

1 INTRODUCTION

1.1 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)

1.2 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.

1.3 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 5km² 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.

1.4 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.

1.5 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.

1.6 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 overcollection.

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 100km² and area of occupancy of less than 10km², 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 downlisted to Vulnerable using 1994 IUCN Red List criteria. Further downlisting is not feasible, as this would require increasing the area of occupancy of greater than 100km² (rule D2). These actions would also allow downlisting 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 downlisting 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.

1.7 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 (Barker 1996b). 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.

1.8 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.

2 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.