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BROODBOOM VERENIGING VAN SUID-AFRIKA

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ON THE COVER:

Encephalartos friderici-guilielmi in habitat close to Cathcart in the Eastern Cape. This picture was taken in October 2021 before the province received good rain during the following summer. The plants are on a southern slope and grow exclusively on rocky ridges. These ridges are separated by level areas with good soil but only two or three juvenile plants, probably less than 10-15 years old, grow in these areas. A few specimens have multiple stems and the population consist of coning adult, sub-adult, and juvenile plants, indicating healthy reproductive conditions. Picture: Wynand van Eeden.

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FROM THE COUNCIL / VAN DIE RAAD

VAN DIE PRESIDENT/FROM THE PRESIDENT

'n Nuwe raad is onlangs verkies vir die Vereniging en met nuwe lede is daar nuwe energie! Die Vereniging het die laaste paar jaar baie stil geraak weens verskeie oorsake. Met nuwe tegnologie en nuwe mense op die raad is dit tyd vir 'n vernuwing.

Daar word gekyk om die konstitusie te moderniseer, ons webtuiste uit te brei en ook om ons bestuurprosesse meer vaartbelyn te maak.

Lede sal aanlyn kan aansluit en betaal en elke streektak het 'n blad waar hulle aktiwiteite kan oplaai en met lede in die streek kan kommunikeer.

ENCEPHALARTOS word steeds gesien as ons grootste bate en 'n bron van inligting wat lede lok. 'n Elektroniese weergawe sal binnekort op die webwerf gelees kan word vir lede wat dit verkies, terwyl gedrukte kopieë beskikbaar sal wees by die streekvoorsitters. 'n Span, onder leiding van die Redakteur, sal voortaan die saamstel en uitgee van ENCEPHALARTOS hanteer en meer inligting sal gegee word sodra die proses in plek is.

Presies hoe die nuwe Vereniging gaan uitsien oor 'n jaar of twee is onseker maar ons probeer om ons lede die beste te gee. Indien daar voorstelle is hoe ons kan verbeter, rig gerus 'n skrywe aan die hulp-sekretaresse, Lizanne Graskie (sien binnekant van voorblad vir kontak besonderhede), en laat ons weet.

Geniet hierdie langverwagte uitgawe en dra asseblief by tot ENCEPHALARTOS!

Beste groete
Wynand van Eeden

A new council was recently elected, and we have new energetic members to help! The last few years were difficult and the Society experienced a down turn in activities. However, with new technology and people joining the board, it is time for a revival.

The constitution needs to be modernised and our website can be improved significantly. We also need to improve our management functions and streamline processes.

Work is in progress to have members join and pay online and each of the regional branches will have a page to communicate with members in that region.

ENCEPHALARTOS is still our biggest asset and a good source of information that attracts members. An electronic copy will be made available on the website for members that prefer this, while printed copies will be available from the regional chairpersons. In future, a team managed by the Editor will help prepare and publish ENCEPHALARTOS. Once this process is in place, members will be informed of how to contribute.

Exactly what the Society will look like in a year or two is uncertain, but we want to give members good value. If you have suggestions on how to improve the offering, please write to the assistant secretary, Lizanne Graskie (see inside cover for contact detail), and let us know your ideas.

Enjoy this long overdue edition and please contribute to ENCEPHALARTOS!

Kind regards
Wynand van Eeden

Encephalartos friderici-guilielmi in habitat close to Cathcart in the Eastern Cape.

IN MEMORIAM:

ISABELLA CLAASSEN, 4TH NOVEMBER 1931–17TH APRIL 2020

Hannes Robbertse, Guillaume Theron & Piet Vorster

Martha Isabella Claassen passed away in an old age home in Pretoria at the age of 88 years. She was born in Schweizer-Reineke. In 1949 she enrolled for B.Sc. at the University of Pretoria, under the tutelage of Prof. H.G.W.J. Schweickerdt. After graduation she enrolled for M.Sc., working on the taxonomy of microscopic freshwater algae. Her work on these tiny but beautiful organisms still stands as a lodestone. On the ground of her thesis she was awarded the Junior Captain Scott medal by the South African Biological Society in 1957 (South African Biological Society, Pamphlet no. 19: 28 (1957). Her doctoral thesis was on the freshwater algae of the erstwhile Transvaal province, and still has not been superseded.

In 1956 she was appointed as Technical Assistant at the Botany Department of the University of Pretoria, and later appointed to the teaching staff. As graduate lecturer she taught the biology of the cryptogams. This course was of enormous importance since it revolved round the evolution of reproductive strategies. I (PV) will not deny that we students often dozed during lectures, and we dreaded the examinations. Shame on us. She was a wonderfully calm, patient, and helpful teacher, and played a definite part in the development of those of us who eventually chose botany as a career.

While an expert on the lower plants, she also had a lively interest in (amongst others) stapeliads and aloes which she grew on the balcony of her apartment. After acquiring a fair sized plot and building her own house on it, she became interested in cycads and eventually built up a very nice collection. It must be remembered that in those days there was a considerable interest in cycads in the botany department. This Botany Department had (and still has) a splendid botanical garden with a respectable collection of cycads. Here (as well as in her own garden) she kept meticulous growth records, and pollinated cycads when the opportunity arose.

Since at least the early 1960's the Botany Department of the University of Pretoria was a centre of interest in cycads, initially nurtured by Prof. H.P. van der Schijff, then head of the Department. While he was never a member of our Society, his enthusiasm for cycads and their biology enthused other members of his Department including Nat Grobbelaar (who conducted research on the symbionts in cycad coralloid rootlets and President of the Society from 1990 to 1993), Hannes Robbertse (who did research on the anatomy and also taxonomy, and President of the Society from 1994 to 1997, and Guillaume Theron (who, together with Hannes Robbertse effected the first hand pollination of a cycad (*Cycas revoluta*) at the University at a time when the pollination of cycads, let alone insect pollination, was still a closed book), and Secretary/Treasurer of the Society from 1997 to 2005). Piet Vorster was never on the University's staff, but became a plant taxonomist, and President of the Society from 2000 to 2005. Isabella Claassen did not conduct official research on cycads, but over the years she made a number of astute observations (see her contributions to ENCEPHALARTOS below).

She was an early member of our Society. Her name was mentioned in our second list of members, in ENCEPHALARTOS no. 50 (June 1997), and she was member no. 156. However, her first contribution in ENCEPHALARTOS appeared in 1992.

During Nat Grobbelaar's presidency the Editor of ENCEPHALARTOS at the time, Neil Munro, stepped down, and Nat persuaded Isabelle to take over the editorship from No. 32 (December 1992). She filled this position with distinction for 11 years, finally retiring in December 2003 with ENCEPHALARTOS no. 76. During her tenure ENCEPHALARTOS grew beyond recognition. Perhaps her most important contribution was the quality of her editing. She personally re-typed every contribution, and spoilt us by doing the page designs as well.

Her private pastime was to grow cycads at home. She had a small nursery where she grew plants from seed, and it was an institution that visitors went home with a delectable seedling. Apart from being truly observant, she had an enquiring mind, and was one of the very first cycadologists to make experimental hybrids. Unlike too many of us, her plants were all well documented. She was a balanced person: she baked legendary chocolate cakes, she read ravenously, and she was an expert on crossword puzzles. She was a faithful and exceptional friend to her colleagues and students, and one could not imagine anyone better to work with.

As much loved as she was, she was also a very retiring person. When she retired from the Editorship, and eventually had to sell her property, she would not accept an honorary membership of the Society, and she terminated her membership of the Society.

As mentioned above, she was an astute observer (and experimentalist – witness her hybridising activities). This is graphically demonstrated by the list of her contributions to ENCEPHALARTOS below.

It was a great privilege to have known and worked with her.

List of contributions to ENCEPHALARTOS

Page numbers in **bold** refer to illustrations.

CLAASSEN, Isabella (December 1987): Brief [tweeslagtige keël by *Encephalartos ferox*]. *Encephalartos* 12: 29.

CLAASSEN, M.I. (June 1991): Brief [ontkieming van saad]. *Encephalartos* 26: 32.

OSBORNE, R.; ROBBERTSE, P.J.; & CLAASSEN, M.I. (December 1991): The longevity of cycad pollen. *Encephalartos* 28:**10**–13.

CLAASSEN, Isabella (December 1992): *Encephalartos* plants in cultivation: unusual cone number. *Encephalartos* 32: **21**–22.

CLAASSEN, Isabella (December 1992): *Encephalartos*: leaves on cones. *Encephalartos* 32: **22**.

CLAASSEN, Isabella (December 1992): [Letter]. *Encephalartos* 32: 28–29.

CLAASSEN, Isabella (June 1993): *Encephalartos* plants in cultivation: unusual cone number. *Encephalartos* 32: 21–22.

CLAASSEN, Isabella (June 1993): *Encephalartos* plants in cultivation: unusual cone number. *Encephalartos* 34: 31–**32**.

CLAASSEN, Isabella (September 1993): "Fishtail" *Encephalartos transvenosus*. *Encephalartos* 35: **20**–**21**.

CLAASSEN, Isabella (September 1993): Bird's nest cycad? *Encephalartos* 35:**26**.

Encephalartos 34: 31–**32**.

CLAASSEN, Isabella (March 1994): *Encephalartos sclavoi*: correct author citation and date of valid publication. *Encephalartos* 37: 9. (Comment by Piet VORSTER in *Encephalartos* 38: 33) (June 1994)).

CLAASSEN, Isabella (March 1994): Notes on leaf variation in *Encephalartos longifolius*. *Encephalartos* 37: **19**–**21**. (Comment by Piet VORSTER in *Encephalartos* 38: 32 (June 1994)).

CLAASSEN, Isabella (March 1994): Report on "Fishtail" *Encephalartos transvenosus Encephalartos* 37: **22**. (Comment by Piet VORSTER in *Encephalartos* 38: 32 (June 1994)).

CLAASSEN, Isabella (March 1994): Burning of *Encephalartos lanatus* to induce leaf formation. *Encephalartos* 37: **24**–25.

CLAASSEN, Isabella (March 1994): Another case of Siamese twins amongst cycad cones [*Encephalartos caffer*]. *Encephalartos* 37: **26**.

CLAASSEN, Isabella (March 1995): Letter: Computer equipment for use of the Editor . *Encephalartos* 41: 39.

HURTER, Johan; GLEN, Hugh; & CLAASSEN, Isabella (December 1995): Focus on *Encephalartos equatorialis*. *Encephalartos* 44: **4**–**9**.

HURTER, Johan; & CLAASSEN, Isabella (March 1996). Focus on *Encephalartos nubimontanus*. *Encephalartos* 45: **4**–**11**.

CLAASSEN, Isabella (March 1996): *Encephalartos* plants in cultivation: unusual cone number . *Encephalartos* 45: **21**–**22**.

HURTER, Johan; & CLAASSEN, Isabella (December 1996): Focus on *Encephalartos whitelockii*. *Encephalartos* 48: **4**–**8**, 9.

CLAASSEN, Isabella: *see* HURTER, Johan; GLEN, Hugh; & CLAASSEN, Isabella (December 1997) : Focus on *Encephalartos hirsutus*. *Encephalartos* 52: 4–7.

[CLAASSEN, Isabella (June 1998)]: New regional branch / Nuwe streektak [Lowveld Regional Branch]. *Encephalartos* 54: 35.

CLAASSEN, Isabella (June 1998): Founding of the Cycad Society of South Africa / Stigting van die Broodboom Vereniging van Suid-Afrika. *Encephalartos* 58: 18.

CLAASSEN, Isabella (June 1999): Notes on *Encephalartos umbeluziensis*, *E. lehmannii* and their artificially gotten offspring [hybrid]. *Encephalartos* 59: 23, **20**.

CLAASSEN, Isabella (June 1999): Interesting *Encephalartos lanatus*. *Encephalartos* 58: **31**.

CLAASSEN, Isabella (June 2000): Focus on… series: index. *Encephalartos* 62: 5–6.

CLAASSEN, Isabella (September 2000): Focus on *Encephalartos senticosus*. *Encephalartos* 63: 4–10.

CLAASSEN, Isabella (March 2002): Steriele megasporofille vorm wortels / Sterile megasporophylls form roots. *Encephalartos* 69: 34, **32**.

CLAASSEN, Isabella (September 2004): Letter: Thank you contributors to our journal / Dankie bydraers aan ons tydskrif. *Encephalartos* 77:12–13.

FROM THE COUNCIL

SLUIT AANLYN AAN BY DIE VERENIGING

Voornemende lede kan aanlyn aansluit op die webwerf, cycadsociety.org. Kliek op die skakel bo regs op die bladsy en volg die instruksies. Lede met 'n bestaande lidnommer moet dit asseblief invul sodat die databasis van lede op datum gebring kan word, sonder om nommers te dupliseer of onnodig nuwe nommers toe te ken.

JOIN THE SOCIETY

Please join the Society by navigating to cycadsociety.org and clicking on the link in the right top corner. Follow the instructions carefully and please use your existing membership number if you have one. This is necessary to update our database of members without duplicating numbers or the unnecessary issuing of new ones.

NEWS FROM THE KWAZULU-NATAL BRANCH:

VISIT TO KNOWN *ENCEPHALARTOS WOODII* LOCALITIES

On Sunday 2020/03/01, members of the KwaZulu-Natal branch went to view the three localities where *Encephalartos woodii* grew:

The first was at the Marianhill Monastry near Pinetown. This plant, according to Sister Amanda, was on the property when she came from the Eastern Cape in 1975. The plant is 4.4 m high and was about 2.1 m high when she first saw it. She took an interest in the plant and started to care for the plant after Sister Engels died at the age of 100 years. Several shoots were removed by Sister Amanda and planted behind the hospital with other cycad species. Prof. R. Osbourne wrote an article regarding the various forms of *Encephalartos woodii* and did DNA tests on the plant.

The plant appears well looked after and has a healthy flush of new leaves with several suckers developing around the head of the plant.

From there the group departed and proceeded to an *Encephalartos woodii* specimen growing in the Old Fort Gardens in Durban. This is a single stem plant of about 5.2 m high. It has several suckers developing around the head area. The known history of this plant is that it was planted at the old fort in 1963, at the time Ernest Thorp was the curator of the botanical gardens.

The group then proceeded to the Botanical Gardens where other *Encephalartos woodii* were viewed. The three original plants that were transported from Ngoya Forest in the early 1900's are looking good and have enormous branches at the crowns.

The smaller one next to the steps is in the process of coning. These plants are happy and look more like monsters than cycads.

Figure 1. Marianhill Monastry *Encephalartos woodii*.

Figure 2. *Encephalartos woodii* in die Old Fort Gardens, Durban.

Figure 3. The original *Encephalartos woodii* from Ngoya Forest discovered by John M Wood, 1895.

POPULATION SIZE, SEX RATIO AND THEIR IMPLICATIONS ON CONSERVATION STATUS OF *ENCEPHALARTOS MACROSTROBILUS* (SCOTT JONES AND JEFF WYNANTS) IN UGANDA

Samuel Ojelel[1], Patrick Mucunguzi[1] & James Kalema[1†]

INTRODUCTION

Over 20% of the world's plant species are threatened with extinction (Brummitt *et al*. 2015). Cycads are the world's most threatened plant species (Swart *et al*. 2019, Vovides 2019, Vovides *et al.* 2019, Bamigboye and Tshisikhawe 2020) with nearly 70% of the known species facing extinction threat (Hoffmann *et al.,* 2010). The most highly threatened species (Critically Endangered) are from the genera *Encephalartos*, *Zamia* and *Cycas* (Nadarajan *et al.* 2018). Notwithstanding their representation of only a small fraction of the world's plant diversity, they comprise a group of global conservation significance (Donaldson, 2003). Africa has 66 species of the genus *Encephalartos* and one species of the genus *Stangeria* (Rousseau, 2012). Although Africa is one of the centres of diversity of cycads (Hill *et al.,* 2003), these species are faced with increasing risk of extinction (Bamigboye *et al.* 2016). For instance, a comparison of the 2003 and 2014 IUCN red lists revealed that the cycad species that have gone extinct have increased by 3.2%. Those in the Critically Endangered category (CR) have increased by 1%, Endangered (EN) by 3%, but those Vulnerable (VU) have decreased by 2% and the Near-Threatened have increased by 4% (Bamigboye *et al.* 2016). It should be noted that in as much as these figures look small, the loss of a single species represents a total loss of its ecosystem productivity, population distribution and genetic diversity (Mukwevho, 2014).

The greatest threat posed to Africa's cycads is the illegal harvesting for international trade (Donaldson & Bösenberg, 1999; Okubamichael *et al.,* 2016, Nadarajan *et al.* 2018, Vovides 2019). Natural rarity due to reproductive failure has been cited to increase the extinction risk of cycads (Donaldson 2003, Swart *et al*. 2019, Vovides 2019; Bamigboye & Tshisikhawe 2020). It is further asserted that habitat destruction and fragmentation, over collection, traditional uses, and reproductive failure are the major factors driving the extinction of cycads (Cabrera-Toledo *et al*. 2018, James *et al*. 2018, Bonta al 2019, Moraswi et al 2019, Pérez-Farrera *et al.* 2019, Segalla *et al*. 2019, Vovides *et al.* 2019). The isolation and low density of cycad populations in nature (Lazcano-Lara and Ackerman 2018) makes them genetically unfit, highly vulnerable to environmental stochasticity (James *et al.* 2018), requiring particular conservation and regeneration plans (Hill *et al.,* 2003). It ought to be noted that several African cycad species have very restricted distribution and occur in disjunct, small populations (Nadarajan *et al*. 2018, Segalla *et al.* 2019, Swart et al 2019) even without intensive cycad collecting (Cousins & Witkowski, 2017). Worse still, they are difficult to access given that they often occur in remote areas, hindering research and conservation action with no protection (Segalla *et al.* 2019, Vovides 2019). The high degree of specialization with their insect pollinators and many other species interactions (Lindstorm 2019, Salzman 2019, Segalla & Morellato 2019) and poor dispersal resulting in clumped dispersion (James et al 2018, Swart *et al.* 2019) make them more susceptible to extinction.

Nearly four fifth (79%) of African cycads are experiencing a decrease in their population (Bamigboye *et al.* 2016), with a likelihood of inbreeding risks (James et al 2018). This is the same situation for cycads in Uganda as three of the four cycad species in the country are threatened with extinction (Byaruhanga *et al*. 2008; Kalema & Mucunguzi 2009; Kalema 2010; Kalema & Beentje 2012, Kalema & Hamilton 2020). The population of the Endangered *Encephalartos macrostrobilus* was estimated to be 200–300 individuals in 2010 (Donaldson 2010) and the species is a Ugandan endemic (Kalema and Beentje 2012). All these individuals occur within a small area of only 50 km^2 and face continuing decline in habitat quality and direct loss of individuals through collections (Donaldson 2010, personal communication by the Moyo District Environment Officer). Donaldson (2010) further reports that although this population is not severely fragmented, it is decreasing. In addition, Kalema and Beentje (2012) reported that the habitat for *E. macrostrobilus* is threatened by heavy livestock grazing, regular fires, fuel wood and timber collection, which adversely affect its recruitment. This situation is worsened by the lack of effective protection accorded to this species in its locality (Kalema and Beentje 2012).

The scientific information on cycad population dynamics and the impact of harvesting and management practices is inadequate. Cognizant of the situation, this study sought to: (i) ascertain the number of mature cycad individuals, (ii) assess the sex ratio of the mature individuals and (iii) assess the threats to the cycad and its habitat. It is envisaged that this information will help in determining implications on the conservation status of

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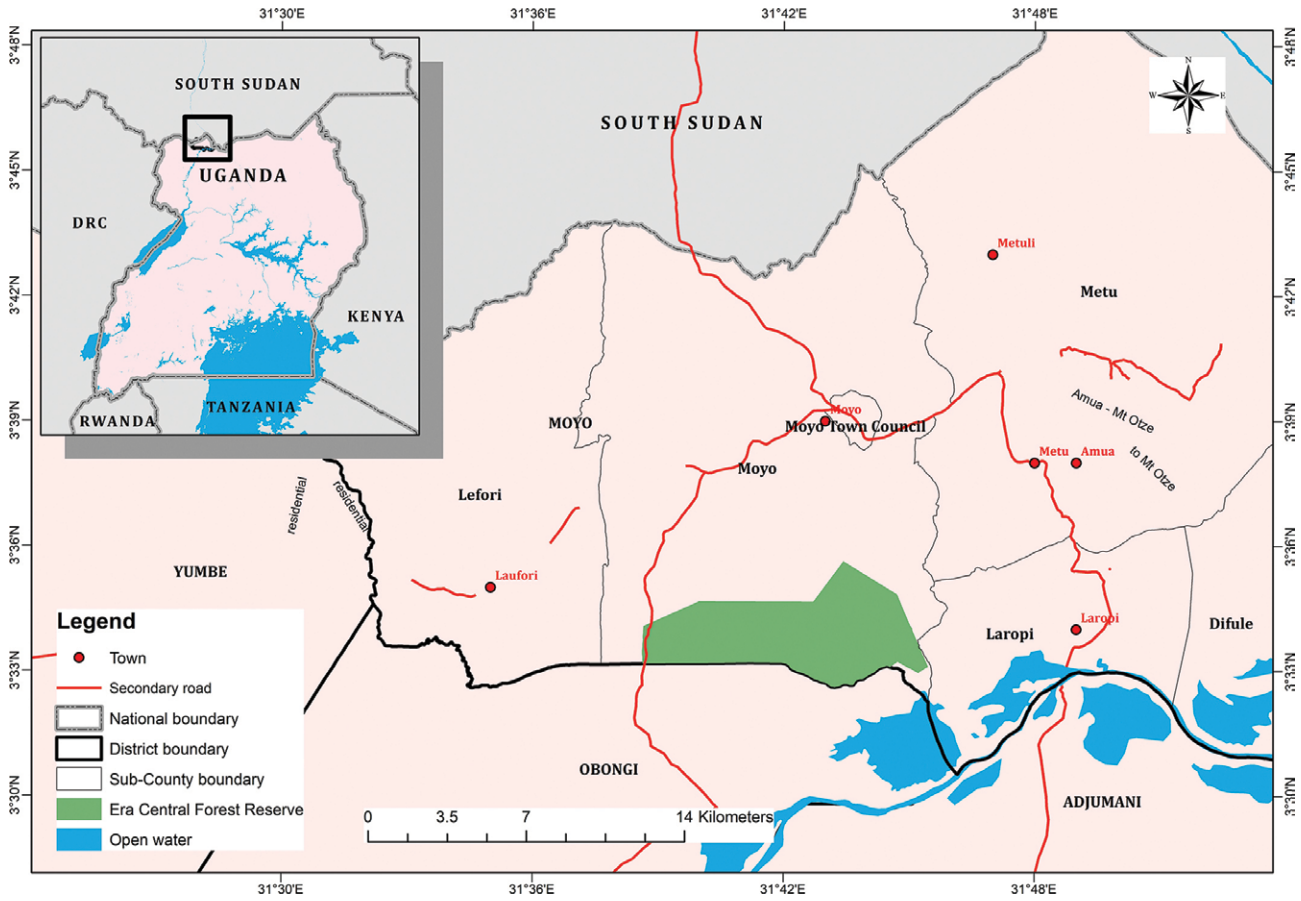

Figure 1: Location of Era Central Forest Reserve, Uganda.

the cycad species. This will further guide the choice of conservation initiatives for ensuring its continued survival.

STUDY AREA

The study was carried out in Era Central Forest Reserve (Figure 1) and the surrounding villages known to harbour the cycad. This area is located in Moyo sub-county, Moyo district, in the north-western corner (West Nile region) of Uganda. The Nile River forms its southern and eastern border, South Sudan is its northern border while Yumbe district is the western border. The district covers an area of 2 059 km^2, of which 192 km^2 is rivers and swamps, 172 km^2 is gazetted forest and game reserves (Moyo District Local Government, 2011). Approximately 78.9% of the districts' land is arable or suitable for cattle grazing with a population density of 115 persons per km^2. It is estimated that over 90% of the district population are involved in agricultural activities, with 86.6% directly involved in some form of subsistence production (UBOS 2017).

The topography is characterized by low plains and rolling hills along the Nile River, at an altitude of 900 m above sea level rising to a series of hills and peaks. The highest peak is mountain Otze at 1 500 m above sea level. The area receives about 1 250 mm of annual rainfall with a distinct dry period that begins from December to February while November and March have moderate rainfall. The highest temperature recorded was 45°C in the months of January to February and lowest 29°C in the months of August to October. The soils mostly comprise of sandy lithosols (Jones and Wynants 1997) and the primary vegetation cover consists of degraded savanna woodlands and isolated thorn bushes with a canopy height of 5 to 20 m (Jones and Wynants 1997) while the hills in sub-counties of Metu and Itula are covered by forests.

DATA COLLECTION

The data was collected in May 2018 with the help of a local guide and the District Environment Officer to ensure reliable local knowledge. We systematically traversed the entire area known to harbour the cycad. It was fairly easy to find the cycad plants both in the forest reserve and community land because of the degradation and open nature of these habitats. There is thus very little likelihood that any cycad trees were missed. All the mature cycad individuals within the community land and Era Central Forest Reserve were enumerated and sexed.

An individual was considered mature if it had its stem above the ground surface. Individuals without macrostrobili or microstrobili were difficult to determine their sex. Where present, the cones, which are morphologically different, were used to categorise the mature individual cycads as male, female or unknown. In a few cases, female individuals were reliably identified in the absence of cones if there were clustered seedlings directly at the base of the individual (James *et al*. 2018). The number of stems was counted. All

the locations of the cycad colonies were geo-referenced and the co-ordinates of each plant individual stored in a Geographic Positioning System hand set. The team combined experiential judgment and observation to assess the threats to the cycad and its habitat. Evidence of direct use of the cycad, e.g. from harvesting, was collected. Activities considered to have negative impact were also recorded.

RESULTS AND DISCUSSION

Population size

A total of 43 cycad colonies were encountered and georeferenced during the survey. In these colonies, 181 mature individuals were enumerated. This is higher than the 100 individuals reported by Scott and Wynants (1997) but less than the estimate of 200–300 individuals in 2003 by Donaldson. Whereas our results show an increase of 81 individuals from the 1997 records, it falls below the 2003 estimates. It is therefore inconclusive as to whether the population is increasing, stagnant or decreasing. There is also likely to have been variation in intensity of survey in the three different studies. Besides, some local residents claimed that a handful of individuals could be encountered as one surveyed towards the South Sudan border which we could not cover due to logistical constraints.

Sex ratio

Basing on the cycad individuals whose sex we were able to determine, the sex ratio of the population was 2:5, female:male (or 28.6% female). This was from six females and 15 males. We could not reliably determine the sex of most of the cycad individuals (160) owing to lack of cones or other dependable attribute. The sexed individuals therefore represent only 11.6% of the entire population of mature individuals enumerated. This assessment of sex was primarily based on cones because cycad species are dioecious (Krieg *et al.* 2017, Salzman 2019, Vovides 2019) and the most reliable way of establishing the sex of an individual is through the type of cone it produces (Giddy 1974). The majority of individuals were indeterminate. Nonetheless, our findings agree with results from a number of earlier studies. Similar findings were reported for *E. equatorialis*, another Uganda endemic cycad (Kalema & Beentje 2012), which was observed to exhibit skewed distribution of 16% female against 84% male (Kalema & Mucunguzi 2009). Comparable percentages were registered by Newell (1983) who reported 14% female against 58% male in *Zamia pumila* while Grobbelaar *et al.* (1989) reported 13.2% female against 58.5% male in older plants of *Encephalartos transvenosus*. However, both reported a year-to-year variation in cone production.

The higher proportion of indeterminate individuals emerges from the observation that mature cycads do not cone every year (Grobbelaar *et al.* 1989). Basing on the assertion of Grobbelaar *et al.* (1989), our observed ratio might therefore deviate to some degree from the true sex ratio of *E. macrostrobilus* since our survey was conducted in one season and a single year. In order to determine the true sex-ratio, there is need to design long-term studies so that a higher representation of mature individuals and more cycles of cone production may be captured. We further assert that this kind of research can unravel significant sex-related information such as differential frequency of cone production by sex and also the relative lifespan of the two sexes.

Threats to the cycad and its habitat

Figure 2 provides the main threats to the cycad and its habitat. Threats to the habitat include burning, widespread stone quarrying because of the many granitic rock outcrops, cattle grazing, tree cutting for charcoal burning, and a dense network of foot paths. Direct threats to the cycad population are frequent burning, and use of its seeds by immigrants from South Sudan as 'beads' they tie round the waist and neck of their children to dispel 'bad omen'. This reduces the regeneration potential of the cycad. Occasionally, there is cutting of the cycad leaves off the trees for no known purpose.

Over 90% of the population of *Encephalartos macrostrobilus* occurs on land communally owned by the local communities. The main socio-economic activity is subsistence agriculture. Tree felling for timber and cutting of poles for construction are carried out and indiscriminate burning is done every year to generate new pastures. These activities continue to pose the greatest threat to habitat quality and survival of the cycad. These activities are not about to cease but rather intensify in the foreseeable future. The area is criss-crossed by trails where trucks pass as they collect the different products. This situation is compounded by the lack of awareness about the conservation and socio-economic value of this cycad. This scenario calls for urgent adoption of measures to arrest the destruction and modification of the habitat. Although illegal collection of individual cycad plants was reported as a threat (Donaldson, 2010), our survey did not find any evidence relating to this. Only a small percentage (<5%) of the cycad population is covered within the Era Central Forest Reserve. Unfortunately, this does not provide it any better protection as there is no effective management and protection of the reserve.

Other important flora

This area also has at least three other globally important plant species namely *Afzelia africana, Vitellaria paradoxa* and *Dalbergia melanoxylon.* The first two of these species are currently rated as Vulnerable while *D. melanoxylon* is Near-Threatened (IUCN 2020). In Uganda, *A. africana* was assessed as nationally Endangered (MTWA (2018). Accordingly, in 2017, the Government of Uganda, through the Ministry of Water and Environment, issued a ban on any cutting, transportation and sale of *Afzelia africana* and *Vitellaria paradoxa* tree logs and their products in the country. This ban was informed by the uncontrolled rampant, illegal harvesting

and trading in the logs and the products of these species which threaten the survival of the species.

Implications on conservation

A combination of small population size, low growth rate and restricted distribution of *Encephalartos macrostrobilus* makes the species susceptible to extinction. These factors imply low genetic variability and very low likelihood of rescue in case the population gets faced with any adverse factor. The situation is made worse by a skewed sex ratio, further reducing chances of the already small population to increase by and to any appreciable level. Worse still, there is reported illegal and hence unregulated harvesting of seed and individual plants yet the population does not produce cones every year. Given that the bigger percentage of the cycad population occurs outside the Era Central Forest Reserve, there is virtually no protection accorded to the habitat and the cycad. Illegal entry into the reserve and degradation of the habitat are taking place unabated. This continues to cause drastic reduction in habitat quality, rendering the cycad unable to recruit to replenish its population. Increasing rate of tree felling and the subsequent habitat

Figure 2. Human activities threatening the cycad and its habitat. A, Burning at 03° 34' 34.9''N, 31° 41' 42.7' E; B, stone quarrying at 03° 34' 54.2''N, 31° 45' 21.1'E; C, cattle grazing in the reserve at 03° 34' 54.1''N, 31° 45' 16.6''E, D, charcoal burning at 03° 34' 34.7''N, 31° 41' 45''E; E, cycad leaves cut off the trees at 3° 34' 35.5''N, 31° 41' 43.8''E; F, conversion to agriculture outside the reserve.

degradation may also limit presence and abundance of the insect pollinators for the cycad. Outside the reserve, cultivation activities affect the cycad individuals as they are cut down. Conversion of their suitable habitat to agriculture land is reducing their population.

CONCLUSION

The population size of *Encephalartos macrostrobilus* is the smallest of the known and surveyed cycad species in Uganda, apparently having declined from previous estimates, with only a paltry fraction conclusively sexed. The sex ratio of the population is skewed with the proportion of males more than double higher than that of females. This population is greatly threatened by indiscriminate human activities that are causing habitat destruction and degradation. This unfortunate decline is bound to continue unless a comprehensive action programme with clear strategies is designed and implemented with active involvement of the local communities, government agencies, non-governmental organizations, research institutions, botanic gardens and universities.

RECOMMENDATIONS

There is need for long term research to monitor the expression of sex characteristics among the mature individuals in this population so as to fully determine the sex ratio. Additional surveys especially towards the South Sudan border will validate the local claims of possible individuals. In terms of securing the survival of this species, urgent measures ought to be put in place to safeguard the habitat. This could be in the form of a buy off of the community land and annexation of the land to the adjacent Era Central Forest Reserve or establishment of a community forest reserve. There is also need to create and enhance awareness among the local populace on cycad conservation and explore plausible avenues for incentivizing cycad conservation. Nature-based solutions for protection of the cycad and the entire biodiversity in the area, as well as ensuring sustainable community livelihoods, need to be found. Socio-economic benefits, e.g. through income generating initiatives such as ecotourism based on the cycad, need to be explored.

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THE *CERATOZAMIA* CONUNDRUM: A RE-FOCUS ON *CERATOZAMIA MEXICANA* AND *C. TENUIS*

José Said Gutiérrez[1], Andrew P. Vovides[2] & Roy Osborne[3]

INTRODUCTION

The various "Focus on …" articles in this magazine have proved to an invaluable source of information, both for botanical research workers and for cycad growers. Over 100 cycad species have now been featured with detailed notes on their taxonomic history, geographic distribution, vegetative and reproductive morphology, ethnobotany, conservation status and cultivation. But taxonomy, like other scientific disciplines, is continuously being re-evaluated; what was true 10 or 50 years ago must sometimes be reviewed and, if necessary, updated in the light of new evidence and research progress.

While we have been fortunate in that nearly all the material published in the "Focus on …" articles remain valid, there is one particular exception that we now rectify, and that is the write up on *Ceratozamia mexicana* as published in Encephalartos #100 (Osborne & Vovides 2010). In simple terms, it is now clear that that article referred to two separate species, *Ceratozamia mexicana* and *C. tenuis,* both species from the State of Veracruz, Mexico (Figure 1). The confusion can be ascribed to a number of causes. Firstly, the 19th century cycad descriptions were often based on juvenile or sterile plants in cultivation in European glasshouses, the origins of which were often only poorly known at best. Secondly, the descriptions were typically single-paragraph latinized texts, often without detailed illustrations; and thirdly, in many cases the relevant herbarium vouchers have been mislaid, lost or destroyed. For these reasons, one can only admire the painstaking "detective" work by the present generation of cycad biologists in resolving the past uncertainties and unknowns. In this article, we aim to clarify the taxonomic definitions of *Ceratozamia mexicana* and *C. tenuis*. The taxonomic issues involved in the matter of the two species are fully discussed in the publication by Andrew Vovides *et al.* (2016), and it is that work that forms the basis for this article.

DEFINITION OF *CERATOZAMIA MEXICANA*

Ceratozamia mexicana was the first species described for the genus, and was so-named by the French botanist Adolphe-Théodore Brongniart in 1846. His description and herbarium voucher was based on plant material growing in the Paris Botanical Garden (Figure 2, Figure 3). The plant material had been collected in the early 1840s by the Belgian botanical explorer, Auguste Ghiesbrecht, from a locality to the south of Xalapa,

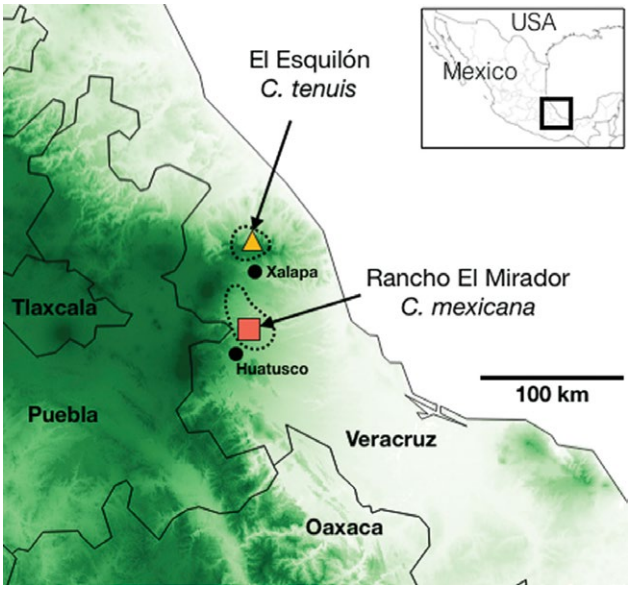

Figure 1. Map of the Mexican State of Veracruz and surrounding areas, showing the type populations for *Ceratozamia mexicana* (El Mirador) and *C. tenuis* (El Esquilón). Dotted-lines indicate the geographic ranges of the species, according to Martínez-Domínguez *et al.* (2018). Green-scale indicates topographic variation, from low (white) to high (dark green) altitudes.

near the Carl Sartorius' Rancho "El Mirador", about 20 km north of the town of Huatusco (Figure 4). Other populations occur at the foot of the Orizaba mountain chain, and closer to Huatusco and Totutla, generally in cloud forests at altitudes from 500–1 300 m.

This cycad became popularly known amongst growers in the USA as the "El Mirador" cycad but has since been determined to be the "true" *Ceratozamia mexicana* (Vovides *et al.* 2016) after a great deal of taxonomic confusion. It is now separated from populations to the north of Xalapa which had been previously merged into a generalized concept of *C. mexicana* (*e.g.* as was portrayed by Osborne & Vovides, 2010, in Encephalartos #100). The discovery of previously-mislaid herbarium sheets from these northern areas has now allowed the latter plants to be typified as a separate species, *C. tenuis*.

CERATOZAMIA MEXICANA

Stems are epigeous, erect to decumbent, globose to ovoid, becoming cylindrical with age, 20–80 cm tall or more in very old plants, 20–45 cm in diameter or more in very old plants. The 5–55 *leaves* forming a terminal crown are 100–270 cm long, 50–90 cm wide, typically (but not always) light green or lime green, with a brown pubescence on emergence, becoming glabrous at maturity (Figure 5). The *leaflet*s are in 12–21 pairs,

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ARTICLES

Figure 2. The holotype of Brongniart's *Ceratozamia mexicana* from the files of the Paris Herbarium. Image kindly supplied by Dennis Stevenson.

lanceolate, mostly planar, basally falcate, coriaceous, flat, opposite to subopposite, 29–51 cm long, 23–37 mm wide, 18–40 mm between leaflets, the apex acuminate, the base attenuate, with conspicuous light green veins. The *petiole* is terete, 30–93 cm long, dark green, and sparsely to moderately armed with short and thin prickles. *Cataphylls* are persistent, densely reddish-brown tomentose at emergence, partially so at maturity, triangular, with an acuminate apex. *Pollen cones* of *Ceratozamia mexicana* are usually solitary, cylindrical to narrowly conical, erect, 24–40 cm long, 55–76 mm in diameter, greenish-yellow initially with a blackish pubescence at maturity, the *peduncle* 3.5–5 cm long, 18–23 mm in diameter, reddish-brown to light brown tomentose; *microsporophylls* are 16–27 mm x 9–21 mm with a non-recurved distal face. *Ovulate cones* are usually solitary, cylindrical, erect but becoming decumbent at maturity, 24–38 cm long, 10–15 cm in diameter, dark green with a blackish pubescence initially, dark green with black and grey trichomes at maturity, the *peduncle* 8–12 cm long, 25–30 mm in diameter, brown to reddish-brown tomentose; *megasporophylls* 20–40 mm x 44–53 mm with a prominent distal face and an obtuse angle between the horns (Figure 6). *Seeds* are ovoid, 20–33 mm long, 15–25 mm in diameter, the sarcotesta fleshy, creamy-white initially, becoming light brown at maturity.

Cultivation. *Ceratozamia mexicana* grows well in cultivation and has good representation in international botanical gardens and private collections, both under the newly prescribed name and as *Ceratozamia* "El Mirador" or (particularly in Florida) *Ceratozamia* "Lime Green" (Figure 7). The species adapts to low light intensities which makes it useful for shady areas in a garden, or as a houseplant. *C. mexicana* is frost tolerant. We would like to caution that there might be many examples in botanical gardens and private collections where the name has been incorrectly applied to specimens of *C. tenuis*.

DEFINITION OF *CERATOZAMIA TENUIS*

In 1999, Dennis Stevenson discovered three oversized herbarium sheets in the archives of the Royal Botanic Gardens at Kew (Figure 8). These had been prepared in 1881 under the instruction of Sir William Turner Thiselton-Dyer (1843–1928), the third Director

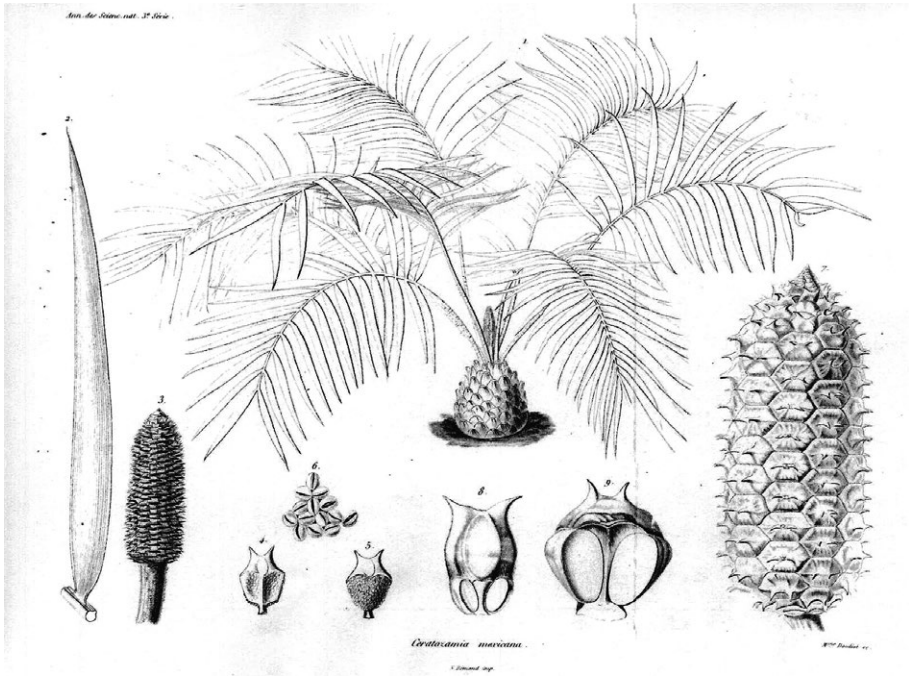

Figure 3. Copy of the illustration from Brongniart's (1846) description of *Ceratozamia mexicana*.

Figure 4. Jorgé Muller, present owner of Rancho El Mirador and a descendent of the original Sartorius family, with *Ceratozamia mexicana* in the hills above his hacienda. Photo: Chip Jones.

of the Gardens, from a Mexican cycad growing in Kew's Palm House. Because of their size, these specimen sheets had not been stored with the regular herbarium vouchers – and had been all but ignored for over 100 years! Thiselton-Dyer (1884) had named the taxon *Ceratozamia mexicana* var. *tenuis*, his epithet from the Latin *tenui*s, meaning slender or thin, alluding to the narrow leaflets of this cycad.

Vovides *et al.* (2016) compared leaflet anatomy to show that this plant material is best ascribed to cycad populations at El Esquilón, a site near the town of Jilotepec and the neighboring town of Coacoatzintla on the road to Naolinco, 20 km northeast of Xalapa in Veracruz. Charles Chamberlain (1919) reported visiting the locality over 100 years ago. Somewhat more abundant stands of the species are found a few kilometers distant in forests at 1 200–1 850 m elevations in Coacoatzintla, and other stands are reported from cloud forests at similar altitudes from Chiconquiaco, Tepetlán (Martínez-Domínguez *et al.* 2018) and a little further to

Figure 5. A newly-emergent leaf of *Ceratozamia mexicana* from the El Mirador locality; the colour is typically a light green or lime green. Photo: Lilí Martínez-Domínguez.

Figure 6. An ovulate cone on an "El Mirador" (= *C. mexicana*) specimen at Montgomery Botanical Center. Photo: Michael Calonje.

the north at Landero y Coss (Chip Jones, pers. comm.). With the decision to do away with varietal names in cycads, the cycad has now been typified as *Ceratozamia tenuis* (Dyer) D.W. Stev. & Vovides. It is also now clear that many of the *Ceratozamia mexicana* specimens in international botanical gardens and private collections should be correctly referred to *C. tenuis*.

CERATOZAMIA TENUIS

*Stem*s of *Ceratozamia tenuis* are epigeous, erect to decumbent, globose but becoming cylindrical with age, 20–100 cm tall or more in very old plants, and 30–45 cm in diameter or more in older plants. The 6–56 *leaves* forming terminal crown are 85–225 cm long, 50–100 cm wide, and typically dark green (*verde oscuro*), with a brown pubescence on emergence, glabrous at maturity (Figure 9, Figure 10). *Leaflet*s are in 15–28 pairs, linear, planar, abaxially curved, basally falcate, papyraceous when emergent, coriacious at maturity, shallowly channeled (caniculate), 23–51 cm long, 10–21 mm wide (but up to 25 mm or more wide in juveniles), with 3–25 mm between leaflets, the apex acuminate and the base attenuate, and with conspicuous light green veins. The *petiole* is terete, straight, 30–93 cm long, green and armed with short thin prickles. *Cataphylls* are persistent, densely reddish-brown tomentose at emergence, partially tomentose at maturity, triangular, with an acuminate apex. *Pollen cones* of are solitary, cylindrical, erect, 26–50 cm long, 50–70 mm in diameter, greenish yellow initially with a blackish pubescence at maturity, the *peduncle* 3.7–22 cm long by 12–25 mm in diameter, reddish brown to light brown tomentose; the *microsporophylls* 17–27 mm x 12–19 mm with a non-recurved distal face. *Ovulate cones* are solitary, cylindrical, erect or decumbent, 22–35 cm long, 8–14 cm in diameter, dark green with a blackish pubescence initially, dark green with blackish trichomes at maturity; the *peduncle* 8–17 cm long by 15–24 mm in diameter, brown to reddish brown tomentose; the *megasporophyll*s 27–31 mm x 42–50 mm

Figure 7. A well-grown specimen of *Ceratozamia* "Lime Green" (= *C. mexicana*) in the Florida garden of Libby Besse. Photo: Michael Perry.

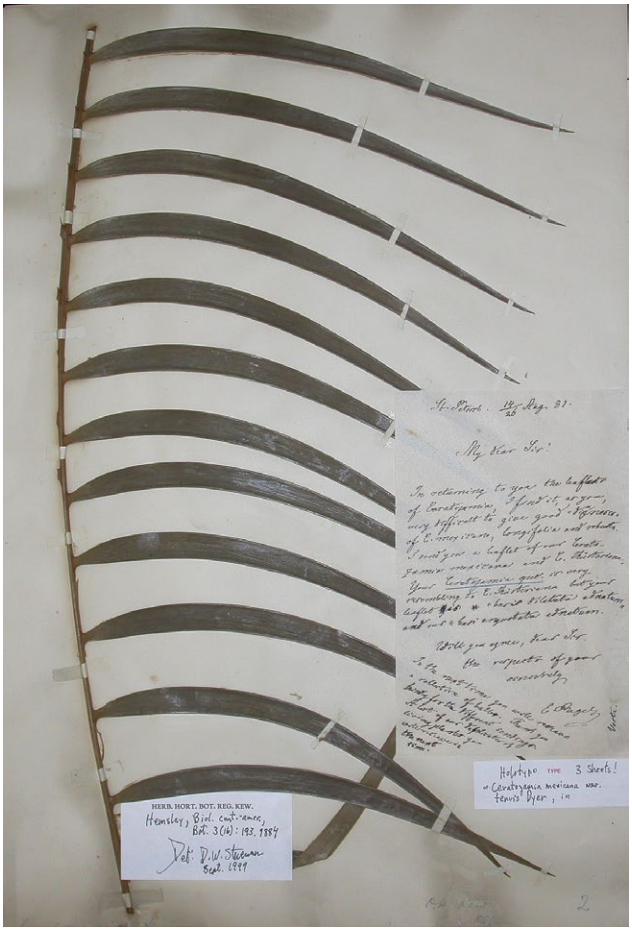

Figure 8. The holotype of Thiselton-Dyer's *Ceratozamia mexicana* var. *tenuis*. Sheet 1 of 3 from the archives of the Kew Herbarium. Image kindly supplied by Dennis Stevenson.

Figure 9. A newly-emergent leaf of *Ceratozamia tenuis* from the El Esquilón locality; the colour is typically a dark green (*verde oscuro*). Photo: Lilí Martínez-Domínguez.

with a prominent distal face, and 90° angle between the horns. *Seeds* are ovoid, 25–30 mm long by 13–18 mm in diameter, the sarcotesta fleshy, creamy white initially, becoming brown at maturity.

Cultivation. *Ceratozamia tenuis* is easily grown in cultivation but is not well represented as such in international botanical gardens and private collections. However, examples are present in many gardens under the name of *C. mexicana*. It is adaptable to low light intensities, which makes it useful for shady areas in a garden, or for use as a houseplant. The species is also frost tolerant.

KEY TO *CERATOZAMIA MEXICANA* AND *C. TENUIS*

In addition to the great set of anatomical leaflet features that are significantly differentiated (as described in Vovides *et al*., 2016), the shape, width and color of leaflets can be also used for species distinction when comparing adult plants.

Leaflets oblong-lanceolate, flat, 20–34 mm wide, and typically light green or lime green on emergence . . . . . *C. mexicana*

Leaflets linear-lanceolate to lanceolate, shallowly channeled (caniculate), 13–18 mm wide, and typically dark green on emergence . . . . . .*C. tenuis*

DISCUSSION

The Mexican State of Veracruz in Mexico is richly endowed with *Ceratozamia* species. The World List of Cycads now recognizes 13 of the 30 species in the genus as being distributed in that State, viz. *Ceratozamia brevifrons, C. decumbens, C. delucana, C. euryphyllidia, C. fuscoviridis, C. haustecorum, C. mexicana, C. miqueliana, C. morettii, C. robusta, C. subroseophylla, C. tenuis* and *C. totonacorum* (Calonje, Stevenson & Osborne 2019). Most species are well delimitated, whereas the case of *C. mexicana-C. tenuis* has brought an interesting debate among botanists and cycad growers. It is now our intention to reach a clarification on the definition of two species and the implications that it brings.

DISTINCTION BETWEEN *C. MEXICANA* AND *C. TENUIS*

Ceratozamia mexicana had become merged into a generalized concept of two species as portrayed in the sense of the Osborne & Vovides (2010) write up on that species in Encephalartos 100. From time-to-time, numerous botanists and growers have expressed concern about the plants labeled as *C. mexicana* not being consistent with Brongniart's (1846) taxonomic description. After the study by Vovides *et al*. (2016), it is clear that the two taxa should be remaining as valid;

Figure 10. A leaf of *Ceratozamia tenuis*, showing the characteristic narrow leaflets, from Landero y Coss near Chiconquiaco, about 40 Km north of Xalapa. Photo: Chip Jones.

furthermore, ongoing molecular studies that include samples of *C. mexicana* and *C. tenuis* (Gutiérrez-Ortega & Pérez-Farrera, unpublished data) can confirm that the two entities, indeed, cannot be merged into one taxon.

Nevertheless, there are varying opinions as to the colouration of the emergent foliage of these two cycad taxa, both in the literature and in personal reports from cycad enthusiasts. Broad consensus is that *Ceratozamia mexicana* (El Mirador population) has leaves that are light green or lime green on emergence, while those of *C. tenuis* (El Esquilón population) are typically a dark green (*verde oscuro*) (Martínez-Domínguez *et al.* 2017). We caution, however, that might there be some plasticity to this feature, and that leaf pigmentation may vary with local environmental factors or may arise from genetic aberrations. Thus, single traits, such as leaf color, might be insufficient for the species identification. It is necessary to consider a set of traits to make a final decision about the identify of a specimen in question (for example, one should also consider the width and shape of leaflets).

Finally, we should remind ourselves that "species" are labels that try to define cohered biological features at the intra- and inter-population levels. In other words, species are defined in consideration of biological traits (morphological, anatomical, genetics, or functional) that are well represented at the population level. Biological trait variations used as diagnostic traits are expected to have an evolutionary origin due to demographic factors or adaptation in evolutionary times (Walters *et al*., 2014). However, sometimes, a minority of plants within populations might present unusual characteristics that make their taxon assignment a difficult task when we do not know their original population. When this happens, one should ask whether aberrations in such plants have a real evolutionary meaning or are simply due to environmental factors or genetic anomalies. This is a complex question that is not easily solved, but a consideration of that question makes us open for discussion about the delimitation between the species; sometimes it leads to the description of additional species. In *Ceratozamia*, the great confusion about the species delimitation might be due to its low intralineage

Figure 11. Plants at the community nursery established in 1992 at Tlachinola for the propagation of *Ceratozamia tenuis.* Photo: Lou Randall.

divergence (González & Vovides, 2002) or recent origin (Nagalingum *et al*., 2012). Thus, one should continuously try to evaluate the characteristics that define the species and find a consensus that best satisfies all available evidence.

Ethnobotany. In the language of the Huastec Mayan people (also known as Teenek), *Ceratozamia mexicana* and *C. tenuis*, in common with several other cycads, are known as *tzalam-Thipac* or *tsalam-Thipaak* in reference to a mythical boy, called *Thipac* or *Thipaak*, who brought maize to the tribes. The Xi'ói (Pame) people use the name *bijio'a*. In Spanish, these species, like many other cycads, is called *costilla de león* (puma's rib), *palma de camote* (from the Nahuatl *camotl*, tuber), *palma imperia*l (imperial palm), *piña del monte* (wild pineapple-like fruit), or *tapacapon* (sometimes *tapacarbon* or *tapacarpon*, rooster's crest or cockscomb).

CONSERVATION IMPLICATIONS

Unfortunately, land clearance for coffee plantations since the mid-1960s has severely curtailed the natural habitat of most stands of *Ceratozamia* species in the State of Veracruz and elsewhere Thus, recognizing *C. tenuis* as a species different from *C. mexicana* is useful for making further conservation strategies. For example, in 1992, a community cycad nursery was established at Tlachinola, Veracruz, which was aimed to perform sustainable propagation of what was then called *C. mexicana* (Vovides *et al.* 2002) (Figure 11) but now correctly named *C. tenuis*. Unfortunately, the nursery is no longer operational.

The current numbers of mature plants of both *C. mexicana* and *C. tenuis* in the wild are not known with certainty, but are thought to be scarce. However, *C. tenuis* in the Coacoatzintla area is locally abundant and dominates the herbaceous strata in its cloud forest habitat. *Ceratozamia mexicana* is current listed in the category A ("Amenazada = threatened) in the Mexican Law NOM-059-SEMARNAT-2010 (Diario Oficial de la Federación, 2010). *Ceratozamia tenuis* is not explicitly listed in that Mexican Law due its recent taxonomic distinction. Nevertheless, according to the criterion 6.2, it can be considered under the same category as *C. mexicana*, A ("Amenazada" = threatened), due its previous taxonomic status. We suggest, however, that the categories for both species should be updated to the P category ("en peligro de extinción" = danger of extinction), similar for most *Ceratozamia* species with narrow distribution ranges and low numbers of known populations in Mexico.

Ceratozamia mexicana, based on the earlier concept of this species, is currently included in the Red List of Threatened Species of the International Union for Conservation of Nature as "VU" (vulnerable). We believe that this category is appropriate for the taxon while further research is needed to assess the current population status. By extension, we think that *C. tenuis* should be considered under the same category as *C. mexicana* until further evaluation. We expect that detailed information about the demography of both species will lead to assigment of appropriate conservation status.

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DOODSNIKKE VAN MY BROODBOOM, 'N ONSIGBARE PES...

Johan Kotze*

Figuur/Figure 1. 'n Gelukkige eienaar by die "gesonde" boom. / A happy owner with his "healthy" tree.

Bykans 20 jaar gelede het ek besluit ek wil 'n broodboom aanskaf waar onderdeur mense kan loop. Op soek na 'n reus, soos in baie van ons tuine en in botaniese tuine groei, vind ek 'n geskikte kandidaat om te koop in Oos-Londen.

Ek bly in Kaapstad en na onderhandeling en met die nodige invoer- en uitvoerpermitte arriveer my droomplant. Die plant is saam met nog ander bome wat vir ander tuine bestem was, vervoer. Om die vervoer van die besending te vergemaklik is al die blare en ook wortels verwyder. Met groot opgewondenheid is 'n spesiale plek uitgekies, langs die ingangspaadjie op 'n prominente plek om as 'n trofeë plant vir altyd te pronk.

Alles het goed gegaan en na die nuwe blare uit is en die boom gevestig het, was almal baie tevrede en hoogs in hul skik. Perfek net soos ek beplan het. Die spesie is *Encephalartos altensteinii* van die Oos-Kaap en boonop 'n wyfie plant met baie potensiaal.

Nou, na baie nuwe groei, nuwe seisoene en goeie versorging begin 'n bekommernis.

Die eerste tekens van probleme het sowat 6 jaar gelede begin. Op die stam het die cambium 'n verdikking begin ontwikkel. Ek het my aanvanklik nie baie daaraan gesteur nie omdat plante in tuine wat goeie versorging kry dikwels verdikkings maak, veral aan die boonste helfte van die stam as deel van die kroon. Die verdikking het egter nie egalig om die stam ontwikkel nie en dit het gelei tot nadere ondersoek. Ek vind toe dat die stam hol klink as ek daarop klop. Op 'n dag besluit ek om van die ou blaarbasisse, waar die verdikking op sy verste uitbult, te verwyder. Groot was my verbasing en teleurstelling om te sien die rede vir hierdie verdikking is 'n swambesmetting van binne af.

Die stam is onmiddellik behandel teen swamme en Dithane, Benomyl, Captan en swawel is om die beurt in die opening na onder, na bo, na links en regs tussen die stam en die bas ingespuit. Hierdie behandeling vind

Figuur/Figure 2. Eerste tekens van 'n probleem. / First signs of trouble.

*Durbanville, Wes-Kaap

Figuur/Figure 3. Die blaarbasisse verwyder en die skade word ontbloot. Hierdie ontdekking het tot my teorie gelei. / Leaf bases removed to reveal the damage inside the stem.

Figuur/Figure 4. Na baie behandeling met swamdoders en uitdroog word pogings, het die onvermydelike afwagting begin. / The stem after drying out and the fungicide treatments. Now we wait and hope for the best!

die afgelope 3 jaar gereeld plaas. Op hierdie stadium begin die blare verbruin, vou na onder en verdroog. Die eens welige blare het verminder na 'n skrale 8 tot 10 blare en verminder steeds. Daar is geen teken van nuwe blaarvorming nie.

Hierdie verskynsel is niks nuuts nie en almal het foto's van soortgelyke verskynsels by broodbome gesien. Dit het my laat wonder hoe het hierdie swam op hierdie manier besit geneem van die spog boom. Die enigste afleiding en gevolglike teorie lê opgesluit in die vervoer van die boom 20 jaar gelede.

Die stam is horisontaal saam met ander bome op die bak van die vragmotor vervoer en het op een of ander manier van die gewieg en op en af geskud onder sy eie gewig geknak en só seergekry. Hierdie seerplek is natuurlik onsigbaar vir die blote oog, kom ons sê 'n haarkrakie in die stam, en net hier het die swam binnegedring en oor tyd op 'n onsigbare manier sy vuilwerk begin doen.

Neem kennis en goeie raad van my teorie – vervoer bome òf vertikaal, sodat die boom regop staan òf stut die stam behoorlik om sagkens op en af te wieg. Goeie ondersteuningsmateriaal is hoë digtheid skuimrubber.

[Johan Kotze reports a problem with a specimen of *Encephalartos altensteinii* that succumbed to a fungal infection. The plant was in his collection for many years and initially grew well until it started to exhibit a thickening on the stem about six years ago. At first it was not seen as a serious problem but with time it worsened until some of the leaf bases were removed. This revealed a serious fungal infection that has caused a lot of damage to the plant. It was immediately treated with various fungicides, but the plant's condition kept deteriorating. Every year for the last three, the plant has been treated to stop further infections, but its condition is still poor. The leaves are dying off and there is no sign of a new flush.

How did this problem start? Johan has a theory that the stem was bruised or injured whilst being transported from East London, 900 km away, to Cape Town. All leaves and roots were cut before the stem was transported without any support on the back of a truck. The suspicion is that the bumping and bouncing on the truck caused the stem to bruise internally and this is impossible to see from the outside. He suggests plants should be transported upright or at the very least, supported with high density foam between the stem and the hard surface of the truck. Ed.]

F.A.W. MIQUEL (1811–1871), FATHER OF CYCAD TAXONOMY

Roy Osborne[1] & Dennis Wm. Stevenson[2]

INTRODUCTION

What's in a name? Botanically, three things: the genus, the species and the authorship, the first two conventionally printed in italics with the authorship abbreviated according to a defined protocol (Brummitt & Powell 1992). Hence, *Cycas media* R.Br. refers to the widely-distributed Queensland cycad described by Robert Brown in 1810.

Reference to the World List of Cycads (http://www.cycadlist.org) shows that there are some prolific cycad species' authors but others with only one taxon to their credit. One outstandingly prolific author is the 19th Century Dutch botanist, Friedrich Anton Wilhelm (sometimes Guilhelm) Miquel (1811–1871 (Figure 1). The abbreviation Miq. is seen in 85 extant cycad species (19 of which are validly-recognised at present), and 31 cycad fossil names.

Miquel's three main cycad volumes were the *Monographia Cycadearum* (1842, Figure 2), his *Cycadaceae quaedam Americanae* (1851, Figure 3) and his *Prodromus Systematis Cycadearum* (1861, Figure 4). Throughout his career, Miquel would publish independently in different languages (Latin, Dutch, German and French), which helped bring widespread recognition to his work. His numerous research publications, both the cycad-related and those dealing with other plant groups, ranged in content from fossils, to physiology, to structure, to plant geography – thus demonstrating his eclectic approach.

Miquel's cycad interests were recognized by colleagues in the specific epithets of the *Ceratozamia miqueliana* H.Wendl. (Figure 5), *Macrozamia miquelii* (F.Muell.) A.DC. (Figure 6) and the obsolete *Cycas miquellii* Warb., *Epicycas miquellii* (Warb.) de Laub., and *Zamia miquellii* W.Bull.

MIQUEL'S CAREER: MEDICAL DOCTOR TO PROFESSOR OF BOTANY

Miquel was born on 24 October 1811 in Neuenhaus, Lower Saxony. He studied medicine at the University of Groningen, graduating in 1833. After a short term of medical practice in Amsterdam, he taught medicine at the clinical school in Rotterdam. In 1840 he married Catherina Madry, daughter of a leading Rotterdam banker. In 1846 he became a member of the Royal Netherlands Academy of Arts and Sciences. He was

Figure 1. F.A.W. Miquel at Utrecht University in 1871. Official portrait by Dutch artist Johan Heinrich Neuman. Reproduced from Wikipedia within public domain.

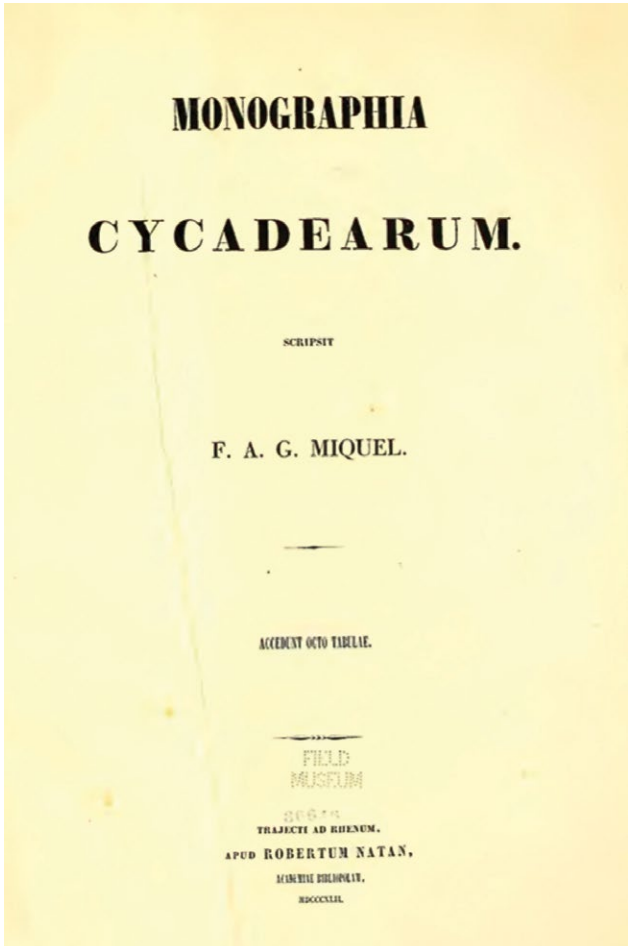

Figure 2. The frontispiece of the 1842 Latin version of Miquel's *Monographia Cycadearum.*

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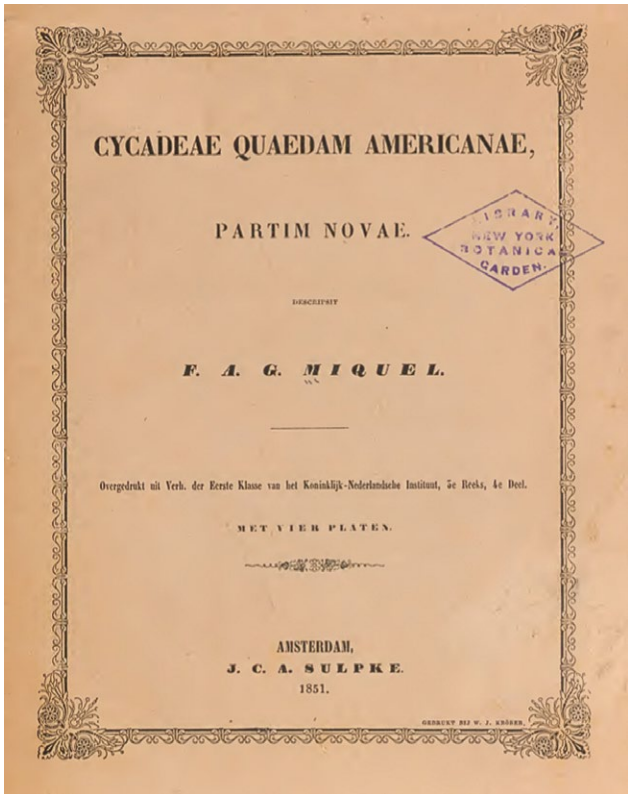

CYCADEAE QUAEDAM AMERICANAE,

PARTIM NOVAE.

DESCRIPSIT

F. A. G. MIQUEL.

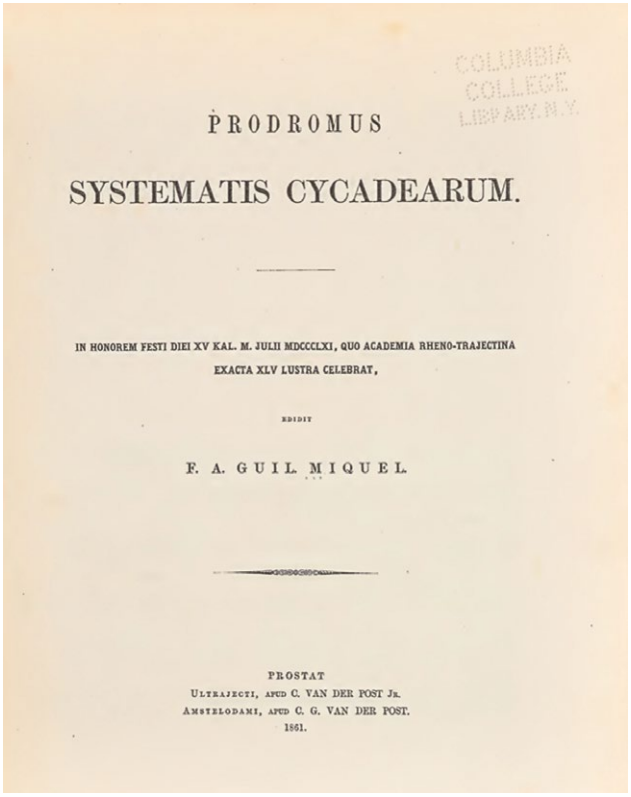
Overgedrukt uit Verh. der Eerste Klasse van het Koninklijk-Nederlandsche Instituut, 3e Reeks, 4e Deel.

MET VIER PLATEN.

AMSTERDAM,
J. C. A. SULPKE.
1851.

GEDRUKT BIJ W. J. KRÖBER.

Figure 3. The frontispiece of Miquel's *Cycadaceae Quedam Americanae*. Part 9 of 1851.



PRODROMUS

SYSTEMATIS CYCADEARUM.

IN HONOREM FESTI DIEI XV KAL. M. JULII MDCCCLXI, QUO ACADEMIA RHENO-TRAJECTINA
EXACTA XLV LUSTRA CELEBRAT,

EDIDIT

F. A. GUIL. MIQUEL.

PROSTAT
ULTRAJECTI, APUD C. VAN DER POST JR.
AMSTELODAMI, APUD C. G. VAN DER POST.
1861.

Figure 4. The frontispiece of the 1861 Latin version of Miquel's *Prodromus Systematis Cycadearum.*

appointed Professor of Botany of the University of Amsterdam (1846–1859) and later at Utrecht University (1859–1871), during which time he also directed the National Herbarium at Leiden.

Figure 5. *Macrozamia miquelii* (F.Muell.) A.DC. in habitat in the Byfield National Park, Queensland, Australia. Photo: Yvonne Dalziel.

MIQUEL'S BOTANICAL WORK

Miquel's botanical work was focused on the relatively new science of plant taxonomy based on Linnean principles. Although his own travels were limited, he corresponded widely with plant collectors in the Dutch East Indies, Suriname, India and Australia and facilitated an impressive number of herbarium deposits. Apart from his cycad interests, he described genera and species in the Casuarinaceae, Myrtaceae, Piperaceae and Polygonaceae, publishing a staggering total of some 7 000 botanical names. Then, in addition to his work with living plants, he turned his attention to paleobotany and made significant advances in the study of fossil of cycads and other fossil plants.

MIQUEL'S PASSING

Miquel passed away in Utrecht on 23 January 1871 at the age of 59, leaving his estate as a legacy to support botanical studies at the University of Utrecht. As a consequence of his distinguished and wide-ranging academic career, his enormous contribution to 19th Century botany, and his passion for cycads, we feel it is appropriate to name him as "Father of Cycad Taxonomy".

ACKNOWLEDGEMENTS

We thank Yvonne Dalziel and Chip Jones for supplying photographs of *Macrozamia miquellii* and *Ceratozamia miqueliana.*

CYCAD SPECIES WITH MIQUEL'S AUTHORSHIP: ACCEPTED EXTANT SPECIES

[Data from the World List of Cycads (Calonje, Stevenson & Osborne 2013-2020)]

- *Ceratozamia brevifrons* Miq. (1847)
- *Ceratozamia latifolia* Miq. (1847)
- *Ceratozamia robusta* Miq. (1847)
- *Cycas armstrongii* Miq. (1868)
- *Cycas glauca* Hort. ex Miq. (1840)
- *Cycas javana* (Miq.) de Laub. (1996)
- *Cycas rumphii* Miq. (1839)
- *Cycas siamensis* Miq. (1863)
- *Cycas sundaica* Miq. ex A.Lindstr. & K.D.Hill (2009)
- *Dioon angustifolium* Miq. (1847)
- *Encephalartos barteri* Carruth. ex Miq. (1868)
- *Macrozamia fraseri* Miq. (1842)
- *Macrozamia macdonnellii* (F.Muell. ex Miq.) A.DC. (1868)
- *Macrozamia mackleayi* Miq. (1868)
- *Macrozamia spiralis* (Salisb.) Miq. (1842)
- *Microcycas calocoma* (Miq.) A.DC. (1868)
- *Zamia fischerii* Miq. (1845)
- *Zamia loddigesii* Miq. (1843)
- *Zamia stricta* Miq. (1851)

Figure 6. *Ceratozamia miqueliana* H.Wendl. in habitat in at Santiago Tuxtla, Veracruz. Mexico. Photo: Chip Jones.

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MIQUEL'S MAJOR PUBLICATIONS

- ***Illustrations de la Flore de l'Archipel Indien.*** 28 editions published between 1871 and 2016 in French and German
- ***Monographia Generis Melocacti.*** 16 editions published between 1838 and 1982 in 3 languages
- ***Flora van Nederlandsch Indie.*** 23 editions published between 1855 and 1856 in 4 languages
- ***Annales Musei Botanici Lugduno-Batavi.*** 12 editions published in 1863 in Latin
- ***De Noord-Nederlandsche Vergiftige Gewassen.*** 17 editions published between 1836 and 1838 in Dutch and possibly one other language
- ***Analecta Botanica Indica; Commentationes de Variis Stirpibus Asiae Australioris.*** 18 editions published between 1850 and 1852 in 3 languages
- ***Monographia Cycadearum.*** 11 editions published in 1842 in Latin and French
- ***Systema Piperacearum.*** 14 editions published between 1843 and 1985 in Latin and and possibly one other language
- ***Prodromus Systematis Cycadearum***. 14 editions published between 1861 and 1993 in Latin
- ***Stirpes Surinamenses Selectae***. 8 editions published between 1850 and 1851 in Latin and Dutch
- ***Illustrationes Piperacearum.*** 13 editions published between 1844 and 1846 in 3 languages
- ***De Palmis Archipelagi Indici Observationes Novae.*** 9 editions published in 1868 in Latin and and possibly one other language
- ***Sumatra, Zijne Plantenwereld en Hare Voortbrengselen.*** 9 editions published in 1862 in Dutch and Latin
- ***Catalogus Musei Botanici Lugduno-Batavi.*** 13 editions published in 1870 in 3 languages
- ***Homerische Flora.*** 7 editions published in 1836 in German and English
- ***Commentarii Phytographici, Quibus Varia Rei Herbariae Capita Illustrantur.*** 11 editions published in 1840 in Latin
- ***Sumatra: Seine Pflanzenwelt und Deren Erzeugnisse.*** 13 editions published in 1862 in German
- ***Catalogus Horti Botanici Amstelodamensis.*** 11 editions published in 1857 in Latin and and possibly one other language
- ***Choix de Plantes Rare ou Nouvelles, Cultivées et Dessinées dans le Jardin Botanique de Buitenzorg. Publié avec une Texte Explicatif.*** 10 editions published between 1863 and 1866 in French
- ***Leerboek tot de Kennis der Artsenygewassen: Derzelver Zamenstelling, Krachten, Gebruik en Pharmaceutische Bereidingen.*** 4 editions published between 1838 and 1859 in Dutch

'N SWAMINFEKSIE OP BROODBOME EN DIE BEHANDELING DAARVAN / A FUNGAL INFECTION ON CYCADS AND ITS TREATMENT

Hannes Venter

'n Verskynsel wat al hoe meer by broodbome gewaar word en deur broodboomliefhebbers onderskat word, is 'n swaminfeksie, vermoedelik veroorsaak deur 'n spesie in die *Colletotrichum* genus. Die opvallendste simptome van die infeksie is nuwe blare wat pers of selfs swart vlekke ontwikkel (Figuur 1). Die blaar kan ook lyk of dit verlep het (Figuur 3, foto van Desember 2019). In baie ernstige gevalle bly die blare kort en onderontwikkel, vertoon pers en raak dan swart en gaan dood sonder om langer as ongeveer 5 cm te groei.

Hierdie artikel is gegrond op my persoonlike ervaring en geskryf nadat ek suksesvol twee plante behandel het en die swam tot so 'n mate onderdruk het dat gesonde blaarvorming kon plaasvind. Daar is moontlik ander kenners op dié gebied, met ander metodes wat al suksesvol gebruik is om die infeksie te behandel. My inligting is nie op die wetenskap gebaseer nie, en dit is nog te vroeg om vas te stel of die swam net onderdruk of heeltemal uitgeroei is.

Willie Tang skryf in die *Handbook of Cycad Cultivation and Landscaping* dat dit meestal die blou *Encephalartos* spesies is wat aangetas word maar na gesprekke met versamelaars in Gauteng is dit duidelik dat dit daar meer voorkom op die groen spesies. My ondervinding in die Wes-Kaap dui daarop dat die blou/grys broodboomspesies meer vatbaar is vir die swam maar dat spesies met groen blare ook aangetas word. Op hierdie stadium lyk dit of die swam enige *Encephalartos* spesie kan aantas.

Dit lyk of hierdie infeksie, in die begin stadium, stadig ontwikkel. Die eerste tekens van die swam word meestal misgekyk na my mening, veral op die groener spesies, en word maklik met sonbrand verwar. Die vroeë tekens van die swam se teenwoordigheid is blare wat

Figuur/Figure 1. *Encephalartos inopinus* blaar met skade veroorsaak deur die swam. / *E. inopinus* leaf with damage caused by the fungus.

A phenomenon that is increasingly observed in cycads and underestimated by cycad lovers, is a fungal infection, presumably caused by a species in the *Colletotrichum* genus. The most prominent symptoms of the infection are new leaves that develop purple or black spots (Figure 1). The leaf may also appear to have wilted (Figure 3, December 2019 photo). In very severe cases the leaves stay short and underdeveloped, appear purple and then turn black and die without growing longer than about 5 cm.

This article is based on personal experience and written after successfully treating only two plants and suppressing the fungus to such an extent that healthy leaf formation could occur. There may be other experts in this field with other methods, already successfully used, to treat the infection. My information is not based on science, and it is still too early to determine if the fungus has just been suppressed or completely eradicated.

According to the new *Handbook of Cycad Cultivation and Landscaping* it is mostly the blue *Encephalartos* species that are affected by this infection but after discussions with collectors in Gauteng, South Africa, it became clear that it occurs on the green species too. My experience in the Western Cape indicates that the blue/grey cycad species are more susceptible to the fungus but that species with green leaves are also affected. At this point it is fair to say the fungus appears to be capable of affecting any *Encephalartos* species.

This infection initially seems to develop slowly. The first signs of the fungus are mostly overlooked in my opinion, especially on the greener species, and are easily

Figuur/Figure 2. *Encephalartos trispinosus*, links met siek blare en regs na die behandeling. / *E. trispinosus*, left with fungal damage and after treatment, as described, on the right.

Figuur/Figure 3. *Encephalartos inopinus* met siek blare links en na die behandeling regs. / *E. inopinus* with fungal damage left and after treatment as described on the right.

voorkom asof dit deur die son uitgedroog is, alhoewel dit nie bruin gebrand is nie. Naby inspeksie mag wys dat die pinnas moontlik reeds pers en swart vlekkies vertoon.

Daaropvolgende stelle blare wys die skade baie duidelik, met meer en groter pers en swart vlekke (Figuur 2 en 3, 2019 foto's). Van hier af gaan die plant vinnig agteruit en elke jaar sal die blare meer verlep voorkom en korter word. Persoonlik het ek besmette broodbome gesien met groot stamme waarvan die blare tot so kort as 5 cm was (Figuur 5).

Dit blyk of die swaminfeksie vir baie jare teenwoordig kan wees en tot dusver kon ek geen gevalle vind waar broodbome dood is as gevolg van die swaminfeksie nie. Dit belemmer wel die groei en voorkoms van broodbome drasties as die swamsiekte vir lang periodes nie behandel word nie. Die afleiding kan gemaak word dat 'n broodboom met die infeksie wel sal doodgaan indien die toestand nie behandel word nie, omdat dit die blare ernstig aantas en fotosintese belemmer.

BEHANDELING

Die twee spesies wat ek tot dusver suksesvol behandel het, is *Encephalartos trispinosus* en *E. inopinus*. Drie ander plante word tans op dieselfde wyse behandel om die metode te toets. Dit sluit in een *E. altensteinii*, een *E. horridus*, asook 'n *E. trispinosus*.

Die *Encephalartos trispinosus* in Figuur 2, is al vir meer as vyf jaar besmet met hierdie swam en was 3 jaar terug verplant. Dit het die plant vermoedelik verswak en die swaminfeksie baie vinniger laat vererger. Dit is dus nie aanbevole om plante met die infeksie te skuif, alvorens dit behandel is nie.

Die *Encephalartos inopinus* het in 2018 die eerste tekens gewys en in 2019 was die infeksie baie erger soos gesien kan word op die foto van Desember 2019 in Figuur 3. Die agterste blare is van 2018 en alhoewel hulle nie te ongesond lyk nie, is dit effens uitgedroog met klein pers vlekkies. Die blare met die verlepte voorkoms confused with sunburn. The early signs of the fungus' presence are leaves that appear to have been burnt by the sun, although not brown. Close inspection may show that the pinnae already have purple and black spots.

Subsequent sets of leaves show the damage very clearly, with more and larger purple and black spots (Figures 2 and 3, 2019 photos). From here, the plant declines rapidly and each year the leaves will appear more wilted and become shorter (Figure 4). Personally, I have seen infected cycads with large stems whose leaves were as short as 5 cm (Figure 5).

It seems that the fungal infection may be present for many years but I have yet to find any cases where cycads have died due to the fungal infection. It does, however, drastically hamper the growth and appearance of cycads if the fungal disease is not treated for long periods. It can be deduced that a cycad with the infection will die if the condition is not treated, because it severely affects the leaves and therefore impedes photosynthesis.

TREATMENT

The two species that I have successfully treated so far are *Encephalartos trispinosus* and *E. inopinus*. Three other plants are currently being treated in the same

Figuur/Figure 4. *Encephalartos altensteinii* waarvan die blare in 2019 net tot 4-5 cm ontwikkel het voor dit heeltemal dood is. Die nuwe blare vir 2020 kan in Figuur 5 gesien word. Dis gesonder maar steeds erg besmet met die swam. / *E. altensteinii* leaves from 2019, which developed only to 4-5 cm before dying off completely. The new leaves can be seen in Figure 5 and although marginally healthier, they are still badly infected with the fungus.

Figuur/Figure 5. *Encephalartos altensteinii* blare waarvan die pinnas se punte doodgaan en wat lyk na sonbrand. / *E. altensteinii* leaves with dead, dry, black tips, which looks similar to sun burn.

wat terug krul, is die 2019 blare en die infeksie is duidelik baie erger.

Meeste broodboomversamelaars, insluitende myself, maak staat op produkte soos Ridomil ('n sistemiese en kontakswamdoder), Benomyl ('n sistemiese swamdoder) en Confidor (sistemiese insekdoder) vir die behandeling van broodbome. Hierdie swam- en insekdoders is voldoende om meeste van die infeksies en plae te beheer. My broodbome word vier keer per jaar voorkomend met hierdie middels behandel en steeds het ek bogenoemde swaminfeksie gehad. Dit wil dus voorkom of hierdie twee swamdoders nie voldoende is om *Colletotrichum* spp. te beheer nie!

Nadat beide plante blare gemaak het in 2019, met die infeksie, het ek besluit om in die volgende groeiseisoen die plante te behandel om die swam onder beheer te kry, of uit te roei. Die behandeling het hoofsaaklik uit drie komponente bestaan, naamlik voeding, water en die korrekte swamdoder wat toegedien is.

1. **Voeding, en in oorvloed**. Beide plante het gereelde kunsmis toedienings gekry met hoë stikstof inhoud. 'n Kommersiële produk, *Boost 1*, wat ook spoorelemente bevat (sien Notas), is gebruik. Tien gram kunsmis, opgelos in 12 Liter water, is toegedien elke drie tot vier weke rondom die plant. Vir plante in potte word 'n laer konsentrasie aanbeveel aangesien die stikstof inhoud baie hoog is en moontlik kan opbou in die pot en sodoende die wortels brand. Die matige gebruik van die kunsmis behoort egter nie 'n probleem te wees in potte nie.

way to test the method. These include *E. altensteinii*, *E. horridus* and another *E. trispinosus*.

The *Encephalartos trispinosus* in Figure 2, has been infected with this fungus for more than five years and was transplanted 3 years ago. This probably weakened the plant and caused the fungal infection to worsen much faster. It is therefore not recommended to move plants with the infection before it has been treated.

The *Encephalartos inopinus* showed the first signs in 2018 and in 2019 the infection was much worse as can be seen in the photo of December 2019 in Figure 3. The posterior leaves are from 2018 and although they do not look too unhealthy, they are slightly desiccated with small purple stains. The wilted leaves that curl back are the 2019 leaves and the infection is clearly much worse.

Most collectors, including myself, rely on products such as Ridomil (a systemic and contact fungicide), Benomyl (a systemic fungicide) and Confidor (systemic insecticide) for the treatment of cycads. These fungicides and insecticides are sufficient to control most of the infections and pests. My cycads are treated with these substances four times a year but still contracted the above fungal infection. Thus, it appears that these two fungicides are not sufficient to control *Colletotrichum* spp. infections!

After both plants made leaves (with the infection) in 2019, I decided to treat the plants in the next growing

Figuur/Figure 6. *Encephalartos inopinus* met blare af gesny tot teen die stam. / *E. inopinus* stem with leaves cut back.

Figuur/Figure 7. *Encephalartos inopinus* met nuwe blare wat begin uitkom, twee maande na alles af gesny is. / *E. inopinus* with new flush of leaves on the way, two months after removal of leaves.

Die tweede produk wat toegedien is, is 'n groei-stimulant genaamd *Marinure* (sien Notas). Dit bevat 3 groei hormone, ouksiene, sitokinien en gibberellien, asook belangrike spoorelemente. Dit is weekliks toegedien teen 5 ml per 5 liter water.

Die derde produk wat gebruik was, is *Bio Ganic All Purpose*. Dit is 'n NPK produk met spoorelemente wat stadig vrygestel word. Dit is toegedien een maal per maand soos aangewys op die verpakking.

2. **Water.** Die kunsmis en groeistimulante wat toegedien was, is almal in water oplosbaar en die plante het dus as gevolg van die gereelde toedienings ook gereeld water gekry.

3. **Swamdoder**. Die uitblinker in die behandeling was 'n swamdoder, *Captab WP*, met Captan as aktiewe bestanddeel. Captan is 'n kontak swamdoder en die twee hoof funksies is om 'n lagie op die blaar te vorm wat swamme verhoed om die blaar binne te dring en dit blok ook die vermoë van swamme om energie te produseer wat die swam dan oor 'n tydperk sal uitroei. Direk na die aangetaste blare verwyder is, het ek begin om Captan een keer 'n week teen 100% van die voorgestelde dosis oor die stam te spuit. 'n Benattingsmiddel ('n paar druppels skottelgoedseep is voldoende) moet in die mengsel gebruik word om die swamdoder deeglik aan die was lagie op die blare te laat kleef en 100% dekking te verseker. Inspekteer die kroon van die plant gereeld vir tekens van nuwe blare.

season to get the fungus under control or to eradicate it. The treatment consisted of three components, namely fertilization, watering and applying the correct fungicide.

1. **Fertilization in abundance.** Both plants received regular fertilizer applications with high nitrogen content. A commercial product, Boost 1, which also contains trace elements (see Notes), was used. Ten grams of fertilizer, dissolved in 12 litres of water, was then applied every three to four weeks around the plant. For plants in pots, a lower concentration is recommended as the nitrogen content is very high and may build up in the pot and thus burn the roots. However, the moderate use of fertilizers should not be a problem in pots.

   The second product applied is a growth stimulant called Marinure (see Notes). It contains 3 growth hormones, auxins, cytokinin and gibberellin, as well as important trace elements. It is applied weekly at 5 ml per 5 litres of water.

   The third product used was Bio Ganic All Purpose. It is a slow release NPK product with trace elements. It is applied once a month as indicated on the packaging.

2. **Water.** Since all these products are dissolved in water, the plants received ample and regular water while being treated.

3. **Fungicide.** The top performer in the treatment was a fungicide, Captab WP, with Captan as the active ingredient. Captan is a contact fungicide, and the two main functions are to form a layer on the leaf which prevents fungi from entering the leaf and it also blocks the ability of fungi to produce energy which will eradicate the fungus over a period of time. Immediately after removing the affected leaves, I began to spray Captan once a week at 100% of the suggested dose over the stem. A wetting agent (a few drops of dishwashing liquid is sufficient) should be used in the mixture to allow the fungicide to adhere well to the wax layer on the leaves and ensure 100% coverage. Regularly inspect the crown of the plant for signs of new leaves.

Figuur/Figure 8. *Encephalartos inopinus* met nuwe gesonde blare na die behandeling. / *E. inopinus* with new, healthy leaves after treatment.

Beide die plante het gou getoon dat hulle weer 'n stel blare wil maak. Sodra die nuwe blare sigbaar was, is Captan teen 35% van die voorgestelde dosis aangemaak, met 'n benatter, en elke derde dag oor die nuwe blare gespuit. Die ligter dosis voorkom dat die blare brand en die aanwending is ook 'n kort, vinnige spuit en nie 'n deurdrenking van die plant nie. Die spuit was korter as 'n sekonde en gelykstaande aan 'n vinnige, hoë druk, mis wat oor die plant val.

RESULTATE

In Figuur 2 kan die siek blare van *Encephalartos trispinosus*, foto van November 2019, vergelyk word met die gesonder blare op die foto van Februarie 2020. Die nuwe blare, na behandeling, is wel effens korter as gevolg van die stremming veroorsaak deur die infeksie, maar lyk heeltemal gesond.

Figuur 3 wys die siek en gesonde blare van *Encephalartos inopinus*. Weereens is die gesonde blare effens korter maar duidelik gesonder as vantevore.

Ek is 'n voorstander daarvan om broodbome voorkomend te behandel teen swamme en insekte en van mening dat broodbome hulle energie verbruik prioritiseer deur eerstens hulle self te beskerm teen swamme en insekte en daarna om te groei. Na my mening versnel die groei proses met voorkomende behandeling teen swamme en insekte en met die toediening van voeding en water daarby sal die plant floreer.

ERKENNING

Ek wil graag twee mense bedank wat 'n bydrae gelewer het met hulle hulp en kennis. Eerstens vir Wynand van Eeden, vir sy raad oor voeding, en tweedens vir Adolf Fanfoni wat sy kennis gedeel het oor verskillende swam- en insekdoders se uitwerking op die broodbome. Laastens 'n woord van dank aan Piet Vorster wat die artikel geproeflees het en verbeteringe voorgestel het.

NOTAS

Marinure (Liquid Norwegian Seaweed) is beskikbaar van *Canyon*, (www.canyon.co.za). *Root Stim* is ook 'n goeie keuse om groei te stimuleer by die siek plante en selfs 'n produk soos *Kelpak*, behoort die nodige uitwerking te hê.

Boost 1 is 'n bekende kunsmis vir broodbome en los op in water vir maklike toediening. *Boost 1* en *Root Stim* kan bestel word by Jackie Cornelius, telefoonnommer 071 121 6982.

Bio Ganic All Purpose is 'n produk van *Atlantic Fertilisers*. Dit is dieselfde as Bounce Back en is 'n organiese produk.

Captab WP is 'n handelsnaam en word vaardig deur Villa (www.villacrop.co.za). Enige swamdoder wat

Both plants soon indicated that they wanted to make a set of leaves again. Once the new leaves were visible, Captan was prepared at 35% of the suggested dose, with a wetting agent, and sprayed over the new leaves every third day. The lighter dose prevents the leaves from burning and the application is also a short, quick spray and not a drench of the plant. The spray was shorter than a second and equivalent to a fast, high pressure, mist falling over the plant.

RESULTS

In Figure 2, the affected leaves of *Encephalartos trispinosus*, photo from November 2019, can be compared with the healthier leaves in the photo from February 2020. The new leaves, after treatment, are slightly shorter due to the strain caused by the infection but looks perfectly healthy.

Figure 3 shows the diseased and healthy leaves of *Encephalartos inopinus*. Again, the new leaves are slightly shorter but clearly healthier than before.

I advocate treating cycads preventively against fungi and insects and believe that cycads prioritize their energy consumption by first protecting themselves from fungi and insects and then allows for growth. In my opinion, the growth process accelerates with preventative treatment against fungi and insects and with the application of nutrition and water the plant will thrive.

ACKNOWLEDGEMENTS

I would like to thank two people who contributed with their help and knowledge. Firstly, to Wynand van Eeden, for his advice regarding fertilisation, and secondly to Adolf Fanfoni, who shared his knowledge on the effects of various fungicides and insecticides on the cycads. I am grateful also to Piet Vorster who proofread the article and suggested improvements.

NOTES

Marinure (Liquid Norwegian Seaweed) is available from Canyon, (www.canyon.co.za). Root Stim is also a good choice to stimulate growth in the sick plants and even a product like Kelpak should have the necessary effect.

Boost 1 is a well-known fertilizer for cycads and dissolves in water for easy application. Boost 1 and Root Stim can be ordered, in South Africa, from Jackie Cornelius, phone 071 121 6982.

Bio Ganic All Purpose is a product of Atlantic Fertilizers. It is the same as Bounce Back and is an organic product.

Captab WP is a brand and is proficiently managed by Villa (www.villacrop.co.za). Any fungicide containing

Captan bevat, kan gebruik word. Captan is redelik veilig om te gebruik, is nie baie giftig nie behalwe vir swamme en veilig vir voordelige insekte soos bye asook vir voëls.

VERWYSINGS

Spesifieke verwysings word nie in die artikel gegee nie terwille van leesbaarheid. Die inligting vir hierdie artikel is baseer op die volgende bronne:

Fanfoni, A. 2017. Cycad Care – They all go together. Uitgegee deur die outeur, Pretoria.

Tang, W., Lindström, A., Vogel, A. 2018. Handbook of Cycad Cultivation and Landscaping, 2de Uitgawe. Beskikbaar aanlyn by http:\cycadgroup.org.

Captan can be used. Captan is reasonably safe to use, is not very toxic except for fungi and safe for beneficial insects such as bees and birds.

REFERENCES

For ease of reading, specific citations are not given in the text. The information given is based mainly on the following sources:

Fanfoni, A. 2017. Cycad Care – They all go together. Published by the author, Pretoria.

Tang, W., Jones, C., Lindström, A., Vogel, A. 2018. Handbook of Cycad Cultivation and Landscaping, 2nd Edition. Published online at http:\cycadgroup.org.

DIE DROOM

AAN ALLE BROODBOOMLIEFHEBBERS, PLANTENTOESIASTE, MENSE WAT NA DIE PLAASLEWE VERLANG, STAPPERS, FIETSRYERS, ADRENALIEN-'JUNKIES' EN BELANGSTELLENDES

Tilania du Preez

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Dink net aan die plesier om deur 'n woud van broodbome te kan loop en rustig jou omgewing te geniet.

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Om “Die Droom” te koördineer word beoog om ‘n Broodboom Trust te stig, met die volgende persone as trustees: Willie Bouwer (bekende prokureur van Pretoria), Tilania du Preez (verteenwoordiger van die Sentraaltak van die Broodboomvereniging) en Sonja Creighton (‘n ondersteuner met kontakte in die Vrouelandbou-Unie en ander instansies).

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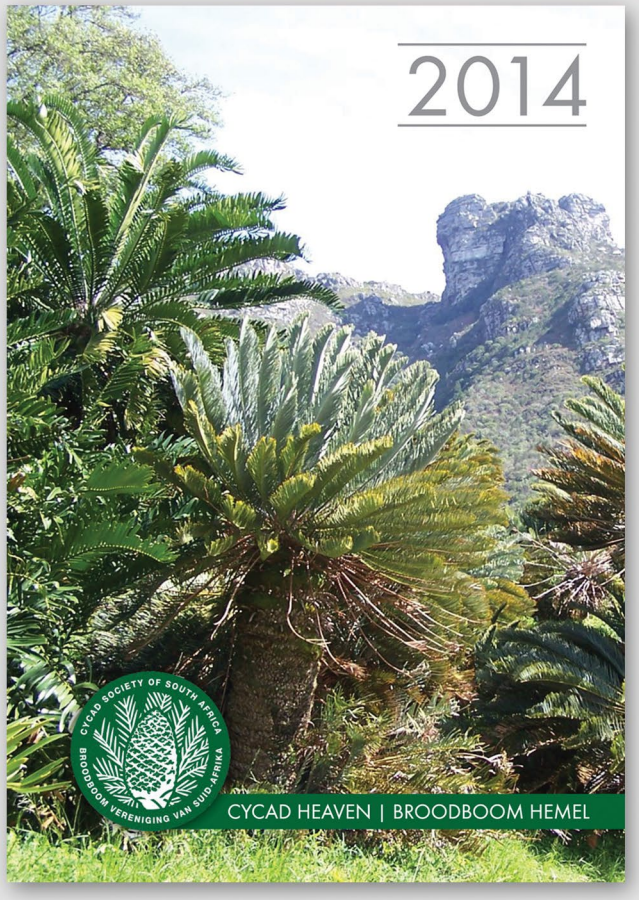

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