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

Conservation Advice

Thelymitra epipactoides

metallic sun-orchid

Conservation Status

Thelymitra epipactoides (metallic sun-orchid) is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) effective from the 16 July 2000. The species was eligible for listing under the EPBC Act as on 16 July 2000 it was listed as Endangered under Schedule 1 of the preceding Act, the *Endangered Species Protection Act 1992* (Cwlth).

Species can also be listed as threatened under state and territory legislation. For information on the current listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl .

The main factors that are the cause of the species being eligible for listing in the Endangered category are its low population size and observed decline, as a result of a combination of threats among which lack of recruitment, grazing, habitat fragmentation, the absence of requisite disturbance events, maintenance activities and competition with weeds are the most significant.

Description

The metallic sun-orchid is a rare orchid (Orchidaceae) that grows 21 – 52 cm tall and produces one long, fleshy, narrow leaf which is tubular at the base. It is a "herbacious perennial geophyte" (it is not a woody plant, it lives for a number of years, and it reproduces using organs that remain under ground). Typically, the metallic sun-orchid bears between seven and 31 flowers, which can be highly variable in size and colour; brown, copper, blue and green are the main colour groups observed in the flowers, with infusions of red, blue or green cells, giving a bronzy or metallic appearance (SWIFFT 2007). The the metallic sun-orchid's leaf arises annually from a summer dormant tuber, and grows on a stem which has 1 – 2 specialised leaves called 'bracts' (Jessop & Toelken 1986). The flower stems (or racemes) on which its clusters of flowers grow are usually an iridescent greyish-green colour with pinkish tints, sometimes brown with a metallic lustre. The petals and sepals are slightly ovular and elongated, and are about 10 – 11 mm long with white hair-tufts. The segment between the hair-tufts is deeply 3-lobed. The anthers are concealed behind the stigma with the exception of the anther point. The stigma is situated well below the middle of the column (Jessop & Toelken 1986). A sweet perfume is associated with the opened flowers, which only open on low humidity, sunny days (Cropper et al., 1989).

Distribution

The metallic sun-orchid occurs across south-eastern Australia from the Eyre Peninsula (in South Australia) to East Gippsland west of Bairnsdale (Victoria). Formerly, the species was also found in the Mount Lofty ranges, although the species is considered extinct in this area (Obst 2005). In 2005, the South Australian population consisted of 89 individuals distributed across 10 populations in the Murraylands, Eyre Peninsula and the south-east of the state (Obst 2005). The largest single population in South Australia at that time was 28 individuals, with several other populations consisting of only one plant (Obst 2005). Five of the ten South Australian populations observed at that time occurred in national parks, a council reserve, or being covered by Heritage Agreements on private land (Obst 2005). The Victorian populations also occurred within parks and reserves (Obst 2005).

Historically widespread throughout south-eastern Australia, in 2013 it was estimated that there were fewer than 1500 metallic sun-orchids remaining in the wild (Reiter et al., 2013).

Relevant Biology/Ecology

The metallic sun-orchid is a winter active geophyte with emergence occuring in concert with cooler conditions and onset of winter rainfall. Floweing from as early as August (Obst 2005), but generally from September through to November (Jessop & Toelken 1986), is followed by summer dormancy.

The metallic sun-orchid is found primarily in mesic coastal heathlands, grasslands and woodlands, but may also be found in drier inland heathlands, open forests and woodlands (Backhouse & Jeanes 1995). The soils and topography that the metallic sun-orchid is found in vary substantially between locations. In the Murray Mallee and Upper South East, soil types where metallic sun-orchids grow vary from sands, sandy loams and loamy sands of pH 6.5 to 8.5 (Obst 2005). Metallic sun-orchids growing in Victoria were observed on duplex sandy loams overlying clay and occasionally on sands. The pH of the more waterlogged soils was generally neutral (pH 6 – 7.5) (Obst 2005).

The metallic sun-orchid is an early succession post-disturbance coloniser (Obst 2005); it responds well to disturbances such as fire or biomass removal, which are known to promote seedling recruitment or flowering (Calder et al., 1989; Coates & Lunt 2001). The species has been described as 'disturbance dependent' (Coates et al., 2003), with some evidence to suggest the removal of fire as a natural disturbance event from the landscape may have contributed to the species' decline (Cropper & Calder 1990).

Burning during the dormant phase (summer/autumn) results in an increase in flower production (Beardsell & Parsons 1980, 1986, in Davies 1992). Fire also reduces competition from shrubs and grasses whilst providing suitable open sites for seedling establishment (Obst 2005). Following a fire there is an increase in recruitment for several years (Cropper 1993). A fast, hot burn is also more beneficial for this species compared with a slow smouldering burn, as a prolonged burn is more likely to damage the root tuberoid which is located just below the soil surface (Cropper 1993).

Seed is set during December and plants are dormant between the end of December and February (pers. comm., in Davies 1991). Plants can produce flowers from their second year of growth onwards for up to a maximum of four consecutive years (Calder et al., 1989). Individual plants can remain dormant for up to two years then grow to produce flowers. However, if dormant for four years or more, plants generally do not reappear (Calder et al., 1989). Longevity of the metallic sun orchid itself is unknown but there are examples of orchid species having survived at least 17 years in the wild (Car 1999).

The metallic sun-orchid relies on deception to attract three pollinator species — two bee species (*Nomia* and *Lasioglassum* spp.) and a blow fly (*Calliphora stygia*) (Cropper & Calder 1990). Pollinators are thought to visit the species as they mimic the main food sources of pollinators (Bates 1984). Once on the flower, tactile, visual and possibly olfactory stimuli direct bees to the false anther formed by the voluminous column wings, where morphological adaptations of the flower ensure that the pollen is deposited on the gaster (posterior) of the bee to effect pollination (Cropper & Calder 1990). There is no obvious food reward for visiting insects.

After successful pollination, the ovary of the flower swells and produces microscopic seeds within a seed capsule (Pobke 2007). The metallic sun-orchid reproduces from seed dispersed to open ground where the vegetation community has been disturbed (Calder et al., 1989), or undergoes annual replacement by root tuberoids (Cropper et al., 1989). The lack of seed set observed on the Victorian coast appears to be due to the absence of pollinators from the heath and grassland communities in which the orchid grows (Cropper & Calder 1990). This may well be a consequence of the reduced number of plants flowering in the ecological community (possibly due to the elimination of fire at these sites), thus not maintaining a floral assemblage attractive to potential pollinators (Cropper & Calder 1990).

Many orchid taxa are known to have mutually dependent relationships with soil fungi for regeneration and with invertebrate pollinators for fertilisation (Cropper & Calder 1990; Rasmussen 1995). The mycorrhizal fungi (*Tulasnella asymmetrica*) is required to initiate successful seed germination in the metallic sun-orchid (Obst 2005). The species reproduces almost exclusively from seed that is dispersed to sites where soil or ecological community disturbance has occurred (Calder et al., 1989). Seeds tend to be short lived (Calder et al., 1989).

Threats

The following table lists the threats impacting the metallic sun-orchid in approximate order of severity of risk, based on available evidence. The removal of fire as a natural disturbance regime is likely to be the primary threat to this species, allowing invasive weed species to outcompete the orchid (and other flowering members of the ecological community), reducing the likelihood of attracting native polinators, which are themselves in competition with introduced pollinators less suited to pollination of the species. Grazing pressure on the metallic sun-orchid, once limited to native species, has been exacerbated by a range of invasive herbiverous species; the human impact also constitutes a significant threat, both directly through damage to individuals, and indirectly through changes to the ecology of the landscape.

Table 1 – Threats impacting metallic sun-orchid in approximate order of severity of risk, based on available evidence.

Threat factor	**Threat type and status**	**Evidence base**
Fire		
Removal of fire from the landscape	known current	The species is disturbance-responsive (Coates et al., 2003). Burning during the orchids dormant phase (summer/autumn) has been found to result in an increase in flower production (Beardsell & Parsons 1980, 1986, in Davies 1992). Fire also temporarily reduces competition from shrubs and grasses (Obst 2005). Current management protocols of actively reducing the frequency and intensities of fire at Victorian coastal populations has lead to climax communities of low species diversity (Calder et al., 1989; Cropper et al., 1989). As a large number of heathland species (including the metallic sun-orchid) depend on fire to stimulate flowering, a reduction in fire frequency has also contributed to a depauperate flowering community. Along with a closed canopy vegetation, this also results in pollinators not being attracted to these areas, leaving the orchids un-pollinated, with a lack of fruit set being recorded (Cropper & Calder 1990).
Too frequent or aseasonal fire	suspected future	Most terrestrial orchids have evolved under conditions of hot summer fires, generally when the plants have been dormant (Backhouse & Jeans 1995). The timing of fire is important with the best time during late summer or early Autumn, after seed dispersal but prior to plant emergence (Todd 2000). Too frequent fire may pose a threat by altering habitat, removing organic surface materials and negatively impacting pollinators and mycorrhizal agents (Pers. Comm. K. Dixon 2016). Although not an issue currently impacting the species, this could become a threat depending on how fire is managed in future.

Invasive species		
Weeds	known current	Perennial veld grass (*Ehrharta calycina*) is a major threat to this species (Obst 2005). Bridal creeper (*Asparagus asparagoides*) also has a very significant impact. Other weeds identified as lesser current threats include wild turnip (*Arisaema triphyllum*), capeweed *(Arctotheca calendula*), pine trees (*Pinus* spp.), gazania (*Gazania* spp.), false caper (*Euphorbia terracina*) and several woody weeds (Obst 2005). Colonisation of sites by perennial veldt grass has been known to occur due to introduction by earth-moving equipment, particularly during fire-fighting activities (Davies 2009).
Invasive herbivores	known current	Grazing can have a profound effect on orchid population dynamics. The removal of buds and shoots can significantly influence emergence and flowering, and a reduction in photosynthetic area in one year may render plants unable to assimilate sufficient carbon reserves to flower in the subsequent year (Coates et al., 2006). Grazing by rabbits (*Oryctolagus cuniculus*), hares (*Lepus europaeus*), deer (*Cervus* spp.) and introduced invertebrates such as Tortricid Moth larvae (Fam. Tortricidae) (Cropper et al., 1989) represent a threat to the metallic sun-orchid, although which particular herbivore is threatening a population varies across the species' range (Obst 2005). For instance, grazing by deer and hare are a threat to several populations in South Australia, near Murray Bridge and Tailem Bend (Obst 2005). At the Gum Lagoon Conservation Park, the metallic sun-orchid is particularly prone to browsing by rabbits, as the shallow drain on which the population occurs provides ready access (Davies 2000). In 1989 rabbits were observed to browse flower stems, with cases where the entire flowering crop of a local population has been wiped out due to this grazing behaviour (Cropper et al., 1989).
European honeybee (*Apis mellifera mellifera*)	suspected current	Feral or managed honeybees *(Apis mellifera mellifera*) may displace populations of *Nomia* spp. (native bees) and affect orchid pollination (hence seed production). Honeybees may be less effective in pollinating flowers — in their discussion on the impact of European bee visitation on *Persoonia mollis* subsp. *maxima*, Rymer et. al. (2005) note that European honeybee behaviour favours self-pollinating or bi-parental inbreeding reproductive systems. Further, the presence of European honeybees may alter the behaviour of native bees, thereby altering patterns of pollen dispersal, or remove pollen from flowers, reducing the quantities of pollen that are transferred (Paton 1996; SA DEH 2006).

Habitat loss and fragmentation		
Development and maintenance activities	known current/future	Populations adjacent to roadsides are at risk from patrol road grading and the creation and maintenance of drainage diversions (SA DEH 2006). Some populations, such as at Port Campbell National Park, are close to roads and occupy sites that were subject to development proposals in 2003 (Coates et al., 2003). In 2005 Obst (2005) speculated that the development of a compositing facility at Monarto, which required road widening along Ferries-McDonald Road, was likely to impact on significant stands of roadside vegetation, and reduce potential habitat for the metallic sun-orchid. In 2000, Davies (2000) noted the construction of minor drains in or adjacent to Gum Lagoon Conservation Park should be avoided, as their effect on the existing water regime (winter water-logging and summer dry), then this could have a serious impact on the metallic sun orchid. Populations occurring near agricultural land are potentially threatened by exposure to fertiliser and chemical drift. At the Wanilla Triangle site on the Lower Eyre Peninsula, the population occurs in a very small reserve with a high edge:core ratio, being bound on two sides by agricultural land. At time of observation, threats included exposure to fertiliser and chemical drift and agricultural weed invasion (SA DEH 2006).
Low population		
Low genetic variability and gene flow	known current	Lack of recruitment is a high risk current threat to all known populations in the South Australian Murray Darling Basin Region (Obst 2005). Populations of the species consist of collections of a few individuals and some instances of isolated individuals; this situation not only impacts on the genetic variability within the population, but as mentioned above, makes sites less attractive for pollinators, further lowering breeding success of remnant individuals.

Human impacts		
Illegal collection by enthusiasts	suspected current	A 2004 field survey reported the disappearance of many rosettes, which may have been caused by illegal collection (Obst 2005), although this is only a suspected threat. Not only does illegal collection reduce the reproductive population, it potentially reduces the likelihood of visitation by pollinators to smaller populations, and can also assist in the distribution of weeds (SWIFFT 2007).
Trail bike riding	known current	Trail bike riding is known to occur at two populations in South Australia (Obst 2005). This can impact the species by damaging or destroying individual plants.
Trampling	suspected current	Trampling by bush walkers, which can damage or destroy individual plants, is a low — but present — threat for this species (Obst 2005).
Herbivory by native species		
Macropus sp. (kangaroos and wallabies), *Corcorax melanorhamphos* (white-winged chough) and *Megamerus kingi* (Chrrysomelid beetle) larvae	known or suspected current/future	The metallic sun-orchid seems to be highly palatable (Calder et al., 1989). In 2005, it was observed to be subject to herbivory that included native macropods (Obst 2005). In addition to this, *Megamerus kingi* (Chrrysomelid beetle) larvae have been observed to graze on leaf material leading to loss of leaf (Cropper et al., 1989). Digging and physical disturbance by *Corcorax melanorhamphos* (white-winged chough) was suspected as a potential cause of the disappearance of many rosettes from a population in South Australia (Obst 2005)[1] though this was not confirmed. Although perceived as a low risk (Obst 2005), herbivory by native species may become problematic where the metallic sun-orchid is subject to the cumulative grazing impacts of a number of native and invasive herbivores, or, in the case of macropods, where populations exceed historic levels, increasing grazing pressure on a population already reduced by a number of other threats.

[1] As direct evidence of this threat was not obtained, action should not be taken without the acquisition of definitive proof of both the suspected activity and the extent or severity of the threat it poses to the species.

Conservation Actions

Conservation and Management priorities

Fire

- The metallic sun-orchid is disturbance-responsive and fire increases flower production. Fire frequency needs to be established such that the supporting plant ecology is sustained and flowering in the orchid is periodically enhanced with fire, the frequeny of which needs to be determined through research. Any such regime should rigorously adhere to the following stipulations:
- In the first instance, conservation managers should only use prescribed burning and other activities where there would be a positive impact upon the persistence of the population, as supported by evidence.
- Where prescribed burning is found to be requisite, these events must be managed to ensure that prevailing fire regimes do not disrupt the metallic sun orchid's lifestyle or those of other species within the broader ecological community; that they support rather than degrade the habitat necessary to the metallic sun-orchid; that they do not promote incursion of invasive species (especially weeds); and that they do not increase impacts of grazing/predation by either invasive or native herbivores on this species.
- Buffers need to be established where practicable to prevent unplanned fire from undermining conservation efforts.
- It must be ensured that fire only occurs within the habitat during the dormant phase of the metallic sun-orchid's life cycle (summer/autumn), noting that late autumn, winter and spring ignitions will have a highly detrimental effect upon the long-term viability and sustainability of the species and is likely to have a deleterious impact on other native species that form the ecological community within which this species occurs.
- The prescribed fire should be of the appropriate intensity and duration (a fast, hot burn is recommended for this species), so as to prevent damage to the tubers beneath the soil surface.
- Avoid the use of fire retardants and fire-fighting foams during fire operations, which could have an adverse impact on the metallic sun-orchid.
- Rigorous weed management should be undertaken immediately post fire to ensure the species is not forced to compete in a vulnerable landscape.
- 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.

Invasive species

Weeds

- Undertake weed control that includes selective herbicide use, using methods appropriate to the weed species present (including but not limited to perennial veldt grass, bridal creeper, wild turnip, capeweed, pine trees, gazania and false caper). Avoid methods which may be inappropriate for use proximate to the metallic sun-orchid. This will require receiving advice from relevant experts on the best removal practices, noting that these will vary depending on the weed species.

Invasive herbivores

- Once the extent, severity, type, and cause of herbivory is identified, management actions should aim to exclude the invasive species (e.g. rabbits, hares and deer) causing the damage from the area, or undertake management of the population to reduce impact.
- Should the impact of native herbivores including *Macropus* spp. be found to be significant, management actions should take steps to fence off key populations until the other threats on this species have been addressed, and the species has been able to recover sufficiently to tolerate native herbivory.

European honeybee

- If beekeeping is found to be undertaken by local communities, effort should be made to promote the keeping of native species, or at a minimum, responsible beekeeping that reduces the impact of introduced bees should be promoted, e.g owners should prevent swarming of bees into bushland areas; and place hives at a distance from orchid habitats.

Habitat loss, disturbance and modifications

- See stakeholder engagement.

Breeding, propagation and other *ex situ* recovery action

- *Ex situ* seed banks provide an important capacity for medium to long-term storage of diaspores of threatened plant species, as well as a source of plants for translocation if this becomes essential for the species' survival, noting that translocation of cultivated plants will be considered only in special cases where there is a high chance of success and where secure sites exist.
- Seed banking should be undertaken in consultation with relevant seed storage professional advice as to appropriate conditions (collection and post-harvest treatment; pre-storage drying; storage temperature; curation and auditing) to ensure diaspore viability is retained.
- Successful *in situ* population management relies on an understanding the obligate relationships between orchids and their mycorrhizal fungi and pollinators, their relationships with associated flora, and their response to environmental processes.

Stakeholder engagement

- Stakeholders for this species include land owners, local councils, local residents (especially bushwalkers and trail bike riders) and orchid enthusiasts.
- Orchids have the potential to act as 'flagship species' for highlighting broader nature conservation and biodiversity issues such as land clearing, grazing, weed invasions and habitat degradation.
- Consultation with land managers should aim to raise awareness of the species to prevent any inadvertent damage to the species via land management and modification practices, such as the impacts of using fertiliser and chemicals at the edge of properties, changing the water regimes in the area, or other practices (keeping non-native bees) that could negatively impact on the orchid. Engagement of local councils that conduct roadside maintenance is paramount.
- The issues surrounding collection and trampling should be promoted in the area, to discourage further take, damage or degradation by residents. Given the risk of take

in this instance, stakeholder engagement should avoid disclosure of the precise locations of important populations.

Survey and Monitoring priorities

- Design and implement a monitoring program or, if appropriate, support and enhance existing programs — monitoring should take particular account of any decline and possible causes for plant disappearance, including the impact of herbivory by non-native and native species. Where a particular species is identified as a primary threat to a population, survey data should inform protective measures to limit the threat to the species.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.

Information and research priorities

- Biological processes fundamental to reproduction and survival need to be identified and conditions to facilitate their functioning included in critical habitat determinations and management prescriptions.
- Undertake survey work in suitable habitat and potential habitat to locate any additional populations/occurrences/remnants.
- Improve understanding of the mechanisms of response to different fire regimes and identify appropriate fire regimes for conservation of the threatened species by undertaking appropriately designed experiments in the field and/or laboratory.
- Where appropriate, use understanding and research on fire responses among related (e.g. congeneric) or functionally similar species to develop fire management strategies for conservation.
- Fire trials should only be undertaken as a last resort when all other means of regeneration of the species has been investigated and, in addition, all weed management and fire impacts including the timing of fire impacts are fully understood.
- Undertake survey work in suitable habitat and potential habitat to locate any additional occurrences to more precisely assess population size and distribution.
- Undertake seed germination and/or vegetative propagation trials to determine the requirements for successful establishment.
- Implement an annual senses to monitor emergence and re-sprouting success.

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