



# Recovery Plan for *Zieria formosa*, *Zieria buxijugum* and *Zieria parrisiae*



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Natural Heritage Trust  
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NSW National Parks and Wildlife Service,  
43 Bridge Street,  
(PO Box 1967),  
**Hurstville NSW 2220**  
Tel: 02 95856444

[www.npws.nsw.gov.au](http://www.npws.nsw.gov.au)

Requests for information or comments regarding the recovery program for the three *Zieria* species considered in this Plan are best directed to:

The *Zieria* Recovery Team coordinator  
Threatened Species Unit  
NPWS Southern Directorate  
PO Box 2115  
**Queanbeyan NSW 2620**  
Ph: (02) 6298 9700

NPWS Far South Coast Region  
PO Box 656  
**Merimbula NSW 2548**  
Ph: (02) 6495 5001

or

The Director,  
Regional Wildlife Programs,  
Wildlife Australia Branch,  
Environment Australia,  
PO Box 636,  
**Canberra ACT 2601**  
Ph: (02) 6274 1111

**Cover photograph:** *Zieria buxijugum*  
**Photographer:** J. D. Briggs

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# Recovery Plan for *Zieria formosa*, *Zieria buxijugum* and *Zieria parrisiae*

## Executive Summary

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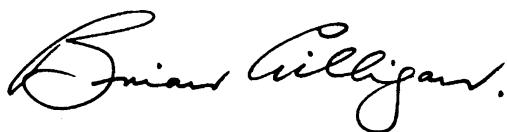
This document constitutes the formal New South Wales State and National Recovery Plan for *Zieria formosa*, *Zieria buxijugum* and *Zieria parrisiae*. It considers the conservation requirements of these species across their known range, identifies the future actions to be taken to ensure their long-term viability in nature and the parties who will carry these out.

The three *Zieria*'s are listed as Endangered under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*, and as Endangered (Schedule 1, Part 1) on the *NSW Threatened Species Conservation Act 1995*. All three species are shrubs that occur on rhyolite rock outcrops and grow to between two and four metres high. In spring these *Zieria*'s produce clusters of small, white or pink flowers at the ends of their branchlets. Only a single population of each species is known. The three species occur on private properties located between about six and 10 km west of Pambula in the far South Coast area of NSW. The species do not co-occur.

The rarity of these *Zieria*'s was first drawn to the attention of the then landowners by the Australian National Herbarium, Canberra during 1986 and 1987, soon after they were discovered. At that time the species were also brought into cultivation at the Australian National Botanic Gardens, Canberra.

The Recovery Actions detailed in this Recovery Plan include; (i) the fencing of *Z. parrisiae* sites to exclude wallabies and the protection of selected plants of *Z. buxijugum* using individual wire mesh guards, (ii) the establishment and maintenance of a regular monitoring program, (iii) determining whether ex-situ populations should be established, (iv) discussion with landowners regarding medium and long term security for the sites, and (v) maintenance of an effective liaison between NPWS and the landowners.

It is intended that this Recovery Plan will be implemented over a period of five years. Most of the Plan will be implemented using the existing resources of NSW National Parks and Wildlife Service and Commonwealth Natural Heritage Trust funding already provided for this purpose. Some currently uncosted additional funds may be required to implement Action 3.2 (establishment of an ex-situ population/s), should this action be determined necessary.



**BRIAN GILLIGAN**  
Director-General



**BOB DEBUS MP**  
Minister for the Environment

## **Acknowledgments**

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This Plan has been prepared by a small Recovery Team working in close consultation with two of the three landholders who have the *Zieria* species growing on their properties.

The members of the Recovery Team are John Briggs and Genevieve Wright from the NSW National Parks and Wildlife Service (NPWS) Southern Directorate, Sharon Davey from NPWS Far South Coast Region and Graham Roche from Bega Valley Shire Council. Warwick Smith of NPWS Southern Directorate was also on the Recovery Team until February, 2000.

The cooperation and enthusiastic support of a previous landowner, Chris Parramore, and the current landholders Sue McIntyre and Greg Carton, Rod and Elisabeth McIntyre and Sue and Brian Sullivan for the protection of these species on their properties is much appreciated.

Environment Australia has provided funding for the preparation of the Recovery Plan and the implementation of several recovery actions.

## 1 Introduction

*Zieria formosa* J. Briggs & J. Armstrong ms., *Z. buxijugum* J. Briggs & J. Armstrong ms. and *Z. parrisiae* J. Briggs & J. Armstrong ms. are all only known from single populations, consisting of 38, 32 and 36 adult plants, respectively. These species occur on three separate rhyolite rock outcrops. *Zieria formosa* occurs on three private properties located about six kilometres west of Pambula. The other two species occur on a private property about 10 km west of Pambula in the Far South Coast region of NSW.

This document constitutes the formal State and National Recovery Plan for these species and as such considers the requirements of the species across their known range. It identifies the actions to be taken to ensure their long-term viability in nature and the parties who will carry these out.

The attainment of the objectives of this Recovery Plan is subject to budgetary and other constraints affecting the parties involved. It may also be necessary to amend this Plan in their event of new information or following recommended changes to the Recovery Program by the Recovery Team in consultation with the private landowners. The information in this Plan is accurate to March 2002.

This Plan has been prepared by the New South Wales National Parks and Wildlife Service (NPWS) in consultation with a small Recovery Team and the private landowners who have these species growing on their properties.

## 2 Legislative Context

### 2.1 Legal Status

*Zieria formosa*, *Z. buxijugum* and *Z. parrisiae* are listed on both the Commonwealth's Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and the NSW Threatened Species Conservation Act 1995 (TSC Act) as Endangered. They are also listed as nationally Endangered by Briggs and Leigh (1996), all with a coding of 2E (Endangered and not reserved).

Among the consequences of being listed as a threatened species on the TSC Act are:

- a Recovery Plan must be prepared;
- consideration must be given to the species in assessing the impacts of developments and activities with the aim of minimising adverse impacts; and

- other actions that are likely to result in the harming or picking of that species or damage its habitat are licenced.

### 2.2 Recovery Plan Preparation

The TSC Act provides a legislative framework to protect and encourage the recovery of threatened species, endangered populations and endangered ecological communities in NSW. Under this legislation the Director-General of National Parks and Wildlife (NPW) has a responsibility to prepare Recovery Plans for all species, populations and ecological communities listed as endangered or vulnerable on the TSC Act schedules. Similarly, the EPBC Act requires that the Commonwealth Minister for the Environment ensures the preparation of a Recovery Plan for nationally listed species and communities or adopts 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 their preparation.

This Recovery Plan has been prepared to satisfy both the requirements of the TSC Act and the EPBC Act. It is the intention of the Director-General of NPW to forward the final version of this Plan to the Commonwealth Minister for 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 it has agreed to be responsible. Public authorities and councils identified as responsible for the implementation of Recovery Plan actions are required by the TSC Act to report annually 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 a Recovery Plan. The government agencies relevant to this Plan are Bega Valley Shire Council (BVSC) and NPWS. Consequently, the actions outlined for each of these agencies must be implemented as described in this Plan.

The EPBC Act specifies that a Commonwealth agency must not take any action that contravenes an approved Recovery Plan.

### 2.4 Relationship to Other Legislation

*Zieria formosa*, *Z. buxijugum* and *Z. parrisiae* occur entirely on private freehold land.

Relevant legislation includes:

- NSW *National Parks and Wildlife Act 1974*
- NSW *Environmental Planning and Assessment Act 1979*
- NSW *Local Government Act 1993*
- NSW *Rural Fires Act 1997*
- NSW *Native Vegetation Conservation Act 1997*
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The interaction of these Acts with the TSC Act is varied. The most significant implications are described below and in Section 2.5.

The clearing of native vegetation in NSW is subject to consent from the Department of Land and Water Conservation (DLWC) in accordance with the NSW *Native Vegetation Conservation Act 1997* (NVC Act). The NVC Act is integrated with the *Environmental Planning and Assessment Act 1979* (EP&A Act), and requires that threatened species are taken into account when considering clearing applications under Part 4 of the EP&A Act. There are however, a series of exemptions, and the NVC Act does not apply to certain types of land including land zoned as 'residential', 'township', 'village', 'industrial', or 'business'. The private land supporting *Z. formosa* is zoned Rural Residential and the land on which *Z. buxijugum* and *Z. parrisiae* occur is zoned Rural 1a. The NVC Act thus applies to all sites of these species.

The *Rural Fires Act 1997* requires that all parties involved in fire suppression and prevention must have regard to the principles of Ecologically Sustainable Development (ESD) when exercising their functions and when preparing Draft Operational Plans and Draft Bush Fire Risk Management Plans. Consideration of the principles of ESD must include the conservation of biological diversity and ecological integrity. Within this, consideration must be given to the impact on threatened species and their habitats.

## 2.5 Environmental Assessment

The New South Wales *Environmental Planning and Assessment Act 1979* (EP&A Act) requires that consent and determining authorities, and the Director-General of NPW, 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.

The following public authorities are currently known to have a decision making function in relation to *Z. formosa*, *Zieria buxijugum* and *Z. parrisiae*:

- The DLWC in relation to private land under the requirements of the NVC Act; and
- The NPWS where a concurrence or consultation role under the EP&A Act is required, or where a Section 91 Licence (under the TSC Act) or a Section 132 Licence (Licence to grow protected or threatened plants for the purposes of sale) is required.

Any action not requiring development consent or approval under the EP&A Act, and which is likely to have a significant impact on *Z. formosa*, *Z. buxijugum* and *Z. parrisiae*, requires a section 91 licence from the Director-General of NPW under the provisions of the TSC Act. Such a licence can be issued with or without conditions, or can be refused. Routine agricultural activities however, are exempt from the provisions of the TSC Act. This means, for example, that those populations of *Z. formosa*, *Z. buxijugum* and *Z. parrisiae* on private land can, in some circumstances, legally be subject to grazing by domestic stock under the provisions of the TSC Act.

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 Minister for the Environment. As these three *Zieria* species are listed nationally under the EPBC Act, any person proposing to undertake actions likely to have a significant impact on any of these 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 Environment Australia 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 a member of these three *Zieria* species and the member is in, or on a Commonwealth area, a permit issued by the Commonwealth Minister under the EPBC Act, will be required.

The 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.

- BVSC;

## 2.6 Critical Habitat

The TSC Act makes provision for the identification and declaration of Critical Habitat for species, populations and ecological communities listed as endangered. Once declared, it becomes an offence to damage Critical Habitat (unless the TSC Act specifically exempts the action) and a Species Impact Statement is mandatory for all developments and activities proposed within Critical Habitat.

To date, Critical Habitat has not been declared for these species under the TSC Act.

Under the EPBC Act, Critical Habitat may be registered for any nationally listed threatened species or ecological community. When adopting a Recovery Plan the Federal Minister for the Environment must consider whether to list habitat identified in the Recovery Plan as being critical to the survival of the species or ecological community. It is an offence under the EPBC Act for a person to knowingly take an action on a Commonwealth area that will significantly damage Critical Habitat (unless the EPBC Act specifically exempts the action). Although this offence only applies to a Commonwealth area, any action that is likely to have a significant impact on a listed species occurring within registered Critical Habitat on other areas is still subject to referral and approval under the EPBC Act. Proposed actions within registered Critical Habitat on non-Commonwealth areas are likely to receive additional scrutiny by the Commonwealth Minister.

This Plan does not specifically identify habitat that is critical to the survival of these species. However NPWS considers that the areas critical to the survival of these species must include as a minimum all habitat currently occupied by them. The distribution, habitat and ecological information included in this Plan (sections 3.2 – 3.6) would assist the Federal Minister for the Environment in identifying habitat that is critical to the survival of these species. NPWS does not consider it appropriate that this Recovery Plan identifies or maps the occurrences of these species in the detail that would be required to define the Critical Habitat.

## 3 Species Information

### 3.1 Description and Taxonomy

*Zieria formosa* is a dense rounded shrub that grows up to 2 m in height. The leaves are arranged in clusters of three leaflets (trifoliolate) on a common stalk, with the leaf clusters occurring in opposite pairs long the branchlets. Both surfaces of the leaves are covered with a dense velvety layer of short stellate (star-shaped) hairs, giving the foliage a pale greyish-green

appearance. The upper surface is covered with numerous small warts (tubercles) whilst the lower surface is sparsely warty. The flowers are pale pink and are arranged in large, 26-45 flowered clusters. The flower clusters arise from the leaf axils near the ends of the branchlets and protrude slightly beyond the leaves. Individual flowers are about 6-9 mm across with four obovate petals. Flowering occurs in September-October. The fruit is a four chambered capsule about 5 mm across. Each chamber contains one or rarely two elliptical dark-brown seeds 2-2.5 mm long. See Figure 1 for photograph of flowering branchlet.



Figure 1. *Zieria formosa*

*Zieria buxijugum* is an erect shrub growing to 3.5 m in height. The leaves are arranged in clusters of three leaflets (trifoliolate) on a common stalk, with the leaf clusters occurring in opposite pairs long the branchlets. The leaves are strongly aromatic when crushed, and both surfaces of the leaf are covered with a dense, velvety layer of stellate (star-shaped) hairs and numerous conspicuous warts (tubercles). The central leaflet is linear to narrow oblanceolate in shape, 15-30 mm long and 2-3 mm broad, with the edges rolled under. The outer leaflets in the cluster are similar, but only about three quarters the size. The leaves are dull grey-green above and pale green beneath. The flowers are white and are arranged in clusters of up to 28. The flower clusters arise from leaf axils near the ends of the branchlets on a common stalk which is up to 1.5 cm long. The individual flowers are 6-7 mm across with four ovate-elliptic petals. Flowering occurs in September. The fruit is a four chambered capsule about 5 mm across. The capsule is red-brown when

young, becoming greenish at maturity. Each chamber contains one or rarely two elliptical dark-brown seeds 2-2.5 mm long. (See cover photograph for illustration of leaves, flowers and very young fruit).

*Zieria parrisiae* is a bushy shrub growing to 4.2 m in height. The leaves are arranged in clusters of three leaflets (trifoliolate) on a common stalk, with the leaf clusters occurring in opposite pairs long the branchlets. The leaves are strongly aromatic when crushed, and the young stems and both surfaces of the leaf are covered with a moderately dense, layer of short stellate (star-shaped) hairs and numerous conspicuous warts (tubercles). The leaf edges are slightly toothed



Figure 2. *Zieria parrisiae*

(dentate) due to the warts and are also slightly rolled under. The leaves are opposite and comprised of three leaflets (trifoliolate). The central leaflet is narrow-lanceolate in shape, 25-30 mm long and 3-4 mm wide, with the edges rolled under. The outer leaflets are similar, but only three quarters the size. The flowers are white and occur in clusters of up to 33. The flower clusters are arranged on a common stalk 10-15 mm long that arises from the axils of leaves near the ends of the branchlets. Individual flowers are 7-9 mm across with four ovate-elliptic petals. Flowering occurs between September and November. The fruit is a warty four-chambered capsule about 5mm across. Each chamber contains one or rarely two elliptical grey-brown seeds about 2 mm long. See Figure 2 for photograph of flowering branchlet.

Note: The above descriptions are a simplification of the descriptions for these species as presented in Armstrong (2002) and Briggs & Leigh (1990).

### 3.2 Distribution

Only a single population of each species is known. The three populations occur on private properties located about six and 10 km west of Pambula in the far South Coast area of NSW (see Figure 3). The species do not co-occur. Numerous searches of similar habitat in the region by several botanists in the 1980s failed to locate other populations (Briggs and Leigh, 1990).

*Zieria formosa* is known from only one population on a rhyolite rock outcrop located at Lochiel, six kilometres south-west of Pambula. In 1987 there were 125 'adult' plants in the population (Briggs and Leigh, 1990). A resurvey of the population in April 2001 found that the adult population (plants >1 m in height) had reduced to 38 plants, but there were also another 700 smaller plants (see Tables 1 & 2). The population is spread over approximately 1 ha.

*Zieria buxijugum* is known from only one population on an ignimbrite rock outcrop on Box Range Farm, approximately 10 km west of Pambula. In 1987 there were only 68 plants in the population (Briggs and Leigh, 1990). When the species was resurveyed in February 1999, the *Z. buxijugum* population was found to have increased to 121 individuals over 1 m in height. However, by April 2001 this had reduced to only 32 plants over 1 m in height, although there were another 273 smaller plants (see Tables 1 & 2). The population is restricted to an area of about 0.4 ha.

*Zieria parrisiae* is also known from only one population on an ignimbrite rock outcrop on Box Range Farm, approximately 10 km west of Pambula.

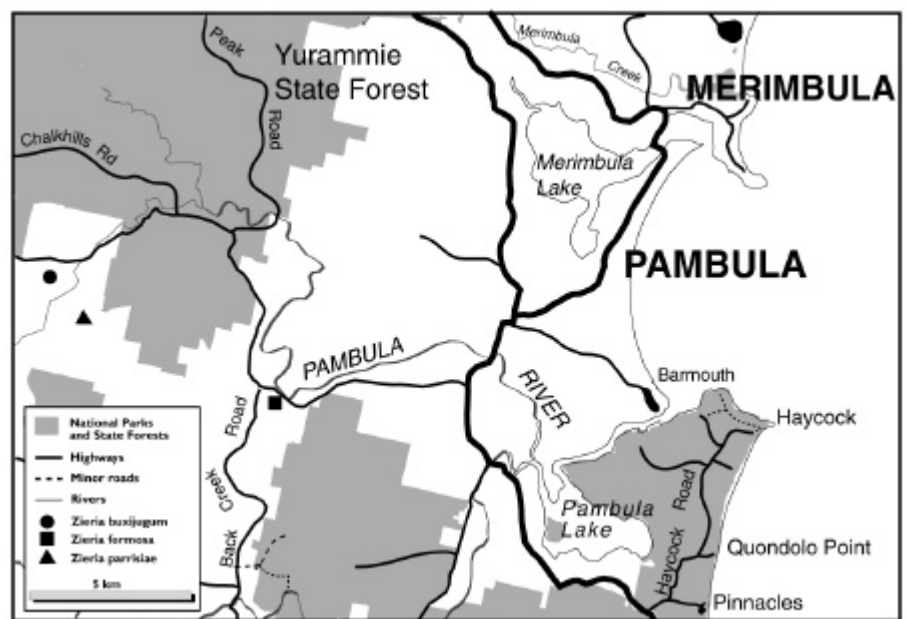


Figure 3. Distribution of *Zieria buxijugum*, *Z. formosa* and *Z. parrisiae*.



In 1987 there were only 40 plants (4 adults and 36 plants resprouting from near their bases) in the population (Briggs and Leigh, 1990). In April 2001 the population was resurveyed and the adult population (plants over 1 m in height) had increased to 36, with another 185 plants also present (see Tables 1 & 2). The population is split into two main patches located about 200 m apart along a small gully. A third, smaller patch is located between the two larger patches.

### 3.3 Land Tenure and Zoning

Most of the population of *Z. formosa* occurs on land zoned Rural Residential, and a small number of plants are on land zoned Rural 1a. The land on which *Z. buxijugum* and *Z. parrisiae* occur is zoned Rural 1a. The primary objective of the Rural 1a zone is to enable the continuation of traditional forms of rural land use and occupation. Neither zoning has any special requirements for the conservation of flora and fauna.

### 3.4 Habitat

*Zieria formosa* occurs on the north-east aspect of an upper, moderately steep slope of a 'break-away' area above a small valley. The soil is a skeletal, grey, sandy loam. The site is strewn with broken ignimbrite rocks and boulders and there is much exposed surface rock. The vegetation is a shrub-dominated community and includes Black Wattle (*Acacia mearnsii*), Blackfellows' Hemp (*Commersonia fraseri*), Large-leaf Hop-bush (*Dodonaea triquetra*), Snowy Mint-bush (*Prostanthera nivea*), Sweet Pittosporum (*Pittosporum undulatum*), White Kunzea (*Kunzea ambigua*), Yellow Tea-tree (*Leptospermum flavescens*), Nodding Blue Lily (*Stypandra glauca*), Cockspur Flower (*Plectranthus parviflorus*), Rock Lily (*Dendrobium speciosum*), Rock Fern (*Cheilanthes tenuifolia*), Shrubby Platysace (*Platysace lanceolata*) and Tree Violet (*Hymenanthera dentata*).

*Zieria buxijugum* occurs on a steep slope with an easterly aspect on an ignimbrite rock outcrop. The soil is a skeletal brown loam with a high organic matter content. There is much exposed ignimbrite rock. The vegetation is a shrub community dominated by Bracelet Honey-myrtle (*Melaleuca armillaris*) and has a sparse shrub layer including Shiny Cassinia (*Cassinia longifolia*), Cockspur Flower, (*Plectranthus parviflorus*), Violet Daisy-bush (*Olearia iodochroa*), Shrubby Platysace (*Platysace lanceolata*) and Rock Lily (*Dendrobium speciosum*). The shrub community is surrounded by Silvertop Ash (*Eucalyptus sieberi*) – Yellow Stringybark (*E. muelleriana*) open-forest.

*Zieria parrisiae* occurs in a gully on a north-north-east-facing mid slope of a steep hillside above a small creek. The soil is a skeletal, grey loam overlying

rhyolite rock. The site is strewn with broken rhyolite rocks and boulders. The species occurs in an intergrade zone between a shrub community and open-forest. The shrub community is dominated by Bracelet Honey-myrtle (*Melaleuca armillaris*), White Kunzea (*Kunzea ambigua*) and Black Wattle (*Acacia mearnsii*). Other associated species include Shiny Cassinia (*Cassinia longifolia*), Cockspur Flower, (*Plectranthus parviflorus*), Blackfellows' Hemp (*Commersonia fraseri*), Shrubby Platysace (*Platysace lanceolata*) and Rock Lily (*Dendrobium speciosum*). The adjacent open-forest is dominated by Yellow Stringybark (*Eucalyptus muelleriana*).

### 3.5 Ecology

#### General

The mature plants of all three species flower prolifically and high levels of fruit set were observed in 1986/87 (Briggs, pers. comm.). Seedlings of varying size are present at all sites (see Table 2), suggesting some recruitment probably would occur in most years in the absence of browsing.

The plants of both *Z. formosa* and *Z. buxijugum* grow mainly in full sun, although some of the *Z. buxijugum* population receives part shade that is provided by associated taller shrubs. Conditions on these sites during summer would be extremely hot, and often very dry. *Zieria parrisiae* occurs as a midstorey shrub and grows in partial to moderately heavy shade. Heavy frosts are uncommon at the three sites, and the driest conditions normally occur during winter.

Competition to seedlings and young plants from other native understorey species appears relatively low, as there is much exposed rock at the three sites and there are few other native sub-shrubs or herbaceous species present.

Following the 1997/98 drought there has been substantial death of the co-dominant shrub (mainly Yellow Tea-tree and White Kunzea) at the *Z. formosa* site, leaving few remaining live adult shrubs on that part of the slope which supports *Z. formosa*.

On the *Z. parrisiae* sites many of the large White Kunzea and Bracelet Honey-myrtle shrubs have become senescent and have either died or have been blown over in storms in the past couple of years. This has resulted in a substantial thinning of the shrub overstorey canopy and has consequently increased light penetration to the understorey. This change in the micro-environment may well be beneficial to the survival and growth of the numerous young *Z. parrisiae* plants that currently comprise the major portion of the population of this species.

*Life Cycle*

*Zieria parrisiae* commences flowering in late September and flowering extends through to early November. *Z. buxijugum* and *Z. formosa* flower mainly in September, with flowering in *Z. formosa* extending into October. The three species are almost certainly insect pollinated, and native bees, hover flies and blowflies have been observed visiting the flowers. Fruit at all stages through to maturity can be found on plants still producing flowers in October. The fruits develop and ripen rapidly, and seed shed appears to be mostly complete by the end of December.

Seven plants (representing three genotypes) of *Z. formosa*, eight plants (one genotype) of *Z. buxijugum* and 27 plants (representing five genotypes) of *Z. parrisiae* are still growing at the Australian National Botanic Gardens (ANBG) from cuttings taken in 1986. These plants have survived 15 years in cultivation in the relatively harsh climate of Canberra where winters are much colder than those that would be experienced in the natural habitat of these species.

Individuals have not been regularly monitored in the field, but the four large, relatively undamaged plants of *Z. parrisiae* observed in 1986 were still healthy in April 2001. Given the large size to which *Z. parrisiae* grows and the slow growth that has taken place over the past 15 years, it would appear that this species

might live for 50 years, or more. The other two species probably live to at least 20 to 30 years old, but there are little data on which to base these estimates.

*Population Structure and Population Trends*

The number of adult plants (>1 m in height) recorded in 1987 by Briggs & Leigh (1990) for the three species is presented in Table 1. Height-class data for each of the species, as measured by Briggs and Wright (unpublished data) in April 2001, are presented in Table 2.

The 70% reduction in the adult population of *Z. formosa* (plants over 1 m in height) from 125 plants in 1987 to 38 in 2001 was primarily due to death of adults during a drought in 1997/98. At the time of a survey of the population in 1999 by Briggs & Smith (unpublished data), 74 dead shrubs of this species were still clearly recognisable, but two years later these have now largely decomposed. Fortunately there has been vigorous seedling regeneration since the 1997/98 drought, and this is reflected in the relatively large number of individuals in the lower height classes.

The 53% reduction in the number of *Zieria buxijugum* plants from 68 in 1986 to 32 plants over 1 m high in 2001 is a recent event, and has been caused by browsing damage sustained during the winter of 2000. At that time, the stems of many of the *Zieria* plants were pruned off, or have subsequently died-back following the browsing damage. Prior to that event, Briggs & Smith (unpublished data) recorded 121 plants over 1 m high in 1999. At that time there had been a 78% increase in the population since 1987. It can be seen from Table 2 that there are still numerous individuals in all the smaller height classes, giving the species potential for substantial recruitment into the taller height class and restoring the number of 'adult' plants to a similar or higher number than that recorded in 1999. It is to be noted that currently only five *Z. buxijugum* plants are over 2 m in height. Because of their height these few plants are less susceptible to heavy browsing than the rest of the population.

There has been a substantial increase (from 4 to 36) in the

**Table 1.** Number of plants (adults) of *Z. formosa*, *Zieria buxijugum* and *Z. parrisiae* in 1987.

	<b>Z. formosa</b>	<b>Z. buxijugum</b>	<b>Z. parrisiae</b>
No. of adults (1 m + high)	125	68	4 (plus 36 resprouting stumps)

Source. Briggs & Leigh (1990)

**Table 2:** Population structure of *Zieria formosa*, *Z. buxijugum* and *Z. parrisiae* in 2001.

Species	Plant height class				Total population
	< 0.2 m	0.2 – 0.5 m	0.5 – 1 m	> 1 m	
<b>Zieria formosa</b>					
Section (Su)*	95	135	153	37	420
Section (St)*	219	82	11	0	312
Section (Po)*	3	1	0	1	5
<b>Total</b>	<b>317</b>	<b>218</b>	<b>164</b>	<b>38</b>	<b>737</b>
% of Total	43%	30%	22%	5%	
<b>Zieria buxijugum</b>					
<b>Total</b>	<b>78</b>	<b>131</b>	<b>64</b>	<b>32</b>	<b>305</b>
% of Total	26%	43%	21%	10%	
<b>Zieria parrisiae</b>					
Sub-popltn lower	39	16	16	21	92
Sub-popltn middle	2	0	1	4	7
Sub-popltn upper	77	23	11	11	122
<b>Total</b>	<b>118</b>	<b>39</b>	<b>28</b>	<b>36</b>	<b>221</b>
% of Total	53%	18%	13%	16%	

number of plants of *Z. parrisiae* over 1 m high since 1987, although it should be noted that only half of these plants are more than 1.5 m in height, and these are not yet likely to contribute substantially to seed production. The four adults of *Z. parrisiae* recorded by Briggs & Leigh in 1986 are still surviving, and these are now between 3.95 m and 4.2 m in height. The population structure of *Z. parrisiae* is currently skewed to the smaller height classes, with 53% of the population being seedlings less than 20 cm high.

#### *Disturbance Regimes*

*Zieria formosa* appears to be relatively unpalatable and shows little sign of being browsed by native or introduced animals.

Prior to winter 2000, *Z. buxijugum* had not shown signs of significant browsing damage, however since then all but the five largest plants have been severely browsed, apparently by Swamp Wallabies. This browsing event had largely ceased during the first half of 2001. Based on observations made in 1986/87 and over the past four years, heavy browsing of *Z. buxijugum* may only be an intermittent disturbance event, but this may well significantly reduce seed production for more than one year following such activity.

Browsing by goats in the mid 1980s had a major adverse impact on the adult population of *Zieria parrisiae*, with all but four of the tallest plants having been smashed and browsed to near ground level. Field observations since 1996 indicate that browsing by Swamp Wallabies is having an ongoing adverse effect on the growth and survival of *Z. parrisiae* seedlings and young plants through the constant 'nipping off' of the seedlings as they produce new growth.

Whilst a drought in 1997/98 had a major impact on the adult population of *Z. formosa*, this drought did not appear to have a significant affect on the other two species.

There is no direct observation on the effects of fire intensity, seasonality or frequency of fire events on any of these species. However, on the sites where *Z. parrisiae* and *Z. buxijugum* occur, the presence of very large individuals of other fire sensitive species indicates that the sites have not been burnt for several decades. It is predicted that these communities would be very slow to recover from fire (Briggs and Leigh 1990).

### 3.6 Ability of Species to Recover

The current small number of large, reproductively mature plants for each species is a concern, in that production of seed is presently very limited and localised on each of the sites. Unless there are significant levels of soil-stored seed (an unknown

factor at present), currently low levels of seed production are likely to limit future recruitment. The development of more plants into large, reproductively mature plants will be important to restore seed production to what is likely to be more normal and desirable levels. Fortunately, the three species currently have substantial numbers of plants in the seedling and lower height classes, indicating all have the ability to recruit given an adequate seed source and favourable conditions. Providing the threats detailed below are removed or adequately controlled there is no strong reason why many of the plants in these lower size classes would not develop into reproductively mature individuals, and a more robust population structure be restored.

## 4 Management Issues and Threats

### 4.1 General

The overarching conservation concern with all three of these species is the small total population size, the current low numbers of large, reproductively mature plants and the extremely small area occupied by each species. This makes each species very susceptible to extinction through stochastic events such as disturbance from wildfire, drought and severe browsing.

Drought appears to be a natural threat, particularly for *Z. formosa*, as tolerance of adults to extremely dry conditions, such as those experienced on the site in 1997/98, has been demonstrated to be low.

In more recent years browsing by Swamp Wallabies has probably become a more serious threat to *Z. buxijugum* and *Z. parrisiae* than it would have been prior to European settlement. This threat is suspected to have increased due to numbers of wallabies in the area having increased with the clearing and establishment of pasture on nearby farmland, coupled with a general rural community trend in recent years to less frequent shooting of these animals.

### 4.2 *Zieria formosa*

More than two thirds of the mature population recorded in 1987 (125 plants) died as a result of the 1997/8 drought. The large number of seedlings is encouraging, but survival rates of this recruitment may depend on continuing favourable seasonal conditions and continuing low levels of browsing by wallabies and rabbits, which are both present at the site.

In 1999 the land surrounding the site was the subject of a Rural Residential subdivision application. Without appropriate controls, there is potential for this subdivision to indirectly impact on the species, through increased nutrients and sediments being carried on to

the site via a small creek draining through the site from the proposed adjacent subdivision. Weed infestation could subsequently become a problem for a section of the population that occurs along a drainage line. BVSC has thus imposed some specific controls on the development to minimize potential indirect impacts on *Z. formosa*. These controls are detailed in section 5 of this Recovery Plan.

#### 4.3 *Zieria buxijugum*

The *Z. buxijugum* population is in an area not currently subject to domestic stock grazing, nor is there likely to be any in this area. Prior to winter 2000 there appeared to be no immediate specific threat to this species, however the severe browsing damage caused by wallabies at that time has had a major impact on most plants, and few are expected to flower in spring 2001. Providing such browsing events occur only every few years then the majority of plants could be expected to recover in the intervening periods and the population remain reasonably stable. Monitoring will be important to determine whether the frequency and impact of possible future browsing events is becoming a significant threat requiring management action.

Fires of low to moderate intensity are unlikely to impact on the entire population, as the site is very rocky and unlikely to carry a fire across the whole of the habitat.

#### 4.4 *Zieria parrisiae*

The major ongoing threat appears to be browsing by wallabies. Both young plants and seedlings are still being severely effected by browsing. The most likely current cause is macropods (an automatically triggered camera placed at the site during 1999 has recorded a Swamp Wallaby adjacent to a browsed *Zieria* plant and goat dung is no longer evident). Because there are so few large, reproductively mature plants, this ongoing browsing is considered a significant threat, particularly as it appears to be slowing the rate of movement of seedlings and smaller plants into the larger size classes.

In 1999 leaf-eating insects were observed to be causing substantial leaf-area loss, particularly on some young plants. Such damage has been considerably less during 2001.

## 5 Previous Recovery Actions

### All species

- Initial population counts for all three species were undertaken in 1986 and 1987 by Briggs & Leigh (1990) (see Table 1).
- In 1986 propagating material was collected from all three species in order to establish ex-situ collections at both the ANBG and the Mount

Annan annex of the Royal Botanic Gardens (MABG). The surviving ex-situ collections currently held at each of these institutions are as follows (Stig Pedersen (ANBG), pers. comm.; Richard Johnston (MABG), pers. comm.).

#### *Z. buxijugum*

34 plants of a single genotype at ANBG and 18 plants from a single genotype at MABG. The genotype at ANBG is from a different parent than that at MABG.

#### *Z. formosa*

6 genotypes at ANBG, with the numbers of plants from the various genotypes being 74, 20, 18, 6, 3 & 1. 3 genotypes at MABG, one of 3 plants, the others of 2 plants each. The genotypes at ANBG are from different parents than those at MABG.

#### *Z. parrisiae*

6 genotypes at ANBG, with the numbers of plants from the various genotypes being 26, 19, 17, 14, 6 & 5. 1 genotype of 4 plants at MABG. The genotype at MABG is from the same parent as one of the ANBG genotypes.

- The adult population of each species was recounted on February 4 and 5, 1999 by NSW NPWS.
- In March and April 2001, NPWS undertook detailed population counts for the three species, allocating plants to one of four height classes (see Table 2).
- In March and April 2001, NPWS established three monitoring plots in the populations of *Z. formosa* and *Z. buxijugum*. For each plot the heights of all plants were measured, and the plants tagged and mapped. In the case of *Z. parrisiae*, the entire population was measured, tagged and mapped.

#### *Zieria formosa*

- BVSC imposed several controls on a Development Application lodged in 1999 for a Rural Residential subdivision adjacent to the area supporting *Z. formosa*. These measures included (1) specifying the location of building envelopes so as to ensure drainage from those sites does not flow onto habitat of *Z. formosa* habitat, (2) changing the location of the access road to avoid sediment runoff from the gravel road onto the *Zieria* site, and (3) a requirement for BVSC consent to clear native vegetation.

#### *Zieria buxijugum*

- In April 2001 NPWS installed 10 wire mesh guards around selected *Z. buxijugum* plants to protect them from browsing by wallabies. The plants chosen for protection were scattered across the site, with the

aim of ensuring a source of seed-producing plants would remain across the site in case there are further severe browsing events. If further severe browsing does occur, then it is expected that protection of some large seed-producing plants will assist future seedling recruitment and population recovery.

***Zieria parrisiae***

- Goats were eradicated from the site by the landowner in 1987/88. Goats were considered the main threat at that stage.
- The population was revisited a few times between February 6 and August 8, 1999, and searches made for the two sites recorded in 1987. Both the previously known sites were eventually found and the population size determined. Mr Chris Parramore also located a small colony of plants of *Z. parrisiae* at Box Range between February 8 and 18, 1999 that had not been found in 1986/87.
- Wire mesh guards were installed during 1999 to protect some of the seedlings and young plants from browsing by wallabies. Several other seedlings were protected by placing branches of dead shrubs over the *Zieria* seedlings to discourage wallabies from feeding on them.

## 6 Proposed Recovery Objectives, Actions and Performance Criteria for 2001-2005

The overall objective of this Recovery Plan is to ensure that the adult populations of *Z. formosa* and *Z. parrisiae* (reproductive plants >1 m in height) increase to at least those levels recorded by Briggs & Leigh (1990) in the mid 1980s, and that there is a substantial increase (approximately 300%) in the current number of adult plants of *Z. parrisiae*.

Due to the extremely restricted distribution and small population sizes, it is not envisaged that these species will ever qualify for removal from the Schedules of the TSC or EPBC Act.

### Specific Objective 1: Control known threats

*Action 1.1: Construct wallaby-proof fences around the three sub-populations of Z. parrisiae.*

Due to the extremely low numbers of reproductive *Z. parrisiae* individuals, all possible measures will be used to increase survival of seedlings and young plants. All the sub-populations have experienced severe browsing by wallabies. It is therefore proposed to construct a wallaby-proof fence around each of the three sub-populations in an effort to reduce this threat. The individual wire mesh guards which were placed around selected *Z. parrisiae* plants in 1999 will be left in place as additional protection against browsing. *Z. formosa* seedlings are also occasionally browsed, but currently the impact of this on recruitment does not appear to be significant and there does not appear to be a need to control browsing by native animals.

#### *Performance Criterion 1.1*

A wallaby-proof perimeter fence is constructed around each of the three sub-populations of *Z. parrisiae* within one year of the approval of this Plan.

*Action 1.2: Afford, if required, protection to additional selected Z. buxijugum plants using individual wire mesh guards.*

Recent heavy browsing by wallabies has had a major impact on *Z. buxijugum* plants. In April 2001, 10 wire mesh guards were installed to protect from further damage a selection of *Zieria* plants distributed across the range of the population. This action will allow some plants to flower and produce seed if heavy browsing re-occurs and will increase the potential for future seedling recruitment. If heavy browsing re-occurs at frequent intervals, then it may be necessary to install additional wire mesh guards to protect a larger portion of the population.

Fencing of the whole of the population is desirable,

and has been seriously considered. However, because of the very steep, rocky and uneven nature of the terrain in the vicinity of the population, this would be a very difficult and expensive task. This option should be reconsidered if severe browsing proves to be a major ongoing threat which can not be adequately ameliorated through the individual protection (using wire mesh guards) of sufficient reproductive adults.

#### *Performance Criterion 1.2*

If monitoring indicates the need, additional individual wire mesh guards are in place within one year of the determination of this need.

### Specific Objective 2: Monitoring

*Action 2: Establish and maintain a regular monitoring program.*

Initially the populations should be monitored every six months to determine mortality and recruitment rates. This monitoring will be used to determine the effectiveness of management actions taken to increase recruitment and survival rates. This is particularly important for *Z. parrisiae* and *Z. buxijugum*. Detailed monitoring should be carried out on a number of *Z. parrisiae* and *Z. buxijugum* seedlings to determine growth rates, mortality and the likely causes of any loss of plants. As knowledge increases and confidence in management actions improves, monitoring frequency could be reduced to annually.

#### *Performance Criterion 2*

A detailed population census is conducted every six months for at least the first two years of this Plan, and subsequently annually for the life of this Plan.

### Specific Objective 3: Determine for each species whether an ex-situ population is required/desirable and if so, establish one.

*Action 3.1: Review the results of Action 2 for each of the three species and determine the need for expansion of ex-situ conservation efforts.*

If there is continued decline in the reproductive adult population size of any of these three species despite management efforts, then an expansion of the current ex-situ population should be undertaken. This may be necessary for *Z. parrisiae* and *Z. buxijugum* in particular, as the number of adults is currently very low for these species.

Such an ex-situ collection could include both increasing the numbers of live plants and also the

establishment of a seed bank. An expanded ex-situ collection would serve primarily as a source of propagating material which could then be used in the propagation of plants for reintroduction into the natural site in the event of a catastrophic reduction in the size of the natural population. Such an event is more likely if the natural population, remains very low. An expanded *ex-situ* population should represent the range of genetic diversity in the wild.

*Performance Criterion 3.1*

Within three years of the approval of this Plan the need for ex-situ conservation has been assessed.

*Action 3.2: If required, establish ex-situ populations and maintain for the purposes of recovery and research.*

If the results from Action 3.1 dictate that *ex-situ* populations are required, then botanical gardens will be approached to establish *ex-situ* populations from either cuttings or seed. Appropriate locations for any *ex-situ* populations will also need to be determined.

*Performance Criterion 3.2*

If determined necessary (Action 3.1), appropriately located *ex-situ* populations are established within four years.

**Specific Objective 4: Establish medium and long term security for sites containing these species**

*Action 4.1: Seek agreement from landowners to the establishment of medium and long term protection for all three sites. Implement these protective mechanisms where agreement is reached.*

At this time, the continued recovery of these species is subject to the good will of the landowners. Although three of the four landowners have expressed their support for efforts to protect these species, if the land were to change ownership, this situation could change. Measures to ensure the medium term protection of these species could include registering the areas as Wildlife Refuges or entering into a Property Agreement under the provisions of the NVC Act. Long-term protection of these sites could be achieved through Voluntary Conservation Agreements between the owners and NPWS.

*Performance Criterion 4.1*

Discussions between NPWS and the landholders have been held within five years to seek medium/long term protection of sites from adverse changes in management regimes or from possible adverse

developments. Implement these measures within five years where agreement is reached.

*Action 4.2: Bega Valley Shire Council to include an advisory note recording the presence of these species on Section 149 Certificates for the relevant properties.*

Although the current landowners are aware, and are supportive of the protection of these species on their land, it is important that future potential purchasers of the properties are made aware of the presence of these species at an early stage. Council staff also change over time and it is also important that BVSC is automatically alerted to the presence of these species should any Development Applications be submitted which might affect them. The recording by BVSC of the presence of these species on section 149 Certificates under the provisions of the *Local Government Act* will assist in achieving this.

*Performance Criterion 4.2*

Within two years BVSC have recorded the presence of these species on s.149 Certificates for the relevant properties.

*Action 4.3: Identification and nomination of Critical Habitat*

The NPWS will consider the benefits of nominating Critical Habitat and, if appropriate and after consultation with the landowners, make a recommendation to the Minister regarding what area should be listed.

*Performance Criterion 4.3*

Within five years NPWS will have made a decision as to whether to recommend to the NSW Minister for the Environment the listing of areas of Critical Habitat for each of the three species.

**Specific Objective 5: Maintenance of an effective liaison between NPWS and the landowners.**

*Action 5: NPWS to maintain regular communication with the landholders*

Communications are required on a regular basis (at least twice yearly) to review progress of the recovery program and ensure the landowners are fully informed.

*Performance Criterion 5*

NPWS is in contact with the landowners at least twice yearly for the life of this Plan.

## 7 Implementation

Table 1 outlines the implementation of recovery actions specified in this Plan for the period of five years from publication.

## 8 Social and Economic Consequences

The social and economic consequences of implementing this Plan are minimal, given the restricted distribution of the species. None of the species occur on land suitable for any form of agriculture. Restriction of mining of rhyolite on Box Range farm may cause the loss of some income to the landowner. Due to the extremely rocky and steep nature of the habitat occupied by *Z. formosa*, it is unlikely that the presence of the species will impose major constraints to likely proposals for the siting and construction of dwellings on these rural residential blocks.

## 9 Biodiversity Benefits

The protection of these three species will in turn protect the rock outcrop communities in which they occur. The shrub communities that occur on rhyolite rock outcrops on the NSW South Coast are uncommon and localised and often also support other rare or threatened species.

## 10 Preparation Details

This Recovery Plan was prepared by John Briggs and Genevieve Wright, Threatened Species Unit, NPWS Southern Directorate, in consultation with the owners of the land on which these species occur. The Plan was edited by Michael Saxon (NPWS).

## 11 Review Date

In relation to its status as the State-endorsed Recovery Plan for *Zieria formosa*, *Zieria buxijugum* and *Zieria parrisiae*, any major changes to this Recovery Plan will require the revised Plan to be placed on public exhibition in NSW and re-approval by the NSW Minister for the Environment. The NPWS or Environment Australia should be contacted if it is believed any change to the Recovery Plan or to the Recovery Program should be considered. This Recovery Plan is to be formally reviewed by the NPWS in conjunction with the landowners within five years from the date of its publication.

## 12 References

- Armstrong, J.A. (2002). The Genus *ZIERIA* (Rutaceae): A systematic and Evolutionary Study. *Aust. Sys. Bot* (in press).
- Briggs, J.D. & Leigh J.H. (1990). Delineation of Important Habitats of Threatened Plant Species in South-Eastern New South Wales, 312 pp. Research Report to the Australian Heritage Commission. (CSIRO: Canberra).
- Briggs, J.D. & Leigh J.H. (1996). Rare or Threatened Australian Plants; 1995 revised edition. (CSIRO: Melbourne).

## 13 Acronyms Used in this Document

**ANBG** – Australian National Botanic Gardens

**BVSC** – Bega Valley Shire Council

**DLWC** – NSW Department of Land and Water Conservation

**EP&A Act** – NSW *Environmental Planning and Assessment Act 1979*

**EPBC Act** – Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

**ESD** - Ecologically Sustainable Development

**MABG** – Mount Annan Botanic Gardens

**NPW Act** – NSW *National Parks and Wildlife Act 1974*

**NPWS** – NSW National Parks and Wildlife Service

**NVC Act** – NSW *Native Vegetation Conservation Act 1997*

**TSC Act** – NSW *Threatened Species Conservation Act 1995*



**Table 2:** Estimated costs, funding source and responsible parties for implementing the actions identified in the Recovery Plan for *Z. formosa* , *Z. buxijugum* & *Z. parrisiae*.

Action No.	Action Description	*Priority	^Feasibility	Responsible Party	Fund source	Cost Estimate (\$/year)					Total Cost (\$)
						2001	2002	2003	2004	2005	
1.1	Construct and maintain wallaby-proof fences	1	80%	NPWS	'in kind'	700	700	700	700	700	3,500
				Contractor	NHT <sup>1</sup>	13,000	1,000				14,000
1.2	Afford, if required, protection to additional <i>Z. buxijugum</i> plants using individual wire mesh guards.	1	90%	NPWS	'in kind'		350				350
					NHT <sup>1</sup>		700				700
2	Monitoring	2	100%	NPWS	'in kind'	1,400	1,400	1,400	1,400	1,400	7,000
					NHT <sup>1</sup>	2,100	2,100				4,200
					Cash			1,400	1,400	1,400	4,200
3.1	Determine need for ex-situ collections	2	90%	NPWS	NHT <sup>1</sup>		350				350
					'in kind'			350			350
3.2	If necessary, establish ex-situ collections	2	80%	NPWS	'in kind'			700♦	350♦		1,050♦
				Botanic Gardens	Cash			Uncosted	Uncosted		Uncosted
4.1	Discuss with landowners the establishment of medium and long term protection of the sites & formalise agreed actions	2	80%	NPWS	'in kind'		350	350	1,050	1,400	3,150
4.2	BVSC to record sites on s.149 Certificates	2	100%	BVSC	'in kind'		350				350
4.3	Consider identification and nomination of Critical Habitat	2	100%	NPWS	'in kind'				350	Uncosted	350
5	Maintain effective liaison between NPWS and the landowners.	2	80%	NPWS	'in kind'	350	350	350	350	350	1,750
<b>Annual and total cost of the Zieria multi-species Recovery Program</b>					NHT <sup>1</sup>	15,100	4,150				19,250
					'in kind'	2,450	3,500	3,850	4,200	3,850	17,850
					Cash			1,400	1,400	1,400	4,200
					<b>TOTAL</b>	<b>17,550</b>	<b>7,650</b>	<b>5,250</b>	<b>5,600</b>	<b>5,250</b>	<b>41,300</b>

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## 15 Costing Explanations

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Where fund source is listed as Cash, funding will be sought from sources such as Natural Heritage Trust, industry sponsors, the NSW State Biodiversity Program and NPWS annual provisions for implementation of threatened species programs.

Salary for 'in-kind' contributions is calculated at \$350 per day, which includes officer salary and on-costs, provision of office space, vehicles, administration support and staff management.

<sup>1</sup> Actions already approved for funding from the Commonwealth Natural Heritage Trust Endangered Species Program.

♦ This money will only be required if the results of Action 3.1 indicate that *ex-situ* conservation measures are required.

\* Priority ratings as defined by Commonwealth Recovery Plan guidelines: 1 - action critical to prevent extinction, 2 - action prevents negative impact short of extinction,

^ Feasibility assessment reflects estimated chance of success of the action on a scale of 0-100%.



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43 Bridge Street  
Hurstville 2220  
(02) 9585 6444