Approved NSW Recovery Plan

Zieria ingramii
Recovery Plan

February 2007

Australian Government

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Environment and
Conservation (NSW)

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Zieria ingramii
Recovery Plan

Prepared in accordance with the New South Wales
Threatened Species Conservation Act 1995

February 2007

Acknowledgments

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Foreword

The conservation of threatened species, populations and ecological communities is crucial for the maintenance of this State's unique biodiversity. In NSW, the *Threatened Species Conservation Act* 1995 (TSC Act) provides the framework to conserve and recover threatened species, populations and ecological communities through the preparation and implementation of Recovery Plans.

The preparation and implementation of Recovery Plans are identified by both the National Strategy for the Conservation of Australia's Biological Diversity and the approved NSW Biodiversity Strategy as a key strategy for the conservation of threatened flora, fauna and invertebrates. The object of a Recovery Plan is to document the research and management actions required to promote the recovery of a threatened species, population or ecological community and to ensure its ongoing viability in nature.

This Recovery Plan describes our current understanding of *Zieria ingramii*, documents research and management actions undertaken to date and identifies actions required and parties responsible to ensure ongoing viability of the species in the wild.

The Department of Environment and Conservation (NSW) has prepared the *Zieria ingramii* Recovery Plan with the assistance of a number of people. I thank these people for their efforts to date and look forward to their continued contribution to the recovery of the species.

BOB DEBUS MP
Minister for the Environment

Executive Summary

Introduction

Zieria ingramii is a slender, spindly shrub that generally grows up to 60cm in height with distinctively aromatic, trifoliolate leaves and small pinkish-white flowers. It is currently only known to occur in Goonoo and Cobbora Forests in the Brigalow and Nandewar Community Conservation Area approximately 50km north east of Dubbo in Central West New South Wales. At least 70 individual plants are currently known to occur in Cobbora Forest and approximately 2100 individual plants are currently known from Goonoo Forest. The species has also been recorded in Goobang National Park near Parkes in Central West NSW in 1997, however this record is questionable and requires further investigation. There are no known immediate threats to the species at present. However, with such a highly restricted distribution, the species is at greater risk of extinction than if it was more widely distributed. Inappropriate management or changes in habitat and unforeseen events such as disease, severe drought or wildfire may result in a significant loss of individuals and potentially lead to the extinction of the species in the wild.

Legislative Context

The *Threatened Species Conservation Act 1995* (TSC Act) provides a legislative framework to protect and encourage the recovery of threatened species, populations and ecological communities in NSW. Under this legislation the Director-General of the Department of Environment and Conservation (DEC) has a responsibility to prepare Priority Action Statements or Recovery Plans for all species, populations and ecological communities listed as critically endangered, endangered or vulnerable on the TSC Act schedules. Similarly, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) enables the Commonwealth Minister for the Environment to require the preparation of a Recovery Plan for nationally listed species and communities or adopt plans prepared by others including those developed by State agencies. Both Acts include specific requirements for the matters to be addressed by Recovery Plans and the administrative process for preparing Recovery Plans.

Legal Status

Zieria ingramii is listed as 'endangered' under both the New South Wales TSC Act and the Commonwealth EPBC Act.

Preparation of Plan

This Recovery Plan has been prepared to satisfy both the requirements of the TSC Act and the EPBC Act and therefore will be the only Recovery Plan for the species. It is the intention of the Director-General of the DEC to forward the final version of this Recovery Plan to the Commonwealth Minister for the Environment for adoption, once it has been approved by the NSW Minister for the Environment.

This draft plan has been prepared with the assistance of interested parties with relevant expertise. Components within the plan do not necessarily represent the views nor the official positions of all the individuals or agencies consulted. The information in this Recovery Plan was accurate to the best of the knowledge of the DEC on the date it was approved.

Recovery Objectives

The overall aims of this Recovery Plan are to prevent the decline of *Zieria ingramii*, to protect populations from threats and to ensure the long term viability of the species in the wild.

The specific objectives are to:

1. determine the species' full range, distribution and abundance and determine whether the species is currently in decline;

2. understand aspects of the species' biology and ecology that are crucial to the recovery effort, including its habitat and resource requirements and the reproductive viability of the wild populations;

3. determine the species response to fire and physical disturbances such as grazing, slashing and road grading;

4. establish an ex-situ conservation plan as insurance against extinction in the wild;

5. identify and mitigate, if possible, any threats to the species;

6. ensure that management of the reserves in which the species currently occurs is appropriate and does not threaten its existence;

7. promote community awareness and support for the conservation of the species.

Recovery Criteria

The achievement of the Recovery Objectives will be assessed based on the following performance criteria:

1. all areas of potential habitat have been surveyed and all populations are mapped, benchmarked and regularly monitored;

2. no *Zieria ingramii* populations experience a significant and permanent decline in numbers and there is no loss of any known populations;

3. knowledge of the biology, ecology, habitat and resource requirements, reproductive viability and recruitment rates for the species exists and is used to guide management decisions;

4. the species response to various fire and physical disturbance regimes is known and the species is managed accordingly in response to these regimes;

5. an ex-situ seed bank exists that is representative of the full geographic range and diversity of the species and that can be used for future propagation if required;

6. the impact of stock grazing on *Z. ingramii* is known and, if required, all known sites in Cobbora Forest are protected from stock;

7. Reserve, Pest and Fire Management Plans for Goonoo and Cobbora Forests acknowledge the existence of the species in these reserves and provide for its protection;

8. no areas of known habitat within Goonoo and Cobbora Forests and Goobang National Park are burnt within a 10 year time frame or slashed for hazard reduction purposes;

9. signs indicating the significance of the roadside environment are erected along the main roads through Goonoo Forest and Goobang National Park where *Z. ingramii* occurs;

10. no roadside sites are damaged from roadside maintenance or weed spraying;

11. Council and Parks and Wildlife staff can adequately identify the species in the field and determine its locations using appropriate maps;

12. the community and all stakeholders are aware of the species and are contributing to conservation actions where appropriate.

Recovery Actions

Recovery actions will involve:

1. identifying, mapping and surveying all areas of potential habitat including those in Goonoo and Cobbora Forests and Goobang National Park, as well as mapping all known populations;

2. undertaking observational studies into reproduction, survivorship, longevity, recruitment and any possible threats or causes of mortality within the wild populations;

3. establishing and monitoring experimental plots to determine the species response to various fire and physical disturbance regimes;

4. monitoring the impact of stock grazing on the population in Cobbora Forest and protecting the population from stock grazing should an adverse affect be determined;

5. studying various aspects of the species' reproductive biology, life history and ecology;

6. recording and determining the species habitat and resource requirements;

7. collecting seed and establishing an ex-situ seedbank;

8. managing fire in accordance with the *Bushfire Environmental Assessment Code for NSW 2006* hazard reduction guidelines for *Z. ingramii;*

9. erecting signage along main roads and providing maps to Councils and the DEC Parks and Wildlife (PWD) staff, showing the location and extent of *Z. ingramii* roadside sites to assist in planning road and track maintenance;

10. training Council and PWD staff in the identification of *Z. ingramii* so that they are able to recognise the species when conducting roadside maintenance and weed spraying;

11. avoiding ecological restoration in areas of known habitat until such time as the species' ecological requirements are better understood and;

12. educating and involving the community and stakeholders in the conservation of the species.

Biodiversity Benefits

The preparation and long term implementation of Recovery Plans for threatened species, populations and ecological communities contributes to, and highlights the importance of conserving all biodiversity. The conservation of biodiversity has a number of wider community benefits. These include:

- provision and maintenance of a range of ecosystem functions on which we and all other species depend;

- contributing to increased biological and ecological knowledge of species, communities, habitats and ecosystems;

- potential medical, economic, agricultural and industrial products; and

- cultural, aesthetic and spiritual values.

The conservation of *Z. ingramii* populations and the habitat in which it occurs will also benefit other species that share the same habitat and have similar biology. This Recovery Plan will increase public awareness of *Z. ingramii* and hence raise the profile of all threatened species. This, in turn, will lead to greater opportunities for the conservation of threatened species and increased protection of biodiversity.

LISA CORBYN
Director General

Table of Contents

1 Introduction

Zieria ingramii is endemic to New South Wales with the only currently known populations located in Goonoo and Cobbora Forests in the Brigalow and Nandewar Community Conservation Area, approximately 50km north east of Dubbo in Central West New South Wales. The species has also been recorded in Goobang National Park near Parkes but this record is currently unconfirmed and requires further investigation. A total of approximately 2170 plants are currently known from Goonoo and Cobbora Forests, which are approximately 20km apart. Both forests occur on Crown land vested with the Minister for the Environment. Goonoo Forest is a dedicated conservation reserve and Cobbora Forest is currently under perpetual lease to private individuals who have used the land for grazing and cropping purposes for a number of years and continue to do so. There are no known immediate threats to the species at present. However, with such a highly restricted distribution, the species is at greater risk of extinction than if it was more widely distributed. Inappropriate management or changes in habitat and unforeseen events such as disease, severe drought or wildfire may result in a significant loss of individuals and potentially lead to the extinction of the species in the wild.

2 Legislative Context

2.1 State and Commonwealth Acts

2.1.1 *Threatened Species Conservation Act 1995*

Z. ingramii is listed as 'Endangered' on Schedule 1 Part 1 of the *Threatened Species Conservation Act 1995* (TSC Act). It is an offence to harm, pick or damage the habitat of a threatened species unless the damage is the result of activities which have been licensed under section 91 of the TSC Act or have otherwise gained approval under the *Environmental Planning and Assessment Act 1979*.

2.1.2 *Environment Protection and Biodiversity Conservation Act 1999*

Z. ingramii is also listed as 'Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This act protects nationally listed threatened species and ecological communities as well as threatened species that occur on Commonwealth land. It is an offence to undertake any actions that may harm, damage or pick a nationally listed threatened species without obtaining prior approval from the Commonwealth Environment Minister. As *Z. ingramii* is listed nationally under the EPBC Act, any person proposing to undertake actions that are likely to have a significant impact on the species must refer the action to the Commonwealth Minister for the Environment, who will then decide whether the action requires EPBC Act approval.

2.1.3 *National Parks and Wildlife Act 1974*

The *National Parks and Wildlife Act 1974* (NPW Act) provides for the reservation, protection and management of natural areas and the protection of native fauna and flora and has been amended with regard to threatened species by the TSC Act 1995. The management of Goonoo and Cobbora Forests and Goobang National Park, where *Z. ingramii* has been recorded, is conducted in accordance with the provisions of the NPW Act. The Act also contains provisions for the licensing of scientific investigations of threatened species.

Therefore, any scientific investigation regarding the species, whether it occurs in or outside a National Park or other conservation reserve, must be licensed under the NPW Act.

2.1.4 *Environmental Planning and Assessment Act 1979*

Land use and development in NSW is subject to evaluation in accordance with the *Environmental Planning and Assessment Act 1979* (EP&A Act). Threatened species are to be taken into account by consent authorities when they are considering development applications under Part 4, and by determining authorities undertaking or approving activities under Part 5 of the Act. The TSC Act amendments to the environmental assessment provisions of the EP&A Act require that consent and determining authorities consider relevant Recovery Plans when exercising a decision making function under Parts 4 and 5 of the EP&A Act. When considering any activity that may affect *Zieria ingramii*, these authorities must consider the conservation strategy outlined in this plan.

2.1.5 *Brigalow and Nandewar Community Conservation Area Act 2005*

The Brigalow and Nandewar Community Conservation Area Act 2005 (CCA Act) establishes a new tenure of public land known as a Community Conservation Area. The Community Conservation Area (CCA) is an internationally recognised reserve concept based on recognised International Union for the Conservation of Nature and Natural Resources (IUCN) reserve categories. The CCA has three statutorily defined conservation zones, gazetted under the NPW Act. The responsibility for these three zones resides with the Minister for the Environment. The first is a conservation and recreation zone, the second is a conservation and Aboriginal culture zone and the third is a conservation, recreation and mineral extraction zone. No commercial extraction of timber can occur in any of these three zones. Goonoo forest is designated predominantly as zone 3 but with some areas to the west as zone 1. Cobbora however, is designated as a Part 11 Lease, separate to the conservation zones but with responsibility for this land also vested with the Minister for the Environment. Management of the CCA conservation zones links directly to management of the existing reserve system, as set out under the NPW Act. The CCA also contains a fourth statutorily defined zone, which provides for commercial timber extraction and mining. Responsibility for this zone resides with the Minister for Primary Industries. No parts of Goonoo or Cobbora Forests are designated as zone 4.

2.2 Recovery Plan Preparation

The TSC Act provides a legislative framework to protect and encourage the recovery of threatened species, populations and ecological communities in NSW. Under this legislation the Director-General of the Department of Environment and Conservation (DEC) has a responsibility to prepare Priority Action Statements or Recovery Plans for all species, populations and ecological communities listed as critically endangered, endangered or vulnerable on the TSC Act schedules. Similarly, the EPBC Act enables the Commonwealth Minister for the Environment to require the preparation of Recovery Plans for nationally listed species and communities or adopt plans prepared by others including those developed by State agencies. Both Acts include specific requirements for the matters to be addressed by Recovery Plans and the administrative process for preparing Recovery Plans.

This Recovery Plan has been prepared to satisfy both the requirements of the TSC Act and the EPBC Act and therefore will be the only Recovery Plan for the species. It is the intention

of the Director-General of the DEC to forward the final version of this Recovery Plan to the Commonwealth Minister of the Environment for adoption, once it has been approved by the NSW Minister for the Environment.

2.3 Recovery Plan Implementation

The TSC Act requires that a public authority must take any appropriate measures available to implement actions included in a Recovery Plan for which they have agreed to be responsible. Public authorities identified as responsible for the implementation of Recovery Plan actions are required by the TSC Act to report on measures taken to implement those actions. In addition, the Act specifies that public authorities must not make decisions that are inconsistent with the provisions of the Plan. Similarly, the EPBC Act specifies that a Commonwealth agency must not take any action that contravenes a Recovery Plan. The DEC, including the Parks and Wildlife Division and the Botanic Gardens Trust, is the only public authority responsible for the implementation of actions contained in this Recovery Plan.

2.4 Critical Habitat

The TSC Act makes provision for the identification and declaration of Critical Habitat. Under this Act, Critical Habitat may be identified for any threatened species, population or ecological community occurring on NSW lands. Once declared, it becomes an offence to damage Critical Habitat (unless the action is exempted under the provisions of the TSC Act) and a Species Impact Statement is mandatory for all developments and activities proposed within declared Critical Habitat.

To date, Critical Habitat, as defined by the TSC Act, has not been declared for *Z. ingramii*. This Recovery Plan identifies habitat features of the locations where *Z. ingramii* currently occurs. However, it's unclear whether any of these features are decisive in allowing or constraining the long term dispersal, distribution, establishment and persistence of *Z. ingramii*. Accordingly, identification and nomination of Critical Habitat for *Z. ingramii* is not proposed as a recovery action in this Recovery Plan.

2.5 Environmental Assessment

The NSW EP&A Act requires that consent and determining authorities, and the Director-General of the DEC as a concurrence authority, consider relevant Recovery Plans when exercising a decision-making function under Parts 4 and 5 of the EP&A Act. Decision-makers must consider known and potential habitat, biological and ecological factors and the regional significance of individual populations.

Any other action not requiring approval under the EP&A Act, and which is likely to have a significant impact on *Z. ingramii*, will require a Section 91 Licence from the Director-General of the DEC under the provisions of the TSC Act (except where there is provision in the TSC Act for such an action). A Section 91 Licence may be issued with or without conditions, or refused.

The EPBC Act regulates actions that may result in a significant impact on nationally listed threatened species and ecological communities. It is an offence to undertake any such actions in areas under State or Territory jurisdiction, as well as on Commonwealth-owned

areas, without obtaining prior approval from the Commonwealth Environment Minister. As *Z. ingramii* is listed nationally under the EPBC Act, any person proposing to undertake actions likely to have a significant impact on this species should refer the action to the Commonwealth Minister for the Environment for consideration. The Minister will then decide whether the action requires EPBC Act approval.

Administrative guidelines are available from the Department of the Environment, Water, Heritage and the Arts to assist proponents in determining whether their action is likely to have a significant impact. In cases where the action does not require EPBC Act approval, but will result in the death or injury of any *Z. ingramii* and the species is in or on a Commonwealth area, a permit issued by the Commonwealth Minister under the EPBC Act will be required.

The Commonwealth Environment Minister can also delegate the role of assessment and approval to other Commonwealth Ministers under a Ministerial Declaration and to the States and Territories under bilateral agreements. The development of a bilateral agreement between NSW and the Commonwealth is not yet complete, but when in place will avoid the need for duplication of environmental assessment.

3 Current Conservation Status

Zieria ingramii is listed as 'Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the NSW *Threatened Species Conservation Act 1995* (TSC Act). The species is also listed as 'Vulnerable' under the International Union for the Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Plants. This status is based upon the ROTAP (Rare or Threatened Australian Plants) codes, which assess the conservation status of Australia's flora from a national perspective. *Zieria ingramii* was assigned the code '2V', where the '2' indicates that the geographic range in Australia is less than 100km and the 'V' indicates that the species is considered vulnerable and at serious risk of extinction in the wild within 20-50 years (Briggs and Leigh 1996). The EPBC Act list of threatened plants has now superseded the use of ROTAP codes as an indication of the national threat status.

4 Description and Taxonomy

4.1 Description

Zieria ingramii J.A. Armstrong (Rutaceae) was described by Armstrong (2002), formalising the following informal taxa: Z. sp. Nov. 'D' in Powell and Armstrong (1980), Z. species 'E' in Armstrong (1991b), Z. sp. 3 (sp. 'D': Goonoo Goonoo SF) in Briggs and Leigh 1996, *Z. ingramii* J.A.Armstr. ms. (Briggs 2388) in Armstrong and Harden (2002). The species was named in honour of Keith Ingram, a scholar and lover of the Australian flora (Armstrong 1991a, 2002).

Zieria ingramii is a small, distinctively aromatic shrub that grows between 40cm and 60cm but may reach up to 1 metre in height. Plants are usually slender and spindly but occasionally

may be bushy and can develop into a medium-sized shrub (Figure 1). Branches are ridged and slightly hairy with opposite and trifoliolate leaves that appear whorled along the branches (Figure 2). The trifoliolate leaves contain three linear leaflets approximately 9-19 mm long and 1-3 mm wide with the central leaflet longer than the two lateral leaflets. Leaflets have acute apices and revolute margins, which are strongly rolled under to conceal all but the midrib of the undersurface. The upper surfaces of the leaves are dotted with oil glands, with simple hairs along the mid-vein furrow. The lower surfaces are not warted but are pubescent with long, simple hairs. Petioles (leaf stalks) are between 1.4 and 2 mm long. The inflorescences contain 3 to 13, but generally 7, small, pale pink or white flowers. Each flower consists of 4 petals approximately 3 mm long with pubescent (hairy) outer surfaces (Figure 3). The fruit is a glabrous, slightly warted, four-chambered capsule that contains dull, black seeds (Armstrong 1991a, 1991b, 2002, Armstrong and Harden 2002, Briggs and Leigh 1990). A more detailed taxonomic description and key for the species can be found in Armstrong and Harden (2002).

4.2 Similar Species

Zieria ingramii is very similar to and may be easily confused with *Zieria aspalathoides* A. Cunn. ex Benth. in Armstrong and Harden (2002), especially in Goonoo Forest where both species occur. Armstrong and Harden (2002) designate the two species into separate groups based on 'plants with branchlets prominently ridged due to the presence of more or less glabrous leaf decurrencies' (Group 2, containing *Z. ingramii*) and those 'not prominently ridged' (Group 3, containing *Z. aspalathoides*). Leaflet length, however, is probably the most easily observed diagnostic feature between the two species although other physical features, as described in Table 1 below, may also assist in differentiating the two (based on Armstrong and Harden 2002).

Table 1: Differentiating features of *Zieria ingramii* and *Zieria aspalathoides*.

Feature	***Z. ingramii***	***Z. aspalathoides***
Leaves	Not warted but dotted with oil glands Hairy Leaf stalks (petioles) 1.4 – 2 mm long	Warted Hairless Leaf stalks (petioles) 1 mm long
Central leaflet	9 – 19 mm long, 1 – 3 mm wide	5 – 8 mm long, 1.3 – 3 mm wide
Inflorescences	Mostly 7 flowers (range 3 –13)	Mostly 3 flowers
Petals	3 mm long	4.5 – 5.5 mm long

Figure 1. *Zieria ingramii* shrub in flower (Photo: M.Bannerman).

Figure 2. *Zieria ingramii* distinctive trifoliolate leaves (Photo: M. Bannerman). Note the whorled appearance of the two opposite trifoliolate leaves along the branch.

Figure 3. *Zieria ingramii* flowers (Photo: M.Bannerman).

4.3 Scientific and Taxonomic Significance

There are 44 species of *Zieria* world wide, with 43 of these species being endemic to Australia and 35 of them occurring in New South Wales. Of these 35 species, 15 are currently listed as 'Endangered', 2 as 'Vulnerable' and 1 as an 'Endangered Population' in NSW alone under the TSC Act, which represents a very high proportion of the genus. In addition, 17 of these 18 species listed in NSW are also listed as nationally threatened under the EPBC Act. This high proportion of threatened species in the genus is reflected in the fact that there is a high proportion of *Zieria* species with very restricted distributions and therefore potentially a high susceptibility to threatening processes. The conservation, management and improved understanding of *Z. ingramii* may assist in guiding recovery efforts for other threatened *Zieria* species in NSW and Australia.

5 Distribution

5.1 Current and Historic Distribution

Zieria ingramii is endemic to NSW and has a very restricted distribution. There is no evidence to suggest that the species was ever 'common' in the Dubbo area or anywhere else and it appears that it is a species of natural rarity (Mackay and Gross 1998). Historically, the species has been recorded in three separate localities within Central West NSW (Figure 4). These include Goonoo Forest and Cobbora Forest north east of Dubbo and Goobang National Park north east of Parkes (Figures 5 and 6). Recent records however, are only in Goonoo and Cobbora Forests, which cover a linear distance of approximately 20km and which both occur in the Central West Slopes Botanical Division of NSW. The records from Goobang National Park are questionable and currently unconfirmed, however, should the species be confirmed at this location, this would extend the known range of the species by another 125km south.

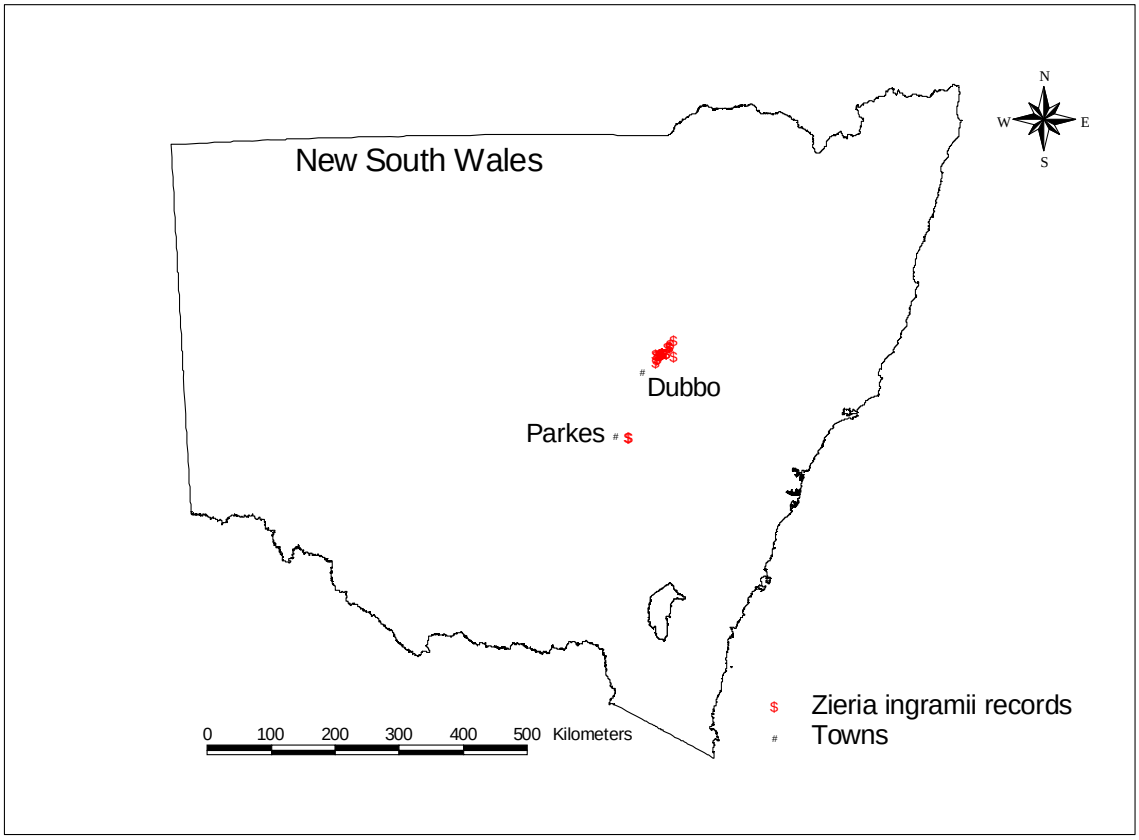

Figure 4: Location of *Zieria ingramii* records in central west New South Wales 1946 - 2006.

Goonoo Forest

The earliest record of *Z. ingramii* was made in 1946 between Dubbo and Mendooran by George Althofer. Since then, a number of records have been made by various individuals within the same area known as Goonoo Forest. These records include the 240 plants found at 6 separate sites by Briggs and Leigh in 1988 and the 150 plants found at 2 additional sites by Lewer and Shelly in 1999. All known sites were re-visited by the DEC in 2004 and again in 2006. A total of 394 plants were found in June 2006 at seven of the twelve known sites in Goonoo. Soon after, another 83 sites were recorded with a total of 1713 plants. Therefore the total number of plants known from Goonoo Forest is 2107 as at October 2006.

Cobbora Forest

In 1998 and 1999, pre-harvest surveys conducted by Forests NSW located a total of approximately 110 plants at four different sites in Cobbora Forest. Two of these sites were re-visited in November 2003 but only one of the sites was located with 7 plants. Two of the sites were re-visited in September 2006, with a total of 70 individual *Z. ingramii* plants being found. The other 2 sites have not been searched at this stage.

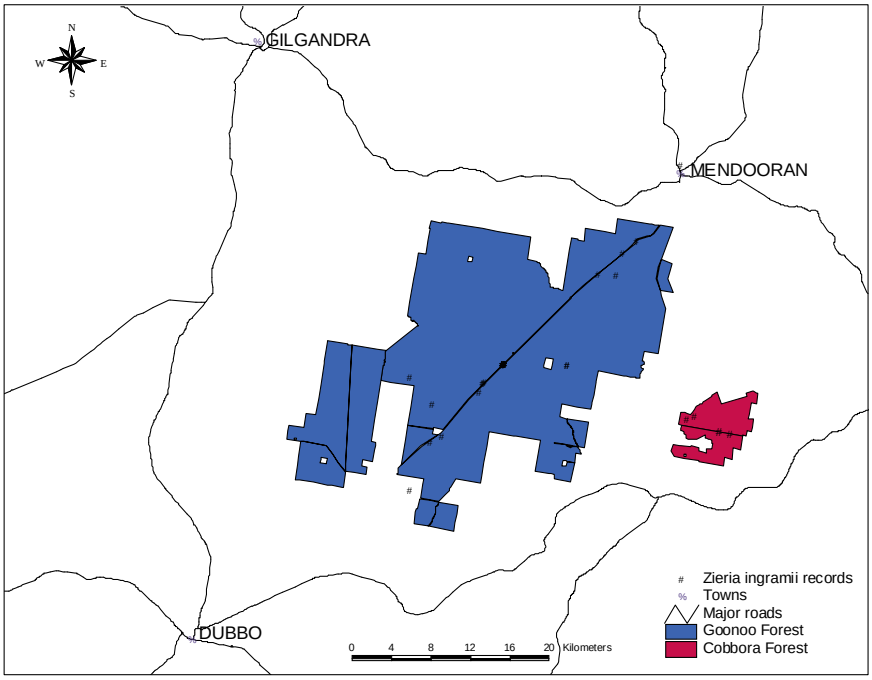

Figure 5: *Zieria ingramii* records in Goonoo and Cobbora Forests 1946 - 2006.

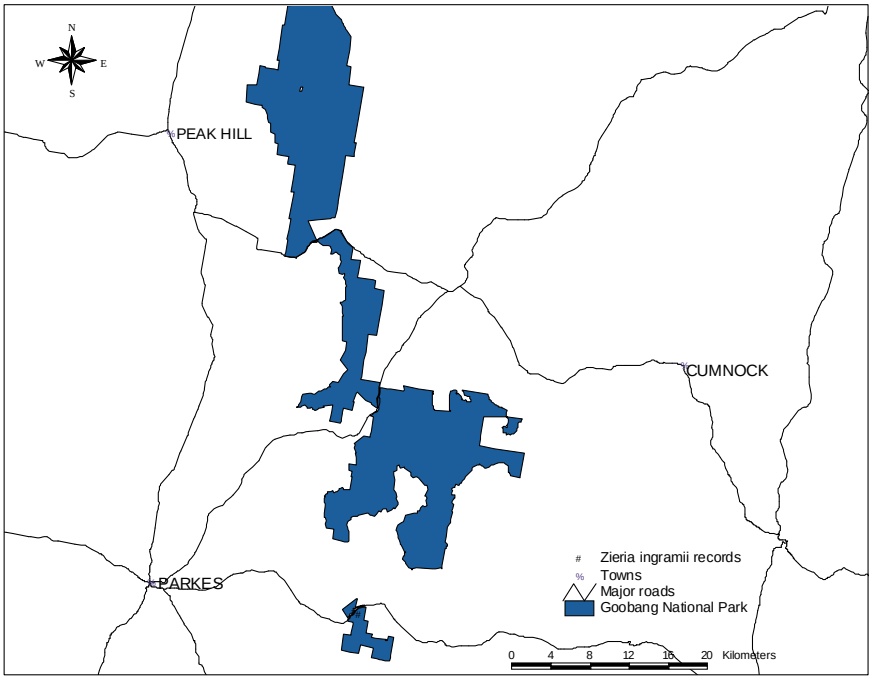

Figure 6: *Zieria ingramii* records in Goobang National Park 1997.

Goobang National Park

In 1997 Eric Whiting collected and reported *Z. ingramii* from two separate sites in Goobang National Park. The identification of the plant material collected is questionable and it is likely that the plants were *Zieria aspalathoides* rather than *Z. ingramii* (E. Whiting, pers. comm.). The two sites were re-visited in 2003 but the exact location of the sites or *Z. ingramii* plants was unable to be found.

5.2 Tenure

Both of the currently known populations of Z. *ingramii* in Goonoo and Cobbora Forests, as well as the third yet unconfirmed location in Goobang National Park, occur on land owned by the Crown and vested with the Minister for the Environment. Cobbora Forest however, is subject to a Part 11 Lease under the Brigalow and Nandewar Community Conservation Area Act 2005 to private landholders who have used the land for grazing and cropping purposes for a number of years and continue to do so.

6 Habitat

6.1 Topography, Soils and Geology

Zieria ingramii has been recorded on gentle slopes or near the crests of low rises, in undulating terrains, mostly on northerly, westerly or southerly aspects, at altitudes of 390-440m above sea level. Plants tend to occur on light sandy soils that have, in general, been described as red-brown to yellow-brown sandy or clay loams, overlying sedimentary rock, which may be outcropping (Briggs and Leigh 1990). Soil and geological maps indicate that the majority of *Z. ingramii* records typically occur on soils of coarse-grained mixed sediments derived from Jurassic quartz sandstone, claystone, conglomerate or massive to cross-bedded coarse pebbly lithic-quartz sandstone, minor fine grained sandstone and siltstone. It has been suggested that particular elements of the soil, such as organic carbon, phosphorous or aluminium levels, may be determining where *Z. ingramii* occurs, which warrants further investigation (see Section 12.1).

6.2 Vegetation

Zieria ingramii typically occurs in *Eucalyptus-Callitris* woodland or open forest communities containing Black Cypress Pine (*Callitris endlicheri*) and Blue-leaved Ironbark (*Eucalyptus nubila*) and a shrubby to heathy understorey (Briggs and Leigh 1990, Armstrong 1991b, M. Kerr, pers. comm.) (Figure 7). In Goonoo Forest in particular, Dwyer's Red Gum (*Eucalyptus dwyeri)* appears to be a key predictor of *Z. ingramii* (M. Kerr, pers. comm.). It has also been noted that it is rare to find *Z. ingramii* without another species of Rutaceae present such as *Zieria aspalathoides, Boronia pinata, B. anthemoides, B. rosmarinifolia, Philotheca salasolifolia* or *Phebalium squamulosum* (M. Kerr, pers. comm. based on notes from Anthony O'Halloran). Other species that have also been recorded at most sites include *Allocasuarina diminuta/Allocasuarina gymnanthera*, *Acacia triptera* and *Calytrix tetragona*. The records in Goobang National Park however, are located within a mapped Red Stringybark (*E. macrorhyncha*)-Bundy Box (*E. goniocalyx*) association (source: Vegetation of Goobang National Park 1:50,000 map digitised from Porteners 1997), although it should be again noted that the accuracy of these records and their locations are unreliable.

Figure 7: Typical *Z. ingramii* habitat in Cobbora Forest (Photo: M. Bannerman).

6.3 Climate

The range of *Z. ingramii* occurs within a warm, temperate climate characterised by the temperature and rainfall patterns of Dubbo. In winter the average daily minimum and maximum temperatures are 2.6^{o}C and 15.2^{o}C, with an average rainfall of 138 mm over three months (median 119 mm) and an average number of 15 frost days per year. In summer the average daily minimum and maximum temperatures are 17.9^{o}C and 33^{o}C, with an average rainfall of 165 mm over three months (median 123 mm). The average annual rainfall is 586.5 mm. These records are based on the equivalent of 42-130 years of data collected from the Darling Street weather station in Dubbo, approximately 35-55km SW of the Goonoo and Cobbora populations, at an elevation of 260m compared with the populations which occur at an elevation of 390-440m (Bureau of Meteorology website: http://www.bom.gov.au/climate/averages/tables/cw_065012.shtml).

Climate in Parkes, 23km W of the Goobang records, is similar to that of Dubbo with the exception that Parkes has average winter temperatures between 4 and 14 ^{o}C with slightly more rainfall and only 7 frost days per year as well as slightly less rainfall in summer (Bureau of Meteorology website: http://www.bom.gov.au/climate/averages/tables/cw_065026.shtml).

Drought years are not uncommon for the region, with the most recent occurring during 2001-2004. Thunderstorms with frequent lightning strikes, which can start wildfires, also occur regularly across the region (Porteners 1997).

7 Biology and Ecology

Flowering and Pollination

Zieria ingramii generally flowers in spring and bears fruit in summer (Armstrong 1991b, 2002, Briggs and Leigh 1990). Plants have been found producing fruit in late November 2003 in Cobbora Forest and with open seed pods in January 2004 in Goonoo Forest. Phenological data currently available for the species from herbarium specimens show that plants can produce flowers and fruits any time between July and March (Gross and Mackay 1998). The species appears to possess functional pollen but other aspects of pollination and reproductive biology are unknown (Armstrong 1991a, 2002). In general, species of *Zieria* are pollinated mostly by flies but also occasionally by butterflies, bees and beetles (Armstrong 2002 in Auld 2001), indicating the type of pollination vectors that may be associated with *Z. ingramii*.

Seed Ecology

Very little is known about the seed ecology of *Z. ingramii*, except that the seeds are released forcibly from dehiscing cocci and each seed has an eliaosome (an oil body), which may play a role in facilitating dispersal of the seeds by ants (Gross and Mackay 1998). A number of other *Zieria* species and indeed a high percentage of species in the Rutaceae family experience seed dormancy and germinate in response to fire or the heat produced from a fire (Auld 2001), suggesting the same may be true for *Z. ingramii*, although this remains to be determined. It should be noted though that the 2 sites found by Lewer and Shelly in Goonoo Forest in 1999 were located in areas of the forest that had been recently burned in a hazard reduction (D. Shelly and S. Lewer, pers. comm.). It should also be noted that the majority of *Z. ingramii* records have been made close to roads or tracks. Whether this is due to survey bias or whether roadside disturbance plays a role in seed germination is unknown but warrants further investigation.

Growth and Survivorship

Nothing is known about the growth or longevity of *Z. ingramii* in the wild, although it has been noticed that plants in Goonoo Forest are weak growing (R. Johnstone, pers. comm.). Two plants in cultivation at the Australian National Botanic Gardens have survived up to 10 and 12 years, which suggests that the plants could be long-lived given the appropriate conditions.

Population Size and Demography

At present there are at least 70 individual plants known to exist in Cobbora Forest and approximately 2100 in Goonoo Forest. Plants in both populations are of various ages with a number of seedlings found at each site. Further investigations should be undertaken to determine whether distinct cohorts at sites are related to fire or other disturbance events in each forest. It appears also that *Z. ingramii* population numbers may fluctuate quite significantly over time, as evidenced by the population counts provided from various surveys over the past 18 years, although whether this is due to differences in survey effort is unknown.

8 Management Issues

8.1 Threats and Reasons for Decline

Zieria ingramii is a naturally rare species, characterised by low population numbers and a highly restricted distribution. Speculation about the species decline before adequate records were maintained is merely conjectural (Mackay and Gross 1998) and it is unknown whether the species is currently declining. Not enough is known about the life history and biology of the species to determine whether recent disappearances at sites in Goonoo Forest are localised extinctions at this stage or whether a viable seed bank exists in the soil at these locations. At present there is no apparent correlation between these disappearances and any known disturbance events, although wildfires have been absent from many areas of Goonoo Forest for over 50 years, which may be a factor (NPWS 2003). Regardless, the species is rare with approximately 2170 known individual plants being recently recorded throughout its range. With such low numbers, it is vital that potential threats and causes of decline, if any, are identified and if possible, mitigated.

8.1.1 Habitat Loss or Modification

Large areas of the forests and woodlands around Dubbo and the surrounding area have been cleared for agricultural purposes since European settlement (Wells *et al.* 1984), although most of this has been in habitats that *Z. ingramii* is not known to occupy (D. Binns, pers. comm.). At present, a large area of potential habitat still occurs in Goonoo Forest and in parts of Cobbora Forest. Since these forests are now state conservation reserves, habitat loss should not be a threat. Over the past 50 years however, the diversity and structure of the vegetation in Goonoo and Cobbora has been significantly modified (A. Deane, pers. comm.), which may have contributed to the possible decline of the species. In addition, any further modification of habitat through various management regimes may pose a threat to the species and should only be carried out where there are known to be no adverse impacts on *Z. ingramii*.

8.1.2 Inappropriate Management

Very little is currently known about *Z. ingramii* with regard to its ecological requirements and response to disturbances and threatening processes. As a consequence, this lack of knowledge may lead to inappropriate management of the species or the environment in which it inhabits, which may potentially threaten the survival of the species. Some of the possible management practices that, if conducted inappropriately, could potentially threaten *Z. ingramii* are outlined below.

Fire Management - the response of *Z. ingramii* to fire is currently unknown. High frequency fire is listed as a Key Threatening Process and may disrupt the life cycle of *Z. ingramii* or alter the vegetation structure and composition of *Z. ingramii* habitat such that the species can no longer survive. On the other hand, fire may be a critical factor in the germination of *Z. ingramii* seeds, as it is for many other *Zieria* species, which means that the absence of fire could potentially be detrimental to the species. Determining the response of *Z. ingramii* to fire is considered to be a high priority for the species. However, in the interim, high frequency fires and, alternatively, the long term absence of fires should be avoided in areas of potential *Z. ingramii* habitat as a precautionary measure until such time as the impact of fire on the species is better understood. Slashing, as an alternative fire management tool, may

also pose a threat to *Z. ingramii*, particularly through physical damage to plants. Slashing should therefore be avoided in areas where *Z. ingramii* is known to occur. The *Bushfire Environmental Assessment Code for NSW* (RFS 2006) hazard reduction guidelines for *Z. ingramii* support the above fire management recommendations. The Code states that hazard reduction fires be conducted no more than once every 10 years for *Z. ingramii* and that no slashing, trittering or tree removal be conducted for hazard reduction purposes within 100m of a known *Z. ingramii* location.

Grazing Management - excessive grazing by domestic stock or native herbivores as well as trampling caused by hoofed stock has the potential to threaten the species. Cobbora Forest is the only area of currently known *Z. ingramii* habitat that is subject to domestic stock grazing, which is permitted by the Part 11 lease under the CCA Act. Stock grazing in Cobbora Forest provides a unique opportunity to monitor the impact of stock grazing on *Z. ingramii*. Investigations into the palatability of *Z. ingramii* to domestic stock and native herbivores and the impact of varying degrees of grazing pressure on the species should be conducted in order to guide future management decisions.

Road and Track Maintenance – road and track maintenance in Goonoo and Cobbora Forests and Goobang NP by either local councils (for main roads) or the DEC may pose a threat to *Z. ingramii* through direct physical damage or loss of plants. Roadside and track maintenance in areas of potential habitat should be undertaken with caution and areas where *Z. ingramii* is known to occur should be avoided until further knowledge is gained regarding the impact of physical disturbances on *Z. ingramii*. In addition, vehicles or heavy plant pulling off to the roadside, in particular along the main roads through Goonoo Forest or Goobang NP, may cause physical damage to plants or severe soil compaction. Although this is considered a minor threat to the species in comparison to other threats, it should still be taken into consideration when managing the roads and tracks around the area.

Weed Management – roadside weed spraying is also a potential threat to *Z. ingramii* particularly if it is conducted on a broadscale approach rather than spot spraying. Spot spraying is a preferable herbicide application method as it is less likely to affect non-target species, including *Z. ingramii*.

Ecological Restoration – the DEC is considering the ecological restoration of some areas in Goonoo Forest in order to restore the natural ecological functions of the forest. Although the means by which ecological restoration will be achieved in particular areas is still being decided, low intensity, 'cool' burns are the preferred means of reducing Black Cypress Pine over large parts of the reserve (A. Deane, pers. comm.). The ecological restoration of Goonoo Forest may pose a threat to *Z. ingramii*, depending on the means by which it is achieved (fire, tree removal, etc.) and the resultant changes in habitat. For example, thinning may affect *Z. ingramii* either through direct physical damage to plants or through changes in community structure and environmental variables (eg. increased light, altered water flow) that will affect the suitability of habitat for the species. On the other hand, Goonoo Forest has changed significantly over the past 100 years due to deliberate fire suppression and exclusion over large parts of the reserve (A. Deane, pers. comm.) which may have contributed to the decline of *Z. ingramii*. Therefore ecological restoration of the forest may improve the suitability of habitat for the species. Either way, conducting ecological restoration in areas that are known to currently contain *Z. ingramii* should be avoided until such time as the habitat requirements for the species and responses to fire and physical disturbances are better understood.

8.1.3 Environmental Stochasticity

Zieria ingramii is a highly restricted species, with only two currently known populations within a geographic range of 20km and one further possible population 125km south. With such a highly restricted distribution the chances that one or all of the populations are destroyed by a single catastrophic event are greater than if the species was more widely distributed. Stochastic processes such as severe drought, wildfire or the introduction of a pest or disease pose a significant threat to the survival of these populations, with the possibility of a single event causing the extinction of the species.

8.2 Social and Economic Issues

8.2.1 Economic Considerations

All currently known populations occur on crown land vested with the Minister for the Environment. These areas are managed according to the NP&W Act for the purpose of natural and cultural heritage conservation. Therefore, there is likely to be only a minimal cost associated with conservation of the species, above that which is already spent on park management. The management of the population in Cobbora Forest, which is currently under lease, may require the exclusion of stock and other herbivores, should overgrazing be determined to be a threat. The cost of this measure could be minimised by fencing the perimeter of the population so that management practices by the leaseholders in the remainder of the forest are unchanged.

8.2.2 Social Considerations

Social benefits that may result from the implementation of this Recovery Plan include increased public awareness and understanding of threatened species and the threats that affect them as well as the benefits associated with the maintenance of biodiversity and sustainable ecosystems. In addition, leaseholders that become involved in recovery actions for the species will gain a sense of 'ownership' of these actions and pride in the knowledge that they have been involved in the conservation of a nationally threatened species for both current and future generations.

8.3 Biodiversity Benefits

The conservation of Z. *ingramii* and its habitat in Goonoo and Cobbora Forests and Goobang National Park will assist in enhancing and protecting habitat for other native flora and fauna species that occur in these conservation reserves. This will contribute to the overall conservation of biodiversity within central NSW, which has a number of wider community benefits. These include:

- provision and maintenance of a range of ecosystem functions on which we and all other species depend;
- contributing to increased biological and ecological knowledge of species, communities, habitats and ecosystems;
- potential medical, economic, agricultural and industrial products; and
- cultural, aesthetic and spiritual values.

This Recovery Plan will increase public awareness of *Z. ingramii* and hence raise the profile of all threatened species. This, in turn, will lead to greater opportunities for the conservation of threatened species and increased protection of biodiversity.

8.4 Roles and Interests of Indigenous Communities

At present the Aboriginal community has not expressed any particular interest in *Z. ingramii*, although it is known that other *Zieria* species were used for medicinal purposes in the past.

9 Previous Actions Undertaken

9.1 Collections and Cultivation

Herbarium Specimens

Zieria ingramii is represented by 30 herbarium specimens in 4 Australian herbaria. Seven specimens are held in the Australian National Herbarium, Canberra; 17 specimens are held in the Royal Botanic Gardens, Sydney; 5 specimens (4 dried, 1 in spirit) are held in the Melbourne Royal Botanic Gardens and 1 specimen is held in the King's Park Botanic Gardens, Perth (Council of Heads of Australasian Herbaria 2006). All specimens were collected from Goonoo Forest between 1978 and 2000.

Live Specimens

Records indicate that propagation of *Z. ingramii* cuttings was attempted by the Australian National Botanic Gardens in Canberra on numerous occasions with up to 81% strike rate, although only 3 live specimens are currently surviving (CANB Herbarium Records 2006, M. Fagg, pers. comm.). These 3 specimens were all derived from the same original parent material, which was collected from Goonoo Forest in January 1988. The first was propagated from the original material in February 1994, the second was propagated from the first in May 1996 and the third was propagated from the second in July 2005 (CANB Herbarium Records 2006). The subsequent ages of the 3 live specimens therefore, are approximately 12 years, 10 years and 14 months, respectively.

Cuttings were also taken from 5 plants in Goonoo Forest in 1993 for cultivation at Mt Annan Botanic Gardens. A total of 36 cuttings were taken and initial propagation attempts were encouraging with a better than 80% strike rate using Clonex purple rooting hormone gel. Records at Mt Annan Botanic Gardens show that all cuttings died in the nursery possibly due to inadequate soil conditions although this is not confirmed. Nevertheless, the Mt Annan Botanic Gardens encountered difficulties in growing plants on after propagation (R. Johnstone, pers. comm.).

A local botanist of the Dubbo area has also been successful in propagating a number of plants, from cuttings taken in Goonoo Forest, that are now 5 years old (M. Kerr, pers. comm.). Further investigations will be undertaken to determine the reasons for the success in growing these plants on, compared with those at Mt Annan Botanic Gardens.

Seed Storage

In late 2005, staff from Mt Annan Botanic Gardens collected 16 seeds from 2 *Z. ingramii* plants in Goonoo Forest. The seeds were dried for a period of 4 months, then placed in the freezer on 5 May 2006 at about 5% moisture content and –18 degrees Celsius. Inference from other seeds stored suggests that this is the most appropriate long-term storage method and is typically the method used by the Gardens for all dessication tolerant seed (R. Johnstone, pers. comm.). Discussions with Mt Annan Botanic Gardens are ongoing regarding the collection and storage of *Z. ingramii* seeds for the purposes of establishing an ex-situ seedbank. The seeds collected will contribute to the NSW Seedbank as well as the SeedQuest Project with the Royal Botanic Gardens, Kew. SeedQuest is an international collaborative plant conservation initiative established by the RBG, Kew, of which the NSW Botanic Gardens Trust is a partner. The aim of SeedQuest is to have 10% of the world's flora held as seed collections by 2010. The NSW Seedbank and the associated seed research unit at Mt Annan Botanic Gardens will play an important role in the collection and storage of seed for SeedQuest. Further information regarding SeedQuest can be obtained direct from the NSW Botanic Gardens Trust.

Germination Studies

Mt Annan Botanic Gardens are also currently investigating the germination requirements of a number of common *Zieria* species with the hope of extrapolating the techniques used to some of the rarer *Zieria* species including *Z. ingramii* (R. Johnstone, pers. comm.).

9.2 Previous Surveys

Goonoo Forest

A number of surveys have been conducted in Goonoo Forest over the past 18 years that have resulted in the location of various *Z. ingramii* sites throughout the forest.

In September 1988 Briggs and Leigh conducted a survey in Goonoo Forest where they located six *Z. ingramii* sites with a total of 240 plants (Briggs and Leigh 1990, Gross and Mackay 1998). The majority of these sites occurred along the Dubbo–Mendooran Road, whilst one site was located along the Frost Road. Plant numbers at the sites varied from 20 to 80 individuals and the areas occupied varied between 0.5 and 5 hectares.

In November 1997 Wilson and Mackay searched the area again and located only one of the Briggs and Leigh sites along the Dubbo-Mendooran Road with 6 plants, as well as a new site along the same road containing 13 flowering individuals (NSW Wildlife Atlas records).

In August 1999 a survey conducted by Steve Lewer and Darren Shelly of the former Department of Land and Water Conservation (DLWC) for another threatened plant, *Rulingia procumbens*, located two additional *Z. ingramii* sites (DLWC 1999). These two sites were located along Cashels Road. One site contained 12 plants over a 0.5ha area. The other site contained 140 plants over 1.5ha. Lewer and Shelly also attempted to find the six sites recorded by Briggs and Leigh in 1988 but were unable to locate these sites.

In January 2004 Melanie Bannerman and Geoff Robertson of the Department of Environment and Conservation revisited a number of previously recorded sites in Goonoo Forest, including those mentioned above. Only three of the six former Briggs and Leigh sites were

found with *Z. ingramii* plants. These were located at the northern end of the forest on the Dubbo-Mendooran Road. The first site contained 150 individual plants over an area of 2ha, the second contained 22 plants over 0.25ha and the third site contained 7 plants within a 100sq.m patch.

All previously recorded sites in Goonoo Forest were again revisited by the DEC in June 2006. Twelve separate sites were re-inspected. Seven sites were found to contain *Z. ingramii* plants. These included five of the Briggs & Leigh sites, one of the Lewer & Shelly sites and one other site previously recorded by Wilson & Mackay in 1997. A total of 394 plants were found at these sites. Soon after, another 83 sites were recorded by the DEC with a total of 1713 plants. Therefore the total number of plants known from Goonoo Forest is 2107 as at October 2006.

Cobbora Forest

In 1998 and 1999, pre-harvest surveys conducted by Forests NSW located four *Z. ingramii* sites in Cobbora Forest. Two of the sites occurred on the northern leasehold and contained less than 20 plants each. The other two sites occurred along the northern boundary of the southern leasehold. One contained around 80 plants within a radius of approximately 20 metres and the other contained only a single plant (H. Stone, pers. comm.). The two northern sites were investigated by the DEC in November 2003 but only one of the sites, containing 7 plants, was located. Two of the sites, one in the northern leasehold and one on the boundary, were re-visited by the DEC in September 2006, with a total of 70 individual *Z. ingramii* plants being found (45 on the boundary and 25 in the north). The other 2 sites have not been searched at this stage.

Goobang National Park

In 1997, Eric Whiting located two *Z. ingramii* sites in the southern section of Goobang National Park along the Parkes-Molong Road. Both sites contained only a few plants each. Voucher specimens from the plants were sent to the Royal Botanic Gardens for identification but were possibly mis-identified, which creates some doubt as to the reliability of these records (E. Whiting, pers. comm). These sites were revisited by the DEC in November 2003 but no plants were located.

Since only a small proportion of potential habitat in these reserves has been surveyed, the actual population is likely to be larger than currently known. Further surveys are therefore required in order to determine the full extent of the populations in these reserves and the surrounding areas.

9.3 Forestry Harvesting Conditions

Prior to 1 December 2005, Goonoo and Cobbora Forests were under the control and management of Forests NSW for the purposes of timber harvesting. As part of the harvesting conditions, Forests NSW were required to undertake surveys for threatened plants prior to harvesting a compartment. In addition, any threatened plants located were required to be protected from forestry activities by licence conditions agreed upon by Forests NSW and the DEC. The licence condition for *Z. ingramii* in Goonoo and Cobbora Forests was to establish an exclusion zone of at least 20 metres wide around all individuals of the species and to prohibit all forestry activities from within this zone. Known plants were therefore not

considered at risk from forestry operations, however, plants that were not detected during surveys had the potential to be affected by forestry activities such as felling, track construction and maintenance.

10 Species Ability to Recover

Zieria ingramii is currently known to occur within at least two state conservation reserves and possibly in a third conservation reserve. Open seedpods were found on many plants in recently located populations and plants were observed flowering in previously recorded populations, indicating that the species is reproductively viable. The current known range and distribution of the species however, is very limited and the ecology of the species is poorly understood, particularly with regard to germination requirements and the impact of threatening processes. Despite these limitations, the ability of *Z. ingramii* to persist in the wild should be high due to the fact that it is protected within a number of conservation reserves, although active management and monitoring is still necessary to ensure its long term persistence in these reserves.

11 Recovery Objectives and Performance Criteria

11.1 Recovery Objectives

The overall aim of this recovery plan is to prevent the decline of *Zieria ingramii*, to protect populations from threats and to ensure the long term viability of the species in the wild.

The specific objectives are to:

1. determine the species' full range, distribution and abundance and determine whether the species is currently in decline;
2. understand aspects of the species' biology and ecology that are crucial to the recovery effort, including its habitat and resource requirements and the reproductive viability of the wild populations;
3. determine the species response to fire and physical disturbances such as grazing, slashing and road grading;
4. establish an ex-situ conservation plan as insurance against extinction in the wild;
5. identify and mitigate, if possible, any threats to the species;
6. ensure that management of the reserves in which the species currently occurs is appropriate and does not threaten its existence;
7. promote community awareness and support for the conservation of the species.

11.2 Recovery Performance Criteria

The achievement of the Recovery Objectives will be assessed based on the following performance criteria:

1. no *Zieria ingramii* populations experience a significant and permanent decline in numbers and there is no loss of any known populations;

2. all areas of potential habitat have been surveyed and all populations are mapped, benchmarked and regularly monitored;

3. knowledge of the biology, ecology, habitat and resource requirements, reproductive viability and recruitment rates for the species exists and is used to guide management decisions;

4. the species response to various fire and physical disturbance regimes is known and the species is managed accordingly in response to these regimes;

5. an ex-situ seed bank exists that is representative of the full geographic range and diversity of the species and that can be used for future propagation if required;

6. the impact of stock grazing on *Z. ingramii* is known and, if required, all known sites in Cobbora Forest are protected from stock;

7. Reserve, Pest and Fire Management Plans for Goonoo and Cobbora Forests acknowledge the existence of the species in these reserves and provide for its protection;

8. no areas of known habitat within Goonoo and Cobbora Forests and Goobang National Park are burnt within a 10 year time frame or slashed for hazard reduction purposes;

9. signs indicating the significance of the roadside environment are erected along the main roads through Goonoo Forest and Goobang National Park where *Z. ingramii* occurs;

10. no roadside sites are damaged from roadside maintenance or weed spraying;

11. Council and Parks and Wildlife staff can adequately identify the species in the field and determine its locations using appropriate maps;

12. the community and all stakeholders are aware of the species and are contributing to conservation actions where appropriate.

12 Recovery Actions

12.1 Action 1 – Survey and Data Collection

All areas of suitable habitat in Goonoo and Cobbora Forests and in Goobang National Park will be surveyed in order to determine the full extent of populations in these reserves. In addition, any other suitable areas of habitat will be identified and surveyed for the presence of *Z. ingramii*. Surveys will be conducted in spring when the species is likely to be flowering and therefore more easily detected and all surveys will be carried out with the permission of relevant landholders. Specimens from newly located populations will be lodged with a suitable herbarium.

At the time of surveys, population and habitat characteristics will also be recorded including population size and demographics, vegetation structure and composition, topography, substrate composition and potential threats. Soil samples will be collected and tested for various elements (organic carbon, phosphorous, aluminium levels, etc) that may assist in determining critical habitat components for the species. The data collected will be used to assist in determining which factors, if any, are most strongly related to the distribution and abundance of the species.

The DEC will also inform relevant landholders of any new distributional data and ensure that all relevant databases are updated within 3 months following the surveys so that informed habitat management decisions can be made.

Outcome:

Surveys will assist in determining the full range and distribution of *Z. ingramii* and the data collected during these surveys will assist in providing a better understanding of habitat preferences and threats to the species.

Agency responsible for implementation:

Department of Environment and Conservation

12.2 Action 2 – Monitoring

Zieria ingramii populations as well as individual plants will be monitored annually to determine population dynamics and the impacts of threatening processes and management regimes on the species. Observational monitoring will be conducted to determine whether plants are reproducing (flowering, fruiting) as well as to determine survivorship, longevity, recruitment and any possible threats or causes of mortality within populations. In addition, the impact of stock grazing on plants in Cobbora Forest will be regularly monitored to determine whether stock grazing is adversely affecting the species. Experimental plots will also be established and particular habitat management regimes applied including fire and physical disturbance (slashing or grading), in order to determine the responses of the species to such regimes. Monitoring will be conducted with the permission and assistance of all relevant land managers and results will be distributed annually to keep land managers informed.

Outcome:

Reproductive ability, population dynamics, threats and causes of mortality will be better understood and any decline in population numbers will be detected. The experimental plots will assist in determining the response of the species to particular management regimes and in guiding future recovery efforts.

Agency responsible for implementation:

Department of Environment and Conservation

12.3 Action 3 – Research

There have been very few studies of the life history attributes of the genus *Zieria* (Armstrong 2002, Auld 2001) and even fewer studies for that of *Z. ingramii*. In order to make appropriate decisions regarding the management and conservation of the species, it is essential that a number of aspects of the species biology and ecology are understood. In particular, the following specific areas of research are required in order to guide management decisions for *Z. ingramii*:

- determining factors that influence flowering;
- determining pollination vectors;
- understanding seed set and seed dispersal methods;
- determining the viability of seeds and soil seed bank dynamics including the period of time required to establish an adequate soil seed bank;
- investigating seedling survival and germination requirements (including the continuation of investigations by Mt Annan Botanic Gardens);
- determining plant longevity, mortality and recruitment rates;
- determining the susceptibility of the species to pathogens and pests;
- determining habitat and resource requirements (eg. specific nutrients, amount of water required/drought tolerance, amount of shade/light and photoperiod, soil components, temperature and climatic variables, vegetation structure and composition);
- investigating any possible competition for resources from other plant species;
- investigating the palatability of the species to domestic stock and native herbivores.

The DEC will encourage the involvement of various research institutes, universities and Botanic Gardens in conducting this research. Some of the monitoring conducted under Action 2 will also assist in contributing to these research questions.

Outcome:

An understanding of the species' biology and ecology will be achieved, which will assist in guiding conservation and management actions for the species. Specific outcomes will be an improved understanding of the reproductive biology of the species, knowledge of the susceptibility of *Z. ingramii* to disease, pests and competition or predation from other species and an improved understanding of the species habitat and resource requirements.

Agency responsible for implementation:

Department of Environment and Conservation

12.4 Action 4 – Establish an Ex-situ Seed Bank

Z. ingramii is characterised by low population numbers and a very restricted distribution, which places the species at a greater risk of extinction than if it was more widely distributed. It is therefore considered prudent to establish a viable and representative ex-situ seed bank as insurance against potential losses in the wild. Mt Annan Botanic Gardens will establish an ex-situ seed bank with seeds collected from both the Goonoo and Cobbora Forest populations and any other extant populations that may be located. In order to establish a representative and viable ex-situ seed bank, at least several hundred viable seeds collected from as great a range of plants as possible would be required although several thousand seeds would be preferred (R. Johnstone, pers. comm.). The aim will be to establish a viable and representative ex-situ seed bank within 5 years of commencement of the Recovery Plan.

Outcome:

A representative and viable ex-situ seed bank will be established, which will assist in providing stock for possible future reintroduction of the species, should the species become extinct in the wild.

Agency responsible for implementation:

Department of Environment and Conservation

12.5 Action 5 – Precautionary Management

Although *Z. ingramii* is now protected within state conservation reserves, a precautionary approach to management of these reserves should be undertaken until such time as the species' response to various management regimes are better understood. In particular, the development of pest, fire and reserve Plans of Management for Goonoo and Cobbora Forests should take into consideration the specific requirements for this species (as well as other threatened species) in these reserves.

Fire management should be conducted in accordance with the *Bushfire Environmental Assessment Code for NSW* (RFS 2006) hazard reduction guidelines for *Z. ingramii*. The code states that fire should be conducted no more than once every 10 years and no slashing, trittering or tree removal within 100m of known *Z. ingramii* plants should occur.

Road and track maintenance should avoid areas where *Z. ingramii* is known to occur. Signs alerting staff and the public to the presence of a significant roadside area should be erected at all currently known and any further located roadside sites. Maps showing the location of all known roadside sites will be provided to the Dubbo City, Warrumbungle Shire and Parkes Shire Councils and Parks & Wildlife Areas responsible for roadside maintenance through Goonoo and Cobbora Forest and Goobang National Park. The maps will show the location and extent of the sites so that Council and Parks & Wildlife staff are aware of these sites when planning roadside maintenance. In addition, the DEC will liaise with the Councils and Parks & Wildlife Areas to identify and resolve any issues that may arise regarding roadside maintenance and *Z. ingramii.*

Weed management should be conducted with extreme caution. Broadscale weed spraying should be avoided in areas where *Z. ingramii* is known or likely to occur. Spot spraying should be conducted with care. In addition to the maps mentioned above, the DEC will provide advice and training to Council and Parks & Wildlife staff in the identification of *Z. ingramii*, to ensure that the species is adequately identified and avoided during weed spraying.

Stock grazing in Cobbora Forest will continue to be permitted, however the impacts on *Z. ingramii* will be regularly monitored. Should it be determined that stock grazing is adversely affecting *Z. ingramii*, then stock should be excluded from all known *Z. ingramii* sites in Cobbora Forest.

Ecological restoration should be conducted with caution in areas of likely *Z. ingramii* habitat and should be avoided in areas of known habitat until such time as the habitat requirements for the species and responses to fire and physical disturbances are better understood.

Outcome:

Zieria ingramii will be protected from inappropriate management regimes that may threaten the species until such time as the species response to particular regimes is better understood.

Agency responsible for implementation:

Department of Environment and Conservation

12.6 Action 6 – Stakeholder and Community Involvement

It is important that the community be made aware of the significance of threatened species and their habitats and their role in the maintenance of biodiversity. The DEC has and will continue to liaise with relevant stakeholders regarding the conservation and management of *Z. ingramii*. An information leaflet for *Z. ingramii* will be distributed to relevant stakeholders and the general community to raise public awareness of the species across its range. Should any *Z. ingramii* populations be found on private land, the DEC will liaise with the landholders to determine appropriate management and conservation of the populations. In addition, the leaseholders of Cobbora Forest will be consulted on all aspects of the management and monitoring of the species on their leasehold.

Outcome:

Community awareness of and support for the conservation and protection of *Z. ingramii* will be enhanced and interested leaseholders or landholders will be involved in the conservation of the populations on their properties and in the decision making regarding the species.

Agency responsible for implementation:

Department of Environment and Conservation

12.7 Action 7 – Recovery Plan Coordination

Effective coordination of this plan is essential to ensure its implementation is conducted in a timely, cost-effective and efficient manner. Coordination of this plan will involve liaison with other recovery programs to ensure that actions do not adversely impact upon other threatened species. Coordination will also involve effective liaison with relevant government agencies, botanical experts, lease or landholders and other stakeholders.

Outcome:

The stated objectives of this Recovery Plan will be achieved in an efficient and coordinated manner with consultation and input from all relevant stakeholders.

Agency responsible for implementation:

Department of Environment and Conservation

13 Alternative Management Strategies

13.1 No Management Action Taken

An alternative strategy for the management of *Z. ingramii* is to undertake no management action for the species. This species is endemic to NSW and is listed both statewide and nationally as endangered, with only two currently known populations, which contain a total of approximately 2100 individual plants. Although there appear to be no immediate threats to the species at present, if no management action is undertaken to protect this species now, it will be more likely that the population will become extinct in the future. Therefore, it is considered prudent to undertake management actions to protect this species in order to ensure its continued survival in the wild.

13.2 Establish an Ex-situ Population

In order to provide insurance against the loss of *Z. ingramii* in the wild, this recovery plan aims to undertake ex-situ conservation of the species. Due to the low numbers of *Z. ingramii* plants in the wild and the fact that previous cuttings collected for cultivation have had poor survival rates in the long-term (R. Johnstone, pers. comm.), it would be inappropriate to collect cuttings or plants for the establishment of an ex-situ population. Instead, the establishment of an ex-situ seed bank has been proposed, which will have less impact on the wild population and better prospects for long-term viability.

13.3 Nomination of Critical Habitat

The nomination of Critical Habitat for *Z. ingramii* would provide additional protection for the species by protecting habitat that is critical for its survival. This Recovery Plan identifies habitat features of the locations where *Z. ingramii* is currently known and previously occurred. However, it is not clear which, if any, of these features are decisive in allowing or constraining the long term dispersal, distribution, establishment and persistence of *Z. ingramii*. Accordingly, identification and nomination of Critical Habitat for *Z. ingramii* are considered inappropriate at this stage and are not proposed as recovery actions in this Recovery Plan.

14 Preparation Details

This Recovery Plan was prepared by Melanie Bannerman, Threatened Species Officer of the Department of Environment and Conservation, in consultation with the Botanic Gardens Trust, the Australian National Botanic Gardens, State Forests NSW and a number of botanical experts. Lesley Forward of the DEC prepared an early version of the plan, amendments were made to the draft by Geoff Robertson, Matt Cameron and Peter Christie of the DEC and an initial review of the biology and ecology of the species was prepared by David Mackay and Caroline Gross.

14.1 Date of Last Amendment

No amendments have been made to date.

14.2 Review Date

This Recovery Plan and the conservation status of *Zieria ingramii* will be reviewed by the DEC within five years of the date of publication. In evaluating the success or otherwise of the Recovery Plan, the DEC will liaise with other relevant stakeholders including the Australian Government Department of the Environment, Water, Heritage and the Arts, the Parks and Wildlife Division of the DEC, the Botanic Gardens Trust and the relevant leaseholders and/or landholders of the properties where *Z. ingramii* occurs.

Table 3: Costing Table

Action No:	Description	Priority	Estimated Cost/yr					Total Cost	Responsible party/funding source	In-kind	Cash
			Year 1	Year 2	Year 3	Year 4	Year 5				
12.1	Survey and Data Collection	1	$10,000					**$10,000**	DEC		
	Data Analysis	1	$5,000					**$5,000**	DEC		**$5,000**
12.2	Monitoring:										**$10,000**
	i. collect baseline data	1	$4,500					**$4,500**	DEC	**$4,500**	
	ii. ongoing monitoring	1		$1,200	$1,200	$1,200	$1,200	**$4,800**	DEC	**$4,800**	
	iii. experimental plots	1		$12,400				**$12,400**	DEC	**$2,400**	**$10,000**
12.3	Research	1		$5,000	$5,000	$5,000	$5,000	**$20,000**	DEC	**$10,000**	**$10,000**
12.4	Ex-situ Conservation:										
	i. seed collection	1		$3,600				**$3,600**	DEC	**$3,600**	
	ii. storage	1		$1,500	$1,500	$1,500	$1,500	**$6,000**	DEC	**$6,000**	
12.5	Precautionary Management:										
	i. maps & ID training	1	$1,500					**$1,500**	DEC	**$1,200**	**$300**
	ii. fire management	2	Ψ	Ψ	Ψ	Ψ	Ψ	**Ψ**	DEC	**Ψ**	
	iii. track maintenance	2	Ψ	Ψ	Ψ	Ψ	Ψ	**Ψ**	DEC	**Ψ**	
	iv. weed management	2	Ψ	Ψ	Ψ	Ψ	Ψ	**Ψ**	DEC	**Ψ**	
	v. grazing management	2				^$2,000	^$2,000	**^$4,000**	DEC		**^$4,000**
12.6	Community Involvement										
	i. prepare & distribute leaflet	3	$1,800					**$1,800**	DEC	**$300**	**$1,500**
	ii. liaise with community	3		$300	$300	$300	$300	**$1,200**	DEC	**$1,200**	
12.7	Recovery Plan Coordination	1	$300	$300	$300	$300	$1,800	**$3,000**	DEC	**$3,000**	
	Total			$24,300	$8,300	$10,300	$11,800	**$77,800**		**$37,000**	**$40,800**

Priority ratings are: 1- Action critical to meeting plan objectives, 2- Action contributing to meeting plan objectives, 3-Desirable, but not essential action.
'In-Kind' Funds represent salary component of permanent staff and current resources.
'Cash' Funds represent the salary component for temporary staff and other costs such as the purchasing of survey and laboratory equipment.
$23,100
Ψ No direct cost as action is liaison.
^ Funds only required if investigation identifies a threat from browsing.

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