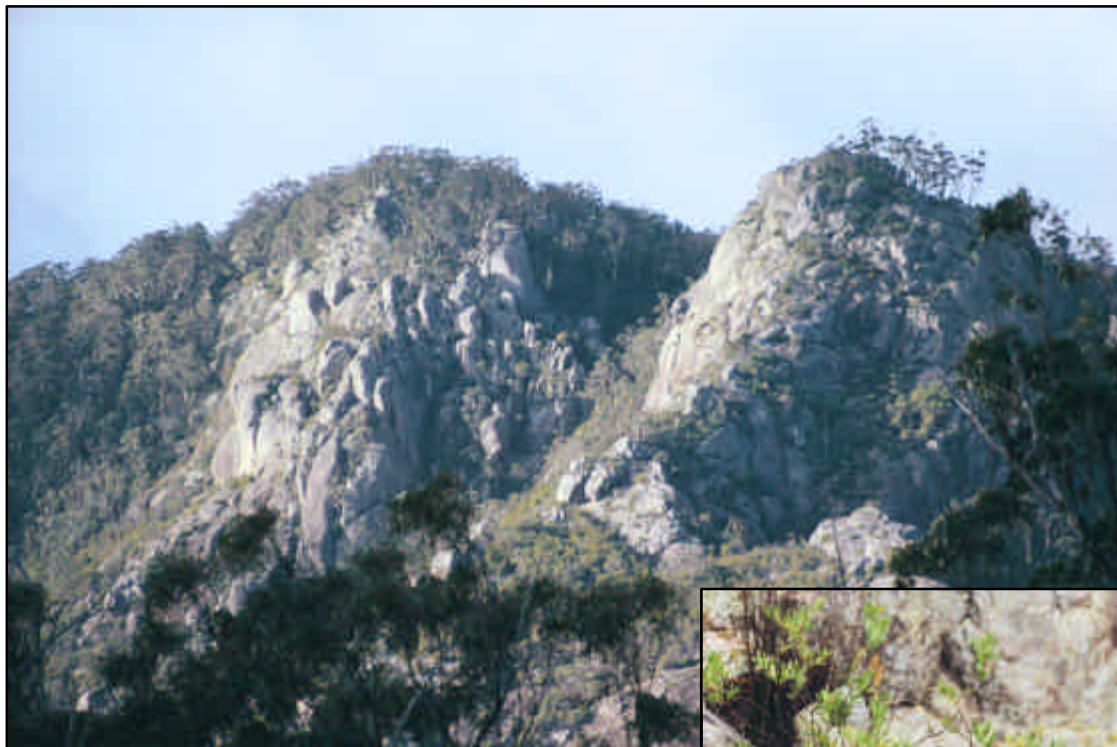




Recovery Plan for Threatened Flora of Rocky Outcrops in South Eastern New South Wales



**Draft for Public Comment
January 2003**

**NSW
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WILDLIFE
SERVICE**

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Recovery Plan for Threatened Flora of Rocky Outcrops in South Eastern New South Wales

Executive Summary

This document constitutes the formal draft Commonwealth and New South Wales State Recovery Plan for the Narrabarba Wattle (*Acacia constablei*), Bega Wattle (*Acacia georgensis*), David's Westringia (*Westringia davidii*), Ralston's Leonema (*Leonema ralstonii*) and Rhyolite Midge Orchid (*Genoplesium rhyoliticum*). It considers the conservation requirements of these species across their known range, identifies actions to be undertaken to ensure their long-term viability in the natural environment and the parties who will carry these out.

The Rhyolite Midge Orchid is listed as Endangered (Schedule 1, Part 1) on the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* and Endangered (Schedule 1, Part 1) on the *NSW Threatened Species Conservation Act 1995*. It is a terrestrial orchid endemic to NSW and is known from only five sites confined to an area approximately 5 by 10 km. The remaining four species are listed as Vulnerable both nationally and in NSW. The Narrabarba Wattle is a shrub or small tree and is a narrow endemic known from only two localities with a total estimated population of 5000. The Bega Wattle is a tree to 12 m and is known from seventeen sites with a distribution spanning 120 km and a total population of approximately 28,000. Ralston's Leonema and David's Westringia are both small shrubs. The former species is found at some 68 sites to the west of Pambula and Eden with a total population of 18,000. The latter species occurs at 20 sites, again to the west of Pambula and Eden but in a somewhat more restricted area. Its population size is estimated to be 7,400.

A Recovery Team was established to prepare this Recovery Plan in 1999. This was followed by detailed survey work on populations at 35 sites, an assessment of threats to the five species and the identification of actions required to ensure their continued survival.

The future recovery actions detailed in this recovery plan include: (i) collection of information on additional occurrences of the species, (ii) monitoring to determine trends in population sizes, (iii) assessment of the extent and severity of threats and their elimination or control, (iv) research on the biology and ecology of the species where appropriate, (v) integration of management requirements into relevant State Forest and NPWS Management Plans, (vi) the development of appropriate conservation/management agreements for sites not within State Forests estate or National Parks, and (vii) provision of information to managers and the community on the significance of species of rocky outcrops in south eastern New South Wales.

It is intended that this recovery plan will be implemented over a five-year period. Many actions will be implemented using existing resources of various NSW Government agencies and community-based groups. An additional \$32,500 will be required to implement the remaining currently unfunded actions.

Brian Gilligan
Director-General

Acknowledgments

The following members of the Recovery Team and their respective agencies/organisations are thanked for their contributions of valuable information, advice, observation and comment toward the development of this Recovery Plan and with the implementation of recovery actions to date:

Stephen Clark (NSW NPWS) – Recovery Team Coordinator
Geoff Carr (Ecology Australia)
Sharon Davey (NSW NPWS)
Stephen Deck (NSW NPWS)
Sue McIntyre (landowner)
Graham Roche (Bega Valley Shire Council)
Chris Slade (State Forests NSW)
Dane Wimbush (community member)

The assistance of the following individuals is also very much appreciated: David Albrecht (Alice Springs Herbarium Parks and Wildlife Commission of the Northern Territory), Doug Binns (State Forests NSW), Barbara Briggs (National Herbarium of NSW), Barry Conn (National Herbarium of NSW), Jane Elith (University of Melbourne), David Keith (NSW NPWS), Bob Makinson (Australian National Herbarium Canberra), Jackie Miles, Kim Pullen (CSIRO Canberra), Jonathan Sanders (NSW NPWS) and Neville Walsh (National Herbarium of Victoria).

Particular thanks to Peter Tucker, Eric Ward, Steve Mathews and Corinna Orscheg for assistance and insights in the field.

The preparation of this Recovery Plan and the associated survey work, assessment of threats to the five species and the identification of actions required to ensure their continued survival has been made possible through funding from the Comprehensive Regional Assessment/Regional Forest Agreement (CRA/RFA) program.

1 Introduction

This Recovery Plan considers five threatened plant species which are endemic to rocky outcrops in the coastal forests of south-east NSW. The five species are:

- Narrabarba Wattle (*Acacia constablei*) and Bega Wattle (*Acacia georgensis*), both small trees to 7 and 12 metres respectively;
- Ralston's Leionema (*Leionema ralstonii*) and David's Westringia (*Westringia davidii*), both medium sized shrubs; and
- Rhyolite Midge Orchid (*Genoplesium rhyoliticum*), a diminutive terrestrial orchid.

While the plight of the individual biota is an important aspect of this plan, it is intended that it will also contribute to the conservation of the rocky outcrop plant communities of which these plants are an integral part. Rocky outcrops within the coastal forests of NSW, have been recognised as supporting a disproportionately high number of rare and biogeographically significant plant species (Keith & Sanders 1990, Binns & Kavanagh 1990). They are also notable for supporting a high proportion of restricted endemic species. Within the Eden Region (an area of some 800,000 ha), Keith & Sanders found that of the 40 plant taxa recognised at the time as being rare or threatened at a national level, 15 occurred on the rocky outcrops which are the subject of this plan. These outcrops cover an area of less than 200 ha comprising some 48 discrete sites. In addition, 6 of these 15 plant taxa were endemic to these same rocky outcrops. More recently Carr and White (in prep) recorded 38 plant taxa of conservation significance which occur on rocky outcrops in south eastern NSW (see Appendix 1).

This document constitutes the formal draft Commonwealth and New South Wales State Recovery Plan for these five species. It considers the conservation requirements of the species across their known range, 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 in this Recovery Plan is subject to budgetary and other constraints affecting the parties involved. It may also be necessary to amend this Recovery Plan in the event of new information or following recommended changes to the Recovery Program by the Recovery Team. The information in this Recovery Plan is accurate to December 2002.

This draft will be placed on public exhibition for a period of six weeks. Readers are invited to comment

on its contents. Further information regarding the submission process and a submission form can be found at the rear of this plan.

2 Legislative Context

2.1 Legal Status

All five species treated in this recovery plan are endemic to rocky outcrops in the South East Forests of NSW. They are listed under the schedules of both the NSW *Threatened Species Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). *Genoplesium rhyoliticum* is considered 'endangered' and is listed under both Acts. The other plant species are considered 'vulnerable' and are listed under Schedule 2 of the TSC Act and under Schedule 1, Part 2 of the EPBC Act.

The current list of *Rare or Threatened Australian Plants* (Briggs and Leigh 1996) applies the following conservation status to the five plant species covered in this recovery plan.

<i>Acacia constablei</i>	2V
<i>Acacia georgensis</i>	2VCi
<i>Genoplesium rhyoliticum</i>	2E
<i>Leionema ralstonii</i>	2VCi
<i>Westringia davidii</i>	2V

Note that '2' indicates that the known geographic range of the species is less than 100 km, 'E' denotes the species is endangered and in serious risk of depletion in the wild within 10-20 years if present land use and threats continue to operate, 'V' denotes the species is not presently 'Endangered' but at risk over a longer period (20-50 years) of disappearing from the wild through continued depletion, or occurs on land whose future use is likely to change and threaten its survival, 'C' indicates that the species has at least one population within a reserve set aside for the conservation of nature or otherwise dedicated for the protection of flora, 'i' indicates that less than 1000 plants are known to occur in a conservation reserve.

Among the consequences of listing as threatened species on the TSC Act are that a Recovery Plan must be prepared, that consideration be given to the species in assessing the impacts of developments and activities with the aim of minimising adverse impacts, and that actions that are likely to result in the harming or picking of that species or damage to its habitat are licensed.

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 the Commonwealth Minister for the Environment to ensure 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.

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 NPW to forward the final version of this draft 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 and councils 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.

In the context of this Recovery Plan, the relevant government agencies are the National Parks and Wildlife Service (NPWS), Bega Valley Shire Council (BVSC), State Forests of New South Wales (SFNSW) and the Rural Fire Service.

2.4 Relationship to Other Legislation

The lands on which these species occur include those that are owned or managed by private landholders, NPWS, SFNSW and BVSC. In addition to the TSC and the EPBC Acts other legislation relevant to this plan include:

The National Parks and Wildlife Act 1974

Many of the known populations of the plant species subject to this plan occur within National Parks reserved under the provisions of the *National Parks*

and *Wildlife Act 1974*, and are in the care and management of the New South Wales National Parks and Wildlife Service. All plants are protected where they occur in National Parks.

The Native Vegetation Conservation Act 1998

The clearing of native vegetation in NSW is subject to consent from the Department of Land and Water Conservation in accordance with the *Native Vegetation Conservation Act 1998*. The Act is integrated with the *Environmental Planning and Assessment Act 1979*, and requires that threatened species are taken into account by consent of the determining authorities when considering clearing applications under Part 4 of the EP&A Act.

The Act also allows for the development of Regional Vegetation Management Plans. Matters relating to threatened species and their habitats must be considered when preparing such a plan. Furthermore a Regional Vegetation Management Plan must be consistent with a Recovery Plan.

The Rural Fires Act 1997

It is a requirement of this Act 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.

The Forestry and National Park Estate Act 1998

This Act integrates the various regulatory regimes for threatened species conservation, environmental planning and assessment, and the protection of the environment. Approval for the carrying out of forestry operations on State Forests is granted under this Act via the Integrated Forestry Operations Approval. The Integrated Forestry Operations Approval for the Eden Region (IFOA) (New South Wales Government 1999 – see Appendix B ‘Terms of Licence under the Threatened Species Conservation Act 1995’) includes measures that protect the rocky habitats.

These measures include the prohibition of specified forestry activities (including timber felling, construction and operation of log dumps and snig tracks and road construction and reopening) within areas of rocky outcrops and cliffs. There is also provision for an additional exclusion zone of 40 m where outcrops are >0.5ha.

The IFOA also makes provision for Forest Management Zoning (FMZ). Its primary objective is to

separate clearly those areas of State Forests which will be managed as conservation reserves and those areas which will be available for timber harvesting and other activities. FMZI accords the highest level of protection for Flora Reserves and specifically lists timber harvesting as an activity not permitted. Other activities may be permitted under conditions specified in the Working Plans for particular Flora Reserves. Prescribed burning, for example, is to be planned to be fully cognisant of the values the area is intended to protect.

In those instances where the activities or actions planned to be carried out in State Forest do not come under the IFOA then the provisions of the EP&A Act must be considered. Further, any action not requiring approval under the EP&A Act, and which is likely to have a significant impact on threatened species requires a Section 91 licence from the NPWS under the provisions of the TSC Act.

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 National Parks and Wildlife, as a concurrence authority, consider relevant recovery plans when exercising a decision making function under Parts 4 & 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 currently have a decision making function in relation to the species considered in this Recovery Plan:

- Bega Valley Shire Council;
- Department of Land and Water Conservation in relation to Crown Land, subject to the provisions of the *Crown Lands Act 1989*, and in relation to private land under the requirements of the NVC Act and the *Rivers and Foreshores Improvement Act 1948*;
- NSW State Forests
- The NPWS as the land manager and determining authority where populations occur on NPWS estate; where a concurrence or consultation role under the EP&A Act is required (all tenures); or where a Section 91 Licence (under the TSC Act) or a Section 132 Licence (Licence to grow protected or threatened plants for sale) (under the NPW Act) is required (all tenures).

Additional public authorities may have a decision making function if the species is located in other areas in the future.

Any other action not requiring approval under the EP&A Act, and which is likely to have a significant impact on the species considered in this Recovery Plan, will require 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.

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 the species considered in this Recovery Plan are listed nationally under the EPBC Act, any person proposing to undertake actions likely to have a significant impact on 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 death or injury of an individual of one or more of the species considered in this Recovery Plan, and the individual 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.

2.6 Critical Habitat

New South Wales

The TSC Act makes provision for the identification and declaration of critical habitat. Under the TSC Act, critical habitat may be identified for any endangered 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 these species. The declaration of critical habitat in NSW is not considered to be a priority for these species at this stage, as other mechanisms provide for their protection.

Commonwealth of Australia

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 that will significantly damage Critical Habitat on Commonwealth land (unless the EPBC Act specifically exempts the action). 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 the rocky outcrop 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 (section 3) 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 Critical Habitat.

3 Species Information

3.1 Narrabarba Wattle (*Acacia constablei* Tindale)

Description and Taxonomy

The Narrabarba Wattle is an erect or spreading shrub or small tree to 5 m, rarely to 7 m high, with 1-5 or more stems and occasionally suckering stems at a short distance from the main stem(s). Plants are very open and sparsely branched, often being unbranched for

some distance; the bark is smooth and persistent and usually mottled with pale lichen and young branches are hairy and angular with longitudinal ridges. Leaves minutely hairy at first, becoming hairless, bipinnate (feathery) to approximately 9 cm long with 5-11 pairs of pinnae (primary divisions), each pinna 1-2 cm long and 0.3-0.4 cm wide. Pinnules (leaflets) in 13-28 pairs, leathery, dark green, narrowly elliptical, 1-2.5 mm long by 0.5-0.6 mm wide; small glands (nectaries) on the upper side of the central stalk of the leaf are situated just below the junction of the pair of pinnules (one each). Flowers tiny, 30-32 borne in fluffy globular clusters (balls) arranged in open racemes in the leaf axils or terminal panicles on ends of branches; the pale yellow stamens are the conspicuous part of the flowers. Pods black, more or less straight, flat to 7 cm long by 7-9 mm wide, minutely hairy when young. Seeds elliptical, black, shiny, to 4 mm long. Flowering is recorded in June-August, and in February and March (a few specimens only). Detailed descriptions are given in Tindale (1980) and Morrison and Davies (1991).

The Narrabarba Wattle is most closely related to the widespread Black Wattle (*A. mearnsii*) with which it occurs at the type locality, and to Dwarf Silver-wattle (*A. nanodealbata*), a Victorian endemic (Tindale 1980). It was described by Tindale in 1980.

Distribution and Confirmed Populations

The Narrabarba Wattle is a narrow South Coast NSW endemic, known from two localities with one discrete population at one location and one metapopulation at the other location (see Figure 1). At the type locality, Narrabarba Hill (Narrabarba Hill Flora Reserve, Nadgee State Forest) the population is by far the largest, occupying several hectares. Four much smaller populations each occupying no more than 0.1 ha occur on rocky ridge-tops distributed over approximately 0.4 km to the north-north-east of Narrabarba Hill. The other population occupies around 0.5 ha on a rocky ridgetop 1.4 km north of Narrabarba Hill on the north side of Wonboyn River.

Some 15 collections of the Narrabarba Wattle are lodged at the NSW National Herbarium, with duplicates at other herbaria. The earliest collection – at the type locality – was apparently made in 1954 (Tindale 1980).

All known populations were documented in the study supporting this Recovery Plan. The Narrabarba Hill population (population AC1) which dominates vegetation of the rocky summit is estimated to contain upwards of 5000 plants. This is by far the largest population. The three smaller populations, distributed to the north-north-east over approximately 0.4 km, respectively contain one plant (population AC2), an

estimated 400 plants (population AC3), and 300 plants (population AC4). No plants were recorded at the largest most northerly outcrop on this ridge beside Swamp Road where it was previously recorded (Briggs & Leigh 1990). Subsequently (June 1999), 20 mature plants and three seedling have been reported from the northern end of the ridge (accessed by climbing up a steep slope above Swamp Road where it turns a corner around the end of the ridge) (J. Miles, pers. comm.). The population north of Wonboyn River (population AC5) contains an estimated 40 plants.

Land Tenure

All populations of the Narrabarba Wattle are on public land within the Nadgee State Forest managed by SFNSW. All known populations are within the boundaries of the proposed Narrabarba Hill Flora Reserve.

Habitat

The Narrabarba Wattle is confined to rhyolite rock outcrops with very poor soil development and high cover of exposed rock (to approximately 95% at Narrabarba Hill). The outcrop at Narrabarba Hill has a knife-edge summit and steep NE and SW aspects; the other sites are topographically much more subdued, often with large expanses of fairly flat rock. Narrabarba Wattle is the dominant or co-dominant

shrub or small tree where it occurs on the rock outcrops. At its best development the Narrabarba Wattle forms an open shrubland of sparsely-branched shrubs to approximately 3 m high (though individual plants are much larger where more favourable conditions allow, such as at the edges of outcrops with deeper soils). The populations are bounded by forests dominated by Silvertop Ash (*Eucalyptus sieberi*), and on the ecotone between the forest and the rock outcrop shrublands up to approximately 8 m wide occur. Black She-oak (*Allocasuarina littoralis*) is abundant, often forming dense stands to 8 m high. These Black She-oak stands appear to compete strongly with the Narrabarba Wattle and mortality of subordinate Narrabarba Wattle is commonly observed, possibly resulting from the combined effects of light and moisture competition. Other common woody plant species occurring with the Narrabarba Wattle include Giant Honey-myrtle (*Melaleuca armillaris* ssp. *armillaris*), Tick Bush (*Kunzea ambigua*), Coastal Zieria (*Zieria 'littoralis'*) and Lance-leaf Platysace (*Platysace lanceolata*). The herbaceous component of the vegetation is poorly developed and the most frequent species include Long-leaved Wallaby Grass (*Notodanthonia longifolia*) and *Lepidosperma urophorum*.

Quadrat data and floristic lists have been collected or compiled at all sites except population AC2 (Carr and White unpubl. data).

Biology and Ecology

The Narrabarba Wattle is confined to rock outcrops on ridge tops where it is the localised vegetation dominant or co-dominant. Geology at all sites is rhyolite. Pollination is assumed to be effected by insects (as is typical of the genus), seeking the floral reward of pollen or perhaps nectar from the extra-floral nectaries (leaf glands). Birds seeking extra-floral nectar may also be involved in pollination. Seeds are assumed to ripen about three months after pollination, as typical in *Acacia*. The seed dispersal mechanism is unknown but seeds may be dispersed by birds attracted to the lipid-rich aril, and by ants, which may also bury seeds. Bird dispersal, if applicable, may take seeds off the site to unfavourable environments. The Narrabarba Wattle is assumed to develop a long-lived soil-stored seed bank (as does Black Wattle), but no data are available on its size or seed longevity. Recruitment in the Narrabarba Wattle has not been adequately studied. However, age structure and mortality in the populations (as well as extrapolation from its closest relative Black Wattle which occurs at Narrabarba Hill) indicates that the species is short-lived and fire sensitive. It may also be affected by extreme drought conditions given that soil moisture carrying capacity for the outcrop sites would be generally low.

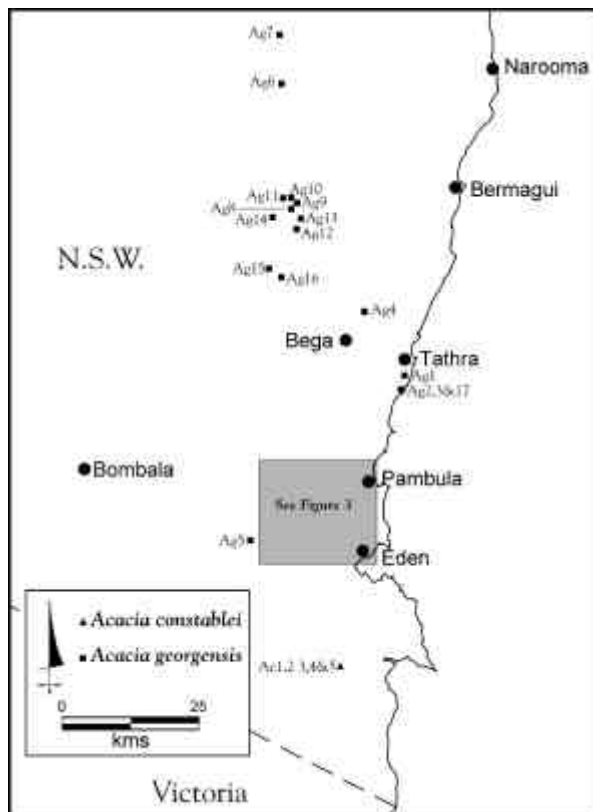


Figure 1. Locations of populations of the Bega and Narrabarba Wattles

All of the populations are assumed to be comprised of a predominantly even-aged cohort which recruited from soil stored seed after the last major fire event, which was in the early 1980's at Narrabarba Hill (Briggs & Leigh 1990). The age-structure of the populations however indicates that there is some recruitment in the absence of fire, but the significance of this is unknown. The degree of sensitivity of the species to fires of lower intensity is not known. Some recent mortality has been observed in populations on the edge of Silvertop Ash forest in the vicinity of Narrabarba Hill. However, there is no record of a recent fire having taken place in this area and the identity of the affected individuals has not been determined.

In the 1997-1998 drought, extensive death of the Narrabarba Wattle occurred at all populations (see Figure 2). An estimated 25% of plants were killed on average at Narrabarba Hill and in the nearby populations. Those plants that survived often suffered a severe regression by the death of branches back to main stems from which they later resprouted. Drought-induced mortality was probably exacerbated by the

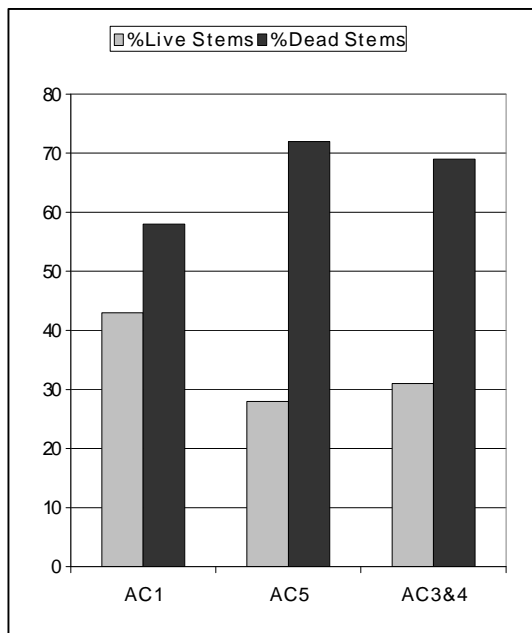


Figure 2. Recent mortality of the Narrabarba Wattle at sites supporting sub-populations.

This representation is based on data from single 20x20 m permanent plots established at each site. AC1 is the largest population on Narrabarba Hill – the plot contained 97 live and dead stems. AC5 is the sub-population of the Narrabarba Wattle growing on the northern side of the Wonboyn River. AC3 & AC4 are populations established on small rocky outcrops below Narrabarba Hill. Note that AC2 did not appear to have any living adult plants.

predations of a range of stem borers and other invertebrate pests, and pathogens evident in most plants.

Threats

Fire

Controlled and uncontrolled fire is the most serious potential threat to Narrabarba Wattle populations. Plants typically reach maximum development at the edges of outcrops if relatively free of competition from Black She-oak stands. In these situations Black She-oak, at least when young, is sensitive to low-intensity burns, and the burns may stimulate high levels of recruitment in this species to the detriment of Narrabarba Wattle. It may be that these low intensity burns are too 'cool' to stimulate significant recruitment in Narrabarba Wattle populations. There is also a potential for fuel reduction burns to occur at a time unfavourable for recruitment in the Narrabarba Wattle. These imposed fires affect the periphery of Narrabarba Wattle populations but fuel loads under these conditions are too low on most of the outcrop areas to carry low-intensity burns.

Wildfires, as 'natural' events, or uncontrolled imposed burns, under more extreme conditions, are able to burn across the whole of the sites carrying Narrabarba Wattle. The populations would be expected to recover from soil-stored seed germination but if the interval between fires was insufficient to allow development of a soil-stored seed bank, populations may be reduced or even eliminated. An appropriate interval between fires for the development of the soil stored seedbank is presently unknown. Further research work on the fire ecology of this species is necessary to determine this.

Drought and Competition

Drought is a recurring, uncontrollable natural phenomenon with the potential to be a highly significant factor in Narrabarba Wattle mortality. Whether or not recruitment will occur in the absence of fire to compensate for drought-induced mortality is unknown but it is probably unlikely, at least in most populations.

Competition, especially from Black She-oak, clearly suppresses or kills many Narrabarba Wattle plants at the edges of the rhyolite outcrops. Manipulation of these plant-plant dynamics could be utilised to favour Narrabarba Wattle, that is, by removing plants competing with Narrabarba Wattle. The merits of such intervention are unknown but the effects of drought and competition should be monitored.

3.2 Bega Wattle (*Acacia georgensis* Tindale)

Description and Taxonomy

The Bega Wattle is ultimately a single-stemmed erect or spreading tree to 12 m or more high with a dense to open, broad, rounded or domed crown, typically as wide as deep. The trunk, to 30 cm (rarely 70 cm) DBH over bark, is branched low down, usually within about 1.5 m of the ground in open-grown trees or unbranched for several metres. The bark is dark grey-brown, and is very deeply fissured in old trees. Mature leaves (phyllodes) are grey-green, hairless or nearly so, erect to spreading or drooping, narrowly elliptical, leathery and sickle shaped to 17 cm long and 3 cm broad; there is a gland (extra-floral nectary) at the base of the phyllode. Flowers with massed pale yellow stamens are arranged in dense, single or paired spikes up to 3.5 cm long by 0.5 cm wide in the leaf axils. Pods are brown, straight, narrow and flat and up to 7 cm long by 3 mm wide. Seeds are black, elliptical, shiny and hard, to 4.5 mm long; they hang when ripe from the open pod on cream or orange-fawn arils. Flowering occurs from August to October. Detailed descriptions are given by Tindale (1980) and Morrison and Davies (1991).

The Bega Wattle is most closely related to Cheels Wattle (*A. cheelii*), a tree of rocky ridges in inland northern NSW from Singleton west to the Warrumbungles and north to the Moree district (Tindale 1980).

Distribution and Confirmed Populations

The Bega Wattle, a narrow South Coast NSW endemic, is known from seventeen sites with seventeen discrete populations:

- Dr George Mountain (the type locality) approximately 10 km north-east of Bega and 10 km from the coast (AG4);
- Kianinny Bay, Tathra (AG1) and three smaller populations 1.5, 2.3 and 3.0 kms to the south (AG2, AG3 and AG17);
- Towamba River (AG5), an outlying population 40 km from the coast;
- Wadbilliga National Park – nine populations extending from Belowra in the north to Warrigal Fire Trail in the south (AG6-AG14); and
- South East Forests National Park (Bemboka Section) – two populations at Desert Creek (AG15 and AG16).

This distribution spans approximately 70 kms from Wadbilliga National Park south to the Towamba River population (see Figure 1).

Some 16 collections are housed at the NSW National Herbarium, with duplicates at other herbaria. The earliest collection (at the type locality) was apparently made in 1974 (Tindale 1980). The three coastal populations south of Kianinny Bay and around Kangarutha Point are known from sight records and photographs made in May 1999 and December 2000 (D. Wimbush, S. Clark and K. McDougall, unpubl. data).

Three populations were documented in the study supporting this Recovery Plan: Dr George Mountain (type locality), Kianinny Bay and Towamba River. The Wadbilliga and South East Forests National Parks populations have been subsequently located and documented by J. Miles (2001). No attempt was made to document the three coastal populations further south discovered by D. Wimbush, S. Clark and K. McDougall; however, the identity of these populations is not in doubt.

The Dr George Mountain population numbers approximately 2,000 plants while the Kianinny Bay population contains an estimated 10,000 plants. The three populations occurring in the South East Forests National Park are estimated to total around 400 individuals and the nine Wadbilliga National Park populations are estimated to be around 15,000.

Tenure

All of the seventeen known populations of the Bega Wattle are on public land:

- The Kianinny Bay population and the three Kangarutha Point populations to the south occur in Bournda National Park – managed by the NSW NPWS;
- The nine Wadbilliga National Park populations are managed by the NSW NPWS;
- The Towamba River population is located in the Coolangubra Section and the two Desert Creek populations occur in the Bemboka Section of the South East Forests National Park – managed by the NSW NPWS; and
- The Dr. George Mountain population is on Crown land which is leased to the BVSC by the Department of Land and Water Conservation. Easements for communications and power are maintained by Telstra and Great Southern Energy respectively.

Habitat

The Bega Wattle occurs on acutely drained, shallow or skeletal loamy soils developed on granite (Dr George Mountain and Belowra), rhyolite (Kianinny Bay) and hardened metamorphic sandstones and siltstones (Wadbilliga and South East Forests National Parks) though soil development varies considerably at these

sites. At all sites there is considerable exposure of rock – as small rocks to massive boulders and rock sheets. The aspect varies between and within sites, but the bulk of the populations are on northern or western exposures, sometimes at the summit (Dr George Mountain) or from the summit to much lower on the slope; slopes are often steep.

At Kianinny Bay plants occur upwards from the upper littoral zone of a high energy coast under the influence of wave splash and salt spray, to highly protected mesic creekside environments with rainforest elements on the inland side of the population away from the coast.

The Bega Wattle is the structural dominant of vegetation where it occurs in its highly discrete populations. Trees grow from approximately 4-15 m high, forming a low, very open to closed forest in which the Bega Wattle comprises 85 to nearly 100% of the canopy. Other tree species are uncommon or rare; they include Hickory Wattle (*Acacia implexa*), Bega Mallee (*E. spectatrix*), Black She-oak (*Allocasuarina littoralis*), Rough-barked Apple (*Angophora floribunda*), White Stringybark (*E. globoidea*), Blue-leaved Stringybark (*E. agglomerata*) and Gully Gum (*E. smithii*).

Because the sites documented are environmentally quite different (e.g. geology, rainfall, aspect, proximity to coast) the associated vegetation communities differ considerably between sites. They would be unlikely to be classified as the same vegetation type. Common or prominent associated woody species include Prickly Bearded-heath (*Leucopogon juniperinus*), Shrubby Platysace (*Platysace lanceolata*), Wallaby Bush (*Beyeria lasiocarpa*) and Slender Tea-tree (*Leptospermum brevipes*). Common herbaceous species include Cockspur Flower (*Plectranthus cf. graveolens*), Long-leaved Wallaby Grass (*Notodanthonia longifolia*), Erect Panic (*Entolasia stricta*), Slender Mat-rush (*Lomandra confertifolia* ssp *rubiginosa*) and *Lepidosperma urophorum*. Overall there is low to very low cover of herbaceous species at all sites.

Quadrat data and floristic lists have been collected at fourteen of the seventeen sites (Carr and White, unpubl. data; and Miles 2001).

Ecology

From the study of the populations which occur in the different environments and on granite, rhyolite and metamorphosed sandstone, it is evident that the Bega Wattle is a very long-lived, highly drought tolerant, fire-sensitive tree. Reproduction is exclusively from seed and plants are incapable of suckering.

Pollination has not been studied but it is assumed that pollination, as in most *Acacia* (Brown *et al.* 1997 and New 1984), conforms to a non-specific insect pollination syndrome and is effected by insects seeking pollen (as a floral reward) or nectar from extra-floral nectaries – the gland at the base of the phyllode. Birds seeking extra-floral nectar may also be involved in pollination.

It is assumed that seed ripens about three months after flowering, as is typical of the genus. In common with many *Acacia*, the seed dispersal vectors are likely to be birds attracted to the lipid-rich fleshy aril. When ripe, seeds are displayed by hanging from the dehisced pod on their arils. Thus, dispersal is potentially over long-distances but such dispersal is liable to take the seeds beyond the highly discrete environments occupied by the Bega Wattle. Short-distance dispersal by ants (and perhaps seed burial) almost certainly occurs; the ants would harvest seed for the aril (food body).

The Bega Wattle is assumed to develop a long-lived soil-stored seed bank, as is typical in *Acacia*, but no data are available on its size or seed longevity. Two types of recruitment patterns are evident in the three populations studied. At the Dr George Mountain and the Towamba River populations, distribution and age structure of the Bega Wattle is very uneven with young to old plants present, including many seedlings at Dr George Mountain. At Kianinny Bay the bulk of the population is considered to be comprised of one or several cohorts which germinated following a past fire for which the date has not been established. Numerous fallen dead stems of similar size were present and this is believed to represent the previous fire-killed population. No seedlings were present at this stand which is assumed to be due to light exclusion by the canopy of the dense population.

Observations made while documenting the Wadbilliga populations (Miles 2001) suggest that the severe fires which kill established stands are likely to stimulate mass recruitment but fire is not essential for recruitment to occur. While recruitment most commonly takes place around the edges of established stands, it can also take place in canopy gaps resulting from death of individuals. Some evidence was also noted of the ability of mature Bega Wattle to survive a fire of moderate intensity.

Little can be inferred about the longevity of individuals except they can be very long-lived (unlike many *Acacia*), and are very slow growing. A dead stem collected at Dr George Mountain of 15 cm diameter has about 35 growth rings indicating at least this age; the maximum stem diameter of a live plant at Towamba River was 70 cm (an exceptional individual) and this is assumed to be several hundred years old.

Threats

Loss by clearing

Several land-use practices have caused direct loss of part of the populations of the Bega Wattle at Dr George Mountain and Kianinny Bay. At Dr George Mountain there are three installations at the summit: a communications facility owned by the BVSC, a powerline owned by Great Southern Energy and a phone line owned by Telstra. A trig point was installed on the summit some years ago and is also used by surveyors. These facilities require access by track and maintenance of easements free of trees. An estimated 5-10% of the Bega Wattle population has been bulldozed or cut in this easement and the road easement. A number of vigorous young plants to 1.5 m, which recruited in the easement, will need to be removed in the next few years.

At the Kianinny Bay site a constructed stepped track approximately 1.2 m wide, commencing at the carpark and running south along the coast has meant the destruction of a small percentage of the Bega Wattle population through which it runs for several hundred metres. It is unlikely to have further adverse effects on the stand.

Increased visitor usage of an informal camping area near Brogo Dam could result in damage to the stand closeby. It may, in time, be necessary to close an existing track leading to this stand.

Weed invasions

At three sites weed invasions constitute a potentially serious threat, although there is no current evidence of deleterious impacts. At Dr George Mountain 13 weed species were recorded in disturbed sites adjacent to the population. The most serious is African Love-grass (*Eragrostis curvula*), a declared noxious weed in NSW, and a threat to recruiting Bega Wattle in the event of fire or other disturbance.

The Kianinny Bay population has urban development on the north side with a large suite of weeds, many of which are garden escapees. Several weed species occur within the population, the most significant of which are Bitou Bush (*Chrysanthemoides monilifera* ssp. *rotundata*) and the succulent herb Heartleaf Ice Plant (*Aptenia cordifolia*), a garden escapee. While weed populations are currently low and are likely to remain so because of intense competition from Bega Wattle, a massed recruitment of weeds would be inevitable if the stand were burnt. They could seriously impede post-fire germination and establishment of Bega Wattle.

At Towamba River, weeds have insignificant cover within the stand but are abundant in the bed of the

river. The only species of concern in this suite of riparian weeds is the currently rare *Eragrostis curvula* which may invade the *Acacia* stand.

Phytophthora cinnamomi

The presence of *Phytophthora cinnamomi* has been inferred close to a stand at Nelsons Creek (Miles 2001). This site and others down-slope from roads or tracks should be monitored for possible invasion by this pathogen.

Fire

At Dr George Mountain the Silvertop Ash forest adjoining the Bega Wattle stand is periodically burnt for fuel reduction. The most recent, burn (approximately 18 years ago) burnt upslope into the populations of the rare plant species Carruthers Leionema (*Leionema carruthersii*) and Bega Mallee (*Eucalyptus spectatrix*) associated with the Bega Wattle population. Both species are resprouters and were apparently unharmed. There is, however, a very high potential to damage populations of Bega Wattle and associated rare plant species by application of an inappropriate fire regime in terms of frequency, intensity and/or timing. Further research needs to be carried out to determine the most appropriate fire regime.

Two private residences are located nearby on the eastern slopes of Dr George Mountain and in the event of a wildfire, fire control activities should endeavour to use existing fire control advantages to avoid damage (for example by bulldozing firebreaks) to the Bega Wattle and associated vegetation, especially rare and vulnerable species.

Similar arguments to those above may apply to the Kianinny Bay Bega Wattle population where planned or unplanned fire and its control may adversely affect plants. There is no evidence that fuel reduction burning or fire management is likely to affect the Bega Wattle populations in Wadbilliga and South East Forests National Parks though the relevant Fire Management Plans need to take the requirements of the species at these sites into account.

3.3 David's Westringia (*Westringia davidii* Conn) and Ralston's Leionema (*Leionema ralstonii* (F. Muell.) Paul G. Wilson))

Description – David's Westringia

David's Westringia (family Lamiaceae) is an ascending perennial shrub to 2 metres in height. Individuals are typically between 0.4 and 1.2 m high (NPWS unpublished data). Leaves are ovate to

obovate in shape, 7-20 mm long, and are arranged along stems in whorls of three. The lower surface of the leaves and the leaf stalk are densely hairy while the upper surface is sparsely hairy to hairless towards the leaf tips. Flowers are arranged in clusters of up to 12 flowers per leaf whorl. Individual flowers consist of a green calyx 2-3 mm long and a white or mauve corolla. The corolla comprises a short tube about 8mm long which opens into a 5-lobed, 2-lipped corolla with lobes 5-7mm long. The corolla is typically pale mauve (occasionally white or deep mauve) with orange dots towards the mouth of the tube. Mericarps (single seeded portion of the fruit) are 2 mm long tapering to a point and contain slightly smaller seeds - approximately 1.4 mm long. Detailed botanical descriptions of the species may be found in Conn (1987) and Conn (1992).

David's *Westringia* was discovered and described as recently as the mid 1980's (Albrecht 1986, Conn 1987). Although David's *Westringia* has close affinities with the common coastal *Westringia fruticosa*, it is readily distinguished from it.

Distribution – David's Westringia

David's *Westringia* is a narrow endemic species confined to rhyolite¹ outcrops above 250 m in elevation, in the coastal ranges to the west of Eden and Pambula (see Figure. 3) in the catchments of the Yowaka and Pambula rivers. The known range or extent of occurrence of the species is less than 2,000 hectares (a narrow strip approximately 10 km north south, by 3 km east west) while the known area it occupies has been estimated at less than 14 hectares. The total known population at the time the survey work associated with this Recovery Plan was carried out was composed of 14 small, discrete populations ranging in size from as few as 20 adult plants, to populations of 800-1000 individuals (NPWS unpublished data). This survey (Carr and White in prep.) estimated the total population to be approximately 5,900 adult individuals (see Appendix 2). More recent survey work carried out by J. Elith (2002) led to the discovery of an additional six discrete sub-populations with numbers totalling 1500².

As the dispersal of propagules between rocky outcrops is unlikely, the disjunct distributional pattern of David's *Westringia* is probably the result of range contraction, presumably as the climate has become increasingly moist following the last glacial maximum.

¹ Note that rhyolite here is used in a generic sense and may include other acid volcanic geologies associated with the 'Boyd Volcanic Complex' including pyroclastic rocks such as ignimbrite.

² Data on the recently documented additional occurrences of this species, Ralston's *Leionema* and Rhyolite Midge Orchid are held by the Threatened Species Unit, Southern Directorate NPWS

Description - Ralston's Leionema

Ralston's *Leionema* (family Rutaceae) is an open, often spindly shrub to 1.5 m high, with glabrous stems and leaves. Leaves are dark green, stalkless, narrowly oblanceolate with a notched tip and are 2.5-4 cm long and around 6 mm wide. Flowers are clustered in groups of 4 - 7 borne on a common pendulous stalk at the ends of branches. Individual flowers are up to 2.5 cm long with pale green petals of around 8 mm in length. Protruding yellow stamens are more than twice as long as the petals and numerous. The fruit or mericarp is up to 10 mm wide and 4-5 mm high and divided into 4 chambers. Detailed descriptions of this species may be found in Western & Porteners (1991) and Wilson (1970).

Ralston's *Leionema* was first described as *Eriostemon ralstonii* by Ferdinand von Mueller in 1860, based on material collected from the Yowaka River. It was subsequently placed in the genus *Phebalium* by Bentham (1863) and recently the section *Leionema* of *Phebalium* to which it was assigned, was raised to generic status (Wilson 1998).

Distribution – Ralston's Leionema

Ralston's *Leionema* is endemic to the coastal ranges of south-east New South Wales between Eden and Pambula and is confined to the catchments of the Towamba, Yowaka and Pambula Rivers (see Figure 3). Its known geographic range is an area of some 32,000 hectares (approximately 13 km north-south and 17 km east-west) extending inland from the coast some 40 km. The species is largely confined to dry, rocky habitats and the known area it occupies is around 50 hectares. Like David's *Westringia* it appears to be restricted to upland rocky outcrops above 250 m ASL. The total known population at the time of the survey work associated with this Recovery Plan comprised some 25 disjunct sub-populations ranging in size from as few as 50 individuals to in excess of 3000 adult plants. This survey estimated the total population to be approximately 14,800 adult individuals (Appendix 2). More recent survey work carried out by J. Elith (2002) located 43 additional discrete sub-populations with total numbers of 3300².

As with David's *Westringia*, the distributional pattern of Ralston's *Leionema* is consistent with a highly specialised species which has undergone a slow range contraction, along with its habitat.

Tenure - David's Westringia

Of the 14 studied sub-populations of David's *Westringia*

- Four occur on freehold land – two separate properties;

- Three occur in Jingera Flora Reserve – managed by SFNSW;
- Three occur in Nullica State Forest – managed by SFNSW; and
- Four occur in the South East Forests National Park (Yowaka Section) – managed by the NSW NPWS.

The six recently discovered sub-populations have the following tenure:

- Four occur in Nullica State Forest
- Two occur in South East Forests National Park

Tenure - Ralston’s Leonema

The 25 sub-populations studied have the following tenure:

- Four occur in Jingera Flora Reserve – managed by SFNSW;
- Five occur in Nullica State Forest – managed by SFNSW; note also that one of these sites is subject to a mineral lease;
- One occurs in Nethercote Falls Flora Reserve – managed by SFNSW;
- Eleven occur in the South East Forests National

Park (Yowaka Section) – managed by the NSW NPWS.

- Four occur on freehold land - two separate properties

The 43 sub-populations recently discovered have the following tenure:

- Twenty-one occur in Nullica State Forest
- Seventeen occur in South East Forests National Park
- Five occur on freehold land

Habitat – Ralston’s Leonema & David’s Westringia

David’s Westringia is largely restricted to shallow organic loam soils that fringe rhyolite outcrops. This narrow niche approximates the ecotone between open forest dominated by Silvertop Ash and the steep slabs of rock which support a mosaic of shrubland, scattered or isolated herbs and shrubs, and patches of bare rock. These thin bands of suitable habitat on rock outcrops are usually less than 30m wide. Suitable habitat is isolated and fragmented across the range of the

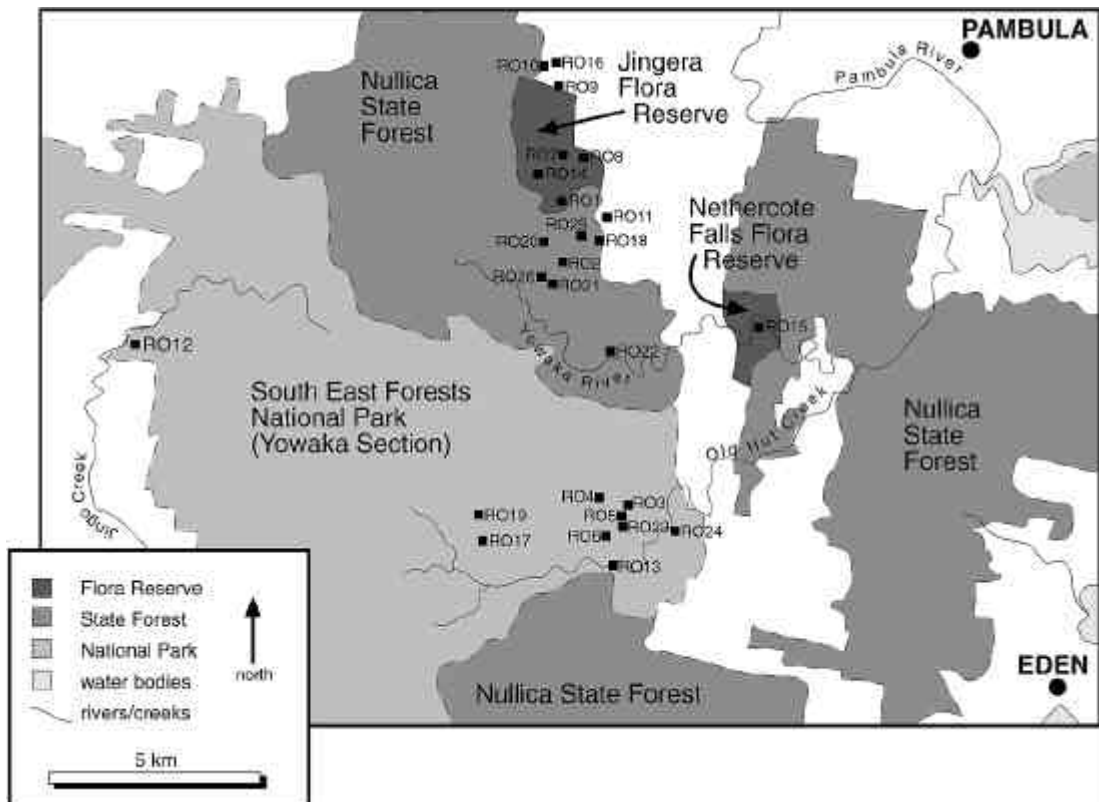


Figure 3. Distribution of rocky outcrops supporting populations of David’s Westringia, Ralston’s Leonema and the Rhyolite Midge Orchid in the catchments of the Yowaka, Pambula and Towamba Rivers and Old Hut Creek, Southeast New South Wales. RO denotes rocky outcrop with populations of one or more of the above species (see also Appendix 2).

species.

The vegetation generally associated with David’s Westringia includes those plant taxa which characterise the shrublands of rhyolite outcrops and the open forests of dry rocky ridges. They include Giant Honey-myrtle (*Melaleuca armillaris* ssp. *armillaris*), Tick Bush (*Kunzea ambigua*), Black She-oak (*Allocasuarina littoralis*), Blue-leaved Stringybark (*Eucalyptus agglomerata*), Ralston’s *Leionema* (*Leionema ralstoni*), Lance-leaved Platysace (*Platysace lanceolata*), *Lepidosperma urophorum*, *Lepidosperma laterale*, Long-leaved Wallaby Grass (*Notodanthonia longifolia*) and Rock Orchid (*Dendrobium speciosum*). For further details on the structure and floristics of rhyolite outcrop communities see Binns and Kavanagh (1990), Keith and Sanders (1990), Keith and Bedward (1999) and Carr and White (in prep.). Less commonly David’s Westringia occurs within riparian shrublands along intermittent streams with similar dominant species to the more typical habitat (one site) and open heathlands on gently sloping rhyolite outcrops dominated by Common Fringe-myrtle (*Calytrix tetragona*), Clustered Darwinia (*Darwinia briggsiae*), Small-leaved Epacris (*Epacris microphylla*) and *Pomaderris ledifolia* (two sites).

Ralston’s *Leionema* is restricted to rocky outcrops and dry ridges. Unlike David’s Westringia with which it co-occurs on at least 20 outcrops, it is not restricted to

rhyolite outcrops. It also occurs on syenite – an intrusive feldspar-rich rock type at Jingera Rock, Devonian meta-sandstone at Barwon Road, Nullica State Forest and on pyrophyllite, a metamorphosed talc-like mineral. Typically, it is found growing on skeletal organic loams or coarse lithosols which are marginal for the development of open forest. It may also be found growing in cracks, fissures and benches on crags and cliff faces. Ralston’s *Leionema* may be locally abundant in the dry shrub communities which characterise rock slabs, screes, cliffs and rocky creeklines and the ecotone between these plant communities and the surrounding open forest. The plant species typically associated with Ralston’s *Leionema* include those which characterise the habitat of David’s Westringia (see above).

While closely associated with David’s Westringia (all known sites which support David’s Westringia also support Ralston’s *Leionema*), Ralston’s *Leionema* has a broader ecological amplitude and occurs in a wider range of plant communities (including Silvertop Ash open forests on ridges and steep slopes) on a wider range of soils types and persists in a variety of micro-habitats.

On a small scale, the distribution and abundance of David’s Westringia and Ralston’s *Leionema* within ostensibly suitable habitat, is typically patchy and it is likely that both species are sensitive to soil depth,

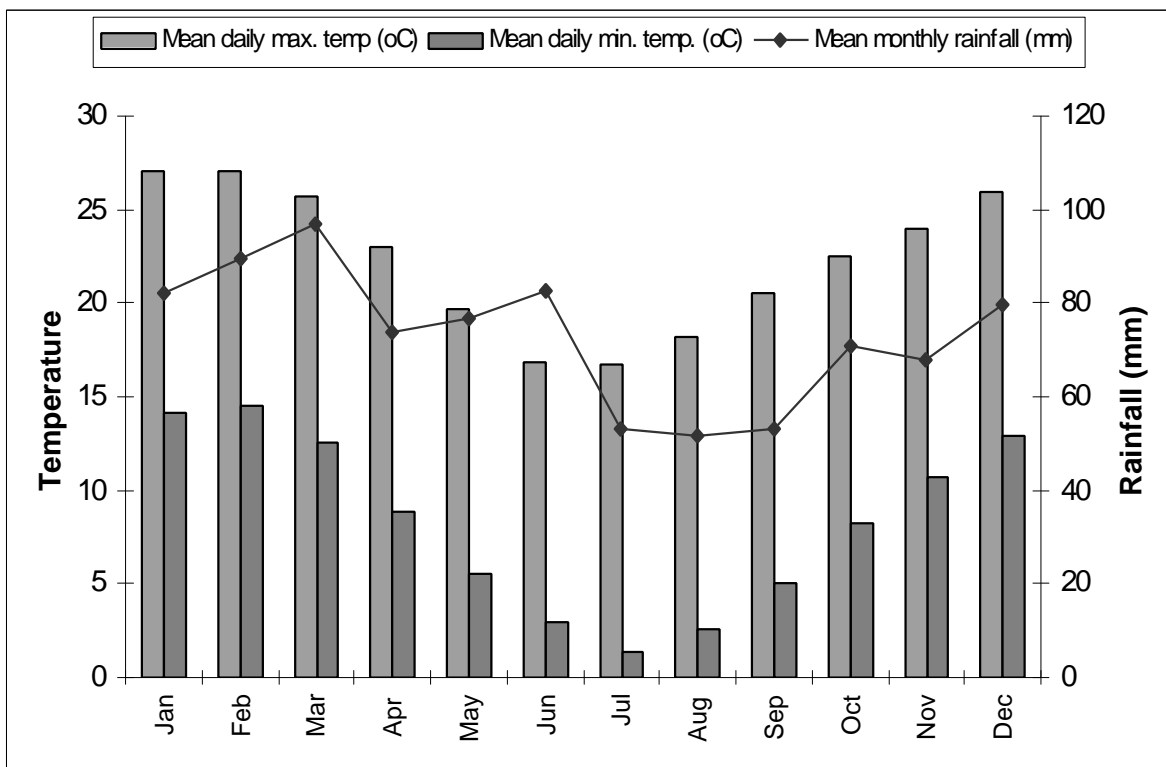


Figure 4. Mean monthly rainfall and temperature for Bega based on climate records collected between 1879 and 1996 (source: Bureau of Meteorology).

exposure and competition with larger shrubs and small trees. Typically both species flourish in mature open shrublands with some soil profile development. Infrequently burnt shrublands and low open forests appear to provide the most suitable habitat and this implies that the shrubs are responsive to and dependent on the dynamics of outcrop plant communities over time.

The climate across the range of David’s *Westringia* and Ralston’s *Leionema* can be classified as ‘maritime temperate’. While the average annual rainfall of nearby Bega is 880 mm (see also Figure 4), it varies between about 550 and 1200 from year to year. The seasonal distribution pattern of this rainfall is poorly defined.

Ecology & biology – David’s Westringia & Ralston’s Leionema

Little is known of the biology and ecology of Ralston’s *Leionema* and David’s *Westringia*. What is known has been gleaned from field observations rather than detailed study.

Both species have similar life-history strategies. Field observations (Carr and White unpubl. data) indicate

that both shrubs are slow growing and relatively long lived. In addition, they are uncommonly drought tolerant, occupying dry rocky habitats (often with northerly aspects) and persisting through protracted periods of below-average rainfall, while some associated species have succumbed to drought stress. During the dry spell culminating in the spring-summer of 1997 many of the dominant shrub species associated with rocky outcrops such as Tick Bush, Lance-leaved Platysace and Giant Honey-myrtle suffered high rates of mortality while very little mortality of David’s *Westringia* or Ralston’s *Leionema* was observed.

David’s *Westringia* is probably an obligate seeding species (D. Keith, NSW NPWS, pers. comm.) and recruitment of seedlings appears to be ongoing in suitable habitat. However, survivorship of seedlings has not been studied. Populations are generally uneven-aged and demonstrate a broad age structure from seedlings through to mature plants (see Figure 5). The age structure of the total population of Ralston’s *Leionema* corresponds with that of a long lived species with continuous germination (see Figure 6). Survival to adulthood is probably rare and is dependent on the availability of limited resources. Populations of both David’s *Westringia* and Ralston’s *Leionema* appear to

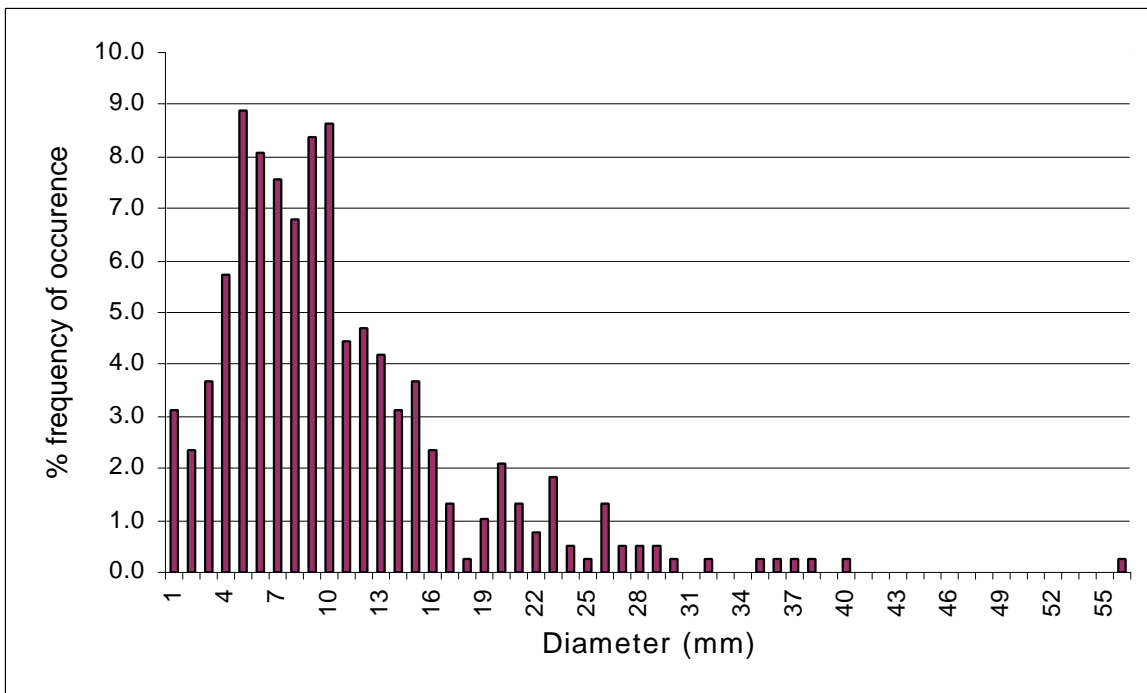


Figure 5. Population structure of David’s *Westringia* using stem diameter as a surrogate for age.

These data were taken from 383 individual plants from all known populations for the species. Note that while all sites exhibited a spread of diameter class, individual populations were conspicuous in the absence of either the largest size class (read oldest age class) and/or in some instances a lack of seedlings. This appeared to be strongly correlated with the density and age of the associated plant community.

be dynamic and are either expanding or contracting, possibly in response to competition with larger shrub species – notably Tick Bush. Both species can resprout from stem bases following disease or drought. Massive recruitment of Long-leaved Platysace following the breaking of the 1997-98 drought (observed in November 1999 and August 2000) may have a deleterious effect on less common species including David’s *Westringia* and Ralston’s *Leionema*.

The response of David’s *Westringia* and Ralston’s *Leionema* to fire is unknown. The preferred rocky habitat of these species is somewhat fire protected due to the lack of litter (fine fuel) accumulation. Fire is not required for germination (Carr & White, pers. obs.). Circumstantial and anecdotal evidence suggests that David’s *Westringia* is fire sensitive (D. Keith pers. comm.) however, this needs to be tested experimentally to provide definitive evidence that this is, in fact, the case. Briggs and Leigh (1990) note that a hazard reduction burn which encroached on one outcrop killed several David’s *Westringia* and Ralston’s *Leionema*. More recent observations at one site suggest that Ralston’s *Leionema* can survive slow moving, low intensity fires and resprouts vigorously from sub-aerial stems or possibly rootstocks. Several

individuals were killed outright suggesting that in places the fire may have reached higher intensities.

Threats – David’s Westringia & Ralston’s Leionema

David’s *Westringia* and Ralston’s *Leionema* are currently not threatened by overt habitat destruction. The preferred habitats of these species are not suitable for agriculture and do not support merchantable timber resources. While none of the extant populations of either shrub species appear to be threatened in the short term, there is some circumstantial evidence for the slow decline of both species. Within their existing range, a number of apparently suitable rocky outcrops do not support either species and several extensive rhyolite outcrops do not support David’s *Westringia*. While both species may persist at these sites as viable, soil-stored seed, the possibility that either or both have suffered localised extinction must be considered in conservation planning.

Fire

The foothill forests across the range of both species are prone to wildfire resulting from lightning strikes in late summer (J. Miles, pers. comm.). However, it has been

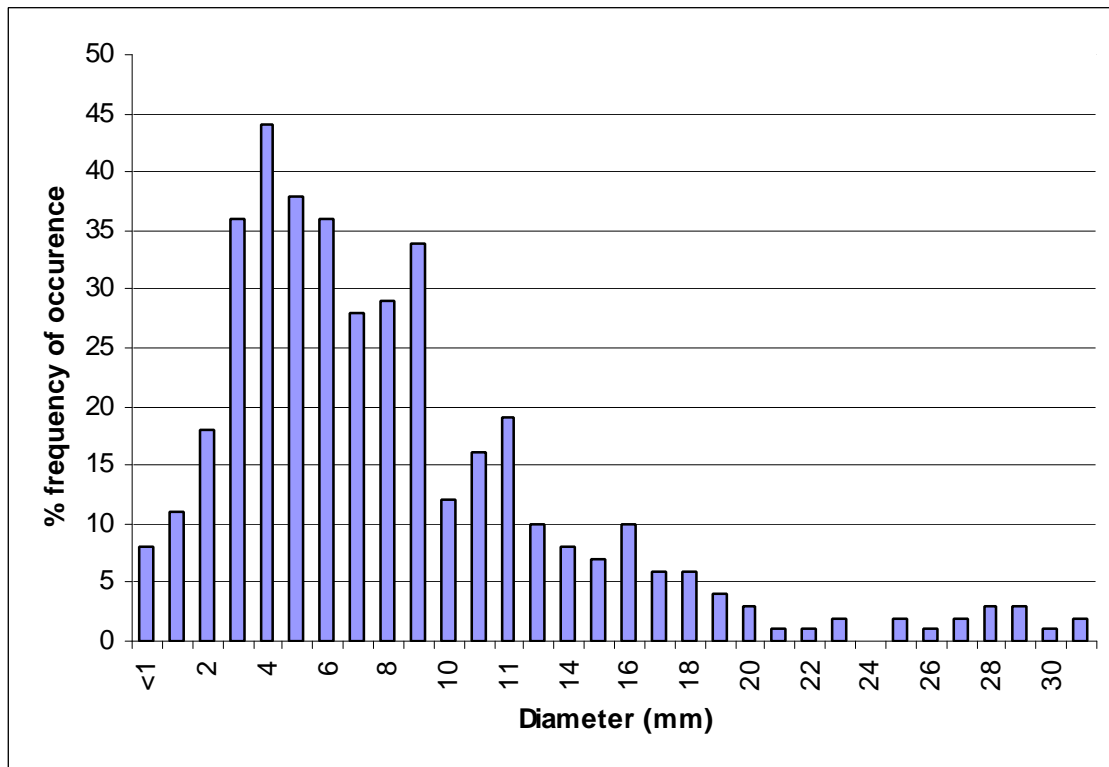


Figure 6. Population structure of Ralston’s *Leionema* using stem diameter as a surrogate for age.

These data were taken from 430 individual plants from all known populations for the species. Note that while all sites exhibited a spread of diameter class, individual populations were conspicuous in the absence of either the largest size class (read oldest age class) and/or in some instances a lack of seedlings. This appeared to be strongly correlated with the density and age of the associated plant community.

postulated by Albrecht (1986) and Briggs and Leigh (1990) that the shrub communities supported by rhyolite outcrops would have been infrequently burnt prior to European settlement, considering the natural protection from wildfire conferred to them by the expanses of bare rock. Hazard reduction burning is routinely employed by land management agencies across large tracts of the forest landscape to check the accumulation of fine fuels and assist in wildfire suppression. Whether this practice results in fire burning in at the edges of outcrops more frequently is currently unknown. If this does prove to be the case, then the effect on life histories and reproductive strategies of affected plant species and critical synecological processes would need to be investigated. Alternatively, if hazard reduction burning decreases the frequency of unplanned fire as suggested by Binns (pers. comm. 1999), the implications of this would need to be assessed.

Disease

The branches of David's Westringia are frequently blackened by sooty mould, which often infects the foliage of many species of *Westringia* (Conn 1987). These infections do not appear to cause significant mortality. The upper surface of the leaves of Ralston's Leionema are sometimes dotted with blisters caused by a Blister Scale insect of the family Asterolecaniidae. As with the sooty mould, these sedentary sap-sucking insects are probably indigenous and cause little if any mortality, but clearly reduce growth on infected branches.

Genetic decline

Sub-populations of both species are scattered and discrete. Sites may support as few as 50 individuals of either species. There are a number of potential genetic consequences of population isolation and fragmentation. In the absence of gene flow, small 'effective populations' of plants may be subject to random genetic drift and inbreeding depression. Over successive generations both these processes can result in a reduction in genetic diversity. Ultimately, reduced genetic diversity will affect the ability of populations to respond to environmental change or disease. Gene flow between sites supporting both Ralston's Leionema and David's Westringia would be effected by birds and insects respectively. However, it is likely that the exchange of genetic material between sub-populations is rare. Therefore it is critical that all remaining populations are retained in the landscape to mitigate against potential genetic decline.

Grazing and Browsing

Grazing and browsing by goats has been noted by Albrecht (1986) and Briggs and Leigh (1990) as a threat to rocky outcrop plant communities in South-

eastern New South Wales. A population of feral goats has been known to occur at Jingera Rock which supports a large population of Ralston's Leionema. Albrecht (1986) also noted that goats were present at a number of other outcrops which support David's Westringia and Ralston's Leionema. Recent surveys of all known populations did not detect direct or indirect evidence of goats.

Numerous individual plants of both species have been severely damaged by intense browsing at one site in the Box Range where the species co-occur. This site is within 200 m of land cleared for pasture. The browsers are likely to be Swamp Wallabies. While there is no evidence that browsing pressure has resulted in any mortality of adult plants of either species, it has dramatically reduced flowering and seed production and probably prevents the recruitment of seedlings.

3.4 Rhyolite Midge Orchid (*Genoplesium rhyoliticum* D. Jones and M. Clements)

Description

The Rhyolite Midge Orchid is a terrestrial, summer-deciduous perennial herb with a large and spherical tuber to 1.8 cm diameter at a depth of 2-6 cm in the soil. The solitary leaf is very narrow, cylindrical to 15 cm long by 2.5 mm diameter, sheathing and completely enclosing the flowering stem. Inflorescence a terminal spike 1-2 cm above the leaf apex; flowers 5-46 crowded in the spike which is up to 5 cm long. Flowers dark yellow-green and maroon, 4-6 mm diameter with three linear-lanceolate sepals to 4-5 mm long by 1 mm wide and 2 shorter, narrow-ovate, very slender - pointed petals. Lip mobile, to 3.5 mm long by 1.7 mm wide, reverse heart-shaped, with fringed margins, the hairs to 0.5 mm long. Fruit a narrow, erect capsule to 4 mm long by 2 mm wide. Flowering occurs for a few weeks in December and January though it has apparently also been observed flowering in October. A detailed description is given by Jones (1991) and Bishop (1996). The species was described in 1991 by Jones and Clements (in Jones 1991).

Distribution and confirmed populations

The Rhyolite Midge Orchid, a narrow South Coast NSW endemic, is known from only six sites spanning a polygon of approximately 7 by 10 km (see Figure 3 and Appendix 2):

- RO24 - the type locality on Old Hut Creek in South East Forests National Park, Yowaka Section, approximately 13 km west northwest of Eden;

- RO3 – Old Hut Creek catchment, approximately 1.8 km northwest of RO24 (also South East Forests National Park);
- RO25 - Nullica State Forest, approximately 19 km northwest of Eden;
- RO15 - Nethercote Falls Flora Reserve, approximately 11 km southwest of Pambula (Binns and Kavanagh 1990);
- RO17 – south of Sugarloaf, South East Forests National Park, Yowaka Section;
- 167 – Old Hut Creek catchment, approximately 1.7 km north of RO24 (Elith, in prep., see also footnote 2 page 10).

Three collections are lodged in the Australian National Herbarium with duplicates in the National Herbarium of NSW. The earliest collection was apparently made in 1985 by Margaret Parris (data on collection at the Australian National Herbarium).

Two populations were documented in the study supporting this Recovery Plan. At the type locality (RO24) 139 plants were recorded, confined to an area of approximately 600 m². At the Nullica State Forest Site (RO25) an estimated 1000+ plants were found in an area of about 1 ha. Plants at site RO3 in South East Forests National Park could not be relocated and the status of the population is unknown. Site RO17 south of the Sugarloaf in South East Forests National Park was newly recorded during this study but all plants were sterile or had been eaten off (perhaps by macropods). The identity of plants here cannot be confirmed but there is little doubt that it is the Rhyolite Midge Orchid given the closely corresponding rhyolite outcrop habitat and an apparent absence of any other *Genoplesium* species on rhyolite in the region. The Nethercote Falls population (RO15) recorded by Binns and Kavanagh (1990) was not investigated and cannot be confirmed.

Tenure

Of the 3 populations of the Rhyolite Midge Orchid located or relocated during this survey:

- one occurs in Nullica State Forest – managed by SFNSW; and
- two occur in the South East Forests National Park (Yowaka Section) – managed by the NSW NPWS.

Habitat

At all documented locations the Rhyolite Midge Orchid occurs in very shallow soil overlying rhyolite rock on a range of aspects. These sites are often too seasonally drought stressed to support shrubs or trees. Vegetation is dominated by dense cover of small fruticose lichens in some locations, and by lichens and/or moss in others. These cryptogams have not been identified. Some plants have been located in

dense stands of shrubs which form heathland (e.g. RO25). The main associated shrub species are Tick Bush (*Kunzea ambigua*), Common Fringe-myrtle (*Calytrix tetragona*), Long-leaved Platysace (*Platysace lanceolata*), Giant Honey-Myrtle (*Melaleuca armillaris ssp. armillaris*), Small-leaved Epacris (*Epacris cf. microphylla*), Ralston's Leionema (*Leionema ralstonii*) and Tangled Pseudanthus (*Pseudanthus divaricatissimus*).

Few herbaceous species are associated with Rhyolite Midge Orchid populations and all have low or very low cover. Other geophytes are common associates, notably orchids e.g. Tiny Greenhood (*Pterostylis parviflora*), Sun Orchids (*Thelymitra* spp.), Bearded Orchids (*Calochilus* spp.), Large Duck Orchid (*Caleana major*), Small Duck Orchid (*C. minor*) and Parson's Bands (*Eriochilus cucullatus*), as well as Tall Sundew (*Drosera peltata ssp. auriculata*). The Common Fringe-lily (*Thsanotus tuberosus*) is also often present and, in leaf, easily confused with the Rhyolite Midge Orchid.

Ecology and Biology

The Rhyolite Midge Orchid is a long-lived tuberous geophyte which has a relatively brief period of activity in late spring-early summer when it is stimulated into growth and flowering by summer rains. At the type locality plants were not evident on 1 January 1999 but appeared soon after heavy rain. They were in full flower in late January (S. Clark, NSW NPWS, pers. comm.). The RO25 site was monitored closely over both the 2001 and 2002 seasons but few individuals were observed to flower.

The tubers of the Rhyolite Midge Orchid (at about 1.8 cm diameter in one plant examined) are large for the size of the plants and constitute the bulk of the biomass at flowering when plants are more-or-less fully developed. Plants occur in very shallow soil over rock and are buried only 2-6 cm deep. Such a large tuber relative to the total mass of the plant is clearly an adaptation to the habitat which may be severely drought stressed. While plants may occur on very exposed western aspects (type locality) they were recorded elsewhere on much more protected mesic aspects.

Growth commences in summer (or perhaps autumn in extreme years). Whilst it is not triggered by rain, growth is hastened. Growth to flowering is very rapid and flowering and fruiting (to the seed dispersal stage) takes only 3 – 4 weeks. The tuber that produces the current leaf and flower (or leaf only in sterile non-flowering plants), is termed the mother tuber. During the growing season a new tuber (daughter tuber) develops to maturity beside the mother tuber, and by the end of the season (presumably about October) it

replaces the mother tuber. At this stage the mother tuber dies. Because of the annual renewal of the whole plant, the orchids are potentially very long lived. Some plants may be decades old but this could only be determined by detailed, long-term monitoring.

By extrapolation from other *Genoplesium* species (Bishop 1996), pollination of the Rhyolite Midge Orchid is effected by small flies – most likely ‘fruit flies’. At the type locality, visitation by the pollinator was highly effective and about 35% of all flowers in the population produced fruit in 1999. Flowering is assumed to be fairly erratic in response to the current season’s rainfall, combined with the size of nutrient reserves in the tuber which is a function of growing conditions experienced in the previous growing season. At the type locality at least 11% of plants flowered in 1999, while only one flowering plant was found among several hundred sterile plants at the Nullica State Forest population (RO25).

Reproductive maturity from seed is not likely to occur until at least year three, assuming adequate growing conditions. For seed germination to occur, as in all orchids, *Genoplesium* has an obligatory requirement for a mycorrhizal fungus; nothing is known about this mycorrhizal relationship except that it will extend throughout the life of the plant. Seed dispersal is passive with minute dust-like seeds potentially capable of being dispersed considerable distances.

Threats

The Rhyolite Midge Orchid is not threatened by anthropogenic factors because of the secure, very rocky habitats. These usually have slight fuel loads generally incapable of carrying fire (an exception is RO25 which has a very dense shrub layer continuous between the adjacent forest and the rocky outcrop). Exotic plant species (mostly wind-dispersed Asteraceae) are absent or very rare. One obvious natural limitation to reproductivity is grazing, presumably by macropods and/or possums. At the type locality at least 8% of plants had their inflorescences (flowering or fruiting spikes) eaten off, but some of this may have occurred after seed dispersal. While grazing may significantly limit reproductivity, it is a natural phenomenon and no management intervention is practicable or warranted. It would also appear, on the basis of observations at site RO25 over the 2001 and 2002 flowering seasons, that inappropriately timed rainfall could also be having a significant adverse effect on reproduction in the Rhyolite Midge Orchid. Some orchid species can be subject to illegal collecting, however, the midge orchid group do not generally attract this type of activity.

4 Ability of Species to Recover

The five species treated in this recovery plan are rare and highly restricted as a result of ‘natural’ ecological and evolutionary processes. Each species is specialised and relatively abundant within a narrowly defined niche. In the absence of unforeseen and unmanageable threats the prognosis for the maintenance of wild populations of all species would appear to be good.

5 Management Issues

5.1 Fire Management

It is clear that periodic fire has shaped the composition of the plant communities that are supported by rocky outcrops in south-east NSW and fire is potentially an important element in maintaining their function, structure and diversity. However, at this juncture it is not clear what fire intensities and frequencies are desirable for the maintenance of the species subject to this plan or for biodiversity outcomes more generally. Given our incomplete understanding of the effects of fire on rocky outcrop species it is difficult to predict the long term consequences of different fire management regimes. A high priority should be given to research and monitoring to provide the data on which to base sound management guidelines.

In particular, the long term implications of hazard reduction burning are unclear. It may be that this management practice will act to decrease the frequency of fire on rocky outcrops by decreasing fuel loads in the vicinity and, therefore, the likelihood of uncontrolled high intensity fires burning across the outcrops. If this turns out to be the case, then deliberate burning of these outcrops may become a future management issue (D. Binns, pers. comm. 1999). On the other hand, regular hazard reduction burning in the vicinity of rocky outcrops may increase the frequency with which burns encroach on outcrop edges. The long term implications of this change in fire regime for species occurring at the edges of outcrops would then need to be investigated.

5.2 Timber Harvesting

The provisions of the IFOA apply to all forestry operations and will apply to the rocky outcrops within the general management areas of State Forests. In particular, specified forestry activities (including timber felling, construction and operation of log dumps and snig tracks and road construction and reopening) are prohibited within areas of rocky outcrops and cliffs. This also applies to an additional exclusion zone of 40 metres where outcrops are >0.5 ha. No timber harvesting will take place in Jingera,

Narrabarba Hill and Nethercote Falls Flora Reserves. The application of these provisions should ensure that the rocky outcrops are adequately protected from these forestry activities.

5.3 Soil Borne Pathogens

Without soil sampling it is not possible to know with certainty whether the pathogenic soil fungus *Phytophthora cinnamomi* is present at the rocky outcrop sites subject to this plan. Deaths of *Xanthorrhoea australis*, a species particularly susceptible to attack from the fungus, have been observed close to rocky outcrops. Further investigations to determine the presence or absence of the fungus and also the sensitivity of the outcrop species to the fungus are considered justifiable. Until the outcome of these investigations is known, it would be prudent to take steps to avoid any possible introduction to these sites whether by vehicle traffic or individuals entering them on foot.

5.4 Weed Invasion

Almost all of the rocky outcrops which support the threatened outcrop plants are weed free. However, *Eragrostis curvula* a very invasive environmental weed may present a threat to two of the Bega Wattle populations.

5.5 Grazing and Browsing

Feral goats could pose an ongoing threat to the flora supported by rocky outcrops. One site at which David's Westringia and Ralston's Leionema are present is currently subject to severe browsing pressure. The mammal responsible for this ongoing damage has not been identified but is likely to be a native herbivore. Browsing by native herbivores may also be a threat to the Rhyolite Midge Orchid.

6 Previous Recovery Actions

No specific actions for these species were undertaken prior to the commencement of the recovery planning process. Provisions for their future management have, however, been made in the recent IFOA. In addition, discussions between NPWS, Bega Valley Shire Council, Great Southern Energy and Telstra on the options for managing the utility easement on Dr. George Mountain have commenced.

Further survey work for additional populations of Bega Wattle has been carried out by Jackie Miles (Miles 2001) and has led to the identification of an additional ten sites for this species (details given in Section 3.2). Field work conducted by Jane Elith (Elith, in prep.) for a PhD thesis on modelling plant distributions has added a further 43 sites with populations of Ralston's Leionema, five sites with populations of David's Westringia and one site with the Rhyolite Midge Orchid. Apart from location and population estimates these sites have not been documented.

NPWS has begun liaison with Bega Valley Shire Council on the eradication of African Love-grass at the Dr George Mountain Bega Wattle site (Action 2.1) and the evaluation of the African Love-grass invasion of the Towamba Valley Bega Wattle population (Action 2.2).

Soil samples have been collected from three rocky outcrop sites (RO 17, RO 19 and RO25) and analysed under the supervision of Brett Summerell of the Plant Disease Diagnostic Unit at the Royal Botanic Gardens in Sydney for the presence of *Phytophthora cinnamomi*. Three samples from RO 17 were positive. Cuttings of David's Westringia and Ralston's Leionema have also been taken for establishment and testing for sensitivity to *Phytophthora cinnamomi*. The results of this work should be available early in 2003.

7 Proposed Recovery Objectives, Actions and Performance Criteria for 2003-2007

The subject plant species are all highly restricted and naturally rare and there is no evidence that the species have declined significantly since populations were first discovered. As a consequence, the objective of this recovery plan is to manage and monitor all known populations such that they are protected from disturbances which may result in local extinction or 'unnatural' decline.

Specific Objective 1: Collect information on additional occurrences of the species and regularly monitor populations.

Action 1.1: Identify and verify additional known and potential occurrences of the Bega Wattle and the Rhyolite Midge Orchid. Manage any additional populations of this and other threatened rocky outcrop species in accordance with the actions in this Recovery Plan.

Further survey is required to acquire baseline information on the three known occurrences of Bega Wattle at Kangarutha Point (Bournda National Park) and an additional site on the southern side of the Tuross River near Belowra. Reports of the occurrence of Rhyolite Midge Orchid at Nethercote Falls (RO15), Sugarloaf (RO17) and Old Hut Creek catchment (RO3 and 167 – Elith, in prep., see also footnote 2 page 10) also need to be thoroughly investigated and other outcrop sites should be surveyed for Rhyolite Midge Orchid populations when the species is in flower. A baseline study was undertaken prior to the development of this Recovery Plan. It established permanent quadrats at the majority of sites known at that time which support one or more of the 5 plant species in this Plan. In each quadrat, species composition and cover were recorded. In addition, the numbers and (where relevant) the dimensions of the 5 target threatened species were also recorded. Future survey and assessment methodology will be consistent with that employed during this baseline study.

Performance Criterion 1.1

Completion of survey and documentation of Bega Wattle sites and potential Nethercote Falls and other Rhyolite Midge Orchid sites within 1 year of the approval of this Recovery Plan.

Action 1.2: Carry out monitoring of known populations at regular (5 yearly) intervals.

Populations of the 5 rocky outcrop plant species will be regularly monitored to detect trends, anticipate potential threats and facilitate early management intervention. This monitoring will be consistent with the methodology employed in the baseline study.

There is a need to gather baseline data on some of the sites included in this plan in order for them to become a part of the monitoring program. Sites for which these data have not been collected include: AC5, AG3, AG17, RO10, RO20-23 and RO26. The sites more recently established by J Elith (in prep., see also footnote 2 page 10) also need to be progressively documented. Highest priority should be given to sites with two or more species (152, 161, 164, 167, 175 and 177) and sites with larger populations (143, 162, 176, 190, 199, 206 and 213).

The five monitored populations of Bega Wattle and 10 monitored populations of Ralston's Leionema and David's Westringia will be selected to sample the range of population sizes, land tenures (note that all populations on freehold land will be monitored) and age of the associated shrub communities.

Performance Criterion 1.2

Monitoring of all known populations of Narrabarba Wattle and Rhyolite Midge Orchid will be completed by the autumn of 2006. In addition, 5 selected populations of the Bega Wattle and 10 selected populations of each of Ralston's Leionema and David's Westringia will also be monitored by the same date.

Specific objective 2: Determine the extent and severity of threatening processes and eliminate or monitor them.

Action 2.1: NPWS to liaise with Bega Valley Shire Council to eradicate African Love-grass at the Dr. George Mountain Bega Wattle site and monitor to determine if the grass becomes re-established from soil-stored seed.

The invasion of African Love-grass plants presents a potentially serious threat to the population of Bega Wattle on Dr. George Mountain. Early intervention in the dispersal and spread of this serious environmental weed is critical. Hence the need for this program of eradication which will be followed up by monitoring at regular intervals for the life of the Recovery Plan.

Performance Criterion 2.1

No African Love-grass plants will be evident within six months of approval of this Recovery Plan at Dr George Mountain. Formal monitoring of African Love-grass and reporting on findings will occur at yearly intervals for 5 years and ongoing control carried out as needed.

Action 2.2: NPWS to control any invasion of African Love-grass at the Bega Wattle site (AG5) in the Towamba River catchment and coordinate control of this noxious weed in the vicinity with the Weeds Committee of the Local Management Team – South East Catchment Management Committee.

Individual African Love-grass plants were found invading the bed and banks of the Towamba River in the vicinity of the Bega Wattle population. These plants have presumably dispersed to this site from populations upstream. There is potential for this species to disperse further and invade the Bega Wattle population. Should this occur, control measures need to be instituted immediately.

In addition, a coordinated approach between NPWS and the Weeds Committee of the Local Management Team – South East Catchment Management Committee to the control of this noxious weed will be developed. A suitable approach might be the creation of a weed free buffer where the species occurs in proximity to the Bega Wattle population and outside the South East Forests National Park.

Performance Criterion 2.2

Any invasion of the Bega Wattle site by African Love-grass controlled and coordinated control of this noxious weed in proximity to the Bega Wattle site established within 1 year of the approval of this Recovery Plan.

Action 2.3: Assess the significance of the browsing of Ralston's Leionema and David's Westringia populations at the Box Range site and institute effective means of control of grazing impacts if required.

Severe browsing pressure is a potential threat to Ralston's Leionema and David's Westringia at the Box Range site. The significance of this impact needs to be fully assessed. If this threat is significant, appropriate protection measures such as fencing need to be devised and carried out.

Performance Criterion 2.3

Assessment of the significance of browsing at Box Range completed by June 2004 and protection of the site from this threat, if required, implemented by end of 2004.

Action 2.4: Establish the significance of feral goat browsing on the conservation of Ralston's Leionema at Jingera Rock and control goats as necessary.

A survey of Jingera Rock will be carried out by the NPWS in the summer of 2003/2004 using appropriate methods to estimate goat numbers and damage to Ralston's Leionema. The report on this survey will include recommendations for goat control, if appropriate, to be implemented by the NPWS. Follow up control of goat populations in the area will need to be continued for the life of this Recovery Plan

Performance Criterion 2.4

Survey or other appropriate methods will be used to evaluate goat damage at Jingera Rock and a report on findings will be completed within two years of the approval of this Recovery Plan and control measures implemented.

Action 2.5: In order to minimise the risk of introducing Cinnamon Fungus into the populations of threatened species, it is recommended that individuals walking onto the rocky outcrop sites take care to remove all soil from footwear.

The regular monitoring resulting from Action 1.2 will evaluate the health of populations and facilitate early response to disease outbreaks. While at this stage it is not known whether or not Cinnamon Fungus poses a risk to populations of the species covered in this plan, the potential for it to be introduced to rocky outcrop sites needs to be minimised. Until research provides a definitive answer on this issue, all parties that may enter these sites from time to time need to be aware of the importance of observing this precaution.

Performance Criterion 2.5

All parties informed of the recommendation that this precaution be observed within 1 year of the approval of this Recovery Plan.

Action 2.6: Assess the significance of pyrophyllite mining as a positive or negative impact on the Ralston's Leionema population in the Back Creek area and develop enhancement or protective measures as appropriate.

In order to assess the possible impact of pyrophyllite mining on Ralston's Leionema it will be necessary to consider the distribution of the species in relation to the mine plan for the lease. This can be done by NPWS in association with the mining company, Commercial Minerals Ltd. If required, a formal agreement between NPWS and Commercial Minerals Ltd (in consultation with the Department of Mineral Resources) can be drawn up regarding appropriate management of the Ralston's Leionema population at this site.

Performance Criterion 2.6

An assessment of the possible positive or negative impact of pyrophyllite mining completed and where necessary, a formal agreement on appropriate measures reached between NPWS and the mining company within one year of the approval of this Recovery Plan.

Action 2.7: Investigate options to narrow or relocate utility easements on Dr George Mountain.

The utility easement for power and telephone lines impacts on an estimated 5-10% of the population at this site. Various options to reduce this impact will be considered in consultation with Telstra and Great Southern Energy and a cost-effective course of action determined as appropriate.

Performance Criterion 2.7

A preferred option identified for reducing the utility easement impact on the Bega Wattle population and the feasibility of implementing this option assessed within one year of the approval of this Recovery Plan.

Action 2.8: Investigate the fire history of all sites which support the 5 threatened species in this Plan.

An understanding of the role that fire has played in the dynamics of populations of the species subject to this plan or the role it has played in their current distribution, may be critical to further research and/or conservation management efforts. To this end the records of the NPWS, State Forests and the Rural Fire Service will be accessed to prepare an overview of the fire histories of the 91 sites which support these plant species. In addition, anecdotal information and other historical resources such as newspapers will be evaluated.

Performance Criterion 2.8

A brief report on the history of wildfire and prescribed fire relevant to the threatened rocky outcrop flora, will be completed before the end of the year 2004.

Specific objective 3: Encourage research on aspects of the biology and ecology of the outcrop species to aid in making informed management decisions.

Action 3.1: Develop a detailed monitoring strategy to be implemented in the event that any populations are burnt or otherwise disturbed.

An understanding of the response of the 5 species to disturbance, particularly that imposed by fire, is

critical to future management decisions ensuring the continued survival of these species. Before the summer of 2003-2004 NPWS, in consultation with SFNSW, will develop a monitoring program to be implemented following the occurrence of fires at any of the sites on State Forests or National Parks. Aspects of the target species ecology and biology to be evaluated will include: mortality, germination and recruitment. This will apply to sites in South East Forests National Park (RO3-6, RO12, RO13, RO17, RO19, RO23, RO24, AG5, AG15, AG16), Wadbilliga National Park (AG6-14) and Bournda National Park (AG1-3 and AG17) and the General Management Area of State Forests to the south of Jingera Flora Reserve (RO2, RO18, RO20, RO21, RO22 and RO26) which will continue to have routine hazard reduction burning measures applied to them. It will also apply to the outcrops with occurrences of threatened species recently documented by Elith (in prep., see also footnote 2 page 10). State Forest will advise NPWS of any fires occurring on these rocky outcrop sites and NPWS will be responsible for either carrying out or contracting the monitoring program.

Performance Criterion 3.1

A detailed monitoring strategy finalised and arrangements in place for its implementation and agreement of fire management authorities to promptly provide information on fire events within 1 year of the approval of this Recovery Plan.

Action 3.2: Undertake research into the seed bank dynamics and the response to fire of the Narrabarba Wattle.

A more detailed understanding of the fire response and seed bank dynamics of the Narrabarba Wattle and also potential competition effects of Black She-oak (*Allocasuarina littoralis*) will be essential in the event that active management of these stands is required to prevent local extinctions. Research, to be supervised jointly by NPWS and State Forests, should focus on the quantity of viable Narrabarba Wattle seed stored in the soil, its longevity and germination requirements. This research will be conducted in the context of the possible use of fire as a tool for managing populations.

Performance Criterion 3.2

Within 1 year of approval of the Recovery Plan funding will be sought for a post-graduate seed-bank and fire response research project into Narrabarba Wattle as an aid to its conservation management.

Action 3.3: Sampling and testing for the presence of Cinnamon Fungus will be carried out on selected rocky outcrop sites.

Monitoring the health of the populations of threatened rocky outcrop species (Action 1.2) and sampling and testing for the presence of the fungal pathogen on rocky outcrops will facilitate the early application of effective control measures if required. In addition, research may need to be carried out to determine the sensitivity of rocky outcrop species to Cinnamon Fungus. This would initially be laboratory based, however, it is recognised that species can exhibit sensitivity in the laboratory and still be resistant in their natural environment. Field based research would be necessary to determine with confidence whether threatened flora species on rocky outcrops are susceptible to Cinnamon Fungus.

Performance Criterion 3.3

A sampling and testing program for the presence of Cinnamon Fungus at selected sites completed by 2004.

Specific objective 4: Integrate site and species management requirements into relevant State Forest, Rural Fire Service and NPWS Plans.

Action 4.1: Hazard reduction burning in Flora Reserves and in the vicinity of site RO25 will take account of the presence of threatened rocky outcrop species and burning will be planned to minimise the occurrence of fire on these outcrops.

Rocky outcrop sites occur in Jingera Flora Reserve (RO1, RO7, RO8 and RO14), Narrabarba Hill Flora Reserve (AC1, AC2, AC3 and AC4) and Nethercote Falls Flora Reserve (RO15). Site RO25, although not within a Flora Reserve, will be treated in the same way as the Flora Reserve sites and will be designated FMZ 3A because of its special significance as a Rhyolite Midge Orchid site as well as supporting large populations of David's Westringia and Ralston's Leionema (and Brigg's Darwinia *Darwinia briggsiae*). The 40 metre exclusion zone of the IFOA will apply to site RO25; however burning in this exclusion zone will depend upon an assessment of the most effective way of excluding fire from the rocky outcrop site itself.

Performance Criterion 4.1

The planning of burning to minimise the occurrence of fire on rocky outcrops incorporated into the Working Plans for Flora Reserves with threatened rocky outcrop species (by the end of 2004); at least until it is demonstrated that hazard reduction burning does not detrimentally affect these species.

Action 4.2: Include appropriate fire management guidelines and fire protection requirements for threatened rocky outcrop

species on private land and in National Parks in the Bega Valley Bush Fire Risk Management Plan and Fire Management Plans and associated Plans of Operations for Southeast Forests, Wadbilliga and Bournda National Parks.

There are 13 fully documented rocky outcrop sites in the South East Forests National Park which support populations of one or more of the threatened species considered in this Recovery Plan (RO3, RO4, RO5, RO6, RO12, RO13, RO17, RO19, RO23, RO24, AG5, AG15 and AG16). Wadbilliga and Bournda National Parks contain a further 13 Bega Wattle sites (AG1-3, AG6-14 and AG17). In addition, there are four fully documented rocky outcrop sites with populations of both David's Westringia and Ralston's Leionema on private land (RO9, RO10, RO11 and RO16). There are also additional sites with one or both of these species recently documented by Elith (in prep., see also footnote 2 page 10). Sites in South East Forests National Park are: 157, 160, 161, 162, 170, 175, 176, 188, 190, 196, 199, 201, 204, 206, 207, 325 and "C". A further five sites occur on freehold land: 133, 143, 213, 214 and "B".

The *Rural Fires Act 1997* requires that hazard reduction work must take into account wildfire history, intensity, frequency and seasonality and reflect the ecological requirements of any threatened species or their habitat, known or likely to occur in the area. In order to ensure that these provisions will apply to the occurrences of threatened species and their habitats that are the subject of this Recovery Plan, information on the locations of these sites and their likely sensitivity to frequent fire needs to be incorporated in the relevant Fire Management and Operations Plans.

Performance Criterion 4.2

Appropriate fire management guidelines and fire protection requirements incorporated in the Bega Valley Bush Fire Risk Management and Operations Plans and the Fire Management and Operations Plans for Southeast Forests, Wadbilliga and Bournda National Parks by the end of 2004.

Action 4.3: Implement an experimental burn in the easement on Dr George Mountain to stimulate regeneration or recruitment of Bega Wattle.

Although the bulk of the population of Bega Wattle at Dr. George Mountain exhibits an age distribution ranging from very young to very old individuals, there are indications that recruitment on the utility easement is being inhibited by very dense growth of *Kunzea ambigua*. The purpose of the autumn burn proposed in this action is to reverse this competitive imbalance and encourage more adequate recruitment to the Bega

Wattle population (this action links to narrowing the easement – Action 2.7).

Performance Criterion 4.3

An autumn burn will be conducted in the cleared easement on Dr. George Mountain with the assistance from local fire authorities within the life of this Recovery Plan. Post-burn monitoring in accordance with Action 3.1 will be carried out following the burn.

Specific objective 5: Develop appropriate conservation/management agreements for sites on private land.

Action 5.1: Investigate the potential for Voluntary Conservation Agreements (VCA's) where populations occur on private land.

Several freehold properties have important rocky outcrops which support populations of Ralston's Leionema and David's Westringia. One of these properties also supports other rare and threatened plant taxa. The owners of these properties will be formally approached by NPWS regarding their involvement in a VCA within the life of this Recovery Plan.

Performance Criterion 5.1

Owners of the properties supporting threatened species will be formally approached by NPWS regarding their involvement in a VCA within the life of this Recovery Plan.

Action 5.2: Initiate discussions with Bega Valley Shire Council with a view to the inclusion of an advisory note recording the presence of threatened species on Section 149 Certificates for relevant private properties.

While it is intended to make current owners aware of the presence of threatened species on their properties through Action 5.1, 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 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 s. 149 Certificates under the provisions of the *Local Government Act* will assist in achieving this.

Performance Criterion 5.2

Agreement reached between NPWS and Bega Valley Shire Council to record the presence of threatened species on s.149 Certificates for relevant private

properties within one year of the approval of this Recovery Plan.

Specific objective 6: Inform the relevant managers and the community of the significance of the species on outcrops of the forests of South Eastern NSW.

Action 6.1: Prepare and distribute an information brochure providing information to the public and enlisting their support in the conservation of these species.

A brochure will be prepared and distributed to the public and land managers to increase awareness of the significance of the species on rocky outcrops and the actions being taken to ensure their continued survival.

Performance Criterion 6.1

Within one year of the approval of the Recovery Plan NPWS will prepare and make available for distribution, a brochure based on the Recovery Plan and supporting information.

Action 6.2 Ensure the Recovery Plan is accessible to the community.

The Recovery Plan will be forwarded to interested members of the community, stakeholders and all relevant land management agencies including State Forests, local Shire Councils, the Rural Fire Service and the Department of Mineral Resources.

Performance Criterion 6.2

Copies of the draft Recovery Plan will be sent to all relevant parties as soon as it becomes available.

8 Implementation

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

9 Social and Economic Consequences

The threatened flora of rocky outcrops in south-east NSW can be adequately protected through existing legislation, and land use policy. It is anticipated that there will be few social or economic consequences of the implementation of this plan.

Most of the direct costs of implementing the plan will be borne by Government with a substantial part of these monies provided by the NSW government and additional funding to be sought from the Federal

Government. Apart from several areas on private land which are known to support populations of Ralston's Leionema and David's Westringia, all outcrops with threatened species covered by this plan are on public land. Of these public land populations, only a limited number exist outside dedicated Flora Reserves (set aside for the conservation of rare plants under the provisions of the *Forestry Act 1916*) and National Parks (see Appendix 2).

Private economic interests may be affected by this plan. The future development of the Back Creek Pyrophyllite Mine may need to be reviewed due to the proximity of a population of Ralston's Leionema. Current mining operations are on a small scale and the impacts of mining on the species (positive or negative) remain to be determined. It is not anticipated, therefore, that the mine will be economically disadvantaged over the life of this plan.

The freehold land supporting populations of species subject to this plan is characterised by shallow soils and precipitous cliffs and gorges. In general, these areas are unsuitable for agricultural activities. The species have persisted at these sites and it is anticipated that the existing low level of use (the removal of minor forest products from the surrounding forest) does not constitute a threat and as such it is not proposed to regulate freehold land use. Any actions to be implemented on freehold land would be negotiated with the relevant landholders.

10 Roles and Interests of Indigenous People

The Local Land Councils, elders and other groups representing indigenous people in the areas where the rocky outcrop species occur have been identified and a copy of the draft Recovery Plan sent to them. Their comments on this draft have been sought and will be considered in the preparation of the final Recovery Plan. It is also the intention of the Recovery Team to consider the role and interests of these indigenous communities in the implementation of the recovery actions identified in this plan.

11 Biodiversity Benefits

The conservation of all remaining populations of the five threatened species in this recovery plan will benefit a range of plant species which are confined to similar rocky habitats (see Appendix 1). Many of these species are rare, disjunct or at the edge of their range.

The events and processes which have led to the current fragmented distribution of all 5 species remain unknown. Further study of these species and the genetic diversity retained within each population may

assist in the management of plant populations recently fragmented by urban or rural disturbance.

12 Preparation Details

This Recovery Plan was prepared by Geoff Carr and Matt White of Ecology Australia. Stephen Clark, Senior Threatened Species Officer, Southern Directorate (NPWS) edited and finalised the plan for publication. Michael Saxon (Manager Threatened Species Unit, Southern Directorate) was responsible for final edits and formatting.

The Recovery Plan has been formulated with the advice and assistance of a Recovery Team. The Recovery Team is a non-statutory group of expert biologists, landowners and managers and other stakeholders and has been established by the NSW National Parks and Wildlife Service (NPWS) to discuss and resolve issues relating to the conservation and management of the species.

13 Review Date

In relation to its status as the State endorsed Recovery Plan for the Narrabarba Wattle, Bega Wattle, David's Westringia, Ralston's Leionema and Rhyolite Midge Orchid, 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, Environment Australia or other Recovery Team members 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 Recovery Team within five years from the date of its publication.

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Table1: Estimated costs of implementing the actions identified in the recovery plan are provided below.

Action No.	Action Description	*Priority	**Feasibility	Responsible Party	Fund source	Cost Estimate (\$'/year)					Total Cost (\$'s)
						2003	2004	2005	2006	2007	
1.1	Identify and verify additional known and potential occurrences of threatened rocky outcrop flora	2	100%	NPWS	cash	0	5,000	0	0	0	5,000
1.2	Carry out monitoring of known populations at regular intervals	2	100%	NPWS	cash	0	0	0	10,000	0	10,000
2.1	Eradicate African Love-grass at the Dr George Mountain Bega Wattle site and follow-up monitoring	1	80%	NPWS (in association with Bega Valley Shire Council)	'in kind'	800	200	200	200	200	1,600
2.2	Evaluate the invasion of African Love-grass at the Towamba River population of Bega Wattle and implement control measures	1	100%	NPWS (in association with Bega Valley Shire Council)	'in kind'	1,000	0	0	0	0	1,000
2.3	Assess the significance of browsing at the Box Range site and implement appropriate control measures if required	1	90%	NPWS	'in kind'	2000	800	0	800	0	3,600
2.4	Assess the significance of goat activity at Jingera Rock and control goats as necessary	2	50%	NPWS	'in kind'	1,200	0	0	0	0	1,200
2.5	Minimise the risk of introducing Cinnamon Fungus into populations of threatened species	2	80%	SFNSW NSW NPWS	'in kind' 'in kind'	200 200	200 200	200 200	200 200	200 200	1,000 1,000
2.6	Assess the effect of pyrophyllite mining on the Ralston's Leionema population. Develop ameliorative measures as necessary	2	100%	NPWS	'in kind'	400	0	0	0	0	400
2.7	Investigate options to narrow utility easements at Dr George Mountain	3	100%	NPWS	'in kind'	1,200	0	0	0	0	1,200
2.8	Investigate the fire history of rocky outcrops supporting the five threatened plant species	3	100%	SFNSW NSW NPWS	'in kind' 'in kind'	0 0	700 700	700 700	0 0	0 0	1,400 1,400
3.1	Develop a detailed monitoring strategy in the event that any outcrops are burnt or otherwise disturbed	2	100%	NSW NPWS SFNSW	'in kind' 'in kind'	800 400	0	0	0	0	800 400
3.2	Undertake research into the seed bank dynamics and response to fire of Narrabarba Wattle	1	100%	NPWS	cash	0	5,000	5,000	5,000	0	15,000
3.3	Sample and test for the presence of Cinnamon Fungus at selected sites	2	100%	NPWS	cash	0	1000	0	0	0	1,000
4.1	Hazard reduction burning in Flora Reserves and site RO25 planned to minimise occurrence of fire on rocky outcrops	2	100%	SFNSW	'in kind'	0	1,000	0	0	0	1,000
4.2	Fire requirements of threatened rocky outcrop species on private land and in National Parks	2	100%	NPWS (in association with Bega Valley)	'in kind'	0	1,000	0	0	0	1,000

	incorporated in relevant Management Plans			Bushfire Management Committee)							
4.3	Conduct an experimental burn in the easement on Dr. George Mountain	3	100%	NPWS (in association with Rural Fire Service)	'in kind'	0	1,000	0	0	0	1,000
5.1	Investigate the potential for Voluntary Conservation Agreements where populations are on private land	2	100%	NPWS	'in kind'	1,000	0	1,000	0	0	2,000
5.2	Seek agreement to include presence of threatened species on s. 149 Certificates for private properties where appropriate	2	100%	NPWS	'in kind'	1,000	0	0	0	0	1,000
6.1	Prepare and distribute an information brochure	3	100%	NPWS	cash	0	1,500	0	0	0	1,500
6.2	Ensure the Recovery Plan is made available to the community, relevant agencies and individuals	3	100%	NPWS	'in kind'	300	0	0	0	0	300
Total					'in kind'	\$10,500	\$5,800	\$3,000	\$1,400	\$600	\$21,300
Total					cash	0	\$12,500	5,000	15,000	0	\$32,500
Total	Annual cost of Rocky Outcrop Recovery Program				'in kind' + cash	\$10,500	\$18,300	\$8,000	\$16,400	\$600	\$53,800

Costings are based on 2002 dollars with no allowance made for inflation

*Priority ratings are as defined by Commonwealth Recovery Plan Guidelines: 1 - Action critical to prevent extinction; 2 - Action prevents negative impact short of extinction; 3 - All other actions.

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

Appendix 1

Rare, threatened and biogeographically significant plant taxa which occur on rocky outcrops in the forests of South-east New South Wales.

Taxon	Status
<i>Acacia subtilinervis</i>	3RCa
<i>Amyema congener</i> ssp. <i>congener</i>	Uncommon Regionally
<i>Aphanopetalum resinosum</i>	Southern distributional limit
<i>Boronia rigens</i>	Uncommon Regionally
<i>Bracteantha viscosa</i>	Uncommon Regionally
<i>Calandrinia calyptrata</i>	Uncommon Regionally
<i>Calandrinia eremaea</i>	Uncommon Regionally
<i>Darwinia briggsiae</i>	2RC- (now 3RC-)
<i>Daviesia alata</i>	Southern distributional limit and range disjunction
<i>Daviesia wyattiana</i>	Uncommon Regionally
<i>Dodonaea multijuga</i>	Southern distributional limit
<i>Eucalyptus spectatrix</i>	2RC-
<i>Grevillea "irrasa</i> ssp. <i>irrasa" (ms)</i>	2RC- (likely conservation status)
<i>Hakea macraeana</i>	Southern distributional limit
<i>Haloragodendron baeuerlenii</i>	3RCa
<i>Hibbertia circumdans</i>	Southern distributional limit
<i>Hovea purpurea</i>	Uncommon Regionally
<i>Leionema carruthersii</i>	3RC-
<i>Leucopogon setiger</i>	Uncommon Regionally
<i>Lomandra confertifolia</i> ssp. <i>rubiginosa</i>	Southern distributional limit
<i>Myoporum bateae</i>	3RC-
<i>Pellaea nana</i>	Uncommon Regionally
<i>Philothea myoporoides</i> ssp. <i>brevipedunculata</i>	3RC-
<i>Philothea myoporoides</i> ssp. <i>myoporoides</i>	Uncommon Regionally
<i>Plectranthus</i> cf. <i>graveolens</i>	Undescribed taxon – conservation status poorly known.
<i>Pomaderris ledifolia</i>	Uncommon Regionally
<i>Pomaderris virgata</i>	3RC-
<i>Prostanthera nivea</i>	Uncommon Regionally
<i>Pseudanthus divaricatissimus</i>	3RCa
<i>Pterostylis longipetala</i>	New regional record.
<i>Pultenaea villifera</i>	3RC-
<i>Wahlenbergia</i> sp. (<i>rhyolite</i>)	Undescribed taxon
<i>Zieria fraseri</i> ssp. <i>compacta</i>	Uncommon Regionally
<i>Zieria</i> sp. G (" <i>buxijugum</i> " ms)	2E
<i>Zieria</i> sp. H (" <i>formosa</i> " ms)	2E
<i>Zieria</i> sp. I (" <i>parrisiae</i> " ms)	2E
<i>Zieria</i> sp. O (" <i>littoralis</i> " ms)	Unusual habitat and northern distributional limit

Key: (from Briggs and Leigh 1995)

'2' indicates that the known geographic range of the species is less than 100 km, '3' indicates that the known geographic range of the species is greater than 100 km,

'E' denotes the species is endangered and in serious risk of depletion in the wild within 10-20 years if present land use and threats continue to operate, 'V' denotes the species is not presently 'Endangered' but at risk over a longer period (20-50 years) of disappearing from the wild through continued depletion, or occurs on land whose future use is likely to change and threaten its survival, 'R' denotes that the species is rare in the wild but which currently does not have an identifiable threat.

'C' indicates that the species has at least one population within a reserve set aside for the conservation of nature or otherwise dedicated for the protection of flora,

'a' indicates that more than 1000 plants are known to occur in a conservation reserve(s), 'i' indicates that less than 1000 plants are known to occur in a conservation reserve(s), '-' indicates that the reserved population size is not accurately known.

Appendix 2

Summary of site information for known locations of *Acacia constablei*, *Acacia georgensis*, *Genoplesium rhyoliticum*, *Westringia davidii*, and *Leionema ralstonii*.

Acacia constablei

Site	Location	Other Threatened Outcrop species recorded at site	Tenure	Estimated population	Approx. area occupied (ha)
AC1	Narrabarba Hill	Nil	State Forest - Narrabarba Flora Reserve	5,000	3.00
AC2	Near Narrabarba Hill	Nil	State Forest - Narrabarba Flora Reserve	1	0.10
AC3	Near Narrabarba Hill	Nil	State Forest - Narrabarba Flora Reserve	400	0.10
AC4	Near Narrabarba Hill	Nil	State Forest - Narrabarba Flora Reserve	300	0.10
AC5	North of the Womboyn River	Nil	State Forest - Narrabarba Flora Reserve	40	0.21
TOTALS		Nil		5,741	3.51

Acacia georgensis

Site	Location	Other Outcrop species present at site	Tenure	Estimated population	Approx. area occupied (ha)
AG1	Kianniny Bay	Nil	Bournda National Park	10,000	3.00
AG2	Kangarutha Point Area 1	Nil	Bournda National Park	??	??
AG3	Kangarutha Point Area 2	Nil	Bournda National Park	??	??
AG4	Dr. George Mountain	Nil	Crown Land Reserve	2,000	2.50
AG5	Towamba River	Nil	South East Forests NP - Coolangubra Section	45	0.60
AG6	Wadbilliga River (Bourkes Road)	Nil	Wadbilliga National Park	310	??
AG7	Belowra	Nil	Wadbilliga National Park	750	??
AG8	Brogo Dam 1	Nil	Wadbilliga National Park	1500	??
AG9	Brogo Dam 2	Nil	Wadbilliga National Park	50	??
AG10	Brogo Dam 3	Nil	Wadbilliga National Park	2000	??
AG11	Brogo Dam 4	Nil	Wadbilliga National Park	150	??
AG12	Warrigal Fire Trail	Nil	Wadbilliga National Park	8000	??
AG13	Nelsons Creek	Nil	Wadbilliga National Park	2000	??
AG14	Nalsons Creek Fire Trail	Nil	Wadbilliga National Park	860	??
AG15	Desert Creek 1	Nil	South East Forests NP – Bemboka Section	50	??
AG16	Desert Creek 2	Nil	South East Forests NP – Bemboka Section	300	??
AG17	Kangarutha Point Area 3	Nil	Bournda National Park	15	??
TOTALS				28,030	??

Genoplesium rhyoliticum

Site	Location	Other Outcrop species recorded at site	Tenure	Estimated population	Approx. area occupied (ha)
RO3	Old Hut Creek Catchment	<i>Leionema ralstonii</i> , <i>Westringia davidii</i>	South East Forests National Park - Yowaka Section	??	??
RO15	Nethercote Falls	<i>Leionema ralstonii</i>	State Forest - Nethercote Flora Reserve	??	??
RO17	Gorge south of Sugarloaf	<i>Leionema ralstonii</i>	South East Forests National Park - Yowaka Section	50?	0.50
RO24	Lower Old Hut Creek	<i>Leionema ralstonii</i>	South East Forests National Park - Yowaka Section	139	0.06
RO25	Yowaka River Catchment (4)	<i>Leionema ralstonii</i> , <i>Westringia davidii</i>	Nullica State Forest	1,000	1.00
TOTALS				1,139	1.56

Westringia davidii

Site	Location	Other Outcrop species present at site	Tenure	Estimated population	Approx. area occupied (ha)
RO1	Jingera FR South	<i>Leionema ralstonii</i>	State Forest - Jingera Flora Reserve	100	0.09
RO2	Yowaka River Catchment (6)	<i>Leionema ralstonii</i>	Nullica State Forest	250	0.08
RO3	Old Hut Creek Catchment	<i>Leionema ralstonii</i>	South East Forests National Park - Yowaka Section	250	0.10
RO4	Yowaka River Catchment (5)	<i>Leionema ralstonii</i>	South East Forests National Park - Yowaka Section	250	0.25
RO5	Old Hut Creek Catchment (1)	<i>Leionema ralstonii</i>	South East Forests National Park - Yowaka Section	800	0.30
RO6	Old Hut Creek Catchment (2)	<i>Leionema ralstonii</i>	South East Forests National Park - Yowaka Section	400	0.18
RO7	Jingera FR	<i>Leionema ralstonii</i>	State Forest - Jingera Flora Reserve	1,000	5.00
RO8	Jingera FR East	<i>Leionema ralstonii</i>	State Forest - Jingera Flora Reserve	600	1.00
RO9	Box Range South	<i>Leionema ralstonii</i>	Freehold ("Box Range")	20	0.16
RO10	Box Range West	<i>Leionema ralstonii</i>	Freehold ("Box Range")	1,000	2.00
RO11	Ocean View	<i>Leionema ralstonii</i>	Freehold ("Ocean View")	300	0.04
RO16	Box Range East	<i>Leionema ralstonii</i>	Freehold ("Box Range")	50	0.16
RO26	Yowaka River Catchment (1)	Nil	Nullica State Forest	50	0.10
RO25	Yowaka River Catchment (4)	<i>Genoplesium rhyoliticum</i> , <i>Leionema ralstonii</i>	Nullica State Forest	800	1.00
TOTALS				5,870	10.46

Leionema ralstonii

Site	Location	Other Outcrop species present at site	Tenure	Estimated population	Approx. area occupied (ha)
RO1	Jingera FR South	<i>Westringia davidii</i>	State Forest - Jingera Flora Reserve	100	0.09
RO2	Yowaka River Catchment (6)	<i>Westringia davidii</i>	Nullica State Forest	250	0.08
RO3	Old Hut Creek Catchment	<i>Westringia davidii</i> , <i>Genoplesium rhyoliticum</i>	South East Forests National Park - Yowaka Section	200	0.10
RO4	Yowaka River Catchment (5)	<i>Westringia davidii</i>	South East Forests National Park - Yowaka Section	200	0.25
RO5	Old Hut Creek Catchment (1)	<i>Westringia davidii</i>	South East Forests National Park - Yowaka Section	100	0.30
RO6	Old Hut Creek Catchment (2)	<i>Westringia davidii</i>	South East Forests National Park - Yowaka Section	300	0.12
RO7	Jingera FR	<i>Westringia davidii</i>	State Forest - Jingera Flora Reserve	2,000	10.00
RO8	Jingera FR East	<i>Westringia davidii</i>	State Forest - Jingera Flora Reserve	2,000	1.00
RO9	Box Range South	<i>Westringia davidii</i>	Freehold ("Box Range")	200	0.24
RO10	Box Range West	<i>Westringia davidii</i>	Freehold ("Box Range")	50	0.04
RO11	Ocean View	<i>Westringia davidii</i>	Freehold ("Ocean View")	500	4.00
RO12	Jingera Rock		South East Forests National Park - Yowaka Section	3,000	3.00
RO13	Upper Old Hut Creek		South East Forests National Park - Yowaka Section	1,000	2.00
RO14	Jingera FR West		State Forest - Jingera Flora Reserve	1,500	3.00
RO15	Nethercote Falls	<i>Genoplesium rhyoliticum</i>	State Forest - Nethercote Flora Reserve	1,000	0.90
RO16	Box Range East	<i>Westringia davidii</i>	Freehold ("Box Range")	500	0.36
RO17	Gorge south of Sugarloaf	<i>Genoplesium rhyoliticum</i>	South East Forests National Park - Yowaka Section	500	0.50
RO18	Pyrophilite Mine		Nullica State Forest	50	0.05
RO19	Sugarloaf		South East Forests National Park - Yowaka Section	100	0.08
RO20	Yowaka River Catchment (2)		Nullica State Forest	50	0.10
RO21	Yowaka River Catchment (3)		Nullica State Forest	100	0.08
RO22	Yowaka River Catchment		Nullica State Forest	100	0.10
RO23	Old Hut Creek Catchment (3)		South East Forests National Park - Yowaka Section	50	0.08
RO24	Lower Old Hut Creek	<i>Genoplesium rhyoliticum</i>	South East Forests National Park - Yowaka Section	??	??
RO25	Yowaka River Catchment (4)	<i>Genoplesium rhyoliticum</i> , <i>Westringia davidii</i>	Nullica State Forest	800	1.00
TOTALS				14,550	27.37

Appendix 3 Making a submission regarding this Draft Recovery Plan

You are invited to make a written submission to the NPWS regarding this draft recovery plan. To make your submission as effective as possible, please:

- refer to the section or action of the plan you wish to address;
- briefly explain the reasons for your comments,
- providing source information or examples where possible; and
- provide your name and address to enable receipt of your submission to be acknowledged.

The NPWS will consider all written submissions received during the period of public exhibition and must provide a summary report of those submissions to the Minister for the Environment prior to final approval of this Recovery Plan.

Please note, that for the purposes of the NSW *Privacy and Personal Information Protection Act 1998* any comments on this draft Recovery Plan, including your personal details, will be a matter of public record and will be stored in the NPWS records system. Following approval of the plan by the Minister, copies of all submissions, unless marked 'confidential', will be available, by arrangement, for inspection at the NPWS office responsible for the preparation of the Recovery Plan.

Should you not wish to have your personal details disclosed to members of the public once the Recovery Plan has been adopted, please indicate below whether you wish your personal details to remain confidential to NPWS and not available for public access. Further information on the *Privacy and Personal Information Protection Act 1998* may be obtained from any office of the NPWS or from the website: www.npws.nsw.gov.au.

Submissions should be received no later than the advertised date. Submissions should be addressed to:

The Director General
c/oThreatened Species Unit,
NPWS Southern Directorate
PO Box 2115
Queanbeyan NSW 2620
Ph: (02) 6298 9700



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