ENCEPHALARTOS

JOURNAL OF THE CYCAD SOCIETY OF SOUTHERN AFRICA

TYDSKRIF VAN DIE BROODBOOMVERENIGING VAN SUIDELIKE AFRIKA

NO. 27

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EDITOR/REDAKTEUR

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VOORBLAD/COVER

New leaf growth of *E. paucidentatus* vigorously breaking through a thick layer of brown wool at the stem apex.

PHOTO – Dr Roy Osborne

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FROM THE PRESIDENT

This issue of ENCEPHALARTOS contains several important matters to which I would like to draw your attention.

Firstly there is the proposed alterations to the existing Constitution. Kindly compare the included copies of the existing and proposed new versions and vote on the acceptance of the new version. It is **important** for the proper functioning of the Society that you vote on the issue **so please do so.**

To keep our expenses down and thereby keep your membership fees as low as possible, we will once again not send out accounts to individual members for their 1992 membership dues. Please use the orange page in the front of this issue of the Journal to renew your membership to the Society for 1992.

Information is provided elsewhere in this issue of the journal about the new arrangements concerning the pollen bank. It will hopefully result in the active participation of more members and also provide a better service to members than had been possible in the past. The success of the venture does however largely depend on your participation.

To provide a better service, the Society's activities are partly administered on a Regional basis. For the Society to function properly, it is therefore essential that interactions between the Regions as well as between the Regions and those individuals who do not have the priviledge of a Regional branch be intimate and harmonious.

With warm greetings.

Nat. GROBBELAAR, President

VAN DIE PRESIDENT

Hierdie uitgawe van ENCEPHALARTOS bevat verskeie belangrike sake waarop ek u aandag wil vestig.

Eerstens word 'n eksemplaar van die bestaande Grondwet sowel as 'n voorgestelde gewysigde Grondwet vir die Vereniging by die tydskrif ingesluit. Vir die behoorlike funksionering van die Vereniging is dit **belangrik** dat u oor die aanvaarding van die gewysigde Grondwet stem. **Doen dit dus asseblief.**

Om ons uitgawes so laag moontlik te hou en sodoende u ledegeld so laag moontlik te hou, sal daar weer nie rekenings vir die 1992 lidmaatskap van die Vereniging aan individuele lede uitgestuur word nie. U word vriendelik versoek om die oranje bladsy voor in die tydskrif te gebruik om u inskrywing vir 1992 te hernu.

Met die nuwe reëling in verband met stuifmeelvoorsiening aan lede, (kyk elders in die uitgawe vir meer besonderhede) hoop ek dat meer mense direk by die saak betrokke sal raak en dat die Vereniging 'n beter diens aan sy lede sal kan verskaf as in die verlede. Die sukses van die onderneming is egter grootliks in u hande.

Vir die beter bediening van ons lede, word die aktiwiteite van die Vereniging deels op 'n Streeksgrondslag bestuur. Die harmonieuse en intieme samewerking tussen Streke en tussen Streke en lede wat nie bevoorreg is om oor 'n Streektak te beskik nie, is egter noodsaaklik as die Vereniging sy funksies behoorlik moet verrig.

Met vriendelike groete,

Nat. GROBBELAAR, President

FOCUS ON... FOKUS OP...

In each edition of ENCEPHALARTOS, we focus on one Southern African species, in the form of an indepth article in layman's language. In this edition the spotlight falls on:	In elke uitgawe van ENCEPHALARTOS fokus ons op een Suider-Afrikaanse broodboomspesies, in die vorm van 'n in-diepte-artikel in leketaal. In hierdie uitgawe val die kollig op:

ENCEPHALARTOS PAUCIDENTATUS

by Roy Osborne

1. INTRODUCTION

The graceful spreading crowns, the glossy dark green foliage, the vigorous growth and the robust trunk of *Encephalartos paucidentatus* make this one of the most striking of all cycads. For a plant with these qualities, remarkably little has been written in our magazine. It is appropriate therefore in this issue to turn the spotlight onto this species.

2. DISCOVERY

There is some confusion as to who first "discovered" *E. paucidentatus*. Records of the Transvaal Colonial Herbarium (later the National Herbarium in Pretoria) indicate three sheets (all numbered H.5185) bearing leaves ascribed to the species in question. The type was allegedly collected in 1908 by Charles Legat, then Conservator of Forests, from a farm Breslau near Pontdrif on the Limpopo River in the Soutpansberg District. The two other sheets, supposedly from the same locality, are attributed to Dr I.B. Pole Evans of the Transvaal Department of Agriculture. Because of extreme unlikelyhood of *E. paucidentatus* occurring in the Soutpansberg area, Dr R.A. Dyer investigated the authenticity of these herbarium specimens and concluded in 1965 that some error had been made.

Dyer pointed out in an article in the 1965 *South African Journal of Science*, that George Thorncroft of Barberton was in regular correspondence with Burtt Davy and Pole Evans during 1908 and that Thorncroft also supplied Archdeacon F.A. Rogers of the Railway Mission with specimens of both *E. laevifolius* and *E. paucidentatus*, at least one of the latter being sent on to the herbarium at Kew. Rev. Rogers himself visited Barberton in 1905 and possibly saw plants in the field at that time. In retrospect then, we must rather credit Thorncroft and Rogers with the plant's "discovery". The botanical description of the species was reported in 1926 by Joseph Burtt Davy of the Transvaal Department of Agriculture when he, working in conjunction with Dr O. Stapf at Kew, published "A Manual of the Flowering Plants and Ferns of the Transvaal, with Swaziland". This publication has been referred to previously in connection with the three other species then described, viz. *E. lanatus* (see ENCEPHALARTOS 16), *E. laevifolius* (see ENCEPHALARTOS 19) and *E. transvenosus* (see ENCEPHALARTOS 20). Burtt Davy coined the name from the latin epithets *paucus* = few and *dentatus* = toothed, in reference to the comparative lack of teeth on the leaflets from the plants studied. It was in this manner that the "Barberton cycad", *Encephalartos paucidentatus* Stapf & Burtt Davy, became known to the western world.

3. DISTRIBUTION

E. paucidentatus occurs sparsely on steep, often rocky, slopes in low forest and mountain bush, in a restricted area in the mountains near Barberton in the Eastern Transvaal and the immediately adjacent mountains in the Piggs Peak district of north-western Swaziland. Plants occur at altitudes up to 1800m where the rainfall range is 1250-1500 mm annually. Sporadic reports of specimens further to the north, e.g. in the Pilgrim's Rest area, and to the east at Komatipoort and in the Lebombo Mountains, are viewed with circumspection.

Cultivated specimens of *E. paucidentatus* are recorded as being present in public collections at Naples Botanical Gardens in Europe; at Foster Gardens in Honolulu, at Huntington, Lotusland and Fairchild Tropical Gardens in the USA, at Ewanrigg Gardens in Harare, at the Botanic Research Institute and the University of Pretoria gardens in Pretoria, at Kirstenbosch and at the Durban Botanical Gardens. Perhaps the first plants in cultivation were those planted

Exploring the mountainous areas of north-western Swaziland - habitat of *E. paucidentatus, E. heenanii* **and** *E. laevifolius*.

The steep rocky sites on which *E. paucidentatus* **is found.**

in the grounds of the Barberton Town Hall near the turn of the century; fine specimens are still to be found there today. The number of plants in private gardens around the world is unknown, but certainly many hundreds adorn South African gardens, particularly in warmer parts of the Transvaal and Natal.

Specimens of *E. paucidentatus* in the Town Hall Gardens at Barberton in the Eastern Transvaal.

4. DESCRIPTION

4.1 STEMS

Specimens of *E. paucidentatus* generally have a robust unbranched stem reaching up to 6 m in height and about 55 cm in diameter. Occasional branching occurs at the base with older stems becoming procumbent. The stem apex supports a set of hard bracts which are usually buried amongst a thick mass of brown wool.

4.2 LEAVES AND LEAFLETS

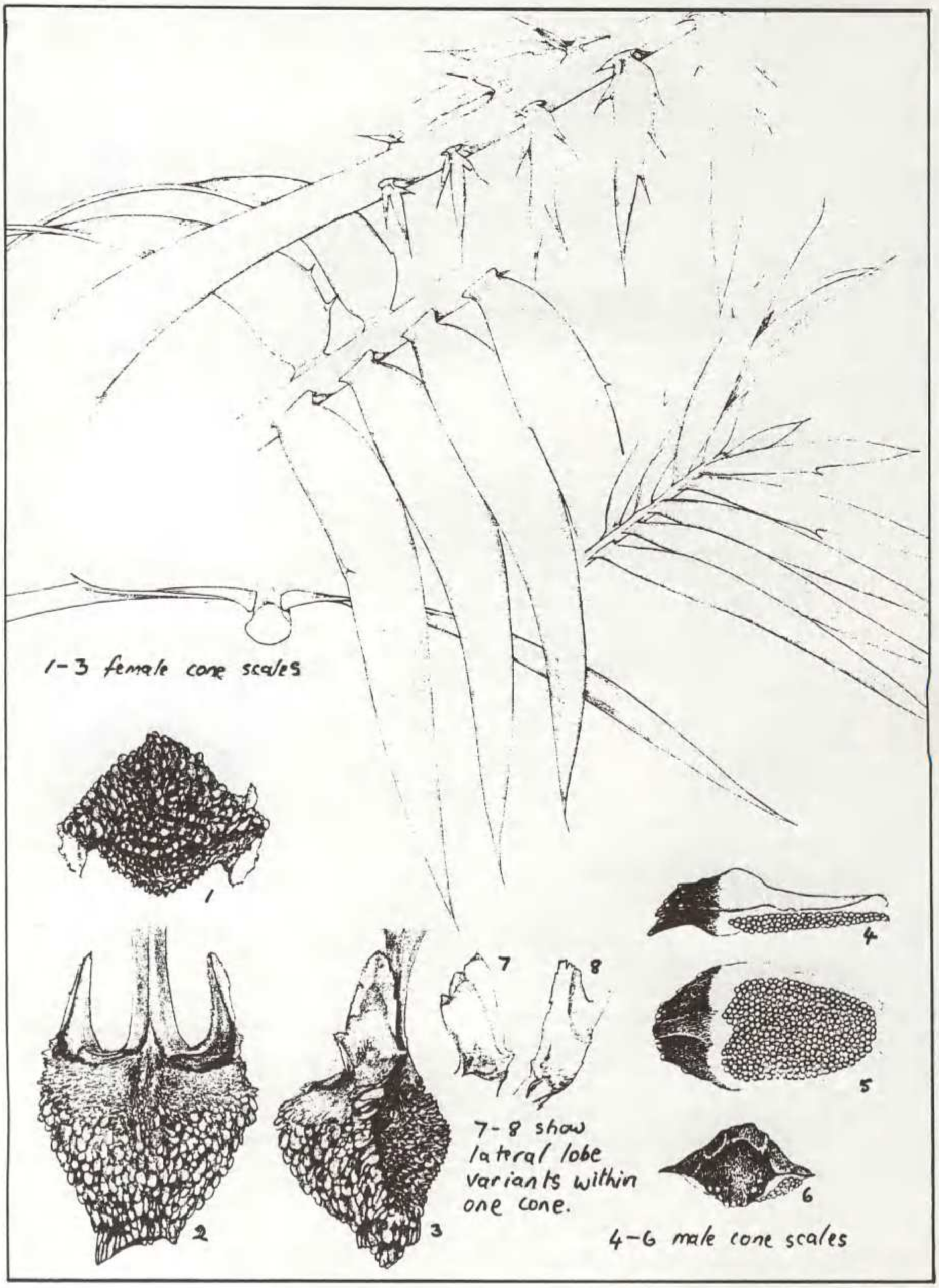
Mature leaves of this species are variable in length between 1 and 2.5 m. The somewhat yellowish leaf rachis is fairly straight but may be slightly curved upwards at the apex. The leaflets bend gracefully down under their own weight from the leaf stalk so as to give a gentle "inverted V" appearance - one of the main vegetative characteristics of the species and one which adds much to its overall form. The inverted V leaflet arrangement is uncommon in the genus, the only other species showing this being *E. heenanii, E. inopinus, E. ghellinckii* and, to some extent, *E. cycadifolius*.

Individual leaflets typically measure 15-25 cm in length by 2 - 3.5 cm in width. They do not overlap - a useful character in distinguishing this species from *E. transvenosus*. A similar diagnostic feature of *E. paucidentatus* is the presence of about 30 conspicuous raised veins on the lower surface of the leaflets. Leaflets are hairly at emergence, but soon shed their hairs to adopt a dark glossy green appearance at maturity. As the species' name implies, there are relatively few teeth on the leaflet margins - sometimes 1 to 3 teeth can be found on either the upper or the lower margin and situated closer to the leaflet base than its apex. Like many species in the genus, the leaflets of *E. paucidentatus* reduce in size towards the leaf bases, ending in a series of small prickles above a petiole about 20 - 45 cm in length.

4.3 CONES

Male plants of *E. paucidentatus* bear up to 5 slender yellowish cones with a covering of short reddish-brown hairs. Supported on a 10 cm peduncle, the cones are 40-60 cm long by 12-15 cm in diameter. The cone scales extend into a downwards-pointing beak 15-20 mm in length with a somewhat serrated margin. Pollen is shed in early winter, typically about July each year.

Close-up detail of the male cone scales showing the extended beak, slightly hairy appearance and somewhat decorated terminus.



Details of leaflets and cone-scales of *Encephalartos paucidentatus*.
Reproduced in reduced form from Douglas Goode's *Cycads of Africa*
by kind permission of the author and publisher.

The female plants bear 1-5 golden-yellow cones about 35-50 cm long by 20-25 cm in diameter and supported on a short stout peduncle. Cones scales are heavily wrinkled, about 5 cm broad (horizontally) by 3.5 cm thick (vertically), and extend into a protruding beak with a prominent concave terminal facet.

Seeds, which are shed 6-7 months after pollination (i.e. about February each year), have an outer fleshy layer of the usual reddish colour common in the genus. They measure about 4 x 2.5 cm with the faintly-ribbed seed kernel having dimensions of 3.5 x 2.0 cm.

5. AFFINITIES AND HYBRIDS

E. paucidentatus and *E. heenanii* grow within 1 km of each other in the Piggs Peak area and both are also fairly close to stands of *E. laevifolius*. It is perhaps for this reason that speculation has been made that *E. heenanii* might be a hybrid between *E. paucidentatus* and *E. laevifolius*. This speculation is discounted by Piet Vorster, largely on the basis that *E. heenanii* breeds "true". In his article (ENCEPHALARTOS 10) on *hybridization in Encephalartos*, Vorster has no records of any natural or artifical hybrids of *E. paucidentatus* with any other species.

In terms of vegetative and reproductive morphology, *E. paucidentatus* shares a number of features with *E. transvenosus* and *E. heenanii*, but these are not such as to confuse their identities. The work by Osborne, Grobbelaar and Vincent, involving a multivariate statistical analysis of 86 different characters in the genus, shows *E. paucidentatus* to be close not only to *E. transvenosus* and *E. heenanii*, but also to *E. natalensis* and the recently-named *E. aemulans* from northern Natal (Vorster 1990).

6. CONSERVATION AND CULTIVATION

The populations of *E. paucidentatus* in habitat have suffered both from the activities of collectors and from the local afforestation programmes. Douglas Goode records that some stands now remain in islands of indigenous vegetation within a sea of pine trees! The threat to the species was such that the Ida Doyer Nature Reserve, just to the south east of Barberton, was established in 1960 specifically to protect a colony of about 100-150 *E. paucidentatus* plants. This reserve has since been incorporated into the Songimvelo National Park which affords protection to several others stands. In terms of the Threatened Plant Unit's listing, *E. paucidentatus* is described as "rare" in South Africa and "vulnerable" in Swaziland. Estimates of the total number of plants presently occurring in habitat vary widely and further work is necessary to establish whether the habitat stocks number in the hundreds or a thousand or so.

A female cone of *E. paucidentatus* about one month before being "ripe" for pollination.

Male cones of *E. paucidentatus* at the pollen-shedding stage.

As part of their ex-situ conservation programme, the Lowveld Botanic Gardens at Nelspruit has grown about 100 plants from seed and curator Johan Kluge plans to set these juveniles into what will later be a seed orchard and invaluable genetic resource for the species.

Mature plants of this species are described by Cynthia Giddy as difficult to re-establish in cultivation, a fact which she ascribes to their very specific habitat requirements. Shade and ample moisture are necessary and sunburn and frost damage should be avoided. My own experience is that seeds of this species germinate easily but that 1-2 year old seedlings are particularly prone to rotting-off problems, even in a very well drained medium. Under the correct conditions, *E. paucidentatus* is one of the fastest-growing cycads and is said to increase 30-50 mm annually in stem height - once stems have attained their maximum diameter.

Difficult as though its establishment in cultivation might be, the large plants in many South African public and private gardens are testimony to a comment from Dr Dyer that "this is one of the most handsome species for cultivation". Those fortunate enough to have such specimens must make every effort to participate in the Society's pollen and seed bank programmes so as to allow our next generation to enjoy this cycad as has been our privilege.

A mature specimen of *E. paucidentatus* in the gardens of the Botanic Research Institute, Pretoria.

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A juvenile plant in the Transvaal Provincial Nursery at Hartebeeshoek.

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VORSTER, P. 1990. *Encephalartos aemulans* (Zamiaceae), a new species from northern Natal. *South African Journal of Botany* **56:** 239-243.

8. ACKNOWLEDGEMENTS

I record my appreciation to Nat Grobbelaar for a critical reading of the first draft of this text. All photographs were taken by the author.

NEW SCIENTIFIC REPORTS

New cycad-related reports which have appeared in the scientific literature are:

Lindblad, P.[1] **& Sellsted, P.** 1990. Occurrence and localisation of an uptake hydrogenase in the filamentous heterocystous cyanobacterium *Nostoc* PCC 73102. *Protoplasma* **159:** 9-15.[[1]· Dept. Physiological Botany, University of Uppsala, P O Box 540, Uppsala, S-751 21 Uppsala, Sweden.]

Lindblad, P.[1], **Tadera, K. & Yagi, F.** 1990. Occurrence of azoxyglycosides in *Macrozamia riedlei* and their effects on the free-living isolated *Nostoc* PCC 73102. *Environmental and Experimental Botany* **30:** 429-434. [[1]· Address as above.]

Lindblad, P.[1]· **Atkins, C.A. & Pate, J.S.** 1990. Nitrogen fixation by freshly isolated *Nostoc* from coralloid roots of the cycad *Macrozamia riedlei* (Fisch. ex Gaud.) Gardn. *Plant Physiology* **95:** 753-759. [[1]· Address as above.]

WANTED : CYCAD PHOTOGRAPHERS

Angelo Danesin, via Fabio Filzi 14, 30171 Venezia-Mestre, Italia is a member of the Cycad Society and would like to correspond with members who are keen cycad photographers. He writes "it does not matter if these plants are in a greenhouse, in gardens or in their natural habitat".

CYCAD POLLEN MORPHOLOGY

A paper on cycad pollen, entitled "Pollen Morphology of the Cycadales, with special reference to the *Encephalartos* species" has been published in *Pollen et Spores* [Vol. 31, No. 3-4, pp. 229-249 of 1989]. It is written by **J. Marshall, N. Grobbelaar** and **J. Coetzee** of the University of Pretoria and by **R. Osborne** from the University of Natal. A total of 121 pollen samples was studied by light and scanning electron microscopy, 98 samples from African cycads. The pollen morphology suggests a strong affinity between *Encephalartos, Lepidozamia, Macrozamia* and *Bowenia*. Similarities exists between *Ceratozamia* and *Zamia* and to a lesser extent *Microcycas*. *Dioon* and *Stangeria* have features in common but *Cycas* pollen differs from all other genera. Although there are differences in surface appearance and size within the individual genera, these are not sufficiently significant to have taxonomic value at that level.

This work was done at more-or-less the same time that **Bijan and Nancy Dehgan** carried out a similar project *[American Journal of Botany* 75: 1501-1516 of 1988]. The two papers reach broadly similar conclusions although some points of difference are apparent. Together, they represent the most detailed investigation into cycad pollen morphology undertaken to date.

A limited number of copies of the *Pollen et Spores* publication is available for distribution from Nat Grobbelaar (P.O. Box 15357, Lynne East 0039).

IN MEMORIAM : CRAIG BOWLES

We note with regret the death of Craig Bowles. Craig (38), one of Natal's leading entrepeneurs, was tragically gunned down in a payroll heist in Bophuthatswana on 27 May this year. Well-known on the South African cycad scene, he had recently assembled what might arguably be one of world's finest collections of *Encephalartos* species in his magnificently landscaped Durban North garden. He was noted both for his direct no-nonsense approach and for his generosity - only last year he donated R 3000 to supplement the expenses of the Southern African delegates to the CYCAD 90 Conference in Australia.

The President, Committee and members record their sincere condolences to Craig's wife, Uraine, and children Justin (13), Shona (9) and Craig Jnr (5).

REPORT ON THE CITES PLANTS COMMITTEE MEETING
ZOMBA , MALAWI
APRIL 15-17th ,1991.

I was invited to attend this meeting as a member of the Cycad Specialist Group of the IUCN Species Survival Commission. The meeting was held in the Houses of Parliament in the old capital of Zomba. Delegates were housed in the Government Hostel which is situated in the Botanic Gardens, accommodation in keeping with a plants meeting.

After arrival at Lilongwe delegates were bussed 320km to Zomba giving them an opportunity of seeing the country with its varied landscapes ranging from Brachystegia woodland, to glimpses of Lake Malawi and the Rift Valley. Before the climb to the forested Zomba plateau begins, Mount Mulanje (3002m) can be seen in the distance.

The CITES meeting was attended by 21 delegates from 17 countries They included the 6 regional representatives of the CITES Plants Committee worldwide, Government representatives of the Plant Regulatory Services from the US Netherlands and Thailand, the directors of the CITES Scientific Authority in Germany and England, the directors of Forestry, National Parks and Rural Development in Senegal, Nigeria, Cameroons, Kenya, Zambia, Malawi and Madagascar as well as other specialist groups.

This was the first CITES Plants Committee meeting to be held on the African continent and the Malawaian Minister of Forestry and Natural Resources in his opening address stated that Malawi in common with many other countries, was concerned at the increase in the international trade in endangered plants. The high demand for these plants puts pressure on the wild populations and threatens the survival of many species. Malawi, although a small country, has 68 Forestry Reserves and 9 National Parks.

The main purpose of the meeting was a Plant seminar and workshop to improve the delegates understanding and implementation of CITES. This was conducted by Ger van Vliet, the Plants Officer from the CITES secretariat in Switzerland. He explained the structure and functioning of CITES, namely that it was a convention concerned with trade issued directly related to conservation issues. He stressed that the plant issues needed to be upgraded to the level of animal protection and that the money involved in the plant trade was comparable to that of the animal trade.

The trade requirements for plants on Appendix 1, Appendix II and Appendix III were discussed. No commercial trade in wild collected plants of Appendix 1 is allowed. This includes all species of the genus Encephalartos and Stangeria as well as Ceratozamia and Microcycas from the new World.Trade is only permitted in artificially propagated plants on Appendix 1. The term "cultivated" has no relevance in terms of CITES. This in effect means that wild collected plants, regardless of how long they have been in cultivation eg plants in private collections are never considered to be artificially propagated. No international trade in them is permitted.

Likewise no commercial trade in wild collected seeds of Appendix 1 plants is permissible. To exempt Encephalartos seeds is a complicated procedure which would require a proposal by the country of origin to the Conference of the Parties and be voted on by all the Parties before it can be ratified.

The Plants Committee however supported my suggestion that wild collected Encephalartos seed should be used for artificial propagation in the country of origin as a conservation measure for reducing the pressure on the wild.

The second major item on the agenda centred on nursery registration. At the CITES conference in Buenos Aires in 1985 registration of nurseries that artificially propogate Appendix 1 plants had been discussed but never complied with. It is now proposed to implement this and criteria for registration were discussed. Only those nurseries that comply with the CITES criteria would in future be allowed to trade internationally. These nurseries would be licensed and monitored by the CITES Scientific Authority in the country of origin.

Reports on the trade in the following Endangered plant taxa were tabled.

African and Madagascan succulents (Ger van Vliet - CITES)

African orchids (Christine Kabuye - Kenya)

Cycads (Cynthia Giddy - RSA)

Tree Ferns (John Braggins - New Zealand)

Bulbs (Onno Wijnands - Netherlands)

Carnivorous and other plant groups (Ger van Vliet - CITES)

Medicinal Plant Trade (Nina Marshall - USA and Christine Kabuye - Kenya)

The meeting dediced that the following proposals would be put to the Conference of the Parties to be held in Japan next year:

- *Registration of nurseries that propagate Appendix 1 plants.*

- *Government support for the artificial propagation of endangered plants.*

- *Strict trade control of endangered African plants to secure the economic potential of each country's natural resources.*

- *A detailed analysis of plant trade to be carried out this year to improve protection of important plants.*

- *A study to be made of medicinal plants to ensure their long term conservation and use.*

Cynthia Giddy
UCN Species Survivial Commission
Cycad Specialist Group

A row of E. gratus planted in front of the Government Hostel in the Zomba Botanic Garden.

A group of delegates to the CITES Plants Committee meeting.

UWE Schippman (Germany) Onno Wijnands (Netherlands) Noel McGough (UK) Dora Mora de Retana (Costa Rica) Ger van Vliet (Switzerland) John Burton (UK) Chanuan Ratanawarsha (Thailand) Beatrice Khayota (Kenya) Nouhou Ndam (Cameroon) Nirina Venance (Madagascar).

NEWS FROM SAAB

The June newsletter from SAAB, the **South African Association of Botanists**, provides some news of interest to our members.

Firstly, we are pleased to pass on the news that our President, **Nat Grobbelaar**, has been awarded the prestigious SAAB Medal for Botany, last awarded in 1985. The medal, which recognises "exceptionally meritorious contribution to botanical research", will be presented at the SAAB Congress Dinner in Durban in January 1992. We salute Nat on yet another distinguished achievement.

Another award of note is that of the SAAB Certificate of Merit, which this year goes to **Dave Hardy** of the National Botanical Institute in Pretoria. This award is for "outstanding contributions in the scientific, technical, artistic, educational or any other botanical field by a person not in possession of a university degree in botany".

A final announcement is that **Gren Lucas** of the Royal Botanic Gardens at Kew, will shortly be visiting South *Africa. Gren* is well-known internationally for his work in the protection of endangered plant species through his association with the IUCN's Species Survival Commission.

NATALENSIS AS A POTPLANT

Dave Balson writes from his home in New Germany, Natal, to tell us that growing cycads from seed is fun, is easy and excellent results are obtained much faster than most people think. The photograph on the left is of a 12-year old (from seed germination) specimen of *Encephalartos natalensis* "which has not had any special attention".

Exotica 91

Durban Exhibition Centre
25-28 April 1991

NATAL SECTION NEWS:

STAND AT EXOTICA 91

The **Exotica 91** Exhibition, held in Durban over the period 25-828 April 1991, was undoubtedly the premier event in Natal's horticultural calender of 1991. The Natal Section Committee of the Society took the opportunity to present an eye-catching cycad display-and-information stand which generated a great deal of interest from the many thousands of visitors to the Exhibition. Natal Section Chairman Harry Gerber was delighted with the response. "Apart from the information on cycads given to the public, we have raised over R 500 for section funds from the sale of raffle tickets and seedlings; in addition, a number of new members have joined the Society", he said. An illustrated lecture on cycads by Johan Bodenstein was well supported.

The raffle plants were kindly donated by Escom's Pinetown District Nursery. The success of the exhibit was due largely to the considerable setting-up assistance from Ken Wyman, Ann Lambert and Chris Dalzell of the Durban Botanic Gardens. The Natal Section gratefully acknowledges the very kind co-operation of all involved in making this venture the success it was.

Above: A view of part of the Natal Section's cycad display at the Exotica 91 horticultural exhibition in Durban.

CYCAD 93 - DATES DECIDED

CYCAD 93, The Third International Conference on Cycad Biology, will be held at Pretoria over the period 5-9 July 1993. An ambitious programme, with appeal to both the layman and the specialist, is planned. The meeting will be preceded by a 3-day trip visiting cycad localities in the Transvaal and a 5-day trip through Natal and the Eastern Cape will follow immediately after the Conference.

A detailed notice with a response form will be circulated in the next issue of ENCEPHALARTOS.

POLLEN EXCHANGE REPORT 1990

By: Cynthia Giddy

The Pollen Exchange has now been in existence for 6 years and to date 53 of our 700 members have sent in details of the male plants in their possession. Regrettably we are still unable to accede to many of the requests as our data bank only notes that a member owns a male plant, not whether it is coning when the request is received. Cycads cone cyclically and not all species cone regularly every year.

In evaluating these replies it is interesting to note that the 53 members who replied, collectively own 594 mature male plants. The average per member is 10-11 plants.

The most common species in collections are **E. natalensis (63), E. villosus (62), E. altensteinii (50), E. trispinosus (48), E. lebomboensis (44), E. ferox (42) E. horridus (38) and Stangeria (40).** Though no cycad can really be considered "common" we nevertheless urgently required pollen sources for the rarer species such as **E. cupidus (1) E. heenanii (2), E. woodii (2), E. cycadifolius (4) E. ghellinckii (5), E. inopinus (6).**

For the benefit of new members, the Pollen Exchange does not store pollen for distribution but merely assists members by putting them in touch with likely sources in their own areas.

It is therefore imperative that members contact us in good time, in fact, as soon as the female cone emerges. With a couple of weeks in hand it is possible to airmail an immature male cone just before it starts shedding pollen. The pollen sacs on the undersides of the cone scales will mature progressively over a period of several days and fresh pollen can be obtained in this way. Do not use a plastic bag as this will cause the cone to sweat in transit. Place the entire conee in a paper bag or newspaper and tape the ends.

Many of our members only request pollen once the red or yellow seeds are visible prior to shedding. By this time it is much too late. it is vital to keep a close watch on the female cone to determine the optimum time for pollination The top sterile scales will open slightly but in some species notably **E. ferox,** this is very difficult to observe. Likewise adverse weather conditions, particularly hot, dry weather will also affect the size of the opening. To further assist those wishing to pollinate their plants, your attention is drawn to the excellent articles by Willie Tang in Encephalartos Nos. 7 and 8.

During 1990 pollen requests were received from 38 members. We were able to assist some but in many cases there was no one with pollen available in the same area as the person enquiring. 9 lots of pollen was sent by mail and 8 people collected either fresh or frozen pollen from my stocks.

I would like to conclude by thanking all the members who have participated by sending in their pollen records and especially record our thanks to the Department of Botany of the University of Pretoria, the Durban Botanic Gardens, Kirstenbosch Botanic Garden and the Lowveld Botanic Garden for their assistance and generosity to our members.

POLLEN BANK

After Cynthia Giddy resigned as national pollen bank officer for the Society, your Executive Committee decided that this function of the Society will probably be better served by the various Regional Branches of the Society. The three existing Regional Branches have each appointed a Pollen Bank Officer on whom you can call for assistance in obtaining cycad pollen. Apart from directing members to suitable possible sources of pollen, the Officers will also attempt to keep stocks of pollen for direct dissemination to members on request.

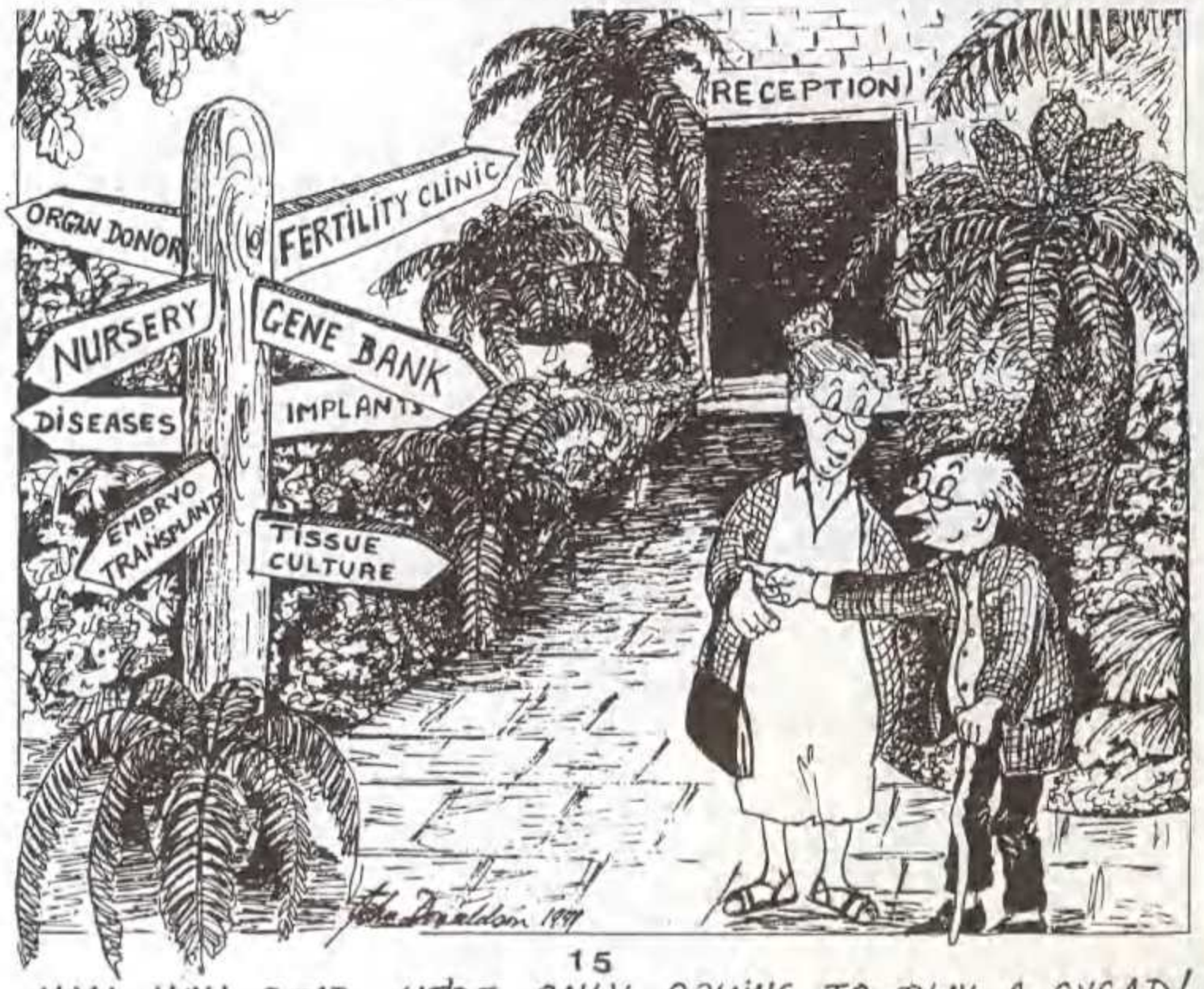
The success of the service will obviously depend largely on the co-operation that the Officers receive from members. Information about mature male plants in your collection and/or gifts of fresh pollen will be highly appreciated by the Officers. For more information about the service, please directly contact the relevant Officers whose addresses and home telephone numbers are provided below. You can rest assured that the Officers will not divulge the origin of a pollen gift should the donor, for security or other reasons, request this.

EASTERN CAPE BRANCH:
Mr H.C.Barnard
P.O.Box 1487
Port Elizabeth, 6000
Tel. (041) 722031

EUGENE MARAIS BRANCH (2 Officers):
Dr P.W.W.Coetzer
P.O.Box 14028
Sinoville, 0129
Tel. (012) 548 0017

Mr J.J.Naude
P.O.Box 13649
Sinoville, 0129
Tel. (012) 57 2657

NATAL BRANCH:
Dr O.J.Minnie
P.O.Box 137
Mtubatuba, 3935
Tel. (035) 550 0646



NOW NOW DEAR, WE'RE ONLY COMING TO BUY A CYCAD!

TO THE RESCUE

Just south of Natal in Transkei there used to be a colony of arborescent cycads quite unlike Encephalartos altensteinii, E. natalensis and E. friderici-guilielmi. When scientists became interested in this colony a few years ago, only three individuals were still present in nature. Subsequently, one of the three plants also disappeared from habitat. As reported elsewhere in this issue of our Journal, the remaining two plants were moved to the Umtamvuna Nature Reserve in Natal recently.

Unfortunately, both the plants that have been saved are males. If any of our members happen to have a female plant that originated from this colony in the north of Transkei, I will be most delighted if he/she will contact me because your Executive Committee would very much like to introduce one or more females from the original colony to the Umtamvuna site without exposing the donor of the plant(s) to prosecution. In this way we hope to ensure the propagation of the species by seed. We are not sure about the identity of the plants because female cones are taxonomically most important in deciding on the identity of a species. Even if the colony does not represent a new species, it would nevertheless be very important to maintain it as a separate ecotype.

On the Oribi Flats, Natal, two individuals of yet another cycad exist at present in nature where once many more used to thrive. In this case we are dealing with plants with subterranean stems and relatively short leaves, quite unlike E. villosus. Your Society would like to arrange to have the two remaining plants moved to the Oribi National Park for protection. Because it is unlikely that the two surviving plants are of opposite sex, I would also be delighted if members who own similar plants that originated from that area would contact me in order that we may work out a way to establish a viable colony of the species in the Oribi Reserve without exposing the donor of such plants to prosecution.

As a Society of Cycad lovers, our first consideration should be the survival of each ecotype of every cycad species. It is impossible for the Nature Conservation authorities to police all cycad habitats effectively. In the case of small cycad populations it is therefore essential to move them to nearby existing nature reserves where they can effectively be protected for the benefit of all. As such colonies grow, seed and seedlings of the plants should in time be made available to those organizations and individuals who are genuinely interested in such plants. Here we have an opportunity to demonstrate to the authorities and the world at large that we, as members of the Cycad Society, genuinely have the long term conservation of our cycads at heart.

Nat. GROBBELAAR,
President, Cycad Society of S.A.

EMBLEM FOR THE SOCIETY

It would be very useful to have a simple but distinctive emblem for the Society which could be used on letterheads, congress satchels, T-shirts, etc.. How about trying your hand at designing a suitable stylized emblem in black and white and sending it to the address below before November 15, 1991. The designer of the emblem that is chosen by the Executive Committee, will receive a R250 cash prize before the end of the year.

N.Grobbelaar
P.O.Box 15357
Lynn East, 0039.

THE RELOCATION OF TWO RARE CYCAD PLANTS

By CYNTHIA GIDDY

In 1986 Tony Abbott an amateur botanist from Port Edward and Prof. Braam van Wyk of Pretoria, in the course of a botanising expedition in Pondoland discovered two clumps of an unknown cycad species. It closely resembled a species which occurs in the Eastern Transvaal. Intensive field work over a wide area failed to locate more specimens. During the next few years a few more plants were located in cultivation among collectors. Regrettably all the plants that have coned to date have been males, a scenario reminiscent of the E. woodii saga.

In view of its rarity and collector appeal it was decided to relocate the remaining two clumps to a more secure locality. Five years of high level consultation followed. Botanists, conservationists and cycad experts were consulted and asked for their opinion as to the wisdom and feasibility of such a drastic step. In view of the unending struggle to contain the poaching of plants from the wild, it was finally decided that despite the risks involved, relocation was the only solution.

In March this year, a reconnaissance party set off to view the plants and assess the feasibility of relocating them. Tony Abbott and Braam van Wyk, were joined by Don Bands and Jim Feeley of the Transkei Department of Nature Conservation Rob Wolter from the Natal Parks Board and two amateur botanists. After several hours travel cross country in 4 x 4 vehicles, the recce party shouldered cameras, water bottles and rucksacks for the final hike to the site.

Situated in an almost inaccessible ravine on a precipitous almost perpendicular slope, we found the first of the two plants, a magnificent multistemmed plant with 5 male cones.

Tony Abbott then confessed that he had spent the previous 5 hours in a dead sweat in case he had led us all to the site to be confronted with a large gaping hole!

The second plant was about 10km distant in an equally inaccessible location. Having virtually needed ropes and climbing gear to reach them, the only solution would be to airlift them by helicopter and even that posed problems as there was nowhere to land. The plants would have to be attached while the helicopter hovered above.

After the reconnaissance trip, a meeting was held with all concerned and permission was given by the Transkei Department of Nature Conservation to relocate the two clumps to the Umtamvuna Reserve. Not only was the soil, geological strata, climate and rainfall pattern virtually the same, but the relocation by air to a site only a few kilometres away would be the least disruptive with minimum stress to the plants. Should a female plant be discovered the establishment of a viable breeding colony would be greatly enhanced if the plants were kept within the boundaries of their original geographical range.

Escom was approached and through the good offices of the Natal Regional Manager, Mr Edgar Wohlberg, they offered to place a helicopter at our disposal when next they did maintenance work in the area. This was indeed a wonderful example of cooperation between the Transkei Department of Conservation, the Natal Parks Board, Escom, North Pondo Sugar Estates who supplied the labour, the Umtamvuna Trust and private individuals who gave of their time and expertise.

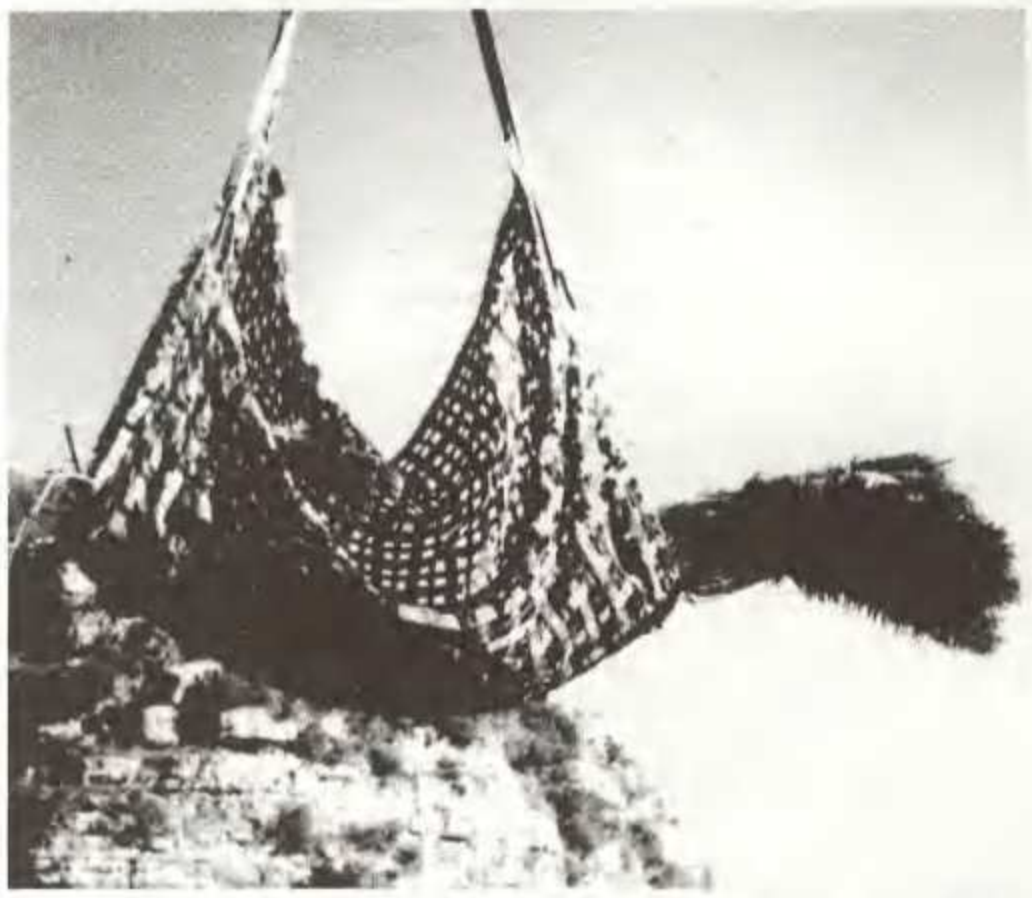
With military precision the relocation was planned and executed.

On the Monday the two plants were carefully dug out and prepared for the airlift, Tuesday was spent at Umtamvuna Reserve preparing the planting holes for the new arrivals and on Wednesday morning shortly after dawn Operation Stork commenced. Both plants were very successfully airlifted to their new home. The entire rescue was the subject of a TV program produced by Teri Leppan with Jonathan Rands as the presenter.

It was with a sense of achievement that all those concerned in the rescue saw the plants officially handed over on Thursday the 16 May by Transkei to the Natal Parks Board at a short ceremony attended by many persons active in the conservation field. However it was also with a feeling of sadness and regret when one considered the reason why it was deemed necessary to do so.

Cycads belong in the wild and they should be safe there from human threat.

Escom helicopter hovers overhead to drop net.



1,6m cycad being airlifted to new home.

Cynthia Giddy treating damaged roots with fungicidal sealing compound watched by Jonathan Rands T.V. presenter and Rob Wolter from the Natal Parks Board.

Tony Abbott who discovered the new cycad. Jonathan Rands and Cynthia Giddy look on.

Mr Mashoba on behalf of the Transkei department of Nature Conservation formally hands over the cycads to Dr. Hans Grobler of the Natal Parks Board.

THE EAST LONDON MUSEUM CYCAD COLLECTION

by Andrew Gubb & Ashton Vice

1. History of the collection

The cycad collection of the East London Museum (ELM) originated in the 1920's with the planting of specimens collected by Dr John Rattray (past Chairman of ELM) in "Naboth's Vineyard", opposite the Technical College. The City Council subsequently built tennis courts on this site and the collection was transferred to the ELM garden, unfortunately without locality data.

During the 1940's and early 1950's, George Gerald Smith, in association with botanists from the National Herbarium in Pretoria, collected cycads throughout South Africa. "G.G." as he was called was an East London businessman who was well known for his knowledge of the succulent genus *Haworthia* and who also served as Chairman of the ELM Board of Trustees. His cycad data comprised part of a major survey of cycad species in the country. In the 1950's, his cycad scientific collection, all specimens having full provenance and with much primary data, was regarded as the largest ex-habitat cycad assembly in the Southern Hemisphere. Several publications by such well-known scientists as Pearson, Verdoorn, Hutchinson, Rattray and Dyer were based on the collection and its associated records.

In 1958, G G Smith presented the collection, then comprising 62 valuable specimens, together with the records, to the East London Museum. Transplanting was completed the following year and the garden was named the "G G Smith Cycad Collection" which, in addition to the specimens in the ELM premises, included plants in the Technical College grounds, along Lukin Road (see **ENCEPHALARTOS** 7: 15) and along and just below Union Avenue.

The collection remained undisturbed until an extension of the ELM buildings in 1983-1984. At some stage, detailed ground plans and lists of information were compiled and are held in the ELM archives. Unfortunately, this documentation is undated and it is only known that various specimens were transplanted to the present site of the Union Avenue/Lukin Road garden of the Museum. Some mortality and theft almost certainly occurred as evidenced by remnants of dead plants and scars on trunks where suckers had been removed.

The collection and the achival material were surveyed by Andrew Gubb during the latter half of 1987. The findings of his survey were that the original collection had deteriorated in quality and extent. Most of the plants were unidentified and there was some doubt about the correctness of the identity pegs that remained.

2. The Present Situation

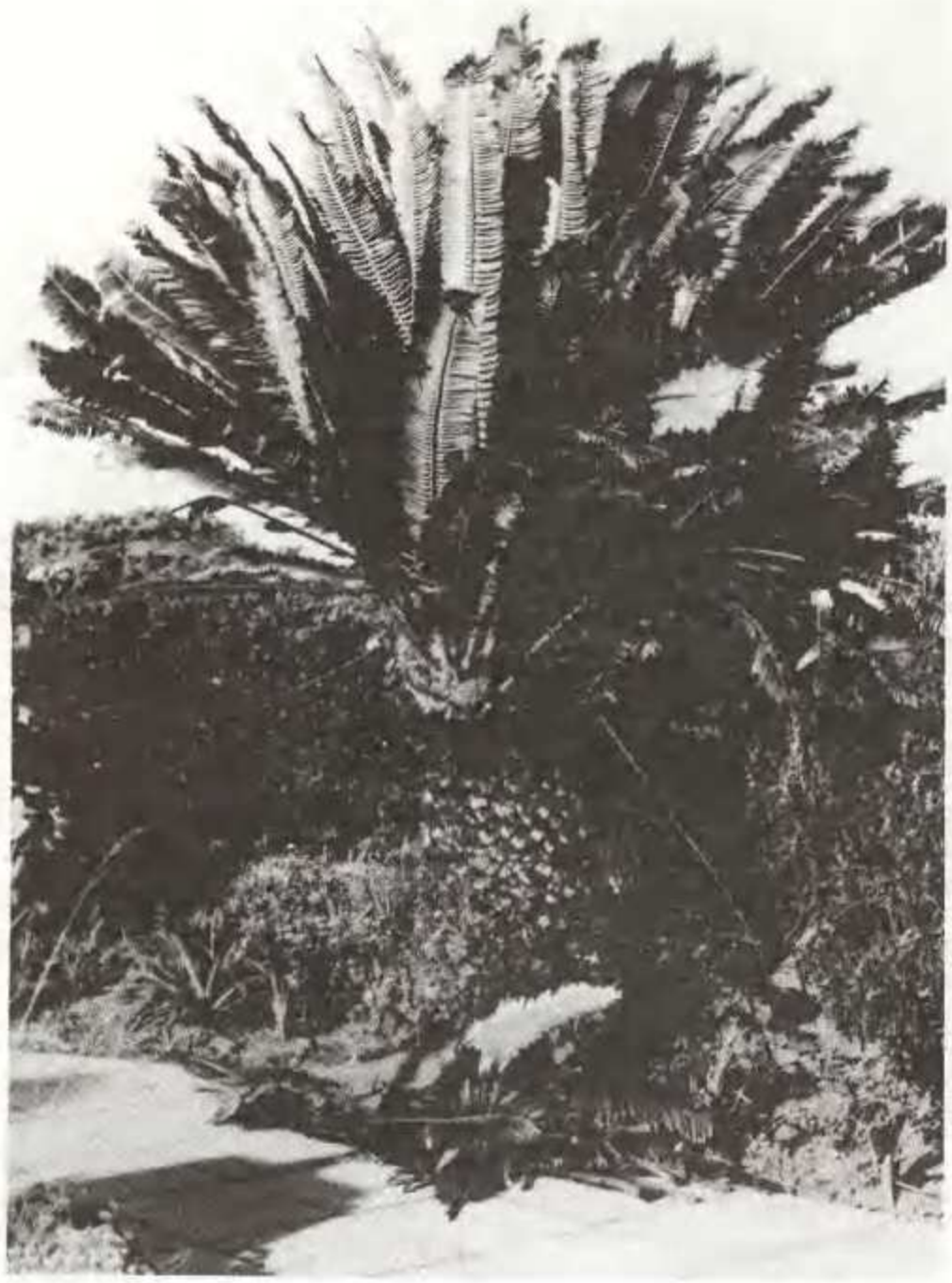
Following the findings as outlined above, it was decided to appoint a knowledgeable and trustworthy curator of the cycad collection (see ENCEPHALARTOS 16: 13). Only recently has this come about, in the form of an offer from East London cycad enthusiast Ashton Vice to care for the collection. Dr Vice has made an enthusiastic start to the project; he and Mr Gubb have planned a programme designed to ensure the wise management, conservation and development of the collection, including such aspects as:

- *biological control of insect predators*
- *wise horticultural practice (layout, pruning, clearing)*
- *identification, labelling of specimens and mapping of the garden*
- *strategies for improved security*
- *programmes for educational use of the collection*
- *focus on and extension of the species endemic to the Eastern Cape, Border, Ciskei and Transkei regions.*

The collection presently includes all the Eastern Cape and Border region cycads. Under Dr Vice's programme, mortality has been arrested and security has improved although periodic thefts still occur.

The authors

Andrew Gubb was the Deputy Director of the ELM until recently; he is now associated with the Wildlife Society of Southern Africa in Cape Town. Ashton Vice is a well-known East London Chiropractor.



A "12-headed" specimen of *Encephalartos horridus* in the ELM grounds.

An impressive specimen of *Encephalartos transvenosus* in the ELM garden.

Ashton Vice inspecting the impressive female cones on a specimen of *Encephalartos longifolius* in the ELM garden.

CYCAD- INSECT RELATIONSHIPS

By: Paul Kennedy
21 Sierra Road
Engadine
N.S.W. Australia
2233

The last two issues of Encephalartos (Nos 23 and 24 - issued concurrently) carried separate and quite contradictory articles about whether insects are involved in the pollination of cycads.

*Basically, Knut Norstog and Priscilla Fawcett in the US are of the opinion that weevils are involved in the pollination of Zamia furfuracea and that the weevil, **Rhopalotria mollis**, eats and breeds in male cones and then visits a female cone, at which point the transport of pollen occurs.*

*On the other hand, Prof D D Pant and Dr Rita Singh from the University of Allahabad in India, after studying various Cycas species in the Roxburgh Botanic Garden at the University, have concluded that male cones harbour insects which spend their entire life cycle within the cone and that, as a consequence - "these insects **cannot** play any role in the pollination of the females.*

I have observed insects, later identified as weevils, in swarm proportions on male cones of Lepidozamia peroffskyana and have photographed the weevils on these cones.

These observations occurred at 3 separate locations in Northern New South Wales. The first sighting was made just prior to Christmas 1988, while the second and third sightings occurred just prior to Christmas 1990.

*When I first saw the insects in 1988 I was somewhat amazed at their numbers and concluded that they must play some part in the pollination of L. peroffskyana. My interest intensified after reading several articles on the wind-blown versus insect pollination debate and after listening to speakers discussing this topic at **Cycad 90**.*

As a result, I collected samples of the insects at both of the locations which I visited in 1990.

*These insects were subsequently identified by Clarry Chadwick, an entomologist at the Australian Museum in Sydney as a weevil - **Tranes lyterioides**. It was the same species of weevil which Chadwick, on the basis of considerable research, has associated with Macrozamia communis cones.*

Chadwick was somewhat surprised at the swarm proportions of the weevils as he had not encountered such numbers in his studies of M. communis.

*The fact that my sightings were all made during the late morning period on hot sunny days also surprised Chadwick as he regarded **Tranes lyterioides** as being primarily a nocturnal insect.*

*In this latter regard, one very practical tip for students of cycad/insect relationships was provided by Chadwick, at **Cycad 90**, when he described how, after sighting weevils on male M. communis female cones until he investigated one location at night and found large numbers of weevils on female cones/plants.*

At each of the three locations where I saw the weevils, some common denominators applied - these were:

1. *That only a very limited coning had occurred at each location.*

2. *That male cones outnumbered female cones (possibly by a ratio of approximately 4:1), and*

3. That the male cones seemed to be in a much further advanced state than the female cones.

Having collected the specimen weevils while on holidays, I then wondered how I was going to keep them alive for 10 days until I returned to home to Sydney where I hoped to have them identified (as enquiries directed to the local Council Entomologist had indicated that weevils were outside his field of expertise).

So, as a possible source of food for the weevils I collected some undergrowth, some juvenile L. peroffskyana leaflets and also some sporophylls (cone scales) which I placed in an empty plastic ice cream container with a sheet of clingwrap.

I checked out the specimens quite frequently and noticed that they were often inactive during the day and active at night. One of their amusing habits at night was to fly from the bottom of the container, hit the sheet of clingwrap and then bounce back to the bottom or against the side of the container (often relatively noisily as their hard shell thudded against the plastic surround of their temporary home).

Some 4/5 days after collecting the weevils I was amazed to see several larvae wriggling around the base of the container. The mystery of their origin was solved several days later when I happened to open a cupboard drawer in which I had kept one of the sporophylls as a possible reserve source of food for the weevils.

What I found was a partly collapsed sporophyll and 7 larvae wriggling around the drawer. Obviously the larvae had bred inside the sporophyll and had emerged through the external tissue as part of their "birth" process.

These larvae appeared to me to be very similar to larvae which I had previously seen inside mature female L. peroffskyana cones that had been collected intact or semi-intact. The presence of larvae in these cones appears to me to be associated which a slimy liquid substance which is not uncommon in the basal areas of such cones.

The above observation has led me to the conclusion that weevils breed in female L. peroffskyana cones as well as in male cones.

One other possible indication that weevils breed in female cones is provided when seeds are occasionally collected with a small hole, about the size of a match head, eaten (or whatever!) through the integument (the hard outer shell of the seed) and with the entire ovule missing. A likely explanation for these holes is that they are caused by weevils using their proboscis to create an entry point into the seed through which they can lay their eggs; this activity would probably occur when the seed was immature and had not yet developed its integument.

Seeds with black blotches of a similar size on the outer flesh are also very common; and when the flesh is removed it is often found that there is a corresponding small cavity on the integument - perhaps indicating an unsuccessful attempt by a weevil to penetrate a developed integument.

In such circumstances, the entry and exit of the adult weevil would need to have occurred during the short period of receptivity of the cone when the sporophylls open up so as to allow pollination to occur.

The interior of the seed would then provide a possible source of food for the ensuing larvae and a place for the larvae to pupate.

Without any positive identification of the larvae which I have seen in female cones, I cannot be certain that weevils do reproduce within female cones as they obviously do within male cones, but I think that, on the law of probability, such is the case.

Photographs are attached which show weevils on the outside of a male cone which had started distending and on a male cone which had not started to distend. Weevils were sighted on both the inside and outside of the cone which had commenced distending . An assessment of the relative numbers of the weevils on the interior versus the exterior of the cone was a virtual impossibility under the circumstances.

Why the weevils are found on both the inside and outside of distending cones is rather intriguing, through their behaviour may be similar to ants which sometimes seem to be going in all different directions when they reach what is apparently their objective.

My examination of female cones at one location resulted in sighting one cone with about 10/12 weevils on the external surface. Unfortunately, about half of these fell off when I brushed away some vines to enable a clear photograph of the cone, although some weevils are still obvious in the photograph.

One other interesting fact about this female cone is the mucus which has exuded from between the very tightly packed sporophylls - this could perhaps hold some attraction for the weevils. A second photograph shows the mucus more clearly.

My photographs prove conclusively that weevils are attracted in massive numbers to male cones of L. peroffskyana, though I did not find any evidence of an attraction of a similar magnitude to female cones. I did, however, record what I considered to be the initial stage of weevils visiting a female cone.

My observations of the attraction of weevils to male cones of L. peroffskyana, combined with Clarry Chadwick's confirmation that weevils are attracted to female M. communis cones, albeit nocturnally, have left me firmly convinced that weevils are, in fact, responsible for the pollination of cycads.

OBSERVATIONS

1. *There seemed to be a very high limited coning in both locations.*

2. *Without counting cones, I would estimate that male cones outnumbered female cones by a ratio of about 4:1.*

3. *The male cones seemed to be much further advanced than the female cones.*

4. *Clarry Chadwick was surprised at the swarm like proportions of the weevils and also as they were active during daylight hours as he regarded them as nocturnal insects.*

5. *From the plant at Grassy Head I collected some sporophylls as a possible source of food for the weevils. Within 3 days I found larvae in the container in which I had placed about 12 of the weevils and 3 sporophylls.*

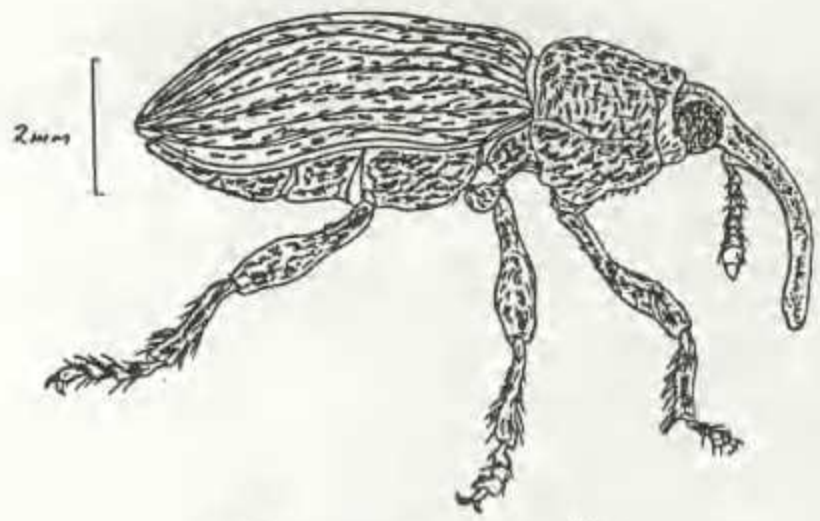
This puzzled me somewhat until the next day when I looked at the one spare sporophyll that I had kept "in reserve" and found it partly demolished and 7 larvae around the bathroom drawer where I had stored it.

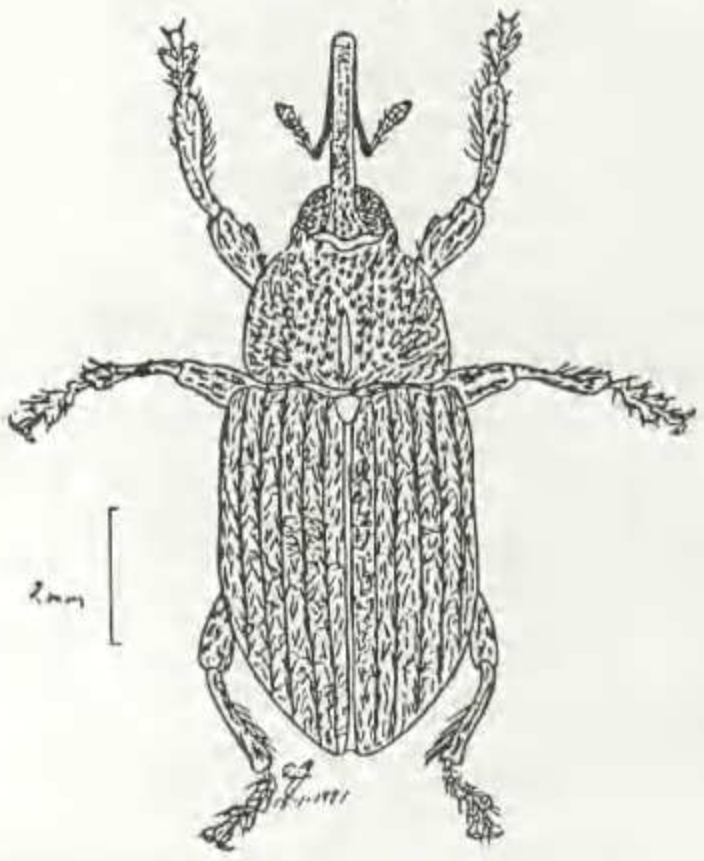
6. *The larvae appeared to me to be the same as the larvae which are often found in mature female L. peroffskyana cones. I will have to confirm L. peroffskyana seeds from a disintegrating cone.*

7. *Just as the weevils breed in the male cone I think that they could also breed in the female cone - this hypothesis is based on my recall of collecting L. peroffskyana seeds with a black blotch about the size of a match head on the seed skin. These blotches are often found on the hard shell of the seed and occasionally seeds are found with a hole piercing the shell, but with no seed within the shell.*

8. *All of the above observations prove nothing, but the conclusions which I draw from them is that cycads are fertilised by insects such as weevils. I do not support the wind pollination theory.*

Tranes lyterioides swarming on outside of male cone of L. peroffskyana.





Tranes lyterioides illustrated by David Jones from the Australian National Botanic Gardens, Canberra

Male cone of L. peroffskyana

WHO CAN HELP ???

REQUIRED : INSECTS OCCURRING ON CYCADS

John Donaldson (National Botanical Institute, Kirstenbosch) and I are busy compiling a booklet on the insects that are associated with cycads in South Africa. The aim of this book is inter alia to give you, the cycad grower and cycad lover, an idea of which insects occur on the various cycad species, what they are doing there and how they affect the plants and their survival. We do, however, need all the data we can get in order to make this book as comprehensible as possible, and would therefore like to appeal to all members of the Society to collect **any** specimens and records for us. It is important for us to obtain such insects from the **natural habitat** of the plants, as specimens in cultivation are often contaminated by insects introduced with other cycads; in some instances, however, such records can also be quite valuable. A few aspects of particular importance:

1. We have no records of insects occurring **E. ghellinckii** and **E. cycadifolius,** but strongly suspect that the enigmatic weevil **Platymerus** lives in its female cones, and other beetles in its male cones. Who has access to such cones?

2. Of the Eastern Cape cycad species, we still need insect data for **E. princeps, E. arenarius** and **Stangeria.** Can anybody get hold of cone material (scales and seeds) of these species?

3. I am currently undertaking a study of the weevil genus **Porthetes,** which lives in the scales of usually the male cones and is distributed from the Eastern Cape right up to Kenya, probably occurring on most species of cycads. However, I have no records of these weevils from particularly the rarer Transvaal cycads and desperately need such in order to revise the genus. The weevils stay in the male cones of i.a. **E. heenani, E. paucidentatus, E. inopinus, E. cupidus, E. humilis** and the **E.** complex. Males cones still shedding pollen are also likely to contain other beetles.

4. We urgently require more insect records from the Natal cycads, as we suspect that a knowledge of these could throw some light on the relationships and taxonomy of the plants themselves. Who can get hold of cones of **E. umbeluziensis, E. lebomboensis** and the various populations of **E. natalensis?** I already have a new species of **Porthetes** from **E. lebomboensis,** and would like to find out how host-specific it is.

5. Who has access to the **Encephalartos** species north of South Africa? We have absolutely no insect records from these, except one weevil which occurs in the axis of female cones of **E.tegulaneus.** The male cones are probably the best place to look for insects, as they are expected to contain not only the **Porthetes** weevil but also other beetles such as **Metacucujus.**

Simply collect such insects in e.g. plastic film vial with some holes, kill them in the deepfreezer, add some tissue paper into the vial and put it in the post, or send pieces of the cone itself. Only soft-bodied insects such as larvae and scale insects must be preserved in alcohol. It's that easy, and **your** contribution can make a huge difference! You can send specimens to either me or John at Kirstenbosch, and please add some collecting data (locality, date, part of plant).

A big thank you.

Rolf G. Oberprieler
Biosystematics Division : Insects
Plant Protection Research Institute
Private Bag X134
Pretoria 0001
SOUTH AFRICA

VILLOSUS SURVEY AT KRANTZKLOOF

A detailed survey of the population of *Encephalartos villosus* at the Krantzkloof Nature Reserve, near Durban, has been commenced. The first phase of the work was carried out over the December 1990 - February 1991 period by University of Natal postgraduate biology student Kevin Weerts under the supervision of Bruce Page and Roy Osborne. It has involved selection of four sites in different areas of the reserve, in which every plant, including seedlings, has been mapped as to position. Each plant has been measured and details of any reproductive activity noted. This will allow the determination of sex ratios and age profiles for the different sites and for the population as a whole. It is estimated that there are about 2000 mature *E. villosus* plants in the reserve as well as a small number of *E. natalensis* and a few nature hybrids of the two species. It is intended that the monitoring will be continued on an annual basis and it is hoped that the survey will be used as a model for similar work for other cycad populations.

The project is funded by the Wildlife Society of Southern Africa, whose increasing interest in our indigenous cycads is noted with appreciation.

Right: Postgradute student Kevin Weerts is dwarfed by a specimen of *E. villosus* in the Krantzkloof Nature Reserve, where he has recently carried out a comprehensive population survey.

CYCAD TOXICITY M. Sc.

Student Jerald J Nair, of the Chemistry Department of the University of Natal in Durban, has been awarded an M. Sc. degree for his investigation into toxic compounds in cycads. The work, extending over a two-year period and supervised by Dr Roy Osborne, addressed the question of the accuracy of different analytical methods for the quantification of the methyl axozymethanol glycosides in different biological samples. Severe doubts have been raised as to the validity of certain techniques used in the past.

Acting as external examiner, Dr K Norstog comments that the thesis is remarkably well-written and a truly professional product. He goes on to suggest follow-up investigations as to the precise locality of the toxins. In plant tissues they appear to be accumulated in specific storage cells called idioblasts. In predating insects it is not clear whether the undigested toxin is simply concentrated in the insect's gut or if there is a sequestration to specific tissues in the insect's body.

Right: University of Natal postgraduate student J J Nair who has been awarded an M.Sc. degree for his work in the analysis of cycad toxins.

OBSERVATIONS ON ROOT CONTRACTION OF E. CYCADIFOLIUS IN LONG AND SHORT PLANTING BAGS

By: Martin Schwellnus

Seedlings of various ENCEPHALARTOS species were transplanted into non standard length planter bags during 1990. The bags measuring 300mm x 140mm (4.6L) against the standard size of 200mm x 160mm (4.0L). The seedlings included a number of E.cycadifolius seedlings of which some were also planted into standard size bags. All seedlings were planted to a depth that the seed (which was still present) was on the surface of the soil.

Observations were made on the depth to which the root contraction had drawn the seedling into the ground by stripping the bags down and removing the soil on the one side of the seedling to a point where the root became exposed.

The difference in the depth between the two groups were very distinct as can be seen from the following measurements:

	Average Depth *	Standard Deviation
Long Bags	*68.2mm*	*18.35*
Standard Bags	*48.4mm*	*17.90*

* *The depth was measured as the distance from the top of the soil to the starting point of the root as indicated by A in the photograph.*

E.cycadifolius

Although the E.cycadifolius seedlings all received the same treatment it became clear during April 1991 that there was a marked difference in the extent to which the seedlings in the long planter bags were drawn into the soil due to root contraction compared to those in the standard bags.

A random sample of 25 seedlings in each planter bag group were selected. The bags were then stripped down and the soil removed on one side of the seedlings to a point where the root was exposed.

The contraction process resulted in a cavity (see B in photograph) caused by the thickening root into which the smaller seedling crown was drawn to a level at which it was well below the surface. In all cases of long planter bags the rachis with some leaflets were to be found in the standard planter bags wherein most cases only the petioles and very few leaflets were drawn in.

In the contraction process E.cycadifolius seeds were drawn down somewhat before they became detached from the seedling in all cases. This assembly was the result of soil resistance.

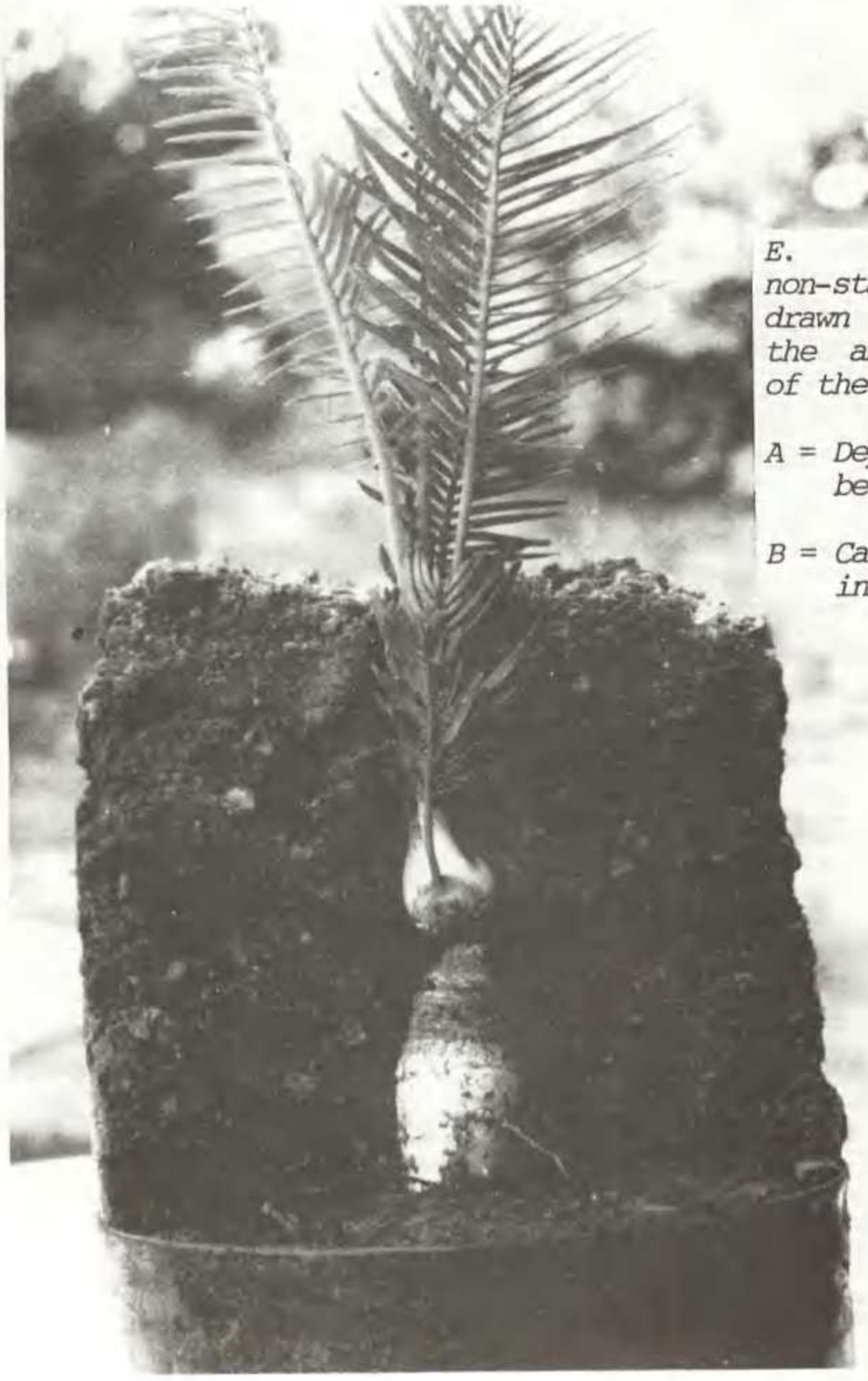
The reason for the difference is most likely to be found in the fact that the root in the longer bags was straight down compared to curved roots in the shallower (standard) bags. Contraction was therefore downwards and not partially sideways as in the standard bags.

This may explain the occurrence of large numbers of E.cycadifolius seedlings surviving in its natural habitat, notwithstanding the occurrence of sometimes over-grazing, or frequent bush fires. In the case of fires the top part of the rachis will be burnt away. The lack of oxygen however, will reduce the heat level and smother the fire before damage is done to the seedling crown.

As animals favour green palatable foliage, plants pushing out new sets of soft green leaves will be prime targets in over-grazed areas where the grazing tends to be less palatable than normal. The sub surface crown of the seedling is however protected against being totally defoliated or severely damaged and therefore has a better chance of survival.

OTHER SPECIES

The other species were of different ages and no seedlings were planted in standard bags allowing within species comparisons. Of the species transplanted only E. horridus showed some lowering of the crown due to contraction during the same time slot. No clear evidence of this could be found in E. longifolius, E. transvenosus, E. trispinosus, E. lebomboensis, E. altensteinii or E. paucidentatus during the same time.



E. cycadifolius seedling in non-standard planter bag with crown drawn below the soil surface. Notice the amount of foliage below the surface of the soil.

A = Depth to which crown has been drawn below soil surface.

B = Cavity formed by contracting root into which crown is drawn.

FOSTER BOTANIC GARDENS IN HAWAII

by Leland Miyano

Foster Garden is the oldest of the four gardens in the Honolulu Botanic Gardens system (HBG), the other three being Ho'omaluhia Park, Wahiawa Botanic Garden and the Koko Crater Botanic Garden. Because of the maturity and historic nature of the plantings, Foster is the showcase garden of the HBG system.

The garden collections began in the 1850's with Dr. William F. Hillebrand introducing economically important plants to the then private estate. After his death, the property transferred to the Foster family whose emphasis shifted to the introduction of ornamental plants. In 1930, Foster Garden was formally deeded to the city of Honolulu. The first director, Harry L. Lyons, placed an emphasis on tree species suitable for reforestation purposes. In 1957, the next director, Paul Weissich, assumed control over the Botanic Gardens and, in 1960, a division of Botanic Gardens was created; laying the foundation of an island-wide, climatically diverse, garden system. It was during Paul Weissichs' tenure that the collecting of cycad species blossomed with over 300 accessions logged. The current director is Michael S. Kristiansen, and, under his able control, cycads will continue to flourish in the Honolulu Botanic Gardens. Kristiansen is committed to conservation and his visionary goals are tailor-made for the long-term stewardship of the cycad collection. Today the Honolulu Botanic Garden system comprises approximately 260 hectares in areas ranging from sea level to 300 m elevation and from 25 to 2500 mm rain per year. The temperature averages from 60°F to 90°F.

Foster Gardens, being the flagship garden, has the most mature plantings of cycads growing within a prehistoric glen built in 1967. The glen is an evolutionary garden that is planted with selaginellas, tree ferns, magnolias, equisetums, and associated primitive floral forms. All the cycads were planted as small individuals and their growth rate has truely been impressive; as has been noted by people fortunate to witness this growth with time. The glen has received the Garden Club of America Founders' award and the on-going maintenance is a joint effort of the City and the Garden Club of Honolulu. The prehistoric glen is a focal point within Foster for both the general public and the cycad specialists who visit. Because of the importance of the glen and the rapidity of growth cycads exhibited there, species of cycads have been actively sought for the Botanic Gardens collection and all genera are represented except for *Chigua*.

The Botanic Gardens is dedicated to increasing its cycad collection through future acquisitions and also propagation by vegetative means and responsible pollinations of female cones. Almost every plant grown in the ground grows well and rapidly. However, experience has taught us that high altitude species such as *Encephalartos laevifolius, E. ghellinckii* and *E. cycadifolius* are not practical for us to grow. Many of the adaptable species appear older than they really are because of their increased girth and height attained in "water-weight gain" or pith expansion due to the high humidity and rainfall. Even xerophytic species such as *E. lehmannii* and *E. eugene-maraisii* adapt well to our moisture and heavy soils given the proper drainage. Generally speaking, species of *Cycas, Ceratozamia* and *Zamia* do especially well and are abundantly represented in the collection.

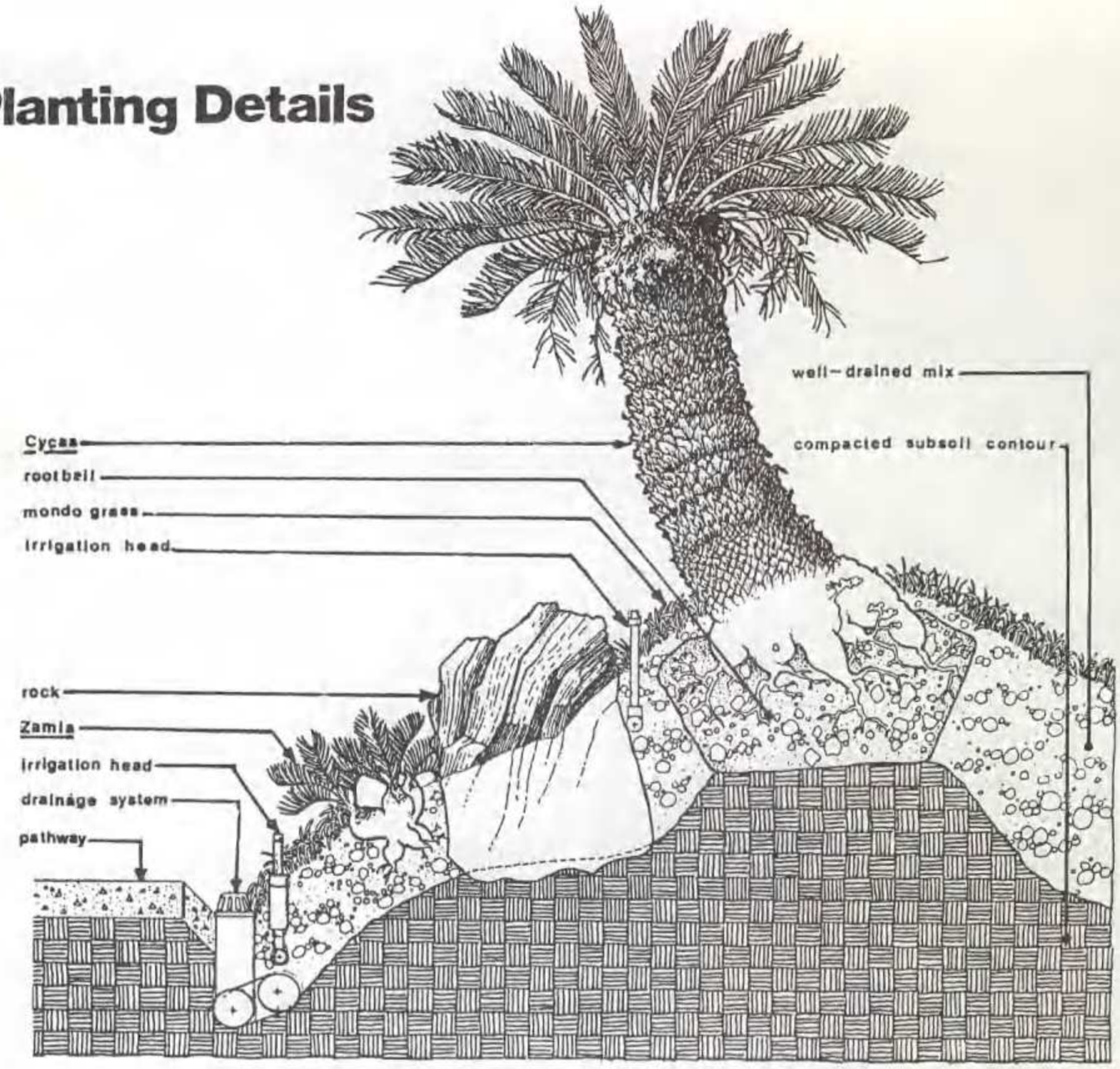
While the glen has the most mature plantings, it is at full capacity and the nursery houses the potted cycads which are destined to be planted at all the sites in the system. We have a great potential for the expansion of the on-going ground plantings. Director Michael Kristiansen has great ideas for these future cycad landscapes and we have the quantities of plants necessary to create exciting garden designs.

Dr Vernon Heywood, Director, Botanic Gardens Conservation Secretariat, at Kew, has stated that the Honolulu Botanic Gardens are "of major international importance" and "these collections undoubtedly represent one of the most significant ex-situ tropical germplasm collections of wild species in existence." We can grow all our plants without expensive greenhouses and outdoors in areas that approximate their natural habitats. Within the cycad collection, we emphasize the tropical species which we grow in the appropriate garden in the system. Our policy of maintaining seeding colonies of the species will also help in the long-term conservation effort regarding cycad populations ex-situ.

The Honolulu Botanic Gardens system is at a threshold of becoming truely important in cycad germplasm preservation. Our amiable climate, stable economy, dedicated director, staff, and support group (Friends of Foster Garden), combined with a conviction to conservation and education, add up to great optimism for expansion and protection of cycads in Hawaii and for the world.

Leland Miyano writes from 619 Hakaka Street, Hololulu, Hawaii, 96816 USA. A landscape designer by profession, he is an enthusiastic member of the Cycad Society of Southern Africa and is an Executive Board member of the Friends of the Foster Garden.

Planting Details



In areas of heavy tropical, clayey soils and high rainfall, this idealized schematic layout will prove helpful in planning a successful, long-term cycad planting.

One of the prize specimens in the Foster Garden is this example of *Encephalartos woodii*

A male cone-bearing plant of *Encephalartos inopinus* at the Foster Garden

The luxuriant leaf growth of this *Encephalartos* from Mocambique testifies to the ideal conditions in the Foster Garden

***Cycas circinalis* at the Foster Botanic Garden in Hawaii**

A NOTE FROM THE DIRECTOR OF HONOLULU BOTANIC GARDENS

by Michael S. Kristiansen

We are indeed fortunate to have the 352 cycad accessions in the collections of the Honolulu Botanic Gardens. Present records illustrate 255 accessions of Zamiaceae, 85 Cycadaceae and 2 Stangeriaceae. Within the four gardens we have diversified ecosystems that facilitate the cultivation of cycads. No botanical garden today is complete without cycads, and ours are just as exciting as many collections I have seen internationally. Visitors to the Foster Gardens enjoy not only the experience of sauntering through the Prehistoric Glen but are intrigued by the history and morphology of these plants.

We intend expanding the collection, particularly into the Koko Crater Botanic Garden where the few species already planted out are thriving. We are determined to complete the collections by the addition of missing species; perhaps one day we may even have enough to illustrate each genus in separate collections. As Leland mentions in his article, the growth has been rampant and the Prehistoric Glen is in urgent need of remodelling and expansion. This will indeed be an exciting time to relandscape with what are now large mature specimens. Leland Miyano has been of invaluable assistance with his interest in the cycads and the gardens.

EVIDENCE OF A SEX CHANGE IN ENCEPHALARTOS MIDDELBURGENSIS

by Roy Osborne

In a previous issue of this magazine (ENCEPHALARTOS 23: 18-20), the author summarised details of thirteen recorded cases of sex changes in cycads. The circumstantial evidence of a sex change presented below, brings the total to fourteen.

The plant is question is a two meter tall, single stemmed, specimen of *Encephalartos middelburgensis* which has been growing for many years in a Westville private garden. A chance inspection of this plant in March this year revealed a large number of seed kernels - probably from a 1990 coning event. About 50 of these seeds were trapped amongst the leaf bases at the stem apex. There is no other tall cycad in the immediate vicinity and I would thus have no doubt that the plant was a female. However, this season the plant has produced six cones and they are all decidedly males! There is no explanation for this evidence other than to accept that the plant has changed from female to male. Unlike the other cases, *there is* no clear traumatic event which may be put forward as a causitave factor for this particular change.

Right: The stem apex of the specimen of *Encephalartos middelburgensis* which has apparently undergone a sex change. Seed kernels from a previous years' female coning are clearly evident amongst the leaf bases - where six male cones are now present. (Photo: R. Osborne.)

REMOVAL AND ROOTING OF BASAL SUCKERS OF E. WOODII

One of the methods of propagating cycads is by the removal and rooting of suckers. In *Encephalartos* these most often arise below ground level and are called basal suckers (very common for example in *E. lehmannii)*; less commonly they arise from the stem at elevated levels. Careful removal of these suckers can lead to the successful propagation of cycads. An added bonus is that, if the sex of the parent plant is known, the sex of the "new" plant is (almost certainly) the same.

The accompanying photographs by Roy Osborne show the procedure he applied to a specimen of *E. woodii.* This particular plant, growing in a private garden in Durban, had three fairly prominent basal suckers, each about 20-30 cm in diameter. Firstly, the soil around the base of the parent plant was excavated to a depth of 1 meter, avoiding damage to the plant's root as far as possible. Next, a sharp curved bush saw was used to cut cleanly through the tissue joining the suckers to the main stem. The suckers were then removed and the cut surfaces - both of the suckers and the main plant - were washed well with water, allowed to dry for an hour or so, dusted with sulphur and finally sealed with a commercial tree-seal product. Leaves on the three suckers were cut back to one-third of their length. The suckers were then potted up in well-drained containers. A little potting mix was placed at the bottom of the containers, covered with a 10cm layer of sharp river sand onto which the base of the sucker rested, and the caudex supported with more sand. The placement was such that the stem apex was well above the top sand surface, rather higher than the plants would be planted in "normal" circumstances. Watering is kept to a minimum, just sufficient to prevent the sand drying completely.

This procedure was carried out in April 1991 and we hope to report another three "woodii's" re-established by the end of the year!

Above: Two of the three suckers potted into containers with sharp sand and with the leaves trimmed back to one-third their original length.

Right: The separated suckers are carefully washed, allowed to dry, dusted with sulphur and sealed before being potted up.

IN MEMORIAM : SERGIO SABATO

We have received word that Dr Sergio Sabato, Professor of Botany at the University of Naples and long-time friend of ours and cycad workers everywhere, died of a heart attack in May this year. He was barely fifty and his untimely death leaves a big hole in the small circle of cycad researchers the world over.

I first met Sergio 12 years ago when he and Aldo Moretti first visited Fairchild Garden. They had either just been or were just about to visit Mexico and had stopped in because the Garden was high on their list of places to see cycads and to talk with people who know about cycads. I recollect spending several days with them, touring the Garden and laboratories, visiting the Everglades and mostly just talking. It was the beginning of a cherished friendship which led to collecting trips in South America and visits to the Naples Botanic Garden where Sergio and his colleagues nurtured their own extensive collection of Mexican and South African cycads. The major research interest at Naples is on cycads and Sergio and his associates have made important advances in our understanding of this singularly important plant group. In addition, during his visits to the Fairchild Garden, Sergio took great pains to help us with the correct identification of a number of our Mexican accessions.

The President, Committee and members of the Cycad Society of Southern Africa join with Knut Norstog in offering sincere condolences to Sergio's family, friends and colleagues.

Sergio was a tall, handsome and sophisticated individual who took a certain pride in having been educated at the University of Padua, which is, as he would sometimes remind us, the oldest university in Europe. His parents were vintners who owned vineyards in the south of Italy but lived in Rome. Sergio loved Rome and enjoyed introducing its wonders to others - we recall with feelings of exhaustion "doing" Rome at a half-run following Sergio as he loped up and down stairways and through alleys.

If a person can still be said to be a universalist in this age of specialities, Sergio was one. He and his colleagues described and named a dozen or so new species of *Dioon, Ceratozamia* and *Zamia*. In addition, they published papers on cycad biochemistry, cytology, morphology and tissue culture. He and Paolo de Luca wrote the first and still the only description on the motile sperm cells of *Encephalartos*. Sergio was also a bibliophile and delighted Priscilla with his knowledge of medieval herbals, Pompeian murals and Etruscan sculpture. Along with others who know him well, we are thankful that we were accorded the opportunity to be his friends and feel that life will never again be quite as interesting now that he has left us. But our loss is much less than that of his family; he married late and leaves his wife, Sylvana, and young son, Gianluca, now about three years old.

Knut Norstog.

Sergio Sabato (with camera) and Dennis Stevenson at the Botanic Gardens in Medellin, Colombia, 1984.

CYCADS

By: Bev Geech

Cycads flourished in the Carboniferous and Mesozoic periods of the Earth's history, some 60 to 250 million years ago. Cycads have been around for 150 million years with very little change, hence they are often referred to as "living fossils", or the "coelacanths of the plant world". They are the most primitive living seedbearing plants known and once had an almost world-wide distribution. Today these magnificant plants are found only in the tropical and temperate zones of the world, including the eastern parts of South Africa. Of all cycads around the world, South African species are most threatened with extinction.

Presently, only 10 genera, comprising about 150 species remain. Two genera are found in South Africa, namely Encephalartos (28 species) and Stangeria (1 species). The seeds of cycads are borne on cones (as with all Gymnosperms), on seperate male and female plants and are pollinated by wind or insects.

Cycads can live for hundreds of years, and can survive both fire and drought. However, they are becoming increasingly threatened due to man's selfishness, greed and corruption. Since the Dutch landed at the Cape in 1652, plants have been sent to countries around the world. The first cycad was collected by Carl Peter Thunberg, who came to South Africa in 1772. South African cycads can be seen at herbaria and botanical gardens around the world. In one year alone, from April 1866 to April 1867, 238 cycads were sent to England, Belgium, Prussia, Ceylon and Mauritius.

The removal of plants from their natural habitat in the veld has increased alarmingly since then. In 1971 the Transvaal declared cycads Specially Protected Plants, and anyone with a cycad in their possession had to apply for a permit. The extent of the problem can be gauged from the fact that within 18 months, more than 8 000 permits had been issued for more than 64 000 cycads. Cycads are now protected in all four provinces.

E. princeps – Komga District, Eastern Cape. PHOTO – Dr Roy Osborne

Huge numbers of cycads have appeared in suburban gardens. Not only do these plants rarely reproduce in city gardens, but often die when they are hurredly uprooted and transported long distances to their new "homes". Few collectors have both male and female plants of the same species, and many are ignorant of the life cycle of these very special plants. Many "collectors" appear to be motivated entirely by the enormous profits that can be made. It is not uncommon to hear of enthusiasts paying R15 000 for a single cycad.

While it is encouraging that such interest should be shown in our indigenous flora, this must not be at the expense of the plants themselves. Above all, plants must not be uprooted from their natural habitat. This is only justified when they are actually threatened by developments such as roads, dams or buildings. For example, when the Jozini Dam was built on the Pongola River, 6 000 cycads were relocated by Operation Wildflower, an organisation which rescues indigenous plants threatened by such development.

While there are laws governing removal of cycads from the wild, enforcement and control appears to be lax and official corruption may be a problem. In terms of the CITES (Convention on International Trade in Endangered Species) agreement, signed by South Africa in 1975, cycads may not be exported unless they are nursery-grown seedlings or form part of a cultural exchange between two botanical institutions.

However, it appears to be relatively easy to obtain the necessary permits for export, especially if one has friends in high places. Early last year, allegations were made in Parliament that people at cabinet level of government appear to be involved. Democratic Party spokesman on the environment, Mr Rupert Lorimer, (then with the PFP) conducted a one-man campaign to get to the bottom of the export of a large collection of cycads to Madeira, an island off the coast of Portugal. Ex-president Botha agreed to the appointment of a commission of inquiry into the deal, whereby 698 (some reports say 750) cycads were exported by Johannesburg businessman Mr Joe Berardo. The long awaited results of this one-man investigation are due to be released soon. The inquiry, undertaken by retired magistrate, Mr Charles van Zyl, began around June 1989. The inquiry has been completed but the results have not yet been made public.

The collection included 9 Encephalartos cupidus, 13 E. inopinus, 31 E. latifrons and 20 E. eugene-maraisii – all endangered species. Many of the cycads were several metres tall, and were probably two to three hundred years old. According to the permit (no 133/1988) dated 19 September 1988, the plants were destined for the Madeira Botanical Gardens. However, it was widely reported that the cycads in fact found their way to the Monte Palace Hotel owned by Mr Berardo in Madeira, and hence to his private home. One wonders why the Cape Department of Nature Conservation issued a permit for export of such a large consignment of cycads to an individual (who obviously has no interest in science). In addition, the cycads were clearly not nursery-grown, and were not destined for a Botanical Garden in any case. Mr Lorimer called the export "a blatant contravention of the spirit if not the letter of the CITES convention which South Africa has given its solemn word to uphold". According to Dr Johan van Zyl, Deputy Director of Nature Conservation in the Cape, the permit was granted because the plants had been legally collected before cycads were classified as endangered. They then became "private property" and for legal purposes could no longer be classified as being "from the wild".

In an answer to a question put to him in Parliament last year, the then Minister of Constitutional Development and Planning, Mr Chris Heunis, under whose portfolio the provincial conservation departments fell, said all the conditions for export under the CITES convention had been met. These were that the export must not be detrimental to the species, that the exporting country must be satisfied that the specimens were not obtained illegally, that the specimens were prepared and shipped in a way which minimised risk of damage, and that the importing country had issued an import permit. It is however obvious that the CITES agreement was violated on four counts: Commercial trade is allowed only in respect of nursery-grown plants, while these cycads were large, mature specimens which could only have come from the wild. Secondly, there was no exchange between scientific institutions for purposes of research. Thirdly, the export seriously endangers survival of certain of the species which are on

the brink of extinction. And finally, South Africa could not have been certain that the plants were not illegally obtained. The seller, Mr Berndt, did not have documentation for the plants. There is also no registered botanical garden in Funchal, Madeira.

Minister Chris Heunis did not appear to be particularly concerned about the issue. Indeed, he said in Parliament that he thought the topic of cycads was not so interesting, and suggested that Mr Lorimer was not so concerned about cycads as about exposing corruption just before an election!

This issue highlights problems associated with agreements such as the CITES convention. Success in protecting endangered and rare plants and animals depends on the governments and conservation bodies of the countries involved being environmentally conscious and above corruption. Sadly, this does not appear to be the case in South Africa.

Mr Joe Berardo, then chairman of the Johannesburg Mining and Finance Corporation, is a well-known National Party supporter, who contributes substantially to NP funds. According to Mr Lorimer, when Mr Berardo stood down as chairman of the Bank of Lisbon, his relationship with the bank was "not a happy one". He left South Africa last year with his business affairs under investigation. Other interesting facts have come to light. For instance, the fax from the Minister of Agriculture in Madeira to the Natal Parks Board requesting permission for an export licence came from the office of the Funchal tobacco company, of which Mr Berardo is a major shareholder.

This scandal could not have come at a worse time for the Nationalist Party of Mr PW Botha, with elections looming a few short months away. Indeed, many top cabinet ministers are (or were) close friends of the controversial businessman, who is a former member of the State President's Economic Advisory Council. Another interesting question to be answered is why Reserve Bank funds were used to finance the hotel built by Mr Berardo in Madeira. And why did the Reserve Bank grant permission for R22 300 worth of cycads to be donated to the Madeira Botanical Gardens, when Mr Berardo had paid more than ten times that amount for the cycads in South Africa, and they are worth five to ten times that amount again on the international black market?

Mr Berardo, who was born in Madeira, obtained the cycads from the Berndt family in East London, alledgedly for about R285 000. According to Mrs Berardo, they took "tremendous care to go through all the right channels and received all the necessary legal permits." The value of the plants exported to Madeira in August 1988 was said to be between R1 to R2 million on the international market. In another twist to this sordid and ugly tale, the same Mr Berndt and his wife were stopped near Port Alfred in the Eastern Cape, en route from Alexandria to East London with 26 cycads in a bakkie and a four-wheel drive vehicle. Several of these cycads were two metres high indicating that they were at least 100 years old. This was in July 1989, one year after the sale of the cycads to Mr Berardo, by the sons of Mr Berndt, to whom he had given the cycads as a gift. Sixty-six year old Trevor Bernt and his wife Pauline were convicted in August in the Port Alfred court of illegal possession of 13 cycads and fined a ridiculous R2 000.

One of the attractions of cycads (to a certain type of person) is their investment value. These scientifically interesting, botanically irreplacable, some would say almost timeless or mythical plants have become a form of currency, and an excellent way of removing vast amounts of capital from South Africa for those with money, power and friends in the right places.

Export of large collections of cycads to other countries have been taking place for years. One such shipment, involving 700 cycads was to Nice, France in 1986. Mr Lorimer pointed out that the shipment may have been connected with attempts to organise a French rugby tour to South Africa at the time. This shipment of cycads was supposedly destined for the Nice Botanical Gardens, but also wound up in a private garden – that of wealthy Frenchman Mr Jean-Pierre Sclavo.

A number of people have been prosecuted in recent years for illegal possession of cycads, but this is probably only the tip of the iceberg. A few examples:

- P J Prinsloo (39) of Moreleta, Pretoria, was found guilty by the regional magistrate in Nylstroom in April 1989 of stealing 27 cycads from the farm Vosdal in the Waterberg district of the Transvaal. He was fined R20 000 for the theft, and ordered to pay an additional R20 000 for costs. He was also sentenced to 3 years imprisonment (suspended for 5 years). It is interesting to note that this man was prosecuted for theft – not for any offences under the province's plant protection laws, and the fine is thus related to their value. He initially appeared in the Naboomspruit court, but the value of the plants was so high that the case was transferred to the regional court. The owner of the farm, Mr Wimpie Ackerman appeared surprised at the severity of the sentence, even though the plants are easily worth R200 000. These particular cycads, Encephalartos eugene-maraisii, are found only in the Waterberg-Middelburg area and are one of the rarest species in the world. In 1983 there were only 118 plants left in the wild. Only 18 plants exist on Mr Ackerman's farm, which have formed about 150 stems. The stolen stems were replanted on the farm.
- In October 1989 an ESKOM official, Mr Ernest Johannes Bouwer (44) of Packard Street, Woodmead, Sandton, was found guilty in the Randburg Magistrate's Court of illegally exporting cycads from the Eastern Cape and importing them to the Transvaal. He was found in possession of 374 cycads, valued at around R500 000. A container truck containing the rare plants was followed from Despatch to his luxury home in Sandton by officials of the then recently formed Endangered Species Protection Unit of the SAP. Apparently, Mr Bouwer also had 300 cycads planted in his garden. This is believed to be the biggest single haul of illegal cycads in South Africa. He was fined a total of R800 and kept the cycads.
- Also in October last year, a second ESKOM official, Mr David Hermanus van Staden (39) appeard in the Randburg Magistrates Court on a charge of illegal possession of 30 cycads.
- Three men from Despatch in the Eastern Cape appeared in the Uitenhage Magistrate's Court for illegal possession of cycads. The men were part of a syndicate which included the ESKOM official Mr Ernie Bouwer.
- Between January and September last year, the Eastern Cape Regional Office of the Cape Nature Conservation Department confiscated 450 cycads.
- Three illegal cycad rings were uncovered in the Ciskei last year alone. There has been a terrible outflow of cycads from the Ciskei, with some species being almost lost to the region.
- ESKOM has been accused of bulldozing rare cycads in the Eastern Cape to clear the way for electricity pylons. Many cycads were left to die in the sun.
- In April 1989, an attempt was made to steal four cycads from The Wilds in Johannesburg. They had been planted 26 years previously. The thief was evidently disturbed, and the uprooted plants were replanted. The week before, thieves stole several cycads from a Nature Conservation Nursery at Hartbeeshoek near Pretoria.
- In June this year, 216 cycads were seized at a nursery on the Natal South Coast, near Port Shepstone. The owner of the nursery refused to make a statement and the case will now go to court. The police colonel in charge of the investigation has said that he cannot understand what all the fuss is about as it is "just a plant".
- Last year a vast collection of 950 cycads changed hands in a single transaction, when Mr CA Bowles of Durban acquired the plants from two collectors in East London. This was all legally done with the necessary permits from the Cape and Natal Provincial Adminstrations. At a conservative estimate of perhaps R10 000 per plant this means a cool R9,5 million investment!

One wonders how many of these plants survive the constant uprooting and relocation thousands of kilometers away, in different soil and climate. Are the male and female plants of the same species kept together? Are these plants bearing fertile seed? Are these crazy collectors aware of the damage they are doing? Why do the relevant conservation authorities not put an end to the plunder?

Obviously the fines being imposed by the courts do not reflect the seriousness of the situation. Apparently magistrates do not view theft of plants in a very serious light. First time offenders charged with illegally exporting cycads from the Cape Province

can be fined a maximum of R1 500 or 18 months imprisonment or both. In the Transvaal, the illegal possession and illegal importing of cycads each carry a maximum fine of R750 or 9 months imprisonment or both. When the cycads in question may have a resale value of R500 000, these fines are obviously not much of a deterrant. Usually the offenders can get away with admission of guilt fines of R100, with minimal publicity and they keep the plants!

It is perfectly legal to obtain plants from nurseries and plants under 15 cm are presumed to be nursery-grown. However the latest scam is for nursery owners to obtain small plants from the wild, and re-sell them legitimately.

Corruption may be occurring at a grass-roots level too. Cycads confiscated by authorities from offenders (people who do not have the relevant permits) may find their way to acquaintances' gardens, where they are replanted "in the interests of conservation".

Reducing the cycad to a valuable commodity to be obtained by any means possible for financial gain underscores the seriousness of the problem. These rare and beautiful survivors of a bygone age are in very real danger of dying out completely. While wealthy investors and poor people alike may reap a short-term benefit from plundering this resource until nothing is left, in the long-term we will all be losers if radical steps are not taken now.

Of the 30 cycad species indigenous to South Africa, 16 are found in the Transvaal. Of these, 6 are threatened with extinction. Some species may be down to as few as 10 or 15 specimens. One rare species, Encephalartos dolomiticus, has recently been made extinct in the natural environment by greedy collectors. Another species, Encephalartos woodii is the rarest plant on Earth. Only one clump of male plants was found in the Mtunzini district of Zululand in 1895. No female plants are known to exist. The species can thus be regarded as being extinct in nature. One specimen is kept in a "cage" by Transvaal Nature Conservation authorities to protect it from theft. The extent of the removal of plants from the wild can be gauged from the fact that 25% of all the endangered Encephalartos inopinus plants are to be found in one private garden in the Transvaal. Thirteen of these plants were included in the shipment to Madeira. Why do the nature conservation authorities not confiscate the plants so that propagation can be done by experienced people?

Ironically most cycads can be cultivated under the correct conditions fairly easily. However, they are very slow-growing plants, and the biggest and most desirable specimens are hundreds of years old. A plant grown from seed may take a hundred years to reach a height of two metres. Cycads have become status symbols, like expensive cars and holiday mansions at the coast. "Collectors" are so keen to acquire prize specimens that money is no object, and the long-term future of the plants is of even less consequence.

According to Douglas Goode of the Durban Museum; 2 species are extinct; 4 are on the brink of extinction; 18 (at least) are heading for extinction. Some people call the exploitation a "rich man's fad" which has grown in momentum over the last 20-odd years. In fact, since around the time that legislation was introduced to protect them. One cannot help wondering whether the legislation was introduced because of the demise of the plants (which means it was already too late); or whether the legislation itself has hastened the decline, because cycads were suddenly perceived to be of monetary value simply because they are so rare.

In rural areas of Ciskei, Transkei and Kwazulu, local people have realised that cycads are in demand and have been selling plants for as little as R2,50 each. Often the plants' roots are damaged in the process and they do not survive. In addition the bark is used for muti, leading to further devastation. According to Cynthia Giddy, South Africa's representative on the cycad specialist group of IUCN, this a relatively new development. With whites offering large amounts of cash for the plants, the belief is spreading that cycads hold mysterious powers. Cycad poaching is rapidly becoming one of the biggest problems facing the Natal Parks Board, with cycads becoming as endangered as the rhino.

Other plants around the world are being similarly decimated. Around the same time that the cycad trade hit the headlines in South Africa, an international orchid smuggler was convicted in the Old Bailey court in London and fined 20 000 pounds (about R80 000) in addition to being jailed for a year, 8 months of which was suspended for one year.

When will the South African public, law enforcement officials and the government wake up? A year ago a cycad workshop was held and the government was urged to drastically increase fines, but so far nothing has happened. Fines have not been updated in 20 years.

These rare plants must be looked after – indeed they must be cherished and protected in the truest sense of the word.

FURTHER READING

CYCADS of South Africa, by Cynthia Giddy, 1984, Struik.
CYCADS of Africa, by Douglas Goode, 1989, Struik.

AUSTRALIAN CYCAD SEEDS

Joe & Karen Perner write to tell us that their 1991 catalogue of Australia habitat-collected cycad seeds is now available. Species listed in the catalogue include:

> *Cycas angulata, C. armstrongii, C. basaltica, C. calcicola, C. furfuracea, C. lane-poolei, C. pruinosa, C. sp.* "Bynoe Harbour/Cox Peninsula", *C. sp.* "Litchfield Park", *C. sp.* "Mount Surprise/Champion's Blue Surprise", *C. sp.* "Port Keats" and *Macrozamia macdonnellii*.

Seed is available subject to the correct habitat conditions for seed set and phytosanitary certificates can be provided. Prices range from US$ 75 to US$ 125 per 100 with reductions for larger quantities. The detailed price list is available from:

> Joe & Karen Perner, Cycad Gardens Nursery,
> 16 Stutterd Street, Katherine, N.T. Australia 0850
> Phone 089 710 335 or Fax 089 711 335.

NEOPOLITAN BOTANICAL CONFERENCE

The 1990 National Conference of Botany was held in the Orto Botanico, the botanical garden associated with the University of Naples. Organised largely by our Italian correspondent, *Aldo Moretti*, a portion of the proceedings was devoted to cycads. Our members Knut Norstog, Dennis Stevenson and Aldo Moretti presented lectures. Delegates at the meeting included many with cycad research interests, viz. Mario Vasquez Torres and Andrew Vovides from Mexico, Eleanor Wurtzel and Dominick Basile from Lehman College, CUNY, New York, Mark Richardson from the Missouri Botanical Garden, M. Grilli Caiola from Rome and P. Medeghini Bonatti from Modena, Italy.

1991 WORLD CYCAD CENSUS -

YOUR CO-OPERATION REQUESTED

A decision was taken at the Second International Conference on Cycad Biology (CYCAD 90, Australia, July 1990) to conduct a global census of cycad plants in habitat and in public and private gardens. Good progress has already been made with respect to plants in habitat and in public gardens. *We now seek the co-operation of private collectors in supplying information on their plants.*

Information gathered in this important and ambitious project will be used to evaluate the present *in-situ* and *ex-situ* conservation status and the gene pool distribution for each species. Whilst *individual returns will be treated confidentially*, the overall statistics will be presented at the forthcoming Third Cycad Conference (CYCAD 93, South Africa, July 1993) and will be reported to the Threatened Plant Unit (TPU) of the International Union for Conservation of Nature and Natural Resources (IUCN). Extracts of the findings will also be made available for publication in this magazine.

Please use the accompanying form (or photocopy thereof) to complete your return. Only details of *mature* (potentially of reproductive age or size) specimens of *known identity* should be recorded; information on juveniles may be included if you wish. Kindly submit your return to the undersigned *within one month* of the date of distribution of this magazine.

We will be most grateful for your kind co-operation.

Sincerely,

Roy Osborne

Roy Osborne, Secretary, 1991 World Cycad Census.

Postal address: 20 Maryvale Road, Westville, 3630 South Africa.

Telephone: 031-866953 *Fax:* 031-8163091.

1991 WORLD CYCAD CENSUS

NAME AND ADDRESS OF PERSON/INSTITUTION:	NAME OF PERSON UNDERTAKING THE SURVEY
PUBLIC ☐ OR PRIVATE ☐ COLLECTION	DATE OF SURVEY:

CYCAD SPECIES (Genus, Species)	NUMBER OF SPECIMENS PRESENTLY IN COLLECTION			
	Male plants	Female plants	Mature plants of unknown sex	Juveniles* (*Optional)

<u>Explanatory notes or comments</u>:

Kindly return the completed for to : Dr Roy Osborne, 20 Maryvale Road, Westville, 3630, South Africa

Tragedy lurks amid beauty

ONE doesn't have to be a mother to appreciate how alarming it can be to see a toddler swallow an ornamental berry. In many cases, the plant turns out to be non-toxic. But how many parents have any knowledge of which plants are poisonous?

Each year, the Poison Information Centre at the Johannesburg Hospital deals with almost 300 cases of plant poisoning, or suspected poisoning.

A doctor at the centre says that commonly a frantic mother phones to say her baby has just chewed the leaf of an elephant's ear, and what should she do? The diagnosis is often confirmed by the sound of screams.

In the case of the elephant's ear (alocasia macrorrhiza), it is known that the sap and root stock are indeed irritant poisons which can cause immense harm to the eyes.

Best response

However, the acrid taste of the elephant's ear normally means that a child rarely consumes anything near the quantity deemed dangerous.

In any event, the best response to an elephant's ear scare is to get the infant straight to a hospital, where staff can decide whether a stomach pump is necessary.

Parents who bring howling children into the hospital are often too distraught to have noticed the plant, or simply don't know its name. In these more complicated cases, the hospital relies on volunteer specialists who have a training in taxonomic botany.

Once a taxonomic botanist has identified the plant, the hospital is able to look up the active poison and administer an antidote. The good news is that fatalities from plant poisoning are rare.

The extent of plant poisoning is varied. With children under five, the poisoning is normally accidental. However, when it comes to teenagers, it is invariably deliberate experimentation.

Teenagers are notorious for testing hearsay information about the hallucinogenic properties of certain seeds or plants. In search of an inexpensive "trip", they can consume something potentially dangerous.

The most extreme cases of plant poisoning have invariably become local legend. Botanists often refer to the story of a man who collected apple pips and stored them in a cup. One day he consumed all the pips in a burst of enthusiasm and promptly died.

Medical experts confirm that apple pips do indeed contain the mildest traces of cyanid. Eaten on their own, they present absolutely no threat to humans. In extreme circumstance of excessive consumption, they can be fatal.

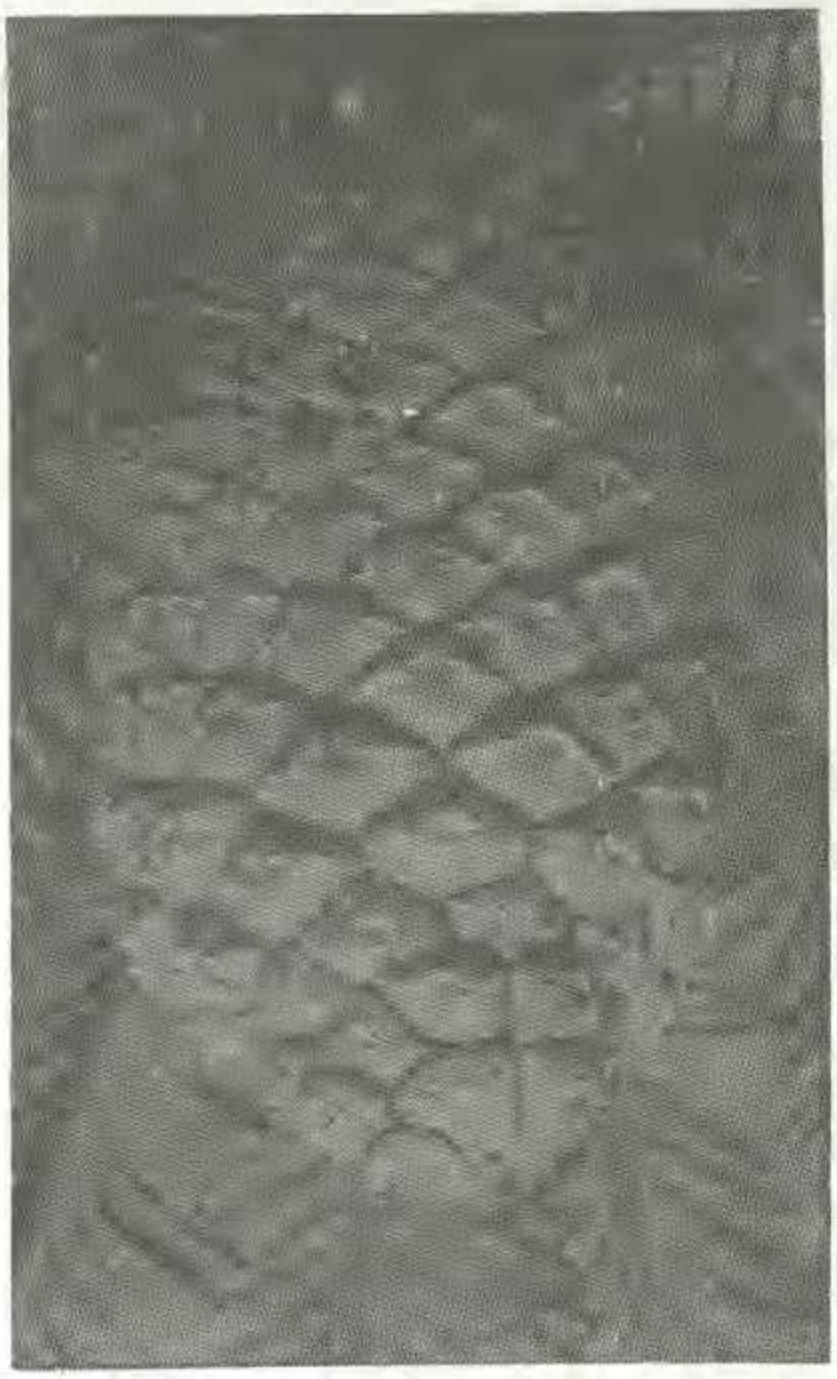
More frivolous cases involve Northern Suburbs hostesses out to impress their guests by adding brightly coloured flowers to the salad. On a celebrated occasion, a delightful bunch of hydrangea flowers was enough to give the "in crowd" a bad bout of gastro-enteritis.

Publicising poisonous plants is not intended to spread alarm and despondency. There will always be poisonous plants in a garden and to avoid them is extremely difficult. The best one can do is to simply learn more about them.

More information can be obtained from the book "Poisonous Plants in South African Gardens and Parks: A Field Guide", by Joan Munday, Donker Press.

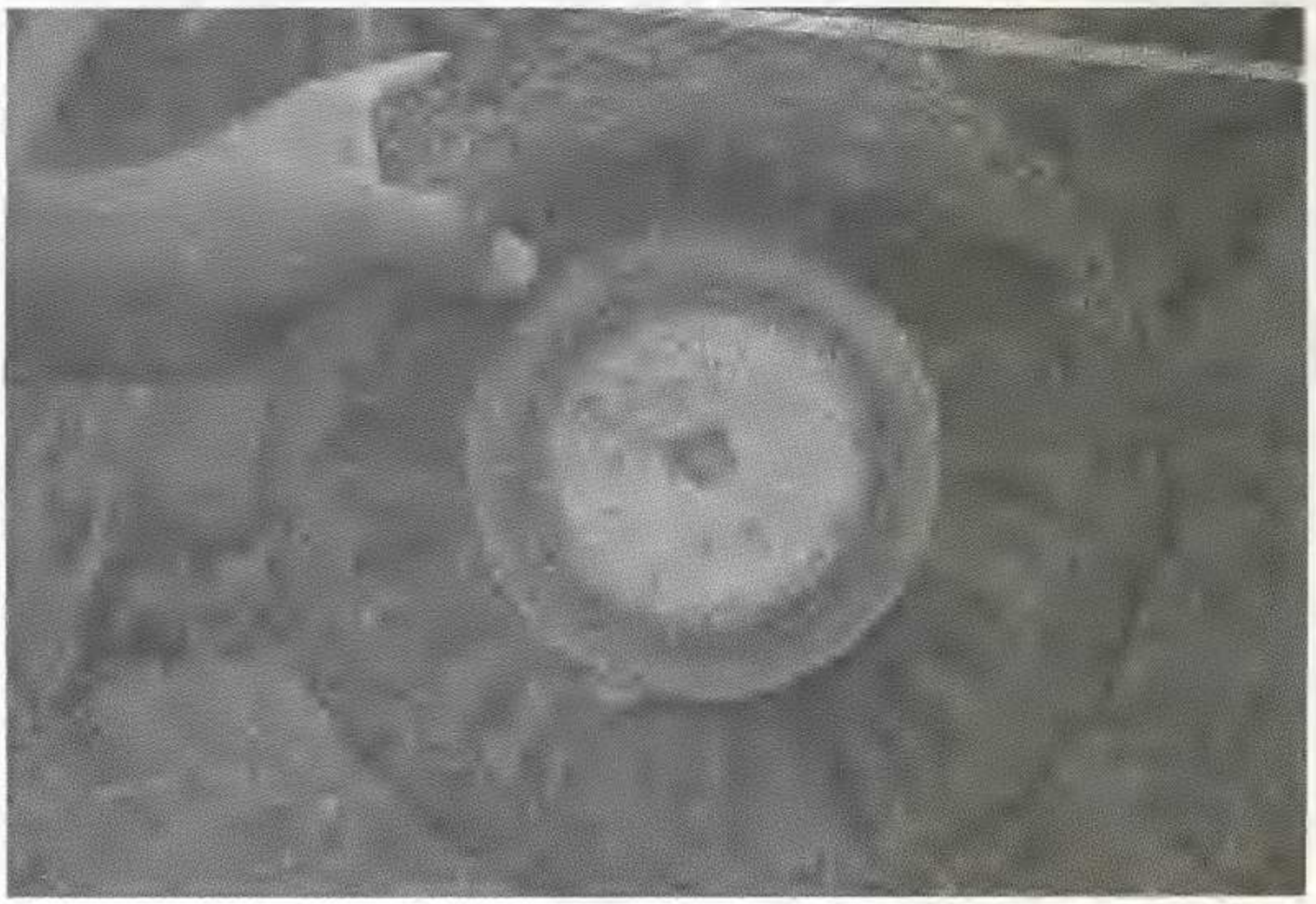
● Here is a list of common garden plants which are know to have poisoned people:

Cycads (encephalartos sp.) — kernals.
Syrings tree (melia azedarach) — berry.
Elephant's ears (alocasia macrorrhiza) — leaves.
Elphant's ears (colocasia esculenta) — leaves.
Oleander shrub (nerium oleander) — leaves.
Dieffenbachia indoor plant (dumb cane) — leaves.
Stinkblaar (datura stramonium) — seed.
Castor oil plant (ricinus communis) — seed.
Tung nut (aleurites fordii) — kernals.



FORBIDDEN FRUIT: The female plant of the popular garden cycad produces large cones resembling pineapples. The ripe seeds of the cones turn orange, yellow or scarlet, but if eaten raw can cause acute gastro-enteritis or even death.

Gardening: KAY MONTGOMERY



The stem of a cycad showing the soft core. The core is edible hence its name **broodboom.**

CYCADS : SET OF LAWS NEEDED

To save these ancient plants we need effective measures that encourage propagation by responsible bodies

CENTRAL BUREAU REPORT

A CONCISE, effective and uniform set of laws which totally prohibits removal of any cycads from the natural habitat is necessary in South Africa, says Roy Osborne, a cycad expert, writing in *Endangered Wildlife*, journal of the Endangered Wildlife Trust.

In an article on proposals for the effective conservation of cycads, Mr Osborne says the only circumstances in which removal can be justified is when operations such as road and dam construction threaten the plants directly.

In this case, he writes, provision should be made for the relocation of specimens, but only to approved botanical gardens or reserves.

The legislation must also clearly provide for the authorised sale, donation, import and export of cycads and an unambiguous distinction must be made between field-collected and nursery-propagated plants.

Mr Osborne says severe penalties must be imposed on those contravening the law. The so-called "Cactus Law" of the USA could be a useful model to follow, he says.

Trangressors may be deemed unfit to possess endangered plants and their collections confiscated.

The second point in a 7-point conservation action plan calls for urgent studies to be made on the possibility of proclaiming additional reserves where cycad habitats are in jeopardy.

Mr Osborne says the emphasis here must lie on the conservation of cycad habitats rather than on cycad species or even populations. The means for this is already provided for in SA by the new Environment Conservation Act

Some excellent work has already been done in this respect. Attention must be given to the matter of security of plants in these reserves, possibly through controlled access with persons identified in entrance records.

He says the noble idea of re-introducing nursery-raised cycads to habitat must be carefully evaluated with attention being paid to the genetic

SMALLHOLDER

Cycads are majestic plants, and public and private plantings should be encouraged. This is a private cycad nursery near Pretoria.

CYCADS

and phytosanitary quality of the material, its prospect of survival to reach sexual maturity and the likelihood of future regeneration from such plants.

Ecological factors such as the frequency of burn cycles and the presence or absence of specific insect pollen vectors must be carefully assessed.

Consideration should be given to making habitat-collected seed and pollen available to approved growers.

Mr Osborne says further work must be done in creating and properly managing viable cycad collections outside the habitat areas.

The existing plant collections at the botanic gardens at Pretoria, Kirstenbosch, Nelspruit and Ewanrigg form a nucleus for expansion.

He says the National Botanic Institute is going ahead with a bold plan to stock each garden under its control with plantings of the cycads representative of its area.

Another point Mr Osborne makes is there must be adequate catering for the horticultural demand. Cycads are majestic plants and public and private plantings will continue, and indeed should be encouraged whenever nursery stock is available.

The essence here is a reliable supply of high-quality material at reasonable prices.

The Lebowa Government, for instance, has in the past few years propagated some 54 000 seedlings of *Encephalartos transvenosus* for distribution from its nursery near Duiwelskloof in the Northern Transvaal.

Equally laudable is the massive cycad propagation venture at Hartbeeshoek, outside Pretoria, by the Transvaal Provincial Authority.

Mr Osborne's fifth point is to call for a register of all sexually-mature plants in public and private gardens. The logistic data of getting the date, and periodically updating it, should not undermine efforts in this direction, he says.

A partial list would be better than none.

This register would carry details such as the number and gender of plants outside their habitats. The efforts of the Cycad Society of Southern Africa, in its programme to establish and maintain seed and pollen banks, deserves support.

He suggests the registration could be conducted under the auspices of either that society or by the Cycad Specialist Group of the Species Survival Commission of the International Union for the Conservation of Nature and Natural Resources.

The sixth point maintains that education must be encouraged wherever possible. Most cycad enthusiasts are receptive to meaningful information.

In the broad sense, educational programmes must cover an awareness of the legislation and its necessity, and should extend to practical aspects on cycad identification and propagation techniques.

A key component of the educational parcel must be to stress that a garden specimen can assume "feature" qualities only a few years after the nursery seedling stage.

"Having a cycad" does not require that a mature plant is removed from habitat. A sense of pride must be instilled in the "homegrown" cycad.

In his last point, Mr Osborne says cycad-orientated research needs stimulation and co-ordination. Good work is presently in progress at some universities, but a lack of funding is inhibiting progress.

He says a more thorough knowledge of cycad reproductive biology would be immensely useful, as would studies on the dynamics of habitat populations. Also, investigations into the storage of genetic material.

Mr Osborne says there is much common ground between this proposed strategy and plans already under consideration by various official and other bodies.

The proposals have the support of the Transvaal directorate of Nature and Environmental Conservation and the Wildlife Society of Southern Africa.●

SMALLHOLDER

The Daily News Thursday May 2 1991

Botanical garden cannot afford rare African cycads

Daily News Correspondent

NELSPRUIT: The Lowveld's National Botanical garden has first option on a rare African cycad collection — but its management cannot afford the R20 000 being charged by the private collector.

And unless the money can be found before the end of the year, the plants will be auctioned, probably for a lot more than R20 000.

The encephartos collection, described as probably the best in the country, belongs to a Nelspruit man who has asked not to be named.

He is keen for the plants to remain in the Lowveld and decided to offer them to the botanical gardens.

According to curator Johan Kluge, the Nelspruit garden has an excellent collection of cycads from many parts of the world.

"But we do not have that many of the varieties found in the rest of Africa, and this is a wonderful opportunity for us," he said.

Mr Kluge hopes a plant lover will buy the collection and donate it to the Lowveld Botanical Garden.

Mr Kluge can be contacted at (01311)-25531 during office hours or at home on 25692.

THE DAILY NEWS, MONDAY, MAY 6, 1991

MAN WHO TOOK CYCAD SUCKER IS FINED R2 000

Court Reporter

THE flora and fauna must be preserved, a Durban magistrate said today when he imposed the maximum fine of R2 000 (or 12 months in prison) on a collector who unlawfully took a sucker from a specially protected cycad.

Thomas Victor de Villiers of Neptune Road, Westville, pleaded guilty before Mr C. Knoetze.

He admitted that on March 24 this year he removed a sucker from a cycad encephalartus woodi in the yard of a home in Umhlanga Rocks Drive.

A member of the Natal Parks Board, Mr Michael Milton, said this was the rarest cycad in the world. Only one male plant had been found. It could be propagated only by suckers and not by cross pollination. One of these cycads would fetch more than R100 000.

Passing sentence, the magistrate said it was clear De Villiers was a collector who knew this was a very rare plant. He knew taking the sucker was unlawful. If he had been an uninformed person it could have made a difference.

De Villiers committed a deliberate act and knew what he was doing was wrong. He knew it was valuable. Fauna and flora had to be protected and people could not be allowed to take protected plants without permission. He said in De Villiers's case he was imposing the maximum fine.

The Natal Mercury Tuesday March 12 1991

Policeman fined R1 500 for having 61 cycads

Mercury Reporter

A PORT Shepstone police sergeant was fined R1 500 (or five months) yesterday for illegally possessing 61 cycads without a permit.

Stephanus Groenewald, 42, of Stawenger Road, Port Shepstone, pleaded not guilty before Mr J Bester in the Port Shepstone Magistrate's Court to illegally possessing them at his home on July 3 last year.

He told the Court he had been collecting cycads since 1971.

Some he had bought from nurseries and others had been given to him as presents by farmers and a Transkei policeman.

In 1986 he had telephoned Mr Nico Snyman of the Natal Parks Board to find out whether he required a permit to possess them and was told by Mr Snyman that he did not.

Natal Parks Board honorary conservation officer and cycad specialist Cynthia Giddy, who identified the plants at Groenewald's home in September, told the Court the plants measured between 10 cm and 1 m and were aged from five to 80 years.

She said because of their commercial value cycads were being collected to the point of extinction in their natural habitat and their survival was under threat.

Mr Bester suspended R1 000 (or two months jail) of Groenewald's fine for five years.

Mr G Peters appeared for the State and Mr G van Gaalen for Groenewald.

The two largest-known Encephalartus altensteinii cycads are hoisted off an Eskom truck, assisted by members of the East London municipal street tree team. The cycads were a donation to Queens Park Zoo from a Macleantown farmer, Mr Arthur Richter. The *plants, which* are *endemic to* the Eastern Cape, measure up to seven metres, and are estimated to be about 800 years old.

EAST LONDON DAILY DESPATCH

± October 1990

The Star Tuesday July 9 1991

Cycad ring smashed

The Natal Parks Board has uncovered a worldwide cycad smuggling network. A spokesman said steps were being taken locally and abroad against the smugglers.

THE DAILY NEWS, WEDNESDAY, APRIL 3, 1991

Action plan to save cycads

Pietermaritzburg Bureau

A SEVEN-point cycad conservation action plan has been proposed by Dr Roy Osborne, a lecturer at the University of Natal in Durban and member of the cycad specialist group of the International Union for the Conservation of Nature's threatened plant unit.

He writes in Endangered Wildlife that in the past two decades there has been an alarming escalation in the trade in Southern African field-collected cycads.

The demand arises from the wealthy status-symbol owner and the fanatical collector who must have one of each species in his garden, whatever the cost.

These people rarely dig the plants out of their habitat sites directly. Instead they make use of an informal network, which unearths a trader who will arrange the deal, taking hefty profits for his risky enterprise.

The informal network includes importers and exporters for overseas shipments. At the bottom is the unsophisticated tribesman who removes the plant for a relatively trivial fee and who is hardly concerned with, or even aware of, the illegality of his actions.

An analagous situation has arisen in Mexico where many thousands of indigenous cycads have been shipped to the United States or Japan.

Illegal trade in cycads, as with that in ivory or rhino horn, is a problem neither quickly nor easily solved.

Constant vigilance by the authorities over all cycad populations is not possible. Any moderate legislation is exploited with questionable "letters of donation" and laundering of plants by export and re-import from one province to another.

Recent cycad auctions in South Africa have had the effect of inflating prices to unrealistic levels and further weighing the risk versus return factor in favour of the unscrupulous.

Plants are not only removed from natural habitats; nearly all botanic institutions and many private owners report a dismaying frequency of thefts of valuable specimens. Successful prosecution of offenders is uncommon and the fines imposed are often low enough for traders to build into their next deal.

Several official and non-government organisations have done excellent work on these problems. These include the nature conservation officials, the Endangered Species Unit of the South African Police, municipalities and conservation societies.

Dr Osborne believes that existing legislation urgently needs rationalisation and revision. A concise, effective and uniform set of laws, which totally prohibits removal of cycads from habitat, is necessary.

The Natal Mercury Friday May 17 1991

Cycads airlifted to nature reserve

Mercury Reporter

TWO cycads of great botanical significance were airlifted to Natal yesterday from Transkei in a joint operation between conservationists and developers.

The cycads which arrived at the Umtamvuma Nature Reserve near Port Edward yesterday were the last two known specimens, with their nearest 'relatives' occurring in the Eastern Transvaal.

Mr Tony Abott, chairman of the Umtamvuma River Trust said 'Operation Cycad' was made possible by the Natal Parks Board, the Transkei Department of Nature Conservation, Eskom and his Trust.

'Scientists pondered for some time whether it would be wise to move the plants, but collector pressure had made it imperative to move them to a more secure location in a formally protected area.'

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