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SOUTH AFRICA

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COVER / VOORBLAD : A sea of cycads? The authors of the "Focus on ..." article claim that stands of *Macrozamia communis* on the New South Wales south coast have the highest plant density of any cycad in the world.

Photo/Foto: Paul Kennedy

CONTENTS / INHOUD

FROM THE PRESIDENT / VAN DIE PRESIDENT	2
NEW CYCAD PUBLICATIONS	4
FROM COUNCIL / VAN DIE RAAD	5
Aid for Zimbabwean members	5
Cycad Society of South Africa / Broodboom Vereniging van Suid-Afrika: New members since August to 4 October 2001 / Nuwe lede vanaf Augustus tot 4 Oktober 2001	5
Woodcut of <i>Cycas circinalis</i>	6
SHORT COMMUNICATIONS / KORT MEDEDELINGE	7
Documenting the data (Reprinted from <i>The Montgomery News</i>)	7
Our evolving cycad collection (Reprinted from <i>The Montgomery News</i>)	7
News from the Lowveld Branch of the Cycad Society of South Africa A. de Beer	9
Leaf succulent <i>Cycas</i> W. Tang	11
Export of indigenous cycad material / Uitvoer van inheemse broodboom materiaal D. Minnaar	12
FOCUS ON / FOKUS OP <i>Macrozamia communis</i> P. Kennedy, C. Thompson and R. Osborne	13

CONTENTS / INHOUD (continued / vervolg)

LETTERS TO THE EDITOR / BRIEWE AAN DIE REDAKTEUR	22
Scaly survivors	
A. Cilliers	22
Nature in motion	
A. Cilliers	22
·Cycad thefts · <i>Stangeria eriopus</i>	
H. Seedat	23
Comments on <i>ENCEPHALARTOS</i> No. 67	
C.S.M. Bothma	23
Speculation in cycads	
J. van der Merwe	24
<i>Encephalartos longifolius</i> : groot vroulike keël (Summary: <i>E. longifolius</i> : large female cone)	
E. du Toit	24
ARTICLES / ARTIKELS	25
In search of <i>Cycas revoluta</i>	
W. Tang	25
Perspectives on cycads in Africa	
J.S. Golding and P.J.H. Hurter	30
NEWSPAPER CLIPPINGS AND PRESS RELEASES / KOERANTUITKNIPSELS EN AMPTELIKE PERSVERKLARINGS	33
'Illegal' cycads found stacked outside kraal	33
US Department of Justice, Northern District of California: Press Releases	34
Broodbome van R4 m. onderskep	35
The Sting	36

Erratum: In *ENCEPHALARTOS* No. 67 (September 2001): Figure 1 on p. 6 was printed upside-down / Figuur 1 op p. 6 is onderstebó gedruk.

FROM THE PRESIDENT



VAN DIE PRESIDENT

After two lean issues, this one is again 36 pages long, thanks to all of you who submitted contributions. Furthermore, I think you will find it to be one of the most interesting issues of recent times.

Cycads are not scarce everywhere, and Australian enthusiasts find it difficult to understand that *Encephalartos* mostly occurs in low numbers and low concentrations. Conversely, South Africans visiting Australia are invariably surprised at the numbers and concentrations of some species, like *Macrozamia*

Na twee dun uitgawes, is hierdie een weer 36 bladsye lank, danksy almal van u wat bydraes ingestuur het. Ek dink ook dat u sal vind dat dit een van die interessantste uitgawes van die laaste tyd is.

Broodbome is nie orals skaars nie, en Australiese entoesiaste kan moeilik verstaan dat *Encephalartos* meestal in klein getalle en lae konsentrasies voorkom. Daarteen, Suid-Afrikaners wat Australië besoek, is sonder uitsondering verras oor hoe baie plante daar voorkom van sekere soorte, en hoe dig opmekaar die plante staan. 'n Voorbeeld hiervan is *Macrozamia*

communis which is featured in this issue's "focus on" section. However, that is no reason for complacency. Many other Australian cycad species, and indeed most cycad species elsewhere in the world, occur in small numbers, in small areas, or in low concentrations, and simply cannot bear harvesting.

On page 12 Derik Minnaar makes a well motivated plea for the complete prohibition of exporting any cycad material from the country of origin. He rightly concludes that in many instances such exports are driven by monetary greed. This is all too true. I cannot but agree with Jack van der Merwe's letter on page 24, where he complains bitterly about seeing cycads as investments. We are not an investment club, but a group of enthusiasts who like to grow these plants, because they are so beautiful and interesting, and there are still so many things to be discovered about them. Here I need only refer to Willie Tang's remarkable article about leaf succulence on page 11. Willie is qualified as a botanist, but is not employed as such. Everyone of us can make similar discoveries in our gardens. But to get back to Derik's argument: personally I like to see members of the public growing wild plants, because it fosters a love for, and interest in, our plants. Sooner or later all of us want to expand our collections to include related species from other parts of the world, but the current CITES regulations make it virtually impossible to exchange material over international borders. I feel that enthusiasts exchanging pollen and seed, usually harvested from their cultivated plants, do not damage the ability of cycads to survive in the wild.

The international cycad fraternity has been shaken by recent arrests of people alleged to have illegally traded with cycads across international borders. This issue's press clippings provide information on what is known at this stage. I think you will all agree that this sort of activity has to stop. Today there are manyfold more cycads in cultivation than have ever been in nature in historic times, and this is due to collectors hand-pollinating their plants and propagating the seeds in their backyard nurseries. There is simply no justification for the removal of a single plant from nature anymore. What then of those rare and elusive species of which we never get any plants? We just have to accept that some species are, at least for the present, too rare to be in private hands.

Lastly, kindly let us know what you think of this issue's colour section. We received unusually many interesting colour photos, and our answer is to place as many of them as possible in colour. However, because we have only four pages for colour photos, it meant that we had to print some smaller, in three instead of two columns per page. An alternative would have been to print some in black and white in larger size.

Piet Vorster

communis, wat behandel word in hierdie uitgawe se "fokus op" afdeling. Dit is egter geen rede om gerus te wees nie. Baie ander Australiese soorte, en inderdaad meeste broodboomsoorte elders in die wêreld, kom voor in klein getalle, in beperkte gebiede, of in lae konsentrasies, en kan eenvoudig nie bekostig dat enige plante verwyder word nie.

Op bl. 12 lewer Derik Minnaar 'n goed-gemotiveerde pleidooi vir 'n totale verbod op die uitvoer van enige broodboom materiaal uit die land van oorsprong. Sy korrekte gevolgtrekking is dat sulke uitvoere in baie gevalle gedryf word deur geldgierigheid. Dit is maar al te waar. Ek kan ook net saamstem met Jack van der Merwe se brief op bl. 24, waarin hy bitterlik te velde trek daarteen dat broodbome as 'n belegging beskou word. Ons is nie 'n beleggingsklub nie, maar 'n groep van liefhebbers wat graag hierdie plante kweek omdat hulle so mooi en interessant is, en daar nog so baie dinge is wat ons omtrent hulle kan ontdek. Hier verwys ek na Willie Tang se merkwaardige artikel oor blaarsukkulensie op bl. 11. Willie is gekwalifiseer as plantkundige, maar werk in 'n ander vakrigting. Elkeen van ons kan net sulke ontdekkings maak in ons tuine. Maar om terug te kom na Derik se argument: persoonlik hou ek daarvan dat die publiek wilde plante kweek, omdat dit 'n liefde vir, en belangstelling in, ons plante bevorder. Vroeër of later begeer elkeen van ons om ons versamelings uit te brei deur verwante soorte van ander wêrelddele te bekom, maar die huidige CITES reëls maak dit feitlik onmoontlik om materiaal oor internasionale grense heen uit te ruil. Ek voel dat entoesiaste wat stuifmeel en saad, gewoonlik geoes van hulle tuinplante, uitruil, nie broodbome se kans benadeel om in die natuur te oorleef nie.

Die internasionale broodboomgemeenskap is geskud deur onlangse inhegtenisnames van mense wat na bewering onwetting met broodbome handel gedryf het oor internasionale grense heen. Hierdie uitgawe se koerantuitknipsels vertel wat op hierdie stadium bekend is. Ek dink u sal almal saamstem dat hierdie soort optrede moet ophou. Vandag is daar veel meer broodbome in tuine as wat daar ooit in menseheugenis in die natuur was, en dit is omdat bykans elke versamelaar sy plante handbestuif en die saad ontkiem in sy agterplaaskwekery. Daar is eenvoudig geen regverdiging meer om 'n enkele plant uit die veld te verwyder nie. Wat dan van daardie seldsame en ontwykende soorte waarvan ons nooit plante kan kry nie? Ons moet net aanvaar dat sommige soorte, vir die huidige ten minste, te skaars is om in private hande te verkeer.

Laastens, laat weet gerus vir ons wat u dink van hierdie uitgawe se kleur-afdeling. Ons het buitengewoon baie interessante kleurfotos ontvang, en ons antwoord is om so veel as moontlik daarvan in kleur te plaas. Omdat ons egter net vier bladsye het vir kleurfotos, het dit beteken dat ons sommige fotos kleiner moes druk, in drie in stede van twee kolomme per bladsy. 'n Alternatief sou gewees het om sommige groter, maar in swart en wit, te druk.

Piet Vorster

NEW CYCAD PUBLICATIONS

CAFASSO, D., COZZOLINO, S., CAPUTO, P & DE LUCA, P. 2001. **Maternal inheritance of plastids in *Encephalartos Lehm* (Zamiaceae, Cycadales).** *Genome* 44(2): 239–241.

[The mode of inheritance of chloroplast DNA has been determined in *Encephalartos* by employing a restriction fragment length polymorphism analysis of chloroplast DNA. Artificial F-1 hybrids were produced between a female specimen of *E. natalensis* and a male specimen of *E. woodii*. The hybridization patterns of all hybrids correspond in all cases, with that of *E. natalensis*, and are different from that of *E. woodii*, thus indicating the maternal inheritance of cpDNA in cycads.]

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DI MICHELE, W.A., MAMAY, S.H., CHANEY, D.S., HOOK, R.W. & NELSON W.J. 2001. **An early Permian flora with late Permian and Mesozoic affinities from north-central Texas.** *Journal of Paleontology* 75(2): 449–460.

[Early Permian (late Leonardian Series) plant assemblages from King Knox, and Stonewall Counties of North-Central Texas are dominated by seed plants, some apparently congeneric with taxa heretofore known only from the late Permian or the Mesozoic. Conifers are the dominant elements including one or more species of *Ullmannia*, *Pseudovoltzia liebiana*, both known from the Late Permian Zechstein flora of Germany and England, *Podozamites* sp., characteristic of the Mesozoic, and *Walchia* sp., abundant in Early Permian floras. Locally common are *Taeniopteris* cf. *eckardtii*, a Zechstein species, an unidentified plant represented by pinnule-like laminae with fine parallel veins, similar to pinnules of some Mesozoic cycads, and calamite stems. Rarely encountered are leaf fragments of the Paleozoic ginkgophyte *Dicranophyllum*, flabellate ginkgophyte leaves, leaves with a broad midvein and narrow, fimbriate lamina, and *Wattia*, typical of the Early Permian. Associated with these foliar remnants are ovulate reproductive structures, including the presumed cycad megasporophyll *Dioonitocarpidium*, known only from the Mesozoic, a voltzialean cone scale similar to *Swedenborgia*, and a variety of seeds, some remarkably similar to *Agathis*, of Cretaceous age. The assemblage includes only rare scraps of foliage and seeds possibly attributable to the pteridophyllous elements (gigantopterids, callipterids, and ferns) that dominate the Permian. The occurrence of derived lineages in xeric habitats during the Early Permian indicates that some supposed Mesozoic groups actually preceded and survived the end-Permian extinction, reappearing in basal lowlands during the mid-Mesozoic.]

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FRIEDMAN, W.E. & FLOYD, S.K. 2001. **Perspective: The origin of flowering plants and their reproductive biology - A tale of two phylogenies.** *Evolution* 55(2): 217–231.

[Recently, two areas of plant phylogeny have developed in ways that could not have been anticipated, even a few years ago. Among extant seed plants, new phylogenetic hypotheses suggest that Gnetales, a group of non-flowering seed plants widely hypothesized to be the closest extant relatives of angiosperms, may be less closely related to angiosperms than was believed. In addition, recent phylogenetic analyses of angiosperms have, for the first time, clearly identified the earliest lineages of flowering plants: *Amborella*, Nymphaeales, and a clade that includes Illiciales/Trimeniaceae/Austrobaileyaceae. Together, the new seed plant and angiosperm phylogenetic hypotheses have major implications for interpretation of homology and character evolution associated with the origin and early history of flowering plants. As an example of the complex and often unpredictable interplay of phylogenetic and comparative biology, we analyzed the evolution of double fertilization, a process that forms a diploid embryo and a triploid endosperm, the embryo-nourishing tissue unique to flowering plants. We demonstrate how the new phylogenetic hypotheses for seed plants and angiosperms can significantly alter previous interpretations of evolutionary homology and firmly entrenched assumptions about what is synapomorphic of flowering plants. In the case of endosperm, a solution to the century-old question of its potential homology with an embryo or a female gametophyte (the haploid egg-producing generation within the life cycle of a seed plant) remains complex and elusive. Too little is known of the comparative reproductive biology of extant non-flowering seed plants (Gnetales, conifers, cycads, and *Ginkgo*) to analyze definitively the potential homology of endosperm with antecedent structures. Remarkably, the new angiosperm phylogenies reveal that a second fertilization event to yield a biparental endosperm, long assumed to be an important synapomorphy of flowering plants cannot be conclusively resolved as ancestral for flowering plants. Although substantive progress has been made in the analysis of phylogenetic relationships of seed plants and angiosperms, these efforts have not been matched by comparable levels of activity in comparative biology. The consequence of inadequate comparative biological information in an age of phylogenetic biology is a severe limitation on the potential to reconstruct key evolutionary historical events.]

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VAJDA, V. 2001. **Aalenian to Cenomanian terrestrial palynofloras of SW Scania, Sweden.** *Acta Palaeontologica Polonica* 46(3): 403–426.

[Dispersed miospore assemblages recovered from 35 drill-core samples from Hollviken 2, Norrevang 1, and Svedala 1 wells, all in SW Scania, Sweden, are described. Over 80 taxa of pollen and spores, ranging from the Aalenian to the Cenomanian were identified. The palynofacies analyses indicates that a continental depositional environment prevailed during the Aalenian in Scania. On the basis of the palynoflora it is suggested that the vegetation consisted of cycads, conifers, pteridophytes and a very limited number of angiosperms.]

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VAN DER BANK, H., WINK, M., VORSTER, P., TREUTLEIN, J., BRAND, L., VAN DER BANK, M. & HURTER, J. 2001. **Allozyme and DNA sequence comparisons of nine species of *Encephalartos* (Zamiaceae).** *Biochemical Systematics & Ecology* 29(3): 241–266.

[Phylogenetic relationships between *Encephalartos altensteinii* Lehmann, *E. longifolius* (Jacquin) Lehmann, *E. princeps* R.A.Dyer and *E. trispinosus* (Hooker) R.A Dyer were studied, using *E. ferox* Bertoloni f. as outgroup. Three continuous and one discontinuous buffer systems were used

and gene products of 14 enzyme coding loci were examined by horizontal starch gel-electrophoresis. Genetic variation was studied in a cultivated population of *E. lehmannii* and the average heterozygosity value for this population is 13.5%, which falls within the range reported for other cycad species. Fixed allele differences between the species studied was not found at any of the loci studied, which suggest that these species are closely related. DNA sequence analysis of *rbcL* and ITS 1 & 2 genes (1428 and 895 basepairs, respectively) confirmed the close genetic relationships between these taxa. According to ITS and *rbcL* sequences *E. altensteinii* and *E. princeps* are sibling taxa which form a sister group to *E. arenarius*, *E. horridus*, *E. latifrons*, *E. lehmannii*, *E. longifolius* and *E. trispinosus*. The genetic distances between both groups were 0.12–0.47% for ITS and 0.08–0.16% for *rbcL* DNA. The results indicate recent (probably pleistocenic) speciation for this group of cycads, and the relationships are discussed with reference to affinities based on morphology and distribution.]

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FROM COUNCIL / VAN DIE RAAD

AID FOR ZIMBABWEAN MEMBERS

Our Zimbabwean members are experiencing serious problems in obtaining foreign exchange to pay their membership fees. This is due to the poor economic situation in general, and the runaway erosion of their currency.

We would therefore like to start a fund to help paying their subscriptions. Please send donations to the Secretary, and mark it *aid for Zimbabwean members*. Unless you express the wish to remain anonymous, we will acknowledge contributions in *ENCEPHALARTOS*. Currently we have 10 Zimbabwean members.

CYCAD SOCIETY OF SOUTH AFRICA / BROODBOOM VERENIGING VAN SUID-AFRIKA

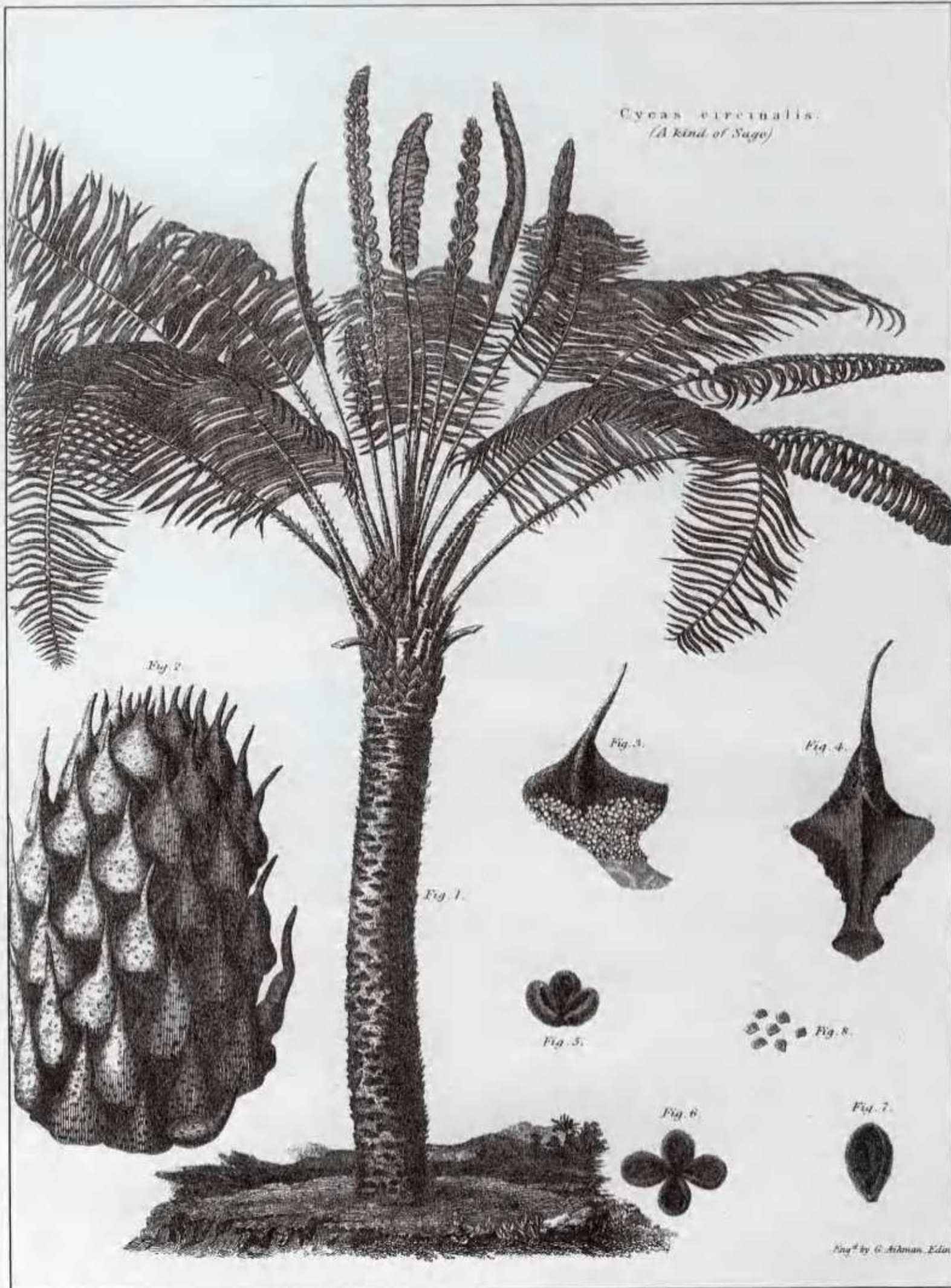
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WOODCUT OF *CYCAS CIRCINALIS*

This magnificent woodcut appeared in *Encyclopaedia Britannica*, ed. 9, vol. 4: 163, pl. XV (1874), at the end of an excellent chapter on *botany*. It is named *Cycas*

circinalis. This name has been grossly miss-applied, but in this case it is probably correct because of the characteristic long needle-like apices to the male cone scales.



SHORT COMMUNICATIONS / KORT MEDEDELINGE

DOCUMENTING THE DATA

Letter from the Executive Director
Terrence Walters, Ph.D.

Reprinted from *The Montgomery News* vol. 9 No. 2 (Fall 2001) [Newsletter of Montgomery Botanical Center]
with permission from the editor.

As we begin the information millennium, only reliable and useful observations will survive the data deluge. MBC's mission is to provide researchers with the type of botanical information that will lead to an increased understanding of the plant world that sustains us. Throughout a plant's life at MBC, the Horticulture and Collections Development (CD) Teams work closely together to ensure that all potentially valuable scientific observations are entered into MBC's collections database. BG-Base and BG-Map are the two computer programs used for data entry, tracking, and retrieval.

Collectors for MBC begin the documentation of our collection when they obtain seed samples from the wild. Extensive notes and photographic images are required for each population sample. Once the seeds arrive at MBC, they are sent to the nursery, where Barbara Judd digitally photographs them. She documents her sowing procedures, collects data on seed germination, and notes the horticultural care and requirements of the developing seedlings. Digital images are taken of taxonomically useful morphological features (e.g., leaf shape and color) during a plant's juvenile stage. Once a week, Barbara submits her documentation to CD Department volunteer Jean Stark for input

into the database.

Once a plant leaves the nursery and becomes part of MBC's Ground Collection, Laurie Danielson, Eric Shroyer, and Scott Massey begin documenting the horticultural care, development, and phenology of each plant. Barbara Bohnsack surveys the new transplants, adding the coordinates to the database with Norma Armstrong's support. Sue Katz takes over the responsibility of digital imaging for plants in the ground. One plant from each population is photographed every other year to visually document growth and development. When a plant becomes reproductive, Sue photographs the entire process, from bud initiation to final seed set. Judy Kay also documents her activities, which are associated with pollen collection, hand pollinations, seed production, and seed distribution.

MBC commits a tremendous amount of energies and resources towards collecting accurate and useful data on our plant collections. We believe that the quality of both our plants and their associated data will make MBC's palm and cycad collections priceless subjects for future scientific enquiries.

OUR EVOLVING CYCAD COLLECTION

Reprinted from *The Montgomery News* Vol. 9 No. 2: 4 (Fall 2001) [Newsletter of Montgomery Botanical Center]
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Eight years have passed since the MBC Team made the commitment to develop a world-class, scientifically-useful, population-based collection of cycads. MBC's first cycad collecting expedition was to southern China in 1992. Since that time, we have mounted an average of two expeditions per year. This year, collecting forays to Belize, Ecuador, Mexico (Figure 1), and Panama have greatly enhanced our New World collection. As a result of these expeditions, 2,426 cycads are growing on the grounds of MBC and over 2,000 seeds and seedlings in the nursery are waiting to be transplanted outdoors.

Expeditions are not the only mechanism by which we add to MBC's cycad collection. We are supporting scientists and students living in various Central and South American countries to collect seeds whenever cones in native populations become mature. One funding contribution has allowed us to support field work by Mexican botanist Miguel Angel Pérez-Farrera. In addition to collecting germplasm, Miguel will be documenting population sites throughout Mexico in anticipation of future MBC expeditions.



Figure 1 In January, MBC, Ganna Walska Lotusland in California, and the Clavijero Botanical Garden in Xalapa, Mexico undertook a cycad expedition to Mexico to document the location and conservation status of populations of *Ceratozamia*. An exciting moment was when Tim Gregory (left) and Jeff Chemnick located *C. hildae* in the wild. The native population contained 10% of the non-fasciculated leaf form (leaf-type held by Tim) and 90% of the normal fasciculated leaf type (leaf held by Jeff).

We strive to increase the horticultural care and scientific value of our cycad collection by interacting with horticulturists and scientists who work with similar collections. This April, Executive Director Terrence Walters met with three cycad scientists and two horticulturists at the Orto Botanico di Napoli in Italy to learn about the care of their cycads, and to encourage them to access MBC's collection for future research studies. In June, Eric Shroyer spent three weeks in South Africa, where he met with numerous cycad experts. Eric gave three lectures to the South African cycad community, promoting the Montgomery name as well as the use of our collections.

This year, we have made great strides with respect to developing the cycad collection. For example, we added six acres to the existing six-acre Cycad Walk. The main path of the Cycad Walk was re-directed from its original east to west direction to a north to south axis. This allowed us to incorporate the new six-acre addition, to take advantage of the long north-south length of our property, and to connect the southern termini of the Cycad and Palm Walks at the Palm Circle.

With the revised Cycad Walk design in hand, we planted a total of 332 cycads into the outdoor beds this spring. One of our plantings is what we believe to be the only wild-collected, population-based sampling of the Japanese native, *Cycas revoluta*. Although this species is the most commonly cultivated cycad in the world, the type of material required for scientific investigations has not been previously available outside of Japan.

We also began the development of our tropical zamia area



Figure 2 This spring, one of the 103 plants in MBC's *Cycas panzhihuaensis* collection coned. Here is a view of the first male cone.

this summer. To protect this rare and truly tropical group of cycads, we planted a large number of dicot trees to provide a full-shade canopy and installed an overhead irrigation system.

Many of the plants collected during the early 1990s expeditions began coning in 2000. This year, we were very excited to see the first coning event in the extremely large *Cycas panzhihuaensis* (Figure 2) collection. Having grown vigorously from seeds collected in China in 1992, these plants are finally starting to reach reproductive maturity.

Another effort designed to improve the quality of our cycad collection is the bringing together of cycad experts. With the aid of a recent contribution from the Bressler Foundation, we have invited 17 of the world's leading cycad scientists to attend a three-day "Cycad Classification Concepts Workshop" at MBC in 2002. The workshop will concentrate on the development of a consistent, practical, and internationally accepted classification for cycad taxa. A shared vision by cycad scientists will allow the pace of cycad research to accelerate, a process in which MBC is proud to participate.

NEWS FROM THE LOWVELD BRANCH OF THE CYCAD SOCIETY OF SOUTH AFRICA.

Alice de Beer
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Received 5 October 2001



Figure 1 Lowveld branch of the S.A. Cycad Society outside the office of the Mbuluzi Game Reserve.

REPORT ON RECENT ACTIVITIES

Encephalartos lebomboensis and E. umbeluziensis excursion

The Lowveld branch of the Cycad Society recently held their annual away weekend field trip. This year our destination was Swaziland to view the *E. umbeluziensis* and *E. lebomboensis* in habitat.

Friday night saw most of the group meet and socialise at the Mbuluzi Game Reserve (Figure 1). The accommodation and facilities were extremely comfortable and of a very high standard. The group hired two camp sites on the banks of one of the tributaries of the Mbuluzi River.

On Saturday morning, we made an early start heading back

to the Managa Border Post in S.A. where we met up with the remainder of the group. Our mission was to view the *E. lebomboensis* on top of the Lebombo Mountain Range. This excursion was made possible by the kind assistance of Gerhard Strydom from Mpumalanga Nature Conservation. The cycads are situated in a sensitive area adjoining S.A., Swaziland and Mozambique borders, which are regularly patrolled by the military.

The group enthusiastically proceeded towards the foothills of the Lebombo Mountain Range. Beautiful specimens of *E. lebomboensis* were already visible high up in the granite outcrops. The climb, however, became increasingly more strenuous and some of the members decided not to continue. A decision was made by the group that some would return to the vehicles while the remainder continued heading for the top of the mountain. After a one and a



Figure 2 *E. lebomboensis* on top of the Lebombo Mountains. Photo: Alice de Beer.



Figure 3 *E. lebomboensis* growing out of a small crack inbetween two rocks. Photo: Alice de Beer.

quarter hour climb, the magnificent sight of many mature cycads was our reward (Figure 2; Colour Figures 13, 14 on pp. 18, 19) Interesting observations were made of plants that had germinated and grown to maturity in the most unlikely places. Some plants were growing in granite rock faults no wider than 10 cm with seemingly no ill effect (Figure 3). One can only but wonder at how these plants have grown with so little soil and moisture at their disposal. One particular plant was growing directly beneath a rock slab, but undoubtedly knowing the perseverance of cycads,

it would eventually succeed to escape this handicap.

Veld fires had swept through a part of the cycad population, with many plants being scorched. This, however, would only mean a temporary setback, as fires must have threatened this colony for millions of years.

A further reward was the incredible view over the Lowveld framed by soothing rock pools and beautiful indigenous vegetation.

Gerhard Strydom told us that this was a healthy population of cycads with self-pollination still taking place.

The afternoon outing took us back into Swaziland to view the *E. umbeluziensis* situated in the Mlawula Nature Reserve. A friendly warden kindly escorted us in the reserve. The access road to the colony was in fairly poor condition as severe flooding had destroyed some bridges and roads during the previous rain season. Much to the surprise of the group, the *E. umbeluziensis*'s were not situated on the riverbanks, but slightly high up in dense vegetation (Colour Figures 10, 12 on p. 18). It was also very encouraging to see a healthy population of plants thriving in their natural habitat. Although lacking the magnificent stem height of some other cycads, *E. umbeluziensis* remains a beautiful small cycad with attractive foliage.

Saturday night saw a late start of the braai fires due to some of the group members not being able to find the main camp site. Sore, tired and thirsty bodies were soothed by a relaxing night around the camp-fire with good food and cold beers. It was agreed by all that special outings such as this, really make it worth while belonging to a Cycad Society.

The weekend was thoroughly enjoyed by all and showed that seeing cycads in their natural habitat is educational and fun.

The Lowveld branch is growing steadily, with participation and contributions from the members increasing.

LEAF SUCCULENT CYCAS

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Received 1 October 2001

In the plant kingdom pronounced leaf succulence occurs in a number of drought adapted flowering plants. Notable examples include aloes and lithops of southern Africa. Most species of these groups have leaves that are relatively reduced in size, but which are very thick and function in water storage. One advantage of this kind of leaf is that they are drought resistant even when they are forming. An emerging leaf of an aloe may suspend its growth when denied water and appear nearly as drought resistant as its older leaves. Cycad leaves, although often described as drought tolerant, are not in the same category. While slightly succulent, they do not store much water. More importantly, when cycad leaves are unfurling they are very soft and vulnerable to drying.

In botany, as in the rest of biology, there is usually an exception to every rule. I report here, an exception or at least an intermediate condition in a cycad - a *Cycas* that more closely exhibits, at the seedling stage, the growth form of leaf succulents. Seeds of *Cycas tansachana* collected in the Fairchild Tropical Garden/Montgomery Foundation 1995 Expedition to Thailand were germinated and grown under warmth and moisture, nearly ideal conditions for cycads. A large portion of the *C. tansachana* seedlings that germinated did not produce leaves for many months. Instead, the seedlings produced several flushes of scale leaves, which remained green and presumably photosynthetic (Colour Figure 28, on p. 20). The growth form of these seedlings were reminiscent of some lithops and haworthias. *Cycas tansachana* grows on limestone cliffs, often out of crevices with no apparent soil (Tang *et al.* 1997, Tang 1999). When exposed to sun, these cliffs can become very hot. I have observed such sun-exposed

cliffs burst into steam during an afternoon shower. It would appear that this species has adapted to such a drought prone habitat by evolving a stem and leaf succulent seedling, the life stage of the plant that is most susceptible to drought stress. Instead of immediately producing a normal leaf, which is very prone to drying out while unfolding, a large proportion of the seedlings photosynthesize with succulent scale leaves and pour their energy into building up a stem. Once they build a stem large enough to resist drought, only then will they attempt to produce a normal leaf. This trait appears to be hardwired in those seedlings that possess it - they will exhibit this trait even if grown under ideal conditions. This trait of delayed leaf production was exhibited in varying degrees by seedlings from the same seed batch. It appears that in this species there is some genetic variation in this trait. The genes for the extreme condition of stem and leaf succulent is maintained in plants that can establish themselves on the barren cliffs. Genes that code for the earlier appearance of normal leaves is maintained in the population since many seeds fall into more favourable spots, such as closer to cliff bases, where conditions are more moist and shady. In this situation, producing a leaf as soon as possible would give the seedling a head start and a competitive advantage over those that do not.

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EXPORT OF INDIGENOUS CYCAD MATERIAL UITVOER VAN INHEEMSE BROODBOOMMATERIAAL

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The export of live indigenous cycad material from South Africa to any other country has been a source of contention for many years. Live indigenous cycad material from South Africa include pollen, pollinated seeds, seedlings, as well as any plants or pieces thereof of the genera *Encephalartos* and *Stangeria*.

Regarding the conservation of these magnificent plants, it is found that natural colonies are being over-collected and some existing plants in nature are now so sparsely distributed that natural pollination becomes increasingly unlikely. Most collectors are not interested in the art of cultivation, resulting in plant collections that only produce the odd hybrid.

Conservation authorities do not have the resources to effectively guard plants in nature. All evidence lead to the fact that the concept of "an abundant cycad species" does not exist any more. Even the country's most prominent cultivators are at times struggling to source viable seed. Some culprits are conservation authorities themselves, who often deny the South African public the opportunity to collect material, or refuse to help with the provision of pollen. By denying others the opportunity to propagate some species, their kingdom remain the prime representation of particular species, for example *E. woodii* and *E. latifrons*.

In the light of the above mentioned facts, it is fair to conclude that the export of cycad material has no advantage to the species whatsoever. On the contrary, the main drive for the export of cycad material is personal enrichment, to the disadvantage of nature and those who try to conserve it for future generations.

It is many people's strong belief that the export of any cycad material from South Africa should be banned until cycads can be considered abundant and freely available to the general public. Let us be concerned and help to develop measures to unselfishly conserve these ancient plants for future generations.

Die uitvoer van lewende inheemse broodboom materiaal vanuit Suid-Afrika na enige ander land is reeds vir baie jare 'n kontroversiële onderwerp. Lewende broodboom materiaal vanuit Suid-Afrika sluit stuifmeel, bestuifde saad, saailinge, asook enige ander plante of dele daarvan van die genusse *Encephalartos* en *Stangeria* in.

Met betrekking tot die bewaring van hierdie besondere plante, is daar gevind dat natuurlike kolonies van sommige van die plante tans so yl versprei is, dat natuurlike bestuiving toenemend onwaarskynlik word. Talle versamelaars stel nie belang in die kweking van broodbome nie, met die gevolg dat daar af en toe slegs kruisings uit sommige van hierdie versamelings voortgebring word.

Bewaringsowerhede het nie voldoende hulpbronne om die plante effektief in die natuur te bewaar nie. Alle aanduidings dui daarop dat 'n "oortloedige broodboomspesie" nie meer bestaan nie. Selfs van ons land se mees prominente kwekers van inheemse broodboomsaailinge sukkel van tyd tot tyd om vrugbare saad te bekom. Soms is selfs van die bewaringsowerhede skuldig deur die publiek te ontnem om sekere spesies te versamel, of om the help in die voorsiening van stuifmeel. Deur Suid-Afrikaners te ontnem van die voorreg om sommige spesies te kweek, bly hulle rykdom steeds die primêre verteenwoordiging van hierdie plante, byvoorbeeld *E. woodii* en *E. latifrons*.

In die lig van bogenoemde feite is dit vanselfsprekend om aan te neem dat die uitvoer van inheemse broodboom materiaal geen voordele vir die plante inhou nie. Inteendeel, die belangrikste dryfveer vir die uitvoer van broodboom materiaal is dikwels persoonlike verryking wat tot nadeel strek van die natuur en diegene wat dit probeer bewaar vir die nageslag.

Baie mense voel sterk daarvoor dat die uitvoer van enige broodboom materiaal vanuit Suid-Afrika verbied moet word todat broodbome as oortloedig beskou kan word. Laat ons besorg wees en help om maatstawe in werking te stel om onbaatsugtig hierdie plante te bewaar vir die nageslag.

FOCUS ON ...

In each edition of *ENCEPHALARTOS*, we focus on one cycad species, in the form of an in-depth article in layman's language. In this edition the spotlight falls on:

FOKUS OP ...

In elke uitgawe van *ENCEPHALARTOS* fokus ons op een broodboomsoort, in die vorm van 'n in-diepte-artikel in leketaal. In hierdie uitgawe val die kollyg op:

MACROZAMIA COMMUNIS L.A.S. Johnson

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INTRODUCTION

In "*Encephalartos*" No. 17 (March 1989, p. 32) a mischievous past editor inserted the following nonsense:

"Q. What is green, subversive and lives in Australia?
A. A communis plot."

Some 50 issues of the magazine further, one could say "the plot thickens". This issue brings in focus the species which is arguably the best known and most horticulturally versatile of the Australian cycads, *Macrozamia communis*. This species also holds global records for being the southernmost of all cycads and, to our knowledge, for having the highest plant density of any cycad population – the plot does indeed thicken. The aptly-selected epithet *communis* is derived from the Latin adjective for "common, or occurring in abundance".

Previous "Focus on" articles covering this genus have featured the Northern Territory's *M. macdonnellii* ("*Encephalartos*" 59), Queensland's *M. longispina* ("*Encephalartos*" 66), *M. lucida* ("*Encephalartos*" 56), *M. moorei* ("*Encephalartos*" 49) and *M. platyrachis* ("*Encephalartos*" 61). Our feature species, the Australian *burrawang*, is the first of the New South Wales cycads to be presented in this series.

DISCOVERY

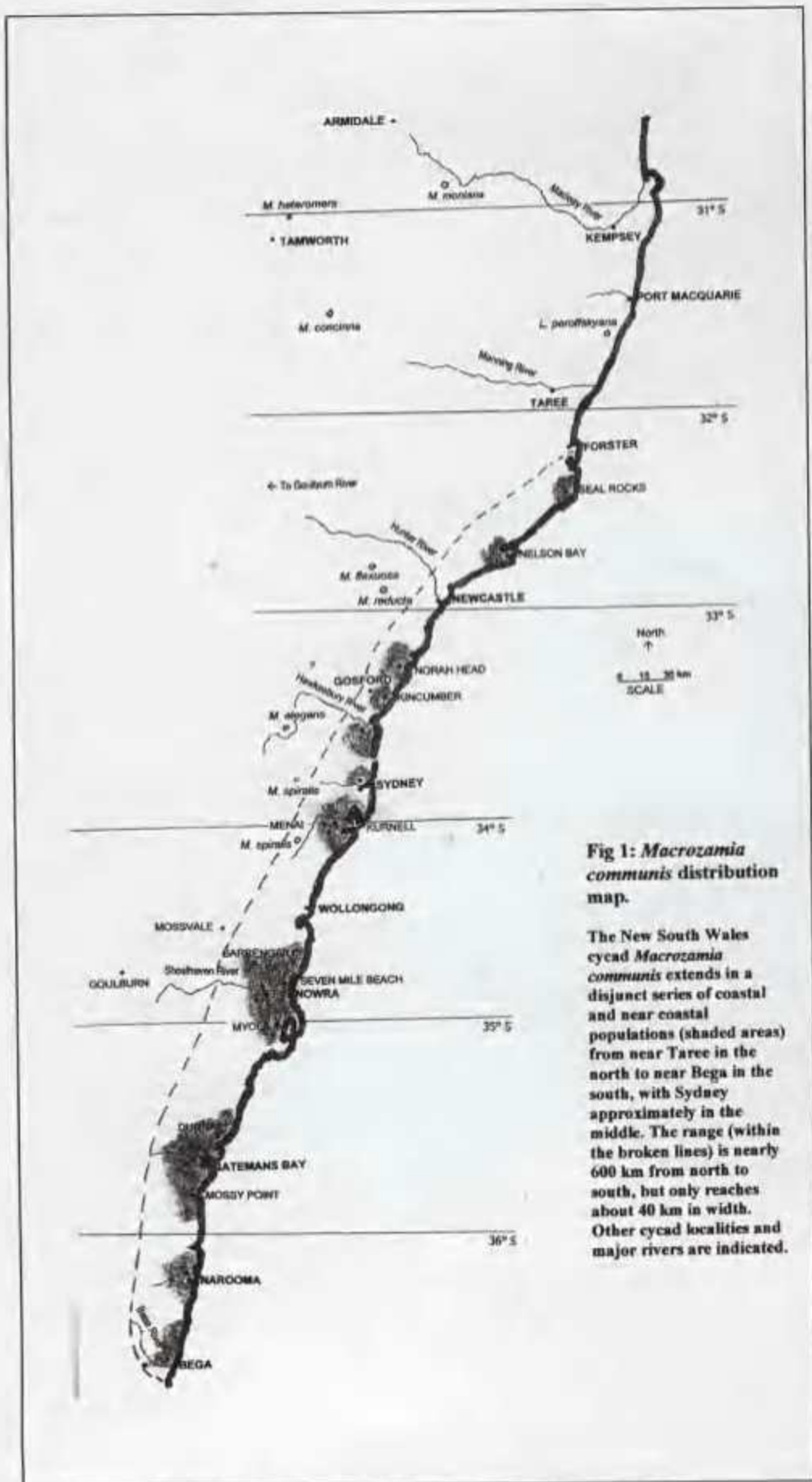
Putting aside eurocentric botany for the moment, it is clear that *Macrozamia communis* was known many years ago to the Australian Aborigines, who valued the plant for its abundant but seasonal seed supplies - having learned to remove the toxic components by various grinding, leaching and baking processes. The name "burrawang" (sometimes "burrawan" or incorrectly "burrawong") is well-documented in the Dhurak Aboriginal language of folk from the present-day Sydney and Illawarra regions. It refers to both

plants and seeds of *M. communis* and has also been ascribed to other New South Wales cycads, including *Lepidozamia peroffskyana*.

Confusion reigns in the early taxonomic treatment of *Macrozamia*. In the June 1770 record from Captain Cook's expedition on the vessel *Endeavour*, accompanying botanists Sir Joseph Banks and Dr D.C. Solander mention - amongst many other strange and unusual plants - a cycad from the area named Botany Bay, just south of present-day Sydney in New South Wales. We believe this sighting must refer to the stand of *Macrozamia communis* which is still to be found in the sand hills at Kurnell, very close to where Captain Cook landed. A specimen collected by David Burton and given the name *Zamia spiralis* by the British botanist Richard Salisbury in 1796, is thought to have originated from Port Jackson in the Sydney area. The plant in question was re-named by Miquel in 1834 as *Encephalartos spiralis* when an early affinity of the African and Australia cycads was noted. Other names which may refer to the same species include *Zamia tridentata*, *Macrozamia tridentata*, *Macrozamia spiralis*, and Schuster's remarkable coinage of "*Macrozamia tridentata* subspecies *cylindrica* var. *corallipes* forma *wallsendensis*". [Interested readers are referred to the taxonomic history of Australian cycads by Ken Hill (1993).] We believe that all these collections refer to the species later named *Macrozamia communis* by Dr Lawrie Johnson in his pioneering work on the taxonomy of Australian cycads (Johnson 1959, 1961). Johnson's type for the species is based on material collected in 1958 from a site 5 km west of Mossy Point, near Batemans Bay on the New South Wales south coast.

DISTRIBUTION

Endemic to the Australian state of New South Wales, *Macrozamia communis* extends from northern stands near Taree southwards to a population in the vicinity of Bega, a distance of nearly 600 km - with Sydney roughly in the



middle (Figure 1). This cycad (Figure 2) has the most southerly distribution in the world, with the population near Bega being at a latitude of $36^{\circ}42'$ south. [South African readers can relate this to Cape Town's position at $33^{\circ}48'$ south.] The *Macrozamia communis* populations are more or less confined to the coast, but may extend about 40 km inland to the foothills of the coastal ranges. (References to a wider distribution given in some earlier texts predate the separation of *M. montana* K.D. Hill and *M. reducta* K.D. Hill & D.L. Jones from *M. communis* 1998.)

Plants on the southern New South Wales coast occur in denser stands (Figure 3; Front Cover) and are larger in stature than plants to the north. The more robust southern populations have plants with a greater number of leaves and correspondingly bigger cones and seeds; seedling plants from the southern populations have broader, flatter leaflets with many teeth. Isozyme studies have quantified genetic differences within and between some of the *Macrozamia communis* populations (Ellstrand *et al.* 1990).



Figure 2 This specimen of *Macrozamia communis* was growing within a few metres of the seashore at Pebbly Beach, Murrumbidgee National Park, approaching the southern end of the distribution area for the species. Photo: Roy Osborne.

DESCRIPTION

1. STEM

Macrozamia communis has a large subterranean caudex, up to 900 mm in diameter, or less commonly an aerial trunk (Colour Figures 1, 2 on p. 17) up to 600 mm in diameter and 1.6 m tall. It is often claimed that well-developed contractile roots keep *Macrozamia* stems below ground level in sandy sites and that this process is mechanically inhibited in shallow or stony soils. In this species it is curious therefore that some of the plants with the tallest stems grow in sandy sites. The stems are usually single; plants with branching are extremely rare; we know only of two such specimens (Colour Figure 6 on p. 17).

2. LEAVES AND LEAFLETS

Mature *Macrozamia communis* plants bear 50 to 100 leaves which are 0.7–2.0 m long, stiff, thick, flat (not keeled), dark green and moderately glossy (Colour Figure 3 on p. 17). Leaves emerge seasonally in tightly packed bunches, gradually spreading outwards with time until finally drying to a "skirt" of dead foliage (Colour Figure 1 on p. 17). [The



Figure 3 Craig Thompson almost lost amongst the foliage of a dense stand of *Macrozamia communis* near Nowra on the New South Wales south coast. Photo: Paul Kennedy.

“skirt” is not retained on plants in areas subject to fire; dramatic charred stems (Colour Figure 2 on p. 17) are more evident at such sites]. The leaf petiole is circular in cross section, 120–400 mm long, 10–16 mm wide, with a short clear base.

Leaflets of *Macrozamia communis* are sharply tipped, 160–360 mm long, 8–13 mm wide, typically with about 65 pairs in a flat plane but projecting forward on the rachis at an angle of about 45°. Stomata occur on the lower surface only. There is a white callous base at the point of insertion onto the rachis (Colour Figure 7 on p. 17). The lowermost leaflets are reduced in size to a few stiff spines.

Seedling leaflets have characteristic small teeth towards the apex; these are not present in mature foliage. Unlike the case in many of its relatives, juvenile leaves of this species assume the adult form fairly early in the plant's development.

3. REPRODUCTIVE STRUCTURES

Male plants of *Macrozamia communis* usually bear multiple (up to 10) greenish-coloured cylindrical cones (Figure 4), 250–450 mm long by 80–120 mm wide and supported on a peduncle 100–150 by 30 mm. The microsporophylls mea-

sure 20–40 mm by 15–25 mm. Each sporophyll has a broad-based apical spine-like appendage which tapers to a sharply-pointed tip. These spines are longer – up to 50 mm – towards the top of the cone. Pollen shedding occurs in late spring, commonly about November.



Figure 4 *Macrozamia communis*, emerging male cones photographed at Bateman's Bay, New South Wales. About 250 mm long, excluding peduncle. Photo: Piet Vorster.

Female plants of *Macrozamia communis* usually bear multiple (up to 4, rarely to 6) greenish-coloured cylindrical cones (Colour Figures 4, 7 on p. 17) measuring 200–450 mm by 100–200 mm. The megasporophylls are about 40–70 mm by 40–80 mm. Like their male equivalents, each megasporophyll has a broad-based apical spine-like appendage which tapers to a sharply-pointed tip; these spines become longer - up to 80 mm - towards the top of the cone. Female cones are receptive to pollination at the same time pollen is available, i.e. around November each year, while cones typically reach full maturity the following March (these times become later in the southern populations). At maturity they weigh about 5 kgs and bear some 150 seeds which fall from the fragmenting cone during the ensuing winter.

Seeds of *Macrozamia communis* are oblong to ovoid, 30–45 mm by 20–30 mm with a brightly-coloured sarcotesta. This is usually bright red (Colour Figure 8 on p. 18), sometimes yellow (Colour Figure 9 on p. 18) and more rarely orange, the colour variation dependent somewhat on locality.

Because of the convenience of having an abundance of material available not too far from Sydney, the reproductive behaviour of the burrawang has been a subject of much research. A detailed life-cycle study was carried out by Brough and Taylor (1939). An important project by Ruth Ballardie and Robert Whelan (1986) revealed that a

"masting" process occurs in some (but not all) burrawang populations; this has widespread influence over seed production, dispersal and predation. This masting process involves long term cycles in cone production, with large percentages of plants in a localised area coning synchronously in the "mast" years, interspersed with several dormant or near-dormant "non-mast" years before another widespread coning event. However, Clarry Chadwick (*pers. comm.* to PK) comments that after an 11-year study of *Macrozamia communis* at three separate locations, he could not determine any overall regular coning pattern and that individual plants had quite irregular coning habits. Personal observations by one of us (PK) are that limited synchronous coning events do sometimes occur in the "non-mast" periods, but only as small pockets ("purple patches") within larger populations. The late Robert Ornduff (1990) carried out an investigation of the reproduction in this species, quantifying factors such as male/female sex ratio and plant size threshold for maturity. A study by Connell and Ladd (1993) compared the population dynamics of *Macrozamia communis* with its Western Australian affiliate, *M. riedlei*.

ECOLOGY

Populations of *Macrozamia communis* occur in wet or dry sclerophyll forests, mostly on old beach sands but also on shallow or stony soils on ridges. The plants are usually understorey to gums, typically the spotted gum, *Corymbia maculata*, and scattered *Banksia* trees in the south, or the Sydney red gum, *Angophora costata*, further to the north.

The term "locally abundant" is conservative when applied to some of the southern burrawang populations; some stands on the New South Wales south coast are so immensely thick as to be almost impenetrable. South African and other overseas visitors to these sites are simply overwhelmed by these astonishing "seas of cycads" (Front Cover). We claim that these impressive populations have the highest population density of any cycad species in the world. [Notwithstanding some massive stands of *Zamia* in Colombia and Panama or maybe even the Florida coontie.]

Rainfall in the *Macrozamia communis* habitats is geographically variable from 880 mm to 1220 mm p.a. with no distinctly seasonal bias. The climate is temperate with "normal" summer maximum temperatures of 29–33°C (but sometimes up to 40°C) and winter minima of -2.5–5.7°C. Frosts can occur and can be quite severe in some areas.

The area of plant-animal interactions in *Macrozamia communis* has been the subject of much recent research and has led to some remarkable discoveries. Early consensus was reached that wind pollination is not significant, and that specific insects are responsible for transporting pollen from the male to the female cones. Clarry Chadwick (1993) put forward a convincing case that the weevil *Tranes lyterioides* (?) and other *Tranes* species are pollen vectors for this cycad - his observations on the nocturnal activity of the weevils in the female cycad cones represent a milestone in cycad pollination biology. A very thorough

recent project carried out by Irene Terry (*in press*) supports Chadwick's findings and further demonstrates that the thrips insect *Cycadothrips chadwickii* transports pollen in *M. communis* populations. Both male and female cones show thermogenesis at the time of pollen shedding and female cone receptivity, with cone temperatures rising several degrees above ambient, quite remarkably at two separate periods during the day. [Interestingly, the thermogenesis event "kicks in" only above ambient temperatures of 20–22°C - presumably another energy-saving strategy.] Irene Terry's work has shown that the first temperature "peak", in the early afternoon, coincides with the time that the thrips insects are active in pollen transport, while the second temperature increase, at dusk, is when the weevils are on the move.

Seed distribution in *Macrozamia communis* also involves plant-animal interactions. The fleshy sarcotesta of ripe seeds is favoured by kangaroos, wallabies and possums. The brush-tailed possum (*Trichosurus vulpecula*) takes seeds to the upper branches of nearby trees as a night-time snack; kangaroos and wallabies eat the fleshy parts of the seeds in the immediate area of the mother plants, consequently one often finds numerous seedlings surrounding adult female plants (Colour Figure 5 on p. 17). The bush rat (*Rattus fuscipes*) stores seeds of *M. communis* in caches but its pattern of storage, and the fact that its teeth often breaks the seed sclerotesta, are not to the plants' benefit. The bush rat also predated on the fleshy parts of young seedlings. Finally, we regard as circumspect a suggestion that fruit-eating bats have any role in *M. communis* seed dispersal.

AFFINITIES

Macrozamia communis is one of 15 members of Section *Macrozamia* in the genus, but appears to lie within a closely-related subset which Hill & Osborne (2001) refer to as the "*Macrozamia communis* group". This group comprises four species (*Macrozamia communis*, *M. montana*, *M. reducta* and, to a lesser extent, *M. diplomera*) which form a geographic replacement pattern in New South Wales.

Mention has been made of the variation within *Macrozamia communis*, only to be expected in any species with a long, narrow and disjunct distribution pattern. But one particular population stands out as "more different" than the general gradation along a north-to-south axis. The cycad plants from Sydney's Menai suburb differ in several respects from other populations of *M. communis*. E.g. the Menai plants have fewer leaves (typically 50) which are a duller green with greyish marbling, a leaflet callous base which is initially coloured pink (Colour Figure 11 on p. 18) but later fades to a creamish-white colour, seeds which are more rounded than those from plants elsewhere, and cones which differ slightly in their morphology. These observations may indicate some inherited genetic contribution from *M. spiralis*, populations of which are located within 30 kms of Menai.



Colour Figure 1



Colour Figure 2



Colour Figure 3



Colour Figure 4



Colour Figure 5

Captions for Colour Figures 1-5

① A mature specimen of *Macrozamia communis* showing the characteristic "skirt" of old leaves. This plant was in an area which had not been subject to a bushfire for a long time. Photo: Craig Thompson. ② Craig Thompson (1.9 m tall) stands next to a mature *M. communis* on a State Forest land subjected to controlled burning. The clear trunk, showing charred leaf bases, is estimated to be 550 mm in diameter. Photo: Paul Kennedy. ③ Paul Kennedy, Australian correspondent to the Cycad Society of South Africa, enjoying the graceful foliage of *M. communis* on the New South Wales southern coast. Photo: Craig Thompson. ④ A newly-emerging female cone on a young *M. communis* plant at Seal Rocks, near the northern end of the distribution range for the species. Photo: Craig Thompson. ⑤ Kangaroos and wallabies have the habit of eating the outer flesh off seeds in the immediate vicinity of female plants, so that mature female plants are often surrounded by cohorts of their own seedlings. Photo: Paul Kennedy.



Colour Figure 6 Dichotomous trunk branching is extremely rare in *M. communis* - this is one of only two such specimens known to the authors. Photo: Paul Kennedy.



Colour Figure 7 The two female cones on this specimen of *M. communis* are almost at the seed-shedding stage. Photo: Craig Thompson.



Colour Figure 8



Colour Figure 9

Captions for Colour Figures 8 and 9: Seeds on *Macrozamia communis* may be red, orange or yellow in colour. These two plants were growing only 3 metres apart at Wyrabalong National Park, near Nora Head. Photos: Paul Kennedy.



Colour Figure 10 *Encephalartos umbeluziensis* surrounded by dense vegetation (Swaziland). Photo: Jarrie van Jaarsveld.



Colour Figure 11 Foliage from the cycads at Menai, near Sydney, are within the distribution range for *Macrozamia communis* but show leaf and cone features which indicate possible genetic contribution from *M. spiralis*. Note the grey foliage and pink callous bases of this specimen. Photo: Craig Thompson.



Colour Figure 12 *Encephalartos umbeluziensis* thriving in its natural environment (Swaziland). Photo: Jarrie van Jaarsveld.



Colour Figure 13 *Encephalartos lebomboensis* fitting perfectly in its environment of rock and indigenous vegetation. Photo: Alice de Beer.



Colour Figure 14 Willie Sopp, Charles de Beer and Blackie Swart appreciating the beauty of the *Encephalartos lebomboensis* in habitat. Photo: Alice de Beer.



Kleurfiguur / Colour Figure 15 *Encephalartos longifolius*, vroulike plant met 'n keël; in 'n privaattuin naby Bredasdorp, Wes-Kaap. / *E. longifolius*, female plant in cone; in a private garden near Bredasdorp, Western Cape. Foto / Photo: Ena du Toit.



Colour Figure 16 Beetles on a female cone of *Encephalartos trispinosus*. Photo: André Cilliers.



Colour Figure 17 Close-up of the beetles shown in Colour Figure 16. Photo: André Cilliers.



Colour Figure 18 *E. laevifolius*; leaves that developed from two scales of a departed sucker. Photo: André Cilliers.



Colour Figure 19 *E. caffer*, small plants developed around the rim of a rotted stem. Photo: André Cilliers.



Colour Figure 20 *E. villosus*, plant that grew from a scale. Photo: André Cilliers.



Colour Figure 21 Male cone of *Cycas revoluta* at South China Botanical Garden. Photo: Willie Tang.



Colour Figure 22 Female "cone" of *Cycas revoluta* at South China Botanical Garden. Photo: Willie Tang.



Colour Figure 23 Wild *Cycas revoluta* growing with *Pandanus* sp. on limestone above the beach at Okinawa Expo Park on the west central coast of Okinawa. Photo: Willie Tang.



Colour Figure 24 Wild *C. revoluta* plant at Okinawa Peace Prayer & Memorial Park with an unusual smooth trunk. Photo: Willie Tang.



Colour Figure 25 *Cycas revoluta* planting at South China Botanical Garden in Guangzhou, China, 2001. These were wild-collected specimens planted in 1972. Original portion of the stems (planted at an angle) and subsequent growth is evident. Photo: Willie Tang.



Colour Figure 26 *Cycas revoluta* at reconstructed Shuri Castle in Okinawa. Photo: Willie Tang.



Colour Figure 27 Female plant of *C. revoluta*, transplanted from the wild, with ripe seed, cultivated by the beach at Okinawa Expo Park. Photo: Willie Tang.



Colour Figure 28 *Cycas tansachana*, several month old seedling with a stem width of over 3 cm, germinated and grown in cultivation. Note that several cycles of scale leaves have formed and that they are green and photosynthetic. Normal leaves have yet to emerge. Photo: Willie Tang.

Previous reports about wild hybrids of *Macrozamia communis* with other species must be reviewed in view of taxonomic changes in the genus; these earlier reports now refer to the wild populations with characters intermediate between *M. reducta* and *M. flexuosa* (large populations some kilometres distant, near Cessnock) and between *M. reducta* and *M. secunda* (occurring side-by-side in small groups at the Munghorn Gap near Mudgee).

Interesting research work in *Macrozamia* genetics is presently being carried out by Dr Goro Kokubugata of Japan's prestigious Tsukuba Botanical Gardens, who has recently spent a good deal of time in Australia. He has been using sophisticated microscopic techniques to examine chromosome morphology and also biochemical techniques to compare the DNA of field-collected *Macrozamia* material. [We look forward to the results from this project.]

CULTIVATION AND CONSERVATION

Macrozamia communis is a graceful but tough and versatile plant for both container and in-ground plantings. We believe that this cycad is highly under-rated by the horticultural industry both locally and abroad, and that it has an as yet unrecognised and very considerable horticultural potential. Seed germinates readily and the young plants, with their dark green leaves, are attractive in their own right. By most cycad standards, this species is fairly fast-growing; an often-quoted example is a plant in the Royal Botanic Gardens, Sydney, which it is claimed grew to 2 m of trunk in 150 years (Johnson 1959). The usefulness of this species lies also in its cold-hardiness - there are not many cycads which tolerate heavy frosts. [Well-known New Zealand grower Keith Boyer tells us that seeds gathered from plants in the southern parts of New South Wales are significantly more cold-tolerant than seeds from plants in the northern parts of its distribution.] Other advantages to this species are its ability to grow well in most soils, in full sun or in shade, and its tolerance to salt-laden sea breezes. Given due attention, mature plants can be transplanted and recover well after a temporary setback.

Because of very large numbers of plants in many populations, *Macrozamia communis* is happily considered "not at risk" in conservation terms (Figure 5). This is despite the fact that many plants have been lost through urban and rural land development and a (mercifully) temporary phase when farmers poisoned the plants in view of a perceived toxic threat to stock. Similarly, the short-lived exploitation of this species as a source of starch for the laundry industry has now been all but forgotten. There is some demand, certainly sustainable, for use of the graceful and long-lived foliage by the floral trade.

Many of the wild stands of *Macrozamia communis* fall within the borders of National Parks, State Forests or vacant Crown land. The stands at the following localities are conveniently accessible to visitors and are all within manageable driving distances from Sydney: *Sydney area*: West Head in the Ku-ring-gai Chase National Park;



Figure 5 Unlike the situation for less common cycads and in other parts of the world, many plants of *Macrozamia communis* grow on vacant land alongside public roads. The huge numbers of these plants mean that there is little threat from plant poachers. Photo: Paul Kennedy.

Georges River National Park at Picnic Point; Botany Bay National Park at Kurnell. *Country areas, north*: Wyrabalong National Park, near Norah Head. *Country areas, south*: Seven Mile Beach National park, near Gerringong; various areas around Batemans Bay, including Pebbly Beach National Park, Durras Lake and Mossy Point.

Macrozamia communis is well-represented in botanical gardens in Europe, the USA and Australia.

ACKNOWLEDGEMENTS

We thank Lou Randall and Irene Terry for their kind assistance in the preparation of this article.

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LETTERS TO THE EDITOR / BRIEWE AAN DIE REDAKTEUR

Dear Editor

SCALY SURVIVORS

We all know that the cycads are ancient plants that have survived through many years to be with us to this day. There are also many stories of plants that have been mutilated in some way or another and have emerged some time later with a new flush of leaves against all odds. I recently became aware of this fact again when a “dead” *Encephalartos laevifolius* sucker produced leaves from the scales of the departed sucker. I removed the sucker about a year ago and noticed recently that it had become soft and was probably dead. I promptly shook the sucker out of the pot of sand in which I had planted it to throw it away. When it emerged I noticed that two of the outer scales of the sucker had formed roots. I immediately planted it again and five months later two leaves emerged at opposite ends of the original sucker (Colour Figure 18 on p.19).



Figure 1 *Ceratozamia mexicana*, small plants developed from a stem that rotted..

Upon investigation I discovered several other cycads which had developed from scales among fellow collectors. I have included photos of an *E. caffer* (Colour Figure 19, on p. 19) where the mother plant rotted and many small plants emerged around the rim of the original stem, all

having developed from scales. The same happened in the case of a *Ceratozamia mexicana* (Figure 1). The *E. villosus* (Colour Figure 20 on p. 19) is an adult plant which grew from a scale many years ago. Does anybody want to donate and *E. woodii* that we can try this with?

André Cilliers, P.O. Box 351, 2520 Potchefstroom, R.S.A.

Received 27 July 2001

Dear Editor

NATURE IN MOTION

In April 2001 I visited Brian Boswell's zoo just outside of Pietermaritzburg. He has a fantastic collection of indigenous and exotic cycads on the premises. Included in these are several *Encephalartos trispinosus* plants. When I arrived there a male and a female plant (adjacent to one another) were both in cone. Upon closer observation I noticed a number of weevils (beetles in the family Curculionidae) sitting on both the male and female cones. Included are some photos of the closed female cone with the weevils (Colour Figure 16 on p. 19). The male cone was, at that time, already open and the beetles on the female cone seemed to be covered with pollen already, indicating that they had visited the male cone. It appeared that the weevils were waiting for the female cone to open so that they could enter it. The insects had long protruding mouthparts (Colour Figure 17 on p. 19) which, it seems, were to be used to penetrate the female cone once the scales had parted and the cone had opened. What was notable to me was the fact that these plants were many hundreds of kilometres from their habitat and that the insects appeared to be specific to the species, since no other insects were observed on the cone. I have always thought that insect pollinators are specific to species. What then happened here? Can anybody help me with this query? Surely these insects cannot be those that pollinate the plants in nature. Either that or the beetles are very widespread. It may also be that this species of cycad does not have a specific

pollinator that is confined to the Eastern Cape area.

André Cilliers, P.O. Box 351, 2520 Potchefstroom, R.S.A.

Received 27 July 2001

[I think the weevils belong to the genus *Antliarhinus* (Brentidae) of which the female has a long hair-like snout. They are not pollinators of cycads but "seed destroyers" as their larvae are seed-feeders. They are not species specific and in southern Africa they can attack virtually any species of *Encephalartos*. You are indeed lucky if this pest hasn't occurred in Potchefstroom as yet. – Editor.]

Dear Editor

• **CYCAD THEFTS** • *STANGERIA ERIOPUS*

Cycad thefts is rife here too. Several years ago specimens were stolen from my garden. They were in containers and placed at the spots where I had intended to plant them to be acclimatized.

The job was done cleanly and professionally. The only consolation I can therefore have is that the possibility of the plants dying in their new "home" was remote because the root systems and the plants themselves were intact when removed from the containers. Why they didn't steal the containers I don't know.

There is another concern that I want to express. The roots of *Stangeria eriopus* are freely available at the market in Victoria Street, Durban. These are displayed openly by the vendors with other bulbs and plant materials which are sold for medicinal purposes. Some of these roots are large and appear to weigh at least half a kilogram each and are freshly harvested.

What are the Nature Conservation Authorities doing about the depredation of these rare plants from the open?

Some years ago a very distinguished cycad authority, I was told by an impeccable source, accompanied by some Nature Conservation personnel made a foray of the market and tried to get across the message that the uprooting of the bulbs was illegal. The vendors and some bystanders became aggressive. Our group beat a hasty retreat.

I have not heard of any further forays being made by the authorities thereafter. The trade in the bulbs therefore goes on unabated. What happens when the source is depleted? Here at least the culprits responsible are openly selling the bulbs - they don't have to find them!

Hassim Seedat, P.O. Box 407, 4000 Durban.

Received 25 July 2001

[The subject of *Stangeria eriopus* lignotubers traded at muti

markets was also raised in some previous issues of our journal, the most recent being the article "Ex situ conservation of *Stangeria eriopus* (Stangeriaceae) at the Durban Botanic Gardens, South Africa" by N.R. Crouch *et al.* in *Encephalartos* 63: 16–18, 23–24 (September 2000). – Editor.]

Dear Editor

COMMENTS ON ENCEPHALARTOS NO. 67

I have finally found a moment to read the latest copy of *Encephalartos* (No. 67), and I realized that I am one of those guilty parties who do not contribute. Therefore I will not complain about the shortage of pages ... but what happened to the staples? My copy arrived in loose leaf form! Could it be "spontaneous disintegration"?

I enjoyed the short story on Danie Nel. Might I add and say that he has been nothing but helpful and encouraging each time I have spoken to him to purchase seeds and plants and he has been more than efficient in dispatching the same (not to mention pollen).

How very sad to hear about the thefts though ... and by members of our Society! I think those found guilty should have their memberships cancelled and all plants confiscated. I also think that it is a good idea to let the rest of us know who the guilty ones are. Perhaps we have inadvertently obtained plants from them and are now sitting with "hot" goods.

A few months ago *Encephalartos* carried an article on the attempt to propagate *E. woodii* from leaf "cuttings". What happened??? Also, a list of frost resistant species would save my sanity as I have moved from Brits to Benoni and my cycads took a serious knock.

And lastly, can someone please clear up the permit issue? For example, if I have purchased seed from the Cycad Society (under its permit number) and I now want to sell the plants (I now own a nursery), do I have to apply for my own permit? Do I obtain all the buyers' details and quote the seed permit number on their invoice? And if I move from Brits to Johannesburg, do I need a permit for that? I seem to get conflicting answers to these questions.

Thanks for the lovely magazine and compliments to the unsung heroes who put in so much effort.

C.S.M. Bothma, P.O. Box 11620, 1514 Rynfield, R.S.A..

Received 26 September 2001

[Members who are **found guilty and are convicted** on the charge of cycad thefts are suspended from our Society. In the news report (in Afrikaans) in "Beeld" of 25 July 2001 (see "Newspaper Clippings" in this issue) the names of some of our members (South Africa, Australia and

Zimbabwe) occur; you can look them up in the "List of Members" in *Encephalartos* 65 (March 2001). Perhaps **Chris Dalzell** can let us know what happened to the *E. woodii* offspring that were propagated from excised leaves. In the book "Cycads of the World" by David L. Jones, he mentions for each *Encephalartos* species, under the heading "Cultivation", whether it is frost-hardy or not. As far as I know export and import permits are required when moving indigenous cycads from one South African province to another. - **Editor.**]

Dear Editor

SPECULATION IN CYCADS

It is with regret that I note that in several local papers and journals the cycad is being promoted as a medium/long term investment. In one report under the heading "Money grows on trees" investors are informed that the value of a cycad has at least trebled from the years 1900 to 2000. This is undoubtedly true in the case of certain species, i.e. *Encephalartos latifrons*, *E. dolomiticus*, etc. but not the great majority of *Encephalartos* species. The more plentiful cycads, if one takes our inflation rate into consideration, have actually become of less monetary value.

My great fear is that, should the cycad become a target for speculators, the already very limited quantity of the scarcer cycads will be further curtailed. The plants available for the production of pure seed of some species are already few and far between.

This brings me to a second point. Why is so little being done to produce pure viable seed of rarer cycads? Surely backing could be found in Governmental circles or through an industrial or commercial firm wanting to have its name exposed to the public.

The required technology could easily be found by obtaining the services of an agricultural student or two from one of the colleges scattered throughout South Africa. The plants required for use as breeding stock could be obtained from stocks seized from illegally collected cycads and held by Magistrates Courts. Such cycads are actually an embarrassment to the court officials as they do not have the facilities or staff to ensure the survival of such plants. I, personally, know of a suitable group of *E. inopinus* which was seized by the Court, and after judgment, was handed over to a body who knew nothing about their requirements. They were planted in an entirely unsuitable environment and have since died back from 18 to 10 specimens. What a waste!

In conversation with a cycad friend, he accused me of being naïve, his standpoint was that the guy who purchased rare cycads at for example R50 000, purchased them as an investment and he would not be at all happy to see seed and plants of his cycads available to every Tom, Dick & Harry at a price that T, D & H could afford.

Naïve or not, I still feel that purebred seed **MUST** be made available to all who wish to see our African cycads flourish as they did in the past.

Jack van der Merwe, P.O. Box 39, 0835 Duiwelskloof, R.S.A.

Received 29 August 2001

Geagte Redaktrise

ENCEPHALARTOS LONGIFOLIUS: GROOT VROU-LIKE KEËL

Ek stuur aan u 'n foto (Kleurfiguur 15 op p. 19) van 'n vroulike *E. longifolius* in my tuin met 'n keël wat ek persoonlik dink buitengewoon groot is. Hierdie broodbome en die een agter hom het ek 24 jaar gelede geplant. Die een agter dra ± elke tweede jaar keëls maar hierdie een het nou vir die eerste keer 'n keël na 24 jaar. Die omtrek van die keël is 105 cm en die lengte 62 cm. Vir die afgelope 30 jaar kweek ek broodbome van sade uit my eie tuin en dit is die grootste keël wat ek nog gehad het. Een spesifieke boom het ongeveer 15 jaar gelede 9 vroulike keëls gelyktydig gehad, 'n reuse oes.

Ek behandel my broodbome so naby as moontlik soos wat hulle in die natuur gewoon is, naamlik geen kunsmis of enige byvoegings nie, en buite die reënseisoen die minimum water. Ek glo dit is die rede waarom my broodbome gesond en siektevry is en floreer en nog honderde jare sal groei.

Kan iemand my dalk sê hoe oud broodbome kan word en het iemand dalk foto's van broodbome wat van ouderdom dood is en nie deur vandalisme nie? 'n Botanikus wat 'n aantal jare gelede in my tuin was het gesê dat van die broodbome in my tuin 2000 en 1500 jaar oud is. Is dit moontlik?

Ena du Toit, Wydgelegen, 7282 Bredasdorp, R.S.A.

Ontvang 10 Oktober 2001

[Ek dink nie hierdie vroulike keël is buitengewoon groot nie. Afmetings wat Cynthia Giddy en Douglas Goode in hulle boeke aangee vir vroulike keëls van *E. longifolius* is: lengte tot 60 cm en deursnee tot 40 cm. - **Redaktrise.**]

Summary

ENCEPHALARTOS LONGIFOLIUS: LARGE FEMALE CONE

Colour Figure 15 on p. 19 shows a female *E. longifolius*, in the garden of Mrs Ena du Toit of Bredasdorp, of which the cone is 62 cm long and has a circumference of 105 cm. As it is the largest cone ever in her garden she thinks it is unusually large. She planted this cycad and the one behind

it 24 years ago. The one in the background cones regularly about every two years but the plant in front coned now for the first time in 24 years.

She would be grateful to learn what the maximum age of

living cycads can be, and if anyone has photographs of cycads that died of old age and not of vandalism? A botanist who visited her garden some years ago told her that some of her cycads are 2000 and 1500 years old; and she asks if this could be possible?

ARTICLES / ARTIKELS

IN SEARCH OF *CYCAS REVOLUTA*

William Tang

Fairchild Tropical Garden, 11935 Old Cutler Road, Miami, Florida 33156, U.S.A.

Received 1 October 2001

INTRODUCTION

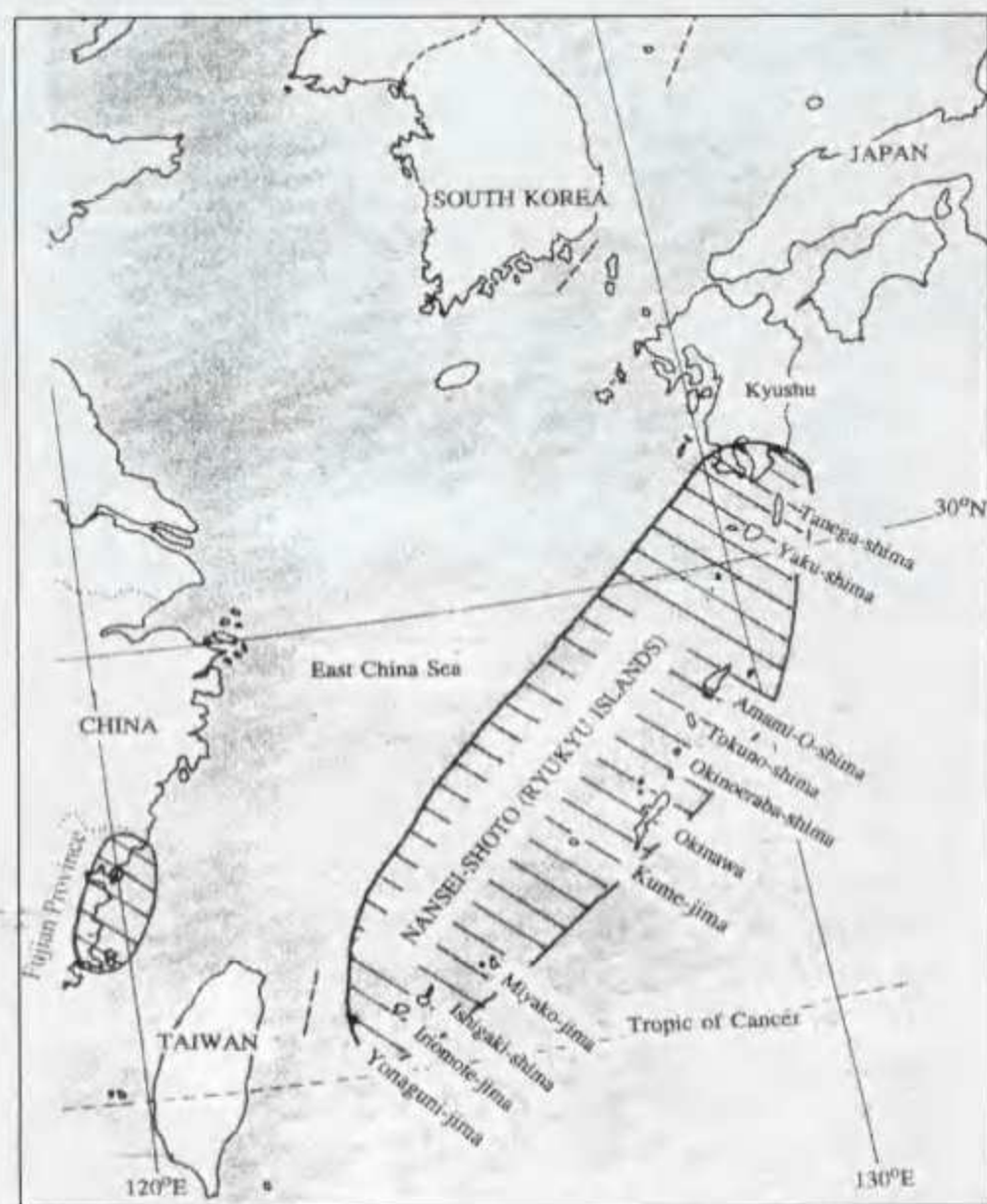


Figure 1 Map of the South China Sea and the distribution of *Cycas revoluta*. Modified from Osborne and Tomiyama (1995).

Cycas revoluta is by far the most widely cultivated cycad. Its striking symmetry and beauty has made it one of man's favourite ornamental plants. It is cultivated in pots and landscapes throughout the tropical, subtropical, and warm temperate regions of the globe and is the only cycad species to achieve the status of "common ornamental plant". For

most of the world, this horticultural love affair with *Cycas revoluta* began with its botanical description in 1784 by the Swedish botanist Carl Thunberg. In China and Japan, however, the cultivation of this cycad began centuries earlier. Despite this long history of cultivation, or perhaps because of it, *Cycas revoluta*'s wild populations are incompletely known and understood. This stands in marked contrast to the African cycads, most of whose geographic distributions are now well documented and widely known. In recent years I have journeyed to the Far East, to China and Japan, in search of *Cycas revoluta*. Below I share some of my findings and observations.

THE BIG PICTURE

Fossils of cycad leaves closely resembling those of *Cycas revoluta* are known from the Tertiary period of Japan (Hollick 1922). This would suggest that this species has existed in this region of Asia for many millions of years. *Cycas revoluta* was until recently found wild in two areas: coastal Fujian province in China and southern Kyushu and the Ryukyu Islands of Japan (see Figure 1). These two areas border opposite sides of the East China Sea. The East China Sea is a shallow extension of the Pacific Ocean that overlies a section of the continental shelf of Asia. During times of lower global sea levels, portions of this shallow sea retreated, exposing extensive land areas and perhaps connected Japan and the Ryukyu islands with mainland Asia. These ancient land bridges appeared to have facilitated the movement of fauna and flora between the two regions. It is quite probable that *Cycas revoluta*, a member of the floral assemblage of this region, colonized new areas of suitable habitat that were exposed by drops in sea level. Thus the distribution of this species changed with changing sea levels and the associated changes in climate. *Cycas revoluta* may have had, at one time, a continuous distribution from Japan to China along open coastal habitats of an East China Sea that was once much smaller.

CYCAS REVOLUTA IN CHINA

Chinese use of herbal medicines extends back thousands of years. Documented use of *Cycas revoluta* as a medicinal plant in China goes back to the 19th century and longer (Whiting 1963, Spencer 1990). Specimens of this species were cultivated in Buddhist temples throughout the warmer areas of the old Chinese empire. Today it remains an extremely popular container and landscape plant in major southern cities such as Guangzhou (Canton), Fuzhou, and Shanghai. Many more can be seen in the smaller towns as well. Potted plants are placed as decoration in the front entrances of many establishments (Figure 2). The main reasons for this use appear to be its beauty and durable evergreen foliage. Few other plants can withstand the drought and pollution along the streets of Chinese cities. The decline of any plants that grace front entrances would be interpreted as bad luck and since *C. revoluta* is one of the few that can thrive in such situations, it has become extremely popular. Such plants probably number in the hundreds of thousands or more. Many more are grown on apartment balconies throughout the region (private gardens are a rare luxury). In Chinese lore this plant is reputed to flower so rarely that when it does, it is considered a portent of an important event.



Figure 2 Potted *C. revoluta* at a restaurant entrance in Yunnan Province, China.

What is the origin of *Cycas revoluta* in China? For many years, it was assumed that this plant was native only to southern Japan, in southern Kyushu and the Ryuku islands (see Figure 1), and that it did not occur naturally in China (Osborne and Tomiyama 1995). Recently, however, the location of wild populations in China was revealed. Based on eyewitness accounts Zhu (1999) and Zou *et al.* (1999) described the existence of extensive populations of *Cycas revoluta* on the coastal areas of Fujian Province. The description below is based on their accounts. They state that prior to the 1960's large healthy populations of *Cycas revoluta* existed in the coastal counties of Pingtan, Fuqing, Changle, Fuzhou, Lianjiang, Luoyuan, Ningde, Fuan, Xiapu, Fuding, and their adjacent islands (see Figure 1). Sporadic populations grew on coastal hills or interior mountains. On the coast they were to be found on gentle slopes facing the sea at elevations between 1–80 metres

above sea level, in situations where they were exposed to abundant sunlight. It is estimated that wild populations covered 1500 hectares, with some plants reaching 5 metres in height. The substrate was a brownish-orange clay, typical of the soils of Southeast Asia, but unlike the limestone habitats where it is found in Japan. Fujian Province has a subtropical climate with average annual temperatures of 20–23°C and a short winter frost period.

The demise of these wild populations began in 1960. During an economic depression from 1960–63, many plants were cut down for food. Locals harvested and ate the starchy stems in these difficult times. In the 1960's and 1970's local businessmen organized peasants to cut or dig up *C. revoluta* from the wild for sale as ornamental plants. They were transported with tractors and lorries to market at Mabi Town and Fuzhou City, from where they were further distributed to other parts of China. In the early 1970's, after the end of the repressive Cultural Revolution, with the desire for prosperity unleashed, the market for *C. revoluta* expanded rapidly. At the beginning plants sold for as little as 0.05 Yuan (less than US\$0.01) per kg, but by the early 1980's the price had gone up to 2000–15000 Yuan (US\$240–1800) per ton. During this period 300–500 tons of *C. revoluta* were exported out of Fujian Province each year. Containers loaded with stacks of *C. revoluta* stems were shipped throughout the country by train. South China Botanic Garden in Guangzhou purchased a container load of these stems in 1972 (H.M. Fan, pers. comm.). These stems suffered a high mortality rate, undoubtedly due to rough handling during their removal and transport from the wild. Those that survived are still growing today at the garden (Colour Figures 21, 22, 25 on pp.19, 20). By the early 1980's these wild populations reached depletion. Surveys in the Fujian habitat of *C. revoluta* in 1996 revealed no wild plants (H.M. Fan and N. Liu, pers. comm.) and these Chinese populations are now believed to be extinct or virtually extinct in the wild.

When I visited Fujian Province in 1998, in the vicinity where wild *C. revoluta* existed, significant numbers of plants were still to be found in cultivation in nurseries and botanic gardens. Plantations exist for the production of seeds (Zou *et al.* 1999). Plantations were established in the 1970's by local nursery people, when it became clear that wild stocks were becoming extirpated. Although production of seeds and propagation based on local stocks occurs, seedlings have been imported into this section of Fujian Province from Taiwan, Korea, and Japan to meet the high demand of the nursery industry. The lack of long range planning or conservation efforts appears to have doomed the Chinese *Cycas revoluta* in the wild. Any horticultural or genetic distinctiveness of the Chinese form may now be diluted out by the influx of material from outside the country. My examination, in May of 1998 (during the pollination season), of plants in botanic gardens and nurseries in the Fujian area revealed no insect visitors on the cones of *C. revoluta*. In Japan, a weevil in the genus *Tychiodes* has been identified as a possible pollinator of the species (Oberprieler 1995, pers. comm.). Observations of these kinds of weevils on cultivated *Cycas* in Thailand suggest that they do not persist in cultivated situations



Figure 3 *Cycas revoluta* growing wild with *Scaevola* sp., above the beach at Okinawa Expo Park.

(Tang, unpublished observations). These observations would suggest that the natural pollinator of *C. revoluta* in China may have gone extinct with the wild populations. Whether it was the same as the pollinator of *C. revoluta* in Japan or different may never be known, and this diminishes our chances of ever reestablishing a wild population back into its original habitat in China.

CYCAS REVOLUTA IN THE RYUKU ISLANDS

Outside of Japan, information on the current state of wild Japanese populations of *Cycas revoluta* was scant, until Osborne and Tomiyama published an article in 1995 (see *Encephalartos* 41). This article gives excellent descriptions of the geographic distribution and cultural uses of *C. revoluta* in Japan. Below, I will only supplement that paper with my own observations on a recent visit to the Island of Okinawa. South of mainland Japan is an arc of limestone islands which stretch southwest toward the island of Formosa (Taiwan) (see Figure 1). The presence of *Cycas revoluta* on these islands is well documented. Most of these islands are low lying, with coral and limestone substrates. On the largest island of the chain, Okinawa, plants were once extremely abundant. I visited this island in 2001. Here *Cycas revoluta* grows out of solid limestone



Figure 4 *Cycas revoluta* grows semi-wild around tombs in Okinawa. These tend to be situated on slopes adjacent to roads.

rock. In the heavily populated southwestern part of the island, farming and urbanization appears to have eliminated most of the cycads and natural vegetation. As one travels north and east, however, large plants can be seen in disturbed vegetation on steep hillsides, particularly around tombs that dot the roadside (Figure 4). Along the coasts,

above beaches, where vegetation is intact the plants can still be found. I have seen thousands of cultivated *Cycas revoluta*, but when I first viewed the wild plants along the beach, it was like seeing the plant again for the first time (Figure 3; Colour Figure 23 on p. 20)! As in cultivation, this is a species for full sun, preferring open sunny locations along beaches and cliffs.

I visited Okinawa in April, during the pollination season. Unfortunately, on this visit I did not observe a single coning plant on Okinawa. Only females with previous year's seeds were seen (Colour Figure 27 on p. 20). Similarly, in south China that same season I did not see any cones among hundreds of cultivated specimens. *Cycas revoluta* appears to require some chilling in the winter season to stimulate cone production and southern Asia experienced a very warm prior winter. In Thailand, in Bangkok and Nong Nooch Tropical Garden, *C. revoluta* growing under year round tropical conditions never cone (A. Lindstrom, pers. comm.). This would support the conclusion the *C. revoluta* requires cool winters to stimulate coning.



Figure 5 *Cycas revoluta* growing on a steep mountain face, southeastern coast of Okinawa.

In cultivated plants we can expect to see a smaller range of variation in vegetative and reproductive characters than in wild plants. This is so because propagation stocks are selected from a wide array of wild plants for particular characters with horticultural appeal. Also, under the stresses of wild conditions, plants may exhibit characters not apparent in cultivation. Therefore, when studying wild populations of *C. revoluta* we can expect to find plants with characters not seen in cultivated plants. On Okinawa, one character I have not seen before in *C. revoluta* were lower sections of stems without leaf base scars (Colour Figure 24 on p. 20). The lower stems on these specimens had a smooth texture with fractured appearance more typically seen on *Cycas clivicola* in Thailand.

Toward the east side of Okinawa, on steep mountain slopes *Cycas revoluta* still numbers in the hundreds (Figure 5). In the remote north section of Okinawa, which is preserved as a national park and remains forested, this plant probably retains its original abundance, probably numbering in the

thousands along the coasts and on exposed mountain slopes.

In stark contrast with Fujian Province, China, in Okinawa, the wild plants, when not in the direct path of human occupation, remain abundant. Japanese *C. revoluta* plantations, most of which are located on the island of Amami-O-Shima produce hundreds of thousands of seeds and seedlings for the world market (Osborne and Tomiyama 1995). There does not appear to be large pressures to collect the plants from the wild on Okinawa. The local economy depends heavily on the local U.S. military bases and tourism from the main islands of Japan. The movement of agricultural commodities appears highly regulated. Life on Okinawa runs on a slower pace than the rest of Japan. There is a large retirement population dependent on pensions and life expectancy is among the highest in the world. The situation is quite different from that in China. The contrast between the fates of the Chinese and Japanese *C. revoluta* should be a text book case of how local economic conditions and the attitudes of local people impact and ultimately determine the fate of local cycad populations.



Figure 6 U.S. soldiers advance on a Japanese foxhole located in a patch of *Cycas revoluta*. The foxhole was just destroyed with a grenade. Central Okinawa, April 2, 1945. U.S. Military photo.

The Ryuku Islands were, until about a century ago, an independent kingdom, with its centre in Okinawa. Its native peoples are not ethnic Japanese, but originated somewhat to the south, perhaps in the Philippines. Centered in the prime trade routes between China, Japan, and the islands to the south, the Ryuku Islands accumulated wealth and influence and began organizing into kingdoms in the 12th Century. Palaces and fortresses were built. The most spectacular of these is Shuri Castle. The reconstructed castle is a tourist spot today. In the historical displays at Shuri Castle is a photo from early in the 20th century showing rows of stately *Cycas revoluta* plants along the castle entrance. The original Castle and grounds were

CYCAS REVOLUTA IN WAR

In April of 1945 Okinawa was the site of one of the largest battles of World War II. A vast U.S. naval armada pounded the island with artillery fire and bombs prior to invasion by sea. A battle raged with defending Japanese troops until mid August. Some 200 000 Japanese soldiers and civilians and 12 500 U.S. troops were killed in desperate fighting. How did this battle affect the cycads on the island? U.S. Military photos documented the course of this battle, demonstrating how U.S. troops assaulted Japanese positions and flushed out soldiers from fortifications (Sakuda 1977). American tactics employed the use of overwhelming firepower to defeat their opponents and massive amounts of ammunition and explosives were expended during the battle. Photos of the habitat show *Cycas revoluta* plants in the midst of the fighting (Figures 6–8). In some of these pictures the stems have clearly been damaged or defoliated. Undoubtedly bullets and shrapnel became lodged in many of the plants that weren't blown apart outright. What was the long-term affect of modern warfare on a population of cycads? Today, some 56 years after the battle, numerous plants of *Cycas revoluta* can still be seen in the former war zone. They are in far fewer numbers than in the war photos.. How many of these died due to battle damage and how many were destroyed during the period of reconstruction and economic expansion after the war? Certainly, in the case of Okinawa, war and its long term aftermath has not been beneficial to *Cycas revoluta*.



Figure 7 U.S. soldiers use smoke grenades to flush out Japanese soldiers in a fortified position of natural limestone. Note damaged and defoliated *C. revoluta* stems. Southern Okinawa, June 6, 1945. U.S. Military photo.

obliterated by artillery fire during World War II, however, the reconstructed castle is complete with a new row of *Cycas revoluta* (Colour Figure 26 on p. 20).



Figure 8 U.S. soldiers take shelter around clumps of *C. revoluta* and a stone lion. Southern Okinawa, June 18, 1945. U.S. Military photo.

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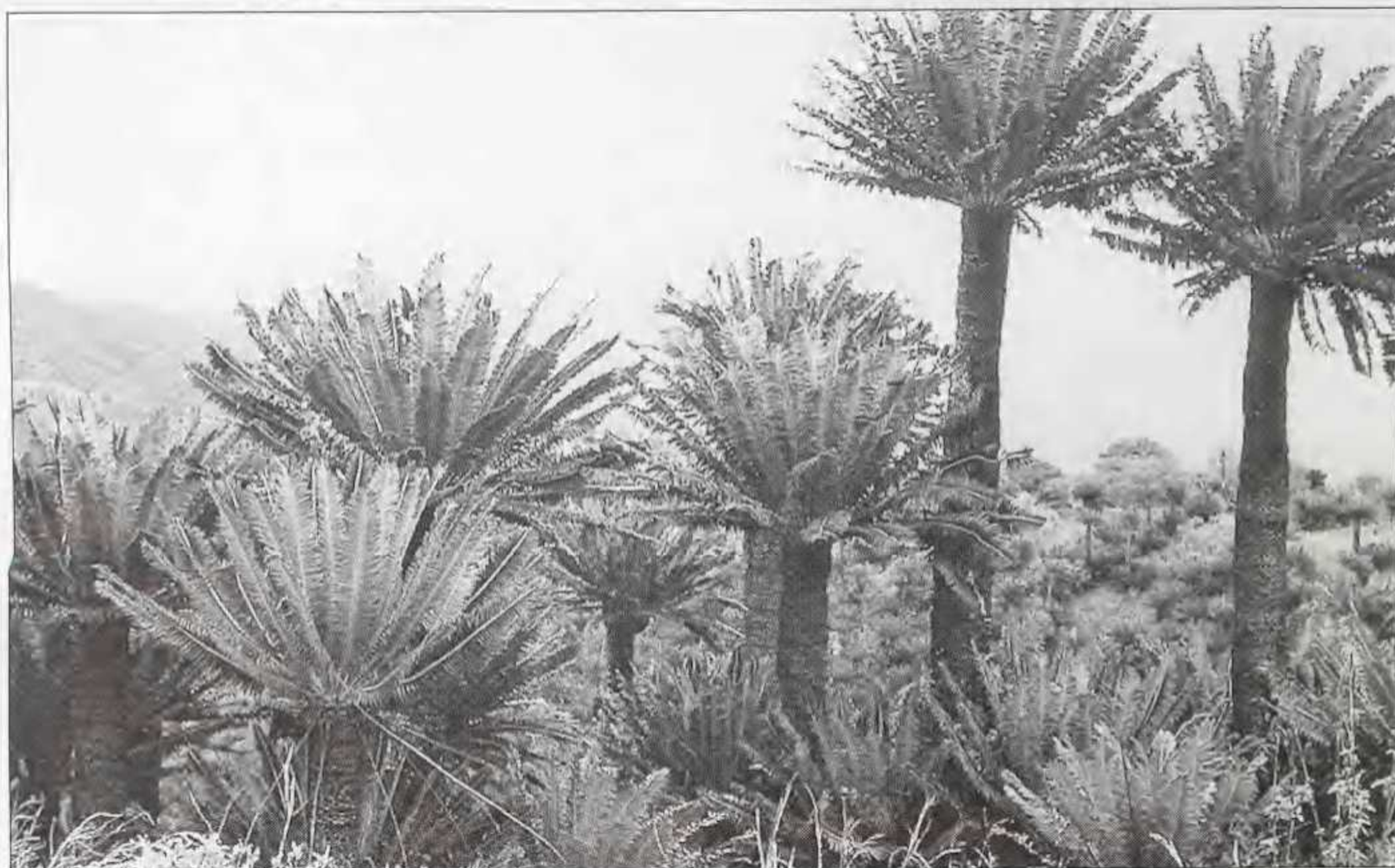
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PERSPECTIVES ON CYCADS IN AFRICA

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Encephalartos transvenosus from the Northern Province in South Africa – one of Africa's tallest and most majestic cycads. Photo: Janice Golding.

Cycads are an ancient group of dioecious seedplants that existed before there were dinosaurs (Jones 1993). Contemporary distribution patterns of the Cycadales

(Gymnospermae) are essentially remnants, consisting of *Ginkgo*-like plants and *Glossopteris*, that existed between 70 and 240 million years ago. The fossil record estimates

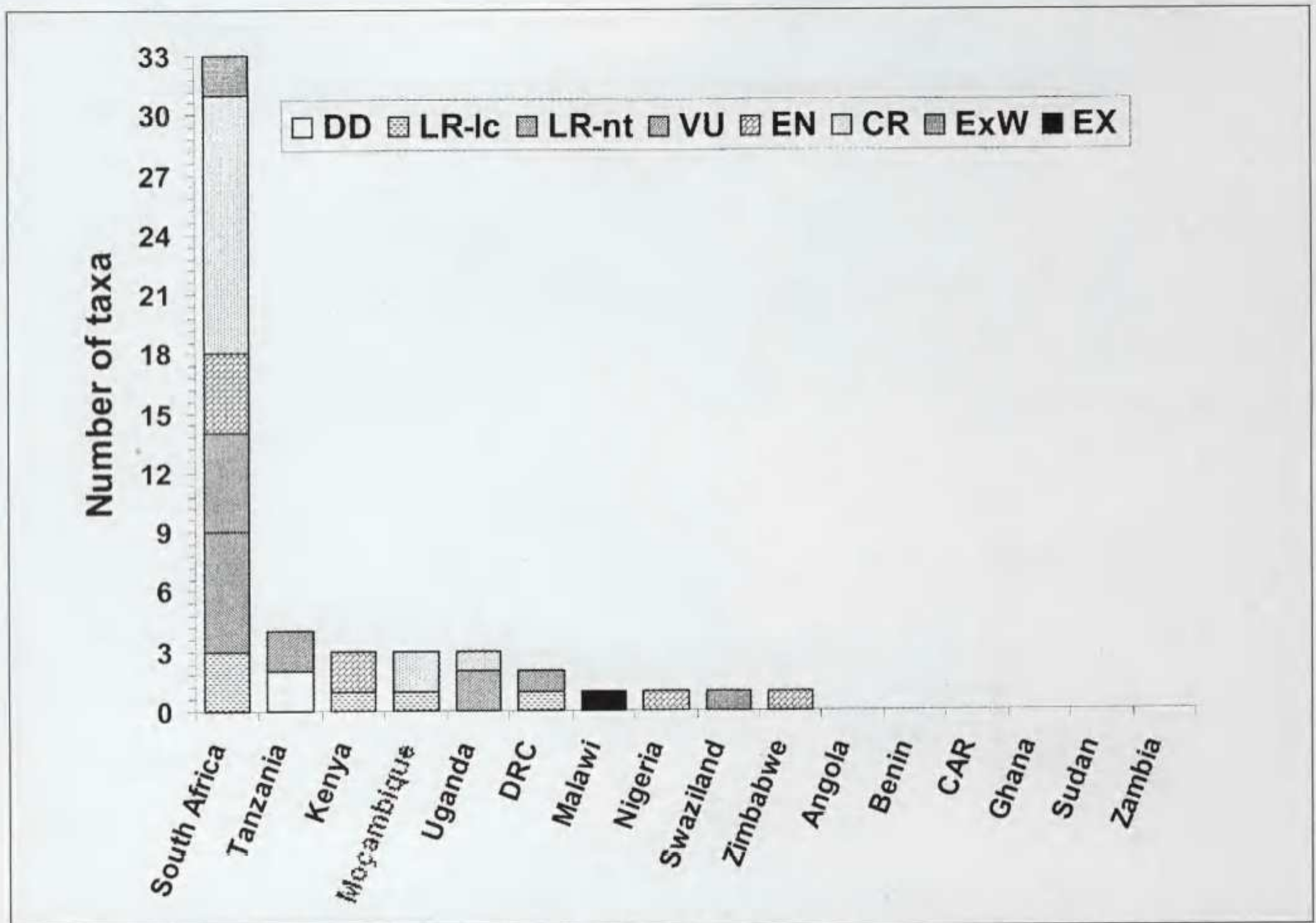


Figure 1 Numbers of globally threatened and data deficient (DD) endemic cycad taxa. CAR = Central African Republic, DCR = Democratic Republic of Congo. [DD = data deficient; LR-lc = low risk, least concern; LR-nt = low risk, not threatened; VU = vulnerable; EN = endangered; CR = critically endangered; ExW = extinct in wild; EX = extinct.]

that cycads comprised about 20% of the vegetation cover at the time.

Cycads were once distributed as far north as Alaska, Siberia and Greenland, and as far south as the Antarctic. Today, these fascinating plants are confined to restricted habitats in the tropics and subtropics of both the Old and New Worlds. All the taxa occurring in Africa are from the genus *Encephalartos* (Zamiaceae) except *Cycas thouarsii* R.Br. ex Gaudich (Cycadaceae) and *Stangeria eriopus* (Kunze) Baill. (Stangeriaceae) (Goode 1989). Interestingly, all African cycad taxa are dependent on insect pollinating agents (Oberprieler 1995a, b).

Cycads are long-lived, have slow growth rates and often have large conspicuous growth forms. They are usually late recruiters and recalcitrant reproducers and are therefore predisposed to being at risk of extinction (Donaldson 1995).

The aim of this article is to provide an analytical overview of all the described and formally undescribed African cycads that appear on the Red Data List.

Cycads listed in CITES

It is well known that cycads are highly desirable collectors'

items and important flagships for conservation. Most African cycads are listed in CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) Appendix I; *C. thouarsii* R.Br. ex Gaudich is listed as an Appendix II species and several poorly known taxa have yet to be incorporated on CITES (WCMC 1998).

Appendix I includes taxa perceived to be threatened and that are, or may be, affected by trade. An export and import permit is required for trade. Appendix II taxa include those that are not perceived to be threatened, but may become so unless trade is regulated. An export permit is required for the trade of Appendix II taxa. To the untrained eye, many cycad taxa are morphologically similar, hence the inclusion of all cycads on CITES irrespective of whether they appear on Red Lists. This minimises confusion and misidentifications, and strengthens law enforcement and protective legislation measures.

Some Cycad Statistics

A total of 74 cycad taxa (including five currently undescribed taxa) occur in 16 sub-Saharan African countries, namely Angola, Benin, Central African Republic, Democratic Republic of the Congo, Ghana, Kenya, Malawi,

Mozambique, Nigeria, South Africa, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe (see map). South Africa has the highest number of cycad taxa (41) recorded for any country on the African continent.

Endemics

Of the continent's cycads, 52 are country endemics (see table). Some 59% of Africa's cycads are globally threatened (i.e. *Critically Endangered*, *Endangered* or *Vulnerable*) (Figure 1). One taxon is *Extinct* (Malawi) and *Encephalartos woodii* Sander, *E. relictus* P.J.H. Hurter and *Encephalartos* taxon B GLOW *in cult.* are known only from relictual individuals now in cultivation – they are *Extinct in the Wild*.

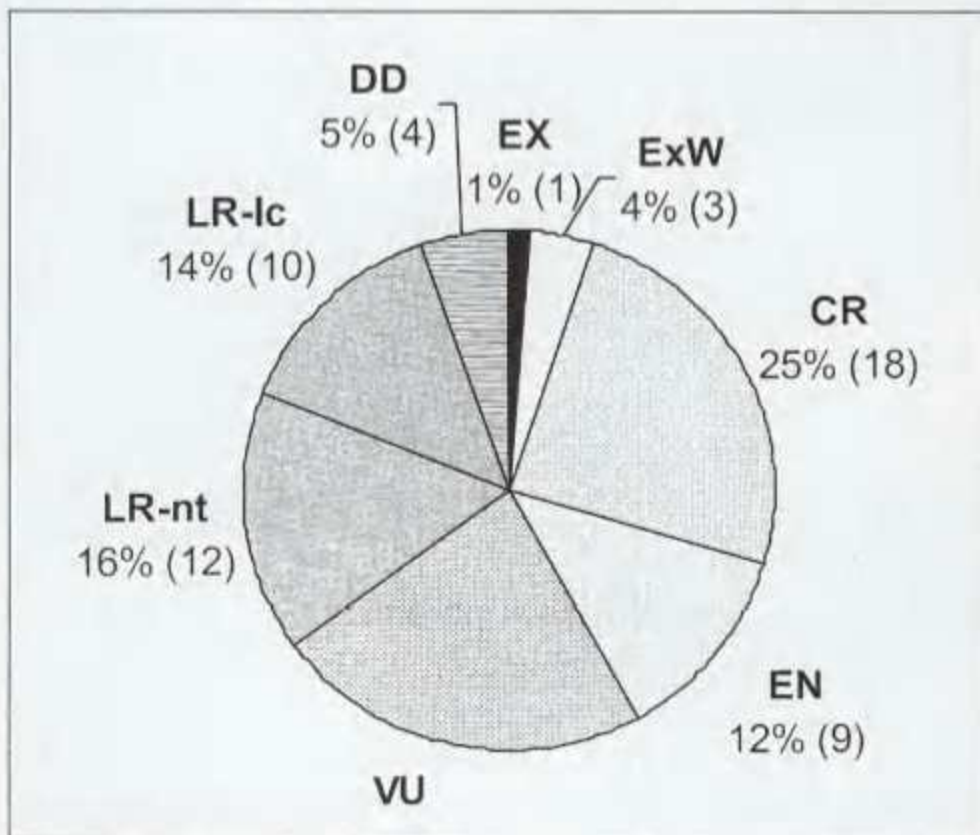


Figure 2 Percentage (and number) of cycad taxa represented in each Red List Category.

Threatened taxa

Forty-four (59%) of the continent's taxa are threatened (Figure 2). Most of these threatened taxa are from Mozambique, South Africa and Swaziland. The criteria most frequently used for assigning these threatened categories are Criterion *A1c*, Criterion *A1d* followed by Criterion *B1+2c*, Criterion *B1+2e*, and Criterion *C2a*. Four taxa are *Data Deficient* (Tanzania: *E. hildebrandtii* var. *dentatus*; Tanzania: *E. kanga*; Angola-Democratic and Republic of Congo: *E. laurentianus*; Uganda, Central African Republic, Democratic Republic of Congo and Sudan: *E. septentrionalis*). Twenty-two are assigned *Lower-Risk* categories.

Reasons for Threatened Status

The criteria most frequently applied to assign the threatened categories are associated with declines of small populations due to habitat degradation and levels of exploitation. The nature and extent of threats attributed to species declines

appear to be different in the southern African region compared to the rest of the continent.



The 16 sub-Saharan African countries in which 74 African cycad taxa occur.

Cycads			
Total numbers of cycad taxa per country			
Country	Taxa	Endemics	Non-endemics
South Africa	41	33	8
Mozambique	14	3	11
Swaziland	9	1	8
Tanzania	8	4	4
Democratic Republic of the Congo	7	2	5
Kenya	6	3	3
Uganda	4	3	1
Zimbabwe	3	1	2
Nigeria	2	1	1
Malawi	2	1	1
Angola	2	0	2
Benin	1	0	1
Central African Republic	1	0	1
Ghana	1	0	1
Sudan	1	0	1
Zambia	1	0	1

Habitat destruction is one of the key threats to cycad populations, however, the most important factor in southern Africa is the activities of plant collectors. Coupled with this, limited and fragmented distribution ranges of discrete populations pose an even greater extinction risk to cycad

taxa. Those listed as *Data Deficient* are found in war-torn and botanically unexplored areas.

General suggestions

Priorities for Field Surveys

In the immediate short term, Angola, Central African Republic, Democratic Republic of the Congo and Sudan represent a low concern for cycad conservation action but a high priority for phytogeographic and floristic work. Once civil and political instability improves in these countries, field survey efforts need to be done.

Much fieldwork is also required in remote areas of some politically stable countries for taxa with cross-border range extensions. For example, *E. marunguensis* and *E. schaijesii*, which are known from Tanzania and Democratic Republic of Congo, may also occur in north-eastern Zambia.

Priorities for Conservation Action

The conservation of cycads in southern Africa is currently of far greater concern than in the rest of the continent because of the high numbers of threatened taxa occurring here. The real causal factors for this probably include greater taxonomic activity and more developed infrastructures leading to habitat degradation and the acquisition of wild cycads. The priority countries for conservation action are South Africa, Swaziland, Mozambique, Zimbabwe, and areas of Kenya, Tanzania, and Uganda where illicit cycad-related activities are known to take place.

More effective law enforcement is needed, particularly internationally, across country borders and provincial juris-

dictions. Taxa that straddle political boundaries of the following countries require special attention: Mozambique-South Africa-Swaziland (3), South Africa-Swaziland (3), Mozambique-Swaziland (2), Mozambique-Zimbabwe (2), Malawi-Mozambique (1) and Benin-Ghana-Nigeria (1).

In conclusion, more field surveys, ecological life-response studies, and formal taxonomic treatments remain prerequisites for determining conservation priorities for African cycads.

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NEWSPAPER CLIPPINGS AND PRESS RELEASES KOERANTUITKNIPSELS EN AMPTELIKE PERSVERKLARINGS

'Illegal' cycads found stacked outside kraal

By KEITH ROSS

DAILY NEWS
JUNE 18 2001

POLICE in Zululand have arrested two men and taken possession of a large haul of cycads illegally removed from a remote part of the region.

The cycads - found in the Emangusi area, near the Tembe Elephant Park - have been valued at more than R240 000.

"There were 35 cycads - all large, well-established plants," said the acting head of the police's organised crime unit in Richards Bay, Captain Brian Dafel.

"The cycads had been collected in that area and were apparently destined for Gauteng."

Dafel said the "illegal" cycads had been stacked outside a kraal, obviously ready for transport.

"Each plant would have been worth quite a lot of money, from R800, depending on its size and condition.

"There were some massive plants. But some had just been hacked out of the ground and stood little chance of survival."

Dafel said there was a big demand for smuggled cycads among "unscrupulous" dealers in the Gauteng area.

"So this has become a popular form of smuggling in the far north of Zululand, where there are some very beautiful cycads."

He said everything possible was being done, under difficult circumstances, to prevent the theft of cycads.

US DEPARTMENT OF JUSTICE, NORTHERN DISTRICT OF CALIFORNIA

In this section:

Press Releases

2000: August, September, October, November, December

2001: January, February, March, April, May, June, July

How you got here:

Home Press Heibloem, et al.

July 25, 2001

The United States Attorney's Office for the Northern District of California announced the unsealing of four indictments, as well as the arrest of six individuals, on charges related to the illegal importation of an internationally protected species of rare orchids or cycads, a primitive plant, in violation of the Convention on International Trade in Endangered Species ("CITES"). Altogether, the four separate indictments charge 11 individuals with illegally importing the plants and arise out of an undercover operation conducted by federal authorities.

In the first 14-count indictment, six individuals are charged with conspiracy, smuggling, and making false statements. According to the indictment Peter H. Heibloem, 47, of Queensland, Australia, Ernest J. Bouwer, 56, of Sandton, South Africa, Donald Joseph Wiener, 64, of Mexico, John H. Baker of Gauteng, South Africa, Ian S. Turner of Harare, Zimbabwe, and Rolf Kyburz of Queensland, Australia, are alleged to have sent approximately \$542,000 worth of protected cycads to the United States from South Africa, Australia, and Zimbabwe.

Of the six people charged in the first indictment, Mister Heibloem, Mister Bouwer and Mister Wiener were arrested on July 20, 2001 by special agents of the United States Fish and Wildlife Service. Mister Heibloem and Mister Bouwer made their initial court appearances on July 20, 2001 in federal court in Los Angeles. Mister Heibloem's next court appearance is in Los Angeles on August 3, 2001 and Mister Bouwer's next court appearance is in Los Angeles on August 8, 2001. Their cases will eventually be heard in San Francisco. Mister Wiener made his initial appearance on July 20, 2001 in federal court in San Diego. His next court appearance is August 22, 2001 in San Francisco before Judge Charles Breyer. Three other individuals named in the first indictment, Mister Baker, Mister Turner and Mister Kyburz remain at large and are believed to be outside the United States.

In a second 29-count indictment, Rolf D. Bauer, 44, of Johannesburg, South Africa and Jan van Vuuren, 54, of Centurion, South Africa are charged with conspiracy, smuggling and making false statements. According to the second indictment, Mister Bauer and Mister van Vuuren sent more than \$300,000 worth of protected cycads to the United States from South Africa. The indictment alleged that the men used invalid permits for the commercial shipments and falsely labelled many of the plants to cover up the lack of a valid permit.

Mister Bauer and Mister Van Vuuren were arrested July 20, 2001 in Las Vegas, Nevada by special agents of the United States Fish and Wildlife Service. They remain in custody pending their transportation to the Northern District of California. Their initial appearance in San Francisco federal court has not yet been scheduled.

In a third 21-count indictment, Antonius Juniarto, of Surabaya, Indonesia, and Iwan Kolopaking, 32, of Jakarta, Indonesia, are charged with conspiracy, smuggling and false statements related to the shipment of rare orchids into the United States from Indonesia. According to the indictment, the two men sent multiple packages of the orchids through the mail with customs declarations falsely identifying the contents as toys. Mister Juniarto and Mister Kolopaking remain at large outside the United States.

A fourth four-count indictment, charges Terence Leung, of Hong Kong, with smuggling related shipments of orchids from Hong Kong into the United States. Mister Leung remains at large outside the United States.

Cycads, which resemble palms or tree ferns, are a small group of primitive-looking plants whose ancestors date back more than 200 million years. Like orchids, certain cycad species face threats in the wild from habitat loss and over-collection. Both groups of plants are protected under CITES - a treaty through which the United States and more than 150 other countries regulate global commerce in imperilled animals and plants. All of the indictments allege that the defendants used invalid permits for the shipments of the rare plants and falsely labelled many of the plants shipped to cover up the lack of a valid permit. The shipments all were allegedly for commercial purposes.

All of the species of cycads described in the indictments are protected under CITES, to which the United States, South Africa, Australia, Zimbabwe, Indonesia and China are parties. The United States implements CITES through the Endangered Species Act. Most of the species at issue are threatened with extinction and may be traded only in exceptional circumstances, and then only with required permits.

The maximum statutory penalty is five years in prison and a \$250,000 fine for each count of conspiracy in violation of 18 United States Code, Section 371, smuggling in violation of 18 United States Code, Section 545, and false statements in violation of 18 United States Code, Section 1001. However, any sentence following conviction would be

dictated by the Federal Sentencing in the discretion of the Court. An indictment simply contains allegations against an individual and, as with all defendants, **these defendants must be presumed innocent of the charges against them unless they are convicted.**

The investigation into the international trade in protected species of orchids and cycads was conducted by special agents from the Branch of Special Operations of the United States Fish and Wildlife Service, as well as the Department of Agriculture's Animal and Plant Health Inspection Service, and authorities in Australia and South Africa. Laurel Beeler, an Assistant United States Attorney in San Francisco and Elinor Colborn and Catherine Pisaturo, from the Justice Department's Environment and Natural Resources Division are prosecuting the case along with attorneys from the United States Attorney's Office for the Central District of California in Los Angeles.



Mnr. Carl Mainen, 'n spesiale agent van die Amerikaanse vis-en-natuurlewedienste, en kapt. Gert van der Merwe van die polisie se eenheid vir bedreigde spesies, by 'n deel van die besending broodbome waarop die naweek op die Johannesburgse Lughawe beslag gelê is. Foto: Annemarie Marais.

Beeld

Woensdag 25 Julie 2001

Broodbome van R4 m. onderskep

Gautengse natuurbewaarder geskors

Annemarie Marais

Nóg inhegtenisnemings kan volg nadat sowat 564 skaars Suid-Afrikaanse broodbome ter waarde van sowat R4,1 miljoen op pad na die VSA deur die polisie se eenheid vir bedreigde spesies op die Johannesburgse Lughawe onderskep is.

'n Gautengse natuurbewaarder is intussen geskors en beslag is gelê op sy rekenaartoerusting en sagte-ware. Hy sal waarskynlik binnekort aangekla word weens die beweerde smokkel met die onderskeie spesies van die bedreigde *Encephelartos*-genus.

Intussen bly die drie Suid-Afrikanners wat die naweek in Kalifornië in hegtenis geneem is op 15 aanklagte van sameswering, smokkelary en die aflê van vals verklarings, in die VSA in aanhouding.

Hulle is mnre. Ernest Bower (56) van Sandton, Rolf Bauer (44) van Johannesburg en Jan van Vuuren (54) van Centurion.

Mnr. Peter Heibloem (47) van Australië is op borgtog van R4 miljoen vrygelaat terwyl die Amerikaanse polisie nog op soek is na mnre. Ian Turner, een van die bekendste *Encephelartos*-versamelaars in Zimbabwe, en Rolf Kyburz van Australië wat hulle dalk in die ondersoek kan help.

Dié inhegtenisnemings kom ná 'n drie jaar lange ondersoek deur die Amerikaanse vis-en-natuurlewedienste na die onwettige handel in onder meer broodbome en orgideë. Die ondersoek is in samewerking met die Suid-Afrikaanse en Australiese polisie gedoen.

Mnr. Carl Mainen, 'n spesiale agent van die vis-en-natuurlewedienste, het gister in Pretoria gesê *Encephelartos*-spesies word teen 'n

gemiddelde prys van sowat R4 000 in die VSA van die hand gesit.

Pryse van tot R40 000 is egter al betaal.

Kapt. Gert van der Merwe van die eenheid vir bedreigde spesies sê hulle glo die "groot visse" is gevang, hoewel vermeende smokkelaars nie té rustig moet slaap nie.

Van Vuuren is klaarblyklik die man by wie Montecasino in Fourways broodbome gekoop het as een van dié besienswaardighede by dié vermaaklikheidsentrum.

Bower is in 1998 in hegtenis geneem weens die onwettige besit van *Encephelartos leavifolius* met 'n straatwaarde van sowat R13 500.

Bauer het in Maart verlede jaar in Barberton 'n opgeskorte vonnis van 12 maande gekry. Beslag is gelê op sy 4x4-voertuig nadat hy betrap is met *E. paucidentatos*-broodbome wat uit die veld gehaal is.

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THE STING

How secret agents snared Qld garden guru

How secret agents snared Qld garden guru

EXCLUSIVE

ONE of Queensland's best known garden experts appeared in a Los Angeles court yesterday charged with smuggling \$1 million worth of rare plants and flowers into the US.

Authorities, who arrested Sunshine Coast garden guru and author Peter Heibloem after an elaborate two-year sting involving secret agents posing as illegal buyers, say he smuggled hundreds of endangered plants, including Australian orchids and ferns.

US authorities have named Brisbane-area nurseryman Rolf Kyburz as a co-conspirator. Kyburz told *The Sunday Mail* the case was nothing but a "witch hunt".



CHARGED: Sunshine Coast businessman Peter Heibloem in his exotic garden.

How the trap was sprung

A MERICAN agents hatched an elaborate trap to ensnare Peter Heibloem on August 7, 1999, at the Cycad '99 conference in Miami, Florida.

According to court documents, undercover agent Kenneth McCloud and a Californian academic whose name is being kept secret convinced Heibloem they were Californian buyers.

The men recorded dozens of conversations and e-mails detailing smuggling operations allegedly masterminded by Heibloem.

On October 10 last year, the agents allegedly recorded Heibloem detailing how he had discovered some of the rare plants in a national park in Australia.

In the recordings he wanted almost \$50,000 for the shipment, saying they didn't

grow on the side of the road and he had sent his associates into the park "to dig 'em out and do it nicely and clean them all up".

He described one of the species as "straight out of the national park" and said to the agents that "if you get caught with these things... you're finished".

In a November 16 telephone conversation with the agents, Heibloem is alleged to have said the rare Australian plants would have tags saying they were legally removed.

"So they'll all be tagged and all the numbers on the tags will be on the permit... it'll look pretty legitimate," he was recorded as telling the agents.

On August 22, 1999, Heibloem is alleged to have spoken for the first time with the undercover agents about

importing ferns from South Africa. According to the court papers, he told them: "As soon as you go over 15cm it's illegal to export it and if you get busted... it's painful."

Five days later, Heibloem is alleged to have told the agents he had come into possession of an extremely rare flower from South Africa that was "looking for a new home".

On July 10 last year, the agents recorded Heibloem boasting about his South African supplier whom he described as a "big landscaper".

"They would love to nail him, they would love to, would love to catch him... he's got huge stocks - I mean the list I supplied you is just like a drop in the bucket," he said.

Heibloem told the agents he would label the plants as

seedlings to get them past Customs.

On January 30 this year, the agents taped a telephone conversation in which Heibloem discussed the risks of smuggling ferns out of Zimbabwe.

"We've got to get through roadblocks and police checks, bloody border guards, and it's a hell of, you know, it's a long winding road to get the plants back home safely," he told them.

The court documents state that on June 26, less than a month before his arrest, US agents received a shipment of 60 rare ferns valued at \$500,000 from Zimbabwe linked to Heibloem.

The court documents allege Heibloem had the profits from the smuggling venture wired from California to bank accounts in Hong Kong and Queensland.