MacArthur Green

ARECLEOCH WINDFARM EXTENSION

Bat Survey Report (2017 Surveys)

Technical Appendix 8.3A

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EXECUTIVE SUMMARY

MacArthur Green was commissioned by ScottishPower Renewables to carry out bat surveys for the proposed Arecleoch Windfarm Extension (hereafter referred to as the 'proposed Development')).

These surveys were undertaken to aid and inform the ecological assessment for the proposed Development's Environmental Impact Assessment Report (EIAR).

This report presents the results of the bat survey work undertaken between 01 May 2017 and 02 October 2017 (inclusive) at the study area.

In total seven bat species and 30,669 bat registrations were recorded within the study area. Species recorded were soprano pipistrelle (*Pipistrellus pygmaeus*), common pipistrelle (*P. pipistrellus*), Leisler's (*Nyctalus leisleri*), noctule (*N. noctula*), brown-long eared bat (*Plecotus auritus*), Natterer's (*Myotis nattereri*) and Daubenton's (*M. Daubentonii*) with an overall Bat Activity Index (BAI) for the study area of 2.27 bat registrations per hour (brph). Bat registrations identified to genus level were *Nyctalus* spp. and *Myotis* spp.

High risk species (*Nyctalus* spp.) accounted for 5% of the registrations recorded within the study area while medium risk (pipistrelle species) and low risk species *(Myotis* and *Plecotus* spp.) accounted for 94% and 1% of the species recorded within the study area , respectively.

Nyctalus spp. were recorded during all survey visits to the study area in May, July and September and at all locations. The location that recorded the greatest *Nyctalus* spp. activity index per night (bat registrations per night [brpn]) was location 9 followed by location 12 and location 1. *Nyctalus* spp. average registrations per month were greater than 1 registration at locations 1, 2, 8, 9 and 12. The highest activity recorded was at location 9 in July with a *Nyctalus* spp. BAI of 9.1 brpn recorded.

Activity levels for medium risk species (pipistrelle species) were high to medium during the survey period.

Low numbers of *Myotis* species (Daubenton's and Natterer's) and brown long-eared bats were recorded for the study area.

Potential bat roosts were recorded along the railway line and are over 400 m from the nearest proposed turbine location and over 150 m from the nearest new infrastructure, respectively. Therefore, disturbance to bat roosts are unlikely.

1 INTRODUCTION

MacArthur Green was commissioned by ScottishPower Renewables (hereafter referred to as the 'applicant') to undertake bat surveys at the proposed Arecleoch Windfarm Extension (hereafter referred to as the 'proposed Development').

The proposed Development's application boundary lies to the south west of the village of Barhill In South Ayrshire. The Glasgow to Stranraer railway line runs along the eastern side of the Site (Figure 8.6).

Bat surveys were undertaken to aid and inform the ecological assessment for the proposed Development's Environmental Impact Assessment Report (EIAR).

A survey plan for bats was conducted in 2017 between 1 May 2017 and 2 October 2017 (inclusive). The survey plan included:

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

The aim of the surveys was to quantify usage and variation of activity levels within the study area. Surveys were carried out during the main bat activity period.

Earlier surveys for bats were carried out in 2015 which are reported separately (see Technical Appendix 8.3B).

2 THE STUDY AREA

The study area in which bat surveys were carried out encompassed the application boundary (refer to Figure 8.6). The study area is located around 2km southwest of the village of Barrhill in South Ayrshire and near the border of Dumfries and Galloway. The study area encompasses the Arecleoch Forest at Shiel Hill and Knockshin. The majority of the study area supports commercial plantation, with large areas of clear fell interspersed between the forestry blocks. The forestry rides support mire habitat. There is a large powerline that intersects the northern section of the study area from west to east. There is also a railway line which runs through the study area from west to east. The connectivity of the study area to surrounding habitats is supported by watercourses. There are several watercourses present, including the Water of Tig to the north and west and the Laggish Burn to the southeast. The White Loan feeds into the Cross Water to the east of the study area. There are also a number of unnamed burns present.

The highest point is located on Shiel Hill located in the northern section of the study area at an elevation of 230m. The majority of the study area is at a lower elevation.

3 BATS AND WINDFARMS

3.1 Policy and Guidance

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

- the Habitats Directive 92/43/EEC;
- Conservation (Natural Habitats, &c.) Regulations 1994 (as amended).
- the Wildlife and Countryside Act 1981 (as amended); and
- the Nature Conservation (Scotland) Act 2004 (as amended).

In the UK, guidelines have been produced with regards to assessing the ecological impact upon bats from windfarm 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 windfarm projects, revision 2014. EUROBATS Publication Series No. 6.

After the completion of field surveys in 2017, Scottish Natural Heritage (SNH) *et al*. (2019) published new survey guidelines for bats and onshore windfarms:

- SNH, Natural England, Natural Resources Wales, RenewableUK, Scottish Power Renewables, Ecotricity Ltd, the University of Exeter & Bat Conservation Trust (BCT) (2019). *Bats and Onshore Wind Turbines: Survey Assessment and Mitigation*.

SNH *et al*. (2019) now replaces the interim Natural England guidance (Natural England, 2014) and bat survey guidelines (Hundt, 2012). Surveys were conducted prior to the release of the 2019 guidance and as such were based on the preceding Natural England (2014) and Hundt (2012) guidance. The surveys and assessment are in line with the applicable guidance in use at the time of survey (Natural England (2014) and Hundt (2012). The subsequent analysis of bat data and assessments of bat activity has been revised and updated to consider the 2019 guidance as far as practicable.

3.2 Potential Impacts

In some circumstances, bats may be at a greater risk of death from wind turbines than birds because they are affected by barotrauma as well as direct collision from blades (Baerwald *et al*. 2008).

Exeter University found that most bat fatalities at UK windfarms 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.

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 3-1 and Table 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 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 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	

SNH *et al.* (2019) guidance includes an updated collision risk assessment for British bat species. This is divided into bat species likely to be threatened due to their susceptibility to wind turbine collisions, and populations likely to be threatened due to impacts from wind turbines. The most notable change in the guidance compared to previous sources (Natural England, 2014) is that certain common species, i.e. common and soprano pipistrelle bats, have been revised from medium collision risk species (Natural England, 2014) to now be considered as high collision risk species (SNH *et al.,* 2019). The population risk has also been revised for common and soprano pipistrelle bats with these bats reclassified from a low population risk (Natural England, 2014) to a medium population vulnerability species (SNH *et al.,* 2019).

This change in collision risk and population vulnerability is mainly due to research work at UK onshore windfarms which has found the relative percentage of fatalities at wind turbines to be soprano pipistrelle (40.6 %), common pipistrelle (48.6 %), noctule bats (10.7 %) with single carcasses of brown long-eared bat, Nathusius' pipistrelle bat and Natterer's bat also recorded (DEFRA, 2016).

A synthesis of European and American data by the Swedish Vindval research programme (Rydell *et al*., 2012) concluded the following habitats to be high risk locations for windfarms; coasts, wetlands, forested hills and ridges with linear landscapes such as lake shores, rivers, treelines, hedgerows, etc. also considered to increase the likelihood of collision. This study found that peak mortality usually (90 %) occurred on nights with low wind speeds in late June to early October and to a lesser extent (10 %) also in April-June. The National Bats & Wind Turbines Project (DEFRA, 2016) found that most nights on which bat casualties occurred had low mean wind speeds (≤5 m/s at ground level; c.a. <10 m/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.

A study on the response of bats to clear fell harvesting in the UK showed bat activity increased in areas of clear fell (Kirkpatrick *et al*., 2017). Activity of *Nyctalus* and pipistrelle species was significantly higher following felling according to the study. *Myotis* spp. activity was similar before and after felling at control and treated sites. The increase in activity was attributed to an increase in invertebrates and manoeuvrability to hunt, as well as edge habitat affording bats protection from environmental conditions and predators. The size of the felled area also influenced activity (for bats overall), with 90 % higher activity in smaller felled stands (less than 5 ha) compared to larger felled stands (greater than 30 ha). For common pipistrelle, activity in felled areas decreased with the duration since harvesting. The greatest activity occurred in stands felled within two months compared to those harvested more than 16 months previously (Kirkpatrick *et al*., 2017). The small-scale felling ('key-holing') required for the installation of wind turbines could put foraging bats at risk of collision with turbines, with access roads and newly felled areas allowing access into different plantation areas and potentially guiding bats toward turbines.

A study that radio tracked female soprano pipistrelle bats over two seasons in an area of the Galloway Forest Park in Scotland found that most individuals selected coniferous habitats over other habitat (Kirkpatrick *et al,* 2018), covering large distances to access plantation areas (mean 9.6 ± 3.12 km^2). At a local scale, bats used forest tracks to access water, felled stands or patches of broadleaved tree cover within the plantation. Sitka spruce plantations support a high abundance of the highland midge (*Culicoides impuctatus*) with it likely that female bats were availing this plentiful food resource in the summer months during lactation which is an energetically expensive period.

There are often species-specific differences in the risks linked with habitat types: e.g. for noctule bats the presence of woodland is associated with increased risk, whereas for pipistrelles, there is some evidence of lowered risk (DEFRA, 2016).

3.3 Study Area Assessment

The appropriate level of effort for a bat survey at a proposed windfarm development depends on the scale of its likely impact, which in turn depends on the size of the project 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 project must be assigned as a high, medium or low risk Site. Annex 3 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 proposed Development.

The study area was assessed as a medium risk site in 2015 (see Technical Appendix 8.3A) with spatial and temporal surveys carried out as per recommended guideline (Hundt, 2012). The results of these surveys showed high risk species (*Nyctalus* species) to be using the study area. Surveys in 2017 were designed in order to collect further data on *Nyctalus* species to determine their fidelity and activity rates within the study area. To achieve this, it was decided that the best approach was to substantially increase the number of static detectors deployed seasonally across the study area and to also increase their operational times. This allowed a large amount of data to be collected and analysed.

The BCT assessment table (Hundt, 2012) which was used to determine the site risk level for bats (see Annex 3 and Annex 4), is comparable to the SNH *et al*. (2019) new survey guidelines (see Annex 7), with both assessment tables using similar factors such as roost sites, value of habitats and connectivity of the study area to determine the risk of the proposed Development to bats. The new guidance does, however, also consider the size of the windfarm and the proximity of the study area to other windfarms. When using the new assessment table (Annex 7), the study area is also assessed to be a medium risk due to the following factors:

- The proposed Development is medium-sized (>10 turbines), with relatively large turbines (75 m blade length), and has other windfarm projects within 5 km;
- Geographical location – the study area is located within the known range of high collision risk species (*Leisler's* / *Nyctalus* spp. and *Pipistrellus* spp.);

- There is negligible roosting suitability within the 200 m plus rotor radius of turbines with a study area dominated by closed conifer plantation which is considered suboptimal for a bat roost;
- During operation there would be medium foraging and commuting suitability within 200 m plus rotor radius of turbines, based on the assumption that clear-felling would occur in stages, and turbines would be key-holed and connected by 5 m wide access tracks; and
- The study area is connected to the wider landscape by some limited linear features of moderate suitability (some watercourses).

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 study area and its environs.

The South West Scotland Environmental Information Centre (SWSEIC) were contacted and asked to provide records for the study area with the search extended by 5 and 10 km from the Site for bat records.

An earlier desk study was carried out on records from the 'Scottish Leisler's Bat Project' supplied to MacArthur Green by John Haddow in May 2015 which is reported on separately (Technical Appendix 8.3B). This search located one *Nyctalus* passive record within 10km of the study area.

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. These records are from the whole of southern Scotland with the records including data from long-term monitoring at proposed windfarms, other developments and on-going research work being carried out by the 'Scottish Leisler's Bat Project' from 2010 to 2014. A search for records within 20km from the Site was completed.

4.2 Temporal Surveys – Static Detectors

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

Thirteen Anabat SD2 detectors were placed at thirteen locations throughout the study area in May, July and September (refer to Figure 8.6). 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. Detectors were deployed for the whole month with memory cards and batteries changed periodically to collect data and maintain the functionality of the detectors. **Error! Reference source not found.** shows a summary breakdown of the temporal survey effort with Table 4-2 listing their GPS locations and a description of the habitat they were placed in.

Table 4-1 Summary of Temporal Surveys

Survey Date	Locations	Total Survey (hrs:mins:secs)	Total Number of Complete Nights
May 01/05/17 – 06/06/17	1	311:01:16	32
	2	349:53:57	36
	3	349:53:57	36
	4	349:53:57	36
	5	349:53:57	36
	6	349:53:57	36
	7	349:53:57	36
	8	349:53:57	36
	9	349:53:57	36
	10	349:54:10	36
	11	349:53:57	36
	12	349:53:57	36
	13	349:53:57	36
	Total	4509:48:53	**464**
July 30/06/17 – 01/08/17	1	290:13:16	32
	2	290:13:16	32
	3	290:13:16	32
	4	290:13:16	32
	5	290:13:17	32
	6	290:13:16	32
	7	290:13:16	32
	8	244:52:27	27
	9	290:13:17	32
	10	290:13:16	32
	11	290:13:17	32
	12	290:13:16	32
	13	290:13:16	32
	Total	3727:31:42	**411**
September 01/09/17 – 02/10/17	1	420:08:06	27
	2	420:08:06	31
	3	420:08:06	31
	4	420:08:08	31
	5	420:08:06	31
	6	325:15:57	24
	7	420:08:06	31
	8	325:16:27	24
	9	420:08:06	31
	10	420:08:06	31
	11	420:08:08	31
	12	420:08:06	31
	13	420:08:06	31
	Total	5272:01:34	**385**
Total Survey (hrs:mins:secs)	**13509:22:09**	**Total Survey (complete nights)**	**1260**

Table 4-2 Description of Anabat Locations

Location	Habitat Description	GPS Location	Bearing	Survey period
1	In the open next to a small stand of deciduous trees, close to forestry track	220715 583063	250	May, July, September
2	North of track on a small open hillock	220354 582192	340	May, July, September
3	In forestry clearing adjacent to the stone ruins of a settlement	219263 581788	350	May, July, September
4	On buttress of bridge along Water of Tig Burn	218550 581431	40	May, July, September
5	Next to forestry track and forestry ride	217484 582049	40	May, July, September
6	Along powerline ride on hard standing area	219510 581304	240	May, July, September
7	Along plantation ride	219761 580803	240	May, July, September
8	In the open at the back of a borrow pit	220746 580824	178	May, July, September
9	Along plantation edge and clear fell and adjacent to burn	221782 581241	272	May, July, September
10	In section of young plantation near forestry track	219320 579736	72	May, July, September
11	Within open area of clear fell	220526 579019	17	May, July, September
12	Within area of clear fell and plantation edge	221275 579184	44	May, July, September
13	Next to road within an area of clear fell	220870 577715	70	May, July, September

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].

Bat registrations per night (brpn) were also used to show *Nyctalus* species activity as this unit is used to determine the requirement for mitigation measure such as curtailment.

BAI (per night) = Total number of bat registrations / number of nights of recording [brpn].

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 windfarm 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 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.

No analysis regarding call structure to separate feeding buzzes from echolocation and social calls was undertaken.

Myotis species calls often overlap depending on their surrounding environs i.e. cluttered or open space. This often makes it difficult to identify *Myotis* bats to species level. If *Myotis* calls could not be identified to species level they were recorded as *Myotis* species.

Some *Nyctalus* spp. calls could not be assigned to species level due to these calls overlapping in frequency. Due to overlap in the call structure of Leisler's and noctule bat calls and the resulting uncertainty of identification for some calls, the BAI for this species was summarised where appropriate, even when identification to species level was undertaken.

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 spectrogram.

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. or *Nyctalus* spp. It is possible that for *Myotis* spp. these recordings could represent species not identified above such as whiskered bat with this species know to occur within Dumfries and Galloway, with a known roost 54 km south east of the Site.

Anabat detectors are a commonly used bat detector for acoustic monitoring at windfarm sites however; all bat detectors have limitations and will only monitor bat activity within a limited area,. Anabats usually have a range of 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 study area can be sampled.

The analysis of bat data is subject to required 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 bat calls as noise files. From data analysis at other sites it was found that 1 % of noise files contained bat calls that could be identified to species level. As noise files were not manually checked, it can be assumed that there was a small loss of bat data.

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 a 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 a 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.

5.1 Recording at Height

No at-height bat detector surveys were undertaken for the proposed Development.

A study by DEFRA (2016) concluded that ground level monitoring may be sufficient for evaluating common and soprano pipistrelle risks, because activity at ground rather than at height was a better predictor of fatality. However, in closed canopy situations where key-holing of turbines is proposed, it was recommended that monitoring at height should be considered because of the difficulty of inferring above-canopy level activity from ground-based detectors. The DEFRA study found no clear linear relationships between the elevation of the detector and the ratio of passes for all species recorded (ground to height), and there was considerable variability between researched sites. It is likely that ground-based surveys gave an accurate account of species composition of bat populations. It may be that activity levels of high flying *Nyctalus* species over closed canopy woodland situations were underestimated, which should be taken into account during any assessment process. It is therefore considered that conducting static detector surveys at ground level only is not considered to have affected the ability to conduct a robust assessment of bat activity at the study area.

6 SURVEY RESULTS

6.1 Desk-based Study

No records were received from the local record centre[1]. Records of *Nyctalus* bats within 20 km of the Site are shown in Figure 8.7.

6.2 Temporal Surveys – Static Detectors

Static detectors were deployed at thirteen proposed turbine locations in May, July and September. Detectors were left out to record for the whole month (refer to Figure 8.6).

In total, seven bat species and 30,669 bat registrations were recorded within the study area throughout the survey period as shown in **Error! Reference source not found.** Species recorded were soprano pipistrelle (PIPPYG), common pipistrelle (PIPPIP), Leisler's (NYCLEI), noctule (NYCNOC), brown-long eared bat (PLEAUR), Natterer's (MYONAT) and Daubenton's (MYODAU) with a total BAI of 2.27 brph. Bat registrations identified to genus level were *Nyctalus* spp. (NYC) and *Myotis* spp. (MYO).

6.2.1 Summary of Activity

The most commonly recorded species was:

- soprano pipistrelle with 23,203 registrations and a BAI of 1.7 brph, followed by;
- common pipistrelle with 5,201 registrations and a BAI of 0.4 brph;
- noctule with 937 registrations and a BAI of 0.07 brph;
- Leisler's with 638 registrations and a BAI of 0.05 brph;
- Daubenton's with 195 bat registrations and a BAI of 0.01 brph;
- *Myotis* spp. with 50 bat registrations and a BAI of 0.003 brph;
- *Nyctalus* spp. with 47 bat registrations and a BAI of 0.003 brph;
- Natterer's with 17 registrations and a BAI of 0.001 brph;
- brown long-eared bat with 11 registrations and a BAI of 0.001 brph.

High risk species (*Nyctalus* species) accounted for 5% of the registrations recorded within the study area while medium risk (pipistrelle species) and low risk species *(Myotis* and *Plecotus* spp.) accounted for 94% and 1% of the species recorded, respectively.

The species composition of the study area is as shown in Graph 6-1.

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

- location 9 (5762 registrations, 5.43 brph);
- location 13 (5706 registrations, 5.38 brph);
- location 1 (4303 registrations, 4.21 brph);
- location 11 (3689 registrations, 3.48 brph);
- location 4 (3184 registrations 3 brph);
- location 12 (2346 registrations 2.21 brph);
- location 7 (1645 registrations, 1.55 brph);
- location 10 (1227 registrations, 1.16 brph);

[1] E-mail exchange with e-mail notifying on unknown length of data provision delays from SWSEIC from 17 April 2019.

- location 5 (989 registrations, 0.93 brph);
- location 8 (801 registrations, 0.87 brph);
- location 3 (417 registrations, 0.39 brph);
- location 2 (384 registrations, 0.36 brph); and
- locations 6 (216 registrations, 0.22 brph).

The BAI per location over the duration of the survey period for low, medium and high risk species in relation to turbine collision risk is illustrated in Graph 6-2 to Graph 6-4.

Analysis of the temporal data is shown in Table 6-1 to Table 6-4 below. In May 7,958 registrations and a BAI of 1.76 brph was recorded. This bat activity increased for July (9,524 registrations and a BAI of 2.6 brph) and September (13,187 registrations and a BAI of 3.2).

Table 6-1 Summary of Temporal Survey Results

Loc.	PIPPYG	PIPPIP	NYCLEI	NYCNOC	NYC	PLEAUR	MYONAT	MYODAU	MYO	NoID	Reg.	BAI [brph]
1	3238	757	106	96	10	0	2	28	0	66	**4303**	**4.21**
2	227	47	49	41	2	3	1	3	1	10	**384**	**0.36**
3	289	64	15	31	2	0	1	10	1	4	**417**	**0.39**
4	2920	150	18	15	2	1	7	26	20	25	**3184**	**3.00**
5	670	226	28	11	2	0	1	26	2	23	**989**	**0.93**
6	117	33	26	19	4	1	1	6	2	7	**216**	**0.22**
7	1172	377	19	21	1	0	1	37	2	15	**1645**	**1.55**
8	465	213	27	64	3	1	0	5	1	22	**801**	**0.87**
9	4106	988	158	380	16	3	2	26	8	75	**5762**	**5.43**
10	928	244	28	11	1	2	0	4	1	8	**1227**	**1.16**
11	3080	552	11	28	0	0	0	9	1	8	**3689**	**3.48**
12	1267	671	116	196	4	0	0	4	3	85	**2346**	**2.21**
13	4724	879	37	24	0	0	1	11	8	22	**5706**	**5.38**
Total Reg.	**23203**	**5201**	**638**	**937**	**47**	**11**	**17**	**195**	**50**	**370**	**30669**	**2.27**
Total BAI [brph]	**1.7**	**0.4**	**0.05**	**0.07**	**0.003**	**0.001**	**0.001**	**0.01**	**0.003**	**0.03**		

(Abbreviations: PIPPYG – soprano pipistrelle; PIPPIP - common pipistrelle; NYCLEI – Leisler; NYCNOC – Noctule; NYC – *Nyctalus* spp.; PLEAUR – brown long-eared; MYONAT –Natterers; MYODAU – Daubenton's; MYO– *Myotis* spp. and NoID – unknown species)

Table 6-2 Summary of Activity Totals – May – 01/05/17-06/06/2017

Loc.	PIPPYG	PIPPIP	NYCLEI	NYCNOC	NYC	PLEAUR	MYONAT	MYODAU	MYO	NoID	Reg.	BAI [brph]
1	161	57	12	50	7	0	2	17	0	5	311	**1.00**
2	49	15	18	11	1	0	0	1	0	7	102	**0.29**
3	69	20	5	14	2	0	0	8	0	2	120	**0.34**
4	823	73	5	7	2	1	3	8	4	9	935	**2.67**
5	81	62	11	5	2	0	0	5	2	3	171	**0.49**
6	62	14	3	3	1	0	1	4	0	1	89	**0.25**
7	619	154	5	5	1	0	1	15	0	5	805	**2.30**
8	143	97	4	14	1	0	0	3	0	5	267	**0.76**
9	825	557	30	176	14	2	2	13	2	40	166	**4.75**
10	361	42	13	6	1	0	0	2	0	2	427	**1.22**
11	1361	284	0	13	0	0	0	7	0	2	166	**4.76**
12	614	373	19	108	3	0	0	0	2	16	113	**3.24**
13	147	102	8	5	0	0	0	4	0	2	268	**0.77**
Total Reg.	**5315**	**1850**	**133**	**417**	**35**	**3**	**9**	**87**	**89**	**99**	**7958**	
Total BAI [brph]	**1.18**	**0.41**	**0.03**	**0.09**	**0.008**	**0.0007**	**0.002**	**0.02**	**0.0197**	**0.02**	**1.76**	

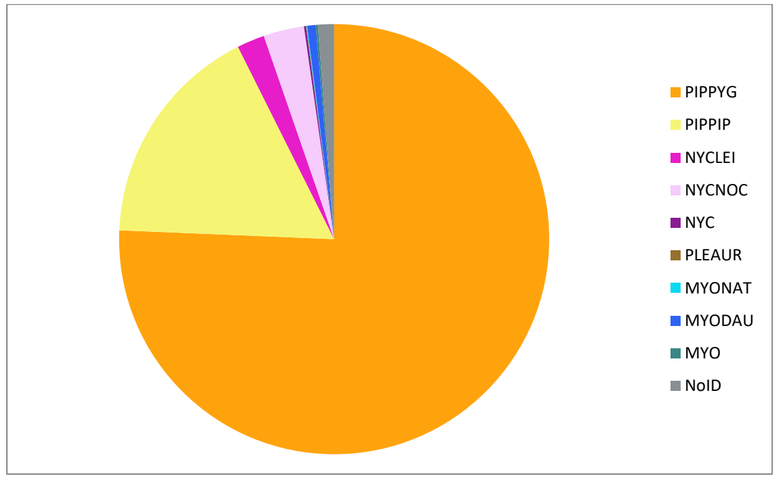
Table 6-3 Summary of Activity Totals – July – 30/06/17-01/08/2017

Loc.	PIPPYG	PIPPIP	NYCLEI	NYCNOC	PLEAUR	MYONAT	MYODAU	NoID	Reg.	BAI [brph]
1	2622	669	82	40	0	0	11	55	**3479**	**11.99**
2	54	18	25	20	0	1	2	2	**122**	**0.42**
3	75	29	8	10	0	1	1	2	**126**	**0.43**
4	797	59	11	7	0	4	9	5	**892**	**3.07**
5	183	108	10	3	0	1	9	19	**333**	**1.15**
6	19	12	7	10	0	0	2	5	**55**	**0.19**
7	325	188	10	10	0	0	18	9	**560**	**1.93**
8	118	79	19	26	0	0	1	11	**254**	**1.04**
9	747	299	112	173	1	0	7	30	**1369**	**4.72**
10	406	185	8	1	2	0	1	5	**608**	**2.09**
11	696	73	8	6	0	0	2	4	**789**	**2.72**
12	309	226	92	76	0	0	1	20	**724**	**2.49**
13	113	63	16	13	0	0	3	5	**213**	**0.73**
Total BAI [brph]	**6464**	**2008**	**408**	**395**	**3**	**7**	**67**	**172**	**9524**	
Total Reg.	**1.73**	**0.54**	**0.11**	**0.11**	**0.001**	**0.002**	**0.02**	**0.05**	**2.6**	

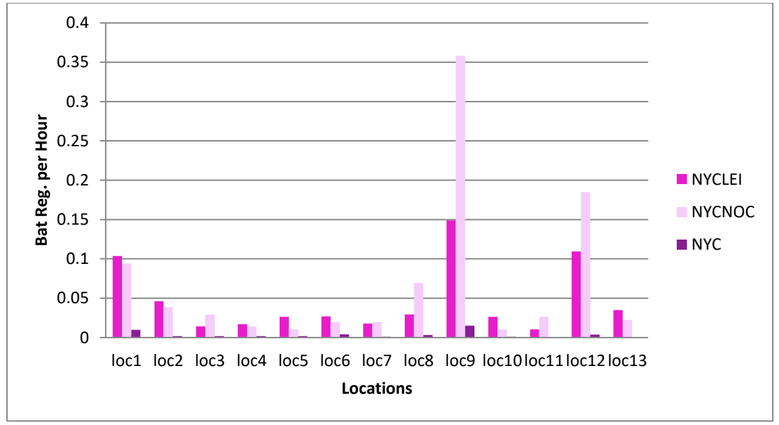
Table 6-4 Summary of Activity Totals – September – 01/09/17-02/10/2017

Loc.	PIPPYG	PIPPIP	NYCLEI	NYCNOC	NYC	PLEAUR	MYONAT	MYODAU	MYO	NoID	Reg.	BAI [brph]
1	455	31	12	6	3	0	0	0	0	6	**513**	**1.22**
2	124	14	6	10	1	3	0	0	1	1	**160**	**0.38**

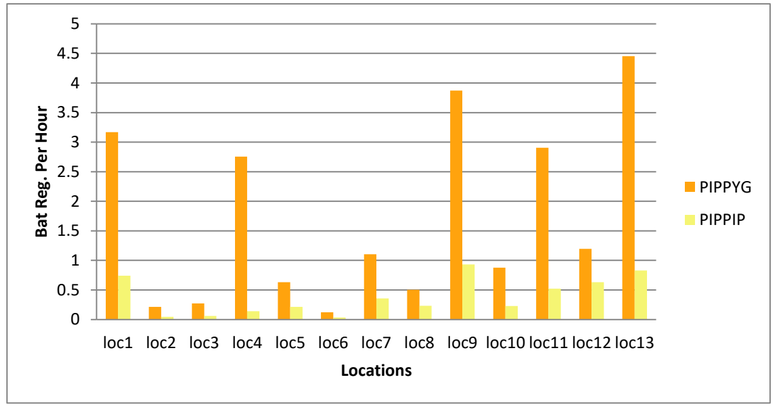
Loc.	PIPPYG	PIPPIP	NYCLEI	NYCNOC	NYC	PLEAUR	MYONAT	MYODAU	MYO	NoID	Reg.	BAI [brph]
3	145	15	2	7	0	0	0	1	1	0	**171**	**0.41**
4	1300	18	2	1	0	0	0	9	16	11	**1357**	**3.23**
5	406	56	7	3	0	0	0	12	0	1	**485**	**1.15**
6	36	7	16	6	3	1	0	0	2	1	**72**	**0.22**
7	228	35	4	6	0	0	0	4	2	1	**280**	**0.67**
8	204	37	4	24	2	1	0	1	1	6	**280**	**0.86**
9	2534	132	16	31	2	0	0	6	6	5	**2732**	**6.50**
10	161	17	7	4	0	0	0	1	1	1	**192**	**0.46**
11	1023	195	3	9	0	0	0	0	1	2	**1233**	**2.93**
12	344	72	5	12	1	0	0	3	1	49	**487**	**1.16**
13	4464	714	13	6	0	0	1	4	8	15	**5225**	**12.44**
Total BAI [brph]	**11424**	**1343**	**97**	**125**	**12**	**5**	**1**	**41**	**40**	**99**	**13187**	
Total Reg.	**2.76**	**0.32**	**0.02**	**0.03**	**0.003**	**0.001**	**0.0002**	**0.01**	**0.01**	**0.02**	**3.2**	



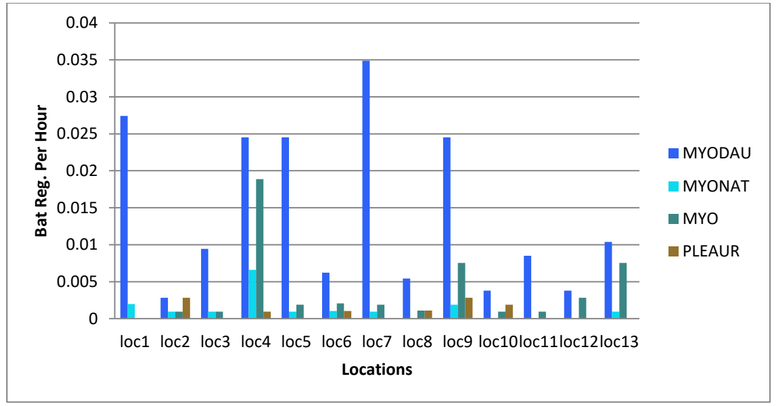
Graph 6-1 Temporal Survey Results: Species Composition of Study Area (based on BAI [brph])



Graph 6-2 Temporal Activity of High Risk Species on Study Area (based on BAI [brph])



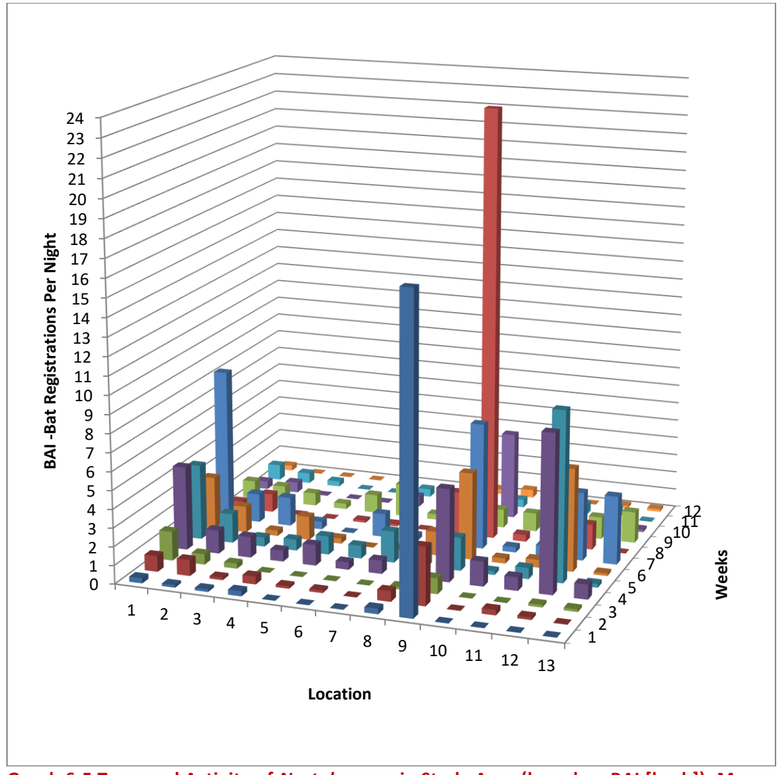
Graph 6-3 Temporal Activity of Medium Risk Species on Study Area (based on BAI [brph])



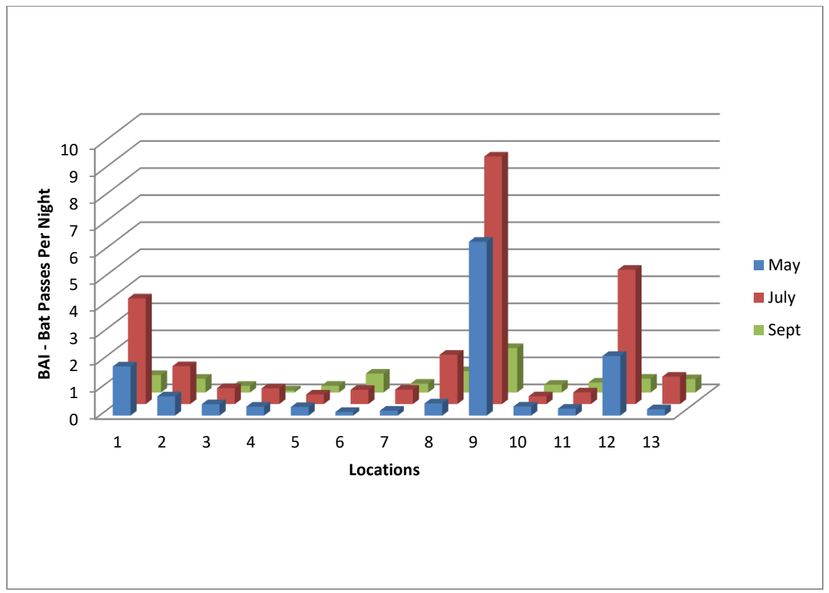
Graph 6-4 Temporal Activity of Low Risk Species on Study Area (based on BAI [brph])

6.2.1 Nyctalus Species Activity

Nyctalus spp. were recorded during all survey visits to the study area in May, July and September and at all locations. The location that recorded the greatest *Nyctalus* spp. activity index per night in May was location 9 followed by location 12 and location 1 as showed in Graph 6-5 and Graph 6-6. This activity was mirrored in July with locations 9, 12 and 1 again recording the most *Nyctalus* registrations. In September location 9 recorded the most *Nyctalus* registrations followed by location 8 and location 6. Location 9 recorded the most *Nyctalus* registrations in May, July and September.



Graph 6-5 Temporal Activity of *Nyctalus* spp. in Study Area (based on BAI [brph]); May = week 1 to 4, July = week 5 to 8 and September = week 9 to 12.



Graph 6-6 Temporal Activity of *Nyctalus* spp. in Study Area per Survey Month (based on BAI [brph])

Error! Reference source not found. shows the hourly times *Nyctalus* spp. registrations were recorded with Graph 6-7 to Graph 6-10 illustrating these results. Dusk and dawn times for the recording period are as follows:

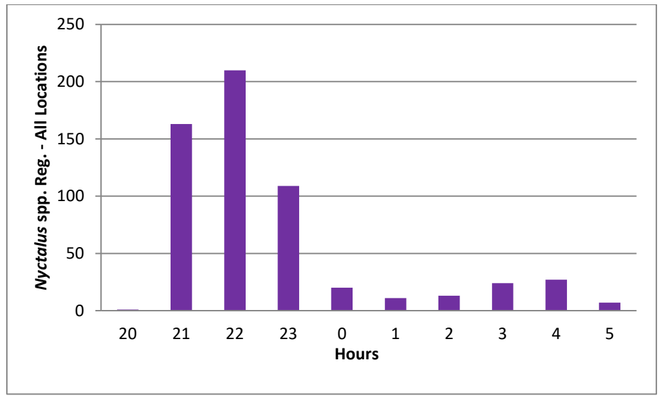
- May – Sunset (20:56 – 21:49) and Dawn (05:33 – 04:40);
- July – Sunset (22:04 – 21:25) and Dawn (04:36 – 05:20);
- September – Sunset (20:10 – 18:54) and Dawn (06:21 – 07:18).

Nyctalus spp. typically leave their roosts approximately 30 minutes before dusk to an hour after dusk (Shiel and Fairley, 1999b on Leisler's and Jones, 1995, on noctule bats). Leisler's bats are known to forage in the morning during lactation in July and return to their roost on average 12 minutes before dawn (Waters *et* al. 1999). The results show a slight bimodal pattern at dusk and dawn in May, July and September. Activity was often greater at dusk with activity decreasing in the middle part of the night to only show a low increase again at dawn.

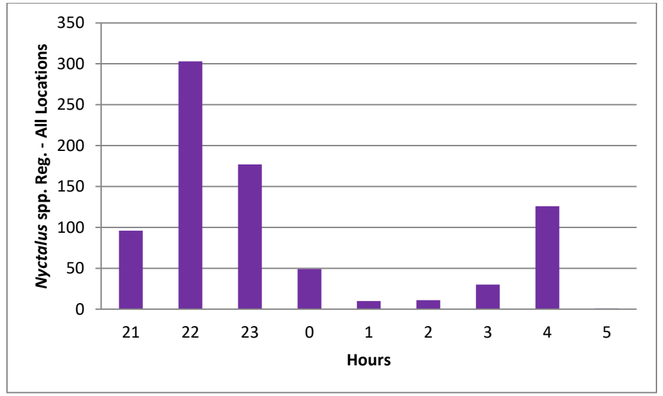
As location 9 recorded the greatest number of *Nyctalus* registrations in May, July and September. The recording times at this location were looked at separately in Graph 6-10. This graph shows peak activity of registrations to be close to dusk. Registrations dropped throughout the night with only a small increased of registrations recorded at dawn.

Table 6-5 Temporal Activity of *Nyctalus* spp. per hour for the Study Area (BAI per night)

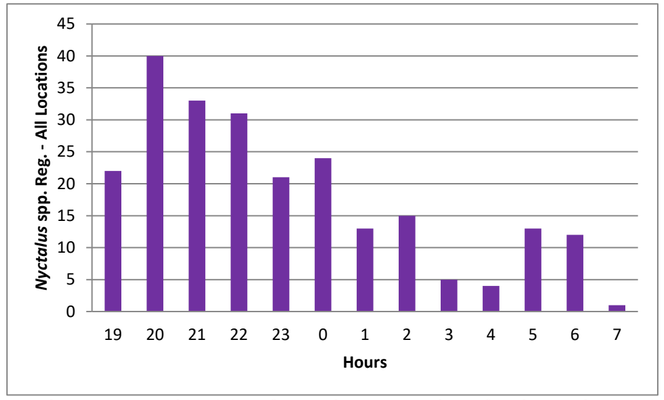
Location	0	1	2	3	4	5	6	7	19	20	21	22	23	Total
1	8	7	2	11	86	3		1	3	3	16	58	14	**212**
2	4	2	6	3	15		1		1	4	8	32	16	**92**
3	4	1	2	3	1					3	8	15	11	**48**
4	4	1		2		3				1	2	3	19	**35**
5	4		2	1	1						7	19	7	**41**
6	13	1	2	3		2	3		1	8	3	4	9	**49**
7	3	2	2	1	15				1	4	3	4	6	**41**
8	8	3	5	7	13	1	2		1	3	3	30	18	**94**
9	5	11	11	13	20	4	5		12	4	213	214	42	**554**
10	3	1		5	2					1	3	11	14	**40**
11	1	1	1	2	1	3			1	4	5	12	8	**39**
12	30	3	4	6	2	1			2	4	16	125	123	**316**
13	6	1	2	2	1	4	1			2	5	17	20	**61**
Total	**93**	**34**	**39**	**59**	**157**	**21**	**12**	**1**	**22**	**41**	**292**	**544**	**307**	**1622**



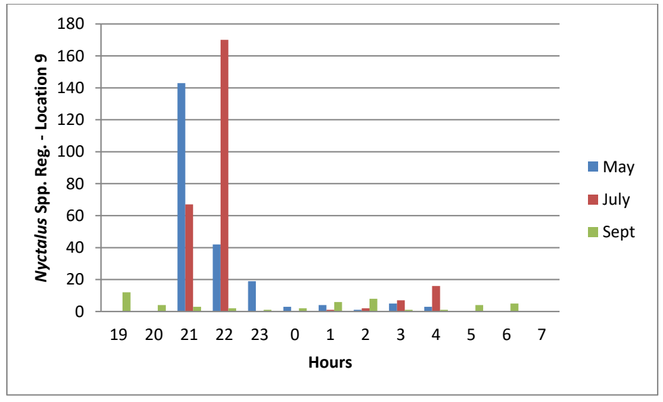
Graph 6-7 Temporal Activity of *Nyctalus* spp. per hour for the Study Area in May (BAI [brpn]), with sunset time between 20:56 – 21:49 and sunrise between 05:33 – 04:40



Graph 6-8 Temporal Activity of *Nyctalus* spp. per hour for the Study Area in July (BAI [brpn]) with sunset time between 22:04 – 21:25 and sunrise between 04:36 – 05:20



Graph 6-9 Temporal Activity of *Nyctalus* spp. per hour for the Study Area in September (BAI [brpn]) with sunset time between 20:10 – 18:54 and sunrise between 06:21 – 07:18



Graph 6-10 Temporal Activity of *Nyctalus* spp. at location 9 per hour (BAI [brpn])

6.3 Potential Bat Roosts

Earlier surveys for bats that were carried out in 2015 (Arecleoch Windfarm Extension, Bat Survey Report (2015 Surveys)) located potential bat roosts along the railway line (TN 1 to 3). These small buildings could not be investigated due to their location immediately adjacent to the railway line and could only be viewed from a distance.

A large cairn which is located out-with the Site was assessed as having low potential to be used as a bat hibernation roost. The stones are structurally stable and are tightly knitted together with the structure dense enough to provide shelter and a stable temperature for a low number of hibernating bats. As this structure is unlikely to hold a stable and high humidity, it could have low potential to be used by species such as pipistrelle bats that are more tolerant to fluctuating humidity.

Target notes can be seen in Annex 5 and are illustrated in Figure 8.8.

7 DISCUSSION

7.1 Survey Overview

In total seven bat species were recorded for the study area. The most commonly recorded species was soprano pipistrelle (PIPPYG), followed by common pipistrelle (PIPPIP), noctule (NYCNOC), Leisler's (NYCLEI), Daubenton's (MYODAU), *Nyctalus* species (NYC), Natterer's (MYONAT) and brown long-eared bat (PLAUR). Bat registrations identified to genus level were *Nyctalus* spp. (NYC) and *Myotis* spp. (MYO).

The results of the temporal surveys show the highest concentration of activity (BAI in bat registrations per hour) to be present at location 9 (5,762 registrations, 5.43 brph) followed by location 13 (5,706 registrations, 5.38 brph), location 1 (4,303 registrations, 4.21brph), location 4 (3,184 registrations, 3.6 brph) and location 12 (2,346, 2.21 brph). The locations that recorded the most bat registrations were areas with clear fell/plantation edge habitat, open clear fell habitat and burn habitat.

No bat roosts or structures with bat roost potential were located within 400 m of a turbine.

All the species recorded within the study area except for Leisler's are on the Scottish Biodiversity List: all pipistrelle species, Daubenton's bat, Natterers', noctule, and brown long-eared bat. Three species are UK Biodiversity Action Plan (UKBAP) species; noctule bats, brown long-eared bat, and soprano pipistrelle. Noctule, common pipistrelle and soprano pipistrelle are also recognised as priority species under the Local Biodiversity Action Plan (LBAP) for South Ayrshire (2007 - 2010) (South Ayrshire Council, 2008).

7.2 High Risk Species

Nyctalus spp. (noctule and Leisler's) were recorded at all locations in May, July and September.

Nyctalus species activity accounted for 5 % of the registrations recorded within the study area with a total of 1,622 registrations.

The location that recorded the greatest *Nyctalus* spp. activity index per night for the survey period was location 9 with an average of 5.7 brpn followed by location 12 with 2.6 brpn, location 1 with 2.1 brph and location 8 with 1.0 brph. All other locations recorded less than 1 brpn for the survey period.

Analysis of *Nyctalus* spp. registrations per hour show that there is a peak in registrations at dusk with a second small peak at dawn. This bimodal pattern is to be expected as bats emerge at dusk and often feed for a few hours before returning to their roost. They may also re-emerge and feed before dawn, in particular during the energy demanding period when females raise their pups (Swift, 1980). Location 9, which recorded the highest BAI of all locations in May, July and September for N*yctalus* spp., recorded peak registrations at dusk with 143 registrations recorded in May and 170 registrations recorded in July. There was a small rise in registrations at dawn but only in low numbers with 3 registrations in May and 16 registrations in July. In September registrations were spread out throughout the night with no clear activity pattern apparent. The flight speed of *Nyctalus* spp. with speeds around 6 m sec^{-1} (Jones, 1995) and 40 km/h (Shiel *et al.*, 1999a) with an early emergence with *Nyctalus* spp. typically emerging from their roosts approximately 30 minutes before dusk to an hour after dusk (Shiel and Fairley, 1999b on Leisler's and Jones, 1995, on noctule bats) makes it difficult to ascertain the proximity of a roost to the Site, as they can fly a long distance in a short space of time. Research has also shown that Leisler's and noctule bats can fly distances of 4.2 km to 13.4 km from their roosts (Waters *et al.*, 1999 & Shiel *et al.*, 1999a). The peak registrations at dusk would however suggest that *Nyctalus* spp. are coming from a roost or roosts in the locality.

Within the wider area of the Site there are features present such as watercourses, a small loch, clear fell, and conifer planation edge habitats that offer foraging potential for *Nyctalus* spp.. With *Nyctalus* spp. activity being slightly higher at locations within the north eastern area of the study area and lower within the south western areas, it may be that the Water of Tig along the northern boundary and the River Stinchar valley to the north and north east contain populations of *Nyctalus* bats, which use the closer parts of the study area for foraging and commuting.

Natural England has identified Leisler's and noctule bats as two of the three species of bat in the UK most likely to be at risk of collision with wind turbines (Natural England 2014).

Recent research work has estimated through spatial modelling that the predicated occurrence of *Nyctalus* spp. is distributed in the south and south eastern areas of Dumfries and Galloway. The proposed Development is within this area of predicate occurrence for *Nyctalus* species.

According to Battersby and Tracking Mammals Partnership (2005) there are about 50,000 noctules in the UK, with only about 250 of these in Scotland while there are 28,000 Leisler's in the UK, with only about 250 of these in

Scotland. Numbers of *Nyctalus* bats in Dumfries and Galloway are not well known. *Nyctalus* species in Scotland are believed to be at the edge of their British and western European ranges (Newson *et al*., 2007) and it is likely that based on the results of the survey of southern Scotland (Newson *et al*., 2007), population sizes for both noctule and Leisler's bats in Scotland are higher than estimated in the past. Mathews et al. (2018) concluded that there is considerable uncertainty surrounding the population estimates for this species, although they revised the population estimates to 100,500 in Great Britain, and 6,100 in Scotland.

For the study area *Nyctalus* spp. average registrations per month were greater than 1 brpn at location 1 (May 1.8 brpn and July - 3.9 brpn), location 2 (July – 1.4 brpn), location 8 (July – 1.8 brpn), location 9 (May - 6.4 brpn, July 9.2 brpn and Sept - 1.6) and location 12 (May 2.2 brpn). The highest activity recorded was at location 9 in July with 9.2 brpn recorded.

Key-holing for the placement of turbines may have an impact on the way *Nyctalus* species are currently utilising the study area, with clear felling known to increase *Nyctalus* activity (Kirkpatrick *et al.* 2017).

7.3 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). For soprano pipistrelle Mathews et al. (2018) estimated a national population of 4,670,000 adults, with a Scottish population of 1,210,000 adults. For common pipistrelle Mathews et al. (2018) estimated a national population of 3,040,000 adults, with a Scottish population of 875,000 adults.

Pipistrelle species were recorded at all locations across the study area. Pipistrelle bats accounted for 94% of the registrations recorded with a total of 23,203 registrations recorded for soprano pipistrelles and a total of 5,201 registrations recorded for common pipistrelles. July recorded a high activity level for medium risk species with a BAI of 11.34 brph recorded at location 1 with 3,291 registrations recorded. During September a moderate activity level with a BAI of 6.35 brph (2,666 registrations) was recorded at location 9 (5,178 registrations) and a high activity was recorded at location 13 with a BAI of 12.32 brph recorded.

Key-holing for the placement of turbines may have an impact on the way soprano and common pipistrelle bats are currently utilising the study area, with clear felling known to increase their activity (Kirkpatrick *et al.* 2017).

7.4 Low Risk Species

Low numbers of *Myotis* species (Daubenton's and Natterer's) and brown long-eared bats were recorded for the study area. *Myotis* species and brown long-eared bats are at low risk for collision and also at low risk at the population level (Natural England, 2014).

Myotis spp. and brown long-eared bat activity across the study area was low.

Within the wider area, there are known records of whiskered bats, although no roost site is known within 10km of the Site. It is therefore possible that a fraction of the *Myotis* spp. calls origin from whiskered bats; calls of this species more often not distinguishable from other *Myotis* spp. Due to the low overall recorded occurrence of *Myotis* spp. in the study area, the potential presence of whiskered bats has not further been considered.

7.5 Previous Surveys

Bat surveys carried out in 2015 recorded a high activity rate post-emergence for pipistrelle species at dusk. Overall bat activity index when combining spatial and temporal surveys for species at risk of collision, was considered to be low for species at high risk (*Nyctalus* spp.), and low for species at low risk (*Myotis* spp. and brown long-eared bat). For medium risk species (common pipistrelle, soprano pipistrelle and pipistrelle species) activity levels were seen to be moderate.

Nyctalus are considered to be an early emerging species. The closest time to dusk that *Nyctalus* species were recorded during the spatial surveys was 38 minutes after sunset, which would be considered a late emergence for *Nyctalus* spp., and this would suggest that a roost is not immediately adjacent to the study area. The temporal surveys recorded *Nyctalus* species at all locations.

The greatest activity (brph) seen throughout the spatial and temporal survey was from medium risk species such as common pipistrelle and soprano pipistrelle. The overall brph for common and soprano pipistrelle species was seen to be moderate with a value of 7.08 brph. The differences in assessment regarding activity for high risk species between the 2015 and 2017 survey results are likely due to a number of factors such as:

- more detector locations used in 2017 and therefore a greater sample size;
- detector operation times increase in 2017 so that detectors operated for a whole month;
- the variability of *Nyctalus* species activity which is influenced by weather, time of year and prey availability; and
- the utilisation of roosts with *Nyctalus* species using several maternity, all male and transitional roosts throughout the summer.

8. REFERENCES

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Annex 1. Protected Species Legal Status

All **bat** species receive protection under the Conservation Regulations (1994) (as amended) only[2].

Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)

Under Regulation 39 (1) it is an offence to:

a) deliberately or recklessly to capture, injure or kill a wild animal of a European protected species;

b) deliberately or recklessly:

i. to harass a wild animal or group of wild animals of a European protected species;

ii. to disturb such an animal while it is occupying a structure or place which it uses for shelter or protection;

iii. to disturb such an animal while it is rearing or otherwise caring for its young;

iv. 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);

v. 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

vi. 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;

c) deliberately or recklessly to take or destroy the eggs of such an animal; or

d) to damage or destroy a breeding site or resting place of such an animal.

Regulation 44 (2e) allows a licence to be granted for the activities noted in Regulation 39 such that:

Preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment.

[2] The Conservation Amendment (Scotland) Regulations (2007) removed EPA from Schedule 5 and 8 of the Wildlife and Countryside Act.

Annex 2. Legal and Conservation Status of UK Bat Species taken from Bat Conservation Trust

Source: http://www.bats.org.uk

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.

Annex 3. 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).

Annex 4. Minimum Standards for Bat Surveys

(Taken from Hundt, 2012)

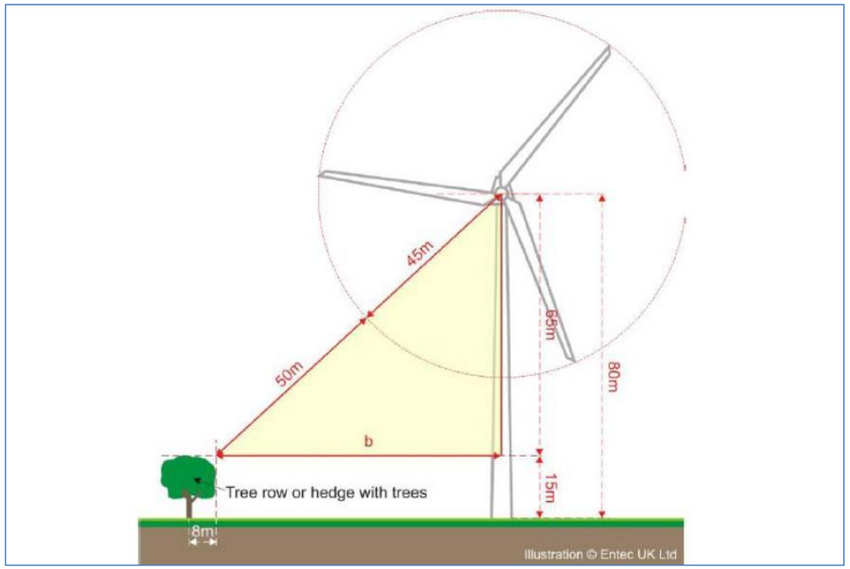
	Site Risk Level		
	Low risk	**Medium risk**	**High risk**
	Roost survey		
Selection of roosts requiring further survey	If evidence of roosting by medium or high-risk species and/or roosts of district importance is found, further survey should follow SNCO guidance and Hundt (2012) guidelines wherever 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	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 5. Target Notes

TN	Feature	Grid Ref.	Notes		Assessment
1	Buildings	NX21010 80243	Small building near railway. Seen at a distance. Assessment not possible. Proposed turbines not within 200m of a so no further survey work required.	21/05/2015	Unknown potential
2	Buildings	NX20244 79472	Small building near railway. Seen at a distance. Assessment not possible. Proposed turbines not within 200m of a so no further survey work required.	21/05/2015	Unknown potential
3	Buildings	NX20044 78256	Small building near railway. Seen at a distance. Assessment not possible. Proposed turbines not within 200m of a so no further survey work required.	21/05/2015	Unknown potential

Annex 6. Illustration to Show 50 m Buffer Zone

(*Taken from Natural England, 2015)*



Annex 7. Initial Site Risk Assessment

(Taken from Scottish Natural Heritage, 2019)

Site Risk Level (1-5)*		Project Size		
		Small	**Medium**	**Large**
Habitat Risk	**Low**	1	2	3
	Moderate	2	3	4
	High	3	4	5

Key: Green (1-2) – low/lowest site risk; Amber (3) – medium site risk; Red (4-5) – high/highest site risk

*Some sites could conceivably be assessed as being of no (0) risk to bats. This assessment is only likely to be valid in more extreme environments, such as above the known altitudinal range of bats, or outside the known geographical distribution of any resident British species.

Habitat Risk	**Description**
Low	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.
Moderate	Buildings, tree 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, treelines and streams.
High	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. At/near edge of range and/or on an important flyway. Close to key roost and/or swarming.

Project Size	**Description**
Small	Small scale development (≤10 turbines). No other wind energy developments within 10km. Comprising turbines <50 m in height.
Medium	Larger developments (between 10 and 40 turbine). May have some other wind developments within 5km Comprising turbines 50-100 m in height
Large	Largest developments (>40 m turbines) with other wind energy developments within 5km. Comprising turbines >100 m in height.