The Minister's delegate approved this Conservation Advice on 16/12/2016.

Conservation Advice

Tetratheca gunnii

Shy Susan

Conservation Status

Tetratheca gunnii (Shy Susan) is listed as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) effective 16 July 2000. The species is eligible for listing as prior to the commencement of the EPBC Act, it was listed as Endangered under Schedule 1 of the *Endangered Species Protection Act 1992* (Cwlth). It was subsequently transferred to the Critically Endangered category under the EPBC Act in October 2001.

This species is also listed as Endangered under the Tasmanian *Threatened Species Protection Act 1995*.

The main factors that are the cause of the species being eligible for listing in the Critically Endangered category are historic declines through land degradation; very small, fragmented populations within a limited Extent of Occurrence; clearing and degradation of suitable habitat including by mining; grazing; evident depletion of the seed bank through lack of appropriate conditions for germination; and susceptibility to the pathogen *Phytophthora cinnamomi*.

Description

Tetratheca gunnii, commonly known as shy susan, is an undershrub with a straggling growth habit. The 15 to 50 cm long branches are slender, wiry and tend to trail through associated plants. Leaves are small, elliptical (oblong) to linear, occur alternately along a stem, and are between 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 four egg-shaped or narrow, downward pointing petals, generally less than 5.5mm long. Flowers are borne singly or occasionally in pairs along a considerable length of the flower stem. The dark brown black pollen-bearing anthers don't have anther tubes. This feature sets them apart from close relatives like *Tetratheca pilosa* (hairy pink-bells), a similar though larger shrub, with leaves 2 – 25 mm long (compared to 2 – 6 mm long) and flowers 3 – 12 mm across, as opposed to 5.5 mm for *T. gunnii* (description based on Potts & Barker (1999)).

Flowering occurs from September to early December. The green or purple fruit is a compressed compartmentalised (or "locular") capsule, 4.0 mm long, 2.5 – 3.0 mm 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[1] appendage. The description is taken from Thompson (1976), Leigh et al. (1984) and Brown et al. (1996)

Distribution

Shy susan is restricted to the serpentine outcrops in the foothills of the Dazzler Range near Beaconsfield, Tasmania, which limits potential habitat to only 5.3 km^2 (Potts & Barker 1999). The species grows in shallow soils, on gently sloping hillsides of easterly or south-easterly aspect (Brown et al., 1986).

[1] An aril is a fleshy, usually bright coloured cover of a seed.

Shy susan has an Area of Occupancy/Extent of Occurrence of 12km^2 using the IUCN 2x2 grid method of calculation.

All of the known shy susan sites are in formal reserves, the majority in Dans Hill Conservation Area, and one in Andersons Creek Regional Reserve; neither reserve class precludes mineral exploration or mining.

In 1986, four populations with a total of 24 plants (20 in one population) were known (prior to that, it was presumed extinct) (Potts & Barker 1999). A severe decline was detected between 1986 and 1994 (Barker 1996a, 1996b). A subsequent intensive and fairly extensive search revealed seven small populations with a total of 86 plants (Barker 1996a, 1996b), separated from one another by at least 300 m 0. At least one population had seed in the soil seed bank as evidenced by the emergence of germinants in 1998 (ibid.). The total number of mature individuals across the entire population was between 80 and 100 in 1999 (Potts & Barker 1999). In 2007, that number had been revised to an estimated 222 plants across eleven populations, based on the discovery of a new population of 113 individuals (North Barker Ecosystem Services 2008), and a census in 2009 revealed 204 mature individuals (TSS, pers. comm.).

Shy susan mainly occurs in heathy *Eucalyptus amgydalina* (black peppermint) dry sclerophyll forest and woodland, with occasional *Eucalyptus ovata* (swamp gum) (Brown et al., 1986; Leigh & Briggs 1992; Potts & Barker 1999) and also in shrubby *Eucalyptus amgydalina/Eucalyptus obliqua* forest (Johnson & Barker 1998). In heathy *Eucalyptus amygdalina*-dominated communities, a shrubby mid-storey of *Allocasuarina littoralis* (black she-oak) and *Banksia marginata* (silver banksia) occur sparsely over a dense, heathy understorey dominated by *Lomandra longifolia* (spiny-headed mat-rush), Correa reflexa (native fuchsia), Hibbertia riparia (stream guinea-flower), *Euryomyrtus ramosissima* (rosy baeckea), *Gahnia spp.* (sedges) and grasses (see Potts & Barker 1999). There are some exceptions to these vegetation associations, for example, the Barnes Hill population occurs in A*llocasuarina littoralis*-dominated woodland, largely devoid of an understorey (Potts & Barker 1999).

The species is often associated with two other range-restricted, Tasmanian endemic plants associated with serpentine geology. These are: *Epacris virgata* (pretty healh) and *Spyridium obcordatum* (creeping dustymiller) (Brown et al.,1986; Leigh & Briggs 1992; Potts & Barker 1999).

Known populations occur in relatively open sites (Barker 1996). The only significant germination event noted prior to the recovery plan occurred in the Barnes Hill population, which occurs in *Allocasuarina* woodland with a very open understorey. Most of the other populations have a significant cover of *Baeckea ramosissi*ma (rosy baeckea) in the understorey and the small size of the shy susan populations indicate that the understorey is repressing germination and/or seedling survival.

Relevant Biology/Ecology

Shy susan reproduces by seed and requires cross-pollination for successful fruit and seed production (Potts & Barker 1999). Seed is dispersed when capsules split on maturity. Insects may aid dispersal as the seed appendage may be a food reward for foraging insects (Potts & Barker 1999). There have been indications that seed remains viable for at least 10 years, and possibly as long as 20 years (Potts & Barker 1999). The absence of an obvious germination catalyst for a germination event circa 1999 at the Barnes Hill population has led to speculation that seed ageing may be an important factor in propagation; this ageing may have been accelerated by successive wet dry cycles and acidity from the litter layer (Potts & Barker 1999). Fire is also believed to be an important stimulant for germination of soil-stored seed. This is because the congeneric, *Tetratheca labillardieri* has been shown to be dependent on seed for regeneration following a hot fire (Duncan 1981) and *Tetratheca hirsuta* shows a significant germination response to smoke (Roche et al., 1997).

Most of the other populations have a significant cover of *Euryomyrtus ramosissi*ma (rosy baeckea) in the understorey. Shy susan is largely self-incompatable and requires cross pollination for fruit set. Subpopulations are small and sparsely distributed and even though numerous flowers are produced, natural fruit set rates were found to be negligible between 1994 and 1998 (Potts and Barker 1999). Natural fruit set rates increased with increasing density of a mixture of potted clones in trials in a garden where native bees were abundant suggesting that in the wild populations are too small and sparse and/or pollinators are limiting. Tetratheca species are buzz-pollinated and do not produce nectar. They are thought to be principally pollinated by native bees. The presence of nectar producing plants within the ecosystem is needed to attract and sustain the pollinators (see Gross et. al., 2003). Browsing emerged as a significant threat on seeing the impact of a prescribed burn in 2002 (Potts 2008). As such one population with germinants was fenced the following year. The increase in the diversity in the understorey in the fenced site was dramatic and the natural conversion from flowers to fruit increased from negligible to 5% suggesting that the low understorey diversity was the major reason for negligible seed set in the wild.

Threats

Shy susan has been impacted to varying degrees by historic land clearance, the removal of fire from the landscape (at appropriate intervals), grazing pressure—historically by domestic stock, also by European rabbits (*Oryctolagus cuniculus)* and native browsers, particularly *Macropus sp.* (native wallabies)—physical disturbance, especially from mineral exploration and mining activities and off-road vehicle use associated with illegal “woodhooking” (non-commercial wood harvesting) with wombats causing localized disturbance, and infection by *Phytophthora cinnamomi* (root rot fungus). Future and continuing threats include mining activities, browsing by native animals and the spread of *Phytophthora cinnamomi.*

Table 1 – Threats impacting the shy susan in approximate order of severity of risk, based on available evidence.

Threat factor	**Threat type and status**	**Evidence base**
Habitat degradation and loss		
Mining Activities	suspected future	The area supporting shy susan is highly prospective and its reserve status allows mining activities (pers. comm. DPIPWE). A mining proposal was submitted to the Commonwealth in past decade but did not proceed. Recent mining exploration activities have increased access for wood workers and increased the risk of spread of *Phytophthora cinnamomi* (Potts 2008).
Land clearance	known past	Land clearance has been a major threat to this species, which was largely redressed through acquisition of privately owned sites through the 1999 Regional Forest Agreement (RFA) Private Land Reserve Program.

Threat factor	Threat type and status	Evidence base
Fire		
Unsuitable fire frequency.	known past/ suspected current	Too long an interval between fires may cause declines due to competition from understorey species (which was observed at the time the 1999 Recovery Plan for this species was written) (Potts & Barker 1999) and an associated decrease in the diversity of understorey species needed to attract and sustain pollinators. Conversely, too short an interval between fires would deplete the soil seed bank and kill standing plants before they could reach reproductive maturity (Potts & Barker 1999). An ecological burn of parts of the Dazzler Range was undertaken in 2002 by Forestry Tasmania, while a hot summer wildfire burnt about two-thirds of the known shy susan sites in early 2010 (DPIPWE pers. comm. 2016). The impact of the fire on the wild and ex situ shy susan sites was found to be quite variable (Schahinger 2010). The extensive Barnes Hill subpopulation suffered by far the most intense burn, with the loss of all levels of the woodland/forest community (Schahinger 2010). Even where the fire was relatively cool, the radiant heat associated with the fire seemed to have affected individual shy susan, with only a couple of healthy-looking plants observed. In 2010, it remained to be seen if affected plants plants had resprouted or indeed if a soil-stored seed bank had been accumulated (Schahinger 2010).
Human activities		
Recreational and illegal harvesting activities	Known past/ current	There is evidence of significant physical disturbance to the species' habitat caused by illegal firewood collection, rubbish-dumping, off-road vehicles and trail bikes. These activities also significantly increase the risk of spreading *Phytophthora cinnamomi* and infecting populations of threatened plants (pers. comm. DPIPWE 2016).
Theft	Known past/ current	Some of the protective fences have been stolen including fencing material from a proposed ex situ site which was abandoned (Potts 2008).
Disease		
Phytophthora cinnamomi (root rot fungus)	known past/ suspected current	At least two populations noted in the 1999 recovery plan were facing the risk of imminent infection by root rot fungus. The impact of this fungus, which has a relatively subdued expression on serpentinite substrates (Schahinger et al., 2003), is exacerbated by other threats, particularly activities that may contribute to the spread of the disease, viz., off-road vehicles, woodhooking, mineral exploration. Parts of the Dans Hill are within a designated *Phytophthora* Management Area (Schahinger et al., 2003).

Threat factor	Threat type and status	Evidence base
Browsing/Grazing		
European rabbits	suspected current	Increased grazing pressure on this species since the introduction of European rabbits to the area is thought to have impacted the species (Potts & Barker 1999).
Domestic stock	suspected past	Formerly suitable habitat is likely to have been cleared and subjected to grazing by domestic stock (Potts & Barker 1999).
Native species	known past & current/suspected future	Browsing by native animals has had a significant impact on the vegetation in the Dazzler Range. The majority of the known shy susan sites were fenced in the mid 2000s, with a recently discovered site partially fenced in 2011. Unfenced sites and extensive areas of potential habitat in the Dazzler Range remain at risk, while the fences erected in 2011 have been compromised by falling trees (pers. comm. DPIPWE 2016).
Weeds	Known past suspected current	There is a large infestations of Spanish heath and pines along Tattersalls Road and there are infestations of Spanish heath, gorse, blackberry and other invasive species in the Crown land block surrounding the Beaconsfield reservoir (Black 2002). There are small infestations of Scotch Thistle in some areas along Andersons Creek. Spanish heath is a fierce competitor in southern Tasmania and has the potential to become a major weed problem in the plan area (Black 2002).

Conservation Actions

Conservation and Management priorities

Habitat loss and fragmentation

Land clearance, recreational activities and mining activities

- Prevent the clearance of any further habitat, or the use of chemicals that might cause existing habitat to become unsuitable.
- Regulate road maintenance activities that have the potential to destroy plants.
- Reconcile mining plans with conservation objectives and develop an adaptive management strategy and decision support system to mitigate the potentially negative impacts of any future mining activities on the species.

Disease

Phytophthora cinnamomi (root rot fungus)

- Regulate increased access created by mining activities to prevent spread of *Phytophthora cinnamomi* throughout the habitat of the species.
- Establish a healthy ex situ population in an area with low risk of infection by *Phytophthora cinnamomi.*
- Ensure stakeholder engagement includes education about the risks associated with *Phytophthora cinnamomi*, how recreational activities can contribute to its spread, and what precautions people can take to reduce the likelihood of damage or transmission of disease into uninfected populations.

- Ensure that human vectors of *Phytophthora cinnamomi*, such as mining activities, recreational use of land, wood-hooking and formal maintenance activities, are effectively managed is a key component of reducing the impact of this threat on the population. Promote hygiene protocols for people accessing the habitat designed to prevent transmission to new sites (Allen & Gartenstein 2010). Where there is good evidence to suggest that public access could infect a healthy population, consider limiting access to uninfected sites, through fencing and gating for example though protective fencing/gating requires ongoing maintenance to repair damage or loss from storms or theft (see Stakeholder engagement).

Fire

Unsuitable fire frequency:

- Prevent any prescribed or unmanaged fire from occurring at the site of key populations for at least the length of time required for the seedbank to be established (no fire should be deliberately introduced until this research priority has been undertaken and the appropriate timing, intensity and frequency of fire is clearly established).
- Where there is sufficient evidence for the necessity of fire in the landscape, whether as a stimulant for germination and increased understorey diversity, or in order to reduce competition from understorey species, an appropriate prescribed fire should be introduced.
- Critically, any use of prescribed or experimental fires must be very well justified. It must have a carefully planned browsing and weed management strategy and demonstrated funding to ensure post-fire monitoring and control actions occur (e.g. browsing and weed control).
- Avoid any prescribed burning from September to early December (the flowering/fruiting period). There may be other parameters to consider, such as the flowering times for companion species or the existence of any developing juveniles (plants must be given time to mature and replenish the seedbank before any prescribed fire use). Manual cross pollination between plants in small populations could be considered to supplement the soil seed store prior to burning.
- Provide maps of known occurrences to local and state Rural Fire Services and seek inclusion of mitigation measures in bush fire risk management plan/s, risk register and/or operation maps. Ensure buffers are included in any fire plan to prevent fire from occurring too quickly after a prescribed burn.

Grazing/Browsing

- Maintain or complete protective fencing (already established around most populations) appropriate to mitigate the effects of browsing by European rabbits and native herbivores.
- Fence known sites after burning.

Breeding, propagation and other ex situ recovery action

- Increase population size and reproductive fitness through stimulation of germination from the soil seed bank or reduction of competition from understorey species (through removal or through undertaking a prescribed burn as appropriate) and increasing the diversity of understorey species to attract and sustain pollinators. Seed set could be

supplemented in situ by manual pollination (Harris et. al., 2009). Ex situ populations will reduce the risk of extinction of the species and provide a source of material for reintroduction should populations decline in the wild. However, establishment rates from plants propagated from cuttings have been poor reducing the cost effectiveness of the process. Improved knowledge of the germination requirements gained from germination trials at the Tasmanian seed Conservation Centre may enable primed seed to be used to supplement small populations or establish ex-situ populations.

- Supplement the seed collection at the Tasmanian Seed Conservation Centre for research and to enable supplementation of declining subpopulations.

Stakeholder Engagement

- Key stakeholders for this species include State and crown reserve managers and local residents. Land users, including cyclists and four wheel drivers, are also an important stakeholder group with a potentially sizeable impact on the species.
- The objectives for public engagement are twofold and will therefore require separate engagement processes. Firstly, there will be a need to engage residents on reduction of threats to the species, including transmission of root rot disease, and habitat degradation caused by off-road vehicles.
- Inform local stakeholders of the dangers of root rot transmission, how it can be transmitted to plants, and steps they can take to prevent accidental transmission of the disease to uninfected populations.
- Prepare a management strategy with the input and from local experts.

Survey and Monitoring priorities

- Survey for new populations and monitor known populations for germination events, seedling survival, diversity of the understorey, signs of infection by *Phytophthora cinnamomi* and other threats. Implement an annual census to monitor emergence and resprouting success and the need for repair or replacement of protective fencing.
- Survey the extent of the impact of *Phytophthora cinnamomi* on all known populations (to inform management strategies for disease containment and eradication)
- Establish the extent of the impact of browsers on all known populations (to inform management strategies such as the ideal placement for fences, optimal control methods, et cetera).
- Consider undertaking a connectivity analysis (see McRae et. al., 2008) of populations, with specific regard to the movement of key pollinators between populations.

Information and research priorities

- Establish clearer understandings of the life cycle of this species including the appropriate times in which to introduce fire to the landscape, and how long plants take following germination to grow and replenish the soil seed bank (therefore, the appropriate interval for fire events).
- Develop threshold levels for use in a decision support management system (e.g. density of plants required to sustain adequate seed set, interval needed between fires to replenish the soil seed bank and population size, the optimum size of populations and diversity in the understorey needed to attract and maintain pollinators and effect cross-pollination).

- Establish which co-habitant plant and native bee species are essential for the continued recovery of the species, and whether there are any plant species within the local ecosystem that may be disadvantaging shy susan, for example, through suppression of the growth of new plants, or discouraging visitation by native bees.
- Determine germination cues with the view to priming seed for direct sowing to supplement sub-populations or to establish ex situ populations.

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