TA6.3 Bat Survey Report

Glenshero Wind Farm

Bat Survey Report

Technical Appendix 6.3

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EXECUTIVE SUMMARY

MacArthur Green was commissioned by RES Ltd on behalf of Simec Wind One Ltd to carry out bat surveys for the proposed Glenshero Wind Farm (referred to as the 'proposed development').

These surveys were undertaken to aid and inform the ecological assessment for the Glenshero Wind Farm Environmental Impact Assessment Report (EIAR).

This report presents the results of the bat survey work undertaken from May 2017 to October 2017 (inclusive) at the site (EIAR Volume 3: Figure 6.7).

Within the site, bats were monitored in the bat study area (as shown on EIAR Volume 3: Figure 6.7) including the area around the proposed turbine locations as well as a control site located along the confluence of the Allt Coire Iain Oig Burn where a control detector was placed (EIAR Volume 3: Figure 6.7). In total three bat species were recorded for the bat study area; soprano pipistrelle, common pipistrelle, and Daubenton's bat with *Myotis* spp. recorded to genus level.

The control detector at location 15 was the only detector that recorded Daubenton's and *Myotis* spp., likely because of its lower altitude and its placement along the confluence of the Allt Coire Iain Oig Burn.

Detectors placed within the turbine developable area only recorded *Pipistrellus* bats with few bat registrations recorded with a low level of activity.

Although the control detector recorded significantly more bat registrations, the activity recorded at this detector would still be considered to be low for *Pipistrellus* species and Daubenton's.

No bat roosts or structures with bat roost potential were located within 200 m of a turbine.

1 INTRODUCTION

MacArthur Green was commissioned by RES Ltd on behalf of SIMEC Wind One Ltd to carry out bat surveys for the proposed Glenshero Wind Farm (hereafter referred to as the 'proposed development').

This report has been produced by MacArthur Green and in accordance with Scottish Natural Heritage guidelines. All staff contributing to this technical appendix have undergraduate and/or postgraduate degrees in relevant subjects, have deep professional ecological impact assessment and ecology survey experience, and hold professional membership of the Chartered Institute of Ecology and Environmental Management (CIEEM). The report has been reviewed and approved by David MacArthur of MacArthur Green and a copy of his CV is included in EIAR Volume 4: Technical Appendix 1.2.

The proposed development site boundary lies on land approximately 8 km west of the village of Laggan, in the Highlands.

Bat surveys were undertaken to aid and inform the ecological assessment for the Glenshero Wind Farm EIAR.

A survey plan for bats was conducted between May and October 2017 (inclusive). The survey plan included;

- Desktop Ecological Appraisal; and
- Temporal (static) surveys.

The aim of the surveys was to quantify site usage and variation of activity levels within the proposed development site boundary. Surveys were carried out during the main bat activity period.

2 THE STUDY AREA

The majority of the site comprises open moorland habitat which is used for grazing livestock and rearing grouse. The turbines are proposed for the northern part of the site, on the northern slopes of Carn Dearg (736m) and the western and eastern slopes of Meall na h-Aisre (862m).

The two main watercourses on site are the Allt Coire Iain Oig and the Allt Gilbe which are fed by a number of smaller watercourses such as the Blackcorrie Burn. The watercourses within the site drain into the River Spey which flows to the south of the site.

The Beauly-Denny 400 kV overhead line intersects the site in the south.

The area over which bat surveys were carried out (hereafter referred to as the 'bat study area'), encompassed the turbine developable area of the site where it is proposed to situate the turbines and a control site on the confluence of the Allt Coire Iain Oig. Anabat detectors (see Section 4) were placed at locations 1 to 14 within the turbine developable area while at the control site, a detector was placed at location 15 (EIAR Volume 3: Figure 6.7).

3 BATS AND WIND FARMS

3.1 Policy and Guidance

All bat species are protected under the following legislation shown below:

- The Habitats Directive 92/43/EEC (as amended);
- The Wildlife and Countryside Act 1981 (as amended); and
- The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended).

Details pertaining to the legal status of bats are included within Annex 1.

In the UK, guidelines have been produced with regards to assessing the ecological impact upon bats from wind farm developments. These guidelines aid in producing mitigation and compensation strategies to minimise any negative impact upon local bat populations. The following guidance documents have been used in the preparation of this report:

- Natural England (2014) Bats and onshore wind turbines: interim guidance. TIN051. Third Edition;
- Hundt, L. (2012) Bat Surveys: Good Practice Guidelines, 2nd Edition, Bat Conservation Trust;
- Collins, J. (ed) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London; and
- Rodrigues, L., et al. (2014) Guidelines for consideration of bats in wind farm projects, revision 2014. EUROBATS Publication Series No. 6.

3.2 Potential Impacts

Exeter University found that most bat fatalities at UK wind farms were common pipistrelle bats, soprano pipistrelle bats and noctule. In addition, single carcasses of brown long-eared bat, Nathusius' pipistrelle bat and Natterer's bat were recorded (DEFRA, 2016). The estimated casualties of the study ranged from 0 to 5.25 bats per turbine per month, and from 0-77 bats per site per month during the survey period (July to October) with considerable variation between sites. The study also found that the percentage casualty rates for soprano pipistrelle, common pipistrelle and noctule bats were higher than the relative proportions of their calls recorded from ground level acoustic surveys.

In the UK three taxa groups have been identified as high risk collision species, with 98% of bat mortality predominantly among taxa adapted to open-air foraging such as: *Nyctalus*, *Pipistrellus* and *Eptesicus* (Rydell *et al.* 2010).

Natural England interim guidance (2014) includes a collision risk assessment for British bat species. This is divided into two parts: (i) bat species likely to be threatened due to impacts from wind turbines and (ii) bat populations likely to be threatened due to impacts from wind turbines (shown in Table 6.3.1 and Table 6.3.2). Different bat species are considered to be at different levels of risk depending on their habitat preferences, flight behaviour and population status. Surveys have therefore been carried out for all bat species.

Table 6.3.1 Bats likely to be at risk from wind turbines (taken from Natural England, 2014)

Low Risk	Medium Risk	High Risk
Myotis species	Common pipistrelle	Noctule
Long-eared bats	Serotine	Leisler's
Horseshoe bats	Soprano pipistrelle	Nathusius' pipistrelle
	Barbastelle	

Table 6.3.2 Populations likely to be threatened due to impacts from wind turbines (taken from Natural England, 2014)

Low Risk	Medium Risk	High Risk
Myotis species	Common pipistrelle	Noctule
Long-eared bats	Serotine	Leisler's
Horseshoe bats	Soprano pipistrelle	Nathusius' pipistrelle
	Barbastelle	

Bats travel between hibernacula sites to summer roosts in spring and autumn and therefore could be impacted negatively if wind farms were positioned between these two areas.

A synthesis of European and American data by the Swedish Vindval research programme concluded the following habitats to be high risk locations for wind farms; coasts, wetlands, forested hills and ridges. Turbines sited along linear landscapes such as lake shores, rivers, treelines, hedgerows, etc., are also considered to increase the likelihood of collision (Rydell *et al*., 2012). This study also found that peak mortality usually (90%) occurred on nights with low wind speeds in late June to early October and to a lesser extend (10%) also in April-June. The Exeter University (DEFRA, 2016) study found that most nights on which bat casualties occurred had low mean wind speeds (≤5m/s at ground level; c.a. <10m/s at nacelle level) and maximum night-time temperature of >10°C, although casualties were only found in 3.6% of nights with low wind speeds during the study.

Rydell found that bat mortality increased with turbine tower height and rotor diameter; the mortality increase with rotor diameter was also found in the UK study (DEFRA, 2016), but nacelle height was not found to be linked to the risk to bats.

3.3 Study Area Assessment

The appropriate level of effort for a bat survey at a proposed wind farm development depends on the scale of its likely impact, which in turn depends on the size of the site and the quality of the habitat. Bat Conservation Trust (BCT) guidance (Hundt, 2012) provides recommendations of minimum standards of survey effort in instances where sampling is required. To determine the survey effort, the site must be assigned as a high, medium or low risk site. Annex 2 contains the BCT assessment table "Factors to consider when determining the survey effort and site risk", which was used to determine the survey effort for the site.

The site was assigned low value due to its geographical location which is not in range of high risk species *(Nyctalus* spp.) and its low foraging/commuting suitability and high altitude with exposed plateaus. Static detectors were deployed seasonally at the proposed turbine or adjacent to turbine locations as per recommended guideline (Hundt, 2012). Detectors were deployed for longer than the current guideline recommendations which recommend a minimum recording 5 nights with detectors instead deployed for a minimum of 10 nights.

No roosting potential is present within the site due to the lack of trees or suitable structures.

4 SURVEY METHODS

4.1 Desk-based Study

A desk-based study was undertaken in order to inform subsequent field surveys and assessment with regards the presence of designated sites/species of interest within the site and its environs. This study also consisted of a search of *Nyctalus* records from the 'Scottish Leisler's Bat Project' which were supplied to MacArthur Green by John Haddow in May 2015. A search for records within 20 km from the development area was completed.

4.2 Temporal Surveys – Static Detectors

Temporal surveys were carried out for the bat study area. Temporal surveys involved leaving static Anabat detectors at specified locations in order to record activity overnight and over prolonged periods of time to quantify a Bat Activity Index (BAI).

Fourteen Anabat Express detectors (locations 1 - 14) were placed adjacent to or on proposed turbine locations. A control detector (location 15) was placed at a control site to the south of the turbine developable area, along the confluence of the Allt Coire Iain Oig. This control site is situated 3.671 km from the nearest proposed turbine (Turbine 39, refer to EIAR Volume 3: Figure 6.7). All detectors were deployed for a minimum time period of 10 nights. Surveys were undertaken during the spring, summer and autumn periods in accordance with BCT guidance (Hundt, 2012). Each detector recorded bats from dusk to dawn with detectors starting 30 minutes before dusk and finishing 30 minutes after dawn.

Table 6.3.3 6.3.3 shows a summary breakdown of the temporal survey effort.

Table 6.3.3 Summary of Temporal Survey Effort

Survey Date	Locations	Total Survey (hrs:mins:secs)	Total Complete Nights
25/05/17 – 06/06/17	1	90:33:15	12
25/05/17 – 06/06/17	2	90:32:36	12
25/05/17 – 06/06/17	3	90:31:39	12
25/05/17 – 06/06/17	4	90:32:06	12
25/05/17 – 06/06/17	5	90:32:26	12
25/05/17 – 06/06/17	6	90:32:57	12
25/05/17 – 06/06/17	7	90:33:22	12
25/05/17 – 06/06/17	8	90:32:34	12
25/05/17 – 06/06/17	9	90:31:27	12
25/05/17 – 06/06/17	10	90:31:11	12
25/05/17 – 06/06/17	11	90:30:30	12
25/05/17 – 06/06/17	12	90:30:03	12
25/05/17 – 06/06/17	13	90:30:48	12
25/05/17 – 06/06/17	14	90:30:44	12
25/05/17 – 06/06/17	15	00:00:00*	0
	Total	**1267:25:43**	**168**
17/08/17 – 29/08/17	1	00:00:00*	0
17/08/17 – 29/08/17	2	64:12:41	6
17/08/17 – 29/08/17	3	64:12:29	6
17/08/17 – 29/08/17	4	64:12:33	6
17/08/17 – 29/08/17	5	64:12:37	6
17/08/17 – 29/08/17	6	75:11:19	7
17/08/17 – 29/08/17	7	115:21:25	11
17/08/17 – 29/08/17	8	64:12:39	6
17/08/17 – 29/08/17	9	64:12:29	6
17/08/17 – 29/08/17	10	103:54:10	10
17/08/17 – 29/08/17	11	125:36:48	12
17/08/17 – 29/08/17	12	64:12:11	6
17/08/17 – 29/08/17	13	64:12:18	6
17/08/17 – 29/08/17	14	64:12:20	6
17/08/17 – 29/08/17	15	125:39:21	12
	Total	**1123:35:23**	**106**
19/09/17 – 03/10/17	1	184:20:30	14
19/09/17 – 03/10/17	2	184:20:30	14
19/09/17 – 03/10/17	3	184:20:35	14
19/09/17 – 03/10/17	4	184:20:30	14
19/09/17 – 03/10/17	5	184:20:31	14
19/09/17 – 03/10/17	6	184:20:29	14
19/09/17 – 03/10/17	7	184:20:30	14
19/09/17 – 03/10/17	8	184:20:30	14
19/09/17 – 03/10/17	9	184:20:35	14
19/09/17 – 03/10/17	10	184:20:30	14
19/09/17 – 03/10/17	11	184:20:36	14
19/09/17 – 03/10/17	12	184:20:36	14
19/09/17 – 03/10/17	13	184:20:35	14
19/09/17 – 03/10/17	14	184:20:36	14
19/09/17 – 03/10/17	15	184:20:20	14
	Total	**2765:07:57**	**210**
Total Survey (hrs:mins:secs)	**5156:09:04**	**Total Survey (complete nights)**	**484**

*Malfunction of equipment with detectors not recording any data

4.3 Method of Analysis

A bat registration is a sequence of bat pulses which is captured on a 15 second Anabat sound file when a bat echolocates close to an Anabat detector. One sound file is counted as one bat registration. As an individual bat can pass a particular feature while foraging and record numerous registrations, it is not possible to estimate the number of individual bats. Therefore, in accordance with BCT guidance (Hundt, 2012) an activity index is used instead which calculates bat registrations per hour (or per night). This allows the analysis of bat activity to estimate abundance and/or activity. The bat activity index (BAI) is calculated as bat registrations per hour (brph) using the following equation:

BAI (per hour) = Total number of bat registrations / number of hours of recording [brph].

Data was analysed using Kaleidoscope 4 Auto ID classifier. The Auto ID classifier identifies Scottish bat species and has an accuracy rate of 96% for soprano and common pipistrelles (Wildlife Acoustics, 2016). The accuracy rate for other Scottish bat species is lower; therefore all other bat species were manually reviewed by an experienced bat ecologist using Kaleidoscope Viewer and AnalookW 4.3.19 software. This method of analysis is in line with current guidelines (Collins, 2016) for data analysis which recommends the manual checking of all non-*Pipistrellus* calls when using automated methods. Sound files labelled as noise were not reviewed manually.

In the absence of any recognised standard criteria to define levels of bat activity (e.g. what quantifies low, medium or high activity) professional judgement has been used, taking into consideration geographical location and experience gained through conducting similar surveys at other sites in the region and throughout Scotland.

5 BAT SURVEY LIMITATIONS

BCT guidance (Hundt, 2012) for proposed wind farm sites indicates that the survey period is from April and October. Surveys were not carried out in April as Scotland often experiences suboptimal weather conditions (i.e. wind, precipitation and temperature) for bat surveys in April. The Bat Survey Guidelines (Collins, 2016) define the optimal survey period for static detector surveys in Scotland as from May to August with sub-optimal surveys possible in April and September.

Due to the high altitude and a low predicted occurrence of bat species in the site as well as the health and safety concerns of working at night at a high altitude, only temporal surveys were carried out for the bat study area. Due to the large collection of data from temporal surveys and the low level of bat activity recorded within the turbine developable area, the lack of transect surveys is not considered to be a limitation to the assessment of the study area.

Some temporal calls were assigned an unknown value (NoID), due to a very faint call or incomplete calls that could not be identified to species level on the spectogram.

For a number of other bat recordings it was only possible to identify the call to genus level and these recordings were classified as *Myotis* spp. It is possible that for *Myotis* spp. these recordings could represent species not identified.

Anabat detectors are a commonly used bat detector for acoustic monitoring at wind farm sites however; all bat detectors have limitations and will only monitor bat activity within a limited area, for Anabats usually around 30 metres, depending on a variety of environmental factors. Furthermore, due to passive monitoring methodologies depending on sound reaching the microphone, the detection rate of bat calls varies with a bias towards loud bat calls with quieter calls, namely brown long-eared bats, potentially being under recorded. As a result of equipment limitations, only relative rather than direct statistical comparisons of bat activity can be made between species and only a set area within the bat study area can be sampled.

There were two occasions when the Anabat detectors malfunctioned and did not record any data; theses occurrences were in May at location 15 (control detector) and in August at location 1. As all of the other detectors recorded a minimum of 5 nights which is in line with current guidelines, with the majority of detectors recording more than 10 nights of data, this small loss of data due to the malfunction of two detectors is not seen to have impacted the amount of data required for an assessment of the bat study area.

The analysis of bat data requires expertise and experience, therefore the Anabat data was analysed by ecologists experienced with bat call analysis using Kaleidoscope Viewer and AnalookW 4.3.19 software.

Kaleidoscope Auto ID classifier can mislabel a small number of bat calls as noise files. From data analysis obtained from other studies, it was found that 1% of noise files contained bat calls that could be identified manually to species level. As noise files were not manually checked, it can be assumed that there was a small loss of bat data, which is unlikely to compromise the robustness of the assessment.

According to recent research work by Exeter University, acoustic recording from the ground underestimates the abundance of soprano pipistrelle and noctule bats within the at risk zone of the turbine rotor sweep (DEFRA, 2016). The study also found that activity levels do not necessary determine the risk level of the site to bats, with sites which recorded high levels of bat activity recording no casualties while sites with low levels of bat activity recorded casualties. It is therefore important to not just rely on activity rates when making an assessment of the site on bats, but to also incorporate factors such as geographical location, habitat suitability, flight corridors, roost suitability and nearby roost locations into the assessment.

The information currently available on bat behaviour in the UK is not sufficient to fully assess the threat that wind turbines may pose to populations (Natural England, 2014), therefore any assessment is made based on the best available data.

6 SURVEY RESULTS

6.1 Desk-based Study

No designated sites/species of interest for bats are within 10 km of the study area. No *Nyctalus* records from the 'Scottish Leisler's Bat Project' were found to be present within 20km of the study area.

6.2 Temporal Surveys – Static Detectors

In total, three bat species were recorded in the bat study area. A total of 288 bat registrations were recorded within the site throughout the survey period as shown in Table 6.3.4. Of these registrations, 261 were recorded on the control detector at location 15 while 27 registrations were recorded on detectors within the turbine developable area (locations 1 – 14 – see EIAR Volume 3: Figure 6.8). Species recorded were soprano pipistrelle (PIPPYG), common pipistrelle (PIPPIP) and Daubenton's (MYODAU); *Myotis* spp. (MYO) was identified to genus level with a total BAI of 0.06 brph. Daubenton's bats and *Myotis* spp. were recorded only at the control site, not on any of the detectors placed within the turbine developable area.

6.2.1 Summary of Activity

The most commonly recorded species was:

- Common pipistrelle with 217 registrations and a BAI of 0.042 brph, followed by;
- Soprano pipistrelle with 49 registrations and a BAI of 0.01 brph;
- *Myotis* spp. with 5 registrations and a BAI of 0.001 brph; and
- Daubenton's with 3 registrations and a BAI of 0.001 brph.

Medium collision risk species (*Pipistrellus* species) accounted for 92% of the registrations recorded for the bat study area, while low risk species (Daubenton's bats and *Myotis* spp.) accounted for 3% of the registrations recorded. Bat calls that could not be identified (NoID) due to incomplete recordings (see limitations section 5) accounted for 5% of the total registrations recorded for the site.

The species composition and activity levels (brph) of the study area are shown in Graphs 6.3.1 to 6.3.4 and illustrated in EIAR Volume 3: Figure 6.8.

The static detector locations that recorded the greatest bat activity index per hour (in order of greatest to least) were:

- Location 15 (control site) (261 registrations, 0.842 brph);
- Location 10 (6 registrations, 0.016brph);
- Location 7 (6 registrations, 0.015 brph);
- Location 6 (4 registrations, 0.011 brph);
- Location 9 (3 registrations 0.009 brph);
- Location 1 (2 registrations 0.007 brph);
- Location 2 (2 registrations 0.006 brph);
- Location 14(1 registrations 0.003brph);
- Location 3 (1 registrations 0.003 brph);
- Location 4 (1 registrations 0.003 brph);

- Location 11 (1 registrations 0.002 brph)

Location 5, 8, 12 and 13 did not record any bat registrations during their deployment period.

Analysis of the temporal data per survey visit is shown in Tables 6.3.5 to 6.3.7 below. In May, 10 registrations and a BAI of 0.008 brph was recorded. This bat activity increased during the August survey to 160 registrations and a BAI of 0.14 brph with bat registrations remaining consistent for the September to October deployment with 118 bat registrations recorded with a brph of 0.04. The increase in bat activity from May to August and to September and October was mainly attributed to an increase in *Pipistrellus* species activity at the control detector, with detectors placed within the turbine developable area recording few bat registrations throughout the survey period.

Table 6.3.4 Summary of Temporal Survey Results

Detector Location	PIPPYG (M)	PIPPIP (M)	MYODAU (L)	MYO (L)	NoID	Reg.	BAI [brph]
1	1	1	0	0	0	2	0.01
2	0	2	0	0	0	2	0.01
3	1	0	0	0	0	1	0.003
4	0	1	0	0	0	1	0.003
5	0	0	0	0	0	0	0.00
6	0	4	0	0	0	4	0.01
7	3	3	0	0	0	6	0.02
8	0	0	0	0	0	0	0.00
9	1	2	0	0	0	3	0.01
10	0	1	0	0	5	6	0.02
11	0	1	0	0	0	1	0.002
12	0	0	0	0	0	0	0.00
13	0	0	0	0	0	0	0.00
14	0	1	0	0	0	1	0.003
15	43	201	3	5	9	261	0.84
Total Reg.	**49**	**217**	**3**	**5**	**14**	**288**	**0.056**
Total BAI [brph]	**0.010**	**0.042**	**0.001**	**0.001**	**0.003**	**0.056**	

(Abbreviations: PIPPYG – soprano pipistrelle; PIPPIP - common pipistrelle; MYODAU – Daubenton's; MYO– *Myotis* spp. and NoID – potential unknown species; H – High collision risk species; M – Medium collision risk species; L – Low collision risk species)

Table 6.3.5 Summary of Activity Totals – May (25/05/17 - -06/06/17)

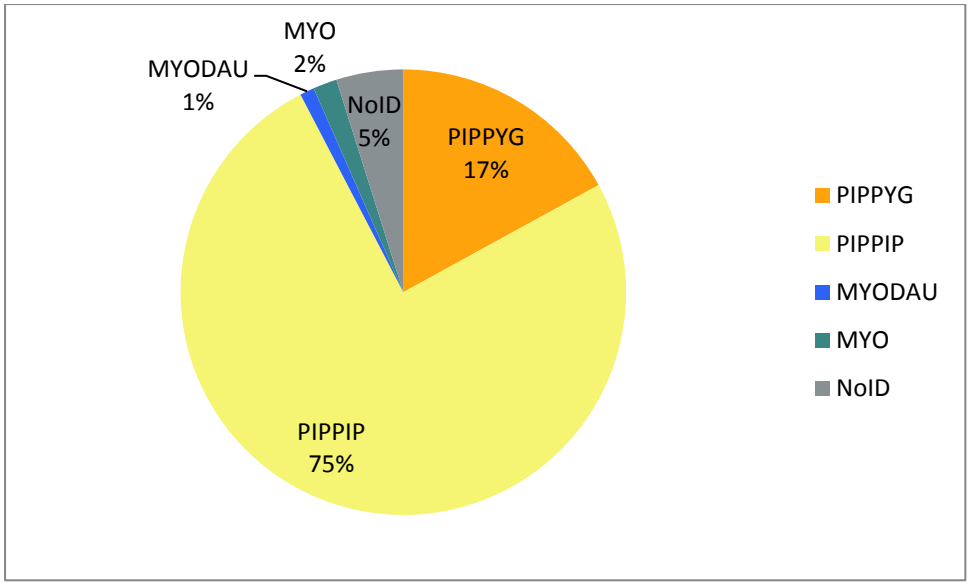
Detector Location	PIPPYG (M)	PIPPIP (M)	MYODAU (L)	MYO (L)	NoID	Reg.	BAI [brph]
1	0	1	0	0	0	1	0.01
2	0	2	0	0	0	2	0.02
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	3	0	0	0	3	0.03
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	1	2	0	0	0	3	0.03
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	1	0	0	0	1	0.01
15	0	0	0	0	0	0	0
Total Reg.	**1**	**9**	**0**	**0**	**0**	**10**	**0.008**
Total BAI [brph]	**0.001**	**0.007**	**0**	**0**	**0**	**0.008**	

Table 6.3.6 Summary of Activity Totals – August (17/08/17- 29/08/2017)

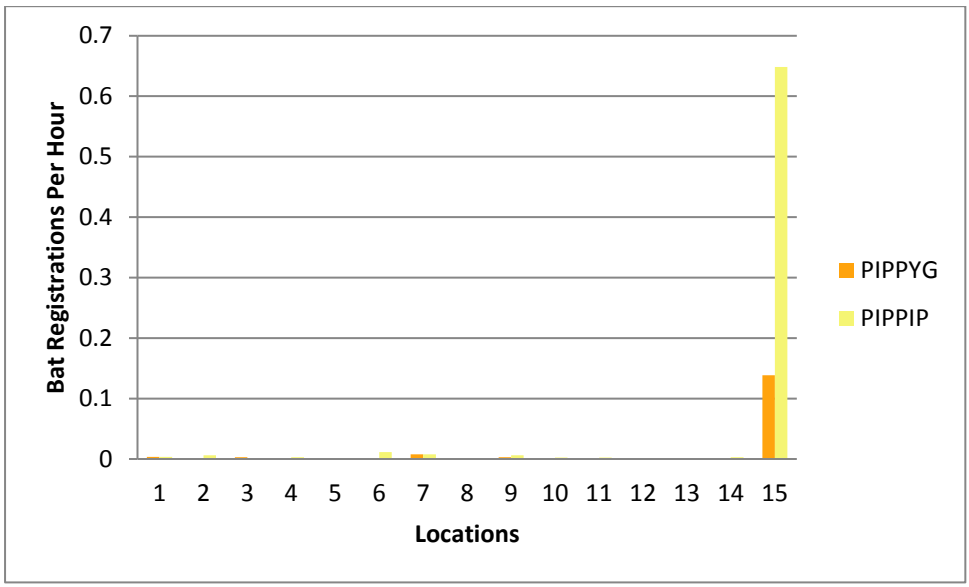
Detector Location	PIPPYG (M)	PIPPIP (M)	MYODAU (L)	MYO (L)	NoID	Reg.	BAI [brph]
1							
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	1	0	0	0	1	0.02
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	3	1	0	0	0	4	0.03
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	1	0	0	5	6	0.06
11	0	1	0	0	0	1	0.01
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	28	107	3	2	8	148	1.18
Total Reg.	**31**	**111**	**3**	**2**	**13**	**160**	**0.14**
Total BAI [brph]	**0.03**	**0.10**	**0.003**	**0.002**	**0.01**	**0.14**	

Table 6.3.7 Summary of Activity Totals – September – October (19/09/17- 03/10/2017)

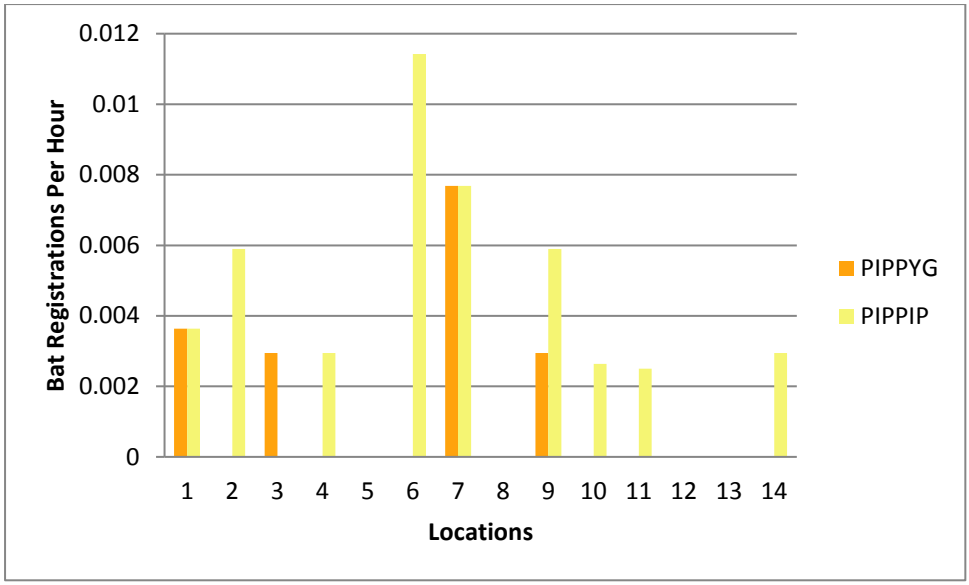
Detector Location	PIPPYG (M)	PIPPIP (M)	MYODAU (L)	MYO (L)	NoID	Reg.	BAI [brph]
1	1	0	0	0	0	1	0.01
2	0	0	0	0	0	0	0
3	1	0	0	0	0	1	0.01
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	1	0	0	0	1	0.01
7	0	2	0	0	0	2	0.01
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	15	94	0	3	1	113	0.61
Total Reg.	**17**	**97**	**0**	**3**	**1**	**118**	**0.04**
Total BAI [brph]	**0.01**	**0.04**	**0**	**0.001**	**0**	**0.04**	**NA**



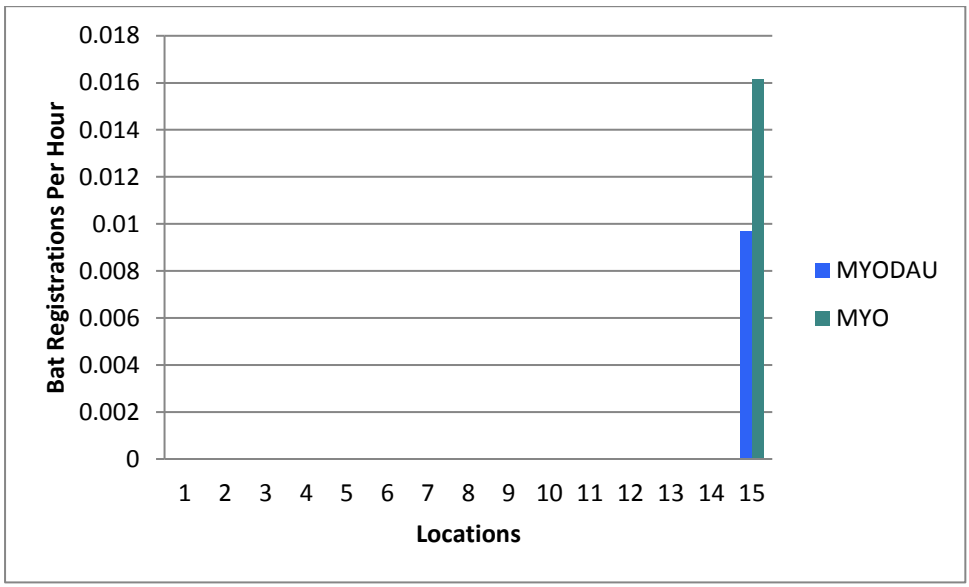
Graph 6.3.1 Temporal Survey Results: Species Composition of the bat study area (based on BAI [brph]), including control detector at Location 15.



Graph 6.3.2 Temporal Activity of Medium Risk Species within the bat study area (based on BAI [brph]), including control detector at Location 15.



Graph 6.3.3 Temporal Activity of Medium Risk Species excluding the control detector within the bat study area (based on BAI [brph]).



Graph 6.3.4 Temporal Activity of Low Risk Species within the bat study area (based on BAI [brph]), including control detector at Location 15.

7 DISCUSSION

7.1 Survey Overview

In total, three bat species were recorded for the bat study area as follows: soprano pipistrelle, common pipistrelle and Daubenton's; *Myotis* spp. was recorded to genus level. It is possible that *Myotis* spp. recordings could represent species not identified.

The results of the temporal surveys show the highest concentration of activity (BAI in bat registrations per hour) to be present at the control detector (location 15) which was placed 3.671 km from the nearest turbine at a lower altitude and along the confluence of the Allt Coire Iain Oig Burn (refer to EIAR Volume 3: Figure 6.7). This control detector accounted for 91% of all bat registrations recorded within the study area.

All other locations recorded few bat registrations with detectors within the vicinity of proposed turbine locations (EIAR Volume 3: Figure 6.8) only recording soprano pipistrelle and common pipistrelle registrations with a total of 27 registrations recorded for this area and a BAI of 0.005 (brph). Location 15 was the only detector that recorded Daubenton's and *Myotis* spp., likely because of its lower altitude and its placement along the confluence of the Allt Coire Iain Oig Burn.

No bat roosts or structures with bat roost potential were located within the bat study area.

All of the species recorded within the bat study area are on the Scottish Biodiversity List: all *Pipistrellus* species and Daubenton's bat. Soprano pipistrelle bats are also UK Biodiversity Action Plan (UKBAP) species.

7.2 Medium Risk Species

Medium risk species included soprano and common pipistrelle bats. These bat species are classed as being at medium risk of collision but are at low risk at the population level due to their distribution and abundance within the UK. Population estimates for common pipistrelle and soprano pipistrelle bats in the UK in 2005 were 2,430,000 and 1,300,000 respectively (JNCC, 2007).

Pipistrellus records accounted for 92% of the registrations recorded for the site (comprising a total of 49 registrations for soprano pipistrelles and 217 registrations for common pipistrelles), of which 85% were recorded at the control detector at location 15 and 7% were recorded within the turbine developable area.

All detectors within the turbine developable area recorded a low level of activity; BAI ranged between 0.01brph to 0.002 brph which is considered to be a low level of activity for *Pipistrellus* species. The control detector recorded a BAI of 0.8 brph which is also considered to be a low level of activity for *Pipistrellus* species.

7.3 Low Risk Species

Low numbers of *Myotis* species (Daubenton's and *Myotis* spp.) were recorded in the bat study area. *Myotis* species are at low risk for collision and also at low risk at the population level (Natural England, 2014). *Myotis* spp. were only recorded on the control detector at location 15 and were not recorded within the turbine developable area.

Myotis spp. activity at the control detector was considered to be low with a BAI of 0.02 brph.

8 CONCLUSION

Low activity levels were recorded for medium and low risk species. No high risk species were recorded within the bat study area and no roosts or potential roost sites were recoded within 30m of an access track or within 200m of a proposed turbine.

Detectors placed within the turbine developable area recorded a low number (27) bat registrations and a BAI of 0.005 (brph). The control detector placed lower down in the valley recorded significantly more bat registrations and accounted for 91% of all the registrations recorded. These results indicate that the turbine developable area is an unfavourable habitat for foraging and commuting bats due to its exposed nature and higher altitude. It is likely that bats only forage and commute across the turbine developable area when the weather conditions are ideal, i.e. low wind, no rain and temperatures above 10 ºC. However, as the turbine developable area is located at high altitude, it is unlikely that such favourable weather conditions for bats occur very often. The results of these surveys indicate that should favourable weather conditions occur, bat forging activity (most likely by soprano pipistrelle and common pipistrelle species) would be low.

There are a number of more suitable foraging habitats for bats in the locality, at lower altitudes than where turbines are proposed, such as at the control site and within the valley floor to the south.

Overall, the level of bat activity recorded within the site is very low.

REFERENCES

Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn.) The Bat Conservation Trust, London. ISBN-13 978-1-872745-96-1.

DEFRA (2016). Understanding the Risk to European Protected Species (bats) at Onshore Wind Turbine Sites to inform Risk Management. University of Exeter.

Hundt, L. (2012). *Bat Surveys: Good Practice Guidelines*, 2nd edition. Bat Conservation Trust ISBN-13: 9781872745985.

JNCC (2007). Second Report by the UK under Article 17 on the implementation of the Habitats Directive from January 2001 to December 2006. Peterborough: JNCC. Available from: www.jncc.gov.uk/article17.

Natural England (2014). *Bats and onshore wind turbines: interim guidance.* Third Edition TIN051. English Nature.

Newson, S., Evans, H., Gillings, S., Jarrett, D., Raynor, R. and Wilson, M. (2017). Large-scale citizen science improves assessment of risk posed by wind farms to bats in southern Scotland. Biological Conservation, 215, pp.61-71.

Rodrigues L., *et al*. (2014) Guidelines for consideration of bats in wind farm projects, revision 2014. EUROBATS Publication Series No. 6.

Rydell, J., Bach, L., Dubourg-Savage, M-J., Green, M., Rodrigues, L. and Hedenström, A. (2010). *Bat mortality at wind turbines in northwestern Europe, Acta Chiropterologica.* Volume 12(2): 261-274.

Rydell, J., Engstrom, H., Hedenström, A., Larsen, J-K., Pettersson, J. and Green, M. (2012). *The effects of wind power on birds and bats: A synthesis*. The Swedish Environmental Protection Agency, Report 6511, August 2012..

BIBLIOGRAPHY

Altringham, J. D. (2003). British Bats. Collins, New Naturalist Series. ISBN 000220147X.

Arnett, E. B., M. Schirmacher, M. M. P. Huso, and J. P. Hayes. (2009). Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. An annual report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.

Arnett, E. B., M. M. P. Huso, M. R. Schirmacher, and J. P. Hayes. (2011). Changing wind turbine cut-in speed reduces bat fatalities at wind facilities. Frontiers in Ecology and the Environment 9(4): 209–214; doi:10.1890/100103 (published online 1 November 2010).

Baerwald, E.F., J. Edworthy, M. Holder, R.M.R. Barlcay (2009). A Large-Scale Mitigation Experiment to Reduce Bat Fatalities at Wind Energy. Facilities. Journal of Wildlife Management, 73(7):1077-1081.

Bat Conservation Trust (2010. Noctule bat. Bat Conservation Trust, London.

Bat Conservation Trust (2009). Determining the impact of wind turbines on bat populations in Great Britain: Phase 1 Report. Bat Conservation Trust, London.

Bat Conservation Trust (2008). Encouraging Bats. A Guide for Bat-friendly Gardening and Living. Bat Conservation Trust, London.

Behr, O., K. Hochradel, J. Mages, M. Nagy, F. Korner-Nievergelt, I. Niermann, R. Simon, F. Stiller, N. Weber, and R. Brinkmann (2014). Bat-Friendly Operation Algorithms: Reducing bat Fatalities at Wind Turbines in Central Europe. International Energy Agency's Wind Task 34 Quarterly Webinar #1.

Collins, J. and Jones, G (2009). Differences in bat activity in relation to bat detector height: implications for bat surveys at proposed windfarm sites. Acta Chiropterologica 11(2): 343-350. doi: http://dx.doi.org/10.3161/150811009X485576.

Entwistle, A. C., Harris, S., Hutson, A. M., Racey, P. A., Walsh, A., Gibson, S. D., Hepburn, I. and Johnston, J. (2001). Habitat management for bats – A guide for land managers, land owners and their advisors. JNCC, Peterborough.

Haddow. J.F. (2012). *Looking for Leisler's – in Scotland.* Central Scotland Bat Group/Auritus Wildlife Consultancy. Available at: http://www.bats.org.uk/data/files/Scottish_BW_Conference_2012/Leislers_poster_Nov_2012.pdf.

Haddow, J. F. & Herman, J. S. (2000). Scottish Bats, Volume 5. ISBN 0952018241.

Harris, S., Morris P., Wray, S. and Yalden, D. (1995). A review of British mammals: population estimates and conservation status of British mammals other than cetaceans. JNCC, Peterborough.

Howe, R.W., W. Evans, and A.T. Wolf. Effects of Wind Turbines on Birds and Bats in Northeastern Wisconsin (2002). Report submitted to Wisconsin Public Service Corporation and Madison Gas and Electric Company.

Johnson, G. D. (2005). A review of bat mortality at wind-energy developments in the United States. Bat Research News 46: 45–49.

Jones, G. (1995). Flight performance, echolocation and foraging behaviour in noctule bats *Nyctalus noctula*. Journal of Zoology, London 237: 303-312.

Kirkpatrick, L., Oldfield, I.F., Park, K. (2017). Responses of bats to clear fell harvesting in Sitka Spruce plantations, and implications for wind turbine installation. Forest Ecology and Management, 395, pp. 1-8.

Kunz, T., Arnett, E.B., Erickson, W.P., Hoar, A.R., Johnson, G.D., Larkin, R.P., Strickland, M.D., Thresher, R.D. and Tuttle, M.D. (2007). Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. Frontiers in Ecology and the Environment 5: 315–324.

Middleton, N., Froud, A. and French, Keith. (2014)_Social Calls of Bat of Britain and Ireland. Pelagic Publishing.

Mitchell-Jones, A. J. and McLeish, A. P. (2004). Bat Workers Manual 3rd Edition. JNCC, Peterborough.

Osborn, B., Wallace, J. and McGuire, R. (2011) Bat Survey Report Loch Hill Proposed Windfarm. Direct Ecology.

Richardson, P. (2000). Distribution Atlas of Bats in Britain and Ireland 1980-1999. The Bat Conservation Trust, London.

Russ, J. (1999). The Bats of Britain & Ireland, Echolocation Calls, Sound Analysis and Species Identification. Alana Books, ISBN 095360490X.

Rydell, J., Bach, L., Dubourg-Savage, M-J., Green, M., Rodrigues, L. and Hedenström, A. (2010). Mortality of bats links to nocturnal insect migration European Journal of Wildlife Research 56(6): 823-827. DOI 10.1007/s10344-010-0444-3.

Scottish Natural Heritage (2007). Natural Heritage and the Law: Bats and People. Scottish Natural Heritage, Battleby.

Swift, S. M. (1980), Activity patterns of Pipistrelle bats (Pipistrellus pipistrellus) in north-east Scotland. Journal of Zoology, 190: 285–295. doi:10.1111/j.1469-7998.1980.tb01428.x

Sutter, C and S. Schumacher. (2017). Bat Detection and Shutdown System for Utility-Scale Wind Turbines. EPRI, Palo Alto, CA.

Wray, S., Wells, D., Long, E. and Mitchell-Jones, T. (2010) Valuing bats in ecological impact assessment, In Practice, No.70, Institute of Ecology and Environmental Management, as cited in Hundt, 2012.

Annex 1. Protected Species Legal Status

All bat species receive protection under the Conservation Regulations (1994) (as amended).

The information contained in this Annex is a summarised version of the legislation and should be read in conjunction with the appropriate legislation.

It is an offence to:

- Deliberately or recklessly to capture, injure or kill a wild animal of a European protected species;
- Deliberately or recklessly:
  - Harass a wild animal or group of wild animals of a European protected species;
  - Disturb such an animal while it is occupying a structure or place which it uses for shelter or protection;
  - Disturb such an animal while it is rearing or otherwise caring for its young;
  - To obstruct access to a breeding site or resting place of such an animal, or otherwise to deny the animal use of the breeding site or resting place (i.e. roost sites);
  - To disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs; or
  - To disturb such an animal in a manner that is, or in circumstances which are, likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young;
- To damage or destroy a breeding site or resting place of such an animal.

Table A.1 Detailing the Legal and Conservation Status of all UK Bats taken from Bat Conservation Trust[1]

Source: http://www.bats.org.uk/pages/bats_and_the_law.html

Species	Legislation / Convention													
	Bern Convention Appendix II	Bonn Convention Appendix II	WCA	Habitats Directive Annex IV	Habitats Directive Annex II	Habs Regs 1994 (as amended) *Scotland*	Conservation of Habs & Species Regs 2010	Conservation Regs (N Ireland) 1995	CROW Act 2000	NERC Act 2006	Wild Mammals Protection Act	UK BAP Priority species	IUCN Red List*	EUROBATS Agreement
Greater horseshoe bat	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	LC	✓
Lesser horseshoe bat	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	LC	✓
Daubenton's bat	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		LC	✓
Natterer's bat	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		LC	✓
Whiskered bat	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		LC	✓
Brandt's bat	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		LC	✓
Bechstein's bat	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NT	✓
Alcathoe bat	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		DD	✓
Noctule	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	LC	✓
Leisler's bat	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		LC	✓
Serotine	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		LC	✓
Common pipistrelle	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		LC	✓
Soprano pipistrelle	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	LC	✓
Nathusius' pipistrelle	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		LC	✓
Brown long-eared bat	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	LC	✓
Grey long-eared bat	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		LC	✓
Barbastelle	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NT	✓
Greater mouse-eared bat	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		LC	✓

*IUCN categories: LC is Least Concern, NT is Near Threatened, DD is Data deficient; see www.iucnredlist.org for more details.

[1] Please refer to the legislation for the precise wording - the above is a brief summary only.

Annex 2. Determining Site Risk

Factors to consider when determining the survey effort and site risk (taken from Hundt, 2012)			
Quality of habitat and number of habitat features likely to affect bat mortality rates if altered by development*	**Species likely to use the site***	**Importance of roosts, of species likely to use site, which may be affected by development***	**Potential risk level of development**
No potential habitat for roosting, foraging or commuting bats	None	Local	Lowest
Small number of potential roost features, of low quality. Low quality foraging habitat that could be used by small numbers of foraging bats Isolated site not connected to the wider landscape by prominent linear features.	Low number, single low risk species High number, several low risk species	Parish	Low
Buildings, trees or other structures with moderate high potential as roost sites on or near the site. Habitat could be used extensively by foraging bats. Site is connected to the wider landscape by linear features such as scrub, tree lines and streams.	Low number, medium risk species High number, medium risk species	District County	Medium
Numerous suitable buildings, trees (particularly mature ancient woodland) or other structures with moderate-high potential as roost sites on or near the site, and/or confirmed roosts present close to or on the site. Extensive and diverse habitat mosaic of high quality for foraging bats. Site is connected to the wider landscape by a network of strong linear features such as rivers, blocks of woodland and mature hedgerows.	High number, single high risk species High number, several high risk species High number, all high risk species	National International	High

*As outlined in current scientific research, SNCO guidance and illustrated in Wray *et al*. (2010). Trials

Annex 3. Minimum Standards for Bat Surveys

(Taken from Hundt, 2012)

	Site Risk Level		
	Low risk	**Medium risk**	**High risk**
	Roost survey		
Selection of roosts requiring further survey	If evidence of roosting by medium or high-risk species and/or roosts of district importance is found, further survey should follow SNCO guidance and Hundt (2012) guidelines wherever possible.		
Survey period	Surveys should provide data for one season as a minimum.		
Survey area	Up to 200m + rotor radius from turbine locations or potential turbine locations	Up to 200m + rotor radius from turbine locations or potential turbine locations	Up to 200m + rotor radius from turbine locations or potential turbine locations
Ground level transect surveys	One visit per transect each season (spring, summer and autumn)	One visit per transect each month (April-Oct)	Up to two visits per transect each month may be required (April-Oct)
Automated surveys at ground level	5 consecutive nights for each single or pair of locations within the survey area, per season	5 consecutive nights for each single or pair of locations within the survey area, per month	Up to 2 sets of 5 consecutive nights for each single or pair of locations within the survey area, per month
Automated surveys at height	See Section 10.5.6 [of Hundt, 2012] for situations where at-height survey may be appropriate For surveys undertaken from masts (met mast or other) survey effort is as outlined above for surveys at ground level.		

Annex 4. Illustration to Show 50 m Buffer Zone

(*Taken from Natural England, 2015)*