SMALL SNAKE ORCHID MONITORING

Lake Wallace offset site

November 2020

Project Number: 20-779

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1. INTRODUCTION

This report presents the findings of population monitoring conducted for the Small Snake Orchid (*Diuris subalpina*) at Lake Wallace in November 2020. The report also consolidates the findings of earlier orchid monitoring conducted at the site between 2014 and 2019 (NGH Environmental 2015-2019).

The monitoring is located adjacent to the Lake Wallace reservoir, approximately 6 kilometres south of Nimmitabel, on land established as an offset site for the water supply dam project. The monitoring report has been prepared for Snowy Monaro Regional Council for submission to the NSW Department Planning, Industry and Environment (formerly Office of Environment and Heritage).

2. BACKGROUND

2.1. LAKE WALLACE PROJECT

Cooma Monaro Shire Council/Snowy Monaro Regional Council completed construction of the 320 megalitre Lake Wallace storage dam on Pigring Creek in mid-2016. The dam provides a town water supply to the nearby village of Nimmitabel.

The dam project required the clearing of native vegetation, including one NSW and one Commonwealth listed Threatened Ecological Community (TEC) (NGH Environmental 2013a). Two offset sites located adjacent to and upstream of the dam were established to compensate for the loss of TEC vegetation. Council is responsible for establishing, managing and monitoring the offset sites in accordance with the Lake Wallace Offset Management Plan (NGH Environmental 2014) and a Conservation Property Vegetation Plan.

The Lake Wallace offset site which surrounds the dam contains a colony of the Small Snake Orchid. The taxon was listed as threatened (as *Diuris pedunculata* sens lat) in NSW at the time of the dam proposal. As a condition of State Government approval for the dam, Council is required to protect and monitor the orchid colony during and following construction:

> **Condition 42**
>
> The colony of Small Snake Orchids identified in the SIS [Species Impact Statement] must be protected through all stages of the project, including temporary fencing during construction.
>
> The Site Environmental Officer must make personnel aware of the location and significance of the colony.
>
> The colony must be monitored during the flowering period each year from project approval until the dam has been constructed and operating for 5 years.
>
> Monitoring results must be provided to OEH within 2 months of the fieldwork. Monitoring must include the number of individuals present, photographs of the colony and an assessment of whether there have been any impacts to the colony.
>
> Any new Small Snake Orchid records at the site must be submitted to OEH and Bionet.

These requirements have been included in the Offset Management Plan. The plan also provides for vegetation condition monitoring at the establishment of the offset sites in 2014, subsequent monitoring after one year (2015), and then every two years until 2025. The orchid and vegetation condition monitoring are to be conducted in mid-November.

2.2. SMALL SNAKE ORCHID

2.2.1. Conservation status and taxonomy

The Small Snake Orchid taxon present at the Lake Wallace site was originally included in the Commonwealth threatened species listing but has been removed following revision of the species. The revision splits *Diuris pedunculata* into the new species *D. subalpina* (found in southeast NSW, ACT and north-east Victoria) and *Diuris pedunculata* which is confined to the New England area of NSW (Jones 2008 in DSEWPAC 2012). The revision has been accepted by the NSW Herbarium.

At the time of project approval, southern *D. subalpina* had been excluded from the Commonwealth listing but the NSW Scientific Committee had not recognised the revision, and the southern taxon remained part of the NSW listing for *D. pedunculata* (A. Treweek OEH pers comm 24 May 2013). The NSW Scientific Committee has since advised that the taxon is now considered to be different to the listed species and is not covered by the NSW *Diuris pedunculata* listing (Dr Mark Eldridge, Chairperson, NSW Scientific Committee pers comm 30 June 2017).

2.2.2. Ecology and habitat

The Small Snake Orchid (*Diuris subalpina*) is a tuberous geophyte inhabiting grassy slopes or flats, often on peaty soils in moist areas, on shale and fine granite, and among boulders. The life cycle typically involves the seasonal emergence of a leaf and flower stem, and the annual renewal of an underground tuber.

The flowering period of the species is stated to be between August and October (Jones 1999, pers. comm in DSEWPAC 2012), although it has been recorded flowering in mid-November in the study area, and at Adaminaby in similar habitat at 1180m ASL (NGH Environmental 2003). Pollination is by sexual deception, with the Small Snake-orchid attracting mostly males of the insect *Halictus lanuginosus*, even though the plants produce nectar and emit a strong scent that usually attracts numerous pollinators (Jersáková et al. 2006 in DSEWPAC 2012). The flowers of some *Diuris* species are believed to mimic native pea flowers to attract pollinators (for example *D. maculata* and *D. aequalis*). Members of the Snake Orchid group most likely mimic yellow lilies such as *Hypoxis* and *Bulbine* species (Bishop 2000).

In the Southern Highlands, the Small Snake Orchid has been recorded at numerous locations including Perisher, Bredbo, Adaminaby, Countegany, Packers Swamp and the ACT.

Figure 2-1 Small Snake Orchid at the offset site

Figure 2-2 Orchid habitat at the Lake Wallace offset site

2.2.3. Lake Wallace orchid colony

The Small Snake Orchid was recorded at the Lake Wallace site as a single colony comprising 15 flowering plants on 15-17 November 2010 (Eco Logical Australia 2011). The colony occurs on a gentle southwest-facing lower slope in woodland dominated by Black Sallee (*Eucalyptus stellulata*) with Snow Gum (*E. pauciflora*). The groundlayer is dominated by the grasses Weeping Grass (*Microlaena stipoides*), Snow Grass (*Poa sieberiana*) and the exotic Sweet Vernal Grass (**Anthoxanthum odoratum*). The groundlayer is relatively diverse, including *Ajuga australis, Asperula scoparia, Craspedia canens, Euchiton japonicus, Haloragis heterophylla, Hypericum gramineum, Leptorhynchos squamatus, Oreomyrrhis eriopoda, Plantago varia, Ranunculus lappaceus, Solenogyne gunnii* and *Viola betonicifolia,* with exotic forbs *Hypochaeris radicata* and *Trifolium* species. Scattered shrubs include *Leptospermum myrtifolia* and *Pimelea curviflora*. The composition and condition of vegetation adjacent to the orchid colony has been documented in the monitoring data collected for the offset monitoring site SW1.

Consistent with the project approval conditions, a fence around the orchid colony was constructed in late 2014, applying a 10 metre buffer around the colony visible in November 2014. A permanent fence with wire mesh, rather than a temporary fence, was constructed because of the threat posed by wild pigs, evidenced by diggings close to the orchid colony. In 2020, a farm gate was installed in the exclosure fence to allow large herbivores to control grass biomass.

The cessation of grazing at the Lake Wallace site, and the exclosure fence, have potential to affect the colony indirectly by reducing grazing and grass biomass removal. In some cases, rare species have been observed to decline following the cessation of stock grazing (e.g. Scarlett and Parsons 1982 and 1990, Cropper 1993, Morgan 1995 in Lunt 2005), which has been attributed to competition from the dominant grasses. However, past research suggests that most geophytes, such as terrestrial orchids, decline when grazed and recover when fenced (Dorrough 2012).

Figure 2-3 New gate installed in the orchid exclosure fence in 2020, allowing controlled access to wild herbivores.

Figure 2-4 Pigs remain a threat at the site; recent pig damage near the exclosure gate in 2020.

3. METHODS

3.1. COLONY CENSUS

Search transects 2 metres wide were used to search for and census flowering Small Snake Orchid plants. The search covered the fenced area and a radius of approximately 20 metres surrounding the fence. The number of individual plants and each plant's reproductive status (bud, flowering or spent) were recorded. Non-flowering plants have not been included in the survey because of difficulty finding and reliably identifying orchid leaves within the grass sward. Incidental observations regarding associated species, habitat, area of occupancy and any impacts or threats to the colony were also made and updated as required.

3.2. GROUNDCOVER AND GRASS HEIGHT SURVEY

Annual groundcover monitoring using the quantitative and repeatable step point method was introduced for the 2016 survey. A line transect was run between the south-east and north-west corner posts of the fenced plot. 54 points were sampled at 0.5 metre intervals, starting from the 1 metre point at the south-east corner and ending at 27.5 metres at the north-west corner. Live cover recording categories included native tree, native shrub, native grass, native herb (other), exotic grass and exotic herb (other). Dominant native grass species were also noted.

The additional measurement of grass height was commenced in the 2017 survey. At five metre intervals along the groundcover transect, the prevailing grass height (excluding flowering stems) was measured using a ruler. The recorded heights were averaged to provide a broad indication of overall groundlayer biomass.

3.3. PHOTOGRAPHS

Photographs were taken in and around the orchid colony, including comparative shots of groundcover inside and outside the orchid fence.

4. MONITORING RESULTS

4.1. SURVEY TIMING, EFFORT AND CONDITIONS

Survey timing, effort and conditions for the five monitoring years are summarised in Table 4-1 below. The increased effort from 2016 is due to the addition of the groundcover and grass height monitoring.

Table 4-1 Survey timing, effort and conditions in 2014-2020

	2014	2015	2016	2017
Date	18 November	17 November	9 November	14 November
Start	8.30 am	9.30 am	1.00 pm	9.15 am
Weather	Warm, sunny, light winds	Warm, sunny, light winds	Mild, calm, partly cloudy	Mild, calm, partly cloudy
Effort	0.75 person hrs	0.5 person hrs	1 person hr	1 person hr

	2018	2019	2020
Date	16 November	11 November	4 November
Start	11.30 am	1.44 pm	12.30 pm
Weather	Mild, calm, partly cloudy	Warm, sunny, light winds	Warm, calm, partly cloudy
Effort	1.25 person hrs	1.25 person hrs	1.25 person hours

4.2. POPULATION SIZE AND REPRODUCTIVE STATUS

The population size and reproductive status of the colony recorded in the six survey years are summarised in Table 4-2.

Eco Logical Australia (2011) recorded 15 flowering plants at the site in 15-17 November 2010. The total number of flowering or fruiting plants recorded in the colony during the monitoring surveys was 9 in 2014, 17 in 2015, 26 in 2016, 8 in 2017, 0 in 2018 and 3 in 2019. No plants were recorded outside the exclosure fence in 2015, 13 were recorded outside the fence in 2016, 1 was recorded outside the fence in 2017, 0 in 2018 and 3 plants were recorded outside the fence in 2019. The 3 flowering plants recorded outside the fence in 2019 were at 706802 5951018, approximately 7 metres south of the south-east corner of the fence (Figure 4-2).

In 2020, 1 flowering plant was recorded inside the fence, 1 metre from the central western fenceline, at 706783 5951034). Outside the fence, 2 flowering orchids were recorded in the same place as plants were recorded in 2019, 2.5 metres and 4 metres from the south-eastern fence section, at 706800 591022 and 706798 5951022.

Table 4-2 Population size and age structure of the Small Snake Orchid colony (2014 - 2020)

	Bud	Flowering	Spent flowers	Fruit	Split capsules	Total
2014						
No. plants	0	8	1	0	0	9
Total	0	8	1	0	0	9
% visible colony	0	88.9	11.1	0	0	100
2015						
No. plants (all inside fence)	0	14	3	0	0	17
Total	0	14	3	0	0	17
% visible colony	0	82.4	17.6	0	0	100
2016						
No. plants - inside fence	1	12	0	0	0	13
No. plants - outside fence	1	12	0	0	0	13
Total	2	24	0	0	0	26
% visible colony	7.7	92.3	0	0	0	100
2017						
No. plants - inside fence	0	7	0	0	0	7
No. plants - outside fence	0	1	0	0	0	1
Total	0	8	0	0	0	8
% visible colony	0	100	0	0	0	100
2018						

	Bud	Flowering	Spent flowers	Fruit	Split capsules	Total
No. plants - inside fence	0	0	0	0	0	0
No. plants - outside fence	0	0	0	0	0	0
Total	0	0	0	0	0	0
% visible colony	-	-	-	-	-	-
2019						
No. plants - inside fence	0	0	0	0	0	0
No. plants - outside fence	0	3	0	0	0	3
Total	0	3	0	0	0	3
% visible colony	-	100	-	-	-	100
2020						
No. plants - inside fence	0	1	0	0	0	1
No. plants - outside fence	0	2	0	0	0	2
Total	0	3	0	0	0	3
% visible colony	-	100	-	-	-	100

4.3. AREA OF OCCUPANCY

Eco Logical Australia (2011) recorded an area of occupancy for the orchid of approximately 150 metres^2. The visible colony in 2014 occupied a reduced area approximately 6 metres x 3 metres, centred on 706786 5951036. This area was extended during the 2015 survey with the recording of additional plants in the north-west corner of the fenced area. No plants were recorded outside the fenced area in 2015.

In 2016, the area of occupancy of the colony was observed to cover the central, northern and western (lower) parts of the fenced area (13 plants). Additional plants (13) were recorded outside the fence, up to 6 metres from the north-west corner and western fenceline. A single plant was recorded 2 metres to the south of the fenced area. The visible area of occupancy for the orchid at the site in 2016 was approximately 160 m^2.

In 2017 the 7 records within the exclusion fence were confined to approximately 20 m^2 in the central west of the area, and a single plant was recorded outside the fence, 9 metres south of the SE corner. No plants were recorded in 2018, inside or outside the fence. No plants were recorded inside the fence in 2019; 3 plants were recorded outside the fence, in a group approximately 7 metres south of the south-east corner post, at 706802 5951018, occupying around 4 m^2. The flowering plants recorded outside the fence in 2020 occupied a similar area to the plants recorded in 2019. A single plant was recorded inside the fence in 2020, near the western edge of the plot.

4.4. GROUNDCOVER

The results of the 2016 - 2020 groundcover transect surveys are summarised in Table 4-3.

During the 2015 survey, the favourable season had resulted in abundant flowering of the exotic perennial Sweet Vernal Grass (**Anthoxanthum odoratum*), estimated to be 15-20% foliage cover. Grass height within the orchid habitat was 10-12 cm, and live Sweet Vernal Grass inflorescences were 30-50cm high. Sweet Vernal Grass was abundant both inside and outside the then-new orchid fence, reflecting the favourable growing season.

In 2016, Sweet Vernal Grass inflorescences were not as prevalent. The fenced area had a high density of old inflorescence stems of the later-flowering native Weeping Grass, indicating a prolific 2015/2016 summer following construction of the fence (refer Figures 4-1 to 4-4). Native grasses (Weeping Grass - *Microlaena stipoides* and Snow Grass - *Poa sieberiana*) made up 63% of the cover. Exotic grasses represented 18.5% of the cover (predominantly Sweet Vernal Grass). Grass height within the fence was around 10 centimetres (excluding Sweet Vernal Grass inflorescence stems).

By 2017, both native grass and exotic grass cover had reduced, and litter cover had tripled. Native grasses were 44.4% of the cover. In terms of grass composition, Snow Grass constituted 56.6%, Sweet Vernal Grass was 20% and Kangaroo Grass made up 16.6% of all grass records. Grass height averaged 12 centimetres. The change was likely the result of the preceding dry period, and the tendency for the Snow Grass sward to thicken and exclude other plants.

Figure 4-1 Grass cover inside (right) and outside the orchid exclosure fence

Figure 4-2 Orchid habitat outside the exclosure in 2020

Figure 4-3 Reduced grass biomass and increased forb cover inside the exclosure fence in 2020

Figure 4-4 Orchid plant recorded inside the exclosure in 2020

In 2019, native grass and forb cover remained relatively constant, but exotic grass cover (principally Sweet Vernal Grass) had declined substantially. This may have been the result of the prolonged dry growing conditions preceding the survey. Average grass height had also declined, reflecting the drought and the ageing native grass sward. Recorded litter cover had increased slightly.

A farm gate was installed in the exclosure fence in 2020, allowing grazing and browsing by wild herbivores to control grass biomass. The 2020 monitoring indicated further reduced grass height and density, despite the wet

growing season. A wide range of native forbs, including *Geranium antrorsum, Hydrocotyle laxiflora* and *Solenogyne gunnii*, had increased in cover and abundance.

Table 4-3 Groundcover transect survey results 2016 - 2020

Stratum	Percent cover				
	2016	2017	2018	2019	2020
Native trees/shrubs (<1m)	0	1.8	0	1.8	0
Native grasses	63.0	44.4	64.8	62.9	44.4
Native herb (other)	7.4	12.9	3.7	7.4	22.2
Exotic grass	18.5	11.1	11.1	1.8	7.4
Exotic herb (other)	1.8	0	0	0	0
Litter	9.3	27.7	22.2	25.9	24.1
Rock (E- embedded, S – surface)	0	0	0	0	0
Bare ground	0	0	0	0	1.8
Total native (%)	**70.4**	**60.9**	**68.5**	**72.2**	**66.6**
Proportion of cover native (%)	**77.6**	**84.6**	**88.1**	**97.5**	**90**
Average grass height	-	12 cm	9.4 cm	7.8 cm	5.4 cm

4.5. IMPACTS AND THREATS

The pig-proof fence has addressed a significant threat to the orchid colony. Pigs remain a potential threat at the site however, and recent diggings were observed close to the exclosure gate during the 2020 survey.

The fence itself introduces a potential threat to the Small Snake Orchid from increased competition and crowding from grasses caused by reduced herbivory. As indicated in earlier surveys, this has been manifested by a thick mat of grass tussocks and litter in the exclosure. The installation of a gate in the fence to allow wild herbivory appears to have resulted in reduced grass height and density. A visual comparison of grass growth inside and outside the exclosure is shown in Figure 4-1. A low remnant layer of dead grass litter persists in the inter-tussock spaces at the site, which is likely to break down over time, subject to moisture availability (see Figure 4-3).

The flowering of terrestrial orchids can be spatially and temporally variable between years. Terrestrial orchids are known to miss flowering seasons during unfavourable conditions, but multi-seasonal dormancy has been linked with mortality in some species (for example, Coates *et al.* 2006). The sharp decline in orchid flowering at the site may be due to the combined impact of drought and excessive grass biomass affecting the core of the colony inside the exclosure fence.

Snow Grass and Kangaroo Grass needs some form of biomass control outside the orchid flowering and seeding period. Biomass control can be achieved by:

- slashing, raking and removal of cuttings
- small-scale ecological burning
- opening the exclosure gate to grazing and browsing by wild herbivores.

Changes in fire frequency will have implications for grass composition. *Poa* species recover more slowly after fire and tend to gradually replace Kangaroo Grass in moister grassland sites in the absence of fire (Prober *et al.* 2007). This is likely to be beneficial for inter-tussock herbs (Prober and Lunt 2008), including the Small Snake Orchid.

Disturbance by burning has also been documented as a trigger which promotes flowering and presumably interrupts dormancy in orchids (Collier and Garnett 2013, Jones *et al.* 1999).

The Early Snake Orchid (*Diuris chryseopsis*) has been observed to have a 6 week flowering period and a 6 week fruiting and seed release period on the Far South Coast (author pers obs). Applying conservative pre-flowering and fruiting/seeding buffers, biomass could be reduced by slashing or burning during the period April - June or opening the exclosure gate to allow wild grazing for the period February - June.

The installation of the gate provides a mechanism to control access of large herbivores within the orchid habitat. Any seasonal opening of the exclosure gate would need to be undertaken in association with regular monitoring and timely closure if nearby pig activity is detected.

The opening of the gate also appears to have resulted in control of eucalypt sapling growth. Increased tree cover and competition would negatively impact the orchid colony over time. Saplings within the exclosure should be monitored and removed if they are seen to be proliferating. The gate further seems to have been effective at controlling Sweet Vernal Grass. This is a fast-growing, shade-tolerant, copes well with nutrient-poor (especially low phosphorous) soils, produces allelopathic chemicals and large quantities of seed, and has a flowering period coinciding with the Small Snake Orchid. The species is still present in the exclosure and will also need to be monitored closely.

5. CONCLUSIONS AND RECOMMENDATIONS

Monitoring in 2020 indicates that weed cover is relatively low at the site, and grass biomass has decreased markedly. Recorded orchid numbers remain low, although the population continues to persist inside and outside the fence. The installation of the gate in the exclosure fence appears to have been effective at reducing grass biomass, reflected in reduced grass height and increased native forb cover.

It is recommended that the exclosure gate be opened each year during the Small Snake Orchid dormant period of February – June to allow wild herbivores to control grass biomass. The gate should not be opened if recent pig activity is apparent within the exclosure paddock.

The gate should be closed during the orchid reproductive period of July-January.

Browsed eucalypt saplings remain present within the exclosure. If wild browsing does not control the growth of these saplings, they will require management intervention to avoid impacts to the orchid colony from increased shade and competition for water and nutrients.

If periodic browsing is not able to restrict the growth of eucalypt saplings within the Small Snake Orchid exclosure, the saplings should be removed using careful cut stump glyphosate application.

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