

Action Statement

Flora and Fauna Guarantee Act 1988

No. 50 (revised in 2004)

Sunshine Diuris *Diuris fragrantissima*

Preamble

This Action Statement is heavily based on the draft Recovery Plan under the **Environment Protection and Biodiversity Conservation Act 1999** prepared for this species by the Department of Sustainability and Environment for the Commonwealth Department of Environment and Heritage.

Description

Sunshine Diuris has two to three slender, channelled, grass-like green leaves, up to 18 cm long. A slender green stem to 20 cm tall, bears one to nine (average four) strongly scented flowers, coloured white with variable purplish hues and streaks, while the lateral sepals are green. The dorsal sepal is triangular and erect, while the lateral sepals are long and slender (to about 60 mm), inrolled, drooping and parallel (giving rise to the name doubletail). The ovate petals project obliquely upwards. The labellum is strongly bilobed, the lateral lobes curved upward, and the fan-shaped mid-lobe projects forward. Flowers open sequentially up the stem, the lowest flower often having collapsed before the top flower buds have opened.

The Sunshine Diuris was originally called the White Diuris, *Diuris alba* R. Br., a species now known to be confined to the central coast of New South Wales (Bishop 1996). It was later known as the white form of the Purple Diuris (*Diuris punctata* var. *albo-violacea* Rupp ex Dockr.) until it was recognised and described as a separate species, *D. fragrantissima* D.L. Jones et M.A. Clem. (cited in Clements 1989).

The species is most similar to the Wedge Diuris *Diuris dendrobioides* Fitzg., a threatened orchid from grasslands in inland western New South Wales and northern Victoria. The Wedge Diuris was included in *D. fragrantissima* by Walsh and Entwistle (1994), although most other authors including Jones (1988), Clements (1989), Gullan *et al.* (1990), Backhouse and Jeanes (1995) and Bishop (1996) have retained *D. dendrobioides* as a separate species.

Distribution and abundance

Sunshine Diuris was once so common in the native grasslands north-west of Melbourne around the time of European occupation, that it was often referred to as 'Snow-in-the-Paddocks' (Richards 2002). Since then the species has suffered a catastrophic decline in range and abundance. Its decline has been attributed to widespread habitat destruction and degradation. Current major threats include weed invasion, predation from introduced herbivores, lack of fire and ill-timed fire.

Sunshine Diuris is now known from only two populations in the wild, at Tottenham and Laverton North, although the latter is the result of reintroduction. There are believed to be fewer than 5 plants in the wild. There are 800-1000 plants in cultivation, principally at the Melbourne Zoo but also at the Royal Botanic Gardens and with private growers

The Tottenham site is owned by Victorian Rail Track (Victrack), a Victorian Government Business Enterprise. The reintroduction site at Laverton North Grassland Reserve is managed by Parks Victoria under the Victorian *Crown Land (Reserves) Act 1978* (Parks Victoria 2000). The site is reserved under the IUCN category IV for the purpose of nature conservation (International Union for the Conservation of Nature 1994; Parks Victoria 2000).

Habitat

Sunshine Diuris appears to have been confined to the grassland plains immediately to the west of Melbourne, particularly between Werribee and Sydenham (Cropper 1993; Jones 1988; Parsons 1981). It grew in native grasslands dominated by Kangaroo Grass *Themeda triandra*, on heavy basalt soils, often with embedded basalt boulders. The sole remaining natural population occurs in a small (one hectare) grassland remnant located along a railway reserve west of Melbourne. *T. triandra* dominates this site with *Austrodanthonia* species, *Dianella longifolia*, *Dianella revoluta*, *Tricoryne elatior*, *Pimelea humilis* and *Dichanthium* species (the latter may be a non-endemic native plant transported to the site).

The sole remaining natural population at Tottenham is found in Western (Basalt) Plains Grassland on shallow clay with exposed basalt boulders. This site, as well as the reintroduction site at Laverton North Grassland Reserve should be considered as part of the critical habitat for the species, although there remains some doubt as to whether they still fulfil the ecological requirements for the species. There is some suggestion that Sunshine Diuris may have had a wider distribution and ecological range than at present (Richards 2002). This could indicate that Sunshine Diuris may be able to tolerate a wider ecological niche than that which it currently occupies.

Life history and ecology

Sunshine Diuris is a terrestrial deciduous herb, emerging annually from a lobed, subterranean tuber. The leaves emerge in late autumn, following the onset of seasonal rains. Flowering commences in late October, through November and is completed by early December.

By mid-summer the leaf has shrivelled, and if pollination has occurred, the seed capsule is ripening. Seed set occurs about six weeks after. The species survives the late summer and early autumn as a dormant tuber. Reproduction is almost entirely from seed, with rare vegetative reproduction apparently possible (Cropper 1993). The irregularly shaped, lobed tuber is replaced annually.

Very little is known of the biology or ecology of Sunshine Diuris. It grows in a complex relationship with a mycorrhizal fungus *Tulasnella calospora* Boudier (Warcup 1971), that initiates seed germination, and assimilates nutrients for the orchid. The degree of dependence upon the fungus, particularly of mature plants, is not known. Some individuals of Sunshine Diuris have survived for over nine years in the wild (Cropper 1993) and over 20 years in cultivation (D. Tonkinson, La Trobe University and C. Knight, Melbourne Zoo, unpubl. data).

Sunshine Diuris is pollinated by a small native bee (Tonkinson 1985), the purplish colour of the flowers mimicking the colour of native lilies that often grow with *Diuris* species. The bee may also be attracted by the strong fragrance of the orchid. Cropper (1993) reported very low natural rates of pollination, with a maximum of only 7% of flowers producing seed pods, which is possibly a function of the rarity of the orchid and hence few opportunities for pollinators to find flowers and effect pollination.

Hot summer fires are likely to enhance flowering in the following flowering season. Fires may indirectly promote seed germination and seedling establishment by altering soil nutrient levels and by reducing competition from associated grasses. This effect may act directly upon the orchid, or indirectly through the fungal symbiont. Most recruitment has been observed one to two years after a summer fire.

Conservation status

National conservation status

Sunshine Diuris has been listed as Endangered under the Commonwealth **Environment Protection and Biodiversity Conservation Act 1999**.

Using the IUCN Red List categories and criteria (2001), Sunshine Diuris is Critically Endangered and is close to extinction in the wild. An application has been made to revise the status of the species from Endangered to Critically Endangered *sensu* IUCN (2001).

Victorian conservation status

Sunshine Diuris has been listed as threatened under the **Flora and Fauna Guarantee Act 1988**.

Sunshine Diuris is considered Endangered in Victoria according to "Advisory List of Rare or Threatened Vascular Plants in Victoria - 2004" (DSE 2004).

Decline and threats

Sites where Sunshine Diuris occurred have now been destroyed, with the exception of the Tottenham Rail reserve and the translocation site at Laverton North Grassland Reserve. Prior to its near extinction in the wild, botanists had been concerned with the plight of Sunshine Diuris for almost 80 years. In 1934, Nicholls (Willis 1951) wrote that 'the species was at one time exceedingly plentiful, but is now becoming scarce'. Willis (1951) believed that 'Victoria's most beautiful orchid' was in dire peril of extinction.

By 1970, only five *D. fragrantissima* populations remained, and by 1980 the species was restricted to the single remaining site at Tottenham rail reserve, where about 100 plants survived. This population continued to decline through the 1980s, with 67 flowering plants recorded in 1982, 11 in 1989, and only one in 1992. No flowering plants were seen in recent years, until a single flowering plant was found at the site in October 1997. A short time later an arsonist set fire to the reserve, and three flowering plants were recorded in October 1998.

Habitat destruction and degradation has undoubtedly been the prime reason for the decline to virtual extinction in the wild of this beautiful orchid. Much of the original native grasslands to the west of Melbourne have been destroyed for agricultural, industrial and urban development, and the remaining areas are mostly small, highly fragmented and often degraded. These habitats once covered about 10% of Victoria, but have now been reduced to less than 1% of their original extent (Barlow and Ross 2001; Stuwe 1986). During the 1970s, four of the five last known stands of Sunshine Diuris, all growing along railway reserves, were destroyed by dumping, cultivation or herbicide use (Parsons 1981). Long fire-free intervals within grasslands may also be accelerating decline, by allowing the development of dense swards of Kangaroo Grass that inhibits regeneration of smaller native herbs (McDougall 1989).

The last remaining population at Tottenham is under enormous pressure. Invasion by *Nassella neesiana* of the surrounding areas is extensive, and now poses a very serious threat to the site in spite of ongoing efforts to control weeds as part of Recovery Plan implementation (Backhouse, Webster *et al.* 2000). Other serious weed species include annual grasses such as *Briza maxima*, *Vulpia bromoides* and *Aira* spp., *Foeniculum vulgare*, *Plantago lanceolata*, and *Romulea rosea* and are widespread throughout the site. Damage of plants by slugs and snails, herbicide spraying, vehicle movement and illegal collections all threaten the population (Tonkinson 1985). Predation of tubers

by the introduced House Mouse *Mus musculus*, was believed responsible for a mortality of perhaps 70% of plants during the mid-1980s (Cropper 1993).

Trampling, particularly by visiting naturalists, has been a major problem in the past, with up to 15% of plants broken or damaged in some years (Cropper 1993). Human interference with the reserve is also cause for concern. Three days after the flowering plant was found in 1997, the grassland reserve was deliberately burnt by an arsonist. Ironically, this event may have been the stimulus for three plants flowering in 1998. However, while fires occurring in late summer are beneficial to the species, too frequent or ill timed fire may be a threat, causing damage to plants, increasing seedling mortality and destroying immature seedpods. It is highly likely that, with so few plants, ecological processes such as natural pollination have also been substantially disrupted.

Existing conservation measures

The plight of Sunshine Diuris has received considerable attention for several decades now. The former Native Plants Preservation Society undertook some recovery actions in the 1950s.

The School of Botany at La Trobe University has had a substantial input into the conservation of the species and was responsible for many of the early conservation management actions. In 1980 they undertook surveys, and later in 1982, the Sunshine Diuris Research Project.

In recent years, other organisations, including the Department of Sustainability and Environment, the Victoria University, the Melbourne Zoo, the Society for Growing Australian Plants (Basalt Plains Group), the Australasian Native Orchid Society, the Royal Botanic Gardens Melbourne, the Australian National Botanic Gardens and local field naturalists have participated in actions to aid the recovery of Sunshine Diuris.

A Recovery Plan was prepared (Backhouse, Webster *et al.* 2000) and implemented between 1998 and 2002. Following is a summary of major recovery actions undertaken to date.

Tottenham site - Management

Considerable liaison took place with the former Public Transport Corporation by the Native Plants Preservation Society and the School of Botany at La Trobe University in the early 1980s. The Native Plants Preservation Society even leased the Tottenham site for some years to protect the plants there. A VLine Vegetation Management Agreement was approved in 1990, and the Tottenham site was listed as Category one site (highest priority for protection) on the VLine Schedule. This agreement is currently being re-

negotiated following privatisation of the PTC. Victorian Rail Track is now the land management authority with responsibilities for the site.

In 1982 the Department of Crown Lands and Survey, in conjunction with SB-LTU, fenced and signposted the Tottenham site in an effort to reduce damage. The site was even supervised during flowering periods in the 1980s to prevent disturbance to and theft of plants. The Tottenham site has been burnt regularly since 1982 to control competition from native grasses and weeds, and to promote flowering and seedling establishment. Baits have been laid for mice, snails and slugs to control predation, and weed control undertaken by volunteers and contractors with a particular focus on the removal of *N. neesiana*. Fencing surrounding the site was upgraded in 1999 and the site was last burnt in February 2000.

Cross-pollination between wild and cultivated plants has taken place in order to maximise the development of viable seed and to maintain genetic diversity. Seed collection has also continued. Trials to infect seed with mycorrhizal fungus using buried seed (seed baiting) have also taken place in the last two years (2001 and 2002) at Tottenham.

A draft Railway Reserve Management Plan (Govanstone, Craigie *et al.* 1992) was prepared which included details for on-going management of the Tottenham site. An Action Plan for Remnant Native Grasslands and Grassy Woodlands of the Melbourne Area was also developed (Department of Conservation and Environment 1990). An Action Statement for the Sunshine Diuris (Webster and McKay 1993) was also prepared and published. This document outlined the future direction for recovery of the species. In March 2000 the first Recovery Plan for the Sunshine Diuris was published, providing greater detail regarding the recovery actions prescribed for the species.

Research on biology and ecology

The School of Botany at La Trobe University has undertaken a considerable amount of autecological research on the species, as part of the Sunshine Diuris Research Project. Research on the species by LaTrobe, the University of Melbourne, RMIT, Royal Botanic Gardens, Victoria University and the Melbourne Zoo has addressed a number of factors relating to the survival of the species. These have included the investigation of the plant's molecular biology, genetic variation, habitat characteristics, life history, population structure, seasonal variation, hand pollination, seed collection, propagation and translocation as well as the effects of weed invasion and of burning regimes.

Survey

When in flower, Sunshine Diuris is a showy, conspicuous species and as such, is easily detected in the field. Searches for the species at historical sites were initiated by the School of Botany at La Trobe University in 1980, but the orchid was only found at one site (the current Tottenham site). Since then, many remnant native grasslands in the Derrimut, Werribee and Broadmeadows areas have been searched by botanists and orchid enthusiasts. So far, all these searches for Sunshine Diuris have proved fruitless.

Propagation

In 1978, J.H. Warcup of the Waite Agricultural Research Institute in South Australia developed a technique to propagate plants from seed, using a symbiotic method of seed germination.

The National Botanic Gardens in Canberra also successfully propagated tubers from seed in 1981, using the Warcup method. Seedlings were then sent to the Royal Botanic Gardens Melbourne and La Trobe University to establish an *ex situ* collection. Mycorrhizal fungi was isolated and cultured in 2002 (Huynh, University of Melbourne, unpubl. data) after a long period of time during which no expertise was available to carry out this vital component of propagation.

Researchers at La Trobe University were also successful in developing germination of seedlings in the laboratory (using the fungal symbiont obtained from National Botanic Gardens, Canberra) in 1985. Thanks to horticulturists at the Melbourne Zoo and members of the Australasian Native Orchid Society, improved propagation techniques have been developed and the numbers of individuals in cultivation have increased dramatically. The collection at La Trobe was maintained until 1991, and was then transferred to Melbourne Zoo, with some plants subsequently distributed to the Royal Botanic Gardens and specialist growers in ANOS to spread the risk. A commercial grower with facilities to produce large numbers of plants (Kevin Western Orchids, South Australia) was contracted as part of Recovery Plan implementation to propagate plants using asymbiotic techniques. Consequently, between 800 and 1,000 plants are currently held in cultivation. In 1999, to safeguard the species from extinction, seed was lodged with Kings Park and Botanic Garden in Perth for cryopreservation, and also at the Royal Botanic Gardens Melbourne for storage.

***Ex situ* conservation and reintroduction**

Re-introduction of plants to wild sites to conserve Sunshine Diuris were attempted as far back as 1950, when the Native Plants Preservation Society translocated the species (and other orchids) from a rail reserve into a fenced area within a wireless mast site at Sydenham (Willis 1951). These plants were

last seen in 1952. Herbicide spraying and other management activities subsequently destroyed the source site.

In 1982, the School of Botany at La Trobe University established an orchid reintroduction site within the Laverton North Grasslands Reserve. Twelve seedlings propagated at the ANBG and 33 tubers propagated at the Waite Institute were initially introduced, followed by another 36 seedlings planted in July 1985. There was a high mortality of seedlings, but several plants matured and flowered.

However, although natural pollination and seed set were observed, there was apparently no seedling establishment at the site (Parsons 1988). Flowering plants were present again in 1991, and again in 2000, but it is believed that the introduced plants have now died out.

Genetic analysis (using enzymes) of *D. fragrantissima* by the Royal Botanic Gardens Melbourne, has guided the breeding program to ensure that the diversity present in the *ex situ* population is maintained (E. James, Royal Botanic Gardens Melbourne unpub. data).

The Victorian Threatened Orchid Recovery Team has also produced cultivation guidelines to maximise consistency and effectiveness of cultivation. A reintroduction strategy and plan for Sunshine Diuris has also been produced (Victorian Threatened Orchid Recovery Team 2002).

Information and awareness

A considerable amount has been written on Sunshine Diuris, both to highlight its plight and guide recovery management. The history and conservation status of Sunshine Diuris was documented by SB-LTU for inclusion in the Register of Rare and Endangered Native Plant species in Victoria (Stuwe 1980). Land managers and the Victorian government conservation department were advised of the sites' conservation significance and provided with management recommendations.

Cropper (1993) prepared a detailed historical account of its conservation and provided management recommendations. An education kit entitled 'Native Grasslands in the Melbourne Area' was produced by the then Department of Conservation and Environment and the Victorian National Parks Association (1992), with funding from the Australian Heritage Commission, and circulated to school groups and interested organisations.

There has been considerable liaison with government agencies, local residents, native orchid societies, naturalists and other community groups, and a media campaign highlighting the plight of

the orchid. In 1998, The Department of Natural Resources and Environment produced an information brochure for the broader community that outlined the plight of the species. A number of papers have been presented at conferences to the scientific community and orchid enthusiasts (James, Akiyama *et al.* 2001; Knight 2002; Knight, James *et al.* 2001; Richards 2002; Thompson 2002). Information has also been disseminated via the Internet outlining current conservation objectives and actions.

Conservation objectives

Long term objective

To ensure that the Sunshine Diuris can survive, flourish and retain its potential for evolutionary development in the wild.

Objectives of this Action Statement

1. Ensure the population at Tottenham and its habitat is managed appropriately
2. Maintain and enhance populations in cultivation
3. Ensure the population at Laverton North Grassland Reserve and its habitat is managed appropriately
4. Establish cultivated plants in the wild

Intended management actions

The intended management actions listed below are further elaborated in DSE's Priority Actions Information System. Detailed information about the actions and locations, including priorities, is held in this system and will be provided annually to land managers and other authorities.

Maintain the population of Sunshine Diuris at Tottenham

1. Monitor site

Regular monitoring of Sunshine Diuris at the Tottenham site will take place three times a year. Data collected will include a count of the number of Sunshine Diuris individuals, flowering and seed - set, plant dimensions, associated native and exotic species and predation. Trends in plant size, emergence and flowering will be reported.

Responsibility: DSE Port Phillip Region

2. Control pests and predators

A number of pests and predators are present at the Tottenham including snails, slugs and the introduced House Mouse. Some bird species may potentially threaten the populations although as yet there is no evidence to verify this. Control

techniques will include fencing and caging of plants as well as baiting for slugs and snails.

Responsibility: Victrack, DSE Port Phillip Region

3. Control pest plants

Weeds have threatened the Tottenham site for a number of years. The most serious weed species are *N. neesiana*, *Plantago lanceolata*, *Foeniculum vulgare*, *Romulea rosea* as well as annual grasses such as *Briza maxima*, *Aira* spp. and *Vulpia bromoides*. Ecologically sensitive weed control to eradicate these species will continue and will be undertaken by a contractor.

Responsibility: Victrack, DSE Port Phillip Region

4. Undertake ecological burning

Although little data is available on the impact of altered fire regimes on Sunshine Diuris, the absence of fire is likely to be a significant threatening process. Data collected by SB-LTU for Sunshine Diuris shows a significant increase in individuals at the Tottenham site after a fire in 1982. However, no significant increases were recorded after other burn events (Cropper 1993). This may be due to numerous additional threats being active at the site during this period as well as a very diminished population. Despite this, the absence of appropriate fire regimes should be considered a serious threatening process (Backhouse, Webster *et al.* 2000). Ecological burns will continue to be undertaken at Tottenham by the Department of Sustainability and Environment.

Responsibility: Victrack, DSE Port Phillip Region

Maintain Sunshine Diuris in cultivation

5. Produce seedlings using in vitro propagation techniques

In vitro propagation has produced large numbers of seedlings grown asymbiotically in a sterile environment. This method is an effective way of boosting the number of plants held in cultivation, particularly for translocation, and for conserving and maintaining genetic diversity. Furthermore, there are no facilities at present to produce large numbers of seedlings symbiotically. *In vitro* propagation will continue over the next five years and will aim to produce 500 de-flasked seedlings annually suitable for fungal inoculation.

Responsibility: Zoos Victoria, Royal Botanic Gardens, DSE Biodiversity & Natural Resources Division

6. Develop techniques for symbiotic inoculation

Techniques to isolate and culture mycorrhizal fungus are now well understood for *D. fragrantissima*. However, further improvement of techniques to inoculate asymbiotically grown seedlings is still required. Plants that are cultivated without their fungal symbiont are

generally less vigorous and are unlikely to survive translocation. Research into methods of fungal inoculation including experimental trials, are needed to increase the quality and quantity of plants suitable for translocation.

Responsibility: Zoos Victoria, Royal Botanic Gardens, DSE Biodiversity & Natural Resources Division

7. Increase plant numbers in cultivation

The Melbourne Zoo and private orchid growers (NOGN and ANOS) have an excellent history of maintaining Sunshine Diuris in cultivation. Their role in the *ex situ* conservation of the species also ensures that plants in cultivation are spread across a wide range of growers. The recovery effort will continue to support and encourage both these groups to maintain and increase plant numbers in cultivation. Melbourne Zoo will continue to produce seedlings for reintroduction and *ex situ* conservation using tuber division and scattering seed around potted parent plants. The cultivation program will produce seedlings from a large number of crosses to maximise genetic diversity in accordance with recent research (E. James, Royal Botanic Gardens Melbourne, unpub. data).

Responsibility: Zoos Victoria, Royal Botanic Gardens, DSE Biodiversity & Natural Resources Division

8. Maintain a database on cultivated plants

Record keeping for plants in cultivation is essential to *ex situ* conservation. A centralised database has been built and maintained by NOGN and provides details on the locations, numbers, origins and growing conditions of plants. This database is invaluable as it enables plants to be easily located, facilitates accuracy in the planning of cross-pollination trials and provides data for analysis to determine optimum growing conditions.

Responsibility: Royal Botanic Gardens, DSE Biodiversity & Natural Resources Division

Manage the Laverton North Grassland Reserve translocation site

9. Control pest animals

A number of pests and predators are likely to be present at the Laverton site. Site monitoring will provide data on current threats and enable development of mitigation measures. Introduced predators may include snails, slugs and the House Mouse. Some bird species may potentially threaten the populations although as yet there is no evidence to verify this (Tonkinson, *pers. comm.*). Pest control will include fencing and caging of plants as well as baiting for slugs and snails.

Responsibility: Parks Victoria

10. Conduct ecological burning

The planning and implementation of ecological burns following guidelines established by Parks Victoria will continue, in order to provide conditions for flowering, pollination and seedling recruitment.

Responsibility: Parks Victoria

11. Control pest plants

Competition from weeds is an ongoing threat to native grassland in Victoria is very high at Laverton North Grassland Reserve. Ecologically sensitive weed control will continue at Laverton North Grassland Reserve by Parks Victoria.

Responsibility: Parks Victoria

Reintroduce plants to Laverton North Grassland Reserve

12. Reintroduce plants to Laverton North Grassland Reserve

The Laverton North Grassland Reserve is the only site remaining with secure tenure for translocation. Attempts to reintroduce cultivated plants into the Laverton site will continue, in tandem with site management, intensive after-care and monitoring. A translocation brief has been prepared (Sunshine Diuris Recovery Team 2003) which includes guidelines for pre- and post-translocation site management to minimise loss of plants.

Responsibility: DSE Port Phillip Region, DSE Biodiversity & Natural Resources Division

Manage the translocated population at Laverton North Grassland Reserve

13. Monitor reintroduction efforts

Regular monitoring of the reintroduced Sunshine Diuris population at the Laverton site will take place four times a year for the duration of this Recovery Plan. Data will include number of Sunshine Diuris individuals, flowering and seed - set, plant dimensions, associated native and exotic species and disturbance. Trends in plant size, emergence and flowering will be reported.

Responsibility: Parks Victoria, DSE Port Phillip Region

14. Evaluate and review reintroduction effort

The reintroduction effort at LNGR will be reviewed on an annual basis to determine whether techniques have been successful or require further revision. Evaluation of techniques and census data will be analysed to determine the direction of future efforts.

Responsibility: Parks Victoria, DSE Port Phillip Region

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Further information can be obtained from Department of Sustainability and Environment Customer Service Centre on 136 186.

Flora and Fauna Guarantee Action Statements are available from the Department of Sustainability and Environment website: <http://www.dse.vic.gov.au>

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