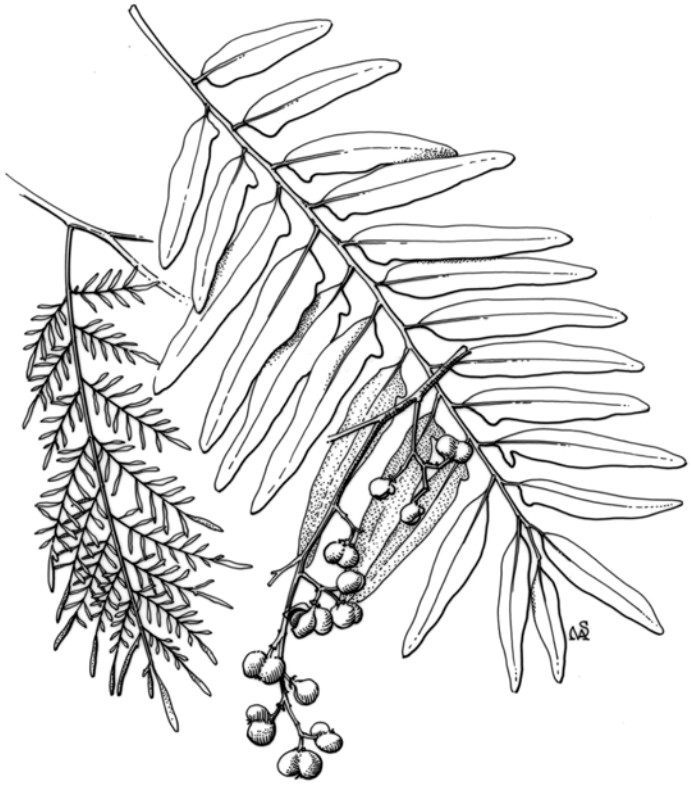
Recovery plan for the Isis tamarind *Alectryon ramiflorus* 2003-2007

Prepared by Mirranie Barker and Stephen Barry for the *Alectryon ramiflorus* Recovery Team



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Prepared by: Mirranie Barker and Stephen Barry for the *Alectryon ramiflorus* Recovery Team

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Cover Illustration
Alectryon ramiflorus, by Ms. Margaret Saul, 1992.

Contents

Summary

This plan is an updated version of the previous recovery plan (Barry 2000) for the endangered plant species the Isis tamarind *Alectryon ramiflorus*. It provides information on the biology and ecology of the species and identifies a range of recovery actions requiring implementation. It also sets out a research and monitoring program on which to base effective management decisions for the future conservation and down listing of the species from endangered to vulnerable status.

A. ramiflorus is listed as endangered under the Queensland *Nature Conservation (Wildlife) Regulation 1994* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and is listed as 2E by Briggs and Leigh (1995). *A. ramiflorus* is known from a main population of at least 37 plants in the Cordalba Forest Reserve and from four smaller populations of one to three plants growing in roadside or riverine remnants near Childers, Queensland.

A. ramiflorus is confined to remnant araucarian microphyll vineforest growing on undulating hillslopes, gullies and alluvial terraces with red krasnozem and poorer sandy clay loam soils. As these communities are fire sensitive, their distribution is affected by fire history patterns and the presence of natural fire barriers.

The habitat of the main population at Cordalba has been protected through the gazettal of the Zillman Scientific Area. Queensland Parks and Wildlife Service (QPWS) will manage the area to limit any threats, principally from fire and introduced species. The species is threatened by a combination of low population size, low rates of natural regeneration, restricted habitat availability and a variety of potential environmental perturbations, e.g. fire, drought stress, grazing and weed invasion. The vulnerability of the other populations to these limiting factors is exacerbated as they occur on tenures not specifically reserved for protection of biodiversity.

Primary objective
The primary objective of the recovery plan is to down list *A. ramiflorus* from endangered to vulnerable within 15 years of the recovery plan's implementation.

Specific recovery objectives
1. To improve the conservation of *in situ* populations.
2. To raise awareness of this species among land managers and the general public, and incorporate into land management decisions the importance of rare and threatened species.
3. To conduct further species-specific surveys to ascertain whether any additional populations can be found.
4. To promote the re-establishment of native vineforest including viable populations of *A. ramiflorus* based on sound knowledge of the species' ecology.
5. To propagate more individuals of this species, ideally from as many parent plants as possible.
6. To preserve the genetic resources of the species *ex situ*.
7. To implement a research and monitoring program, including population monitoring and research into plant propagation and cultivation, comparative morphological and genetic variability, and the ecological requirements of the species.

Performance criteria
1. The conservation of *in situ* populations is improved though habitat protection and site management.
2. Land managers and the public are well informed about *A. ramiflorus* and the Isis Scrub and have access to information that promotes their long-term survival through dissemination of information and organisation of community activities.

3. Further species-specific surveys are conducted. All significant vineforest remnants in the region are surveyed for the presence/absence of *A. ramiflorus* and known populations are protected from identified threats.
4. Re-establishment of at least one patch of native vineforest including a viable population of *A. ramiflorus*.
5. Further individuals of this species are propagated and distributed to re-establishment sites, known sites and to each of the major regional botanic gardens in southeast Queensland.
6. *Ex situ* genetic resources preserved.

Recovery actions

1. Provide secure habitat by negotiating with landholders and managers for the placement of critical habitat under a conservation agreement or protected tenure; and actively managing sites to ameliorate threatening processes (exclusion of grazing stock, implementation of an appropriate fire regime and weed control).
2. Inform and involve the public and other stakeholders in the recovery of *A. ramiflorus* through production of publicity material, liaison with community groups and operation of the recovery team.
3. Undertake further surveys of vineforest remnants in the Childers-Bundaberg-Goodnight Scrub area to locate new populations.
4. Undertake controlled cultivation and propagation ensuring representation from the full genetic range and reintroduce plants into rehabilitated areas typical of the original Isis Scrub.
5. *Ex situ* storage of seeds and genetic material representing the full genetic range.
6. Determine the ecological requirements and the genetic diversity of this species and monitor populations to detect the effects of management practices.

1. Introduction

This document is an update of the recovery plan prepared by Stephen Barry (2000) for the endangered plant the Isis tamarind *Alectryon ramiflorus*. It provides information on the biology and ecology of the species and identifies a range of recovery actions. It also sets out a research and monitoring program on which to base effective management decisions for the future conservation and down listing of the species from endangered to vulnerable.

A. ramiflorus is listed as endangered under the Queensland *Nature Conservation (Wildlife) Regulation 1994* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, and is listed as 2E by Briggs and Leigh (1995). *A. ramiflorus* is known from a main population of at least 37 plants in the Cordalba Forest Reserve and from four smaller populations of one to three plants growing in roadside or riverine remnants near Childers, Queensland.

Taxonomy

A. ramiflorus belongs to the family Sapindaceae. It is locally known as the Isis tamarind.

Description

Individual trees may be single or multi-stemmed, often branching low to the ground, reaching 16m in height. The species readily forms adventitious shoots where aerial stems are damaged or come in contact with the soil surface. The outer bark is soft and flaky and light brown in colour; the older branches have numerous prominent lenticels whilst the young branches and leaf axes have pale brown hairs. Leaves are highly variable or polymorphic, especially in juvenile and adventitious shoot stages, when they are sometimes bipinnate (four to18 leaflets in mature leaves, 24-38 in juvenile leaves). The arrangement of the leaflets is sub-opposite or alternate, with the rachis extending beyond the leaflets; the leaf stalk has a small swelling at the junction with the stem. Individual leaflets are lobed or pinnate, with rounded or notched tips. The inflorescences grow in clusters of two to seven and are borne on older branches or sometimes on the younger shoots; individual flowers are small (3-3.5mm diameter), pale green and without petals; stamens six to eight, ovary one, two to three lobed; borne in spring and summer. The fruits are green, usually two lobed and five to six by nine millimetres; take three months to ripen; seeds are brownish and half-enclosed by a red aril. Distinctive features of the species are the variable and polymorphic leaves and leaflets and the clustering of inflorescences on the older branches of the tree.

Life history and ecology

Reproductive biology

The reproductive biology of *A. ramiflorus* is not well understood. Plants sucker from the base, if damaged, or from prostrate above ground stems, which come in contact with the surface soil, producing a multi-stemmed habit. The somewhat clumped distribution of individuals in the Cordalba population suggests that seed dispersal is poor or plants may reproduce asexually by root suckering.

Observations taken over the last decade suggest that flowering and fruiting behaviour in *A. ramiflorus* is very limited or highly variable from year to year and between adult plants. Where flowering does occur, the flowers typically form in mid-summer and are often aborted before developing to an early fruiting stage. This may be associated with the lack of suitable pollination vectors owing to the fragmentation of the available habitat. The showy red aril of the fruit suggests the seed is dispersed by birds or possibly by ants.

The location of 80+ seedlings under an adult tree at Cordalba indicates that germination and initial growth may not be a limiting factor. This high initial establishment rate occurred even after 8.3kg (wet weight) of seeds had been removed. Seedling mortality was high with only a few seedlings surviving the relatively hot and dry summer conditions. Seedling dispersal was poor with all seedlings recorded within a five-metre radius of the parent trees. Production of

viable fruit appears to be limited to a few individuals in a population, only one adult being responsible for all the *ex situ* propagated seedlings. Preliminary genetic investigations indicate that there is no variation between the sole parent plant and its seedlings (Robinson 2001).

Current population size
In late 1999 there were 69 individuals, 26 of these being considered sexually mature. Trees with a stem diameter at breast height (dbh, measured at 1.3m height) of at least 6cm were considered to be mature, as this was the minimum stem width recorded for flowering individuals. Table 1 shows the number of plants per site.

A survey in 1991 found that many *A. ramiflorus* plants were in poor health due to drought stress, the identification of some individuals being difficult due to lack of leaves. Another survey in July 1994 reassessed tree survival and found that all adult trees of *A. ramiflorus* >10cm dbh had survived with four of the original fifteen younger trees unable to be relocated and presumed dead. The total population of 32 plants was recorded, three more than had previously been recorded in the 1991 census.

The results of further surveys of the Cordalba site undertaken in late 1996 to early 1997 and in late 1999, indicate that the population is increasing. The population contains plants of varying diameter and height with the majority of individuals having a diameter of less than 10cm. The increase in population size is consistent with the observation that the dry rainforest community at this site is expanding.

Natural regeneration at the other sites near Childers is minimal, especially compared to the regeneration occurring at the Cordalba site.

Distribution and habitat

A. ramiflorus is known from a small main population within the Cordalba Forest Reserve – Zillman Scientific Area, 24km northwest of Childers, and from four additional sites closer to Childers, in southeast Queensland (Table 1). The four Childers sites are scattered remnant distributions of a once extensive “Isis Scrub” community. The original scrub has largely been cleared and the land is now grazed by cattle or farmed for sugar cane and small crops. No additional populations of the species have been located to date during botanical surveys in the Childers-Bundaberg-Goodnight Scrub district.

Table 1: *Location of all naturally occurring* A. ramiflorus

Locality	Latitude	Longitude	Tenure	No. plants	No. trees planted
Cordalba Forest Reserve	-25.1250	152.0583	State Forest Reserve, managed by QPWS	17 adult 43 juvenile	12
Francey Road	-25.2033	152.2758	Road Reserve, managed by Isis Shire Council	1 adult 1 juvenile	
The Yards	-25.2375	152.2503	Road Reserve, managed by Isis Shire Council	3 adult	20
Helms Scrub	-25.2494	152.2625	Reserve (Refuse station), managed by Isis Shire Council	2 adult 1 juvenile	8
Smith Creek	-25.2708	152.3117	Freehold	3 adult	6

Habitat critical for survival and important populations

A. ramiflorus is known to occur naturally from only five populations. Four of these populations only contain two to three individuals. Therefore all sites containing this species are considered critical.

Site descriptions

Cordalba Forest Reserve

The Cordalba site has a small patch of araucarian microphyll vineforest, approximately 1.9ha in extent, situated on the western edge of the Cordalba Forest Reserve. The scrub community is bounded by cleared freehold land to the west and by mixed eucalypt open forest to the north, south and east. Relict eucalypt species within the scrub suggest the vineforest is currently expanding its local distribution. Recent fire history and the distribution of natural firebreaks have played a significant role in determining the balance between scrub and eucalypt forest development in this region.

The site extends eastwards from a ridgeline and typically has moderately inclined hill slopes and gullies. The surface soils are poorly drained, acidic (pH 5), pale brown, gravelly and sandy clays. The geology is mapped as phyric to microphyric olivine basalt. However, a surface rock fragment collected at the site was determined to be granitic in origin. The scrub has a low and uneven canopy (6-12m tall) with emergent trees to 25m. Floristic composition is typical of other “dry rainforest” communities in the district. A road and associated drainage works have caused local disturbance to the site and canopy gaps are readily colonized by the shrub *Murraya ovatifoliolata* and by lantana which forms dense thickets.

This site has been declared a scientific area under the *Forestry Act 1959* and stock proof fencing has been erected and firebreaks constructed to protect the community from accidental disturbance, grazing and fire impacts.

The values associated with the Cordalba site have been recognised by its recent gazettal as a State forest scientific area. As part of the Southeast Queensland Regional Forest Agreement, the Cordalba State Forest has been re-gazetted as forest reserve. The designation as a scientific area under the Forestry Act is not a tenure, merely the designation by regulation as a special management area.

Childers sites

Francey Road, Smith Creek, ”The Yards” and Helm’s Scrub

The four Childers sites differ from the Cordalba site in that they all have red krasnozem soils. Three of the sites occur in alluvial areas (Francey Road, Helm’s Scrub and Smith Creek) whereas the fourth is a west-facing moderately inclined hill slope and gully at the margin of the red soil plateau (“The Yards”). All four sites are fairly narrow linear strips (20-50m) of remnant araucarian microphyll vineforest in close association with eucalypt open forest communities (e.g. Queensland blue gum *Eucalyptus tereticornis* and narrow-leaved ironbark *E. crebra*). Varying degrees of disturbance (fire, grazing, thinning, etc.) have allowed a number of pioneer or weed species to establish, particularly at the Francey Rd, Helm’s Scrub and “The Yards” sites (e.g. hickory wattle *Acacia disparrima,* lantana *Lantana camara,* guinea grass *Panicum maximum*, blady grass *Imperata cylindrica* var*. major,* pink periwinkle *Catharanthus roseus* and asparagus fern *Asparagus densiflorus*).

The Childers sites remain unprotected with varying degrees of disturbance and exposure to threatening processes. All four sites contain populations of *A. ramiflorus* of one to three adult plants only. The Francey Road site is situated within a road reserve and is threatened by routine road/bridge maintenance works including periodic burning and slashing. “The Yards” site is also situated on a road reserve. The Smith Creek site occurs on freehold land and has a remnant riparian corridor of microphyll vineforest surrounded by sugar cane crops and grazing land. The riparian corridor extends for a distance of several kilometres and, at the site, averages 30-50m in width. The Helm’s reserve is an Isis Shire Reserve and the site of the refuse station for the Childers Township.

Threatening processes

At all localities, the small remnant vine forest patches and individual *A. ramiflorus* trees are susceptible to a number of potential threatening processes including:

- further loss of habitat and continued fragmentation of existing patches increasing the susceptibility of the habitat and individual *A. ramiflorus* individuals to wind damage, insect predation and drought;
- competition from weeds, primarily lantana, asparagus fern, mother of millions and guinea grass, with minor weeds such as coral berry, wild tobacco and Brazilian nightshade;
- grazing and trampling of seedlings and juveniles by introduced and native animals such as cattle and wallabies;
- inappropriate fire regimes;
- low population size and a small number of reproductively successful individuals producing a restricted gene pool and a potential for inbreeding depression; and
- road maintenance and other local Government activities.

Existing conservation measures

The Cordalba site is being managed by QPWS for the long-term survival of *A. ramiflorus* and its habitat. If required, controlled burning and control of weeds and introduced animals will be undertaken in the surrounding open forest. Twelve *A. ramiflorus* seedlings have been planted and are being monitored to assess survival.

Green Corps undertook a rehabilitation project for Helm's Reserve. They removed introduced weeds; replanted gaps with dry vine scrub species, including eight *A. ramiflorus* seedlings; controlled erosion; and provided visitor facilities. The Childers branch of Greening Australia Bush Care will monitor the site and co-ordinate any future activities.

The owners of the land containing the Smiths Creek population have agreed to participate in a Land for Wildlife scheme. Funding was gained through the WWF Rainforest Recovery Project and realignment of the existing fence, weed control and rainforest plantings were undertaken. Planting included six *A. ramiflorus* seedlings.

Official signage has been erected at the three reserve sites. The signs say "Environmentally Significant Area" and identify a contact number for persons to call before undertaking any work in the area.

A. ramiflorus has been successfully propagated and twenty seedlings have been planted at "The Yards" site and another six plants have been planted on another Childers Land for Wildlife property. It has also been established at a number of regional botanic gardens as well as a few private gardens in the Bundaberg-Childers area. All seedlings have been sourced from one adult tree.

Benefits to other species or communities

- Improved conservation of other threatened and poorly known species in the study area including *Quassia bidwillii*, *Cossinia australiana* and an as yet undescribed *Cupaniopsis* sp. "Biggenden" for which there are currently fewer than 15 plants known (J. Randall pers. comm.).
- Greater protection and re-establishment of lowland "dry rainforest" remnants that have been seriously over-cleared in Queensland and northern New South Wales.

Consultation with indigenous people

Use of *A. ramiflorus* by indigenous people has not been documented, although a related species, *Alectryon tomentosus,* has edible, pleasant-tasting fruit and the bark was used as a fish poison. Members of the Sapindaceae family often have edible or partially edible fruit and

are known collectively as “native tamarinds” due to the flavour resembling that of the pod of the Indian tamarind (*Tamarindus indica* of the Caesalpiniaceae family).

Mirranie Barker gave a talk on the *A. ramiflorus* to the Gurang Land Council at Bundaberg in July 2002 and interest in this species was generated. Investigations are underway to find out if there were any occasions where elders used *A. ramiflorus* during their day-to-day activities. It is hoped that a working relationship will be developed with the Gurang Land Council to promote awareness, and co-operation in the management, of *A. ramiflorus*.

Affected interests

The organisations/people that would be affected by the implementation of recovery actions for *A. ramiflorus* are private landholders, the Isis Shire Council and Queensland Parks and Wildlife Service. Landholders with known populations of *A. ramiflorus* occurring on their property have been actively involved in the conservation of this species, as has the Isis Shire Council. It is expected that their level of dedication to the conservation of this species will continue. QPWS has an ongoing commitment to the conservation of this species in the Cordalba Forest Reserve and oversees the implementation of recovery actions.

Social and economic impact

There are no organisations or individuals going to be disadvantaged by the implementation of this plan.

International obligations

The species is not listed under any international agreements.

2. Recovery objectives and criteria

Primary objective

The primary objective of the Recovery Plan is to downlist *A. ramiflorus* from endangered to vulnerable within 15 years of the plan’s implementation.

Specific recovery objectives

1. To improve the conservation of *in situ* populations.

2. To raise awareness of this species among land managers and the general public, and incorporate into land management decisions the importance of rare and threatened species.

3. To conduct further species-specific surveys to ascertain whether any additional populations can be found.

4. To promote the re-establishment of native vineforest including viable populations of *A. ramiflorus* based on sound knowledge of the species’ ecology.

5. To propagate more individuals of this species, ideally from as many parent plants as possible.

6. To preserve the genetic resources of the species *ex situ*.

7. To implement a research and monitoring program, including population monitoring and research into plant propagation and cultivation, comparative morphological and genetic variability, and the ecological requirements of the species.

Performance criteria

The success of the recovery plan will be judged against the following performance criteria:

1. The conservation of *in situ* populations is improved though habitat protection and site management:
    - Nature refuges and road closure negotiated with the appropriate authority.
    - Management of sites negotiated with landowners or trustees.
    - Relocated part of the cattle proof fence around the Cordalba site.
    - All known sites maintained by controlling weeds and introduced animals, protecting the sites from fire and promoting the expansion of patches.
    - There is no net loss of *A. ramiflorus* populations.
    - *Ex situ* grown plants are planted into known sites.

2. Land managers and the public are well informed about *A. ramiflorus* and the Isis Scrub and have access to information that promotes their long-term survival through dissemination of information and organisation of community activities.

3. Further species-specific surveys are conducted. All significant vineforest remnants in the region are surveyed for the presence/absence of *A. ramiflorus* and known populations are protected from identified threats.

4. Re-establishment of at least one patch of native vineforest including a viable population of *A. ramiflorus*.

5. Further individuals of this species are propagated and distributed to re-establishment sites, known sites and to each of the major regional botanic gardens in south-east Queensland with plantings sufficient to preserve the genetic variability of the species. The location and management of plants are documented and readily available to interested parties.

6. *Ex situ* genetic resources preserved through:
    - The lodgement of plant material from the 17 adult plants into the Australian Plant DNA Bank.
    - The lodgement of seeds into the Australian Tree Seed Centre or a local seed bank, to ensure maximum longevity of the viability of seeds.
    - The planting of plants representing the genetic range into at least two botanical gardens.
    - Research into viability and storage of seed undertaken through the Australian Tree Seed Centre.

7. A research program implemented and preliminary research findings obtained, including:
    - Successful techniques in plant propagation and cultivation.
    - Analysis of the comparative morphological and genetic variability of *A. ramiflorus*.
    - Ecological requirements of the species.
    - Determination of the health, and the factors affecting the health, of existing populations, individuals and plantings through monitoring.

Evaluation of the recovery plan

The *Alectryon ramiflorus* recovery team will monitor the progress of the recovery plan and regularly assess the implementation of recovery actions.

The recovery plan will be independently reviewed in 2007. A revision of the plan will be written at the end of the five-year period, or earlier, if new information warrants major changes.

Table 2. *Summary of relationship between specific objectives, performance criteria and actions.*

Specific objective	Performance criteria	Action
Objective 1 Improve the conservation of *in situ* populations	Criterion 1 Conservation of *in situ* populations is improved	Action 1. Negotiations with Council and DNRM, Encourage landowners to conserve species, Undertake management at sites
Objective 2 Raise awareness of *A. ramiflorus*	Criterion 2 Land managers and the public are well informed about *A. ramiflorus*	Action 2.1 Disseminate information about species
		Action 2.2 Organise community participation in seed collection, collecting propagative material and planting
		Action 2.3 Arrange regular recovery team meetings
Objective 3 Conduct further species-specific surveys	Criterion 3 Further species-specific surveys are conducted	Action 3 Carry out surveys in potential habitat
Objective 4 Promote the re-establishment of native vineforest	Criterion 4 At least one patch of native vineforest is re-established	Action 1.3 Promote the regeneration of this species within its known habitat
		Action 2.2 Organise community participation in seed collection, collecting propagative material and planting
Objective 5 Propagate more individuals of *A. ramiflorus*	Criterion 5 Further individuals of *A. ramiflorus* are propagated and distributed to a range of sites	Action 4 Undertake propagation from a range of parent trees into re-establishment sites, known sites, botanic gardens.
Objective 6 Preserve the genetic resources of the species ex situ	Criterion 6 *Ex situ* genetic resources are preserved	Action 5 DNA and seed storage carried out, Plants established in botanic gardens.
Objective 7 Implement a research program	Criterion 7 Research program is implemented	Action 6 Ecological research, genetic research, research into propagation methods, and population monitoring are carried out

3. Recovery actions

Summary of actions

1. Provide secure habitat by negotiating with landholders and managers for the placement of critical habitat under a conservation agreement or protected tenure; and actively managing sites to ameliorate threatening processes (exclusion of grazing stock, implementation of an appropriate fire regime and weed control).
2. Inform and involve the public and other stakeholders in the recovery of *A. ramiflorus* through production of publicity material, liaison with community groups and operation of the recovery team.
3. Undertake further surveys of vineforest remnants in the Childers-Bundaberg-Goodnight Scrub area to locate new populations.

4. Undertake controlled cultivation and propagation ensuring representation from the full genetic range and reintroduce plants into rehabilitated areas typical of the original Isis Scrub.
5. *Ex situ* storage of seeds and genetic material representing the full genetic range.
6. Determine the ecological requirements and the genetic diversity of this species and monitor populations to detect the effects of management practices.

Action 1
Provide secure habitat

1.1 Secure known habitat through a combination of tenure measures and negotiated conservation agreements. Negotiate with the Isis Shire Council and the Department of Natural Resources and Mines to declare nature refuges over the three Childers reserve sites and where possible undertake road closures.

1.2 Manage known habitats to reduce the impacts of threatening processes For existing and new populations of *A. ramiflorus*, encourage landowners to actively conserve this species through a variety of methods, including a conservation agreement under the *Nature Conservation Act 1992.* Negotiate suitable management of the Francey Road site with the trustee, Isis Shire Council. Negotiate an agreement under the Nature Conservation Act with the landholder adjacent to the Smith Creek site to actively manage the part of the araucarian scrub occurring on their property as part of the habitat required by *A. ramiflorus*. Relocate part of the cattle proof-fence around the Cordalba site to promote the secure advancement of the existing dry rainforest patch, and maintain existing fence.

1.3 Promote the regeneration of this species within its known habitat. Undertake routine management, involving community groups and QPWS staff, on all known sites to minimise the impacts of weeds, introduced animals, fire and any other threatening process. Plant *ex situ* grown plants into the five known sites and monitor their success. Tag, identify and document all plants for future monitoring work.

Potential contributors: Isis Shire Council, Department of Natural Resources and Mines, QPWS, Greening Australia, community groups.

Action 2
Inform and involve the public and other stakeholders in the recovery of *A. ramiflorus*

2.1 Disseminate information

A brochure containing information on *A. ramiflorus* and the threats to its survival will be produced. A poster will be developed highlighting the Isis Scrub and *A. ramiflorus* in particular. This poster will be made available to schools, local government offices, government departments and community groups. Opportunities to publicise the need for protection of dry rainforest and *A. ramiflorus* in the local and state media will be examined and promoted.

2.2 Community participation

The recovery team and Greening Australia is actively involved in organising community groups and Green Corp in the rehabilitation of *A. ramiflorus* habitat on freehold and reserve land. A variety of groups including Greening Australia, Bundaberg and District Urban Landcare Association and Tondoon Botanic Gardens have been involved in producing seedlings. Propagative material will be collected under appropriate permits from the Queensland Parks and Wildlife Service. Seed collection will be supervised by Greening Australia and will not exceed 10 per cent of total estimated seed production. Future community participation will be actively encouraged to continue the momentum already developed.

2.3 Effective functioning of the recovery team.

Representatives of stakeholders will attend meetings to discuss relevant issues. The plan will be re-written at the end of the five-year period.

Potential contributors: Recovery team, QPWS, Greening Australia, Bundaberg and District Urban Landcare Association, members of the community.

Action 3
Undertake further surveys

Undertake further surveys of all major vineforest remnants in Childers-Bundaberg-Goodnight Scrub district. Although the Cordalba-Childers-Goodnight Scrub district has received a considerable amount of botanical survey in the past there is a reasonable likelihood that additional populations of this species can be found. Given the extremely low total known population of this species, further targeted surveys are required. Any new populations will be provided with appropriate protective measures.

Potential contributors: Community groups, QPWS, University study.

Action 4
Undertake controlled cultivation and propagation

Carry out controlled cultivation and propagation of *A. ramiflorus* at re-establishment sites, known sites and major regional botanic gardens. Preliminary research on asexual reproduction using tissue culture and cuttings indicates that stem cuttings taken from juveniles and softwood are the most successful method of asexual reproduction (van Kampen 2001). At present, seedlings that have been propagated have come from only one parent plant. Records on the location and survival of each propagule will be maintained. The location and management of plants will be documented.

Potential contributors: University study.

Action 5
Ex situ storage of seeds and genetic material

5.1 Extracts of DNA from all known mature individuals will be preserved in the Australian Plant DNA Bank and seeds will be stored in the Australian Tree Seed Centre. Genetic material will be resubmitted after five years to minimise any detrimental effects of the storage on the DNA. Extracts of material are available for conservation biology research. Both agencies will use some of this material to undertake additional research or make it available for other interested parties to undertake research. Seeds will be resubmitted approximately every five years to minimise any detrimental effects on seed viability. Seed collection will not exceed 10 per cent of total estimated seed production.

5.2 *A. ramiflorus* has been successfully propagated and established at Mt. Coot-tha Botanic Gardens, Brisbane, the Bundaberg Botanic Gardens and a few private gardens in the Bundaberg-Childers district. The source of these individuals is from a single mature tree. Propagated seedlings (refer to Action 5) from other adult plants will be made available to these Gardens. Managers of the Tondoon Botanic Gardens, Gladstone, Kershaw Botanic Gardens, Rockhampton, and various smaller parks and gardens in the Childers area will be approached to promote the establishment of other *ex situ* collections.

Potential contributors: Australian Plant DNA Bank, Australian Tree Seed Centre, Botanic Gardens.

Action 6
Determine the ecological requirements and the genetic diversity of this species

Since there are very few populations and individuals of *A. ramiflorus*, any decline in numbers or genetic diversity should be minimised. To achieve this, future management should be based on sound knowledge of the species' response to its environment and perturbations occurring in that environment. The following research into the biology, ecology and genetics of the species needs to be undertaken to provide this knowledge:

6.1 Investigate the population dynamics and reproductive biology of the species, including limits to seed production, germination and establishment, and response to fire, soil nutrients and variable moisture regimes. Measure the rates of growth, flower and fruit production, mortality and recruitment as well as the health of a significant sample of the populations and determine if there are any correlations with environmental variables. Identify pollinators and predators and their effects on the long-term viability of populations.

6.2 Preliminary genetic research was limited to samples containing juvenile foliage, as extracting material from adult plants was problematic. Further research is required to determine a method to extract viable genetic material from adult plants and to undertake genetic and morphological analysis from a significant sample of both adults and seedlings.

6.3 Additional research is required to increase the low success rates for cuttings taken from mature plants. Propagation using cuttings could then be broadly applied assuring the genetic diversity of this species is represented.

6.4 Monitor populations to determine the effects of management activities and other factors affecting the habitat. All plants in the population will be permanently marked to facilitate a periodic census of each population. Ecological monitoring will be undertaken to determine if management practices identified in Action 2 are having a positive influence on the species' recovery.

Potential contributors: *Potential contributors*: Sunshine Coast University, Griffith University, Australian Plant DNA Bank, Greening Australia, and the Isis Land Care Council, QPWS.

4. Cost of recovery

Table 3. *Estimated cost of recovery per annum (including in-kind costs)*

Action No.	**Action description**	**Cost estimates years 1 to 5**					**Totals**
		1	**2**	**3**	**4**	**5**	
1	Provide secure habitat	$6000	$6000	$6000	$6000	$6000	$30,000
2	Inform and involve the public and other stakeholders	$ 5000	$2000	$2000	$5000	$2000	$16,000
3	Undertake further surveys	$10,000	$10,000	$5000	0	0	$25,000
4	Undertake controlled cultivation and propagation	$6000	$6000	$3000	$3000	$3000	$21,000
5	Ex-situ storage of seeds and genetic material	$4000	0	0	0	$4000	$8000
6	Determine the ecological requirements and the genetic diversity, monitoring	$21,000	$21,000	$21,000	$16,000	$16,000	$95,000
Totals		$52,000	$45,000	$37,000	$30,000	$31,000	$195,000

5. Acknowledgments

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7. Appendix 1. Recovery team

Alectryon ramiflorus Recovery Team members, as of July 2002.

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Trevor Ritchie	Queensland Parks and Wildlife Service
Kym Sparshot	Queensland Parks and Wildlife Service
Ernie Rider	Queensland Parks and Wildlife Service
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