Prime Super

Diapur Wind Farm Year 2 Post Construction Monitoring DRAFT Report




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Acknowledgments

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Executive Summary

The Diapur Wind Farm is located at Diapur approximately 20km west of Nhill Victoria (refer to Figure 1), 350 kilometres north-west of Melbourne. The Diapur Wind Farm occurs in the Wimmera bioregion in the Wimmera Catchment Management Authority area (CMA) within the jurisdiction of the Shire of Hindmarsh.

The Diapur Wind Farm consists of two wind turbines (refer to Figure 2), each with a maximum tip height of 200 metres and a minimum Rotor Swept Area (RSA) height of 50 metres Above Ground Level (AGL) and maximum blade length of 75m.

Diapur Wind Farm Pty Ltd was required to implement an endorsed Bat and Avian Management Plan (BAM Plan) to meet the planning requirements of the minister for Planning. Mortality analysis is based on completion of carcass searches, scavenger trials and detectability trials. The objective of the analysis of the combined attributes is to answer the following:

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

The first year of monitoring commenced within 30-days of the two proposed turbines being commissioned for operation in December 2021. The 2nd and final year of monitoring was completed monitoring in November 2023. All monitoring activities were undertaken by suitably qualified and experienced ecologist/s.

The ecologist/s 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 75 metres of each turbine.

Seven bats were found within the RSA and considered to have died because of turbine strike (refer to Figure 3). The collisions consisted of three southern freetail bats (*Ozimops planiceps*), two white-striped freetail bats (*Austronomous australis*), one Lesser Long-eared bat (*Nyctophilus geoffroyi*), one Gould’s Wattled bat and, one Nankeen Kestrel (*Falco cenchroides*). The deaths of these species did not trigger a non-conservation species incident report as per the BAM Plan requirements, Section 4.2.

The median bat mortality rates for the 2023 monitoring period were estimated to be 25 bats and 5 birds over the 12-month monitoring period (Symbolix, 2024), an average of 12.5 mortalities per turbine for bats and 2.5 per turbine for birds.

The results of the relevant surveys and reviews for the Diapur Wind Farm is consistent with estimates by Maloney (2019) and Symbolix (2020)and the risk to microbats and birds is moderate for the 2023 monitoring period.

1 Introduction

1.1 Project Background

The Diapur Wind Farm is located at Diapur approximately 20km west of Nhill Victoria (refer to Figure 1), 350 kilometres north-west of Melbourne.

The Diapur Wind Farm consists of two wind turbines (refer to Figure 1), each with a maximum tip height of 200 metres and a minimum Rotor Swept Area (RSA) height of 50 metres Above Ground Level (AGL) and maximum blade length of 75m.

Diapur Wind Farm Pty Ltd sought an amendment to reduce the minimum Rotor Swept Area (RSA) to a height of 50m AGL from the original height of 60m AGL whilst still maintaining a maximum tip height of 200m. Ecology and Heritage Partners (E&HP 2017) assessed the study area based on a maximum tip height of 220m and minimum rotor swept area of 24m AGL.

The total construction impact area was estimated to be approximately 4.42 hectares including access tracks, cables, and turbine hardstands (E&HP 2017).

The Bat and Avifauna Management Plan (BAM Plan) for Diapur Wind Farm (EcoAerial 2019) was based on the findings of site assessments undertaken by Ecology and Heritage Partners (E&HP) on 13 and 14 October 2015 (EHP 2017) and input from Belinda Cant, DELWP's representative and statisticians from Symbolix.

1.2 Bird and Bat Management Plan Objectives

The objectives of the BAM Plan are to establish a monitoring framework aimed at answering the following:

- Is operation of the wind farm resulting in significant levels of bird and microbat mortality?
- What is the estimated annual mortality rate?
- What species are being impacted?
- Is there seasonal variation in the number of bird and bat mortalities?

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.
  - Detail procedures for the periodic reporting to DEECA.
  - Provide a clear summary of management actions required to address the Conditions of Approval (CoA).

Following endorsement of the BAM Plan, Diapur Wind Farm Pty Ltd was responsible for engaging suitably qualified ecologists to implement the BAM Plan.

1.3 Project Area

The E&HP (2017) site assessment identified approximately 37ha of native vegetation and 42 scattered trees within the wider study area. One community of state significance was present within the study area: Grey Box – Buloke Grassy Woodland (#434). No communities of national significance occur. Vegetation communities present within the project footprint include:

- Low Rises Woodland EVC_ 66 (Endangered)
- Sandstone Ridge Shrubland EVC _ 93 (Vulnerable)
- Lowan Sands Mallee EVC_882 (Vulnerable).

Twenty-nine native fauna species were recorded within the study area: 28 birds and one reptile. No significant fauna species were recorded during the field assessment (E&HP 2017).

Notwithstanding the lack of records of threatened fauna within 10km buffer the study area, E&HP (2017) noted that there is suitable habitat, albeit marginal, within the site for the nationally threatened Red-tailed Black-Cockatoo south-eastern subspecies (RTBC). They considered that: "*Given the very small extent of potential habitat proposed for removal and availability of similar and higher quality habitat in the broader landscape, the project is considered unlikely to significantly impact upon the RTBC"*.

There are two historical records (1978 & 1979) of the *Flora and Fauna Guarantee Act 1989* (FFG Act) listed Eastern Great Egret *Ardea modesta. "Eastern Great Egret is likely to occasionally forage within the study area, particularly within areas of pasture following rainfall events. Given the small size of the proposed wind farm and low likelihood of large numbers of Eastern Great Egret regularly using the study area, the potential operational impacts on the species are likely to be low (E&HP 2017)".*

Microbats are known to be susceptible to collision with wind turbines, in a particular White-striped Freetail Bats, Southern Freetail Bat and Gould's Wattled Bat. A review of VBA contains no bat records within 10 kilometres of the study area. The lack of records was considered an artefact that surveys have not been undertaken in the region, rather than the surrounding landscape does not support bat populations (E&HP 2017).

The BatMap online tool (Australasian Bat Society 2024) was reviewed with a 30km buffer of the wind farm. BatMap identified nine species as likely to occur:

1. White-striped Freetail Bat - *Austronomous australis*
2. Gould's Wattled Bat - *Chalinolobus gouldii*
3. Chocolate Wattled Bat - *Chalinolobus morio*
4. Lesser Long-eared Bat - *Nyctophilus geoffroyi*
5. Southern Freetail Bat - *Ozimops planiceps*
6. Yellow-bellied Sheathtail Bat - *Saccolaimus flaviventris*
7. Inland Broad-nosed Bat - *Scotorepens balstoni*

8. Southern Forest Bat - *Vespadelus regulus*
9. Little Forest Bat - *Vespadelus vulturnus*

The issued Planning Permit (PA1700251) states the requirement to prepare a Bird and Avifauna Management Plan (BAM) Plan, aimed at minimising bird and bat strike events because of the operation of the wind farm. This report provides the results of the first years monitoring as outlined in the endorsed BAM Plan.

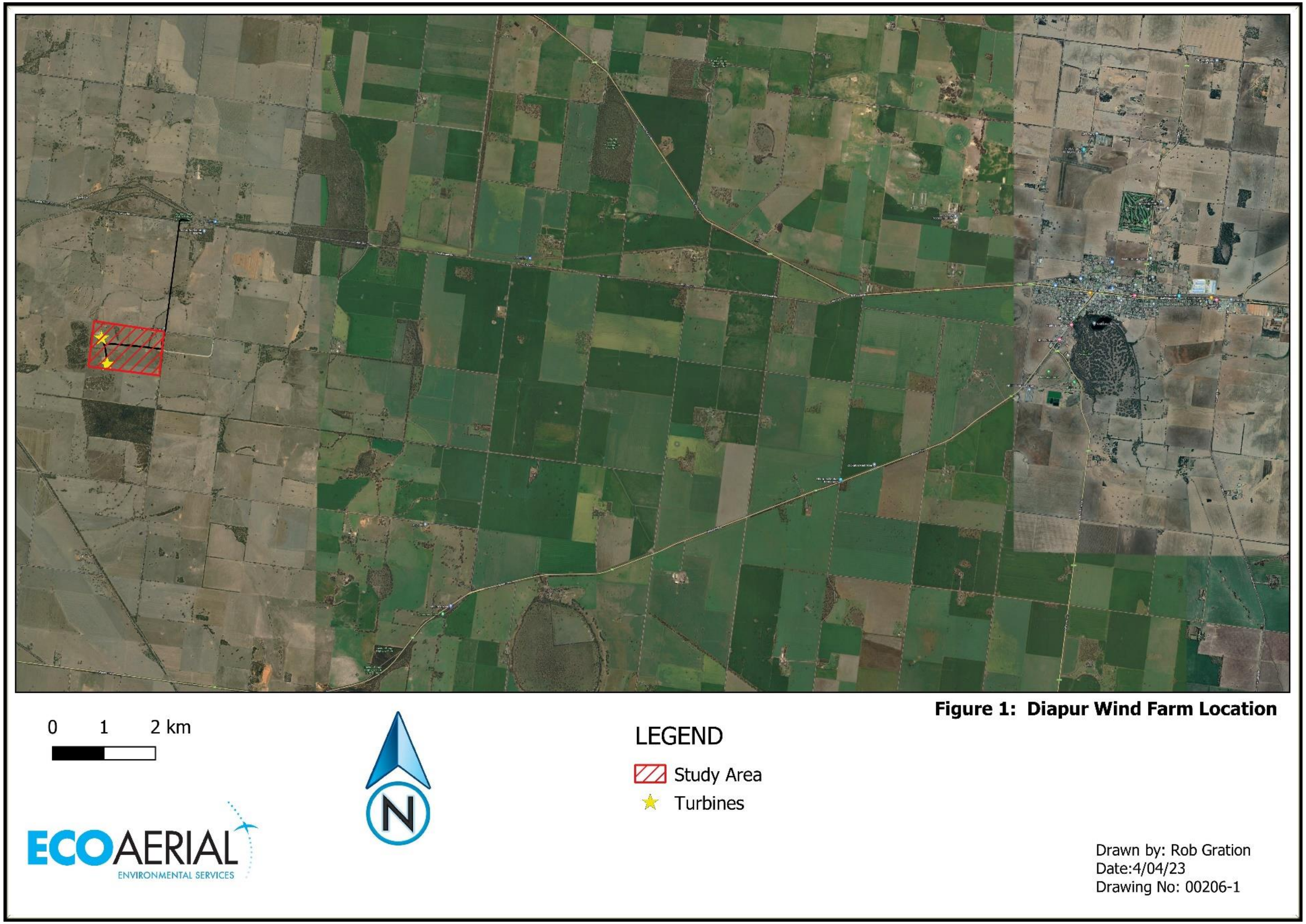

Figure 1: Diapur Wind Farm Location

Drawn by: Rob Gration
Date:4/04/23
Drawing No: 00206-1

250 0 250 500 750 1000 m

Map Projection: Simple Mercator
WGS 84

Legend

Turbines

Development Footprint

Figure 2: Diapur Wind Farm Site

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Drawing No: 00206-2

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1.4 Acronyms

Acronym	Description
BAM Plan	Bird and Avifauna Management Plan
CoA	Conditions of Approval
DEECA	Department of Energy, Environment and Climate Action, formerly DELWP
DELWP	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

2 Methods

2.1 Operational Monitoring Program

The mortality analysis is based on completion of carcass searches, scavenger trials and detectability trials. The objective of the analysis of these combined attributes is to answer the following:

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

EcoAerial was engaged by Diapur Wind Farm Pty Ltd to develop a Bat and Avifauna Management Plan (BAM Plan) in consultation with DELWP and statisticians, Symbolix, to address the following planning permit conditions:

Condition 34: *The Environmental Management Plan must include a Bat and Avifauna Management Plan (BAM Plan), which must:*

a) *include a statement of the objectives and overall strategy for minimising bird and bat strike arising from the operation of the facility.*

b) *include a mortality monitoring program of at least two years duration that commences when the first turbine is commissioned, or such other time approved by* Department of Environment, Land, Water and Planning *(DELWP) Environment Portfolio. The monitoring program must include:*

   i. *procedures for reporting any bird and bat strikes to DELWP;*

   ii. *information on the efficacy of searches for carcasses of birds and bats, and, where practicable, information on the rate of removal of carcases by scavengers, so that correction factors can be determined to enable calculations of the likely total number of mortalities; and*

   iii. *procedures for the regular removal of carcasses likely to attract raptors to areas near turbines.*

c) *Be prepared in consultation with DELWP Environment Portfolio prior to submission to the responsible authority.*

Condition 35: *When the monitoring program required under the BAM Plan is complete, the operator must submit a report to the responsible authority and DELWP Environment Portfolio setting out the findings of the program. The report must be:*

a) *To the satisfaction of the responsible authority and DELWP Environment portfolio*

b) *Made publicly available on the operator's website.*

Condition 36. *After considering the report submitted under Condition 34 and consulting with DELWP Environment Portfolio the responsible authority may direct the operator to conduct further investigation of impacts on birds and bats. Any further investigations must be undertaken by the wind energy facility operator to the satisfaction of the responsible* *authority and DELWP Environment Portfolio.*

Notwithstanding that the CoA states monitoring for 2-years is required, the second year of monitoring may not be warranted. If the first year of monitoring provides sufficient information to not warrant another year of monitoring, or the risk to birds and bats is considered low, the Department of Energy, Environment and Climate Action (DEECA, formerly DELWP) could be consulted to review the existing monitoring program. Options may be to cease monitoring or instigate alternative measures.

In this instance the proponent continued with a 2nd year of monitoring.

2.2 Methodology

2.2.1 Field Assessment

The post construction monitoring commenced in December 2022 when Turbines 1 and 2 were commissioned for operation. This report covers the 2nd year of operation, December 2022 – November 2023.

2.2.2 Carcass Searches

Monthly carcass searches in the 2nd year were undertaken at each turbine site approx.mid-month starting in December 2022. Carcass searches were completed for the 2nd year of monitoring in November 2023. Carcass searches were undertaken over a 12-month period. To reduce error and refine mortality estimates, a pulse search method was deployed as prescribed by Symbolix, i.e., a second carcass search was undertaken two days following each primary search.

Access to conduct the April carcass search was not permitted by the landowners. Sheep were present in the turbine paddocks for lambing and disturbance would cause sheep to abandon their lambs. October carcass search wasn't completed due to the field staff member being in hospitalised due to a medical issue. EcoAerial consulted with Symbolix, the company responsible for undertaking the mortality modelling, they stated the mortality modelling takes into account any information gaps.

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 75 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 are found, DEECA were to be notified within two days.

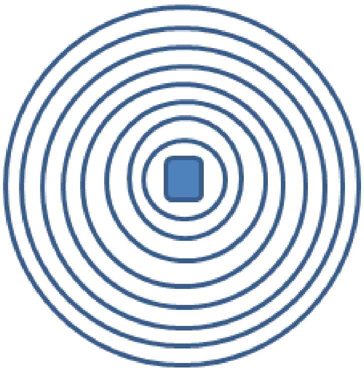

Diagram 1: Example of concentric transects at 4m intervals.

2.2.3 Scavenger Trials

Scavenger trials were undertaken for both the 1st and 2nd years of monitoring, results for the 1st year can be found in the year 1 report. The results for the 2nd and final year are presented in 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 over the two monitoring periods Spring 2023 and Summer 2023. Whilst it was planned for scavenger trials to take place in Autumn and Spring, access to the turbine paddocks was not permitted by the landowners in the Autumn. Sheep were present in the turbine paddocks for lambing and disturbance would cause sheep to abandon their lambs and scavenger trials would increase the likelihood of predation by foxes.

EcoAerial consulted with Symbolix, the company responsible for undertaking the mortality modelling, about conducting the scavenger trial in summer and checking regime. They stated there were not any issues with the timing for the mortality modelling.

The scavenger trial carcasses were checked twice a day for days 1-3, once on day 4, 11, 18 & 30 for the Spring Trial and twice a day for days 1-3, once on day 7, 12, 21 & 30 for the Summer Trial. Any carcasses remaining after day 30 were removed.

A summary of the scavenger trial procedure is provided below:

- Two bat carcasses and three bird carcasses were placed randomly within the 75-metre search area of each turbine for the spring and summer trial.
- Carcasses were checked as described above until they were removed by scavengers or after 30-days after placement.

2.2.4 Searcher Detectability Trials

Searcher detectability trials were prior to the spring and summer scavenger trial (refer to Attachment B). The efficiency trials, in conjunction with scavenger trials, were used to correlate mortality estimates by Symbolix, (refer to Attachment C). 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 or knew where they were placed. The searcher applied the same search method as intended for normal carcass searches.

2.2.5 Data Analysis

All results from carcass searches, detectability trials and scavenger trials 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 modelling and analysing wind farm collision data.

The mortality estimate method used by Symbolix (e.g., Symbolix simulator, unpubl) 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).

2.2.6 Reporting

This report is the second and final report providing details of the outcomes of monitoring activities from December 2022 to November 2023. The report details the methods and results of monitoring, and recommendations if ongoing monitoring is warranted or if alternative measures should be investigated.

The contents of the Year 2 report include:

- Detailed survey methods (including list of observers, dates and times of observations).
- Estimates of bat mortality rates based on carcass searches, detectability trials and scavenger trials.
- Detected mortality for all species recorded during the carcass searches.
- Any other wind turbine related bird and bat mortality recorded on site but not during designated carcass searches (i.e., incidental records by site personnel, etc.).
- Raw data sourced from carcass searches, detectability trials and scavenger trials.

A discussion of the results, including:

- Whether indirect impacts on bird and bat use of the site are significant at a regional, state or national level, or if listed species were affected indirectly.
- Whether the level of mortality was ecologically significant for birds and / or bat species.
- Whether continuation of the monitoring program is warranted and, if so, in what form.
- Any discernible differences in collision rates between lit and unlit turbines, where relevant.

- Any recommendations for reducing mortality, if necessary.

3 Results

No threatened species were found during the carcass searches, and neither was there any incidental records. A total of eight individuals were found during the formal carcass searches, seven microbats and one bird. Details of the results of the carcass search, scavenger /searcher detectability trials and bat detector results are provided below.

3.1 Carcass Search

Seven bats, three Southern Freetail Bats , two White-striped Freetail Bats, one Lesser Long-eared Bat, one Gould's Wattled Bat and one Nankeen Kestrel were found within the RSA and considered to have died because of turbine strike (refer to Figure 3). A female Southern Freetail Bat was found alive on the hardstand of Turbine 2. There were no signs of trauma because of impact with tower or blade. It made a full recovery and was fed meal worms and was released the following evening. Refer to Photograph 1 prior to release. It was likely that the turbine blade vortices forced the bat to the ground and the low overnight temperatures caused it to go into torpor. Table 1 below details the carcasses records.

Photograph 1: Southern Freetail Bat prior to release.

The wind speed and temperature leading up to the collision events, were sourced from the turbine tower weather stations. Weather conditions are recorded every 10 minutes.

Column 2 in Table 2 (refer below) is the minimum wind speed recorded leading up to an incident. Columns 3 and 4 provide the median overnight windspeed and temperature for the two turbines from 7.30pm to 7am. The feathering of the turbine blade threshold (i.e., less than 3m/s) occurred for short periods leading up to each of the incidents:

- 23/01/2023 (1.4m/s) between 9.00pm and 9.10pm
- 8/02/2023 (3.7m/s) between 8.30pm and 8.40pm
- 8/03/2023 (3.9m/s) between 4.10am and 4.20am
- 23/05/2023 (2.5m/s) between 5.20am and 5.30am
- 27/06/2023 (5.8m/s) between 3.30am and 3.40am

- 19/11/2023 (0.7m/s) between 4.20 and 4.30am.

There were periods of wind speeds below the flight speed of White-striped Freetail Bat (approx. 8.3 m/s) and Ozimops sp (8.1m/s) leading up to each incident.

Table 1: Turbine Strike Incidents

Incident No	Carcass Id	Survey Type	Turbine	Species	Sex / age	Distance from Tower (m)	Date
1	OZISP1	Formal	1	*Ozimops planiceps*	Female / Adult	40	23/01/2023
2	OZISP2	Formal	1	*Ozimops planiceps*	Female / Adult	32	11/02/2023
3	LLeB1	Formal	2	*Nyctophilus geoffroyi*	Female / Adult	43	11/03/2023
4	OZISP3	Formal	2	*Ozimops planiceps*	Female / Adult	52	11/03/2023
5	KEST1	Formal	2	*Falco cenchroides*	Unknown	46	24/05/2023
6	WsFB1	Formal	1	*Austronomous australis*	Male / Adult	30	24/05/2023
7	WsFB2	Formal	1	*Austronomous australis*	Unknown / Adult	5	27/06/2023
8	GWB	Formal	1	*Chalinolobus gouldii*	Male / Adult	31	20/11/2023

Table 2: Nightly Weather Conditions Leading up to Incidents.

Date	Turbine No	Wind Speed minimum m/s @ 110m	Overnight Wind Speed Average m/s @ 110m	Overnight Temp C Average @ 110m
19/01/2023 - 23/01/2023	1	0.7	9.58	16.83
7/02/2023 - 11/02/2023	1	3.7	9.77	18.81
7/03/2022 -11/03/2023	2	3.9	8.53	13.34
20/05/2023 - 24/05/2023	2	2.5	7.63	10.21
23/06/2023 -27/06/2023	1	5.8	12.48	8.22
16/11/2022- 20/11/2023	1	0.7	6.82	13.92

Figure 3: Carcass Finds

Drawn By: R. Gration
Date: 6/02/2024
Drawing No:00478.1

3.2 Scavenger Trials

The scavenger trials were conducted over two seasons, (Winter / Spring, August – September 2023 and Summer, November / December 2023), to account for any variances in site conditions, (e.g., grazed and un-grazed pasture) and seasonal behaviour of scavengers.

The results were consistent across both scavenger surveys with 3 carcasses remaining at the completion of 30-days.

Carcasses remained for between 13-days and 30-days during the Spring trial and 1-day and 30-days for the summer trial. Figures 4 & 5 details where the carcasses were randomly placed for both the scavenger and searcher detectability trials.

0 50 100 m

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Figure 4: Scavenger Trial Spring 2023

Drawn By: R. Gration
Date: 6/02/2024
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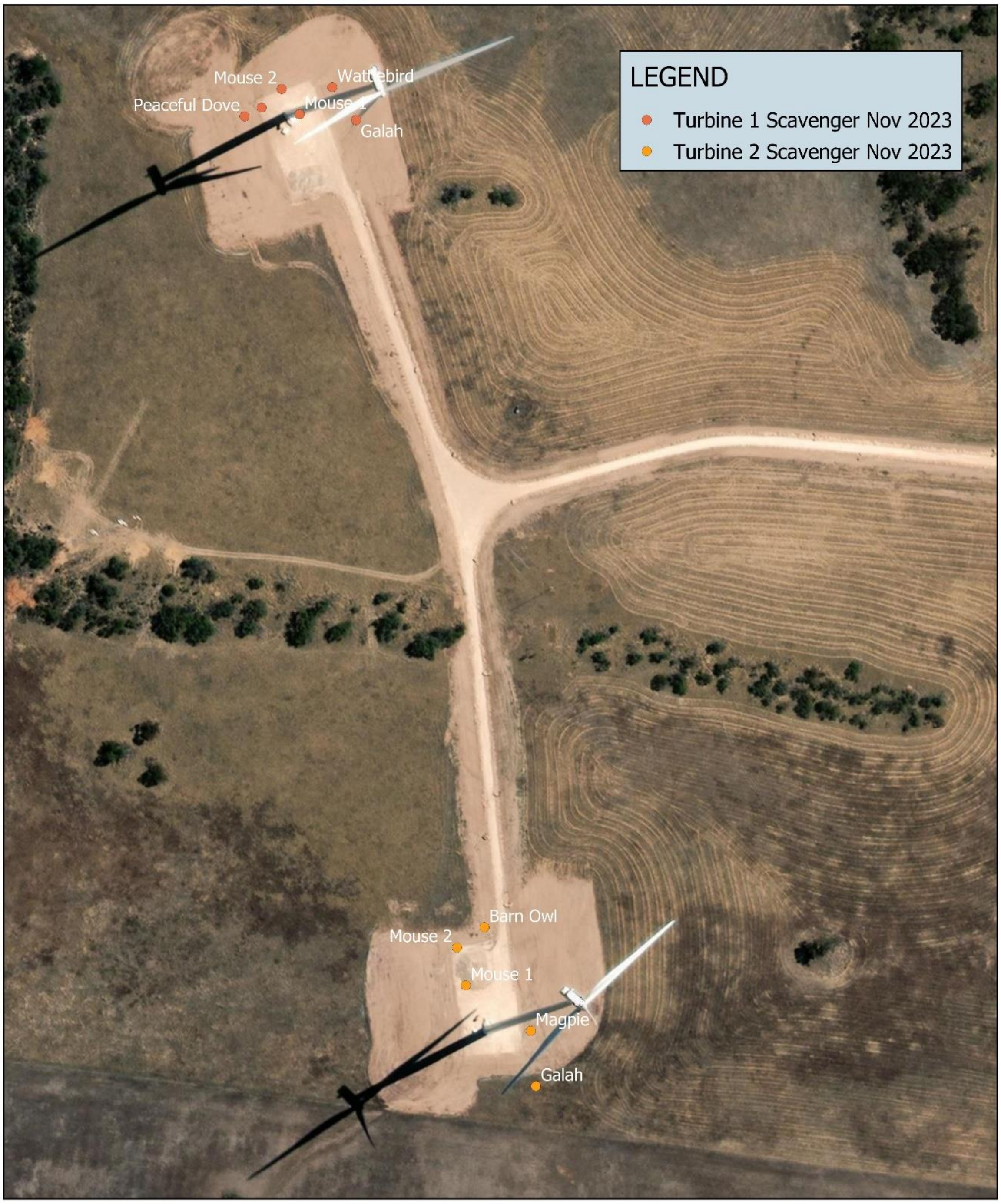

0 50 100 m

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Figure 5: Scavenger Trial Summer 2023

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Date: 6/02/2024
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3.2.1 Spring 2023

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

Table 6: Carcass removal during Winter / Spring.

TURBINE	SCAVENGER TYPE	GROUND TYPE	DAY REMOVED	SCAVENGER DATE
1	Mouse (bat surrogate)	Hardstand	13	11/09/2023
1	Mouse (bat surrogate)	Paddock	13	11/09/2023
1	Red-rumped Parrot	Paddock	2	30/08/2023
1	Barn Owl	Paddock	Removed at end of trial	Not applicable
1	Barn Owl	Paddock	Removed at end of trial	Not applicable
2	Mouse	Hardstand	1	29/08/2023
2	Mouse	Paddock	13	11/09/2023
2	Magpie	Paddock	Removed at end of trial	Not applicable
2	Blackbird	Paddock	1	29/08/2023
2	Barn Owl	Paddock	1	29/08/2023

3.2.2 Summer 2022 / 2023

All carcass remained for the duration of the 30-days. Refer to Table 7.

Table 7: Carcass removal during Summer.

TURBINE	SCAVENGER TYPE	GROUND TYPE	DAY REMOVED	SCAVENGER DATE
1	Mouse (bat surrogate)	Hardstand	0	20/11/2023
1	Mouse (bat surrogate)	Paddock	1	21/11/2023
1	Galah	Paddock	7	27/11/2023
1	Red Wattlebird	Paddock	Removed at end of trial	Not applicable
1	Peaceful dove	Paddock	Removed at end of trial	Not applicable
2	Mouse (bat surrogate)	Hardstand	7	27/11/2023
2	Mouse (bat surrogate)	Paddock	7	27/11/2023
2	Barn Owl	Paddock	7	27/11/2023
2	Magpie	Paddock	Removed at end of trial	Not applicable
2	Galah	Paddock	9	21/11/2023

3.3 Searcher Detectability Trials 2023

The searcher detectability trials were conducted over two seasons in 2023 to account for any variances in site conditions, (e.g., growing of pasture, grazed pasture, seasonal conditions) (refer to Figures 4 & 4 above). Eighteen of the 20 carcasses (90%) were found.

3.3.1 Winter / Spring 2023

The height of vegetation was approx., 10-12cm because of heavy grazing throughout the autumn through to spring (refer to Photograph 2). Carcasses were relatively easy to observe. Both field staff found 4 of the 5 carcasses during the winter / spring trial at their turbine detectability site. In both instances a bat surrogate was missed.

3.3.2 Summer 2023

Ground conditions persisted into the summer trial, refer to Photograph 3. Both field staff found 5 of 5 carcasses at their turbine detectability site.

Photograph 2: Sheep present for approx., 6-months from March through to September 2023

Photograph 3: Typical of ground conditions during scavenger and detectability trials in 2023.

The results of the 2023 scavenger and searcher efficiency trials were used for the collision modelling as per the endorsed BAM Plan, (refer sections 2.2 & 2.3, EcoAerial 2019). The results of the scavenger and searcher efficiency trials are provided in Attachment A & B.

4 Discussion

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

4.1 Species Significance of Turbine Collision

Seven microbats; three southern freetail bats, (3 females), two white-striped freetail bats (1 male, one unknown due to state of carcass, refer to photograph 4), one Lesser Long-eared Bat (female), Gould's Wattled Bat (Male) and, one bird carcass, a Nankeen Kestrel were considered to have been killed because of turbine collision. None of these species are listed threatened species.

Photograph 4: Desiccated White-striped Freetail Bat carcass

The eight incidents were recorded whilst undertaking the formal carcass searches. Two southern freetail bats were found at Turbine 1 and, one at Turbine 2. The two white-striped freetail bats were found at Turbine 1 as was the Gould's Wattled Bat. The Nankeen Kestrel and Lesser Long-eared Bat were found at Turbine 2.

We note that in the days prior to a bat carcass being found, there were periods during the night of relatively low wind speed (refer to Table 2). A wind speed above the feathering of the blades, i.e., 3m/s and below 9m/s occurs is within the flight speed of southern freetail bat, (8.1m/s) and white-striped freetail bat, (8.3m/s), (Bullen and McKenzie 2016). There were few instances when the turbines were feathered to reduce the risk of collision.

4.2 Collision Risk Modelling

The collision risk modelling was undertaken by Symbolix Pty Ltd. The estimated median mortality rate was calculated to be 25 bats, 12.5 mortalities per turbine and 5 birds, 2.5 mortalities per turbine, for the 12-month monitoring period December 2022~November 2023. A copy of the Collison Risk Modelling report is provided in Attachment D.

4.2.1 Collision Risk Compared to Other Wind Farms

The annual collision risk per turbine was not able to be calculated so the average was applied for the two turbines. This is an artefact of the low number of carcass found at turbines and it is not statistically justified to make comparisons (Symbolix 2020). There is also limited publicly available data for a comparable wind farm (i.e., two turbines in western Victoria). Statistical analysis between the first and second year wasn't possible due to the following variables:

- La Nina Year 1 and / El Nino Year 2
- Ground conditions, lightly grazed Year 1 and heavily grazed Year 2 influencing searcher efficiency and scavenger trials results.

A review by Moloney et al (2019) and a detailed assessment undertaken 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 5,432 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 south-western / western Victoria.

Moloney et al (2019) estimated a median collision per turbine rate of approx. 13 bats per turbine with the White-striped Freetail Bat alone constituting 6 deaths <u>per turbine</u> annually. The median number of bat mortalities at Diapur Wind Farm for the 2023 monitoring period, (12.5 per turbine) is consistent with Moloney et al (2019) estimates and slightly higher than Symbolix (2020) estimates (9.27 per turbine). The median number of bird collisions is consistent with both Symbolix and Maloney (2019) estimates, approximately 5 per turbine.

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 and Southern Freetail Bat (Gration unpublished).

The collision results at Diapur Wind farm are consistent with the median estimates of as described in Maloney et al (2019). Ther median collision results for bats is higher than Symbolix (2020) estimates and consistent with bird collision estimates.

4.3 Mitigation Measures to Reduce Risk

4.3.1 Carrion Removal

The Diapur property is mixed agricultural property with the main activities being the production of sheep and crops. The landowner has not been required to remove any carrion. and stockpile pits.

While there is no longer any site personal on the property, the landowner continued to keep look for carrion whilst undertaking farming activities. Rabbit warrens are not present on the property and there has not been the need for a baiting or warren ripping program. Fox baiting is undertaking prior to lambing each year in early autumn.

4.3.2 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 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.

Supplementary Mitigation Measures

There has not been any impact triggers requiring the implementation of supplementary mitigation measures.

4.3.3 Further Reporting of Incidental Carcasses

The landowners were made aware that should they find any incidental carcasses on their property that they are to contact the new owners, Diapur Wind Farm Pty Ltd representative, Jason Wang. Any carcasses are to be handled with gloves, put into a bag, and placed in a freezer. The Diapur Wind Farm Pty Ltd representative was to contact EcoAerial's Director, Rob Gration, who would organise for the carcass to be collected. No incidents were reported by the landowners outside of the monthly carcass searches.

4.4 Conclusion

The collision results indicate that bats and birds are flying at Rotor Swept Area (RSA) height. The estimated collision rates for birds and bats at Diapur is consistent with wind farms analysed by Maloney et al, (2019) and Symbolix (2020).

4.5 Monitoring results in relation to the BAM Plan Objectives

The objective of the analysis of these combined attributes is to answer the following:

1. Is operation of the wind farm resulting in indirect impacts on bird and bat significant at a regional, state or national level, or if listed species where affected.
    - There were no incidents with any EPBC Act or FFG Act listed species. Whilst it cannot be confirmed there are no indirect impacts, the results of the collision risk modelling provide an indication of likely site use. Activity is likely to be confined to vegetation patches to the west and south of the turbines. Commuting between these patches takes birds and bats south of the turbines.
2. Is the level of mortality ecologically significant?
    - The median mortality rate is estimated to be 12.5 bats and 5 bird per turbine annually. This is consistent with estimates at other wind farms across Victoria (Maloney et al, 2019; Symbolix, 2020). Therefore, it is considered the mortality rates are not ecologically significant.
3. Is the continuation of the monitoring warranted and if so, in what form?
    - Monitoring was undertaken under La Nina and El Nino conditions. The collision modelling indicates the site is of low risk to birds and moderate risk to bats when compared to other wind farm sites. On this basis the continuation of monitoring is not required beyond the BAM Plan monitoring period.
4. Is there a change in collision rates between unlit and lit turbines, if applicable?

- Due to the low number of incidents (8), and both turbines are lit, it was not statistically possible to access any variation of mortalities.

5. Describe any recommendations for reducing mortality through turbine strike.
    - Based on the number of estimated turbine collisions, there are no supplementary mitigation measures likely to reduce mortality further.

The results of the second and final year of post construction monitoring indicates that the risk to bats and birds is consistent with other wind farms in Victoria and therefore considered a moderate risk site for birds and bats.

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Attachment A- Scavenger Trials - 2023

TRIAL_START_DATE	TRIAL_START_TIME	TURBINE	SPECIES	SCAVENGE_SPECIES_TYPE	SCAVENGE_CARCASS_ID	GROUND_TYPE	COMMENTS	INTERVAL1	INTERVAL2
28/08/2023	8:25:00	1	Mouse	Bat surrogate	T1-B1	Hardstand		28/08/2023 8:25	11/09/2023 11:50
28/08/2023	8:25:00	1	Mouse	Bat surrogate	T1-B2	Paddock		28/08/2023 8:25	11/09/2023 11:50
28/08/2023	8:25:00	1	Red-rumped Parrot	bird	T1-B3	Paddock		28/08/2023 8:25	30/08/2023 17:30
28/08/2023	8:25:00	1	Barn Owl	bird	T1-B4	Paddock		28/08/2023 8:25	
28/08/2023	8:25:00	1	Barn Owl	bird	T1-B5	Paddock		28/08/2023 8:25	
28/08/2023	8:25:00	2	Mouse	Bat surrogate	T2-B1	Hardstand		28/08/2023 8:25	29/08/2023 17:30
28/08/2023	8:25:00	2	Mouse	Bat surrogate	T2-B2	Paddock		28/08/2023 8:25	11/09/2023 11:50
28/08/2023	8:25:00	2	Magpie	bird	T2-B3	Paddock		28/08/2023 8:25	
28/08/2023	8:25:00	2	Blackbird	bird	T2-B4	Paddock		28/08/2023 8:25	29/08/2023 17:30
28/08/2023	8:25:00	2	Barn owl	bird	T2-B5	Paddock		28/08/2023 8:25	29/08/2023 17:30
20/11/2023	8:20:00	1	Mouse	Bat surrogate	T1-B1B	Hardstand		20/11/2023 17:18	20/11/2023 17:18
20/11/2023	8:20:00	1	Mouse	Bat surrogate	T1-B2B	Pasture		20/11/2023 17:18	21/11/2023 16:38
20/11/2023	8:20:00	1	Galah	Bird	T1-B3B	Pasture		20/11/2023 17:18	27/11/2023 13:50
20/11/2023	8:20:00	1	Red Wattlebird	Bird	T1-B4B	Pasture		20/11/2023 17:18	
20/11/2023	8:20:00	1	Peaceful Dove	Bird	T1-B5B	Pasture		20/11/2023 17:18	
20/11/2023	8:20:00	2	Mouse	Bat surrogate	T2-B1B	Hardstand		20/11/2023 17:14	27/11/2023 13:50
20/11/2023	8:20:00	2	Mouse	Bat surrogate	T2-B2B	Pasture		20/11/2023 17:14	27/11/2023 13:50
20/11/2023	8:20:00	2	Barn Owl	Bird	T2-B3B	Pasture		20/11/2023 17:14	27/11/2023 13:50
20/11/2023	8:20:00	2	Magpie	Bird	T2-B4B	Pasture		20/11/2023 17:14	
20/11/2023	8:20:00	2	Galah	Bird	T2-B5B	Pasture		20/11/2023 17:14	21/11/2023 16:30

Attachment B- Searcher Detectability Trials - 2023

DATE	TURBINE	OBSERVER	OBSERVER_TYPE	GROUND_TYPE	SPECIES	DETECT_SPECIES_TYPE	DETECT_CARCASS_ID	DISTANCE_M	FOUND	COMMENTS
28/08/2023	1	Rob Gration	Human	Hardstand	mouse	Bat surrogate	T1-B1	9.5	1	
28/08/2023	1	Rob Gration	Human	Hardstand	mouse	Bat surrogate	T1-B2	46.5	0	
28/08/2023	1	Rob Gration	Human	Pasture	Red-rumped Parrot	Bird	T1-B3	47	1	
28/08/2023	1	Rob Gration	Human	Pasture	Barn Owl	Bird	T1-B4	41	1	
28/08/2023	1	Rob Gration	Human	Pasture	Barn Owl	Bird	T1-B5	58	1	
28/08/2023	2	Alex Petkov-Gration	Human	Hardstand	mouse	Bat surrogate	T2-B1	16.5	1	
28/08/2023	2	Alex Petkov-Gration	Human	Pasture	mouse	Bat surrogate	T2-B2	21	0	
28/08/2023	2	Alex Petkov-Gration	Human	Pasture	Barn Owl	Bird	T2-B3	31	1	
28/08/2023	2	Alex Petkov-Gration	Human	Pasture	Blackbird	Bird	T2-B4	62	1	
28/08/2023	2	Alex Petkov-Gration	Human	Pasture	Magpie	Bird	T2-B5	64	1	
20/11/2023	1	Rob Gration	Human	Hardstand	mouse	Bat surrogate	T1-B1B	6.5	1	
20/11/2023	1	Rob Gration	Human	Pasture	mouse	Bat surrogate	T1-B2B	16.4	1	
20/11/2023	1	Rob Gration	Human	Pasture	galah	Bird	T1-B3B	37.25	1	
20/11/2023	1	Rob Gration	Human	Pasture	Red Wattledbird	Bird	T1-B4B	27.5	1	
20/11/2023	1	Rob Gration	Human	Pasture	Peaceful Dove	Bird	T1-B5B	25.5	1	
20/11/2023	2	Alex Petkov-Gration	Human	Hardstand	mouse	Bat surrogate	T2-B1B	26.25	1	
20/11/2023	2	Alex Petkov-Gration	Human	Pasture	mouse	Bat surrogate	T2-B2B	47.5	1	
20/11/2023	2	Alex Petkov-Gration	Human	Pasture	bird	Barn Owl	T2-B3B	56	1	
20/11/2023	2	Alex Petkov-Gration	Human	Pasture	bird	Magpie	T2-B4B	25	1	
20/11/2023	2	Alex Petkov-Gration	Human	Pasture	bird	Galah	T2-B5B	42	1	

Attachment C – Carcass Search Finds 2023

SURVEY_ID	CARCASS_ID	FORMAL	TURBINE	SPECIES	SPECIES_TYPE	DISTANCE_M
3J	OZISP1	1	1	Southerrn Freetail Bat	Bat	40
1F	OZISP2	1	1	Southerrn Freetail Bat	Bat	32
1MA	LLeB1	1	2	Lesser Long-eared Bat	Bat	43
1MA	OZISP3	1	2	Southerrn Freetail Bat	Bat	52
2M	KEST1	1	2	Nankeen Kestrel	Feather Spot	46
1M	WsFB1	1	1	White-striped Freetail Bat	Bat	30
1JU	WsFB2	1	1	White-striped Freetail Bat	Bat	5
2N	GWB1	1	1	Gould's Wattled Bat	Bat	31

Attachment D – Collision Risk Report - Symbolix

Diapur Wind Farm Mortality Estimate - Year 2

Prepared for EcoAerial, 1 March 2024, Ver. 1.0

This report outlines an analysis of bird and bat mortality at Diapur Wind Farm from 22/11/2022 to 22/11/2023, the second year period of operation. The analysis is broken into the three related components below:

- Searcher efficiency / detectability – estimated from trials in October 2022, December 2022, August 2023 and November 2023
- Scavenger loss rates – estimated from trials in August 2023 and November 2023
- Mortality estimates - based on surveys at two turbines, from 19/12/2022 to 22/11/2023

1 Available data

Turbine data, mortality survey data, and adjunct survey data was provided by EcoAerial. Species archetype data was taken from Hull and Muir (2010).

1.1 Data cleaning

Carcass finds, searcher efficiency, scavenger efficiency data:

- Coding of species names was made consistent

Otherwise, data was used as provided by EcoAerial.

2 Statistical 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 method to achieve this.

Best practice estimators project the number of found carcasses (C) up to the number of actual mortalities (M). They should account for:

- The probability a carcass will be detected by the searcher (p)
- The probability a carcass is not lost to scavenge or decay prior to the search (r)
- The probability a carcass falls within the searched area (a)
- The fraction of turbines searched (f)

Most mortality estimators, e.g. (Huso 2011), can be conceptualised as a ratio estimator

$$\hat{M} = \frac{C}{\hat{p} \cdot \hat{r} \cdot \hat{a} \cdot f} \tag{1}$$

with the terms in the denominator providing a "boost factor" to the number of carcasses found, C.

However, a limitation of analytical methods is estimating r when the time between surveys is not constant. In Australia, it is common for the time between searches to vary due to seasonal changes in effort or the use of a pulsed design in which the turbine is searched monthly with a return visit a few days later. Additionally, ratio estimators cannot handle the cases when zero carcasses are found, as zero multiplied by any number still gives zero.

To address this, Symbolix have developed a Monte Carlo algorithm. We have used this method for mortality estimates at over forty wind farms in Australia to date.

Monte Carlo methods (Sawilowsky (2003), Ripley (1987)) simulate a large set of possible survey results, by simulating the actual survey protocol, and sampling from empirical distributions for scavenge loss and searcher efficiency. In this way, we directly sample the probability a carcass was lost before the survey, negating the need to calculate r analytically each time.

We then estimate how many carcasses were truly generated, given the range of searcher and scavenger efficiencies, 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 (number of carcasses found).

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).

Figure 1 provides an overview of the methodology. A detailed explanation can be found in Stark and Muir (2020).

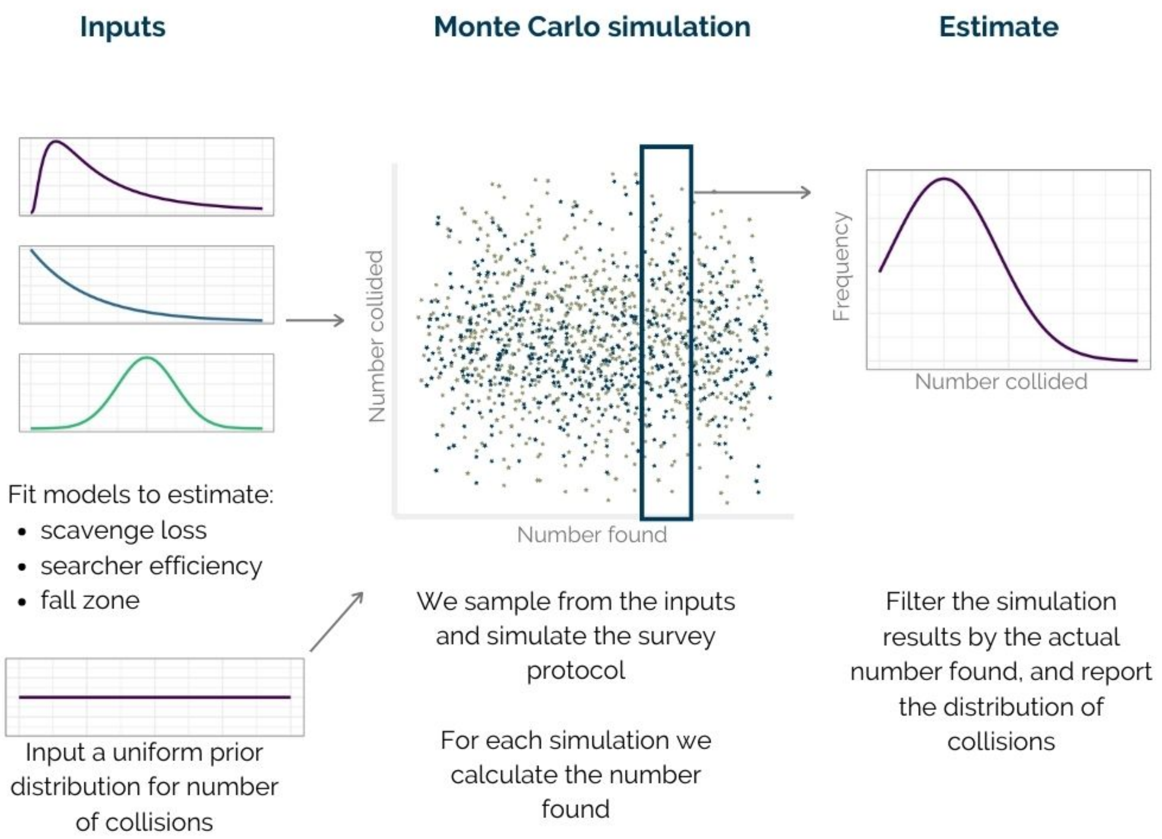

Figure 1: Overview of how the mortality estimation works.

The following sections outline how we estimate p, r and a. C is given by the field observation data, and f is defined by the survey design.

3 Analysis and modelling

The survey program consisted of carcass searches, and adjunct scavenger and detection trials. We summarise the methods, field data and analysis results for each below.

3.1 Carcass search data

Carcass searches were undertaken monthly at each turbine, in a 75m radius around each turbine tower. An ecologist walked concentric transects around each turbine tower at four metre intervals.

The carcass searches provide the C and f terms in Section 2.

3.1.1 Survey effort

The mortality estimate was based on a dated list of turbine surveys. The survey frequency is summarised in Table 1. Each turbine was surveyed twice each month out to 75m, with one standard and one pulse survey being conducted.

Table 1: Number of surveys per month, in the second year of surveys.

Date	Pulse	Standard
2022 Dec	2	2
2023 Jan	2	2
2023 Feb	2	2
2023 Mar	2	2
2023 May	2	2
2023 Jun	2	2
2023 Jul	2	2
2023 Aug	2	2
2023 Sep	2	2
2023 Nov	2	2

100% (of two total) turbines were searched at Diapur. In the Monte Carlo algorithm, we explicitly simulate the survey design. The proportion of turbines sampled (f) is therefore accounted for in the simulation.

3.1.2 Carcass finds

The breakdown of found carcasses per species are summarised in Table 2.

Table 2: Carcasses found during formal surveys, over the second year of surveys.

Species	Bat	Feather Spot
Nankeen Kestrel		1
Gould's Wattled Bat	1	
Lesser Long-eared Bat	1	
Southern Freetail Bat	3	
White-striped Freetail Bat	2	

3.2 Searcher efficiency

The aim of searcher efficiency trials is the quantify the effectiveness of observers, at finding carcasses. They provide the p term in Equation 2.

3.2.1 Field methods

The searcher efficiency data is primarily sourced from trials conducted in 2023 Aug, 2023 Nov, 2022 Oct, and 2022 Dec. Carcasses were laid out, and an ecologist searched for the carcasses using the same protocol as the main mortality survey. If the carcass was found, "success" was recorded, else "failure" was the ecologist missing the carcass.

The detectability trials used birds (24 replicates), bats (eight replicates), and bat surrogates (eight replicates) of various size classes.

Table 3: Count of species and species classes used during the detection trials.

Species	Type	Replicates
Gould's Wattled Bat	Bat	1
White-striped Freetail Bat	Bat	7
House Mouse (Bat Proxy)	Bat surrogate	8
Australian Magpie	Bird	10
Common Barn Owl	Bird	7
Common Blackbird	Bird	1
Galah	Bird	2
Long-billed Corella	Bird	1
Peaceful Dove	Bird	1
Red Wattlebird	Bird	1
Red-rumped Parrot	Bird	1

3.2.2 Statistical methods

We estimated searcher efficiency by fitting binomial generalised linear models (GLMs). The optimal model was determined, guided by the small-sample Akaike Information Criterion (Anderson and Burnham 2004), otherwise known as the AICc.

The theory of AIC is deep and complex, and beyond the scope of this report. However, to summarise, AIC is a method for choosing the best approximating model of the "truth". For each model we fit to the data, we calculate the AIC. We compare the differences in AIC between models, which in turn informs us of the weight of evidence for that particular model.

AIC is not the same as significance testing. We do not aim to state anything is significant at the 5% level, instead we aim to find a good model fit for the data. Additionally, we also consider two other principles guiding model selection. They are parsimony (a simpler model is preferable to a more complex model), and application (for example, it's all well and good to find that cloud cover affects detection rates, but it's not feasible to incorporate cloud cover into a mortality estimate).

AICc is a modification of AIC, which is appropriate for smaller sample sizes.

3.2.3 Results

The top model according to AICc selection was the one which split by species type (bat/bird). We aggregated bats and bat surrogates.

Table 4: Detection efficiencies for Birds and Bats.

Variable	Birds	Bats
Number found	24	11
Number placed	24	16
Mean detectability proportion	1	0.69
Detectability lower bound (95% CI)	0.86	0.41
Detectability upper bound (95% CI)	1	0.89

The probability of detection for Bats in 69%, with a 95% confidence interval of [41%, 89%]. The probability of detection for Birds in 100%, with a 95% confidence interval of [86%, 100%].

3.3 Scavenger efficiency

In order to accurately estimate mortality, we must account for carcass loss to scavengers. Scavenger trials are performed to quantify the time until a carcass is completely lost as a result of scavenger activity, which is the r term in Section 2.

3.3.1 Field methods

Scavenger efficiency trials were conducted in August 2023 and November 2023. The trials ran over approximately 21 days. In total, 12 bird carcasses and 8 bat proxy (mouse) carcasses were used. Carcasses were checked periodically by human observers to determine timing of scavenger events.

Table 5: Species types for scavenger trials.

Species	Type	Replicates
House Mouse	Bat Surrogate	8
Red-rumped Parrot	Bird	1
Common Barn Owl	Bird	4
Australian Magpie	Bird	2
Common Blackbird	Bird	1
Galah	Bird	2
Red Wattlebird	Bird	1
Peaceful Dove	Bird	1

3.3.2 Statistical methods

Survival analysis (Kaplan and Meier (1958), Kalbfleisch and Prentice (2011)) was used to determine the distribution of time until complete loss from scavenge (or decay). Survival analysis was required to account for the fact that we do not necessarily know the exact time of scavenge loss, only an interval in which the scavenge event happened. For example, any carcass which is unscavenged at the end of the trial, has its scavenge event in the interval [x, ∞] (where x is the length of the trial).

By performing survival analysis we can estimate the time until carcass loss after a given length of time, despite these unknowns.

We fit parameterised models to analyse significant factors influencing time to scavenge (carcass species type etc), and to find the most appropriate distribution to fit the time-to-loss curve (e.g. log-normal, exponential).

Time to carcass loss is influenced by the parameters discussed above and the distribution of the loss curve we fit to the data (Huso, Dalthorp, and Korner-Nievergelt 2015). The choice of loss function is important because it should capture the behaviours and relative time dependence of the various scavengers. Generally, the best distribution is the log-normal distribution (Stark and Muir 2020).

3.3.3 Results

AICc analysis of the survival regression models, showed the most parsimonious model was the model that combines bird and bat scavenger rates.

Figure 2 shows the survival curve fitted to the combined Bird and Bat cohorts. The survival curve (smooth solid line for fitted regression curve, jagged step function for empirical removal rate) shows the estimated proportion of the set remaining at any given time. The shaded portions are the 95% confidence intervals on the estimate.

Under these assumptions, the median time to carcass removal via scavenge for is 6 days, with a 95% confidence interval of [3, 14.1] days.

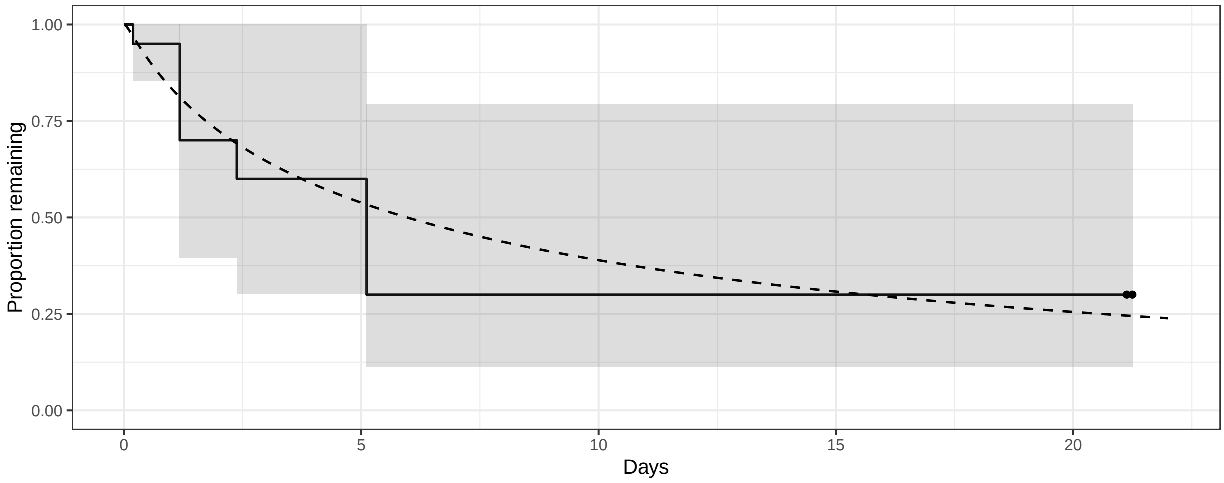

Figure 2: Empirical survival curves (the step function), with 95% confidence intervals shaded. The smooth curves present the fitted model.

Note: for the scavenger trial analysis (unlike the detection trial analysis), we did *not* aggregate the 2022 and 2023 trial data. We only used the 2023 trial data. Due to significantly hotter weather conditions, longer grass, and older carcasses (R. Gration, *pers. comms*) in the first year, we used the 2023 trials as being more representative of the 2023 conditions.

3.4 Coverage factor

The coverage factor estimates the probability that, given a carcass falls at a searched turbine, that the carcass falls within the searched area. This contributes to the a term in Section 2.

3.4.1 Fall zone simulation - methods

We generated a carcass fall-zone distribution for the each species class (i.e. birds and bats), given the turbine size at the wind farm. The fall-zone distribution is the end result of the simulation method detailed in Hull and Muir (2010). The simulation method is a ballistics model describing avifauna strikes by turbine blades.

3.4.2 Coverage factor calculation - methods

The percentage of the fall zone not covered by the survey area, provides a correction factor in the mortality estimate. Because carcasses that fall outside the searched area have a zero probability of being detected by a survey, the likelihood of landing in this region is essential to understanding the relationship between detections and actual losses.

3.4.3 Simulation inputs

Table 6 displays the dimensions and RPM of the turbines at Diapur Wind Farm while Table 7 shows the bird and bat physical parameters used. These are input into the fall zone simulation.

Turbine specifications were provided by EcoAerial. Bird and bat parameters were sourced from the archetypes in Hull and Muir (2010).

Table 6: Turbine specifications for Diapur Wind Farm.

Rotor Diameter (m)	Tower Height (m)	RPM
150	125	12

Table 7: Species size archetype parameters.

Species type	Archetype	Mass (kg)	Min. area (sq m)	Max. area (sq m)
Bat	Gould's Wattled Bat	0.014	0.0028	0.014
Medium Bird	Raven	0.68	0.0450	0.100

3.4.4 Results

Figure 3 displays the simulation results, given the factors specified above. We display the cumulative density function (CDF) on the y axis versus the distance from turbine on the x axis for each species type. The CDF describes the expected proportion of carcass which fall less than or equal to a certain distance from the turbine. For example, we see that we expect about 93% of bat carcasses to fall within 75m of the turbine.

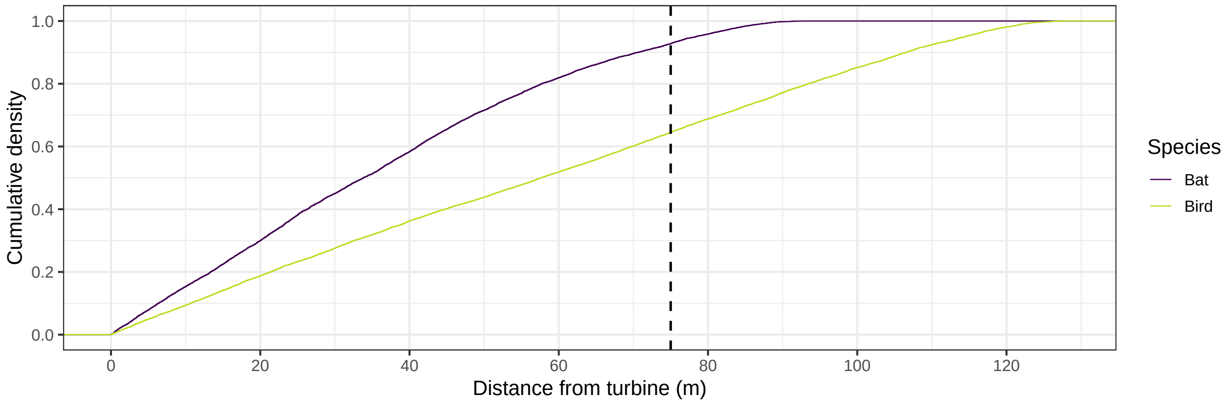

Figure 3: Cumulative distribution function of the fall zone simulation output, for birds and bats. Vertical line indicates survey radius

Once the fall zone distribution is calculated, we generate a "coverage factor" for each species type. The coverage factor represents the proportion of carcasses which fall within the searched area.

On average, we assume that 64% of bird strikes and 93% of bat strikes will land within the searched area.

4 Mortality estimate

With estimates for scavenge loss, searcher efficiency, and survey coverage, we converted the number of bat and bird carcasses detected, into an estimate of overall mortality at Diapur Wind Farm from 22/11/2022 to 22/11/2023.

The mortality estimation is done via a Monte Carlo algorithm. We used 25000 simulations for bats and 25000 simulations for birds, 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 model assumptions are listed below:

- There were 2 turbines on site available to strike bats and birds.
- Search frequency for each turbine was taken from a list of actual survey dates (see Table 1 for a summary).
- Mortalities were allowed to occur from 22/11/2022 (approximately one month from the first survey in year 2), until the final surveyed date (22/11/2023).
- Bats and birds are on-site at all times during this period.
- Bats and birds that are struck are immediately replaced (i.e. strikes one day do not affect the chance of strikes the next).
- 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.
- Finds are random and independent, and not clustered with other finds.
- There was equal chance of any turbine being involved in a collision / mortality.
- We took scavenge loss and searcher efficiency rates as outlined above.
- We assumed a log-normal scavenge shape.
- 2 turbines (100% of the farm) were surveyed, and were searched out to a 75 metre radius, in accordance with the supplied survey data.
- The coverage factor was 64% for Birds and 93% for Bats.

4.1 Bats

During the second year of surveys a total of seven bats were found during formal surveys. The resulting (median) estimate of total mortality is 25 bats lost on site over the second year period.

Table 8 and Figure 4 display the percentiles of the distributions, to show the confidence on the mortality estimate.

Based on the detected carcasses, measured detectability, scavenge rate, and survey effort, we expect that there was a total site loss of around 25 bats over the full survey period, and are 95% confident that fewer than 56 individuals were lost in the second year of surveys.

Table 8: Percentiles of estimated total bat losses in the second year of surveys.

0%	50% (median)	90%	95%	99%	99.9%
8	25	46	56	80	97

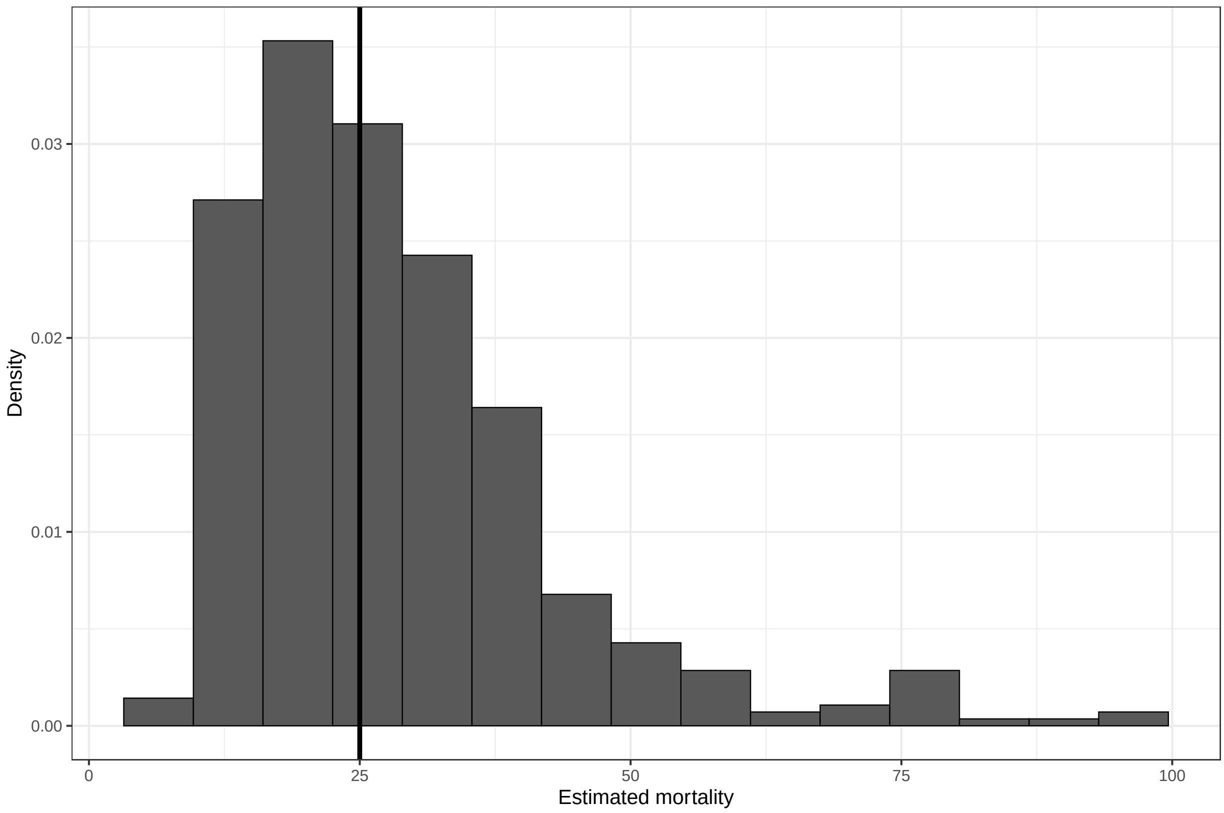

Figure 4: Histogram of the total losses distribution (bats). The black solid line shows the median.

4.2 Birds

During the second year period of surveys a total of one bird was found during formal surveys. The resulting (median) estimate of total mortality is five birds lost on site over the survey period.

Table 9 and Figure 5 display the percentiles of the distributions, to show the confidence on the mortality estimate.

Based on the detected carcasses, measured detectability, scavenge rate, and survey effort, we expect that there was a total site loss of around five birds over the full survey period, and are 95% confident that fewer than 18 individuals were lost in the second year of surveys.

Table 9: Percentiles of estimated total bird losses in the second year of surveys.

0%	50% (median)	90%	95%	99%	99.9%
1	5	14	18	30	35

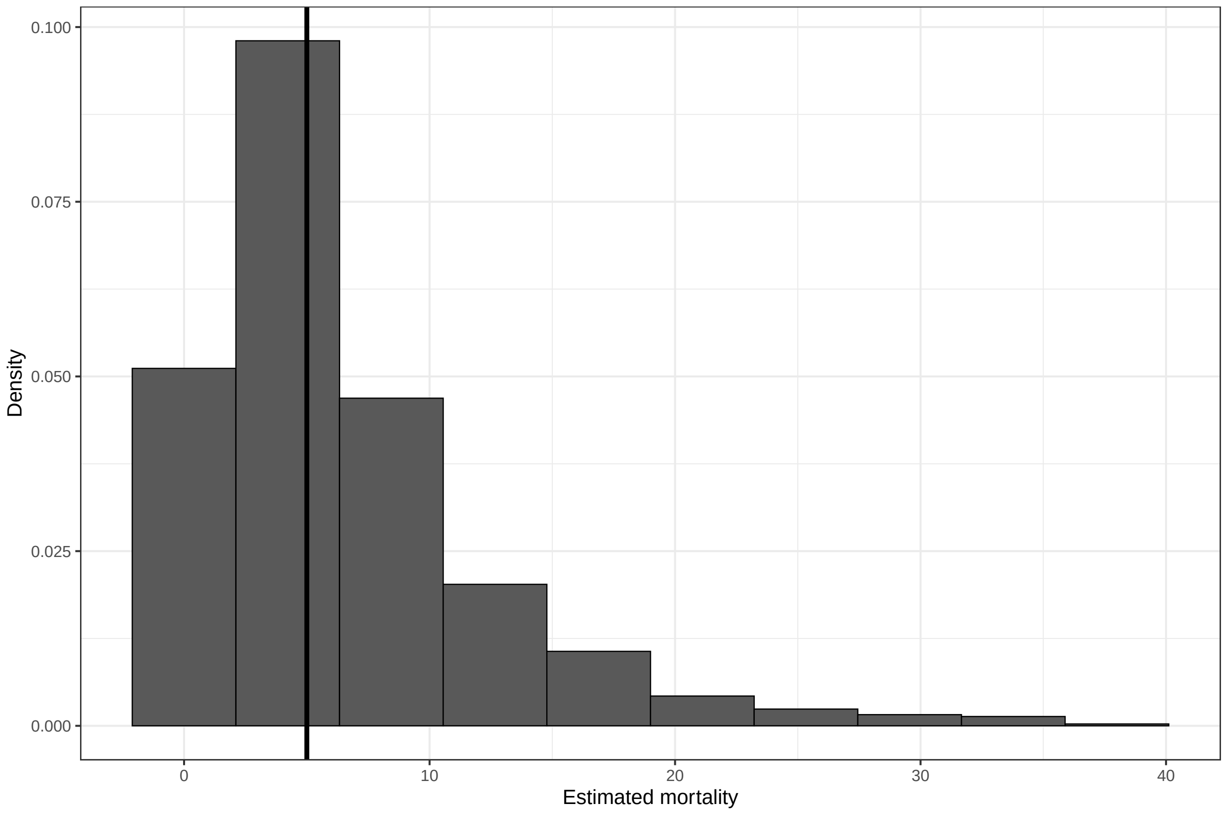

Figure 5: Histogram of the total losses distribution (birds). The black solid line shows the median.

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