DEPARTMENT OF ENVIRONMENTAL AFFAIRS

NOTICE 315 OF 2017

NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT NO. 10 OF 2004)

BIODIVERSITY MANAGEMENT PLAN FOR ELEVEN CRITICALLY ENDANGERED AND FOUR ENDANGERED *ENCEPHALARTORS* CYCAD SPECIES

I, Bomo Edith Edna Molewa, Minister of Environmental Affairs, hereby publish the Biodiversity Management Plan for 11 critically endangered and four endangered *Encephalartors* Cycad species, in terms of section 43(1)(b)(i) read with 43(3) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004), set out in the Schedule hereto.

BOMO EDITH EDNA MOLEWA
MINISTER OF ENVIRONMENTAL AFFAIRS

BIODIVERSITY MANAGEMENT PLAN - SPECIES FOR

11 CRITICALLY ENDANGERED AND 4 ENDANGERED ENCEPHALARTOS SPECIES

Prepared for:

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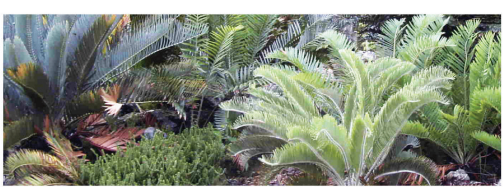

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

2030 NDP

SCHEDULE

BIODIVERSITY MANAGEMENT PLAN FOR 11 CRITICALLY ENDANGERED AND 4 ENDANGERED *ENCEPHALARTOS* SPECIES

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

EXECUTIVE SUMMARY

Encephalartos species (or cycads as they are more commonly known as) are collectively the most threatened plant group in South Africa today. Twelve of the 37 (32%) *Encephalartos* species that occur in South Africa are regarded as Critically Endangered, while an additional three are already considered Extinct in the Wild. There are less than 100 plants left in the wild for seven of the Critically Endangered species, four species of which are on the brink of extinction. A further four *Encephalartos* species are regarded as Endangered. The predominant threat facing Encephalartos species is the ongoing illegal removal of adult plants from wild populations to meet the current demand for large Encephalartos species for private collections and for landscaping purposes. Recently, Encephalartos species have also been poached for use in *muthi*-markets where these plants are used for traditional purposes. Adult plants are also highly valued as parental stock for seedling propagation for both the domestic and international cycad trade.

The Department of Environmental Affairs (DEA) requested the South African National Biodiversity Institute (SANBI) to develop, by 15 January 2015, a generic Biodiversity Management Plan (BMP) for key Encephalartos species in accordance with Section 43 of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEM:BA) and the NEM:BA Norms and Standards for Biodiversity Management Plans for Species (BMP-S).

The aim of the BMP-S is to ensure the long-term survival in nature of the 15 *Encephalartos* species. For the purpose of this BMP long-term survival is interpreted as halting the decline of the *in situ* populations and thereafter attaining a population growth which will result in a down-listing of the species in terms of its conservation status in the IUCN Red List. The 15 Encephalartos included in the BMP-S are *Encephalartos aemulans, E. arenarius, E. cerinus, E. cupidus, E. dolomiticus, E. dyerianus, E. eugene-maraisii, E. heenanii, E. hirsutus, E. horridus, E. inopinus, E. laevifolius, E. lebomboensis, E. middelburgensis,* and *E. msinganus.*

Stakeholders were identified through a literature review as well as in consultation with the SANBI, the BMP-S Project Steering Committee and several members of the public with an interest in Encephalartos species. During the stakeholder identification process, the names and contact details of stakeholders were registered on a database of interested and affected parties. A total of 246 stakeholders were registered in the stakeholder database, which included the following stakeholder groups:

- National Stakeholders (DEA, SANParks, SANBI, etc.) (33);
- Provincial Stakeholders (e.g. provincial conservation agencies) (57);
- Municipal Stakeholders (e.g. Nelson Mandela Metropolitan Municipality) (15);
- Private Conservation Stakeholders (SA Hunters and Game Conservation Association, Endangered Wildlife Trust, Private Nature Reserves, etc.) (26);
- Cycad Society of South Africa (CSSA), Growers, Collectors (39);
- National Botanical Gardens/ Botanical Society Stakeholders (18);
- Academic or Research Stakeholders (12);
- Landowners (24);
- Industry (Transnet, Coega IDZ, etc.) (7); and
- Other Stakeholders (15).

Overarching principles and operational guidelines were identified to govern the successful implementation of the overall BMP-S, including the establishment of a Cycad Steering Committee consisting of a collaboration between the Department of Environmental Affairs, the South African

National Biodiversity Institute, provincial conservation agencies and the private sector represented by the CSSA.

Generic aspects of the BMP-S which are applicable to all 15 *Encephalartos* species include an increase in protection of wild cycads, essential research, and effective management of confiscated cycads and *ex situ* collections. Specific objectives, actions and recovery targets were established for all 15 *Encephalartos* species ranging from surveys to determine current population status, identification of secure sites for reintroduction, proclamation of areas as Specially Protected Areas in terms of the National Environmental Management: Protected Areas Act (NEM:PAA) (Act 57 of 2003) to recovery objectives such as reintroduction of seed and / or seedlings into secure localities.

DEFINITIONS

Aichi Targets	Aichi Targets of the Convention of Biological Diversity includes a Strategic Plan which is comprised of a shared vision, a mission, strategic goals and 20 targets, collectively known as the Achi Targets. The Strategic Plan serves as a flexible framework for the establishment of national and regional targets and it promotes the coherent and effective implementation of the three objectives of the CBD (https://www.cbd.int/doc/strategic-plan/2011-2020/Aichi-Targets-EN.pdf)
Alien species	A species that is not an indigenous species. Or an indigenous species translocated or intended to be translocated to a location outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention.
Biodiversity	Biodiversity is the variability among living organisms from all sources including *inter alia* terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
Community	Assemblage of populations living in a prescribed area or physical habitat, inhabiting some common environment.
Conservation	The management of the biosphere so that it may yield the greatest sustainable benefit to the present generation while maintaining its potential to meet the needs and aspirations of future generations. The wise use of natural resources to prevent loss of ecosystem function and integrity.
Conservation concern	Species of conservation concern are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient - Insufficient Information (DDD) (http://redlist.sanbi.org/redcat.php).
Conservation status	An indicator of the likelihood of that species remaining extant either in the present day or the near future, or a measure of its extinction risk denoted by the species' Red List status. Many factors are taken into account when assessing the conservation status of a species: not simply the number of individuals remaining, but the overall increase or decrease in the population over time, breeding success rates, known threats, and so on.
Critically Endangered	A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five International Union for the Conservation of Nature (IUCN) Red List criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction (http://redlist.sanbi.org/redcat.php).
Data Deficient	There is inadequate information to make a direct, or indirect, assessment of a taxon's risk of extinction based on its distribution and/or population status. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that a threatened classification is appropriate.
Endangered	A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN Red List criteria for Endangered, indicating that the species is facing a very high risk of extinction (http://redlist.sanbi.org/redcat.php).
Ex situ	Off-site or outside a species' natural habitat.
Flora	The plant life of a region.
Forb	An herbaceous plant other than grasses.

Genebank	A biorepository which preserves genetic material of plant species, and includes seed banks and living plant collections.
Habitat	Type of natural environment in which plants and animals live.
In situ	Within a species' natural habitat.
Indigenous	A species that occurs naturally in South Africa
Invasive species	Naturalised alien plants that have the ability to reproduce, often in large numbers. Aggressive invaders can spread and invade large areas.
IUCN Red List	The IUCN Red List is set upon precise criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world.
Least Concern	A species is Least Concern when it has been evaluated against the IUCN Red List criteria and does not qualify for any other Red List category. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category (http://redlist.sanbi.org/redcat.php).
Mitigation	The implementation of practical measures to reduce adverse impacts.
Natural Distribution range	The spatial extent of the historical occurrence in the wild as can be determined through all available records and publications
Near Threatened	A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN Red List criteria for Vulnerable, and is therefore likely to become at risk of extinction in the near future (http://redlist.sanbi.org/redcat.php).
Protected Plant	These plants are protected by the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEM:BA) and other provincial legislation. No person may sell, buy, transport, or harvest this plant without a permit from the relevant authority.
Stakeholder	Natural or juristic person(s) that has an interest in, or may be affected by, a particular obligation or decision or activity, relating to or resulting from a management plan, either as individuals or representative of a group, and include landowners
Threat	Any action that causes a decline in populations and compromises the future survival of a species or anything that has a detrimental effect on a species.
Threatened	Threatened species are species that are facing a high risk of extinction. Any species classified in the IUCN Red List categories Critically Endangered, Endangered or Vulnerable is a threatened species (http://redlist.sanbi.org/redcat.php).
Viable	The ability of a species or population to survive or persist and reproduce over multiple generations or a long time period.
Vulnerable	A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction (http://redlist.sanbi.org/redcat.php).

ABBREVIATIONS

BMA	Biodiversity Management Agreement
AFLPs	Amplified Fragment Length Polymorphism
BMP	Biodiversity Management Plan
BMP-S	Biodiversity Management Plan for Species
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CSSA	Cycad Society of South Africa
CR	Critically Endangered
DEA	Department of Environmental Affairs
EC DEDEAT	Eastern Cape Department of Economic Development, Environmental Affairs and Tourism
EKZNW	Ezemvelo KZN Wildlife
EN	Endangered
EPWP	Expanded Public Works Programme
GCS	Garden Conservation Strategy
GDARD	Gauteng Department of Agriculture and Rural Development
GSPC	Global Strategy for Plant Conservation
IUCN	International Union for the Conservation of Nature
IUCN-SSC	International Union for the Conservation of Nature – Species Survival Commission
KNP	Kruger National Park
KZN	KwaZulu-Natal
LC	Least Concern
LEDET	Limpopo Department of Economic Development, Environment and Tourism
MTPA	Mpumalanga Tourism and Parks Agency
NBG	National Botanical Garden
NEM:BA	National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
NEM:PAA	National Environmental Management: Protected Areas Act (Act No. 57 of 2003)
NT	Near Threatened
RAPD	Random Amplified Polymorphic DNA
RFID	Radio Frequency Identification
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SEF	Strategic Environmental Focus (Pty) Ltd
TOPS	Threatened or Protected Species
UCT	University of Cape Town
UP	University of Pretoria
VU	Vulnerable
WfW	Working for Water
WoF	Working on Fire

ACKNOWLEDGEMENTS

Numerous people have contributed to the process of compiling this Biodiversity Management Plan by participating in key stakeholder meetings, reviewing and commenting on draft documents and finalization of the draft document. People and/or organizations that made invaluable contributions to the BMP included, but was not limited to: Ezemvelo KZN Wildlife, Mpumalanga Tourism and Parks Agency, Limpopo Department of Economic Development, Environment and Tourism, Eastern Cape Department of Economic Development, Environmental Affairs and Tourism, Department of Environmental Affairs, the South African National Biodiversity Institute, the Department of Plant Pathology and Microbiology at the University of Pretoria, South African National Parks, and the CSSA. All the members of the public that participated in the stakeholder engagement workshops are acknowledged for their contributions.

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1 INTRODUCTION

1.1 Project Description

Cycads (*Encephalartos* species) are collectively the most threatened plant group in South Africa today. Twelve of the 37 (32%) *Encephalartos* species that occur in South Africa are regarded as Critically Endangered, while an additional three are already considered Extinct in the Wild. There are less than 100 plants left in the wild for seven of the Critically Endangered species, four species of which are on the brink of extinction. A further four *Encephalartos* species are regarded as Endangered. The predominant threat facing cycads is the on-going illegal removal of adult plants from wild populations to meet the current demand for large cycads for private collections and for landscaping purposes. Recently, cycads have also been poached for use in *muthi*-markets where these plants are used for traditional purposes. Adult plants are also highly valued as parental stock for seedling propagation for both the domestic and international cycad trade.

The Department of Environmental Affairs (DEA) requested the South African National Biodiversity Institute (SANBI) to develop, by 15 January 2015, a generic Biodiversity Management Plan (BMP) for key *Encephalartos* species in accordance with Section 43 of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEM:BA) and the NEM:BA Norms and Standards for Biodiversity Management Plans for Species (BMP-S) (gazetted in March 2009). The NEM:BA Norms and Standards provide for a national approach and minimum standards for the development of a BMP-S. A BMP-S can be developed for one or more species, population or meta-population, and for any indigenous or migratory species. A BMP-S must aim to provide for the long-term survival of species in the wild and also provide the platform for an implementing organization or responsible entity as appointed by the Minister of Environmental Affairs (the "Minister") to monitor and report on the progress regarding implementation. Strategic Environmental Focus (Pty) Ltd (SEF), as independent environmental consultants and ecological specialists, was appointed by the SANBI to develop a generic BMP for 11 Critically Endangered (CR) and four Endangered (EN) *Encephalartos* species as well as specific details for each species. Table 1-1 summarizes the *Encephalartos* species included in this BMP, as well as the provinces in which they occur.

Table 1-1: *Encephalartos* species included in the BMP-S as well as the province in which they occur

Species	Province	Red List Status
Encephalartos aemulans	KwaZulu-Natal (KZN)	CR
Encephalartos arenarius	Eastern Cape	EN
Encephalartos cerinus	KZN	CR
Encephalartos cupidus	Limpopo & Mpumalanga	CR
Encephalartos dolomiticus	Limpopo	CR
Encephalartos dyerianus	Limpopo	CR
Encephalartos eugene-maraisii	Limpopo	EN
Encephalartos heenanii	Mpumalanga	CR
Encephalartos hirsutus	Limpopo	CR
Encephalartos horridus	Eastern Cape	EN
Encephalartos inopinus	Limpopo	CR
Encephalartos laevifolius	Eastern Cape, KZN, Limpopo, Mpumalanga	CR
Encephalartos lebomboensis	KZN & Mpumalanga	EN
Encephalartos middelburgensis	Mpumalanga & Gauteng	CR

Species	Province	Red List Status
Encephalartos msinganus	KZN	CR

1.2 Aim of the BMP-S

The aim of the BMP-S is to ensure the long-term survival in nature of the 15 *Encephalartos* species. For the purpose of this BMP, long-term survival is interpreted as halting the decline of the *in situ* populations and thereafter attaining a population growth which will result in a down-listing of the species in terms of its conservation status in the IUCN Red List.

1.3 Terms of Reference

In addition to all requirements specified in the NEM:BA Norms and Standards for BMP-S, the BMP-S must include the following for each *Encephalartos* species listed in Table 1-1:

- A recovery plan with recovery targets;
- Economic incentives for *in situ* conservation; and
- Recommended stewardship initiatives.

1.4 Methods

The methods for developing a generic BMP for the identified 11 Critically Endangered and 4 Endangered *Encephalartos* species were developed in accordance with Section 43 of the NEM:BA as well as the NEM:BA Norms and Standards for BMP-S.

According to the NEM:BA Norms and Standards for BMP-S, this plan must –

- be aimed at ensuring the long-term survival in nature of the species to which the plan relates;
- provide for the responsible person, organisation or organ of state to monitor and report on progress with implementation of the plan; and
- be consistent with:
  a) The Act;
  b) The national environmental management principles;
  c) The national biodiversity framework;
  d) Any applicable bioregional plan;
  e) Any plans issued in terms of Chapter 3 of the National Environmental Management Act (Act No. 107 of 1998);
  f) Any municipal integrated development plans;
  g) Any plans prepared in terms of national or provincial legislation that is affected; or
  h) Any relevant international agreements binding on the Republic.

1.4.1 Project Steering Committee

A BMP-S Project Steering Committee was established to guide and facilitate the development of the BMP-S. A Steering Committee meeting was convened on 24 March 2014 in order to establish the generic objectives of the BMP-S. A final steering committee meeting was held on the 27 October 2014 to discuss the outcomes of the BMP-S. These steering committee meetings were attended by representatives from national and provincial conservation and environmental agencies, as well as representatives from SEF.

1.4.2 Stakeholder identification and compilation of an interested and affected parties database

Stakeholders were identified through a literature review as well as in consultation with the SANBI, the BMP-S Project Steering Committee and several members of the public with an interest in cycads.

During the stakeholder identification process, the names and contact details of stakeholders were registered on a database of interested and affected parties. The database was used to:

- Capture all details pertaining to identified stakeholders (names, contact details, etc.) so that they could be notified of the proposed project,
- Invite stakeholders to scheduled stakeholder workshops; and
- Update stakeholder details as the process proceeded.

A total of 246 stakeholders were included in the stakeholder database, which included the following stakeholder groups:

- National Stakeholders (DEA, SANParks, SANBI, etc.) (33);
- Provincial Stakeholders (e.g. provincial conservation agencies) (57);
- Municipal Stakeholders (e.g. Nelson Mandela Metropolitan Municipality) (15);
- Private Conservation Stakeholders (SA Hunters and Game Conservation Association, The Endangered Wildlife Trust, Private Nature Reserves, etc.) (26);
- CSSA, Growers, Collectors (39);
- National Botanical Gardens/ Botanical Society Stakeholders (18);
- Academic or Research Stakeholders (12);
- Landowners (24);
- Industry (Transnet, Coega IDZ, etc.) (7); and
- Other Stakeholders (15).

In addition to the above, a notification was posted on an online cycad forum, namely “CYCADfriends” at http://cycadfriends.co.za, to inform over 1200 users of the BMP-S process.

1.4.3 Stakeholder Workshops

During the course of the project, SEF convened regional workshops in the various provinces in order to allow stakeholders an opportunity to provide input into the BMP-S process. Workshops were scheduled from 10:00 to 15:00 with a registration period from 09:00 to 10:00. Details of the workshops held as part of the BMP-S process are provided in Table 1-2.

Table 1-2: List of stakeholder workshops conducted by SEF as part of the BMP-S process

Province	Date	Venue	Number of attendees
KwaZulu-Natal	18 June 2014	Ezemvelo KwaZulu-Natal Wildlife, Queen Elizabeth Park, 1 Peter Brown Drive, Montrose, Pietermaritzburg	29
Eastern Cape	3 July 2014	Collegiate Provincial Building, Corner of Belmont Terrace and Castle Hill, Central, Port Elizabeth	29
Mpumalanga	22 July 2014	Mpumalanga Tourism and Parks Agency (MTPA) Auditorium, N4 National Road, Halls Gateway, Mattafin, Nelspruit	17
Limpopo	24 July 2014	Limpopo Department of Economic Development, Environment and Tourism Auditorium, Corner of Dorp and Suid Streets, Polokwane	14
Gauteng	6 August 2014	SANBI, Pretoria NBG, 2 Cussonia Avenue, Brummeria, Pretoria	37

The purpose of these workshops was to obtain comments or suggestions from stakeholders on targets and action items for inclusion in the BMP-S. Landowners (or their designated managers) and community leaders who were not able to attend the workshops were consulted in person.

Due to the sensitive nature of the information associated with cycads in the wild, the identity of landowners is omitted from this public document.

A PowerPoint Presentation was provided at each of the meetings, describing the following main items:

- Introduction to the Project and Project Team;
- Overview of the BMP-S process;
- Aim and objectives of the BMP-S and workshop;
- Generic aspects for the BMP-S; and
- Specific details regarding identified *Encephalartos* species for the purpose of the BMP-S.

At each of the provincial workshops the list of generic aspects that was discussed at previous workshops was presented to the next round of workshop attendees. At the national workshop held in Gauteng Province, all the proposed actions arising from the Provincial Workshops were presented for comment.

In order to ensure that all comments and/ or concerns regarding the BMP-S process and all proposed actions and targets were recorded accurately, digital voice recordings were taken during all workshops proceedings.

1.4.4 Additional meetings

Given that the Cycad Society of South Africa (CSSA) have expertise or interests in several or all the identified *Encephalartos* species, SEF invited the representatives of the CSSA to an initial introductory meeting before the stakeholder engagement process was rolled-out. The objective of this meeting was to introduce the project team leading the process and to obtain suggestions in terms of how the CSSA could contribute to the process.

The meeting took place on 24 April 2014 at SEF's offices at the CSIR campus in Pretoria and was attended by Mr Mark Crooks (private capacity), Mr Byron Grant (SEF), Ms Karin van der Walt (SEF) and Ms Jessica de Beer (SEF).

In addition to the above, SEF also attended the "Round Table Discussion on Cycads" on 9 June 2014, which was hosted by the South African Hunters and Game Conservation Association. The purpose of this meeting was not to discuss the BMP-S, although the meeting was used as an opportunity to introduce the BMP-S process to a wide range of stakeholders.

On 10 June 2014 SEF scheduled a meeting with the DEA's Directorate Bio-prospecting and Biodiversity Economy at the DEA's offices. A second meeting was scheduled with the Gauteng Department of Rural Development's (GDARD) enforcement officers and representatives from the University of Pretoria.

1.5 Limitations

Information on which the BMP-S is based was obtained through comprehensive literature reviews and consultation with provincial and national conservation agencies, stakeholders and landowners. No fieldwork or population verification studies were conducted as part of this BMP-S.

2 BACKGROUND

2.1 Overview

All living *Encephalartos* species can be divided into three families; Cycadaceae, Stangeriaceae and Zamiaceae which altogether are represented as 10 general and 331 species and subspecies (Osborne *et al*., 2012). Two of these, Stangeriaceae (containing the genus *Stangeria*) and Zamiaceae (which includes all *Encephalartos* species) occur in South Africa.

South Africa is considered to be one of the centres of cycad *Encephalartos* species diversity, hosting more than half of the known *Encephalartos* species in Africa, with 76% of the *Encephalartos* species occurring in South Africa considered to be endemic. However, 78% of the South African *Encephalartos* species are threatened with extinction, with twelve *Encephalartos* species classified as Critically Endangered (CR), four classified as Endangered, and ten classified as Vulnerable (Raimondo *et al*., 2009). In addition, three of the four *Encephalartos* species which are classified as Extinct in the Wild (EW), namely *Encephalartos brevifoliolatus, E. nubimontanus* and *E. woodii*, used to occur in South Africa. It should be noted that there are unconfirmed reports of additional populations of *E. nubimontanus*, but until these reports have been verified, the official listing remains EW and, therefore, the *Encephalartos* species is not included in this BMP-S.

2.2 Identified threats to wild populations

2.2.1 The illegal removal and trade in mature specimens from the wild

The illegal collection of wild *Encephalartos* species for horticultural and medicinal purposes affects all *Encephalartos* species in South Africa and is considered the primary threat for all 15 *Encephalartos* species included in this BMP-S. *Encephalartos* species are used for traditional medicine across South Africa, with some *Encephalartos* species such as *E. ferox* (NT)*, E. ghellincki* (VU)*, E. natalensis* (NT)*, E. senticosus* (VU) and *E. villosus* (LC) also traded in traditional medicine markets. In recent years bark harvesting for the medicinal trade has increased and this has resulted in declines in wild populations with complete loss of some populations in KZN and the Eastern Cape (Cousins *et al*., 2012).

Due to their slow growth rate, *Encephalartos* populations are very sensitive to harvesting, and it is estimated that some populations can take up to 70 years to recover from the removal of only five adult plants (Raimondo and Donaldson, 2003).

2.2.2 Habitat transformation and current land-use practises

Habitat transformation affects only some of the *Encephalartos* species in South Africa. *Encephalartos* species such as *E. horridus* and *E. arenarius* have been directly affected by habitat loss through urban expansion and coastal resort developments.

2.2.3 Alien invasive plants

In general, the threat posed by the invasion of alien plant species is not considered to be significant for most South African *Encephalartos* species. It should however be noted that alien plants have invaded many regions where *Encephalartos* species occur naturally. For example, there are dense stands of *Lantana camara* and *Chromolaena odorata* on the lower slopes of the Lebombo Mountain Range in Mpumalanga Province where *E. lebomboensis* is known to occur (Tommie Steyn, pers. comm.). It is probable that the primary impact from the dense stands of alien plants will be on the recruitment of *Encephalartos* species due to the altered environment for germination.

2.2.4 Diseases

Many plant species are affected by invasive pests and pathogens in their natural habitat mostly as a result of introduction of non-native pests and pathogens in their natural habitats. Increasing changes in climate may also lead to currently harmless pathogens and pests becoming problems. Non-native pathogens such as *Aulacaspis yasumatsui* (Cycad Aulacaspis Scale/CAS) has been identified by the IUCN as possibly the single most important threat to wild *Encephalartos* populations and conservation collections around the world (IUCN SSC, 2006). This *Aulacaspis yasumatsui* (Cycad Aulacaspis Scale/CAS) has been identified in Pretoria, Durban and Richards Bay in South Africa (Prof Jolanda Roux, DST/NRF Centre of Excellence in Tree Health Biotechnology; the University of Pretoria, pers. comm. November 2014).

2.3 Applicable International Agreements

2.3.1 Convention on Biological Diversity

South Africa ratified the Convention on Biological Diversity (CBD) in 1995. The objectives of this convention are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the use of genetic resources.

The CBD in 2010 adopted the Strategic Plan for Biodiversity 2011-2020 at the 10th Meeting of the Parties (COP) Nagoya, Japan. The plan outlines 20 Aichi Targets to achieve global biodiversity conservation. Amongst others, these include the following which is relevant for the purposes of the BMP-S:

- Target 12: By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

2.3.2 The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement of which South Africa became a signatory in 1975. More than 180 countries are currently party to this Convention which is the largest wildlife conservation agreement in existence. The trade in wild animals and plants is a major threat to the survival of some species. The contracting Parties therefore recognize that international co-operation is essential for the protection of certain species of wild fauna and flora against over-exploitation for international trade. All *Encephalartos* species are included on Appendix I to CITES, and international exports for commercial purposes are therefore prohibited, although specimens artificially propagated for commercial purposes may be exported. A notice published in the Government Gazette in May 2012 prohibits the export of large artificially propagated *Encephalartos* specimens. International trade in *Encephalartos* species are regulated in South Africa by the CITES Regulations which came into force on 5 March 2010.

2.3.3 Global Strategy for Plant Conservation (GSPC)

The CBD described above has also adopted the Global Strategy for Plant Conservation (GSPC), which is a program of the United Nations' Convention on Biological Diversity. The GSPC aims to slow the pace of plant extinction around the world. The GSPC has five objectives with16 targets which respond to the objectives of the GSPC. In this regard, South Africa is in the process of developing the National Strategy for Plant Conservation (NSPC) to fit into the global strategy.

2.4 Applicable National Legislation

2.4.1 National Environmental Management: Biodiversity Act (Act 10 of 2004)

NEM:BA provides for the management and conservation of biological diversity within South Africa, as well as the use of indigenous biological resources in a sustainable manner, the fair and equitable sharing among stakeholders of benefits arising from bio-prospecting involving indigenous biological resources; and gives effect to ratified international agreements relating to biodiversity which are binding on South Africa.

The Minister may, in terms of Section 56 of NEM:BA and by notice in the Government Gazette, publish a list of species that are threatened or in need of national protection – (TOPS). Currently, with the exception of one or two species, all indigenous *Encephalartos* species are listed as Critically Endangered, Endangered, Vulnerable or Protected. NEM:BA regulates restricted activities involving listed threatened or protected species through a permit system. Section 57(1) of NEM:BA provides that a person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7 of the NEM:BA.

Section 57(2) makes provision that the Minister may, by notice in the Government Gazette, prohibit the carrying out of a restricted activity if such activity may have a negative impact on the survival of a listed threatened or protected species. On 14 May 2012 the Minister published under section 57(2) the prohibition of certain restricted activities involving certain *Encephalartos* species in Government Gazette No. 35344 for immediate implementation. The notice stipulates that, unless required for conservation or enforcement purposes, the following restricted activities involving wild specimens of listed threatened or protected *Encephalartos* species are prohibited:

- Collect, pluck, uproot, destroy;
- Export from the South Africa, sell, trade, buy;
- Receive, give, donate, accept, acquire, dispose;
- Import into South Africa, convey, move, translocate; and
- Possess, exercise physical control (except where permits have been issued, prior to the publication of this notice, for plants that form part of legally obtained parental stock).

Section 43 of NEM:BA also makes provision for the development of Biodiversity Management Plans for Species (BMP-S) as a tool to manage species such as *Encephalartos*.

2.4.2 Threatened or Protected Species (TOPS) Regulations - 2007

In terms of Section 89 of NEM:BA and Regulation 11 of the TOPS regulations, a risk assessment in accordance with Regulation 15 may be required by the issuing authority before a restricted activity involving a wild population of a listed critically endangered species can be approved. Regulation 27 of the TOPS regulations also require the registration of a facility where specimens of plant species that are listed as threatened or protected are grown and/ or sold for commercial purposes.

2.4.3 National Environmental Management: Protected Areas Act (Act 57 of 2003)

Specially protected areas can be declared by the Minister in terms of the National Environmental Management: Protected Areas Act (NEM:PAA) (Act 57 of 2003). These specially protected areas are declared in order to protect highly sensitive, outstanding ecosystems, species, geological or physical features. The focus of these areas is not on tourism or sustainable use but rather on scientific research or environmental monitoring. Special Nature Reserves have the highest level of protection and are even more important than a National Park, and therefore offences in these areas are dealt with more seriously than in other protected areas.

2.5 International processes

2.5.1 The International Union for Conservation of Nature (IUCN)

The International Union for Conservation of Nature (IUCN) was established in France in 1948 as the "International Union for the Protection of Nature". The IUCN brings together states, government agencies and a diverse range of non-governmental organisations (NGOs) working at field and policy levels, together with scientists and experts to protect nature. The IUCN Red List is a tool to determine the risk of extinction to species and plays an important role in guiding conservation activities of government, NGOs and scientific institutions. South Africa became a State Member of the IUCN on 23 July 1993. The IUCN is increasingly playing a prominent role in guiding conservation activities of governments, NGOs and scientific institutions with a goal of providing information and analyses on the status, trends and threats to species in order to inform and catalyse action for biodiversity conservation.

3 GENERIC BIODIVERSITY MANAGEMENT PLAN

3.1 Overarching Principles and operational guidelines

It is expected that the BMP-S will be implemented in a complex and dynamic environment. It is therefore considered important to identify over-arching principles which will govern the successful implementation of the overall BMP-S and provide context within which the planning components have been derived. The following principles have been identified and discussed with key role players and stakeholders and are considered to be relevant in providing an important framework for the successful implementation of the BMP for the identified *Encephalartos* species:

1) The focus of this BMP is the long term survival of the *Encephalartos* species in the wild. It should however be noted that this process forms part of a holistic approach described in the draft "National Management Strategy and Action Plan for Cycads" (2014);
2) The only way to guarantee the long-term survival and evolution of plant species, and their associated ecological links, is to ensure plants are maintained in vigorous populations in the wild – or *in situ* conservation;
3) Although it is recognized that *in situ* (on-site) conservation is the best biological approach for the long term conservation of biological diversity, many *Encephalartos* species have declined to the point where an integrated approach, including *in situ* and *ex situ* (off-site) actions is required to prevent extinction;
4) Information relating to known localities of *Encephalartos* populations in the wild will be handled as confidential to minimize the threat of illegal harvesting of these populations. Objectives and actions relating to sensitive data will be coordinated by the implementing agent (SANBI in consultation with provincial conservation agencies);
5) It is recommended that a *Encephalartos* species BMP Implementation Committee consisting of a collaborative partnership between DEA, SANBI and the private sector represented by the CSSA is established to oversee the implementation of the BMP;
6) It is recommended that seed and seedlings be utilized for species recovery. In specific instances, the use of mature plants can be considered;
7) The seed to be utilized for species recovery may be sourced from (in order of preference): a) wild plants; b) NBGs and other state owned nurseries; or c) willing private growers or nurseries. It should however be considered that there is a significant risk of introducing pathogens/pests into wild populations of *Encephalartos* species in South Africa (Prof Jolanda Roux, pers. comm. November 2014). The trade in plants has been shown to be one of the most important mechanisms of spread of pests and pathogens globally, with tree health experts considering the problem so important that the Montesclaros Declaration was drawn up to advocate for an end in the trade of live plants (http://www.iufro.org/science/divisions/division7/70000/publications/montesclaros-declaration/);
8) Risk of diseases. Pathogens can spread in many ways and through various pathways which include soil, plant material, equipment, shoes, water, and air. The use of seedlings and mature plants to establish new populations in the wild or to augment existing populations should therefore be undertaken with extreme care so as not to introduce non-native pathogens/pests into these areas. Pathogens can spread on plant associated soil/growth media, soil in vehicle tyres or on the shoes and planting equipment of people conducting the transplants. Great care should be taken by the teams that transplant the *Encephalartos* species to ensure that insects and pathogens are not hiding beneath plant bracts, on roots etc. In addition to this, the following measures are recommended (Prof Jolanda Roux, pers. comm. November 2014):

- Staff undertaking the augmentation of natural *Encephalartos* populations should be carefully trained in pest and disease recognition and all plants should be examined in details before release for transplanting;
- Nurseries growing plants should be inspected regularly;
- Care should be taken in the application of chemicals in the nurseries, as these may mask infection/infestations, resulting in diseased/infected plants being sent to the field;
- Any observations of possible disease/pest occurrences on plants should be reported to plant health experts for further investigation.

9) Where the long term goal for a species is to recreate a self-sustaining population, it must be ensured that required ecological processes such as pollination and dispersal are intact or can be re-established (Da Silva *et al*., 2011);
10) Where plants in the wild do not produce seed/ do not produce sufficient seed to meet recovery targets, plants in *ex situ* collections can be used provided that the purity of parental stock is confirmed through DNA barcoding (to be conducted by the University of Johannesburg). In instances where plants in *ex situ* collections are used to propagate seed for augmentation/reintroduction purposes, extensive measures should be taken to prevent any hybridization with other species and to ensure that the seed is disease and pest free;
11) Where an *Encephalartos* species is known from more than one locality, recovery will be effected with seed sourced from a specific locality as far as possible, in order to keep localities/ forms separate until further research has been undertaken regarding the evolutionary significance of the localities/ forms and the conservation genetics of the *Encephalartos* species;
12) Species recovery will only be conducted if areas into which recoveries are effected can be secured against poaching;
13) Recovery actions, including the establishment of *ex situ* collections from wild-sourced seed, would involve restricted activities stipulated in terms of Section 57 of NEM:BA. Therefore, a TOPS permit must be obtained before any such activities are conducted;
14) Although the intent is to save plants in the wild, it is recognized that *ex situ* collections can play an important role provided that these collections are managed to ensure genetic purity and health of specimens (disease and pest free). *Ex situ* collections at NBGs will only be expanded if current security systems can be upgraded to prevent theft of valuable specimens;
15) Harvesting of *Encephalartos species* for medicinal purposes is included under the definition of poaching or illegal removal;
16) Recovery plans must:
    - Comply with all legal requirements for conducting a restricted activity in terms of Section 57 of NEM:BA;
    - Identify optimal sites for recovery through a combination of desktop mapping, habitat modelling and field verifications;
    - Include a protocol of procedures which should stipulate how plants/seeds will be collected, who will collect plants/seeds, artificial pollination etc.
    - Include a protocol of procedures for preventing the introduction of pathogens and pests (refer to principle 8)
17) It is accepted that landowners may participate in breeding programmes that fit within the context of this management plan, and that subject to all legal requirements being met, seedlings can be produced from wild populations to meet the demand for plants in the trade and to provide income to cover management and protection costs.

3.2 Increase protection of wild *Encephalartos* populations from poaching

Background

The provincial conservation agencies that are mandated to protect wild *Encephalartos* populations from poaching are experiencing severe capacity constraints such as shortages of human resources and budget. Thus, the enforcement of strict protection measures which have been developed for *Encephalartos* species in the wild is hampered. In addition to the challenges of securing wild populations, it is difficult to prove the origin of wild plants once present in the horticultural market. Although the use of microchips to mark wild plants is useful for monitoring of wild populations, microchips are less successful as a deterrent against poaching since they can be removed from poached plants.

Based on updated research and technology, improved unique microchips have been procured by the DEA to mark priority wild *Encephalartos* populations. At the same time, pilot studies will be conducted on marking wild plants with microdots. These data microdots are microscopic discs that contain unique information linked to *Encephalartos* species and locality and the laser-etched code can be stored on a national verification database (Xaba and Bosenberg, 2012). An additional method which is being investigated to secure plants in the wild is the use of transponders or tag devices which will immediately alert law enforcement authorities when marked plants are poached or when the tag devices are tampered with.

Research is also being conducted on the use of stable isotopes to determine the origin of *Encephalartos* species. Stable isotopes are chemical tracers that record the characteristics of the environment such as geology and rainfall and these tracers are fixed in the plant tissue. Two research phases have already been conducted and the results are promising. The growing histories of two specimens within the NBGs were successfully reconstructed using stable isotope ratios and radio carbon dating (Retief *et al*., 2014). The use of stable isotopes and radio carbon dating is already being piloted in an *Encephalartos* species investigation, while the required forensic procedures are being devised. The next phase of this research will involve the development of a forensic stable isotope reference database for wild *Encephalartos* populations that can be used in future investigations and prosecutions.

Objective 1

To incentivize the *in situ* protection of wild *Encephalartos* populations through increasing the economic value of wild *Encephalartos* species.

Action 1: Develop a protocol for the approval of wild seed harvest for seedling production programmes for trade purposes in accordance with the CITES[1] Resolution Conf. 11.11 (Rev.CoP15).	
Champions/ Responsibility	SANBI, DEA and provincial conservation agencies
Funding	SANBI
Timeline	Within one year of publication of this BMP
Deliverable	Protocol for the approval of wild seed harvest for seedling production programmes for trade purposes

[1] Convention on International Trade in Endangered Species of Wild Fauna and Flora

Objective 2
To improve provincial capacity for implementation of protection measures for wild plants.

Action 1: Design and implement a security plan that deals with adequate anti-poaching personnel for priority plants, adequate equipment etc.	
Champions/ Responsibility	DEA to co-ordinate in collaboration with provincial conservation agencies and relevant departments within the South African Polices Services
Funding	Provincial conservation agency annual budgets
Timeline	Within three years of publication of this BMP
Deliverable	All essential anti-poaching posts filled and essential equipment available

Objective 3
To mark priority wild *Encephalartos* populations with new super unique microchips.

Action 1: Mark all priority wild *Encephalartos* populations with new microchips	
Champions/ Responsibility	DEA to purchase microchips. Provincial conservation agencies to insert microchips. The SANBI to advise on selection of priority populations. DEA to co-ordinate.
Funding	Purchase: DEA Application: Provincial budgets
Timeline	Within one year of publication of BMP
Deliverable	All priority wild populations marked

Objective 4
To pilot studies on the use of microdots for marking of wild *Encephalartos* populations.

Action 1: Identify one priority population per province and apply uniquely coded microdots in accordance with an agreed protocol	
Champions/ Responsibility	SANBI/ Provincial conservation agencies
Funding	Purchase of microdots: SANBI (25% of Scientific Authority budget to be allocated to actions in this BMP) Application: Provincial budgets
Timeline	Within one year of publication of BMP
Deliverable	At least one population per province marked according to agreed protocol

Action 2: Monitor the presence of microdots on marked plants	
Champions/ Responsibility	SANBI/ Provincial conservation agencies
Funding	Provincial budgets
Timeline	Annually
Deliverable	Monitoring report

Objective 5

To develop a forensic stable isotope reference database for wild *Encephalartos* populations for use in *Encephalartos* species investigations and prosecutions.

Action 1: Develop a forensic stable isotope reference database for wild *Encephalartos* populations	
Champions/ Responsibility	SANBI/ the University of Cape Town/ DEA/ SAPS
Funding	SANBI to source (25% of Scientific Authority budget to be allocated to actions in this BMP)
Timeline	Five years
Deliverable	A stable isotope reference database to provide forensic evidence in court for *Encephalartos* species investigations and prosecutions

3.3 Conduct essential research to ensure effective implementation of this BMP

Background

Many of the essential research fields described below have been initiated with various universities such as the University of KwaZulu-Natal, the University of Pretoria, the University of Cape Town, the University of Johannesburg, Rhodes University and the Nelson Mandela Metropolitan University and collaborations should be formed with these universities to continue future efforts.

Objective 1

To formulate a research plan that prioritizes research documented below.

Action 1: Formulate a research plan.	
Champions/ Responsibility	SANBI in collaboration with provincial conservation authorities
Funding	None required
Timeline	Within six months of publication of this BMP
Deliverable	A research priority list

3.3.1 Pollinators

Beetle species such as *Porthetes, Metacucujus* and *Xenoscelus* are important pollinators of *Encephalartos* species in South Africa. A lower diversity of insects has been observed on *Encephalartos* species in the northern parts of the country (Mpumalanga and Limpopo provinces) than on *Encephalartos* species in the south-eastern parts (Eastern Cape and KZN Provinces) (Donaldson, 1997; 1999). It is possible that insect pollinators are absent from small *Encephalartos* populations, with specialised weevils becoming locally extinct as these populations decline (Daly *et al*., 2006), although recent studies found that potential pollinators exist in male cones within small populations (Carin Swart, pers. comm., September 2014). The successful recovery of *Encephalartos* species as specified in this BMP will depend on the presence or reintroduction of pollinators.

Objective 1

To determine whether cucujid pollinators can be transferred between *Encephalartos* species.

Action 1: Conduct research to determine if cucujid pollinators can be transferred between *Encephalartos* species and can therefore be released into populations where they have become locally extinct.	
Champions/ Responsibility	SANBI
Funding	SANBI to source funding
Timeline	Five years
Deliverable	Published research papers on the species-specificity of cucujid pollinators

3.3.2 Sex identification of Encephalartos species

Prakash and Van Staden from the University of KwaZulu-Natal (pers. comm. 2006) made use of RAPD markers to identify the sex in *Encephalartos* seedlings which was based on the assumption that there is a single genetic system across all *Encephalartos* species. It is thought that more sensitive methods such as AFLPs or next generation restriction-site-associated DNA (RAD) sequencing approaches are needed for sex determination in *Encephalartos* species (Prof Nigel Barker, Rhodes University, pers. comm. September 2014). The sex determination of *Encephalartos* species will have valuable applications for recovery efforts during which sex ratios can be re-established in wild populations as well as determining the sex of adult non-coning plants in wild populations. This application could also prove to be useful for trade purposes, as female plants are considered more valuable than male plants.

Objective 1

To explore various molecular techniques to determine the sex of *Encephalartos* species.

Action 1: Continue research into molecular methods for determining the sex of *Encephalartos* species (adults and seedlings).	
Champions/ Responsibility	Universities
Funding	To be determined
Timeline	Five years
Deliverable	Published research papers on sex identification techniques for *Encephalartos* species

3.3.3 Species Recovery

Species recovery includes the manipulation, enhancing or restoration of *Encephalartos* species populations and for the purpose of this report also refers to restoration and reintroduction. Techniques used for recovery of *Encephalartos* species should be researched to ensure results are available for future recovery plans. Recovery techniques should be scientifically based and should address essential research questions such as survival rates of plants where the method of introduction involved seed, seedlings or adult plants, as well as comparisons between various replanting methods to determine the role of crowding and/or density dependant mortalities, nurse plants and land-use on germination and establishment. This research could also be conducted on more common *Encephalartos* species for which seed and seedlings are more readily available.

Objective 1
To conduct research into species recovery techniques.

Action 1: Initiate research projects in collaboration with recognized universities to increase knowledge on the restoration ecology of *Encephalartos* species.	
Champions/ Responsibility	SANBI, Mpumalanga Tourism and Parks Agency (MTPA), the Tshwane University of Technology (TUT), other universities
Funding	SANBI and/or universities to source funding
Timeline	Five years
Deliverable	Published research papers on the restoration ecology of *Encephalartos* species

3.3.4 Maintenance and restoration of essential mutualisms

Encephalartos species are the only known gymnosperms that fix nitrogen symbiotically through an association with cyanobacteria which are located in the coralloid roots (dichotomously branched structures arising from the lateral roots) (Peters *et al.,* 1986 in Zheng *et al.,* 2002). Studies conducted by Zheng *et al.* (2002) demonstrated that individual coralloid roots as well as the developmental stages of the individual root clusters can host multiple cyanobacteria. The role of cyanobacteria in the survival and growth of South African *Encephalartos* species is not clearly understood and research into these and other essential mutualisms should be determined.

Objective 1
To determine the role of *Encephalartos* species mutualisms and the importance of maintaining and restoring these mutualisms.

Action 1: Explore the role and importance of mutualisms such as cyanobacteria in *Encephalartos* species.	
Champions/ Responsibility	SANBI to coordinate
Funding	SANBI to source funding
Timeline	Five years
Deliverable	Published research papers on essential *Encephalartos* specie mutualisms

3.3.5 Diseases

According to Prof Jolanda Roux from the University of Pretoria (pers. comm. October 2014), virtually no scientific research into diseases of *Encephalartos* species has been conducted in Africa (including South Africa) to date. Research conducted by the DST/NRF Centre of Excellence in Tree Health Biotechnology (FABI) in 2013 confirmed the presence of a microbial disease on *E. transvenonsus* in the Modjadji Nature Reserve. In 2014 samples from the Durban Botanical Garden (DBG) were submitted to FABI for the identification of a white, scaly growth on the cones of *Cycas thouarsii* and *Encephalartos* species. The non-native *Aulacaspis yasumatsui* (Hemiptera: Coccoidea: Diaspididae) or commonly known as Cycad Aulacaspis Acale (CAS) was identified. Further investigations revealed that the scale (CAS) was killing *C. thouarsii* plants in gardens in Richards Bay and several gardens in Pretoria, with low level infestations also recorded on garden specimens of *Encephalartos* species. The presence of this non-native scale is of grave concern since CAS is not native to Africa and has been identified by the IUCN as one of the biggest threats to the survival of native *Encephalartos* species. Based on these preliminary studies it is considered essential that pest and disease studies are undertaken for all the *Encephalartos* species on the BMP. It is crucial that plant experts,

conservation staff and cycad enthusiasts monitor, photograph and report to FABI all observations of possible disease and pest occurrences on *Encephalartos* in South Africa, both *in situ* and *ex situ*.

Objective 1
To increase research efforts into *Encephalartos* diseases in wild populations and *ex situ* collections.

Action 1: Document the occurrence of the non-native Cycad Aulacaspis Scale (CAS) in South Africa.	
Champions/ Responsibility	The University of Pretoria, NBGs, CSSA, provincial conservation agencies
Funding	UP and SANBI to source
Timeline	Five years
Deliverable	Atlas on the occurrence of CAS in South Africa

Action 2: Document the occurrence of pests and diseases affecting *Encephalartos* species in South Africa, with special reference to the 15 *Encephalartos* species in the BMP.	
Champions/ Responsibility	The University of Pretoria, NBGs, CSSA, provincial conservation agencies
Funding	UP and SANBI to source
Timeline	Five years
Deliverable	Atlas on the occurrence of pests and diseases affecting *Encephalartos* species in South Africa

Objective 2
To communicate research findings on cycad pests and diseases on a continuous basis to collectors and nurseries.

Action 1: Communicate research findings on cycad pests and diseases to all nurseries and collectors through the BMP Implementation Committee and CSSA.	
Champions/ Responsibility	BMP Implementation Committee, CSSA, SANBI and the University of Pretoria
Funding	No funding required
Timeline	Five years
Deliverable	Articles and other communication materials on cycad pests and diseases

3.3.6 Species identification through DNA

The use of nuclear ribosomal internal transcribed spacer regions 1 and 2 (ITS 1&2), the chloroplast encoded *rbcl* gene, ISSR genomic fingerprinting, allozyme and random amplified polymorphic DNA (RAPD) techniques have been used to try and resolve the molecular history and the relationship within the genus *Encephalartos* with limited success in the past (Treutlein *et al.,* 2005; Chaiprasongsuk *et al.,* 2007), however new advancements in these DNA techniques are developing rapidly.

At the University of Johannesburg DNA barcoding was initially performed by using two gene regions *rbcLa & matK* which was able to discriminate only around 50% of South Africa's *Encephalartos* species. However, researchers have now completed a sequencing matrix for *Encephalartos* species using three additional genes, *trnH-psbA,* ITS and Needly, and all of Africa's *Encephalartos* species can now be identified using DNA barcoding techniques (Prof Michelle van der Bank, pers. comm., November 2014). In 2015 the University of Johannesburg will also start to build a genetic profile of *Encephalartos* species using microsatellites and AFLPs which will allow researchers to trace the

origin of the *Encephalartos* species and thereby distinguish between very closely related *Encephalartos* species (Prof Michelle van der Bank, pers. comm., November 2014).

Objective 1
To use DNA barcoding techniques to identify closely related *Encephalartos* species and to resolve their taxonomy (e.g. *E. heenanii* and *E. paucidentatus*).

Action 1: Identify closely related *Encephalartos* species using DNA barcoding techniques and resolve their taxonomy.	
Champions/ Responsibility	University of Johannesburg and SANBI Biosystematics
Funding	University of Johannesburg
Timeline	Five years
Deliverable	Taxonomic publication

3.3.7 Genetic variation within subpopulations/localities

Encephalartos species such as *E. laevifolius, E. hirsutus* and to some extent *E. middelburgensis* and *E. arenarius* were historically recorded from more than one subpopulation or locality which were often widely separated. Most of these subpopulations/localities no longer contain a functional population and in many cases the *Encephalartos* species is considered extinct from the locality. Although plants from these localities are considered to be more valuable in trade, there is still uncertainty if the subpopulations are genetically distinct. Species recovery as described in this BMP-S will take the cautious approach and only recover *Encephalartos* species in various subpopulations/localities using parental stock from the same subpopulation/locality. However this could result in inbreeding and a loss of genetic fitness. It is, therefore, important to determine if there is genetic variation and assess its role in the genetic fitness and adaptability of the *Encephalartos* species. Although the reasons for variations could be complex, the aim should be to determine principles for recovery when dealing with subpopulations or different localities.

Objective 1
To conduct conservation genetics research on different subpopulations / localities of *E. laevifolius* and *E. hirsutus* in order to inform species recovery.

Action 1: Determine if there is genetic variation between subpopulations / localities of *E. laevifolius* and *E. hirsutus*.	
Champions/ Responsibility	To be determined
Funding	To be determined
Timeline	Five years
Deliverable	Recommendations for species recovery at different localities / subpopulations based on genetic considerations

3.3.8 Ex situ collections and maintenance of genetic integrity

Ex situ conservation is considered to be a tool to ensure the survival of a wild population and should preferably be established within the distribution range or region of the taxa. However the option of locating an *ex situ* collection outside the taxa's natural range can be considered if the taxa is threatened by natural catastrophes, political and social disruptions, or if further research, isolation or germplasm banking is required. Irrespective of the locality of the *ex situ* collection it should be managed in ways that minimize the loss of capacity for expression of natural behaviours and loss of ability to later again thrive in natural habitats (IUCN SSC, 2002). The management of *ex situ*

populations must minimize any deleterious effects associated with *ex situ* conservation such as loss of genetic diversity, artificial selection, pathogen transfer and hybridization. There are various *ex situ* conservation methods (Laliberte, 1997), some of these are already in use for some of the *Encephalartos* species in this BMP-S:

- **Field genebanks:** Field genebanks (also known as living collections) are usually established for long-lived, recalcitrant species. The disadvantage of field genebanks is that they usually require a great deal of space and are susceptible to natural disasters, the spread of diseases and may suffer from neglect. Hybridization between *Encephalartos* species is an important aspect which needs to be managed through strict controlled pollination programmes. In South Africa, field genebanks have been established as various NBGs and further research is needed to ensure that these collections are managed to maintain genetic integrity;
- **In vitro storage methods:** Is the storage of germplasm in laboratory conditions and is also suited for long-term conservation of recalcitrant *Encephalartos* species or *Encephalartos* species which are vegetatively propagated. The germplasm is stored at low temperatures under slow growth conditions or cryopreserved in liquid nitrogen at -196°C. The main limitation of cryopreservation is the need for special equipment, techniques and trained staff. More research is needed to define the mechanisms of desiccation and chilling injury (Eberhart *et al.,* 1991 in Laliberte, 1997). Preliminary studies conducted by the Kew Millennium Seed Bank Project on *E. middelburgensis, E. altensteinii* and *E. latifrons* showed recovery of 85% germination rate on Murashige and Skoog (MS) basal culture media supplemented with activated charcoal (Jayanthi Nadarajan, pers. comm.); and
- **Pollen Banks:** Pollen preservation requires little space but some cytoplasmic genes might be lost during the storage process. Information about the storage characteristics of pollen from the wild is limited and further research is required.

Objective 1

To continue research into the use of in vitro storage techniques to establish *ex situ* conservation collections.

Action 1: Investigate the possibility of using in vitro storage for *ex situ* conservation.	
Champions/ Responsibility	SANBI/Kew Millennium Seed Bank Project
Funding	To be determined
Timeline	Five years
Deliverable	Documented methods for in vitro storage of *Encephalartos* species

3.3.9 Climate change

The uptake of carbon dioxide (CO_2), which is one of the principle greenhouse gases, during photosynthesis make plants major regulators of global climate change (Hawkins *et al.,* 2008). Over the past 30 years, climate change has produced numerous shifts in the distributions and abundances of *Encephalartos* species (Prof Nigel Barker, Rhodes University, pers. comm. September 2014). Physiological responses of plants to climate change include responses to rising CO_2 levels, temperature changes, available water, light levels and levels of methane, while there could also be a significant change in plant community interactions such as competition, plant/pollinator and plant/pathogen interactions (Hawkins *et al.,* 2008). There is a concern that if biome shifts occur and the climate envelope of *Encephalartos* species is no longer compatible with their geographic position, then extinction is unavoidable (Prof Nigel Barker, Rhodes University, pers. comm. September 2014). Research into climate modelling for *Encephalartos* species could be based on available distribution data, but warrants further research.

Objective 1
To investigate the potential impact of climate change on South African *Encephalartos* species.

Action 1: Conduct climate modelling to assess the potential impact of climate change on South African *Encephalartos* species.	
Champions/ Responsibility	Rhodes University
Funding	To be determined
Timeline	Five years
Deliverable	Publications on the predicted impact of climate change on South African *Encephalartos* species

3.4 Effective management of confiscated *Encephalartos* species

Background
Confiscated *Encephalartos* species are illegally harvested wild plants which have been seized during law enforcement operations. Large numbers of confiscated *Encephalartos* species are now present in local and national government controlled facilities and nurseries, some of which may have the potential to be used as parental stock for species recovery. There is no national database that records the confiscated *Encephalartos* species present in government nurseries and facilities and in private custodianship.

Encephalartos species are usually damaged when they are removed from the wild. When these damaged plants are confiscated, law enforcement officials often do not have the knowledge, experience and/ or resources to effectively treat and manage the damaged plants, resulting in high mortalities of the confiscated plants. Many private growers and collectors have extensive knowledge and experience in *Encephalartos* specie maintenance and have access to the resources required to ensure the survival of the plants. The private sector has expressed their willingness to develop guidelines for the management of confiscated *Encephalartos* species, with important steps and methods to deal with confiscated plants described.

Objective 1
To develop guidelines for law enforcement officials for the care of confiscated and damaged *Encephalartos* species.

Action 1: Develop a guideline describing the recommended methods for the caring of confiscated and damaged *Encephalartos* species, inclusive of a list of relevant experts to contact	
Champions/ Responsibility	CSSA – Xander de Kock
Funding	Not required
Timeline	Within one year of publication of this BMP
Deliverable	Recommended steps for the caring of confiscated and damaged *Encephalartos* species

Objective 2

To identify key growers and horticulturists in all provinces who will assist law enforcement officials when damaged *Encephalartos* species need to be treated.

Action 1: Identify key growers and horticulturists who will care for confiscated plants	
Champions/ Responsibility	CSSA in collaboration with NBGs and provincial conservation agencies
Funding	Not required
Timeline	Within one year of publication of this BMP
Deliverable	List of relevant experts to contact for advice on the caring of confiscated and treatment of damaged *Encephalartos* species

Objective 3

To formalize private custodianships of confiscated plants.

Action 1: Formalize custodianship of confiscated plants in private collections and nurseries	
Champions/ Responsibility	Provincial conservation agencies in collaboration with SANBI
Funding	Not required
Timeline	Within one year of publication of this BMP
Deliverable	Custodianship agreements formalized

3.5 Establish, maintain and secure *ex situ* genebank collections of all the CR and EN *Encephalartos* species

Background

As a signatory to the Convention on Biological Diversity (CBD), South Africa is required to develop a National Strategy for Plant Conservation (NSPC) which is aligned to the Global Strategy for Plant Conservation (GSPC) 2011-2020. The GSPC consists of 16 targets and is applied through the International Agenda for Botanical Gardens (BGCI, 2012). Further, Section 11(1)(h) of NEM:BA requires the SANBI to establish, maintain, protect and preserve collections of plants in NBGs and in herbaria. The SANBI through its Garden Conservation Strategy (GCS) is currently developing a strategy for *Encephalartos* specie collections in National Botanical Gardens, to be aligned with this BMP.

With the increased demand within the trade for various rare *Encephalartos* species, the collections at NBGs have been the target of theft in the past 10 years. Upgrades to the current security systems are urgently needed to ensure the safe-keeping of these *ex situ* collections. In instances where individual plants which are of conservation value as defined in this BMP are currently in private or state-owned custodianship, it is recommended that these plants remain at the current locality provided such a locality is secure. This will decrease the risk of losing valuable *Encephalartos* species through relocation or a single theft event in NBGs. In this regard, it is strongly recommended that the BMP Implementation Committee support the "Cycad Saviours" initiative of the Cycad Society of South Africa so as to facilitate collaborative participation between private collectors and conservation departments.

Ex situ collections which have been established for conservation purposes should furthermore aim to maintain the genetic integrity of the collection and maintain the insect assemblages associated with conservation collections. In order to maintain the insect assemblages associated with *Encephalartos* collections, the use of pesticides should be limited especially on indigenous *Encephalartos* species.

Objective 1

To compile a confidential database for *ex situ Encephalartos* species of potential conservation value.

Action 1: Establish a database for *ex situ Encephalartos* species of potential conservation value located within private collections through the Cycad Saviours initiative	
Champions/ Responsibility	CSSA (CSSA) – Japie Steenkamp
Funding	CSSA
Timeline	Within one year of the publication of this BMP
Deliverable	Database for *Encephalartos* species of potential conservation value located within private collections.

Action 2: Confirm conservation value of *ex situ Encephalartos* species on database through DNA barcoding and stable isotope analysis	
Champions/ Responsibility	SANBI
Funding	SANBI (25% of Scientific Authority budget to be allocated to actions in this BMP)
Timeline	Within one year of the publication of this BMP
Deliverable	Validated database for *Encephalartos* species of conservation value located within private collections

Action 3: Establish a database for *ex situ Encephalartos* species of potential conservation value located within national and international government facilities	
Champions/ Responsibility	SANBI
Funding	SANBI (25% of Scientific Authority budget to be allocated to actions in this BMP)
Timeline	Within one year of the publication of this BMP
Deliverable	Database for *Encephalartos* species of potential conservation value located within national and international government facilities

Objective 2

To establish, maintain and secure *ex situ* genebank collections of all the CR and EN *Encephalartos* species in NBGs.

Action 1: Upgrade security of valuable *Encephalartos* species collections at NBGs to prevent theft of *Encephalartos* species	
Champions/ Responsibility	SANBI through its NBGs
Funding	SANBI (NBGs)
Timeline	Within one year of publication of this BMP
Deliverable	Secure *Encephalartos* collections at NBGs

Action 2: Following agreement with owners of private collections, mark confirmed *ex situ Encephalartos* species of conservation value located within private collections with microdots	
Champions/ Responsibility	SANBI
Funding	SANBI
Timeline	Within one year of publication of this BMP
Deliverable	Confirmed *Encephalartos* species of conservation

	value located within private collections marked with microdots

Action 3: Manage and coordinate *ex situ* conservation collections (including private collections where possible) for all the *Encephalartos* species in this BMP	
Champions/ Responsibility	SANBI (NBGs) in collaboration with private growers and collectors
Funding	SANBI (NBGs)
Timeline	Within one year of publication of this BMP
Deliverable	Strategy for *Encephalartos* collections in National Botanical Gardens

Action 4: Develop a protocol for duplicate collections and material exchange between NBG *Encephalartos* genebanks.	
Champions/ Responsibility	SANBI (NBGs)
Funding	Not required
Timeline	Protocol developed within one year of publication of this BMP and implemented within the 5 year timeframe of this BMP
Deliverable	Protocol for duplicate collections and material exchange developed and implemented

Action 5: Pilot the RFID *Encephalartos* species theft detection system at Lowveld NBG	
Champions/ Responsibility	SANBI
Funding	SANBI and the University of Kent to source funding
Timeline	Pilot project to commence within one year of publication of this BMP
Deliverable	Analysis of the effectiveness of the RFID *Encephalartos* species theft detection system

Action 6: Train key personnel in the maintenance of *ex situ* conservation collections for *Encephalartos* species to ensure genetic purity (by preventing hybridization) and retention of important insect assemblages.	
Champions/ Responsibility	SANBI through NBGs
Funding	SANBI (NBGs)
Timeline	Within one year of publication of the BMP
Deliverable	Key personnel managing the conservation collections for *Encephalartos* species trained to prevent hybridization of important collections and to maintain important insect assemblages

4 SPECIES-SPECIFIC ACTION PLANS

4.1 *Encephalartos aemulans*

Background

Encephalartos aemulans occurs in a single locality in the Vryheid district of KZN where it grows on south-facing sandstone cliffs and in short grassland. The latest aerial counts conducted by EKZNW indicated that there are less than 600 plants in the population. In the past, poaching was considered to be severe and the *Encephalartos* species was therefore listed as CR under the Red List criteria B1ab(v)+2ab(v); C2a(ii) (IUCN version 3.1). The remaining plants in the *E. aemulans* population are actively protected by the landowners who have expressed little interest in benefiting from any economic incentives at this stage.

Encephalartos aemulans is represented in a small *ex situ* collection at one of the NBGs and seedlings are fairly common in trade.

Objective 1

To create and maintain an enabling environment for the community on whose land the *E. aemulans* plants occur, to carry out appropriate management actions and to provide the level of security necessary to prevent further poaching of plants from the wild.

Action 1: Inform and educate all landowners and custodians of the conservation value of *E. aemulans* and of current legislative regulations pertaining to the destruction and/or harvesting of plants, plant parts and seed.	
Champions/ Responsibility	EKZNW District Conservation Officer and EKZNW Scientific Services
Funding	Resources are available in EKZNW annual operational budget with cost estimation for this action around R500.00
Timeline	Within one year of publication of this BMP
Deliverable	Informed landowners and custodians

Action 2: Finalize stewardship agreements with the landowners to secure the known population of *E. aemulans*	
Champions/ Responsibility	EKZNW Stewardship Division
Funding	Resources are available in EKZNW annual operational budget (R5600.00 travel and R12 880.00 personnel hours)
Timeline	Within one year of publication of this BMP
Deliverable	Signed stewardship agreements

Action 3: Present and discuss all management recommendations for the *E. aemulans* population and obtain buy-in from the landowners	
Champions/ Responsibility	EKZNW Stewardship Division
Funding	Resources are available in EKZNW annual operational budget (R5600.00 travel and R1 840.00 personnel hours)
Timeline	Within one year of publication of this BMP
Deliverable	Stewardship agreements implemented

Objective 2
To reduce the loss of individuals, populations, pollinators and habitat critical for the survival of *E. aemulans* in the wild.

Action 1: Undertake ground surveys to determine the current population size and assess threats to the *E. aemulans* population	
Champions/ Responsibility	EKZNW Scientific Services EKZNW Stewardship Division
Funding	Resources are available in EKZNW annual operational budget (R5600.00 travel and R16 560.00 personnel hours)
Timeline	Within two years of publication of this BMP
Deliverable	Report on the size of and threats to the *E. aemulans* population with recommended actions for addressing the threats

Recovery Targets
Encephalartos aemulans is listed as CR since it is confined to one locality, and although this population has been targeted by poachers, the remaining plants are considered to be largely secure. One neighbouring property where *E. aemulans* has been depleted is not considered suitable and secure for recovery at this stage. The remaining population is recruiting well and conservation interventions such as artificial pollination or population augmentation are not needed. The long term target for *E. aemulans* is to increase the total population size to 3500 individuals (at 4 sites with at least 500 adults each) and thereby achieving a population status of Least Concern (LC).

Recovery Objective 1
To increase the size of the population of *E. aemulans* through seed augmentation at three extant sites by a minimum of 200 plants (>5 years) by 2030.

Action 1: Collect seed from wild plants and plant them at three extant sites within the existing population	
Champions/ Responsibility	EKZNW Scientific Services
Funding	Resources are available in annual EKZNW operational budget which requires R2300.00 for personnel costs
Timeline	Annually or when seeds are available for five years
Deliverable	Progress report on seed augmentation at three extant sites

Recovery Objective 2
To develop a monitoring plan to acquire information required to evaluate the effectiveness of management and to identify where objectives are not being met and/or interventions are required.

Action 1: Develop a monitoring plan for *E. aemulans*	
Champions/ Responsibility	EKZNW Scientific Services
Funding	Resources are available in annual EKZNW operational budget which requires R2300.00 for personnel costs.
Timeline	Within five years of publication of this BMP.
Deliverable	A monitoring plan in accordance with EKZNW norms and standards for monitoring.

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

4.2 *Encephalartos arenarius*

Background
Encephalartos arenarius occurs in a small area in the Eastern Cape Province between the towns of Nanaga in the west and Canon Rocks in the east. In 2010 it was estimated that the total population size was between 850 and 1500 mature individuals, although it is very difficult to obtain an accurate estimation since the plants grow in densely wooded coastal dune forests (Donaldson, 2010). Repeat photographs have indicated a 50% decline in the past 60 years, and with its restricted distribution it is listed as EN under the Red List criteria A2acd; B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v); C1 (IUCN version 3.1). The Eastern Cape Department of Economic Development, Environmental Affairs and Tourism (EC DEDEAT) has a database of the localities of all the *E. arenarius* populations, but no recent surveys have been undertaken and it is unknown whether these populations are still extant. *E. arenarius* is present in formally protected areas managed by SANParks, although there is uncertainty about the exact numbers, and monitoring of these plants is currently not taking place.

Encephalartos arenarius is represented in a small *ex situ* collection at a NBG which requires enhancement to ensure better genetic representation. Private growers have expressed concern for approximately 85 plants at a farmhouse close to Alexandria. However, the wild origin of these plants is not clear and they are therefore not at this stage considered to be suitable parental stock for species recovery.

Objective 1
To determine the current population status of *E. arenarius* on both private land and within areas formally protected by SANParks.

Action 1: Resurvey all known populations of *E. arenarius*	
Champions/ Responsibility	EC DEDEAT, SANBI, SANParks, the Nelson Mandela Metropolitan University, Rhodes University
Resources/Funding	EC DEDEAT, SANBI (25% of Scientific Authority budget to be allocated to actions in this BMP) and SANParks
Timeline	Within one year of the publication of this BMP
Deliverable	Report on current population status of *E. arenarius*

Objective 2
To determine the status of suitable habitat for *E. arenarius* within its distribution range.

Action 1: Determine the habitat status of *E. arenarius* through GIS modelling of suitable habitat and then ground truthing of areas deemed suitable.	
Champions/ Responsibility	DEDEAT, SANBI, SANParks, the Nelson Mandela Metropolitan University, Rhodes University
Resources/Funding	DEDEAT and SANBI (25% of Scientific Authority budget to be allocated to actions in this BMP)
Timeline	Within two years of the publication of this BMP
Deliverable	Report on current habitat status of *E. arenarius* with suitable sites for species recovery identified

Recovery Targets
Due to a lack of information on the current population, it is not possible to set realistic recovery targets for this *Encephalartos* species. In addition to this, it is unclear how much of the habitat considered suitable for *E. arenarius* has been transformed and will therefore be suitable for species recovery. It is therefore recommended that recovery targets are only determined upon completion of the population and habitat survey.

Recovery Objective 1
To set recovery targets for *E. arenarius* once objectives 1 and 2 above have been achieved.

Action 1: Set recovery targets for *E. arenarius*	
Champions/ Responsibility	*Encephalartos* species BMP Implementation Committee
Resources/Funding	To be determined
Timeline	After five years or once necessary information has been obtained
Deliverable	Recovery targets for *E. arenarius*

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

4.3 *Encephalartos cerinus*

Background

Encephalartos cerinus is a rare *Encephalartos* species from KZN and within six months after its description in 1989, most of the known population was illegally harvested for horticultural purposes. This *Encephalartos* species is currently listed as CR under the Red List criteria A2acd; B1ab(i,ii,iv,v)+2ab(i,ii,iv,v);C2a(ii) (IUCN version 3.1).

While this *Encephalartos* species is now thought to be extinct in the wild, there have been unconfirmed reports of four or five individual plants still present in the wild. Although recent surveys conducted by EKZNW failed to locate any plants, possible additional localities still need to be verified. It is however likely that if any additional plants are still present in the wild, these populations will be very small and unlikely to support essential ecosystem processes or viable populations of pollinators. Closely related *Encephalartos* species such as *E. villosus* and *E. aplanatus* are pollinated by a *Porthetes* species (weevil) and it is thus probable that *E. cerinus* would have had the same pollinator (Prof John Donaldson, SANBI, pers. comm.).

Objective 1

To determine if any *E. cerinus* plants still remain in the wild.

Action 1: Survey all known localities for *E. cerinus* plants	
Champions/ Responsibility	EKZNW through collaboration with private collectors who reportedly know of additional localities
Resources/Funding	EKZNW annual survey budget which includes R3000.00 for travel and R7260.00 for personnel
Timeline	Within two years of publication of this BMP
Deliverable	Report documenting results of survey of known *E. cerinus* localities

Objective 2

To identify at least two secure sites within the natural distribution range of *E. cerinus* that can be used for species reintroduction.

Action 1: Identify two secure sites within the historic distribution range for species reintroduction	
Champions/ Responsibility	EKZNW through collaboration with the SANBI/ NBGs
Resources/Funding	EKZNW annual budget which include R920.00 for personnel to map and model
Timeline	Within five years of publication of this BMP
Deliverable	Map showing location of at least two suitable sites for species reintroduction

Objective 3
To conduct research on potential *Encephalartos* species-specific pollinators.

Action 1: Undertake pollinator research on large *ex situ* collections of *E. cerinus* with a specific emphasis on *Porthetes* species (weevil)	
Champions/ Responsibility	SANBI
Resources/Funding	SANBI to source
Timeline	Studies initiated within five years of publication of this BMP
Deliverable	Research project registered at a recognized University

Recovery Targets
Recovery targets should be determined after all possible localities for the *Encephalartos* species have been surveyed and should be based on the number of plants remaining in the wild. Should surveys fail to locate any plants remaining in the wild, two suitable recovery sites within the historic distribution range should be identified and research should be conducted to determine if processes essential for a natural functioning population can be re-established.

Recovery Objective 1
To set recovery targets for *E. cerinus* once objectives 1 and 2 above have been achieved.

Action 1: Set recovery targets for *E. cerinus*	
Champions/ Responsibility	*Encephalartos* species BMP Implementation Committee
Resources/Funding	To be determined
Timeline	After five years or once necessary information has been obtained
Deliverable	Recovery targets for *E. cerinus.*

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

4.4 *Encephalartos cupidus*

Background
Encephalartos cupidus is restricted to a small area in the Drakensberg in Mpumalanga and Limpopo where it mainly occurs in open grassland in between large boulders and cliff ledges (Grobbelaar, 2004). Although this *Encephalartos* species occurs in provincial nature reserves, severe declines have been observed during which numbers plummeted from more than 1100 plants in 1984 to less than 50 plants today (Government Gazette, 2013). *Encephalartos cupidus* has therefore been listed as CR under the Red List criteria A2acd; B1ab(ii, iv,v)+2ab(ii, iv,v) (IUCN version 3.1).

There are unconfirmed reports of a relatively large *E. cupidus* population within the species' historic distribution range within Limpopo. The area is, however, very mountainous and very difficult to traverse or survey. Since *E. cupidus* plants are relatively small, it is difficult to observe them during aerial surveys. In cultivation, *E. cupidus* cones frequently and this has resulted in hundreds of seedlings being produced. Accordingly, this *Encephalartos* species is considered to be relatively common and inexpensive in trade.

Objective 1
To verify reports of a large *E. cupidus* population in Limpopo.

Action 1: Conduct ground survey to determine if *E. cupidus* is present in Limpopo	
Champions/ Responsibility	LEDET
Resources/Funding	LEDET
Timeline	Within two years of publication of this BMP
Deliverable	Report confirming absence / presence of *E. cupidus* population in Limpopo

Recovery Targets
The recovery targets for *E. cupidus* are based on recovery actions already underway in the province of Mpumalanga. The availability of resources and seed for recovery actions were also considered. There is a viable *ex situ* collection of *E. cupidus* within the NBGs which can be used as a source of seed for reintroductions. Mr Fanie Vermaak and Mr Jan Joubert from the CSSA (CSSA) have also volunteered to donate at least 200 seed towards the achievement of recovery targets. The long term recovery target for *E. cupidus* is to increase the population to 1000 plants. To obtain the long term recovery target the following short term objective (5 years) is recommended.

Recovery Objective 1
To plant a total of 500 *E. cupidus* seed back into the species' historic distribution range.

Action 1: Plant 500 *E. cupidus* seed back into secure locations in previously occupied areas	
Champions/ Responsibility	Mpumalanga Tourism and Parks Agency (MTPA) with seed sourced from NBGs and Mr Fanie Vermaak and Jan Joubert from the CSSA.
Resources/Funding	MTPA annual *Encephalartos* species budget of R147 912.00
Timeline	Within five years of publication of this BMP
Deliverable	Records and report on germination results Monitoring report on the survival and growth of seedlings

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

4.5 *Encephalartos dolomiticus*

Background
Encephalartos dolomiticus is a rare *Encephalartos* species restricted to the south eastern region of Limpopo. An aerial survey in 2012 indicated that there are approximately 130 plants remaining in the wild. It is, however, possible that stems rather than individual plants were counted during the survey. To date, all the surveys for this *Encephalartos* species were conducted from the air and essential information such as sex of individuals and age structure of the population, as well as data on recruitment and pollinators are vague or unknown. It is furthermore unknown whether the current land use practises such as burning cycles or grazing have a detrimental effect on recruitment of *E. dolomiticus* seedlings.

It is presumed that the *E. dolomiticus* population is declining, and the threat of illegal harvesting for horticultural and medicinal purposes is severe. *E. dolomiticus* is highly sought after and expensive in the horticultural trade and no viable *ex situ* genebanks currently exist for this *Encephalartos* species. *Encephalartos dolomiticus* is currently listed as CR under the Red List criteria A2d; C1 (IUCN version 3.1).

The demand for *E. dolomiticus* seedlings is higher than what the commercial nurseries can currently produce, but despite this, landowners currently show no interest in propagating and selling seedlings grown from wild harvested seed. In order to rather explore tax incentives for the conservation of this *Encephalartos* species, it is recommended that a Biodiversity Management Agreement (BMA) is entered into with these landowners in accordance with Section 44 of NEM:BA and Section 37C of the Income Tax Act, (Act 58 of 1962).

Objective 1
To conduct a ground-based population survey for *E. dolomiticus* in order to obtain a more accurate assessment of the population size and structure.

Action 1: Conduct a ground-based population survey for *E. dolomiticus*	
Champions/ Responsibility	LEDET
Resources/Funding	LEDET annual survey budget
Timeline	Within one year of publication of this BMP
Deliverable	Report on the size and structure of the *E. dolomiticus* population Recommendation on the feasibility of removing suckers from wild populations for the establishment of *ex situ* conservation collections / genebanks

Objective 2
Upon completion of the population survey, to investigate the effect of current land use practises on *E. dolomiticus* with the aim of advising on management actions at each locality.

Action 1: Investigate the effect of current land use practices on *E. dolomiticus*	
Champions/ Responsibility	SANBI
Resources/Funding	SANBI to source
Timeline	Within five years of publication of this BMP
Deliverable	Ecological management plan for each locality

Objective 3
To enter into a BMA with landowners on whose properties *E. dolomiticus* occurs.

Action 1: Initiate a BMA with landowners on whose properties *E. dolomiticus* occurs	
Champions/ Responsibility	LEDET (stewardship programme), DEA
Resources/Funding	None required
Timeline	Within five years of publication of this BMP
Deliverable	BMAs between landowners and the Minister in accordance with section 44 of NEM:BA

Objective 4
To explore and advise on tax incentives relating to the BMA.

Action 1: Advise on tax incentives for landowners who have entered into the BMA	
Champions/ Responsibility	SANBI, DEA
Resources/Funding	None required
Timeline	Within five years of publication of this BMP
Deliverable	Summary of tax incentives available to landowners who have entered into the BMA

Objective 5
To establish an *ex situ* conservation collection / genebank for *E. dolomiticus*.

Action 1: If found to be feasible, selectively remove suckers from E. dolomiticus plants.	
Champions/ Responsibility	SANBI through NBGs and LEDET
Resources/Funding	Internal resources – NBGs
Timeline	Within two years of publication of this BMP
Deliverable	Curation records of suckers removed from wild population

Action 2: Establish *ex situ* conservation genebank at identified NBG	
Champions/ Responsibility	SANBI through NBGs and LEDET
Resources/Funding	Internal resources – NBGs
Timeline	Within two years of publication of this BMP
Deliverable	*Ex situ* genebank at identified NBG

Recovery Targets
Due to the incomplete information regarding the population size and other ecological aspects (such as sex of individual plants, coning frequencies, pollination and recruitment) of *E. dolomiticus,* it is not possible to set realistic short term recovery targets for this *Encephalartos* species. It is therefore recommended that recovery targets are determined during the five years revision of this BMP.

Recovery Objective 1
To set recovery targets for *E. dolomiticus* once objective 1 above has been achieved.

Action 1: Set recovery targets for *E. dolomiticus*	
Champions/ Responsibility	*Encephalartos* species BMP Implementation Committee
Resources/Funding	To be determined
Timeline	After five years or once necessary information has been obtained
Deliverable	Recovery targets for *E. dolomiticus*

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

4.6 *Encephalartos dyerianus*

Background

Encephalartos dyerianus is known from a single granite mountain in Limpopo where it occupies an area of less than 10 ha (Government Gazette, 2013). Although most of the population occurs within a Provincial Nature Reserve, the *Encephalartos* species was until recently still affected by poaching, resulting in a continued decline. Armed guards based at the population have, however, virtually eliminated poaching. *E. dyerianus* is currently listed as CR under the Red List criteria B1ab(v)+2ab(v) (IUCN version 3.1). There are viable *ex situ* collections of this *Encephalartos* species in NBGs. An ecological management plan has been compiled for the Nature Reserve; however it does not address the management of *E. dyerianus* specifically.

Objective 1

To proclaim the Lilly Nature Reserve as a specially protected area in terms of the NEM:PAA.

Action 1: Declare Lilly Nature Reserve as a specially protected area	
Champions/ Responsibility	LEDET in collaboration with DEA
Resources/Funding	None required
Timeline	Within five years of publication of this BMP
Deliverable	Lilly Nature Reserve declared as a Specially protected area in terms Section 18 of the NEM:PAA

Objective 2

To adapt the current ecological management plan for Lilly Nature Reserve to focus on management and monitoring of the *E. dyerianus* population.

Action 1: Include management and monitoring actions for *E. dyerianus* in the management plan for Lilly Nature Reserve	
Champions/ Responsibility	LEDET
Resources/Funding	No funding required
Timeline	Within five years of publication of this BMP
Deliverable	Management and monitoring actions for *E. dyerianus* in Lilly Nature Reserve management plan, including recommendations on time of year and parameters (e.g. seedlings, numbers of cones, sex ratios, size classes) for monitoring

Objective 3

To conduct a pilot study on the use of microdots and the University of Kent's *Encephalartos* species theft detection system in the *E. dyerianus* population.

Action 1: Establish a pilot study at the *E. dyerianus* population to test the effectiveness of microdots and the University of Kent's *Encephalartos* species theft detection system as a security measure	
Champions/ Responsibility	SANBI/ the University of Kent
Resources/Funding	SANBI/ the University of Kent to source
Timeline	Within one year of publication of this BMP
Deliverable	Monitoring and evaluation plan for RFID tags

	deployed and microdots applied to *E. dyerianus* population

Objective 4
To establish breeding colonies for *E. dyerianus* around Lilly Nature Reserve in collaboration with private landowners.

Action 1: Consult with private landowners neighbouring Lilly Nature Reserve on the establishment of breeding colonies for *E. dyerianus*	
Champions/ Responsibility	LEDET
Resources/Funding	No funding required
Timeline	Within five years of publication this BMP
Deliverable	List of interested landowners

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

Recovery Targets
Encephalartos dyerianus is listed as CR since it is confined to one locality of less than 10ha and although this population has been targeted by poachers, the overall decline was not considered to the significant. The population is reportedly recruiting well and is therefore not in need of human intervention such as artificial pollination or population augmentation.

4.7 *Encephalartos eugene-maraisii*

Background
Encephalartos eugene-maraisii occurs on rocky hills and steep slopes in grassland and savanna in small scattered sub-populations in the Waterberg and adjacent areas (Grobbelaar, 2004). There has been significant poaching of this *Encephalartos* species over the past 30 years and it is estimated that the population has declined by more than 50% over this period, with between 900 and 1000 plants remaining in the wild. Most of the remaining sub-populations are located on private Nature Reserves and in formally protected areas managed by SANParks. *Encephalartos eugene-maraisii* is currently listed as EN under the Red List criteria A2d; C1 (IUCN version 3.1).

Plants in formally protected areas are monitored regularly with individual plants marked, measured and GPS referenced and although complete population surveys are not conducted on the private Nature Reserves, monitoring is conducted on portions of the sub-population. This *Encephalartos* species is not currently represented in a viable *ex situ* collection at the NBGs.

Objective 1
To establish an *ex situ* genebank for *E. eugene-maraisii* at the Lowveld NBG.

Action 1: Source seed from stable wild subpopulations of *E. eugene-maraisii*	
Champions/ Responsibility	SANBI in collaboration with private Nature Reserves and landowners
Resources/Funding	SANBI through NBGs
Timeline	Within one year of publication of this BMP
Deliverable	An *ex situ* genebank for *E. eugene-maraisii* comprised of at least 100 seedlings

Objective 2
To establish an *in situ* genebank for *E. eugene-maraisii* on a private Nature Reserve located within the current species' distribution range.

Action 1: Plant *Encephalartos* species recovered from poaching incidences in a designated area on a private Nature Reserve to form an *in situ* genebank	
Champions/ Responsibility	Private landowners in collaboration with SANBI
Resources/Funding	Private landowner
Timeline	Within one year of publication of this BMP
Deliverable	A secure *in situ* genebank for *E. eugene-maraisii* comprising of plants recovered from poaching incidences

Recovery Targets
Since the subpopulation within the protected area managed by SANParks is comprised of reproductive male and female plants and natural recruitment is present, no artificial pollination or augmentation is considered necessary for this subpopulation at this stage. It is estimated that up to 500 plants have recently been poached from one of the private Nature Reserves and it is therefore recommended that recovery efforts are focussed within the affected portion of the private Nature Reserve with the long term target to replace the 500 plants lost to poachers. Seed or seedlings needed for the recovery can be sourced from the *in situ* genebank (as per Objective 2 above).

Recovery Objective 1
To replace the 500 *E. eugene-maraisii* plants illegally harvested from the private Nature Reserve within the last few years.

Action 1: Plant 500 seed or seedlings into depleted areas in the private Nature Reserve recently affected by poaching	
Champions/ Responsibility	Private landowners in collaboration with SANBI
Resources/Funding	SANBI to source funding for monitoring
Timeline	Within five years of publication of this BMP
Deliverable	Monitoring plan for planted seed or seedlings

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

4.8 *Encephalartos heenanii*

Background
Encephalartos heenanii occurs on a provincial nature reserve in Mpumalanga and in Swaziland where it grows on very steep slopes in short grassland. According to surveys conducted in 1995 the population historically consisted of approximately 115 plants but poaching has resulted in a rapid decline with less than 24 plants recorded in 2009 (Government Gazette, 2013). Recent surveys have failed to locate any plants and reproductive failure is anticipated for any remaining wild plants. *Encephalartos heenanii* is currently listed as CR under the Red List criteria B1ab(ii,iv,v)+2ab(ii,iv,v) (IUCN version 3.1).

Viable *ex situ* collections of *E. heenanii* do not exist either within the NBGs or other government nurseries. *E. heenanii* plants tend to cone infrequently and it appears that artificial pollination success

and seedling survival is relatively low. Members from the CSSA have volunteered to donate seed and/or seedlings for species recovery on condition that they can monitor the recovery process.

Objective 1
To establish a confidential database of genetically pure *E. heenanii* in private possession that can be used as parental stock.

Action 1: Create a confidential database containing records of genetically pure *E. heenanii* plants and source seedlings in private possession	
Champions/ Responsibility	SANBI, CSSA
Resources/Funding	No funding required
Timeline	Within one year of the publication of this BMP
Deliverable	Confidential database of genetically pure *E. heenanii* plants (national and international)

Recovery Targets
The recovery of *E. heenanii* will depend on the number of seed and / or seedlings which can be sourced for recovery processes. This *Encephalartos* species is currently not represented in a viable *ex situ* conservation collection at any of the NBGs. Due to absence of cones or low coning rates of *E. heenanii* plants in some NBGs, it is recommended that efforts are placed into species recovery rather than focussing on establishing *ex situ* genebanks. Since there is currently no database for privately owned *E. heenanii* plants, and it is not known how many seed/seedlings will be available for recovery, it is recommended that the recovery target for *E. heenanii* be determined once objectives 1 and 2 above have been achieved.

Recovery Objective 1
To set recovery targets for *E. heenanii* once objective 1 above has been achieved.

Action 1: Set recovery targets for *E. heenanii*	
Champions/ Responsibility	*Encephalartos* species BMP Implementation Committee
Resources/Funding	To be determined
Timeline	After five years or once necessary information has been obtained
Deliverable	Recovery targets for *E. heenanii.*

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

4.9 *Encephalartos hirsutus*

Background
Encephalartos hirsutus historically occurred in three widely separated localities, but due to extreme pressure from poachers, only one individual remains in an inaccessible locality. Helicopter surveys conducted in 2012 located no additional plants in the wild (Government Gazette, 2013). There are unconfirmed reports that *E. hirsutus* used to occur in formally protected areas managed by SANParks. This *Encephalartos* species is facing an extremely high risk of extinction and is listed as CR under the Red List criteria A4acd; B2ab(iii,iv,v); C1 (IUCN version 3.1). At present, there are no viable *ex situ* genebanks under state control for this *Encephalartos* species. A small number of confiscated plants are however held in a secure, privately-owned locality.

Objective 1
To establish/ formalize *ex situ* genebanks for *E. hirsutus* in two secure localities.

Action 1: Formalise a memorandum of understanding with custodians of confiscated plants and establish these plants in two secure genebanks	
Champions/ Responsibility	SANBI & LEDET
Resources/Funding	None
Timeline	Within one year of publication of this BMP
Deliverable	Two secure genebanks for *E. hirsutus* Memoranda of understanding formalizing current custodianship of confiscated *E. hirsutus* plants

Objective 2
To establish a database of genetically pure parental stock under state or private control (national and international) that can be used to source seed for additional genebanks.

Action 1: Create a confidential database containing records of privately owned and state owned *E. hirsutus* plants	
Champions/ Responsibility	SANBI, CSSA
Resources/Funding	None required
Timeline	Within one year of publication of this BMP
Deliverable	Confidential database of genetically pure *E. hirsutus* parental stock (national and international)

Objective 3
To identify three potential sites suitable for *E. hirsutus* species reintroduction.

Action 1: Conduct habitat suitability modelling to identify three potential sites for future *E. hirsutus* species reintroduction	
Champions/ Responsibility	LEDET (biodiversity planning programme)
Resources/Funding	No funding required
Timeline	Within five years of publication of this BMP
Deliverable	Map indicating the location of three potential sites for *E. hirsutus* species reintroduction

Objective 4
To determine whether *E. hirsutus* historically occurred in the Kruger National Park (KNP).

Action 1: Conduct extensive surveys to determine presence of *E. hirsutus* in the KNP	
Champions/ Responsibility	SANParks
Resources/Funding	SANParks
Timeline	Within five years of publication of this BMP
Deliverable	Survey report

Action 2: Conduct stable isotope tests of *ex situ* plants purported to originate from KNP	
Champions/ Responsibility	UCT
Resources/Funding	SANParks
Timeline	Within five years of publication of this BMP
Deliverable	Research report

Recovery Targets
Recovery is not considered a viable short- to medium-term option for this *Encephalartos* species since only one individual of *E. hirsutus* currently remains in the wild and no formal *ex situ* genebanks currently exist. In addition to this, it is highly unlikely that essential natural ecosystem processes such as pollination are still present in the wild. Since the pollinator for this *Encephalartos* species was never known and no other *Encephalartos* species is considered to be a close relative, extensive research is required to determine if *Porthetes* species can be used as pollinators in recovered populations (Prof John Donaldson, SANBI, pers. comm.).

Recovery Objective 1
To set recovery targets for *E. hirsutus* once the above mentioned objectives have been achieved.

Action 1: Set recovery targets for *E. hirsutus*	
Champions/ Responsibility	*Encephalartos* species BMP Implementation Committee
Resources/Funding	To be determined
Timeline	After five years or once necessary information has been obtained
Deliverable	Recovery targets for *E. hirsutus*

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

4.10 *Encephalartos horridus*

Background
Encephalartos horridus occurs in xeric thicket vegetation between Port Elizabeth and Uitenhage in the Eastern Cape. This *Encephalartos* species has declined by more than 50% due to habitat destruction (urban settlements) and collecting for horticultural purposes and is now considered extinct from some localities. *Encephalartos horridus* is currently listed as EN under the Red List criteria A2acd (IUCN version 3.1). According to Eastern Cape DEDEAT and SANParks, the exact extent of the species' distribution as well as subpopulation sizes are unknown since a complete population survey has never been conducted.

Landowners who were consulted as part of the this BMP did not express any interest in economic incentives for the conservation of *E. horridus* and it is therefore recommended that BMAs are entered into with these landowners in accordance with Section 44 of NEM:BA. The option of tax incentives can subsequently be explored. It should however be noted that since the complete distribution of *E. horridus* is unknown, not all landowners could be consulted during this BMP.

Encephalartos horridus is represented in *ex situ* collections at the NBGs, however, a recent increase in the theft of this *Encephalartos* species has resulted in a significant reduction in the number of plants within these collections. Therefore, it is crucial that these *ex situ* collections are secured and restored (see 3.3.8 objective 1).

Objective 1
To determine the current distribution and size of *E. horridus* populations.

Action 1: Conduct a population survey for *E. horridus*	
Champions/ Responsibility	EC DEDEAT, SANBI, SANParks, the Nelson Mandela Metropolitan University, Rhodes University
Resources/Funding	SANBI (25% of Scientific Authority budget to be allocated to actions in this BMP)
Timeline	Within five years of the publication of this BMP
Deliverable	Report on the current population status of *E. horridus*

Objective 2
To enter into a BMA with landowners on whose properties *E. horridus* occurs.

Action 1: Initiate a BMA with landowners on whose properties *E. horridus* occurs	
Champions/ Responsibility	EC DEDEAT (stewardship programme) in collaboration with the SANBI
Resources/Funding	EC DEDEAT
Timeline	Within five years of publication of this BMP
Deliverable	BMAs between landowners and the Minister in accordance with section 44 of NEM:BA

Recovery Targets
Due to a lack of current population information, it is not possible to set realistic recovery targets for this *Encephalartos* species. It is therefore recommended that recovery targets are only determined upon completion of the population survey.

Recovery Objective 1
To set recovery targets for *E. horridus* once objective 1 above has been achieved.

Action 1: Set recovery targets for *E. horridus*	
Champions/ Responsibility	*Encephalartos* species BMP Implementation Committee
Resources/Funding	To be determined
Timeline	After five years or once necessary information has been obtained
Deliverable	Recovery targets for *E. horridus*

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

4.11 *Encephalartos inopinus*

Background
Encephalartos inopinus is restricted to a small area in Limpopo where it grows on dolomite cliffs and in dense scrub (Grobbelaar, 2004). During initial surveys conducted in 1992, more than 670 plants were counted. However, subsequent aerial surveys indicated that the population declined to 81

individuals in 2004. Surveys conducted in 2008 and 2012 failed to locate any plants and it is thus possible that the species may be extinct in the wild (Government Gazette, 2013). *E.inopinus* is currently listed as CR under the Red List criteria A2acd; B1ab(i,ii,iv,v)+B2ab(i,ii,iv,v);C1+2a(i) (IUCN version 3.1).

A small number of *E. inopinus* plants are currently established in government nurseries, however these plants cone infrequently and subsequently very few seedlings are produced. Private growers and members of the CSSA (CSSA) in Mpumalanga and Limpopo have volunteered to donate seedlings to the Lowveld NBG to establish a viable genebank for *E. inopinus*.

The locality where *E. inopinus* historically occurred is located on communal land, and although it is at this stage not considered to be a secure site for recovery, the community has expressed interest in proclaiming the area as nature reserve.

Objective 1
To establish a genebank for *E. inopinus* at the Lowveld NBG.

Action 1: Source seedlings from private growers and members of the CSSA	
Champions/ Responsibility	SANBI (Lowveld NBG), private growers and members of the CSSA
Resources/Funding	None required
Timeline	Within one year of publication of this BMP
Deliverable	A secure genebank for *E. inopinus* at the Lowveld NBG

Objective 2
To proclaim the area where *E. inopinus* historically occurred as a Nature Reserve in terms of the NEM:PAA.

Action 1: Investigate and formalize the proclamation of the communal area around Penge as a Nature Reserve	
Champions/ Responsibility	LEDET
Resources/Funding	LEDET
Timeline	Within five years of publication of this BMP
Deliverable	Declaration of the Penge area as a Special Nature Reserve in terms of Section 18 of NEM:PAA

Recovery Targets
Recovery is not considered a viable short to medium term option for this *Encephalartos* species since the area where *E. inopinus* used to occur is not currently considered to be a secure location. In addition to this, it is highly unlikely that essential natural ecosystem processes such as pollination are still present in the wild. Since the pollinator for this *Encephalartos* species was never known and no other *Encephalartos* species is considered to be a close relative, extensive research is required to determine if *Porthetes* species can be used as pollinators in recovered populations (Prof John Donaldson, SANBI, pers. comm.). Due to the lack of a suitable recovery area, it is recommended that recovery objectives are determined once objectives 1 and 2 above have been achieved.

Recovery Objective 1
To set recovery targets for *E. inopinus* once the above mentioned objectives have been achieved.

Action 1: Set recovery targets for *E. inopinus*	
Champions/ Responsibility	*Encephalartos* species BMP Implementation Committee
Resources/Funding	To be determined
Timeline	After five years or once necessary information has been obtained
Deliverable	Recovery targets for *E. inopinus*

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

4.12 *Encephalartos laevifolius*

Background
Historically, *Encephalartos laevifolius* used to occur in Mpumalanga, KZN, and the Eastern Cape as well as in Swaziland, but today it predominantly occurs in Mpumalanga within the Kaapsehoop mountain range with an isolated colony occurring further north. The population in the Kaapsehoop area initially numbered 1700 plants but severe poaching has resulted in less than five plants remaining. The subpopulations in Blyderivierspoort Nature Reserve in Mpumalanga as well as the subpopulations in KZN and the Eastern Cape are all extinct due to poaching. *Encephalartos laevifolius* is currently listed as CR under the Red List criteria A2acde (IUCN version 3.1).

The Kaapsehoop subpopulation of *E. laevifolius* is represented in viable *ex situ* collections in NBGs, while three plants from the Blyderivierspoort Nature Reserve were recovered from poachers and planted at a secure site.

Objective 1
To identify an additional three secure sites within the species' historic distribution range where *E. laevifolius* can be reintroduced in Mpumalanga.

Action 1: Identify three secure sites within the historic distribution range of *E. laevifolius* for species recovery	
Champions/ Responsibility	MTPA
Resources/Funding	MTPA annual *Encephalartos* species budget of R147 912.00 (not for procurement of land)
Timeline	Within one year of the publication of this BMP
Deliverable	Map indicating three suitable sites for species recovery

Objective 2
To establish a viable genebank for *E. laevifolius* in a secure locality using the Blyderivierspoort Nature Reserve plants recovered from poachers.

Action 1: Establish a viable genebank for *E. laevifolius* with seed sourced from the recovered Blyderivierspoort Nature Reserve plants	
Champions/ Responsibility	MTPA in collaboration with LEDET
Resources/Funding	MTPA annual *Encephalartos* species budget of R147 912.00 / LEDET
Timeline	Within five years of publication of this BMP
Deliverable	Viable genebank for *E. laevifolius* at a secure location

Recovery Targets
The recovery targets for *E. laevifolius* are based on recovery actions already underway. The availability of resources and seed for recovery actions were taken into consideration.

Due to expanding human settlements, habitat destruction and free access to the area, the locality at Kaapsehoop where the five remaining adult plants grow is not considered suitable for species recovery. There is a viable *ex situ* collection of *E. laevifolius* within the NBGs which can be used to supply seed for species recovery for the subpopulation occurring in the Kaapsehoop Mountain Range.

Recovery Objective 1
To undertake species recovery for *E. laevifolius* within the three identified localities.

Action 1: Plant 2000 *E. laevifolius* seed within the three identified localities	
Champions/ Responsibility	MTPA
Resources/Funding	MTPA annual *Encephalartos* species budget of R147 912.00
Timeline	Within five years of publication of this BMP
Deliverable	A report documenting the progress and success of species recovery for *E. laevifolius* in three localities

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

4.13 *Encephalartos lebomboensis*

Background
Encephalartos lebomboensis occurs in northern KZN and in the Mananga area of eastern Mpumalanga, as well as in the adjacent areas in Mozambique and Swaziland. This *Encephalartos* species is threatened by poaching for horticultural and traditional medicine purposes, with unconfirmed reports indicating increased harvesting of mature plants for the medicinal plant market, while expanding agricultural activities are threatening the habitat. Invasion by alien plant species such as *Lantana camara* (Lantana) and *Chromolaena odorata* (Triffid Weed) is an additional threat.

It is estimated that there are approximately 5000 plants remaining in the wild, although no recent surveys have been conducted in Mpumalanga or KZN. *Encephalartos lebomboensis* is currently listed as EN under the Red List criteria A2acd; B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v) (IUCN version 3.1).

Encephalartos lebomboensis is a popular *Encephalartos* species among horticultural collectors with both forms (Mananga and Piet Retief) common in cultivation and easily obtainable at nurseries. This *Encephalartos* species also exists in viable *ex situ* collections at the NBGs with numerous seed already donated to MTPA for species recovery and to the community nursery at Mananga when it was still operating.

Objective 1
To establish the present population size of *E. lebomboensis* and quantify poaching impacts for both horticultural and medicinal purposes.

Action 1: Conduct ground-based surveys of *E. lebomboensis*	
Champions/ Responsibility	MTPA/ EKZNW/ SANBI
Resources/Funding	MTPA/ EKZNW/ SANBI (25% of Scientific Authority budget to be allocated to actions in this BMP)
Timeline	Within two years of the publication of this BMP
Deliverable	Report of survey conducted in KZN and Mpumalanga indicating present population size of *E. lebomboensis* and poaching impacts

Objective 2
To clear alien plant infestations such as *Lantana camara* and *Chromolaena odorata* within the *E. lebomboensis* population at Mananga.

Action 1: Collaborate with Working on Fire (WoF), Working for Water (WfW) and/ or Expanded Public Works Programme (EPWP) on the removal of alien invasive plants from the Lebombo Mountain at Mananga	
Champions/ Responsibility	MTPA in collaboration with WoF, WfW and/ or EPWP
Resources/Funding	WoF, WfW and EPWP budgets
Timeline	Within five years of publication of this BMP
Deliverable	Report indicating results of alien plant clearance on the Lebombo Mountain at Mananga

Objective 3
To ascertain whether *E. lebomboensis* currently occurs in formally protected areas managed by SANParks.

Action 1: Conduct extensive surveys for *E. lebomboensis* in SANParks formally protected areas	
Champions/ Responsibility	SANParks
Resources/Funding	SANParks
Timeline	Within five years of publication of this BMP
Deliverable	Report indicating results of surveys for *E. lebomboensis* in SANParks formally protected areas

Recovery Targets
The recovery targets for this *Encephalartos* species are applicable to the plants occurring in Mpumalanga. Recovery should be undertaken with seed sourced from NBGs and other government

nurseries. A genebank (breeding colony) has been established close to Piet Retief within the species' historic distribution range and these plants are currently producing cones. Recovery targets for KZN could not be determined since the current subpopulation size is only an estimate.

Recovery Objective 1
To establish an *in situ* genebank for *E. lebomboensis* at various ranger outposts at Mananga.

Action 1: Plant 2000 *E. lebomboensis* seed at various ranger outposts at Mananga	
Champions/ Responsibility	MTPA in collaboration with NBGs
Resources/Funding	MTPA annual *Encephalartos* species budget of R147 912.00
Timeline	Within five years of publication of this BMP
Deliverable	Report on the germination success of 2000 seed planted at ranger outposts at Mananga

Recovery Objective 2
To augment subpopulations of *E. lebomboensis* growing within the species' historic distribution range at Piet Retief.

Action 1: Plant 1000 seed in secure localities within the historic distribution range at Piet Retief	
Champions/ Responsibility	MTPA
Resources/Funding	MTPA annual *Encephalartos* species budget of R147 912.00
Timeline	Within five years of publication of this BMP
Deliverable	Report documenting the germination success of 1000 seed of *E. lebomboensis* planted at secure localities within the historic distribution at Piet Retief

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

4.14 *Encephalartos middelburgensis*

Background
Encephalartos middelburgensis has a fragmented distribution and is confined to the Witbank, Middelburg and Bronkhorstspruit areas of Mpumalanga and Gauteng. It is estimated that the total population currently consists of less than 350 plants, most of these confined to a single Nature Reserve in Mpumalanga. Total population decline is currently estimated at approximately 60% with the threat of poaching still present. *Encephalartos middelburgensis* is currently listed as CR under the Red List criteria A2acd+4acd; C1 (IUCN version 3.1).

Outside of the Nature Reserve, the high amount of poaching has resulted in a severely fragmented population with many of the individuals now occurring in isolation. Mpumalanga Tourism and Parks Agency (MTPA) is currently involved with numerous restoration projects for this *Encephalartos* species, both inside and outside of protected areas. A small number of plants occur within a private Nature Reserve in Gauteng and an *Encephalartos* Species Management Plan has been submitted by the landowner to the GDARD. In this *Encephalartos* Species Management Plan, it is proposed that the population be artificially pollinated and seed and/ or seedlings used for restoration on the same property. Future goals of this management plan are to expand the project to neighbouring properties.

Encephalartos middelburgensis is currently represented in one viable *ex situ* collection within the NBGs.

Objective 1
To investigate the ecology and restoration of *E. middelburgensis*, including restoration success with seed compared to seedlings.

Action 1: Register and undertake a research project on the ecology and restoration of *E. middelburgensis*	
Champions/ Responsibility	MTPA and the Tshwane University of Technology
Resources/Funding	MTPA annual *Encephalartos* species budget of R147 912.00
Timeline	Within five years of publication of this BMP
Deliverable	Research report on the ecology and restoration of *E. middelburgensis*

Recovery Targets
The recovery targets for *E. middelburgensis* are based on recovery actions already underway. The availability of resources and seed for recovery actions were also considered.

Recovery Objective 1
To augment *E. middelburgensis* subpopulations in Mpumalanga with an additional 140 seed or seedlings.

Action 1: Plant an additional 140 *E. middelburgensis* seed/ seedlings in secure wild locations, sourcing seed from a) wild populations or b) the NBG genebank	
Champions/ Responsibility	MTPA
Resources/Funding	MTPA annual *Encephalartos* species budget of R147 912.00
Timeline	Within five years of publication of this BMP
Deliverable	Report documenting the germination / establishment success of at least 140 *E. middelburgensis* seed or seedlings planted in secure wild locations

Recovery Objective 2
To augment the *E. middelburgensis* subpopulation growing in a private Nature Reserve in Gauteng with at least 400 seed or seedlings.

Action 1: Carry out artificial pollination and subpopulation recovery as per the *Encephalartos* Species Management Plan submitted to GDARD for plants on a private Nature Reserve in Gauteng	
Champions/ Responsibility	Philip Rousseau
Resources/Funding	Philip Rousseau
Timeline	Within five years of publication of this BMP
Deliverable	Report documenting the germination / establishment success of at least 400 *E. middelburgensis* seed or seedlings planted on a private Nature Reserve in Gauteng

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

4.15 *Encephalartos msinganus*

Background

Encephalartos msinganus is restricted to a small area in the Msinga district of KZN where it grows in short grassland on steep slopes. It is estimated that between 100 and 200 plants used to occur in the wild, however, poaching has reduced the population to a small number of scattered individuals (Government Gazette, 2013). *Encephalartos msinganus* is currently listed as CR under the Red List criteria B1ab(iii,v)+2ab(iii,v); C1+2a(ii) (IUCN version 3.1). Regular aerial surveys of the population have indicated the presence of coning individuals. Ground-based surveys have not been conducted to confirm the presence of seedlings however, since the terrain is difficult to traverse, it is possible that seedlings would be overlooked. The remaining plants grow among large boulders and on steep cliffs and are difficult to reach.

The land on which the population of *E. msinganus* occurs belongs to the Msinga Community. The older members of the Msinga Community are aware of the plants and are displeased with the fact that people are removing the plants. There are unconfirmed reports that the children from the Msinga community remove wild seedlings for trade. *E. msinganus* is represented in a viable *ex situ* collection in at least one NBG.

Objective 1

To create and maintain an enabling environment for the Msinga community to carry out appropriate management actions and to provide the level of security necessary to prevent further poaching of *E. msinganus* plants from the wild.

Action 1: Inform all major landowners and custodians of the significance of *E. msinganus* and current legislative regulations pertaining to the destruction and/or harvesting of plants, plant parts and seed	
Champions/ Responsibility	District Conservation Officer - Greytown EKZNW Community Conservation
Resources/Funding	Resources are available in the annual operational budget for EKZNW and includes R1500.00 for travel and R3680.00 for personnel hours
Timeline	Within one year of publication of this BMP
Deliverable	Records of meetings with community members and school heads

Action 2: Investigate the possibility of conservation agreements with the landowners/community to secure the known populations/subpopulations of *E. msinganus*	
Champions/ Responsibility	EKZNW Stewardship Division
Resources/Funding	Resources are available in the annual operational budget for EKZNW and includes R300.00 for travel and R7260.00 for personnel hours
Timeline	Within two years of publication of this BMP
Deliverable	Records of meetings with community members

Action 3: Present and discuss all management recommendations to obtain buy-in from the Msinga community	
Champions/ Responsibility	EKZNW District Conservation Officer in Greytown and Community Conservation Officer
Resources/Funding	Resources are available in the annual operational budget for EKZNW and includes R1500.00 for travel and R36800.00 for personnel hours
Timeline	Within two years of publication of this BMP
Deliverable	Records of meetings with community members

Objective 2

To reduce the loss of plants and habitat critical for the survival of *E. msinganus* in the wild.

Action 1: Assess the current population size of *E. msinganus* using data from aerial and ground surveys	
Champions/Responsibility	EKZNW Scientific Services
Resources/Funding	Resources are available in the annual operational budget for EKZNW and includes R4500.00 for travel and R23 760.00 personnel hours
Timeline	Within 1 year of publication of this BMP
Deliverables	Report on the current population size of *E. msinganus*

Action 2: Engage with landowners and community members over the establishment of a security plan at Msinga	
Champions/Responsibility	District Conservation Officer - Greytown Community Conservation
Resources/Funding	Funding for implementation of security plan (This could include fencing; payment of a security custodian etc.)
Timeline	Within four years of publication of this BMP
Deliverables	Reports on poaching incidents Security plan

Objective 3

To increase the distribution of *E. msinganus* within its natural habitat and to satisfy the local demand for *Encephalartos* species by establishing a viable population at community homesteads.

Action 1: Determine the number of homesteads that currently have *E. msinganus* plants and the number of additional plants required to satisfy the needs of the community.	
Champion /Responsibility	EKZNW Community Conservation
Resources/Funding	Resources are available in the annual operational budget for EKZNW and includes R1500.00 for travel and R3120.00 personnel hours
Timeline	Within 5 years of publication of this BMP
Deliverables	Report on the feasibility of planting one *E. msinganus* plant at each homestead of the Msinga community

Objective 4

To monitor management effectiveness and achievement of objectives for *E. msinganus*.

Action 1: Develop a monitoring plan for *E. msinganus*	
Champion /Responsibility	Scientific Services EKZNW
Resources/Funding	Resources are available in the annual operational budget for EKZNW and includes R9200.00 personnel hours
Timeline	Within two years of publication of this BMP
Deliverables	A monitoring plan Mitigatory management interventions where required

Action 2: Survey and report on *E. msinganus* population status	
Champions/Responsibility	Scientific Services EKZNW
Resources/Funding	Resources are available in the annual operational budget for EKZNW and include Aerial surveys: R6500.00 (5 hours) Travel: R1500.00 (fuel, tyres, maintenance and vehicle purchase costs in 4x4 Diesel DC)/annum Personnel: R8970.00 (39 hrs)
Timeline	Annual
Deliverables	A monitoring report/ status report

Recovery Targets

The long term population target for *E. msinganus* is 5000 plants (at 5 sites with at least 1000 adults each) and although there is scope for the recovery of *E. msinganus,* it is not considered a realistic short term (less than five years) target since the population size, recruitment, number of coning plants and the accessibility of these coning individuals are not known. In order to achieve the long-term target for *E. msinganus,* one objective with a number of subsidiary actions have been developed.

Recovery Objective 1
To increase the population size of *E. msinganus* at three extant sites to a minimum of 500 plants (of more than 5 years of age) by 2030.

Action 1: Hand pollinate cones of *Encephalartos* species growing in community gardens (including schools) and in the wild where possible	
Champions/ Responsibility	EKZNW Scientific Services
Resources/Funding	Resources are available in the annual operational budget for EKZNW and includes R1500.00 for travel and R3440.00 personnel hours
Timeline	Within one year of publication of this BMP
Deliverable	Report documenting the increase in the number of viable seed in the wild and in community gardens

Action 2: Collect and plant seeds in suitable sites within existing subpopulations	
Champions/ Responsibility	EKZNW Scientific Services
Resources/Funding	Resources are included in previous objectives
Timeline	Annually or when seeds are available for five years
Deliverable	Progress report documenting the germination success of planted *E. msinganus* seed

Action 3: Establish a propagation programme for *E. msinganus* at the local school	
Champions/ Responsibility	EKZNW Scientific Services
Resources/Funding	EKZNW
Timeline	Within 5 years of the publication of this BMP
Deliverable	Propagation programme for *E. msinganus* at the local school

When implementing the actions above, full consideration must be given to the principles and operational guidelines outlined in 3.1 of this document.

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APPENDIX A: GENERIC OBJECTIVES, ACTIONS AND CHAMPIONS

Description	Objective	Action	Champion
Increase protection of wild *Encephalartos* species populations from poaching	To incentivize the *in situ* protection of wild *Encephalartos* populations through increasing the economic value of wild *Encephalartos* species.	Develop a protocol for the approval of wild seed harvest for seedling production programmes for trade purposes in accordance with the CITES Resolution Conf. 11.11 (Rev.CoP15).	SANBI, DEA and provincial conservation agencies
	To improve provincial capacity for implementation of protection measures for wild plants.	Design and implement a security plan that deals with adequate anti-poaching personnel for priority plants, adequate equipment etc.	Provincial conservation agencies, DEA and relevant departments within the South African Polices Services
	To mark priority wild *Encephalartos* populations with new super unique microchips.	Mark all priority wild *Encephalartos* populations with new microchips	DEA to purchase microchips. Provincial conservation agencies to insert microchips. The SANBI to advise on selection of priority populations
	To pilot studies on the use of microdots for marking of wild *Encephalartos* populations.	Identify one priority population per province and apply uniquely coded microdots in accordance with an agreed protocol	SANBI/ Provincial conservation agencies
		Monitor the presence of microdots on marked plants	SANBI/ Provincial conservation agencies
	To develop a forensic stable isotope reference database for wild *Encephalartos* populations for use in *Encephalartos* specie investigations and prosecutions.	Develop a forensic stable isotope reference database for wild *Encephalartos* populations	SANBI/ the University of Cape Town
Conduct essential research to ensure effective implementation of this BMP	To formulate a research plan that prioritizes research documented in the following sections:	Formulate a research plan	SANBI in collaboration with provincial conservation authorities
	Pollinators: To determine whether cucujid pollinators can be transferred between *Encephalartos* species.	Conduct research to determine if cucujid pollinators can be transferred between *Encephalartos* species and can therefore be released into populations where they have become locally extinct.	SANBI
	Sex identification of *Encephalartos species*: To explore various molecular techniques	Continue research into molecular methods for determining the sex of *Encephalartos* species (adults and seedlings).	Universities

Description	Objective	Action	Champion
	to determine the sex of *Encephalartos* species.		
	Species Recovery: To conduct research into species recovery techniques.	Initiate research projects in collaboration with recognized universities to increase knowledge on the restoration ecology of *Encephalartos* species.	SANBI, Mpumalanga Tourism and Parks Agency (MTPA), the Tshwane University of Technology (TUT), other universities
	Maintenance and restoration of essential mutualisms: To determine the role of *Encephalartos* mutualisms and the importance of maintaining and restoring these mutualisms.	Explore the role and importance of mutualisms such as cyanobacteria in *Encephalartos* species	SANBI to coordinate
	Diseases: To increase research efforts into *Encephalartos* diseases in wild populations and *ex situ* collections.	Document the occurrence of the non-native Cycad Aulacaspis Scale (CAS) in South Africa.	The University of Pretoria, NBGs, CSSA, provincial conservation agencies
		Document the occurrence of pests and diseases affecting *Encephalartos* in South Africa, with special reference to the 15 *Encephalartos* species in the BMP.	The University of Pretoria, NBGs, CSSA, provincial conservation agencies
	Species identification through DNA: To use DNA barcoding techniques to identify closely related *Encephalartos* species and to resolve their taxonomy (e.g. *E. heenanii* and *E. paucidentatus*).	Identify closely related *Encephalartos* species using DNA barcoding techniques and resolve their taxonomy.	University of Johannesburg
	Genetic variation within subpopulations/localities: To conduct conservation genetics research on different subpopulations / localities of *E. laevifolius* and *E. hirsutus* in order to inform species recovery.	Determine if there is genetic variation between subpopulations / localities of *E. laevifolius* and *E. hirsutus*.	To be determined
	Ex situ collections and maintenance of genetic integrity: To continue research into the use of in vitro storage techniques to establish *ex situ* conservation collections.	Investigate the possibility of using in vitro storage for *ex situ* conservation.	SANBI/Kew Millennium Seed Bank Project

Description	Objective	Action	Champion
	Climate change: To investigate the potential impact of climate change on South African *Encephalartos* species.	Conduct climate modelling to assess the potential impact of climate change on South African *Encephalartos* species.	Rhodes University
Effective management of confiscated *Encephalartos* species	To develop guidelines for law enforcement officials for the care of confiscated and damaged *Encephalartos* species.	Develop a guideline describing the recommended methods for the caring of confiscated and damaged *Encephalartos* species, inclusive of a list of relevant experts to contact	CSSA – Xander de Kock
	To identify key growers and horticulturists in all provinces who will assist law enforcement officials when damaged *Encephalartos* species need to be treated.	Identify key growers and horticulturists who will care for confiscated plants	CSSA in collaboration with NBGs and provincial conservation agencies
	To formalize private custodianships of confiscated plants.	Formalize custodianship of confiscated plants in private collections and nurseries	Provincial conservation agencies in collaboration with SANBI
Establish, maintain and secure *ex situ* genebank collections of all the CR and EN *Encephalartos* species	To compile a confidential database for *ex situ Encephalartos* species of potential conservation value.	Establish a database for *ex situ Encephalartos* species of potential conservation value located within private collections through the Cycad Saviours initiative	CSSA (CSSA) – Japie Steenkamp
		Confirm conservation value of *ex situ Encephalartos* species on database through DNA barcoding and stable isotope analysis	SANBI
		Establish a database for *ex situ Encephalartos* species of potential conservation value located within national and international government facilities	SANBI
	To establish, maintain and secure *ex situ* genebank collections of all the CR and EN *Encephalartos* species in NBGs.	Upgrade security of valuable *Encephalartos* species collections at NBGs to prevent theft of *Encephalartos* species	SANBI through its NBGs
		Following agreement with owners of private collections, mark confirmed *ex situ Encephalartos* species of conservation value located within private collections with microdots	SANBI
		Manage and coordinate *ex situ* conservation collections (including private collections where possible) for all the *Encephalartos* species in this BMP	SANBI (NBGs) in collaboration with private growers and collectors

Description	Objective	Action	Champion
		Develop a protocol for duplicate collections and material exchange between NBG *Encephalartos* genebanks.	SANBI (NBGs)
		Pilot the RFID *Encephalartos* species theft detection system at Lowveld NBG	SANBI
		Train key personnel in the maintenance of *ex situ* conservation collections for *Encephalartos* species to ensure genetic purity (by preventing hybridization) and retention of important insect assemblages.	SANBI through NBGs

APPENDIX B: SPECIES-SPECIFIC OBJECTIVES, ACTIONS AND CHAMPIONS

Species	Objective	Action	Champion
Encephalartos aemulans	To create and maintain an enabling environment for the community on whose land the *E. aemulans* plants occur, to carry out appropriate management actions and to provide the level of security necessary to prevent further poaching of plants from the wild.	Inform and educate all landowners and custodians of the conservation value of *E. aemulans* and of current legislative regulations pertaining to the destruction and/or harvesting of plants, plant parts and seed.	EKZNW District Conservation Officer and EKZNW Scientific Services
		Finalize stewardship agreements with the landowners to secure the known population of *E. aemulans*	EKZNW Stewardship Division
		Present and discuss all management recommendations for the *E. aemulans* population and obtain buy-in from the landowners	EKZNW Stewardship Division
	To reduce the loss of individuals, populations, pollinators and habitat critical for the survival of *E. aemulans* in the wild.	Undertake ground surveys to determine the current population size and assess threats to the *E. aemulans* population	EKZNW Scientific Services and EKZNW Stewardship Division
	Recovery Objective 1: To increase the size of the population of *E. aemulans* through seed augmentation at three extant sites by a minimum of 200 plants (>5 years) by 2030.	Collect seed from wild plants and plant them at three extant sites within the existing population	EKZNW Scientific Services
	Recovery Objective 2: To develop a monitoring plan to acquire information required to evaluate the effectiveness of management and to identify where objectives are not being met and/or interventions are required.	Develop a monitoring plan for *E. aemulans*	EKZNW Scientific Services
E. arenarius	To determine the current population status of *E. arenarius* on both private land and within areas formally protected by SANParks.	Resurvey all known populations of *E. arenarius*	EC DEDEAT, SANBI, SANParks, the Nelson Mandela Metropolitan University, Rhodes University
	To determine the status of suitable habitat for *E. arenarius* within its	Determine the habitat status of *E. arenarius* through GIS modelling of suitable habitat and then ground	DEDEAT, SANBI, SANParks, NMMU, Rhodes University

Species	Objective	Action	Champion
	distribution range.	truthing of areas deemed suitable	
	Recovery objective 1: To set recovery targets for *E. arenarius* once objectives 1 and 2 above have been achieved.	Set recovery targets for *E. arenarius*	*Encephalartos* species BMP Implementation Committee
E. cerinus	To determine if any plants still remain in the wild	Survey all known localities for *E. cerinus* plants	EKZNW through collaboration with private collectors who reportedly know of additional localities
	To identify at least two secure sites within the natural distribution range of *E. cerinus* that can be used for species reintroduction.	Identify two secure sites within the historic distribution range for species reintroduction	EKZNW through collaboration with the SANBI/ NBGs
	To conduct research into potential species-specific pollinators	Undertake pollinator research on large *ex situ* collections of *E. cerinus* with a specific emphasis on *Porthetes* species (weevil)	SANBI
	Recovery objective 1: To set recovery targets for *E. cerinus* once objective 1 and 2 have been achieved	Set recovery targets for *E. cerinus*	*Encephalartos* species BMP Implementation Committee
E. cupidus	To verify reports of a large *E. cupidus* population in Limpopo	Conduct ground surveys to determine if *E. cupidus* is present in Limpopo	LEDET
	Recovery objective 1: To plant a total of 500 *E. cupidus* seed back into the species' historic distribution range	Plant 500 viable *E. cupidus* seed back into secure locations in previously occupied areas	Mpumalanga Tourism and Parks Agency (MTPA) with seed sourced from NBGs and Mr Fanie Vermaak and Jan Joubert from the CSSA.
E. dolomiticus	To conduct a ground-based population survey for *E. dolomiticus* in order to obtain a more accurate assessment of the population size and structure.	Conduct a ground-based population survey for *E. dolomiticus*	LEDET
	Upon completion of the population survey, to investigate the effect of current land use practises on *E. dolomiticus* with the aim of advising on management actions at each locality.	Investigate the effect of current land use practices on *E. dolomiticus*	SANBI

Species	Objective	Action	Champion
	To enter into a BMA with landowners on whose properties *E. dolomiticus* occurs.	Initiate a BMA with landowners on whose properties *E. dolomiticus* occurs	LEDET (stewardship programme), DEA
	To explore and advise on tax incentives relating to the BMA.	Advise on tax incentives for landowners who have entered into the BMA	SANBI, DEA
	To establish an ex situ conservation collection / genebank for *E. dolomiticus*.	If found to be feasible, selectively remove suckers from *E. dolomiticus* plants.	SANBI through NBGs and LEDET
		Establish *ex situ* conservation genebank at identified NBG	SANBI through NBGs and LEDET
	Recovery objective 1: To set recovery targets for *E. dolomiticus* once objective 1 above has been achieved.	Set recovery targets for *E. dolomiticus*	Encephalartos species BMP Implementation Committee
E. dyerianus	To proclaim the Lilly Nature Reserve as a Specially protected area in terms of the NEM:PAA.	Declare Lilly Nature Reserve as a Specially protected area	LEDET in collaboration with DEA
	To adapt the current ecological management plan for Lilly Nature Reserve to focus on management and monitoring of the *E. dyerianus* population.	Include management and monitoring actions for *E. dyerianus* in the management plan for Lilly Nature Reserve	LEDET
	To conduct a pilot study on the use of microdots and the University of Kent's *Encephalartos* species theft detection system in the *E. dyerianus* population.	Establish a pilot study at the *E. dyerianus* population to test the effectiveness of microdots and the University of Kent's *Encephalartos* species theft detection system as a security measure	SANBI / the University of Kent
	To establish breeding colonies for *E. dyerianus* around Lilly Nature Reserve in collaboration with private landowners	Consult with private landowners neighbouring Lilly Nature Reserve on the establishment of breeding colonies for *E. dyerianus*	LEDET
E. eugene-maraisii	To establish an *ex situ* genebank for *E. eugene-maraisii* at the Lowveld NBG.	Source seed from stable wild subpopulations of *E. eugene-maraisii*	SANBI in collaboration with private Nature Reserves and landowners
	To establish an *in situ* genebank for *E. eugene-maraisii* on a private Nature Reserve located within the current	Plant *Encephalartos* species recovered from poaching incidences in a designated area on a private Nature Reserve to form an *in situ* genebank	Private landowners in collaboration with SANBI

Species	Objective	Action	Champion
	species' distribution range.		
	Recovery objective 1: To replace the 500 *E. eugene-maraisii* plants illegally harvested from the private Nature Reserve within the last few years	Plant 500 seed or seedlings into depleted areas in the private Nature Reserve recently affected by poaching	Private landowners in collaboration with SANBI
E. heenanii	To establish a confidential database of genetically pure *E. heenanii* in private possession that can be used as parental stock	Create a confidential database containing records of genetically pure *E. heenanii* plants and source seedlings in private possession	SANBI, CSSA
	Recovery objective 1: To set recovery targets for *E. heenanii* once objectives 1 and 2 above have been achieved.	Set recovery targets for *E. heenanii*	*Encephalartos* species BMP Implementation Committee
E. hirsutus	To establish/ formalize *ex situ* genebanks for *E. hirsutus* in two secure localities.	Formalise a memorandum of understanding with custodians of confiscated plants and establish these plants in two secure genebanks	SANBI & LEDET
	To establish a database of genetically pure parental stock under state or private control (national and international) that can be used to source seed for additional genebanks.	Create a confidential database containing records of privately owned and state owned *E. hirsutus* plants	SANBI, CSSA
	To identify three potential sites suitable for species reintroduction.	Conduct habitat suitability modelling to identify three potential sites for future species reintroduction	LEDET (biodiversity planning programme)
	To determine whether *E. hirsutus* historically occurred in the Kruger National Park.	Conduct extensive surveys to determine presence of *E. hirsutus* in the KNP	SANParks
		Conduct stable isotope tests of *ex situ* plants purported to originate from KNP	UCT
	Recovery objective 1: To set recovery targets for *E. hirsutus* once the above mentioned objectives have been achieved.	Set recovery targets for *E. hirsutus*	*Encephalartos* species BMP Implementation Committee
E. horridus	To determine the current distribution and size of *E. horridus* populations.	Conduct a population survey for *E. horridus*	EC DEDEAT, SANBI, SANParks, the Nelson Mandela Metropolitan University, Rhodes University

Species	Objective	Action	Champion
	To enter into a BMA with landowners on whose properties *E. horridus* occurs.	Initiate a BMA with landowners on whose properties *E. horridus* occurs	EC DEDEAT (stewardship programme) in collaboration with the SANBI
	Recovery objective 1: To set recovery targets for *E. horridus* once objective 1 above has been achieved.	Set recovery targets for *E. horridus*	*Encephalartos* species BMP Implementation Committee
E. inopinus	To establish a genebank for *E. inopinus* at the Lowveld NBG.	Source seedlings from private growers and members of the CSSA	SANBI (Lowveld NBG), private growers and members of the CSSA
	To proclaim the area where *E. inopinus* historically occurred as a Nature Reserve in terms of the NEM:PAA.	Investigate and formalize the proclamation of the communal area around Penge as a Nature Reserve	LEDET
	Recovery objective 1: To set recovery targets for *E. inopinus* once the above mentioned objectives have been achieved	Set recovery targets for *E. inopinus*	*Encephalartos* species BMP Implementation Committee
E. laevifolius	To identify an additional three secure sites within the species' historic distribution range where *E. laevifolius* can be reintroduced in Mpumalanga.	Identify three secure sites within the historic distribution range of *E. laevifolius* for species recovery	MTPA
	To establish a viable genebank for *E. laevifolius* in a secure locality using the Blyderivierspoort Nature Reserve plants recovered from poachers.	Establish a viable genebank for *E. laevifolius* with seed sourced from the recovered Blyderivierspoort Nature Reserve plants	MTPA in collaboration with LEDET
	Recovery objective 1: To undertake species recovery for *E. laevifolius* within the three identified localities	Plant 2000 *E. laevifolius* seed within the three identified localities	MTPA
E. lebomboensis	To establish the present population size of *E. lebomboensis* and quantify poaching impacts for both horticultural and medicinal purposes.	Conduct ground-based surveys of *E. lebomboensis*	MTPA/ EKZNW/ SANBI
	To clear alien plant infestations such as	Collaborate with Working on Fire (WoF), Working for Water (WfW) and/ or Expanded Public Works	MTPA in collaboration with WoF, WfW and/ or EPWP

Species	Objective	Action	Champion
	Lantana camara and *Chromolaena odorata* within the *E. lebomboensis* population at Mananga.	Programme (EPWP) on the removal of alien invasive plants from the Lebombo Mountain at Mananga.	
	To ascertain whether *E. lebomboensis* currently occurs in formally protected areas managed by SANParks.	Conduct extensive surveys for *E. lebomboensis* in SANParks formally protected areas	SANParks
	Recovery objective 1: To establish an *in situ* genebank for *E. lebomboensis* at various ranger outpost at Mananga.	Plant 2000 *E. lebomboensis* seed at various ranger outposts at Mananga	MTPA in collaboration with NBGs
	Recovery objective 2: To augments subpopulations of *E. lebomboensis* growing within the species' historic distribution range at Piet Retief	Plant 1000 seed in secure localities within the historic distribution range at Piet Retief	MTPA
E. middelburgensis	To investigate the ecology and restoration of *E. middelburgensis*, including restoration success with seed compared to seedlings.	Register and undertake a research project on the ecology and restoration of *E. middelburgensis*	MTPA and the Tshwane University of Technology
	Recovery objective 1: To augment *E. middelburgensis* subpopulations in Mpumalanga with an additional 140 seed or seedlings.	Plant an additional 140 *E. middelburgensis* seed/ seedlings in secure wild locations, sourcing seed from a) wild populations or b) the NBG genebank	MTPA
	Recovery objective 2: To augment the *E. middelburgensis* subpopulation growing in a private Nature Reserve in Gauteng with at least 400 seed or seedlings.	Carry out artificial pollination and subpopulation recovery as per the *Encephalartos* Species Management Plan submitted to GDARD for plants on a private Nature Reserve in Gauteng	Philip Rousseau
E. msinganus	To create and maintain an enabling environment for the Msinga community to carry out appropriate management actions and to provide the level of	Inform all major landowners and custodians of the significance of *E. msinganus* and current legislative regulations pertaining to the destruction and/or harvesting of plants, plant parts and seed	District Conservation Officer - Greytown EKZNW Community Conservation
		Investigate the possibility of conservation agreements	EKZNW Stewardship Division

Species	Objective	Action	Champion
	security necessary to prevent further poaching of *E. msinganus* plants from the wild.	with the landowners/community to secure the known populations/subpopulations of *E. msinganus*	
		Present and discuss all management recommendations to obtain buy-in from the Msinga community	EKZNW District Conservation Officer in Greytown and Community Conservation Officer
	To reduce the loss of plants and habitat critical for the survival of *E. msinganus* in the wild.	Assess the current population size of *E. msinganus* using data from aerial and ground surveys	EKZNW Scientific Services
		Engage with landowners and community members over the establishment of a security plan at Msinga	District Conservation Officer-Greytown Community Conservation
	To increase the distribution of *E. msinganus* within its natural habitat and to satisfy the local demand for *Encephalartos* species by establishing a viable population at community homesteads.	Determine the number of homesteads that currently have *E. msinganus* plants and the number of additional plants required to satisfy the needs of the community.	EKZNW Community Conservation
	To monitor management effectiveness and achievement of objectives for *E. msinganus*.	Develop a monitoring plant for *E. msinganus*	Scientific Services EKZNW
		Survey and report on *E. msinganus* population status	Scientific Services EKZNW
	Recovery objective 1: To increase the population size of *E. msinganus* at three extant sites to a minimum of 500 plants (of more than 5 years of age) by 2030.	Hand pollinate cones of *Encephalartos* species growing in community gardens (including schools) and in the wild where possible	EKZNW Scientific Services
		Collect and plant seeds in suitable sites within existing subpopulations	EKZNW Scientific Services
		Establish a propagation programme for *E. msinganus* at the local school	EKZNW Scientific Services