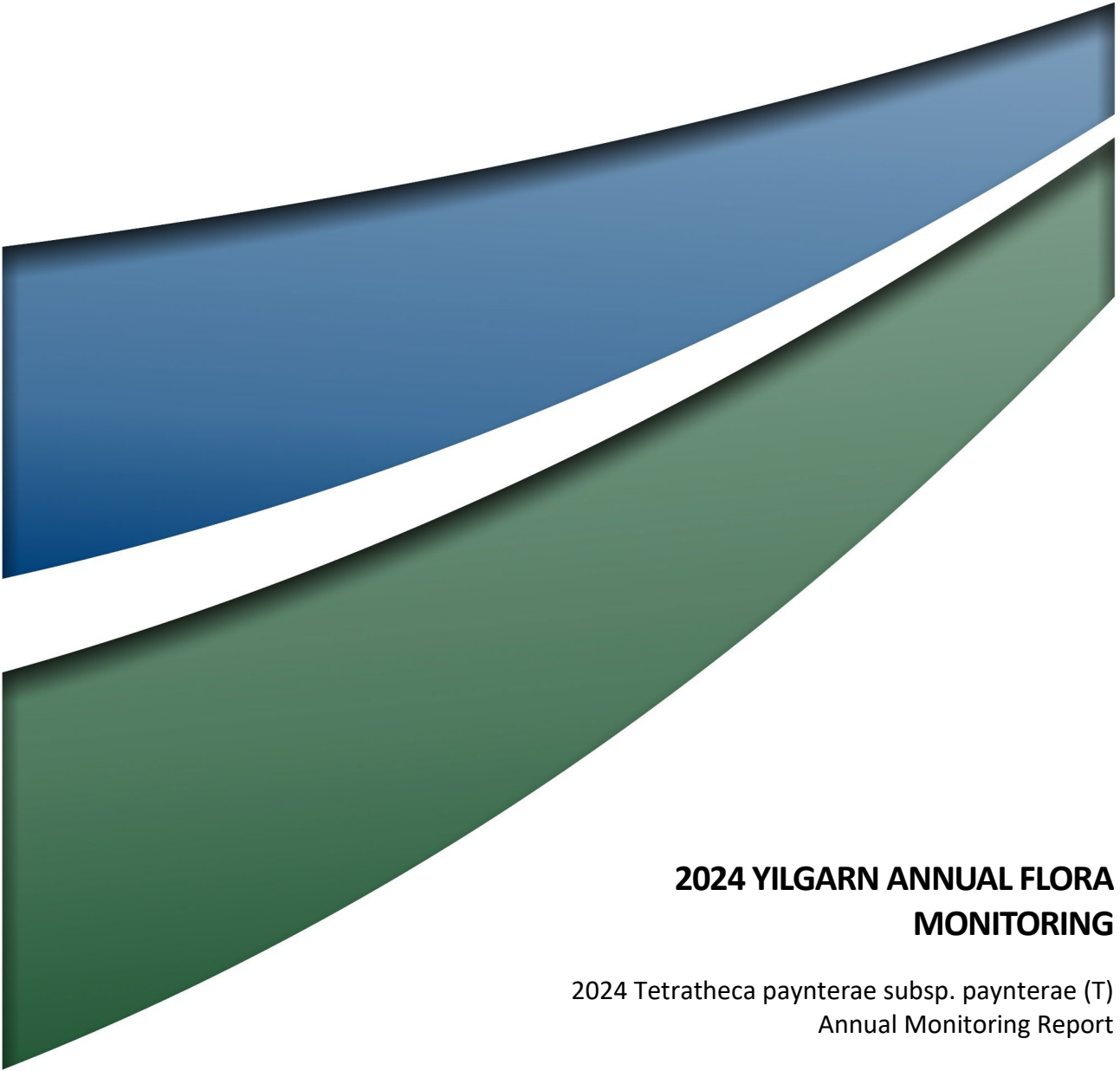




2024 YILGARN ANNUAL FLORA MONITORING

2024 *Tetratheca paynterae* subsp. *paynterae* (T)
Annual Monitoring Report

FINAL

March 2025

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Annual Monitoring Report

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Mineral Resources Limited

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Report No. 24247/R08
Date: March 2025



This report was prepared using
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Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

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1.0 Introduction

Yilgarn Iron Pty Ltd (YIPL) is a wholly owned Mineral Resources Limited (MinRes) subsidiary that owns iron ore, fixed plant, equipment, and non-process infrastructure in the Yilgarn Operations and at the Port of Esperance. Yilgarn Operations are located approximately 50 km northeast of Southern Cross in the Yilgarn Region of Western Australia within the local government area of Shire of Yilgarn and Shire of Menzies. The Yilgarn Operations comprises five discrete mine sites including Koolyanobbing, Mt Jackson, Windarling, Deception, and Parker Range. To date the Project area has been subject to mining activities for an extended period, as far back as the 1950s at Koolyanobbing. As operations ceased and restarted, the mining areas expanded out to include Mt Jackson, Windarling, and Deception. Current activities at the project include active mining across Deception (Deception and Claw Pits), Koolyanobbing (A pit) and Windarling (W1, W3 and W10 Pits), with waste material being deposited across several waste rock landforms, and as backfill in sterilised pits.

The environmental aspects of the project are managed in accordance with YIPL's Environmental Policy and Environmental Management System (EMS). The Yilgarn Operations Flora and Vegetation Management Plan (FVMP) (MRL, 2019) forms part of YIPL's EMS. The management plan has been prepared to address:

- Environmental risk associated with flora and vegetation for all YIPL's Yilgarn Operations.
- Statutory obligations relating to flora and vegetation, under Ministerial Statement 982, applying to YIPL's operations at Windarling, Mt Jackson, Deception, Koolyanobbing, and the haul roads and associated infrastructure.

The Windarling Range Project located approximately 160 Km northeast of Southern Cross involves mining of iron ore near Windarling Peak with processing at Koolyanobbing and then road and rail transport to the Port of Esperance for export.

Tetratheca paynterae subsp. *paynterae* (*T. paynterae* subsp. *paynterae*), listed as Critically Endangered (CR) under the *Biodiversity Conservation Act 2016* (BC Act) and Endangered (EN) under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), is known only to the Windarling Range.

Specific management actions related to obligations under the YIPL environmental approval (Ministerial Statement 982) outlined in the FVMP, includes undertaking annual monitoring of Rare Flora taxa and native vegetation for potential impacts from mining operations.

As part of the approvals for the Windarling Range Project, ongoing monitoring of *T. paynterae* subsp. *paynterae* has been conducted since 2011 in accordance with Ministerial Statement 982.

1.1 Scope of works

Umwelt was commissioned by MinRes to conduct the 2024 *Tetratheca paynterae* subsp. *paynterae* annual monitoring and reporting within the Windarling Range in accordance with the Yilgarn Operations FVMP (MRL, 2019). The results of the 2024 annual monitoring are presented in this report.

1.2 Background

1.2.1 Climate

The climate of the Southern Cross subregion is described as arid to semi-arid warm Mediterranean, with 250–300 mm of mainly winter rainfall. The nearest Bureau of Meteorology (BoM) weather station with comprehensive data collection and recent historic climate data is Windarling (no. 012141), located approximately 2 km south of the monitored populations of *T. paynterae* subsp. *paynterae*. Some historical gaps in rainfall data exist for the Windarling weather station, including a lack of data after August 2023. For this reason, rainfall data from the next nearest weather stations, Koolyanobbing (no. 012227) approximately 100 km south of Windarling and Southern Cross Airfield (no. 012320) approximately 136 km south of Windarling, have been utilised where gaps exist, prioritising Koolyanobbing rainfall data over Southern Cross.

The average long term annual rainfall received at Windarling between 2005 and 2023 was 274.3 mm per year (BoM, 2024). The average annual rainfall for Southern Cross Airfield (298.3 mm (BoM, 2024)) has been included for comparison to the rainfall in the 12 months preceding the 2024 annual monitoring due to a lack of available data for Windarling and Koolyanobbing weather stations. Timing and the amount of rainfall is known to effect the population dynamics of *T. paynterae* subsp. *paynterae* (DPaW, 2016). A total rainfall of 178.7 mm is estimated in the 12 months prior to the 2024 annual monitoring. **Appendix A** presents the climate data and sources utilised within this report.

Figure 1.1 presents the total annual rainfall (**Appendix A** presents the source of data for each month) recorded during the 12-month period prior to each annual monitoring of *T. paynterae* subsp. *paynterae* since 2011. The Windarling average long-term annual rainfall (274.3 mm) has been included for comparison in years 2011–2023. As there was incomplete rainfall data for Windarling in the 12 months prior to monitoring, the Southern Cross Airfield long-term average (298.3 mm) is included 2023/2024. Four of the last five years have recorded lower than average annual rainfall, three of which are over 40% lower than the long-term average.

Figure 1.2 presents the total monthly rainfall recorded in the 12 months prior to the 2024, 2023 and 2011 annual monitoring with reference to the long-term average annual rainfall at the Windarling and Southern Cross weather stations. In the six months leading up to the October 2024 annual monitoring the estimated monthly rainfall was higher in every month compared to records from the preceding year. Note that these monthly totals are a combination of Koolyanobbing and Southern Cross Airfield weather station records due to the lack of data available for Windarling.

The Southern Cross Airfield weather station is the closest source for temperature data. The mean monthly temperature for the 12 months prior to the 2011, 2023 and 2024 monitoring and the long-term mean monthly temperatures at Southern Cross Airfield weather station are presented in **Figure 1.3**. Mean monthly temperatures at Southern Cross Airfield were relatively consistent with the long-term average throughout the 12 months prior to the 2024 annual monitoring.

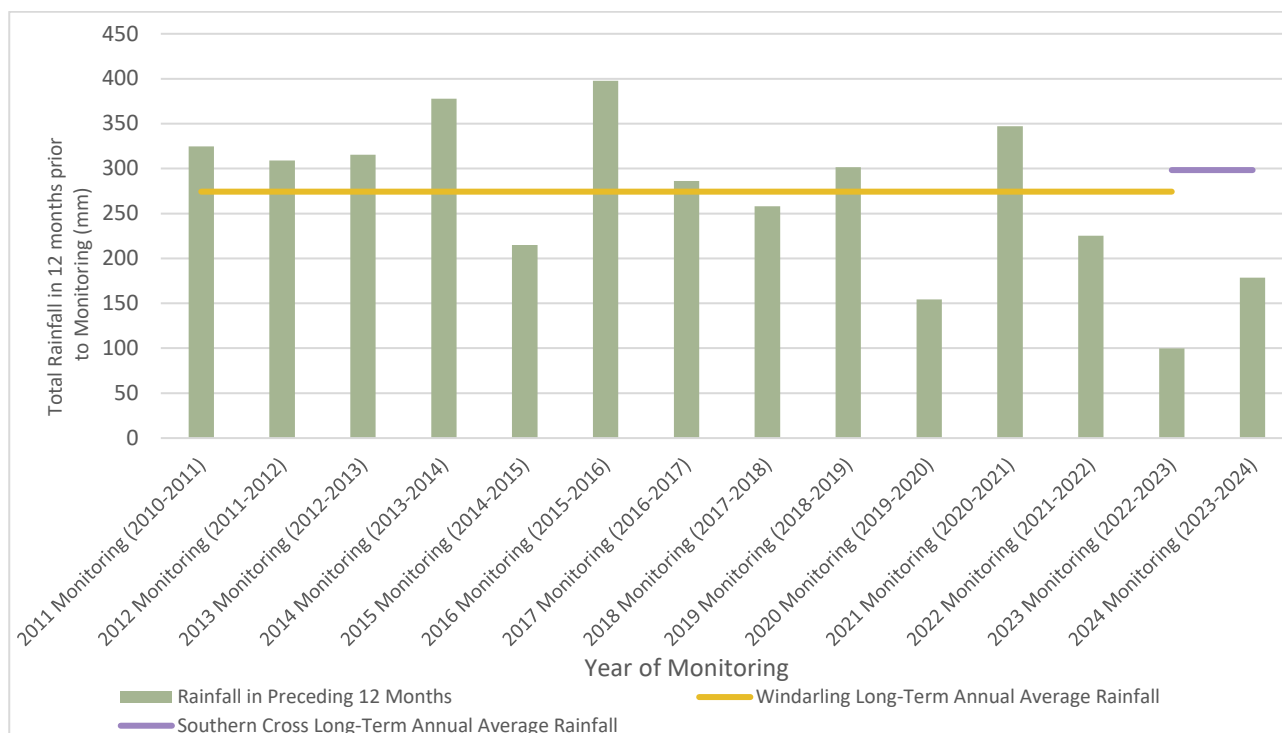


Figure 1.1 Annual Rainfall at Windarling and Koolyanobbing/Southern Cross Airfield (2023–2024 only) for the 12 Months Prior to Each Annual Monitoring Event

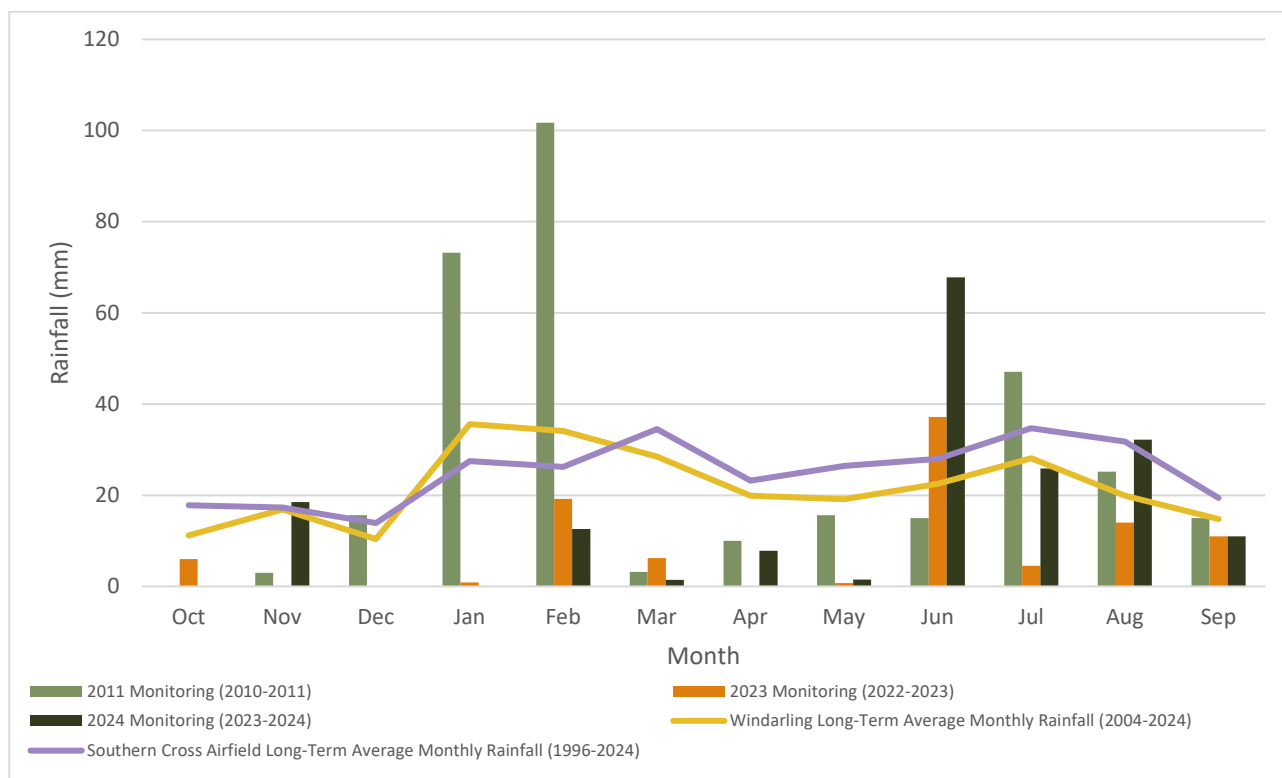


Figure 1.2 Monthly Rainfall Data for the 12 Months Prior to Annual Monitoring in 2024, 2023 and 2011

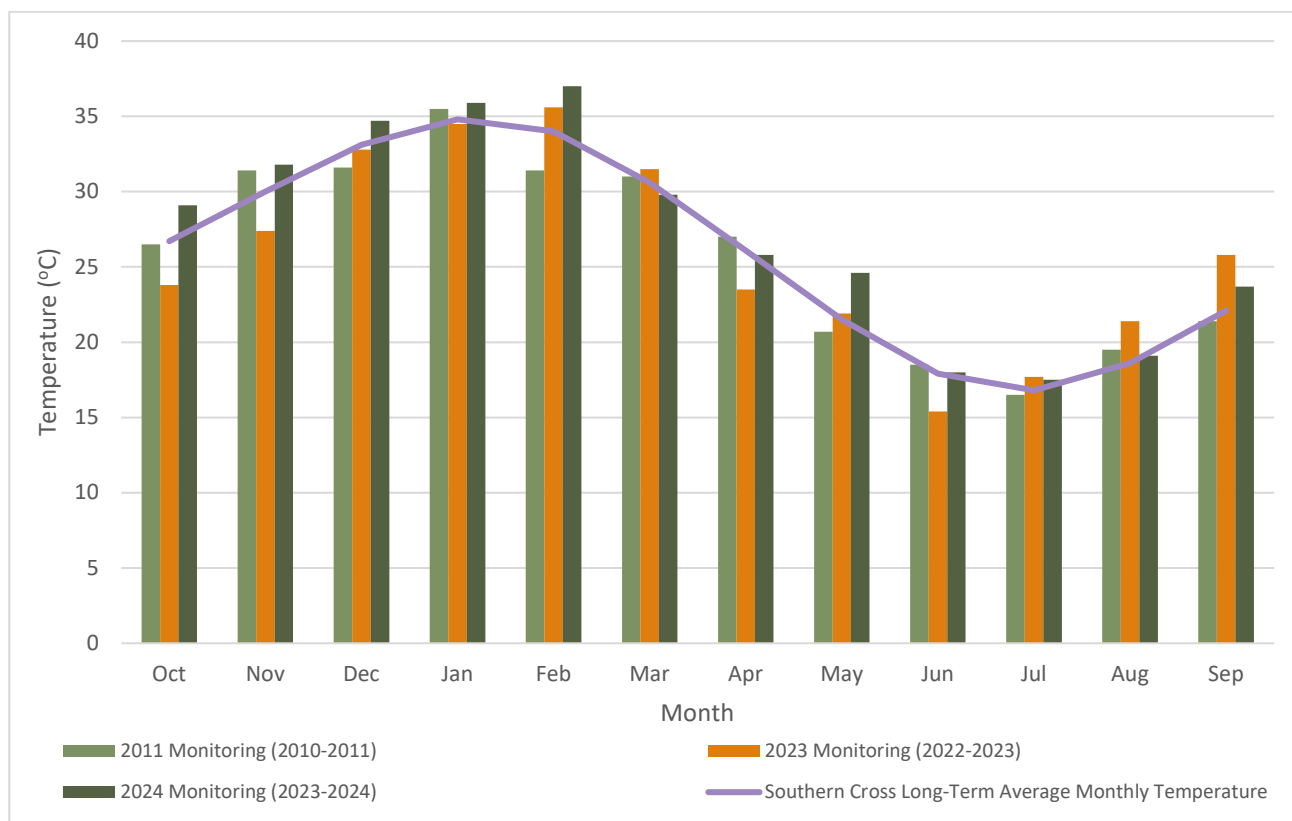


Figure 1.3 Southern Cross Airfield Mean Monthly Temperature in 12 months Prior to Monitoring in 2011, 2023 and 2024, Including the Long-term Mean Monthly Temperature

1.2.2 Monitoring History

Monitoring of *T. paynterae* subsp. *paynterae* has been undertaken at Windarling since 2003. A review of the sampling methodology was undertaken by Data Analysis Australia (DAA) in 2011, finding that sampling allowed for notable quantitative gaps concerning reproductive rates and survival of young plants, and failed to address the need to adequately monitor the sustainability of the population (DAA, 2011). DAA recommended an updated sampling methodology aiming to monitor reproductive success (new seedlings), proportion of population in a reproductive state, plant death and survival of young plants.

Annual monitoring of *T. paynterae* subsp. *paynterae* subsequent to the review conducted by DAA, 2011, has employed the same methodology to the current date.

2.0 Methodology

2.1 Monitoring Methodology

The revised monitoring design recommended by DAA (2011) consists of monitoring approximately 1,000 plants across the Windarling Ridge. To achieve this sample size, six existing monitoring blocks were selected ensuring that the sub-sample would capture dynamics that were representative of the entire population. This included one block from the area most likely to be affected by mining activity (Area B), one block from the western end of the ridge, one block from the southern side of the ridge and three blocks from the remaining main section. Using this approach, DAA drew a random sample with blocks 4, 23, 29, 40, 45, 85 and 90 being selected for monitoring (**Figure 2.1**).

In addition, a number of individuals within each block were randomly selected for condition assessment (percentage of alive foliage) applying the method developed by DAA (2011). DAA (2011) recommended that a subsample of 80–100 individuals should be sufficient to detect meaningful change. Based on this recommendation, 139 plants were randomly selected in 2011 for condition assessment. Since then, the condition of the same randomly selected plants has been recorded each year. Dead individuals are replaced using the methods developed by DAA (2011).

Plant Monitoring

All *T. paynterae* subsp. *paynterae* individuals within the blocks were tagged with plastic sheep tags with a unique identification number. For each individual within the selected monitoring blocks the following information is recorded annually:

- Block number
- Unique plant identification number
- Width (cm) (for new individuals only)
- Plant Status (Reproductive, Vegetative, Juvenile (1–3 years old), Seedling (<1 year old), or Dead)
- Presence/absence of flowers/fruits/buds.

For the random sub-sample of the monitoring population to have condition assessed, the percentage of 'alive plant' is also recorded. Newly dead plants that were historically assessed for condition are replaced with another randomly selected plant utilising the DAA (2011) methodology.

Dust Monitoring

Dust deposition data is collected monthly from 16 deposition gauges in proximity to the *T. paynterae* subsp. *paynterae* monitoring blocks, with an additional five gauges located at control sites (**Figure 2.1**). The measurement of dust from each gauge is recorded in grams of ash per square meter per month (Ash/g/m²/month). An acceptable level of 40 g/m²/month has been determined not to have a negative impact on the health and condition of individuals at Windarling. MRL – PLEASE CONFIRM SOURCE OF THE LEVEL



Legend

Dust Deposition Gauge

- | | |
|---|--|
| ● A | ● G |
| ● B | ● H |
| ● C | ● I |
| ● D | ● J |
| ● E | ● P1A |
| ● F | ● P1B |
| | ● P2A |

● P2B

● P3A

● P3B

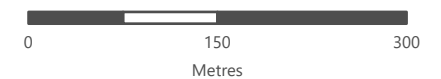
Monitoring Blocks

Annual Monitoring Blocks

Census Monitoring Blocks

FIGURE 2.1

Tetratheca paynterae subsp.
paynterae Annual Monitoring
Blocks and Dust Deposition
Gauges



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Image Source: ESRI Basemap (2023) | Data Source: Landgate (2024), DBCA (2024), Umwelt (2024), SynergyRED (2024)

2.2 2024 Monitoring

The 2024 annual monitoring was conducted between 21–25 October by Umwelt.

Plants of *T. paynterae* within seven monitoring blocks (4, 23, 29, 40, 45, 85 and 90) were assessed, recording data on the aspects outlined in **Section 2.1**. All individuals within each block were assessed. This included plants not previously tagged (juvenile or later development). For individuals that could not physically be reached safely, assessment was made using binoculars.

Newly identified individuals in 2024 were incorporated into the monitoring by glueing a red plastic tag (with unique number between 3,701 and 3,800) as close as possible whilst still visible to the plant. **Photo 2.1** presents an example of a newly tagged individual. Coordinates of the plant's location were recorded, with a photo.

Individuals selected for condition assessment between 2011 and 2022 were reassessed for condition in 2024. Plants that were recorded as newly dead in 2023, and dead in 2024 were replaced by another randomly selected individual for condition assessment. Newly dead plants in 2024 were not replaced so that the decline in health could be captured in the data.



Photo 2.1 Newly Tagged *Tetratheca paynterae* subsp. *paynterae*

2.3 Data Analysis

Data analysis conducted in 2024 followed the same protocol for analysis presented in previous annual monitoring reports. The data collected in 2024 was compared to the data from monitoring conducted in 2011 (first year using the current methodology) and 2023 (previous years data).

All statistical analysis in 2024 will be conducted internally by MinRes, as per written instruction to Umwelt.

3.0 Results

3.1 Population Assessment

Table 3.1 presents a summary of the results from the assessment of seven monitoring blocks in 2024, and summaries from 2011 and 2023 for comparison.

Table 3.1 Summary of Results from 2011, 2023 and 2024 Annual Monitoring

Plant Status/Category	2011	2023	2024	Change 2011–2024	Change 2023–2024
Dead	189	423	489	300	66
Seedling ¹	26	5	44	18	39
Seedlings as % of Total Alive Population	3%	<1%	5%	-	-
Juvenile ¹	10	26	25	15	-1
Vegetative	95	171	115	20	-56
Reproductive	797	553	630	-168	76
Reproductive as % of Total Alive Population	86%	73%	77%	-	-
Not Located/not accessible ²	0	52	5	5	-47
Total Alive Population ^{2, 3}	928	755	814	-117	56
Total Population ²	1117	1230	1308	191	78
Percentage Total Population Alive (%)	83	61	62	-21	1
¹ plants recorded as seedlings one year are recorded as juvenile the following year, unless reproductive or dead.					
² does not include plants that were previously assessed but deemed outside of the monitoring block in 2024					
³ excludes plants that were not found					

In summary:

- 1303 *T. paynterae* subsp. *paynterae* individuals were assessed during the 2024 annual monitoring. This number represents the monitored population, including individuals that were Reproductive, Vegetative, Seedling, Juvenile and Dead. Individuals that were Not Located in 2024 have been left out as they were not physically assessed.
- The Total Population in 2024 increased to 1308. This includes Reproductive, Vegetative, Seedling, Juvenile, Dead and the Not Located individuals.
- 814 individuals were recorded as Alive in 2024, representing 62% of the Total Population, comparable to the results of the 2023 annual monitoring (61%). It is important to note that 52 individuals (4% of the Total Population) in 2023 were Not Located. These Not Located individuals in 2023 are likely to have influenced the outcome of the Percentage Total Population Alive in 2023.

- Of the Total Alive population in 2024, 77% (630 individuals) were Reproductive (flowers, fruits and/or buds) and 14% (115 individuals) were recorded as vegetative.
- 44 new seedlings and 25 juveniles were recorded in 2024, representing 5% and 3% respectively of the Total Alive Population.
- A total of 489 Dead individuals (cumulative count of Dead individuals since 2011) were recorded in 2024, of which 57 were newly recorded as Dead.

Figure 3.1 presents the proportion of the monitored population in 2011, 2023 and 2024 at each life stage. A similar trend in the proportion of Reproductive and Vegetative individuals can be seen throughout most of the blocks between all three years. All blocks show a reduction in the proportion of Reproductive individuals from 2011 to 2023, before a slight increase in this proportion from 2023 to 2024 (except for block 90 (closest to the pit) which has continued to decline from 2023 to 2024). The proportion of Vegetative individuals within each block has decreased between 2023 and 2024. This is associated with an increased proportion of the population that are Reproductive in 2024.

3.1.1 Total Alive

The Total Alive individuals, as well as the number of plants Not located, each year is presented in **Figure 3.2**. Monitoring in 2024 recorded the highest number of alive individuals (814 individuals; 7.8% increase since 2023) since 2017 (820 individuals). There is a general declining trend in the Total Alive individuals since 2011, with the exception of 2019 and 2022 (less than 3% increase in both cases) where slight increases were observed.

Figure 3.3 provides a breakdown of the number of Alive individuals by monitoring block between 2011 and 2024. The Total Alive individuals was lower in 2024 than 2011 in all monitored blocks except block 40 that shows an increase in 2024. Total Alive individuals was observed to generally increase between 2023 and 2024, except blocks 4 and 90. Block 40 recorded the highest number of alive individuals since the commencement of monitoring in 2011 with 160 individuals and had a 5.3% increase from 2011. Block 90 (closest to the pit) has a consistent trend in decreasing Total Alive individuals since 2011.

3.1.2 Reproductive Status

An 8.2% increase in the reproductive percentage of the mature population was observed between 2023 and 2024 (**Figure 3.4**). From **Figure 3.4** a general relationship between rainfall received in the 12 months preceding each survey and the proportion of reproductive mature plants is observed. This is evident to varying degrees for all years except for 2014 and 2022, indicating that other factors have influenced reproductivity. The timing of rainfall potentially affects the reproductive status of the plants. Although below average rainfall was received in the 12 months prior to the 2024 monitoring (**Figure 1.1**), the monthly rainfall was above average during June (67.8 mm) and August (32.2 mm) leading up to the 2024 surveys conducted in October (**Figure 1.2**).

Figure 3.5 presents the proportion of Reproductive individuals within each monitoring block in 2011, 2023 and 2024. There is a decrease in the proportion of reproductive individuals from 2011 to 2023 and 2024 within every monitoring block. Little variability was observed in the proportion of Reproductive individuals within each monitoring block between 2023 and 2024 (four blocks recorded a slight increase whilst three blocks recorded a slight decrease).

Figure 3.6 presents the proportions of the reproductive population with Flowers, Fruits and/or Buds during the 2011, 2023 and 2024 annual monitoring. In 2024, 7.1% of the reproductive population displayed Buds, 74% displayed Flowers and 60.3% displayed Fruits. The proportion of plants observed with buds decreased from 85% in 2011 to 22% in 2023 and only 7.1% in 2024. This is the lowest rate of observed buds since 2011. The lower bud presence may be due to early rainfall resulting in longer time for development of buds to flowering and/or the determination of a bud vs a very young flower. The proportion of plants with Flowers and Fruits was generally similar in 2011, 2023 and 2024.

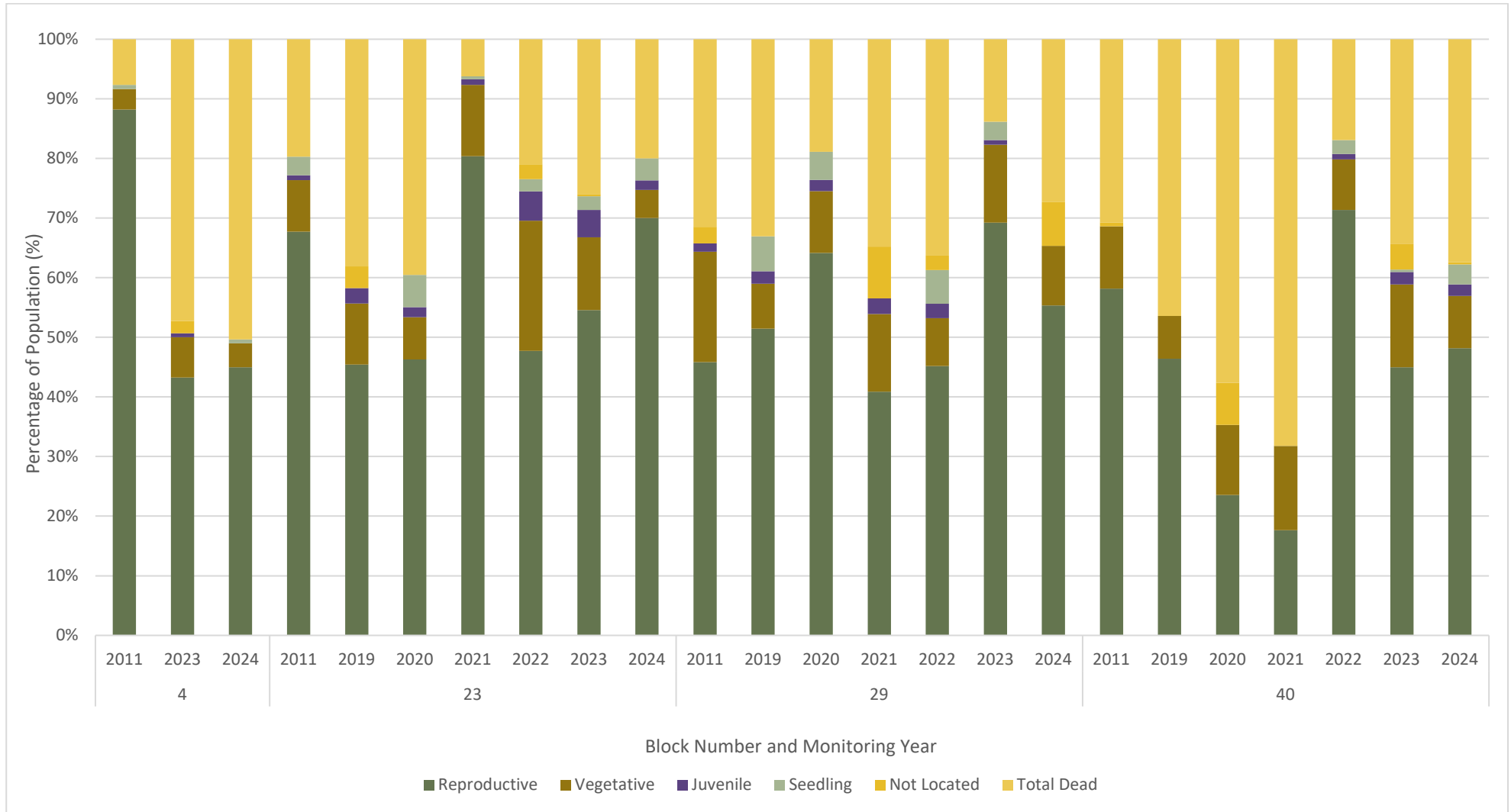


Figure 3.1 Population within Each Block at Each Life Stage in 2011, 2023 and 2024

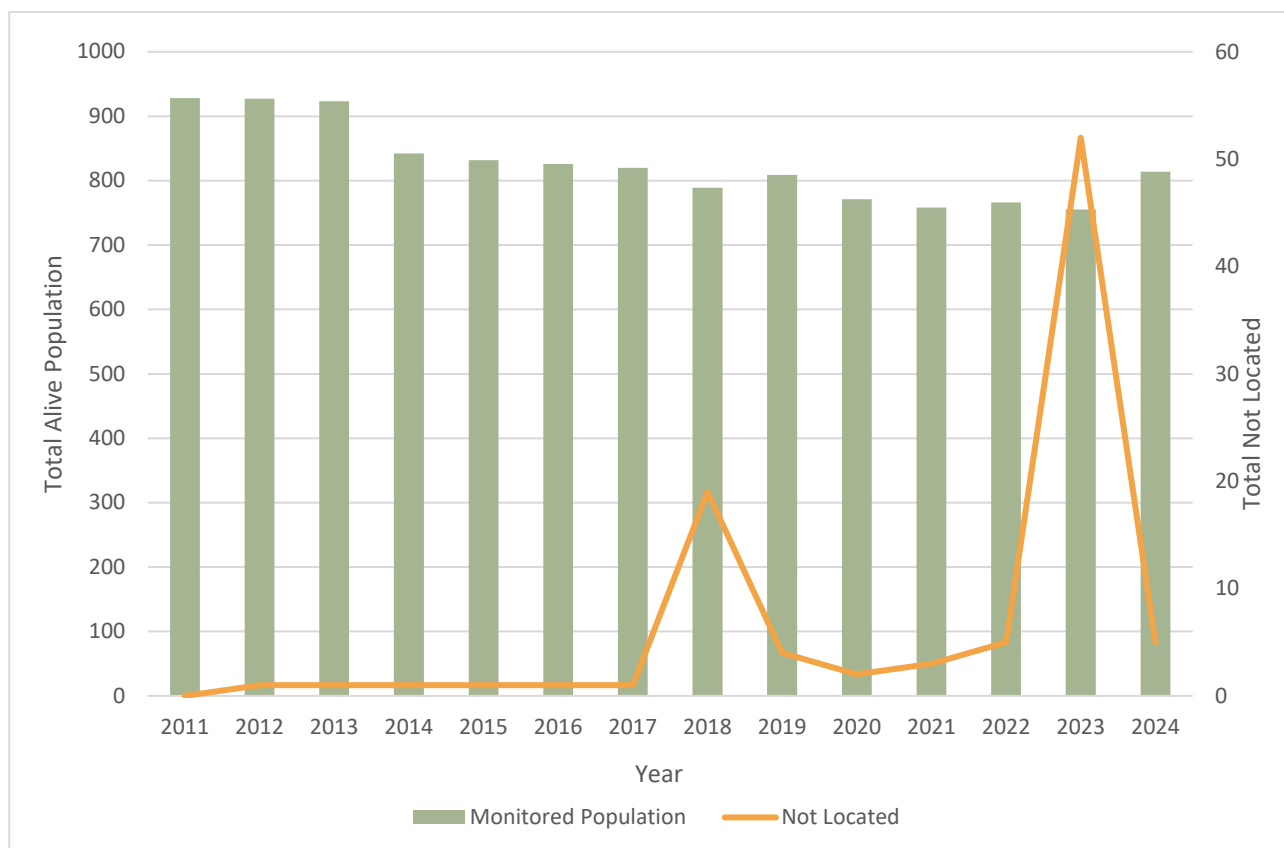


Figure 3.2 Total Number of Alive Plants Each Year Since 2011, Including the Number of Plants Not Located

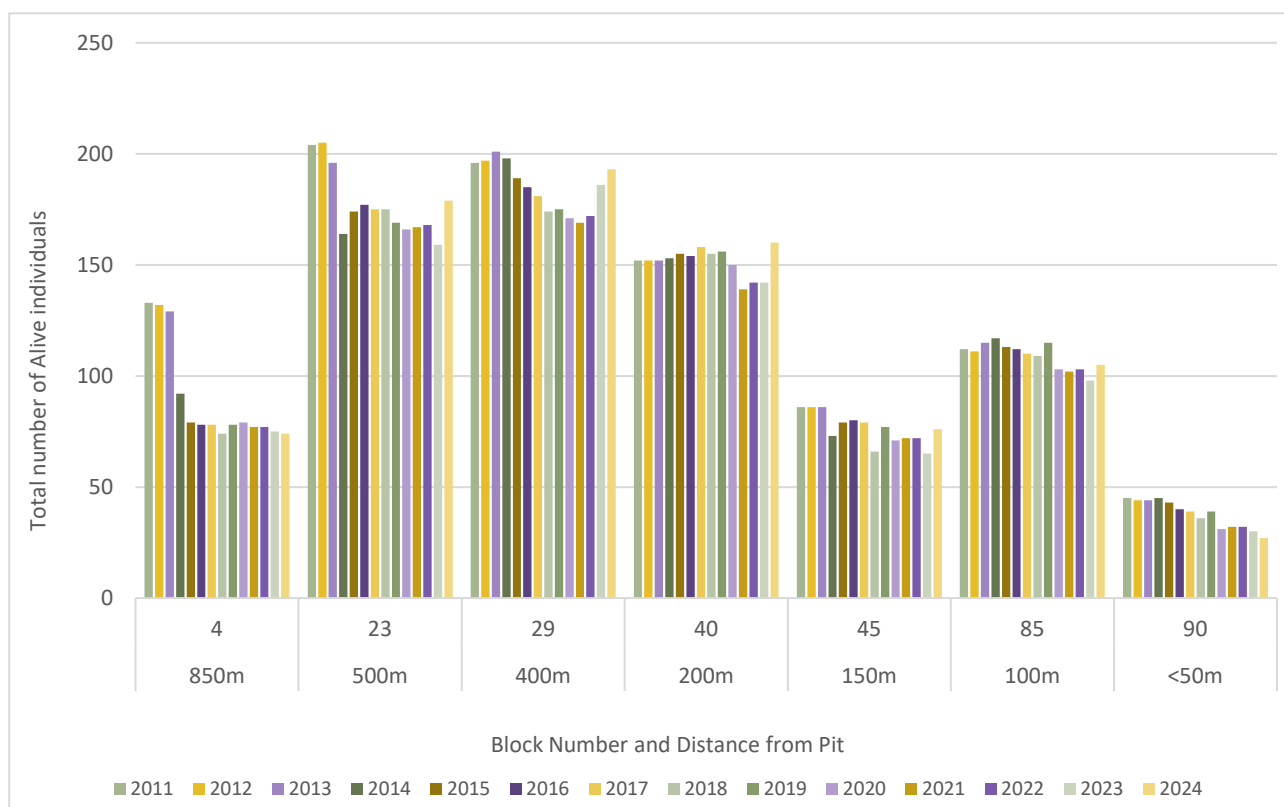


Figure 3.3 Number of Alive Individuals within Each Block Between 2011 and 2024

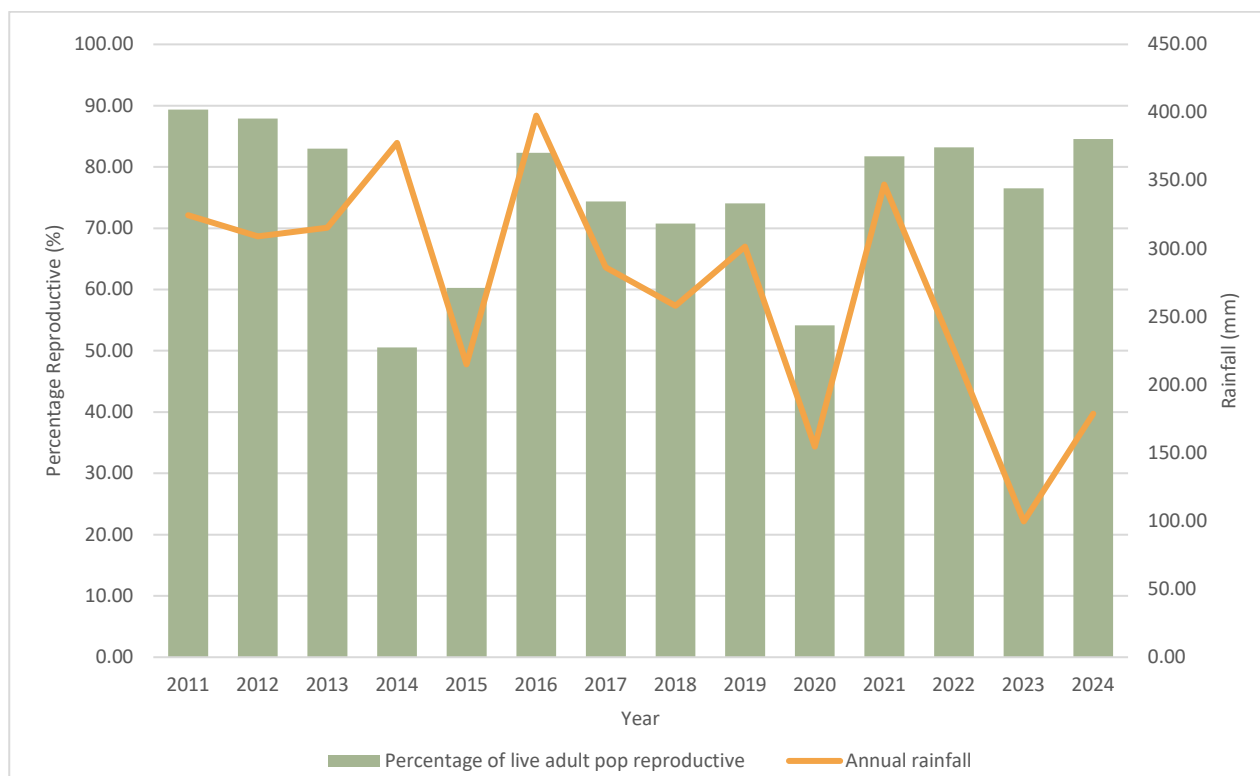


Figure 3.4 Percentage of Alive Population that is Reproductive and the Annual Rainfall for Each Year Between 2011 and 2024

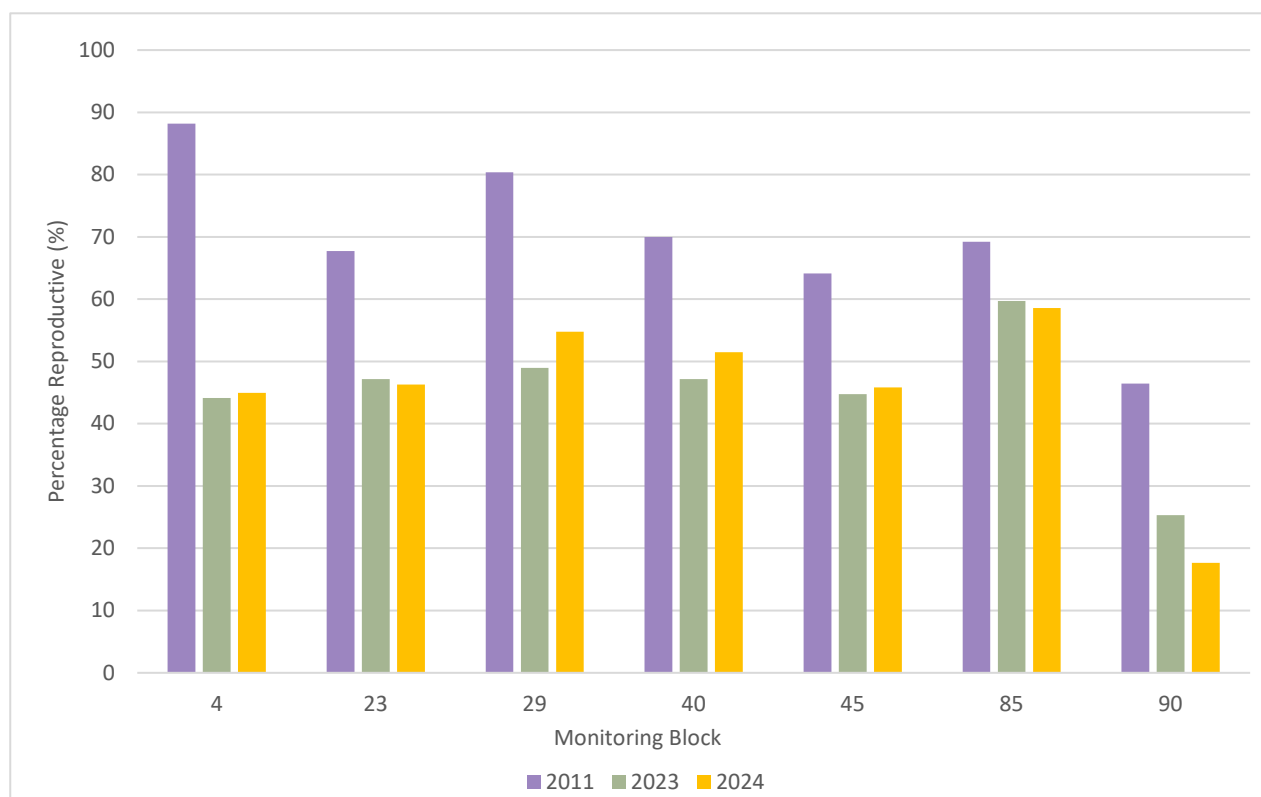


Figure 3.5 Proportion of Alive Population Recorded as Reproductive within Each Monitoring Block in 2011, 2023 and 2024

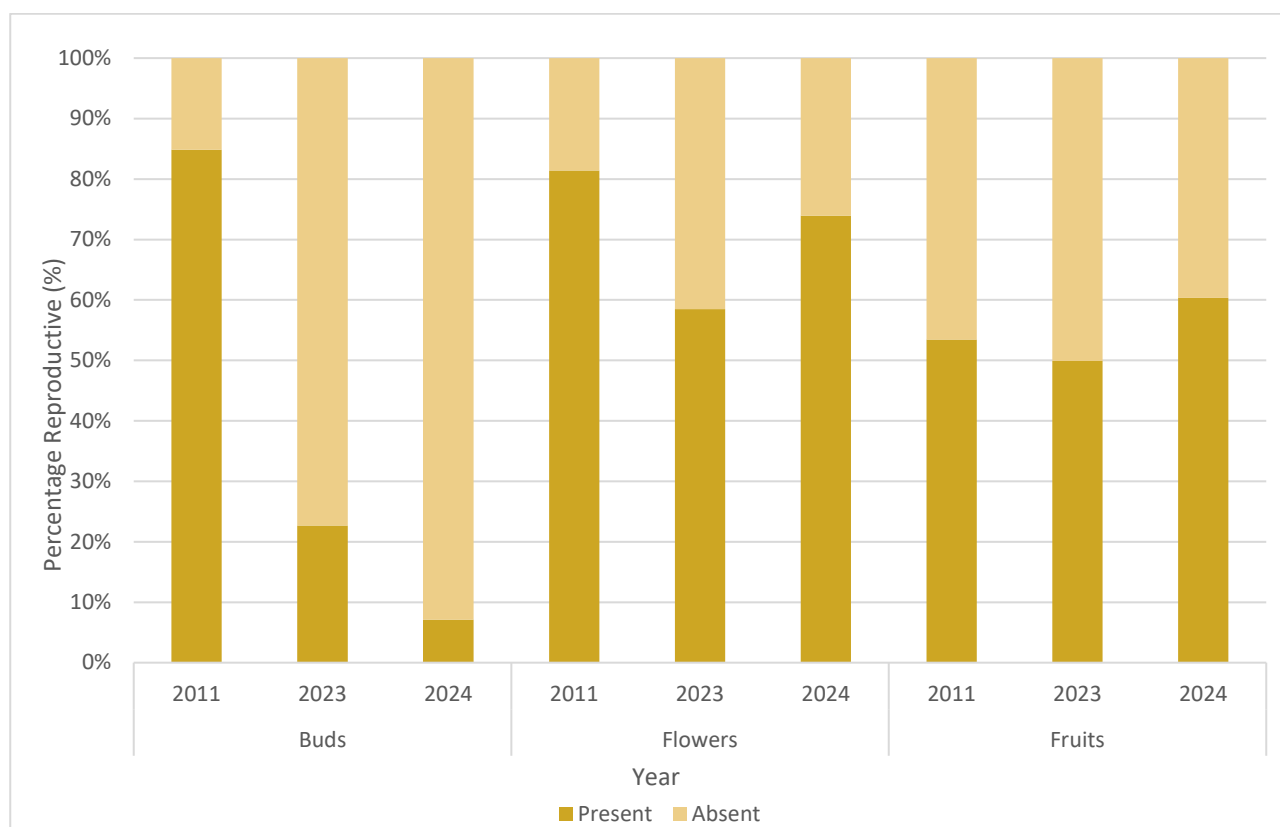


Figure 3.6 Reproductive Characteristics (Flowers, Fruits and Buds) in 2011, 2023 and 2024

3.1.3 Recruitment and Mortality

A total of 44 seedlings were recorded in 2024, the highest number recorded in any year since the revised monitoring program commenced in 2011 (**Appendix B**). This represents a recruitment rate of 5.83% (**Figure 3.7**).

Recruitment rates observed within each monitoring block in 2012, 2023 and 2024 are presented in **Figure 3.8**. The 2024 recruitment rates in blocks 4, 23, 29, 40 and 45 were higher than in 2012 and 2023. No recruitment was recorded in blocks 85 or 90 (closest to pits) in 2012, 2023 or 2024.

The Mortality rate since 2011 is shown in **Figure 3.9**. A mortality rate of 7.5% was observed in the 2024 annual monitoring, an increase from the previous two years and the second highest rate since 2012.

Mortality rates observed within each monitoring block are presented in **Figure 3.10**. Mortality rates in 2024 were comparatively higher than in 2012 and 2023 in every block, except for block 85 which observed higher mortality in 2023 (3.88%). Block 90, closest to the pit, recorded the highest mortality in 2024 of 13.33% whilst Block 85 recorded the lowest (2.04%).

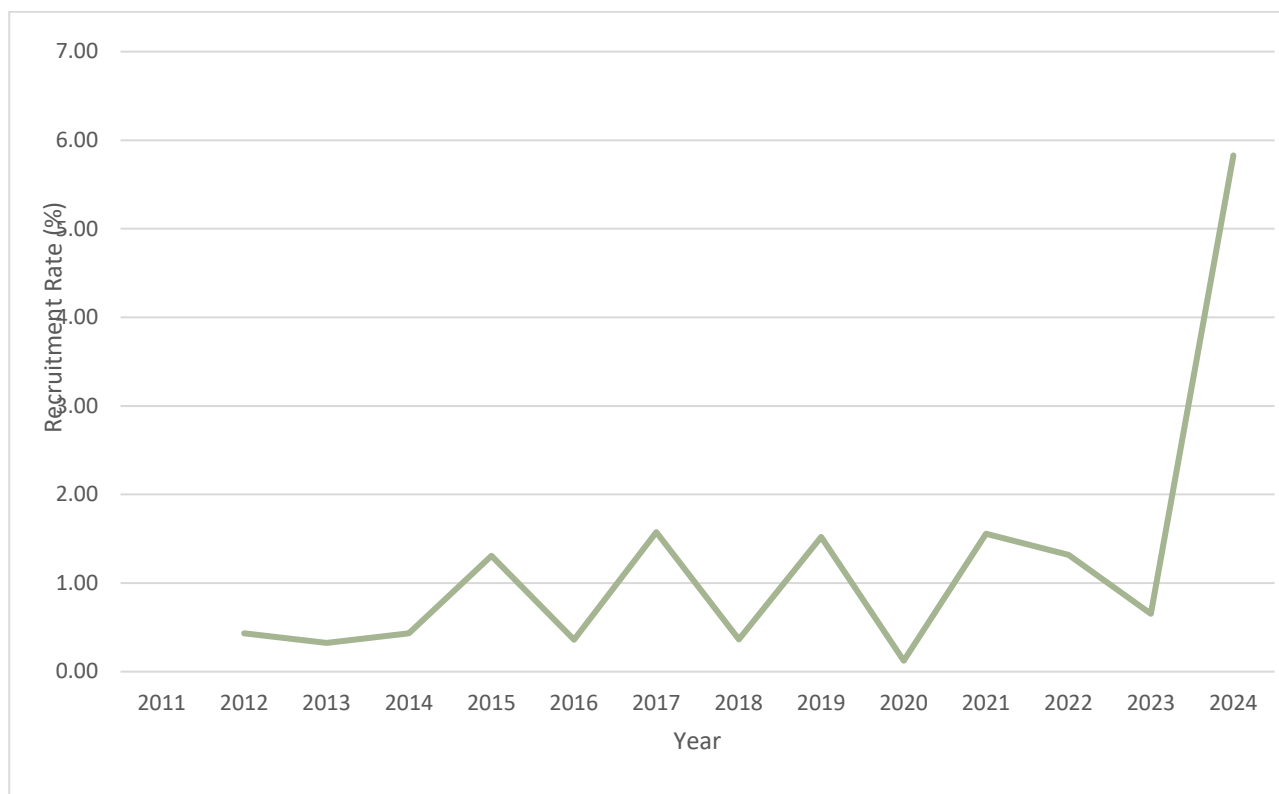


Figure 3.7 Recruitment Rate Between 2023 and 2024

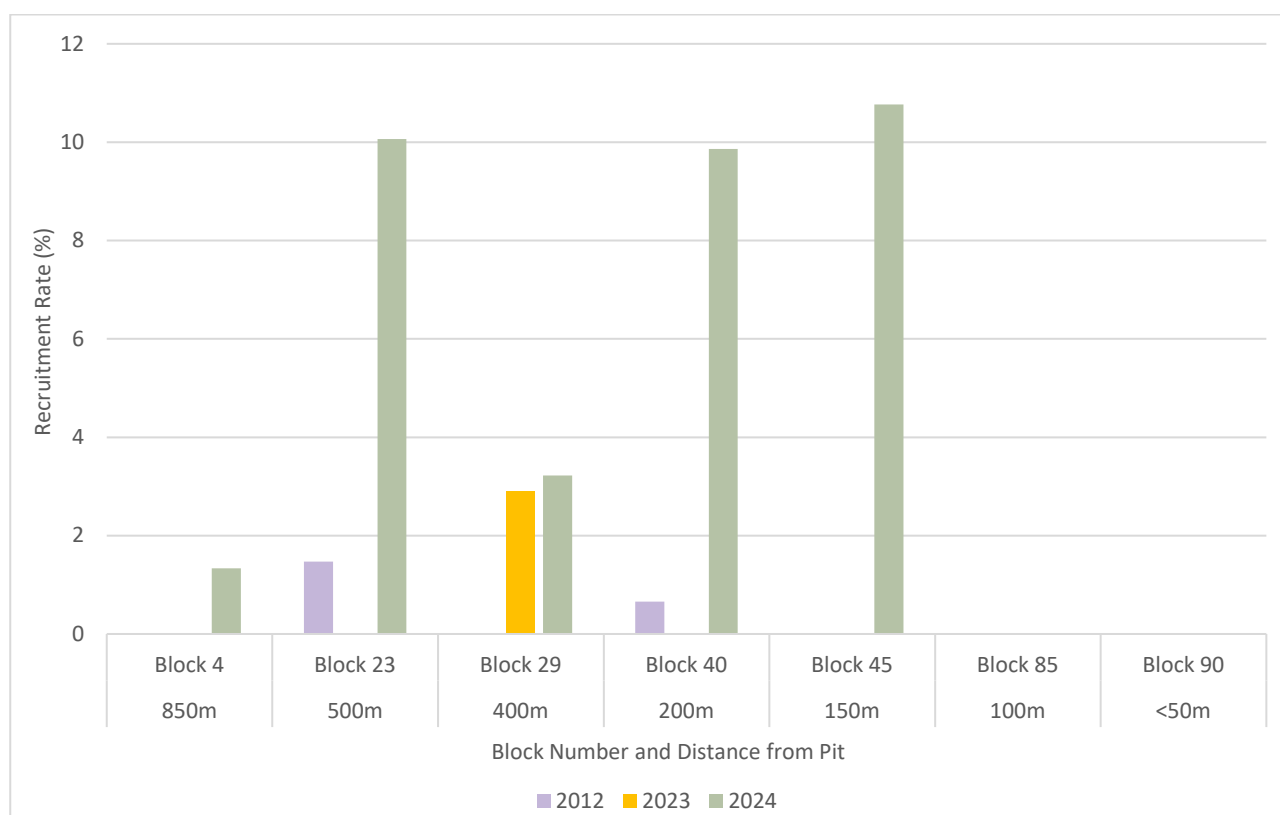


Figure 3.8 Number of Seedlings Recorded in Each Block in 2011, 2023 and 2024

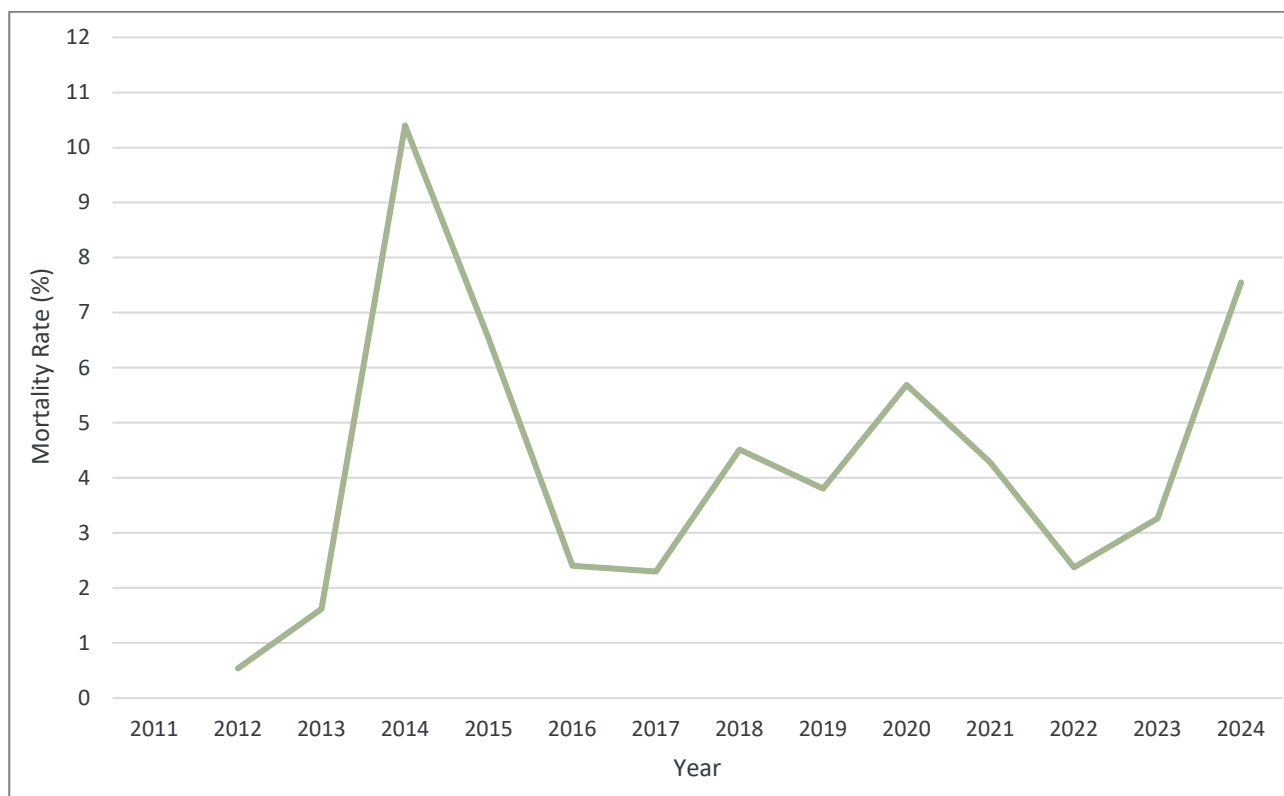


Figure 3.9 Mortality Rate Between 2023 and 2024

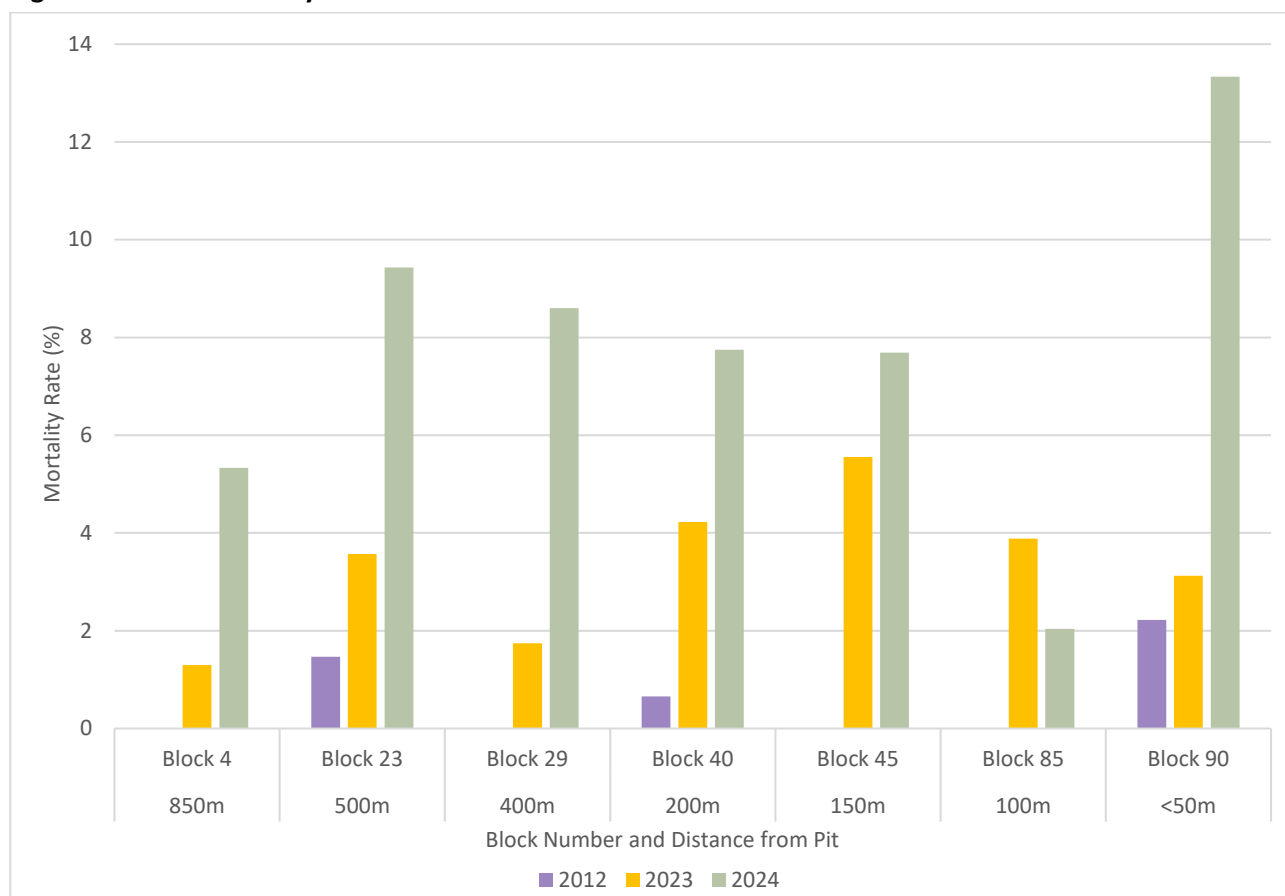


Figure 3.10 Mortality Rate within in Block in 2012, 2023 and 2024

3.2 Condition Assessment

Condition assessments (percentage of Alive Plant) were conducted on 130 individuals in 2024. Plant condition ranged between 0% (newly dead individual) and 85%.

The average plant Condition, by Block, from 2011 to 2024 is presented a **Figure 3.11**. Historically there was a general decline in Condition between 2011 and 2018 followed by a gradual increase up to 2024.

Figure 3.12 presents the plant Condition, grouped into the five Condition categories, for 2011, 2023 and 2024 as a percentage of the monitored population. More plants were in a lower Condition category in 2023 and 2024 than 2011. Less than 30% of the population in 2023 and 2024 recorded condition higher than 41%. While in 2011, more than 55% of the population recorded a Condition higher than 41%.

The average condition of plants in all blocks assessed in 2024 was 36% (SE 1.66), 2% higher than in 2023 and 11.1% lower than 2011 (**Figure 3.13**). The average condition in all blocks in 2024 was lower than in 2011. The average condition in five blocks (4, 23, 40, 45 and 90) increased in 2024 compared to 2023, whilst slight decreases were observed in two blocks (29 and 85). The average condition amongst monitoring blocks in 2024 ranged from 31.2% (SE 3.65) in block 40 to 43.5% (SE 5.47) in block 45.

Figure 3.14 presents the change in average condition between 2023 and 2024 for each block. The greatest change observed was an increase of 8.2% (SE 3.63) recorded in block 90. The least change observed in 2024 was in block 40, recording a decrease in average condition of 0.7% (SE 1.02).

3.3 Dust Deposition

Dust levels recorded at Windarling between October 2023 and September 2024 are summarised in **Table 3.2** and presented graphically in **Figure 3.15**. Dust levels did not exceed the 40 g/m²/month during the 12 months prior to the 2024 annual monitoring. Collectively the DDG located at Penny's wall recorded the highest amounts of dust between November 2023 and February 2024, with the highest amount of dust (4.9 g/m²/month) recorded at P1A in December 2023.

Most sites reached their peak dust levels in either December 2023 or January 2024, before slowly reducing until reaching the lowest levels in June 2024. Dust levels remained below 1g/m²/month between June and September 2024. The decline in dust levels coincides with increased rainfall and a reduction in mining activity.

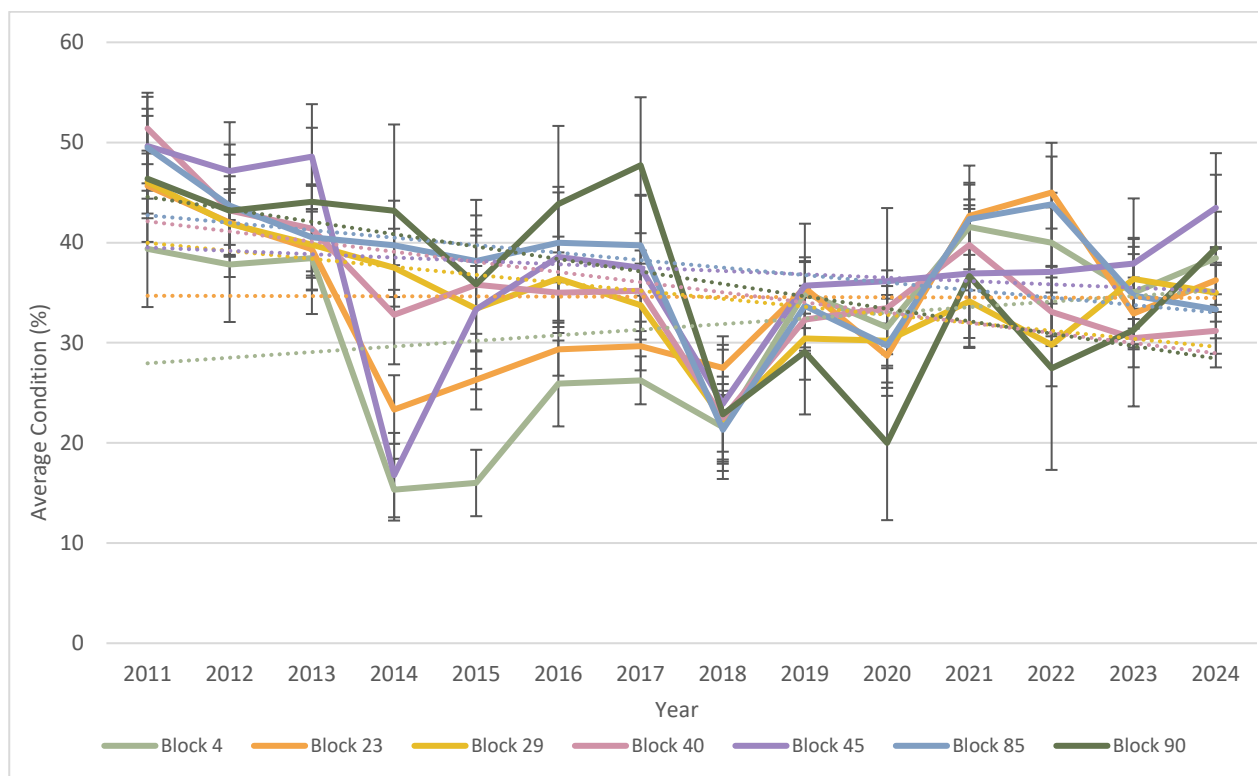


Figure 3.11 Average Condition of Each Block Between 2011 and 2024

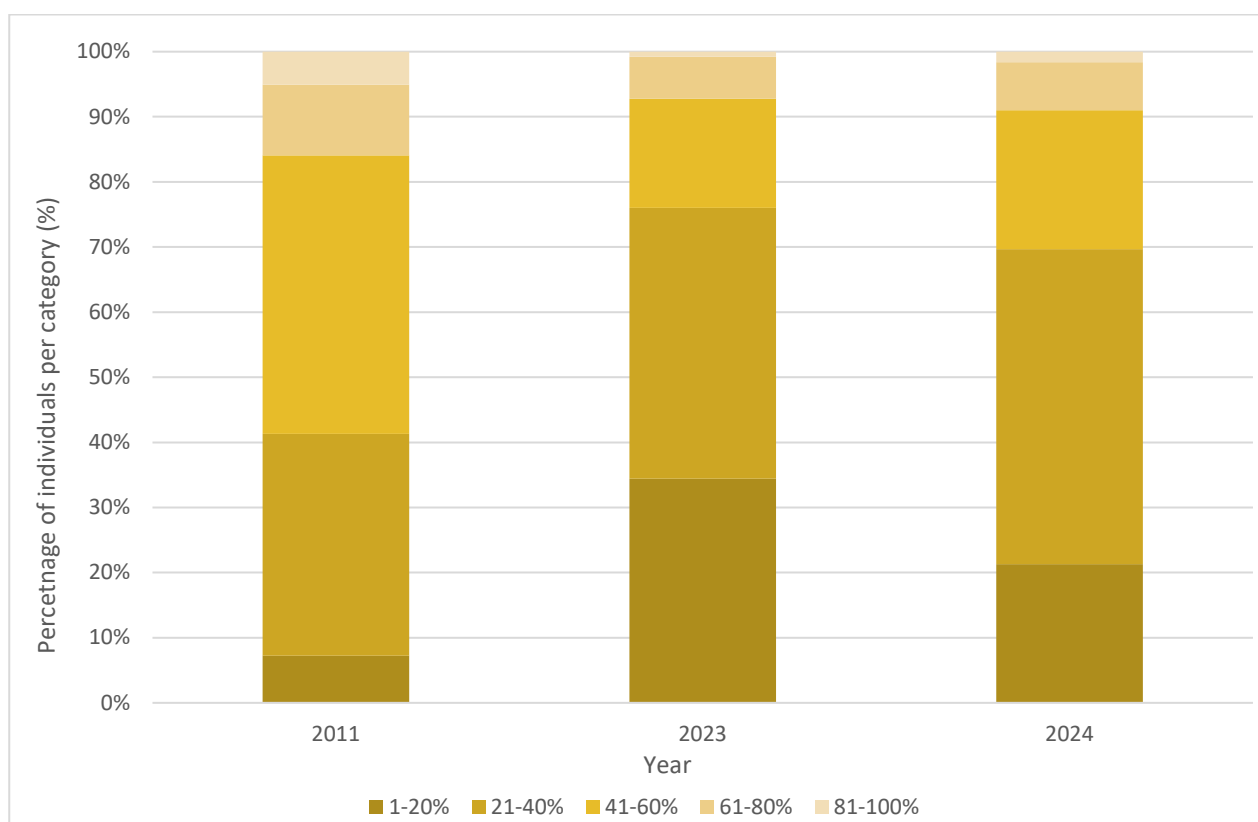


Figure 3.12 Proportions of Population Recorded in Each Condition Category in 2011, 2023 and 2024

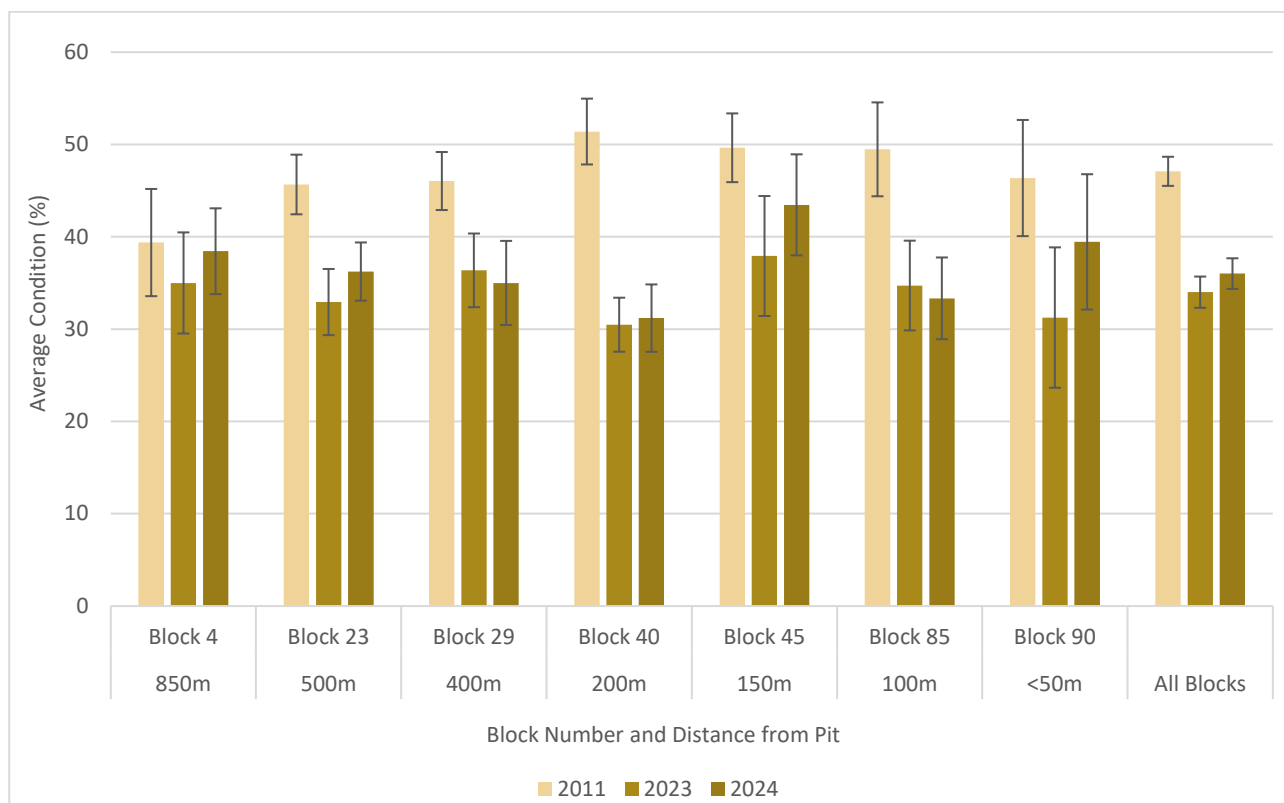


Figure 3.13 Average Condition Recorded in Each Monitoring Block in 2011, 2023 and 2024

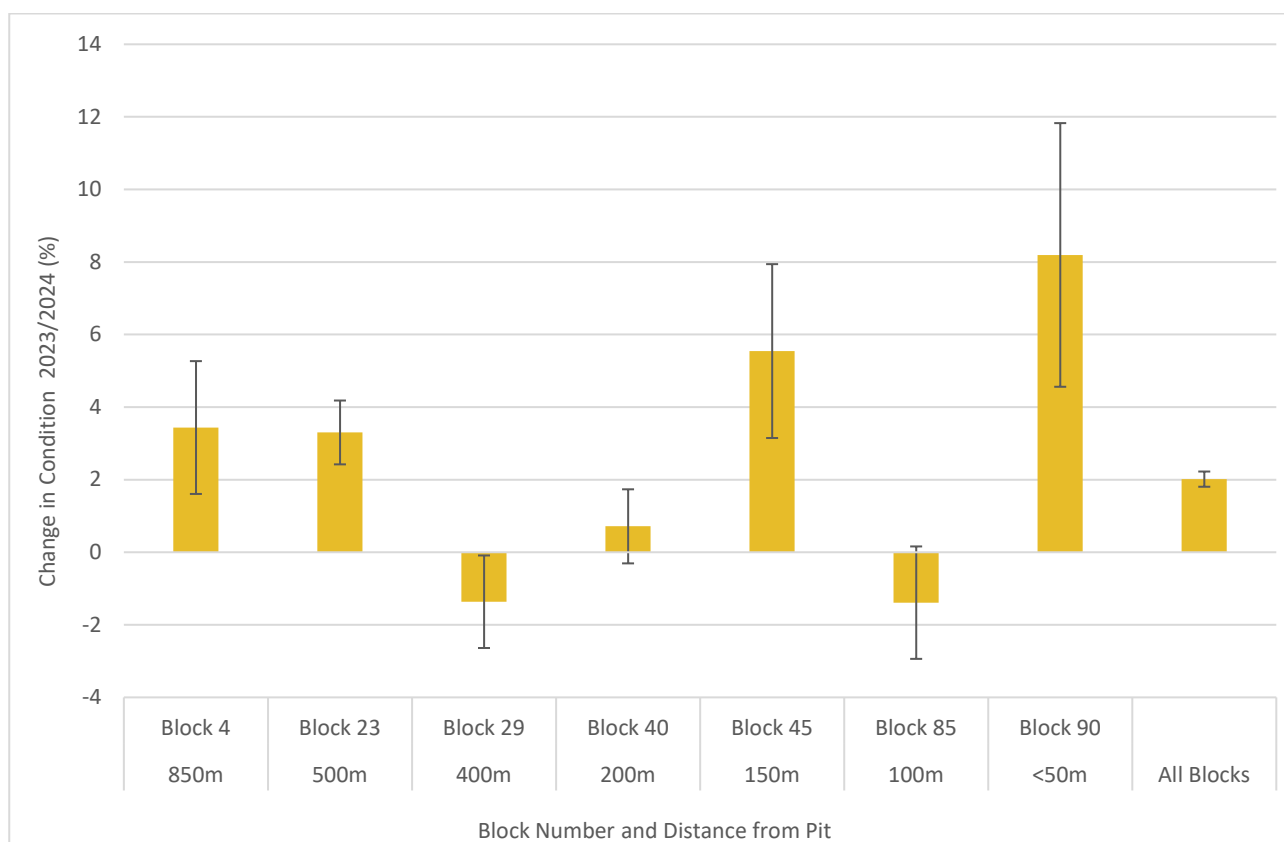


Figure 3.14 Change in Average Condition within Each Plot Between 2023 and 2024

Table 3.2 Summary of Dust Deposition Data at Windarling between October 2023 and September 2024

Plot	Distance from pit	S _a – Ash g/m ² /month													
		Oct-2023	Nov-2023	Dec-2023	Jan-2024	Feb-2024	Mar-2024	Apr-2024	May-2024	Jun-2024	Jul-2024	Aug-2024	Sep-2024	Oct-2024	Trigger level
A	Near Pit	0.2	0.7	1.7	2.6	2.4	2	1	0.5	0.57	0.24	0.98	0.76	0.27	40
B	Near Pit	0.21	0.5	0.42	0.73	1.2	0.81	0.46	0.53	0.22	0.16	0.14	0.37	0.19	40
C	Near Pit	0.27	0.65	1.5	1.5	1.2	0.68	0.5	0.38	0.21	0.1	0.11	0.29	0.15	40
D	Transition	0.16	0.62	1.2	1	1	0.84	0.52	0.3	0.41	<0.10	0.16	0.17	0.2	40
E	Transition	0.1	0.28	0.14	1.1	0.52	0.15	0.37	0.33	0.25	0.18	0.41	0.17	0.1	40
G	Transition	0.11	0.63	0.68	1.3	1.4	0.96	0.68	0.45	0.34	0.23	0.43	0.33	0.17	40
H	Far Pit	0.1	0.42	0.94	0.98	1.1	0.74	0.69	0.35	0.26	0.15	0.18	0.21	0.1	40
I	Far Pit	0.27	0.44	0.75	0.85	0.89	0.89	0.35	0.33	0.22	<0.10	0.14	0.24	0.16	40
J	Far Pit	0.27	0.67	0.87	1.1	0.98	0.82	0.59	0.44	0.29	0.17	0.47	0.42	0.19	40
P1A	Penny's Wall	0.32	1.1	4.9	3.5	2.6	1.9	1	1.9	0.94	0.41	0.6	0.67	0.44	40
P1B	Penny's Wall	0.15	0.35	2.9	2.9	2.4	1.6	1.5	1.4	0.64	0.25	0.45	0.58	0.4	40
P2A	Penny's Wall	0.28	0.72	2.9	2.6	2.1	1.8	0.87	1.3	0.66	0.36	0.44	0.49	0.26	40
P2B	Penny's Wall	0.41	0.78	1.9	2.6	3	2	1.2	1.6	0.97	0.4	0.49	0.74	0.59	40
P2S	Penny's Wall	-	-	-	-	-	-	-	-	-	-	-	-	-	40
P3A	Penny's Wall	0.4	0.79	4.1	4.4	3.8	2.5	2.1	2.3	1.2	0.4	0.4	0.65	0.31	40
P3B	Penny's Wall	0.44	0.78	2.9	2.9	2.4	2.1	1.2	1.4	0.98	0.24	0.5	0.52	0.24	40
K	Control	0.1	0.38	0.54	0.15	0.48	0.56	0.47	0.15	0.25	0.12	0.22	0.32	0.1	40
Y	Control	0.1	0.1	0.45	0.32	0.39	0.31	0.44	0.15	0.22	<0.10	0.38	0.26	0.32	40
Z	Control	0.45	0.8	1.1	0.97	1.2	0.76	0.37	0.39	0.51	<0.10	0.34	0.5	0.32	40
W	Control	0.1	0.36	0.55	0.36	0.68	0.23	0.13	0.16	0.14	<0.10	0.16	0.23	0.2	40
X	Control	0.1	0.34	0.4	0.28	0.48	0.35	0.11	0.23	0.14	<0.10	-	0.42	0.16	40
L	Replicate	0.12	0.55	0.76	1.3	-	1	-	0.3	0.25	0.21	0.34	0.29	-	40
M	Blank	-	-	-	0.10	-	0.1	-	-	0.1	-	<0.10	-	-	40

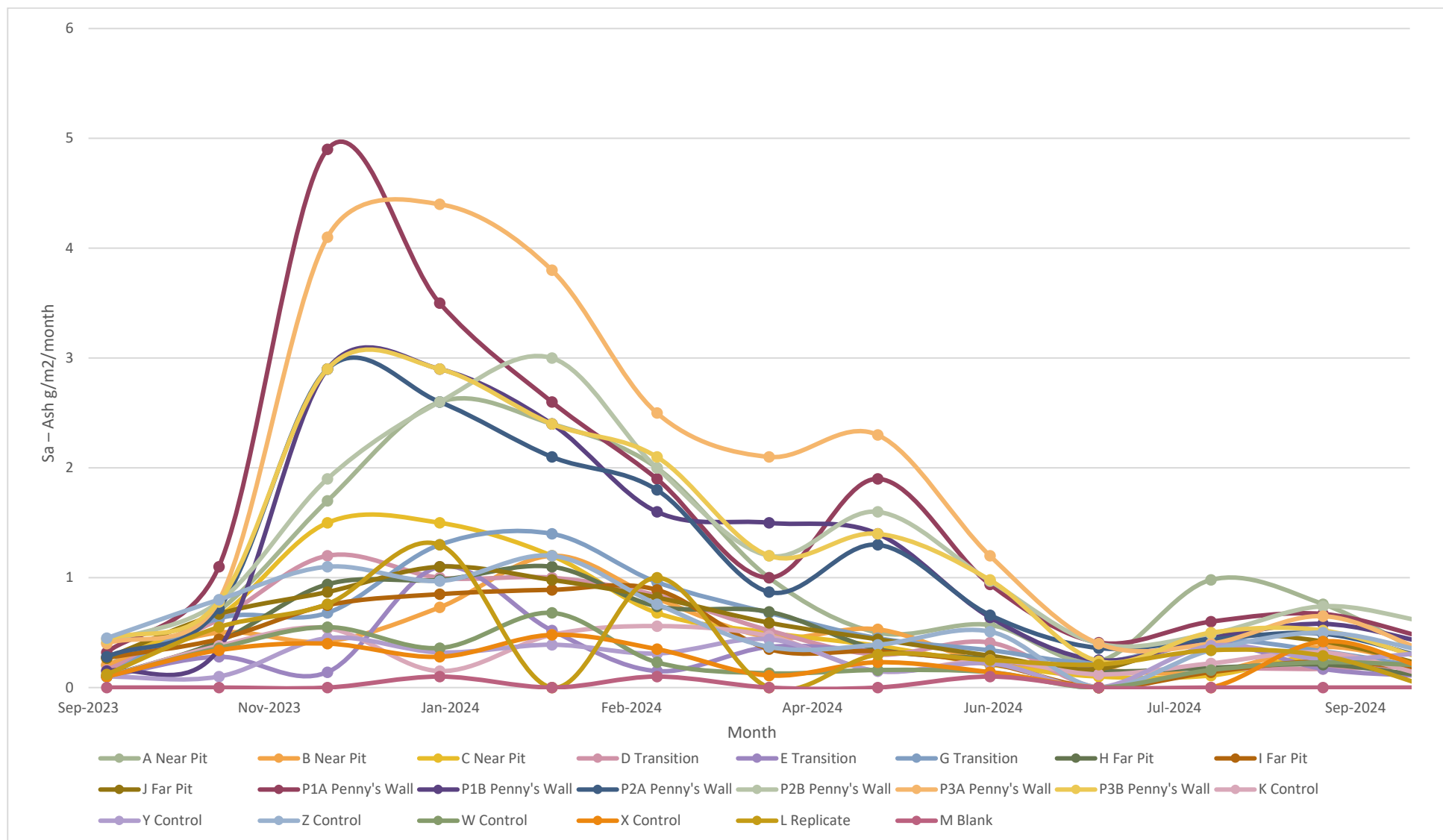


Figure 3.15 Dust Levels Recorded at each DDG between October 2023 and September 2024

4.0 Discussion and Conclusion

Population Assessment

The 2024 annual monitoring of *T. paynterae* subsp. *paynterae* recorded an increase of 78 individuals in the Total Population when compared to 2023. This increase comprises the new Seedlings, plus other Juvenile and Adult plants not previously tagged. The number of plants Not Located decreased from 52 in 2023 to five in 2024. The 52 Not Located individuals in 2023 was the highest of any year since the implementation of the updated sampling methodology in 2011. The Not Located plants from 2023 may impact the relative accuracy of changes observed between the 2023 and 2024 population data.

The Total Alive population increased between 2023 and 2024. Irrespective of the uncertainty due to the large number of Not Located individuals in 2023, the increase is attributed largely to the number of Seedlings (44) recorded in 2024. The higher recruitment in 2024 may be due to above average rainfall received in the four months prior to the 2024 monitoring. Yates et al., n.d. (2008) found that above average rainfall between May and September is required to stimulate seed germination and follow-up summer rainfall to increase the survival rates of Seedlings.

There is not a clear relationship between distance from mining operations and recruitment. The majority of Seedlings in 2024 were recorded 200 m or more from the nearest mining activity. No Seedlings were recorded in 2024 close (<50 m and 100 m) to the pit and only a small number were recorded in Block 4, at 850 m from mining activity, suggesting that proximity to mining has not influenced the recruitment between 2023 and 2024.

The total number of Reproductive individuals increased by 77 between 2023 and 2024, however, only a small increase in the proportion of the Total Population that was Reproductive. This is due in part to the number of Seedlings and Juveniles recorded in 2024 and the number of Not Located plants in 2023. Also, an decrease in the number of Vegetative individuals results in an increase in the proportion of the adult population being Reproductive.

The proportion of Reproductive individuals exhibiting Flowers and/or Fruits was similar between 2024, 2023 and 2011, however the proportion of plants with Buds in 2024 was lower than 2023 and much lower than 2011. This may be due to rainfall patterns. *T. paynterae* subsp. *paynterae* flowering can occur at any time of the year after substantial rainfall but occurs mainly at the end of winter between August and October (Yates et al., n.d. 2008). With the above average rainfall in June 2024 potentially stimulating the early development of reproductive structures, the plants reproductive cycle is more advanced than in previous years.

There were 57 newly Dead individuals recorded in 2024. Due to the high number of Not Located individuals in 2023 (52 individuals), it is difficult to determine if the count of newly Dead plants in 2024 is an accurate representation of new deaths (2023–2024) in the population. The number of Dead individuals in 2023 (423 individuals) was lower than that recorded in 2022 (436 individuals), indicating that a number of the Not Located plants would have likely been Dead.

The high mortality rate recorded in 2024 is associated with two consecutive years of below average rainfall. Potentially, Dead plants Not Located in 2023 could have increased the apparent mortality rate in 2024. The highest mortality rate was recorded in 2014 (Appendix B) within a period of above average rainfall

(Appendix A), although below average rainfall had been recorded for June, July and August prior to the monitoring. Lower rainfall from June to August in 2014 was unlikely to have attributed to such a severe increase in mortality recorded that year, indicating that other factors likely influenced the decline.

In the 12 months prior to the 2024 annual monitoring the mean monthly temperatures recorded at Southern Cross (nearest weather station with the most reliable temperature data available) were relatively consistent with the long-term historical mean, although slightly above average for nine of the months. This consistent above average mean monthly temperature, coupled with two consecutive years of below average rainfall may have contributed to an increase in mortality.

The low dust deposition recorded at Windarling, was associated with reduced mining activity in the 12 months prior to monitoring. It is unlikely that dust levels contributed to an increase in mortality in 2024.

Condition Assessment

Annual monitoring in 2024 generally saw an improvement in average condition of *T. paynterae* subsp. *paynterae* at Windarling. Increases in the average condition were recorded in most blocks in 2024 except for blocks' 29 and 85, where slight decreases were observed. In both cases, the average condition has reduced by less than 1.5%. This is unlikely significant considering the visual method for estimating the percentage of Alive plant is likely to be variable between personnel conducting the work and interpretation of the procedures between differing consultancies.

Impacts on plant Condition as a result of mining activity was not evident. Plants in Block 90 (closest to mining operations) recorded a substantial increase in the average condition in 2024, as did block 45 (150 m from mining operations).

Although total rainfall in the 12 months prior to monitoring was well below average, the majority of the rainfall received for that period was received in the four months preceding the surveys. Rainfall received between June and September 2024 was 20% higher than the long-term average rainfall received during those months. This may have provided conditions more favourable for plant growth and the overall increase in condition.

There is considerable fluctuation between the average Conditions of each block between the years of 2014 and 2017, suggesting small scale site conditions, such as soils (opposed to rainfall etc.) may have influenced plant Conditions. The relatively small variation in average Condition between each block in 2024, suggests that small scale factors are unlikely to have influenced condition in the past 12 months.

Visually assessing the percentage of the plant alive is relatively subjective and likely to vary between assessor. Changes in plant Condition should be interpreted cautiously and used as an indicator of broader trends, rather than specific indicator of changes in the health of the *T. paynterae* subsp. *paynterae* population.

5.0 References

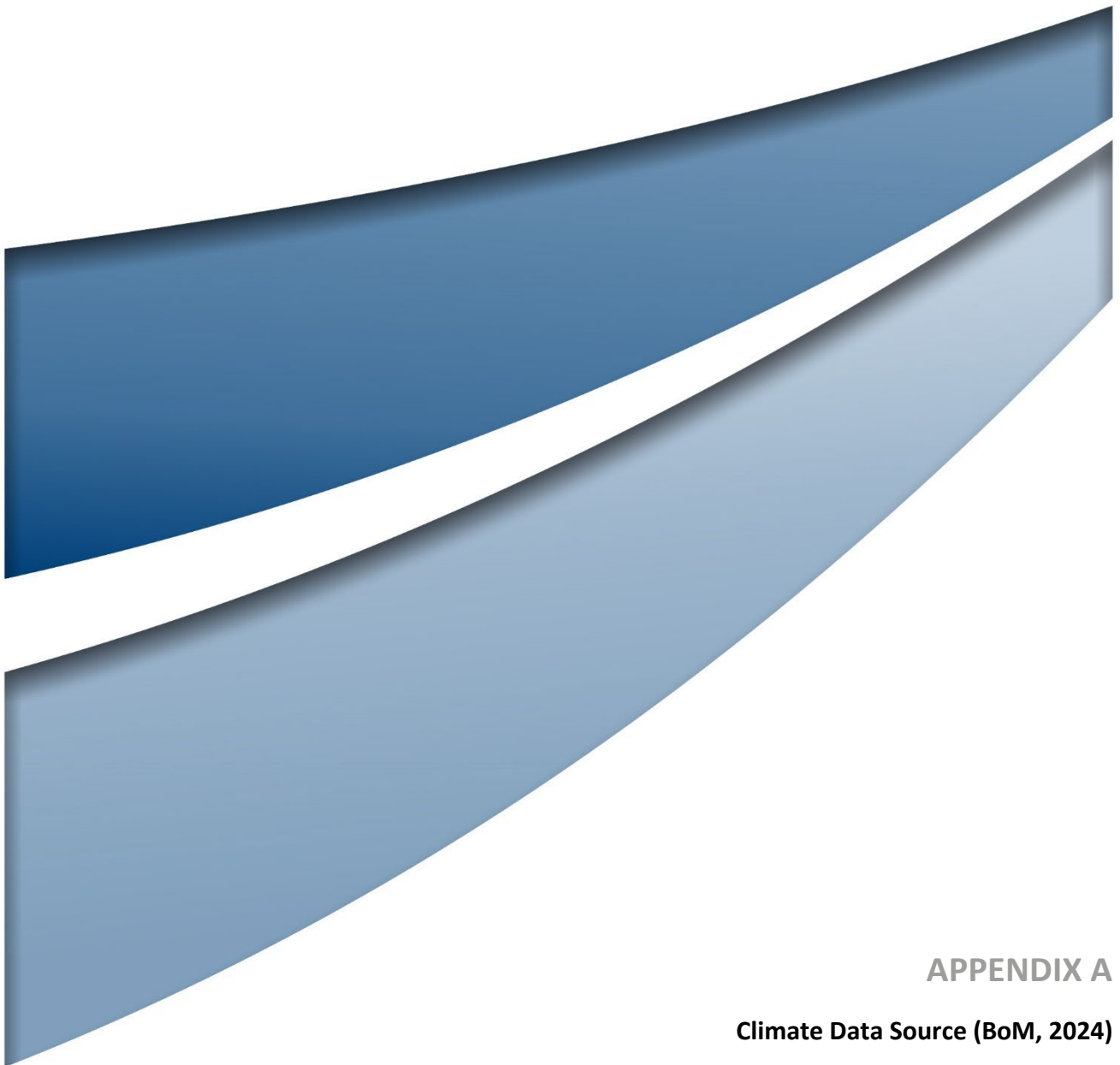
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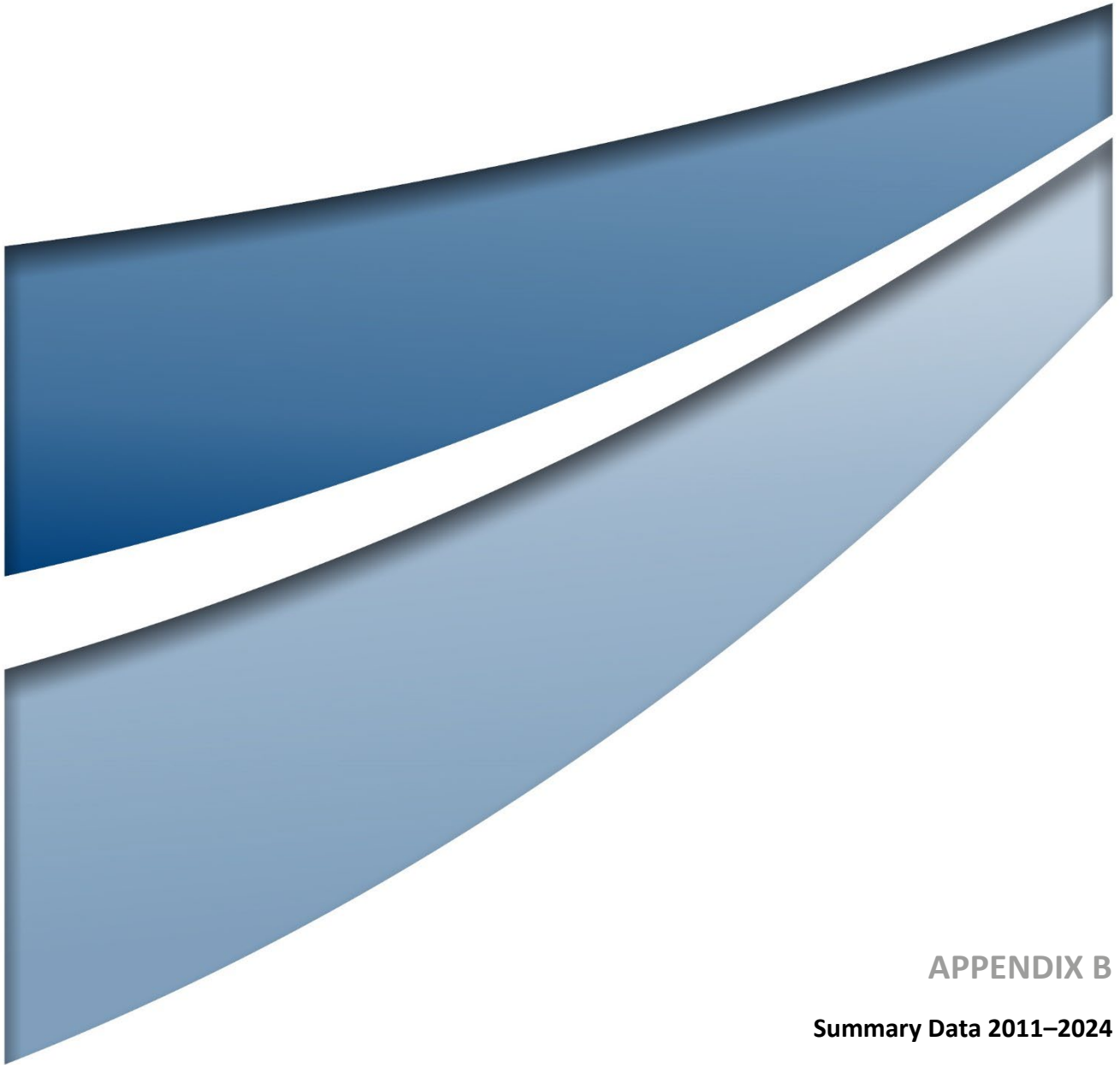


APPENDIX A

Climate Data Source (BoM, 2024)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual rainfall	Long Term Annual Average
2011 Monitoring (2010–2011)	0	3	15.6	73.2	101.7	3.2	10	15.6	15	47.1	25.2	15	324.6	274.3
2012 Monitoring (2011–2012)	71.6	16.8	61	34	5	54.7	1.4	8.8	24.5	15.6	2.6	13	309	274.3
2013 Monitoring (2012–2013)	18.8	28.6	22.2	43.6	0.4	54.8	21.2	45.8	15.4	25.2	12.6	26.8	315.4	274.3
2014 Monitoring (2013–2014)	8.4	25.4	3.6	162.4	2.5	10.2	60.2	44	8.8	14.8	12.2	25.2	377.7	274.3
2015 Monitoring (2014–2015)	28.2	9.2	7.2	0.6	1.2	38.3	25.7	7.6	17.4	19	58.9	1.6	214.9	274.3
2016 Monitoring (2015–2016)	13	52.6	18.4	63.6	40.4	43.6	24.1	29.4	39	36.6	29.4	7.6	397.7	274.3
2017 Monitoring (2016–2017)	10	0.5	16.6	53.4	112	11.4	2.2	6.9	6	17.9	33.6	15.7	286.2	274.3
2018 Monitoring (2017–2018)	1	20.2	8.4	59	51.2	9.5	0.3	3.2	24.8	32.6	46.8	1	258	274.3
2019 Monitoring (2018–2019)	27.9	35.6	14.6	0.2	8.9	59.4	63	3.4	60.8	15.1	10.7	2	301.6	274.3
2020 Monitoring (2019–2020)	4.1	0	13.2	22.4	38.9	13.1	0.2	9.3	12.5	13.2	27.6	0	154.5	274.3
2021 Monitoring (2020–2021)	0	28.8	1.4	2.3	27.8	88.2	6.5	63.2	8.2	105.1	12.1	3.6	347.2	274.3
2022 Monitoring (2021–2022)	15	27.6	0	3.2	23	22.7	1	15.5	24.1	19.6	48.6	25	225.3	274.3
2023 Monitoring (2022–2023)	6	0	0	0.9	19.2	6.2	0	0.7	37.2	4.5	14	11	99.7	274.3
2024 Monitoring (2023–2024)	0	18.5	0	0	12.6	1.4	7.8	1.5	67.8	25.9	32.2	11	178.7	274.3

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual rainfall	Long Term Annual Average
Windarling Long-Term Average Monthly Rainfall (2004-2024)	11.2	16.9	10.4	35.6	34.1	28.5	19.9	19.1	22.5	28.1	19.9	14.8	-	274.3
Southern Cross Airfield Long-Term Average Monthly Rainfall (1996-2024)	17.8	17.3	13.9	27.5	26.2	34.5	23.2	26.4	28	34.7	31.8	19.4	-	298.3
	Legend													
		Data sourced from Windarling weather station (012141)												
		Data sourced from Koolyanobbing weather station (012227)												
		Data sourced from Southern Cross Airfield weather station (012320)												



APPENDIX B

Summary Data 2011–2024

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Dead	189	195	209	301	322	331	350	367	370	411	435	436	423	489
Juvenile	10	31	26	19	6	12	7	13	3	9	2	11	26	25
Seedling ¹	26	4	3	4	11	3	13	3	12	1	12	10	5	44
Vegetative	95	108	152	405	324	145	205	226	206	349	136	125	171	115
Reproductive	797	784	742	414	491	666	595	547	588	412	608	620	553	630
Not Located ²	-	1	1	1	1	1	1	19	4	2	3	5	52	5
Total Population ²	1117	1123	1133	1144	1155	1158	1171	1175	1183	1184	1196	1207	1230	1308
Total Alive Population ^{2, 3}	928	927	923	842	832	826	820	789	809	771	758	766	755	814
Percentage of Total Population Alive (%)	83.08	82.55	81.47	73.60	72.03	71.33	70.03	67.15	68.39	65.12	63.38	63.46	61.38	62.23
Percentage of Total Population Dead (%)	16.9	17.4	18.4	26.3	27.9	28.6	29.9	31.23	31.28	34.71	36.37	36.12	34.39	37.39
Mortality rate (%)	-	0.54	1.6	10.4	6.5	2.4	2.3	4.5	3.8	5.7	4.3	2.4	3.3	7.5
Change in Mortality	-	-	1.1	8.8	-3.9	-4.1	-0.1	2.2	-0.7	1.9	-1.4	-1.9	0.9	4.3
Percentage of Alive adult Population Reproductive	89.3	87.9	83.0	50.5	60.2	82.1	74.4	70.8	74.1	54.1	81.7	83.2	76.4	84.6
Percentage of Alive adult Population Vegetative	10.7	12.1	20.5	49.5	39.8	17.9	25.6	29.2	25.9	45.9	18.3	16.8	23.6	15.4
Recruitment rate (%)		0.43	0.32	0.43	1.31	0.36	1.57	0.37	1.52	0.12	1.56	1.32	0.65	5.83
¹ plants recorded as seedlings one year are recorded as juvenile the following year, unless reproductive or dead.														
² does not include plants that were previously assessed but deemed outside of the monitoring block in 2024														
³ excludes plants that were not found														

