BayWa r.e.

Ferguson Wind Farm Year 1 Post Construction Monitoring Report

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Acknowledgments

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Contents Page number

Executive Summary

The Ferguson Wind Farm is located approximately 6.5 kilometres west of Kennedys Creek) and consists of three turbines, each with a maximum tip height of 200 metres and a minimum Rotor Swept Area (RSA) height of 64 metres (E&HP, 2019). Operational commissioning of Turbine 1 occurred in November 2020, with Turbines 2 and 3 becoming operational in April 2021.

The project area is on the northwest side of Princetown Rd between Turrong Rd (refer to Figure 1), and Boorook Rd. Land management consists of grazed pasture for beef production and areas used to grow silage (feed). The project area is slightly sloping with scattered farm dams and gully lines of mature remnant vegetation.

Ferguson Wind Farm Pty Ltd was required to implement an endorsed BAM Plan to meet the planning requirements of the minister for Planning. The scope of works focusses on a; "*mortality monitoring program to answer the following key questions through the completion of carcass searches, scavenger trials and detectability trials":*

1. *What is the estimated annual mortality rate?*
2. *What species are being impacted?*
3. *Is there seasonal variation in the number of microbat mortalities?*

(E&HP 2019)

The ecologist walked concentric transects around each turbine tower at four metre intervals undertaking a pulse survey 2-days after the primary search. A range finder was directed at the turbine tower to maintain the correct transect spacing. Each primary and pulse event inspected an area up to 60 metres of each turbine.

Two bats and one bird were found within the RSA and were considered to have died because of turbine strike (refer to Figure 3). There was one Chocolate Wattled Bat (*Chalinolobus morio*), one Gould's Wattled Bat (*Chalinolobus gouldii*) and one Dusky Woodswallow (*Artamus cyanopterus*).

The median bat mortality rates for the 2021 monitoring period were estimated to be 47 bats over the 12-month monitoring period (Symbolix, 2022), average of 15.6 mortalities per turbine.

Seven bat detectors were deployed to cover the peak roost movement period of Southern Bent-wing Bats in spring/early summer and late summer/early autumn. No Southern Bent-wing Bat calls or Southern Bent-wing Bat call complexes were recorded over the two monitoring periods.

Bat activity varied depending on the proximity to suitable bat habitat i.e., water and native vegetation. Location 3 located on the edge of a large patch of native vegetation had the highest average of bat call activity per / night, autumn 78 calls p/n and spring 128 calls p/n.

The results of the relevant surveys and reviews indicates that the risk posed by the Ferguson Wind Farm to threatened microbats and birds is low.

1 Introduction

1.1 Project Background

The Ferguson Wind Farm was approved by the Victorian Minister for Planning on 12 April 2017. The wind energy facility is located approximately 6.5 kilometres west of Kennedys Creek) and consists of three turbines, each with a maximum tip height of 200 metres and a minimum Rotor Swept Area (RSA) height of 64 metres (E&HP, 2019). Operational commissioning of Turbine 1 occurred in November 2020, with Turbines 2 and 3 becoming operational in April 2021.

Ferguson Wind Farm Pty Ltd is required to implement an endorsed BAMP to meet the planning requirements of the minister for Planning.

1.2 Bird and Bat Management Plan Objectives

The key objectives as outlined in the BAM Plan (E&HP 2019) were to focus on a; "*mortality monitoring program to answer the following key questions through the completion of carcass searches, scavenger trials and detectability trials":*

- What is the estimated annual mortality rate?
- What species are being impacted?
- Is there seasonal variation in the number of bird and bat mortalities?

Are Southern Bent-wing Bats using the wind farm area during peak migration periods, and if so,

- Are they flying at RSA height?
- How frequent is bat activity?
- Are all habitat types being utilised?

(E&HP 2019)

1.3 Project Area

The project area is on the northwest side of Princetown Rd between Turrong Rd and Boorook Rd, (refer to Figure 1). Land management of the project area consists of grazed pasture for beef production and areas used to grow silage. The project area is slightly sloping with scattered farm dams and gully lines of mature remnant vegetation.

1.4 Acronyms

Acronym	Description
BAM Plan	Bird and Avifauna Management Plan
CoA	Conditions of Approval
DELWP	Victorian Department of Environment, Land, Water and Planning
E&HP	Ecology and Heritage Partners
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FFG Act	*Flora and Fauna Guarantee Act 1988*
RSA	Rotor Swept Area
VBA	Victorian Biodiversity Database

Figure 1: Ferguson Wind Farm

0 100 200 m

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2 Methods

2.1 Methodology

2.1.1 Field Assessment

The post construction monitoring commenced in December 2020 when Turbine 1 was commissioned for operation. Post construction monitoring commenced at Turbines 2 and 3 in April 2021 when they were commissioned for operation. This report covers the first 12-months of operation, December 2020 – November 2021

2.1.2 Carcass Searches

Monthly carcass searches were undertaken at each turbine site mid-month starting in December 2020. Carcass searches were completed for the 1st year of monitoring in November 2021. Carcass searches were undertaken for a total of 12 months. To reduce error and refine mortality estimates, a pulse search method was deployed i.e., a second carcass search was undertaken two days following each primary search.

Searches commenced when suitable weather conditions prevailed. The ecologist walked concentric transects (refer to Diagram 1) around each turbine tower at four metre intervals. The pulse survey was conducted in the opposite direction to the primary survey 2-days later.

A range finder was directed at the turbine tower to maintain the correct transect spacing. Each primary and pulse event inspected an area within 60 metres of each turbine. The following steps were undertaken during each event:

- The searcher walked at a slow walking pace depending on ground layer conditions (i.e., height of pasture / silage) and searched thoroughly for carcasses.
- Carcasses found during the search were removed to avoid re-counting.
- Personnel wore gloves to remove carcasses. Carcasses were placed in a plastic bag and placed in a second plastic bag.
- Carcasses were labelled with the species name, turbine number, waypoint number and survey date.
- All bat carcasses were placed in a freezer for use with searcher efficiency and scavenger trials.
- The Carcass Search Data Sheet was completed.
- In event that any carcasses of conservation-listed species animals are found, DELWP are notified within two days.

Diagram 1: Example of concentric transects at 4m intervals.

2.1.3 Scavenger Trials

Scavenger trials were undertaken for the first year (refer to Attachment A). The results were used to estimate the length of time a bat carcass remains detectable before being scavenged. The scavenger trials in conjunction with detectability trials were used to correlate mortality estimates (refer to Section 2.1.5) over the two monitoring periods. One element of the original method was replaced, the use of cameras.

The use of cameras on a working farm has inherent risks of failure due to disturbance / damage by stock and vehicles. Cameras also introduce a bias in the results due to scavengers associating a camera with a food source.

In place of cameras, the carcasses were checked by an ecologist. The changes to the method are shown below. The method used was developed after consultation with Symbolix, the company responsible for undertaking the mortality modelling.

The carcasses were checked twice a day for the first 3-days and then once every 2nd day up to day 11, once on day 14 then, once a day every 4-days thereafter until all carcasses were removed by scavengers or, the 30-day period was completed.

Two one-month scavenger trials were undertaken in the first year, one in spring (October 2021), and one in autumn (April 2021). A summary of the procedure is provided below:

- Three bat carcasses and surrogates (e.g., mice) were placed randomly within the 60-metre search area of each turbine for the Spring trials (14/4/2021-20/4/2021). Two surrogates and 1 bat were placed at each turbine. Surrogates were used for the Autumn trials (16/10/2021-16/11/2021) due to a lack of bat carcasses.
- Carcasses were checked as described above until they were removed by scavengers or at 30-days after placement.

2.1.4 Searcher Detectability Trials

Searcher detectability trials were undertaken in conjunction with the scavenger trials in the 1st year (refer to Attachment B). The efficiency trials, in conjunction with scavenger trials, were used to correlate mortality estimates. A summary of the procedure is provided below:

- Carcasses were placed by personnel not performing the searches and in a variety of exposures to simulate a range of conditions.

- The searcher was not present when the carcasses were placed and did not know the location of the carcasses. The searcher applied the same search method as intended for normal carcass searches.

2.1.5 Data Analysis

All results from carcass searches, detectability trials and scavenger trials and Southern Bent-wing Bat monitoring are included in the report. The results of carcass monitoring, searcher detectability and scavenger trials were analysed by Symbolix, a specialist data analyst company with extensive experience analysing wind farm collision data.

The mortality estimate method used by Symbolix (e.g., Symbolix simulator, unpubl. or GenEst https://doi.org/10.3133/tm7A2) accounts for survey imperfections in an unbiased manner and statistically estimates the annual bat strike. The model assumes bats are present throughout the year and whilst the collision risk weighting can be adjusted for the winter, it has minimal effects on the results (Stark, E. 2022 pers comm. 1 March).

2.1.6 Southern Bent-Wing Bat Monitoring

The objective of the Southern Bent-wing Bat (SBwB) monitoring was to assess if Southern Bent-wing Bats are using the study site and if so, are they at RSA height and the extent of activity.

Bat detectors were deployed during the assumed peak movement between roosts, i.e., spring/ early summer (Mid-October ~ mid-December) and late summer/early autumn (Mid-February ~ Mid-April) for up to 8-weeks per season. The monitoring data has been incorporated into this report. A decision tree (45-55kHz) was used to concentrate on calls that can be attributed to Southern Bent-wing Bat. The decision tree includes species within the SBwB call complex i.e., Little Forest Bat (*Vespadelus vulturnus*) and Chocolate Wattled Bat (*Chalinolobus morio*). Bat call analysis was undertaken by EcoAerial's Principal Ecologist, Rob Gration, using Analook Insight (Ver 2.0.1.0.g1ca0e76) software. The presence of all species that can be identified by the characteristic call shape / frequency have been included for the 1st year of monitoring.

Seven bat detectors, (3 x Song Meter 4ZC & 4 x Song Meter Mini Bat, Wildlife Acoustics™), were deployed across the project area. In the absence of a pulley system on the meteorological tower, two detectors were placed at height on the guy wires of the meteorological tower (50m AGL and 25m AGL). A third detector was placed at the base of the meteorological tower (4m AGL). The other 4 detectors were located near dams and remnant vegetation. Two detectors were attached to fence posts near dams to minimise damage by stock, and two fixed to canopy trees.

Table 1 provides photographs of the bat detector deployments. Figure 2 provides details of detector locations. The deployment of bat detectors will be replicated in Year 2 of monitoring.

Table 1: Bat detector deployment

ID	Site Photographs	Comments
IMG_20210216_094957		Location 1 Patch of native vegetation approx.90m from Turbine 1 tower.
IMG_20210216_100637		Location 2 Dam located approx. 160m from Turbine 2 tower.
IMG_20210216_102106		Location 3 Patch of native vegetation approx.300m from Turbine 2 tower and 180m from Turbine 3 tower.

ID	Site Photographs	Comments
IMG_20210216_103756		Location 4 Dam located approx. 270m from Turbine 3 tower.
IMG_1598		Location 5 Meteorological Tower 4m AGL
IMG_1595		Location Meteorological Tower 25m AGL 6

ID	Site Photographs	Comments
IMG_1597		Location 7 Meteorological Tower 50m AGL

Figure 2: Bat Detector Locations

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0 100 200 m

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2.1.7 Reporting

This report is the first of two annual reports providing details of the outcomes of monitoring activities from December 2020 to November 2021. A monthly email summary report was provided to DELWP at the completion of the monthly carcass search.

3 Results

No threatened species were found during the carcass or during the bat detector monitoring, (754 bat detector nights). The focal species, Southern Bent-wing Bat was not recorded at the site. Details of the results of the carcass search, scavenger /searcher detectability trials and bat detector results are provided below.

3.1 Carcass Search

Two bats and one bird were found within the RSA and were considered to have died because of turbine strike (refer to Figure 3). There was one Chocolate Wattled Bat (*Chalinolobus morio*), one Gould's Wattled Bat (*Chalinolobus gouldii*) and one Dusky Woodswallow (*Artamus cyanopterus*). Table 2 below details near which turbines the carcasses were found.

Table 2: Turbine Strike Incidents

Incident No	Carcass Id	Survey Type	Turbine	Species	Sex / age	Distance from Tower (m)	Date
1	GWB	Formal	3	Gould's Wattled Bat (GWB)	Male / Adult	29	15/05/2021
2	CWB	Formal	3	Chocolate Wattled Bat (CWB)	Male / Adult	12	17/09/2021
3	DW	Formal	2	Dusky Woodswallow (DW)	Unknown	23	18/11/2021

The wind speed leading up to the carcass finds at the turbines were sourced from the turbines' weather monitoring equipment (Tables 3-7).

Table 3: Windspeed leading up to bat incident 1 (GWB) - Turbine 3.

Date	Wind speed average m/s @ 110m	Temp Celsius @ 110m
10/05/2021-11/05/2021	13.75	7.64
11/05/2021-12/05/2021	5.27	8.58
12/05/2021-13/05/2021	8.94	9.55
13/05/2021-14/05/2021	12.31	7.87
14/05/2021-15/05/2021	15.78	7.44

Table 4: Windspeed leading up to bat incident 2 (CWB) - Turbine 3.

Date	Wind speed average m/s @ 110m	Temp Celsius @ 110m
12/09/2021-13/09/2021	7.83	7.46
13/09/2021-14/09/2021	3.71	7.21
14/09/2021-15/09/2021	3.27	6.58
15/09/2021-16/09/2021	4.50	8.01
16/09/2021-17/09/2021	13.48	9.67

Table 5: Windspeed leading up to bird incident 1 (DW) - Turbine 2.

Date	Wind speed average m/s @ 110m	Temp Celsius @ 110m
14/11/2021	13.38	7.68
15/11/2021	10.37	8.19
16/11/2021	4.92	9.34
17/11/2021	3.51	12.72
18/11/2021	12.75	17.18

Figure 3: Carcass Locations

0 100 200 m

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3.2 Scavenger Trials

The scavenger trials were conducted over two seasons, (Autumn, April 2021 & Spring, October 2021), to account for any variances in site conditions, (e.g., grazed pasture, silage prior and post baling) and seasonal behaviour of scavengers.

The results of the scavenger trials varied between seasons, with carcasses taken quicker during the Autumn trials. This is considered an artefact that there was very little ground cover (refer to Photograph 1 below), and fox control had not yet been undertaken. Carcass offtake for Autumn was 1 day to 6 days.

Unsurprisingly carcasses remained for between 1 day and 30 days due to presence of silage and pasture and fox control undertaken post Autumn trials. Figure 4 details where the carcasses were randomly placed for both the scavenger and searcher detectability trials.

The results of the 2021 scavenger trials were used for the collision modelling for the 2021 monitoring period. Full details are provided in Attachment E.

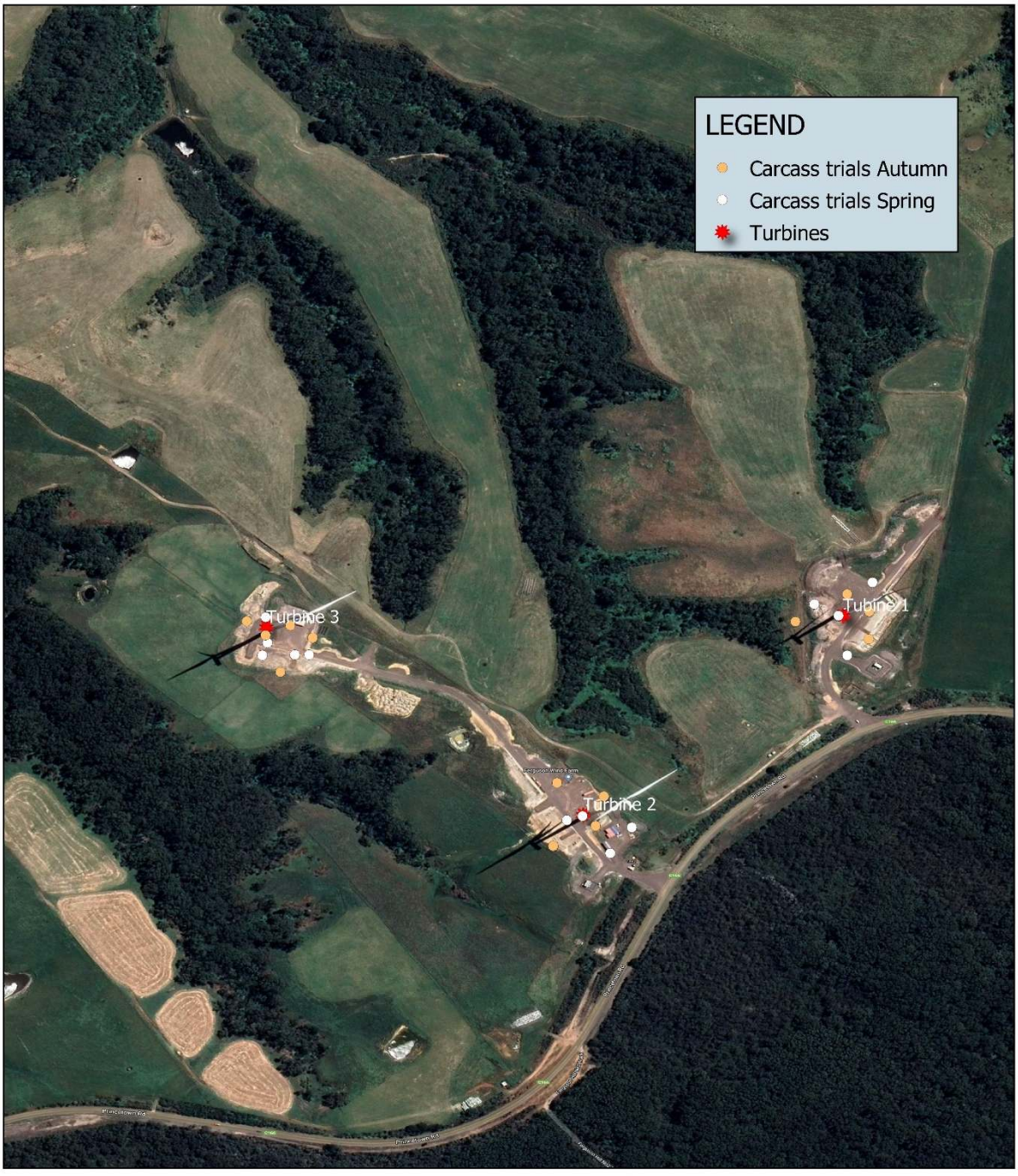

Figure 4: Scavenger and Searcher Effeciency Trials

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3.2.1 Autumn 2021

Carcass removal occurred over a period of 6-days. Refer to Table 6.

Table 6: Carcass removal during Autumn.

TURBINE	SCAVENGER TYPE	GROUND TYPE	DAY REMOVED	SCAVENGER DATE
1	WsFB	Pasture	1	15/04/2021
1	Mouse	Pasture	1	15/04/2021
1	Mouse	Hardstand	1	15/04/2021
1	Mouse	Weed	4	18/04/2021
2	SBwB	Weeds	1	15/04/2021
2	Mouse	Paddock	1	15/04/2021
2	Mouse	Paddock	6	20/04/2021
2	Mouse	Paddock	3	17/04/2021
3	LaFB	Pasture	1	15/04/2021
3	Mouse	Pasture	2	16/04/2021
3	Mouse	Hardstand	2	16/04/2021
3	Mouse	Hardstand	1	15/04/2021
3	Mouse	Pasture	2	16/04/2021

Legend: WsFB = White-striped Freetail Bat; SBwB = Southern Bent-winged Bat; CWB = Chocolate Wattled Bat LaFB; Large Forest Bat

3.2.2 Spring 2021

All but one carcass was removed over a period of 12-days. One carcass lasted the full 30-days. Refer to Table 7.

Table 7: Carcass removal during spring.

TURBINE	SCAVENGER TYPE	GROUND TYPE	DAY REMOVED	SCAVENGER DATE
1	Mouse	Hardstand	6	20/10/2021
1	Mouse	Paddock	6	20/10/2021
1	Mouse	Paddock	3	17/10/2021
1	Mouse	Hardstand	4	18/10/2021
2	Mouse	Hardstand	30	-
2	Mouse	Paddock	4	18/10/2021
2	Mouse	Paddock	12	26/10/2021
2	Mouse	Hardstand	4	18/10/2021
3	Mouse	Paddock	8	22/10/2021
3	Mouse	Paddock	6	20/10/2021
3	Mouse	Hardstand	8	22/10/2021
3	Mouse	Paddock	3	17/10/2021

3.3 Searcher Detectability Trials 2021

The searcher detectability trials were conducted over two seasons in 2021 to account for any variances in site conditions, (e.g., grazed pasture, silage prior and post) and seasonal behaviour of scavengers. Fourteen of the 25 carcasses (56%) were found.

3.3.1 Autumn

The ground conditions during the autumn trials were considerably different compared to the spring trials, 10 of 13 carcasses were found during the Autumn trials. There was very little vegetation present during autumn compared to the spring trials (refer to photograph 1).

Photograph 1: Typical of ground conditions during autumn detectability trials. Turbine 1

3.3.2 Spring

Pasture and silage had established since the spring trials making carcasses harder to find (refer to photograph 2). Ground conditions were also extremely wet during the spring trials making the carcasses harder to see on the hardstands and in the paddocks (refer to photograph 3).

Photograph 2: Typical of groundcover present during spring detectability trials. Turbine 1

Photograph 3: Mouse carcass placed for detectability trial on water saturated hardstand.

3.4 Bat detector Surveys

The focus of the bat detector surveys was Southern Bent-wing Bat (SBwB) but also included Yellow-bellied Sheathtail Bat. An inventory of non-threatened species was undertaken in Year 1. Seven species were identified at the site and two call complex:

1. White-striped Freetail Bat
2. Southern Freetail Bat
3. Gould's Wattled Bat
4. Eastern Falsistrelle
5. Large Forest Bat
6. Little Forest Bat
7. Chocolate Wattled Bat.

Call Complex:

1. *Vespadelus sp*
2. *Nyctophilus sp.*

The two species associated with the SBwB call complex were identified from their characteristic call features:

1. Chocolate Wattled Bat - *Chalinolobus morio*
2. Little Forest Bat - *Vespadelus vulturnus*

Refer to Attachment C for call images indicative of species identified by their characteristic call features.

3.4.1 Autumn 2021

A total of 12,248 files (Table 8) with bat call files within a frequency range of 10-55 kHz were recorded. The frequency range covers all bats likely to be present in the region.

A microphone failure at Location 3 limited the detector nights at this location (refer to Table 8) but recorded the greatest average number of call files per night (78p/n). Location 3 is in a relatively large tract of native vegetation. Locations 1, 2, and 4 averaged call files per night in the 40's, Location 1 is in native vegetation and 2 and 4 near dams. Bat activity was greater near native vegetation and waterbodies. Location 5, 6 and 7 were at 4m, 25m, 50m AGL respectively on the meteorological tower. Unsurprisingly the average bat activity at height was half that of ground-based bat detectors. This is consistent with the findings of Pennay and Mills (2017) and other windfarms where the author has analysed bat activity (e.g., Timboon West Wind Farm, Willatook Wind Farm and Woolsthorpe Wind Farm).

The number of call files (Table 9) extracted by the software as Southern Bent-wing Bat call complex (SBwB) was 38. All files were visually analysed and identified as either Chocolate Wattled Bat or forest bat species. Location 3 recorded the greatest average number of call complex files per night (0.90p/n). There were no calls attributed to Southern Bent-wing Bat.

Table 8: Results for bat call files between 10-55kHz

AUTUMN 2021

Location No	Proximity Water (m)	Proximity Vegetation (m)	Detector Nights	No of Files	Ave / night
1	390	0	56	2,324	41.50
2	10	50	56	2,668	47.64
3	160	0	21	1,646	78.38
4	15	120	56	2,323	41.48
5	160	180	56	948	16.93
6	160	180	56	1,171	20.91
7	160	180	56	1,168	20.86
TOTAL			**357**	**12,248**	**38.24**

Table 9: Results for SBwB call complex files before visual analysis.

AUTUMN 2021

Location No	Proximity Water (m)	Proximity Vegetation (m)	Detector Nights	No of Files	Ave / night
1	390	0	56	0	0
2	10	50	56	9	0.16
3	160	0	21	19	0.90
4	15	120	56	4	0.07
5	160	180	56	4	0.07
6	160	180	56	2	0.04
7	160	180	56	0	0
TOTAL			**357**	**38**	**0.18**

Refer to Figure 2 for detector locations.

3.4.2 Spring 2021

A total of 11,647 files with pulses attributed to bat call files within the frequency range of 10-55 kHz were recorded (Table 10).

Location 3 recorded the highest average number of bat calls per night (123p/n). A SD Card error reduced the downloadable number of detector nights at Location 3 (refer to table 10). As was the case during the Autumn surveys, the detectors placed at height had the lowest average number of nightly calls.

The number of call files (Table 11) extracted by the software as Southern Bent-wing Bat call complex (SBwB) was 51. All 51 files were visually analysed and were identified as either Chocolate Wattled Bat or forest bat species. Location 3 recorded the greatest average number of call complex files per night (0.71p/n). There were no calls attributed to Southern Bent-wing Bat.

Table 10: Results for bat call files between 10-55kHz.

SPRING 2021

Location No	Proximity Water (m)	Proximity Vegetation (m)	Detector Nights	No of Files	Ave / night
1	390	0	62	4,211	67.92
2	10	50	62	1,809	29.18
3	160	0	31	3,834	123.68
4	15	120	61	977	16.02
5	160	180	59	54	0.92
6	160	180	61	213	3.49
7	160	180	61	549	9.00
TOTAL			**397**	**11,647**	**35.74**

Table 11: Results for SBwB call complex files before visual analysis.

SPRING 2021

Location No	Proximity Water (m)	Proximity Vegetation (m)	Detector Nights	No of Files	Ave / night
1	390	0	62	5	0.08
2	10	50	62	19	0.31
3	160	0	31	22	0.71
4	15	120	61	4	0.07
5	160	180	59	0	0.00
6	160	180	61	1	0.02
7	160	180	61	0	0.00
TOTAL			**397**	**51**	**0.17**

4 Discussion

The findings of the bat detector survey, carcasses search, searcher detectability, scavenger trials and collision risk monitoring are discussed below.

4.1 Southern Bent-wing Bat Monitoring

Bat detector surveys were undertaken for a period of 754 detector nights during the autumn and spring Southern Bent-wing Bat roost movement periods. A total of 23,895 files (Autumn 12,248 and Spring 11,647), contained recordings consistent with bat call pulses of species likely to be present in the wider project area.

Bat activity varied depending on the proximity to suitable bat habitat i.e., water and native vegetation. Location 3 located within an extensive area of native vegetation recorded the highest average nightly calls in both autumn and spring.

The number of files targeting Southern Bent-wing Bat was 89 (Autumn 38 & Spring 51). The calls of two species associated with the call complex; Chocolate Wattled Bat and Little Forest Bat were identified by their characteristic call features (refer to Attachment G). Both are relatively common in the south-west region.

Autumn Results

There were no calls attributed to Southern Bent-wing Bat or the SBwB call complex. SBwB call complex were visually identified as either Chocolate Wattled Bat or forest bats.

Spring Results

There were no calls attributed to Southern Bent-wing Bat or the SBwB call complex. SBwB call complex were visually identified as either Chocolate Wattled Bat or forest bats.

4.2 Species Significance of Turbine Collision

Two microbats; Gould's Wattled Bat and Chocolate Wattled Bat and, 1 bird carcass; Dusky Woodswallow were considered to have been killed because of turbine collision. None of these species are listed threatened species.

The 3 incidents were recorded whilst undertaking the formal carcass searches. The two bats were found at Turbine 3 and the Dusky Woodswallow at Turbine 2.

We note that in the 4 days prior to a bat carcass being found, there was at least one night with periods of relatively low wind speed e.g., 5m/s, (refer to Tables 3~7). A wind speed of 5km/h is less than the flight speed of Gould's Wattled Bat, 6.7m/s and Chocolate Wattled Bat, 6.1m/s (Bullen and McKenzie 2016).

Dr Greg Richards (2008) refers to the increased collision risk on nights of low wind speed in the Ryan's Corner Wind Farm Environment Effect Statement Panel Hearing report. Low wind speed nights may be a contributing factor for bat collisions at Ferguson Wind Farm.

4.3 Collision Risk Modelling

The collision risk modelling was undertaken by Symbolix Pty Ltd. The estimated median mortality rate was calculated to be 47 bats, 15.5 mortalities per turbines. A copy of the Collison Risk Modelling report is provided in Attachment D.

4.3.1 Collision Risk Compared to Other Wind Farms

The collision risk per turbine annually was not able to be calculated so the average was applied for the 3 turbines. This is an artefact of the low number of bat carcass found at turbines and it is not statistically justified to make comparisons (Symbolix 2020). There are no publicly available data for a comparable wind farm (i.e., 3 turbines).

A review by Moloney et al (2019) and a detailed assessment undertaken recently by Symbolix (2020) have been used for comparison. The authors acknowledge the limitation of both studies because of the potential lack of consistency with the carcass search method deployed.

The Symbolix data is based on 5432 surveys covering an area of 147^2km comprising 428 bats and 355 bird carcasses. Symbolix estimated the median turbine collision for bats as 9.25 per turbine per year in western Victoria.

Moloney et al (2019) estimated a higher median collision per turbine rate of approx. 13 bats per turbine with the White-striped Freetail bat alone constituting 6 deaths per turbine annually. The median number of mortalities at Ferguson Wind Farm is estimated to be 15.5 bats per turbine for the 2021 monitoring period. This is slightly above the Moloney et al (2019) turbine estimates but consistent with Wind Farm A, referred to in the Maloney report (2019).

Gration's (unpublished) analysis of bat call characteristics of bats most prevalent in turbine collisions found that 91% of collisions are bats with a call frequency of 35kHz or less. This is consistent with studies undertaken overseas by Weller and Baldwin (2012).

Bats with a pulse duration of between 7.5ms and 12ms, wavelength between 9.5mm and 28.5mm and inter-pulse duration of between 118ms and 715ms are at greater risk e.g., White-striped Freetail bat, Southern Freetail Bat and Gould's Wattled Bat (Gration unpublished).

The results are consistent with the median estimates of collision rates as described in Maloney et al (2017).

4.4 Mitigation Measures to Reduce Risk

4.4.1 Carrion Removal

The Ferguson property is primary agricultural with the main activity the production of beef cattle. The landowner has not been required to remove any carrion or was there the need for carrion stockpiles or pits.

While there is no longer any site personal on the property the landowner continues to keep an eye out for carrion whilst undertaking farming activities.

European rabbits and or warrens are not present on the property and there has not been the need for a baiting or warren ripping program.

4.4.2 Additional Mitigation Measures

None of the additional mitigation measures outlined in the BAM Plan has been required. Feeding of stock is confined to pasture and silage grown and bailed on-site. There are not any lights present at the turbines or within proximity to the turbines. Only working animals

are present within the operational area of the farm and they are locked up when not working. Domestic animals are confined when not working.

4.4.3 Supplementary Mitigation Measures

To date, there have not been any impact triggers requiring the implementation of supplementary mitigation measures. It is acknowledged that should there be any evidence of any impact triggers, one or more of the supplementary mitigation measures triggers may require implementation.

4.4.4 Further Reporting of Incidental Carcasses

The landowners are aware that should they find any incidental carcasses on their property that they are to contact the BayWa r.e. site representative. Any carcasses are to be handled with gloves, put into a bag, and placed in a freezer.

The BayWa r.e. representative will contact EcoAerials Director, Rob Gration, who will organise for the carcass to be collected by local ecologist Lauren Eddy (Plume Ecology), a Timboon resident. A report will be prepared for DELWP as per the BAM Plan requirements, outlining if any further mitigation measures will be implemented.

4.5 Conclusion

As expected, the levels of activity close to the Turbines (due to their location in paddocks), and at height were considerably lower than locations where native vegetation or a waterbody are close. The lower activity levels near the turbines are considered an artefact of the lack of suitable habitat for microbats. Bat activity was considerably lower at height (e.g., Locations 5-7), constituting 27% of bat activity in Autumn and 7% in the Spring.

The pattern of bat activity at height is consistent with the findings of Pennay and Mills (2017). Bat activity near vegetation is also consistent with research by Lumsden (2007), Pennay and Mills (2017) and the report author's experience undertaking bat call analysis at wind farms. Bat activity is concentrated where suitable habitat exists in the form of native vegetation and waterbodies.

Location 3 in the both the Autumn (80.51%) and Spring (95.31%) had the highest percentage of calls within the frequency range analysed for SBwB and SBwB call complex.

There were no calls of SBwB, or calls attributed to the SBwB call complex recorded over the 754 detector nights. Two of the species associated with the call complex, Chocolate Wattled bat and Little Forest Bat were positively identified by their characteristic call features. The SBwB call complex recordings pre-visual analysis were a very small proportion of the total number of calls recorded; Autumn 0.31% and Spring 0.44%.

The collision results indicate that bats are flying at Rotor Swept Area (RSA) height, albeit with low activity levels and the estimated collisions rate is consistent with other wind farms (Maloney et al, 2019). There was not any discernible difference with the number of bat collisions between seasons and, bat activity is concentrated where native vegetation, or a waterbody is present. Bat activity is many orders of magnitude lower in the RSA.

4.6 Monitoring results in relation to the BAMP Objectives

The key objectives as outlined in the BAMP (E&HP 2019) were to establish an outcome-focussed and adaptive monitoring program aimed at answering the following key questions:

1. Is operation of the wind farm resulting in microbat mortality, and if so:
    - What is the estimated annual mortality rate?

The median mortality rate is estimated to be 47 bats annually. This is consistent with estimates at other wind farms across southwest Victoria (Maloney et al, 2019).

- What species are being impacted?

A total of 2 bats were found during the carcass search of the 3 turbines. Two species of bat have died because of collision with the turbine/s - Gould's Wattled Bat and Chocolate Wattled bat. There were no incidents with the EPBC Act and FFG Act listed Southern Bent-wing Bat.

Is there seasonal variation in the number of microbat mortalities?

Due to the low number of incidents (2), it was not statistically possible to access any seasonal variation of microbat mortalities.

2. Are Southern Bent-wing Bats using the wind farm area during peak migration periods, and if so:

- Are they flying at RSA height?

There was no incident with a Southern bent-wing Bat colliding with a turbine and bat detector monitoring did not record any Southern Bent-wing Bat calls or the call complex at height.

- How frequent is bat activity?

Bat activity (bat files) overall is greatest during Autumn. Unsurprisingly bat activity is greatest near remnant patches of native vegetation. Bat activity at height was several orders of magnitude lower than activity at ground level.

3. Describe mitigation measures to reduce the risk of bat and bird mortality through turbine strike:

    - Provide a framework for responding to detected impacts on bats and birds.

The E&HP (2019) BAMP, Section 6.1.2. Figure 3., provides the decision-making framework for responding to impacts on bats and birds. This framework will continue to apply to the post 2-years on monitoring period should a carcass be found by the landowner.

    - Detail procedures for the periodic reporting of findings to DELWP.

As per the E&HP BAMP (2019), Section 7, any incidental carcass finds post construction monitoring period will be reported to DELWP. The framework for reporting is as described in Section 6.1.2, Figure 3 of the BAMP. Further to this a monthly email report is submitted to DELWP outlining the carcass search results.

    - Provide a clear summary of management actions required to address the subject Conditions of Approval (CoA).

All management actions have been implemented as required of the Conditions of Approval and the Summary of BAM Plan Measures Section 8 of the E&HP (2019) BAMP. There have not been any triggers for any further actions.

The results of the first year of post construction monitoring indicates that the risk to non-threatened bat species by the Ferguson Wind Farm is consistent with other wind farms in south-west Victoria and a low risk to Southern Bent-wing Bat.

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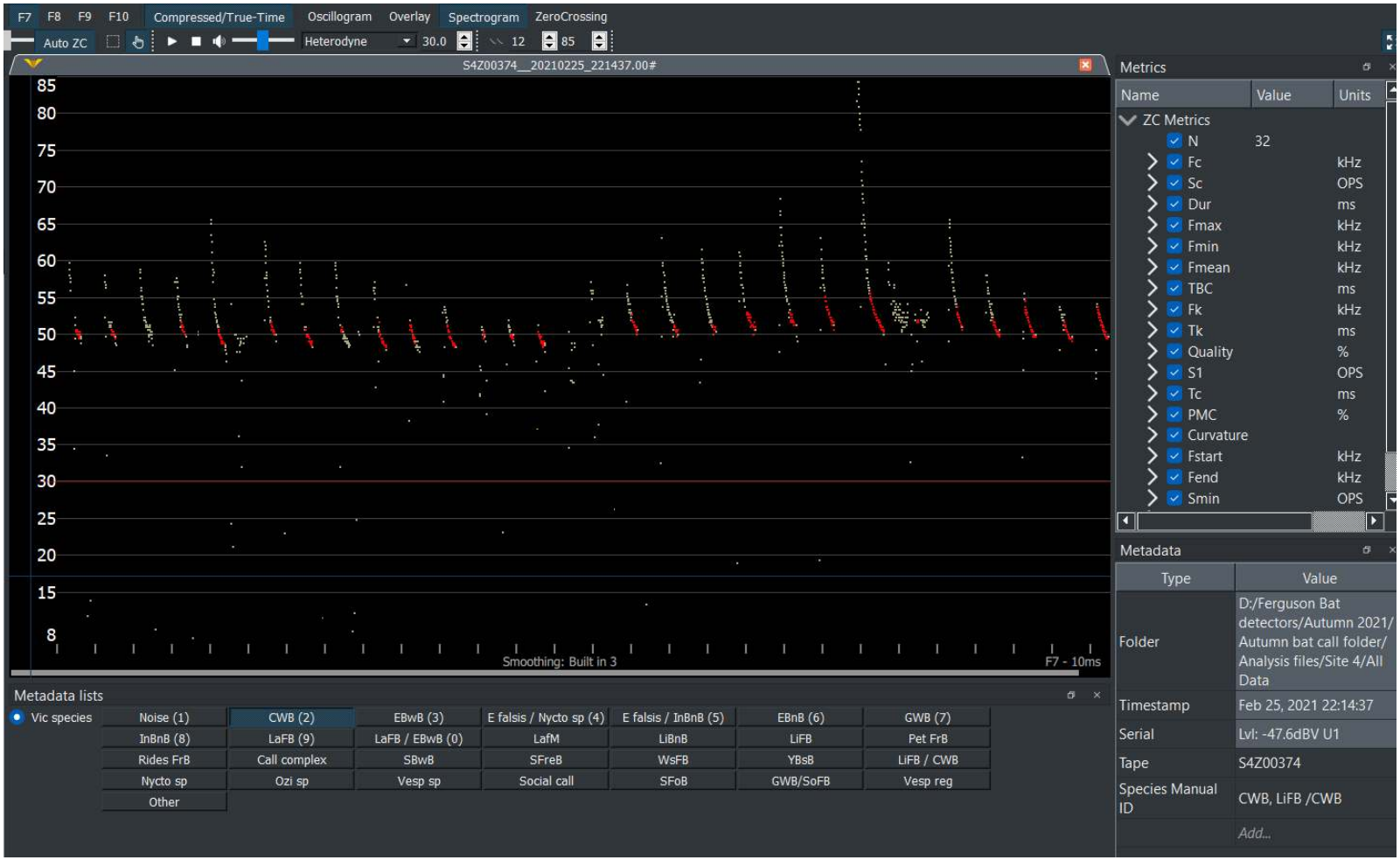
Attachment A- Scavenger Trials: Autumn and Spring 2021

TRIAL_START_DATE	TRIAL_START_TIME	TURBINE	SPECIES	SCAVENGE_SPECIES_TYPE	SCAVENGE_CARCASS_ID	GROUND_TYPE	DAYS	INTERVAL1	INTERVAL2
14/04/2021	9:46:00	1	BAT	WSFT	FE1	Paddock	1	14/04/2021 14:10	15/04/2022 9:44
14/04/2021	9:46:00	1	BAT PROXY	MOUSE	FE2	Paddock	1	14/04/2021 14:11	15/04/2022 9:45
14/04/2021	9:46:00	1	BAT PROXY	MOUSE	FE3	Hardstand	1	14/04/2021 14:12	15/04/2022 9:46
14/04/2021	9:46:00	1	BAT PROXY	MOUSE	FE4	weeds	4	16/04/2021 14:13	18/04/2021 8:15
14/04/2021	10:15:00	2	BAT	SBWB	FE5	weeds	1	14/04/2021 14:10	15/04/2021 16:46
14/04/2021	10:15:00	2	BAT PROXY	MOUSE	FE6	Paddock	1	14/04/2021 14:10	15/04/2021 16:48
14/04/2021	10:15:00	2	BAT PROXY	MOUSE	FE7	Paddock	6	15/04/2021 16:47	20/04/2021 10:15
14/04/2021	10:15:00	2	BAT PROXY	MOUSE	FE8	Paddock	3	15/04/2021 16:48	17/04/2021 14:24
14/04/2021	10:46:00	3	BAT	LaFB	FE9	Paddock	1	14/04/2021 17:10	15/04/2022 9:10
14/04/2021	10:46:00	3	BAT PROXY	MOUSE	FE10	Paddock	2	15/04/2021 16:52	16/04/2021 16:28
14/04/2021	10:46:00	3	BAT PROXY	MOUSE	FE11	Hardstand	2	15/04/2021 16:53	16/04/2021 16:26
14/04/2021	10:46:00	3	BAT PROXY	MOUSE	FE12	Hardstand	1	14/04/2021 17:12	15/04/2021 16:50
14/04/2021	10:46:00	3	BAT PROXY	MOUSE	FE13	Paddock	2	15/04/2021 16:48	16/04/2021 8:28
16/10/2021	9:10:00	1	BAT PROXY	MOUSE	FE1	Hardstand	6	18/10/2021 10:30	20/10/2021 10:15
16/10/2022	9:10:00	1	BAT PROXY	MOUSE	FE2	Paddock	6	18/10/2021 10:31	20/10/2021 10:16
16/10/2022	9:10:00	1	BAT PROXY	MOUSE	FE3	Paddock	3	16/10/2021 12:10	17/10/2021 10:40
16/10/2022	9:10:00	1	BAT PROXY	MOUSE	FE4	Hardstand	4	17/10/2021 16:20	18/10/2021 12:45
16/10/2022	9:40:00	2	BAT PROXY	MOUSE	FE5	Hardstand	30	14/11/2021 12:30	
16/10/2022	9:40:00	2	BAT PROXY	MOUSE	FE6	Paddock	4	17/10/2021 16:20	18/10/2021 12:50
16/10/2022	9:40:00	2	BAT PROXY	MOUSE	FE7	Paddock	12	24/10/2021 10:50	26/10/2021 11:15
16/10/2022	9:40:00	2	BAT PROXY	MOUSE	FE8	Hardstand	4	17/10/2021 16:21	18/10/2021 16:15
16/10/2022	10:12:00	3	BAT PROXY	MOUSE	FE9	Paddock	8	20/10/2021 11:30	22/10/2021 11:15
16/10/2022	10:12:00	3	BAT PROXY	MOUSE	FE10	Paddock	6	18/10/2021 14:05	20/10/2021 11:31
16/10/2022	10:12:00	3	BAT PROXY	MOUSE	FE11	Hardstand	8	20/10/2021 11:32	22/10/2021 11:16
16/10/2022	10:12:00	3	BAT PROXY	MOUSE	FE12	Paddock	3	16/10/2021 15:15	17/10/2021 14:10

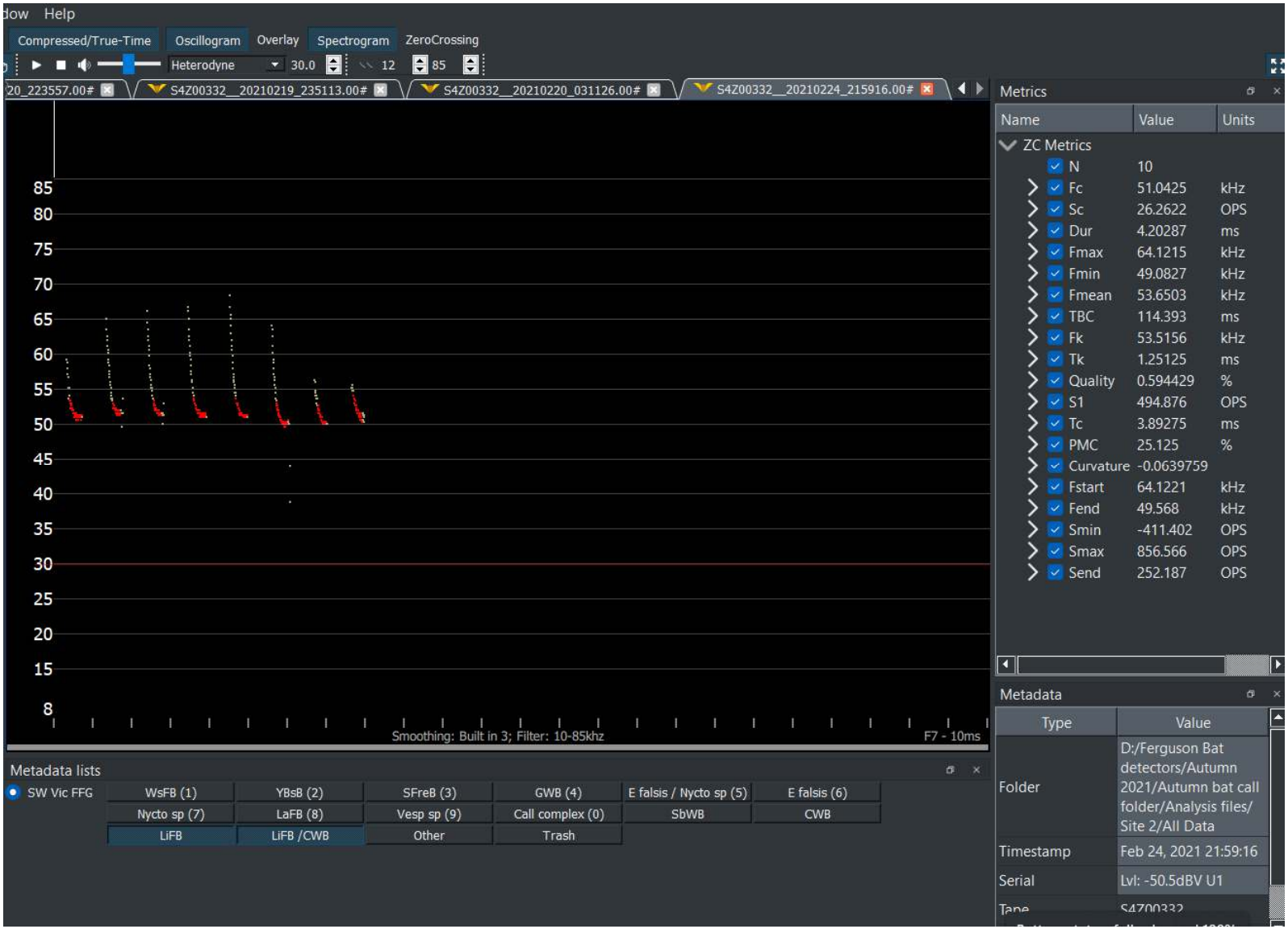
Attachment B- Searcher Detectability Trials: Autumn and Spring 2021

DATE	TURBINE	OBSERVER	OBSERVER_TYPE	GROUND_TYPE	SPECIES	DETECT_SPECIES_TYPE	DETECT_CARCASS_ID	DISTANCE_M	FOUND	COMMENTS
14/04/2021	1	Lauren Eddy	Human	Pasture	WSFB	bat proxy	FE1	47	1	WSFB= white-striped freetail bat
14/04/2021	1	Lauren Eddy	Human	Pasture	Mouse	bat proxy	FE2	27	1	mouse
14/04/2021	1	Lauren Eddy	Human	hardstand	Mouse	bat proxy	FE3	25	1	mouse
14/04/2021	1	Lauren Eddy	Human	weeds	Mouse	bat proxy	FE4	58	1	mouse
14/04/2021	2	Lauren Eddy	Human	weeds	SBWB	bat proxy	FE5	32	0	Southern bent-winged bat
14/04/2021	2	Lauren Eddy	Human	pasture	Mouse	bat proxy	FE6	18.5	1	mouse
14/04/2021	2	Lauren Eddy	Human	Pasture	Mouse	bat proxy	FE7	56	1	mouse
14/04/2021	2	Lauren Eddy	Human	Pasture	Mouse	bat proxy	FE8	58	0	mouse
14/04/2021	3	Lauren Eddy	Human	Pasture	LaFB	bat proxy	FE9	60	0	large forest bat
14/04/2021	3	Lauren Eddy	Human	Pasture	Mouse	bat proxy	FE10	26.5	1	mouse
14/04/2021	3	Lauren Eddy	Human	hardstand	mouse	bat proxy	FE11	6	1	mouse
14/04/2021	3	Lauren Eddy	Human	hardstand	mouse	bat proxy	FE12	26.5	1	mouse
14/04/2021	3	Lauren Eddy	Human	Pasture	mouse	bat proxy	FE13	51.5	1	mouse
16/10/2021	1	Lauren Eddy	Human	Hardstand	Mouse	bat proxy	FE1	8	1	Very wet conditions, mouse blended in with background
16/10/2021	1	Lauren Eddy	Human	Paddock	Mouse	bat proxy	FE2	36	0	Very wet conditions, mouse blended in with background
16/10/2021	1	Lauren Eddy	Human	Paddock	Mouse	bat proxy	FE3	56	0	Very wet conditions, mouse blended in with background
16/10/2021	1	Lauren Eddy	Human	Hardstand	Mouse	bat proxy	FE4	57	0	Very wet conditions, mouse blended in with background
16/10/2021	2	Lauren Eddy	Human	Hardstand	Mouse	bat proxy	FE5	57	0	Very wet conditions, mouse blended in with background
16/10/2021	2	Lauren Eddy	Human	Paddock	Mouse	bat proxy	FE6	60	0	Very wet conditions, mouse blended in with background
16/10/2021	2	Lauren Eddy	Human	Paddock	Mouse	bat proxy	FE7	14	1	Very wet conditions, mouse blended in with background
16/10/2021	2	Lauren Eddy	Human	Hardstand	Mouse	bat proxy	FE8	6	1	Very wet conditions, mouse blended in with background
16/10/2021	3	Lauren Eddy	Human	Paddock	Mouse	bat proxy	FE9	46	1	Very wet conditions, mouse blended in with background
16/10/2021	3	Lauren Eddy	Human	Paddock	Mouse	bat proxy	FE10	28	0	Very wet conditions, mouse blended in with background
16/10/2021	3	Lauren Eddy	Human	Hardstand	Mouse	bat proxy	FE11	11	0	Very wet conditions, mouse blended in with background
16/10/2021	3	Lauren Eddy	Human	Paddock	Mouse	bat proxy	FE12	24	0	Very wet conditions, mouse blended in with background

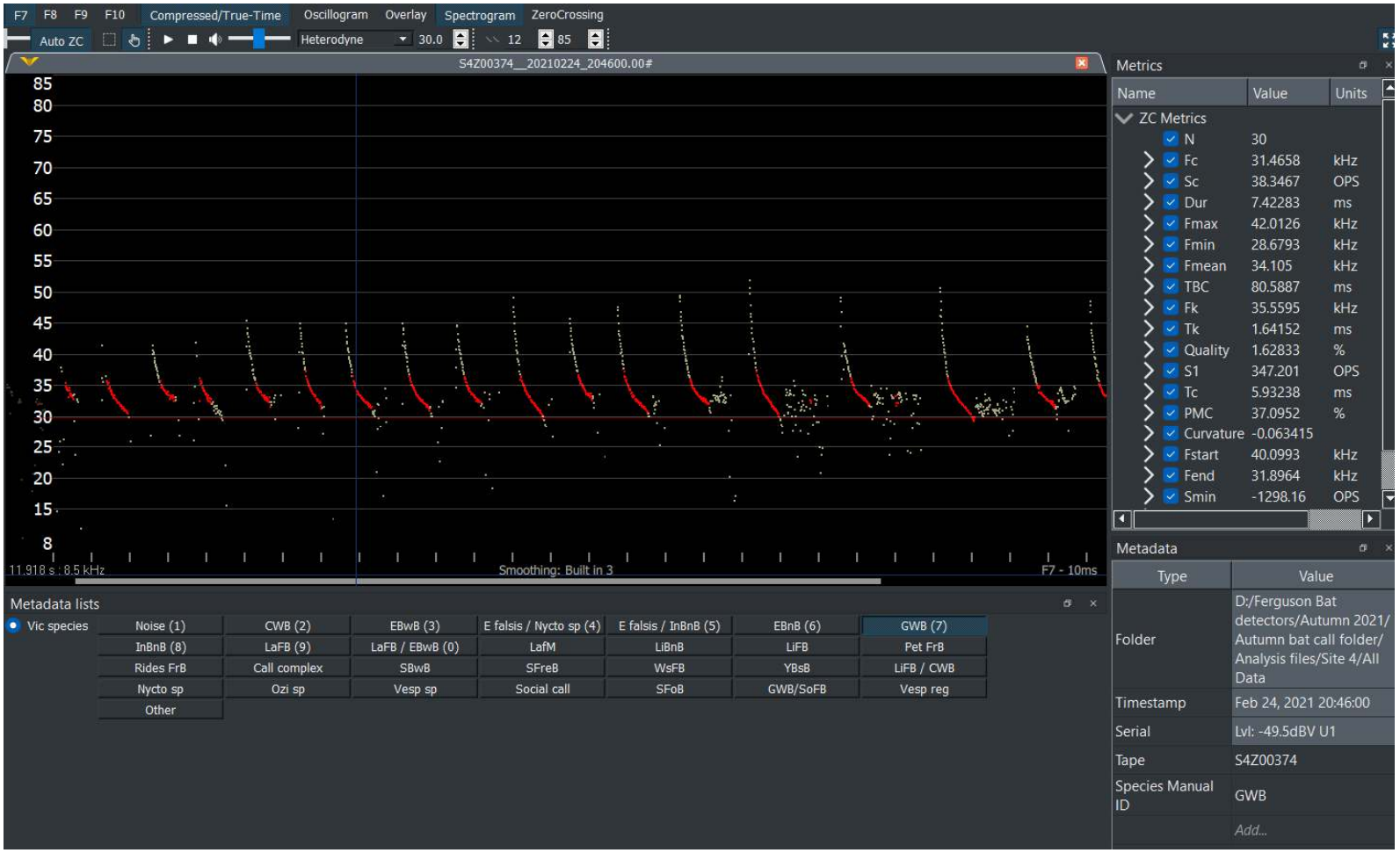
Attachment C – Bat Call Images



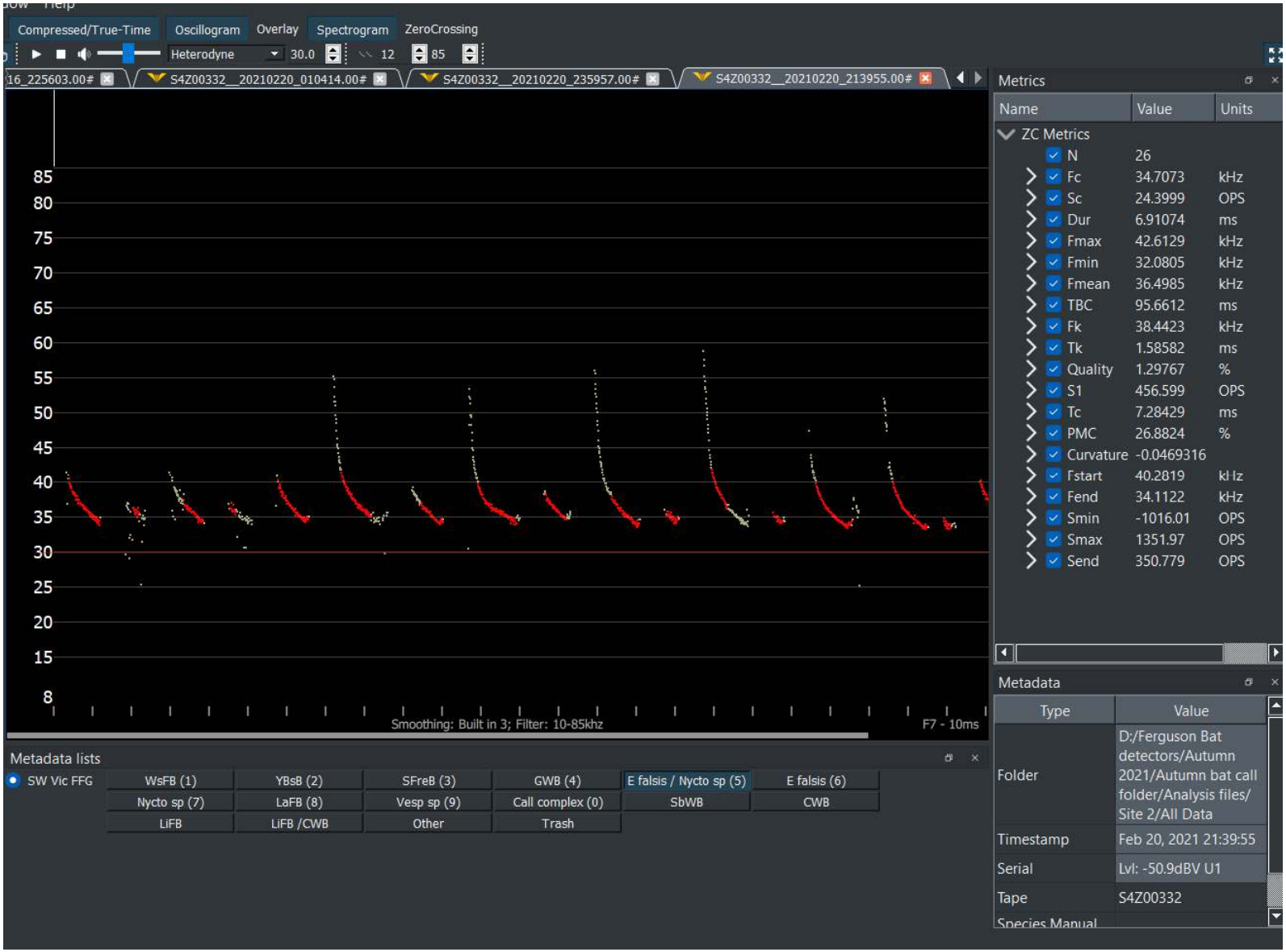
Chocolate Wattled Bat – one of the species associated with the Southern Bent-wing Bat call complex.



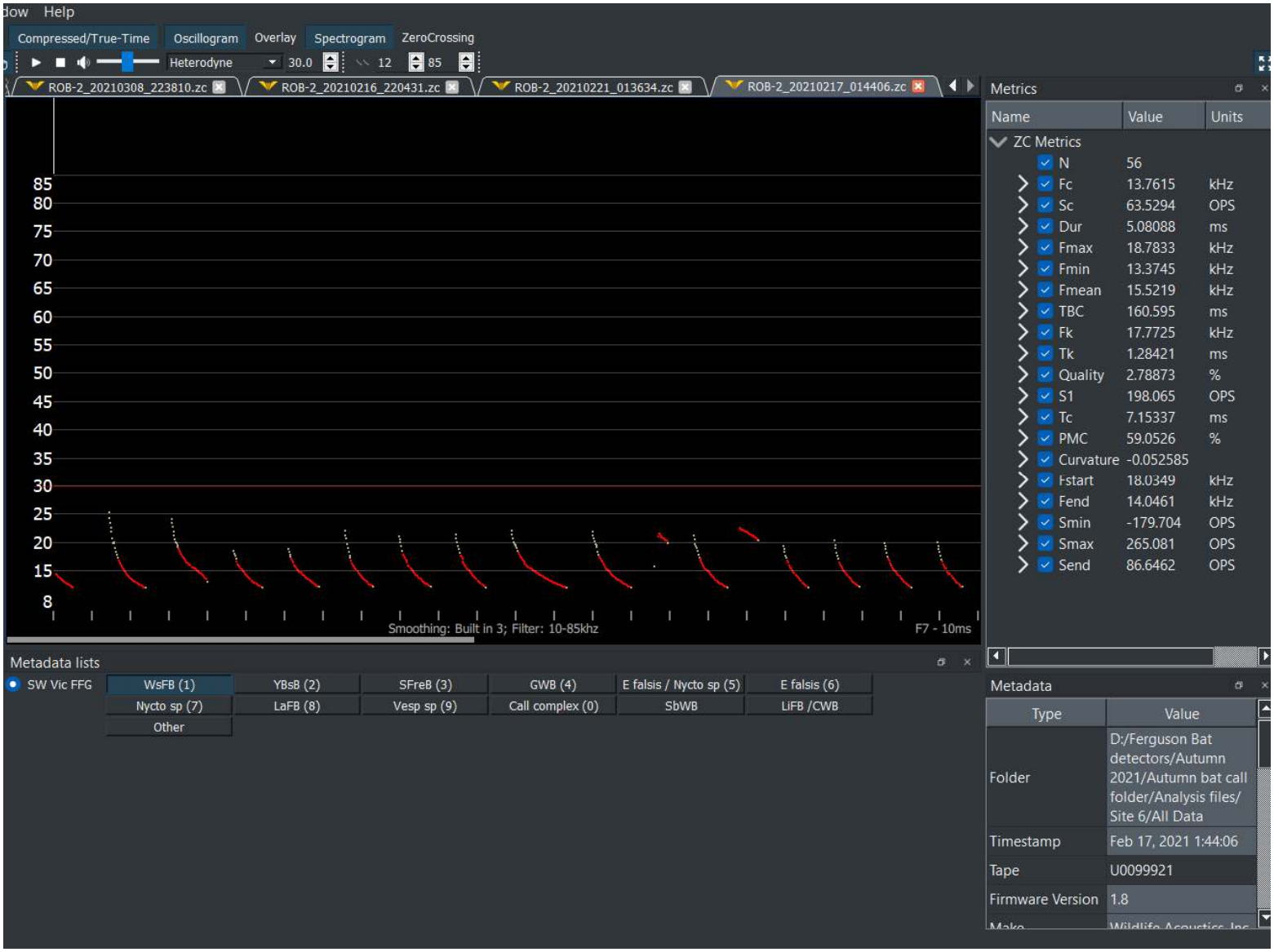
Little Forest Bat - one of the species associated with the Southern Bent-wing Bat call complex.



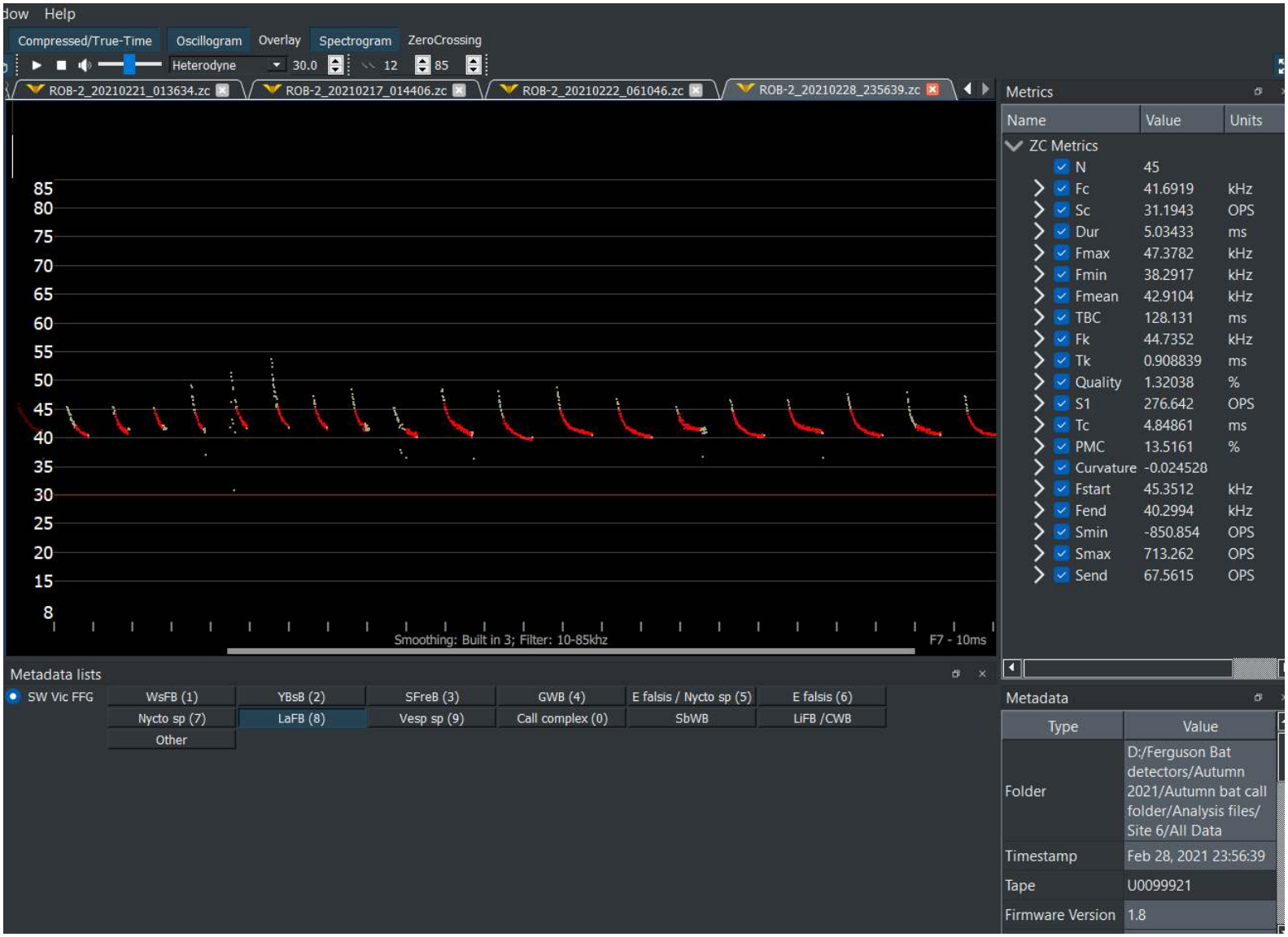
Gould’s Wattled Bat



Eastern Falsistrelle



White-striped Freetail Bat



Large Forest Bat

Attachment D – Collison Risk Report - Symbolix

symbolix

Ferguson Wind Farm Mortality Estimate - Year 1

Prepared for EcoAerial Environmental Services, 10 February 2022, Ver. 1.21

This report outlines an analysis of the mortality data collected at the Ferguson Wind Farm from 2020-12-14 to 2021-11-18. The analysis is broken into the three related components below:

- Searcher efficiency / detectability – estimated from trials in April 2021 and October 2021
- Scavenger loss rates – consisting of trials in April 2021 and October 2021
- Mortality estimates - based on monthly surveys from 2020-12-14 to 2021-11-18. Note that that out of the three turbines, two were not running until late March 2021.

The data was collected and provided by EcoAerial Environmental Services 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 analysed was collected, verified and provided to us from EcoAerial Environmental Services.

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 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 (2021-04-14 and 2021-10-16). Both bat ($n = 3$) and "bat proxy" (mouse, $n = 22$) carcasses were used to determine bat searcher efficiencies.

Due to unique ground conditions at Ferguson Wind Farm (R. Gration, *pers. comms*) we have split the detection rate in the following way. At Turbine 1, in the first four months of operation, the ground under the turbine was cleared so had high detectability. Therefore, to estimate its detection rate, we use the four trials held at Turbine 1 in April. This yields a point estimate of 100% with a 95% confidence interval of [40%, 100%]. At Turbines 2 and 3 (all survey period), and for the rest of the survey period for Turbine 1, there was grass/pasture under the turbine. To estimate its detection rate, we have used the remaining 21 trials, which gives a point estimate of 48% with a 95% confidence interval of [26%, 70%].

Table 1 summarises the result.

Table 1: Detection efficiency for bats.

Variable	T1 first four months	T2 & 3, T1 last eight months
Number found	4	10
Number placed	4	21
Mean detectability proportion	1	0.48
Lower bound (95% CI)	0.4	0.26
Upper bound (95% CI)	1	0.7

To summarise:

- **At Turbines 2 and 3 we used the above stated searcher efficiency, which is 48% with a 95% confidence interval of [26%, 70%]**
- **At Turbine 1, we use a searcher efficiency which is a weighted average of the T1 April trial (1/3 weight, corresponding to first 4 months), and the remaining grass/pasture trials (2/3 weight, corresponding to last 8 months). Overall, this gives an estimate of 65% with a 95% confidence interval of [44%, 82%]**

Scavenger efficiency

Scavenger efficiency trials were conducted at the same time as the searcher efficiency trials. Trials ran over 30 days, and used the same set of species as the searcher efficiency trials.

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.

There was no evidence that the scavenger rate differed by ground type. Scavenger rates from both trials have been aggregated, though we note that there was some evidence that scavenger rates differed between the two trials. As carcass searches were performed year-round, we expect the aggregated scavenger rate will account for possible seasonal differences across the survey year.

Figure 1 shows a survival curve fitted to the combined cohort of bats and bat proxies. The survival curve (solid line) shows 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 4% to 65% of carcasses to remain after five days with the expectation being around 17%.

Under these assumptions, the median time to total loss via scavenge is 1.7 days, with a 95% confidence window of [1.1, 2.6] days.

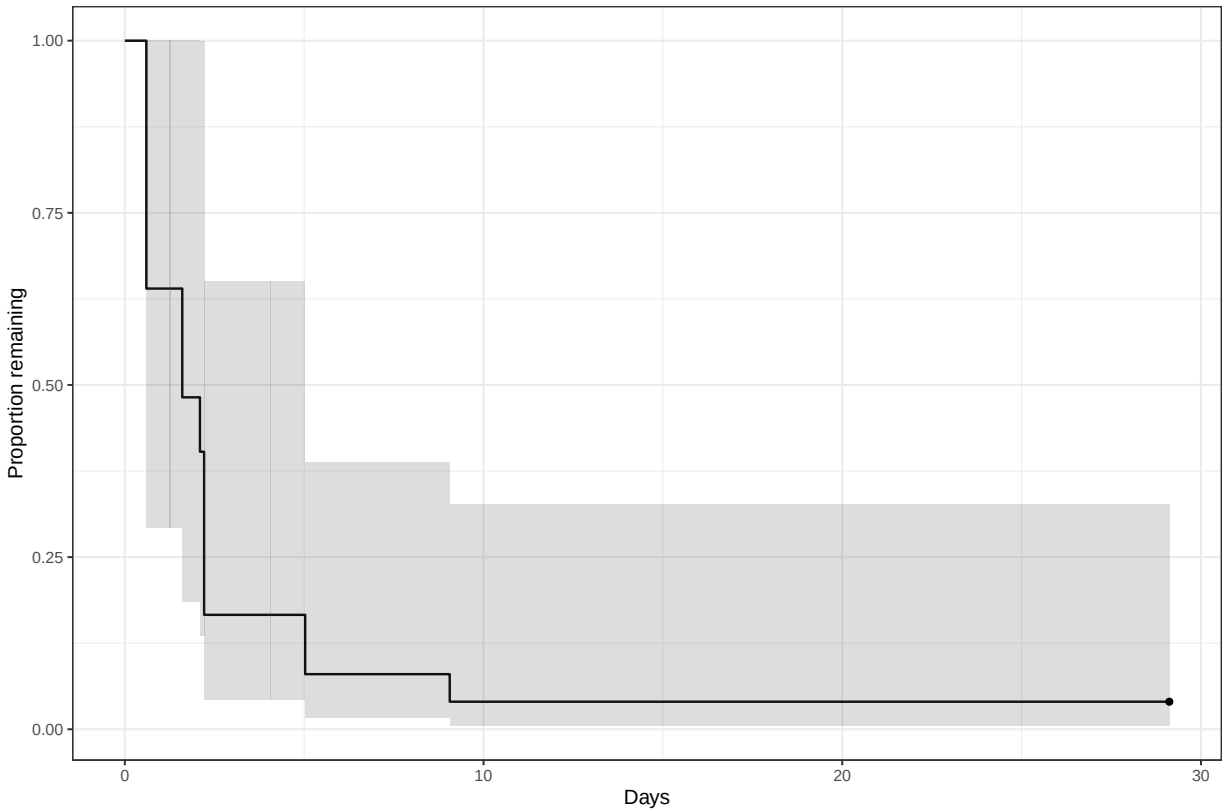


Figure 1: Combined survival curve for bats and bat proxies, with 95% confidence interval shaded.

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 turbines were surveyed twice each month (when operational; two turbines did not become operational until late March), with a pulse survey performed two days after the standard survey. Turbines were surveyed out to a radius of 60 metres in both standard and pulse surveys.

Table 2: Number of surveys per month.

Date	Number of surveys
2020 Dec	2
2021 Jan	2
2021 Feb	2
2021 Mar	2
2021 Apr	6
2021 May	6
2021 Jun	6
2021 Jul	6
2021 Aug	6
2021 Sep	6
2021 Oct	6
2021 Nov	6

Mortality estimate - year one

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 Ferguson Wind Farm from 2020-11-14 to 2021-11-18 (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 3 turbines on site.
- Search frequency for each turbine was taken from a list of actual survey dates (see Table 2 for a summary).
- For turbine 1, mortalities were allowed to occur up to a month before the initial survey (2020-12-14) and until the final surveyed date (2021-11-18). As turbines 2 and 3 were not operational for the whole survey period, for these turbines mortalities were allowed to occur from 2021-03-24 until 2021-11-18.
- 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.
- We took scavenge loss and search efficiency rates as outlined above.
- All three turbines were searched twice each month out to a 60 metre radius. We estimated the "coverage factor" for the survey – i.e. the total fall zone surveyed (using estimates from Hull and Muir (2010)). We assumed that the coverage factor was 85% 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 formal surveys in the first year of surveys.

Species	Number found
Chocolate Wattled bat	1
Gould's Wattled bat	1

Bat mortality estimate – results

During the first year of surveys a total of two 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 53 and a median of 47 bats lost on site over the twelve months.

Table 4 and Figure 2 display the percentiles of the distributions 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 53 bats over the survey period, and are 95% confident that fewer than 109 individuals were lost.

Table 4: Percentiles of estimated total bat losses over the first year of surveys.

0%	50% (median)	90%	95%	99%	99.9%
5	47	91	109	149	180

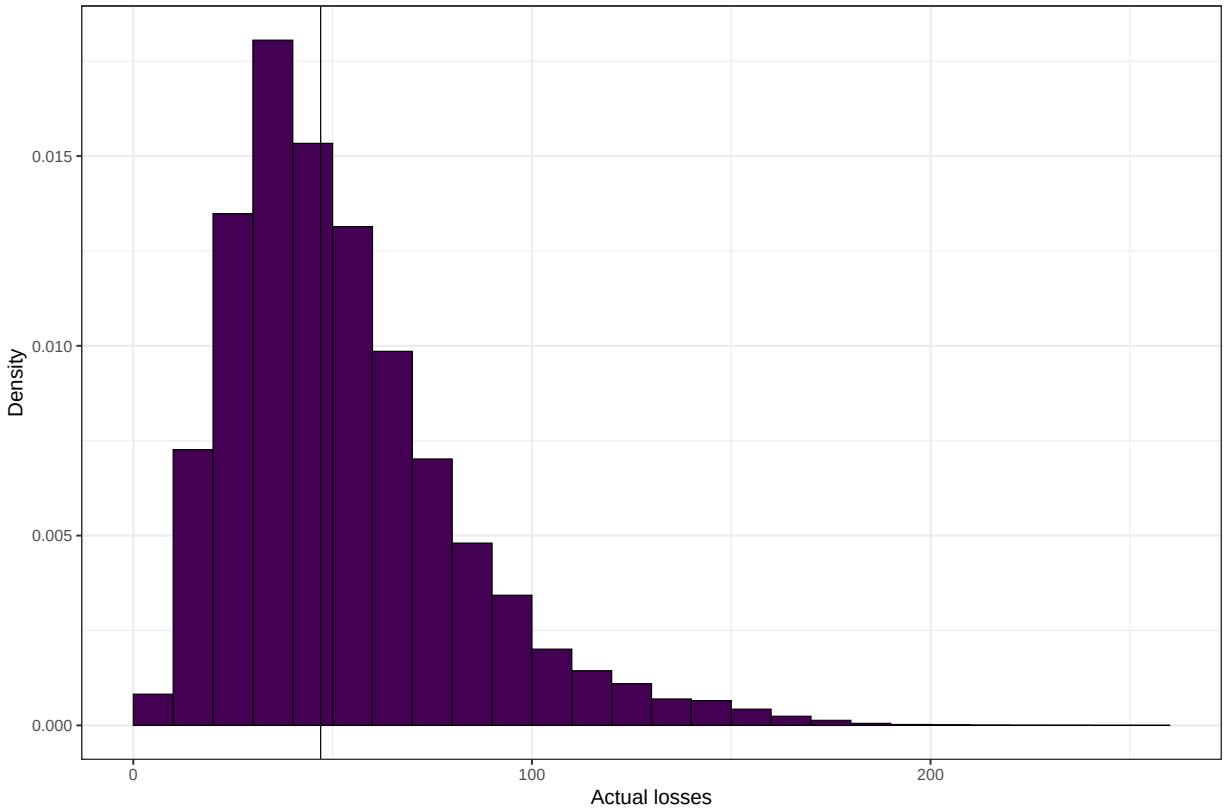


Figure 2: Histogram of the total losses distribution (bats), given two were detected on-site. The black solid line shows the median.

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.

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