Technical Appendix 7.2: Protected Species

Artfield Forest Wind Farm

Technical Appendix 7.2: Protected Species

avianecology

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1 INTRODUCTION

1.1.1 This Technical Appendix has been prepared to accompany Chapter 7: 'Ecology' of the Artfield Forest Wind Farm (hereafter the Proposed Development) Environmental Impact Assessment Report (EIA) Report.

1.1.2 It presents detailed methodologies and results of desk studies and field surveys completed to inform the design and assessment of the Proposed Development.

1.1.3 It should be read with reference to the following figures, presented in **Volume 3a** of the Artfield Forest EIA Report:

- **Figure 7.1**: Statutory Designated Sites for Nature Conservation
- **Figure 7.5**: Existing Terrestrial Mammal Records;
- **Figure 7.6**: Terrestrial Mammal Survey Results;
- **Figure 7.7**: Bat Activity Survey Plan;
- **Figure 7.8**: Bat Activity Survey Results;
- **Figure 7.9**: Fish Records; and,
- **Figure 7.10**: Fish Habitat Survey Sample Points and Results.

1.1.4 Included within this report are the following:

- Desk study to identify the presence, or likely presence, of protected and notable species;
- Terrestrial mammal surveys;
- Bat activity surveys; and
- Fisheries habitat surveys.

1.2 Site Overview

1.2.1 The Site is located approximately 8km northwest of Kirkcowan, 15km west of Newton Stewart, east of Artfield Fell. The Site is shown on Figure 7.1: Statutory Designated Sites for Nature Conservation (EIAR Volume 3a).

1.2.2 The habitats comprise a mix of commercially managed coniferous forestry and rough grazing pastures. The Site also supports areas of recently felled and replanted woodland together with compartments of mixed plantation woodland.

1.2.3 Several watercourses intersecting the Site, which primarily drain into the Tarf Water. The Mulniegarroch Burn / Purgatory Burn form part of the Site's north-western boundary.

1.2.4 The eastern extent of the Site holds previous planning consent for the (now lapsed) Gass Wind Farm, comprising nine wind turbines and associated infrastructure (Dumfries and Galloway Council

Planning Reference 14/P/1/0674). Reference is made in this report to the Environmental Impact Assessment undertaken for that application[1].

1.2.5 EIA documentation for the adjacent Kilgallioch Extension Wind Farm (2019[2]) has also been reviewed to inform the baseline and where relevant, records are presented on **Figure 7.5 and 7.6** in **Volume 3a** of the EIA Report.

2 METHODOLOGY

2.1.1 This section provides detailed methodologies of desk studies and field studies undertaken to establish baseline protected species information to inform the design and assessment of the Proposed Development.

2.1.2 Field surveys were completed by Avian Ecology personnel, with the exception of the Fish Habitat surveys, which was undertaken by Galloway Fisheries Trust (GFT).

2.1.3 Avian Ecology surveys have been undertaken by S Whiteley BSc (Hons) MCIEEM, A Hulme *BSc (Hons.)*, Z Hinchcliffe *BSc (Hons.)* and A Morley *BSc (Hons.)*, all professional ecologists with considerable experience in the survey and identification of field signs of protected species in Scotland.

2.1.4 Fisheries surveys were undertaken by the GFT are detailed in full within **Annex 5**.

2.2 Desk Study

2.2.1 A desk study review of available information was undertaken to identify possible ecological constraints and designated sites within proximity to Site.

2.2.2 Key data sources are summarised in **Table 2.1**.

Table 2.1: Desk study – key data sources.

Key Source	Information Sought	Search Area
Sitelink[3]	Statutory designated sites for nature conservation with qualifying protected species interests.	Within 5km of the Site boundary, extended to 10km for sites with qualifying bat interests (**Figure 7.1** in Volume 3a of the Artfield Forest EIA Report.)
Scotland's Environment Map[4]	Status of watercourses.	Watercourses which intersect or immediately adjacent to the Site.
Article 17 Habitats Directive Report (2019)[5]	The location of the Site with regards to known species	n/a.
	ranges in the UK.	
South West Scotland Environmental Information Centre (SWSEIC)	Existing protected species records and non-statutory designated sites with protected species interest.	Within 5km of the Site boundary, extended to 10km for bats (**Figure 7.5** in Volume 3a of the Artfield Forest EIA Report).
Scottish Squirrels[6]	Existing records of red squirrels.	Within 2km of the Site.
Gass Wind Farm Environmental Statement (ES) Chapter 7	Existing protected species records from baseline surveys.	Study areas are shown on **Figures 7-6 to 7-14** of the Gass Wind Farm ES.
Kilgallioch Extension Wind Farm EIA Report Chapter 9	Existing protected species records from baseline surveys.	Study Areas are shown on **Figure 8.5** of the Kilgallioch Extension Wind Farm EIA Report.
Galloway Fisheries Trust	Information on local fish populations.	No response received.

2.3 Field Surveys – Terrestrial Mammals (excluding bats)

2.3.1 Detailed knowledge of the presence or likely presence of protected mammal species within proximity to the Proposed Development has been derived from field surveys.

Key Guidance

2.3.2 This section has been prepared with reference to the following guidance documents:

- Standing Advice for Planning Consultations. Protected Species: Otter *Luta lutra* (SNH, 2020a[7]);
- Standing Advice for Planning Consultations. Protected Species: Badger *Meles meles* (SNH, 2020b[8]);
- Standing Advice for Planning Consultations. Protected Species: Pine Marten *Martes martes* (SNH, 2020c[9]);
- Standing Advice for Planning Consultations. Protected Species: Water Vole *Arvicola amphibius* (SNH, 2020d[10]); and,
- Standing Advice for Planning Consultations. Protected Species: Red Squirrel *Sciurus vulgaris* (SNH, 2020e[11]).

[1] Sgurr Energy 2014 14_P_1_0674 Environmental Statement Vol. 2 Appendix 7A phase 1 Habitat and NVC Survey, and Drawing no. 162183-003 Figure 7.5 NVC Results.
[2] Scottish Power Renewables (2019) Kilgallioch Extension Wind Farm EIA Report. – Chapter 8 Ecology and Biodiversity

[3] https://sitelink.nature.scot/home
[4] https://www.environment.gov.scot/
[5] https://jncc.gov.uk/our-work/article-17-habitats-directive-report-2019-species/

[6] https://scottishsquirrels.org.uk/squirrel-sightings/
[7] SNH (2020a) Standing Advice for Planning Consultations. Protected Species: Otter. SNH, Inverness.
[8] SNH (2020b) Standing Advice for Planning Consultations. Protected Species: Badger. SNH, Inverness.
[9] SNH (2020c) Standing Advice for Planning Consultations. Protected Species: Pine Marten. SNH, Inverness.
[10] SNH (2020d) Standing Advice for Planning Consultations. Protected Species: Water Vole. SNH, Inverness.
[11] SNH (2020e) Standing Advice for Planning Consultations. Protected Species: Red Squirrel. SNH, Inverness.

Aims of the Study

2.3.3 The aims of the terrestrial mammal surveys were to:

- Assess the habitats within the survey area to identify features that have the potential to support protected terrestrial mammals; and,
- Identify presence, or likely absence, of protected terrestrial mammals.

Survey Approach

2.3.4 Terrestrial mammal surveys were carried out between 12th September and 4th November 2019 alongside bat activity surveys, followed up with an additional walkover visit on 2nd September 2020. Survey effort comprised walkover surveys and camera trap surveys.

Walkover Surveys

2.3.1 Surveys comprised a systematic search of areas out to at least 100m of the Proposed Development as access allowed, in order to identify signs indicating the presence, or potential presence, of terrestrial mammals as detailed in **Table 2.2**. The survey area is presented on **Figure 7.6** in Volume 3a of the Artfield Forest EIA Report.

2.3.2 The Study Area was extended to accessible areas within 200m of the Proposed Development for otter and 250m for pine marten in accordance with SNH guidance (2020a[7] and 2020c[9]).

2.3.3 Surveys were undertaken during weather conditions conducive to the survey of terrestrial mammals.

Table 2.2: Walkover survey methods.

Species	Method
Otter	The walkover survey sought to identify field evidence indicative of otter presence along watercourse stretches within the Study Area including spraints, paw prints, paths, slides, food remains, potential holts and other places used for shelter.
Badger	The walkover survey sought to identify field evidence indicative of badger within the Study Area including setts, mammal runs, paw prints, hair, snuffle holes, scratching posts and latrines. As the majority of the Study Area comprised closed canopy commercial forestry, typically unfavourable for badger sett creation and foraging, search effort focused on linear habitat features, grassland habitats and woodland pockets.
Pine marten	Pine martens are primarily found in woodland habitats, including conifer plantations. They will also venture into open habitats to hunt, particularly if prey is abundant. Dens are typically made in hollow trees, amongst rocks and boulders or in disused bird nests or squirrel dreys. A search was therefore made for potential den sites within woodland habitats and rocky outcrops within the Study Area. Pine martens can be territorial and will leave scats on tracks and notable features to mark their territory such as rocks, tree stumps, and intersections with linear features such as watercourses, fences and woodland edges. An examination of suitable features within the study area was therefore also made for potential pine marten scats.
Water vole	The walkover survey sought to identify field evidence indicative of water vole presence along watercourse stretches within the Study Area including potential burrows, faeces, latrines, feeding stations, lawns, paw prints and

Species	Method
	sightings.

Camera Traps

2.3.4 As the majority of the walkover Study Area comprises commercial forestry plantation, most land was inaccessible and therefore the placement of camera traps was undertaken within the Site to further identify the presence of terrestrial mammals. The placement of camera traps was focused amongst woodland plantation edges, with equipment purposefully set out in locations more likely to capture mammals entering or leaving these habitats.

2.3.5 Two camera trap locations were deployed as illustrated on **Figure 7.6** in Volume 3a of the Artfield Forest EIA Report. A description of habitat features at each trap location is provided in **Table 2.3**. Mackerel baited camera traps were deployed from 12th September to 4th November 2019, with batteries changed on the 10th October 2019.

Table 2.3: Camera trap locations and recording dates.

Camera Trap	Grid Reference	Habitat Description
1	NX2522266590	Positioned on a tree overlooking a wall where a pine marten scat had been found.
2	NX2468867171	Positioned on an existing post by a large spruce overlooking a watercourse.

2.4 Field Surveys - Bats

Key Guidance

2.4.1 This section has been prepared with reference to current Joint Agency guidance: *'Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation'* (2019[12]) a document prepared jointly by NatureScot, Natural England, Natural Resources Wales (NRW) and the Bat Conservation Trust (BCT).

2.4.2 Additional pieces of guidance and peer reviewed literature have also been referred to and are referenced where relevant.

Survey Approach

2.4.3 Bat activity surveys were undertaken in accordance with current NatureScot guidance (SNH, 2019[12]) to establish the bat species assemblage using the Study Area, the spatial and temporal distribution of bat activity, the location and extent of commuting or foraging habitat used by bats and the locations of roosts and swarming sites that could potentially be affected by the Proposed Development.

2.4.4 The following surveys were undertaken:

[12] SNH, Natural England, Natural Resources Wales, RenewablesUK, ScottishPower Renewables, Ecotricity Ltd, the University of Exeter, and The Bat Conservation Trust (2019). Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation. Version: January 2019

- Preliminary Roost assessment of buildings and trees; and,
- Ground-level activity surveys.

2.4.5 Ground-level activity survey data have been uploaded to the Ecobat database and analysed using the Mammal Society's software, in accordance with NatureScot (SNH, 2019[12]) guidance.

2.4.6 The Study Area for field surveys is presented on **Figure 7.7 (EIAR Volume 3a)**.

Aims of the Study

2.4.7 The aims of the bat surveys were to:

- Assess the habitats within the Site to identify features that have the potential to support maternity roosts and significant hibernation roosts;
- Identify species using the Site and temporal and spatial variations;
- Assess the level of activity of bats within the Site; and,
- Assess the potential risks to bats in line with NatureScot (SNH, 2019[12]) guidance.

2.4.8 This report presents the methodology and result of bat surveys. It also presents the assessment of 'Site Risk' in accordance with NatureScot (SNH, 2019[12]) guidance.

Habitat Appraisal for Potential Bat Roost Features

2.4.9 The Study Area was walked during daylight hours to search for potential bat roost features within the Site and within at least 200m plus blade tip of the Proposed Development turbine locations.

2.4.10 The walkover was conducted alongside the Extended Phase 1 Habitat survey in June 2019, and updated in September 2020.

2.4.11 Identified trees were assessed from ground level and not subject to endoscope inspection or aerial inspection of elevated features.

Ground-level Static Surveys

2.4.12 Automated static detectors were deployed within the Site in May, July, August and October 2020, sampling the spring, summer and autumn periods (Spring: April-May, Summer: June-mid-August, Autumn: mid-August-October).

2.4.13 A total of 12 static detector locations were used. These are illustrated in **Figure 7.7** in Volume 3a of the Artfield Forest EIA Report and detailed in **Table 2.4,** including distance to nearest proposed turbine location.

2.4.14 NatureScot (SNH, 2019[12]) guidance stipulates that survey effort should be focused in those parts of the Site where turbines are most likely to be located. Detectors were therefore positioned as near to proposed turbine locations as possible, based on an initial layout at the time of survey. The deployment of detectors at turbine locations was constrained by dense plantation forestry, and therefore effort was focused to forest rides and clear-fell areas.

2.4.15 Each monitoring location comprised a single Songmeter (SM2) bat detector fitted with a single omnidirectional microphone attached to a 1m high wooden stake or tree. Activity generated was based on a full spectrum or zero-crossing analysis of the captured sound files[13].

2.4.16 Automated detectors were programmed to commence recording approximately 30 minutes before sunset and finish recording half an hour after sunrise, with all automated detectors set up to record simultaneously, to allow comparison of activity recorded across the Site for the same monitoring period.

2.4.17 Automated detectors were deployed for a minimum of consecutive 10 nights during each monitoring period at the onset of an appropriate weather window for bat activity i.e. forecast temperatures of >8°C (at dusk), maximum ground level wind speeds of 5m/s and no, or only very light, rainfall. Weather data was collected from a TFA Nexus Weather station deployed within the Site. See **Table 2.5** for details of the number of nights of deployment for each detector.

2.4.18 Detailed survey effort and photographs of example static locations are presented in **Annex 2** and weather data is presented in **Annex 3**.

Table 2.4: Monitoring locations.

Detector I.D.	Grid Ref	Nearest Turbine	Distance from Turbine (m)	Phase 1 Habitat Classification[14]	Linear Feature within 50m
MS1	NX2350268803	T4	71.39	A2.2 - Forestry track	Coniferous plantation edge.
MS2	NX2326369113	T1, T2	T1= 352.7 T2= 271.5	D6 – Wet heath	Coniferous plantation edge.
MS3	NX2298368629	T3	182.1	A2.2 - Forestry track	Coniferous plantation edge.
MS4	NX2268168585	T5	229.8	E - Blanket Mire	Coniferous plantation edge.
MS5	NX2399367316	T8, T9	T8= 608.8 T9= 479.5	A2.2 - Open clearing within woodland adjacent to forestry track.	Coniferous plantation edge.
MS6	NX2467167192	T12	310.2	B5 – marshy grassland	Coniferous plantation edge.
MS7	NX2413167200	T11	368.6	A2.2 - Forestry track	Coniferous plantation edge.
MS8	NX 476265907	T11	1608	B2.2 – semi improved neutral grassland	Coniferous plantation edge.
MS9	NX2509165540	T11	2,055	B5 – marshy grassland	Stone wall
MS10	NX2564266952	T12	988.9	A2.2 – recently planted (young)	n/a
MS11	NX2408466631	T11	890.6	A2.2 - Forestry track	Coniferous

[13] During the first year of implementation of SNH guidance (2019), a combination of full spectrum and zero-crossing bat detectors is considered acceptable. Zero-crossing detectors are however, expected to be replaced over time with full spectrum detectors

[14] JNCC (2010) Handbook for Phase 1 Habitat Survey – a technique for environmental audit. JNCC. Peterborough

Detector I.D.	Grid Ref	Nearest Turbine	Distance from Turbine (m)	Phase 1 Habitat Classification[14]	Linear Feature within 50m
					plantation edge.
MS12	NX2387966337	T11	1,239	A2.2 - Forestry track	Coniferous plantation edge.

Table 2.5: Recorded nights at monitoring stations.

I.D.	No. Nights		
	Spring	Summer	Autumn
MS1	10	54	28
MS2	10	54	39
MS3	10	54	39
MS4	0	15	28
MS5	10	32	40
MS6	1	0	18
MS7	10	54	20
MS8	10	54	27
MS9	10	46	36
MS10	10	27	36
MS11	2	50	21
MS12	2	32	4

Survey Limitations

2.4.19 Occasional detector failures occurred. These are common events and are not considered to affect the overall validity of the data set.

2.4.20 MS4 failed to record during the spring period (May 2019). MS12 in summer and autumn (August and October) recorded 3 and 4 nights respectively. Following the failure of MS4 in spring (May 2019), detectors in summer and autumn were left out for significantly longer periods to compensate for any short recording lengths (maximum of 21 nights in summer and 34 nights in autumn).

2.4.21 Overall, the majority of detectors recorded for at least 11 nights per season, above the recommended minimum 10 nights (SNH, 2019[12]). Minor limitations are unlikely to result in substantial limitations to the dataset.

2.4.22 With regard to weather data, one night of sampling was excluded from the analysis as it did not meet the criteria for appropriate weather conditions (SNH, 2019[12]) and no bats were recorded.

2.4.23 Nights were also recorded in weather conditions which did not meet the criteria, but bat activity was still recorded so these have been included within the analysis. Although it is recognised that poor weather can affect bat activity, excluding these data from the analysis skews the dataset and would

remove some high collision risk species (noctule, Leisler's) from the dataset. Subsequently inclusion of these nights represents a precautionary approach.

2.4.24 For the purposes of analysis, the beginning of autumn recording period was considered to be the 17th August 2020.

2.4.25 Bat equipment was left out recording in the first week of November 2020 but the results have been excluded from analysis.

2.4.26 Data recorded from the on-Site weather station is presented, although some failures did occur during May when no rain was recorded.

2.4.27 Temperatures reached <8°C on 11 nights in October, with temperatures steadily decreasing across the month. In recognition of the extended survey period this is not considered to be a limitation.

Data Analysis and Assumptions of Bat Activity

2.4.28 Bat sound analysis has been undertaken by Ms S. Whiteley BSc MCIEEM, who has completed specific training on bat sound analysis (training by Dr S. Sowler MCIEEM) and has over 8 years' experience conducting sound analysis for wind farm developments across the UK and 9 years' experience completing bat surveys.

2.4.29 Analysis and interpretation of bat activity has followed the principles presented within Collins (2016[15]) and NatureScot (SNH, 2019[12]) guidance.

2.4.30 Digital sonograms were analysed through Kaleidoscope Pro (Wildlife Acoustics) software using AutoID Version 5.1.9g before being uploaded to the Ecobat Tool (Lintott et al., 2018[16]) for analysis. A selection of sonograms was manually checked prior to uploading to Ecobat, through Kaleidoscope Viewer and Analook (Titley Scientific).

2.4.31 Bat detectors record the passage of echolocating bats, therefore enabling an estimation of relative bat activity levels at a particular location or feature within a survey area.

2.4.32 For the purpose of sonogram analysis, bat activity was taken as the number of 'bat registered calls' i.e. a sequence of echolocation calls consisting of two or more call notes (pulse of frequency), not separated by more than one second (White and Gehrt, 2001[17], Gannon *et al*., 2003[18]), with a minimum call note length of >= two milliseconds.

2.4.33 It should be noted that as an individual bat can pass a particular location or feature on several occasions while foraging, it is subsequently not possible to estimate the number of individual bats recorded.

2.4.34 Weather data were also analysed to check for any periods of poor weather which could have affected bat activity. In accordance with NatureScot (SNH, 2019[12]) guidelines, bat surveys should be

[15] Collins, J. (ed) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd Edition). The Bat Conservation Trust, London.
[16] Lintott, P.R., Davison, S., van Breda, J., Kubasiewicz, L., Dowse, D., Daisley, J., Haddy, E. and Mathews, F., 2018. Ecobat: An online resource to facilitate transparent, evidence-based interpretation of bat activity data. Ecology and evolution, 8(2), pp.935-941
[17] White, E. & Gehrt, S. (2001). *Effects of recording media on echolocation data from broadband bat detectors*. Wildlife Society Bulletin 29: 974-978
[18] Gannon, W., Sherwin, R. & Haymond, S. (2003). *On the importance of articulating assumptions when conducting acoustic studies of habitat use by bats*. Wildlife Society Bulletin 31: 45-61

undertaken in appropriate weather: temperatures of >8°C at dusk, maximum ground level wind speed of >5m/s and no, or only very light rainfall.

Assessment of Relative Activity Levels

2.4.35 In accordance with NatureScot (SNH, 2019[12]) guidance, Ecobat was used to provide an objective interpretation of the relative importance of bat activity levels recorded within the Site. Ecobat is a free online tool provided by the Mammal Society. The tool compares baseline bat activity data collected for a site, with a national database (i.e. the 'reference range').[19], collected from similar areas at the same time of year. It then provides a percentile rank for each species and provides a numerical way of interpreting the results rather than relying on professional judgement alone. The online tool remains limited by the amount of data in the database on a locational basis; and therefore the results should be regarded as indicative rather than conclusive evidence of the importance of a site for bats.

2.4.36 As Ecobat is in its infancy, naturally there are fewer data in the reference range, reducing the confidence in the assigned category. It does however provide a guide for discussion along with Site-specific circumstances (e.g. habitats present, desk study information).

2.4.37 For each night that bat activity is recorded, Ecobat reports the percentile (and associated confidence value) of the data against the software's reference range. For example, data reported as being within the 81st percentile means that 81% of the nights within the reference range have less than or equal to the number of bat passes than the night being analysed.

2.4.38 **Table 2.6** presents the percentile and bat activity categories, replicated from NatureScot (SNH, 2019) guidance.

Table 2.6: Percentile scope and categorised level of bat activity.

Percentile	Bat Activity Category
81st to 100th	High
61st to 80th	Moderate to High
41st to 60th	Moderate
21st to 40th	Low to Moderate
0 to 20th	Low

2.4.39 For the purposes of analysis in Ecobat, the following parameters were used to stratify the reference range:

- Only records from within 30 days of the survey date.
- Only records from within 200km^2 of the detector locations.

2.4.40 The reference range for each species is given by Ecobat, and Ecobat recommend a reference range of >200 to be confident in the relative activity level. With the exception of brown long-eared bat *Plecotus auritus*, all species reached this threshold which provides increased confidence to the results:

- Brown long-eared - 170

[19] The number of other records that data for the site have been compared against.

- Common pipistrelle *Pipistrellus* – 1,402
- Leisler's bat *Nyctalus leisleri*- 430
- *Myotis* species – 867
- Noctule *N. noctula* – 644
- Soprano pipistrelle *P. pygmaeus*– 2,175

2.4.41 When data are entered into Ecobat for analysis, there is no allowance for entering recording nights where no bat passes were recorded, and so the analysis is carried out only on presence data. For example, the detector may have recorded 200 bat passes over a seven day period; all of these passes were recorded on two nights but the Ecobat Medians and Means only consider those two nights in their analysis, not the full seven days. This can act to skew the results and elevate the risk levels of percentile ranks calculated.

2.4.42 Ecobat output is therefore regarded as an indicative assessment and to be considered alongside desk study information and professional judgement, rather than conclusive evidence of the importance of a site for bats.

2.5 Field Surveys - Fisheries

2.5.1 Fish Habitat Surveys were undertaken by GFT in September 2020 and their report is presented in **Annex 5**.

2.5.2 All watercourses within the Site were surveyed in accordance with Scottish Fisheries Coordination Centre (SFCC) guidance (2007)[20] and with reference to additional species-specific guidance (e.g. in the context of Hendry and Cragg-Hine (2003)[21], to inform the likelihood of the presence of salmonids, eels, freshwater pearl mussel *Margaritifera margaritifera* and other protected/BAP species (incl. lamprey *Petromyzon marinus*) and potential for spawning and nursery areas.

2.5.3 Full details of methodology are provided within GFT report included in **Annex 5**.

[20] https://www.sfcc.co.uk/resources/habitat-surveying.html
[21] Hendry, Dr K., Cragg-Hine., Dr D (2003) Restoration of Riverine Salmon Habitats. A Guidance Manual. Environment Agency.

3 RESULTS

3.1.1 This section presents the results of desk study and field surveys and should be read with reference to **Figure 7.5** to **7.10 (EIAR Volume 3a)**.

3.1.2 Photographs from field surveys are presented in **Annex 1**.

3.2 Statutory Designated Sites for Nature Conservation

3.2.1 A review of Sitelink identifies that the River Bladnoch SAC intersects the Site, as shown on **Volume 3a Figure 7.1** of the Artfield Forest EIA Report. The River Bladnoch SAC is notified for supporting Atlantic salmon *Salmo salar.*

3.2.2 No other statutory designated sites for nature conservation with protected species interests were identified within 5km of the Site (extended to 10km for bats).

3.3 Pine Marten

3.3.1 Pine martens are protected under the Wildlife and Countryside Act 1981 (as amended in Scotland[22]). Certain methods of killing or taking pine martens are illegal under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)[25]. Listed on the Scottish Biodiversity List (SBL)[26].

Desk Study

3.3.2 A summary of desk study records are presented in **Table 3.1**.

Table 3.1: Desk study records summary – Pine marten

Source	Records
SWSEIC	A single record of pine marten was returned from SWSEIC within 5km of the Site, near to Muirglass, 1.5km north of the Site and is presented on Figure 7.5 (EIAR Volume 3a).
Gass Wind Farm ES	Field surveys were undertaken for the Gass Wind Farm submission between 2012 and 2013 (survey methodology guidance not referenced). No evidence of pine marten was recorded.
Kilgallioch Extension Wind Farm EIA Report	No evidence of pine marten was recorded during field surveys in 2019 following Vincent Wildlife Trust (2017[23]) and CIEEM (2013[24]) guidance.

[22] https://www.legislation.gov.uk/ukpga/1981/69/section/11/scotland

[23] Vincent Wildlife Trust (2015) Managing forests and woodlands for pine martens. Practical measures to protect and benefit pine marten. Available online at: https://www.vwt.org.uk/wp-content/uploads/2015/04/Pine-Martens-and-Forest-Management-Leaflet.pdf

[24] CIEEM (2013). Competencies for Species Survey: Pine Marten. Available online at: https://cieem.net/wpcontent/uploads/2019/02/CSS-PINE-MARTEN-April-2013.pdf

Field Surveys

3.3.3 Potential scats were found during surveys undertaken in 2019 and 2020 at the following locations and are shown on Figure 7.6: Terrestrial Mammal Results (EIAR Volume 3a):

- NX24649 67121 (2019);
- NX23884 67081 (2019);
- NX25222 66590 (2019);
- NX 24597 66384 (2019); and,
- NX22475 68712 (2020).

3.3.4 A possible pine marten form (resting site) was found 20m from the NX22475 68712 scat in 2020 at the base of a stone wall at grid reference NX22497 68722.

3.3.5 Dense coniferous plantation within the Site provides extensive suitable habitat for pine marten. The suitability of the Site is further enhanced due to its connectivity to a large conifer resource in the wider area.

3.4 Otter

3.4.1 As a European protected species, the otter is fully protected under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)[25]. Otters are also listed on the SBL[26].

Desk Study

3.4.2 A summary of desk study records are presented in **Table 3.2** and records are presented on **Figure 7.6 in Volume 3a** of the EIA Report.

[25] https://www.legislation.gov.uk/uksi/1994/2716/contents/made

[26] https://www.webarchive.org.uk/wayback/archive/20160402063428/http://www.gov.scot/Topics/Environment/Wildlife-Habitats/16118/Biodiversitylist/SBL

Table 3.2: Desk study records summary - Otter

Source	Records
SWSEIC	No records were received for otter within 5km of the Site.
Gass Wind Farm ES	Field surveys were undertaken for the Gass Wind Farm submission between 2012 and 2013 following Chanin, P (2003).[27] guidance. An otter spraint was found along the Tarf Water, no other evidence recorded. (Figure 7.6 of Gass Wind Farm ES).
Kilgallioch Extension Wind Farm EIA Report	A potential hover (lay-up site) was identified on Tarf Water (a clear entrance and slide) however there was no evidence of use by otter (footprints or spraints). Otter spraints were found elsewhere within the Study Area.

Field Surveys

3.4.3 No resting sites or any other evidence of otter was identified during 2019 walkover surveys.

3.4.4 An otter scat was found on a small footbridge at grid reference NX23239 69161 in September 2020. The scat contained fish bones.

3.4.5 Common frog *Rana temporia* and toad *Bufo*, otter prey species, were abundant across the Site during the September 2020 survey.

3.4.6 Watercourses within the Site are suitable for commuting and foraging otter and tributaries offered suitable vegetation structure to support resting animals; however the dense coniferous plantation and wetland habitats provide limited potential for establishment of a holt.

3.5 Water Vole

3.5.1 The water vole receives partial protection under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended in Scotland[22]). Water Voles are also listed on the Scottish Biodiversity List[26].

Desk Study

3.5.2 A summary of desk study records are presented in **Table 3.4** and presented on **Figure 7.6 in Volume 3a** of the EIA Report.

Table 3.4: Desk study records summary – Water vole

Source	Records
SWSEIC	No records were received from SWSEIC for water vole within 5km of the Site.
Gass Wind Farm ES	Field surveys were undertaken for the Gass Wind Farm submission between 2012 and 2013 following Strachen, R (2006).[28] identified suitable habitat along tributaries. No evidence of water vole was identified.

[27] Chanin, P (2003). Natura Life Series, Monitoring the European Otter. Natural England

[28] Strachan, R. (2006). Water Vole Conservation Handbook. Wildlife Conservation Research Unit, Oxford.

Source	Records
	Tarf Water was considered to be too fast flowing to support water vole
Kilgallioch Extension Wind Farm EIA Report	Results of terrestrial mammal surveys are presented on Figure 8.5, Volume 2 of the Kilgallioch Extension Wind Farm EIA Report and Figure 7.5 in Volume 3a. Evidence of water vole including burrows, droppings and feeding was identified on Monandie Burn, Loch Strand and Tarf Water. All three of these watercourses intersect the Site. Surveys followed Strachan, D. *et al.,* (2016.[29]) guidance. Evidence along Tarf Water was concentrated along slow flowing sections 1.6km north of the Site. The nearest burrow on Tarf Water was 530m north of the Site. No evidence of water vole was found along the stretch of Tarf Water on the northern boundary of the Site which borders the plantation woodland. Burrows, feeding remains and droppings were recorded on Loch Strand near High Eldrig, c. 380m north of the Site. Evidence on Monandie Burn included burrows, feeding and droppings. The Kilgallioch Extension survey results indicated a large water vole population was present on Loch Strand and Monandie Burn.

Field Surveys

3.5.3 Signs of water vole presence were identified during 2019 and 2020 surveys. Results are presented on **Figure 7.6 in Volume 3a** of the Artfield Forest EIA Report.

3.5.4 Burrows were found during the Phase 1 Habitat Survey in 2019 on bare peat banks at grid reference NX24378 67655 but were more representative of use by rat than water vole. Possible mink *Neovision vision* footprints and run was adjacent to the burrows.

3.5.5 Further burrows were recorded on a tributary of Tarf Water at grid reference NX23205 69177 with numerous burrows but also indicative of rat. However, one burrow had feeding remains outside of water horsetail *Equisetum arvense*, typical of water vole in 2019 and is presented on Figure 6.6 (EIAR Volume 3a).

3.5.6 Burrows and fresh feeding remains were found 20-30m upstream of the burrows at NX23221 69171 in September 2020 at grid references NX232690 which were typical of water vole. These records are also presented on **Figure 7.6 (EIAR Volume 3a)**.

3.5.7 Tarf Water was considered to be too fast flowing to support water vole; however the slower flowing tributaries provide suitable burrow creation opportunities and feeding resources.

[29] Dean, M, Strachan, R, Gow, D and Andrews, R (2016).The Water Vole Mitigation Handbook (Mammal Society Mitigation Guidance Series). Matthews, F and Chanin, P Eds, Mammal Society, London

3.6 Red Squirrel

3.6.1 Red squirrels are afforded protection under the Wildlife and Countryside Act 1981 (as amended in Scotland[22]) and Nature Conservation Act 2004. Listed on the SBL[26].

Desk Study

3.6.2 A summary of desk study records are presented in **Table 3.5** and records are presented on **Figure 7.5 in Volume 3a** of the EIA Report.

Table 3.5: Desk study records summary – Red squirrel

Source	Records
Scottish Squirrels	The nearest record to Site was a red squirrel sighting within 100m south of the Site in October 2018 at grid reference: NX 25366 64616.
SWSEIC	A total of 19 red squirrel records were received from SWSEIC. The majority of records related to Balminnoch Camp or Three Lochs Caravan Park. The closest records to Site was 930m east within plantation forestry adjacent to Meikle Cairn.
Gass Wind Farm ES	Field surveys were undertaken for the Gass Wind Farm submission between 2012 and 2013 following Gurnell, J, *et al* (2001[30]) guidance. Possible foraging evidence was found (although could not be differentiated from grey squirrel *Sciurus carolinensis*).
Kilgallioch Extension Wind Farm EIA Report	No evidence of red squirrel was identified within the Kilgallioch Extension site during 2019 surveys following Gurnell, J, *et al* (2001[31]) guidance.

Field Surveys

3.6.3 No evidence of red squirrel was recorded during the terrestrial mammal surveys in 2019 or 2020.

3.6.4 Conifer plantations in the northern and central sections of the Site provide extensive suitable habitat for red squirrel. The suitability of the Site is further enhanced due to its connectivity to a large conifer resource in the wider area.

[30] Gurnell J, *et al* (2001). Forestry Commission Practice Note 11. Forestry Commission, Edinburgh. Available at: http://www.forestry.gov.uk/pdf/fcpn011.pdf/$FILE/fcpn011.pdf

[31] Gurnell J, *et al* (2001). Forestry Commission Practice Note 11. Forestry Commission, Edinburgh. Available at: http://www.forestry.gov.uk/pdf/fcpn011.pdf/$FILE/fcpn011.pdf

3.7 Eurasian Badger

3.7.1 Badgers are afforded protection under the Protection of Badgers Act 1992, as amended by the Wildlife and Natural Environmental (Scotland) Act 2011[32].

Desk Study

3.7.2 A summary of desk study records are presented in **Table 3.6** and presented on **Figure 7.5 in Volume 3a** of the EIA Report.

Table 3.6: Desk study records summary - Badger

Source	Records
SWSEIC	No records were received for badger within 5km of the Site.
Gass Wind Farm ES	No evidence of presence was identified during 2012 and 2013 surveys following Scottish Badgers (2007[33]) guidance.
Kilgallioch Extension Wind Farm EIA Report	No evidence of presence was identified within the Kilgallioch Extension site during 2019 surveys following Scottish Badgers (2018[34]) guidance. An incidental sighting of badger prints was observed during peat probing surveys in 2019, 1.1km east of the Proposed Development. This record is presented on **Figure 6.5 in Volume 3a** of the EIA Report.

Field Surveys

3.7.3 No evidence of badgers was recorded during field surveys.

3.7.4 The forested regions to the north of the Tarf Bridge may provide some small areas of suitable habitat for badgers; however it was noted that the majority of the plantation is planted over wet habitats. As badgers prefer free-draining soils for the purposes of sett construction, much of the Site was found to be unsuitable for sheltering badgers.

3.7.5 There are small areas of grassland that may provide foraging and commuting opportunities within Gass Farm. However, the Site is dominated by conifer plantation, which has a low biomass of earthworms, the main constituent of the badger diet, compared to other habitats. The open areas within Gass Farm may therefore offer foraging opportunities for badger but they are unlikely to be present within the coniferous plantation woodland habitats, which occupy the majority of the Site.

[32] https://www.legislation.gov.uk/asp/2011/6/contents/enacted

[33] Scottish Badgers (2007) Level 1 Badger Awareness Manual, SNH Scotland's Wildlife Badgers and Development(http://www.snh.org.uk/publications/on-line/wildlife/Badgersanddevelopment/development.asp)

[34] Scottish Badgers (2018). Surveying for Badgers: Good Practice Guidelines. Available online at: https://www.scottishbadgers.org.uk/userfiles/file/planning_guidelines/Surveying-for-Badgers-Good-Practice-Guidelines_V1.pdf

3.8 Bats

3.8.1 Bats are European Protected species, afforded comprehensive protection under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)[25].

Desk Study

3.8.2 With reference to the 2019 UK Habitats Directive Article 17 Report[35], the Site is located within the known species distribution range for the following bat species:

- Brown long-eared bat;
- Common pipistrelle;
- Daubentons;
- Natterers *Myotis nattereri*;
- Leisler's bat;
- Noctule;
- Soprano pipistrelle; and,
- Whiskered *M. mystacinus*

3.8.3 A summary of desk study records are presented in **Table 3.7** and presented on **Figure 6.6 in Volume 3a** of the EIA Report.

Table 3.7: Desk study records summary - Bats

Source	Records
SWSEIC	SWSEIC returned records for the following species, including the nearest record from the Site: • Daubentons bat *Myotis daubentonii* – 2km east*;* • Natterer's – 2km east; • Leisler's – 8.5km south east*;* • Pipistrelle species *Pipistrellus spp.* – 1.5km north west*;* • Common pipistrelle*;* c.550m south; and, • Soprano pipistrelle - <100m south. All records related to bats in flight. No roost records were returned.
Gass Wind Farm ES	Bat surveys were undertaken in 2012 and 2013. Results are presented on Figure 7.7 to 7.11 of the Gass Wind Farm ES and appendix 7C. Surveys consisted of: • Initial scoping daytime walkover survey in 2012 (now referred to as a Preliminary Roost Assessment and Habitat Appraisal). • Walked transect surveys in 2012 and 2013.
Kilgallioch Extension Wind Farm EIA Report	No roosts were identified within 450m of proposed turbine locations. A potential roost was identified at High Eldrig, which is located c. 1.44km from the nearest Proposed Development turbine. Ground-level activity surveys undertaken in 2019 following NatureScot (SNH, 2019) guidance identified the following species: • Soprano pipistrelle; • Common pipistrelle; • Noctule; • Leisler's; • Myotis spp; and, • Brown long-eared bat. Surveys sampled the spring (May), summer (June) and autumn (August) periods. The Ecobat Assessment completed to inform the project concluded an Overall Site Risk of Medium at the majority of detector locations for common and soprano pipistrelle and *Nyctalus* species.

[35] https://jncc.gov.uk/our-work/article-17-habitats-directive-report-2019-species/

Field Surveys

3.8.4 Field surveys undertaken included:

- Preliminary Roost Assessment of buildings and trees;
- Habitat Assessment;
- Ground-Level Activity Survey Results, which include:
    - Overall Site results;
    - Temporal activity results (per month);
    - Spatial activity results (per detector);
    - Weather data; and,
    - Ecobat Results.
- Species result summaries; and,
- Assessment of Potential Site Risk.

Preliminary Roost Assessment of Buildings and Trees

3.8.5 Potential roost features within 200m + rotor radius (275m) were absent; the Site is dominated by coniferous plantation woodland which offers negligible roost opportunities and unlikely to support maternity or significant hibernation roosts.

3.8.6 The only buildings within the Site are at Low Eldrig. These comprise two adjacent stone buildings located at NX251679 (presented on **Figure 6.7 in Volume 3a** of the EIA Report). Each building was in a poor condition, with no roof, no windows and had not been in use for some time. Photographs of the buildings are presented in **Annex 1**.

3.8.7 The larger of the buildings (shown in Photograph reference P9-P12, **Annex 1**) supported a large gable end wall with exposed chimney cavities internally. The cavities could provide opportunities for small numbers of roosting bats and were considered to offer low roosting potential.

3.8.8 The second building consisted of four stone walls with no roof. All walls were exposed. Potential opportunities for roosting bats were considered to be negligible.

3.8.9 Ten mature ash *Fraxinus excelsior* trees were located within 10m of the buildings and were considered to offer low bat roost potential.

3.8.10 Overall the Site is considered to provide low/negligible bat roosting potential.

Habitat Assessment

3.8.11 The habitats within the Site comprise low value habitats in large commercial forestry areas, intersected by sheltered forest rides supporting wet heath and blanket bog habitats, which offer moderate foraging opportunities for foraging bats. The Tarf Water is considered likely to provide a foraging and commuting resource for bats, by offering slow flowing water in the main, sheltered by bordering wet heath and blanket bog habitats and commercial plantation forestry.

3.8.12 Upper reaches of burns and watercourses within the Site offer lower value foraging and commuting opportunities as they are in the main, over shadowed by forestry.

3.8.13 There is a lack of potential roosting locations within the Site and therefore the Site is likely to be primarily used for foraging of a small number of bats, with commuting primarily focused towards the Tarf Water.

Ground-level Activity Surveys

3.8.14 Overall 22,675 bat passes were recorded, over 12 monitoring stations and 895 nights of recording.

Overall Site Results

3.8.15 Bats were detected on 98 nights between 22/05/2019 and 31/10/2019, out of a possible 103 recording dates from 12 static bat detectors.

3.8.16 Species identified are presented in **Table 3.8** along with potential collision risk and population vulnerability as described in NatureScot (SNH, 2019[12]) guidance.

Table 3.8: Species recorded, collision risk and population vulnerability.

Species	Collision Risk	Population Vulnerability
Brown long-eared	Low	Low
Common pipistrelle	High	Medium
Leisler's bat	High	High
Myotis species	Low	Low/Medium
Noctule	High	High
Soprano pipistrelle	High	Medium

3.8.17 **Table 3.9** presents the total number of bat passes recorded, with soprano pipistrelle representing 77.6% of all records.

Table 3.9: Total number of bat passes.

Species	No. Bat Passes	Percentage of total (%)	Max Passes per Night	Mean Passes per Night[36]
Brown long-eared	29	0.1	2	0.03
Common pipistrelle	3,132	13.8	210	3.50
Leisler's	308	1.4	28	0.34
Myotis	507	2.2	26	0.57
Noctule	1,105	4.9	40	1.23
Soprano pipistrelle	17,594	77.6	749	19.66
Total	22,675	100.0	749	25.34

[36] Total passes recorded / total nights included

Spatial Distribution

3.8.18 The maximum and mean bat passes per night for each species, at each detector for all months are presented in **Table 3.10**. Results are presented on **Figure 6.8** in **Volume 3a** in the EIA Report.

Table 3.10: Maximum and mean bat passes per night per detector.

Species	Detector ID	Nights Recorded	No. Bat Passes	Max Passes per Night	Mean Passes per Night[37]
Brown long-eared	MS3	103	6	2	0.06
	MS5	82	4	2	0.05
	MS6	19	11	2	0.58
	MS9	92	2	1	0.02
	MS11	73	6	2	0.08
Common pipistrelle	MS1	92	284	52	3.09
	MS2	103	361	361	3.50
	MS3	103	209	24	2.03
	MS4	43	28	28	0.68
	MS5	82	40	6	0.65
	MS6	19	131	14	0.49
	MS7	84	231	27	6.89
	MS8	91	13	8	2.75
	MS9	92	606	73	0.14
	MS10	73	208	54	6.59
	MS11	73	120	26	2.85
	MS12	38	929	210	1.64
Leisler's	MS1	92	4	2	0.04
	MS2	103	16	9	0.16
	MS3	103	17	3	0.17
	MS5	82	57	10	0.70
	MS6	19	21	4	1.11
	MS7	84	42	28	0.50
	MS9	92	52	5	0.57
	MS10	73	1	1	0.01
	MS11	73	16	5	0.22
	MS12	38	82	17	2.16
Myotis	MS1	92	32	4	0.35
	MS2	103	10	2	0.10
	MS3	103	36	3	0.35
	MS5	82	61	13	0.74
	MS6	19	27	6	1.42
Noctule	MS9	92	99	12	1.08
	MS10	73	5	1	0.07
	MS11	73	28	5	0.38
	MS12	38	209	26	5.50
Soprano pipistrelle	MS1	92	48	8	0.52
	MS2	103	24	4	0.23
	MS3	103	265	31	2.57
	MS4	43	1	1	0.02
	MS5	82	107	15	1.30
	MS6	19	109	17	5.74
	MS7	84	28	19	0.33
	MS8	91	188	40	2.07
	MS9	92	85	18	0.92
	MS10	73	105	39	1.44
	MS11	73	78	8	1.07
	MS12	38	68	9	1.79
	MS1	92	426	81	4.63
	MS2	103	499	80	4.84
	MS3	103	384	34	3.73
	MS4	43	16	9	0.40
	MS5	82	253	28	3.09
	MS6	19	3744	687	197.05
	MS7	84	905	102	10.77
	MS8	91	2	1	0.02
	MS9	92	4025	523	43.75
	MS10	73	3792	749	51.95
	MS11	73	728	112	9.96
	MS12	38	2820	414	74.21

[37] Total passes recorded / total nights included

Temporal Distribution

3.8.19 **Table 3.11** presents the maximum and mean bat passes per night recorded for each detector.

Table 3.11: Mean and maximum bat passes per night per month.

Species	Month	Nights Recorded	Total No. Bat Passes	Max passes per night	Mean passes per night[38]
Brown long-eared	May	85	1	1	0.01
	Jul	239	3	1	0.01
	Aug	46	25	4	0.54
Common pipistrelle	May	85	394	74	4.64
	Jun	255	1658	230	6.50
	Jul	239	279	117	1.17
	Aug	46	587	127	12.76
	Oct	321	214	56	0.67
Leisler's	May	85	6	4	0.07
	Jun	255	51	12	0.20
	Jul	239	127	39	0.53
	Aug	46	117	15	2.54
	Oct	321	7	3	0.02
Myotis	May	85	40	15	0.47
	Jun	255	219	27	0.86
	Jul	239	28	8	0.12
	Aug	46	132	19	2.87
	Oct	321	88	14	0.27
Noctule	May	85	55	19	0.65
	Jun	255	293	31	1.15
	Jul	239	179	50	0.75
	Aug	46	392	71	8.52
	Oct	321	186	57	0.58
Soprano pipistrelle	May	85	1765	624	20.76
	Jun	255	3046	229	11.95
	Jul	239	3284	1571	13.74
	Aug	46	6162	960	133.96
	Oct	321	3336	987	10.39

[38] Total passes recorded / total nights included

Weather Data

3.8.20 Weather data are presented in **Annex 3**.

3.8.21 Very little rain was recorded across the survey period and this is most likely due to the sheltered nature of the location of the weather station, within commercial plantation forestry.

3.8.22 Where nights were recorded in weather conditions which did not meet the criteria, but bat activity was still recorded, these have been included within the analysis. Whilst it is recognised that poor weather can affect bat activity, excluding these data from the analysis skews the data set and would remove some higher collision risk species (noctule, Leisler's) from the data set.

3.8.23 The majority of survey nights were undertaken in suitable weather conditions and the surveying period was extended beyond the requirements of NatureScot guidance (2019[12]). Subsequently the bat survey data recorded is considered to be representative for the Site.

Ecobat Results

3.8.24 Full Ecobat results are presented in **Annex 4**.

3.8.25 All bat passes were uploaded to Ecobat Tool for percentile analysis and a total of 22,594 bat passes were included within their percentile analysis. Some files were excluded by their filters.

3.8.26 **Table 3.12** presents the key metrics of the Ecobat output for each species. Data from all monitoring locations are used to provide Site-wide averages/medians. Common and soprano pipistrelles fall under the 'High' bat activity category (See **Section 2.4**).

3.8.27 Spatial and temporal percentile analysis is presented separately under '*Assessing Potential Risks to Bats* (Section 3.8.51)'

Table 3.12: Number of nights recorded bat activity fell into each activity band or each species within the Site.

Species/Species Group	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
Brown long-eared	0	0	0	4	17
Common pipistrelle	47	66	51	60	96
Leisler's	2	10	15	17	44
Myotis	3	19	16	34	86
Noctule	14	27	56	40	81
Soprano pipistrelle	159	101	62	44	89

Table 3.13: Percentiles for each species within the Site.

Species/Species Group	Median Percentile [39]	95% CIs [40]	Max Percentile [41]	Nights Recorded	Activity Level
Brown long-eared	6	6 - 6	35	21	Low
Common pipistrelle	48	65 - 82	98	320	Moderate
Leisler's	21	6 - 6	89	88	Low to Moderate
Myotis	6	6 - 6	87	158	Low
Noctule	35	6 - 56	91	218	Low to Moderate
Soprano pipistrelle	66	88 - 93.5	100	455	Moderate

Potential Bat Roosts within Close Proximity to Site

3.8.28 Ecobat analysis showed that activity was recorded within the species-specific emergence time for the following locations:

- MS1 – common and soprano pipistrelle;
- MS2 – soprano pipistrelle and Myotis;
- MS3 - – common and soprano pipistrelle, noctule and Myotis;
- MS4 – soprano pipistrelle;
- MS5 – common and soprano pipistrelle, Myotis, brown long-eared;
- MS6 – common and soprano pipistrelle;
- MS7 – common and soprano pipistrelle and Leisler's;
- MS8 – common and soprano pipistrelle and noctule;
- MS9 – common and soprano pipistrelle, Myotis, Leisler's and noctule;
- MS10 – common and soprano pipistrelle;
- MS11 – common and soprano pipistrelle; and,
- MS12 – common and soprano pipistrelle.

3.8.29 Based on the Ecobat analysis above, it is likely that roosts for five widespread bat species are present within or in close proximity to the Site.

[39] A numerical representation of average activity levels relative to the surrounding landscape (within 200 km) for each night of surveying.
[40] An indication of the confidence in the median percentile.
[41] A numerical representation of maximum activity levels on any one night relative to the surrounding landscape (within 200 km) for each night of surveying

Species Summaries

Brown long-eared bat

3.8.30 Brown long-eared bat was recorded at MS3, MS5, MS6, MS9 and MS11. Temporal activity was consistently low, with all detectors recording low levels. Activity was highest at MS11, although still considered to fall under the Low activity level when compared to the reference range.

3.8.31 Activity was recorded in May, July and August, and was consistently low.

3.8.32 Low/moderate activity was recorded on four nights during the survey period and 17 nights of low activity were recorded. No nights representative of high to moderate activity were recorded.

3.8.33 Overall, activity for brown long-eared bat is considered to be representative of Low activity, using the criteria set out in NatureScot (SNH, 2019[12]).

Common Pipistrelle

3.8.34 Common pipistrelle was recorded at all monitoring stations with the exception of MS4. Activity was highest at MS12 with moderate to high activity recorded, and low to moderate or moderate at other locations. The mean pass rate (passes per hour/night) was highest at MS5, although still considered to fall under the Low to Moderate category when compared to the reference range.

3.8.35 Activity was recorded across all months, with moderate activity in spring and early summer and low to moderate in autumn.

3.8.36 Forty-seven nights of high activity were recorded over the survey period, with 96 nights which recorded low activity.

3.8.37 Overall, activity for common pipistrelle is considered to be representative of Low to Moderate / Moderate activity using the criteria set out in set out in NatureScot (SNH, 2019[12]).

Leisler's

3.8.38 Leisler's bat was recorded at all monitoring stations with the exception of MS4 and MS8. Activity was highest at MS7, with moderate activity recorded. All other monitoring stations recorded low or low to moderate activity.

3.8.39 Activity was recorded across all months. Activity was highest in May and July (low to moderate) and low in other months.

3.8.40 Two nights were considered to represent high activity, with the majority recording low activity (44 nights).

3.8.41 Overall, activity for Leisler's bat is considered to be representative of Low to Moderate activity using the criteria set out in set out in NatureScot (SNH, 2019[12]).

Myotis

3.8.42 Myotis bat species were recorded at MS1, MS2, MS3, MS5, MS6, MS9, MS10, MS11 and MS12. Activity was highest at MS12, with moderate activity recorded. All other monitoring stations recorded low or low to moderate activity.

3.8.43 Activity was recorded across all months, with activity highest in May and July (low to moderate). In other month's activity was low.

3.8.44 Three nights were considered to represent high activity, with the majority recording low activity (86 nights).

3.8.45 Overall, activity for Myotis is considered to be representative of Low to Moderate activity using the criteria set out in NatureScot (SNH, 2019[12]).

Noctule

3.8.46 Noctule was recorded at all monitoring stations with the exception of MS4. Activity was highest at MS3, MS5, MS6 and MS10, with moderate activity recorded. All other monitoring stations recorded low or low to moderate activity.

3.8.47 Activity was recorded across all months. Activity was low to moderate overall, with moderate activity in June and August.

3.8.48 Fourteen nights were considered to represent high activity, with the majority recording low activity (81 nights).

3.8.49 Overall, activity for Noctule is considered to be representative of Low to Moderate activity using the criteria set out in NatureScot (SNH, 2019[12]).

Soprano pipistrelle

3.8.50 Soprano pipistrelle was recorded at all monitoring stations. High activity was recorded at MS6 and MS12. All other monitoring stations recorded moderate to low activity.

3.8.51 Activity was recorded across all months. Activity in July was highest, representing high activity. Other months were moderate to high.

3.8.52 High activity was recorded on 159 nights, the highest for any species; however, 947 nights were sampled overall (all monitoring stations combined), therefore high activity is only representative of 16.8% of nights.

3.8.53 Overall, activity for soprano pipistrelle is considered to be representative of Moderate activity using the criteria set out in set out in NatureScot (SNH, 2019[12]).

Assessing Potential Risks to Bats

3.8.54 As highlighted in NatureScot (SNH, 2019[12]) guidance, wind turbine projects can impact on bats by:

- Collision mortality, barotrauma and other injuries (although it is important to consider these in the context of other forms of anthropogenic mortality);
- Loss or damage to commuting and foraging habitat, (wind farms may form barriers to commuting or seasonal movements, and can result in severance of foraging habitat);
- Loss of, or damage to, roosts; and,
- Displacement of individuals or populations (due to wind farm construction or because bats avoid the wind farm area).

3.8.55 To ensure that bats are protected by minimising the risk of collision, an assessment of impact at a Site requires a detailed appraisal of:

- The level of activity of all bat species recorded at the Site assessed both spatially and temporally;

- The risk of turbine-related mortality for all bat species recorded at the Site during bat activity surveys; and,
- The effect on the species' population status if predicted impacts are not mitigated.

3.8.56 The above information should be interpreted in the context of likely impacts on local populations. Relevant factors that should be considered include whether populations are at the edge of their range, cumulative effects, presence of protected areas designated for their bat interest and proximity to maternity roosts, key foraging areas or key flight routes, including possible migration routes.

Assessing Potential Risk

3.8.57 NatureScot guidance presents a two-stage process for assessing the potential risk to bats as a result of onshore wind turbine developments (SNH, 2019[12]):

Stage 1 - gives an indication of the potential risk level of a Site, based on a consideration of habitat and development-related features; and,

Stage 2 – uses the output of Stage 1 (i.e. the potential risk level of a Site) to provide an overall risk assessment based on the activity level of high collision risk species.

3.8.58 The assessment is intended to assist in the identification of those developments which are of greatest concern in terms of potential collision risks at the population level and inform the potential requirements for mitigation.

3.8.59 To inform the assessment ground-level static surveys were undertaken between May and October 2019 in accordance with NatureScot (SNH, 2019[12]) guidance.

Stage 1 – Initial Site Risk Assessment

3.8.60 In accordance with statutory guidance (SNH, 2019[12]), an assessment of risk has been carried out for all high collision risk species[42] recorded during bat activity surveys. This should be read with reference to Tables 2 – 3b of SNH guidance (SNH, 2019[12]). The assessment has not been undertaken for brown long-eared due to the low number of passes recorded.

3.8.61 The values and classification criteria provided within Table 3a of statutory guidance (SNH, 2019[12]) are replicated in **Table 3.8**. The criteria are intended to be taken as a guide, with habitat and development-related features at proposed wind farm sites rarely matching rigid descriptions. Professional judgement is therefore required to interpret and assign risk categories and conclude on the overall Site Risk Level.

3.8.62 In accordance within NatureScot (SNH, 2019[12]) guidance, the habitats within the Site most closely resemble 'Moderate Risk' habitats: *small number of potential roost features, or low quality; 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*.

3.8.63 The Proposed Development comprises a 'Medium' Project Site (10-40 turbines) of 12 wind turbines with a maximum height of 180m in height. There are also wind farms developments within 5km of the Site.

[42] As classified in "Table 2: Level of potential vulnerability of populations of British bat species" of current statutory guidance (SNH, 2019).

3.8.64 In accordance with the Site Risk Level matrix (replicated in **Table 3.14**), the Site is assessed as being of Medium Risk (3).

Table 3.14: Stage 1 – Initial Site Risk Assessment (taken from Table 3a of SNH (2019[12]) guidance)

Site Risk Level (1-5)	Project Size			
Habitat Risk		**Small**	**Medium**	**Large**
	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.				

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

Stage 2 – Overall Risk Assessment

3.8.65 Stage 2 has only been completed for species at high risk of collision, namely common and soprano pipistrelles, Leisler's and noctule.

3.8.66 In order to derive an "Overall Risk Assessment" the determined Bat Activity Category derived from the Ecobat Tool Output Report is compared against the Site Risk Level (Stage 1), using the matrix presented in **Table 3.15** (based on Table 3b in SNH, 2019[12]) to determine the level of overall risk.

Table 3.15: Overall Risk Assessment (Table 3b from SNH (2019[12]) guidance). Key: green = Low, Amber = Medium, Red = High.

Site Risk Level	Ecobat Activity Category					
	Nil	**Low**	**Low-Moderate**	**Moderate**	**Moderate-High**	**High**
Lowest	0	1	2	3	4	5
Low	0	2	4	6	8	10
Medium	0	3	6	9	12	15
High	0	4	8	12	15	18
Highest	0	5	10	15	20	25

3.8.67 The calculated Overall Risk Assessment per species, both temporally and spatially, generated from Ecobat for those nights where bats were recorded is presented in **Table 3.16** and **3.17**. The values as presented in the matrix in **Table 3.15** are presented, but the Overall Risk Category provided is concluded on the basis of the determined Ecobat conclusion and professional judgement. This enables reference to all available information and recognises the limitations of Ecobat.

3.8.68 The Ecobat tool is in its infancy and given current limitations in available bat survey data on the database, definitive bat activity for regions are not generated and bat activity representations are instead indicative for each region.

3.8.69 Based on this our results show that overall there is a Low/Medium likelihood of the Proposed Development resulting in significant impact on bats. Data collected indicates low/medium activity levels based on bat passes night. There are occasional nights which would represent medium/high activity (soprano pipistrelle at MS6 and in July), but such spikes in activity are not consistent with levels of high activity over an extended period.

3.8.70 Overall, for all species and detectors combined, the relative bat passes per night is 25, representative of low to medium activity.

3.8.71 In summary, the Overall Risk Assessment for common pipistrelle, Liesler's and noctule is considered to fall under "Low/Medium Site Risk", with soprano pipistrelle under 'Medium Site Risk'.

Table 3.16 Stage 2 - Evaluation of bat activity and overall activity level for each species per detector location.

Species / species group	I.D	Median Percentile[43]	Nights Recorded	Activity Category[44]	Site Risk Level (Stage 1)	Overall Risk Assessment (Stage 2)
Brown-long	MS1	-	-	-	-	-

[43] Based on the Median Percentile
[44] Median percentile in brackets

Species / species group	I.D	Median Percentile[43]	Nights Recorded	Activity Category[44]	Site Risk Level (Stage 1)	Overall Risk Assessment (Stage 2)
eared	MS2	-	-	-	-	-
	MS3	6	4	Low (1)	Medium (3)	Low (3)
	MS4	-	-	-	-	-
	MS5	6	3	Low (1)	Medium (3)	Low (3)
	MS6	6	7	Low (1)	Medium (3)	Low (3)
	MS7	-	-	-	-	-
	MS8	-	-	-	-	-
	MS9	6	2	Low (1)	Medium (3)	Low (3)
	MS10	-	-	-	-	-
	MS11	6	5	Low (1)	Medium (3)	Low (3)
	MS12	-	-	-	-	-
Common pipistrelle	MS1	35	41	Low to Moderate (2)	Medium (3)	Medium (6)
	MS2	48	27	Moderate (3)	Medium (3)	Medium (9)
	MS3	48	40	Moderate (3)	Medium (3)	Medium (9)
	MS4	-	-	-	Medium (3)	-
	MS5	35	14	Low to Moderate (2)	Medium (3)	Medium (6)
	MS6	35	27	Low to Moderate (2)	Medium (3)	Medium (6)
	MS7	52	28	Moderate (3)	Medium (3)	Medium (9)
	MS8	31	2	Low to Moderate (2)	Medium (3)	Medium (6)
	MS9	48	44	Moderate (3)	Medium (3)	Medium (9)
	MS10	35	33	Low to Moderate (2)	Medium (3)	Medium (6)
	MS11	35	31	Low to Moderate (2)	Medium (3)	Medium (6)
	MS12	80	33	Moderate to High (4)	Medium (3)	Medium (12)
Leisler's	MS1	6	3	Low (1)	Medium (3)	Low (3)

Species / species group	I.D	Median Percentile[43]	Nights Recorded	Activity Category[44]	Site Risk Level (Stage 1)	Overall Risk Assessment (Stage 2)
	MS2	6	6	Low (1)	Medium (3)	Low (3)
	MS3	6	11	Low (1)	Medium (3)	Low (3)
	MS4	-	-	-	Medium (3)	-
	MS5	35	15	Low to Moderate (2)	Medium (3)	Medium (6)
	MS6	35	11	Low (1)	Medium (3)	Low (3)
	MS7	56	3	Moderate (3)	Medium (3)	Medium (9)
	MS8	-	-	-	Medium (3)	-
	MS9	6	17	Low (1)	Medium (3)	Low (3)
	MS10	6	1	Low (1)	Medium (3)	Low (3)
	MS11	6	8	Low (1)	Medium (3)	Low (3)
	MS12	35	13	Low to Moderate (2)	Medium (3)	Medium (6)
Myotis	MS1	6	16	Low (1)	Medium (3)	Low (3)
	MS2	6	8	Low (1)	Medium (3)	Low (3)
	MS3	6	23	Low (1)	Medium (3)	Low (3)
	MS4	-	-	-	-	-
	MS5	35	14	Low to Moderate (2)	Medium (3)	Medium (6)
	MS6	6	12	Low (1)	Medium (3)	Low (3)
	MS7	-	-	-	-	-
	MS8	-	-	-	-	-
	MS9	35	40	Low to Moderate (2)	Medium (3)	Medium (6)
	MS10	6	5	Low (1)	Medium (3)	Low (3)
	MS11	6	15	Low (1)	Medium (3)	Low (3)
	MS12	62	25	Moderate	Medium	Medium (6)

Species / species group	I.D	Median Percentile[43]	Nights Recorded	Activity Category[44]	Site Risk Level (Stage 1)	Overall Risk Assessment (Stage 2)
					(3)	
Noctule	MS1	6	21	Low (1)	Medium (3)	Low (3)
	MS2	6	14	Low (1)	Medium (3)	Low (3)
	MS3	48	38	Moderate (3)	Medium (3)	Medium (9)
	MS4	-	-	-	Medium (3)	-
	MS5	52	14	Moderate (3)	Medium (3)	Medium (9)
	MS6	48	22	Moderate (3)	Medium (3)	Medium (9)
	MS7	21	6	Low to Moderate (2)	Medium (3)	Medium (6)
	MS8	56	18	Moderate (3)	Medium (3)	Medium (9)
	MS9	6	27	Low (1)	Medium (3)	Low (3)
	MS10	48	13	Moderate (3)	Medium (3)	Medium (9)
	MS11	35	23	Low to Moderate (2)	Medium (3)	Medium (6)
	MS12	35	22	Low to Moderate (2)	Medium (3)	Medium (6)
Soprano pipistrelle	MS1	48	50	Moderate (3)	Medium (3)	Medium (9)
	MS2	35	47	Low to Moderate (2)	Medium (3)	Medium (6)
	MS3	35	52	Low to Moderate (2)	Medium (3)	Medium (6)
	MS4	56	3	Moderate (3)	Medium (3)	Medium (9)
	MS5	62	22	Moderate to High (4)	Medium (3)	Medium (12)
	MS6	92	34	High (5)	Medium (3)	High (15)
	MS7	73	48	Moderate to High (4)	Medium (3)	Medium (12)
	MS8	6	2	Low (1)	Medium (3)	Low (3)
	MS9	77	54	Moderate to High (4)	Medium (3)	Medium (12)

Species / species group	I.D	Median Percentile[43]	Nights Recorded	Activity Category[44]	Site Risk Level (Stage 1)	Overall Risk Assessment (Stage 2)
	MS10	81	55	High (5)	Medium (3)	High (15)
	MS11	56	56	Moderate (3)	Medium (3)	Medium (9)
	MS12	93	32	High (5)	Medium (3)	High (15)

Table 3.17 Evaluation of bat activity and overall activity level for each species per month.

Species	Month	Median Percentile	Nights Recorded	Activity Category	Site Risk Level	Overall Risk Assessment (Stage 2)
Brown Long-eared	May	6	1	Low (1)	Medium (3)	Low (3)
	Jun	-	-	-	-	-
	Jul	6	5	Low (1)	Medium (3)	Low (3)
	Aug	6	15	Low (1)	Medium (3)	Low (3)
	Oct	-	-	-	-	-
Common pipistrelle	May	56	30	Moderate (3)	Medium (3)	Medium (9)
	Jun	56	122	Moderate (3)	Medium (3)	Medium (9)
	Jul	42	36	Moderate (3)	Medium (3)	Medium (9)
	Aug	35	74	Low to Moderate (2)	Medium (3)	Medium (6)
	Oct	35	58	Low to Moderate (2)	Medium (3)	Medium (6)
Leisler's	May	31	2	Low to Moderate (2)	Medium (3)	Medium (6)
	Jun	6	13	Low (1)	Medium (3)	Low (3)
	Jul	35	21	Low to Moderate (2)	Medium (3)	Medium (3)
	Aug	6	47	Low (2)	Medium (3)	Low (3)
	Oct	6	5	Low (2)	Medium (3)	Low (3)
Myotis	May	6	15	Low (1)	Medium (3)	Low (3)
	Jun	48	35	Moderate (3)	Medium (3)	Medium (6)
	Jul	6	14	Low (1)	Medium (3)	Low (3)
	Aug	6	51	Low (1)	Medium (3)	Low (3)
	Oct	6	43	Low (1)	Medium (3)	Low (3)
Noctule	May	21	12	Low to Moderate (2)	Medium (3)	Medium (6)
	Jun	48	53	Moderate (3)	Medium (3)	Medium (9)

Species	Month	Median Percentile	Nights Recorded	Activity Category	Site Risk Level	Overall Risk Assessment (Stage 2)
	Jul	35	31	Low to Moderate (2)	Medium (3)	Medium (6)
	Aug	48	71	Moderate (3)	Medium (3)	Medium (9)
	Oct	35	51	Low to Moderate (2)	Medium (3)	Medium (6)
Soprano pipistrelle	May	66	33	Moderate to High (4)	Medium (3)	Medium (12)
	Jun	62	128	Moderate to High (4)	Medium (3)	Medium (12)
	Jul	81	53	High (5)	Medium (3)	High (15)
	Aug	72	121	Moderate to High (4)	Medium (3)	Medium (12)
	Oct	59	120	Moderate (3)	Medium (3)	Medium (9)

3.9 Fisheries and Freshwater Pearl Mussel

3.9.1 Freshwater pearl mussel are protected under the Wildlife and Countryside Act 1981 (as amended in Scotland)[22] and by the Nature Conservation Act 2004. Listed on the SBL[26].

6.1.1 Freshwater pearl mussel are thought to be present in the River Bladnoch catchment, and recent electrofishing surveys by GFT in 2019 confirmed glochidia presence on trout parr at an undisclosed location (GFT, 2019)[45].

3.9.2 The Site falls under the River Bladnoch catchment[46] in the Solway Tweed River Basin District. The Site also forms part of the Tarf Water and Tarf Water to Water of Malzie, to Drumpail and Tidal Weir nested catchments.

3.9.3 The European Water Framework Directive (WFD) requires that surface waterbodies in member states are classified according to ecological status. The Scotland's Environment website[47] confirms the status of the following watercourses within the Site:

- Tarf Water: Poor status.

3.9.4 The remainder of the watercourses within the Site are not classified.

[45] https://gallowayfisheriestrust.org/news.php?nID=282?nID=282#:~:text=Last%20week%20GFT%20were%20out,Bladnoch%20surveying%20four%20different%20sites.&text=Freshwater%20pearl%20mussels%20can%20live,of%20the%20longest%2Dlived%20invertebrates.

[46] https://map.environment.gov.scot/sewebmap/

[47] https://www.environment.gov.scot

Desk Study

3.9.5 A summary of desk study records are presented in **Table 3.15** and records are presented on **Figure 6.9 in Volume 3a** of the EIA Report. .

Table 3.16: Desk study records summary – Fisheries and freshwater pearl mussel

Source	Records
SWSEIC	No records were received from SWSEIC for protected fish and fresh water pearl mussel within 5km.
Gass Wind Farm ES	Field surveys were undertaken for the Gass Wind Farm submission in 2014 following SFCC (2007)[48], NatureScot (SNH) [49] and Wentworth CK (1992)[50] guidance. The survey area is shown on Figure 7-12 of the Gass Wind Farm ES. Electrofishing surveys undertaken in 2014 on four watercourses recorded the following: • Tarf Water, un-named burn – 224701, 565555 (trout); • Tarf Water, un-named burn – 224782, 565537 (eel, trout); • Tarf Water, un-named burn – 225110, 565522 (eel, trout); and, • Tarf Water – 225161, 566130 (salmon, trout).
Kilgallioch Extension Wind Farm EIA Report	Electrofishing surveys were undertaken by GFT in 2019. Five sample locations were included within the River Bladnoch catchment as follows, results also presented on **Figure 6.9 (EIAR Volume 3a)**: • Tarf Water, Ha' Hill Burn - NX228700 (Pike *Esox lucius*, eel and trout); • Tarf Water, Monandie Burn - NX240692 (juvenile trout); • Tarf Water - NX240688 (juvenile salmon, juvenile trout); • Tarf Water, Loch Eldrig Outflow - NX250693 (no fish); and, • Tarf Water, Loch Strand Burn - NX247691 (juvenile trout).

Field Surveys

3.9.6 A total of 10 watercourses were subject to a fish habitat survey. Locations of surveyed watercourses are presented on **Figure 6.10 (EIAR Volume 3a)**. The full GFT Report is provided as **Annex 5**.

3.9.7 Results of the survey are as follows:

[48] SFCC (2007). Habitat Surveys Training Course Manual, Available at http://www.sfcc.co.uk/resources/habitatsurveying.html

[49] SNH Freshwater pearl mussel survey protocol for use in site-specific projects. http://www.snh.gov.uk/docs/A372955.pdf

[50] Wentworth CK (1922) A scale grade and class terms for clastic sediments. *Journal of Ecology* 30, 377-392.

- Purgatory Burn: this watercourse contains a range of good quality instream habitats. This burn could support populations of salmonids, eels, juvenile lamprey and Freshwater Pearl mussels.
- Tributary draining Moss of Horse Hill: this watercourse did not contain suitable habitats for fish or Freshwater Pearl mussels.
- Tarf Water: this watercourse contains a range of good quality instream habitats. This river could support populations of salmonids, eels, juvenile lamprey and Freshwater Pearl mussels.
- Un-named tributary: this watercourse contains some limited areas of suitable habitat for trout only.
- Un-named tributary draining Brough Hill: this watercourse contains some areas of suitable habitat for trout only.
- Three burns draining from Low Eldrig: two of these burns were considered large enough to support populations of salmonids, eels and juvenile lamprey. One of the burns was considered unsuitable for fish or Freshwater Pearl mussels.
- Un-named tributary draining Black and White Hills: this watercourse contains a range of good quality instream habitats. This burn could support populations of salmonids, eels, juvenile lamprey and Freshwater Pearl mussels.
- Drumpail Burn: this watercourse contains a range of good quality instream habitats. This burn could support populations of salmonids, eels, juvenile lamprey and Freshwater Pearl mussels. The Drumpail Burn is designated as part of the River Bladnoch SAC for Atlantic salmon.

3.10 Reptiles

3.10.1 All reptile species are afforded limited protection under the Wildlife and Countryside Act 1981 (as amended in Scotland)[22]. Three species listed on the SBL[26], of which two have the potential to occur on or around the Site (adder *Vipera berus* and slow worm *Anguis fragilis*[51]).

3.10.2 Two records of common lizard *Zootoca vivipara* and a single adder were received from SWSEIC.

3.10.3 Dense coniferous plantation woodland is considered unsuitable for reptiles species, but woodland edge habitats provide basking and foraging opportunities and stone walls intersecting the Site provide hibernacula.

3.11 Amphibians

3.11.1 Great crested newt *Triturus cristatus* and natterjack toads *Epidalea calamita* are European protected species[25]; however the Site does not fall within the known distribution of either species[52, 53]. All other amphibian species are afforded general protection under Wildlife and Countryside Act 1981 (as amended in Scotland[22]). Common toad is listed on the SBL[26].

3.11.2 Four records for common toad and two records of common frog were received from SWSEIC within 5km of the Site.

[51] Distribution information from https://www.arc-trust.org/
[52] https://www.nature.scot/plants-animals-and-fungi/amphibians-and-reptiles/natterjack-toad
[53] As defined by the Joint Nature Conservation Committee: https://sac.jncc.gov.uk/species/S1166/

3.11.3 Wet heathland habitats and woodland edge are likely to provide suitable foraging and hibernacula opportunities. Two ponds are located in the eastern extents of the Site, >600m from the nearest proposed turbine.

3.12 Invertebrates

3.12.1 SWSEIC returned 12 records for invertebrates within 5km of the Site. records included one mayfly (*Siphlonurus alternatus*), one beetle (*Meloe violaceus*), two butterflies (small heath *Coenonympha pamphilus* and small pearl bordered fritillary *Boloria selene*) and eight moths (Dark-barred twin spot carpet *Xanthorhoe ferrugata,* buff ermine *Spilosoma lutea,* white ermine *S. lubricipeda,* garden tiger *Arctia caja,* rustic *Holplodrina blanda,* broom *Ceramica pisi,* small square-spot *Diarisa rubi* and double dart *Graphiphora augur*).

3.13 Other Species

3.13.1 A single record was received of Western European hedgehog *Erinaceus europaeus* and six records of brown hare *Lepus europaeus.* Records are presented on **Figure 6.5 in Volume 3a** of the EIA Report.

3.13.2 Deer observations from the camera trap surveys are presented in **Annex 6**.

ANNEX 1 – Site Photographs

Annex 1 – Site Photographs

Photograph	Reference	Description
	P1	2019 - Potential pine marten scat at NX24649 67121
	P2	2019 - Potential pine marten scat at NX23884 67081
	P3	2019 - Camera trap 1 location.

Photograph	Reference	Description
	P4	2019 - Camera trap 1 location.
	P5	2019 - Camera trap 2 location.
	P6	2020 – water vole feeding remains at NX23265 69046

Photograph	Reference	Description
	P7	2020 - burrows at NX23265 69046
	P8	2020 – pine marten scat at NX22475 68712
	P9	2020 – buildings at Low Eldrig NX25193 67947

Photograph	Reference	Description
	P10	2020 – buildings at Low Eldrig NX25193 67947. External gable end.
	P11	2020 – buildings at Low Eldrig NX25193 67947. Internal gable end with chimney cavities.
	P12	2020 – buildings at Low Eldrig NX25193 67947. Internal gable end with chimney cavities.

Photograph	Reference	Description
	P13	2020 – buildings at Low Eldrig NX25177 67929. Second small outbuilding.

ANNEX 2 – Bat Survey Effort

Annex 2 – Bat Survey Effort

Detector	Date Start	Date End	No. Nights
MS1	22/05/2019	31/05/2019	11
MS2	22/05/2019	31/05/2019	11
MS3	22/05/2019	31/05/2019	11
MS4	FAIL	FAIL	0
MS5	22/05/2019	31/05/2019	11
MS6	22/05/2019	23/05/2019	1
MS7	22/05/2019	31/05/2019	11
MS8	22/05/2019	31/05/2019	11
MS9	22/05/2019	31/05/2019	11
MS10	22/05/2019	31/05/2019	11
MS11	29/05/2019	31/05/2019	11
MS12	29/05/2019	31/05/2019	11
MS1	01/06/2019	02/07/2019	32
MS2	01/06/2019	02/07/2019	32
MS3	01/06/2019	02/07/2019	32
MS4	FAIL	FAIL	0
MS5	01/06/2019	12/06/2019	12
MS7	01/06/2019	02/07/2019	32
MS8	01/06/2019	02/07/2019	32
MS9	01/06/2019	24/06/2019	24
MS10	01/06/2019	05/06/2019	5
MS11	01/06/2019	28/06/2019	28
MS12	01/06/2019	28/06/2019	28
MS1	26/07/2019	16/08/2019	21
MS2	26/07/2019	16/08/2019	21
MS3	26/07/2019	16/08/2019	21
MS4	26/07/2019	09/08/2019	14
MS5	26/07/2019	16/08/2019	21
MS6	26/07/2019	16/08/2019	21
MS7	26/07/2019	16/08/2019	21
MS8	26/07/2019	16/08/2019	21
MS9	26/07/2019	16/08/2019	21
MS10	26/07/2019	16/08/2019	21
MS11	26/07/2019	16/08/2019	21
MS12	26/07/2019	29/07/2019	3
MS2	17/08/2019	23/08/2019	6
MS3	17/08/2019	23/08/2019	6
MS5	17/08/2019	23/08/2019	6
MS6	17/08/2019	23/08/2019	6
MS7	17/08/2019	23/08/2019	6
MS9	17/08/2019	21/08/2019	4
MS10	17/08/2019	23/08/2019	6
MS11	17/08/2019	23/08/2019	6
MS1	03/10/2019	31/10/2019	28
MS2	03/10/2019	31/10/2019	34
MS3	03/10/2019	31/10/2019	34
MS4	03/10/2019	31/10/2019	28
MS5	03/10/2019	31/10/2019	34
MS6	03/10/2019	09/10/2019	12
MS7	03/10/2019	11/10/2019	14
MS8	03/10/2019	30/10/2019	27
MS9	03/10/2019	31/10/2019	32
MS10	03/10/2019	27/10/2019	30
MS11	03/10/2019	12/10/2019	15
MS12	03/10/2019	07/10/2019	4

ANNEX 3 – Weather Data

Annex 3 – Weather Data

Cells highlighted in orange are nights representative of poor weather conditions (temperatures< 8C, wind speed >5 m/s and moderate to heavy rainfall) but are included within the analysis as bats were recorded during these conditions.

One night (highlighted in red) is excluded as no bats were recorded and weather was considered inappropriate in accordance with NatureScot (SNH, 2019) guidance.

Date	Temp at Dusk (°C)	Rainfall (mm)[1]	Maximum Wind Speed (m/s)[2]
Spring			
22/05/2019	10.3	0	0
23/05/2019	10.9	12	0.2
24/05/2019	10.5	0	0
25/05/2019	12.4	13.2	0.7
26/05/2019	9.4	1.6	0
27/05/2019	9.7	1.6	0
28/05/2019	17.4	0.6	0
29/05/2019	10.2	12.4	0.4
30/05/2019	13.8	10.2	0
31/05/2019	10.6	5	0.7
01/06/2019	12.3	10	0
02/06/2019	10.9	0	0
03/06/2019	9.9	1	0
04/06/2019	9.9	11.8	0
05/06/2019	10.8	4.2	0
06/06/2019	8.1	0.2	0
07/06/2019	10.1	1.4	0
08/06/2019	10.4	1.6	0.3
09/06/2019	9.6	0	0
10/06/2019	9.9	10.4	0
11/06/2019	12.3	0	0
12/06/2019	11.5	5.6	0
13/06/2019	8.2	0	0.2
14/06/2019	9.8	13	0
15/06/2019	9.8	0	0.2
16/06/2019	11.1	1.2	0
17/06/2019	10.3	4.8	0
18/06/2019	10.6	0	0
19/06/2019	10.7	2.6	0
20/06/2019	9.2	1.4	0
21/06/2019	9.7	0	0
22/06/2019	11.9	0	0
23/06/2019	15	4.6	0
24/06/2019	21.7	0	0.5
25/06/2019	25.8	0	2
26/06/2019	16	0	2
27/06/2019	16	0	2
28/06/2019	21	0	2
29/06/2019	16	0	2
30/06/2019	15	0.2	15
Summer			
01/07/2019	14	0	15

[1] Rainfall data in May 2019 acquired from SEPA at Castle Kennedy due to a weather station malfunction: https://apps.sepa.org.uk/rainfall/data/index/116042. The average rainfall for the first survey period was 3.6mm and 4.93mm for the second. Any rainfall recorded higher than average was considered inappropriate.

[2]Wind speed recorded in hourly intervals between approximately 20:42 and 05:42 each night.

Date	Temp at Dusk (°C)	Rainfall (mm)[1]	Maximum Wind Speed (m/s)[2]
02/07/2019	13	0	13
26/07/2019	15.6	0	0.1
27/07/2019	13.5	17.8	0.4
28/07/2019	15.0	17.4	0.4
29/07/2019	13.4	0	0
30/07/2019	14.4	1	0.5
31/07/2019	15.5	0	1.9
01/08/2019	16.7	0	0.4
02/08/2019	16.1	0	0
03/08/2019	17.4	1.2	0
04/08/2019	14.3	9.4	0.7
05/08/2019	14.7	3.6	0.5
06/08/2019	13.0	7.6	0.3
07/08/2019	13.3	0	0.3
08/08/2019	13.4	22.6	1.3
09/08/2019	16.0	10	2.5
10/08/2019	14.0	0.2	0.7
11/08/2019	11.4	0	1.8
12/08/2019	11.3	0.4	0.1
13/08/2019	10.2	7.8	0.1
14/08/2019	14.7	9.6	0.2
15/08/2019	12.7	15.2	2
16/08/2019	15.2	0.8	0.9
Autumn			
17/08/2019	11.6	6	0.5
18/08/2019	12.0	1.2	1.1
19/08/2019	11.2	5.8	0.4
20/08/2019	12.6	0	0.8
21/08/2019	13.5	5.4	1.4
22/08/2019	15.3	0.2	0.2
23/08/2019	28.1	0	0.1
03/10/2019	8.8	4.9	2.3
04/10/2019	8.8	0	0.2
05/10/2019	11.4	0	1.0
06/10/2019	8.4	0	0
07/10/2019	10.2	0	0.1
08/10/2019	8.7	0	0
09/10/2019	7.2	0	0
10/10/2019	10.6	0	0.3
11/10/2019	8.6	0	0.1
12/10/2019	6.5	0	0
13/10/2019	7.7	0	0
14/10/2019	8.6	0	0
15/10/2019	9.2	0	0.1
16/10/2019	7.1	0	0
17/10/2019	9.2	0	0.6
18/10/2019	6.7	0	0
19/10/2019	4.8	0	0
20/10/2019	3.1	0	0
21/10/2019	5.6	0	0
22/10/2019	8.5	0	0.5
23/10/2019	9.5	0	1.3

Date	Temp at Dusk (°C)	Rainfall (mm)[1]	Maximum Wind Speed (m/s)[2]
24/10/2019	5.4	0	0
25/10/2019	4.4	0	0
26/10/2019	2.3	0	0.1
27/10/2019	4.7	0	0
28/10/2019	1.9	0	0
29/10/2019	3.4	0	0
30/10/2019	5.0	0	0.6
31/10/2019	7.1	0	0.9

ANNEX 4 – Ecobat Output Report

This report was produced free of charge by the Mammal Society to support evidence-based conservation of bats.

The following analyses are based on data supplied by the user to the Mammal Society's Ecobat website. The outputs are designed to assist decision-making, but do not replace expert interpretation by the user. The creation of the Ecobat tool was supported by the Natural Environment Research Council (NERC).

Bat Activity Analysis

Site Name:

Author:

17/11/2020

Summary

Bats were detected on **98** nights between **2019-05-22** and **2019-10-31**, using **12** static bat detectors. Throughout this period **6** species were recorded. **Table 1.** Detectors were placed at the following locations:

Detector ID	Latitude	Longitude
MS6	54.96842	-4.74052
MS9	54.95374	-4.73296
MS1	54.98246	-4.75975
MS3	54.98072	-4.76774
MS12	54.96046	-4.75235
MS11	54.96317	-4.74933
MS2	54.98516	-4.76367
MS5	54.96929	-4.75119
MS10	54.96660	-4.72522
MS7	54.96830	-4.74895
MS8	54.95691	-4.73831
MS4	54.98022	-4.77243

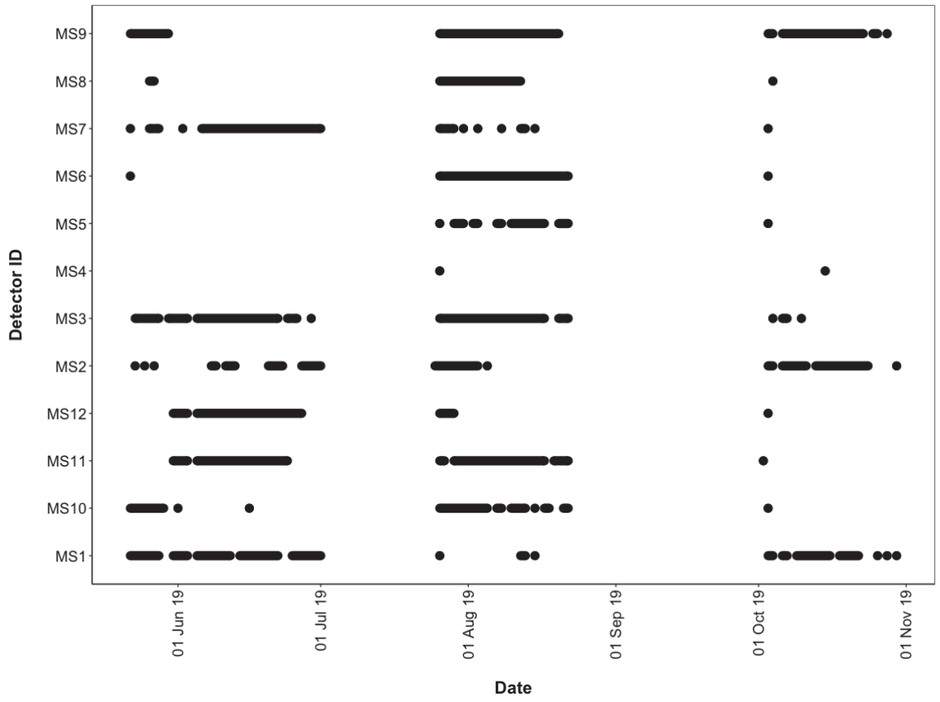
Survey Nights

Table 2. The number of nights that bats were detected on each recorder. This is not the same as the number of nights that detectors were active if there were nights when no bats were detected.

Detector ID	No. of nights
MS1	60
MS10	55
MS11	60
MS12	35
MS2	50
MS3	63
MS4	3
MS5	26
MS6	34
MS7	48
MS8	21
MS9	61

Survey Nights

Figure 1. Horizontal bars show nights when acoustic detectors recorded bats.



PART 1: Percentiles Analysis

This first part of the analysis looks at the relative activity levels of the bats you recorded. We take your value for the total bat passes each night for each species, and compare this to the values in our reference database. We tell you what percentile your data falls at, and therefore what the relative activity level is. For example, if the reference database has values of 5, 10, 15, 20 and you submit a value of 18, this will be the 80th percentile, and be classed as high activity.

The reference range dataset was stratified to include:

- Only records from within 30 days of the survey date.
- Only records from within 200km radius of the survey location.

PER DETECTOR

Table 3. Summary table showing the number of nights recorded bat activity fell into each activity band for each species.

Detector ID	Species/Species Group	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
MS1	*Myotis*	0	0	3	2	11
MS1	*Nyctalus leisleri*	0	0	0	1	2
MS1	*Nyctalus noctula*	0	2	4	3	12
MS1	*Pipistrellus pipistrellus*	6	8	4	7	16
MS1	*Pipistrellus pygmaeus*	6	14	12	8	10
MS10	*Myotis*	0	0	0	0	5
MS10	*Nyctalus leisleri*	0	0	0	0	1
MS10	*Nyctalus noctula*	2	3	3	1	4
MS10	*Pipistrellus pipistrellus*	2	7	6	7	11
MS10	*Pipistrellus pygmaeus*	28	10	9	0	8
MS11	*Myotis*	0	1	2	2	10
MS11	*Nyctalus leisleri*	0	1	1	1	5
MS11	*Nyctalus noctula*	0	4	6	4	9
MS11	*Pipistrellus pipistrellus*	1	1	5	13	11
MS11	*Pipistrellus pygmaeus*	9	18	12	5	12
MS11	*Plecotus auritus*	0	0	0	1	4
MS12	*Myotis*	3	11	4	1	6
MS12	*Nyctalus leisleri*	1	3	1	2	6
MS12	*Nyctalus noctula*	0	3	5	5	9
MS12	*Pipistrellus pipistrellus*	16	11	1	4	1
MS12	*Pipistrellus pygmaeus*	29	2	1	0	0
MS2	*Myotis*	0	0	0	1	7
MS2	*Nyctalus leisleri*	0	1	0	0	5
MS2	*Nyctalus noctula*	0	0	1	3	10
MS2	*Pipistrellus pipistrellus*	7	4	4	5	7
MS2	*Pipistrellus pygmaeus*	6	8	8	7	18
MS3	*Myotis*	0	0	0	5	18
MS3	*Nyctalus leisleri*	0	0	1	3	7
MS3	*Nyctalus noctula*	6	7	7	8	10
MS3	*Pipistrellus pipistrellus*	1	12	10	3	14
MS3	*Pipistrellus pygmaeus*	6	9	8	10	19
MS3	*Plecotus auritus*	0	0	0	1	3
MS4	*Pipistrellus pygmaeus*	0	1	1	0	1
MS5	*Myotis*	0	3	0	6	5
MS5	*Nyctalus leisleri*	0	4	2	5	4
MS5	*Nyctalus noctula*	1	3	6	2	2
MS5	*Pipistrellus pipistrellus*	0	1	1	7	5
MS5	*Pipistrellus pygmaeus*	5	7	3	4	3
MS5	*Plecotus auritus*	0	0	0	0	3
MS6	*Myotis*	0	1	1	1	9
MS6	*Nyctalus leisleri*	0	0	2	4	5
MS6	*Nyctalus noctula*	2	1	9	4	6
MS6	*Pipistrellus pipistrellus*	0	7	6	8	6
MS6	*Pipistrellus pygmaeus*	31	2	1	0	0
MS6	*Plecotus auritus*	0	0	0	2	5
MS7	*Nyctalus leisleri*	1	0	2	0	0
MS7	*Nyctalus noctula*	1	0	1	1	3
MS7	*Pipistrellus pipistrellus*	5	7	4	3	9
MS7	*Pipistrellus pygmaeus*	17	13	4	5	9

MS8	*Nyctalus noctula*	2	4	9	1	2
MS8	*Pipistrellus pipistrellus*	0	0	1	0	1
MS8	*Pipistrellus pygmaeus*	0	0	0	0	2
MS9	*Myotis*	0	3	6	16	15
MS9	*Nyctalus leisleri*	0	1	6	1	9
MS9	*Nyctalus noctula*	0	0	5	8	14
MS9	*Pipistrellus pipistrellus*	9	8	9	3	15
MS9	*Pipistrellus pygmaeus*	22	17	3	5	7
MS9	*Plecotus auritus*	0	0	0	0	2

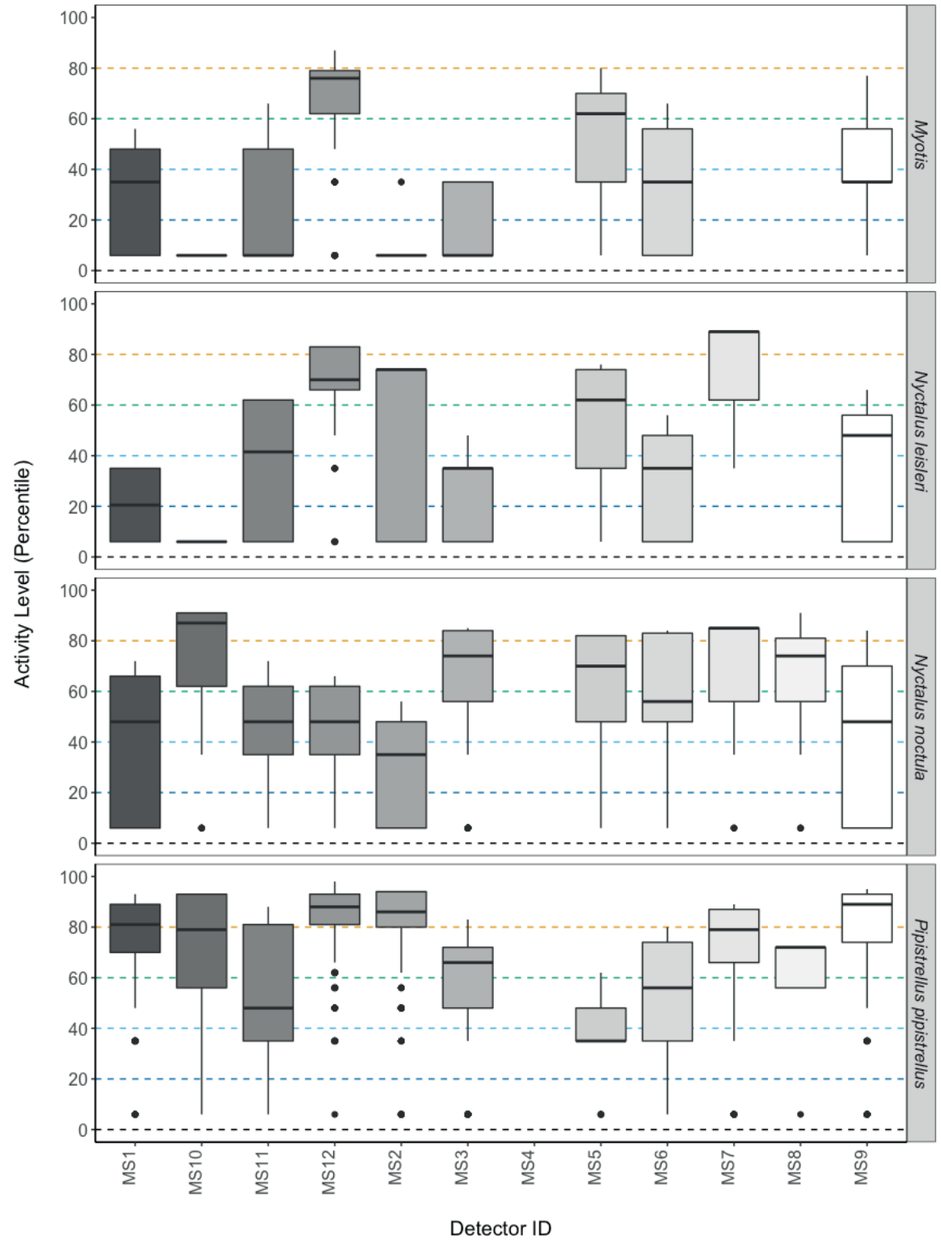
Table 4. Summary table showing key metrics for each species recorded. The reference range is the number of nights for each species that your data were compared to. We recommend a Reference Range of 200+ to be confident in the relative activity level.

Detector ID	Species/Species Group	Median Percentile	95% CIs	Max Percentile	Nights Recorded	Reference Range
MS1	*Myotis*	6	6 - 27	56	16	867
MS1	*Nyctalus leisleri*	6	6 - 6	35	3	430
MS1	*Nyctalus noctula*	6	6 - 36	72	21	644
MS1	*Pipistrellus pipistrellus*	35	27 - 48	93	41	1402
MS1	*Pipistrellus pygmaeus*	48	41.5 - 58.5	95	50	2175
MS10	*Myotis*	6	6 - 6	6	5	867
MS10	*Nyctalus leisleri*	6	0	6	1	430
MS10	*Nyctalus noctula*	48	27 - 67	91	13	644
MS10	*Pipistrellus pipistrellus*	35	27 - 49.5	93	33	1402
MS10	*Pipistrellus pygmaeus*	81	65 - 82	100	55	2175
MS11	*Myotis*	6	6 - 31	66	15	867
MS11	*Nyctalus leisleri*	6	6 - 34	62	8	430
MS11	*Nyctalus noctula*	35	20.5 - 45.5	72	23	644
MS11	*Pipistrellus pipistrellus*	35	20.5 - 35	88	31	1402
MS11	*Pipistrellus pygmaeus*	56	45 - 65	96	56	2175
MS11	*Plecotus auritus*	6	6 - 6	35	5	170
MS12	*Myotis*	62	41 - 69	87	25	867
MS12	*Nyctalus leisleri*	35	6 - 52.5	83	13	430
MS12	*Nyctalus noctula*	35	20.5 - 41.5	66	22	644
MS12	*Pipistrellus pipistrellus*	80	65 - 82	98	33	1402
MS12	*Pipistrellus*	93	87.5 -	99	32	2175

	pygmaeus		93			
MS2	*Myotis*	6	6 - 6	35	8	867
MS2	*Nyctalus leisleri*	6	6 - 6	74	6	430
MS2	*Nyctalus noctula*	6	6 - 20.5	56	14	644
MS2	*Pipistrellus pipistrellus*	48	35 - 64	94	27	1402
MS2	*Pipistrellus pygmaeus*	35	31 - 50.5	95	47	2175
MS3	*Myotis*	6	6 - 20.5	35	23	867
MS3	*Nyctalus leisleri*	6	6 - 27	48	11	430
MS3	*Nyctalus noctula*	48	35 - 57	85	38	644
MS3	*Pipistrellus pipistrellus*	48	31 - 52	83	40	1402
MS3	*Pipistrellus pygmaeus*	35	31 - 45.5	89	52	2175
MS3	*Plecotus auritus*	6	6 - 6	35	4	170
MS4	*Pipistrellus pygmaeus*	56	6 - 74	74	3	2175
MS5	*Myotis*	35	20.5 - 48.5	70	14	867
MS5	*Nyctalus leisleri*	35	20.5 - 54.5	76	15	430
MS5	*Nyctalus noctula*	52	35 - 64	82	14	644
MS5	*Pipistrellus pipistrellus*	35	20.5 - 35	62	14	1402
MS5	*Pipistrellus pygmaeus*	62	41.5 - 68	89	22	2175
MS5	*Plecotus auritus*	6	6 - 6	6	3	170
MS6	*Myotis*	6	6 - 31	66	12	867
MS6	*Nyctalus leisleri*	35	6 - 41.5	56	11	430
MS6	*Nyctalus noctula*	48	27 - 52	84	22	644
MS6	*Pipistrellus pipistrellus*	35	34 - 52	80	27	1402
MS6	*Pipistrellus*	92	88 -	100	34	2175
	pygmaeus		93.5			
MS6	*Plecotus auritus*	6	6 - 20.5	35	7	170
MS7	*Nyctalus leisleri*	56	48 - 89	89	3	430
MS7	*Nyctalus noctula*	21	6 - 56	85	6	644
MS7	*Pipistrellus pipistrellus*	52	36 - 61.5	89	28	1402
MS7	*Pipistrellus pygmaeus*	73	49 - 74.5	96	48	2175
MS8	*Nyctalus noctula*	56	45.5 - 66	91	18	644
MS8	*Pipistrellus pipistrellus*	31	31 - 31	56	2	1402
MS8	*Pipistrellus pygmaeus*	6	6 - 6	6	2	2175
MS9	*Myotis*	35	20.5 - 35	77	40	867
MS9	*Nyctalus leisleri*	6	6 - 35	62	17	430
MS9	*Nyctalus noctula*	6	20.5 - 27	56	27	644
MS9	*Pipistrellus pipistrellus*	48	38 - 57	95	44	1402
MS9	*Pipistrellus pygmaeus*	77	61 - 79.5	100	54	2175
MS9	*Plecotus auritus*	6	6 - 6	6	2	170

###Figures

Figure 2. The recorded activity of bats during the survey. The centre line indicates the median activity level whereas the box represents the interquartile range (the spread of the middle 50% of nights of activity)



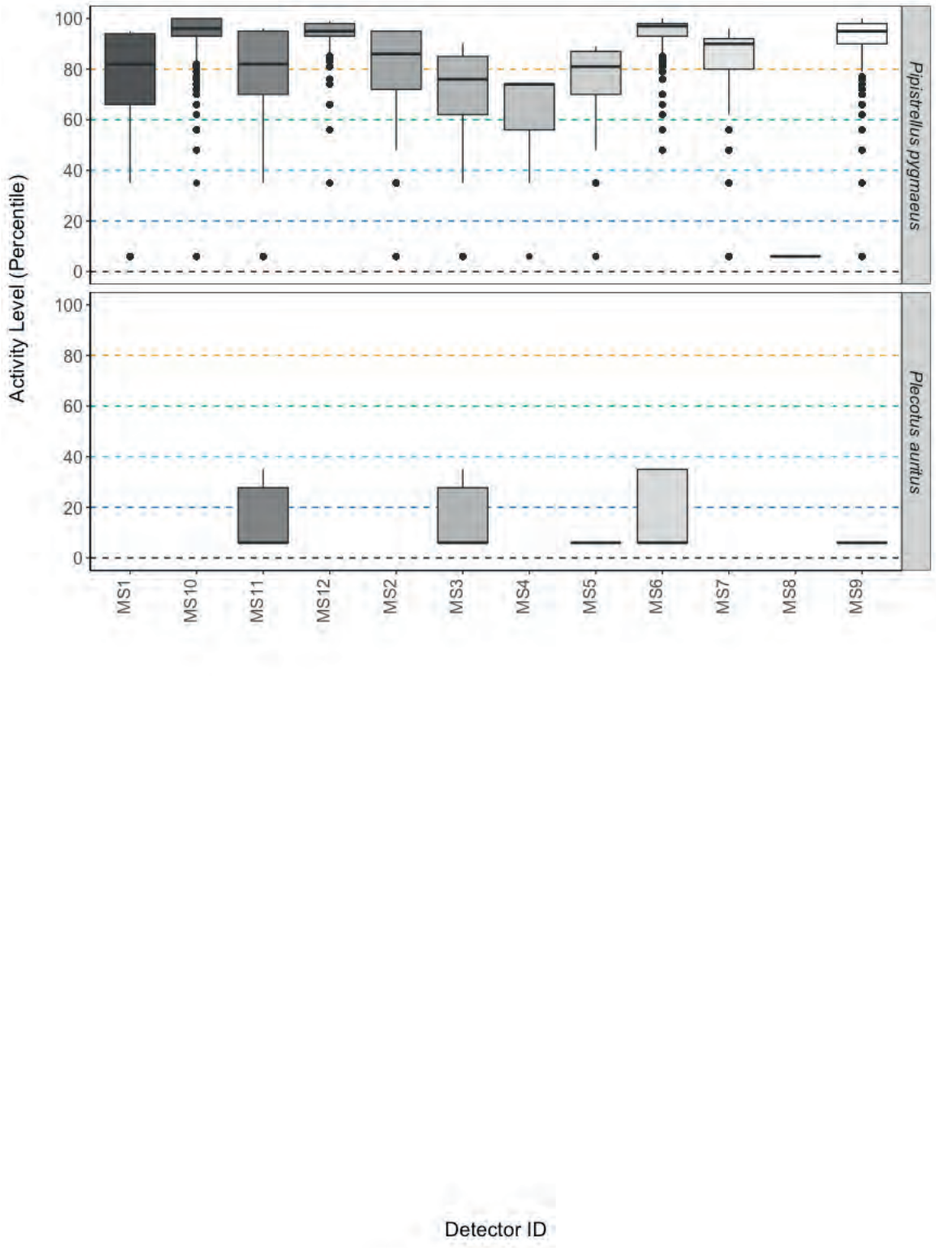
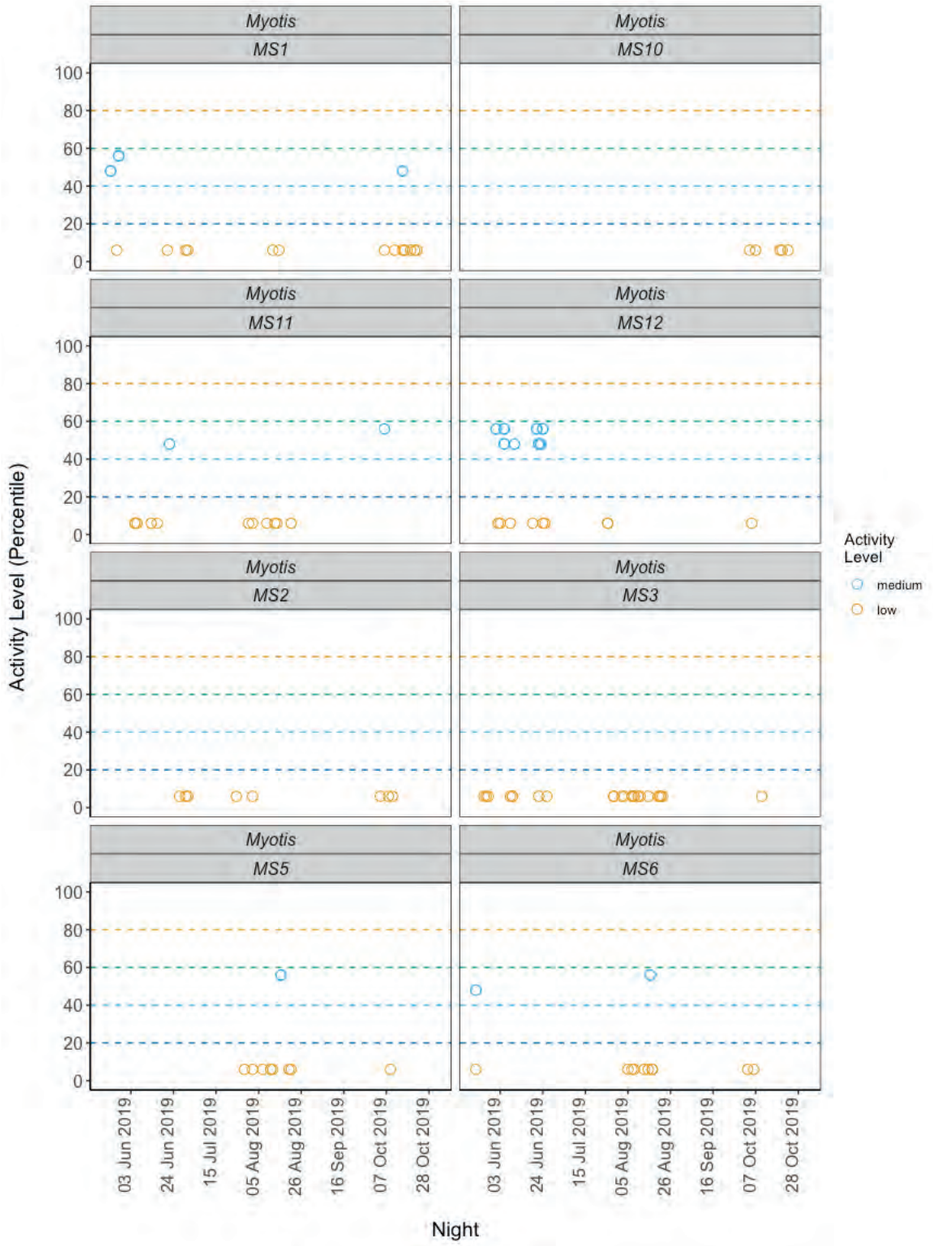
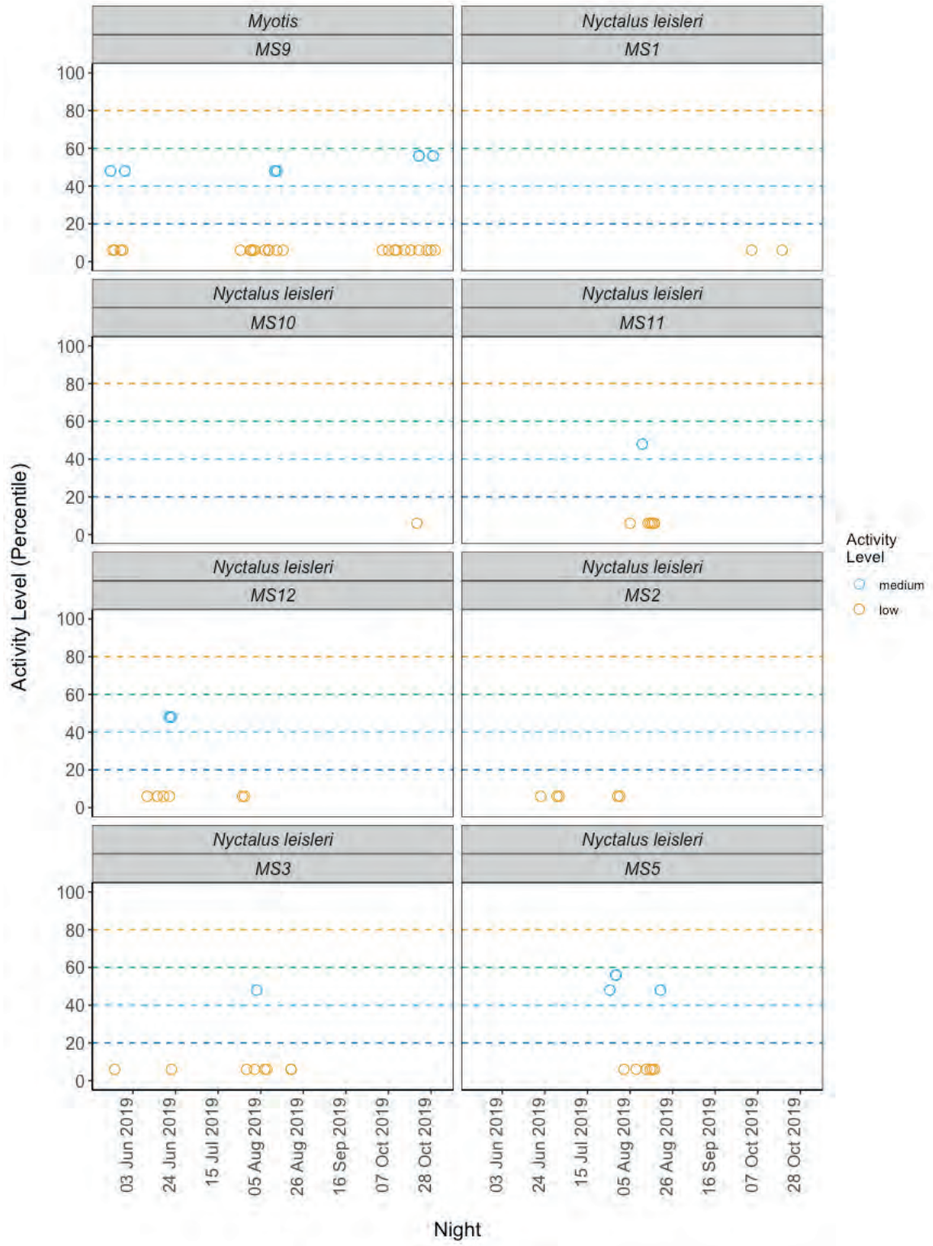
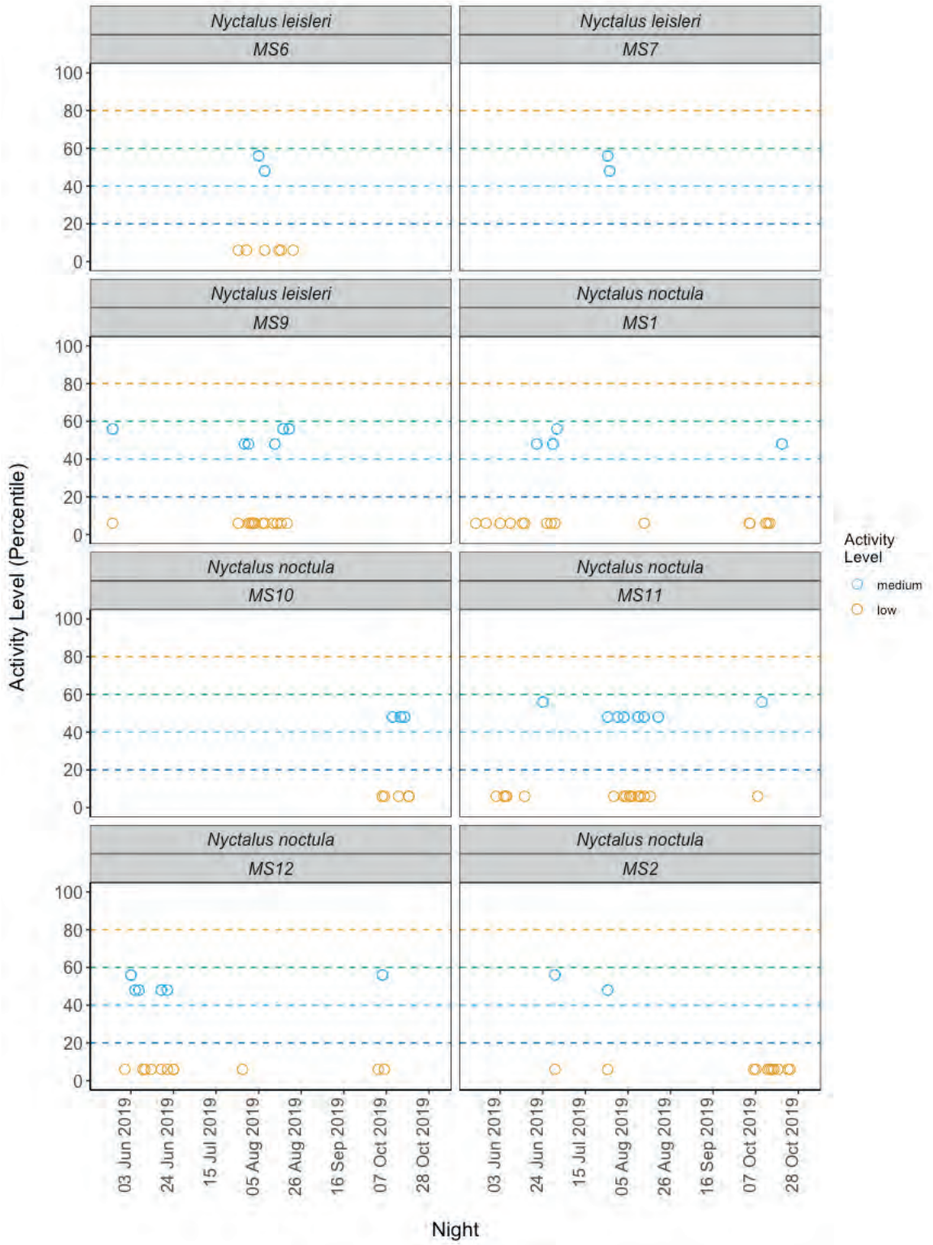
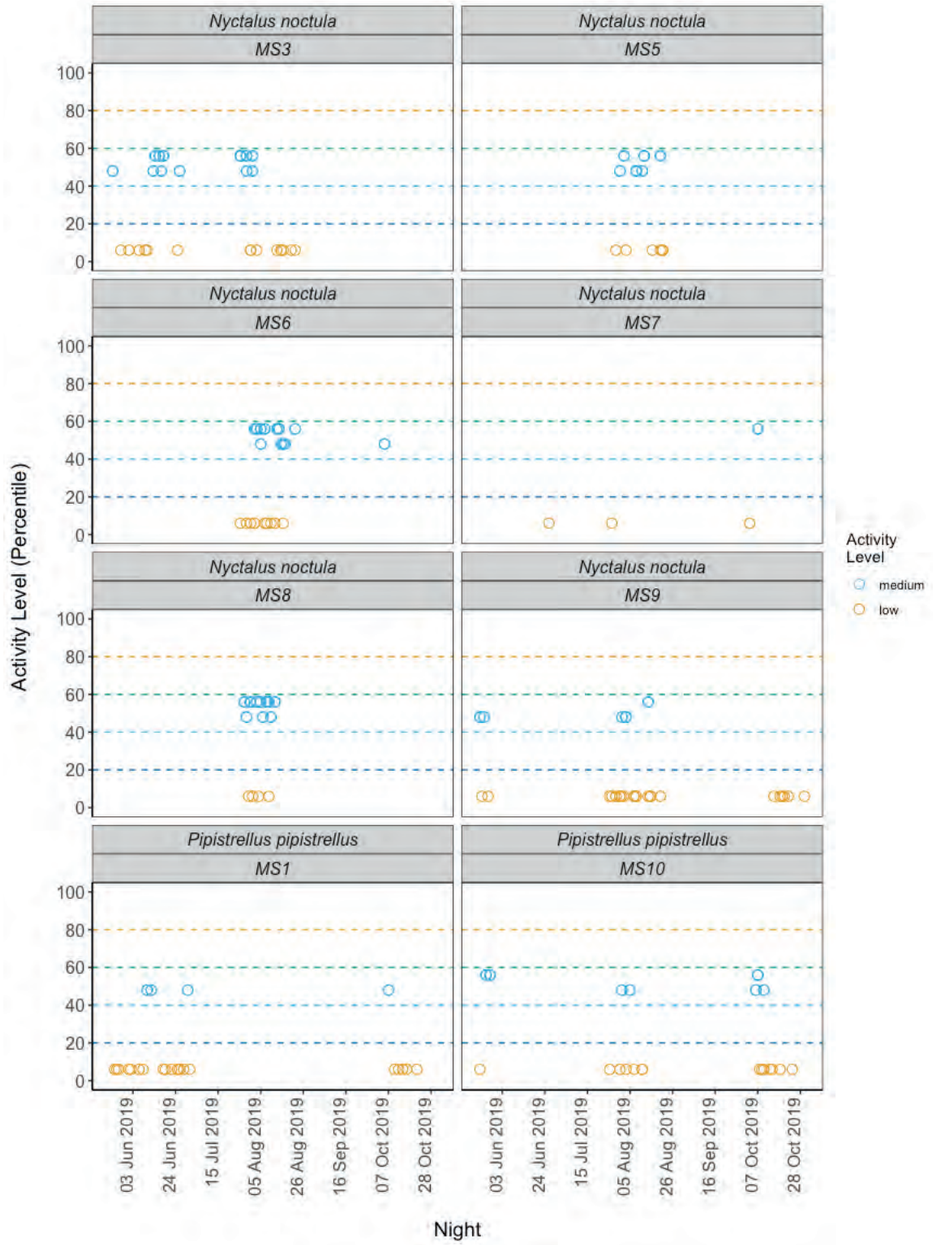


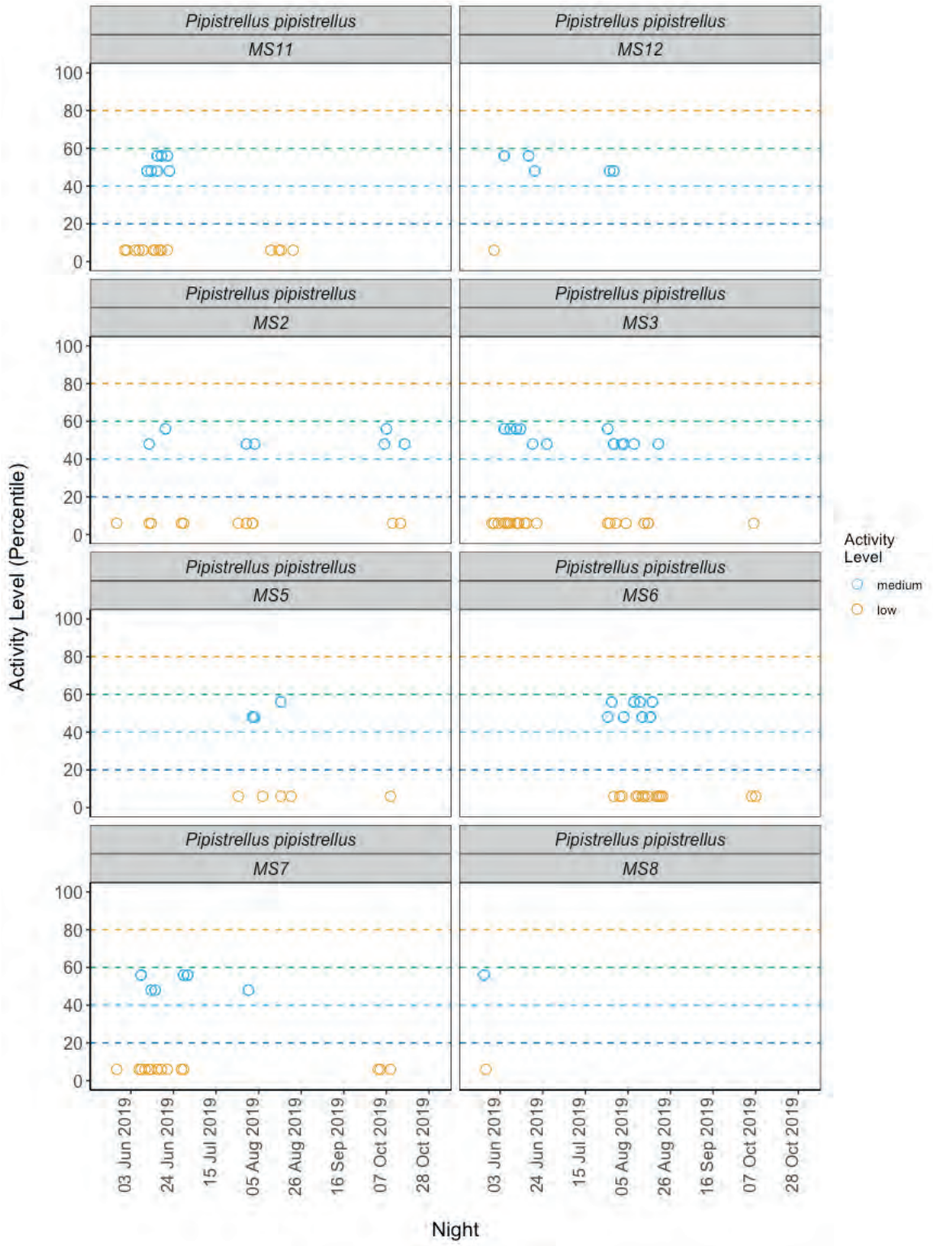
Figure 3. The activity level (percentile) of bats recorded across each night of the bat survey.

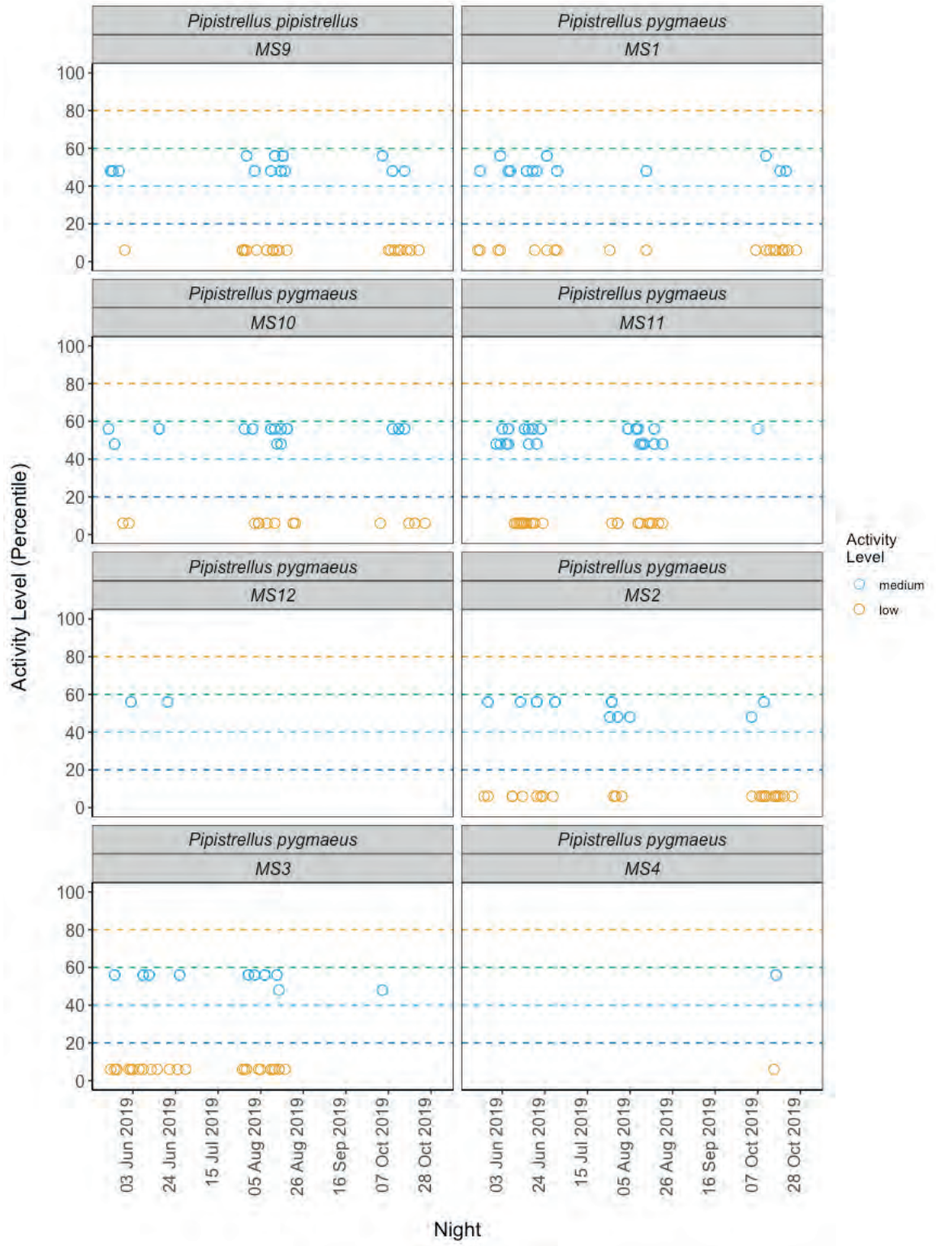

Myotis
MS1
Myotis
MS10
Myotis
MS11
Myotis
MS12
Myotis
MS2
Myotis
MS3
Myotis
MS5
Myotis
MS6
Activity Level (Percentile)
0
20
40
60
80
100
03 Jun 2019
24 Jun 2019
15 Jul 2019
05 Aug 2019
26 Aug 2019
16 Sep 2019
07 Oct 2019
28 Oct 2019
Night
Activity Level
medium
low

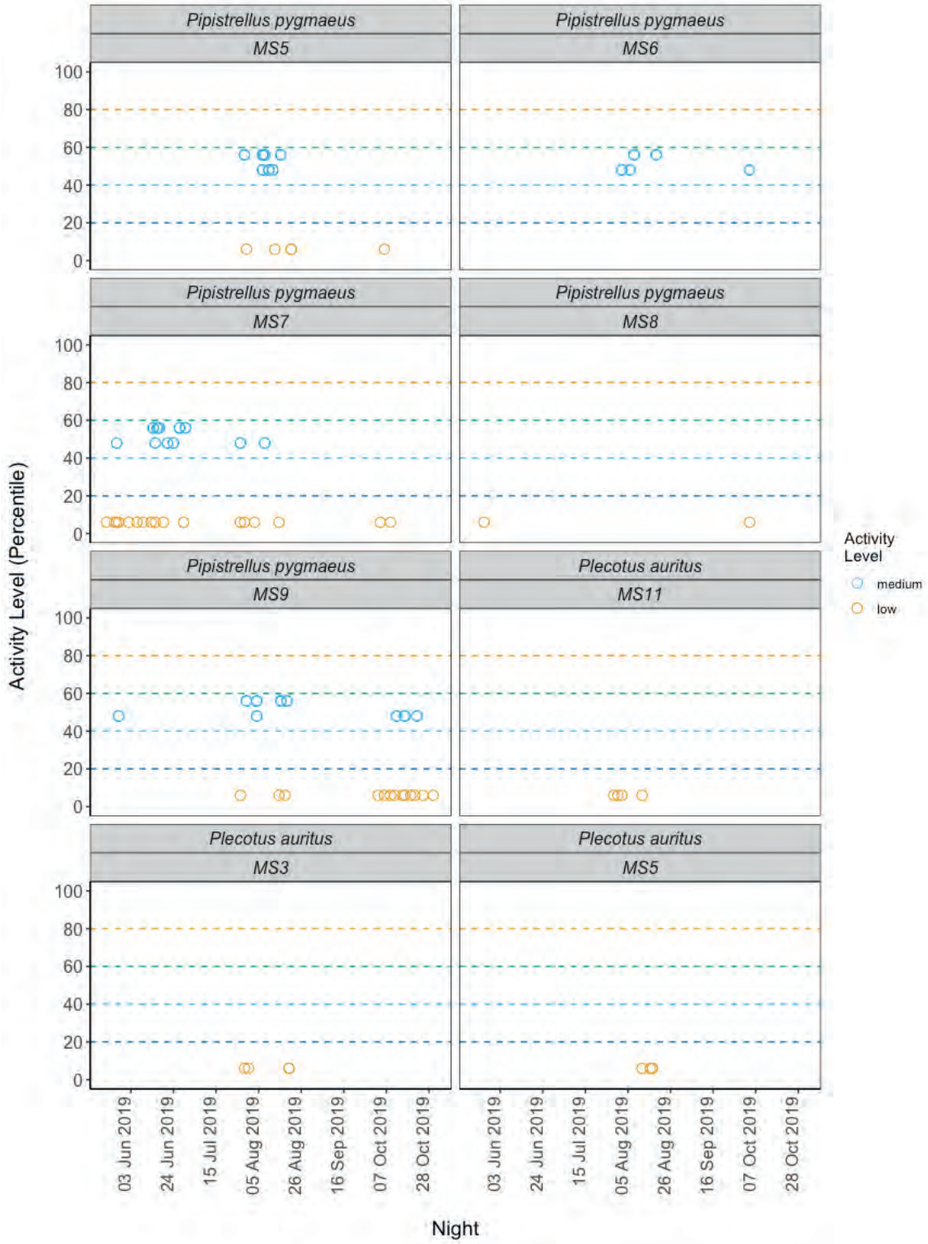

Myotis
MS9
Nyctalus leisleri
MS1
Nyctalus leisleri
MS10
Nyctalus leisleri
MS11
Nyctalus leisleri
MS12
Nyctalus leisleri
MS2
Nyctalus leisleri
MS3
Nyctalus leisleri
MS5
Activity Level (Percentile)
0
20
40
60
80
100
03 Jun 2019
24 Jun 2019
15 Jul 2019
05 Aug 2019
26 Aug 2019
16 Sep 2019
07 Oct 2019
28 Oct 2019
Night
Activity Level
medium
low

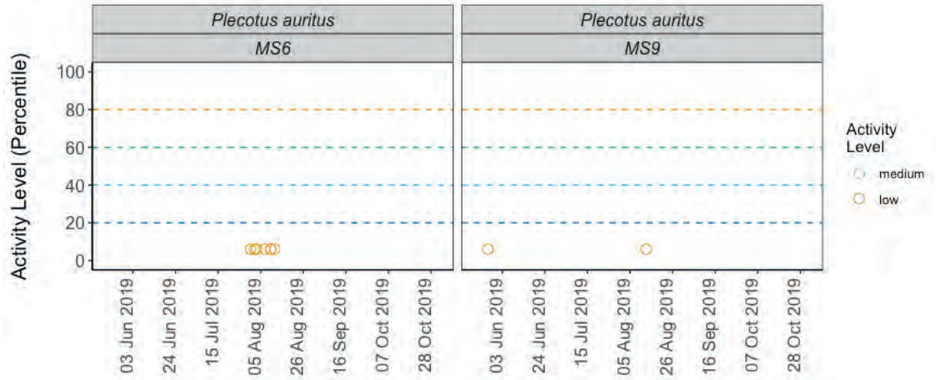

Nyctalus leisleri
MS6
Nyctalus leisleri
MS7
Nyctalus leisleri
MS9
Nyctalus noctula
MS1
Nyctalus noctula
MS10
Nyctalus noctula
MS11
Nyctalus noctula
MS12
Nyctalus noctula
MS2
Activity Level (Percentile)
0
20
40
60
80
100
03 Jun 2019
24 Jun 2019
15 Jul 2019
05 Aug 2019
26 Aug 2019
16 Sep 2019
07 Oct 2019
28 Oct 2019
Night
Activity Level
medium
low


Nyctalus noctula
MS3
Nyctalus noctula
MS5
Nyctalus noctula
MS6
Nyctalus noctula
MS7
Nyctalus noctula
MS8
Nyctalus noctula
MS9
Pipistrellus pipistrellus
MS1
Pipistrellus pipistrellus
MS10
Activity Level (Percentile)
0
20
40
60
80
100
03 Jun 2019
24 Jun 2019
15 Jul 2019
05 Aug 2019
26 Aug 2019
16 Sep 2019
07 Oct 2019
28 Oct 2019
Night
Activity Level
medium
low


Pipistrellus pipistrellus
MS11
MS12
MS2
MS3
MS5
MS6
MS7
MS8
Activity Level (Percentile)
100
80
60
40
20
0
03 Jun 2019
24 Jun 2019
15 Jul 2019
05 Aug 2019
26 Aug 2019
16 Sep 2019
07 Oct 2019
28 Oct 2019
Night
Activity Level
medium
low


Pipistrellus pipistrellus
Pipistrellus pygmaeus
MS9
MS1
MS10
MS11
MS12
MS2
MS3
MS4
Activity Level (Percentile)
100
80
60
40
20
0
03 Jun 2019
24 Jun 2019
15 Jul 2019
05 Aug 2019
26 Aug 2019
16 Sep 2019
07 Oct 2019
28 Oct 2019
Night
Activity Level
medium
low


Pipistrellus pygmaeus
MS5
Pipistrellus pygmaeus
MS6
Pipistrellus pygmaeus
MS7
Pipistrellus pygmaeus
MS8
Pipistrellus pygmaeus
MS9
Plecotus auritus
MS11
Plecotus auritus
MS3
Plecotus auritus
MS5
Activity Level (Percentile)
100
80
60
40
20
0
03 Jun 2019
24 Jun 2019
15 Jul 2019
05 Aug 2019
26 Aug 2019
16 Sep 2019
07 Oct 2019
28 Oct 2019
Night
Activity Level
medium
low


Plecotus auritus
MS6
Plecotus auritus
MS9
Activity Level (Percentile)
100
80
60
40
20
0
03 Jun 2019
24 Jun 2019
15 Jul 2019
05 Aug 2019
26 Aug 2019
16 Sep 2019
07 Oct 2019
28 Oct 2019
Activity Level
medium
low

Night

PER DETECTOR, PER MONTH

Table 5. Summary table showing the number of nights recorded bat activity fell into each activity band for each species at each detector during each month.

Detector ID	Species/Species Group	Month	Nights of High Activity	Nights of Moderate / High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
MS1	*Myotis*	May	0	0	2	0	1
MS1	*Myotis*	Jun	0	0	0	0	2
MS1	*Myotis*	Jul	0	0	0	0	1
MS1	*Myotis*	Aug	0	0	0	0	2
MS1	*Myotis*	Oct	0	0	1	2	5
MS1	*Nyctalus leisleri*	Oct	0	0	0	1	2
MS1	*Nyctalus noctula*	May	0	0	0	0	2
MS1	*Nyctalus noctula*	Jun	0	2	2	0	6
MS1	*Nyctalus noctula*	Jul	0	0	1	0	0
MS1	*Nyctalus noctula*	Aug	0	0	0	1	0
MS1	*Nyctalus noctula*	Oct	0	0	1	2	4
MS1	*Pipistrellus pipistrellus*	May	0	1	0	1	3
MS1	*Pipistrellus pipistrellus*	Jun	6	6	3	2	7
MS1	*Pipistrellus pipistrellus*	Jul	0	0	0	0	1
MS1	*Pipistrellus pipistrellus*	Aug	0	1	0	1	0
MS1	*Pipistrellus pipistrellus*	Oct	0	0	1	3	5
MS1	*Pipistrellus pygmaeus*	May	0	0	0	1	2
MS1	*Pipistrellus pygmaeus*	Jun	3	7	8	2	3
MS1	*Pipistrellus pygmaeus*	Jul	1	0	0	1	0
MS1	*Pipistrellus pygmaeus*	Aug	0	0	1	1	0
MS1	*Pipistrellus pygmaeus*	Oct	2	7	3	3	5
MS10	*Myotis*	Oct	0	0	0	0	5
MS10	*Nyctalus leisleri*	Oct	0	0	0	0	1
MS10	*Nyctalus noctula*	Oct	2	3	3	1	4
MS10	*Pipistrellus pipistrellus*	May	1	4	1	0	0
MS10	*Pipistrellus pipistrellus*	Jul	0	1	0	1	2
MS10	*Pipistrellus pipistrellus*	Aug	0	1	2	3	3
MS10	*Pipistrellus pipistrellus*	Oct	1	1	3	3	6
MS10	*Pipistrellus pygmaeus*	May	6	1	0	0	1
MS10	*Pipistrellus pygmaeus*	Jun	0	0	1	0	1
MS10	*Pipistrellus pygmaeus*	Jul	4	1	1	0	0
MS10	*Pipistrellus pygmaeus*	Aug	4	4	5	0	3
MS10	*Pipistrellus pygmaeus*	Oct	14	4	2	0	3
MS11	*Myotis*	Jun	0	0	1	0	4
MS11	*Myotis*	Jul	0	0	0	0	1
MS11	*Myotis*	Aug	0	0	0	0	5
MS11	*Myotis*	Oct	0	1	1	2	0
MS11	*Nyctalus leisleri*	Jul	0	1	0	0	0
MS11	*Nyctalus leisleri*	Aug	0	0	1	1	5
MS11	*Nyctalus noctula*	Jun	0	0	1	0	4
MS11	*Nyctalus noctula*	Jul	0	2	1	0	0
MS11	*Nyctalus noctula*	Aug	0	2	3	2	4

MS11	*Nyctalus noctula*	Oct	0	0	1	2	1
MS11	*Pipistrellus pipistrellus*	May	0	0	0	0	1
MS11	*Pipistrellus pipistrellus*	Jun	0	1	5	7	6
MS11	*Pipistrellus pipistrellus*	Jul	0	0	0	2	0
MS11	*Pipistrellus pipistrellus*	Aug	0	0	0	1	4
MS11	*Pipistrellus pipistrellus*	Oct	1	0	0	3	0
MS11	*Pipistrellus pygmaeus*	May	0	0	1	0	0
MS11	*Pipistrellus pygmaeus*	Jun	1	8	6	0	6
MS11	*Pipistrellus pygmaeus*	Jul	2	1	0	0	2
MS11	*Pipistrellus pygmaeus*	Aug	3	7	4	2	4
MS11	*Pipistrellus pygmaeus*	Oct	3	2	1	3	0
MS11	*Plecotus auritus*	Jul	0	0	0	0	2
MS11	*Plecotus auritus*	Aug	0	0	0	1	2
MS12	*Myotis*	Jun	3	11	4	0	4
MS12	*Myotis*	Jul	0	0	0	0	1
MS12	*Myotis*	Oct	0	0	0	1	1
MS12	*Nyctalus leisleri*	Jun	0	3	1	1	4
MS12	*Nyctalus leisleri*	Jul	1	0	0	0	2
MS12	*Nyctalus leisleri*	Oct	0	0	0	1	0
MS12	*Nyctalus noctula*	May	0	0	0	0	1
MS12	*Nyctalus noctula*	Jun	0	3	4	3	5
MS12	*Nyctalus noctula*	Jul	0	0	0	1	1
MS12	*Nyctalus noctula*	Oct	0	0	1	1	2
MS12	*Pipistrellus*	May	0	0	0	0	1
	pipistrellus						
MS12	*Pipistrellus pipistrellus*	Jun	14	8	0	3	0
MS12	*Pipistrellus pipistrellus*	Jul	1	1	1	1	0
MS12	*Pipistrellus pipistrellus*	Oct	1	2	0	0	0
MS12	*Pipistrellus pygmaeus*	Jun	23	1	1	0	0
MS12	*Pipistrellus pygmaeus*	Jul	4	0	0	0	0
MS12	*Pipistrellus pygmaeus*	Oct	2	1	0	0	0
MS2	*Myotis*	Jun	0	0	0	0	2
MS2	*Myotis*	Jul	0	0	0	0	2
MS2	*Myotis*	Aug	0	0	0	0	1
MS2	*Myotis*	Oct	0	0	0	1	2
MS2	*Nyctalus leisleri*	Jun	0	0	0	0	2
MS2	*Nyctalus leisleri*	Jul	0	1	0	0	3
MS2	*Nyctalus noctula*	Jun	0	0	1	0	0
MS2	*Nyctalus noctula*	Jul	0	0	0	1	1
MS2	*Nyctalus noctula*	Oct	0	0	0	2	9
MS2	*Pipistrellus pipistrellus*	May	0	0	0	1	1
MS2	*Pipistrellus pipistrellus*	Jun	2	3	1	3	2
MS2	*Pipistrellus pipistrellus*	Jul	3	1	0	0	1
MS2	*Pipistrellus pipistrellus*	Aug	2	0	0	0	1
MS2	*Pipistrellus pipistrellus*	Oct	0	0	3	1	2
MS2	*Pipistrellus pygmaeus*	May	0	0	1	0	1
MS2	*Pipistrellus pygmaeus*	Jun	1	2	3	2	5
MS2	*Pipistrellus*	Jul	3	0	2	0	2

	pygmaeus						
MS2	*Pipistrellus pygmaeus*	Aug	2	1	1	0	0
MS2	*Pipistrellus pygmaeus*	Oct	0	5	1	5	10
MS3	*Myotis*	May	0	0	0	0	3
MS3	*Myotis*	Jun	0	0	0	0	4
MS3	*Myotis*	Jul	0	0	0	2	1
MS3	*Myotis*	Aug	0	0	0	3	9
MS3	*Myotis*	Oct	0	0	0	0	1
MS3	*Nyctalus leisleri*	May	0	0	0	0	1
MS3	*Nyctalus leisleri*	Jun	0	0	0	1	1
MS3	*Nyctalus leisleri*	Jul	0	0	0	0	1
MS3	*Nyctalus leisleri*	Aug	0	0	1	2	4
MS3	*Nyctalus noctula*	May	1	0	1	2	1
MS3	*Nyctalus noctula*	Jun	5	7	3	3	3
MS3	*Nyctalus noctula*	Jul	0	0	2	0	1
MS3	*Nyctalus noctula*	Aug	0	0	1	3	5
MS3	*Pipistrellus pipistrellus*	May	0	0	0	0	2
MS3	*Pipistrellus pipistrellus*	Jun	0	8	5	1	7
MS3	*Pipistrellus pipistrellus*	Jul	0	2	2	0	1
MS3	*Pipistrellus pipistrellus*	Aug	1	1	3	2	3
MS3	*Pipistrellus pipistrellus*	Oct	0	1	0	0	1
MS3	*Pipistrellus pygmaeus*	May	0	0	1	1	2
MS3	*Pipistrellus pygmaeus*	Jun	0	4	2	4	8
MS3	*Pipistrellus pygmaeus*	Jul	2	0	1	0	3
MS3	*Pipistrellus*	Aug	2	5	3	4	6
	pygmaeus						
MS3	*Pipistrellus pygmaeus*	Oct	2	0	1	1	0
MS3	*Plecotus auritus*	Jul	0	0	0	0	2
MS3	*Plecotus auritus*	Aug	0	0	0	1	1
MS4	*Pipistrellus pygmaeus*	Jul	0	1	0	0	0
MS4	*Pipistrellus pygmaeus*	Oct	0	0	1	0	1
MS5	*Myotis*	Jul	0	0	0	1	1
MS5	*Myotis*	Aug	0	3	0	5	3
MS5	*Myotis*	Oct	0	0	0	0	1
MS5	*Nyctalus leisleri*	Jul	0	1	1	1	0
MS5	*Nyctalus leisleri*	Aug	0	3	1	4	4
MS5	*Nyctalus noctula*	Jul	1	1	1	0	0
MS5	*Nyctalus noctula*	Aug	0	2	5	2	2
MS5	*Pipistrellus pipistrellus*	Jul	0	0	0	2	1
MS5	*Pipistrellus pipistrellus*	Aug	0	1	1	5	3
MS5	*Pipistrellus pipistrellus*	Oct	0	0	0	0	1
MS5	*Pipistrellus pygmaeus*	Jul	3	0	0	0	1
MS5	*Pipistrellus pygmaeus*	Aug	2	5	3	1	1
MS5	*Pipistrellus pygmaeus*	Oct	0	2	0	3	1
MS5	*Plecotus auritus*	Aug	0	0	0	0	3
MS6	*Myotis*	May	0	0	0	0	1
MS6	*Myotis*	Aug	0	0	1	1	6
MS6	*Myotis*	Oct	0	1	0	0	2
MS6	*Nyctalus leisleri*	Jul	0	0	0	1	2
MS6	*Nyctalus leisleri*	Aug	0	0	2	3	3
MS6	*Nyctalus noctula*	Jul	1	0	0	1	2
MS6	*Nyctalus*	Aug	0	1	8	3	4

	noctula						
MS6	*Nyctalus noctula*	Oct	1	0	1	0	0
MS6	*Pipistrellus pipistrellus*	May	0	1	0	0	0
MS6	*Pipistrellus pipistrellus*	Jul	0	1	1	2	1
MS6	*Pipistrellus pipistrellus*	Aug	0	5	5	5	3
MS6	*Pipistrellus pipistrellus*	Oct	0	0	0	1	2
MS6	*Pipistrellus pygmaeus*	May	1	0	0	0	0
MS6	*Pipistrellus pygmaeus*	Jul	5	1	0	0	0
MS6	*Pipistrellus pygmaeus*	Aug	21	1	0	0	0
MS6	*Pipistrellus pygmaeus*	Oct	4	0	1	0	0
MS6	*Plecotus auritus*	Jul	0	0	0	0	1
MS6	*Plecotus auritus*	Aug	0	0	0	2	4
MS7	*Nyctalus leisleri*	Jul	1	0	2	0	0
MS7	*Nyctalus noctula*	Jun	0	0	0	0	1
MS7	*Nyctalus noctula*	Jul	1	0	0	1	1
MS7	*Nyctalus noctula*	Oct	0	0	1	0	1
MS7	*Pipistrellus pipistrellus*	May	0	0	0	0	1
MS7	*Pipistrellus pipistrellus*	Jun	5	7	2	3	5
MS7	*Pipistrellus pipistrellus*	Jul	0	0	2	0	0
MS7	*Pipistrellus pipistrellus*	Oct	0	0	0	0	3
MS7	*Pipistrellus pygmaeus*	May	0	0	0	0	4
MS7	*Pipistrellus pygmaeus*	Jun	12	8	2	2	2
MS7	*Pipistrellus pygmaeus*	Jul	1	2	1	1	1
MS7	*Pipistrellus pygmaeus*	Aug	0	1	1	2	1
MS7	*Pipistrellus pygmaeus*	Oct	4	2	0	0	1
MS8	*Nyctalus noctula*	Jul	0	2	2	1	1
MS8	*Nyctalus noctula*	Aug	2	2	7	0	1
MS8	*Pipistrellus pipistrellus*	May	0	0	1	0	1
MS8	*Pipistrellus pygmaeus*	May	0	0	0	0	1
MS8	*Pipistrellus pygmaeus*	Oct	0	0	0	0	1
MS9	*Myotis*	May	0	1	2	2	3
MS9	*Myotis*	Jul	0	0	0	2	2
MS9	*Myotis*	Aug	0	2	2	5	3
MS9	*Myotis*	Oct	0	0	2	7	7
MS9	*Nyctalus leisleri*	May	0	0	1	0	0
MS9	*Nyctalus leisleri*	Jul	0	0	2	0	1
MS9	*Nyctalus leisleri*	Aug	0	1	3	1	8
MS9	*Nyctalus noctula*	May	0	0	2	0	2
MS9	*Nyctalus noctula*	Jul	0	0	0	1	3
MS9	*Nyctalus noctula*	Aug	0	0	3	3	5
MS9	*Nyctalus noctula*	Oct	0	0	0	4	4
MS9	*Pipistrellus pipistrellus*	May	4	3	1	1	0
MS9	*Pipistrellus pipistrellus*	Jul	2	0	0	0	3
MS9	*Pipistrellus pipistrellus*	Aug	3	3	5	2	4
MS9	*Pipistrellus pipistrellus*	Oct	0	2	3	0	8

MS9	*Pipistrellus pygmaeus*	May	7	2	0	0	0
MS9	*Pipistrellus pygmaeus*	Jul	3	3	0	0	0
MS9	*Pipistrellus pygmaeus*	Aug	10	8	2	0	0
MS9	*Pipistrellus pygmaeus*	Oct	2	4	1	5	7
MS9	*Plecotus auritus*	May	0	0	0	0	1
MS9	*Plecotus auritus*	Aug	0	0	0	0	1

Table 6. Summary table showing key metrics for each species recorded per month. Please note that we cannot split the reference range by month, hence this column is not shown in this table.

Detector ID	Species/Species Group	Month	Median Percentile	95% CIs	Max Percentile	Nights Recorded
MS1	*Myotis*	May	48	6 - 27	56	3
MS1	*Myotis*	Jun	6	6 - 27	6	2
MS1	*Myotis*	Jul	6	6 - 27	6	1
MS1	*Myotis*	Aug	6	6 - 27	6	2
MS1	*Myotis*	Oct	6	6 - 27	48	8
MS1	*Nyctalus leisleri*	Oct	6	6 - 6	35	3
MS1	*Nyctalus noctula*	May	6	6 - 36	6	2
MS1	*Nyctalus noctula*	Jun	6	6 - 36	72	10
MS1	*Nyctalus noctula*	Jul	56	6 - 36	56	1
MS1	*Nyctalus noctula*	Aug	35	6 - 36	35	1
MS1	*Nyctalus noctula*	Oct	6	6 - 36	48	7
MS1	*Pipistrellus pipistrellus*	May	6	27 - 48	79	5
MS1	*Pipistrellus pipistrellus*	Jun	55	27 - 48	93	24
MS1	*Pipistrellus pipistrellus*	Jul	6	27 - 48	6	1
MS1	*Pipistrellus pipistrellus*	Aug	49	27 - 48	62	2
MS1	*Pipistrellus pipistrellus*	Oct	6	27 - 48	48	9
MS1	*Pipistrellus pygmaeus*	May	6	41.5 - 58.5	35	3
MS1	*Pipistrellus pygmaeus*	Jun	56	41.5 - 58.5	94	23
MS1	*Pipistrellus pygmaeus*	Jul	65	41.5 - 58.5	95	2
MS1	*Pipistrellus pygmaeus*	Aug	42	41.5 - 58.5	48	2
MS1	*Pipistrellus pygmaeus*	Oct	52	41.5 - 58.5	87	20
MS10	*Myotis*	Oct	6	6 - 6	6	5

MS10	*Nyctalus leisleri*	Oct	6	0	6	1
MS10	*Nyctalus noctula*	Oct	48	27 - 67	91	13
MS10	*Pipistrellus pipistrellus*	May	80	27 - 49.5	84	6
MS10	*Pipistrellus pipistrellus*	Jul	21	27 - 49.5	74	4
MS10	*Pipistrellus pipistrellus*	Aug	35	27 - 49.5	79	9
MS10	*Pipistrellus pipistrellus*	Oct	35	27 - 49.5	93	14
MS10	*Pipistrellus pygmaeus*	May	94	65 - 82	99	8
MS10	*Pipistrellus pygmaeus*	Jun	31	65 - 82	56	2
MS10	*Pipistrellus pygmaeus*	Jul	86	65 - 82	93	6
MS10	*Pipistrellus pygmaeus*	Aug	61	65 - 82	96	16
MS10	*Pipistrellus pygmaeus*	Oct	84	65 - 82	100	23
MS11	*Myotis*	Jun	6	6 - 31	48	5
MS11	*Myotis*	Jul	6	6 - 31	6	1
MS11	*Myotis*	Aug	6	6 - 31	6	5
MS11	*Myotis*	Oct	46	6 - 31	66	4
MS11	*Nyctalus leisleri*	Jul	62	6 - 34	62	1
MS11	*Nyctalus leisleri*	Aug	6	6 - 34	48	7
MS11	*Nyctalus noctula*	Jun	6	20.5 - 45.5	56	5
MS11	*Nyctalus noctula*	Jul	70	20.5 - 45.5	72	3
MS11	*Nyctalus noctula*	Aug	35	20.5 - 45.5	62	11
MS11	*Nyctalus noctula*	Oct	35	20.5 - 45.5	56	4
MS11	*Pipistrellus pipistrellus*	May	6	20.5 - 35	6	1
MS11	*Pipistrellus pipistrellus*	Jun	35	20.5 - 35	66	19
MS11	*Pipistrellus pipistrellus*	Jul	35	20.5 - 35	35	2
MS11	*Pipistrellus pipistrellus*	Aug	6	20.5 - 35	35	5
MS11	*Pipistrellus pipistrellus*	Oct	35	20.5 - 35	88	4
MS11	*Pipistrellus pygmaeus*	May	48	45 - 65	48	1
MS11	*Pipistrellus pygmaeus*	Jun	56	45 - 65	82	21
MS11	*Pipistrellus pygmaeus*	Jul	79	45 - 65	96	5
MS11	*Pipistrellus pygmaeus*	Aug	63	45 - 65	92	20
MS11	*Pipistrellus pygmaeus*	Oct	72	45 - 65	90	9
MS11	*Plecotus auritus*	Jul	6	6 - 6	6	2
MS11	*Plecotus auritus*	Aug	6	6 - 6	35	3
MS12	*Myotis*	Jun	64	41 - 69	87	22
MS12	*Myotis*	Jul	6	41 - 69	6	1
MS12	*Myotis*	Oct	21	41 - 69	35	2
MS12	*Nyctalus leisleri*	Jun	35	6 - 52.5	70	9
MS12	*Nyctalus leisleri*	Jul	6	6 - 52.5	83	3
MS12	*Nyctalus leisleri*	Oct	35	6 - 52.5	35	1
MS12	*Nyctalus noctula*	May	6	20.5 - 41.5	6	1
MS12	*Nyctalus noctula*	Jun	35	20.5 - 41.5	66	15
MS12	*Nyctalus noctula*	Jul	21	20.5 - 41.5	35	2
MS12	*Nyctalus noctula*	Oct	21	20.5 - 41.5	56	4
MS12	*Pipistrellus pipistrellus*	May	6	65 - 82	6	1

MS12	*Pipistrellus pipistrellus*	Jun	83	65 - 82	98	25
MS12	*Pipistrellus pipistrellus*	Jul	64	65 - 82	88	4
MS12	*Pipistrellus pipistrellus*	Oct	66	65 - 82	81	3
MS12	*Pipistrellus pygmaeus*	Jun	93	87.5 - 93	99	25
MS12	*Pipistrellus pygmaeus*	Jul	95	87.5 - 93	96	4
MS12	*Pipistrellus pygmaeus*	Oct	84	87.5 - 93	84	3
MS2	*Myotis*	Jun	6	6 - 6	6	2
MS2	*Myotis*	Jul	6	6 - 6	6	2
MS2	*Myotis*	Aug	6	6 - 6	6	1
MS2	*Myotis*	Oct	6	6 - 6	35	3
MS2	*Nyctalus leisleri*	Jun	6	6 - 6	6	2
MS2	*Nyctalus leisleri*	Jul	6	6 - 6	74	4
MS2	*Nyctalus noctula*	Jun	56	6 - 20.5	56	1
MS2	*Nyctalus noctula*	Jul	21	6 - 20.5	35	2
MS2	*Nyctalus noctula*	Oct	6	6 - 20.5	35	11
MS2	*Pipistrellus pipistrellus*	May	21	35 - 64	35	2
MS2	*Pipistrellus pipistrellus*	Jun	48	35 - 64	94	11
MS2	*Pipistrellus pipistrellus*	Jul	82	35 - 64	94	5
MS2	*Pipistrellus pipistrellus*	Aug	84	35 - 64	87	3
MS2	*Pipistrellus pipistrellus*	Oct	42	35 - 64	56	6
MS2	*Pipistrellus pygmaeus*	May	31	31 - 50.5	56	2
MS2	*Pipistrellus pygmaeus*	Jun	35	31 - 50.5	86	13
MS2	*Pipistrellus pygmaeus*	Jul	56	31 - 50.5	95	7
MS2	*Pipistrellus pygmaeus*	Aug	84	31 - 50.5	95	4
MS2	*Pipistrellus pygmaeus*	Oct	35	31 - 50.5	80	21
MS3	*Myotis*	May	6	6 - 20.5	6	3
MS3	*Myotis*	Jun	6	6 - 20.5	6	4
MS3	*Myotis*	Jul	35	6 - 20.5	35	3
MS3	*Myotis*	Aug	6	6 - 20.5	35	12
MS3	*Myotis*	Oct	6	6 - 20.5	6	1
MS3	*Nyctalus leisleri*	May	6	6 - 27	6	1
MS3	*Nyctalus leisleri*	Jun	21	6 - 27	35	2
MS3	*Nyctalus leisleri*	Jul	6	6 - 27	6	1
MS3	*Nyctalus leisleri*	Aug	6	6 - 27	48	7
MS3	*Nyctalus noctula*	May	35	35 - 57	83	5
MS3	*Nyctalus noctula*	Jun	62	35 - 57	85	21
MS3	*Nyctalus noctula*	Jul	56	35 - 57	56	3
MS3	*Nyctalus noctula*	Aug	6	35 - 57	48	9
MS3	*Pipistrellus pipistrellus*	May	6	31 - 52	6	2
MS3	*Pipistrellus pipistrellus*	Jun	56	31 - 52	74	21
MS3	*Pipistrellus pipistrellus*	Jul	56	31 - 52	72	5
MS3	*Pipistrellus pipistrellus*	Aug	42	31 - 52	83	10
MS3	*Pipistrellus pipistrellus*	Oct	38	31 - 52	70	2
MS3	*Pipistrellus pygmaeus*	May	21	31 - 45.5	56	4
MS3	*Pipistrellus pygmaeus*	Jun	35	31 - 45.5	62	18

MS3	*Pipistrellus pygmaeus*	Jul	31	31 - 45.5	89	6
MS3	*Pipistrellus pygmaeus*	Aug	46	31 - 45.5	86	20
MS3	*Pipistrellus pygmaeus*	Oct	66	31 - 45.5	85	4
MS3	*Plecotus auritus*	Jul	6	6 - 6	6	2
MS3	*Plecotus auritus*	Aug	21	6 - 6	35	2
MS4	*Pipistrellus pygmaeus*	Jul	74	6 - 74	74	1
MS4	*Pipistrellus pygmaeus*	Oct	31	6 - 74	56	2
MS5	*Myotis*	Jul	21	20.5 - 48.5	35	2
MS5	*Myotis*	Aug	35	20.5 - 48.5	70	11
MS5	*Myotis*	Oct	6	20.5 - 48.5	6	1
MS5	*Nyctalus leisleri*	Jul	56	20.5 - 54.5	76	3
MS5	*Nyctalus leisleri*	Aug	35	20.5 - 54.5	74	12
MS5	*Nyctalus noctula*	Jul	72	35 - 64	82	3
MS5	*Nyctalus noctula*	Aug	48	35 - 64	76	11
MS5	*Pipistrellus pipistrellus*	Jul	35	20.5 - 35	35	3
MS5	*Pipistrellus pipistrellus*	Aug	35	20.5 - 35	62	10
MS5	*Pipistrellus pipistrellus*	Oct	6	20.5 - 35	6	1
MS5	*Pipistrellus pygmaeus*	Jul	85	41.5 - 68	89	4
MS5	*Pipistrellus pygmaeus*	Aug	62	41.5 - 68	87	12
MS5	*Pipistrellus pygmaeus*	Oct	35	41.5 - 68	74	6
MS5	*Plecotus auritus*	Aug	6	6 - 6	6	3
MS6	*Myotis*	May	6	6 - 31	6	1
MS6	*Myotis*	Aug	6	6 - 31	56	8
MS6	*Myotis*	Oct	6	6 - 31	66	3
MS6	*Nyctalus leisleri*	Jul	6	6 - 41.5	35	3
MS6	*Nyctalus leisleri*	Aug	35	6 - 41.5	56	8
MS6	*Nyctalus noctula*	Jul	21	27 - 52	83	4
MS6	*Nyctalus noctula*	Aug	48	27 - 52	70	16
MS6	*Nyctalus noctula*	Oct	66	27 - 52	84	2
MS6	*Pipistrellus pipistrellus*	May	66	34 - 52	66	1
MS6	*Pipistrellus pipistrellus*	Jul	35	34 - 52	74	5
MS6	*Pipistrellus pipistrellus*	Aug	48	34 - 52	80	18
MS6	*Pipistrellus pipistrellus*	Oct	6	34 - 52	35	3
MS6	*Pipistrellus pygmaeus*	May	91	88 - 93.5	91	1
MS6	*Pipistrellus pygmaeus*	Jul	97	88 - 93.5	100	6
MS6	*Pipistrellus pygmaeus*	Aug	91	88 - 93.5	98	22
MS6	*Pipistrellus pygmaeus*	Oct	93	88 - 93.5	97	5
MS6	*Plecotus auritus*	Jul	6	6 - 20.5	6	1
MS6	*Plecotus auritus*	Aug	6	6 - 20.5	35	6
MS7	*Nyctalus leisleri*	Jul	56	48 - 89	89	3
MS7	*Nyctalus noctula*	Jun	6	6 - 56	6	1
MS7	*Nyctalus noctula*	Jul	35	6 - 56	85	3
MS7	*Nyctalus noctula*	Oct	31	6 - 56	56	2
MS7	*Pipistrellus pipistrellus*	May	6	36 - 61.5	6	1
MS7	*Pipistrellus*	Jun	66	36 -	89	22

	pipistrellus			61.5		
MS7	*Pipistrellus pipistrellus*	Jul	52	36 - 61.5	56	2
MS7	*Pipistrellus pipistrellus*	Oct	6	36 - 61.5	6	3
MS7	*Pipistrellus pygmaeus*	May	6	49 - 74.5	6	4
MS7	*Pipistrellus pygmaeus*	Jun	79	49 - 74.5	93	26
MS7	*Pipistrellus pygmaeus*	Jul	57	49 - 74.5	92	6
MS7	*Pipistrellus pygmaeus*	Aug	35	49 - 74.5	79	5
MS7	*Pipistrellus pygmaeus*	Oct	85	49 - 74.5	96	7
MS8	*Nyctalus noctula*	Jul	52	45.5 - 66	76	6
MS8	*Nyctalus noctula*	Aug	56	45.5 - 66	91	12
MS8	*Pipistrellus pipistrellus*	May	31	31 - 31	56	2
MS8	*Pipistrellus pygmaeus*	May	6	6 - 6	6	1
MS8	*Pipistrellus pygmaeus*	Oct	6	6 - 6	6	1
MS9	*Myotis*	May	35	20.5 - 35	77	8
MS9	*Myotis*	Jul	21	20.5 - 35	35	4
MS9	*Myotis*	Aug	35	20.5 - 35	62	12
MS9	*Myotis*	Oct	35	20.5 - 35	56	16
MS9	*Nyctalus leisleri*	May	56	6 - 35	56	1
MS9	*Nyctalus leisleri*	Jul	48	6 - 35	48	3
MS9	*Nyctalus leisleri*	Aug	6	6 - 35	62	13
MS9	*Nyctalus noctula*	May	27	20.5 - 27	48	4
MS9	*Nyctalus noctula*	Jul	6	20.5 - 27	35	4
MS9	*Nyctalus noctula*	Aug	35	20.5 - 27	56	11
MS9	*Nyctalus noctula*	Oct	21	20.5 - 27	35	8
MS9	*Pipistrellus pipistrellus*	May	70	38 - 57	95	9
MS9	*Pipistrellus pipistrellus*	Jul	6	38 - 57	93	5
MS9	*Pipistrellus pipistrellus*	Aug	48	38 - 57	89	17
MS9	*Pipistrellus pipistrellus*	Oct	6	38 - 57	70	13
MS9	*Pipistrellus pygmaeus*	May	88	61 - 79.5	98	9
MS9	*Pipistrellus pygmaeus*	Jul	81	61 - 79.5	98	6
MS9	*Pipistrellus pygmaeus*	Aug	80	61 - 79.5	100	20
MS9	*Pipistrellus pygmaeus*	Oct	35	61 - 79.5	89	19
MS9	*Plecotus auritus*	May	6	6 - 6	6	1
MS9	*Plecotus auritus*	Aug	6	6 - 6	6	1

PER SITE

In this 'Per Site' section of the analysis, all values are taken from across all of the detectors to provide site-wide averages/medians.

Table 7. Summary table showing the number of nights recorded bat activity fell into each activity band for each species.

Species/Species Group	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
Myotis	3	19	16	34	86
Nyctalus leisleri	2	10	15	17	44
Nyctalus noctula	14	27	56	40	81
Pipistrellus pipistrellus	47	66	51	60	96
Pipistrellus pygmaeus	159	101	62	44	89
Plecotus auritus	0	0	0	4	17

Table 8. Summary table showing key metrics for each species recorded.

Species/Species Group	Median Percentile	95% CIs	Max Percentile	Nights Recorded
Myotis	6	6 - 6	87	158
Nyctalus leisleri	21	6 - 6	89	88
Nyctalus noctula	35	6 - 56	91	218
Pipistrellus pipistrellus	48	65 - 82	98	320
Pipistrellus pygmaeus	66	88 - 93.5	100	455
Plecotus auritus	6	6 - 6	35	21

###Figures

Figure 4. The activity level (percentile) of bats recorded across each night of the bat survey for the **entire site**.

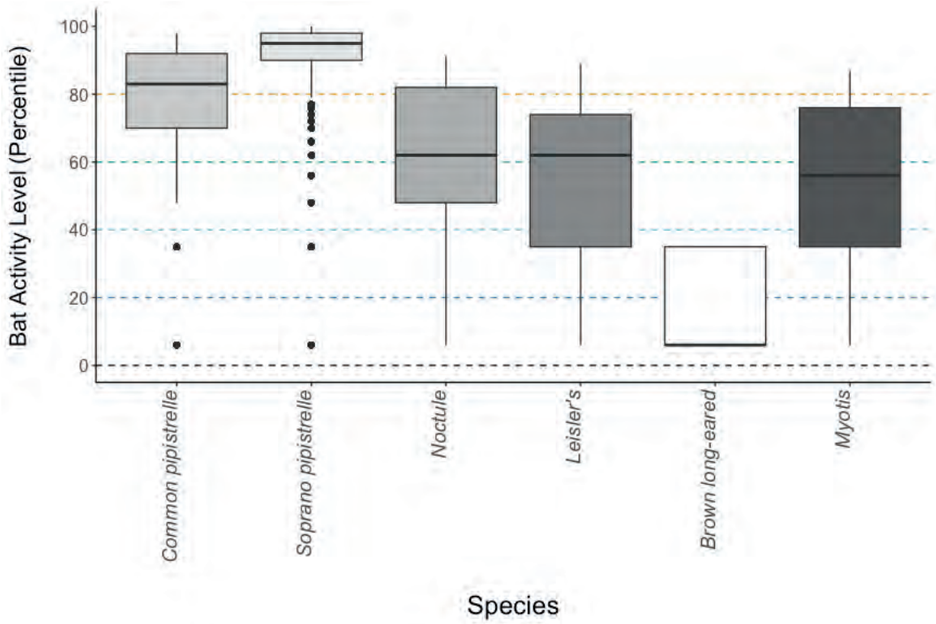
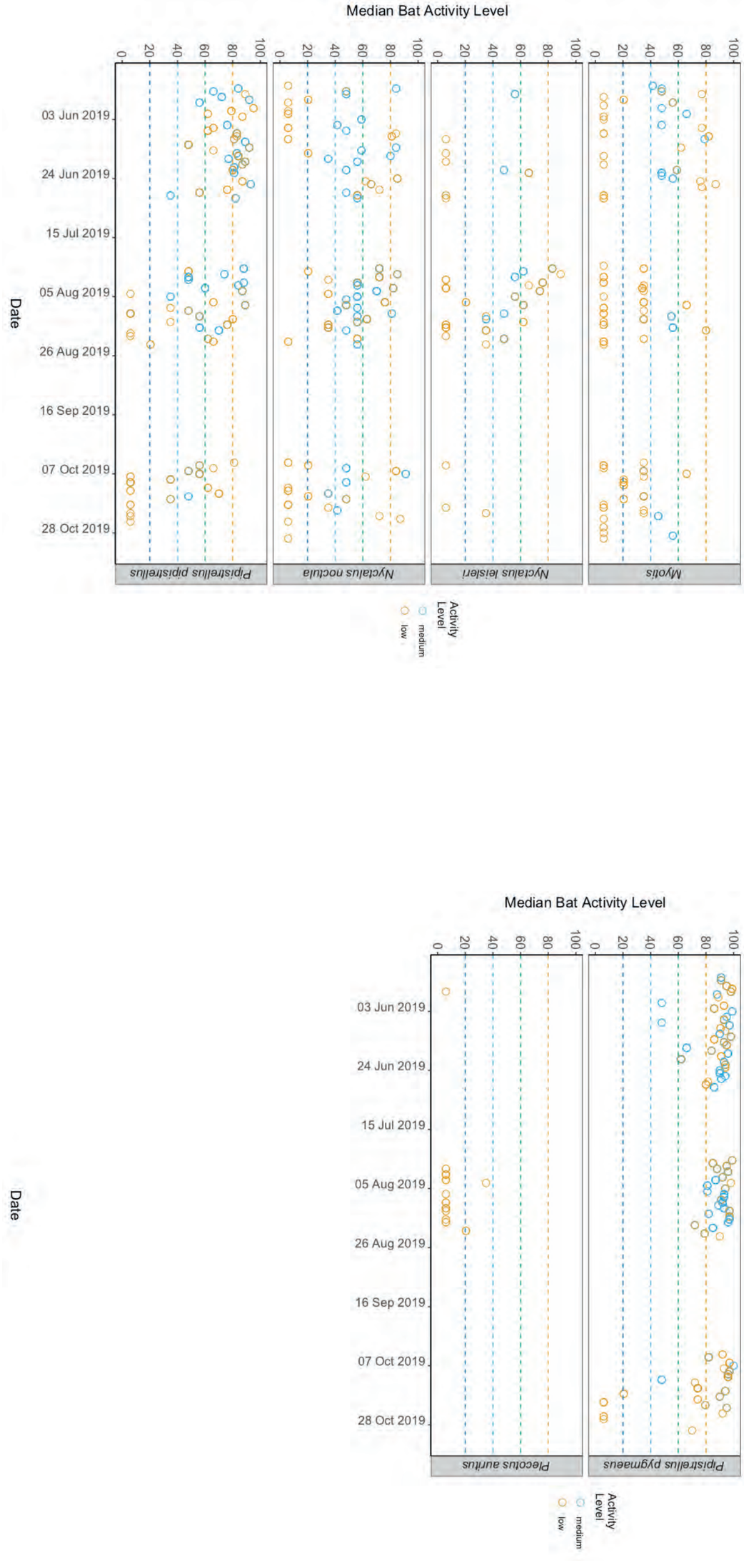


Figure 5. The median activity levels of bats recorded across all detectors each night.


Median Bat Activity Level
0
20
40
60
80
100
Myotis
Nyctalus leisleri
Nyctalus noctula
Pipistrellus pipistrellus
Pipistrellus pygmaeus
Plecotus auritus
03 Jun 2019
24 Jun 2019
15 Jul 2019
05 Aug 2019
26 Aug 2019
16 Sep 2019
07 Oct 2019
28 Oct 2019
Date
Activity Level
medium
low

PER SITE, PER MONTH

Table 9. Summary table showing the number of nights recorded bat activity fell into each activity band for each species during each month.

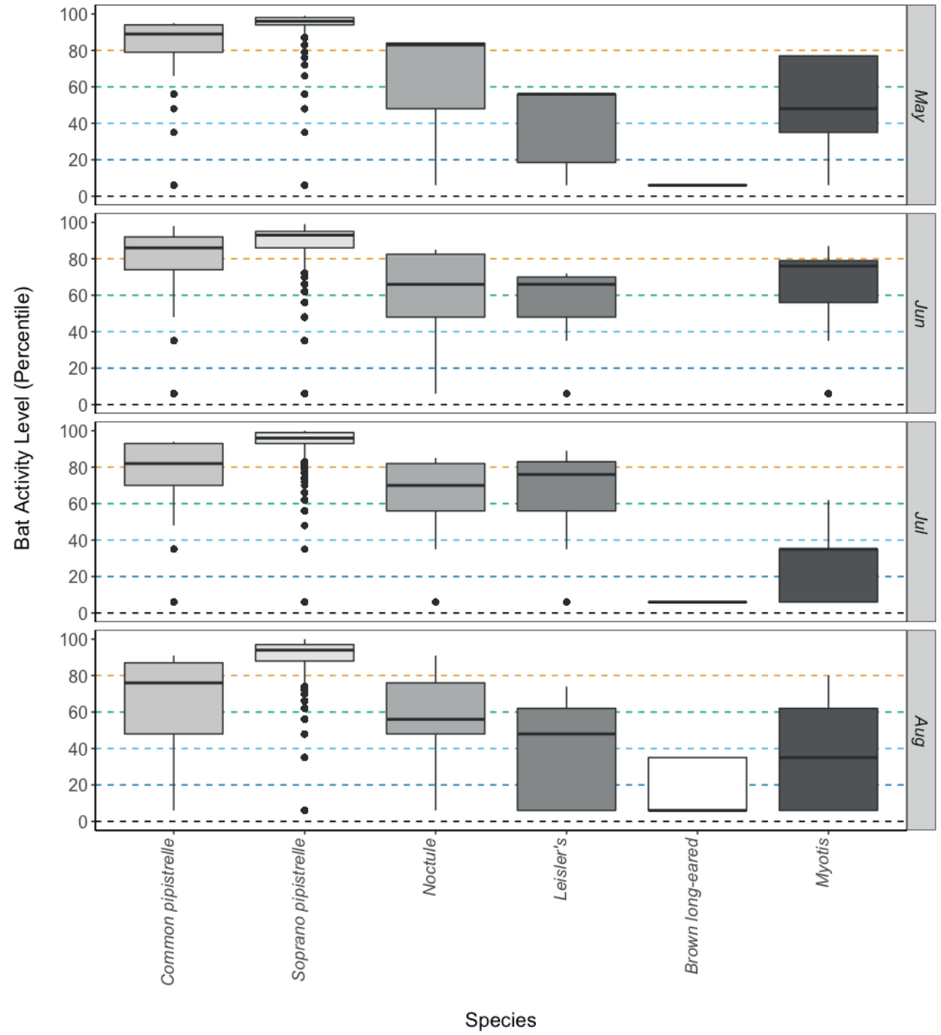
Species/Species Group	Month	Nights of High Activity	Nights of Moderate/ High Activity	Nights of Moderate Activity	Nights of Low/ Moderate Activity	Nights of Low Activity
Myotis	May	0	1	4	2	8
Myotis	Jun	3	11	5	0	16
Myotis	Jul	0	0	0	5	9
Myotis	Aug	0	5	3	14	29
Myotis	Oct	0	2	4	13	24
Nyctalus leisleri	May	0	0	1	0	1
Nyctalus leisleri	Jun	0	3	1	2	7
Nyctalus leisleri	Jul	2	3	5	2	9
Nyctalus leisleri	Aug	0	4	8	11	24
Nyctalus leisleri	Oct	0	0	0	2	3
Nyctalus noctula	May	1	0	3	2	6
Nyctalus noctula	Jun	5	12	11	6	19
Nyctalus noctula	Jul	3	5	7	6	10
Nyctalus noctula	Aug	2	7	27	14	21
Nyctalus noctula	Oct	3	3	8	12	25
Pipistrellus pipistrellus	May	5	9	3	3	10
Pipistrellus pipistrellus	Jun	27	33	16	19	27
Pipistrellus pipistrellus	Jul	6	6	6	8	10
Pipistrellus pipistrellus	Aug	6	12	16	19	21
Pipistrellus pipistrellus	Oct	3	6	10	11	28
Pipistrellus pygmaeus	May	14	3	3	2	11
Pipistrellus pygmaeus	Jun	40	30	23	10	25
Pipistrellus	Jul	28	9	5	2	9
pygmaeus						
Pipistrellus pygmaeus	Aug	44	32	20	10	15
Pipistrellus pygmaeus	Oct	33	27	11	20	29
Plecotus auritus	May	0	0	0	0	1
Plecotus auritus	Jul	0	0	0	0	5
Plecotus auritus	Aug	0	0	0	4	11

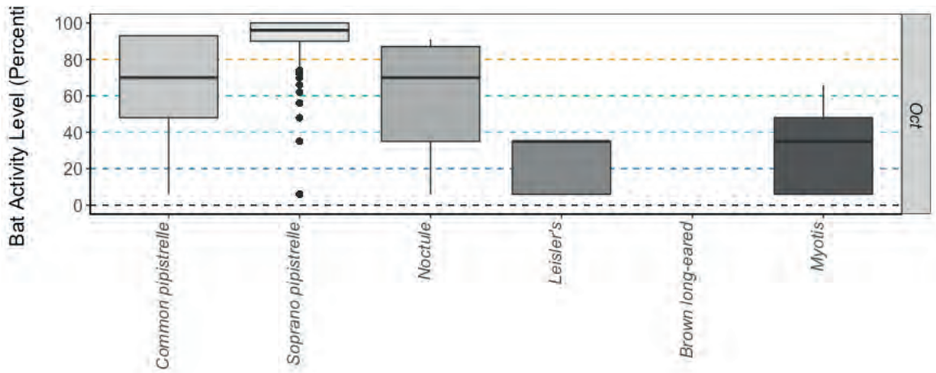
Table 10. Summary table showing key metrics for each species recorded per month.

Species/Species Group	Month	Median Percentile	95% CIs	Max Percentile	Nights Recorded
Myotis	May	6	6 - 31	77	15
Myotis	Jun	48	6 - 6	87	35
Myotis	Jul	6	6 - 6	35	14
Myotis	Aug	6	6 - 6	70	51
Myotis	Oct	6	6 - 6	66	43
Nyctalus leisleri	May	31	6 - 35	56	2
Nyctalus leisleri	Jun	6	6 - 6	70	13
Nyctalus leisleri	Jul	35	6 - 6	89	21
Nyctalus leisleri	Aug	6	6 - 41.5	74	47
Nyctalus leisleri	Oct	6	6 - 6	35	5
Nyctalus noctula	May	21	6 - 36	83	12
Nyctalus noctula	Jun	48	6 - 56	85	53
Nyctalus noctula	Jul	35	6 - 56	85	31
Nyctalus noctula	Aug	48	6 - 36	91	71
Nyctalus noctula	Oct	35	6 - 56	91	51
Pipistrellus pipistrellus	May	56	65 - 82	95	30
Pipistrellus pipistrellus	Jun	56	65 - 82	98	122
Pipistrellus pipistrellus	Jul	42	65 - 82	94	36
Pipistrellus pipistrellus	Aug	35	38 - 57	89	74
Pipistrellus pipistrellus	Oct	35	65 - 82	93	58
Pipistrellus pygmaeus	May	66	88 - 93.5	99	33
Pipistrellus pygmaeus	Jun	62	87.5 - 93	99	128
Pipistrellus pygmaeus	Jul	81	88 - 93.5	100	53
Pipistrellus pygmaeus	Aug	72	88 - 93.5	100	121
Pipistrellus pygmaeus	Oct	59	88 - 93.5	100	120
Plecotus auritus	May	6	6 - 6	6	1
Plecotus auritus	Jul	6	6 - 6	6	5
Plecotus auritus	Aug	6	6 - 6	35	15

###Figures

Figure 6. The activity level (percentile) of bats recorded across each night of the bat survey for the entire site, split between months.





PART 2: Nightly Analysis

ENTIRE SURVEY PERIOD

Sunrise and Sunset Times

Table 11. The times of sunset and sunrise the following morning for surveys beginning on the date shown.

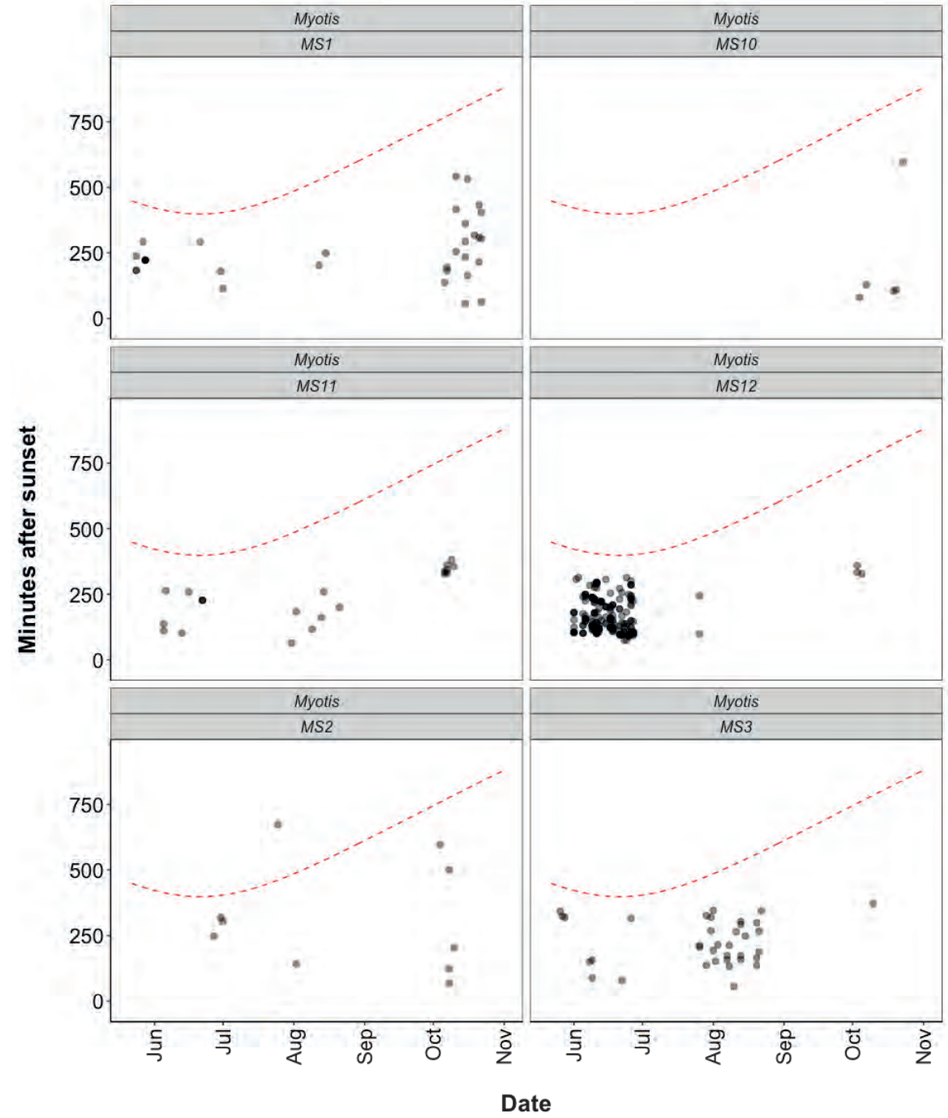
Night (y-m-d)	Sunset (hh:mm)	Sunrise (hh:mm)	Night Length (hours)
2019-05-22	21:31	05:00	7.5
2019-05-23	21:33	04:59	7.4
2019-05-24	21:35	04:57	7.4
2019-05-25	21:36	04:56	7.3
2019-05-26	21:38	04:55	7.3
2019-05-27	21:39	04:54	7.2
2019-05-28	21:41	04:52	7.2
2019-05-29	21:42	04:51	7.2
2019-05-30	21:44	04:50	7.1
2019-05-31	21:45	04:49	7.1
2019-06-01	21:46	04:48	7.0
2019-06-02	21:48	04:47	7.0
2019-06-03	21:49	04:46	7.0
2019-06-05	21:51	04:45	6.9
2019-06-06	21:52	04:44	6.9
2019-06-07	21:53	04:43	6.8
2019-06-08	21:54	04:43	6.8
2019-06-09	21:55	04:42	6.8
2019-06-10	21:56	04:42	6.8
2019-06-11	21:57	04:41	6.7
2019-06-12	21:58	04:41	6.7
2019-06-13	21:59	04:41	6.7
2019-06-14	21:59	04:41	6.7
2019-06-15	22:00	04:40	6.7
2019-06-16	22:00	04:40	6.7
2019-06-17	22:01	04:40	6.7
2019-06-18	22:01	04:40	6.6

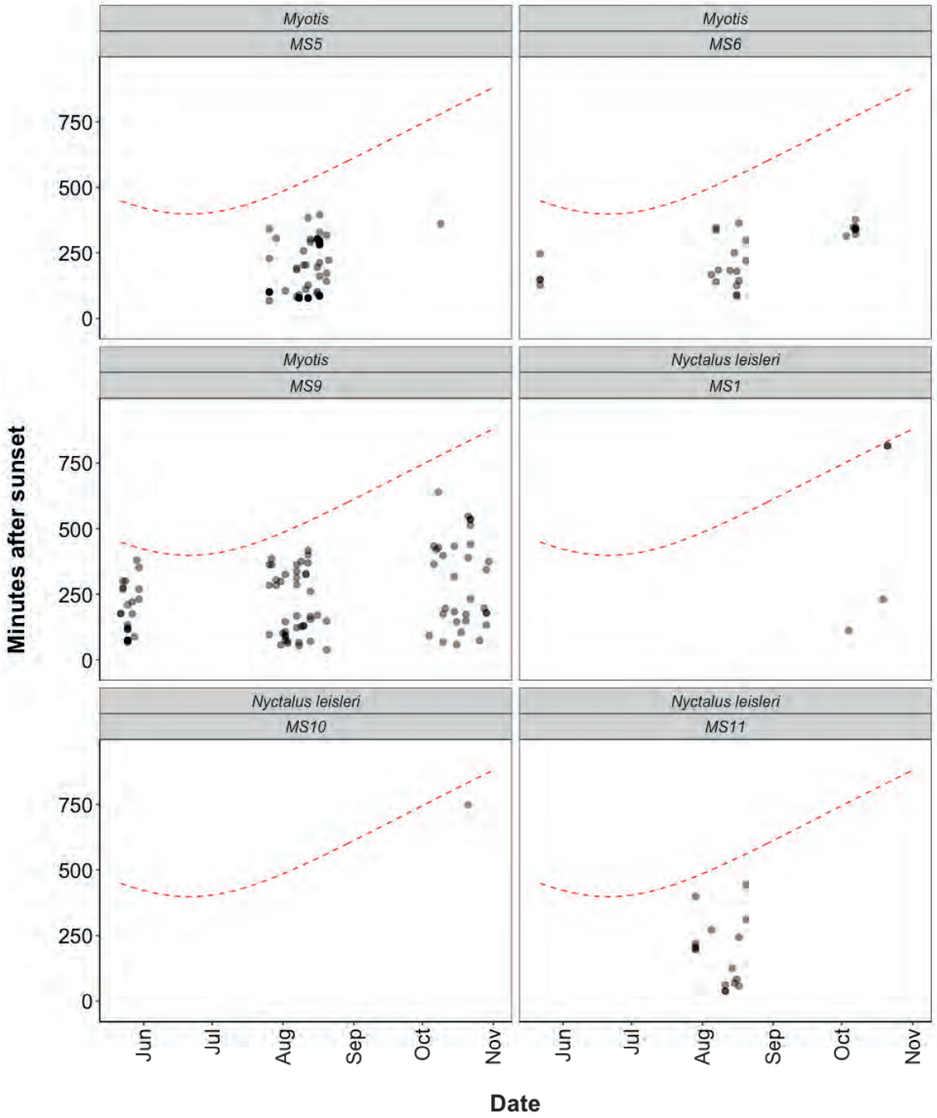
2019-06-19	22:02	04:40	6.6
2019-06-20	22:02	04:40	6.6
2019-06-21	22:02	04:41	6.6
2019-06-22	22:03	04:41	6.6
2019-06-23	22:03	04:41	6.6
2019-06-24	22:03	04:42	6.6
2019-06-25	22:03	04:42	6.7
2019-06-26	22:03	04:43	6.7
2019-06-27	22:03	04:43	6.7
2019-06-28	22:02	04:44	6.7
2019-06-29	22:02	04:44	6.7
2019-06-30	22:02	04:45	6.7
2019-07-01	22:02	04:46	6.7
2019-07-25	21:36	05:18	7.7
2019-07-26	21:35	05:19	7.7
2019-07-27	21:33	05:21	7.8
2019-07-28	21:31	05:23	7.9
2019-07-29	21:30	05:24	7.9
2019-07-30	21:28	05:26	8.0
2019-07-31	21:26	05:28	8.0
2019-08-01	21:24	05:30	8.1
2019-08-02	21:22	05:32	8.2
2019-08-03	21:20	05:33	8.2
2019-08-04	21:18	05:35	8.3
2019-08-05	21:16	05:37	8.3
2019-08-06	21:14	05:39	8.4
2019-08-07	21:12	05:41	8.5
2019-08-08	21:10	05:42	8.5
2019-08-09	21:08	05:44	8.6
2019-08-10	21:06	05:46	8.7
2019-08-11	21:04	05:48	8.7
2019-08-12	21:02	05:50	8.8
2019-08-13	21:00	05:52	8.9
2019-08-14	20:57	05:54	8.9
2019-08-15	20:55	05:56	9.0
2019-08-16	20:53	05:57	9.1
2019-08-17	20:51	05:59	9.1
2019-08-18	20:48	06:01	9.2
2019-08-19	20:46	06:03	9.3
2019-08-20	20:44	06:05	9.4
2019-08-21	20:41	06:07	9.4
2019-08-22	20:39	06:09	9.5
2019-10-02	18:55	07:25	12.5
2019-10-03	18:53	07:27	12.6
2019-10-04	18:50	07:29	12.6
2019-10-05	18:48	07:31	12.7
2019-10-06	18:45	07:33	12.8
2019-10-07	18:43	07:34	12.9
2019-10-08	18:40	07:36	12.9
2019-10-09	18:38	07:38	13.0
2019-10-10	18:35	07:40	13.1
2019-10-11	18:33	07:42	13.2
2019-10-12	18:30	07:44	13.2
2019-10-13	18:28	07:46	13.3
2019-10-14	18:25	07:48	13.4
2019-10-15	18:23	07:50	13.5
2019-10-16	18:20	07:52	13.5
2019-10-17	18:18	07:54	13.6
2019-10-18	18:16	07:56	13.7
2019-10-19	18:13	07:58	13.7
2019-10-20	18:11	08:00	13.8
2019-10-21	18:09	08:02	13.9
2019-10-22	18:06	08:04	14.0
2019-10-23	18:04	08:06	14.0
2019-10-24	18:02	08:08	14.1
2019-10-25	17:59	08:10	14.2
2019-10-26	17:57	07:12	14.2
2019-10-28	16:53	07:16	14.4
2019-10-29	16:51	07:18	14.5
2019-10-30	16:48	07:20	14.5
2019-10-31	16:46	07:22	14.6

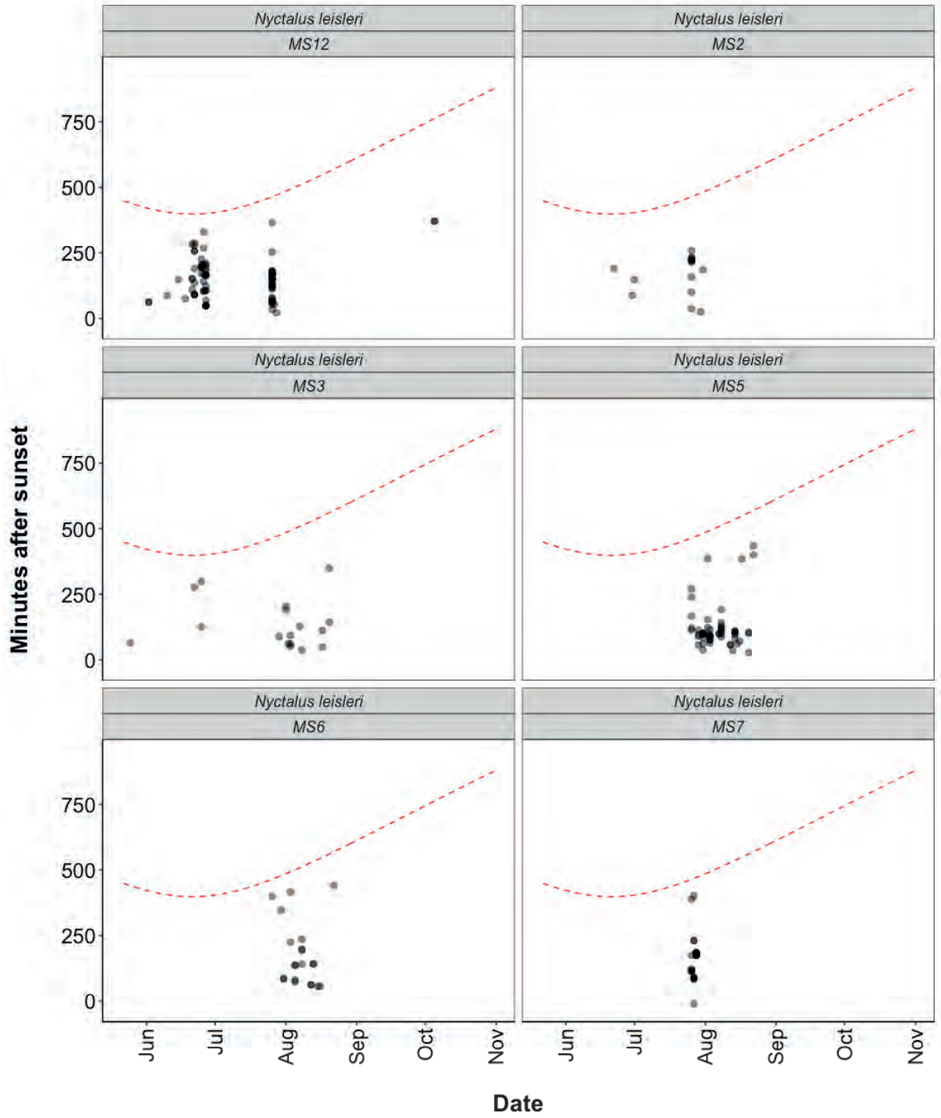
Distribution of Bat Activity Across the Night through Time

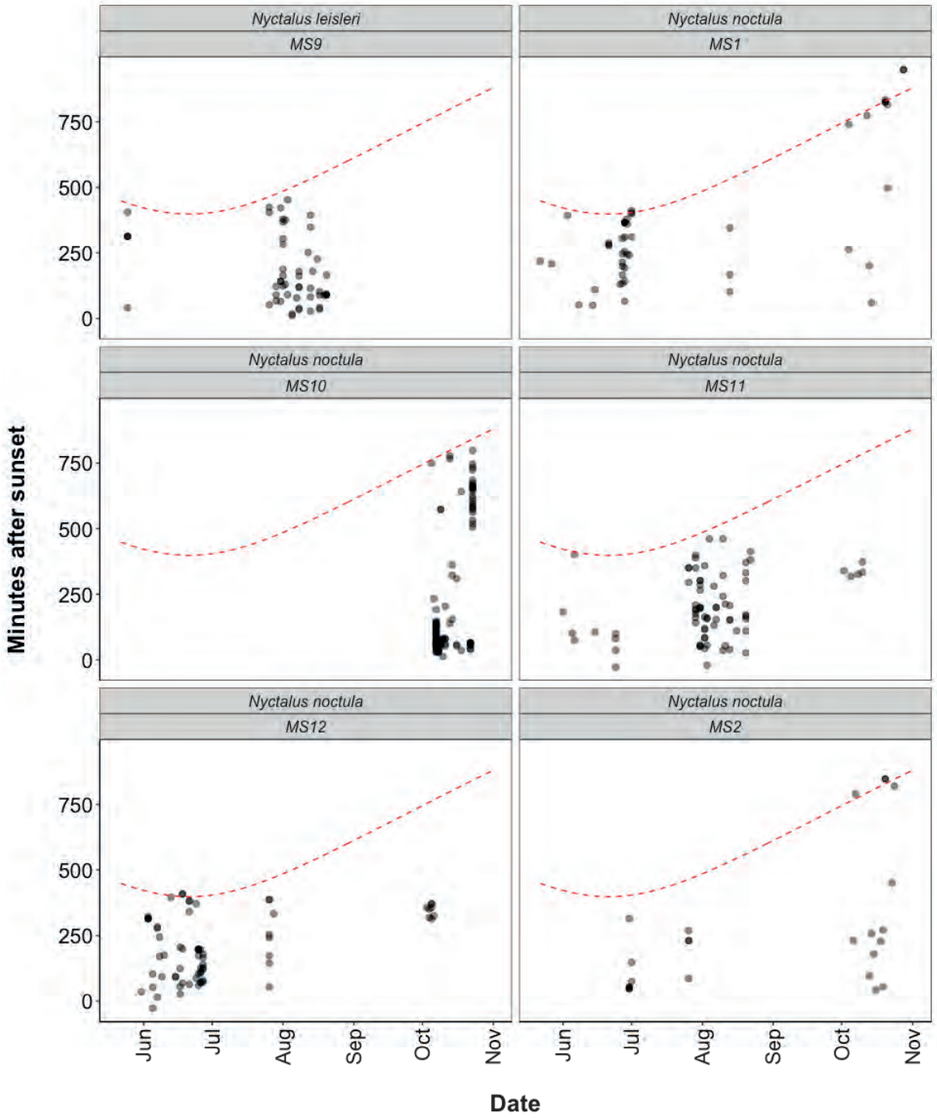
Per Detector

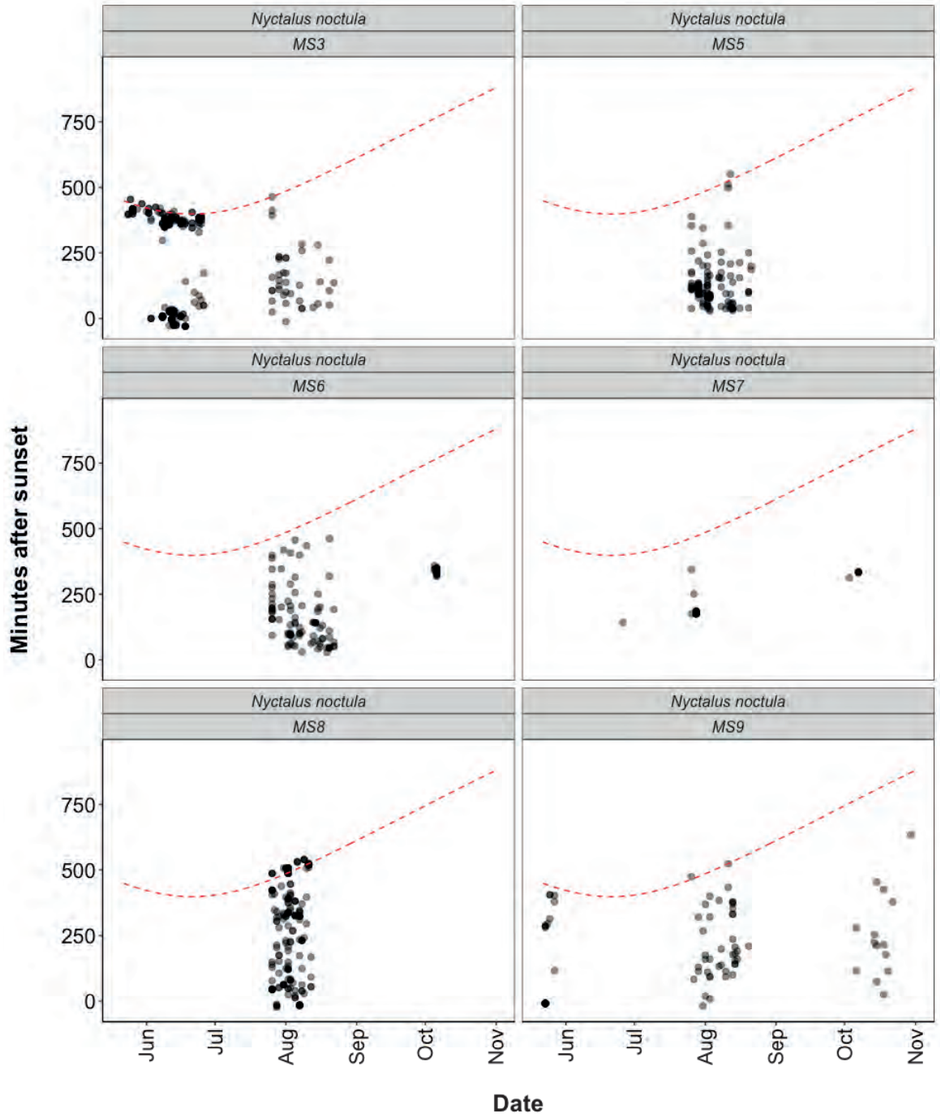
Figure 7. Timing of bat calls plotted as minutes before/after sunset, whereby 0 on the y axis represents sunset. Sunrise throughout the survey period is depicted as the red dashed line. Colours indicate kernel densities, with darkest colours showing peaks of activity. These colours are comparative only within each plot, and do not account for overall activity.

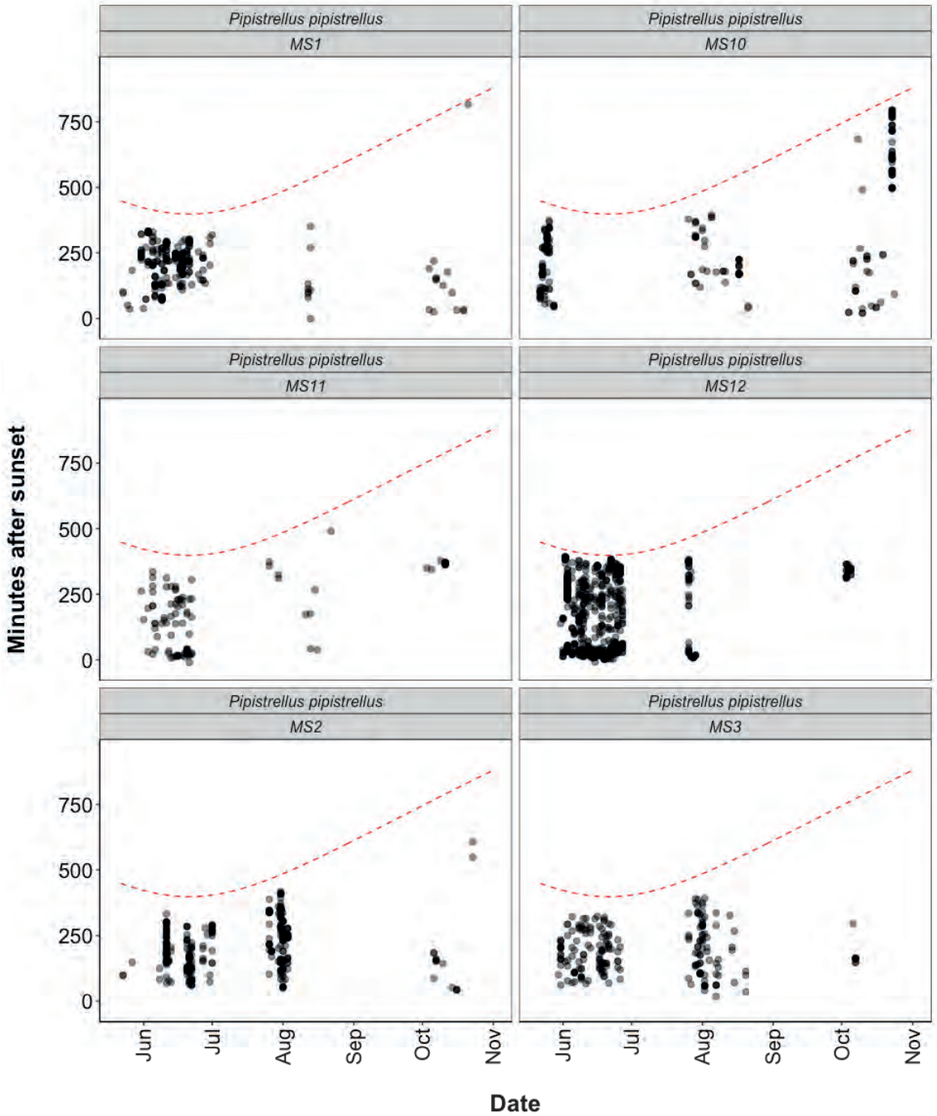


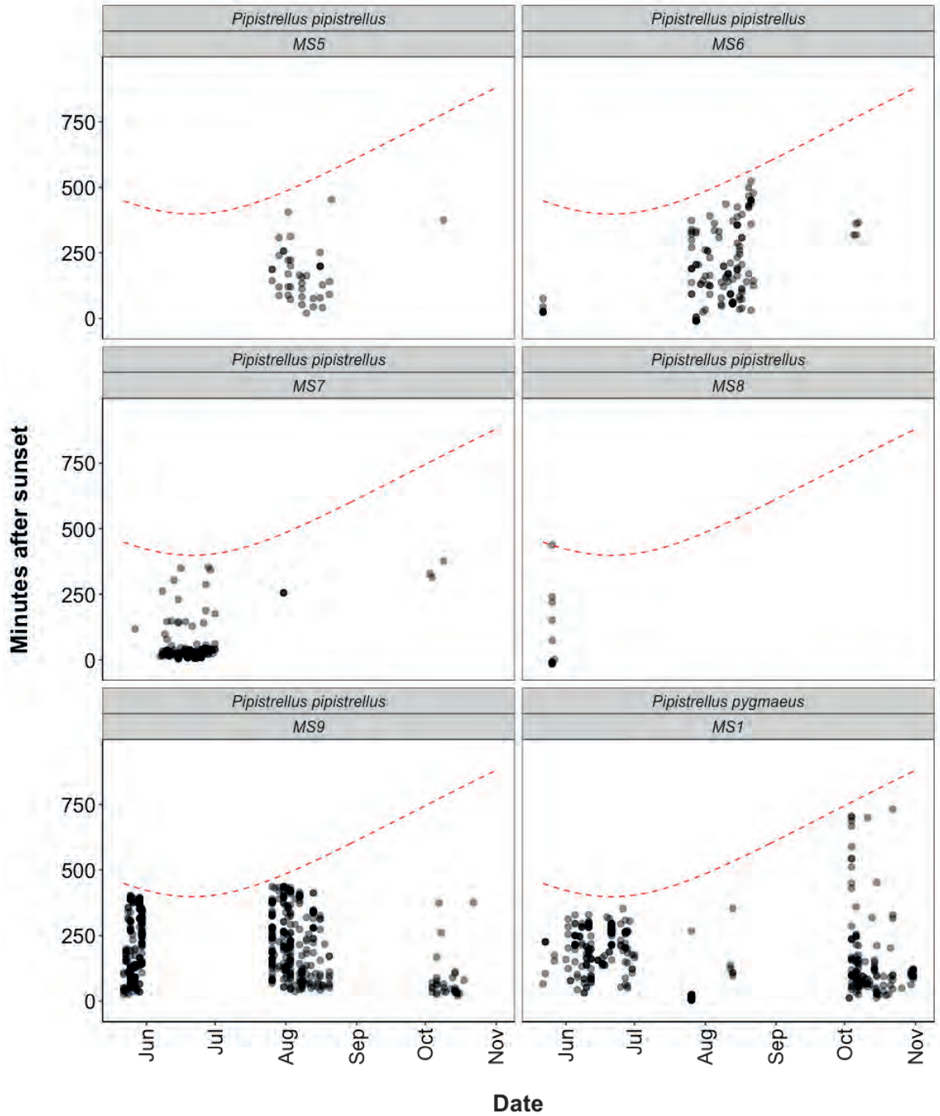

Myotis
MS5
Myotis
MS6
Myotis
MS9
Nyctalus leisleri
MS1
Nyctalus leisleri
MS10
Nyctalus leisleri
MS11
Minutes after sunset
0
250
500
750
Jun
Jul
Aug
Sep
Oct
Nov
Date

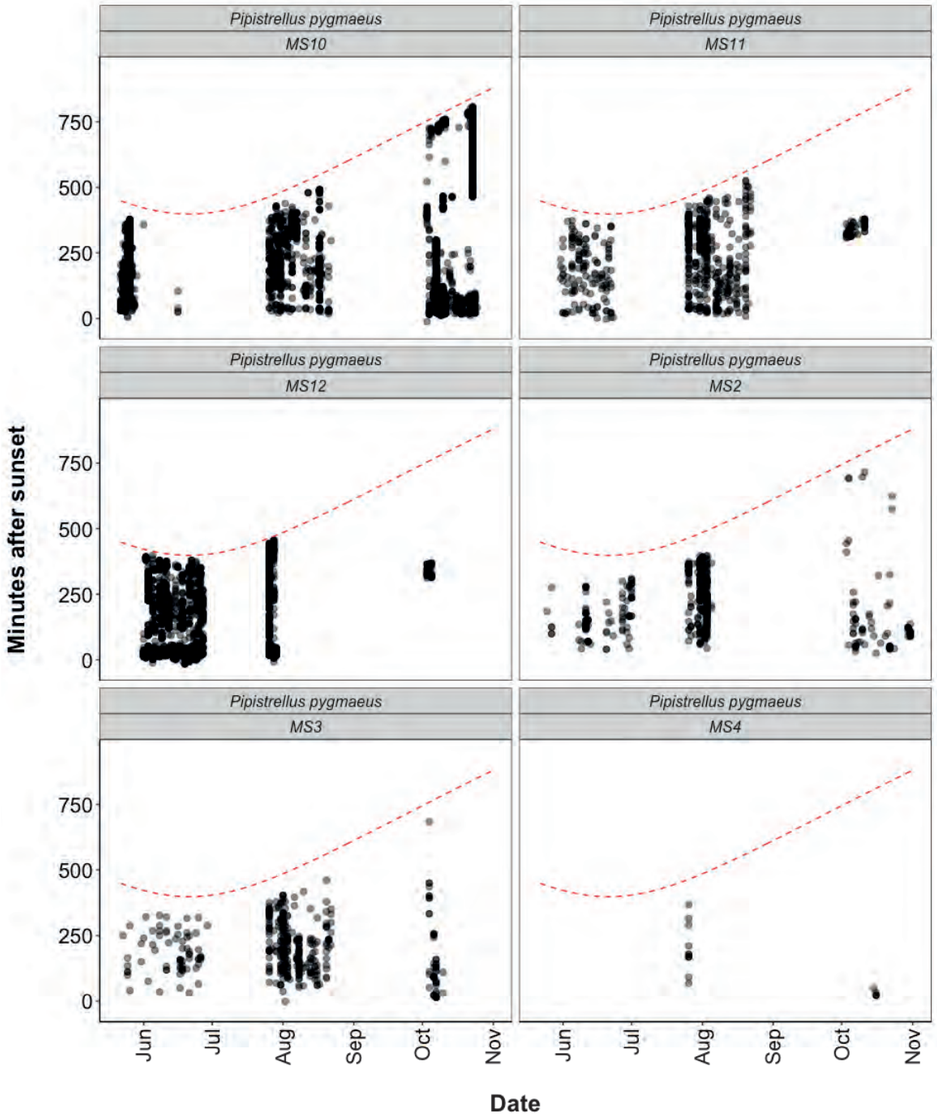

Nyctalus leisleri
MS12
Nyctalus leisleri
MS2
Nyctalus leisleri
MS3
Nyctalus leisleri
MS5
Nyctalus leisleri
MS6
Nyctalus leisleri
MS7
Minutes after sunset
0
250
500
750
Jun
Jul
Aug
Sep
Oct
Nov
Date

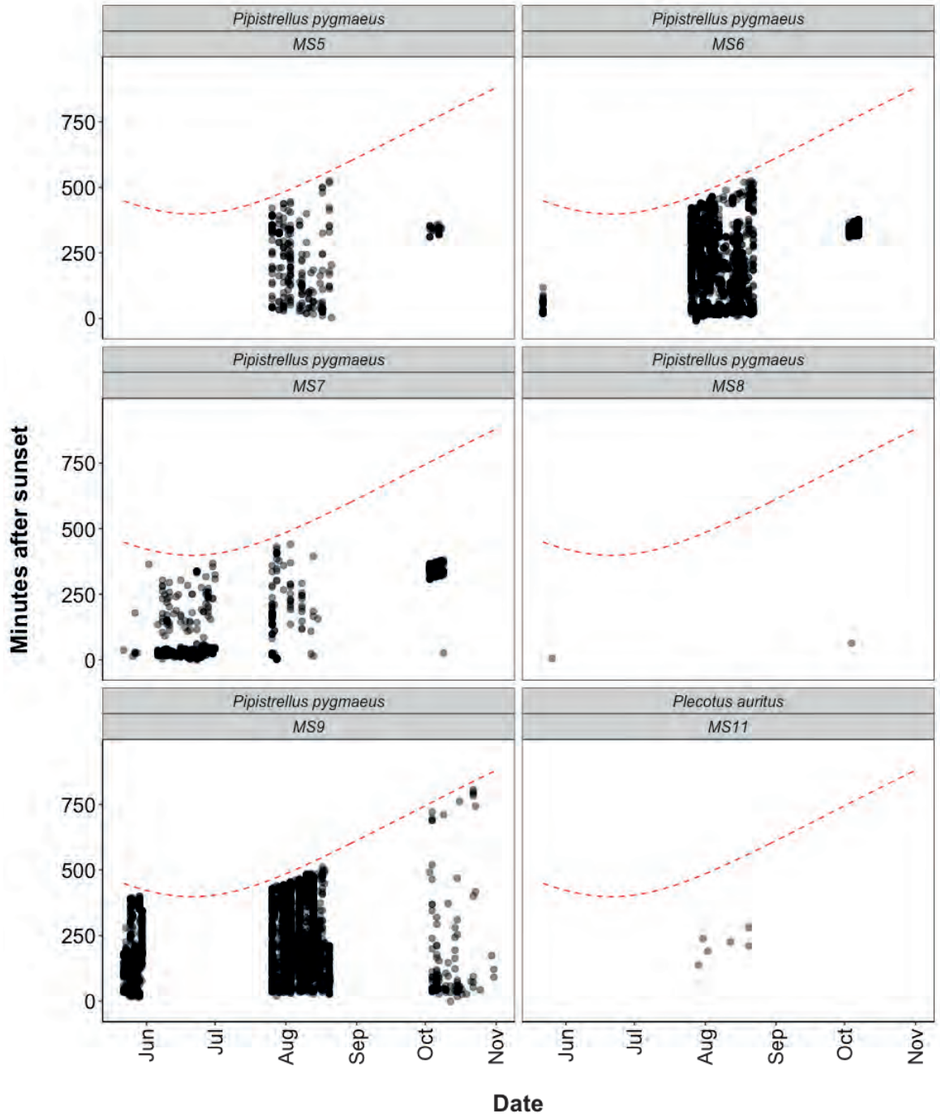

Nyctalus leisleri
MS9
Nyctalus noctula
MS1
Nyctalus noctula
MS10
Nyctalus noctula
MS11
Nyctalus noctula
MS12
Nyctalus noctula
MS2
Minutes after sunset
0
250
500
750
Jun
Jul
Aug
Sep
Oct
Nov
Date

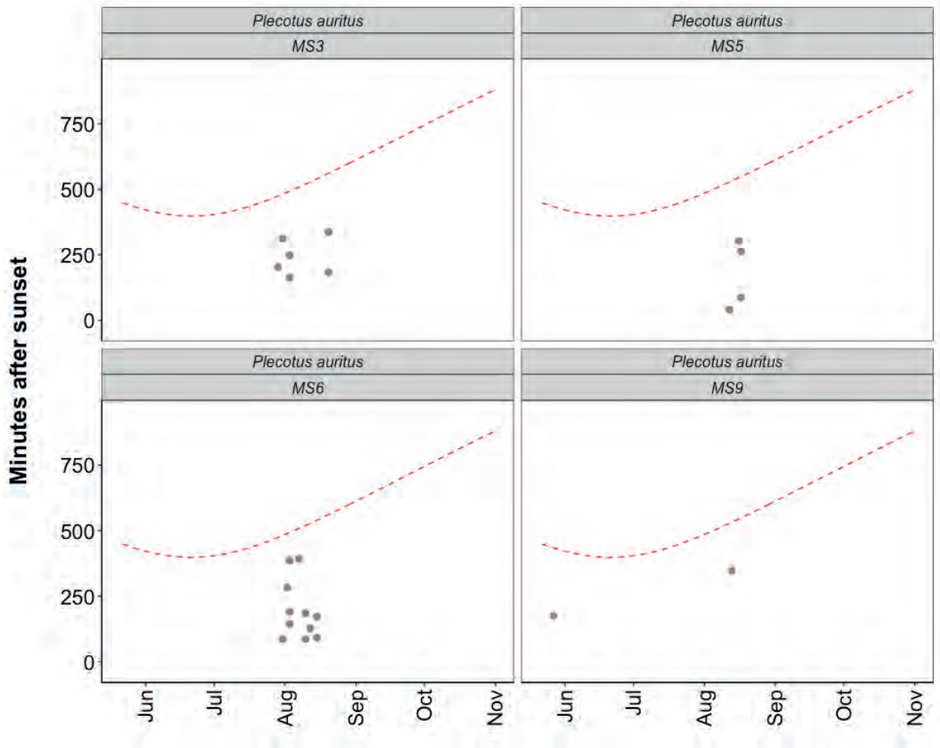

Nyctalus noctula
MS3
Nyctalus noctula
MS5
Nyctalus noctula
MS6
Nyctalus noctula
MS7
Nyctalus noctula
MS8
Nyctalus noctula
MS9
Minutes after sunset
0
250
500
750
Jun
Jul
Aug
Sep
Oct
Nov
Date


Pipistrellus pipistrellus
MS1
Pipistrellus pipistrellus
MS10
Pipistrellus pipistrellus
MS11
Pipistrellus pipistrellus
MS12
Pipistrellus pipistrellus
MS2
Pipistrellus pipistrellus
MS3
Minutes after sunset
0
250
500
750
Jun
Jul
Aug
Sep
Oct
Nov
Date


Pipistrellus pipistrellus
MS5
Pipistrellus pipistrellus
MS6
Pipistrellus pipistrellus
MS7
Pipistrellus pipistrellus
MS8
Pipistrellus pipistrellus
MS9
Pipistrellus pygmaeus
MS1
Minutes after sunset
0
250
500
750
Jun
Jul
Aug
Sep
Oct
Nov
Date


Pipistrellus pygmaeus
MS10
Pipistrellus pygmaeus
MS11
Pipistrellus pygmaeus
MS12
Pipistrellus pygmaeus
MS2
Pipistrellus pygmaeus
MS3
Pipistrellus pygmaeus
MS4
Minutes after sunset
0
250
500
750
Jun
Jul
Aug
Sep
Oct
Nov
Date


Pipistrellus pygmaeus
MS5
Pipistrellus pygmaeus
MS6
Pipistrellus pygmaeus
MS7
Pipistrellus pygmaeus
MS8
Pipistrellus pygmaeus
MS9
Plecotus auritus
MS11
Minutes after sunset
0
250
500
750
Jun
Jul
Aug
Sep
Oct
Nov
Date



Roost Emergence Time and Bat Observation

Based on: *Russ, Jon. 2012. British Bat Calls a Guide to species Identification. Pelagic Publishing.*

For more information see https://rbats-blog.updog.co/2018/05/29/bat-emergence/

Bat Passes Potentially Indicating Close Proximity to a Roost (Russ 2012) - Table

Table 12. Number of bat calls recorded before the upper time of the species-specific emergence time range, and which therefore may potentially indicate the presence of a nearby roost.

Table continues below

Species	Detector ID	2019-05-22	2019-05-23	2019-05-24	2019-05-25	2019-05-26
Common pipistrelle	MS1	0	0	0	0	0
Common pipistrelle	MS10	0	0	0	0	0
Common pipistrelle	MS11	0	0	0	0	0
Common pipistrelle	MS12	0	0	0	0	0
Common pipistrelle	MS3	0	0	0	0	0
Common pipistrelle	MS5	0	0	0	0	0
Common pipistrelle	MS6	4	0	0	0	0
Common pipistrelle	MS7	0	0	0	0	0
Common pipistrelle	MS8	0	0	0	0	7
Common pipistrelle	MS9	1	0	1	0	0
Soprano pipistrelle	MS1	0	0	0	0	0
Soprano pipistrelle	MS10	0	0	3	2	0

Soprano pipistrelle	MS11	0	0	0	0	0	0	0	0	0	0	0	0	0
Soprano pipistrelle	MS12	0	0	0	0	0	0	0	0	0	0	0	0	0
Soprano pipistrelle	MS2	0	0	0	0	0	0	0	0	0	0	0	1	1
Soprano pipistrelle	MS3	0	0	0	0	0	0	0	0	5	0	2	6	
Soprano pipistrelle	MS4	0	0	0	0	0	0	0	0	0	0	0	0	
Soprano pipistrelle	MS5	0	0	0	0	0	0	0	0	0	0	0	0	
Soprano pipistrelle	MS6	13	0	0	0	0	0	0	0	0	0	0	0	
Soprano pipistrelle	MS7	0	0	0	0	1	0	0	0	0	0	0	0	
Soprano pipistrelle	MS8	0	0	0	0	1	0	0	0	0	0	0	0	
Soprano pipistrelle	MS9	0	0	1	5	4	1	0	0	2	2	1	1	
Noctule	MS11	0	0	0	0	0	0	0	0	39	4	44	69	
Noctule	MS12	0	0	0	0	0	0	0	0	0	0	0	0	
Noctule	MS3	0	0	0	0	0	0	0	0	0	0	0	0	
Noctule	MS8	0	0	0	0	0	0	0	0	0	0	0	0	
Noctule	MS9	0	18	0	0	0	0	0	0	0	0	0	0	
Leisler's	MS7	0	0	0	0	0	0	0	0	0	0	0	0	
Leisler's	MS9	0	0	0	0	0	0	0	0	0	0	0	0	
Brown long-eared	MS5	0	0	0	0	0	0	0	0	0	0	0	0	
Myotis	MS1	0	0	0	0	0	0	0	0	0	0	0	0	
Myotis	MS11	0	0	0	0	0	0	0	0	0	0	0	0	
Myotis	MS2	0	0	0	0	0	0	0	0	0	0	0	0	
Myotis	MS3	0	0	0	0	0	0	0	0	0	0	0	0	
Myotis	MS5	0	0	0	0	0	0	0	0	0	0	0	0	
Myotis	MS9	0	0	0	1	0	0	0	0	0	0	0	0	

Table continues below

2019-05-27	2019-05-28	2019-05-29	2019-06-01	2019-06-02	2019-06-03	2019-06-05

Table continues below

2019-06-06	2019-06-07	2019-06-08	2019-06-09	2019-06-10	2019-06-11	2019-06-12
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	1
0	0	5	17	5	2	7
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	1	3	0	2	16	1
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
25	0	30	16	37	11	5
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
5	2	5	5	24	24	3
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	16	0	0	1	16
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Table continues below

2019-06-13	2019-06-14	2019-06-15	2019-06-16	2019-06-17	2019-06-18	2019-06-19
0	0	0	0	0	0	0
0	0	0	0	0	0	0
1	1	1	4	0	1	2
29	6	8	0	8	13	25
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
2	2	9	4	0	8	21
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	2	0	0	0
0	2	1	1	0	0	0
3	30	70	0	22	8	26
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
5	4	3	8	2	13	8
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
12	3	0	4	0	6	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Table continues below

2019-06-20	2019-06-21	2019-06-22	2019-06-23	2019-06-24	2019-06-25	2019-06-26
0	0	0	0	0	0	0
0	0	0	0	0	0	0
7	3	2	0	0	0	0
2	4	7	1	10	19	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
17	27	5	9	0	21	5
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
1	0	4	1	0	0	0
4	22	4	51	4	9	3
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
10	39	22	19	3	30	5
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	1	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Table continues below

2019-06-27	2019-06-28	2019-06-29	2019-06-30	2019-07-26	2019-07-27	2019-07-28
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
2	0	0	0	3	3	13
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	9
2	3	0	1	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	81	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
4	0	0	0	27	10	65
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	4	0	23
3	1	2	4	10	1	13
0	0	0	0	0	0	0
0	0	0	0	0	0	1
0	0	0	0	0	0	0
0	0	0	0	0	0	0

0	0	0	0	0	0	0
0	0	0	0	0	0	4
0	0	0	0	0	0	0
0	0	0	0	0	1	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	1	0	0
0	0	0	0	0	0	0

Table continues below

2019-07-29	2019-07-30	2019-07-31	2019-08-01	2019-08-02	2019-08-03	2019-08-04
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
3	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	1	0	0	0	0	1
0	0	1	0	0	3	0
31	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	1	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
9	1	84	20	3	15	1
0	0	0	0	0	0	0
0	0	0	0	0	0	0

0	0	0	0	0	0	0
0	0	0	0	0	1	0
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	0	0	0	0	0	0
0	0	1	0	0	1	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	1	0	0	1	0

Table continues below

2019-08-05	2019-08-07	2019-08-08	2019-08-10	2019-08-12	2019-08-13	2019-08-15
0	0	0	0	0	1	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	1	0	0	0	0	0
0	0	0	1	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	2	0	1	2	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	1	0	2	0	1	0

12	20	4	18	6	11	3
0	0	0	0	1	1	0
0	0	0	0	0	0	0
0	0	0	0	0	1	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	10	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
2	0	0	0	0	0	0
0	0	0	0	1	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	0	0	0	0	0	0
0	0	2	0	0	0	0

Table continues below

2019-08-16	2019-08-17	2019-08-18	2019-08-19	2019-08-20	2019-08-21	2019-08-22
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	1	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	1	1	0	0	3	0
0	1	0	0	1	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	5	0	0	0	1	0
2	3	4	5	8	25	8
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	2	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	1	0	0

Table continues below

2019-10-03	2019-10-04	2019-10-06	2019-10-07	2019-10-08	2019-10-09	2019-10-10
0	0	1	0	0	0	0
0	2	0	0	0	0	2
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	2	0	0	0	0
2	0	0	1	0	0	0
1	16	1	30	7	11	18

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	3	5	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	1	0
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	1	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	1

Table continues below

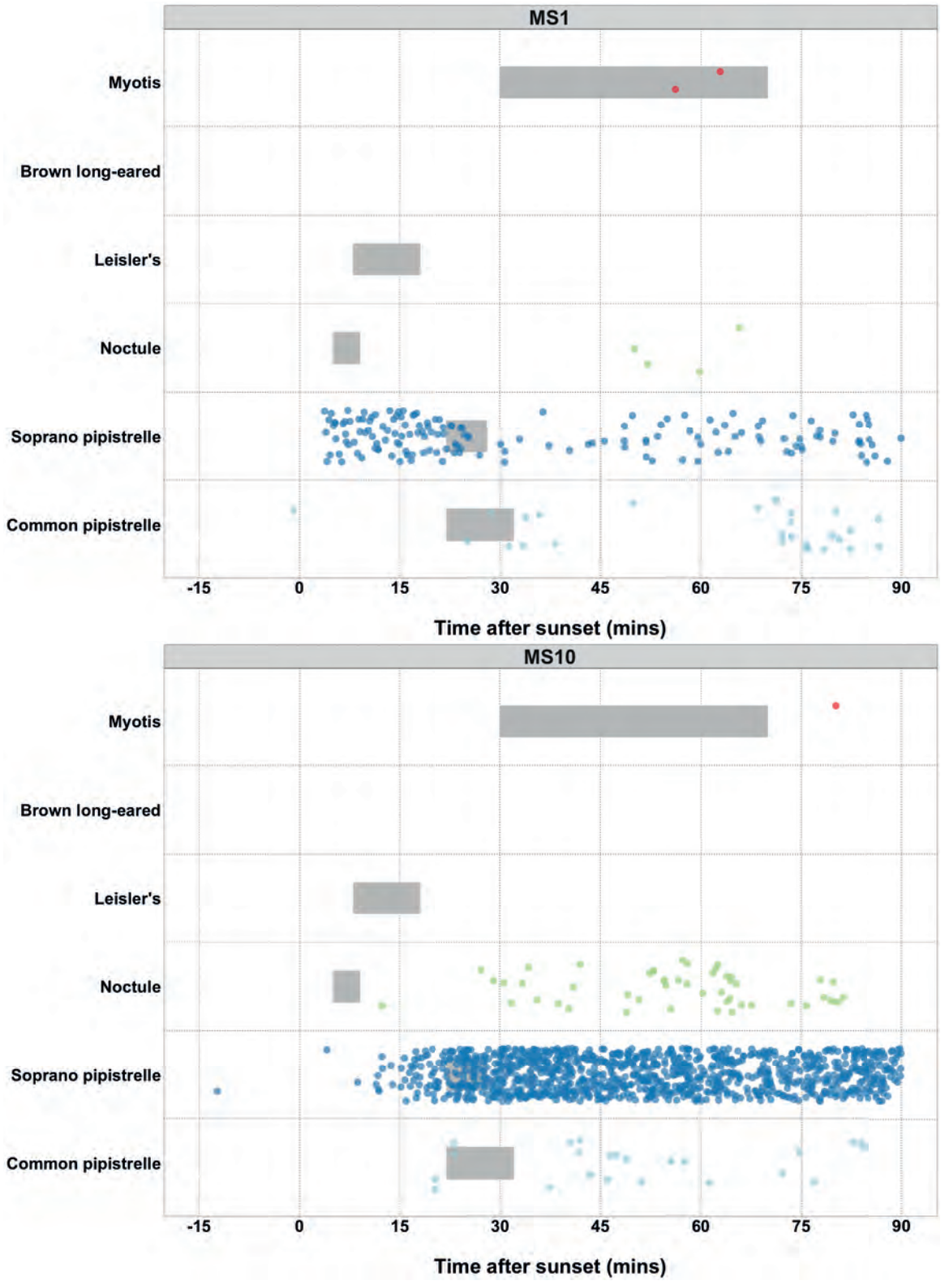
2019-10-11	2019-10-12	2019-10-15	2019-10-16	2019-10-17	2019-10-18	2019-10-19
0	0	0	1	0	0	1
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	2	1	0	0	0
0	0	3	1	0	0	1
30	1	1	3	0	5	3
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	0	0	0	0	0	0
0	0	0	3	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	1	1	0	1	0	1
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	1	0	0	0

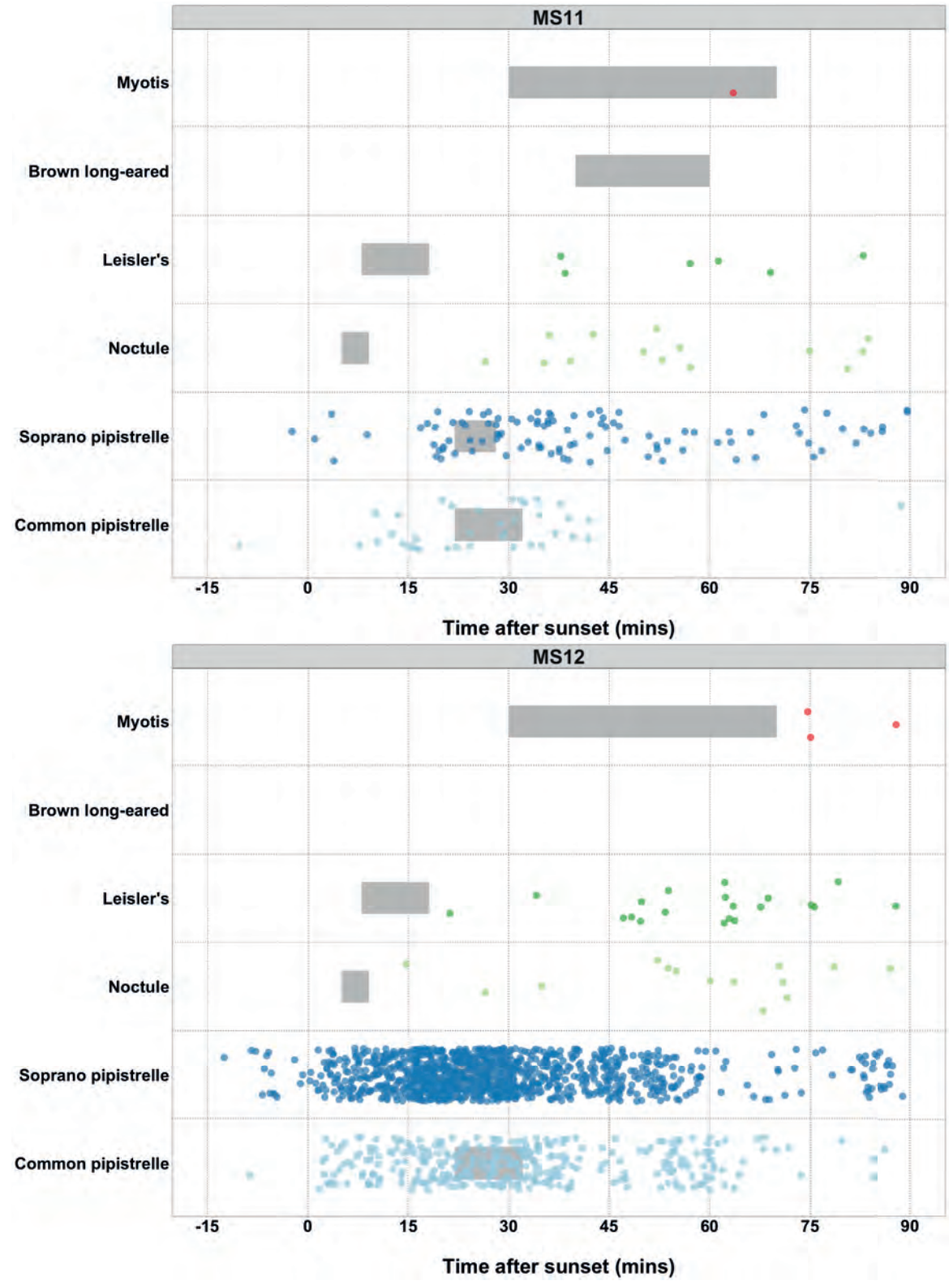
2019-10-20	2019-10-21	2019-10-22	2019-10-24
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

0	0	0	0
0	0	0	0
0	0	0	0
1	0	0	0
0	3	3	11
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	1	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Bat Passes Potentially Indicating Close Proximity to a Roost (Russ 2012) - Figures

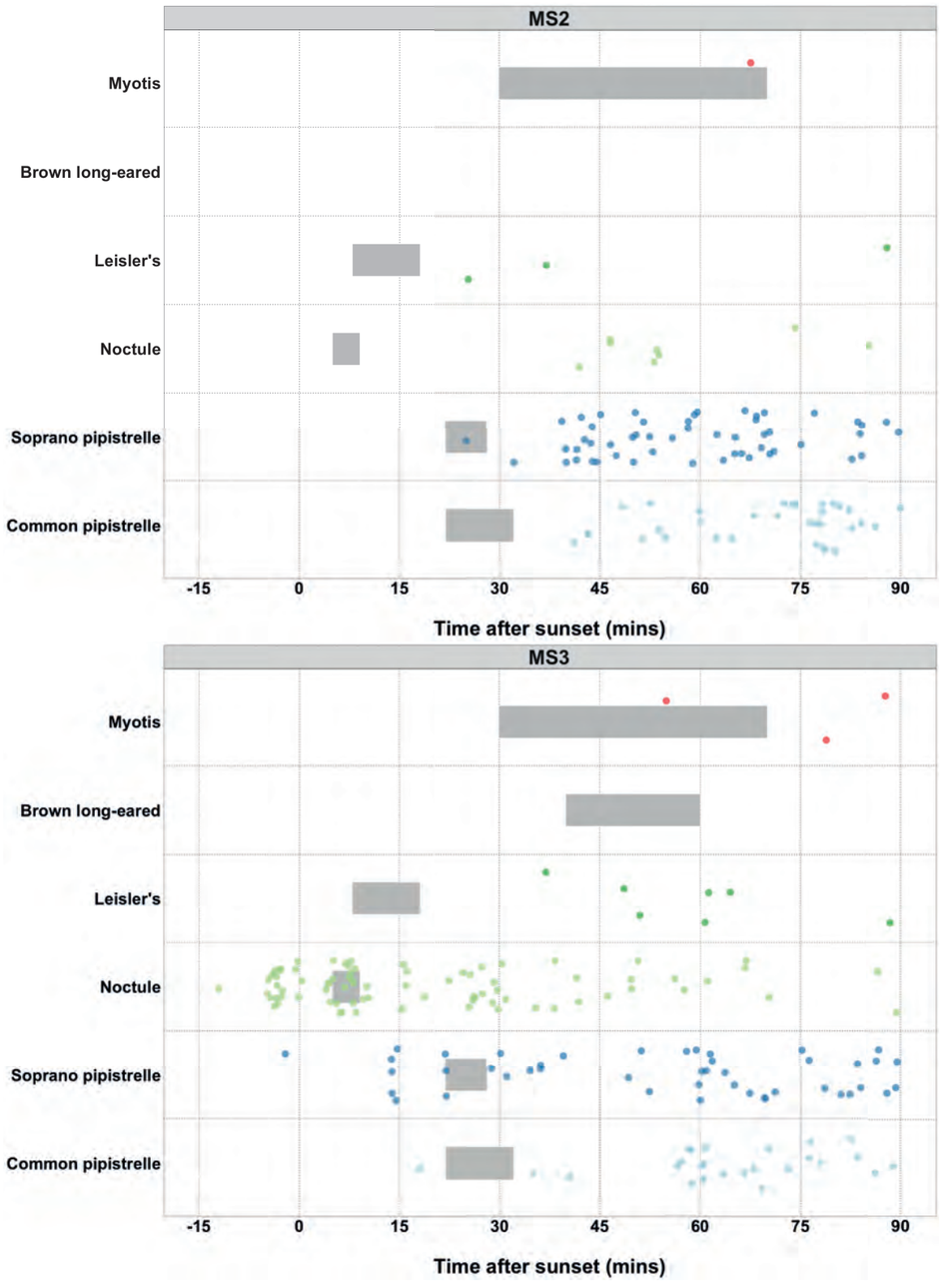
Figure 8. Time from 15 minutes before to 90 minutes after sunset. Species-specific emergence time ranges are shown as grey bars. Bat passes overlapping species-specific grey bars, or occuring earlier than this time range, may potentially indicate the presence of a nearby roost.


MS1
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)


MS11
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

MS10
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

MS12
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)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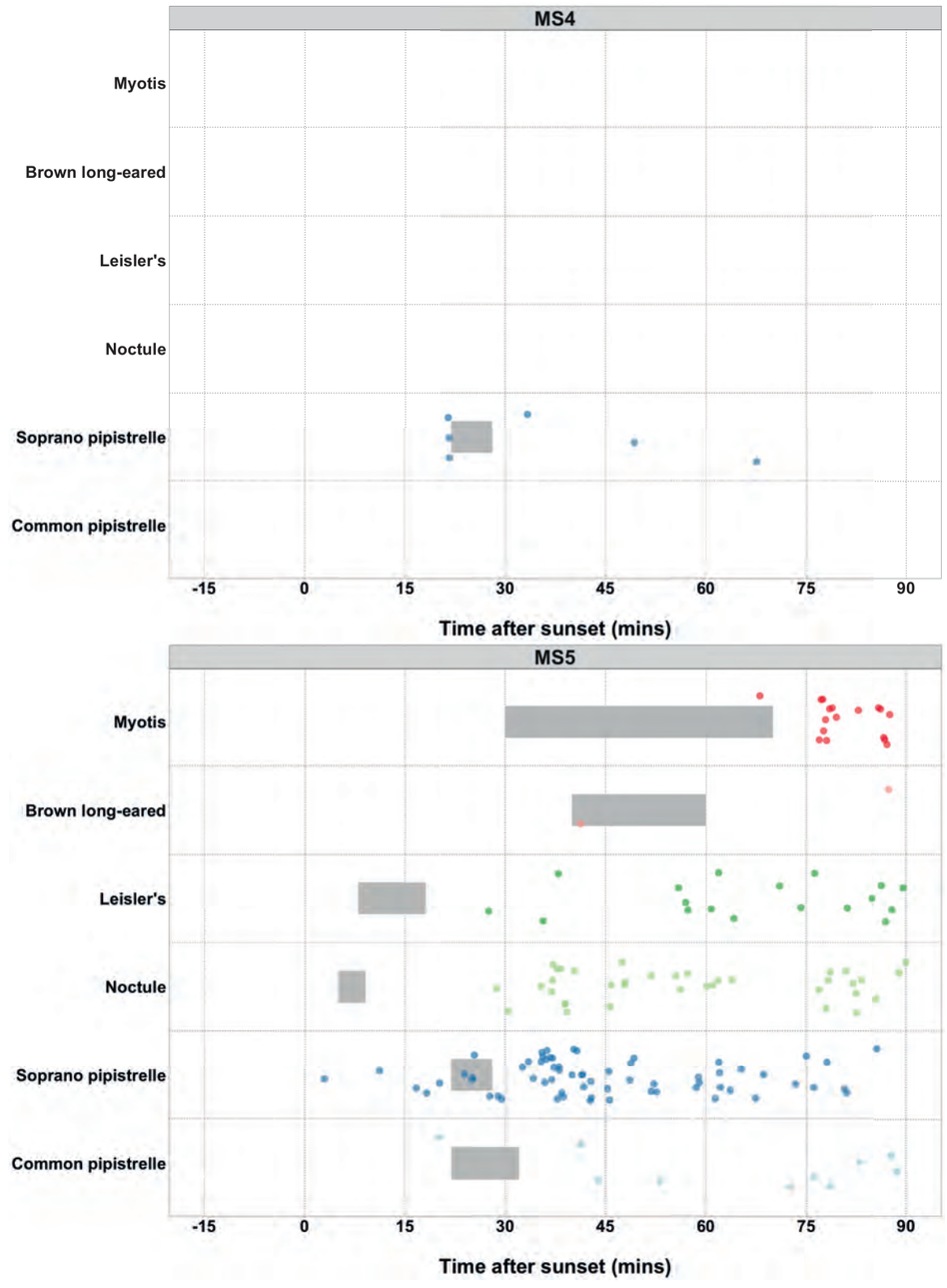
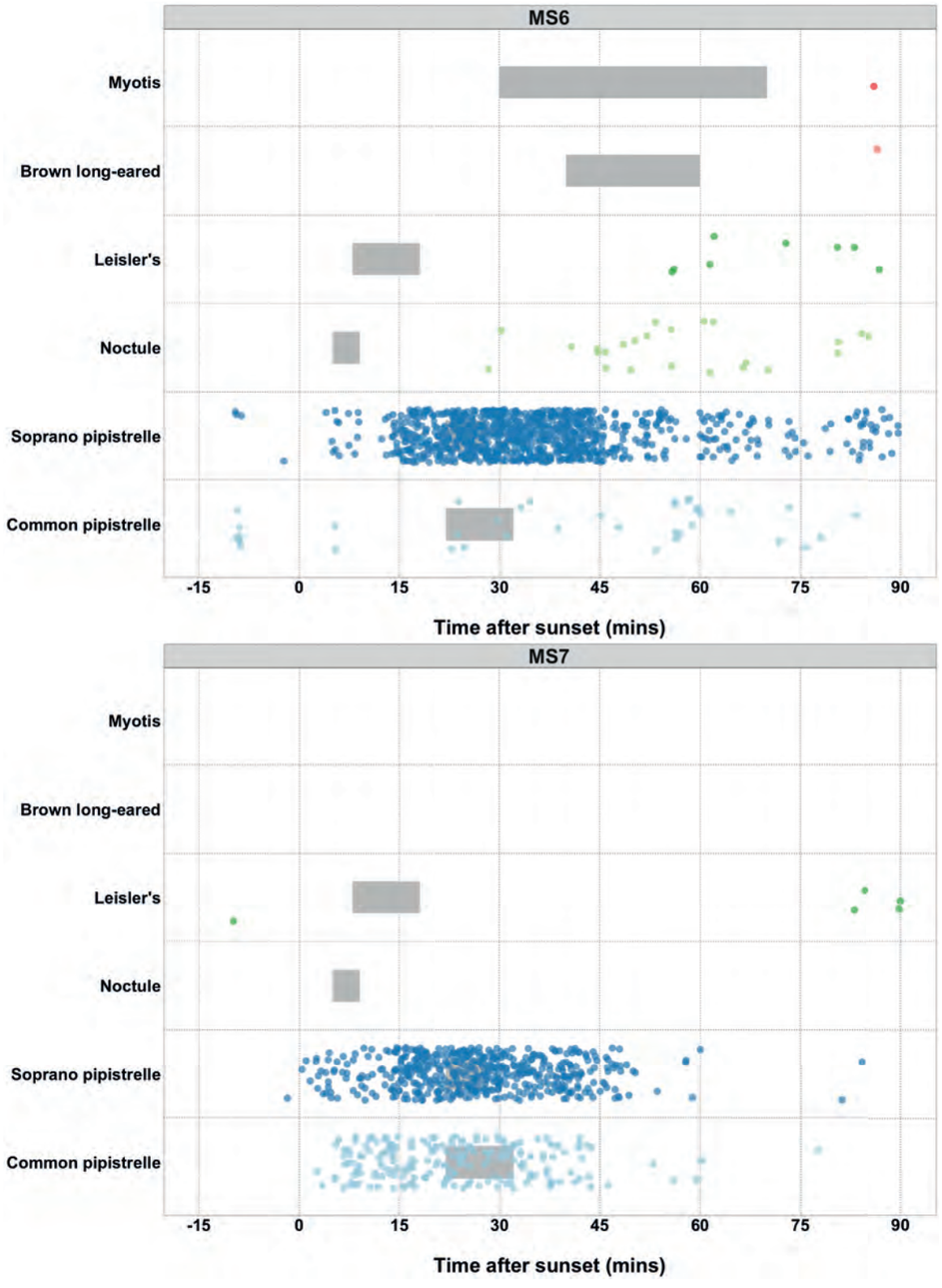
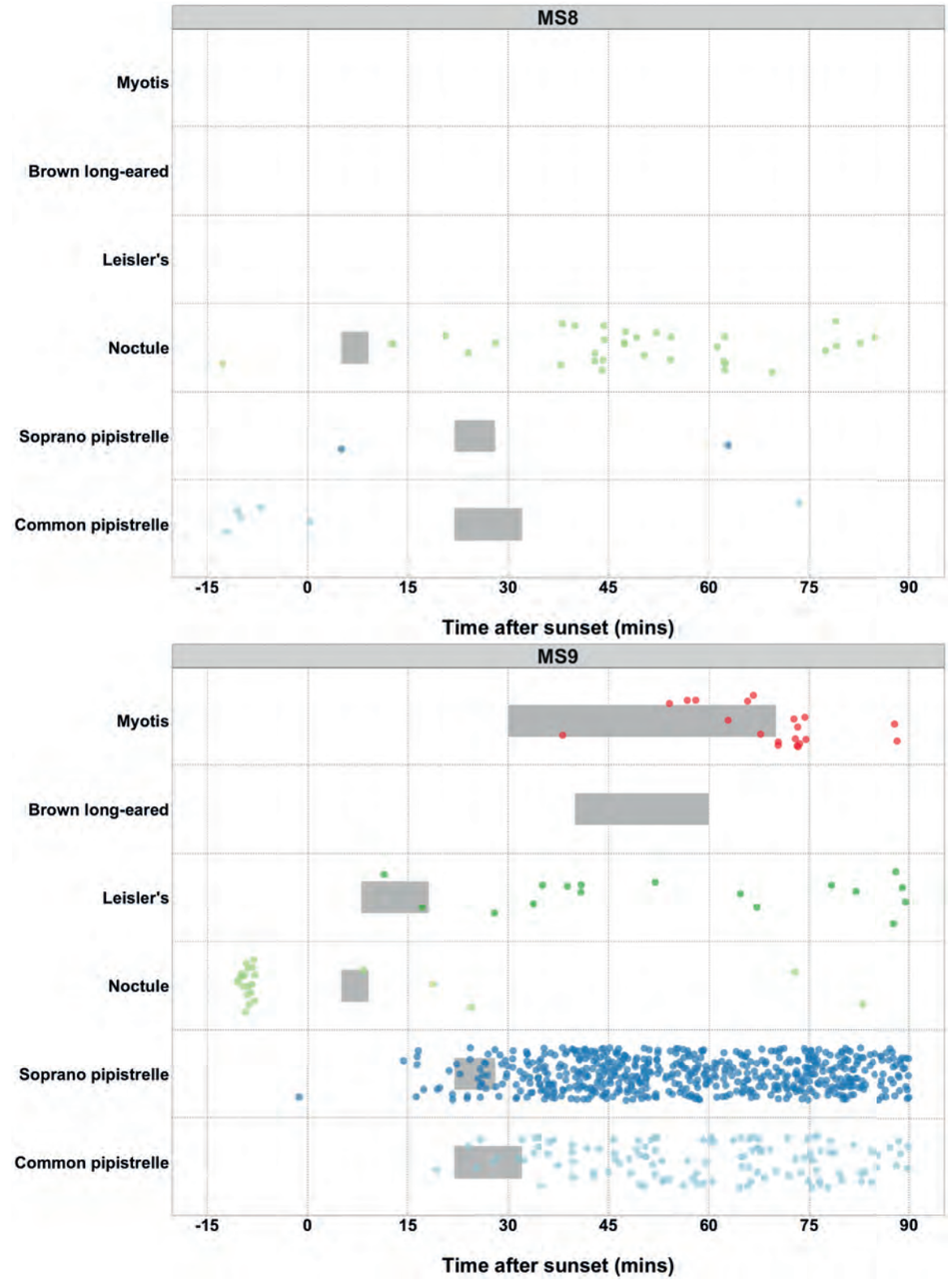
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)


MS4
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

MS3
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

MS5
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)


MS6
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)


MS8
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

MS7
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

MS9
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

Bat Passes Potentially Indicating Close Proximity to a Roost (Maternity Period Only)

Table 13: *Maternity period defined as 15th June - 30th July.*

Table continues below

Species	Detector ID	2019-06-15	2019-06-16	2019-06-17	2019-06-18	2019-06-19
Common pipistrelle	MS11	1	4	0	1	2
Common pipistrelle	MS12	8	0	8	13	25
Common pipistrelle	MS6	0	0	0	0	0
Common pipistrelle	MS7	9	4	0	8	21
Soprano pipistrelle	MS1	0	0	0	0	0
Soprano pipistrelle	MS10	0	2	0	0	0
Soprano pipistrelle	MS11	1	1	0	0	0
Soprano pipistrelle	MS12	70	0	22	8	26
Soprano pipistrelle	MS6	0	0	0	0	0
Soprano pipistrelle	MS7	3	8	2	13	8
Soprano pipistrelle	MS9	0	0	0	0	0
Noctule	MS11	0	0	0	0	0
Noctule	MS3	0	4	0	6	0
Noctule	MS8	0	0	0	0	0
Leisler’s	MS7	0	0	0	0	0
Myotis	MS5	0	0	0	0	0

Table continues below

2019-06-20	2019-06-21	2019-06-22	2019-06-23	2019-06-24	2019-06-25	2019-06-26
7	3	2	0	0	0	0
2	4	7	1	10	19	0
0	0	0	0	0	0	0
17	27	5	9	0	21	5
0	0	0	0	0	0	0
0	0	0	0	0	0	0
1	0	4	1	0	0	0
4	22	4	51	4	9	3
0	0	0	0	0	0	0
10	39	22	19	3	30	5
0	0	0	0	0	0	0
0	0	0	0	1	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Table continues below

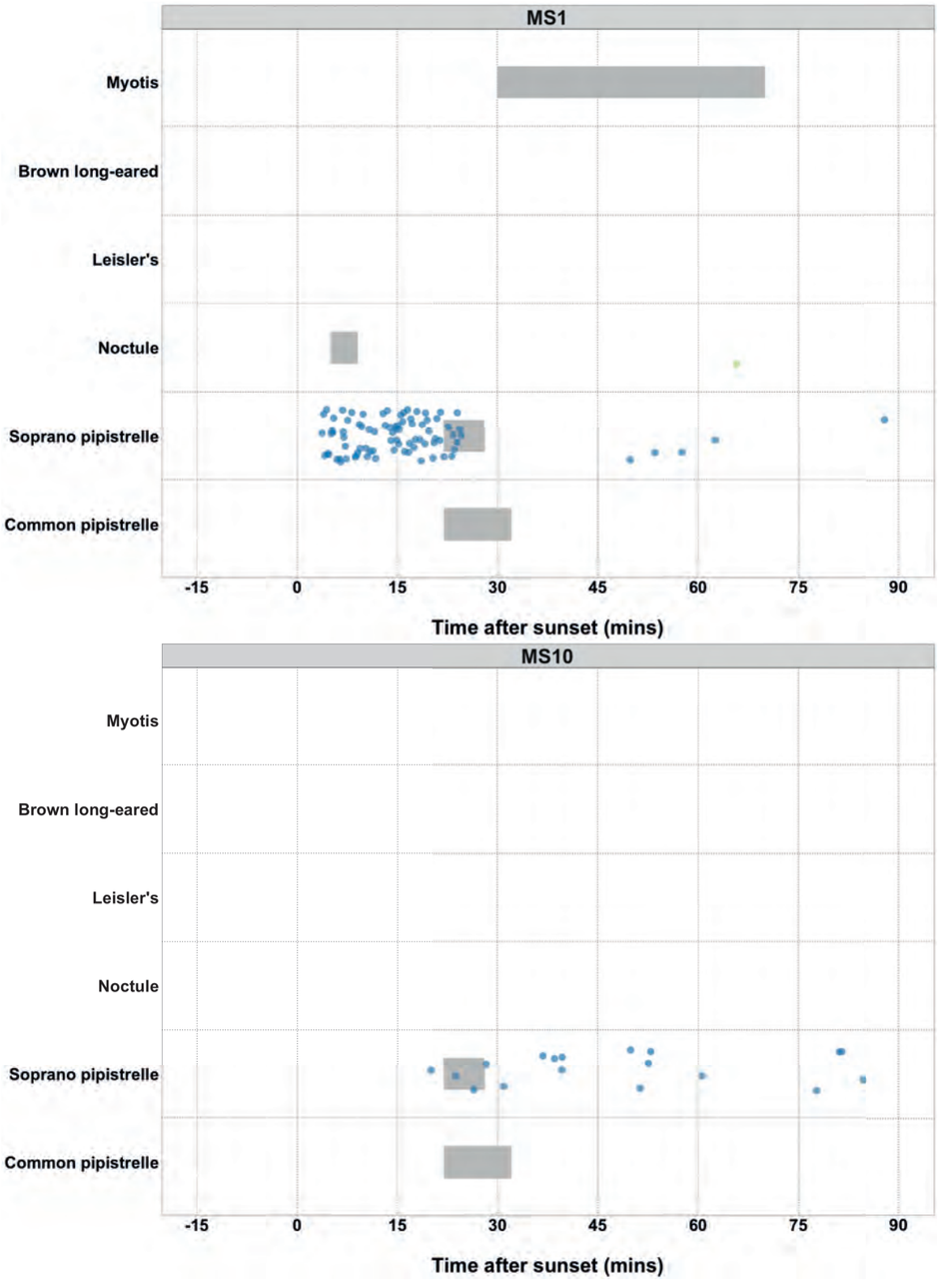
2019-06-27	2019-06-28	2019-06-29	2019-06-30	2019-07-26	2019-07-27	2019-07-28
0	0	0	0	0	0	0
2	0	0	0	3	3	13
0	0	0	0	0	0	9
2	3	0	1	0	0	0
0	0	0	0	81	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
4	0	0	0	27	10	65
0	0	0	0	4	0	23
3	1	2	4	10	1	13
0	0	0	0	0	0	1
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	4
0	0	0	0	0	1	0
0	0	0	0	1	0	0

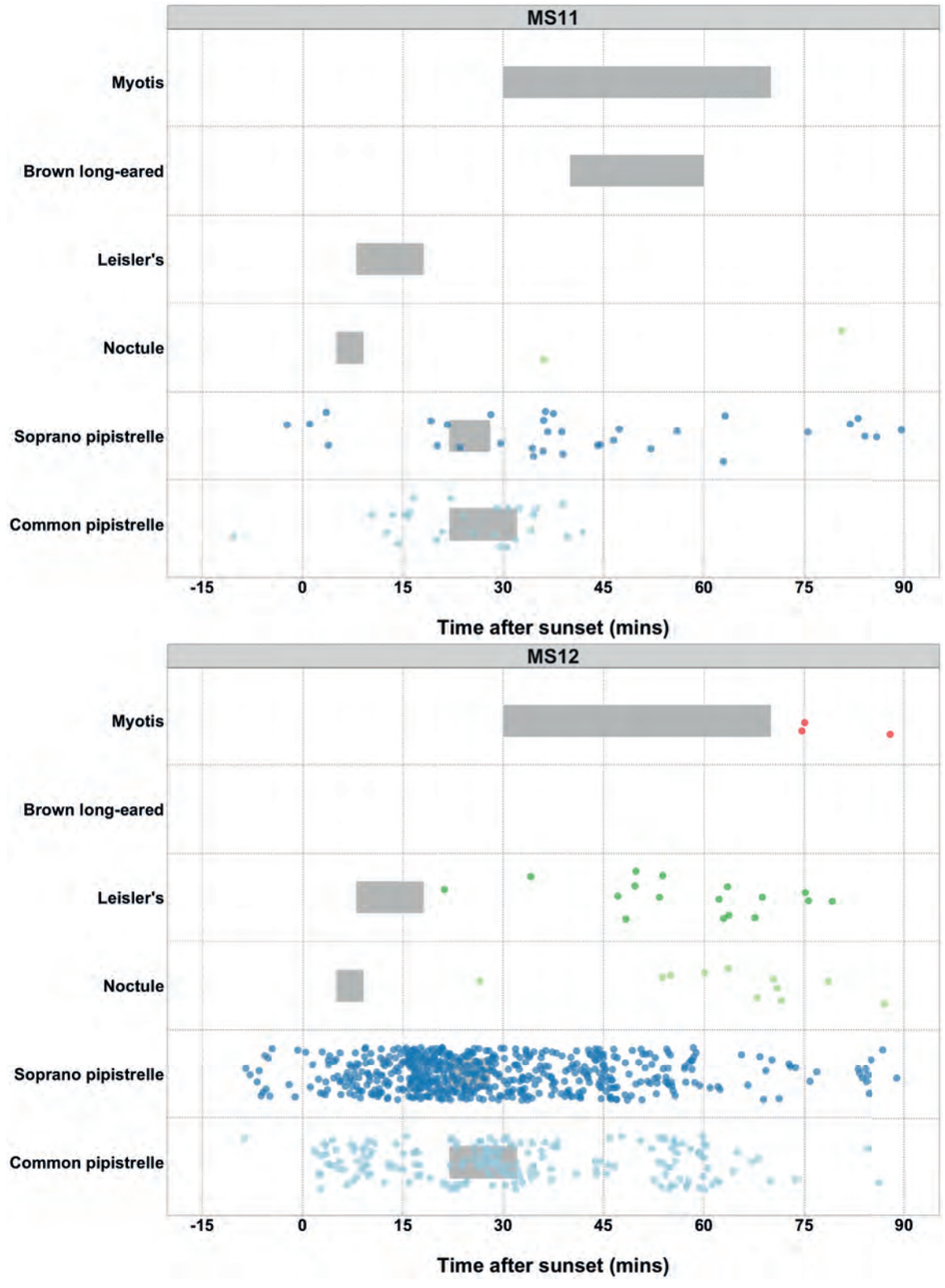
2019-07-29	2019-07-30

0	0
3	0
0	0
0	0
0	0
0	1
0	0
31	0
9	1
0	0
0	0
0	0
0	0
0	0
0	0
0	0

Bat Passes Potentially Indicating Close Proximity to a Roost (Maternity Period Only)

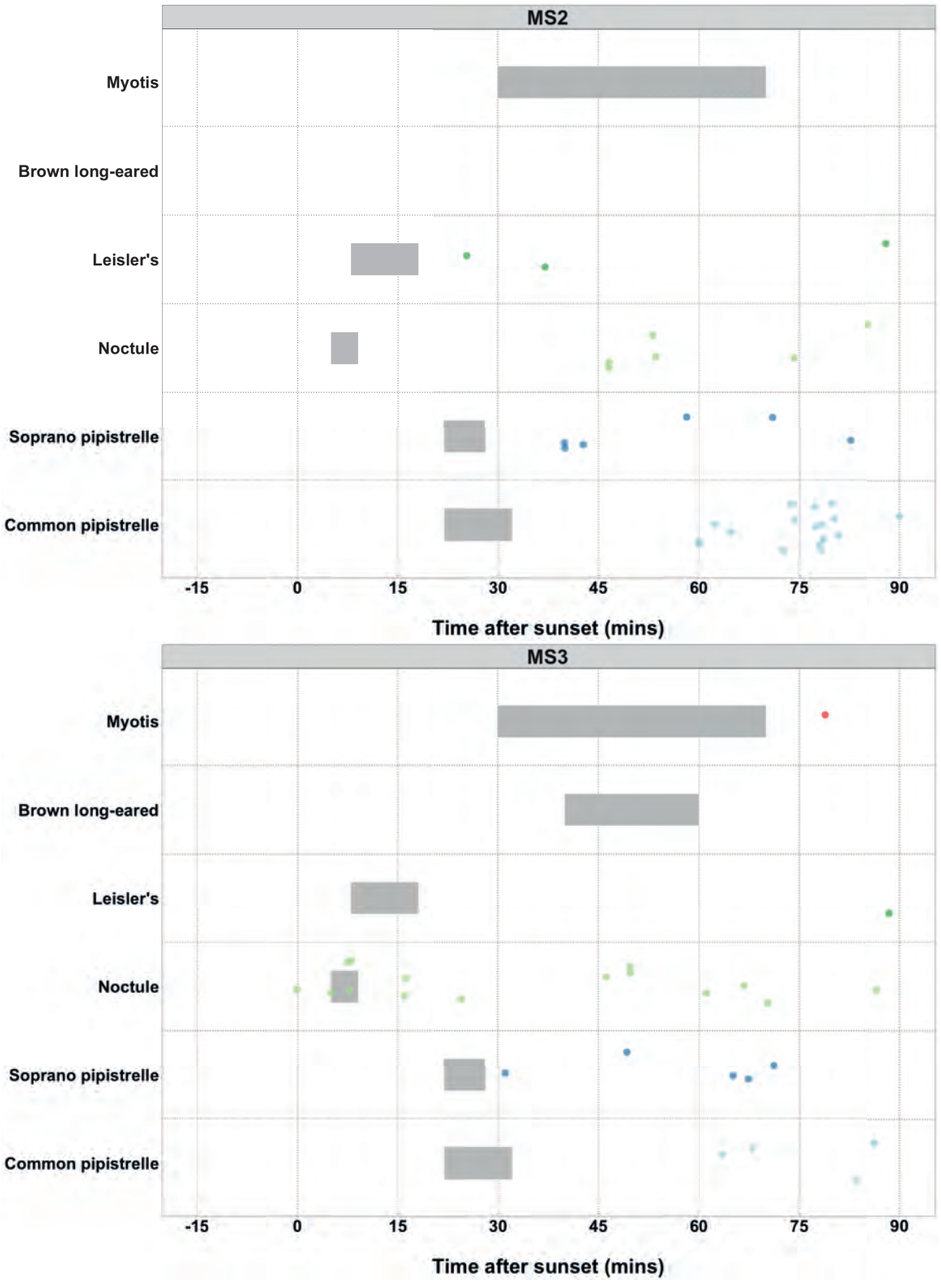
Figure 9. *Maternity period defined as 15th June - 30th July.*

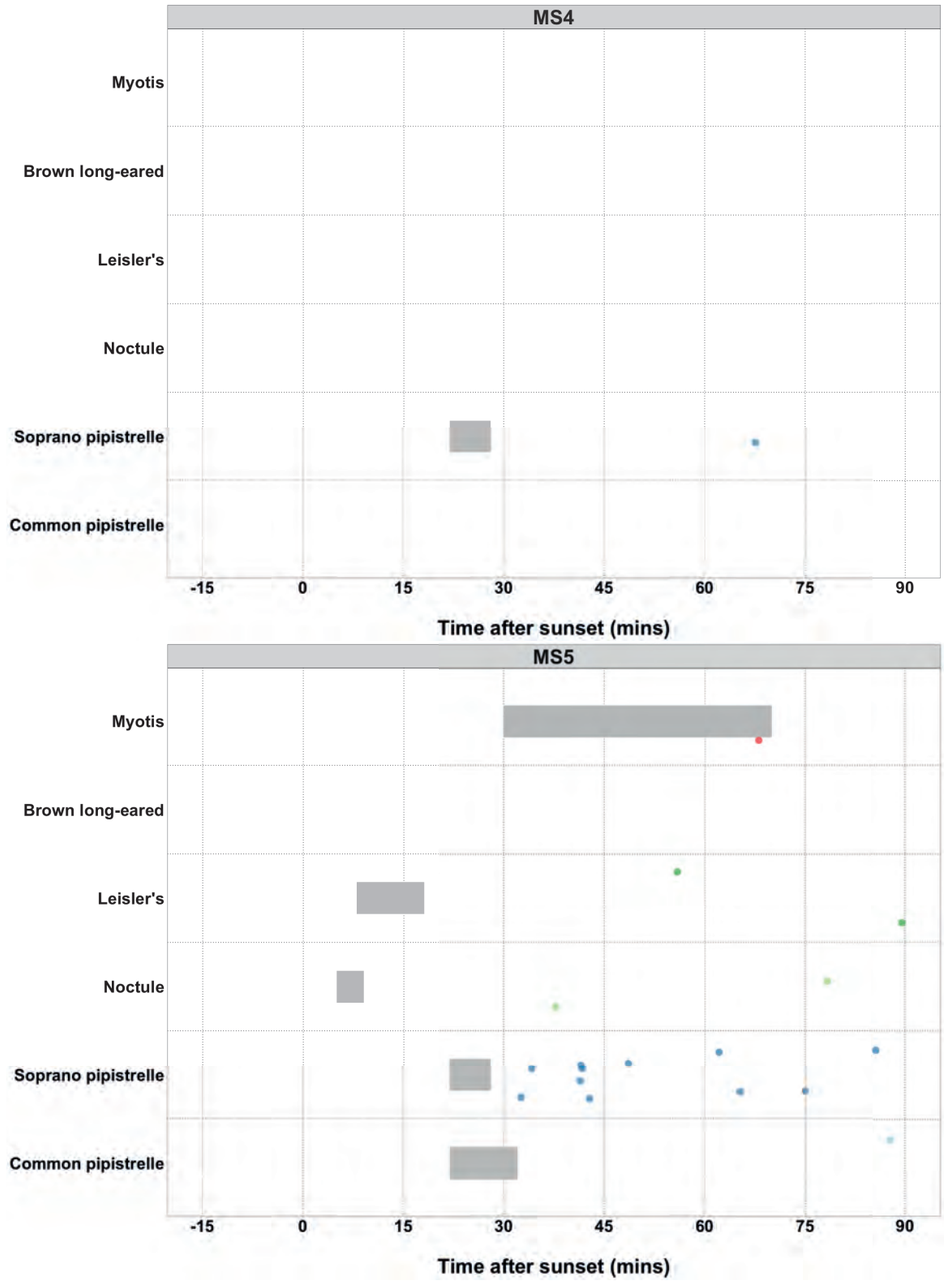

MS1
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)


MS11
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

MS10
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

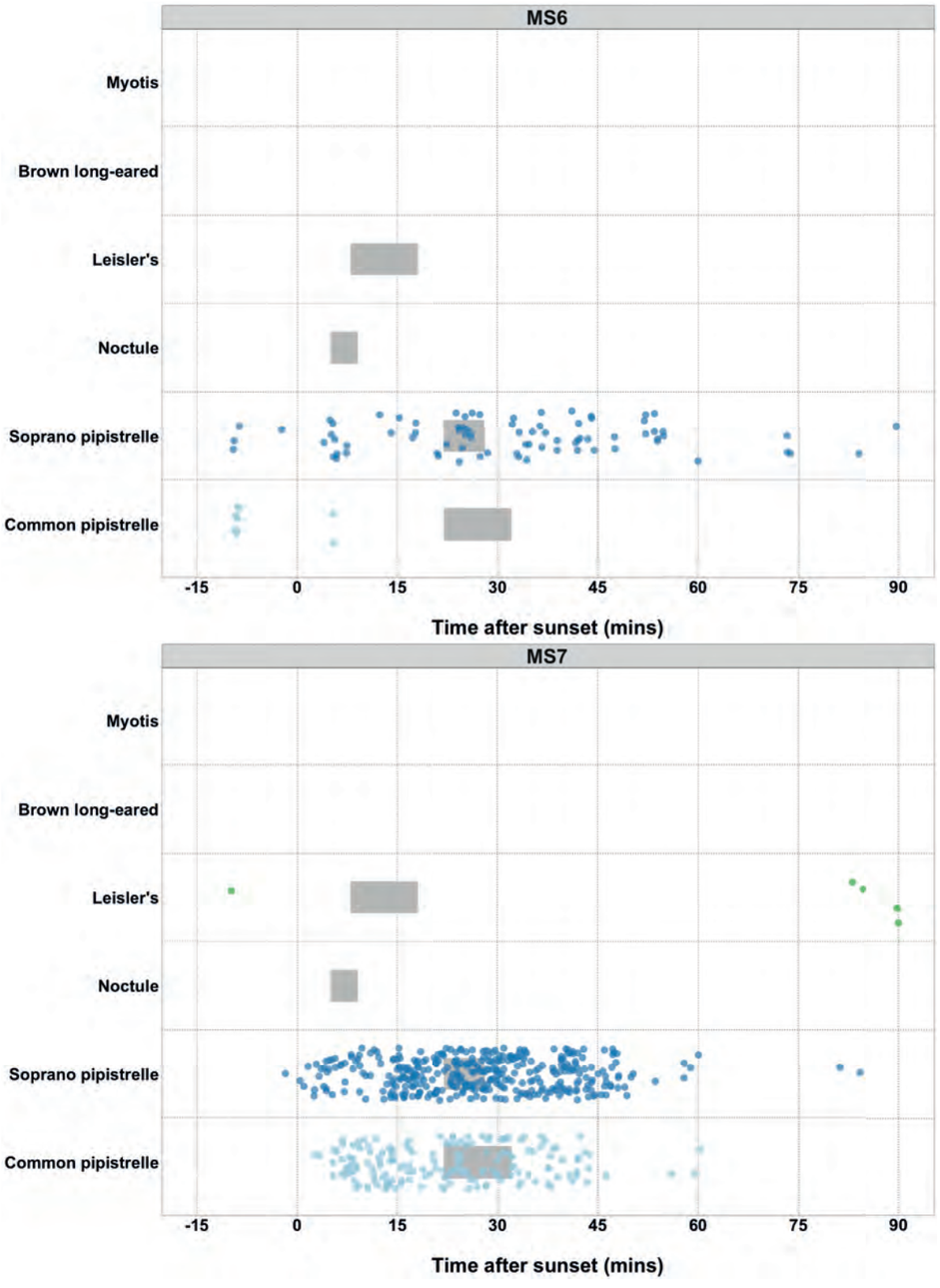
MS12
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

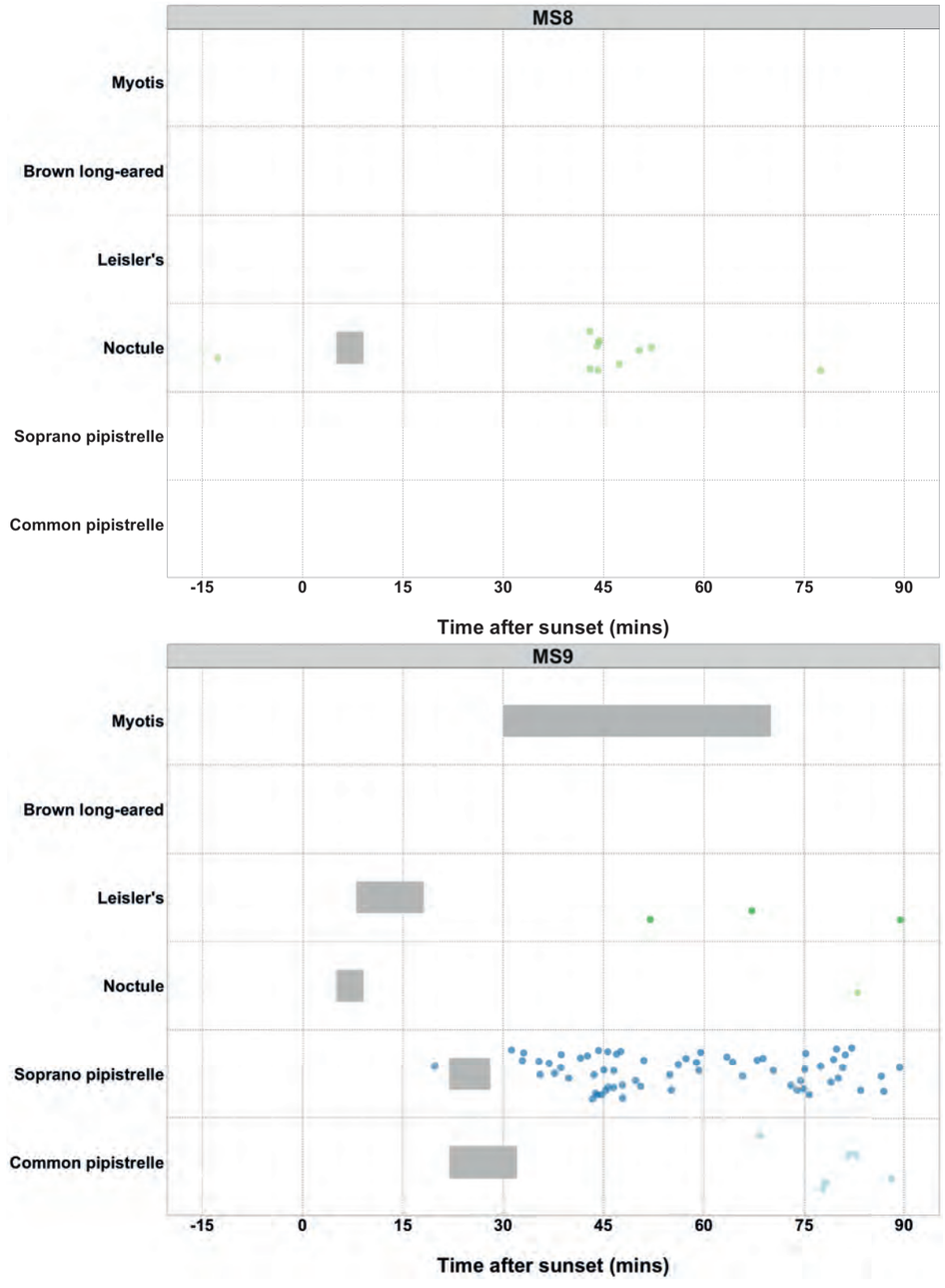

MS2
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)


MS4
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

MS3
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

MS5
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)


MS6
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)


MS8
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

MS7
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

MS9
Myotis
Brown long-eared
Leisler's
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

Counts of Bat Passes

All detectors

Table 14. The total number of passes recorded for each species across all of the detectors. The 'Total' percentage may not be exactly 100% due to rounding of the percentages per species.

Species	Passes (No.)	Percentage of total (%)
Common pipistrelle	3116	13.8
Soprano pipistrelle	17540	77.6
Noctule	1101	4.9
Leisler's	308	1.4
Brown long-eared	29	0.1
Myotis	500	2.2
Total	22594	100.0

Counts of Bat Passes

Per Detector

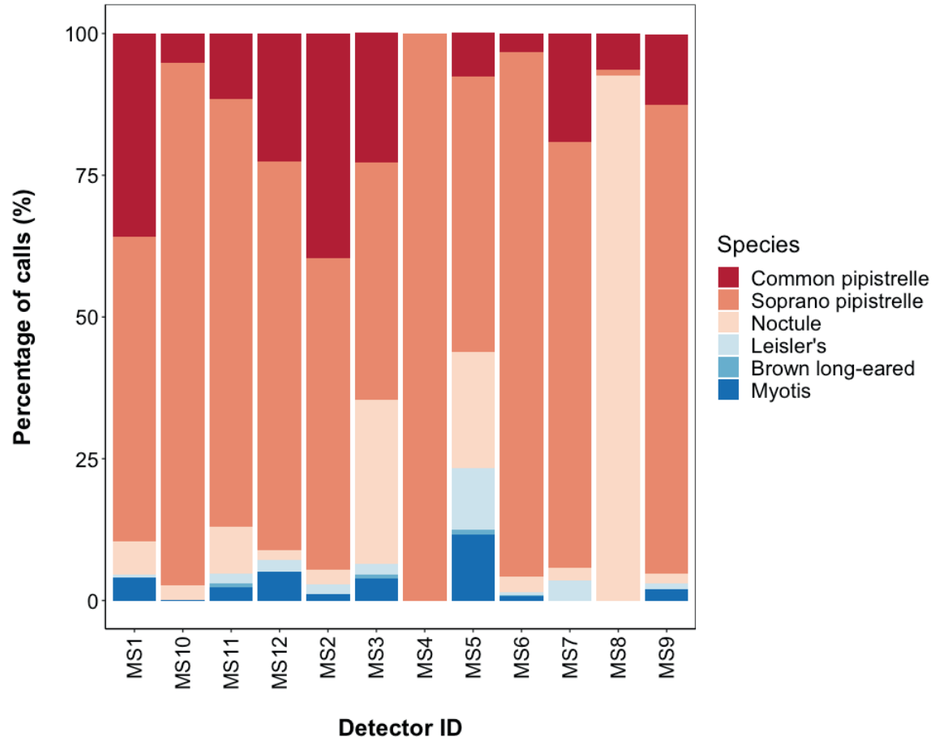
Table 15. The number of passes recorded for each species at each detector.

Species	Detector ID	Count (No)	Percentage by Detector (%)
Common pipistrelle	MS1	284	35.8
Common pipistrelle	MS10	208	5.1
Common pipistrelle	MS11	104	11.6
Common pipistrelle	MS12	929	22.6
Common pipistrelle	MS2	361	39.7
Common pipistrelle	MS3	209	22.8
Common pipistrelle	MS5	40	7.7
Common pipistrelle	MS6	131	3.2
Common pipistrelle	MS7	231	19.2
Common pipistrelle	MS8	13	6.4
Common pipistrelle	MS9	606	12.4
Soprano pipistrelle	MS1	426	53.7
Soprano pipistrelle	MS10	3792	92.2
Soprano pipistrelle	MS11	677	75.4
Soprano pipistrelle	MS12	2820	68.6
Soprano pipistrelle	MS2	499	54.8
Soprano pipistrelle	MS3	384	41.9
Soprano pipistrelle	MS4	16	100.0
Soprano pipistrelle	MS5	253	48.5
Soprano pipistrelle	MS6	3742	92.6
Soprano pipistrelle	MS7	904	75.0
Soprano pipistrelle	MS8	2	1.0
Soprano pipistrelle	MS9	4025	82.7
Noctule	MS1	48	6.0
Noctule	MS10	105	2.6
Noctule	MS11	74	8.2
Noctule	MS12	68	1.7
Noctule	MS2	24	2.6
Noctule	MS3	265	28.9

Noctule	MS5	107	20.5
Noctule	MS6	109	2.7
Noctule	MS7	28	2.3
Noctule	MS8	188	92.6
Noctule	MS9	85	1.7
Leisler's	MS1	4	0.5
Leisler's	MS10	1	0.0
Leisler's	MS11	16	1.8
Leisler's	MS12	82	2.0
Leisler's	MS2	16	1.8
Leisler's	MS3	17	1.9
Leisler's	MS5	57	10.9
Leisler's	MS6	21	0.5
Leisler's	MS7	42	3.5
Leisler's	MS9	52	1.1
Brown long-eared	MS11	6	0.7
Brown long-eared	MS3	6	0.7
Brown long-eared	MS5	4	0.8
Brown long-eared	MS6	11	0.3
Brown long-eared	MS9	2	0.0
Myotis	MS1	32	4.0
Myotis	MS10	5	0.1
Myotis	MS11	21	2.3
Myotis	MS12	209	5.1
Myotis	MS2	10	1.1
Myotis	MS3	36	3.9
Myotis	MS5	61	11.7
Myotis	MS6	27	0.7
Myotis	MS9	99	2.0

Species Composition

Figure 10. Percentage species composition of passes at each detector.



PART 2a: Presence Only

THE NEXT SECTION OF THE REPORT FEATURES THE RAW DATA SUPPLIED TO ECOBAT AND ONLY TAKES INTO ACCOUNT THE PRESENCE, AND NOT THE ABSENCE, OF EACH BAT SPECIES. FOR EACH NIGHT, THERE IS NO 'ZERO DATA' FOR WHEN SPECIES WERE NOT DETECTED.

Nightly Bat Pass Rate (Bat passes per hour)

Median Per Detector

Table 16. The median Nightly Pass Rate (bat passes per hour, per night) of each species. If NA, then no bat passes.

Bat pass rates are often highly variable between nights, with some nights having few or no passes and other nights having high activity. In these circumstances, the median is likely to be a more useful summary of the 'average' activity than is the mean. For further information see: *Lintott, P. R., & Mathews, F. (2018). Basic mathematical errors may make ecological assessments unreliable. Biodiversity and Conservation, 27(1), 265-267.* https://doi.org/10.1007/s10531-017-1418-5

Species	Detector ID	Median Pass Rate
Common pipistrelle	MS1	0.6
Common pipistrelle	MS10	0.4
Common pipistrelle	MS11	0.6
Common pipistrelle	MS12	0.4
Common pipistrelle	MS2	0.6
Common pipistrelle	MS3	0.4
Common pipistrelle	MS5	0.6
Common pipistrelle	MS6	0.8
Common pipistrelle	MS7	0.6
Common pipistrelle	MS8	2.1
Common pipistrelle	MS9	0.8
Soprano pipistrelle	MS1	0.5
Soprano pipistrelle	MS10	0.4
Soprano pipistrelle	MS11	0.4
Soprano pipistrelle	MS12	0.5
Soprano pipistrelle	MS2	0.4
Soprano pipistrelle	MS3	0.4
Soprano pipistrelle	MS4	0.8
Soprano pipistrelle	MS5	0.4
Soprano pipistrelle	MS6	0.5
Soprano pipistrelle	MS7	0.6
Soprano pipistrelle	MS8	1.0
Soprano pipistrelle	MS9	0.4

Noctule	MS1	1.3
Noctule	MS10	0.4
Noctule	MS11	0.3
Noctule	MS12	1.0
Noctule	MS2	0.4
Noctule	MS3	1.4
Noctule	MS5	0.2
Noctule	MS6	0.2
Noctule	MS7	0.2
Noctule	MS8	0.2
Noctule	MS9	0.3
Leisler's	MS1	0.3
Leisler's	MS10	18.1
Leisler's	MS11	0.3
Leisler's	MS12	0.9
Leisler's	MS2	0.6
Leisler's	MS3	0.2
Leisler's	MS5	0.4
Leisler's	MS6	0.2
Leisler's	MS7	0.6
Leisler's	MS9	0.4
Brown long-eared	MS11	2.4
Brown long-eared	MS3	2.2
Brown long-eared	MS5	0.1
Brown long-eared	MS6	1.0
Brown long-eared	MS9	3.2
Myotis	MS1	0.5
Myotis	MS10	0.1
Myotis	MS11	0.2
Myotis	MS12	0.3
Myotis	MS2	0.2
Myotis	MS3	0.5
Myotis	MS5	0.4
Myotis	MS6	0.2
Myotis	MS9	0.2

Nightly Bat Pass Rate (Bat passes per hour)

Mean per Detector

Table 17. The mean Nightly Pass Rate (bat passes per hour, per night) of each species at each detector. Values are given to 1 decimal place.

We recommend using the median values given above, for the reasons stated above, but provide the mean values in the table below.

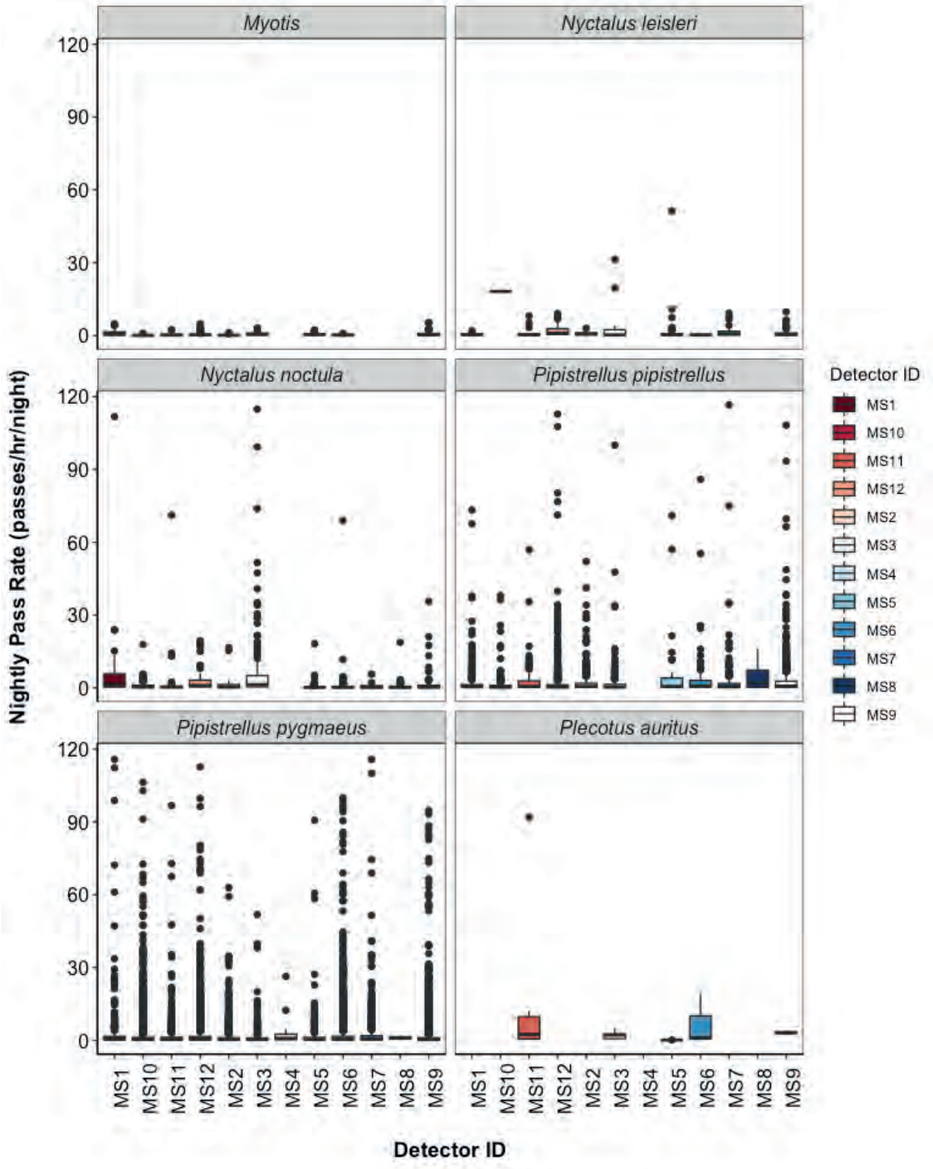
Species	Detector ID	Mean Pass Rate
Common pipistrelle	MS1	2.7
Common pipistrelle	MS10	1.7
Common pipistrelle	MS11	3.0
Common pipistrelle	MS12	2.2
Common pipistrelle	MS2	2.4
Common pipistrelle	MS3	2.4
Common pipistrelle	MS5	5.9
Common pipistrelle	MS6	3.5
Common pipistrelle	MS7	3.0
Common pipistrelle	MS8	4.2
Common pipistrelle	MS9	3.5
Soprano pipistrelle	MS1	3.2
Soprano pipistrelle	MS10	1.9
Soprano pipistrelle	MS11	2.0
Soprano pipistrelle	MS12	2.3
Soprano pipistrelle	MS2	2.3
Soprano pipistrelle	MS3	1.6
Soprano pipistrelle	MS4	3.5
Soprano pipistrelle	MS5	2.5
Soprano pipistrelle	MS6	2.4
Soprano pipistrelle	MS7	2.5
Soprano pipistrelle	MS8	1.0
Soprano pipistrelle	MS9	1.7
Noctule	MS1	6.0
Noctule	MS10	1.1
Noctule	MS11	1.8

Noctule	MS12	3.0
Noctule	MS2	2.0
Noctule	MS3	5.5
Noctule	MS5	0.6
Noctule	MS6	1.3
Noctule	MS7	0.7
Noctule	MS8	0.6
Noctule	MS9	1.9
Leisler's	MS1	0.7
Leisler's	MS10	18.1
Leisler's	MS11	1.3
Leisler's	MS12	1.8
Leisler's	MS2	0.8
Leisler's	MS3	3.7
Leisler's	MS5	1.8
Leisler's	MS6	0.4
Leisler's	MS7	1.5
Leisler's	MS9	1.2
Brown long-eared	MS11	18.2
Brown long-eared	MS3	2.1
Brown long-eared	MS5	0.1
Brown long-eared	MS6	5.4
Brown long-eared	MS9	3.2
Myotis	MS1	1.1
Myotis	MS10	0.2
Myotis	MS11	0.5
Myotis	MS12	0.4
Myotis	MS2	0.3
Myotis	MS3	0.7
Myotis	MS5	0.6
Myotis	MS6	0.3
Myotis	MS9	0.7

Nightly Bat Passes (Bat passes per hour)

Per Detector - Figures

Figure 11. Boxplots for the number of bat passes per hour each night, for each detector. The 'box' shows the interquartile range, which is where the middle 50% of the data lie. The line dividing the box is the median, the mid-point of the data. The 'whiskers' extend from the box and represent the ranges for the bottom 25% and the top 25% of the data values, excluding outliers. An outlier is any extreme value that lies further away from the box than 1.5 times the interquartile range. Outliers are shown as dots. Where very few passes are recorded it is not possible to produce the box, so the data are shown as a line.



SPLIT BY MONTH

Total Bat Passes per Detector, each Month

Per Detector

Table 18. The total number of bat passes of each species in each month at each detector. This table simply tells you how many bats of each species were recorded passing each detector during each month. These numbers are not standardised by the night length, or how many nights each detector was active for during each month.

Species	Detector ID	May	Jun	Jul	Aug	Oct
Common pipistrelle	MS1	17	243	1	9	14
Common pipistrelle	MS10	77	0	15	35	81
Common pipistrelle	MS11	1	77	4	6	16
Common pipistrelle	MS12	1	849	54	0	25
Common pipistrelle	MS2	3	144	119	81	14
Common pipistrelle	MS3	15	101	35	50	8
Common pipistrelle	MS5	0	0	9	30	1
Common pipistrelle	MS6	6	0	30	91	4
Common pipistrelle	MS7	1	220	7	0	3
Common pipistrelle	MS8	13	0	0	0	0
Common pipistrelle	MS9	287	0	98	189	32
Soprano pipistrelle	MS1	7	192	84	6	137
Soprano pipistrelle	MS10	859	5	285	444	2199
Soprano pipistrelle	MS11	3	136	252	235	51
Soprano pipistrelle	MS12	0	2043	733	0	44
Soprano pipistrelle	MS2	6	76	169	170	78
Soprano pipistrelle	MS3	10	60	71	191	52
Soprano pipistrelle	MS4	0	0	11	0	5
Soprano pipistrelle	MS5	0	0	92	138	23
Soprano pipistrelle	MS6	35	0	1511	1841	355
Soprano pipistrelle	MS7	7	542	105	31	219
Soprano pipistrelle	MS8	1	0	0	0	1
Soprano pipistrelle	MS9	842	0	603	2461	119
Noctule	MS1	2	27	4	3	12

Noctule	MS10	0	0	0	0	105
Noctule	MS11	0	9	22	38	5
Noctule	MS12	1	51	8	0	8
Noctule	MS2	0	5	6	0	13
Noctule	MS3	24	202	17	22	0
Noctule	MS5	0	0	39	68	0
Noctule	MS6	0	0	21	68	20
Noctule	MS7	0	1	22	0	5
Noctule	MS8	0	0	48	140	0
Noctule	MS9	28	0	7	36	14
Leisler's	MS1	0	0	0	0	4
Leisler's	MS10	0	0	0	0	1
Leisler's	MS11	0	0	5	11	0
Leisler's	MS12	0	46	34	0	2
Leisler's	MS2	0	2	14	0	0
Leisler's	MS3	1	3	1	12	0
Leisler's	MS5	0	0	19	38	0
Leisler's	MS6	0	0	4	17	0
Leisler's	MS7	0	0	42	0	0
Leisler's	MS9	5	0	10	37	0
Brown long-eared	MS11	0	0	2	4	0
Brown long-eared	MS3	0	0	2	4	0
Brown long-eared	MS5	0	0	0	4	0
Brown long-eared	MS6	0	0	1	10	0
Brown long-eared	MS9	1	0	0	1	0
Myotis	MS1	8	2	1	2	19
Myotis	MS10	0	0	0	0	5
Myotis	MS11	0	8	1	5	7
Myotis	MS12	0	204	2	0	3
Myotis	MS2	0	2	2	1	5
Myotis	MS3	3	5	6	21	1
Myotis	MS5	0	0	8	52	1
Myotis	MS6	4	0	0	15	8
Myotis	MS9	25	0	9	33	32

Survey Effort

Table 19. The number of survey nights per month per detector.

Month	Detector ID	No. of Survey Nights
May	MS1	8
May	MS10	8
May	MS11	1
May	MS12	1
May	MS2	3
May	MS3	8
May	MS6	1
May	MS7	4
May	MS8	2
May	MS9	9
Jun	MS1	26
Jun	MS10	2
Jun	MS11	23
Jun	MS12	26
Jun	MS2	13
Jun	MS3	25
Jun	MS7	26
Jul	MS1	2
Jul	MS10	6
Jul	MS11	5
Jul	MS12	4
Jul	MS2	8
Jul	MS3	6
Jul	MS4	1
Jul	MS5	4
Jul	MS6	6
Jul	MS7	6
Jul	MS8	6
Jul	MS9	6
Aug	MS1	3

Aug	MS10	16
Aug	MS11	21
Aug	MS2	4
Aug	MS3	20
Aug	MS5	15
Aug	MS6	22
Aug	MS7	5
Aug	MS8	12
Aug	MS9	20
Oct	MS1	21
Oct	MS10	23
Oct	MS11	10
Oct	MS12	4
Oct	MS2	22
Oct	MS3	4
Oct	MS4	2
Oct	MS5	7
Oct	MS6	5
Oct	MS7	7
Oct	MS8	1
Oct	MS9	26

Nightly Bat Pass Rate for each Month

Median Per Detector

Table 20. The median Nightly Pass Rate (bat passes per hour, per night) of each species throughout each month. If NA, then no bat passes.

Bat pass rates are often highly variable between nights, with some nights having few or no passes and other nights having high activity. In these circumstances, the median is likely to be a more useful summary of the 'average' activity than is the mean. For further information see: *Lintott, P. R., & Mathews, F. (2018). Basic mathematical errors may make ecological assessments unreliable. Biodiversity and Conservation, 27(1), 265-267.* https://doi.org/10.1007/s10531-017-1418-5

Species	Detector ID	May	Jun	Jul	Aug	Oct
Common pipistrelle	MS1	0.7	0.6	0.7	0.4	0.8
Common pipistrelle	MS10	0.3	NA	0.4	1.6	0.3
Common pipistrelle	MS11	4.8	0.4	0.3	2.0	1.4
Common pipistrelle	MS12	0.7	0.4	0.3	NA	0.7
Common pipistrelle	MS2	0.7	1.1	0.4	0.5	0.6
Common pipistrelle	MS3	1.3	0.6	0.2	0.5	0.5
Common pipistrelle	MS5	NA	NA	0.4	1.0	0.7
Common pipistrelle	MS6	1.3	NA	0.5	1.2	2.1
Common pipistrelle	MS7	2.5	0.6	0.6	NA	0.2
Common pipistrelle	MS8	2.1	NA	NA	NA	NA
Common pipistrelle	MS9	1.1	NA	0.5	0.6	0.5
Soprano pipistrelle	MS1	0.1	0.6	1.2	0.3	0.3
Soprano pipistrelle	MS10	0.7	2.7	0.4	0.6	0.3
Soprano pipistrelle	MS11	1.7	0.5	0.6	0.4	0.2
Soprano pipistrelle	MS12	NA	0.6	0.4	NA	0.2
Soprano pipistrelle	MS2	0.4	0.7	0.4	0.4	0.3
Soprano pipistrelle	MS3	0.2	0.6	0.3	0.4	0.5
Soprano pipistrelle	MS4	NA	NA	1.9	NA	0.3
Soprano pipistrelle	MS5	NA	NA	0.4	0.4	0.2
Soprano pipistrelle	MS6	0.3	NA	0.5	0.5	0.4
Soprano pipistrelle	MS7	0.6	0.6	0.4	0.5	0.5
Soprano pipistrelle	MS8	0.1	NA	NA	NA	1.9
Soprano pipistrelle	MS9	0.3	NA	0.6	0.3	0.4

Noctule	MS1	3.0	3.3	0.8	0.4	0.8
Noctule	MS10	NA	NA	NA	NA	0.4
Noctule	MS11	NA	1.2	0.4	0.2	0.7
Noctule	MS12	0.8	1.8	0.6	NA	0.8
Noctule	MS2	NA	1.0	1.4	NA	0.3
Noctule	MS3	1.1	2.0	0.2	0.2	NA
Noctule	MS5	NA	NA	0.2	0.2	NA
Noctule	MS6	NA	NA	0.2	0.2	0.4
Noctule	MS7	NA	1.1	0.1	NA	0.9
Noctule	MS8	NA	NA	0.2	0.2	NA
Noctule	MS9	0.9	NA	0.3	0.2	0.7
Leisler's	MS1	NA	NA	NA	NA	0.3
Leisler's	MS10	NA	NA	NA	NA	18.1
Leisler's	MS11	NA	NA	0.8	0.1	NA
Leisler's	MS12	NA	0.8	1.4	NA	1.6
Leisler's	MS2	NA	0.2	0.8	NA	NA
Leisler's	MS3	31.4	2.4	0.2	0.2	NA
Leisler's	MS5	NA	NA	0.4	0.3	NA
Leisler's	MS6	NA	NA	0.4	0.2	NA
Leisler's	MS7	NA	NA	0.6	NA	NA
Leisler's	MS9	1.0	NA	0.6	0.2	NA
Brown long-eared	MS11	NA	NA	1.9	6.5	NA
Brown long-eared	MS3	NA	NA	3.9	1.1	NA
Brown long-eared	MS5	NA	NA	NA	0.1	NA
Brown long-eared	MS6	NA	NA	12.7	0.9	NA
Brown long-eared	MS9	2.5	NA	NA	3.8	NA
Myotis	MS1	0.8	2.2	0.7	0.3	0.4
Myotis	MS10	NA	NA	NA	NA	0.1
Myotis	MS11	NA	0.3	0.1	0.7	0.2
Myotis	MS12	NA	0.3	0.4	NA	0.1
Myotis	MS2	NA	0.4	0.1	1.2	0.2
Myotis	MS3	0.3	0.4	1.3	0.4	0.6
Myotis	MS5	NA	NA	0.3	0.4	0.1
Myotis	MS6	0.4	NA	NA	0.2	0.1
Myotis	MS9	0.1	NA	0.2	0.3	0.2

Nightly Bat Pass Rate for each Month

Mean per Detector

Table 21: The mean Nightly Pass Rate (bat passes per hour, per night) of each species throughout each month. Values are given to 1 decimal place.

We recommend using the median values given above, for the reasons stated above, but provide the mean values in the table below.

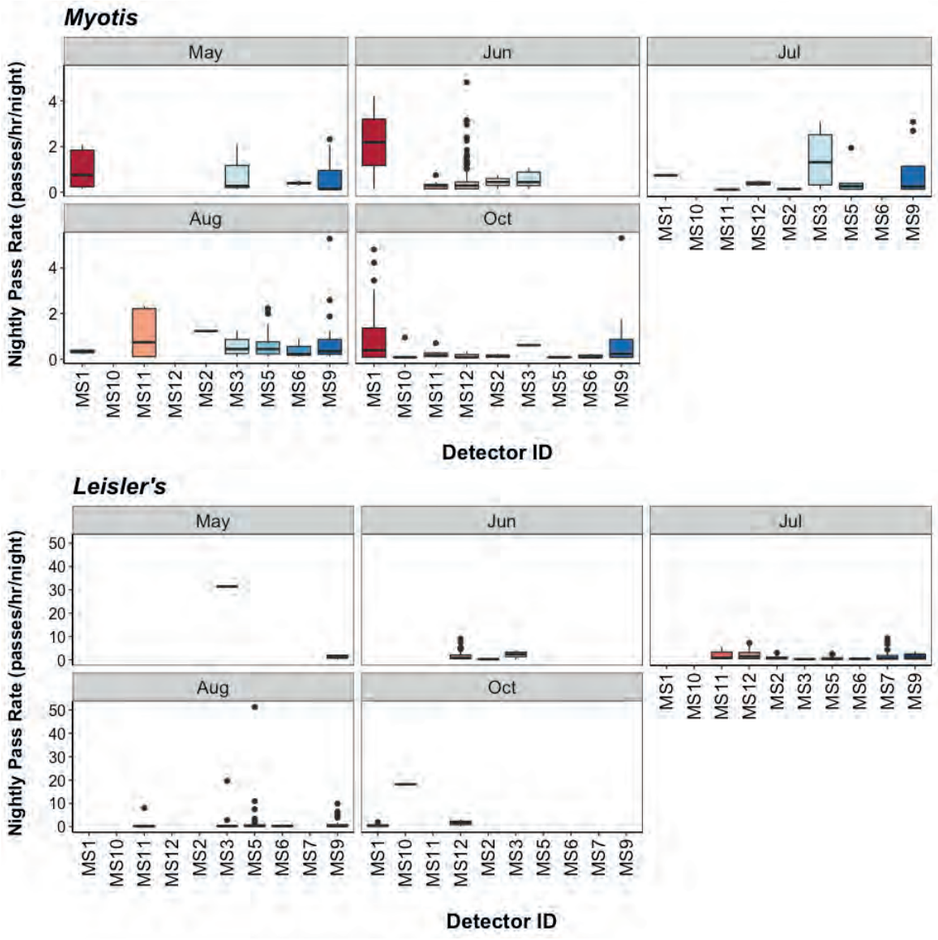
Species	Detector ID	May	Jun	Jul	Aug	Oct
Common pipistrelle	MS1	2.9	2.6	0.7	2.2	4.4
Common pipistrelle	MS10	1.3	NA	0.6	3.8	1.3
Common pipistrelle	MS11	4.8	2.5	0.3	4.6	5.7
Common pipistrelle	MS12	0.7	2.3	0.6	NA	2.4
Common pipistrelle	MS2	1.4	4.0	1.2	1.3	2.9
Common pipistrelle	MS3	5.3	2.8	0.6	2.3	1.7
Common pipistrelle	MS5	NA	NA	0.4	7.7	0.7
Common pipistrelle	MS6	2.1	NA	0.5	4.5	5.1
Common pipistrelle	MS7	2.5	3.1	1.0	NA	0.2
Common pipistrelle	MS8	4.2	NA	NA	NA	NA
Common pipistrelle	MS9	5.1	NA	0.9	2.5	2.2
Soprano pipistrelle	MS1	0.2	4.2	4.5	0.3	1.2
Soprano pipistrelle	MS10	3.1	2.2	1.1	2.3	1.4
Soprano pipistrelle	MS11	1.3	3.8	2.0	1.2	0.5
Soprano pipistrelle	MS12	NA	2.5	1.7	NA	0.6
Soprano pipistrelle	MS2	2.1	2.9	2.6	2.3	1.2
Soprano pipistrelle	MS3	0.4	2.9	1.6	0.9	2.7
Soprano pipistrelle	MS4	NA	NA	5.0	NA	0.3
Soprano pipistrelle	MS5	NA	NA	2.5	2.7	1.0
Soprano pipistrelle	MS6	0.3	NA	2.6	2.4	1.5
Soprano pipistrelle	MS7	1.3	3.2	1.0	3.1	1.5
Soprano pipistrelle	MS8	0.1	NA	NA	NA	1.9
Soprano pipistrelle	MS9	0.9	NA	2.7	1.8	2.2
Noctule	MS1	3.0	9.4	2.8	0.5	1.1
Noctule	MS10	NA	NA	NA	NA	1.1
Noctule	MS11	NA	11.7	0.6	0.4	0.7

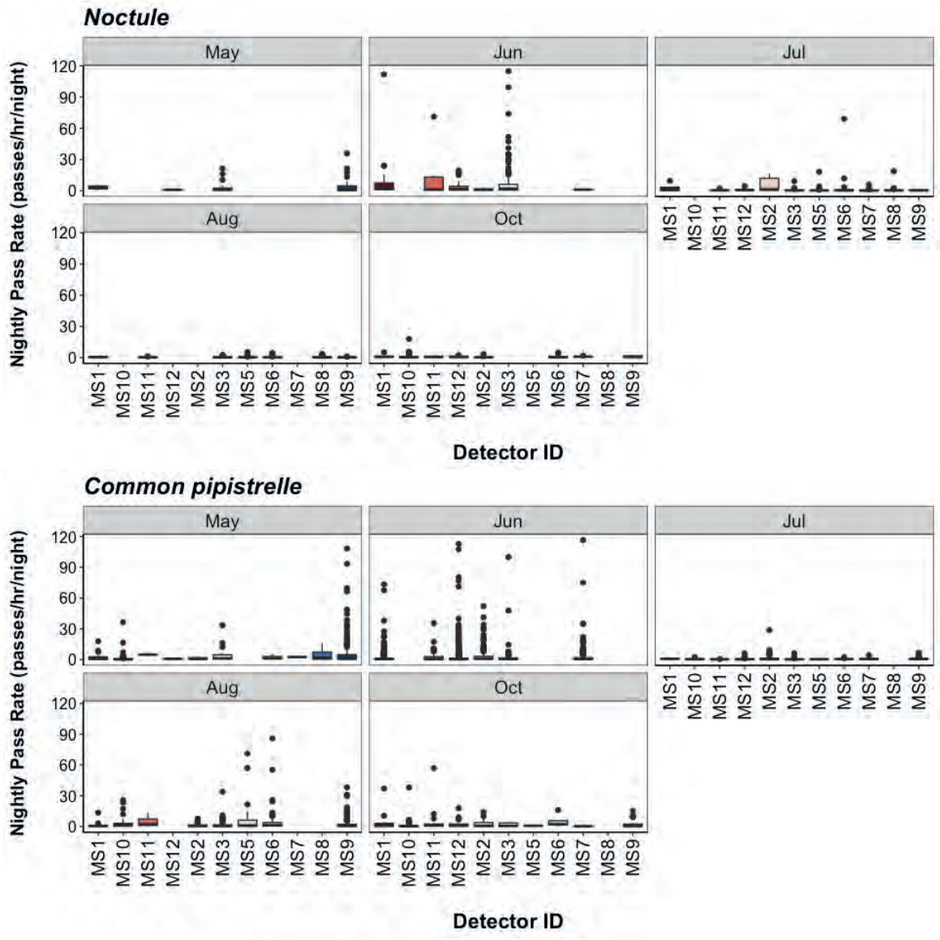
Noctule	MS12	0.8	3.7	1.1	NA	0.8
Noctule	MS2	NA	1.3	5.8	NA	0.6
Noctule	MS3	3.2	6.7	1.1	0.6	NA
Noctule	MS5	NA	NA	0.9	0.5	NA
Noctule	MS6	NA	NA	4.4	0.5	0.9
Noctule	MS7	NA	1.1	0.7	NA	0.9
Noctule	MS8	NA	NA	0.9	0.6	NA
Noctule	MS9	4.6	NA	0.6	0.3	1.0
Leisler's	MS1	NA	NA	NA	NA	0.7
Leisler's	MS10	NA	NA	NA	NA	18.1
Leisler's	MS11	NA	NA	2.0	0.9	NA
Leisler's	MS12	NA	1.6	2.2	NA	1.6
Leisler's	MS2	NA	0.2	0.9	NA	NA
Leisler's	MS3	31.4	2.2	0.2	2.0	NA
Leisler's	MS5	NA	NA	0.7	2.3	NA
Leisler's	MS6	NA	NA	0.4	0.3	NA
Leisler's	MS7	NA	NA	1.5	NA	NA
Leisler's	MS9	1.1	NA	1.4	1.2	NA
Brown long-eared	MS11	NA	NA	1.9	26.3	NA
Brown long-eared	MS3	NA	NA	3.9	1.2	NA
Brown long-eared	MS5	NA	NA	NA	0.1	NA
Brown long-eared	MS6	NA	NA	12.7	4.7	NA
Brown long-eared	MS9	2.5	NA	NA	3.8	NA
Myotis	MS1	1.0	2.2	0.7	0.3	1.1
Myotis	MS10	NA	NA	NA	NA	0.2
Myotis	MS11	NA	0.3	0.1	1.1	0.2
Myotis	MS12	NA	0.4	0.4	NA	0.2
Myotis	MS2	NA	0.4	0.1	1.2	0.1
Myotis	MS3	0.8	0.6	1.5	0.6	0.6
Myotis	MS5	NA	NA	0.5	0.6	0.1
Myotis	MS6	0.4	NA	NA	0.4	0.1
Myotis	MS9	0.6	NA	0.9	0.7	0.6

Nightly Bat Pass Rate for each Month

Per Detector - Figures

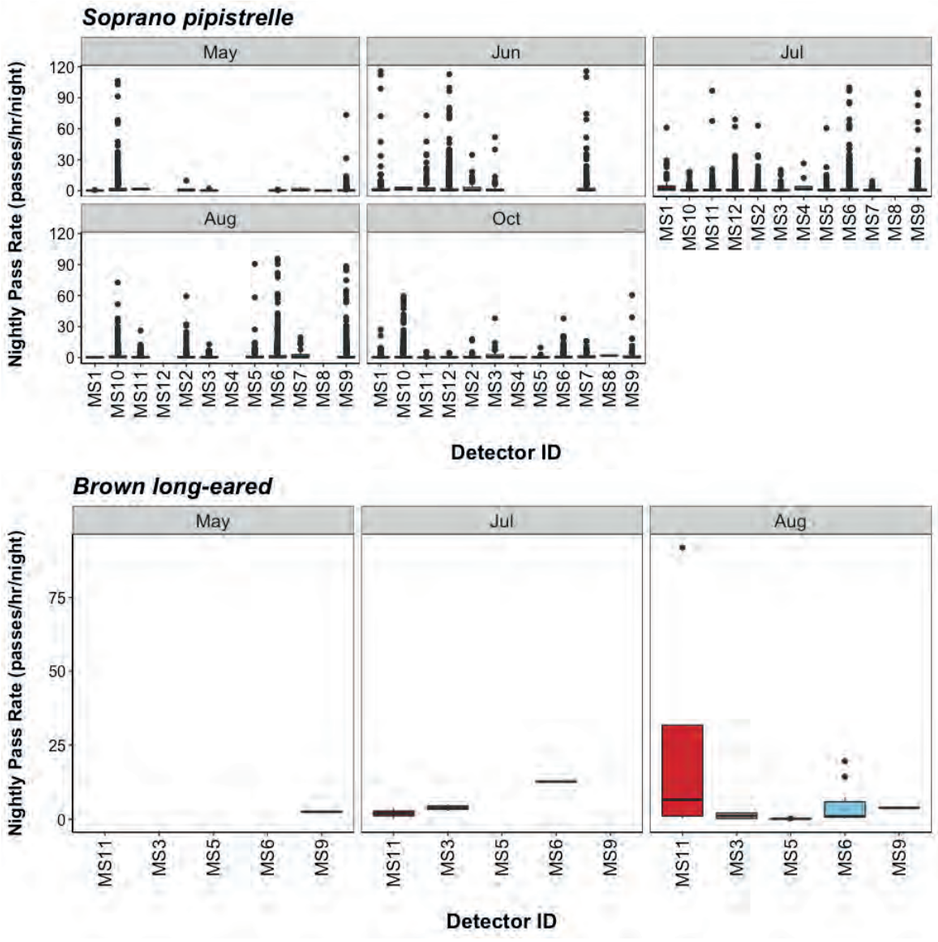
Figure 12. Figures show boxplots for the number of bat passes per hour by detector, for each month. The 'box' shows the interquartile range, which is where the middle 50% of the data lie. The line dividing the box is the median, the mid-point of the data. The 'whiskers' extend from the box and represent the ranges for the bottom 25% and the top 25% of the data values, excluding outliers. An outlier is any extreme value that lies further away from the box than 1.5 times the interquartile range. Outliers are shown as dots. Where very few passes are recorded it is not possible to produce the box, so the data are shown as a line.


Myotis
May
Jun
Jul
Aug
Oct
Nightly Pass Rate (passes/hr/night)
0
2
4
MS1
MS10
MS11
MS12
MS2
MS3
MS5
MS6
MS7
MS8
MS9
Detector ID


Noctule
May
Jun
Jul
Aug
Oct
Nightly Pass Rate (passes/hr/night)
0
30
60
90
120
MS1
MS10
MS11
MS12
MS2
MS3
MS5
MS6
MS7
MS8
MS9
Detector ID

Leisler's
May
Jun
Jul
Aug
Oct
Nightly Pass Rate (passes/hr/night)
0
10
20
30
40
50
MS1
MS10
MS11
MS12
MS2
MS3
MS5
MS6
MS7
MS9
Detector ID

Common pipistrelle
May
Jun
Jul
Aug
Oct
Nightly Pass Rate (passes/hr/night)
0
30
60
90
120
MS1
MS10
MS11
MS12
MS2
MS3
MS5
MS6
MS7
MS8
MS9
Detector ID



Bat Activity per Detector Location

Figure 13. Detector ID reference:

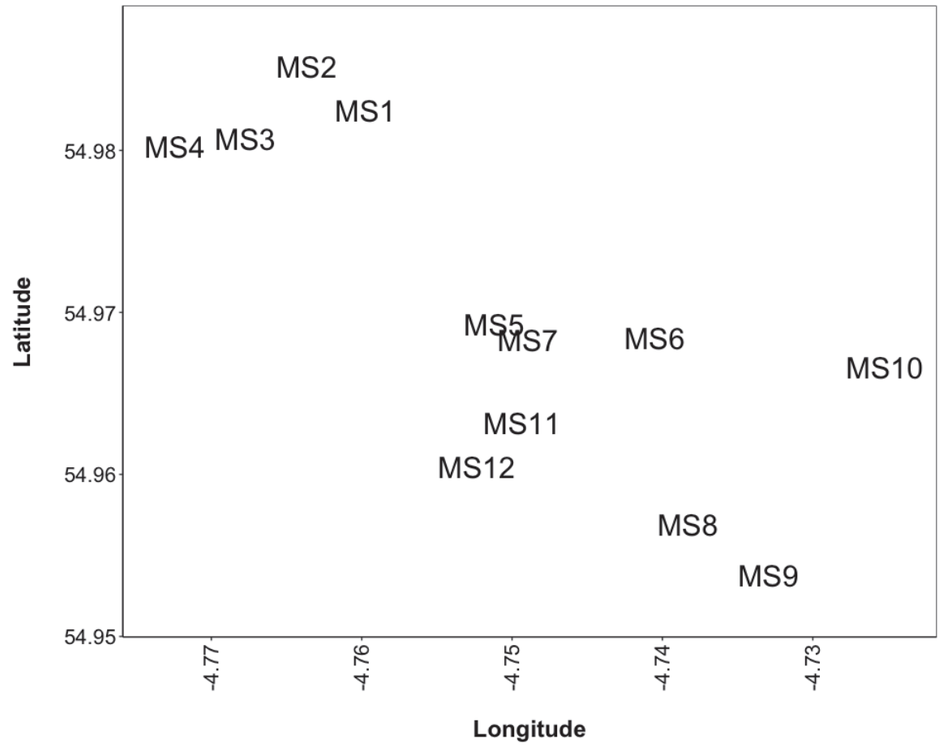


Figure 14. Median Nightly Pass Rate (bat passes/hr/night) throughout the survey period - represented by the size and colour of the point at each detector location.

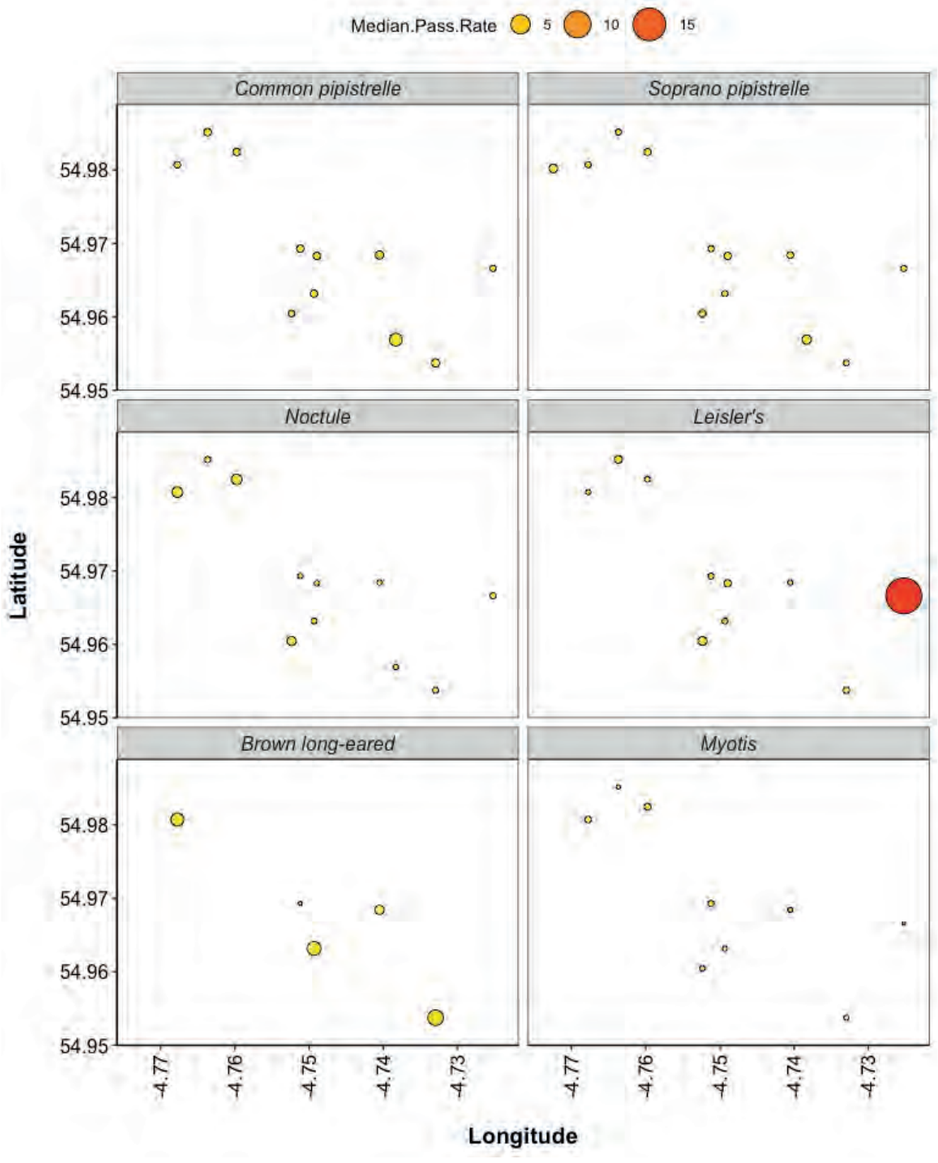
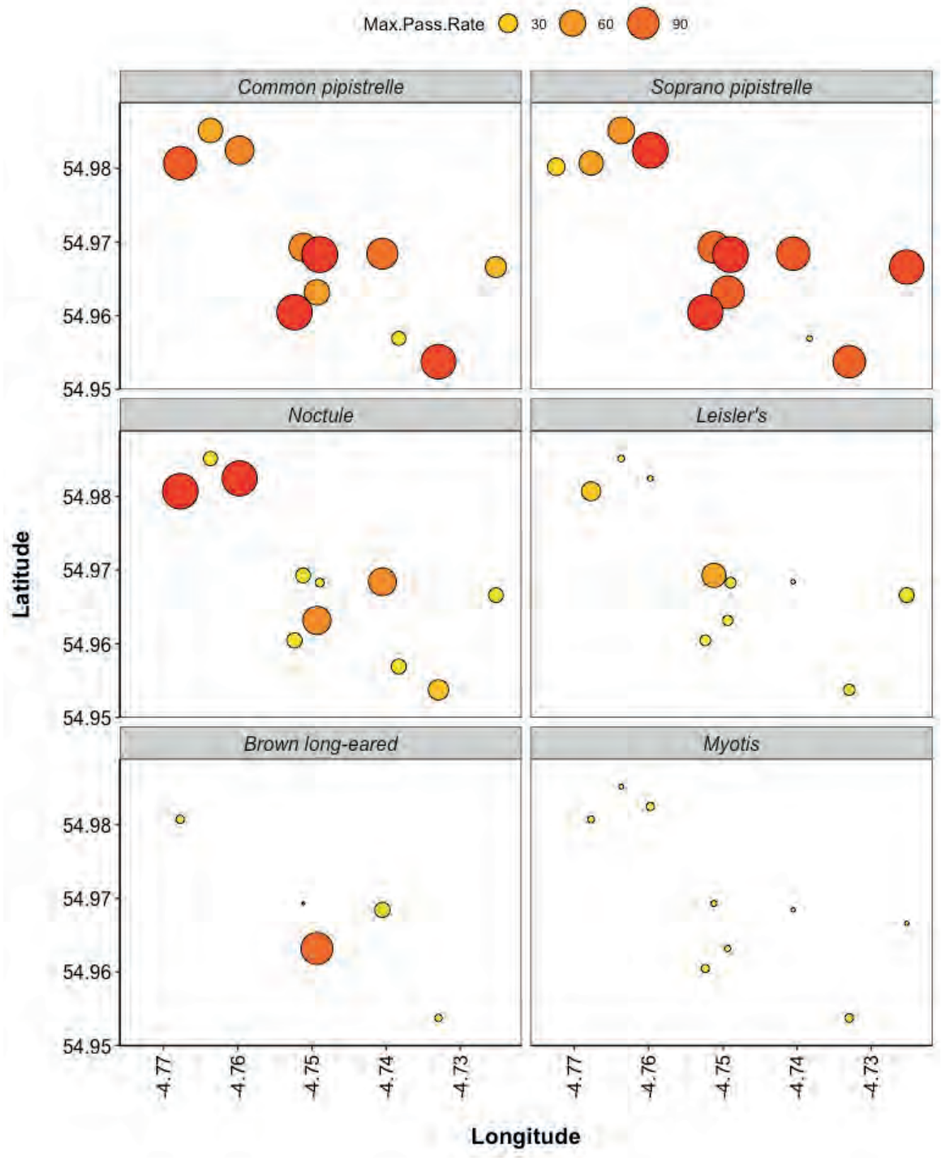


Figure 15. Maximum Nightly Pass Rate (bat passes/hr/night) recorded in a single night throughout the survey period - represented by the size and colour of the point at each detector location.



ANNEX 5 – Galloway Fisheries Trust

A Scottish Registered Charity
No. SC 020751

Commissioned Report No. – JRAD191120

Fisheries Habitat survey for proposed Artfield Forest Wind Farm

November 2020

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This report should be quoted as:

Galloway Fisheries Trust. November 2020. Fisheries Habitat survey for proposed Artfield Forest Wind Farm. Report JRAD191120

Summary

Fisheries Habitat survey for proposed Artfield Forest Wind Farm

Commissioned Report No.: JRAD191120
Contractor: Avian Ecology Limited
Year of publication: November 2020

Keywords

Artfield Forest; habitat survey; Tarf Water; Wind Farm; baseline

Background

The Galloway Fisheries Trust (GFT) was commissioned by Avian Ecology Limited to carry out a targeted walk-over fisheries habitat survey for the proposed Artfield Forest Wind Farm (herein referred to as the 'Development'), near Glenluce in Dumfries and Galloway.

The habitat surveys were undertaken on a section of the upper Tarf Water and various tributaries which drain the development site. The surveys were undertaken to assess the potential of these watercourses to support various important fish and Freshwater Pearl mussel populations to make recommendations regarding whether additional surveys would be required. The Tarf Water is covered by the River Bladnoch Special Area of Conservation (SAC) which is designated for Atlantic salmon.

Main findings

- A total of 10 watercourses were surveyed during this survey.
- Purgatory Burn: this watercourse contains a range of good quality instream habitats. This burn could support populations of salmonids, eels, juvenile lamprey and Freshwater Pearl mussels.
- Tributary draining Moss of Horse Hill: this watercourse did not contain suitable habitats for fish or Freshwater Pearl mussels.
- Tarf Water: this watercourse contains a range of good quality instream habitats. This river could support populations of salmonids, eels, juvenile lamprey and Freshwater Pearl mussels. The Tarf is designated as part of the River Bladnoch SAC for Atlantic salmon.
- Un-named tributary: this watercourse contains some limited areas of suitable habitat for trout only.
- Un-named tributary draining Brough Hill: this watercourse contains some areas of suitable habitat for trout only.
- Three burns draining from Low Eldrig: two of these burns were considered large enough to support populations of salmonids, eels and juvenile lamprey. One of the burns was considered unsuitable for fish or Freshwater Pearl mussels.

- Un-named tributary draining Black and White Hills: this watercourse contains a range of good quality instream habitats. This burn could support populations of salmonids, eels, juvenile lamprey and Freshwater Pearl mussels.

- Drumpail Burn: this watercourse contains a range of good quality instream habitats. This burn could support populations of salmonids, eels, juvenile lamprey and Freshwater Pearl mussels. The Drumpail Burn is designated as part of the River Bladnoch SAC for Atlantic salmon.

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1 INTRODUCTION

The Galloway Fisheries Trust (GFT) was commissioned by Avian Ecology Limited to carry out a targeted walk-over fisheries habitat survey for the proposed Artfield Forest Wind Farm (herein referred to as the 'Development'), near Glenluce in Dumfries and Galloway.

The habitat surveys were undertaken on a section of the upper Tarf Water and various tributaries which drain the development site. The surveys were undertaken to assess the potential of these watercourses to support various important fish and Freshwater Pearl mussel populations to make recommendations regarding whether additional surveys would be required. The Tarf Water is covered by the River Bladnoch Special Area of Conservation (SAC) which is designated for Atlantic salmon.

The possible impacts that any land based wind farm development and its associated infrastructure could have on surrounding fish populations are well documented. The potential for fish species and their habitats to be affected by the Development mainly occurs during the construction and decommissioning phases of the Development. During the construction phase potential impacts include: siltation from ground disturbance, accelerated or exacerbated erosion, hydrological changes, pollution and the blocking or hindering of the upstream/downstream migration of fish. During the operational phase potential impacts include: the effects of poor road drainage, accelerated levels of erosion, fish access and the maintenance of silt traps and road crossings. Potential risks during the decommissioning phase are broadly similar to those in the construction phase. These potential effects could all impact on the surrounding fish populations by causing direct mortality of juveniles and adults, changes in food availability, avoidance behaviour resulting in unused habitat, blocking of migration routes to spawning beds or the damage of instream and riparian habitats.

There is a variety of legislation, regulations and guidance in place relating to fish species that may be present in watercourses within the Tarf Water catchment.

Atlantic salmon (*Salmon salar*) are an internationally important fish species which is listed under Annex II and V of the European Habitats Directive (1992) (only in freshwater), Appendix III of the Bern Convention (1979) (only in freshwater) and are a local priority species in the Dumfries and Galloway Local Biodiversity Action Plan. Atlantic salmon are also a species of Conservation Concern on a UK level. Brown trout/sea trout (*Salmo trutta*) are also a UK Biodiversity Action Plan species.

In recent years there have been concerns around Europe over low eel (*Anguilla anguilla*) stocks. It is currently unknown why there was such a rapid decline but it was possibly linked to over-exploitation, inland habitat loss, climate and ocean current changes, disease and pollution. European Eel Regulations (EC) No 1100/2007 aim to establish measures to recover eel stocks. One such measure was the production of Eel Management Plans for the Scotland River Basin and the Solway Tweed River Basin District within which the Border Esk catchment lies. Fishing or taking eels is illegal (unless licensed) under The Freshwater Fish Conservation (Prohibition on Fishing for Eels) (Scotland) Regulations 2008. Eels are also a UKBAP priority species.

Both River and Brook lampreys (*Lampetra fluviatilis* and *Lampetra planeri*) are protected under Annex IIa and III of the EC Habitats and Species Directive 1992, with River lamprey also being protected under Appendix III the Bern Convention 1979. River lampreys are species of Conservation Concern on a UK level. Sea lampreys (*Petromyzon marinus*) are listed in Annexes IIa and Va of the Habitats Directive, Appendix III of the Bern Convention and as a Long List Species in the UK Biodiversity Action Plan.

Freshwater Pearl mussels (*Margaritifera margaritifera*) are fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended), are listed on the EU Habitats and Species Directive (Annexes II and V) and Appendix III of the Bern Convention 1979. They are included on the IUCN Invertebrate Red List, where their status is described as Vulnerable. Freshwater Pearl mussels are also classified as a priority species in the UK Biodiversity Action Plan.

2 METHODOLOGY

2.1 Data recording

The walk-over habitat surveys were undertaken on the 8, 9, 14 and 18 September 2020 and aimed to provide general information on the current status of the instream and bankside habitats present within the watercourses within and in the immediate vicinity of the boundary of the development, specifically those which may be affected by the construction activities and/or upgrading of watercourse crossings. A modified Hendry and Cragg-Hine (1997) walk-over survey was undertaken.

This method of habitat surveying allows for much ground to be covered, giving the maximum amount of information to be gained in the minimum amount of time. The walk-over habitat surveys aimed to provide an insight into the status and locations of spawning gravels and juvenile habitat areas within the watercourses.

During the surveys, information on substrate type, bank structure and obstructions to fish movement are recorded. General comments on individual stretches of river are recorded to assist in the rapid overview of the survey area as a whole. A photographic record of the watercourses was collected during the surveys.

It is policy to disinfect all relevant equipment prior to and following work in each river catchment to ensure there is no transfer of non-native invasive species.

The watercourses were each surveyed by two experienced GFT surveyors. The predominant habitat type was recorded within specific stretches, and defined as described in Table 1. The habitats described are not disparate but regarded as definable parts of a spectrum of habitats found in a river. The bankside structure and surrounding land use was also described where appropriate.

Habitat Type	Classification
Spawning gravel	Stable gravel up to 30 centimetre (cm) deep that is not compacted or contains excessive silt. Substrate size with a diameter of 0.8 to 10.2 cm
Silted spawning habitat	Stable gravel up to 30 cm deep that is compacted or contains excessive silt. Substrate size with a diameter of 0.8 to 10.2 cm
Fry habitat *	Shallow (<0.2 metre (m)) and fast flowing water indicative of riffles and runs with a substrate dominated by gravel (16 – 64 millimetre (mm)) and cobbles (64 – 256 mm)
Parr habitat *	Riffle – run habitat that is generally faster and deeper than fry habitat (0.2 – 0.4 m). Substrate consists of gravels (16 – 64 mm), cobbles (64 – 256 mm) and boulder (> 256 mm)
Mixed juvenile habitat *	A mix of fry and parr habitat, suited to both age classes in combination – the deeper, faster, larger substrate areas used by parr, and the shallower, slower, smaller substrate areas used by fry
Glides	Smooth laminar flow with little surface turbulence and generally greater than 0.3 m deep
Pools	No perceptible flow and usually greater than 1 m deep
Flow constriction	Where physical features provide a narrowing of the channel resulting in increased velocity and depth (often combined with a localised increase in gradient and bedrock substrates)
Obstacles/Obstruction to migration	A structure or item identified as a potential obstruction to fish passage at certain water heights (e.g. impassable falls, weirs, bridge aprons, shallow braided river sections preventing upstream migration during low flows)

** If significant amounts of fry and parr habitat were found to co-exist in the same section, these habitat classifications are often combined and classified as mixed juvenile habitat. Where parr habitat is mentioned this will refer to habitat that has principally been identified as habitat more suited to parr than fry however will habitually contain a lower quantity of fry habitat and habitat which is suited to both fry and parr.*

Problematic bank structures such as areas of erosion were recorded, if present. If the reason for the problem was evident then this was highlighted, e.g. over-grazing by sheep causing a collapsing bank.

Obstructions were assessed for complete impassability at any flow or for being passable under certain flow conditions. Additional comments were also made as to the nature and permanency of the obstruction. Photographs were taken throughout the survey and of all major obstructions.

Instream characteristics are described, moving in an upstream direction, in the information below. Banksides are referenced as right or left bank in a downstream direction.

The report will also highlight stretches of habitat suitable for Freshwater Pearl mussels, eels and juvenile lampreys.

3 RESULTS

3.1 Habitat survey

3.1.1 Purgatory Burn (along boundary)

The survey started at NX 22790 69272 where the Purgatory Burn outflows into the Tarf Water. The survey was undertaken in an upstream direction.

The first ~400 m of the burn, up to NX 22716 68894, is deep slow **glide** with a silt base (Figure 1). Wet widths varied from 7 – 10 m wide. This section would be expected to support older trout parr only.

Figure 1: Lower Purgatory Burn (looking downstream towards Tarf)

The burn then narrowed with an average width of ~4 m, although widths ranged from 2 – 5 m wide (Figure 2 and 3) up until NX 22294 68273 - a length of approximately 1,050 m. Here the gradient increases and the bed of the burn becomes a mix of cobbles and boulders. The dominant flow type was a mix of run / riffle with some glide present. The main habitat present is **juvenile habitat** although where the gradient is greatest then it becomes **parr habitat** due to the larger substrate present. Some pockets of good **spawning substrate** was present behind boulders which could be utilised by trout.

This section contains suitable habitat to potentially support Freshwater Pearl mussels, European eels. Some small pockets of finer substrates are present which could be utilised by juvenile lamprey.

Within this section there were some short sections of deep **glide**: NX 22469 68785 (~20 m long and 11 m wide), NX 22429 68510 (~60 m long and 9 m wide), NX 22377 68457 (~30 m long and 8 m wide).

There was a small bedrock waterfall at NX 22575 68845 but it was considered that fish would easily access over it.

Figure 2: Purgatory Burn providing juvenile habitat (looking upstream)

Figure 3: Purgatory Burn providing parr habitat (looking downstream)

Figure 4: Upper point of survey section on Purgatory Burn (looking upstream)

The burn then changes to deep slow **glide** for a length of 30 m, averaging 5 m wide with a peaty base. This section would be expected to only support a trout parr population. The

survey for this section stopped where the burn leaves the development area and the conifer plantation at NX 22306 68257.

All of the Purgatory Burn sections which were surveyed had Sitka spruce plantation present on the right bank which was planted well back from the burn. The left bank of the burn opened up onto moorland health. No deciduous trees were present in the riparian zone.

3.1.2 Un-named tributary draining Moss of the Horse Hill

The survey started at NX 23222 69171 where the burn outflows into the Tarf Water. The survey was undertaken in an upstream direction.

The first section up to the road bridge is ~110 m long. This lower section of the burn is deep slow **glide**, with a silt base (Figure 5). Wet widths varied from 1 – 2 m wide. The burn flows under the road via a culvert set low in the bed. Fish would be able to access through the culvert easily.

Figure 5: Lower un-named tributary (draining Moss of the Horse Hill)

Upstream of the bridge the burn continues to be a meandering slow deep **glide** with a peaty base (Figure 6). It gradually starts to narrow and become straighter. In the upper reaches that were surveyed (Figure7) it clearly has been dug out and is basically an artificial channel.

Figure 6: Mid un-named tributary (draining Moss of the Horse Hill)

Figure 7: *Upper un-named tributary (draining Moss of the Horse Hill)*

As illustrated in Figure 8 below, various deep drains enter this burn. These drains have been used to drain the surrounding peat land to assist in the planting of Sitka spruce plantations.

Figure 8: Peatland drainage into un-named tributary (draining Moss of the Horse Hill)

The survey was terminated at NX 23314 68665 as the burn was becoming very narrow.

This section does not contain suitable habitat to support fish populations or Freshwater Pearl mussels.

All of the sections which were surveyed had Sitka spruce plantation present on both banks which was planted reasonably close to the burn. The vegetation present between the conifers and burn was typical of moorland health. No deciduous trees were present in the riparian zone.

3.1.3 Tarf Water (runs along site boundary)

The survey started at NX 24920 66511 close to where the Tarf Water leaves the boundary of the development site. The survey was undertaken in an upstream direction.

Figure 9: Tarf Water (looking downstream)

Where the survey started, both upstream and downstream, the river offers excellent **juvenile habitat** (Figure 9). The river contains a healthy mix of gravel, pebbles, cobbles and boulders which offers both **spawning substrates** for salmonids and habitat for both salmonid fry and parr. The river here is mostly 8 – 10 m wide. A good gradient results in a flow dominated by run with riffle and glide also present. These conditions also provide suitable conditions for juvenile lamprey, eels and Freshwater Pearl mussels. These conditions continue for roughly 1,150 m up to NX 24988 67168. Throughout this section conifer plantations are present on both banks and are planted a decent distance back from the water.

A small waterfall (potential **obstruction**) was present at NX 24988 67168. It is caused by bedrock and has a drop of ~2 m over a length of 10 m – it was not considered a problem for fish to access over it. Bedrock caused a further **flow constriction** 20 m upstream at NX 24984 67192 but again it was not considered to be a problem for fish access.

Figure 10: Riffle between deeper glide

Upstream of these falls the gradient falls and for 1,600 m, until NX 23973 68598, the river is a series of slower deeper glide sections separated by short sections of run / riffle where gradient exists (Figure 10 and 11). Wetted widths vary, mostly between 5 – 8 m wide. Typically these riffles are cobble and boulders and offer some potential **parr habitat**. Flows in the deeper areas is glide and some larger substrates are present so even the glide areas would be expected to support some salmon and trout parr. Habitat is not particularly suitable for Freshwater Pearl mussels but eels and juvenile lamprey could be present in the pockets of suitable habitat. Some better habitat is present around the outflow from the Loch Strand Burn for ~250 m where **juvenile habitat** is present and some **spawning substrates** are present. All of this section has conifer planation on both banks which are set back a reasonable distance.

Figure 11: Section of deeper glide

Within this section at NX 24366 67827 there is a small bed rock flow constrictor with a 3 m wide notch which drops 1 m over a length of approximately 8 m. There are no concerns regarding fish access here.

Instream habitats improve significantly from NX 23973 68598. Nearly 400 m of good **juvenile habitat** was present which had some patches of **spawning substrate** present too. A waterfall (Figure 12) was present as NX 23988 69151. The falls drop ~1.5 m but are a series of small steps which fish will be able to easily access over.

Figure 12: Bed rock falls

Upstream of the falls there is a length of 240 m, by 6 m wide, of good **juvenile habitat** (Figure 13). The river then widens to 8 – 10 m, is dominated by boulders and is a mix of small sections of glide and riffles. This gives ~ 125 m of good **parr habitat** up until NX 23014 69256. Habitat here is suitable to potentially support a Freshwater Pearl mussel population.

Figure 13: Good juvenile habitat

The river then changes and becomes deep and slow **glide** for just over 1,000 m (Figure 14) which was estimated at 10 – 15 m wide. This glide will not support any of the main fish species of interest. Within this length there are two short sections where the river narrows, water shallows and offers parr habitat at NX 22856 69343 (20 m long) and NX 23014 69256 (50m long) (Figure 15).

Figure 14: Deep slow glide

Figure 15: Short section of parr habitat

The survey terminated NX 22790 69272 where the Tarf Water left the development area.

3.1.4 Un-named tributary

The survey started at NX 23947 68401 where this watercourse outflows into the Tarf Water. The survey was undertaken in an upstream direction.

The lower 40 m of the burn flows through grassland and has been dredged and straightened in the past (Figure 16). It is ~0.5 m deep and averages 0.4 m wide here.

Figure 16: Lower section of burn before it enters the conifer plantation

The burn then enters a mature block of conifers which has been planted right up to the edge of the water. The conifer trees totally over shade the water and no riparian vegetation is present. The wetted width continues to be narrow and ranges between 0.2 m – 0.4 m wide. Instream habitats are poor and mostly peat for the first 30 m within the plantation, up to NX 23869 68330 (Figure 17).

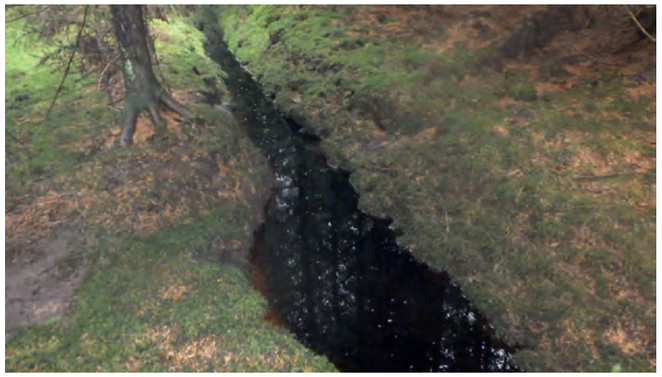

Figure 17: Poor habitat in the plantation (looking upstream)

The gradient then increases and the substrate becomes mostly a mix of gravel and pebbles for nearly 100 m. Flow speed increases and becomes run with some riffle. Some **spawning substrates** are present for trout and **fry habitat** is present. From NX 23816 68227 the burn further improves with some cobble and boulders present (Figure 18) and can be described as **juvenile habitat** for 50 m. As the burn approaches the road bridge it reduces in habitat quality again with more peat in the substrate and reduces in size (Figure 19).

The survey was terminated at the road bridge as the burn became too small and was unsuitable to support fish.

This section only contains suitable habitat to potentially support a trout fry population in the middle 150 m surveyed although the habitat quality is relatively low. The habitat present is not suitable for European eels, juvenile lamprey or Freshwater Pearl mussels.

Figure 18: Fry habitat present (looking upstream)

Figure 19: Poor habitat as the burn approaches the road bridge (looking upstream)

3.1.5 Un-named tributary draining Brough Hill

The survey started at NX 24538 67359 where this watercourse outflows into the Tarf Water. The survey was undertaken in an upstream direction. Conifers border the entire length of the burn.

The lower burn has been dredged and straightened in the past (Figure 20). Here the burn is up to 1 m wide and contains a substrate mix of peat and cobbles. **Parr habitat** was present here. The burn is heavily shaded as the bankside conifers are very close. After 70 m (NX 24466 67343) the gradient of the burn increases and the substrate changes to a gravel, pebble and cobble mix. The burn becomes **juvenile habitat** for about 250 m with some suitable **fry habitat** and **spawning substrate** (Figure 21).

The burn then splits into three at NX 24200 67437. Two of these tributaries are just peat drains but left hand one was considered worth surveying as it contained flows and habitat suitable to support fish.

Figure 20: Lower burn (looking upstream)

Figure 21: Good instream habitat (looking upstream)

Figure 22: Fry habitat (looking upstream)

The burn widens and shallows but still contains suitable substrates and flows for **fry habitat** (Figure 22). At this point the burn is totally over-shaded by conifers planted on the banksides. The burn is up to 1.5 m wide. This habitat types continues up to the road bridge which is ~250 m from where the burn split.

Figure 23: Heavily over-shaded burn (looking upstream)

The culvert at the road crossing, NX 23973 67414, was considered an unpassable **obstruction** to migratory fish as it is raised and of narrow diameter. Upstream of the road the burn reduces in size but continues to provide **fry habitat** (Figure 23). The burn here has been clearly dredged in the past but contains suitable substrate to potentially support a trout population. The surrounding conifers continue to heavily over-shade the burn.

A waterfall was present at NX 23935 67272. It was ~1.3 m high and would be an **obstruction** to salmonids unless flows were very high.

Figure 24: End of survey (looking upstream)

The survey was terminated at NX 23855 66912 as the burn had become too small to support fish populations as width was under 0.5 m wide (Figure 24). The bed of the burn was also becoming peat. This was ~500 m upstream of the road bridge.

This burn did not contain habitats suitable for Freshwater Pearl mussels.

3.1.6 Three un-named burns draining area around Low Eldrig

A total of three un-named burns were surveyed close together which collectively drain the area around Low Eldrig. All burns were surveyed in an upstream direction.

The most downstream of the burns was surveyed from the road bridge at NX 25135 66851 which is located just upstream of where it flows into the Tarf. The culvert was easily passable for fish. The burn then flows through a narrow straight channel which had been dredged in the past (Figure 25). The dredged section is ~70 m long and provides **juvenile habitat** although substrate size is small. This channel has been used to divert the burn away from its natural course so that the lower natural 700 m of the burn channel is now dry.

Figure 25: Lower burn which had been dredged (looking upstream)

From NX 25216 66916 the burn enters into a conifer plantation. Here the burn widens and becomes very shallow. With a very small substrate present it was considered only **fry**

habitat and **spawning substrate** was present (Figure 26). The width ranged between 1 – 2 m.

Figure 27: Fry habitat (looking upstream)

From NX 25358 67156 the burn became heavily over-shaded by bankside conifers so no riparian vegetation was present. Gradient increased from here as did the size of substrate giving a 60 m length of **parr habitat** (Figure 28). The burn then left the plantation and a nice section of juvenile habitat was present up to the road bridge at NX 25365 67245.

Figure 28: Parr habitat (looking upstream)

The culvert under the road bridge was considered problematic (likely **obstruction**) to migratory fish as it is raised and narrow.

Upstream of the road bridge the substrate in the burn was larger and the burn continued to provide suitable **juvenile habitat** for ~380 m until the survey was stopped at NX 25560 67480 at the boundary of the development area. Upstream of the road the conifers are planted away from the edge of the burn so a grass / rushes riparian zone is present. This burn does not offer potential habitat for Freshwater Pearl mussels.

Figure 29: Upstream of the road bridge (looking upstream)

The second burn was surveyed from NX 25019 67242 close to where it discharges into the Tarf Water. The lower 25 m of the burn is open but then it enters a conifer plantation and is totally over-shaded (Figure 30). While the burn is only 0.5 m wide before it enters the trees once into the planation it becomes shallow with a width up to 1 m. The gradient is limited, substrates are small and it appears to have been dredged in the past. Habitat present is **fry habitat** for the lower 150 m. The burn then splits into two at NX 25046 67352 and each branch becomes too small to support fish so the survey was terminated here. It is unlikely that the habitats present would support any fish apart from possibly a low trout fry population. The burn does not contain habitat suitable for Freshwater Pearl mussels.

Figure 30: Heavily over-shaded by conifer plantation

The third burn surveyed had a short open section up from the Tarf before it entered conifer plantation at NX 24895 67235. At the edge of the forest there was a built up of debris which would be an obstruction for any salmonids trying to ascend the burn.

Figure 31: Heavily over-shaded (looking upstream)

The burn is heavily over-shaded in the plantation and has no riparian vegetation (Figure 31). The burn has been dredged before and contains a mix of substrates – mostly gravel in the lower reaches and then more cobble as the gradient increases. The burn is up to 1 m wide in the plantation and **fry habitat** to start with and then some **juvenile habitat** where the gradient increases. A lot of riffle is present.

Figure 32: A lot of windblown conifers lie over the burn

As the burn comes close to the edge of the plantation there are many windblown trees lying over the burn until the burn leaves the existing plantation at NX 24912 67498. A length of ~300 m of the burn flows through the mature conifer plantation. There is a possibility that trout, eels and juvenile lamprey could be present.

The burn then enters an open section where the surrounding conifers have been felled and replanting is well away from the burn (Figure 33). The burn here is 0.6 m – 0.8 m wide and has thick riparian vegetation dominated by rushes. Suitable substrates are present so this section was considered as **fry habitat** due to the small size of the burn. The survey was terminated at NX 24932 67647 as the burn had become too small. This watercourse contains no habitat suitable for Freshwater Pearl mussels.

Figure 33: Burn opens up

3.1.7 Un-named tributary draining Black and White Hills

The survey started at NX 24921 65566 where the burn enters the development area. The survey was undertaken in an upstream direction.

The burn had a steep gradient resulting in a series of small pools (Figure 34). Bed rock and boulders are the main substrate here and the burn was 1.5 m wide. The habitat here was **parr habitat**.

Figure 34: Good parr habitat in the lower section surveyed

The burn then levels out and after 70 m (of **juvenile habitat**) there is a road bridge at NX 24784 65536. This pipe bridge has been very badly designed and is acting as an **obstruction** to migratory fish (Figure 35). The thin diameter of the pipes, raised pipes and blockages in the pipes all combine to make it very hard for any fish migration. A few deciduous bankside trees are present downstream of the bridge but none are present upstream of the bridge.

Figure 35: Poorly designed road bridge

The bridge is holding back water flow upstream for up to 30 m before becoming good **juvenile habitat**. Width is 1.3 m and there is a good mix of substrates and flows. As the burn levels out the quality of the habitat reduces as it enters where the conifer plantation had

until recently heavily shaded the burn (Figure 36). Approximately 300 m upstream of the bridge at NX 24440 65224, it was felt that instream habitats were no longer suitable for fish due to the silt base (Figure 37).

The burn would be expected to support eels, juvenile salmon and trout and possibly juvenile lamprey. The lower burn could also support Freshwater Pearl mussels.

Figure 36: Surrounding plantation has been recently felled

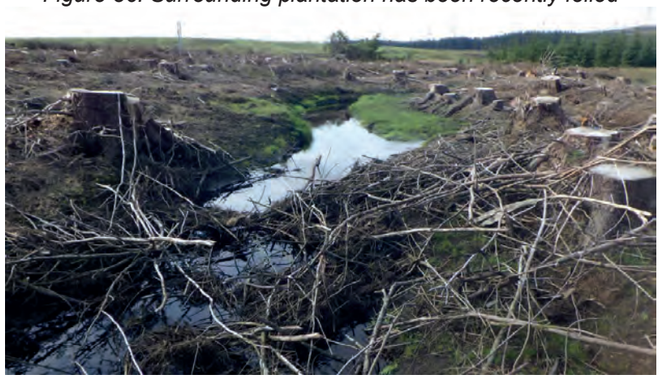

Figure 37: The burn became very slow flowing with a peat base

3.1.8 Drumpail Burn (and tributary)

The survey started at NX 22471 65364 where the Drumpail Burn enters the development area. The survey was undertaken in an upstream direction.

The burn first flowed round the edge of the plantation and is roughly 1.3 m wide and provides good **juvenile habitat**. The substrate is a mix of pebbles and cobbles and has a mix of run and glide flow (Figure 38).

Figure 38: Good juvenile habitat before it enters the conifer plantation

The burn quickly enters the conifer plantation where although the trees are not planted right to the edge off the burn they do shade it heavily (Figure 40). Good instream habitats are present (Figure 39) and the entire 350 m which was surveyed until the burn left the trees was considered suitable **juvenile habitat**. The burn width is all ~1 m wide. The burn would be expected to support eels, juvenile trout and possibly juvenile lamprey. The burn could also support Freshwater Pearl mussels.

The survey terminated at NX 22470 65710 where the burn left the development area (Figure 41).

Figure 39: Good substrate to support fish

Figure 40: Heavily shaded section of the burn in the forest

Figure 41: Top of section surveyed

The tributary of the Drumpail Burn was not surveyed as it was considered too small to support a fish population.

4 SUMMARY OF FINDINGS AND FURTHER SURVEY RECOMMENDATIONS

A total of 10 watercourses were surveyed during this survey. The main findings are listed below:

- Purgatory Burn: this watercourse contains a range of good quality instream habitats. This burn could support populations of salmonids, eels, juvenile lamprey and Freshwater Pearl mussels.

- Tributary draining Moss of Horse Hill: this watercourse did not contain suitable habitats for fish or Freshwater Pearl mussels.

- Tarf Water: this watercourse contains a range of good quality instream habitats. This river could support populations of salmonids, eels, juvenile lamprey and Freshwater Pearl mussels. The Tarf is designated as part of the River Bladnoch SAC for Atlantic salmon.

- Un-named tributary: this watercourse contains some limited areas of suitable habitat for trout only.

- Un-named tributary draining Brough Hill: this watercourse contains some areas of suitable habitat for trout only.

- Three burns draining from Low Eldrig: two of these burns were considered large enough to support populations of salmonids, eels and juvenile lamprey. One of the burns was considered unsuitable for fish or Freshwater Pearl mussels and this no further surveys were recommended.

- Un-named tributary draining Black and White Hills: this watercourse contains a range of good quality instream habitats. This burn could support populations of salmonids, eels, juvenile lamprey and Freshwater Pearl mussels.

- Drumpail Burn: this watercourse contains a range of good quality instream habitats. This burn could support populations of salmonids, eels, juvenile lamprey and Freshwater Pearl mussels. The Drumpail Burn is designated as part of the River Bladnoch SAC for Atlantic salmon.

ANNEX 6 – Deer Observations

Annex 6 – Deer Observations

Photograph	Reference	Description
	D1	Roe
	D2	Roe
	D3	Roe

Technical Appendix 7.3: Outline Habitat Management Plan

Artfield Forest Wind Farm

Technical Appendix 7.3: Outline Habitat Management Plan

avianecology

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1 INTRODUCTION

1.1.1 This Technical Appendix has been prepared to accompany Chapter 7: 'Ecology' of the Artfield Forest Wind Farm (hereafter the Proposed Development) Environmental Impact Assessment Report (EIA) Report.

1.1.2 It presents outline habitat management principles that will be finalised through consultation as the 'Artfield Forest Wind Farm Habitat Management Plan', hereafter referred to as the HMP, following receipt of consent and on completion of detailed site investigation works.

1.1.3 The final HMP will be agreed with relevant stakeholders (Section 1.6) prior to the commencement of construction works via a suitably worded planning condition. Once finalised, the HMP will remain in place as agreed, subject to reviews for effectiveness, for the operational lifetime of the Proposed Development and in accordance with the planning condition.

1.1.4 The (now expired) consent for Gass Wind Farm (Dumfries and Galloway Council Planning Reference 14/P/1/0674)[1] included an Outline Habitat Management Plan as Appendix 7F of the Environmental Statement ('the Gass Wind Farm ES'), which will be referred to, where relevant.

1.1.5 The HMP presents outline measures to enhance habitats within the Site which will benefit the following, but limited to: habitats, fisheries, terrestrial mammals, birds and invertebrates.

1.1.6 This report should be read with reference to **Figure 7.3.1**: Habitat Management Plan.

1.2 Aims and Objectives

1.2.1 The HMP includes one Key Aim:

- **Aim 1: Create new habitats to aid biodiversity on site.**

  The objectives to meet this aim will comprise:

  1 Increase the number and diversity of species;

  2 Raise the water table in areas that have the potential to support blanket bog and wet heath habitats;

  3 Maintain targeted HMP areas free of tree encroachment; and,

  4 Explore the potential for native woodland planting along the Tarf Water Corridor.

1.2.2 The effectiveness of management prescriptions and habitat improvements in achieving the aims and objectives of the HMP will be monitored, with the results reported, in accordance with timings and protocols to be agreed through a SGRC.

1.3 Site Location

1.3.1 The Site is located approximately 8km northwest of Kirkcowan and 15km west of Newton Stewart, Dumfries and Galloway, Scotland, and is dominated by commercially managed plantation forestry. The Site also supports areas of sheep grazed pasture in the south east and recently felled and replanted woodland together with compartments of mixed plantation woodland.

1.3.2 The eastern extent of the Site holds previous planning consent for the Gass Wind Farm, comprising nine wind turbines and associated infrastructure (as detailed in the Gass Wind Farm ES).

1.4 Current Site Conditions

1.4.1 Full Site habitat descriptions are provided within Technical Appendix 7.1: Habitats and Vegetation and are not repeated here, but a summary is provided below. Baseline habitats are presented on **Figure 7.2** and **Figure 7.3** included in **Volume 3a**.

1.4.2 The Site predominantly consists of Sitka spruce *Picea sitchensis* plantation woodland, of varying maturity and height, with areas of clear-fell and recently planted growth. Small areas of broadleaved planting and mixed plantation woodland are also present. A network of forestry tracks intersect the Site. Full details on forestry are provided in Chapter 14: Forestry (EIAR Volume 2) and Figures 14.1 to 14.6 (EIAR Volume 3a).

1.4.3 The Site lies within the Tarf Water Catchment and is intersected by numerous watercourses and drainage ditches that feed into Tarf Water. The Mulniegarroch Burn / Purgatory Burn form part of the Sites north western boundary.

1.4.4 The Tarf Water forms part of the River Bladnoch Special Area of Conservation (SAC). The SAC is notified for supporting Atlantic salmon *Salmo salar*, but is currently classified as in 'Unfavourable – Recovering' condition[2]. The upper reaches of the Bladnoch are negatively affected by acidification due to afforestation and peatland degradation[3].

1.4.5 Forest rides generally consist of narrow linear tracts of marshy grassland or wet heath vegetation; often with mosaics of purple moor grass *Molinia caaerulea* frequent rushes and a range of sphagnum species. One ride in the north west showed typical blanket bog vegetation on deep peat, with bog forming sphagnums and common cottongrass *Cardamine pratensis.* Vegetation present within forest rides and along riparian corridors is indicative of underlying peatland habitats which have been overplanted with commercial forest.

1.4.6 Open areas of sheep grazed pasture are located in the south east of the Site, within Gass Farm. Open fields consist of semi-improved grassland and also an area of mosaic of acid grassland, wet heath and marshy grassland.

1.4.7 The Site supports varying depths of peat, as described in Technical Appendix 2.3: Peat Survey Results (EIAR Volume 4).

1.4.8 **Table 1.1** details key vegetation communities and coverage, along with estimated permanent habitat loss from the Proposed Development.

Table 1.1: Habitat Coverage within the Site.

Habitat/Community	Baseline Coverage (ha)	Permanent Habitat Loss (ha)
Broadleaved semi-natural woodland (A1.1.1)	1.61	0
Broadleaved plantation woodland (A1.1.2)	4.11	0

[1] Sgurr Energy 2014 14_P_1_0674 Environmental Statement Vol. 2 Appendix 7A phase 1 Habitat and NVC Survey, and Drawing no. 162183-003 Figure 7.5 NVC Results.

[2] https://sitelink.nature.scot/site/8355

[3] https://www.gallowayfisheriestrust.org/bladnoch-restoration-feasibility-study.php

Habitat/Community	Baseline Coverage (ha)	Permanent Habitat Loss (ha)
Coniferous plantation (A1.2.2)	626.5	43.55
Recently felled coniferous woodland (A4.2)	17.88	0
Sphagnum bog: blanket bog (E1.6.1)	4.35	0.15ha
Fen: valley mire (E3.1)	4.16	0
Marshy grassland (B5)	31.68	0.36
Semi-improved neutral grassland (B2.2)	40.08	0.1ha
Wet dwarf shrub heath (D2)	3.6	0
Wet heath/acid grassland mosaic (D6)	25.66	0.4ha

1.5 Implementation

1.5.1 The HMP shall be implemented for the operational period of the Proposed Development, with associated works commencing prior to the commissioning of the wind farm, where necessary, as detailed herein.

1.5.2 Responsibility of the finalisation and implementation of the HMP will be borne by the "Owner(s)" of the Artfield Forest Wind Farm, as consented, and/or any subsequent "Owner(s)".

1.5.3 All works associated with the implementation of the HMP will be undertaken by the "Owner(s)" of the Artfield Forest Wind Farm, as consented, and/or any subsequent "Owner(s)", or by their appointed agents.

1.5.4 The "Owner(s)" of the Artfield Forest Wind Farm shall be responsible for the cost of implementing the HMP; including the cost of carrying out any monitoring, except where otherwise specified or agreed with the Steering Group and Review Committee.

1.6 Steering Group and Review Committee

1.6.1 A Steering Group and Review Committee (SGRC) will be established prior to the finalisation of the HMP to meet or correspond regularly to discuss the effectiveness of prescribed management measures and monitoring techniques, monitoring results and recommendations for any amendments to the HMP.

1.6.2 For the first five years of implementation, the steering group will meet or correspond at least annually.

1.6.3 The following bodies shall be invited to form part of the steering group and review committee:

- The Owners of the Proposed Development;
- The Landowners (or their representatives);
- NatureScot;
- SEPA;
- Scottish Forestry;
- Dumfries and Galloway Council; and,
- Galloway Fisheries Trust.

1.6.4 The "Owner(s)" and "Landowner(s)" of the Artfield Forest Wind Farm, together with an independent ecologist appointed by the Owner(s) (at their cost), shall also form part of the steering group and review panel.

2 AIMS AND OBJECTIVES

2.1 Approach to HMP

2.1.1 The Proposed Development infrastructure layout has been designed to minimise potentially significant effects on sensitive ecological features and peat reserves. A description of the Proposed Development is given in Chapter 2: Development Description (EIAR Volume 2).

2.1.2 Opportunities for restoration and enhancement peatland and heath habitats has been identified to enhance the biodiversity, flood storage and carbon sequestration/storage of the Site.

2.1.3 Chapter 14: Forestry, Figure 14.4 (EIAR Volume 3a) presents the proposed clear-felling activities to facilitate the Proposed Development. Forestry removal measures will comprise a combination of key-holing and compartment clear-felling in the north and west.

2.1.4 Where clear-felling is proposed, replacement tree planting will be undertaken but will maintain a 97m unplanted buffer around each turbine (embedded mitigation to prevent potentially significant effects on bats, See Chapter 7: Ecology (EIAR Volume 2)). This HMP will therefore focus initially on unplanted clear-fell areas and riparian corridors.

2.1.5 It is proposed that the aims, objectives and management prescriptions outlined herein will be further refined and prescribed through detailed site investigation work and further consultation with the SGRC.

2.1.6 No ditch blocking will be undertaken on watercourses identified with the potential to support fish, eel or freshwater pearl mussel species (Technical Appendix 7.2: Protected Species), or prevent obstruction to fish movement.

2.1.7 Where management prescriptions (dam creation) or other operations may result in impacts on protected species or habitats, protective measures will be implemented as follows:

- Habitat Specific Protection Plans (HSPPs) detailing good practice measures for construction works within wet dwarf shrub heath and blanket bog habitats. HSPPs will detail measures required to manage construction works within these sensitive habitats and include habitat restoration measures; and,
- Species Protection Plans (SPPs) for Protected Species so as to ensure all works are completed in accordance with relevant legislative requirements. Where necessary, derogation licences will be obtained from NatureScot.

2.2 Objective 1: Increase the Number and Diversity of Species

2.2.1 The aim will be to encourage the creation of more native habitats, i.e. specifically heath and/or moorland flora and avoid encroachment of tree/scrub to contribute to increasing the number and diversity of species present within the Site.

Prescriptions

2.2.2 The prescriptions required to achieve Objective 1 are presented in **Table 2.1**.

Table 2.1: Prescriptions of Objective 1.

Objective	Management Prescription
Improve the number and diversity of species	The encouragement of improved diversity of vegetation species will be influenced by Objectives 2 and 3. Within key-hole areas the primary management prescription will be maintaining the areas tree/scrub free and controlling deer grazing suitable for the improved diversity of heath habitats. Targeted re-wetting of suitable areas will create conditions for improved diversity of blanket bog and wet heath habitats.

2.3 Objective 2: Raise the Water Table in Areas that have the Potential to Support Blanket Bog and Wet Heath Habitats

2.3.1 Bog and wet heath habitats within the Site have been historically impacted through the planting of commercial forestry, installation of forestry tracks and artificial ditches, which affect the natural hydrology of the Site. The extent of existing watercourses is presented on **Figure 7.3.1**.

2.3.2 The principal mechanism proposed for improving and restoring bog and wet heath habitats on the Site is raising of the water level within habitats, supported by appropriate management and monitoring. It is therefore proposed to implement a bog and wet heath hydrological improvement plan ('re-wetting'), aimed at retaining water within targeted sections of the HMP area by directing it away from the ditch line and back into water dependent habitats (i.e. blanket bog and wet heath).

2.3.3 The effectiveness of the re-wetting regime will be monitored through the implementation of a hydrological monitoring plan. This will seek to regularly monitor hydrological and biological responses within priority areas for re-wetting through the installation of water-table monitors (such as dipwells) to record water table levels and botanical sampling plots to assess responsive vegetation changes.

2.3.4 It is recognised that commercial plantation forestry severely impacts the availability of ground water and therefore, any drain blocking will be reviewed upon forestry removal, when the baseline water levels can be re-established.

2.3.5 Proposed locations for re-wetting will be subject to site investigation surveys and assessment by suitably qualified hydrologists and ecologists and liaison with the SGRC.

Prescriptions

2.3.6 The prescriptions required to achieve Objective 2 are presented in **Table 2.2**.

2.3.7 The objective will be to improve the quality and extent of blanket bog and wet heath habitats by removing self-seeded commercial species trees and maintaining water table depth within a favourable range for the establishment of peatland vegetation e.g. 25cm from the surface for *Sphagnum* re-establishment (as per Price and Whitehead, 2001[4]).

[4] Price, J.S. and Whitehead, G. (2001) Developing hydrological thresholds for Sphagnum recolonization on an abandoned cutover bog. *Wetlands*, **21** (1), pp 32-40.

2.3.8 This will be achieved through the maintenance of unplanted forestry areas and damming of ditches, 'ground-smoothing' (Short and Robson, 2016)[5], where required. This may include digging out stumps, flipping and burying them to smooth out the surface.

2.3.9 The precise locations of re-wetting areas will be determined through further Site investigations and subject to agreement with SGRC.

2.3.10 Should any backfilling of ditches be required, works will utilise peat extracted during construction of the Proposed Development. Further site investigations will determine the suitability and effectiveness of ditch backfilling. Existing drains can also be re-profiled by the construction of 'wave dams', where appropriate. In summary, the proposed approach will comprise:

- a small trial of ditch-backfilling to fine-tune the backfilling methodology;
- survey of full peat re-wetting areas to inform a detailed plan of operations, including peat transport routes and volume requirements;
- identification of suitable and unsuitable peat within the excavation areas; and,
- backfilling and construction of peat dams as planned following strict conditions and monitoring by the ECoW, concurrently with the construction operations.

2.3.11 Where backfilling is not considered appropriate (e.g. due to steepness), dams (in-situ excavated peat dams or other construction type) may be installed as an alternative or used in combination with ditch backfilling. All operations will comply with the best practice and mitigation measures relating to hydrology as described in Chapter 9 of the EIA Report (Volume 2) and implemented in the Construction Environmental Management Plan (CEMP) (see EIAR Volume 4: Technical Appendix 2.1) and final Peat Management Plan (PMP) (for draft PMP, please see EIAR Volume 4: Technical Appendix 2.4).

Table 2.2: Objectives and Management Prescriptions of Objective 2.

Objective	Management Prescription
Restore blanket bog and wet heath habitats	Following the removal of forestry, investigation works will be undertaken to identify the requirement for drain blocking to increase the water level, avoiding potential impacts on surrounding forestry.
	Install dams, where required, using existing site habitats (e.g. 'wave dams' or peat to be extracted from construction activities). Dams may be required in order to increase water levels to conditions suitable for Sphagnum species.
	Manage deer and livestock densities to prevent over and under grazing.

2.4 Objective 3: Maintain Targeted HMP Areas Free of Tree Encroachment

2.4.1 Where areas have been selected for Objectives 1 and 2, these will be managed to minimise tree and scrub encroachment. This will be undertaken alongside the monitoring programme (Section 3), with any identified encroachment removed in the same year as survey, if possible.

[5] Short and Robson (2016) An alternative approach to Landscape scale peatland restoration. Scottish Power Renewables. CIEEM In Practice. No.93. Winchester.

2.5 Objective 4: Explore the potential for native woodland planting along the Tarf Water Corridor

2.5.1 Native woodland planting and restoration will be explored along the Tarf Water Corridor, if appropriate locations are identified through consultation with the SGRC and subject to site investigation works pre-construction.

2.5.2 The proposed locations will be been determined using the following criteria:

- Locations will support suitable soil structure (avoiding peatland habitats); and,
- Avoiding areas which have been identified as suitable for re-wetting (as stated in Objective 2).

2.5.3 Further site investigations will be undertaken prior to planting and agreed with the SGRC and in accordance with industry good practice and guidelines applicable prior to planting.

2.5.4 The final species list and planting densities will be determined following further site investigations.

2.5.5 Subsequent follow-up establishment operations will be carried out to ensure woodland planting is established satisfactorily and in accordance with current industry good practice guidelines.

2.6 Other Measures

2.6.1 Other measures will be discussed with the SGRC to improve Site habitats for fisheries, such as the clearance of fallen Sitka from watercourses, where required.

2.6.2 As detailed within Technical Appendix 9.2: Watercourse Crossing Assessment (EIAR Volume 4), existing culverts within the Site will be upgraded, where required, to ensure hydraulic conveyance and allow the free flowing passage of mammals and aquatic ecology, therefore access may be improved across the Site for fisheries.

2.7 Restricted Operations within HMP Areas

2.7.1 The following operations will be prohibited within the HMP areas:

- Clearing of existing ditches and watercourses;
- Application of any insecticides, fungicides or molluscicides;
- Application of lime or any other substance to alter the soil acidity;
- Cutting or topping vegetation except to control injurious weed species;
- Burning of vegetation or other materials;
- Use of roll or chain-harrow;
- Carrying out any earth moving activities;
- Use for off-road vehicles;
- Construction of tracks, roads, yards, hard standing or other structures; and,
- Storage of materials of machinery.

3 MONITORING AND REVIEW

3.1.1 The final HMP will be agreed with the SGRC and be updated to reflect site investigation works prior to construction.

3.1.2 Monitoring prescriptions to achieve the Key Aims are presented in **Table 3.1** and will be agreed through consultation with the SGRC.

3.1.3 Provisionally, monitoring will be undertaken in years 3, 5, 10 and 15 during the operational life of the Proposed Development. The frequency of monitoring thereafter will be agreed with NatureScot and the SGRC.

3.1.4 The monitoring plan shall be agreed through the SGRC and will seek to collect consistent and standard environmental information to enable monitoring comparisons between sample years and to allow comparisons between different sites and scientific literature as required. Monitoring will consist of the following actions:

- Water Levels: these will be monitored annually during the construction phase and for the following five years, then every five years thereafter by the use of dipwells. Measurements will be undertaken in February, May, August and November of each monitoring year.
- Vegetation Monitoring: a habitat condition assessment will be undertaken at Year 1 to establish baseline habitats and repeated in each monitoring year. Photograph reference locations will be used to monitor habitats and surveys will only be undertaken during the summer months.
- Peat Depth: peat probing will be undertaken at the same location of dipwells, undertaken in tandem with vegetation monitoring.
- Self-seeded woodland: identification of self-seeded woodland and scrub will be identified and removed or managed, as required.
- Native woodland planting: successful establishment.

Table 3.1: Monitoring Prescriptions and Target Outcomes.

Monitoring Prescription	Target Outcome
Water Levels	In targeted re-wetting areas (Objective 2) water table to be just below the sphagnum bog surface, with vegetation communities representative of blanket bog and wet heath communities detailed in **Table 1.1**.
Vegetation Monitoring. Objective 1**:** Vegetation communities representative of heath communities and increased diversity over monitoring period. Objective 2: Key indicator species for the assessment of prevalence of blanket bog and wet heath communities, notably Sphagnum and *Molinia* abundance are: • *Sphagnum papillosum* and *S.magellanicum* in blanket bog habitats.	**Within Objective 1 targeted areas:** The following indicators should be monitored: • Visible trampling or uprooting from large grazing animals should be absent. • Bare peat should comprise <1% of basal cover. • *Eriphorum* spp. and *Calluna vulgaris* should be present. • *Molinia* grassland coverage to be <5%. • Rush coverage to be <5%. • Bracken coverage to be <5%.
	Within Objective 2 targeted areas:

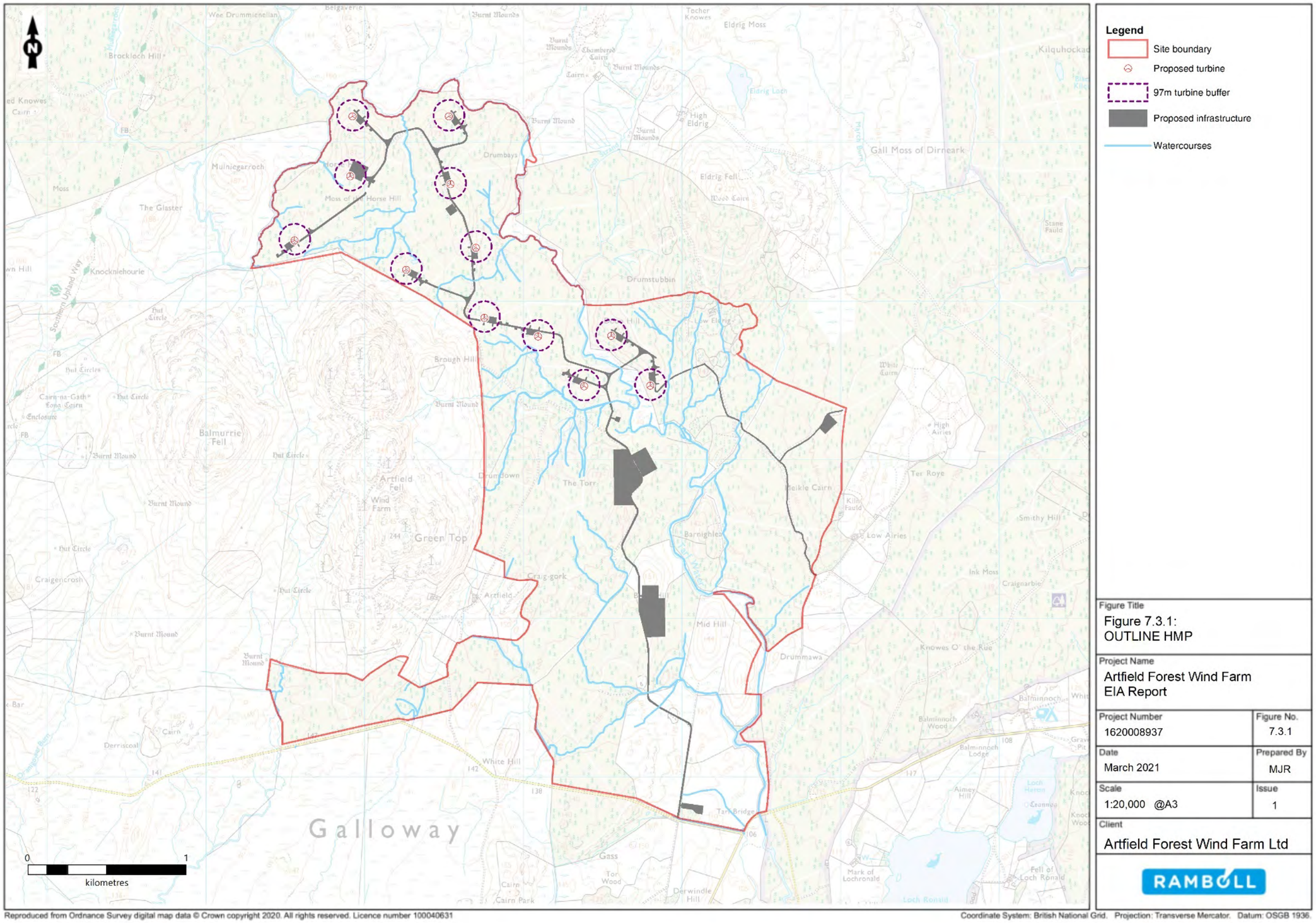
Monitoring Prescription	Target Outcome
• Crowberry and billberry in wet heath habitats. A minimum of 25 permanent quadrat sample locations will be selected within HMP areas. Each quadrat will identify: • Presence/absence of target species. • Height and abundance of *Calluna vulgaris.* Depth of water table via dipwell monitoring.	Vegetation communities representative of blanket bog and wet heath communities detailed in **Table 1.1** and support the following: • *Sphagnum papillosum* and *S.magellanicum* should be present. • *Sphagnum* spp. should account for at least 30% of basal cover. • Visible trampling or uprooting from large grazing animals should be absent. • Bare peat should comprise <1% of basal cover. • *Eriphorum* spp. and *Calluna vulgaris* should be present but a combined cover of <75%. • *Molinia* grassland coverage to be <5%. • Bracken coverage to be <5%. • Rush coverage to be <5%. Deer management and livestock densities will be reviewed, as necessary to reduce or increase grazing, as required.
Self-seeded Woodland	Identify extent of self-seeded trees followed by removal as necessary. No tree growth and minimise scrub growth within targeted HMP areas.
Native Woodland Planting	Where undertaken, the success of planting should be monitored for the first 5 years annually. Any dying/dead specimens will be replaced in the next planting season.

3.2 Reporting and Review

3.2.1 The SGRC will meet or correspond at least annually. Reports will be provided in Years 3, 5, 10 and 15 of the operational life of the Proposed Development. Frequency of monitoring and reporting thereafter will be agreed with the SGRC and relevant consultees.

3.2.2 The HMP is intended to remain a live document which will be updated and amended, as necessary on result of site investigation works and monitoring.

Figure 7.3.1: Outline HMP



Technical Appendix 7.4: Information to Inform Habitats Regulations Appraisal

Artfield Forest Wind Farm

Technical Appendix 7.4:
Information to Inform Habitats Regulations Appraisal

avianecology

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1 INTRODUCTION

1.1.1 This Technical Appendix has been prepared to accompany Chapter 7: Ecology of the Artfield Forest Wind Farm (hereafter the Proposed Development) Environmental Impact Assessment (EIA) Report.

1.1.2 This report has been prepared to provide the Competent Authority (CA) with the necessary ecological information to inform an appraisal regarding the potential for Adverse Effects on Site Integrity (AESI) or Likely Significant Effects (LSE) of the Proposed Development on the qualifying interests of European Designated Sites[1] in accordance with the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended for Scotland), hereafter the 'Habitat Regulations'[2].

1.1.3 The Habitats Regulations have been recently updated and remain in force under the Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations 2019.

1.1.4 The European Designated Sites in this instance comprise the River Bladnoch Special Area of Conservation (SAC), which the component Tarf Water intersects the Proposed Development.

1.1.5 Kirkcowan Flow SAC is located c. 1.2 km north of the Site and Kilhern Moss SAC is located 4.2 km south west of the Proposed Development. These two sites are located within different catchments to the Site and therefore no pathway for effects is identified. No other European designated sites with potential connectivity to the Proposed Development have been identified.

1.1.6 This Report therefore provides information in relation to the River Bladnoch SAC only, in relation to the construction, operation and decommissioning of the Proposed Development, alone or in combination with other projects or plans.

1.1.7 The need for a Habitats Regulations Appraisal (HRA) to be undertaken by a CA was identified in NatureScot's EIA Scoping response (See Table 7.1 of Chapter 7 in Volume 2).

1.1.8 It should be read with reference to the following figures, presented in **Volume 3a** of the EIA Report:

- **Figure 7.1:** Statutory Designated Sites for Nature Conservation;
- **Figure 7.9**: Electrofishing Records; and,
- **Figure 7.10**: Fish Habitat Survey Sample Points and Results.

1.1.9 This report takes account of the best available knowledge, all applicable legislation, guidance and relevant case law. In particular, the report notes the European Court of Justice ruling (Case C323/17), typically referred to as 'People over Wind' and has therefore excluded consideration of the Construction Environment Management Plan (CEMP), included as Appendix 2.1, or any other mitigation when assessing the potential for LSEs (for Stage 1: Screening by the CA). Where a LSE has been identified, the potential for adverse effects on the integrity of a European site or its qualifying interest is further considered in association with mitigation measures to inform the CA, should it wish to proceed to Stage 2: Appropriate Assessment.

[1] European Sites are interpreted under the Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations 2019, The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 and The Conservation of Habitats and Species Regulations 2017 4 (as amended) in Scotland which provides for the protection of sites of UK-wide importance (including SACs and SPAs) identified under the EC Directive on the Conservation of Natural Habitats and Wild Fauna and Flora (92/43/EEC) and the EC Directive on the Conservation of Wild Birds (2009/147/EC) and defined under the 1994 regulations. For convenience, sites of wetland importance, known as Ramsar sites identified under the Ramsar Convention 1979 as included in the definition of 'European Sites' for the purposes of assessment.

[2] The Conservation (Natural Habitats, &c.) Regulations 1994.

1.2 Legislative Background

1.2.1 The Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (The Habitats Directive) and Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds (codified version of Directive 79/409/EEC as amended) (The Birds Directive), together form the overarching pieces of nature conservation legislation in force within Scotland.

1.2.2 Under these Directives, the most important sites for biodiversity are protected through designation as Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) known as European Sites, which are of importance within the UK-wide network of protected sites.

1.2.3 The Birds and Habitats Directives are transposed into Scottish legislation through the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) and the Conservation (Natural Habitats, &c.) (EU Exit) (Scotland) (Amendment) Regulations 2019 ("The Habitats Regulations"). The Habitats Regulations places a statutory duty on all "competent authorities" to act in accordance with the Directives. The regulations subsequently requires an "appropriate assessment" (AA) to be carried out by the CA in respect of any proposed plan or project, which has the potential to have a significant effect on a European site and; which is not directly connected with or necessary to the management of the site for nature conservation.

1.2.4 Where no alternative solutions exist and where it cannot be concluded that there will no adverse effect upon the integrity of a European site, a plan or project may still be permitted where it can be demonstrated that there are Imperative Reasons of Overriding Public Interest (IROPI) for the plan or project. Where this occurs, compensation is required to protect the integrity of the UK-wide site network.

1.2.5 NatureScot guidance[3] (SNH, 2018) and Scottish Government guidance[4] (2020) has also been referred to for the purposes of this Technical Appendix.

1.3 The Habitats Regulations Appraisal (HRA) Process

1.3.1 The structure of the HRA process presented includes:

- **Stage 1: Screening** – the screening process which identifies the likely impacts upon a European site of a project or plan alone or in combination and considers whether these impacts are likely to be significant;
- **Stage 2: Appropriate Assessment** – the consideration of the impact on the integrity of the European site of the project or plan alone, or in-combination with other plans or projects with respect to the site's structure and function and its conservation objectives. Additionally, where there are adverse impacts, an assessment of the potential mitigation of those impacts;
- **Stage 3: Assessment of alternative solutions** – the process which examines alternative ways of achieving the objectives of the plans or projects that avoid adverse potential impacts on the integrity of the European site.

[3] Scottish Natural Heritage (2018). Natura sites and the Habitats Regulations: How to consider proposals affecting SACs and SPAs in Scotland. The essential quick guide.

[4] https://www.gov.scot/publications/eu-exit-habitats-regulations-scotland-2/

- **Stage 4: Assessment where no alternative solutions exist and where adverse potential impacts remain** - an assessment of compensatory measures where, in the light of an assessment of Imperative Reasons of Overriding Public Interest (IROPI), it is deemed that the project or plan should proceed.

1.3.2 The outcome of screening (Stage 1) determines whether further Stages of assessment are required. Under the Regulations, Stage 2 is required when, in view of a European Site's conservation objectives, the effect of a project or plan:

- is likely to have a significant impact on a European Site in Great Britain (either alone or in combination with other plans and projects); and,
- is not directly connected with or necessary to the management of the site.

1.3.3 This report presents the outcome of **Stage 1** in relation to the Proposed Development, and additionally includes reference to specific mitigation measures as further information with regard to **Stage 2**: Appropriate Assessment.

2 INFORMATION TO INFORM THE APPRAISAL

2.1 Project Information and Site Context

Description of Project

2.1.1 The Site is shown on **Figure 7.1** (Statutory Designated Sites for Nature Conservation) in **Volume 3a** of the EIA Report.

2.1.2 The Proposed Development comprises the construction, operation and decommissioning of 12, 180m to tip wind turbines and associated infrastructure. Full details are provided in **Chapter 2: Development Description** of the EIA Report.

2.1.3 Construction works are anticipated to last for up to 18 months. Works will be limited to specific hours (secured by planning condition), with limited working at weekends and no working on bank holidays.

2.1.4 The existing main access to the Site is from the existing farm track through Gass Farm connecting to existing forestry tracks within Gass Forest and onwards into Artfield Forest. New watercourse crossings are required to facilitate development, including a crossing over the Tarf Water, a component of the River Bladnoch SAC, into Meikle Cairn Forest.

2.1.5 The operational life of the Proposed Development is 30 years, after which, infrastructure will be removed, or the lifetime extended subject to further planning controls. During operation, the wind farm will be subject to routine maintenance and habitat management works during daylight hours.

2.1.6 Six new watercourse crossings are proposed within the Site, including a single span bridge crossing of the Tarf Water. All other crossings will comprise bottomless arch culverts. A further three existing crossings will require repair/replacement.

2.1.7 With the exception of the Tarf Water crossing and associated track leading to and from the bridge, no infrastructure will be located within at least 50 m of the River Bladnoch SAC.

Site Context

2.1.8 The Site is located approximately 8km northwest of Kirkcowan, 15km west of Newton Stewart, east of Artfield Fell.

2.1.9 The habitats comprise a mix of commercially managed coniferous forestry and rough grazing pastures. The Site also supports areas of recently felled and replanted woodland together with compartments of mixed plantation woodland.

2.1.10 Several watercourses intersect the Site, which primarily drain into the Tarf Water. The Mulniegarroch Burn / Purgatory Burn form part of the Site's north western boundary. The Tarf Water which forms part of the River Bladnoch SAC intersects the Site.

2.1.11 The eastern extent of the Site has previously been awarded planning consent for the Gass Wind Farm, comprising nine wind turbines and associated infrastructure (Dumfries and Galloway Council Planning Reference 14/P/1/0674). The projects consent notice has now expired and the development will not be constructed. Reference is made in this Technical Appendix to the Environmental Impact Assessment undertaken for that application[5].

2.1.12 The Site falls under the River Bladnoch catchment in the Solway Tweed River Basin District. The Site also forms part of the Tarf Water and Tarf Water to Water of Malzie, to Drumpail and Tidal Weir nested catchments.

2.2 European Sites - River Bladnoch SAC

2.2.1 River Bladnoch SAC[6] (UK0030249) flows from Loch Maberry in South Ayrshire to Wigtown Bay. It includes the Tarf Water which intersects the Site.

2.2.2 The SAC covers an area of 272.6 ha and supports an internationally important Atlantic salmon *Salmo salar* population.

2.2.3 NatureScot's commissioned report in 2014[7] undertook an assessment of juvenile and adult fish populations of the River Bladnoch. The report included an electrofishing sample point on the Tarf Water, c.5km downstream of the Site which confirmed juvenile Atlantic salmon presence, although the assessment of adult populations by rod catches resulted in an overall conclusion of "unfavourable – recovering" for the SAC.

2.2.4 Poor water quality linked to commercial forestry, grazing and introduction of non-native fish species are the key issues resulting in negative impacts on the Atlantic salmon populations of the SAC[7].

European Site Objectives

2.2.5 The Site is designated under article 4(4) of the Directive (92/43/EEC) as it hosts the following species listed in Annex II:

- Atlantic salmon

2.2.6 The most recently published Conservation Objectives for the River Bladnoch SAC states as follows:

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and

To ensure for the qualifying species that the following are maintained in the long term:

[5] Sgurr Energy (2014) Gass Wind Farm. ES Chapter 7 Ecology
[6] https://sac.jncc.gov.uk/site/UK0030249
[7] Rivers and Fisheries Trusts of Scotland (2014) Data Supporting Site Condition Monitoring of Atlantic salmon SACs. Scottish Natural Heritage Commissioned Report No. 755.

- Population of the species, including range of genetic types, as a viable component of the site.
- Distribution of the species within site.
- Distribution and extent of habitats supporting the species.
- Structure, function and supporting processes of habitats supporting the species.
- No significant disturbance of the species.

2.3 Information on Qualifying Features

2.3.1 Information pertaining to the potential presence or otherwise of Atlantic salmon which represent a qualifying feature for the River Bladnoch SAC European site has been established through:

- Desk study including records from South West Scotland Environmental Information Centre (SWSEIC) and review of Gass Wind Farm Environmental Statement (ES) Chapter 7[8] and Kilgallioch Extension Wind Farm EIA Report Chapter 9[9]; and,
- A Fish Habitat survey in 2020.

2.3.2 Full details on methodology and results are presented in **Volume 4 Technical Appendix 7.2: Protected Species** and are summarised below.

Desk Study

2.3.3 A summary of desk study records are presented in **Table 2.1** and records are presented on **Figure 7.9** in **Volume 3a** of the EIA Report.

Table 2.1: Desk study records summary – Fisheries

Source	Records
SWSEIC	No records were received from SWSEIC for protected fish within 5km.
Gass Wind Farm ES	Field surveys were undertaken for the Gass Wind Farm submission in 2014 following SFCC (2007)[10], NatureScot (SNH) [11] and Wentworth CK (1992)[12] guidance. The survey area is shown on Figure 7-12 of the Gass Wind Farm ES. Electrofishing surveys undertaken in 2014 on four watercourses recorded the following: • Tarf Water, un-named burn – 224701, 565555 (trout); • Tarf Water, un-named burn – 224782, 565537 (eel, trout); • Tarf Water, un-named burn – 225110, 565522 (eel, trout); and, • Tarf Water – 225161, 566130 (salmon, trout).
Kilgallioch Extension Wind Farm EIA Report	Electrofishing surveys were undertaken by GFT in 2019. Five sample locations were included within the River Bladnoch catchment as follows, results also presented on **Figure 6.9**: • Tarf Water, Ha' Hill Burn - NX228700 (Pike *Esox lucius*, eel and trout); • Tarf Water, Monandie Burn - NX240692 (juvenile trout); • Tarf Water - NX240688 (juvenile salmon, juvenile trout); • Tarf Water, Loch Eldrig Outflow - NX250693 (no fish); and, • Tarf Water, Loch Strand Burn - NX247691 (juvenile trout).

[8] Sgurr Energy 2014 14_P_1_0674 Environmental Statement.
[9] Scottish Power Renewables (2019) Kilgallioch Extension Wind Farm EIA Report. – Chapter 8 Ecology and Biodiversity
[10] SFCC (2007). Habitat Surveys Training Course Manual, Available at http://www.sfcc.co.uk/resources/habitatsurveying.html
[11] SNH Freshwater pearl mussel survey protocol for use in site-specific projects. http://www.snh.gov.uk/docs/A372955.pdf
[12] Wentworth CK (1922) A scale grade and class terms for clastic sediments. *Journal of Ecology* 30, 377-392.

Field Surveys

2.3.4 A total of 10 watercourses were subject to a fish habitat survey in September 2020. Locations of surveyed watercourses are presented on **Figure 7.10** in **Volume 3a** of the EIA Report. The full GFT Report is provided as **Annex 5** in **Technical Appendix 7.2: Protected Species**.

2.3.5 Results of the survey are as follows:

- Purgatory Burn: this watercourse contains a range of good quality instream habitats. This burn could support populations of salmonids, eels, juvenile lamprey and Freshwater Pearl mussels.
- Tributary draining Moss of Horse Hill: this watercourse did not contain suitable habitats for fish or Freshwater Pearl mussels.
- Tarf Water: this watercourse contains a range of good quality instream habitats. This river could support populations of salmonids, eels, juvenile lamprey and freshwater pearl mussels.
- Un-named tributary: this watercourse contains some limited areas of suitable habitat for trout only.
- Un-named tributary draining Brough Hill: this watercourse contains some areas of suitable habitat for trout only.
- Three burns draining from Low Eldrig: two of these burns were considered large enough to support populations of salmonids, eels and juvenile lamprey. One of the burns was considered unsuitable for fish or freshwater pearl mussels.
- Un-named tributary draining Black and White Hills: this watercourse contains a range of good quality instream habitats. This burn could support populations of salmonids, eels, juvenile lamprey and freshwater pearl mussels.

- Drumpail Burn: this watercourse contains a range of good quality instream habitats. This burn could support populations of salmonids, eels, juvenile lamprey and freshwater pearl mussels. The Drumpail Burn is designated as part of the River Bladnoch SAC for Atlantic salmon.

2.4 Site Suitability for Qualifying Features of European Sites

2.4.1 A total of 10 watercourses within the Site were subject to walkover habitat surveys in September 2020. In summary, six watercourses provided suitable habitat for salmonides and eels. Two more provided suitable habitat for trout only, and two did not contain any suitable habitats for fish species.

2.4.2 The Tarf Water and on-Site tributaries offer varied habitat suitability for Atlantic salmon. It is therefore reasonable to conclude that the species is potentially present within suitable watercourses within the Site as their presence has previously and recently been established through desk study within the upper and lower reaches of the River Bladnoch north and south of the Site.

3 STAGE 1: SCREENING

3.1.1 The Project is not directly connected with or necessary to the management of the European Site and therefore a HRA is required.

3.1.2 A *Likely Significant Effect* or LSE is, in this context, any appreciable effect that may reasonably be predicted as a consequence of a plan or project, that may affect the conservation objectives of the features for which the site was designated, but excluding trivial or inconsequential effects.

3.1.3 Where a LSE is identified, further assessment has been undertaken as set out in Section 4: *Appropriate Assessment* of this document to consider the potential for significant adverse effects on the integrity of the SAC or its qualifying interest species.

3.1.4 The following activities which could result in LSE are:

- Six new crossings including one over the Tarf Water (8m width) and five on small burns within the Site which are functionally linked to the River Bladnoch SAC (maximum 0.5m width);
    - Five new crossings (WC2, WC3, WC4 AND WC7) on small burns requiring circular culverts; and,
    - Crossing of the Tarf Water (WC5) which will consist of a single-span bridge.
- Three existing watercourse crossings requiring repair/upgrades (WC1, WC8 and WC9). All three crossings consisted of circular culverts which will likely require repair/upgrading;
- Clear felling of commercial plantation forestry (for more details, please refer to Chapter 14: Forestry in EIAR Volume 2);
- Laying and construction of tracks, excavation of turbine foundations, borrow pits and cables; and,
- General presence of increased traffic and movement of vehicles around the Site during construction, operational and decommissioning phases.

3.2 Potential Effects Summary

3.2.1 The potential for the Proposed Development to directly or indirectly affect qualifying interests of the European site has been considered in relation to:

- Direct habitat loss or change;
- Direct harm to qualifying interest features (Atlantic salmon);
- Indirect adverse effects on qualifying habitats and species or functionally linked land or watercourses from surface water runoff, sedimentation and/or contamination of freshwater habitats.

3.2.2 These potential effects can occur either through construction-related activity, or due to the operation or decommissioning phases of the Proposed Development.

Habitat Loss or Change

3.2.3 The Tarf Water, a component of the River Bladnoch SAC intersects the Site.

3.2.4 The Proposed Development requires the construction of a single span bridge over the Tarf Water which could result in direct habitat loss or change within the Tarf Water.

3.2.5 The Proposed Development also requires the construction of five small burn crossings and upgrading works to three existing crossings within the Site which are functionally linked to the River Bladnoch SAC as they drain into the Tarf Water. These activities could result in direct habitat loss or change to functionally linked habitats on the Tarf Water.

3.2.6 Subsequently the screening assessment, on a precautionary basis concludes that the Proposed Development could result in a 'LSE', which is considered further at Stage 2: Appropriate Assessment (Section 4).

Direct Harm to Qualifying Interest Species

3.2.7 Potential for direct harm to Atlantic salmon is only considered during the construction and decommissioning phases.

3.2.8 Construction or removal (if required) of the Tarf Water crossing could result in the direct injuring/killing of Atlantic salmon and restrict movement within the SAC and functionally linked watercourses within the Site.

3.2.9 Subsequently the screening assessment, on a precautionary basis concludes that the Proposed Development could result in a 'LSE', which is considered further at Stage 2: Appropriate Assessment (Section 4).

Indirect Effects

3.2.10 All habitats within the Site drain into the Tarf Water as shown on Figure 9.1.

3.2.11 Atlantic salmon, a qualifying interest species of the SAC, may be potentially affected through pollution-related incidents (e.g. fuel spillage, acidification through clear-felling and sedimentation from erosion and surface water runoff) associated with the construction, operation and decommissioning phases of the Proposed Development.

3.2.12 Such incidents are likely to be localised and minor in scale; however could have indirect LSE on the River Bladnoch SAC Atlantic salmon population through for example changes in water quality or

siltation of watercourse bed substrates which would in turn reduce spawning success and egg survival.

3.2.13 Subsequently the screening assessment, on a precautionary basis concludes that the Proposed Development could result in a 'LSE', which is considered further at Stage 2: Appropriate Assessment (Section 4).

3.3 Screening Conclusion

3.3.1 After undertaking the Stage 1: Screening assessment, it is concluded that:

- The European site intersects the Proposed Development;
- The Proposed Development is not directly connected with or necessary to the management of European site;
- The Proposed Development is considered, either alone or in combination with any other plans or projects, to have LSEs upon the River Bladnoch SAC, when assessed in the absence of any mitigation, in relation to its potential to cause direct habitat loss, direct effects on qualifying interest species, disturbance, sedimentation, pollution. LSEs are considered to be restricted to the construction and decommissioning phases, in relation to new watercourse crossings or refurbishment of existing crossings and operational maintenance of the Proposed Development.

3.3.2 An appropriate assessment is therefore required in relation to the potential for direct habitat loss and/or change and indirect impacts to adversely affect the integrity of the SAC and its qualifying interest species.

4 STAGE 2: APPROPRIATE ASSESSMENT OF EFFECTS

4.1.1 Consideration of measures included within a Project which have the effect of reducing or mitigating the effects of that Project on a European site have not been considered within Stage 1: Screening but must instead be assessed with respect to the integrity of the site concerned at Stage 2: Appropriate Assessment.

4.1.2 The Adverse Effect on Integrity Test undertaken in the Appropriate Assessment can take account of the protection measures forming part of the integral design or physical characteristics of the project aimed at avoiding or reducing any direct adverse effects for the site (Briels C-521/12, 2014).

4.1.3 In the absence of consideration of water crossing design and water pollution control measures, the Project has the potential to affect the integrity of the River Bladnoch SAC during construction, operation or decommissioning.

4.1.4 The following Section details the mitigation measures included within the design of the Project, which are also set out in the outline CEMP (Technical Appendix 2.1) and then an assessment of LSE in consideration of these measures is undertaken.

4.1.5 Full details are provided within Technical Appendix 9.2: Watercourse Crossing Assessment.

4.1.6 With the exception of the Tarf Water crossing, which will comprise a single span bridge (with no instream supports required), watercourse crossings will consist of new culverts and be sized to allow continuous flow.

4.1.7 Works directly affecting watercourses and within wider habitats within the Site (i.e. forestry removal) have the potential to generate pollution, sedimentation and erosion, which in turn could affect the SAC population of Atlantic salmon, either through direct toxicity or changes to supporting habitats.

4.1.8 The detailed design of each watercourse crossing would seek to ensure hydraulic conveyance is maintained, as well as allowing the free passage of aquatic ecology and Atlantic salmon.

4.1.9 The Proposed Development will require the removal of commercial forestry (for more details, please see Chapter 14: Forestry in EIAR Volume 2). Some of the forestry removal is located within 50m of functionally linked watercourses and could therefore result in acidification runoff.

4.2 Mitigation during Construction

Construction Environmental Management Plan (CEMP)

4.2.1 An outline CEMP is provided in EIA Report Volume 4: **Technical Appendix 2.1: CEMP**. The mitigation will be secured by planning condition within the planning consent as part of the final CEMP.

4.2.2 The CEMP will be submitted to NatureScot for approval prior to the commencement of construction works, in consultation with DGC and the SEPA.

4.2.3 The agreed CEMP will be in place during the construction, phase of the Proposed Development. The CEMP will include all good practice construction measures, pollution prevention controls and monitoring to be implemented over the course of the Proposed Development in line with current industry and mandatory statutory guidance and as detailed within **Chapter 2: Development Description**.

4.2.4 The CEMP will include:

- a detailed breakdown of the phasing of construction activities;
- a pollution risk assessment of the Site and the proposed activities;
- identification of all Controlled Waters that may be affected by the works and temporary discharge points to these watercourses;
- planning and design of appropriate pollution control measures during earthworks and construction;
- storage of all fuel and other chemicals in accordance with best practice procedures;
- ensuring that concrete batching is undertaken only at a designated area at the temporary construction compound, 50 m from the nearest watercourse;
- management of the pollution control system, including dewatering of excavations (if required) away from watercourses;
- contingency planning and emergency procedures; and
- on-going monitoring of construction procedures to ensure management of risk is maintained.

4.2.5 A suitably qualified and experienced Ecological Clerk of Works (ECoW) will be appointed prior to the commencement of construction and decommissioning activities and through whom appropriate ecological advice would be provided throughout.

4.2.6 The ECoW (or appointed 'clerks' on behalf of the ECoW) will also maintain a watching brief as necessary throughout the construction and decommissioning phase to ensure compliance with relevant legislation and advise on any working restrictions.

4.2.7 The ECoW will be responsible for overseeing watercourse crossing installations and upgrading works, implementing a Watercourse Crossing Method Statement (WCMS) and monitor the recommended mitigation measures to ensure they are appropriate and functioning correctly to protect watercourses and fish populations in the vicinity and downstream.

4.2.8 The construction of the watercourse crossings and access tracks will be carried out in accordance to NatureScot and Scottish Environment Protection Agency (SEPA).[13] guidance and final construction details will be approved by SEPA in accordance with the CAR Regulations.[14] post planning consent.

4.2.9 The detailed scope of the role and responsibilities of the ECoW will be agreed in consultation with NatureScot as part of the CEMP.

Direct Habitat Loss / Change

4.2.10 Construction of the water crossings will be carried out in accordance with best SEPA practice.[15] and SEPA Guidance for Pollution Prevention.[16], with full details of proposed mitigation measures at watercourse crossings provided **in Chapter 9: Hydrology, Hydrogeology and Geology**.

4.2.11 Measures to be implemented will include:

- Implementation of at least a 50m buffer from all watercourses within the Site, with the exception of six unavoidable new watercourse crossings and three watercourse crossings requiring repair;
- A WCMS will be included within the final approved CEMP that will include detailed prescriptions for the construction of watercourse crossings;
- New crossings would be constructed on a mixture of natural channels and artificial drains. Further details are provided in **Technical Appendix 9.2: Watercourse Crossing Assessment** in **Volume 4 of the EIA Report**. The crossings will be designed to maintain the free passage of aquatic ecology;
- Splash boards and run-off diversion measures, including silt fencing adjacent and parallel to watercourses beneath bridges and at culvert crossings, will be used at all crossings during construction to prevent direct siltation of watercourses.

4.2.12 The new crossings would likely comprise either an open bottom or a full culvert in accordance with SEPA guidance.[17], with the exception of the Tarf Water crossing which would consist of a single span structure (bridge). This will retain hydraulic connectivity and passage for fish and additional wildlife.

4.2.13 The Tarf Water crossing will minimise disturbance to the bank and bed, maintaining bank habitats under the crossing. In-stream supports are not required and no in-river workings will be required.

4.2.14 Splash boards and run-off diversion measures, including silt fencing adjacent and parallel to watercourses beneath bridges and at culvert crossings, will be used at all crossings during construction to prevent direct siltation of watercourses.

[13] SEPA (no date). WAT-SG-25: Good Practice Guide – River Crossings
[14] Water Environment (Controlled Activities) (Scotland) Regulations 2011, as amended
15 SEPA, 2010. Engineering in the Water Environment: Good Practice Guide, River Crossings
[16] SEPA 2018. Works and Maintenance in or Near water: GPP5
[17] SEPA Position Statement to support the implementation of the Water Environment (Controlled Activities) (Scotland) Regulations 2001: WAT-PS-06-02: Culverting of Watercourses – Position Statement and Supporting Guidance. June 2015. Version 2.0. https://www.sepa.org.uk/media/150919/wat_ps_06_02.pdf

4.2.15 The proposed crossings will be of sufficient size so as not to restrict or concentrate flows downstream and to convey flows during periods of heavy rainfall (e.g. 1 in 200-year event plus climate change allowance).

4.2.16 In addition, as detailed above, the WCMS will include all good practice construction measures and pollution prevention controls, to negate potentially significant effects upon the aquatic environment over the construction phase and operational lifetime of the Proposed Development.

4.2.17 The WCMS will include measures so as to ensure all works are completed in accordance with relevant legislative requirements.

4.2.18 The requirement for monitoring of water quality within watercourses downstream of the Proposed Development will be agreed with SEPA. Procedures for this would be detailed in the CEMP and the WCMS. Prior to works commencing, baseline water quality monitoring shall be carried out (both upstream and downstream) and repeated during the construction works at agreed intervals.

Direct Harm to Qualifying Interest Species

4.2.19 Potential direct adverse effects on Atlantic salmon could only occur during the construction of the Tarf Water Crossing the installation of five new culverts and the repair/upgrade of three existing crossings.

4.2.20 The Tarf Water crossing will consist of a single-span bridge structure, with no in-river supports required. No in-river work will be required and banks and bed will remain unaffected during construction.

4.2.21 Atlantic salmon are potentially present within watercourses on Site which drain into the Tarf Water, as identified through fish habitat surveys in September 2020.

4.2.22 The CEMP includes for pre-construction population surveys and water quality monitoring which will guide the construction of the five onsite culverts. Locations will be microsited where possible to select thinnest sections and allow continuous flow.

4.2.23 Installation of the culverts will be undertaken in accordance with Scottish Government guidance.[18] and through consultation with SEPA.

Indirect Pollution / Runoff

4.2.24 Measures incorporated in the Project design for construction and operational phases are detailed within the outline CEMP, included in **Technical Appendix 2.1: Construction Environmental Management Plan** in **Volume 4 of the EIA Report**.

4.2.25 The measures included refer to standard pollution control that will be incorporated into the Project regardless of the connectivity with any European site, with the principal function of ensuring that there is no contamination of local environments and nearby important habitats (e.g. blanket bog and wet heath).

4.2.26 Detailed description of measures that shall be implemented to mitigate potential negative impacts due to the release of diffuse pollution due to forestry operations are discussed in **Chapter 14: Forestry** in **Volume 4 of the EIA Report**.

[18] River Crossings and Migratory Fish: Design Guidance: https://www.webarchive.org.uk/wayback/archive/20150219064647/http://www.gov.scot/Topics/marine/science/Publications/publicationslatest/rivercrossings

4.2.27 Detailed description of measures that shall be implemented to mitigate potential negative impacts due to contamination (chemical pollution), sedimentation and erosion, and alteration to surface water flows and runoff are discussed in **Chapter 9: Hydrology, Hydrogeology and Geology** in **Volume 4 of the EIA Report.**

4.2.28 Measures will include:

- A site construction licence as required under the Water Environment (Controlled Activities) (Scotland) Regulations 2011, as amended (CAR) would be obtained from SEPA prior to any construction works being undertaken. The licence will detail the pollution prevention measures to be used on site, the results of further site investigation and detailed site drainage and pollution control design to be undertaken prior to construction. The construction site licence would be regulated by SEPA.

- Measures include the implementation of a Pollution Prevention Plan (PPP) as part of the CEMP that will be compiled by the contractor in accordance with SEPA guidance[19] to ensure that the release of sediments or pollutants or disruption to hydrology to the surrounding environment is avoided.

- To ensure that all drainage measures employed during the construction phase of the Proposed Development are maintained appropriately and remain effective, the performance of the drainage measures will be monitored. The drainage management works will, therefore, be supervised by the ECoW and shall be in accordance with the CEMP.

- The storage of potentially contaminative materials (oils, cements / grouts) will be carried out at least 50m from watercourses. Fuels, oils or chemicals stored onsite will be suitably bunded and sited over an impervious base and according with the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended).

- The requirement for monitoring of water quality within watercourses downstream of the Proposed Development will be agreed with SEPA and Marine Scotland. Procedures for this would be detailed in the CEMP. Prior to works, baseline water quality monitoring will be carried out (both upstream and downstream) and repeated during the construction works at agreed intervals.

- Where drains are installed, either temporarily during the construction phase or in association with the installation of site infrastructure, check dams will be installed at suitable intervals (as defined by the gradient of the drain) to reduce flow velocity and allow the settlement of sediment loads prior to discharge to watercourses. These will be detailed in the PPP.

- Details of construction phase SuDS would be included in the PPP and the final CEMP, as required, to provide a surface water management and treatment train that will mitigate potential adverse impacts on the hydrology of the site and surrounding areas during the construction, operation and decommissioning phases of the Proposed Development. Measures would ensure that pre-development runoff rates are maintained and that rates of runoff to watercourses are not increased. A full SuDS solution will be developed prior to construction. Construction site plans and proposed drainage measures shall form a PPP that would be compiled by the contractor.

[19] Supporting Guidance (WAT-SG-75), Sector Specific Guidance: Construction Sites February 2018, URL: https://www.sepa.org.uk/media/340359/wat-sg-75.pdf (accessed 19 November 2020)

- At the limited number of locations where a track is required to cross a watercourse, or where other infrastructure is necessary within 50m of a surface watercourse, either as described in the EIA Report or as identified by the ECoW, the installation of SuDS measures shall be supervised by the ECoW during the construction phase of works. The requirement for monitoring of water quality within watercourses downstream of the Proposed Development will be agreed with SEPA. Procedures for this will be detailed in the CEMP. Prior to works, baseline water quality monitoring shall be carried out (both upstream and downstream) and repeated during the construction works at agreed intervals.

- Detailed description of measures that shall be implemented to mitigate potential negative impacts due to the release of diffuse pollution from forestry operations are discussed in **Chapter 14: Forestry**. Keyhole felling of areas around proposed turbine locations and site infrastructure will be carried out. It is proposed within the Outline Habitat Management Plan (HMP) that restoration of underlying peat shall be undertaken around proposed turbine locations. Restoration of these areas will include measures such as drain/grip blocking to maintain a suitable water table level for the restoration of blanket-bog habitats. Commercial forestry operations will continue across further areas included within the Site boundary. Good practice measures shall be implemented by the contractor responsible for felling operations in line with applicable General Binding Rules[20] and forestry industry good practice measures to protect the water environment[21].

- Any requirement for surface water or groundwater abstraction will be completed in accordance with the CAR.

4.3 Mitigation during Operation

4.3.1 A site maintenance programme with regard to site plant and infrastructure will be implemented by the successful contractor.

4.3.2 A maintenance schedule will be developed for all SuDS and drainage assets installed at construction stage to ensure that the function and benefit provided by the asset remains for the operational lifetime of the Proposed Development.

4.4 Mitigation during Decommissioning

4.4.1 The mitigation employed during the decommissioning phase would be expected to be similar to that used during the construction phase.

4.4.2 At the point of full or partial decommissioning of the Proposed Development, the CEMP developed during the construction phase will provide guidance for the management of risk to the water environment. The CEMP would be reviewed and updated as appropriate to reflect future good practice guidance (along with any changes in legislation, climate, designations, habitats or water use) and used to plan decommissioning activity.

4.4.3 The potential for some infrastructure to remain in-situ should be assessed, taking in to account the potential disturbance to the surrounding area and the potential impacts were the backfill of excavations required (e.g. chemical effects of off-site material or the reconfiguration of established drainage pathways). Where infrastructure is retained it would be shown that to do so represents the best practicable environmental option.

[20] EARS: Natural Scotland, undated. Reducing the Risk of water Pollution, Diffuse Pollution General Binding Rules (DP GBRs): Forestry. Available online: https://www.sepa.org.uk/media/59566/dp_gbr_forestry.pdf [Last accessed, October 2020]

[21] Forestry Research, 2019. Practice Guide: Managing Forest Operations to Protect the Water Environment.

4.5 Appropriate Assessment

4.5.1 In the absence of mitigation, potential for LSE on the River Bladnoch SAC has been identified. Significant adverse effects on salmon and the integrity of supporting habitats cannot be ruled out.

4.5.2 However, with the inclusion of the mitigation outlined, LSE on the integrity of the River Bladnoch SAC and qualifying interest species would avoid all of the identified LSEs and subsequently no adverse effects on the integrity of the European sites, or its qualifying species will occur.

4.6 Appropriate Assessment of Effects In-combination

4.6.1 Regulation 63 requires that the HRA process must consider the potential for a LSE of a proposed development either alone or in combination with other plans and projects. In-combination effects are subsequently considered to be restricted to potential direct effects from habitat loss and/or change and indirect effects of contamination/sedimentation/pollution with all other potential effects inconsequential on the SAC.

4.6.2 In-combination effects must be:

- Practically feasible; and,
- Interpreted and applied in a proportionate manner.

4.6.3 Operational sites are considered highly unlikely to impact surface waters in connection to the site and not assessed further with regards to potential cumulative effects.

4.6.4 Kilgallioch Extension Wind Farm is the only other project identified for inclusion within the in-combination assessment. Kilgallioch Extension is current in planning and located within the same hydrological catchment of the Proposed Development.

4.6.5 Airies II is currently at Scoping stage and therefore detailed information is not available on potential for LSEs and required mitigation, therefore including the project within the In-combination assessment would be unreasonable.

4.6.6 Notwithstanding, a high level assessment can be undertaken on the assumption that for any development to proceed it will be required to comply with legislation and planning policy, and a full assessment of effects and subsequent mitigation or compensation will be required, as necessary. In the NatureScot scoping response for Airies II, it is recommended that the development will need to include sufficient mitigation measures to ensure no adverse effects on the integrity of the River Bladnoch SAC and this could be achieved through an appropriate CEMP/PPP and through the sensitive design of the development. The potential for cumulative effects to occur is therefore considered to be inconsequential.

4.6.7 Kilgallioch Extension concluded that in the absence of mitigation, LSEs on Atlantic salmon and the integrity of the River Bladnoch SAC would occur. With the adoption of proposed mitigation measures included within the AA (Scottish Power Renewables, 2019)[22] the project would not adversely affect the integrity of any European Site or their qualifying interest, either alone or in combination with other plans or projects**.**

[22] Scottish Power Renewables (2019) Kilgallioch Extension Wind Farm EIA Report. Volume 3 Appendix 8.6:HRA.

4.6.8 The mitigation measures proposed have also been accepted by NatureScot in their recent consultation response[23].

4.6.9 It is considered that should the all three developments be constructed at the same time, there is no evidence to suggest that in-combination effects would occur and result in appreciable additive effects above those already identified for the Proposed Development alone due to the comprehensive mitigation provided by Kilgallioch Extension and the mitigation proposed as part of this Project.

4.6.10 Potential in-combination effects would therefore be nugatory and there would be no adverse effects on the integrity of the SAC or its qualifying species as a result.

5 CONCLUSIONS

5.1.1 LSEs have been identified on the River Bladnoch SAC, a European site and information to inform an Appropriate Assessment has been provided, including mitigation measures that will form a committed part of the Project.

5.1.2 The mitigation measures as described will ensure direct or indirect effects on the favourable conservation status of qualifying species (Atlantic salmon) and hence no effects on the integrity of the River Bladnoch SAC. Similarly there will be no appreciable effects on functionally linked habitat likely to affect the integrity of the SAC.

5.1.3 The mitigation measures proposed are well established and in line with guidance and regulation and hence can be considered to be achievable and effective in preventing identified potential adverse effects. The mitigation will be secured by planning condition within the planning consent as part of the final CEMP.

[23] Available on Energy Consents Unit website: https://www.energyconsents.scot/ApplicationDetails.aspx?cr=ECU00001996&T=3. Dated 6th April 2020.