevant or simply incorrect. Likewise, if you search the social media, you come up with a diversity of fact and fantasy. Ian Bassingthwaighte, long-serving Council member of our Society, suggested that it was time we published a succinct update on the theme of cycad toxicity; something that would be of interest to growers and researchers alike. The definitive paper on the subject was the "Toxicity of Cycads" written by Marjorie Whiting in 1963. We are not attempting to repeat a comprehensive review of this very complex field but instead to summarise the currently-known material, while alerting readers to "fake news" where incorrect facts have crept into and sometimes innocently perpetuated in the social media.

ANCIENT TRIBES: FOOD, MEDICINE AND CEREMONY?

Material from different cycad species has long been in use by primitive people in the Americas, Africa, Australia, Asia, and the Pacific and Indian Oceans islands, as an emergency or ceremonial foodstuff; the tribespeople were aware of the possible toxicity of this material and had learned, independently and at some cost, how to detoxify the products using various soaking, washing, ageing and roasting processes. Generally, the carbohydrate-rich cycad seeds were used, but sometimes the pith from the stems or even sections of the roots were the source. Also known is the use of toxic cycad material as a rodenticide, for medical purposes, and for the unfortunate and gruesome purpose of getting rid of unwanted children.

WHENCE "*ENCEPHALARTOS*" AND "BROODBOOM"?

The Cape Hottentot people are said to have made a crude form of bread from pith scooped out of the stems of local cycads, a process documented by Carl Thunberg when he named the plant "*Zamia caffra*" in 1800. The Swedish botanist relayed the information to Lehmann who in 1834 coined the genus name *Encephalartos* from the Greek words *en* = within, *kephali* = head, *artos* = bread. That usage likewise gave rise to the Afrikaans name "broodboom" and Thunberg's "*Zamia caffra*" is most likely to have been Lehmann's *Encephalartos longifolius*. It was clear that the indigenous people were aware of the dangers of eating the cycad material and had developed a rough but effective way to detoxify it before making their bread.

HUMAN VICTIMS OF CYCAD POISONING

In 1697, the Dutch explorer Willem de Vlamingh and his crew of one of his three vessels, the "Geelvinck", became violently ill after eating *Macrozamia reidlei* seeds on the coast of Western Australia. A parallel incident was when James Cook's crew were attempting to repair their damaged "Endeavour" on the coast of northern Queensland in 1770. They noticed from fire residues that the local Aboriginals used cycad seeds, fed some local *Cycas media* subsp. *banksii* seeds to the ship's hogs and then proceeded to consume more seeds, with two of the pigs dying and the men becoming severely incapacitated as a result. Several other early Australian expeditions had similar experiences where cycads temporarily jeopardised the success of their missions. These included the La Perouse expedition in 1788 when the crew sampled *Macrozamia communis* near Botany Bay, Mathew Flinders' experience with *Macrozamia dyeri* near Esperance, Sir George Grey's 1839 party eating *Macrozamia riedlei* in Western Australia, and John Stuart's 1860 culinary encounter with *Macrozamia macdonnellii* in central Australia.

Probably the best-known South African incident of cycad poisoning to humans was when the Jan Smuts' boer commando was under siege from British forces in

Figure 1. Signage at the George Brown Botanical Gardens in Darwin, Australia, showing how the Northern Territory Aboriginal people used to make a crude bread from seeds of the various *Cycas* species abundant in the area.

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the Suurberg in 1901, and when they supplemented their meagre supplies by eating roasted seeds of *Encephalartos longifolius*. Smuts himself and about half his men were comatose for about 48 hours and narrowly escaped capture as a result.

In an earlier military episode, a number of troops stationed in Florida during the American Civil War (1861–1865) were badly affected after eating untreated *Zamia* products.

The Japanese islands of Okinawa and Amami, with such an abundance of *Cycas revoluta*, was an epicentre of cycad poisoning from the early 1900s up to the end of World War II. Desperately short of conventional food sources, the islanders used the "sotetsu" (cycad) seeds as a substitute ingredient in their traditional miso paste. Only a few locals knew how to treat the seeds to remove the toxic elements; many did not and succumbed to headaches, abdominal pains, vomiting and death, in a period which become known as the "sotetsu hell".

The indigenous Chamorro people on the Mariana Islands of Guam and Rota were known to use *Cycas micronesica* seed as a dietary supplement for at least two centuries but, as is the case with the Japanese in the Ryukyus, ate more during times of famine. The situation on Guam has attracted a great deal of clinical research and also forms the basis for a major section of Oliver Sacks' book "The Island of the Colour Blind". Systematic studies have shown that cycad seed consumption is correlated with the extraordinarily high incidence of debilitating and often fatal neurodegenerative disorders such as Alzheimer's disease, amyotrophic lateral sclerosis (ALS) and amyotrophic lateral sclerosis/parkinsonism-dementia complex (ALS-PDC). The frequency of these diseases has dropped significantly as the Chamorro people have become westernised and their dietary habits changed.

Symptoms similar to those seen in the Mariana Islands have also been recorded from human patients on the Kii peninsula of Honshu, Japan, and from the Auyu and Jaqai linguistic groups of Papua, Indonesia.

INCIDENTS WITH ANIMALS

All mammals and several other animals are potential victims to cycad poisoning. There are accounts where farm animals such as sheep, cattle, goats, horses, pigs, domestic pets like dogs and cats, and other animals such as monkeys, rats, mice, rabbits, hamsters, guinea pigs, squirrels and raccoons, have become severely ill or have died after ingesting cycad seeds, leaves or roots. We are, however, circumspect about reports of non-mammalian animals such as chickens, turkeys, fish and insects being poisoned by cycads. Animal poisoning incidents have been reported from Australia, Bahamas, the Dominican Republic, Mexico, New Guinea, Puerto Rico, South Africa and the USA, and all ten genera of cycads have been implicated.

Most of these incidents are when the animals have swallowed whole cycad seeds. Incidents are known where dogs that have eaten *Zamia* seeds start vomiting within as little as 15 minutes while others that have ingested *Cycas revoluta* seeds have taken three days to show a similar response. Other early clinical symptoms include diarrhea, weakness, seizures. Apart from immediate gastrointestinal toxicity, it is the more insidious damage to the liver and kidneys that leads to fatalities; symptoms here are characterised by cirrhosis, jaundice and an abnormal buildup of fluid in the abdomen. Pets may appear bruised, have nose bleeds, blood in the stools, bloody straining and blood in the joints.

By contrast, wild animals are usually more comfortably adapted to living with cycads. It is known that that baboons (*Papio ursinus*) and vervet monkeys (*Cercopithecus pygerythrus*) frequently eat seeds of cycads local to their territory. They digest the fleshy sarcotesta and later excrete the seed remains with the sclerotesta intact, seemingly without any ill-effects. Similarly, African elephants are known to eat *Encephalartos poggei* and

Figure 2. Baboon faeces showing remains of *Encephalartos caffer* seeds in a mountainous area overlooking the Kei River. The animals appear to digest the fleshy sarcotesta with no ill effects but the sclerotesta remains intact. Photo: Wynand van Eeden.

Figure 3. *Encephalartos friderici-guilielmi* in a farming area where cows have eaten the emergent foliage apparently without any ill effects. Photo: Wynand van Eeden.

excrete the "cleaned" seeds in a useful heap of dung. The same behaviour is known for large frugivorous birds such as hornbills, turacos and parrots. Many other wild animals appear to nibble on the fleshy parts of cycad seeds with impunity, and all these animals are contributing to seed dispersal.

It is not always the cycad seeds that have led to toxic incidents with livestock. Serious toxicity events have occurred when grazing sheep or cattle in Australia have eaten freshly emergent *Cycas* or *Macrozamia* foliage. There are also accounts of cattle in Mexico being poisoned after grazing on fresh leaf flushes of *Dioon edule*, while in the Dominican Republic reports of several years ago indicate that 500 cattle were affected annually by *Zamia pumila* poisoning; similarly the loss of cattle in Puerto Rico has been ascribed to their browsing on the leaves of *Zamia portoricensis.* These incidents have happened most often during periods following a drought or fire, when the fresh green cycad leaves seem to be the only available palatable material. The resulting debilitating condition, for which there is no known treatment, is a progressive paralysis of the hindquarters. The farmers call this the "zamia staggers", "bovine staggers", "rickets", "wobbles" or "crampy"; the affected animals progressively lose mobility and ultimately die through dehydration and hunger.

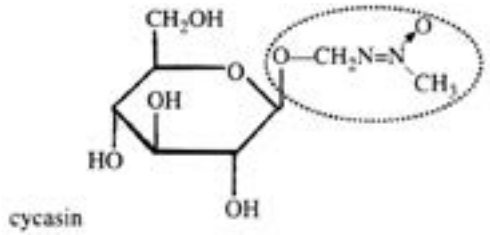
By contrast and somewhat surprisingly, cows in South Africa which browse on the foliage of *Encephalartos friderici-guilielmi* seem to suffer no ill effects.

THE CHEMISTRY UNRAVELLED

Essentially there are two main different types of cycad toxins, the methylazoxymethanol (MAM) glycosides and at least one non-protein amino acid.

Of the MAM glycosides, the two common ones are cycasin and macrozamin; the lesser-known but closely-related compounds are called neocycasins. Cycasin has a chemical structure comprising the MAM unit bound to a glucose sugar portion. Macrozamin has the same MAM unit bound to a "double sugar" (glucose and xylose, or primeverose) portion. Macrozamin is generally more abundant than cycasin, occurring at concentration of 0.2 to 5% by fresh weight. The neocycasins, known only from the genus *Cycas*, have yet other combinations of sugars associated with the MAM unit. These MAM glycosides are exclusive to cycads and are not known in any other plants. The question remains as to how and why the cycads evolved to have this toxin – the obvious "anti-predator defense" is best-guess speculation. Some wit asked recently on the social media "if the Mesozoic cycads got themselves toxic, is that why the herbivorous dinosaurs went extinct?" Maybe they have a point, or this may remain a Mesozoic mystery.

Quite different in its structure and mode of action is the non-protein amino acid BMAA (beta-methylamino-L-alanine). This cycad toxin is similar in structure to the better-known compound BOAA (beta-oxalylamino-L-alanine) that occurs in *Lathyrus sativus* (grass or chickling pea) and some related leguminous plants, where excessive consumption is linked to a motoneuron disease known as lathyrism, a pathological condition marked by tremors, muscular weakness and paraplegia, especially prevalent in some areas of Bangladesh, Ethiopia, India and Nepal. Some species of *Cycas* have BMAA at levels as high as 0.18% by fresh weight; other genera have much lower concentrations. Both BMAA and BOAA are usually associated with cyanobacteria



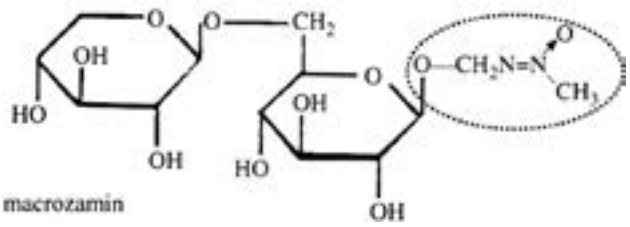


Figure 4. The chemical structure of cycasin (upper) and macrozamin (lower). The MAM component is the portion within the dotted circle. From Osborne 1988.

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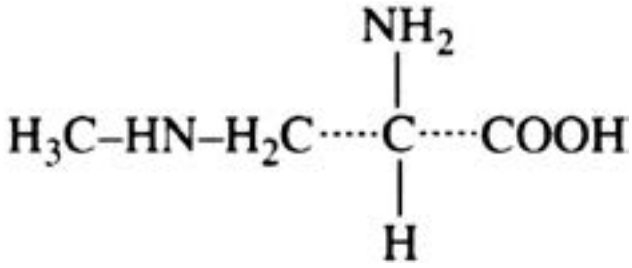

Figure 5. The chemical structure of BMAA. From Osborne 1988.

but we do not know if the presence of BMAA in cycad tissue is in any way related to a cycad-cyanobacterial association.

The amounts of the various cycad toxins vary with the cycad species and are different in different parts of the plant; we believe that it is probable that local environmental factors will also affect the nature, quantity and distribution of toxins. The limited research into these aspects seems to indicate that the highest concentrations, particularly of cycasin and macrozamin, are in the fleshy megagametophytic tissue, i.e. in the "endosperm" encased within the seed sclerotesta. That too makes sense; we speculate that seed-dispersing animals know that there is a tasty sarcotesta reward for their services, but equally they have learned not to bite further into the seed interior.

ALERT: BE CAREFUL CLEANING CYCAD SEEDS

Any persons cleaning cycad seeds for storage, shipment or later planting should wear tough waterproof gloves and eye-protection during the process. Unprotected and prolonged contact with the semi-liquid – and toxic – sarcotesta "pulp" could lead to toxins entering through exposed skin areas, or getting splashed into the eyes, with unfortunate results.

THE CLINICAL BASIS

What is interesting is that the MAM glycosides cycasin and macrozamin, are NOT toxic as such. It is only when the toxins get ingested into a mammalian stomach that things start happening. The intestinal microflora in the gut provides an enzyme called beta-glucosidase which cleaves off the sugar portion from the glycoside, leaving the free MAM to do its damage. The free MAM heads straight for the liver where a cascade of physiological events occurs, chiefly involving oxidation of MAM to its aldehyde and subsequent decomposition to highly aggressive methylcarbonium ions. The longer term and more insidious damage is to the nervous system and several reports suggest that chronic affects may include development of cancers.

The fact that the intact MAM glycosides are harmless means that animals without that mammalian gut microflora will have not be affected. That's why birds, reptiles, fish and insects appear to be much less prone, possibly even immune, to the effects of cycad toxins, and it also explains why cycad pollen, if entering through the nasal passages, is much less toxic to humans than if it was taken into via the stomach.

In contrast to the MAM glycosides, less is known about the toxic physiology of the non-protein amino acids. As mentioned previously, BMAA has been implicated in the occurrence of neurodegenerative disorders, particularly on the Pacific islands of Gaum and Rota.

A SNEEZE AT THE POLLEN?

There have been alarmist reports in the media about the dangers of exposure to cycad pollen. Certainly, cycad pollen does contain toxins; the nature and concentrations of these varying according to the cycad species and local environmental factors. We maintain that there is a very limited risk of toxicity from short-term exposure to cycad pollen.

However, a significant number of people have an immediate and severe allergic reaction after exposure to male cycad cones at their pollen-shedding stage. This is an allergy in the same sense as similar responses after exposure to other fine particles – it is nothing to do with toxic properties. Unfortunately, people who have this allergy often show progressively worse symptoms in subsequent events; they may need to have a supply of

Figure 6. Perhaps, after all, it WAS the cycads that led to the demise of the browsing brontosaurus and its Mesozoic friends. Image from Larry Hodgson, "The Laidback Gardener".

antihistamines (such as Celestamine or Zyrtec) on hand if chance exposures cannot be avoided.

ALERT: CAUTION WITH CYCAD POLLEN CONES

A general precaution for cycad enthusiasts who may want to harvest pollen for artificial pollination purposes is simple: wear a well-fitting face mask covering mouth and nose; wash yourself, your mask and clothes after handling male cones or pollen.

WHAT TO DO IN AN EMERGENCY?

If you are a first responder to an incident where a child or animal has accidentally swallowed one or more cycad seeds, here's your best course of action.

- Keep the child or animal calm and warm
- DO NOT try to induce vomiting
- For a child, contact your local emergency services*
- *dial 112 in South Africa, 000 in Australia or 911 in the USA
- Or for an animal, contact your local veterinary clinic

The early symptoms of cycad poisoning, both for humans and animals, are stomach cramps, nausea, vomiting, diarrhoea and severe stomach cramps.

There is no antidote for cycad toxins. Clinicians will usually attempt to minimise absorption of toxins from the patient's gut, then manage hydration, and administer medication to assist with liver and kidney recovery.

ACKNOWLEDGEMENTS

We thank Ian Bassingthwaighte, Tom Broome, Christian Faulkner, Ken Hennell, Rolf Oberprieler and Hiroyuki Takanashi for useful input during the preparation of this text.

LITERATURE CITED

For ease of reading, we have not given specific citations in the text sections. The information has been mainly gathered from the following sources:

Jones, D.J. 2002. Cycads of the World – ancient plants in today's landscape. Reed New Holland, Sydney.

Grobbelaar, N. 2002. Cycads, with special reference to the southern African species. Published by the author, Pretoria.

Norstog, K.J. & T.J. Nicholls. 1997. The Biology of the Cycads. Cornell University Press, New York.

Osborne, R. 1988. An Investigation into *in vitro* culture and phytochemical aspects of some members of the order Cycadales. Ph.D. thesis, University of Natal, Pietermaritzburg.

Sacks, O. 1996. The Island of the Colour Blind. Picador, London.

Whitelock, L.M. & D. Benadom. 2015. The Cycads. Two volumes, Superb Succulents, California.

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THE CYCAD EXTINCTION CRISIS IN SOUTH AFRICA

Wynand van Eeden & Tim Gregory

Figure 1. A bird's eye view of the top of the hill at Lillie Flora Nature reserve.

The IUCN Red List lists only four species of cycad as extinct in the wild (EW) and all four were endemic to South Africa. Only one, *Encephalartos woodii*, was known from one single clone. All the others were multiple plants or even populations, even *E. relictus*, although they occurred in a confined area. All four species became extinct due to human intervention and specifically for the horticultural trade. If one considers that fourteen more species of *Encephalartos* are now listed as critically endangered (CR) or endangered (E) and that a few of these are considered functionally extinct in the wild already, the South African situation is dire indeed! Nowhere else in the world are cycads so sought after and do they fetch such high prices, as in South Africa.

WHAT CAN BE DONE ABOUT THIS?

Currently only a few species occur in official reserves where some kind of protection is offered. However, most reserves focus on animals and not specifically the plants and it is usually a coincidence if cycads do occur in reserves. The only exception to this is Lillie Flora Nature Reserve in which *Encephalartos dyerianus* occurs and

Figure 2. This is one single plant! Just imagine how much time it took for this plant to grow into this wonderful shape and how few resources it had to accomplish this!

Figure 3. This specimen of *E. dyerianus* must be very old, judging by the length of the stem on the right.

the cycads have survived mostly because armed guards are on duty 24/7/365.

To remedy this lack of focus, a new conservation oriented, non-profit company, *Wild Cycad Conservancy NPC*, or *WCC*, was registered in South Africa, with the aim to acquire land on which endangered cycad species occur, to have this land declared as reserves and to make the reserves sustainable. The reserves will be managed by the WCC and as far as possible in co-operation with the original landowner, where possible. As a non-profit organisation, the WCC is run by volunteers and entirely dependent on donations. WCC will be registered as a public benefit organisation (PBO) in South Africa and a 501c3 organisation in the US. The management structure currently is made up of a board of directors and an advisory board with members from across the world.

WCC is currently working on two projects to alleviate pressure on wild cycads. The species involved are *E. dyerianus* and *E. eugene-maraisii*. Both species are represented by viable, self-sustaining populations although both are in need of better protection to stop them from declining further.

E. DYERIANUS AND LILLIE FLORA NATURE RESERVE.

E. dyerianus is currently represented in only one population and is under pressure from poachers, regardless of the fact that they have to face armed guards who rigorously protect these plants. During a visit to Lillie Flora in October 2019, one guard pointed out a

Figure 4. Mother Nature pulled out all the stops at Lillie Flora to put on a magnificent display of weird and wonderful shapes to show what can be done if left alone for hundreds of years.

Figure 5. A young seedling, clinging on to life in a harsh, inhospitable place. It will most likely be unsuccessful as very few survive the long dry periods and extreme heat from the sun. There is little evidence of sub-adults in the population and it seems seed viability may become an issue, if it is not already. Seeing seedlings like this in a population is not a good sign by itself. Plants of various ages must be present in a population for it to be still viable. Without sub-adult plants the presence of seedlings only indicate that pollination vectors are still active but as population size decreases, this function is under pressure and will eventually seize. If the vector is exclusive to the cycad species, the species is doomed to fail.

few places where poachers tried to harvest suckers or pups from the plants. This species is, however, abundant in private collections and at least one Botanical Garden propagates it and sells seedlings to the public. Why do poachers risk life and limb to get hold of these wild collected plants? The authors doubt there is a serious demand for horticultural purposes, given the availability of the species from legal sources. Poached plants will be more difficult to re-establish and are more likely to die, compared to established nursery grown seedlings or mature plants in collections. The size of what can be poached and safely removed from habitat is also limited because it must be carried out on foot. This precludes collectors that may buy illegally wild collected material since they usually want bigger specimens for display. One plausible reason is poverty and these plants are seen as "money growing in the wild" and if you can get to it you can generate an income from this resource. This is not sustainable however, and once all usable material is removed, the poachers must move on to a new population or species.

Poachers exacerbate the problem by chopping or breaking down old mature stems that prevent access to smaller stems or suckers, suitable to be removed for the illegal trade. This has serious consequences for the cycads as they rely on a long life strategy to survive natural changes in habitat or climate. Once these old stems are gone and the root stock dies, the population deteriorates quickly to a point where it is no longer viable.

Lillie Flora has been guarded against poachers for a very long time and it seems this is the only effective strategy, in this case, to keep plants safe. The same strategy did not work for *E. hirsutus*, however! What is

Figure 6. *E. dyerianus* has chosen a picturesque hill to call home.

Figure 7. The stem in the foreground bent and broke with time due to the colossal weight but with some tissue still intact, it refused to give in. A great example of the resilience of cycads, regardless of the harsh habitat they grow in.

immediately obvious is the commitment of the guards living with the plants. They are very serious about not allowing any harm to come to the cycads. Any specimens recovered after an incident are planted and cared for in the reserve. Plants are watered and treated to ensure they have the best chance possible for survival.

WHAT CAN WE DO?

Keeping these guards on the reserve is a necessity and without them *E. dyerianus* will be extinct in the wild in a matter of months, if not sooner. It is thus important to keep these guards motivated to fulfil this task.

Conditions on the hill where the cycads grow are tough. You spend your days in the African sun without even cold water or the comforts we are used at home. Tents provide the only shelter and there is no communications infrastructure. Water has to be carried up the hill for drinking and cooking and no fresh vegetables or fruit is available due to a lack of refrigeration facilities. With the input from the guards a

Figure 8. The view to the north east of Lillie Flora Nature reserve. At some point in the distant past the flat lands below the hill must have been populated by cycads as well.

Figure 9. The difference in the flora on the hill and the surrounding plains are very stark. The hill has a cooler climate and conditions are a little better without the extreme heat of the plains below.

Figure10. Leaf detail of *E. dyerianus*.

Figure 11. The armed guards with the cycad expedition members at Lillie Flora Nature Reserve. Left to right at the back are Xander de Kock, Tim Gregory, George Mann, and in front, Wynand van Eeden, Vanessa Handley and Stan Rogers.

few possibilities have been identified of how conditions can be improved. A comprehensive plan will be compiled in co-operation with the relevant role players to address some of the improvements needed at Lillie Flora Nature Reserve. Tentatively, it will include a better water supply, a small solar installation to provide electricity for charging equipment, better accommodation for staff, refrigeration for food as well as improved security. To fund the improvements at the reserve, a project was started by WCC and there is already a commitment from a private funder in the USA for US$3000. It is hoped that the same amount can be raised by members of the Cycad Society of South Africa, to contribute to this project.

NATIONAL RESERVES FOR CYCADS.

The WCC was started after similar projects were done successfully in Mexico, where land was purchased for reserves and managed by an NGO, to stop endangered species from declining further. This model kept the current owners on the property to maintain any business or farming activities with the provision that the cycad populations not be disturbed in any way. It was hoped the same model can be utilised in South Africa but efforts so far indicate at least some modification of the model is necessary.

Encephalartos eugene-maraisii has been under severe pressure from poachers a few years ago and many plants were lost. Poachers would cut down mature stems to get access to smaller suckers that are easier to remove and sell. The people responsible has been identified and over a period of some years, dealt with. A property in the Waterberg has been identified and is in the process of being bought. Once this project has been successfully concluded, it will be an excellent starting point to get other landowners to collaborate and work with WCC to stop further extinctions.

Securing land for reserves is not the only activity of WCC. Future projects will expand the scope to include the establishment of assurance populations of threatened species, as well as re-introduction programmes when feasible.

ENCEPHALARTOS WOODII – THE HISTORY

Paul Mostert

I will start with the *Encephalartos woodii* that was found in the Ngoya forest in Kwazulu Natal (then called Natal) north coast, near the town of Mtunzini.

John Medley Wood (1827–1915) was a merchant sailor, Natal farmer, trader, sportsman, founder of the Natal herbarium, curator of the Natal botanic gardens (later renamed the Durban Botanical Gardens) and above all a botanist with a passionate interest in the local indigenous flora.

The first wild group of *E. woodii* was found at a granite dome in the Ngoya Forest, Zululand by John Medley Wood in 1895.

John Wood was born 1827 and died in 1915 and was superintendent of The Natal Botanic Gardens, Durban. He removed some of the larger stems from the group of *E. woodii* in the Ngoya Forest and transported them to Durban. John Wood had a great interest in the plant and ordered James Wylie to return to the same locality. In 1906 James Wylie returned with the remaining two stems on Ox wagons which were also planted in the botanical gardens, he had brought the side shoots (suckers) with.

To this day, 3 of the original stems are still flourishing in the botanical gardens. These plants are in excessive of 6 ½ to 7 meters with several shoots mainly at the top section of the trees.

I quote from a cycad journal from the Cycad Society of South Africa, this article was written by Prof Roy Osborne, March 1986"

"In the year 1895 I was on a botanical collecting trip with wagon and oxen in Zululand and having reached a spot where the country was very rough. I stayed for several days botanising in the vicinity and in so doing found a solitary clump of *Encephalartos* consisting of four stems. The tallest of which was 18 ft high with proportionate girth of stem and with a few offsets at the base. The stems were all male and not another pant of the species could be found in the vicinity. The site where this cluster of plants were found was a steep, south facing slope on the fringes of Ngoya Forest, about 30 km from Mtunzini.

Whilst Wood explored the vegetation, he found two other cycads growing close by, *Stangeria* and *E. ngoyanus*. The theory was that the latter was seedlings of *E. woodii*.

In 1903 John Wood sent his assistant, James Wylie, who later succeeded him as curator of the botanical gardens, to Zululand to fetch some of the smaller off shoots. Three of these about 1 m in height were planted in the Durban Botanical Gardens, where, after about two years of dormancy, they commenced vigorous growth.

John Wood reported later that of the seven *Encephalartos* species then in the gardens; "These three, as far as the foliage is concerned, are in his opinion not only the handsomest of all, but are strikingly different from the others"

A juvenile *E. woodii*, a basal sucker or shoot, has a thorny leaf and as the plant matures it loses all the thorns on the leaves.

In March 1907, Wylie collected two of the larger trunks for the botanical gardens. At the time he noted that the biggest of the original four trunks were badly mutilated and was not expected to survive.

Figure 1. The original *Encephalartos woodii* found in 1895 by Wood.

Figure 2. Sucker donated from the Durban Botanical Gardens to Ian Garland's farm in Mtunzini

Specimens of the plant material had by then reached Kew Gardens where, on the basis of leaf character, the plant was listed under the name *Encephalartos altensteinii* var. *bispinosa* J.M. Wood. Other plants from basal offsets had been shipped to the horticultural firm Messrs Sander and Sons of St. Albans and Bruges, who published a description in the gardener's chronicle of 25 April 1908 (P257) naming the plant officially as *Encephalartos woodii*.

The last stem that was badly mutilated was later removed. In his book "The Living Cycad", Prof Charles Chamberlain of Chicago describes the following in 1912 in the company of a Zulu guide briefed by Wylie. They went to the remaining trunk which was 3 m in height. According to the old Forestry Department records at Eshowe, which is about 30 km from Mtunzini, an officer named Prior was concerned about the survival of the remaining stem. It was badly damaged by the activities of the Zulu medicine men and veld fires. It was removed in 1916 and sent to the government botanist in Pretoria. This trunk according to records was then 3,6 m long and 46cm in diameter. According to records it appears this plant was in 1964 relocated to the Union Buildings in Pretoria and died at the Union Buildings.

A further interesting record was revealed when Mr BJ Huntley, who traced the copy of the letter of forester Prior dated 22 May 1916. It reads "Only two plants (presumably trunks of the old root stock) of this species (enc. woodii) are known. "I intend cutting both, one for

Figure 3. 1895 *Encephalartos woodii*

Figure 4. Canopy shape of *Encephalartos woodii* leaves

Figure 6. "Leather-ish" texture of the *Encephalartos woodii* leaf

Figure 5. Cone emerging from one of the *Encephalartos woodii* offsets

Figure 7. This is the base of the 6.5 m *Encephalartos woodii* which shows how the trunk compacts under the pressure of the weight of the plant

Figure 8. This is a photo of the two original *Encephalartos woodii.*

Figure 9. Juvenile *Encephalartos woodii* leaf clearly showing the 'thorns'

Figure10. Mature *Encephalartos woodii* leaf

him (Wylie) and one for Pretoria" The vegetation has been burnt in the vicinity during the last year or two and the stems are clipped by natives so if they are removed now they will serve a better purpose to the botanical world than if they remain there." The very same Huntley went on a 3 week stay into the Ngoya forest. He had located the spot where the plants had been removed, a steep south facing slope on the margin of the forest. This he has done with the assistance of an old wize Zulu of about 85 years, the only one who really knew *E. woodii*. Huntley also concluded by saying that he doubted very much if the species was still to be found there.

Further excursions in that area followed and no other specimens of *E. woodii* were discovered, although Ian Garland, a well-known Natal conservationist pointed out that the area has been completely and systematically surveyed and maintains that it is not impossible that one or more plants are present in a remote area. This area until recent have been explored and the only plants that were found were *E. nogoyanus*, a broad leaf *E. natalensis* and *Stangeria*.

In honour of Ian Garland a specimen of *E. woodii* was planted on his property near Mtunzini. To date this plant is flourishing.

Ask any enthusiast with a complete cycad collection what is their most prized possession and the answer is invariably *E. woodii*.

PRESENT DISTRIBUTION:

One of the first available suckers of the *E. woodii* was planted in the centre of Durban at Medwood Gardens, this plant was stolen in 1976. The rumour was it was a unscrupulous American collector. The plant was 1.8 m tall. Currently *E. woodii*'s are well established in the following countries:

Figure 11. One of the original suckers that was donated to the Cape Town Botanical Gardens (Kirstenbosch)

South Africa, Zimbabwe, England, France, Italy, USA, Australia, Philippines and Japan. Specimens that are accounted for world wide should not be more than 500 in total.

THE ONLINE WORLD LIST OF CYCADS:

WWW.CYCADLIST.ORG

Roy Osborne

Nearly all cycad enthusiasts are now computer-savvy to the extent that they can search the worldwide web for information, send and view photographic images, examine maps, correspond with like-minded friends, book holidays, and even do the weekly shopping. However, not all our cycad friends are aware of a facility that is proving to be the most reliable, up-to-date and accurate source of information on cycads; that is the online World List of Cycads (WL), www.cycadlist.org

The first iteration of the WL was published in "Encephalartos" 35 years ago (Osborne & Hendricks 1985); this was a simple listing of the then-known 130 cycad species. This list was followed by a successive number of updates as changes in taxonomy and outlook made each previous list obsolete. These lists have been presented at the various International Conferences on Cycad Biology, and elsewhere, but as the world moved into a more technological age, it was clear that an electronic version would be altogether more manageable and useful. In 2013 the initiative was taken by Michael Calonje to develop this as a project at the Montgomery Botanical Center, Florida, USA.

The online WL is produced under the auspices of the IUCN Cycad Specialist Group and is administered by Michael Calonje, with assistance from Dennis Stevenson and Roy Osborne. The database was constructed using software of the Botanical Research and Herbarium Management Systems (BRAHMS). Its primary goal is to provide reliable up-to-date information on the taxonomy of cycads for use by researchers, conservation planners and plant enthusiasts. The online site now provides a comprehensive compilation of cycad names including accepted names, synonyms, illegitimate names, nomina dubia, and invalidly published names.

Users can search all cycad names using several different fields or browse all currently accepted names. Additional information provided for names includes details associated with their publication, nomenclatural types and their location in herbaria, the species distribution by country and province, and the IUCN Red List conservation status. Links are provided for convenient access to relevant scientific papers or their abstracts, and an extensive cycad bibliography is published. In addition, as at December 2019 the WL hosted 7,624 user-contributed photographic images, mostly of cycads in their natural habitats – these are freely available for educational and research use through Creative Commons licensing.

*cycad101@bigpond.com

The online version of the World List of Cycads is constantly updated to reflect changes in cycad nomenclature and taxonomy. The current list consists of a total of 10 accepted genera and 356 accepted species, divided as follows:

Bowenia (2), *Ceratozamia* (30), *Cycas* (117), *Dioon* (16), *Encephalartos* (65), *Lepidozamia* (2), *Macrozamia* (41), *Microcycas* (1), *Stangeria* (1) and *Zamia* (81).

During 2019, the site received over 1000 online visitors every month. The tireless efforts of Michael Calonje in his management of the WL must surely be recognised and appreciated by each one of these visitors. Two examples of search responses follow; one for *Encephalartos umbeluziensis* and one for Zamia brasiliensis. We encourage readers of this magazine to bookmark the WL for easy and regular access.

Example 1: A search for *Encephalartos umbeluziensis* provides the following data:


Encephalartos umbeluziensis R.A.Dyer
Published in: Fl. Pl. Africa 28: pl. 1100. 1951. (Fl. Pl. Africa)
Distribution: Mozambique, Swaziland
Conservation Status: EN
Type information
Collector and Number: B.A. Kay PRE 28429
Locality: Mozambique. On banks of Umbeluzi River in bush near Lourenco Marques, Sep 1945
Type Location(s): HT:PRE; IT:GRA, M, NBG, NH

The page then also allows one to see a range of images for the species, as in the example:

Encephalartos umbeluziensis in Maputo Province, Mozambique. Image 2833 on the WL, provided by Obety José Baptista.

ARTICLES

Example 2: A search for the recently-published Zamia brasiliensis provides the following data:

Zamia brasiliensis Calonje & Segalla

Published in: Phytotaxa 404 (1): 1-11. 2019. (Phytotaxa)

Distribution: Brazil (Mato Grosso, Rondônia)

Conservation Status: [EN]

Type information

Collector and Number: R. Segalla & M.C. Jesus ITA01

Locality: Brazil: Mato Grosso: Itaúba, 295, 18 Sep 2018

Type Location(s): HT:UFMT;IT:INPA

One of several images included for this species is:

Zamia brasiliensis in Mato Grosso Province, Brasil. Image 6550 on the WL, provided by Rosane Segalia.

LITERATURE CITED:

BRAHMS Botanical Research and Herbarium Management System. Downloaded 24 Nov 2019. http://herbaria.plants.ox.ac.uk/bol/brahms/

Calonje M., D.W. Stevenson & R. Osborne. 2013–2019. The World List of Cycads, online edition. Downloaded 24 Nov 2019. http://www.cycadlist.org.

Osborne, R. & J. Hendricks. 1985. A world list of cycads. Encephalartos 3: 13–17.

INDEX TO *FOCUS ON...* ARTICLES UP TO ISSUE 135

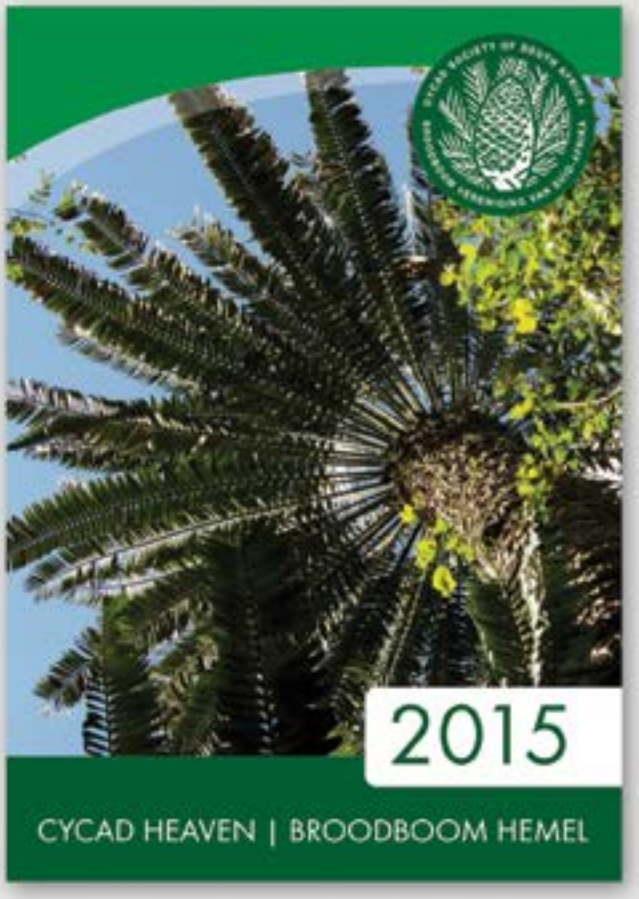
Compiled by Piet Vorster

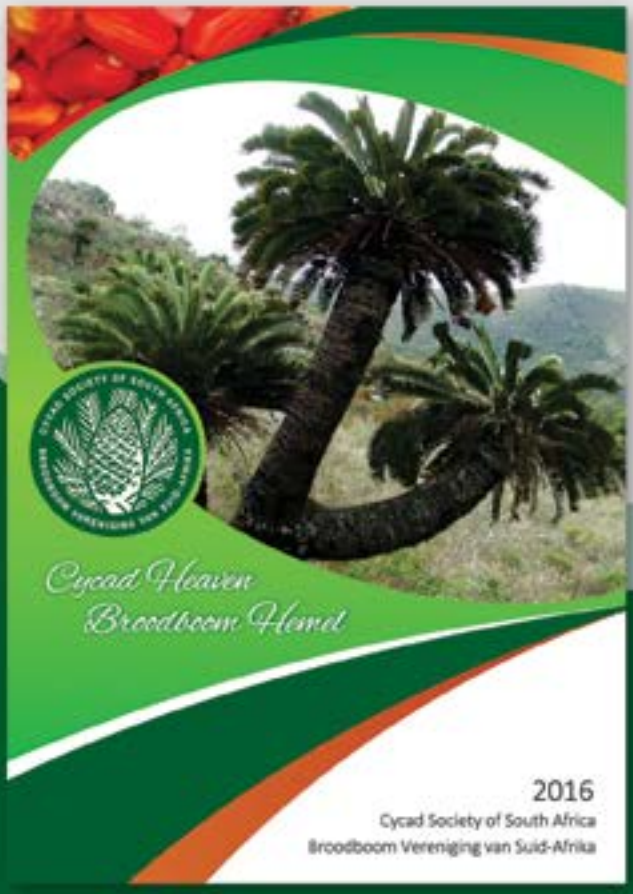
The practice of mini-monographs on individual cycad species is as old as the Society. The first *Focus-on...* article graced ENCEPHALARTOS no. 1, with Maans Kemp treating *Encephalaros longifoliu*s. Up to the time of writing some 105 of this series have been published. Even so, this presents only a third of the known species, therefore you can look forward to many more such articles.

This collection makes one wonder if it won't be nice to publish these articles together as a book. However, there are not yet enough articles to make such a book sufficiently comprehensive, but we can certainly keep it in mind.

Something else of which we have been thinking is to re-publish the older articles, firstly because the earlier issues of ENCEPHALARTOS are no longer available (though the electronic version *is*), secondly so much new information has become available, and thirdly because our standard of reproduction has now become so much better than in the early years. This is where every member can become involved: a vast untapped number of excellent photographs must be gathering dust in our personal collections. Do write in to tell us what you think of this idea.

DVD'S BESKIKBAAR VAN DIE SENTRAAL TAK





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The annual membership fees for TCS are listed below. For your convenience, you may join or renew your membership online using PayPal (see www.cycad.org/members/membership-info.htm), and you may pay your dues up to three years in advance, except for student memberships, which can only be paid one year at a time.

Two of the most important benefits of TCS membership are the Cycad Newsletter and the Cycad Society Seedbank.

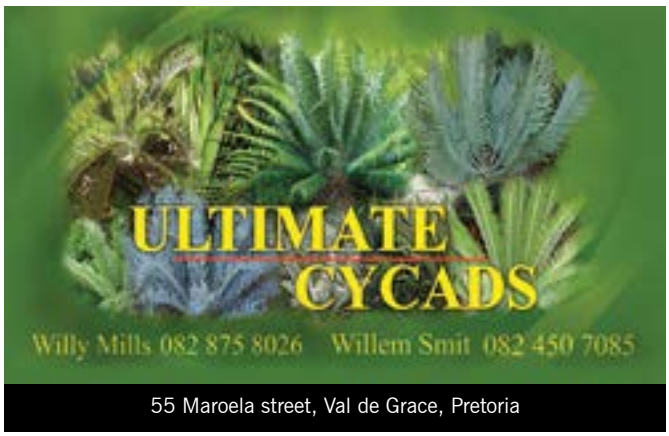
- Student Memberships: $25.00 per year
- Non-US Student Memberships: $35.00 per year
- US Memberships: $35.00 per year
- Non-US Memberships: $45.00 per year

BOOKS WANTED

Copies wanted of the following books:

- Speculations on the *Encephalartos* species of Mozambique, Capela, P. (2nd edition), 2010
- *Encephalartos nubimontanus* – a distinction between 11 variants, De Klerk, D., 2004
- Bothalia, Part VIII, Vol 4. – The Cycads of Southern Africa, Dyer, R.A., 1965
- Cycad Cultivation and Landscaping, Tang, W., 1995

Please contact Ferdie Endemann:
082 321 1431
ferdie.endemann@gmail.com
Strand, Western Cape South Africa



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Using cones to identify Indigenous Cycads book on special for R200 on website. www.cycadid-sa.co.za.

Navrae / Enquiries:
Cornia Hugo – tel.: 082 944 2341

ENCEPHALARTOS

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Contributions may be written in English or Afrikaans. Manuscripts must be typed. Short communications and letters to the editor may either be typed or in legible handwriting. All pages of a manuscript must be numbered consecutively. Photographs should be of excellent quality with clear details and adequate contrast. Authors are welcome to send illustrations in electronic format with the following requirements:

- Scan at 300 dpi.
- Save as jpeg, using maximum file size (i.e. minimum compression).
- Send by e-mail to **wynand@ananzi.co.za** and mark 'For Encephalartos'.

The tables and figures/photographs of a manuscript should be numbered and all tables should have a heading. All figures and photographs should have a legend. All figures/photographs should bear written on the reverse the name of the author, figure number and the top of the figure or photograph.

Formal descriptions of new cycad taxa and new name combinations may be published in ENCEPHALARTOS. Authors are however, advised to rather publish such articles in the journal *Novon* which has been established especially for such articles. Articles on potential new cycad taxa, without formally describing them as new taxa, may also be published in ENCEPHALARTOS. To avoid any possible confusion of names of such taxa in future, they should be designated for example by terms such as Species A or Species 99. Do not ascribe provisional names to potential new cycad taxa.

Contributions should reach the editor not later than:

March issue	: First week of January
June issue	: First week of April
September issue	: First week of July
December issue	: Last week of September

One copy of the ENCEPHALARTOS issue in which a contribution appears, will be supplied gratis to all non-member authors.

Note: If applicable, all figures and photographs will be reduced or enlarged to fit over either one, two or three columns when printed.

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VOORSKRIFTE AAN OUTEURS

Bydraes kan in Afrikaans of Engels geskryf word. Manuskripte moet getik wees. Kort mededelings en briewe aan die redakteur mag getik of in duidelik leesbare handskrif wees. Nommer alle bladsye van 'n manuskrip opeenvolgend. Foto's moet van goeie gehalte wees, voldoende kontras besit en besonderhede duidelik toon. Skrywers is welkom om illustrasies in elektroniese formaat te stuur, met die volgende vereistes:

- Skandeer teen 300 dpi.
- Stoor as jpeg, maksimum lêergrootte (d.w.s. minimum kompressie).
- Stuur per e-pos na **wynand@ananzi.co.za** en merk 'Vir Encephalartos'.

Die tabelle en figure/foto's van 'n manuskrip moet genommer wees en elke tabel moet 'n opskrif hê. Alle figure en foto's moet 'n onderskrif hê. Agter op elke figuur/foto moet die naam van die outeur en die nommer van die figuur/foto geskryf word en die bopunt van die figuur of foto moet aangedui word.

Alhoewel die formele beskrywing van nuwe broodboom taksons en nuwe naamkombinasies in ENCEPHALARTOS opgeneem kan word, word daar aanbeveel dat sodanige artikels eerder in die tydskrif *Novon*, wat spesiaal vir sodanige artikels in die lewe geroep is, gepubliseer word. Artikels oor potensiële nuwe broodboomtaksons kan ook opgeneem word in ENCEPHALARTOS sonder dat die artikels die nuwe takson formeel beskryf. Om latere moontlike naamsverwarring van sodanige taksons tot die minimum te beperk, moet die potensiële nuwe takson in die artikel deur terme soos byvoorbeeld Spesie A of Spesie 99 aangedui word.

Bydraes moet die redakteur voor of op die volgende datums bereik:

Maart-uitgawe	: Eerste week van Januarie
Junie-uitgawe	: Eerste week van April
September-uitgawe	: Eerste week van Julie
Desember-uitgawe	: Eerste week van September

Een eksemplaar van die ENCEPHALARTOS uitgawe waarin 'n bydrae verskyn, sal gratis aan alle nie-lid outeurs voorsien word.

Nota: Waar van toepassing, sal alle finaal gedrukte figure en foto's verklein of vergroot word om oor óf een, twee óf drie kolomme te pas.

Tariewe om in ENCEPHALARTOS te adverteer:

Bladsy grootte	Swart en wit	Kleur
Kwart blad	R175	R250
Half blad	R350	R500
Vol blad	R700	R1000

Lede: tot 'n maksimum van 'n kwartblad gratis—slegs swart en wit.

Om in ENCEPHALARTOS te adverteer, kontak die Sekretaris-tesourier en/of Redakteur.