Hornsdale Wind Farm SEB Offset Area

Monitoring 2024

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Prepared by EBS Ecology for NEOEN

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GLOSSARY AND ABBREVIATION OF TERMS

ANOVA	Analysis of Variance – statistical method used to test differences between two or more means by analysing the variance of the sampling distribution of the mean.
app	Application
BOM	Bureau of Meteorology
Burrow	Any hole or burrow suitable for a PBTL
cm	Centimetre(s)
Cryptogam	Biological soil crust most often composed of fungi, lichens, cyanobacteria, bryophytes and algae in varying proportions
DP	Declared Plant
DSE	Dry Sheep Equivalent – standard measure of feed demand which represents a 50 kilogram (kg) wether which consumes 1.0 kg dry matter per day. A pregnant or lactating ewe has a greater energy requirement, and the amount varies according to the advancing pregnancy and the size of the lamb once it is born and feeding.
EBS	Environmental and Biodiversity Services – trading as EBS Ecology
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GPS	Global Positioning System
ha	Hectare(s)
HWF	Hornsdale Wind Farm
HWF1	Hornsdale Wind Farm Stage 1
HWF2	Hornsdale Wind Farm Stage 2
HWF3	Hornsdale Wind Farm Stage 3
ID	Identification (e.g., of species)
JPH	Juveniles Per Hectare - the mean of the total number of juvenile perennial native grass tussocks (i.e. multiplied by 10,000).
km	Kilometre(s)
LMR	Landscape Management Region
LSA Act	*Landscape South Australia Act 2019*
mm	Millimetre(s)
m	Metre(s)
MW	Mega Watt(s)

NPW Act	*National Parks and Wildlife Act 1972*
R	Rare – under the *National Parks and Wildlife Act 1972*
NV Act	*Native Vegetation Act 1991*
Project	Hornsdale Wind Farm: A 315 MW renewable electricity project consisting of 99 wind turbine generators.
PBTL	Pygmy Blue-tongue Lizard (*Tiliqua adelaidensis*)
PCQM	Point Centre Quarter Method
pers. comm.	Personal communication
p-value	The level of marginal significance within a statistical hypothesis test representing the probability of the occurrence of a given event. The p-value is used as an alternative to rejection points to provide the smallest level of significance at which the null hypothesis would be rejected.
Quadrat/Q	1 ha monitoring quadrat (Quadrats 1–12)
R^2	The coefficient of determination – the proportion of the variance in the dependent variable that is predictable from the independent variable(s).
SA	South Australia(n)
SEB	Significant Environmental Benefit
SEB Offset Area	Area of land set aside for conservation, to offset for native vegetation clearance during construction of the Project – incorporates the required 3.1 ha PBTL offset.
sp.	Species
ssp.	Subspecies
TPH	Tussocks Per Hectare
WoNS	Weed of National Significance
$\bar{x}$	Sample mean
%	Percent

EXECUTIVE SUMMARY

Hornsdale Wind Farm (HWF) is a 315 Megawatt (MW) renewable electricity project consisting of 99 wind turbine generators and battery storage (the Project) located north of Jamestown in the Mid North region of South Australia (SA). The Project Area extends approximately 15 kilometres (km) in a north-south direction, and approximately 8 km in an east-west direction, with a footprint covering 75 hectares (ha).

As part of the EPBC Act approval process an offset was calculated to offset the potential impacts to the EPBC Act listed Pygmy Blue-tongue Lizard (PTBL) (*Tiliqua adelaidensis*) (see EPBC Act referral 2012/6573). To meet the requirements under the *Native Vegetation Act 1991* (NV Act) figures for a Significant Environmental Benefit (SEB) were calculated to determine the required offset for clearance of native vegetation associated with the construction of the Project (see *Hornsdale Wind Farm Native Vegetation Clearance Report* (EBS Ecology 2013)).

Annual PBTL and vegetation surveys within the SEB Offset Area are part of a long-term annual monitoring program, which is an EPBC Act approval condition (approval 3d) of the Project (see *Hornsdale Wind Farm Annual Compliance Report under the EPBC Act September 2018* (EBS 2018a)). The program involves annual surveys that will run until 2027, as per the approval conditions.

The key results of the 2024 PBTL survey include:

- A total of 480 burrows across the 11 quadrats were checked for PBTL occupancy in 2024, of which 55 burrows (11.46 %) contained one or more PBTLs (386 burrows in 2023, 8.20% containing PBTL).
- A total of 56 PBTLs were recorded in 55 burrows including 47 adults and nine juveniles (32 PBTL in 2023). PBTLs were found in nine of the 11 quadrats.
- The mean number of PBTLs per quadrat observed in 2024 was less than the baseline, but greater than the 2023 surveys. There was a significant difference in the mean number of PBTLs between the seven sampling years.
- There was a significant relationship between the spring-summer rainfall and both the total number of PBTLs and the number of spider holes observed.
- The mean number of PBTLs per quadrat across the five surveys was significantly greater on eastern than western slopes.

The key results of the 2024 vegetation survey include:

- A total of 82 flora species were observed across the 12 one ha quadrats in 2024. This included 46 native flora species, three of which are State Rare, and 36 weed species, six of which are Declared under the *Landscape South Australia Act 2019*. Weed cover was lower in 2024 than in 2023.
- Based on the data to date native and weed species diversity has significantly increased since 2018. However, this may reflect variations in survey effort and climatic conditions, not improvement in condition.
- Relative to the 2023 results, there has been a decrease in tussock spacing and decrease in tussock height.
- The mean percentage of cryptogam cover decreased in 2024, while the mean percentage of bare ground cover has increased. The mean percentage of litter cover has decreased in 2024 when

compared to 2023 (70.42 %) but has increased when compared to 2022, when this variable was measured for the first time.

- There was found to be a significant relationship between spring-summer rainfall and the mean percentage of bare ground and cryptogam and mean tussock basal width. There was also found to be a significant relationship between spring-summer rainfall and the mean tussock height.

The following recommendations have been made:

- Management continues to follow actions that are described in the SEB Management Plan, including the completion and submission of paddock datasheets or an extract from the farm management app.
- Quadrats should continue to be monitored annually until the completion of the specified monitoring regime (2028). This should include information on spider burrows and rainfall data.
- Continue winter grazing to reduce annual exotic grass and retain patchiness for PBTL, adjusting the Dry Sheep Equivalent (DSE) to reflect climatic conditions. Reviewing the grazing regime as the year progresses and as climatic conditions become more evident would be beneficial.
- Prioritise the control of Declared woody weeds that have potential to alter the structure of grassland vegetation.
- The Land Manager and NEOEN determine ongoing management actions in consultation with a suitably qualified Ecologist, based on the recommendation in this report.

The following actions should be undertaken in 2024 and leading into the 2025 monitoring period:

- In cooperation with the landowner, review the grazing regime within the SEB Offset Area on an annual basis. Given the vegetation condition, the area would benefit from increased grazing pressure in early to mid 2024.
- Leading into spring 2024, maintain communication with landowners to determine climatic conditions and continue reactive grazing management, increasing grazing pressure in spring if required.
- Ensure the Land Manager remains familiar with the *Paddock Monitoring Datasheet* and *Activity Record Datasheet.*

Discussion between EBS Ecology and the landowner occurred on site during the monitoring period. Grazing regime was discussed at this time, with the following outcomes:

- Additional grazing period – sheep were introduced to the SEB area in April 2024, a month earlier than in previous years, to break up litter cover prior to the winter growth period.
- Sheep will remain in the SEB area throughout winter as per the management plan. At winter's end, vegetation conditions will be assessed in view of the current and predicted spring weather patterns.
- The landowner has committed to following any recommendations made by EBS Ecology at that time, including the continuation of grazing later into spring (if required) to further reduce weed and litter cover.

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1 INTRODUCTION

1.1 Hornsdale Windfarm

Hornsdale Wind Farm (HWF) is a 315 Megawatt (MW) renewable electricity project consisting of 99 wind turbine generators and battery storage (the Project) located north of Jamestown in the Mid-North region of South Australia (SA). The Project Area extends approximately 15 kilometres (km) in a north-south direction, and approximately 8 km in an east-west direction (Figure 1).

A Significant Environmental Benefit (SEB) offset was required under the *Native Vegetation Act 1991* (NV Act) to offset the clearance of native vegetation associated with the construction of HWF1, HWF2 and HWF3. A Pygmy Blue-tongue Lizard (PBTL) (*Tiliqua adelaidensis*) offset was also required as part of an approval condition under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), to compensate for the potential impact to PBTLs resulting from the wind farm development. The PBTL is listed as nationally endangered under the EPBC Act and State endangered under the *National Parks and Wildlife Act 1972* (NPW Act).

The SEB offset for native vegetation has been delivered for all three stages of the Project in a parcel of land 142.54 hectares (ha) in size, located [redacted] (SEB Offset Area) (Figure 1). A significant population of PBTLs is present within the SEB Offset Area. Therefore, the PBTL offset of 3.1 ha has been incorporated into the SEB Offset Area, which is protected under the NV Act and is listed on the property title.

A summary of EPBC Act and previous NV Act approvals for the Project is provided in Table 1.

Table 1. Summary of the relevant approvals associated with the Hornsdale Wind Farm.

Development Stage	Relevant legislation	Approval reference
HWF1	NV Act	2013/3012/764
HWF2	NV Act	2013/3012/764
HWF3	NV Act	2016/3101/764
All	EPBC Act	EPBC 2012/6573

1.2 Objectives

The long-term objectives of the monitoring program are to:

- Undertake long-term (10 years) monitoring of native vegetation and the PBTL population to ensure that suitable conditions are provided within the SEB Offset Area to maintain or increase existing population numbers of PBTLs (including their habitat);
- Identify any threats that may be occurring within SEB Offset Area; for example, weed incursions, feral animals, or changes in vegetation structure, which may negatively affect the PBTL population; and
- Identify any actions that are required to maintain native grasslands with a rich diversity of species, and little disturbance from exotic weeds.

The objectives of this report are to:

- Provide the results of the 2024 vegetation and PBTL annual monitoring surveys within the SEB Offset Area;
- Compare survey results between the current and previous surveys to identify if any obvious changes in vegetation condition and/or the PBTL population are occurring within the SEB Offset Area, and if so, examine how these factors influence one another; and
- Provide management recommendations to improve the vegetation condition in the SEB Offset Area and benefit the PBTL population.

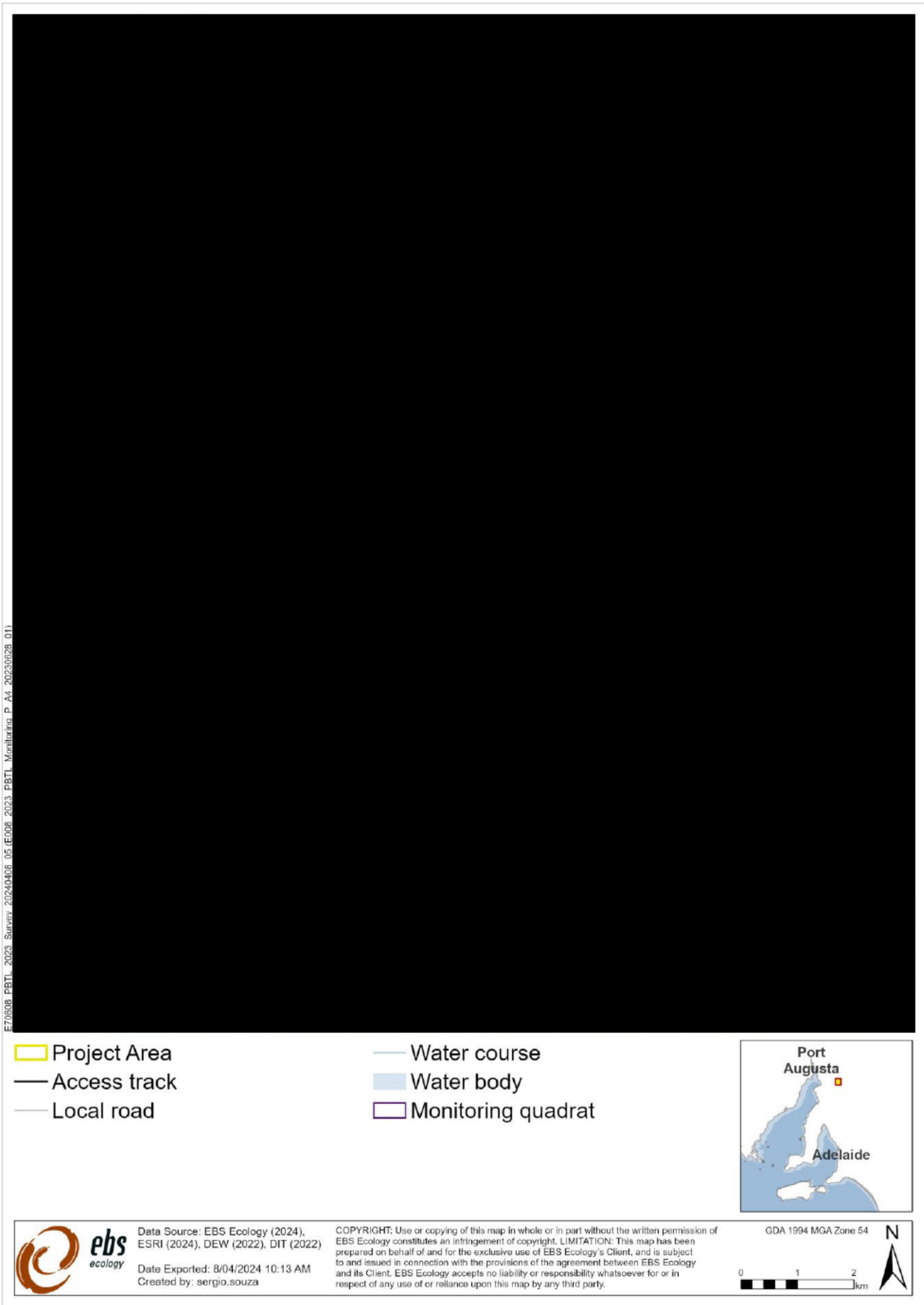

Figure 1. Location of the Hornsdale Wind Farm and the SEB Offset Area.

2 BACKGROUND

2.1 Previous surveys and reports

Numerous flora and fauna assessments have been undertaken by EBS Ecology at HWF. These reports are listed in Section 9 (page 72).

2.2 SEB Offset Area

The SEB Offset Area within the HWF was selected based on the following key considerations:

- The occurrence of a poor to moderate quality native grassland that could be improved over time with active management;
- The occurrence of a significant population (>30 individuals) of PBTLs; and
- The location within the HWF Project Area and the Northern and Yorke Landscape Management Region (LMR).

A management plan has been prepared for the SEB Offset Area by EBS Ecology (EBS Ecology 2017a). The SEB Offset Area Management Plan devised long-term management measures aimed at improving vegetation condition and protecting PBTLs.

2.3 Current management and land ownership

The cadastre and ownership details of the SEB Offset Area are provided in Table 2. Since the land's purchase in 2008, it has been lightly grazed by sheep, and mainly by lambing ewes. Generally, little to no grazing occurs prior to 1 May each year, to facilitate the growth of fodder. Since 2017, gazing has occurred according to the regime recommended in EBS Ecology 2017a.

Table 2. Hornsdale Wind Farm SEB Offset Area details.

Owner	[redacted]
Manager	[redacted]
Address	PO Box 233, Jamestown SA 5491
Local Government Area	Northern Areas Council
LMR Region	Northern and Yorke
Hundred	Belalie
Parcel details	[redacted]
Titles	[redacted]
Location	[redacted], Jamestown

Comments from the landowner indicate that the previous four spring/summer periods, including 2020, 2021, 2022 and 2023 have been exceptional seasons. The area has received well-above average rainfall (see Section 2.4) with vegetative growth occurring at a level not experienced since the establishment of the Hornsdale SEB. As these conditions were abnormal and not expected, prior to 2023, sheep numbers were not increased above the recommended management regime.

2.3.1 Meeting onsite in 2023

A meeting was held onsite in September of 2023, between the landowner, a NEOEN representative and staff from EBS. The current management regime, recent climatic conditions, completion of activity datasheets and future grazing management were discussed with the following points highlighted:

- Increased grass cover and thatch possibly negatively impacting PBTL;
- Increased spring/summer rainfall over the past two to three years leading to continued grass growth throughout the summer period during paddock rest period;
- Reluctance of grazing through summer due to unpredictable rainfall, fire risk and wider farm/livestock management practices; and
- Lack of paddock datasheets from previous years impacting ability to interpret trends in the data.

The meeting was beneficial, and the following solutions were proposed:

- Implement an additional grazing period in April 2023, with a longer grazing period through to September 2023 if wet conditions persist; and
- Better communication between landowner, NEOEN and EBS in terms of paddock management, including submission of paddock data sheets or equivalent.

An agreement to continue more open communication between the three parties in attendance and an indication from the landowner that greater flexibility in altering grazing regimes in response to changes in climatic conditions was possible. This included extending the 2023 grazing period from 22 September to 9 October 2023.

The landowner also committed to sharing annual management activities by providing an extract of the farm management application (app) currently used to collect this information. This will be used in lieu of activity datasheets.

Additional conversations with the landowner during the 2024 monitoring confirmed that an additional grazing period in April through to late September will also occur in 2024 given climatic conditions in the summer of 2023.

Annual record sheets for activity and paddock monitoring for the previous year is provided in Appendix 1.

2.3.2 Responsibilities

Hornsdale Asset Co previously negotiated an agreement with the landholders to manage the SEB Offset Area. Whilst it will be the responsibility of the landholders to implement the management plan, HWF will still be responsible for ensuring the plan is implemented to a suitable standard. If the implementation of the plan does not occur or is not implemented to the required standard, HWF, in consultation with the landholder, can undertake corrective action to ensure the plan is implemented suitably. This may involve providing further direction to the landholder or utilising the resources of an external contractor to implement specific tasks.

2.4 Rainfall

2.4.1 Annual rainfall

Rainfall data is important as it impacts heavily on vegetation growth. Monthly rainfall data was sourced from the closest weather station to HWF, which is located at Yongala (Station: 019062, BOM 2024). The recorded monthly rainfall at Yongala has been highly variable since 2015, the year preceding the commencement of monitoring (Figure 2).

Table 3 provides a summary of mean monthly rainfall and annual rainfall in millimetres (mm) from 2015 to 2023. Rainfall in 2015 was close to the long-term annual mean, with significant rainfall in January and April, and above average rainfall in November. Above average rainfall occurred in seven months in 2016, with significant rainfall occurring in January, March, September and December. However, the mean monthly rainfall and the annual rainfall both progressively declined each year from 2016 until 2019, with the annual rainfall for 2019 less than half the long-term annual mean (BOM 2024).

In 2020, rainfall returned to above average, with the total of 444.3 mm being 80.5 mm above the long-term mean. In 2020, October was the wettest month, with 81.0 mm, providing exceptional growing conditions for vegetation, while the winter months from May till August all recorded below average monthly rainfall (Figure 2). Rainfall was below average in 2021, although higher than the 2016-2019 period. There was high rainfall in the winter months (53.4 mm in June and 72.8 in July) as well as in November (88.2 mm), again providing exceptional growing conditions for vegetation. Rainfall returned to above average in 2022, with 418.1 mm recorded at Yongala. Dry late summer (January to February) and autumn conditions were followed by a wet winter and spring. Rainfall was well above average from August to December, providing ideal conditions for growth of winter and spring annual grasses.

Rainfall in 2023 returned to below the long-term annual and monthly means, with 243.1 mm recorded during the year and a monthly mean of 20.3 mm. Above average rainfall, however, was received in November and December, resulting in good conditions again for the growth of winter and spring annual grasses despite much of the year receiving below average rainfall.

Table 3. Summary of mean monthly and annual rainfall (Yongala Station, 2015–2023).

Year	Mean monthly rainfall (mm)	Annual rainfall (mm)
Long-term mean	30.3	363.8
2015	27.5	329.6
2016	41.9	502.4
2017	25.0	300.5
2018	17.8	213.2
2019	14.5	174.2
2020	37.0	444.3
2021	24.7	296.4
2022	34.8	418.1
2023	20.3	243.1

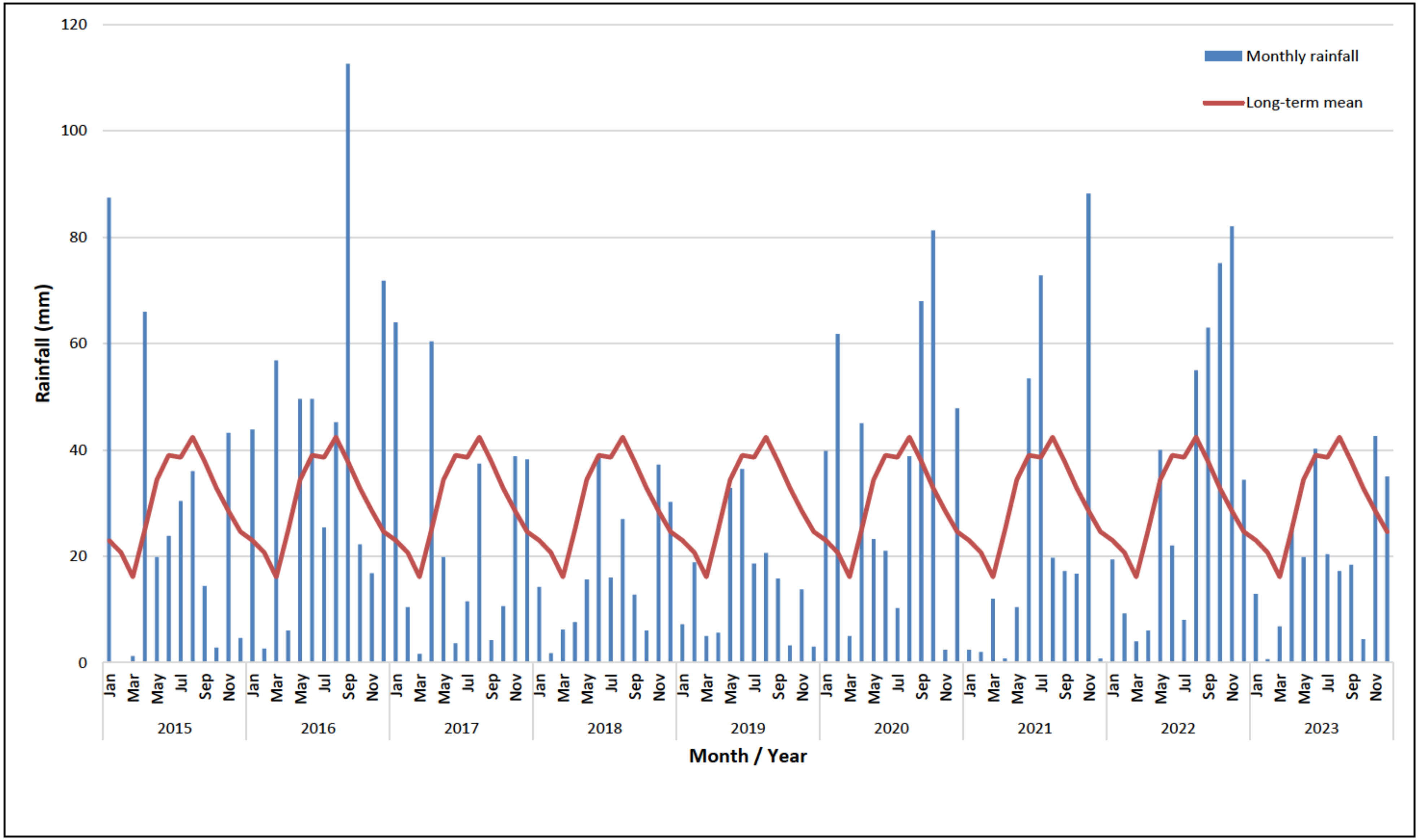

Figure 2. Monthly rainfall (mm) from 2015 to 2023 (Yongala Station: 019062) (BOM 2024). Long-term mean monthly rainfall for each month represented by red line.

2.4.2 Spring and summer rainfall

Discussions with the landowner following the 2021, 2022 and 2023 monitoring periods indicated that high spring and summer rainfall may be an important factor influencing vegetation and litter cover. It may also have an influence on the detectability of spider burrows.

Since 2014, rainfall between September and the following January has been characterised by falls below the long-term average of 146.8 mm for the period, with one above average year in 2016. A total of 287.4 mm was recorded between September of that year and January 2017.

In contrast, three of the four previous years (2020, 2022 and 2023) have each recorded above the average spring and summer rainfall with 2021 recording average spring and summer rainfall. A peak of 267.4 mm was recorded in the 2022 period (Figure 3).

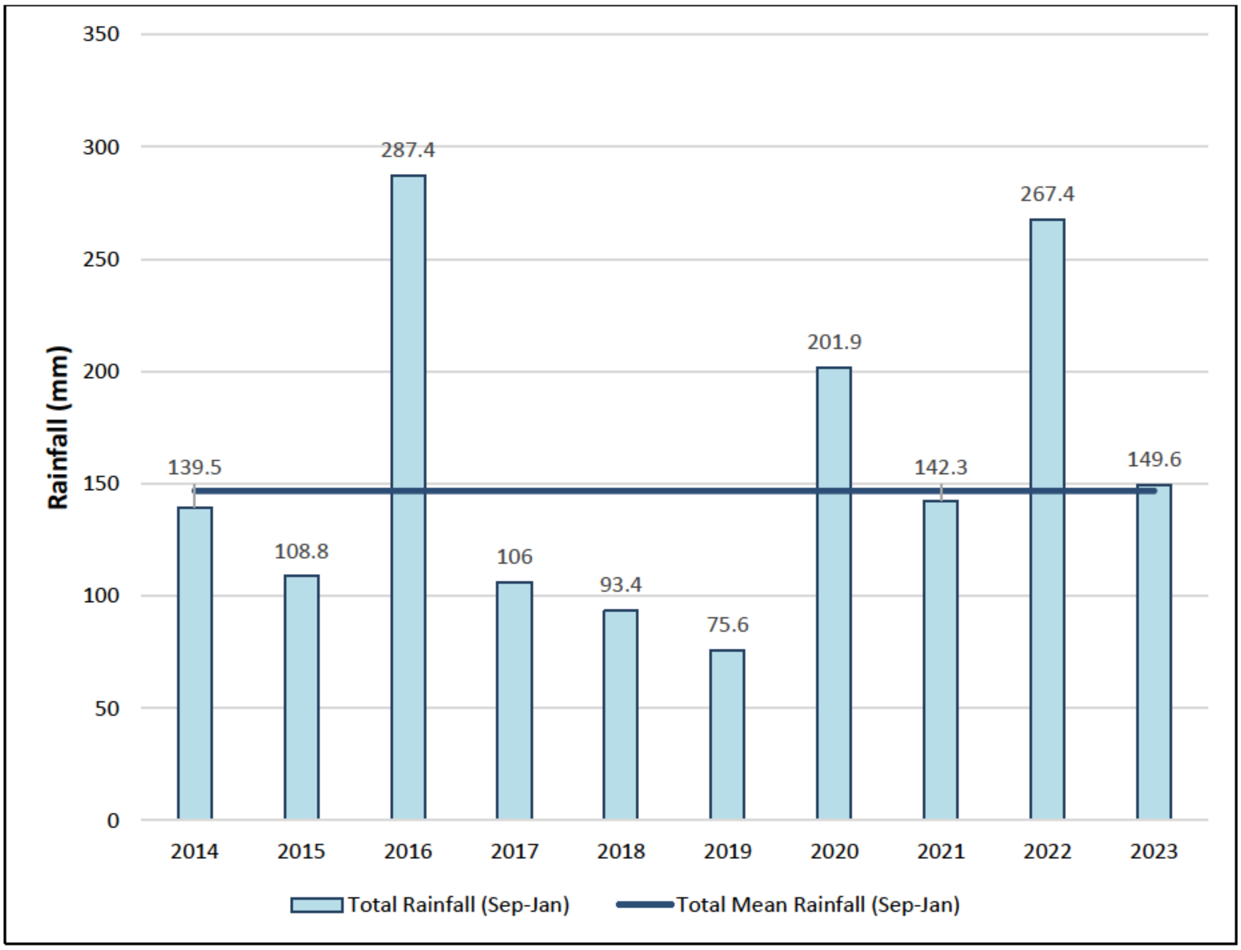

Figure 3. Spring and summer (September to January) rainfall recorded since 2014 (Yongala Station: 019062) (BOM 2024).

2.5 Weather conditions during the survey

The weather conditions during the field surveys (4 – 7 March 2024) were warm and generally conducive to good detection rates of burrows on all four days of the survey (Table 4). An average maximum temperature of 32.8˚C, and an average minimum temperature of 14.6˚C was recorded along with no rainfall over the four day period (BOM 2024).

Table 4. Weather observations for the duration of the 2024 PBTL and Vegetation surveys (Yongala Station: 019062) (BOM 2024).

Date	Temp (°C)		Rain (mm)
	Min	Max	
04/03/2024	11.9	28.3	0
05/03/2024	12.1	34.8	0
06/03/2024	17.0	35.0	0
07/03/2024	17.4	33.0	0
Mean	14.6	32.8	0

3 METHODS

3.1 Field survey dates

The 2024 annual PBTL and vegetation monitoring was undertaken by Ecologists from EBS Ecology from 4 to 7 March 2024.

3.2 Monitoring quadrats

Monitoring was conducted within 12 quadrats (Figure 4). Eight quadrats (Quadrat 1 to 8) were established in 2015 and four (Quadrat 9 to 12) were established in 2018. Of the 12 quadrats, 11 are located within open grassland, while one (Quadrat 12) is located within a small area of *Allocasuarina verticillata* (Drooping Sheoak) Woodland. Drooping Sheoak Woodland is considered unsuitable habitat for PBTLs and, therefore, Quadrat 12 is not monitored for PBTL presence and abundance.

Each quadrat is 100 x 100 metre (m) (1 ha) in size and oriented in a north-south direction. A steel dropper is located in each corner of the quadrat to permanently mark the quadrats. The GPS Coordinates of the corner posts for each quadrat are provided in Appendix 2. A photo of each quadrat is taken from the north-eastern corner looking to the south-western corner during each annual monitoring survey (OEH 2009). These photos are provided in Appendix 3.

3.3 Monitoring history

3.3.1 PBTL monitoring (11 quadrats)

Eight PBTL monitoring quadrats were established in 2016 as part of HWF Stages 1 and 2, which were subsequently surveyed during the baseline survey (EBS Ecology 2016b). Quadrats 9–11 were established and monitored, along with Quadrats 1–8, in 2018. Quadrats 1–11 have been surveyed and data analysed in subsequent years.

3.3.2 Vegetation monitoring (12 quadrats)

Baseline data was collected across the 12 monitoring quadrats in 2018, with year 1 and year 2 monitoring conducted in 2019 and 2020 respectively. Additional vegetation monitoring attributes were collected as baseline data in 2020 and in 2022 to assist in determining vegetation condition trends.

[redacted]

E70808_PBTL_2023_Survey_20230628_01 (F008_2023_PBTL_Monitoring_P_A4_20230628_01)

Project area
Access track
Monitoring quadrat

Data Source: EBS Ecology (2023), ESRI (2023), DEW (2022), DIT (2022)

Date Exported: 25/07/2023 1:42 PM
Created by: Jesse.Carpenter

GDA 1994 MGA Zone 54

0 100 200 Meters

N

Figure 4. Location of monitoring Quadrats 1–12 within the SEB Offset Area. Pygmy Blue-tongue Lizards are not monitored in Quadrat 12.

3.4 Detailed monitoring methods

Monitoring was undertaken using similar methods to the 2023 and 2022 surveys. Detailed discission on both the PBTL and vegetation monitoring methods are provided in those reports (EBS Ecology 2023 and EBS Ecology 2022).

3.5 Survey limitations

3.5.1 PBTL monitoring

The ground cover of vegetation was at an optimal stage (reasonably dry and lacked growth) for conducting searches for PBTLs, as the lack of vegetative growth aids in detecting spider burrows. Despite the high search effort (see Section 3.4) and favourable weather conditions, high litter and vegetation cover was not conducive to the easy detection of spider burrows. It is likely that burrows were not detected and therefore not surveyed for PBTLs.

The PBTL demography data collected should be treated with caution, as it is difficult to distinguish age-associated features with a burrow/video scope, particularly when views of PBTLs are restricted to within the burrow only.

3.5.2 Vegetation monitoring

At the time of the monitoring surveys, not all plants (particularly grasses) could be identified to species level due to lack of seed or other diagnostic features, caused by seasonal variation. Most plants were identified to genus or species level. However, some native and exotic species were completely dried off and could not be identified. Nonetheless, the data collected is considered to provide an adequate representation of the diversity at the SEB Offset Area.

High cover of litter and ground vegetation meant that juvenile grasses were difficult to detect, being largely obscured by rank grasses.

3.6 Statistical analyses

The PBTL and vegetation data analyses were conducted using the R software environment for statistical and graphical computing (R Core Team 2020).

3.6.1 PBTL monitoring

Type II one-way ANOVAs were used for statistical analyses to detect differences in the number of burrows, spiders and PBTLs recorded in the Baseline, 2018, 2019, 2020, 2021, 2022, 2023 and 2024 surveys. Type II ANOVAs are used to test for effects in an unbalanced design when there is no interaction observed between the explanatory variables, which is appropriate here given the different number of quadrats sampled during the baseline survey and since no interactions between the explanatory variables were detected. A p-value of 0.05 was used to infer a significant difference in PBTL numbers in response to the explanatory variables.

Type II two-way ANOVAs were used for statistical analyses to detect differences in the number of PBTLs in response to year and the number of burrows and spiders, respectively, as well as any differences in the number of PBTLs in response the various rainfall variables (i.e., the total rainfall 12 months, three months, one month and three winter months preceding each survey – data from BOM 2024).

A subset of the PBTL data (i.e., 2018–2024 data) was also analysed using ANOVA to test for the influence of vegetation condition variables (collected during the 2018–2024 vegetation surveys) on the number of PBTLs.

3.6.2 Vegetation monitoring

One-way ANOVAs were used for statistical analyses to detect differences in the vegetation attributes recorded in the 2018, 2019, 2021, 2022, 2023 and 2024 surveys. A p-value of 0.05 was used to infer a significant difference.

3.6.3 Influence of rainfall on vegetation condition variables and PBTLs

Given anecdotal comments from the landowner regarding spring – summer rainfall, the total rainfall recorded for the spring – summer period (September to January) prior to each monitoring survey was analysed. Previous years data analysis has concentrated only on rainfall totals for the three months prior to the monitoring survey, that is December, January and February.

The September to January rainfall (see Section 2.4.2) was compared to the total number of PBTLs recorded and variables that might influence the habitat suitability and detectability of PBTL:

- Total number of spider holes surveyed across all quadrats.
- Cover (%) of bare ground + cover (%) of cryptogam, using the mean of the 1m x 1m quadrat measure calculated across all 12 monitoring sites.
- Basal width, tussock height and per-cent dead material, using the mean of the 1m x 1m quadrat measure calculated across all 12 monitoring sites.

While weed cover and litter cover may also influence habitat suitability, these variables were not compared to rainfall as those datasets have only been recorded since 2020.

The Pearson Correlation Coefficient of each dataset was calculated to determine if any relationships exist with increasing spring – summer rainfall.

4 PYGMY BLUE-TONGUE LIZARD MONITORING RESULTS

4.1 2024 results

4.1.1 Pygmy Blue-tongue Lizards

A total of 480 burrows across the 11 quadrats were checked for PBTL occupancy, of which 55 burrows (11.46%) contained one or more PBTLs (Figure 5; Table 5). Overall, 56 PBTLs were recorded in the 55 burrows (47 adults; nine juveniles).

PBTL were found in nine of the 11 quadrats. The highest number of PBTLS were recorded in Quadrat 3 (20 individuals from 119 burrows checked), followed by Quadrat 5 (11 individuals from 63 burrows checked). No PBTLs were recorded in Quadrats 2 and 11 (from 21 and 7 burrows checked respectively) (Figure 5; Table 5).

A positive correlation was found between the number of burrows and the number of PBTLs present within a quadrat (p-value = 0.000; R^2 = 0.905 (Figure 6A). This was found to be statistically significant, meaning that more burrows surveyed resulted in higher numbers of PBTL (i.e., the highest number of PBTL were found in Quadrat 3 (20), which also had the greatest number of burrows checked (119) (Table 5).

There was no significant difference in the number of PBTLs in response to aspect in 2024 (p-value = 0.127) (Figure 6B).

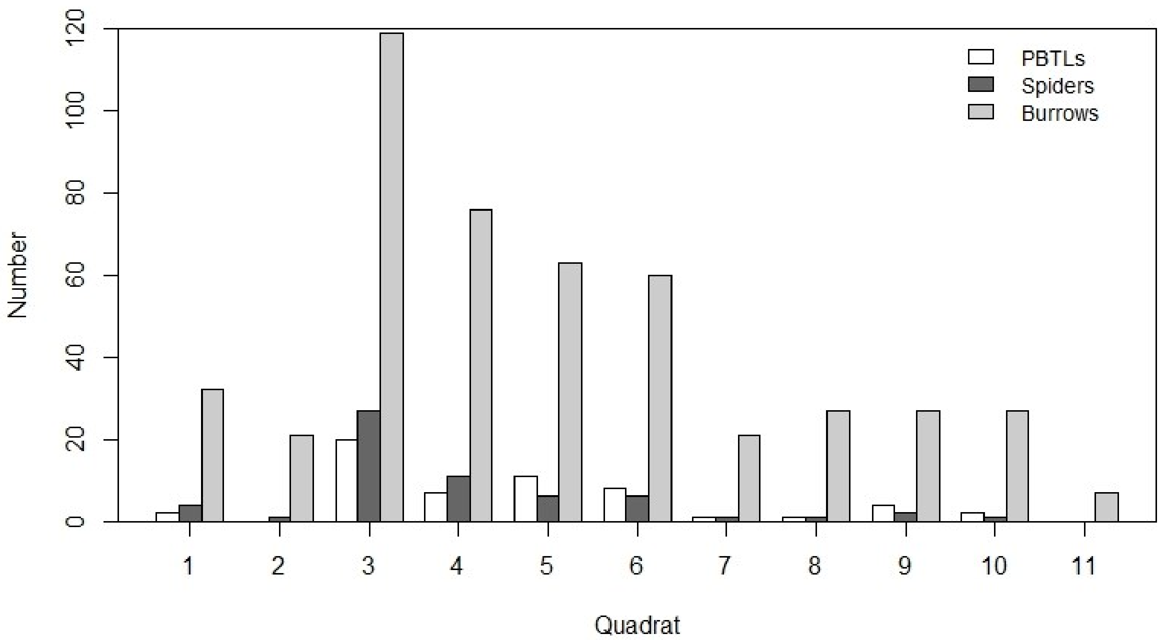

Figure 5. The number of burrows, spiders and PBTLs observed within Quadrat 1–11 in 2024.

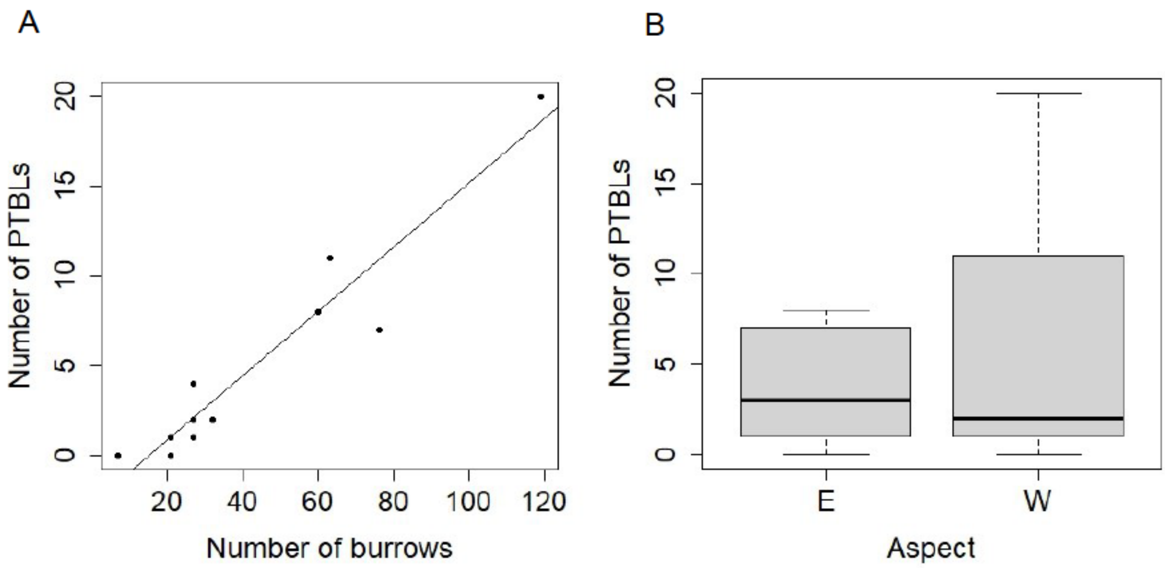

Figure 6. (A) The positive correlation between the number of burrows and number of PBTLs observed within each quadrat in 2024 (R^2 = 0.9048). (B) The distribution (minimum, maximum, median, 25th and 75th percentiles, outliers) of the numbers of PBTLs observed in quadrats on eastern (E) and western (W) orientated slopes in 2024.

4.1.2 Spiders

A total of 60 spiders were observed, with the most recorded in Quadrat 3 (27 individuals) and the least in Quadrats 11 (0 individuals) (Figure 5; Table 5).

4.1.3 Burrows

Density

A total of 480 burrows across the 11 quadrats were checked for PBTL occupancy. The density of burrows was highly variable over the SEB Offset Area, ranging from 7 burrows in Quadrat 11 to 119 in Quadrat 3 (Figure 5; Table 5). A higher density of burrows occurred on western facing slopes (242 burrows) than eastern facing slopes (211 burrows) despite one more quadrat being on eastern facing slopes than western facing slopes (Figure 4; Table 5).

Quadrats 3, 4 and 5 had the highest number of burrows surveyed, while Quadrats 11, 2 and 7 had the fewest burrows.

Depth

The majority of burrows surveyed were <10 cm (155 burrows; 32.36%) and 10–20 cm (260 burrows; 54.28%) in depth, with 43 burrows 20–30 cm in depth (8.98%) and 21 burrows >30 cm in depth (4.38%) (Figure 7). The majority of PBTLs occurred in burrows 10-20 cm in depth (44 burrows; 78.57%), followed by burrows 20-30cm cm in depth (10 burrows; 17.86%) and >10 cm in depth (2 burrows; 3.57%) (Figure 7). No PTBLs were observed in burrows <30 cm in depth. Quadrat 3 contained the most burrows 10–20 cm in depth (Figure 8), and recorded the highest numbers of PBTLs (Figure 5).

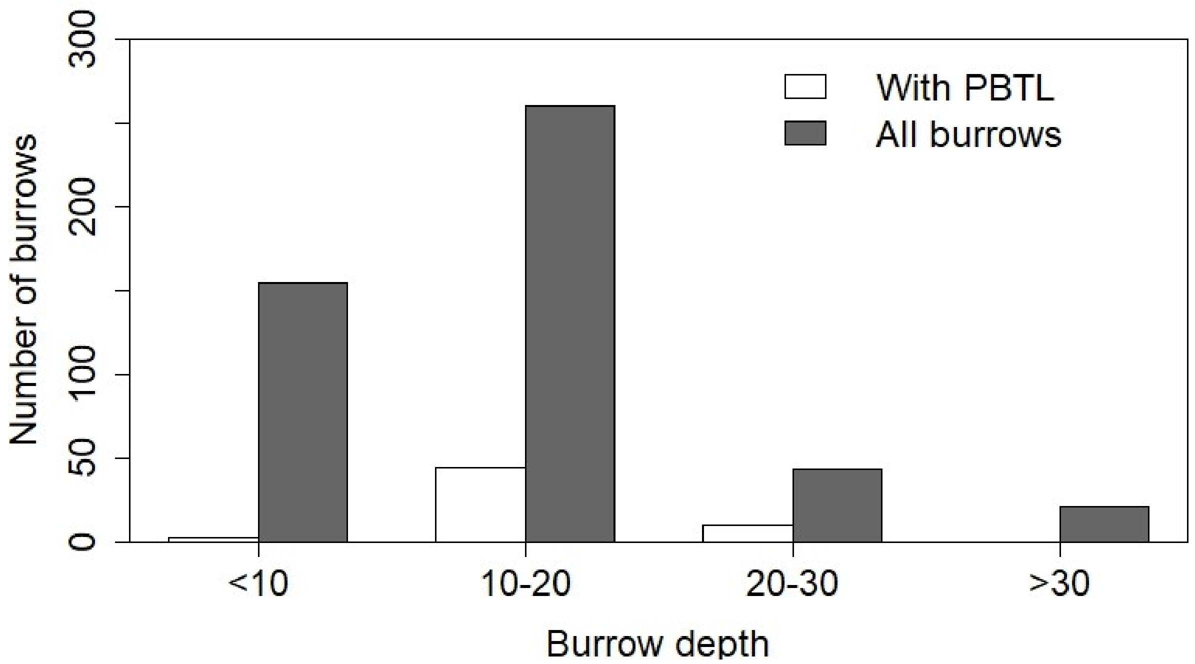

Figure 7. The number of burrows containing PBTLs and the total number of burrows in each depth class in all quadrats in 2024.

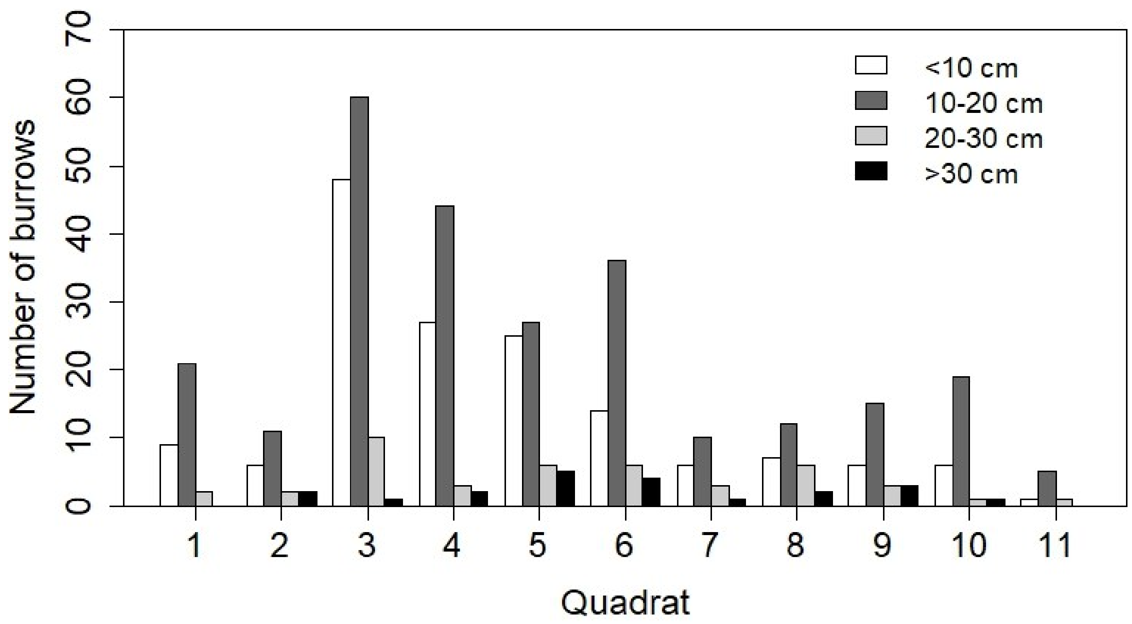

Figure 8. The total number of burrows in each depth class in Quadrats 1–11 in 2024.

4.1.4 Other burrow contents

Invertebrates observed within burrows across all quadrats included ants (6), beetles (9), centipedes (4), millipedes (6), scorpions (4), snails (6) and weevils (19) (Table 5).

A total of 311 burrows contained debris, while one small snake, likely a juvenile *Pseudonaja textilis* (Eastern Brown Snake) was also recorded in a burrow at Site 3. (Table 5).

Table 5. Summary of the results from the 2024 PBTL monitoring quadrats.

Quadrat	Aspect	Burrows with PBTLs	Juvenile PBTLs	Adult PBTLs	Total PBTLs	% Burrows with PBTLs	Ant	Beetle	Centipede	Debris	Millipede	Scorpion	Snail	Snake	Spider	Weevil	Total burrows
1	W	2	0	2	2	6.25				24					4	2	32
2	E	0	0	0	0	0	1	1		18					1		21
3	W	20	4	16	20	16.81		1		62	1	1	4	1	27	2	119
4	E	7	1	6	7	9.21			2	53		1			11	2	76
5	W	10	1	10	11	15.87	1	3		39	1				6	3	63
6	E	8	2	6	8	13.33			2	37	3		2		6	3	60
7	W	1	0	1	1	4.76		1		18					1		21
8	E	1	0	1	1	3.70	2			22					1	1	27
9	E	4	0	4	4	14.81	1	1		17	1				2	1	27
10	E	2	1	1	2	7.41		2		17		2			1	3	27
11	W	0	0	0	0	0	1			4					0	2	7
Total/ Mean		**55**	**9**	**47**	**56**	**11.46**	**6**	**9**	**4**	**311**	**6**	**4**	**6**	**1**	**60**	**19**	**480**

4.1.5 Quadrat 1

A total of 32 burrows were checked within Quadrat 1 in 2024, two of which contained PBTL (6.25 %) (Figure 9). Two adult PBTL were recorded, with remaining burrows containing debris (24), spiders (4) and weevils (2) (Table 5).

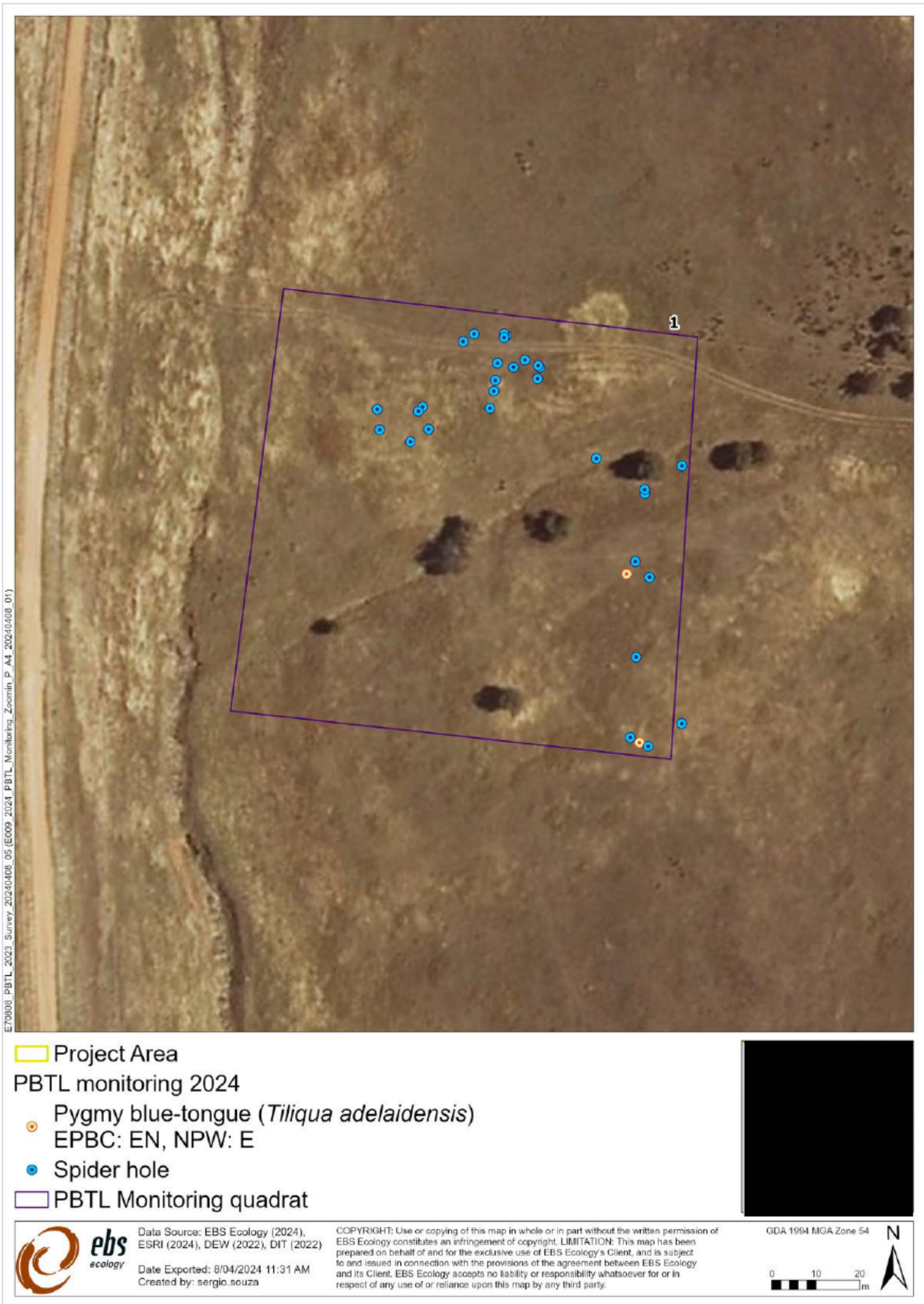

Figure 9. Location of burrows surveyed and PBTLs observed within Quadrat 1 during the 2024 survey.

4.1.6 Quadrat 2

Twenty one burrows were checked within Quadrat 2 in 2024, none of which contained PBTLs (0 %) (Figure 10). The remainder of burrows contained debris (18), ants (1), beetles (1) and spiders (1) (Table 5).

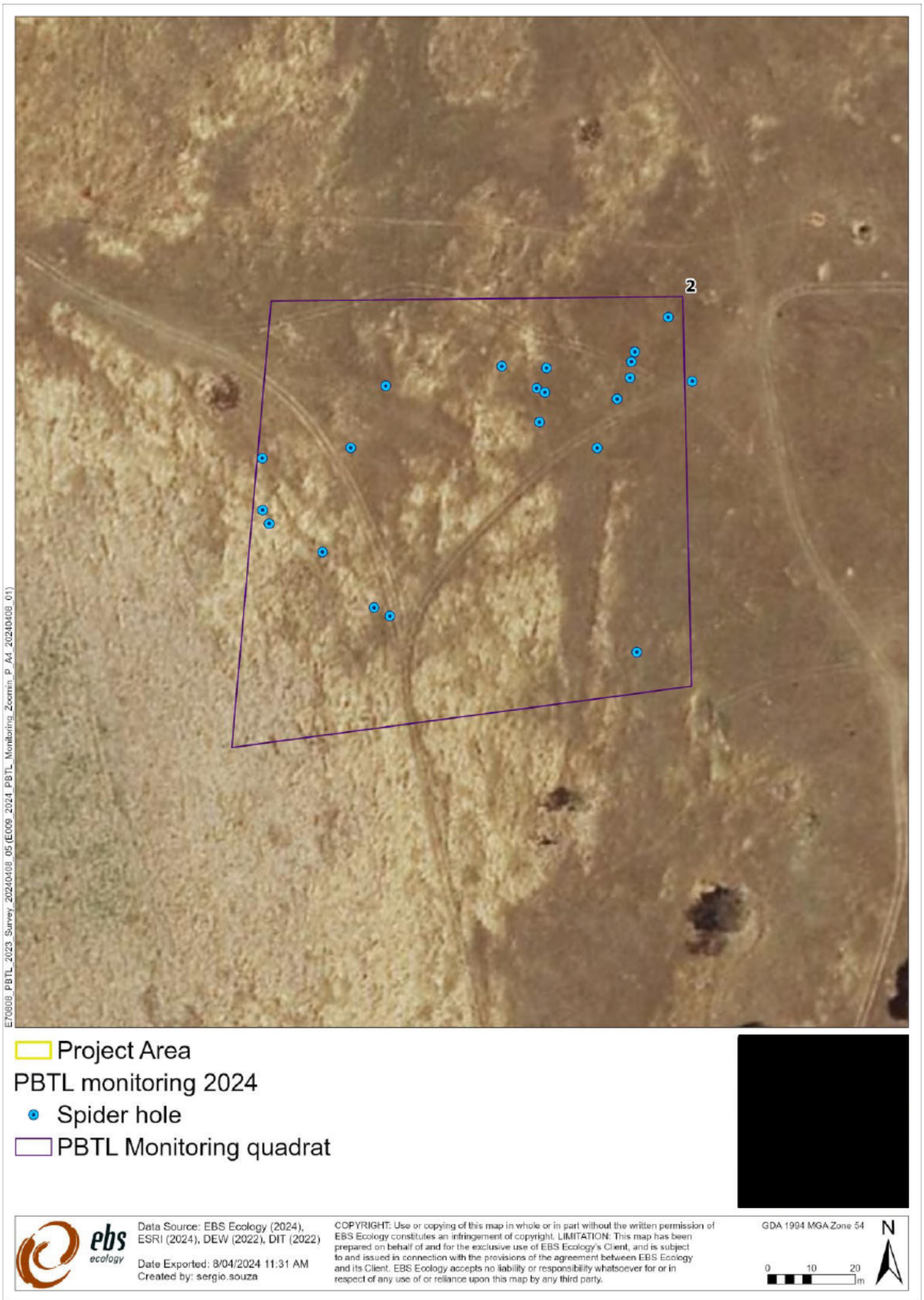

Figure 10. Location of burrows surveyed and PBTLs observed within Quadrat 2 during the 2024 survey.

4.1.7 Quadrat 3

A total of 119 burrows were checked within Quadrat 3 in 2024, twenty of which contained PBTLs (16.81 %) (Figure 11). A total of 20 PBTLs were recorded (16 adults; four juveniles). Remaining burrows contained debris (62), spiders (27), snails (4), weevils (2), beetles (1), millipedes (1) and scorpions (1) (Table 5).

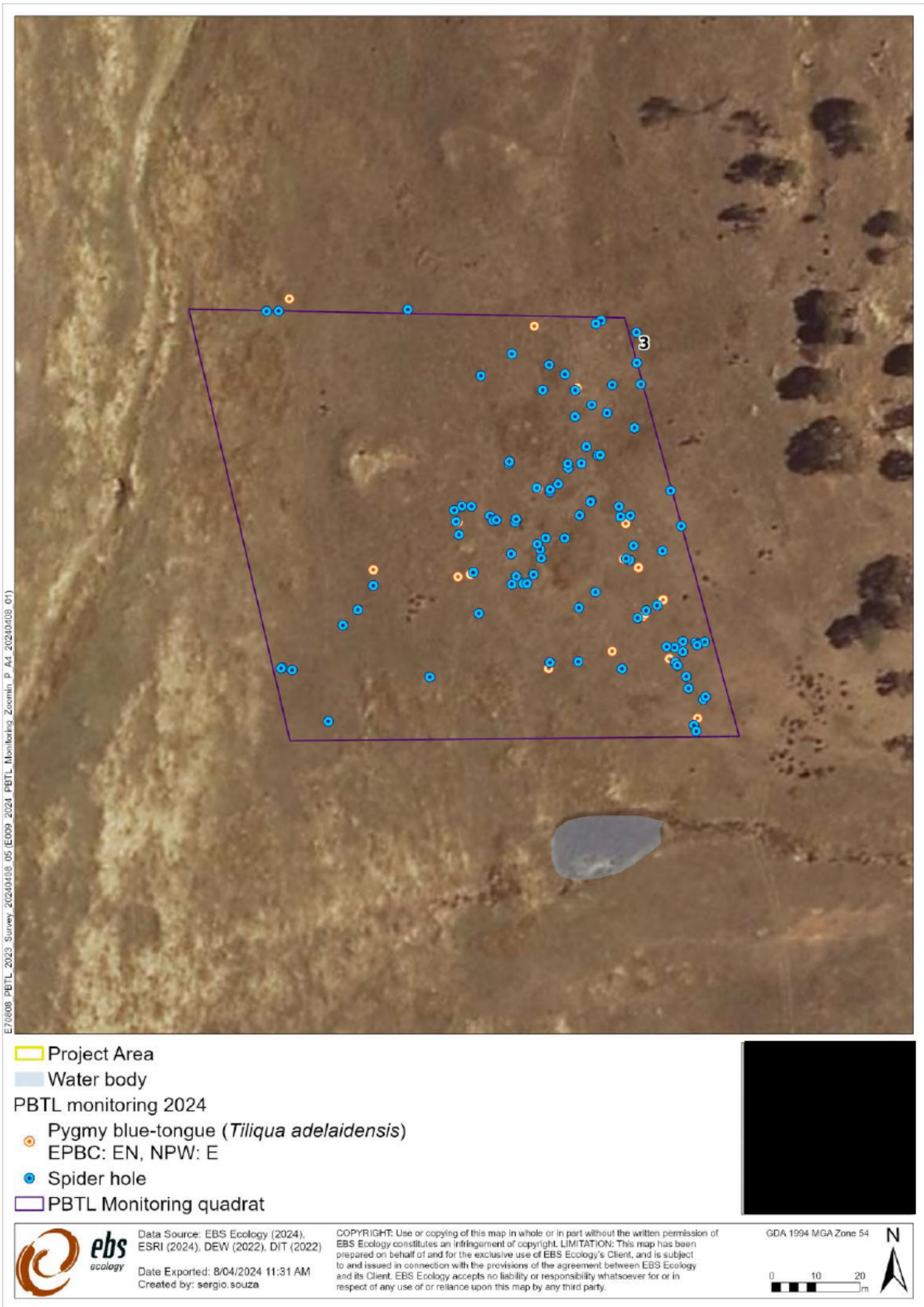

Figure 11. Location of burrows surveyed and PBTLs observed within Quadrat 3 during the 2024 survey.

4.1.8 Quadrat 4

A total of 76 burrows were checked within Quadrat 4 in 2024, seven of which contained PBTLs (9.21 %) (Figure 12). A total of seven PBTLs were recorded (six adults; one juvenile). Remaining burrows contained debris (53), spiders (11), centipedes (2), weevils (2), and scorpions (1) (Table 5).

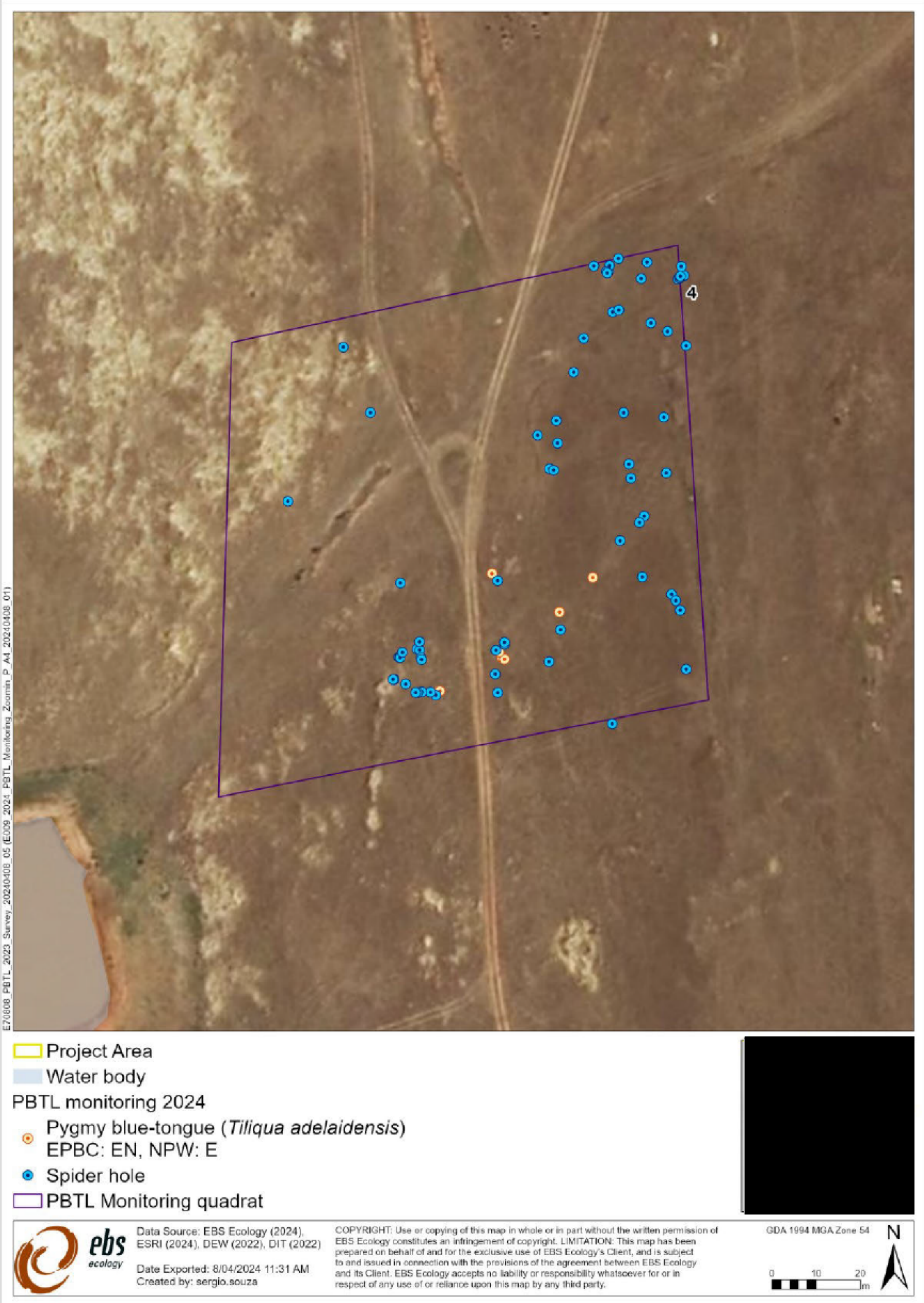

Figure 12. Location of burrows surveyed and PBTLs observed within Quadrat 4 during the 2024 survey.

4.1.9 Quadrat 5

A total of 63 burrows were checked in Quadrat 5 in 2024, ten of which contained PBTLs (15.87 %) (Figure 13). A total of 11 PBTLs were recorded (10 adult; one juvenile), with remaining burrows containing debris (39), spiders (6), beetles (3), weevils (3), millipedes (1) and ants (1) (Table 5).

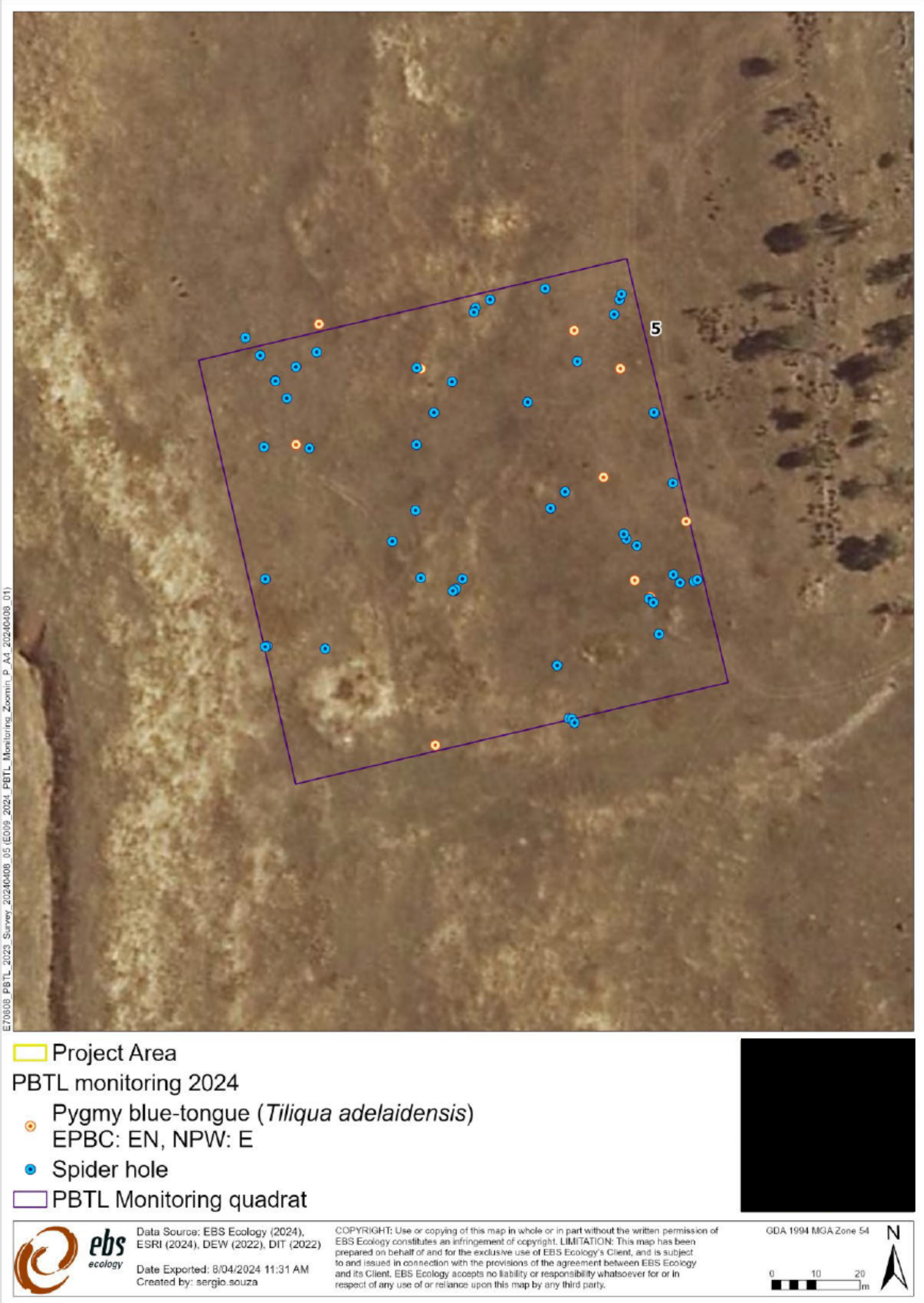

Figure 13. Location of burrows surveyed and PBTLs observed within Quadrat 5 during the 2024 survey.

4.1.10 Quadrat 6

A total of 60 burrows were checked within Quadrat 6 in 2024, eight of which contained PBTLs (13.33 %) (Figure 14). A total of eight PBTLs were recorded (six adults; two juveniles), with remaining burrows containing debris (37), spiders (6), millipedes (3), weevils (3), centipedes (2) and snails (2) (Table 5).

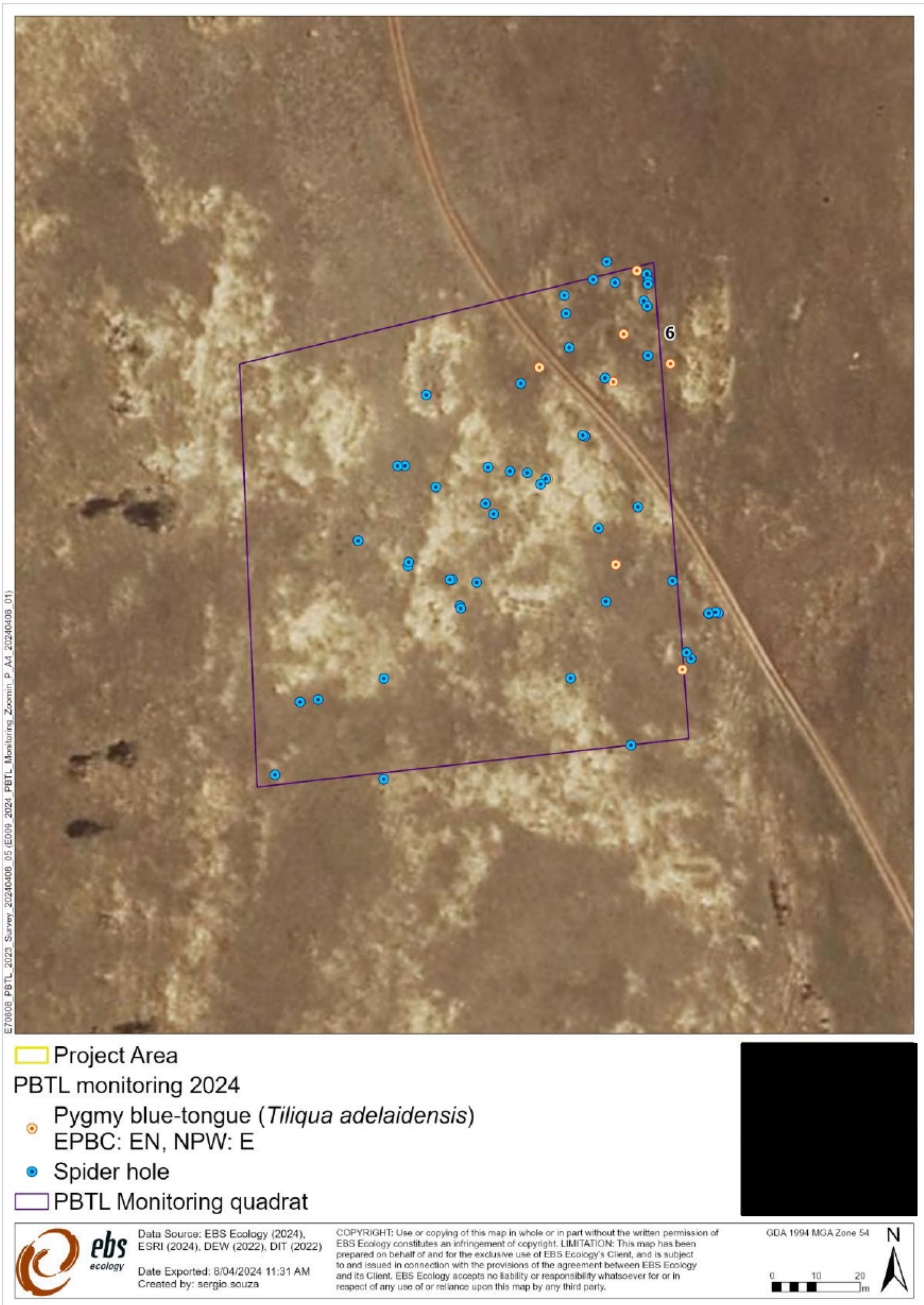

Figure 14. Location of burrows surveyed and PBTLs observed within Quadrat 6 during the 2024 survey.

4.1.11 Quadrat 7

A total of 21 burrows were checked within Quadrat 7 in 2024, one of which contained PBTLs (4.76 %) (Figure 15). A total of two PBTLs were recorded (one adult; one juvenile), with remaining burrows containing debris (18), beetles (1) and spiders (1). (Table 5).

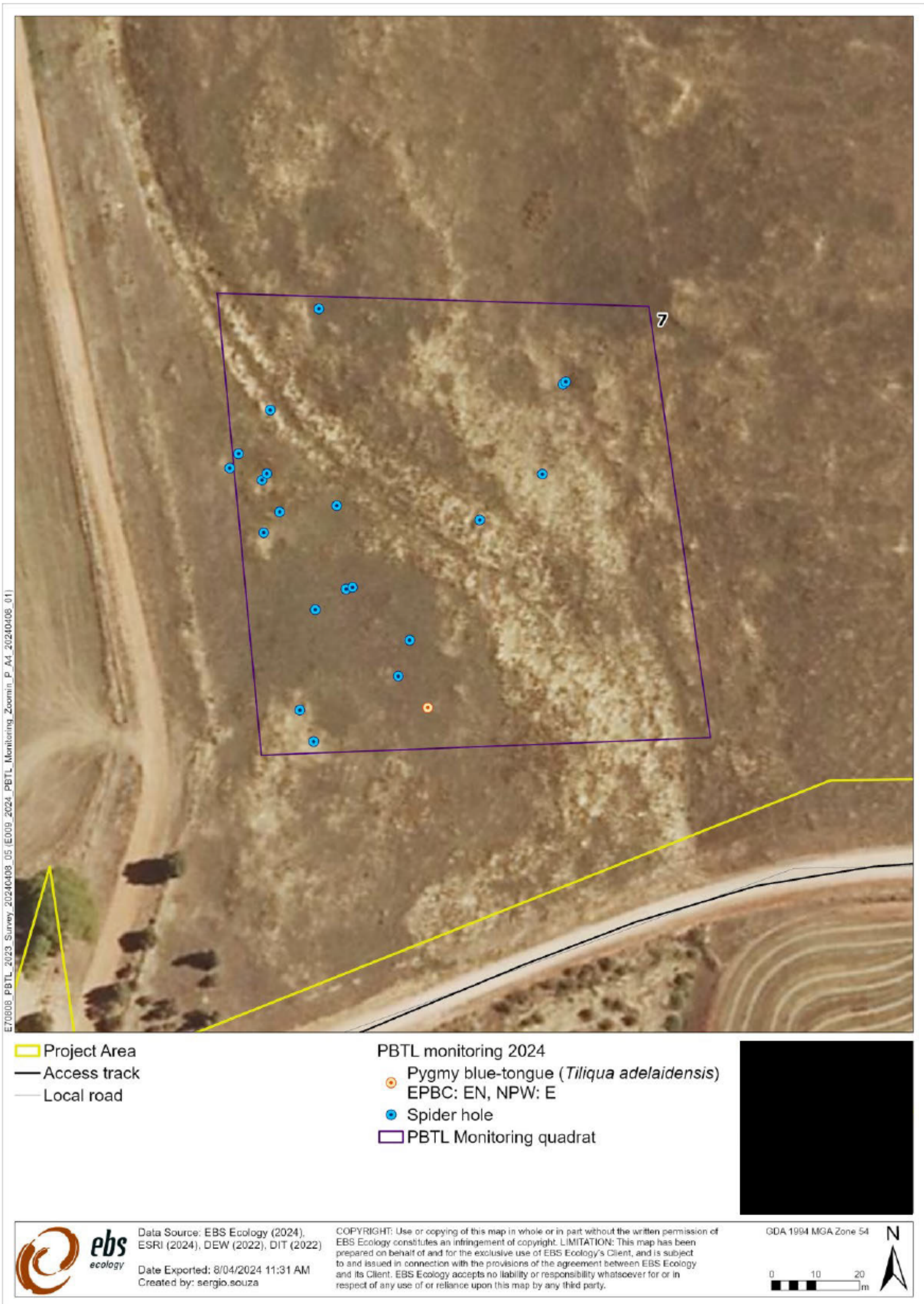

Figure 15. Location of burrows surveyed and PBTLs observed within Quadrat 7 during the 2024 survey.

4.1.12 Quadrat 8

A total of 27 burrows were checked within Quadrat 8 in 2024, one of which contained a PBTL (3.70 %) (Figure 16). A total of one PBTL was recorded (one adult), with the remaining burrows containing debris (22), ants (2), spiders (1) and weevils (1) (Table 5).

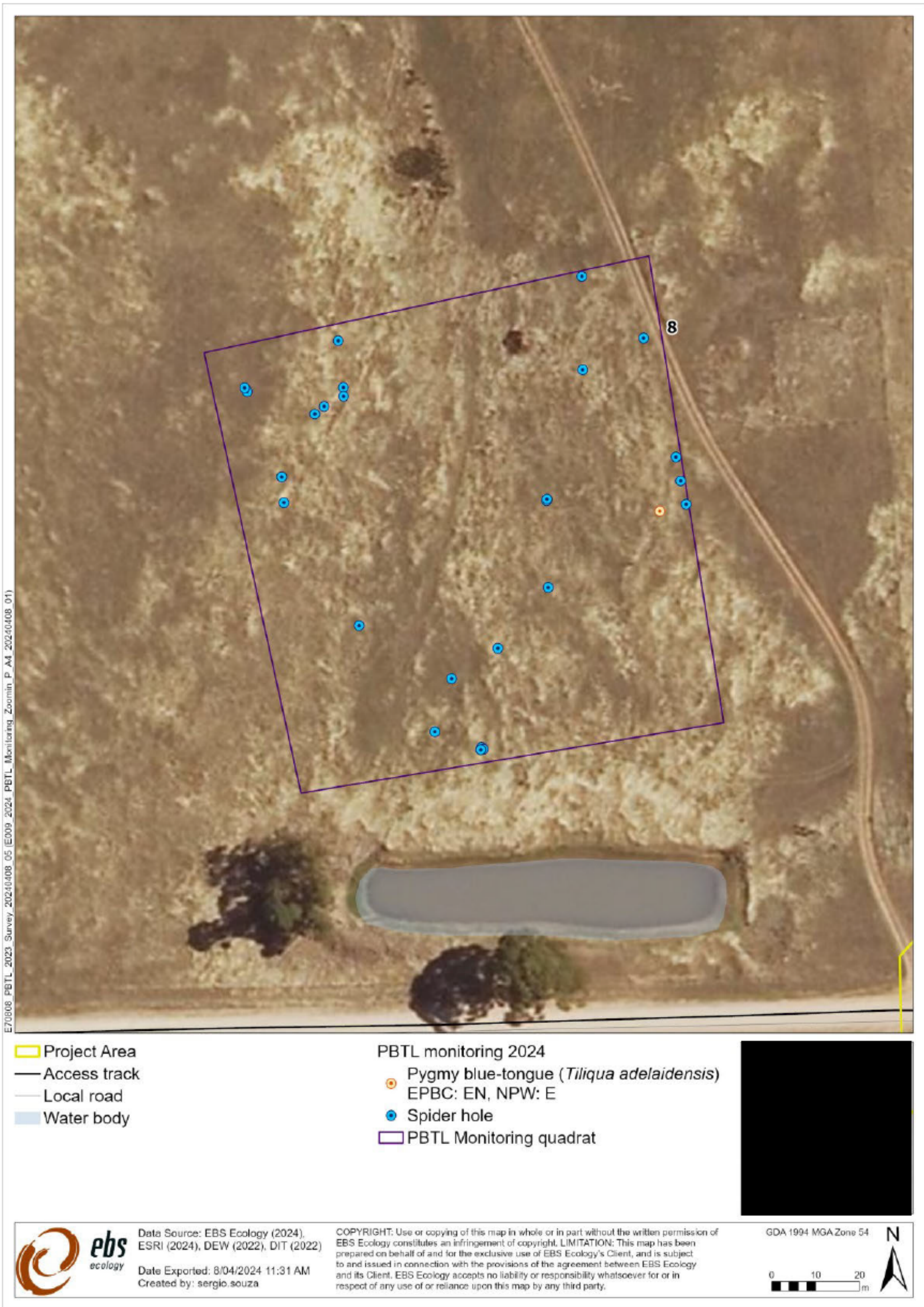

Figure 16. Location of burrows surveyed and PBTLs observed within Quadrat 8 during the 2024 survey.

4.1.13 Quadrat 9

A total of 27 burrows were checked within Quadrat 9 in 2024, four of which contained PBTLs (14.81 %) (Figure 17). A total of four PBTL were recorded (four adults), with the remaining burrows containing debris (17), spiders (2), ants (1), beetles (1), millipedes (1) and weevils (1) (Table 5).

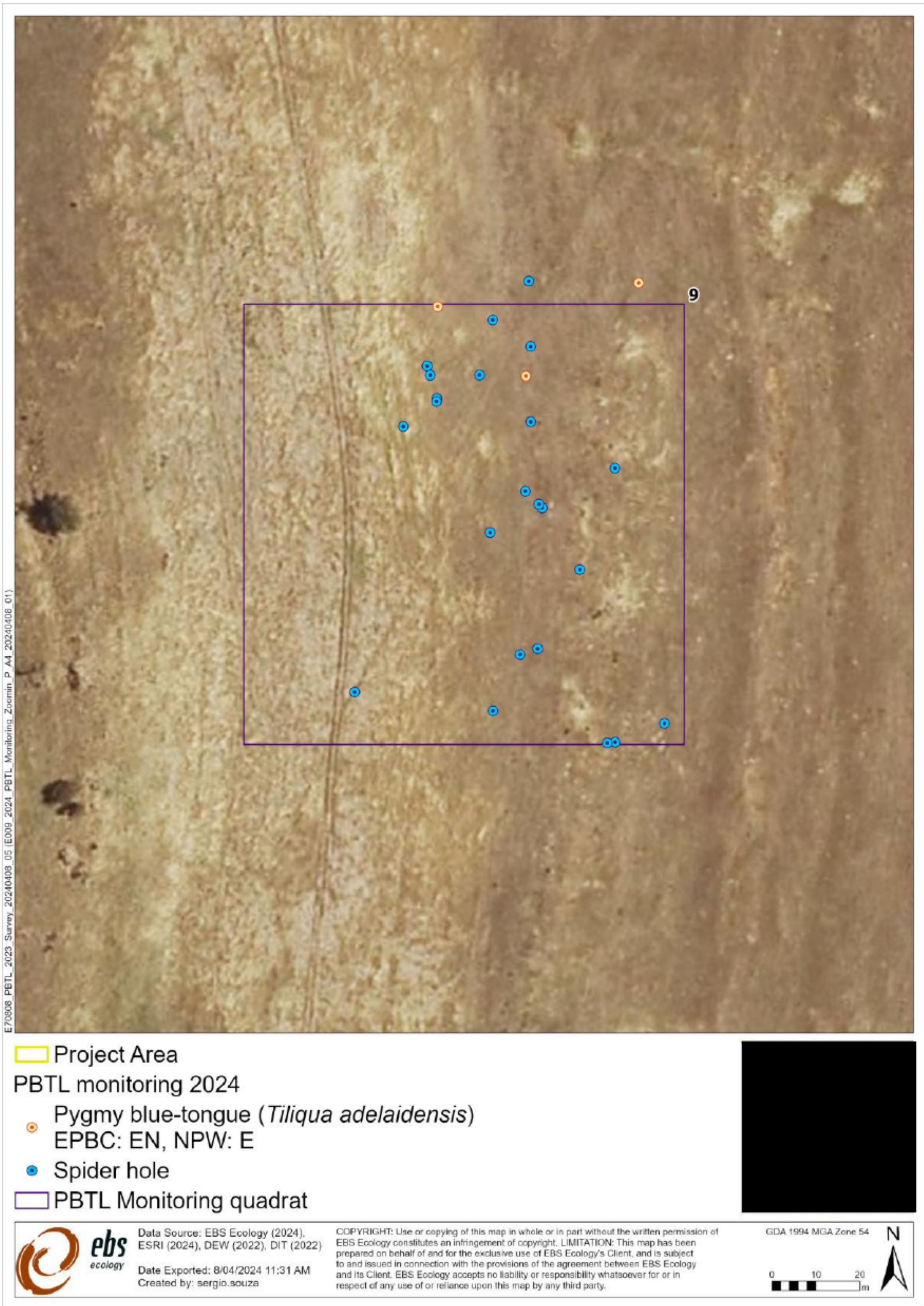

Figure 17. Location of burrows surveyed and PBTLs observed within Quadrat 9 during the 2024 survey.

4.1.14 Quadrat 10

A total of 27 burrows were checked within Quadrat 10 in 2024, two of which contained an PBTLs (7.41 %) (Figure 18). A total of two PBTL were recorded (one adult; one juvenile), with the remaining burrows containing debris (17), weevils (3), beetles (2), scorpions (2) and spiders (1) (Table 5).

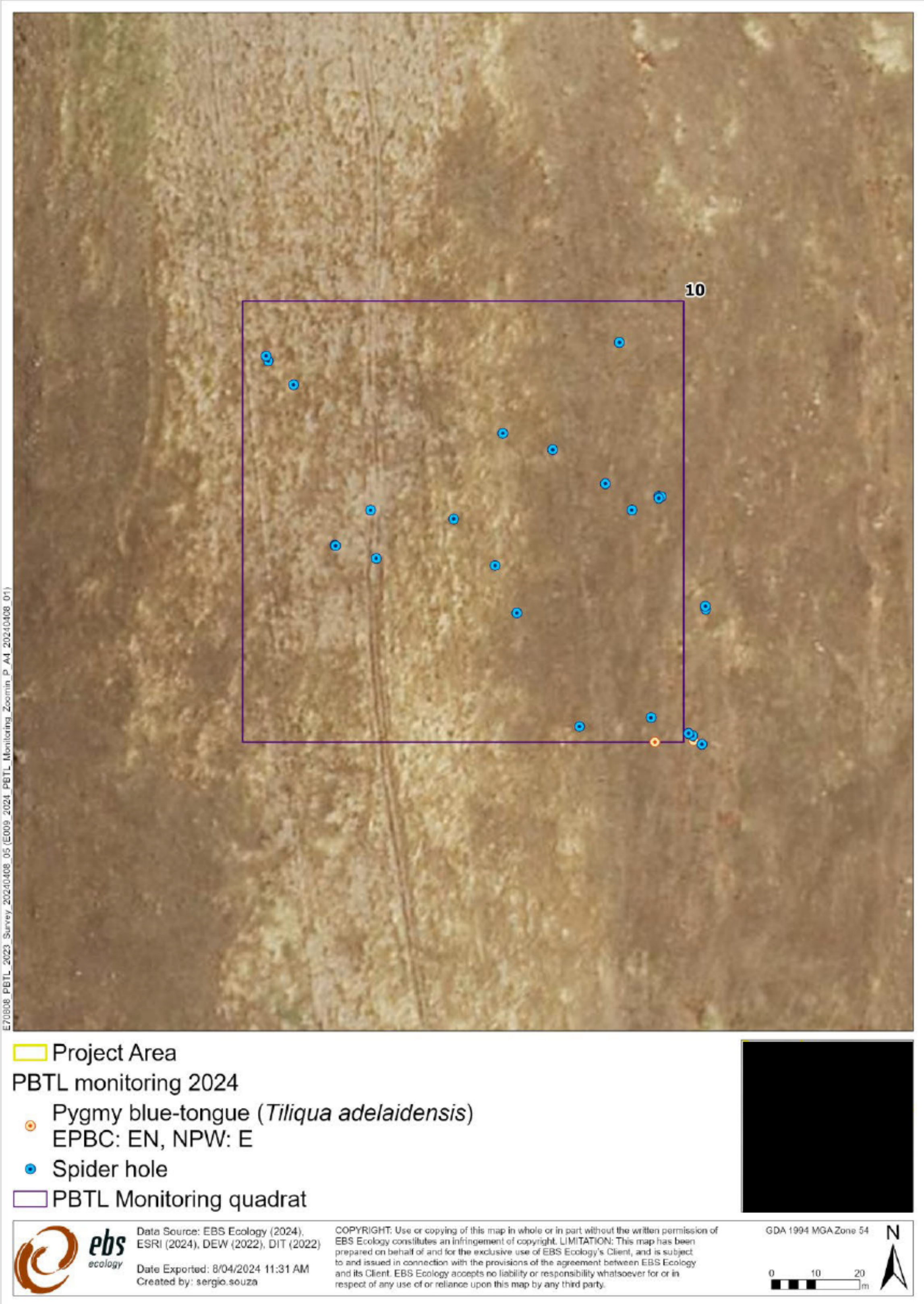

Figure 18. Location of burrows surveyed and PBTLs observed within Quadrat 10 during the 2024 survey.

4.1.15 Quadrat 11

A total of seven burrows were checked within Quadrat 11 in 2024, none of which contained PBTLs (0 %) (Figure 19). Most burrows contained debris (4) while weevils (2) and ants (1) were present in the remaining holes (Table 5).

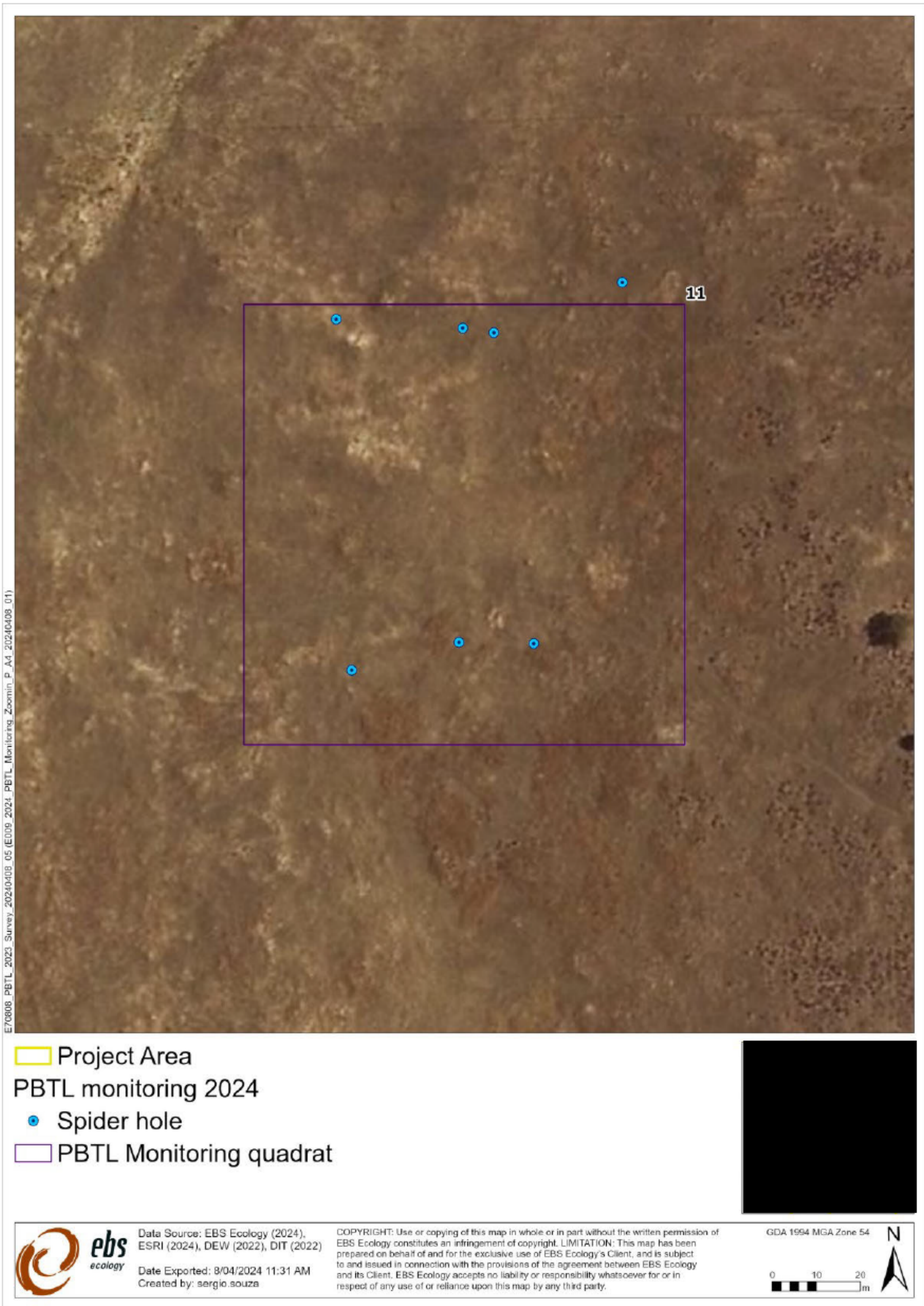

Figure 19. Location of burrows surveyed and PBTLs observed within Quadrat 11 during the 2024 survey.

4.2 Comparison between years

4.2.1 PBTLs

The mean number of PBTLs per quadrat observed in 2024 ($\bar{x}$ = 5.10 individuals) was less than the baseline ($\bar{x}$ = 17.40 individuals), 2018 ($\bar{x}$ = 16.60 individuals), 2019 ($\bar{x}$ = 19.10 individuals) and 2020 ($\bar{x}$ = 10.30 individuals), 2021 ($\bar{x}$ = 3.70 individuals) and 2022 ($\bar{x}$ = 8.73 individuals) but greater than the 2023 ($\bar{x}$ = 2.91 individuals) surveys (Figure 20). There was a significant difference in the mean number of PBTLs between the seven sampling years (p-value = 0.003) with the significant differences occurring between years 2019 and 2021 (0.044) and 2019 and 2023 (0.027).

Relative to 2023, the number of PBTLs increased in most quadrats with the exception of Quadrats 2, 8 and 11 (where it was the same) and Quadrats 4 and 6 (where it decreased). Quadrats 2, 4 and 6 recorded much lower PBTL numbers than the preceding years (2018-2020) (Figure 21). Quadrats 3 and 5 had the highest number of PBTLs, unlike previous years.

The proportion of adult PBTLs observed in 2024 (83.93 %) was lower than 2022 (88.30 %), 2021 (95.10 %), 2019 (91.90 %) and 2020 (84.07 %) surveys but higher than the 2023 (56.25%), 2018 (83.53 %) and Baseline (71.94 %) surveys. The proportion of juvenile PBTLs observed in 2024 (16.07 %) was lower than the 2023 (43.75 %), 2018 (16.47 %) and Baseline (28.06 %) surveys but higher than the 2022 (11.70 %), 2021 (4.98 %), 2020 (15.93 %) and 2019 (8.10 %) surveys.

A significant positive correlation was detected between the number of PBTLs and spiders (p-value = 0.000) (R^2 = 0.141) across the surveys (Figure 22A). The number of PBTLs and burrows is provided in Figure 22B, with a significant positive association also found (p-value = 0.000) (R^2 =0.542).

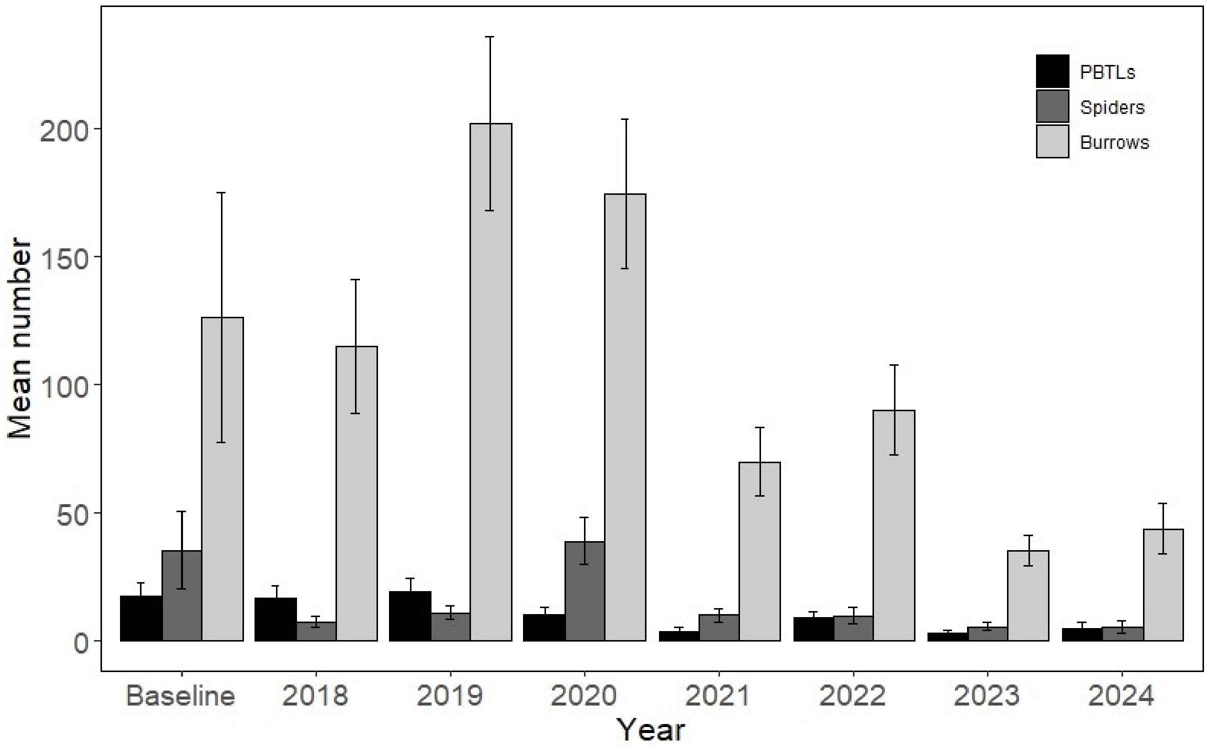

Figure 20. The mean number (± S.E.) of PBTLs, spiders and burrows across the 11 quadrats during the baseline, 2018, 2019, 2020, 2021, 2022, 2023 and 2024 surveys (n.b. the Baseline survey only surveyed Quadrat 1–8).

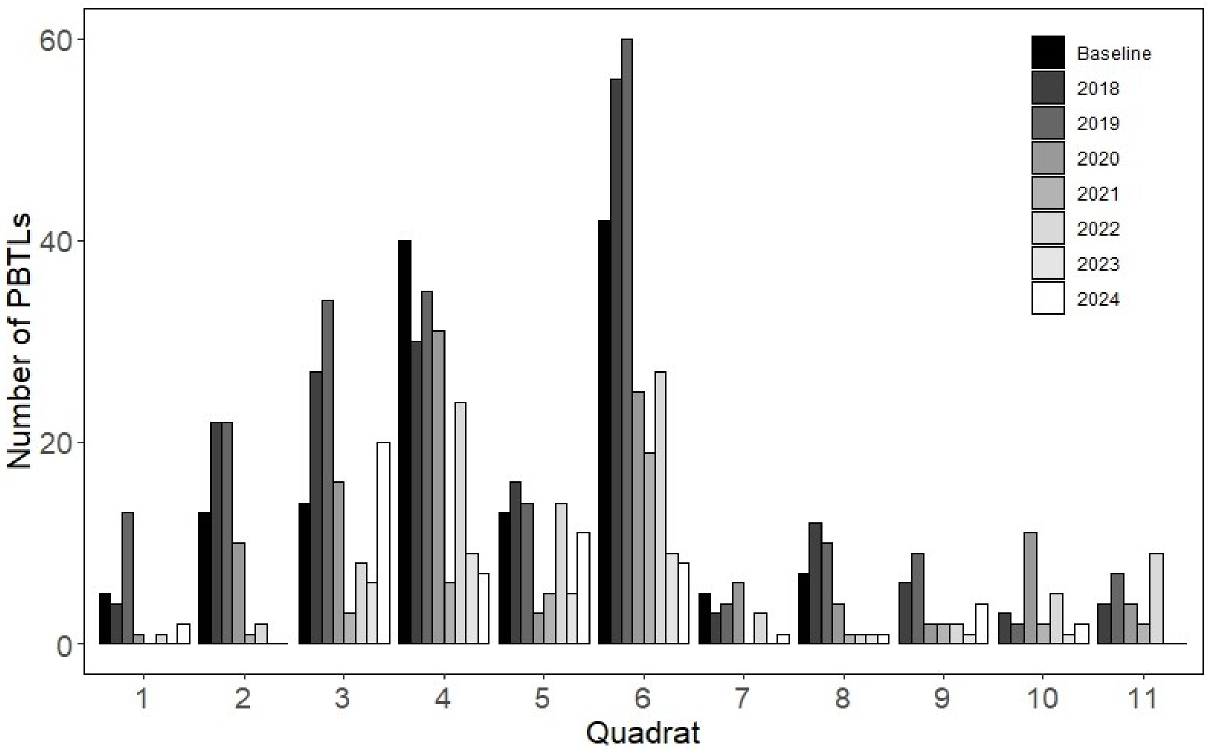

Figure 21. The number of PBTLs observed within each quadrat during the baseline, 2018, 2019, 2020, 2021, 2022, 2023 and 2024 surveys (n.b. the Baseline survey only surveyed Quadrat 1–8).

Table 6. The total number of PBTLs within each age class recorded during the Baseline, 2018, 2019, 2020, 2021, 2022, 2023 and 2024 surveys (n.b. the Baseline survey only surveyed Quadrat 1–8; the 2020, 2021, 2022, 2023 and 2024 surveys classified PBTLs as Adult or Juvenile).

Age class	Baseline	2018	2019	2020	2021	2022	2023	2024
Adult	100	142	193	95	39	84	18	47
Sub-adult	10	8	15					
Juvenile	29	20	2	18	2	12	14	9
Total	**139**	**170**	**210**	**113**	**41**	**96**	**32**	**56**

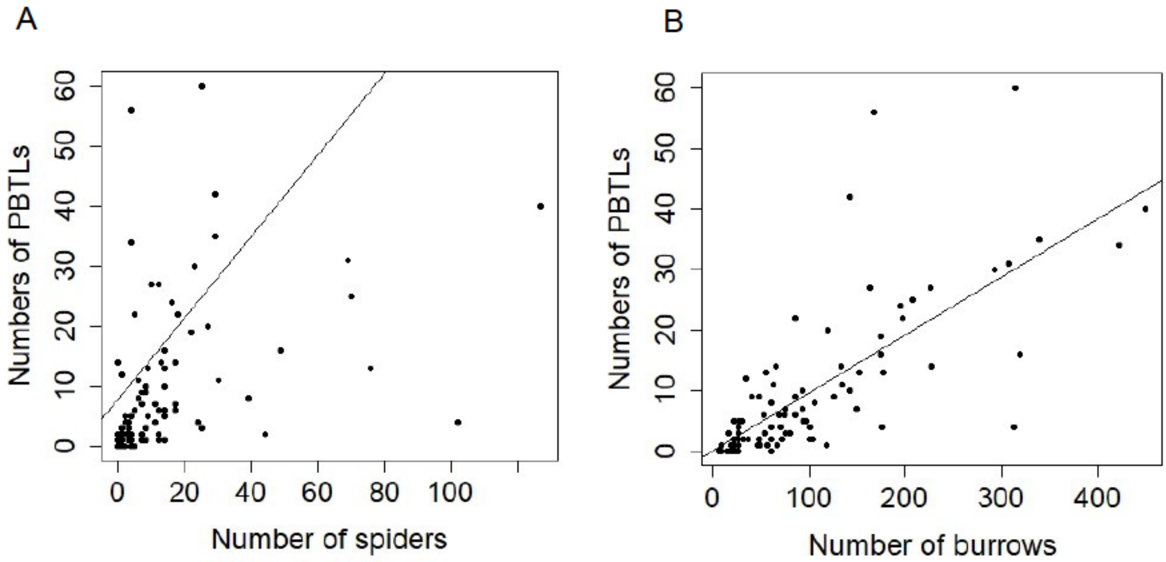

Figure 22. The positive correlation between the numbers of PBTLs and spiders (A) and burrows (B).

4.2.2 Spiders

The mean number of spiders per quadrat observed in 2024 ($\bar{x}$ = 5.45) was lower than all previous years: 2023 ($\bar{x}$ = 5.64 individuals), 2022 ($\bar{x}$ = 9.90 individuals) 2021 ($\bar{x}$ = 10 individuals), 2020 ($\bar{x}$ = 38.72 individuals), 2019 ($\bar{x}$ = 11.00 individuals), 2018 ($\bar{x}$ = 7.27 individuals), and the baseline ($\bar{x}$ = 35.50 individuals) surveys (Figure 20).

This difference was statistically significant (p-value = 0.000), with the Tukey post hoc test revealing a significant difference between the Baseline and 2018 surveys (p-value = 0.036), Baseline and 2023 surveys (p-value = 0.021), Baseline and 2024 surveys (p-value = 0.020), 2018 and 2020 surveys (p-value = 0.004), 2019 and 2020 surveys (p-value = 0.017), 2020 and 2021 surveys (p-value = 0.012), 2020 and 2022 surveys (p-value = 0.011) and 2020 and 2023 surveys (p-value = 0.002).

Relative to 2023, the number of spiders decreased in Quadrats 1, 6, 9, 10 and 11, remained the same in Quadrats 2 and 7 and increased in Quadrats 3, 4, 5 and 8 (Figure 23).

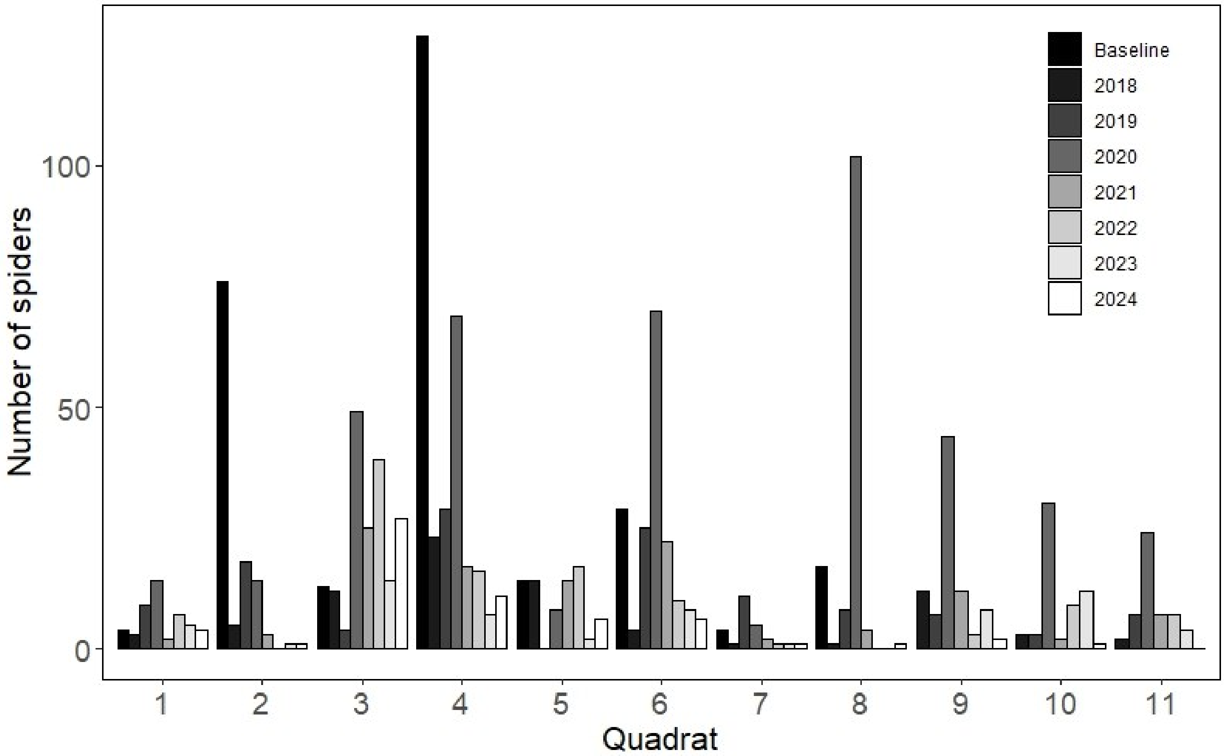

Figure 23. The number of spiders observed within each quadrat during the baseline, 2018, 2019, 2020, 2021 2022, 2023 and 2024 surveys (n.b. the baseline survey only surveyed Quadrat 1–8).

4.2.3 Burrows

The mean number of burrows per quadrat observed in 2024 ($\bar{x}$ = 43.64) was greater than 2023 ($\bar{x}$ = 35.10) but less than all previously conducted surveys: 2022 ($\bar{x}$ = 90.30), 2021 ($\bar{x}$ = 70.00), 2020 ($\bar{x}$ = 171.10), 2019 ($\bar{x}$ = 202.10), 2018 ($\bar{x}$ = 115.10) and Baseline ($\bar{x}$ = 126.38) (Figure 20).

This difference was statistically significant (p-value = 0.000), with the Tukey post hoc test revealing a significant difference between the 2019 and 2021 surveys (p-value = 0.006), 2019 and 2022 surveys (p-value = 0.035), 2019 and 2023 surveys (p-value = 0.000), 2019 and 2024 surveys (p-value = 0.000), 2020 and 2023 surveys (p-value = 0.003) and 2020 and 2024 surveys (p-value = 0.007).

Relative to 2023, the number of burrows decreased in Quadrats 2, 9, 10 and 11, and increased in Quadrats 1, 3, 4, 5, 6, 7 and 8 (Figure 24).

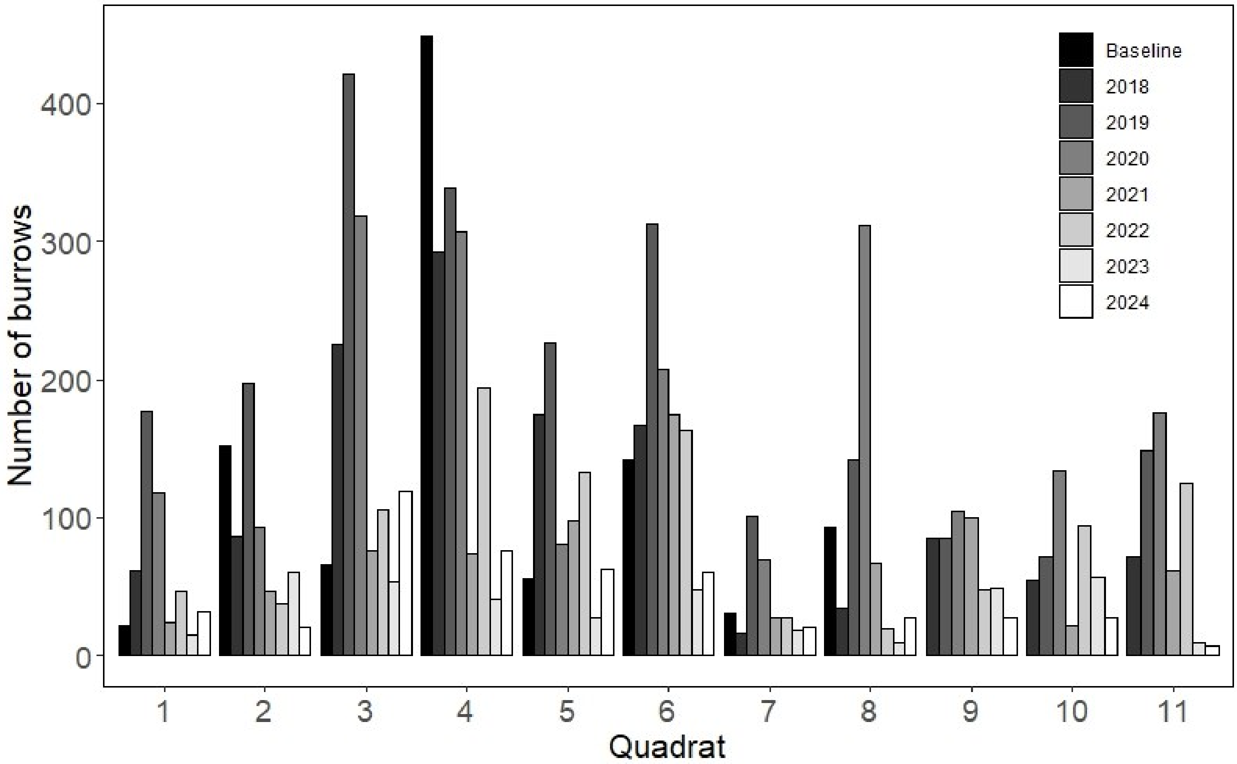

Figure 24. The number of burrows checked within each quadrat during the baseline (2016), 2018, 2019, 2020, 2021, 2022, 2023 and 2024 surveys (n.b. the baseline survey only surveyed Quadrat 1–8).

4.3 Influence of rainfall, aspect and vegetation condition variables on PBTLs

4.3.1 Rainfall

As for previous years, the number of PBTLs were compared against rainfall 3 months prior to survey, total rainfall for the year prior to survey, rainfall 1 month prior to survey and rainfall in the winter prior to survey. There was no correlation detected for any of these rainfall timeframes.

When compared to the spring-summer rainfall recorded prior to the monitoring (i.e. total rainfall for September to January), some relationships were detected. There was found to be a significant relationship between the total number of PBTLs and the spring-summer rainfall recorded prior to the monitoring period (p-value = 0.000) (Figure 25). Indicating that with increasing rainfall in spring and summer, the total number of PBTLs observed decreases. Similarly, there is also a significant relationship between the total number of spider holes observed and the spring-summer rainfall recorded prior to the monitoring period (p-value = 0.000) (Figure 26). This also indicates that with increasing spring and summer rainfall, the total number of spider holes observed decreases.

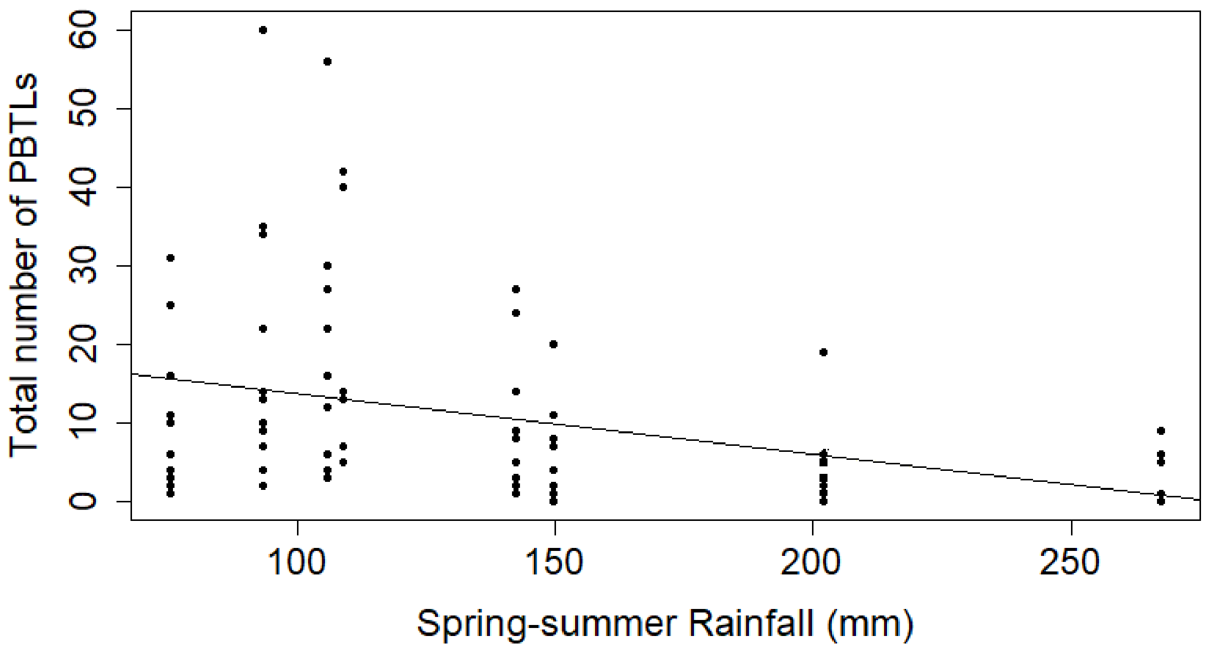

Figure 25. The total number of PBTLs detected during each monitoring year plotted against spring-summer rainfall.

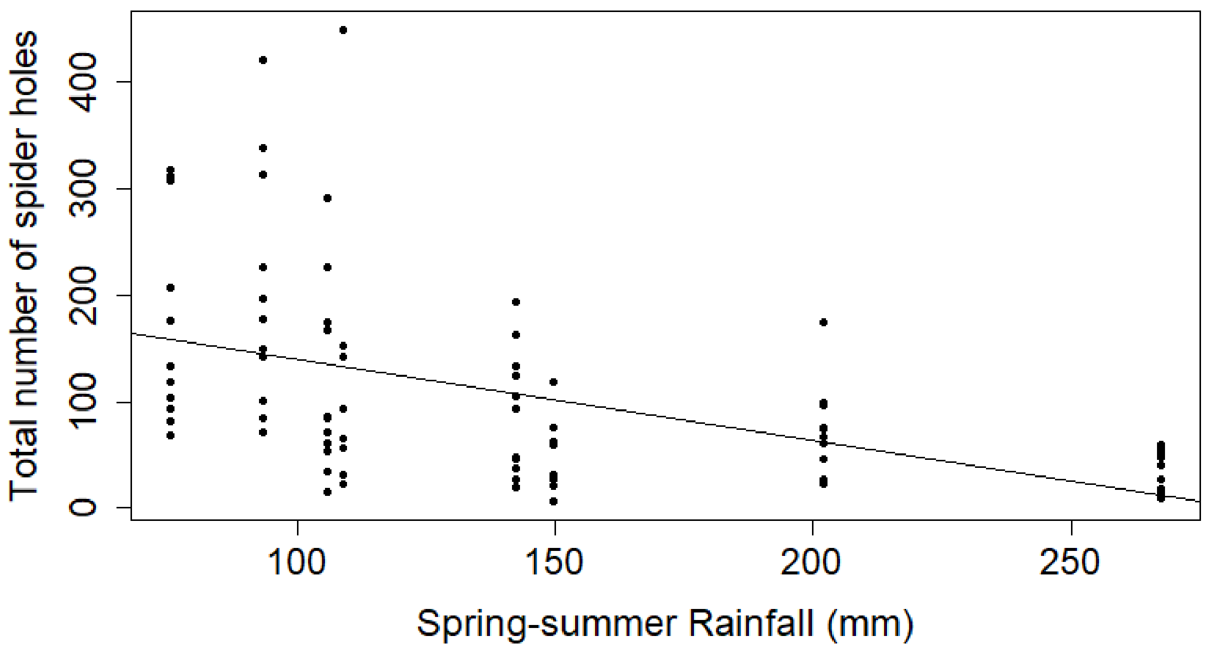

Figure 26. The total number of spider holes detected during each monitoring year plotted against spring-summer rainfall.

4.3.2 Aspect

The mean number of PBTLs per quadrat across the seven surveys was significantly greater on eastern than on western slopes (p-value = 0.042) (Figure 27A).

4.3.3 Vegetation condition variables

The mean number of PBTLs per quadrat in 2018–2022 decreased with increasing grass tussock basal width, but with the addition of the 2023 and 2024 data, there is no association (p-value = 0.544) (Figure 27B).

A significant correlation was found between increasing bare ground and the number of PBTLs (p-value = 0.001) (Figure 28A). Similarly, a significant correlation was found between increasing cryptogam and the number of PBTLs (p-value = 0.019) (Figure 28B)

No correlations were detected between the number of PBTLs, and the remaining vegetation condition variables tested.

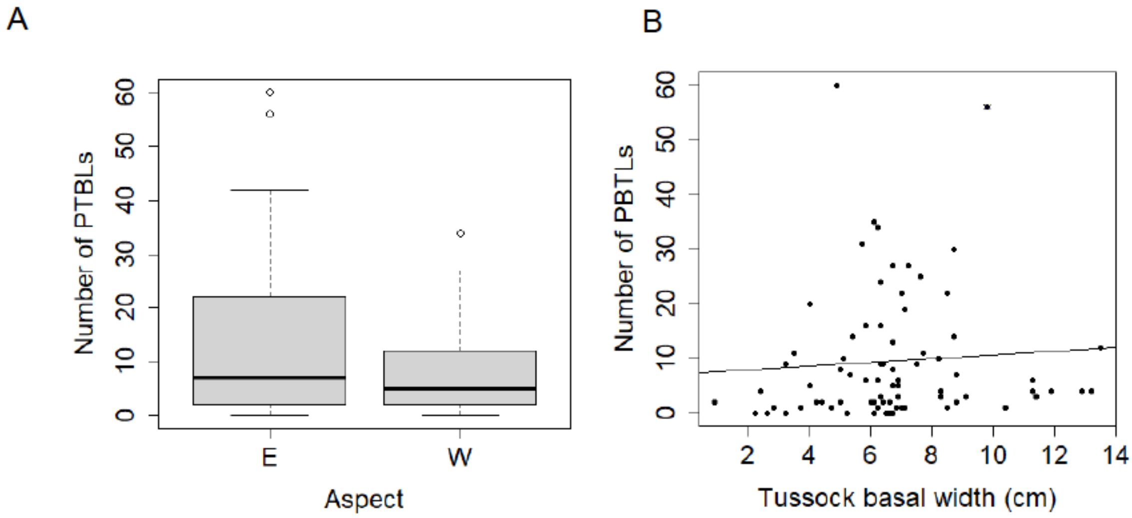

Figure 27. (A) The distribution (minimum, maximum, median, 25th and 75th percentiles, outliers) of the number of PBTLs observed in quadrats on eastern (E) and western (W) orientated slopes across all five surveys. (B) The positive correlation between the tussock basal width (cm) and number of PBTLs observed within each quadrat in 2024.

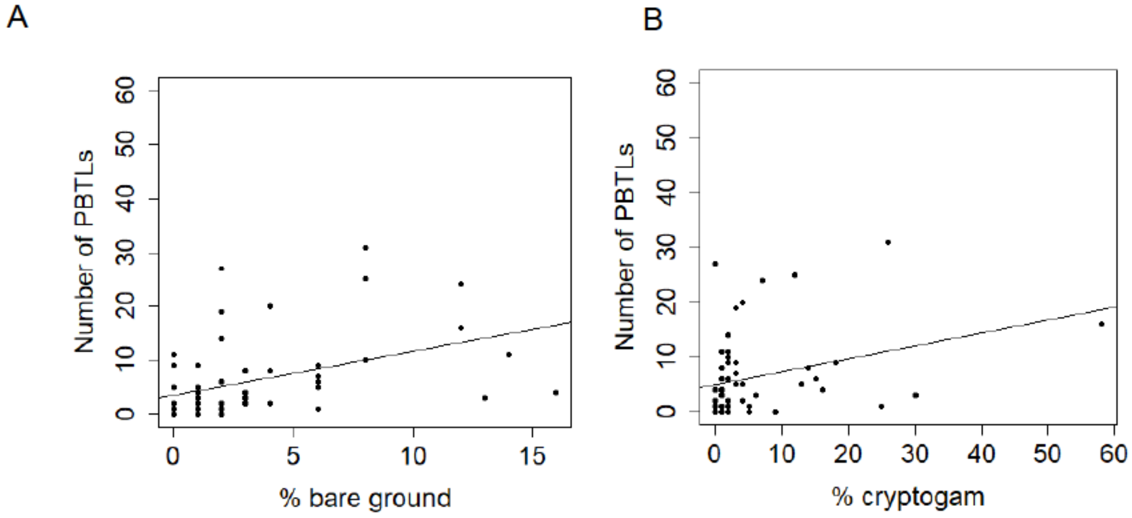

Figure 28. (A) The positive correlation between bare ground (%) and number of PBTLs observed within each quadrat in 2024. (B) The positive correlation between cryptogam (%) and number of PBTLs observed within each quadrat in 2024.

5 VEGETATION MONITORING RESULTS

5.1 2024 results

The results of the 2024 vegetation monitoring surveys are presented below. A comparison of the data recorded of all seven survey years (2018–2024) is provided in Section 5.2.

5.1.1 Vegetation associations per quadrat

A summary of descriptions and condition notes of each of the vegetation associations per quadrat is provided in Table 7 below.

Table 7. Summary of vegetation associations and vegetation condition notes in 2024 within each monitoring quadrat.

Quadrat	Broad Vegetation Group	Description
1	Tussock Grassland on Low Footslopes and Drainage Areas	Dense *Themeda triandra* (Kangaroo Grass)/*Austrostipa* sp. (Spear-grass) Grassland in moderate to good condition with some juvenile recruitment. The grassland had good structural diversity with an abundance of dense tussocks, with evidence of only light grazing. Regeneration of *Allocasuarina verticillata* (Drooping Sheoak) was recorded. There was a high cover of litter throughout the quadrat, with very little bare ground or space in the vegetation.
2	Tussock Grassland on Eastern Slopes	Highly degraded mixed Grassland of *Aristida behriana* (Brush-wire Grass) +/- *Austrostipa/Rytidosperma* sp. (Wallaby Grass), but with areas free of native species. Few juvenile tussocks were recorded. Weeds and litter are dominant, particularly *Avena barbata* (Wild Oats). Declared Weeds *Marrubium vulgare* (Horehound) and *Echium plantagineum* (Salvation Jane) were also present. The quadrat was characterised by cracking clay soils, with many large soil cracks present.
3	Tussock Grassland on Western Slopes	Dense sward with lower-growing tussocks in fair condition, dominated by *Aristida behriana*, *Austrostipa* sp. and *Avena barbata*. Grasses have become increasingly rank, particularly on the lower slope, with an increasing dominance of *Themeda triandra*. The site is rocky and occurs on a west facing hill slope with weeds (*Avena barbata*) increasing downslope and vegetation cover becoming sparser up slope. Some recruitment of juvenile tussocks was recorded.
4	Tussock Grassland on Eastern Slopes	*Aristida behriana* and *Austrostipa* sp. Grassland in poor condition with occasional patches of *Themeda triandra*. Condition improves upslope but historical impact remains evident likely due to position near the old dam. *Avena barbata* and *Salvia verbenaca var.* (Wild Sage) were abundant. There was a high cover of litter throughout the quadrat.
5	Tussock Grassland on Western Slopes	Low growing *Austrostipa scabra*/*A. behriana* Grassland in poor to moderate condition on west facing hill slope improving upslope. Abundant Wild Oats with some previous grazing evident.
6	Tussock Grassland on Eastern Slopes	Mixed age *Austrostipa* sp. Grassland in moderate condition. Good spacing of native grass tussocks, but a high weed and litter cover and little bare ground.
7	Tussock Grassland on Low Footslopes and Drainage Areas	Dense low *Themeda triandra*/*Austrostipa* Grassland in poor to moderate condition with a high cover of weeds including Wild Oats and *Trifolium angustifolium*. Some juvenile tussock recruitment.
8	Tussock Grassland on Low Footslopes and Drainage Areas	Grassland in poor to moderate condition with native *Austrostipa* sp., *Rytidosperma caespitosum* (Common Wallaby-grass), *Aristida behriana* and *Walwhalleya proluta* (Panic Grass) tussocks. Spacing between tussocks and recruitment observed. Weeds/exotic species (particularly *Avena barbata*) were

		abundant throughout, and Declared Plants Horehound and Salvation Jane were observed. The quadrat was dominated by large soil cracks, probably the result of saturation or inundation during a period of high rainfall.
9	Tussock Grasslands on Rocky Ridges	Degraded site on ridge dominated by Wild Oats. Minimal bare ground, with dense thatch covering spaces between plants. There was a higher diversity of native species in rocky area on the cliff edge. Scattered *Enneapogon nigricans* (Black-head Grass), *Austrostipa* and *Aristida behriana*. *Salvia verbenaca var.* was frequent and a few individual *Marrubium vulgare* (Declared weed) plants were recorded.
10	Tussock Grasslands on Rocky Ridges	Located in an area of poor-quality grassland dominated by Wild Oats. Minimal bare ground, with dense thatch covering spaces between plants. *Austrostipa* tussocks very widely spaced with little recruitment observed.
11	Tussock Grassland on Western Slopes	Mixed grassland in moderate condition with *Triodia irritans* (Spinifex) scattered throughout and good cover of *Aristida behriana* and other native grasses with only light grazing impact. Mid-dense cover of *Avena barbata* was present.
12	Woodlands on Rocky Slopes	This quadrat is located in a patch of *Allocasuarina verticillata* (Drooping Sheoak) woodland on a west facing slope in moderate to good condition. Good diversity and dominated by State Rare *Cryptandra campanulata* (Long-flower Cryptandra) and native tussock grasses. Low diversity and cover of weeds.

5.1.2 Summary of 2024 results

A total of 82 flora species were observed across the twelve 1 ha quadrats in 2024. This included 46 native flora species and 36 weed species (Appendix 4). Three flora species listed as Rare under the *National Parks and Wildlife Act 1972* (NPW Act) were observed within the SEB Offset Area:

- *Cryptandra campanulata* (Long-flower Cryptandra) (Quadrats 1, 3–6 and 10–12);
- *Maireana rohrlachii* (Rohrlach's Bluebush) (Quadrat 6); and
- *Rumex dumosus* (Wiry Dock) (Quadrats 3, 7 and 9).

Six weed species declared under the *Landscape South Australia Act 2019* (LSA Act) were observed within the SEB Offset Area:

- *Chondrilla juncea* (Skeleton Weed) (Quadrat 10);
- *Echium plantagineum* (Salvation Jane) (Quadrats 1–12);
- *Marrubium vulgare* (Horehound) (Quadrats 1–12);
- *Reseda lutea* (Cut-leaf mignonette) (Quadrats 2, 5 and 7–9);
- *Rosa canina* (Dog Rose) (Quadrats 1–3, 5 and 7–12); and
- *Xanthium spinosum* (Bathurst Burr) (Quadrats 1, 2 and 4–10).

The mean number of tussocks per hectare was 140,000, and the mean number of juvenile tussocks per hectare was 21,146 (Table 8). The mean percentage of dead material in grass tussocks was 27.97 %. Mean weed cover was 7.80 %, which was similar to, but slightly less than, the 1 ha estimate of weed cover (22.50 %). Mean cryptogam cover (1.33 %) and mean cover of bare ground (3.32 %) were both very low.

Mean litter cover (74.86 %) was recorded for the third time this survey year and accounts for lower weed cover percentages, since all dead plant material laying on the ground was counted as litter.

The mean plant spacing was 25.86 cm, and the mean plant basal width and height were 3.94 cm and 15.76 cm, respectively.

A summary of the 2024 per quadrat and per plant results for each of the twelve 1 ha quadrats is provided in Table 8. Complete lists of all the native and weed species observed within in each quadrat are provided in Appendix 4.

Table 8. Summary of 2024 vegetation monitoring per quadrat and per plant results.

Quadrat	Per Quadrat											Per Plant	
	Native species diversity	Weed species diversity	Tussocks (per ha)	Juvenile tussocks (per ha)	Dead material (%)	Weed cover (%)	Weed cover 1 ha estimate (%)	Cryptogam cover (%)	Bare ground cover (%)	Litter cover (%)	Plant spacing (cm)	Plant basal width (cm)	Plant height (cm)
1	29	20	150,000	50,000	22.50	7	10	0.00	2.22	75.03	24.83	4.15	21.79
2	13	25	85,000	5,000	37.57	17	50	0.00	0.25	79.13	29.70	2.18	12.25
3	24	18	156,250	15,000	24.53	3	15	3.53	4.28	79.63	23.63	4.00	10.40
4	17	20	201,250	20,000	36.87	2	20	2.88	5.53	75.88	22.29	5.32	12.46
5	22	15	77,500	21,250	19.85	7	20	2.19	14.16	73.69	32.27	3.51	11.09
6	21	19	57,500	3,750	35.82	11	30	0.97	3.94	78.06	29.44	5.00	10.80
7	17	19	90,000	47,500	15.22	3	20	0.00	0.25	61.25	24.81	6.83	27.04
8	15	24	102,500	10,000	14.31	6	15	0.00	0.47	79.34	32.33	7.02	18.62
9	18	21	67,500	3,750	34.44	12	35	0.00	1.03	83.16	26.52	2.38	13.61
10	18	20	206,250	18,750	38.28	24	40	0.00	0.16	75.34	24.67	0.89	17.13
11	21	13	193,750	22,500	30.31	2	10	1.06	1.78	81.56	23.41	3.20	20.12
12	30	15	292,500	36,250	25.90	0	5	5.28	5.78	56.25	16.42	2.85	13.82
Total/ Mean	**20.42**	**19.08**	**140,000**	**21,146**	**27.97**	**7.80**	**22.50**	**1.33**	**3.32**	**74.86**	**25.86**	**3.94**	**15.76**

5.2 Comparison between 2018 – 2024 results

5.2.1 Native species diversity

Mean native species diversity within the SEB Offset Area was the highest since surveys began with 20.25 species in 2024, compared to 15.50 species in 2023, 18.30 species in 2022, 13.20 species in 2021, 14.91 in 2020, 7.42 in 2019 and 5.75 in 2018 (Figure 29).

Mean native species diversity was significantly different between 2018 and 2020 (p-value = 0.000), 2018 and 2021 (p-value = 0.002), 2018 and 2022 (p-value = 0.000), 2018 and 2023 (p-value = 0.000), 2018 and 2024 (p-value = 0.000), 2019 and 2020 (p-value = 0.002), 2019 and 2021 (p-value = 0.039), 2019 and 2022 (p-value = 0.000), 2019 and 2023 (p-value = 0.001), 2019 and 2024 (p-value = 0.000) and 2021 and 2024 (p-value – 0.004).

All native species recorded in the SEB Offset Area for 2018 to 2024 are listed in Appendix 4 – Table 10, with native species diversity at each quadrat for 2018 to 2024 provided in Appendix 4 – Table 12.

In 2024, a total of 46 native species were observed within the SEB Offset Area, compared to 43 in 2023, 45 in 2022, 39 in 2021, 41 in 2020, 24 in 2019, and 20 in 2018. No new native species were detected for the first time in 2024 (Appendix 4 – Table 14).

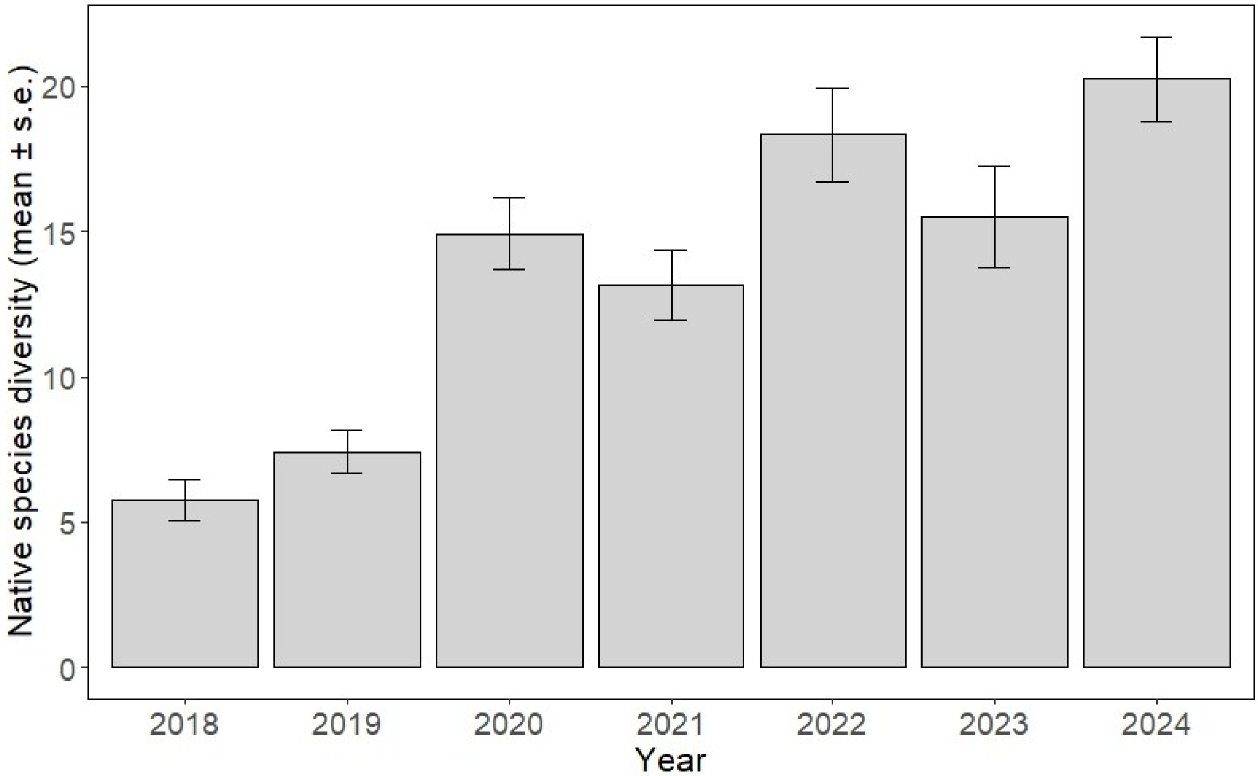

Figure 29. Mean native species diversity from 2018 - 2024.

5.2.2 *Weed species diversity*

Mean weed species diversity within the SEB Offset Area increased to 19.08 in 2024, compared to 18.40 in 2023, 15.2 in 2022, 12.25 species in 2021, 10.58 species in 2020, 6.17 in 2019 and 3.50 species in 2018 (Figure 30). Mean weed species diversity overall was significantly different between all years (p-value = 0.000 except between 2019-2020 and 2022-2024 where p-value =0 .010), except between 2018-2019, 2020-2021, 2021-2022 and 2023-2024.

All weed species recorded in the SEB Offset Area for 2018 to 2024 are listed in Appendix 4 – Table 11,wih weed species diversity at each quadrat for 2018 to 2024 provided in Appendix 4 – Table 12.

In 2024, a total of 36 weed species were observed within the SEB Offset Area, compared to 43 in 2023, 34 in 2022, 30 in 2021, 22 in 2020, 14 in 2019, and 13 in 2018. This included two weed species that were detected for the first time in the SEB Offset Area (Appendix 4 – Table 11).

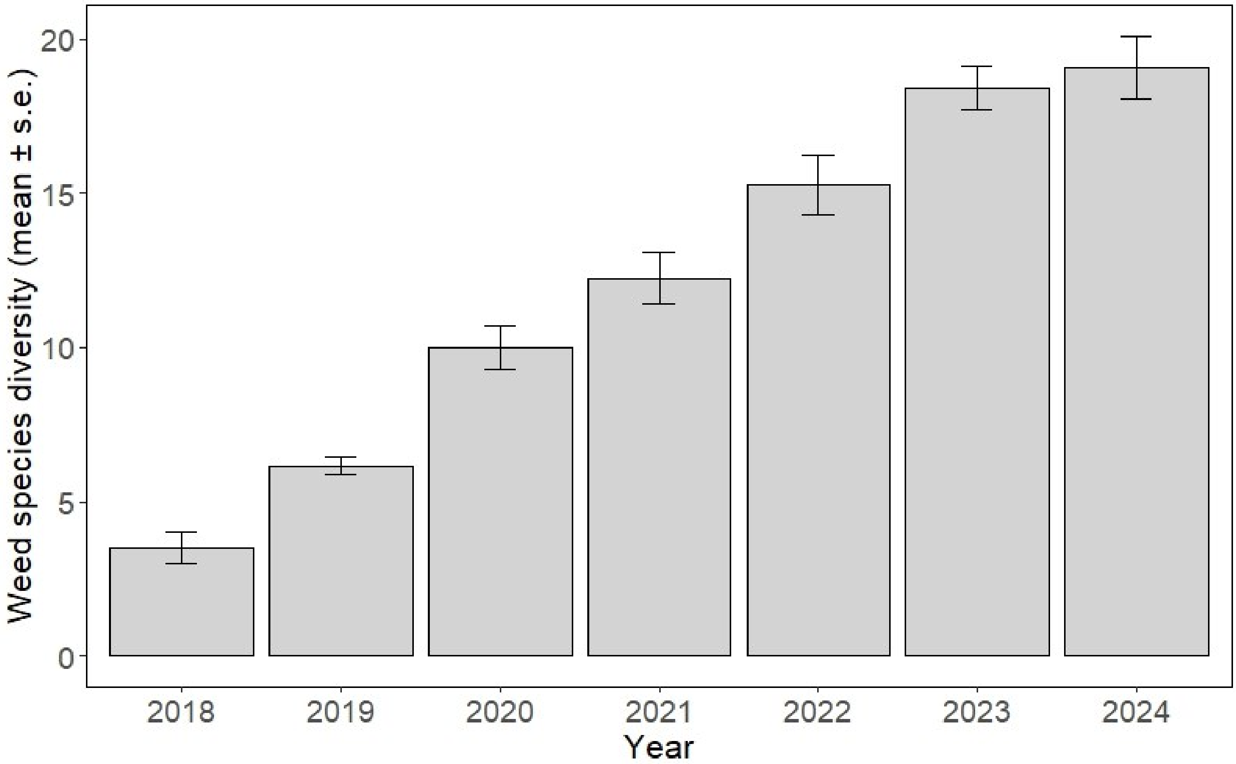

Figure 30. Mean weed species diversity in 2018 to 2024.

5.2.3 Perennial plant spacing

The mean spacing of perennial plants decreased to 25.86 cm in 2024 compared to 26.74 cm in 2023 but remained higher than 2022 (20.85). This was lower than all other previous survey years including 2021 (26.00 cm), 2020 (56.9 cm), 2019 (41.6 cm) and 2018 (29.7 cm) (Figure 31). These differences were significant between 2020 and 2021 (p-value = 0.027), 2020 and 2022 (p-value = 0.005), 2020 and 2023 (p-value = 0.036), and 2020 and 2024 (p-value = 0.026).

Mean spacing of perennial plants at each quadrat for 2018 to 2024 is provided in Appendix 4 – Table 16. Mean plant spacing decreased in Quadrats 2, 3, 5, 6, 8, 9, 10 and 12 while it increased in Quadrats 1, 4, 7 and 11. Five of the twelve quadrats had a mean spacing that was further than the 2018 spacings.

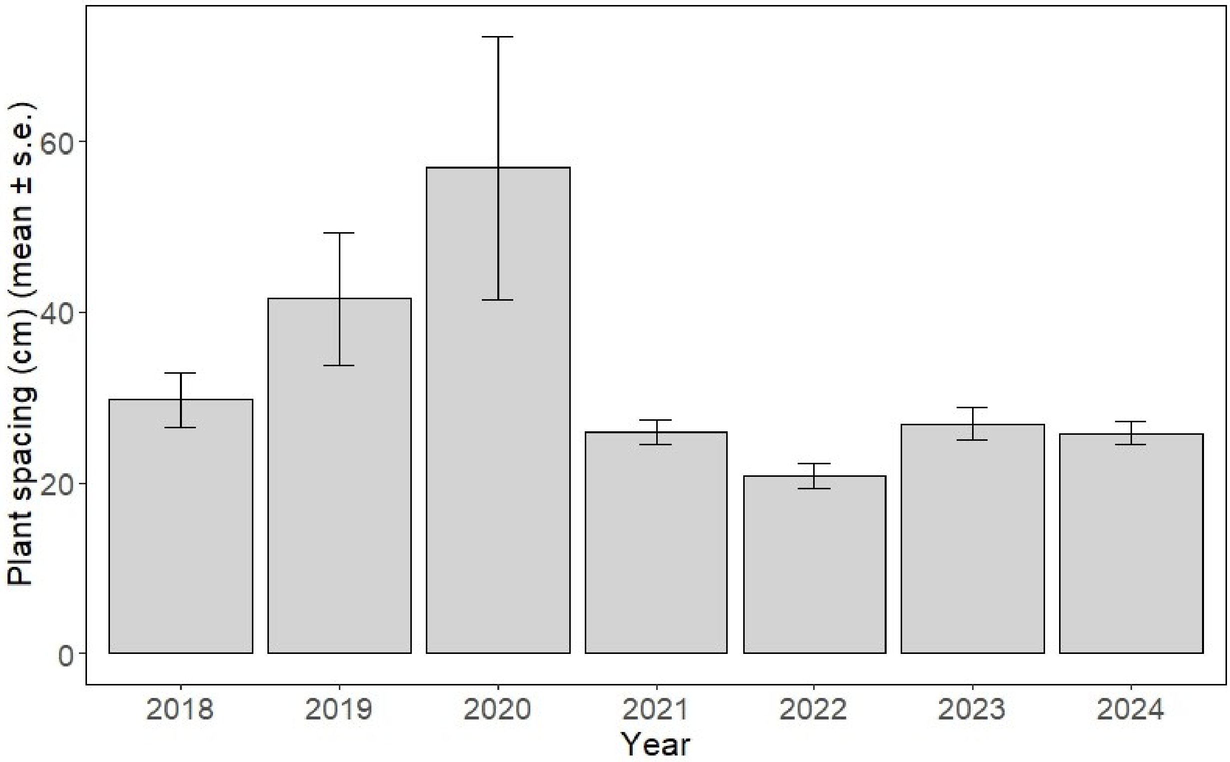

Figure 31. Mean plant spacing in 2018 to 2024.

5.2.4 Perennial plant density (tussocks per hectare)

The decrease in perennial plant spacing is reflective of the increase in the mean number of perennial grass tussocks per hectare (TPH) in 2024 of 140,000 from 90,000 in 2023, 164,583 in 2022, 94,815 in 2021, 121,583 in 2020 and 114,167 in 2019 (Figure 32). This difference was not significant (p-value = 0.107). The mean number of TPH in 2018 was 95,000, however, this was calculated from Quadrats 9–12 only and therefore not included in Figure 32 and the statistical analysis.

Mean TPH at each quadrat in 2018 (Quadrats 9–12 only), 2019, 2020, 2021, 2022, 2023 and 2024 is provided in Appendix 4 – Table 17. From 2023 to 2024 mean TPH increased in all quadrats except Quadrat 7, while from 2022 to 2023, mean TPH decreased at all quadrats.

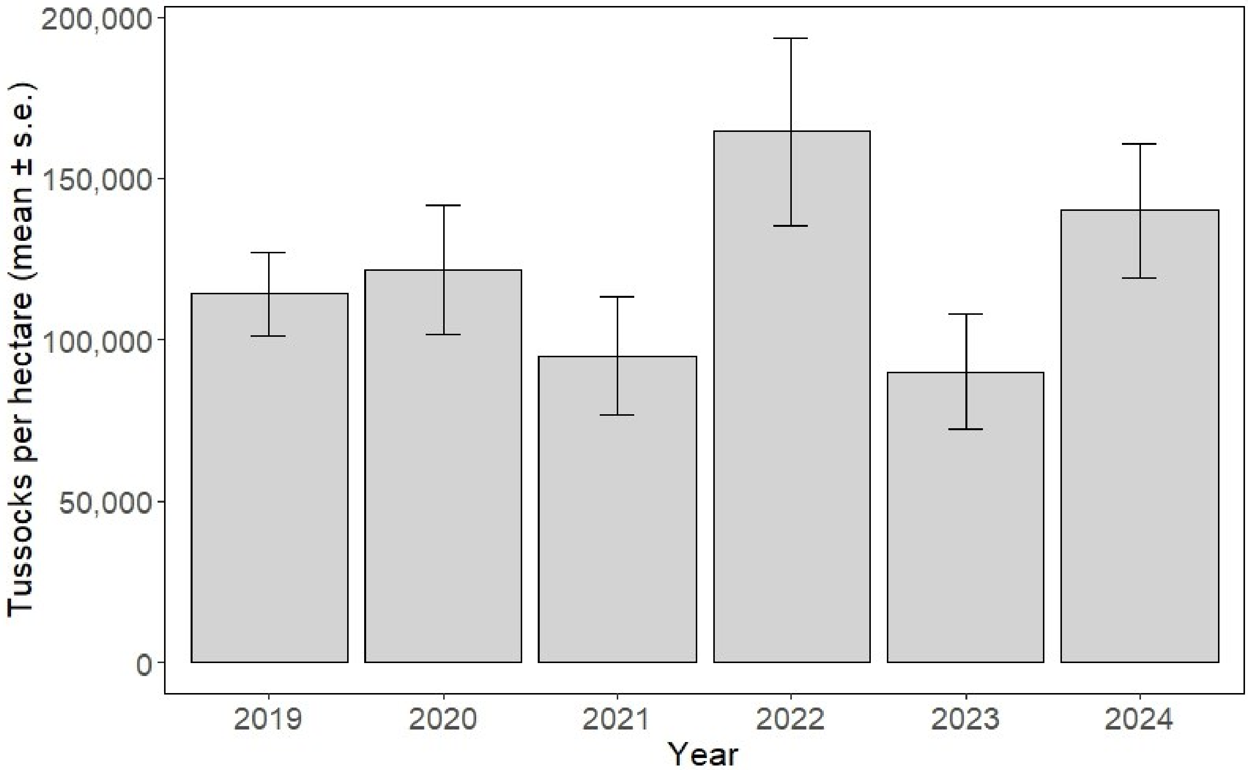

Figure 32. Mean tussocks per hectare from 2019 to 2024. 2018 data is not plotted as data is only available for Quadrats 9–12.

5.2.5 Juvenile recruitment (juveniles tussocks per hectare)

The mean number of juvenile perennial grass tussocks per hectare in 2024 (21,146 juveniles per hectare (JPH)) was higher than all previous years except one: 2018 (9,550 JPH), 2019 (15,667 JPH), 2021 (4,400 JPH), 2022 (9,911 JPH) and 2023 (5,167 JPH). The only year that more JPH were recorded was in 2020 (86,083 JPH).

These differences were significant between 2019 and 2020 (p-value = 0.001), 2020 and 2021 (p-value = 0.000), 2020 and 2022 (p-value = 0.000), 2020 and 2023 (p-value = 0.000) and 2020 and 2024 (p-value = 0.003). The mean number of JPH in 2018 was only calculated from Quadrats 9–12 only and is therefore not included in Figure 33 and the statistical analysis.

Mean JPH at each quadrat in 2018 (Quadrats 9–12 only), 2019, 2020, 2021, 2022, 2023 and 2024 is provided in Appendix 4 –Table 18. From 2023 to 2024, mean JPH was higher at all twelve quadrats (in Appendix 4– Table 18).

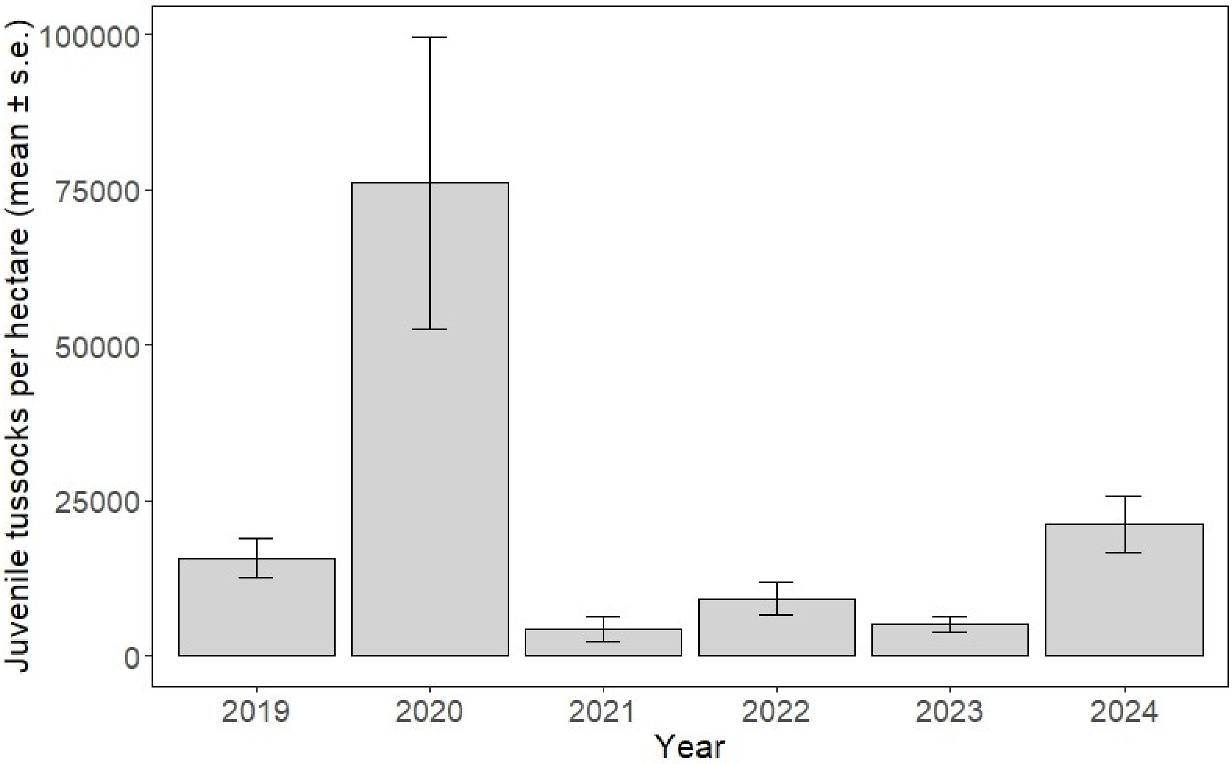

Figure 33. Mean juvenile tussocks per hectare from 2019 to 2024. 2018 data is not plotted as data is only available from Quadrats 9–12.

5.2.6 Perennial plant size and health attributes

Perennial plant basal width

The mean basal width of perennial plants decreased again to 3.94 cm in 2024, from 4.94 cm in 2023, 6.80 cm in 2022, 7.06 cm in 2021, 7.95 cm in 2020, 7.43 cm in 2019, and 9.58 cm in 2018 (Figure 34). This difference is significant between 2018 and 2022 (p-value = 0.025), 2018 and 2023 (p-value = 0.000), 2018 and 2024 (p-value = 0.000), 2019 and 2024 (p-value = 0.002), 2020 and 2023 (p-value = 0.010), 2020 and 2024 (p-value = 0.000), 2021 and 2024 (p-value = 0.007) and 2022 and 2024 (p-value = 0.016).

Mean perennial plant basal width at each quadrat in 2018, 2019, 2020, 2021, 2022, 2023 and 2024 is provided in Appendix 4 – Table 19. From 2023 to 2024 mean perennial plant basal width decreased at nine quadrats and increased at 3 quadrats. All quadrats have a smaller perennial basal width than the baseline survey in 2018 (Appendix 4– Table 19).

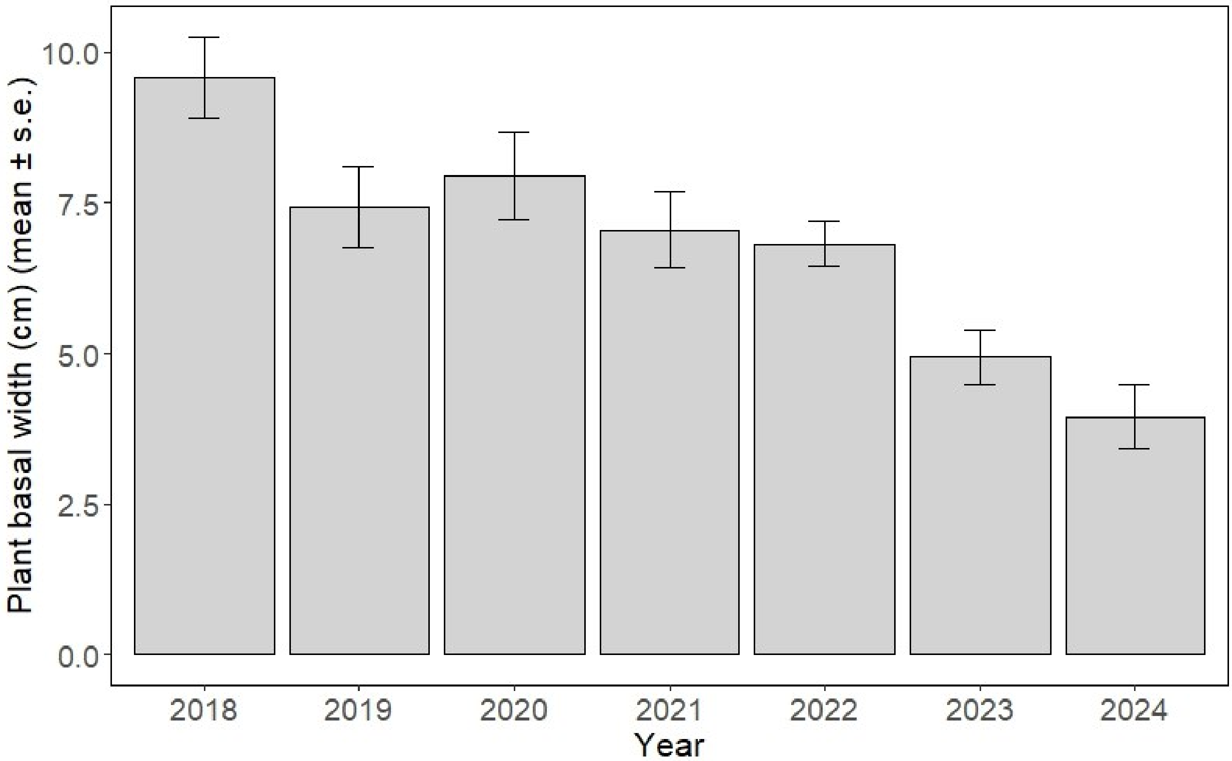

Figure 34. Mean basal width of perennial plants from 2018 to 2024.

Perennial plant height

The mean height of perennial plants decreased to 15.76 cm in 2024 from 18.91 cm in 2023, 25.19 cm in 2022 and 22.43 cm in 2021 but remained higher than 11.44 cm in 2020, 6.88 cm in 2019, and 15.71 cm in 2018 (Figure 35).

Mean perennial plant height was significantly different between 2018 and 2019 (p-value = 0.020), 2018 and 2022 (p-value = 0.009), 2019 and 2021 (p-value = 0.000), 2019 and 2022 (p-value = 0.000), 2019 and 2023 (p-value = 0.000), 2019 and 2024 (p-value = 0.019), 2020 and 2021 (p-value = 0.001), 2020 and 2022 (p-value = 0.000) and 2022 and 2024 (p-value = 0.010).

Mean perennial plant height at each quadrat in 2018 to 2024 is provided in Appendix 4 – Table 20. From 2023 to 2024, mean perennial plant height decreased at nine quadrats and increased at three quadrats (Appendix 4 – Table 20).

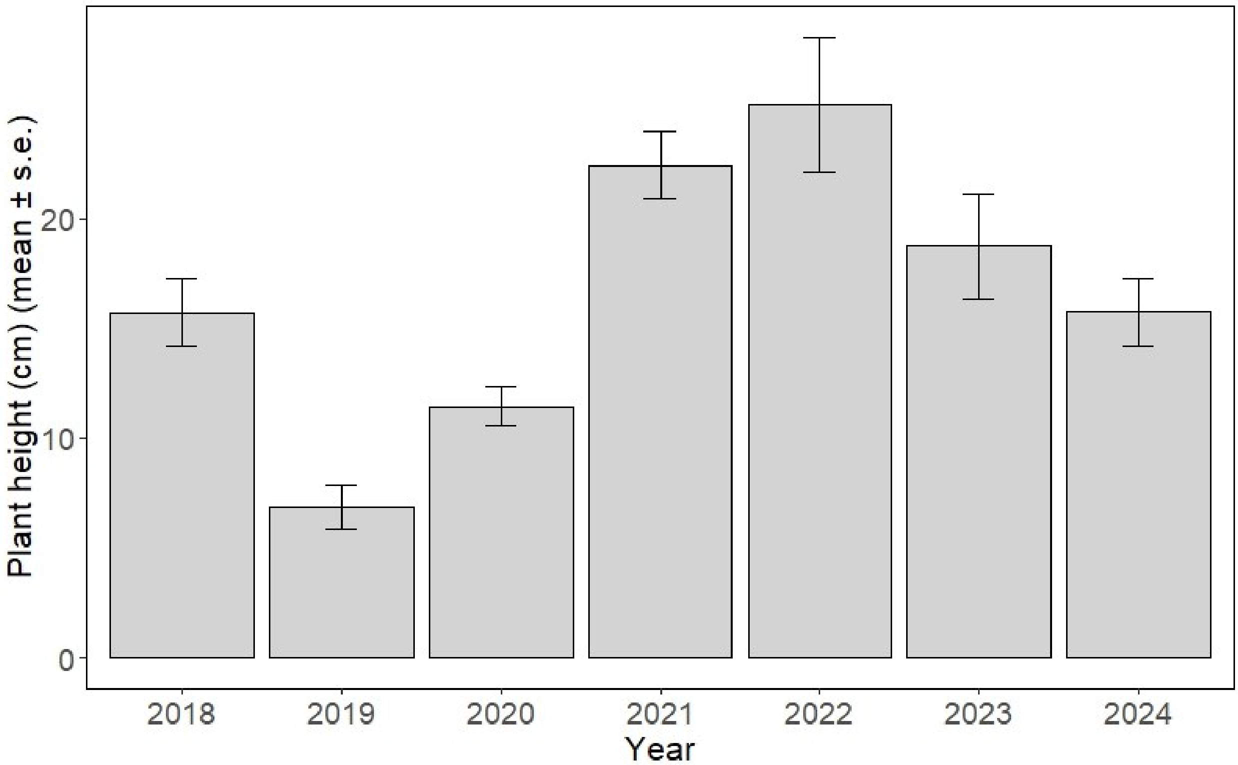

Figure 35. Mean height of perennial plants from 2018 to 2024.

Dead material on perennial grass tussocks

The mean percentage of dead material on perennial grass tussocks significantly decreased from 54.70 % in 2023 to 27.97 % in 2024 (p-value = 0.000) (Figure 36). The mean percentage of dead material was higher than in 2022 (16.66 %) but lower than all other remaining years: 2018 (92.25 %), 2019 (84.74 %), 2020 (39.91 %) and 2021 (80.67 %). The mean percentage of dead material in 2018 was only calculated from Quadrats 9–12 and is therefore not included in Figure 36 and the statistical analysis.

Mean percentage of dead material on perennial grass tussocks was also significant between 2020 and 2023 (p-value = 0.026), as well as between 2019 and 2020, 2019 and 2023, 2019 and 2024, 2020 and 2021, 2020 and 2022, 2021 and 2022, 2021 and 2023, 2021 and 2024, 2022 and 2023 and 2023 and 2024 (p-values = 0.000).

Mean percentage of dead material on perennial grass tussocks at each quadrat in 2018 to 2024 is provided in Appendix 4– Table 21. From 2023 to 2024, mean percentage of dead material decreased at 10 quadrats and increased at two quadrats, with all quadrats being higher than in 2022. Between 2019 and 2024, mean percentage of dead material decreased at all twelve quadrats (Appendix 4 – Table 21).

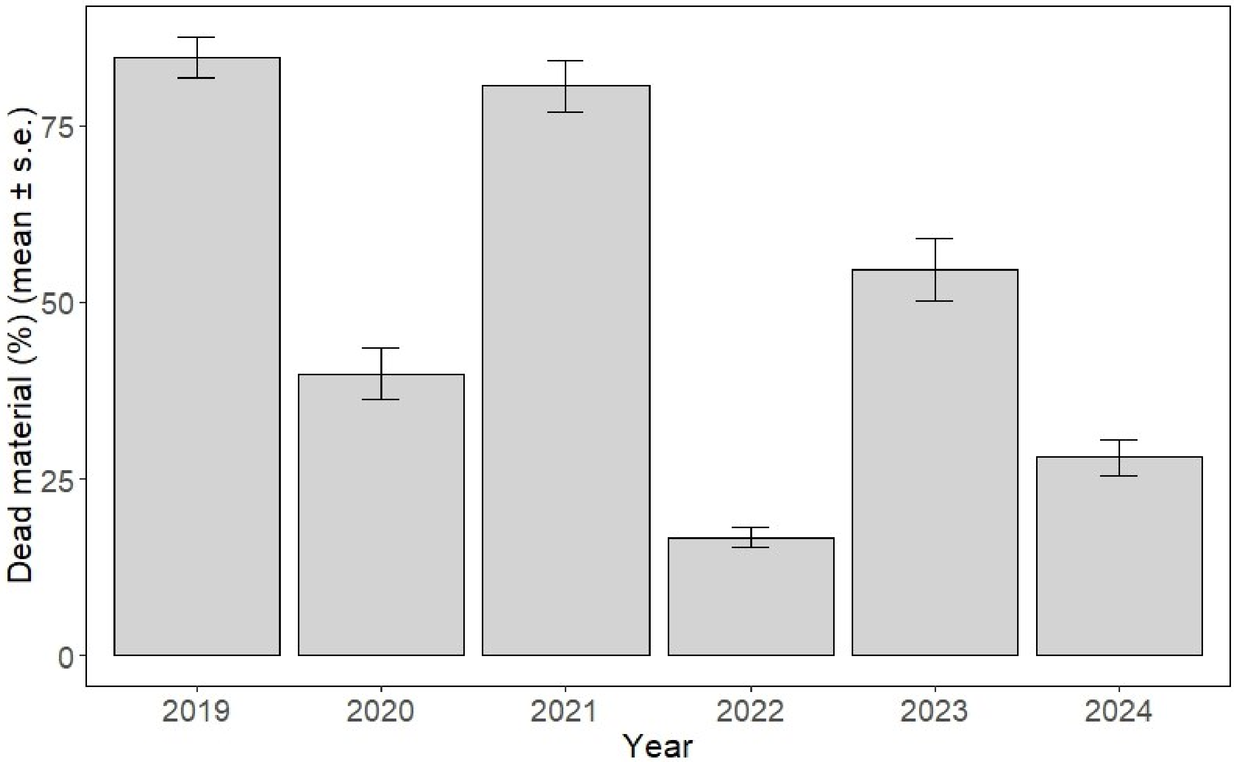

Figure 36. Mean percentage of dead material on perennial grass tussocks from 2019 to 2024. 2018 data is not plotted as data is only available from Quadrats 9–12.

5.2.7 Percentage weed cover

The mean weed cover based on 1x1 m surveys is lower in 2024 (7.80 %) compared to 2023 (14.42 %) but remains higher than in 2022 (2.41 %). This is lower than all other previous years surveyed: 2018 (39.50 %), 2019 (31.98 %), 2020 (59.73 %) and 2021 (58.50 %) (Figure 37). Weed cover based on 1x1 m surveys was 39.50% in 2018 but this was calculated from Quadrats 9–12 only and is therefore not included in the statistical analysis. Mean weed cover based on 1x1 m surveys was significant between 2019 and 2020 (p-value = 0.031), 2019 and 2021 (p-value = 0.045), 2019 and 2022 (p-value = 0.018), 2020 and 2022, 2020 and 2023, 2020 and 2024, 2021 and 2022, 2021 and 2023 and 2021 and 2024 (p-values = 0.000).

Mean weed cover based on 1 ha estimates in 2024 indicated higher weed cover than the 1x1 m surveys (22.50 %) and was higher than estimates in 2023 (20.42 %) and 2022 (3.75 %) but lower than all other previous years: 2018 (40.50 %), 2019 (35.50 %), 2020 (48.33 %) and 2021 (57.92 %) (Figure 38). Mean weed cover based on 1 ha estimates was 40.50% in 2018 but this was calculated from Quadrats 9–12 only and is therefore not included in the statistical analysis. Mean weed cover based on 1 ha estimates was significant between 2019 and 2022 (p-value = 0.002), 2020 and 2022 (p-value = 0.000), 2020 and 2023 (p-value = 0.012), 2020 and 2024 (p-value = 0.022), 2021 and 2022 (p-value = 0.000), 2021 and 2023 (p-value = 0.000) and 2021 and 2024 (p-value = 0.000).

Mean weed cover based on 1x1 m surveys and 1 ha estimates at each quadrat from 2018 to 2024 is provided in Appendix 4– Table 22 and Table 23. Based on 1x1 m sampling from 2023 to 2024, eight quadrats decreased in weed cover. When comparing 2022 to 2024, the majority of the 12 quadrats increased in weed cover (only Quadrats 8 and 12 decreased in weed cover). When compared to 2019, 2020 and 2021, all 12 quadrats in 2024 have decreased in weed cover. Based on 1 ha estimates from 2023 to 2024 a decrease in weed cover occurred in six quadrats, an increase occurred in five quadrats and one quadrat remained the same. All quadrats have increased in 2024 when compared to 2022 but have decreased in the majority of quadrats when compared to 2020 and 2021 (Quadrat 12 has remained the same between 2020, 2021 and 2024). Between 2019 and 2024, mean weed cover decreased at 10 of 12 quadrats and increased at two quadrats. (Appendix 4 – Table 23).

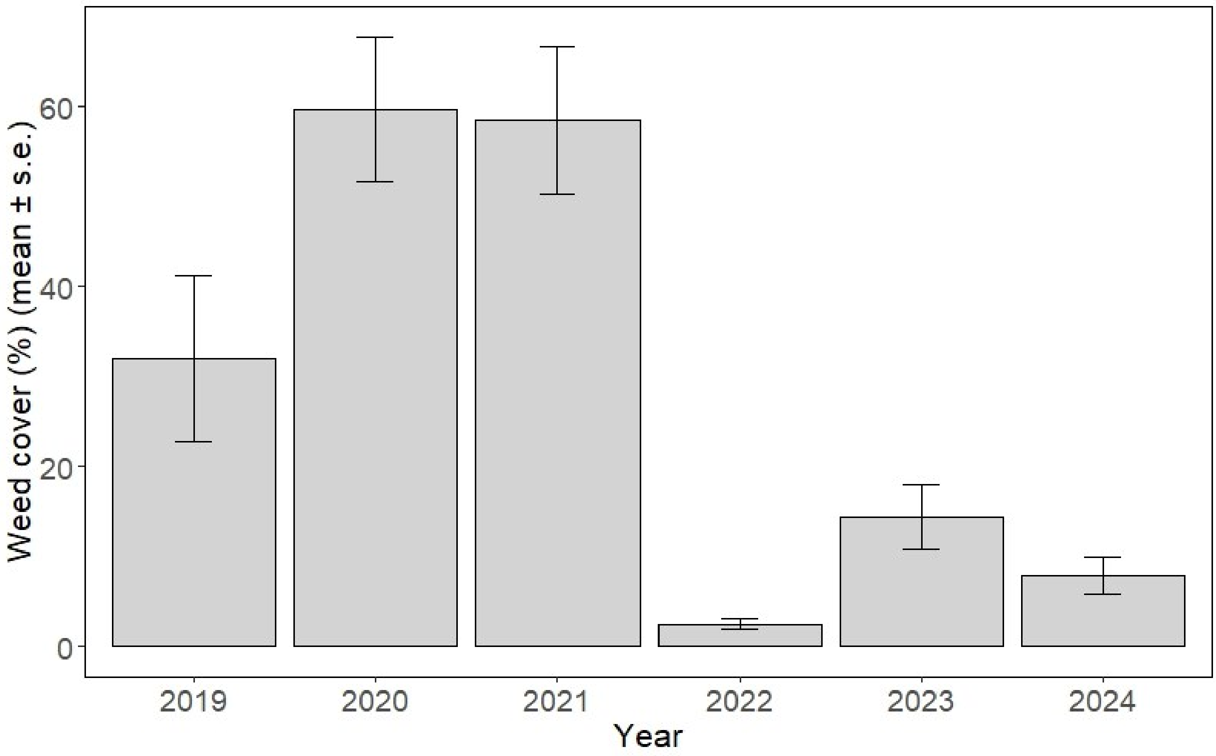

Figure 37. Mean percentage weed cover based on 1 x 1 m surveys from 2019 to 2024. 2018 data is not plotted as data is only available from Quadrats 9–12.

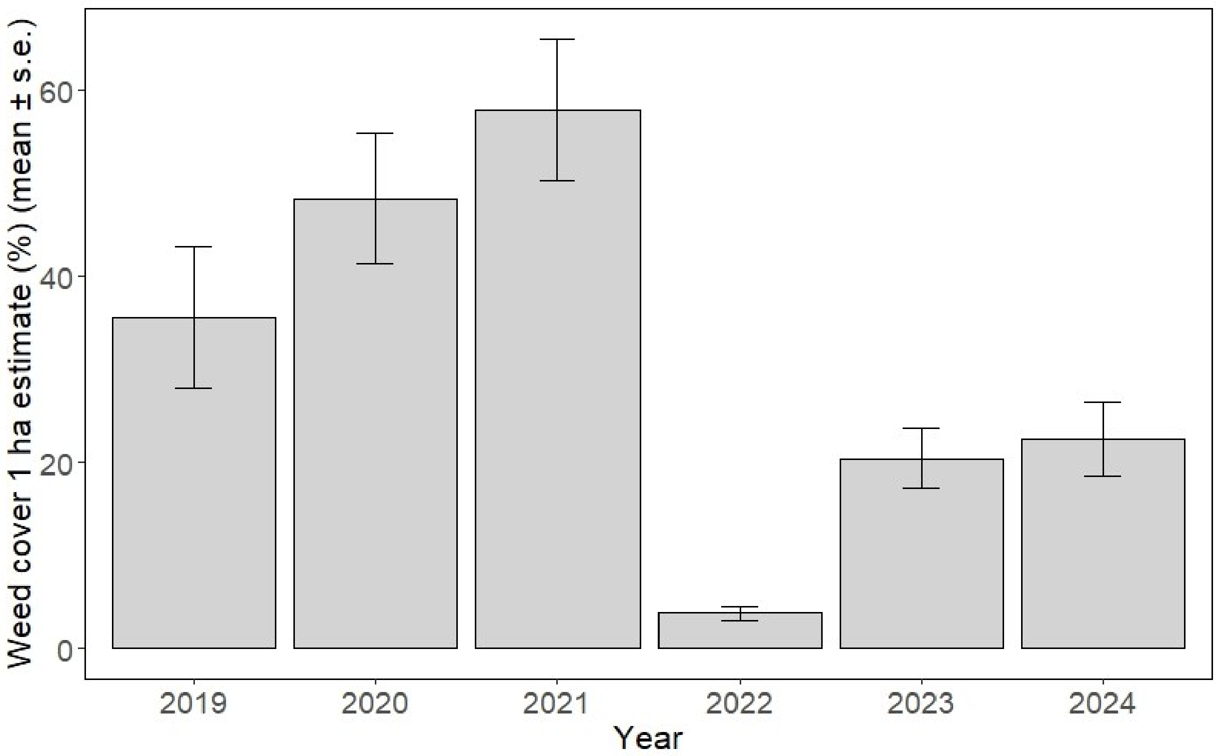

Figure 38. Mean percentage weed cover based on 1 ha estimate from 2019 to 2024. 2018 data is not plotted as data is only available from Quadrats 9–12.

5.2.8 Percentage cryptogam cover

The mean percentage of cryptogam cover decreased to 1.33 % in 2024, compared 2.95 % in 2023, 5.66% in 2022, 3.33% in 2021, and 20.29% in 2020 (Figure 39). The difference in the mean percentage of cryptogam cover was significant between 2020 and all other years (2021 p-value = 0.001; 2022 p-value = 0.004; 2023 p-value = 0.000; 2024 p-value = 0.000).

Mean percentage of cryptogam cover at each quadrat in 2020, 2021, 2022, 2023 and 2024 is provided in Appendix 4 – Table 24. From 2023 to 2024, mean percentage of cryptogam cover decreased at 10 quadrats, increased at one quadrat and remained the same at one quadrat. Between 2020 and 2024, mean percentage of cryptogam cover decreased at all 12 quadrats (Appendix 4 – Table 24).

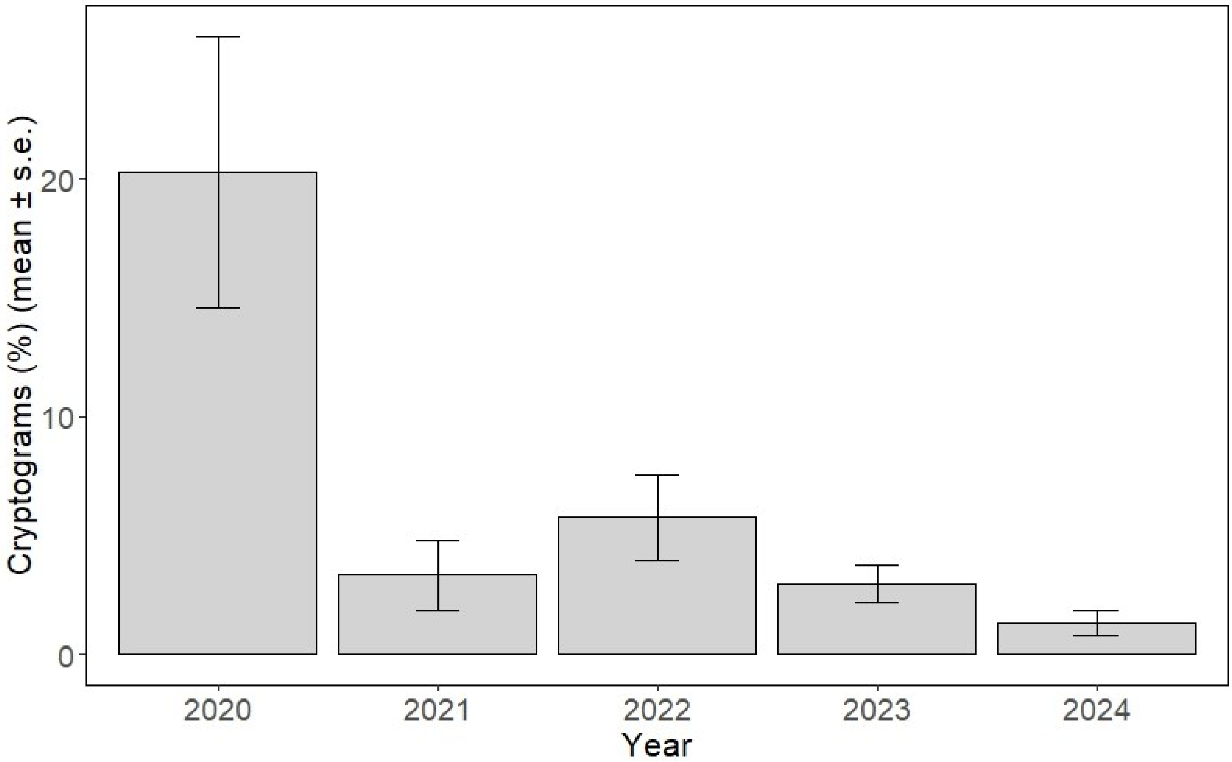

Figure 39. Mean percentage of cryptogam cover from 2020 to 2024. Data from 2018 and 2019 is not plotted as data is only available from 2020 to 2024.

5.2.9 Percentage bare ground

The mean percentage of bare ground cover has increased in 2024 (3.32 %), when compared to 2023 (1.59 %) and 2021 (2.33 %) but was lower than all other previous years: 8.06 % in 2020, and 3.00% in 2022 (Figure 40). The mean percentage of bare ground cover was significant between 2020 and all other years (2021 p-value = 0.002; 2022 p-value = 0.007; 2023 p-value = 0.000; 2024 p-value = 0.013).

Mean percentage of bare ground cover at each quadrat in 2020, 2021, 2022, 2023 and 2024 is provided in Appendix 4 – Table 25. From 2023 to 2024, mean percentage of bare ground cover increased at nine quadrats and decreased at three quadrats. Between 2020 and 2024, mean percentage of bare ground cover decreased in all quadrats except Quadrat 5 (Appendix 4 – Table 25).

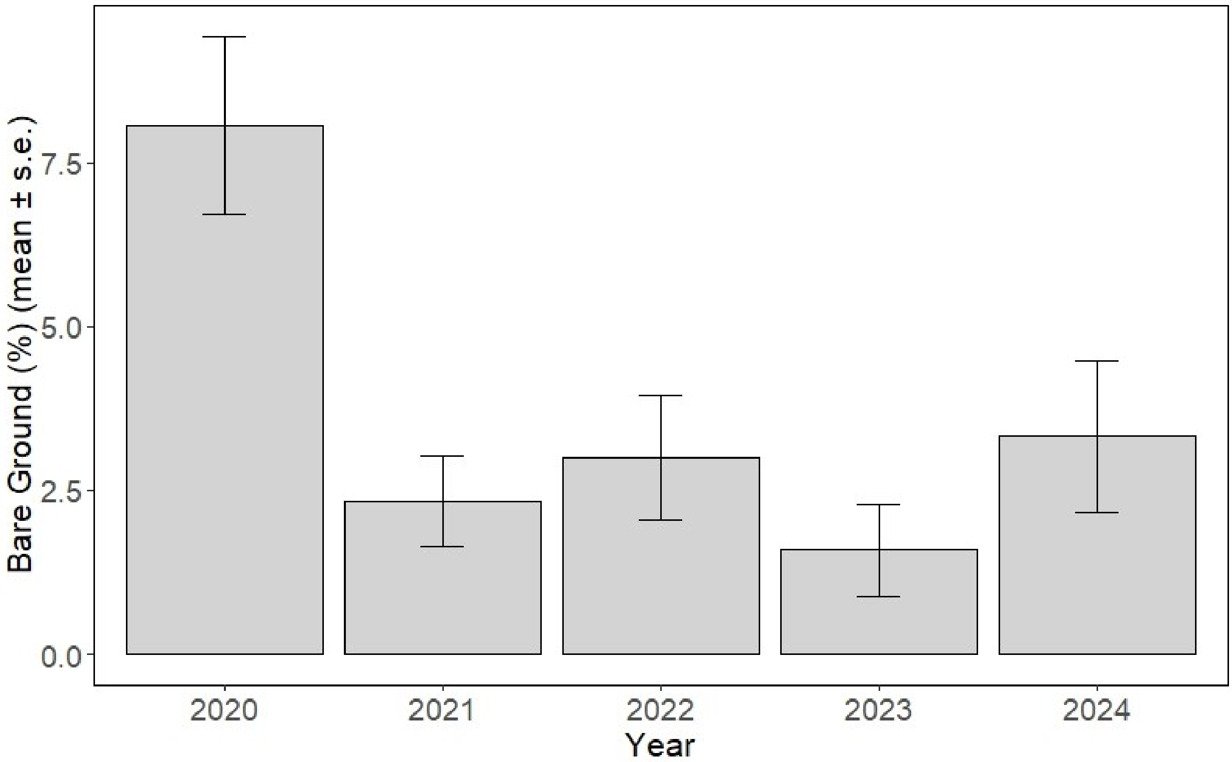

Figure 40. Mean percentage of bare ground cover from 2020 to 2024. Data from 2018 and 2019 is not plotted as data is only available from 2020 to 2024.

5.2.10 Percentage litter

The mean percentage of litter cover has decreased in 2024 (74.86 %) when compared to 2023 (70.42 %) but has increased when compared to 2022 (73.13 %) (Figure 41). None of these differences were found to be statistically significant.

Mean percentage of litter cover at each quadrat in 2022, 2023 and 2024 is provided in Appendix 4 – Table 26. From 2023 to 2024 and 2022 to 2024, mean percentage of litter cover increased at six quadrats and decreased at six quadrats.

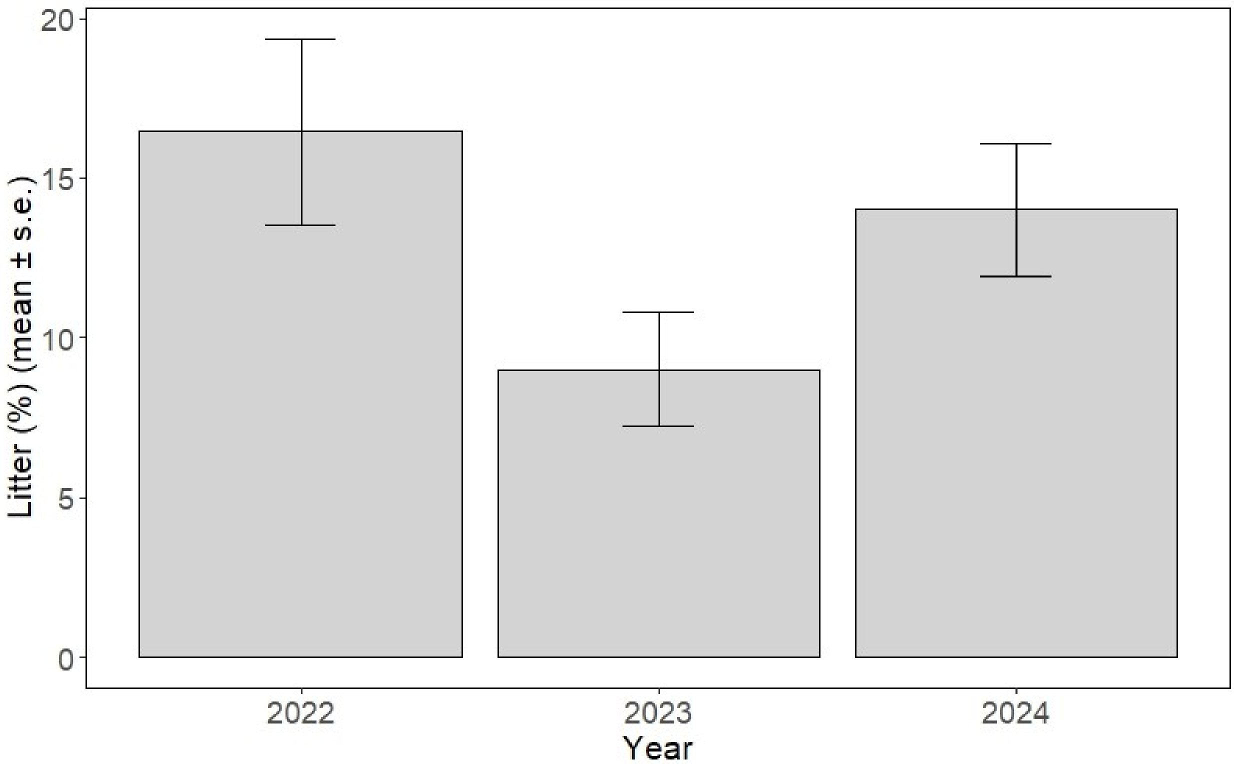

Figure 41. Mean percentage of litter cover from 2022 to 2024. Data from 2018 to 2021 is not plotted as data is only available from 2022 to 2024.

5.2.11 Influence of rainfall on vegetation parameters

When spring-summer rainfall (i.e. total rainfall for September to January) was compared to vegetation monitoring data, there was found to be a significant relationship between the mean percentage of bare ground and cryptogam (p-value = 0.000) (Figure 42) and mean basal width (p-value = 0.000) (Figure 43). Both of these parameters indicate that with increasing rainfall, the mean percentage of bare ground and cryptogam and the mean basal width decrease. Furthermore, when spring-summer rainfall was compared to the mean height of perennial plants, there was found to be a significant relationship (p-value = 0.001) (Figure 44). The height of perennial tussocks increased during periods of higher rainfall.

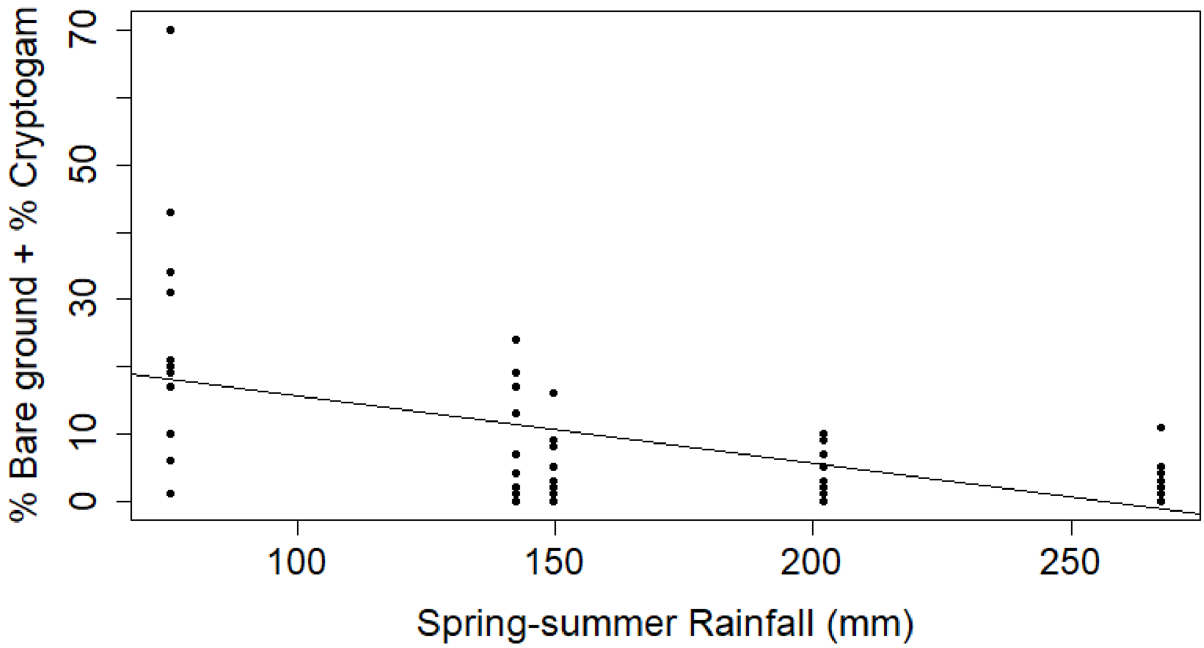

Figure 42. The mean percentage of bare ground and cryptogam cover measured during each monitoring year plotted against spring-summer rainfall.

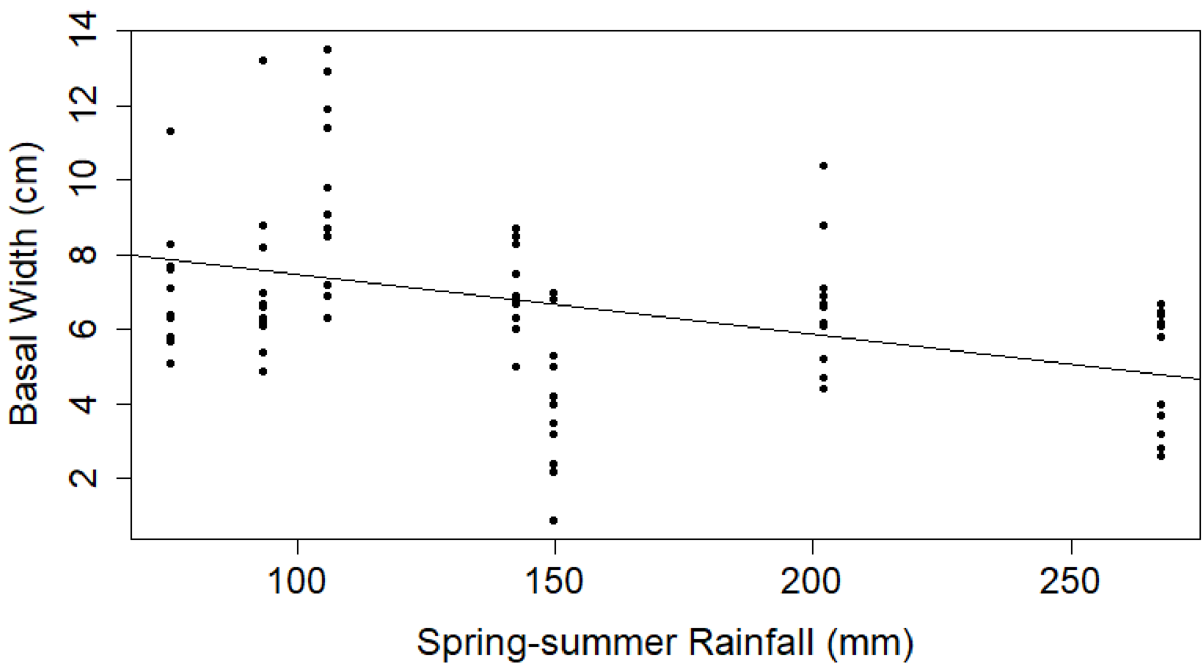

Figure 43. The mean basal width of perennial plants measured during each monitoring year plotted against spring-summer rainfall.

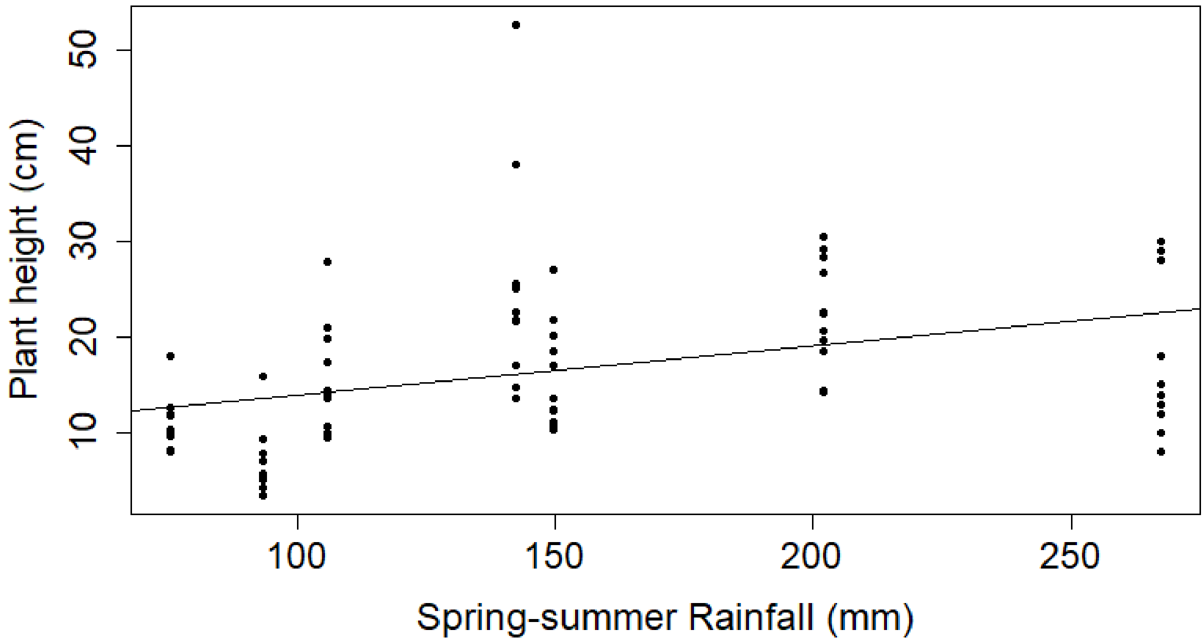

Figure 44. The mean height of perennial plants measured during each monitoring year plotted against spring-summer rainfall.

6 DISCUSSION

6.1 PBTL monitoring

This report presents year seven (2024) results of the SEB Offset Area PBTL monitoring.

6.1.1 PBTL Abundance

The mean number of PBTLs per quadrat observed in 2024 ($\bar{x}$ = 5.10 individuals) was greater than in 2023 ($\bar{x}$ = 2.91 individuals) but less than in all other years of monitoring:

- Baseline, $\bar{x}$ = 17.38 individuals.
- 2018, $\bar{x}$ = 16.64 individuals.
- 2019, $\bar{x}$ = 19.09 individuals.
- 2020, $\bar{x}$ = 10.03 individuals.
- 2021, $\bar{x}$ = 3.70 individuals.
- 2022, $\bar{x}$ = 8.73 individuals.

This result follows a decrease in PBTLs per quadrat from 2022 to 2023, which is different to the previous general downward trend in numbers in the previous years of monitoring. There is a significant difference in the mean number of PBTLs between the seven monitoring years (p-value = 0.003).

Further monitoring will be important to determine the trajectory or stochasticity of the PBTL population within the SEB Offset Area. Although the detection of spider burrows was better in 2024, detecting spider burrows in previous monitoring years, particularly 2023, was a limitation given the strong relationship between the number of burrows checked and PBTLs recorded. Future monitoring will also be important in determining any change in trajectory following implementation of recommendations, including changing grazing practices.

6.1.2 Juvenile PBTL

The proportion of juvenile PBTLs observed in 2024 (83.93 %) was lower than 2022 (88.30 %), 2021 (95.10 %), 2019 (91.90 %) and 2020 (84.07 %) surveys but higher than the 2023 (56.25%), 2018 (83.53 %) and Baseline (71.94 %) surveys. Female PBTLs produce litters of 2-4 live young between late January and mid-March (Hutchinson *et al.* 1994). The higher proportion of juvenile PBTLs observed may be due, at least in part, to the timing of surveys. Most surveys have been undertaken in February, while the 2024 survey occurred in early March, later in the breeding season when more juveniles might be expected.

Greater juvenile numbers may also be the result of rainfall. Although no correlation between high spring – summer rainfall was found in the statistics, evidence from PBTL surveys conducted by EBS Ecology in other areas also indicates a high proportion of juvenile PBTLs following the 2024 breeding season.

The lack of correlation between rainfall and juvenile numbers may relate to the overall small sampling size. Data from future monitoring years at Hornsdale may produce some relationship between rainfall and the proportion of juvenile PBTLs observed.

6.1.3 Rainfall and PBTL

There was no correlation detected in any of the data with rainfall periods tested for previous monitoring years (including rainfall 3 months prior to survey, total rainfall for the year prior to survey, rainfall 1 month prior to survey and rainfall in the winter prior to survey) Some relationships were found between rainfall between September and January (spring - summer).

There was found to be a significant relationship between the total number of PBTLs and the spring-summer rainfall recorded prior to the monitoring period (p-value = 0.000) (Figure 25). Similarly, there was also a significant relationship between the total number of spider holes observed and the spring-summer rainfall recorded prior to the monitoring period (p-value = 0.000) (Figure 26). Both findings indicate that with increasing rainfall, the total number of PBTLs observed and the total number of spider holes observed decreases.

These relationships suggest that total rainfall experienced between September and January is influencing vegetation structure, particularly cover. Correlations between some data and increasing rainfall suggests that vegetation cover is denser during high rainfall in spring and summer. Relationships between PBTLs and spider holes suggest that this may be detrimental to both.

6.1.4 Slopes and PBTL abundance

The mean number of PBTLs per quadrat across the seven surveys was significantly greater on eastern than western slopes (p-value = 0.042) (Figure 27A). This continues the relationship between aspect and PBTLs from all previous years of monitoring.

6.1.5 Vegetation and PBTL

The mean number of PBTLs per quadrat in 2018–2022 decreased with increasing grass tussock basal width, but with the addition of the 2023 and 2024 data, there is no association (p-value = 0.544) (Figure 27B). The 2018 – 2022 relationship corresponds with the preferred vegetation cover of the species, which ranges from moderate to sparse (Duffy *et al.* 2012).

A significant correlation was found between increasing bare ground and the number of PBTLs (p-value = 0.001) (Figure 28A). With the increasing percentage of bare ground, the number of PBTLs also increases. This may be due to the availability of bare ground for spiders to make holes, creating more habitat for PBTL. Similarly, a significant correlation was found between increasing cryptogam and the number of PBTLs (p-value = 0.019) (Figure 28B). This significant relationship may be due to a high percentage of cryptogam detected in 2020 survey, creating an outlier given most of the previous cryptogam percentages were recorded at 30 % or below.

No correlations were detected between the number of PBTLs, and the remaining vegetation condition variables tested.

The lack of any relationship between number of PBTLs and tussock width following the input of the 2024 data and the lack of any other relationship with other variables suggests that PBTL numbers may be influenced by factors not currently measured by the monitoring. This might include litter cover, a variable that has only been collected since 2022.

Like tussock width, litter cover influences the per-cent of bare ground and is detrimental to the moderate to sparse vegetation cover PBTLs prefer. Future monitoring of litter cover may result in the detection of a relationship between the number of PBTLs and litter cover.

6.1.6 Spiders versus PBTL

The mean number of spiders per quadrat observed in 2024 ($\bar{x}$ = 5.45) was lower than all previous years and statistically significant (p-value = 0.000) (Figure 20):

- Baseline, $\bar{x}$ = 35.50 individuals.
- 2018, $\bar{x}$ = 7.27 individuals.
- 2019, $\bar{x}$ = 11.00 individuals.
- 2020, $\bar{x}$ = 38.72 individuals.
- 2021, $\bar{x}$ = 10.00 individuals.
- 2022, $\bar{x}$ = 9.90 individuals.
- 2023, $\bar{x}$ = 5.64 individuals.

The Tukey post hoc test revealed a significant difference between the Baseline and 2018 surveys (p-value = 0.036), Baseline and 2023 surveys (p-value = 0.021), Baseline and 2024 surveys (p-value = 0.020), 2018 and 2020 surveys (p-value = 0.004), 2019 and 2020 surveys (p-value = 0.017), 2020 and 2021 surveys (p-value = 0.012), 2020 and 2022 surveys (p-value = 0.011), 2020 and 2023 surveys (p-value = 0.002).

Relative to 2023, the number of spiders decreased in Quadrats 1, 6, 9, 10 and 11, remained the same in Quadrats 2 and 7 and increased in Quadrats 3, 4, 5 and 8 (Figure 23).

A significant positive correlation was detected between the number of PBTLs and spiders (p-value = 0.000) (R^2 = 0.141) across the surveys (Figure 22A). A significant correlation was also detected between the number of PBTLs and burrows (p-value = 0.000) (R^2 =0.542) across the surveys (Figure 22B). This is as expected since it is widely accepted that PBTLs occupy single-entrance, vertical burrows made by Lycosid and Mygalomorph spiders (Hutchinson *et al.* 1994; Milne 1999; Milne and Bull 2000; Milne *et al.* 2003; Souter *et al.* 2007).

Given the single-entrance, vertical burrows that PBTLs inhabit are constructed by Lycosid and Mygalomorph spiders (Hutchinson *et al.* 1994; Milne and Bull 2000; Milne *et al.* 2003; Souter *et al.* 2007), the long-term conservation of PBTLs is reliant upon maintaining viable populations of burrowing spiders (Fellows *et al.* 2009).

Based on the variability in the number of spiders observed thus far, further monitoring is required to determine the trajectory or stochasticity of spider populations in the SEB Offset Area, which in turn may impact on the PBTL population. The population dynamics of spiders, especially Lycosids and Mygalomorphs, are complex, with factors including prevailing weather, predation, parasitism and competition, all potentially impacting the number of individuals present (Humphreys 1976; Conley 1984; Spiller and Schoener 1995).

6.1.7 Burrows and PBTL

The mean number of burrows per quadrat observed in 2024 ($\bar{x}$ = 43.64) was greater than 2023 ($\bar{x}$ = 35.10) but less than all previously conducted surveys: (Figure 20):

- Baseline $\bar{x}$ = 126.38.
- 2018 $\bar{x}$ = 115.10.
- 2019 $\bar{x}$ = 202.10.
- 2020 $\bar{x}$ = 171.10.
- 2021 $\bar{x}$ = 70.00.
- 2022 $\bar{x}$ = 90.30.

This difference was statistically significant (p-value = 0.000), with the Tukey post hoc test revealing a significant difference between the 2019 and 2021 surveys (p-value = 0.006), 2019 and 2022 surveys (p-value = 0.035), 2019 and 2023 surveys (p-value = 0.000), 2019 and 2024 surveys (p-value = 0.000), 2020 and 2023 surveys (p-value = 0.003) and 2020 and 2024 surveys (p-value = 0.007).

Relative to 2023, the number of burrows decreased in Quadrats 2, 9, 10 and 11, and increased in Quadrats 1, 3, 4, 5, 6, 7 and 8 (Figure 24).

In general, burrows were difficult to detect due to the high cover of vegetation and litter, with litter cover reaching near 100% in some of the 1m x 1m quadrats. However, even where bare ground was present and burrows should have been easy to detect, few burrows were found. The reasons for this are not known. High rainfall that results in saturated soil, particularly in the monitoring quadrats situated in run-on areas, may destroy the integrity of spider burrows and might be a factor.

Future monitoring may determine if there has been an actual decrease in spider burrows, or whether low numbers in 2024, 2023, 2022 and 2021 are due to detection difficulty or other factors.

6.2 Vegetation monitoring

This report presents year seven (2024) results of the SEB Offset Area monitoring and provides some early analysis of data to determine trends across the SEB Offset Area. Minimal analysis was undertaken following baseline and Year two monitoring, being too early in the monitoring program to detect any meaningful changes.

6.2.1 Native species diversity

Across all monitoring quadrats, a total of 46 native plant species were recorded. This is the highest number of species recorded for any monitoring period (Appendix 4 – Table 10).

Mean native species diversity within the SEB Offset Area was also the highest since surveys began with 20.25 species in 2024, compared to the next highest being 18.30 species recorded in 2022. Mean native species diversity was significantly different between 2018 and 2020 (p-value = 0.000), 2018 and 2021 (p-value = 0.002), 2018 and 2022 (p-value = 0.000), 2018 and 2023 (p-value = 0.000), 2018 and 2024 (p-value = 0.000), 2019 and 2020 (p-value = 0.002), 2019 and 2021 (p-value = 0.039), 2019 and 2022 (p-value = 0.000), 2019 and 2023 (p-value = 0.001), 2019 and 2024 (p-value = 0.000) and 2021 and 2024 (p-value – 0.004).

Increases in diversity may be due to winter grazing on weedy annual grass, facilitating opportunities for recruitment of more vulnerable native herbaceous species and an overall decrease in grazing pressure. Decreased grazing pressure may result in palatable native species becoming easier to detect and increase successful recruitment. Small shrubs such as *Eutaxia microphylla* (Common Eutaxia), for example, are palatable species that suffer from preferential grazing when land is heavily grazed.

Given the land use history of the SEB area, any increase in overall native species diversity may be limited by the seed bank present in the soil and native species that occur in adjacent areas.

Three species listed as Rare under the *National Parks and Wildlife Act 1972* were again observed in 2024:

- *Cryptandra campanulata* (Long-flower Cryptandra) (Quadrats 1, 3–6 and 10–12);
- *Maireana rohrlachii* (Rohrlach's Bluebush) (Quadrat 6); and
- *Rumex dumosus* (Wiry Dock) (Quadrats 3, 7 and 9).

Maireana rohrlachii and *Rumex dumosus* were first observed in 2020 while *Cryptandra campanulata* was initially recorded as *Cryptandra amara* (now *Cryptandra campanulata*) in 2018.

6.2.2 Weed species diversity and cover

Weed diversity has increased since baseline and in the short term since 2023, with two new weeds, from a total of 36 species, observed in 2024 (Appendix 4 – Table 11):

- *Rumex crispus* (Crispy Dock); and
- *Scabiosa atropurpurea* (Pincushion).

Mean weed diversity increased from 18.40 species in 2023 to 19.08 in 2024. and was significantly different between all years (p-value = 0.000 except between 2019-2020 and 2022-2024 where p-value =0 .010), except between 2018-2019, 2020-2021, 2021-2022 and 2023-2024.

While grazing remains a land management tool within the SEB area, there is a continued likelihood that new weed species might be recorded. New species might be introduced by being transported by livestock or in contaminated feed, for example.

The mean weed cover based on 1x1 m surveys is lower in 2024 (7.80 %) compared to 2023 (14.42 %) but remains higher than in 2022 (2.41 %). This is lower than all other previous years surveyed: 2018 (39.50 %), 2019 (31.98 %), 2020 (59.73 %) and 2021 (58.50 %) (Appendix 4 – Table 22). Mean weed cover based on 1x1 m surveys was significant between 2019 and 2020 (p-value = 0.031), 2019 and 2021 (p-value = 0.045), 2019 and 2022 (p-value = 0.018), 2020 and 2022, 2020 and 2023, 2020 and 2024, 2021 and 2022, 2021 and 2023 and 2021 and 2024 (p-values = 0.000).

Mean weed cover based on 1 ha estimates indicated higher weed cover than the 1 x 1 m surveys (22.50 %). Mean weed cover based on 1 ha estimates was significant between 2019 and 2022 (p-value = 0.002), 2020 and 2022 (p-value = 0.000), 2020 and 2023 (p-value = 0.012), 2020 and 2024 (p-value = 0.022), 2021 and 2022 (p-value = 0.000), 2021 and 2023 (p-value = 0.000) and 2021 and 2024 (p-value = 0.000).

The statistics do not support expectations that weed cover should be higher following years of high rainfall. This may be due to variations in observers and the way in which data has been collected. In 2022, 2023 and 2024, for example, most weed material was annual grasses and forbs that were dead and detached by the late summer monitoring period. This was therefore counted as litter cover and not weed cover. It is unclear what was counted as weed cover in previous years. So long as future monitoring is consistent with 2022, 2023 and 2024 methods, this limitation may become less prevalent.

Most weeds within the SEB Offset Area are annual grasses or small herbaceous weeds that are not feasible to manually control. However, they may be able to be controlled through strategic winter grazing, which is preferred to avoid potential impacts to PBTLs associated with other methods (e.g., broad scale herbicide application, heavy machinery impacts, etc.). Weeds recommended for targeted control due to their capacity to suppress native vegetation growth and increasing spread are summarised in Table 9.

Table 9. Location and control methods, suitable for a conservation area, for weed species recommended for targeted control (Robertson *et al.* 2005; PIRSA 2018).

Species	Common name	Quadrats present	Impacts	Control methods
Echium plantagineum	Salvation Jane	1–12	• Competes with grasslands and pastures • Toxic to livestock	• Multiple biocontrol agents available (contact Natural Resources Northern and Yorke). • Spot spray when actively growing and before seed set. Avoid contact with desirable plants.
Marrubium vulgare	Horehound	1–12	• Competes with grasslands and pastures • Unpalatable • Burrs contaminate wool • Taints meat of livestock if forced to consume	• Horehound Plume Moth (*Wheeleria spilodactylus*) biocontrol. Larva feeds on growing tips and defoliates plants. Collect leaves with larvae present in late spring / early summer and deposit on leaves of new plants. • Manual removal ensuring complete removal of root system from soil. However, ensure spider / PBTL burrows are not destroyed in the process. • Spot spray in autumn and spring, as immature plant before flowering. Avoid contact with desirable plants.
Onopordum acaulon	Horse Thistle	1–10	• Competes with grasslands and pastures • Spine-toothed leaves • Toxic to livestock	• Manual removal ensuring complete removal of root system from soil. However, ensure spider / PBTL burrows are not destroyed in the process. • Spot spray. Avoid contact with desirable plants.
Polygonum aviculare	Wireweed	4, 6	• Competes with grasslands, pastures and crops • Toxic to livestock	• Spot spray. Avoid contact with desirable plants.
Reseda lutea	Cut-leaf Mignonette	2, 5, 7–9	• Competes with grasslands, pastures and crops	• Manual removal at rosette stage. Suitable for individuals and small infestations. However, ensure spider / PBTL burrows are not destroyed in the process. • Spot spray in winter and spring, before flowering. Avoid contact with desirable plants.
Rosa canina	Dog Rose	1–3, 5, 7–12	• Forms prickly thickets • Invades grasslands and pastures	• Pull seedling and grub small plants. • Cub and swab in late spring and summer, while plants are actively growing.
Salvia verbenaca	Wild Sage	1–12	• Competes with grasslands and pastures • Unpalatable	• Spot spray in autumn and winter, as immature plant before flowering and seed set. Avoid contact with desirable plants.
Xanthium spinosum	Bathurst Burr	1, 2, 4–10	• Burrs contaminate wool • Spiny stems • Seedling toxic to livestock	• Spot spray between September and April, as immature plant before burr formation. Avoid contact with desirable plants.

6.2.3 Bare ground and cryptogam cover

The mean percentage of cryptogam cover decreased to 1.33 % in 2024, compared 2.95 % in 2023, 5.66% in 2022, 3.33% in 2021, and 20.29% in 2020 (Appendix 4 – Table 24). The difference in the mean percentage of cryptogam cover was significant between 2020 and all other years (2021 p-value = 0.001; 2022 p-value = 0.004; 2023 p-value = 0.000; 2024 p-value = 0.000).

The mean percentage of bare ground cover has increased in 2024 (3.32 %), when compared to 2023 (1.59 %) and 2021 (2.33 %) but was lower than all other previous years: 8.06 % in 2020, and 3.00% in 2022 (Appendix 4 – Table 25). The mean percentage of bare ground cover was significant between 2020 and all other years (2021 p-value = 0.002; 2022 p-value = 0.007; 2023 p-value = 0.000; 2024 p-value = 0.013).

The cover of bare ground and cryptogam is effectively an indication of the openness of grassland habitat. Greater cover of these two variables may be indicative of more ideal PBTL habitat. It may also be true that a higher amount of bare ground and cryptogam makes detection of spider burrows easier, leading to the detection of more PBTLs.

6.2.4 Litter cover

The mean percentage of litter cover has decreased in 2024 (74.86 %) when compared to 2023 (70.42 %) but has increased when compared to 2022 (73.13 %). None of these differences were found to be statistically significant (Appendix 4 – Table 26). As this variable was measured for the first time in 2022, it is likely that there is not enough data be able to determine whether changes in litter cover are statistically significant. Previously, litter was included as a part of weed cover percentage and may account for the reduction in weed cover in 2022 and 2023 (Appendix 4 – Table 22). It is important to continue to measure these variables for future data analysis.

6.2.5 Perennial plant spacing and juvenile tussocks

The mean spacing of perennial plants decreased to 25.86 cm in 2024 compared to 26.74 cm in 2023 but remained higher than 2022 (20.85) (Appendix 4 – Table 16). These differences were significant between 2020 and 2021 (p-value = 0.027), 2020 and 2022 (p-value = 0.005), 2020 and 2023 (p-value = 0.036), and 2020 and 2024 (p-value = 0.026).

It is expected that the number of tussocks per hectare would increase following periods of high rainfall, such as what has been experienced in 2021 and 2022. This expectation was supported by 2022 monitoring results, and has been supported by 2024 results, where TPH was similar to 2022 results. In years where TPH did not increase following periods of high rainfall, this may be due to limitations caused by the high amount of litter and weed cover in many of the 1x1 m Quadrats (Figure 45). In such cases, perennial tussocks were only visible following considerable efforts to remove litter cover (Figure 46). Many tussocks may not have been detected as a result.

Decreased TPH may also be due to a low long-term survival rate of juvenile tussocks, with large numbers of juveniles germinating as a result of 2021 spring rains being counted in 2022 but not surviving until the 2023 or 2024 monitoring. A low long-term survival rate could be caused by a number of factors, but with continued high rainfall and the absence of heavy grazing pressure may be caused by increased competition from weeds and litter cover.

Figure 45. 1x1 m quadrat with 100% litter cover. Any perennial tussocks are not visible.

Figure 46. 1x1 m quadrat after litter has been removed. Some small perennial tussocks are visible.

The mean number of juvenile perennial grass tussocks per hectare in 2024 (21,146 JPH) was higher than all previous years except one (Appendix 4 – Table 18). These differences were significant between 2019 and 2020 (p-value = 0.001), 2020 and 2021 (p-value = 0.000), 2020 and 2022 (p-value = 0.000), 2020 and 2023 (p-value = 0.000) and 2020 and 2024 (p-value = 0.003). The increase in juvenile perennial grass tussocks per hectare in 2024 may be due to the absence of grazing pressure and high rainfall recorded in recent years. As mentioned above, it may well be the case that juveniles germinating as a result of 2021 spring rains are only now being counted as a part of 2024 monitoring. The decrease in JPH in previous years despite continued high rainfall and absence of grazing pressure may be due to high litter and weed cover that has accumulated over several years of high rainfall, as discussed above. It may also be a reflection of survey limitations since juvenile tussocks were very difficult to detect given the absence of bare ground and lack of space in the vegetation.

6.2.6 Perennial plant size and health attributes

The mean basal width of perennial plants decreased again to 3.94 cm in 2024, from 4.94 cm in 2023, 6.80 cm in 2022, 7.06 cm in 2021, 7.95 cm in 2020, 7.43 cm in 2019, and 9.58 cm in 2018 (Appendix 4 – Table 19). This difference is significant between 2018 and 2022 (p-value = 0.025), 2018 and 2023 (p-value = 0.000), 2018 and 2024 (p-value = 0.000), 2019 and 2024 (p-value = 0.002), 2020 and 2023 (p-value = 0.010), 2020 and 2024 (p-value = 0.000), 2021 and 2024 (p-value = 0.007) and 2022 and 2024 (p-value = 0.016).

The mean height of perennial plants also decreased to 15.76 cm in 2024 from 18.91 cm in 2023 but remains taller than in 2020, 2019 and 2018 (Appendix 4 - Table 20). Mean perennial plant height was significantly different between 2018 and 2019 (p-value = 0.020), 2018 and 2022 (p-value = 0.009), 2019 and 2021 (p-value = 0.000), 2019 and 2022 (p-value = 0.000), 2019 and 2023 (p-value = 0.000), 2019 and 2024 (p-value = 0.019), 2020 and 2021 (p-value = 0.001), 2020 and 2022 (p-value = 0.000) and 2022 and 2024 (p-value = 0.010).

The mean percentage of dead material on perennial grass tussocks significantly decreased from 54.70 % in 2023 to 27.97 % in 2024 (p-value = 0.000) (Appendix 4 - Table 21). Mean percentage of dead material on perennial grass tussocks was also significant between 2020 and 2023 (p-value = 0.026), as well as between 2019 and 2020, 2019 and 2023, 2019 and 2024, 2020 and 2021, 2020 and 2022, 2021 and 2022, 2021 and 2023, 2021 and 2024, 2022 and 2023 and 2023 and 2024 (p-values = 0.000).

A decrease in basal width, tussock height and percentage of dead material are likely a reflection of climatic conditions and survey timing but may also be a reflection of declining tussock health. One would expect, however, an increase in the percentage of dead material to be reflective of declining tussock health. High spring and summer rainfall may have caused a large flush of growth that has begun to die off after a dry late summer period. This is especially so given that tussock height remains higher and dead material remains lower than during the early monitoring years.

The photographs taken at each quadrat (Appendix 3), present visual changes in the grassland over time at Quadrats 1–8 since 2016; and all twelve quadrats since 2018. The photos show a reduction in bare ground and increase in dead litter and thatch since monitoring began.

6.2.7 Rainfall and vegetation parameters

There was found to be significant correlations between spring-summer rainfall and the mean percentage of bare ground and cryptogam (p-value = 0.000) (Figure 42) and mean basal width (p-value = 0.000) (Figure 43). Both of these parameters indicate that with increasing rainfall, the mean percentage of bare ground and cryptogam and the mean basal width decrease. Subsequently, when spring-summer rainfall was compared to the mean height of perennial plants, there was also found to be a significant relationship (p-value = 0.001) (Figure 44). The height of perennial tussocks increased during periods of higher rainfall.

These parameters are closely related to the relationships between PBTLs and spider holes, indicating that with higher spring-summer rainfall, vegetation structure, particularly cover is influenced. With an increase in spring-summer rainfall, both bare ground and cryptogam significantly decrease leading to a more closed type of grassland habitat. As mentioned in Section 6.2.3, more cover of these two variables may be indicative of more ideal PBTL habitat and as such less cover may result in less than ideal habitat for PBTL. More data is required to verify these observations particularly with climatic conditions changing on an annual basis.

6.2.8 Grazing impact and ongoing management

Overall, the grassland appeared less grazed in 2024 compared with previous years, with a decrease in tussock spacing and increase in litter and thatch. Given the landowner has maintained grazing patterns in line with the management plan, this is most likely due to increased vegetation growth due to climatic conditions. It is not likely to be due to any real decrease in grazing pressure.

There is statistical evidence that total rainfall experienced between September and January is influencing vegetation structure, particularly cover. Significant relationships between some of data and increasing rainfall suggests that vegetation cover is denser during high rainfall in spring and summer and that this detrimentally impacts both PBTLs and spider holes.

At the time of preparation of the Hornsdale Wind Farm Vegetation Offset Management Plan (EBS Ecology 2017a), ewes were stocked from the start of May to late August at a rate of 2.5 ewes per ha (M. Clark *pers. Comm.* 2013 in EBS Ecology 2017a). It appears that during spring and summers with high rainfall, the SEB area would potentially benefit from extending grazing periods into mid-late spring (i.e. late September to October). Discussions with the landowner and a meeting onsite in 2023 (see Section 2.3.1), confirmed that an extension to the grazing period in 2023 from 22 September to 9 October 2023 occurred. It was also confirmed that an additional grazing period in April will also occur in 2024 given climatic conditions in the summer of 2023. The duration of this grazing period is yet to be determined and will depend on the climatic conditions observed throughout the rest of the year.

It should be noted that this corrective management undertaken in 2023 and proposed to be undertaken 2024 coincides with the return of more average climatic conditions given the lack of rainfall for much of South Australia after January of 2024. Vegetation may be beginning to transition back towards better habitat for PBTL as bare ground increases, despite the fact that litter cover and therefore thatch has not changed much since it was first measured in 2022.

It should also be noted that control of Declared weed species, *Xanthium spinosum* (Bathurst Burr) was undertaken by the landowner during the 2024 monitoring period. More information on this is likely to be provided in the future, through annual record sheets or via the farm app that the landowner uses.

6.2.9 Future monitoring / analysis

Future analyses of plant attributes can continue to explore rainfall variables to determine the influence of seasonal rainfall patterns on plant condition. Trends in litter can also be further analysed in the coming years.

Future analyses should also determine if there are any significant changes in any of the plant attributes in response to grazing variables (e.g., stocking rate, grazing period, etc.), which could then be used to inform adaptive management. This may be particularly important if dry conditions observed at the start of 2024 persist.

7 RECOMMENDATIONS

The following recommendations relating to both vegetation and PBTL monitoring, and the overall management of the SEB Offset Area are made:

- Management continues to follow actions that are described in the SEB Management Plan (EBS Ecology 2013, 2017a), including the following;
    - Complete and submit the *Paddock Monitoring Datasheet* to NEOEN to assist the management of the grazing program.
    - Submit the *Activity Record Datasheet* to NEOEN at the end of each financial year until 2028.
    - Example of both datasheets are attached as Appendix 5.
    - In lieu of completing and submitting the *Paddock Monitoring Datasheet* and *Activity Record Datasheet*, provide an extract of the farm management app currently used to collect this information, ensuring that all information provided is the same as the datasheets previously provided.
- Quadrats should continue to be monitored annually by a suitably qualified Ecologist in February for PBTL presence, and surveyors should be kept constant, where possible, to ensure a robust dataset is compiled. Results from the PBTL monitoring program should then be used to make management decisions that will improve the quality of PBTL habitat in the SEB Offset Area;
- Additional data on spider burrows (e.g., hole depth) should continue to be collected and analysed in future years to provide insight into the availability of burrows suitable for PBTLs;
- Vegetation condition and rainfall data should continue to be incorporated into future analyses of PBTL survey data to help explain any annual variability in results. Analyses will become more robust as more data is collected throughout the monitoring program;
- Monitor quadrats for threatened flora as observed across the SEB Offset Area in 2021, 2022, 2023 and 2024;
- Continue winter grazing to reduce annual exotic grass and retain patchiness for PBTL, adjusting the Dry Sheep Equivalent (DSE) to reflect climatic conditions. Reviewing the grazing regime as the year progresses and as climatic conditions become more evident would be beneficial. Consider the following:
    - Extend the grazing period into spring during years of high rainfall to reduce weed biomass, particularly spring germinates, increase bare ground and break up litter mats.
    - Lower DSE, shorten graze periods or increase rest periods on rocky ridges where widespread deterioration of grassland condition has been observed.
- Prioritise the control of Declared woody weeds that have potential to alter the structure of grassland vegetation. This includes the following species:
    - *Marrubium vulgare* (Horehound);

  - *Rosa canina* (Dog Rose); and
  - *Xanthium spinosum* (Bathurst Burr).
- The Land Manager and NEOEN determine ongoing management actions in consultation with a suitably qualified Ecologist, based on the recommendation in this report.
- Collect temperature data on site during field survey to reduce limitations due to incomplete climate data sets.

8 2024/2025 PRIORITY ACTIONS

8.1 Priority actions

The following actions should be undertaken in 2024 and leading into the 2025 monitoring period:

- In cooperation with the landowner, review the grazing regime within the SEB Offset Area on an annual basis. Given the vegetation condition, the area would benefit from increased grazing pressure in early to mid 2024.
- Leading into spring 2024, maintain communication with landowners to determine climatic conditions and continue reactive grazing management, increasing grazing pressure in spring if required.
- Ensure the Land Manager remains familiar with the *Paddock Monitoring Datasheet* and *Activity Record Datasheet.*

8.2 Implementation of priority actions

Following the monitoring survey undertaken in 2024 and considering results and the actions identified above, the following has been implemented;

- Discussion between EBS Ecology and the landowner occurred on site during the monitoring period. Grazing regime was discussed at this time, with the following outcomes:
    - Additional grazing period – sheep were introduced to the SEB area in April 2024, a month earlier than in previous years, to break up litter cover prior to the winter growth period.
    - Sheep will remain in the SEB area throughout winter as per the management plan. At winter's end, vegetation conditions will be assessed in view of the current and predicted spring weather patterns.
    - The landowner has committed to following any recommendations made by EBS Ecology at that time, including the continuation of grazing later into spring (if required) to further reduce weed and litter cover.

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10 APPENDICES

10.1 Appendix 1. 2023 Annual record sheets

Activity Record Datasheet - *To be filled in by landholders as work progresses, then issued to NEOEN at the end of each financial year.*

Management Action (e.g. fox baiting / shooting, boxthorn control)	**Date**	**Time spent on task** (hrs / days)	**Comments** (Completed/more remaining/ follow up required – provide estimate of time remaining)
Marrubium vulgare (Horehound) spraying	02/09/2023	6 hours	More remaining, ongoing
Rosa canina (Dog Rose) spraying	25/09/2023	5 hours	Ongoing, new plants every year
Control of Foxes (*Vulpes vulpes*) – Shooting	25/04/2023	2 hours	Ongoing

Paddock Monitoring Datasheet - *To be filled in by landholders as grazing management progresses.*

Paddock Name	Paddock Size	Date in	Date out	A. Grazing Days	B. Estimate of feed left (kg/DM/ha)	C. Sheep number and type	D. DSE rating	E. Total DSE of mob	F. Feed utilised (kg)	G. Rest Period (days)	I. DSE days/ha	J. DSE days/ha/yr
Nth Hills	70 Ha	1/05/2023	31/08/2023	103	200	210 Ewes 250 Lambs				171	390	
Sth Hills	67 Ha	1/05/2023	31/08/2023	103	200	210 Ewes 250 Lambs				171	390	
Sth Hills	67Ha	13/09/2023	21/09/2023	9	500	290 Merino Lambs					60	
Sth Hills	67 Ha	22/09/2023	9/10/2023	18	500	400 Ewes					140	

10.2 Appendix 2. GPS coordinates of each monitoring quadrat markers.

Monitoring quadrat	Northeast		Southeast		Southwest		Northwest	
	Easting	Northing	Easting	Northing	Easting	Northing	Easting	Northing
1	274553	6333589	274547	6333493	274447	6333504	274459	6333600
2	274885	6333546	274887	6333457	274782	6333443	274791	6333545
3	274587	6333218	274613	6333123	274511	6333122	274488	6333220
4	274923	6333245	274930	6333142	274819	6333120	274822	6333223
5	274623	6332969	274646	6332873	274548	6332850	274526	6332946
6	274971	6332890	274979	6332782	274877	6332867	274881	6332771
7	274601	6332627	274615	6332529	274513	6332525	274503	6332630
8	275060	6332684	275077	6332578	274981	6332562	274959	6332662
9	274896	6334207	274896	6334107	274796	6334107	274796	6334207
10	274866.6	6334408	274866.6	6334308	274766.6	6334308	274766.6	6334408
11	274422.6	6334716	274522.6	6334616	274422.6	6334616	274422.6	6334716
12	274613	6333981	274633	6333884	274540	6333866	274516	6333964

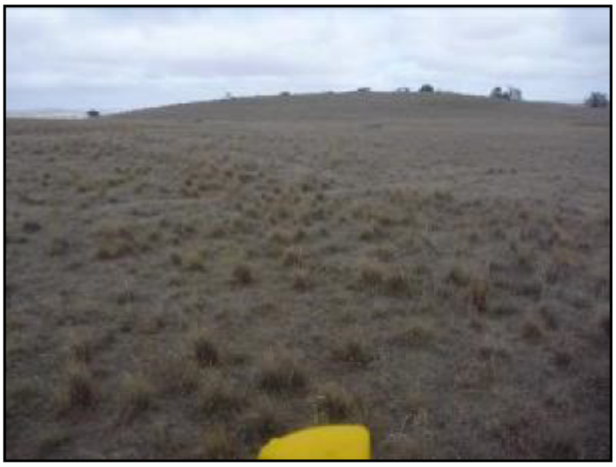
10.3 Appendix 3. Vegetation monitoring quadrat photographs.

Quadrat 1 photographs

	
Baseline PBTL (2016)	2020
	
2018	2021
	
2019	2022

	
2023	2024

Quadrat 2 photographs

<table>
<tr><td></td><td></td></tr>
<tr><td>Baseline PBTL (2016)</td><td>2020</td></tr>
<tr><td></td><td></td></tr>
<tr><td>2018</td><td>2021</td></tr>
<tr><td></td><td></td></tr>
<tr><td>2019</td><td>2022</td></tr>
</table>

	
2023	2024

Quadrat 3 photographs

<table>
<tr><td></td><td></td></tr>
<tr><td>Baseline PBTL (2016)</td><td>2020</td></tr>
<tr><td></td><td></td></tr>
<tr><td>2018</td><td>2021</td></tr>
<tr><td></td><td></td></tr>
<tr><td>2019</td><td>2022</td></tr>
</table>

	
2023	2024

Quadrat 4 photographs

	
Baseline PBTL (2016)	2020
	
2018	2021
	
2019	2022

	
2023	2024

Quadrat 5 photographs

	
Baseline PBTL (2016)	2020
	
2018	2021
	
2019	2022

	
2023	2024

Quadrat 6 photographs

	
Baseline PBTL (2016)	2020
	
2018	2021
	
2019	2022

	
2023	2024

Quadrat 7 photographs

	
Baseline PBTL (2016)	2020
	
2018	2021
	
2019	2022

	
2023	2024

Quadrat 8 photographs

	
Baseline PBTL (2016)	2020
	
2018	2021
	
2019	2022

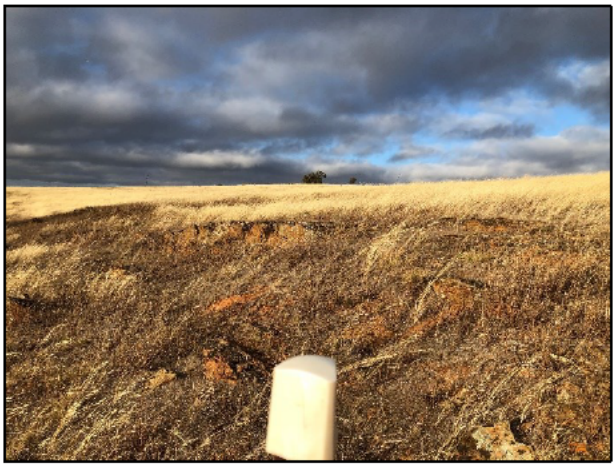
	
2023	2024

Quadrat 9 photographs

No photo, site established in 2018	
Baseline PBTL (2016)	2020
	
2018	2021
	
2019	2022

	
2023	2024

Quadrat 10 photographs

No photo, site established in 2018	
Baseline PBTL (2016)	2020
	
2018	2021
	
2019	2022

	
2023	2024

Quadrat 11 photographs

<table>
<tr><td>No photo, site established in 2018</td><td></td></tr>
<tr><td>Baseline PBTL (2016)</td><td>2020</td></tr>
<tr><td></td><td></td></tr>
<tr><td>2018</td><td>2021</td></tr>
<tr><td></td><td></td></tr>
<tr><td>2019</td><td>2022</td></tr>
</table>

	
2023	2024

Quadrat 12 photographs

No photo, site established in 2018	
Baseline PBTL (2016)	2020
	
2018	2021
	
2019	2022

	
2023	2024

10.4 Appendix 4. Vegetation monitoring data tables.

Table 10. The presence of native species recorded per monitoring quadrat (Q) in 2024.

Scientific Name	Common Name	Conservation Status		New in 2024	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
		EPBC Act	NPW Act													
Acacia pycnantha	Golden Wattle															✓
Acaena novae-zelandiae	Bidgee Widgee				✓	✓				✓				✓		✓
Allocasuarina verticillata	Drooping Sheoak				✓	✓	✓		✓	✓						✓
Anthosachne scabra	Common Wheat-grass															
Anthosachne sp.	Wheat-grass															
Aristida behriana	Bruch Wire-grass				✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Asperula conferta	Common Woodruff				✓											✓
Atriplex semibaccata	Berry Saltbush															
Austrostipa scabra group	Falcate-awn Spear-grass				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Austrostipa sp.	Spear-grass				✓	✓	✓		✓	✓				✓	✓	✓
Boerhavia dominii	Tar-vine								✓		✓		✓	✓		✓
Bursaria spinosa	Bursaria															✓
Calocephalus citreus	Lemon Beauty-heads				✓		✓		✓						✓	✓
Calostemma purpureum	Pink Garland-lily															
Cheilanthes distans	Bristly Cloak-fern				✓											
Cheilanthes sp.	Rock fern															
Chloris truncata	Windmill Grass						✓									
Compositae sp.	Daisy family															
Convolvulus remotus	Grassy Bindweed				✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Convolvulus sp.	Bindweed					✓				✓					✓	
Cryptandra campanulata	Long-flower Cryptandra		R		✓		✓	✓	✓	✓				✓	✓	✓
Cryptandra sp. floriferous (W.R.Barker 4131)	Pretty Cryptandra				✓				✓							✓
Dianella sp.	Flax-lily															
Dichanthium sericeum ssp.	Silky Blue-grass								✓							
Dysphania melanocarpa	Black Crumbweed															
Einadia nutans	Climbing Saltbush												✓			

Scientific Name	Common Name	Conservation Status		New in 2024	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
		EPBC Act	NPW Act													
Enneapogon nigricans	Black-head Grass				✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Euphorbia drummondii group					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Eutaxia microphylla	Common Eutaxia															
Glycine rubiginosa	Twining Glycine						✓						✓			
Gonocarpus elatus	Hill Raspwort				✓						✓	✓				✓
Juncus aridicola	Inland Rush				✓		✓		✓	✓						
Lagenophora huegelii	Coarse Bottle-daisy															
Liliaceae sp.	Lily Family															
Lomandra effusa	Scented Mat-rush										✓					
Lomandra multiflora ssp. dura	Hard Mat-rush				✓		✓	✓	✓						✓	✓
Lomandra sororia	Sword Mat-rush												✓			✓
Lomandra sp.															✓	✓
Lysiana exocarpi ssp. exocarpi	Harlequin Mistletoe				✓											✓
Maireana aphylla	Cotton-bush										✓					
Maireana enchylaenoides	Wingless Fissure-plant				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Maireana rohrlachii	Rohrlach's Bluebush		R							✓						
Oxalis perennans	Native Sorrel				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Panicum decompositum	Native Millet					✓						✓	✓	✓	✓	
Pleurosorus rutifolius	Blanket Fern															
Rumex dumosus	Wiry Dock		R				✓				✓		✓			
Rytidosperma caespitosum	Common Wallaby-grass				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Rytidosperma sp.																
Salsola australis	Buckbush															
Sida corrugata var.	Corrugated Sida				✓		✓	✓	✓	✓		✓				
Sida petrophila	Rock Sida															✓
Sida sp.																
Teucrium racemosum	Grey Germander									✓		✓				
Themeda triandra	Kangaroo Grass				✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Thysanotus sp.																
Triodia irritans	Spinifex				✓		✓								✓	✓

Scientific Name	Common Name	Conservation Status		New in 2024	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
		EPBC Act	NPW Act													
Vittadinia blackii	Narrow-leaf New Holland Daisy				✓		✓	✓				✓	✓	✓	✓	✓
Vittadinia cuneata var.	Fuzzy New Holland Daisy				✓		✓	✓	✓	✓	✓	✓	✓	✓		✓
Vittadinia gracilis	Woolly New Holland Daisy				✓		✓	✓	✓	✓	✓		✓	✓	✓	✓
Wahlenbergia sp.	Native Bluebell				✓			✓					✓	✓		
Walwhalleya proluta	Rigid Panic				✓	✓	✓	✓	✓	✓	✓	✓				
Xanthorrhoea quadrangulata	Rock Grass-tree				✓										✓	✓
Xanthorrhoea sp.	Yacca/Grass-tree															
		Total plant Species		**New in 2024**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Q11**	**Q12**
				0	29	13	24	17	22	21	17	15	18	18	20	29

EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999*. NPW Act: *National Parks and Wildlife Act 1972*. R: Rare.

Table 11. The presence of weed species recorded per monitoring quadrat (Q) in 2024.

Scientific name	Common name	Declared under the LSA Act	New in 2024	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Aira sp.	Hair-grass														
Avena barbata	Bearded Oat			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Avena sativa	Cultivated Oat														
Bromus diandrus	Great Brome			✓	✓				✓	✓		✓	✓	✓	✓
Bromus hordeaceus	Soft Bromus														
Bromus rubens															
Carthamus lanatus	Saffron Thistle				✓	✓						✓			
Centaurea melitensis	Malta Thistle														
Chondrilla juncea	Skeleton Weed	✓											✓		
Chrozophora tinctoria											✓				
Cichorium intybus	Chicory									✓					
Cucumis myriocarpus	Paddy Melon			✓	✓	✓	✓	✓	✓			✓	✓		
Echium plantagineum	Salvation Jane	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Eragrostis curvula	African Love-grass	✓													
Erodium cicutarium	Cut-leaf Herons-bill			✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Heliotropium curassavicum	Smooth Heliotrope				✓		✓			✓	✓	✓	✓		✓
Heliotropium europaeum	Common Heliotrope			✓	✓	✓	✓	✓	✓		✓	✓	✓		✓
Hordeum glaucum/leporinum					✓		✓		✓						
Hordeum marinum															
Hypochaeris radicata	Rough Cats-ear			✓	✓	✓		✓				✓	✓		
Lactuca serriola	Prickly Lettuce									✓	✓	✓			
Lepidium africanum	Common Peppercress						✓		✓		✓	✓	✓		
Lolium sp.	Ryegrass			✓							✓				

Scientific name	Common name	Declared under the LSA Act	New in 2024	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Malva sp.											✓				
Marrubium vulgare	Horehound	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Medicago minima	Woolly Burr-medic				✓	✓				✓				✓	
Moraea setifolia	Thread Iris			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Onopordum acaulon	Horse Thistle			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Onopordum acanthium															
Picnomon acarna	Soldier Thistle														
Poa bulbosa															
Polygonum aviculare	Wireweed						✓		✓						
Reseda lutea	Cut-leaf mignonette	✓			✓			✓		✓	✓	✓			
Rosa canina	Dog Rose	✓		✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
Rumex crispus	Crispy Dock		✓	✓	✓						✓				
Rumex sp.											✓				
Salvia verbenaca	Wild Sage			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Scabiosa atropurpurea	Pincushion		✓			✓									
Solanum nigrum	Black Nightshade														
Sonchus oleraceus	Common Sow-thistle			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sonchus sp.	Sow-thistle			✓	✓		✓		✓	✓	✓	✓	✓	✓	
Tribulus terrestris	Caltrop	✓													
Trifolium angustifolium				✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Trifolium campestre	Hop Clover			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Trifolium repens					✓										
Trifolium resupinatum															
Trifolium sp.				✓	✓	✓	✓		✓					✓	✓
Trifolium vesiculosum	Arrow-leaf Clover														

Scientific name	Common name	Declared under the LSA Act	New in 2024	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Triticum aestivum	Common Wheat														
Verbascum virgatum	Twiggy Mullein														
Vulpia sp.	Fescue						✓				✓				✓
Xanthium spinosum	Bathurst Burr	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓		
Total Weed Species		**Declared under the LSA Act**	**New in 2024**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Q11**	**Q12**
		8	2	20	25	18	20	15	19	19	24	21	20	13	15

LSA Act: Landscape South Australia Act 2019

Table 12. Native species diversity of each quadrat in 2018, 2019, 2020, 2021, 2022, 2023 and 2024.

Quadrat	Native Diversity						
	2018	2019	2020	2021	2022	2023	2024
1	6	8	23	18	27	23	29
2	4	4	9	7	9	10	13
3	5	8	16	15	22	19	24
4	4	6	11	11	15	12	17
5	8	10	14	17	23	18	22
6	6	8	15	13	16	14	21
7	4	5	12	12	15	15	17
8	4	8	11	10	12	11	15
9	5	8	15	15	20	12	18
10	3	4	14	11	16	7	18
11	8	7	10	8	20	16	21
12	12	13	20	21	25	29	30
Mean	**5.75**	**7.42**	**14.92**	**13.17**	**18.33**	**15.50**	**20.42**

Table 13. Weed species diversity of each quadrat in 2018, 2019, 2020, 2021, 2022, 2023 and 2024.

Quadrat	Weed Diversity						
	2018	2019	2020	2021	2022	2023	2024
1	2	7	9	10	15	21	20
2	4	8	16	13	23	19	25
3	3	6	9	12	13	16	18
4	1	6	11	10	12	16	20
5	3	7	9	12	15	18	15
6	3	7	15	14	14	16	19
7	4	6	9	13	12	19	19
8	5	6	8	17	15	22	24
9	7	6	13	15	17	21	21
10	4	6	11	13	20	21	20
11	5	5	8	6	15	15	13
12	1	4	9	11	12	17	15
Mean	**3.50**	**6.17**	**10.58**	**12.25**	**15.25**	**18.42**	**19.08**

Table 14. The number of quadrats that each native species were recorded in the SEB Offset Area in 2018, 2019, 2020, 2021, 2022, 2023 and 2024.

Scientific name	Common Name	Number of quadrats						
		2018	2019	2020	2021	2022	2023	2024
Acacia pycnantha	Golden Wattle	0	0	0	1	1	1	1
Acaena novae-zelandiae	Bidgee Widgee	0	0	0	1	2	1	5
Allocasuarina verticillata	Drooping Sheoak	1	3	5	5	5	4	6
Anthosachne scabra	Common Wheat-grass	0	0	0	1	0	0	0
Anthosachne sp.	Wheat-grass	0	0	0	1	1	0	0
Aristida behriana	Brush Wire-grass	12	12	12	12	12	12	11
Asperula conferta	Common Woodruff	0	0	1	1	2	2	2

Scientific name	Common Name	Number of quadrats						
		2018	2019	2020	2021	2022	2023	2024
Atriplex semibaccata	Berry Saltbush	0	0	1	0	1	0	0
Austrostipa scabra group	Falcate-awn Spear-grass	12	12	11	11	12	11	12
Austrostipa sp.	Spear-grass	0	0	12	6	10	9	8
Boerhavia dominii	Tar-vine	0	0	3	4	4	3	5
Bursaria spinosa	Bursaria	1	1	1	1	1	1	1
Calocephalus citreus	Lemon Beauty-heads	1	3	3	3	4	4	5
Calostemma purpureum	Pink Garland-lily	0	0	0	0	1	0	0
Cheilanthes distans	Bristly Cloak-fern	0	2	2	0	5	2	1
Cheilanthes sp.		0	0	0	0	1	3	0
Compositae sp.	Daisy Family	0	0	1	0	0	0	1
Chloris truncata	Windmill Grass	0	0	0	0	3	0	0
Convolvulus remotus	Grassy Bindweed	0	0	0	7	9	11	10
Convolvulus sp.	Bindweed	2	4	7	1	2	1	3
Cryptandra campanulata (previously Cryptandra amara)	Long-flower Cryptandra	1	3	6	6	5	5	8
Cryptandra sp. floriferous	Pretty Cryptandra	1	3	0	0	2	1	3
Dianella sp.	Flax-lily	0	0	0	1	0	0	0
Dichanthium sericeum ssp.	Silky Blue-grass	0	0	0	1	1	0	1
Dysphania melanocarpa	Black Crumbweed	0	0	1	0	2	0	0
Einadia nutans ssp.	Climbing Saltbush	0	0	1	0	0	0	1
Enneapogon nigricans	Black-head Grass	4	3	4	6	9	7	11
Euphorbia drummondii	Spurge	1	5	12	10	12	11	12
Eutaxia microphylla	Common Eutaxia	0	0	0	0	0	2	0
Glycine rubiginosa	Twining glycine	0	2	1	1	0	2	4
Gonocarpus elatus	Hill Raspwort	0	0	3	1	4	1	2
Juncus aridicola	Inland Rush	0	0	1	3	4	4	4
Lagenophora huegelii	Coarse Bottle-daisy	0	0	0	0	0	1	0
Liliaceae sp.	Lily Family	0	0	1	0	1	3	0
Lomandra effusa	Scented Mat-rush	0	0	0	1	0	0	1
Lomandra multiflora ssp. dura	Hard Mat-rush	0	0	4	6	8	6	6
Lomandra sororia	Sword Mat-rush	0	0	2	2	3	2	2
Lomandra sp.	Mat-rush	2	1	0	0	0	0	2
Lysiana exocarpi ssp. exocarpi	Harlequin Mistletoe	0	0	2	2	2	2	2
Maireana aphylla	Cotton-bush	0	0	1	0	0	0	1
Maireana enchylaenoides	Wingless Fissure-plant	6	4	11	10	12	11	12
Maireana rohrlachii	Rohrlach's Bluebush	0	0	1	1	1	1	1
Oxalis perennans	Native Sorrel	0	0	12	1	6	4	12
Panicum decompositum	Native Panic	0	0	0	1	0	1	5
Pleurosorus rutifolius	Blanket Fern	0	0	2	0	0	0	0
Rumex dumosus	Wiry Dock	0	0	2	1	1	3	3

Scientific name	Common Name	Number of quadrats						
		2018	2019	2020	2021	2022	2023	2024
Rytidosperma caespitosum	Common Wallaby-grass	3	9	10	11	11	9	12
Rytidosperma sp.	Wallaby-grass	0	0	2	0	0	1	0
Salsola australis	Buckbush	0	1	0	1	2	0	0
Sida corrugata	Corrugated Sida	0	0	0	0	7	7	6
Sida petrophila	Rock Sida	0	0	1	0	0	0	1
Sida sp.	Sida	2	1	0	3	0	0	0
Teucrium racemosum	Grey Germander	2	1	2	0	0	0	2
Themeda triandra	Kangaroo Grass	6	7	7	9	11	10	11
Thysanotus sp.		0	0	0	0	0	1	0
Triodia irritans.	Spinifex	3	3	4	3	3	2	4
Vittadinia blackii	Narrow-leaf New Holland Daisy	1	2	2	4	6	1	8
Vittadinia cuneata var.	Fuzzy New Holland Daisy	0	0	7	7	9	6	10
Vittadinia gracilis	Woolly New Holland Daisy	5	2	0	6	7	8	10
Wahlenbergia sp.	Native Bluebell	0	0	3	0	1	0	4
Walwhalleya proluta	Rigid Panic	1	2	2	3	11	6	8
Xanthorrhoea quadrangulata	Yacca/Grass-tree	3	3	3	2	3	3	3
Xanthorrhoea sp.	Yacca/Grass-tree	0	0	0	0	0	0	0
Totals native species within SEB Offset Area		**21**	**24**	**41**	**41**	**45**	**43**	**46**

Table 15. The number of quadrats that each weed species were recorded in the SEB Offset Area in 2018, 2019, 2020, 2021, 2022, 2023 and 2024.

Scientific name	Common Name	Number of quadrats						
		2018	2019	2020	2021	2022	2023	2024
Aira sp.	Hair-grass	0	0	0	0	2	7	0
Avena barbata	Bearded Oat	12	12	12	12	12	12	12
Avena sativa	Cultivated Oat	0	0	0	0	1	3	0
Bromus diandrus	Great Brome	0	0	4	1	8	10	8
Bromus hordeaceus	Soft Brome	0	0	0	0	0	4	0
Bromus rubens	Red Brome	0	0	0	0	0	2	0
Carthamus lanatus	Saffron Thistle	3	6	6	9	8	11	3
Centaurea melitensis	Malta Thistle	0	0	0	0	2	2	0
Chondrilla juncea	Skeleton Weed	0	0	0	0	3	3	1
Chrozophora tinctoria	Turnsole	0	0	0	1	3	3	1
Cichorium intybus	Chicory	0	1	0	1	2	4	1
Cucumis myriocarpus	Paddy Melon	1	2	5	4	8	2	8
Echium plantagineum	Salvation Jane	1	9	12	10	12	12	12
Eragrostis curvula	African Love-grass	0	0	0	0	3	0	0
Erodium cicutarium	Cut-leaf Heron's-bill	0	0	12	0	2	0	10
Heliotropium curassavicum	Smooth Heliotrope	2	5	0	5	5	0	7

Scientific name	Common Name	Number of quadrats						
		2018	2019	2020	2021	2022	2023	2024
Heliotropium europaeum	Common Heliotrope	3	2	12	11	9	0	10
Hordeum glaucum/leporinum		0	0	1	3	4	1	3
Hordeum marinum		0	0	0	0	0	4	0
Hypochaeris radicata	Rough Cat's Ear	0	0	1	2	6	5	6
Lactuca serriola	Prickly Lettuce	0	0	0	0	0	3	3
Lepidium africanum	Common Peppercress	0	0	2	1	2	4	5
Lolium sp.	Rye-grass	0	1	1	3	0	0	2
Malva sp.	Mallow	1	0	0	0	0	2	1
Marrubium vulgare	Horehound	6	7	10	6	10	11	12
Medicago minima	Woolly Burr-medic	0	0	0	6	5	9	4
Moraea setifolia	Thread Iris	0	5	12	10	4	6	12
Onopordum acaulon	Horse Thistle	0	0	3	7	8	5	10
Onopordum acanthium		0	0	0	0	0	1	0
Picnomon acarna	Soldier Thistle	0	0	0	0	3	6	0
Poa bulbosa		0	0	0	0	0	4	0
Polygonum aviculare	Wireweed	0	0	1	1	2	2	2
Reseda lutea	Cut-leaf Mignonette	0	0	1	0	1	4	5
Rosa canina	Dog Rose	3	2	7	8	7	10	10
Rumex crispus	Crispy Dock	0	0	0	0	0	0	3
Rumex sp.	Dock	0	3	0	3	4	3	1
Salvia verbenaca	Wild Sage	6	10	12	9	12	12	12
Solanum nigrum	Black Nightshade	0	0	0	0	1	0	1
Scabiosa atropurpurea	Pincushion	0	0	0	0	0	0	0
Sonchus oleraceus	Common Sow-thistle	0	0	4	8	10	11	12
Sonchus sp.	Sow-thistle	1	3	0	0	2	1	9
Tribulus terrestris	Caltrop	0	0	2	0	0	0	0
Trifolium angustifolium		0	0	0	12	12	10	11
Trifolium campestre	Hop Clover	0	0	12	11	8	11	12
Trifolium repens		0	0	0	1	0	2	1
Trifolium resupinatum		0	0	0	0	0	3	0
Trifolium sp.	Narrow-leaf Clover	2	9	0	0	0	1	7
Trifolium vesiculosum	Arrow-leaf Clover	0	0	0	0	0	3	0
Triticum aestivum	Common Wheat	0	0	0	0	0	4	0
Verbascum virgatum	Twiggy Mullein	0	0	0	0	0	2	0
Vulpia sp.	Fescue	0	0	1	0	0	9	3
Xanthium spinosum	Bathurst Burr	1	0	1	2	2	1	9
Total weed species within SEB Offset Area		**13**	**15**	**23**	**26**	**34**	**43**	**36**

Table 16. Mean plant spacing (cm) at each quadrat in 2018, 2019, 2020, 2021, 2022, 2023 and 2024.

Quadrat	Mean plant spacing (cm)						
	2018	2019	2020	2021	2022	2023	2024
1	24.00	22.20	30.72	18.10	12.86	17.67	24.83
2	37.50	22.50	41.48	33.90	26.89	33.55	29.70
3	15.30	21.20	23.53	20.10	15.36	26.88	23.63
4	24.50	24.50	17.73	22.90	13.30	20.97	22.29
5	32.40	31.60	40.25	29.50	19.09	35.87	32.27
6	19.70	91.10	76.78	23.40	26.66	31.69	29.44
7	23.50	30.10	69.88	24.20	20.23	24.25	24.81
8	37.70	44.90	58.15	27.80	24.69	33.85	32.33
9	49.20	38.60	45.19	31.10	27.34	31.06	26.52
10	47.40	99.80	216.88	33.20	24.88	27.77	24.67
11	21.60	24.20	29.11	26.90	19.17	18.75	23.41
12	23.60	48.30	33.45	20.30	19.77	18.61	16.42
Mean	**29.70**	**41.58**	**56.93**	**26.00**	**20.85**	**26.74**	**25.86**

Table 17. Mean number of tussocks per hectare in each quadrat in 2018, 2019, 2020, 2021, 2022, 2023 and 2024.

Quadrat		Mean tussocks per hectare					
	2018	2019	2020	2021	2022	2023	2024
1	-	150,000	204,000	230,000	302,000	144,000	150,000
2	-	120,000	76,000	50,000	54,000	17,000	85,000
3	-	190,000	200,000	190,000	256,000	114,000	156,250
4	-	160,000	231,000	110,000	281,000	130,000	201,250
5	-	100,000	95,000	90,000	151,000	48,000	77,500
6	-	100,000	84,000	50,000	88,000	53,000	57,500
7	-	90,000	90,000	120,000	153,000	119,000	90,000
8	-	70,000	60,000	60,000	74,000	57,000	102,500
9	80,000	80,000	103,000	30,000	66,000	24,000	67,500
10	60,000	30,000	10,000	20,000	63,000	17,000	206,250
11	120,000	150,000	111,000	90,000	166,000	149,000	193,750
12	120,000	130,000	195,000	100,000	321,000	207,000	292,500
Mean	**95,000**	**114,167**	**121,583**	**94,815**	**164,583**	**90,000**	**140,000**

Table 18. Mean number of juvenile tussocks per hectare in each quadrat in 2018, 2019, 2020, 2021, 2022, 2023 and 2024.

Quadrat	Mean juvenile tussocks per hectare						
	2018	2019	2020	2021	2022	2023	2024
1	-	30,000	99,000	10,000	13,000	8,000	50,000
2	-	10,000	59,000	0	3,000	1,000	5,000
3	-	40,000	13,000	10,000	9,000	14,000	15,000
4	-	10,000	36,000	0	13,000	4,000	20,000
5	-	20,000	33,000	0	8,000	2,000	21,250
6	-	10,000	16,000	0	10,000	0	3,750
7	-	10,000	130,000	20,000	26,000	11,000	47,500

Quadrat	Mean juvenile tussocks per hectare						
	2018	2019	2020	2021	2022	2023	2024
8	-	3,000	49,000	10,000	11,000	3,000	10,000
9	1,000	5,000	158,000	0	1,000	1,000	3,750
10	6,000	10,000	308,000	0	3,000	4,000	18,750
11	1,200	20,000	68,000	0	4,000	7,000	22,500
12	30,000	20,000	64,000	0	19,000	7,000	36,250
Mean	**9,550**	**15,667**	**86,083**	**4,400**	**9,911**	**5,167**	**21,146**

Table 19. Mean plant basal width (cm) at each quadrat in 2018, 2019, 2020, 2021, 2022, 2023 and 2024.

Quadrat	Mean plant basal width (cm)						
	2018	2019	2020	2021	2022	2023	2024
1	12.90	6.70	7.06	6.60	8.55	6.45	4.15
2	8.50	7.00	5.14	4.70	4.97	2.56	2.18
3	7.20	6.20	5.83	6.90	6.69	5.75	4.00
4	8.70	6.10	5.66	6.20	6.25	3.21	5.32
5	6.30	5.40	6.25	6.70	8.68	4.04	3.51
6	9.80	4.90	7.58	7.10	6.58	6.36	5.00
7	11.40	13.20	11.27	5.20	8.25	6.67	6.83
8	13.50	8.20	11.30	10.40	6.79	6.18	7.02
9	6.90	6.30	6.40	4.40	5.98	3.66	2.38
10	9.10	6.60	7.69	6.10	6.91	2.82	0.89
11	11.90	8.80	8.25	8.80	7.45	6.12	3.20
12	8.80	9.80	12.81	11.60	4.45	5.33	2.85
Mean	**9.58**	**7.43**	**7.95**	**7.06**	**6.80**	**4.93**	**3.94**

Table 20. Mean plant height (cm) at each quadrat in 2018, 2019, 2020, 2021, 2022, 2023 and 2024.

Quadrat	Mean plant height (cm)						
	2018	2019	2020	2021	2022	2023	2024
1	21.00	9.40	12.59	22.60	38.14	29.99	21.79
2	14.00	3.50	8.06	19.70	21.78	14.69	12.25
3	13.60	5.50	10.28	29.20	17.08	18.22	10.40
4	10.70	3.50	8.20	22.50	25.02	14.29	12.46
5	14.50	5.70	9.59	30.50	25.25	13.28	11.09
6	17.30	4.30	10.13	26.70	21.70	12.04	10.80
7	27.90	15.90	18.00	18.60	52.68	28.93	27.04
8	19.80	7.00	12.61	20.60	25.63	28.42	18.62
9	10.00	5.00	8.05	28.30	22.66	8.46	13.61
10	9.50	5.80	11.81	14.30	14.72	10.38	17.13
11	13.60	7.80	12.03	14.40	13.62	17.76	20.12
12	16.60	9.10	16.03	21.80	24.08	30.44	13.82
Mean	**15.71**	**6.88**	**11.44**	**22.43**	**25.19**	**18.91**	**15.76**

Table 21. Percentage dead material on tussocks (%) in each quadrat in 2018, 2019, 2020, 2021, 2022, 2023 and 2024.

Quadrat	Dead material on grass tussocks (%)						
	2018	2019	2020	2021	2022	2023	2024
1	-	77.00	30.00	59.00	17.00	55.40	22.50
2	-	86.00	42.14	94.00	9.00	24.40	37.57
3	-	66.00	27.50	74.00	20.13	66.40	24.53
4	-	82.00	17.00	88.00	15.50	52.30	36.87
5	-	83.00	51.25	73.00	17.25	67.30	19.85
6	-	96.00	55.71	88.00	15.00	80.70	35.82
7	-	88.00	51.88	58.00	10.75	45.50	15.22
8	-	94.00	46.43	82.00	10.88	46.20	14.31
9	97.00	97.00	39.63	95.00	15.25	55.00	34.44
10	96.00	95.00	51.67	95.00	21.25	35.60	38.28
11	97.00	83.00	43.75	84.00	25.25	57.90	30.31
12	79.00	70.00	21.88	78.00	22.63	69.70	25.90
Mean	**92.25**	**84.74**	**39.91**	**80.67**	**16.66**	**54.70**	**27.97**

Table 22. Mean percentage (%) weed cover within 1 x 1 m quadrats in 2018, 2019, 2020, 2021, 2022, 2023 and 2024.

Quadrat	Mean weed cover (%) (1 x 1 m quadrats)						
	2018	2019	2020	2021	2022	2023	2024
1	-	10	36	36	1	30	7
2	-	41	84	90	4	4	17
3	-	5	16	26	1	18	3
4	-	19	57	48	1	43	2
5	-	21	60	39	2	12	7
6	-	53	79	69	3	15	11
7	-	31	76	62	1	17	3
8	-	86	63	74	9	1	6
9	62	89	79	97	2	2	12
10	88	98	96	94	2	2	24
11	7	19	68	62	2	19	2
12	1	1	4	5	2	10	0
Mean	**39.50**	**31.98**	**59.73**	**58.50**	**2.41**	**14.42**	**7.80**

Table 23. Percentage (%) weed cover within 1 ha quadrats in 2018, 2019, 2020, 2021, 2022, 2023 and 2024.

Quadrat	Weed cover (%) (1 ha quadrat)						
	2018	2019	2020	2021	2022	2023	2024
1	-	30	30	40	1	25	10
2	-	30	60	90	5	15	50
3	-	5	20	30	1	25	15
4	-	25	30	50	2	50	20
5	-	25	40	40	5	20	20
6	-	40	60	70	5	20	30

Quadrat	Weed cover (%) (1 ha quadrat)						
	2018	2019	2020	2021	2022	2023	2024
7	-	25	50	60	5	25	20
8	-	70	60	70	10	10	15
9	70	70	75	90	3	10	35
10	80	85	85	90	3	10	40
11	10	20	50	60	3	25	10
12	2	1	5	5	2	10	5
Mean	**40.50**	**35.50**	**48.33**	**57.92**	**3.75**	**20.42**	**22.50**

Table 24. Percentage (%) cryptogam cover at each quadrat in 2020, 2021, 2022, 2023 and 2024.

Quadrat	Cryptogam cover (%)				
	2020	2021	2022	2023	2024
1	25.10	5.00	1.75	1.30	0.00
2	2.14	0.00	0.00	0.00	0.00
3	58.13	6.00	14.13	2.40	3.53
4	25.63	1.00	6.75	3.30	2.88
5	30.25	4.00	2.13	2.80	2.19
6	11.50	3.00	0.38	1.80	0.97
7	15.00	2.00	1.13	1.30	0.00
8	1.25	1.00	0.43	1.10	0.00
9	2.19	0.00	3.50	4.60	0.00
10	1.31	0.00	12.50	0.60	0.00
11	16.00	0.00	17.50	8.90	1.06
12	55.00	18.00	7.75	7.30	5.28
Mean	**20.29**	**3.33**	**5.66**	**2.95**	**1.33**

Table 25. Percentage (%) bare ground at each quadrat in 2020, 2021, 2022, 2023 and 2024.

Quadrat	Bare ground cover (%)				
	2020	2021	2022	2023	2024
1	5.80	2.00	1.75	0.33	2.22
2	8.13	1.00	1.38	0.00	0.25
3	11.63	3.00	3.38	1.90	4.28
4	7.63	6.00	12.25	1.30	5.53
5	13.38	6.00	1.75	1.10	14.16
6	8.00	2.00	1.63	0.20	3.94
7	5.63	1.00	1.13	1.20	0.25
8	16.13	1.00	0.00	1.80	0.47
9	4.38	0.00	2.88	0.10	1.03
10	0.19	0.00	0.00	0.00	0.16
11	2.75	0.00	5.50	2.10	1.78
12	13.13	6.00	4.38	9.00	5.78
Mean	**8.06**	**2.33**	**3.00**	**1.59**	**3.32**

Table 26. Percentage litter at each quadrat in 2022, 2023 and 2024.

Quadrat	Litter cover (%)		
	2022	2023	2024
1	68.75	53.90	75.03
2	88.50	98.90	79.13
3	76.88	63.30	79.63
4	65.63	44.40	75.88
5	72.50	81.10	73.69
6	89.38	83.30	78.06
7	74.13	47.80	61.25
8	89.29	90.60	79.34
9	88.13	96.10	83.16
10	78.13	100.00	75.34
11	48.75	65.60	81.56
12	37.50	20.00	56.25
Mean	**73.13**	**70.42**	**74.86**

10.5 Appendix 5. Annual record sheet templates

Activity Record Datasheet - *To be filled in by landholders as work progresses, then issued to NEOEN at the end of each financial year.*

Management Action **(e.g. fox baiting / shooting, boxthorn control)**	**Date**	**Time spent on task (hrs / days)**	**Comments (Completed/more remaining/ follow up required – provide estimate of time remaining)**

Paddock Monitoring Sheet - ***To be filled in by landholders as grazing management progresses.***

Paddock Name:...

Paddock Size	Date in	Date out	A. Grazing Days	B. Estimate of feed left (kg/DM/ha)	C. Sheep number and type	D. DSE rating	E. Total DSE of mob	F. Feed utilised (kg)	G. Rest Period (days)	I. DSE days/ha	J. DSE days/ha/yr

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