TETRATHECA GUNNII

RECOVERY PLAN

2001–2005

DEPARTMENT of
PRIMARY INDUSTRIES,
WATER and ENVIRONMENT

Tasmania

Natural Heritage Trust
Helping Communities Helping Australia

Environment Australia

Prepared by **Wendy Potts and Philip Barker**

TETRATHECA GUNNII RECOVERY PLAN 2001-2005

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SUMMARY

Current Species Status

Tetratheca gunnii, commonly known as Shy Susan, is an endangered Tasmanian endemic. It is listed as Endangered in *the Endangered Species Protection Act 1992*, the 1998 Endangered Flora Network (ANZECC) *Threatened Australian Flora* list and the Tasmanian *Threatened Species Protection Act 1995*. It qualifies as Critically Endangered using 1994 IUCN criteria and IUCN criteria modified by the Endangered Flora Network in 1998. It was rediscovered in 1986 on serpentine outcrops in the foothills of the Dazzler Range near Beaconsfield (Brown *et al.* 1986) after being listed as extinct (Leigh *et al*. 1984). In 1986, 2 populations (each consisting of 2 subpopulations) with a total of 24 individuals (20 in one subpopulation) were known. Barker (1996a,b) detected a severe decline by 1994. A subsequent intensive and fairly extensive search revealed seven small populations with a total of 86 individuals (Barker 1996a,b). At least one population has seed in the soil seed bank as evidenced by the emergence of germinants in 1998.

Habitat Requirements and Limiting Factors

Tetratheca gunnii is a focal species of serpentine outcrops in the foothills of the Dazzler Range near Beaconsfield. This species is restricted to serpentine outcrops in this region, limiting potential habitat to only 530ha. Seed set has been extremely poor, despite profuse flowering, probably due to a sparse distribution with low numbers of individuals in populations and subsequently a low outcrossing rate. Outcrossing is necessary for successful seed set in this species (Threatened Species Unit 1998). Inappropriate fire regimes may also contribute to population decline through an increase in competition from understorey species if fire events are too infrequent and possible depletion of the soil seed bank if fires are too frequent. *Tetratheca gunnii* is susceptible to the root rot fungus *Phytophthora cinnamomi*, with at least two populations infected (Barker 1996a). Mining activities and off road vehicle use in the area increase the threat of spread of infection. Land clearance has been a major threat though this threat is now being addressed through acquisition of privately owned sites through the 1999 Regional Forest Agreement (RFA) Private Land Reserve Program.

Overall Recovery Objective

To establish stable and viable populations of *Tetratheca gunnii* that are self-perpetuating. This will involve down-listing of *Tetratheca gunnii* from Critically Endangered to Vulnerable over 7 years based on 1994 IUCN Red List criteria or from Critically Endangered to Endangered over 7 years based on modified 1994 IUCN Red List criteria (1998 Endangered Flora Network modifications).

Specific Objectives

1. Increase numbers and reproductive fitness of mature individuals.
2. Protect populations at risk from *Phytophthora cinnamomi.*
3. Create public awareness and allow community involvement in the recovery process.
4. Develop mechanisms to manage populations in the long term.

Recovery Criteria

There is a quantifiable decrease in the risk of extinction over 5 years of Recovery Plan implementation.

Progress Criteria

1. Increase in the number of mature individuals in the two largest populations to at least 250 and 50 respectively.
2. Increase in reproductive fitness to at least 10% of flowers developing fruit in at least 3 populations.

3. Firing of at least two populations to reduce competition from understorey species and to promote germination.

4. Treatment of at least two populations in immediate danger of infection with *Phytophthora cinnamomi* with protective sprays.

5. Development of an agreement with the mining industry of areas to be protected should mining activities increase in the area.

6. Distribution amongst the community of information along with approximately 500 plants consisting of at least 40 clones for *ex situ* storage of genotypes.

7. Involvement of community groups and volunteers in the recovery process.

8. Development of an adaptive management strategy and decision support system for use beyond the duration of the Recovery Plan.

Actions Needed

1. Survey for new populations and monitor known populations for germination events, seedling survival and signs of infection by *Phytophthora cinnamomi* and other threats.

2. Manage habitat to increase population size and reproductive fitness through stimulation of germination from the soil seed bank or translocation and reduction of competition from understorey species.

3. Protect habitat from *Phytophthora cinnamomi* with protective sprays and by managing access.

4. Distribute a representative sample of clones amongst the community to establish a significant *ex situ* holding, create public awareness and allow community involvement in the recovery process.

5. Reconcile mining plans with conservation objectives and use results of actions to develop an adaptive management strategy and decision support system for use beyond the duration of the Recovery Plan.

Estimated Cost of Recovery

Contributing agencies are the Endangered Species Program, a program of the Natural Heritage Trust, administered through Environment Australia, the Resource Management and Conservation Division of the Tasmanian Department of Primary Industries, Water and Environment and Forestry Tasmania. Volunteer input has been included. 1999 prices in $.

Actions	1	2	3	4	5	Total
Year 1	23 300	11 460	7 640	7 640	7 640	57 680
Year 2	34 100	17 400	17 400	4 340	4 340	77 580
Year 3	24 700	23 200	7 200	15 900	15 900	86 900
Year 4	9 080	5 740	5 540	5 540	5 540	31 440
Year 5	15 220	7 420	4 600	4 600	4 600	36 440
Total	106 400	65 220	42 380	38 020	38 020	290 040

Biodiversity Benefits

Serpentine soils are recognised for supporting high levels of endemism and as serpentine is often restricted in area, associated endemics are frequently rare and threatened. *Tetratheca gunnii* is a focal species of the serpentine outcrops near Beaconsfield and often co-occurs with other threatened species including *Epacris virgata* and *Spyridium obcordataum.* T. *gunnii* occurs in an unusual community dominated by *Eucalyptus amygdalina* and *E. ovata* over a heathy understorey. The existence of viable self-perpetuating populations of *Tetratheca gunnii* is indicative of a healthy and biodiverse ecosystem. This is because *Tetratheca gunnii* is a non-nectar producing species that is thought to be principally

pollinated by native bees and the presence of nectar producing species are required to sustain the pollinators necessary for *Tetratheca gunnii* to self perpetuate.

INTRODUCTION

Description

Tetratheca gunnii, commonly known as Shy Susan, is an undershrub with a straggling growth habit. The 15 to 50cm long branches are slender and wiry and tend to trail through associated plants. Leaves are small, alternate, elliptical to linear, 2-6 mm long and 0.5-1.5 mm wide ending in a blunt points often surrounded by very small stiff hairs. The flowers are pale lilac to deep pink-purple with 4 obovate or elliptical petals generally less than 5.5mm long. They are borne singly or occasionally in pairs on peduncles 2-4.5mm long in the leaf axils usually along a considerable length of stem. The dark brown black anthers are distinctive for the species in that they lack an apical tube. Flowering occurs from September to early December. The green or purple fruit is a compressed 2(-3) locular capsule, obovate to cuneate, 4.0mm long, 2.5-3.0mm wide, with a uniform cover of sparsely scattered gland tipped hairs. Seeds are brown, 3.0mm long, and almost oblong with a pale aril-like appendage. The description is taken from Thompson (1976), Leigh *et al.* (1984) and Brown *et al.* (1996)

Taxonomic Status

Tetratheca is a genus in the Tremandraceae, a family represented by 3 endemic genera in Australia, one of which occurs in Tasmania. Tasmania has 5 species of *Tetratheca*, with *Tetratheca gunnii* being the only species endemic to the state (Buchanan 1999). Curtis and Morris (1975) included *Tetratheca gunnii* Hook. f. as a variant of *Tetratheca pilosa* but subsequently it has been recognised as a distinct species (Thompson 1976) due to the smaller foliage and flowers and characteristic lack of an anther tube.

Distribution

Tetratheca gunnii occurs on serpentine outcrops in the foothills of the Dazzler Range near Beaconsfield. Potential habitat is limited with serpentine outcrops in this region restricted to only 530ha. Seven populations are known and are separated from one another by at least 300m. Two populations each consist of 2 subpopulations separated by approximately 100m. The populations have a linear range of 5km, an extent of occurrence of 5km^2 and occupy an area of approximately 0.6ha. One population, consisting of 2 subpopulations and another subpopulation are known to have become extinct between 1986 and 1994 and the number of individuals in the other subpopulation known in 1986 had declined from 20 to 6 during the same period (Brown *et al.* 1986, Barker 1996a,b). The species had been collected once in 1843 and was presumed to be extinct until its rediscovery in 1986 (Leigh *et al.* 1984, Brown 1986).

A total of 86 mature individuals were known in 1994 (Barker 1996b) following an intensive and fairly extensive search, and although a few of these individuals have since died, approximately 15 recently germinated seedlings at the Barnes Hill population commenced flowering in 1998. Only 2 standing plants were discovered at this site in 1994, though neither were robust enough to produce flowers (Barker 1996b). The emergence of approximately 1000 germinants during the last three years indicates a significant soil seed bank at this site. However, only one germinant has been noted to date at the other known sites and Barker (1996b) did not find evidence of a soil seed bank in any of the three populations examined.

Habitat

Tetratheca gunnii is restricted to serpentine soils which are known for their high levels of endemic flora (Proctor and Woodell 1971, Kruckeberg 1984). As serpentine is often restricted in area, its associated endemics are often rare. In this case, the serpentine substrate supports a unique community that is dominated by *Eucalyptus amygdalina* and *E. ovata* over a heathy understorey. The understorey is a mosaic of tall heath dominated by *Epacris virgata* (also a threatened species), low heath dominated by *Hibbertia riparia and Baekea ramosissima* but may also be grassy. The Barnes Hill population is a little different, occurring in a woodland of *Allocasuarina littoralis* and is largely devoid of an understorey.

The *Tetratheca gunnii* habitat is relatively open however, the more open rocky sites associated with ridges tend to support *Spyridium obcordatum*, another threatened species. Some populations are associated with disturbance-induced openness from mining activities and wood harvesting.

Life History

Tetratheca gunnii reproduces by seed and requires cross-pollination for successful fruit and seed production. Native bees are thought to be important pollinators of *Tetratheca* species (Hingston and McQuillan 1998, Hingston 1999) which generally require sonication for pollen release. Manipulated cross-pollination of flowers of 14 *Tetratheca gunnii* clones had a success rate of between 30 and 90% for each clone in conversion of flowers to fruits (average of 63%) though these levels are unlikely to be achieved *in situ* as pollinators are usually limiting in field situations. Also, visitation rates on non-nectar producing species such as *Tetratheca* are generally

low and may be dependent on the flowering of certain nectar producing species in the area to sustain pollinators (Hingston 1999). In comparison, manipulated self-pollination gave an average conversion rate between clones of 6%, this figure likely to be inflated due to accidental contamination and the influence of some clones that may be partially self-compatible. *In situ,* the conversion rate of flowers to fruit was estimated to be 1% (Barker 1996b), this low rate indicating an absence of pollinators or, more likely, an inadequate number of flowers and density of plants to attract pollinators and effect cross-pollination. The latter scenario is the more likely as the conversion rate in a home garden of a small group of a mixture of potted clones was 3.6% between clones when open pollinated.

Seed is dispersed when capsules split on maturity. Insects may aid dispersal as the seed appendage may be a food reward for foraging insects. The recent germination event at the Barnes Hill population is indicative of a longevity of seed in the soil of at least between 10 and 20 years (using minimum age of the 2 standing plants found in 1994 and estimated time of the last fire at this site). However, Barker (1996b) did not find evidence of a soil seed bank in three populations and it may be that the soil seed bank has been depleted in most populations and is not being replenished, as current levels of seed set are negligible.

Fire is believed to be an important stimulant for germination of soil-stored seed. This is because the congeneric, *T. labillardieri,* has been shown to be dependent on seed for regeneration following a hot fire (Duncan 1981) and *T. hirsuta* shows a significant germination response to smoke (Roche *et al.* 1997). In addition, fire does create openness and some *Tetratheca gunnii* populations are associated with open sites created by disturbance caused by mining activities and timber removal. However, no populations have been found on recently burnt sites though it is not known whether these sites previously supported the species (Barker 1996b). A trigger for the recent germination event in the Barnes Hill population is not obvious, suggesting that seed ageing may be an important factor. Seed ageing may have been accelerated at this site by successive wet and dry cycles and acidity created from the dead *Allocasuarina* needles in the litter layer. Germination at this site has occurred over the last three years with the oldest plants just starting to flower. The low number of plants in other populations may indicate that the understorey is inhibiting germination and/or seedling survival. Using monitoring data, plant longevity has been estimated to be at least 10 years.

Reasons for Listing

Tetratheca gunnii is currently rare in a rare habitat. Its extremely restricted distribution places it at high risk of extinction. Its fragmented distribution increases this risk as the 7 individual populations are extremely small and each is extremely vulnerable to extinction through normal population fluctuations. The small size of individual populations has caused the additional disadvantage of reducing seed set to negligible levels. There is some evidence to suggest that the soil seed bank of many populations has become seriously depleted. On top of all this, the species is susceptible to the root rot fungus, *Phytophthora cinnamomi,* which occurs in the area and is likely to spread further due to off road vehicle use, wood harvesting and mining activities. Two populations are known to be infected (Barker 1996a). The species is also thought to be susceptible to inappropriate fire frequencies. Too long an interval between fires may cause declines due to competition from understorey species and too short an interval between fires may deplete the soil seed bank and kill standing plants before they reach reproductive maturity and replenish the soil seed bank.

The current distribution pattern and low numbers of individuals are indicative of a decline from past levels. The species was originally collected in 1843 and not recollected until 1986 when its listing as Presumed Extinct (Leigh *et al*. 1984) prompted a search for the species (Brown *et al.* 1986). In this search, only 24 individuals in 2 populations (each consisting of 2 subpopulations and with 20 individuals were in one subpopulation) were found and these had declined to only 1 population consisting of one subpopulation with 6 individuals by 1994 (Barker 1996a,b). Declines since European settlement are likely to be mainly due to changed burning practices and an increase in grazing due to the introduction of rabbits and more recently due to mining activities and wood harvesting as well as spread of *Phytophthora cinnamomi*. Suitable habitat is also likely to have been cleared and subjected to grazing by domestic stock. Brown *et al.* (1986) consider *Tetratheca gunnii* to be at risk from over-collection.

Tetratheca gunnii qualifies as Critically Endangered using 1994 IUCN criteria. It qualifies under rules B and C. For Rule B, it satisfies the threshold conditions of an extent of occurrence of less than 100km^2 and area of occupancy of less than 10km^2, subrule B1 (severely fragmented distribution) and subrule B2 (continuing decline). For Rule C, it satisfies the threshold condition of less than 250 mature individuals and subrule C2 (continuing decline and no population with greater than 50 mature individuals).

The distribution thresholds for rule B are unlikely to be surpassed due to the restricted habitat. Qualification for subrule B2 cannot be negated due to susceptibility to *Phytophthora cinnamomi* even though the risk can be mitigated in the short term by protective sprays and managing access to

populations and risk of spreading infection through mining activities. *Tetratheca gunnii* is currently deemed to have a severely fragmented distribution as fragmentation of the total population is the likely cause of alarmingly low levels of seed set. There are too few mature individuals in current populations to attract pollinators to effect cross-pollination and seed set. This criterion would not apply if seed set could be increased significantly in at least 3 of the 7 known populations. This could be achieved by increasing the number of mature individuals to adequate density and ensuring an adequate level of nectar producing species capable of sustaining pollinators in the area.

Negation of Rule C would also involve increasing the number of mature individuals. A mature individual has been defined for *Tetratheca gunnii* as those producing flowers, in which case the total number of mature individuals is currently between 80 and 100. Increasing the number of mature individuals to 250 or the number of mature individuals in one population to greater than 50 would not allow qualification for the Critically Endangered category and further increases to 2500 and 250 respectively would not allow qualification for the Endangered category.

If actions are such that *Tetratheca gunnii* can no longer be considered to be severely fragmented and at least one population has greater than 250 mature individuals, the species can be down listed to Vulnerable using 1994 IUCN Red List criteria. Further down listing is not feasible, as this would require increasing the area of occupancy of greater than 100km^2 (rule D2). These actions would also allow down listing from Critically Endangered to Endangered using IUCN criteria modified by the Endangered Flora Network in 1998 as long as 90% of the mature individuals do not occur in a single population. Further down listing to Vulnerable would require 90% of mature individuals to occur in greater than 5 populations. This would require a significant increase in the size of all known populations.

Existing Conservation Measures

Tetratheca gunnii was included in studies to set up long term monitoring plots for selected species threatened by *Phytophthora cinnamomi* (Barker 1996a) and to select viable populations of threatened plants for conservation management (Barker1996b). All known populations are being included in the CAR Reserve System through acquisition of privately owned sites in the 1999 RFA Private Land Reserve Program and inclusion of other sites in Forest Reserves. A 3-year Interim Recovery Plan was proposed by the Tasmanian Parks and Wildlife Service, now the Resource Management and Conservation Division of the Department of Primary Industries, Water and Environment. Implementation of this plan commenced in 1998. The writing of this Recovery Plan was an action of the Interim Recovery Plan.

Strategy for Recovery

The *Tetratheca gunnii* Recovery Plan will run for 5 years and is based on **strategies** which include survey and monitoring, habitat management, threat amelioration, public awareness and community involvement and planning and long term management. Specifically they are:

1. Survey for new populations and monitor known populations for germination events, seedling survival and signs of infection by *Phytophthora cinnamomi* and other threats.

2. Manage habitat to increase population size and reproductive fitness through stimulation of germination from the soil seed bank or translocation and reduction of competition from understorey species.

3. Protect habitat from *Phytophthora cinnamomi* with protective sprays and by managing access.

4. Distribute a representative sample of clones amongst the community to establish a significant *ex situ* holding, create public awareness and allow community involvement in the recovery process.

5. Reconcile mining plans with conservation objectives and use results of actions to develop an adaptive management strategy and decision support system for use beyond the duration of the Recovery Plan.

A *Tetratheca gunnii* Recovery Team has been established and currently consists of representatives from the Threatened Species and Communities Section of Environment Australia, the Resource Management and Conservation Division of the Department of Primary Industries, Water and Environment, Forestry Tasmania and the Threatened Species Network. The Recovery Team will supervise the activities of a project officer that will be employed on a part time basis for a total of 74 weeks over five years.

RECOVERY OBJECTIVES AND CRITERIA

The **overall objective** of the Recovery Plan is to establish stable and viable populations of *Tetratheca gunnii* that are self-perpetuating. This will involve down-listing of *Tetratheca gunnii* from Critically Endangered to Vulnerable over 7 years based on 1994 IUCN Red List criteria or from Critically Endangered to Endangered over 7 years based on modified 1994 IUCN Red List criteria (1998 Endangered Flora Network modifications).

Specific objectives are:

1. Increasing numbers and reproductive fitness of mature individuals.

2. Protecting populations at risk from *Phytophthora cinnamomi*.

3. Creating public awareness and allowing community involvement in the recovery process.

4. Developing mechanisms to manage populations in the long term.

The **criteria** for achieving the objectives constitute a quantifiable decrease in the risk of extinction over 5 years of Recovery Plan implementation. They are:

1. An increase in reproductive fitness to at least 10% of flowers developing fruit in at least 3 populations.

2. An increase in the number of mature individuals in the two largest populations to at least 250 and 50 respectively.

3. The firing of at least two populations to reduce competition from understorey species.

4. The treatment of at least two populations in immediate danger of infection with *Phytophthora cinnamomi* with protective sprays.

5. The development of an agreement with the mining industry of areas to be protected should mining activities increase in the area.

6. The distribution amongst the community of information along with approximately 500 plants consisting of at least 40 clones for *ex situ* storage of genotypes.

7. The involvement of community groups and volunteers in the recovery process.

8. The development of an adaptive management strategy and decision support system for use beyond the duration of the Recovery Plan.

RECOVERY ACTIONS

1. Survey and Monitoring

Surveying for new populations and monitoring known populations for germination events, seedling survival and signs of infection by *Phytophthora cinnamomi* and other threats is needed. As only less than 100 mature individuals are currently known to exist in the wild, the finding of more individuals and populations is likely to significantly influence the assessment of conservation status. The probability of finding new populations or individuals is high. This is despite the fact that a previous intensive and fairly extensive search was conducted in 1994 (Barker 1996a,b). While search time is limited by the flowering period, this can be offset by increased manpower using volunteers to enable an intensive search of the 530ha of serpentine outcrops in the area. A repeat search is warranted as a recent mass germination event from the soil seed bank in the Barnes Hill population may be indicative of suitable conditions for germination at other sites especially as the time since the last fire has been estimated to be similar at each of the known populations (Barker 1996a). Additionally, some known populations are associated with ground or canopy disturbance from past mining activities and recent disturbance events in some areas may have triggered germination. Known populations should also be checked for new recruitment or decline. Threats to new and known populations, including signs of infection by *Phytophthora cinnamomi*, can be determined as populations are found or revisited.

Careful monitoring of the Barnes Hill population following the emergence of approximately 1,000 seedlings in 1996 to 1998 will give important insight into the effective management of *Tetratheca gunnii*. As some of these seedlings attain reproductive maturity, monitoring of the relationship between density of individuals, abundance of flowers and successful seed production will help to determine the cause of alarmingly poor seed set in populations monitored to date. The optimum size of populations needed to attract pollinators and effect cross-pollination and successful seed set can be determined as well as threshold levels for use in a decision support management system e.g. density of plants required to sustain adequate seed set and interval needed between fires to replenish the soil seed bank and population size. This assumes the most likely scenario that the necessary pollinators are present in the wild though monitoring will determine whether this is the case. Seedling survival will also need to be tracked and, given the low total number of individuals of *Tetratheca gunnii* in the wild, it would be prudent to intervene to maximise seedling survival in this population where possible. This may involve disease control or protection from grazing.

Endangered Species Program funds are required to cover the salary of a research officer, vehicle costs, travel allowances and stakes and tags. Contributions from the Resource Management and Conservation Division of the Department of Primary Industries, Water and Environment and volunteers are included.

Year	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Cost	23 300	11 460	7 640	7 640	7 640	57 680

2. Habitat Management

Managing habitat to increase the population size and reproductive fitness by stimulating germination from the soil seed bank or translocation and reduction of competition from understorey species is needed. An increase in the number of mature individuals of *Tetratheca gunnii* in the wild is essential to reduce the risk of extinction. It will be necessary to promote recruitment and increase levels of reproductive fitness to sustain populations. Reducing competition from understorey species by the use of fire will be important to achieve these aims.

Reduction of competition from understorey species by fire is thought to be necessary for two reasons; to promote germination and seedling survival and to attract pollinators. Known populations occur in relatively open sites (Barker 1996). The only significant germination event noted to date has occurred in the Barnes Hill population, which occurs in *Allocasuarina* woodland with a very open understorey. The ground is mostly covered by a thin layer of dead needles. Most of the other populations have a significant cover of *Baeckea ramosissima* in the understorey and the small size of these *Tetratheca gunnii* populations may indicate that the understorey is repressing germination and/or seedling survival. Also, a recent study showed no overlap in pollinators of *Tetratheca labillardierei* and *Baeckea ramosissima* despite similar flowering times (Hingston 1999). It may be that the increased cover of *Baeckea ramosissima* has caused a decrease in the level of nectar producing species that are capable of attracting and sustaining pollinators of *Tetratheca gunnii*. As well as decreasing competition in the understorey, fire is likely to increase the diversity of plant species thereby attracting a greater diversity of pollinators to the area.

Additionally, fire is likely to directly stimulate germination from the soil seed bank. There is some evidence from congenerics that the species will germinate in response to fire. *Tetratheca labillardieri* has been shown to be dependent on seed for regeneration following a hot fire (Duncan

1981) and *T. hirsuta* shows a significant germination response to smoke (Roche *et al.* 1997). Germination trials are currently in place to determine the response of *Tetratheca gunnii* to heat and smoke and unless these trials show a detrimental effect on germination, it is planned to implement ecological burns in at least two populations.

Fire induced germination will be dependent on the existence of a soil seed bank. The germination event in the Barnes Hill population indicates the existence of a soil seed bank with a longevity of at least 10-20 years. However, Barker (1996b) did not find evidence of a soil seed bank in three populations, assuming that the seed would be distinguishable and that a hot water treatment would stimulate germination from soils. Results from germination trials currently in place will shed light on these findings and help determine the need to supplement populations with seed before or after burning. This can be done in two ways, manipulated cross-pollination *in situ*, or through translocation of seed produced by manipulated cross-pollination in the nursery using propagated plants. The latter option will allow the opportunity for seed to be primed for germination before sowing using results from the germination trials now being undertaken.

As a last resort, plant numbers can be increased in populations through translocation of plants propagated from nursery-produced seed or cuttings. Up to 50 clones have been propagated to date from cuttings taken from the wild and are being maintained in a nursery. Translocation using clones is less desirable than using seed as genetic variation is not increased and there is less opportunity for cross-pollination. Additionally, translocation using seed is more cost effective and feasible and is potentially less damaging to the habitat. Any translocation undertaken will follow guidelines for the translocation of threatened plants in Australia (Australian Network for Plant Conservation Translocation Working Group 1997)

Follow-up monitoring will be required to determine the success of this action and to collate data for the adaptive management process and reassessment of conservation status.

Endangered Species Program funds are required to cover the salary of a research officer, fire crews, vehicle costs, travel allowances, nursery costs and materials. Contributions from the Resource Management and Conservation Division of the Department of Primary Industries, Water and Environment, volunteers and Forestry Tasmania are included.

Year	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Cost	34 100	17 400	17 400	4 340	4 340	77 580

3. Phytophthora Management

The habitat needs to be protected from Phytophthora cinnamomi by using protective sprays and managing access. Experiments are currently in progress to determine effective and non-toxic application rates of phosphonate sprays for protection from infection from *Phytophthora cinnamomi* using nursery grown plants as standard rates have been shown to cause some branch death (Barker 1996a). Additionally, threshold protective levels in the foliage will be determined to determine timing of additional sprays to maintain protection. Lower rates may need to be applied for follow-up sprays to avoid toxicity. All populations will be treated on completion of trials. Broad scale protection over adjacent habitat will be investigated and implemented if feasible as this would greatly reduce the risk of infection of *Tetratheca gunnii* and associated threatened species.

There is evidence of disturbance caused by off road vehicles including trail bikes, 4WD vehicles and skidders. This significantly increases the risk of spreading *Phytophthora cinnamomi* and infecting populations. Methods to manage access, such as ditches and gates will be investigated and implemented if feasible.

Endangered Species Program funds are required to cover the salary of a research officer, vehicle costs, travel allowances, spray applications and laboratory costs. Contributions from the Resource Management and Conservation Division (RMC) of the Department of Primary Industries, Water and Environment, volunteers and Forestry Tasmania are included.

Year	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Cost	24 700	23 200	7 200	15 900	15 900	86 900

4. Community Involvement

This action involves distributing a representative sample of clones among the community to establish a significant *ex situ* holding, create public awareness and allow community involvement in the recovery process. Approximately 50 clones have been propagated from cuttings taken from plants in the wild. These are being maintained in a nursery. Distribution of plants of these clones amongst the community for planting in home gardens has a number of benefits. Collectively, plantings in home gardens constitute a significant *ex situ* population, particularly if this number of clones is represented. The plantings will reduce the risk of extinction of the species and provide a source of material for reintroduction should populations decline in the wild. This mechanism increases public awareness of the species and its predicament and allows participation in the

recovery process by members of the community with little effort and time. In addition, availability of plants will reduce collection pressure from the wild and associated risks of disturbance and infection with *Phytophthora cinnamomi.* Over-collection is considered by Brown *et al.* (1986) to be a threat to the species. Considerable interest has been shown by growers of native plants particularly as the plant is attractive when in flower.

A mechanism for the propagation and distribution of plants has been established to satisfy the above aims and funding was granted by the Threatened Species Network Community Grants Scheme to the Friends of the Gardens in 1999 to kick-start the process for a number of species including *Tetratheca gunnii*. The scheme will be overseen by the Tasmanian Threatened Species Unit in the Resource Management and Conservation Division of the Department of Primary Industries, Water and Environment. The Friends of the Gardens will propagate plants at their site at the Royal Tasmanian Botanical Gardens from stock plants being maintained by the Tasmanian Threatened Species Unit. Approximately 150 packs consisting of three plants (each a different clone) and information about the species will be distributed. Grower contact details and clone numbers in each pack will be kept and growers will be contacted at intervals to determine the health of plants and the feasibility of collection of seed or cuttings should these be required for future conservation actions. Other community groups, namely Wildcare and the Understorey Network, are interested in becoming involved in this scheme.

Endangered Species Program funds are required to cover the salary of a research officer and vehicle costs. Contributions from the Resource Management and Conservation Division of the Department of Primary Industries, Water and Environment, volunteers, community groups and Forestry Tasmania are included.

Year	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Cost	9 080	5 740	5 540	5 540	5 540	31 440

5. Adaptive Management Strategies

Plans for mining need to be reconciled with the conservation objectives of *Tetratheca gunnii* and a long-term adaptive management strategy needs to be developed. While all known populations are being included in the CAR Reserve System, sites are not protected from mining activities. One company has the mining rights in the area and has completed exploration, making it imperative to seek agreement as to how *Tetratheca gunnii* can be conserved should mining proceed. Primary mining interests may not be with the serpentine outcrop habitat of *Tetratheca gunnii* but in the surrounding ironstone gravels which are a rich source of nickel. Mining activities may inadvertently destroy plants or put populations at risk by spreading *Phytophthora cinnamomi.* As impacts of mining activities can be best mitigated at the planning stage, it is proposed to develop guidelines with the Mineral Resources Tasmania Division of the Department of Infrastructure, Energy and Resources to alert mining companies and contractors to rare plant conservation issues, identify sites and detail precautions that need to be taken to avoid the infection and spread of *Phytophthora cinnamomi*. Contact details of Resource Management and Conservation Division staff that would be able to help with and provide advice for any proposals will be provided in the guidelines. The guidelines will be distributed to key companies and contractors operating in the area.

An adaptive management program will be established to test the effectiveness of management prescriptions. A basic monitoring program will be established to detect changes in site conditions that require an adaptive management response. Planned responses will be detailed in a decision support system. The planned responses will deal with *Phytophthora cinnamomi*, fire management, population decline, translocation and rehabilitation of mining sites. This action is essential to cement all of the planning and works undertaken in previous actions and allow for long-term management beyond the duration of this Recovery Plan. All locations and responses to actions taken will be documented and databased as necessary.

Endangered Species Program funds are required to cover the salary of a research officer, vehicle costs, travel allowances and materials. Contributions from the Resource Management and Conservation Division of the Department of Primary Industries, Water and Environment, volunteers and Mineral Resources Tasmania are included.

Year	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Cost	15 220	7 420	4 600	4 600	4 600	36 440

IMPLEMENTATION SCHEDULE

1999 costs in $/year.

Task	Task Description	Priority	Feasibility	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
1	Survey and Monitoring	1	100%	23 300	11 460	7 640	7 640	7 640	57 680
2	Habitat Manipulation	1	80%	34 100	17 400	17 400	4 340	4 340	77 580
3	Habitat Protection	1	90%	24 700	23 200	7 200	15 900	15 900	86 900
4	Community Involvement	2	90%	9 080	5 740	5 540	5 540	5 540	31 440
5	Long-Term Management	1	80%	15 220	7 420	4 600	4 600	4 600	36 440
Total				106 400	65 220	42 380	38 020	38 020	290 040

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TETRATHECA GUNNII RECOVERY PLAN: 2001-2005

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