

# Management Program for Cycads



in the Northern Territory of Australia, 2009-2014



fresh ideas | real results

#### A Management Program for Cycads in the Northern Territory of Australia 2009-2014

## Parks and Wildlife Service of the Northern Territory

Department of Natural Resources, Environment, The Arts and Sport PO Box 496 Palmerston, Northern Territory, 0831

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Front cover: C armstrongii by D. Liddle

## **Executive Summary**

The aim of this management program is to maintain viable wild populations of all cycad taxa and cycad habitats across their range in the Northern Territory.

Objectives to achieve this aim are:

- 1. To promote the conservation of cycad populations through sustainable land management practices.
- 2. To develop and apply strategies for the ecologically sustainable use of cycads.
- 3. To provide for the wise use of cycads that will otherwise be destroyed through land use permitted under relevant legislation.
- 4. To facilitate essential research.
- 5. To promote public awareness and education.

The invasion of exotic pasture grasses into cycad habitat is increasing fuel load, giving rise to substantial increases in fire intensity. In the absence of sympathetic land management, high intensity fires are expected to have a major deleterious impact on cycad populations in the savanna woodlands of the Northern Territory. Adult cycad stems capable of producing seeds are particularly at risk from high intensity fire events. In addition, loss of habitat due to land clearing is having a negative impact on wild populations in some areas. Sustainable harvest of cycads provides an opportunity for landholders to maintain wild populations while providing a financial incentive to maintain cycad habitats. Concern for the conservation of Northern Territory cycads, in combination with the requirement for a management program to allow export of wild harvested cycad products other than seed, has led to this program.

All Northern Territory cycads are listed under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. In recognition of this listing, the export of cycad products such as whole plants or leaves requires an export permit issued by the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999*. In the Northern Territory, commercial harvest of cycads requires a permit issued under the *Territory Parks and Wildlife Conservation Act*. This program specifies limits and conditions for the harvest of cycads. The program also provides for monitoring and assessment of harvest impacts.

Provision exists for the salvage of cycads from areas where they will be destroyed in the pursuit of other legitimate purposes such as construction of roads or under a clearing permit. Research that supports the aim of this program will be encouraged. Extension activities will include the dissemination of research findings and providing guidelines on harvesting cycads. The biology, ecological significance and value of cycads will be promoted in a variety of media and landholder extension activities. The program encourages the conservation of cycads through sustainable land management practices.

The management measures and performance indicators are aligned to the overall program objectives and the performance indicators summarised in a milestone matrix (Appendix 1).

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## 1. Introduction

#### 1.1 Species Subject to Management

Family:	Cycadaceae
Genus/Species:	All species, subspecies and hybrids of the Genus <i>Cycas</i> found in the wild in the Northern Territory
Family:	Zamiaceae
Genus/Species:	Macrozamia macdonnellii

The term cycad encompasses plants of the families Cycadaceae and Zamiaceae. Cultivated cycads are exempt from the provisions of this management program. Under the Australian Government *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*, cycads, including artificially propagated plants, must be sourced from an approved program if they are to be exported commercially. During the life of this management program, the Department of Natural Resources, Environment, The Arts and Sport (NRETAS) will consult with other government departments and industry stakeholders regarding the inclusion of artificially propagated cycads under this program.

#### 1.2 Legislation and International Obligations

#### 1.2.1 Northern Territory

The Parks and Wildlife Commission may formulate and implement programs for the purposes of the protection, conservation, sustainable use, control and management of wildlife under section 32 of the *Territory Parks and Wildlife Conservation (TPWC) Act*. This cycad management program applies to the whole of the Northern Territory.

A permit is required to take cycad plants or plant material, for commercial use. All cycads that are listed as threatened wildlife in the Northern Territory are Protected Wildlife under section 3 of the *Territory Parks and Wildlife Conservation Regulations*. Threatened species require ministerial approval and permits to take for any purpose (commercial or otherwise).

In addition to the requirements for permits for taking of cycads, provision exists for support by the Parks and Wildlife Commission of the Northern Territory in the management of cycad populations on various types of land tenure. The legislative basis for such support under the *TPWC Act* is summarised below.

- On Reserved Land: Parks and Reserves may be declared under section 12 and plans of management are prescribed under sections 18 and 19. The management of cycad populations may be addressed through park plans of management.
- On Aboriginal Land: the Parks and Wildlife Commission may enter into an agreement with Aboriginal Land holders relating to schemes for the protection and conservation of wildlife under section 73.
- On Private Land: the Parks and Wildlife Commission may enter into an agreement with a land owner relating to schemes for the protection and conservation of wildlife under section 74.

Under the *Pastoral Land Act* and *Crown Lands Act*, a licence may be required to take plants or plant products from Pastoral or Crown Lands.

Territory legislation is considered to be effective in regulating the management of cycad species found in the wild within the Northern Territory.

#### 1.2.2 Other States and Territories

Only two of the 10 Northern Territory *Cycas* species have populations that occur in other states. Eight of the *Cycas* species are endemic to the Northern Territory. *Cycas angulata* is found in isolated stands in western Queensland and on Bountiful Island in the Gulf of Carpentaria. Cycad populations located in the Northern Territory near the Queensland border that were previously recognised as *Cycas brunnea* are no longer considered as distinct from *Cycas angulata* (Dixon, 2004). However, in regulations under Queensland's *Nature Conservation Act 1992, Cycas brunnea* is classified as a 'rare plant' in schedule 4 and *Cycas angulata* as a plant of 'least concern' in schedule 6. Both species are classified as 'protected' and are subject to the *Nature Conservation (Protected Plants) Conservation Plan 2000.* Under the plan, the taking of 'protected' plants is subject to control whether for commercial or recreational purposes.

*Cycas pruinosa* occurs in the eastern Kimberly Region of Western Australia and along with other cycads has been declared as 'protected flora' under the Western Australian *Wildlife Conservation Act 1950-1979*. As a result, a permit is required to harvest from crown land or to sell cycads from private property in Western Australia. Controls on harvest areas, quantities, period and products may be applied.

With the above exceptions, other states and territories are not involved in the management of wild populations of cycad species found in the Northern Territory. However, the Queensland regulations and the declaration of cycads as 'protected flora' in Western Australia demonstrate widespread legislative support for the conservation of cycads across northern Australia.

#### 1.2.3 Australian

All Northern Territory cycads are included under Section 303CA(1) of the *EPBC Act 1999* that relates to the listing of species subject to the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Section 303CC of the *EPBC Act 1999* addresses the export of native flora listed under Section 303CA (1). Either wild harvested or artificially propagated plants must be sourced from an approved program or operation if they are to be exported commercially. *Macrozamia macdonnellii* is listed as **Vulnerable** under the *EPBC Act 1999* and thus is an eligible listed threatened species. Eligible listed threatened species generally can not be exported unless they come from an approved artificial propagation program (Section 303FL), though there is limited provision for export in exceptional circumstances under Section 303GB. The import and export of cycad seed is regulated by the Australian Quarantine and Inspection Service, under the *Quarantine Act 1908* and the *Export Control Act 1982*.

#### 1.2.4 International

All Northern Territory cycads are listed under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. In recognition of this listing, unrestricted international trade in seed is allowed, but export of other cycad products such as whole plants or leaves requires an export permit issued by the Australian Government under the *EPBC Act 1999*. Importing countries may have stricter domestic measures. The export of whole plants requires a tag (see section 3.2.5).

#### **1.3 Cycad Conservation Status and Management Issues**

*Macrozamia macdonnellii* is listed as **Vulnerable** to extinction under the Australian Government *EPBC Act 1999.* Under the *TPWC Act, Cycas armstrongii* is listed as **Vulnerable** in the Northern Territory. This status applies to the taxon as a whole. However, individual populations of some taxa that are not listed appear to be in decline from contemporary fire regimes, land clearing and previous uncontrolled harvesting. A description and distribution of each species is provided in the Background Information (Section 9). Those populations of cycads whose taxonomy is unclear appear to be locally abundant with no immediate threat to their survival.

Northern Territory cycads are slow growing and little is known about the ecology of many of the species, giving rise for concern about their sustainable management in the face of pressure from land clearance and contemporary fire regimes, along with the potential for expansion of harvesting in some areas. Contemporary and anticipated fire regimes are a serious issue for cycads as the invasion of exotic pasture grasses into cycad habitat is increasing fuel load, giving rise to a substantial increase in fire intensity (Rossiter *et al.* 2003). Adult cycad stems capable of producing seed are particularly at risk from high intensity fire events (Liddle, 2004). Concern for the conservation of Northern Territory cycads in combination with the requirement for a management program to allow the export of wild harvested cycad products other than seed has led to this program. The management program has been developed in accordance with section 32 of the *TPWC Act*.

## 2. Aim and Objectives

The aim of this management program is to:

## Maintain viable wild populations of all cycad taxa and cycad habitats across their range in the Northern Territory

Objectives to achieve this aim are:

- 1. To promote the conservation of cycad populations through sustainable land management practices.
- 2. To develop and apply strategies for the ecologically sustainable use of cycads.
- 3. To provide for the wise use of cycads that will otherwise be destroyed through land use permitted under relevant legislation.
- 4. To facilitate essential research.
- 5. To promote public awareness and education.

The aim and objectives are consistent with the principles of management of Part IV, section 31, of the *TPWC Act* and objects of Part 13A, section 303BA, of the *EPBC Act* 1999.



### 3. Management Measures

#### 3.1 Land Management and Non-commercial Harvest

#### 3.1.1 Agreements for Management of Populations

On private land, management agreements with landholders will be pursued where landholders are willing to participate, and anticipated outcomes include a conservation benefit such as sustainable management of cycad habitats. Agreements may be made in association with commercial harvest of cycads.

#### 3.1.2 Parks and Reserves

Six species of cycads (*Cycas armstrongii*, *Cycas calcicola*, *Cycas canalis*, *Cycas conferta*, *Cycas maconochiei* subsp. *maconochiei* and *Macrozamia*. *macdonnellii*) are found on parks and reserves in the Northern Territory. The reservation of cycad populations will be considered in the declaration of parks and reserves.

All wildlife on parks and reserves is protected. Under clause 18 of the Territory Parks and Wildlife Conservation By-laws, plants and plant material may be taken from a park or reserve if such removal is part of an approved management program under the *TPWC Act*. While provision exists for the removal of cycads or cycad products from parks or reserves, issue of the required permit will only be considered for scientific purposes or, in exceptional circumstances such as salvage from road construction. Where cycad populations occur on parks and reserves, specific management requirements will be addressed in plans of management.

#### 3.1.3 Land Clearing and Bioregional Planning

The potential local and regional effects on the status of cycad populations will be taken into account in considering land clearing and other development applications. The cumulative effects of land use decisions on cycad populations will be taken into account in preparing nature conservation plans for individual sites or bioregions. A key functional responsibility of NRETAS is to assess and advise Government on environmental issues arising from proposed land uses.

#### 3.1.4 Permits for Land Clearing Purposes

Under the *TPWC Act*, a permit is required by individuals to take Protected Wildlife or their parts for non-commercial purposes. In the case of cycads, *Cycas armstrongii* is protected due to its threatened status under the *TPWC Act*. Where land clearing has been approved under the formal procedures of the Northern Territory Government, no additional permit will be required to take cycads for non-commercial purposes on areas designated to be cleared. Cycads salvaged from such areas for commercial purposes will be subject to the commercial harvest provisions of this program (see section 3.2.5)

Non-commercial take of whole cycads or cycad parts requires the permission of the landholder. On Crown Land where responsibility for management of the resource rests with the Northern Territory Government, proposals for non-commercial harvest will be assessed on a case by case basis, however, harvest from Crown Land will generally be restricted to salvage only.

#### 3.1.5 Traditional Harvest

Use of cycads for food, ceremonial or religious purposes by Aboriginals who have traditionally used an area may continue in accordance with section 122 of the *TPWC Act* and will not be controlled by this management program. However, any commercial utilisation by Aboriginals, or on Aboriginal Lands by non-Aboriginal people will be subject to the commercial use provisions of this program.

- Develop and implement a Geographical Information System (GIS) database of the distribution and abundance of cycads to assist with providing advice to minimise the impact of land clearing on cycad populations.
- Incorporate guidance on maintaining cycad populations when providing advice on land use proposals that may impact on significant cycad populations.
- Assess all permit applications for non-commercial harvest of protected cycads on all land tenures, ensure permit conditions are set in accordance with the provisions of this management program and issue permits as appropriate under the *TPWC Act*.
- Assess all permit applications for non-commercial harvest of unprotected cycads from Crown Land, ensure permit conditions are set in accordance with the provisions of this management program and issue permits as appropriate under the *TPWC Ac*t.

#### 3.2 Commercial Harvest

#### 3.2.1 Permits for Commercial Harvest

Cycad products harvested commercially include seeds, leaves and whole plants. Seeds are supplied to the nursery industry for cultivation of plants while leaves are harvested for use as greenery in flower arrangements within the florist industry. Whole plants are harvested for use in landscaping.

A permit is required to take a cycad for commercial purposes. Wild harvest operations may be either sustainable operations where the long-term maintenance of the cycad populations and their habitat is a primary objective of the activity; or salvage operations where whole plants or other cycad products that would otherwise be destroyed under legitimate land use activities are taken. For sustainable harvests from private or leasehold land, preference will be given to the landholder, over non-landholder harvesters, for the issue of a permit for commercial use. The landholder is the person who has primary responsibility for management of the land and as such is viewed as the person who should take responsibility for the harvest and should gain a financial return if so desired. On Crown Land, a permit may be issued to a harvester but will normally be limited to salvage or scientific research. A permit for a salvage operation may be issued to a harvester on either private or Crown Land.

#### 3.2.2 Harvest Areas

Areas for harvest will be negotiated with landholders upon request for a permit to harvest. Management areas for specific taxa will be delineated into harvest areas identified by either natural features or artificial markers. In extensive stands of cycads, some areas will be reserved from harvesting to prevent the imposition of a single treatment over the whole population.

#### 3.2.3 Seed Harvesting

Sustainable commercial harvest of seed will be limited to removal of 25% of the well formed seeds, i.e. seeds that appear viable, from an individual cycad stem in any one calendar year. This limitation restricts collection within a harvest area to a maximum of 25% of total seed production and avoids the removal of all seed in a local area. In cases of salvage harvest, all seeds may be collected.

Sustainable harvest of seed from threatened taxa, either Northern Territory or Australian listed (currently *Macrozamia macdonnellii* and *Cycas armstrongii*), will only be considered in circumstances where the Director of the Parks and Wildlife Commission or their delegate is satisfied there is likely to be a positive conservation outcome from the harvest. Such circumstances include use of the seed to establish *ex-situ* populations at registered botanical gardens, scientific or educational purposes, and management of wild populations whereby limited harvesting of selected populations will result in improved management of the species. Harvesting prescriptions for taxa from these categories of conservation concern will be set on a case by case basis and may be more restrictive than the regimes detailed above.

#### 3.2.4 Leaf Harvesting

The market requires well-formed leaves with minimal defects, often resulting in the collection of only a small percentage of leaves from any individual stem. The maximum sustainable harvest will be 25% of leaves from any individual stem within a calendar year. Leaf harvesting will be restricted to individuals that are not currently reproducing and that have an above ground stem at least 5 cm tall. This prescription purposefully excludes harvest from reproductively active individuals and juvenile plants that have not developed an obvious above ground stem. To minimise the risk of a cumulative effect on the health of cycad plants, sustainable leaf and seed harvesting will not be allowed from the same cycad stem in any one year. In cases of salvage harvest, all leaves may be collected.

Sustainable harvest of leaves from threatened taxa will only be considered in circumstances where the Director of Parks and Wildlife or their delegate is satisfied there is likely to be a positive conservation outcome from the harvest. Harvesting prescriptions for taxa from these categories of conservation concern will be set on a case by case basis and may be more restrictive than the regimes for taxa classified as being of least concern.

#### 3.2.5 Whole Plant Harvesting

The taking of plants will be assessed on a case-by-case basis. The maximum annual off-take of any commercial sustainable harvesting prescription for whole plants, for any individual taxon, will not exceed 10% of the estimated population of that taxon on the area of harvest. Where sustainable plant harvest occurs in conjunction with seed or leaf harvesting from the same individual, the sustainable seed and leaf harvest limits of 25% apply. With regard to seeds, this limitation is to maintain seed supply on the harvest site and with leaves, to minimise the cumulative loss of nutrients from the site. In cases of salvage harvest all plants, along with accompanying seed and leaves, may be collected.

Harvesting of Australian Government eligible listed threatened species (currently *M. macdonnellii*) will be limited to vouchered samples for registered botanical gardens, scientific research, educational purposes and exceptional circumstances where there is a clearly demonstrated conservation outcome from the harvest.

All permits for whole plant harvest will include the condition that all plants must be labelled with a Parks and Wildlife Commission approved tag prior to removal from the harvest site.

#### 3.2.6 Wild Harvest Limit Determination

Wild harvest limits for individual permits will be determined by the Director of Wildlife, in line with the prescriptions specified in this plan. Harvest areas and harvest prescriptions will be prescribed as conditions of permits to take cycads. While recognising existing gaps in available information, harvest limits will be set after consideration of the following:

- trends in the size and structure of the cycad populations;
- year-to-year variation in reproduction and recruitment;
- management objectives for specific areas;
- proportion of total population subject to harvest;
- review of previous harvests;
- review of past and current research;
- the likely aesthetic impact of a harvest; and
- other relevant information.

In response to the paucity of information on the population dynamics of most Northern Territory cycads, an adaptive management approach will be used whereby prescriptions will be refined as more information becomes available. While recognising the need to be adaptive, this management plan recognises the precautionary principle and will ensure that scientific uncertainty will not be used as an excuse to postpone management measures aimed at protecting wild cycad populations and their habitat.

#### 3.2.7 Fees and Royalties

A permit fee may be introduced during the life of this plan. Royalties will be determined by the Minister by notice in the Government Gazette.

#### 3.2.8 Harvesting Returns

Returns providing details of harvested flora are required as a condition of all permits. Information required includes, but is not limited to, the permit number, permittee's name, taxon, product, detailed information on harvest location, quantity from each area harvested in the period and list of the people or businesses the cycads were sold to. With whole plant harvest, for each numbered tag return information will include the length of the stem. With sustainable operations whole plant harvest tags must be matched with positional information for the harvest point obtained by a global positioning system while with salvage operations location by global position system or a detailed site plan of the harvest site will be required. Detailed information matching tags, plant size and harvest location will provide a tool to assist in auditing harvest operations and assist in monitoring compliance with permit requirements. Nil returns are required if no harvesting is undertaken in a period. Returns are to be submitted to the Parks and Wildlife Permits Section within NRETAS.

A summary report of permits issued and material harvested will be produced annually. Data from harvesting returns will be summarised in the five yearly review of the plan that will detail the extent of cycad harvesting in the Northern Territory, and the type and quantity of material taken. Data from the harvesting returns will be used in the evaluation of harvesting impacts and to provide feedback on the administration of the program.

#### 3.2.9 Overseas Export of Plants and Leaves

Plants and leaves destined for overseas export for commercial purposes will be limited to those harvested from approved sustainable operations. This emphasis on sustainable operations will facilitate approvals for export under Australian Government legislation. In addition, the promotion of wild harvested plants or leaves as derived only from sustainable operations will assist marketing Northern Territory cycads overseas as environmentally sound products. While overseas demand will provide an economic incentive for landholders to manage cycad populations and their habitat; this approach will minimise any incentive for landholders to clear land to obtain financial returns from the sale of salvaged cycads.

#### 3.2.10 Artificially Propagated Cycads

The primary focus of this management program is on management of wild populations of cycads. Under the *EPBC Act 1999* artificially propagated plants must be sourced from an approved program if they are to be exported commercially. Except in exceptional circumstances, eligible listed threatened species (currently *Macrozamia macdonnellii*) cannot be exported unless they come from an approved artificial propagation program. NRETAS will consult with other government departments and the Nursery and Garden Industry of the Northern Territory to explore options to manage artificially propagated plants and thus facilitate access to export markets.

- Assess all permit applications for commercial use of cycads, ensure permit conditions are set in accordance with the provisions of this management program and issue permits as appropriate under the *TPWC Act*.
- Monitor and audit all harvest applications, approvals and returns, and investigate and resolve any discrepancies.
- Review permit conditions annually and amend where necessary.

#### 3.3 Salvage Operations

Areas where cycads are likely to be destroyed in the pursuit of other legitimate purposes such as construction of roads or fire breaks or under a clearing permit, will be eligible for the issue of permits for utilisation by salvage. Clearing applications lodged under the *Planning Act* are advertised in regional newspapers and copies are available for viewing by the public for 14 days at NRETAS, Darwin. Copies of current clearing permits are available from the Vegetation and Land Management Branch of NRETAS. All permits for the removal of cycads will include the condition that all plants must be labelled with a Parks and Wildlife Commission approved tag prior to removal from the salvage site.

#### **Performance Indicator**

• Assess all permit applications for salvage of cycads, ensure permit conditions are set in accordance with the provisions of this management program and issue permits as appropriate under the *TPWC Act*.

#### 3.4 Research

As part of the adaptive management approach adopted in this program, NRETAS will encourage research that assists in achieving the aim of this program. A high priority will be given to writing up the results of past research on the effects of harvest and fire on cycads. Priorities for future research include: the response of wild cycad populations to various harvesting prescriptions and the impact of harvesting practices and associated land management on cycad habitat; and survey and mapping of significant cycad populations. Mechanisms for implementing research outcomes include harvesting prescriptions specified on permits to take cycads. For research purposes only, the restrictive prescriptions limiting the proportion of seeds, leaves or plants that may be harvested in a local population may be relaxed. The application of provisions will be assessed on a case by case basis and will only be considered in the framework of a clearly specified experimental design which is expected to lead to an increase in knowledge that will feed back into future management prescriptions. Cycad specimens may be taken for identification and taxonomic purposes subject to the collector holding an appropriate permit issued under the *TPWC Act*.

- Assess all permit applications for research on cycads and issue permits as appropriate under the *TPWC Act*.
- Provide research results on the impacts of fire and harvesting on cycads to the public.

#### 3.5 Public Awareness and Education

The biology, ecological significance and economic value of cycads will be promoted in a variety of media and landholder extension activities conducted by NRETAS. The George Brown Darwin Botanical Gardens maintains a cycad collection which includes all species found in the Northern Territory. Media and extension activities will include promoting awareness of this program, along with the regulatory requirements pertinent to implementation of this plan. To complement web based information about plant harvesting and permits under the *TPWC Act*, a brochure providing guidelines to harvesting cycads in the Northern Territory will be produced. Extension activities will include dissemination of research findings.

Foci for extension activities will include the responsibilities of landholders and land management prescriptions targeted at sustainable management of cycad populations and their habitat. A brochure detailing the natural history and wise management of *Cycas armstrongii* populations will be produced with the target audience to include small block owners near Darwin.

- Maintain a publicly accessible display of Northern Territory cycads at George Brown Darwin Botanic Gardens with interpretive information.
- Compile and distribute a brochure providing guidelines to cycad harvesting.
- Compile and distribute a brochure targeted at landowners on management of cycad populations.

## 4. Monitoring and Assessment

#### 4.1 Impact Monitoring

Under this management program monitoring will be implemented to record the impact of harvesting on plant populations. Harvesting returns will form an integral component of the impact monitoring by providing information on the type, extent and quantity of material harvested. Monitoring activities may be required of the harvester as part of the permit conditions. In the case of land clearing, the proportion of a species that is affected will be monitored.

Three tiers of assessment applying both qualitative and quantitative techniques will be undertaken to monitor population trends.

#### **Qualitative Inspections**

Qualitative inspections will be undertaken periodically at harvest and other sites, and information recorded on disturbance and population structure. The inspection will focus on evidence that may indicate population trends such as recruitment and fire effects on the target species. Observations will also be recorded on other components of the habitat, particularly any response that may be related to harvest activities, such as evidence of disturbance to other vegetation. The presence of exotic grasses that can result in increased fuel loads, an estimate of time since fire and evidence of fire impact will also be recorded.

#### **Quantitative Impact Monitoring**

Sampling transects will be set up at selected sites subject to harvest, and at comparable unharvested sites. Monitoring of cycads will be conducted on a regular basis with the period between assessment subject to apparent population trends, but is anticipated to be in the order of three to five years. Sampling will be targeted to provide feedback on the population response to potentially significant events such as harvest, intense wildfires or cyclones. Two levels of quantification will be implemented: rapid assessment transects where no attempt will be made to tag individual cycads; and detailed assessment sites where plants will be tagged. Building on population monitoring conducted over the last decade, a rapid assessment protocol will be developed. The protocol will focus on recording the trend of the adult component of the cycad population and providing an early warning system to avoid undesirable population changes.

At a subset of sites detailed quantitative assessment will be conducted using tagged plants to follow cycad population trends. Initial reassessment of cycads will be undertaken within 5 years, with subsequent periods between reassessment determined by the observed population response. At selected sites sampling will include non-cycad species with a focus on other woody species, as these taxa are likely to reflect change in the community in response to fire management. Floristic lists and woody abundance will be reassessed at least every decade to reveal long-term population trends.

#### Assessment

The data on population size and structure, and plant performance from sites subject to harvest will be compared against unharvested sites. Where differences in population or plant response are found, these differences will be evaluated and harvest levels adjusted accordingly.

- Develop and implement a GIS database to provide a spatial context to harvest return data and to assist in planning and implementing population monitoring.
- Develop rapid assessment protocols to provide qualitative and quantitative assessment of cycad populations.
- Implement qualitative and quantitative assessment in conjunction with selected representative sustainable harvest operations to monitor the management and response of cycad populations.
- Implement detailed quantitative assessment at a subset of sites, including assessment of non-cycad vegetation to guide management prescriptions.
- Compare cycad population data from harvested and unharvested sites to guide management prescriptions.

## 5. Management Strategies

Should monitoring indicate that management aims and objectives are not being met, harvest prescriptions will be altered or other actions taken in accordance with this program. Cycad data from monitoring plots will be used to develop population models that will provide an early warning of population decline for these long-lived plants. Similarly, habitat data, floristic composition and abundance of non-cycad woody species collected at a selection of sites will be analysed for evidence of change arising from actions under this management program. Should there be a need to change harvest practices to avoid overharvesting or other unsustainable practices, the system of annual permits provides a mechanism to rapidly introduce changes into operational systems. Provision exists under section 59 of the *TPWC Act* to cancel permits should information become available that indicates a new threat or new circumstances in relation to the survival of cycads or their habitat.

#### **Performance Indicator**

• Adjust management practices as necessary in response to the monitoring of harvest activities, cycad population trends and their habitat.



## 6. Reports

The program will be audited internally by the Northern Territory Government on an annual basis. A report of progress against the performance indicators identified in this management program will be produced annually and made available to the public. The report will include:

- Progress against performance indicators.
- Harvest statistics including:
  - Number of permits issued for sustainable and salvage operations;
  - Quantity of seeds harvested for each species from sustainable and salvage operations;
  - Number of leaves harvested for each species from sustainable and salvage operations; and
  - Number of plants harvested for each species from sustainable and salvage operations.
- Industry compliance statistics including:
  - Number of inspections of premises or harvest operations;
  - Number of caution notices issued and reason for issue;
  - Number of alleged offences investigated and outcomes;
  - Any joint surveillance/enforcement activities completed with other agencies; and
  - Any unusual situations that arose (e.g. drought or fire, market influences).
- Impact monitoring undertaken including:
  - Number of sites where qualitative assessment undertaken;
  - Number of sites where quantitative assessment undertaken applying rapid assessment protocols; and
  - Number of sites where quantitative assessment undertaken applying detailed assessment protocols.

Monitoring results from harvested and other wild populations will be summarised into a report produced as part of the five year review of the management program.

- Annually audit the progress of the management program against each of the performance indicators.
- Submit an annual progress report to the Australian Government and make this report available to the public.

## 7. Compliance

Wildlife regulations and permit conditions will be enforced by Conservation Officers appointed under the *TPWC Act*. Instruction on the requirements of this program and responsible harvesting practices will be included in the training of Conservation Officers undertaken by NRETAS. To ensure compliance with permit conditions and determine the extent, if any, of illegal harvesting, spot visits will be made to both harvested and unharvested areas and businesses on-selling the harvested cycads. Particular attention will be given to threatened populations and populations that have suffered from uncontrolled harvesting in the past. Field inspection of harvested. Substantial penalties apply under sections 66 and 67 of the *TPWC Act* for offences relating to protected and unprotected wildlife.

#### **Performance Indicators**

- Incorporate instruction on the requirements of this program and responsible harvesting practices in the training of Conservation Officers.
- Conduct spot visits to harvesting operations and permitted harvest areas, along with non-harvested areas and businesses on-selling harvested cycads, to verify permit return information.
- Ensure compliance with permit conditions is at or near 100% and addressing permit breaches through warning letters, caution notices, infringement notices or prosecution is at or near 100%.

#### 8. Review of Program

This management program will be reviewed as required under section 32(2) of the *TPWC Act* within five years of the date of commencement. The review will include details about how the program objectives have been met over the life of the program.

#### **Performance Indicator**

• Review and update the management program by 2014.

## 9. Background Information

#### 9.1 Biology of Cycads

Cycads are long-lived, slow-growing, woody plants. They have male and female plants, develop cones and reproduce by seed. Sexual dimorphism is evident only in the cone of mature plants with male *Cycas* bearing a compact conical shaped reproductive structure and female *Cycas* bearing an open structure which encircles the stem. The age at maturity is unknown for most species and is probably influenced by environmental conditions. In cultivation many cycads reach maturity within 15 years, but it is likely that this time could be considerably longer in the wild. Any attempt to equate age with size is hampered by the fact that plants can regenerate from old bases or root stock.

Reproduction by individual plants can be annual, but may be sporadic or in intervals of up to or over 15 years depending on species and environmental conditions. Cycads are one of the few seed plants that produce motile sperm cells, a sign of their primitiveness. Pollination is believed to be primarily by insect vectors, especially beetles in the family *Boganiidae*. Cones produce an odour to attract the insects. Seeds are dispersed by gravity, water and animals. Germination may not occur at seed maturity because the embryo usually has an after-ripening period depending on the species. Seed predation by rats and humans can occur.

Cycads have various ways to cope with adverse conditions. Most cycads grow in impoverished soils. Additional nitrogen is acquired from cyanobacteria living in symbiosis on the cycad's coralloid roots at the soil surface. Seedlings are vulnerable to predation, fire and desiccation. Contraction of the primary root pulls the apical growing point underground providing protection. If the crown is destroyed, plants will produce new flushes of leaves; and if the apical growing shoots are damaged, branching can occur. In extreme circumstances when part or all of the above ground stem is destroyed, regeneration can occur from stem bases or old root stock.

#### 9.2 Description and Status of Northern Territory Cycads

Northern Territory *Cycas* have a slender to stout emergent trunk with leaf bases typically retained on the trunk at senescence. New leaves emerge in a flush, and are erect with coiled leaflets that may be smooth or with hairs that are shed with age. Mature leaves are pinnate and oblong in outline and flat or keeled in cross-section. The petioles may or may not be spinescent and the leaflets have prominent midribs. Male cones are large and cylindrical; whereas female plants have loose and open reproductive structures. In addition to the 10 recognised Northern Territory *Cycas* species, there are populations that may constitute hybrids between recognised species.

Species in the genus *Cycas* appear to hybridise freely, assisted by a common number of chromosomes (n=22). In addition, there appears to be no pollinator specificity. Interspecific reproductive barriers appear to be either temporal or geographic in nature, (ie different cone development times and geographic separation), respectively. Neither of these are present between several species in the Daly River to Litchfield area. Considerable variability is evident in hybrids of *Cycas armstrongii*, *Cycas calcicola* and *Cycas conferta*. Hybridism is a natural occurrence where species are within pollination range of each other. Although not a threat *per se*, it is necessary to be aware of hybrid occurrence when considering the distribution and genetic integrity of individual species. The increased use of cycads, both native and exotic, in landscaping may result in new hybrids in the future.

The sole representative of *Macrozamia* in the Northern Territory is a medium sized cycad with a stout trunk. Leaf bases are retained at senescence. Petioles are smooth and expanded at the base and leaflets lack a midrib. Cones are sexually dimorphic with female cones broad and large, and male cones smaller and narrow.

#### 9.2.1 Cycas angulata R.Br.

**Species description:** Large cycad up to 12 m, occasionally taller, with thick black trunk 30-60 cm in diameter, often swollen at the base. Leaves 100-160 cm have 170-360 leaflets attached to the rhachis at 38-64° with the midrib raised below and only slightly raised above. For a detailed discussion see Dixon (2004). This taxon encompasses *Cycas angulata* R.Br. and *Cycas brunnea* K.D. Hill presented in Hill (1992, 1996), Hill and Osborne (2001), and Jones (2002).

**Habitat:** Sand to sandy loam in sparse grassy woodland with deep sands where cycads are the dominant vegetation.

**Range:** East of Borroloola along the Gulf of Carpentaria to the Robinson River with dense stands extending along the



Wearyan River and east, inland of the salt flats, to the Robinson River. Also known from three populations on Wollogorang Station. Other populations are found around Lawn Hill in western Queensland and Bountiful Island in the Gulf of Carpentaria. Further examination of Wollogorang Station may reveal additional populations.

**Land tenure:** All stands are on leasehold or pastoral lease land. The majority are within four pastoral properties: Manangoora, Greenbank, Wollogorang, and Robinson River. The species does not occur in any parks or reserves.

**Population dynamics:** The majority of *Cycas angulata* populations are dominated by trunked plants most of which are greater than 1 m tall. The ratio of juveniles (non-seedlings without trunks) to trunked specimens varies among populations (1:20 to 3:2) and does not appear to be related to last fire. Evidence of seedlings is destroyed by fire, so primary recruitment can only be evaluated in unburnt areas where a ratio of seedlings per female can be greater than 10:1. The ratio of juveniles (non-seedlings without trunks) to trunked specimens from one of the Wollogorang populations studied is approximately 4:3. Plants as short as 1-2 m may be mature, and in the mid 1990s the ratio of seedlings per female was greater than 5:1. Evidence of adult mortality is minimal, so even minor recruitment would appear sufficient to maintain the population.

**General status:** With total numbers estimated at over 1 million plants, *Cycas angulata* is abundant over a large area. Fire appears to be well managed throughout the species range. The main damage to plants is from high winds often associated with cyclones. However mortality from wind damage appears to be minimal as the cycads respond by branching and regenerating from old bases and root stocks. Reproduction appears sporadic with a small percentage of females seeding in most years and a majority of females seeding only every 3 or 4 years. Cycads pose a problem for pastoralists because of their toxicity; however most station managers seem resigned to live with them.

**Potential threats:** At present the species is secure. Current controlled burning practices have minimised the impact of fire and should continue. No major clearing is anticipated in the area. However, development in the area, especially for tourism, could result in more clearing in the future.

#### 9.2.2 Cycas arenicola K.D.Hill

**Species description:** Short cycad to 2 m, occasionally taller, with a stocky trunk 25-40 cm in diameter. Leaves 93-163 cm have 176-254 leaflets attached to the rhachis at 48-58° with the midrib prominent below and only slightly, if at all, raised above. For a detailed description see Hill (1993) and Dixon (2004).

Habitat: Broken sandstone country on sandy soils on scree.

**Range:** Upper East Alligator River, along the eastern end of the Ranger fault line and along the upper Liverpool River. Because *Cycas arenicola* has been found in relatively inaccessible places, it is quite possible that other populations exist in the general area.

**Land tenure:** All stands are on Aboriginal land in Arnhem Land. It is not included in any parks or reserves.

Population dynamics: Unknown

**General status:** *Cycas arenicola* is locally abundant and because of its remoteness, not considered at risk from development such as land clearing.

Potential threats: Due to its remote locality, wildfire is a possible threat.



#### 9.2.3 Cycas armstrongii Miq.

**Species description:** Medium cycad up to 6 m with a slender trunk 6-12 cm in diameter. Branching occurs along with occasional offsets and basal suckers. Leaves form an obliquely erect to spreading crown. Each has 84-156 leaflets attached to the rhachis at about 56-70° with a prominent midrib above. For a detailed description see Hill (1996), Hill and Osborne (2001), Jones (2002) and Dixon (2004).

**Habitat:** Mainly in open grassy woodland on yellow and red earths, limited in the area by drainage.

**Range:** Around the Darwin area south to near Hayes Creek, west to within 50 km of the coast and eastward past the Adelaide River floodplain to the north-western corner of Kakadu National Park. Also on the Tiwi Islands, Cobourg Peninsula, and Cox Peninsula.



Land tenure: Cycas armstrongii is found in multiple land tenures including private, government and leasehold. It is found on the following parks and reserves: Berry Springs Nature Park, Black Jungle Conservation Area, Blackmore River Conservation Reserve, Casuarina Coastal Reserve, Djukbinj National Park, Garig Gunak Barlu National Park, Holmes Jungle Nature Park, Howard Springs Hunting Reserve, Howard Springs Nature Park, Kakadu National Park, Litchfield National Park and Manton Dam Recreation Area.

**Population dynamics:** Population modelling based on experimental work near Darwin reveal resilience of the population to a wide range of frequency of low intensity fire but population decline when subject to frequent high intensity fire (Liddle 2004).

**General status:** This species is locally abundant but less than 1% of the population is included in conservation reserves. The species has been classified as **Vulnerable**, using the IUCN criteria, based on a predicted >30% reduction in population size over a 100 year period commencing a decade ago. Land clearing for urban, rural and horticulture in the greater Darwin area is reducing the available habitat. Such land clearing is expected to continue as Darwin expands. In particular, prime cycad habitat with deep loamy soil has been identified as land suitable for horticulture. It is anticipated that substantial areas of prime habitat on the Tiwi Islands will be cleared for forestry. The prevalence of high intensity fire events is expected to increase (Rossiter *et al.* 2003) as exotic grasses invade native vegetation in the Darwin Region (Kean and Price 2003).

**Potential threats:** Land clearing and inappropriate fire regimes, particularly arising from increased fuel load due to invasion of exotic grasses, are major threats. Mortality in excess of 50% of adult stems per fire event has been recorded when subject to fuel loads of 20 tonnes per hectare (Liddle 2004). The exotic pasture species gamba grass *Andropogon gayanus* supports fuel loads up to 20 tonnes per hectare and the exotic perennial mission grass *Pennisetum polystachyon* supports fuel loads up to 27 tonnes per hectare. Both of these exotic species are spreading rapidly and have the potential to extend over the full range of *Cycas armstrongii*. Seed development occurs over a long period from October through September. Fires have varying effects on individual female reproduction, depending on stage of seed development, intensity of fire and height of female.

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#### 9.2.4 Cycas arnhemica K.D.Hill

**Species description:** Medium cycad 5 m tall, rarely to 7 m, with a slender trunk 12-20 cm in diameter. Leaves 52-116 cm long with 98-262 leaflets attached to the rhachis at 48-80° with the midrib prominent below and only slightly, if at all, raised above. For a detailed description see Dixon (2004). This taxon encompasses the three subspecies previously recognised by Hill (1994, 1996).

**Habitat:** Found in savanna forests dominated by *Eucalyptus tetrodonta* and *Eucalyptus miniata* on deep white to yellow sands over laterite, or on old beach dunes in near coastal sites on Groote Eylandt.

**Range:** Found around the Goyder River in central Arnhem Land. Groote Eylandt and the central north coast of Arnhem Land.

**Land tenure:** All stands are on Aboriginal land and the species is not included in any parks or reserves.

**Population dynamics:** Data from monitoring sites suggest a healthy balance of size classes within populations near Maningrida (Griffith *et al.*, 2005).

General status: Locally abundant.

**Potential threats:** Frequent fires are reported to have reduced the numbers of viable seed (Hill, 1994).

#### 9.2.5 Cycas calcicola Maconochie

**Species Description:** Small to medium cycad up to 3 m in height and 30 cm in diameter having an obliquely erect crown with flat straight leaves. Each leaf contains 198-504 leaflets moderately spaced on the rhachis at 48-80° with a raised midrib beneath. For a detailed description see Maconochie (1978), Hill (1996), Hill and Osborne (2001), Jones (2002) or Dixon (2004).

**Habitat:** Sparse, stunted woodland with limestone outcrops or sandy flats derived from sandstone with other vegetation varied, including *Eucalyptus miniata, Eucalyptus phoenicea, Corymbia porrecta, Corymbia confertiflora, Melaleuca* species and *Syzygium* species. The soils are sandy over quartzite, shale and limestone.

**Range:** Three main areas are Litchfield Park, along the Daly River from the crossing southeast to Oolloo and northwest of Katherine. Smaller scattered stands may link these major groups. A population occurs on Bullo River Station and Spirit Hills in the Victoria River District.





**Land tenure:** Large numbers of *Cycas calcicola* are found in Litchfield National Park and a smaller population is at Kintore Caves Nature Park near Katherine. The remaining stands are on pastoral lease except for some small populations around Katherine on private and government land, and populations in the proposed wilderness park in the Spirit Hills area.

**Population dynamics:** Only in unburnt areas are juveniles outnumbering trunked specimens. In 1994 the vast majority of adult plants were reproductive and the sex ratio appeared to be even. Primary recruitment can only be evaluated in unburnt areas where in 1994 few seedlings were present. Adult mortality is evident in areas of high intensity fire (Parks and Wildlife Commission unpublished data 1994).

**General status:** The populations around Katherine are in poor condition due to fire and past uncontrolled collection. However, the larger populations in the Daly River and Litchfield areas appear in better condition, though fire damage is widespread. Population estimates are: >7,000 for the Daly River; >5,000 for Litchfield Park; >1,500 for Katherine; and >5,000 individuals for Bullo River and Spirit Hills (Parks and Wildlife Commission unpublished data 1994, 1995 and 1996).

**Potential threats:** The main concern for these populations is fire. Evidence of fire damage has been widespread in the past, including stem loss or weakening and sap exudation in the severely burned populations. Illegal seed and plant collection in the past has contributed to the decline of populations adjacent to the Stuart Highway near Katherine.

#### 9.2.6 Cycas canalis K.D.Hill

**Species description:** Medium cycad up to 3 m, occasionally taller, with a slender trunk 7-14 cm in diameter. Leaves 65-93 cm long with 86-146 leaflets attached to the rhachis at 44-69°. Midrib slightly raised above and prominent below. For a detailed description see Dixon (2004). This taxon encompasses the two subspecies previously recognised by Hill (1994, 1996).

**Habitat:** *Cycas canalis* is found in Eucalypt forest woodland dominated by *Eucalyptus miniata* on well-drained lateritic soils.

**Range:** *Cycas canalis* is found around Channel Point to Tjuwaliyn (Douglas) Hot Springs Park and south to the Flora River Nature Park.



**Land tenure:** *Cycas canalis* occurs on Aboriginal and pastoral leasehold land. Small populations occur on Tjuwaliyn (Douglas) Hot Springs Park and Flora River Nature Park.

**Population dynamics:** The Channel Point population of *Cycas canalis*, has a small proportion (<5%) of adults greater than 1 m tall. Seedlings are few and many apparently juvenile plants are regrowth from old bases or root stock. The remaining populations appear to have a more balanced population structure with a larger percentage of adults.

**General status:** *Cycas canalis* is locally very abundant,. The population at Channel Point is subject to heavy infestation by Chrysomelidae beetles which may limit the plants' resources, negatively impacting on reproduction.

**Potential threats:** Large areas of the Channel Point population have been cleared for agriculture and there is a potential that additional areas will be cleared for agriculture and tourist development. Frequent fire appears to be a threat to reproduction in the Channel Point population. In the remaining populations fire and land clearing are possible threats, with extensive clearing for agriculture proposed for the Daly Basin.

#### 9.2.7 Cycas conferta Chirgwin

**Species Description:** Medium-sized cycad reaching 6 m in height and 15 cm in diameter. Petioles 24-34 cm long with 124-192 leaflets often overlapping with flush midrib. Lower petiole may be smooth or with a series of short thorns. For detailed description see Chirgwin and Wigston (1993) and Dixon (2004).

**Habitat:** Found mainly on rocky outcrops and stunted woodland overlying Cullen granite and sandstone and quartz of the Brocks Creek Group. The soils are grey gravelly loams. *Eucalyptus miniata* is the dominant tree species in the woodland whereas the cycads are dominant on the outcrops.



Range: From between Jim Jim Falls and Graveside Gorge in

Kakadu, southwest through Goodparla and Mary River Station to Foelsche Headland, and north to Burrell Creek near Adelaide River. A large population of *Cycas conferta* has been reported near the headwaters of the Fergusson River, but as yet has not been confirmed.

**Land tenure:** The majority of plants occur on pastoral leases with small to medium size stands in Kakadu National Park.

**Population dynamics:** Reproduction rate is low and may be suppressed due to fire in areas such as Harriet Creek. Recruitment is hard to assess because of late season fires.

**General status:** Population estimates exceed 30,000 plants with a major concentration at Harriet Creek. In the past, the large population at Harriet Creek has been extensively harvested for seed. Some of the smaller populations along the Kakadu Highway have been severely impacted by past removal of plants. However, because of the large numbers over a substantial area, the species is not presently at risk.

**Potential threats:** Contemporary fire regimes appear to be having a negative impact in some areas. There is a need to maintain controls on harvest as removal of plants from easily accessible sites could negatively impact on some populations.

#### 9.2.8 Cycas maconochiei Chirgwin & K.D.Hill

**Species description:** Medium to tall cycad 3 m in height, rarely to 7 m, with a trunk 9 to 15 cm in diameter. Leaves 62-128 cm long with 152-288 leaflets attached to the rhachis at 61-85°. Midrib slightly raised above and prominent below. Two subspecies occur: *Cycas maconochiei* subsp. maconochiei with dull bluish green leaflets that retain some hair; and *Cycas maconochiei* subsp. *viridus* K.D.Hill with glossy mid-green leaflets which become hairless with age. For a detailed description see Dixon (2004). *Cycas maconochiei* subsp. maconochiei encompasses two subspecies previously recognised by Hill (1996).



**Habitat:** Sparse woodland usually dominated by *Eucalyptus miniata* on a variety of well-drained soils. Also found in swampy areas and coastal dunes.

**Range:** *Cycas machonochiei* subsp. *maconochiei* occurs in coastal areas west of Darwin from Cox Peninsula and Fog Bay extending south to the mouth of the Victoria River and inland toward Dorisvale. Populations also occur on the Tiwi Islands. *Cycas maconochiei* subsp. *viridis* is known only from Fossil Head.

Land tenure: The majority of the area is Aboriginal land with other private and leasehold land in the northern part. *Cycas maconochiei* subsp. m*aconochiei* occurs on Indian Island Conservation Area.

#### Population dynamics: Unknown

**General status:** The two subspecies are locally abundant; however *Cycas maconochiei* subsp. *maconochiei* is under threat of substantial population decline through land clearing and

inappropriate fire regimes. Insufficient data exists to adequately classify the status of *Cycas maconochiei* subsp. *viridis*.

**Potential threats:** Land clearing threatens populations in localised areas. The invasion of exotic grasses into areas of native vegetation and an increase in fire intensity due to increases in fuel load is likely to have a negative impact on this species.



#### 9.2.9 Cycas orientis K.D.Hill

**Species description:** Medium cycad up to 4 m, occasionally taller, with a slender trunk 8-14 cm in diameter. Leaves 52-124 cm have 96-210 leaflets attached to the rhachis at 53-79° with midrib slightly to moderately raised above and prominent below. For a detailed description see Hill (1994, 1996) and Dixon (2004).

**Habitat:** Found in savanna forests dominated by *Eucalyptus tetrodonta* and *Eucalyptus miniata* on deep white to yellow sands over laterite.

Range: Eastern Arnhem Land to Lake Evella.

**Land tenure:** All stands are on Aboriginal land. It is not known from any park or reserve.

Population dynamics: Unknown

General status: The species is locally abundant over a large area (Hill, 1994).

**Potential threats:** Little is known about the species. However, inappropriate fire regimes pose a threat to the species (Dixon pers. obs.)

#### 9.2.10 Cycas pruinosa Maconochie

**Species description:** Medium cycad to 2 m, with a trunk 25-40 cm in diameter. Leaves grey green to bluish grey, 72-110 cm long bearing 158-420 leaflets with revolute margins, attached to the rachis at about 51-69° and obliquely erect with the basal portion of the leaf broadly U shaped and the distal 2/3<sup>rds</sup> of the leaf forming a deep keel in or cross section. For a detailed description see Maconochie 1978, and Dixon (2004).

**Habitat:** In the Northern Territory *Cycas pruinosa* generally occurs in savanna woodland dominated by *Eucalyptus miniata* and *Eucalyptus tetrodonta*, and open shrublands on sandstone. The population on Kirkimbie Station occurs on limestone.

Range: In the Northern Territory known from Bullo River and

Kirkimbie Stations, and the Spirit Hills area (NT Herbarium database). In Western Australia it occurs in the ranges west and south of the Kununurra-Ord River area (Maconochie 1978).

**Land tenure:** In the Northern Territory *Cycas pruinosa* occurs on pastoral lease and in the proposed wilderness park in the Spirit Hills area.

**Population dynamics:** Preliminary data from monitoring sites established in the Spirit Hills area reveal little change in population structure over a nine year period (NRETAS unpublished data).

**General status:** Survey by NRETAS indicate in excess of ten thousand plants occur in the Northern Territory and the species is not considered to be at risk.

Potential threats: Fire is the main potential threat to the taxon in the Northern Territory.





#### 9.2.11 Macrozamia macdonnellii (F.Muell. ex Miq.) A.DC.

**Species description:** A medium cycad to 3 m tall with a stout trunk to 1 m in diameter, often procumbent. Blue-green leaves 1.2-2 m have 120-170 crowded leaflets attached to the rhachis at 40°. One or two cones are typically produced at one time per plant, but up to 5 cones have been recorded. The seeds are probably the largest of any cycad, weighing 50 g. For a more detailed description refer to Hill and Osborne (2001) or Jones (2002).

**Habitat:** Found in sheltered gorges and on hills of both metamorphic and sedimentary rock.

**Range:** It is restricted to the Krichauff, George Gill, Harts and MacDonnell Ranges in central Australia.



Land tenure: Between 60% and 70% occur on parks and

reserves with the remainder on Aboriginal land and pastoral lease. The parks and reserves containing cycads are Finke Gorge National Park, Ruby Gap Nature Park, Watarrka National Park and West MacDonnell National Park.

**Population dynamics:** Females cone very sporadically and recruitment is dependent on rains which are unpredictable. Based on work done at Pimelea Valley in Finke Gorge less than 20% of plants are adults and over 50% of plants have an above ground stem under 5 cm high. Preece (2005) found that less than 5% of individuals were seedlings and evidence indicates that plants are very long-lived.

**General status:** *Macrozamia macdonnellii* is thought to be a relict species surviving in a narrow ecological niche in an otherwise hostile environment. Many small populations (n=<1000) exist; however, larger populations are limited to Kings Canyon and Palm Valley. Little recruitment occurs and growth in the wild appears to be the slowest of Northern Territory cycads. The species is classified as **Vulnerable** under the *EPBC Act 1999* and a draft national recovery plan is being prepared (Nano and Pavey, in prep). This listing is due to the species restricted occurrence in severely fragmented populations, in combination with a projected decline due to fire and illegal harvesting. In a recent review of plants listed as threatened under the *TPWC Act*, the species was downlisted to near threatened. This reclassification was due to the reasonably large and extensive population in combination with a lack of evidence of a mechanism of decline. The species displayed a strong ability to resprout following intense fires in 2002 and a study by Preece (2005) indicated that fire was not a significant factor in the distribution of the species.

**Potential threats:** Illegal seed collection is a potential threat to populations at accessible sites. There is concern about an apparent decline in the Black-Footed Rock-wallaby, *Petrogale lateralis*, populations. If Rock-wallabies undergo a decline this may have an adverse effect on seed dispersal.

#### 9.3 Historical Use of Cycads

Cycads have long been used by Aboriginal people in the Northern Territory (Thieret 1958). The seed is rich in starch and is treated by heat and leaching to remove toxins before being eaten. Exudates from the leaves and sporophylls are used for medicinal purposes, as is the ground seed. This usage is thought unlikely to create problems for wild cycad populations or require management.

The toxins that cycads contain may cause paralysis in cattle. Although not a preferred feed, cycad leaves are eaten by cattle, especially during dry conditions when more palatable food is scarce. In the past cycad eradication was promoted by the Department of Primary Industry and Fisheries (Wesley-Smith 1973). While such eradication is no longer actively promoted by government agencies, many pastoralists view cycads as a threat to cattle and seek ways to reduce or eliminate them. An intention of this management program is to raise the profile of cycads and their habitat through the return of royalties to landholders from sustainable harvesting and a public awareness campaign.

Cycad plants and seed are in demand from cycad enthusiasts and from the nursery trade. While traditionally the primary demand has been from specialist collectors, cycads are increasingly popular in landscaping and as pot plants. There is demand from the ornamental leaf trade due to their attractive shape and long shelf-life. The leaves are commonly used to complement orchid stems and in dried flower arrangements. To date, collection has posed little threat to the survival of species. However, in the past some small populations have been decimated by uncontrolled removal of plants and seed. It is a thrust of the management program to promote public awareness of cycads and allow for legal collection from the wild to help meet the demand with minimal impact on any wild population.

#### 9.4 Conservation

The recurrence of intense late dry season fires threaten some cycad populations. Fire destroys existing seed (Wesley-Smith 1973, Liddle 2004) and seedling mortality appears to be increased by fire (Chirgwin 1990). These observations support the proposal that frequent burning inhibits regeneration. On the other hand fire appears to promote seed production in other situations (Jones 2002). Intense fires may damage plants and increase their susceptibility to insect damage, especially termites, and disease (NRETAS unpublished data). Under the auspices of a previous management program for cycads, research has been undertaken to examine the impact of various fire regimes on Cycas armstrongii (Liddle 2004). Modelled population response under various frequencies of low intensity fire reveal resilience of cycad populations to a broad range of fire frequency. In contrast, high intensity fire more frequently than one in five years resulted in population decline. Given the prominence of fire in many Top End landscapes (Williams et al. 2001) and the rapid spread of exotic grasses (Kean and Price 2003) which give rise to intense fires (Rossiter et al. 2003), there is a significant evolving threat to cycads and their habitat. The evidence provides weight to the argument that landscapes supporting cycads will require active management to avoid long-term population decline. Obtaining an economic return from the sustainable harvest of cycads provides one of few incentives available to landholders to conserve cycads and their habitat. The impact of fire on populations will continue to be evaluated in the cycad monitoring program and the results incorporated into cycad management prescriptions.

With the expansion of rural development and agriculture, especially in the Darwin and Katherine Regions, cycads such as Cycas armstrongii, Cycas canalis and Cycas maconochiei subsp. maconochiei are especially vulnerable to clearing. The projected rate of clearing within the range of Cycas armstrongii, in combination with the invasion of exotic grasses, has been sufficient to warrant this species being classified as Vulnerable to extinction under Red List criteria (IUCN 2001). Clearing on pastoral land is regulated under the provisions of the Pastoral Land Act and written consent from the Pastoral Land Board is required before clearing can proceed. Northern Territory Pastoral Land Clearing Guidelines include provisions for the protection of threatened species and sensitive or significant plant communities. Under the provisions of the *Planning Act*, clearing controls are in place on all freehold and Crown Land of one hectare or more outside of existing towns and current plan areas such as Darwin, Katherine and Alice Springs. Land Clearing Guidelines include provisions for the protection of threatened species and sensitive or significant plant communities. As part of this management program, NRETAS will provide advice to other sections of Government involved in approving land clearing proposals for areas with cycads. To assist in providing advice, the extent of clearing of cycads will be monitored using data from the Vegetation and Land Management Branch of NRETAS.



Figure 1: The number of permits issued for cycad harvesting from 1995 to 2005.

#### 9.5 Harvesting History

Prior to 1992 there was provision under the *Forestry Act 1980* for regulation of cycad harvesting through Forest Products Licences and under the *Crown Lands Act* through Miscellaneous Licences. Few licences were issued and limited information is available to indicate the scale of harvesting. The number of permits and licences issued for the taking of cycads under the *TPWC Act* between 1995 and 2005 is provided in Figure 1. Early in the period leaf harvesting predominated while in the later years seed and whole plant harvesting have become more prominent (Figure 2). Based on harvesting returns, the majority of plant harvest has been of *Cycas maconochiei* subsp. *maconochiei* (45%) and *Cycas canalis* (2%). Leaf harvest has been primarily from *Cycas armstrongii* (98%), with a small proportion of *Cycas maconochiei* subsp. *maconochiei* (2%). Seed harvest has been spread across *Cycas angulata* (41%), *Cycas canalis* (3%) and *Cycas arnhemica* (1%).



Figure 2: Quantity of (a) cycad plants, (b) leaves and (c) seeds harvested from 1995 to 2005 based on permit

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return data.
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Appendix 1: Milestone Matrix for Cycad Management Program 2009 to 2014

2014		Implement, ongoing	Ongoing	Ongoing	Ongoing
2013		Implement, ongoing	Ongoing	Ongoing	Ongoing
2012		Implement, ongoing	Ongoing	Ongoing	Ongoing
2011	nt practices	Implement, ongoing	Ongoing	Ongoing	Ongoing
2010	nd manageme	Implement, ongoing	Ongoing	Ongoing	Ongoing
2009	sustainable la	Develop	Ongoing	Ongoing	Ongoing
Officer	ations through	P4 (Sustainable Use)	P4 (Sustainable Use)	Director of Wildlife	Director of Wildlife
Reference	n of cycad popul	<ol> <li>Land management and non-commercial harvest</li> </ol>	3.1 Land management and non-commercial harvest	<ol> <li>Land management and non-commercial harvest</li> </ol>	3.1 Land management and non-commercial harvest
Milestone	Objective 1 – To promote the conservatio	Develop and implement a GIS database of the distribution and abundance of cycads to assist with providing advice to minimise the impact of land clearing on cycad populations	Incorporate guidance on maintaining cycad populations when providing advice on land use proposals that may impact on significant cycad populations	Assess all permit applications for non- commercial harvest of protected cycads on all land tenures, ensure permit conditions are set in accordance with the provisions of this management program and issue permits as appropriate under the <i>Territory Parks and Wildlife</i> <i>Conservation Act</i>	Assess all permit applications for non- commercial harvest of unprotected cycads from Crown Land, ensure permit conditions are set in accordance with the provisions of this management program and issue permits as appropriate under the <i>Territory Parks and Wildlife</i> <i>Conservation Act</i>
	Milestone         Reference         Officer         2009         2010         2012         2013         2014	Milestone         Reference         Officer         2009         2010         2012         2013         2014           Objective 1 – To promote the conservation of cycad populations through sustainable land management practices         2013         2014         2014         2014         2013         2014	MilestoneReferenceOfficer20092010201120132014Objective 1 - To promote the conservation of cycad populationsName20092010201120132014Develop and implement a GIS database of the distribution and abundance of minimise the impact of land clearing on harvest3.1 Land use)P4 (Sustainable Develop ongoingDevelop implement, ongoingImplement, implement, implement, ongoing201320142014	MilestoneReferenceOfficer20092010201220132014Objective 1 - To promote the conservation of cycad populationsficer20092010201220132014Develop and implement a GIS database3.1 LandP4 (SustainableDevelopImplement,Implement	MilestoneReferenceOfficer20092010201120132014Objective 1 - To prome the conservation of cycal populations through sustainableDevelop and implement a GIS database3.1 LandP4 (SustainableDevelopImplement,Imp

	Prodram	Action			Yea	-		
Milestone	Reference	Officer	2009	2010	2011	2012	2013	2014
Objective 2 – To develop and apply strat	egies for the eco	logically sustair	nable use of cy	/cads				
Assess all permit applications for commercial use of cycads, ensure permit conditions are set in accordance with the provisions of this management program and issue permits as appropriate under the <i>Territory Parks and Wildlife</i> <i>Conservation Act</i>	3.2 Commercial harvest	Director of Wildlife	Ongoing	Оngoing	Ongoing	Ongoing	Ongoing	Олдоілд
Monitor and audit all harvest applications, approvals and returns, and investigate and resolve any discrepancies	3.2 Commercial harvest	P4 (Sustainable Use)	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Review permit conditions annually and amend where necessary	3.2 Commercial harvest	P4 (Sustainable Use)	Annually	Annually	Annually	Annually	Annually	Annually
Develop and implement a GIS database to provide a spatial context to harvest return data and to assist in planning and implementing population monitoring	4.1 Impact monitoring	P4 (Sustainable Use)	Develop	Implement, ongoing	Implement, ongoing	Implement, ongoing	Implement, ongoing	Implement, ongoing
Develop rapid assessment protocols to provide qualitative and quantitative assessment of cycad populations	4.1 Impact monitoring	P4 (Sustainable Use)	Develop					
Implement qualitative and quantitative assessment in conjunction with selected representative sustainable harvest operations to monitor the management and response of cycad populations	4.1 Impact monitoring	P4 (Sustainable Use)		Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Implement detailed quantitative assessment at a subset of sites, including assessment of non-cycad vegetation to guide management prescriptions	4.1 Impact monitoring	P4 (Sustainable Use)	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Compare cycad population data from harvested and unharvested sites to guide management prescriptions	4.1 Impact monitoring	P4 (Sustainable Use)	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing

ne	Program Reference	Action Officer	6000	2010	Year 2011	2012	2013	2014
5 Mana strategi	gement es	P4 (Sustainable Use)	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
7 Comp	oliance	P4 (Sustainable Use)	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
7 Compli	auce	P4 (Sustainable Use)	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
7 Complia	ance	P4 (Sustainable Use)	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
of cycads	that wi	ill otherwise be	destroyed thr	ough land use	e permitted un	der relevant le	egislation	
3.3 Salvage pperations		Director of Wildlife	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
ch								
3.4 Resea	rch	Director of Wildlife	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
3.4 Resear	-я	P4 (Sustainable Use)	Ongoing	Articles on <i>Cycas</i> <i>armstrongii</i>	Article on Cycas calcicola	Ongoing	Ongoing	Ongoing

	Program	Action			Үеа	-		
Milestone	Reference	Officer	2009	2010	2011	2012	2013	2014
Objective 5 – To promote public awarene	ess and educatio	и						
Maintain a publicly accessible display of Northern Territory cycads at George Brown Darwin Botanic Gardens with interpretive information	3.5 Public awareness and education	Curator of Botanic Gardens	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Compile and distribute a brochure providing guidelines to cycad harvesting	3.5 Public awareness and education	P4 (Sustainable Use)	Compile and distribute					
Compile and distribute a brochure targeted at landowners on management of cycad populations	3.5 Public awareness and education	P4 (Sustainable Use)		Compile and distribute				
Annually audit the progress of the management program against each of the performance indicators	6 Reports	P4 (Sustainable Use)	Annually	Annually	Annually	Annually	Annually	Annually
Submit an annual progress report to the Australian Government and make this report available to the public	6 Reports	P4 (Sustainable Use)	Annually	Annually	Annually	Annually	Annually	Annually
Review and update the management program by 2014	8 Review of program	P4 (Sustainable Use)					Commence	Complete

## **Appendix 2: Glossary**

The following definitions are taken from the Territory Parks and Wildlife Conservation Act.

"Crown Land" means land -

- (a) held by the Territory for an estate in fee simple; or
- (b) in respect of which neither a lease granted by the Territory is in force nor an estate in fee simple has been granted by the Territory;

"interfere with", in relation to an animal or a plant, means to -

- (a) harm, disturb, alter the behaviour of or otherwise affect the capacity of the animal or plant to perform its natural processes; or
- (b) damage or destroy the habitat of the animal or plant:

"private land" means any land which is not Crown Land;

"**protected wildlife**" means a species of wildlife or an animal or plant of a species of wildlife that is protected under section 43;

"**sustainable use**", in relation to wildlife, means the taking or using of wildlife at a level that is capable of being continued without endangering the capacity of the wildlife to maintain itself and sustain its natural processes;

"**take**" means – (b) in relation to a plant - to sever, remove, damage or destroy, or assist to sever, remove, damage or destroy, the plant;

"**unprotected wildlife**" means a species of wildlife or an animal or plant of a species of wildlife that is not protected wildlife;

"wildlife" means -

- (a) animals and plants that are indigenous to Australia;
- (b) animals and plants that are indigenous to the Australian coastal sea or the sea-bed and subsoil beneath that sea;
- (c) migratory animals that periodically or occasionally visit Australia or the Australian coastal sea;
- (d) animals and plants of a kind introduced into Australia, directly or indirectly, by Aboriginals before the year 1788; and
- (e) such other animals and plants as are prescribed.