

Bird Banding at Bowra

Station: 2020 Report



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for Birds Queensland

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1.0 Introduction

In late 2012 Birds Queensland (BQ) and the Australian Wildlife Conservancy (AWC) agreed on the terms for a long-term bird banding project at Bowra Sanctuary. This project was designed to examine survival, longevity, productivity, and movements of birds occupying the sanctuary. This report details the results of the eighth (2020) banding trip and provides some comparisons with the data collected during previous visits. On all trips pre-selected locations in all major habitats at Bowra were sampled to ensure inclusion of the full diversity of bird species on the sanctuary and to assess the degree of site-fidelity and habitat specialisation among all species. Until this year, all banding activities had been conducted over the late March–early April Easter period, but due to restrictions imposed by the Covid-19 pandemic in 2020, the visit was postponed until August. Consequently, comparisons of results from previous years should be interpreted cautiously since visit this year was in late winter rather than autumn.

1.1 Study Aims

Whilst the population ecology and life history characteristics of many Australian birds of the temperate zone are now well known, such information is largely lacking for birds inhabiting the arid zone, which covers over one half of the continent. Longevity, survivorship, productivity, territory size, local movements, breeding seasonality, and moult strategies are known for only a handful of arid-adapted species. This project aims to partially redress this knowledge gap by determining the life history characteristics of a range of common arid zone species using Bowra Sanctuary.

This is being achieved by establishing marked (banded) populations of these birds at multiple sites representing the range of habitats on Bowra Sanctuary. The populations will be re-sampled at regular intervals over a 10-year period. With bird count data, which are continuously collected by BQ volunteers, these banding statistics will furnish valuable information on population fluctuations among common species within the sanctuary. This information should be useful to AWC in making decisions about the management of Bowra’s ecosystems.

Over the coming years recapture data for common species will be analysed to estimate species-specific survival rates, productivity and local movements, whilst biometric data will be used to determine the extent and type of morphological variation, such as sexual dimorphism and body condition. Data on moult and breeding signs will be used to ascertain the annual cycle of these species. To provide an indication of total avifauna present, species lists at each site will be maintained to monitor species that are unlikely to be captured in mistnets (e.g. aerial insectivores, raptors, and waterbirds).

2.0 Methods

Birds are captured using mist nets. They are then banded, measured, and examined to record moult, fat, and breeding signs. Finally, they are weighed and released. Recaptured birds have their band number recorded and are measured and examined in the same way. Species seen and heard at each site are also recorded. The methods are based on the constant effort methods used by banding schemes worldwide in their monitoring of bird populations. They have been adapted slightly for this study, but still maintain the basic pre-requisites for standardised monitoring through the consistent reuse of the same locations, as well as the recording of effort across standardised catching times.

2.1 Banding Locations

Bowra Sanctuary is located 15 km northwest of Cunnamulla, Queensland. The property was an active sheep and then cattle station from the 1890's until the AWC's purchase of the property in 2010. Since 2010, the property has been gradually de-stocked and artificial water sources have been reduced. The sanctuary has a range of habitats including gidgee woodlands, cyprus-pine woodlands, acacia scrublands, open grasslands, stony mulga with poplar box, riparian coolabah and lignum, and riparian river red gum. There is one near permanent natural waterhole on the property at Gumholes, one semi-permanent waterhole at Sawpits, and other ephemeral water points in years with good rains. There is an artificial permanent water source at the Homestead Lagoon. The Bore Drain, which extended along the eastern side of the property, was removed in 2017 after the banding trip. All other artificial permanent water sources have been removed, and now contain water only after good rains.

Prior to the first visit in 2013, ten areas that cover the range of habitats known at Bowra Sanctuary were selected as candidates for permanent sampling locations (Appendix 1). Over the eight years of the project 35 sites have been sampled across the ten areas. In 2013 seven sites from seven areas were sampled. In 2014 sampling increased to 13 sites in eight areas. From 2015 until now, all ten areas were sampled, starting with 17 sites in 2015, and increasing to 28 sites in 2018 (Appendix 1).

In 2019 sampling all sites proved difficult due to heavy rainfall during the trip, and only nine of the ten areas were visited as wet conditions prevented access to Area 8. The rain event contrasted with the extremely dry initial site conditions on arrival when water was present only at the Homestead (Area 1) and Back Dam (Area 9). Even Gumholes (Area 7) and Sawpits (Area 2) were completely dry. As a result of heavy rain, the property became flooded and largely inaccessible, preventing access to all sites in Area 8 and one site each in Area 9 and Area 10. Consequently, seven of the 28 sites sampled in 2018 were not sampled in 2019, although they were photographed as a record of the condition of the habitat. To compensate in 2019, seven new sites in Area 1 were sampled. This area included patches dominated by *Callitris* (Cyprus-pine) woodland which had hitherto been poorly sampled.

Due to Covid-19 social distancing protocols, the 2020 visit was made with a significantly reduced team size, with the consequence that sampling also needed to be reduced. Thus fewer sites (23) were visited than in previous years, but all areas were sampled at least once. Access to Area 8

(Western Paddock) was restricted due to waterlogged access roads and only one site was sampled. Other areas were wet but accessible with care.

All sites are shown in Appendix 1, and Appendices 2-30 present photographs of all sites. The sites visited and their frequencies are shown in Table 1.

Table 1: Long term bird banding sites at Bowra Sanctuary and the years surveyed. New sites marked with an asterisk

Site name	Habitat	Location of central point	2013	2014	2015	2016	2017	2018	2019	2020
AREA 1: HOMESTEAD										
Site 1A – Homestead	Gidgee and <i>Acacia victoriae</i> (homestead area with permanent billabong)	-27.989673 145.609957	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Site 1B – Cottage Dam	Gidgee and Acacia scrub adjacent to intermittent water source	-27.990395 145.595152	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Site 1C – Bore Drain	Gidgee and Acacia scrub adjacent to permanent water until 2017.	-27.986238 145.611463	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Site 1D – Shearers Qtrs	Low, sparsely distributed <i>Acacia spp</i> with mixed grasses.	-27.991789 145.609039	No	No	No	Yes	No	Yes	Yes	Yes
Site 1E – Bottle Dump*	Open Cypress Woodland	-27.98559 145.60458	No	No	No	No	No	No	Yes	No
Site 1F – Main Drive 0km*	Gidgee Woodland	-27.98705 145.60978	No	No	No	No	No	No	Yes	No
Site 1G – Main Drive 0.5km*	Open Acacia scrub	-27.986769 145.620438	No	No	No	No	No	No	Yes	No
Site 1H – Main Drive 1km*	Open Acacia scrub	-27.986769 145.620438	No	No	No	No	No	No	Yes	No
Site 1I – Main Drive 1.5km*	Open Acacia scrub	-27.98774 145.62569	No	No	No	No	No	No	Yes	No
Site 1J – Main	Open Cypress Woodland and	-27.98963	No	No	No	No	No	No	Yes	No

Site name	Habitat	Location of central point	2013	2014	2015	2016	2017	2018	2019	2020
Drive 2.5km*	Acacia Scrub	145.63772								
Site 1K – Main Drive 3.0km*	Open Acacia scrub	-27.988901 145.638138	No	No	No	No	No	No	Yes	No
AREA 2: SAWPITS AREA										
Site 2A – Sawpits	Coolabah and Lignum near permanent water (riparian)	-27.963091 145.580451	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Site 2B – Sawpits West	Coolabah and Lignum near permanent water (riparian)	-27.962908 145.576762	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AREA 3: MAIN CREEK CROSSING AREA										
Site 3A – Main Creek Crossing	Poplar Box, Coolabah, Cypress pine and Emu bush understory	-27.978665 145.577755	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Site 3B – Main Creek, Ian's Place	Poplar Box, Coolabah, Cypress pine with flowering <i>Corymbia clarksoniana</i>	-27.986998 145.576950	No	No	No	Yes	Yes	Yes	Yes	Yes
Site 3C – Quarry Road Junction	Woodland of Poplar Box with shrubby <i>Eremophila</i> and <i>Acacia</i> understorey, grass. Intermittent water source present	-27.977660 145.561000	No	No	No	Yes	Yes	Yes	Yes	Yes
Site 3D – Loading Dock	Woodland of Poplar Box and Mulga with shrubby <i>Eremophila</i> and <i>Acacia</i> understorey, grass. Intermittent water source present in some years	-27.980307 145.557022	No	No	No	No	Yes	Yes	Yes	Yes
AREA 4: STONY LOOKOUT AREA										

Site name	Habitat	Location of central point	2013	2014	2015	2016	2017	2018	2019	2020
Site 4A – Stony Lookout	Poplar Box, Emu Bush and young Mulga	-27.980600 145.545890	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Site 4B –Stony Lookout West	Mature Mulga on rocky red hill side with some small <i>Eremophila</i> shrubs	-27.979052 145.534302	No	No	Yes	Yes	Yes	Yes	Yes	Yes
AREA 5: STONY MULGA AREA										
Site 5 – Stony Mulga	Mature Mulga	-27.982977 145.526987	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AREA 6: TABLELANDS AREA										
Site 6A – Tablelands	Red gibber with Mulga areas, Emu bush understory in places	-27.952868 145.537045	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Site 6B – Tablelands Top	Open red gibber with mixed grass cover, sparsely distributed trees.	-27.951810 145.538650	No	No	No	Yes	Yes	Yes	Yes	Yes
AREA 7: GUMHOLES AREA										
Site 7A – Gumholes	River Red Gums beside permanent water (riparian)	-27.999016 145.529182	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Site 7B – Gumholes West	Poplar Box, Emu Bush and young Mulga	-27.995302 145.525265	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AREA 8: WESTERN PADDOCK AREA										
Site 8A – Western Paddock	Gidgee and Emu bush to 2.5m high with intermittent water source	-27.963945 145.508320	Yes	No	No	No	Yes	Yes	No	No
Site 8B – Small Dam	Mulga to 2m with intermittent water source and scrub nearby	-27.955108 145.484709	No	Yes	Yes	Yes	Yes	Yes	No	No
Site 8C – Bottom Trough	Mulga to 2m with intermittent water source and scrub nearby	-27.972794 145.516823	No	Yes	Yes	Yes	Yes	Yes	No	Yes

Site name	Habitat	Location of central point	2013	2014	2015	2016	2017	2018	2019	2020
Site 8D – Middle Dam	<i>Myoporum</i> and <i>Eremophila</i> shrubland to 2.5 m height adjacent to intermittent water source	-27.972617 145.486450	No	No	Yes	No	No	Yes	No	No
Site 8E – Top Corner	Mulga to 2m with scrub and intermittent water source	-27.943278 145.487111	No	No	No	Yes	Yes	Yes	No	No
AREA 9: SOUTH HOMESTEAD AREA										
Site 9A – South of Homestead	<i>Acacia victoriae</i> - <i>A. excelsa</i> scrub with <i>E. populnea</i> and Cypress	-28.010793 145.561674	Yes	No	Yes	Yes	Yes	Yes	No	Yes
Site 9B – Back Dam	<i>Myoporum</i> and <i>Eremophila</i> shrubland to 2.5 m height adjacent to semi-permanent water	-28.027130 145.56250	No	No	No	No	Yes	Yes	Yes	Yes
AREA 10: SOUTHERN BORE DRAIN AREA										
Site 10A – Southern Bore	Low woodland and scrub	-28.004643 145.607888	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Site 10B – Homestead Loop Wetland	Gidgee and Acacia scrub adjacent to ephemeral water source	-28.013430 145.603300	No	No	No	Yes	Yes	Yes	Yes	Yes
Site 10C – S Bore 2.5km South	Mixed woodland and Acacia scrub	-28.008806 145.620194	No	No	No	Yes	Yes	Yes	Yes	Yes
Site 10D - S Bore 5km South	Mixed woodland and Acacia scrub	-28.016820 145.623020	No	No	No	Yes	Yes	Yes	No	No

2.2 Trapping, Banding, and Measuring

Birds were trapped in mist nets of lengths between 12 and 18 m, with multiple nets used per site. At each site, mist netting was conducted from mid afternoon to dusk (14:00–18:00 hrs) on the first day

of sampling, and from dawn to midday on the following day (06:00–12:00 hrs). Sampling effort was calculated as total net length x hours of operation. Capture rates (Table 2) were calculated for each site by dividing the total number of birds caught by the effort expended and Table 2 also includes the comparative rates for those sites for each year of the study. Weather conditions, as well as other environmental factors (e.g. presence of flowering trees) that may affect capture rates, were also noted for each banding session.

Each captured bird was banded, aged and sexed (where possible), weighed, measured, and thoroughly examined for moult and signs of breeding before release. Where possible, ratios of adults to juveniles were used to indirectly estimate productivity and these data are presented below (Table 5). Measurements taken on captured birds were wing chord length, tarsus length, tail length, total head length (to nearest 0.1 mm), exposed culmen, and weight to the nearest 0.1g. The amount of inter-clavicular fat and pectoral muscle tissue were estimated by visual examination using a score from 0 (nil) to 5 (maximum) and 0 to 3 respectively. Body condition was assessed by regressing weight against the composite size measurements. These mensural data combined with data on plumage characters enabled an initial assessment of morphological variation, such as sexual dimorphism in selected species. It also allows the identification of accurate ageing and sexing criteria. Such criteria will be useful in future comparisons with other studied populations of the same or related species as the dataset develops.

Moult data were also collected for any birds in active wing moult. In addition, all species seen or heard during each banding session were recorded to identify the species present at each site.

3 Results

This year the banding activities program was conducted from 8 to 15 August 2020. Multiple sites were surveyed within ten sampling areas, resulting in a total sample of 23 from the 35 previously sampled sites. The habitats sampled included mulga woodlands, riparian vegetation, and a range of other habitats including semi-permanent billabongs, gidgee woodland, mixed acacia scrub and *Callitris* woodland. A significant change to the property hydrology first observed during the 2018 survey was the piping of the open bore drain in mid-2017. This removed a permanent water source of the four sites that are adjacent to the bore drain, one in Area 1 and three in Area 10 (Table 1). This year was the third year of monitoring how the distribution of birds on the property may have changed since that event. It was also the first opportunity since the removal of the open drain to examine bird distribution in a wet year.

3.1 Species banded

In 2020 a total of 1,136 birds of 49 species were captured. This included 1,091 new individuals representing all 49 species and 41 recaptured individuals representing 14 species (Table 3). This year saw the highest mean catch rate since the project began in 2013, in stark contrast to the previous year (2019) which saw the lowest recorded catch rate to date (Fig. 1).

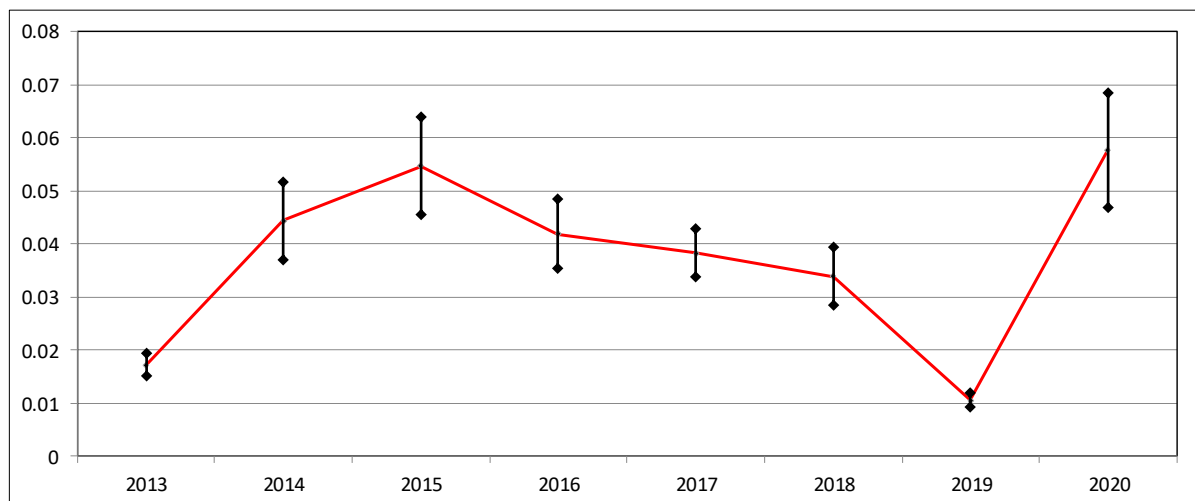


Figure 1: Mean Catch rate across all locations for each year of the study

Since 2013 a total of 6,443 individuals of 90 species (Table 3) have been banded, of which 470 individuals of 37 species have been recaptured. The most commonly captured species in 2020 was the Zebra Finch (Table 4), accounting for 30.5% of the total catch. The Diamond Dove and Budgerigar were the second and third most frequently captured, accounting for 18.8% and 16.1%, respectively. These three species accounted for 65.4% of the entire catch. In contrast, while the White-plumed Honeyeater is normally one of the most captured species, it accounted for only 5.9% of the catch in 2020, the lowest proportion recorded to date.

Five species were captured for the first time: Little Button-quail, Brown Goshawk, Black Honeyeater, Tree Martin, and Fairy Martin. Brown Goshawks are seen regularly at Bowra, but their behaviour and low population density makes them an unlikely candidate for capture with regular mist netting techniques. Visiting later in the year provided the opportunity to catch species not generally recorded in March or April. Black Honeyeaters typically visit the property from August onwards. Both martin species were breeding, Fairy Martins nesting on several of the Homestead buildings. Little Button-quail are rarely recorded on the property but the favourable breeding conditions of 2020 apparently resulted in a substantial influx. These favourable conditions doubtless contributed to the high catch rates for Budgerigar, Diamond Dove and Zebra Finch, notably all granivorous species.

At all sites that were sampled in 2020, capture rates were higher than in 2019, and in many cases higher than most other years. This highlights the large numbers of birds present throughout the sanctuary during this year's visit. The highest catch rates were in Area 10 along the Southern Bore Drain site and in Area 1 at the Bore Drain head. This indicates the high use of these areas by birds even after the drain was piped three years ago. The lowest capture rates in 2020 were at the Mulga sites, but even here the catch rates here were significantly higher than in recent years.

The greatest number of species captured per site was 16 at the Homestead Loop Wetland (Area 10), followed by 13 species at Sawpits (Area 2), and 12 species at the Homestead (Area 1). The

lowest numbers of captured species were in Mulga sites (5 and 9 species), though these totals were higher than in previous years.

The numbers of species observed or heard at each site (Appendix 31) did not mirror the trends for birds captured while mist-netting. The highest numbers of species recorded were at Area 1 Homestead (59 species), Area 1 Shearers Quarters (58), and Area 2 Sawpits West (40). The lowest number of species observed (12) was at Area 8 Bottom Trough.

Table 2: Comparison of capture rates, and number of bird species seen and captured at each site over the seven years of sampling.

Location	2013 Capture rate	2014 Capture rate	2015 Capture rate	2016 Capture rate	2017 Capture rate	2018 Capture rate	2019 Capture rate	2020 Capture rate	2020 No. birds caught total	2020 Species total caught	2020 Species Total Seen
Site 1A- Homestead	0.022	0.023	0.071	0.021	0.062	0.104	0.014	0.064 0.061	72	12	57
Site 1B - Cottage Dam	n/a	0.046	0.114	0.036	0.022	0.008	0.003	0.046	23	8	20
Site 1C- Bore Drain	n/a	0.097	0.048	0.046	0.064	0.012	0.021	0.090	138	11	38
Site 1D- Shearers Quarters	n/a	n/a	n/a	0.016	n/a	0.049	0.028	0.009	6	2	58
Site 1E – Bottle Dump	n/a	n/a	n/a	n/a	n/a	n/a	0.007	n/a	n/a	n/a	n/a
Site 1F – Main Drive 0km	n/a	n/a	n/a	n/a	n/a	n/a	0.004	n/a	n/a	n/a	n/a
Site 1G – Main Drive 0.5km	n/a	n/a	n/a	n/a	n/a	n/a	0.025	n/a	n/a	n/a	n/a
Site 1H – Main Drive 1km	n/a	n/a	n/a	n/a	n/a	n/a	0.003	n/a	n/a	n/a	n/a
Site 1I – Main Drive 1.5km	n/a	n/a	n/a	n/a	n/a	n/a	0.000	n/a	n/a	n/a	n/a
Site 1J – Main Drive 2.5km	n/a	n/a	n/a	n/a	n/a	n/a	0.013	n/a	n/a	n/a	n/a
Site 1K – Main Drive 3.0km	n/a	n/a	n/a	n/a	n/a	n/a	0.005	n/a	n/a	n/a	n/a
Site 2A – Sawpits	0.018	0.06	0.039	0.022	0.051	0.093	0.011	0.069	59	13	29
Site 2B - Sawpits West	n/a	0.104	0.142	0.008	0.062	0.038	0.000	0.092	55	8	40
Site 3A - Main Creek Crossing	n/a	0.068	0.046	0.010	0.027	0.038	0.012	0.031	32	6	27
Site 3B – Main Creek, Ian's place	n/a	n/a	n/a	0.070	0.071	0.033	0.019	0.058	28	5	21
Site 3C – Quarry Road junction	n/a	n/a	n/a	0.063	0.077	0.012	0.013	0.067	59	9	38
Site 3D – Loading Dock	n/a	n/a	n/a	n/a	0.066	0.006	0.000	0.017	14	9	17
Site-4A- Stony Lookout	0.004	0.006	0.007	0.013	0.016	0.004	0.004	0.007	15	6	22
Site 4B- Stony Lookout – West	n/a	n/a	0.007	0.064	0.010	0.004	0.004	0.018	19	9	26
Site 5-Stony Mulga	0.007	0.006	0.020	0.014	0.003	0.002	0.005	0.037	17	6	28
Site 6A- Tablelands	n/a	0.016	0.033	0.039	0.019	0.003	0.003	0.048	23	8	17
Site 6B – Tablelands Top	n/a	n/a	n/a	0.009	0.013	0.011	0.005	0.023	12	7	21
Site 7A – Gumholes	0.01	0.029	0.045	0.024	0.01	0.065	0.013	0.043	54	9	33
Site 7B - Gumholes West	n/a	0.035	0.014	0.016	0.028	0.003	0.002	0.017	11	5	31
Site 8A - Western Paddock	0.018	n/a	n/a	n/a	0.019	0.014	n/a	n/a	n/a	n/a	n/a
Site 8B - Small Dam	n/a	0.056	0.093	0.027	0.014	0.009	n/a	n/a	n/a	n/a	n/a
Site 8C - Bottom Trough	n/a	0.044	n/a	0.009	0.007	0.010	n/a	0.013	10	7	12
Site 8D - Middle Dam	n/a	n/a	0.070	n/a	n/a	0.020	n/a	n/a	n/a	n/a	n/a
Site 8E – Top Corner	n/a	n/a	n/a	0.064	0.023	0.011	n/a	n/a	n/a	n/a	n/a
Site 9A - South Homestead	0.018	n/a	0.035	0.026	0.024	0.008	n/a	0.065	43	7	25
Site 9B – Back Dam	n/a	n/a	n/a	n/a	0.084	0.076	0.014	0.042 0.130	52	10	44
Site 10A-Southern Bore Drain	n/a	n/a	0.094	0.057	0.089	0.004	0.004	0.275	86	4	32
Site 10B – Homestead Loop Wetland	n/a	n/a	n/a	0.020	0.049	0.022	0.009	0.075	91	16	31
Site 10C - Southern Bore Drain 2.5km S	n/a	n/a	n/a	0.044	0.029	0.033	0.002	0.46	32	8	32

Location	2013 Capture rate	2014 Capture rate	2015 Capture rate	2016 Capture rate	2017 Capture rate	2018 Capture rate	2019 Capture rate	2020 Capture rate	2020 No. birds caught total	2020 Species total caught	2020 Species Total Seen
Site 10D - Southern Bore Drain 5km S	n/a	n/a	n/a	0.123	0.027	0.017	n/a	n/a	n/a	n/a	n/a

Table 3: Number of individuals of each species banded (N) and re-trapped (R) in each area during April 2019, and the grand total caught over the duration of the study (2013-2020)

Species	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Site 8		Site 9		10		2020 Total		Grand Total	
	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R
Little Button-quail	1				2				1										1		5	0	5	0
Common Bronzewing																					0	0	12	0
Crested Pigeon																					0	0	17	0
Diamond Dove	64		9		20		1				1		20		1		37		59	1	212	1	274	1
Peaceful Dove	6		3		1								6						1		17	0	237	22
Horsfield's Bronze Cuckoo	1												2						1		4	0	10	0
Spotted Nightjar																					0	0	1	0
Australian Owlet Nightjar																					0	0	3	1
Black-tailed Native-hen																					0	0	10	1
Black-fronted Dotterel	8																				8	0	30	1
Red-kneed Dotterel																					0	0	1	0
Collared Sparrowhawk																					0	0	1	0
Brown Goshawk	1																				1	0	1	0
Rainbow Bee-eater																					0	0	1	0
Sacred Kingfisher					1																1	0	17	0
Red-backed Kingfisher																					0	0	1	0
Laughing Kookaburra																					0	0	2	0
Brown Falcon																					0	0	1	0
Galah																					0	0	5	0
Major Mitchell's Cockatoo																					0	0	4	0
Red-winged Parrot																					0	0	7	0
Red-rumped Parrot																					0	0	4	0
Blue Bonnet																					0	0	5	0
Mulga Parrot															1		1		1		3	0	42	1
Australian Ringneck			3												2						5	0	67	1
Bourke's Parrot							1										3				4	0	39	3
Blue-winged Parrot																					0	0	1	0
Budgerigar	2		48		1								2				3		127		183	0	184	0
Spotted Bowerbird	3																				3	0	81	1
White-browed Treecreeper					1																1	0	17	1
Brown Treecreeper	4	1	7	5	16	2							3	1			1		3	2	34	11	160	39
Variegated Fairy-wren	1		1		4																6	0	49	4

	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Site 8		Site 9		10		2020 Total		Grand Total	
Species	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R
Splendid Fairy-wren					2	2	6		7	1	3										18	3	162	9
White-winged Fairy-wren																		2			2	0	28	1
Striped Honeyeater																					0	0	21	0
Noisy Friarbird																					0	0	1	0
Little Friarbird			1														1				2	0	16	0
Brown Honeyeater																					0	0	61	1
Blue-faced Honeyeater																					0	0	4	0
Brown-headed Honeyeater																					0	0	28	0
Pied Honeyeater																					0	0	3	0
Black Honeyeater							2				2										4	0	4	0
Crimson Chat																					0	0	5	0
Spiny-cheeked Honeyeater	6	1									1								1		8	1	338	5
Singing Honeyeater	1				3												2		3		9	0	291	14
Grey-headed Honeyeater											2										2	0	26	1
White-plumed Honeyeater	17	6	16	1	4								11	1	1		3		7		59	8	1516	254
White-fronted Honeyeater																					0	0	2	0
Yellow-throated Miner	2																				2	0	121	0
Striated Pardalote																					0	0	2	0
Weebill																					0	0	19	0
Redthroat					1																1	0	2	0
Southern Whiteface	2	1															1		3	1	6	2	20	5
Yellow-rumped Thornbill																					0	0	37	4
Yellow Thornbill																					0	0	13	0
Inland Thornbill					2		2		1		2										7	0	74	11
Chestnut-rumped Thornbill	2	2					2		2		1		3		1				2		13	2	154	7
Grey-crowned Babbler			2																		2	0	23	1
Hall's Babbler							2				1										2	1	40	5
Chestnut-crowned Babbler	7																		9	1	16	1	81	12
Varied Sittella																			2		2	0	12	0
Black-faced Cuckoo-Shrike																					0	0	1	0
White-winged Triller					1														1		2	0	10	0
Chestnut-breasted Quail-thrush																					0	0	3	0
Rufous Whistler	2	1					1				1		1				1		1		7	1	89	1
Grey Shrike-thrush	2																				2	0	25	0
Crested Bellbird							1												2		3	0	14	0
Pied Butcherbird																			1		1	0	35	0
Grey Butcherbird																					0	0	31	2
White-browed Woodswallow																					0	0	3	0
Black-faced Woodswallow																					0	0	7	0
Little Woodswallow																					0	0	1	0
White-breasted Woodswallow																					0	0	14	1

	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Site 8		Site 9		10		2020 Total		Grand Total	
Species	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	R
Willie Wagtail	7	2	1		1								2	1			2		6		19	3	102	9
Grey Fantail																					0	0	30	0
Little Crow																					0	0	1	0
Restless Flycatcher	2																				2	0	8	1
Magpie-lark																					0	0	9	0
White-winged Chough																	1				1	0	2	0
Apostlebird																					0	0	8	0
Red-capped Robin	1				1		4		3		2		4		2		3	1	1		21	1	157	4
Jacky Winter	1																				1	0	34	3
Hooded Robin	1																		5	2	6	2	35	3
Mistletoe Bird																					0	0	24	1
Plum-headed Finch			1																		1	0	53	0
Zebra Finch	78	4	7		65		12		1		18		8		2		34		117		342	4	799	7
Double-barred Finch																					0	0	503	32
Tree Martin	1																				1	0	1	0
Fairy Martin	28																				28	0	28	0
Rufous Songlark	1		9		3												1				14	0	23	0
Total Species Caught	28	8	13	2	18	2	11	0	6	1	10	1	11	3	7	0	15	1	23	5	48	14	90	37

3.2 Capture rates of species between years

Many species have been caught in sufficiently large numbers to indicate trends over the eight years of sampling. Several insectivorous species including Inland Thornbill, Red-capped Robin, Willie Wagtail and Variegated Fairy-wrens have shown consistent capture rates over the study period. Granivores and nectarivores, on the other hand, have shown significant variation in capture rates between years (Table 4). The small granivorous Zebra Finch, Diamond Dove and Budgerigar were present in the catch for the first time in several years and accounted for almost two-thirds (65.4%) of all birds caught.

The contribution of White-plumed Honeyeaters in 2020 (5.9%) was the lowest catch rate recorded to date for this species, and fewer birds were observed compared to previous years (Table 4). The last two years have shown a significant decline in the population on the property. This decline is the subject of a separate analysis which is intended for publication in 2021. Honeyeaters accounted for only 8.5% of the total catch in 2020.

Table 4: Percentage contribution of each species to the total number of individuals and species caught each year

Species	2013 %	2014 %	2015 %	2016 %	2017 %	2018 %	2019 %	2020 %
Little Button-quail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Common Bronzewing	0.0	0.2	0.2	0.0	0.2	0.3	1.1	0.0
Crested Pigeon	0.0	0.0	0.3	0.0	0.6	0.8	0.8	0.0
Diamond Dove	1.3	4.1	0.8	0.0	0.3	0.2	0.0	18.8
Peaceful Dove	6.4	1.2	6.9	4.2	5.9	1.8	1.1	1.5
Horsfield's Bronze Cuckoo	0.0	0.1	0.3	0.0	0.1	0.0	0.0	0.4
Spotted Nightjar	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
Australian Owlet Nightjar	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0
Black-tailed Native-hen	0.0	0.0	0.0	0.0	0.7	0.3	0.0	0.0
Black-fronted Dotterel	0.0	0.1	0.3	0.6	0.5	0.8	0.4	0.7
Red-kneed Dotterel	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Collared Sparrowhawk	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0
Brown Goshawk	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Rainbow Bee-eater	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
Sacred Kingfisher	0.0	0.5	0.1	0.4	0.0	0.8	0.0	0.1
Red-backed Kingfisher	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Laughing Kookaburra	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0
Brown Falcon	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Galah	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.0
Major Mitchell's Cockatoo	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0
Red-winged Parrot	0.6	0.0	0.3	0.0	0.2	0.0	0.0	0.0
Red-rumped Parrot	0.0	0.0	0.0	0.0	0.0	0.2	1.1	0.0
Blue Bonnet	0.0	0.0	0.0	0.0	0.1	0.6	0.0	0.0
Mulga Parrot	0.0	0.0	0.2	0.1	0.6	3.2	3.4	0.3
Australian Ringneck	1.9	0.1	0.3	0.9	2.2	1.7	2.3	0.4
Bourke's Parrot	0.0	0.0	0.2	0.8	1.0	1.8	0.4	0.4
Blue-winged Parrot	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Budgerigar	0.0	0.1	0.0	0.0	0.0	0.0	0.0	16.1
Spotted Bowerbird	0.0	0.0	0.7	1.0	3.7	1.4	1.5	0.3
White-browed Treecreeper	0.0	0.1	0.2	0.6	0.3	0.3	0.0	0.1
Brown Treecreeper	3.8	2.8	1.5	1.4	3.5	2.6	8.3	4.0
Variegated Fairy-wren	1.4	0.6	0.3	1.1	1.7	0.5	0.0	0.5
Splendid Fairy-wren	5.1	1.3	3.0	3.2	3.4	0.9	2.3	1.9
White-winged Fairy-wren	0.0	0.6	0.3	1.3	0.0	0.0	0.4	0.2
Striped Honeyeater	0.0	0.1	0.1	0.3	1.0	0.5	0.0	0.0
Noisy Friarbird	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Little Friarbird	0.0	0.7	0.1	0.4	0.0	0.0	0.0	0.2
Brown Honeyeater	0.6	4.0	0.5	3.7	0.2	0.2	0.8	0.0
Blue-faced Honeyeater	0.0	0.0	0.0	0.0	0.2	0.0	0.4	0.0

Species	2013 %	2014 %	2015 %	2016 %	2017 %	2018 %	2019 %	2020 %
Brown-headed Honeyeater	0.0	0.4	0.0	1.7	0.1	0.2	0.4	0.0
Pied Honeyeater	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Black Honeyeater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Crimson Chat	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.1
Spiny-cheeked Honeyeater	1.9	2.0	2.7	11.2	11.0	0.0	1.1	0.8
Singing Honeyeater	3.3	2.0	3.3	6.3	8.5	5.5	4.1	0.8
Grey-headed Honeyeater	0.0	0.1	0.1	0.8	0.9	0.2	0.8	0.2
White-plumed Honeyeater	23.9	25.7	26.4	35.9	18.7	48.7	18.4	5.9
White-fronted Honeyeater	0.6	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Yellow-throated Miner	0.0	0.1	1.2	1.4	2.6	5.2	7.9	0.2
Striated Pardalote	0.0	0.0	0.0	0.0	0.1	0.0	0.4	0.0
Weebill	1.4	0.2	0.2	0.9	0.1	0.0	0.0	0.0
Redthroat	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Southern Whiteface	0.0	0.2	0.0	0.1	0.8	0.2	1.1	0.7
Yellow-rumped Thornbill	1.9	0.2	0.3	0.1	1.0	1.8	2.6	0.0
Yellow Thornbill	0.0	0.4	0.1	0.0	0.2	0.5	0.4	0.0
Inland Thornbill	2.5	1.0	1.1	1.6	1.5	1.2	1.5	0.6
Chestnut-rumped Thornbill	7.6	2.0	0.9	2.3	3.2	2.8	5.6	1.3
Grey-crowned Babbler	0.0	0.2	0.2	0.0	0.2	1.7	1.5	0.2
Hall's Babbler	0.0	0.4	0.7	0.8	1.3	0.2	1.5	0.3
Chestnut-crowned Babbler	3.8	0.0	1.1	0.1	3.1	1.2	3.4	1.5
Varied Sittella	0.0	0.1	0.2	0.0	0.6	0.0	0.0	0.2
Black-faced Cuckoo-Shrike	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
White-winged Triller	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.2
Chestnut-breasted Quail-thrush	0.6	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Rufous Whistler	2.0	2.6	1.4	1.3	0.7	0.6	1.9	0.7
Grey Shrike-thrush	2.5	0.4	0.1	0.8	0.2	0.0	0.0	0.2
Crested Bellbird	0.6	0.1	0.0	0.2	0.2	0.3	0.8	0.3
Pied Butcherbird	0.0	0.0	0.2	1.0	1.4	0.5	0.0	0.1
Grey Butcherbird	0.6	0.1	0.7	0.3	1.0	0.8	0.4	0.0
White-browed Woodswallow	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Black-faced Woodswallow	0.0	0.0	0.0	0.3	0.0	0.5	0.0	0.0
Little Woodswallow	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
White-breasted Woodswallow	0.6	0.1	0.2	0.7	0.0	0.0	0.8	0.0
Willie Wagtail	1.9	1.0	1.4	1.9	0.7	2.8	3.0	1.9
Grey Fantail	0.6	1.2	0.1	0.0	0.2	0.6	3.0	0.0
Little Crow	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Restless Flycatcher	0.0	0.1	0.2	0.1	0.0	0.3	0.4	0.2
Magpie-lark	0.6	0.1	0.0	0.3	0.2	0.2	0.4	0.0

Species	2013 %	2014 %	2015 %	2016 %	2017 %	2018 %	2019 %	2020 %
White-winged Chough	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Apostlebird	0.0	0.3	0.1	0.0	0.1	0.0	1.1	0.0
Red-capped Robin	7.0	1.4	1.8	1.9	2.8	2.5	6.4	1.9
Jacky Winter	0.6	0.1	0.4	0.1	1.0	0.8	3.8	0.1
Hooded Robin	0.6	0.2	0.2	0.6	1.0	0.3	1.9	0.7
Mistletoe Bird	0.6	0.3	0.3	1.0	0.1	0.2	1.1	0.0
Plum-headed Finch	0.0	4.4	0.3	0.0	0.0	0.0	0.0	0.1
Zebra Finch	3.8	27.6	13.4	0.1	0.1	0.3	0.0	30.5
Double-barred Finch	9.4	10.0	23.8	4.9	5.7	0.3	0.0	0.0
Fairy Martin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5
Tree Martin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Rufous Songlark	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.2
NUMBER OF SPECIES CAUGHT	32	53	53	52	59	51	43	49
NUMBER OF BIRDS CAUGHT	157	1073	1102	1092	1129	649	266	1136

3.3 Proportion of juveniles

Ageing criteria have been developed for most of the species caught, and data collected this year confirmed these criteria or added new criteria. However, a few birds were recorded as “age unknown” due either to their tendency to undergo a complete post juvenile moult shortly after fledging or through lack of knowledge of appropriate criteria for those species. The remaining birds could be aged as either adult birds (typically 1 or more years old) or juveniles (within first year of age).

Among species in which more than ten individuals were caught, the highest proportions of juveniles were found in the following species: Budgerigar (83.6%), Willie Wagtail (59.1%), Diamond Dove (54.0%), and White-plumed Honeyeater (49.3%) (Table 5). Only 45.4% of the Zebra Finches caught were identified as juveniles, but the species is known to achieve full adult plumage and breed within their first year. Therefore, it is likely that the proportion of individuals <1 year in this species was considerably higher than suggested by morphometrics and plumage.

Of the 1,114 captured birds for which age could be estimated in 2020, 561 (50.3%) were considered juvenile. This high juvenile proportion was second only to the 56.7% rate recorded in 2015 and significantly higher than in the previous three years (22.8–26.0%). In the first four years of the project (2013-2016) the proportion varied from 39.4% to 56.7% (Fig. 2).

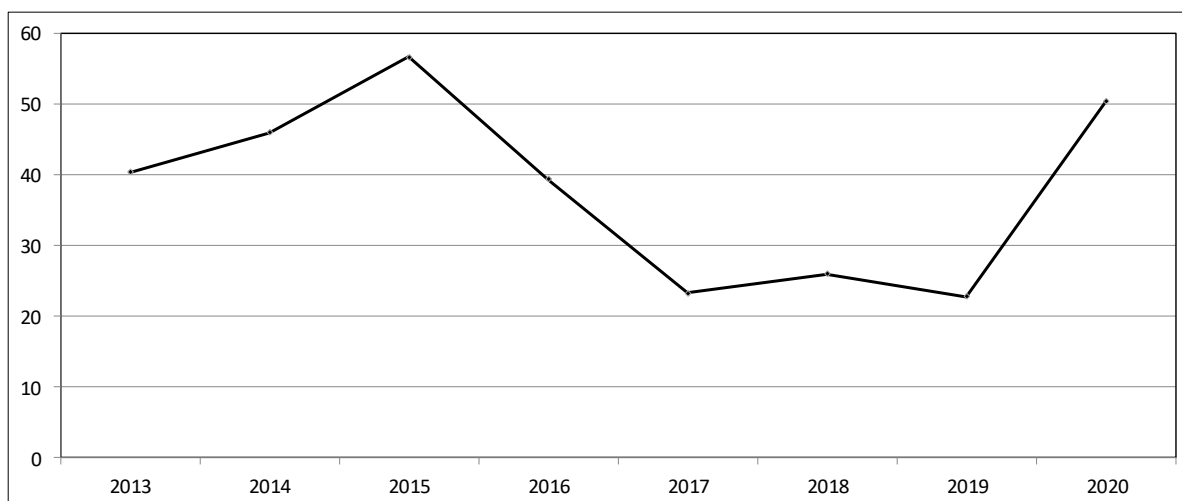


Figure 2: Proportion of juveniles as a percentage of the total catch (all species)

Table 5: Estimated age of birds captured and banded during August 2020, and comparison of the percentage of juveniles between sample years

Species	Adult	Juvenile	Unknown	Total	2013 % Juvenile	2014 % Juvenile	2015 % Juvenile	2016 % Juvenile	2017 % Juvenile	2018 % Juvenile	2019 % Juvenile	2020 % Juvenile
Little Button-quail	4	1		5	-	-	-	-	-	-	-	20.0
Common Bronzewing				0	-	-	-	-	33.3	0.0	0.0	-
Crested Pigeon				0	-	-	0.0	-	14.3	0.0	0.0	-
Diamond Dove	98	115		213	-	60.0	66.7	-	25.0	100.0	-	54.0
Peaceful Dove	10	7	1	18	30.0	33.3	48.8	52.0		16.7	33.3	38.9
Horsfield's Bronze Cuckoo	1	3		4	-	-	100.0	-	100.0	-	-	75.0
Spotted Nightjar				0	-	-	-	-	-	-	-	-
Australian Owlet Nightjar				0	-	-	-	-	0.0	0.0	-	-
Black-tailed Native-hen				0	-	-	-	-	44.4	0.0	-	-
Black-fronted Dotterel	6	2		8	-	-	33.3	71.4	16.7	20.0	0.0	25.0
Red-kneed Dotterel				0	-	-	0.0	-	-	-	-	-
Collared Sparrowhawk				0	-	-	-	-	-	-	0.0	-
Brown Goshawk	1			1	-	-	-	-	-	-	-	0.0
Rainbow Bee-eater				0						100.0	-	-
Sacred Kingfisher		1		1	-	100.0	-	100.0	-	100.0	-	100.0
Red-backed Kingfisher				0	-	-	-	100.0	-	-	-	-
Laughing Kookaburra				0	-	-	-	-	-	0.0	-	-
Brown Falcon				0	-	-	-	-	0.0	-	-	-
Galah				0	-	0.0	-	-	100.0	-	-	-
Major Mitchell's Cockatoo				0	-	-	-	-	-	0.0	-	-
Red-winged Parrot				0	-	-	-	-	0.0	-	-	-
Red-rumped Parrot				0						0.0	0.0	-
Blue Bonnet				0	-	-	-	-	0.0	0.0	-	-

Species	Adult	Juvenile	Unknown	Total	2013 % Juvenile	2014 % Juvenile	2015 % Juvenile	2016 % Juvenile	2017 % Juvenile	2018 % Juvenile	2019 % Juvenile	2020 % Juvenile
Mulga Parrot	1	2		3	-	-	-	-	0.0	0.0	11.1	66.7
Australian Ringneck			4	4	-	-	-	20.0	0.0	9.1	0.0	0.0
Bourke's Parrot	1	3		4	-	-	-	-	30.8	41.7	0.0	75.0
Blue-winged Parrot				0	-	-	-	-	0.0	-	-	-
Budgerigar	30	153		183	-	-	-	-	-	-	-	83.6
Spotted Bowerbird	2	1		3	-	-	-	41.7	28.3	0.0	0.0	33.3
White-browed Treecreeper	1			1	-	-	-	-	0.0	0.0	-	0.0
Brown Treecreeper	42	3		45	-	8.3	-	-	4.5	17.6	4.5	6.7
Variegated Fairy-wren	3		3	6	0.0	25.0	-	30.8	19.0	0.0	-	0.0
Splendid Fairy-wren	14	4	4	22	25.0	10.0	45.5	18.4	19.0	16.7	0.0	18.2
White-winged Fairy-wren				0	-	-	-	20.0	-	-	0.0	-
Striped Honeyeater				0	-	-	-	0.0	0.0	33.3	-	-
Noisy Friarbird				0	-	-	-	-	-	-	-	-
Little Friarbird	1	1		2	-	50.0	-	60.0	-	-	-	50.0
Brown Honeyeater				0	-	40.0	0.0	13.6	66.7	0.0	50.0	-
Blue-faced Honeyeater				0	-	-	-	-	33.3	-	0.0	-
Brown-headed Honeyeater				0	-	20.0	-	10.0	0.0	0.0	0.0	-
Pied Honeyeater				0	-	-	-	33.3	-	-	-	-
Black Honeyeater	1	3		4	-	-	-	-	-	-	-	75.0
Crimson Chat	1			1	-	-	-	-	33.3	-	-	0.0
Spiny-cheeked Honeyeater	4	5		9	66.7	28.6	64.5	48.9	35.3	-	0.0	55.6
Singing Honeyeater	3	5	1	9	40.0	38.5	50.0	28.6	20.8	16.7	18.2	55.6
Grey-headed Honeyeater	1	1		2	-	-	-	44.4	45.5	0.0	50.0	50.0
White-plumed Honeyeater	34	33		67	47.2	41.1	47.9	35.7	24.4	28.5	38.8	49.3
White-fronted Honeyeater				0	0.0	-	-	0.0	-	-	-	-
Yellow-throated Miner	2			2	-	-	50.0	35.3	15.6	35.3	14.3	0.0
Striated Pardalote				0	-	-	-	-	0.0	-	0.0	-
Weebill				0	-	-	33.3	45.5	0.0	-	-	-
Redthroat	1			1	-	-	0.0	-	-	-	-	0.0
Southern Whiteface	4	2	2	8	-	-	-	-	0.0	0.0	0.0	25.0
Yellow-rumped Thornbill				0	-	-	-	-	0.0	33.3	42.9	-
Yellow Thornbill				0	-	-	-	-	0.0	0.0	0.0	-
Inland Thornbill	4	3		7	50.0	0.0	50.0	42.1	10.5	12.5	0.0	42.9
Chestnut-rumped Thornbill	10	4	1	15	50.0	44.4	22.2	21.4	22.5	16.7	6.7	26.7
Grey-crowned Babbler	1	1		2	-	50.0	50.0	-	66.7	36.4	50.0	50.0
Hall's Babbler	2	1		3	-	50.0	62.5	22.2	18.8	0.0	0.0	33.3
Chestnut-crowned Babbler	9	8		17	28.6	-	8.7	-	39.5	37.5	44.4	47.1
Varied Sittella			2	2	-	-	-	-	0.0	-	-	0.0
Black-faced Cuckoo-Shrike				0	-	-	-	0.0	-	-	-	-
White-winged Triller	1	1		2	-	80.0	-	-	-	-	-	50.0

Species	Adult	Juvenile	Unknown	Total	2013 % Juvenile	2014 % Juvenile	2015 % Juvenile	2016 % Juvenile	2017 % Juvenile	2018 % Juvenile	2019 % Juvenile	2020% Juvenile
Chestnut-breasted Quail-thrush				0	0.0	-	-	-	0.0	-	-	-
Rufous Whistler	5	3		8	66.7	51.7	43.8	62.5	55.6	50.0	20.0	37.5
Grey Shrike-thrush	2			2	0.0	20.0	-	40.0	33.3	-	-	0.0
Crested Bellbird	2	1		3	0.0	0.0	-	0.0	66.7	0.0	0.0	33.3
Pied Butcherbird	1			1	-	-	100.0	50.0	35.3	0.0	-	0.0
Grey Butcherbird				0	-	-	62.5	50.0	46.2	20.0	0.0	-
White-browed Woodswallow				0	-	-	-	66.7	-	-	-	-
Black-faced Woodswallow				0	-	-	-	25.0	-	33.3	-	-
Little Woodswallow				0	-	-	0.0	-	-	-	-	-
White-breasted Woodswallow				0	-	-	-	50.0	-	-	0.0	-
Willie Wagtail	9	13		22	66.7	80.0	75.0	60.9	33.3	61.1	37.5	59.1
Grey Fantail				0	-	57.1	-	-	100.0	100.0	25.0	-
Little Crow				0	-	-	-	-	100.0	-	-	-
Restless Flycatcher	2			2	-	-	50.0	-	-	-	0.0	0.0
Magpie-lark				0	-	-	-	100.0	0.0	0.0	0.0	-
White-winged Chough	1			1	-	-	-	0.0	-	-	-	0.0
Apostlebird				0	-	-	-	-	100.0	-	33.3	-
Red-capped Robin	11	11		22	36.4	50.0	76.9	65.2	40.0	12.5	23.5	50.0
Jacky Winter		1		1	-	-	60.0	-	23.1	0.0	30.0	100.0
Hooded Robin	8			8	-	-	100.0	50.0	33.3	-	20.0	0.0
Mistletoebird				0	-	50.0	100.0	66.7	100.0	0.0	0.0	-
Plum-headed Finch		1		1	-	44.4	33.3	-	-	-	-	100.0
Zebra Finch	189	157		346	50.0	53.1	54.9	-	0.0	50.0	-	45.4
Double-barred Finch				0	60.0	71.2	74.5	64.4	1.4	100.0	-	-
Fairy Martin	25	3		28	-	-	-	-	-	-	-	10.7
Tree Martin	1			1	-	-	-	-	-	-	-	0.0
Rufous Songlark	4	8	2	14	-	33.3	-	-	-	-	-	57.1

3.4 Moulting and morphometrics

A total of 65 individuals (5.8% of all birds captured) representing only 5 species were undergoing active primary moult in 2020 (Table 6). This is the lowest proportion of birds in moult recorded to date. The highest was in 2015 when 21.7% of the birds captured were in moult, and the second lowest was in 2014 when only 8.2% of the captured birds were moulting (Fig. 3). This low rate is almost certainly due in large part to the unusual sampling time in 2020. Most birds moult after breeding, And for many species on the property, breeding activity peaks in August (R. Noske, unpubl. data).

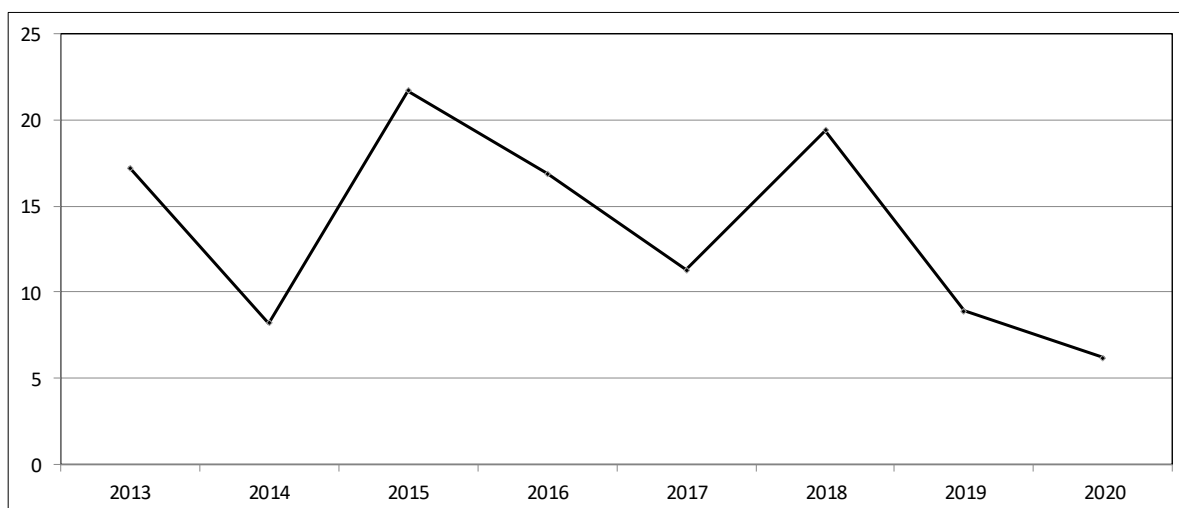


Figure 3: Percentage of birds caught in active wing moult in each year of the study

Table 6: Number of species recorded moulting during April 2019

Species	Adult	Juvenile	Unknown	Total	2013 % Juvenile	2014 % Juvenile	2015 % Juvenile	2016 % Juvenile	2017 % Juvenile	2018 % Juvenile	2019 % Juvenile	2020 % Juvenile
Little Button-quail	4	1		5	-	-	-	-	-	-	-	20.0
Common Bronzewing				0	-	-	-	-	33.3	0.0	0.0	-
Crested Pigeon				0	-	-	0.0	-	14.3	0.0	0.0	-
Diamond Dove	98	115		213	-	60.0	66.7	-	25.0	100.0	-	54.0
Peaceful Dove	10	7	1	18	30.0	33.3	48.8	52.0		16.7	33.3	38.9
Horsfield's Bronze Cuckoo	1	3		4	-	-	100.0	-	100.0	-	-	75.0
Spotted Nightjar				0	-	-	-	-	-	-	-	-
Australian Owlet Nightjar				0	-	-	-	-	0.0	0.0	-	-
Black-tailed Native-hen				0	-	-	-	-	44.4	0.0	-	-
Black-fronted Dotterel	6	2		8	-	-	33.3	71.4	16.7	20.0	0.0	25.0
Red-kneed Dotterel				0	-	-	0.0	-	-	-	-	-
Collared Sparrowhawk				0	-	-	-	-	-	-	0.0	-
Brown Goshawk	1			1	-	-	-	-	-	-	-	0.0
Rainbow Bee-eater				0						100.0	-	-
Sacred Kingfisher		1		1	-	100.0	-	100.0	-	100.0	-	100.0
Red-backed Kingfisher				0	-	-	-	100.0	-	-	-	-
Laughing Kookaburra				0	-	-	-	-	-	0.0	-	-
Brown Falcon				0	-	-	-	-	0.0	-	-	-
Galah				0	-	0.0	-	-	100.0	-	-	-
Major Mitchell's Cockatoo				0	-	-	-	-	-	0.0	-	-
Red-winged Parrot				0	-	-	-	-	0.0	-	-	-
Red-rumped Parrot				0						0.0	0.0	-
Blue Bonnet				0	-	-	-	-	0.0	0.0	-	-
Mulga Parrot	1	2		3	-	-	-	-	0.0	0.0	11.1	66.7
Australian Ringneck			4	4	-	-	-	20.0	0.0	9.1	0.0	0.0

Species	Adult	Juvenile	Unknown	Total	2013 % Juvenile	2014 % Juvenile	2015 % Juvenile	2016 % Juvenile	2017 % Juvenile	2018 % Juvenile	2019 % Juvenile	2020% Juvenile
Bourke's Parrot	1	3		4	-	-	-	-	30.8	41.7	0.0	75.0
Blue-winged Parrot				0	-	-	-	-	0.0	-	-	-
Budgerigar	30	153		183	-	-	-	-	-	-	-	83.6
Spotted Bowerbird	2	1		3	-	-	-	41.7	28.3	0.0	0.0	33.3
White-browed Treecreeper	1			1	-	-	-	-	0.0	0.0	-	0.0
Brown Treecreeper	42	3		45	-	8.3	-	-	4.5	17.6	4.5	6.7
Variegated Fairy-wren	3		3	6	0.0	25.0	-	30.8	19.0	0.0	-	0.0
Splendid Fairy-wren	14	4	4	22	25.0	10.0	45.5	18.4	19.0	16.7	0.0	18.2
White-winged Fairy-wren				0	-	-	-	20.0	-	-	0.0	-
Striped Honeyeater				0	-	-	-	0.0	0.0	33.3	-	-
Noisy Friarbird				0	-	-	-	-	-	-	-	-
Little Friarbird	1	1		2	-	50.0	-	60.0	-	-	-	50.0
Brown Honeyeater				0	-	40.0	0.0	13.6	66.7	0.0	50.0	-
Blue-faced Honeyeater				0	-	-	-	-	33.3	-	0.0	-
Brown-headed Honeyeater				0	-	20.0	-	10.0	0.0	0.0	0.0	-
Pied Honeyeater				0	-	-	-	33.3	-	-	-	-
Black Honeyeater	1	3		4	-	-	-	-	-	-	-	75.0
Crimson Chat	1			1	-	-	-	-	33.3	-	-	0.0
Spiny-cheeked Honeyeater	4	5		9	66.7	28.6	64.5	48.9	35.3	-	0.0	55.6
Singing Honeyeater	3	5	1	9	40.0	38.5	50.0	28.6	20.8	16.7	18.2	55.6
Grey-headed Honeyeater	1	1		2	-	-	-	44.4	45.5	0.0	50.0	50.0
White-plumed Honeyeater	34	33		67	47.2	41.1	47.9	35.7	24.4	28.5	38.8	49.3
White-fronted Honeyeater				0	0.0	-	-	0.0	-	-	-	-
Yellow-throated Miner	2			2	-	-	50.0	35.3	15.6	35.3	14.3	0.0
Striated Pardalote				0	-	-	-	-	0.0	-	0.0	-
Weebill				0	-	-	33.3	45.5	0.0	-	-	-
Redthroat	1			1	-	-	0.0	-	-	-	-	0.0
Southern Whiteface	4	2	2	8	-	-	-	-	0.0	0.0	0.0	25.0
Yellow-rumped Thornbill				0	-	-	-	-	0.0	33.3	42.9	-
Yellow Thornbill				0	-	-	-	-	0.0	0.0	0.0	-
Inland Thornbill	4	3		7	50.0	0.0	50.0	42.1	10.5	12.5	0.0	42.9
Chestnut-rumped Thornbill	10	4	1	15	50.0	44.4	22.2	21.4	22.5	16.7	6.7	26.7
Grey-crowned Babbler	1	1		2	-	50.0	50.0	-	66.7	36.4	50.0	50.0
Hall's Babbler	2	1		3	-	50.0	62.5	22.2	18.8	0.0	0.0	33.3
Chestnut-crowned Babbler	9	8		17	28.6	-	8.7	-	39.5	37.5	44.4	47.1
Varied Sittella			2	2	-	-	-	-	0.0	-	-	0.0
Black-faced Cuckoo-Shrike				0	-	-	-	0.0	-	-	-	-
White-winged Triller	1	1		2	-	80.0	-	-	-	-	-	50.0
Chestnut-breasted Quail-thrush				0	0.0	-	-	-	0.0	-	-	-
Rufous Whistler	5	3		8	66.7	51.7	43.8	62.5	55.6	50.0	20.0	37.5
Grey Shrike-thrush	2			2	0.0	20.0	-	40.0	33.3	-	-	0.0

Species	Adult	Juvenile	Unknown	Total	2013 % Juvenile	2014 % Juvenile	2015 % Juvenile	2016 % Juvenile	2017 % Juvenile	2018 % Juvenile	2019 % Juvenile	2020% Juvenile
Crested Bellbird	2	1		3	0.0	0.0	-	0.0	66.7	0.0	0.0	33.3
Pied Butcherbird	1			1	-	-	100.0	50.0	35.3	0.0	-	0.0
Grey Butcherbird				0	-	-	62.5	50.0	46.2	20.0	0.0	-
White-browed Woodswallow				0	-	-	-	66.7	-	-	-	-
Black-faced Woodswallow				0	-	-	-	25.0	-	33.3	-	-
Little Woodswallow				0	-	-	0.0	-	-	-	-	-
White-breasted Woodswallow				0	-	-	-	50.0	-	-	0.0	-
Willie Wagtail	9	13		22	66.7	80.0	75.0	60.9	33.3	61.1	37.5	59.1
Grey Fantail				0	-	57.1	-	-	100.0	100.0	25.0	-
Little Crow				0	-	-	-	-	100.0	-	-	-
Restless Flycatcher	2			2	-	-	50.0	-	-	-	0.0	0.0
Magpie-lark				0	-	-	-	100.0	0.0	0.0	0.0	-
White-winged Chough	1			1	-	-	-	0.0	-	-	-	0.0
Apostlebird				0	-	-	-	-	100.0	-	33.3	-
Red-capped Robin	11	11		22	36.4	50.0	76.9	65.2	40.0	12.5	23.5	50.0
Jacky Winter		1		1	-	-	60.0	-	23.1	0.0	30.0	100.0
Hooded Robin	8			8	-	-	100.0	50.0	33.3	-	20.0	0.0
Mistletoebird				0	-	50.0	100.0	66.7	100.0	0.0	0.0	-
Plum-headed Finch		1		1	-	44.4	33.3	-	-	-	-	100.0
Zebra Finch	189	157		346	50.0	53.1	54.9	-	0.0	50.0	-	45.4
Double-barred Finch				0	60.0	71.2	74.5	64.4	1.4	100.0	-	-
Fairy Martin	25	3		28	-	-	-	-	-	-	-	10.7
Tree Martin	1			1	-	-	-	-	-	-	-	0.0
Rufous Songlark	4	8	2	14	-	33.3	-	-	-	-	-	57.1

3.5 Body Mass Analysis

Over the duration of this study almost all the birds captured have been weighed which allows body mass comparisons between years. Some species, such as the thornbills (Figs. 4 and 5), have maintained remarkably consistent body mass between years despite the varied environmental conditions. Between 2013 and 2019, the mean body mass of Chestnut-rumped Thornbills varied only 0.3 g (from 6.1 g to 6.4 g) over the study period (Fig. 4), while that of Inland Thornbills varied only 1.0 g (6.5– 7.5 g) (Fig. 5). However, in 2020 both species showed significant increases in body mass in comparison to previous years.



Figure 4: Adult Chestnut-rumped Thornbill body mass

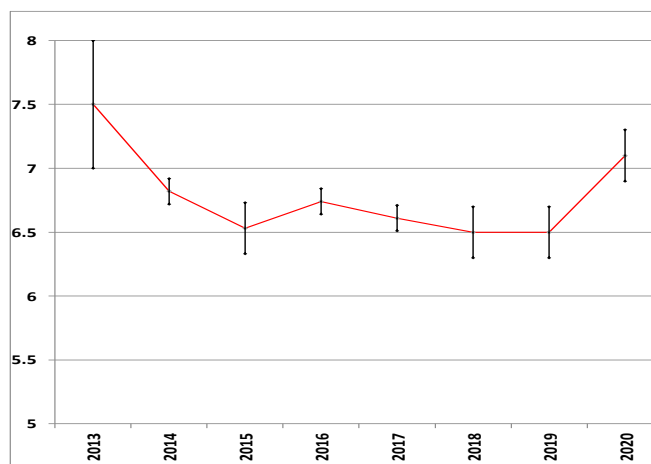


Figure 5: Adult Inland Thornbill mean body mass

Other species have shown consistent declines in body mass between years. The White-plumed Honeyeater declined from a mean body mass of 17.0-17.5g in 2013 through 2015 to only 16.0g in 2017 and 15.8g in 2018 and 2019 (Fig. 6). A slight improvement in body mass was recorded in 2020 but mean body mass was still considerably lower than in the first four years of the study. The Singing Honeyeater also showed a decline in mean body mass from over 25g in 2013-14 to 23.0g in 2017 and 2018. Despite mean body mass increasing to 24.8g in 2019, body mass was the lowest recorded to date at only 22.8g in 2020 (Fig. 7).

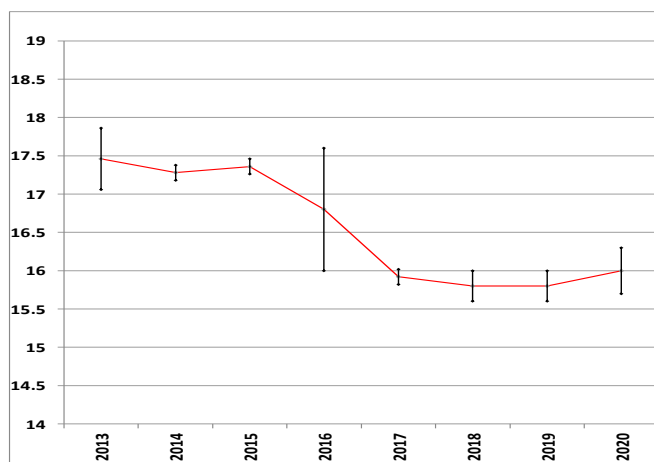


Figure 6: Adult White-plumed Honeyeater body mass

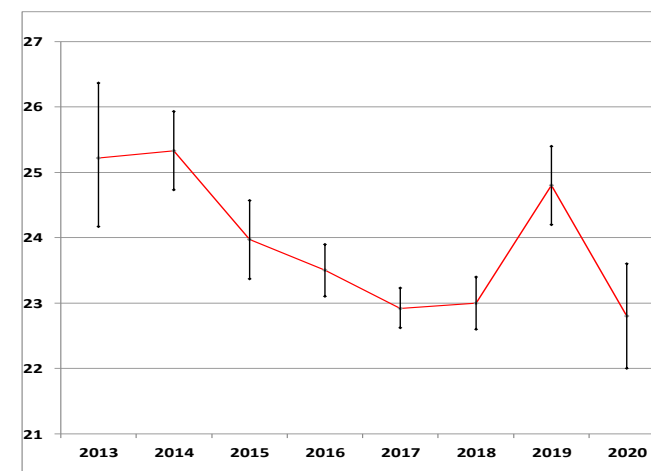


Figure 7: Adult Singing Honeyeater mean body mass

A further six species for which mean body mass data has been graphed show similar trends, including the Peaceful Dove (Fig. 9) and Brown Treecreeper (Fig. 8) which showed significant variations early in the study, but appear to be more consistent in more recent years. It is assumed that since birds are caught in the mornings and afternoons with the same method each year that individual daily weight variations are not influencing this analysis, but this will be examined in more detail in future analyses.



Figure 8: Adult Brown Treecreeper mean body mass

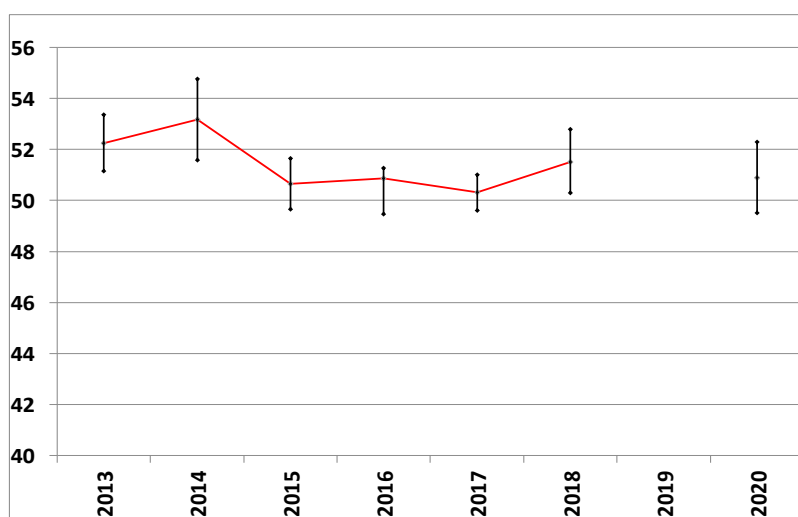


Figure 9: Adult Peaceful Dove mean body mass

3.6 Recaptures

In 2020 a total of 28 individuals that were banded in previous years were recaptured. Twenty-two (78.6%) of these birds were recaptured at the same site where they were banded (Table 7), demonstrating high site fidelity among these species. The oldest bird, a White-plumed Honeyeater, was recaptured at the same location where it was banded 6 years ago.

Six birds were recaptured at locations away from their original banding sites (Table 7). All recaptures were caught within 1 km of their original banding site, and all except two of these were within the same area. The two exceptions were both Splendid Fairywrens that were recaptured in the area adjacent to which they were banded.

Table 7: Birds recaptured in 2019 banded at the same location in a previous year

Band Number	Species	Age	Sex	Location Captured	Date Caught	Years Elapsed	Distance
023-28581	White-plumed Honeyeater	2+		Bowra Area 1: Bore Drain	09/04/2015	5yrs	0km
				Bowra Area 1: Bore Drain	09/08/2020		
01C-31273	Chestnut-rumped Thornbill	1+		Bowra Area 1: Bore Drain	20/04/2017		0.5km
				Bowra Area 1: Shearers Quarters	08/08/2020		
025-93694	White-plumed Honeyeater	1+		Bowra Area 1: Bore Drain	09/04/2015	5yrs	0.2km
				Bowra Area 1: Homestead	09/08/2020		
037-29120	White-plumed Honeyeater			Bowra Area 1: Homestead	18/04/2014	6yrs	0km
				Bowra Area 1: Homestead	09/08/2020		
036-70614	Willie Wagtail	2		Bowra Area 1: Homestead	25/03/2016	4yrs	0km
				Bowra Area 1: Homestead	09/08/2020		
052-71406	Chestnut-crowned Babbler	2+		Bowra Area 10: Southern Bore Drain	14/04/2017	3yrs	0km
				Bowra Area 10: Southern Bore Drain	10/08/2020		
027-15055	Hooded Robin	2+	F	Bowra Area 10: Homestead Loop Wetland	17/04/2017	3yrs	0km
				Bowra Area 10: Homestead Loop Wetland	10/08/2020		

Band Number	Species	Age	Sex	Location Captured	Date Caught	Years Elapsed	Distance
037-34724	Brown Treecreeper	2+	M	Bowra Area 10: Homestead Loop Wetland	17/04/2017	3yrs	0km
				Bowra Area 10: Homestead Loop Wetland	10/08/2020		
036-77302	Brown Treecreeper	2+	M	Bowra Area 10: Homestead Loop Wetland	17/04/2017	3yrs	0km
				Bowra Area 10: Homestead Loop Wetland	10/08/2020		
01C-00023	Southern Whiteface	1+		Bowra Area 10: Homestead Loop Wetland	05/04/2018	2yrs	0km
				Bowra Area 10: Homestead Loop Wetland	10/08/2020		
01C-05003	Splendid Fairywren	1+		Bowra Area 3: Quarry Road Junction	21/04/2019	1yr	0km
				Bowra Area 3: Quarry Road Junction	10/08/2020		
01C-05008	Splendid Fairywren	1+		Bowra Area 3: Quarry Road Junction	21/04/2019	1yr	0.5km
				Bowra Area 3: Loading Dock	11/08/2020		
01A-87246	Splendid Fairywren	1+	M	Bowra Area 7: Gumholes West	18/04/2017	3yrs	0.5km
				Bowra Area 5: Stony Mulga	12/08/2020		
051-94728	Hall's Babbler	1+		Bowra Area 6: Tablelands	21/04/2019	1yr	0km
				Bowra Area 6: Tablelands	12/08/2020		
043-05516	Brown Treecreeper	1+	M	Bowra Area 2, Sawpits	19/04/2014	6yrs	0km
				Bowra Area 2, Sawpits	13/08/2020		
037-43495	White-plumed Honeyeater	2		Bowra Area 2, Sawpits	15/04/2017	3yrs	0km
				Bowra Area 2, Sawpits	13/08/2020		
042-47873	Brown Treecreeper	1+	M	Bowra Area 2, Sawpits	06/04/2015	5yrs	0km
				Bowra Area 2, Sawpits	13/08/2020		
042-74606	Brown Treecreeper	2+	F	Bowra Area 2, Sawpits	21/04/2019	1yr	0km
				Bowra Area 2, Sawpits	13/08/2020		
042-66230	Brown Treecreeper	2+	M	Bowra Area 3, Ian's Place	30/03/2018	2yrs	0km
				Bowra Area 3, Ian's Place	13/08/2020		
042-57724	Brown Treecreeper	2+	M	Bowra Area 3, Ian's Place	17/04/2017	3yrs	0km
				Bowra Area 3, Ian's Place	13/08/2020		
037-52693	Willie Wagtail	2+		Bowra Area 7, Gumholes	06/04/2018	2yrs	0km
				Bowra Area 7, Gumholes	13/08/2020		
042-82466	Brown Treecreeper	2+	F	Bowra Area 7, Gumholes	21/04/2019	1yr	0km
				Bowra Area 7, Gumholes	13/08/2020		
037-61581	White-plumed Honeyeater	2+		Bowra Area 7, Gumholes	22/04/2019	1yr	0km
				Bowra Area 7, Gumholes	13/08/2020		
037-52464	Brown Treecreeper	2-	M	Bowra Area 1: Cottage Dam	31/03/2018	2yrs	0km
				Bowra Area 1: Cottage Dam	14/08/2020		
042-74601	Brown Treecreeper	2+	F	Bowra Area 2: Sawpits West	30/03/2018	2yrs	0km
				Bowra Area 2: Sawpits West	14/08/2020		
042-66255	Brown Treecreeper	2+	M	Bowra Area 2: Sawpits	15/04/2017	3yrs	0.2km
				Bowra Area 2: Sawpits West	14/08/2020		
01C-00379	Red-capped Robin	2+	M	Bowra Area 10, South Homestead	01/04/2018	2yrs	0km
				Bowra Area 10, South Homestead	14/08/2020		
037-67557	Willie Wagtail	2-		Bowra Area 1: Homestead	20/04/2019	1yr	0km
				Bowra Area 1: Homestead	15/08/2020		

3.7 Climate and Resources

The environmental conditions at Bowra have varied markedly over the eight years of the study. The 2013 visit followed the driest summer recorded since 2010 with very little water or green foliage on the property. Between December 2013 and the 2014 banding trip, Cunnamulla received 185 mm of rain which resulted in numerous areas of standing water and extensive seeding grasses. The town received 205 mm of rain between December 2014 and the 2015 banding trip, and standing water was present at many locations on the property. However, water levels at Sawpits (Area 2) and Gum Holes (Area 7) were significantly lower in 2015 than in 2014. Patches of seeding grasses were smaller and generally only associated with nearby water sources. In 2016 water levels at permanent water sources were very low, similar to those seen in 2015, but there were numerous temporary water bodies resulting from rain in February and March including 38 mm falling 10 days before the sampling period commenced.

The 2017 visit followed a very dry summer in which only 52 mm of rain fell between January and April. As a result, the property was extremely dry, and the permanent water sources at Sawpits (Area 2) and Gumholes (Area 7) were very low. Ground vegetation was very dry and sparse. The only other water sources were the Homestead Lagoon (Area 1), Bore Drain (Sites 1 and 10), Back Dam (Area 9), and the waterhole at the Loading Dock and Quarry Road Junction (Area 3). Insects were observed to be less abundant than normal in many parts of the property.

The following year (2018) was the driest Bowra had experienced since the study began. During the previous 12 months, the Cunnamulla region received only 200 mm of rain, so even the semi-permanent water sources of Sawpits and Gumholes were significantly reduced and evaporating rapidly. Since the open bore drain channel was filled in, the only water sources at the normal level were the bore-fed Homestead lagoon and dam. Ground vegetation was virtually absent in many locations. Back Dam (Area 9), which contained water at the beginning of the survey, was reduced to mud by the end of the survey.

The 2019 visit saw even drier conditions than in 2018, as only 133.5 mm had fallen in Cunnamulla in the previous 12 months. For the first time since the study started both Sawpits (Area 2) and Gumholes (Area 7) were completely dry. The only water sources remaining on the property were at the Homestead (Area 1) and a small residual pool of water in Back Dam (Area 9). Ground vegetation was extremely sparse in all parts of the property, and even highly arid-adapted tree species such as Mulga showed signs of distress. However, during two days of the sampling period, 93.8mm of rain fell. This unexpected rain flooded much of the sanctuary and disrupted fieldwork. All the water sources and dams were replenished and main creek flowed with flood water. Later in 2019 visitors and volunteers at Bowra reported significant vegetation growth and large numbers of breeding birds.

During 2020 Bowra received rain regularly, with over 300 mm of rain falling in Cunnamulla over the previous 12 months. Visiting in April was not possible due to COVID-19 restrictions, but a visit was made by a small team in August. This visit followed regular rainfall on the property in the prior two months. The property's semi-permanent water bodies were full again as was Back Dam (Area 9) and many of the smaller more ephemeral water holes. The dams in the Western Paddock (Area 8) could

not be visited since that part of the sanctuary was inaccessible due to wet conditions. Standing water was present at most sites and ground vegetation, including grasses, was abundant in stark contrast to recent years when ground cover has been almost absent.

4.0 Discussion

A total of 111 species were recorded across all the sites at which banding was conducted during the 2020 bird banding period. This is the highest number of species recorded to date. The three years with the lowest numbers of species were recorded (2013, 2018 and 2019) were also three of the driest years at Bowra. This variation in bird species richness among the eight years, concomitant with conspicuous fluctuations in abundance, suggest that many birds emigrate from the site during unfavourable conditions or are present in such low numbers that they remain undetected.

The first sample in 2013 followed a series of extremely dry summers, and both the banding results and anecdotal evidence suggested that the abundance of birds on the station was extremely low at that time. This contrasted with the 2014 visit when numbers of birds, particularly finches, were obviously greater and concentrated around a number of water sources. In 2015 water was again abundant throughout the property, and numbers of birds remained high. The 2016 visit followed a period of heavy rain, and while there were many areas of temporary standing water, green herbage was relatively sparse.

The following three years (2017-2019) were very different from the previous three (2014-2016). There were low water levels at Sawpits and Gumholes, and the non-bore fed dams were very low or dry during 2017-2018. The influence of water sources on bird dispersion was noticeable as several birds were captured at dry, but previously wet, sites and then recaptured later in the week near water sources. . The impact of water scarcity on the avifauna was even clearer in 2019, when the driest conditions to date coincided with the lowest species diversity and catch rate on the property thus far.

During the 2019 visit there was a large rain event which flooded much of the property, and there had been regular rain from that time until the visit in August 2020. The property still had standing water in all areas, extensive ground cover including seeding grasses, and large numbers of birds with signs of recent and ongoing breeding. Thus, the evidence over eight years suggests a strong correlation between rainfall and bird abundance, though the true nature of this relationship await statistical analysis.

In contrast to previous years when the partly nectarivorous honeyeaters were the most frequently captured family, granivores accounted for the highest numbers of species caught in 2020. Three species (Budgerigar, Diamond Dove and Zebra Finch) accounted for about two-thirds of the total catch for the week. The proportion of juveniles in all three species suggested intense breeding activity in the region. This was presumably a response to the availability of seeding grasses observed on the property. In contrast the abundance of White-plumed Honeyeaters remained very low, suggesting that they have not yet recovered from the long period of drought conditions, and presumed scarcity of insects and nectar, between 2017 and 2019.

Body mass in all species was higher in 2020 than in previous years, which indicates that conditions have allowed birds to recover from the impacts of previous drought years. This was reflected even in the arid country specialist species and the Brown Treecreeper. Over the course of the study these birds have previously shown little variation between years. However, honeyeater species did not show a significant increase in body mass which suggests that partial nectarivores may require more time to recover from the impacts of drought.

That the proportion of juveniles in 2020 was the highest recorded to date reflects the atypical sampling time this year, but may also indicate favorable conditions for most species. The very low proportion of birds in moult also reflects the high numbers of juveniles present. Most species undergo primarily moult after breeding so a low incidence of moult across all age classes indicates adult birds were probably either still breeding or had recently bred.

The present study has already made a significant contribution to our understanding of the population dynamics of birds of the Australian arid zone. However, additional samples are required to clarify the relationships between environmental factors including rainfall, the annual avian cycle, and productivity of these bird species. While opportunistic breeding by birds in arid parts of Australia is well known, few datasets exist on typical breeding seasons. The banding data from this project, combined with observational data of breeding in future years, will help to reveal the mechanisms underlying the timing of breeding and moult of south western Queensland's arid-adapted birds.

The banding dataset is currently being used for two scientific papers to start answering the above questions. The first is looking at the impacts of protracted drought on the condition and breeding success of White-plumed Honeyeaters at Bowra. The second will assess how the water availability affects the distribution and abundance of birds on the property.

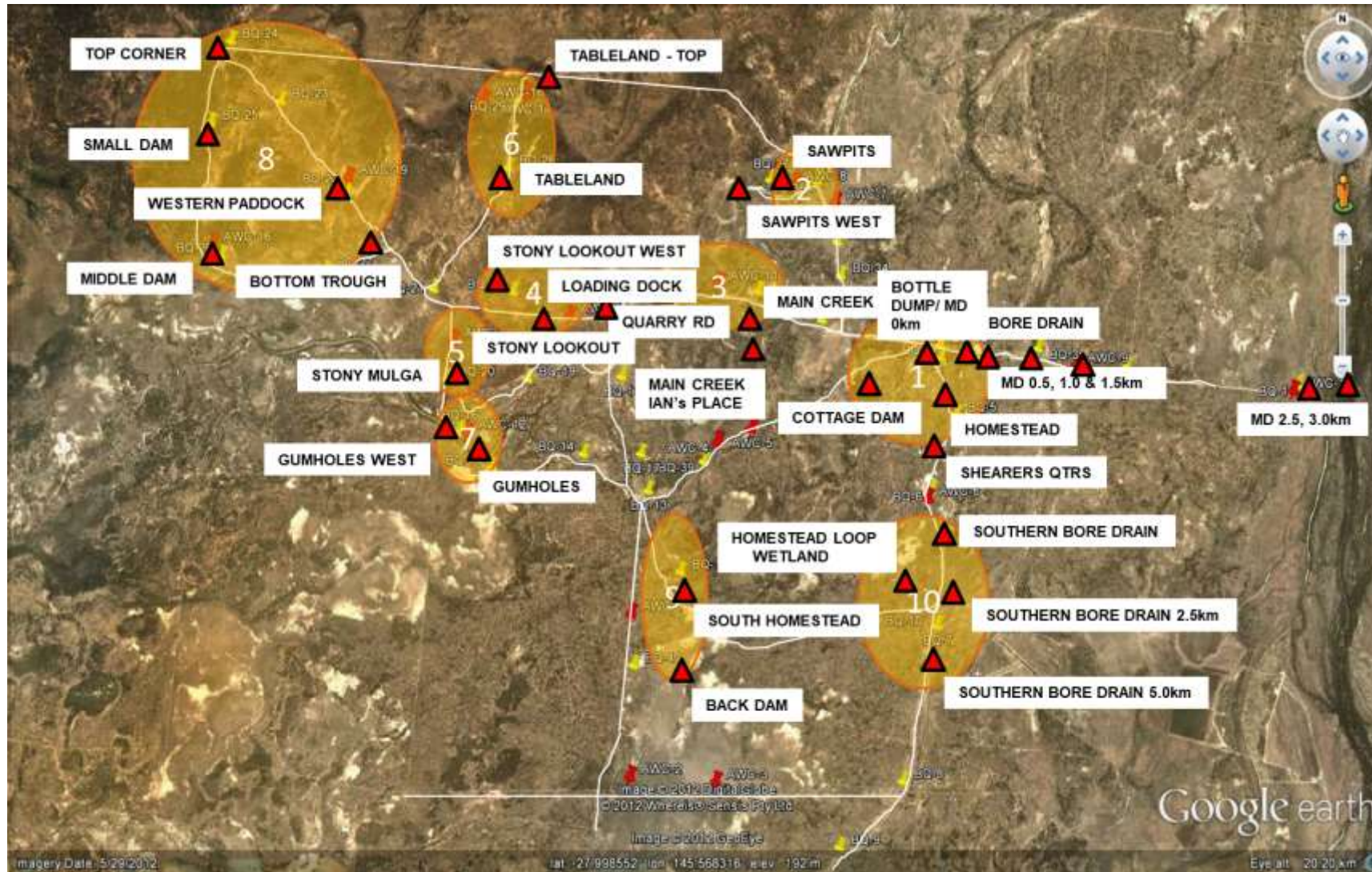
5.0 Next Survey

The next survey is scheduled for 2–11 April 2021, coinciding with Easter. It is again planned to have two to three field teams to ensure sampling includes both a wide range of the available habitats and locations and as many of the previous sites as possible.

6.0 Acknowledgments

The following A and R class banders formed the banding team in the 2020 survey: David Braithwaite, Miriam Braithwaite, Robert Bush, Jon Coleman, Rainer Ebel, David Edwards, Ofalia Ho, Stephen Macdonald and Ross McMillan. Allison Roberts made all the on-site arrangements for the team's visit, hosted us on site and assisted with data entry. She and Deirdre Chrzescijanski provided assistance in the field. We are also grateful to John Kanowski, Richard Seaton and John Barton at AWC for supporting this project.

Appendix 1: Banding areas and sites selected at Bowra Station



Appendix 2: Site 1 – Homestead -Net Locations and Site Images





Appendix 3: Site 1 – Shearers Quarters -Net Locations and Site Images





Appendix 4: Site 1 – Cottage Dam -Net Locations and Site Images





Appendix 5: Site 1 – Bore Drain -Net Locations and Site Images





Appendix 6: Site 2 – Sawpits - Net Locations and Site Images





Appendix 7: Site 2 – Sawpits-West - Net Locations and Site Images





Appendix 8: Site 3 – Main Creek - Net Locations and Site Images





Appendix 9: Site 3 – Ian’s Place - Net Locations and Site Images





Appendix 10: Site 3-Quarry Road - Net Locations and Site Images



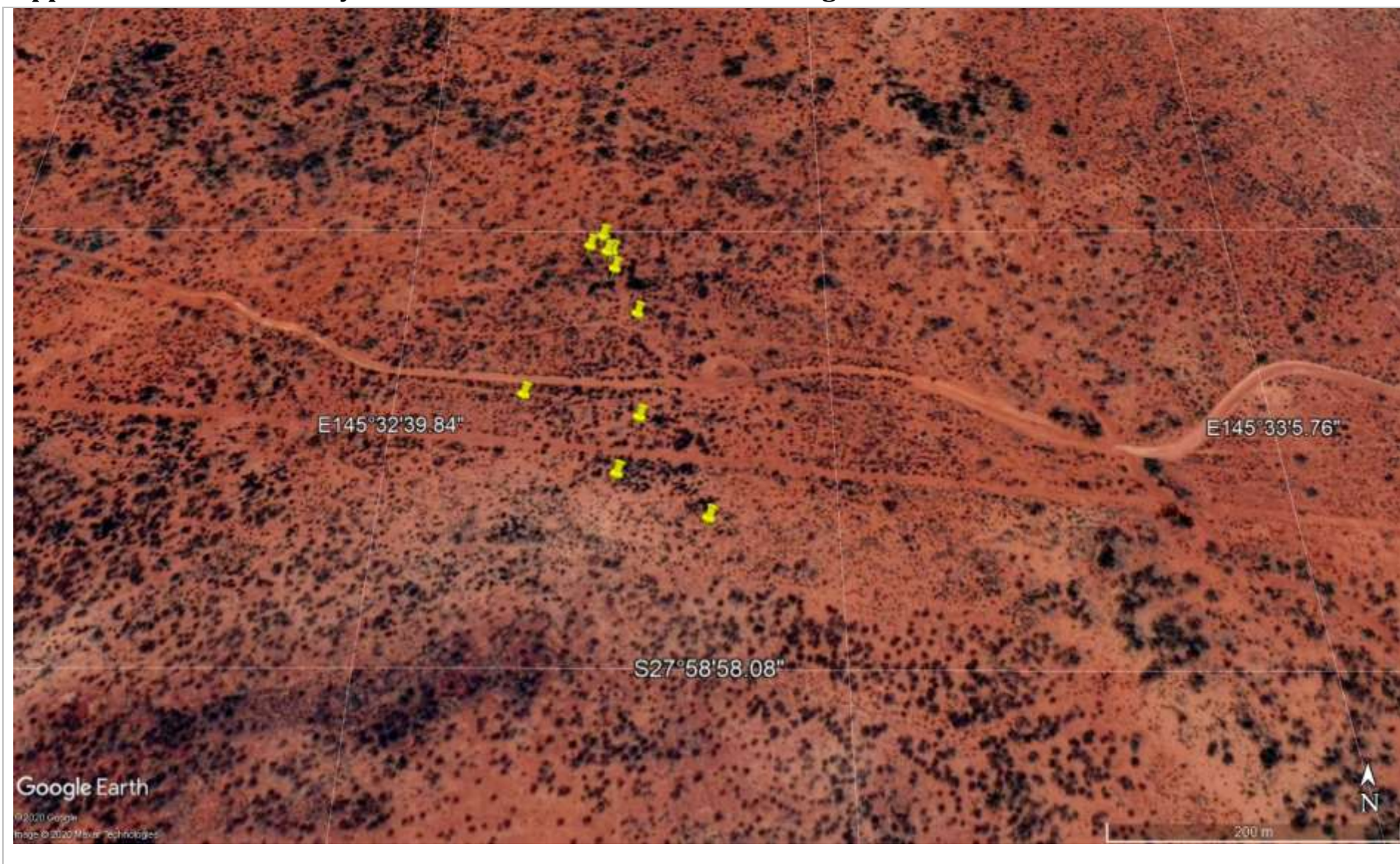


Appendix 11: Site 3 – Loading Dock- Net Locations and Site Images





Appendix 12: Site 4 – Stony Lookout - Net Locations and Site Images



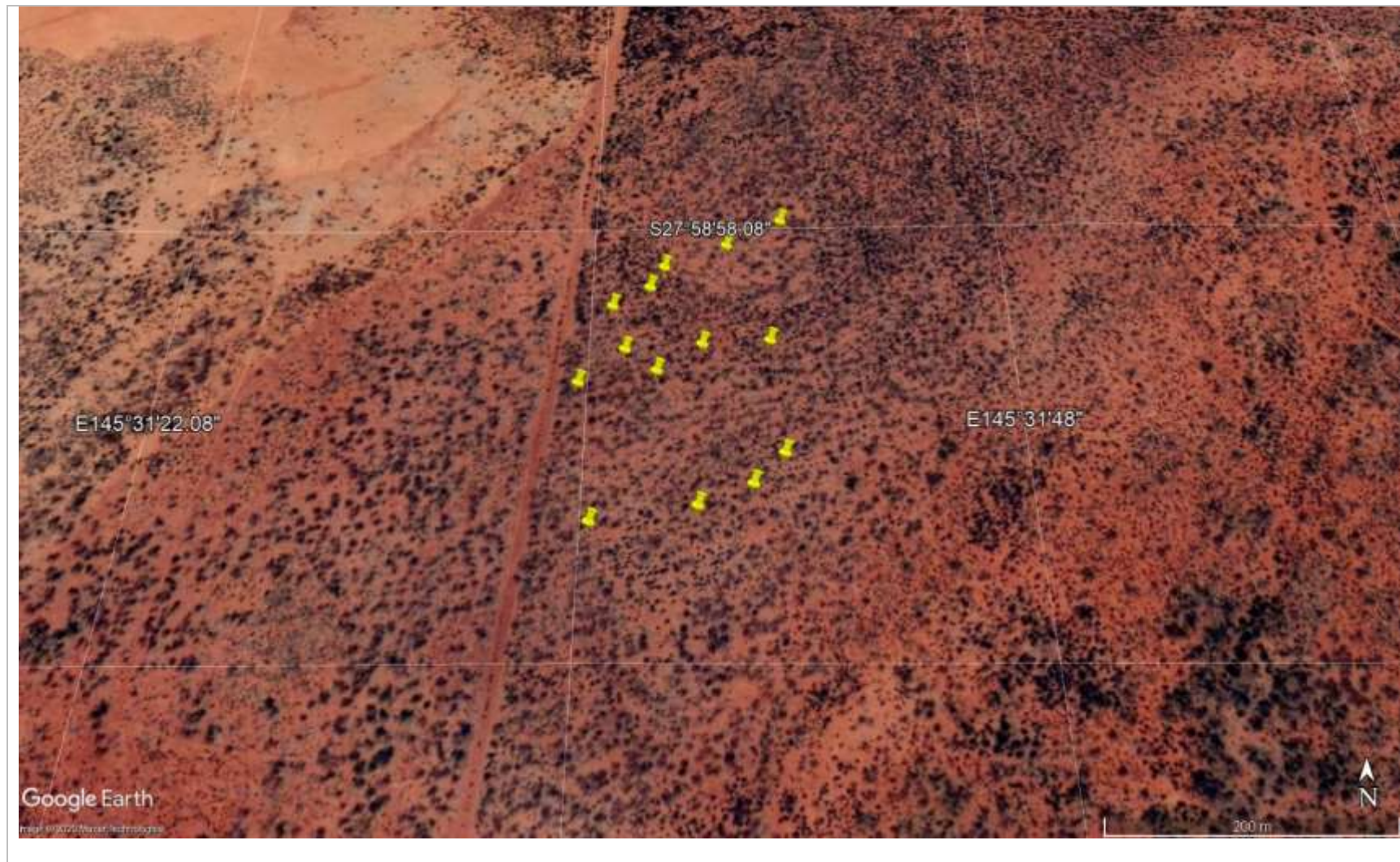


Appendix 13: Site 4 – Stony Lookout West - Net Locations and Site Images





Appendix 14: Site 5 – Stony Mulga - Net Locations and Site Images





Appendix 15: Site 6 – Tablelands -Net Locations and Site Images





Appendix 16: Site 6 – Tablelands Top - Net Locations and Site Images



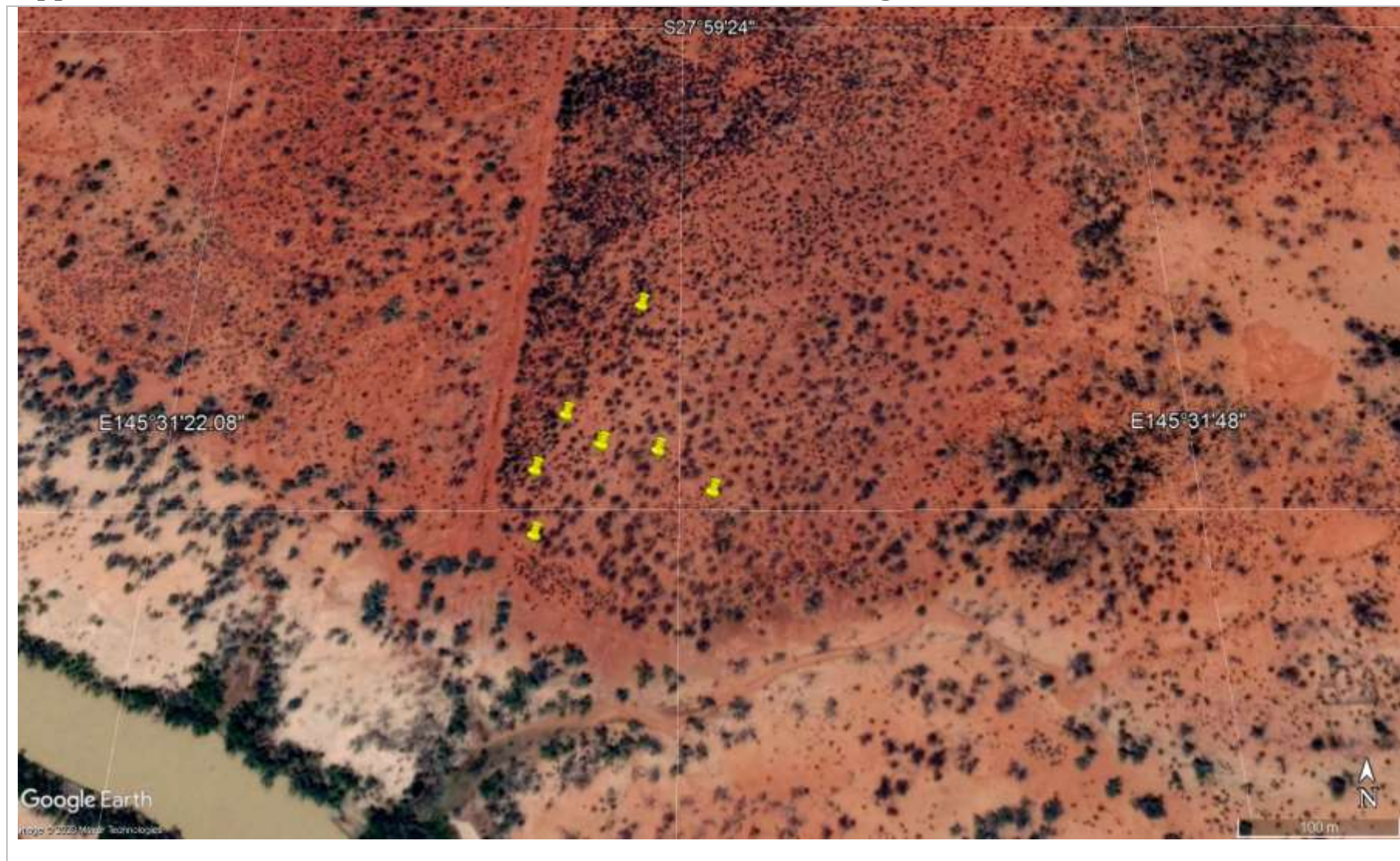


Appendix 17: Site 7 – Gumholes - Site Images- Net Locations and Site Images



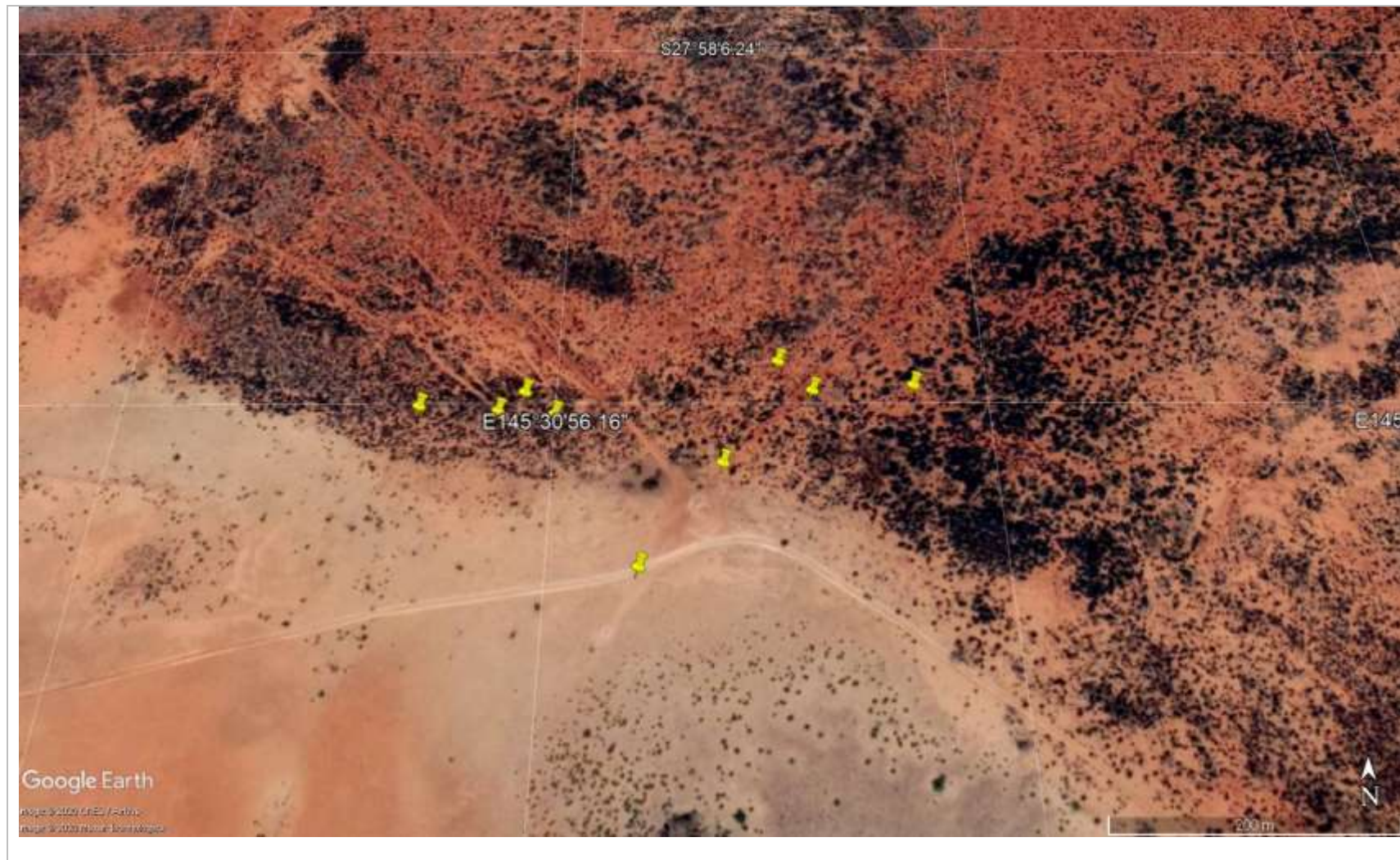


Appendix 18: Site 7 – Gumholes West - Net Locations and Site Images





Appendix 19: Site 8 – Western Paddock – Bottom Trough - Net Locations and Site Images





Appendix 20: Site 8 – Western Paddock – Small Dam - Net Locations and Site Images

NO BIRDS CAUGHT IN 2020, SITE INNACCESSIBLE

Appendix 21: Site 8 – Western Paddock – Middle Dam - Net Locations and Site Images

NO BIRDS CAUGHT IN 2020, SITE INNACCESSIBLE

Appendix 22: Site 8 – Top Corner - Net Locations and Site Images

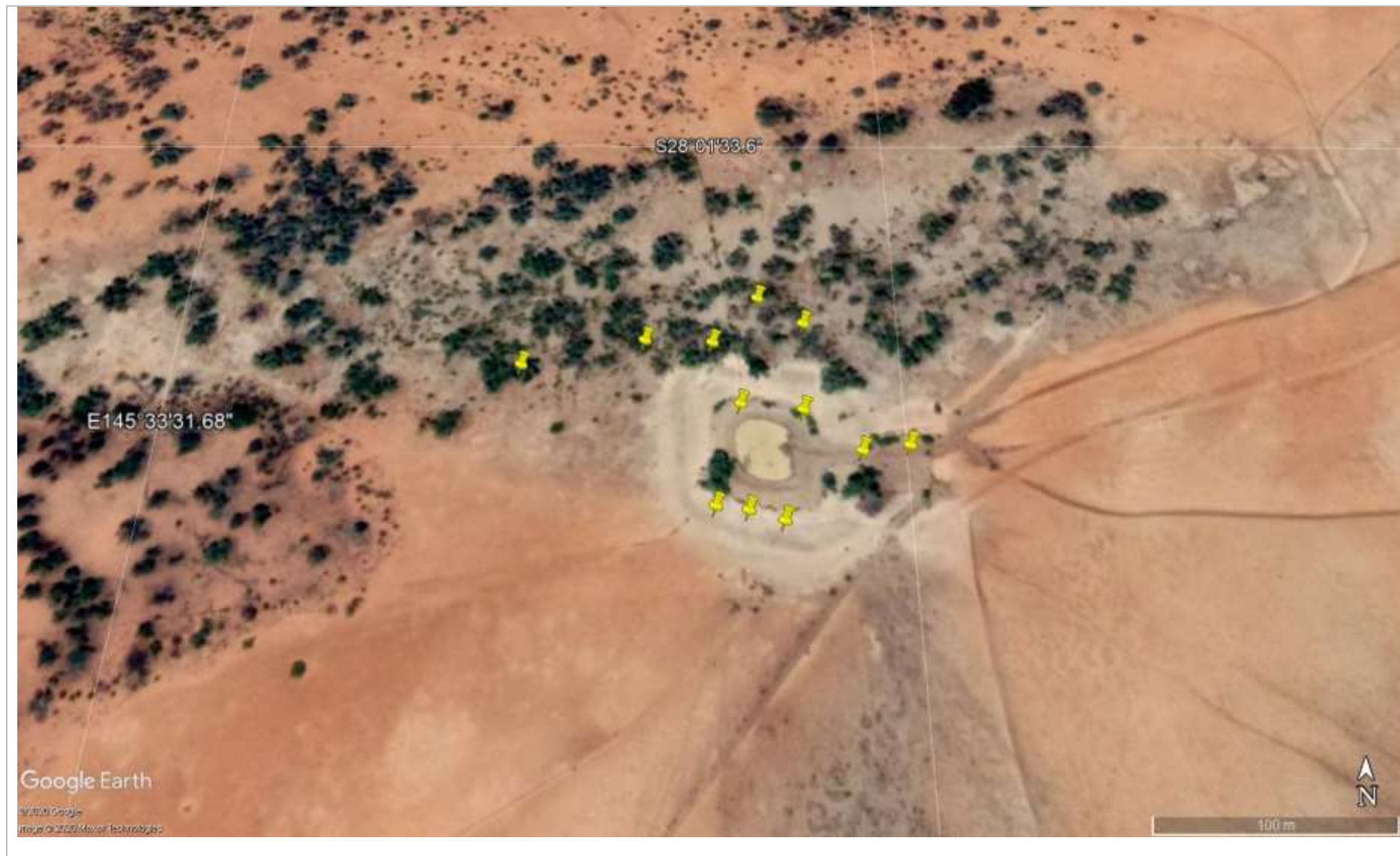
NO BIRDS CAUGHT IN 2020, SITE INNACCESSIBLE

Appendix 23: Site 8 – Western Paddock - Net Locations and Site Images

NO BIRDS CAUGHT IN 2020



Appendix 24: Site 9 – Back Dam - Net Locations and Site Images





Appendix 25: Site 9 –South Homestead - Net Locations and Site Images





Appendix 26: Site 10 – South Bore Drain - Net Locations and Site Images





Appendix 27: Site 10 – South Bore Drain 2.5km - Net Locations and Site Images





Appendix 28: Site 10 – South Bore Drain 5km - Net Locations and Site Images

NO BIRDS CAUGHT IN 2020

Appendix 29: Site 10 – Homestead Loop Wetland - Net Locations and Site Images





Appendix 30: Site 1 – Example Main Drive Site, Bottle Dump - Net Locations and Site Images

NO BIRDS CAUGHT IN 2020



Appendix 31: Species seen during banding visits

	9/08	9/08	9/08	9/08	10/08	10/08	10/08	11/08	11/08	11/08	12/08	12/08	12/08	12/08	13/08	13/08	13/08	13/08	14/08	14/08	14/08	14/08	15/08
Species	Area 1, Shearer's Quarters	Area 1, Homestead Lagoon	Area 1, Bore Drain	Area 3, Main Creek	Area 3, Quarry Rd Junction	Area 10, S. Bore Drain	Area 10, Homestead Loop Wetland	Area 4, Stony Lookout West	Area 4, Stony Lookout	Area 3, Loading Dock	Area 8 Bottom Trough	Area 6, Tablelands Top	Area 6, Tablelands	Area 5, Stony Mulga	Area 9, Back Dam	Area 3, Ian's Place	Area 2, Sawpits	Area 7, Gumholes	Area 10, South Bore Drain 2.5km	Area 1, Cottage Dam	Area 2, Sawpits West	Area 9, Homestead Circuit	Area 7, Gumholes West
Emu				X								X			X			X	X	X	X	X	
Little Button quail	X		X		X	X								X									
Australian wood duck																	X	X			X		
Pacific Black duck																	X				X		
Grey teal																	X						
Australasian grebe			X																				
Australian pelican																	X						
White necked heron		X	X															X					
White faced heron			X																				
Australian Black shouldered kite																			X				
Black kite	X	X	X			X													X				
Whistling kite	X	X	X			X								X			X	X					X
Black breasted buzzard		X		X				X															
Collared sparrowhawk	X	X		X																			
Brown goshawk	X	X													X						X		
Little eagle																							X
Wedge tailed eagle				X					X			X											X
Spotted harrier													X										
Brown falcon					X									X					X		X		X
Nankeen kestrel	X					X								X									

	9/08	9/08	9/08	9/08	10/08	10/08	10/08	11/08	11/08	11/08	12/08	12/08	12/08	12/08	13/08	13/08	13/08	13/08	14/08	14/08	14/08	14/08	15/08
Species	Area 1, Shearer's Quarters	Area 1, Homestead Lagoon	Area 1, Bore Drain	Area 3, Main Creek	Area 3, Quarry Rd Junction	Area 10, S. Bore Drain	Area 10, Homestead Loop Wetland	Area 4, Stony Lookout West	Area 4, Stony Lookout	Area 3, Loading Dock	Area 8 Bottom Trough	Area 6, Tablelands Top	Area 6, Tablelands	Area 5, Stony Mulga	Area 9, Back Dam	Area 3, Ian's Place	Area 2, Sawpits	Area 7, Gumholes	Area 10, South Bore Drain 2.5km	Area 1, Cottage Dam	Area 2, Sawpits West	Area 9, Homestead Circuit	Area 7, Gumholes West
Australian hobby	X	X				X								X									
Brolga crane							X																
Bush stone curlew	X	X																					
Australian Black winged stilt		X																					
Black fronted dotterel		X	X				X										X	X			X		
Masked lapwing	X	X																					
Diamond dove	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
Peaceful dove	X	X	X	X	X	X	X	X	X					X	X	X	X	X		X	X		X
Common bronzewing	X	X		X	X	X	X		X	X		X		X	X	X		X			X	X	X
Crested pigeon	X	X	X			X			X	X	X				X		X			X	X		X
Major-Mitchell's Cockatoo	X	X	X		X	X	X	X	X	X		X			X	X	X	X	X	X	X	X	X
Gallah	X	X	X		X	X	X	X			X		X	X	X	X	X	X		X	X	X	X
Red-winged Parrot	X	X	X															X			X		
Cockatiel	X	X		X					X				X		X		X	X			X	X	
Budgerigar	X	X	X	X	X		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Blue Bonnet	X	X										X					X						
Mallee Ringneck	X	X		X	X	X		X			X	X	X	X	X	X	X	X	X	X	X	X	
Red rumped parrot			X													X							
Bourke's parrot	X					X	X	X			X			X	X					X			X
Mulga Parrot		X			X			X			X		X		X						X	X	
Pallid cuckoo				X											X				X		X		
Fan tailed cuckoo				X					X							X							X
Horsfield's bronze cuckoo	X	X	X		X	X				X							X	X	X		X	X	
Southern boobook															X								
Australian owl nightjar	X	X																			X		

	9/08	9/08	9/08	9/08	10/08	10/08	10/08	11/08	11/08	11/08	12/08	12/08	12/08	12/08	13/08	13/08	13/08	13/08	14/08	14/08	14/08	14/08	15/08
Species	Area 1, Shearer s Quarter s	Area 1, Homest ead Lagoon	Area 1, Bore Drain	Area 3, Main Creek	Area 3, Quarry Rd Junctio n	Area 10, S. Bore Drain	Area 10, Homest ead Loop Wetlan d	Area 4, Stony Lookout West	Area 4, Stony Lookout	Area 3, Loading Dock	Area 8 Bottom Trough	Area 6, Tablela nds Top	Area 6, Tablela nds	Area 5, Stony Mulga	Area 9, Back Dam	Area 3, Ian's Place	Area 2, Sawpits	Area 7, Gumhol es	Area 10, South Bore Drain 2.5km	Area 1, Cottage Dam	Area 2, Sawpits West	Area 9, Homestead Circuit	Area 7, Gumholes West
Spotted nightjar														X							X		
Laughing kookaburra	X	X	X		X	X															X		
Sacred kingfisher				X																			
Rainbow bee-eater			X		X																		
Varied Sittella							X																
White browed treecreeper					X																		
Brown treecreeper	X	X	X	X		X	X								X	X	X	X		X	X	X	
Splendid fairy wren	X	X			X			X	X	X			X										X
Variegated fairy wren	X	X			X		X										X						
White winged fairy wren																			X				
Red-browed pardalote					X																		X
Striated pardalate	X	X													X								
Redthroat										X													
Western gerygone								X							X								
Weebill																					X		
Inland thornbill								X	X	X		X		X									
Chestnut-rumped Thornbill	X	X	X		X		X	X	X			X	X	X					X			X	X
Yellow rumped thornbill	X																						
Southern Whiteface	X	X	X			X	X															X	
Spiny-cheeked Honeyeater	X	X	X	X	X		X	X	X	X		X	X		X		X	X			X		
Little friarbird	X											X			X	X	X	X	X	X	X		X
Blue faced honeyeater	X	X																					
Yellow-throated Miner	X	X	X	X	X	X									X	X	X	X	X	X	X		X
Striped Honeyeater								X							X				X		X		
Grey-headed Honeyeater												X			X								

	9/08	9/08	9/08	9/08	10/08	10/08	10/08	11/08	11/08	11/08	12/08	12/08	12/08	12/08	13/08	13/08	13/08	13/08	14/08	14/08	14/08	14/08	15/08
Species	Area 1, Shearer's Quarters	Area 1, Homestead Lagoon	Area 1, Bore Drain	Area 3, Main Creek	Area 3, Quarry Rd Junction	Area 10, S. Bore Drain	Area 10, Homestead Loop Wetland	Area 4, Stony Lookout West	Area 4, Stony Lookout	Area 3, Loading Dock	Area 8 Bottom Trough	Area 6, Tablelands Top	Area 6, Tablelands	Area 5, Stony Mulga	Area 9, Back Dam	Area 3, Ian's Place	Area 2, Sawpits	Area 7, Gumholes	Area 10, South Bore Drain 2.5km	Area 1, Cottage Dam	Area 2, Sawpits West	Area 9, Homestead Circuit	Area 7, Gumholes West
Singing honeyeater					X		X		X	X		X		X	X							X	
White plumed honeyeater	X	X	X	X	X	X	X								X	X	X	X	X	X	X		
Black Honeyeater								X	X			X		X									
Crimson chat													X										X
Jacky winter	X	X	X	X	X	X	X									X			X				X
Red capped robin			X		X		X	X	X	X	X	X	X	X					X			X	X
Hooded Robin			X			X	X		X							X							
Hall's Babbler					X								X	X									X
Grey crowned babbler																		X	X		X		
Chestnut-crowned Babbler	X	X				X									X				X			X	
Chestnut breasted quail thrush								X				X		X									
Rufous whistler	X	X	X		X		X		X			X	X	X	X			X	X			X	X
Crested Bellbird	X	X		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X		X	X
Grey shrike thrush	X	X	X	X	X	X									X			X		X			
Restless flycatcher	X	X			X	X				X	X				X			X					X
Willie wagtail	X	X	X	X	X	X	X				X	X	X		X	X	X	X	X	X	X	X	X
Grey fantail			X																				
Black faced cuckoo shrike	X	X	X	X	X			X						X				X	X		X	X	
White winged triller				X										X			X		X				
White breasted woodswallow	X	X													X			X			X		X
White-browed woodswallow								X							X								
Masked woodswallow					X			X						X	X						X	X	
Black faced woodswallow	X				X		X	X							X				X		X		
Little Woodswallow					X									X	X								

	9/08	9/08	9/08	9/08	10/08	10/08	10/08	11/08	11/08	11/08	12/08	12/08	12/08	12/08	13/08	13/08	13/08	13/08	14/08	14/08	14/08	14/08	15/08
Species	Area 1, Shearer s Quarter s	Area 1, Homest ead Lagoon	Area 1, Bore Drain	Area 3, Main Creek	Area 3, Quarry Rd Junctio n	,Area 10, S. Bore Drain	Area 10, Homest ead Loop Wetlan d	Area 4, Stony Lookout West	Area 4, Stony Lookout	Area 3, Loading Dock	Area 8 Bottom Trough	Area 6, Tablela nds Top	Area 6, Tablela nds	Area 5, Stony Mulga	Area 9, Back Dam	Area 3, Ian's Place	Area 2, Sawpits	Area 7, Gumhol es	Area 10, South Bore Drain 2.5km	Area 1, Cottage Dam	Area 2, Sawpits West	Area 9, Homestead Circuit	Area 7, Gumholes West
Grey butcherbird	X	X					X					X										X	
Pied butcherbird	X	X	X				X	X		X	X	X					X		X				X
Maggie lark	X	X	X	X	X	X	X			X					X	X	X	X	X	X			X
Australian maggie	X	X	X												X			X		X	X	X	
Australian raven	X	X	X	X	X	X	X	X	X			X		X	X	X	X	X	X		X	X	X
White- winged Cough															X								
Apostlebird	X	X				X	X								X					X			
Spotted Bowerbird	X	X																					
Rufous Songlark	X	X		X	X	X	X								X	X	X				X		
Double barred finch					X																		
Zebra finch	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X	X	X
Plum-headed Finch																					X		
Mistletoebird	X	X																					
White-backed Swallow									X														
Welcome swallow	X	X																					
Tree martin	X	X					X								X			X					
Fairy martin	X	X	X																				
TOTAL SPECIES SEEN	59	58	38	27	39	31	32	26	22	17	12	21	17	28	44	21	29	33	30	20	40	25	31

Appendix 32: Timed Counts at Banding Locations at Bowra

	Date	9/08/2020	9/08/2020	9/08/2020	13/08/2020	9/08/2020	10/08/2020	11/08/2020	11/08/2020	11/08/2020	12/08/2020	12/08/2020	15/08/2020	12/08/2020	13/08/2020	14/08/2020	10/08/2020
	Time	0900-0930	0930-1000	0930-1000	0900-0930	0904-0934	0900-0930	0900-0930	0750-0820	0915-0945	0837-0907	0845-0915	0900-0930	0915-0945	0935-1005	0900-0930	0909-0929
	Location	Area 1, Shearers Quarters	Area 1, Homestead Lagoon	Area 1, Bore Drain	, Area 2, Sawpits	Area 3, Main Creek	Area 3, Quarry Rd Junction	, Area 3, Loading Dock	Area 4, Stony Ridge West	Area 4, Stony Ridge	, Area 5, Stony Muga	, Area 6, Tablelands Top	, Area 7, Gumholes West	, Area 8, Bottom Trough	, Area 9, Back Dam	, Area 10, South Bore Drain 2.5km	, Area 10, S. Bore Drain
Emu	Dromaius novaehollandiae					14									2		
Little Buttonquail	Turnix velox			1			1				1						
Australian wood duck	Chenonetta jubata				2												
Pacific Black duck	Anas superciliosa				5												
Grey teal	Anas gracilis				2												
White necked heron	Ardea pacifica		1														
Black kite	Milvus migrans	1	1													1	
Whistling kite	Haliastur sphenurus	1	1		1						1		1			1	1
Collared sparrowhawk	Accipiter cirrhocephalus	1	1														
Brown goshawk	Accipiter fasciatus	1	1												1		
Little eagle	Hieraetus morphnoides												1				
Wedge tailed eagle	Aquila audax												1				
Brown falcon	Falco berigora						1										
Nankeen kestrel	Falco cenchroides	1	1														
Australian hobby	Falco longipennis	1	1														1
Bush stone curlew	Burhinus grallarius	1	1														
Australian Black winged stilt	Himantopus leucocephalus		2														
Black fronted dotterel	Elsayornis melanops		5		1												
Masked lapwing	Vanellus miles	1	2														
Diamond dove	Geopelia cuneata	4	2		7	2	5	1	5		2		5		15	5	16
Peaceful dove	Geopelia striata		1		6	1	2	1	2				2				
Common bronzewing	Phaps chalcoptera		1														
Crested pigeon	Ocyphaps lophotes	12	3		4												3

	Date	9/08/2020	9/08/2020	9/08/2020	13/08/2020	9/08/2020	10/08/2020	11/08/2020	11/08/2020	11/08/2020	12/08/2020	12/08/2020	15/08/2020	12/08/2020	13/08/2020	14/08/2020	10/08/2020
	Time	0900-0930	0930-1000	0930-1000	0900-0930	0904-0934	0900-0930	0900-0930	0750-0820	0915-0945	0837-0907	0845-0915	0900-0930	0915-0945	0935-1005	0900-0930	0909-0929
	Location	Area 1, Shearers Quarters	Area 1, Homestead Lagoon	Area 1, Bore Drain	, Area 2, Sawpits	Area 3, Main Creek	Area 3, Quarry Rd Junction	, Area 3, Loading Dock	Area 4, Stony Ridge West	Area 4, Stony Ridge	, Area 5, Stony Muga	, Area 6, Tablelands Top	, Area 7, Gumholes West	, Area 8, Bottom Trough	, Area 9, Back Dam	, Area 10, South Bore Drain 2.5km	, Area 10, S. Bore Drain
Major-Mitchell's Cockatoo	Lophochroa leadbeteri	22	22		1		2		2	2			1			2	3
Gallah	Eolophus roseicapilla	5	2		1					2	1				1		5
Red-winged Parrot	Aprosmictus erythropterus	3	7		1												
Cockatiel	Nymphicus hollandicus													1	60		
Budgerigar	Melopsittacus undulatus	95	35		200	140	527	30	39	85	32	1	122	60	200	105	190
Blue Bonnet	Northiella haematogaster	2										2					
Mallee Ringneck	Barnardius zonarius	7	2		2	1			2							1	
Bourke's parrot	Neopsephotus bourkii										2		2				3
Mulga Parrot	Psephotus varius						2		2						2		
Pallid cuckoo	Cuculus pallidus														2	1	
Horsfields bronze cuckoo	Chrysococcyx basalis	1	1	1				1								1	
Laughing kookaburra	Dacelo novaeguineae	1	1														1
sacred kingfisher	Todiramphus sanctus					1											
Rainbow bee-eater	Merops ornatus			1													
Brown treecreeper	Climacteris picumnus	3	3	1	2	2				2					4		
Splendid fairy wren	Malurus splendens	1					3	2	4	1	4						
Variegated fairy wren	Malurus lamberti		1				2										
Red-browed pardalote	Pardalotus rubricatus						1						3				
Striated pardolate	Pardalotus striatus	1	1														
Inland thornbill	Acanthiza apicalis								13		2	1					
Chestnut-rumped Thornbill	Acanthiza uropygialis	3					1		9	7	2					1	
Southern Whiteface	Aphelocephala leucopsis	1														3	
Spiny-cheeked Honeyeater	Acanthogenys rufogularis	1	2		1		2					2					
Little friarbird	Philemon citreogularis	1			1							6	2		3	1	

	Date	9/08/2020	9/08/2020	9/08/2020	13/08/2020	9/08/2020	10/08/2020	11/08/2020	11/08/2020	11/08/2020	12/08/2020	12/08/2020	15/08/2020	12/08/2020	13/08/2020	14/08/2020	10/08/2020
	Time	0900-0930	0930-1000	0930-1000	0900-0930	0904-0934	0900-0930	0900-0930	0750-0820	0915-0945	0837-0907	0845-0915	0900-0930	0915-0945	0935-1005	0900-0930	0909-0929
	Location	Area 1, Shearers Quarters	Area 1, Homestead Lagoon	Area 1, Bore Drain	, Area 2, Sawpits	Area 3, Main Creek	Area 3, Quarry Rd Junction	, Area 3, Loading Dock	Area 4, Stony Ridge West	Area 4, Stony Ridge	, Area 5, Stony Muga	, Area 6, Tablelands Top	, Area 7, Gumholes West	, Area 8, Bottom Trough	, Area 9, Back Dam	, Area 10, South Bore Drain 2.5km	, Area 10, S. Bore Drain
Blue faced honeyeater	Entomyzon cyanotis	2	2														
Yellow-throated Miner	Manorina flavigula				6	1	1	3					3		3		
Striped Honeyeater	Plectorhyncha lanceolata															2	
Grey-headed Honeyeater	Lichenostomus keartlandi											3					
Singing honeyeater	Lichenostomus virescens						1	2	1	3		2					
White plumed honeyeater	Lichenostomus penicillatus	3	4	5	4	2									4	2	4
Black Honeyeater	Sugomel niger								2	1	2	1					
Jacky winter	Microeca fascians	1	2	1													
Red capped robin	Petroica goodenovii								1	4	2						
Hooded Robin	Malanodryas cucullata															1	
Hall's Babbler	Pomatostomus halli								4		2						
Grey crowned babbler	Pomatostomus temporalis															6	
Chestnut-crowned Babbler	Pomatostomus ruficeps	9														5	
Rufous whistler	Pachycephala rufiventris	1	2				1			2		1	1			1	
Crested Bellbird	Oreoica gutturalis	2			1		3	2	3	2	3		2	1	1	3	1
Grey shrike thrush	Colluricincla harmonica	1	2							1							1
Restless flycatcher	Myiagra inquieta	2	2										1		1		1
Willie wagtail	Rhipidura leucophrys	2	3	4	2	1	1	1					2		3	1	
Black faced cuckoo shrike	Coracina novaehollandiae	2	2	2	2		1									3	
White winged triller	Lalage tricolor							1								5	
White breasted woodswallow	Artamus leucorhynchus		3										1		10		
White-browed woodswallow	Artamus superciliosus														20		
Masked woodswallow	Artamus personatus										25				2		
Black faced woodswallow	Artamus cinereus	2													3		

	Date	9/08/2020	9/08/2020	9/08/2020	13/08/2020	9/08/2020	10/08/2020	11/08/2020	11/08/2020	11/08/2020	12/08/2020	12/08/2020	15/08/2020	12/08/2020	13/08/2020	14/08/2020	10/08/2020
	Time	0900-0930	0930-1000	0930-1000	0900-0930	0904-0934	0900-0930	0900-0930	0750-0820	0915-0945	0837-0907	0845-0915	0900-0930	0915-0945	0935-1005	0900-0930	0909-0929
	Location	Area 1, Shearers Quarters	Area 1, Homestead Lagoon	Area 1, Bore Drain	, Area 2, Sawpits	Area 3, Main Creek	Area 3, Quarry Rd Junction	, Area 3, Loading Dock	Area 4, Stony Ridge West	Area 4, Stony Ridge	, Area 5, Stony Muga	, Area 6, Tablelands Top	, Area 7, Gumholes West	, Area 8, Bottom Trough	, Area 9, Back Dam	, Area 10, South Bore Drain 2.5km	, Area 10, S. Bore Drain
Little Woodswallow	Artamus minor										1				2		
Grey butcherbird	Cracticus torquatus	1										1					
Pied butcherbird	Cracticus nigrogularis	3							1								1
Magpie lark	Grallina cyanoleuca	2	2	1	3		2						1		2	1	2
Australian magpie	Gymnorhina tibicen	3															
Australian raven	Corvus coronoides	3		1			2	1	1	4	1	1	1		2	2	5
Apostlebird	Struthidea cinerea	12	3														
Spotted Bowerbird	Chlamydera maculata	1	2		1												
Rufous Songlark	Cincloramphus mathewsi	2	4		1										5		3
Zebra finch	Taeniopygia guttata	5	15	2	3	10	57	5	17	15	2	8	40	8	4	25	10
Mistletoebird	Dicaeum hirundinaceum	1	1														
Welcome swallow	Hirundo neoxena	2	2														
Tree martin	Hirundo nigricans		1														
Fairy martin	Hirundo ariel	4	28	14													
TOTAL SPECIES SEEN	85	48	44	12	25	11	21	12	17	14	17	12	19	4	24	24	18

Appendix 33: Raw data from the 2020 Banding at Bowra

See Attached Spreadsheet