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ENCEPHALARTOS

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Journal of the Cycad Society of South Africa

ENCEPHALARTOS

Tydskrif van die Broodboom Vereniging van Suid-Afrika

On the cover:

Cycas conferta, growing in the southern part of Kakadu National Park in the Northern Territory, Australia. The habitat is open sclerophyll woodlands and very dry and hot. Having visited and experienced conditions here, it becomes quite clear to the observer why Australian *Cycas* species do not do well outside its habitat.

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FROM THE COUNCIL / VAN DIE RAAD

JAAREINDFUNKSIE – SENTRAAL STREEKTAK

Die afsluitingsfunksie van die sentraaltak is gehou op 20/11/2010 in die tuin van Exclusive Cycads in Pretoria. Daar is eers 'n jaareind vergadering gehou waartydens 'n nuwe voorsitter, John Kloppers en ondervoorsitter, Mark Crooks, verkies is. 'n Paar ander sake is bespreek waaronder die nuwe grondwet se aanvaarding of verwerping.

Hierna was daar 'n praatjie oor die voeding van broodbome. Die funksie is afgesluit met 'n heerlike braai en gesellige saamverkeer.

Dion du Toit

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MACROZAMIA OCCIDUA D.L. JONES & P.I. FORST.

Roy Osborne *

Figure 1.—: Roy Osborne (right) with Park Ranger Ian Elms, on site at Sundown National Park, May 2010. Photo: Angela Osborne.

Introduction

In our various Focus on ... articles, we have so far featured only 13 of Australia's 41 endemic *Macrozamia* species. The most recent of these was the treatment in Encephalartos 101 of *M. miquelii* (Osborne & Randall 2010). This was preceded by an article on *M. viridis* (Osborne & Forster 2008), a species from the rugged granite hills in the Girraween National Park and nearby areas in Queensland's Darling Downs district. In this issue, we return to the Darling Downs, but move some 50 km to the west, to focus on a related cycad, *Macrozamia occidua*, an interesting but little-known species with a much-restricted distribution endemic to the Sundown National Park and immediately adjacent area.

The epithet *occidua* (from *occiduus* = going down, setting, western) is an oblique reference to the setting of the sun in the west and hence to the name of the Park in which it is found.

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Discovery

In 1990, Peter Hazelgrove, then the ranger at Sundown National Park, drew the attention of botanists to the existence of cycads in the Park. Follow-up visits by David Jones and Paul Forster in 1993 led to the knowledge that these cycads were another variant in what was emerging as a set of taxa broadly related to *Macrozamia plurinervia* from New South Wales (see discussion on distinguishing features below).

In 1994, David Jones and Paul Forster formally described *Macrozamia occidua,* together with six other section *Parazamia* cycads from southeast Queensland. The holotype, *P.I. Forster 12663B & P. Machin*, comprising two sheets and carpological material from a male plant, was collected in January 1993 and is filed in the Brisbane herbarium (BRI).

Distribution, habitat and ecology

The 16 000 hectare Sundown National Park and Sundown Resources Reserve is located in high "traprock" country along the Queensland/New South Wales border. The area is dissected by feeder creeks and tributaries of

Figure 2.—: *Macrozamia occidua* is difficult to find in the rough terrain of Sundown National Park, where it grows understorey to the "Stringybark" eucalyptus. Photo: Roy Osborne.

the Severn River, with faulting, folding and weathering leading to sharp ridges and spectacular steep-sided gorges. Most of the area is within a 600–1000 m altitudinal zone. More than 130 bird species are represented. Macropods include grey kangaroos, wallaroos, red-necked, swamp and pretty-face wallabies, marsupial mice, gliders and possums. [Further information about Sundown National Park is readily available on several websites, e.g. http://www.derm.qld.gov.au/parks/sundown/index.html].

Two stands of *Macrozamia occidua* fall within the Park's borders and another group is on hilly farmland adjacent to the Park. The cycads grow at close to 1000 m altitude in open eucalypt woodlands in sandy soils derived from acid-intermediate volcanics of on sloping terrain. The dominant eucalypts are *Eucalyptus prava* and *E. sideroxylon*; other associated plants include *Dampiera purpurea*, *Goodenia delicata*, *Hibbertia stricta*, *Podolepis arachnoidea*, *Persoonia sericea*, *Olearia microphylla*, *Leucopogon muticus*, *L. melaleucoides*, *Brachyloma daphnoides* and *Melichrus urceolatus*.

The climate is hot and moist in mid-summer to cool and dry in mid-winter; mean maximum temperatures reaching 27°C in December and January and the minimum falling to 1°C in July. The yearly rainfall averages 766 mm with December and January being the two wettest months. The cycads occur in an area subject to occasional fires, and this may have an impact on their reproductive behaviour.

Cones of *Macrozamia occidua* mature between September and January. Nothing is known of the insect pollinators, but we speculate that a *Tranes* weevil similar to that known from *M. conferta* and *M. machinii* (Terry et al. 2008) is a likely candidate. Seeds ripen between

Figure 3.—: The typical appearance of *Macrozamia occidua* in habitat. Photo: Roy Osborne.

February and April; dispersal agents are not documented but frugivorous birds, rodents and some marsupials may be involved.

Description, vegetative structures

[Details from the species description by Jones & Forster (1994)]

Macrozamia occidua has a more-or-less ovoid, non-branching, subterranean **stem**, 10–20 cm in diameter. Stems bear 1–5 erect, dark green **leaves**, 40–75 cm long, in an obliquely erect, sparse crown. The leaf base is expanded into a spoon-shaped structure, 5.5–9 cm by 1.5–2.5 cm, densely covered with fawn to grey-green, soft wool. The **petiole** is 10–25 cm long, 6–10 mm wide at the lowermost leaflet, flat adaxially, strongly convex abaxially, subtending a dark green rachis that is spirally twisted 2–4 times, each leaf bearing 80–120 leaflets at about 60° to the rachis, the leaflets crowded, 3–24 mm apart, and arranged roughly in two ranks but not always in opposite pairs. **Leaflets** are linear, obliquely erect to spreading, dark green above, glaucous-pruinose beneath, concave adaxially in cross section, not twisted except at the base, hypostomatic, the apex acuminate, sometimes bidentate or tridentate, with a callous base that is greenish-yellow to yellow, or rarely pink, in colour. **Median leaflets** are 6–20 cm long by 3–10 mm wide, distal and proximal leaflets are somewhat shorter.

Description, reproductive structures

[Details from the species description by Jones & Forster (1994)]

Pollen cones of *Macrozamia occidua* are 1–2 per plant, straight, more-or-less cylindrical, 10–24 cm long excluding the peduncle, 3.5–5 cm in diameter, glaucous, with a peduncle 8–15 cm long and 16-20 mm in diameter, the peduncle round in cross section and irregularly furrowed. **Microsporophylls** are cuneate to broadly cuneate, 15–25 mm by 10–17 mm, the distal microsporophylls with stiff pointed spines to 5 mm long, other microsporophylls with only vestigial apical spines.

Ovulate cones of *Macrozamia occidua* are borne singly, and are ovoid, 10–14 cm long excluding the peduncle, 5–7 cm in diameter, erect, glaucous, with a peduncle 6–16 cm long, 12–16 mm in diameter, the peduncle round to elliptical in cross section and furrowed. **Megasporophylls** are 20–25 mm long including the stipe, the outer face transversely elliptical to transversely ovate, 20–30 mm by 11–13 mm, with a prominent sunken area just below the apical spine, spines increasing in length distally, the longest about 20 mm long. **Seeds** are ellipsoid, 18–25 mm long by 15–20 mm in diameter, the sarcotesta orange when ripe.

Distinguishing features

There have been various attempts to find intrasectional groupings or species complex associations within *Parazamia*. Jones and Forster (1994) held the view that *M. occidua* falls within their "Macrozamia plurinervia complex", a set of seven taxa with moderately broad to broad, shallowly concave leaflets, comprising *M. conferta*, *M. cranei*, *M. fearnsidei*, *M. machinii*, *M. occidua*, *M. playtyrachis* and *M. viridis*. With some similarities, Hill & Osborne (2001) considered *Macrozamia occidua* as part of a "Macrozamia pauli-guilielmi group" of 11 species including *M. concinna*, *M. conferta*, *M. cranei*, *M. crassifolia*, *M. fearnsidei*, *M. flexuosa*, *M. machinii*, *M. occidua*, *M. parcifolia*, *M. pauli-guilielmi* and *M. plurinervia*, characterised by more-or-less erect leaves, a rachis that is spirally twisted several times, and narrow undivided leaflets with incurved margins. Hill (1998) and Forster (2004) both concede that these section *Parazamia* groupings are to some extent artificial.

Macrozamia occidua seems most closely-related to *M. cranei*, *M. machinii* and *M. plurinervia*, and is distinguished from them by its short leaves and short broad leaflets. Allozyme studies carried out at the CSIRO laboratories in Canberra by Sharma et al. (2004) have shown that these four taxa form a well-defined clade, which is itself sister to a second clade comprising *M. viridis*, *M. fearnsidei* and *M. conferta*. Further anatomical and molecular studies are necessary to define better these intrasection associations.

Ethnobotany

I have no knowledge of any ethnobotanical usage of *Macrozamia occidua*.

Conservation status

Because of its severely restricted distribution, *Macrozamia occidua* is considered vulnerable (VU) on the

Figure 4.—: Leaf detail of *Macrozamia occidua*, showing a spirally twisted rachis and greenish-yellow callous bases at the point of insertion of the leaflets into the rachis. Photo: Roy Osborne.

Figure 5.—: Two pollen cones on a *Macrozamia occidua* specimen in the Sundown National Park. Photo: Ken Hill.

present IUCN Red List (IUCN 2010). The total number of mature plants was estimated to be between 1000 and 2500 and the two populations in Sundown National Park are considered as "stable" in an area of occurrence of 50 km^2 (Hill 2003), but I believe that the number of plants may be less than this estimate. Furthermore, regeneration from seedling generations seems to be very limited. The cycad is gazetted as a Rare or Threatened Plant under Queensland Nature Conservation Legislation.

Cultivation

Macrozamia occidua is almost unknown in cultivation and is it likely that any seeds or seedlings being traded have been illegally sourced. The small stature of this cycad would undoubtedly make it an attractive pot plant but its slow growth rate detracts from its horticultural appeal. Any collectors who may have acquired male and female plants are encouraged to produce viable seeds crops so that this species does eventually become more readily available. As for all section *Parazamia* cycads, a porous, sandy soil with good drainage, and adequate sunlight, would be important requirements

Acknowledgments

Lou Randall, Leonie Stanberg, and Sundown National Park Ranger Ian Elms assisted in the preparation of this article.

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Cold winter precedes mast coning year for female *Cycas panzhihuaensis* plants at Montgomery Botanical Center

Claudia Calonje & Michael Calonje *

Figure 1.—: *Cycas panzhihuaensis* in habitat at Panzhihua nature preserve. Photograph by Terrence Walters.

Cycas panzhihuaensis is a highly ornamental species that is fast-growing, horticulturally forgiving, and extremely cold hardy. In cultivation, it has been recorded surviving temperatures below 10° F (-12.2° C).

It is somewhat similar in appearance to *Cycas revoluta*, but it bears an attractive coat of orange wool on the stem apex, has bluish green leaves, and its male cones produce a distinctive licorice odor. Unlike *Cycas revoluta*, which has been cultivated for centuries, *Cycas panzhihuaensis* has only been in the horticultural trade since the late 1990's, and is therefore not yet widely available.

Cycas panzhihuaensis is endemic to China, where it occurs in southern Sichuan and northern Yunnan provinces (Figure 1) The specific epithet refers to Panzhihua Prefecture in southern Sichuan Province, where the species was first collected (Hill, 2008).

Cycas panzhihuaensis is considered the most abundant Chinese cycad (Hill 2008), with a single population estimated at 120,000 individual plants as recently as 1990 (Zhou et al. 1990). However, this species is now listed as "Vulnerable" in the IUCN Red List of endangered species. It is threatened by clear cutting, plant harvesting, and a large mining operation in its area of distribution (Hill, 2009).

Montgomery Botanical Center (MBC) hosts an extensive collection of 88 plants of *Cycas panzhihuaensis* developed from seeds collected in China in 1992, 1993, and 1994 (see Walters & Yang, 1994 and Walters et al., 1995).

In 2001, two male plants from the 1993 collection produced their first cones, and two years later the first female plant produced cones. After these first coning events, the staff at MBC was optimistic that the coning events would increase every year and that MBC would be able to produce thousands of seeds of this threatened cycad through its pollination program.

Interestingly, although new plants continued to produce cones in the following years, most of these plants were male, and many plants had not coned at all even though many appeared large enough to do so. As of last year, only 4 plants had produced female cones compared to 31 male plants.

However, this season a total of 10 female plants produced cones for the first time (Figure 2), compared to only 3 male plants. Currently, at MBC there have been 34 plants producing male cones, 14 plants producing female cones, and 39 plants, which have yet to produce cones.

Montgomery Botanical Center
Miami, Florida, USA

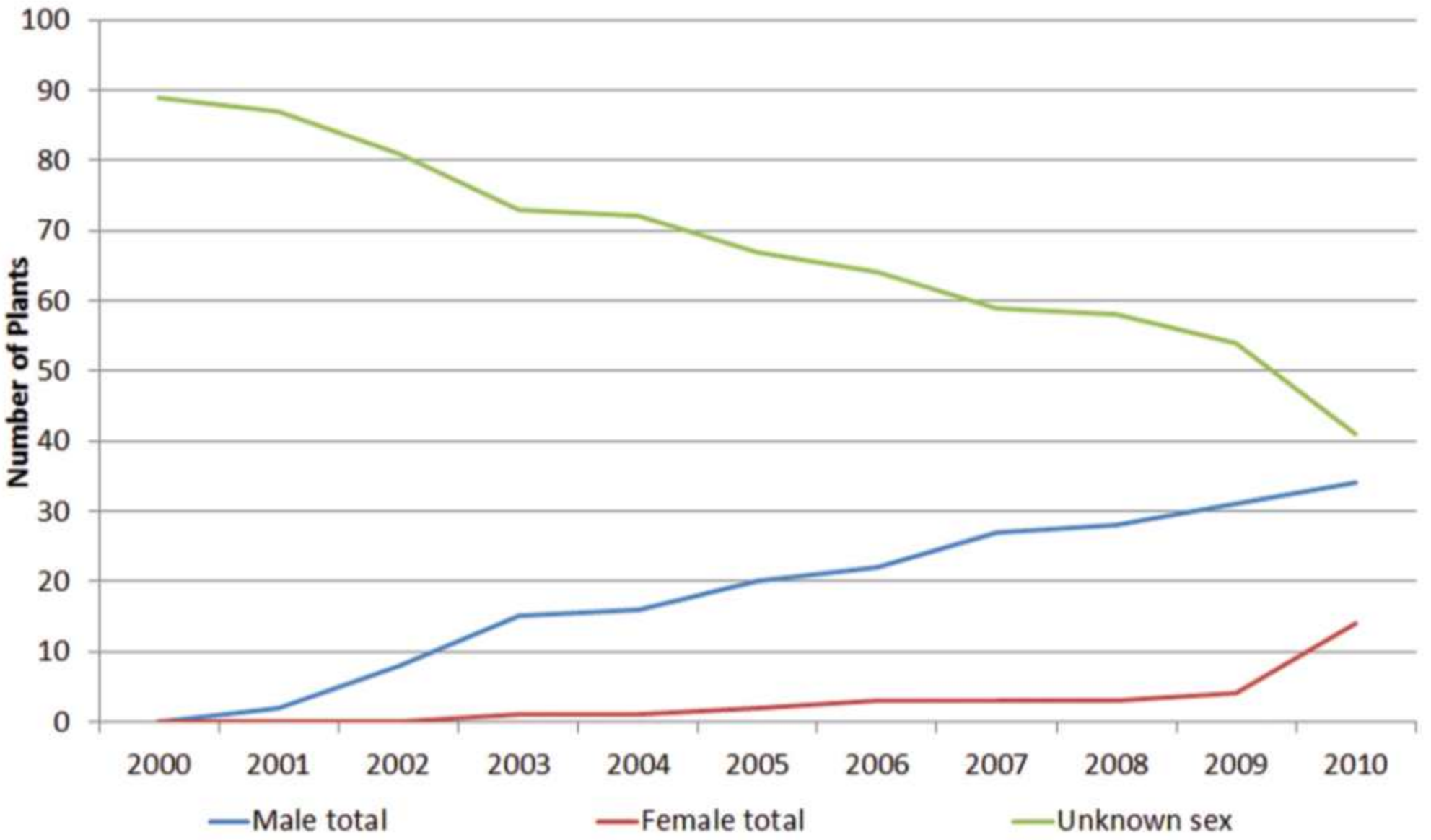

Figure 2.—: Cumulative Sex ratio of *Cycas panzhihuaensis* collection at MBC.

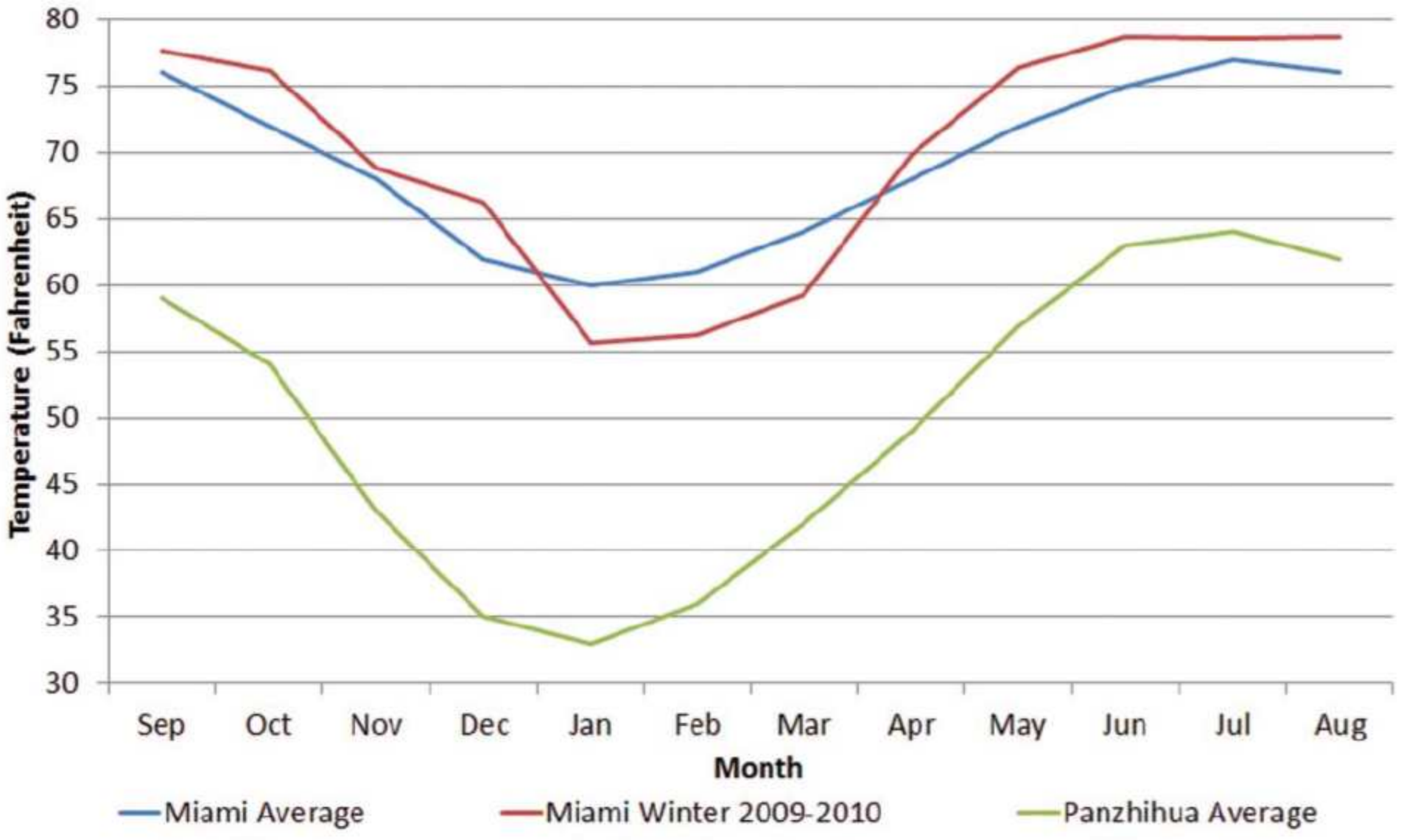

Figure 3.—: Fig. 3 - Average minimum monthly temperatures in Miami and Panzhihua compared to Winter 2009-2010 in Miami

There are several possible explanations for this unusual coning behavior. When cultivating a large group of cycads from seed, it is quite often the case that male plants will begin coning before female plants. This was illustrated by Ornduff (1996) in a study monitoring a cultivated cohort of *Zamia integrifolia*. It is likely that male plants typically begin coning at an earlier age than females because producing female cones requires a higher energy investment from plants than producing male cones (see Tang, 1993), and thus need to attain a larger size to produce female cones than to produce male cones.

In this case, male plants at MBC began to cone two years before female plants did, but this does not explain the fact that three times as many female plants produced cones for the first time this year as did male plants. An alternative and more likely explanation is that this spike in coning for female plants was the result of especially

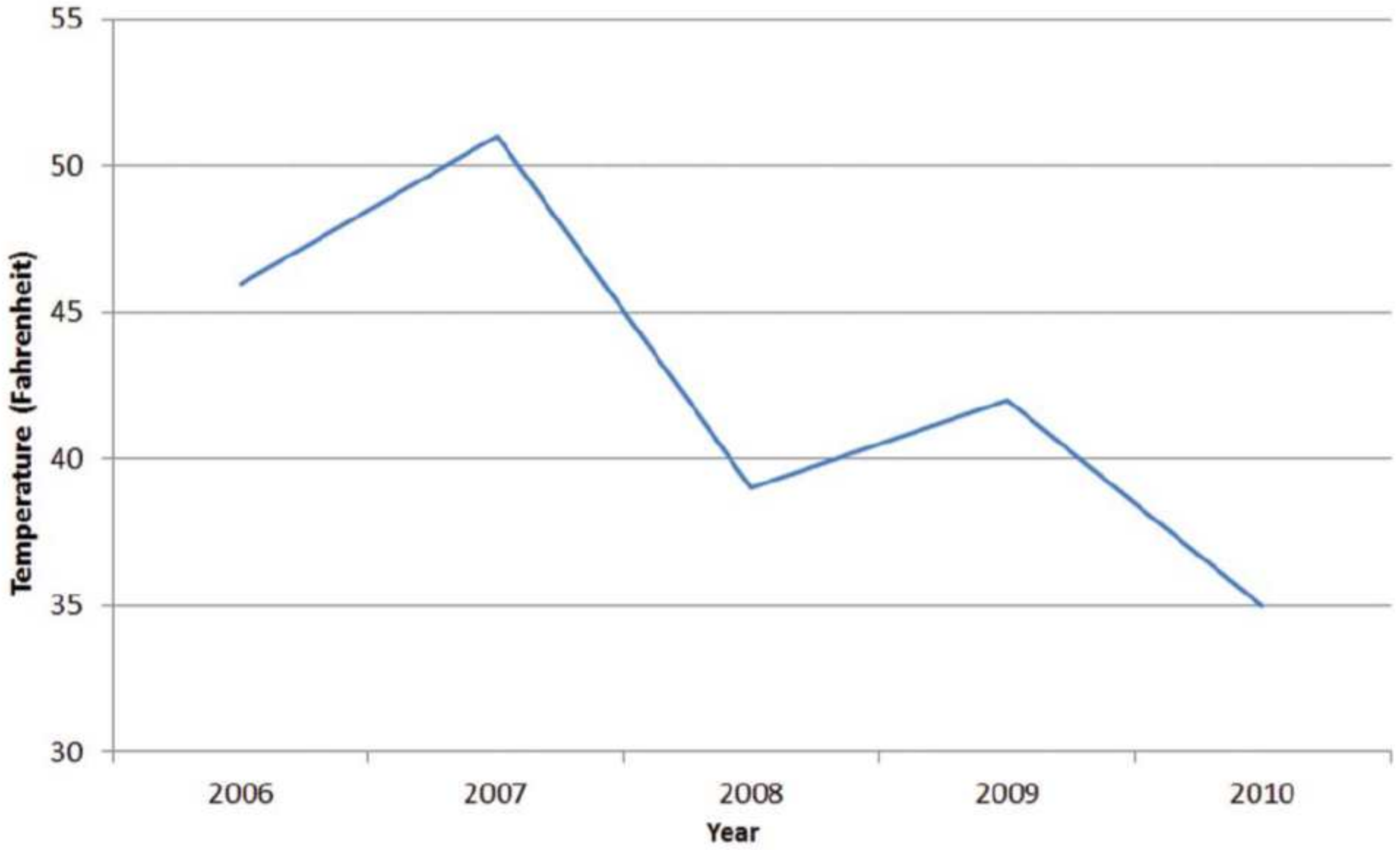

Figure 4.—: Lowest January temperature in the last 5 years.

Figure 5.—: Multi-headed plant at MBC carrying 5 female cones.

cold weather at MBC during the 2009-2010 winter season, which was colder than usual and a little closer to the weather near Panzhihua City, China, where MBC's collection was derived from (Figures 3 & 4).

Osborne & Grobbelaar (2004) examined coning behavior in *Cycas revoluta* cultivated in several geographic locations throughout the world, and found a direct correlation between winter minimum temperature and coning behavior. They posited that a period of low winter temperature is required for cone initiation in this species. We believe that this is the most likely explanation for this mast coning year for female *Cycas panzhihuaensis* at MBC. Interestingly, this species does appear to produce female cones more readily and at a smaller size further up north in Florida, where winter temperatures get lower (Larry Krauss, pers. Comm.).

Cold spells can be detrimental to our living collections from tropical regions so we generally don't look forward to them. In this case the 2009-2010 cold spell was a mixed blessing, as it allowed us the opportunity to hand-pollinate female cones of several plants in our collection (Figure. 5). Hopefully the resulting seeds will help, making this beautiful yet threatened cycad more available in cultivation.

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VOTE FOR THE NEW CONSTITUTION.

The closing date for the acceptance of votes for the new Constitution is 31 December 2010. If you still wish to submit your vote, either by mail or electronically, kindly ensure that it reaches the Secretary by that date.

STEM VIR DIE NUWE GRONDWET

Die sluitingsdatum vir die aanvaarding van stemme vir die nuwe Grondwet is 31 Desember 2010. Indien u steeds u stem wil laat geld deur middel van pos of e-pos, maak asseblief seker dat dit die Sekretaris teen daardie datum bereik.

The 4th Botanical Garden's Conservation International Symposium.

The critical difference between Extinction and Survival; ex situ conservation of *Encephalartos* species in the Lowveld National Botanical Garden, SA.

Karin van der Walt *

The 4th Botanical Garden's Conservation International symposium was held in Dublin, Ireland between 13 and 18 June 2010 and attracted 370 delegates from 53 countries. The focus of the symposium "Addressing global change – a new agenda for Botanical Gardens" included a scientific programme consisting of eight themes which covered all aspects of work done in Botanical Gardens ranging from research, community education to addressing climate change in gardens. Under the theme of "The global strategy for plant conservation – 2010 and beyond", a cycad collections consortium was held which included presentations from South Africa, Mexico, USA and China.

Abstract:

Worldwide the cycad flora consists of about 308 species, of which an astronomical 62% are currently listed as threatened. In South Africa the rate is slightly higher – 68% of the indigenous *Encephalartos* species are threatened.

In the 1980s the Lowveld National Botanical Garden started a project to collect endangered *Encephalartos* species. Specimens of the same species but from different geographical areas and differing morphologically from each other, are housed in separate seed orchards (for example *E. ngoyanus, E. lebomboensis*). The seed orchards are currently well established, with most plants producing cones on a regular basis. The ultimate objective with seed produced by plants in the seed orchards is enhancement or reintroduction in the wild. However, pressures on wild populations and garden collections by irresponsible collectors often prevent success in this regard. The alternative at this stage is to propagate highly sought after species and sell them to the public to relieve the pressure on wild populations.

Intensive management and involvement in cycad conservation (*ex situ* and *in situ*) over the past three years have highlighted problems, successes and challenges for the conservation of *Encephalartos* species in South Africa.

* Lowveld National Botanical Garden, SANBI.

Keywords:

Encephalartos collections, threatened plants, *ex situ* conservation, Botanical Gardens, South Africa.

The International Union for Conservation of Nature – Cycad specialist Group reported in 2003 that 82% of the world's cycad species are threatened with extinction in the near future, while in South Africa, 89% of the 38 recognized species are currently listed as Extinct, Extinct in the Wild, Critically Endangered, Endangered or Vulnerable (IUCN Red List – SANBI 2008). Although the reasons why these ancient seed plants are facing such a bleak future are not unique to South Africa, unscrupulous harvesting of mature plants from their natural habitat for use in landscaping and private collections is the biggest reason for the rapid decline of many species.

The South African National Biodiversity Institute (SANBI) has a network of 9 National Botanical Gardens throughout South Africa, one of these, the Lowveld National Botanical Garden (LNBG) represents the subtropical climate of the north-eastern part of the country. During the early 1980's the LNBG has started to intensify collection efforts of the genus Zamiaceae focussing on African and South African species. Soon afterwards the severity of the extinction threat to many South African species were realized, which prompted the LNBG to extent *Encephalartos* collections to be more genetically representative. These collections aimed to be mostly from wild collected seed, but in some instances included plants which were confiscated by conservation authorities from private collectors when it was found to be illegally possessed. *Encephalartos* species obtained for conservation purposes were planted in field gene banks, which are fenced off and for security reasons not accessible to the public. The *Encephalartos* collection has subsequently grown and unfortunately also attracted some unwanted attention which lead to a series of thefts, which necessitated the use of alarm systems and security guards to protect these valuable collections in LNBG. Currently there are 38 *Encephalartos* and one *Stangeria* species recognized in South Africa; 19 of these are represented in LNBG as viable *ex situ* collections which can be considered to be genetically representative of at least one know locality for each species. A further 9 species are present

Figure 1.—: Cycad species from fire climax grasslands are burned every 2nd to 3rd year to simulate natural processes.

in LNBG but although these plants are mature and cone-producing, they are typically small collections and many from unknown localities. The remaining species are represented as single plants, and mostly do not cone on a regular basis.

The initial cycad collections were planted in the cultivated areas of LNBG and grouped either according to different geographical areas or families. During a new wave of cycad thefts from 2005, Botanical Gardens in SA with significant cycad collections became targets, and this necessitated the translocation of many valuable species from landscaped areas to the field gene banks where security measures could be installed. The *Encephalartos* field gene bank at LNBG is an extensive open air planting with South African *Encephalartos* species, which have been collected with the aim of establishing viable *ex situ* conservation collections. *Encephalartos* species are divided into different sections, and in cases where a species is represented from more than one geographical locality, these collections are housed separately and is also managed as separate collections to ensure genetic purity. This ensures that the collections can be used for restoration, reintroduction or enhancement when the opportunity arises. Intensive management of the collections in the gene bank includes the simulation of natural phenomena such as wet and dry seasons, as well as fires. Plants from fire climax grasslands are burned on a biennial cycle by covering the plants with dry grass and setting it alight during the fire season, which is between August and September.

Effective management of the conservation collection is achieved by attaching a label with an unique number to each plant and this is linked to a photographic record and an electronic database. The electronic database include all the collection information of the plant, accession numbers, GPS reading of the current locality in the garden, sex of the plant, number of suckers, year cones produced, month cones mature, number of cones, in the case of females – pollination data such as date and method used, number of seed harvested, number of seed viable, number of seed germinated after 1 year. Any other information regarding fertilization, pests, diseases and treatments are also indicated on the database.

As part of the Threatened Plants Project in LNBG, cycad seedlings are propagated on large scale primarily to satisfy the public demand for these unique plants, but

Figure 2.—: New growth following a burn.

Figure 3.—: Burning programmes has resulted in cone production in *E. humilis*, which previously produced only 1 cone in 15 years.

Figure 4.—: Female *Encephalartos longifolius* cone covered with stockings to prevent hybridization and insect predation.

ultimately the aim is the reintroduction of seedlings into the natural habitat once these plants can be safeguarded. The large collection of *Encephalartos* species in a confined area makes it important to intensively manage the plants especially during their reproduction stage to prevent hybridization between closely related species. Hybridization is prevented by taking the following steps:

- Male cones are removed once they reach maturity and start to shed pollen. Procedures for removing the male cone involves cutting the stalk carefully with a sharp knife while ensuring that the cone is kept in an upright position. Once the cone is free, it is laid down on newspaper and stored in a draft-free room for three days to allow all the pollen sacs to open. Pollen is then collected in labelled containers and stored in a fridge at 4°C for up to two years. Stored pollen is used to pollinate female cones in LNBG, and the surplus is made available to the public and the local cycad society's pollen bank.

- Female cones of the genus *Encephalartos* are fully receptive for pollen when the cone scales become loose and this creates a small gap between the scales on the top half of the cone. In nature this will allow insects access into the middle of the female cone and by rubbing their pollen covered bodies against the sticky ovaries ensures pollination. The access of insects into the cones are prevented in LNBG by covering the mature cone with a nylon stocking before the cone scales separate the stockings are left on for up to 3 weeks after artificial pollination was done. During the pollination period, cones are monitored on a daily basis and once the gap between the scales is observed, a small amount of water is poured into the scale opening, if the water runs through the cone and appears at the bottom, the cone is ready for pollination. There are two pollination methods used in LNBG; the first is a wet method, where one teaspoon of pollen is mixed with 100ml clean water and poured into the cone. The second method is a dry method where pollen is blown into the scale openings by using a syringe or turkey baster. The pollination method is repeated twice during the period when the female is most receptive. Where possible females are pollinated with pollen obtained from the male plants of the same geographical area.

- At the first sign of disintegration, the female cones are removed to prevent seed predation by baboons and monkeys. Seed is then prepared for short term storage by removing the fleshy outer layer and after its has been treated with a fungicide, it is hanged in a well-ventilated room until the start of the warmer seasons when the seed is transferred to unheated sand beds in the cycad germination house and moistened with a mist spray at 2 hour intervals. Once the seed has germinated and the radicle has reached a minimum length of 2cm, the seedling is planted into a 4lt plastic plant bag with a soil medium of 50% river sand and 50% compost and placed in the cycad seedling nursery where it is grown on for purposes ranging from sales, landscaping in LNBG or second generation *ex situ* conservation collections.

Revenue generated from the sale of cycad seedlings are used to fund all *in situ* and *ex situ* plant conservation activities in Mpumalanga and it is this project that enables the LNBG to provide valuable *in situ* conservation support to the critically endangered *Encephalartos middelburgensis*. A project proposal was accepted in which LNBG and the local conservation authority, Mpumalanga Tourism and Parks Agency, are combining resources to reassess all the sub-populations of this species, and based on the results from the assessment, female plants that have become isolated due to removal of mature plants by poachers, are currently artificially pollinated according to scientifically accepted standards. A species action plan for *E.middelburgensis* is being developed which includes an updated species assessment, reports on all sub-populations as well as conservation action recommendations for each sub-population.

Figure 5.—: The cycad seedling nursery. Seedlings are sold to the public and could in future be used for reintroductions.

The cycad collections consortium - overview

The following summary of the cycad collections consortium was written by all the participants and edited by Andrew P. Vovides from the Instituto de Ecoligia in Mexico.

Cycad Collections in Botanic Gardens: challenges and opportunities

A. P. Vovides

Living cycad collections exemplify the *ex situ* conservation role of botanic gardens. Relict populations, severe extirpation pressures, and robust illegal trade make *ex situ* cultivation a necessary key step in long-term conservation of these unique "living fossils". Their basal position in seed plant phylogeny make them an invaluable research resource and Knut Norstog has referred to them as "the Rosetta Stone" for understanding seed plant evolution. Cycads are also important horticultural species for landscaping and gardening.

Considering an unprecedented increase of species descriptions over recent decades due to fieldwork and collections, five gardens with active *ex situ* cycad conservation programmes have discussed their approaches to cycad conservation, and detailed their challenges and successes. These collections range from comprehensive world scale, historic and national cycad collections with

Figure 6.—: Germination facilities at Lowveld National Botanical Garden.

Figure 7.—: Pictured here is the critically endangered *Encephalartos middelburgensis* in habitat. Most of the sub-populations of this species have become severely fragmented due to illegal removal of mature specimens.

research ranging from horticultural, alpha taxonomy, systematics, genetics, genomics, phytogeography, phytochemistry, ultrastructure, DNA bar-coding and sustainable management. In passing, regarding historic collections, I must mention Ireland's National Botanic Garden, Glasnevin, Dublin that holds an important living specimen of *Ceratozamia fuscoviridis* an original living collection of David Moore, a past director of the Garden, from 1878 and also a voucher found by Dennis Stevenson which enabled us to clear up a vexing taxonomic problem. To keep a living specimen alive for over 130 years is no mean feat and speaks very highly of generations of horticulturists at the Glasnevin Garden.

Dennis Stevenson of the New York Botanical Garden summing the past 30 years of cycad research to conservation that resulted in quadrupling the world's cycad flora from around 80 to over 320 spp and stressed the importance of field-work and laboratory research as being an advance of our knowledge of cycad biology. Karin van der Walt of the Lowveld National Botanical Garden of the South African National Biodiversity Institute spoke on the efforts of the on *Ex Situ* conservation of endangered *Encephalartos* species at population level forming seed orchards for enhancement or reintroduction purposes and stressed the security problems of specimen theft by collectors that is hampering this noble conservation action. Nan Li of the Shenzhen Fairy Lake Botanical Garden in China presented detailed progress in cycad conservation and researches at the China National Cycad Conservation Centre followed by Patrick Griffith of the Montgomery Botanical Centre, USA who presented the living cycad collections at Montgomery, a world based documented collection, and discussed collaborative field-work, constructive partnership between the Centre and the horticulture industry, stressed the utility of the living collection for research and comparison of collection data with laboratory data. To end the symposium Andrew P.Vovides of Instituto de Ecologia in Mexico presented a preamble on the Mexican living cycad collection at the Jardín Botánico Francisco Javier Clavijero in Xalapa, from its early beginnings in the late 1970s in a makeshift back yard greenhouse to its present day position in the Botanic Garden. The collection, unique in Latin America, holds representatives of all the known species described for Mexico as well as at least one species of the old world genera. The collection was used to complete the Flora de Veracruz, Zamiaceae fascicle and later research on cytotaxonomy, anatomy, molecular systematics, molecular bar-coding and taxonomy where 19 new species descriptions were based on the living collections. Work on cultivation improvement is ongoing for extension and outreach projects on the propagation of cycads in rural nurseries aimed at sustainable management.

The symposium was very well attended and successful. Suggestions for the conclusions included exchange of information such as horticultural techniques between the gardens holding cycad collections as well as staff exchange for short periods. A cycad collections in botanic gardens and institutions consortium be formed with the objective of sharing collections listings in collaboration with BGCI as well as molecular or DNA collections data bases.

Figure 8.—: *Ceratozamia fuscoviridis* in the glasshouse at the National Botanical Garden of Ireland.

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Further reading:

4th Global Botanic Gardens Congress : Addressing global change – a new agenda for botanic gardens. *http://www.bgci.org/resources/news/0698/*

The cycad extinction crisis:
http://www.sanbi.org/index.php?option=com_content&view=article&id=1029:south-african-cycads-face-extinction-crisis&catid=68:biodiversity-plant-a-program-news&Itemid=138.

Acknowledgements:

I am thankful to the South African Cycad Society for providing financial assistance to attend the 4th BGCI congress in Dublin, Ireland.

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2011 LIDMAATSKAPFOOIE

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Cycas nathorstii J. SCHUST (CYCADACEAE), A New Record for Kerala State, India

Raju Antony, S. M. Shareef & N. Mohanan *

Abstract

Cycas nathorstii J. Schust, is reported for the first time from Kerala. This species described from Sri Lanka was earlier reported in India from Chingelpet, Tamil Nadu. A brief description and photographs are provided here for its easy identification.

Introduction

Cycas L., the monotypic genus of the family Cycadaceae consists of about 100 species, mainly distributed in Indo-Chinese and Australian regions (Lindstrom & Hill, 2007). It is also the sole living cycad group occurring in Asia. In India, there are 8 species so far reported *viz. Cycas annaikalensis* Rita Singh & Radha, *C. beddomei* Dyer, *C. ciricinalis* L., *C. indica* A. Lindstrom & K. D. Hill, *C. nathorstii* J. Schust., *C. pectinata* Buch.-Ham., *C. spherica* Roxb. and *C. zeylanica* (J. Schust.) A. Lindstrom & K. D. Hill. *Cycas annaikalensis* and *C. indica* are the newly described species from South India. *C. circinalis* and *C. annaikalensis* are already reported from Kerala.

While conducting surveys and explorations in Kerala state for studying the natural populations of *Cycas circinalis*, the authors could notice an interesting *Cycas* growing in deciduous forests in Palaruvi in Kollam district, a part of the Agasthyamala Biosphere Reserve, South India. On critical examination of the specimen with authentic literature, it was identified as *C. nathorstii* J. Schust., which was confirmed later by Dr. Lindstrom, an expert on Cycad systematics. This species originally described from Sri Lanka, was later reported from Chingelpet, Tamil Nadu, India (Lindstrom & Hill, 2007). Present occurrence in Kerala forms a new distributional record to the state. The populations in Chingelpet are reported to be facing severe threat mainly due to habitat destruction and over exploitation. Stem cuttings are widely utilized for medicinal purposes by local medical practitioners. The extraction of leaves for decorative purposes also accelerates the rate of the depletion of populations. Several populations are represented only by a few scattered individuals. But the populations recorded at Palaruvi are facing not much threat except the collection of seeds by tribal people for making steam cake, a local food item.

Description

Cycas nathorstii J. Schust. Pflanzenr. 99: 75. Fig. 10 E. 1932. Lindstrom & Hill, The genus *Cycas* (Cycadaceae) in India. *Telopea* 11(4): 480-481. 2007.

Stems arborescent, up to 2 m tall; growing in humus rich soil; base not strongly swollen; barks thick with or without persistent cataphylls and leaf bases. Petiole up to 69 cm long, glabrous, spinescent for 90 % of length. Leaves bright green, semi-glossy, up to 236 cm long, flat in section, up to 180 leaflets; newly emerging leaves bright green, tomentum shedding early. Basal leaflets not gradually reducing to spines. Median leaflets simple, up to 29 x 0. 9 cm, 20 mm apart on rachis; section flat; margins flat, apex softly acuminate, not spinescent; midrib raised below. Cataphylls narrowly triangular, soft, thinly sericeous or lacking tomentum, up to 55 mm long. Pollen cones not seen. Megasporophylls 22.5 - 42 cm long, persistently brown tomentose; ovules 4 - 8, glabrous; lamina lanceolate, 55 – 60 x 20 – 30 mm, shortly dentate with lateral spines at margins; apical spines up to 12 mm long, 4 - 6 mm wide at base. Seeds 30 - 40 x 30 – 35 mm, flattened-ovoid; sarcotesta yellow, fibrous layer absent; sclerotesta smooth; spongy endotesta absent.

Specimens examined: India, Kerala, Kollam dist., Palaruvi, *Raju Antony*, 09. 10. 2009, 58184; (TBGT); 13.10.2009, 69500 (TBGT); 13.10. 2010, *Shareef*, 69357 (TBGT).

Ecology: Common, growing in humus rich soil in moist deciduous forest.

Distribution and habitat: Sri Lanka & India (Kerala & Tamil Nadu). In Sri Lanka, it occurs in inland and upland forests in the north of the island, usually in somewhat drier sites. In India, it is growing in two localities *viz*. Chingelpet in Tamil Nadu and Palaruvi forest in Kerala. Chingelpet populations are in flat lands whereas in Palaruvi on upland deciduous forest.

Note: Specimens of *Cycas nathorstii* were earlier included under *Cycas circinalis* L. Later the German botanist Julius Schuster distinguished it as a distinct species in 1932, based on the specimens collected by George Thwaites. *Cycas nathorstii* is closely allied to *C. circinalis* L., but can be distinguished from the latter by bright green young leaves; narrowly triangular megasporophyll apices with numerous fine lateral spines extending to the very tip and flattened-ovoid seeds against bluish green young leaves; megasporophylls apices broader with an extended distinct apical spine that is free from lateral teeth and elongated seeds.

There are about 250 plants, from small seedlings to several years old trees, seen in about 1 sq. km area in Palaruvi. The ripened ovule is characterized by a fragrance similar to the ripened fruits of *Spondias pinnata*, a wild edible plant. The fragrance could be detected about 300 m away from the population. The seedlings and mature seeds were collected as part of the *ex-situ* conservation program on Cycads and are grown at the Cycad Conservatory of Tropical Botanic Garden and Research Institute.

Key to Cycas species in Kerala

1a. Lateral teeth of megasporophylls less than 5 mm long
  2a. Young leaves bluish green; seeds elongated . . *C. circinalis.*
  2b. Young leaves bright green; seeds flattened ovoid . . . . . *C. nathorstii*
1b. Lateral teeth of megasporophylls 5-10 mm long . . . . . *C. annakailensis*

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Figure 1.—: A. Habit, B. Megasporophylls, C. Young leaves, D&E. Megasporophylls with mature ovules, seed (inset).

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A Reassessment of the Conservation Status of *Cycas beddomei* DYER (CYCADACEAE), an Endemic of the Tirupati-Kadapa hills, Andhra Pradesh, India, and comments on its CITES status.

B. Ravi Prasad Rao [1], M.V. Suresh Babu & John Donaldson *

Abstract

Cycas beddomei Dyer (Cycadaceae), an endemic of Tirupati-Kadapa hills, Andhra Pradesh, India is re-assessed in terms of the International Union for the Conservation of Nature Red List status and inclusion in Appendix I of Convention on International Trade in Endangered Species. New data available from field surveys indicates that *C. beddomei* should be classified as Endangered (EN B1 a, b (i–v) + B2 a, b (i–v)) and that it still meets the biological criteria for inclusion in Convention on International Trade in Endangered Species Appendix I under criterion B (Bi, iii, iv).

Key words: Criteria, endangered, red list status, Tirupati-Kadapa hills.

Introduction

Conservation status of a species is an indicator of the likelihood of that species continuing to survive in nature. The International Union for the Conservation of Nature (IUCN) is the world's main authority on the conservation status of species (Mrosovsky, 1997) and the IUCN Red List provides an objective evidence-based system for classifying species in terms of the risk of extinction. Such conservation assessments are a useful tool to prioritise species for conservation action and to monitor the change in status of species over time. The IUCN system assesses the threat to a species based on five core criteria: decline in populations over a period that is relevant for the species (based on generation time); the distribution of the species together with factors that may influence ongoing survival within its current distribution; small population size and continuing decline; very small populations or small distribution area; and quantitative assessment of extinction risk (e.g. modeling). Assessments are always done using the best available information, but often only partial information is available unless detailed field studies have been carried out. As a result, assessments need to be updated on a regular basis or when new information becomes available.

Cycas beddomei is endemic to the Tirupati-Kadapa hills of Andhra Pradesh state, India. It is an enigmatic species in that its conservation status has been variously assessed as Vulnerable (Nayar & Sastry, 1987), Endangered (Rao *et al*. 2003) and Critically Endangered (Jadhav *et al.* 2001; Hill *et al.* 2003). It is also the only Indian cycad and the only species of *Cycas* to be listed on Convention on International Trade in Endangered Species (CITES) Appendix I (Inskipp & Gillett, 2005). The remainder of *Cycas* species are on CITES Appendix II. Some of the uncertainty regarding the status of *C. beddomei* has been due to the lack of primary data but studied populations of *C. beddomei* in their native habitat and this provides an opportunity to review the conservation status based on recent field observations and mapping of the wild population (Suresh & Rao, 2009; Rao *et al.* 2009).

CITES also makes provision for a periodic review of species that are listed on the CITES Appendices. This means that the information on the species should be reviewed to ensure that the species meets the biological and trade criteria for listing on the Appendices. Given the new data available on *C. beddomei,* it is also an opportunity to review whether this species meets the biological criteria listing on Appendix I of CITES.

Materials and methods

The mapping of the population and distribution pattern of *C. beddomei* is based on the studies carried out in the hill ranges of Seshachlam hills (also known as Tirupa-

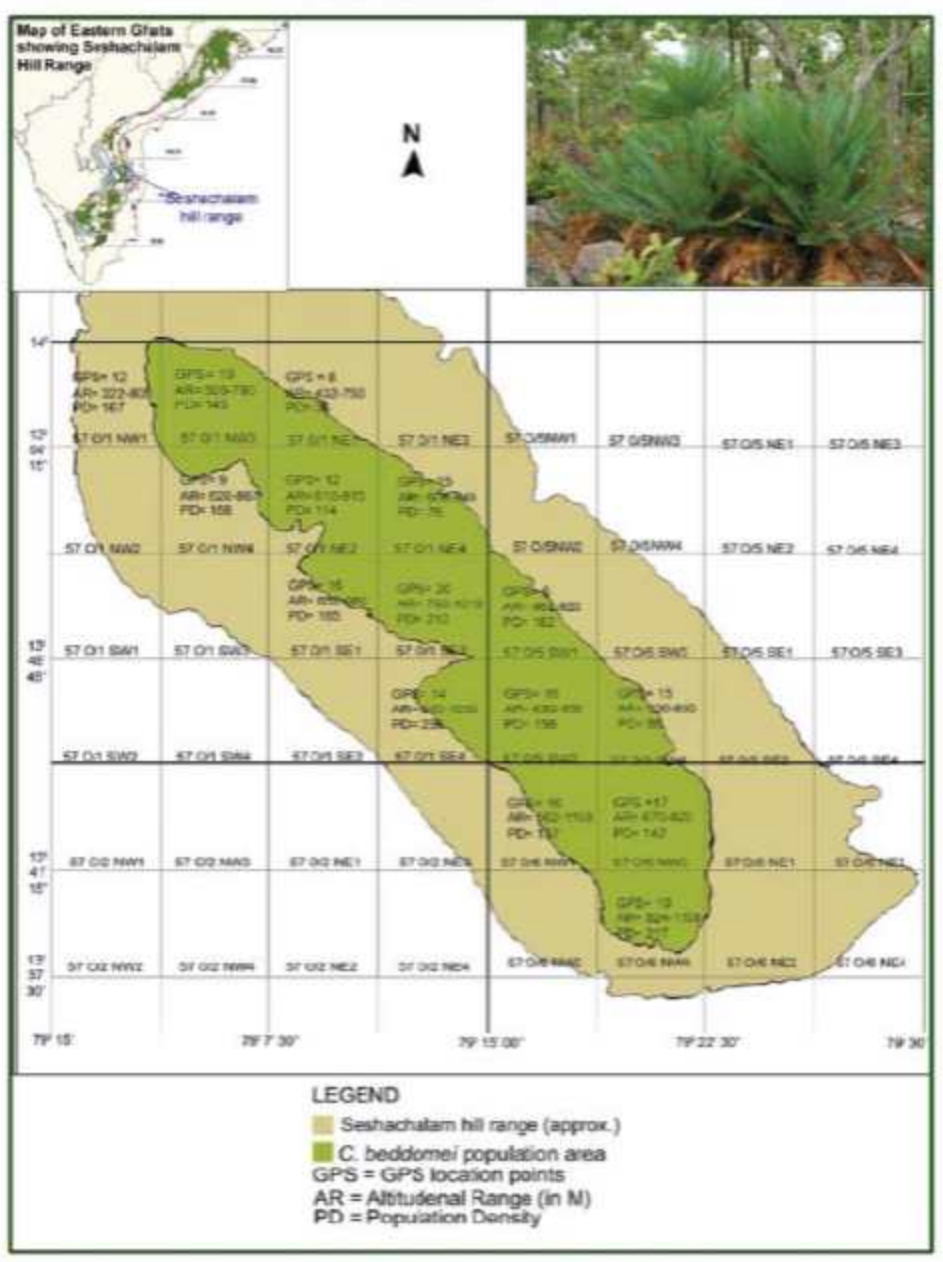

Figure 1.—: Map of Seshachalam hills showing grids, altitude and population density of *Cycas beddomei*.

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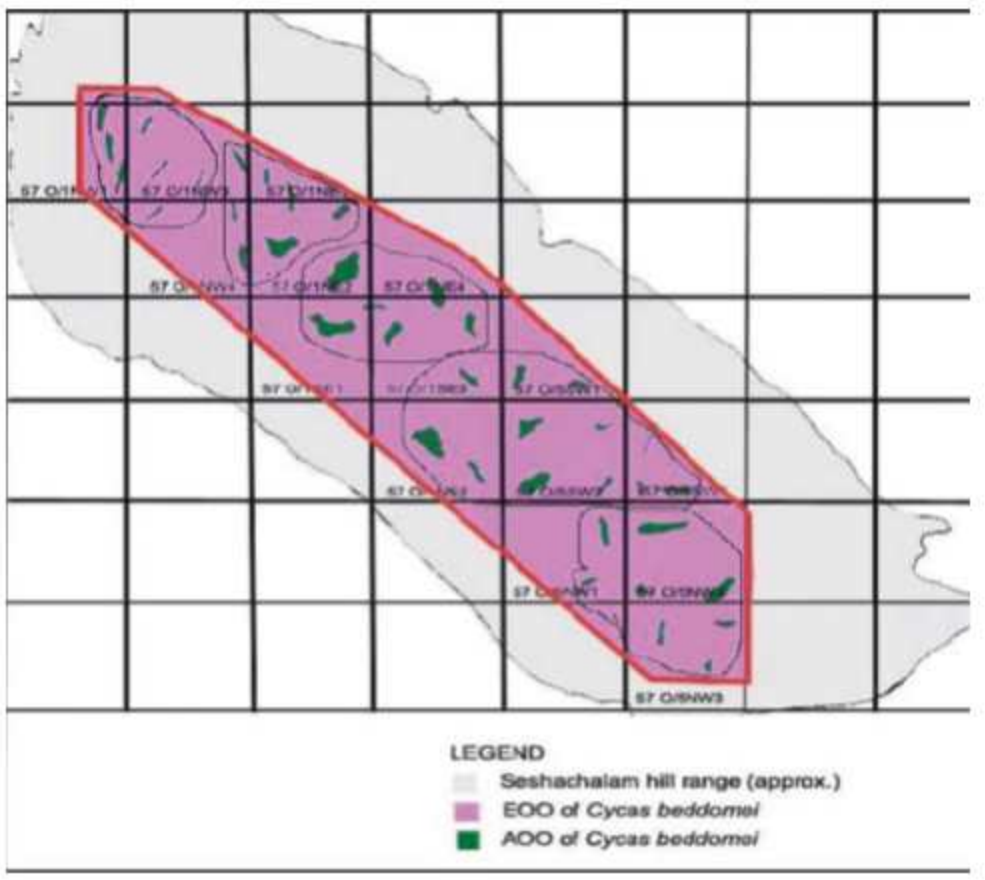

Figure 2.—: Map showing area of occurrence (EOO) and area of occupancy (AOO) of *Cycas beddomei*.

ti-Kadapa hills) located in the South Eastern Ghats of Andhra Pradesh (13°37'–15°58'N and 79°15'–79°30'E) at different altitudes (200–1150 m above mean sea level) (Figure 1) during 2006-09. *Cycas beddomei* is locally known as 'Peritha' or 'Madanakamakshi'. It appears almost like a small phoenix tree with a distinct trunk of up to 1.5 m. The plants are dioecious. Male plants tend to form clumps and the females tend to grow as single stems in the study area, as observed by Whitelock (2002). Leaves are pale green, up to 1 m long; leaflets narrow, linear, 12–18 cm × 2–3.5 mm, with revolute margins. Male cones are oblong-ovoid, 35 × 16 cm, with a short peduncle. Megasporophylls up to 4 × 2 cm. Ovules usually 2–4, occasionally 6–8, inserted above the middle of the stalk, up to 4 cm across (Figure 2).

The data for the current assessment were derived from a survey of the Tirupati-Kadapa hills. The area was stratified into grids of 6.25 × 6.25 km using remote sensing data (IRS-1C). Preliminary explorations in grids revealed the presence of *C. beddomei* in only15 grids (Figure 1). Transects of 1000 × 5 m (essentially quadrants of 5000m^2) were laid down in each grid; in case of heterogeneous terrain, a larger number of smaller quadrants (500–250 m length x 5m) were used that added up to the same sampling area. This amounts to approximately 0.019 % of the total area, which provides an adequate sampling intensity (Shivaraj *et al.* 2000). In all the 15 grids, *C. beddomei* plants (>2 cm height) were counted and considered for the analysis. Wherever the species was found in the grids, geographic coordinates were recorded and the shortest continuous boundary for the species population has been drawn on the grid map. EOO is measured by a minimum convex polygon containing all the sites of occurrence. The exact Area of Occupancy (AOO) of the species within the grids is studied taking into account the terrain features with respect to altitude and valleys.

Version 3.1 of the IUCN (2001) criteria was applied for reviewing the conservation status of the species. The CITES status was reviewed using CITES Res. Conf 9.24 (http://www.cites.org/eng/res/all/09/E09-24R14.pdf).

Table 1. Grid-wise population of *Cycas beddomei*

Grid number	Location	Average Altitude of the grid	No. of individuals (>2cm stem height)	AOO within the grid (in km^2)
57O/1NW1	N13° 57' 30" E79° 2' 45.4"	800	167	0.9
57O/1NW3	N13° 56'45.2" E79° 4' 6.3"	790	145	1.4
57O/1NW4	N13° 54' 6.9" E79° 6' 41.3"	860	168	0.9
57O/1NE1	N13° 57' 2.3" E79° 7' 39.4"	750	36	0.8
57O/1NE2	N13° 55' 2.5" E79° 10' 36.4"	650	114	1.9
57O/1NE4	N13° 33' 9.2" E79° 12' 25.4"	792	76	0.6
57O/1SE1	N13° 50' 32" E79° 10' 51.3"	980	165	1.2
57O/1SE3	N13° 49' 25" E79° 13' 26.7"	1010	210	1.9
57O/1SE4	N13° 47' 30" E79° 12' 15.2"	960	236	1.8
57O/5SW1	N13° 50' 2.8" E79° 15' 48.4"	920	182	0.6
57O/5SW2	N13° 46' 6.8" E79° 16' 2.01"	950	156	1.9
57O/5SW4	N13° 45' 19" E79° 20' 24.3"	850	86	0.6
57O/6NW1	N13° 43' 8.9" E79° 18' 32.4"	1150	137	0.6
57O/6NW3	N13° 43' 1.2" E79° 21' 12.4"	820	142	1.6
57O/6NW4	N13° 40' 46" E79° 19' 59.2"	1108	217	1.4
			2237	18.1

According to Article II of the Convention, Appendix I shall include all species threatened with extinction which are or may be affected by trade. Resolution conf 9.24 provides criteria for assessing whether a species is threatened with extinction and therefore qualifies for inclusion in Appendix I. These criteria are similar to the IUCN Red List criteria but tend to be less specific.

In terms of CITES, a species is considered to be threatened with extinction if it meets, or is likely to meet, **at least one** of the following criteria.

A. The wild population is small, and is characterized by **at least one** of the following:

i) an observed, inferred or projected decline in the number of individuals or the area and

quality of habitat; or ii) each subpopulation being very small; or iii) a majority of individuals being concentrated geographically during one or more life history phases; or iv) large short-term fluctuations in population size; or v) a high vulnerability to either intrinsic or extrinsic factors.

B. The wild population has a restricted area of distribution and is characterized by **at least one** of the following:

i) fragmentation or occurrence at very few locations; or ii) large fluctuations in the area of distribution or the number of subpopulations; or *Resolution Conf. 9.24 (Rev. CoP14) – 4*

iii) a high vulnerability to either intrinsic or extrinsic factors; or iv) an observed, inferred or projected decrease in any one of the following: the area of distribution; or the area of habitat; or the number of subpopulations; or the number of individuals; or the quality of habitat; or

the recruitment.

C. A marked decline in the population size in the wild, which has been **either**:

i) observed as ongoing or as having occurred in the past (but with a potential to resume); or

ii) inferred or projected on the basis of any one of the following: a decrease in area of habitat; or a decrease in quality of habitat; or levels or patterns of exploitation; or a high vulnerability to either intrinsic or extrinsic factors; or a decreasing recruitment.

Results and discussion

In total, 2237 individuals of *C. beddomei* were counted in the 15 transects; in all grids, female trees were more abundant (65–71%) than male trees (19–35%) (Table 1). It was observed that the species was absent below 500m altitude in the Seshachalam hills and mostly present only above 600m. The species was not found in valleys and seemed to be restricted to top slopes. Further, the species was found growing predominantly in black soils. Other substrates such as shale rocks, which support another Eastern Ghats endemic *Pterocarpus san-*

Figure 3.—: *Cycas beddomei* in habitat.

Figure 4.—: Female plants of *Cycas beddomei*.

talinus, had low incidence of *Cycas beddomei.* Taking these observations into consideration, a grid map has been prepared for measuring the EOO of the species. The EOO is calculated to about 388 km^2, which lies between 13°37'–13°58'N and 79°2'–79°22'E (Figure 3).

The species had a patchy distribution within the grids and substantial areas in the individual grids (over 90% in many cases) did not have plants (Figure 3). The AOO was calculated taking the patchy distribution and the absence of plants in valleys into consideration. The total AOO of *C. beddomei* is calculated to about 18.1 Km^2 (1800 ha). The overall population size of the species was estimated by extrapolating the average recorded individuals in all 15 transects (7.5 ha supporting 2237 individuals= 536879 individuals in 1800 ha). This refers to individuals of *C. beddomei* with a stem height > 2cm. Results pertaining to AOO and number of individuals recorded in transects are presented in Table1.

These data were used to assess the IUCN Red List status using the five IUCN criteria.

Criterion A – decline in populations. The available data do not give any indication of change in population size over time so this criterion cannot be applied to *C. beddomei*.

Criterion B – area of distribution. This Criterion uses two estimates of population distribution, i.e. the Extent of Occurrence (EOO) and the Area of Occupancy (AOO). EOO is essentially a measure of how risk is spread across a geographic area. It is defined as the area contained within the shortest continuous imaginary boundary, which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon (IUCN guidelines). One of the easiest measures for EOO is the area within a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence) (IUCN 2001). The EOO for *C. beddomei* is estimated to be 522 km^2.

The assessment of Criterion B also requires information on three sub criteria, i.e. the number of locations,

Figure 5.—: Male cone of *Cycas beddomei*.

Figure 6.—: Male plants of *Cycas beddomei* in habitat.

evidence of continuing decline, or evidence of fluctuating populations. The distribution of *C. beddomei* in the Tirupati-kadapa hills indicates that it is a single-site endemic. The overall distribution falls within an area of ca. 50km x 8 km and it is conceivable that a single event (e.g. disease) would affect the entire population. A conservative approach would therefore be to consider this as one location. However, the observations in the field indicated that at least 5 can be identified as these locations are separated by deep valleys.

Although there is no overall estimate of decline, the population is considered to be experiencing ongoing decline because of habitat modification and continuing threats. The main threats are man-made fires for vigorous growth of forest grass, which happen once in a year; harvesting of male cones for Ayurveda medicine; uprooting plants for ornamental purpose; and occasional collection of individuals for pith extraction for flour making. As a result, *C. beddomei* satisfies the sub criteria for continuing decline based on observed, inferred or projected parameters for i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and or quality of habitat; (iv) number of locations/ subpopulations; and (v) number of mature individuals.

In summary, the EOO of *Cycas beddomei* is estimated to be 522 km^2, the AOO as 18.1 km ^{2}, and it is considered to occur at one location (conservative) or at most 5 locations. It also satisfies the sub criteria for continuing decline. This falls within the range for the Endangered category.

Criterion C – small population size and decline. Based on extrapolation from sampled transects, the population of *C. beddomei* could be >500 000 individuals with a stem height >2cm. Although these are not all mature individuals, the number of mature plants would certainly exceed the requirements for Vulnerable status (i.e. <10 000). As a result, *C. beddomei* is not assessed as threatened in terms of this criterion.

Criterion D – very small or restricted populations. To qualify for Vulnerable status in terms of this criterion, the population size must be <1000 or the AOO should be <20km^2. The population size is considerably higher but the AOO is 18.1 km^2, in which case *C. beddomei* could qualify as VU under criterion D.

Criterion E. No demographic modeling has been undertaken so this criterion does not apply.

Based on the new data, *C. beddomei* is assessed as Endangered under criterion B and Vulnerable under Criterion D. The overall re-assessment is:

EN B1 a, b (i–v) + B2 a, b (i–v)

CITES listing

Using the same analyses as above, we applied the data to the CITES listing criteria.

CITES Criterion A – small wild population. CITES does not provide specific numbers to determine what a small

Figure 7.—: Ovules of *Cycas beddomei*.

population is. However, the more rigorous IUCN system suggests that a population size of >20000 should not be considered a small population. The estimated population size of >500 000 is not regarded as a critically small population size.

CITES Criterion B – restricted distribution: *C. beddomei* has a restricted distribution and is assessed to occur at 5 locations. This implies a high probability that the population would be vulnerable to factors such as disease, fire, land use, and harvesting impacts. The IUCN assessment also highlighted a decline in area of distribution, area of habitat, number of sub-populations, number of individuals and quality of habitat as a threat to *C. bedommei.* It therefore meets the biological criteria for Criterion B.

CITES Criterion C – marked decline in population decline. There is insufficient evidence to determine whether populations have experienced a marked decline.

On the basis of available data, *C. beddomei* appears to meet the biological criteria for inclusion in Appendix I under criterion B (Bi, iii, iv).

Acknowledgements

We thank the Department of Biotechnology for supporting the ongoing project on 'Quantitative assessment and mapping of plant resources of the Eastern Ghats' (BT/PR 6603/NDB/51/089/2005). We also acknowledge the support received from the Forest Department of Andhra Pradesh during our field visits from time to time.

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Dioon spinulosum: Sucker growing on cone stalk

William Tang *

In previous issues of Encephalartos I reported on the formation of cycad cones which developed into branches in *Encephalartos trispinosus* (1) and *Zamia furfuracea* (2, 3). These stem bulbs developed from abnormal cones which had a stalk, but no sporophylls or ovules and continued to grow attached to the plant like a branch or sucker. Here I report another instance of a sucker growing on a cone stalk in *Dioon spinulosum*. In this case a male cone developed normally, however, I did not allow the cone to mature and shed its pollen, but snapped it off before pollen shedding began. Normally the maturation process in cones ends with the death and decay of the cone when pollen shedding or seed production is complete. In this case I must have interrupted the chemical signaling process, because the remaining cone stalk remained alive and began to form a callus on its broken end. Gradually two small suckers formed on this callus and after more than 10 years one of these suckers produced a leaf (see Fig. 1). Normally *Dioon spinulosum* displays strong apical dominance, meaning that no branches or suckers will form on the plant. In this case, the specimen was re-rooted from a piece of stem that snapped off during hurricane Andrew in 1992 (see Tang 1995b for picture of the re-rooting trunk) and many suckers formed at the base of the re-rooted stem. It is possible that re-rooted trunk sections behave differently from a normal plant and allow the suckering process to occur on cone stalk remnants. Or perhaps this particular plant has weak apical dominance, allowing the formation of suckers on the stem in a species that does not normally display this kind of growth. This observation suggests a method for producing suckers on cycad species, which normally do not produce suckers.

Figure 1.—: Sucker with a leaf growing on an old cone stalk in a male specimen of *Dioon spinulosum*; note that more than ten years of growth has occurred on this trunk since this cone stalk first formed.

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* Miami Springs, Florida, U.S.A.

LETTERS TO THE EDITOR / BRIEWE AAN DIE REDAKTEUR

Die redakteur,

Ek het onlangs die *Cycas revoluta* (Figuur 1) met 'n baie mooi voorbeeld van 'kristaat' vorming gesien. Die plant staan in oom Roelof van Wyk se land, een van 200 *C. revoluta* plante en almal is 13 jaar oud. Dit is die eerste keer wat dit gebeur en is opgemerk op 20 /11/2010.

Die plant is 80 cm hoog met die kop deursnit 40cm. Die keël se mates is 50cm hoog, 38cm breed, en van links na regs 75cm. Daar is 9 aanhegtings aan die kopgedeelte. Sigbare keëls is: middel 3 enkel keëls en 2 dubbel keëls, regterkant 6 enkel keëls, linker kant 8 enkel keëls, voorkant 3 keëls en agter 'n verdere 3 keëls. Dit gee ons 'n totaal van 27 keëls aan al 9 aanhegtings. Al die keëls het 'n normale stuifmeel produksie getoon.

Groete
Dion du Toit

[Dion reports the first sighting of a fasciation (also known as cristate) of the cone in a large planting of *C. revoluta*. It seems to be 27 'cones' on only 9 peduncles and pollen production was normal for the species. For more information see ENCEPHALARTOS No. 90, page 21. Ed.]

Zimbabwe Cycad Trust

30th July 2010

Reg. Number: 1161/2007

• 11A Lyndhurst Road, Monavale • Harare
• P. O. Box M280,Mabelreign • Harare • Zimbabwe
• Telephone/Fax +263-4-331590 • e-mail technical@citchem.co.zw

Basic history

Following the horrific farm invasions in Zimbabwe stating in 2000 we decided to for the Zimbabwe Cycad Trust. Many of these farmers had beautiful gardens often with cycads and in most cases these had to be rapidly abandoned as the farmers fled for their lives. I some cases a few lucky individuals managed to get off their collections but then found that they were now living in town houses with no space for planting, or were having to relocated to a new country. This was also followed with a serious economic down turn in Zimbabwe and National Collections at the Harare Botanical Gardens and Ewanrigg Botanical Gardens (Arcturus), were found wanting for funds to keep these maintained.

The Political situation was highly charged and people feared donations to Government controlled institutions; hence the Zimbabwe Cycad Trust was born.

In 2007 this trust acquired the remaining collection of the late John Burbidge of Chipinge in Zimbabwe. 2008 saw us acquire the plants of Merle Michelle (Daughter of the late Raymond Munch, after whom *Encephalartous munchii* is named), as they being forced off their family farm had to relocate to the United Kingdom for medical reasons. Then is 2009 we finally managed to acquire the Homersfield Trust collection of Ian Turner, again as he was relocating to the United Kingdom. These combined collections together with that held within the Bluff Hill Industrial Park, Harare, as well as those of the present Trustees, probably represents one of the most comprehensive collections of Cycads on the planet.

We are presently looking for donations so that the Trust can acquire a sufficiently large enough site so that a permanent public display can be enjoyed by all visitors to Harare, Zimbabwe. If any of your members of Organisations would like to assist then this would be much appreciated.

The Objectives of the Trust are:

1. The Zimbabwe Cycad Trust was established by Notarial Deed as from 1st December 2007 and that deed was registered by the Registrar of Deeds under reference 1161/2007.

2. The objects of the Trust are –

a. to develop a comprehensive scientifically reliable international collection for Cycads in a way that promotes conservation, scientific investigation, and educational opportunities through use of the collection;

b. to acquire a suitable area of land in Harare upon which to establish the collection;

c. to permit the general public of Zimbabwe and tourist and visitors to Zimbabwe to have access to the collection upon payment of the admission fees fixed by the Trustees;

d. to propagate Cycad seed and seedlings from mature plants in the collection and to make them available for sale to the general public and for export to other countries;

e. to cultivate palms, orchids and succulent plants as the area referred to in paragraph (b) hereof as a secondary objective to that referred to in paragraph (a) hereof and to make such plants available for sale to the general public and for export to other countries;

f. to publish information on Cycads and to disseminate that information in Africa and worldwide;

g. to foster, encourage, stimulate and promote networking on Cycad studies within Africa and throughout the developing world;

h. to liaise and corporate with Governments, parastatals, local authorities, research institutes and individuals.

i. to establish a permanent repository for private Natural history collections and other subjects of interest.

3. The Trustees of the Zimbabwe Cycad Trust are Ian Ross Waters, Brian Schlachter and Michael John Kimberley, all of them are well know in Zimbabwe and elsewhere as experts in cycad cultivation and propagation.

4. The office of the Zimbabwe Cycad Trust is at Citchem (Private) Limited, 34 Kenmark Crescent, Bluff Hill, Harare [Telephone 310003 -6; Fax 310006; Email bushy@citchem.co.zw or technical@citchem.co.zw].

5. The Zimbabwe Cycad Trust urgently seeks the donation to it of an area of land in Harare upon which to establish the collection.

6. The Trustees are available to meet with potential donors of land including the Department of National Parks which is responsible for Ewanrigg National Park in Arcturus and the Ministry of Agriculture which is responsible for the National Botanic Garden in Harare.

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