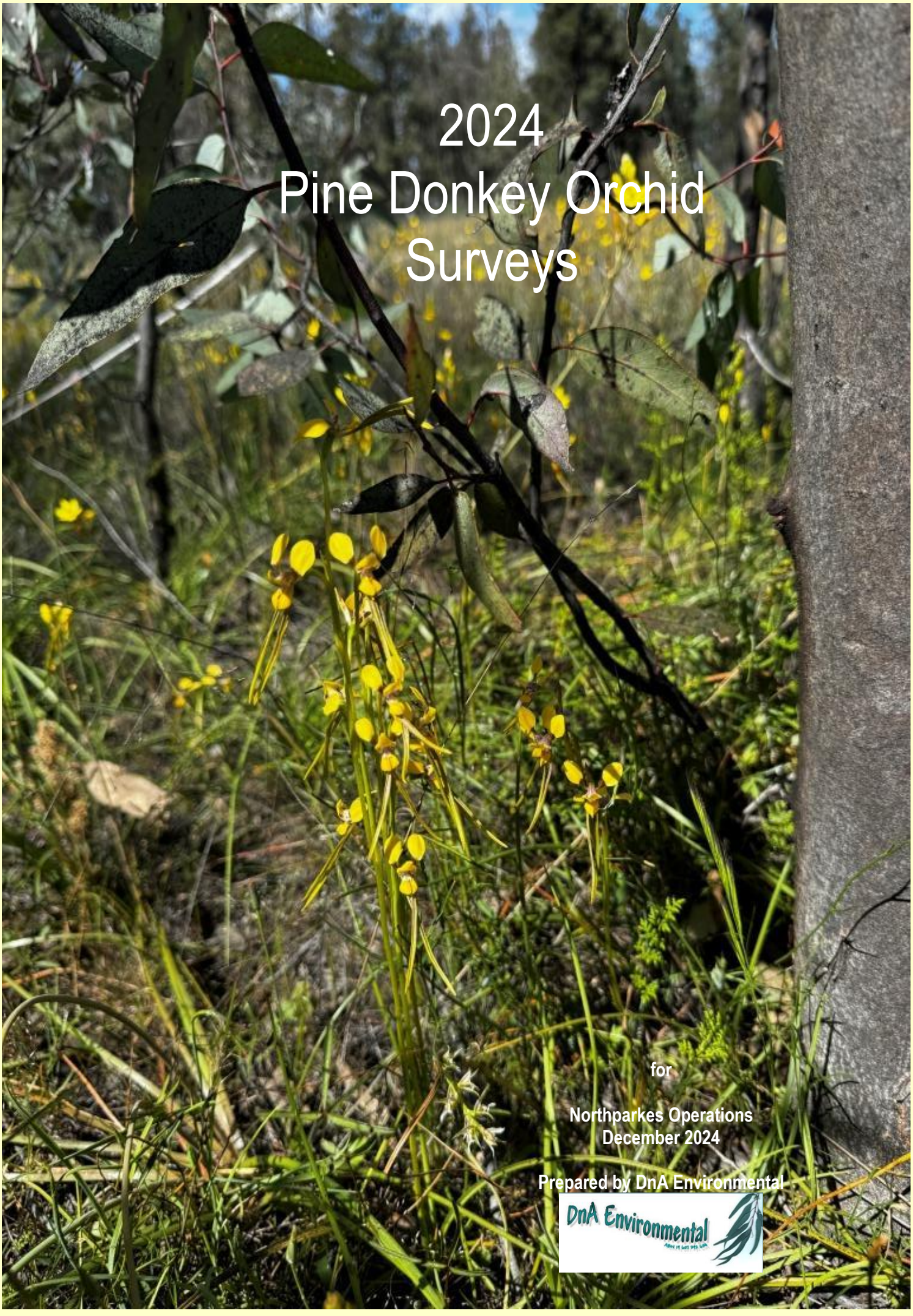
2024 Pine Donkey Orchid Surveys



for

Northparkes Operations
December 2024

Prepared by DnA Environmental

Disclaimer

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Acknowledgements

Field work and associated reports were previously undertaken by Dr Donna Johnston and Andrew Johnston from DnA Environmental. Since 2021, field surveys have been undertaken by Andrew Johnston (DnA Environmental) and Ray Mjadwesch (Mjadwesch Environmental Service Support). Reports continue to be prepared by Dr Donna Johnston and Andrew Johnston.

Executive summary

Ecological surveys undertaken at Northparkes Operations identified *Diuris tricolor* (Pine Donkey Orchid; PDOs), a threatened terrestrial herb species listed as vulnerable under the *Biodiversity Conservation Act 2016* on the mine site in 2011/2012. As part of approval conditions associated with the Northparkes Operations Extension Project, ongoing surveys and management of the Pine Donkey Orchid populations has since been required.

Targeted surveys and assessments of ground cover in two known populations of PDOs have been undertaken in spring since 2014. This report provides the results of these surveys to comply with approval conditions, as well as to fulfil the requirements outlined in the Northparkes Biodiversity Offset Management Plan (BOMP) and Species Management Plan for the PDO.

Since monitoring began, rainfall has been variable with drought conditions during 2017 – 2019, followed by several years of unprecedented rainfall causing widespread flooding across the state during 2020 – 2022. In 2023, particularly dry conditions returned and rainfall was limited from April to October, while this year, above average rainfall occurred throughout most of the year.

These extreme seasonal conditions experienced over the past ten years has had a significant influence on the diversity, abundance and composition of the monitoring sites and on orchid population densities. These have also been compounded by increased levels of browsing and disturbances by resident macropod populations, especially under the shelter of the tree canopies during extended dry periods.

Population densities of *Diuris tricolor* have been the lowest when rainfall was limited prior to and during the emergence period (August – September) and especially in 2019 at the height of the drought. Population densities were initially highest during 2016 and then 2020 - 2022 and 2024, which had above average rainfall throughout most of year. Subsequently the density in the orchid populations have been variable, with overall populations having increased from 199 since monitoring began in 2014. Highest population counts of 3063 were recorded this year, with high densities being recorded at both survey locations.

Scattered *Callitris glaucophylla* (White Cypress Pine) and *Eucalyptus dwyeri* (Dwyer's Red Gum) seedlings occurred throughout the LF population. A selective removal program targeting *Callitris* regeneration was undertaken in 2018. There continues to be *E. dwyeri* saplings, with additional *E. dwyeri* regeneration occurring in the LF area. At Adavale Lane, patches of *Callitris glaucophylla* regeneration was occurring.

Since 2020, there have been high levels of ground cover at both population sites, being typically comprised of perennial ground covers, dead leaf litter and scattered annual plants. There has been an increase in species diversity at both locations, however this also included an increase in exotic species diversity. These favourable seasonal conditions also promoted the growth and abundance of PDOs and a range of other native species with similar habitat traits such as *Arthropodium fimbriatum [Dichopogon fimbriatus]* (Nodding Chocolate Lily), *Bulbine bulbosa* (Bulbine Lily) and *Prasophyllum campestre* (Inland Leek Orchid). Above average rainfall however, also resulted in increased diversity and abundance of weeds and made observing small orchids amongst tall and dense vegetative growth difficult, especially in 2020 when weed growth was prolific.

This year, favourable conditions continued to support a combination of native and exotic plants. In the Limestone Forest, native plants provided 61 – 70% of the live plant cover, while in Adavale Lane there was 40 – 62% native plant cover.

There continued to be a range of common exotic species in both survey locations, with many species having become widely naturalised throughout the surrounding agricultural areas. More undesirable weeds were in limited abundance compared to previous years and were largely restricted to small pockets of higher disturbance such as old stockcamps and/or areas where kangaroos frequently camp.

Swainsona sericea is listed under the NSW Biodiversity Conservation Act as a vulnerable species and has been recorded in the Limestone Forest exclusion site. Since 2020 a small population of *Prasophyllum campestre,* another orchid species of interest has also been recorded.

Conclusion

Population densities of PDO's, ground cover abundance and floristic diversity at LF and AL survey areas appear to be inherently implicated with the changes in seasonal conditions. These were also compounded with changes in disturbance and grazing pressure by resident macropods especially during drought in 2019. The exclusion fence constructed in 2020 has reduced this disturbance in the LF population. The AL orchid populations continue to be subjected to some level of macropod grazing, however currently there appears to be minimal impact. The unfenced roadside verges may also be periodically impacted by travelling stock, however impacts from livestock grazing have not been observed since 2019.

Population densities of PDOs have been the lowest when rainfall was limited prior to and during the emergence period, with no orchids recorded at all during the height of the drought in 2019. Densities of orchids have overall increased from 199 individuals since monitoring began in 2014 to 3063 individuals being recorded this year, with high densities being recorded at both survey locations.

The level of undesirable weeds has significantly declined since 2020. Despite the persistence of many naturalised exotic species there has been an increasing abundance of PDO's suggesting there is limited impact or effects from competition given the current distribution, diversity and density of weeds. No further management of weeds or tree regeneration is considered necessary at this time.

Ongoing monitoring and observation for potential management of woody weeds, biomass, exotic species competition and vertebrate pest management (as per current BOMP requirements) is required. *Swainsona sericea* and *Prasophyllum campestre* and the range of other native woodland species that coexist in the LF and AL conservation areas will also benefit from strategic management requirements that may be implemented.

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1 Introduction: 2024 Pine Donkey Orchid surveys

The Northparkes Operations is located in central western New South Wales (NSW) approximately 27 kilometres north north-west of the town of Parkes. It is a joint venture between Evolution Mining (80%) and the Sumitomo Group (20%), with Evolution Mining (Northparkes) Pty Limited as managers of the mine. Northparkes produces ore from the mine at a rate of approximately 6.5 – 7.5 million tonnes per annum. Northparkes consists of underground operations accessing several copper sulphide porphyry ore bodies. In addition, Northparkes farms the majority of its 6,115 ha landholding, including ~ 2,456 ha of land within three existing mining leases.

1.1 Project Background

The Northparkes Operations Extension Project (formerly known as the Northparkes Mines Step Change Project) (the Project) was approved with conditions under the *Environmental Planning and Assessment Act 1979* (NSW) DC11_0060) and the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia) EPBC 2013/6788) in 2014. Key elements of the Project included:

- continued underground block cave mining in two existing ore bodies;
- the development of an additional underground block cave mine, under one of the existing open cut pits:
- additional campaign open cut mining in existing mine leases;
- augmenting approved Tailings Storage Facilities (TSF's);
- moving the existing access road;
- construction of the new TSF (Rosedale): and
- extending the life of the mine by seven years to 2032.

1.2 Scope and purpose

Ecological surveys undertaken in 2011 and 2012 as part of the Environmental Assessment for the Project identified the pine donkey orchid (*Diuris tricolor*) (PDO), a threatened terrestrial herb species listed as vulnerable under the Biodiversity Conservation Act 2016, on the mine site. In response to comments from the Office of Environment and Heritage (OEH), conditions relating directly to the management of the PDO populations are included in the Development Consent conditions for the Project (DC11_0060) as outlined in Table 1-1.

As per the condition, Northparkes has produced a Biodiversity Management Plan (referred to the as Biodiversity Offset Management Plan (BOMP: CMOC 2014)) for the project. A Species Management Plan (CMOC 2015a) for the PDOs was also produced to specifically manage potential impacts on the populations of this species at Northparkes.

Targeted surveys of the two known populations at Limestone Forest (LF) E48 subsidence zone and Adavale Lane (AL) have been undertaken in spring since 2014 to comply with these conditions, with the annual reports presenting the results of these surveys.

Table 1-1. Development Consent conditions relating to the management of the pine donkey orchid

Schedule	Condition number	Condition
3	24	The Proponent shall actively manage and main the populations of Pine Donkey Orchid located to the north of the project area (near Adavale Lane) and near the E48 subsidence zone.
3	29	The Proponent shall prepare and implement a Biodiversity Management Plan for the project to the satisfaction of the Secretary. This plan must: (d) Include a detailed description of the measures that would be implemented for: - Managing and maintaining the populations of Pine Donkey Orchid located to the north of the project area (near Adavale Lane) and near the E48 subsidence zone.

Figure 1-1. *Diuris tricolor* (Pine Donkey Orchid).

1.3 Survey teams

Surveys for the Environmental Assessment undertaken in 2013 in 2014 were completed by Umwelt. In 2016 (CMOC 2016), surveys were undertaken by Vivien Howard (MEnvPl, BSc) from Niche Environment and Heritage and Roisin Feeney (Northparkes Environment Advisor- Ecology (MSc, BSc (Hons1), BA)).

In 2015 (CMOC 2015b) and 2017 – 2020, field surveys as described in this report were undertaken Dr Donna Johnston (PhD, BAppSc (Hons), MEIANZ) and Andrew Johnston (BAppSc), DnA Environmental senior ecologists. In 2015 field assistance was provided by Roisin Feeney (Northparkes Environment Advisor- Ecology (MSc, BSc (Hons 1), BA).

In 2018, additional field assistance was provided by Michael Thomas, Nathan Jones and Donna Shaw (Northparkes Environmental Department). In 2019 additional field assistance was again provided by Michael Thomas.

Since 2021, field surveys have been undertaken by Andrew Johnston (DnA Environmental) and Ray Mjadwesch (BAppSc; MEIANZ) of Mjadwesch Environmental Service Support, while reports continue to be undertaken by Dr Donna Johnston and Andrew Johnston (DnA Environmental).

1.4 Survey timing

The specific dates the PDO surveys were undertaken are provided in Table 1-2. In 2014 and 2015, many of the orchids had withered due to the later timing and onset of hot dry conditions, resulting in most, if not all, individuals having lost their petals and were withered right back. This made identifying individuals difficult, particularly in Adavale Land (AL) where there was a higher ground cover abundance of other species which obscured vision.

Since 2016, the Pine Donkey Orchid surveys have been undertaken much earlier in the month to better coincide with the flowering season of this species. PDO populations are regularly monitored by NPO staff for flowering individuals from late September to early October to further refine survey periods and optimise detection of PDO and PDO counts.

Table 1-2. Dates PDO surveys have been undertaken.

Year	Ecologists	Date
2013	Umwelt	25 - 26th September
2014	Umwelt	11th and 14th November,
2015	DnA Environmental	20 - 21st October
2016	Niche Environment	4 - 5th October
2017	DnA Environmental	4 - 5th October
2018	DnA Environmental	2 – 3rd October
2019	DnA Environmental	10th October
2020	DnA Environmental	24 – 25th and 28th September
2021	DnA Environmental	28 – 29th September and 5th October.
2022	DnA Environmental	2 - 4th October
2023	DnA Environmental	2 – 3rd October
2024	DnA Environmental	30th Sept - 2nd October

2 Methodology

PDO surveys have been undertaken in the two known locations including the E48 subsidence zone near Limestone Forest (LF) and Adavale lane (AL). Since 2015 provisions were also made for the inclusion of species composition and cover abundance data in order to fulfil monitoring requirements according to the most recent revision of the Biodiversity Offset Management Plan (BOMP, Umwelt 2014). Monitoring requirements specified within the BOMP included:

- **Annual orchid monitoring during flowering period:** Annual seasonal monitoring during the flowering period (September to October) to assess the ongoing status of the population will be undertaken. The location of all individuals are to be recorded using a handheld GPS and a total count is to be provided for each population.
- **Ground cover monitoring:** Monitoring of ground cover abundance and flora species composition using permanent five × five metre floristic plots will be undertaken. Three five × five metre floristic plots will be established at the Adavale Lane population and another three at the E48 population. The plots will be positioned to measure the species composition and cover abundance of ground covers in the population areas.
- **Weed monitoring:** Weed monitoring via walking meandering transects through both populations, and where required weed control. All weed control actions will be undertaken outside the flowering period of the species.
- **Annual fence inspections**

2.1 Orchid population distribution

Individual orchids occurring within the LF population were located using 5m wide stratified and systematic bands within the fenced exclusion area using 50m measuring tapes to delineate these bands where possible. At AL, transects were increased to 10 – 15m transects, until patches of PDOs were detected.

Transects were slowly traversed and when individuals were located, coloured marker flags were inserted adjacent to each individual (Figure 2-1). At every individual orchid, or sometimes a group of orchids, GPS recordings were taken with each being recorded onto a log sheet. When more than one individual occurred within a 1m radius, GPS coordinates recorded them as a group. These data were recorded and uploaded to create a spreadsheet and location map of individuals occurring in each population.

Since 2020, an expanded search outside the exclusion fences has also been undertaken outside the exclusion fence at LF and AL populations. The method of systematically traversing the population areas in 5m bands was undertaken and focussed on the less weedy open clearings areas and preferred habitat. In 2023, search areas at E48 were also tracked using GPS.

Figure 2-1. Transects were used and individual orchids and/or clumps were marked with marker flags.

2.2 Permanent ground cover monitoring quadrats

Three 5 x 5m permanent monitoring quadrats were also first established within each of the two known populations at LF and AL in 2015. The monitoring plot was aligned in a northerly direction with the vegetation transect situated on the western side of the quadrat. Marker pegs were established in each corner so that they can be readily re-established at each annual monitoring event. The monitoring methodology was adapted from the Biometric Manual 3.1 (DECCW 2011). Within each of the 5 x 5m quadrats, the floristic diversity and cover abundance of individual species using Braun-Blanquet methodology occurring within five (5) replicated 1 x 1 m subplots undertaken along a permanent vegetation transect. Total floristic diversity was also recorded by searching systematically in increasing sized sub-plots, these being 1x1, 1x2, 2x2 and 5x5m areas. Ground cover monitoring data sheets are provided in previous PDO monitoring reports, including DnA Environmental (2019).

A map showing the locations and monitoring quadrats of the two PDO populations is given in Figure 2-2. GPS coordinates of LF and AL orchid monitoring quadrats are provided in Table 2-1. These monitoring plots were established in areas where the PDO were recorded by Umwelt in 2014, however due to the hot dry conditions in 2015 when permanent quadrats were first established, not all sites may have contained PDO individuals.

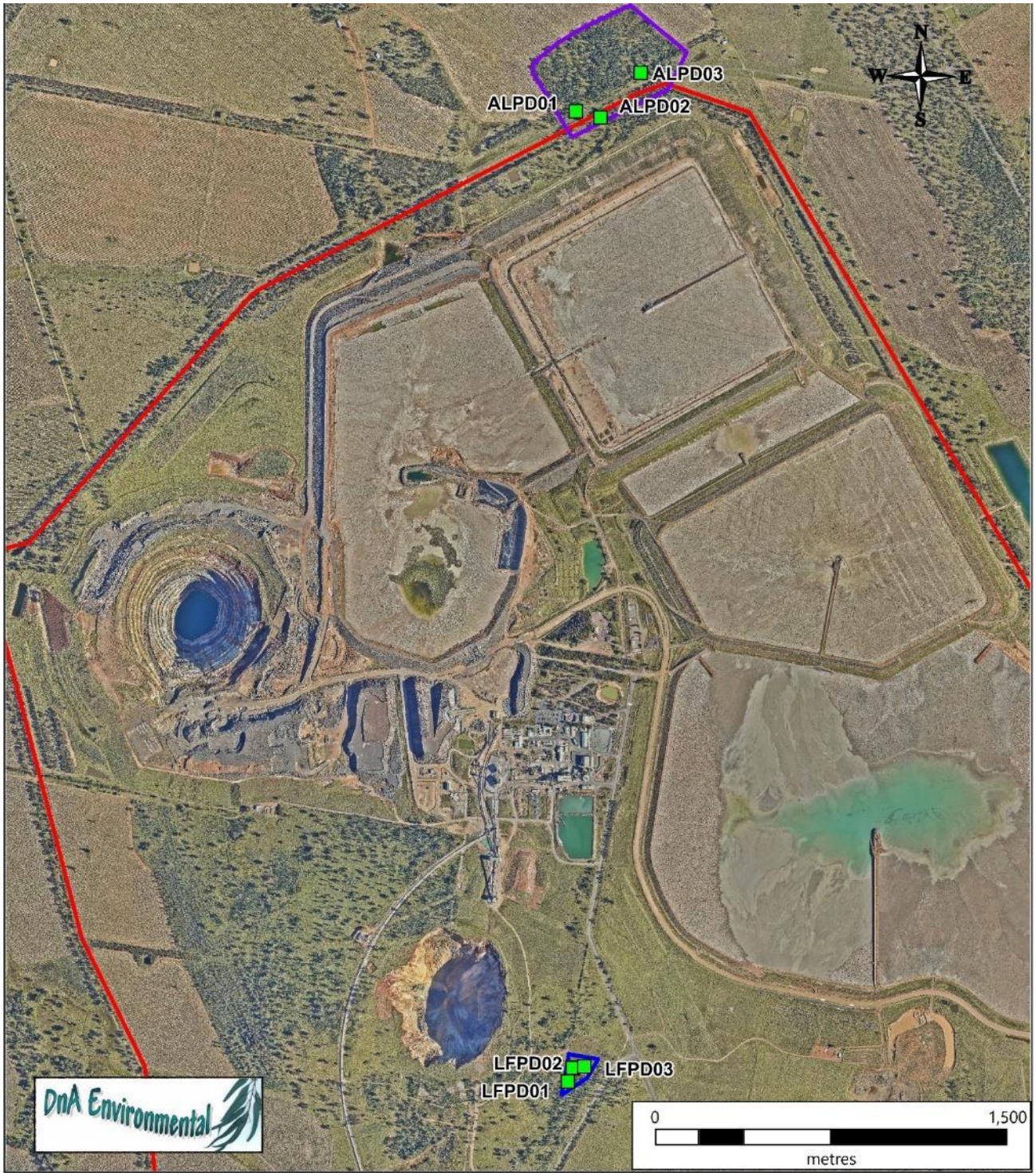


Figure 2-2. Map showing the locations and monitoring quadrats in the two PDO populations.

Table 2-1. GPS coordinates of the LF and AL PDO monitoring quadrats.

Site	Start Easting	Start Northing	End Easting	End Northing
LFPDO1	55 598592	6356209	55 598593	6356212
LFPDO2	55 598613	6356266	55 598613	6356271
LFPDO3	55 598661	6356273	55 598663	6356280
ALPDO1	55 598625	6360341	55 598629	6360341
ALPDO2	55 598730	6360314	55 598735	6360317
ALPDO3	55 598903	6360505	55 598910	6360506

3 Results

3.1 Rainfall

The long-term average annual rainfall recorded at Parkes Airport is 616mm (BoM 2024), however there have been extreme seasonal conditions and high variability in annual rainfall since these surveys commenced (Figure 3-1). Annual rainfall was well below average in 2015 while in 2010 and 2016, there was above average annual rainfall of 1026mm and 772mm which caused widespread flooding. This was followed by three consecutive years of extremely dry conditions during 2017 - 2019, with these being the worst drought years on record. Since 2020, improved rainfall conditions have occurred with several extreme and unprecedented flood events occurring across the state, with totals of 741- 1008mm for three consecutive years during 2020 – 2022.

Dry conditions were experienced from February to October in 2023, while above average rainfall occurred from November to January 2024. Since then, monthly rainfall has been variable, however relatively good rainfall was recorded April through to August this year. Despite limited rainfall in March and September, rainfall recorded to the end of October this year was slightly above average with 584 mm, compared to an expected average of 497 mm for the same yearly period (Figure 3-2).

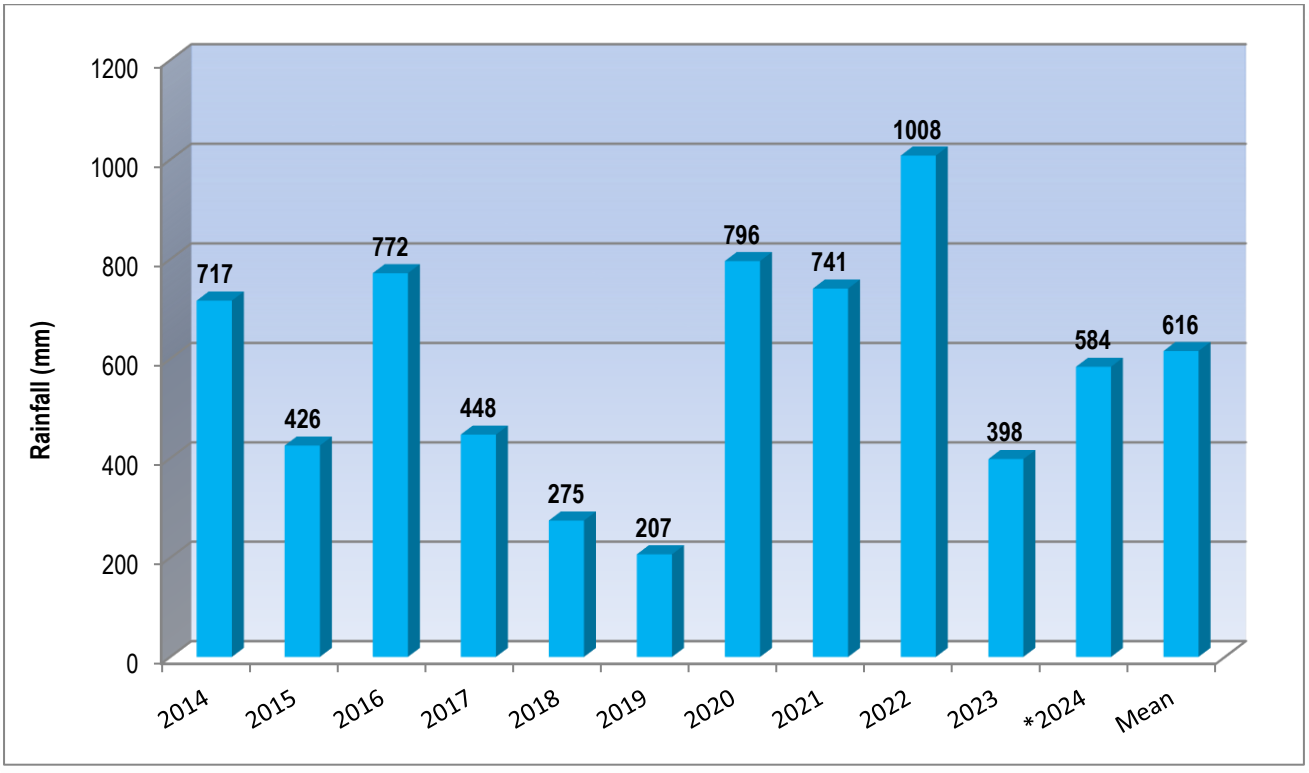


Figure 3-1. Total annual rainfall recorded at NPO January 2014 to the end of October 2024 compared to the long-term averages recorded at Parkes Airport) (BoM 2024).

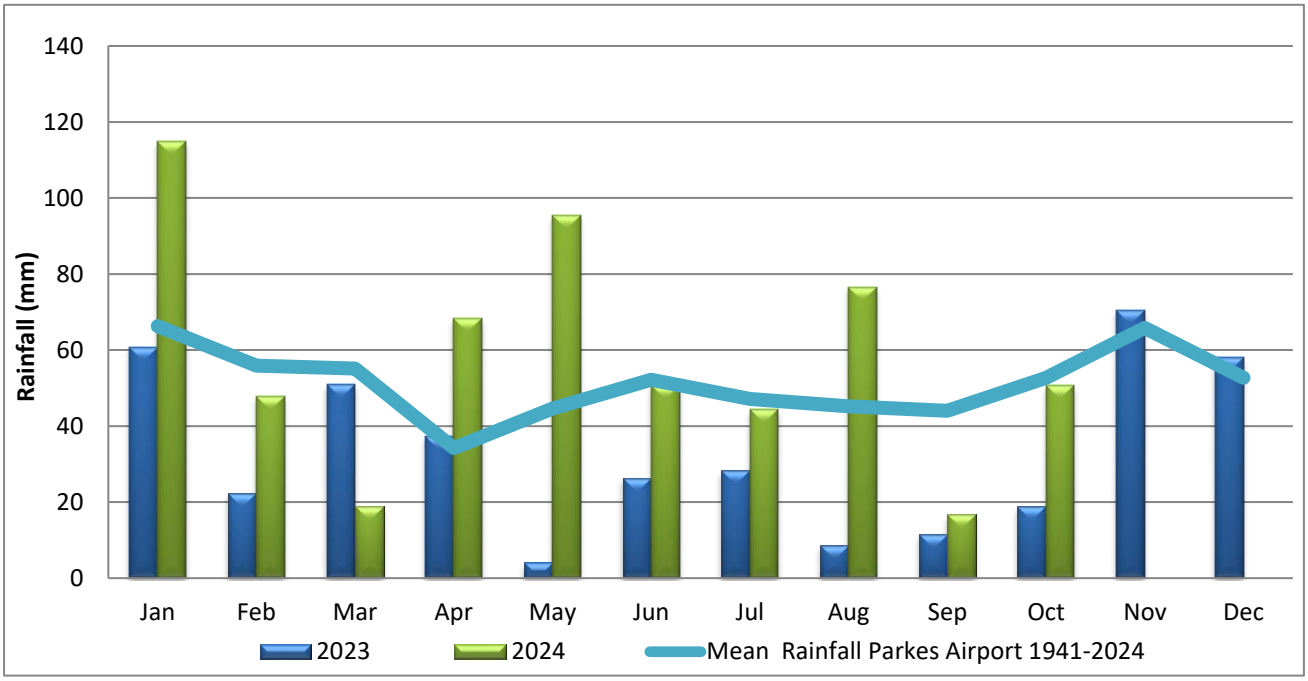


Figure 3-2. Monthly rainfall recorded at NPO January 2023 to the end of October 2024 compared to the long-term monthly averages recorded at Parkes Airport (BoM 2024).

3.2 Effects of seasonal conditions on ground covers

Densities of PDO recorded at the two populations have varied significantly over the years, with the seasonal conditions and survey timing having a significant impact on the orchid populations, ground cover abundance and ease of identification. In 2017, exceptionally dry conditions resulted in individuals being stunted with most being 10 - 15cm in height. Some individuals had finished flowering, while others were in bud.

In 2018, very dry conditions persisted throughout the year. There was however 31 mm and 29 mm of rain during August and September which promoted the emergence of some PDOs. The combination of dry conditions and slightly earlier surveying resulted in individuals that were also very small and many were still in bud. In 2019, no individuals were recorded at all as a result of the continued dry conditions and increased grazing pressure by macropods (Table 3-1, Figure 3-4).

Increased growth and abundance of grassy vegetation and weeds in 2020 year made locating the orchids more difficult. In the Limestone Forest, PDOs were growing amongst several other species with yellow flowers and there were large patches of *Echium plantagineum* (Patterson's Curse) in the Callitris woodland areas. In Adavale Lane, the abundance of exotic annual ground covers, including tall dense thickets of *Echium plantagineum* made locating individuals particularly hard, if not impossible. On the northern side of the road *Echium plantagineum* was often taller than the surveyors!

In 2021, seasonal conditions continued to be favourable and with a lower of height and abundance of weeds, the conditions for locating orchids had significantly improved since 2020. The ongoing seasonal conditions resulted in an increased orchid population, with many individuals growing in close proximity to each other or in tight clumps. Above average rainfall continued into 2022, and while ground cover was abundant it was typically 20 – 30 cm tall and there were significantly fewer weeds, especially at Adavale Lane.

Dry conditions returned in 2023, with most of the herbaceous understorey having hayed off, PDOs were relatively easy to locate. This year, favourable conditions were experienced throughout most of the year, with there being moderate levels of ground cover, few weeds and increased numbers of PDO's. High densities of orchids often

occurred in tight clumps and often occurred amongst other yellow flowering species such as *Bulbine bulbosa* (Bulbine Lily) and *Chrysocephalum apiculatum* (Common Everlasting), making counting of individuals a little difficult at times (Figure 3-3).

Figure 3-3. PDOs often occurred in tight clumps amongst other yellow flowering species.

3.3 PDO population densities

The distribution of individuals found in each of the known populations in LF and AL in 2015 - 2024 is provided in Figure 3-6 and Figure 3-7. Additional individuals have been located outside of the LF exclusion fence, on the eastern and western sides of the exclosure in 2018 and 2020 - 2022. In 2023, 194 individuals were located outside the LF exclusion fence, while in 2024 the number of individuals found outside of the exclusion fence at LF has increased to 477.

In 2023, search areas at LF (E48) were expanded and tracked using GPS. No additional locations were found with all PDOs occurring near previously recorded locations.

Previously highest population counts were recorded in 2022, with total of 2271 orchids, however favourable growing conditions resulted in a total of 3063 orchids this year, with high numbers recorded in both the Limestone Forest and Adavale Lane populations. PDOs were found in areas not recorded before at Adavale Lane (Figure 3-5.

Table 3-1. Population densities of *Diuris tricolor* (Pine Donkey Orchid).

Population	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Limestone Forest	69	143	485	37	494	0	770	973	1491	834	1315
Adavale Lane	130	38	603	37	52	0	180	859	780	73	1748
Total	**199**	**181**	**1088**	**74**	**546**	**0**	**950**	**1832**	**2271**	**907**	**3063**

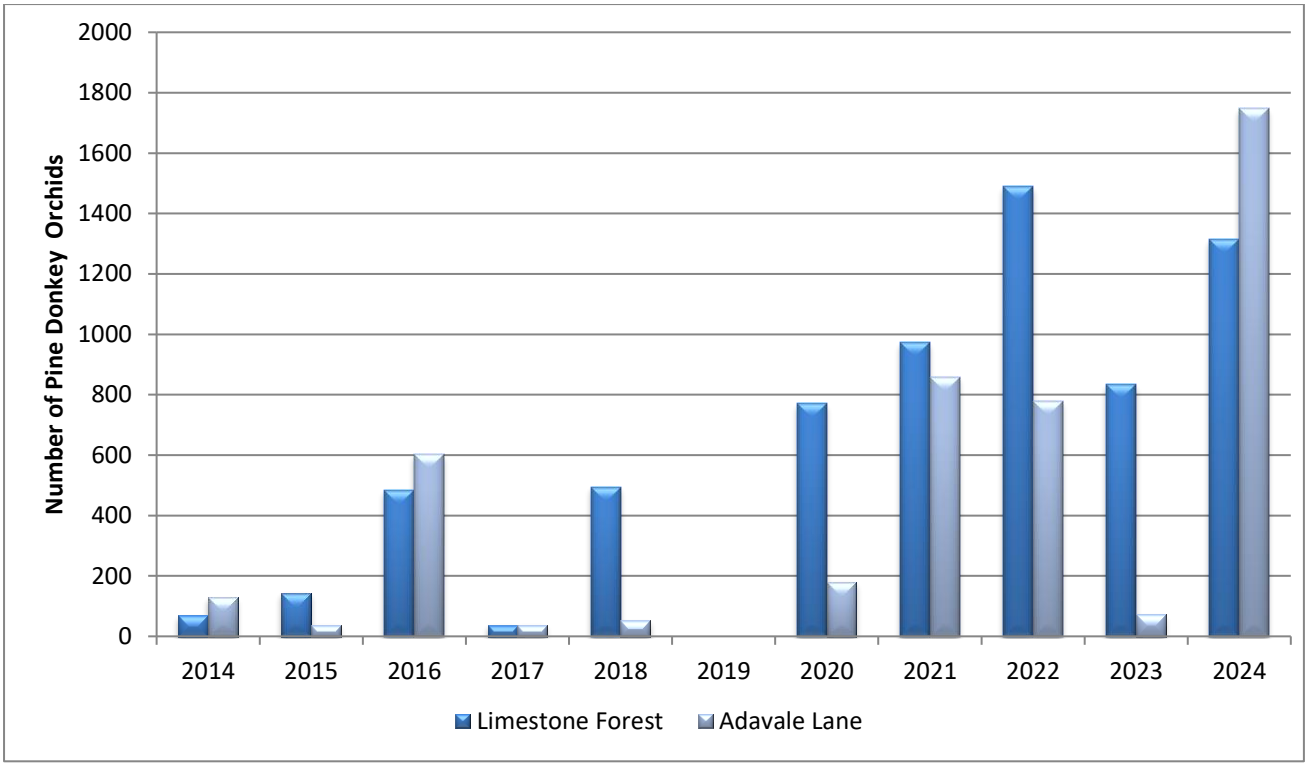


Figure 3-4. Pine Donkey Orchid densities recorded at the two known populations since 2014.

Figure 3-5. PDOs were found in areas not recorded before at Adavale Lane.

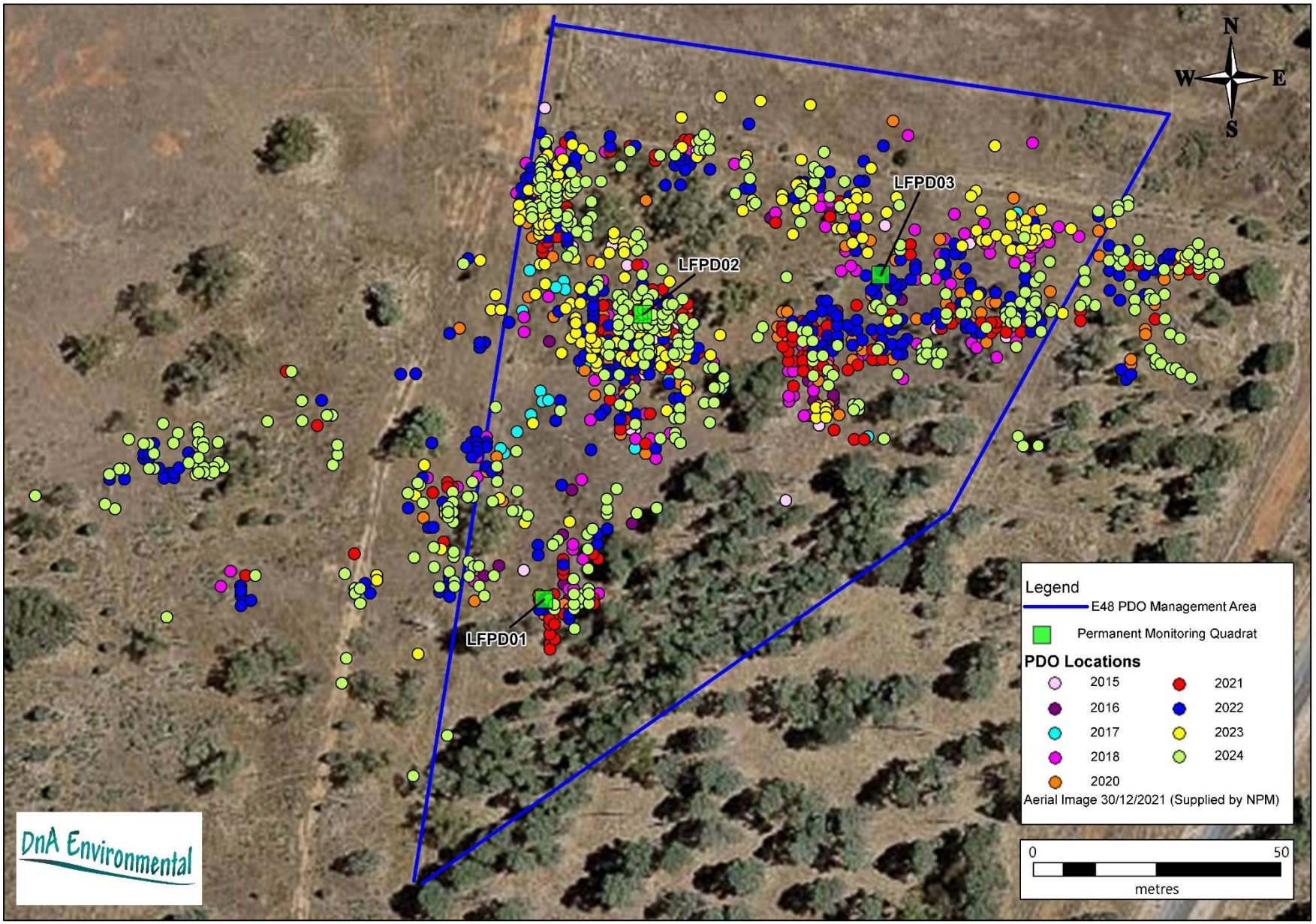


Figure 3-6. Distribution of the *Diuris tricolor* at Limestone Forest 2015 – 2024.

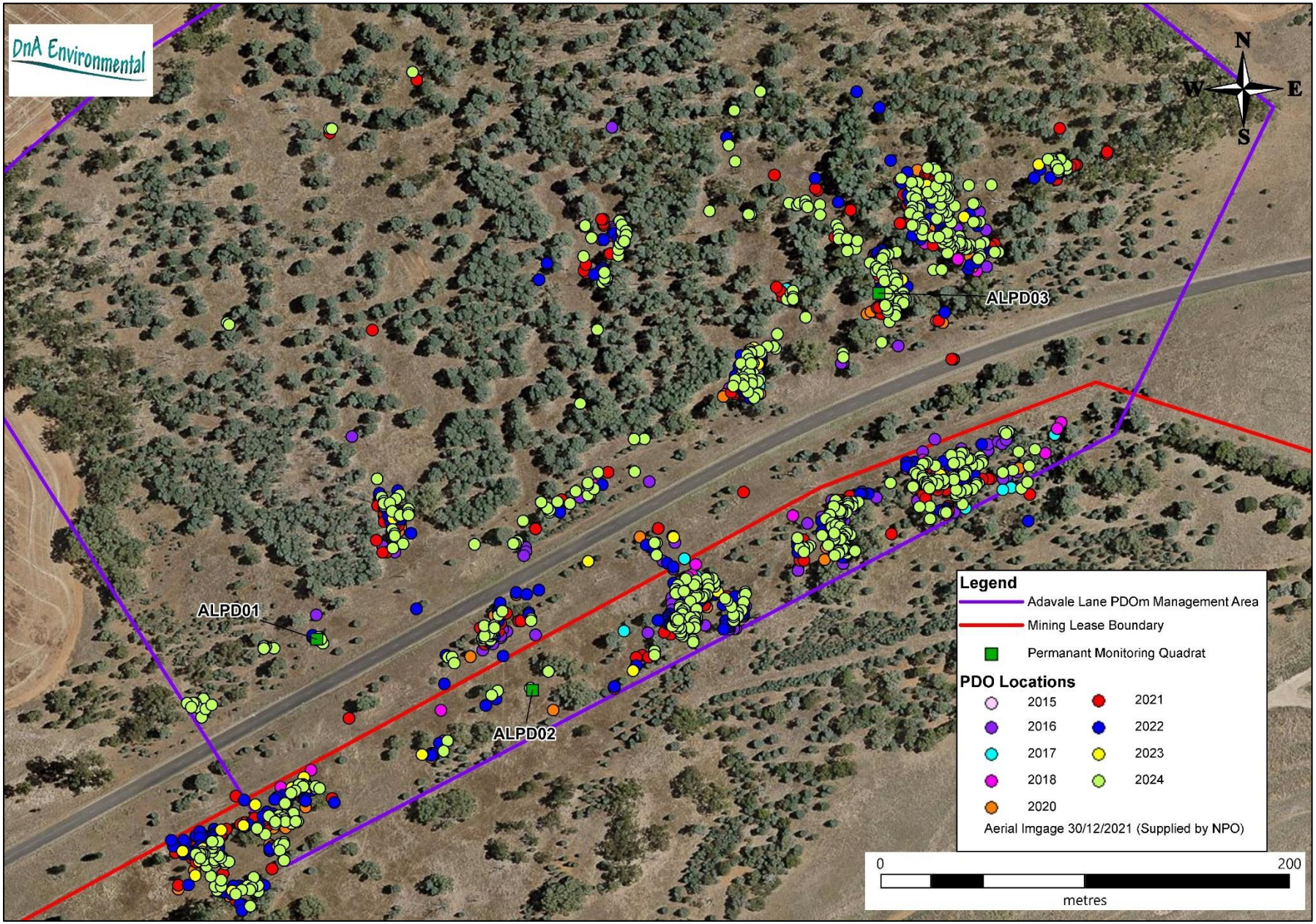


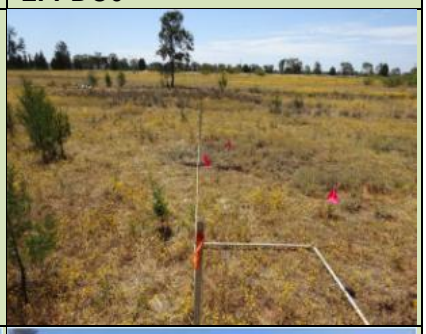
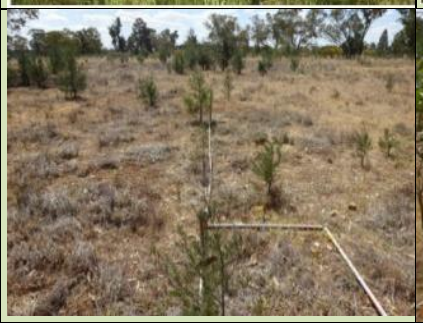
Figure 3-7. Distribution of the *Diuris tricolor* at Adavale Lane 2015 – 2024.

3.4 Photo-points

Permanent photo-points along the vegetation transects in the LF (Table 3-2) and AL (Table 3-5) have been taken every year since 2015 to illustrate changes occurring in the vegetation communities. Note the *Callitris* regeneration in the Limestone Forest was selectively removed in 2018.

In 2016, site photographs and subsequent data taken in LFPD02 and LFPD03 were named incorrectly by Niche Environment and Heritage in their report that year. Subsequently, photo-points and vegetation transects may also have not been established along the same transects in 2016 and as result, some differences may have been incurred for this reason.

Table 3-2. Photo-points at three permanent monitoring quadrats established at Limestone Forest during 2015 – 2024.

Year	LFPDO1	LFPDO2	LFPDO3
2015			
2016 Niche Environment and Heritage			
2017			
2018			

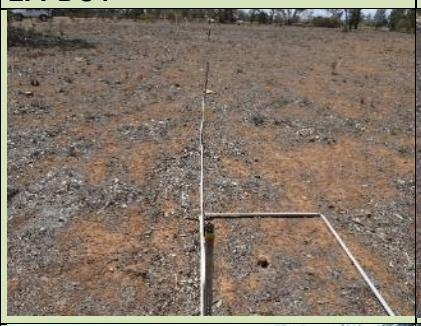
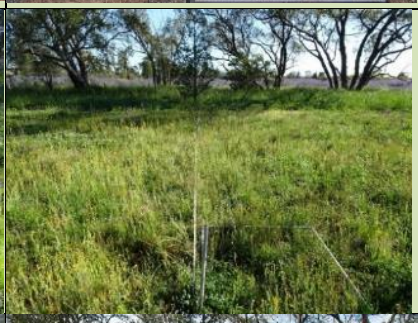
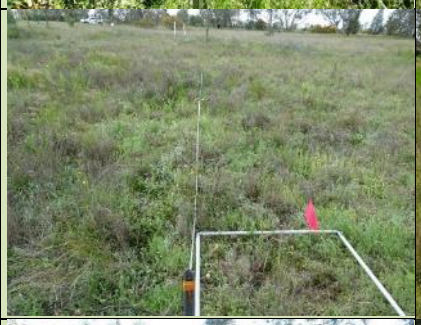
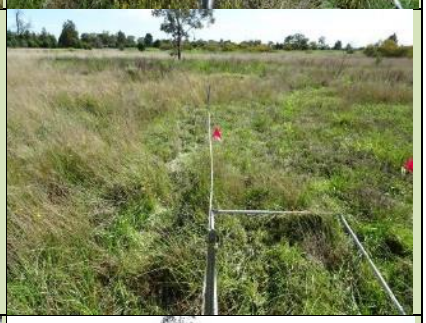
Year	LFPDO1	LFPDO2	LFPDO3
2019			
2020			
2021			
2022			
2023			
2024			

Table 3-3. Photo-points at the three permanent monitoring quadrats established at Adavale Lane during 2015 – 2024.

Year	ALDO1	ALPDO2	ALPDO3
2015			
2016			
2017			
2018			
2019			

Year	ALDO1	ALPDO2	ALPDO3
2020			
2021			
2022			
2023			
2024			

3.5 Ground cover monitoring results

3.5.1 Permanent photo-points

Photo-points of ground cover in LF (Table 3-4) and AL (Table 3-5) monitoring sites have been taken every year since 2015. The photographs clearly illustrate the profound effect that the seasonal conditions and the level of

disturbance by animals have had on the ground cover in the various locations. Changes in ground cover abundance and composition have also had an impact of PDO populations as evidenced by the fluctuations in population densities.

Table 3-4. Permanent photo-points of ground cover composition in Limestone Forest monitoring quadrats.

Year	LFPDO1	LFPDO2	LFPDO3
2015			
2016			
2017			
2018			
2019			

Year	LFPDO1	LFPDO2	LFPDO3
2020			
2021			
2022			
2023			
2024			

Table 3-5.Permanent photo-points of ground cover composition in Adavale Lane monitoring quadrats.

Year	ALPDO1	ALPDO2	ALPDO3
2015			
2016			
2017			
2018			
2019			

Year	ALPDO1	ALPDO2	ALPDO3
2020			
2021			
2022			
2023			
2024			

3.5.2 Total Ground Cover

Total ground cover, which is a combination of leaf litter, annual plants, cryptogams, rocks, logs and live perennial plants (<0.5m in height) recorded in the LF and AL PDO quadrats are provided in Figure 3-8 and Figure 3-9. In 2019, ground was significantly affected by drought and overgrazing, with all sites having some level of bare

ground. Since 2020, there has been high levels of ground cover at both population sites and there continues to be 100% ground cover recorded at all monitoring locations.

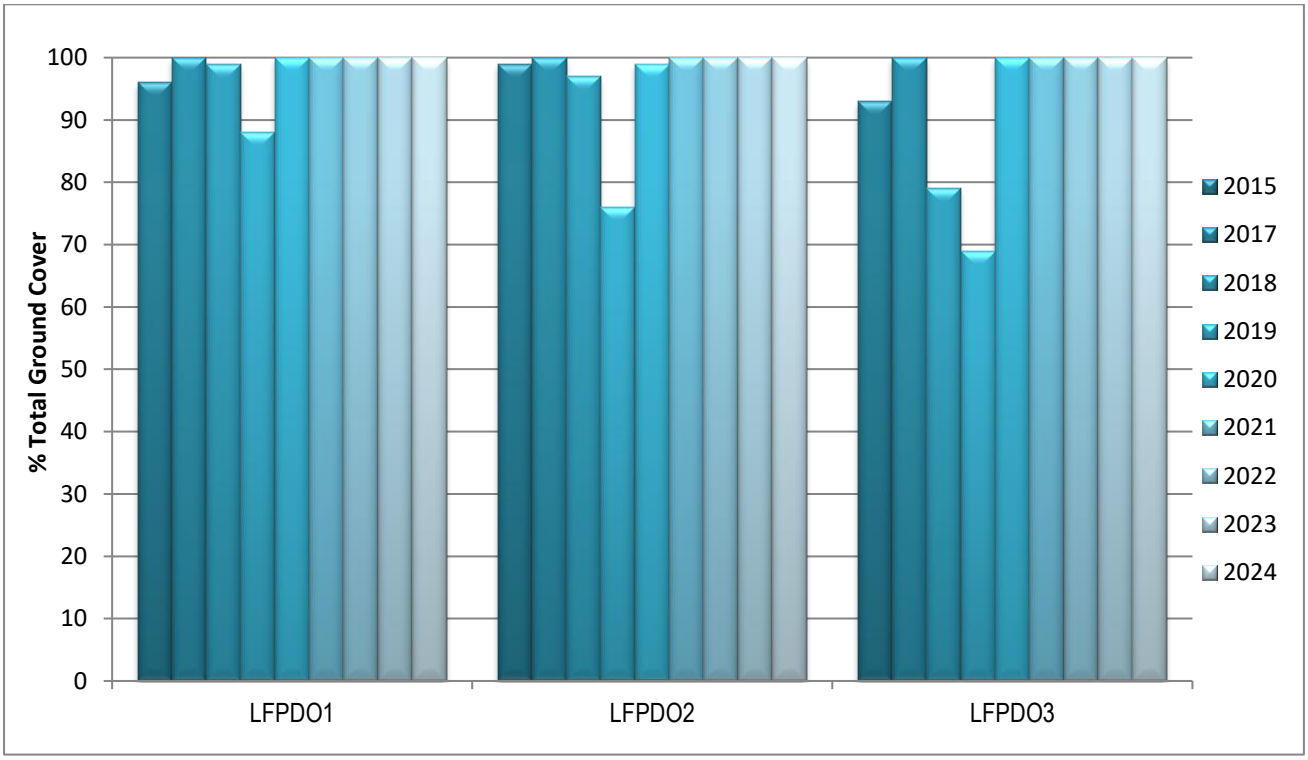


Figure 3-8. Total ground cover recorded in LF PDO monitoring sites.

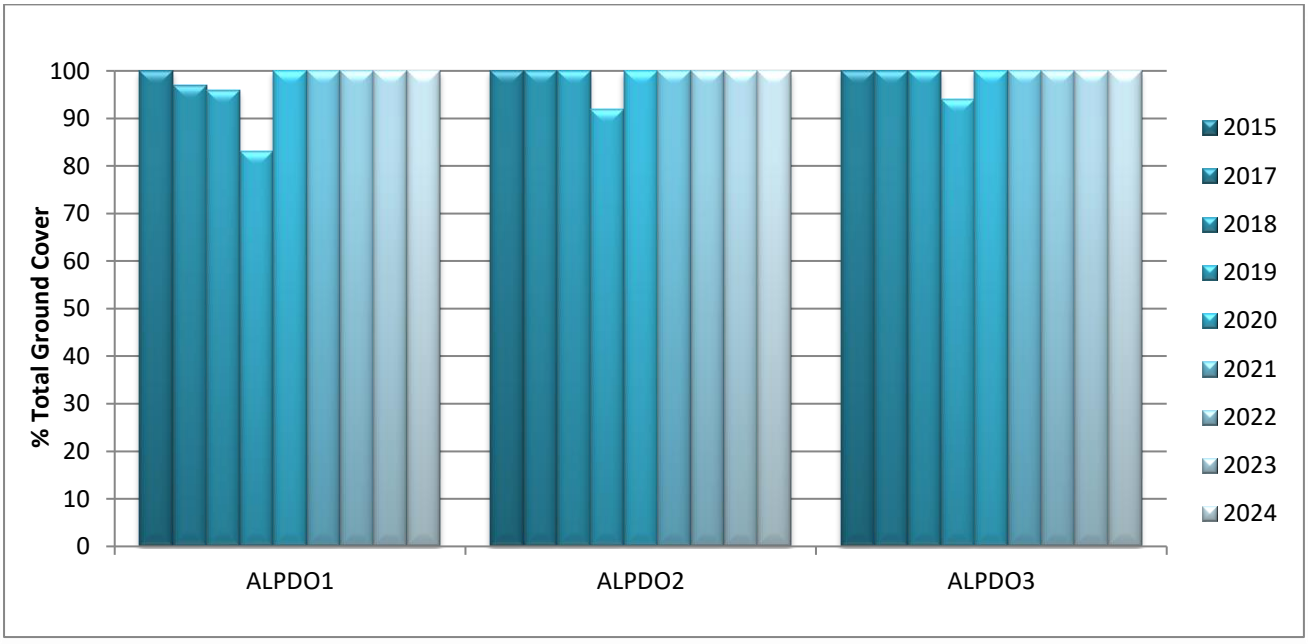


Figure 3-9. Total ground cover recorded in AL PDO monitoring sites.

3.5.3 Structural composition

An average of ground cover and structural compositions of LF and AL PDO monitoring quadrats this year are provided in Figure 3-10 and Figure 3-11. In LF sites, there has been an increase in perennial ground cover which

provided 24 – 59% of the total ground cover. There continues to be relatively high levels of dead leaf litter and scattered annual plants were present in two monitoring plots.

After the drought in 2020, annual plants were dominant in ALPDO1 and ALPDO3, while there was a high cover of dead leaf litter in ALPDO2. This year, perennial ground covers had increased to provide 38 – 68% ground cover, while there continues to be variable levels of dead leaf litter and annual plants 12 – 18% cover across three plots. Cryptogams continued to be recorded in ALPDO2 and these provided 16% cover on average. A *Callitris glaucophylla* sapling has grown to provide some vertical cover up to 4.0 m in height in ALPDO3.

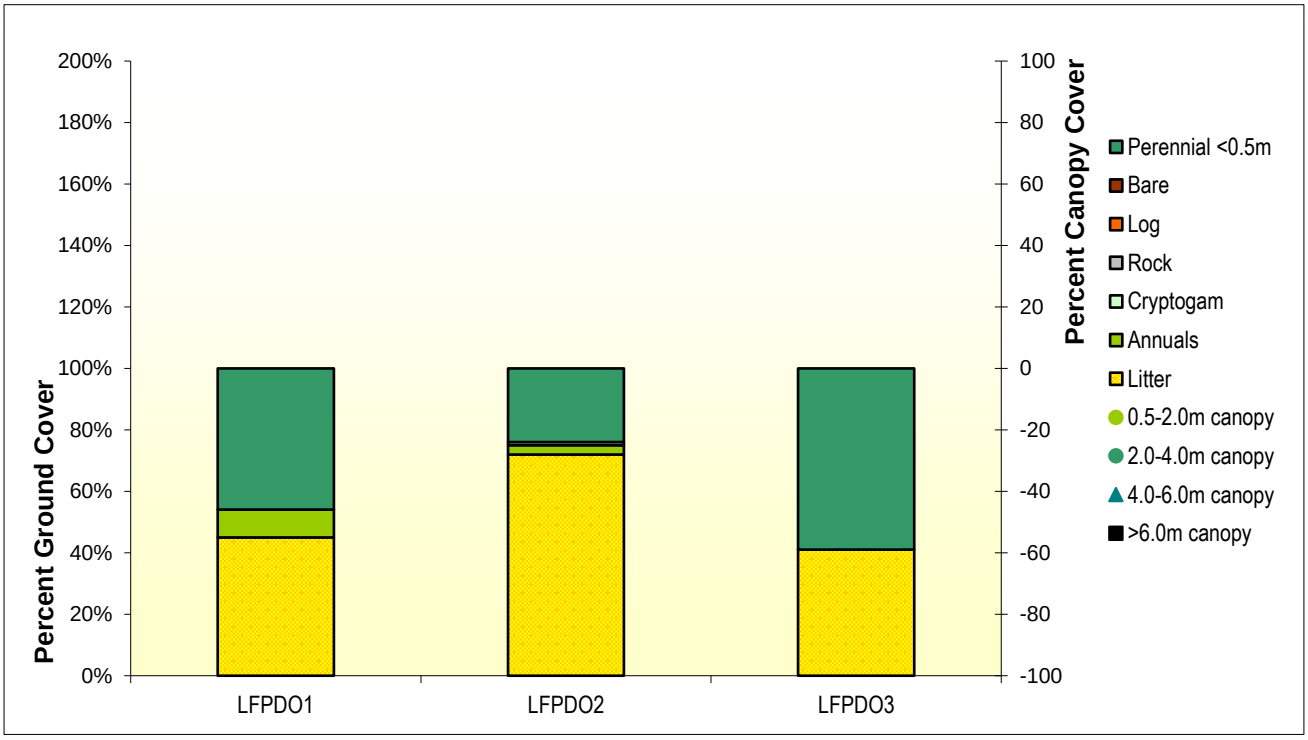


Figure 3-10. Average percent ground cover and projected foliage cover recorded in LF PDO monitoring sites in 2024.

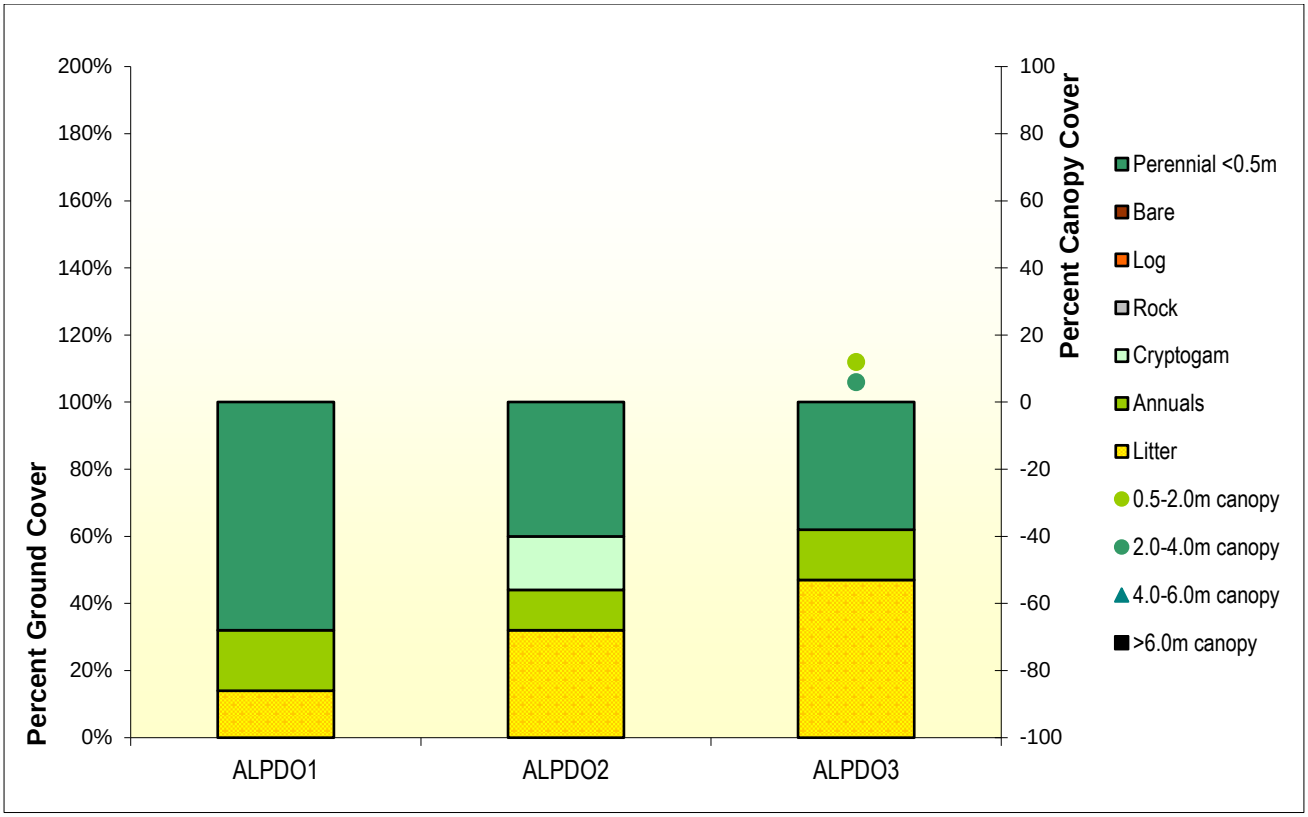


Figure 3-11. Average percent ground cover and projected foliage cover recorded in AL PDO monitoring sites in 2024.

3.5.4 Floristic diversity

In total there were 71 species recorded in the six, 5 x 5m monitoring plots this year of which 26 (37%) were exotic species (Appendix 1).

Total floristic diversity recorded in 5 x 5m Limestone Forest monitoring plots in 2015 – 2024 is provided in Figure 3-12. The level of diversity has fluctuated with changes in seasonal conditions and degree of grazing intensity and/or management intervention of the area. Floristic diversity was very low during 2017 - 2019 due to a period of long drought, and parts of the ALPDO1 were also subjected to very heavy grazing by travelling stock during this time.

Since 2020, there has been improved seasonal conditions and above average rainfall over the last few years stimulated a lot of plant growth, including an abundance of annual native and exotic plants with relatively high species diversity being recorded in 2020. These favourable seasonal conditions also promoted the growth and abundance of PDOs and a range of other native species with similar habitat traits such as *Arthropodium fimbriatum [Dichopogon fimbriatus]* (Nodding Chocolate Lily), *Bulbine bulbosa* (Bulbine Lily) and *Prasophyllum campestre* (Inland Leek Orchid). Above average rainfall however, also resulted in increased diversity and abundance of weeds and made observing small plants amongst tall and dense vegetative growth difficult, especially in 2020 when weed growth was prolific.

The onset of dry conditions throughout 2023 resulted in a decline in species diversity across the range of monitoring sites, however this was followed by an increased diversity this year after good rainfall conditions throughout most of the year, with 21 – 25 species in the LF quadrats (Figure 3-12) and 30 – 41 species in AL quadrats (Figure 3-13). There has however, also been an increase in exotic species and this year there were 7 – 8 exotics in LF (Figure 3-14) and 12 – 21 in the AL populations (Figure 3-15).

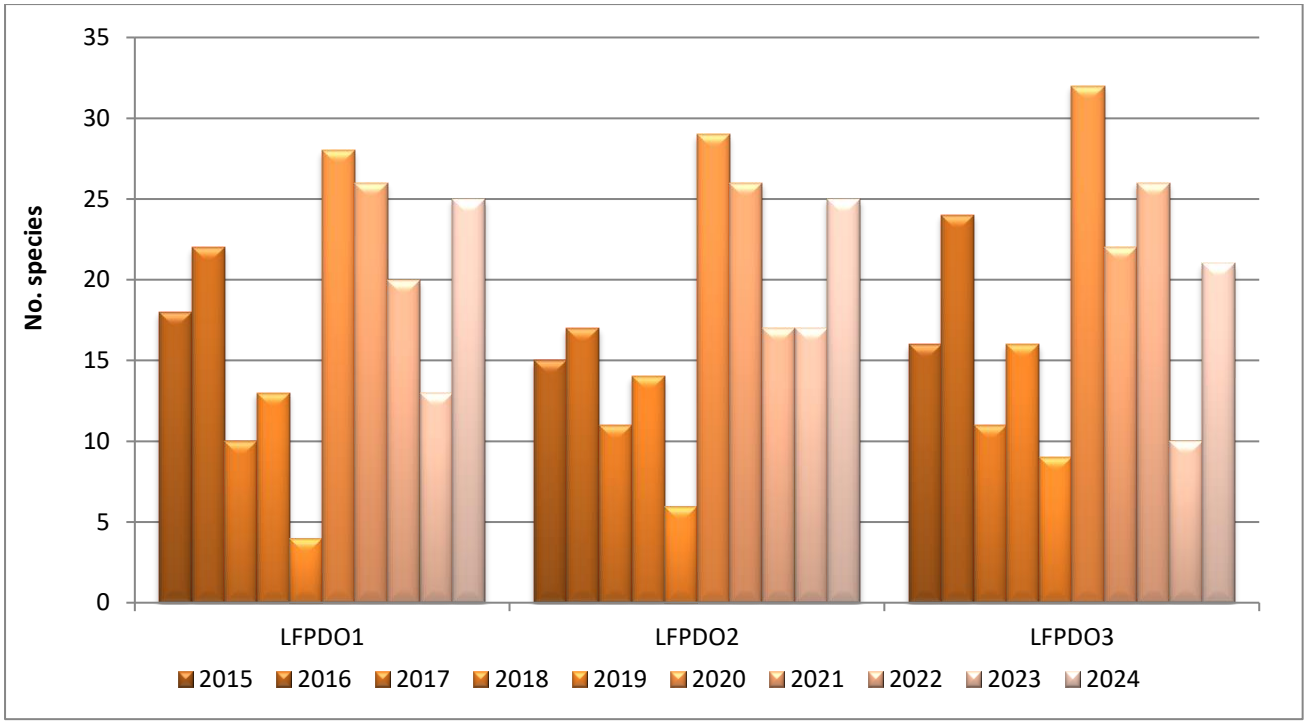


Figure 3-12. Total species diversity recorded in the LFPDO monitoring sites.

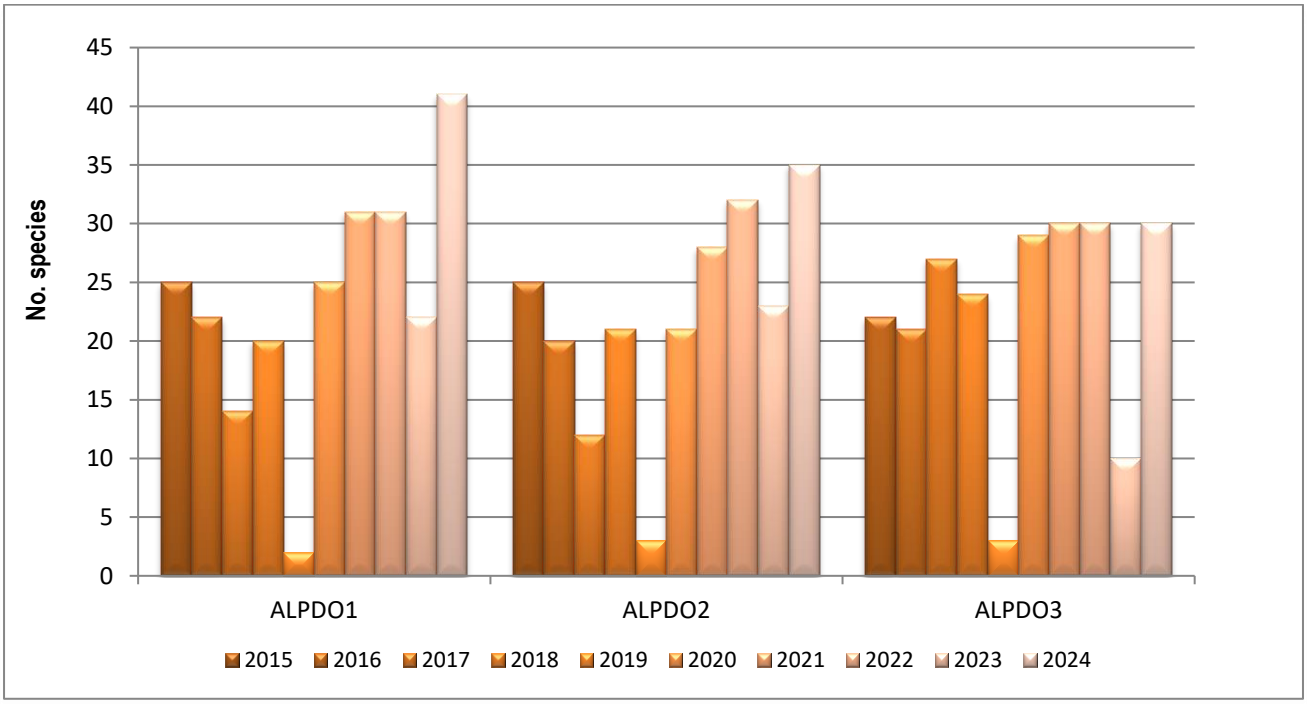


Figure 3-13. Total species diversity recorded in the ALPDO monitoring sites.

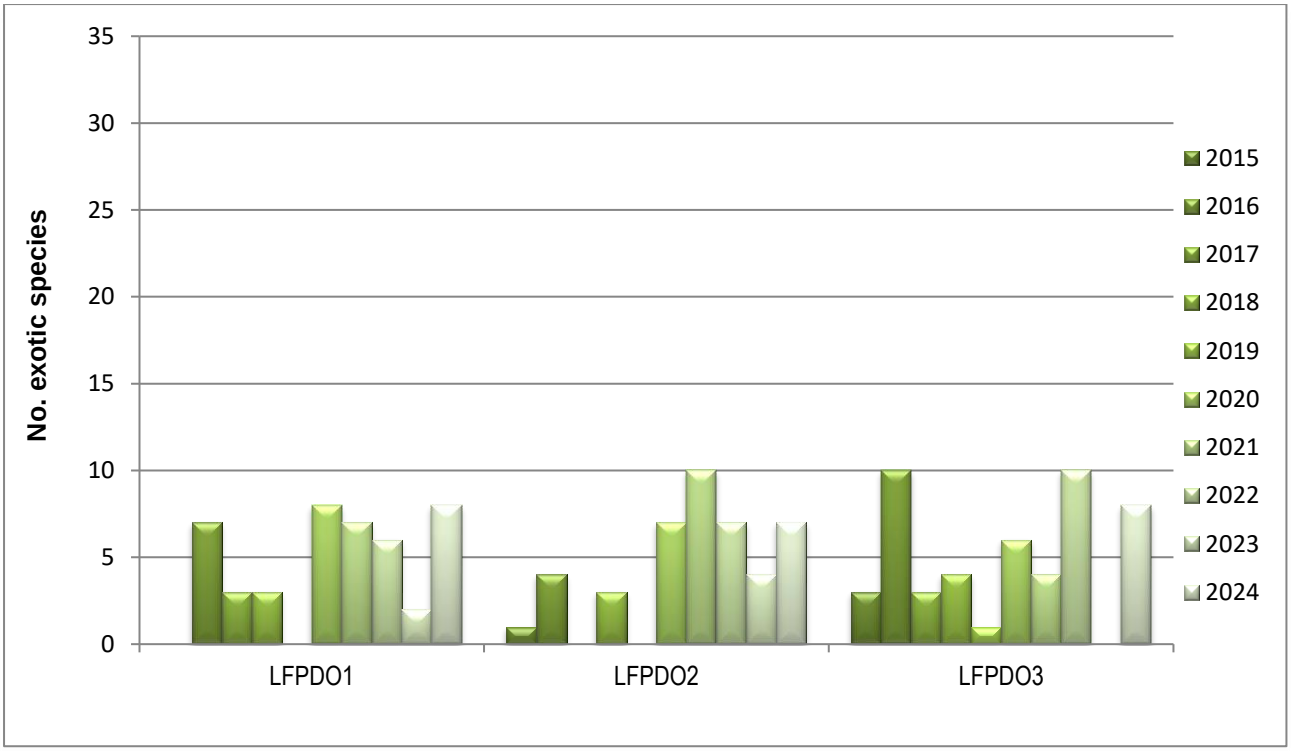


Figure 3-14. Exotic species diversity recorded in the LFPDO monitoring sites.

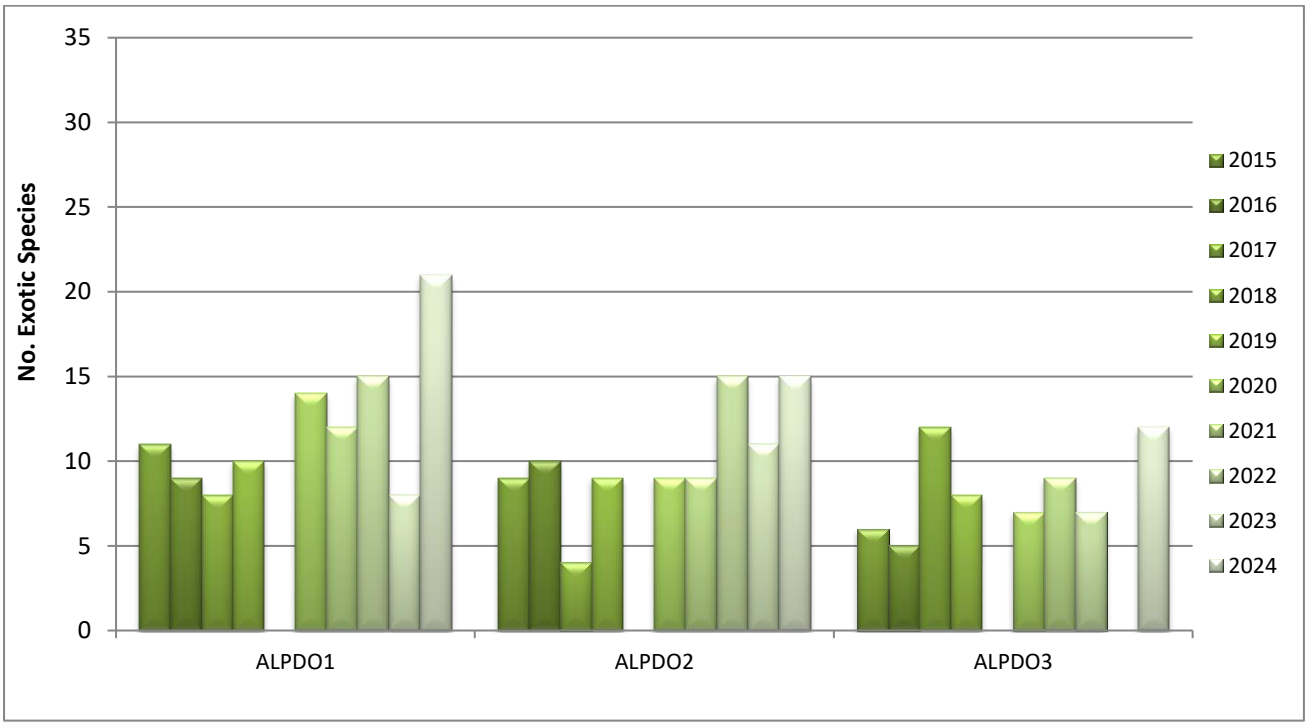


Figure 3-15. Exotic species diversity recorded in the ALPDO monitoring sites.

3.5.5 Average species diversity/m^2

Overall, ground cover diversity was typically higher in the AL populations, but they also tended to contain a higher diversity of weeds. In the LF sites the average number of species per m^2 has increased since last year and ranged from 5.6 – 7.6 native species/m^2, while there were 3.8 – 4.4 exotic species/m^2 (Table 3-6).

In AL populations, the diversity of native species per m^2 increased to 6.0 – 8.2 native species, with there also being an increase in exotic species with 6.2 – 11.0 exotic species/m^2 this year.

Table 3-6. Average diversity of native and exotic species /m² in each monitoring plot in 2024.

Site Name	Native species/m²	Exotic species/m²
LFPDO1	6	4
LFPDO2	7.6	4.4
LFPDO3	5.6	3.8
ALPDO1	6	11
ALPDO2	7.6	8
ALPDO3	8.2	6.2

3.5.6 Pine Donkey orchid densities in the quadrats

The density of PDO's found in the 5x5m monitoring plots have varied over the years with none being recorded in the small monitoring plots in 2017 or 2019, while none were recorded anywhere at all in 2019 at the height of the drought. This year there were 1 - 9 individuals recorded in Limestone Forest monitoring quadrats. While there continued to be none recorded in ALPD02, there were also increased densities in the other two plots, with 18 PDOs recorded ALPDO03 this year (Figure 3-16).

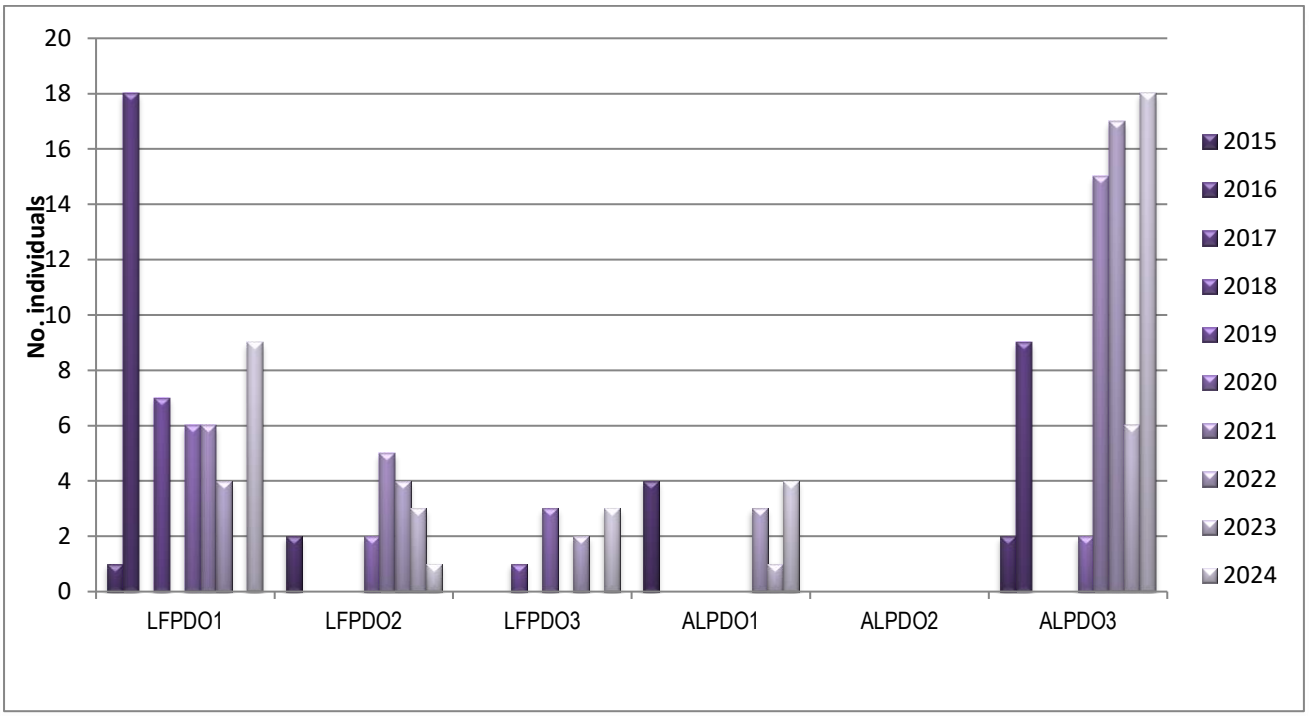


Figure 3-16. Density of PDO's in the 5x5m monitoring plots.

3.5.7 Tree and shrub regeneration

Callitris glaucophylla (White Cypress Pine) and *E. dwyeri* (Dwyer's Red Gum) regeneration have also been recorded, as they have the potential to influence PDOs.

In 2015, scattered *Callitris* seedlings were recorded in all LF plots, while seven *E. dwyeri* saplings (<2.0m) were also recorded in LFPDO2. A selective removal program was undertaken in 2018 where all *Callitris* regeneration was removed. The larger *E. dwyeri* saplings were retained in LFPDO2, with additional *E. dwyeri* regeneration occurring in the LF area after the drought, with numerous young seedlings/saplings up to 2.0m tall continuing to be recorded in LFPD01. In ALPDO1 there continues to be one large *Callitris* (23cm dbh) and in ALPDO3 there were five *C. glaucophylla* seedlings with most now exceeding 2.0m in height (Figure 3-17).

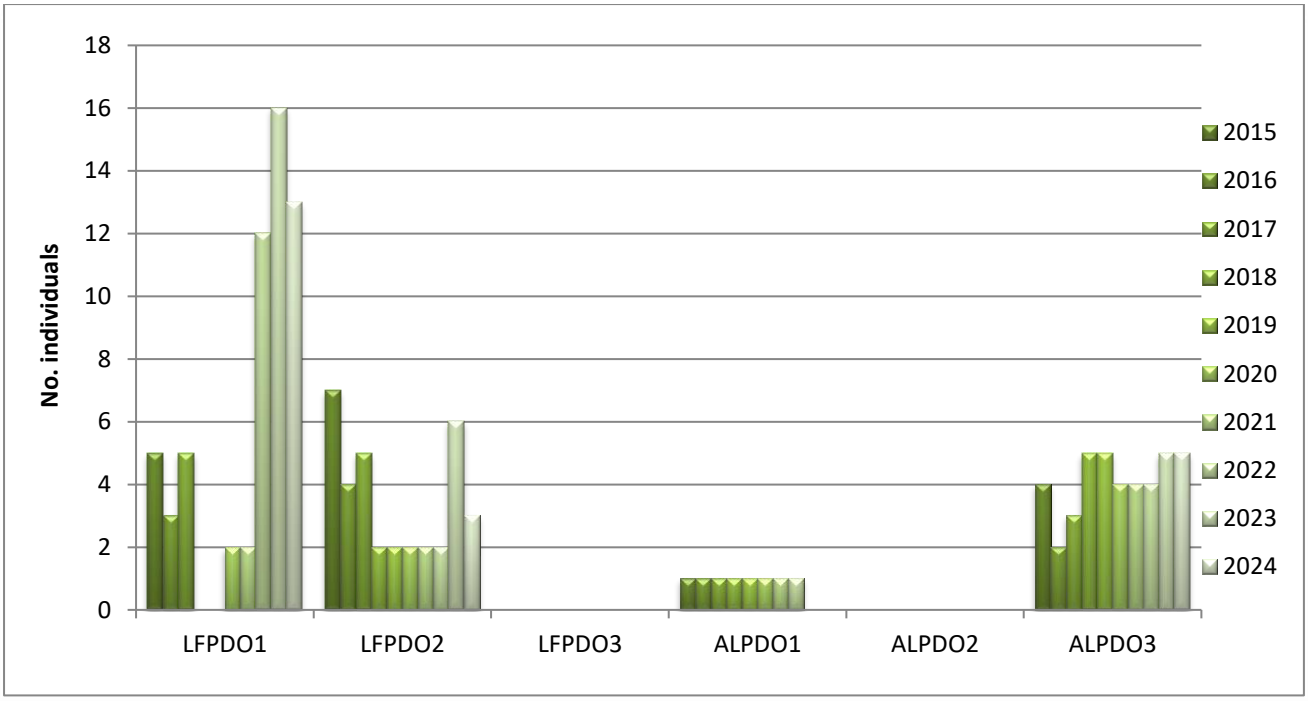


Figure 3-17. Density of tree and shrub seedlings recorded in the 5 x5 m monitoring plots.

3.5.8 Percent native ground cover

The percent native ground cover is an ecological indicator used to provide some measure of the cover abundance of the live native vegetation along the vegetation transect and therefore indicates the level of weediness at the monitoring sites. While it is only an estimation, the percent cover of endemic ground cover species has been derived by the following equation:

Percent cover endemic species = sum of the five Braun- Blanquet scores for native species / (sum of the five Braun- Blanquet scores of exotic species + native species) x 100.

In agricultural areas, the percentage of live native plant cover often tends to increase during drier seasonal conditions as growth of many exotic annual species cannot be sustained, thus leaving the hardier native perennial ground cover to provide most of the live ground cover. In more favourable seasonal conditions, the opposite typically occurs.

There has been high variability in the proportion of ground cover provided by native species between the two PDO populations, with the higher percentage of native cover typically being recorded in the LF population. In 2019 however, drought conditions resulted in only the hardiest native perennial ground covers to persist and almost all surviving plants were native.

Since the drought was broken in 2020 there was significant growth and high abundance of exotic annual species, followed by dry conditions throughout 2023, where most ground covers were native in all monitoring plots. This year, favourable conditions continued to support a combination of native and exotic plants. In the Limestone Forest, native plants provided 61 – 70% of the live plant cover, while in Adavale Lane, there was 40 – 62% native plant cover (Figure 3-18).

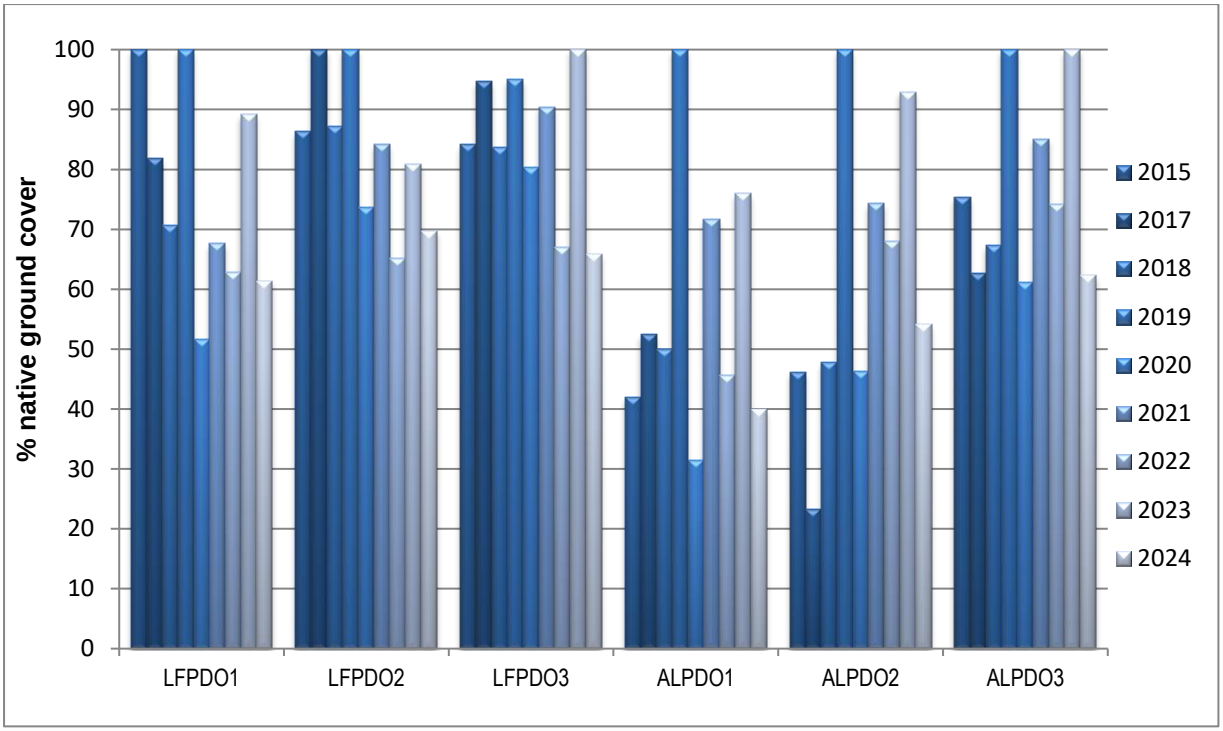


Figure 3-18. Percent endemic ground cover recorded in PDO monitoring sites.

3.5.9 Common species recorded at Limestone Forest

Table 3-7 provides a list of species common in the LF and recorded in all three monitoring plots this year. *Aristida jerichoensis* var. *jerichoensis* (Jericho Wiregrass), *Arthropodium strictum* (Chocolate Lily), *Bulbine bulbosa* (Bulbine Lily), *Cheilanthes sieberi* (Rock Fern), *Chrysocephalum apiculatum* (Common Everlasting), *Convolvulus erubescens* (Australian Bindweed), *Microtis unifolia* (Common Onion Orchid), *Wurmbea dioica* (Early Nancy) were recorded in all three plots and so was *Diuris tricolor* (Pine Donkey Orchid).

Hypochaeris glabra (Smooth Catsear), *Trifolium subterraneum* (Subterraneum Clover) and *Vulpia muralis* (Rats-tail Fescue), were common exotic species. A comprehensive list of species recorded in the PDO monitoring sites in 2024 has been provided in Appendix 1.

Table 3-7. Common species recorded in the Limestone Forest population in 2024.

exotic	Scientific Name	Common Name	Growth Form
	Aristida jerichoensis var. jerichoensis	Jericho Wiregrass	g
	Arthropodium strictum	Chocolate Lily	h
	Bulbine bulbosa	Bulbine Lily	h
	Cheilanthes sieberi	Rock Fern	f
	Chrysocephalum apiculatum	Common Everlasting	h
	Convolvulus erubescens	Australian Bindweed	h
	Diuris tricolor	Pine Donkey Orchid	h
*	*Hypochaeris glabra*	Smooth Catsear	h
	Microtis unifolia	Common Onion Orchid	h
*	*Trifolium subterraneum*	Subterraneum Clover	h
*	*Vulpia muralis*	Rats-tail Fescue	g
	Wurmbea dioica	Early Nancy	h

Key to growth form: t = tree; s = shrub; ss =sub-shrub; h = herb; g = grass, r = reed; v = vine; f = fern; p = parasite.

3.5.10 Common species recorded at Adavale Lane

Table 3-8 provides a list of species common at AL and recorded in all three monitoring plots this year. *Arthropodium strictum* (Chocolate Lily), *Bulbine bulbosa* (Bulbine Lily), *Calotis lappulacea* (Yellow Burr Daisy), *Cheilanthes sieberi* (Rock Fern), *Dichondra repens* (Kidney Weed), *Wahlenbergia luteola* (Australian Bluebell) and *Xerochrysum bracteatum* (Golden Everlasting) were common native herbs, while *Austrostipa scabra* (Speargrass) was also very common.

There were also a variety of weeds and other exotic species that have become naturalised in the area including *Echium plantagineum* (Paterson's Curse), *Hypochaeris radicata* (Flatweed), *Petrorhagia nanteuilii* (Proliferous Pink), *Vulpia muralis* (Rats-tail Fescue) as well as a variety of different thistles, *Medicago* and *Trifolium* species. A comprehensive list of species recorded in the PDO monitoring sites in 2024 has been provided in Appendix 1.

Table 3-8. Common species recorded in the Adavale Lane population in 2024.

exotic	Scientific Name	Common Name	Growth Form
	Arthropodium strictum	Chocolate Lily	h
	Austrostipa scabra	Speargrass	g
	Bulbine bulbosa	Bulbine Lily	h
	Calotis lappulacea	Yellow Burr Daisy	h
	Cheilanthes sieberi	Rock Fern	f
	Dichondra repens	Kidney Weed	h
*	*Echium plantagineum*	Paterson's Curse	h
*	*Hypochaeris radicata*	Flatweed	h
*	*Lactuca serriola*	Prickly Lettuce	h
*	*Medicago polymorpha*	Burr Medic	h
*	*Petrorhagia nanteuilii*	Proliferous Pink	h
*	*Sonchus oleraceus*	Milk Thistle	h
*	*Trifolium arvense*	Haresfoot Clover	h
*	*Trifolium glomeratum*	Clustered Clover	h
*	*Vulpia muralis*	Rats-tail Fescue	g
	Wahlenbergia luteola	Australian Bluebell	h
	Xerochrysum bracteatum	Golden Everlasting	h

Key to growth form: t = tree; s = shrub; ss =sub-shrub; h = herb; g = grass, r = reed; v = vine; f = fern; p = parasite.

3.6 Most abundant species

The most abundant species recorded in each of the PDO monitoring sites this year are provided in Table 3-9. The most abundant species were those that collectively summed to a Braun-Blanquet total of 10 or more from the five replicated sub-plots along the vegetation transect. The maximum score that can be obtained by an individual species is 30.

In the LF survey area, several native species including *Chrysocephalum apiculatum* (Common Everlasting) *Aristida jerichoensis* var. *jerichoensis* (Jericho Wiregrass), *Bulbine bulbosa* (Bulbine Lily), *Cheilanthes sieberi* (Rock Fern) and *Arthropodium strictum* provided the most ground cover. At Adavale Lane, *Arthropodium strictum, Dichondra repens* and *Panicum effusum* (Hairy Panic) were the most abundant native species. Several *Trifolium species* were also relatively abundant in both locations. The cover of abundance of individual species recorded in each monitoring plot has been provided in Appendix 2.

Table 3-9. The most abundant species recorded in the PDO monitoring sites in 2024.

Exotic	Scientific Name	Common Name	LFPDO1	LFPDO2	LFPDO3	ALPDO1	ALPDO2	ALPDO3
*	*Trifolium arvense*	Haresfoot Clover	11					13
	Chrysocephalum apiculatum	Common Everlasting	18		20			
	Aristida jerichoensis var. jerichoensis	Jericho Wiregrass		12				
	Bulbine bulbosa	Bulbine Lily		14				
	Cheilanthes sieberi	Rock Fern		11				
*	*Trifolium subterraneum*	Subterraneum Clover			12			
	Arthropodium strictum	Chocolate Lily			11	11	13	
*	*Trifolium repens*	White Clover				13		
	Panicum effusum	Hairy Panic					13	16
	Dichondra repens	Kidney Weed						15

3.7 Threatened species

Swainsona sericea (Silky Swainsona), listed under the NSW Biodiversity Conservation Act as vulnerable was recorded in the LF area. Identification was confirmed by the National Herbarium of NSW in 2015. Since 2020 a small population of *Prasophyllum campestre,* another species of orchid also emerged. While it is not a listed species, its presence in the site for the first time in 2020 is of interest.

During 2021 and 2022, the abundance of *Swainsona sericea* and *Prasophyllum campestre* appeared to have increased with the improved seasonal conditions. In 2023, *S. sericea* was less abundant and no *Prasophyllum campestre* was present presumably due to the dry conditions. This year, both species were present.

Figure 3-19. ***Swainsona sericea*** **(left) and** ***Prasophyllum campestre*** ***(right) in the Limestone Forest PDO exclusion site. *Photo: A. Johnston, R. Mjadwesch.**

3.8 Weeds

Meandering transects are undertaken to locate orchids as well as to identify any weeds which may have the potential to impact on the orchid populations. Previously a range of annual exotic herbs and grasses were frequently found throughout the survey areas, with most being common agricultural weeds naturalised in the local area. Areas that were particularly dominated by annual weeds such as *Echium plantagineum* (Paterson's Curse) and *Sisymbrium irio* (London Rocket) were typically under tree canopies as a result of old stock camps developed under previous grazing regimes.

Increased grazing and disturbance by macropods during the drought, in both the survey areas resulted in overgrazing and annual weeds typically occurred in limited abundance. Following good rainfall in 2020, the understorey of the Callitris woodlands had become dominated by *Echium plantagineum*, which were 1.5 - 2.0m tall (Figure 3-20). Other exotic annual species such as *Trifolium subterraneum* (Subterraneum Clover) and *Arctotheca calendula* (Capeweed) were quite dominant through the LF survey area, while several Trifolium species, especially *Trifolium arvense* (Haresfoot Clover) were abundant at AL.

In 2021, seasonal conditions continued to be favourable and with increasing competition levels of more desirable native species, there was typically a reduction in the abundance and growth rates of exotic annual weeds.

In 2022, there continued to be a range of common exotic species in both survey areas. The most abundant of these being a variety of *Trifolium* species. The more undesirable weeds such as *Echium plantagineum*, *Arctotheca calendula* and *Cirsium vulgare* had limited abundance compared to previous years and were largely restricted to small pockets of higher disturbance such as old stockcamps and/or areas where kangaroos frequently camp.

In 2023, annual weeds were in low abundance due to the dry conditions. Some thistles remained in old stockcamps under shady trees, however most in the open areas were stunted and withering. In 2024, weeds such as *Cirsium vulgare* and *Echium plantagineum* were typically in scattered in low abundance or occurred in patches in old stockcamp areas (Figure 3-21).

Figure 3-20. In 2020 the understorey of the Callitris woodlands were dominated by 1.5 - 2.0m *Echium plantagineum* in woodland at LF and AL PDO surveys areas.

Figure 3-21. This year, annual weeds were smaller, less abundant and scattered across PDO surveys areas.

3.9 Fence inspections

The exclusion fence around the Limestone Forest population previously appeared to be in good working order, with little to no evidence of overgrazing by macropods. In 2019, the ongoing drought resulted in macropods breaching the exclusion fence as fodder became more and more limited. As a result, the height of the exclusion fence was increased in an attempt to prevent macropods from entering the protected area. In 2020, the exclusion fence was replaced by a larger stronger fence and there has been no evidence of grazing by macropods since then.

The fences at AL appear to be adequate to prevent grazing from travelling livestock from the wider conservation areas. The narrow roadside verges included in the Adavale Lane population may be intermittently grazed by travelling stock and were subjected to very heavy grazing by travelling stock during drought in 2019. Heavy grazing and disturbance by macropods was also evident in the larger wooded conservation area to the north of Adavale Lane, especially during the drought. Since 2020, there has been little evidence of grazing by livestock, and resident macropod appear to have little overall impact on the area.

4 Conclusion

The orchid population densities, ground cover abundance and floristic diversity at LF and AL appear to be inherently implicated with the changes in seasonal conditions. These were also compounded with changes in disturbance and grazing pressure by resident macropods, however an exclusion fence constructed in 2020 has reduced this disturbance in the LF population. The AL orchid populations continue to be subjected to some level of macropod grazing, however currently there appears to be minimal impact. The unfenced roadside verges may also be periodically impacted by travelling stock, however impacts from livestock grazing have not been observed since 2019.

Population densities of *Diuris tricolor* have been the lowest when rainfall was limited prior to and during the emergence period (August – September) and especially in 2019. Population densities were initially highest during 2016 and then 2020 - 2022 and 2024 which had above average rainfall throughout most of year. Subsequently the density in the orchid populations have been variable, with overall populations having increased from 199 since monitoring began in 2014. Highest population counts of 3063 were recorded this year, with high densities being recorded at both survey locations.

In woodland areas at LF and AL, there was an exceptionally high abundance of undesirable annual weeds following good rainfall in 2020, however the abundance of these annual weeds has significantly declined since then. The current distribution and density of undesirable weeds are unlikely to present a threat to any of the orchid populations and no further management in the short-term is considered necessary at this time. The recurrence of problematic areas could however be targeted by a carefully designed and implemented herbicide regime, when orchids are dormant underground.

Resident macropods and/or travelling livestock may also assist in reducing the grassy biomass. While macropod numbers are not easily managed at the AL area, they could be readily manipulated within the LF exclusion area by leaving the access gate open during late winter – very early spring before PDOs emerge, and again late summer -autumn after the orchids have died off below ground level.

Continued monitoring of the orchid populations, ground cover species and their abundance combined with managed grazing levels will assist in the ongoing management requirements of the PDO populations, and these also be determined by the changes in seasonal conditions. Natural regeneration of tree species has also occurred in the population areas, with increasing numbers of tree seedling having been recorded over the past few years.

Ongoing monitoring and observation for potential management of woody weeds, biomass, exotic species competition and vertebrate pest management (as per current BOMP requirements) is required. *Swainsona sericea* and *Prasophyllum campestre* and the range of other native woodland species that also occur in the conservation areas will also benefit from the strategic management interventions that may be implemented.

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Appendix 1. Species recorded in PDO monitoring quadrats 2024

Note "1" denotes the presence of that species and is not a measure of cover abundance
Key to growth forms: t = tree; s = shrub; ss =sub-shrub; h = herb; g = grass, r = reed; v = vine; f = fern; p = parasite

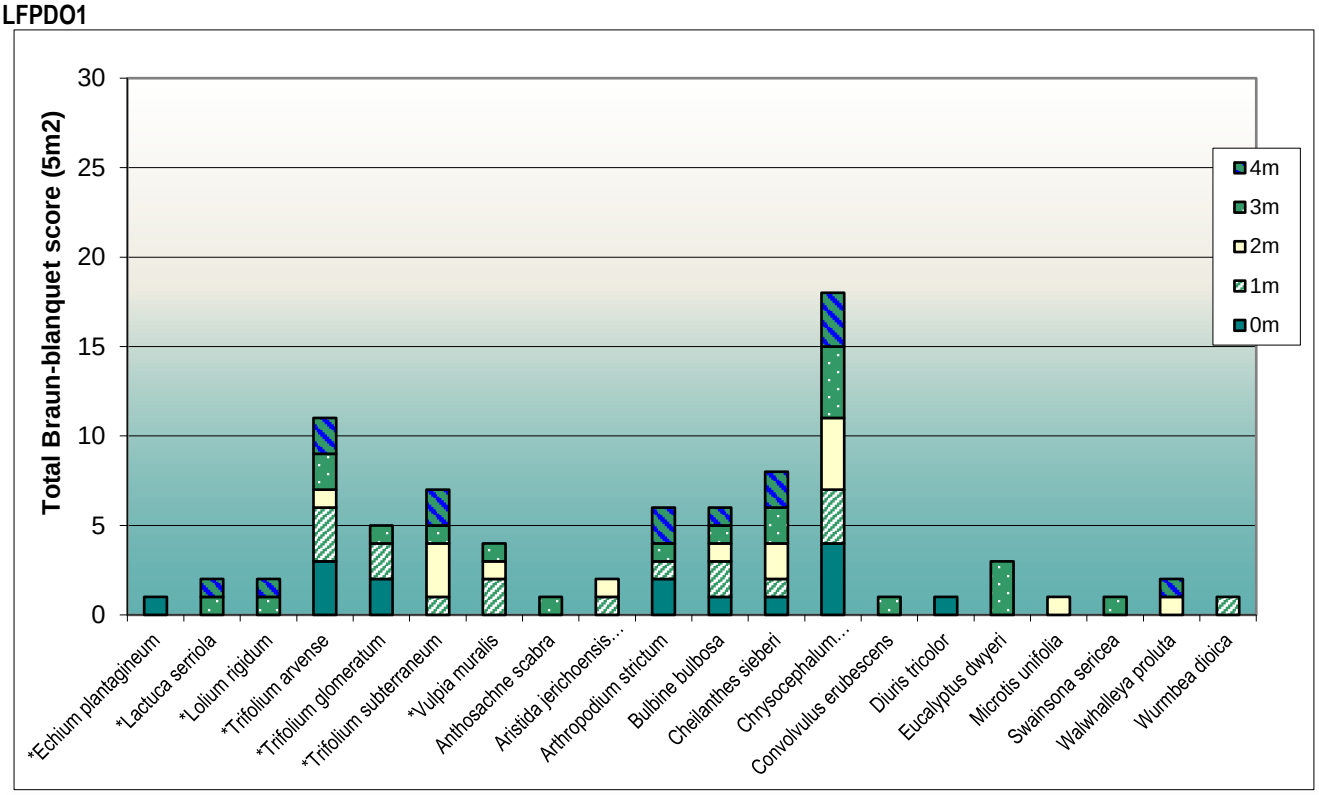
Family	exotic	Scientific Name	Common Name	Growth Form	LFPDO01	LFPDO02	LFPDO03	ALPDO01	ALPDO02	ALPDO03
Adiantaceae		*Cheilanthes sieberi*	Rock Fern	f	1	1	1	1	1	1
Amaranthaceae		*Ptilotus gaudichaudii var. gaudichaudii*	Paper Foxtail	h		1	1			
Apiaceae		*Daucus glochidiatus*	Australian Carrot	h		1			1	1
Asparagaceae		*Arthropodium strictum*	Chocolate Lily	h	1	1	1	1	1	1
Asphodelaceae		*Bulbine bulbosa*	Bulbine Lily	h	1	1	1	1	1	1
Asteraceae	*	*Aster subulatus*	Wild Aster	h					1	
Asteraceae		*Calotis lappulacea*	Yellow Burr Daisy	h	1			1	1	1
Asteraceae	*	*Carthamus lanatus*	Saffron Thistle	h					1	
Asteraceae		*Chrysocephalum apiculatum*	Common Everlasting	h	1	1	1			
Asteraceae		*Cymbonotus lawsonianus*	Bear's Ear	h					1	
Asteraceae	*	*Hypochaeris glabra*	Smooth Catsear	h	1	1	1	1		1
Asteraceae	*	*Hypochaeris radicata*	Flatweed	h		1	1	1	1	1
Asteraceae	*	*Lactuca serriola*	Prickly Lettuce	h	1			1	1	1
Asteraceae		*Senecio prenanthoides*	A Fireweed	h				1	1	
Asteraceae	*	*Sonchus oleraceus*	Milk Thistle	h		1		1	1	1
Asteraceae		*Triptilodiscus pygmaeus*	Austral Sunray	h		1				
Asteraceae		*Vittadinia cuneata*	Fuzzweed	h					1	
Asteraceae		*Xerochrysum bracteatum*	Golden Everlasting	h				1	1	1
Boraginaceae		*Cynoglossum australe*	Australian Hounds Tounge	h				1		1
Boraginaceae	*	*Echium plantagineum*	Paterson's Curse	h	1			1	1	1
Brassicaceae	*	*Lepidium africanum*	Peppercress	h				1		
Campanulaceae		*Wahlenbergia gracilenta*	Annual Bluebell	h		1				
Campanulaceae		*Wahlenbergia gracilis*	Sprawling Bluebell	h	1					
Campanulaceae		*Wahlenbergia luteola*	Australian Bluebell	h			1	1	1	1
Caryophyllaceae	*	*Cerastium glomeratum*	Mouse-ear Chickweed	h					1	

Family	exotic	Scientific Name	Common Name	Growth Form	LFPDO01	LFPDO02	LFPDO03	ALPDO01	ALPDO02	ALPDO03
Caryophyllaceae	*	*Petrorhagia nanteuilii*	Proliferous Pink	h		1	1	1	1	1
Chenopodiaceae		*Einadia nutans*	Climbing Saltbush	h						1
Colchicaceae		*Wurmbea dioica*	Early Nancy	h	1	1	1		1	
Convolvulaceae		*Convolvulus erubescens*	Australian Bindweed	h	1	1	1		1	
Convolvulaceae		*Dichondra repens*	Kidney Weed	h				1	1	1
Crassulaceae		*Crassula colorata*	Dense Stonecrop	h					1	1
Cupressaceae		*Callitris glaucophylla*	White Cypress Pine	t		1		1		1
Fabaceae (Faboideae)		*Glycine tabacina*	Variable Glycine	h						1
Fabaceae (Faboideae)	*	*Medicago polymorpha*	Burr Medic	h				1	1	1
Fabaceae (Faboideae)		*Swainsona sericea*	Silky Swainsona	h	1					
Fabaceae (Faboideae)	*	*Trifolium angustifolium*	Narrow-leaf Clover	h				1	1	
Fabaceae (Faboideae)	*	*Trifolium arvense*	Haresfoot Clover	h	1		1	1	1	1
Fabaceae (Faboideae)	*	*Trifolium campestre*	Hop Clover	h				1	1	
Fabaceae (Faboideae)	*	*Trifolium glomeratum*	Clustered Clover	h	1		1	1	1	1
Fabaceae (Faboideae)	*	*Trifolium hirtum*	Rose Clover	h				1		
Fabaceae (Faboideae)	*	*Trifolium repens*	White Clover	h				1		
Fabaceae (Faboideae)	*	*Trifolium subterraneum*	Subterraneum Clover	h	1	1	1			
Geraniaceae	*	*Erodium cicutarium*	Common Crowsfoot	h				1		
Goodeniaceae		*Velleia paradoxa*	Spur Velleia	h	1		1			
Lamiaceae	*	*Salvia verbenaca*	Wild Sage	h				1		
Lomandraceae		*Lomandra collina*	A Mat-rush	h		1				
Malvaceae		*Sida corrugata*	Corrugated Sida	h				1		1
Myrtaceae		*Eucalyptus dwyeri*	Dwyer's Red Gum	t	1	1				
Orchidaceae		*Diuris tricolor*	Pine Donkey Orchid	h	1	1	1	1		1
Orchidaceae		*Microtis unifolia*	Common Onion Orchid	h	1	1	1		1	
Orchidaceae		*Prasophyllum campestre*	A Leek Orchid	h		1				
Orchidaceae		*Pterostylis bicolor*	Bicolor Greenhood	h		1	1	1		
Oxalidaceae		*Oxalis perennans*	Yellow Wood-sorrel	h				1		
Poaceae	*	*Aira cupaniana*	Silvery Hairgrass	g		1	1			
Poaceae		*Anthosachne scabra*	Common Wheatgrass	g	1					
Poaceae		*Aristida jerichoensis var. jerichoensis*	Jericho Wiregrass	g	1	1	1			

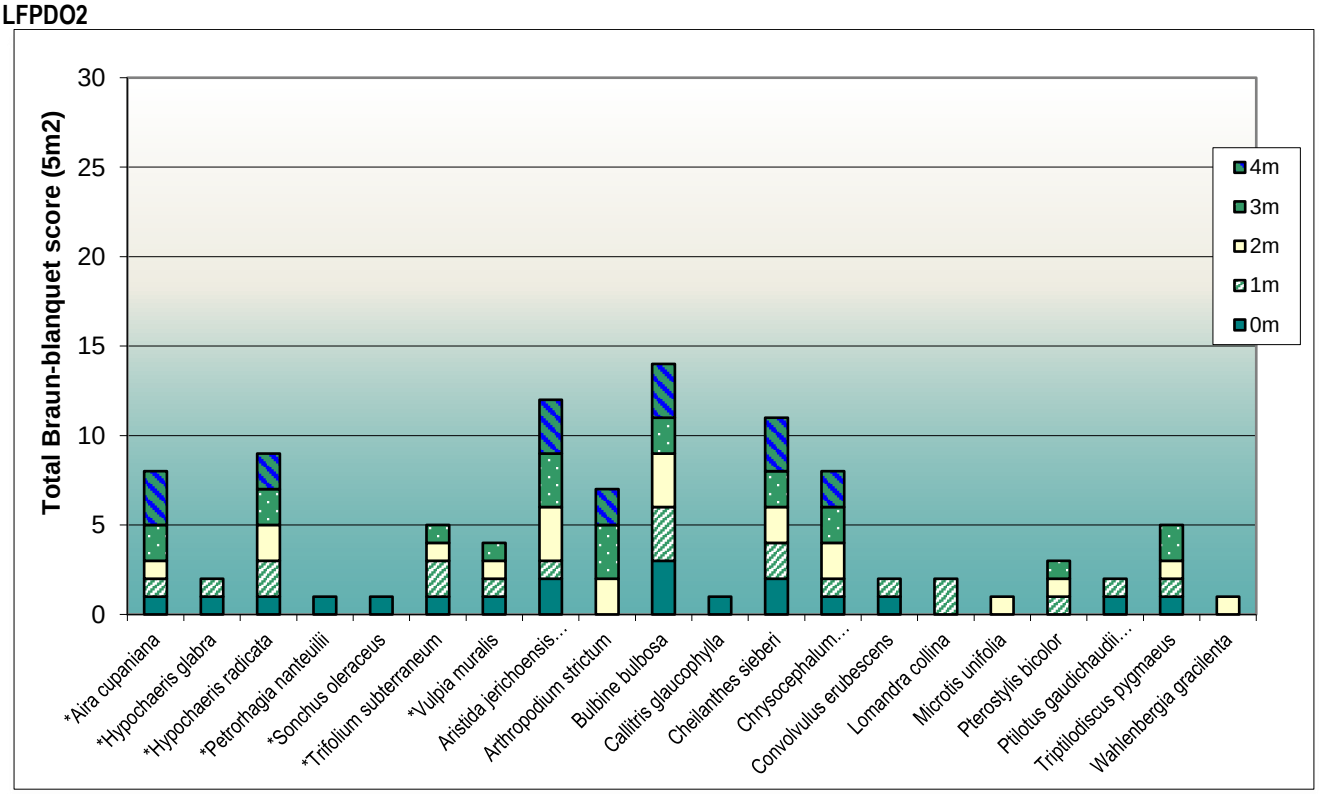
Family	exotic	Scientific Name	Common Name	Growth Form	LFPDO01	LFPDO02	LFPDO03	ALPDO01	ALPDO02	ALPDO03
Poaceae		*Austrostipa bigeniculata*	Tall Speargrass	g				1		
Poaceae		*Austrostipa scabra*	Speargrass	g				1	1	1
Poaceae	*	*Avena fatua*	Wild Oats	g				1	1	
Poaceae		*Bothriochloa macra*	Red-leg Grass	g				1	1	
Poaceae	*	*Bromus hordeaceus*	Soft Brome	g				1		1
Poaceae	*	*Eragrostis curvula*	African Lovegrass	g				1		
Poaceae	*	*Lolium rigidum*	Wimmera Ryegrass	g	1			1		1
Poaceae		*Panicum effusum*	Hairy Panic	g						1
Poaceae		*Panicum sp.*	A Panic	g				1	1	
Poaceae		*Rytidosperma caespitosum*	Wallaby Grass	g				1		
Poaceae		*Rytidosperma setaceum*	Small-flowered Wallaby Grass	g					1	
Poaceae		*Sporobolus creber*	Western Rat's-tail Grass	g				1	1	
Poaceae	*	*Vulpia muralis*	Rats-tail Fescue	g	1	1	1	1	1	1
Poaceae		*Walwhalleya proluta*	Rigid Panic	g	1					1
Polygonaceae		*Rumex brownii*	Swamp Dock	h	1					

Appendix 2: Species cover abundance in individual 5x5m monitoring plots in 2024

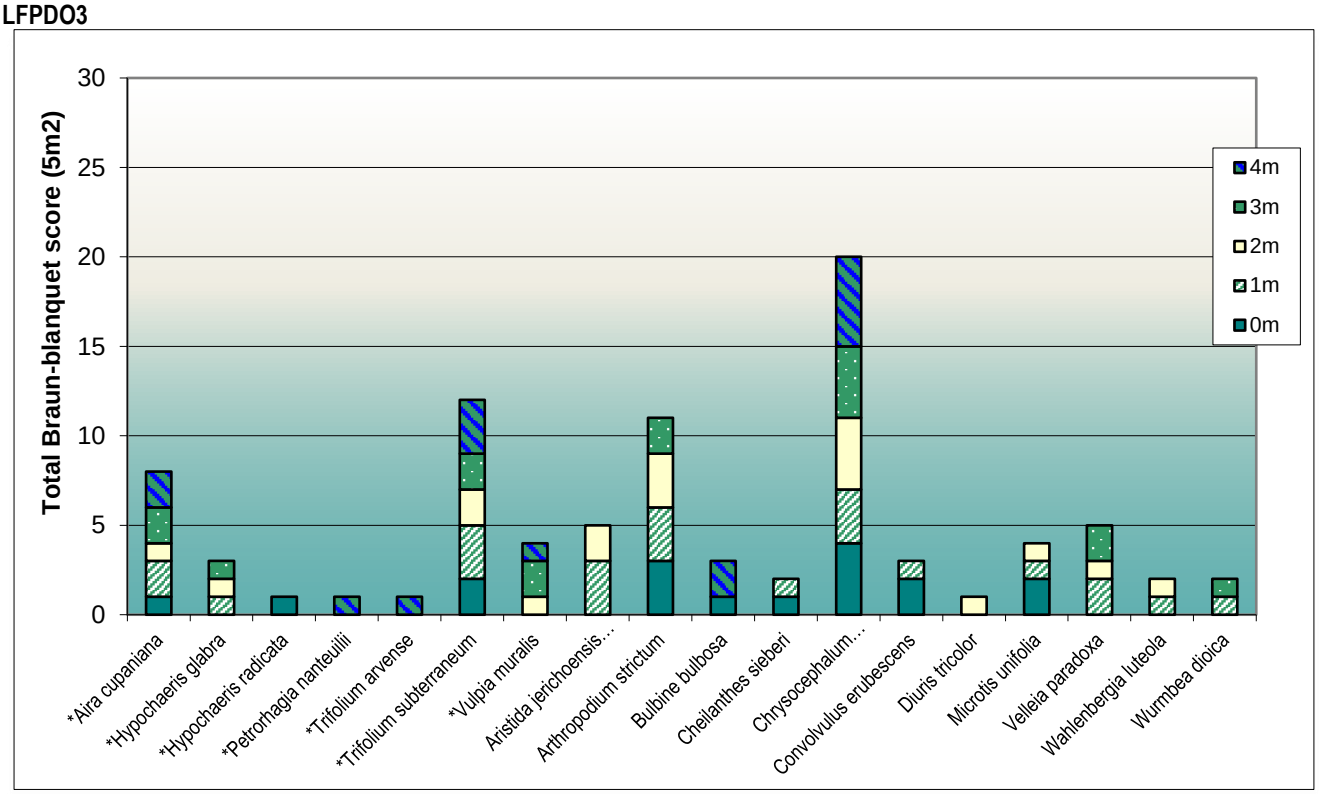
LFPDO1



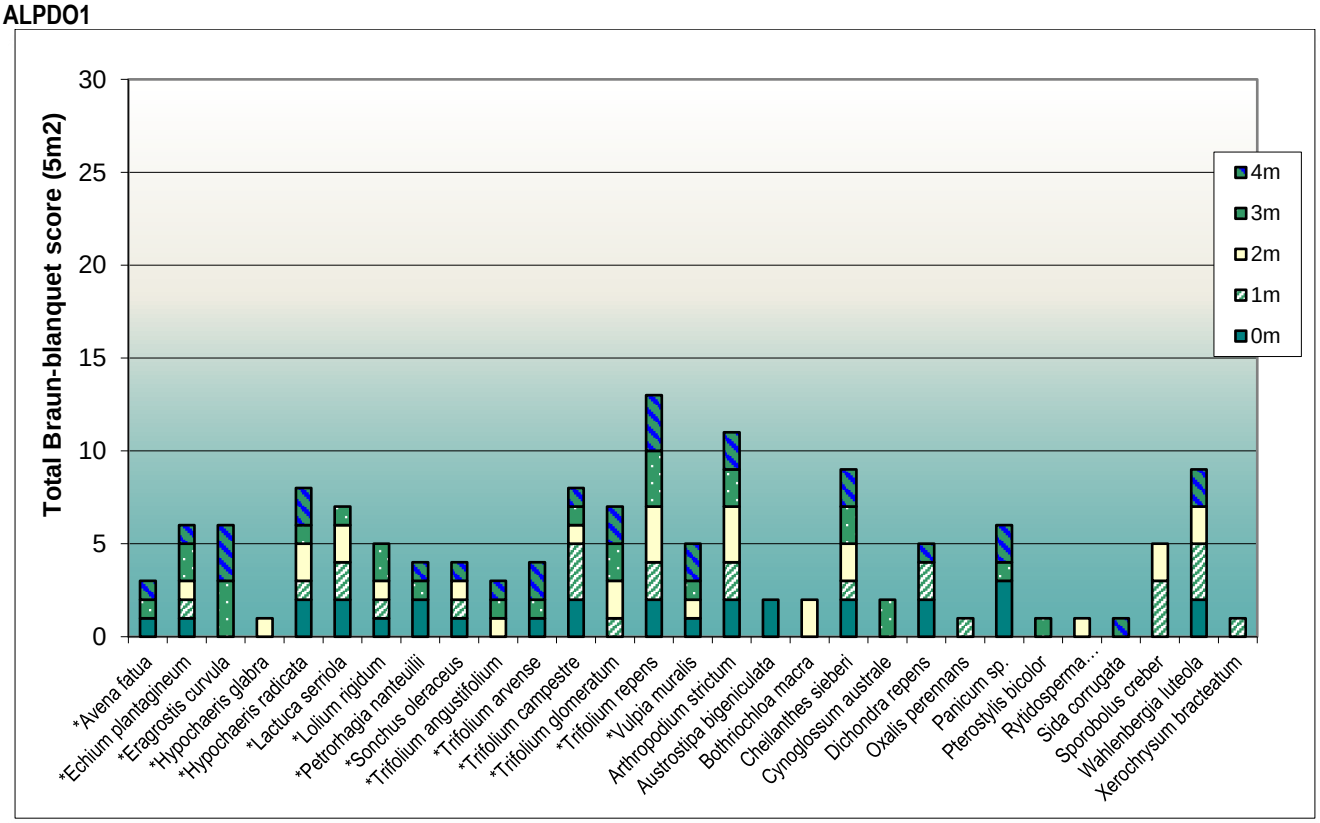
LFPDO2



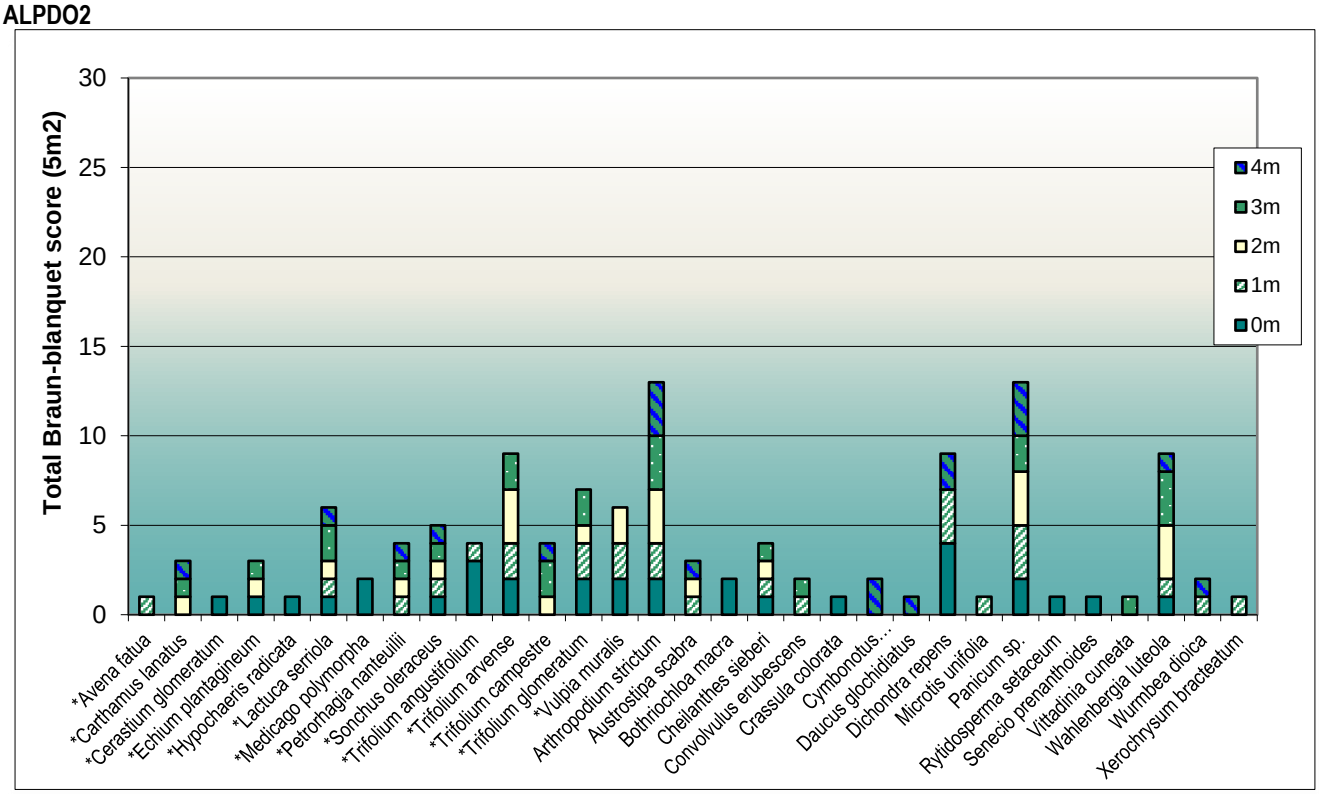
LFPDO3



ALPDO1



ALPDO2



ALPDO3