

The critical difference between extinction and survival: *ex situ* conservation of *Encephalartos* species in the Lowveld National Botanical Garden, SA.

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Abstract

Worldwide the cycad flora consists of about 297 species, of which an astronomical 82% are currently listed as threatened. In South Africa the rate is slightly higher – 89% of the indigenous *Encephalartos* species are threatened. In the 1980s the Lowveld National Botanical Garden started a project to collect endangered *Encephalartos* species. Specimens of the same species but from different geographical areas and differing morphologically from each other are housed in separate seed orchards (for example *E. ngoyanus*, *E. lebomboensis*). The seed orchards are currently well established, with most plants producing cones on a regular basis. The ultimate objective with seed produced from plants in the seed orchards is enhancement or reintroduction in the wild. However, pressures on wild populations and garden collections by irresponsible collectors often prevent success in this regard. The alternative at this stage is to propagate highly sought after species and sell them to the public to relieve the pressure on wild populations. Intensive management and involvement in cycad conservation (*ex situ* and *in situ*) over the past three years have highlighted problems, successes and challenges for the conservation of *Encephalartos* species in South Africa.

Keywords

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

The International Union for Conservation of Nature – Cycad Specialist Group - reported in 2003 that 82% of the world's cycad species are threatened with extinction in the near future, while in South Africa, 89% of the 36 recognized species are currently listed as Extinct, Extinct in the Wild, Critically Endangered, Endangered or Vulnerable (IUCN Red List – SANBI 2008). Although the reasons why these ancient seed plants are facing such a bleak future are not unique to South Africa, unscrupulous harvesting of mature plants from their natural habitat for use in landscaping and private collections is the biggest reason for the rapid decline of many species.

The South African National Biodiversity Institute (SANBI) has a network of 9 National Botanical Gardens throughout South Africa. One of them, the Lowveld National Botanical Garden (LNBG) represents the sub-tropical climate of the north-eastern part of the country. During the early 1980's the LNBG has started to intensify collection efforts in the genus *Zamiaceae* focussing on African and South African species. Soon afterwards the severity of the extinction threat to many South African species were realized, which prompted the LNBG to extend *Encephalartos* collections to be more genetically representative. These collections aimed to be mostly from wild collected seed, but in some instances included plants which were confiscated by conservation authorities from private collectors when it was found to be illegally possessed. *Encephalartos* species obtained for conservation purposes were planted in field gene banks, which are fenced off and for security reasons not accessible to the public. The *Encephalartos* collection has subsequently grown and unfortunately also attracted some unwanted attention, which lead to a series of thefts, which necessitated the use of alarm systems and security

guards to protect these valuable collections in LNBG. Currently there are 36 *Encephalartos* species recognized in South Africa; 19 of these are represented in LNBG as viable *ex situ* collections which can be considered to be genetically representative of at least one known locality for each species. A further 9 species are present in LNBG, but although these plants are mature and cone-producing, they are typically small collections and many from unknown localities. The remaining species are represented as single plants, and mostly do not cone on a regular basis.

The initial cycad collections were planted in the cultivated areas of LNBG and are grouped either according to different geographical areas or families. During a new wave of cycad thefts from 2005, Botanical Gardens in SA with significant cycad collections became a target for collectors, and this necessitated the translocation of many valuable species from landscaped areas to the field gene banks where security measures could be installed. The *Encephalartos* field gene bank at LNBG is an extensive open air planting with South African *Encephalartos* species, which have been collected with the aim of establishing viable *ex situ* conservation collections. *Encephalartos* species are divided into different sections, and in cases where a species is represented from more than one geographical locality, these collections are housed separately and are also managed as separate collections to ensure genetic purity. This ensures that the collections can be used for restoration, reintroduction or enhancement when the opportunity arises. Intensive management of the collections in the gene bank includes the simulation of natural phenomena such as wet and dry seasons, as well as fires. Plants from fire climax grasslands are burned on a biennial cycle by covering the plants with dry grass and setting it alight during the fire season which is between August and September. Effective management of the conservation collection is achieved by attaching a label with a unique number to each plant and this is linked to a photographic record and an electronic database. The electronic database includes all the collection information of the plant, accession numbers, GPS reading of the current locality in the garden, sex of the plant, number of suckers, year cones produced, month cones mature, number of cones, and in the case of females – pollination data such as date and method used, number of seeds harvested, number of seeds viable, number of seeds germinated after 1 year. Any other information regarding fertilization, pests, diseases and treatments are also indicated on the database.

As part of the Threatened Plants Project in LNBG, cycad seedlings are propagated on a large scale primarily to satisfy the public demand for these unique plants, but ultimately the aim is the reintroduction of seedlings into the natural habitat once these plants can be safeguarded. The large collection of *Encephalartos* species in a confined area makes it important to intensively manage the plants especially during their reproduction stage to prevent hybridization between closely related species. Hybridization is prevented by taking the following steps:

- Male cones are removed once they reach maturity and start to shed pollen. The procedure for removing the male cone involves cutting the stalk carefully with a sharp knife while ensuring that the cone is kept in an upright position. Once the cone is free, it is laid down on newspaper and stored in a draft-free room for three days to allow all the pollen sacs to open. Pollen is then collected in labelled containers and stored in a fridge at 4°C for up to two years. Stored pollen is used to pollinate female cones in LNBG, and the surplus is made available to the public and the local cycad society's pollen bank.
- Female cones of the genus *Encephalartos* are fully receptive for pollen when the cone scales become loose and this creates a small gap between the scales on the top half of

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

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

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

References

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