SCWF:

Third Year Annual Report – Bat and Avifauna Management Plan 2020/2021

FINAL REPORT

Prepared for Tilt Renewables

28 June 2022

Biosis offices

NEW SOUTH WALES

Albury
Phone: (02) 6069 9200
Email: albury@biosis.com.au

Newcastle
Phone: (02) 4911 4040
Email: newcastle@biosis.com.au

Sydney
Phone: (02) 9101 8700
Email: sydney@biosis.com.au

Western Sydney
Phone: (02) 9101 8700
Email: sydneyoffice@biosis.com.au

Wollongong
Phone: (02) 4201 1090
Email: wollongong@biosis.com.au

VICTORIA

Ballarat
Phone: (03) 5304 4250
Email: ballarat@biosis.com.au

Melbourne (Head Office)
Phone: (03) 8686 4800
Email: melbourne@biosis.com.au

Wangaratta
Phone: (03) 5718 6900
Email: wangaratta@biosis.com.au

Document information

Report to:	Tilt Renewables
Prepared by:	Inka Veltheim Erin Baldwin
	Wyn Russell
	Matt Gibson
Biosis project no.:	33737
File name:	33737.Salt Creek.BAM Plan.Yr 3 Report.FIN05.20220628
Citation:	Biosis 2022. SCWF: Third Year Annual Report – Bat and Avifauna Management Plan 2020 / 2021. Report for Tilt Renewables. I Veltheim, E Baldwin, W Russell, M Gibson. Biosis Pty Ltd. Project no 33737.

Document control

Version	Internal reviewer	Date issued
Draft version 01	Mark Venosta	01/10/2021
Draft version 02	Ian Smales	26/11/2021
Final version 01	Matt Gibson	08/12/2021
Final version 02	Inka Veltheim	14/12/2021
Final version 03	Inka Veltheim	29/04/2022
Final version 04	Inka Veltheim	07/06/2022
Final version 05	Inka Veltheim	28/06/2022

Acknowledgements

Biosis acknowledges the contribution of the following people and organisations in undertaking this study:

Year 2 and Year 3:

- Tilt Renewables Australia Pty Ltd: Eliza Budd, Marita Giles
- Vestas Australian Wind Technology P/L: Michael Crane, Cameron Aitken

- Farm manager, Tom Wilson
- Department of Environment, Land, Water and Planning for access to the Victorian Biodiversity Atlas

Biosis staff involved in this project were:

- Jules Farquhar, Wyn Russell (field investigation)
- Julian Turner (mapping)
- Jules Farquhar, Wyn Russell, Erin Baldwin, Matt Gibson, Inka Veltheim, Rose Baulch (reporting)

Detailed Grey-headed Flying-fox investigations Year 2 and Year 3:

- Tilt Renewables Australia Pty Ltd: Marita Giles, Eliza Budd
- Vestas Australian Wind Technology P/L: Cameron Aitken, Michael Crane
- Farm manager, Tom Wilson
- Alan Rossouw, Russell Rodda
- Department of Environment, Land, Water and Planning for access to the Victorian Biodiversity Atlas and for contact details for Warrnambool Grey-headed Flying-fox colony, and information on the Colac colony.
- CSIRO: Eric Vanderduys for discussions on camp count methodology

Biosis staff involved in this project were:

- Caitlin Potts, Jules Farquhar, Wyn Russell, Paul Ter, Jack Furdson, Mark Venosta & Ben Williams (field investigation)
- Michael Knudsen (mapping)
- Ian Smales, Mark Venosta, Matt Gibson (quality assurance)

Biosis offices

NEW SOUTH WALES

Albury
Phone: (02) 6069 9200
Email: albury@biosis.com.au

Newcastle
Phone: (02) 4911 4040
Email: newcastle@biosis.com.au

Sydney
Phone: (02) 9101 8700
Email: sydney@biosis.com.au

Western Sydney
Phone: (02) 9101 8700
Email: sydneyoffice@biosis.com.au

Wollongong
Phone: (02) 4201 1090
Email: wollongong@biosis.com.au

VICTORIA

Ballarat
Phone: (03) 5304 4250
Email: ballarat@biosis.com.au

Melbourne (Head Office)
Phone: (03) 8686 4800
Email: melbourne@biosis.com.au

Wangaratta
Phone: (03) 5718 6900
Email: wangaratta@biosis.com.au

Contents

Part A – Brolga and bat utilisation monitoring program

Part B – Bird and bat strike monitoring program

Tables

Figures

Appendices

1. Part A – Introduction

1.1 Project background and scope of assessment

Salt Creek Wind Farm (SCWF or the Project) was commissioned in July 2018 and consists of 15 turbines (150 metres maximum tip height), infrastructure, roads, a switch yard and a site office. The Bat and Avifauna Management Plan (BAM Plan) (Jacobs Group 2017) outlines monitoring and reporting requirements over a three year period, including a 'dry', 'intermediate' and 'wet' year, which are not required to be undertaken in sequential years. The three years of monitoring were undertaken as follows:

- Year 1: July 2018–June 2019 by Nature Advisory (2020)
- Year 2: August 2019–July 2020 by Biosis (2020a)
- Year 3: August 2020–July 2021 by Biosis (this report)

Biosis Pty Ltd (Biosis) was commissioned by Tilt Renewables Australia Pty Ltd (the Proponent) to undertake Year 3 2020–2021 of the post-construction bird and bat utilisation monitoring program at SCWF, as outlined in the SCWF BAM Plan (Jacobs Group 2017). The BAM plan fulfils Condition 33 (PL 06/304) of the SCWF planning permit granted as part of the Moyne Shire Council for the Project.

Specifically, the plan requires monitoring and reporting of:

- The Brolga *Antigone rubicunda* during flocking and breeding season.
- Southern Bent-wing Bat *Miniopterus orianae bassanii* and other microbat species identified using bat call detectors.
- Other species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the *Flora and Fauna Guarantee Act 1988* (FFG Act) and the *Advisory list of Threatened Vertebrate Fauna in Victoria – 2013* (the Advisory List).

The BAM Plan also includes a mitigation and management strategy with a zero net-impact objective for the above species, which requires mitigation and offsetting if a BAM Plan defined significant impact is recorded. A significant impact in the BAM Plan is defined as:

- A threatened bird or bat (or recognisable parts thereof) listed under the EPBC Act, FFG Act or on the Advisory List, is found dead or injured within the wind farm footprint once the operation of the first turbine within the wind farm has commenced.

The Year 3 bird and bat strike monitoring program was undertaken by Elmoby Ecology (Part B this report).

The Year 1 monitoring report (Nature Advisory 2020) identified the need to implement a Grey-headed Flying-fox monitoring program, which was undertaken by Biosis Pty Ltd for the Year 3 monitoring, and the Year 2 monitoring (Biosis 2020). The scope for the Year 3 Grey-headed Flying-fox monitoring included:

- Monthly monitoring from October 2020 to April 2021 in proximity to the site of a potential temporary Grey-headed Flying-fox camp where the species was observed flying, located at Woodcutters Lane south of SCWF (identified by Nature Advisory 2020).

Monthly monitoring at this location was also undertaken in Year 2 from October 2019 to April 2020 (Biosis 2020).

Additionally, carcasses of the Grey-headed Flying-fox were detected on the SCWF in March 2020, which triggered further investigations (Biosis 2020) and included surveys for the species' use of the wind farm and the surrounding suitable habitats. Recommendations arising from this investigation included further detailed investigations in 2021, which were implemented from February 2021 until May 2021. This Year 3 annual monitoring report includes a summary of Grey-headed Flying-fox observations detected during the detailed investigations into the species presence, movements and habitat within the wind farm and its surrounds. Further specifics of the detailed investigation are contained in Biosis (2021).

This Year 3 Annual Report outlines the results, implications and recommendations of the Year 3 monitoring period in accordance with the BAM Plan (Jacobs Group 2017) and is divided into two sections:

- Part A: Salt Creek Wind Farm: Brolga and bat utilisation monitoring program.
- Part B: Bird and bat strike monitoring program.

Implications and recommendations of findings for each distinct monitoring program activity are presented in Part A for the Brolga and bat utilisation program and in Part B for the bird and bat strike monitoring program. Part A includes a summary of Grey-headed Flying-fox observations detected during the detailed investigations into the species presence, movements and habitat within the wind farm and its surrounds.

1.2 Summary of recommendations

1.2.1 Brolga utilisation monitoring program

No further monitoring of Brolga activity or mortality is recommended, as the risk of impact is deemed low due to overall low Brolga activity within 3–5 kilometres of the wind farm. This is unlikely to change over the project's lifetime, although the timing of Brolga presence and activity may vary year-to-year depending on rainfall's effect on wetland habitat suitability.

1.2.2 Bat utilisation monitoring program

As multiple variables (including detector and microphone models, microphone sensitivity, installations methods and weather conditions) can affect the detectability of sound and, as a consequence, the recording of bat calls, it is recommended that trigger levels for management response(s) for SCWF continue to be defined by the number of mortalities that may be detected through incidental carcass monitoring rather than indirect measures of bat utilisation monitoring.

No confirmed Southern Bent-wing Bat mortalities have been recorded at the SCWF during Year 1 (Nature Advisory 2020), Year 2 or Year 3 (Elmoby Ecology Part B in Biosis (2020), Part B this report). Although an increased number of the species' calls were detected in Year 3, a small number were at turbine nacelle height. Therefore the risk of Southern Bent-wing Bat mortalities is likely to remain low. If rainfall is a factor in increased activity levels and movements across the wind farm, there was no indication that the highest rainfall of the three years in Year 3 had any influence on Southern Bent-wing Bat activity, with Year 1 'dry' and Year 3 'wet' activity similar and with the highest activity recorded in Year 2 'intermediate' rainfall year. Biosis provides the following recommendations, based on the Year 1, Year 2 and Year 3 BAM plan bat utilisation program results and with the consideration of sufficiently having monitored across years with different rainfall that could influence microbat activity and collision risk at the SCWF:

- Mortality monitoring is not continued, however incidental carcass finds will be reported in accordance with the BAM Plan.

1.2.3 BAM plan-defined significant impacts – Grey-headed Flying-fox

Management of BAM Plan-defined significant impacts on the Grey-headed Flying-fox will be incorporated into Grey-headed Flying-fox management plan, currently being prepared for the SCWF.

1.3 Location of the study area

The study area is located approximately 55 kilometres north of Warrnambool, 22 kilometres south of Lake Bolac and approximately 190 kilometres west of Melbourne (Figure 1). It encompasses approximately 750 hectares of grazing land. The study area is within Moyne Shire. The study area includes:

- The wind farm boundary.
- 3 kilometre and 5 kilometre radius around the perimeter of the wind farm boundary for brolga breeding and flocking monitoring respectively.
- Up to an approximately 10 kilometre radius for the Grey-headed Flying-fox habitat assessment.

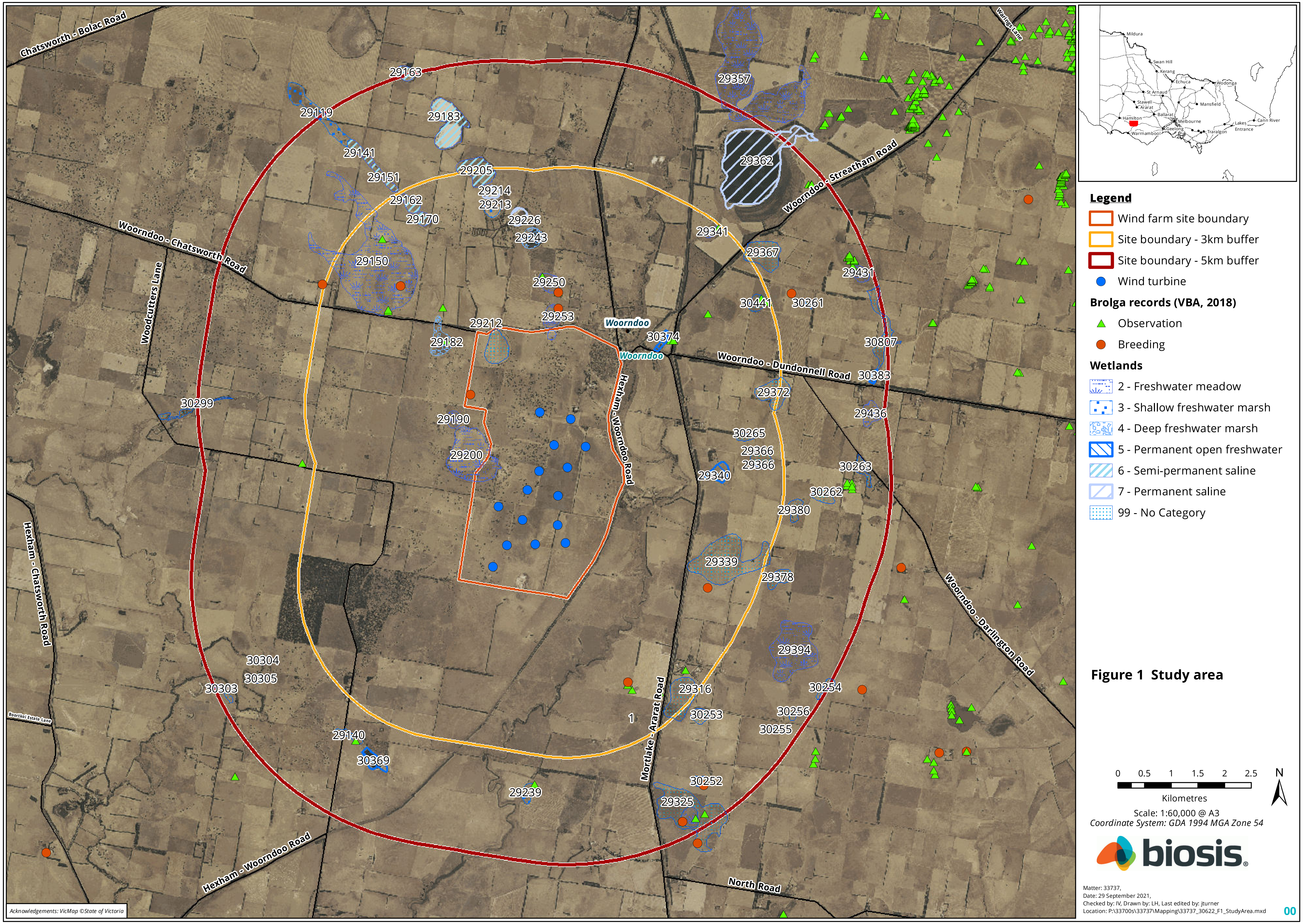


Figure 1 Study area

2. Part A – Methods

2.1 Determining seasonality of a monitoring year based on rainfall

The BAM Plan specifies that utilisation monitoring should be undertaken in 'wet', 'intermediate' and 'dry' years to assess activities of birds and bats during years of variable rainfall. It also states that a protocol to determine the seasonality of monitoring years will be developed in consultation with DELWP and to the satisfaction of Moyne Shire Council (Section 1.2)

DELWP developed a protocol in 2019 for the SCWF to classify years into one of the three categories based on Bureau of Meteorology (BOM) 1980 to 2021 monthly rainfall data from the Lake Bolac Post Office Weather Station. This method was used to determine the seasonality of Year 1 monitoring (Nature Advisory 2020).

In 2019, DELWP indicated the following via email communications with the Proponent, which included information regarding the BAM Plan and seasonality protocols, as follows (as per email from Steph Southby (DELWP) On Behalf of Barwon South West Planning, Tuesday 1 October 2019 10:43 AM to Tilt Renewables and the Moyne Shire Council). The primary objective and recommended method is summarized below.

> "A primary objective behind the requirement to sample different climatic conditions is to ensure the results of Brolga utilisation surveys and carcass searches reflect the range of conditions likely to occur over the life of the WF. At Salt Creek, Brolga utilisation and the risk of mortality is likely to be highest during the breeding season (July-December inclusive). As such, DELWP Environment considers that the seasonality protocol should be focussed on classifying breeding seasons as either dry, intermediate or wet. Given site utilisation and breeding activity is largely tied to wetland filling, the protocol is required to account for preceding rainfall. To this end, it is recommended that the following protocol is adopted for Year 1 (July 2018 – June 2019) and Year 2 (August 2019 – July 2020):"

1. Source BOM monthly rainfall data from 1979 – 2018 (Lake Bolac Post Office Station)
2. Calculate the 'total contributing rainfall' for each breeding season between 1980–2018, 2019 and 2020 by totaling the monthly rainfall from the preceding November to the end of the subject breeding season e.g. for Year 1 this is November 2017–2018 inclusive
3. Calculate the Mean and Standard Deviation of the total contributing rainfall 1980–2018, e.g. Mean = 640 mm, Standard Deviation = 112 mm
4. Calculate the spread of data in normal distribution and define Dry, Intermediate and Wet breeding seasons according to the Empirical Rule (68% of data falls within one Standard Deviation from the Mean, 95% fall within two standard deviations and 99.7% fall within three standard deviations:
   - Intermediate season: One Standard Deviation of the Mean e.g. 528 – 752 mm
   - Dry season: Two/Three Standard Deviations of the Mean (lower) e.g. <528 mm
   - Wet season: Two/Three Standard Deviations of the Mean (upper) e.g. >752 mm

After a review of the DELWP methodology, Biosis identified a number of limitations of the DEWLP-proposed method, which meant that attributing seasonality in this way does not meet the primary objective or adequately consider the ecological response of the Brolga to rainfall. These are listed below:

- There is no evidence that rainfall data 8 months prior to Brolga breeding season influences habitat availability, suitability or number of breeding pairs that could be present in an area.
- Breeding wetlands dry up in summer/autumn (January – April) and fill up with autumn/early winter rains (May – June). Therefore 2 months prior to breeding season would be expected to influence Brolga breeding activity and habitat availability.
- Evidence from northern Australia indicates that Brolgas initiate breeding activity within or after a high rainfall fortnight and immediately after major seasonal rainfall event(s) (Sundar et al. 2019). Furthermore, a breeding event was recorded in the Year 2 BAM Plan monitoring in June 2020 (Biosis 2020). Brolgas in south-west Victoria would generally be expected to respond similarly to rainfall and initiate nesting after increased rainfall. Such rainfall generally occurs from April onwards within this region. However, a longer lead time may be expected in south-western Victoria compared with northern Australia to initiate nesting, as most breeding wetlands are small (<10 ha) (White 1987, Myers 2001, Sheldon 2004, Veltheim et al. 2019), are vulnerable to cropping (Casanova & Casanova 2016) and have drainage channels through them (Corrick 1982), which is likely to affect wetland filling and reduce water retention below suitable levels for Brolga nesting initiation. It is therefore reasonable to expect that late autumn and winter rains (May onwards) are most influential in determining timing of Brolga breeding activity of a given breeding season in south-west Victoria.
- The DELWP methodology excludes rainfall for 6 months of each monitoring period (January to June). The Brolga breeding season can extend from January to March in wet years and therefore the DEWLP methodology excludes months when breeding and activity in 'wet' years (and 'wet' summers) could be higher than in 'dry' years at and within 3 kilometres of SCWF. The DELWP methodology also excludes the rainfall for a full flocking season within the monitoring periods (flocking season December to May) and for 6 months of bird and bat mortality monitoring.
- Excluding rainfall data from January to June excludes half of the monitoring period, and more importantly excludes late February to April each year, which is known to have a peak in microbat and Grey-headed Flying-fox activity and an increased bat carcass detection.

Consequently, Biosis proposed a modification to the seasonality protocol, to calculate the rainfall from two months prior to the monitoring year (May) to the end of the monitoring year (June the following year). Calculating rainfall from May to June preceding a monitoring season, and the known Brolga breeding season, is based on an assumption that rainfall in months immediately preceding the known Brolga breeding season influence the water levels, inundation and retention of water in potentially suitable breeding wetlands for the species. This assumption is based on knowledge of Brolga breeding ecology and timing of breeding event initiation

The modification relates to the months of rainfall incorporated into the calculations, but the protocol retains other aspects of the DELWP methodology. The modified protocol is as follows:

1. Source BOM monthly rainfall data from 1979 – 2020 (Year 2) and 1979 – 2021 (Year 3) (Lake Bolac Post Office Station).
2. Calculate the 'total contributing rainfall' for each breeding season between 1980–2020 and 2021 by totaling the monthly rainfall from the preceding May to the end of the monitoring season. For Year 2 this is May 2019 to June 2020 inclusive and May 2020 to June 2021 inclusive.

3. Calculate the Mean and Standard Deviation of the total contributing rainfall 1980–2020 and 1980–2021.
4. Calculate the spread of data in normal distribution and define Dry, Intermediate and Wet breeding seasons according to the Empirical Rule (68% of data falls within one Standard Deviation from the Mean, 95% fall within two standard deviations and 99.7% fall within three standard deviations):
   - Intermediate season: One Standard Deviation of the Mean
   - Dry season: Two/Three Standard Deviations of the Mean (lower)
   - Wet season: Two/Three Standard Deviations of the Mean (upper)
5. Data from the Westmere weather station was used where rainfall for the Lake Bolac Post Office weather station was missing.

DELWP confirmed support of the modifications to the seasonality protocol for Year 2 and Year 3 (as per email from Melanie Savage (DELWP) on behalf of Barwon South West Planning, Friday 27 May 2022 to Tilt Renewables and the Moyne Shire Council).

2.1.1 Rainfall during Brolga breeding season – July to December

As the primary objective was to monitor across varying climatic conditions, the rainfall for the Brolga breeding seasons in Year 1, Year 2 and Year 3 was also examined to assess whether this condition has been sufficiently met in the 'dry', 'wet' and 'intermediate' in the monitoring years. Total rainfall for the breeding season July to December and for May to December were calculated. The rainfall within the breeding season (July to December) including the two preceding months (May to June) were included for comparison, as this is likely to influence the presence and breeding activity initiation.

2.2 Brolga utilisation monitoring program

2.2.1 General Brolga survey method

During each survey, the observer used binoculars and a tripod-mounted spotting scope to survey each wetland. The water level of the wetland was recorded along with relevant weather variables (cloud cover, air temperature, precipitation, wind speed and wind direction). All bird species utilising the wetland and surrounding habitat were identified to species level, counted and recorded. Any waterbirds nesting were also noted.

2.2.2 Flocking season survey

Brolga flocking season surveys were undertaken for two consecutive days in each month from December 2020 to June 2021 (Table 1). All mapped wetlands with potentially suitable Brolga habitat (DELWP 2016) and where the landholder had provided permission for access within 5 kilometres of the SCWF were included (Figure 1).

Table 1 Brolga surveys August 2020–June 2021

Date	Name	Position and qualifications
21/12/2020 – 22/12/2020	Jules Farquhar	Zoologist, BAppSci (Hons)
18/01/2021 – 19/01/2021	Jules Farquhar	Zoologist, BAppSci (Hons)
25/02/2021 – 26/02/2021	Jules Farquhar	Zoologist, BAppSci (Hons)
22/03/2021 – 23/03/2021	Jules Farquhar	Zoologist, BAppSci (Hons)
19/04/2021 – 10/04/2021	Jules Farquhar	Zoologist, BAppSci (Hons)

Date	Name	Position and qualifications
18/05/2021 – 19/05/2021	Jules Farquhar	Zoologist, BAppSci (Hons)
23/06/2021 – 24/06/2021	Wyn Russell	Zoologist, BAppSci

2.2.3 Breeding season survey

Brolga breeding season surveys were undertaken for two consecutive days each month from August 2020 to December 2020, and in July 2021 (Table 2). These surveys included all mapped wetlands with potentially suitable Brolga breeding habitat (DELWP 2016) and landholder access within 3 kilometres of SCWF boundary (Figure 1). Where landholder permission to enter the properties was not granted, wetlands were surveyed from nearby roads, if possible.

Table 2 Brolga surveys August 2020 - December 2020 and July 2021

Survey Dates	Name	Position and qualifications
19/08/2020 – 20/08/2020	Jules Farquhar	Zoologist, BAppSci (Hons)
21/09/2020 – 22/09/2020	Jules Farquhar	Zoologist, BAppSci (Hons)
26/10/2020 – 27/10/2020	Jules Farquhar	Zoologist, BAppSci (Hons)
16/11/2020 – 17/11/2020	Jules Farquhar	Zoologist, BAppSci (Hons)
21/12/2020 – 22/12/2020	Jules Farquhar	Zoologist, BAppSci (Hons)
19/07/2021 – 20/07/2021	Wyn Russell	Zoologist, BAppSci

2.2.4 Brolga utilisation monitoring program limitations

During the Brolga surveys, the observer was only able to survey a single wetland at a time, potentially missing peaks of Brolga activity at specific wetlands at certain times, such as early morning, midday and late afternoon. The effects of this survey limitation were reduced by alternating the times when each wetland was surveyed during each survey week. Surveys were also conducted in the early morning, immediately after dawn and into the late afternoon up to sunset to capture Brolga roosting and any flight activity. Local landholders were also contacted regularly to gather information on any Brolga activity they had observed in the local area.

High rainfall during the 2020 – 2021 survey period led to widespread flooding of paddocks and ephemeral waterways within the region. This may have led to Brolgas utilising areas outside of regular wetlands within 3 kilometres and 5 kilometres of the SCWF where the surveys took place.

Detailed analyses and comparison of differences between pre-construction and post-construction data are not possible due to different survey effort in the pre-construction surveys and very low numbers of Brolgas recorded in all surveys. Pre-construction flocking and breeding surveys were only conducted in one month of the year, whereas the post-construction monitoring incorporated full year monthly flocking and breeding surveys. Direct comparison of occupancy and suitability of wetlands for breeding during the post-construction period is not possible, due to different survey effort between Year 1 and Years 2 and 3, as well as the uneven survey effort of wetlands between monthly monitoring in Year 1. Therefore all comparisons presented in this report are qualitative.

2.3 Bat utilisation monitoring program

2.3.1 Detection methods

Microbats were surveyed using ultrasonic detectors at pre-determined survey locations, as specified in the BAM Plan. At each survey location, one detector was installed on a turbine at a height of approximately 85 m, and one was installed near the ground (approximately 1 m high). Ground detectors were installed on fence posts at the closest possible location to the turbine base (Figure 2).

Figure 2 SM4 detector mounted on a fence near Turbine 13

Detectors at turbine height were mounted by Salt Creek Wind Farm technicians on the galvanized steel mesh platform on the turbine nacelle. The microphone was aimed to the rear of the turbine.

Two types of Wildlife Acoustics detectors were used during the study:

- Song Meter SM4BAT ZC – deployed at 85 m on turbines
- Song Meter Mini

It was necessary to use two types of detector models in Year 3, due to issues with detector availability and supply. The configuration settings for all Song Meter detectors are in Table 3 below.

Table 3 Bat detector configuration settings

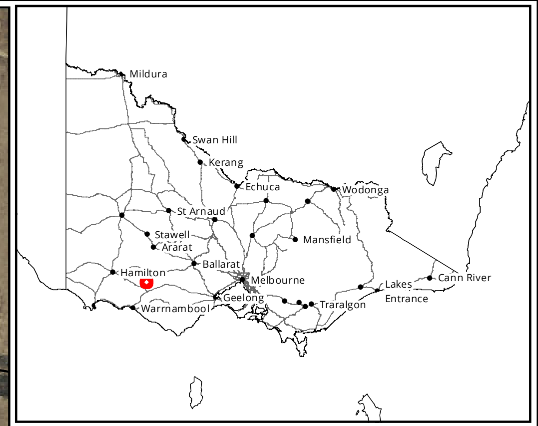
Setting	Value
Sample rate	192000
Channels	Mono-L
File Format	ZC
Division Ratio	16
Location Prefix	MLWF
Start time	19:00
Stop time	07:00

2.3.2 Monitoring points and survey timing

Detectors were deployed to record bat calls at four survey locations across two monitoring periods (Table 4, Figure 3).

Table 4 Location and timing of ultrasonic bat monitoring (all dates inclusive)

Turbine	Position	Detector type	Deployed	Collected	No. of nights
Spring 2020					
T02	**Ground**	Songmeter Mini	27/10/2020	21/12/2020	56
T02	**Turbine**	Songmeter SM4 ZC	27/10/2020	15/01/2021	81
T05	**Ground**	Songmeter Mini	27/10/2020	21/12/2020	56
T05	**Turbine**	Songmeter SM4 ZC	27/10/2020	15/01/2021	81
T10	**Ground**	Songmeter Mini	27/10/2020	21/12/2020	56
T10	**Turbine**	Songmeter SM4 ZC	27/10/2020	15/01/2021	81
T13	**Ground**	Songmeter Mini	27/10/2020	21/12/2020	56
T13	**Turbine**	Songmeter SM4 ZC	27/10/2020	15/01/2021	81
Autumn 2021					
T02	**Ground**	Songmeter Mini	25/02/2020	5/05/2021	70
T02	**Turbine**	Songmeter SM4 ZC	17/03/2021	5/05/2021	51
T05	**Ground**	Songmeter Mini	25/02/2020	5/05/2021	70
T05	**Turbine**	Songmeter SM4 ZC	17/03/2021	5/05/2021	51
T10	**Ground**	Songmeter Mini	25/02/2020	5/05/2021	70
T10	**Turbine**	Songmeter SM4 ZC	17/03/2021	5/05/2021	51
T13	**Ground**	Songmeter Mini	25/02/2020	5/05/2021	70
T13	**Turbine**	Songmeter SM4 ZC	17/03/2021	5/05/2021	51



Legend

- Wind farm site boundary
- Turbine access tracks
- Wind turbine
- Bat detector locations

Figure 3 Bat detector locations

0 0.25 0.5 0.75 1

Kilometres

N

Scale: 1:20,000 @ A3

Coordinate System: GDA 1994 MGA Zone 54

biosis.

Matter: 33737,
Date: 29 September 2021,
Checked by: IV, Drawn by: LH, Last edited by: jturner
Location: P:\33700s\33737\Mapping\33737_30622_F3_BatDetectors.mxd

00

2.3.3 Call identification and analysis

Bat calls were predominately analysed using the automated identification software AnaScheme, developed by Matthew Gibson (Biosis) and widely used in the automated analysis of microbat vocalisations within Australia. AnaScheme allows for development of identification keys based on analysis of reference calls. The key used to analyse bat calls for the SCWF was the South West Victoria key, which was developed and tested by Lindy Lumsden and Peter Griffroen of Arthur Rylah Institute, DELWP (Key to bats of south-west Victoria, dated 20 June 2011).

The AnaScheme system applies a conservative approach to identifying calls in that only clear, high quality calls are assigned to a species. The system also counts recordings that match the criteria to be considered true bat calls, but may be of insufficient quality to identify to species level. This allows a measure of overall bat activity to be calculated.

Calls processed through AnaScheme were manually checked using Anabat Insight software (Titley Scientific) for quality assurance. Only calls with a medium to high level of confidence (i.e. sequences with characteristic shape and frequency present, and with relevant pulse slope and duration) were included for analysis.

Bat calls recorded at the base of T02, T10 and T13 during the autumn 2021 monitoring period were analysed manually using Anabat Insight without the use of AnaScheme due to technical issues. Call identification for these detectors was undertaken manually using a library of identified reference calls within the south-western region of Victoria including confirmed calls of Southern Bent-wing Bats from Lindy Lumsden of DELWP. Only calls with a medium to high level of confidence (i.e. sequences with characteristic shape and frequency present, and with relevant pulse slope and duration) were included for analysis. Examples of calls identified to species level for both methods of analysis are provided in Appendix 1.

Results of bat utilisation from before and after wind farm operation (in each of the three years of monitoring), were compared and included consideration for the rainfall conditions recorded across the three monitoring years, as required under the BAM Plan.

Year 3 data was collated and analysed with the following datasets:

- Pre-construction (Biosis Research 2006):
  - Spring 2005: 19/10/2005 – 19/10/2005
  - Summer 2006: 14/02/2006 – 16/02/2006
  - Autumn 2006: 24/04/2006 – 27/04/2006
- Year 1 (Nature Advisory 2020):
  - Spring: 26/10/2018 – 20/12/2018
  - Autumn: 04/02/2019 – 14/04/2019
- Year 2 (Biosis 2020):
  - Spring: 15/10/2019 – 19/12/2019
  - Autumn: 20/02/2020 – 28/04/2020

2.3.4 Bat utilisation monitoring program limitations

Limitations included:

- Over the duration of the monitoring program, no calls have been recorded for the following ground and turbine detector sites due to equipment failure or damage:
  - Base of T10 and T13 during the spring (October – December) 2019 monitoring period (equipment failure).
  - Base of T02, T05, T10 and T13 during the autumn (February – May) 2021 monitoring period (equipment failure).
  - Turbine of T10 during the autumn (February – May) 2021 monitoring period (water damage).
- A limited number of calls were recorded for the base of T13 during the spring (October – December) 2020 period. A large portion of files contained on this detector were found to be blank, suggestive that equipment had failed partway through the recording period.
- During the autumn (February – April) 2020 monitoring period, the detector at T13 on the turbine did not record any calls. However, there were a significantly large number of files which were background noise.
- Two types of detector models were deployed during the monitoring period, due to issues with detector availability and supply. Differences in detectors, microphone models and microphone sensitivity are all likely to affect the detectability of sound and, as a consequence, bat call recordings.
- Bat call data is limited in its ability to provide population data and does not provide information on abundance. Analysis is therefore restricted to identifying species present and estimating overall activity based on the number of call sequences recorded.

2.4 BAM plan-defined significant impact – Grey-headed Flying-fox monitoring

2.4.1 Background

A Grey-headed Flying-fox carcass was found at SCWF on 25 September 2018 (Nature Advisory 2020). The species is listed as vulnerable under the Commonwealth *Environment Protection and Biodiversity Act 1999* (EPBC Act) and the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act).

The BAM Plan mitigation and management strategy outlines the requirements to achieve a zero net-impact for species other than the Brolga and Southern Bent-wing Bat, which are listed under the EPBC Act , the FFG Act or the (now redundant) Advisory list of Threatened Vertebrate Fauna in Victoria (DSE 2013). The BAM Plan also outlines a requirement to undertake an investigation if a significant impact is identified, with the significant impact defined as:

"A threatened bird or bat (or recognisable parts thereof) listed under the EPBC Act, FFG Act or on the Advisory List, is found dead or injured within the wind farm footprint once the operation of the first turbine within the wind farm has commenced."

2.4.2 Monthly monitoring

In response to the Grey-headed Flying-fox carcass find, a regular monitoring program for this species commenced in August 2019. As part of the Year 3 BAM Plan surveys, monthly monitoring at dusk was undertaken from October 2020 to April 2021 south of SCWF at Woodcutters Lane, where the species was recorded flying in March 2019, and where a suspected temporary flying fox camp was identified (BL&A 2019) (Table 5, Figure 4).

Table 5 Monthly Grey-headed Flying-fox surveys October 2020–April 2021

Date	Name	Position and qualifications
26/10/2020	Jules Farquhar	Zoologist, BAppSci (Hons)
16/11/2020	Jules Farquhar	Zoologist, BAppSci (Hons)
21/12/2019	Jules Farquhar	Zoologist, BAppSci (Hons)
18/1/2020	Jules Farquhar	Zoologist, BAppSci (Hons)
25/2/2020	Jules Farquhar	Zoologist, BAppSci (Hons)
22/3/2020	Jules Farquhar	Zoologist, BAppSci (Hons)
19/4/2020	Jules Farquhar	Zoologist, BAppSci (Hons)

2.4.3 Detailed investigation

In 2020, the annual monitoring detected a Grey-headed Flying-fox carcass at the wind farm on 11 March 2020. This triggered a response to a BAM Plan defined significant impact and as a result, Biosis undertook further investigations from 19 March 2020 to 12 May 2020. Subsequently, Elmoby Ecology increased carcass survey monitoring to fortnightly frequency during this period. A report was prepared for Tilt Renewables, which was provided to Moyne Shire Council and Department of Land, Water and Environment (DELWP):

- Biosis 2020. Salt Creek Wind Farm: Grey-headed Flying-fox significant impact investigation. Report for Tilt Renewables Australia Pty Ltd. Veltheim, I. Smales, I. Biosis Pty Ltd, Melbourne. Project no. 31923.

DELWP supported the recommendations for additional monitoring outlined in this report (SP460092 PL06/304.01, 8 July 2020).

In February 2021, Biosis Pty Ltd was commissioned by Tilt Renewables Australia Pty Ltd to undertake further monitoring and a detailed investigation into Grey-headed Flying-fox activity at the SCWF. This report details the findings of that investigation.

A detailed investigation in 2021 was undertaken as a response to further Grey-headed Flying-foxes found within the wind farm from February 2021–May 2021 (Biosis 2021), which also included increased frequency of carcass monitoring (Part B this report). This investigation was conducted in an attempt to further understand the timing and potential factors influencing Grey-headed Flying-fox presence at SCWF. The full details of these findings are presented in Biosis (2021), and a summary of the methods and results are presented in this report, focusing on:

- Survey locations for detecting Grey-headed Flying-foxes.
- Daytime habitat assessments to document foraging resources within 5 kilometres.
- An attempt to find camp locations within 10–15 kilometres of the SCWF.
- Camp counts at Colac and Warrnambool.

The aim of the detailed investigation was to document occurrence, numbers and behaviour of Grey-headed Flying-fox at the SCWF through:

- Dusk, dawn and all-night surveys to document their presence on the SCWF site.
- Dusk camp exit surveys to document number of Grey-headed Flying-foxes leaving the camp and flying towards the SCWF.

- Evening surveys to document the species presence in previously mapped suitable habitat (flowering Sugar Gum) within the wind farm and at a windbreak identified through satellite tracking data in the Atlas of Living Australia as being used by the species in 2020.

Figure 4 Monthly BAM Plan monitoring of Grey-headed Flying-fox

biosis

Matter: 33737,
Date: 29 September 2021,
Checked by: IV, Drawn by: LH, Last edited by: jturner
Location: P:\33700s\33737\Mapping\33737_30622_F4_GHFFSurveyLoc.mxd 00

2.4.4 Grey-headed Flying-fox dusk, dawn and all-night surveys

Nocturnal surveys to detect the presence and numbers of Grey-headed Flying-foxes flying through the wind farm were undertaken to determine if flights occur at particular times of night and if there were any other discernable patterns to activity, such as use of particular geographic parts of the wind farm or influence of weather conditions.

Survey summary and timing

Fortnightly Grey-headed Flying-fox dusk and dawn surveys on the SCWF began on 18 February 2021. The monitoring frequency was increased to weekly visits from 17 March 2021 until 14 May 2021 and involved:

- 2 nights of weekly dusk and dawn monitoring, including
  - 1 night of all night monitoring from dusk to dawn (18 March 2021 to 29 April 2021)
  - 1 night of surveying Sugar Gum windbreak on the wind farm and near Woorndoo-Streatham Road, near Lake Eyang, for the presence of foraging Grey-headed flying-foxes (until 7 April 2021). The windbreak near Lake Eyang was surveyed in 2021 as a Grey-headed Flying-fox fitted with a satellite transmitter (Atlas of Living Australia data) appeared to have foraged at this location in 2020.
  - Using a thermal camera to detect Grey-headed Flying-foxes at night, throughout the entire survey period.
- 1 night of weekly dusk camp exit count at the Woodcutters Lane/Hamilton Highway within approximately 0.5 kilometres of the Hexham pine plantation camp (3 March 2021; 17 March 2021 to 28 April 2021).
- Recording the date, location, survey start and end time, weather details (air temperature, wind speed and direction, humidity, precipitation and cloud). If a Grey-headed Flying-fox was observed, the time of observation, number of individuals, behaviour and direction of flight were recorded.

Grey-headed Flying-fox surveys at the SCWF coincided with mortality monitoring undertaken by Elmoby Ecology (Part B this report), to understand if the number of mortalities (if any) could be associated with the number of individual Grey-headed Flying-foxes flying through the wind farm.

The dates of the monitoring were (see also Appendix 2):

- 18 February – 19 February (beginning of fortnightly monitoring)
- 3 March – 4 March
- 17 March – 19 March (beginning of weekly monitoring)
- 23 March – 25 March
- 30 March – 1 April
- 6 April – 8 April
- 14 April – 16 April
- 20 April – 22 April
- 28 April – 30 April
- 4 May – 6 May

- 12 May – 14 May

The cessation of monitoring was based on activity of Grey-headed Flying-foxes on the wind farm, determined through the field investigation, mortality monitoring and the 2020 monitoring period. In 2020, the trigger to cease monitoring was two weeks after any Grey-headed Flying-foxes were recorded in mortality monitoring or during dusk and dawn surveys. In 2021, the only carcass detected was on 5 March 2021, and the last Grey-headed Flying-fox was observed at the wind farm on 8 April 2021 and none were recorded at the Hexham pine plantation camp on 20 April 2021. The all-night monitoring and two-day dusk and dawn monitoring thus ceased on 30 April 2021. The single-day weekly dusk and dawn surveys were continued until mid-May (4-5 May 2021; 13-14 May 2021) to remain consistent with the timing of the 2020 investigation.

Dusk and dawn monitoring

The dusk and dawn monitoring involved:

- Dusk survey from 30 minutes before sunset to 2 hours after sunset (unless Grey-headed Flying-foxes were seen still flying 2 hours after sunset, in which case monitoring was to continue until the frequency reduced to one flying-fox per 15 minutes).
- Dawn survey from 1.5 hours before sunrise to 30 minutes after sunrise.
- Same turbine location surveyed on subsequent dusk and dawn surveys.
- Using a thermal imaging camera (FLIR model E60 and E75) to detect Grey-headed Flying-foxes. A single camera was used until 8 April 2021; two cameras were used from 14 April 2021 until 14 May 2021, with each of the two field personnel stationed at separate turbines.

On 18 February 2021, the turbine location for the surveys was selected based on where Grey-headed Flying-foxes were observed flying through the wind farm in the early 2020 monitoring season. Subsequent turbine locations were selected on the basis of mortalities or previously recorded flight paths (Biosis 2020) ensuring all turbines were surveyed at least once at dawn and dusk during the entire monitoring period (February–May 2021).

The Sugar Gum windbreak on the wind farm site and another on Woorndoo-Streatham Road, near Lake Eyang, was surveyed to check for any foraging individuals on nights alternate to the all-night wind farm site monitoring (Appendix 3: Grey-headed Flying-fox surveys outside of the SCWF 2021).

The Sugar Gum plantations immediately west of Woodcutter's Lane and Cobra Killuc Wildlife Reserve were visited on 18 February 2021 to search for roosting Grey-headed Flying-foxes (Appendix 2). The Woodcutter's Lane plantation is largely visible from the roadside and was observed from there due to having no permission to access the land. BL&A (2019) observed an aggregation of 120 Grey-headed Flying-foxes in February 2019 (BL&A 2019) at the Woodcutter's Lane Sugar Gum plantation, although the presence of a camp there was not confirmed then and no evidence for one there has been found during all subsequent investigations. No further visits were made to these locations during the current investigations, as a large camp was found in the Hexham pine plantation on 26 February 2021, and weekly surveys were subsequently focused on documenting numbers departing the camp and flying through the wind farm. However, monthly dusk monitoring of these sites continued as part of the BAM Plan requirements.

Dusk Hexham pine plantation camp exit count

A large camp was found at Hexham pine plantation on 26 February 2021 (Figure 4). Camp exit counts near the camp were conducted by two observers, one each stationed at Woodcutter's Lane 600 metres from Hamilton Highway and Hexham-Woorndoo Road on the following dates (Appendix 3):

- 3 March 2020 (five days after the camp was discovered on 26 February 2021)

- 17 March 2020 (beginning of weekly monitoring)
- 31 March 2020
- 6 April 2020
- 15 April 2020
- 20 April 2020
- 28 April 2020

The observers undertook the surveys simultaneously with the dusk surveys conducted by another team at SCWF. Camp exit counts started 30 minutes before sunset and finished 30 minutes after last light, or until it was too dark to see. When Grey-headed Flying-foxes were observed, the team on the wind farm site was alerted, in an attempt to estimate the proportion of individuals from the camp flying across the wind farm.

All-night monitoring

One night of all-night monitoring was undertaken each week from 18 March 2021 until 29 April 2021. Each of these monitoring sessions began after the dusk survey and finished before the dawn surveys. A team of two people working two over-night shifts moved from turbine to turbine to search for Grey-headed Flying-foxes flying through the wind farm and foraging in River Red Gums and Sugar Gums. The observers also listened for the characteristic vocalisations of the species while on site.

All turbines were surveyed in each all-night monitoring period in a random order, with random numbers generated in R (R Core Team 2013). Twenty minutes was spent at each turbine, except on 18 March 2021 when 15 minutes was spent at each turbine. Observers scanned the sky and horizon with a thermal imaging camera (FLIR model E60 and E75) to detect Grey-headed Flying-foxes.

Grey-headed Flying-fox camp counts and searches

The nearest known Grey-headed Flying-fox camps to SCWF are at Warrnambool and Colac and the recently discovered Hexham pine plantation. Monthly population counts were taken at these camps where possible, and when access was made available to the Hexham pine plantation.

- 18 February 2021
  - Warrnambool
  - Colac
- 18 and 19 March 2021
  - Warrnambool (18 March)
  - Colac (18 March)
  - Hexham (19 March)
- 20 April 2021
  - Warrnambool
  - Colac
  - Hexham
- 25 May 2021

- Hexham
- 24 June 2021
  - Warrnambool
  - Colac

The camp counts followed the National Flying-fox monitoring program methodology (Westcott et al. 2011), which involves counting camp sites during the day. Where it was possible, counts coincided with the national count timing, which occur around 19 February and 19 May annually. It was found that the Grey-headed Flying-foxes at the Hexham pine plantation were disturbed when walking through the camp. The number of Grey-headed Flying-foxes at this camp were estimated using the following methods, with two observers undertaking the count:

- Observers mapped the perimeter of the Grey-headed Flying-fox colony by walking around it with a GPS.
- Twenty random points were selected within the pine plantation, using a distance and angle from randomly generated values in R. Observers walked to the point location directed by the randomly created distance and angle, which became the centre of the survey location.
- Area-based count: Observers counted the number of Grey-headed Flying-foxes within a 10 metre × 10 metre square.
- Tree-based count:
  - Observers counted the number of Grey-headed Flying-foxes in a single tree at the centre of the survey location.
  - Observers measured the distance between trees within each row, and the spacing between rows.
  - A point grid was generated and overlaid on the mapped colony area, based on the measured spacing between trees.
- The total number of Grey-headed Flying-foxes present at the camp was estimated for:
  - Area-based estimate by extrapolating the average number of Grey-headed Flying-foxes in the twenty 10 metre × 10 metre squares across the camp size area (estimated from the GPS-mapped perimeter).
  - Tree-based estimate by extrapolating the average number of Grey-headed Flying-foxes in the twenty single trees, across the total number of trees within the camp perimeter (estimated from the point grid).

2.4.5 Grey-headed Flying-fox monthly monitoring and detailed investigations limitations

The monthly monitoring was undertaken at Woodcutter's Lane, adjacent to a Sugar Gum plantation located within private property. Nature Advisory (2020) observed an aggregation of Grey-headed Flying-fox at this location in February 2019 and concluded it was most likely a temporary camp site. However, subsequent monitoring has not found this site to contain a camp site, or frequent Grey-headed Flying-fox activity though groups and individuals were recorded flying through the same area during the Year 2 2019–2020 monthly monitoring. In February 2021, Biosis found a camp site within a pine plantation near Hexham and thus the Woodcutters Lane location is considered unlikely to be a camp site. Therefore, monitoring at this location was not considered to contribute greatly to informing the potential presence of Grey-headed Flying-foxes in the area, and camp exit counts at the pine plantation and the wind farm provided a higher likelihood of detecting the species.

The detailed investigation was undertaken at a time when Grey-headed Flying-foxes were known to occur within and in proximity to the SCWF. Flowering eucalypts, one of the main food resources of the Grey-headed Flying-fox, were present for most of the investigation period. The investigation was restricted to the February–May survey period. By early February, Sugar Gums had started flowering and were heavy with buds, and one Grey-headed Flying-fox was observed on the wind farm site. It is possible some individuals may have been present or flying through the wind farm prior to early-mid February when the surveys started. However, the survey results indicate the majority of Grey-headed Flying-fox movements in the area occurred during the survey period.

Grey-headed Flying-foxes may have been moving through the wind farm outside of the intensive weekly surveys. The 2020 and 2021 findings indicate the species is present and moving through the area in large numbers for a short pulse through the late summer and autumn months. Although the frequency was increased to weekly monitoring, some groups are likely to have been missed and not represented in the findings. However, the investigation was considered to be sufficient to provide detailed information on the presence and flight behaviour of the Grey-headed Flying-fox in the SCWF area, to inform on-going management.

The all-night surveys initially attempted to obtain two replicate surveys at each turbine within a night, with 15-minute observation rounds at each turbine. However, after the first all-night survey it was clear that a substantial amount of time was spent moving between turbines, reducing time available to survey at the turbine locations and obtaining two replicates between the dusk and dawn surveys was not possible. The time at each turbine was increased to 20 minutes for all subsequent surveys. It is possible that some individual bats were missed while moving between turbines. However, it is considered that a sufficient amount of time throughout the night was spent, repeated at weekly intervals, to detect Grey-headed Flying-foxes and to understand the frequency and number of movements after dusk and before dawn.

The thermal imaging cameras used to detect the Grey-headed Flying-foxes at night were inhibited by rain and fog, reducing their effective range depending on the level of rainfall and density of the fog. This rarely reduced the effective range to a point where the cameras would have been unable to detect an individual flying through the turbine impact area.

The observers were able to survey at one location at a time within the wind farm on each visit and at any one time the thermal camera scanning was limited to this location, with the exception of the dusk and dawn surveys on 14 April 2021 to 14 May 2021 when two turbines were surveyed each time. It is likely that the counts of Grey-headed Flying-foxes do not represent the total number of all individuals flying through, and individual flying-foxes may have been missed during the survey as the observers did not have visual coverage of the entire site for the full duration of each survey. Additionally, although observers scanned the horizon around 360° repeatedly with the thermal camera, some individuals may have been missed. However, the surveys were conducted at alternating locations and times each survey week. This allowed the surveys to detect any areas of the wind farm that had higher levels of Grey-headed Flying-fox activity. By alternating survey locations and times, splitting observers up during dusk and dawn surveys and conducting surveys across the entire wind farm throughout the night the surveys provide sufficient information to understand the movement and behaviour of the Grey-headed Flying-fox across the wind farm during the February–May 2021 period and to further inform the species' management and collision risk impact at SCWF.

The flight height of Grey-headed Flying-foxes was estimated when possible. However, at night and while using a thermal camera the field of vision is reduced and estimating flight height becomes difficult. Therefore, this information was not always captured, but the observations are sufficient to understand the flight behaviour of the species in relation to turbine rotor swept height.

2.5 Carrion removal program

The BAM Plan requires implementation of a carrion removal program. Tilt Renewables has provided information on the carrion removal program. Carrion removal is routinely undertaken at SCWF by the farm manager. If carrion is reported by the site manager, it is reported immediately and removed within one – two days.

2.6 Fox control program

The permit requires the implementation of a Fox control program. Fox Control is undertaken at SCWF annually, just prior to lambing season. Additional ad-hoc fox control is undertaken based on fox activity observed by the landowner.

3. Part A – Results

3.1 Determining seasonality of a monitoring years 1, 2 and 3 based on rainfall

For the Year 3 monitoring period, the total rainfall was 775 mm for the period May 2020 – June 2021 (Figure 5). Year 3 monitoring period is classed as a 'wet' year (Table 6).

Year 1 was classified as a 'dry' year (Nature Advisory 2020). The SCWF BAM Plan Year 1 Report was endorsed and resolved as satisfactory in relation to the BAM Plan requirements on 28 July 2020 (Tilt Renewables 2022).

The seasonality for all the monitoring years is classified as follows (Table 6, Figure 5):

- Year 1 – Dry (Nature Advisory 2020)
- Year 2 – Intermediate
- Year 3 – Wet

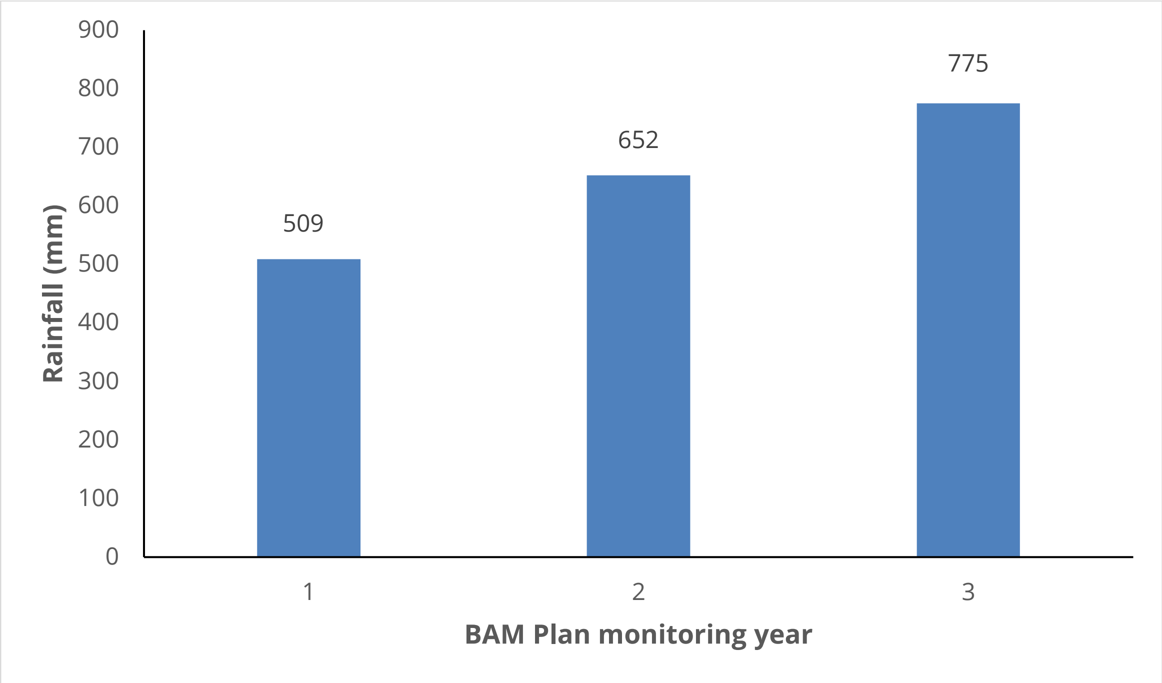


Figure 5 Rainfall for BAM Plan monitoring Year 1, Year 2 and Year 3. Year 1 rainfall was calculated using the DELWP methodology (Nature Advisory 2020), Year 2 and Year 3 were calculated using the modified Biosis methodology.

Table 6 Determination of seasonality for Year 1, Year 2 and Year 3

Time period years	Total rainfall	Rainfall from 1980 mean (standard deviation)	Thresholds based on mean and one standard deviation Dry Intermediate Wet	Seasonality class
Year 3 **August 2020 – July 2021**				
May 2020 – June 2021 ***(Biosis 2020 method)***	775	649 (109)	<540 540 – 758 **>758**	WET
Year 2 **August 2019 – July 2020**				
May 2019 – June 2020 ***(Biosis 2020 method)***	652	645 (109)	<537 **537 – 754** >754	INTERMEDIATE
Year 1 **July 2018 – June 2019**				
November 2017 – December 2018 ***(DELWP 2019 method; Nature Advisory (2020))***	509	640 (112)	**<528** 528 – 752 >752	DRY

Based on rainfall across the Year 1, Year 2 and Year 3 monitoring periods, it is evident that a range of rainfall conditions occurred and that the rainfall between the monitoring years is sufficiently different to consider them as 'dry', 'intermediate' and 'wet' with regards to potential ecological responses of Brolgas, microbats and Grey-headed Flying-foxes (Figure 5, Table 6, Table 7). The following section further details the rainfall in each year during the Brolga breeding season.

Table 7 Monitoring results for Year 1, Year 2 and Year 3 SCWF BAM Plan (GHFF = Grey-headed Flying-fox; N.B. no Brolga flocking activity was recorded in any year).

Monitoring period	Seasonality determination	Brolga activity	Bats carcass searches	Birds carcass searches
Year 1 **July 2018 – June 2019**	**Dry** (Nature Advisory 2020)	**Total: 1 observation** **Breeding observations: 0** 1 pair September 2018	**Total: 23** 22 microbats 1 GHFF	**Total: 23**
Year 2 **August 2019 – July 2020**	**Intermediate** (Biosis 2021)	**Total: 6 observations** **Breeding observations: 4** 1 pair on nest August 2019 1 pair on nest October 2019 1 pair on nest October 2019 1 pair November 2019 1 pair December 2019 1 pair on nest June 2020	**Total: 65** 52 microbats 13 GHFF	**Total: 47**
Year 3 **August 2020 – July 2021**	**Wet** (Biosis 2022)	**Total: 0 observations** **Breeding observations: 0**	**Total: 62** 61 microbats 1 GHFF	**Total: 48**

3.1.1 Rainfall during Brolga breeding season – July to December

The July to December rainfall was lowest in Year 2, with total rainfall at 209 mm and highest in Year 3 with 448 mm. The rainfall difference between Year 1 and Year 2 was 34 mm, and 91 mm between Year 2 and Year 3 (Figure 6). When May and June, the two months prior to the Brolga breeding season are considered, Year 1 was driest with 351 mm, Year 2 had 21 mm higher rainfall than Year 1, and Year 3 had 76 mm higher rainfall than Year 2 (Figure 6).

Rainfall in the months immediately preceding the known Brolga breeding season is likely to influence availability of suitable habitat. Therefore, the rainfall from May to December in each year has been used here to demonstrate the differences in breeding season rainfall conditions in the 'dry' Year 1, 'intermediate' Year 2 and 'wet' Year 3. Based on the rainfall and given the primary objective stated in Section 2.1, Year 1 was classified as 'dry', Year 2 as 'intermediate' and Year 3 as 'wet' (Figure 6).

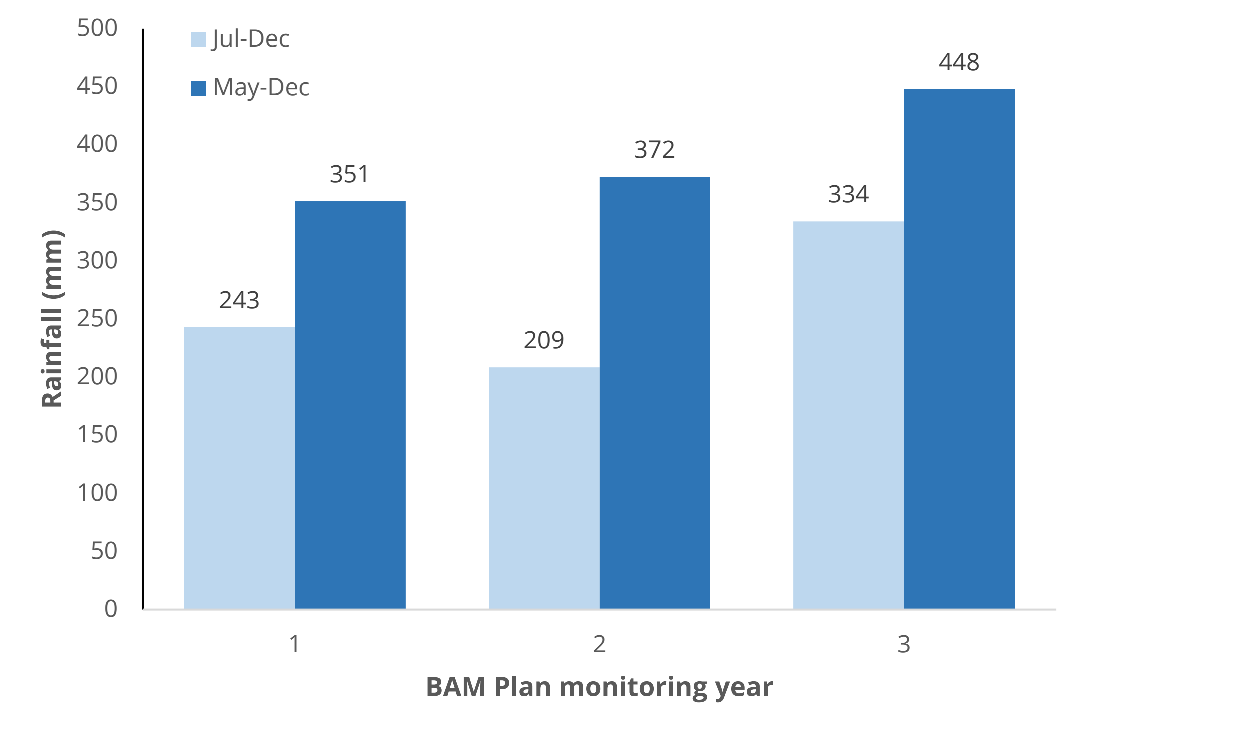


Figure 6 **Rainfall during and preceding Brolga breeding seasons in Year 1, Year 2, Year 3 of BAM Plan monitoring. The figure shows rainfall for July to December (the species' known breeding season) and rainfall for the breeding season and including two preceding months, most likely to influence breeding habitat suitability and activity.**

3.2 Brolga utilisation monitoring program

3.2.1 Flocking season survey

Year 3 2020–2021

A Brolga flocking roost site is defined as meeting all of the criteria listed below (DSE 2012):

- More than one year of recording.
- One or more records of counts equal to or greater than 10 birds.
- Recorded in more than one month.

Brolga flocking season surveys were undertaken from December 2020 to June 2021 at accessible mapped wetlands within 5 kilometres of the SCWF boundary (Figure 7, Appendix 5). No Brolga were observed flocking at any wetlands within 5 km of the SCWF boundary during this time and therefore no Brolga flock roost sites were present during the monitoring.

Brolgas were recorded using a total of five wetlands during the Year 3 flocking season surveys. A pair of adult Brolgas was observed at wetland 29339 (Figure 7, Appendix 5) on 26/02/2021. The pair was observed to be foraging together within the wetland, which comprised of an open grassy paddock with a small dam.

A local landholder reported sighting 4 to 5 Brolgas at wetland 29183 and the surrounding dams (wetlands 29205, 29214 and 29213) in early June (seen approximately 08/06/2021).

Comparison of flocking survey findings before and after construction

No Brolga flocking was recorded within 5 kilometres of the SCWF boundary before or after the SCWF became operational.

Before construction, Biosis conducted flocking season surveys in April 2006, within 40 kilometres of SCWF boundary and focused on known Brolga flocking areas at Willaura, Pura Pura, Darlington and Penshurst. Flocking was recorded at Willaura, Pura Pura and Penshurst (Biosis 2006) but not within 5 kilometres of the SCWF boundary, though two Brolgas were observed at Woorndoo (Appendix 6 Figure 7).

In the post-construction flocking surveys, the observations in May 2020 in all wetlands except 29205 were thought to be most likely the same pair moving between the wetlands. It was not possible to confirm whether the pair in 29205 was additional, as they were surveyed at different times of the day within a period and a distance that would enable them to move between other wetlands within the 5 kilometre radius.

Therefore, in all years, pre- and post-construction, although no flocking was observed, it is most likely that only one pair was present during the surveys, indicating that a pair may occasionally be present during the flocking season.

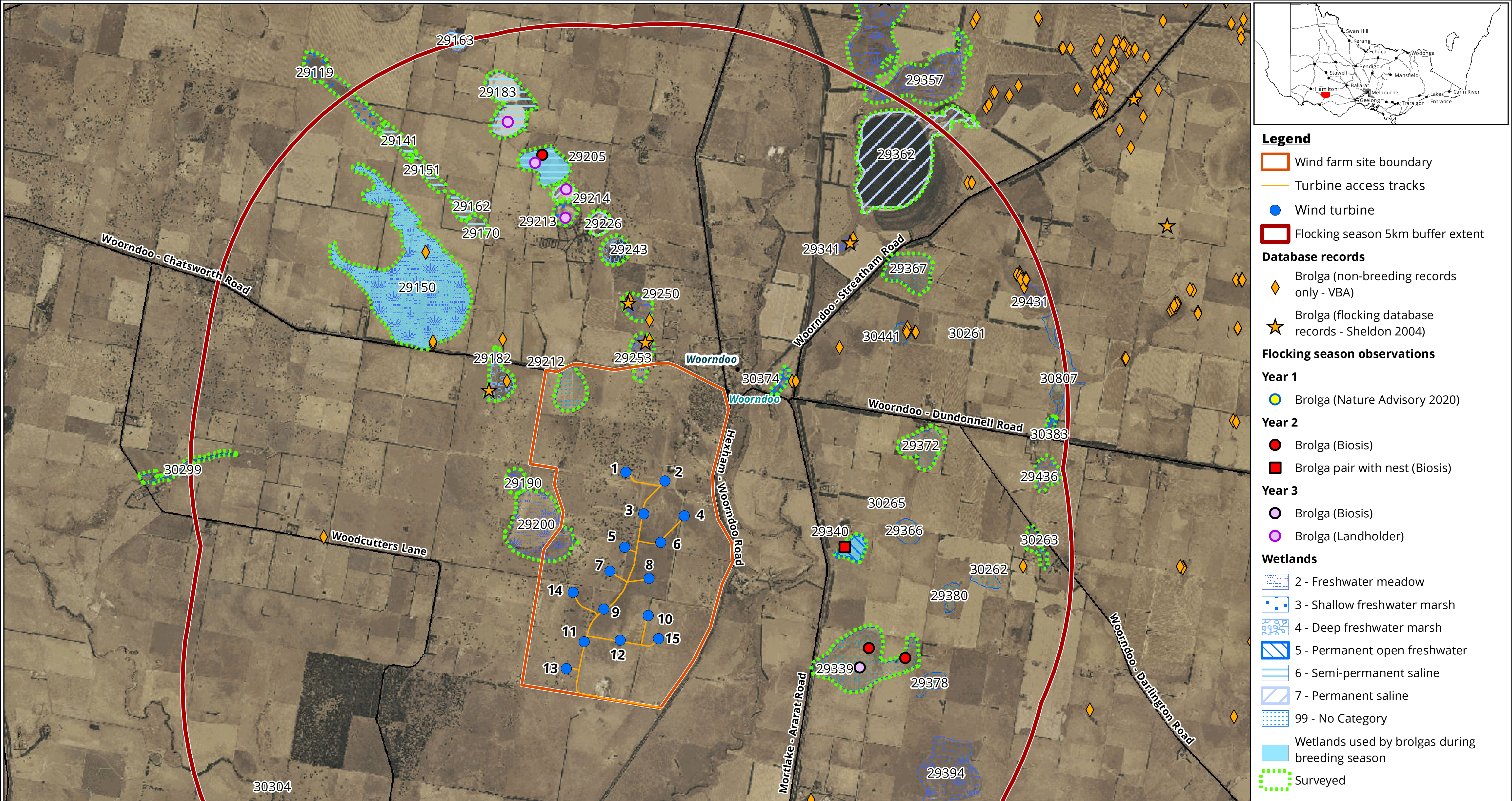


Figure 7 Brolga flocking season observations December 2020 June 2021

0 0.5 1 1.5 2 2.5
Kilometres
N

Scale: 1:55,000 @ A3
Coordinate System: GDA 1994 MGA Zone 54

biosis.

Matter: 33737,
Date: 04 October 2021,
Checked by: IV, Drawn by: LH, Last edited by: jturner
Location: P:\33700s\33737\Mapping\33737_30622_F7_BrolgaFlockingObs.mxd

3.2.2 Breeding season survey

Year 3 2020–2021

Brolga breeding season surveys were undertaken from August 2020 to December 2020 and in July 2021. Surveys were conducted at accessible mapped wetlands within 3 kilometres of the SCWF boundary (Figure 8,). No Brolgas were observed during the Year 3 BAMP Plan breeding season surveys.

Comparison of breeding survey findings before and after construction

One pair of Brolgas was recorded during Year 1 breeding season surveys, one in Year 2 (at two different wetlands) and none in Year 3. Breeding activity was recorded only in Year 2 (Appendix 7, Figure 8), with nests recorded within 2.4–4.0 kilometres of the nearest turbine (Table 7). No successful breeding was observed within or outside of 3 kilometres from turbines, and the nest in the Salt Creek waterway failed due to being washed away. Reasons for lack of breeding success for the other nests and wetlands are unknown. Biosis conducted breeding season surveys in October 2006, before the wind farm was constructed, within 40 kilometres of SCWF boundary and recorded no breeding Brolgas within 3 kilometres of the SCWF boundary (Biosis 2006).

Table 8 Distance of brolga pairs with nests to turbines, recorded in Year 2

Date	Wetland ID	Distance to nearest turbine (m)
5 August 2019	Salt Creek waterway	3515
20 August 2019	29150	3625
15 October 2019	29150	3966
16 October 2019	29150	3937
24 June 2020	29340	2406

Historical records, together with the pre-construction and post-construction surveys indicate that Brolga breeding utilisation within 3 kilometres of the SCWF has not changed. There are eight historical breeding records in the Victorian Biodiversity Atlas (Appendix 9, Figure 8). Three of these can be associated with a wetland. The SCWF BAM Plan surveys recorded Brolgas at three wetlands during the breeding season surveys. Of these, one wetland – 29150 has been used historically and was used by breeding brolgas in Year 2 of the BAM Plan surveys.

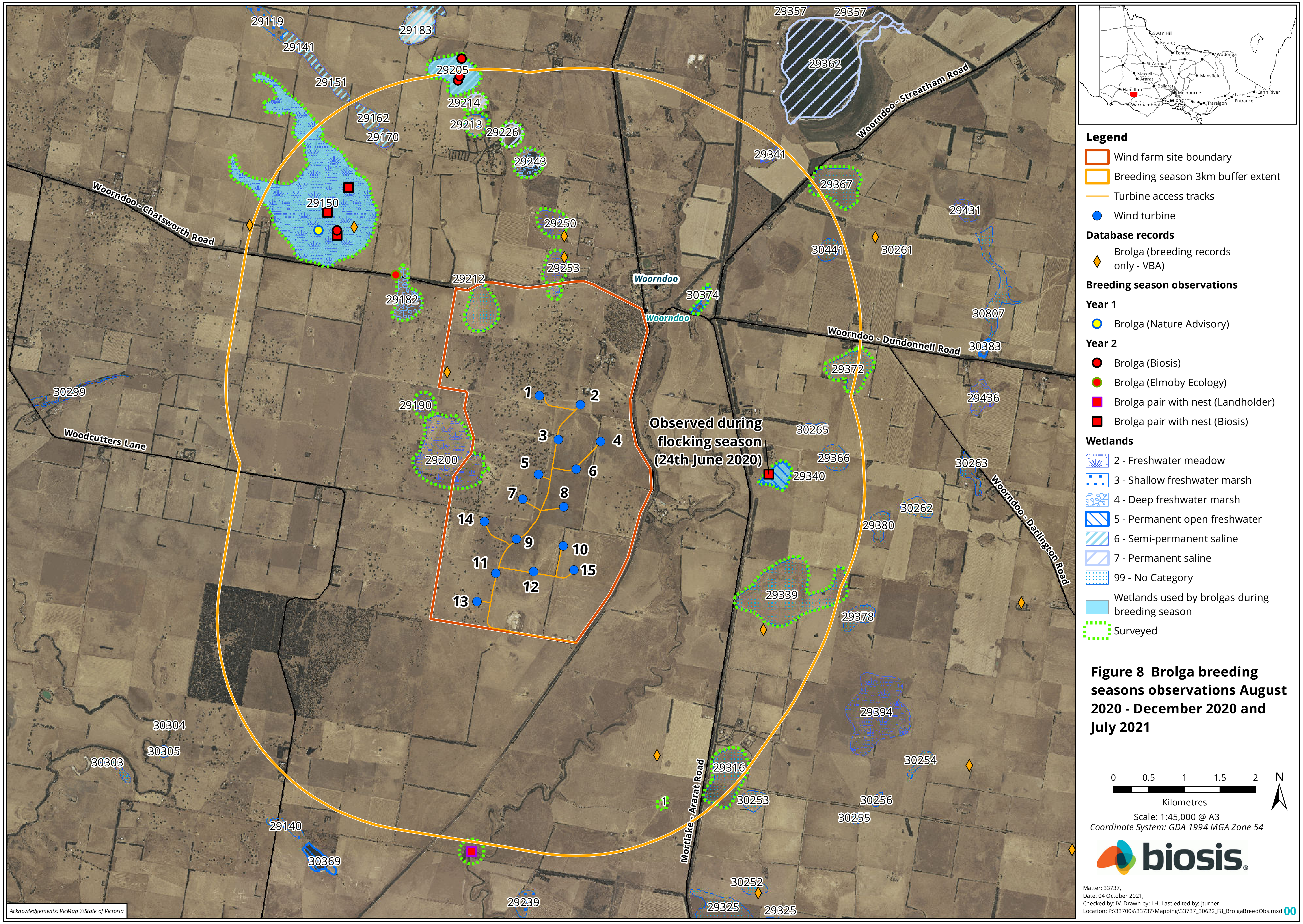


Figure 8 Brolga breeding seasons observations August 2020 - December 2020 and July 2021

Scale: 1:45,000 @ A3
Coordinate System: GDA 1994 MGA Zone 54

biosis

Matter: 33737,
Date: 04 October 2021,
Checked by: IV, Drawn by: LH, Last edited by: jturner
Location: P:\33700s\33737\Mapping\33737_30622_F8_BrolgaBreedObs.mxd 00

3.3 Bat utilisation monitoring program

3.3.1 Bat species richness

Year 3 2020–2021

Eight species of bats were identified during the analysis of calls from the Year 3 monitoring period. These include:

- White Striped Freetail Bat *Austronomous australis*
- Gould's Wattled Bat *Chalinolobus gouldii*
- Chocolate Wattled Bat *Chalinolobus morio*
- Western Broad-nosed Bat *Scotorepens balstoni*
- Southern Bent-wing Bat *Miniopterus orianae bassanii*
- Large Forest Bat *Vespadelus darlingtoni*
- Southern Forest Bat *Vespadelus regulus*
- Little Forest Bat *Vespadelus vulturnus*
- Eastern False Pipistrelle *Falsistrellus tasmaniensis*

This includes one new species which were not detected during monitoring undertaken in Year 2 (Western Broad-nosed Bat).

Additional species likely to utilise the SCWF site are Freetail and Long-eared Bats, but they can only be identified to genus level:

- Free-tailed Bats *Ozimops* sp. (formerly *Mormopterus* sp.)
  Ultrasonic calls of two free-tailed bat species cannot be reliably ascribed to a particular species. Most or all of the calls recorded at SCWF are likely to be the Southern Free-tailed Bat *Ozimops planiceps* or Ride's Free-tailed Bat *Mormopterus ridei*.
- Long-eared Bats *Nyctophilus* sp.
  Ultrasonic calls of the three Victorian Long-eared Bat species cannot be reliably distinguished. Most or all of the calls recorded at SCWF are likely to be from the Lesser Long-eared Bat *Nyctophilus geoffroyi*, while some may be from Gould's Long-eared Bat *Nyctophilus gouldi*. In Victoria, the threatened Greater Long-eared Bat *Nyctophilus corbeni* is limited to the north-west of the State.

Complexes were assigned to calls where characteristics of various species overlap but cannot be definitely described to either a genus or species. This includes:

- Southern Bent-wing Bat Complex
  Ultrasonic calls of Southern Bent-wing Bat are similar to *Vespadelus* sp. Most or all of these calls are likely to be Southern Bent-wing Bat or Little Forest Bat.

Appendix 10 provides a list of the recorded species, genera and/or complexes:

- Recorded by Biosis during baseline monitoring undertaken in 2006 prior to the SCWF construction.

- Recorded by Biosis at post-construction monitoring sites during the Year 2 and Year 3 monitoring periods.
- Recorded by Nature Advisory at post-construction monitoring sites during the 2018-2019 monitoring period. This list is limited to those which exhibit call frequencies within 45-55 hertz, as per the detail provided in the Year 1 2018-2019 monitoring report (Nature Advisory 2020).

For all monitoring seasons and periods, species have only been included for calls that could be identified to species, genera or complex level with a medium or higher level of confidence.

Detectors with poor quality or noise recording represented 93% of all recordings.

Comparison of microbat utilisation surveys – before and after operation

The acoustic monitoring undertaken at SCWF during the Year 3 monitoring period found a similar composition of bat species to those identified prior to construction as well as during post-construction monitoring undertaken in Year 1 and Year 2 (Appendix 10). Nature Advisory (2020) only provided specific details of bat species that exhibit call between 45–55 hertz. All species, genera and/or complexes which exhibit calls between 45 – 55 hertz recorded during the 2018-2019 monitoring period were also recorded during the Year 2 and Year 3 monitoring periods (Table 9, Table 10).

Two additional species (Gould's Wattled Bat and White Striped Freetail Bat), which exhibit calls < 45 hertz, were recorded flying at both ground and at height across all post-construction monitoring periods. However, monitoring undertaken in Year 1 (Nature Advisory 2020) does not stipulate which detector locations these species were recorded and are thus excluded from Table 9 and Table 10. Seasons and locations in which Gould's Wattled Bat and White Striped Freetail Bat were recorded during the Year 2 and Year 3 monitoring periods are detailed in (Appendix 10).

Table 9 Comparison of species, genera and complexes with calls within 45 – 55 hertz that were detected at ground monitoring sites in Year 1 against results for those species, genera and complexes collected in Year 2 and Year 3

Species	Common/complex name	Ground (1 m)											
		T02			T05			T10			T13		
Spring		2018	2019	2020	2018	2019	2020	2018	2019	2020	2018	2019	2020
Miniopterus orianae bassanii	Southern Bent-wing Bat		X	X		X	X		X			-	
Chalinolobus morio													
Miniopterus orianae bassanii	Southern Bent-wing Bat Complex			X						X		-	
Vespadelus vulturnus													
Chalinolobus morio	Chocolate Wattled Bat	X	X	X	X	X	X	X	X	X		-	
Nyctophilus geoffroyi	Long-eared Bat sp.		X	X		X	X	X	X	X		-	
Nyctophilus gouldi													
Vespadelus darlingtoni													
Vespadelus regulus	Forest Bat sp.	X	X	X	X	X	X	X	X	X	X	-	
Vespadelus vulturnus													
Autumn		2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021
Miniopterus orianae bassanii	Southern Bent-wing Bat	X	X	-		X	-	X	X	-	X	X	-
Chalinolobus morio													
Miniopterus orianae bassanii	Southern Bent-wing Bat Complex	X		-			-	X		-	X		-
Vespadelus vulturnus													
Chalinolobus morio	Chocolate Wattled Bat	X	X	-	X	X	-	X	X	-	X	X	-
Nyctophilus geoffroyi	Long-eared Bat sp.		X	-		X	-		X	-		X	-
Nyctophilus gouldi													
Vespadelus darlingtoni													
Vespadelus regulus	Forest Bat sp.	X	X	-	X	X	-	X	X	-	X	X	-
Vespadelus vulturnus													

Note to table: ' – ' Equipment failure (no calls recorded)

Table 10 Comparison of species, genera and complexes with calls within 45 – 55 hertz that were detected at turbine monitoring sites in Year 1 against results for those species, genera and complexes collected in Year 2 and Year 3

Species	Common/complex name	Turbine (nacelle 85 m)											
		T02			T05			T10			T13		
Spring		2018	2019	2020	2018	2019	2020	2018	2019	2020	2018	2019	2020
Miniopterus orianae bassanii	Southern Bent-wing Bat		X						-	X			
Chalinolobus morio	Southern Bent-wing Bat Complex								-				
Miniopterus orianae bassanii													
Vespadelus vulturnus													
Chalinolobus morio	Chocolate Wattled Bat	X			X			X	-				
Nyctophilus geoffroyi	Long-eared Bat sp.								-				
Nyctophilus gouldi													
Vespadelus darlingtoni	Forest Bat sp.	X	X		X	X			-			X	
Vespadelus regulus													
Vespadelus vulturnus													
Autumn		2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021
Miniopterus orianae bassanii	Southern Bent-wing Bat		X	X			X			-		-	
Chalinolobus morio	Southern Bent-wing Bat Complex									-		-	
Miniopterus orianae bassanii													
Vespadelus vulturnus													
Chalinolobus morio	Chocolate Wattled Bat	X					X			-	X	-	
Nyctophilus geoffroyi	Long-eared Bat sp.					X				-		-	
Nyctophilus gouldi													
Vespadelus darlingtoni	Forest Bat sp.		X	X	X	X				-		-	
Vespadelus regulus													
Vespadelus vulturnus													

Note to table: ' – ' Equipment failure (no calls recorded)

3.3.2 Bat activity

Year 3 2020–2021

Biosis acknowledge that a large number of poor-quality calls could not be identified to species or species-group level during analysis in Year 3. Many of these recordings were clearly bat calls, but were of insufficient duration or quality to allow confident identification. Additionally, most detectors recorded high levels of extraneous noise, which may have limited the potential for these detectors to record bat calls. Noise may be generated by a range of factors, including background noise, insects or electrical interference. Appendix 10 provides the number of calls of Year 3 monitoring results.

Comparison of microbat utilisation surveys – before and after operation

Appendix 10 provides the number of calls of:

- Species, genera and/or complexes identified by Biosis during baseline monitoring undertaken in 2006 prior to Salt Creek's construction.
- Species, genera and/or complexes identified by Biosis to have been recorded at monitoring sites during the 2019–2020 and 2020–2021 monitoring periods.
- Southern Bent-wing Bat identified by Nature Advisory to have been recorded at monitoring sites during the 2018–2019 monitoring period.

For all monitoring seasons and periods, only those calls which could be identified to species, genera or complex with a medium or higher level of confidence have been included.

Consistent with previous monitoring periods (Year 2), least concern species including Forest Bats, Freetail Bats, Gould's Wattled Bat and White Striped Freetail Bat remained the most commonly occurring genera or species across the site; as reflected by the locations and highest number of successfully identified calls recorded during the Year 3 monitoring period.

More calls were typically recorded in autumn compared with spring, which coincides with pup emergence and flight. Specifically, a significant number of calls were recorded at ground based detectors in autumn 2020. However, as no data was successfully recorded at ground based detectors in autumn 2021, comparisons between ground based activity recorded in autumn 2020 and autumn 2021 cannot be made. Nevertheless, it is noted that bats flying at heights at SCWF are considered to be those at greatest risk of collisions with the moving rotors of a turbine and that increased bat activity, as reflected by call recordings, may not accurately reflect abundance.

3.3.3 Bat activity at height

The height at which bats fly within the SCWF site is relevant to the likelihood of collision with a wind turbine. Bats flying at rotor swept height at SCWF are therefore considered to be those at greatest risk of collisions with the moving rotors of a turbine.

Year 3 2020–2021

Six genera and one genus grouping of bats were recorded at detectors deployed at 85 m during the Year 3 monitoring period (Appendix 2). This includes five genera/species previously detected during monitoring undertaken in Year 2 and one new species (Western Broad-nosed Bat).

Comparison of microbat utilisation surveys – before and after operation

Consistent with the Year 2 monitoring season , Gould's Wattled Bat and White Striped Freetail Bat appear to be the most commonly occurring species detected flying at height in Year 3, as reflected by the locations and highest number of successfully identified calls recorded during the Year 3 monitoring period.

3.3.4 Significant bat species utilisation

Year 3 2020–2021

The EPBC Act listed critically endangered Southern Bent-wing Bat was identified within the SCWF site during spring 2020 and autumn 2021 through call analysis. In some cases this species was recorded as part of a complex (see Section 3.4.1 for description of this complex), where it could not be separated from similar calls of other species.

Comparison of microbat utilisation surveys – before and after operation

The number of calls identified as Southern Bent-wing Bat and Southern Bent-wing Bat Complex (see Section 3.3.1 for definition of this complex) over the duration of the post-construction monitoring program are provided in Appendix 10. Comparison of successful call recordings of the Southern Bent-wing Bat and Southern Bent-wing Bat Complex found:

- Calls were recorded in all post-construction monitoring years.
- Calls were recorded at ground and at height over the duration of the monitoring program. However, most activity was typically recorded at ground level (at 1m height).
- Calls were recorded in spring and autumn over the duration of the post-construction monitoring program, excluding spring 2018 where no calls were recorded at either ground or at height.
- Call activity was highest in autumn compared with spring based on comparisons of data collected between 2018 and 2021.
- Call activity was highest in Year 2 when compared with results collected in Year 3 and Year 1.
- Call activity was consistently highest at ground detector site T10 over the duration of the post-construction monitoring program.

3.4 BAM plan-defined significant impact – Grey-headed Flying-fox monitoring

Grey-headed Flying-fox monitoring occurred in Year 2 and Year 3:

- Year 2:
  - Monthly, Woodcutter's Lane: August 2019 – July 2020
  - Detailed investigation: 19th March–12th May 2020.
- Year 3:
  - Monthly, Woodcutter's Lane: August 2020 – July 2021
  - Detailed investigation: 18th February – 14th May 2021.

Year 3 2020–2021

In the Year 3 monitoring period, no Grey-headed Flying-foxes were recorded during the monthly monitoring at Woodcutter's Lane. The species was recorded only during the detailed investigations carried out between 18 February 2021 and 14 May 2021 (Table 11, Figure 9).

During Year 3, Grey-headed Flying-foxes were first observed on the wind farm in a Lilly Pilly *Syzygium smithii* in the week of 8–12 February 2021 when average Sugar Gum canopy flowering was about 8% (Figure 10) (Biosis 2021). A single Grey-headed Flying-fox turbine collision mortality in 2021 was detected on 5 March, when average Sugar Gum flowering was at 10% (Table 11, Figure 10) (Elmoby Ecology Part B this report, Biosis 2021). No Grey-headed Flying-foxes were detected on the wind farm from 14 April 2021 onwards, or at the Hexham camp on 20 April 2021, at a time when the Sugar Gum canopy flowering had declined to 4.5% (Biosis 2021). No Grey-headed Flying-foxes were observed in the Sugar Gum windbreak or the River Red Gums within the wind farm during the Year 3 monitoring.

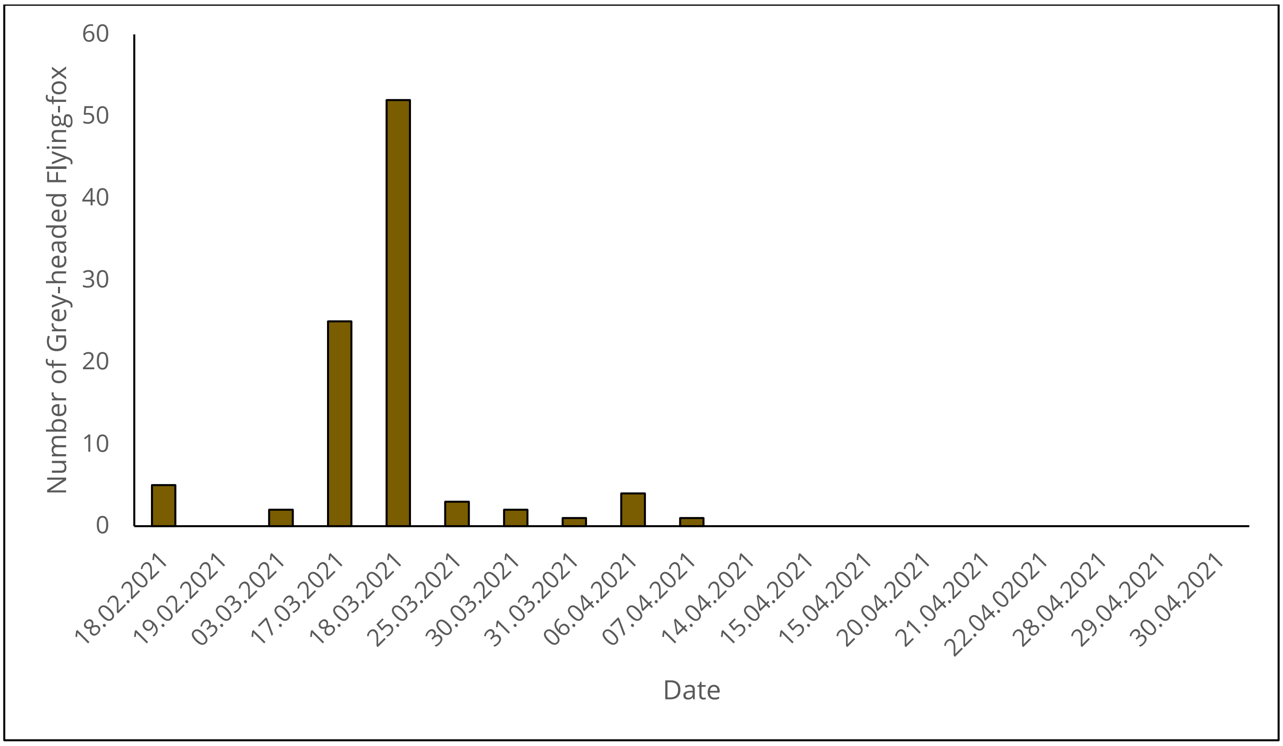


Figure 9 Number of Grey-headed Flying-fox detected at SCWF 2021

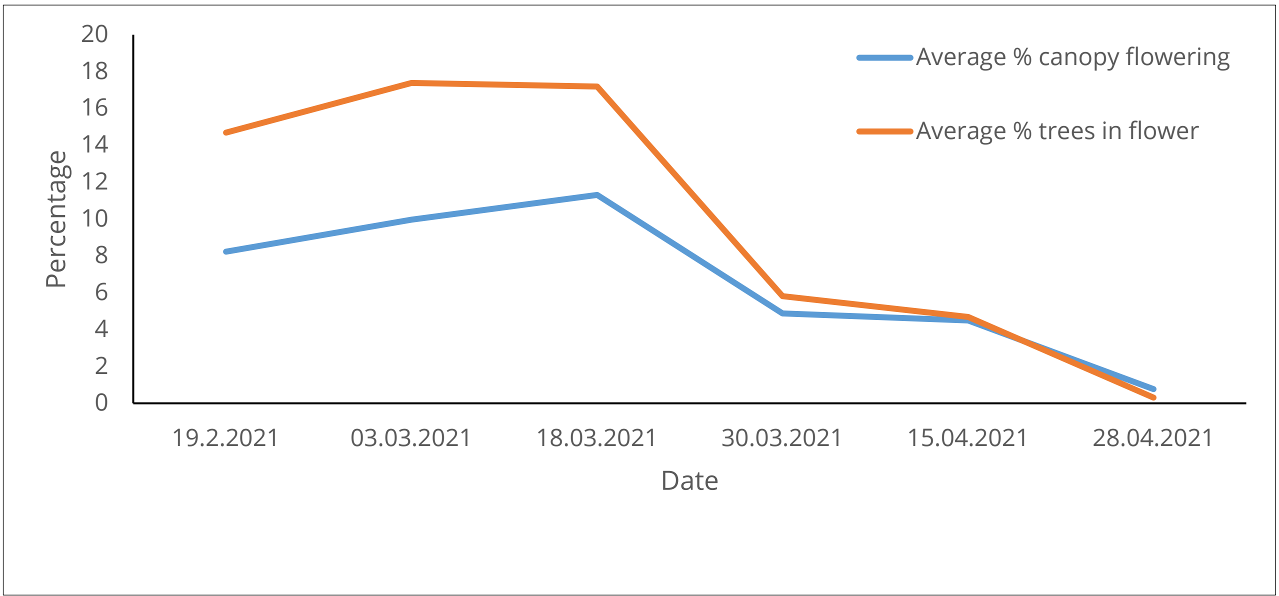


Figure 10 Sugar Gum flowering within 5 kilometres of the SCWF 2021

Table 11 Grey-headed Flying-fox at the SCWF and Hexham camp exit surveys 2021

Date	Survey type	Sunset/ Sunrise (24 hr)	Time (24 hr)	Number of flying-foxes	Location	Flight direction and height (m)	Time since sunset	Time to sunrise
18/02/2021	Wind farm dusk	20:23	21:20 – 21:40	5	T2	SE	57 min	
03/03/2021	Camp exit	20:05	20:37 – 21:01	12	Woodcutters Lane	N 5 – 50	32 min	
03/03/2021	Wind farm dusk	20:05	21:40 – 21:41	2	T7	SE	1 hr 35 min	
17/03/2021	Camp exit	19:44	20:20 – 20:40	31	Woodcutters Lane	N 10 – 20	36 min	
17/03/2021	Wind farm dusk	19:44	20:35 – 20:55	25	T9	N 15 – 80	52 min	
18/03/2021	Wind farm dawn	07:30	06:02 – 06:18	4	T9	SE		1 hr 28 min
18/03/2021	Wind farm dusk	19:43	20:32 – 21:07	52	T9	N	49 min	
23/03/2021	Camp exit	19:35	20:17 – 20:37	4	Hexham-Woorndoo Rd	N, E 25	42 min	
23/03/2021	Camp exit	19:35	20:23 – 20:30	3	Woodcutters Lane	N	48 min	
25/03/2021	Wind farm dawn	07:36	06:02 – 06:19	3	T2	S 5 – 50		1 hr 34 min
30/03/2021	Wind farm dusk	19:24	20:22 – 20:55	2	T3	N, E 10 – 50	58 min	
31/03/2021	All-night	19:23	23:07	1	T11	N 45	3 hr 44 min	
31/03/2021	Camp exit	19:23	19:23 – 19:25	5	Woodcutters Lane	ENE 40	0 min	

Date	Survey type	Sunset/ Sunrise (24 hr)	Time (24 hr)	Number of flying-foxes	Location	Flight direction and height (m)	Time since sunset	Time to sunrise
06/04/2021	Wind farm dusk	18:14	19:18 – 19:52	4	T11	N, W 20 – 120	1 hr 4 min	
07/04/2021	Wind farm dusk	18:12	19:51	1	T1	N, E 20	1 hr 49 min	
08/04/2021	All-night (observed while driving)	18:12 06:49	00:50	1	T5	W 5	6 hr 38 min	5 hr 59 min

3.4.1 Grey-headed Flying-fox camp counts and searches

The Grey-headed Flying-fox numbers at the Warrnambool camp remained stable between February and June 2021 (510–620 individuals). Least numbers of individuals were present on 18 February 2021 (n=510) and a peak in numbers occurred on 20 April 2021 (n=620).

The Hexham pine plantation estimates for 19 March 2021 were as follows:

- Camp area (m^2): 31,637.
- Trees 2 metres apart within each row.
- Tree rows spaced 2.5 metres apart.
- Estimated number of trees within the camp area: 6,314.
- Mean number of Grey-headed Flying-foxes:
  - Area-based count estimate: 4,666.
  - Tree-based count estimate: 27,150.

The Hexham camp was found abandoned on 20 April 2021.

The Colac camp average size varied from a maximum average of 1,550 individuals on 18 February 2021 to a minimum of 1,045 on 18 March and 1,130 on 20 April 2021. The Colac camp was found abandoned on 24 June 2021.

Biosis (2020) estimated 1000+ Grey-headed Flying-foxes were present at the Warrnambool camp on 15 April 2020 and BL&A (2019) reported 500 individuals in October 2018. The numbers present in 2021 reflect average known numbers of Grey-headed Flying-foxes of 500 individuals at the Warrnambool camp (BL&A 2019), though up to 3,500 have been recorded there in the past (BL&A 2019).

Biosis did not undertake formal colony counts at the Colac camp in 2020. However, based on Colac Otway Shire Council 2020 counts, in January 2020 a total of 6,500 Grey-headed Flying-fox occupied the Colac camp in May 2020 numbers reduced to 400 and in July 2020, to 200 individuals (Colac Otway Shire Council 2019). The camp count results reflect the variability in the presence and numbers of individuals at different Victorian camp sites.

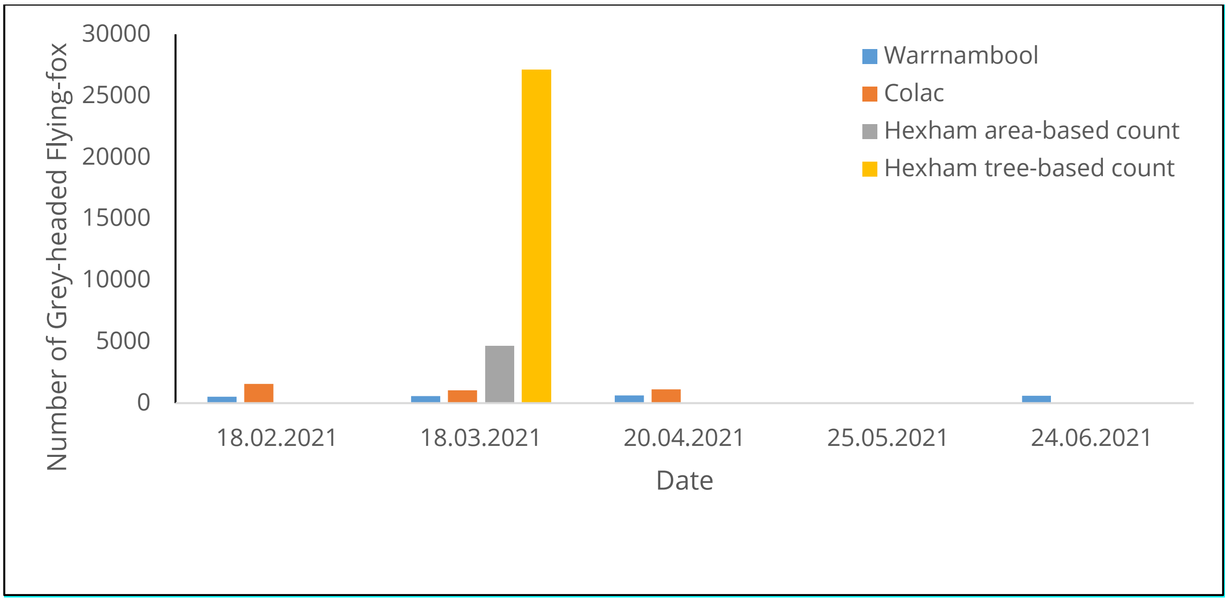


Figure 11 Grey-headed Flying-fox camp count results 2021

Comparison of Grey-headed Flying-fox occurrence – before and after operation

No Grey-headed Flying-foxes were known to occur in the SCWF and its vicinity prior to construction. The nearest records in the Victorian Biodiversity Atlas were from 2007, 50 kilometres north-east near Glenthompson (BLA 2019) and the nearest camp is in Warrnambool, some 57 kilometres south of the wind farm. Given the complete lack of records pre-construction, only the results from Year 1, Year 2 and Year 3 monitoring are reported here.

The first evening survey (2 hours after sunset) in 2020 was on 19 March. Systematic dusk monitoring of Grey-headed Flying-foxes on the wind farm started on 26 March in 2020 and 18 February in 2021. As part of the 2020 BAM Plan monthly monitoring at Woodcutter's Lane, the first Grey-headed Flying-fox were recorded on 20 February 2020 (6 individuals) and large groups of Grey-headed Flying-fox were seen on 10 March 2020 (n=825) and 19 March 2020 (n=574) (Figure 12) and mortalities were detected on the wind farm on 10 March 2020 (Figure 13), indicating the species was present and flying through the wind farm. A total of 96 individuals were observed flying through the wind farm on the first dusk survey night, 26 March 2020 (Figure 13). In 2019, Grey-headed Flying-foxes were recorded at Cobra Killuc Nature Reserve on 22 February 2019 (n=41) and at Woodcutters Lane on 27 February 2019 (n=120) (Figure 12).

The highest number of mortalities were detected in 'intermediate' Year 2 autumn (n = 14 during formal surveys; n=1 incidental find) (Biosis 2020, Elmoby Ecology 2020) and lowest in 'wet' Year 3 autumn (n=1). Slightly higher number of mortalities were recorded in 'dry' Year 1 (n=1 25 September 2019; n=3 20-22 February 2019). The Grey-headed Flying-fox carcass found at SCWF on 25 September 2018 is the only mortality recorded in spring over three years when BAM Plan monitoring and additional investigations have been carried out. Although the recorded mortalities were higher in Year 2 than Year 3, a similar total number of individuals was observed flying through the wind farm (98 in 2020 and 92 in 2021). The monitoring began later in 2020 so some groups flying through may have gone undetected. The number of individuals detected flying through the wind farm in Year 2 and Year 3 is a much smaller proportion of the overall numbers of Grey-headed Flying-foxes that occurred in the area in autumn of both years (Biosis 2021), with groups totalling 1,529 in 2020 at Woodcutters Lane. The 2021 detailed investigation focused monitoring efforts on the wind farm and the Hexham camp and the Woodcutters Lane location was not monitored.

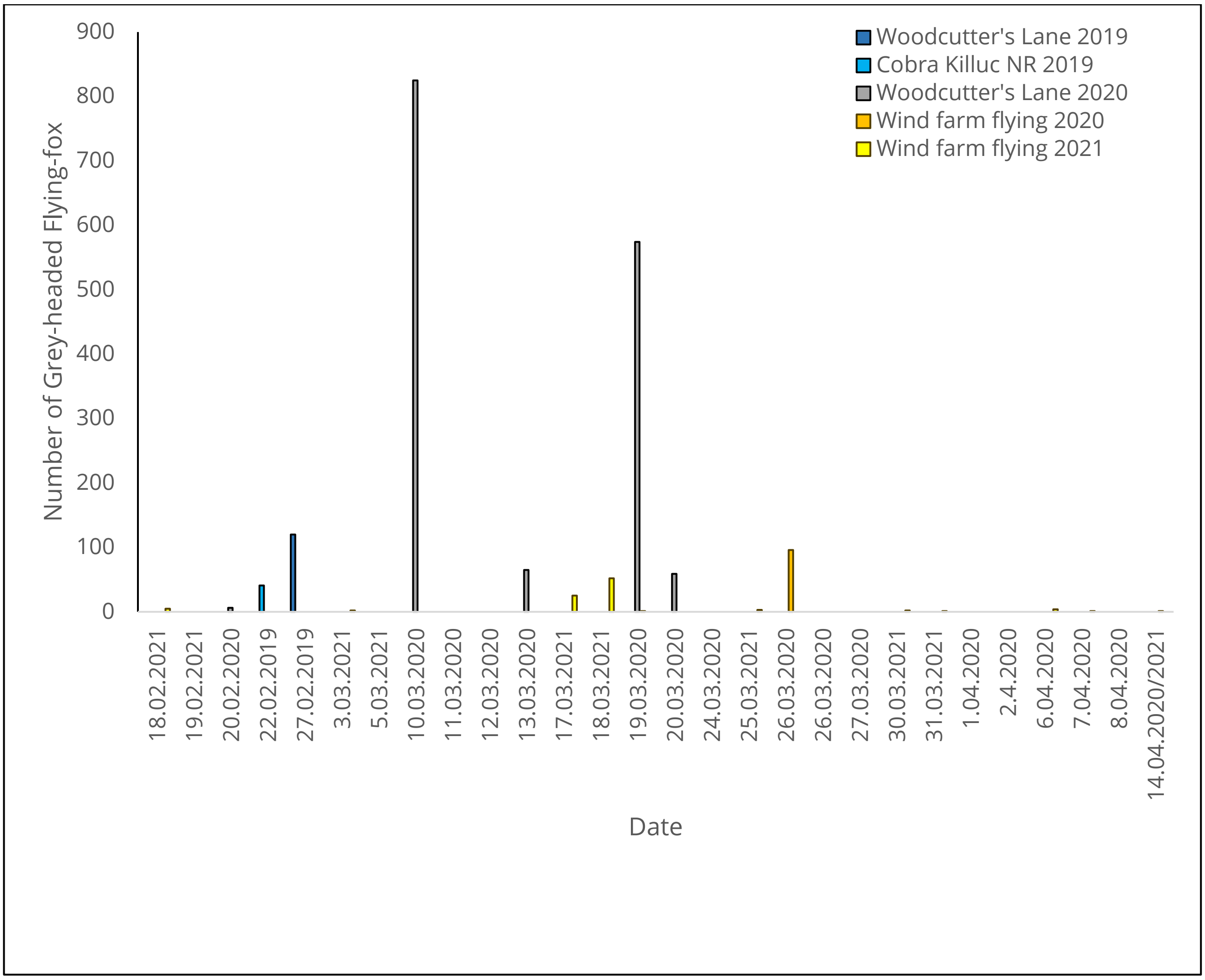


Figure 12 Number of Grey-headed Flying-fox individuals recorded in 2019 (BL&A 2019), 2020 (Biosis 2020) and 2021

The timing of Grey-headed Flying-fox presence in Year 3 (2021), with Year 2 (2020) and Year 1 (2019) was similar, with first individuals detected on 18 February in 2021, and numbers of individuals flying through the wind farm on 17 March 2021 (n=25) and 18 March 2021 (n=52) (Figure 12, Figure 13). The last individuals detected in 2021 were a week earlier (6–7 April) compared with 2020 (14 April) (Figure 12, Figure 13). In 2019 Grey-headed Flying-foxes were recorded in mid-February (22 and 27 February) outside the wind farm at Cobra Killuc Nature Reserve and Woodcutters Lane, however none was observed in fortnightly surveys from 28 March 2019 to 30 April 2019.

Fewer numbers of Grey-headed Flying-foxes were observed flying through the wind farm and Woodcutter's Lane in 2021 than in 2020. No surveys were undertaken on the wind farm in 2019 and a single observation at Woodcutters Lane in mid-February 2019 indicates smaller numbers were present in 2019 than in 2020, although the survey effort is not comparable due to an increased frequency of sampling in 2020 compared with 2019.

In 2019, three Grey-headed Flying-fox carcasses were found 20-22 February 2019. A total of 18 mortalities have been recorded at SCWF to date (between September 2018 and July 2021). The first mortalities occurred at approximately the same time in 2020 and 2021 (11 March in 2020; 5 March in 2021), however 2-3 weeks earlier in 2019 (20-22 February 2019) (Appendix 11). In 2020, the mortalities occurred over a six-week period, whereas in 2019 they were recorded over three days and in 2021 one mortality was found on one day only. Fewer mortalities were recorded in 2021 (n=1), and in 2019 (n=1 25 September 2019; n=3 20-22 February 2019) compared with 2020 (n=14 during formal surveys; n=1 incidental find) (Biosis 2020, Elmoby Ecology 2020) (Figure 13). The Grey-headed Flying-fox carcass found at SCWF on 25 September 2018 is the only mortality recorded in spring over three years of BAM Plan monitoring.

In summary, the timing of Grey-headed Flying-fox presence was similar over the three consecutive years of monitoring, although the exact timing, number of individuals present in the wind farm and surrounds and the number and timing of mortalities varied between the years. Therefore, the Grey-headed Flying-fox have been recorded at about the same time each year over three years – from early-February to early April (over eight weeks), with peak numbers from mid-February to late March (over six weeks) (Figure 12). In Year 3 the timing of presence coincided with 8-11% Sugar Gum flowering and presence of a camp within the Hexham pine plantation, which was discovered in 2021. The 11% Sugar Gum canopy flowering coincided with the greatest number of Grey-headed Flying-foxes detected flying through the wind farm on 17 March 2021 and 18 March 2021 (Figure 9, Figure 10, Figure 13). Sugar Gum were not systematically monitored in Year 1 or Year 2 but the presence of the Grey-headed Flying-foxes coincided with observed Sugar Gum flowering in these years also.

During the 2021 monitoring of Sugar Gum flowering, the peak flowering occurred during a 4-week period. The flowering increased from 8% to a peak of 11% within a month, from 19 February 2021 and until 18 March 2021 (Figure 10). The average percentage of canopy flowering, and trees in flower, then rapidly decreased to 4.5% and 4.7% within two weeks, before declining further to 0.8% canopy flowering and 0.3% trees in flower after another two weeks of monitoring on 28 April 2021.

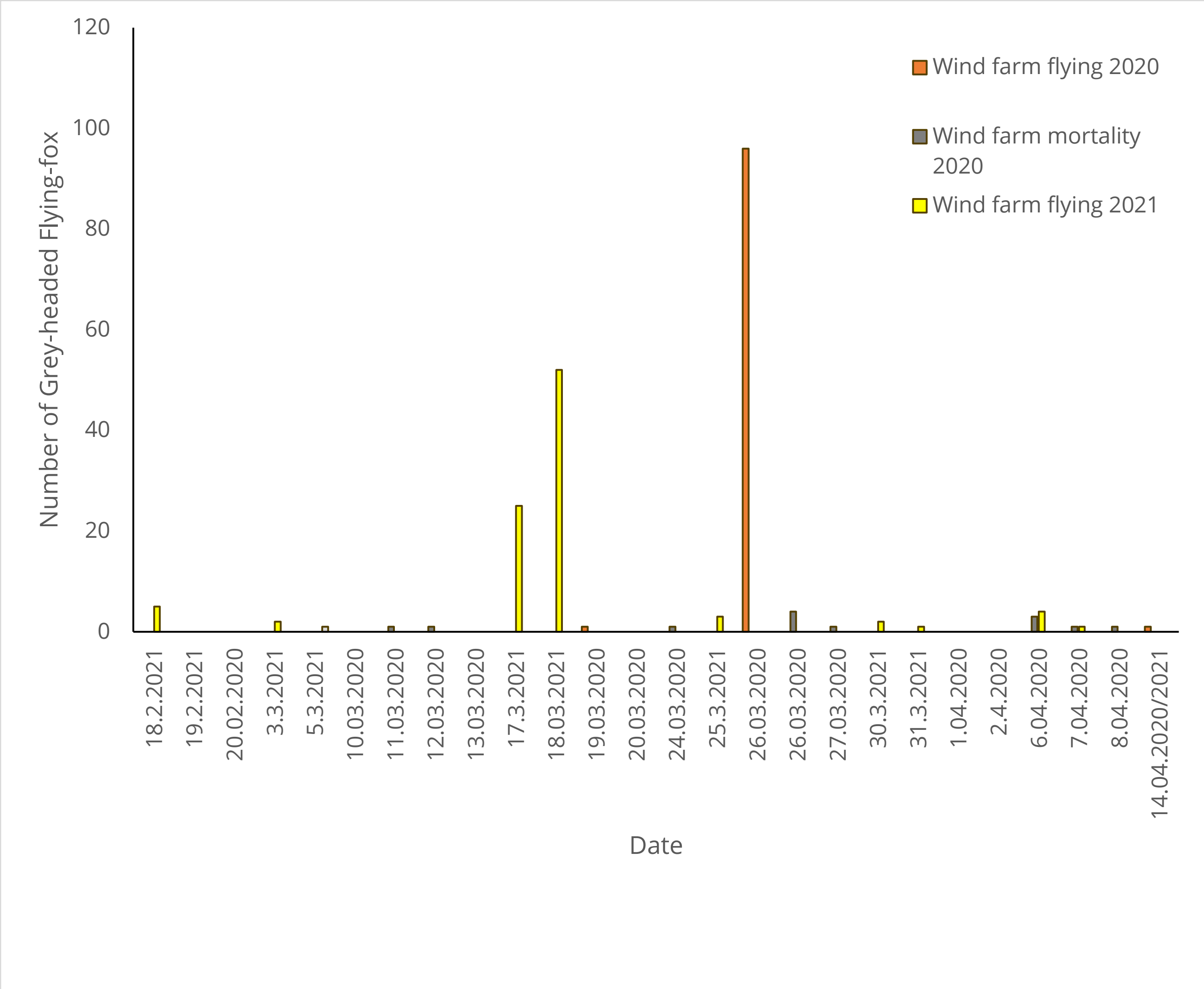


Figure 13 Number of Grey-headed Flying-fox detected on the wind farm in 2020 and 2021 (the 2019 mortalities are excluded as no simultaneous wind farm dusk/dawn observations were undertaken in that year)

3.4.2 Grey-headed Flying-fox dusk, dawn and all-night surveys – wind farm and camp exit surveys Year 2 and Year 3

Daily timing of flights

Grey-headed Flying-foxes were detected on seven dusk surveys and two dawn surveys out of the total 20 dusk and dawn surveys, and on two of the total seven all-night surveys (Table 11), indicating that most flights occurred around dusk. The time of Grey-headed Flying-fox occurrence at SCWF in 2021 was similar to 2020, though on two occasions (3 March; 7 April) their flights through the wind farm were over the expected known emergence time of 34–55 minutes for this species (Meade et al. 2019) (Table 11). The two observations of Grey-headed Flying-foxes during dawn surveys were 1 hr 28 min and 1 hr 34 min before sunrise.

The flight direction of individuals was more variable in 2021 than in 2020. In 2020, flights were from south-west to north-east (Biosis 2020), whereas in 2021, individuals were recorded flying across the wind farm from south-west to south-east, south to north, west to east and east to west (Table 11). A number of the flights did not cross the entire turbine layout in 2021 as they did in 2020.

In 2021, as noted in 2020, fewer individuals were recorded returning towards camp before dawn than were seen at dusk, and pre-dawn flights also occurred much less frequently than dusk flights across the wind farm. In 2020, 59 Grey-headed Flying-foxes were seen flying north to south at Woodcutters Lane, before dawn on 20 March, towards the Hexham pine plantation. In 2021, Grey-headed Flying-foxes were seen on two pre-dawn surveys at the wind farm, with four and three individuals observed on 18 March and 25 March respectively. The 2020 Atlas of Living Australia data of a satellite-tracked individual in 2020 indicates some movement back and forth does occur before Grey-headed Flying-foxes completely move away from the local area.

The simultaneous camp exit counts and wind farm counts indicated that generally fewer Grey-headed Flying-foxes flew north, and across the wind farm compared with numbers that were present at the camp (4,666–27,150) or departed the camp (Table 11). On 3 March 2021, 12 individuals were seen during the camp exit count, and two were recorded on the wind farm 1 hr 3 minutes later. On 17 March 2021, a total of 31 Grey-headed Flying-foxes were counted leaving the camp and flying north towards the wind farm, with 25 individuals counted on the wind farm 15 minutes later. From 23 March 2021 to 31 March 2021, small numbers of Grey-headed Flying-fox flew north from the camp, towards SCWF (5–7 individuals). None were recorded flying through the wind farm at dusk on these dates. Small numbers of individuals (n=1–4) were seen at the wind farm at dusk on other dates, until 7 April 2021, suggesting that majority of the Grey-headed Flying-foxes had moved away from the area by this date.

3.4.3 Recorded and estimated mortalities at SCWF in Year 1 (2019), Year 2 (2020) and Year 3 (2021)

Spatial patterns of observations and mortalities at SCWF

Grey-headed Flying-foxes were detected in flight at turbines 1, 2, 3, 5, 7, 9 and 11 and a mortality was recorded at turbine 9 in 2021 (Figure 14). In 2020, individuals were observed at turbines 1, 2 and 8, and mortalities were recorded at turbines 1, 2, 3, 5, 6, 7, 9, 14. Mortalities were detected at turbines 3, 10 and 14 in February 2019, and turbine 5 in September 2018 (BL&A 2019) (Appendix 8). No Grey-headed Flying-foxes have been observed or recorded during carcass searches at turbines 4, 12, 13 and 15. These results suggest that Grey-headed Flying-foxes fly mostly through the middle and the western parts of the SCWF.

Summary of mortality estimation for Grey-headed Flying-foxes in Year 2 and Year 3

Part B of this Year 3 report outlines the methods and results of Grey-headed Flying-fox mortality estimation. A total of 13 Grey-headed Flying-fox carcasses were found during formal surveys, with 12 of these found in Year 2 and one (1) in Year 3. The findings from the formal surveys and carcass persistence trial resulted in a mean estimated mortality of 78 individuals, and 95% confidence of fewer than 125 individuals, over the 24-month period. The average annual mortality was estimated to be 2.6 individuals per turbine, per year. However, the actual number of mortalities is likely to vary from year-to-year depending on the location of flowering food resources and the flight paths Grey-headed Flying-foxes take to access the resources.

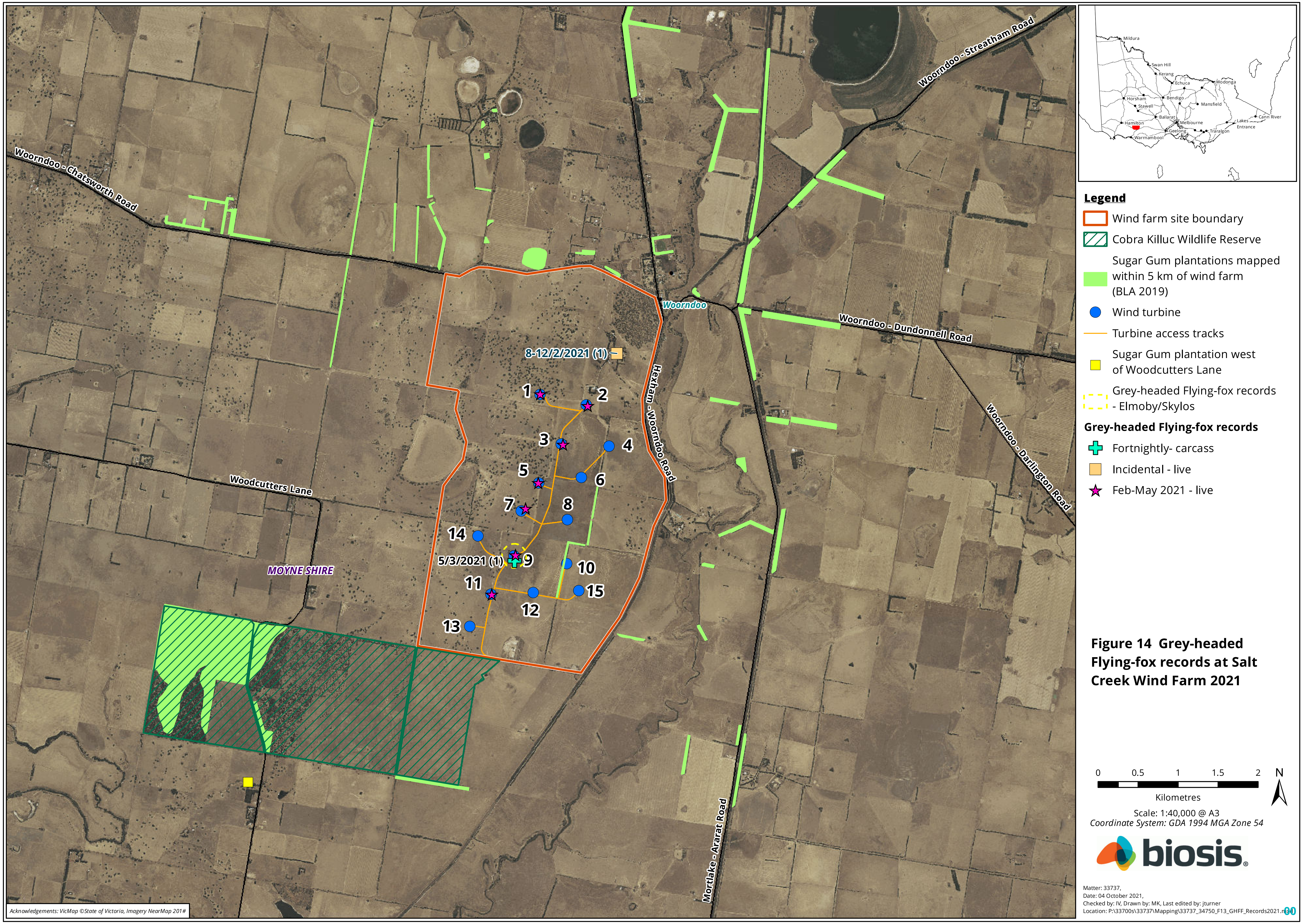


Figure 14 Grey-headed Flying-fox records at Salt Creek Wind Farm 2021

Matter: 33737,
Date: 04 October 2021,
Checked by: IV, Drawn by: MK, Last edited by: jturner
Location: P:\33700s\33737\Mapping\33737_34750_F13_GHFF_Records2021.mxd

00

3.5 Carrion removal program

If and when carrion was reported by the site manager, it was reported immediately and removed within one – two days.

3.6 Fox control program

A shooting contractor was last engaged for the Fox control program during Apr / May and Jun / Jul 2021.

4. Part A – Implications and recommendations

4.1 Brolga utilisation monitoring program

4.1.1 Flocking season

No brolgas were observed flocking within 5 kilometres of the SCWF during the pre-construction, Year 1, Year 2 or Year 3 monitoring. The area within the 5 kilometre radius around the wind farmis not known to support any regular flocking. Single pairs in all years, and a group of 4-5 Brolgas in Year 3 (flocking season 2021), were recorded using 11 different wetlands during the flocking seasons over the three year monitoring period. In May 2020, a Brolga pair was found using multiple wetlands and one pair was found with a nest in June 2020. It is possible that two pairs were present in May 2020, but this could not be confirmed as the wetlands were surveyed at different times of the day.

The pre- and post-construction flocking season observations do not meet the three criteria required for a wetland to be defined as a flock roost site (DSE 2012):

- More than one year of recording.
- One or more records of counts to or greater than 10 birds.
- Recorded in more than one month.

The nearest known flocking area to SCWF are the Darlington/Dundonnell/Streatham (Salt Lake/Pink Lake/Blue Lake complex) approximately 16 kilometres east and Lake Bolac, approximately 18 kilometres north east of the wind farm. Brolgas are known to move from flocking areas to breeding areas in May-June (Arnol, White, & Hastings 1984, Veltheim 2018). The pairs, and the group of 4–5 in 2021, observed within 5 kilometres of the SCWF are likely to be breeding pairs or a family group, dispersing from a flocking area to a breeding area. Given the lack of Brolga flocks during the flocking season monitoring pre- construction and over a 3-year post-construction monitoring period, which spanned a range of rainfall conditions, the risk of wind farm related impacts to Brolgas between December and June for the lifetime of the Project is very low.

4.1.2 Breeding season

The SCWF appears to regularly support one breeding pair. There is no indication based on historical data from the VBA, pre-construction surveys in 2006 (Biosis 2006) or the post-construction surveys that there has been a change in the number of breeding pairs within 3 kilometres of the wind farm during the Brolga breeding season (July – December). Brolgas were only recorded nesting in Year 2, which was determined to be an intermediate rainfall year. Nesting attempts in the Year 2 breeding season were recorded three times between August 2019 and December 2019, and once during the Year 3 flocking season in June 2020. All these breeding attempts were unsuccessful as no chicks hatched or fledged. No breeding attempts were recorded in the years that were determined as dry (Year 1) and wet (Year 3), with one pair recorded in Year 1 (September 2018) and none in Year 3. A VBA breeding record from 1984, an observation from the pre-construction flocking surveys and post-operation monitoring suggests that wetland 29150 remains to be used by Brolgas, including for nesting.

The higher rainfall in Year 2 compared with Year 1 may have resulted in increased water levels in wetlands potentially suitable for breeding within 3 kilometres of the SCWF. In contrast the complete lack of Brolga observations in Year 3, which had the highest rainfall of the 3-year monitoring period, could suggest the water levels in wetlands may have been too high to be suitable for nesting.

However it should be noted that no analyses have been undertaken, or are required under the BAM plan, to link local rainfall with wetland water levels or breeding wetland availability, nor to collect variables that could help understand breeding success or failure or to try and separate it from any potential effect of the wind farm on nesting activity or breeding success. Additionally, several variables could be contributing to the number of Brolgas attempting to breed, or to failed breeding attempts and it is not possible to draw any conclusions based on the observations of a single pair. Nest initiation and breeding success of Brolgas can be influenced by water levels in a wetland (which in turn may vary depending on the depth and area of the wetland, and whether it has a drain), disturbance, stock use of the wetland, inexperience of a breeding pair, influence of other brolga pairs or other species such as swans competing for nest sites, and native and introduced predators.

Therefore it is not possible to determine, or draw any conclusions on the reasons for differences in breeding attempts between pre-construction or post-construction wind farm operation, or between years with different amount of rainfall, or to determine why the breeding attempts in 2019–2020 were unsuccessful and why the overall Brolga activity was lower in Year 1 (single pair) and Year 3 (no Brolgas observed). However, given the continued presence of a pair within 3 kilometres of the SCWF, it is unlikely the wind farm has had an effect on Brolga breeding pair numbers, presence, occupancy or breeding activity.

4.1.3 Recommendations for brolga utilisation program

There is no evidence to date of Brolga collisions with SCWF infrastructure (Elmoby Ecology 2021) after three subsequent years of flocking and breeding season monitoring. Based on the carcass searches and the breeding and flocking season monitoring surveys, collision risk to Brolgas at SCWF is likely to be low. The 3-year monitoring program is considered to have sufficiently spanned across different rainfall conditions, which could influence wetland availability and their suitability for breeding Brolgas and numbers and activity during flocking seasons. Brolga nesting attempts have occurred within 2.4–4.0 kilometres of the nearest SCWF turbine, with the first attempt within 3 kilometres of turbines recorded in Year 2 (June 2020). The low number of Brolga observations and activity indicates the risk of impact on Brolga breeding activity is very low for the project's lifetime.

No further monitoring of Brolga activity or mortality is recommended, as the risk of impact is deemed low due to overall low Brolga activity within 3–5 kilometres of the wind farm. This is unlikely to change over the project's lifetime, although the timing of Brolga presence and activity may vary year-to-year depending on rainfall's effect on wetland habitat suitability.

4.2 Bat utilisation monitoring program

The objective of the BAM Plan microbat monitoring program is to document microbat occurrence and activity at the SCWF site over a minimum of three years following the commencement of turbine operations. In accordance with Condition 33 (PL 06/304) of the planning permit, monitoring must include provisions for assessment of the influence of wet and dry climatic conditions on the utilisation of the subject land by bat populations. These provisions allow for the splitting of the monitoring program over non-sequential years so that results better reflect the long term utilisation of the site by bats.

Data collected during Year 3 adds to operational data collected in Year 2 and Year 1 as well as to pre-construction data previously collected by Biosis in 2006. Seasonality across the years was determined to sufficiently represent conditions that microbats could experience and respond to – Year 1 was determined 'dry', Year 2 'intermediate' and Year 3 'wet' (Section 3.1). Microbat monitoring undertaken to date is therefore considered to meet Tilt Renewable's Australia Pty Ltd monitoring requirements, as outlined in Section 3.2 of the SCWF BAM Plan.

Acoustic monitoring undertaken at SCWF during the Year 3 found a similar composition of microbat species to those identified prior to construction and during the Year 1 and Year 2 operational monitoring periods. This includes the critically endangered Southern Bent-wing Bat.

The number of Southern Bent-wing Bat calls detected in Year 2 was much higher than the number of calls detected in Year 1 (Nature Advisory 2020) or Year 3. In Year 1, a total of five calls of the species, and 14 of the species complex, were detected at ground level at three turbines (T02, T10, T13). No calls were detected at turbine height. In Year 2 a total of 49 calls were detected in spring with seven at turbine height and 724 calls were detected in autumn, including three at turbine height. Year 3 activity was similar to Year 1, with a total 14 calls were recorded in spring with four at turbine height, and 4 calls at turbine height were recorded in autumn (ground detectors in autumn Year 3 failed).

The reason for the higher number of Southern Bent-wing Bat at the SCWF in Year 2 is unknown. A number of uncontrolled variables prevent making conclusions and numeric comparisons between years or seasons based on the bat call data. These include detector and microphone models, microphone sensitivity, installations methods and weather conditions, which can affect bat activity and detectability of sound. Therefore, based on the collected data no comparisons can be made between overall bat activity levels, and no inferences can be made between the higher number of calls detected and the overall higher bat mortality detected in Year 2 and Year 3.

Analysis of calls identified as Southern Bent-wing Bat and Southern Bent-wing Bat Complex over the duration of the post-construction monitoring program found:

- Calls were recorded in all post-construction monitoring years.
- Calls were recorded at ground and at height over the duration of the monitoring program. However, most activity was typically recorded at ground.
- Calls were recorded in spring and autumn over the duration of the post-construction monitoring program, excluding spring 2018 where no calls were recorded at either ground or at height.
- Call activity was found to be higher in autumn compared with spring based on comparisons between data collected between 2018 and 2021.
- Call activity was highest in the years of Year 2 when compared with results collected in Year 3 and Year 2.
- Call activity was consistently highest at ground detector site T10 over the duration of the post-construction monitoring program.

Call activity monitored over the duration of the monitoring program suggests Southern Bent-wing Bat utilisation of the site does not appear to be influenced by the operation of SCWF. Nevertheless, it is acknowledged that bat activity, as reflected by call recordings, does not necessarily reflect seasonal or locational abundance.

4.2.1 Mortality of Gould's Wattled Bats and White-striped Free-tail Bats

DELWP requested an investigation into the potential biological implications of the Gould's Wattled Bat and White-striped Free-tail Bat mortalities at SCWF, as part of the Year 3 report review process, addressed in this section.

Both the White-striped Free-tailed Bat and the Gould's Wattled Bat are common and widespread and not listed under the EPBC Act or FFG Act. Both are listed of 'Least Concern' in the IUCN Red List. The International Union for Conservation of Nature (IUCN) Red List entry has assessed the current populations for each species

(Lumsden et al. 2021, Pennay 2020). White-striped Freetail Bat was assessed as decreasing and includes the following text (Pennay 2020):

"Listed as Least Concern in view of its wide distribution, occurrence in many protected areas, tolerance of a broad range of habitats including urban and disturbed areas and, large population. Despite the likelihood the species has undergone substantial local declines in regions where wind turbines are widespread these areas are limited in relation to the species total range and as an overall population it is currently unlikely to be declining fast enough to qualify for listing in a threatened category."

"It is widely recorded, in part because it has a call audible to humans and does not require specialist equipment to detect (Pennay et al. 2011). It appears to be a common species throughout its range and local populations are suspected to be declining due to mortality at wind farms. This species is highly susceptible to collision with wind turbines, presumably because its preferred foraging height overlaps with the elevation of wind turbine rotors. It was the first bat species recorded to be killed by wind turbines (Hall and Richards 1972), and it is the most commonly recorded bat species in monitoring of fatalities at windfarms (M. Pennay pers. comm.). It is possible that local populations are seriously impacted by wind farm developments given the high rates of mortality and low rates of reproduction, particularly in high wind areas where multiple wind farms operate. These localised impacts are unlikely to cause sufficient decline in the species overall population to despite its apparent tolerance of habitat disturbance. The species may be threatened by loss of large old trees that provide suitable roosting and breeding habitat through land clearing for agriculture, urban development, or changed fire regimes in particular the impact of important central hub roosts is unknown. It has been recorded in the diet of feral cats (Woinarski et al 2018). Global warming may be a serious threat to this species in the future because the species is tied to temperate Australia."

No citation or source on the potential impact of wind farms on local populations is provided, or on the method for assessing the decline.

The IUCN Red List assessment considers Gould's Wattled Bat population as stable and includes the following text for the Gould's Wattled Bat (Lumsden et al 2021):

"This species is listed as Least Concern in view of its wide distribution, use of a broad range of habitats, large population size, adaptability to modified environments, and because it is not known to be declining."

"It is a common and widespread species (Dixon and Lumsden 2008) and the population is assumed to be stable."

"Although this species can roost in artificial habitats, in many areas it is dependent on trees for roosting and foraging, and so it is susceptible to habitat loss and degradation due to ongoing decline of mature trees from residential expansion, timber harvest, and ranching. Increased fires from drought also contributes to the loss of roost trees. Climate change has brought increased extremes in weather and drought which negatively impacts survival. Feral and domestic cats are known to prey on the species."

No known published sources of population estimates for either species exist. Estimating biological implications of mortalities at the SCWF is therefore not possible.

White-striped Freetail Bat

A response on the White-striped Free-tailed Bat mortalities at the Dundonnell Wind Farm was recently provided to Tilt Renewables (September 2021). Below is a summary, with additional information, relevant to SCWF.

The White-striped Free-tailed Bat is a common and widespread species occurring across virtually all habitats in southern Australia, including alpine areas and urban areas. The species roosts in trees across their range either individually or in roosts of up to 20 individuals (Churchill 2008). Females produce one young per year

(Churchill 2008). Their diet primarily consists of moths and beetles, and they are known to fly 50 metres or more above the ground (Churchill 2008), which places them at particular risk of colliding with wind turbines. White-striped Free-tailed Bats represent the majority (67%) of all bat carcass finds at wind farms across Victoria (Moloney et al 2019).

To date, 62 White-striped Free-tailed Bat carcasses have been found at SCWF from 2018 to 2021 (Year 1 = 8; Year 2 = 34; Year 3 = 20). There is no information available on population numbers for the species. It is therefore not currently possible to differentiate between different population scales, nor assess the broader implications of the mortalities observed so far at SCWF. In the absence of population information, other wind farms provide additional and useful context to the mortalities observed.

Moloney et al. (2019) calculated mortality rates for White-Striped Freetail Bat and Gould's Wattled Bat for two Victorian wind farms. At one wind farm, they estimated mortality of 6.2 White-striped Free-tailed Bats per turbine per year, which equated to 397 individuals per year at that particular wind farm (64 turbines) and 2.7 per turbine per year, totalling 378 individuals (140 turbines) (locations not specified) (Moloney et al. 2019).

At SCWF White-striped Freetail Bat carcasses were 25%–52% of all detected bat mortalities, and therefore less than all bat carcass finds at other Victorian wind farms in Moloney et al. (2019) (note that Grey-headed Flying-fox is combined with microbats). At SCWF this species represents the majority of carcass finds.

The range of estimated mortality differs between wind farms. However, using these estimates for the White-striped Freetail Bat, for SCWF (15 turbines) mortalities could be expected in the range of 41–101 individuals. Total bat mortality estimates for SCWF varied from 196 (Year 1), 342 (Year 2) and 277 (Year 3). It is not possible to determine the annual mortality estimate for the White-striped Freetail Bat at SCWF, as all the bats were combined for the estimate (microbats and Grey-headed Flying-fox combined).

Gould's Wattled Bat

The Gould's Wattled Bat is common, widespread and occurs throughout Australia. Gould's Wattled Bat is a tree-hollow roosting species with a preference for River Red Gum (*Eucalyptus camadulensis*) (Churchill 2008). They are adaptable and found in a variety of habitats (Churchill 2008). Colonies can vary from 8 to 40 in tree hollows (Churchill 2008) and the SCWF contains suitable habitat as River Red Gums are present within and along the western boundary of the wind farm. Colonies consist of females, with males roosting as solitary individuals and daily movements between roosts are common (Churchill 2008). Roosts can be occupied throughout the year for many years, with bats entering hibernation in the cooler months.

Gould's Wattled Bat eats a variety of flying invertebrate species and moths that form the main part of their diet (Churchill 2008). Foraging movements are commonly within 5-10 km, and up to 15 km, from roost (Churchill 2008), indicating bats using SCWF could roost locally in the adjacent River Red Gums, or fly from further away. The species flies at or below canopy height and follows forested edges while moving and foraging (Churchill 2008). The mortalities at SCWF indicate the species also flies higher than at tree canopy height, given carcasses have been found under turbines.

A total of 33 Gould's Wattled Bat carcasses have been found at SCWF from 2018 to 2021 (Year 1 = 8; Year 2 = 4; Year 3 = 21). There is no information available on population numbers for the species and assessing the impact to the population is therefore not possible. Information from other wind farms provides some context to the level of mortalities recorded elsewhere in Victoria for this species.

Mortality rates of Gould's Wattled Bat at one wind farm was 1.0 per turbine per year (64 per year for 64 turbines) and 0.7 at another wind farm (98 per year for 140 turbines). The per turbine per year mortality estimate is not available for the Gould's Wattled Bat at the SCWF but if similar rates of mortality are expected the total would range from 11 to 15 per year. This indicates that Gould's Wattled Bat may have a higher mortality rate in some years (per year per turbine) than would be expected at these two other wind farms in

Victoria. The actual number of mortalities found at SCWF varied between years and the reason for variation is unknown. The proximity of River Red Gums, which is the species known and preferred roost tree may explain the higher than expected mortality in some years.

Summary

Both the White-striped Free-tailed Bat and the Gould's Wattled Bat are common and widespread species. Carcasses of both species have been recorded at Victorian wind farms, with White-striped Freetail Bats comprising the majority of bat carcasses detected.

Moloney et al. (2019) considered mean mortalities of 378–397 White-striped Freetail Bats from two Victorian wind farms as 'very high and likely to represent a significant proportion of the local population of this species in these areas', noting that density estimates for the species are lacking. The total mean number of all bat mortalities (microbats and Grey-headed Flying-fox combined) at SCWF were estimated at 196–342. Annual White-striped Freetail Bat mortality at SCWF is therefore less than at the wind farms Moloney et al. (2019) included in their study. Nevertheless, the SCWF monitoring results suggest some impact to local populations near SCWF but with the lack of density or population estimate data it is difficult to ascertain the magnitude of this impact. Pennay (2020) states that wind farm impacts resulting in decline of local populations of this species are unlikely to significantly affect the overall population at a rate to change its status from a common to a threatened species.

Gould's Wattled Bat mortalities are lower than for White-striped Freetail Bats at Victorian wind farms where mortality estimates are possible (Moloney et al. 2019). At SCWF the mortality rate may be higher in some years, per turbine per year, than at other wind farms (Moloney et al. 2019). Although local, state or national population estimates for this species are lacking, an average annual mortality of 11–15 individuals is unlikely to have a population level impact during the operational phase of the SCWF.

4.2.2 Recommendations for bat utilisation program – microbats

As multiple variables (including detector and microphone models, microphone sensitivity, installations methods and weather conditions) can affect the detectability of sound and, as a consequence, the recording of bat calls, it is recommended that trigger levels for management response(s) for SCWF continue to be defined by the number of mortalities that may be detected through incidental carcass monitoring rather than indirect measures of bat utilisation monitoring.

No confirmed Southern Bent-wing Bat mortalities have been recorded at the SCWF during Year 1 (Nature Advisory 2020), Year 2 or Year 3 (Elmoby Ecology Part B in Biosis (2020) and Part B this report). Although an increased number of the species' calls were detected in Year 2, only a small number were at turbine nacelle height. These findings indicate the species can fly within the rotor swept area and risk of collision mortality to individual Southern Bent-wing Bat exists. This risk is difficult to quantify due to the lack of mortality detections at SCWF, and as activity at nacelle height cannot be directly linked to collision risk. If rainfall is a factor in increased activity levels and movements across the wind farm, there was no indication that the highest rainfall of the three years in Year 3 had any influence on Southern Bent-wing Bat activity, with Year 1 'dry' and Year 3 'wet' activity similar and with the highest activity recorded in Year 2 'intermediate' rainfall year. Biosis provide the following recommendations, based on the Year 1, Year 2 and Year 3 BAM plan bat utilisation program results and with the consideration of sufficiently having monitored across years with different rainfall that could influence microbat activity and collision risk at the SCWF:

- Mortality monitoring is not continued, however incidental carcass finds will be reported in accordance with the BAM Plan.

4.3 BAM plan-defined significant impacts – Grey-headed Flying-fox monitoring

Over the 3-year monitoring period at the SCWF, a BAM plan-defined significant impact on the Grey-headed Flying-fox has occurred in each year, as at least one individual has been detected in carcass searches (Nature Advisory 2020, Elmoby Ecology Year 2 (Part B in Biosis 2020), Elmoby Ecology Year 3 Part B in this report). Although the level of impact on the Grey-headed Flying-foxes at SCWF to date is not considered to represent a significant impact as defined under the EPBC Act (Biosis 2020), individual mortalities and injuries of this species from SCWF are defined as a significant impact under the BAM plan due to the species' conservation status. Mortalities have been detected in each monitoring year and the number of mortalities each year is unpredictable and likely to vary depending on the intensity and location of flowering Sugar Gums. A camp was found within a pine plantation near Hexham, with an estimated 4,666–27,150 Grey-headed Foxes present in March 2021 and the Biosis surveys indicate that groups move in different directions from the camp and a very small proportion appear to be flying through the wind farm. The camp is likely to form annually and individuals may fly through the wind farm while the camp is present.

The survey and monitoring results indicate that Grey-headed Flying-fox will occur in the area and fly through the SCWF each year, for the lifetime of the wind farm and as long as food resources and the Hexham camp remain viable to support the Grey-headed Flying-fox locally. Therefore, annual mortalities, and a BAM plan-defined significant impact on this species are likely to occur for the operational lifetime of the wind farm. Mortality surveys and carcass persistence trials estimated a mean mortality of 78 individuals, and 95% confidence of fewer than 125 individuals, over the 24-month period. The average annual mortality was estimated to be 2.6 individuals per turbine, per year, though the actual number of mortalities is likely to vary from year-to-year depending on the location of flowering food resources and the flight paths Grey-headed Flying-foxes take to access the resources.

The studies completed to date indicate that the species moves through the wind farm in larger numbers during late summer–autumn, which are most likely to represent migratory movements, in response to weather and increased food availability within 10–15 kilometres of the wind farm at this time of the year. Southward movements in spring (September–October) also occur and have resulted in a mortality previously (Nature Advisory 2020) but the monitoring suggests the risk of collision is lower than in autumn.

4.3.1 Recommendations for BAM plan-defined significant impacts Grey-headed Flying-fox

Management of BAM Plan-defined significant impacts on the Grey-headed Flying-fox will be incorporated into Grey-headed Flying-fox management plan, currently being prepared for the SCWF.

After a review of the Year 3 monitoring report and findings, DELWP and Council have recommended an additional three years of Grey-headed Flying-fox mortality monitoring to understand annual variation in the species' activity and mortality; and to understand the longer-term implications of the species' mortality rates at SCWF.

Report 236

Post Construction Bird and Bat Monitoring Results, Year 3: August 2020 to July 2021

Salt Creek Wind Farm, Victoria

Prepared by
Emma Bennett

for

Tilt Renewables Pty Ltd.

September 2019

ELMOBY ECOLOGY

5. Part B – Introduction

5.1 Background

The purpose of this report is to summarise findings of the Year 3 of post construction bird and bat monitoring at the Salt Creek Wind Farm in accordance with the approved BAM Plan. The BAM Plan was developed by Jacobs Group Pty Ltd in accordance with Condition 33 (PL 06/304) of the planning permit issued by the Shire of Moyne for the Salt Creek Wind Farm.

Collection and use of specimens were conducted under the Wildlife Act 1975 Research Permit number 10007321, allowing for the collection and storage of birds and bats found dead within the wind farm site and along roadsides for the purpose of scavenger and searcher efficiency trials.

5.2 Scope and Objective

As outlined in the BAM Plan, the primary scope of the bird and bat monitoring program is to:

Monitor the impact of the Salt Creek Wind Farm on populations of significant avifauna species that may utilise the site, in particular:

- Brolga (*Antigone rubicunda*)
- Southern Bent Wing Bat (*Miniopterus schreibersii bassanii*); and,
- Other species listed under the Environment Protection and Biodiversity Conservation Act 1999, the Flora and Fauna Guarantee Act 1988 and the Advisory list of Threatened Vertebrate Fauna in Victoria –2013 (the Advisory List).

And if required, to:

> *Develop a Mitigation and Management Strategy for any biologically significant impacts on Brolgas and bats arising from the wind energy facility operations.*

The study area encompasses all 15 turbines of Salt Creek Wind Farm to a radius of 132m from the base of the turbine. Salt Creek Wind Farm is located 190km west of Melbourne, approximately 55km north of Warrnambool and 70km east of Hamilton (Figure 15). Access to the Salt Creek Wind Farm is off Hexham-Woorndoo Road. The Salt Creek Wind Farm site encompasses 750 hectares of grazing land located in the eastern section of the Salt Creek Merino Stud. The Salt Creek Wind Farm is predominantly cleared agricultural land used for livestock grazing.

Figure 15 Location of turbines for Salt Creek Wind Farm. Image courtesy of Google Maps

5.3 Climatic Conditions

Under the BAM Plan, impact monitoring must occur in the first available 'dry', 'intermediate', or 'wet' year. Determination of the climatic classification of the year was done in consultation with the Department of Environment Land, Water and Planning (DELWP). Year 1 of monitoring was determined to be 'dry' (see Year 1 Report, Nature Advisory). Year 2 of monitoring was determined to be 'intermediate', and Year 3 of monitoring was determined to be a 'wet' year (see Part A Section 3.1).

6. Part B – Methods

6.1 Data Analysis Overview

Quantifying bird and bat mortality from turbine collision is an ongoing management issue for wind energy facilities, and different sites present different risks. Differences in monitoring requirements across Victoria means that data analysis must account for variations in survey effort, survey detection success, and scavenger efficiency. Data analysis was undertaken by Symbolix using Monte-Carlo simulations, which account for differences in survey effort. Full methods can be found in Appendix 12.

6.2 Carcass Persistence Trials

Persistence trials determine how long a carcass persists in the survey area before being removed by scavenging animals such as foxes, ravens, and birds of prey. Four trials were undertaken in Year 1 by Nature Advisory to determine the rate at which carcasses persist within the survey area and this rate was considered adequate for Year 2 and 3 mortality estimates (full methods for this can be found in Year 1 and 2 Reports). An additional trial was undertaken in Year 3 to target removal rates for Grey-headed Flying-foxes (Appendix 13). Quantifying the rate of removal by scavengers is essential to understand how many carcasses are available for detection by observers and to provide correction factors for subsequent impact estimates.

6.2.1 Grey-headed Flying-fox persistence

Rabbits of a similar weight were used as a proxy to determine removal rates for Grey-headed Flying-foxes as large bat carcasses were unavailable at the time of the study. Carcasses (n=15) were randomly distributed among the turbines at Salt Creek Wind Farm, with no more than 2 carcasses at each turbine. Rabbit source (store-bought/wild shot) and colour was recorded, as well as placement time, underlying substrate, and distance from turbine. Carcasses were between 700g and 900g if store-bought and 800g and 1000g if wild shot. Cameras set to a 1 hour time delay recorded the carcasses, and site visits were conducted on days 1, 7, 14, 21, and 31 to ensure camera operation and to check if carcasses had been moved outside the field of view. Existing infrastructure was used to secure cameras. The time a carcass was last seen was recorded via photo analysis.

6.2.2 Data Analysis

Survival analysis was used to determine the average time carcasses remained in the field before scavenging. As an exact time of removal is not known for all carcasses, survival analysis provides an interval in which the scavenge event has occurred. Survival analysis is used to fit a curve to the data which provides an estimate of the survival percentage after a given length of time (full details can be found in Appendix 13).

6.3 Searcher Efficiency

Searcher efficiency trials determine the likelihood of a survey team detecting a carcass during formal surveys if one is present. Carcasses are randomly distributed by an independent individual throughout the survey area at least one hour prior to search team (handler and dog) arrival. To ensure dogs are not tracking human footsteps, carcasses are thrown from a randomly designated point and allowed to land naturally. GPS coordinates of the throw location and direction of throw are recorded, and an indirect path is walked back to the vehicle. Whilst handlers are aware of the trial being undertaken, the trial is still considered blind as handlers are unaware of carcass number and type and which turbines are and are not baited, thus providing sufficient blinding to validate the testing. GPS tracking of both dogs and handlers allows survey duration to be compared to standard non-trial surveys to ensure additional effort is not made by search teams in light of trials being conducted.

6.3.1 Data Analysis

Observer efficiency data was provided to Symbolix to allow for correction based on observational bias. The dog and handler teams engaged at Salt Creek Wind Farm are simultaneously engaged in work at other wind energy facilities and all searcher efficiency data was provided to Symbolix. Trials conducted at Salt Creek Wind Farm were compared with other trials conducted on the same dog and handler teams and analysed for differences using binomial regression and differences between birds and bats using stepwise AIC selection.

6.4 Carcass Searches

Carcasses surveys were conducted by trained detection dogs and their handlers monthly from August 2020 until July 2021, with additional fortnightly surveys from September to October 2020, and March to April 2021 at every turbine to a radius of 130m. Dogs searched across the turbines using transects approximately 20m apart depending on topography, and were fitted with live tracking GPS collars to ensure full coverage of the survey area. Finds were then recorded by the handler and removed from the survey area. Amendments to the original BAMP methodology were approved by the Moyne Shire on the 30/8/2019 allowing the use of dogs to replace humans in the search for bird and bat carcasses. Full details of the survey methodology can be found in Section 3.3.1.3 of the BAM Plan.

6.4.1 Data Analysis

Mortality estimations are calculated via three Monte-Carlo simulations, one for bats (less Grey-headed Flying-foxes), one for birds, and an additional estimation for Grey-headed Flying-foxes. Each used 25,000 simulations of the survey design. Random numbers of virtual mortalities were constructed, along with the scavenge loss time and carcass persistence (based on the measured confidence intervals). The proportion of virtual carcasses that were “found” was recorded for each simulation. Those trials that had the same outcome as the reported survey detections were collated, and the initial conditions (i.e., how many true losses) were reported on.

This simulator has been found to perform comparably to other theoretical estimators, but more easily incorporates changing or complex survey designs. Full details of the analysis can be found in Appendix 9.

7. Part B – Results

7.1 Searcher Efficiency

Searcher efficiency trials were carried out at Salt Creek Wind Farm in Year 2, and data was combined with additional surveys from Silverton Wind Farm for the same dog/handler teams. There was no evidence that searcher efficiency differed between the sites nor the target (different sized birds or bats), thus data was aggregated into a single estimate to provide a stronger confidence of the mean. Searcher efficiency was 96% with a 95% confidence interval of [89%, 99%] (Table 11).

Table 12 Detection efficiency combined

Variable	Combined estimate
Number found	74
Number placed	77
Mean detectability proportion	0.96
Detectability lower bound (95% confidence interval)	0.89
Detectability upper bound (95% confidence interval)	0.99

7.2 Carcass Persistence

7.2.1 Year 1

Four carcass persistence trials, with a total of 40 carcasses, were conducted by Nature Advisory in each season of Year 1, with complete data used for analysis. There were 3 carcasses remaining at the end of the trial, 2 large birds and 1 large bat. Due to the limited sample size, differences between classes (birds or bats) or seasons was not investigated, and a combined survival curve for all birds and bats was derived (Figure 16). The survival curves show us that the mean time to total loss by scavengers is 2.1 days with a 95% confidence window of [1.2, 3.8] days.

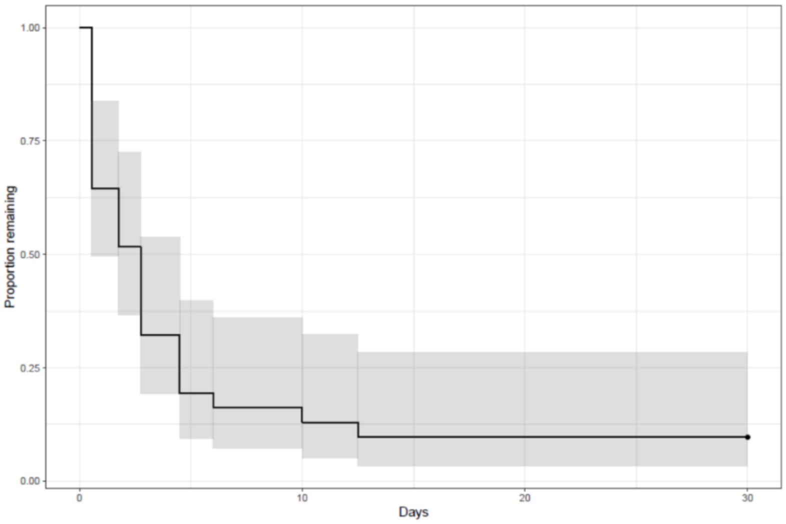


Figure 16 Survival curve showing persistence for all birds and bats combined with 95% confidence interval shaded.

7.2.2 Grey-headed Flying-fox Trial

The type of rabbit carcass (wild or store-bought), the distance from the turbine, and the substrate the carcass was on did not influence the time to scavenge. Therefore, a simple intercept model was used to describe persistence. The median time to scavenge was 3.2 days with 95% confidence [1.6, 6.3] days (Figure 17).

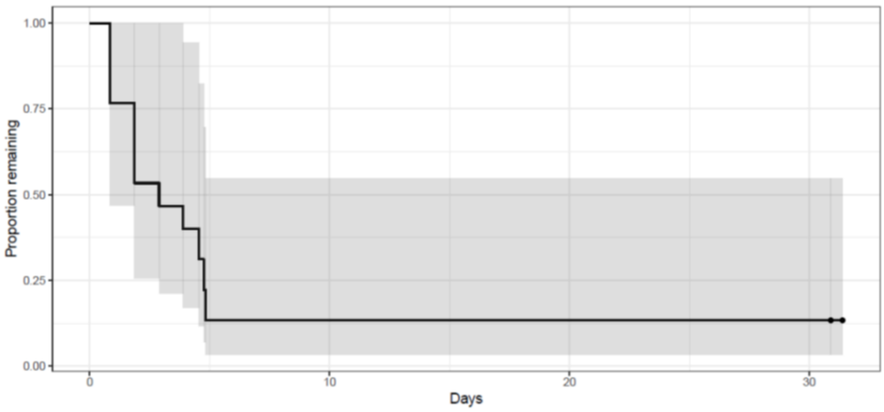


Figure 17 Survival curve fitted to data. The circles at the end of the curve represent carcasses still on the ground at the end of the trial. The grey shading shows the 95% confidence interval

Comparison of this trial with previous trials at Salt Creek Wind Farm and state averages for Victoria (Symbolix 2020) are provided in Figure 18 and Table 12.

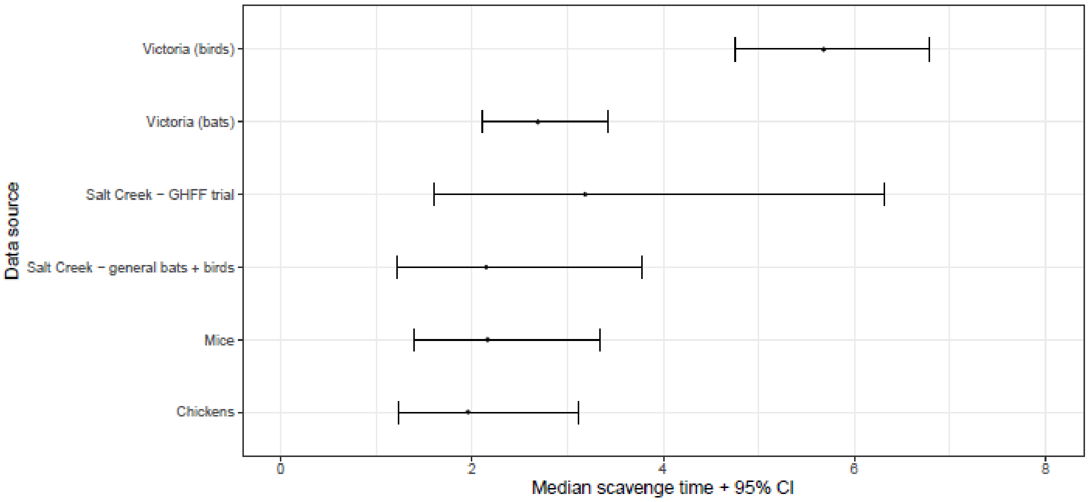


Figure 18 Comparison of median scavenger rates.

Table 13 Median and confidence intervals for various persistence rates

Source	Median	CI
Victoria (birds)	5.7	[4.8, 6.8]
Victoria (bats)	2.7	[2.1, 3.4]
Victoria (Wedge-tailed Eagles)	287.3	[130.1, 634.5]
Salt Creek – general birds and bats	2.1	[1.2, 3.8]
Salt Creek – Grey-headed Flying-fox trial	3.2	[1.6, 6.3]
Mice	2.2	[1.4, 3.3]
Chickens	2.0	[1.2, 3.1]

7.3 Carcass Searches

Carcass searches for Year 3 were carried out between August 2020 and July 2021. Across all 15 turbines, 253 searches were conducted (Table 13). During the month of August, two turbines were not surveyed due to the presence of active lambing.

Table 14 Carcass Survey Summary per month

	Date	Number of surveys
2020	Aug	13[1]
	Sep	30
	Oct	30

	Date	Number of surveys
	Nov	15
	Dec	15
	Jan	15
2021	Feb	15
	Mar	32
	Apr	43
	May	15
	Jun	15
	Jul	15

[1] *An agreement between Salt Creek Merino Stud Farm manager and detection dog handlers from Skylos Ecology was verbalised and teams are to avoid turbines with active lambing when working dogs.*

A total of 62 bats and 48 birds/feather spots were found during routine mortality searches (Table 14). An additional 3 'incidental' carcasses were found outside the survey area (Table 15). These incidental findings were not included in the formal analysis.

Table 15 Summary of species found during carcass searches (see alsoAppendix 14)

	Species	Count
	Eastern falsistrelle	1
	Gould's long-eared bat	1
	Southern free-tailed bat	1
	Chocolate wattled bat	7
	Gould's wattled bat	21
	White-striped free-tailed bat	20
	Large forest bat	1
	Lesser long-eared bat	4
	Little forest bat	2
	Grey-headed flying fox	1
	Unidentifiable bat	3
birds	Australian magpie	11
	Starling	5
	Nankeen kestrel	4
	Australasian pipit	2
	Sulphur crested cockatoo	3
	Brown falcon	2
	Eastern barn owl	2
	Unidentified bird	2
	Wedge-tailed eagle	2
	Black shouldered kite	1

	Species	Count
	Eurasian skylark	1
	European sparrow	1
	Fan tailed cuckoo	1
	Long billed corella	1
	Peregrine falcon	1
	Quail species	1
	Sacred kingfisher	1
	Yellow-rumped thornbill	1
	Australian raven	1
	Crimson rosella	1

Table 16 Summary of incidental finds outside survey area

Species	Month
Wedge-tailed eagle	August 2020
Straw-necked Ibis	October 2020
White-striped free-tailed bat	February 2020

7.3.1 Mortality estimation for bats

Across the Year 3 survey period, a total of 62 bats were found at Salt Creek Wind Farm, with 61 finds being microbats from the two families Vespertilionidae (night bats) and Molossidae (free-tailed bats). The remaining bat, one Grey-headed Flying-fox is from the family Pteropodidae. Finds were found in every month except May and July, with three quarters of all bats found during the two month period of March and April. The resulting estimate, taking into consideration carcass persistence and searcher efficiency, is a mean loss of 342 bats for the survey period. Based on the detected carcasses we can be 95% confidence that fewer than 484 individual bats were lost (Figure 19).

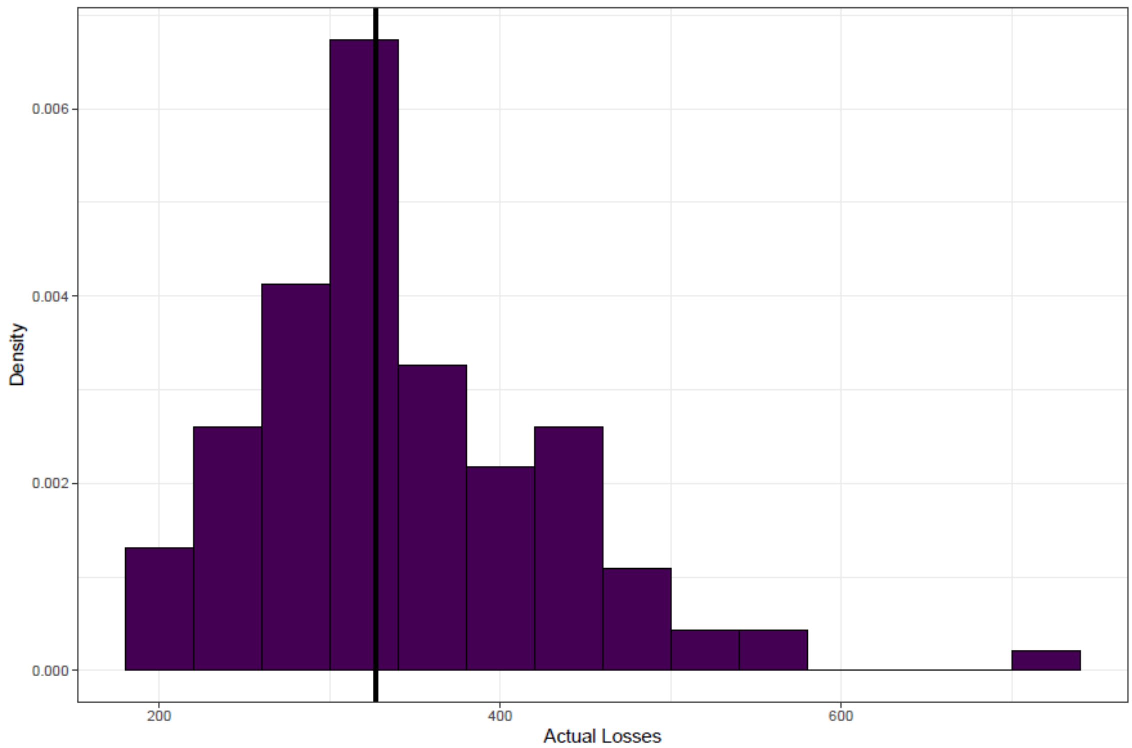


Figure 19 Empirical distribution of bat losses at Salt Creek Wind Farm

7.3.2 Comparison of bat mortality between Year 2 and 3

During the Year 2 of surveys, a total of 65 bats were found, providing an expected mean mortality of 377, and 95% confidence that fewer than 584 individuals were lost. This differs from previous reported estimates due to the use of a log-normal scavenge shape instead of exponential and minor updates to the simulation methods. In comparison, the estimated mortality for year 3 is 342 bats. Using the statistical test Kolmogorov-Smirnov to determine if there is a significant difference between the modelled distribution of years it was found that there was no evidence for a difference in the distribution of mortalities between Year 2 and Year 3. This contrasts with Year 1where it was found that the distribution of Year 1 is shifted left relative to Year 2 and thus mortality is higher in Year 2 (and therefore Year 3) relative to Year 1.

7.3.3 Mortality estimation for Grey-headed Flying-foxes in Year 2 and Year 3

A total of 13 Grey-headed Flying-fox carcasses were found during formal surveys across Year 2 and Year 3. The resulting estimate, which accounted for searcher efficiency, scavenging rate, search area and timing of surveys, is a mean expected loss of 78 Grey-headed Flying-foxes over the 24-month survey period, with 95% confidence that fewer than 125 individuals were lost (Figure 20).

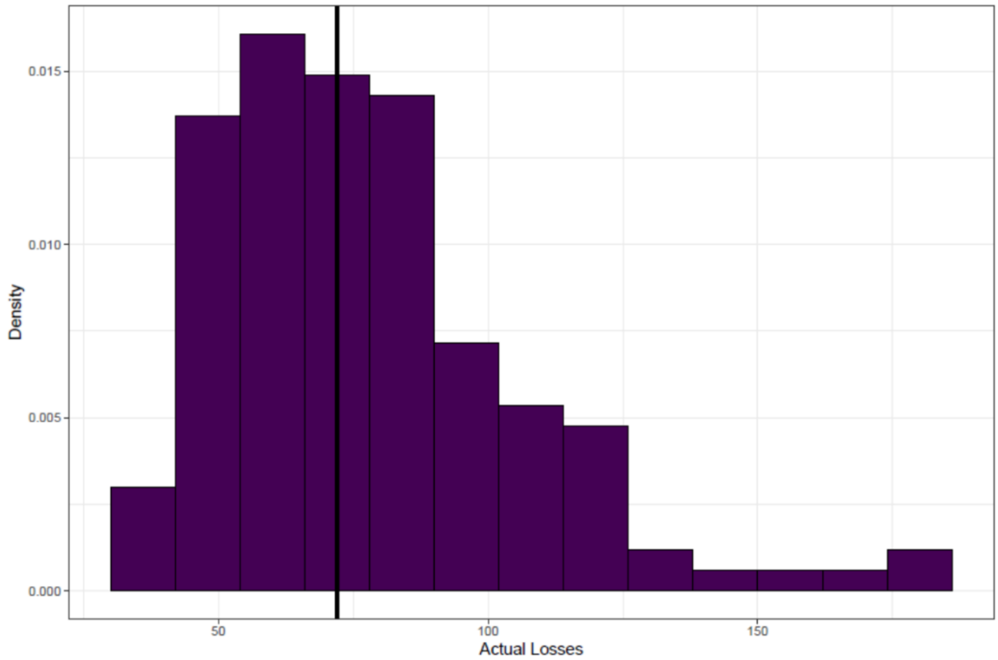


Figure 20 Empirical distribution of Grey-headed Flying-fox losses over both years 2 and 3 combined. The solid black line shows the median.

7.3.4 Mortality estimation for birds

Across the survey period, a total of 48 birds were found at Salt Creek Wind Farm, with carcasses detected in each month except November. No temporal distribution was evident. The resulting estimate, taking into consideration scavenger removal and searcher efficiency, is a mean loss of 265 birds for the period. Based on the detected carcasses we can be 95% confident that fewer than 414 individual birds were lost (Figure 21).

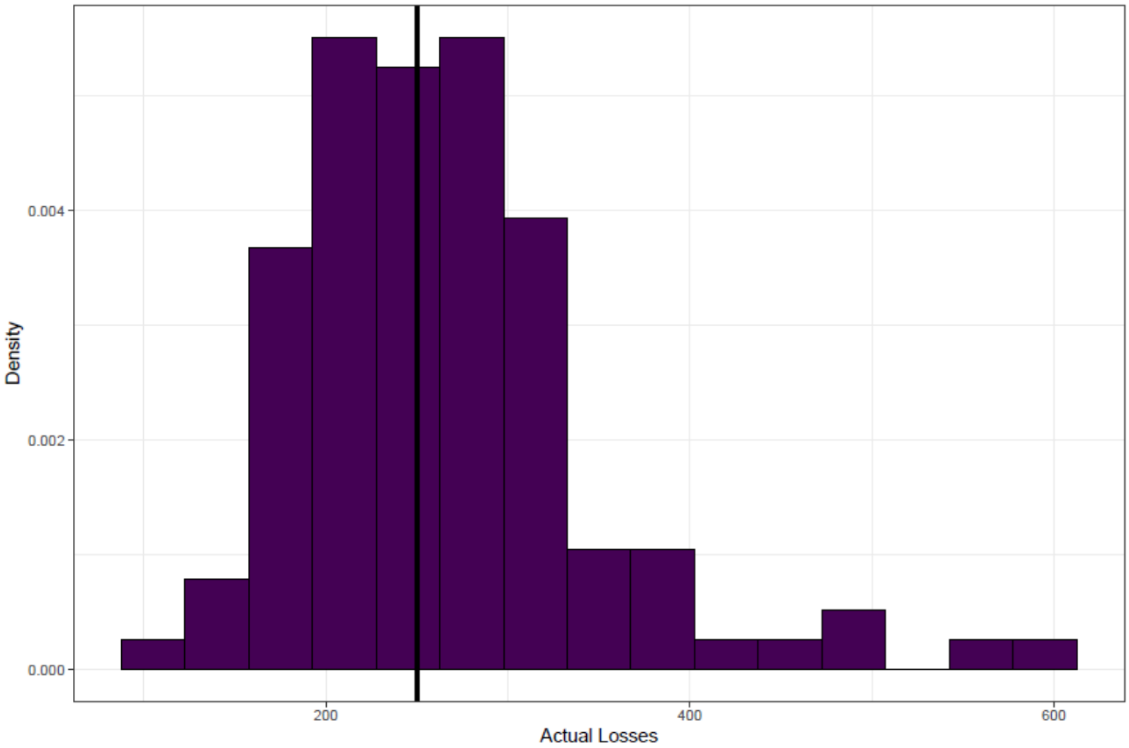


Figure 21 Empirical distribution of bird losses at Salt Creek Wind Farm

7.3.5 Comparison of bird mortality between Year 2 and Year 3

During Year 2 surveys, a total of 47 birds were found providing an expected mean annual mortality of 279, and 95% confidence that fewer than 415 individuals were lost. Again, it is noted that this differs from previous reported figures due to the use of a log-normal scavenge shape instead of exponential and updates to the simulation methods. In comparison, the estimated mortality for Year 3 is 265 birds. No evidence for a significant difference between the modelled distribution of years was found using the Kolmogorov-Smirnov statistical test. This in contrast with Year 1, where it was found that the distribution of Year 1 is shifted left relative to Year 2, and thus mortality is higher in Year 2 (and therefore Year 3) relative to Year 1.

8. Part B – Discussion

8.1 Searcher Efficiency

Results from several trials indicated that combined searcher efficiency for detection of both birds and bats is 96% [89%, 99%] and consistent (and slightly higher) with other sites utilising dog/handler teams. There was no difference in the detectability of birds and bats by the dog/ handler teams and this is primarily driven by dogs' use of olfactory detection rather than visual based searches. The use of dogs is particularly advantageous for small targets such as bats and small birds where evidence suggests that humans have low detection rates (Mathews et al. 2013).

8.2 Carcass Persistence

The influence of carcass persistence on final mortality estimates should not be underestimated. In Victoria it has been demonstrated that microbats disappear at a faster rate than small to large birds, which are removed faster than large raptors, such as eagles. The sample size presented here is not sufficient to determine carcass-specific persistence rates, thus we acknowledge that scavenging times for bats is likely faster and for birds likely slower than the 2.1 days presented here as a mean removal time. It is useful when comparing persistence to include studies undertaken at different locations where possible to increase sample size, particularly where similar removal rates exist, such as neighbouring wind farms or those under similar land use. State-wide data prepared by Symbolix for DELWP shows that the mean removal time for birds across western Victoria is 5.7 days, and the mean removal time for bats is 2.7 days, which differs substantially from the 2.1 days used to estimate mortality here.

The measured removal rate for rabbits was 3.2 days, which is slower than the 2.1 days recorded during previous scavenger trials. Evidence from the state-wide analysis suggests mice of similar weight make a valid proxy for microbats, and thus rats or rabbits of a similar weight should be a valid proxy to measure the removal of GHFFs from the survey area. The recorded scavenging rate for rabbits could be slower than the previous trials as rabbits may be scavenged at a slower rate than other carcasses, the change in climatic conditions from dry to wet may influence scavenger activity, or because efforts to reduce fox numbers in the vicinity have been effective. Small sample sizes across each of the carcass persistence trials means it is difficult to have certainty around removal rates however the measured removal rate for Grey-headed Flying-foxes/rabbits is consistent with the state-wide averages (Figure 4) and provides a useful benchmark for further trials.

8.3 Carcass Searches

8.3.1 Microbat Mortality

Overall mortality estimates for micro-bats at Salt Creek Wind Farm are 95% confident that no more than 484 bats were impacted during Year 3 of monitoring. The average number of micro-bats likely to be impacted per turbine per year is 23 with a 95% confidence that less than 32 micro-bats will be impacted. This is similar to Year 2 where an estimated 25 micro-bats per turbine where impacted, but an increase on Year 1 where an average of 13 micro-bats per turbine were impacted. More than three quarters of all micro-bats detected during Year 3 surveys were found in March and April, and no bats were found from June through to October.

The diversity of bat species found at Salt Creek Wind Farm is indicative of the location of the site. Species such as white-striped free-tailed bats (*Austronomus australis*) are typical of farmlands and open areas, whilst the forest bats (*Vespadelus species*) are more frequently associated with forested sites which are less prevalent at this location.

8.3.2 Grey-headed Flying-fox Mortality

Almost all GHFF carcasses were detected in Year 2, with only a single collision recorded in Year 3. Changes in site use, availability of food resources, and population abundance are discussed in Part A of this Year 3 report, which provides further insight into the effects of mortality on populations. The average number of Grey-headed Flying-foxes likely to be impacted by the Salt Creek Wind Farm is 2.6 per turbine per year, although this number will vary in response to site utilisation.

8.3.3 Bird Mortality

Overall mortality estimates for birds at Salt Creek Wind Farm are 95% confident that no more than 265 birds were impacted during the third year of monitoring. The average number of birds likely to be impacted per turbine per year is 18 birds, with a 95% confidence that less than 28 birds per turbine will be impacted. This is similar to Year 2 where 19 birds per turbine were impacted, but an increase on Year 1 where an average of 9 birds per turbine were impacted.

8.3.4 Comparison of Mortality

Mortality is relatively consistent for both birds and bats in Years 2 and 3, where consistent field methods were used. Differences in the distribution of finds from Year 1 may either be due to changes in field methods, or that Year 1 was considered a dry year, whilst Year 2 was intermediate, and Year 3 was wet.

8.4 Significant Impacts

Events considered as significant impacts are outlined in Section 4 of the endorsed BAM Plan for Salt Creek Wind Farm. The Grey-headed Flying-foxes, listed as vulnerable under the Commonwealth EPBC Act and vulnerable in Victoria (DSE 2013) was detected during routine surveys. No other species listed under the Commonwealth EPBC Act, threatened under Victoria's FFG Act or species listed as vulnerable, endangered or critically endangered under the Advisory list of threatened vertebrate fauna in Victoria (DSE 2013) were found during carcass searches at Salt Creek Wind Farm.

9. Part B – Recommendations

9.1 Searcher Efficiency

It is recommended that no further searcher efficiency trials are needed. The same dog and handler teams have consistently performed to a high standard across multiple wind farms sites in Victoria and NSW, and results are consistent for the detection team regardless of the different vegetation and location at which they were tested.

9.2 Carcass Persistence

Changes in carcass persistence may have influenced the final mortality estimation and would have provided additional certainty around estimations had further trials been conducted in Year 3. If further mortality surveys are undertaken, it is recommended that additional persistence trials are conducted to ensure that changes to scavenger behaviour and differences in bat and bird removal are captured at the time of data collection.

9.3 Mortality Survey

Estimates from the previous two years of surveys have demonstrated high mortality for both birds and bats at Salt Creek Wind Farm. No bird species listed as threatened or endangered were detected and the species found are typical of wind farm collisions reported in western Victoria. It is unlikely that for any of the species detected, the mortality events at Salt Creek Wind Farm will threaten population viability. At this site, over two-thirds in Year 2 and three-quarters in Year 3 of bat carcasses were collected in March and April, although it should be noted that additional search effort occurred in these months. Additionally, all Grey-headed Flying-foxes carcasses were found in March and April and therefore these months can be considered the highest impact to both micro and macro bats throughout the year. Impacts and implications of the Grey-headed Flying-fox mortalities were investigated by Biosis (Part A).

References

Arnol J, White D, & Hastings I 1984. *Management of the Brolga (Grus rubicundus) in Victoria*, Department of Conservation, Forests and Lands, Fisheries and Wildlife Service, Resources and Planning Branch, Technical Report Series No. 5. Department of Conservation, Forests and Lands, Melbourne, Australia.

Biosis 2021. Salt Creek Wind Farm: Grey-headed Flying-fox significant impact investigation. Report for Tilt Renewables Australia Pty Ltd. Veltheim, I., Farqhuhar, J., Russell, W. Biosis Pty Ltd, Ballarat, VIC. Project no. 34750.

Biosis 2020a. Salt Creek Wind Farm: Second Year Annual Report – Bat and Avifauna Management Plan 2019 / 2020. Report for Tilt Renewables Australia Pty Ltd. Veltheim, I, Gibson, M, Potts, C. Biosis Pty Ltd. Ballarat, VIC. Project no. 30622.

Biosis 2020. *Salt Creek Wind Farm: Grey-headed Flying-fox significant impact investigation*, Report prepared for Tilt Renewables Australia Pty Ltd. Veltheim. I, Smales. I, Biosis Pty Ltd, Melbourne, VIC. Project no. 31923.

Biosis Research (2006). *Bat Activity Report for the Proposed Salt Creek Wind Farm, Woorndoo, Victoria.* Report prepared for NewEn Australia Pty Ltd. Gilmore, D. & Venosta, Biosis Research Pty Ltd, Melbourne, VIC. Project no. 5800.

BL&A 2019. *Salt Creek Wind Farm Grey-headed Flying-fox impact assessment report*, Report prepared for Tilt Renewables Australia Pty Ltd. Brett Lane and Associates, June 2019, Report No. 15101 (16.4), Hawthorn, Australia.

Casanova M & Casanova A 2016. *Current and future risks of cropping wetlands in Victoria: Technical report. Charophyte Services*, The State of Victoria, Department of Environment, Land, Water and Planning.

Colac Otway Shire Council (2019). Colac Grey-headed Flying-fox Management Plan 2019 – 2024. Colac Otway Shire Council, Geelong, Australia. Commonwealth of Australia (2017). Draft national recovery plan for the Grey-headed Flying-fox (*Pteropus poliocephalus*). Department of the Environment and Energy. Canberra, Australia.

Corrick A 1982. Wetlands of Victoria III. Wetlands and waterbirds between Port Phillip Bay and Mount Emu Creek, Proceedings of the Royal Society of Victoria 94: 69–87.

DELWP 2016. Victorian Wetland Inventory (Current), Department of Environment, Land, Water, and Planning. East Melbourne, Victoria. https://discover.data.vic.gov.au/dataset/victorian-wetland-inventory-current.

DSE 2013. *Advisory List of Threatened Vertebrate Fauna in Victoria – 2013*, Victorian Government Department of Sustainability and Environment. Melbourne, Victoria.

DSE 2012. *Interim Guidelines for the Assessment, Avoidance, Mitigation and Offsetting of Potential Wind Farm Impacts on the Victorian Brolga Population 2011*, Victorian Government Department of Sustainability and Environment.

Jacobs Group 2017. *Salt Creek Wind Farm: Bat and Avifauna Management Plan*, Report to Salt Creek Wind Farm Pty Ltd. P Burn, Jacobs Group Pty Ltd, Melbourne, VIC. Project No. IS122900.

Mathews F, Swindells M, Goodhead R, August TA, Hardman P, Linton DM, & Hosken DJ 2013. 'Effectiveness of search dogs compared with human observers in locating bat carcasses at wind-turbine sites: a blinded randomized trial', *Wildlife Society Bulletin*, 37: 34–40.

Meade, J., van der Ree, R., Stepanian, P.M. et al. (2019). Using weather radar to monitor the number, timing and directions of flying-foxes emerging from their roosts. Sci Rep 9, 10222 (2019). https://doi.org/10.1038/s41598-019-46549-2.

Myers A 2001., *Factors influencing the nesting success of brolgas, Grus rubicundus in Western Victoria*,Honours thesis, School of Ecology and Environment, Deakin University, Burwood, Australia.

Nature Advisory 2020. *Salt Creek Wind Farm. Bat and Avifauna Management Plan – First Annual Report*, BAM Plan Year 1 Report April 2020. Report No. 15101 (17.3), Hawthorn, Australia.

Gopi Sundar, K. S., Grant, J. D. A., Veltheim, I., Kittur, S., Brandis, K. McCarthy, M., A. & Scambler, E. C. (2019) Sympatric cranes in northern Australia: abundance, breeding success, habitat preference and diet, Emu - Austral Ornithology, 119:1, 79-89.

R Core Team, 2013. R: A Language and Environment for Statistical Computing. R Foundation 673 for Statistical Computing, Vienna. http://www.R-project. org/.

Sheldon R 2004., *Characterisation and modelling of brolga (Grus rubicundus) habitat in south-western Victoria: relationships between habitat characteristics, brolga abundance and flocking duration*, Honours Thesis, University of Ballarat, Australia.

Symbolix 2020. *Post construction bird and bat monitoring at wind farms in Victoria*, Public report – preprint. Symbolix Pty Ltd.

Veltheim I 2018., *Movements, behaviour and ecology of the brolga, Antigone rubicunda, at multiple spatial and temporal scales*, PhD thesis, School of Applied and Biomedical Sciences, Faculty of Science and Technology, Federation University Australia, Ballarat, Victoria.

Veltheim I, Cook S, Palmer GC, Hill FAR, & McCarthy MA 2019. 'Breeding home range movements of pre-fledged brolga chicks, *Antigone rubicunda* (Gruidae) in Victoria, Australia – Implications for wind farm planning and conservation', *Global Ecology and Conservation*, 20: e00703.

Westcott, D.A., McKeown, A., Murphy, H.T., and Fletcher, C. S. 2011. A monitoring method for the grey-headed flying-fox, *Pteropus poliocephalus.*

White D 1987. The status and distribution of the brolga in Victoria, Australia, Pages 115-131 in G. Archibald and R. F. Pasquier. Proceedings of the 1983 International Crane Workshop.

Appendix 1: Species reference calls used in bat call analysis

Southern Bent-wing Bat *Miniopterus orianae bassanii*

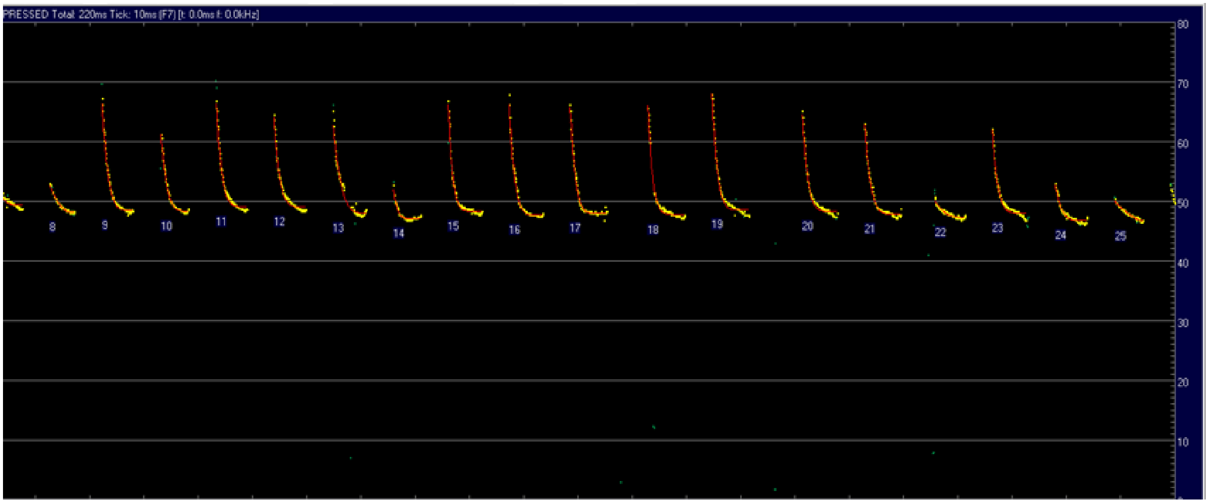


Figure 22 Example of Southern Bentwing Bat call in Anascheme.

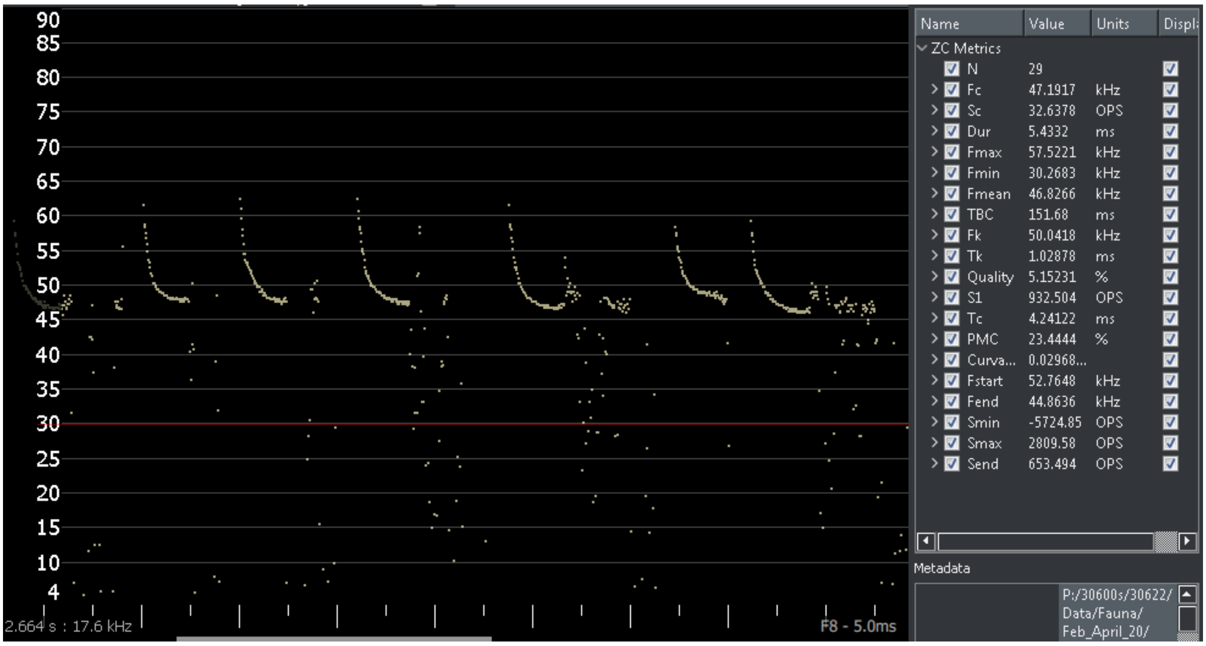


Figure 23 Example of Southern Bent-wing Bat call in Anabat Insight.

White-striped Freetail Bat *Austronomus australis*

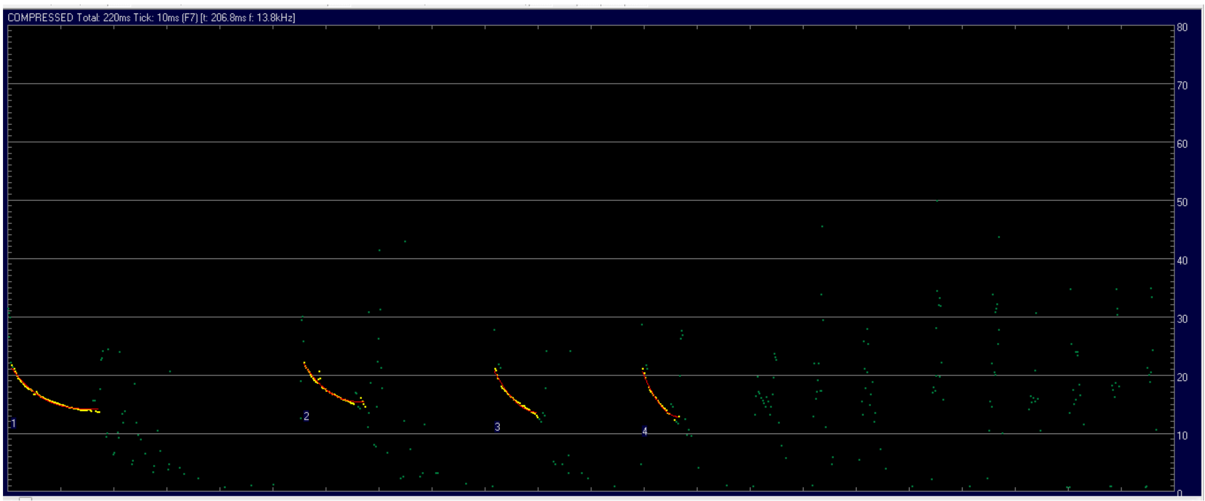


Figure 24 Example of White-striped Freetail Bat call in Anascheme.

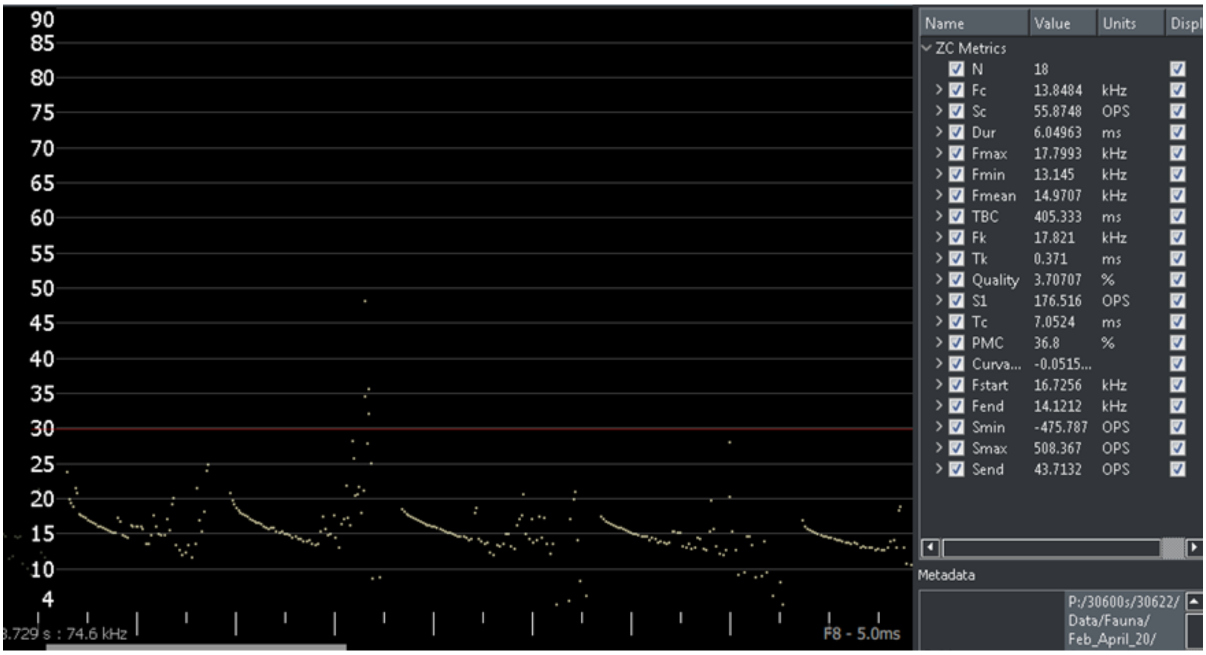


Figure 25 Example of White-striped Freetail Bat call in Anabat Insight.

Gould's Wattled Bat *Chalinolobus gouldii*

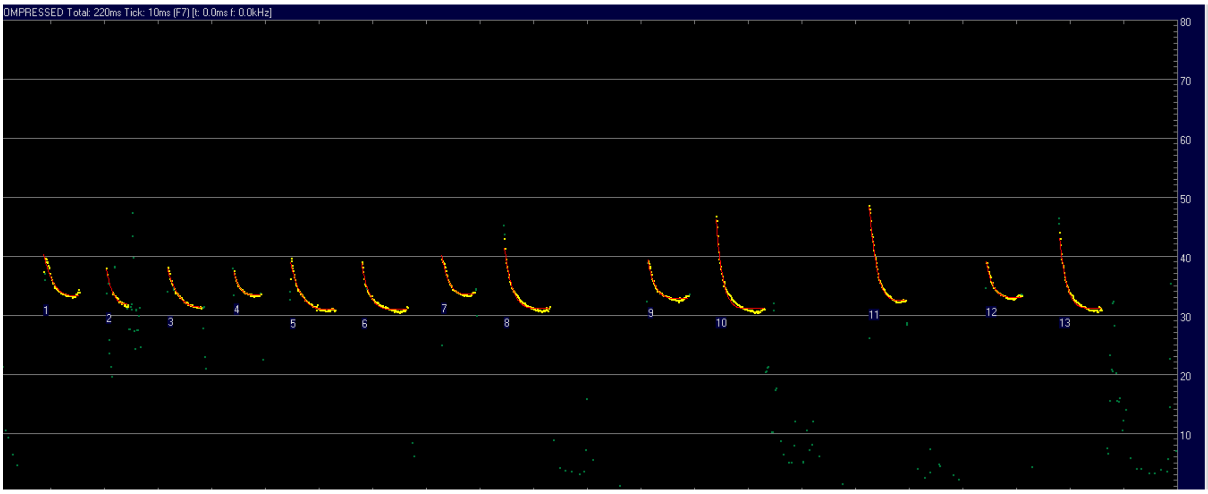


Figure 26 Example of Gould's Wattle Bat call in Anascheme.

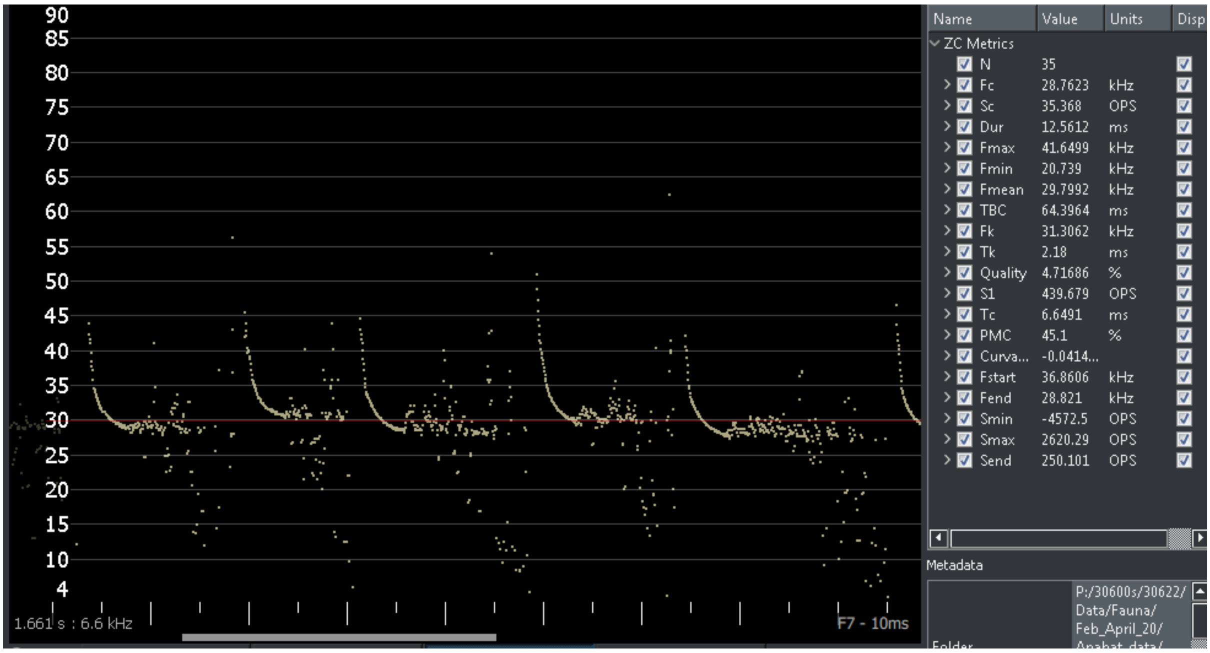


Figure 27 Example of Gould's Wattle Bat call in Anabat Insight.

Chocolate Wattled Bat *Chalinolobus morio*

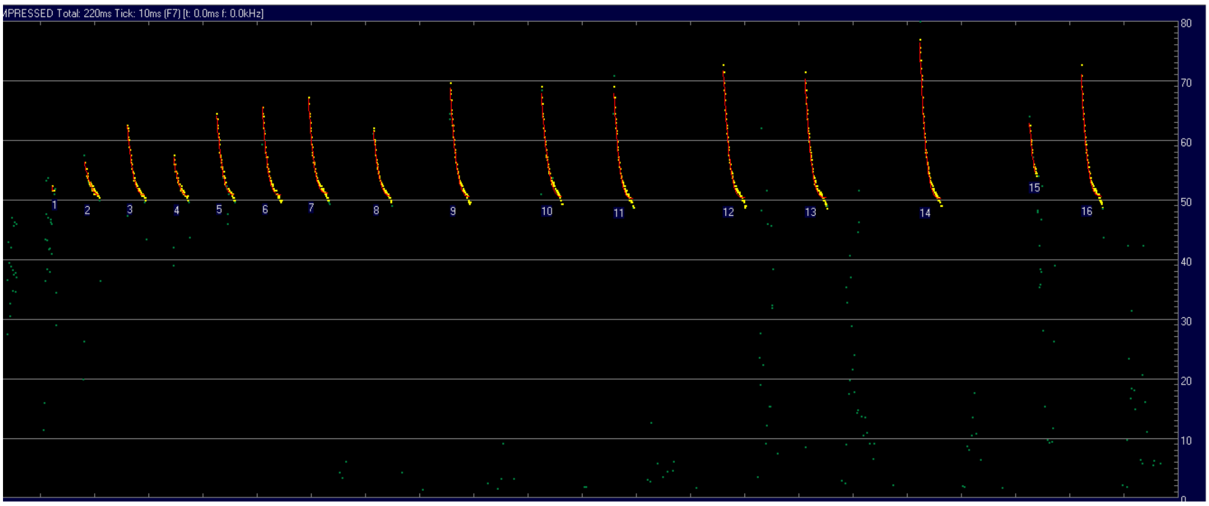


Figure 28 Example of Chocolate Wattle Bat call in Anascheme.

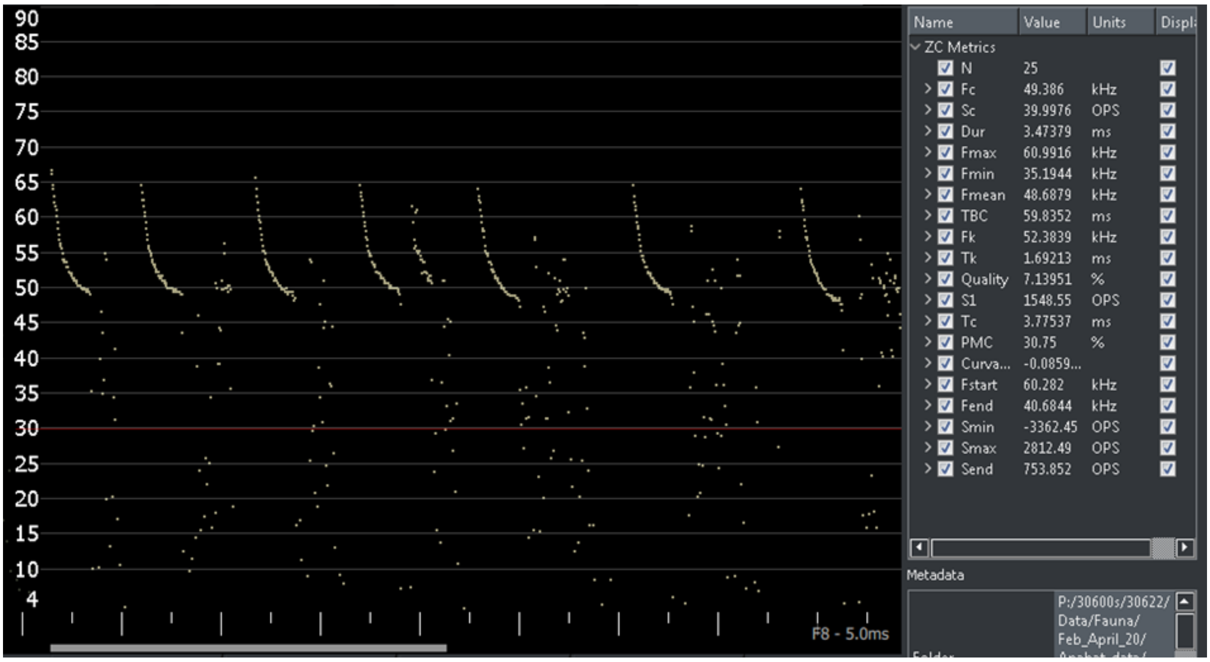


Figure 29 Example of Chocolate Wattle Bat call in Anabat Insight.

Eastern Falsistrelle *Falsistrellus tasmaniensis*

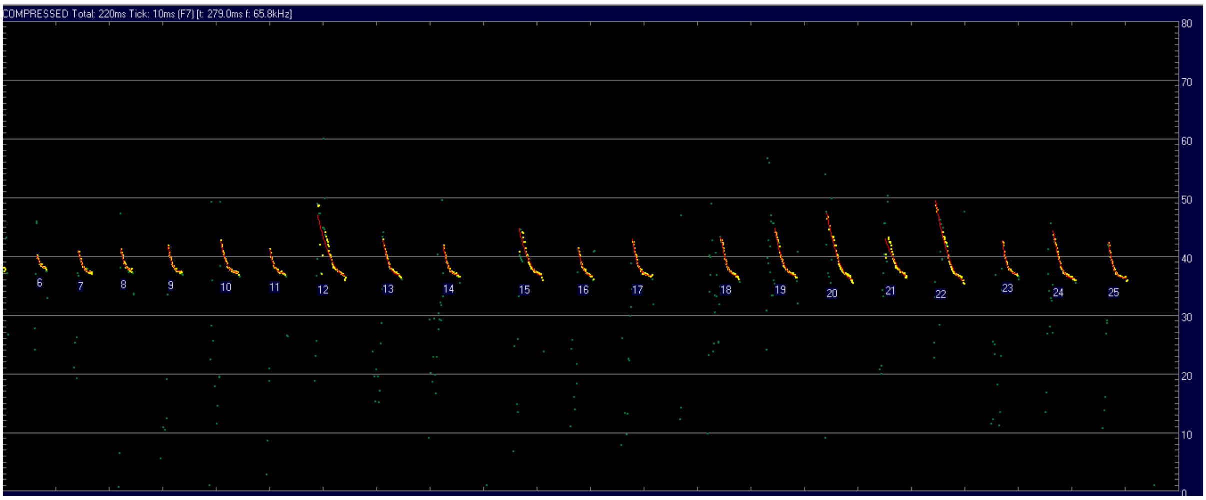


Figure 30 Example of Eastern Falsistrelle call in Anascheme.

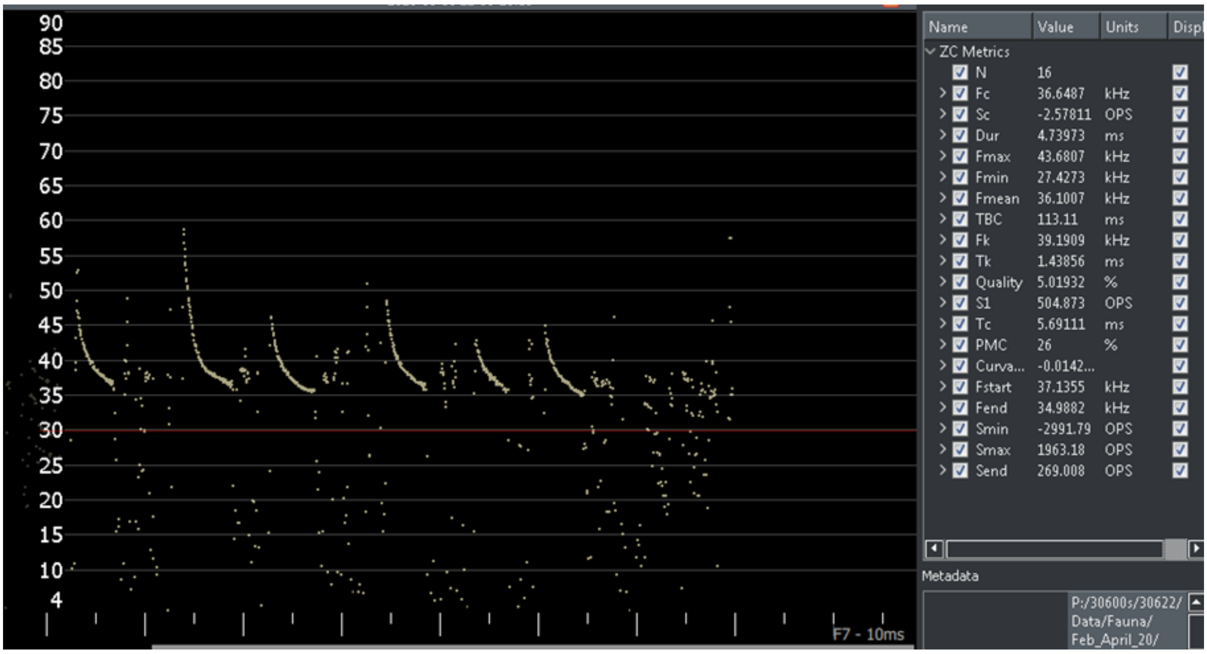


Figure 31 Example of Eastern Falsistrelle call in Anabat Insight.

Large Forest Bat *Vespadelus darlingtoni*

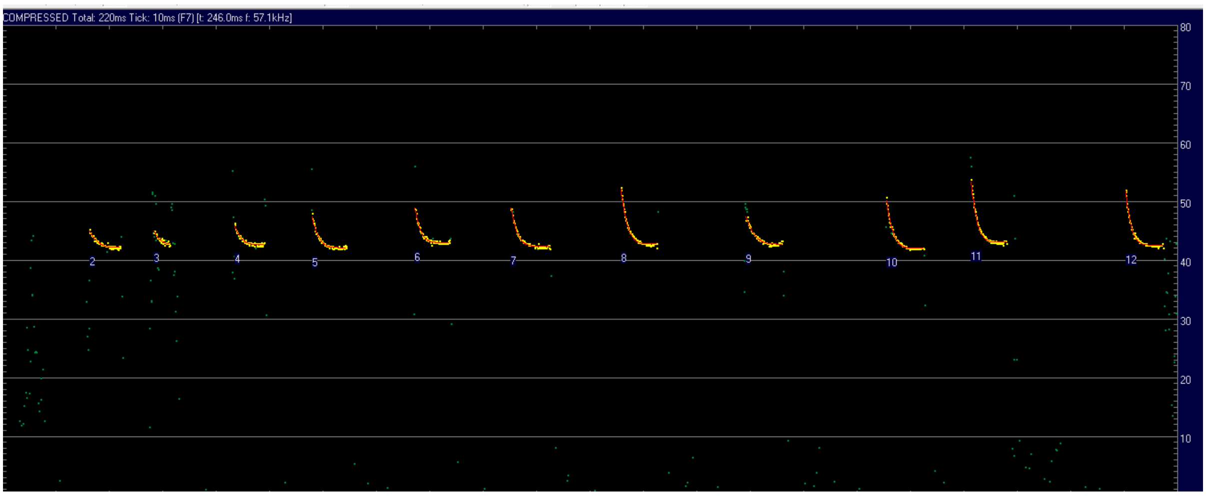


Figure 32 Example of Large Forest Bat call in Anascheme.

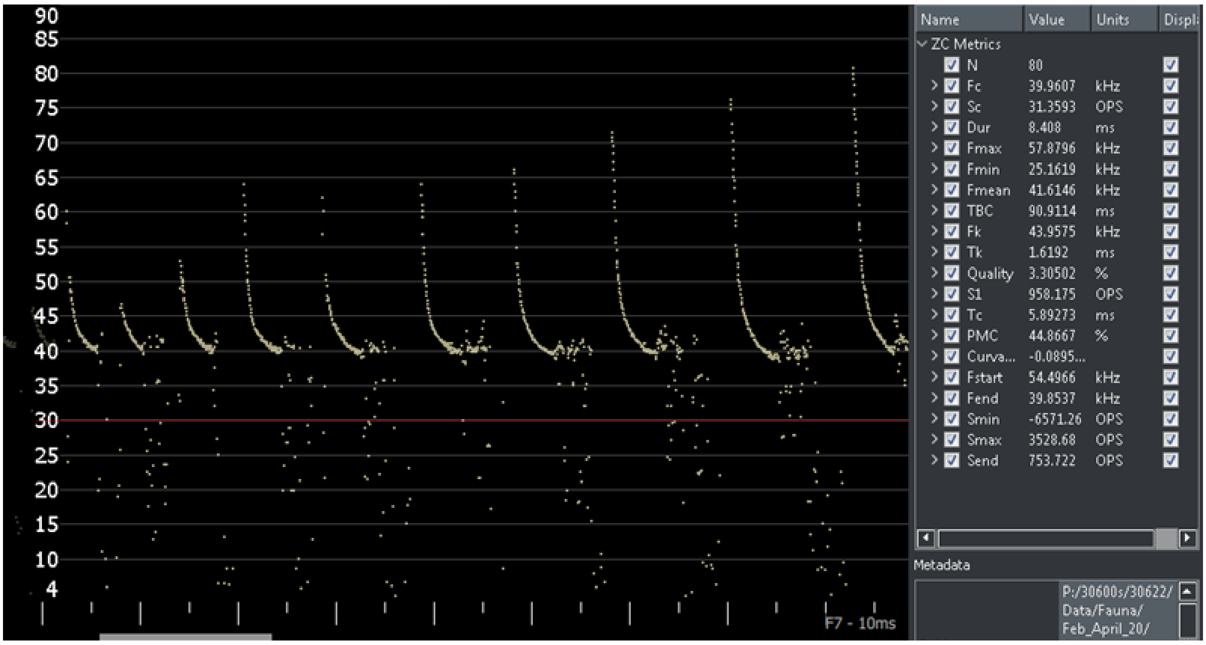


Figure 33 Example of Large Forest Bat call in Anabat Insight.

Little Forest Bat *Vespadelus vulturnus*

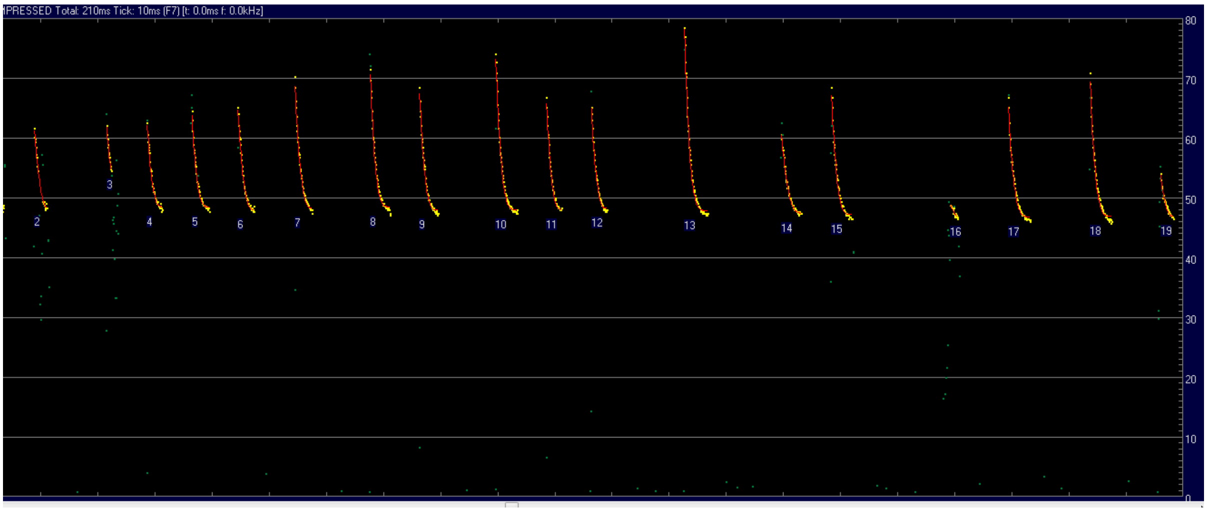


Figure 34 Example of Little Forest Bat call in Anascheme.

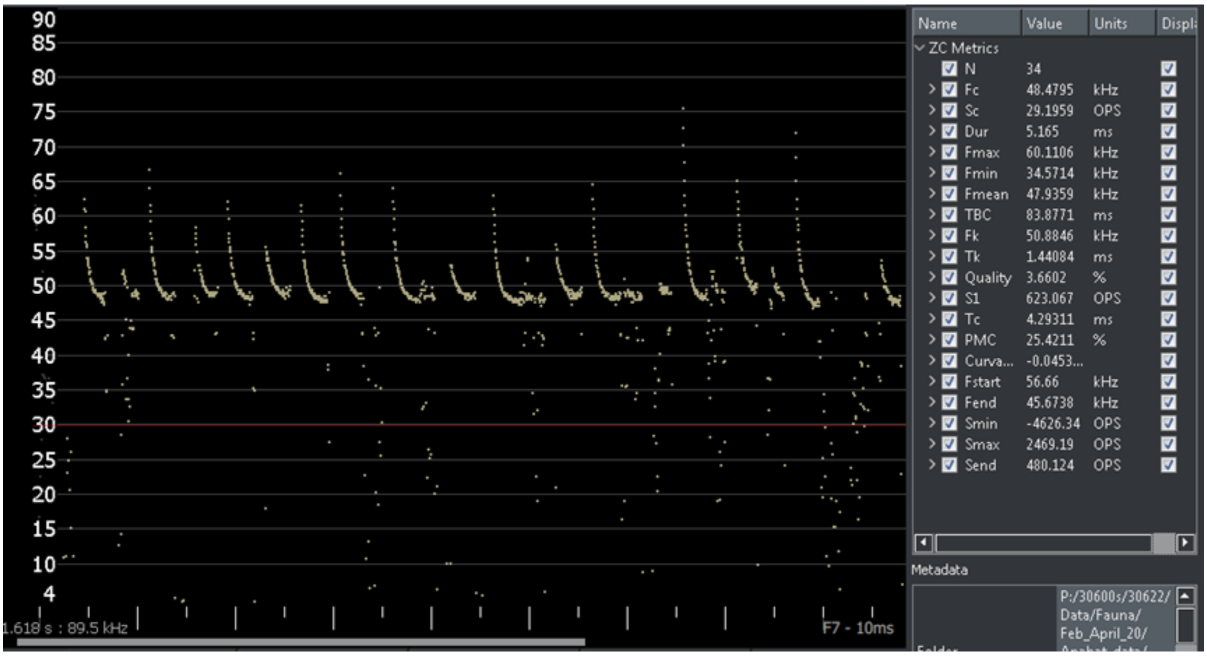


Figure 35 Example of Little Forest Bat call in Anabat Insight.

Southern Forest Bat *Vespadelus regulus*

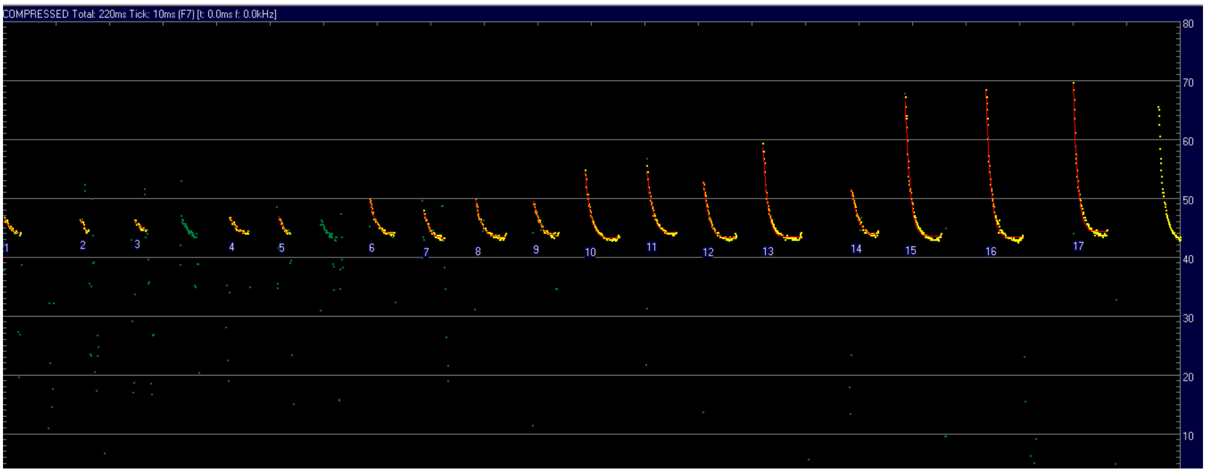


Figure 36 Example of Southern Forest Bat call in Anascheme.

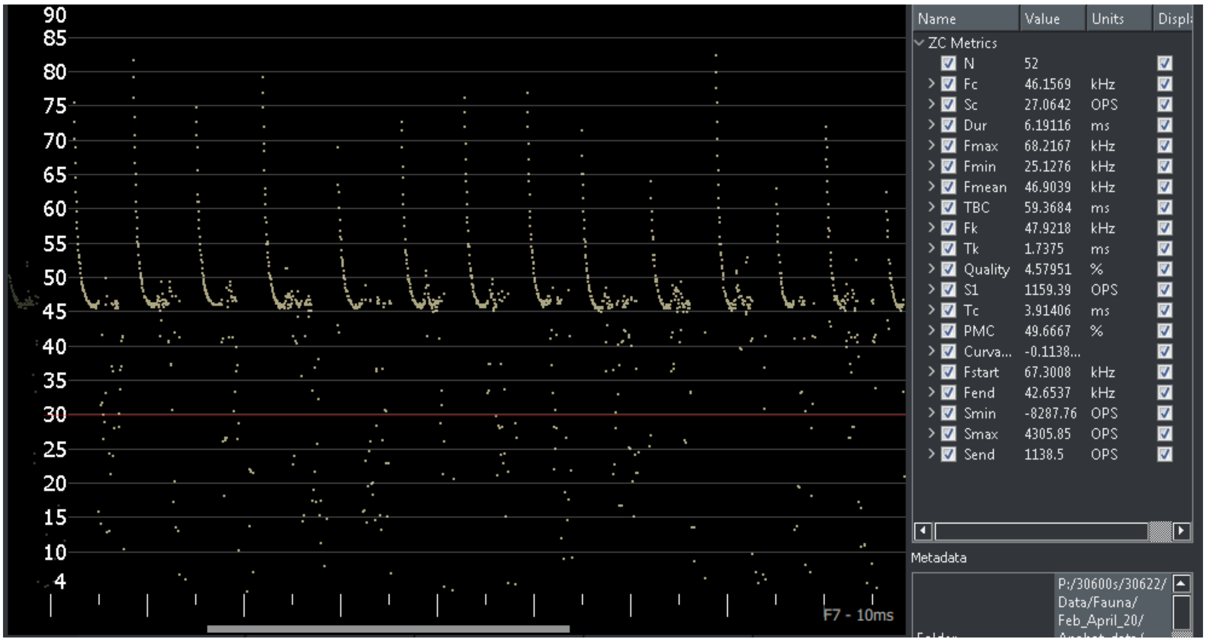


Figure 37 Example of Southern Forest Bat call in Anabat Insight.

Freetail Bats *Ozimops* spp.

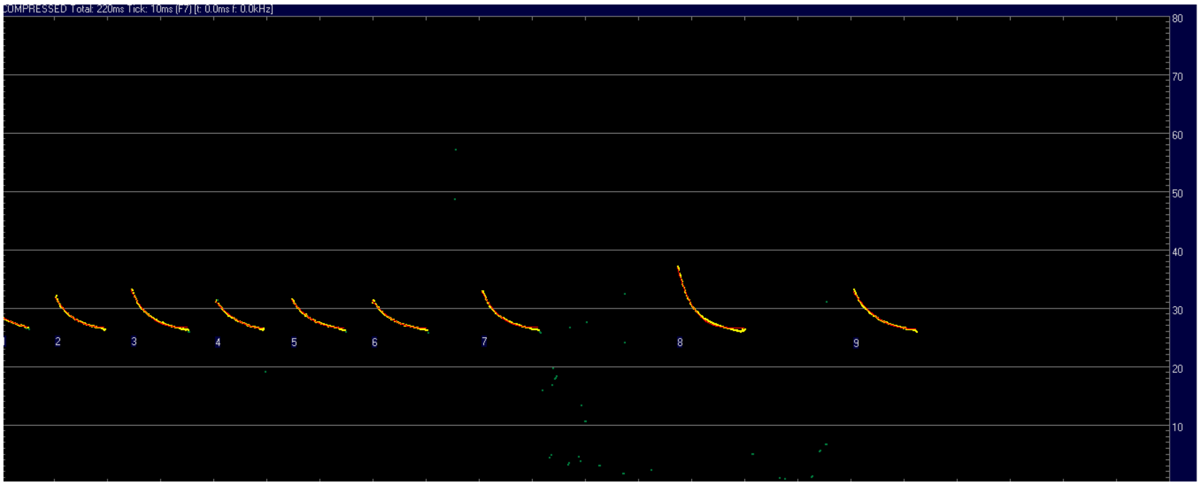


Figure 38 Example of Freetail Bat call in Anascheme.

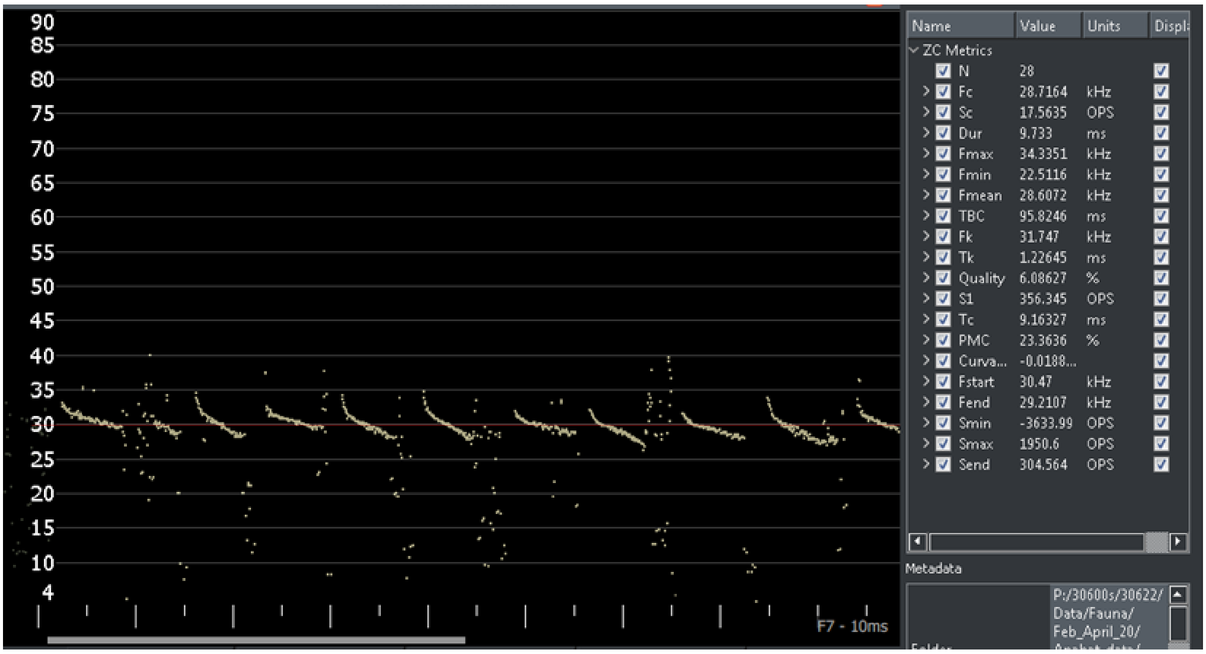


Figure 39 Example of Freetail Bat call in Anabat Insight.

Long-eared Bats *Nyctophilus* spp.

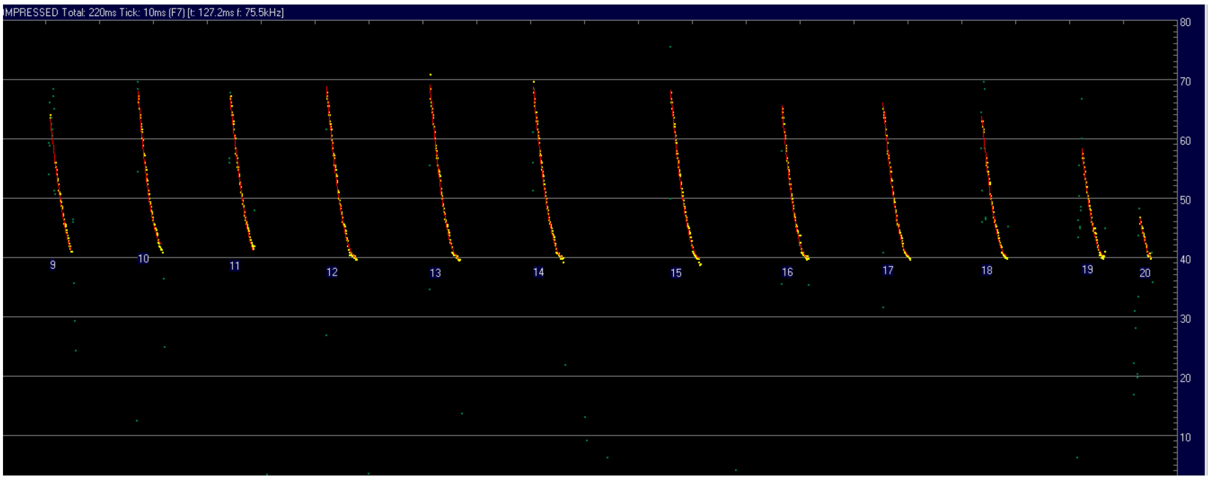


Figure 40 Example of Long-eared Bat call in Anascheme.

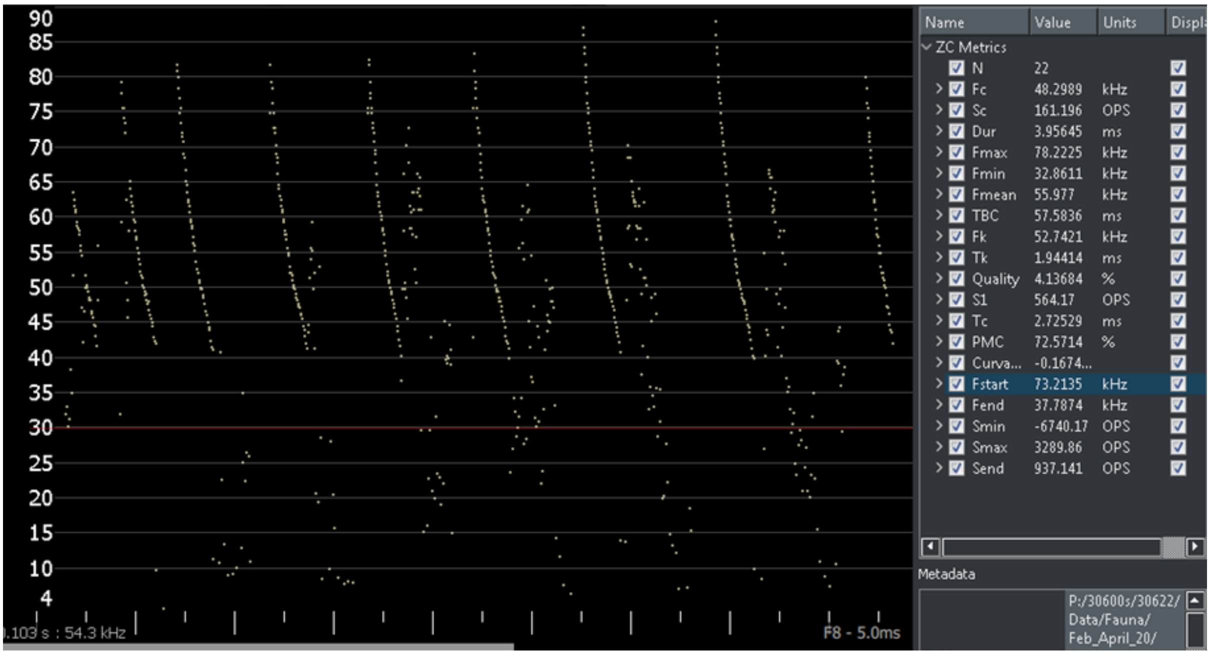


Figure 41 Example of Long-eared Bat call in Anabat Insight.

Appendix 2: Grey-headed Flying-fox surveys 2021 at the SCWF

Date	Survey type	Location	Sunset/ sunrise time (24 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
18/02/2021	Wind Farm Dusk	T2	20:24; 07:00	19:55	22:00	28.5	5.2	NE	35.9	clear
19/02/2021	Wind Farm Dawn	T2	20:24; 07:00	06:00	07:30	19.3	11	NW	56	clear
3/03/2021	Wind Farm Dusk	T7	20:07; 07:14	19:37	22:34	13.1	12	S	69.3	cloudy
3/03/2021	Windbreak	T10 Windbreak	20:07; 07:14	22:45	23:17	11.4	7.7	S	69.3	cloudy
4/03/2021	Wind Farm Dawn	T7	20:07; 07:14	06:04	07:44	12.8	4	S	68.6	cloudy
17/03/2021	Wind Farm Dusk	T9	19:44; 07:33	19:20	21:45	12.8	3.7	SE	70.9	clear
17/03/2021	Windbreak	T10 Windbreak	19:44; 07:33	21:55	22:21	19.9	14	NE	69	clear
17/03/2021	Rapid turbine	T10	19:44; 07:33	22:30	22:45	16.9	5.1	NE	72.1	clear
17/03/2021	Rapid turbine	T8	19:44; 07:33	23:00	23:15	17.7	7.6	NE	70	clear
17/03/2021	Rapid turbine	T12	19:44; 07:33	23:27	23:42	17.2	6.4	NE	73.3	clear
17/03/2021	Rapid turbine	T11	19:44; 07:33	23:47	24:02	17.9	11.8	NE	69.8	clear
18/03/2021	Rapid turbine	T2	19:44; 07:33	24:12	24:27	16.7	10.4	NE	74	clear
18/03/2021	Rapid turbine	T8	19:44; 07:33	24:36	24:51	17.1	16	NE	74	clear

Date	Survey type	Location	Sunset/ sunrise time (24 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
18/03/2021	Rapid turbine	T14	19:44; 07:33	01:00	01:15	16.4	9.4	E	69.7	clear
18/03/2021	Rapid turbine	T8	19:44; 07:33	01:23	01:38	16.2	13.9	E	78.9	clear
18/03/2021	Rapid turbine	T15	19:44; 07:33	02:00	02:15	16	8	E	76	clear
18/03/2021	Rapid turbine	T4	19:44; 07:33	02:24	02:39	16	8	E	76	clear
18/03/2021	Rapid turbine	T14	19:44; 07:33	02:46	03:01	16	8	E	76	clear
18/03/2021	Rapid turbine	T7	19:44; 07:33	03:05	03:20	15.5	4.5	E	78	no record
18/03/2021	Rapid turbine	T3	19:44; 07:33	03:25	03:40	15.5	4.5	E	78	no record
18/03/2021	Rapid turbine	T1	19:44; 07:33	03:47	04:02	15.5	4.5	E	78	no record
18/03/2021	Rapid turbine	T9	19:44; 07:33	04:09	04:24	17	5.5	NE	75	no record
18/03/2021	Rapid turbine	T5	19:44; 07:33	04:31	04:46	17	5.5	NE	75	no record
18/03/2021	Rapid turbine	T4	19:44; 07:33	04:55	05:10	17	5.5	NE	75	no record
18/03/2021	Rapid turbine	T13	19:44; 07:33	05:22	05:37	17.5	5	N	66	no record
18/03/2021	Wind Farm Dawn	T9	19:44; 07:33	05:41	08:00	15.1	3.1	N	73	clear
18/03/2021	Wind Farm Dusk	T9	19:44; 07:33	19:14	21:44	22.5	12.3	S	46.4	clear
19/03/2021	Wind Farm Dawn	T9	19:44; 07:33	05:30	08:00	14.9	9.3	E	86.4	fog

Date	Survey type	Location	Sunset/ sunrise time (24 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
23/03/2021	Wind Farm Dusk	T7	19:35; 07:36	19:05	21:35	18.4	15	SW	93	cloudy
23/03/2021	Rapid turbine	T5	19:35; 07:36	21:37	21:57	17	11.2	SW	93	cloudy
23/03/2021	Rapid turbine	T1	19:35; 07:36	22:03	22:23	17	7.8	SW	87.2	cloudy
23/03/2021	Rapid turbine	T15	19:35; 07:36	22:35	22:55	16.4	8.2	SW	90	cloudy
23/03/2021	Windbreak	T10 Windbreak	19:35; 07:36	23:00	23:08	16.4	8.2	SW	90	cloudy
23/03/2021	Rapid turbine	T14	19:35; 07:36	23:11	23:31	16.2	10	SW	100	light rain
23/03/2021	Rapid turbine	T13	19:35; 07:36	23:37	23:57	16	8.3	SW	100	light rain
23/03/2021	Rapid turbine	T10	19:35; 07:36	24:04	24:24	16	8.3	SW	100	light rain
23/03/2021	Rapid turbine	T2	19:35; 07:36	24:30	24:50	15.5	10.5	SW	92	light rain
23/03/2021	Rapid turbine	T12	19:35; 07:36	24:53	01:13	15.5	10.5	SW	92	light rain
24/03/2021	Rapid turbine	T4	19:35; 07:36	01:42	02:02	15	13	W	100	light rain
24/03/2021	Rapid turbine	T9	19:35; 07:36	02:14	02:34	15	13	W	100	light rain
24/03/2021	Rapid turbine	T7	19:35; 07:36	02:37	02:57	15	13	W	100	light rain
24/03/2021	Rapid turbine	T8	19:35; 07:36	03:02	03:22	15.7	13	W	100	light rain
24/03/2021	Rapid turbine	T11	19:35; 07:36	03:32	03:52	15.7	13	W	100	light rain

Date	Survey type	Location	Sunset/ sunrise time (24 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
24/03/2021	Rapid turbine	T6	19:35; 07:36	03:57	04:17	15.8	9	SW	100	fog
24/03/2021	Rapid turbine	T3	19:35; 07:36	04:22	04:42	15.8	9	SW	100	fog
24/03/2021	Rapid turbine	T7	19:35; 07:36	04:48	08:05	15.7	6	SW	100	fog
24/03/2021	Wind Farm Dusk	T2	19:35; 07:36	19:04	21:34	17.2	20	SW	100	cloudy
24/03/2021	Windbreak	T10 Windbreak	19:35; 07:36	21:40	21:50	16	20	WSW	100	light rain
25/03/2021	Wind Farm Dawn	T2	19:35; 07:36	05:40	08:06	13.4	26	WSW	100	cloudy
30/03/2021	Wind Farm Dusk	T3	19:24; 07:42	18:54	21:24	17.3	4.5	SW	61.6	clear
30/03/2021	Windbreak	T10 Windbreak	19:24; 07:42	21:31	21:46	12.9	3.1	SW	87.2	clear
31/03/2021	Wind Farm Dawn	T3	19:24; 07:42	05:46	08:12	13.3	0	no wind	97.6	fog
31/03/2021	Wind Farm Dusk	T3	19:24; 07:42	18:53	21:34	23	3.3	E	46	clear
31/03/2021	Windbreak	T10 Windbreak	19:24; 07:42	21:45	22:03	16.6	2.1	NE	59.2	clear
31/03/2021	Rapid turbine	T14	19:24; 07:42	22:12	22:32	16.6	2.1	NE	59.2	clear
31/03/2021	Rapid turbine	T13	19:24; 07:42	22:41	23:01	16.6	2.1	NE	59.2	clear
31/03/2021	Rapid turbine	T11	19:24; 07:42	23:03	23:23	16.5	0	no wind	67	clear
31/03/2021	Rapid turbine	T9	19:24; 07:42	23:28	23:48	16.5	0	no wind	67	clear

Date	Survey type	Location	Sunset/ sunrise time (24 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
31/03/2021, 1/04/2021	Rapid turbine	T10	19:24; 07:42	23:53	00:13	14.7	4.6	N	64.4	clear
1/04/2021	Rapid turbine	T12	19:24; 07:42	24:18	24:38	14.7	4.6	N	64.4	clear
1/04/2021	Rapid turbine	T5	19:24; 07:42	24:43	01:03	14.7	4.6	N	64.4	clear
1/04/2021	Rapid turbine	T6	19:24; 07:42	01:06	01:26	13.9	2.3	N	64.1	clear
1/04/2021	Rapid turbine	T6	19:24; 07:42	01:45	02:05	15.4	4.2	SW	68.7	clear
1/04/2021	Rapid turbine	T4	19:24; 07:42	02:10	02:30	15.4	4.2	SW	68.7	clear
1/04/2021	Rapid turbine	T1	19:24; 07:42	02:36	02:56	13.4	4.4	SW	83.4	clear
1/04/2021	Rapid turbine	T3	19:24; 07:42	02:59	03:19	13.4	4.4	SW	83.4	clear
1/04/2021	Rapid turbine	T7	19:24; 07:42	03:21	03:41	14.4	2.2	SW	66.7	clear
1/04/2021	Rapid turbine	T15	19:24; 07:42	03:46	04:06	14.4	2.2	SW	66.7	clear
1/04/2021	Rapid turbine	T8	19:24; 07:42	04:09	04:29	15	5.4	SW	67.6	clear
1/04/2021	Wind Farm Dawn	T5	19:24; 07:42	05:40	08:03	15.5	5.4	SW	63.5	clear
6/04/2021	Wind Farm Dusk	T11	18:14; 06:48	17:44	20:15	16.3	5.4	SSE	64.1	clear
6/04/2021	Windbreak	T10 Windbreak	18:14; 06:48	20:18	20:31	13.1	6.4	SE	84	clear

Date	Survey type	Location	Sunset/ sunrise time (24 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
6/04/2021	Rapid turbine	T7	18:14; 06:48	20:34	20:54	13.1	6.4	SE	84	clear
6/04/2021	Rapid turbine	T2	18:14; 06:48	20:57	21:17	12.3	8.6	E	83	clear
6/04/2021	Rapid turbine	T8	18:14; 06:48	21:22	21:42	12.3	8.6	E	83	clear
6/04/2021	Rapid turbine	T3	18:14; 06:48	21:48	22:08	11.4	8	E	83.6	clear
6/04/2021	Rapid turbine	T11	18:14; 06:48	22:12	22:32	11.4	8	E	83.6	clear
6/04/2021	Rapid turbine	T5	18:14; 06:48	22:36	22:56	11.4	8	E	83.6	clear
6/04/2021	Rapid turbine	T10	18:14; 06:48	23:04	23:24	12.4	5.3	E	85.5	clear
6/04/2021	Rapid turbine	T15	18:14; 06:48	23:27	23:47	12.4	5.3	E	85.5	clear
7/04/2021	Rapid turbine	T4	18:14; 06:48	00:00	00:20	11.8	2.3	E	85.6	clear
7/04/2021	Wind Farm Dusk	T1	18:14; 06:48	17:42	20:12	21.1	3.8	E	68.4	clear
7/04/2021	Windbreak	T10 Windbreak	18:14; 06:48	22:23	10:38	16.1	0	no wind	74.3	clear
8/04/2021	Wind Farm Dawn	T1	18:14; 06:48	04:53	07:19	12.8	2.8	NW	86.7	clear
7/04/2021	Rapid turbine	T6	18:14; 06:48	00:56	01:16	12	7.2	SE	85.1	clear
8/04/2021	Observation	T5	18:14; 06:48	00:50	00:50	12	7.2	SE	85.1	clear
7/04/2021	Rapid turbine	T13	18:14; 06:48	01:21	01:41	12	7.2	SE	85.1	clear

Date	Survey type	Location	Sunset/ sunrise time (24 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
7/04/2021	Rapid turbine	T9	18:14; 06:48	01:45	02:05	11.4	5	SE	86.5	clear
7/04/2021	Rapid turbine	T1	18:14; 06:48	02:09	02:29	11.4	5	SE	86.5	clear
7/04/2021	Rapid turbine	T14	18:14; 06:48	02:38	02:58	11.6	2.1	SE	84	clear
7/04/2021	Rapid turbine	T12	18:14; 06:48	03:06	03:26	11.6	2.1	SE	84	clear
7/04/2021	Wind Farm Dawn	T11	18:14; 06:48	04:52	07:18	11.6	1.4	SE	88.8	cloudy
14/04/2021	Wind Farm Dusk	T14	18:02; 06:56	17:32	19:45	16	11.8	SW	70.8	cloudy
14/04/2021	Wind Farm Dusk	T5	18:02; 06:56	17:32	20:02	16	11.8	SW	70.8	cloudy
14/04/2021	Windbreak	T10 Windbreak	18:02; 06:56	20:08	20:23	14.8	4.3	SW	56	cloudy
15/04/2021	Wind Farm Dawn	T14	18:02; 06:56	04:59	07:26	11.8	15.8	NW	72	cloudy
15/04/2021	Wind Farm Dawn	T5	18:02; 06:56	04:59	07:26	11.8	15.8	NW	72	cloudy
15/04/2021	Wind Farm Dusk	T13	18:02; 06:56	17:31	20:01	14.1	13.8	SW	73.8	cloudy
15/04/2021	Wind Farm Dusk	T15	18:02; 06:56	17:31	20:01	14.1	13.8	SW	73.8	cloudy
15/04/2021	Windbreak	T10 Windbreak	18:02; 06:56	20:04	20:19	12	10.5	WSW	89.9	light rain
15/04/2021	Rapid turbine	T7	18:02; 06:56	20:22	20:42	12	10.5	WSW	89.9	light rain
15/04/2021	Rapid turbine	T1	18:02; 06:56	20:44	21:04	12.6	4.8	S	83.3	cloudy

Date	Survey type	Location	Sunset/ sunrise time (24 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
15/04/2021	Rapid turbine	T2	18:02; 06:56	21:05	21:25	12.6	4.8	S	83.3	cloudy
15/04/2021	Rapid turbine	T11	18:02; 06:56	21:27	21:47	12.6	4.8	S	83.3	cloudy
15/04/2021	Rapid turbine	T12	18:02; 06:56	21:50	22:10	11.6	5.7	SW	83.8	cloudy
15/04/2021	Rapid turbine	T9	18:02; 06:56	22:14	22:34	11.6	5.7	SW	83.8	cloudy
15/04/2021	Rapid turbine	T4	18:02; 06:56	22:38	22:58	11.6	5.7	SW	83.8	cloudy
15/04/2021	Rapid turbine	T13	18:02; 06:56	23:04	23:24	11.3	9.4	SW	82.9	cloudy
15/04/2021	Rapid turbine	T8	18:02; 06:56	23:32	23:52	11.3	9.4	SW	82.9	cloudy
15/04/2021, 16/04/2021	Rapid turbine	T3	18:02; 06:56	23:55	00:15	11.8	3.8	SW	76.8	cloudy
16/04/2021	Rapid turbine	T14	18:02; 06:56	01:00	01:20	9.5	8.1	SW	75.8	cloudy
16/04/2021	Rapid turbine	T5	18:02; 06:56	01:28	01:48	9.5	8.1	SW	75.8	cloudy
16/04/2021	Rapid turbine	T10	18:02; 06:56	02:04	02:24	10.9	5	SW	70.3	cloudy
16/04/2021	Rapid turbine	T6	18:02; 06:56	02:36	02:56	10.9	5	SW	70.3	cloudy
16/04/2021	Rapid turbine	T15	18:02; 06:56	03:09	03:29	10.3	5.7	SW	69.5	cloudy
16/04/2021	Wind Farm Dawn	T13	18:02; 06:56	05:00	07:36	10.2	3.2	SW	68.4	cloudy

Date	Survey type	Location	Sunset/ sunrise time (24 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
16/04/2021	Wind Farm Dawn	T15	18:02; 06:56	05:00	07:36	10.2	3.2	SW	68.4	cloudy
20/04/2021	Wind Farm Dusk	T10	17:54; 07:01	17:24	19:54	11	1.2	SSW	64.3	clear
20/04/2021	Wind Farm Dusk	T1	17:54; 07:01	17:24	19:54	11	1.2	SSW	64.3	clear
20/04/2021	Windbreak	T10 Windbreak	17:54; 07:01	19:58	20:13	10.1	1.3	S	68.1	clear
20/04/2021	Rapid turbine	T10	17:54; 07:01	20:13	20:33	9.2	3.5	W	68.5	clear
20/04/2021	Rapid turbine	T1	17:54; 07:01	20:42	21:02	9.2	3.5	W	68.5	clear
20/04/2021	Rapid turbine	T7	17:54; 07:01	21:17	21:37	8.4	2.7	ESE	68.9	clear
20/04/2021	Rapid turbine	T15	17:54; 07:01	21:42	22:02	8.4	2.7	ESE	68.9	clear
20/04/2021	Rapid turbine	T3	17:54; 07:01	22:09	22:29	7.5	2.9	S	73	clear
20/04/2021	Rapid turbine	T5	17:54; 07:01	22:33	22:53	7.5	2.9	S	73	clear
20/04/2021	Rapid turbine	T8	17:54; 07:01	22:55	23:15	6.1	2.6	SW	78	clear
20/04/2021	Rapid turbine	T13	17:54; 07:01	23:19	23:39	6.1	2.6	SW	78	clear
20/04/2021, 21/04/2021	Rapid turbine	T4	17:54; 07:01	23:44	00:04	6	3.8	SW	81	clear
21/04/2021	Rapid turbine	T6	17:54; 07:01	00:05	00:25	6	3.8	SW	81	clear

Date	Survey type	Location	Sunset/ sunrise time (24 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
21/04/2021	Rapid turbine	T11	17:54; 07:01	12:39	12:59	6.8	6.2	W	77.2	cloudy
21/04/2021	Rapid turbine	T2	17:54; 07:01	01:05	01:15	6.8	6.2	W	77.2	cloudy
21/04/2021	Rapid turbine	T14	17:54; 07:01	01:38	01:58	7.2	4.1	W	72.6	cloudy
21/04/2021	Rapid turbine	T9	17:54; 07:01	02:03	02:23	7.2	4.1	W	72.6	cloudy
21/04/2021	Rapid turbine	T12	17:54; 07:01	02:35	02:55	5.4	5.1	W	75.1	cloudy
21/04/2021	Wind Farm Dawn	T1	17:54; 07:01	05:04	07:31	7.5	3.4	W	71.7	cloudy
21/04/2021	Wind Farm Dawn	T10	17:54; 07:01	05:04	07:31	7.5	3.4	W	71.7	cloudy
21/04/2021	Wind Farm Dusk	T14	17:54; 07:01	17:23	19:53	12.8	22	SW	61	clear
21/04/2021	Wind Farm Dusk	T8	17:54; 07:01	17:23	19:53	12.8	22	SW	61	clear
21/04/2021	Windbreak	T10 Windbreak	17:54; 07:01	20:00	20:15	11.2	8	WSW	24	clear
22/04/2021	Wind Farm Dawn	T14	17:54; 07:01	05:05	07:32	10.2	12.5	W	80.6	clear
22/04/2021	Wind Farm Dawn	T8	17:54; 07:01	05:05	07:32	10.2	12.5	W	80.6	clear
28/04/2021	Wind Farm Dusk	T3	17:44; 07:08	17:14	19:44	12.6	0	no wind	70.5	clear
28/04/2021	Wind Farm Dusk	T4	17:44; 07:08	17:14	19:44	12.6	0	no wind	70.5	clear
28/04/2021	Windbreak	T10 Windbreak	17:44; 07:08	19:50	20:05	11.5	0	no wind	79	clear

Date	Survey type	Location	Sunset/ sunrise time (24 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
28/04/2021	Rapid turbine	T7	17:44; 07:08	20:14	20:34	11.5	0	no wind	79	clear
28/04/2021	Rapid turbine	T11	17:44; 07:08	20:39	20:59	11.5	0	no wind	79	clear
28/04/2021	Rapid turbine	T9	17:44; 07:08	21:04	21:24	11.8	0	no wind	79.1	clear
28/04/2021	Rapid turbine	T8	17:44; 07:08	21:28	21:48	11.8	0	no wind	79.1	clear
28/04/2021	Rapid turbine	T6	17:44; 07:08	21:50	22:10	12	0	no wind	78.9	clear
28/04/2021	Rapid turbine	T1	17:44; 07:08	22:17	22:37	12	0	no wind	78.9	clear
28/04/2021	Rapid turbine	T12	17:44; 07:08	22:45	23:05	12	0	no wind	78.9	clear
28/04/2021	Rapid turbine	T13	17:44; 07:08	23:10	23:30	10.4	0	no wind	80.1	clear
28/04/2021	Rapid turbine	T4	17:44; 07:08	23:39	23:59	10.4	0	no wind	80.1	clear
29/04/2021	Rapid turbine	T10	17:44; 07:08	00:05	00:25	10.2	1.3	SSW	80	clear
29/04/2021	Rapid turbine	T15	17:44; 07:08	00:35	00:55	8.2	2.9	WNW	86.4	clear
29/04/2021	Rapid turbine	T14	17:44; 07:08	01:02	01:22	8.2	2.9	WNW	86.4	clear
29/04/2021	Rapid turbine	T2	17:44; 07:08	01:28	01:48	7.9	1.2	WNW	86.2	clear
29/04/2021	Rapid turbine	T5	17:44; 07:08	01:53	02:13	7.9	1.2	WNW	86.2	clear
29/04/2021	Rapid turbine	T3	17:44; 07:08	02:18	02:38	7.6	6	W	87	clear

Date	Survey type	Location	Sunset/ sunrise time (24 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
29/04/2021	Wind Farm Dawn	T4	17:44; 07:08	05:11	07:40	6.7	4.5	W	89.8	clear
29/04/2021	Wind Farm Dawn	T3	17:44; 07:08	05:15	07:44	6.7	4.5	W	89.8	clear
29/04/2021	Wind Farm Dusk	T12	17:44; 07:08	17:13	19:43	14.9	0	no wind	75.2	clear
29/04/2021	Wind Farm Dusk	T13	17:44; 07:08	17:13	19:43	14.9	0	no wind	75.2	clear
29/04/2021	Windbreak	T10 Windbreak	17:44; 07:08	19:45	20:00	12.9	0	no wind	84.9	clear
30/04/2021	Wind Farm Dawn	T6	17:44; 07:08	05:12	07:39	4.5	0	no wind	89	clear
30/04/2021	Wind Farm Dawn	T13	17:44; 07:08	05:12	07:39	4.5	0	no wind	89	clear
4/05/2021	Wind Farm Dusk	T6	17:39; 07:13	17:09	19:39	9.6	8.2	S	70.2	clear
4/05/2021	Wind Farm Dusk	T14	17:39; 07:13	17:09	19:39	9.6	8.2	S	70.2	clear
4/05/2021	Windbreak	T10 Windbreak	17:39; 07:13	19:45	20:00	8.9	7.2	SSW	76.1	clear
5/05/2021	Wind Farm Dawn	T12	17:39; 07:13	05:16	07:43	3.6	3.4	WSW	89.9	clear
5/05/2021	Wind Farm Dawn	T14	17:39; 07:13	05:16	07:43	3.6	3.4	WSW	89.9	clear
13/05/2021	Wind Farm Dusk	T9	1730;720	1658	1928	9.3	11.3	SW	78.2	light rain
13/05/2021	Wind Farm Dusk	T1	1730;720	1658	1928	9.3	11.3	SW	78.2	light rain
13/05/2021	Windbreak	T10 Windbreak	1730;720	1930	1940	7.9	11.6	SW	83.1	clear

Date	Survey type	Location	Sunset/ sunrise time (24 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
14/05/2021	Wind Farm Dawn	T1	1729;721	524	752	7.5	12.2	NW	89.2	light rain
14/05/2021	Wind Farm Dawn	T9	1729;721	524	752	7.5	12.2	NW	89.2	light rain

Appendix 3: Grey-headed Flying-fox surveys outside of the SCWF 2021

Date	Survey type	Location	Sunset/ sunrise time (25 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
18/02/2021	Day roost check	Woodcutters Lane	20:24; 07:00	18:10	18:30	32	4.1	N	31.5	clear
18/02/2021	Day roost check	Cobra Killuc Reserve	20:24; 07:00	18:30	18:50	31.6	3.5	N	30.2	clear
03/03/2021	Camp Exit	Woodcutters Lane	20:07; 07:14	19:30	21:02	13.8	11.1	S	72	Partially cloudy
03/03/2021	Camp Exit	Hexham-Woorndoo Rd	20:07; 07:14	19:30	21:07	13.8	11.1	S	72	Partially cloudy
03/03/2021	Post Dusk Windbreak	Woorndoo-Streatham Rd Windbreak	20:07; 07:14	22:40	23:46	11.4	7.7	S	69.3	cloudy
17/03/2021	Camp Exit	Hexham-Woorndoo Rd	19:44; 07:33	19:40	20:40	22.5	4	E	57	cloudy
17/03/2021	Camp Exit	Woodcutters Lane	20:24; 07:00	19:45	20:35	22.5	4	E	57	cloudy
18/03/2021	Post Dusk Windbreak	Woorndoo-Streatham Rd Windbreak	20:07; 07:14	22:00	22:15	18.2	8.5	NE	64.7	clear
23/03/2021	Camp Exit	Hexham-Woorndoo Rd	19:44; 07:33	19:15	20:45	16.6	15	WSW	100	cloudy
23/03/2021	Camp Exit	Woodcutters Lane	19:44; 07:33	19:17	20:39	18.5	15	SW	93	cloudy

Date	Survey type	Location	Sunset/ sunrise time (25 hr)	Time Start (24 hr)	Time End (24 hr)	Air temperature (°C)	Wind speed (km/h)	Wind direction	Relative humidity (%)	Weather
30/03/2021	Post Dusk Windbreak	Woorndoo-Streatham Rd Windbreak	19:44; 07:33	22:00	22:10	12.8	2.9	SW	87.3	clear
31/03/2021	Camp Exit	Hexham-Woorndoo Rd	19:44; 07:33	18:54	20:15	20.8	8.1	S	45.1	clear
31/03/2021	Camp Exit	Woodcutters Lane	19:44; 07:33	18:54	20:20	20.6	5.6	S	44.8	clear
07/04/2021	Post Dusk Windbreak	Woorndoo-Streatham Rd Windbreak	19:35; 07:36	22:55	23:10	15.8	0	no wind	76.2	clear
06/04/2021	Camp Exit	Hexham-Woorndoo Rd	19:35; 07:36	17:45	19:05	16.8	1.4	SE	66.5	clear
06/04/2021	Camp Exit	Woodcutters Lane	19:24; 07:42	17:48	19:07	16.9	1.5	SE	66.8	clear
15/04/2021	Camp Exit	Hexham-Woorndoo Rd	19:24; 07:42	17:31	18:37	14.3	15	SW	80	cloudy
15/04/2021	Camp Exit	Woodcutters Lane	19:24; 07:42	17:31	18:37	14.3	15	SW	80	cloudy
20/04/2021	Camp Exit	Hexham-Woorndoo Rd	18:14; 06:48	17:24	18:29	9.7	4.5	SW	80	cloudy
20/04/2021	Camp Exit	Woodcutters Lane	18:14; 06:48	17:24	18:29	9.7	4.5	SW	80	cloudy
28/04/2021	Camp Exit	Hexham-Woorndoo Rd	18:14; 06:48	17:15	18:30	13.1	1.2	N	72.3	cloudy
28/04/2021	Camp Exit	Woodcutters Lane	18:02; 06:56	17:18	18:30	13	1.5	N	73.5	cloudy

Appendix 4: Rainfall from Lake Bolac (Post Office) ad Mortlake Racecourse stations

Station: Lake Bolac (Post Office)
Number: 89016

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2018	9.6	9.6	19	12.4	63.6	44.6	48.4	64.4	16.8	20.8	39.4	53.4	402
2019	1.8	13.6	12.8	12.6	97.6	66.2	46.8	50.8	35.4	27.6	41.6	6.4	413.2
2020	27	57.6	16.4	65.2	67.6	46.2	30	65.4	83.6	68.2	58.8	28.2	614.2
2021	126	5.4	36.2	27.2	53.8	78.8							

Station: Mortlake Racecourse
Number: 90176

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2018	13	17	21.2	23	104.4	61.8	65.4	57.4	23.4	14.8	39.6	39	480
2019	5.6	23.4	33.2	12.4	132	92.2	67.4	82	55.6	51	42.6	18.2	615.6
2020	19.2	75.2	18.6	67.6	88.4	49.6	27.2	74.6	94	101.6	71.2	42.6	729.8
2021	93.8	8.4	24.2	36.4	68	67.2							

Difference in rainfall between Mortlake Racecourse Road and Lake Bolac (Post Office) weather stations

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2018	-3.4	-7.4	-2.2	-10.6	-40.8	-17.2	-17	7	-6.6	6	-0.2	14.4	-78
2019	-3.8	-9.8	-20.4	0.2	-34.4	-26	-20.6	-31.2	-20.2	-23.4	-1	-11.8	-202.4
2020	7.8	-17.6	-2.2	-2.4	-20.8	-3.4	2.8	-9.2	-10.4	-33.4	-12.4	-14.4	-115.6
2021	32.2	-3	12	-9.2	-14.2	11.6							

Appendix 5: Brolga flocking season survey detailed results

December 2020 wetland surveys

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29205	21.12.2020	Large shallow dam in paddock	Open water, lower than past months	4 Black Swan; 20 Black Winged Stilts; 5 Straw-Necked Ibis; 2 Musk Duck; 33 Eurasian Coot; 6 White Faced Heron	fine	nil	25	3.6	w
29214	21.12.2020	Large shallow dam in paddock	70% full	2 Little Pied Cormorant, 4 Swifts, 2 Black Swan, 12 Grey Teal					
29213	21.12.2020	Large shallow dam in paddock	70% full	4 Black Swan, 7 Australian Shelduck					
29226	21.12.2020	Deep lake with surrounding vegetation	70% full	4 White Faced Heron, 12 Black Winged Stilts, 20 Black Swan, 34 Grey Teal					
29212	21.12.2020	Grassy paddock, no wetland	Dry, tall grass and sheep	No Birds					
29182	21.12.2020	Wetland in paddock with large dead trees standing in water	Little water, lots of aquatic vegetation	40 Straw Necked Ibis; 22 Little Pied Cormorant; 40 Tern; 2 Black Swan; 3 White Necked Heron; 3 Royal Spoonbill; 2 White Ibis; 5 Pacific Black Duck					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29150	21.12.2020	Grassy paddock with depression that fills seasonally	Dry	No Birds					
29252	21.12.2020		Dry, grazed paddock	No Birds					
29253	21.12.2020	Dam in paddock	Shallow water with aquatic vegetation	1 Wood Duck; 3 Royal Spoonbil; 1 White Faced Heron; 1 White Necked Heron; 2 Straw-necked Ibis					
29250	21.12.2020	Dam in paddock	Dry	No Wetland Birds					
29243	21.12.2020	Deep lake with surrounding vegetation	90% full	20 Eurasian Coot, 40 Grey Teal, 66 Black Swan, 4 White Faced Heron, 2 White Ibis					
29200	21.12.2020	Open paddock with shallow depression	Dry, tall grass	30 White-Necked Heron; 5 Straw-Necked Ibis; 2 White Ibis; 27 Tern; 1 Black Swan On Nest; 4 Spoonbill; 2 Grey Teal; 2 Silver Gull					
29190	21.12.2020	Swampy wetland with reeds	No water, tall grass and reeds	No Birds					
1	21.12.2020	Dam in paddock with surrounding trees	70% full	3 Australian Shelduck, 2 Australian Wood Duck					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29316	21.12.2020	Seasonal swamp	Small dam full, no other water, grass cover	6 Pacific Black Duck, 2 Black Swan (Flying Overhead), 7 Masked Lapwing					
30252	21.12.2020	Dam in paddock	Not recorded	No Birds					
29339	21.12.2020	Dam in paddock	Tall grass, hard to see birds or water if present	3 White Necked Heron, 6 Wood duck, 12 Masked Lapwing					
29340	21.12.2020	Deep dam and shallow wetland	50% full	30 Eurasian Coot, 35 Black Swan, 10 Purple Swamp Hen, 4 Little Pied Cormorant; 17 Grey Teal					
30374	21.12.2020	Wetland in paddock	Full	2 Purple Swamp Hen, 10 Eurasian Coot, 6 Wood duck					
29372	21.12.2020	Dam in paddock	Dry	1 White Necked Heron					
29367	21.12.2020	Dam in paddock	Dry	No Birds	fine	nil	23.4	1.1	sw
29140	22.12.2020	Small dam in creekline	Partially full, water level declining	1 White Faced Heron, 3 Australian White Ibis, 4 Pacific Black Duck	partly cloudy	light rain	17.7	6.2	sw
30369	22.12.2020	Dam in drainage line	High water level	50 Eurasian Coot, 5 White Faced Heron, 2 Black Swan, 1 Masked Lapwing, 5 Pacific Black Duck					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
30299	22.12.2020	Drainage line	Dry	No Birds					
29119	22.12.2020	Shallow dam in grassy paddock	Shallow water	4 Shell Duck, 4 Masked Lapwing 2 White Faced Heron,					
29141	22.12.2020	Small dam in paddock	Shallow	No Wetland Birds					
29151	22.12.2020	Small dam in paddock	Shallow	No Birds					
29162	22.12.2020	Small dam in paddock	Could not see any water	No Birds					
29170	22.12.2020	Small dam in paddock	Could not see any water	No Birds					
29183	22.12.2020	Shallow saline lake with surrounding trees and shrubs	Shallow	24 Grey Teal, 5 Masked Lapwing, 17 Banded Stilt, 2 White Faced Heron, 6 Little Pied Cormorant					
29362	22.12.2020	Large deep lake	Full	45 Pacific Black Duck Or Grey Teal, 64 Black Swan, Over 40 Eurasian Coot, 6 Masked Lapwing, 10 Shelduck					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
30383	22.12.2020	Drainage line	Tall grass, hard to see birds or water if present	No Birds					
29436	22.12.2020	Dam in paddock	Tall grass, hard to see birds or water if present	No Birds					
30263	22.12.2020	Dam in paddock	Little water	2 Masked Lapwing					
29325	22.12.2020	Paddock with shallow depression	Dry, grass cover	No Birds	fine	nil	26	14.2	sw

January 2021 wetland surveys

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29205	18.01.2021	Large shallow dam in paddock	Open water, lower than past months	37 Banded Stilts; 15 Royal Spoon Bill; 2 Little Pied Cormorant; 5 Black Swan; 4 Australian Shelduck	fine	nil	27.3	11.2	w
29214	18.01.2021	Large shallow dam in paddock	70% full	10 Black Swan; 10 White Necked Heron; Hundreds Of Grey Teal					
29213	18.01.2021	Large shallow dam in paddock	70% full	4 White Faced Heron; 3 Masked Lapwing; 1 White-Faced Heron					
29226	18.01.2021	Deep lake with surrounding vegetation	70% full	9 White Faced Heron; 7 Terns					
29212	18.01.2021	Grassy paddock, no wetland	Dry, tall grass and sheep	No Birds					
29182	18.01.2021	Wetland in paddock with large dead trees standing in water	Little water, lots of aquatic vegetation	40 Australian White Ibis; 17 White-Necked Heron; 12 Strawn Necked Ibis; 12 Black Swan; 7 Royal Spoon Bill; 4 Little Pied Cormorant; 34 Pacific Black Duck					
29150	18.01.2021	Grassy paddock with depression that fills seasonally	Dry	No Birds					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29252	18.01.2021		Dry, grazed paddock	No Birds					
29253	18.01.2021	Dam in paddock	Shallow water with aquatic vegetation	25 Australian White Ibis; 7 White Necked Heron; 40 Straw-Neck Ibis; 6 White-Faced Heron; 5 Pacific Black Duck					
29250	18.01.2021	Dam in paddock	Dry	30 Straw-Necked Ibis; 25 Australian White Ibis					
29243	18.01.2021	Deep lake with surrounding vegetation	70% full	2 Black Swan; 3 Little Pied Cormorant; 1 Royal Spoon Bill					
29200	18.01.2021	Open paddock with shallow depression	Dry, tall grass	5 Australian White Ibis; 10 Australian Shelduck					
29190	18.01.2021	Swampy wetland with reeds	No water, tall grass and reeds	No Birds					
1	18.01.2021	Dam in paddock with surrounding trees	50% full	2 Masked Lapwing; 1 White Faced Heron					
29316	18.01.2021	Seasonal swamp	Small dam full, no other water, grass cover	4 Pacific Black Duck; 1 Brown Falcon; 7 Australian White Ibis					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
30252	18.01.2021	Dam in paddock	Not recorded	No Birds					
29339	18.01.2021	Dam in paddock	Tall grass, hard to see birds or water if present	1 Little Pied Cormorant (Flying Overhead); 2 White Faced Heron; 4 Masked Lapwing					
29340	18.01.2021	Deep dam and shallow wetland	50% full	7 Black Swan; 6 Purple Swamp Hen; 30 Grey Teal; 15 Pacific Black Duck; 2 Australian Shell Duck; 2 Masked Lapwing					
30374	18.01.2021	Wetland in paddock	Full	4 Eurasian Coot; 2 Australian White Ibis					
29372	18.01.2021	Dam in paddock	Dry	No Birds					
29367	18.01.2021	Dam in paddock	Dry	4 Wood duck; 2 White-Faced Heron	fine	nil	25.4	6.6	sw
29140	19.01.2021	Small dam in creekline	Partially full, water level declining	No Birds	partly cloudy	nil	19.4	3.4	w
30369	19.01.2021	Dam in drainage line	High water level	6 White Faced Heron; 2 Little Pied Cormorant; 1 Royal Spoon Bill					
30299	19.01.2021	Drainage line	Dry	No Birds					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29119	19.01.2021	Shallow dam in grassy paddock	Shallow water	4 Royal Spoon Bill, 2 Masked Lapwing, 1 White Ibis, 2 White Faced Heron					
29141	19.01.2021	Small dam in paddock	Shallow, water level declining	28 Galah, 12 Pacific Black Duck, 5 Freckled Duck, 4 Shell Duck					
29151	19.01.2021	Small dam in paddock	Shallow water level declining	No Birds					
29162	19.01.2021	Small dam in paddock	Could not see any water	No Birds					
29170	19.01.2021	Small dam in paddock	Could not see any water	No Birds					
29183	19.01.2021	Shallow saline lake with surrounding trees and shrubs	Shallow	29 Australian Shell Duck; 4 Pacific Black Duck; 3 Masked Lapwing					
29362	19.01.2021	Large deep lake	Full	Lots Of Swans					
30383	19.01.2021	Drainage line	Tall grass, hard to see birds or water if present	No Birds					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29436	19.01.2021	Dam in paddock	Tall grass, hard to see birds or water if present	No Birds					
30263	19.01.2021	Dam in paddock	Little water	No Birds					
29325	19.01.2021	Paddock with shallow depression	Dry, grass cover	10 Straw Necked Ibis	Cloudy	nil	19.6	7.8	nw

February 2021 wetland surveys

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29183	25.02.2021	Shallow saline lake with surrounding trees and shrubs	90% full	10 Australian Shelduck; 6 Wood Duck, 7 Silver Gull	Partly cloudy	nil	20.6	12.4	w
29205	25.02.2021	Large shallow dam in paddock	Open water, lower than past months	5 Balch Swan, 10 Spoon Bill, 40 Shell Duck, 50 Grey Teal 7 Banded Stilt, 10 White Faced Heron	Partly cloudy	nil	21.4	11.4	w
29214	25.02.2021	Large shallow dam in paddock	60% full	No Birds	Partly cloudy	nil	20.5	10	w
29213	25.02.2021	Large shallow dam in paddock	60% full	No Birds	Partly cloudy	nil	19.5	6.3	w
29243	25.02.2021	Deep lake with surrounding vegetation	70% full	2 Black Swan, 10 White Faced Heron, 2 Banded Stilt	Partly cloudy	nil	18.6	8.8	w
29253	25.02.2021	Dam in paddock	Dry	24 Straw Necked Ibis, 6 White Faced Heron, 3 White Ibis	Cloudy	nil	18	6.4	w
29250	25.02.2021	Dam in paddock	Dry	No Birds	Cloudy	nil	19.2	6.6	w
29243	25.02.2021	Deep lake with surrounding vegetation	open shallow water, much lower than	100 Black Swan, 5 Spoon Bill, 0ver 100 Grey Teal, 10 White Faced Heron, 25 Silver Gull	Cloudy	nil	15.3	5.8	w

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
			previous months, 60% full						
29212	25.02.2021	Grassy paddock, no wetland	Dry, tall grass and sheep	No Birds	Light rain	Light rain	15	9.4	w
29182	25.02.2021	Wetland in paddock with large dead trees standing in water	Almost dry, no standing water	20 Black Swan, 5 White Faced Heron, 7 Masked Lapwing, 2 White Ibis, 15 Grey Teal.	Light rain	Light rain	15.6	11.2	w
29150	25.02.2021	Grassy paddock with depression that fills seasonally	Dry	No Birds	Light rain	Light rain	14.7	8.3	w
29141	25.02.2021	Small dam in paddock	Almost dry, 10% water left	No Birds	Light rain	Light rain	14.5	9.5	w
29151	25.02.2021	Small dam in paddock	Dry	No Birds	Light rain	Light rain	14.5	8	w
29119	25.02.2021	Shallow dam in grassy paddock	Dry	No Birds	Light rain	Light rain	14.5	8.8	w
29170	25.02.2021	Small dam in paddock	Could not see any water	No Birds	Cloudy	nil	14	8.9	w
29162	25.02.2021	Small dam in paddock	Could not see any water	No Birds	Cloudy	nil	14	8.9	w

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
30299	25.02.2021	Drainage line	Dry	3 Masked Lapwing	Cloudy	nil	13.4	3.4	w
29140	25.02.2021	Small dam in creekline	Partially full, water level declining	2 White Faced Heron, 1 Little Pied Cormorant, 1 White Necked Heron	Cloudy	nil	13	5.6	w
30369	25.02.2021	Dam in drainage line	High water level	30 Grey Teal, 1 Little Pied Cormorant, 2 Masked Lapwing, 18 Pacific Black Duck	Cloudy	nil	13.1	7.7	w
29325	26.02.2021	Paddock with shallow depression	Dry, grass cover	No Birds	Cloudy	nil	11.3	4	s
30325	26.02.2021	Dam in paddock	Not recorded	No Birds	Cloudy	nil	11.3	4	s
1	26.02.2021	Dam in paddock with surrounding trees	30% full	5 Grey Teal	Cloudy	nil	11.9	4	s
29316	26.02.2021	Seasonal swamp	Small dam full, no other water, grass cover	6 Wood Duck	Cloudy	nil	12.6	2.3	se
30253	26.02.2021	Dam in paddock	Not recorded	15 Australian Shelduck	Cloudy	nil	13.4	4.1	se
29339	**26.02.2021**	**Dam in paddock**	**Tall grass, hard to see birds or water if present**	**2 Adult Brolga Foraging - 37.9239263; 142.8193251**	**Cloudy**	**nil**	**13.6**	**3.2**	**se**

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29340	26.02.2021	Deep dam and shallow wetland	50% full	50 Pacific Black Duck, 10 Purple Swamp Hen, 17 Australian Shell Duck, 20 Eurasian Coot	Cloudy	nil	14.9	5.7	se
30374	26.02.2021	Wetland in paddock	80% full	2 Little Pied Cormorant, 33 Wood Duck	Cloudy	nil	16	4.9	se
29372	26.02.2021	Dam in paddock	Dry	No Birds	Cloudy	nil	17.6	4.3	se
30263	26.02.2021	Dam in paddock	Little water	7 White Ibis	Cloudy	nil	18.9	1.6	se
30383	26.02.2021	Drainage line	Tall grass, hard to see birds or water if present	No Birds	Cloudy	nil	18.1	1.6	se
29436	26.02.2021	Dam in paddock	Tall grass, hard to see birds or water if present	No Birds	Cloudy	nil	18.1	1.6	se
29367	26.02.2021	Dam in paddock	Dry	No Birds	Cloudy	nil	18.6	4.7	se
29362	26.02.2021	Large deep lake	Full	50 Black Swan, 70 Eurasian Coot, 5 White Ibis, 35 Pacific Black Duck, 30 Grey Teal,	Cloudy	nil	19.6	3.9	se

March 2021 wetland surveys

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29183	22.03.2021	Shallow saline lake with surrounding trees and shrubs	80% full	2 Little Pied Cormorant, 2 Wood Duck, 4 Masked Lapwing	Cloudy	nil	16.9	7.4	ne
29205	22.03.2021	Large shallow dam in paddock	Shallow, 50% full	5 White Faced Heron, 2 Black Swan, 11 Shell Duck	Cloudy	nil	19.2	11.2	ne
29214	22.03.2021	Large shallow dam in paddock	50% full	No Birds	Cloudy	nil	21.5	10	ne
29213	22.03.2021	Large shallow dam in paddock	50% full	No Birds	Cloudy	nil	21.8	9.7	ne
29226	22.03.2021	Deep lake with surrounding vegetation	shallow open water, water level declining	8 Black Swan	Cloudy	nil	21.4	4.3	ne
29243	22.03.2021	Deep lake with surrounding vegetation	Water level declining from previous month	68 Black Swan, 20 Australian Shell Duck, 5 Masked Lapwing, 16 Eurasian Coot	Cloudy	nil	22.6	6.3	ne
29250	22.03.2021	Dam in paddock	Dry	No Birds	Cloudy	nil	22.8	12.2	ne
29253	22.03.2021	Dam in paddock	Dry	No Birds	Cloudy	nil	22.5	12.9	ne
29212	22.03.2021	Grassy paddock, no wetland	Dry, tall grass and sheep	No Birds	Cloudy	nil	23	13	ne

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29182	22.03.2021	Wetland in paddock with large dead trees standing in water	Almost dry, no standing water	18 Black Swan (Some With Young), 6 White Faced Heron, Silver Gull	Cloudy	nil	23	13.6	ne
29150	22.03.2021	Grassy paddock with depression that fills seasonally	Dry	No Birds	Cloudy	nil	22.3	16.5	ne
29141	22.03.2021	Small dam in paddock	Dry	No Birds	Cloudy	nil	21.6	14.3	ne
29151	22.03.2021	Small dam in paddock	Dry	No Birds	Cloudy	nil	21	14.7	ne
29119	22.03.2021	Shallow dam in grassy paddock	Dry	No Birds	Cloudy	nil	21	14.7	ne
29170	22.03.2021	Small dam in paddock	Could not see any water	No Birds	Cloudy	nil	21	14.7	ne
29162	22.03.2021	Small dam in paddock	Could not see any water	No Birds	Cloudy	nil	19.1	14.7	ne
30299	22.03.2021	Drainage line	Dry	No Birds	Cloudy	nil	19.8	15.4	ne
29140	22.03.2021	Small dam in creekline	Partially full, water level declining	1 White Faced Heron, 20 Galah	Cloudy	nil	18.5	15.4	ne
30369	22.03.2021	Dam in drainage line	High water level	60 Eurasian Coot, 20 Grey Teal, 15 Pacific Black Duck	Cloudy	nil	18.5	15.8	ne

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29325	23.03.2021	Paddock with shallow depression	Dry, grass cover	20 Straw-Necked Ibis, 2 Masked Lapwing	Cloudy	nil	17.1	7	e
30325	23.03.2021	Dam in paddock	Not recorded	No Birds	Cloudy	nil	17.2	7.5	e
1	23.03.2021	Dam in paddock with surrounding trees	30% full	1 White Ibis	Cloudy	nil	17.2	9.6	e
29316	23.03.2021	Seasonal swamp	Small dam full, no other water, grass cover	2 White Faced Heron, 6 Straw-Necked Ibis	Cloudy	light rain	17.3	5.6	e
30253	23.03.2021	Dam in paddock	Not recorded	15 Australian Shelduck	Cloudy	light rain	17.3	9.5	e
29339	23.03.2021	Dam in paddock	Tall grass, hard to see birds or water if present	2 Shell Duck, 3 Masked Lapwing	Cloudy	light rain	18.1	6.7	e
29340	23.03.2021	Deep dam and shallow wetland	50% full	6 Black Swan, 8 Purple Swamp Hen, 40 Pacific Black Duck, 15 Eurasian Coot	Cloudy	light rain	18.3	9	e
30374	23.03.2021	Wetland in paddock	80% full	2 Little Pied Cormorant, 33 Wood Duck	Cloudy	light rain	18.6	8.5	sw
29372	23.03.2021	Dam in paddock	Dry	No Birds	Cloudy	light rain	18.7	10.6	sw
30263	23.03.2021	Dam in paddock	Little water	No Birds	Cloudy	light rain	18.5	13	sw

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
30383	23.03.2021	Drainage line	Tall grass, hard to see birds or water if present	No Birds	Cloudy	light rain	19.3	11	sw
29436	23.03.2021	Dam in paddock	Tall grass, hard to see birds or water if present	No Birds	Cloudy	nil	18.5	5.3	sw
29367	23.03.2021	Dam in paddock	Dry	No Birds	Cloudy	nil	19	7.3	sw
29362	23.03.2021	Large deep lake	Full	28 Eurasian Coot, 25 Grey Teal, 10 Pacific Black Duck, 4 Masked Lapwing	Cloudy	nil	18.6	6.6	sw

April 2021 wetland surveys

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29183	19.04.2021	Shallow saline lake with surrounding trees and shrubs	80% full	3 White Faced Heron; 4 Australian Shelduck	Cloudy	nil	15.6	7.4	nw
29205	19.04.2021	Large shallow dam in paddock	Shallow, 50% full	6 Black Swan, 5 Australian Shelduck; 4 White Faced Heron; 2 Masked Lapwing	Cloudy	nil	16.2	8.3	nw
29214	19.04.2021	Large shallow dam in paddock	Almost completely dry	No Birds	Cloudy	nil	18.7	13.5	nw
29213	19.04.2021	Large shallow dam in paddock	50% full	4 Black Swan, 10 Grey Teal	Cloudy	nil	17.5	15.1	nw
29226	19.04.2021	Deep lake with surrounding vegetation	shallow open water, water level declining	2 Black Swan; 1 White Faced Heron; 1 Australian White Ibis; 20 Eurasian Coot	Cloudy	nil	18.1	11.3	nw
29243	19.04.2021	Deep lake with surrounding vegetation	Shallow water, same as previous month	100 Black Swan, 30 Australian Shell Duck, 25 Eurasian Coot, 15 Pacific Black Duck	Cloudy	nil	17.4	13.8	nw
29250	19.04.2021	Dam in paddock	Dry	No Birds	Cloudy	nil	17.4	7.6	nw
29253	19.04.2021	Dam in paddock	Dry	No Birds	Cloudy	nil	17	9.1	nw

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29212	19.04.2021	Grassy paddock, no wetland	Dry, tall grass and sheep	No Birds	Cloudy	nil	15.3	7.5	nw
29182	19.04.2021	Wetland in paddock with large dead trees standing in water	Almost dry, no standing water	No Birds	Cloudy	nil	15.5	11.7	nw
29150	19.04.2021	Grassy paddock with depression that fills seasonally	Dry	No Birds	Cloudy	nil	15.6	11.7	nw
29141	19.04.2021	Small dam in paddock	Dry	No Birds	Cloudy	nil	14.5	11.7	nw
29151	19.04.2021	Small dam in paddock	Dry	No Birds	Cloudy	nil	14.5	11.7	nw
29119	19.04.2021	Shallow dam in grassy paddock	Dry	No Birds	Cloudy	nil	14.5	11.7	nw
29170	19.04.2021	Small dam in paddock	Could not see any water	No Birds	Cloudy	nil	14.5	11.7	nw
29162	19.04.2021	Small dam in paddock	Could not see any water	No Birds	Cloudy	nil	14	10.3	nw
30299	19.04.2021	Drainage line	Dry	2 Australian White Ibis	Cloudy	nil	13.1	10	nw
29140	19.04.2021	Small dam in creekline	Partially full, water level increasing	No Waterbirds	Cloudy	nil	13.5	9	nw

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
30369	19.04.2021	Dam in drainage line	High water level	50 Grey Teal/Pacific Black Duck; 8 Black Swan; 4 Masked Lapwing	Cloudy	nil	13.1	15.3	nw
29325	21.04.2021	Paddock with shallow depression	Dry, grass cover	No Birds	partly cloudy	nil	6.3	4.3	nw
30325	21.04.2021	Dam in paddock	Not recorded	No Birds	partly cloudy	nil	7.1	13.2	nw
1	21.04.2021	Dam in paddock with surrounding trees	70% full	7 Eurasian Coot	partly cloudy	nil	6.9	10.3	nw
29316	21.04.2021	Seasonal swamp	Small dam full, no other water, grass cover	6 Pacific Black Duck, 2 Masked Lapwing	partly cloudy	nil	9.2	13.5	nw
30253	21.04.2021	Dam in paddock	Not recorded	No Birds	partly cloudy	nil	9.3	9.2	nw
29339	21.04.2021	Dam in paddock	Tall grass, hard to see birds or water if present	7 White Ibis, 1 White Faced Heron, 4 Australian Shell Duck	partly cloudy	nil	10.1	6	nw
29340	21.04.2021	Deep dam and shallow wetland	80% full	22 Eurasian Coot, 38 Black Swan, 10 Purple Swamp Hen, 27 Grey Teal, 5 Pacific Black Duck	partly cloudy	nil	10	9.3	nw

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
30374	21.04.2021	Wetland in paddock	80% full	4 Purple Swamp Hens, 17 Eurasian Coot	Cloudy	nil	11.1	9.3	nw
29372	21.04.2021	Dam in paddock	Dry	No Birds	Cloudy	nil	11.9	7	nw
30263	21.04.2021	Dam in paddock	Little water	No Birds	Cloudy	nil	11.8	8.3	nw
30383	21.04.2021	Drainage line	Tall grass, hard to see birds or water if present	No Birds	Cloudy	nil	12	7.9	nw
29436	21.04.2021	Dam in paddock	Tall grass, hard to see birds or water if present	No Birds	Cloudy	nil	12.4	12	nw
29367	21.04.2021	Dam in paddock	Dry	4 Wood Duck	Cloudy	nil	12.4	8.6	nw
29362	21.04.2021	Large deep lake	Full	At Least 30 Black Swan, 20 Eurasian Coot, 15 Australian Shelduck, 47 Grey Teal	Cloudy	nil	13	6.9	nw

May 2021 wetland surveys

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29183	18.05.2021	Shallow saline lake with surrounding trees and shrubs	80% full	No Birds	Cloudy	nil	19.3	5.3	n
29205	18.05.2021	Large shallow dam in paddock	Shallow, 50% full	8 Masked Lapwing; 17 Australian Shelduck; 20 Black Swan; 30 Eurasian Coot	Cloudy	nil	17.8	6.2	n
29214	18.05.2021	Large shallow dam in paddock	almost completely dry	No Birds	Cloudy	nil	16.6	11.4	n
29213	18.05.2021	Large shallow dam in paddock	50% full	6 Grey Teal, 12 Pacific Black Duck; 2 White Necked Heron	Cloudy	nil	15.4	13	n
29226	18.05.2021	Deep lake with surrounding vegetation	shallow open water, water level declining	10 Black Swan; 46 Eurasian Coot; 7 Banded Stilt; 1 White Faced Heron	Cloudy	nil	16	9.2	n
29243	18.05.2021	Deep lake with surrounding vegetation	Shallow water, same as previous month	50 Black Swan, 30 Grey Teal; 60 Eurasian Coot	Cloudy	nil	15.3	11.7	n
29250	18.05.2021	Dam in paddock	Dry	No Birds	Cloudy	nil	15.3	5.5	n
29253	18.05.2021	Dam in paddock	Dry	No Birds	Cloudy	nil	14.9	7	n

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29212	18.05.2021	Grassy paddock, no wetland	Dry, tall grass and sheep	No Birds	Cloudy	nil	13.2	5.4	n
29182	18.05.2021	Wetland in paddock with large dead trees standing in water	Almost dry, no standing water	10 Black Swan; 5 White Faced Heron; 3 Masked Lapwing; 4 Australian Shell Duck	Cloudy	nil	13.4	9.6	n
29150	18.05.2021	Grassy paddock with depression that fills seasonally	Dry	No Birds	partly cloudy	nil	13.5	9.6	n
29141	18.05.2021	Small dam in paddock	Dry	No Birds	partly cloudy	nil	12.4	9.6	n
29151	18.05.2021	Small dam in paddock	Dry	No Birds	partly cloudy	nil	12.4	9.6	n
29119	19.05.2021	Shallow dam in grassy paddock	Dry	No Birds	partly cloudy	nil	12.4	9.6	n
29170	19.05.2021	Small dam in paddock	Could not see any water	No Birds	partly cloudy	nil	10.2	7.1	n
29162	19.05.2021	Small dam in paddock	Could not see any water	No Birds	partly cloudy	nil	11	3.9	n

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
30299	19.05.2021	Drainage line	Dry	No Birds	partly cloudy	nil	10.9	7.2	n
29140	19.05.2021	Small dam in creekline	Partially full, water level increasing	6 Pacific Black Duck	partly cloudy	nil	12	7.2	n
30369	19.05.2021	Dam in drainage line	High water level	23 Eurasian Coot	partly cloudy	nil	12.8	4.9	n
29325	19.05.2021	Paddock with shallow depression	Dry, grass cover	No Birds	Cloudy	nil	12.7	6.2	n
30325	19.05.2021	Dam in paddock	Not recorded	No Birds	Cloudy	nil	12.9	5.8	n
1	19.05.2021	Dam in paddock with surrounding trees	Partially full	2 Eurasian Coot; 2 Wood Duck	Cloudy	nil	13.3	9.9	n
29316	19.05.2021	Seasonal swamp	Small dam full, no other water, grass cover	12 Masked Lapwing; 2 Silver Gull; 10 Pacific Black Duck	Cloudy	nil	13.3	6.5	n
30253	19.05.2021	Dam in paddock	Not recorded	No Birds	Cloudy	nil	13.9	4.8	n
29339	19.05.2021	Dam in paddock	Tall grass, hard to see birds or water if present	8 Straw Necked Ibis	Cloudy	nil	15.4	9.6	n

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29340	19.05.2021	Deep dam and shallow wetland	80% full	22 Black Swan; 10 Purple Swamp Hen; 40 Eurasian Coot; 4 Pacific Black Duck	Cloudy	nil	14.7	8.2	n
30374	19.05.2021	Wetland in paddock	80% full	5 Purple Swamp Hen; 10 Pacific Black Duck	Cloudy	nil	15.3	7.9	n
29372	19.05.2021	Dam in paddock	Dry	No Birds	Cloudy	nil	16.8	6.9	n
30263	19.05.2021	Dam in paddock	Little water	No Birds	Cloudy	nil	16.3	9.3	n
30383	19.05.2021	Drainage line	Tall grass, hard to see birds or water if present	No Birds	Cloudy	nil	15.4	8.9	n
29436	19.05.2021	Dam in paddock	Tall grass, hard to see birds or water if present	No Birds	Cloudy	nil	14.9	13	n
29367	19.05.2021	Dam in paddock	Dry	No Birds	Cloudy	nil	14	9.6	n
29362	19.05.2021	Large deep lake	Full	30 Black Swan; 28 Pacific Black Duck	Cloudy	nil	14.4	7.9	n

June 2021 wetland surveys

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29183	22.06.2021	Shallow saline lake with surrounding trees and shrubs	NA	4-5 Brolgas, Landholder Observation					
29250	23.06.2021	Dam in paddock	Shallow	1 Royal Spoonbill	Cloudy	light rain	10.7	19	nnw
29253	23.06.2021	Dam in paddock	Shallow	2 Black Swan, 12 Pacific Black Duck	Cloudy	light rain	10.6	17.4	nnw
29212	23.06.2021	Grassy paddock, no wetland	Dry, tall grass and sheep	No Birds	Cloudy	light rain	10.8	18.9	nnw
29182	23.06.2021	Wetland in paddock with large dead trees standing in water	Almost full	12 Black Swan, 2 Silver Gull, 6 White Faced Heron , 2 Straw Neck Ibis	Cloudy	light rain	11.2	19	nnw
29150	23.06.2021	Grassy paddock with depression that fills seasonally	Shallow covering of water	5 Masked Lapwing, 4 Black Swan, 2 Australian Shelduck	Cloudy	light rain	11.2	22.1	nnw
29119	23.06.2021	Shallow dam in grassy paddock	Full	No Birds	Cloudy	light rain	11.4	17.9	nnw
29141	23.06.2021	Small dam in paddock	Shallow	No Birds	Cloudy	light rain	11.8	18.6	nnw
29151	23.06.2021	Small dam in paddock	Partially full	No Birds	Cloudy	light rain	11.7	18.7	nnw

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29162	23.06.2021	Small dam in paddock	Partially full	4 Black Swan	Cloudy	light rain	12.1	19.8	nnw
29170	23.06.2021	Small dam in paddock	Shallow	2 Australian Shelduck, 13 Black Swan	Cloudy	light rain	12.6	21.1	nnw
30299	23.06.2021	Drainage line	Dry	2 Australian Shelduck, 2 Masked Lapwing	Cloudy	nil	13.2	23.2	nw
29140	23.06.2021	Small dam in creekline	Full	No Birds	Cloudy	nil	13.4	21.7	nw
30369	23.06.2021	Dam in drainage line	Full	2 Black Swan, 4 Pacific Black Duck, 2 Masked Lapwing	Cloudy	nil	13.5	21.6	nw
29239	23.06.2021	Creekline with old Brolga nest record	No access to site, surveyed surrounding area with Spotting scope		Cloudy	nil	12.8	18.4	nw
29190	23.06.2021	Swampy wetland with reeds	No water, tall grass and reeds	No Birds	Cloudy	nil	12.9	16.3	nw
29200	23.06.2021	Open paddock with shallow depression	Dry, tall grass, kangaroos grazing	No Birds	Cloudy	nil	13.3	15.4	nw
29243	23.06.2021	Deep lake with surrounding vegetation	Mostly full	6 Black Swan (Including 1 Pair Building A Nest In The Middle Of The Lake)	Cloudy	nil	13.7	15.7	nw

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29226	23.06.2021	Deep lake with surrounding vegetation	Mostly full	6 Silver Gull	Cloudy	nil	13.9	16.2	nw
29183	23.06.2021	Shallow saline lake with surrounding trees and shrubs	Full	2 Black Swan, 5 Silver Gull	Cloudy	nil	14	16.4	nw
29205	23.06.2021	Large shallow dam in paddock	Full	No Birds	Cloudy	nil	13.7	17	nw
29214	23.06.2021	Large shallow dam in paddock	Mostly full	No Birds	Cloudy	nil	14.2	16.6	nw
29213	23.06.2021	Large shallow dam in paddock	Mostly full	No Birds	Cloudy	nil	14.1	16.2	nw
30374	24.06.2021	Wetland in paddock	Full, sheep in paddock	No Birds	Cloudy	nil	8.9	11.9	e
29357	24.06.2021	Grassy paddock	Flooded grassy paddock, shallow pools	No Birds	Cloudy	nil	8.9	12	e
29362	24.06.2021	Large deep lake	Full	2 Black Swan, 250Eurasian Coot	Cloudy	nil	9	12	e
30383	24.06.2021	Drainage line	Small pools	No Birds	Cloudy	nil	9.1	13.4	e

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29436	24.06.2021	Dam in paddock	Dam partially full, tall grass	No Birds	Cloudy	nil	9.3	16.7	e
30263	24.06.2021	Dam in paddock	Full	No Birds	Cloudy	nil	9.2	15.4	e
29372	24.06.2021	Dam in paddock	Dam partially full, tall grass	No Birds	Cloudy	nil	9.6	15.3	e
29340	24.06.2021	Deep dam and shallow wetland	Mostly full, surrounding paddock flooded	2 Black Swan, 2 Masked Lapwing, 1 Purple Swamp Hen, 6 Eurasian Coot	Cloudy	nil	10	13.2	e
29339	24.06.2021	Dam in paddock	Dry, grazed paddock	No Birds	Cloudy	nil	10.2	14	e
29316	24.06.2021	Seasonal swamp	Shallow water over approx. 10% of paddock	2 Australian Shelduck, 12 Straw Neck Ibis	Cloudy	nil	9.8	14.2	e
30253	24.06.2021	Dam in paddock	Full	No Birds	Cloudy	nil	10.5	12.6	e
30255	24.06.2021	Grassy paddock	Dry paddock, no water	No Birds	Cloudy	nil	10.3	10.9	e
30256	24.06.2021	Grassy paddock	Dry paddock, no water	No Birds	Cloudy	nil	10.7	9.8	e
1	24.06.2021	Dam in paddock with surrounding trees	Partially full	No Birds	Cloudy	nil	11.1	9.7	e
30252	24.06.2021	Dam in paddock	Dry	No Birds	Cloudy	nil	11.5	11.2	e

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29325	24.06.2021	Paddock with shallow depression	Shallow puddles, tall grass	No Birds	Cloudy	nil	11.6	11.5	e
30375	24.06.2021	Grassy paddock	Flooded grassy paddock, shallow pools	No Birds	Cloudy	nil	11.9	13	e

Appendix 6: Brolga flocking season – 3-year comparison

Comparison of Brolga flocking utilisation results within 5 kilometres of SCWF, before and after operation and across 'dry', 'intermediate' and 'wet' climatic conditions

Month	Before 2006	After Year 1 2018 – 2019 DRY	After Year 2 2019 – 2020 INTERMEDIATE	After Year 3 2020 – 2021 WET
December	NA	0	0	0
January	NA	0	0	0
February	NA	0	0	2 Brolga 26th Wetland 29339
March	NA	2 Brolga 29th Wetland 30369	0	0
April	2 Brolga 25th Near Wetland 29150 & 29182	2 Brolga 17th-18th Wetland 30369	0	0
May	NA	2 Brolga 23rd-24th Wetland 30369	2 Brolga 18th 10:45 Wetland 1 2 Brolga	0

Month	Before 2006	After Year 1 2018 – 2019 DRY	After Year 2 2019 – 2020 INTERMEDIATE	After Year 3 2020 – 2021 WET
			18th 11:15 Wetland 30255 2 Brolga 18th 12:15 29339 2 Brolga 18th 15:00 29205 2 Brolga 19th 10:17 30253 2 Brolga 19th 11:30 29339	
June	NA	2 Brolga 18th-19th Wetland 30369	2 Brolga with nest 24th Wetland 29340	4-5 Brolga Early June (via landholder) Wetlands 29183 29205 29214 29213

Appendix 7: Brolga breeding season survey detailed results

August 2020 wetland surveys

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29205	19.08.2020	Large shallow dam in paddock	Not recorded	Silver Gull, Australian Shelduck, Grey Teal, Magpie, Black Swan, Masked Lapwing, Pacific Black Duck	Rain, heavy cloud	light rain	9.7	11	NW
29214	19.08.2020	Large shallow dam in paddock	Not recorded	Masked Lapwing, Silver Gull, Sulphur-Crested Cockatoo, Magpie Lark					
29213	19.08.2020	Large shallow dam in paddock	Not recorded	Masked Lapwing, Silver Gull, Grey Teal					
29226	19.08.2020	Deep lake with surrounding vegetation	Not recorded	Wood Duck, Grey Teal, Black Swan, Magpie					
29243	19.08.2020	Deep lake with surrounding vegetation	Not recorded	Black Swan, Wood Duck, Australian Shelduck, Masked Lapwing, Grey Teal					
29250	19.08.2020	Dam in paddock	Not recorded	Pacific Black Duck, Wood Duck, Australian Shelduck, Masked Lapwing, Magpie					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29253	19.08.2020	Dam in paddock	Not recorded	Australian Shelduck, Wood Duck, Silver Gull, Straw-Necked Ibis					
29200	19.08.2020	Open paddock with shallow depression	Not recorded	Australian Shelduck, Wood Duck, Pacific Black Duck, Brown Falcon, Magpie, Australian Raven					
29190	19.08.2020	Swampy wetland with reeds	Not recorded	Magpie	Partly cloudy	nil	13.5	9.7	NW
29252	19.08.2020		Not recorded	Magpie, Wood Duck	Partly cloudy	nil	13.5	9.7	NW
29212	19.08.2020	Grassy paddock, no wetland	Not recorded	Magpie, Australian Shelduck, Wood Duck, Grey Teal					
29182	19.08.2020	Wetland in paddock with large dead trees standing in water	Not recorded	White-Necked Heron, Black Swan, Grey Teal, Australian Raven, Australian Shelduck, Magpie, Silver Gull, Masked Lapwing					
29150	19.08.2020	Grassy paddock with depression that fills seasonally	Not recorded	White-Necked Heron, Black Swan, Grey Teal, Australian Raven, Sulphur-Crested Cockatoo, Australian Shelduck, Magpie, Masked Lapwing					
30374	19.08.2020	Wetland in paddock	Not recorded	Pacific Black Duck, Eurasian Coot					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29367	19.08.2020	Dam in paddock	Not recorded	White-Necked Heron, Masked Lapwing, Wood Duck, Magpie, Little Raven	Overcast	nil	10.2	13.9	NW
29316	20.08.2020	Seasonal swamp	Not recorded	Black Swan, Magpie, Little Raven, Pacific Black Duck	Partly cloudy	nil	8.1	2.3	W
1	20.08.2020	Dam in paddock with surrounding trees	Not recorded	Grey Teal, Chestnut Teal, Pacific Black Duck, Magpie					
29339	20.08.2020	Dam in paddock	Not recorded	Little Pied Cormorant, Magpie, Little Raven					
29340	20.08.2020	Deep dam and shallow wetland	Not recorded	Black Swan, Purple Swamphen, Pacific Black Duck, Masked Lapwing, Grey Teal, Magpie					
29372	20.08.2020	Dam in paddock	Not recorded	White-Faced Heron, Little Raven, Masked Lapwing, Grey Teal	Partly cloudy	nil	11.5	5.2	W

September 2020 wetland surveys

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29205	21.09.2020	Large shallow dam in paddock	Not recorded	White-Faced Heron, Black Swan, Masked Lapwing, Australian Shelduck	Fine	nil	14	7.8	W
29214	21.09.2020	Large shallow dam in paddock	Not recorded	Grey Teal, Red-Capped Plover					
29213	21.09.2020	Large shallow dam in paddock	Not recorded	Black Swan, Grey Teal, Masked Lapwing, Silver Gull					
29226	21.09.2020	Deep lake with surrounding vegetation	Not recorded	Hooded Plover, Black Swan, Australian Shelduck					
29243	21.09.2020	Deep lake with surrounding vegetation	Not recorded	Black Swan, Pied Stilt, Australian White Ibis, Grey Teal, Australian Shelduck					
29250	21.09.2020	Dam in paddock	Not recorded	Straw-Necked Ibis					
29253	21.09.2020	Dam in paddock	Not recorded	Grey Teal, Chestnut Teal, Silver Gull					
29200	21.09.2020	Open paddock with shallow depression	Not recorded	Australian Shelduck, Wood Duck, Pacific Swift, Black Swan, White-Necked Heron, Masked Lapwing, Magpie					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29190	21.09.2020	Swampy wetland with reeds	Not recorded	Australian Shelduck					
29252	21.09.2020		Not recorded	Wood Duck, Australian Shelduck					
29212	21.09.2020	Grassy paddock, no wetland	Not recorded	Magpies					
29182	21.09.2020	Wetland in paddock with large dead trees standing in water	Not recorded	Black Swan, White-Necked Heron. Australian White Ibis, Banded Stilt, Australian Shelduck, Grey Teal, Wood Duck, Eurasian Coot					
29150	21.09.2020	Grassy paddock with depression that fills seasonally	Not recorded	Black Swan, Banded Stilt, Magpie, Masked Lapwing, Australian Shelduck	Fine	nil	16.4	3.7	NW
30374	22.09.2020	Wetland in paddock	Not recorded	Eurasian Coot, Grey Teal, Pacific Black Duck, Wood Duck	Partly cloudy	Light rain	9.3	11	SW
29367	22.09.2020	Dam in paddock	Not recorded	Wood Duck, Masked Lapwing					
29316	22.09.2020	Seasonal swamp	Not recorded	Grey Teal, Pacific Black Duck, Magpie					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
1	22.09.2020	Dam in paddock with surrounding trees	Not recorded	Grey Teal, Masked Lapwing					
29339	22.09.2020	Dam in paddock	Not recorded	Australian Raven, Magpie					
29340	22.09.2020	Deep dam and shallow wetland	Not recorded	Black Swan, White-Faced Heron, Eurasian Coot, Grey Teal, Pacific Black Duck, Purple Swamphen					
29372	22.09.2020	Dam in paddock	Not recorded	Australian White Ibis, Magpie, Australian Raven	Partly cloudy	Light rain	11.2	7	SW

October 2020 wetland surveys

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29205	26.10.2020	Large shallow dam in paddock	Not recorded	15 Straw-Necked Ibis; 5 Black Winged Stilts; 2 Black Swan; 2 Musk Duck; 5 Silver Gull; 14 Eurasian Coot	fine	nil	11.2	4.6	W
29214	26.10.2020	Large shallow dam in paddock	Not recorded	2 Grey Teal; 2 Black Swan; 2 Masked Lapwing					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29213	26.10.2020	Large shallow dam in paddock	Not recorded	2 Mask Lapwing; 2 Shell Duck					
29226	26.10.2020	Deep lake with surrounding vegetation	Not recorded	2 Black Swan; 10 Australian Shelduck; 2 Magpie Lark; 2 Masked Lapwing					
29212	26.10.2020	Grassy paddock, no wetland	Not recorded	200 Straw-Necked Ibis; 100 White Ibis; 7 Australian Raven; 4 Masked Lapwing; 3 Australian Shelduck					
29182	26.10.2020	Wetland in paddock with large dead trees standing in water	Not recorded	34 Black Swan (10 On Nests); 10 Banded Stilts; 15 Pacific Black Duck; 5 Masked Lap Wing; 7 Australian Shelduck; 1 White Faced Heron					
29150	26.10.2020	Grassy paddock with depression that fills seasonally	Not recorded	24 Black Swan (17 On Nests); 1 White Faced Heron; 20 Wood Ducks; 1 Straw-Necked Ibis; 13 Ravens					
29252	26.10.2020		Not recorded	3 Magpie					
29253	26.10.2020	Dam in paddock	Not recorded	25 Little Pied Cormorant; 1 White-Necked Heron; 70 Eurasian Coot; 6 Black Swan (One On Nest); 2 Masked Lapwing; 10 Banded Stilt; 40 Grey Teal; 8 Pacific Black Duck					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29250	26.10.2020	Dam in paddock	Not recorded	54 Straw-Necked Ibis; 5 White Ibis; 2 Little Pied Cormorant; 17 Banded Stilt; 8 White-Necked Heron; 2 Pacific Black Duck					
29243	26.10.2020	Deep lake with surrounding vegetation	Not recorded	2 Black Swan (One On Nest And One In Water With 6 Chicks); 2 Pacific Black Duck; 4 Magpie; 22 Eurasian Coot					
29200	26.10.2020	Open paddock with shallow depression	Not recorded	170 Straw-Necked Ibis; 20 White Ibis; 17 Pacific Black Duck; 15 Banded Stilt; 9 White Necked Heron; 35 Grey Teal; 6 Magpie; 4 Australian Raven					
29190	26.10.2020	Swampy wetland with reeds	Not recorded	4 Magpie	partly cloudy	nil	15.6	6.4	W
1	27.10.2020	Dam in paddock with surrounding trees	Not recorded	6 Grey Teal; 10 Eurasian Coot; 3 Magpie					
29316	27.10.2020	Seasonal swamp	Not recorded	2 Pacific Black Duck; 1 White-Faced Heron; 10 Little Raven; 6 Magpie; 5 White Ibis					
29339	27.10.2020	Dam in paddock	Not recorded	5 Magpie; 2 Little Pied Cormorant; 3 Masked Lapwing; 10 Grey Teal; 35 Straw-Necked Ibis					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29340	27.10.2020	Deep dam and shallow wetland	Not recorded	45 Black Swan (6 On Nests); 20 Purple Swamp Hen; 17 Eurasian Coot; 6 White Ibis; 2 Masked Lapwing; 30 Grey Teal					
30374	27.10.2020	Wetland in paddock	Not recorded	12 Eurasian Coot; 10 Grey Teal; 6 Magpie; 1 White Faced Heron					
29372	27.10.2020	Dam in paddock	Not recorded	5 Masked Lapwing; 7 Raven; 18 Straw-Necked Ibis					
29367	27.10.2020	Dam in paddock	Not recorded	2 Wood Duck; 8 White-Necked Heron; 6 Magpie; 10 Pacific Black Duck	fine	nil	13	0.7	W

November 2020 wetland surveys

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29205	16.11.2020	Large shallow dam in paddock	Not recorded	57 Black Swan; 12 Banded Stilt; 4 Masked Lapwing; 2 White-Faced Heron	fine	nil	15.3	9.8	SW
29214	16.11.2020	Large shallow dam in paddock	Not recorded	2 Black Swan					
29213	16.11.2020	Large shallow dam in paddock	Not recorded	2 Masked Lapwing					
29226	16.11.2020	Deep lake with surrounding vegetation	Not recorded	2 Pacific Black Duck; 2 Australian Shell Duck					
29212	16.11.2020	Grassy paddock, no wetland	Not recorded	12 Straw-Necked Ibis; 3 Australian Shell Duck; 7 Magpie					
29182	16.11.2020	Wetland in paddock with large dead trees standing in water	Not recorded	2 White Faced Heron; 1 Cattle Egret; 16 Black Swan; 3 Straw-Necked Ibis; 1 Little Pied Cormorant; 2 Masked Lapwing; 3 Little Raven; 5 Pacific Black Duck					
29150	16.11.2020	Grassy paddock with depression that fills seasonally	Not recorded	7 Black Swan; 20 Grey Teal; 3 Little Raven; 1 White Face Heron					
29252	16.11.2020		Not recorded	No Birds					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29253	16.11.2020	Dam in paddock	Not recorded	2 Black Swan; 8 Banded Stilt; 2 Australian Shell Duck; 4 Little Pied Cormorant					
29250	16.11.2020	Dam in paddock	Not recorded	10 Straw-Necked Ibis; 4 White Ibis; 4 Pacific Black Duck					
29243	16.11.2020	Deep lake with surrounding vegetation	Not recorded	2 Black Swan; 6 Eurasian Coot; 1 Masked Lapwing; 3 Magpie; 4 Pacific Black Duck					
29200	16.11.2020	Open paddock with shallow depression	Not recorded	2 White Necked Heron; 16 Grey Teal; 18 White Ibis; 17 Pacific Black Duck; 20 Straw-Necked Ibis; 15 Magpie; 12 Australian Raven					
29190	16.11.2020	Swampy wetland with reeds	Not recorded	No Birds	partly cloudy	nil	19.3	3.4	E
1	17.11.2020	Dam in paddock with surrounding trees	Not recorded	2 Pacific Black Duck; 2 Masked Lapwing	partly cloudy	nil	14.5	1.1	SW
29316	17.11.2020	Seasonal swamp	Not recorded	6 Little Ravens					
29339	17.11.2020	Dam in paddock	Not recorded	1 White Necked Heron; 2 Little Raven; 4 Magpie					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29340	17.11.2020	Deep dam and shallow wetland	Not recorded	10 Purple Swamp Hen; 24 Eurasian Coot; 18 Grey Teal; 2 Pacific Black Duck; 1 Little Pied Cormorant; 1 Magpie					
30374	17.11.2020	Wetland in paddock	Not recorded	5 Eurasian Coot					
29372	17.11.2020	Dam in paddock	Not recorded	No Birds					
29367	17.11.2020	Dam in paddock	Not recorded	No Birds	fine	nil	18		SW

December 2020 wetland surveys

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29205	21.12.2020	Large shallow dam in paddock	Open water, lower than past months	4 Black Swan; 20 Black Winged Stilts; 5 Straw-Necked Ibis; 2 Musk Duck; 33 Eurasian Coot; 6 White Faced Heron	fine	nil	25	3.6	w
29214	21.12.2020	Large shallow dam in paddock	70% full	2 Little Pied Cormorant, 4 Swifts, 2 Black Swan, 12 Grey Teal					
29213	21.12.2020	Large shallow dam in paddock	70% full	4 Black Swan, 7 Shelduck					
29226	21.12.2020	Deep lake with surrounding vegetation	70% full	4 White Faced Heron, 12 Black Winged Stilts, 20 Black Swan, 34 Grey Teal					
29212	21.12.2020	Grassy paddock, no wetland	Dry, tall grass and sheep	No Birds					
29182	21.12.2020	Wetland in paddock with large dead trees standing in water	Little water, lots of aquatic vegetation	40 Straw Necked Ibis; 22 Little Pied Cormorant; 40 Tern; 2 Black Swan; 3 White Necked Heron; 3 Royal Spoonbill; 2 White Ibis; 5 Pacific Black Duck					
29150	21.12.2020	Grassy paddock with depression that fills seasonally	Dry	No Birds					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29252	21.12.2020		Dry, grazed paddock	No Birds					
29253	21.12.2020	Dam in paddock	Shallow water with aquatic vegetation	1 Wood Duck; 3 Royal Spoonbill; 1 White Faced Heron; 1 White Necked Heron; 2 Straw-Necked Ibis					
29250	21.12.2020	Dam in paddock	Dry	No Wetland Birds					
29243	21.12.2020	Deep lake with surrounding vegetation	90% full	20 Eurasian Coot, 40 Grey Teal, 66 Black Swan, 4 White Faced Heron, 2 White Ibis					
29200	21.12.2020	Open paddock with shallow depression	Dry, tall grass	30 White-Necked Heron; 5 Straw-Necked Ibis; 2 White Ibis; 27 Tern; 1 Black Swan On Nest; 4 Spoonbill; 2 Grey Teal; 2 Silver Gull					
29190	21.12.2020	Swampy wetland with reeds	No water, tall grass and reeds	No Birds					
1	21.12.2020	Dam in paddock with surrounding trees	70% full	3 Australian Shelduck, 2 Australian Wood Duck					
29316	21.12.2020	Seasonal swamp	Small dam full, no other water, grass cover	6 Pacific Black Duck, 2 Black Swan (Flying Overhead), 7 Masked Lapwing					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
30252	21.12.2020	Dam in paddock	Not recorded	No Birds					
29339	21.12.2020	Dam in paddock	Tall grass, hard to see birds or water if present	3 White Necked Heron, 6 Wood duck, 12 Masked Lapwing					
29340	21.12.2020	Deep dam and shallow wetland	50% full	30 Eurasian Coot, 35 Black Swan, 10 Purple Swamp Hen, 4 Little Pied Cormorant; 17 Grey Teal					
30374	21.12.2020	Wetland in paddock	Full	2 Purple Swamp Hen, 10 Eurasian Coot, 6 Wood duck					
29372	21.12.2020	Dam in paddock	Dry	1 White Necked Heron					
29367	21.12.2020	Dam in paddock	Dry	No Birds	fine	nil	23.4	1.1	sw
29140	22.12.2020	Small dam in creekline	Partially full, water level declining	1 White Faced Heron, 3 Australian White Ibis, 4 Pacific Black Duck	partly cloudy	light rain	17.7	6.2	sw
30369	22.12.2020	Dam in drainage line	High water level	50 Eurasian Coot, 5 White Faced Heron, 2 Black Swan, 1 Masked Lapwing, 5 Pacific Black Duck					
30299	22.12.2020	Drainage line	Dry	No Birds					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29119	22.12.2020	Shallow dam in grassy paddock	Shallow water	4 Shell Duck, 4 Masked Lapwing 2 White Faced Heron,					
29141	22.12.2020	Small dam in paddock	Shallow	No Wetland Birds					
29151	22.12.2020	Small dam in paddock	Shallow	No Birds					
29162	22.12.2020	Small dam in paddock	Could not see any water	No Birds					
29170	22.12.2020	Small dam in paddock	Could not see any water	No Birds					
29183	22.12.2020	Shallow saline lake with surrounding trees and shrubs	Shallow	24 Grey Teal, 5 Masked Lapwing, 17 Banded Stilt, 2 White Faced Heron, 6 Little Pied Cormorant					
29362	22.12.2020	Large deep lake	Full	45 Pacific Black Duck Or Grey Teal, 64 Black Swan, Over 40 Eurasian Coot, 6 Masked Lapwing, 10 Shelduck					
30383	22.12.2020	Drainage line	Tall grass, hard to see birds or water if present	No Birds					

Wetland ID	Survey date	Wetland description	Wetland status	Birds observed	Weather	Precipitation	Ait Temp	Wind speed	Wind direction
29436	22.12.2020	Dam in paddock	Tall grass, hard to see birds or water if present	No Birds					
30263	22.12.2020	Dam in paddock	Little water	2 Masked Lapwing					
29325	22.12.2020	Paddock with shallow depression	Dry, grass cover	No Birds	fine	nil	26	14.2	sw

Appendix 8: Brolga breeding season – 3-year comparison

Comparison of Brolga breeding utilisation results within 3 kilometres of SCFW, before and after operation and across 'dry', 'intermediate' and 'wet' climatic conditions

Month	Before 2006	After Year 1 2018 – 2019 DRY	After Year 2 2019 – 2020 INTERMEDIATE	After Year 3 2020 – 2021 WET
July	NA	0	NA	NA
August	NA	0	2 Brolga with nest 5th Salt Creek waterway (via landholder) 1 Brolga 19th Wetland 29150 2 Brolga with nest 20th Wetland 29150	0
September	NA	2 Brolga No date 29150	0	0
October	0	0	2 Brolga with nest 15th & 16th Wetland 29150	0

Month	Before 2006	After Year 1 2018 – 2019 DRY	After Year 2 2019 – 2020 INTERMEDIATE	After Year 3 2020 – 2021 WET
November	NA	0	2 Brolga 19th Wetland 29205 2 Brolga No date Wetland 29182 (via Elmoby Ecology)	0
December	NA	0	2 Brolga 19th Wetland 29205	0
July	NA	NA	0	0

Appendix 9: Historical Brolga breeding records within 3 kilometres of SCWF

Year	Month*	Wetland	Details	Brolga recorded breeding during SCWF BAM Plan surveys
Associated with a wetland				
1984	January	29150	No details	Yes
1992	August	29253	2 Brolga	No
1992	December	29250	3 Brolga	No
Not associated with a wetland, nearest wetland and distance provided below				
1984	January	29150	745 m	NA
1984	January	29339	112 m	NA
1984	January	30267	324 m	NA Note, this record is 400 m outside of the 3 km survey area
2000	January	29316	818 m	NA
2002	October	29190	354 m	NA

*N.B. For years with January as a month of record appear to be default dates in the VBA (all records with a date 1/1/1984). January is considered to be outside of the normal Brolga breeding season (June-December), though breeding can occur over summer in very wet years and when breeding wetlands remain suitable.

Appendix 10: Summary records of calls of bat species recorded during 2020 - 2021

Table 17 Bat calls identified during the 2020-2021 monitoring period.

Genera / Species / Complex Name	Ground (1 m)				Turbine (nacelle 85 m)				Total calls
	T02	T05	T10	T13	T02	T05	T10	T13	
November – December 2020									
Austronomus australis	68	15	13	10	22	22		1	151
Chalinolobus gouldii	53	33	112			8	20	3	229
Chalinolobus morio	5	7	29				1		42
Falsistrellus tasmaniensis	28		6						34
SBWB Complex	12		68	7					87
Miniopterus orianae bassanii	7	3					4		14
Ozimops sp.	33	57	23	32	5	2	16	4	172
Nyctophilus sp.	39	6	6	4					55
Vespadelus darlingtoni	13	8	21					1	43
Vespadelus regulus	14	2	69	3					88
Vespadelus vulturnus	29	2	105	6					142
Scotorepens balstoni							6		6
February – April 2021									
Austronomus australis	-	-	-	-	63	71	-	18	152
Chalinolobus gouldii	-	-	-	-	2	8	-	13	23
Chalinolobus morio	-	-	-	-		1	-		1
Falsistrellus tasmaniensis	-	-	-	-			-		0
SBWB Complex	-	-	-	-			-		0
Miniopterus orianae bassanii	-	-	-	-	2	2	-		4

Genera / Species / Complex Name	Ground (1 m)				Turbine (nacelle 85 m)				Total calls
	T02	T05	T10	T13	T02	T05	T10	T13	
Ozimops spp.	-	-	-	-	31	19	-	16	66
Nyctophilus sp.	-	-	-	-			-		0
Vespadelus darlingtoni	-	-	-	-	8		-		8
Vespadelus regulus	-	-	-	-			-		0
Vespadelus vulturnus	-	-	-	-			-		0
Scotorepens balstoni	-	-	-	-		5	-	3	8

Note: ' – ' Equipment failure / environmental damage (no calls recorded).

Table 18 Bat calls identified during the 2019-2020 monitoring period.

Genera / Species / Complex	Ground (1 m)				Turbine (nacelle 85 m)				Total calls
	T02	T05	T10	T13	T02	T05	T10	T13	
November – December 2019									
Austronomus australis	62	64	232	-	62	42	-	57	519
Chalinolobus gouldii	51	133	48	-	3	3	-	1	239
Chalinolobus morio	51	26	41	-			-		118
Falsistrellus tasmaniensis	4	1	8	-			-		13
SBWB Complex									
Miniopterus orianae bassanii	3	33	6	-	7		-		49
Ozimops spp.	76	128	17	-	3	1	-	2	227
Nyctophilus sp.	25	22	7	-			-		54
Vespadelus darlingtoni	11	22	37	-	3		-		73
Vespadelus regulus	17	27	66	-			-	1	111
Vespadelus vulturnus	24	31	22	-	2	1	-		80
February – April 2020									
Austronomus australis	1510	1734	1060	1441	29	224	181	-	6179
Chalinolobus gouldii	330	1142	10933	600	1	16	7	-	13029
Chalinolobus morio	44	3	181	10				-	238
Falsistrellus tasmaniensis	16							-	16
SBWB Complex									
Miniopterus orianae bassanii	25	12	624	63	3			-	727
Ozimops spp.	113			2	13	8	17	-	153
Nyctophilus sp.	144	43	280	72		1		-	540
Vespadelus darlingtoni		211	1398	47				-	1656
Vespadelus regulus			49	71		2		-	122
Vespadelus sp.	87	146	402					-	635

Genera / Species / Complex	Ground (1 m)				Turbine (nacelle 85 m)				Total calls
	T02	T05	T10	T13	T02	T05	T10	T13	
Vespadelus vulturnus			14		2			-	16

Note: ' – ' Equipment failure / environmental damage (no calls recorded).

Table 19 Bat calls recorded during the 2018-2019 monitoring period.

Species	Common / Genera / Complex name	Ground (1 m)				Turbine (nacelle 85 m)			
		T02	T05	T10	T13	T02	T05	T10	T13
Spring 2018									
Miniopterus orianae bassanii	Southern Bent-wing Bat								
Chalinolobus morio									
Miniopterus orianae bassanii	Southern Bent-wing Bat Complex								
Vespadelus vulturnus									
Chalinolobus morio	Chocolate Wattled Bat	Y	Y	Y		Y	Y	Y	
Nyctophilus geoffroyi	Long-eared Bat sp.			Y					
Nyctophilus gouldi									
Vespadelus vulturnus	Little Forest Bat	Y	Y	Y					
Vespadelus darlingtoni									
Vespadelus regulus	Forest Bat sp.	Y	Y	Y	Y	Y	Y		
Vespadelus vulturnus									
Autumn 2019									
Miniopterus orianae bassanii	Southern Bent-wing Bat	2		1	2				
Chalinolobus morio									
Miniopterus orianae bassanii	Southern Bent-wing Bat Complex	3		7	4				
Vespadelus vulturnus									
Chalinolobus morio	Chocolate Wattled Bat	Y	Y	Y	Y	Y			Y
Nyctophilus geoffroyi	Long-eared Bat sp.								
Nyctophilus gouldi									
Vespadelus vulturnus	Little Forest Bat	Y	Y	Y	Y				
Vespadelus darlingtoni									
Vespadelus regulus	Forest Bat sp.	Y	Y	Y	Y		Y		
Vespadelus vulturnus									

Table 20 Bat calls identified during baseline monitoring undertaken in 2006.

Genera / Species	Common / Complex	Ground - spring 05	Ground - summer 06	50m - summer 06	Ground - autumn 06	50m - autumn 06
		19-21/10/05	16-21/2/06	17-21/2/06	24-26/4/06	24-26/4/06
Number of files recorded		**51**	**56**	**20**	**14**	**8**
Austronomus australis	White-striped Freetail Bat		10	14		2
Ozimops planiceps	Southern Freetail Bat		2			
Vespadelus regulus	Southern Forest Bat				2	
Chalinolobus morio	Chocolate Wattled Bat		1			
Chalinolobus gouldii	Gould's Wattled Bat	19	13	1	1	2
Ozimops Species 2	Southern Freetail Bat Complex					
Ozimops planiceps	*Southern Freetail Bat*					1
Chalinolobus gouldii *Ozimops* Species 2	Gould's Wattled Bat/Southern Freetail Bat Sp 2 Complex		3			1
Chalinolobus gouldii *Ozimops planiceps*	Gould's Wattled Bat/Southern Freetail Bat Complex	7			3	1
Chalinolobus gouldii *Scotorepens balstoni*	Gould's Wattled Bat / Eastern Broadnosed Bat Complex		1			
Nyctophilus sp.	Long-eared Bat(s)	3	5			
Vespadelus sp.	Forest Bat(s)				1	
Vespadelus darlingtoni *Vespadelus regulus*	Large Forest Bat / Southern Forest Bat Complex		6		1	
Chalinolobus morio *Miniopterus orianae bassanii* *Vespadelus vulturnus*	Little Forest Bat / Southern Bent-wing Bat / Chocolate Wattled Bat Complex	1			2	
Chalinolobus morio			2			

Genera / Species	Common / Complex	Ground - spring 05	Ground - summer 06	50m - summer 06	Ground - autumn 06	50m - autumn 06
		19-21/10/05	16-21/2/06	17-21/2/06	24-26/4/06	24-26/4/06
Miniopterus orianae bassanii	Chocolate Wattled Bat / Southern Bent-wing Bat Complex	21	13	5	4	1
Unidentified (poor quality)		21	13	5	4	1

Appendix 11: Grey-headed Flying-fox survey mortalities in Year 1, Year 2 and Year 3

Turbine number	Number of collisions	Date
1	2	6 April 2020 20 April 2020
2	2	24 March 2020 26 March 2020
3	2	20 February 2019 27 March 2020
5	2	25 September 2018 8 April 2020
6	1	12 March 2020
7	2	11 March 2020 7 April 2020
9	3	26 March 2020 6 April 2020 3 March 2021
10	1	21 February 2019
14	3	22 February 2019 26 March 2020 6 April 2020
Total	18	Spring 2018 Late summer 2019 Autumn 2020

Appendix 12: Symbolix Report Salt Creek Wind Farm Mortality Estimate Year 3

Salt Creek Wind Farm Mortality Estimate - Year 3

Prepared for Elmoby Ecology, 1 September 2021, Ver. 1.0

This report outlines an analysis of the mortality data collected at the Salt Creek Wind Farm Wind Farm from 2020-08-17 to 2021-07-23. The analysis is broken into the three related components below:

- Searcher efficiency / detectability – estimated from trials in January 2020 and May 2020
- Scavenger loss rates – consisting of trials in October 2018, November 2018, December 2018, February 2019, April 2019 and May 2019
- Mortality estimates - based on monthly surveys at 15 turbines, from 2020-08-17 to 2021-07-23

The data was collected and provided by Elmoby Ecology (except for scavenger efficiency trial data, which were provided by Nature Advisory) and is analysed "as-is." A brief summary of the data is provided below, and the ultimate focus of this report is a discussion of the potential mortality.

Available data

The data for the second and third years and for the searcher efficiency trials was collected, verified, and provided to us from Elmoby Ecology. Data from scavenger efficiency trials was provided to us by Nature Advisory[1].

Methodology overview

Mortality through collision is an ongoing environmental management issue for wind facilities. Different sites present different risk levels; consequently different sites have different monitoring requirements. In order to estimate the mortality loss at a given site (in a way that is comparable with other facilities) we must account for differences in survey effort, searcher and scavenger efficiency. We used a Monte-Carlo simulation to achieve this.

The analysis used survey data to estimate the average time to scavenge loss and searcher efficiency (and related confidence intervals). The algorithm then simulated different numbers of virtual mortalities. We could then estimate how many carcasses were truly in the field, given

[1] Symbolix mortality spreadsheet SCWF 190801.xlsx

the range of searcher and scavenger efficiencies, and the survey frequency and coverage, and the true “found” details. After many simulations, we can estimate the likely range of mortalities that could have resulted in the recorded survey outcome.

This method has been benchmarked against analytical approaches (Huso (2011), Korner-Nievergelt et al. (2011)). Its outputs are equivalent but it is able to robustly model more complex survey designs (e.g. pulsed surveys, rotating survey list).

Searcher efficiency

Two searcher efficiency trials were held (2020-01-07 and 2020-05-11) at two different locations (Salt Creek and Silverton). Both used dogs as observers.

The detectability trials used both bird (32 replicates) and bat carcasses (45 replicates). A range of bird sizes were used, ranging from small (Sparrow) to medium (Brown falcon). Feather spots (e.g. Magpie wing) were also used. One small bird, 27 medium birds, and four feather spots were used. Bat carcasses of various species (including White Striped Freetail Bats and Eastern Falsistrelles) were used to determine bat detectability.

We found no evidence that the searcher efficiency differed between the trials held at Salt Creek and Silverton. We also found no evidence that searcher efficiency differed between bats and birds (small birds, medium birds, and feather spots combined). Therefore, bird and bat detection efficiencies are aggregated in the following mortality estimate.

Table 1 summarises the result.

Detectability for bats and birds is 96%, with a 95% confidence interval of [89%, 99%].

Table 1: Detection efficiencies for birds and bats.

Variable	Bats and Birds
Number found	74
Number placed	77
Mean detectability proportion	0.96
Detectability lower bound (95% confidence interval)	0.89
Detectability upper bound (95% confidence interval)	0.99

Scavenger efficiency

Scavenger efficiency trials were conducted on 2018-10-24, 2018-11-22, 2018-12-19, 2019-02-21, 2019-04-17 and 2019-05-23. Trials ran over 30 days. A range of bird sizes were used, ranging from small (Common Myna), to medium (Peregrine Falcon), to large (Australian Magpie). Both small (White-striped Freetail) and large (Grey-headed flying fox) bats were used.

Survival analysis (Kaplan and Meier (1958)) was used to determine the average time until complete loss from scavenge. Survival analysis was required to account for the fact that we do not know the exact time of scavenge loss, only an interval in which the scavenge event happened. By performing survival analysis we can estimate the average survival percentage after a given length of time, despite these unknowns.

Based on these surveys there is no evidence that birds and bats have different scavenger rates, based upon AICc selection. Therefore, bird and bat scavenger rates are aggregated in the following mortality estimate.

Figure 1 shows a survival curve fitted to the combined cohort of bats and bird. The survival curves (solid lines) show the estimated proportion of the sets remaining at any given time. The shaded portions are the 95% confidence intervals on the estimates. For example, we see that we expect around 5% to 32% of carcasses to remain after ten days with the expectation being around 13%.

Under these assumptions, the median time to total loss via scavenge is 2.1 days, with a 95% confidence window of [1.2, 3.8] days.

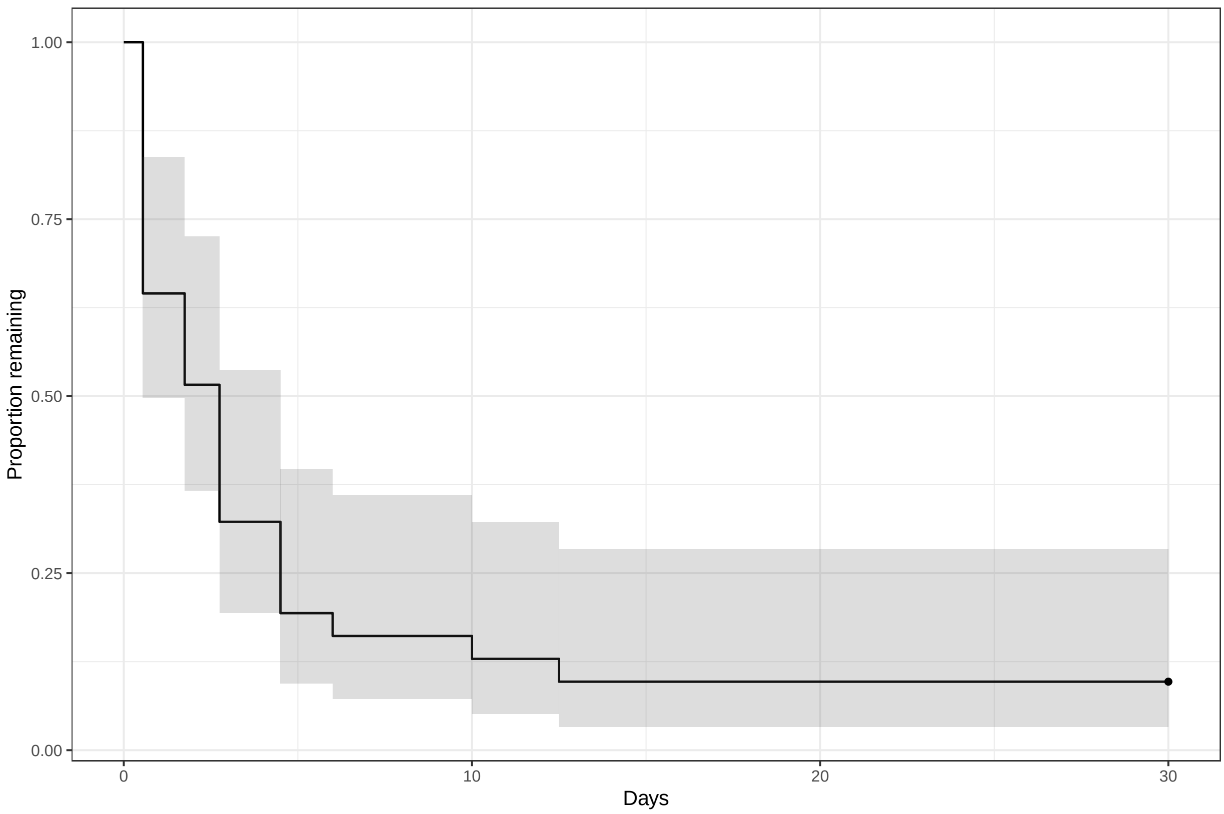


Figure 1: Combined survival curves for birds and bats, with 95% confidence interval shaded.

Mortality projection inputs

Carcass search data

The mortality estimate was based on a dated list of turbine surveys. The survey frequency is summarised in Table 2. All 15 turbines were surveyed once a month, except for in September, October, March, and April when they were surveyed fortnightly. All turbines were surveyed out to a radius of 130 metres.

Table 2: Number of surveys per month.

Date	Number of surveys
2020 Aug	13
2020 Sep	30
2020 Oct	30
2020 Nov	15
2020 Dec	15
2021 Jan	15
2021 Feb	15
2021 Mar	32
2021 Apr	43
2021 May	15
2021 Jun	15
2021 Jul	15

Mortality estimate

Mortality estimation – methodology

With estimates for scavenge loss and searcher efficiency we then converted the number of bat and bird carcasses detected into an estimate of overall mortality at Salt Creek Wind Farm from 2020-07-16 to 2021-07-23 (we allow for collisions to occur up to a month prior to the first survey).

The mortality estimation is done via Monte-Carlo simulation. We used 25000 simulations with the survey design simulated each time. Random numbers of virtual mortalities were simulated, along with the scavenge time and searcher efficiency (based on the measured confidence intervals). The proportion of virtual carcasses that were "found" was recorded for each simulation. Finally, those trials that had the same outcome as the reported survey detections were collated, and the initial conditions (i.e. how many true losses there were) reported on.

The complete set of model assumptions are listed below.

- There were 15 turbines on site.
- Search frequency for each turbine was taken from a list of actual survey dates (see Table 2 for a summary).
- Mortalities were allowed to occur up to a month before the initial survey (2020-07-16) and until the final surveyed date (2021-07-23).
- Birds are on-site at all times during this period.
- Bats are on-site at all times during this period.
- Finds are random and independent, and not clustered with other finds.
- There was equal chance of any turbine individually being involved in a collision / mortality.
- We assumed a log-normal scavenge shape, which Stark and Muir (2020) have shown accurately describes the scavenger profile of carcasses in Victoria. We note that this differs from previous years (Symbolix 2019, 2020), where we instead assumed an exponential scavenge shape.
- We took scavenge loss and search efficiency rates as outlined above.
- All 15 turbines were earched out to a 130 metre radius. We estimated the "coverage factor" for the survey – i.e. the total fall zone surveyed for birds and bats (using estimates from Hull and Muir (2010)). We assumed that the coverage factor was 99% for birds and 99% for bats.

Mortality projection results

After running the simulation we investigated the distribution of mortalities that could have resulted in the actual numbers found during the surveys. The breakdown of found carcasses per species are summarised in Table 3.

Table 3: Carcasses found during the third year of surveys.

Species	Bat	Bird	Feather Spot
Gould's Wattled Bat	21	0	0
WSFT	20	0	0
Chocolate Wattled Bat	7	0	0
Lesser Long-eared Bat	4	0	0
Unidentified bat	3	0	0
Little Forest Bat	2	0	0
Eastern Falsistrelle	1	0	0
GHFF	1	0	0
Gould's Long-eared Bat	1	0	0
Large Forest Bat	1	0	0
Southern Freetail	1	0	0
Australian Magpie	0	6	5
Common Starling	0	3	2
Nankeen Kestrel	0	3	1
Australasian Pipit	0	2	0
Brown Songlark	0	2	0
Striated Pardalote	0	2	0
Sulphur-crested Cockatoo	0	2	0
Brown Falcon	0	1	2
Eastern Barn Owl	0	1	1
Unidentified bird	0	1	1
Wedge-tailed Eagle	0	1	1
Black-shouldered Kite	0	1	0
Eurasian Skylark	0	1	0
European Sparrow	0	1	0
Fan-tailed Cuckoo	0	1	0
Long-billed Corella	0	1	0
Peregrine Falcon	0	1	0
Quail sp.	0	1	0
Sacred Kingfisher	0	1	0
Yellow-rumped Thornbill	0	1	0
Australian Raven	0	0	1
Crimson Rosella	0	0	1

There were also a small number of "incidental" finds (see Table 4), which were carcasses found outside the formal surveys. These finds are not included in the formal mortality estimate.

Table 4: Incidental finds.

Species	Date
Wedge-tailed Eagle	2020-08-18
Straw-necked Ibis	2020-10-11
WSFT	2021-02-18

Bat mortality estimate – year three

During the third year of surveys a total of 62 bats were found during formal surveys (Table 3). The resulting estimate of total mortality, accounting for searcher efficiency, scavenge rate, search area and timing of surveys is an expectation (mean) of 342 and a median of 327 bats lost on site over the twelve months.

Table 5 and Figure 2 display the percentiles of the distribution, to show the confidence interval in this average.

Based on the detected carcasses and measured detectability and scavenge rate, we expect that there was a total site loss of around 342 bats over the survey period, and are 95% confident that fewer than 484 individuals were lost.

Table 5: Percentiles of estimated total bat losses over the third year of surveys.

0%	50% (median)	90%	95%	99%	99.9%
194	327	452	484	565	686

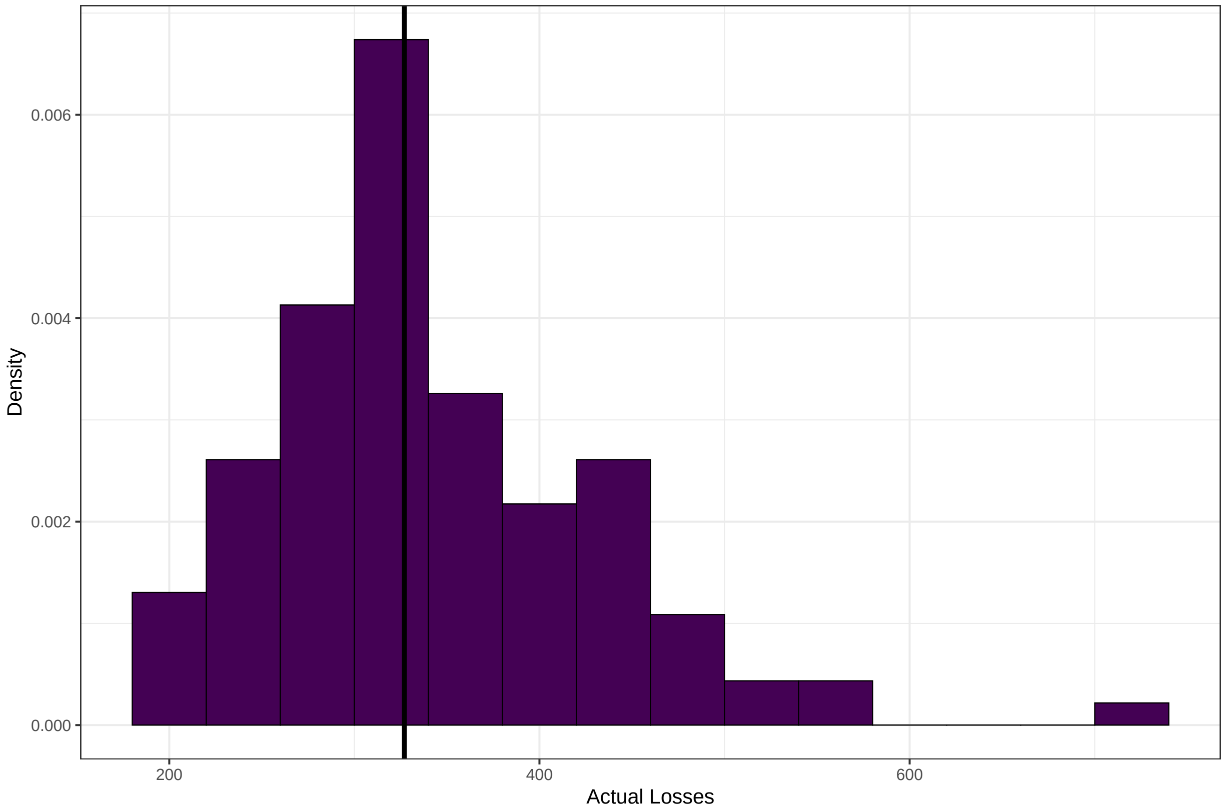


Figure 2: Histogram of the total losses distribution (bats), given 62 were detected on-site. The black solid line shows the median.

Bird mortality estimate - year three

During the third year of of surveys a total of 48 birds were found during formal surveys (Table 3). The resulting estimate of total mortality, accounting for searcher efficiency, scavenge rate, search area and timing of surveys is an expectation (mean) of 265 and a median of 250 birds lost on site over the twelve months.

Table 6 and Figure 3 display the percentiles of the distribution, to show the confidence interval in this average.

In determining the estimate, we have used the standard practice of assuming that all carcasses and all feather spots (regardless of size or composition) are attributable to the wind turbines.

Based on the detected carcasses and feather spots and measured detectability and scavenge rate, we expect that there was a total site loss of around 265 birds over the survey period, and are 95% confident that fewer than 414 individuals were lost.

Table 6: Percentiles of estimated total bird losses over the third year of surveys.

0%	50% (median)	90%	95%	99%	99.9%
120	250	350	414	570	588

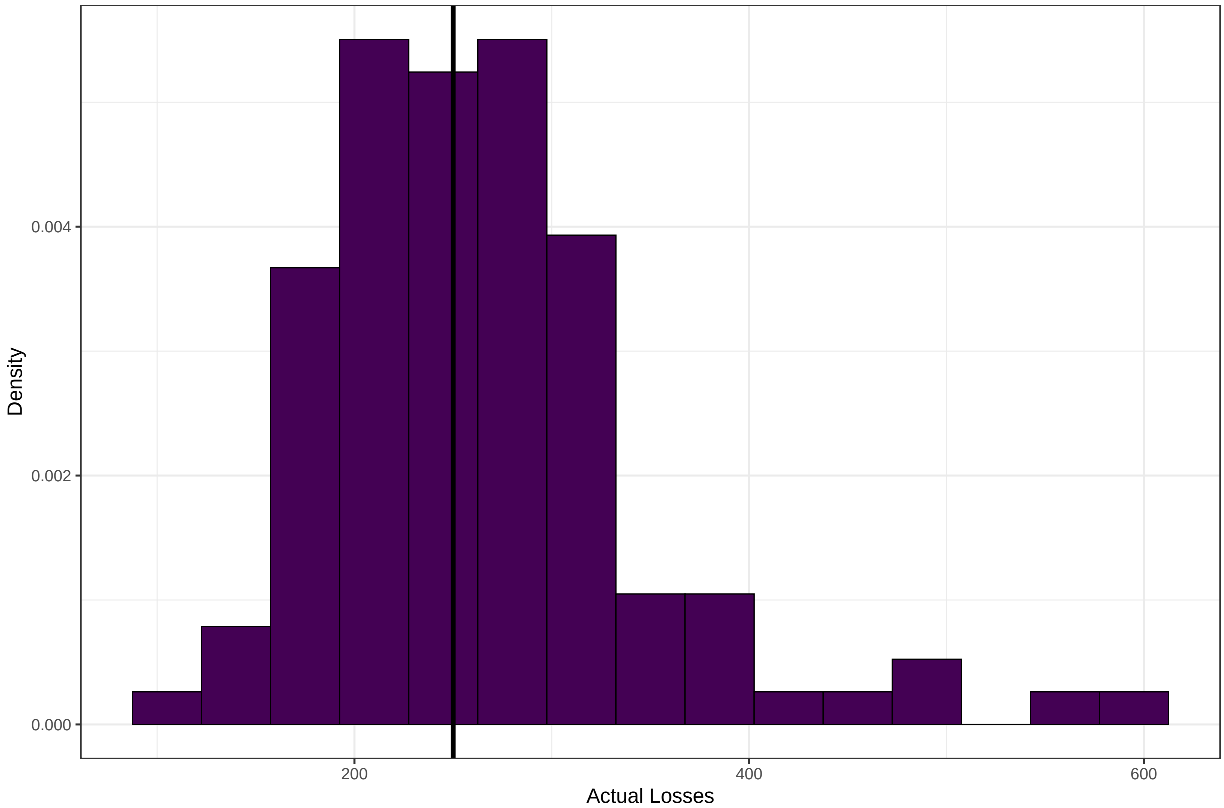


Figure 3: Histogram of the total losses distribution (birds), given 48 were detected on-site. The black solid line shows the median.

Grey-headed Flying Fox mortality estimate - year two and three combined

During the second and third year of surveys a total of 13 Grey-headed Flying Foxes (GHFFs) were found during formal surveys. The resulting estimate of total mortality, accounting for searcher efficiency, scavenge rate, search area and timing of surveys is an expectation (mean) of 78 and a median of 72 GHFFs lost on site over the twenty-four months.

Table 7 and Figure 4 display the percentiles of the distribution, to show the confidence interval in this average.

Based on the detected carcasses and feather spots and measured detectability and scavenge rate, we expect that there was a total site loss of around 78 GHFFs over the second and third year of surveys, and are 95% confident that fewer than 125 individuals were lost.

Table 7: Percentiles of estimated total GHFF losses over the second and third year of surveys.

0%	50% (median)	90%	95%	99%	99.9%
30	72	117	125	176	181

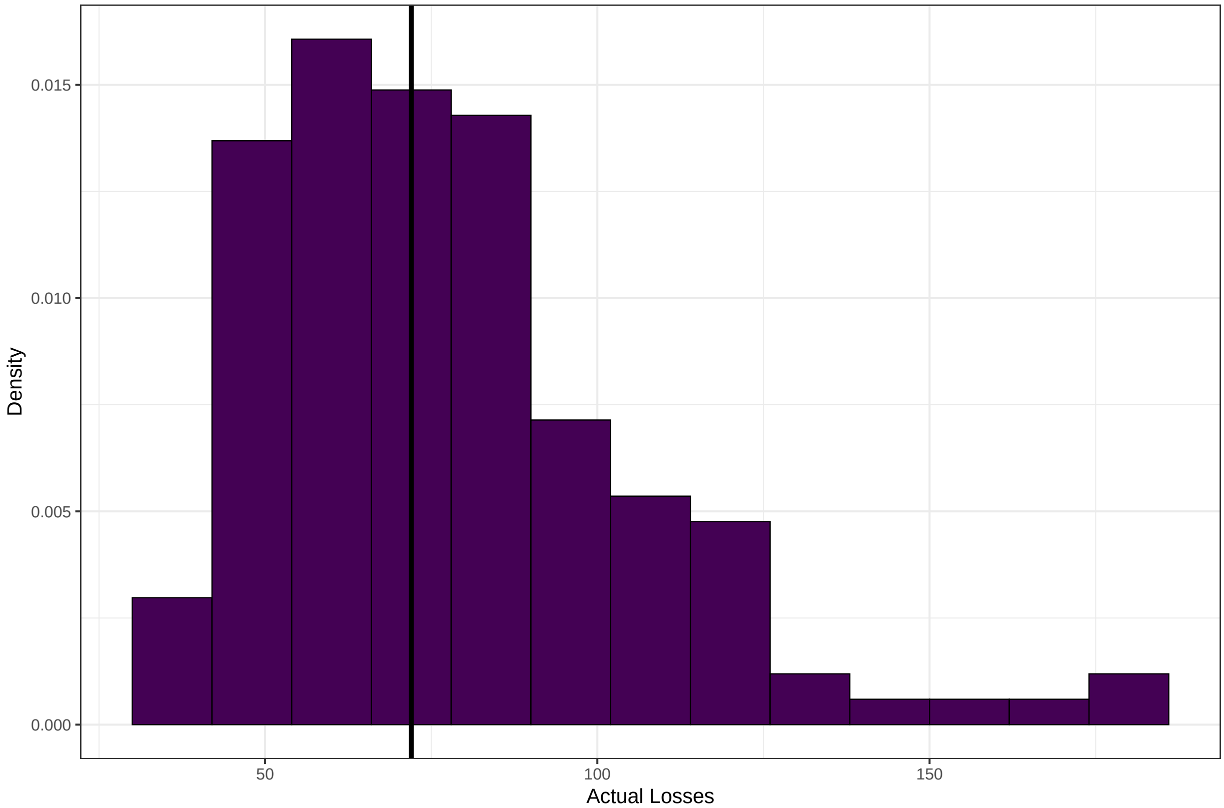


Figure 4: Histogram of the total losses distribution (GHFFs), given 13 were detected on-site. The black solid line shows the median.

Comparison of year two and year three results

Bat results

During the second year of surveys (2019-07-19 to 2020-07-15) a total of 65 bats were found during formal surveys. The resulting estimate of total mortality is an expectation (mean) of around 377 bats over the survey period, and we are 95% confident that fewer than 584 individuals were lost. We note that this differs from the previously reported estimate (Symbolix 2020) due to the use of a log-normal scavenge shape instead of exponential and minor updates to the simulation method.

In comparison, in the third year of surveys a total of 62 bats were found during formal surveys. The resulting estimate of total mortality is an expectation of 342 bats over the survey period, and we are 95% confident that fewer than 484 individuals were lost.

Statistical testing (using the Kolmogorov-Smirnov test) was used to determine if there was a significant difference between the modelled distribution of mortalities in year two and year three.

When considering all bat mortalities, we find no evidence for a difference in the distribution of mortalities in year two and year three (the test statistic $D = 0.15$ is less than the critical value D* = 0.35 at the 0.05 significance level).

Assuming all model assumptions hold, this would imply that the true total number of bat losses in year three was not significantly different from the number of losses in year two.

Bird results

During the second year of surveys a total of 47 birds were found during formal surveys. The resulting estimate of total mortality is an expectation of around 279 birds over the survey period, and we are 95% confident that fewer than 415 individuals were lost. We note that this estimate differs from the previously reported estimate (Symbolix 2020) due to the use of a log-normal scavenge shape instead of exponential and minor updates to the simulation method.

In comparison, in the third year of surveys a total of 48 birds were found during formal surveys. The resulting estimate of total mortality is an expectation of 265 birds over the survey period, and we are 95% confident that fewer than 414 individuals were lost.

Using the Kolmogorov-Smirnov test, we find no evidence for a difference in the distribution of mortalities in year two and year three (the test statistic $D = 0.11$ is less than the critical value D* = 0.35 at the 0.05 significance level).

Assuming all model assumptions hold, this would imply that the true total number of bird losses in year three was not significantly different from the number of losses in year two.

Concluding remarks

In evaluating the potential impact, it is important to remember that all mortality estimators have an inherent assumption that there is an unlimited supply of carcasses to be found. In particular, we did not apply an upper limit on the number of bats that could be onsite, and we assumed that bats were present all year round. The ecological feasibility of this assumption should be accounted for if using these results to comment on overall ecological impact.

References

Hull, CL, and Stuart Muir. 2010. "Search Areas for Monitoring Bird and Bat Carcasses at Wind Farms Using a Monte-Carlo Model." *Australasian Journal of Environmental Management* 17 (2): 77–87.

Huso, Manuela MP. 2011. "An Estimator of Wildlife Fatality from Observed Carcasses." *Environmetrics* 22 (3): 318–29.

Kaplan, Edward L, and Paul Meier. 1958. "Nonparametric Estimation from Incomplete Observations." *Journal of the American Statistical Association* 53 (282): 457–81.

Korner-Nievergelt, Fränzi, Pius Korner-Nievergelt, Oliver Behr, Ivo Niermann, Robert Brinkmann, and Barbara Hellriegel. 2011. "A New Method to Determine Bird and Bat Fatality at Wind Energy Turbines from Carcass Searches." *Wildlife Biology* 17 (4): 350–63.

Stark, E, and S Muir. 2020. "Post Construction Bird and Bat Monitoring at Wind Farms in Victoria."

Symbolix. 2019. "Salt Creek Wind Farm Mortality Estimate - Year 1."

———. 2020. "Salt Creek Wind Farm Mortality Estimate - Year 2."

Appendix 13: Scavenger Trial for Grey-headed Flying-foxes

Short Report 234

Salt Creek Wind Farm Scavenger Trial for Grey-Headed Flying Foxes

April-May 2021

Prepared by

Emma Bennett

for

Tilt Renewables

July 2021

Document Information

Report to	Tilt Renewables Biosis Pty Ltd
Prepared by	Emma Bennett
This study was undertaken on site at the Salt Creek Wind Farm with consent from the Land manager	Tilt Renewables
Data Collection	Joel Ellis
Citation	Elmoby Ecology Bennett, E. Elmoby Ecology, Clunes Vic. Salt Creek Wind Farm Scavenger Trial for Grey Headed Flying Foxes. Project No. 234
Document Control	Draft V.01 July 2021

1 INTRODUCTION

The purpose of this mini-report is to summarise carcass persistence findings for grey-headed flying foxes (GHFF) at the Salt Creek Wind Farm in western Victoria. Carcass persistence studies support mortality estimates, and are required to understand suitable survey intervals to maximise the likelihood of carcass detection. GHFFs are listed as threatened in Victoria, and the discovery of carcasses during routine mortality surveys at Salt Creek Wind Farm has triggered further investigation into this species and the impact of the wind farm to the GHFF population. To understand population level impacts, it is important to increase certainty regarding GHFF mortality estimates. Part of this includes understanding the rates at which GHFF carcasses are removed from the survey area by scavenging animals.

Traditional carcass persistence trials use a range of birds and microbats to estimate carcass persistence in the field to provide correction factors when estimating wind farm mortality rates. To our knowledge, the only trial which has used fruit or macrobats to estimate carcass persistence was undertaken in northern Queensland using bats collected during heat wave mortality events (Amanda Hancock, personal communication). This trial concluded that macrobats persist longer than birds or microbats; however, the condition of the carcass was not recorded, and dehydration of the carcass during the heat wave event may have contributed to longer persistence times. In addition, persistence trials in Queensland may not be representative of those in western Victoria due to the differing climate and scavenger species.

For the purpose of this investigation, entire GHFF carcasses were not available; therefore, rabbits were chosen for their similar size and weight. Proxy species are commonly used in detectability trials; for example, where microbats are unavailable, mice are considered a suitable substitute (Symbolix 2020). Rabbits bred for snake food are readily available frozen, and additional wild shot rabbits were also procured. The use of rabbits as a proxy is supported by the work of Barrientos *et al* (2018), which demonstrated from a wide review of carcass persistence studies that mammals persist longer than birds and that weight is an important factor in mean persistence, as has been shown in Australia with the aforementioned use of mice as a proxy for microbats.

Collection and use of specimens were conducted under the *Wildlife Act 1975* Research Permit number 10008753 which allows for the collection and storage of dead birds of bats found within the wind farm site and along state roadsides for the purpose of scavenger and searcher efficiency trials.

2 METHODS

Carcasses (n=15) were randomly distributed among the turbines at Salt Creek Wind Farm, with no more than 2 carcasses at each turbine. Rabbit breed and colour were recorded, as well as time of deployment, substrate, and distance from turbine. Carcasses were between 700g and 900g if store bought and 800g and 1000g if wild shot. Cameras set to a 1 hour time delay recorded the carcasses and site visits were conducted on days 1, 7, 14, 21 and 31 to ensure camera operation and to check if carcasses had been moved outside the field of view. Existing infrastructure was used to secure cameras. The time a carcass was last seen was recorded via photo analysis. Survival analysis within the R statistical programming language was used to determine the average time until complete loss. Stepwise AIC selection was used to determine the best model to describe the survival of rabbit carcasses (see Appendix 1 for further details).

3 RESULTS

The type of carcass (wild or store bought), the distance from the turbine, and the substrate the carcass was on did not influence the time to scavenge. Therefore, a simple intercept model was used to describe persistence. The median time to scavenge was 3.2 days with 95% confidence [2.5, 4] days (Figure 1).

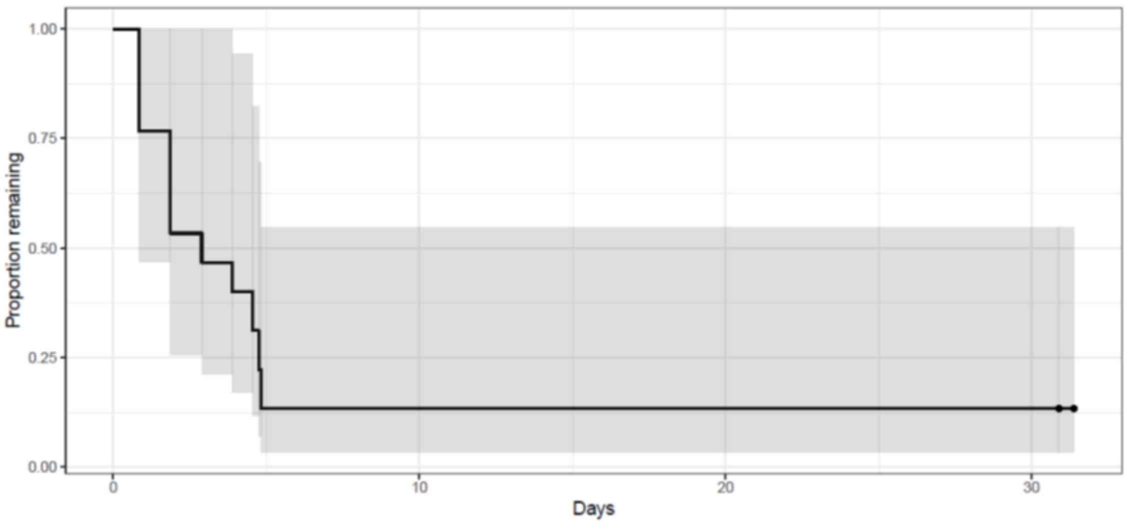


Figure 1 Survival curve fitted to data. The circles on the right were the carcasses still on the ground at the end of the trial. The grey shading shows 95% confidence interval.

Comparison of this trial with previous trials at Salt Creek Wind Farm and state averages for Victoria are provided in Figure 2 and Table 1.

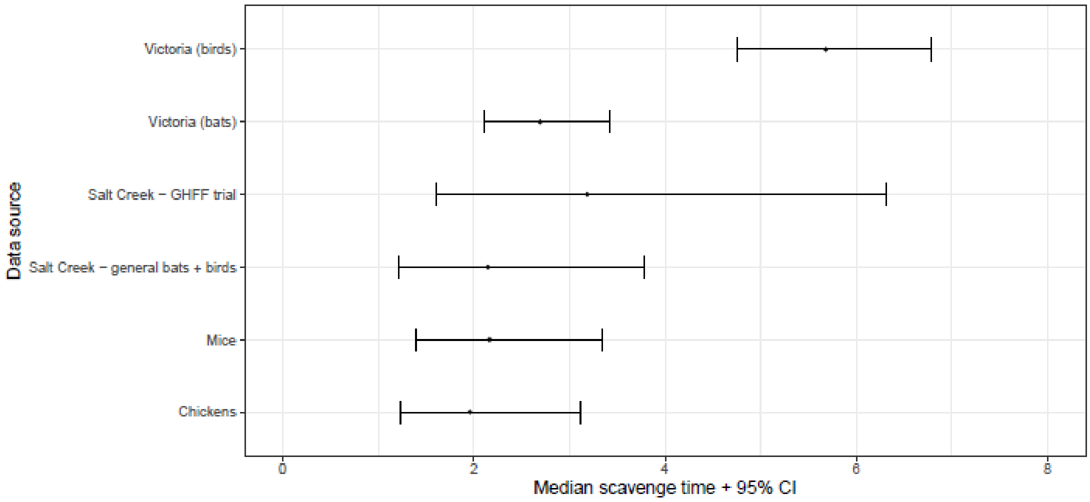


Figure 2 Comparison of median scavenger rates.

Table 1 Median and confidence intervals for various persistence rates

Source	Median	CI
Victoria (birds)	5.7	[4.8, 6.8]
Victoria (bats)	2.7	[2.1, 3.4]
Victoria (WTEs)	287.3	[130.1, 634.5]
Salt Creek – general birds and bats	2.1	[1.2, 3.8]
Salt Creek – GHFF trial	3.2	[1.6, 6.3]
Mice	2.2	[1.4, 3.3]
Chickens	2.0	[1.2, 3.1]

4 DISCUSSION

Persistence of rabbits as a GHFF proxy in this trial is similar to other scavenger trials undertaken in Victoria, albeit with a slightly higher median persistence than the general bird and bat persistence trials conducted previously at Salt Creek Wind Farm. The median persistence rate for Salt Creek is low (2.1 days) compared to state averages; however, the slightly slower removal rate of rabbits (3.2 days) is consistent with overseas trials that have demonstrated weight and size as a predictive factor in scavenger removal (i.e., heavier carcasses are removed more slowly). Due to the limited sample size (15 carcasses), there is an unsurprising large confidence interval surrounding removal rate of rabbits. However, when compared to Victorian averages, there is a consistent pattern for scavenger activity which suggests that GHFF would also fit within this range. Therefore, it seems rabbits are likely a good representative for GHFF removal and are removed slightly slower than smaller bats and birds at Salt Creek.

If further GHFF mortality surveys are undertaken, it would be useful to repeat this study with rabbits (in the absence of GHFF carcasses) to increase the confidence of the persistence estimate and thus overall confidence in mortality impact estimations.

5. REFERENCES

Barrientos, R., R. C. Martins, F. Ascensão, M. D'Amico, F. Moreira, L. Borda-de-Água. 2018. A review of searcher efficiency and carcass persistence in infrastructure-driven mortality assessment studies. Biological Conservation **222**: 146-153.

Symbolix. 2020. Post construction bird and bat monitoring at wind farms in Victoria. Public Report Preprint prepared for DELWP. Symbolix Ptd.Ltd.

6. APPENDIX

1. Symbolix Report: Grey-headed flying fox scavenger trial analysis at Salt Creek Wind Farm.

Appendix 1

Grey-headed flying fox scavenger trial analysis at Salt Creek Wind Farm

Prepared for Elmoby Ecology, 9 June 2021, Ver. 0.9 - for review

Introduction

This is a short memo aiming to understand and quantify the carcass persistence time of grey-headed flying foxes (GHFF) at Salt Creek Wind Farm (western Victoria).

We note that no GHFF carcasses were available at the time, so similarly sized rabbits were used.

Statistical methods

Survival analysis (Kaplan and Meier (1958), implemented in the R statistical programming language with Therneau (2020)) was used to determine the average time until complete loss from scavenge. Survival analysis was required to account for the fact that we do not know the exact time of scavenge loss, only an interval in which the scavenge event happened. By performing survival analysis we can estimate the average survival percentage after a given length of time, despite these unknowns.

We're interested in quantifying the scavenger rates, rather than testing a specific hypothesis. Therefore, stepwise AICc selection (Sugiura 1978) was used to find the model best describing the data, rather than formal hypothesis testing. We checked for effects of carcass type (store or wild rabbit), distance from turbine, and substrate (ground type).

Results

Scavenger rates

We used survival regression under the assumption of log-normally distributed survival time (this assertion is supported by Stark and Muir (2020)).

The best fit model was found to be the simple intercept-only formulation. This means that we don't model time-to-scavenge as having a dependence on carcass type, distance from turbine, or substrate.

Under this model, the median time to scavenge was 3.2 days with a 95% confidence interval of [2.5, 4] days.

A plot of the empirical survival curve can be found in Figure 1.

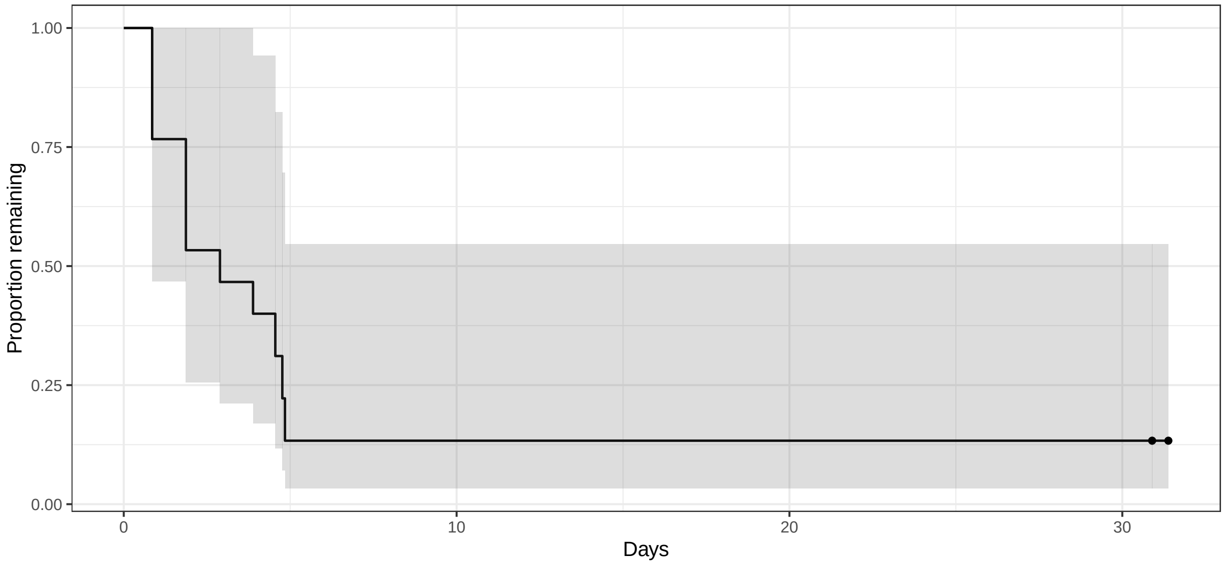


Figure 1: Kaplan-Meier survival curve fitted to the provided data. The circles denotes right-censored points (i.e. the carcass was still on-ground at the end of the trial). The grey shading shows the 95% confidence interval.

Comparison to other measured rates

We have access to scavenger trial data for:

- carcasses at Salt Creek Wind Farm (Symbolix 2020); and
- carcasses Victoria-wide (Stark and Muir 2020).

We provide a brief comparison of the GHFF trial scavenger rates to these other two sources.

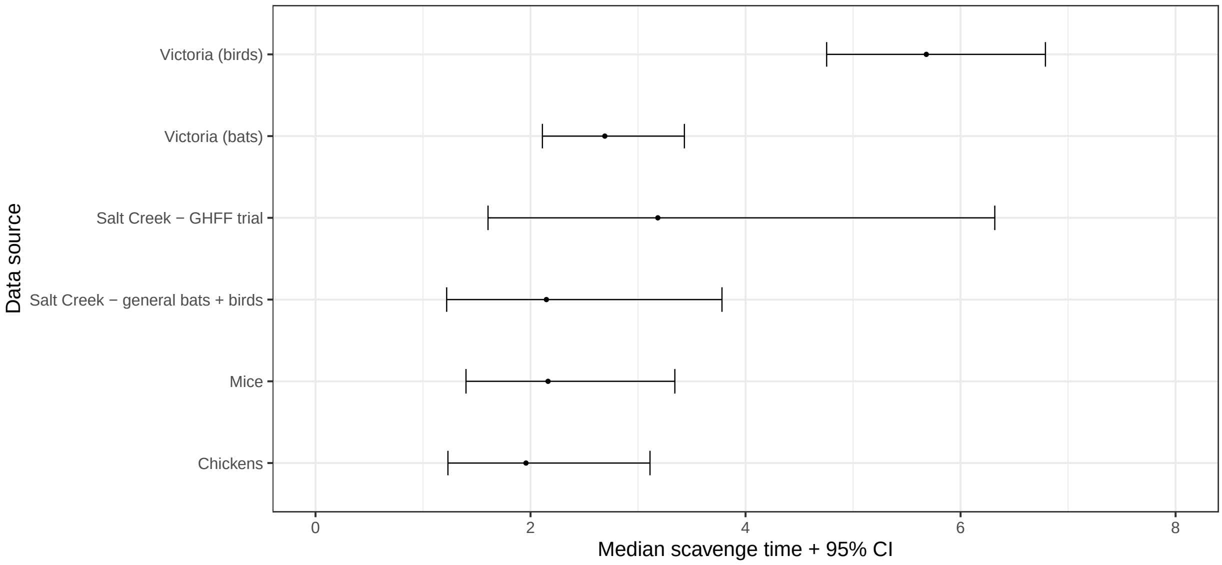


Figure 2: Comparison of (median) scavenger rates from various sources. We've excluded WTEs from this plot for readbility, as their scavenge time is two orders of magnitude larger.

Table 1: Median and confidence intervals on various scavenger rates.

Source	Median	CI
Victoria (birds)	5.7	[4.8, 6.8]
Victoria (bats)	2.7	[2.1, 3.4]
Victoria (WTEs)	287.3	[130.1, 634.5]
Salt Creek - general bats + birds	2.1	[1.2, 3.8]
Salt Creek - GHFF trial	3.2	[1.6, 6.3]
Mice	2.2	[1.4, 3.3]
Chickens	2.0	[1.2, 3.1]

Figure 2 and Table 1 shows this comparison. We can see that the carcasses in the GHFF trial have a median scavenge time that is higher compared to the general Salt Creek rate, and also compared to the general Victorian bat rate. However, the wide confidence interval means that we wouldn't claim they're significant differences, at this stage.

It's not surprising that the confidence interval is so large. The sample size for this trial is relatively small (15 carcasses), and survival analysis generally involves very long-tailed distributions, which makes the standard errors relatively large.

Conclusions

Carcasses in the trial generally had a greater time-to-scavenge, compared with both Salt Creek, and general bat rates. There is not yet evidence to suggest that GHFF have significantly different scavenger rates to bats in general.

Because rabbit carcasses were used instead of GHFF carcasses, there is a potential confounder. The assumption is that the similar weighted and coloured rabbits would be treated similarly to GHFF. However, we don't possess any evidence supporting this assumption.

References

Kaplan, Edward L, and Paul Meier. 1958. "Nonparametric Estimation from Incomplete Observations." *Journal of the American Statistical Association* 53 (282): 457–81.

Stark, E, and S Muir. 2020. "Post Construction Bird and Bat Monitoring at Wind Farms in Victoria."

Sugiura, Nariaki. 1978. "Further Analysts of the Data by Akaike's Information Criterion and the Finite Corrections: Further Analysts of the Data by Akaike's." *Communications in Statistics-Theory and Methods* 7 (1): 13–26.

Symbolix. 2020. "Salt Creek Wind Farm Mortality Estimate - Year 2."

Therneau, Terry M. 2020. *A Package for Survival Analysis in R*. https://CRAN.R-project.org/package=survival.

Appendix 14: Summary of finds at Salt Creek Year 3

Date	Turbine	Species	Species type	Distance (m)
18/02/2021	14	Chocolate Wattled Bat	bat	25
18/03/2021	2	Chocolate Wattled Bat	bat	51
15/04/2021	14	Chocolate Wattled Bat	bat	50
15/04/2021	9	Chocolate Wattled Bat	bat	50
16/04/2021	3	Chocolate Wattled Bat	bat	19
29/04/2021	9	Chocolate Wattled Bat	bat	18
22/06/2021	11	Chocolate Wattled Bat	Bat	59
14/04/2021	8	Eastern Falsistrelle	bat	35
5/03/2021	9	Grey-headed Flying-fox	bat	86
17/08/2020	13	Gould’s Wattled bat	bat	78
15/09/2020	5	Gould’s Wattled bat	bat	42
15/09/2020	5	Gould’s Wattled bat	bat	100
16/09/2020	12	Gould’s Wattled bat	bat	27
27/10/2020	12	Gould’s Wattled bat	Bat	35
27/10/2020	4	Gould’s Wattled bat	bat	61
22/12/2020	1	Gould’s Wattled bat	bat	115
21/01/2021	9	Gould’s Wattled bat	bat	81
16/02/2021	7	Gould’s Wattled bat	bat	95
18/02/2021	14	Gould’s Wattled bat	bat	90
17/03/2021	8	Gould’s Wattled bat	bat	15
17/03/2021	12	Gould’s Wattled bat	bat	67
18/03/2021	9	Gould’s Wattled bat	bat	42
19/03/2021	11	Gould’s Wattled bat	bat	42
3/04/2021	10	Gould’s Wattled bat	bat	37
3/04/2021	11	Gould’s Wattled bat	bat	5
3/04/2021	11	Gould’s Wattled bat	bat	73
15/04/2021	11	Gould’s Wattled bat	bat	128
16/04/2021	1	Gould’s Wattled bat	bat	30
16/04/2021	1	Gould’s Wattled bat	bat	32
28/04/2021	14	Gould’s Wattled bat	bat	12
14/04/2021	6	Gould's long eared bat	bat	86
17/03/2021	8	Large Forest Bat	bat	52
19/08/2020	7	Lesser Long-eared Bat	bat	48
18/02/2021	15	Lesser Long-eared Bat	bat	61
18/03/2021	9	Lesser Long-eared Bat	bat	27
16/04/2021	5	Lesser Long-eared Bat	bat	7
18/03/2021	14	Little Forest Bat	bat	21

Date	Turbine	Species	Species type	Distance (m)
28/04/2021	14	Little Forest Bat	bat	8
24/11/2020	5	Southern Freetail	bat	57
19/02/2021	2	Unknown	bat	32
2/04/2021	14	Unknown	bat	58
28/04/2021	12	Unknown	bat	60
18/02/2021	9	White-striped Freetail Bat	bat	140
5/03/2021	11	White-striped Freetail Bat	bat	27
5/03/2021	10	White-striped Freetail Bat	bat	84
5/03/2021	10	White-striped Freetail Bat	bat	80
5/03/2021	14	White-striped Freetail Bat	bat	53
5/03/2021	14	White-striped Freetail Bat	bat	13
5/03/2021	2	White-striped Freetail Bat	bat	21
5/03/2021	2	White-striped Freetail Bat	bat	20
17/03/2021	6	White-striped Freetail Bat	bat	35
17/03/2021	12	White-striped Freetail Bat	bat	47
18/03/2021	14	White-striped Freetail Bat	bat	58
19/03/2021	10	White-striped Freetail Bat	bat	20
19/03/2021	10	White-striped Freetail Bat	bat	37
19/03/2021	11	White-striped Freetail Bat	bat	22
1/04/2021	12	White-striped Freetail Bat	bat	25
1/04/2021	13	White-striped Freetail Bat	bat	7
1/04/2021	13	White-striped Freetail Bat	bat	23
3/04/2021	15	White-striped Freetail Bat	bat	41
4/04/2021	5	White-striped Freetail Bat	bat	38
16/04/2021	15	White-striped Freetail Bat	bat	31
16/04/2021	10	White-striped Freetail Bat	bat	16
17/03/2021	8	Australasian Pipit	bird	22
2/04/2021	9	Australasian Pipit	bird	100
12/10/2020	5	Australian Magpie	bird	18
27/10/2020	15	Australian Magpie	bird	37
18/02/2021	5	Australian Magpie	bird	37
16/04/2021	1	Australian Magpie	bird	54
22/06/2021	11	Australian Magpie	bird	84
23/06/2021	2	Australian Magpie	bird	47
26/10/2020	11	Black-shouldered kite	bird	59
17/02/2020	11	Brown Falcon	bird	26
24/01/2021	12	Brown Songlark	bird	40
24/01/2021	11	Brown Songlark	bird	110
26/10/2020	3	Common Starling	bird	12
27/10/2020	12	Common Starling	bird	12
22/07/2021	10	Common Starling	bird	123

Date	Turbine	Species	Species type	Distance (m)
5/03/2021	10	Eastern Barn Owl	bird	26
21/12/2020	15	Eurasian Skylark	bird	50
27/10/2020	12	European Sparrow	bird	82
26/05/2021	8	Fan-tailed Cuckoo	bird	78
15/04/2021	7	Long-billed Corella	bird	19
24/01/2021	11	Nankeen Kestrel	bird	111
5/03/2021	15	Nankeen Kestrel	bird	56
26/05/2021	4	Nankeen Kestrel	bird	109
24/01/2021	12	Peregrine Falcon (juvenile)	bird	47
5/03/2021	9	Quail sp.	bird	76
27/09/2020	8	Sacred Kingfisher	bird	87
11/10/2020	1	Straw-necked Ibis	bird	142
28/09/2020	9	Striated Pardalote	bird	55
31/03/2021	6	Striated Pardalote	bird	25
19/02/2021	2	Sulphur-crested Cockatoo	bird	39
19/02/2021	2	Sulphur-crested Cockatoo	bird	66
15/09/2020	9	Unidentified bird	bird	118
18/08/2020	14	Wedge-tailed Eagle	bird	40
17/09/2020	14	Wedge-tailed Eagle	bird	45
6/03/2021	1	Yellow-rumped Thornbill	bird	55
28/09/2020	5	Australian Magpie	FS	107
22/12/2020	4	Australian Magpie	FS	84
19/02/2021	4	Australian Magpie	FS	116
27/05/2021	9	Australian Magpie	FS	50
24/06/2021	9	Australian Magpie	FS	23
17/08/2020	12	Australian Raven	FS	72
17/03/2021	12	Brown Falcon	FS	121
15/04/2021	13	Brown Falcon	FS	70
22/06/2021	10	Common Starling	FS	117
22/07/2021	4	Common Starling	FS	78
26/10/2020	5	Crimson Rosella	FS	113
5/03/2021	11	Eastern Barn Owl	FS	17
18/02/2021	15	Nankeen Kestrel	FS	46
18/02/2021	14	Unknown	FS	43
18/09/2020	14	Wedge-tailed Eagle	FS	74