



AN ASSESSMENT OF THE BAT FAUNA AT THE HEPBURN COMMUNITY WIND FARM, LEONARDS HILL, VICTORIA

Dr G.C. Richards

Prepared for Hepburn Wind Park Co-operative Ltd, March 2011

Greg Richards and Associates Pty Ltd

Australasian Bat Fauna Specialists

Postal:	P.O. Box 9, Gungahlin, ACT 2912
Office:	23 Tanderra Crescent, Ngunnawal, ACT
Phones:	02 6255 0606
Mobile:	0408 221 520
Email:	batmangr@bigpond.net.au
ABN	99 074 890 823

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EXECUTIVE SUMMARY

The consultant was commissioned by Hepburn Community Wind Park Co-operative (Ltd) ('Hepburn Wind') to conduct an assessment of the bat fauna at the Hepburn Community Wind Farm, Leonards Hill, 10km south of Daylesford, Victoria. The wind farm is comprised of two turbines located in an open paddock. The study was designed to be conducted in two phases: a pre-construction survey in Spring 2010, and a follow up survey in Summer 2011 when seasonal bat activity was expected to be highest. This report provides results and interpretations of the final survey, conducted in January 2011.

Bat calls were recorded using automated Anabat recorders, repeating the sampling conducted in the previous November. Calls were sampled at four locations that were selected to reflect differences in habitats: an open paddock, within a large tract of forest, at a forest edge at a stock dam, along the edge of roadside eucalypts. The assessment of flying fox activity in the project area was carried out by obtaining local knowledge from people who were skilled in wildlife identification and aware of these large animals in their local environment.

A total of 1512 identifiable bat calls were recorded during the November 2010 survey and 2271 were recorded during the January 2011 survey, from a total of at least ten species. The Southern Forest Bat, the Eastern Broadnosed Bat and the White-striped Freetail Bat were the most dominant species in the community in January 2011, whereas during November 2010 the Large Forest Bat was also one of the most dominant, and the White-striped Freetail Bat less so.

During January 2010, bat activity predominated at site H-3, the stock dam at a forest edge, whereas in the previous survey the predominant site was H-4, located within forest. Of importance to the wind farm assessment is that in open pasture, where the two turbines will be located, bat activity was very low during both surveys (less than 1% of the total calls), and overall only three or four of the ten species were present.

Strong winds appeared to suppress bat activity and the species count at the turbine site. Wind speed data was recorded from a meteorological tower located on Leonards Hill. Data was extracted for the period dusk to dawn, and average wind speeds for 10-15 minute time periods were then allocated to classes of 1 m/sec. November and December 2010 had similar wind regimes, both peaking at 3.0-3.9 m/sec, whereas in January 2011 when bat activity was halved, the peak in the wind speed distribution was 5.0-5.9 m/sec. Therefore, when bat activity is high in summer there is still a suppression of activity in open areas. Bureau of Meteorology data for Ballarat showed that the region has, on average over the period 1957 - 2010, strong winds for most of the year.

In the last 30 years there have been only a few records of Grey-headed Flying Foxes around Daylesford but in recent times there have been a number of changes in its utilisation at a landscape scale. Recent regional records were obtained from a local wildlife biologist who reported that the nearest colony to the Hepburn Community Wind Farm is approximately 80 km away at Bendigo, which was established in 2010. It can be expected that flying fox utilisation of the project area would be highly infrequent, especially in large numbers, though such is not impossible given the current extension of range of this species in Victoria. It was recommended that flowering patterns and potential resultant visitation by flying foxes be monitored.

INTRODUCTION

The consultant was commissioned by Hepburn Community Wind Park Co-operative Ltd ('Hepburn Wind') to conduct an assessment of the bat fauna likely to be present and also recorded at the Hepburn Community Wind Farm, Leonards Hill, 10km south of Daylesford, Victoria (Figure 1). The wind farm is comprised of two turbines, located in an open paddock. The study was designed to be conducted in two phases: a pre-construction survey in Spring 2010, and a follow up survey in Summer 2011 when seasonal bat activity was expected to be highest. This report provides results and interpretations of the two surveys.

A search of the consultant's database was conducted to generate a list of species that could potentially occur in or near the study area, irrespective of habitat type, and as a guide to designing the survey methodology. Using a search block of 36°00' to 38°00'E by 144°00' to 145°00'S, it was shown that a total of 16 species have been recorded in this area (Table 1).

Table 1: List of species likely to be present in the project area, based on records extracted from the consultants database. Filled circle indicates species listed in the <i>Environment Protection and Biodiversity Conservation</i> (EPBC) or <i>Flora and Fauna Guarantee</i> (FFG) Acts				
Family	Species	EPBC	FFG	Records
Flying-foxes	Pteropodidae			
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	●	●	14
Little Red Flying Fox	<i>Pteropus scapulatus</i>			4
Sheath-tail Bats	Emballonuridae			
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>		●	4
Evening Bats	Vespertilionidae			
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>			102
Chocolate wattled Bat	<i>Chalinolobus morio</i>			76
Eastern Falsistrelle	<i>Falsistrellus tasmaniensis</i>			23
Large-footed Myotis	<i>Myotis macropus</i>			1
Lesser Longeared Bat	<i>Nyctophilus geoffroyi</i>			136
Gould's Longeared Bat	<i>Nyctophilus gouldi</i>			31
Inland Broadnosed Bat	<i>Scotorepens balstoni</i>			14
Large Forest Bat	<i>Vespadelus darlingtoni</i>			10
Southern Forest Bat	<i>Vespadelus regulus</i>			3
Little Forest Bat	<i>Vespadelus vulturnus</i>			8
Miniopteridae	Bentwing Bats			
Eastern Bentwing Bat	<i>Miniopterus schreibersii</i>		●	9
Freetail Bats	Molossidae			
White-striped Freetail Bat	<i>Austronomus australis</i>			103
Southern Freetail Bat	<i>Mormopterus (planiceps forms)</i>			13
Total records				551

Figure 1: Location of the Hepburn Community Wind Farm in a regional perspective.



METHODS

Insectivorous bats

Bat calls were recorded using automated Anabat recorders that operated all night for five nights. Most bat species are easily identifiable from computer displays of zero-crossing analyses, apart from the two Longeared bats which are inseparable, and the Eastern Bentwing Bat, the calls of which are often difficult to separate from those of forest bats. Bat calls were recorded in the spring of 2010 (November) and also during the following summer (January 2011).

Insectivorous bats were sampled at four locations that were selected to reflect differences in habitats. The two turbines will be positioned in an open paddock, habitat that is usually considered to be poor for bats, but was monitored during the study. Because the site was bounded by eucalypt forest, which is primary habitat for bats, one site was located within forest, another at a forest edge at a stock dam, and another pointing along the edge of roadside eucalypts. Site locations are shown in Figure 2.

Flying foxes

The assessment of flying fox activity in the project area was carried out by obtaining local knowledge from people who were skilled in wildlife identification and aware of these large animals in their local environment.

STUDY AREA and SAMPLING SITES

The location of sampling sites, with a brief description of the habitat, is outlined in Table 2 and shown in Figure 2.

Table 2: Location of the four sampling sites used to monitor the local bat fauna within the turbine area and its environs.			
Site	Latitude	Longitude	Habitat
H-1	37°25.625	144°07.289	Open site where turbines will be located
H-2	37°25.478	144°06.932	At a house fence, pointing along edge of roadside eucalypts
H-3	37°25.275	144°07.760	Farm dam at edge of a large tract of forest
H-4	37°25.801	144°07.968	Along a track inside a large tract of intact forest

Figure 2: Location of bat sampling sites at the Hepburn Community Wind Farm.



RESULTS AND DISCUSSION

Weather Conditions during Survey

Weather conditions were quite variable during the survey, and summary data for the period leading up to, and during the survey, is shown in Table 3. Overnight minima ranged from 3.0 to 14.4°C across the two survey sessions. There was light rainfall just before the spring survey, with some (0.6 mm) on the first day. Notably, the region is very windy for much of the year and such was the case during the survey (Table 3). Wind is a weather parameter that appears to affect bat activity. During a study at Canberra the activity of a community of ten species ceased activity at around 20-25 km/hr (Richards, unpublished). This wind speed is similar to the maximum flight speed of most species, and indicates that for bats it is energetically disadvantageous to forage when manoeuvrability is difficult, and prey will doubtfully be active.

Table 3: Summary of basic weather data two surveys, measured at Ballarat by the Bureau of Meteorology. The survey periods are highlighted in green.

Date	Minimum temp (°C)	Maximum temp (°C)	Rainfall (mm)	Wind speed at 3pm (km/hr)
1-Nov	2.2	11.8	1.2	15
2-Nov	6.5	15.1	0.6	20
3-Nov	5.9	12.5	2.2	20
4-Nov	3.0	13.3	0.6	31
5-Nov	5.4	17.1	0	20
6-Nov	7.7	19.7	0	22
7-Nov	10.9	21.7	0	39
8-Nov	5.4	19.5	0	11
9-Nov	5.9	24.6	0	31
15-Jan	12.9	27.5	0	11
16-Jan	14.4	26.8	0	17
17-Jan	10.5	18.6	0	28
18-Jan	10.4	17.4	0.2	19
19-Jan	9.4	20.6	0	19
20-Jan	9.9	26.9	0	13

Insectivorous Bat Species Recorded

A total of 1512 identifiable bat calls were recorded during the November 2010 survey and 2271 were recorded during the January 2011 survey, from at least ten species (Table 4).

Calls from the two Longeared bats (*Nyctophilus* sp.) are difficult to separate to species level, and are likely to represent two taxa that are common in south-eastern Australia, the Lesser Longeared Bat (*N. geoffroyi*) and Gould's Longeared Bat (*N. gouldi*). A similar problem exists with call similarities between the Eastern Bentwing Bat (*Miniopterus schreibersii*¹) and the forest bats (*Vespadelus* spp.) but they can usually be distinguished by subtle frequency changes at the terminal phase of the call.

Species that have been previously recorded from the region but were not recorded during the survey included the Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*) and the Large-footed Myotis (*Myotis macropus*). The former species is quite rare and the latter forages for prey on the surface of smooth-flowing water bodies, which were not present in the project area.

Insectivorous Bat Activity and Relative Abundance

Calls recorded by bat detectors do not offer an indication of numbers of individual animals but instead provide an insight into the activity levels of members of the community, and their relative abundance. Results for November 2010 are shown in Table 4, and for January 2010 in Table 5.

Table 4: Total bat activity recorded during the spring survey in November 2010.						
Common name	Species	Turbine area	Roadside eucalypts	Stock dam at forest edge	Within forest	Totals
		H-1	H-2	H-3	H-4	
White-striped Freetail Bat	<i>Austronomus australis</i>	2	19	2	-	23
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	-	5	10	9	24
Chocolate Wattled Bat	<i>Chalinolobus morio</i>	-	-	5	10	15
Eastern Falsistrelle	<i>Falsistrellus tasmaniensis</i>				3	3
Eastern Bentwing Bat?	<i>Miniopterus schreibersii</i> ?	-	-	-	2	2
Southern Freetail Bat	<i>Mormopterus</i> sp.4	2	19	3	5	29
Eastern Freetail Bat	<i>Mormopterus</i> sp.2	-	3	5	3	11
Longeared Bats	<i>Nyctophilus</i> sp.	-	2	7	3	12
Inland Broadnosed Bat	<i>Scotorepens balstoni</i>	-	-	-	87	87
Large Forest Bat	<i>Vespadelus darlingtoni</i>	-	58	266	35	359
Southern Forest Bat	<i>Vespadelus regulus</i>	8	77	313	539	937
Little Forest Bat	<i>Vespadelus vulturnus</i>	-	5	3	2	10
	Totals	12	188	614	698	1512

¹ Referred occasionally as *Miniopterus orianae oceanensis*

Table 5: Total bat activity recorded during the summer survey in January 2011.					
Common name	Turbine area	Roadside eucalypts	Stock dam at forest edge	Within forest	Totals
White-striped Freetail Bat	6	9	288	13	316
Gould's Wattled Bat	-	5	114	25	144
Chocolate Wattled Bat	-	-	16	19	35
Eastern Falsistrelle	-	-	-	2	2
Eastern Bentwing Bat?	-	-	2	5	7
Southern Freetail Bat	4	36	12	17	69
Eastern Freetail Bat	-	4	26	11	41
Longeared Bats	1	18	17	12	48
Eastern Broadnosed Bat	-	-	308	97	405
Large Forest Bat	-	92	25	27	144
Southern Forest Bat	3	105	313	598	1019
Little Forest Bat	-	4	18	19	41
Totals	14	273	1139	845	2271

The Southern Forest Bat, the Eastern Broadnosed Bat and the White-striped Freetail Bat were the most dominant species in the community in January 2011, whereas during November 2010 the Large Forest Bat was also one of the most dominant, and the White-striped Freetail Bat less so.

Habitat Utilisation by Insectivorous Bats

During the spring survey, bat activity predominated at site H-4 which was located within forest (Figure 3) and at site H-3 at a stock dam on the edge of the same forest. During January 2010, bat activity predominated at site H-3, the stock dam at a forest edge, whereas in the previous survey the predominant site was H-4, located within forest. Over 80% of the total activity was focused in these habitats. The Large and Southern Forest Bats were the most dominant species in these habitats (Tables 4 and 5). The site at a tract of roadside eucalypts (H-2), bat activity and the species composition was far less than at sites H-3 and H-4, and here the White-striped Freetail Bat was more dominant than elsewhere. Of importance to the wind park assessment is that in open pasture, where the two turbines will be located, bat activity was very low (less than 1% of the total calls), and only three species were present.

This pattern is similar to other wind farm sites in Victoria and New South Wales when open pasture is compared with woodland or forest (G. Richards, commercial-in-confidence and unpublished). Apart from forest and stock dams at forest edges providing far more insect resources another issue raised in this study is the probable effect of wind speed and wind gusts on the ability of bats to forage in open, unprotected areas. Reference to Table 3 shows that these parameters were above 25 km/hr (when bat activity ceases) quite often during both surveys, yet bat activity in the sites protected from the wind by forest was still substantial.

Figure 3: Forested habitat at site H-4 in the environs of the proposed Hepburn Wind Park, which is where bat activity was most dominant during the survey. Photograph by Ms Tracy Anthony.



Differences in Activity Patterns

As expected, bat activity was generally higher in summer than in spring (Table 6), assumedly because night temperatures were much warmer during the later survey. Daily temperature ranges at nearby Ballarat during the two surveys were 6.5 – 18.3°C and 10.9 – 22.1°C respectively.

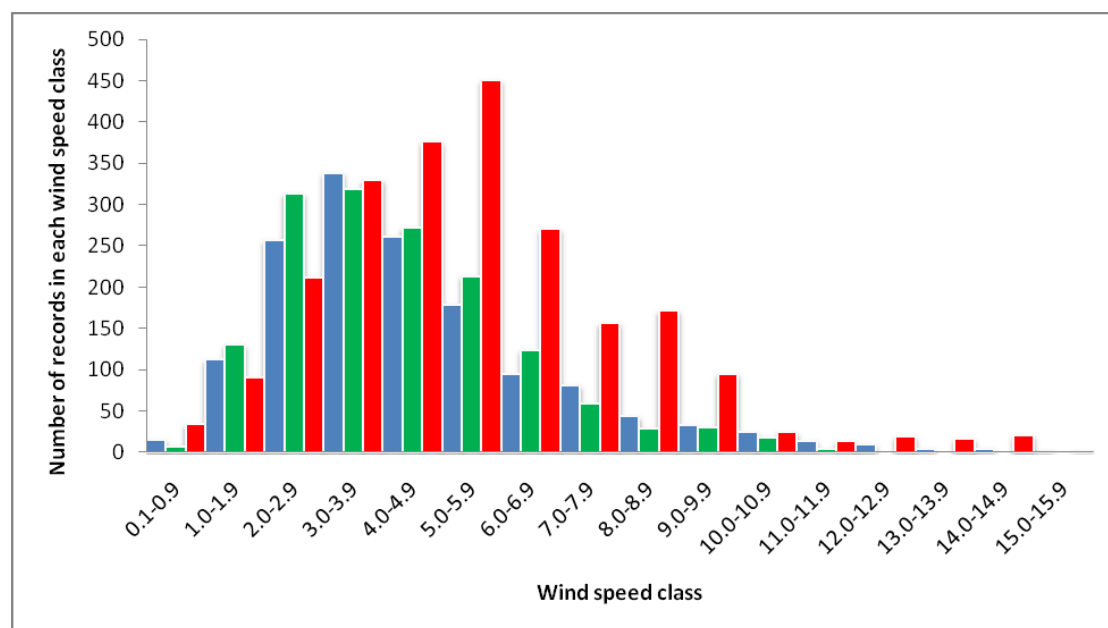
Table 6: Comparison between the total calls recorded from each species during the November 2010 and January 2011 surveys.		
Common name	Nov-10	Jan-11
White-striped Freetail Bat	23	316
Gould's Wattled Bat	24	144
Chocolate Wattled Bat	15	35
Eastern Falsistrelle	3	2
Eastern Bentwing Bat?	2	7
Southern Freetail Bat	29	69
Eastern Freetail Bat	11	41
Longeared Bats	12	48
Eastern Broadnosed Bat	87	405
Large Forest Bat	359	144
Southern Forest Bat	937	1019
Little Forest Bat	10	41
Total calls	1512	2271

Considering that a significant results from the November 2010 survey was that strong winds appeared to suppress bat activity and species count at the turbine site (Leonards Hill), wind speed data was analysed to elucidate whether this effect still prevailed, and was responsible for the suppression in activity in the turbine area during the summer survey.

Wind speed data was recorded from a meteorological tower located on Leonards Hill, and was provided by the proponent for the survey period. During November 2010 and December 2010, data was averaged every 15 minutes, and in January 2010 it was recorded every 10 minutes, giving a dataset of 11,081 records. To gain an insight into the wind regime that prevailed during the spring-summer period, data was extracted for the period dusk to dawn, for convenience being defined as 6:00 am to 6:00 pm on the following day.

Average wind speeds were then allocated to classes of 1 m/sec, and the results are shown in Figure 3. What is notable is that November and December 2010 had similar wind regimes, both peaking at 3.0-3.9 m/sec, whereas in January 2011 when bat activity was halved, the peak in the wind speed distribution was 5.0-5.9 m/sec. Therefore, when bat activity is high in summer there is still a suppression of activity in open areas.

Figure 4: Number of records in each wind speed class recorded every 10-15 minutes at the turbine site.



The January peak of 5.0-5.9 m/s indicates that the strong winds are creating difficulty in flight manouverability by bats, as well as affecting the flight and manouverability of their prey which is much lighter in weight. Table 7 shows the number of records in each month that equaled or exceeded 5.0 m/s. In November and December 2010, one third of the night wind was at this speed or greater, whereas in January more than half the night exceeded this speed (Table 7). Table 8 indicates that the region has, on average, strong winds for most of the year, and that the winds measured for the survey period are representative of the entire year.

Table 7: The high wind regime during and between the survey periods.

	Nov-10	Dec-10	Jan-11
Number of records <= 5.0 m/s	487	477	1235
Total night records for the month	1470	1518	2277
Percentage of records <= 5.0 m/s	33	31	54

Table 8: Wind speeds taken from the climate averages for Ballarat Aerodrome 1957-2010, measured in km/hr by the Bureau of Meteorology. The average wind speed through the night would lie between the 3:00 pm and 9:00 am values, though wind usually drops somewhat at night. Months when bats are usually active are highlighted in green. 18 km/hr equates to 5.0 m/sec.

Month	Wind speed (km/hr)	
	3:00 PM	9:00 AM
January	21.4	20.5
February	20.9	19.3
March	20.0	17.7
April	19.6	16.2
May	18.6	13.7
June	19.8	14.7
July	20.7	14.5
August	22.0	16.7
September	22.2	19.3
October	21.3	20.7
November	20.6	19.6
December	20.8	19.7

Flying Fox Utilisation Assessment

The assessment of the Grey-headed Flying Fox was carried out by interviewing Ms Tanya Loos, a qualified biologist and dedicated naturalist, who was able to provide an insight into activity patterns of this species. In the last 30 years there have been only a few records of this species around Daylesford (Richards, unpublished) but in recent times there have been a number of changes in its utilisation at a landscape scale. Grey-headed Flying Foxes are now permanently located at Yarra Bend in the Melbourne area, and appear to be extending their range from that site by occupying new camp locations elsewhere. National surveys conducted in 2004 and 2005 did not locate camps at Daylesford, Ballarat or Bendigo².

² http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=186

This can be attributed to a number of factors: an extensive 10 year drought which would have reduced the extent of flowering and nectar production in native forests, major bushfires in February 2009, and lately extensive rain leading to major flooding and extensive nectar washout.

Ms Loos reported (15 February 2010) that the nearest colony to the Hepburn Community Wind Farm is approximately 80 km away at Bendigo, which was established in 2010 and, because it stayed over the winter, it may now be permanent. Ms Loos also reported that in the last few years there have been only three other records: two animals flying around at Wendourie (Ballarat) and a female electrocuted on powerlines at Castlemaine.

It can be expected that flying fox utilisation of the project area would be highly infrequent, especially in large numbers, though such is not impossible given the current extension of range of this species in Victoria.

It is recommended that the operators of Hepburn wind farm make regular observations of flowering patterns of forest blocks in the vicinity of the turbine area. If extensive/mass flowering is noted, inspections should be made daily beneath turbines for flying fox carcasses, and further advice be sought from relevant experts and/or state fauna agencies.

CONCLUSIONS

In the environs of the project area, bat activity appears to be focused upon forested areas, with very little activity in open pasture where insect prey is likely to be less, and exposure to strong winds reduces the ability of bats to forage efficiently.

It is possible that the Eastern Bentwing Bat, listed as threatened in the Victorian *Flora and Fauna Guarantee Act*, is present in the environs of the wind farm. Calls attributable to this species were very low in number and were only recorded in forest, and not the turbine area.

Considering that patterns of habitat utilisation, it can be concluded from both the preliminary and final surveys that there would be very little interaction by bats with turbines.

Circumstantial evidence indicates that flying foxes rarely visit the project area, but recent changes in distribution patterns suggest that their presence during periods of forest flowering should be monitored



Greg Richards and Associates Pty Ltd
Australasian Bat Fauna Specialists

Postal:	P.O. Box 9, Gungahlin, ACT 2912
Office:	23 Tanderra Crescent, Ngunnawal, ACT
Phones:	02 6255 0606 or 0408 221 520
Email:	batmangr@bigpond.net.au
ABN	99 074 890 823

CAPABILITY STATEMENT:

BAT FAUNAS AND WIND FARMS -

ASSESSMENTS, MONITORING AND PLANNING



GREG RICHARDS AND ASSOCIATES PTY LTD is a specialist consultancy that focuses upon bat fauna assessments for various developments, such as wind farms, mining and gas projects, and major urban developments.

DR GREG RICHARDS, the Principal, has over forty years of experience with bats, starting with his 27 year career in CSIRO's Wildlife and Ecology Division, and then as a specialist consultant in private practice.

EXPERIENCE has taken him to study bats in all of Australia's ecosystems, however remote, and to various countries in Southeast Asia and the Pacific. International projects have included the major oil and gas pipeline in Papua New Guinea, and mining projects in Laos and Kalimantan.



Assembling a bat trap in Papua New Guinea

CREDENTIALS include:

- Membership of relevant societies including Environment Institute of Australia and New Zealand, Ecological Society of Australia, Royal Zoological Society of NSW and Australasian Bat Society (various committee positions)
- Scientific Advisor for Bat Conservation International (Texas)
- Member of the ACT Natural Resources Management Advisory Committee, and the ACT Flora and Fauna Committee, both of which directly advise the ACT Environment Minister

PUBLICATIONS include numerous scientific papers, many in international journals, and various books and book chapters. Highlights include:

- *Bats of Eastern Australia* (Australia's first field guide, with L.S. Hall, 1979)
- *Flying Foxes: Fruit and Blossom Bats of Australia* (with L.S. Hall, 2000)
- Editor for bat chapters in the 1983, 1995 and 2008 national mammal books.
- *The Natural History of Australian Bats* (with L.S. Hall, current)
- *Flying Fox and Drifting Sand: 80 years later* (current).

WIND FARMS have been a major focus area for this company, where issues with local bat faunas are invariably quite complex, especially when threatened species are involved. Projects are taken through the full suite of essential processes such as initial field surveys, liaison with consent agencies, expert witness duties in legal challenges (NSW) and Panel Hearings (Victoria) to the preparation of construction and operation management plans and resultant monitoring.

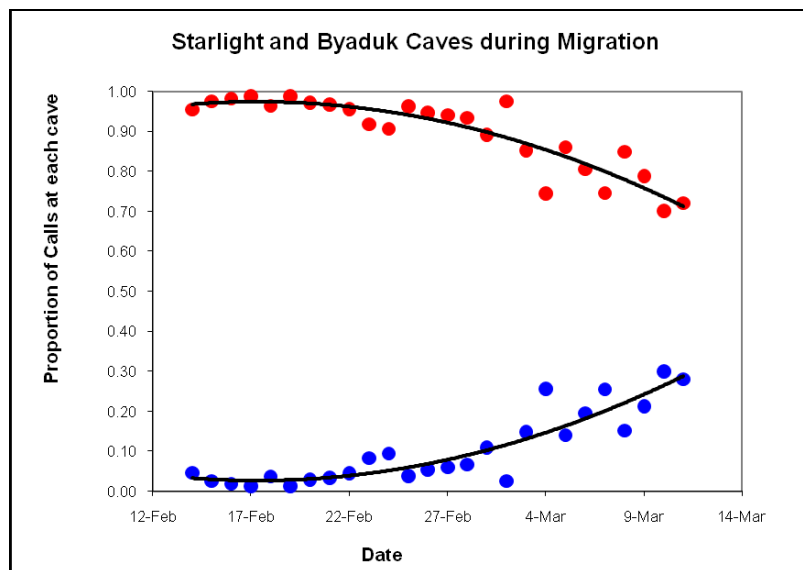
WIND FARM PROJECTS and various aspects of the company's involvement in them, have included :

	Location	Field survey	Legal aspects	Planning	Supplementary research	Monitoring
NSW	Bannister	•				
	Blayney	•				
	Bodangora	•				
	Capital	•		•	•	•
	Crookwell	•				
	Flyers Creek	•				
	Glen Innes	•				
	Gunning	•				
	Monaro	•				
	Mount Spring	•				
	Taralga	•	•	•		
	Woodlawn	•		•		
	Yass			•	current	
VIC	Bald Hills	•				
	Hawkesdale	•	•	•	•	
	Hepburn	•				
	MacArthur	•	•	•	•	
	Ryan Corner	•	•		•	
	Toora	•				•
	Wonthaggi	•				
	Mortlake			•	•	
SA	Woakwine	•			•	

RESEARCH CAPABILITY is innovative and of a high scientific standard, essential to address unique situations that may arise. A few examples of supplementary research projects for wind farms include:

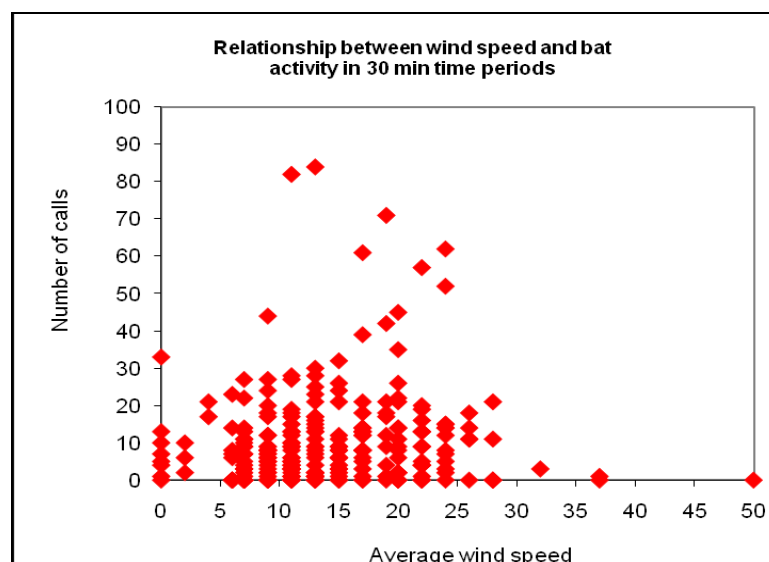
- *Potential for the threatened Eastern Bentwing Bat to occupy the Kallbilli portion of the Capital Wind Farm during annual migrations* – involved long-term habitat monitoring
- *Southern Bentwing Bat (Critically Endangered) migration patterns at a landscape scale in south western Victoria* – involved strategic monitoring at

breeding and wintering caves and at high quality habitat along potential routes, and examined the dispersal pattern from the breeding cave (see Figure below).



Pattern of dispersal by Southern Bentwing Bats from a breeding cave(Starlight) to a wintering cave (Byaduk)

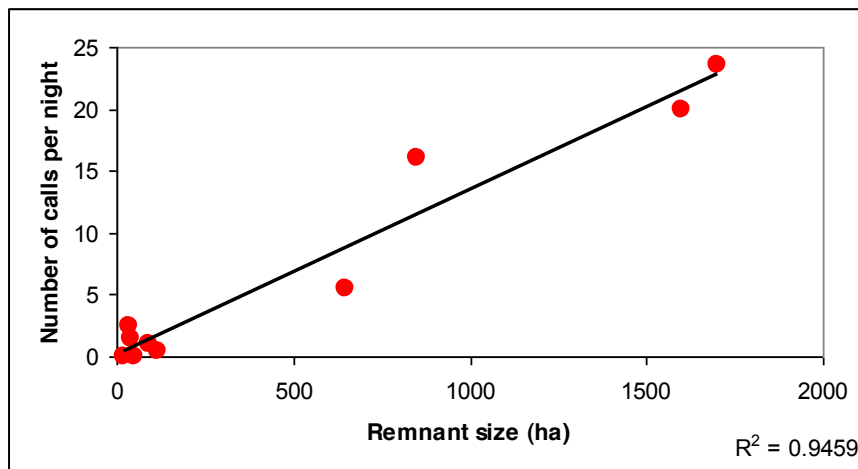
- *Effect of wind speed on bat activity* – research conducted in Canberra to prove hypothesis that bats would be unable to fly and forage in strong winds, and showed that most activity ceased at wind speeds in the 20-25 kph range, a factor that can be included in potential collision modeling (see Figure below).



Bat activity at Canberra (over 280 points on graph, many of which overlap)

- *Habitat utilisation by the threatened Yellow-bellied Sheathtail Bat* – showed that size of woodland remnants determined relative abundance, with this species needing more than 500 ha to support what could be considered to be

a viable population (see Figure below); hence turbines near small remnants would not be expected to cause significant impacts.



Utilisation of woodland remnants by the Yellow-bellied Shearwater Bat

- Research is currently proposed to study *Eastern Bentwing Bat migration patterns at a landscape scale* from a breeding cave in southeastern NSW in relation to the proposed Yass Wind Farm. Results will contribute to an adaptive management plan to reduce the potential for collisions with turbine blades.



Eastern Bentwing Bats emerging from a breeding cave near Wee Jasper, NSW [photograph by Steve Parish]

- *Utilisation of airspace at an operational wind farm at Toora, Victoria* (in conjunction with Brett Lane and Associates Pty Ltd) – studied the level of activity of bats at and away from turbines using paired sites, during a period when carcass monitoring was being conducted. No difference in activity of nine species at paired sites was noted, nor were there any apparent fatalities.



The White-striped Freetail Bat, a high-flying species often found at wind farms, and an excellent example of the old adage ... *beauty is in the eye of the beholder!*

[Photograph by Steve Parish]

INNOVATIVE TECHNIQUES available from the Company include the use of state of the art bat call detection systems, including a new system where data can be downloaded remotely from the office, without daily attendance in the field. This system has direct application for monitoring at turbines during the operational phase of wind farms, allowing impact mitigation within 24 hours of an alert such as high numbers of threatened species. In high risk areas where consent agencies require turbine shutdown, the period where energy production is lost can be refined with great accuracy.

Other methods available include infra-red video monitoring at cave entrances etc, and use of thermal imaging cameras for monitoring at turbines.

INSURANCES such as Professional Indemnity and Public Liability are maintained at \$5 million and \$20 million respectively.



Hepburn Wind Farm

Bird and Bat Mortality Survey Interim Report

11th July 2011 – 9th January 2012

Prepared by: Emma Bennett

Elmoby Ecology

Report No. HW01



Written Summary

Bird and bat carcasses have been monitored weekly at the Hepburn Wind Farm since July 2011 following operational commencement of the turbines. Both turbines have been surveyed 26 times each to a radius of 100m, giving a total of 52 turbine searches for the 6 month period. Turbines were not surveyed on the 19th September due to difficulty in accessing the site. On average turbine 1 has had 97% of the area surrounding the turbine searched; whilst due to excessive grass length over summer, turbine 2 has had on average 86% of the site searched.

In total 2 finds have been recorded over the 6 month period. On the 11th of July, the first search for the study, a feather spot, consisting of more than 20 feathers, was found 69m east of turbine 1. This was identified as *most likely* belonging to a brown falcon and without a carcass can only be assumed to be a result of a turbine collision. On the 26th of December, a white striped freetail bat was found 28m south-west of turbine 1. This is likely to have been a turbine collision as white striped freetail bats are particularly susceptible to collision mortality at wind farms.

From the 9th of January 2012, intensity of surveys has increased to thrice weekly with the additional 2 surveys per week completed to 50m in order to focus on bat carcass detection. In addition, a scavenger trial and observer efficiency trial will be conducted in late summer to autumn to enable full analysis of the results pending the 12 month completion of the study.

In line with other small wind farms with less than 3 turbines around the globe, the Hepburn Wind Farm is experiencing very low rates of bird and bat collisions. Pending the results of the next 6 months of surveys it seems likely that the reported collision rate of the Hepburn Wind Farm will be very low.

A full report, including analysis of the data and presentation of the sites impact based on strikes per turbine per year will be presented after the completion of surveys scheduled to finish in August 2012.

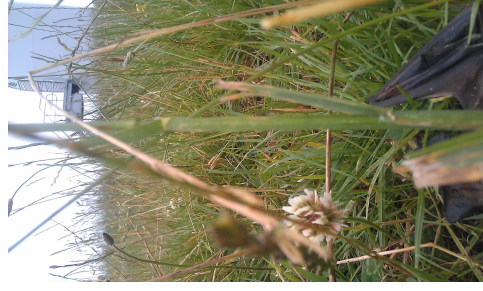
TABLE SUMMARY OF FINDS 11th July 2011 – 9th January 2012

Find ID	Date	Turbine	Bat Carcass	Bird Carcass	Feather Spot	Species	Conservation Status	Proximity to Turbine	Condition	Impact with turbine
1	11/7/11	1	0	0	1	Brown Falcon	secure	69m East	Feathers only. Carcass consumed by scavengers (foxes).	possible
1	26/12/11	1	1	0	0	White Striped Freetail	secure	28m SW	Complete, fresh adult male	likely

Find ID 1: Brown Falcon



Find ID 2: White Striped Freetail



Hepburn Community Wind Farm
Bird and Bat Monitoring
2011 – 2012 Annual Report

Prepared for:
Hepburn Community Wind Park Cooperative Limited

Elmoby Ecology

Quantifying the effects of Wind Turbines on Birds and Bats
PO Box 454, Creswick
Vic, 3363.
Ph. 0423 206 352

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Report No. HW02

INTRODUCTION

Bird and bat monitoring post construction is becoming routine practise both in Australia and overseas. There are no consistent standards in Australia for undertaking monitoring and most plans are developed with consultants and local regulators as part of the bat and avifauna management (BAM) plan for the wind farm. At the Hepburn Community Wind Farm the purpose of mortality monitoring is to:

Determine the impacts of the wind farm on bird and bat species that presently utilise the site and to help develop appropriate mitigation measures, if required. (BAM plan, Hepurn Community Wind Farm).

The monitoring program at Leonards Hill has been designed to identify all bird and bat species which may have been impacted and to assess if the level of impact falls within the expected range for a wind facility of this size.

METHOD

Bird and bat carcasses were monitored weekly at the Hepburn Community Wind Farm from July 2011 to July 2012 to a radius of 100m at both turbines. Between January 9th 2012 and April 20th an additional 2 surveys per turbine per week were undertaken to a radius of 50m. Trained scent dogs were used to search the area systematically and all remains were collected and the following parameters recorded; GPS location, distance and direction from turbine, species and condition.

Correction Factors

Searcher Efficiency

Correction factors for the estimates were derived from independent observability trials conducted over a number of days in March 2012 where Poppy and handler obtained a detection rate of 100% for 20 bats and 20 bird carcasses.

Scavenger Trials

The correction factor for scavenging rates was based on a scavenger trial conducted in March 2012. Previous studies in the region have indicated that there is no significant seasonal variation in the removal of carcasses (Elmoby Ecology, ST06) and thus seasonal variation was not measured. The mean persistence rate for carcasses at Leonards Hill is 4.1 ± 0.6 days and the bio3 carcass persistence estimator is 0.42 for 7 days for birds and 0.7 and 0.62 for 2-3 days for bats (Elmoby Ecology, report ST07).

Reduced Area

Not all the area was available to search underneath turbines during every survey. Factors such as long grass on hot days and the presence of cattle reduced the available area considered safe for the dog and handler. As such, an estimate was derived by the surveyor on the day and a yearly estimation of percentage surveyed was derived and corrected for in calculations.

Calculations

To estimate total number of carcasses for the study period, results obtained were corrected for scavenger rates and observer efficiency, as described by Johnson et al (2002), with the added correction for the reduced area less than 100% of the survey plot (R).

Estimated total number of carcasses

$$m = \frac{N \times I \times C}{k \times t \times p \times R}$$

where N is the total number of turbines, I is the interval between searches in days, C is the total number of carcasses found in the study period, k is the number of turbines sampled, t is the mean number of days carcasses remain in the study area before being removed, p is searcher efficiency and R is the reduced area due to site difficulties.

Data was then converted to number of carcasses per turbine per year and per MW per year. Strikes per megawatt (MW) is presented to reflect the international trend in presentation of mortality estimates and to allow comparison with similar sized wind farms overseas.

RESULTS

A total of 162 searches, 104 to 100m and 58 to 50m were carried out on site with 1 feather spot (table 1) and 5 bats (table 2) detected. Appendix 1 shows a summary of each find. No listed bird or bat species were recorded during surveys. The only evidence of a bird strike was found during the first week of surveys and only feathers remained. Feather identification was inconclusive, although most likely from a brown falcon or similar species.

Extrapolating the feather spot using Johnson's equation gives 1.9 birds per turbine per year. If turbines are analysed separately, this reduces the estimation to 1.9 birds per year for turbine T2 and 0 birds per year for T1. This gives a total number birds colliding with the turbines as 2 per year (table 3).

Four of the five bats found on site were the white striped freetail bat. The other species was a southern forest bat. Both bat species were recorded as present in the turbine area in the pre-construction bat assessment. There was one bat found in December prior to the increased search. Data was analysed separately for the 7 day surveys between July – December 2011 and May – July 2012 and the thrice weekly surveys from January – April 2012.

Extrapolating the bat data the same way gives an estimation of 2.5 bats per turbine for January to April and 2 bats per turbine for May to December. In total this estimates that 9 bats per year will collide with the turbines (table 3).

Birds		
Species	% of total	number found
Brown Falcon (unconfirmed) <i>Falco berigora</i>	100%	1

Table 1: Bird species found on site showing the number found and the percentage of total finds. Feather identification was not conclusive.

Bats		
Species	% of total	number found
White Striped Freetail <i>Tadarida australis</i>	80%	4
Southern Forest Bat <i>Vespadelus regulus</i>	20%	1

Table 2: Bat species found on site showing the number found and the percentage of total finds. White striped freetail bats are the most likely bat to collide with a turbine accounting for all but one of the bat carcasses found.

	Turbine T1	Turbine T2	Total
# turbines surveyed for year	81	81	162
# turbines searched to 100m	52	52	104
# turbines searched to 50m	27	27	58
percentage of area searched 100m	98%	86%	92%
percentage of area searched 50m	100%	90%	95 %
# birds found	0	1	1
Estimated bird strikes per MW per year			0.9
Estimated bird strikes per turbine year			1.9
Estimated Number of bird collisions per year			2
# bats found	3	2	5
# white-striped freetails	3	1	4
Estimated bat strikes per MW (Jan-Apr)			1.2
Estimated bat strikes per turbine (Jan-Apr)			2.5
Estimated bat strikes per turbine (May-Dec)			2
Estimated Number of bat collisions per year			9

Table 3: Summary from Hepburn Community Wind Farm 12 month mortality study, showing overall mortality estimates and individual impacts for birds and bats.

DISCUSSION

No listed species of birds or bats were found as part of routine mortality searches. The estimated impact of the Hepburn Community Wind Farm to bird and bat mortality is 2 birds per year and 5 bats between January and April or 9 bats per season. The calculations aim to over-estimate mortality and all numbers are rounded up to represent the worst-case scenario. Therefore the rates of 1 bird per turbine per year, and 5 bats per turbine per year can be considered as the maximum value of the estimation.

No bird carcasses were found during the study period, however a patch of feathers typical of post scavenging remains was recorded in the first week of surveys. Whilst the identification of the feather spot was inconclusive, it is possible that they were from a brown falcon or similar species. Brown falcons have been recorded in mortality searches at other wind facilities and appear to be the most susceptible raptor to turbine collisions in Victoria (personal experience). The estimation of 2 birds per year, or 1 bird per turbine is low when considered with the range reported internationally of 0-125 birds per turbine per year (Erickson et al 2001, Krijgsveld et al 2009, Strickland et al 2011).

The discovery of feathered remains in the first week of operation may represent an initial impact rather than an ongoing impact as no evidence of any bird mortality has since been found. Studies in both the USA and the UK have demonstrated avoidance of small scale wind farms by raptors and water birds reporting zero bird collisions at facilities with 3 or less turbines (Sharp et al 2010, Pickering and Roberts 2011). These studies have analysed both pre- and post-construction flight paths to demonstrate avoidance behaviour in birds. Given the low level of mortality recorded at Leonards Hill it is possible that avoidance behaviour by local bird populations may be a factor in the low mortality.

The white striped freetail bat accounted for 80% of the bats found on site which is similar to other studies on bat mortality in the region (Bennett, 2011). The estimated level of bat mortality at Leonards Hill is consistent with other wind farms in Australia (personal experience) and overseas (Strickland et al 2011) which report ranges of 0-40 bats/MW/year with most studies recording between 2 and 10 bats/MW/year. Hepburn Community Wind Farm falls at the lower end of the range and therefore does not exceed the expected level of bat mortality for a wind farm of this size.

The increased search intensity for bats was due to commence in late October, however due to logistical reasons thrice weekly surveying commenced in January. The number of bat searches did not reach the target of 156 searches between October and April, falling short by 50 surveys (25 per turbine). Given that the estimated level of bat mortality does not fall outside the range expected for similar sized turbines further studies may not be necessary. If further investigation is required in order to meet the target of 156 bat searches, then weekly surveys from

November through to April would provide a second year of data which will take into consideration annual fluctuations in bat activity. It is not necessary to undertake surveys in consecutive years; therefore further bat mortality monitoring could occur in years 2, 3, 4 or later depending upon resources.

In summary, estimated mortality rates are relatively low at the Hepburn Community Wind Farm with an impact unlikely to exceed 2 bird and 10 bat strikes per year. No listed species were affected and thus there is no need to undertake any mitigation strategies at this stage. Further monitoring should be considered if there is reason to believe that there is a significant change in bird utilisation on site

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APPENDIX 1 – Mortality Summary

Find ID	Date	Turbine	Bat Carcass	Bird Carcass	Feather Spot	Species	Conservation Status	Proximity to Turbine	Condition	Impact with turbine
1	11/7/11	1	0	0	1	Brown Falcon (unconfirmed)	secure	69m East	Feathers only. Carcass consumed by scavengers (foxes).	possible
2	26/12/11	1	1	0	0	White Striped Freetail	secure	28m SW	Complete, fresh adult male	likely
3	16/2/12	1	1	0	0	White Striped Freetail	secure	40m East	Impact trauma, fresh	likely
4	29/3/12	T1	1	0	0	White Striped Freetail	secure	7m SW	male, complete, fresh	likely
5	4/4/12	T2	1	0	0	Southern Forest Bat	Secure	5m East	Complete, fresh	likely
6	20/4/12	T2	1	0	0	White Striped Freetail	Secure	35m East	Complete, fresh	likely