

Goomig Project Gouldian Finch Monitoring - Foraging Activity and Grass Phenology 2022-2023



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Goomig Gouldian Finch Monitoring – Foraging and Grass

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1.0 Executive Summary

The Goomig Project (Weaber Plains Development Project) is an irrigated agricultural development located approximately 30 km north of Kununurra, which involves clearing of approximately 9,260 ha of vegetation for agriculture. Approximately 11,470 ha of native vegetation surrounding, or remaining between, the cleared areas is designated as a buffer area (the study area for the purposes of this report) to be managed to protect surrounding conservation reserves and watercourses (Strategen 2014).

Monitoring of Gouldian Finch wet season foraging activity, and phenology and productivity of grasses important for foraging in the buffer area during ongoing operation, is required as conditions of the approval for the project, and is outlined in the Gouldian Finch Conservation Plan (GFCP; Strategen 2014). Item 8 of the monitoring regime requires “*annual wet-season monitoring of foraging activity in critical wet-season feeding areas in close proximity to breeding areas, to be undertaken between November and April each year*”, and Item 9 requires “*mapping and annual monitoring of the phenology and productivity of wet season feeding habitat, and assessment of their use by Gouldian Finches, to be undertaken between November and April each year*”.

Wet season foraging and grass monitoring in the buffer area were conducted across two phases in December 2022 and March 2023. Foraging activity was systematically monitored by undertaking 20 minute, two hectare surveys at 58 locations within the study area, with any opportunistic observations made outside of the systematic surveys also recorded. Grass phenology and productivity was monitored at 41 previously-determined monitoring locations within the study area, consistent with past monitoring.

No Gouldian Finches were recorded in the study area during the systematic foraging surveys in December and March, nor were any observed opportunistically during these months. Hence, foraging activity in the study area during the wet season still appears to be very low. In contrast to the previous season, no Gouldian Finches were recorded opportunistically during the April and May nest box monitoring surveys either. It is likely that the lack of foraging activity in the later part of the wet season is related to the decline in breeding activity. The reasons for their absence earlier in the wet season prior to breeding are less apparent, though it is possible that birds are already moving to areas in proximity to their breeding areas by this time. During the previous season, Gouldian Finches moved back into the study area during April and particularly May, apparently after breeding, but this was not observed this year. The comparatively low numbers of other nomadic seed-eating birds such as *Pictorella Mannikin* and *Diamond Doves* suggests that this absence may have been related to a change in seed availability, possibly due to the later season, or to increased seed quality and availability during the previous season following dry season fires in the preceding year.

Total coverage of foraging grasses was lower than in previous seasons based on December data, though sorghum and spinifex remained the dominant grasses by cover. The most significant decline appeared to be in sorghum, and transects in several areas had little or no cover of the monitored key foraging grasses. This is particularly prevalent in transects placed in narrow segments of remnant native vegetation between cleared agricultural areas. Transect by transect data is not available from surveys prior to 2021, so it is not possible to determine whether this was the case previously, but it seems possible that there has been a change in vegetation composition from key Gouldian Finch foraging grasses to sedge-dominated vegetation in these areas.

Flowering and seeding rates recorded in March 2023 were higher overall compared to the previous season, though this varied between different grass species. The most notable increase in seeding rates was observed in spinifex (*Triodia* spp.; 41.6% seeding in 2023 compared to 0.8% in 2022), which is unsurprising as the majority of spinifex was burnt in 2021 prior to the 2021-22 surveys. Seeding rates in sorghum (*Sarga/Sorghum* spp.) were lower in 2023, but flowering rates were higher, suggesting that sorghum was flowering and setting seed later this season compared to last season. By contrast, *Themeda triandra* flowering rates were significantly lower, with none

observed flowering during monitoring this season, compared to almost half of plants during the previous season. This may also indicate later flowering compared to last season, which would also be consistent with observations that low-lying areas were inundated much later into the year in 2023 compared to 2022.

The results of the monitoring during the 2022 season indicate that the target (identified in the GFCP) of “no reduction in baseline¹ [wet season] foraging activity which can be attributed to Buffer Area management” has not been met, as no Gouldian Finches were recorded during systematic foraging surveys in the wet season nor incidentally during nest box monitoring in April and May. It is not possible to clearly determine whether the target for grass productivity and phenology (identified in the GFCP) of “no reduction in baseline¹ phenology and productivity which can be attributed to Buffer Area management” is being met this season due to several confounding factors such as high inter-seasonal variation in phenology, and a lack of control sites. However, there is some evidence of changes to vegetation composition in some parts of the study area.

We make the following recommendations regarding ongoing monitoring and management based on the results of monitoring in the 2021-22 season:

1. Investigate potential causes of decline in foraging activity, in accordance with corrective actions identified in the GFCP in the event of the identified target not being met.
2. Continue the ongoing removal of cattle from the buffer area (study area) in accordance with the buffer management plan (Strategen 2012).
- 3a. Expand or revise the monitoring program to encompass foraging locations outside of the buffer area to provide control data; OR
- 3b. Incorporate relevant data obtained by other monitoring programs at suitable control sites in the region into the assessment and reporting each year.

¹ Baseline data have not been defined explicitly in the GFCP – we have treated 2014 breeding season foraging counts and the 2015 grass monitoring data as the baseline for this purpose, as these are the earliest data available to us, though data from prior to clearing commencing would be preferable.

2.0 Introduction

2.1 Project Background

The Goomig Project (formerly Weaber Plains Development Project) is an irrigated agricultural development located approximately 30 km north of Kununurra (Figure 2.1) and is an expansion of the existing stage 1 of the Ord River Irrigation Scheme. The project was approved by the then Department of Sustainability, Environment, Water, Population and Communities in 2011.

The project involves clearing approximately 9,260 ha of vegetation for agriculture. Approximately 11,470 ha of native vegetation surrounding, or remaining between, the cleared areas has been designated as a buffer area (the study area) to be managed to protect surrounding conservation reserves and watercourses (Strategen 2014).

2.2 Project Scope

Gouldian Finch monitoring in the buffer area of the Goomig Project during ongoing operation is required as a condition of approval for the project. A Gouldian Finch Conservation Plan (GFCP) has been prepared which includes a monitoring regime to be implemented to satisfy this condition (Strategen 2014). Biota Environmental Sciences (Biota) was engaged by the Department of Primary Industries and Regional Development (DPIRD) to implement this monitoring during the 2022-23 season.

The scope of the current study was to undertake monitoring surveys to meet the requirements of Items 7, 8 and 9 in Table 3 of the GFCP for the 2021-22 season:

- *Item 7: Annual monitoring of breeding populations, including timing and reproductive outputs (i.e. clutch size and fledging success), to be undertaken annually between February and July;*
- *Item 8: Annual wet-season monitoring of foraging activity in critical wet-season feeding areas in close proximity to breeding areas, to be undertaken between November and April each year; and*
- *Item 9: Mapping and annual monitoring of the phenology and productivity of wet season feeding habitat, and assessment of their use by Gouldian Finches, to be undertaken between November and April each year.*

This report addresses the results of the wet season foraging activity and grass phenology monitoring (Item 8 and Item 9). Item 7 is addressed in a separate report (Biota 2023).

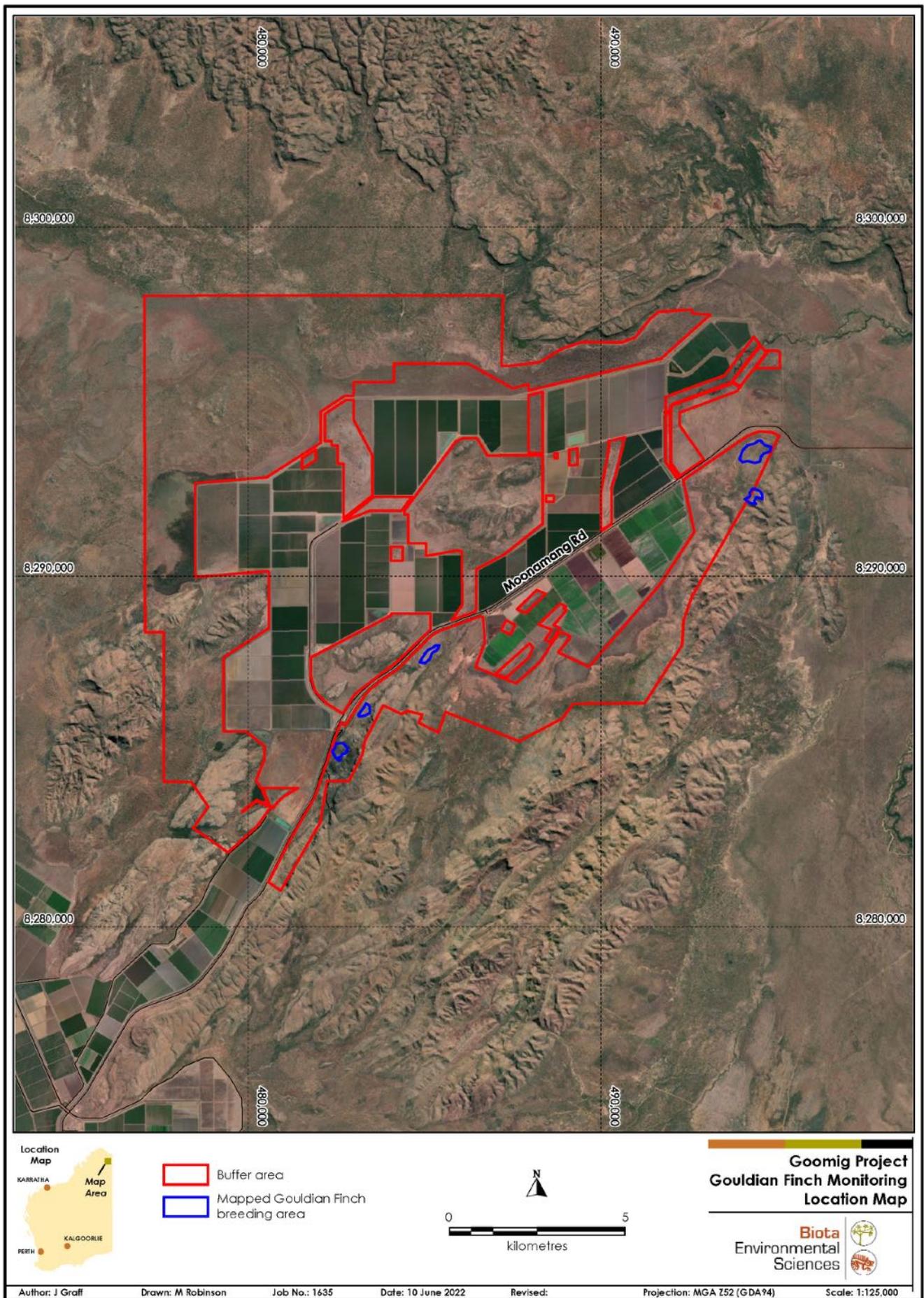


Figure 2.1: Goomig Project buffer area (the study area).

2.3 Gouldian Finch (*Chloebia gouldii*)

2.3.1 Distribution

The Gouldian Finch formerly occurred across large areas of tropical northern Australia, from Cape York in Queensland to the Kimberley region of Western Australia. However, over the last 100 years, the species has declined markedly in range and abundance, and is now recorded reliably only from the Northern Territory and Western Australia, with infrequent records in Queensland (O'Malley 2006).

In Western Australia, the Gouldian Finch occurs throughout much of the Kimberley region in the north-east of the state, from the Dampier Peninsula in the west, south to Mornington Wildlife Sanctuary and Halls Creek, and east to Lake Argyle and the WA border (Johnstone and Storr 2004, Cornell Lab of Ornithology 2022).

2.3.2 Habitat

Known breeding habitat for Gouldian Finches primarily comprises rocky hillslopes with smooth-barked eucalypts, including *Eucalyptus brevifolia*, *E. tinnitans* (O'Malley 2006), *E. miniata*, and *Corymbia dichromophloia* (Brazill-Boast et al. 2011), located in proximity (usually <2 km) to permanent fresh water sources for drinking (O'Malley 2006). An understorey of suitable foraging grasses is also typically an important component of breeding habitat (Brazill-Boast et al. 2011).

During the non-breeding season, Gouldian Finches disperse from breeding areas into adjacent lowland areas, favouring woodland areas with an understorey of suitable foraging grasses (Dostine et al. 2001).

2.3.3 Breeding Ecology

Gouldian Finches nest almost exclusively in eucalypt hollows, though there are historical reports of nesting in termite mounds (Tidemann 1996). In the east Kimberley, they nest in hollows in the cavity-bearing eucalypts *Corymbia dichromophloia* and *Eucalyptus miniata* (Brazill-Boast et al. 2010, 2011). Selection of hollows is highly dependent on structural characteristics of the hollow and the number of suitable hollows available in an area (Brazill-Boast et al. 2010, 2011).

Eggs are laid between February and June near Wyndham in Western Australia (Brazill-Boast et al. 2010), and between January and August, depending on wet season rainfall, on Newry Station in the Northern Territory (Tidemann et al. 1999). The average clutch size at Northern Territory study sites was 5.2 ± 1.3 , and pairs were recorded laying up to three clutches per season (Tidemann et al. 1999).

2.3.4 Diet

The Gouldian Finch is an obligate granivore, feeding almost entirely on grass seeds, though insects are occasionally taken (Johnstone and Storr 2004). Research in the Northern Territory found Gouldian Finches foraged mostly on the ground in burnt areas during the dry season, feeding on fallen seed from annual grasses, particularly sorghum (*Sarga*) species, which was exposed by the burning of the grass cover (Dostine et al. 2001). During the wet season, the finches fed on seeds of perennial grasses, including *Themeda triandra*, *Alloteropsis semialata*, *Chrysopogon fallax*, and *Heteropogon triticeus*, taking seeds directly off the grasses as they ripen (Dostine et al. 2001).

2.3.5 Conservation and Threatening Processes

The Gouldian Finch is listed as Endangered at federal level under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). It is not listed as threatened under state legislation in Western Australia, but is listed as a Priority 4 species by the Department of Biodiversity, Conservation and Attractions (DBCAs). Outside of Western Australia, the Gouldian Finch is also

listed as Endangered under the *Nature Conservation Act 1992* in Queensland, and as Vulnerable in the Northern Territory under the *Territory Parks and Wildlife Conservation Act 2000*.

The current key threatening processes for Gouldian Finches are considered to be changes in vegetation due to altered fire regimes and grazing by introduced animals (O'Malley 2006, Legge et al. 2015). More regular, intense fires were found to be related to poorer body condition in Gouldian Finches from the late dry season to late wet season (Legge et al. 2015). This is likely because they reduce food availability by burning the annual grass seeds used for dry season foraging, damaging the perennial grasses used for wet season foraging, and reducing the spatial and temporal complexity in seed availability relied on to provide year-round food resources (Watkinson et al. 1989, Crowley and Garnett 2001, Legge et al. 2015). Regular intense fires have also been found to reduce nest hollow availability (Brazill-Boast et al. 2010, 2011). Heavy grazing is also likely to reduce food availability for Gouldian Finches, by decreasing seed yields and extent of key Gouldian Finch foraging grasses (Crowley and Garnett 2001).

Commercial trapping of wild finches also coincided with major declines in Gouldian Finch populations in the Kimberley until it ended in 1986 (Franklin et al. 1999). High levels of infestation by mites in the air sacs of wild Gouldian Finches have also been reported, and have been suggested as a possible cause of population declines, but the actual extent of the impact is uncertain (O'Malley 2006).

2.4 Gouldian Finches in the Study Area

2.4.1 Foraging

Suitable foraging habitat for Gouldian Finches exists within the Goomig Project buffer area. Gouldian Finches were recorded foraging in the buffer area during the breeding season each season from 2014 to 2018; the number of individuals ranged from 17 to 32, with all records from within the mapped breeding areas (Save The Gouldian Fund 2014, 2015a, 2016a, 2017a, 2018a). Survey effort varied somewhat between seasons, but the general trend remains the same when this is accounted for (Figure 2.2). The majority of these records were from breeding areas where active nests were also recorded, with the exception of the 2018 season when a single individual was seen in a breeding area where no nests were detected (Save The Gouldian Fund 2018a). During the 2021 survey, a single adult male was recorded, also from within a mapped breeding area, though no active nests were recorded that season (Jackett 2021a). No individuals were recorded during the systematic surveys in March 2022, but several individuals were observed opportunistically in April and two small flocks were observed in May (Biota 2022a).

Gouldian Finches have also been observed using the Goomig Project buffer area during the non-breeding season. Individuals were recorded by Animal Plant Mineral (APM) during general bird surveys in the project area in August 2010 (Save The Gouldian Fund 2015b), and 73 individuals were subsequently recorded during targeted surveys in 2011 (Save The Gouldian Fund 2011a). No Gouldian Finches were sighted in the development envelope or buffer areas during the initial land-clearing phase in 2012 (Save The Gouldian Fund 2011a). However, following completion of clearing, Gouldian Finches were again recorded in the buffer area, and the number of individuals recorded trended upwards with 14 individuals sighted in 2013, 29 in 2014, 38 in 2015, 33 in 2016, and a high count of 52 in 2017 (Save The Gouldian Fund 2011a, 2011a, 2015b, 2016b, 2017b). This count was still lower than the pre-clearing count of 73 individuals, including 65 individuals in the study area, but is approximately equivalent when standardised for survey effort (Figure 2.3). No counts were undertaken during the 2018-19 and 2019-20 non-breeding seasons, then only a single juvenile individual was recorded during the October 2020 survey (Jackett 2021b) and no individuals were observed during the December 2021 survey (Biota 2022a).

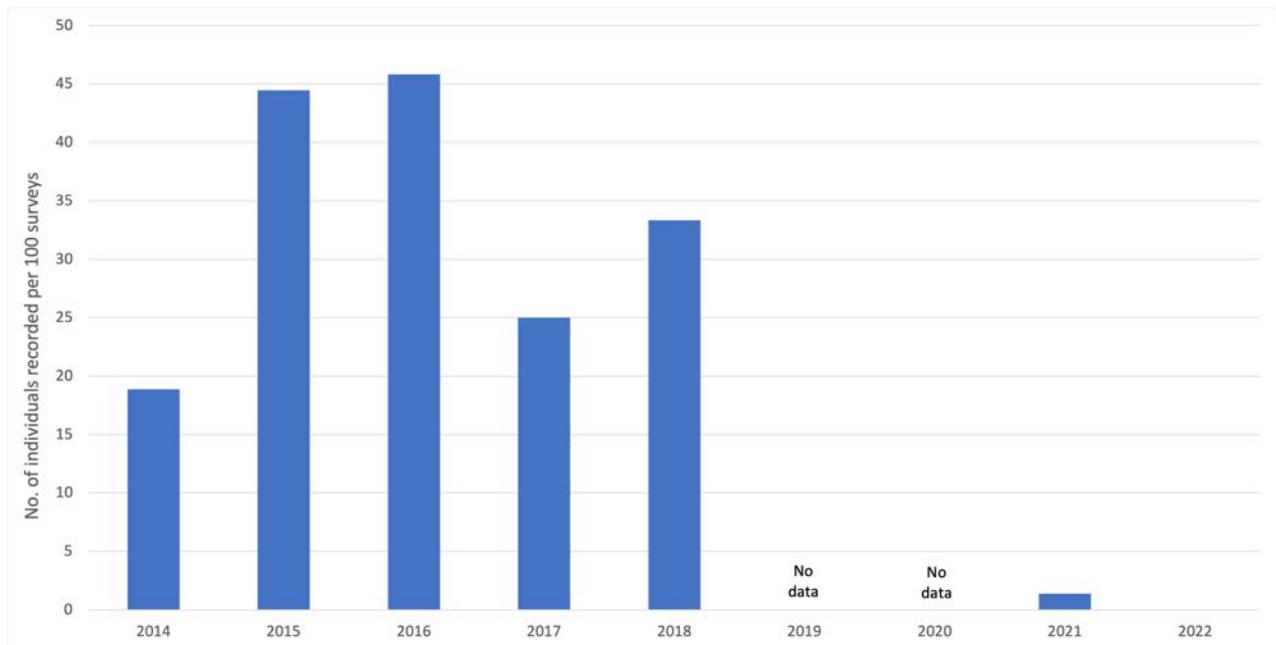


Figure 2.2: Individuals recorded during previous breeding season surveys, standardised for survey effort.

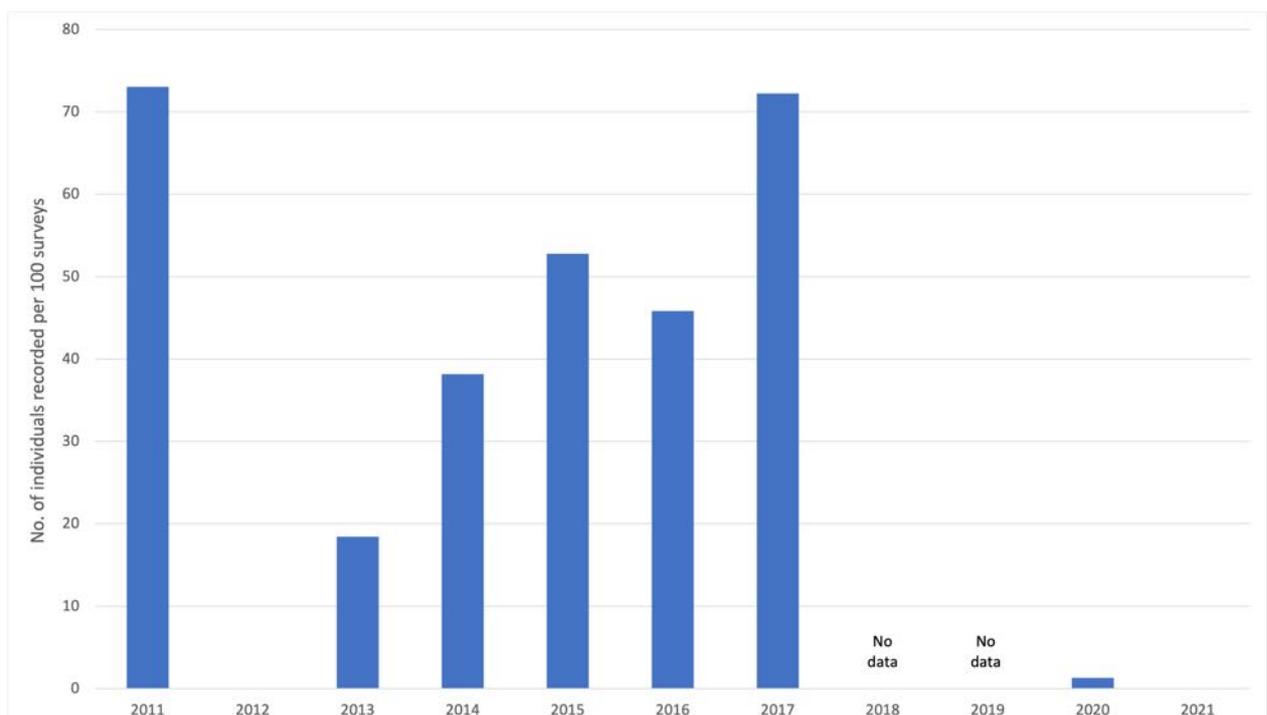


Figure 2.3: Individuals recorded during previous non-breeding season surveys, standardised for survey effort.

2.4.2 Breeding

Suitable breeding and non-breeding habitat for Gouldian Finches exists within the Goomig Project development area and buffer area (Figure 2.1). Suitable breeding habitat was identified in 2010, with 11 areas of suitable habitat identified (Pryke 2010). Gouldian Finches were recorded breeding in five of these areas during a detailed survey in 2011, with 43 active nests recorded that season in natural hollows (Save The Gouldian Fund 2011b). As clearing for the project commenced following the 2011 season, we have treated this as the baseline breeding activity level for the purpose of addressing the GFCP target for breeding activity in the buffer areas. The number of active nests recorded declined in subsequent years, to 29 in 2012 and 12 in 2013 (Save The Gouldian Fund 2012, 2013).

Following the 2013 breeding season, 120 artificial nest boxes were erected in the five known breeding areas to provide additional suitable nesting sites (Save The Gouldian Fund 2014). The

following breeding season (2014), nine active nests were recorded in the study area, all using the newly-installed artificial nest boxes (Save The Gouldian Fund 2014). The number of active nests recorded increased again in subsequent years, to 26 in 2015, 32 in 2016, and 43 in 2017, before declining again to 23 in 2018 (Save The Gouldian Fund 2015a, 2016a, 2017a, 2018a). All active nests recorded since the installation of artificial nesting boxes have been recorded from these nest boxes, with none recorded from natural hollows, despite searches of all previously identified potentially suitable natural hollows. No monitoring was undertaken during the 2019 and 2020 breeding seasons, and no active nests were located during the 2021 breeding season, albeit from only a single phase of survey undertaken in March (Jackett 2021a). The 2021 survey also identified that a large proportion (79%) of the artificial nest boxes were missing or damaged and recommended repairing or installing new nest boxes (Jackett 2021a). As a result, additional nest boxes were erected in the northern section of the buffer area in 2021. Surveys in the 2022 breeding season again recorded no active nests in the study area (Biota 2022b).

3.0 Methods

3.1 Survey Team and Timing

The wet season foraging activity and grass cover and phenology monitoring were undertaken in December 2022 and March 2023, with any additional opportunistic observations made during nest box monitoring trips in April and May 2023 also recorded.

Survey personnel and qualifications are outlined in Table 3.1, with timing and scope of surveys outlined in Table 3.2.

Table 3.1: Survey team and experience.

Personnel	Position	Qualifications	Years of Experience	Project Role
Garth Humphreys	Principal Ecologist/Director	BSc (Hons)	33	Project Director
John Graff	Senior Zoologist	BSc (Hons)	16	Project Manager, field survey, data analysis and reporting
Joshua Keen	Senior Zoologist	BSc (Hons)	8	Field survey
Hayley Winter	Graduate Zoologist	BSc (Hons)	1	Field survey, data analysis and reporting
Louis Masarei	Senior Zoologist (contractor)	BSc	7	Field survey

Table 3.2: Survey timing and personnel.

Survey Dates ¹	Team Members	Activities
9 th – 15 th December 2022	John Graff, Louis Masarei	Foraging activity surveys Grass phenology monitoring
10 th – 20 th March 2023	John Graff, Joshua Keen	Foraging activity surveys Grass phenology monitoring Nest box monitoring
14 th – 17 th April 2023	John Graff, Hayley Winter	Nest box monitoring
9 th – 11 th May 2023	John Graff, Hayley Winter	Nest box monitoring

¹ Excludes travel-only days.

3.2 Weather and Seasonal Conditions

Weather conditions during both survey phases were typical for the wet season in the region, with hot, relatively humid conditions and scattered thunderstorms, particularly in the afternoons. However, little rainfall fell during the surveys (Table 3.3).

Rainfall over the wet season leading into the surveys was above average overall (1046 mm against a long-term median of 769 mm), with extensive heavy rainfall recorded in November, December, and January (Figure 3.1). Mean maximum and minimum temperatures over the preceding year were also approximately equivalent to long term averages, but July 2022 and May 2023 averaged notably cooler (Figure 3.1).

Table 3.3: Weather conditions during surveys.

Temperature and rainfall data taken from DPIRD Kimberley Research Station weather station; wind data from Bureau of Meteorology Kununurra Aero weather station.

Survey	Date	Max Temp (°C)	Min Temp (°C)	Rainfall (mm)	Wind at 9am (km/h)	Wind at 3pm (km/h)
Phase 1 (Foraging surveys and grass transects)	9 th Dec 2022	43.3	24.1	0.0	6 WNW	7 N
	10 th Dec 2022	42.1	26.6	0.0	4 W	9 NNE
	11 th Dec 2022	40.9	23.2	1.8	7 NNW	7 SSE
	12 th Dec 2022	40.5	27.2	0.0	7 N	11 N
	13 th Dec 2022	38.4	24.5	0.0	6 S	13 WSW
	14 th Dec 2022	39.2	24.3	0.0	9 NE	15 E
	15 th Dec 2022	37.1	24.4	0.0	15 NE	26 SW
Phase 2 (Foraging surveys, grass transects, nest box monitoring)	10 th Mar 2023	38.0	23.4	0.0	9 S	9 ESE
	11 th Mar 2023	38.3	20.4	0.0	9 S	9 SSE
	12 th Mar 2023	39.1	18.0	0.0	13 WSW	13 E
	13 th Mar 2023	39.4	20.1	0.0	7 WSW	11 SSE
	14 th Mar 2023	38.3	21.2	0.0	15 ESE	22 ESE
	15 th Mar 2023	37.1	19.5	0.0	20 NE	15 NE
	16 th Mar 2023	38.1	24.0	0.2	9 N	13 NNE
	17 th Mar 2023	40.2	23.7	0.0	13 NW	11 SE
	18 th Mar 2023	39.5	22.9	0.0	4 E	6 SE
	19 th Mar 2023	38.1	23.2	0	7 NNW	26 NE
	20 th Mar 2023	37.2	23.1	8	9 NE	20 N

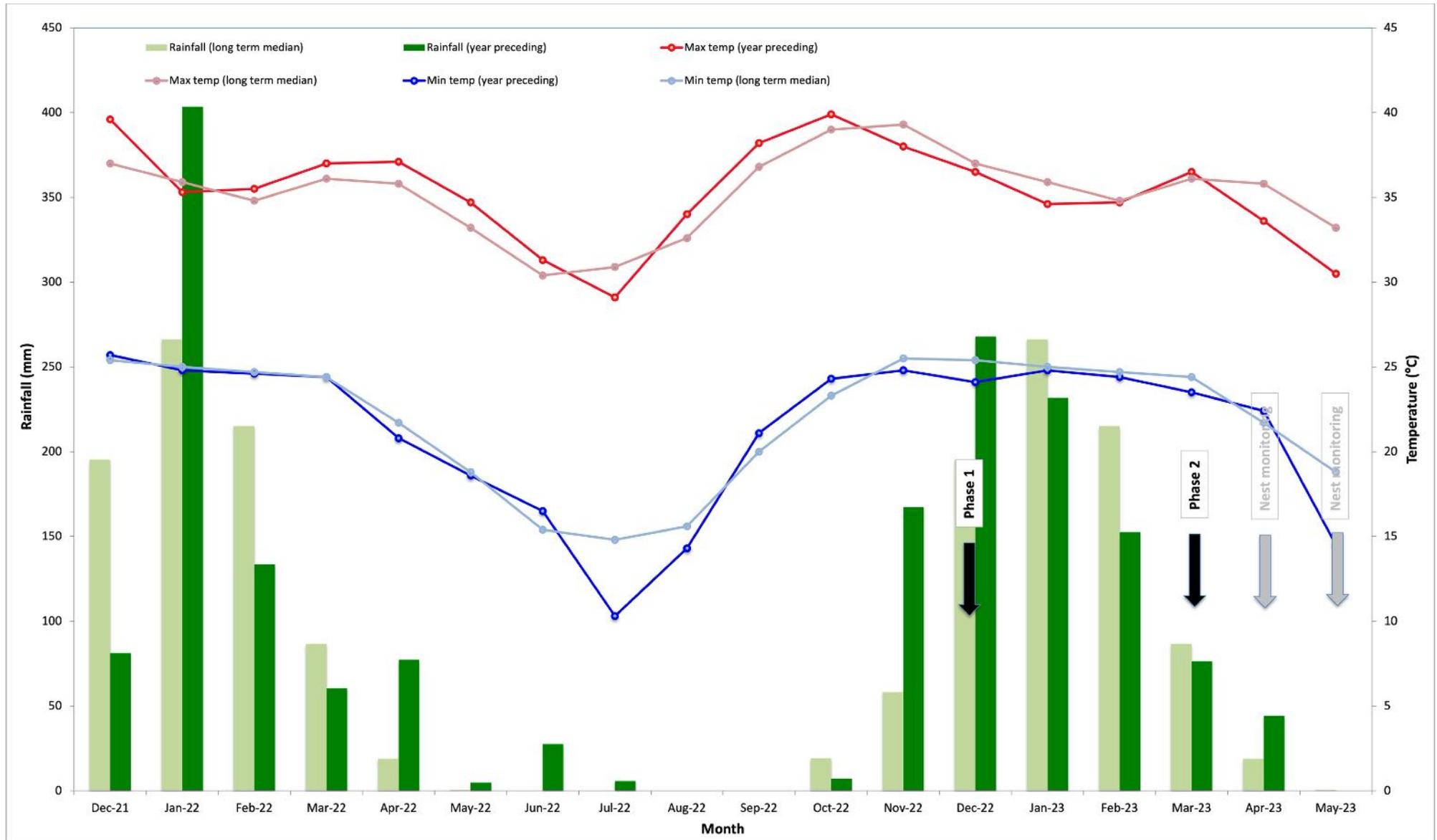


Figure 3.1: Rainfall and temperature data for the previous year compared to long-term averages.

Rainfall data taken from DPIRD Kimberley Research Station weather station; temperature data from Bureau of Meteorology Kununurra Aero weather station.

3.3 Gouldian Finch Foraging Surveys

Gouldian Finch foraging activity was monitored by undertaking 20 minute, two hectare plot surveys in breeding and non-breeding buffer areas. A total of 58 plots were surveyed during each monitoring phase, including 25 plots within mapped Gouldian Finch breeding areas and 33 plots in the surrounding buffer areas (Figure 3.2). This methodology was chosen to retain consistency with previous wet season monitoring, and the plots surveyed were the same as those surveyed during the 2021-22 monitoring, allowing comparable count data to be collected. Although count data is no longer specifically required by the GFCP, ongoing systematic count data is still useful for identifying presence and population trends in the study area. The Long-tailed Finch (*Poephila acuticauda*) and Masked Finch (*P. personata*) are the two finch species that most regularly co-occur with Gouldian Finches. Systematic count data for these species is also presented following recommendations from the 2020-21 monitoring, as these data may provide context for observed changes in Gouldian Finch numbers (Jackett 2021a, 2021b).

Surveys were undertaken within the first four hours after sunrise, when bird activity was expected to be highest. Each survey plot was surveyed by a single observer moving systematically through the plot for 20 minutes, recording all bird species observed within the plot area, along with a total count for each species. Birds located outside of the plot boundary were not recorded as part of the systematic survey. For observations of finch species made during the systematic surveys, the species, number of individuals, and a GPS location for the observation were recorded. Where Gouldian Finches were observed, the following additional information was also recorded where possible:

- Age class and sex;
- Activity (e.g. foraging, flyover, drinking, sitting in tree, carrying nesting material); and
- If foraging, the species of grass they were feeding on (recorded to at least genus-level wherever possible).

Incidental observations of finch species from the study area made outside of the systematic surveys were also recorded, along with the same information outlined above.

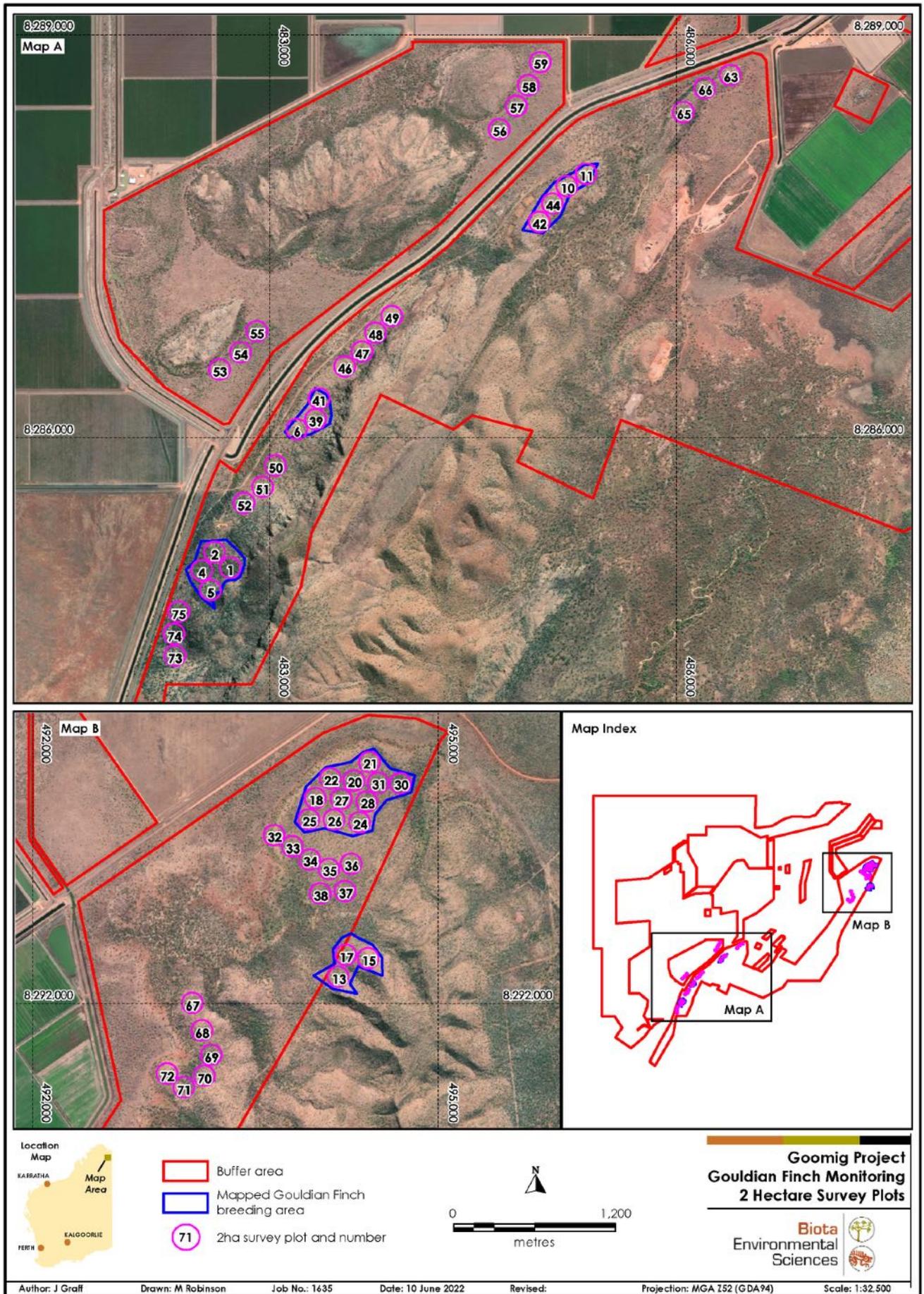


Figure 3.2: Location of the two hectare foraging survey plots.

3.4 Grass Monitoring

Grass monitoring was undertaken by re-surveying 41 previously established monitoring sites, each including a 50 m transect extending diagonally into a broader 50 m x 50 m quadrat (Figure 3.3), marked by aluminium pickets at each end. Twenty-one of these monitoring sites were located within the previously identified Gouldian Finch breeding areas, and the remaining 20 within the surrounding buffer areas (Figure 3.4; Appendix 3).

Grass monitoring focussed on those grass species identified as key food sources for Gouldian Finch by Dostine et al. (2001). Specifically, this includes the following species:

- Sorghum (*Sarga/Sorghum* spp.);
- Spinifex (*Triodia* spp.);
- Cockatoo Grass (*Alloteropsis semialata*);
- Golden Beard Grass (*Chrysopogon fallax*);
- Spear Grass (*Heteropogon* spp.);
- Native Millet (*Panicum decompositum*);
- White Grass (*Sehima nervosum*);
- Kangaroo Grass (*Themeda triandra*); and
- Rice Grass (*Xerochloa laniflora*).

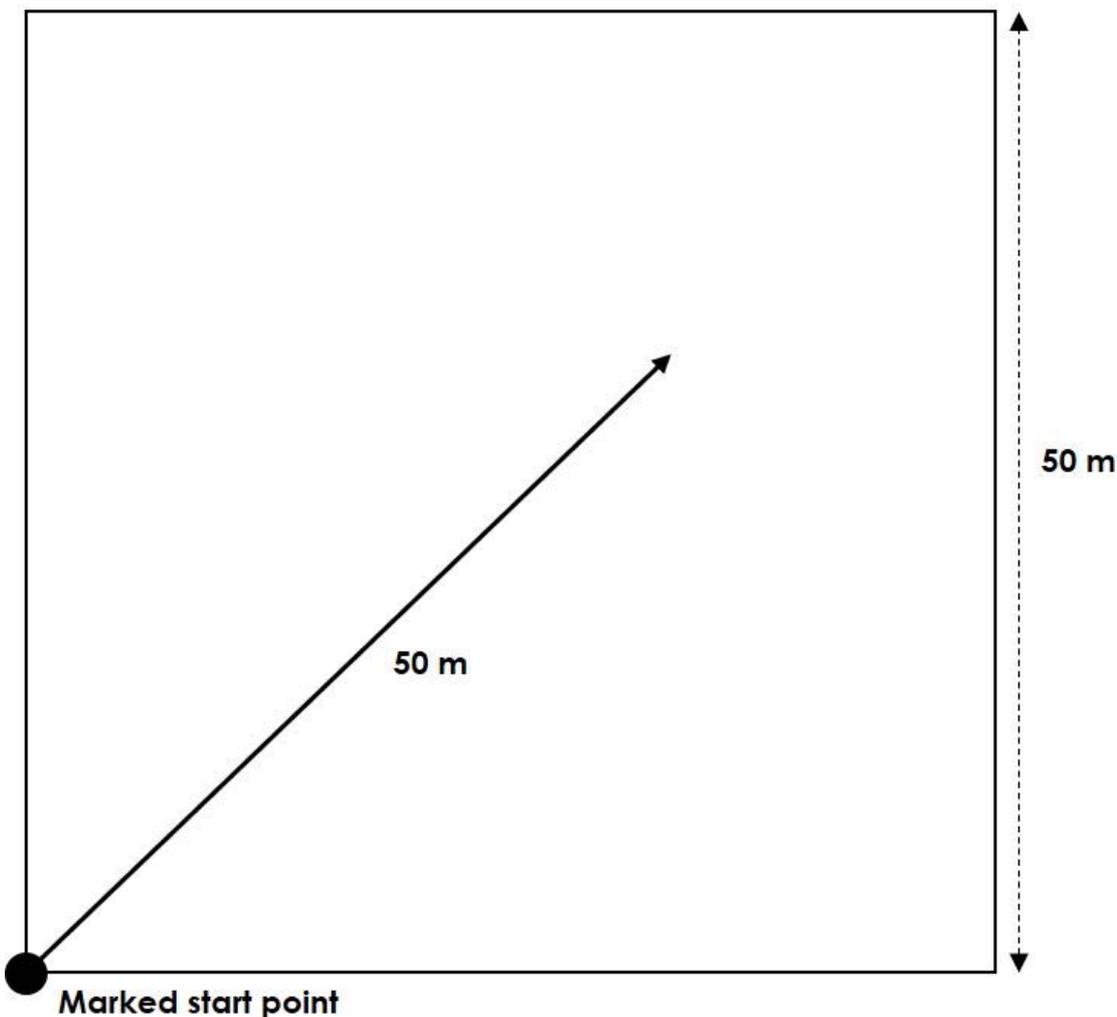


Figure 3.3: Schematic representation of grass monitoring site.

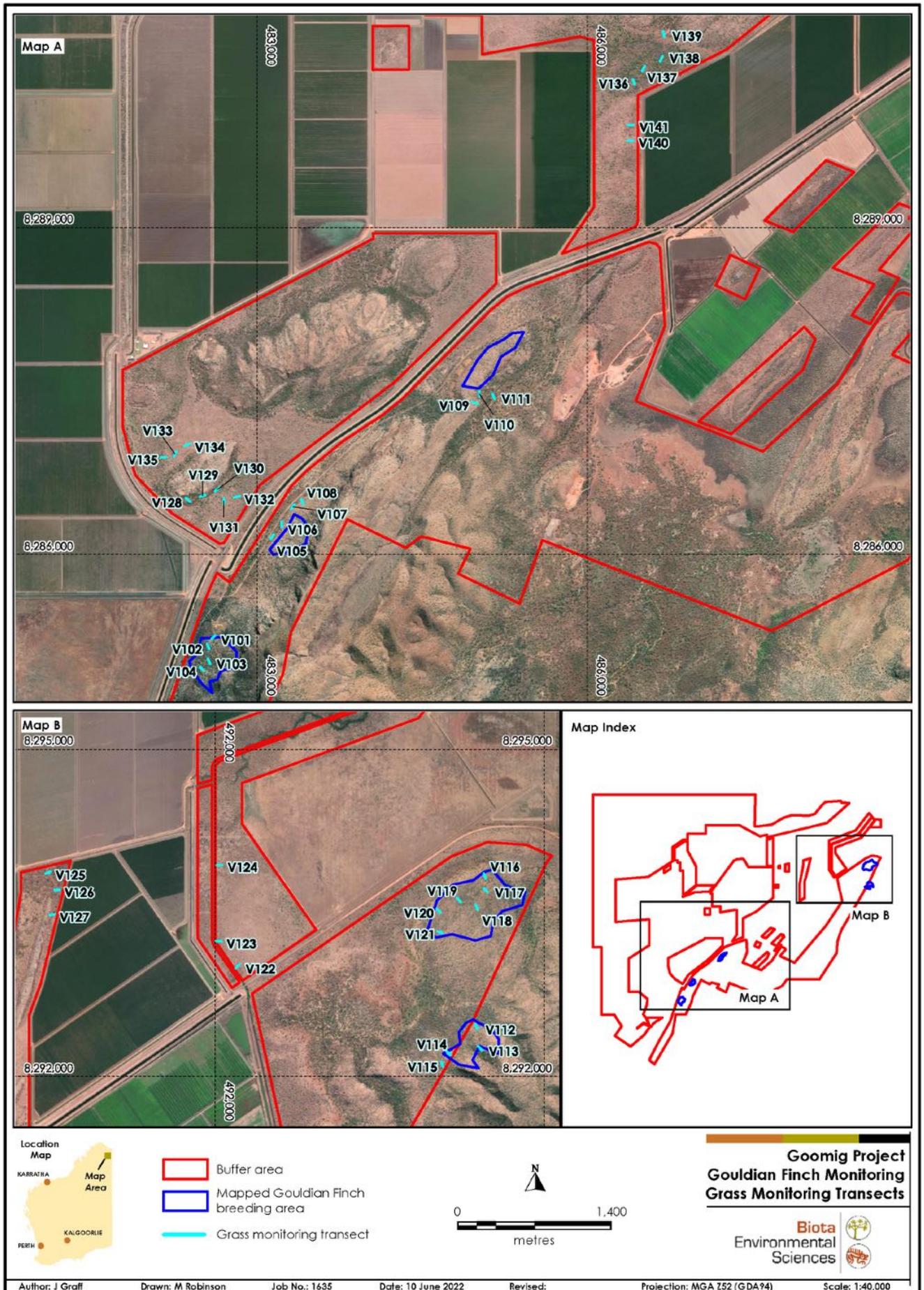


Figure 3.4: Location of grass monitoring sites.

3.4.1 Grass Coverage

A 50 m transect was marked between the established monitoring pickets, where these could be located; or using the provided GPS location and bearing if the pickets could not be located. The original location of one monitoring site (V127) was in an area that has since been cleared based on the provided GPS location; this site was re-established in remaining bushland immediately adjacent to the original location. Where pickets were found in a different location to the provided GPS point, a new GPS location was recorded using a high-accuracy GPS tablet. The full updated list of transect locations is provided in Appendix 3.

Along each 50 m transect, the coverage of important foraging grass species was recorded by measuring (in centimetres) the extent of grass intersecting the line of the tape, either above or below the tape. Measurements were taken for the first metre in every five metres, giving a total of 10 sections of measurements per transect, each of one metre in length (Figure 3.5). This approach followed that used during the previous monitoring season (Jackett 2021c). Earlier reports do not indicate that this approach was used in previous monitoring seasons, however the methodology provided with the raw data from these monitoring phases states “10 measurements are recorded at 5 m intervals along the tape”.

The total coverage of foraging grasses was then calculated by totalling the measurements for each species along the tape. The percentage cover for each species was also calculated. In addition, the proportion of the total extent of suitable foraging grasses was calculated, following the approach used to present results of previous monitoring (e.g. Save The Gouldian Fund 2018b).

3.4.2 Grass Phenology

To assess phenology, three 1 x 1 m quadrats were examined, at the 0 – 1 m, 25 – 26 m, and 49 – 50 m marks of the 50 m transect (see Figure 3.5). All quadrats were placed on the right side of the transect, looking down the transect from the starting point. Within each quadrat, the total number of individuals of each foraging grass species was recorded, along with the number of individuals flowering and the number of individuals seeding.

3.4.3 Additional Environmental Factors

Additional factors affecting the availability of important foraging grasses were also assessed within the broader 50 m x 50 m quadrat at each monitoring site; specifically, evidence of fire and cattle activity. Evidence of each of these disturbance sources was scored categorically as either:

- None;
- Low;
- Medium;
- High; or
- Extreme.

Monitoring prior to the 2021-22 season also included a “Patchy” category; we have not included this in the past two seasons of monitoring as we consider it inconsistent with the approach of the other categories, which indicate a level of impact rather than a spatial extent of impact.

Scoring was based on the visible evidence of fire (e.g. burn scarring on trees, burnt vegetation etc.) or cattle activity (e.g. tracks, dung, evidence of grazing/trampling of vegetation, sightings of animals). Monitoring from the 2018 season and before based scores on “direct effect on the availability and distribution of critical feeding grasses” (e.g. Save The Gouldian Fund 2018b). We have taken any observed direct effects into account, but have considered all visible evidence of fire and cattle activity when determining the score. This allows the scoring data to be used to investigate indirect effects such as changes in species composition, which may be compromised if only visible effects on foraging grasses are considered.

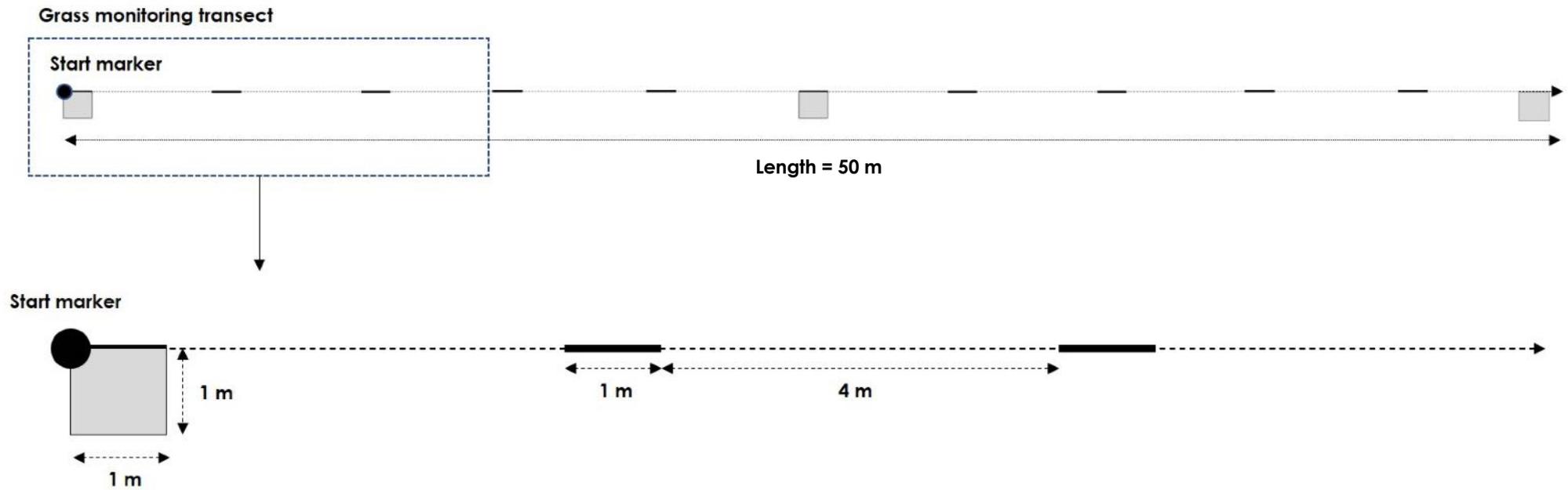


Figure 3.5: Schematic representation of 50 m grass monitoring transect and 1 m x 1 m phenology quadrats (adapted from Jackett 2021a).

3.5 Limitations

The results of the 2022-23 foraging activity and grass monitoring should be assessed giving consideration to the following potential limitations;

- Identification of grasses in the field when not seeding or flowering can be challenging, particularly during December when much of the grass is senescent, so it is possible that some of the grasses were not identified correctly, particularly during the December survey.
- Past reports (2014-2018) have not included grass measurements/cover from surveys later in the season (i.e. January to April), meaning that comparisons regarding grass cover could only be made using data from the December surveys. Additionally, grass cover data presented in these reports often appeared to be inconsistent, particularly with regard to the cover measures compared to the percentages of critical feeding grasses available (e.g. Table 4, Save The Gouldian Fund 2016c, Table 3, 2017c). We have taken the cover measures to be accurate for the purposes of comparisons in this report.

4.0 Results

4.1 Gouldian Finch Foraging Surveys

No Gouldian Finches were recorded from the study area during the systematic foraging surveys, which were undertaken in December 2022 and March 2023. In addition, no individuals were observed opportunistically on these trips. This follows on from similar observations in the previous two seasons of monitoring (Figure 4.1). No Gouldian Finches were observed opportunistically within the study area during the nest monitoring survey phases in April or May.

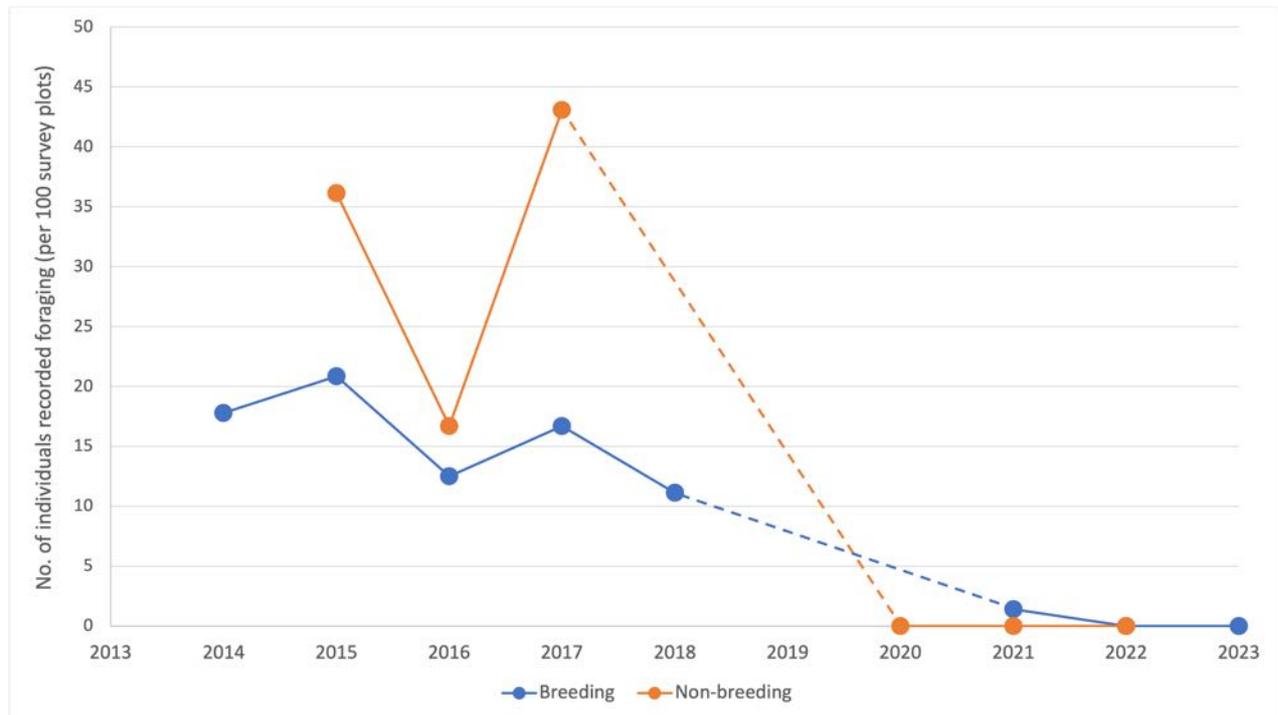


Figure 4.1: Number of Gouldian Finch recorded foraging in the study area during systematic surveys (standardised for survey effort).

In total, eight other finch species were recorded from the study area from systematic and/or opportunistic observations during the current surveys:

- Crimson Finch (*Neochmia phaeton*);
- Star Finch (*Bathilda ruficauda*);
- Double-barred Finch (*Stizoptera bichenovii*);
- Australian Zebra Finch (*Taeniopygia castanotis*);
- Masked Finch (*Poephila personata*);
- Long-tailed Finch (*Poephila acuticauda*);
- Yellow-rumped Mannikin (*Lonchura flaviprymna*); and
- Chestnut-breasted Mannikin (*Lonchura castaneothorax*).

Records of other finch species from the study area are shown in Figure 4.2 (December 2021 survey records) and Figure 4.3 (March 2022 survey records). Opportunistic observations of other finch species from the April and May nesting surveys were not comprehensive so have not been mapped.

The Long-tailed Finch (*Poephila acuticauda*) and Masked Finch (*P. personata*) are the two species that most regularly co-occur with Gouldian Finches. Both species were observed in the

study area this season during both the December 2022 and March 2023 surveys (Table 4.1). However, the total numbers observed were considerably lower in both months than during the corresponding surveys in the 2021-22 season (Table 4.1).

Table 4.1: Masked and Long-tailed Finch records from the study area for the 2022-23 season.

Survey	Masked Finch		Long-tailed Finch	
	No. Survey Plots	Total Count	No. Survey Plots	Total Count
October 2020 ¹	8 (n=76)	49	12	114
March 2021	7 (n=72)	24	15	87
December 2021	8 (n=58)	103	10	414
March 2022	4 (n=58)	17	7	65
December 2022	5 (n=58)	22	6	33
March 2023	5 (n=58)	10	9	34

¹ Survey plots cover different areas to those used in 2021-23 surveys.

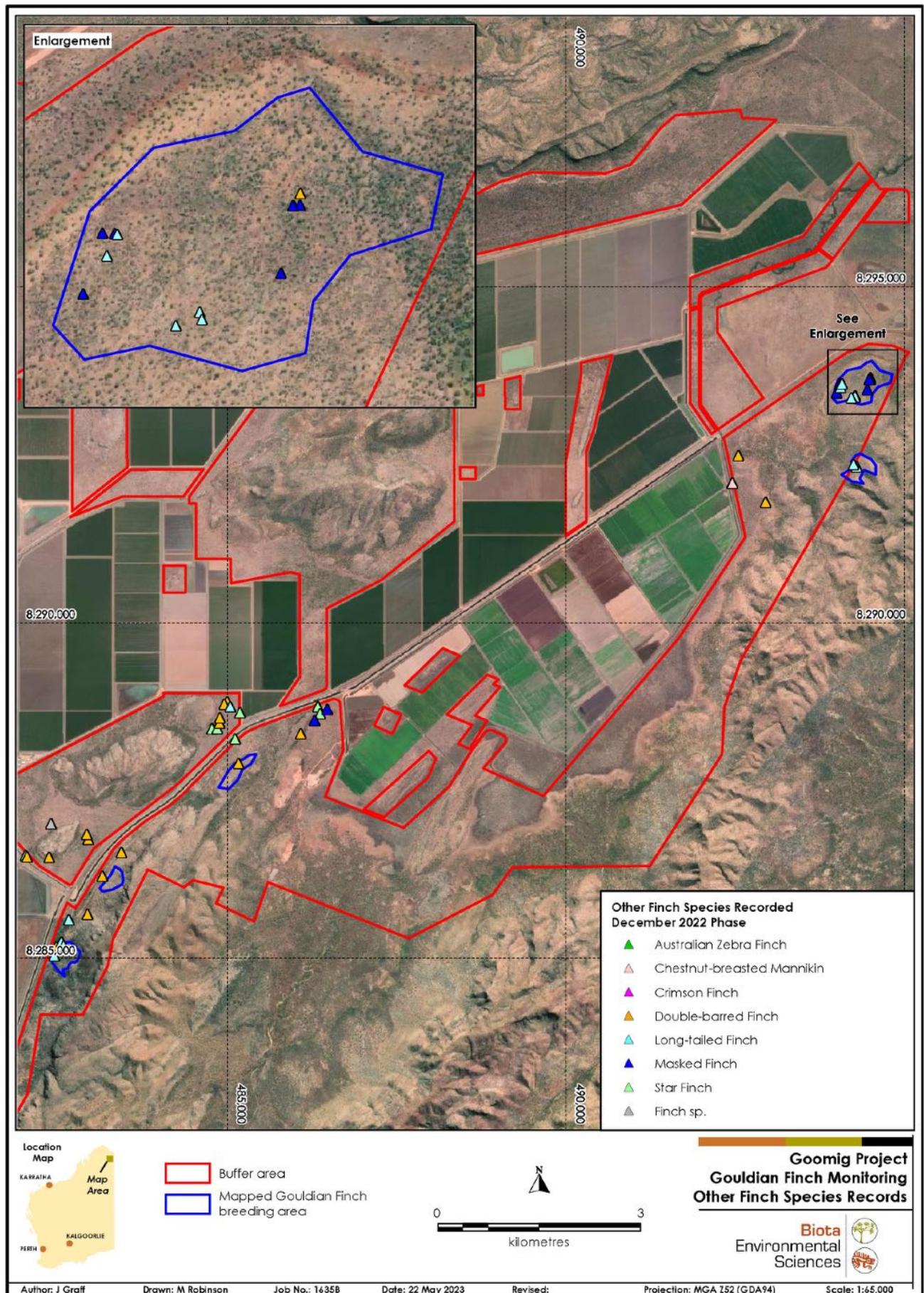


Figure 4.2: Location of other finch species records from study area in December 2022.

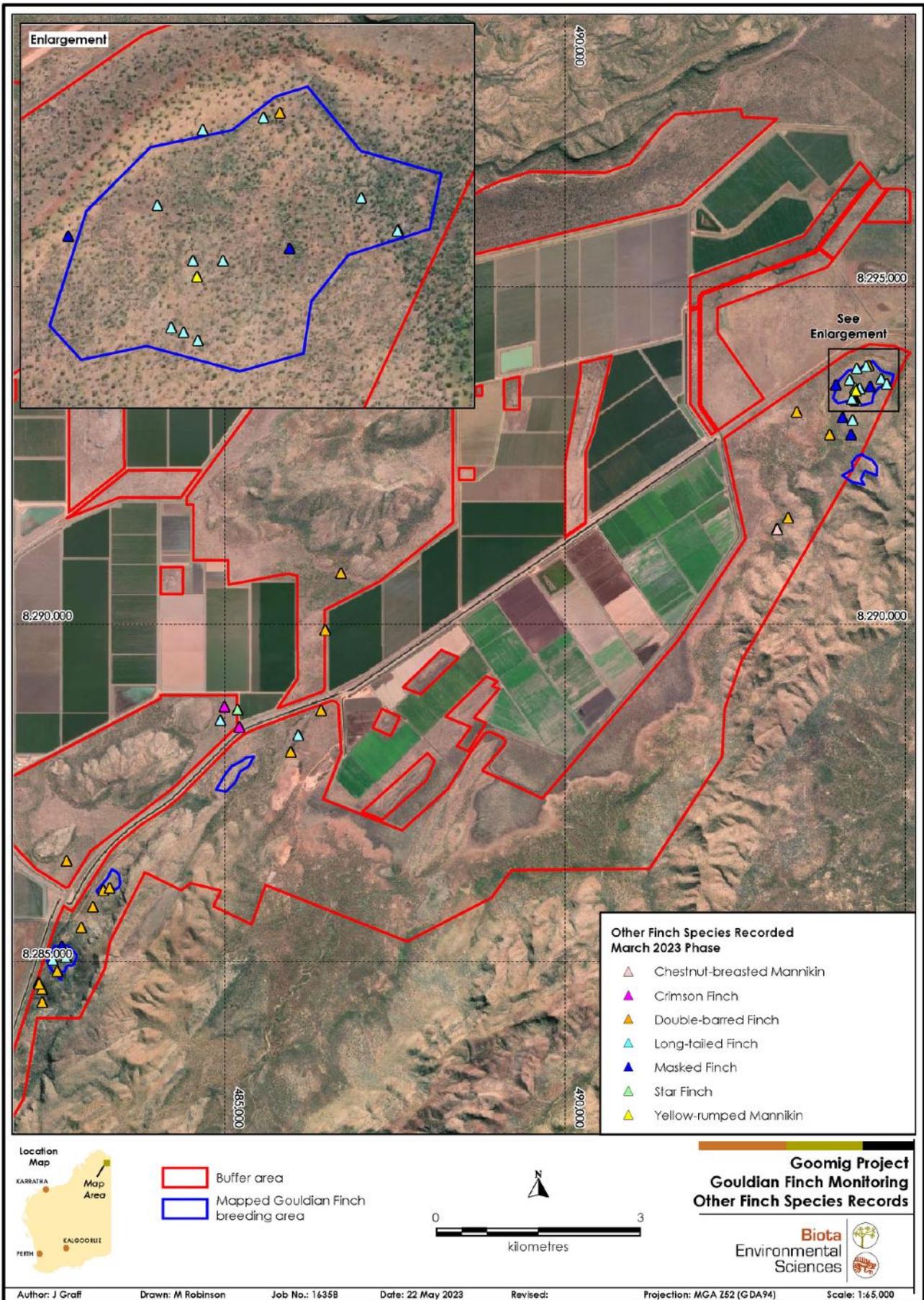


Figure 4.3: Location of other finch species records from study area in March 2023.

4.2 Grass Cover and Phenology

4.2.1 Grass Coverage

The dominant foraging grasses recorded within the study area were sorghum (*Sarga/Sorghum* spp.) and spinifex (*Triodia* spp.), followed by *Themeda triandra* (Table 4.2), consistent with results from the December surveys in previous seasons, where sorghum and spinifex have been the dominant species (Table 4.3). The total percentage coverage of sorghum was similar to the previous December survey in 2021, but significantly lower than the percentage cover in earlier December surveys (Table 4.3). The total percentage cover of spinifex had increased compared the December 2021 survey, to a level more consistent with the percentage cover in earlier December surveys (Table 4.3).

Spinifex (*Triodia* spp.) and *Heteropogon* sp. were recorded only on transects within Gouldian Finch breeding habitat, while the remaining foraging grasses were recorded almost exclusively on transects within Gouldian Finch non-breeding habitat, with the exception of sorghum (*Sarga/Sorghum* spp.), which occurred extensively in both breeding and non-breeding areas (Table 4.4).

Table 4.2: Grass cover in the study area in 2022-23.

Grass	December 2022			March 2023		
	Length ¹ (cm)	Proportion		Length ¹ (cm)	Proportion	
		Foraging Grasses ²	Total Cover ³		Foraging Grasses ²	Total Cover ³
<i>Sarga/Sorghum</i> spp.	3,859	39.8	9.4	7,010	54.7	17.1
<i>Triodia</i> spp.	3,039	31.3	7.4	3,125	24.4	7.6
<i>Themeda triandra</i>	1,190	12.3	2.9	1,005	7.8	2.5
<i>Heteropogon</i> sp.	770	7.9	1.9	900	7.0	2.2
<i>Panicum decompositum</i>	450	4.6	1.1	660	5.2	1.6
<i>Chrysopogon fallax</i>	390	4.0	1.0	20	0.2	<0.1
<i>Alloteropsis semialata</i>	0	0.0	0.0	90	0.7	0.2

¹ Length measured intersecting the tape.

² The proportion of the total extent of target foraging grasses.

³ The proportion of the total extent of ground measured (i.e. percentage cover).

Table 4.3: Comparison of December¹ grass coverage (percentage total cover) between years.

Grass	Dec 2014	Dec 2015	Dec 2016	Dec 2017	2018-20 ²	Dec 2021	Dec 2022
<i>Sarga/Sorghum</i> spp.	14.9	18.5	22.4	25.0	No data	9.8	9.4
<i>Triodia</i> spp.	7.6	6.0	9.7	6.2	No data	4.7	7.4
<i>Themeda triandra</i>	0.1	0.1	0.2	0.5	No data	3.9	2.9
<i>Chrysopogon fallax</i>	1.1	1.1	1.5	1.6	No data	0.9	1.9
<i>Heteropogon</i> sp.	2.0	1.4	2.9	4.1	No data	1.5	1.1
<i>Panicum decompositum</i>	0.2	0.1	0.3	0.6	No data	0.8	1.0
<i>Alloteropsis semialata</i>	0.5	0.4	0.5	0.1	No data	0.0	0.0
Total	26.4	27.6	37.5	38.1	-	21.6	23.7

Note: Number of transects is 34 in 2014 and 2015, 38 in 2016, then 41 in 2017 and 2021.

¹ Data from later season surveys comparable to the March data are not presented in previous reports.

² Data from late 2021 available only from October, so has not been included here.

Table 4.4: Comparison of grass coverage (percentage total cover) between Gouldian Finch breeding areas and non-breeding habitat.

Grass	December 2022		March 2023	
	Breeding	Non-breeding	Breeding	Non-breeding
<i>Sarga/Sorghum</i> spp.	9.8	9.0	20.5	13.6
<i>Triodia</i> spp.	14.5	0.0	14.9	0.0
<i>Themeda triandra</i>	0.0	6.0	0.0	5.0
<i>Heteropogon</i> sp.	3.7	0.0	4.3	0.0
<i>Panicum decompositum</i>	0.0	2.3	0.0	3.3
<i>Chrysopogon fallax</i>	0.1	1.8	0.0	0.1
<i>Alloteropsis semialata</i>	0.0	0.0	0.4	0.0

4.2.2 Grass Phenology

Very few grasses were recorded flowering or seeding during the December 2022 surveys, as expected at the end of the dry season (Table 4.5). During the March 2022 surveys, most sorghum (*Sarga/Sorghum* spp.) plants were flowering or seeding (77% flowering or seeding), while almost half of the spinifex (*Triodia* spp.) plants were flowering (Table 4.5).

Sorghum (*Sarga/Sorghum* spp.) was the only grass recorded in significant numbers in both breeding and non-breeding areas (Table 4.6). Most sorghum growing in Gouldian Finch breeding habitat was flowering or seeding in March 2022 (89.8% flowering or seeding), while most of the sorghum growing in the non-breeding areas was not seeding (19.8% flowering, none seeding; Table 4.6).

Table 4.5: Grass phenology in the study area 2022-23.

Grass	December 2022			March 2023		
	Total	Flowering	Seeding	Total	Flowering	Seeding
<i>Sarga/Sorghum</i> spp.	413	0 0.0%	0 0.0%	1,138	427 37.5%	450 39.5%
<i>Triodia</i> spp.	243	0 0.0%	10 4.1%	137	1 0.7%	57 41.6%
<i>Themeda triandra</i>	25	0 0.0%	0 0.0%	12	0 0.0%	0 0.0%
<i>Heteropogon</i> sp.	33	0 0.0%	1 3.0%	42	0 0.0%	0 0.0%
<i>Panicum decompositum</i>	3	0 0.0%	1 33.3%	5	0 0.0%	4 80.0%
<i>Chrysopogon fallax</i>	5	0 0.0%	0 0.0%	3	0 0.0%	0 0.0%
<i>Alloteropsis semialata</i>	0	-	-	1	0 0.0%	1 100%

Table 4.6: Comparison of grass phenology in March 2022 between Gouldian Finch breeding and non-breeding areas.

Grass	Breeding			Non-breeding		
	Total	Flowering	Seeding	Total	Flowering	Seeding
<i>Sarga/Sorghum</i> spp.	931	386 41.5%	450 48.3%	207	41 19.8%	0 0.0%
<i>Triodia</i> spp.	137	1 0.7%	57 41.6%	0	-	-
<i>Themeda triandra</i>	0	-	-	12	0 0.0%	0 0.0%
<i>Heteropogon</i> sp.	41	0 0.0%	0 0.0%	1	-	-
<i>Panicum decompositum</i>	0	-	-	5	0 0.0%	4 80.0%
<i>Chrysopogon fallax</i>	0	-	-	3	0 0.0%	0 0.0%
<i>Alloteropsis semialata</i>	1	0 0.0%	1 100%	0	-	-

In comparison to previous years, the seeding rates of the grasses later in the season were broadly similar to previous seasons (Table 4.7). The proportion of sorghum plants seeding was lower than in previous seasons, but the proportion flowering was significantly higher than in most previous seasons (Table 4.8). Conversely, the proportion of spinifex plants in flower was considerably lower than previous seasons, including 2022 (Table 4.8).

Table 4.7: Comparison of percentage of grasses seeding in March (Feb-April¹) between years.

Grass	Mar 2015	Mar 2016	Feb 2017	Apr 2017	Mar 2018	2019-21	Mar 2022	Mar 2023
<i>Sarga/Sorghum</i> spp.	89.3	67.5	89.4	78.5	54.6	No data	53.2	39.5
<i>Triodia</i> spp.	58.7	43.2	24.5	64.5	45.6		0.8	41.6
<i>Themeda triandra</i>	0.0	0.0	0.0	6.7	1.2		0.0	0.0
<i>Heteropogon</i> sp.	9.3	0.0	0.0	0.0	0.0		-	0.0
<i>Panicum decompositum</i>	0.0	0.0	0.0	0.0	0.0		-	80.0
<i>Chrysopogon fallax</i>	14.3	3.2	0.5	1.2	1.2		0.0	0.0
<i>Alloteropsis semialata</i>	15.4	2.3	7.6	3.6	2.8		0.0	100

¹ March results used for comparability except for 2017, when surveys were undertaken in February and April – both included.

Table 4.8: Comparison of percentage of grasses flowering in March (Feb-April¹) between years.

Grass	Mar 2015	Mar 2016	Feb 2017	Apr 2017	Mar 2018	2019-21	Mar 2022	Mar 2023
<i>Sarga/Sorghum</i> spp.	13.2	3.4	63.2	8.7	5.7	No data	0.3	37.5
<i>Triodia</i> spp.	24.3	21.3	34.5	18.5	11.6		3.1	0.7
<i>Themeda triandra</i>	4.6	1.2	4.5	2.6	2.1		49.3	0.0
<i>Heteropogon</i> sp.	11.2	7.3	9.4	7.3	2.3		-	0.0
<i>Panicum decompositum</i>	0.0	0.0	6.7	0.0	0.0		-	0.0
<i>Chrysopogon fallax</i>	1.3	0.0	3.6	0.0	0.0		0.0	0.0
<i>Alloteropsis semialata</i>	19.5	11.3	18.4	9.6	3.4		0.0	0.0

¹ March results used for comparability except for 2017, when surveys were undertaken in February and April – both included.

4.2.3 Fire

No fires affected the study area this season, resulting in noticeably less evidence of fire in the study plots compared to the 2021-22 monitoring season where two fires occurred in the southern and northern parts of the study area.

Table 4.9: Evidence of fire at the 41 grass study plots for the 2022-23 season.

Fire Evidence	December 2022		March 2023	
	No. of Plots	%	No. of Plots	%
None	15	36.6	25	61.0
Low	20	48.8	11	26.8
Medium	6	14.6	5	12.2
High	0	0.0	0	0.0
Extreme	0	0.0	0	0.0

4.2.4 Cattle Grazing

Some evidence of cattle activity and damage was observed within the study plots during the current study during both survey phases, with activity observed on more plots during the March survey than the December survey (Table 4.10). This contrasted with the 2021-22 survey when activity was detected in more plots in December, and no activity was noted in plots in March. Evidence of cattle within study plots this monitoring season comprised tracks/pads and dung.

The number of plots where cattle activity was detected increased compared to the previous year overall, but remains significantly lower than activity levels when monitoring commenced (Table 4.11). However, qualitatively, cattle activity appeared lower this season than during the 2021-22 monitoring, and no cattle were directly observed in the study area this season.

Table 4.10: Evidence of cattle at the 41 grass study plots for the 2022-23 season.

Fire Evidence	December 2022		March 2023	
	No. of Plots	%	No. of Plots	%
None	37	90.2	31	75.6
Low	3	7.3	10	24.4
Medium	1	2.4	0	0.0
High	0	0.0	0	0.0
Extreme	0	0.0	0	0.0

Table 4.11: Comparison of percentage cattle evidence from 2022-23 with previous seasons.

Cattle Evidence	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2020-21	2021-22	2022-23
None	4.9	56.2	83.5	84.7	100.0	100.0	100.0	87.8	82.9
Low	18.3	5.4	3.4	3.2	0.0	0.0	0.0	9.8	31.7
Medium	12.2	36.9	13.1	12.1	0.0	0.0	0.0	2.4	2.4
High	18.3	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Extreme	46.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

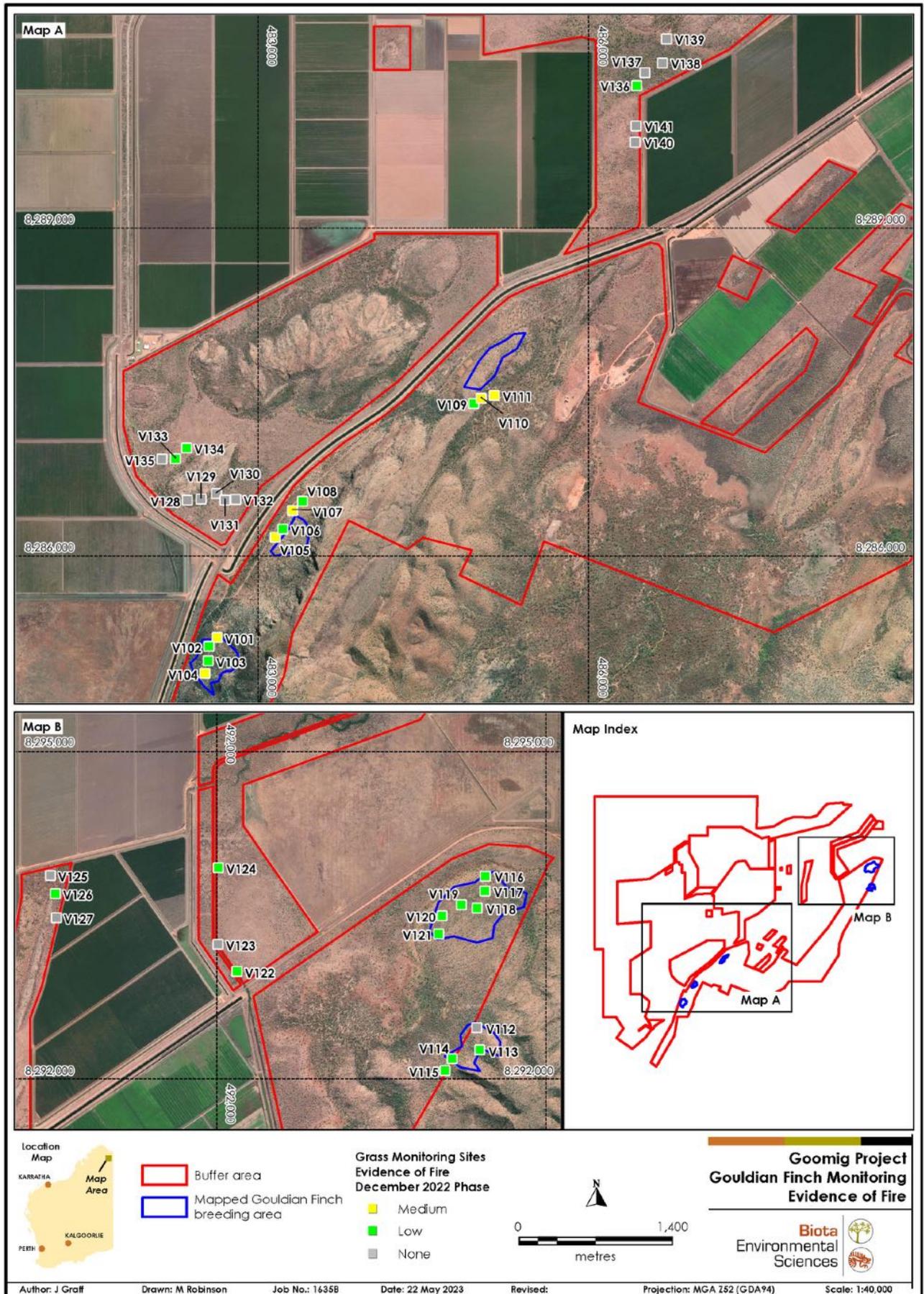


Figure 4.4: Evidence of fire at vegetation plots – December 2022.

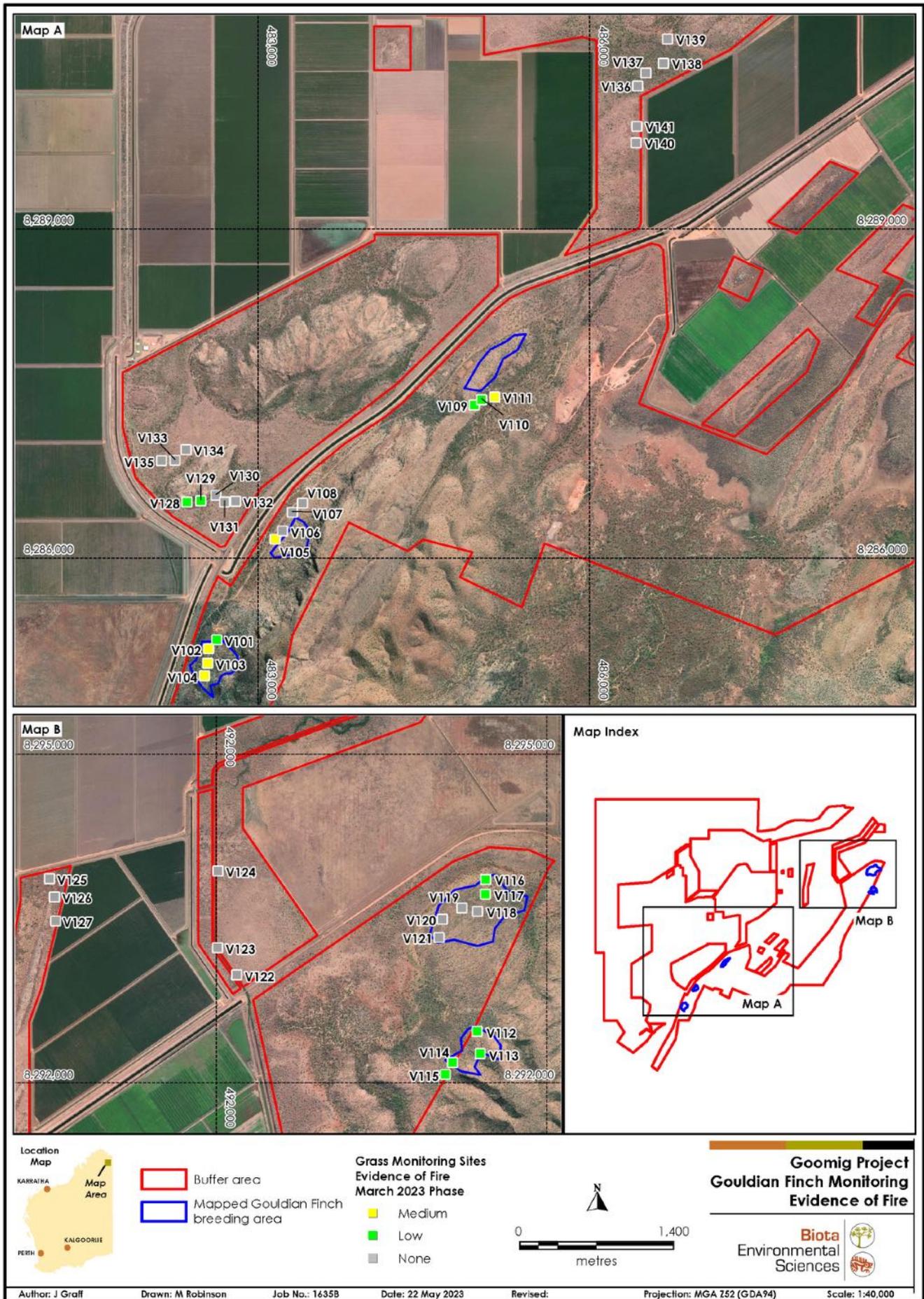


Figure 4.5: Evidence of fire at vegetation plots – March 2023.

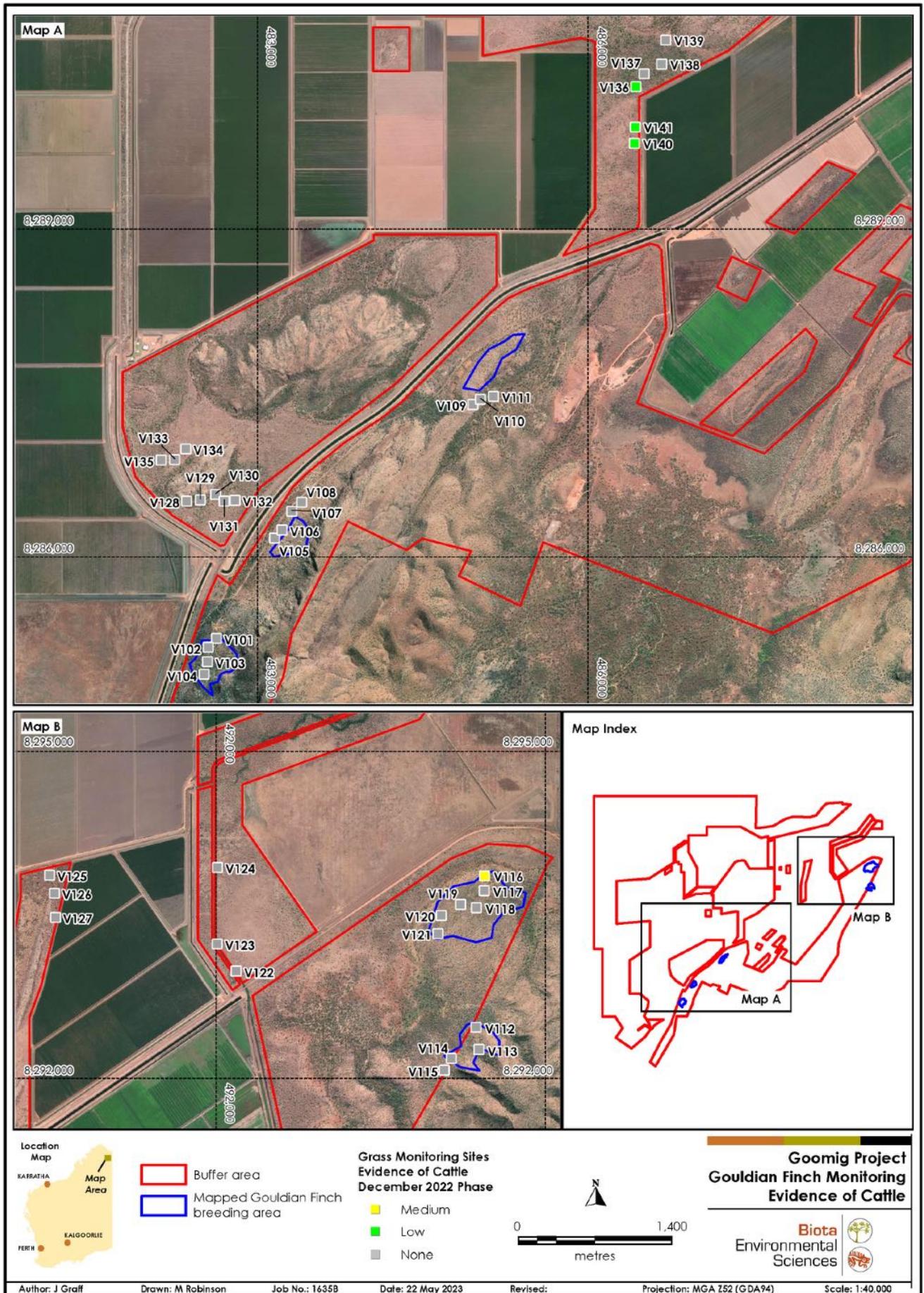


Figure 4.6: Evidence of cattle activity at vegetation plots – December 2022.

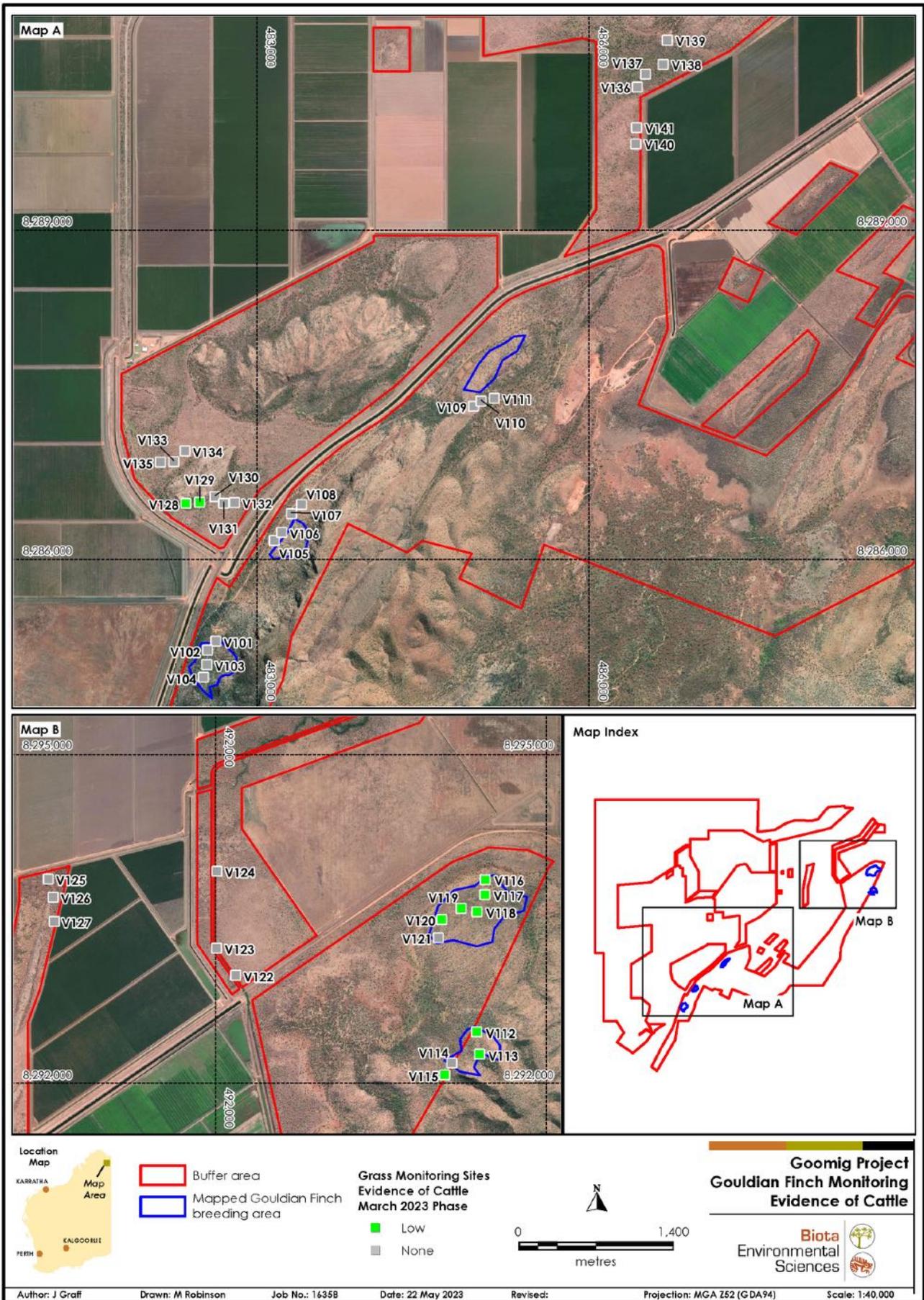


Figure 4.7: Evidence of cattle activity at vegetation plots – March 2023.

5.0 Discussion

No Gouldian Finches were observed during the 2022-23 monitoring season, a decrease from the 2021-22 surveys. No Gouldian Finches were recorded during the systematic surveys in December 2021 or March 2022, but opportunistic observations were made in April and May 2022 (Biota 2022a). The timing of the observations, and presence of juveniles in the flocks in May, indicated that these birds likely moved into the study area after breeding elsewhere.

It is likely that the lack of foraging activity in the buffer area during the breeding season is related to the decline in breeding activity (and by implication, decline in breeding habitat quality) in the study area (Biota 2022b, 2023). During breeding season, Gouldian Finches typically rely on foraging habitat in the immediate vicinity of their nesting sites (Brazill-Boast et al. 2011), and previous foraging records in the breeding season from the study area have come almost exclusively from breeding areas. However, the decline in condition of the artificial nest boxes was rectified during the 2022 dry season and no nesting was recorded during the 2023 breeding season. It is possible that there is a lag in uptake of nest boxes is due to the absence of breeding in the study area in recent seasons.

The reasons for their absence earlier in the wet season prior to breeding are also less apparent, though it is possible that birds have already moved to areas in proximity to their breeding habitat by this time. We hypothesised that the late season fire in November-December 2021 may have reduced the availability of seed in these areas, and hence their suitability for Gouldian Finch foraging (Biota 2022a). However, the lack of records again in 2022-23 suggest that this was not a key factor in their absence; indeed, observations from the Northern Territory suggest that Gouldian Finches favour recently burnt areas for foraging at times (Dostine et al. 2001).

The absence of Gouldian Finches from the study area in April and May, in contrast to the previous year, appears likely to be related to a change in the availability of seed resources, as other nomadic seed-eating bird species such as Pictorella Mannikins and Diamond Doves were also absent or present in significantly lower numbers. The reasons for this variation in food availability aren't clear, as seeding rates in these areas were similar to those recorded the previous year. However, seasonal conditions appeared to be delayed compared to last year, with flowering and seeding taking place later (see below) and significant areas of inundation still present in lower-lying areas in May (these largely dry by April in 2022). Hence, it is possible that these species may move into these areas later in the year as conditions become suitable. There is also evidence that Gouldian Finches prefer areas burnt during the previous dry season for breeding, due to increased availability and nutritional quality of sorghum seed post-fire (Weier et al. 2016), so it is possible that Gouldian Finches and other seed eating birds preferentially foraged in these areas in 2022 following dry season fires in 2021 for similar reasons.

Total coverage of foraging grasses was broadly similar to the previous season based on December data. Sorghum and spinifex remained the dominant grasses by cover, however spinifex cover had increased compared to the previous season as plants recovered following the fires in 2021. Cover of sorghum was significantly lower in December compared to 2017 and earlier (no data is available from 2018-2020). Transects in several areas had little or no cover of the key foraging grasses being monitored, with vegetation cover largely comprising sedges. This is particularly prevalent in transects located in narrow segments of remnant native vegetation between cleared agricultural areas, including transects 125-127 and 136-141. Transect by transect data is not available from surveys prior to 2021, so it isn't possible to determine whether this was the case previously, but it seems possible that there has been a change in vegetation composition from key Gouldian Finch foraging grasses to sedge-dominated vegetation in these areas.

Flowering and seeding rates recorded in March 2023 were higher overall compared to the previous season, though this varied between different grass species. The most notable increase in seeding rates was observed in spinifex (*Triodia* spp.; 41.6% seeding in 2023 compared to 0.8% in 2022), which is unsurprising as the majority of spinifex had recently been burnt in 2022. Seeding rates in sorghum (*Sarga/Sorghum* spp.) were lower in 2023, but flowering rates were higher, suggesting that sorghum was flowering and setting seed later this season compared to last

season. By contrast, *Themeda triandra* flowering rates were significantly lower this season, with none observed flowering during monitoring this season, compared to almost half of plants during the previous season. This may also indicate later flowering compared to last season, which would also be consistent with observations that low-lying areas were inundated much later into the year in 2023 compared to 2022.

Observations at survey plots indicated a slight increase in cattle activity in the study area during the current season compared to the previous season, particularly during the March survey. However, qualitative observations across the study area over the four surveys did not suggest the same increase. Nevertheless, the ongoing evidence of cattle incursions into the buffer area highlights the need for ongoing destocking of the buffer area. Initial destocking is reported to have “substantially increased” the availability and productivity of Gouldian Finch foraging grasses in the buffer area (Save The Gouldian Fund 2018b). Evidence of fire at survey plots was significantly lower than the previous, which is unsurprising as fires had affected large parts of the study area during 2021, but none had affected these areas in 2022.

6.0 Conclusions and Recommendations

The targets for the monitoring of Gouldian Finch wet-season foraging activity (Item 8) and grass productivity and phenology in the study area identified in the GFCP (Strategen 2014) are as follows:

- No reduction in baseline foraging activity which can be attributed to Buffer Area management (Item 8); and
- No reduction in baseline phenology and productivity which can be attributed to Buffer Area management (Item 9).

The results of the 2022-23 monitoring indicate that there has been a decline in baseline foraging activity during the wet season, as no Gouldian Finches were observed during the wet season systematic foraging surveys for a second consecutive season². Hence, the target for foraging activity outlined in the GFCP has not been met again this season. We consider that the most likely cause of this decline in foraging activity in the wet season is the decline in suitability of the breeding locations due to decline in condition of the artificial nest boxes. However, this was rectified during the 2022 dry season and no nesting was recorded during the 2023 breeding season. It is possible that there is a lag in uptake of refurbished nest boxes due to the absence of breeding in the study area in recent season. Alternatively, it is possible that changes in vegetation composition, or the direct clearing, may also have played a role. As such, we recommend investigating potential causes of decline in foraging activity, in accordance with corrective actions identified in the GFCP in the event of the identified target not being met.

Monitoring results indicate that there have been some changes in the cover of Gouldian Finch foraging grasses within the study area. In particular, sorghum cover at monitoring transects has declined overall compared to pre-2019 monitoring, and vegetation along transects in several areas appears to be dominated by sedges. These sedge-dominated areas tended to be in narrower remnant bushland areas between cleared agricultural areas, but a lack of individual transect data from earlier monitoring means it is not possible to be certain whether this is a recent change. Overall, there appear to have been some changes to vegetation cover and phenology within the study area. However, confounding factors such as inter-seasonal variation in phenology and the lack of control sites mean it is not possible to clearly determine whether the target for grass productivity and phenology has been this season.

Both identified targets within the GFCP require that changes in baseline measures are not “attributed to Buffer Area management”. Identifying whether any recorded changes are attributable to buffer area management is difficult to do with certainty without concurrent data from control locations outside of the buffer area. This could, for example, allow the separation of the impact of any regional stochastic processes such as drought from local influences arising from the project itself. To address this, we recommend consideration be given to either:

- Expanding or revising the monitoring program to encompass foraging locations outside of the buffer area to provide control data; OR
- Incorporating relevant data obtained by other monitoring programs at suitable control sites in the region into the assessment and reporting each year.

² We have taken the baseline level of wet season foraging activity to be the foraging activity observed during the 2014 breeding surveys: this is the earliest breeding season foraging data available to us, and is a closer fit to “wet season” than September-October non-breeding surveys, though the lack of specific dates for the foraging surveys (not included in reports from 2014-2018) means it is not possible to be absolutely certain they were undertaken during the wet season.

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Appendix 1

Location of 2-ha Survey Plots



Plot No.	Location (centre point)		Habitat
	Latitude	Longitude	
1	-15.512015	128.838781	Breeding
2	-15.510956	128.837698	Breeding
4	-15.512190	128.836817	Breeding
5	-15.513514	128.837416	Breeding
6	-15.502691	128.843371	Breeding
10	-15.486355	128.861985	Breeding
11	-15.485526	128.863311	Breeding
13	-15.447296	128.946463	Breeding
15	-15.446046	128.948531	Breeding
17	-15.445816	128.946988	Breeding
18	-15.435252	128.944886	Breeding
20	-15.434064	128.947560	Breeding
21	-15.432818	128.948634	Breeding
22	-15.433927	128.945931	Breeding
24	-15.436887	128.947946	Breeding
25	-15.436683	128.944449	Breeding
26	-15.436700	128.946182	Breeding
27	-15.435308	128.946667	Breeding
28	-15.435477	128.948439	Breeding
30	-15.434246	128.950758	Breeding
31	-15.434215	128.949230	Breeding
32	-15.437748	128.942051	Breeding ¹
33	-15.438498	128.943309	Breeding ¹
34	-15.439389	128.944499	Breeding ¹
35	-15.440025	128.945828	Breeding ¹
36	-15.439679	128.947357	Breeding ¹
37	-15.441529	128.946937	Breeding ¹
38	-15.441679	128.945227	Breeding ¹
39	-15.502029	128.844664	Breeding
41	-15.500636	128.844918	Breeding
42	-15.488754	128.860082	Breeding
44	-15.487520	128.860984	Breeding
46	-15.498475	128.846674	Non-breeding ²
47	-15.497464	128.847867	Non-breeding ²
48	-15.496212	128.848794	Non-breeding ²
49	-15.495091	128.849916	Non-breeding ²
50	-15.505136	128.841892	Non-breeding ²
51	-15.506572	128.841015	Non-breeding ²
52	-15.507666	128.839740	Non-breeding ²
53	-15.498665	128.838061	Non-breeding ²
54	-15.497515	128.839505	Non-breeding ²
55	-15.496095	128.840622	Non-breeding ²
56	-15.482519	128.857320	Non-breeding ²
57	-15.480954	128.858508	Non-breeding ²
58	-15.479554	128.859339	Non-breeding ²
59	-15.477999	128.860160	Non-breeding ²
63	-15.478885	128.873240	Non-breeding ²
65	-15.481368	128.870001	Non-breeding ²
66	-15.479758	128.871480	Non-breeding ²
67	-15.449061	128.936403	Non-breeding ²
68	-15.450907	128.937066	Non-breeding ²

Plot No.	Location (centre point)		Habitat
	Latitude	Longitude	
69	-15.452557	128.937710	Non-breeding ²
70	-15.453966	128.937223	Non-breeding ²
71	-15.454740	128.935808	Non-breeding ²
72	-15.453815	128.934650	Non-breeding ²
73	-15.517931	128.834965	Non-breeding ²
74	-15.516463	128.834909	Non-breeding ²
75	-15.514963	128.835234	Non-breeding ²

¹ Not within mapped breeding areas but in close proximity in potentially suitable habitat.

² We use the term "non-breeding habitat" rather than "buffer" used in previous reports to describe areas outside of the breeding areas to avoid confusion with the project buffer area.

Appendix 2

Location and Orientation of Feeding Grass Transects



Transect ID	Start Point		Direction	End Point ¹		Habitat ²
	Latitude	Longitude		Latitude	Longitude	
V101	-15.50998	128.837954	SW			Breeding
V102	-15.510692	128.837253	SSE			Breeding
V103	-15.511916	128.837311	SSE			Breeding
V104	-15.512927	128.836983	NW			Breeding
V105	-15.50163	128.842918	SW	-15.502003	128.842673	Breeding ³
V106	-15.501016	128.843589	N			Breeding ³
V107	-15.499496	128.844418	NE	-15.499136	128.844672	Breeding ³
V108	-15.498699	128.845254	SSE			Breeding ³
V109	-15.49062	128.859749	ESE			Breeding ³
V110	-15.49019	128.860379	N			Breeding ³
V111	-15.489967	128.861468	SSE			Breeding ³
V112	-15.444789	128.947513	SSE			Breeding
V113	-15.446613	128.947742	SE			Breeding
V114	-15.447354	128.945399	NW			Breeding
V115	-15.448331	128.944789	NNW			Breeding ³
V116	-15.432262	128.948225	SSE			Breeding
V117	-15.433489	128.948237	SE			Breeding
V118	-15.434844	128.947535	SSE			Breeding
V119	-15.434622	128.946273	NW			Breeding
V120	-15.435514	128.944561	NW			Breeding
V121	-15.437042	128.944297	ESE			Breeding
V122	-15.44012	128.927135	NE			Non-breeding
V123	-15.437878	128.92547	E			Non-breeding
V124	-15.431537	128.925544	E			Non-breeding
V125	-15.432073	128.911435	WSW			Non-breeding
V126	-15.433615	128.911749	E			Non-breeding
V127 ⁴	-15.435621	128.911803	WSW	-15.435684	128.911347	Non-breeding
V128	-15.498584	128.835465	SE			Non-breeding
V129	-15.498496	128.836672	ENE			Non-breeding
V130	-15.498035	128.837967	NE			Non-breeding
V131	-15.498614	128.838668	S			Non-breeding
V132	-15.49856	128.839546	ENE	-15.49842	128.840032	Non-breeding
V133	-15.495138	128.834464	NNE			Non-breeding
V134	-15.494251	128.835365	ENE			Non-breeding
V135	-15.495202	128.833352	E			Non-breeding
V136	-15.464288	128.873552	NNW	-15.463891	128.873388	Non-breeding
V137	-15.463181	128.874206	NNE	-15.46279	128.874398	Non-breeding
V138	-15.462381	128.875716	NNE	-15.461959	128.875923	Non-breeding
V139	-15.460355	128.876092	NNW	-15.459918	128.875957	Non-breeding
V140	-15.468982	128.873429	W			Non-breeding
V141	-15.467654	128.873468	W			Non-breeding

¹ End point recorded where this differed substantially from end point estimated from transect direction.

² We use the term "non-breeding habitat" rather than "buffer" used in previous reports to describe areas outside of the breeding areas to avoid confusion with the project buffer area.

³ Included as breeding as in immediate proximity to breeding areas and to retain consistency with previous surveys, but outside mapped breeding areas.

⁴ Original location of V127 now cleared; new location in adjacent vegetation included here.

Appendix 3



Bird Survey Data



Common Name	Species	Survey Plot																														
		01		02		04		05		06		10		11		13		15		17		18		20		21		22		24		
		Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	
Wandering Whistling Duck	<i>Dendrocygna arcuata</i>																															
Radjah Shelduck	<i>Radjah radjah</i>																															
Green Pygmy Goose	<i>Nettapus pulchellus</i>																															
Pacific Black Duck	<i>Anas superciliosa</i>																															
Brown Quail	<i>Coturnix ypsilophora</i>																												2			
Spotted Nightjar	<i>Eurostopodus argus</i>																															
Tawny Frogmouth	<i>Podargus strigoides</i>																															
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>																													2		
Pheasant Coucal	<i>Centropus phasianinus</i>						1			1		2	1				1															
Pacific Koel	<i>Eudynamys orientalis</i>										1																					
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>																															
Horsfield's Bronze Cuckoo	<i>Chrysococcyx basalis</i>												1		1						1				1		1		1	2	1	
Little Bronze Cuckoo	<i>Chrysococcyx minutillus</i>																															
Brush Cuckoo	<i>Cacomantis variolosus</i>						1				1									1				2	1	1		1	1	1		
Crested Pigeon	<i>Ocyphaps lophotes</i>																							2		1		2				
White-quilled Rock Pigeon	<i>Petrophassa albipennis</i>				1																											
Diamond Dove	<i>Geopelia cuneata</i>																															
Peaceful Dove	<i>Geopelia placida</i>	2		2	3	1	2			2	3	3		1		2	3				2	2	7	1	2	2	4	1		2		4
Bar-shouldered Dove	<i>Geopelia humeralis</i>						2				7	4	2			3					1	2				1						
Brolga	<i>Antigone rubicunda</i>																															
Red-backed Buttonquail	<i>Turnix maculosus</i>																															
Chestnut-backed Buttonquail	<i>Turnix castanotus</i>																															
Red-chested Buttonquail	<i>Turnix pyrrhothorax</i>																															
Oriental Pratincole	<i>Glareola maldivarum</i>																															
Australian White Ibis	<i>Threskiornis molucca</i>																													4		
Glossy Ibis	<i>Plegadis falcinellus</i>																													55		
Royal Spoonbill	<i>Platalea regia</i>																													6		
Black Bittern	<i>Ixobrychus flavicollis</i>																															
Nankeen Night Heron	<i>Nycticorax caledonicus</i>																															
Eastern Cattle Egret	<i>Bubulcus coromandus</i>																															
Great Egret	<i>Ardea alba</i>																															
Intermediate Egret	<i>Ardea intermedia</i>																												3			
Wedge-tailed Eagle	<i>Aquila audax</i>										1																					
Brown Goshawk	<i>Accipiter fasciatus</i>																													1		
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>																															
Black Kite	<i>Milvus migrans</i>		1	1						2																						
Whistling Kite	<i>Haliastur sphenurus</i>									1																						
Brahminy Kite	<i>Haliastur indus</i>																															
Oriental Dollarbird	<i>Eurystomus orientalis</i>											1		1									1		1					1		
Blue-winged Kookaburra	<i>Dacelo leachii</i>										1		2	2		2											1	1				
Sacred Kingfisher	<i>Todiramphus sanctus</i>																1					1		1		2	1			1		
Rainbow Bee-eater	<i>Merops ornatus</i>																															
Nankeen Kestrel	<i>Falco cenchroides</i>																															
Brown Falcon	<i>Falco berigora</i>									1																						
Black Falcon	<i>Falco subniger</i>																															
Cockatiel	<i>Nymphicus hollandicus</i>																															
Red-tailed Black Cockatoo	<i>Calyptorhynchus banksii</i>						3					3		4	2									2				6		7		

Common Name	Species	Survey Plot																													
		01		02		04		05		06		10		11		13		15		17		18		20		21		22		24	
		Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar
Galah	<i>Eolophus roseicapilla</i>											2						1						7		8		6			
Little Corella	<i>Cacatua sanguinea</i>									4		2		3		1		2						1							
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>																														
Red-winged Parrot	<i>Aprosmictus erythropterus</i>					2						3	1			2		2				1	2	2	1	2	1	1		3	
Red-collared Lorikeet	<i>Trichoglossus rubritorquis</i>					3				4		4	1	2																	
Great Bowerbird	<i>Chlamydera nuchalis</i>					1	1	1		2		1																			
Black-tailed Treecreeper	<i>Climacteris melanurus</i>																				1									1	
Red-backed Fairywren	<i>Malurus melanocephalus</i>											2									1			1				2	2	2	
Rufous-throated Honeyeater	<i>Conopophila rufogularis</i>								2				1		2						4		2	3						2	
Little Friarbird	<i>Philemon citreogularis</i>																											1	1		
Silver-crowned Friarbird	<i>Philemon argenticeps</i>	1	1							2	1															2					
Brown Honeyeater	<i>Lichmera indistincta</i>		7		1		1				2			1			4		2		2						2			2	
Blue-faced Honeyeater	<i>Entomyzon cyanotis</i>					3																									
Black-chinned Honeyeater	<i>Melithreptus gularis</i>																														
White-throated Honeyeater	<i>Melithreptus albugularis</i>	2	2	3	1	2	1	2			1			1			1				2								1		
White-gaped Honeyeater	<i>Stomiopera unicolor</i>								1																						
Yellow-tinted Honeyeater	<i>Ptilotula flavescens</i>																														
Yellow-throated Miner	<i>Manorina flavigula</i>			2		3	2										2				3	1									
Striated Pardalote	<i>Pardalotus striatus</i>			1			1										1						1		1		2				
Weebill	<i>Smicromis brevirostris</i>		2		3	5				2				2		2	3		2	2	1				2			4	2	2	
White-throated Gerygone	<i>Gerygone olivacea</i>																														
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>					3							3							3		3	2		2	4	4				
Black-faced Woodswallow	<i>Artamus cinereus</i>																				3									5	
Little Woodswallow	<i>Artamus minor</i>																														
Silver-backed Butcherbird	<i>Cracticus argenteus</i>				1																										
Pied Butcherbird	<i>Cracticus nigrogularis</i>								1			1				1		1	1	2				1			3			2	
Black-faced Cuckooshrike	<i>Coracina novaehollandiae</i>					1				1		1		1							1					2	3		1	2	
White-bellied Cuckooshrike	<i>Coracina papuensis</i>					1			4	1		3	1							1						4	1			2	
White-winged Triller	<i>Lalage tricolor</i>															1					1									1	2
Varied Sittella	<i>Daphoenositta chrysoptera</i>																														
Rufous Whistler	<i>Pachycephala rufiventris</i>									1	1	1				1					2	1	1	1	2	1	1	1	1	1	
Grey Shrikethrush	<i>Colluricincla harmonica</i>																			2		1	1	1							
Sandstone Shrikethrush	<i>Colluricincla woodwardi</i>	1							1	1																					
Olive-backed Oriole	<i>Oriolus sagittatus</i>																					1			1		2				
Green Oriole	<i>Oriolus flavocinctus</i>																														
Willie Wagtail	<i>Rhipidura leucophrys</i>																1													1	1
Northern Fantail	<i>Rhipidura rufiventris</i>																														
Magpie-lark	<i>Grallina cyanoleuca</i>					1					2																1	1			
Leaden Flycatcher	<i>Myiagra rubecula</i>																														
Paperbark Flycatcher	<i>Myiagra nana</i>																														
Torresian Crow	<i>Corvus orru</i>										3			1																2	
Jacky Winter	<i>Microeca fascinans</i>																						1								1
Fairy Martin	<i>Petrochelidon ariel</i>																														
Rufous Songlark	<i>Cincloramphus mathewsi</i>																														1
Tawny Grassbird	<i>Cincloramphus timoriensis</i>																														
Golden-headed Cisticola	<i>Cisticola exilis</i>										2	4																			
Mistletoebird	<i>Dicaeum hirundinaceum</i>					1																			1		1				1

Common Name	Species	Survey Plot																													
		01		02		04		05		06		10		11		13		15		17		18		20		21		22		24	
		Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar
Crimson Finch	<i>Neochmia phaeton</i>																														
Star Finch	<i>Bathilda ruficauda</i>																														
Double-barred Finch	<i>Stizoptera bichenovii</i>								2		2	2															1				
Australian Zebra Finch	<i>Taeniopygia castanotis</i>																														
Masked Finch	<i>Poephila personata</i>																					10									
Long-tailed Finch	<i>Poephila acuticauda</i>		2	2		1	3													14		5						2			
Yellow-rumped Mannikin	<i>Lonchura flaviprymna</i>																														
Chestnut-breasted Mannikin	<i>Lonchura castaneothorax</i>																														
Species Total		4	6	7	5	16	9	3	11	18	9	17	9	8	3	12	5	6	4	18	9	11	7	16	7	18	15	8	11	15	15

Common Name	Species	Survey Plot																													
		25		26		27		28		30		31		32		33		34		35		36		37		38		39		41	
		Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar
Wandering Whistling Duck	<i>Dendrocygna arcuata</i>																														
Radjah Shelduck	<i>Radjah radjah</i>																														
Green Pygmy Goose	<i>Nettapus pulchellus</i>																														
Pacific Black Duck	<i>Anas superciliosa</i>																														
Brown Quail	<i>Coturnix ypsilophora</i>													4																	
Spotted Nightjar	<i>Eurostopodus argus</i>																					3									
Tawny Frogmouth	<i>Podargus strigoides</i>					2																									
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>															1					1					1			1		
Pheasant Coucal	<i>Centropus phasianinus</i>																											2		1	
Pacific Koel	<i>Eudynamys orientalis</i>									1							1													1	
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>																													1	
Horsfield's Bronze Cuckoo	<i>Chrysococcyx basalis</i>	1			2			2	1				1																		
Little Bronze Cuckoo	<i>Chrysococcyx minutillus</i>																														
Brush Cuckoo	<i>Cacomantis variolosus</i>								1	1		1		1														1		1	
Crested Pigeon	<i>Ocyphaps lophotes</i>					2										3	3														
White-quilled Rock Pigeon	<i>Petrophassa albipennis</i>																														
Diamond Dove	<i>Geopelia cuneata</i>																					1									
Peaceful Dove	<i>Geopelia placida</i>		3		3	1	5	3	3	5	2	1	2		2	2	3	4				2					1	5	7	2	2
Bar-shouldered Dove	<i>Geopelia humeralis</i>							2		2					1													2	3	4	2
Brolga	<i>Antigone rubicunda</i>			2		2																									
Red-backed Buttonquail	<i>Turnix maculosus</i>																														
Chestnut-backed Buttonquail	<i>Turnix castanotus</i>					1																									
Red-chested Buttonquail	<i>Turnix pyrrhorostrax</i>																														
Oriental Pratincole	<i>Glareola maldivarum</i>																					2									
Australian White Ibis	<i>Threskiornis molucca</i>		3																												
Glossy Ibis	<i>Plegadis falcinellus</i>						35																								
Royal Spoonbill	<i>Platalea regia</i>																														
Black Bittern	<i>Ixobrychus flavicollis</i>																														
Nankeen Night Heron	<i>Nycticorax caledonicus</i>						1																								
Eastern Cattle Egret	<i>Bubulcus coromandus</i>		3				18																								
Great Egret	<i>Ardea alba</i>																														
Intermediate Egret	<i>Ardea intermedia</i>				4		3		3						1																
Wedge-tailed Eagle	<i>Aquila audax</i>																													1	
Brown Goshawk	<i>Accipiter fasciatus</i>						1			1					1															1	
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>																														
Black Kite	<i>Milvus migrans</i>																														
Whistling Kite	<i>Haliastur sphenurus</i>																														
Brahminy Kite	<i>Haliastur indus</i>																														
Oriental Dollarbird	<i>Eurystomus orientalis</i>					1						1			1						1								3	2	
Blue-winged Kookaburra	<i>Dacelo leachii</i>							1	1				1	2	1														1	1	
Sacred Kingfisher	<i>Todiramphus sanctus</i>					1		3		1						1				1		2				1		3			
Rainbow Bee-eater	<i>Merops ornatus</i>																				1								1		
Nankeen Kestrel	<i>Falco cenchroides</i>																														1
Brown Falcon	<i>Falco berigora</i>																														
Black Falcon	<i>Falco subniger</i>																														
Cockatiel	<i>Nymphicus hollandicus</i>										5																				
Red-tailed Black Cockatoo	<i>Calyptorhynchus banksii</i>	4	4	2				3		12																		3		4	

Common Name	Species	Survey Plot																													
		25		26		27		28		30		31		32		33		34		35		36		37		38		39		41	
		Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar
Galah	<i>Eolophus roseicapilla</i>		3				2						12		2	2			2	2		2									
Little Corella	<i>Cacatua sanguinea</i>			4														2		4				6							
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>							1																							
Red-winged Parrot	<i>Aprosmictus erythropterus</i>		1		3		2	2	2	2	1	1	5				1		3	2	3					1	1	2	2		
Red-collared Lorikeet	<i>Trichoglossus rubritorquis</i>	2						3					10	3							4							2	2		
Great Bowerbird	<i>Chlamydera nuchalis</i>							1													1								3		
Black-tailed Treecreeper	<i>Climacteris melanurus</i>																	1		1				2		2					
Red-backed Fairywren	<i>Malurus melanocephalus</i>	2	1	2		2	2			3		1	2	2	1				1												
Rufous-throated Honeyeater	<i>Conopophila rufogularis</i>	2			1		2										3		5			5		2		6					
Little Friarbird	<i>Philemon citreogularis</i>		3		1						1				1		5		2		1										
Silver-crowned Friarbird	<i>Philemon argenticeps</i>														1		2	2												1	
Brown Honeyeater	<i>Lichmera indistincta</i>		4				2		1								1			1		2				1				1	
Blue-faced Honeyeater	<i>Entomyzon cyanotis</i>																														
Black-chinned Honeyeater	<i>Melithreptus gularis</i>																											1			
White-throated Honeyeater	<i>Melithreptus albogularis</i>								2																1					3	
White-gaped Honeyeater	<i>Stomiopera unicolor</i>														1																
Yellow-tinted Honeyeater	<i>Ptilotula flavescens</i>										1																				
Yellow-throated Miner	<i>Manorina flavigula</i>																														
Striated Pardalote	<i>Pardalotus striatus</i>		1				1		1	1			2				1								1		1		1		
Weebill	<i>Smicromis brevirostris</i>								1	6		2		1					2	2	2		8		2	4	2		4	3	
White-throated Gerygone	<i>Gerygone olivacea</i>																		1												
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>	6	3		3		5		2			3			2	4	3	3	2				4								
Black-faced Woodswallow	<i>Artamus cinereus</i>				2		4					2						1	1	1		2	15	2		1					
Little Woodswallow	<i>Artamus minor</i>																			2											
Silver-backed Butcherbird	<i>Cracticus argenteus</i>																														
Pied Butcherbird	<i>Cracticus nigrogularis</i>														1	1				1		1		1					1		
Black-faced Cuckooshrike	<i>Coracina novaehollandiae</i>	1	1	3	1	1			1	1			1			1			2		3		1		1		1				
White-bellied Cuckooshrike	<i>Coracina papuensis</i>							1	2	1	3	1	2	1	2	4	1		2		4	2	2	3							
White-winged Triller	<i>Lalage tricolor</i>				1		3	1												2				1							
Varied Sittella	<i>Daphoenositta chrysoptera</i>					4														3			4		2						
Rufous Whistler	<i>Pachycephala rufiventris</i>	3				1		1		3	1	1	2	1				1	1			1	1	2	1	3	1	1		1	
Grey Shrikethrush	<i>Colluricincla harmonica</i>			1				1					2				1	1		1		1		2		2					
Sandstone Shrikethrush	<i>Colluricincla woodwardi</i>																											1		1	1
Olive-backed Oriole	<i>Oriolus sagittatus</i>					2		1		1		2											1							1	
Green Oriole	<i>Oriolus flavocinctus</i>									1																					
Willie Wagtail	<i>Rhipidura leucophrys</i>					3		1		1									1			2	2	1			2				
Northern Fantail	<i>Rhipidura rufiventris</i>																														
Magpie-lark	<i>Grallina cyanoleuca</i>																			1								1		1	
Leaden Flycatcher	<i>Myiagra rubecula</i>																														
Paperbark Flycatcher	<i>Myiagra nana</i>																														
Torresian Crow	<i>Corvus orru</i>										2																	1			
Jacky Winter	<i>Microeca fascinans</i>			1		1	1														1				1						
Fairy Martin	<i>Petrochelidon ariel</i>																														
Rufous Songlark	<i>Cincloramphus mathewsi</i>																				1		2	1	1						
Tawny Grassbird	<i>Cincloramphus timoriensis</i>																														
Golden-headed Cisticola	<i>Cisticola exilis</i>																														3
Mistletoebird	<i>Dicaeum hirundinaceum</i>			1	1	1		3							1						1										1

Common Name	Species	Survey Plot																													
		25		26		27		28		30		31		32		33		34		35		36		37		38		39		41	
		Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar
Crimson Finch	<i>Neochmia phaeton</i>																														
Star Finch	<i>Bathilda ruficauda</i>																														
Double-barred Finch	<i>Stizoptera bichenovii</i>											4																	3		
Australian Zebra Finch	<i>Taeniopygia castanotis</i>																														
Masked Finch	<i>Poephila personata</i>	2						2	1		1	5						3									1				
Long-tailed Finch	<i>Poephila acuticauda</i>			9	6		8				5									2											
Yellow-rumped Mannikin	<i>Lonchura flaviprymna</i>						4																								
Chestnut-breasted Mannikin	<i>Lonchura castaneothorax</i>																														
Species Total		9	12	9	12	15	18	17	15	17	10	15	10	14	11	8	16	12	18	14	12	10	11	13	8	10	13	12	8	16	8

Common Name	Species	Survey Plot																													
		42		44		46		47		48		49		50		51		52		53		54		55		56		57		58	
		Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar
Wandering Whistling Duck	<i>Dendrocygna arcuata</i>																														
Radjah Shelduck	<i>Radjah radjah</i>																														
Green Pygmy Goose	<i>Nettapus pulchellus</i>																														
Pacific Black Duck	<i>Anas superciliosa</i>																														
Brown Quail	<i>Coturnix ypsilophora</i>																														
Spotted Nightjar	<i>Eurostopodus argus</i>																														
Tawny Frogmouth	<i>Podargus strigoides</i>																														
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>																														
Pheasant Coucal	<i>Centropus phasianinus</i>																														
Pacific Koel	<i>Eudynamys orientalis</i>																														
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>																														
Horsfield's Bronze Cuckoo	<i>Chrysococcyx basalis</i>																														
Little Bronze Cuckoo	<i>Chrysococcyx minutillus</i>																														
Brush Cuckoo	<i>Cacomantis variolosus</i>																														
Crested Pigeon	<i>Ocyphaps lophotes</i>																														
White-quilled Rock Pigeon	<i>Petrophassa albipennis</i>																														
Diamond Dove	<i>Geopelia cuneata</i>																														
Peaceful Dove	<i>Geopelia placida</i>																														
Bar-shouldered Dove	<i>Geopelia humeralis</i>																														
Brolga	<i>Antigone rubicunda</i>																														
Red-backed Buttonquail	<i>Turnix maculosus</i>																														
Chestnut-backed Buttonquail	<i>Turnix castanotus</i>																														
Red-chested Buttonquail	<i>Turnix pyrrhothorax</i>																														
Oriental Pratincole	<i>Glareola maldivarum</i>																														
Australian White Ibis	<i>Threskiornis molucca</i>																														
Glossy Ibis	<i>Plegadis falcinellus</i>																														
Royal Spoonbill	<i>Platalea regia</i>																														
Black Bittern	<i>Ixobrychus flavicollis</i>																														
Nankeen Night Heron	<i>Nycticorax caledonicus</i>																														
Eastern Cattle Egret	<i>Bubulcus coromandus</i>																														
Great Egret	<i>Ardea alba</i>																														
Intermediate Egret	<i>Ardea intermedia</i>																														
Wedge-tailed Eagle	<i>Aquila audax</i>																														
Brown Goshawk	<i>Accipiter fasciatus</i>																														
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>																														
Black Kite	<i>Milvus migrans</i>																														
Whistling Kite	<i>Haliastur sphenurus</i>																														
Brahminy Kite	<i>Haliastur indus</i>																														
Oriental Dollarbird	<i>Eurystomus orientalis</i>																														
Blue-winged Kookaburra	<i>Dacelo leachii</i>																														
Sacred Kingfisher	<i>Todiramphus sanctus</i>																														
Rainbow Bee-eater	<i>Merops ornatus</i>																														
Nankeen Kestrel	<i>Falco cenchroides</i>																														
Brown Falcon	<i>Falco berigora</i>																														
Black Falcon	<i>Falco subniger</i>																														
Cockatiel	<i>Nymphicus hollandicus</i>																														
Red-tailed Black Cockatoo	<i>Calyptorhynchus banksii</i>																														

Common Name	Species	Survey Plot																												Total	
		59		63		65		66		67		68		69		70		71		72		73		74		75					
		Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar		
Wandering Whistling Duck	<i>Dendrocygna arcuata</i>					10																						10	0		
Radjah Shelduck	<i>Radjah radjah</i>																											1	0	3	
Green Pygmy Goose	<i>Nettapus pulchellus</i>																												0	2	
Pacific Black Duck	<i>Anas superciliosa</i>							2																					2	0	
Brown Quail	<i>Coturnix ypsilophora</i>	2																				2							11	2	
Spotted Nightjar	<i>Eurostopodus argus</i>												1																3	1	
Tawny Frogmouth	<i>Podargus strigoides</i>																												2	3	
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>																												3	3	
Pheasant Coucal	<i>Centropus phasianinus</i>		1		1																	1		1	1				18	16	
Pacific Koel	<i>Eudynamys orientalis</i>							1		1																			10	1	
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>																												1	0	
Horsfield's Bronze Cuckoo	<i>Chrysococcyx basalis</i>										2																		17	13	
Little Bronze Cuckoo	<i>Chrysococcyx minutillus</i>							1																					1	0	
Brush Cuckoo	<i>Cacomantis variolosus</i>	1		1		1				1				1						1		1		1					22	12	
Crested Pigeon	<i>Ocyphaps lophotes</i>																												10	3	
White-quilled Rock Pigeon	<i>Petrophassa albipennis</i>																												1	0	
Diamond Dove	<i>Geopelia cuneata</i>																												0	2	
Peaceful Dove	<i>Geopelia placida</i>	14	7	3	2	2	1	4		3	2		1	4	2	5	2	4	8	8		3	5	3	5	1	1		150	139	
Bar-shouldered Dove	<i>Geopelia humeralis</i>		6	2		1	8	6	3	2		1		1					2	1					4	1			82	61	
Brolga	<i>Antigone rubicunda</i>																												4	0	
Red-backed Buttonquail	<i>Turnix maculosus</i>																					1							2	0	
Chestnut-backed Buttonquail	<i>Turnix castanotus</i>																												5	5	
Red-chested Buttonquail	<i>Turnix pyrrhothorax</i>																												2	0	
Oriental Pratincole	<i>Glareola maldivarum</i>			1				25																					28	0	
Australian White Ibis	<i>Threskiornis molucca</i>				3		8																						4	14	
Glossy Ibis	<i>Plegadis falcinellus</i>																												0	102	
Royal Spoonbill	<i>Platalea regia</i>																												6	0	
Black Bittern	<i>Ixobrychus flavicollis</i>																												0	1	
Nankeen Night Heron	<i>Nycticorax caledonicus</i>								1																				0	2	
Eastern Cattle Egret	<i>Bubulcus coromandus</i>																												0	41	
Great Egret	<i>Ardea alba</i>						1																						0	1	
Intermediate Egret	<i>Ardea intermedia</i>																												0	15	
Wedge-tailed Eagle	<i>Aquila audax</i>																												2	0	
Brown Goshawk	<i>Accipiter fasciatus</i>															1													4	4	
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>																												1	0	
Black Kite	<i>Milvus migrans</i>		1														1												4	11	
Whistling Kite	<i>Haliastur sphenurus</i>					1																							1	2	3
Brahminy Kite	<i>Haliastur indus</i>																												1	0	
Oriental Dollarbird	<i>Eurystomus orientalis</i>				2	1	1														2						1	2	24	8	
Blue-winged Kookaburra	<i>Dacelo leachii</i>						2				1	1	1		1					2	2						2		22	23	
Sacred Kingfisher	<i>Todiramphus sanctus</i>		1						1	1				3		1		1											26	3	
Rainbow Bee-eater	<i>Merops ornatus</i>	2	2	3				2																	3		4		23	11	
Nankeen Kestrel	<i>Falco cenchroides</i>																												2	2	
Brown Falcon	<i>Falco berigora</i>															1													0	2	
Black Falcon	<i>Falco subniger</i>																												2	0	
Cockatiel	<i>Nymphicus hollandicus</i>																												0	5	
Red-tailed Black Cockatoo	<i>Calyptorhynchus banksii</i>	2		3			6		4	3			1	7		6					2		3	2			2		90	52	

Common Name	Species	Survey Plot																												Total	
		59		63		65		66		67		68		69		70		71		72		73		74		75					
		Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar		
Galah	<i>Eolophus roseicapilla</i>																											44	13		
Little Corella	<i>Cacatua sanguinea</i>			2		23		2																				73	13		
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>																											0	1		
Red-winged Parrot	<i>Aprosmictus erythropterus</i>		2							1	1			3		1	1	1								2	3	34	46		
Red-collared Lorikeet	<i>Trichoglossus rubritorquis</i>				2		4		5	3			2						6	6						2	2	66	36		
Great Bowerbird	<i>Chlamydera nuchalis</i>					1			1		1		1				1		1				1			1	1	28	12		
Black-tailed Treecreeper	<i>Climacteris melanurus</i>																											7	1		
Red-backed Fairywren	<i>Malurus melanocephalus</i>	4								1										2			1					27	28		
Rufous-throated Honeyeater	<i>Conopophila rufogularis</i>	3	2	3		3	3	3			2			5		3	2	4	1	2							2	41	66		
Little Friarbird	<i>Philemon citreogularis</i>													1	1	1		2	2									6	21		
Silver-crowned Friarbird	<i>Philemon argenticeps</i>		2								1	1	2		2		1	2		2			1	1			1	34	37		
Brown Honeyeater	<i>Lichmera indistincta</i>					2	7				2		1						2					1				9	71		
Blue-faced Honeyeater	<i>Entomyzon cyanotis</i>																											3	1		
Black-chinned Honeyeater	<i>Melithreptus gularis</i>																											0	1		
White-throated Honeyeater	<i>Melithreptus albogularis</i>		3		3	2		1		2	1	1	2	2		1	2	1		1	3			4		4		46	33		
White-gaped Honeyeater	<i>Stomiopera unicolor</i>									2		2											2					9	10		
Yellow-tinted Honeyeater	<i>Ptilotula flavescens</i>														1													0	2		
Yellow-throated Miner	<i>Manorina flavigula</i>																											11	6		
Striated Pardalote	<i>Pardalotus striatus</i>		1			1													2									2	27		
Weebill	<i>Smicronis brevirostris</i>					2				2		2		6		3	2			2	2			2		2	2	58	54		
White-throated Gerygone	<i>Gerygone olivacea</i>																											1	0		
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>	14		2						2				2		3	2		4				4	3	3			57	60		
Black-faced Woodswallow	<i>Artamus cinereus</i>	1		1				1								1		3										20	27		
Little Woodswallow	<i>Artamus minor</i>																	3										5	0		
Silver-backed Butcherbird	<i>Cracticus argenteus</i>																					1		2				4	3		
Pied Butcherbird	<i>Cracticus nigrogularis</i>			1		2			1		1	1	2		1	1	1	1	1				2		2			22	24		
Black-faced Cuckooshrike	<i>Coracina novaehollandiae</i>			2					3	1	1	1							1		1							25	23		
White-bellied Cuckooshrike	<i>Coracina papuensis</i>	1							1	2						2										1		35	35		
White-winged Triller	<i>Lalage tricolor</i>																											7	6		
Varied Sittella	<i>Daphoenositta chrysoptera</i>																											10	3		
Rufous Whistler	<i>Pachycephala rufiventris</i>	1	1	1		1	1			1	2	1	1	3	1	2	2	1	2	2								49	26		
Grey Shrikethrush	<i>Colluricincla harmonica</i>												1	1	1				1	1	1							19	5		
Sandstone Shrikethrush	<i>Colluricincla woodwardi</i>																							1	2				8	7	
Olive-backed Oriole	<i>Oriolus sagittatus</i>															1							1						18	0	
Green Oriole	<i>Oriolus flavocinctus</i>																												2	0	
Willie Wagtail	<i>Rhipidura leucophrys</i>			2		1				1		2		1			1			1									17	8	
Northern Fantail	<i>Rhipidura rufiventris</i>																												1	1	
Magpie-lark	<i>Grallina cyanoleuca</i>			1	1	1	1			1	1												1		2		1	14	17		
Leaden Flycatcher	<i>Myiagra rubecula</i>										1																		1	6	
Paperbark Flycatcher	<i>Myiagra nana</i>		1									1													1				1	2	
Torresian Crow	<i>Corvus orru</i>	1																					2		1				11	7	
Jacky Winter	<i>Microeca fascinans</i>																												5	2	
Fairy Martin	<i>Petrochelidon ariel</i>			2																					7				9	0	
Rufous Songlark	<i>Cincloramphus mathewsi</i>																												5	1	
Tawny Grassbird	<i>Cincloramphus timoriensis</i>	1																											5	0	
Golden-headed Cisticola	<i>Cisticola exilis</i>	3	10	6	5				2																	3		2	64	59	
Mistletoebird	<i>Dicaeum hirundinaceum</i>							1		1				1		1								1		1			23	4	

Common Name	Species	Survey Plot																												Total	
		59		63		65		66		67		68		69		70		71		72		73		74		75					
		Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar	Dec	Mar		
Crimson Finch	<i>Neochmia phaeton</i>		2																									3	2		
Star Finch	<i>Bathilda ruficauda</i>			12																								16	0		
Double-barred Finch	<i>Stizoptera bichenovii</i>	6			2	15									1				2					3		2		5	46	31	
Australian Zebra Finch	<i>Taeniopygia castanotis</i>																											0	0		
Masked Finch	<i>Poephila personata</i>			3			4																					22	10		
Long-tailed Finch	<i>Poephila acuticauda</i>	2					4																					33	34		
Yellow-rumped Mannikin	<i>Lonchura flaviprymna</i>																											0	5		
Chestnut-breasted Mannikin	<i>Lonchura castaneothorax</i>																											0	4		
Species Total		16	15	19	8	14	17	14	8	18	13	14	10	13	12	11	16	12	15	17	7	10	10	18	11	11	12	85	80		

Appendix 4

Grass Transect Monitoring Data



December

Transect	<i>Sarga/Sorghum</i> spp.	<i>Triodia</i> spp.	<i>Themeda</i> <i>triandra</i>	<i>Heteropogon</i> sp.	<i>Panicum</i> <i>decompositum</i>	<i>Chrysopogon</i> <i>fallax</i>	<i>Alloteropsis</i> <i>semialata</i>	Other
V101	-	-	-	-	-	-	-	57
V102	230	190	-	-	-	-	-	-
V103	50	245	-	-	-	-	-	-
V104	-	190	-	-	-	-	-	5
V105	150	-	-	320	-	-	-	250
V106	50	-	-	-	-	-	-	395
V107	50	-	-	-	-	-	-	308
V108	1	139	-	400	-	-	-	721
V109	-	195	-	-	-	-	-	105
V110	30	80	-	50	-	30	-	450
V111	-	-	-	-	-	-	-	-
V112	60	325	-	-	-	-	-	50
V113	475	85	-	-	-	-	-	-
V114	155	360	-	-	-	-	-	110
V115	430	-	-	-	-	-	-	45
V116	-	160	-	-	-	-	-	470
V117	-	120	-	-	-	-	-	170
V118	180	230	-	-	-	-	-	-
V119	70	50	-	-	-	-	-	15
V120	200	310	-	-	-	-	-	-
V121	100	360	-	-	-	-	-	-
V122	360	-	90	-	50	330	-	50
V123	250	-	-	-	-	-	-	250
V124	440	-	320	-	-	-	-	120
V125	100	-	-	-	-	-	-	230
V126	70	-	-	-	-	-	-	310
V127	-	-	-	-	-	-	-	400
V128	80	-	-	-	-	-	-	300
V129	-	-	-	-	-	-	-	510
V130	100	-	210	-	-	30	-	430
V131	80	-	-	-	130	-	-	610
V132	20	-	-	-	30	-	-	800
V133	140	-	570	-	-	-	-	-
V134	160	-	-	-	240	-	-	260

Transect	<i>Sarga/Sorghum</i> spp.	<i>Triodia</i> spp.	<i>Themeda</i> <i>triandra</i>	<i>Heteropogon</i> sp.	<i>Panicum</i> <i>decompositum</i>	<i>Chrysopogon</i> <i>fallax</i>	<i>Alloferopsis</i> <i>semialata</i>	Other
V135	-	-	-	-	-	-	-	910
V136	-	-	-	-	-	-	-	440
V137	-	-	-	-	-	-	-	745
V138	-	-	-	-	-	-	-	395
V139	-	-	-	-	-	-	-	420
V140	-	-	-	-	-	-	-	640
V141	-	-	-	-	-	-	-	345
Total	4,031	3,039	1,190	770	450	390	0	11,316

March

Transect	<i>Sarga/Sorghum</i> spp.	<i>Triodia</i> spp.	<i>Themeda</i> <i>triandra</i>	<i>Chrysopogon</i> <i>fallax</i>	<i>Heteropogon</i> sp.	<i>Panicum</i> <i>decompositum</i>	<i>Alloferopsis</i> <i>semialata</i>	Other
V101	120	30	-	-	-	-	-	110
V102	300	60	-	-	-	-	-	40
V103	230	110	-	-	-	-	-	20
V104	130	350	-	-	-	-	-	-
V105	490	-	-	360	-	-	-	70
V106	770	-	-	-	-	-	-	100
V107	440	-	-	-	-	-	-	220
V108	20	380	-	-	-	-	-	100
V109	160	260	-	-	-	-	-	50
V110	700	60	-	-	-	-	-	350
V111	570	-	-	590	-	-	-	-
V112	270	115	-	-	-	-	-	170
V113	490	175	-	-	-	-	-	-
V114	300	235	-	-	-	-	-	120
V115	650	-	-	-	-	-	-	-
V116	-	180	-	-	-	-	90	390
V117	-	240	-	-	-	-	-	670
V118	305	110	-	-	-	-	-	255
V119	50	50	-	-	-	-	-	780
V120	40	325	-	-	-	-	-	20
V121	130	445	-	-	-	-	-	-
V122	450	-	-	-	-	-	-	680
V123	30	-	-	-	80	-	-	880

Transect	<i>Sarga/Sorghum</i> spp.	<i>Triodia</i> spp.	<i>Themeda</i> <i>triandra</i>	<i>Chrysopogon</i> <i>fallax</i>	<i>Heteropogon</i> sp.	<i>Panicum</i> <i>decompositum</i>	<i>Alloteropsis</i> <i>semialata</i>	Other
V124	10	-	-	-	-	-	-	720
V125	-	-	-	-	-	-	-	730
V126	590	-	-	-	120	-	-	530
V127	270	-	-	-	-	-	-	480
V128	440	-	-	-	-	-	-	420
V129	480	-	-	-	-	-	-	240
V130	40	-	350	-	-	20	-	490
V131	265	-	-	-	150	-	-	255
V132	20	-	-	-	240	-	-	698
V133	80	-	655	-	-	-	-	-
V134	50	-	-	-	70	-	-	720
V135	30	-	-	-	-	-	-	720
V136	-	-	-	-	-	-	-	760
V137	-	-	-	-	-	-	-	900
V138	-	-	-	-	-	-	-	750
V139	130	-	-	-	-	-	-	870
V140	-	-	-	-	-	-	-	1000
V141	-	-	-	-	-	-	-	880
Total	9,050	3,125	1,005	950	660	20	90	16,188

Appendix 5

Grass Phenology Data



Transect	Quadrat	Month	Grass Species	Total Individuals	No. Flowering	No. Seeding
V102	1	Dec	<i>Triodia</i> spp.	2	0	0
V102	2	Dec	<i>Triodia</i> spp.	1	0	0
V102	3	Dec	<i>Triodia</i> spp.	3	0	0
V103	1	Dec	<i>Triodia</i> spp.	2	0	0
V103	2	Dec	<i>Triodia</i> spp.	6	0	0
V103	3	Dec	<i>Triodia</i> spp.	7	0	0
V104	1	Dec	<i>Triodia</i> spp.	3	0	1
V104	2	Dec	<i>Triodia</i> spp.	3	0	1
V104	3	Dec	<i>Triodia</i> spp.	4	0	2
V105	1	Dec	<i>Sarga/Sorghum</i> spp.	23	0	0
V105	2	Dec	<i>Heteropogon</i> sp.	18	0	1
V106	3	Dec	<i>Sarga/Sorghum</i> spp.	2	0	0
V107	1	Dec	<i>Sarga/Sorghum</i> spp.	1	0	0
V107	2	Dec	<i>Sarga/Sorghum</i> spp.	1	0	0
V108	1	Dec	<i>Heteropogon</i> sp.	7	0	0
V108	1	Dec	<i>Triodia</i> spp.	3	0	0
V108	1	Dec	<i>Sarga/Sorghum</i> spp.	2	0	0
V108	2	Dec	<i>Heteropogon</i> sp.	8	0	0
V108	2	Dec	<i>Triodia</i> spp.	1	0	0
V108	3	Dec	<i>Sarga/Sorghum</i> spp.	5	0	0
V108	3	Dec	<i>Triodia</i> spp.	4	0	1
V109	1	Dec	<i>Triodia</i> spp.	3	0	1
V109	2	Dec	<i>Triodia</i> spp.	1	0	1
V109	3	Dec	<i>Triodia</i> spp.	6	0	1
V112	1	Dec	<i>Triodia</i> spp.	9	0	0
V112	2	Dec	<i>Sarga/Sorghum</i> spp.	2	0	0
V112	2	Dec	<i>Triodia</i> spp.	2	0	0
V112	3	Dec	<i>Sarga/Sorghum</i> spp.	35	0	0
V113	1	Dec	<i>Triodia</i> spp.	6	0	0
V113	2	Dec	<i>Sarga/Sorghum</i> spp.	50	0	0
V113	3	Dec	<i>Sarga/Sorghum</i> spp.	23	0	0
V114	1	Dec	<i>Sarga/Sorghum</i> spp.	60	0	0
V114	2	Dec	<i>Sarga/Sorghum</i> spp.	13	0	0
V114	2	Dec	<i>Triodia</i> spp.	4	0	0
V114	3	Dec	<i>Triodia</i> spp.	7	0	0
V114	3	Dec	<i>Sarga/Sorghum</i> spp.	3	0	0
V115	2	Dec	<i>Sarga/Sorghum</i> spp.	11	0	0
V115	3	Dec	<i>Sarga/Sorghum</i> spp.	25	0	0
V116	1	Dec	<i>Triodia</i> spp.	15	0	0
V116	2	Dec	<i>Triodia</i> spp.	10	0	1
V117	1	Dec	<i>Triodia</i> spp.	5	0	0
V117	2	Dec	<i>Triodia</i> spp.	1	0	1
V118	1	Dec	<i>Triodia</i> spp.	12	0	0
V118	2	Dec	<i>Triodia</i> spp.	15	0	0
V118	3	Dec	<i>Sarga/Sorghum</i> spp.	30	0	0
V118	3	Dec	<i>Triodia</i> spp.	15	0	0
V119	2	Dec	<i>Triodia</i> spp.	25	0	0
V119	3	Dec	<i>Sarga/Sorghum</i> spp.	40	0	0

Transect	Quadrat	Month	Grass Species	Total Individuals	No. Flowering	No. Seeding
V120	1	Dec	<i>Triodia</i> spp.	8	0	0
V120	2	Dec	<i>Triodia</i> spp.	15	0	0
V120	2	Dec	<i>Sarga/Sorghum</i> spp.	7	0	0
V120	3	Dec	<i>Sarga/Sorghum</i> spp.	20	0	0
V120	3	Dec	<i>Triodia</i> spp.	9	0	0
V121	1	Dec	<i>Triodia</i> spp.	11	0	0
V121	2	Dec	<i>Triodia</i> spp.	14	0	0
V121	3	Dec	<i>Triodia</i> spp.	11	0	0
V122	1	Dec	<i>Chrysopogon fallax</i>	5	0	0
V122	1	Dec	<i>Sarga/Sorghum</i> spp.	3	0	0
V122	2	Dec	<i>Sarga/Sorghum</i> spp.	8	0	0
V122	3	Dec	<i>Sarga/Sorghum</i> spp.	7	0	0
V123	1	Dec	<i>Sarga/Sorghum</i> spp.	1	0	0
V123	2	Dec	<i>Sarga/Sorghum</i> spp.	3	0	0
V123	3	Dec	<i>Themeda triandra</i>	3	0	0
V124	1	Dec	<i>Sarga/Sorghum</i> spp.	7	0	0
V124	2	Dec	<i>Themeda triandra</i>	4	0	0
V124	2	Dec	<i>Sarga/Sorghum</i> spp.	1	0	0
V124	3	Dec	<i>Themeda triandra</i>	6	0	0
V124	3	Dec	<i>Sarga/Sorghum</i> spp.	5	0	0
V125	2	Dec	<i>Themeda triandra</i>	1	0	0
V126	3	Dec	<i>Sarga/Sorghum</i> spp.	1	0	0
V127	3	Dec	<i>Themeda triandra</i>	1	0	0
V130	1	Dec	<i>Themeda triandra</i>	4	0	0
V131	2	Dec	<i>Sarga/Sorghum</i> spp.	2	0	0
V132	1	Dec	<i>Sarga/Sorghum</i> spp.	5	0	0
V132	2	Dec	<i>Panicum decompositum</i>	1	0	0
V133	1	Dec	<i>Sarga/Sorghum</i> spp.	8	0	0
V133	2	Dec	<i>Themeda triandra</i>	3	0	0
V133	3	Dec	<i>Sarga/Sorghum</i> spp.	3	0	0
V133	3	Dec	<i>Themeda triandra</i>	3	0	0
V134	1	Dec	<i>Sarga/Sorghum</i> spp.	5	0	0
V134	2	Dec	<i>Sarga/Sorghum</i> spp.	1	0	0
V134	3	Dec	<i>Panicum decompositum</i>	1	0	1
V140	1	Dec	<i>Panicum decompositum</i>	1	0	0
V101	1	Mar	<i>Sarga/Sorghum</i> spp.	3	0	0
V102	1	Mar	<i>Sarga/Sorghum</i> spp.	3	0	3
V102	1	Mar	<i>Triodia</i> spp.	1	0	1
V102	2	Mar	<i>Sarga/Sorghum</i> spp.	3	0	3
V102	3	Mar	<i>Sarga/Sorghum</i> spp.	4	0	4
V102	3	Mar	<i>Triodia</i> spp.	1	0	1
V103	1	Mar	<i>Sarga/Sorghum</i> spp.	3	0	3
V103	2	Mar	<i>Triodia</i> spp.	4	0	3
V103	2	Mar	<i>Sarga/Sorghum</i> spp.	3	0	2
V103	3	Mar	<i>Triodia</i> spp.	4	0	2
V103	3	Mar	<i>Sarga/Sorghum</i> spp.	2	0	2
V104	1	Mar	<i>Triodia</i> spp.	6	0	2
V104	1	Mar	<i>Sarga/Sorghum</i> spp.	1	0	1

Transect	Quadrat	Month	Grass Species	Total Individuals	No. Flowering	No. Seeding
V104	2	Mar	<i>Triodia</i> spp.	7	0	2
V104	3	Mar	<i>Triodia</i> spp.	4	0	3
V105	1	Mar	<i>Sarga/Sorghum</i> spp.	10	5	0
V105	1	Mar	<i>Heteropogon</i> sp.	1	0	0
V105	2	Mar	<i>Sarga/Sorghum</i> spp.	20	20	0
V105	2	Mar	<i>Heteropogon</i> sp.	5	0	0
V105	3	Mar	<i>Heteropogon</i> sp.	15	0	0
V105	3	Mar	<i>Sarga/Sorghum</i> spp.	10	4	0
V106	1	Mar	<i>Sarga/Sorghum</i> spp.	40	40	0
V106	2	Mar	<i>Sarga/Sorghum</i> spp.	60	50	10
V106	3	Mar	<i>Sarga/Sorghum</i> spp.	30	25	0
V107	1	Mar	<i>Sarga/Sorghum</i> spp.	50	0	40
V107	2	Mar	<i>Sarga/Sorghum</i> spp.	20	8	0
V107	3	Mar	<i>Sarga/Sorghum</i> spp.	4	4	0
V108	1	Mar	<i>Sarga/Sorghum</i> spp.	15	12	0
V108	2	Mar	<i>Triodia</i> spp.	5	0	1
V108	3	Mar	<i>Triodia</i> spp.	4	0	2
V109	1	Mar	<i>Sarga/Sorghum</i> spp.	4	4	0
V109	1	Mar	<i>Triodia</i> spp.	2	0	2
V109	2	Mar	<i>Sarga/Sorghum</i> spp.	10	5	0
V109	3	Mar	<i>Triodia</i> spp.	4	0	0
V109	3	Mar	<i>Sarga/Sorghum</i> spp.	2	2	0
V110	1	Mar	<i>Sarga/Sorghum</i> spp.	30	0	10
V110	2	Mar	<i>Sarga/Sorghum</i> spp.	60	5	55
V110	3	Mar	<i>Sarga/Sorghum</i> spp.	60	10	50
V110	3	Mar	<i>Heteropogon</i> sp.	4	0	0
V111	1	Mar	<i>Heteropogon</i> sp.	6	0	0
V111	1	Mar	<i>Sarga/Sorghum</i> spp.	6	2	1
V111	2	Mar	<i>Sarga/Sorghum</i> spp.	40	10	20
V111	2	Mar	<i>Heteropogon</i> sp.	10	0	0
V111	3	Mar	<i>Sarga/Sorghum</i> spp.	80	10	70
V112	1	Mar	<i>Sarga/Sorghum</i> spp.	13	8	5
V112	2	Mar	<i>Sarga/Sorghum</i> spp.	18	14	4
V112	2	Mar	<i>Triodia</i> spp.	5	0	5
V112	3	Mar	<i>Sarga/Sorghum</i> spp.	30	0	30
V113	1	Mar	<i>Sarga/Sorghum</i> spp.	25	20	5
V113	1	Mar	<i>Triodia</i> spp.	6	0	5
V113	2	Mar	<i>Sarga/Sorghum</i> spp.	50	15	35
V113	3	Mar	<i>Sarga/Sorghum</i> spp.	10	5	5
V114	1	Mar	<i>Sarga/Sorghum</i> spp.	40	0	40
V114	2	Mar	<i>Sarga/Sorghum</i> spp.	15	0	15
V114	2	Mar	<i>Triodia</i> spp.	3	0	3
V114	3	Mar	<i>Sarga/Sorghum</i> spp.	12	10	2
V114	3	Mar	<i>Triodia</i> spp.	8	0	2
V115	1	Mar	<i>Sarga/Sorghum</i> spp.	8	8	0
V115	2	Mar	<i>Sarga/Sorghum</i> spp.	30	0	30
V115	3	Mar	<i>Sarga/Sorghum</i> spp.	30	25	5
V116	2	Mar	<i>Triodia</i> spp.	5	0	5

Transect	Quadrat	Month	Grass Species	Total Individuals	No. Flowering	No. Seeding
V117	1	Mar	<i>Triodia</i> spp.	2	0	1
V117	1	Mar	<i>Alloteropsis semialata</i>	1	0	1
V117	2	Mar	<i>Triodia</i> spp.	1	0	1
V118	1	Mar	<i>Sarga/Sorghum</i> spp.	25	15	0
V118	2	Mar	<i>Sarga/Sorghum</i> spp.	2	1	0
V118	3	Mar	<i>Sarga/Sorghum</i> spp.	20	20	0
V119	1	Mar	<i>Sarga/Sorghum</i> spp.	2	1	0
V119	2	Mar	<i>Triodia</i> spp.	5	0	3
V119	3	Mar	<i>Triodia</i> spp.	11	0	2
V120	1	Mar	<i>Triodia</i> spp.	5	0	0
V120	2	Mar	<i>Triodia</i> spp.	9	0	7
V120	3	Mar	<i>Sarga/Sorghum</i> spp.	20	20	0
V120	3	Mar	<i>Triodia</i> spp.	10	0	1
V121	1	Mar	<i>Sarga/Sorghum</i> spp.	8	8	0
V121	1	Mar	<i>Triodia</i> spp.	6	1	0
V121	2	Mar	<i>Triodia</i> spp.	10	0	3
V121	3	Mar	<i>Triodia</i> spp.	9	0	0
V122	1	Mar	<i>Sarga/Sorghum</i> spp.	6	0	0
V122	2	Mar	<i>Sarga/Sorghum</i> spp.	14	0	0
V122	3	Mar	<i>Sarga/Sorghum</i> spp.	40	0	0
V123	2	Mar	<i>Sarga/Sorghum</i> spp.	2	0	0
V124	1	Mar	<i>Sarga/Sorghum</i> spp.	1	0	0
V124	3	Mar	<i>Sarga/Sorghum</i> spp.	2	0	0
V126	1	Mar	<i>Themeda triandra</i>	6	0	0
V126	1	Mar	<i>Sarga/Sorghum</i> spp.	2	0	0
V126	2	Mar	<i>Panicum decompositum</i>	2	0	2
V127	3	Mar	<i>Sarga/Sorghum</i> spp.	4	0	0
V128	2	Mar	<i>Sarga/Sorghum</i> spp.	3	3	0
V129	1	Mar	<i>Sarga/Sorghum</i> spp.	3	0	0
V129	2	Mar	<i>Sarga/Sorghum</i> spp.	60	30	0
V130	1	Mar	<i>Themeda triandra</i>	2	0	0
V130	1	Mar	<i>Heteropogon</i> sp.	1	0	0
V130	2	Mar	<i>Chrysopogon fallax</i>	1	0	0
V131	1	Mar	<i>Sarga/Sorghum</i> spp.	3	0	0
V131	3	Mar	<i>Sarga/Sorghum</i> spp.	30	0	0
V131	3	Mar	<i>Panicum decompositum</i>	1	0	1
V132	1	Mar	<i>Sarga/Sorghum</i> spp.	5	0	0
V132	2	Mar	<i>Panicum decompositum</i>	1	0	1
V133	1	Mar	<i>Sarga/Sorghum</i> spp.	5	0	0
V133	2	Mar	<i>Themeda triandra</i>	3	0	0
V133	3	Mar	<i>Sarga/Sorghum</i> spp.	7	0	0
V133	3	Mar	<i>Themeda triandra</i>	1	0	0
V134	1	Mar	<i>Sarga/Sorghum</i> spp.	4	0	0
V134	2	Mar	<i>Chrysopogon fallax</i>	2	0	0
V134	3	Mar	<i>Panicum decompositum</i>	1	0	0
V135	2	Mar	<i>Sarga/Sorghum</i> spp.	6	0	0
V139	2	Mar	<i>Sarga/Sorghum</i> spp.	10	8	0

Appendix 6

Grass Monitoring Transect Photos





V101 – December 2021



V101 – March 2022



V102 – December 2021



V102 – March 2022



V103 – December 2021



V103 – March 2022



V104 – December 2021



V104 – March 2022



V105 – December 2021



V105 – March 2022



V106 – December 2021



V106 – March 2022



V107 – December 2021



V107 – March 2022



V108 – December 2021



V108 – March 2022



V109 – December 2021



V109 – March 2022



V110 – December 2021



V110 – March 2022



V111 – December 2021



V111 – March 2022



V112 – December 2021



V112 – March 2022



V113 – December 2021



V113 – March 2022



V114 – December 2021



V114 – March 2022



V115 – December 2021



V115 – March 2022



V116 – December 2021



V116 – March 2022



V117 – December 2021



V117 – March 2022



V118 – December 2021



V118 – March 2022



V119 – December 2021



V119 – March 2022



V120 – December 2021



V120 – March 2022



V121 – December 2021



V121 – March 2022



V122 – December 2021



V122 – March 2022

No image

V123 – December 2021



V123 – March 2022



V124 – December 2021



V124 – March 2022



V125 – December 2021



V125 – March 2022



V126 – December 2021



V126 – March 2022



V127 – December 2021



V127 – March 2022



V128 – December 2021



V128 – March 2022



V129 – December 2021



V129 – March 2022



V130 – December 2021



V130 – March 2022



V131 – December 2021



V131 – March 2022



V132 – December 2021



V132 – March 2022



V133 – December 2021



V133 – March 2022



V134 – December 2021



V134 – March 2022



V135 – December 2021



V135 – March 2022



V136 – December 2021



V136 – March 2022



V137 – December 2021



V137 – March 2022



V138 – December 2021



V138 – March 2022



V139 – December 2021



V139 – March 2022



V140 – December 2021



V140 – March 2022



V141 – December 2021



V141 – March 2022