



Memo: Western Range Ghost Bat VHF
Study

Biologic Environmental Survey
Memo to Rio Tinto Iron Ore

March 2020



Introduction

Biologic Environmental Survey (Biologic) was commissioned by Rio Tinto to undertake a VHF tracking study on the Ghost Bat at their proposed Western Range mining operations, located approximately 17 kilometres (km) west of the town of Paraburdoo. The key objective of the study was to gain a better understanding of Ghost Bat movements at Western Range and to identify significant habitats, particularly with regards to foraging grounds. The study was undertaken by attaching VHF transmitters (digitally encoded) to individuals and using a fixed location automated VHF tracking system to record movements.

Methods

Five field trips have been undertaken to date. The first trip was conducted in February 2019 to construct the fixed-location VHF towers and to attach digitally encoded transmitters to two Ghost Bats. The second trip was undertaken in May 2019 to tag a further five Ghost Bat individuals and to retrieve data from the VHF towers. The third trip was conducted in August 2019 to perform VHF tower maintenance and upgrades and to retrieve VHF data. Trip 4, conducted in September 2019, installed additional omni-directional and directional towers at Western Range and surrounding areas and tagged a further Ghost Bat individual. Finally, Trip 5 was undertaken in November 2019 to retrieve data from the VHF receivers.

A total of 35 towers (27 omni-directional and eight directional towers) were installed at Western Range and surrounding area by the end of the Project (Figure 1, Table 1). Not all towers were active during the entire time of VHF tracking (Table 1). The configuration of the towers was optimised to identify significant Ghost Bat habitats within the Project Area, particularly with regards to foraging habitats:

- Fifteen towers were set-up at Western Range to determine the relative importance of this area as a roosting and foraging habitat for Ghost Bats. Of these, tower 5751 was located in front of Cave 6, tower 53E7 was located in front of Cave 14 and tower 9E15 was located at the entrance of Cave 11. All three caves represent known Ghost Bat roosts.
- Four towers (4135, AC48, 5BE8 and 6405) were placed where Pirraburdu Creek cuts through the Paraburdoo Ranges, an area of increased productivity within the landscape. A permanent freshwater pool is also located in the nearby vicinity of the tower, potentially providing drinking opportunities for the target bat species.
- Five towers (CDAD, B549, B893, E5CE, A080) were located in the flats to the north of Western Range to determine whether Ghost Bats leave the upper ranges to forage in the plains to the north.
- Two towers (2EA7 and 9E54) were located in the flats to the south of Western Range to determine whether Ghost Bats leave the upper ranges to forage in the plains to the south.
- Three towers (72A6, CCD3 and 8AC3) were positioned near open water bodies that potentially provide drinking and foraging opportunities for the Ghost Bats.
- Two towers (7295, F06C) were positioned at the base of Mt Truchanas, located 35 km north of the Project Area. Several caves available to the Ghost Bats are located in the immediate vicinity

of the two towers, including CPAN-12 (Biologic, 2018). The two towers aimed to identify any regional movements of Ghost Bats between the roost sites at Western Range and Mt Truchanas.

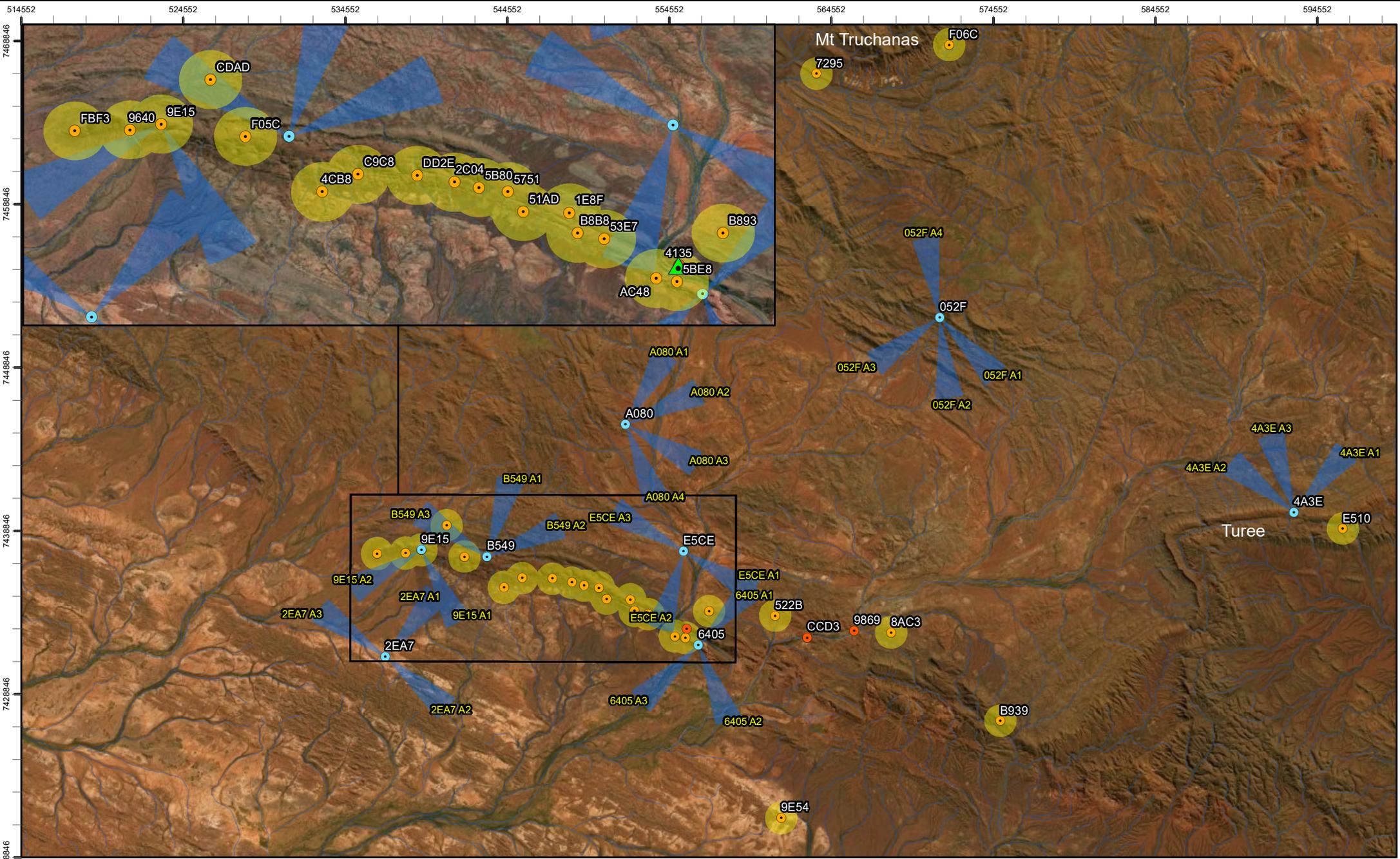
- Two towers (E510 and 4530) were placed in upper ranges at Turee. Several Ghost Bat day and night roosts are located in the immediate vicinity of the towers. The towers aimed to identify any regional movements of Ghost Bats between the roost sites at Western Range and Turee.
- One tower (052F) was placed in a mountainous area 18 km north-east of Paraburdoo township to identify potential habitat use in the upper ranges.
- One tower (B939) was positioned at Eastern Range to assess whether Ghost Bats are utilising the upper ranges in the eastern section of the Project Area.
- The remaining tower (9869) was located within Seven Mile Creek just outside of Paraburdoo township to monitor Ghost Bat movements along the creekline.

Table 1: VHF tower locations and details

Area	Area description	Tower ID	Antenna Direction	Date Installed	Date Deactivated	Location	
						Latitude	Longitude
Omni-directional towers							
Western Range	Upper ranges at the most western section of Western Range	FBF3	-	02/09/19	-	-23.171	117.357
Western Range	Six Mile Creek cutting through the western section of Western Range. Near Caves 7-10.	B893	-	03/09/18	25/08/19	-23.171	117.374
		9640		02/09/19	-		
Western Range	Upper ranges of Western Range - west	F05C	-	22/02/19	-	-23.173	117.410
Western Range	At southern, lower lying area of Western Range	4CB8	-	25/02/19	-	-23.190	117.433
Western Range	Upper ranges of Western Range – central. Near Caves 12 and 15.	C9C8	-	04/09/18	-	-23.185	117.444
Western Range	Upper ranges of Western Range – central. Near Cave 13	DD2E	-	04/09/18	-	-23.185	117.463
Western Range	Upper ranges of Western Range – central	2C04	-	04/09/18	-	-23.187	117.474
Western Range	Upper ranges of Western Range – east	5B80	-	24/02/19	-	-23.189	117.482
Western Range	Upper ranges of Western Range – east. Near Caves 6, 16 and 17.	5751	-	22/02/19	-	-23.190	117.491
Western Range	Upper ranges of Western Range – east. Near Caves 4 and 5.	51AD	-	21/02/19	-	-23.196	117.495
Western Range	Upper ranges of Western Range – east.	1E8F	-	02/09/19	-	-23.197	117.510
Western Range	Upper ranges of Western Range – east.	B8B8	-	23/02/19	-	-23.203	117.512
Western Range	Valley within eastern section of Western Range. Near Cave 14.	53E7	-	21/02/19	-	-23.205	117.520
Pirraburdu Creek	Upper ranges at the eastern section of Western Range, overlooking Pirraburdu Creek.	AC48	-	25/02/19	-	-23.217	117.537
Pirraburdu Creek	Upper ranges at the most eastern section of Western Range, overlooking Pirraburdu Creek.	5BE8	-	21/02/19	-	-23.218	117.543
Pirraburdu Creek	Pirraburdu Creek where it cuts through the Paraburdoo Ranges. Near a permanent water pool (Ratty Springs).	4135 (mini)	-	02/09/19	-	-23.213	117.544
Flats north of Western Range	Overlooking Six Mile Creek north of the Western Ranges	CDAD	-	02/09/19	-	-23.156	117.399
Flats north of Western Range	Overlooking Pirraburdu Creek north of the Western Ranges	B893	-	02/09/19	-	-23.203	117.557
Kelly's Pool	150 m long waterbody	72A6	-	04/09/18	04/05/19	-23.215	117.618
		0101		06/05/19	01/06/19		
Kelly's Pool	150 m long waterbody	CCD3 (mini)	-	02/09/19	-	-23.217	117.616

Area	Area description	Tower ID	Antenna Direction	Date Installed	Date Deactivated	Location	
						Latitude	Longitude
Seven Mile Creek	Seven Mile Creek near Paraburdoo township	9869 (mini)	-	02/09/19	-	-23.213	117.645
Paraburdoo Waste Water Plant	Open wastewater plant	8AC3	-	02/09/19	-	-23.214	117.667
Flats south of Western Range	Flats south-east of Western Range	9E54	-	02/09/19	-	-23.317	117.601
Eastern Range	Upper ranges	B939	-	02/09/19	-	-23.263	117.733
Turee	Located in the upper Turee ranges near Bellary Creek. Two potential Ghost Bat maternity roosts and several night roosts are located in the immediate vicinity of the tower.	E510	-	02/09/19	-	-23.155	117.939
Mt Truchanas	Located at the south-western base of Mt Truchanas. Several Ghost Bat day and night roosts are located in the nearby vicinity, including a potential maternity roost.	7295	-	02/09/19	-	-22.905	117.621
Mt Truchanas	Located at the south-eastern base of Mt Truchanas. Several Ghost Bat day and night roosts are located in the nearby vicinity, including a potential maternity roost.	F06C	-	02/09/19	-	-22.889	117.700
Directional towers							
Western Range	Upper ranges of Western Range – west. Near Cave 11, a potential Ghost Bat maternity roost. Both antennas are facing towards the flats in the south.	9E15	SE - 153°	04/09/18	-	-23.169	117.384
			SW - 240°				
Pirraburdu Creek	Upper ranges of Western Range – east. Antennas are facing towards a minor drainage line (NE) and the plains near Pirraburdu Creek (S, NW).	6405	NE - 43°	04/09/18	-	-23.222	117.551
			S - 158°				
			NW - 226°				
Flats to south of Western Range	Flats to the south of Western Range, antennas are facing towards several drainage lines.	2EA7	NE - 40°	04/09/18	-	-23.228	117.362
			SE - 130°				
			NW - 305°				
Flats north of Western Range	Upper ranges of Western Range – west. All three antennas are facing towards the flats in the north.	B549	N - 17°	23/02/19	-	-23.173	117.423
			NE - 67°				
			NW - 303°				
Flats north of Western Range	Overlooking Pirraburdu Creek north of the Ranges.	E5CE	SE - 120°	04/09/18	-	-23.170	117.542
			S - 197°				
			NW - 300°				
Flats north of Western Range	Overlooking Pirraburdu Creek north of the Ranges.	A080	NE - 30°	24/02/19	-	-23.100	117.506
			E - 66°				

Area	Area description	Tower ID	Antenna Direction	Date Installed	Date Deactivated	Location	
						Latitude	Longitude
			SE - 119° S - 158°				
Ranges north-east of Paraburdoo township	Upper Ranges 18 km north-east of Paraburdoo	052F	SE - 136° S - 173° SW - 235° N - 350°	25/02/19	-	-23.040	117.695
Turee	Located in the upper Turee ranges near Bellary Creek. Two potential Ghost Bat maternity roosts and several night roosts are located in the immediate vicinity of the tower. All antennas are facing north towards Bellary Creek.	4530	NE - 41° NW - 308° N - 343°	02/09/19	-	-23.146	117.910



Legend		
	VHF Towers	Indicative Detection Area
	Directional	Directional
	Omni-directional	Omni-directional
	Mini Omni-Towers	Mini Omni-directional
		Watercourse

biologic
Environmental Survey

N
1:300,000
0 3.5 7 14 km

Rio Tinto Iron Ore
Western Range Ghost Bat VHF Study
Figure 1: Tower Configuration

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
Size A4. Created 13/01/2020

Results

Eight Ghost Bats, comprising four females and four males, were captured and tagged over the course of the study (Table 2). Of these, five Ghost Bats were tagged at Cave 11 (Western Range - west), one Ghost Bat was tagged at Cave 14 (Western Range - east), one at Cave 6 (Western Range - central) with the remaining Ghost Bat being tagged at cave CPAN-12 at Mt Truchanas (Table 2). The average weight of the captured individuals was 127 g, whereby the average weight of females was 119 g and the average weight of males was 137 g (Table 2).

Table 2: Ghost Bats tagged during the study and summary of detection events

Individual ID	Tag ID	Tagging date	Tagging location	Sex	Wing clip (Y/N)	Weight (g)
31857	133	21/02/2019	Cave 14	M	Y	122
31859	135	26/02/2019	Cave 6	M	Y	155
31854	130	05/05/2019	Cave 11	F	Y	145
31856	132	05/05/2019	Cave 11	M	Y	135
34347	199	05/05/2019	Cave 11	F	Y	115
34348	200	05/05/2019	Cave 11	F	Y	100
34349	201	05/05/2019	Cave 11	F	Y	115
38020	266	27/09/2019	CPAN-12	M	Y	-
Average						127

A total of 26,939 raw detections were recorded from all eight tagged Ghost Bats during the survey. After excluding erroneous detections made before tagging commenced, the 26,939 raw detections were aggregated into 284 unique detection events – the results of which are reported on hereafter. Each Ghost Bat individual was recorded by an average of 35.5 detection events over the sampling period, with a minimum of five detections (individual 34348, female) and a maximum of 85 detections (individual 34347, female) (Table 3).

On average, individuals were detected for 6.5 nights, with a minimum detection period of three nights (individuals 31854 and 31856, female and male respectively) and a maximum detection period of 13 nights (individual 38020, male) (Table 3). The detection period of all Ghost Bats was substantially lower than the anticipated battery life of a single tag (1 - 13 days vs ~30 days). Thus, it can be confidently assumed that the transmitters either became dislodged or that individuals migrated out of the detection areas and did not return prior to the tag detaching.

There was no indication that the tagging procedure temporarily altered the behaviour of the Ghost Bats, as most Ghost Bats returned to the cave they were tagged in the night after tagging, and detection data did not show altered movement patterns following tagging.

Table 3: Overview of Ghost Bat detections

Bat ID	Detection events (aggregated)			Sampling Length (nights)
	First	Last	Total	
31857	21/02/2019 (pm)	26/02/2019 (am)	17	5
31859	26/02/2019 (pm)	06/03/2019 (am)	75	8
31854	05/05/2019 (pm)	07/05/2019 (pm)	22	3
31856	05/05/2019 (pm)	8/05/2019 (am)	41	3
34347	05/05/2019 (pm)	18/05/2019 (am)	85	13
34348	05/05/2019 (pm)	09/05/2019 (pm)	5	5
34349	05/05/2019 (pm)	10/05/2019 (pm)	26	6
38020	27/09/2019 (pm)	05/10/2019 (pm)	13	9
Average			35.5	6.5
Total			284	52

The five Ghost Bats tagged at Cave 11 in May 2019 (individuals 31854, 31856, 34347, 34348, 34349) were most frequently detected by tower 9E15 ($n = 78$) which was located at the entrance of Cave 11 (Table 4). In the majority (83%) of nights, the first detection of the night and the last detection of the previous night were recorded by this tower or by tower 2EA7 A1. This suggests that the five Ghost Bats were mostly roosting in, or near, Cave 11 during the sampling period, with two days also being spent roosting in the central section of Western Range near towers C9C8 and 2C04. A common flight pattern of the five bats was to emerge from 9E15 and to immediately head south, circling between 9E15 A1 & A2, B893/9640 and 2EA7 A1 & A2 for up to 1.5 hours at a time. However, most nights the bats then disappeared from the detection range of all towers for extended (up to 10.5 h) periods of time, only to occasionally return to the towers south of Western Range (9E15 A1/A2, B893/9640, F05C and 2EA7 A1 A2) throughout the night. Together this indicates that the five bats mainly foraged outside of the Project Area, both near towers 9E15 A1/A2 and 2EA7 A1/A2 in the flats to the south of Western Range as well as largely outside of the detection range of the towers.

The Ghost Bat tagged at Cave 14 in February 2019 (individual 31857) was most frequently detected by towers 5BE8 and 53E7 ($n = 6$) (Table 4). Both towers were in close vicinity to Cave 14 where the individual likely roosted in at least two nights during the sampling period. This bat did not move further west into Western Range. Instead, the bat spent the vast majority of its recorded time (11.4 h, or 94%) near tower 6405 A1 which was directed towards a minor drainage line (Table 5). However, the bat spent most of its time outside of the detection range of all towers, suggesting that it was mainly foraging outside of the Project Area. As the bat was frequently last detected by towers north of Western Range before disappearance, it is likely that the individual foraged in the plains to the north of Western Range.

The Ghost Bat tagged at Cave 6 in February 2019 (individual 31859) was most frequently detected by tower DD2E in the central section of Western Range, where the bat also spent the vast majority of its time (11.6 h, or 61%). Unlike the other Ghost bats tagged during this study, this individual frequently circled between multiple towers at Western Range, including C9C8, DD2E, 5751, 51AD, B8B8 and 53E7. This suggests that this bat did not only utilise Western Range for diurnal roosting purposes, but also as a likely foraging ground. In two nights, the individual disappeared from the detection range of

all towers for extended periods of time, suggesting that extensive foraging also occurred in the plains to the north and south of Western Range (outside of the Project Area).

The Ghost Bat tagged at CPAN-12 in September 2019 (individual 38020) roosted exclusively in this cave during the sampling period. CPAN-12 is located at the base of Mt Truchanas, approximately 35 km to the north-east of Western Range. The bat was only detected by the two towers at Mt Truchanas (F06C and 7295), suggesting that there was no regional movement between the roosts at Mt Truchanas and Western Range during the sampling period. As observed with the other Ghost Bats, the individual typically disappeared from the detection range of all towers for the majority of the night, suggesting that it was mainly foraging outside of the Project Area and away from its roosting location.

In summary, the preliminary findings of the Ghost Bat VHF tracking study at Western Range indicate that the majority of bats mainly utilised Western Range for diurnal roosting purposes. Bats were found to have roosted in Cave 11, Cave 6 and Cave 14 during the sampling period, with further roosting likely also occurring near towers C9C8, DD2E, 2C04 in the central section of Western Range. With the exception of Ghost Bat individual 31859, the bats spent very little time near towers in Western Range and were only detected by towers within Western Range in the beginning and end of each night upon leaving and entering the roost. Instead, bats spent the vast majority of their time outside of the detection range of all towers, suggesting that they mainly favoured foraging in the plains to the south and north of Western Range. Therefore, the VHF detection results indicate that the Ghost Bats foraged both in the upper ranges as well as in the surrounding plains, with an overall preference for foraging in the plains.

Yours sincerely,

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Table 4: Total number of detection events at each tower and for each bat

Bat ID	WESTERN RANGE												PIRRABURDU CREEK			FLATS SOUTH OF WESTERN RANGE			PLAINS NORTH OF WESTERN RANGE										MT TRUCHANAS		Total	
	B893/9640	9E15		F05C	C9C8	DD2E	2C04	5B80	5751	51AD	B8B8	53E7	5BE8	6405			2EA7			B549			E5CE			A080				7295		F06C
		A1	A2											A1	A2	A3	A1	A2	A3	A1	A2	A3	A1	A2	A3	A1	A2	A3	A4			
31859	-	-	-	-	7	25	-	11	16	7	3	1	-	-	-	-	-	-	1	-	1	-	-	2	-	-	-	1	-	-	75	
31857	-	-	-	-	-	-	-	-	-	-	-	1	5	5	-	-	-	-	-	-	1	-	-	3	-	-	-	2	-	-	17	
34349	5	4	13	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	26		
34348	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	5		
34347	2	22	9	14	1	-	-	-	6	-	2	-	-	-	-	-	26	3	-	-	-	-	-	-	-	-	-	-	-	85		
31854	-	7	3	4	-	1	2	-	-	-	-	-	-	-	-	-	4	1	-	-	-	-	-	-	-	-	-	-	-	22		
31856	5	6	10	3	2	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	4	3	-	-	-	-	-	-	-	41		
38020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13		
Total	12	40	38	23	10	26	2	11	22	7	5	2	5	5	0	0	41	4	0	1	5	4	0	0	5	0	0	0	3	2	11	284

Note: Only towers with detections are listed.

Table 5: Total detection event duration (in minutes) at each tower and for each bat

Bat ID	WESTERN RANGE												PIRRABURDU CREEK			FLATS SOUTH OF WESTERN RANGE			PLAINS NORTH OF WESTERN RANGE										MT TRUCHANAS		Total	
	B893/9640	9E15		F05C	C9C8	DD2E	2C04	5B80	5751	51AD	B8B8	53E7	5BE8	6405			2EA7			B549			E5CE			A080				7295		F06C
		A1	A2											A1	A2	A3	A1	A2	A3	A1	A2	A3	A1	A2	A3	A1	A2	A3	A4			
31859	-	-	-	-	48.7	697	-	78.9	234	41.4	29.2	1.1	-	-	-	-	-	-	0.23	-	0.93	-	-	6.18	-	-	-	1.42	-	-	1,139	
31857	-	-	-	-	-	-	-	-	-	-	-	1.57	27.4	685	-	-	-	-	-	1.57	-	-	-	11.1	-	-	-	3.2	-	-	730	
34349	9.83	9.57	100.61	3.9	-	-	-	-	-	-	-	-	-	-	-	-	8.85	-	-	-	-	-	-	-	-	-	-	-	-	133		
34348	-	0.48	8.07	-	-	-	-	-	-	-	-	-	-	-	-	-	0.62	-	-	-	-	-	-	-	-	-	-	-	-	9.17		
34347	1.34	72.82	35.12	134	10.7	-	-	-	48.4	-	17.2	-	-	-	-	-	93.8	2.43	-	-	-	-	-	-	-	-	-	-	-	416		
31854	-	18.3	39.17	35.2	-	4.53	13.8	-	-	-	-	-	-	-	-	-	22.3	2.75	-	-	-	-	-	-	-	-	-	-	-	136		
31856	5.87	18.02	64.79	24.4	8.61	-	-	-	-	-	-	-	-	-	-	-	40.8	-	-	-	4.6	20.6	-	-	-	-	-	-	-	188		
38020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	99.1		
Total	17.04	119.19	247.76	197	68.1	702	13.8	78.9	283	41.4	46.5	2.67	27.4	685	0	0	166	5.18	0	0.23	6.17	21.5	0	0	17.2	0	0	0	4.62	4.53	94.6	2,850

Note: Only towers with detections are listed.

Individual movements

Individual 31859 - Male

Individual 31859 was recorded for eight nights following tagging at Cave 6, from the evening of the 26th February to the morning of the 6th March 2019. A total of 75 detection events from 10 towers were received during this time. Of the ten towers that received detections, eight were located within Western Range, with the remaining two towers (E5CE and A080) located in the flats to the north of the ranges. The majority of detections ($n = 25$) were made at tower DD2E, where the bat also spent the vast majority of its time (11.6 h, or 61%). This suggests that the individual was foraging in the vicinity of the tower during the sampling period. The bat was also frequently detected at tower 5751 ($n = 16$) where it spent approximately 20% of its recorded time (3.91 h).

During the eight-night sampling period, the individual usually emerged around 9 pm and was last detected around 5.30 am. In three of the nights, the first detection of the night was recorded by tower 5751, located in close proximity to Cave 6 where the individual was originally tagged. First detections of the night were also recorded by towers DD2E (1 night), 5B80 (1 night), C9C8 (1 night) and 51AD (two nights), suggesting that the individual may have roosted in multiple caves within Western Range during the sampling period.

The most common flight pattern of this individual was to emerge from a tower within the central part of Western Range (between towers C9C8 and 51AD) and to then continuously circle back and forth between multiple towers at Western Range, including (from west to east) C9C8, DD2E, 5751, 51AD, B8B8 and 53E7. In one of the nights, the bat was also briefly detected by B549 (A1 and A3) before disappearing for 7.5 h, suggesting that it was foraging in the flats to the north of Western Range. Similarly, the individual was briefly detected by E5CE (A3) and A080 (A4) in another night, suggesting that the bat was foraging in the creek lines (e.g. Seven Mile Creek) north of Western Range during this time.

Individual 31857 - Male

Individual 31857 was recorded for five non-continuous nights following tagging at Cave 14, from the evening of the 21st to the morning of the 26th February 2019. A total of 17 detection events from six towers were received during this time. The bat spent the vast majority of its time (11.4 h, or 94%) at tower 6405 A1 which was directed towards a minor drainage line to the north-east of the tower. This suggests that the individual was foraging in the vicinity of the tower during the sampling period. The bat also spent large amounts of time outside of the detection range of all towers, suggesting that further foraging occurred outside of the Study Area. As the bat was frequently last detected by towers north of Western Range before disappearance, it is likely that the individual foraged in the plains to the north of Western Range.

The bat was first detected at 53E7 or 5BE8 in two of the nights, suggesting it was roosting in Cave 14 where it was originally tagged during this time. The bat exhibited a different movement pattern each night during the sampling period. In the first night, it emerged from 53E7 and immediately flew north to

E5CE A3. It then disappeared from the detection range of the tower for 2 h before returning to Western Range (tower 5BE8) later in the night. The bat was not detected in the following night, suggesting that it may have been roosting outside of the Study Area. In the third night, it was first detected at B549 A2 and disappeared from the detection range of all towers for 7.5 h. It returned to Western Range (tower 5BE8) later in the night, briefly flying by E5CE A3 and 6405 A1 beforehand. In the fourth night, the bat emerged from 5BE8 and immediately flew north, flying by 6405 A1, A080 A4, and E5CE A3 on the way. The bat then disappeared from the detection range of all towers for 7 h before returning to Western Range (5BE8) later in the night. In the last night of the sampling period, the bat emerged from 6405 A1 and spent 5 h in the vicinity of the tower. Its last detection was at that tower at 03:01 am. The individual was not detected again in the remainder of the sampling period, suggesting that it either vacated the Study Area or that the tag became dislodged.

Individual 34349 – Female

Individual 34349 was recorded for six nights following tagging at Cave 11, from the evening of the 5th May to the evening of the 10th May 2019. A total of 26 detection events from four towers were received during this time. In all six nights, the first detection event of the night was recorded by 9E15 (A1 or A2), suggesting that the individual was exclusively roosting at Cave 11 during the sampling period. The majority of detections were made at tower 9E15 ($n = 17$) near Cave 11. Tower B893/9640 located to the immediate west of Cave 11 recorded 5 detections, whereas tower F05C to the east of Cave 11 recorded two detections. The remaining two detections were recorded by tower 2EA7 A1.

Most commonly, the bat flew south following emergence from Cave 11, flying by 9E15 (A1 or A2) before being picked up by tower F05C, B893/9640 and/or 2EA7 A1. However, the bat did not spend a significant amount of time near these towers. In all nights, the individual disappeared from the detection range of all towers for 6 – 10.5 h, indicating that its main foraging grounds were located outside of the Project Area. As the bat was not detected by any of B549's antennas directed towards the plains to the north of Western Range, the individual's main foraging grounds may have been located in the plains to the south or west of Western Range. In some nights, the bat periodically returned to 9E15 A1 and A2 and 23A7 A1 later in the night. The bat was last detected on the 10th May 2019 at 9E15 A2, after which time it either vacated the Study Area or its tag became dislodged outside of the detection range of all towers.

Individual 34348 - Female

Individual 31848 was recorded for five nights following tagging at Cave 11, from the evening of the 5th May to the evening of the 9th September 2019. A total of five detection events from two towers were received during this time. During the first night, the individual emerged from 9E15 A1 & A2 (Cave 11) and immediately headed south to tower 23A7 A1 (flyby). The bat was not detected again in the following two nights, suggesting that it was roosting and foraging outside of the Project Area. In the fourth night, the bat returned to 9E15 A2 in the early morning (05:45) and roosted in Cave 11. The individual emerged from Cave 11 the following evening and was not detected again during the remainder of the sampling

period, suggesting that it either vacated the Study Area or that its tag became dislodged outside of the detection range of all towers.

Individual 34347 - Female

Individual 34347 was tracked for the longest period of time (13 nights), from the evening of the 5th May to the morning of the 18th May 2019. A total of 85 detection events from seven towers were received during this time. In all thirteen nights, the bat either emerged from 9E15 (A1 or A2) or from 2EA7 A1, suggesting that the bat roosted exclusively in Cave 11 (tagging location) during the sampling period.

The most common flight pattern of this individual was to head south following emergence from Cave 11, flying by 9E15 A1/A2 before being picked up by F05C and 2EA7 A1. In most nights, the individual then disappeared from the detection range of all towers for up to 10.5 hours before returning to Cave 11 in the early morning. However, some nights, the individual intermittently returned to 9E15 A1/A2, F05C and 2EA7 A1 where it spent up to 1.5 hours at a time. This suggests that this bat foraged to the south of Western Range, near 9E15 A1/A2 and 2EA7 A1 as well as largely outside of the detection range of the towers. In three nights, the bat also headed further west and was briefly detected by towers within the central (C9C8 and 5751)) and eastern (B8B8) section of Western Range (approximately 10 min long stays).

Individual 31856 - Male

Individual 31856 was recorded for three nights following tagging at Cave 11, from the evening of the 5th May to the morning of the 8th May 2019. A total of 41 detection events from six towers were received during this time. The individual likely roosted at multiple locations during the sampling period, with matching first and last detection events being recorded at Cave 11 (towers 9E15 A1/A2, 2EA7 A1, two nights) and C9C8 (one night).

A typical movement pattern for this bat was to fly back and forth between 9E15 A1 and A2, F05C and 2EA7 A1 for up to one hour following emergence, suggesting that it was foraging in the flats to the south of Western Range. However, in all nights, the individual disappeared from the detection range of all towers for 7 - 9 hours, indicating that it was mainly foraging outside of the Project Area. In two of the nights, the bat also flew north, flying by C9C8 before being detected by B549 (A1 and A2), indicating that some foraging also occurred in the plains to the north of Western Range.

Individual 31854 – Female (gravid)

Individual 31854 was recorded for three nights following tagging at Cave 11, from the evening of the 5th May to the evening of the 7th May 2019. A total of 22 detection events from five towers were received during this time. In the majority ($n = 2$) of nights, the individual was first detected at 9E15 A1, suggesting that it was roosting in the vicinity of this tower during the sampling period (most likely Cave 11 where the bat was originally tagged). In the remaining night, the bat also appeared to have roosted near tower 2C04, located in the central section of Western Range. Cave 13 is located 900 m north-west of that tower.

In the first night, the bat emerged from 9E15 A1 and immediately disappeared from the detection range of all towers for 6.5 hours. It then periodically flew by 9E15 A1 and F05C, but spent most of its time outside of the detection range of the tower, suggesting that it was foraging in the plains to the south of Western Range. Its last detection of the night was at 2C04 at 05:13 am. In the second night, the bat was first detected by 2C04 at 18:50. The individual then flew west to DD2E and disappeared for 7 h. It then circled back and forth between 2EA7, 9E15 and F05C for the remainder of the night, suggesting that it was foraging in the plains to the south of Western Range. In the last night, the bat emerged from 9E15 A1 and spent 15 min in its vicinity. The individual was not detected again in the remainder of the sampling period, suggesting that it either vacated the Study Area or that the tag became dislodged.

Individual 38020 - Male

Individual 38020 was recorded for nine nights following tagging at CPAN-12 (27/09/2019), from the evening of the 27th September to the evening of the 5th October 2019. CPAN-12 is located at the base of Mt Truchanas, approximately 35 km to the north-east of Western Range. In all nine nights, the bat was first detected by F06C, suggesting that it was roosting at CPAN-12 during the sampling period. Following emergence at F06C, the individual typically disappeared from the detection range of all towers for the remainder of the night. In one of the nights, it was also briefly detected by 7295 further west at Mt Truchanas.