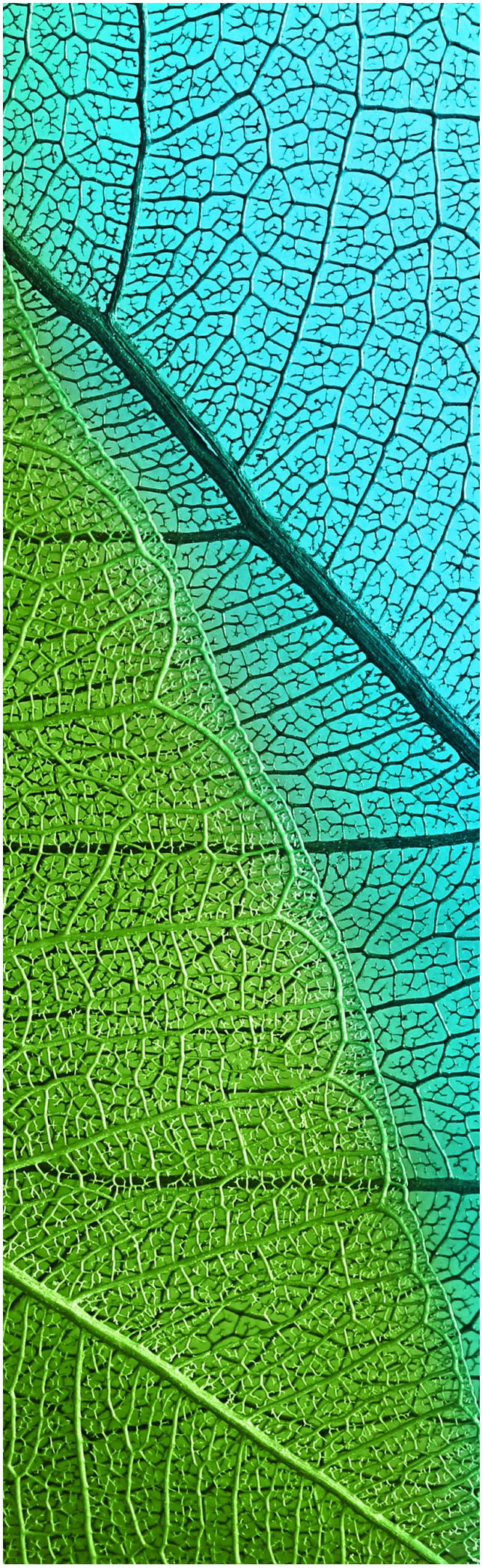

Bango Wind Farm

Interim report on baseline bat and avifauna assessments

Prepared for CWP Renewables

May 2021
Report No. 18173 (3.4)

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1. Executive summary

Nature Advisory Pty Ltd undertook a pre-commissioning fauna assessment of the Bango Wind Farm in New South Wales. The area investigated, referred to herein as the 'study area', comprised an area within 200 metres of the development footprint of the approved wind farm, including tracks, turbine locations and associated infrastructure.

This investigation was commissioned to provide baseline data on birds and bats that utilise the study area as detailed in the draft Bango Wind Farm Bird and Bat Management Plan (BBAMP) Report version 1.24 (1st April 2021). This report includes the interim results for bird utilisation surveys and incidental raptor observations over four seasons of pre-construction surveys, bat surveys, and Superb Parrot surveys.

The wind farm project is located across the ridges and slopes across farmland primarily used for grazing. The project is dominated by pasture with some remnant woodland and forest habitats distributed across the region. A total of eight threatened bird and bat species have been recorded at the wind farm including the following.

- Superb Parrot (*Polytelis swainsonii)* (EPBC Act: Vulnerable, BC Act: Vulnerable)
- Brown Treecreeper (*Climacteris picumnus victoriae)* (BC Act: Vulnerable)
- Diamond Firetail (*Climacteris picumnus victoriae)* (BC Act: Vulnerable)
- Dusky Woodswallow (*Artamus cyanopterus cyanopterus)* (BC Act: Vulnerable)
- Varied Sittella (*Daphoenositta chrysoptera)* (BC Act: Vulnerable)
- Speckled Warbler (*Chthonicola sagittate*) (BC Act: Vulnerable)
- Large Bent–winged Bat (*Miniopterus orianae oceanensis)* BC Act: Vulnerable)
- Yellow–bellied Sheathtail Bat (*Saccolaimus flaviventris)* (BC Act: Vulnerable).

The data collected from these studies will contribute to the pre-construction data baseline. The results from these surveys can be compared with future studies to determine if there has been any change or impact as a result of the construction and operation of the Bango Wind Farm.

The bird utilisation surveys were undertaken over four seasons and compiled records of 73 species. The Sulphur-crested Cockatoo (*Cacatua galerita*), Galah (*Eolophus roseicapilla)*, Australian Magpie (*Gymnorhina tibicen)*, Australian Raven (*Corvus coronoides*) and Wedge–tailed Eagle (*Aquila audax)* were the most common occurring birds flying at Rotor Swept Area (RSA) heights (between 40m – 200m above ground) which puts them at risk of colliding with turbines. These are all common and widespread species typically occurring on farmland across south–east Australia.

The bat surveys have recorded 13 bat species frequenting the study area including two listed species, the Large Bent–winged Bat and the Yellow–bellied Sheathtail Bat. There were few records of Yellow–bellied Sheathtail Bat and it was considered to be low risk of them colliding with turbines.

The Large Bent–winged Bat was recorded in the study area during the autumn and spring surveys. Higher activity levels of Large Bent–winged Bat were reported during the summer-autumn 2019 and spring 2019 surveys associated with forested woodland.

Lower activity levels of the Large Bent–winged Bat were recorded in the autumn 2020 surveys. This is the season when Large Bent–winged Bat may migrate to non-breeding caves closer to the coast.

Incidental observations were made of raptors flying across the landscape. In total, 79 observations were recorded from seven raptor species at Bango Wind Farm during the monitoring period. The Wedge–tailed Eagle and Nankeen Kestrel (*Falco cenchroides*) were the most common species recorded and were reported flying at RSA heights which puts them at risk of colliding with turbines.

Superb Parrot surveys were undertaken in 2019 during their breeding season which is the only time the species are present in the region. A total of 37 observations and 131 movements were recorded during the current investigation. Superb Parrot were observed in the study area in four distinct clusters listed below.

- Near the entrance of the wind farm site along to the west along Lachlan Valley Way
- Near the centre of the Kangiara cluster, near the cross roads of the access tracks
- Along Tangmangaroo Road
- In the south-east section of the Mt Buffalo cluster

Superb Parrots were observed flying at or below 30 metres height, which is below RSA height.

There were no Superb Parrot observed breeding within 200 metres of turbine locations.

The BBAMP for Bango Wind Farm details the construction phase and operational monitoring for the Bango Wind Farm. Specific details on methodology are provided in Appendix 1 of the BBAMP.

2. Introduction

CWP Renewables Pty Ltd engaged Nature Advisory Pty Ltd to conduct a pre-commissioning fauna assessment of the Bango Wind Farm in New South Wales. The area investigated, referred to herein as the 'study area', comprised an area within 200 metres of the development footprint of the approved wind farm, including tracks, turbine locations and associated infrastructure.

This investigation was commissioned to provide baseline data on birds and bats that utilise the study area as detailed in the Bango Wind Farm Bird and Bat Management Plan (BBAMP) Report no. 18173 (1.24) (Nature Advisory 2021)

This report replaces BL&A Report 18173 (2.1) and provides a interim dataset for Bird Utilisation Surveys (BUS), four seasons of raptor surveys, two bat utilisation surveys, and two surveys of Superb Parrot during the breeding season.

Specifically, the scope of the investigation is included below.

- Bird Utilisation Survey
  - Completing the point-based bird utilisation survey over four seasons, at:
    - Seven impact points; and
    - Three reference points.
- Bat surveys
  - Two seasonal surveys for a minimum of one month each in:
    - Spring 2019; and
    - Summer 2020.
- Raptor surveys
  - Incidental observations of raptor movements observed across the wind farm site over four seasons.
- Superb Parrot survey
  - Roaming surveys within 200 metres of the turbines
  - Identifying any hollows acting as nests within 100 metres of turbines sites
  - Two roaming surveys
    - Early in the breeding season; and
    - Later in the breeding season.

This report is divided into the following sections:

Section 3 describes the methods and presents the results of the BUS.

Section 4 describes the methods and presents the results of the bat survey.

Section 5 describes the methods and presents the results of the raptor survey.

Section 6 describes the methods and presents the results of the Superb Parrot survey.

Section 7 presents conclusions from the pre-commissioning fauna assessments.

This investigation was undertaken by a team from Nature Advisory comprising Guille Mayor (Zoologist), Eamon O'Meara (Zoologist), Curtis Doughty (Senior Zoologist), Bernard O'Callaghan (Senior Ecologist and Project Manager) and Brett Lane (Principal Consultant).

3. Bird utilisation survey

3.1. Introduction

The bird utilisation survey (BUS) was undertaken consistent with the requirements for a "Level One" bird risk assessment in accordance with Best Practice Guidelines for Wind Energy Developments in Australia issued by the Clean Energy Council (2018).

Four pre-construction bird utilisation surveys were undertaken by experienced zoologists from 2019–2020; one in each season to account for seasonal differences in bird activity and presence of species (due to migration). The dates and surveyors were undertaken are detailed below.

- Autumn: 30/04/2019 – 01/05/2019 (Curtis Doughty, Guille Mayor)
- Winter: 08/07/2019 – 13/07/2019 (Eamon O'Meara)
- Spring: 07/10/2019 – 12/10/2019 (Guille Mayor)
- Summer: 18/02/2020 – 21/02/2020 (Eamon O'Meara).

3.2. Methodology

3.2.1. Fixed-point bird count

The fixed-point bird count method involved an observer stationed at a survey point for 15 minutes. The adequacy of using 15 minutes as an interval to record the presence of birds during bird utilisation surveys was investigated in an earlier study at another wind farm site (Brett Lane & Associates Pty Ltd, unpublished data). This showed that 82 to 100 percent (average 88 percent) of species actually seen in one hour of surveying were seen in the initial 15 minutes of observation. Based on this result, the period of 15 minutes used in the formal bird utilisation surveys was considered adequate to generate representative data on the bird species in the area during the survey.

During this period, all bird species and numbers of individual birds observed within 200 metres were recorded. The species, the number of birds and the height of the bird when first observed were documented. For species of concern (threatened species, waterbirds and raptors), the minimum and maximum heights were recorded.

Flight height is presented as below, at or above RSA height.

A = Below RSA (<40 metres above ground).

B = At RSA (40 – 200 metres above ground).

C = Above RSA (> 200 metres above ground).

Table 1 below gives an example of when each point was counted on any particular survey day. Scheduling ensured that all points were visited equally at different times of day to allow for time-of-day differences in bird movements and activity. Every survey point (impact and reference) was visited eight times over the survey period (Figure 1).

Table 1: Times when points were counted for each fixed-point bird count survey day

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
8:00-8:30	Travel to site	R2				5
8:30-9:00		22		5	7	6
9:00-9:30			R3	6	17	R2
9:30-10:00		5	7	R2		22
10:00-10:30		6	17	22		
10:30-11:00		R2			R3	5
11:00-11:30		22		5	7	6
11:30:12:00			R3	6	17	22
12:30 - 13:00	R3	5	7	R2		Travel From site
13:00 -13:30	7	6	17	22		
13:30-14:00	17	R2			R3	
14:00-14:30		22		5	7	
14:30-15:00			R3	6	17	
15:00-15:30	R3	5	7	R2		
15:30-16:00	7	6	17	22		
16:00-16:30	17	R2			R3	

Note: See Figure 1 for survey point locations. The prefix 'R' refers to reference points.

3.2.2. Locations of survey points

Over the four survey periods, ten fixed survey points were established: seven impact points and three reference points. Impact points were located near proposed turbine locations and reference points were located at least 500 metres away from turbine locations in areas of similar habitat.

The survey points were distributed as evenly as possible across the wind farm (subject to access constraints) to maximise coverage in areas where wind turbines are likely to be sited (Figure 1). Impact points were positioned as far as possible on elevated ground, allowing a clear view in all directions.

Table 2 below provides a description of the habitats associated with each survey point.

Table 2 Habitat associated with each survey point

Survey point	Habitat
5	Located on top of a rocky granite ridge. Grassy forest habitat, the overstorey dominated by Scribbly Gum (*Eucalyptus rossii*) and Bundy (*Eucalyptus goniocalyx*) with some Red Stringybark (*Eucalyptus macrorhyncha*), lots of fallen timber present.
6	Located on top of a flat ridge, the area was rocky with a lot of dead trees and fallen timber. Some lightwood still standing and dominated with native understorey. North facing slope had some scattered trees including Yellow Box (*Eucalyptus melliodora*) and White Box (*Eucalyptus albens*) with some Blakely's Red Gum (*Eucalyptus blakelyi*) and Cassinia middle storey.
7	Located on top of a ridge. Habitat in this area was a mixture between open pasture with scattered trees and woodland. The overstorey was dominated by Red Stringybark, Bundy and Scribbly Gum, some Spreading Wattle (*Acacia genistifolia*) shrubs present and native pasture grasses.
12	Located along a granite ridge with a mixture of open native pasture on east facing slope and woodland on west facing slope. Woodland dominated by Bundy, Scribbly Gum and Yellow Box.
17	Located on top of a ridge in pasture land. Remnant trees located along fence lines and scattered in paddocks dominated by White Box, Yellow Box and Scribbly Gum.
21	This point was located on top of a ridge that runs north-south. It has granite boulders, native pasture, scattered trees dominated by Bundy and some Scribbly Gum and Silver Wattle (*Acacia dealbata*). Grazed by sheep.
22	Located along a ridge with granite outcrops and boulders. Woodland habitat dominated by Yellow Box, Bundy, Scribbly Gum and White Box. No middle storey, sparse native grasses and leaf litter.
R1	Roadside vegetation dominated by a strip of mature Yellow Box, some Blakely's Red Gum, and Lightwood and Cassinia shrubs as understorey. Grazing paddocks outside the roadside with some scattered mature gums.
R2	Open grazing paddock flanked East and West by two streams that run N-S dominated by planted Willows and mature gums. Understorey comprised Silver Wattle, small shrubs, and rushes.
R3	Located on a lower ridge to other sites, may be considered the slope with pasture and roadside habitats. The roadside was dominated by mature eucalypts including Blakely's Red Gum, Bundy and Yellow Box and some Lightwood with Cassinia shrubs throughout and native grasses. The pasture areas had regenerating eucalypts, Cassinia and native grasses.

3.2.3. Incidental observations

In addition to the observations during formalised, fixed-point counts, incidental observations of birds of concern (threatened species, raptors, waterbirds) were made whilst travelling throughout the wind farm site. Notes are also made on birds observed in remnant woodlands and any early morning and evening roosting movements. Emphasis was placed on observing birds that were moving through the site at RSA height.

3.2.4. Analysis

Observations were recorded in the pre-defined field observation datasheets. Raw data was then entered into spreadsheet file and tables and graphs were extracted. Graphs were generated in Microsoft Excel and R (R Core Team 2018).

To investigate the variations of species diversity and abundance between impact and reference sites and among seasons, analysis of variance (ANOVA) was performed, with species diversity and abundance as dependent variables and sites type (impact/reference) with seasons as predicting factors. Abundance data were log-transferred to meet normal distribution in ANOVA tests. All statistical analyses were undertaken in R environment (R Core Team 2018). All means are presented as mean ± SE (mean ± standard error).

3.2.5. Limitations

The bird utilisation survey was undertaken during the four different seasons in 2019-2020. This was undertaken to collect a range of data and include migratory birds that may only occur at certain times of the year.

In spring, birds such as magpies and ravens would be breeding and holding territories within the study area. Additionally, most migratory bird species, including the summer visitors, would be present in the region.

The summer survey was done when construction had already commenced and survey point 21 had to be moved to an area close by in similar habitat as the initial point was located in a construction zone where machinery and works would influence the survey outcomes. Summer usually provides observations of larger family groups of birds and some early flocking that increases in autumn.

In autumn and winter, birds such as starlings, cockatoos, ravens, or magpies usually occur in flocks generating larger counts. However, there may be a lack of observations for several surveys if the flocks are in a different area. Furthermore, migrant species are not present in the region.

For these reasons the utilisation rates and species abundances recorded are considered to be representative of the site for a whole year, as time of day and seasonal changes in bird activity and occurrence have been controlled for in the sampling design. They are also considered to provide baseline data on which to assess the bird risks associated with Bango Wind Farm.

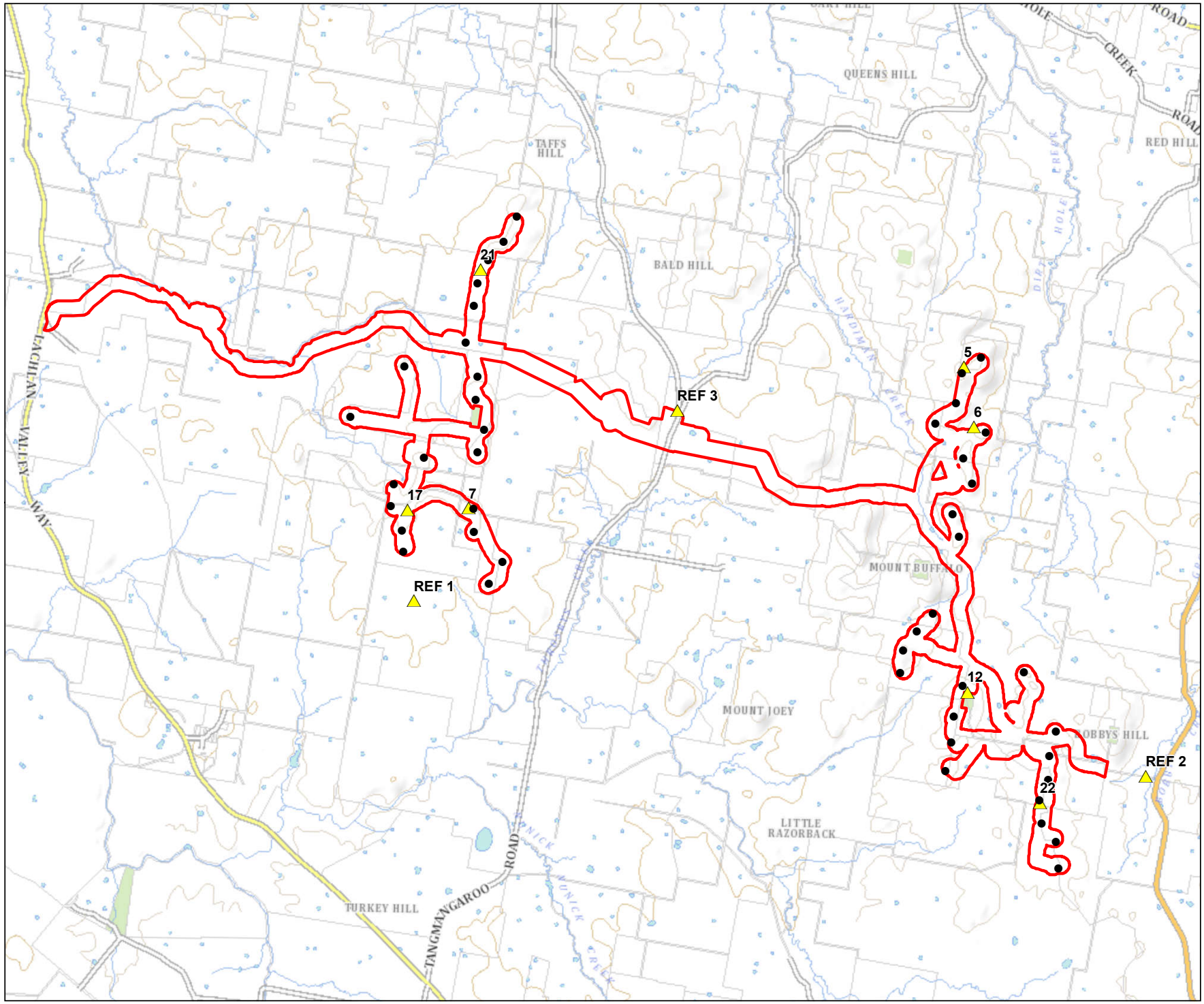

Figure 1: BUS locations

Project: BANGO WIND FARM
Client: CWP Renewables Pty Ltd
Date: 19/05/2021

Legend

- Development corridor
- Turbines
- BUS locations

N

Metres
0 750 1,500

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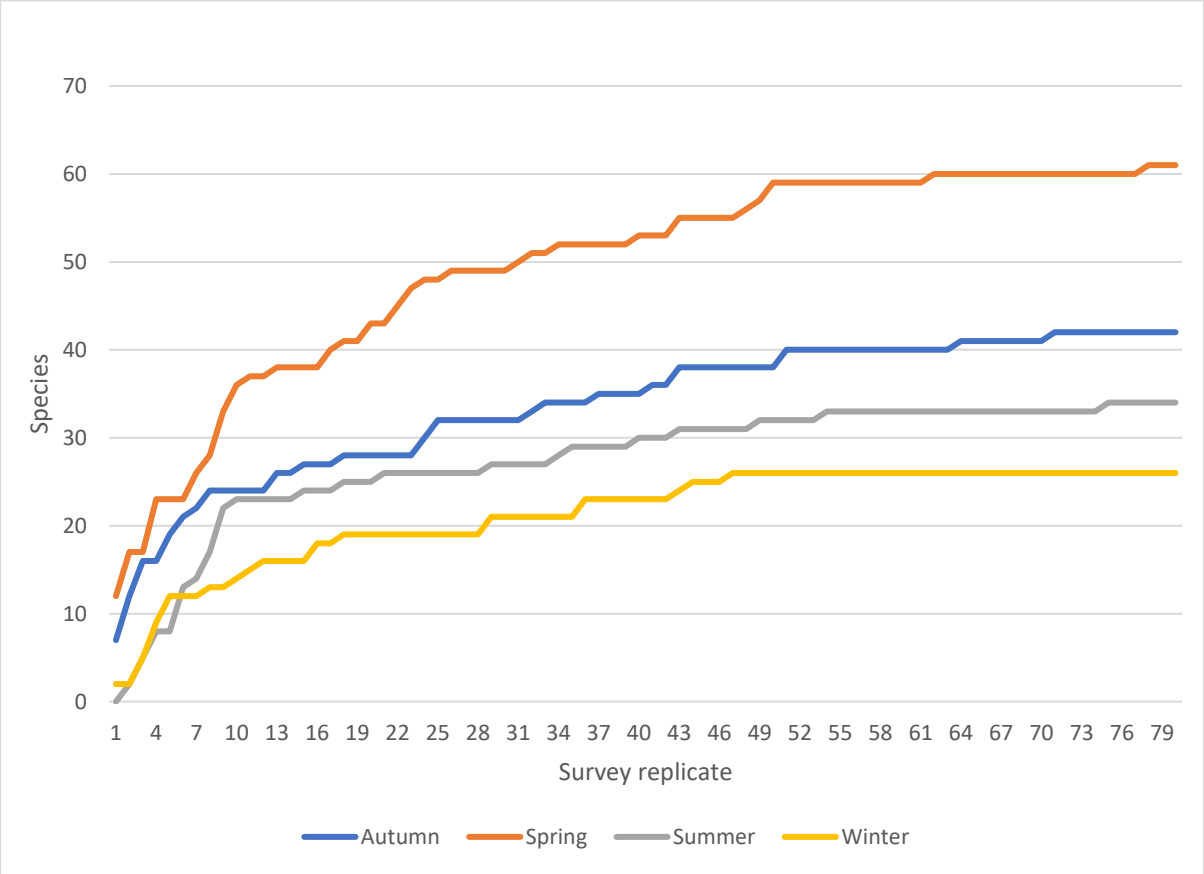
3.3. Results

3.3.1. Survey suitability

The cumulative number of species observed from the consecutive fixed-point bird counts conducted at the observation points during the survey period has been plotted (Figure 2). This indicated that the number of species recorded levelled out after 60 counts. This supports the adequacy of using eight replicates to generate representative data on the bird species in the area during the relevant time of year.

Figure 2: The cumulative number of species of birds recorded during consecutive counts at the impact points on Bango Wind Farm.



3.3.2. Species composition

A total of 73 bird species were recorded during the combined surveys over the year. Of these 67 species were recorded at the impact survey points and 59 at the reference survey points (Table 4). Species recorded were predominantly farmland and bushland species with some records of raptors and waterbirds.

Species diversity varied between each season. Diversity was highest in spring and lowest in winter. Species diversity differs between seasons due to changes in presence and abundance, activity, changes in foraging behaviour and seasonal changes in habitat choice by birds.

The five most common species at the impact and reference survey points are presented below in Table 3.

Table 3: The five most common bird species recorded at BUS points at Bango Wind Farm

Impact survey points	Reference survey points
Sulphur-crested Cockatoo	Common Starling
Australian Magpie	Australian Magpie
Common Starling	Galah
Eastern Rosella	Crimson Rosella
Buff-rumped Thornbill	Superb Fairy-wren

The five most common species recorded at the impact survey points comprised 63% of all birds and at the reference survey points the five most common birds comprised 18%.

The total number of birds observed at each survey point varied between 1,491 at survey point 17, to 258 at survey point 6 (Table 4). Bird diversity was slightly lower at reference points (59 species) than at impact points (67 species) thought more impact sites were surveyed than reference sites. On average after eight replicates, abundance was slightly higher at impact points (633 birds per impact site) than at reference points (545 birds per reference site).

Table 4: Number and height distribution of bird species at survey points during four seasons of BUS at Bango Wind Farm

Site	5		6		7		12		17			21		22		R1		R2		R3		Total
Species/height	A	B	A	B	A	B	A	B	A	B	C	A	B	A	B	A	B	A	B	A	B	
Australian Hobby									1													**1**
Australian Magpie	37		55		38		86	11	66			73		150	4	73		89		45		**727**
Australian Pipit	1		1				2					7		1		2						**14**
Australian Raven	2		2	1	11		14		6	1		18		29	10	10	13	3		15		**135**
Australian Wood Duck					4		10		5					18				2				**39**
Black-faced Cuckoo-shrike	11		5		6	1	3		4			6		2		9		19		3		**69**
Brown Falcon										1		4								2		**7**
Brown Goshawk			1																			**1**
Brown Thornbill									6											4		**10**
Brown Treecreeper	11																					**11**
Buff-rumped Thornbill	43		23		47		6		7					15						55		**196**
Common Bronzewing	1				1				21											1		**24**
Common Starling			5		3	1	61			1		230		116		244	30	15		13		**719**
Crested Pigeon																3		11				**14**
Crimson Rosella	5		36		66		32		85			13		41		42		24		24		**368**
Eastern Rosella			7		53		20		166			6		28		24		6		16		**326**
Eastern Spinebill			1																			**1**
Eastern Yellow Robin	1		3											7								**11**
Flame Robin												1										**1**
Galah	2		6		50		26		33	3		6		13	40	18	6	33		40		**276**
Golden Whistler					7				2													**9**
Grey Butcherbird					1																	**1**
Grey Fantail	3		2		21													4		17		**47**
Grey Shrike-thrush	5		1		6		3		4					2		5		5		10		**41**
Laughing Kookaburra			1		8															1		**10**
Little Corella					10				98							3		3				**114**
Little Friarbird			1																	3		**4**
Magpie-lark			1		3		12		28			3		2		7		1		4		**61**
Mistletoebird					9				1											2		**12**
Nankeen Kestrel							2					2	2			3	2	3		2		**16**
Noisy Friarbird	2		10		4		3		4			1								3		**27**
Noisy Miner					2		17		22					8		11				2		**62**
Pacific Black Duck	2															3						**5**
Pallid Cuckoo														2								**2**
Pied Butcherbird							3															**3**
Pied Currawong	1		1		6		12		49			3		16		1		4		1		**94**
Rainbow Bee-eater						5										3						**8**
Red Wattlebird	32		2		14		3		9			1		13		1		3		16		**94**
Red-capped Robin	1																	2				**3**
Red-rumped Parrot														19		50	6					**75**
Restless Flycatcher												1										**1**
Rufous Songlark																4				1		**5**
Rufous Whistler	3				2		1									1		3		13		**23**
Sacred Kingfisher					3											1						**4**
Scarlet Robin	2		32		8				11					2								**55**

Site	5		6		7		12		17			21		22		R1		R2		R3		Total
Species/height	A	B	A	B	A	B	A	B	A	B	C	A	B	A	B	A	B	A	B	A	B	
Silvereye	7				2											5		26		2		**42**
Speckled Warbler	2																					**2**
Spotted Pardalote	4		6		12				3			1		2						5		**33**
Striated Pardalote	15		4		33	7	5		23			2		3		18		3		2		**115**
Striated Thornbill	44		7		24		17		6					22						9		**129**
Sulphur-crested Cockatoo					49	220	70		772	5		23		37		21		5	3	6		**1211**
Superb Fairy-wren									5							51		25		17		**98**
Superb Parrot														1		14		4		1		**20**
Varied Sittella					10									4		20						**34**
Wedge-tailed Eagle	1	9	2			2					1										1	**16**
Weebill			13		2				14							1				15		**45**
Welcome Swallow							3									7		1		5		**16**
Western Gerygone			1		1		2													7		**11**
Whistling Kite																				1		**1**
White-browed Scrubwren																2		5				**7**
White-eared Honeyeater	1				6															13		**20**
White-faced Heron																		3				**3**
White-necked Heron															2							**2**
White-plumed Honeyeater					6		3		25							44		3		32		**113**
White-throated Gerygone			8				3							5						3		**19**
White-throated Treecreeper	11		9		32		7		1					4						12		**76**
White-winged Chough					23									61		11		21		18		**134**
White-winged Triller												1		5		1		7		1		**15**
Willie Wagtail									1					5		16		4		5		**31**
Yellow Thornbill	1		2		10				1											14		**28**
Yellow-faced Honeyeater			1		1													3		4		**9**
Yellow-rumped Thornbill	8		8		25		11							20				8				**80**
Yellow-tailed Black-Cockatoo																25		6				**31**
Total	**259**	**9**	**257**	**1**	**619**	**236**	**437**	**11**	**1479**	**11**	**1**	**402**	**2**	**653**	**56**	**754**	**57**	**354**	**3**	**465**	**1**	**6067**

Notes: R = Reference; A = Below RSA height; B = At RSA height; C = above RSA height.

3.3.3. *Variabilities of species richness and abundance among survey points*

The diversity of bird species (species/survey) varied between the seven impact and three reference observation points and depended on the habitat surrounding each of the points. Table 4 summarises results for abundance and height distributions for each point. Points within or close to patches of woodland returned higher richness than those within open habitats. These types of locations included impact points 7, 17 and 22 and reference points R1, R2 and R3 which showed the highest diversity of birds compared to impact points 6 and 21 (Figure 3. The mean number of species detected per site varied from 5.68 ± 0.32 at impact points and 7.67 ± 0.72 at reference points. ANOVA test suggested that this difference is significant (ANOVA, F= 8.2, df= 1 & 250, p= 0.004).

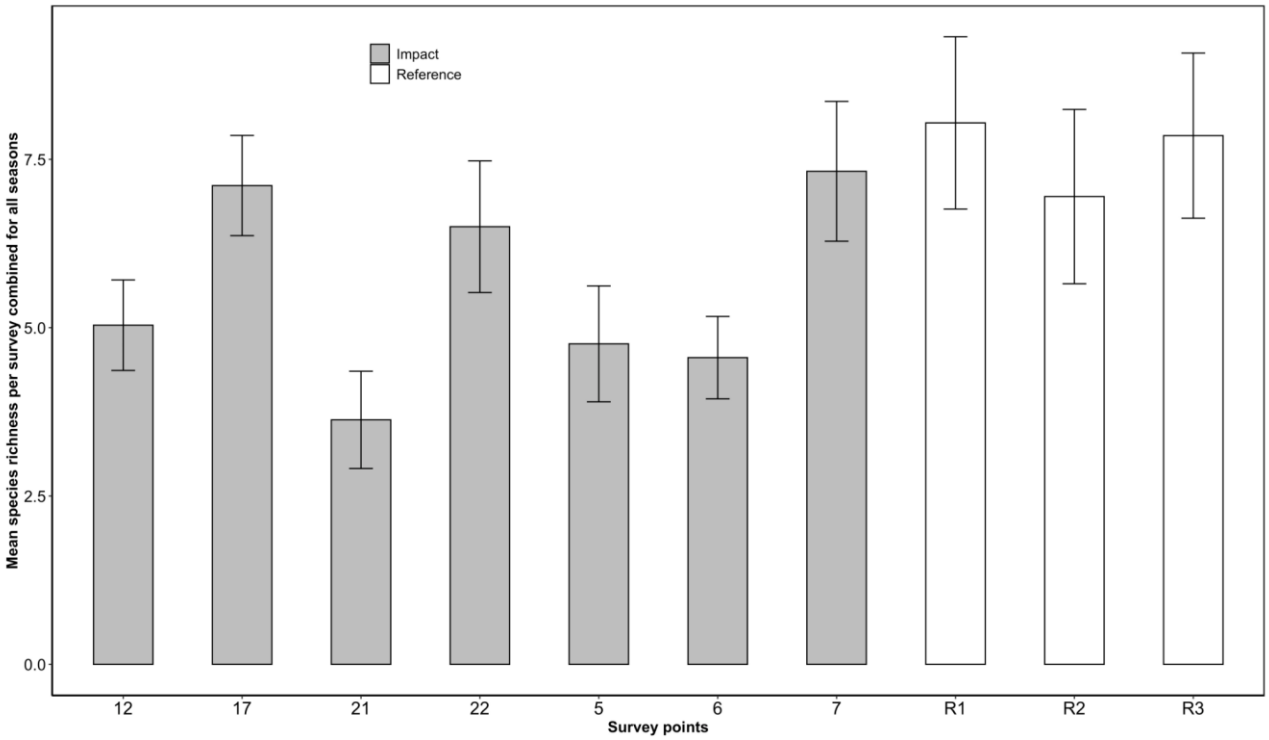


Figure 3: Mean species richness for all sites across all seasons surveyed

Mean abundance of birds (number of birds/survey) varied slightly between sites. The variations of abundance among site were similar when compared to each other with the exception of site 17 which had a spike due to high number of Sulphur-crested Cockatoo at this particular site compared to other sites (Figure 4). Mean number of birds recorded per survey at impact points varied from 24.36 ± 2.86 individuals/survey at impact sites to 23.34 ± 2.92 individuals/survey at reference sites (Figure 4). The difference between mean abundance of bird was found to be statistically insignificant between impact and reference points (ANOVA, F= 0.04, df= 1 & 250, p= 0.38).

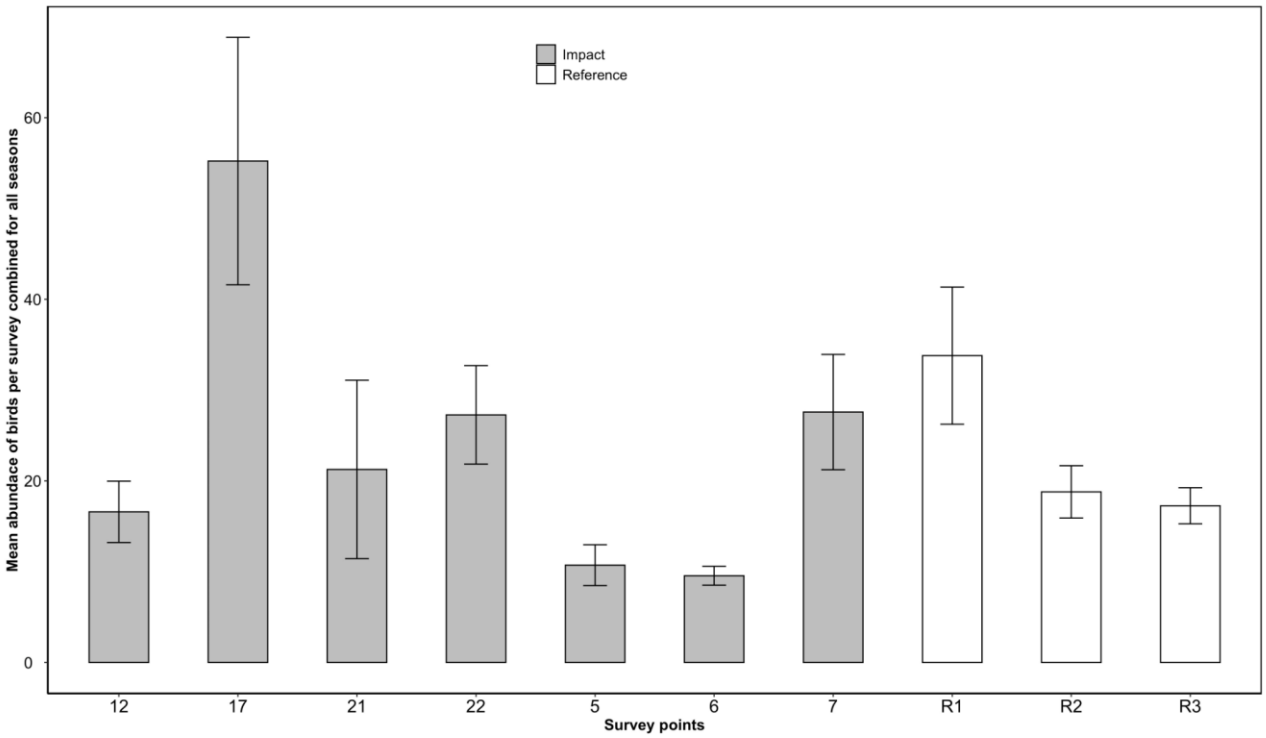


Figure 4: Mean abundance of birds per site over the four seasons surveyed.

3.3.4. *Flight heights*

Bird heights were classified as below (< 40 metres), at (40–200 metres) and above (> 200 metres) RSA height. Detailed results of the number of birds recorded at the different flight heights are presented in Table 5.

Table 5: Summary of birds recorded at the three flight heights

Flight Height	Impact survey points		Reference survey points	
	Number of birds	Percentage of all birds	Number of birds	Percentage of all birds
A (below RSA)	4,106	67.68%	1,573	25.93%
B (at RSA)	326	5.37%	61	1.01%
C (above RSA)	1	0.02%	0.00	0.00%
Total birds recorded	**4,433**	**73%**	**1,634**	**27%**

The five most abundant species flying at RSA are detailed in Table 6.

Table 6: The five most abundant species flying at RSA height at Bango Wind Farm

Impact points	Reference points
Sulphur-crested Cockatoo	Common Starling
Galah	Australian Raven
Australian Magpie	Galah
Australian Raven	Red-rumped Parrot
Wedge-tailed Eagle	Sulphur-crested Cockatoo

3.3.5. *Threatened species*

The majority of birds found to utilise the proposed wind farm site were common, widespread birds. Of the species recorded during the bird utilisation surveys the following species is listed as Vulnerable under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the NSW *Biodiversity Conservation Act 2016* (BC Act).

- Superb Parrot.

The following species recorded during the bird utilisation surveys are listed as Vulnerable under the BC Act.

- Brown Treecreeper
- Varied Sittella
- Speckled Warbler.

Furthermore, during the travels between survey points, Diamond Firetail and Dusky Woodswallow, Vulnerable under the BC Act, was also observed.

3.3.6. Raptors

Six raptor species were recorded in low numbers during the bird utilisation surveys, comprising 42 observations in total (Table 7). The presence of these raptors varied between seasons.

Wedge-tailed Eagle and Nankeen Kestrel were the most abundant raptor species at Bango Wind Farm. They were seen regularly throughout the study area. It is possible that up to three resident pairs of eagles frequently utilise the Bango Wind Farm site. During the lambing season (for the majority of properties this was winter), Wedge-tailed Eagle utilisation rates were higher as eagles from other territories moved in to scavenge on dead lambs. The Wedge-tailed Eagle often flew at RSA heights and 75% of Wedge-tailed Eagle flights observed were at RSA height.

The number of raptors was low in relation to the total number of birds recorded during the survey. However, raptors formed approximately 17.28% of all birds seen at RSA height (Table 7). Based on the utilisation rate by other raptors at the impact points, risks to them are likely to be low.

3.3.7. Waterbirds

Four waterbird species were recorded during the surveys, comprising 49 observations in total (0.8% of all birds). Of these, 39 individuals were Australian Wood Duck (*Chenonetta jubata*) (Table 7).

The Australian Wood Duck is a very common farmland waterbird that usually roosts along the edges of farm dams and in trees and forages in farm dams and open paddocks next to dams during both day and night. It is a gregarious bird, known to move and forage in flocks. Flocks of this species were observed at several farm dams throughout the wind farm site. This species was not observed flying at RSA heights.

The remaining waterbirds recorded at impact points were common species, comprising Pacific Black Duck (*Anas superciliosa*), White–faced Heron (*Egretta novaehollandiae*) and White Necked Heron (*Ardea pacifica*).

The proposed Bango Wind Farm site contained many small farm dams and a low number of naturally occurring, small wetlands. Dams generally lacked aquatic vegetation with bare and

trampled edges from regular use by domestic stock. None of the waterbirds observed at Bango Wind Farm were threatened species, either under Commonwealth or state conservation legislation.

Table 7: Raptor and Waterbird species recorded at survey points during four seasons surveys at Bango Wind Farm

Raptors	Summer			Autumn			Winter			Spring			Grand Total	Total at RSA	Total Raptor Flights (%)	Flights at RSA (%)	Flights recorded at RSA compared with all bird flights at RSA (%)	Flights recorded at RSA compared with all bird flights observed (%)
	A	B	C	A	B	C	A	B	C	A	B	C						
Australian Hobby	1		1										1		2.38		0.41	
Brown Falcon				1	1	1	1		1	4			7	1	16.67	2.38	2.88	0.02
Brown Goshawk										1			1		2.38		0.41	
Nankeen Kestrel	1		1	2		2				9	4		16	4	38.1	9.52	6.58	0.09
Wedge-tailed Eagle		1		3	4	3		3			4	1	16	12	38.1	28.57	6.58	0.28
Whistling Kite	1		1										1		2.38		0.41	
Total	**3**	**1**	**3**	**6**	**5**	**6**	**1**	**3**	**1**	**14**	**8**	**1**	**42**	**17**	**100**	**40.48**	**17.28**	**0.4**
Waterbirds	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**Grand Total**	**Total at RSA**	**Total Waterbird Flights (%)**	**Flights at RSA (%)**	**Flights recorded at RSA compared with all bird flights at RSA (%)**	**Flights recorded at RSA compared with all bird flights observed (%)**
Australian Wood Duck							35			4			39		79.59			
Pacific Black Duck										5			5		10.2			
White-faced Heron										3			3		6.12			
White-necked Heron		2											2	2	4.08	4.08	0.82	0.08
Total		**2**					**35**			**12**			**49**	**2**	**100**	**4.08**	**0.52**	**0.03**

Notes: A=below RSA; **B=** at RSA; **C**= above RSA.

4. Bat survey

4.1. Introduction

Bat surveys were undertaken in spring 2019 and in summer/autumn 2020, to coincide with the migration period of the Large Bent–winged Bat. Ultrasonic bat detector surveys were carried out in autumn 2019 and autumn 2012 to collect baseline and species data. No winter surveys were undertaken as bat activity is minimal on most nights at this time of year. Observations also indicate that bat fatalities at wind farm sites are confined to the warm months from October to April, indicating that most bat activity is seasonal.

The aim of the surveys was to collect information on the presence and absence of bat species across the wind farm site, including any threatened species listed under the commonwealth EPBC Act or state BC Act. This information was collected by using ultrasonic bat detectors that record the high-pitched echolocation calls of bats. The relative frequency of recording (activity levels) of species at each site is used as a surrogate or abundance. The spring 2019 and summer/autumn 2020 surveys were particularly focused on gathering data on the presence/absence of Large Bent-winged Bat (LBB) (*Miniopterus orianae oceanensis*) that had appeared in previous surveys. LBB is listed as Vulnerable under the NSW BC Act.

4.2. Methodology

The bat surveys used ultrasonic bat detectors (Song Meter detectors) to detect the species-specific echolocation calls of free-flying bats. All survey sites were representative of the habitat types found across Bango Wind Farm and were located at wind turbine sites.

The following surveys were undertaken:

- During the autumn 2019 surveys, the following five sites were surveyed (see Table 8 and Figure 5).
- During the spring 2019 surveys, four sites were surveyed (Table 9).
- During the summer & autumn 2020 surveys, 18 sites were surveyed as agreed with BCD which were representative of habitat variability across the Bango Wind Farm (Table 9).
- A total of 776 detector nights were surveyed across the autumn/spring 2019 and summer/autumn 2020 surveys.

Table 8: Autumn 2019 survey sites, duration, and habitat description.

Site	Sample dates	Total detector-nights	Habitat
1	Autumn 2019 (29 Apr–2 May)	3	Grazed hilltop surrounded by open woodland
2	Autumn 2019 (29 Apr–2 May)	2	Open woodland with grassy grazed understorey
3	Autumn 2019 (29 Apr–2 May)	3	Forest clearing on hilltop
4	Autumn 2019 (29 Apr–2 May)	2	Ecotone of grazing paddocks and forest
5	Autumn 2019 (29 Apr–2 May)	3	Ecotone of grazing paddocks and open woodland

Table 9: Spring 2019, and Summer-Autumn 2020 survey sites, duration, and habitat description.

Site	Sample dates	Total detector-nights	Habitat
1	Spring 2019 (7 Oct-19 Nov) / Summer 2020 (17-28 Feb)	54	Grazed hilltop surrounded by open woodland
2	Spring 2019 (7 Oct-19 Nov) / Summer 2020 (17-28 Feb)	54	Open woodland with grassy grazed understorey
3	Summer 2020 (17–28 Feb)	11	Forest clearing on hilltop
4	Spring 2019 (7 Oct–20 Nov) / Summer 2020 (17–28 Feb)	55	Ecotone of grazing paddocks and forest
5	Spring 2019 (7 Oct–20 Nov) / Summer 2020 (17–28 Feb)	55	Ecotone of grazing paddocks and open woodland
6	Autumn 2020 (28 Feb–21 Mar)	22	Base of Met Mast, open woodland with understorey
7	Autumn 2020 (28 Feb–21 Mar)	22	Base of Met Mast, open woodland with understorey
8	Autumn 2020 (28 Feb–4 May)	66	On Met Mast (50m above ground), open woodland with understorey
9	Autumn 2020 (28 Feb–4 May)	66	On Met Mast (50m above ground), open woodland with understorey
10	Autumn 2020 (28 Feb–4 May)	66	On Met Mast (50m above ground), open woodland with understorey
11	Autumn 2020 (28 Feb–21 Mar)	22	Stony rise on grazed grassy hill with scattered trees
12	Autumn 2020 (28 Feb–21 Mar)	22	Ecotone of grazed grassy hills and woodland
13	Autumn 2020 (28 Feb–21 Mar)	22	Grazing paddocks next to farm dwellings
14	Autumn 2020 (21 Mar–4 May)	44	Open woodland with grassy grazed understorey
15	Autumn 2020 (21 Mar–4 May)	44	Woodland with grazed clearings and understorey
16	Autumn 2020 (21 Mar–4 May)	44	Stony rise on grazed grassy hill with scattered trees
17	Autumn 2020 (21 Mar–4 May)	44	Open woodland with grassy grazed understorey
18	Autumn 2020 (21 Mar–4 May)	44	Grazed grassy slope with scattered trees

4.2.1. Detectors and analysis

The Songmeter 4 detectors (SM4s) were programmed to commence operation at dusk and to record ultrasonic bat calls throughout the night with recordings ceasing at dawn.

The electronic bat detector unit used an SDHC card that recorded bat echolocation calls, along with the date and time of each call.

During the surveys in spring 2019 and summer/autumn 2020, Song Meters were programmed to detect LBB and species whose call averages 43-48 kHz, therefore they did not provide species data beyond LBB and three forest bat (FB) species.

Calls from the units were downloaded and sent to Greg Ford (Balance! Environmental, Toowoomba, Queensland) for identification. The files from the recording sites were viewed in echolocation software, which provides a sonogram display of frequency versus time.

Call identification was based on a key developed by comparing the characteristics of bat calls with reference calls from known species recorded across Australia. Identification is largely based on changes to frequency patterns over time, especially as the characteristic frequency changes.

Only those recordings that contained at least three definite and discrete pulses were classified as bat calls. For most species, a call sequence of several seconds in duration is required before identification can be made confidently.

4.2.2. Timing of the surveys

2012 Surveys (ERM)

The spring 2012 survey was undertaken in October and November by ERM using Anabat detectors distributed across the proposed wind farm site. Bat recordings were undertaken for a minimum of two nights per site at 13 locations), totalling at least 26 detector nights (see ERM 2013 for detailed methods).

2019 - 2020 Surveys (Nature Advisory)

The autumn 2019 survey was undertaken for four consecutive nights (29th April to 2nd May) at five different locations, totalling 13 detector nights, using five Song Meter detectors distributed across the proposed wind farm site.

The spring 2019 survey was undertaken over 43–44 consecutive nights (7th October to 19th or 20th November 2019) at four different locations using four Song Meter detectors distributed across the proposed wind farm site (total detector nights = 174) – see Figure 6.

A total of 583 detector nights were surveyed during the summer/autumn 2020 surveys. The summer-autumn 2020 survey was undertaken from 17th February to May 4th 2020 using five Song Meter detectors ranging 11 - 39 nights per site with over 583 detector nights - See Figure 6.

4.2.3. Limitations

The identification of echolocation calls from microbats in south-eastern Australia is facilitated by the fact that many calls are species-specific. Calls that could not be identified definitively were allocated to species complexes.

A further limitation in the use of this technique is that it is not possible to census bat numbers. For example, ten calls of a species may be recorded but it is not known if this represents ten individuals of that species or one individual of that species flying past the bat recorder ten times. Therefore, it is not possible to determine utilisation rates, only activity levels.

The bat detectors used during this survey sample a limited airspace to a distance of approximately 20 to 30 metres. The detectors deployed on the met masts at 50 metres height had a range of approximately 15 metres above and 15 metres below the detector.

Weather conditions, including severe storms during the recording period, may affect bat activity levels, which vary in response to variables such as air temperature, relative humidity, barometric

pressure, wind speed, direction and gusts, rain and moonlight. Typically, bats are found to be less active during the circumstances listed below.

- During periods of full moon, and when the moon is high in the sky
- At wind speeds of over ten metres per second
- During moderate to heavy rainfall.

Finally, the drought and fire events of the summer of 2019/2020 has a tremendous impact on natural systems and ecology. It is certain that these events had impacts on the ecology and species such as bats. However, there is little certainly how these bat species were impacted by the fire, smoke and haze.

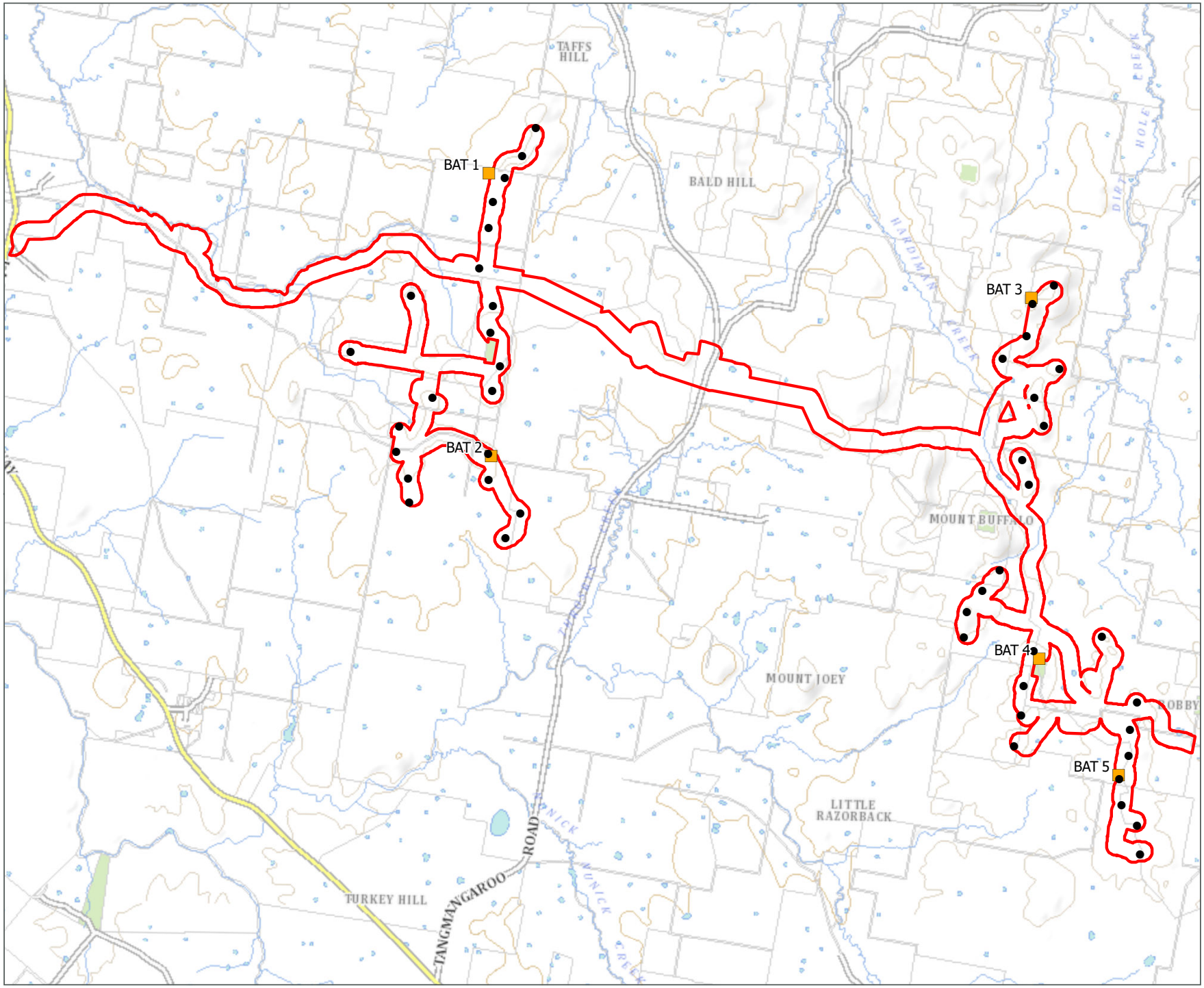


Figure 5: Locations of songmeters
SURVEY - AUTUMN 2019

Project: Bango Wind Farm
Client: CWP Renewables Pty Ltd
Date: 23/11/2020

- Development corridor
- Songmeter locations
- Turbines

N

Metres
0 800

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

Main frame - Created by: - E:\GIS\2018 Jobs\18173\18173 FIG songmeter and BUS 200211.mxd

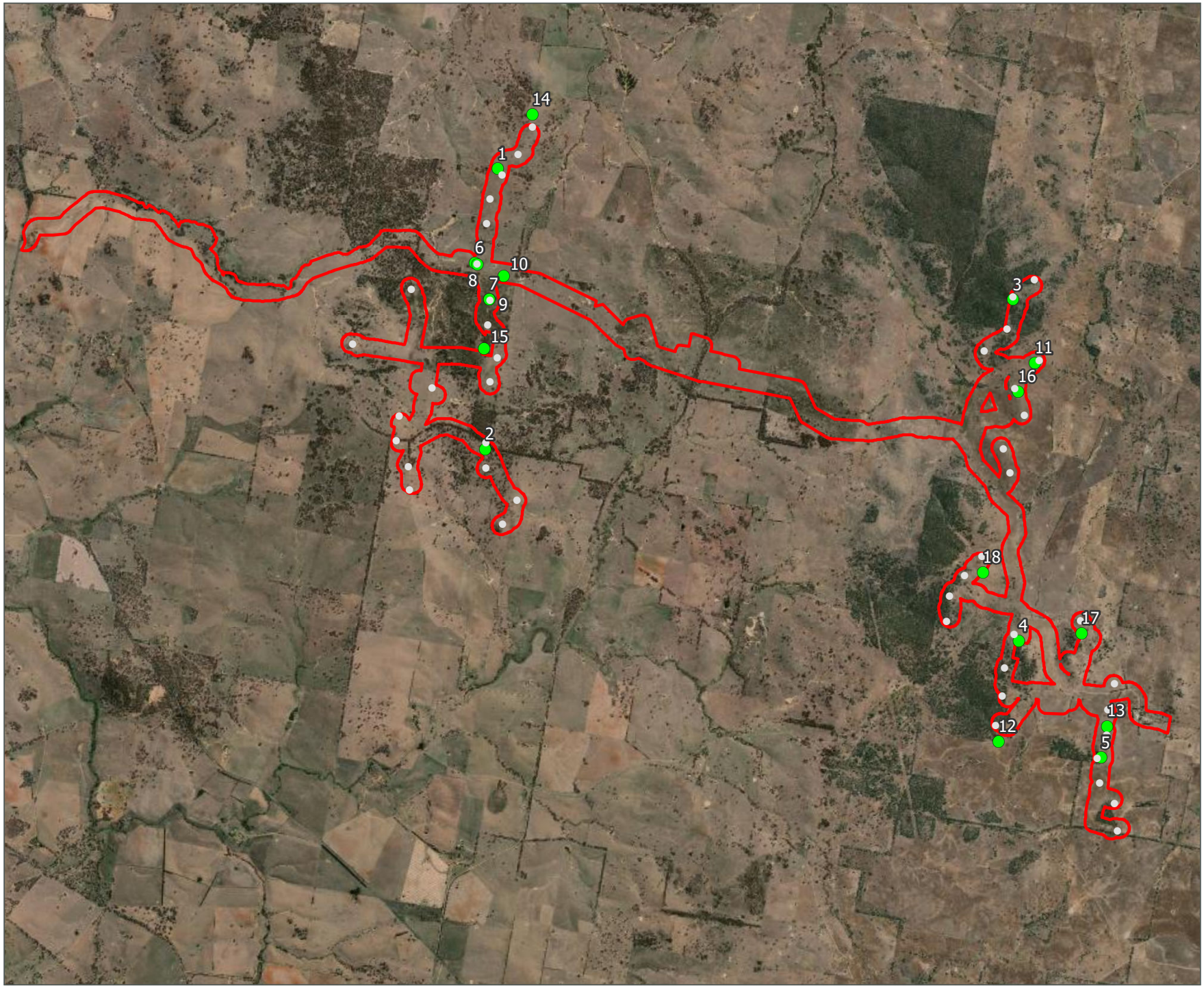


Figure 6: Location of the Song Meters at Bango Wind Farm during Spring (1-5) and Summer-Autumn (1-18)

Project: Bango Wind Farm
Client: CWP Renewables Pty Ltd
Date: 23/11/2020

Development corridor
Turbines
Songmeter locations

N

Metres
0 1,000

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PO Box 337, Camberwell, VIC 3124, Australia
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03 9815 2111 - info@natureadvisory.com.au

Main frame - Created by: - E:\GIS\2018 Jobs\18173\18173 Bat recorder locations ALL 200804.mxd

4.3. Results

4.3.1. Autumn 2012 (ERM) and autumn 2019 (Nature Advisory) surveys

The autumn 2012 (ERM, 2013) and autumn 2019 (Appendix 2) surveys provided a representative picture of the occurrence of 13 bat species in the study area (Table 10) and several species complexes for calls not attributable to a single species.

Table 10 Compilation of bat species recorded during the autumn 2012 and autumn 2019 surveys

Common name	*Scientific name*	Conservation status	Species occurrence (2012)	Species occurrence by site (2019)
Chocolate Wattled Bat	*Chalinolobus morio*	Common, secure	Present	S1, S2, S3, S4, S5
Gould's Wattled Bat	*Chalinolobus gouldii*	Common, secure	Present	S1, S2, S3, S4, S5
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	Vulnerable, BC Act.	Present	S1, S2, S3, S4, S5
Little Broad-nosed Bat	*Scotorepens greyii*	Common, secure		S5
Little Forest Bat	*Vespadelus vulturnus*	Common, secure	Present	S1, S2, S3, S5
Western Broad-nosed Bat	*Scotorepens balstoni*	Common, secure		S2, S5
White-striped Freetail Bat	*Austonomus australis*	Common, secure	Present	S2, S3, S5
Eastern Freetail-Bat	*Ozimops ridei*	Common, secure	Present	Not reported
Large Forest Bat	*Vespadelus darlingtonia*	Common, secure	Present	Not reported
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	Common, secure	Present	Not reported
Southern Forest Bat	*Vespadelus regulus*	Common, secure	Present	Not reported
Yellow-bellied Sheathtail-Bat	*Saccolaimus flaviventris*	Vulnerable, BC Act.	Present	Not reported
Southern Freetail-Bat	*Ozimops planiceps*	Common, secure	Present	Not reported
Species complexes				
Gould's Wattled Bat/Freetail species complex	*Mormopterus planiceps / O. ridei*	(species complex)	Not reported	S1, S2, S3, S4, S5
Gould's Wattled Bat/Western Broad-nosed Bat species complex	*Nyctophilus sp.*	(species complex)	Not reported	S1, S2, S3, S4, S5
Forest Bat/Little Broad-nosed Bat species complex	*Vespadelus sp./S. greyii*	(species complex)	Not reported	S2, S3, S5
Southern Bent-wing Bat/Little Forest Bat	*M orianae/V. vulturnus*	(species complex)	Not reported	S2, S3, S4, S5
Large Forest Bat/Southern Forest Bat	*Vespadelus darlingtonia/V. regulus*	(species complex)	Not reported	S1, S2, S3, S5
Lesser Long-eared Bat/Gould's Long-eared Bat	*Nyctophilus geoffroyi/N. gouldii*	(species complex)	Present	S1, S2, S3, S4, S5
South-eastern Freetail-Bat/Eastern Freetail-Bat	*Ozimops planiceps/O. ridei*	(species complex)	Not reported	S1, S2, S5
Freetail Bat sp.	*Mormopterus sp.*	(species complex)	Present	-
Lesser Long-eared Bat/Gould's Long-eared Bat	*Nyctophilus geoffroyi/N. gouldii*	(species complex)		-

Common name	*Scientific name*	Conservation status	Species occurrence (2012)	Species occurrence by site (2019)
Long-eared Bat sp.	*Nyctophilus sp.*	(species complex)	Present	-
South-eastern Freetail-Bat/Eastern Freetail-Bat	*Ozimops planiceps/O. ridei*	(species complex)	-	Present
Southern Bent-wing Bat/Little Forest Bat	*M orianae/V. vulturnus*	(species complex)	-	Present

Of the species recorded, 11 were common, widespread and secure species that commonly occur across a wide range of habitats throughout south-eastern Australia, particularly in areas of woodland. Two were listed as vulnerable under NSW BC Act, comprising the Large Bent-winged Bat and the Yellow-bellied Sheathtail Bat.

Table 11: Results of 4-night survey autumn 2019 (See Appendix 2)

Site-name:	Site 1	Site 2	Site 3	Site 4	Site 5	Species total
Total detector-nights:	3	2	3	2	3	13
Positively identified calls						
Chalinolobus gouldii	1	9	2	14	49	**75**
Chalinolobus morio	18	11	18	2	1	**50**
Nyctophilus geoffroyi / N. gouldi	2	13	31	1	4	**51**
Scotorepens balstoni		3			36	**39**
Scotorepens greyii					13	**13**
Vespadelus darlingtoni / V. regulus	7	42	48		20	**117**
Vespadelus vulturnus	1	40	20		9	**70**
Miniopterus orianae oceanensis	1	67	490	5	8	**571**
Austronomus australis		70	4		7	**81**
Ozimops planiceps / O. ridei	4	8			12	**24**
Unresolved calls						
C. gouldii / Ozimops sp.	43	459	80	147	372	**1101**
C. gouldii / Scotorepens balstoni	3	18	3	22	256	**302**
V. darlingtoni / V. regulus / S. greyii		3	120		5	**128**
M. orianae / V. vulturnus		30	217	3	4	**254**
Site total	80	773	1033	194	796	**2876**
Mean calls per detector-night	27	387	344	97	265	**221**
Confirmed calls per night for Miniopterus orianae oceanensis	0.3	33.5	163.3	2.5	2.7	**43.9**

The results of the autumn 2019 survey (Table 11) can be summarised as follows::

- Similar bat species to the autumn 2012 data;
- High number of the LBB at site 3, with lesser numbers at site 2;
- Relatively lower numbers of LBB at sites 1.

Based on these findings, it was recommended to the proponent to complete additional more detailed bat surveys in summer-autumn 2020 to determine the usage of the site by LBB. These studies were completed and are detailed below in Section 4.3.2.

4.3.2. Spring 2019 and summer-autumn 2020 surveys

Spring 2019 (7th October - 20th November 2019)

Surveys in spring 2019 and summer/autumn 2020 targeted LBB and species whose call averages 43-48 kHz, therefore they did not provide species data beyond LBB and three forest bat (FB) species. Balance! Environmental reported (Appendix 3), out of the 5,469 calls that were filtered as potential LBB, over 50% (2,921) consisted in calls of one of three forest bat species (*Vespadelus darlingtoni*, *V. regulus*, *V. vulturnus*). Some 793 calls (14.5%) were positively identified as LBB and the 1,755 remaining calls (32%) that could not be reliably differentiated were allocated to the LBB/FB group (Table 12).

Table 12: Number of calls, per site, of LBB, LBB/FB complex, and FB group (spring survey period)

Number of calls recorded across Spring survey period 2019				
Site	**LBB**	**LBB/FB group**	**FB group**	**Site Total**
1	91	689	928	1708
2	426	361	873	1660
4	173	512	717	1402
5	103	193	403	699
Total Calls	**793**	**1755**	**2921**	**5469**
Calls per night (over 174 recording nights) Spring survey period 2019				
Site	**LBB**	**LBB/FB group**	**FB group**	**Site Total**
1	0.5	4.0	5.3	9.8
2	2.4	2.1	5.0	9.5
4	1.0	2.9	4.1	8.1
5	0.6	1.1	2.3	4.0
Total Calls /night	**4.6**	**10.1**	**16.8**	**31.4**

Notes: LBB = Large Bent–winged Bat; FB = Forest Bat.

Summer-Autumn survey 2020 (17th February – 4th May 2020)

Out of 10,767 potential LBB calls filtered, more than 90% consisted of one of three FB species (*V. darlingtoni, V. regulus, V. vulturnus*). A total of 32 calls (<1%) were positively identified as LBB and the 933 remaining calls (9%) that could not be reliably differentiated were allocated to the LBB/FB group. Due to the variation in detector nights between sites the mean number of calls per detector-night were calculated. (Table 12

Table 13: Number of calls, per site, of LBB, LBB/FB complex, and FB group and mean calls per detector-night for the same species (Summer-Autumn 2020).

	Total calls detected			Mean calls per detector-night		
Site	LBB	LBB/FB group	FB group	LBB	LBB/FB group	FB group
1			50			4.55
2	1	17	262	**0.09**	1.55	23.82
3	3	35	310	**0.27**	3.18	28.18
4	3	9	78	**0.27**	0.82	7.09
5		16	469		1.45	42.64
6		3	76		0.14	3.45
7		1	130		0.05	5.91
8	1	14	29	**0.02**	0.22	0.45
9		3	6		0.05	0.09
10		17	32		0.26	0.49
11		12	470		0.55	21.36
12	7	190	1,929	**0.32**	8.64	87.68
13		17	325		0.77	14.77
14	1	94	193	**0.02**	2.14	4.39
15		320	4,724		7.27	107.36
16	4	84	490	**0.09**	1.91	11.14
17	5	43	93	**0.11**	0.98	2.11
18	7	58	136	**0.16**	1.32	3.09
Total Calls	**32**	**933**	**9,802**	**0.08**	**1.74**	**20.48**

4.3.3. Bat activity – existing information

LBB pregnant females migrate from their wintering areas on the coast to their staging and maternity caves inland in spring, which may be in short migration events over a few weeks. The closest maternity cave to Bango Wind Farm is Church Cave (Wee Jasper, NSW), 60 kilometres south.

Migration and dispersal events can be detected by ultrasound bat recorders, usually as one or two nights recording a large spike of calls. Previous bat studies carried out by Brett Lane & Associates in 2014 recorded LBB migration between Church Cave and the coast, in a proposed windfarm 65 kilometres east of the caves. The spikes were recorded over two separate nights, being 617 and 331 calls in two recording sites on 8th Mar and 2,463 calls on one site on 13th March 2020. On the same nights at other recording sites within five kilometres, very low activity levels were recorded for this species. Given that the population increases significantly after breeding, large spikes are only expected in February–March. A pilot study in 2015-17 at a site 20km west of Church Cave showed large spikes of bat activity in summer-autumn, and smaller but significant peaks in November, matching with the expected spring arrival of the pregnant females into the staging caves en route to the final stop at the maternity cave in Wee Jasper.

Based on monitoring of the LBB in Church Cave (Wee Jasper, NSW) for the last nine years by Doug Mills and Michael Pennay (NSW OEH), a seasonal lifecycle pattern comprising four distinct phases including the following has been proposed:

- Staging
- Movement from staging to maternity site
- Birth and lactation
- Weaning.

Staging

Groups of pregnant female LBBs start to gather in a number of 'staging caves' en route to the maternity cave form early October until mid-December.

Movement from staging to maternity site

From mid- December, the pregnant bats move from staging caves to the main maternity cave at Wee Jasper over approximately three weeks. Typically, by late December most of the bats have arrived.

Birth and lactation

Once gathered at the maternity cave, most bats give birth to a single pup, the young are left in the warmth and high humidity of the cave each night while the mothers forage for insects within proximity of the cave so they can return several times a night to feed the young. During this phase, the adult population at the maternity cave is relatively stable from early January through until mid-February.

Weaning

From mid-February onwards, the young are weaned and start to fly from the maternity site to feed independently. Almost doubling the number of bats foraging in the area.

4.3.4. Bat activity – surveys results

Spring survey (7th October - 20th November 2019)

Site-based comparison of activity levels

The overall level of activity of bat calls recorded in the 43-48 kHz range (LBB call frequency range) at Site 5 were lower than at the other three sites (Table 9 and Figure 7). The relative proportion of calls allocated reliably to FB group was consistent across all four sites, ranging from 51% (Site 4) to 58% (Site 5). In contrast, the proportion of calls reliably identified to LBB varied considerably (5% to 26%) between sites. However, there were a relatively higher number of calls at Site 2 with an average of 2.4 calls per night.

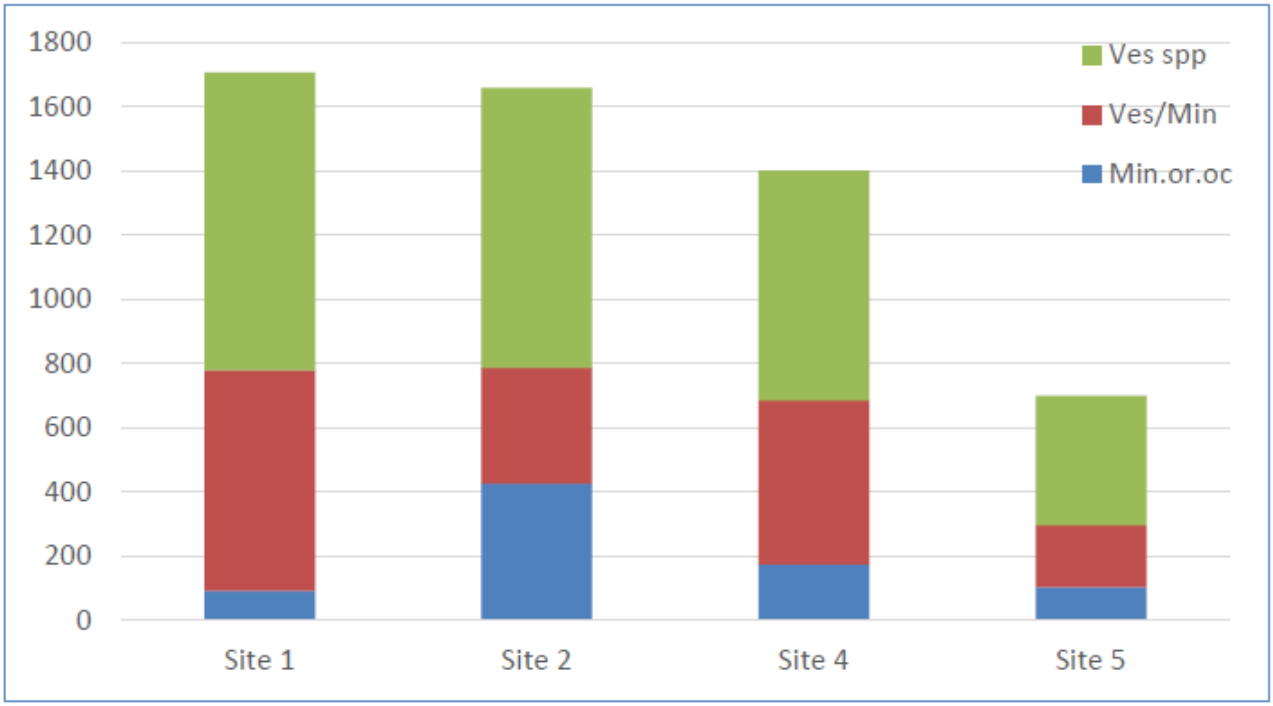

Figure 7: Distribution of total number of calls per site, of LBB, LBB/FB Complex, and FB group (Spring 2019)

Variance in nightly activity levels

Activity levels varied between nights at each site, although there was a similar pattern of peaks and troughs in activity. The most notable similarity in these patterns is the substantial drop in activity levels at all sites between 4th and 10th November 2019, likely due to a cooler, rainy period. Interestingly and contrary to the expected weather-related low activity, a significant activity peak at Site 2 on the night of 6th November is recorded. While activity levels at all sites recovered from the night of 12th November, there was another noticeable spike in activity level at Site 2 on that night. Furthermore, this increase in activity level at Site 2 appears to be driven largely by a significant concentration of LBB activity (Figure 8). Balance! Environmental reports (Appendix 4) the spikes were likely due to warmer daytime temperatures and overnight minimums.

Using a precautionary approach, the spring 2019 data may reflect that Site 2 recorded some type of event that caused a concentration of calls with 75 calls being recorded on the 12th November 2019 which may have represented somewhere between 75 calls from one bat or one call from 75 bats. It is unclear whether this is possibly a migration event of LBB in the vicinity on 12th November 2019. Apart from the spike of confirmed LBB calls, the number LBB/FB complex calls was much larger than any other night. Therefore, it can be assumed that a proportion of that LBB/FB group calls on that night at that site were likely attributable to LBB. Overall this night was a night of higher bat activity.

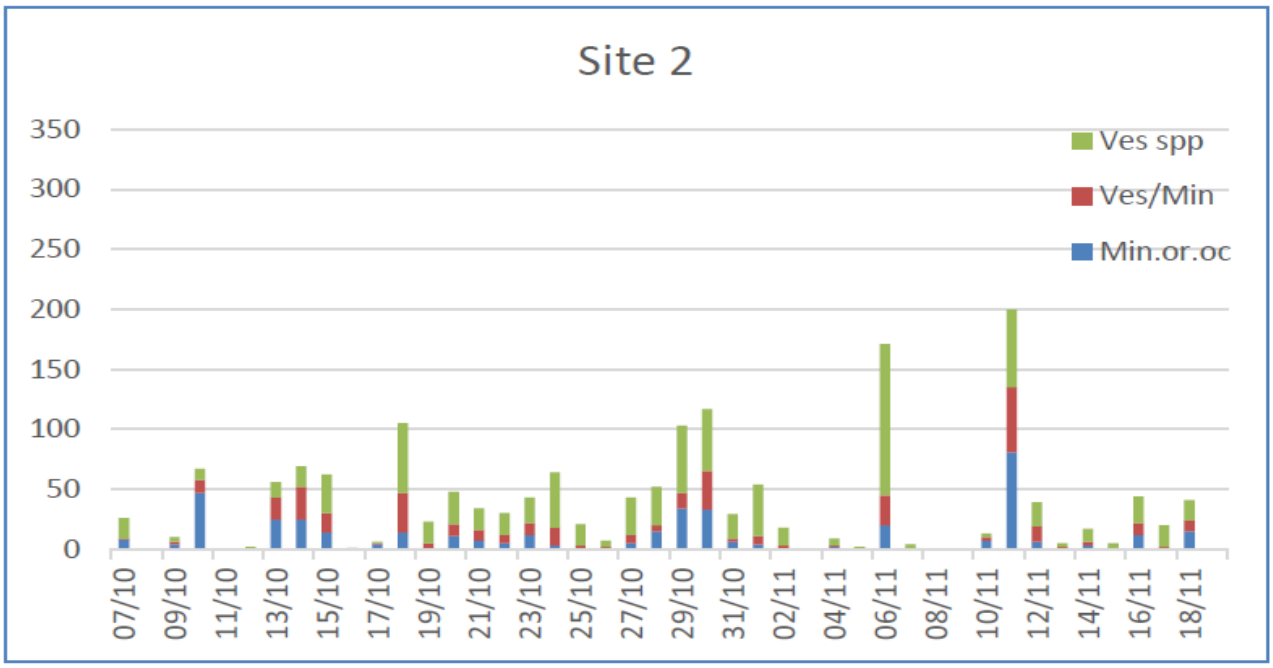

Figure 8: Nightly changes in activity at site 2 of LBB, LBB/FB. Complex, and FB group

Summer-Autumn survey (17th February – 4th May 2020)

Site-based comparison of activity levels

Table 10 and Figure 8 highlights the level of bat activity at the site 2 where of the LBB, LBB / Forest bat complex. The number of confirmed calls of the LBB was 32 calls across the 18 sites in the summer-autumn survey with an average of 0.08 calls / detector night.

Activity levels of bats calling in the 43-48 kHz range varied substantially across the survey area, with the variance driven primarily by FB group species activity (see Table 13, Figure 9). The detectors deployed at height on Met Masts (Sites 8, 9 and 10) consistently recorded the lowest activity levels and only one call of LBB was recorded over 198 recorder nights (1st April 2020, Site 8 – near open woodland with understorey).

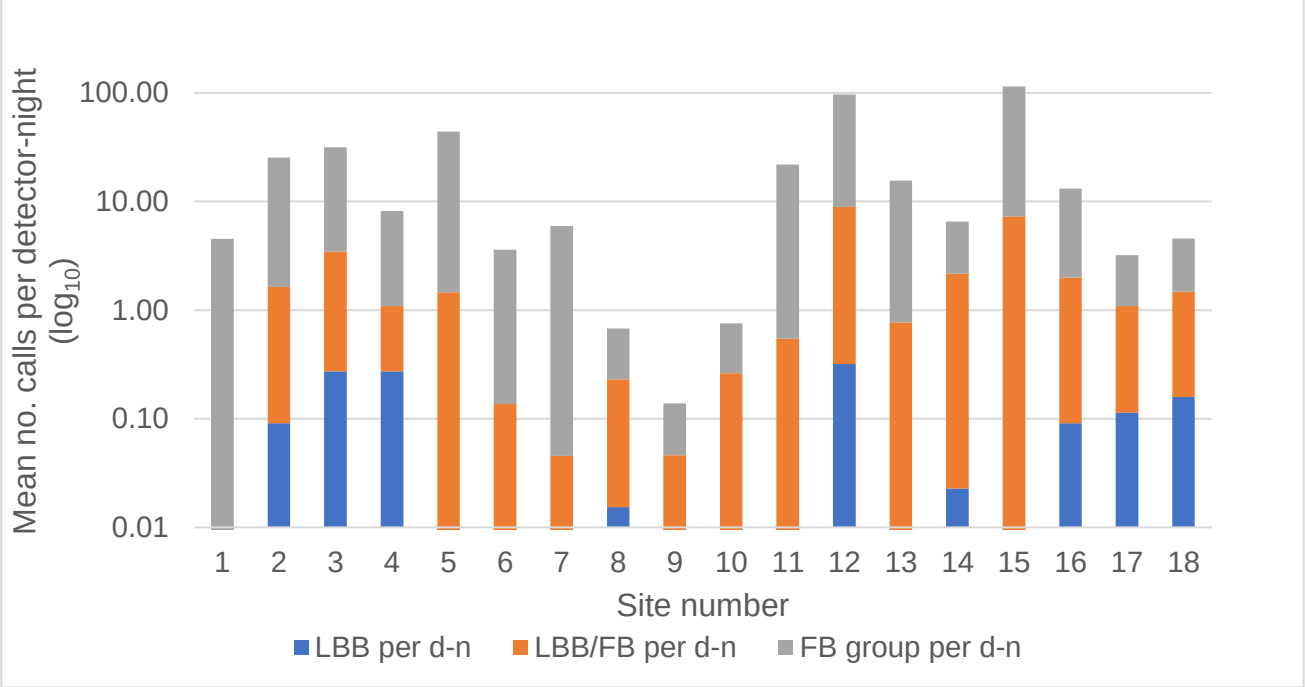

Figure 9: Relative activity levels (mean number of calls detected per night) of LBB, LBB/FB and FB group at Bango Wind Farm February - May 2020

Variance in nightly activity levels

An overall decline in mean activity levels across the study area was observed from late summer into autumn due to the drop in night temperatures towards the end of April (see Figure 2 in Appendix 4.

Variation between autumn 2019 and summer autumn 2020.

The summer-autumn 2019 survey was for only over a 5-night period. While the summer-autumn survey was for 45 days at 18 sites in total. In comparing these two surveys the following is noted:

- Site 3: In autumn 2019 recorded an average of 164 calls/night over three nights. The 2020 survey recorded in the same location an average of 0.27 calls per night. It is noted that this site is close to tree vegetation. This treed vegetation is highly likely to have influenced numbers at the site;
- Site 2: In autumn 2019 recorded an average of 33.5 calls/night over two nights. The 2020 survey recorded in the same location an average of 0.9 calls per night. However, it is noted that site 2 also had a higher number of calls in spring 2020. It is noted that this site is close to treed vegetation. This treed vegetation is highly likely to have influenced numbers at the site.

4.4. Discussion

The following is noted from the compilation of data from the baseline bat surveys:

- The initial ERM survey in spring 2012 confirmed only 2 LBB calls in the 2-week survey period.
- The autumn 2019 survey identified high level of LBB activity at two sites (Site 2 and 3) with an average of 164 calls/night over three night at site 3. These two sites are associated with treed vegetation on the site and are also has higher bird abundance.
- The level of LBB activity in spring 2019 was relatively high with a level of 4.6 calls per detector night with site 2 having an average of 2.4 calls / night the highest of the four sites.
- The higher number of calls at site 2 is most likely to be a simple association with forest in the area. However, one spring night there were a higher number of LBB calls as well as calls of other bat species. However, the reason for the higher calls over individual nights in spring is not clear, since due to its location it is unlikely that Bango Wind Farm sits in between the migration route between the caves and the non-breeding areas in the eastern coastal lowlands of NSW.
- There was only one LBB call recorded by Song Meter detectors deployed at 50 metres height. The remainder were recorded by Song Meter detectors at ground level.
- The overall low rate of LBB calls in the February - May period (see Figure 7), which covers the dates when they are expected to mass-migrate to the coast, suggests that Bango Wind Farm is not located within the post-breeding migration route.
- There were significant fires in the spring of 2019. The impact on bats populations, food availability, movements and migration is not known.
- Finally, the monitoring program of the BBAMP has been designed to identify impacts to the LBB with stratification of sites including forested and non-forested habitats.

5. Raptor survey

5.1. Introduction

Raptor surveys were undertaken by experienced zoologists from 2019–2020. Zoologists were on site each season conducting surveys. While on site raptor observations were recorded across the study area.

5.2. Methodology

All raptors that were observed across the study area were recorded and flight paths marked on a map. The following data was documented for each flight observed during the monitoring program.

- Species name
- Number of birds
- Time first observed
- Time the bird/s flew out of sight or landed
- Distance and bearing from observer
- The location of the bird (air, perched or ground)
- Height of the bird when first observed
- The height range of the bird (minimum and maximum heights)
- Elevation of the fixed point
- The landscape the bird was observed in (valley, slope or ridge)
- Flight direction (toward, away, parallel to ridge or circling), and
- Flight behaviour (soaring, gliding, hovering, flapping, display, resting, mobbing or foraging).

The raptor surveys were conducted in conjunction with the four pre-construction bird utilisation surveys by experienced zoologists from 2019–2020; one in each season to account for seasonal differences in bird activity and presence of species (due to migration). The dates and surveyors were undertaken are detailed below.

- Autumn: 30/04/2019 – 01/05/2019 (Curtis Doughty, Guille Mayor)
- Winter: 08/07/2019 – 13/07/2019 (Eamon O'Meara)
- Spring: 07/10/2019 – 12/10/2019 (Guille Mayor)
- Summer: 18/02/2020 – 21/02/2020 (Eamon O'Meara).

5.3. Results

In total, 79 observations were recorded from seven raptor species at Bango Wind Farm during the monitoring period. The species recorded are listed in Table 14below. Detailed information of all raptor observations is presented in Appendix 5, with flight paths mapped in Figure 10.

Table 14: Number of observations for each raptor species at Bango Wind Farm

Species	Number of observations
Wedge-tailed Eagle	31
Nankeen Kestrel	25
Brown Goshawk	10
Brown Falcon	7
Peregrine Falcon	2
Whistling Kite	2
Australian Hobby	2
Total	**79**

There were at least three resident Wedge-tailed Eagle pairs observed in the study area, with three active nests recorded during the 2019 breeding season. These are shown on Figure 10.

5.4. Discussion

The following is noted from the compilation of data from the baseline raptor surveys:

- The Wedge-tailed eagle was the most common raptor species observed, with 31 observations (39% of all raptor observations). This likely includes several birds observed more than once each.
- Three resident pairs of Wedge-tailed Eagles with active nests were observed in the study area.
- The Nankeen Kestrel was also a commonly observed raptor with 25 observations recorded (31 % of all raptor observations).

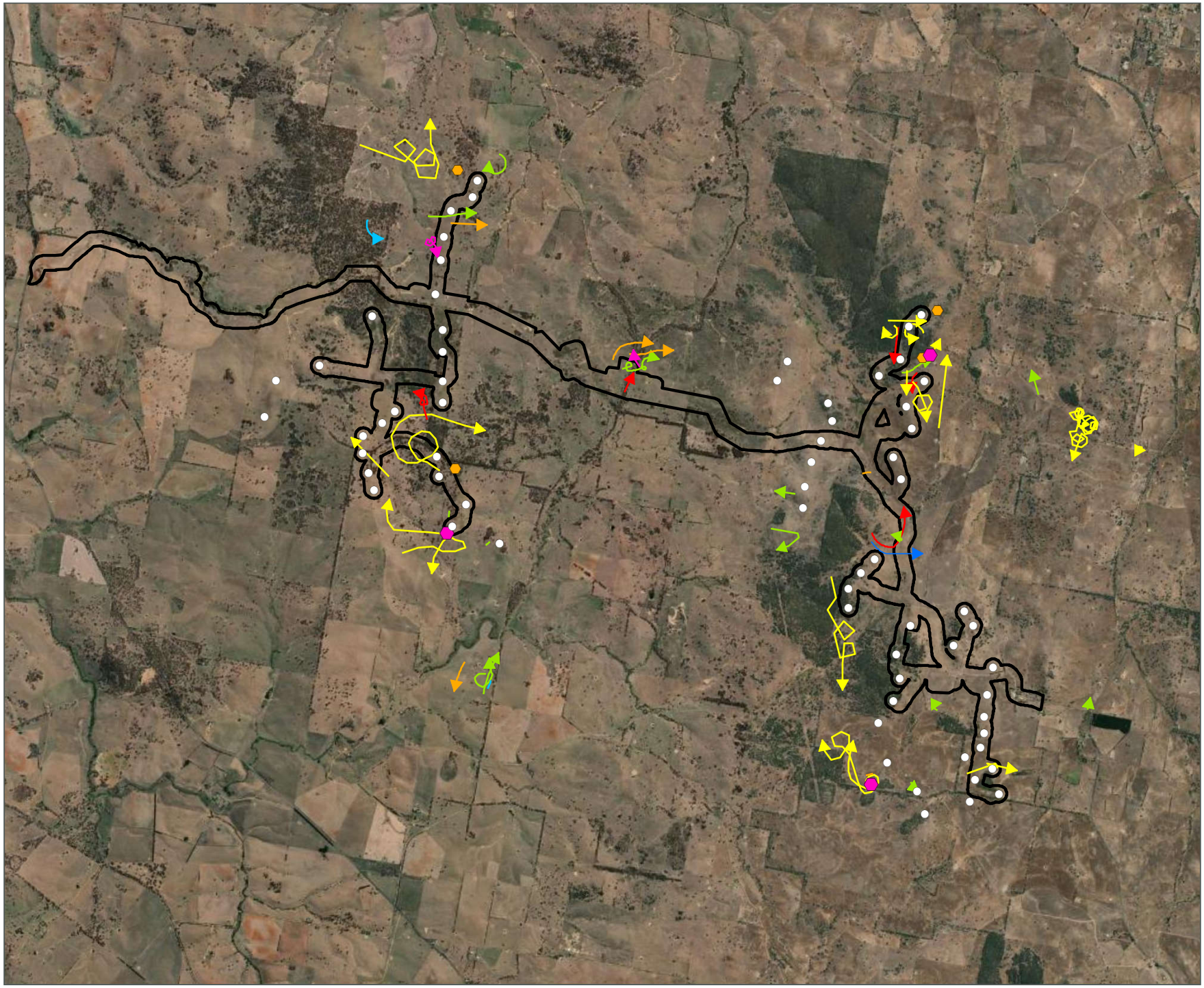

Figure 10: Flight paths

Project: Bango Wind Farm
Client: CWP Renewables Pty Ltd
Date: 19/05/2021

- Development corridor
- Turbines
- Aus Hobby
- Brown Falcon
- Brown Goshawk
- Nankeen Kestrel
- Wedge-tailed Eagle
- Whistling kite

Wedge-tailed Eagle Nests

- Active 2019 (3)
- Inactive 2019 (4)

N

Metres
0 1,000

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6. Superb Parrot survey

6.1. Introduction

Two Superb Parrot surveys were undertaken during the breeding season of 2019. This investigation was undertaken to determine if any trees in the development footprint that had hollows were being used by Superb Parrots for breeding within 100 metres of any turbines.

The survey was for three days early in the breeding season and for three days at the end of the breeding season in line with the BBAMP. The data generated by these surveys will be used for a comparison of pre and post commissioning data to identify potential affects or impacts on the species or its behaviour that the operation of the Bango Wind Farm might cause.

The aims of the survey were to:

- Determine whether breeding of Superb Parrot is occurring within 200 metres of turbines; and
- To determine whether Superb Parrots are observed demonstrating "risk behaviour". Risk behaviour for Superb Parrot is defined as 10 or more Superb Parrots observed flying between turbines at a height that would result in levels of collision of potential consequence for the population of the species.

This results of this survey (presented below) will be compared with similarly collected post-construction data in the first annual report of the BBAMP. This will provide an assessment and recommendations for additional surveys to NSW Department of Planning, Industry and Environment (DPIE) and the Commonwealth Department of Agriculture, Water and Environment.

6.2. Methodology

Roaming surveys were undertaken at the Bango Wind Farm during the Superb Parrot breeding season during 2019. The initial survey was undertaken from 7th – 10th October 2019.

This methodology outlined in the BBAMP was for the first survey:

- Focussed transect surveys 250 metres either side of the wind farm infrastructure;
- The observer walked at a rate of up to 2 km/hour;
- All trees with Hollows identified within 200 metres of infrastructure with locations provided to the survey team were observed for nesting;
- If Superb Parrots were observed in the study area, monitoring was undertaken to determine if they were nesting. This included watching parrot activity to determine if nesting was occurring, determining the sex of birds in flocks and attempting to follow parrots to nest trees;
- If nest trees were located in the focus areas, these trees were documented and recorded. Daily visits would have been undertaken to record activity;
- All Superb Parrot and other threatened species observations were recorded and marked with a handheld GPS.

The follow-up survey was undertaken from 18th – 21st November 2019 in the areas of suitable habitat and locate any nesting trees within 100 metres of the development footprint. When

Superb Parrot were observed within the development footprint they were intensively studied to determine if they were nesting in trees that may be removed. This included watching parrot activity to determine if nesting was occurring by determining the sex of birds in flocks and attempting to follow parrots to nest trees.

If trees were located in the survey areas that were considered likely to be used for breeding by Superb Parrots, these trees would have been documented and marked.

All suitable Superb Parrot habitat was noted, any observations of individuals marked on a map and flights recorded. Data gathered on all flights observed included: observation number, date, start and end time of flight, the number of parrots, age of parrots, flight height, direction and behaviour, and any other notable observations (e.g. food sources).

All Superb Parrot and other threatened species observations were recorded and marked with a handheld GPS.

6.2.1. Limitations

The timing of the Superb Parrot survey, its duration and the weather conditions under which surveying was undertaken (generally fined with light to moderate winds), were considered suitable for detecting the species. The overall survey effort was considered sufficient to detect significant populations of Superb Parrot and to further understand its breeding behaviour within the study area.

6.3. Results

6.3.1. Existing information

The NSW BioNet Atlas (May 2020) has 93 Superb Parrot records within ten kilometres of the wind farm from 1982 to 2019. The area is known to be within the breeding range of this species. Many surveys have been undertaken throughout the wind farm site and there have been multiple observations of Superb Parrot. The Superb Parrot breed in the region from September to December before departing to non-breeding grounds further north.

6.3.2. 2019 breeding season results

A total of 37 observations and 131 movements were recorded during the current field surveys (Table 12 and Figure 9). Superb Parrot showed a preference for Yellow Box – Blakey's Red Gum woodland within the study area. The Yellow Box – Blakely's Red Gum community occurs in the lower lying areas of the study area and was generally not along the ridges.

Superb Parrot were observed in the study area in four distinct areas, listed below and shown in Figure 9:

- Near the entrance of the wind farm site along to the west along Lachlan Valley Way;
- In the centre of the Kangiara turbine cluster, near the crossroads of the access tracks;
- Along Tangmangaroo Road; and
- In the south-east section of the Mount Buffalo turbine cluster.

Entrance to wind farm site off Lachlan Valley Way

Superb Parrot were observed resting and foraging in the acacia shrubs that have been planted along this road. Also seen flying over temporary site office into small patch of Yellow Box trees (flight 33, Figure 9). Six birds were seen in this area over two days in November 2019. Bird behaviour suggested breeding was occurring but searching failed to locate evidence of nesting.

In the centre of the Kangiara turbine cluster

The centre of the Kangiara turbine cluster was the most popular area in the development footprint for the Superb Parrot over the surveying period. The species was only recorded at this location during the October surveys, with a total of 67 birds. Superb Parrots were attracted to the seeding Long Storksbill (*Erodium botrys*) which is a small ground herb. The trees in this area were large and contained hollows suitable for breeding but breeding activity was not confirmed.

Along Tangmangaroo Road

Tangmangaroo Road was lined with eucalypt trees dominated by Yellow Box and Blakely's Red Gum. Trees were remnant and some contained hollows suitable for nesting though no nesting was observed during the surveys. The parrots were seen feeding on the ground, resting in trees and flying from tree to tree. Observations here were a little biased as more time was spent along the road traversing to and from the site and some observations were outside the 200-metre buffer zone from the development footprint. Only three birds were observed within 200 metres of the development footprint, a further 18 birds were observed further south of the study area from the road, away from turbine sites.

South-east section of the Mount Buffalo turbine cluster

This area supported more Superb Parrot activity that other parts of the wind farm site, both in October and November 2019. Most birds were observed further than 200 metres from the development footprint. A mixture of eucalypt species occurred in this section of the wind farm, though some areas were dominated by Yellow Box and Blakely's Red Gum. It is possible that Superb Parrot was breeding in this area though no nests were found, despite searching. Almost all birds observed during October surveys were males, which suggests females were incubating at the nest. Males, females and juvenile birds were observed in November surveys which indicates they had left the nest by this time.

6.4. Discussion

- Superb Parrot was observed in the study area in four distinct clusters. Two of these clusters will have turbines within them and are listed below:
    - In the centre of the wind farm site near the crossroads of the access tracks; and
    - In the south-east section of the wind farm site. Superb Parrots were most commonly observed flying at or below a height of 20 metres above ground (approximately 95% of all observations).
- There were two observations of Superb Parrots flying at 30 metres height. All other Superb Parrots were observed at or below 20 metres height.
- All Superb Parrot flights observed were below RSA height.
- Three observations involved a flock of 10 or more Superb Parrots.
- Superb Parrot nesting was not confirmed at the site though is considered possible in hollow bearing trees of Yellow Box/Blakey's Red Gum habitat.

Table 15: Superb Parrot observations at Bango Wind Farm 2019 breeding season

Obs. no.	Date	Start time	End time	Species count	Age	Flight height (m)	Flight direction	Flight behaviour	Notes
1	7/10/2019	14:10	14:10	1	Adult	10	W	Flap	Feeding on ground before flying into a tree.
2	7/10/2019	14:15	14:15	1	Adult	10	E	Flap	Flew over road.
3	8/10/2019	17:03	17:03	1	Adult	20	SE	Flap	Passing through.
4	8/10/2019	17:14	17:14	4	Adult	20	W	Flap	Flew over landscape before ducking down behind trees in gully.
5	8/10/2019	17:27	17:27	1	Adult	10	E	Flap	Flew into Yellow Box before flying back where it came from.
6	8/10/2019	17:50		35	Mixed				Birds feeding on ground, short flight to nearby Yellow Box and ground.
7	9/10/2019	8:47	8:47	2	Adult	20	N	Flap	
8	9/10/2019	9:37	9:37	1	Adult	20	N	Flap	Passing through.
9	9/10/2019	9:54	9:54	1	Adult	10	N	Flap	Passing through suitable breeding habitat there in Yellow Box.
10	9/10/2019	10:16	10:17	1	Adult	10	SE	Flap	Flew from tree (White Box) around and into another tree (Yellow Box).
11	9/10/2019	10:17	10:17	1	Adult	10	N	Flap	Flew from a tree (Yellow Box) across open country into a tree line.
12	9/10/2019	10:19	10:19	6	Mixed	10	NE	Flap	Flew from a tree (Yellow Box) to the tree line and landed in another Yellow Box.
13	9/10/2019	10:28	10:28	2	Adult	30	N	Flap	Seen briefly flying over canopy.
14	9/10/2019	11:32	11:32	1	Adult	10	N	Flap	Flew through (suitable breeding habitat).
15	9/10/2019	12:20	12:21	1	Adult	10	SE	Flap	
16	10/10/2019	9:19	9:19	1	Adult	20	W	Flap	Flew along access track before landing in a tree.
17	10/10/2019	9:20	9:20	3	2 Adult, 1 juvenile	0	-		Was feeding on ground.
18	10/10/2019	9:48	9:48	2	Adult	10	E	Flap	Flew into a tree.
19	7/10/2019	15:30	15:50	2	Adult male	5	SE	Flap	Seen foraging on ground. Flew to tree and back down onto the ground.
20	8/10/2019	16:45	16:46	1	Adult male	5	W	Flap	From BUS point 12, bird actively on the move.
21	9/10/2019	11:00	11:15	4	3 Adult male, 1 juvenile	5-10	SE	Flap	One male feeding juvenile, just black iris and head movements.
22	10/10/2019	8:15	8:30	4	Mixed	5	N	Flap	Mixed group traveling following Argali Road.
23	9/10/2019	11:50	11:51	2	Adult male	5		Flap	Foraging on ground, flushed to nearby tree.
24	9/10/2019	16:20	16:23	8	Adult mixed	5-10	SW	Flap	Foraging, flushed to tree and moved to other trees south-west.
25	11/10/2019	16:00	16:15	1	Adult male	5-10	SW	Flap	In trees, moves to a tree in the open.
26	12/10/2019	8:30	8:45	3	Adult male	5-10			Perched on trees, calling, may be nesting.
27	11/10/2019	15:14	15:18	10	Adult mixed	5-10	W	Flap	Group calling from east and landing on trees.
28	11/10/2019	16:20	16:21	8	Adult	10-15	N	Flap	Group traveling north, parallel to road.
29	12/10/2019	11:24	11:27	1	Adult male	10-20	S	Flap	Perches solitary dead tree and flying south.
30	18/11/2019	14:24	14:24	1	Adult male	10	SE	Flap	Flew between trees.
31	18/11/2019	14:27	14:27	1	Adult male	10	N	Flap	Flew along road reserve.
32	19/11/2019	14:22	14:22	2	Adult female	10	SW	Flap	Flew across road from tree to tree (Blakely's Red Gum).
33	19/11/2019	15:50	15:50	4		10	SE	Flap	Flew around temporary office site.
34	20/11/2019	10:30	10:30	4		20	W	Flap	Flew from tree to tree.
35	20/11/2019	10:36	10:36	3	2 Adult male, 1 Adult female/juvenile	20	SE	Flap	Flew across open country to treeline.
36	20/11/2019	10:39	10:40	2	1 Adult male, 1 Adult female/juvenile	30	W	Flap	Flew across open country and into a tree.
37	20/11/2019	10:57	10:57	5	3 Adult male/2 Adult female/juvenile	20	NW	Flap	Flew from Black Wattle.
38	8/10/2019	17:43	17:43	10	Mixed	0	-	-	Mixed flock feeding on the seeds of *Erodium aureum* on the ground.

Figure 11: Superb Parrot Locations

Project: Bango Wind Farm
Client: CWP Renewables Pty Ltd
Date: 23/11/2020

- Development corridor
- Turbines
- Flock sightings
- Flight paths

DIRTHOLE CREEK ROAD
HARRYS CREEK ROAD
TANGMANGAROO ROAD
HILLVIEW LANE
LACHLAN VALLEY WAY
DREWS ROAD
WARGEILA ROAD
KANGIARA ROAD
WHITE FLAG ROAD
TELFORD LANE
BENDENINE ROAD
MOORBYS LANE
LAVERSTOCK ROAD

N

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Main frame - Created by: - E:\GIS\2018 Jobs\18173\18173 Flight paths 200116.mxd

7. Conclusion

This section presents the conclusion of the these interim baseline assessments. The data collected from these studies is to be used as baseline data pre-construction. The results can be compared with future studies to determine if there has been any change or impact as a result of the construction and operation of the Bango Wind Farm.

7.1. Birds

The conclusions from the BUS of the Bango Wind Farm are presented below.

- The study area was largely cleared plateaux, with patches of woodlands and scattered dams, supporting a low diversity and abundance of common, predominantly farmland birds, with woodland species in the small areas of woodland scattered across the site.
- The utilisation rate of the Wedge-tailed Eagle was higher during the lambing season.
- The study area supports comparatively few raptors or waterbirds, which are groups considered vulnerable to collision with operating wind turbines, compared with similar settings and habitats at wind farm sites elsewhere in southern NSW.
- The abundance of bird species was higher during autumn due to flocking of bird species including ravens, magpies, starlings, and cockatoos.
- The number of birds recorded was highest in autumn (2,218), dropping to a minimum of 772 in winter, 1,135 in summer and 1,931 in spring. The area is on some altitude and winters are cold, pushing many species to lower areas during those months that return in Spring.
- Bird diversity declined from spring to winter, with common farmland birds dominating the species list in winter. A total of 59 species were recorded in spring, 43 species in autumn, 33 in summer and 26 species in the winter survey.
- The number of species recorded flying at RSA height was highest in spring (10) followed by autumn (six), summer (three) then winter (two). Ravens and Sulphur-crested Cockatoo were common at RSA heights in all seasons, followed by Galah. Raptors were not common at RSA, except for the Wedge-tailed Eagle, which was seen flying at RSA heights in all seasons, with its lowest numbers in summer.
- Waterbirds were found to be largely confined to farm dams and were in low abundance with the exception of the Australian Wood Duck, which is a common farmland waterbird on the site.

Four species of threatened birds were recorded utilising the study area (Superb Parrot, Brown Treecreeper, Varied Sittella and Speckled Warbler) during the official BUS. Two additional species were observed incidentally while traversing across the site including the Diamond Firetail and Dusky Woodswallow. The utilisation rate in the investigation area for these threatened species was found to be low. Therefore, the collision risk to threatened species from operating turbines is consequently low.

7.2. Bats

The conclusions from the bat surveys of the Bango Wind Farm are presented below.

- A total of 13 bat species and 12 species complexes have been recorded at the Bango Wind Farm
- Two threatened bat species listed as vulnerable under the BC Act have been recorded at the Bango Wind Farm including the Large Bent–winged Bat and Yellow–bellied Sheathtail Bat
- Targeted surveys were undertaken for Large Bent-winged Bat at the Bango Wind Farm site during the spring and autumn migratory periods:
    - Higher activity levels of Large Bent–winged Bat during the spring surveys.
    - Lower activity levels in the autumn 2020 surveys suggests that Bango Wind Farm was not highly utilised in the migration from the breeding caves at Wee Jasper and the non-breeding areas in the eastern coastal lowlands of NSW.
    - One Large Bent-winged Bat call was confirmed at height of 50 metres above the ground from monitoring at 3 wind mast. The detectors deployed at height on Met Masts (Sites 8, 9 and 10) and this call was the only call of LBB was recorded over 198 recorder nights.

7.3. Raptors

In total, 79 observations were recorded from seven raptor species at Bango Wind Farm during the monitoring period. No threatened species of raptor were recorded at Bango Wind Farm.

The Wedge-tailed Eagle is the most commonly observed raptor in the study area, with 31 observations. This total likely includes several birds seen more than once each. There were at least three resident pairs in the study area, with three active nests recorded during the 2019 breeding season.

The Nankeen Kestrel is also a commonly observed raptor with 25 observations recorded. Other species recorded includes the Brown Goshawk, Brown Falcon, Peregrine Falcon, Whistling Kite and Australian Hobby.

7.4. Superb Parrot

The Bango Wind Farm is within the known breeding range of the Superb Parrot. It visits the area each year from September to December. Nesting was not confirmed at the site though is considered likely in hollow bearing trees of Yellow Box/Blakey's Red Gum habitat.

Superb Parrot was observed in the study area in four distinct clusters. Two of these clusters will have turbines within them and are listed below:

- In the centre of the Kangiara turbine cluster, near the crossroads of the access tracks; and
- In the south-east section of the Mt Buffalo turbine cluster.

In the centre of the wind farm two turbines are located within the observed Superb Parrot habitats, including Turbines 94 and 115. In the used habitat in the south-east of the wind farm site: 2, 5, 7, 12, 24, 32, 46, 47, 61, 67, 107 and 112.

All observations of the Superb Parrot were at or below a height of 30 metres above ground (below RSA height). Three observations involved a flock of 10 or more Superb Parrots.

The Bird and Bat Adaptive Management Plan (Section 2.4.3) provides for targeted Superb Parrot monitoring in the first year of operation of the wind farm and incidental monitoring. The BBAMP also has a protocol for responding to confirmed use of hollow trees for breeding within 200 metres of any turbine.

8. References

Clean Energy Council, 2018. Best Practice Guidelines – for implementation for wind energy projects in Australia.

Environmental Resource Management (ERM) 2013. Bango Wind Farm Ecological Impact Assessment, prepared for Wind Prospect CWP.

Nature Advisory 2021. Bango Wind Farm – Bird and Bat Adaptive Management Plan - Report No. 18173 (1.24), Nature Advisory, Hawthorn East, consultant report prepared for Bango Wind Farm Pty. Ltd.

Appendix 1: Bird Utilisation Survey raw data

Autumn 2019 BUS Raw data

Site	5								6								7								12							
Replicate	1	2		3	4	5	6	7	8	1	2	3		4	5	6	7	8	1	2		3	4	5	6		7	8	1	2	3		4		5	6	7	8
Species/height class	A	A	B	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A	B	A	A	A	A	B	A	A	A	A	A	B	A	B	A	A	A	A
Australian Magpie				1	1	2		2		6	2	1			3		6	3		2			6				2		1	8		8		3	2	6	8	10
Australian Pipit						1																																
Australian Raven					1			1					1									2	1				1		5		2		1		1	1		
Brown Falcon																																						
Brown Treecreeper							1	1	4																													
Buff-rumped Thornbill				1				3	20					10					10	20																		
Common Bronzewing	1																																					
Common Starling																	5														15		5					7
Crimson Rosella	2	1		2						1		2				12	6		4											12	2			2			2
Eastern Rosella																							2	2					2	2						2	2
Eastern Spinebill														1																								
Eastern Yellow Robin							1																															
Flame Robin																																						
Galah										2								4	2	4			2		6		1	2			3							
Grey Butcherbird																								1														
Grey Fantail																			1	2			1		1		1											
Grey Shrike-thrush																				2			1															
Laughing Kookaburra																							1															
Little Corella																									10													
Magpie-lark										1																					2		1		2	1		
Mistletoebird																			1						1			1										
Nankeen Kestrel																															1				1			
Noisy Miner																													1						3			
Pied Butcherbird																												1							1	1		
Pied Currawong																				1									4						3		5	
Red Wattlebird	25																																					
Restless Flycatcher																																						
Scarlet Robin									2											4			2		2													
Speckled Warbler									2																													
Spotted Pardalote	2				1					1									3						1		1	1										
Striated Pardalote	1				3	1								3																								
Striated Thornbill	1	4		4				4	10					5											10													
Sulphur-crested Cockatoo																			10							100											11
Varied Sittella																									10													
Wedge-tailed Eagle			2				1			1								1			2																	
Weebill										1				3																									
Welcome Swallow																																						
White-eared Honeyeater									1															1	1														
White-plumed Honeyeater																															2							
White-throated Treecreeper	2			1	1	1			1	1				1	1				1				2	1	2		1	2			1							
White-winged Chough																																						
Yellow Thornbill																				2																		
Yellow-rumped Thornbill									5											10					10											2		
Total	34	5	2	9	7	5	3	11	45	14	2	3	1	23	4	12	17	8	32	47	2	2	18	5	54	100	6	7	9	27	28	8	7	3	11	14	11	37

Autumn 2019 BUS Raw data continued

Site	17										21								22									R3								
Replicate	1	2	3	4	5	6	7		8		1	2	3	4	5	6	7	8	1	2	3	4		5	6	7		8	1	2	3	4	5	6	7	8	
Species/height class	A	A	A	A	A	A	A	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A	B	A	A	A	B	A	A	A	A	A	A	A	A	A	Totals
Australian Magpie	4		3	4	6	1	4		2		8	10	1	7	4	3	12	2	2	12	20	4	4	20	10	12		20	4	1		7	4	2		4	**280**
Australian Pipit																												1										**2**
Australian Raven								1					4									2			2	1											**27**
Brown Falcon										1																					1						**2**
Brown Treecreeper																																					**6**
Buff-rumped Thornbill																			2						2							10		10		10	**98**
Common Bronzewing	4	4	7						1																								1				**18**
Common Starling														3								1				4					2					2	**44**
Crimson Rosella				2	18	10	4		1		2			4	2			2	1	6	1	4		2	5	4											**116**
Eastern Rosella	12		15	2	24	20	20		34												2							12									**153**
Eastern Spinebill																																					**1**
Eastern Yellow Robin																																					**1**
Flame Robin											1																										**1**
Galah	12				2	2	2		2											2	7				2		40				11		2	2			**112**
Grey Butcherbird																																					**1**
Grey Fantail																																					**6**
Grey Shrike-thrush																																					**3**
Laughing Kookaburra																																					**1**
Little Corella	10		30	30		20	4		4																												**108**
Magpie-lark	2	2	2	2	2	2	2		1																						2						**24**
Mistletoebird	1																												1				1				**6**
Nankeen Kestrel																																					**2**
Noisy Miner		2			3	1	2		5											8													2				**27**
Pied Butcherbird																																					**3**
Pied Currawong	15	1	1				6		6									3			4	10			2												**61**
Red Wattlebird	1						1																	1													**28**
Restless Flycatcher														1																							**1**
Scarlet Robin																			2																		**12**
Speckled Warbler																																					**2**
Spotted Pardalote	3																								1							1		1			**16**
Striated Pardalote																																					**8**
Striated Thornbill																			2																		**40**
Sulphur-crested Cockatoo	33	50	200	160	5	150	60		100												4	6		6													**895**
Varied Sittella																																					**10**
Wedge-tailed Eagle																																					**7**
Weebill						2																										3		2	2		**13**
Welcome Swallow																																			5		**5**
White-eared Honeyeater																																	1	1	2	2	**9**
White-plumed Honeyeater						1																														2	**5**
White-throated Treecreeper																			1	1						1			1		1	1			1	1	**27**
White-winged Chough																				25	30	6															**61**
Yellow Thornbill																																					**2**
Yellow-rumped Thornbill																			10																		**37**
Totals	**97**	**59**	**258**	**200**	**60**	**209**	**105**	**1**	**156**	**1**	**11**	**10**	**5**	**15**	**6**	**3**	**12**	**7**	**20**	**54**	**68**	**33**	**4**	**29**	**24**	**22**	**40**	**33**	**6**	**1**	**17**	**22**	**9**	**18**	**12**	**21**	**2281**

Winter 2019 BUS at impact sites Raw data

Site	5								6							7								12						17							21				22					
Replicate	1	2		3	4	5	7	8	2	3	4	5	6	7	8	1	2	3		4	5	6	7	8	1	4	5	6	7	8	1	2	3	4	7		8	4	5	7	8	1	2	3	7	8	
Species/height class	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	Totals
Australian Magpie	5	5		3	2	2	5	2	3		5		2	2	2					2	3	2	5		10	2	3	4	2	3	2	4	1	4	3		4		2	3	2	2	3	3	2		109
Australian Pipit														1																																1
Australian Raven																							2	2							1		1			3				3						12
Australian Wood Duck																							3				5	5						2							2		16			33
Brown Falcon																																						1								1
Buff-rumped Thornbill																																	7													7
Common Bronzewing																															2															2
Common Starling																									27													37								64
Crested Pigeon																																														0
Crimson Rosella									2			2						2				9		5	3	3	3	3				3		3		9					2	5		2	2	58
Eastern Rosella																	2	13						4	8									15		2								2	46
Eastern Yellow Robin										3																																		7			10
Galah	2															2																														4
Golden Whistler																					3																										3
Grey Fantail																																														0
Grey Shrike-thrush																																	3	1												4
Magpie-lark																2									4	2								2	2												12
Noisy Miner																											4		5	4																	13
Pied Currawong																																	2	7		7											16
Scarlet Robin									5	7	6	3	3	2	6																			11												43
Sulphur-crested Cockatoo																1	1		120					2	2											5	3				4						138
Wedge-tailed Eagle			2																																											2
White-eared Honeyeater																																														0
White-plumed Honeyeater																																														0
White-throated Treecreeper									1	2			1			3																														7
Willie Wagtail																																		1												1
Totals	7	5	2	3	2	2	5	2	11	12	11	5	6	5	8	8	3	15	##	2	6	11	10	13	54	7	15	12	7	7	2	7	4	19	45	5	28	37	3	3	5	10	15	19	4	4	586

Winter 2019 BUS at reference sites Raw data

Site	R1								R2					R3				
Replicate	1	2	3	4	5	6	7	8	1	4	5	7	8	1	5	7		
Species/height class	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	Totals
Australian Magpie	4	3	3	3	2	3		2		4		3	2					**29**
Australian Pipit			1															**1**
Australian Raven											1		1		1			**3**
Australian Wood Duck													2					**2**
Buff-rumped Thornbill															10	7		**17**
Crested Pigeon									7									**7**
Crimson Rosella	3	2		2			3					5	3			7		**25**
Eastern Rosella	3		2			2	3				2		3		3			**18**
Galah									2									**2**
Grey Fantail														1				**1**
Grey Shrike-thrush														3				**3**
Magpie-lark			2															**2**
Noisy Miner			7															**7**
Sulphur-crested Cockatoo										2			1					**3**
Wedge-tailed Eagle																	1	**1**
White-eared Honeyeater															2	3		**5**
White-plumed Honeyeater														3				**3**
White-throated Treecreeper														2				**2**
Willie Wagtail									1					2				**3**
Totals	**10**	**5**	**15**	**5**	**2**	**5**	**6**	**2**	**10**	**6**	**3**	**8**	**12**	**11**	**16**	**17**	**1**	**134**

Spring 2019 BUS Raw data

Site	5										6								7								12							17										
Replicate	1		2		3		4	5	6	7	1	2	3	4	5	6	7	8	1		2		3		4	5	6	7	8	1	2	3	4	5	6	7	1	2	3		4			5	6	7
Species/height class	A	B	A	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	B	C	A	A	A
Australian Magpie	2						1	1	2		2	2	2	1		1	1	2	2						1					1	2	3	2	3	1	2					3				1	6
Australian Pipit																																													
Australian Raven																																1		3											
Australian Wood Duck																							1													2								1
Black-faced Cuckoo-shrike	3		3					1	1	1		1		2				2		1			2		2	1				1	1						2						1	1
Brown Falcon																																													
Brown Goshawk														1																															
Brown Treecreeper			1					2	1	1																																		
Buff-rumped Thornbill	2				1		1	2	7	6	1	1	1	2	2	2	2	2							2	1	7	3	4		1	1	2		2									
Common Starling																								1				3			3			4							1			
Crested Pigeon																																													
Crimson Rosella											1	1	3	1	1	1			2		2				1	2	2	2	1			2						2			1				2
Eastern Rosella														3		2		2			1		2		1	6	3	2					2		2		1					1	3	3
Galah																					1		2		3		2	2				2				1		1		2				2
Grey Fantail								1	1	1	1						1		1		1		1		4	3	1	3	1															
Grey Shrike-thrush	1		1		1			1	1								1								1					1	1			1										
Laughing Kookaburra															1						1				1																			
Little Corella																																													
Little Friarbird																	1																											
Magpie-lark																												1								2	2	2		1					
Mistletoebird																							3			1		2																
Nankeen Kestrel																																													
Noisy Friarbird							2								4	4	1	1			3				1										2	1					2	2		
Noisy Miner																										2											2					3	4	
Pacific Black Duck							2																																					
Pallid Cuckoo																																													
Pied Currawong										1			1												2				1													1			
Rainbow Bee-eater																								5																					
Red Wattlebird	1				1						1					1			1		2		4		2		1	2	2		1			1		1			2		2				3
Red-capped Robin										1																																			
Red-rumped Parrot																																													
Rufous Songlark																																													
Rufous Whistler								1	2																		2						1											
Sacred Kingfisher																									1		1	1																	
Silvereye	5								2																			2																	
Spotted Pardalote										1			3		1			1					5			1																			
Striated Pardalote	2		3				1	1	3									1	1		5			7	1		2	2	1			1	1	1	1	1	3	3	3					1		1
Striated Thornbill	2		2				4	3	7	3	2								4							2		4	4	2	2	2	1	7	3					2				4
Sulphur-crested Cockatoo																					1				3	3	3		2												1				
Superb Fairy-wren																																													
Superb Parrot																																													
Varied Sittella																																													
Wedge-tailed Eagle		2		1		1																																			1				
Weebill											2	2		1		2		2							2													2		2			2	2	4
Welcome Swallow																																													
Western Gerygone											1																			1	1													
White-browed Scrubwren																																													
White-eared Honeyeater																										1	2	1																	

Site	5										6								7												12							17													
Replicate	1		2		3		4	5	6	7	1	2	3	4	5	6	7	8	1		2		3		4	5	6	7	8	1	2	3	4	5	6	7	1	2	3		4			5	6	7
Species/height class	A	B	A	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	B	C	A	A	A
White-faced Heron																																															
White-plumed Honeyeater																																1																
White-throated Gerygone													1	1	1	2	2	1															3													
White-throated Treecreeper	2							1	2			1			1				2		1		4		2	2	1	3	2	1				3	1	1										
White-winged Chough																							4		8	3																				
White-winged Triller																																															
Willie Wagtail																																															
Yellow Thornbill	1															2			2		2		1			1	2																			
Yellow-faced Honeyeater											1								1																												
Yellow-rumped Thornbill	3											1	5				2										3		2	2	1			4	2											
Yellow-tailed Black-Cockatoo																																														
Grand Total	**24**	**2**	**10**	**1**	**3**	**1**	**11**	**14**	**29**	**15**	**12**	**9**	**16**	**12**	**11**	**17**	**11**	**14**	**16**	**1**	**20**	**5**	**31**	**8**	**35**	**30**	**30**	**30**	**26**	**9**	**13**	**10**	**9**	**32**	**13**	**8**	**5**	**11**	**13**	**1**	**12**	**3**	**1**	**8**	**12**	**31**

Spring 2019 BUS Raw data continued

Site	21						22								R1								R2								R3								
Replicate	1		2	3	4	5	1	2	3		4	5	6	7	1		2	3	4	5	6	7	8	1		2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	
Species/height class	A	B	A	A	A	A	A	A	A	B	A	A	A	A	A	B	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	Totals
Australian Magpie	2		4	2	5	3	2	10	2		8	2	1	1	2		3		3	4	2		10	3		3	6		12	1	4	8	2	1				2	2	2	**156**
Australian Pipit			4		1	2												1																						**8**
Australian Raven					1	10	2		2	10	6	1	5	5				2																3	1	1	2	2	3		**60**
Australian Wood Duck																																									**4**
Black-faced Cuckoo-shrike			2	1	3								1		2			1		1		1	3	2			3	8	1	2		3	1				1	1			**63**
Brown Falcon			1			2																																	1	**4**
Brown Goshawk																																								**1**
Brown Treecreeper																																								**5**
Buff-rumped Thornbill							1	2	2		1	2	3																				2			2	2		2		**74**
Common Starling			2		180		1	1	1		100		3		15	30	1	1		6	8	15		2		10			3				6				3			**400**
Crested Pigeon																				3				1				2			1									**7**
Crimson Rosella	1		1	1			1	1	1		1	1	2		2		1	1			1	2				2	4	2		2	1	3	4	1	1	2	4	3	2		**75**
Eastern Rosella	1		2			3	2				2	2	4	2						2	2	2		1									3	2	2	2	2			2	**72**
Galah															1	6				5	3	3	3	1		2		2	11	2	9	4	1		6		3			3	**83**
Grey Fantail																										1	1	1				1	2	3	2	5	1	1	1	1	**40**
Grey Shrike-thrush														1			1							1					1	1	1	1	1	1	1	1	1			1	**23**
Laughing Kookaburra																																	1								**4**
Little Corella																				3												3								**6**
Little Friarbird																																			2	1					**4**
Magpie-lark	1		1		1		1							1	1				1				1			1								1				1		**19**
Mistletoebird																																								**6**
Nankeen Kestrel		2	2													2	2				1			2															2	**13**
Noisy Friarbird	1																																	1	2					**27**
Noisy Miner																																								**11**
Pacific Black Duck																					3																			**5**
Pallid Cuckoo								1			1																													**2**
Pied Currawong																							1			1				1		2								**11**
Rainbow Bee-eater																							3																	**8**
Red Wattlebird					1		1		2		2	2	3	2									1	1				2					4	2	1		4	1	2		**59**
Red-capped Robin																													2											**3**
Red-rumped Parrot													2	2	6	6		3			1	1																		**21**
Rufous Songlark															2		1	1																			1			**5**
Rufous Whistler																							1							2	1		3	1		1	1	2	3	2	**23**
Sacred Kingfisher																					1																				**4**
Silvereye																							5	5		5			2	3	5	6	2							**42**
Spotted Pardalote					1									1																							1		1	1	**17**
Striated Pardalote					1	1	1					2			2					1						2				1				1					1	**59**
Striated Thornbill							2	2	5		4	3	2	2																			2							**82**
Sulphur-crested Cockatoo								2	1		3		5										8		3	2							3				1			**41**
Superb Fairy-wren															4		1	3	3	3	2	2	2	1		2	2	3	2	2		1		2		2			1	**38**
Superb Parrot											1				6		2		2	1	3								4							1				**20**
Varied Sittella												2		2																										**4**
Wedge-tailed Eagle																																								**5**
Weebill															1																			2	2	1	1	1		1	**32**
Welcome Swallow																													1											**1**
Western Gerygone																																		2	2	1	1	1			**11**
White-browed Scrubwren																							2					1	1		1	2								**7**
White-eared Honeyeater																																						2			**6**

Site	21						22								R1									R2								R3								
Replicate	1		2	3	4	5	1	2	3		4	5	6	7	1		2	3	4	5	6	7	8	1		2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	
Species/height class	A	B	A	A	A	A	A	A	A	B	A	A	A	A	A	B	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	Totals
White-faced Heron																										2	1													**3**
White-plumed Honeyeater															2		3	2	2	3	1	2								2	1									**19**
White-throated Gerygone												4	1																								1	1		1	**19**
White-throated Treecreeper								1																									2	1		1		1			**36**
White-winged Chough																											2						3	5	1	3	3	1	1	1	**35**
White-winged Triller			1					2			1		2						1					2		3	1					1		1						**15**
Willie Wagtail							1					1	2	1	2		2	2	2	2	2	2				1				1	1					1	1			**24**
Yellow Thornbill																																	2	2	2	2	3	1		2	**26**
Yellow-faced Honeyeater																								1		1	1						2	1	1						**9**
Yellow-rumped Thornbill							1	3	2		2	2												3		1		1	3												**43**
Yellow-tailed Black-Cockatoo																							25									6									**31**
Grand Total	**6**	**2**	**20**	**4**	**194**	**21**	**16**	**25**	**18**	**10**	**132**	**24**	**36**	**20**	**48**	**44**	**17**	**17**	**14**	**34**	**30**	**30**	**65**	**26**	**3**	**39**	**21**	**22**	**43**	**19**	**26**	**41**	**43**	**32**	**28**	**26**	**36**	**22**	**20**	**22**	**1931**

Summer 2020 BUS impact sites Raw data

Site	5			6				7							12						17						21		22						
Replicate	3	5	6	1	3	5	6	1	2	3	5	6	7	8	1	2	3	4	5	8	1	2	3	6	7	8	1	5	1	2	3	5	6	7	
Species/height class	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	A	A	A	Totals
Australian Hobby																										1									**1**
Australian Magpie		1		1	3		5	3	6		3		1		5	1		3	3	1	5	1	3		3	2	3		6			5		3	**67**
Australian Pipit																		2																	**2**
Australian Raven				1		1					3										1										1	2			**9**
Black-faced Cuckoo-shrike			2								1									1									1						**5**
Brown Thornbill																					6														**6**
Common Bronzewing										1											1					2									**4**
Common Starling																											8						5		**13**
Crimson Rosella							3				18	11		5							5		2	17		6									**67**
Eastern Rosella								5		4	6										7	4		3											**29**
Galah								6	2		6	7					2		19		2	2		6			2	4				2			**60**
Golden Whistler											4										2														**6**
Grey Shrike-thrush											2																		1						**3**
Laughing Kookaburra											4		1																						**5**
Magpie-lark																										2									**2**
Pied Currawong									2												3														**5**
Red Wattlebird			5																																**5**
Red-rumped Parrot																													4			9	2		**15**
Striated Pardalote											6	15												5	7										**33**
Sulphur-crested Cockatoo								8			5	10							57		2			8				23	6						**119**
Superb Fairy-wren																										5									**5**
Wedge-tailed Eagle	1																																		**1**
Welcome Swallow																3																			**3**
White-necked Heron																														2					**2**
White-plumed Honeyeater											6													9	11	4									**30**
White-throated Treecreeper											3										1														**4**
White-winged Chough												8																							**8**
Grand Total	**1**	**1**	**7**	**2**	**3**	**1**	**8**	**22**	**10**	**5**	**67**	**51**	**2**	**5**	**5**	**4**	**2**	**5**	**79**	**2**	**35**	**7**	**5**	**48**	**21**	**22**	**13**	**27**	**18**	**2**	**1**	**18**	**7**	**3**	**509**

Summer 2020 BUS reference sites Raw data

Site	R1									R2						R3								Totals
Replicate	1	2	3	4	5	6		7	8	1	2	3	4	5	6	1	2	3	4	5	6	7	8	
Species/height class	A	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Australian Magpie	4	7	3	3	5	3		4		5	1	8	4	6	19	2		1		6	5			**86**
Australian Raven			4				13	2	2	1							2							**24**
Black-faced Cuckoo-shrike					1																			**1**
Brown Thornbill																							4	**4**
Common Starling	100	50		5	4	27		12																**198**
Crimson Rosella	8				3	9		5		2														**27**
Eastern Rosella		4	4																					**8**
Galah	2							1								2		2		2	6			**15**
Grey Shrike-thrush	1	1			2																1			**5**
Magpie-lark	2																							**2**
Nankeen Kestrel													1											**1**
Noisy Miner	4																							**4**
Pied Currawong																1								**1**
Red Wattlebird																1					1			**2**
Red-rumped Parrot	6	4	6		6	12		5																**39**
Striated Pardalote			3	2	1	3		6																**15**
Striated Thornbill																			7					**7**
Sulphur-crested Cockatoo	1				6	5		1												2				**15**
Superb Fairy-wren	6	5	6		7			7		7			5				7						5	**55**
Varied Sittella	10	10																						**20**
Welcome Swallow			7																					**7**
Whistling Kite																					1			**1**
White-necked Heron																								**0**
White-plumed Honeyeater	3	2	5		3	9		7									3			3	12	4	5	**56**
White-winged Chough								11		8				11										**30**
Willie Wagtail					1	1										1								**3**
Grand Total	**147**	**83**	**38**	**10**	**39**	**69**	**13**	**61**	**2**	**23**	**1**	**8**	**10**	**17**	**19**	**7**	**12**	**3**	**7**	**13**	**26**	**4**	**14**	**626**

Appendix 2: Autumn 2019 bat report

Microbat Call Identification Report

Prepared for ("Client"):	Brett Lane & Associates Pty Ltd
Survey location/project name:	Bango Wind Farm, Rye Park, NSW
Survey dates:	29 April – 2 May 2019
Client project reference:	
Job no.:	BLA-1904
Report date:	29 May 2019

Methods

Data received

Balance! Environmental received 24,679 zero-crossing analysis bat call sequence files (ZC files), recorded at five sites in the Rye Park (NSW) area, between 29th April and 2nd May 2019.

Call analysis and identification

All ZC files were processed with the Cluster Analysis function of Wildlife Acoustics' Kaleidoscope Pro (Version 5.1.8), which automatically grouped calls into clusters according to similarities in zero-crossing parameters. Each cluster was then attributed to a species or species group following manual verification of call spectrograms in the Kaleidoscope Viewer. Where clusters were labelled as potentially belonging to *Miniopterus orianae* (syn. *M. schreibersii*) or one of the *Vespadelus* species, every file was carefully scrutinised to obtain a positive identification if possible.

Species identification was based on reference calls and derived metrics from southern New South Wales and/or published call descriptions (e.g. Reinhold et al. 2001; Pennay et al. 2004). Identification was also guided by considering the probability of species' occurrence based on published distribution information (e.g. Churchill 2008; van Dyck *et al.* 2013) and on-line database records (e.g. http://www.ala.org.au).

Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at http://www.ausbats.org.au/.

Species nomenclature follows Jackson & Groves (2015).

Results

Call detection rates

The analysis identified 2876 individual bat calls, recorded from a total survey effort of 13 detector-nights (see **Table 1**). Mean call detection rate was 221 calls per detector-night, with a range from 27 calls per detector-night (Site 1) to 387 calls per detector-night (Site 2).

A summary of the numbers of calls recorded per species at each site is provided in **Appendix 1**.

Species identified

At least 10 and up to 13 species were recorded during the Rye Park survey (see **Table 1**).

Thirty-one percent (899) of the identifiable calls were positively attributed to one of seven unique species: *Chalinolobus gouldii; C. morio; Scotorepens balstoni; S. greyii; Vespadelus vulturnus; Miniopterus orianae;* and *Austronomus australis*. Another 192 calls (6.7% of total) were reliably attributed to three undifferentiated co-generic species pairs: *Vespadelus darlingtoni / V. regulus; Nyctophilus geoffroyi / N. gouldi;* and *Ozimops planiceps / O. ridei.*

The other 1785 calls (62% of total) exhibited features that were intermediate between two or more unrelated species. These "unresolved" calls were allocated to the following multi-species groups: *C. gouldii / Ozimops spp.; C. gouldii / Scotorepens balstoni; V. darlingtoni / V. regulus / S. greyii;* and *M. orianae / V. vulturnus*. Where the latter groups were identified for a Site, all group members are listed as "possible" in **Table 1** unless one or more group members were also positively identified from other (more typical) calls.

Sample spectrograms of all call-types recorded during this survey are presented in **Appendix 2**.

Threatened species

One threatened species – *Miniopterus orianae oceanensis* (syn. *M. schreibersii oceanensis*; Eastern Bent-winged Bat) – was positively identified in this data set:

Almost 20% (571) of the identified calls were attributed to this species and another 254 calls (9% of total) potentially belonged to the species but could not be reliably differentiated from *Vespadelus* spp. calls. *M. o.* oceanensis was the second-most frequently recorded species after the combined group of *C. gouldii* and *Ozimops* spp. (see **Figure 1**).

Table 1. Bat calls recorded during the Bango Wind Farm survey, Rye Park, NSW, April-May 2019.
Bold typeface indicates listed threatened species (NSW *Biodiversity Conservation Act 2016*).
♦ = 'definite' - at least one call was attributed unequivocally to the species
□ = 'possible' - calls like those of the species were recorded, but were not reliably identified

Site-name:	Site 1	Site 2	Site 3	Site 4	Site 5
Chalinolobus gouldii	♦	♦	♦	♦	♦
Chalinolobus morio	♦	♦	♦	♦	♦
Nyctophilus geoffroyi / N. gouldi	♦	♦	♦	♦	♦
Scotorepens balstoni	□	♦	□	□	♦
Scotorepens greyii		□	□		♦
Vespadelus darlingtoni / V. regulus	♦	♦	♦		♦
Vespadelus vulturnus	♦	♦	♦	□	♦
Miniopterus orianae oceanensis	♦	♦	♦	♦	♦
Austronomus australis		♦	♦		♦
Ozimops planiceps / O. ridei	♦	♦	□	□	♦

Comparative activity levels

Figure 1 demonstrates the dominance of *C. gouldii, Ozimops* spp. and *M. orianae oceanensis* in the data set. Significant variance in overall activity between sites is also evident, with Sites 1 and 4 exhibiting relatively low bat activity compared with the other three sites. Site 3 appears to be favoured by *M. o. oceanensis*, as the majority of calls recorded from that species were detected there.

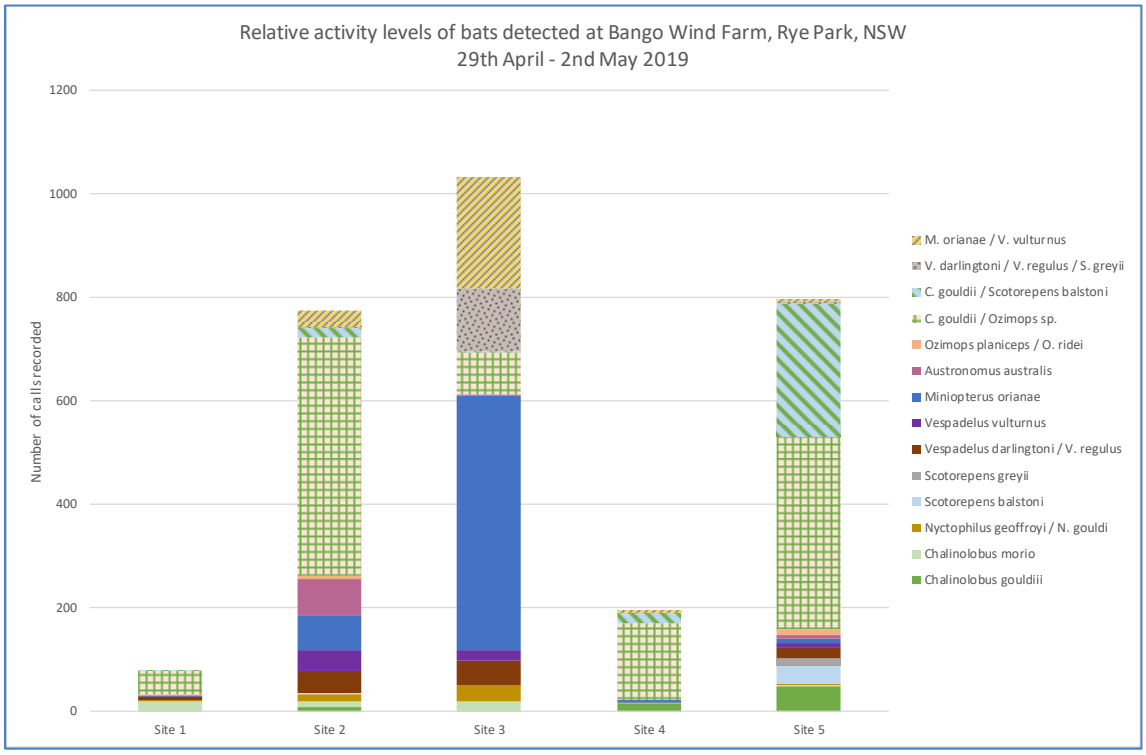


Figure 1 Relative activity levels (mean calls per night) of bats recorded during the Bango Wind Farm survey at Rye Park, NSW, 29 April – 2 May 2019.

References

Churchill, S. (2008). *Australian Bats*. Jacana Books, Allen & Unwin; Sydney.

Jackson, S. and Groves, C. (2015). Taxonomy of Australian Mammals. CSIRO Publishing, Melbourne.

Pennay, M., Law, B. and Reinhold, L. (2004). *Bat Calls of New South Wales*. Department of Environment and Conservation, Hurstville.

Reardon, T. (2003). Standards in bat detector based surveys. *Australasian Bat Society Newsletter* **20**, 41-43.

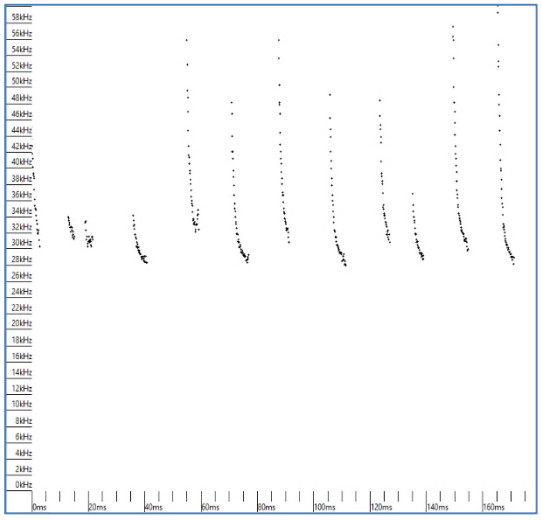
Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales*. Department of Natural Resources and Mines, Brisbane.

van Dyck, S., Gynther, I. and Baker, A. (ed.) (2013). *Field Companion to the Mammals of Australia*. New Holland; Sydney.

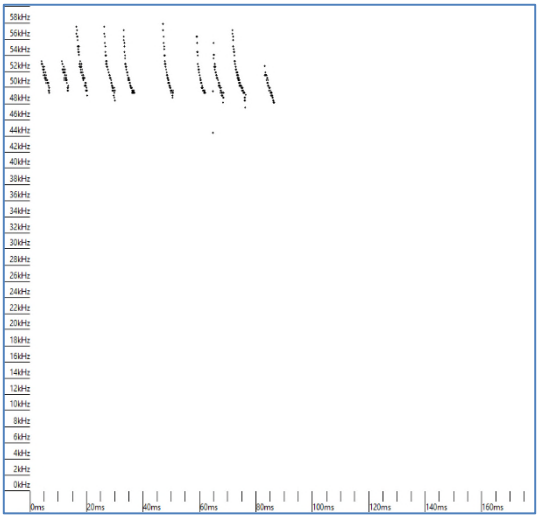
Appendix 1 Number of calls recorded per species at five detector sites in the Bango Wind Farm study area, Rye Park, NSW, 29th April – 2nd May 2019.

Site-name:	Site 1	Site 2	Site 3	Site 4	Site 5	Species total
Total detector-nights:	3	2	3	2	3	13
Positively identified calls						
Chalinolobus gouldii	1	9	2	14	49	75
Chalinolobus morio	18	11	18	2	1	50
Nyctophilus geoffroyi / N. gouldi	2	13	31	1	4	51
Scotorepens balstoni		3			36	39
Scotorepens greyii					13	13
Vespadelus darlingtoni / V. regulus	7	42	48		20	117
Vespadelus vulturnus	1	40	20		9	70
Miniopterus orianae	1	67	490	5	8	571
Austronomus australis		70	4		7	81
Ozimops planiceps / O. ridei	4	8			12	24
Unresolved calls						
C. gouldii / Ozimops sp.	43	459	80	147	372	1101
C. gouldii / Scotorepens balstoni	3	18	3	22	256	302
V. darlingtoni / V. regulus / S. greyii		3	120		5	128
M. orianae / V. vulturnus		30	217	3	4	254
Site total	80	773	1033	194	796	2876
Mean calls per detector-night	27	387	344	97	265	221

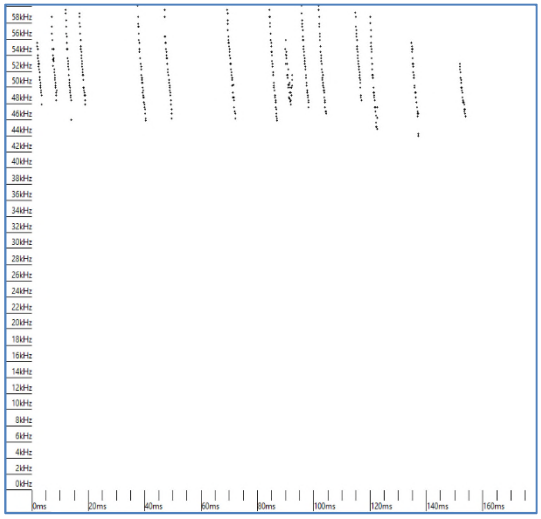
Appendix 2 Representative bat-calls recorded at Rye Park, NSW, 29th April – 2nd May 2019. Time between pulses removed; time-scale (*x*-axis) 5ms per tick



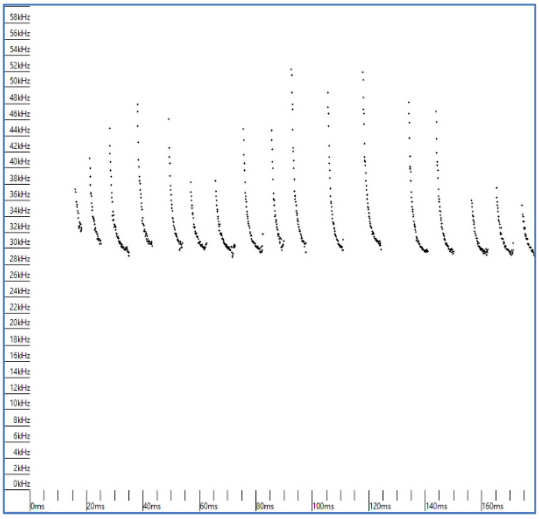
Chalinolobus gouldii



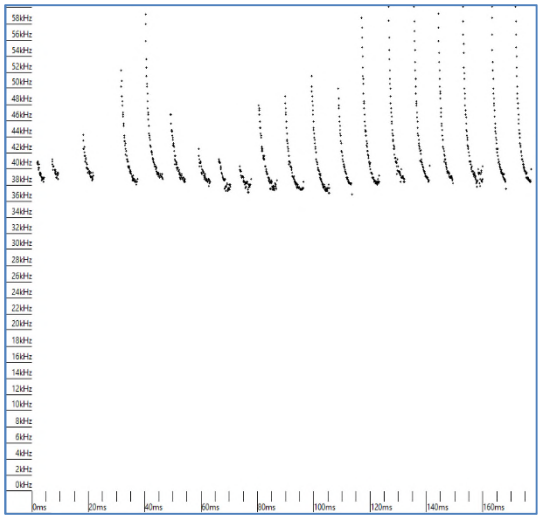
Chalinolobus morio



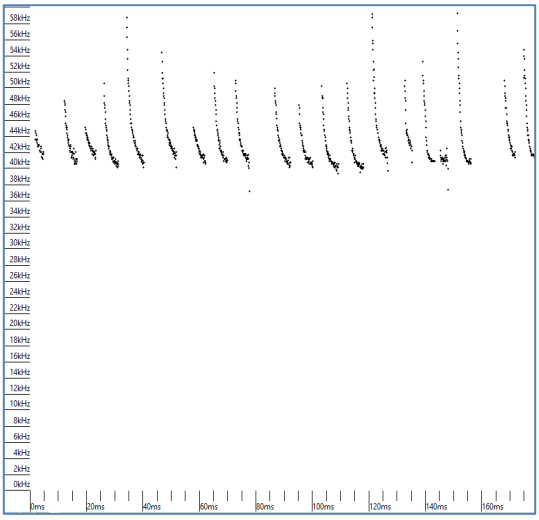
Nyctophilus geoffroyi / N. gouldi



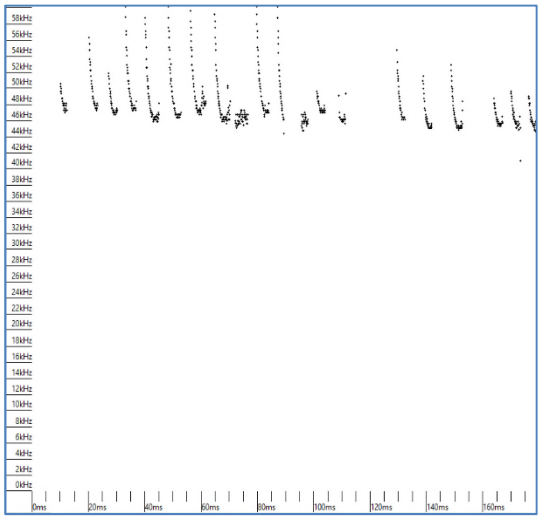
Scotorepens balstoni



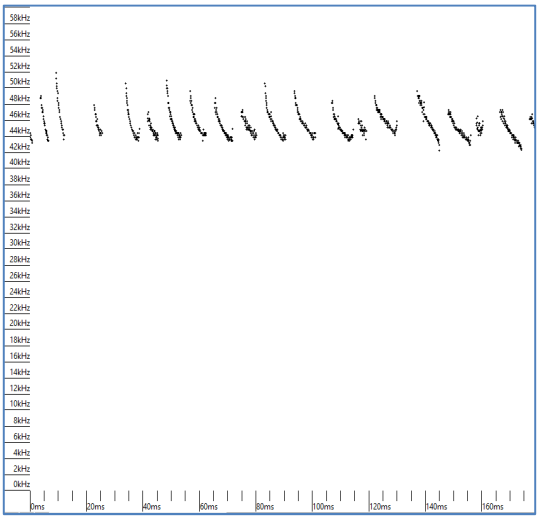
Scotorepens greyii



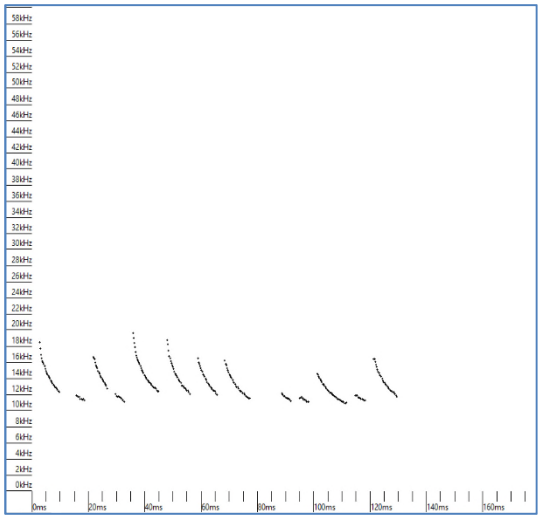
Vespadelus darlingtoni / V. regulus



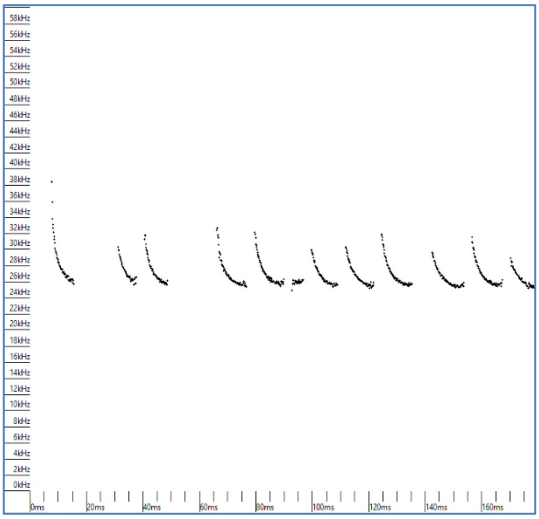
Vespadelus vulturnus



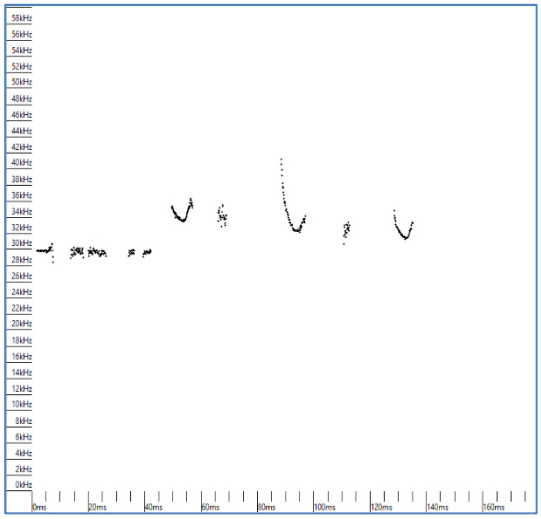
Miniopterus orianae



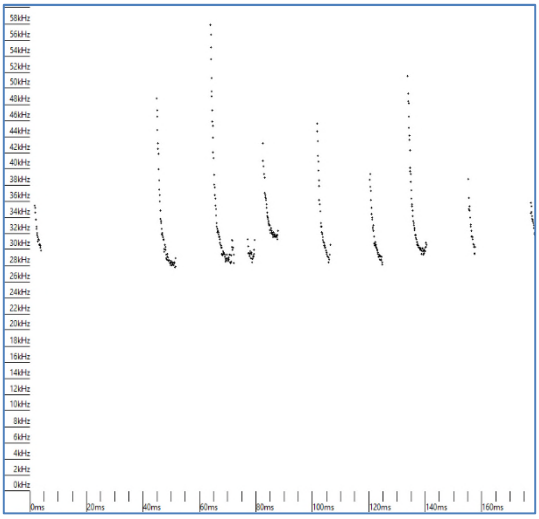
Austronomus australis



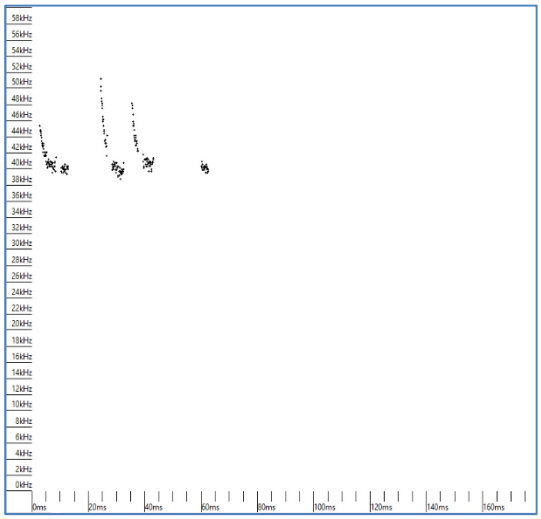
Ozimops planiceps / O. ridei



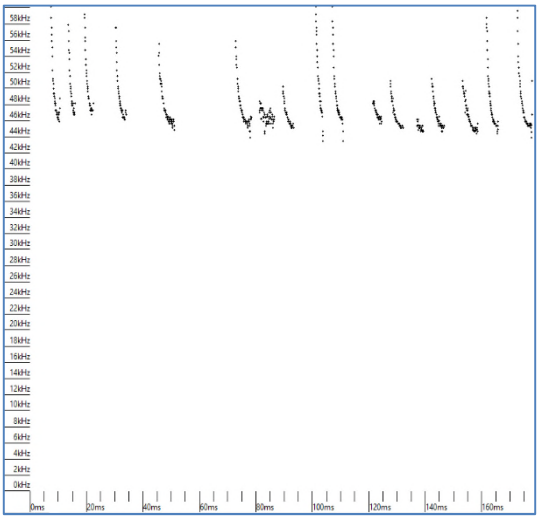
C. gouldii / Ozimops spp.



C. gouldii / Scotorepens balstoni



V. darlingtoni / V. regulus / S. greyii



M. orianae / V. vulturnus

Appendix 3: Spring 2019 bat report

Microbat Call Identification Report

Prepared for ("Client"):	Nature Advisory
Survey location/project name:	Bango Wind Farm, NSW
Survey dates:	7 October - 19 November 2019
Client project reference:	18173-3
Job no.:	NAD-2002
Report date:	5 April 2020

Methods

Data received

Balance! Environmental received 42,514 zero-crossing analysis bat call sequence files (ZC files), recorded with four Song Meter detectors (Wildlife Acoustics, Maynard MA, USA). Each detector was deployed for 44 consecutive nights (7th October and 19th November 2019) in the Bango Wind Farm (WF) study area.

The brief for this analysis was to determine the presence and activity patterns of the Eastern Bent-winged Bat (*Miniopterus orianae oceanensis*) for each site.

Call analysis and identification

Call analyses were performed in *Anabat Insight* (Titley Scientific, Brisbane).

The following series of filters were applied to the submitted dataset to extract a set of files containing calls potentially attributable to *M. o. oceanensis*:

- Phase 1 filter - average characteristic frequency (Fc) of 43-48 kHz
    - Due to the large size of the submitted dataset, it was decided to first filter the data to select out only those files that potentially contained calls within the frequency range typically occupied by *M. o. oceanensis*
- Phase 2 filter – noise and useless call elimination
    - Files that passed Phase 1 were filtered to remove those that contained only poor-quality calls (highly fragmented, few pulses) of limited diagnostic use
- Phase 3 filter – removal of non-target species
    - The average Fc filter used in Phase 1 allowed through numerous files that contained multiple calls above and below the target frequency range, which resulted in average Fc for the file being within the 43-48 kHz bounds of Phase 1
    - A per-pulse filter was thus applied to the Phase 2 output to eliminate files that contained fewer than 3 pulses within the 43-48 kHz range

Calls that passed the 3-phase filtration were then processed manually, with species identification achieved by comparing each spectrogram and it's associated call-metrics with those available in published data (e.g. Reinhold et al. 2001; Pennay *et al.* 2004) and regionally relevant reference calls.

Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at http://www.ausbats.org.au/.

Species nomenclature follows Jackson & Groves (2015).

Results

The final analysis dataset generated by the filtration process included 5469 calls that were potentially attributable to *M. o. oceanensis*. More than half (2921) of those calls were identified as belonging to one of three *Vespadelus* species (*V. darlingtoni, V. regulus, V. vulturnus*), while 793 calls (14.5% of total) were reliably attributed to *M. o. oceanensis*. The other 32% (1755 calls) could not be reliably differentiated and were allocated to a combined *Miniopterus/Vespadelus* group. **Table 1** provides a site-by-site breakdown of calls allocated to the three taxa.

Table 1 Bango WF survey - 7th October to 19th November 2019
Number of calls allocated to three taxa in the 43-48 kHz characteristic frequency range.

Species	Site 1	Site 2	Site 4	Site 5	Species Total
Miniopterus orianae oceanensis	91	426	173	103	793
M. o. oceanensis or *Vespadelus* sp.	689	361	512	193	1755
Vespadelus sp.	928	873	717	403	2921
Site Total	1708	1660	1402	699	5469

Site-based comparison of activity levels

Substantially fewer calls in the 43-48 kHz range were recorded at Site 5 than at the other three sites (see **Table 1** and **Figure 1**). The relative proportion of calls allocated reliably to *Vespadelus* spp. was consistent across all four sites, ranging from 51% (Site 4) to 58% (Site 5). In contrast, the proportion of calls reliably identified to *M. o. oceanensis* varied considerably (5% to 26%) between sites.

Failure to reliably identify a significant proportion of the calls recorded at each site (*i.e.* 22%-40% of calls allocated to *Miniopterus/Vespadelus*) means that accurate comparison of *M. o. oceanensis* activity levels is not possible.

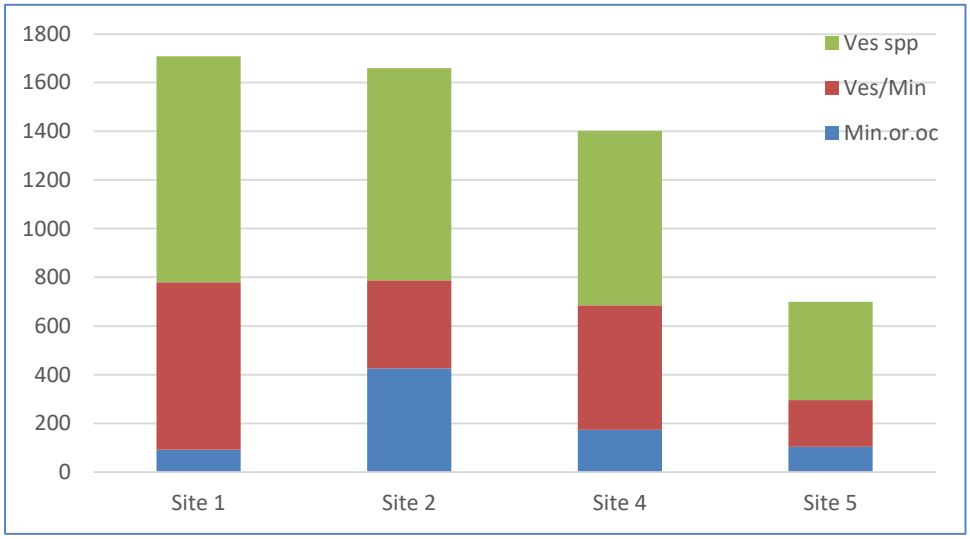


Figure 1 Comparison of total activity levels during the Bango WF survey October-November 2019

Variance in nightly activity levels

Activity levels varied considerably between nights for each site, although a similar pattern of peaks and troughs in activity levels is apparent (see **Figure 2**). The most notable similarity in these patterns is the substantial drop in activity levels at all sites between 4th and 10th November, except for a significant activity peak at Site 2 on the night of 6th November.

While activity levels at all sites recovered from the night of 12th November, there was another noticeable spike in activity level at Site 2 on that night. Furthermore, this sudden jump in activity level at Site 2 on 11th November appears to be driven largely by a significant concentration of *M. o. oceanensis* activity.

Some of the nightly variance in activity levels may be explained by the influence of weather patterns during the survey. In particular, the lower activity levels in the first week of November may have been a response to a cooler rainy period (see **Figure 3**). Similarly, the spikes in activity at Site 2 on the nights of 6th and 11th November appear to be linked to warmer daytime temperatures and higher overnight minima on those two nights.

References

Pennay, M., Law, B. and Reinhold, L. (2004). *Bat Calls of New South Wales*. Department of Environment and Conservation, Hurstville.

Reardon, T. (2003). Standards in bat detector based surveys. *Australasian Bat Society Newsletter* **20**, 41-43.

Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales*. Department of Natural Resources and Mines, Brisbane.

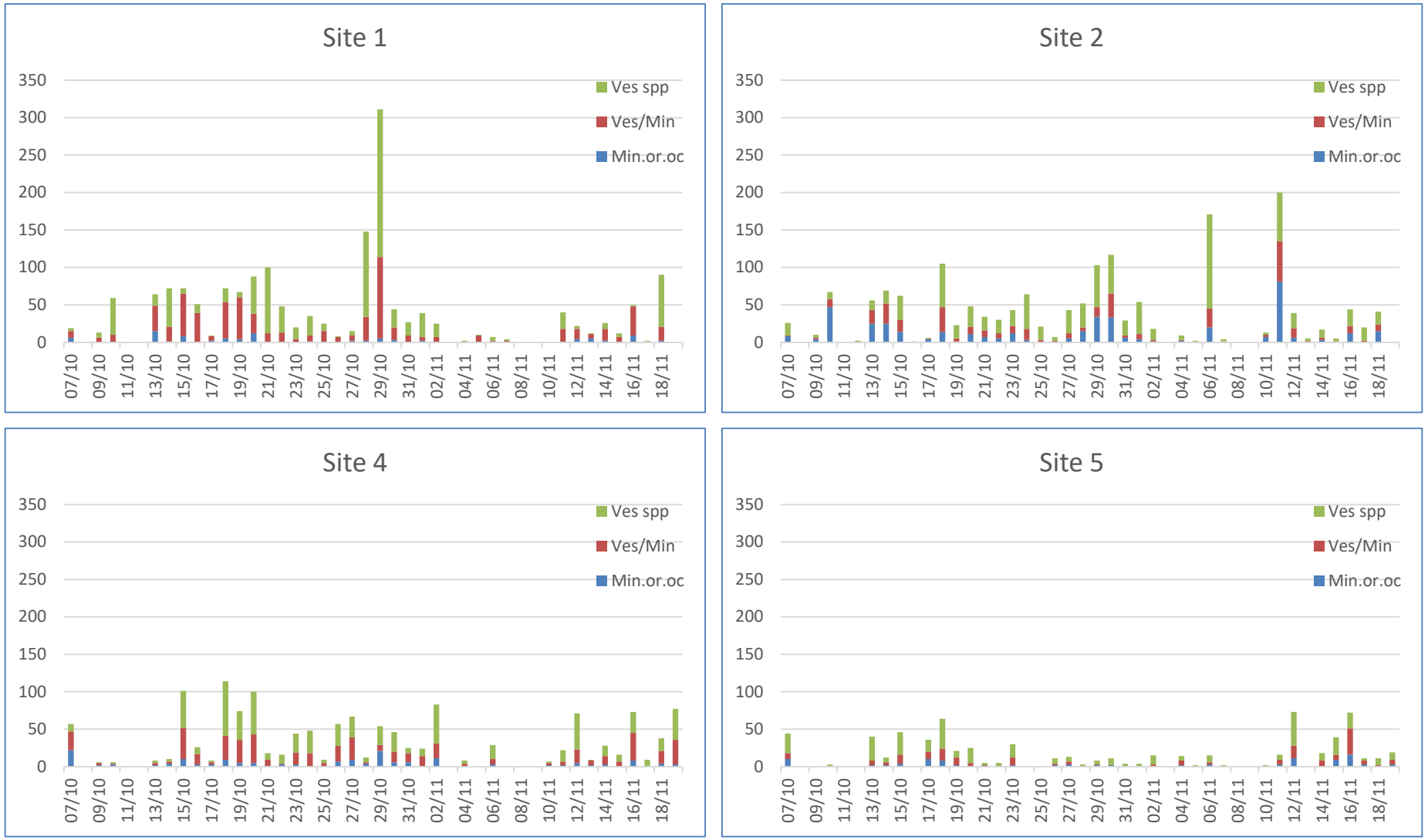


Figure 2. Nightly variance in activity levels of *M. o. oceanensis* and *Vespadelus* spp. at four sites in the Bango WF study area

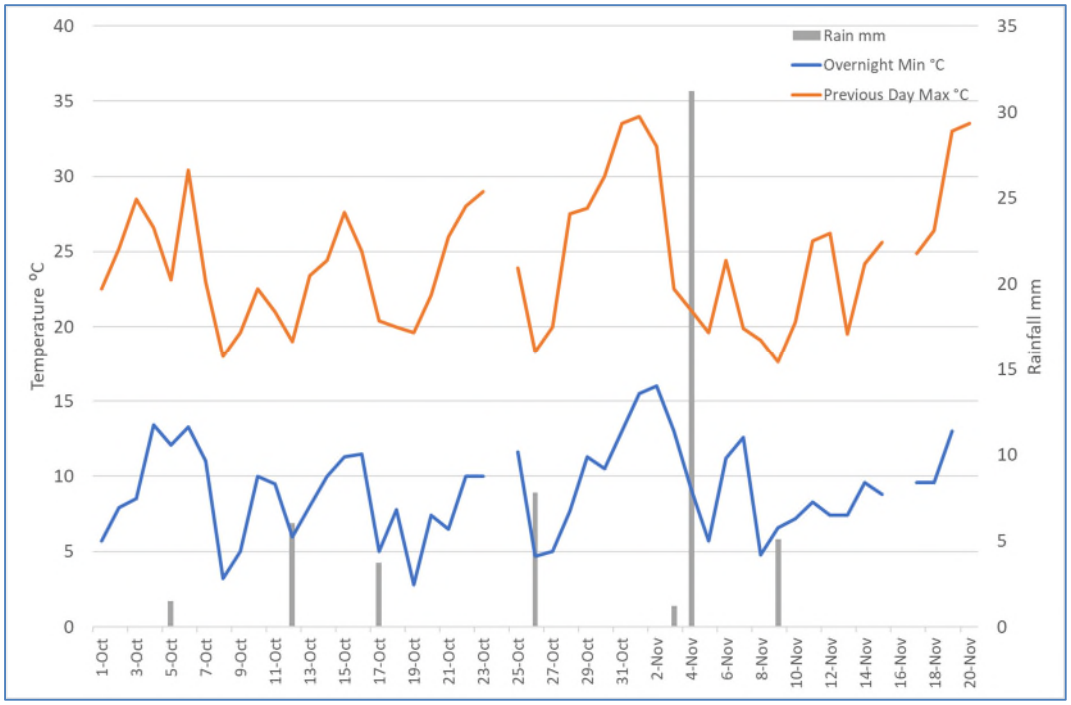
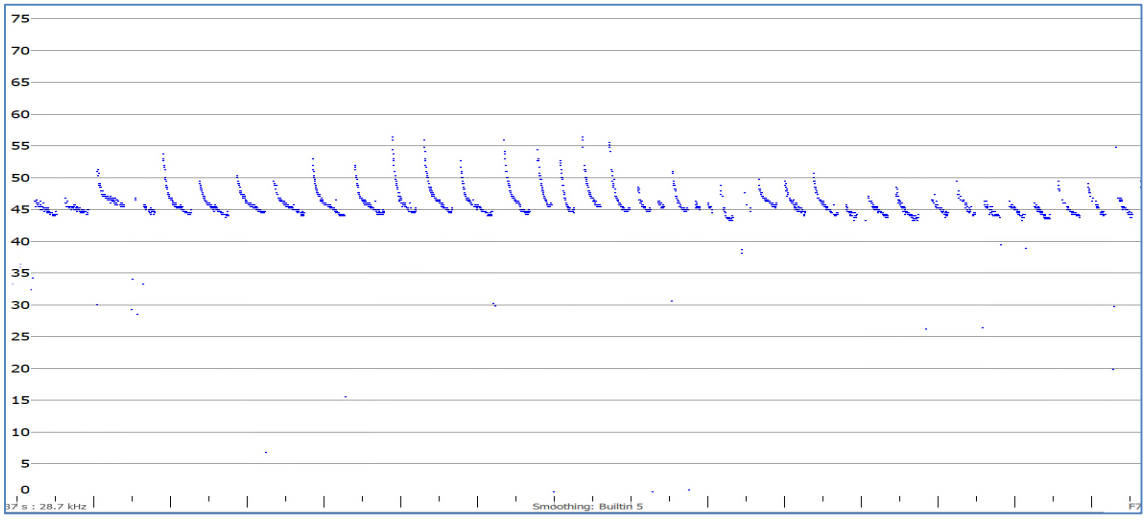
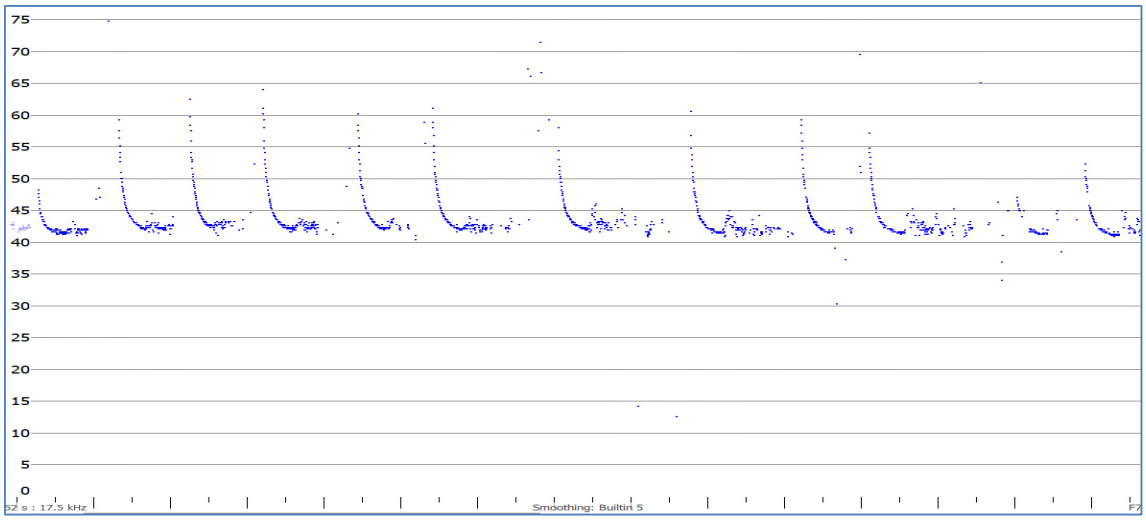


Figure 3. Weather conditions during the Bango WF bat monitoring, October-November 2019.
Source: Bureau of Meteorology Daily Weather Observations - Burrinjuck Dam (station 073007)
http://www.bom.gov.au/climate/dwo/201910/html/IDCJDW2021.201910.shtml
http://www.bom.gov.au/climate/dwo/201911/html/IDCJDW2021.201911.shtml

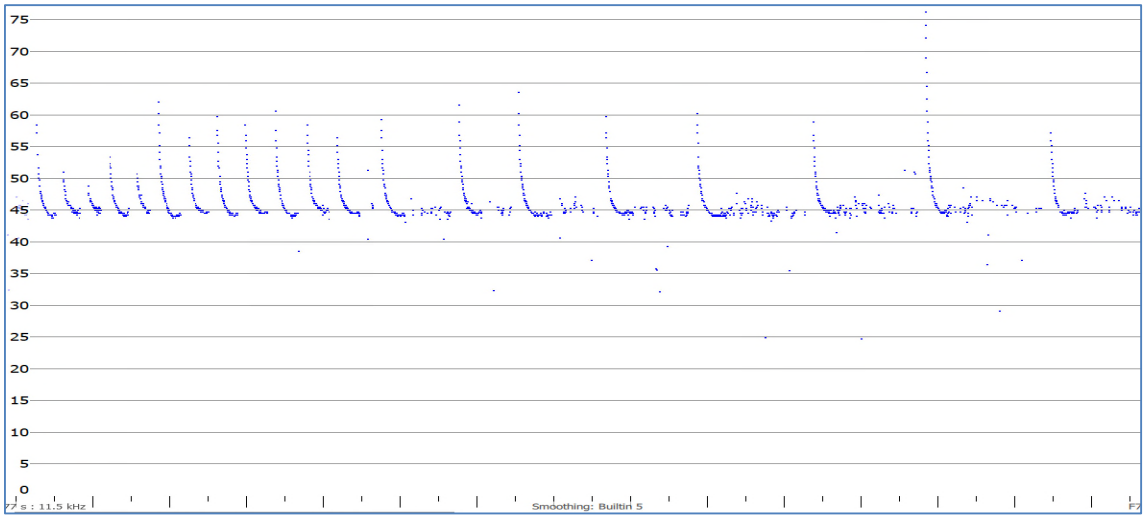
Appendix 2 Representative bat-calls recorded at Bango Wind Farm, October-November 2019. Time between pulses removed; time-scale (*x*-axis) 10ms per tick



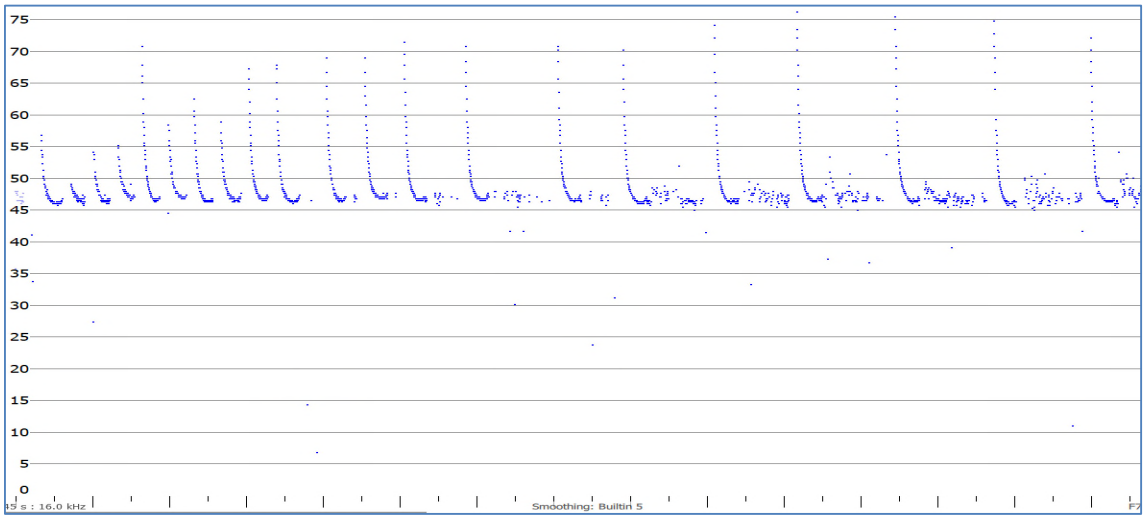
Miniopterus orianae oceanensis



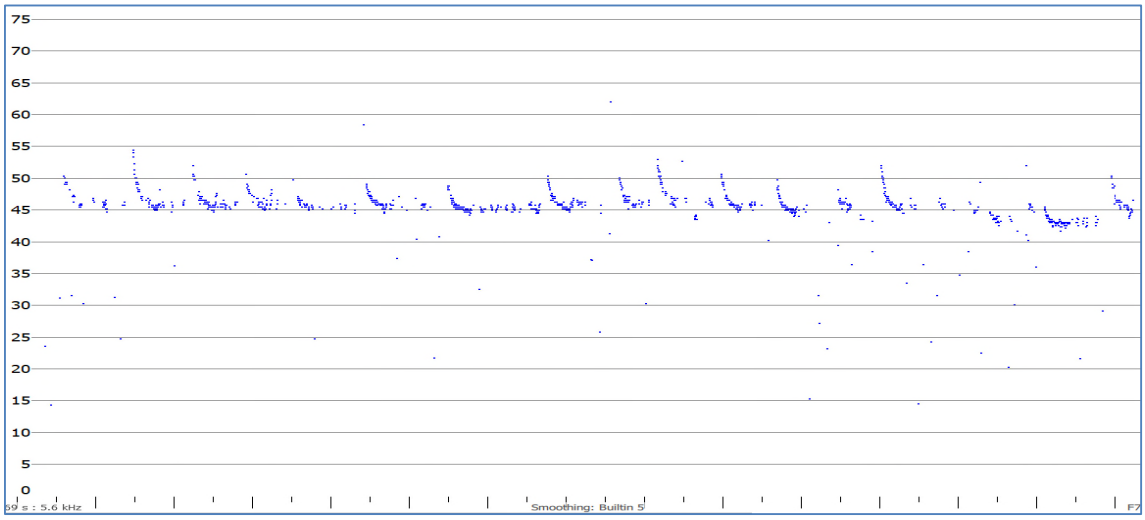
Vespadelus darlingtoni



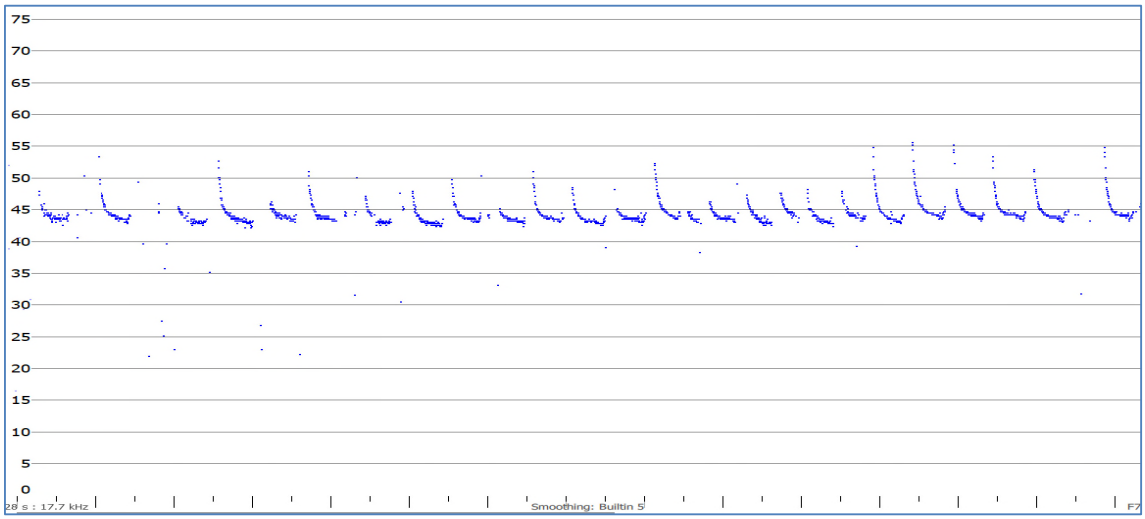
Vespadelus regulus



Vespadelus vulturnus



M. o. oceanensis / *Vespadelus* sp.



M. o. oceanensis / *Vespadelus* sp.

Appendix 4: Summer/autumn 2020 bat report

Microbat Call Identification Report

Prepared for ("Client"):	Nature Advisory
Survey location/project name:	Bango Wind Farm, NSW
Survey dates:	17 February – 4 May 2020
Client project reference:	18173
Job no.:	NAD-2007
Report date:	16 July 2020

Methods

Data received

Balance! Environmental received more than half-a-million zero-crossing analysis bat call sequence files (ZC files) recorded with Song Meter detectors (Wildlife Acoustics, Maynard MA, USA). Eighteen 'sites' were sampled between 17th February and 4th May 2020 (see **Table 1**), with a total survey effort of 580 detector-nights (D-N).

The brief for this analysis was to determine the presence and activity patterns of the Eastern Bent-winged Bat (*Miniopterus orianae oceanensis*) for each site.

Table 1 Bat detector deployment schedule; Bango Wind Farm, 17 February – 4 May 2020.

Site	Detector ID	Sample dates	Total detector-nights (D-N)
Site 1	S4Z00538	17-28 Feb	11
Site 2	S4Z00824	17-28 Feb	11
Site 3	S4Z00603	17-28 Feb	11
Site 4	S4Z00894	17-28 Feb	11
Site 5	S4Z00764	17-28 Feb	11
Site 6	S4Z00538	28 Feb – 21 Mar	22
Site 7	S4Z00824	28 Feb – 21 Mar	22
Site 8	S4Z00838	28 Feb – 4 May	65
Site 9	S4Z00887	28 Feb – 4 May	65
Site 10	S4Z00850	28 Feb – 4May	65
Site 11	S4Z00603	28 Feb – 21 Mar	22
Site 12	S4Z00894	28 Feb – 21 Mar	22
Site 13	S4Z00764	28 Feb – 21 Mar	22
Site 14	S4Z00538	21 Mar – 4 May	44
Site 15	S4Z00824	21 Mar – 4 May	44
Site 16	S4Z00603	21 Mar – 4 May	44
Site 17	S4Z00894	21 Mar – 4 May	44
Site 18	S4Z00764	21 Mar – 4 May	44

* Sites 6 & 7 deployed at base of met-mast; Sites 8, 9 & 10 deployed at height on met-mast

Call analysis and identification

Call analyses were performed in *Anabat Insight* (version 1.9.4; Titley Scientific, Brisbane).

The following series of filters were applied to the submitted dataset to extract a set of files containing calls potentially attributable to *M. o. oceanensis*:

- Phase 1 filter - average characteristic frequency (Fc) of 43-48 kHz
  - Due to the large size of the submitted dataset, it was decided to first filter the data to select out only those files that potentially contained calls within the frequency range typically occupied by *M. o. oceanensis*
- Phase 2 filter – noise and useless call elimination
  - Files that passed Phase 1 were filtered to remove those that contained only poor-quality calls (highly fragmented, few pulses) of limited diagnostic value
- Phase 3 filter – removal of non-target species
  - The average Fc filter used in Phase 1 allowed through numerous files that contained multiple calls above and below the target frequency range, which resulted in average Fc for the file being within the 43-48 kHz bounds of Phase 1
  - A per-pulse filter was thus applied to the Phase 2 output to eliminate files that contained fewer than 3 pulses within the 43-48 kHz range

Calls that passed the 3-phase filtration were then processed manually, with species identification achieved by comparing each spectrogram and its associated call-metrics with those available in published data (e.g. Reinhold et al. 2001; Pennay *et al.* 2004) and regionally relevant reference calls.

Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at http://www.ausbats.org.au/.

Species nomenclature follows Jackson & Groves (2015).

Results

The final analysis dataset generated by the filtration process included 10,767 calls that were potentially attributable to *M. o. oceanensis*. More than 90% (9802) of those calls were identified as belonging to one of three *Vespadelus* species (*V. darlingtoni, V. regulus, V. vulturnus*), while just 32 calls (<1% of total) were reliably attributed to *M. o. oceanensis*. The other 933 calls could not be reliably differentiated and were allocated to a combined *Miniopterus/Vespadelus* group.

Table 1 provides a site-by-site breakdown of total call counts and mean detection rates (calls per detector-night) for each taxon.

Site-based comparison of activity levels

Activity levels of bats calling in the 43-48 kHz range varied substantially across the survey area, with the variance driven primarily by *Vespadelus* spp. activity (see **Table 2** and **Figure 1**). Significantly, however, the detectors deployed at height on met-masts (Sites 8, 9 & 10) consistently recorded the lowest activity levels.

Table 2 Bango WF survey, 17th February to 4th May 2020:
Call detection rates for three taxa in the 43-48 kHz characteristic frequency range.
Minori = *M. o. oceanensis*; MinVes = unresolved calls; Vesspp = *Vespadelus* spp.

Site	Total calls detected			Mean calls per detector-night		
	Minori	MinVes	Vesspp	Minori	MinVes	Vesspp
Site 1	0	0	50	0.00	0.00	4.55
Site 2	1	17	262	0.09	1.55	23.82
Site 3	3	35	310	0.27	3.18	28.18
Site 4	3	9	78	0.27	0.82	7.09
Site 5	0	16	469	0.00	1.45	42.64
Site 6	0	3	76	0.00	0.14	3.45
Site 7	0	1	130	0.00	0.05	5.91
Site 8	1	14	29	0.02	0.22	0.45
Site 9	0	3	6	0.00	0.05	0.09
Site 10	0	17	32	0.00	0.26	0.49
Site 11	0	12	470	0.00	0.55	21.36
Site 12	7	190	1929	0.32	8.64	87.68
Site 13	0	17	325	0.00	0.77	14.77
Site 14	1	94	193	0.02	2.14	4.39
Site 15	0	320	4724	0.00	7.27	107.36
Site 16	4	84	490	0.09	1.91	11.14
Site 17	5	43	93	0.11	0.98	2.11
Site 18	7	58	136	0.16	1.32	3.09
Totals	32	933	9802	0.08	1.74	20.48

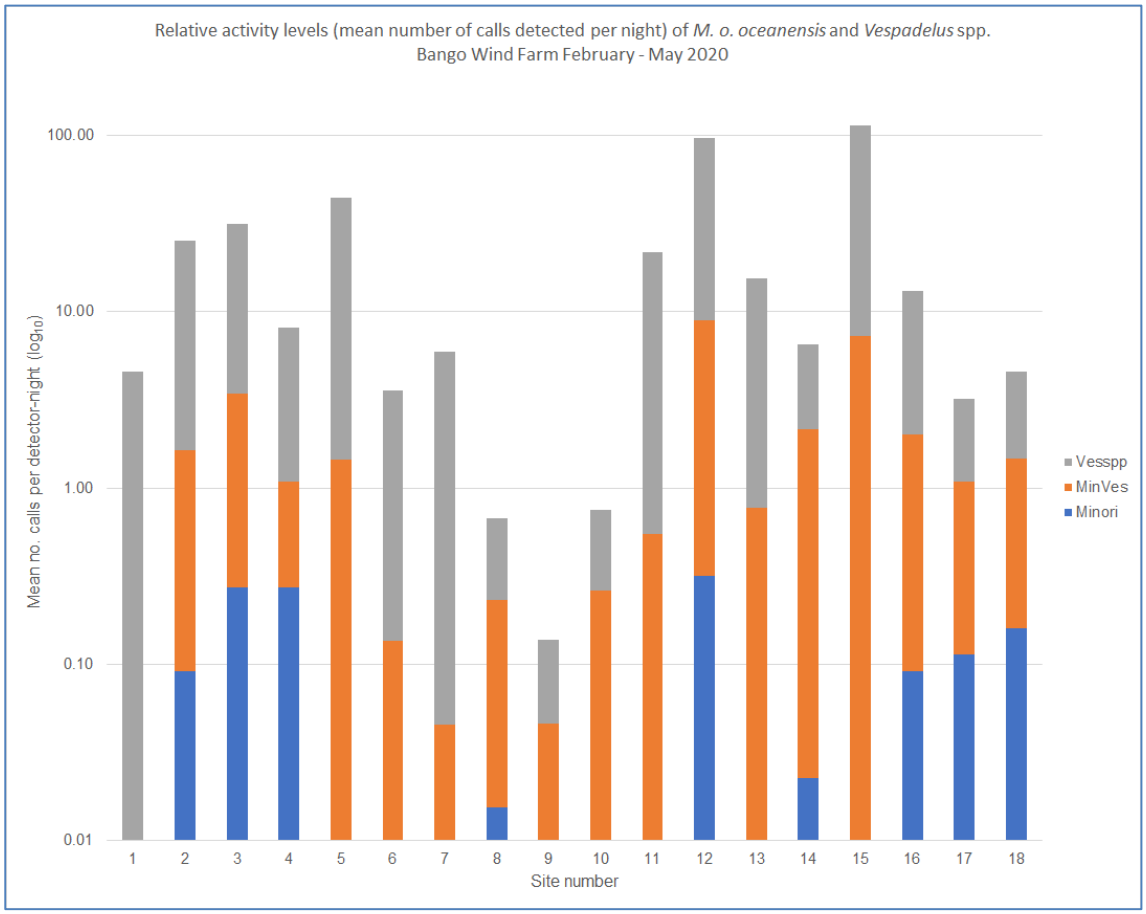


Figure 1 Comparison of mean bat activity levels per site at Bango WF, February-May 2020. Note the logarithmic y-axis to account for the low *M. o. oceanensis* detection rate.

Variance in nightly activity levels

There was a general decline in mean activity levels across the project area as the season progressed from the warmer nights of February to cooler nights in late April/early May (see **Figure 2**). Sites that were sampled simultaneously (*i.e.* Sites 1-5, Sites 6-13 and Sites 8-10 & 14-18; see **Table 1**) exhibited similar variance in activity patterns in response to local weather conditions (*e.g.* lower activity on cooler nights), but otherwise differed considerably in overall activity and that attributable to each identified taxon (see **Appendix 1**).

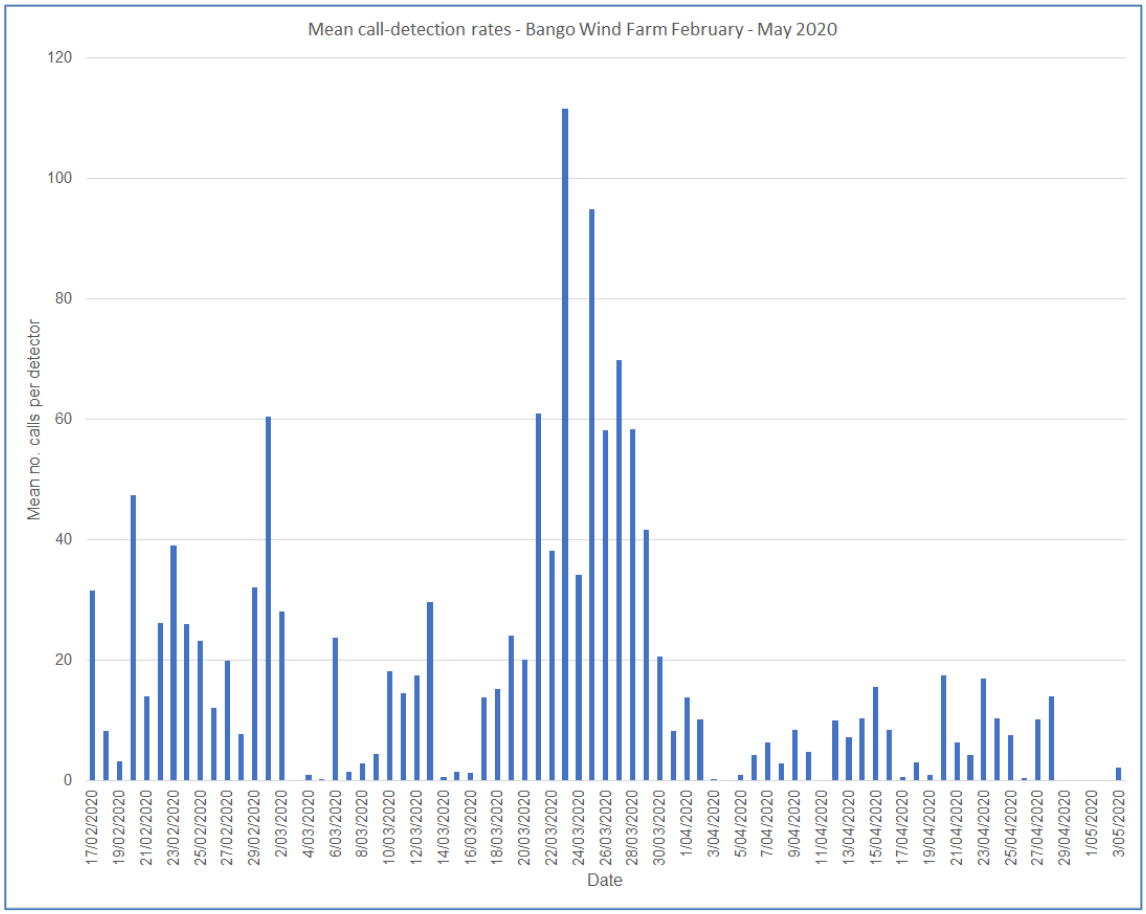


Figure 2 Comparison of bat activity levels throughout the February-May 2020 survey period at Bango WF. Mean number of calls recorded per detector per night.

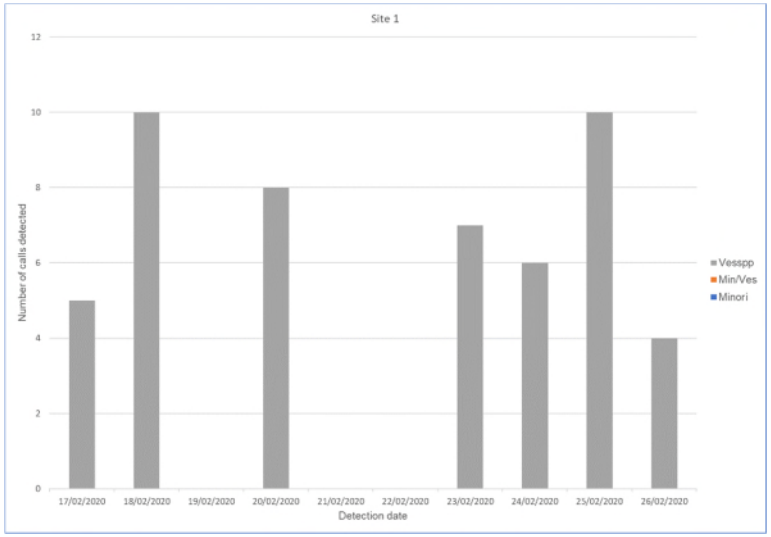
References

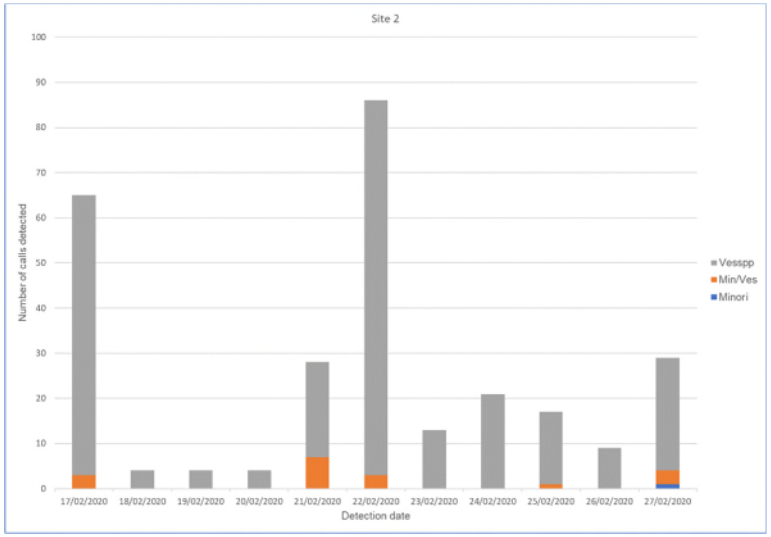
Pennay, M., Law, B. and Reinhold, L. (2004). *Bat Calls of New South Wales*. Department of Environment and Conservation, Hurstville.

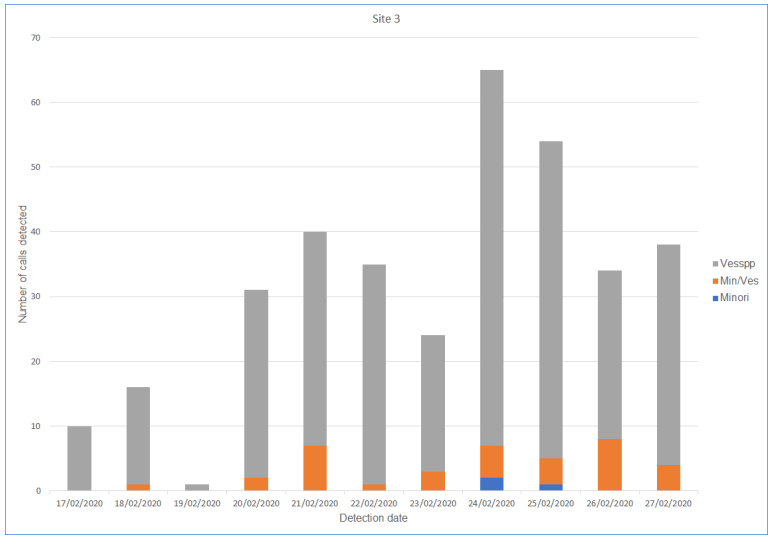
Reardon, T. (2003). Standards in bat detector based surveys. *Australasian Bat Society Newsletter* **20**, 41-43.

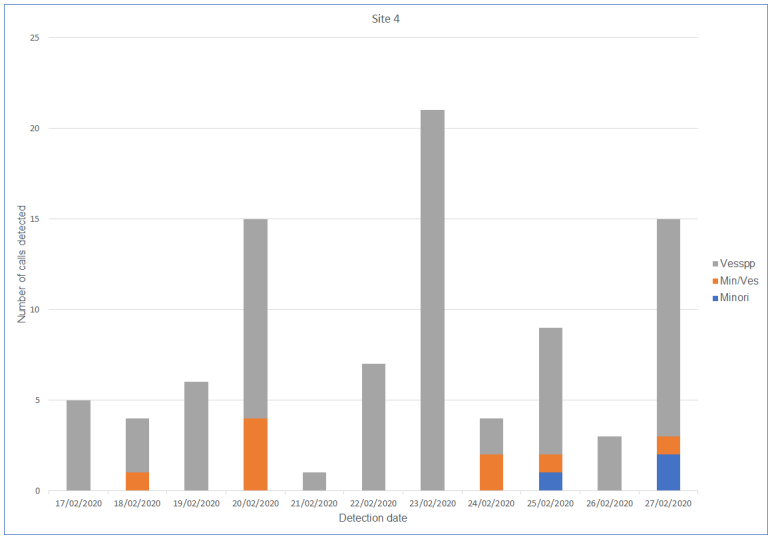
Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales*. Department of Natural Resources and Mines, Brisbane.

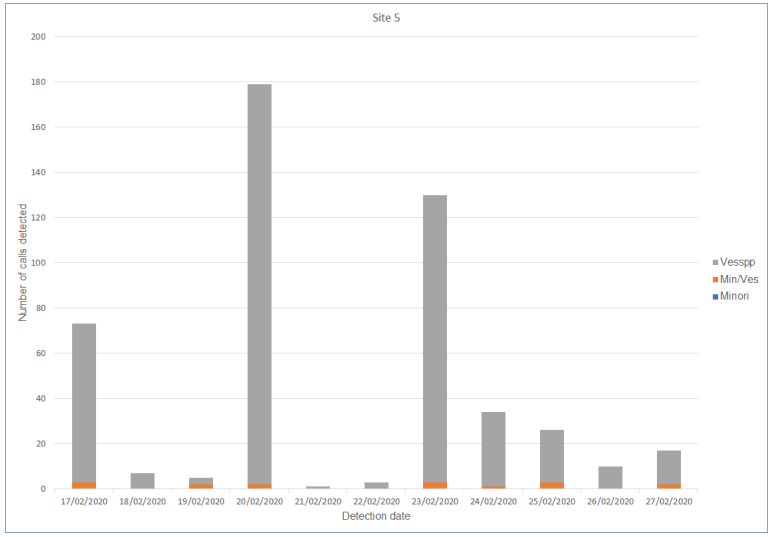
Appendix 1. Nightly variance in activity levels of *M. o. oceanensis* and *Vespadelus* spp. at 18 sites in the Bango WF study area

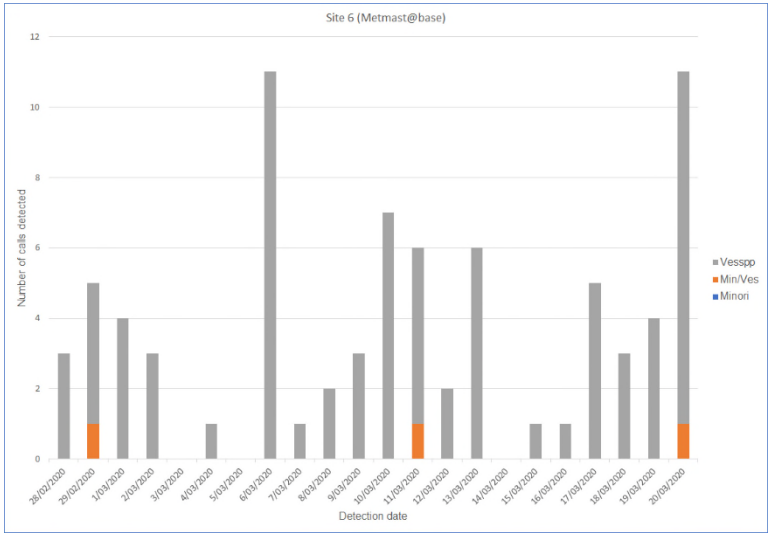


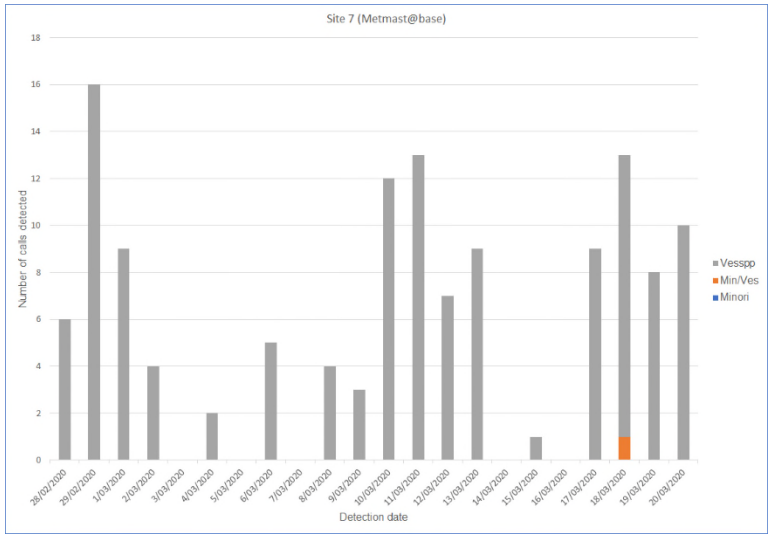


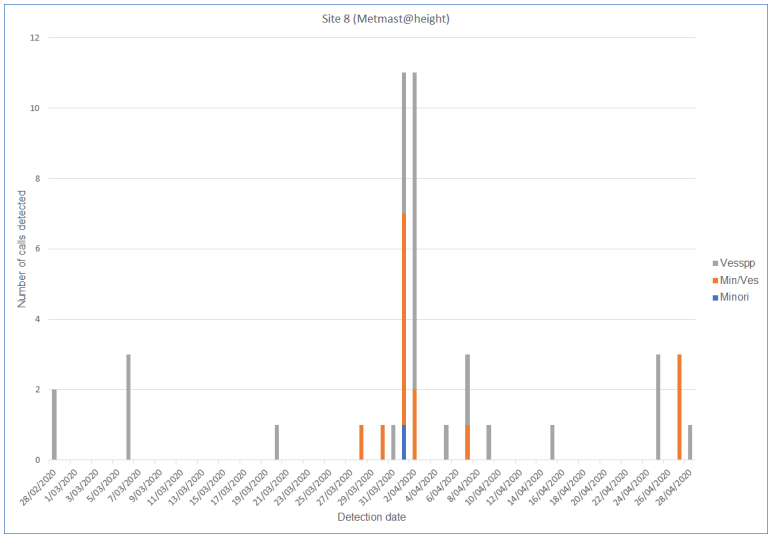


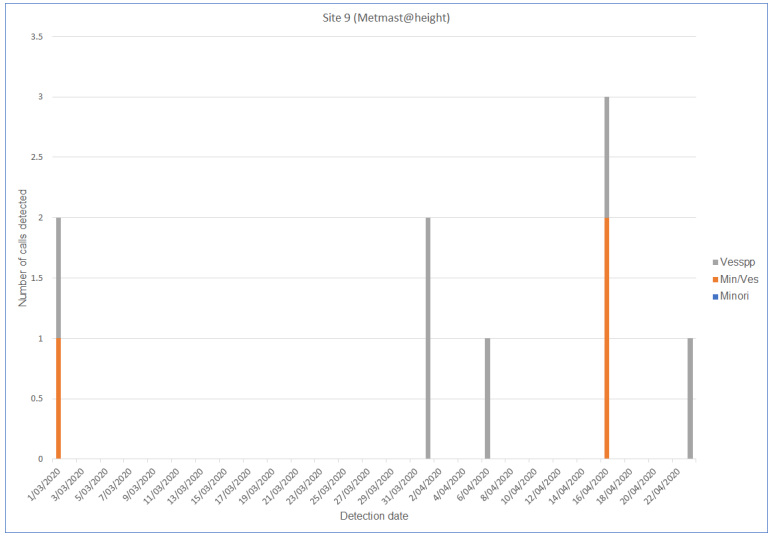


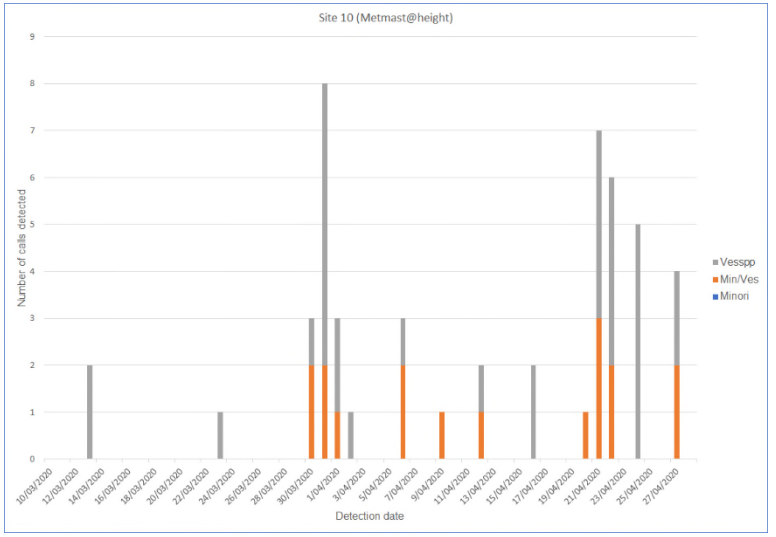

Site 5
Number of calls detected
Detection date
Vesspp
Min/Ves
Minori

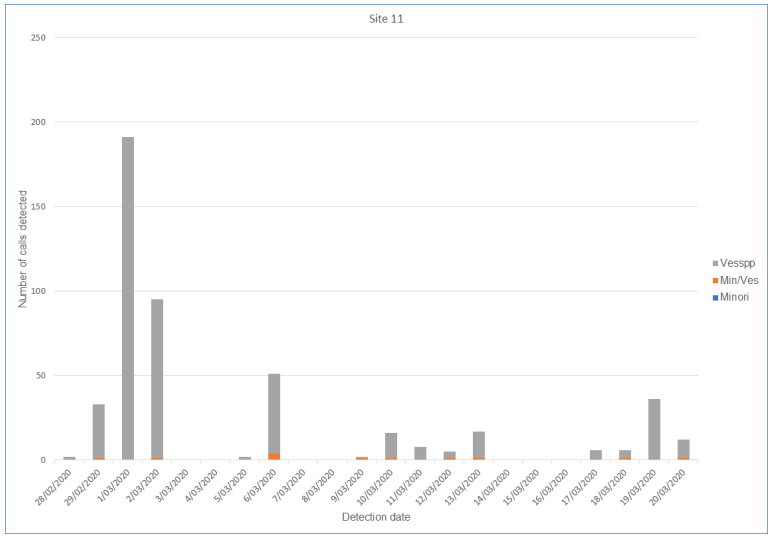

Site 6 (Metmast@base)
Number of calls detected
Detection date
Vesspp
Min/Ves
Minori

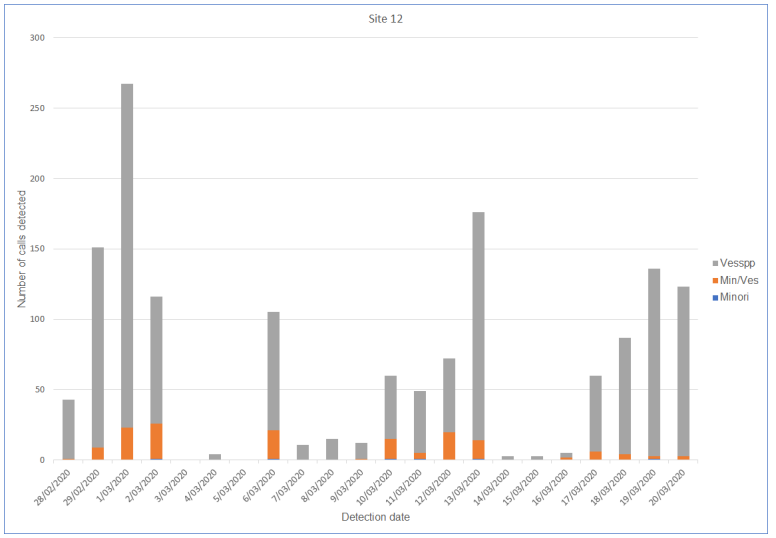

Site 7 (Metmast@base)
Number of calls detected
Detection date
Vesspp
Min/Ves
Minori

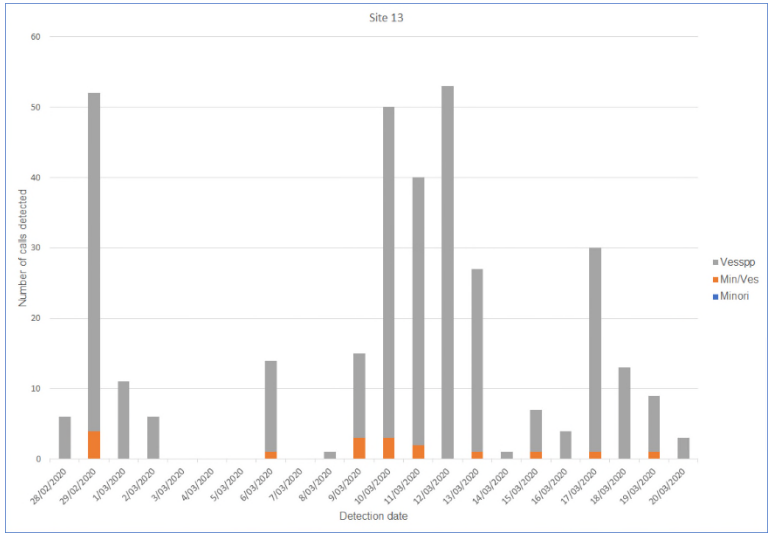

Site 8 (Metmast@height)
Number of calls detected
Detection date
Vesspp
Min/Ves
Minori

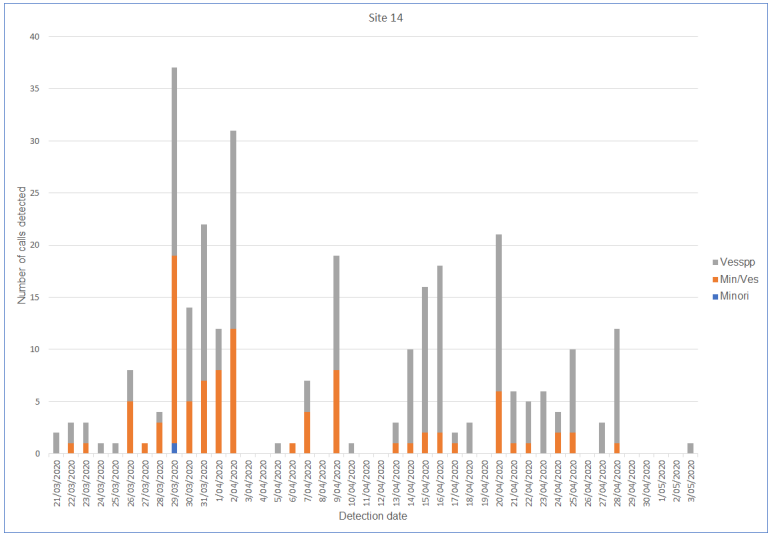

Site 9 (Metmast@height)
Number of calls detected
Detection date
Vesspp
Min/Ves
Minori

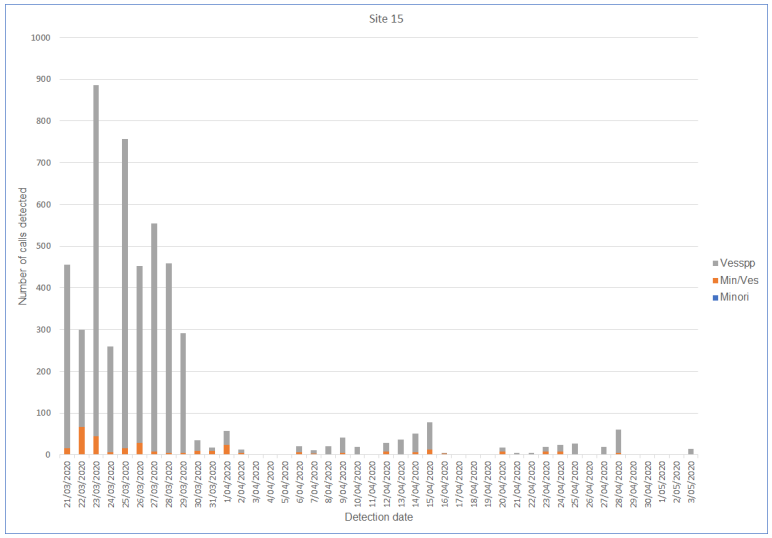

Site 10 (Metmast@height)
Number of calls detected
Detection date
Vesspp
Min/Ves
Minori

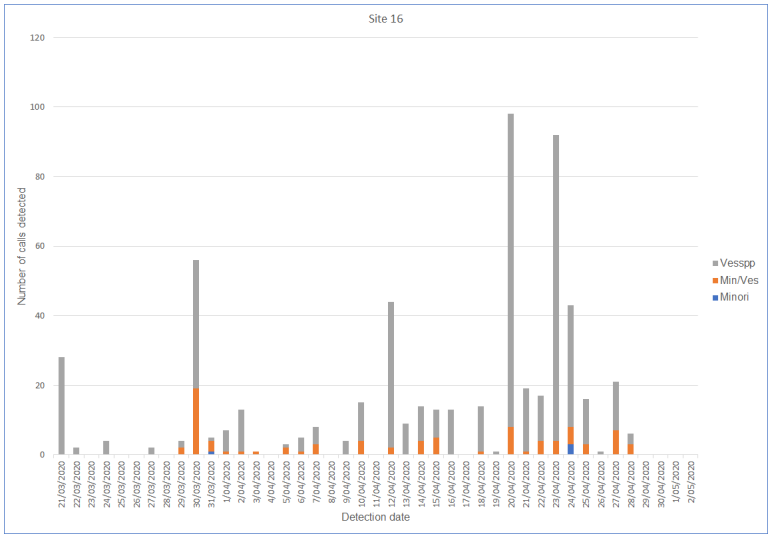

Site 11
Number of calls detected
Detection date
Vesspp
Min/Ves
Minori

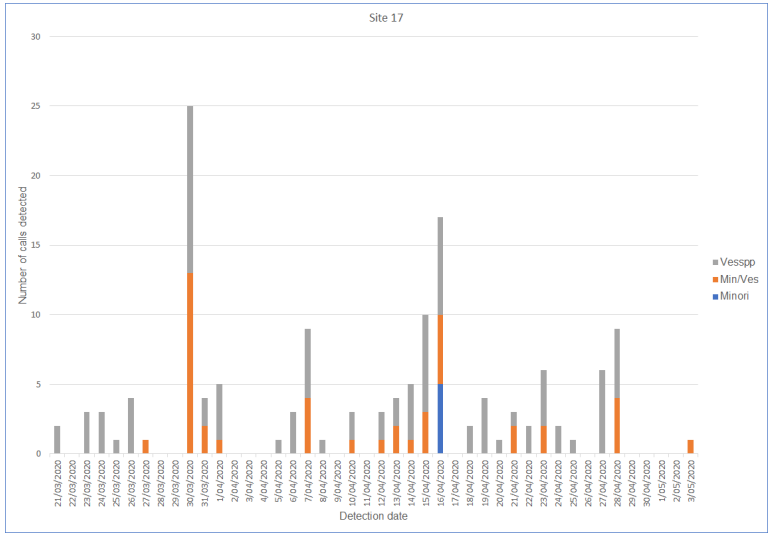

Site 12
Number of calls detected
Detection date
Vesspp
Min/Ves
Minori

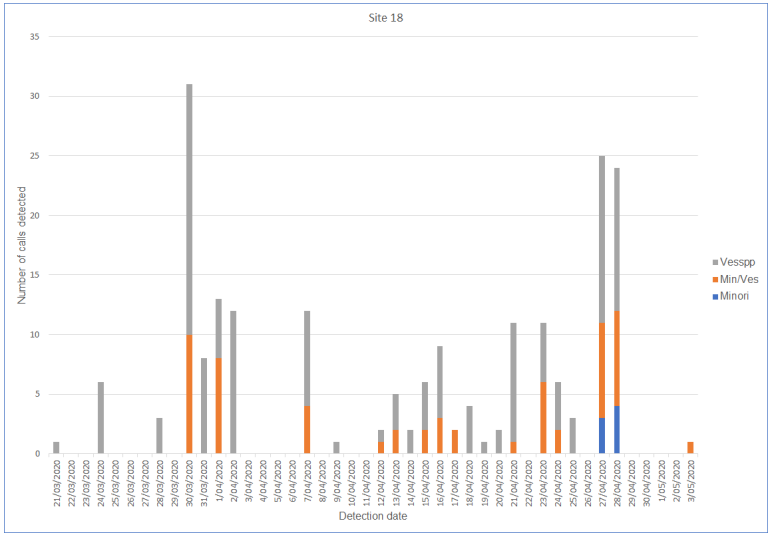

Site 13
Number of calls detected
Detection date
Vesspp
Min/Ves
Minori


Site 14
Number of calls detected
Detection date
Vesspp
Min/Ves
Minori

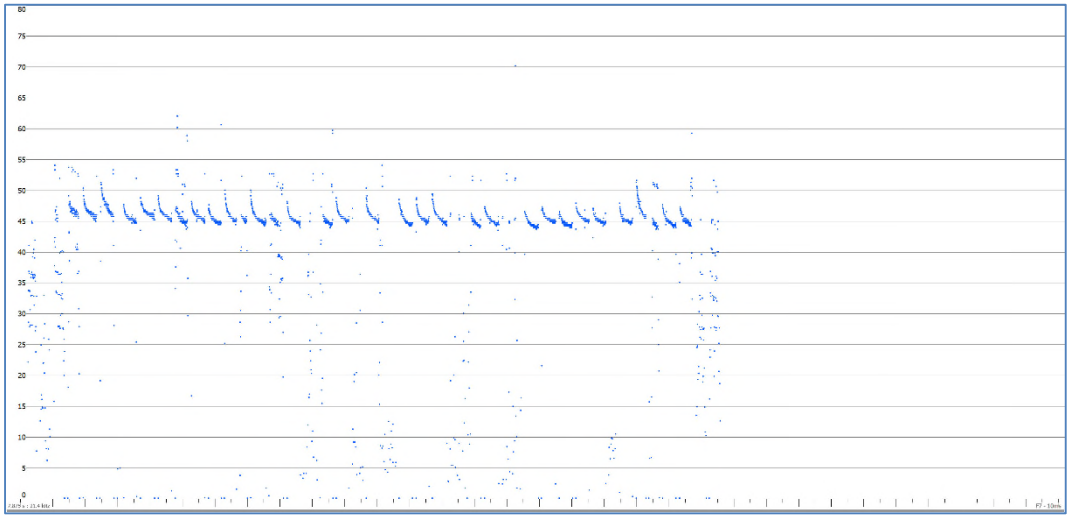

Site 15
Number of calls detected
Detection date
Vesspp
Min/Ves
Minori


Site 16
Number of calls detected
Detection date
Vesspp
Min/Ves
Minori

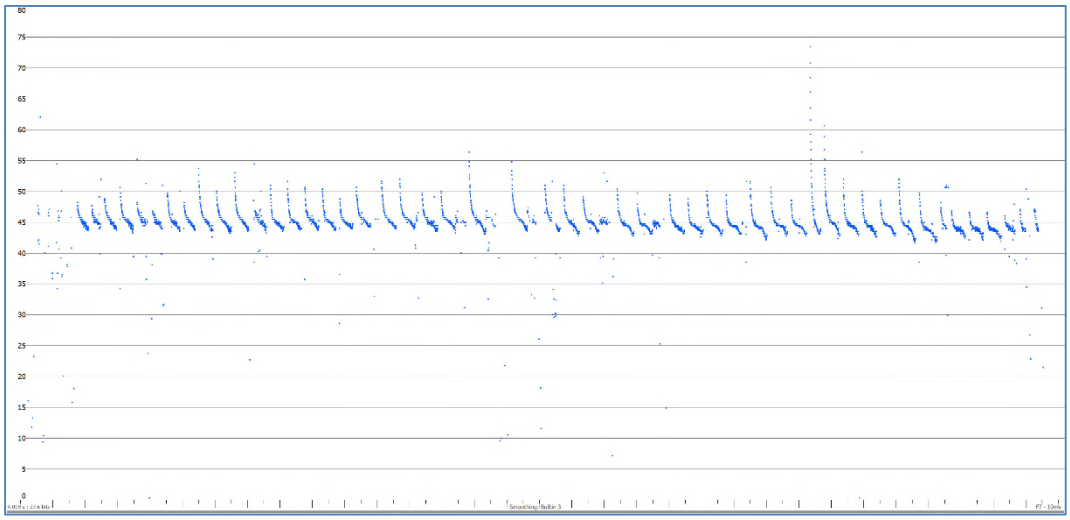

Site 17
Number of calls detected
Detection date
Vesspp
Min/Ves
Minori


Site 18
Number of calls detected
Detection date
Vesspp
Min/Ves
Minori

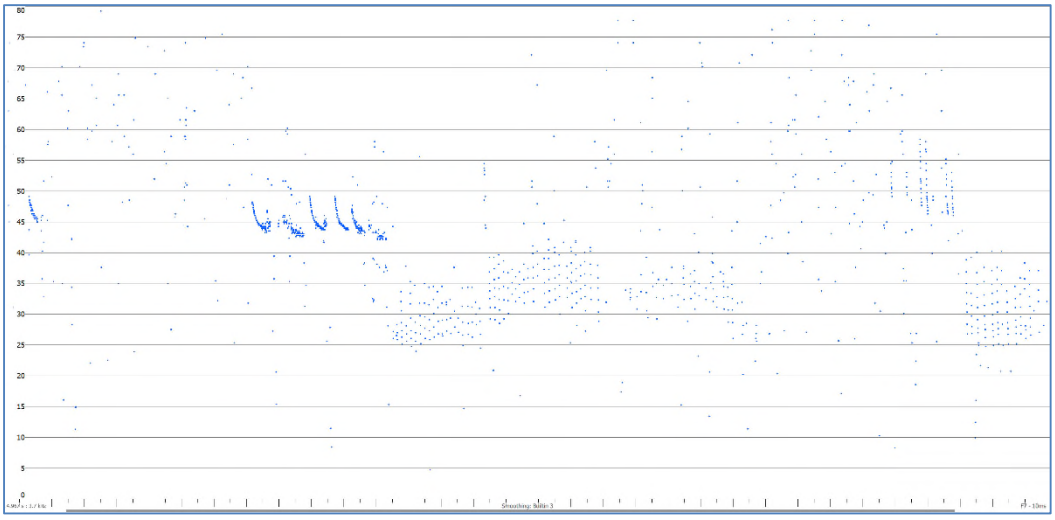
Appendix 2 Representative bat-calls recorded at Bango Wind Farm, February-May 2020. Time between pulses removed; time-scale (*x*-axis) 10ms per tick



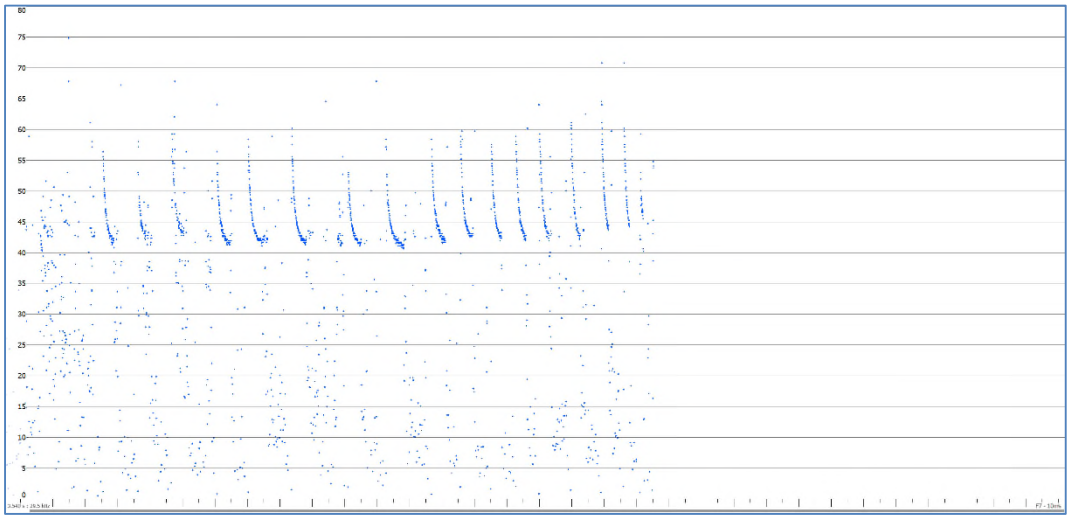
Miniopterus orianae oceanensis



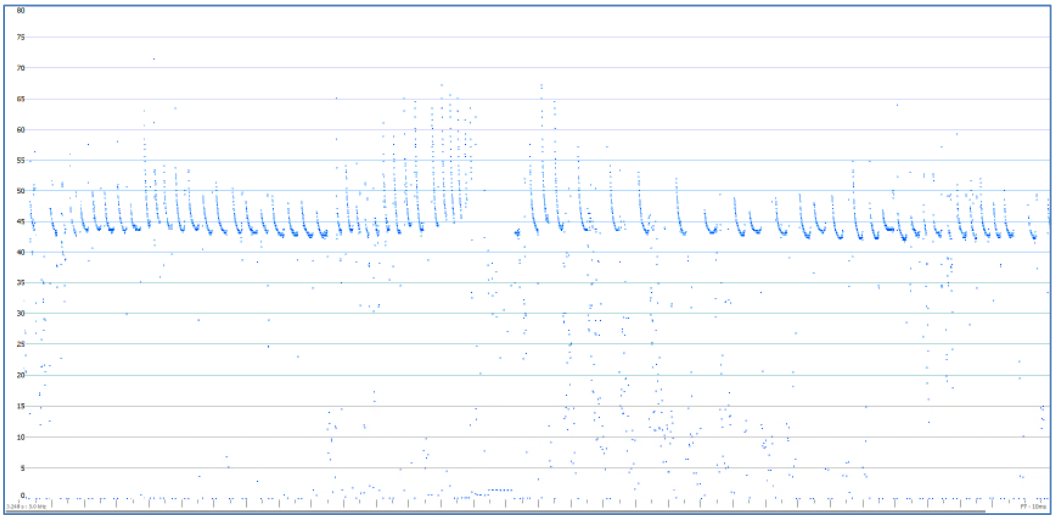
Miniopterus orianae oceanensis



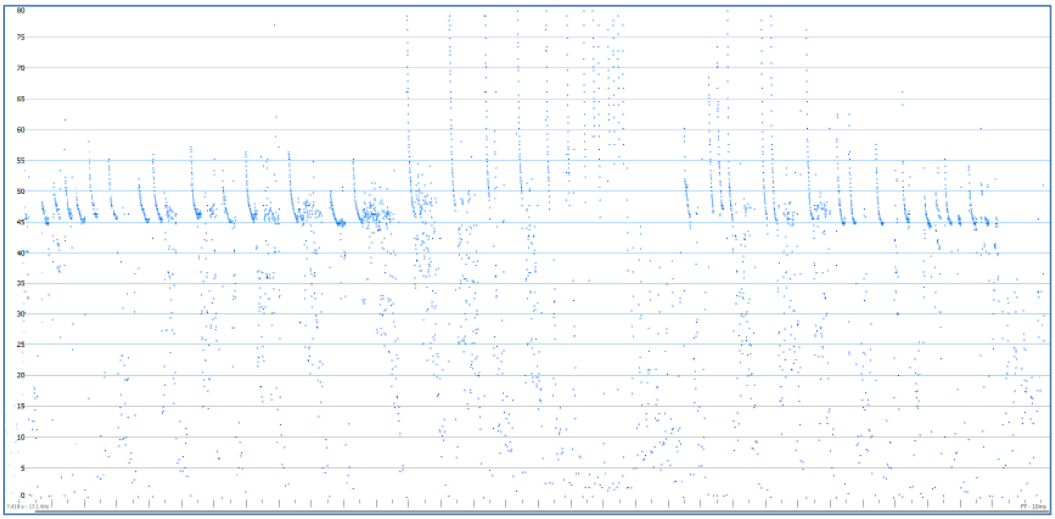
Miniopterus orianae oceanensis with feeding buzz



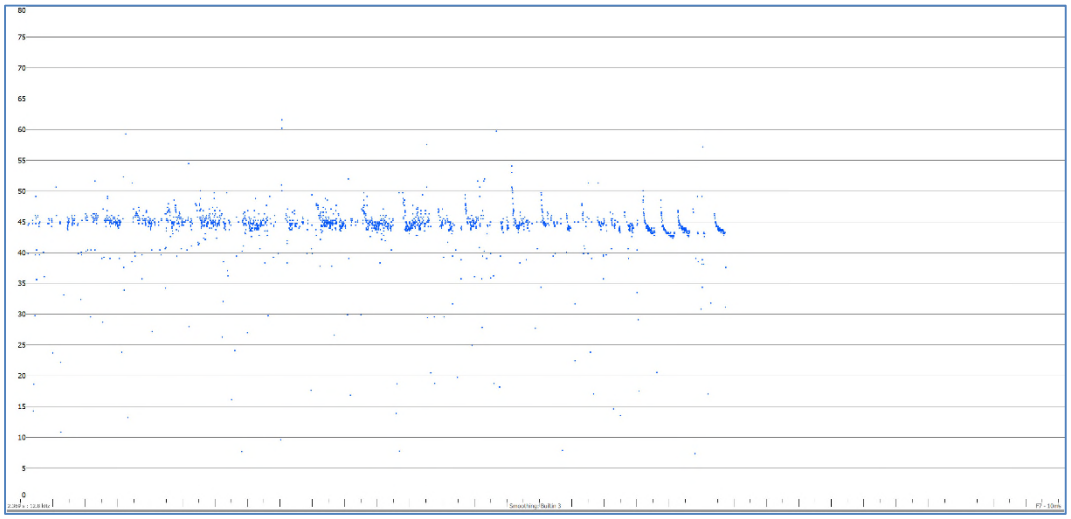
Vespadelus darlingtoni



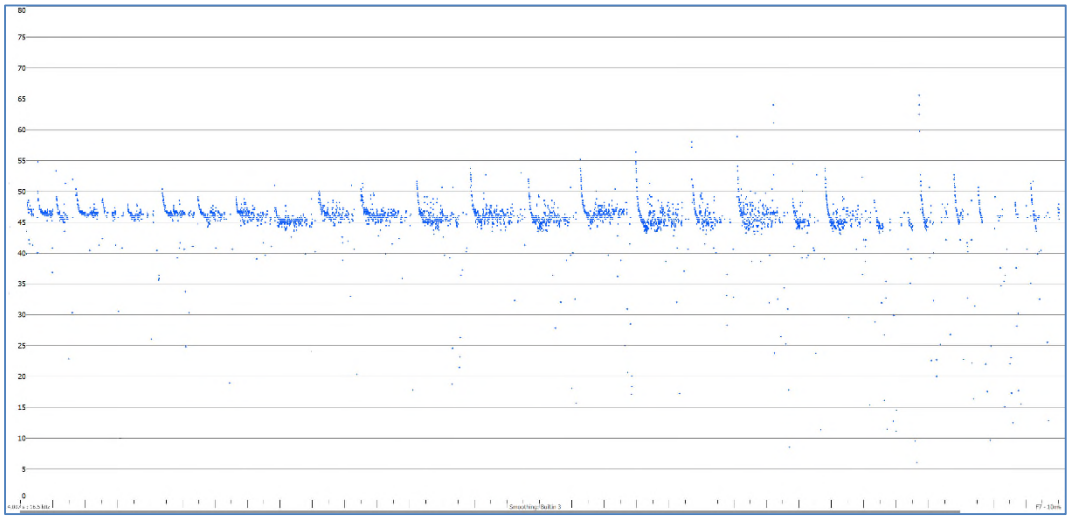
Vespadelus regulus with feeding buzz



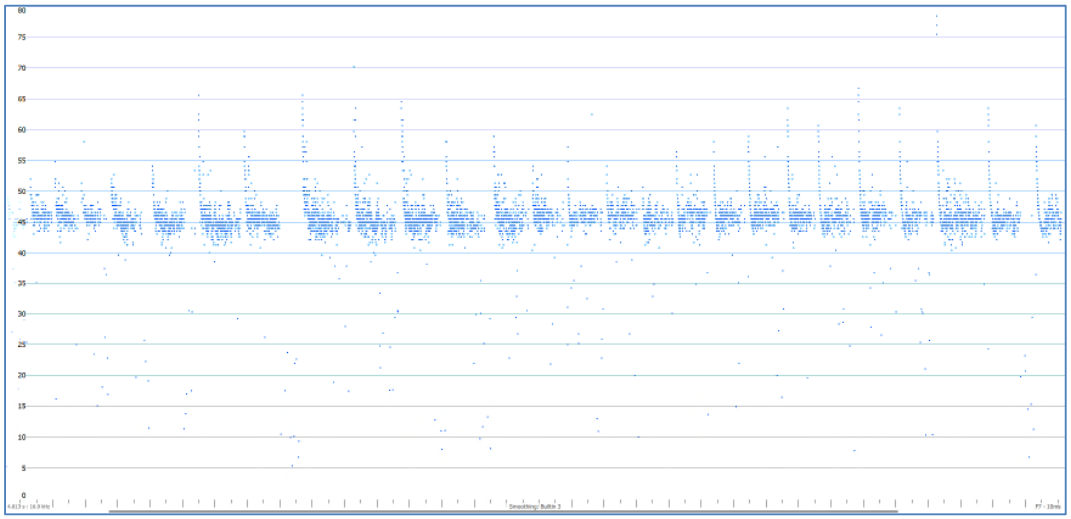
Vespadelus vulturnus with feeding buzz



M. o. oceanensis / *Vespadelus* sp.



M. o. oceanensis / *Vespadelus* sp.



M. o. oceanensis / *Vespadelus* sp.

Appendix 5: Raw data for raptor observations at Bango Wind Farm

Flight number	Species	Species count	Start time	End time	Distance	Bearing	Location	Height	Height range of bird	Landscape	Direction
1	Wedge-tailed Eagle	2	7/10/2019 11:54	7/10/2019 11:59	100	N	Air	80	80-200	Slope	Circling
2	Wedge-tailed Eagle	2	7/10/2019 12:15	7/10/2019 12:17	10	SW	Air	10	10-160	Slope	Away
3	Nankeen Kestrel	1	7/10/2019 12:36	7/10/2019 12:36		SW	Air	10	10	Slope	Away
4	Nankeen Kestrel	2	7/10/2019 12:46	7/10/2019 12:46		NE	Air	10	5-20	Slope	Parallel to ridge
5	Brown Goshawk	1	7/10/2019 14:40	7/10/2019 14:41		SE	Air	20	10-30	Slope	Toward
6	Nankeen Kestrel	1	9/10/2019 15:10	9/10/2019 15:12			Air	20	10-20	Ridge	West
7	Nankeen Kestrel	1	9/10/2019 15:24	9/10/2019 15:25			Air	20	10-20	Ridge	South
8	Wedge-tailed Eagle	2	9/10/2019 16:30	9/10/2019 16:30			Bird in air, Ground	40	0-40	Ridge	South
9	Nankeen Kestrel	1	10/10/2019 10:28	10/10/2019 10:30			Air	10	10-20	Ridge	West
10	Australian Hobby	1	10/10/2019 11:00	10/10/2019 11:00			Air	10	10	Slope	East
11	Nankeen Kestrel	2	7/10/2019 13:20	7/10/2019 13:35	100	E	Air	50	20-100	Ridge	Circling
12	Nankeen Kestrel	1	7/10/2019 17:45	7/10/2019 18:00	150		Perched	20	20	Slope	
13	Wedge-tailed Eagle	3	8/10/2019 8:45	8/10/2019 9:00	200	W	Air	50	50-200	Ridge	Circling
14	Nankeen Kestrel	2	8/10/2019 9:10	8/10/2019 9:20	200		Perched	10	10	Valley	
15	Nankeen Kestrel	1	8/10/2019 10:45	8/10/2019 10:50	500	N	Air	20	10-50	Ridge	Circling
16	Wedge-tailed Eagle	1	8/10/2019 14:17	8/10/2019 14:18	200	E	Air	50	50-100	Ridge	Away
17	Brown Falcon	1	9/10/2019 8:56	9/10/2019 8:59	200	S	Perched	20	1-10	Valley	Away
18	Wedge-tailed Eagle	1	9/10/2019 10:30	9/10/2019 10:31	50	NW	Air	500	500-100	Ridge	Away
19	Nankeen Kestrel	2	9/10/2019 11:20	9/10/2019 11:21	20	N	Air	20	10-50	Valley	Away
20	Brown Falcon	1	9/10/2019 12:00	9/10/2019 12:01	50	E	Air	5	1-10	Ridge	Circling
21	Nankeen Kestrel	2	9/10/2019 13:26	9/10/2019 13:40	100		Perched	10	5-20	Slope	
22	Brown Goshawk	1	9/10/2019 9:30	9/10/2019 9:35	150	E	Air	10	1-10	Slope	Parallel to ridge
23	Brown Goshawk	2	9/10/2019 10:35	9/10/2019 10:38	10	N	Air	50	50-100	Valley	Circling
24	Peregrine Falcon	2	9/10/2019 10:39	9/10/2019 10:40	100	E	Air	100	100-150	Valley	Circling
25	Brown Goshawk	1	10/10/2019 9:27	10/10/2019 9:30	100	E	Air	5	1-10	Slope	Parallel to ridge
26	Brown Goshawk	2	10/10/2019 9:36	10/10/2019 9:37	100	S	Air	100	50-200	Slope	Parallel to ridge
27	Brown Falcon	1	11/10/2019 12:45	11/10/2019 12:50	300	E	Air	300	100-500	Slope	Parallel to ridge
28	Nankeen Kestrel	2	11/10/2019 12:45	11/10/2019 12:50	50	E	Air	50	50-100	Valley	Circling
29	Wedge-tailed Eagle	2	11/10/2019 11:00	11/10/2019 11:30	10	NE	Perched	15	10-20	Slope	Circling
30	Brown Falcon	2	11/10/2019 13:00	11/10/2019 13:15	150	E	Air	10	5-20	Slope	Away
31	Brown Goshawk	3	11/10/2019 13:30	11/10/2019 13:32	50	N	Perched	10	10-20	Valley	Away
32	Nankeen Kestrel	1	11/10/2019 8:30	11/10/2019 8:40	100	N	Air	20	10-50	Valley	Circling
33	Wedge-tailed Eagle	1	19/11/2019 11:45	19/11/2019 11:47		S	Air	100	60-100	Slope	Toward
34	Nankeen Kestrel	1	20/11/2019 9:58	20/11/2019 9:58		SE	Air	10	10-20	Slope	Parallel to ridge
35	Wedge-tailed Eagle	2	20/11/2019 10:10	20/11/2019 10:16		NW	Air	20	20-150	Slope	Toward
36	Wedge-tailed Eagle	1	20/11/2019 10:12	20/11/2019 10:14		NW	Air	2	2-50	Slope	Away
37	Brown Falcon	1	20/11/2019 10:26	20/11/2019 10:26		NE	Ground	1	0-1	Ridge	Parallel to ridge
38	Nankeen Kestrel	1	20/11/2019 11:11	20/11/2019 11:12		W	Perched	20	10-20	Ridge	Away
39	Nankeen Kestrel	2	20/11/2019 12:32	20/11/2019 12:33		W	Air	20	10-30	Valley	Circling
40	Brown Falcon	1	20/11/2019 12:40	20/11/2019 12:40		W	Air	20	10-20	Valley	Away
41	Wedge-tailed Eagle	1	20/11/2019 13:08	20/11/2019 13:08		W	Air	80	60-100	Ridge	Circling
42	Wedge-tailed Eagle	2	18/02/2020 16:11	18/02/2020 16:15	1000	N	Air		40-200	Ridge	Circling
43	Wedge-tailed Eagle	3	19/02/2020 9:57	19/02/2020 10:03	500	E	Air		20-200	Slope	Circling
44	Wedge-tailed Eagle	1	19/02/2020 11:54	19/02/2020 11:54	500	S	Air		50-100	Valley	Parallel to ridge
45	Wedge-tailed Eagle	1	19/02/2020 12:40	19/02/2020 12:40	10	S	Ground		0-100	Valley	Away
46	Nankeen Kestrel	1	19/02/2020 14:22	19/02/2020 14:22	20	W	Perched		1-20	Valley	Away
47	Whistling Kite	1	20/02/2020 10:08	20/02/2020 10:08	0	S	Air		15-20	Valley	Away
48	Whistling Kite	1	20/02/2020 10:33	20/02/2020 10:37	300	SW	Air		50-100	Valley	Circling
49	Australian Hobby	1	20/02/2020 14:25	20/02/2020 14:27	50	SW	Perched		10-20	Valley	Away

Flight number	Species	Species count	Start time	End time	Distance	Bearing	Location	Height	Height range of bird	Landscape	Direction
50	Wedge-tailed Eagle	3	21/02/2020 8:17	21/02/2020 8:17	250	SE	Air		20-50	Slope	Parallel to ridge
51	Wedge-tailed Eagle	1	21/02/2020 12:26	21/02/2020 12:26	0	W	Air		20-30	Valley	Circling
52	Wedge-tailed Eagle	2	21/02/2020 11:27	21/02/2020 11:30	500	W	Air		100-300	Ridge	Circling
53	Nankeen Kestrel	1	21/02/2020 14:12	21/02/2020 14:12	50	E	Air		10-50	Valley	Away