Lochluichart Wind Farm Extension II (LXX)
on behalf of Infinergy Limited
Technical Appendix 2.A: Ecology

avian ecology

Document Control				
Project Name:	Lochluichart Wind Farm Extension II			
Project Number:	Infin-342-1358			
Report Title	Ecology			
Issue	**Date**	**Notes**	**Prepared**	**Reviewed**
V1	28/10/2021	Draft for client comment	A Hulme *BSc*	C.Garratt *PhD*

CONTENTS

ANNEXES

Annex 1: Weather Data for Bat Activity Survey Effort

Annex 2: Existing Bat Species Recorded – HBRG

Annex 3: *Ecobat* Output Report

1 INTRODUCTION

1.1.1 This report details the results of ecology surveys undertaken for the Lochluichart Extension II in 2021. The land encompassing the entire development, as shown on **Figures 2.0 and 2.1** are herein referred to as the **'**Site'.

1.1.2 It presents detailed methodologies and results of desk studies and field surveys completed to establish baseline conditions with regards to ecological species and habitats, in order to inform the design and assessment of the windfarm development. These surveys comprised bat activity and roost potential surveys, and a National Vegetation Classification (NVC) survey, extended to include recording of signs of, or suitability for, protected and notable species.

1.1.3 This report should be read with reference to the following specific figures, presented in Volume 2 of the Further Environmental Information (FEI) Addendum:

- **Figure 2.0**: Bat Survey Plan 2021; and
- **Figure 2.1**: Extended Habitat Survey Results 2021.

1.2 Aims of the Study

1.2.1. The aims of the 2021 surveys were to:

- Bat survey**:**
  - 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 in use;
  - Assess the level of activity of bats within the site; and,
  - Assess the potential risks to bats in line with NatureScot guidance (SNH, 2019).
- Extended NVC Habitat Survey:
  - Identify any material changes in baseline habitats present in the Site since results of the previous surveys; and
  - Record features indicating the presence, or likely presence, of protected or notable species.

1.3 Site Overview

1.3.1 The Site, an extension to Lochluichart Wind Farm as shown by the red-line application boundary in **Figure 2.0**, is located approximately 20km to the south east of Dingwall in Highland Council, Scotland.

1.3.2 The Site largely comprises areas of blanket bog and wet dwarf shrub heath with interspersed compartments of young coniferous plantation woodland. Small watercourses are also present throughout the Site. The surrounding landscape comprises similar open habitats of blanket bog and heath and the waterbody Loch Glascarnoch is located approximately 100m north of the Site.

1.3.3 Full habitat descriptions are provided in **Appendix 10.A Habitats and Vegetation** of the EIA Report.

2 BATS

2.1 Methodology

2.1.1 The approach to baseline information gathering with regards to bats has been undertaken with reference to current NatureScot guidance 'Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation' (SNH, 2019)[1].

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

Desk Study

2.1.3 A desk study was undertaken to inform the approach to field survey work and provide context for subsequent assessment.

2.1.4 The desk study has included a review of:

- Aerial imagery and Ordinance Survey (OS) maps to identify any features of potential value to foraging, commuting or roosting bats;
- A review of SiteLink[2] to identify the proximity of the Site to any national or internationally designated sites for nature conservation, with bat qualifying interests;
- A review of existing bat records within 10km of the Site, including species and roost records, obtained from the following key sources;
    - Records request to the Highland Biological Recording Group (HBRG);
- A review of the Sites location in relation to species known ranges in Scotland, with reference to the most recent UK Habitats Directive[3] Article 17 Report[4]; and,
- The location of other wind farm developments, including the number of turbines and their size within 10km of the Site through a review of THC 'Wind Turbine Map'[5].

Field Surveys

2.1.5 The aims of baseline field surveys for bats were to establish the bat species assemblage using the Site, the spatial and temporal distribution of bat activity within the Site, the location and extent of commuting and foraging habitat used by bats and, the locations of any maternity roosts and/or any significant hibernation or swarming sites that could potentially be affected by the proposed Development.

2.1.6 The following surveys have been completed:

- Habitat Assessment;

[1] SNH (2019) Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation#6.1%C2%A0+Assessing+bat+activity+levels [Accessed September 2021
[2] https://sitelink.nature.scot/home [Accessed September 2021].
[3] Council Directive 92/43/EEC.
[4] https://jncc.gov.uk/our-work/article-17-habitats-directive-report-2019-species/#regularly-occurring-species-vertebrate-species-mammals-terrestrial [Accessed September 2021].
[5] https://highland.maps.arcgis.com/apps/webappviewer/index.html?id=5ec04b13a9b049f798cadbd5055f1787 [Accessed September 2021].

- Ground-level Static Bat Activity Surveys; and,
    - Roost Surveys.

2.1.7 The Habitat Assessment and Preliminary Roost Assessment were undertaken on 1st September 2021 by Mr M. Wood, a suitably competent ecologist with considerable experience of undertaking bat activity surveys for proposed wind farm developments, at comparable sites across Scotland.

Habitat Assessment

2.1.8 An initial habitat assessment of the Site was undertaken to appraise the potential value of habitats within the Site for commuting and foraging bats, using the criteria detailed within Bat Conservation Trust (BCT) guidance (Collins, 2016).

2.1.9 The assessment was informed through a review of aerial imagery and comprised a daylight walkover of potentially suitable habitat features within the Site.

Preliminary Roost Assessment

2.1.10 Features with the potential to support maternity roosts and significant hibernation and/or swarming sites within a Zone of Influence (ZoI) of the five proposed turbine locations, were identified through a review of aerial imagery and the habitat assessment. The ZoI was defined as a buffer of 200m of the proposed turbine locations, plus the candidate turbine rotor radius (75m) i.e. within a total of 275m from the proposed turbine locations.

2.1.11 A daytime, ground-level preliminary roost assessment in accordance with Collins guidance (2016), was therefore undertaken. Identified trees were assessed from ground level and not subject to endoscope inspection or aerial inspection of elevated features.

Ground-level Static Surveys

2.1.12 Automated static detectors were deployed within the Site in May, June, August 2021, sampling the spring, summer and autumn periods (Spring: April-May, Summer: June-July, Autumn: August-October) in accordance with NatureScot guidance (SNH, 2019).

2.3.6. The total deployment duration of static monitoring over the spring, summer and autumn sampling periods are detailed in **Table 2.1**.

2.3.7. A total of five static detector locations were used to survey areas within proximity of the five proposed turbine locations. These are illustrated in **Figure 2.0** and detailed in **Table 2.2**.

2.3.8. Each monitoring location comprised either a single SM2, SM4 or SM4 Mini 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.

2.3.9. 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.

2.3.10. 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.

Table 2.1: Total duration of static monitoring during each monitoring period

Monitoring Period	MS Location*	Period Start	Period End	Total Deployment Duration (No. of nights)
Spring	LOC 1-5	20/05/2021	04/06/2021	15
Summer	LOC 1-5	17/06/2021	29/06/2021	12
Autumn	LOC 1-5	17/08/2021	31/08/2021	14

Table 2.2: Monitoring station (MS) recording period summary.

MS Ref.	Grid Ref.	Phase 1 Habitat Classification	Linear Feature within 50m	Nearest Turbine	Distance from Turbine (m)	Phase 1 Habitat Classification at Nearest Turbine	No. of Successful Recording Nights (excluding nights with unsuitable weather)		
							Spring	Summer	Autumn
LOC 1	NH 3400968766	Blanket bog.	Young coniferous plantation edge.	T4	80	Blanket bog.	10	6	14
LOC 2	NH 3326868761	Blanket bog.	N/A.	T5	40	Blanket bog.	0	6	14
LOC 3	NH 3263368596	Wet dwarf scrub heath.	N/A.	T6, T7	T6=100 T7=380	Wet dwarf scrub heath.	11	6	14
LOC 4	NH 3203568946	Blanket bog.	N/A.	T8	140	Blanket bog.	11	6	14
LOC 5	NH 3219269045	Blanket bog.	N/A.	T7, T8	T7=450 T8=50	Blanket bog.	0	6	14

Data Analysis and Assumptions of Bat Activity

2.1.13 Bat sound analysis has been undertaken by A Hulme *BSc*, who has over four years' experience conducting sound analysis for wind farm developments across the UK and five years' experience completing bat surveys.

2.1.14 Analysis and interpretation of bat activity has followed the principles presented within Collins (2016) and NatureScot guidance (SNH, 2019**Error! Bookmark not defined.**).

2.1.15 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) for analysis. All sonograms were manually checked prior to uploading to *Ecobat*, through Kaleidoscope Viewer and Analook (Titley Scientific).

2.1.16 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) guidelines, bat surveys should be undertaken in appropriate weather: temperatures of >8^{o}C at dusk, maximum ground level wind speed of >5m/s and no, or only very light rainfall.

Assessment of Relative Activity Levels

2.1.17 In accordance with NatureScot guidance (SNH, 2019), *Ecobat* was used to provide an objective interpretation of the relative importance of bat activity levels recorded within the Site.

2.1.18 *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'), 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 (see 'Limitations' below).

2.1.19 For each night that bat activity is recorded, *Ecobat* reports the percentile and associated confidence limits of the data against the software's reference range. **Table 2.3** presents the percentile and bat activity categories, replicated from NatureScot (SNH, 2019) guidance.

Table 2.3: 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

2.1.20 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.

2.1.21 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. The reference range for each species is listed below:

- Common pipistrelle *Pipistrellus pipistrellus* – 1,215
- Soprano pipistrelle *Pipistrellus pygmaeus*– 550
- *Myotis* species – 278
- Noctule *Nyctalus noctula* – 158
- Brown long-eared *Plecotus auritus* - 41

2.1.22 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. This is particularly true for sites with low bat activity, where zero-nights may be representative of overall activity levels.

2.1.23 *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.

Limitations

2.1.24 Two of the species recorded within the Site had a reference range below the *Ecobat* recomended number of <200 (noctule; 158 and brown long-eared; 41). The data within the reference range used to compare activity levels between Site data and other records within 200km^2 is likely to have been obtained from surveys undertaken at proposed or operational wind farm sites. Thus, most of the records are likely to be from low value habitats (upland, exposed commercial forestry) compared to habitats of greater value (such as those detailed in Table 3a of NatureScot guidance (SNH, 2019) and listed under 'High'); hence a reference range below 200.

2.1.25 The *Ecobat* tool remains is in its infancy, and naturally there are fewer data sets in the reference range, reducing the confidence in the assigned category. The tool does however, provide a guide for discussion along with Site-specific circumstances (e.g., habitats present, desk study information) and its use is advised in accordance with NatureScot guidance (SNH, 2019).

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

2.1.27 LOC 2 and LOC 5 failed to record during the spring period. As a result LOC 2 and LOC 5 failed to record for the minimum 10 nights during the spring period and for a combined 30 nights (recorded for 26 nights) over the three survey periods.

2.1.28 LOC 4 recorded during the spring period, but did not record any bat activity. This may have been caused due to a malfunction of the microphone on the static monitoring station or simply a lack of bat activity in the vicinity of the monitoring station.

2.1.29 Deployment periods are shown in **Table 2.1**.

2.1.30 With regard to weather data, four nights of sampling during the spring and six nights during the summer monitoring periods were excluded from the analysis as they did not meet the criteria for appropriate weather conditions (SNH, 2019) and no bats were recorded.

2.1.31 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) from the dataset. Subsequently inclusion of these nights represents a precautionary approach.

2.1.32 Due to the weather station failing during the summer recording period weather data was taken from online resources; SEPA[6] (rainfall) and WorldWeatherOnline[7] (temperature and wind). The nearest weather mast for both online resources is at Dingwall, located approximately 22km south-east of the Site. Additionally for an unknown reason weather data for the nights of 17th and 18th of August could not obtained from the weather station. Bats where recorded active during both nights and so are considered suitable recording nights.

2.1.33 Analysing bat sonograms using Kaleidoscope can clearly identify certain species. However, some genus groups (such as *Myotis spp*.) can be difficult to determine the specific species due to their similar styles of calls. In addition, it can be difficult to determine species or even genus in some circumstances, due to partial calls being heard or due to distortion from, for example passing cars, rain or wind. In cases when it is not possible to identify a bat call to genus, it is labelled as an unknown bat. If the genus can be identified but not the species, the call is labelled by the genus group only.

2.1.34 The detectability of some bat species, such as brown long-eared, is lower than that of, for example, noctule and *Pipistrellus spp*.. The echolocation calls of brown long-eared are comparatively more difficult to detect with bat detectors, and their particular hunting strategies take them into less open habitats. Careful interpretation has therefore been applied when comparing survey results across species.

2.2 Results

Desk Study

Statutory Designated Sites for Nature Conservation

2.2.1 In review of Sitelink, the Site is not located within 10km of any national or internationally designated site for nature conservation, with bat qualifying interests.

2.2.2 In consultation with the HBRG, no non-statutory designated sites for nature conservation with bat interest are located within 2km of the Site.

Existing Bat Records

2.2.3 In consultation, the HBRG returned a total of 69 bat records for the period 2008 – 2017 from within 10km of the Site. Records were attributable to brown long-eared bat, common pipistrelle, soprano pipistrelle and *Pipistrellus spp.* (unknown pipistrelle species) with further details provided in **Annex 2**.

[6] https://www2.sepa.org.uk/rainfall/data/index/115329 [Accessed 04/10/2021]
[7] https://www.worldweatheronline.com/dingwall-weather-history/highland/gb.aspx [Accessed 04/10/2021]

2.2.4 A total of nine roost records were returned from within 10km of the Site. These consisted of three brown long-eared bat, three soprano pipistrelle and three *Pipistrellus spp.* roosts.

UK Bat Species Range

2.2.5 In review of the UK Habitats Directive Article 17 Report 'Habitats Directive Report 2019: Species Conservation Status Assessments 2019' based on Mathews *et al*. (2018), the Site is located within the known UK distribution range for the following bat species:

- Brown long-eared;
- Soprano pipistrelle;
- Common pipistrelle; and,
- Daubenton's bat *Myotis daubentoni*.

2.2.6 Whilst beyond the general distribution range of brown-long eared bat, this species was recorded within the Site and *Ecobat* tool also includes 41 records within their reference range for within 200km of the Site, and therefore the species is known to be present within the wider area.

Field Surveys

Habitat Assessment

2.2.7 The habitats within the Site are considered to be of low habitat risk for bats, in accordance with criteria presented in NatureScot guidelines (SNH, 2019).

2.2.8 The predominantly open areas of blanket bog and heath provide relatively poor foraging and commuting opportunities for bat species; however woodland edge habitat and the intersecting water courses running through the Site offer more suitable foraging opportunities and also likely connectivity with potentially higher value habitats within the wider landscape.

Preliminary Roost Assessment of Buildings and Trees

2.2.9 Potential roost features within the Site were limited; the Site is dominated by blanket bog and wet dwarf scrub heath and areas of young coniferous plantation woodland which offers negligible roost opportunities and so is unlikely to support roosts of any kind; including maternity or significant hibernation roosts.

2.2.10 Overall, the site is considered to provide negligible bat roosting potential.

Bat Activity Surveys

Summary of Results and Activity Levels

2.2.11 Bats were detected on 27 dates between 20/05/2021 and 31/08/2021, out of a possible 37 recording dates from five static bat detectors.

2.2.12 Species identified are presented in **Table 3.1** along with potential collision risk and population vulnerability as described in NatureScot guidance (SNH, 2019).

2.2.13 Overall, a total of 661 bat passes were recorded over a total of 132 survey nights (successful recording nights at all five detectors combined; see **Table 2.2**), as summarised in **Table 3.2**.

2.2.14 The full *Ecobat* output report is included as **Annex 3**.

Table 3.1: Bat species recorded, collision risk and population vulnerability.

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

Table 2.21: Total number of bat passes.

Species	Passes (No.)	Percentage of total (%)	Max Passes per Night	Mean Passes per Night
Common pipistrelle	265	43.4%	62	0.08
Myotis species	40	6.5%	4	2.01
Noctule	22	3.6%	6	0.30
Soprano pipistrelle	274	44.8%	61	0.17
Brown long-eared	10	1.6%	2	2.08
Total	**611**	**100.0%**	**135**	**4.63**

Ecobat Results

2.2.15 **Table 3.3** presents the number of nights species activity was recorded at each activity band.

2.2.16 **Table 3.4** presents the key metrics of the *Ecobat* output for each species. Data from all monitoring locations are used to provide Site-wide averages/medians.

Table 2.3: 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
Common pipistrelle	2	8	7	12	11
Myotis species	0	0	0	10	18
Noctule	0	0	1	1	15
Soprano pipistrelle	2	7	7	8	23
Brown long-eared	0	0	0	2	6

Table 2.4: Percentiles for each species within the Site.

Species/Species Group	Total Passes	Passes per Night		Median Percentile[8]	95% Cis[9]	Max Percentile [10]	Nights Recorded
		Recorded [11]	Included in *Ecobat*[12]				
Common pipistrelle	265	0.08	9.81	27	59.5 - 59.5	90	40
Myotis species	40	2.01	1.48	0	27 - 27	40	28
Noctule	22	0.30	0.81	0	0 - 0	53	17
Soprano pipistrelle	274	0.17	10.15	27	50.6 - 76	89	47
Brown long-eared	10	2.08	0.37	0	0 - 0	27	8

Spatial Distribution

2.2.17 The *Ecobat* output median and mean nightly pass rate (passes per hour, per night) of each species, at each detector for all months is presented in **Table 2.5**. The use of the median value is recognised to provide the more accurate representation of activity, as bat activity levels between nights can be highly variable, and thus the median provides a more reliable value than the mean or maximum (Lintott and Mathews, 2018). In addition, the dataset is unlikely to be normally distributed; therefore the median is the most appropriate metric to report.

2.2.18 Data for 'Includes Absences' and 'Excludes Absences' are included in **Table 3.5**. Includes absences takes into account nights when no bats were recorded and therefore lowers the overall medians and means (note this does not include any nights when no bats of any species were recorded as these are filtered out by *Ecobat* in the initial data upload to the *Ecobat* tool, see Limitations).

2.2.19 When absences are excluded medians and means are higher and show peaks in the data, which is especially useful for sites with low bat activity when peaks can be easily overlooked in large data sets.

Table 2.5: Median and Mean bat pass rate per species, per detector.
Detector locations not included recorded no bat passes.

Species	Detector ID	Total Bat Passes	Median Pass Rate (passes per hour/night)		Mean Pass Rate (passes per hour/night)	
			Incl. Absences	Excl. Absences	Incl. Absences	Excl. Absences
Common	LOC 1	164	0.2	0.3	0.7	1

[8] A numerical representation of average activity levels relative to the surrounding landscape (within 200 km) for each night of surveying.
[9] An indication of the confidence in the median percentile.
[10] A numerical representation of maximum activity levels on any one night relative to the surrounding landscape (within 200 km) for each night of surveying
[11] Total recorded nights for the survey period is 132.
[12] A total of 27 nights were included in *Ecobat*'s analysis. Nights when no bats are recorded are excluded.

Species	Detector ID	Total Bat Passes	Median Pass Rate (passes per hour/night)		Mean Pass Rate (passes per hour/night)	
			Incl. Absences	Excl. Absences	Incl. Absences	Excl. Absences
pipistrelle	LOC 2	67	0.2	0.3	0.4	0.7
	LOC 3	13	0.3	0.7	0.3	0.7
	LOC 4	11	0	0.3	0.1	0.3
	LOC 5	10	0.1	0.1	0.2	0.2
Soprano pipistrelle	LOC 1	153	0.2	0.2	0.7	0.9
	LOC 2	93	0.3	0.4	0.6	0.8
	LOC 3	5	0.1	0.1	0.2	0.2
	LOC 4	14	0.2	0.3	0.2	0.3
	LOC 5	9	0.1	0.1	0.1	0.2
Noctule	LOC 1	8	0	0.1	0	0.1
	LOC 2	8	0	0.1	0.1	0.2
	LOC 4	4	0	0.1	0	0.1
	LOC 5	2	0	0.1	0	0.1
Brown long-eared	LOC 1	7	0	0.1	0	0.1
	LOC 2	1	0	0.1	0	0.1
	LOC 3	1	0	0.1	0	0.1
	LOC 4	1	0	0.1	0	0.1
Myotis species	LOC 1	24	0.1	0.2	0.1	0.2
	LOC 2	12	0	0.2	0.1	0.2
	LOC 4	2	0	0.1	0	0.1
	LOC 5	2	0	0.1	0	0.1

Table 2.6: Percentiles for each species per detector location for the whole survey period.
Activity Level is based on the median percentile.

Species/Species Group	Detector ID	Median Percentile	95% CIs	Max Percentile	Nights Recorded	Activity Level
Common pipistrelle	LOC 1	27	33.5 - 60	90	18	Low to Moderate
	LOC 2	40	27 - 68.5	76	11	Low to Moderate
	LOC 3	60	59.5 - 59.5	61	2	Moderate

Species/Species Group	Detector ID	Median Percentile	95% CIs	Max Percentile	Nights Recorded	Activity Level
	LOC 4	24	50.5 - 50.5	53	4	Low to Moderate
	LOC 5	0	40 - 40	53	5	Low
Myotis species	LOC 1	0	27 - 27	40	17	Low
	LOC 2	27	27 - 27	40	7	Low to Moderate
	LOC 4	0	0 - 0	0	2	Low
	LOC 5	0	0 - 0	0	2	Low
Noctule	LOC 1	0	0 - 0	27	7	Low
	LOC 2	0	0 - 0	53	4	Low
	LOC 4	0	0 - 0	0	4	Low
	LOC 5	0	0 - 0	0	2	Low
Soprano pipistrelle	LOC 1	0	40 - 78	89	19	Low
	LOC 2	48	50.5 - 76	77	13	Moderate
	LOC 3	0	0 - 0	27	4	Low
	LOC 4	34	33.5 - 44	48	6	Low to Moderate
	LOC 5	0	37.5 - 37.5	48	5	Low
Brown long-eared	LOC 1	0	0 - 0	27	5	Low
	LOC 2	0	0	0	1	Low
	LOC 3	0	0	0	1	Low
	LOC 4	0	0	0	1	Low

Table 3.7: The number of nights sampled (detectors were operational for), the number of nights bats were recorded and the total number of bat recorded per monitoring station. Percentage distribution of no. bats is also presented.

Detector ID	No. Nights Sampled	No. of nights Bats were Recorded	Percentage of Nights Bats were Recorded	Total No. Bats recorded	Percentage Distribution of No. Bats
LOC 1	36	26	72.2%	356	58.27%
LOC 2	26	16	61.5%	181	29.62%
LOC 3	37	4	10.8%	32	5.24%
LOC 4	37	9	24.3%	19	3.11%
LOC 5	26	7	26.9%	23	3.76%

Temporal Activity

2.2.20 Activity levels were calculated by *Ecobat* per species (or species group) per month to allow for temporal variations in bat activity, as presented in **Table 2.8**. Median and maximum percentiles and corresponding activity levels are presented.

Table 2.8: Percentiles for each species each month within the site.
Activity Level is based on the median percentile.

Species/Species Group	Month	Median Percentile	95% CIs	Max Percentile	Nights Recorded	Activity Level
Common pipistrelle	May	27	33.5 - 60	58	4	Low to Moderate
	Jun	0	33.5 - 60	27	3	Low
	Aug	40	59.5 - 59.5	90	33	Low
Myotis species	May	0	27 - 27	0	6	Low
	Jun	0	27 - 27	27	5	Low
	Aug	0	27 - 27	40	17	Low
Noctule	Aug	0	0 - 0	53	17	Low
Soprano pipistrelle	May	0	40 - 78	40	5	Low
	Jun	0	50.5 - 76	0	9	Low
	Aug	40	50.5 - 76	89	33	Low to Moderate
Brown long-eared	Aug	0	0 - 0	27	8	Low

Potential bat roosts within or close to the site

2.2.21 *Ecobat* analysis showed that no activity was recorded within the species-specific emergence time for any of the static monitoring locations. This supports that there are no bat roosts present at the Proposed Development.

Weather Conditions

2.2.22 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) from the data set.

2.2.23 The majority of survey nights were undertaken in suitable weather conditions (31 out of 41). Subsequently the bat survey data recorded is considered to be representative for the Site.

2.2.24 Weather data are presented in **Annex 1**.

2.3 Assessment of the Potential Risks to Bats

Stage 1 – Initial Site Risk Assessment

2.3.1 In accordance with NatureScot guidance (SNH, 2019) an assessment of the potential risk level of the proposed Development Site, has been undertaken based on a consideration of habitat and development-related features detailed in Table 3a of the NatureScot guidance (SNH, 2019).

2.3.2 The values and classification criteria provided within Table 3a of NatureScot guidance (SNH, 2019) 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 has therefore been applied to interpret and assign risk categories and conclude on the overall risk level for the Site.

2.3.3 The Site has been assessed as having an overall 'Site Risk' of **2**, represent a **Low Site Risk**:

- The Site 'Habitat Risk is classified as **Low**.
- The Site 'Project Size' is classified as being **Medium**. The Site itself only comprises the development of five turbines of up to 150m tip height and thus would be classified as Low, however, there are an additional three operational wind farm developments located within close proximity, being immediately south/south-east of the Site, comprising a total of 42 turbines (Corriemoillie (19 turbines), Lochluichart (17 turbines) and Lochluichart Extension (six turbines)); the additional five turbines within this already well developed area is likely to increase the risk of bat collisions and thus the Site is classified as being **Medium**.

Stage 2 – Overall Risk Assessment

2.3.4 In accordance with NatureScot guidance (SNH, 2019), Stage 2 should be carried out separately for all high collision risk species recorded, which includes the following species recorded during bat activity surveys for the proposed Development:

- Noctule bat;
- Common pipistrelle; and,
- Soprano pipistrelle.

2.3.5 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 3b in SNH (2019) to determine the level of overall risk.

2.3.6 The calculated 'Overall Risk Assessment' per species, both temporally and spatially, is presented in **Table 5.1**. The Overall Risk Category provided is concluded on the basis of the determined *Ecobat* conclusion and professional judgement on the basis of all available information and in recognition of the limitations of *Ecobat*.

2.3.7 As outlined, 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.

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

2.3.9 In recognition of the limitations associated with the *Ecobat* tool, the output of Stage 2 should be treated with caution.

Table 5.1: Overall Risk Assessment (Table 3b from SNH (2019) guidance). Key: green = Low, Amber = Medium, Red = High

Species / species group	I.D	Median Percentile	Percentile Category	Overall Risk Assessment (Stage 2)
Common pipistrelle	LOC 1	27	Low to Moderate	Low (4)
	LOC 2	40	Low to Moderate	Low (4)
	LOC 3	60	Moderate	Moderate (6)
	LOC 4	24	Low to Moderate	Low (4)
	LOC 5	0	Low	Low (2)
Myotis species	LOC 1	0	Low	Low (2)
	LOC 2	27	Low to Moderate	Low (4)
	LOC 4	0	Low	Low (2)
	LOC 5	0	Low	Low (2)
Noctule	LOC 1	0	Low	Low (2)
	LOC 2	0	Low	Low (2)
	LOC 4	0	Low	Low (2)
	LOC 5	0	Low	Low (2)
Soprano pipistrelle	LOC 1	0	Low	Low (2)
	LOC 2	48	Moderate	Moderate (6)
	LOC 3	0	Low	Low (2)
	LOC 4	34	Low to Moderate	Low (4)

Species / species group	Month	Median Percentile	Percentile Category	Overall Risk Assessment (Stage 2)
Myotis species	May	0	Low	Low (2)
	Jun	0	Low	Low (2)
	Aug	0	Low	Low (2)
Noctule	Aug	0	Low	Low (2)
Common pipistrelle	May	27	Low to Moderate	Low (4)
	Jun	0	Low	Low (2)
	Aug	40	Low	Low (2)
Soprano pipistrelle	May	0	Low	Low (2)
	Jun	0	Low	Low (2)
	Aug	40	Low to Moderate	Low (4)
Brown long-eared	Aug	0	Low	Low (2)

	LOC 5	0	Low	Low (2)		
Brown long-eared	LOC 1	0	Low	Low (2)		
	LOC 2	0	Low	Low (2)		
	LOC 3	0	Low	Low (2)		
	LOC 4	0	Low	Low (2)		

3 HABITATS AND PROTECTED MAMMALS

3.1 Methodology

3.1.1 Given the existence of habitat data for the Proposed Development from survey work undertaken in 2010, 2015 and 2017, and the low likelihood of significant changes to the recorded baseline habitats having occurred in the intervening period, surveys in 2021, completed on 23 August, comprised an updated habitat walkover survey to identify any material changes in baseline habitats recorded within the Site since previous results were collected. All surveys were undertaken in accordance with industry guidance applicable at the time:

- JNCC - Handbook for Phase I Habitat Survey – a Technique for Environmental Audit 2010;
- Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) 2009; and,
- National Vegetation Community Users' Handbook – (Rodwell, 2006).

3.1.2 Habitat survey methods were extended to include the additional recording of specific features indicating the presence, or likely presence, of protected or notable species.

3.2 Results

Habitats

3.2.1 Overall, it would appear that the plant communities present at Loch Luichart have not changed since the surveys undertaken in 2017. The site is mix of either M17 bog or M15 wet heath, the M17 occurring on deeper peat (generally over 50cm deep) and the M15 on shallow peat (less than 50cm deep). However, the walkover found the distribution of these communities to differ from the 2017 mapping, with the M17 bog community being much more extensive in the northern half of the site (this area was not mapped in detail in the 2017 survey). A large M6 *Carex echinata* flush was also noted in this northern area, with a few other similar flushes scattered across the site.

3.2.2 The planted Scots pine *Pinus sylvestris* that covers much of the site was found to have the same distribution, with trees averaging around 4–6m in height.

3.2.3 Additionally, some U4 type grassland was found to have colonised a landscaped former borrow pit in the northern part of the Site.

Community descriptions

M15 – *Trichophorum germanicum* – *Erica tetralix* wet heath

3.2.4 This community covers much of the site. It occurs on shallow peat, under 50cm deep with an average depth of *c*. 30cm but can tolerate depth shallower than 5cm deep. It mostly is present on the 'higher' ground of the site and on steeper slopes.

3.2.5 Vegetatively it is dominated by dense tufts of *Trichophorum germanicum*, with a mix of *Erica tetralix*, *Narthecium ossifragum*, small amounts of *Molinia caerulea*, *Eriophorum angustifolium* and *Calluna vulgaris* with lichens and mosses such as *Cladonia* species, *Racomitrium lanuginosum* and *Sphagnum capillifolium* often being numerous. Grazing by red deer on the site and within this community appears high, probably resulting in the very suppressed ericoids present.

M17 –*Trichophorum germanicum* – *Eriophorum vaginatum* mire

3.2.6 This habitat can look very similar to the adjacent M15 communities but differs in that it occurs on deep peat at least 50cm deep, often much deeper. It is found on flat or gently sloping ground where deeper peat has been able to accumulate, and is generally damper on the surface. It is also exposed to the fairly heavy grazing by deer that the M15 communities suffer from. Also, much of the bog has had furrows cut into its surface and Scots Pine planted.

3.2.7 Vegetatively it has more *Calluna vulgaris* than the M15 and a greater amount of tussock forming *Eriophorum vaginatum*, mosses such as *Racomitrium lanuginosum* and lichens are much reduced with *Sphagnum capillifolium* and *S. papillosum* becoming more abundant. *Erica tetralix*, *Trichophorum germanicum*, *Narthecium ossifragum*, *Drosera rotundifolia* and *D. anglica* are also numerous.

U4 – *Festuca ovina - Agrostis capillaris - Galium saxatile* grassland

3.2.8 This community appears to only have recently colonised a landscaped borrow pit at NH 33227 70106. It is largely composed of *Agrostis capillaris*, with some *Festuca ovina* and occasional *Potentilla erecta* some scattered *Juncus effusus*.

M6 –*Carex echinata-Sphagnum recurvum/auriculatum* mire

3.2.9 The flush at NH 33165 69058 is typical of other M6 flushes that are scattered in a few localities across the site. They are found within the M17 communities, with deep, wet peat. Sedges present include *Carex echinata*, *C. nigra* and *C. panicea*. Other plants include *Narthecium ossifagum*, *Molinia caerulea, Erica tetralix* and *Drosera rotundifolia*. Mosses include *Sphagnum fallax* and *S. papillosum*.

Protected species

Mammals

3.2.10 Only red deer evidence was noted on the site during the survey visit, with footprints and dung numerous and widespread. The few burns that criss-cross the site have potential for both visiting otters and resident water vole, although no evidence of either species was noted.

3.2.11 There are no structures or trees that look suitable for bat roosts anywhere within the boundaries of the Site.

3.2.12 No evidence of badger presence was noted; the wet and peaty nature of the Site largely make it unsuitable for sett construction. There is a little potential for foraging pine marten, but the trees present on site are not yet mature and no structures suitable for denning were noted so the Site is unsuitable for this species to be resident. No evidence of the species was noted.

3.2.13 A few fox scats were noted, mostly along the edge of the windfarm access track. No dens were found.

REFERENCES

Collins, J. (ed.) (2016). *Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn)*. The Bat Conservation Trust, London.

Gannon, W., Sherwin, R. and Haymond, S. (2003). On the importance of articulating assumptions when conducting acoustic studies of habitat use by bats. *Wildlife Society Bulletin*, **31**, pp. 45-61.

Hundt, L. (2012). *Bat Surveys: Good Practice Guidelines (2nd edn)*. The Bat Conservation Trust, London.

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.

Mathews, F., Kubasiewicz, L.M., Gurnell, J., Harrower, C.A., McDonald, R.A. and Shore, R.F. (2018). A Review of the Population and Conservation Status of British Mammals: Technical Summary. A report by the Mammal Society under contract to Natural England, Natural Resources Wales and Scottish Natural Heritage. Natural England, Peterborough.

Rodwell, J.S. (2006) NVC Users' Handbook, JNCC, Peterborough, ISBN 978 1 86107 574 1

ANNEX 1: WEATHER CONDITIONS

Table A2.1 below provides weather conditions for Bat Activity Survey periods. Weather conditions are shown for dusk.

Table A2.1: Weather Conditions.

Date	Temperature (C°)	Wind speed (mps)	Rain (mm)
20/05/2021	7	1.4	0
21/05/2021	4	3.2	0
22/05/2021	3	0	0
23/05/2021	5	0	0
24/05/2021	13	0	0
25/05/2021	5	7.9	0
26/05/2021	5	18.7	0
27/05/2021	10	0	0
28/05/2021	7	0	0
29/05/2021	9	0	0
30/05/2021	11	1.4	0
31/05/2021	24	0	0
01/06/2021	11	4.7	0
02/06/2021	13	4.7	0
03/06/2021	19	0	0
17/06/2021	11	7.2	0
18/06/2021	9	25.2	0
19/06/2021	7	7. 2	0
20/06/2021	8	21.6	0
21/06/2021	11	14.4	0
22/06/2021	7	28.8	0
23/06/2021	13	28.8	0
24/06/2021	10	14.4	0
25/06/2021	10	14.4	0
26/06/2021	12	10.8	0

27/06/2021	15	14.4	0
28/06/2021	17	7.2	0
29/06/2021	16	7.2	0
17/08/2021	15	28.80	0
18/08/2021	10	25.20	0.2
19/08/2021	10	1.44	0
20/08/2021	13	3.24	0
21/08/2021	12	4.68	0.25
22/08/2021	13	3.24	0
23/08/2021	13.7	3.24	0
24/08/2021	15	3.24	0
25/08/2021	15.7	3.24	0
26/08/2021	13.7	3.24	0
27/08/2021	11.1	3.24	0
28/08/2021	11.6	1.44	0
29/08/2021	10.8	7.92	0
30/08/2021	11.2	4.68	0
31/08/2021	8.8	3.24	0

ANNEX 2: EXISTING BAT SPECIES RECORDS – HBRG

Table A3.1 below provides further details of bat records provided by the HBRG from within 10km of the Site.

Table A4.1: Existing bat species records – HBRG.

Species	Date	Location	Sample Spatial Reference	Abundances	Comment
Pipistrelle spp.	22/12/2008	Lochluichart	NH3363	1 Count	Flying in daytime.
Pipistrelle spp.	26/11/2008	Torriegorrie	NH3763	1 Count	Seen regularly.
Pipistrelle spp.	27/02/2009	Torriegorrie	NH3763	1 Count	
Pipistrelle spp.	28/02/2009	Torriegorrie	NH3763	1 Count	
Pipistrelle spp.	17/02/2009	Torriegorrie	NH3763	2 Count	
Pipistrelle spp.	18/02/2009	Torriegorrie	NH3763	1 Count	
Pipistrelle spp.	23/02/2009	Torriegorrie	NH3763	1 Count	
Pipistrelle spp.	26/02/2009	Torriegorrie	NH3763	1 Count	
Pipistrelle spp.	18/09/2011	Torriegorrie	NH3763	8 Count	Emerging from roost in cottage roof.
Pipistrelle spp.	19/09/2011	Torriegorrie	NH3763	11 Count	Emerging from roost in cottage roof.
Pipistrelle spp.	28/09/2011	Torriegorrie	NH3763	2 Count	Feeding by burn.
Pipistrelle spp.	09/05/2011	Torriegorrie	NH3763	3+ Count	
Pipistrelle spp.	10/11/2011	Torriegorrie	NH3763	1 Count	Feeding.
Pipistrelle spp.	27/04/2011	Torriegorrie	NH3763	2 Count	
Pipistrelle spp.	06/01/2017	Torriegorrie	NH3763	1 Count	Seen foraging.
Pipistrelle spp.	28/12/2016	Torriegorrie	NH3763	1 Count	Seen foraging.
Pipistrelle spp.	26/09/2010	Torriegorrie	NH3763	1 Count	Feeding just before dark.
Pipistrelle spp.	30/09/2010	Torriegorrie	NH3763	1 Count	Feeding just before dark.
Pipistrelle spp.	08/10/2010	Torriegorrie	NH3763	2 Count	Feeding just before dark.

Species	Date	Location	Sample Spatial Reference	Abundances	Comment
Pipistrelle spp.	21/08/2010	Torriegorrie	NH3763	4 Count	Emerging from roost.
Pipistrelle spp.	25/10/2009	Torriegorrie	NH3763	2 Count	
Pipistrelle spp.	26/09/2009	Torriegorrie	NH3763	1 Count	Dead.
Pipistrelle spp.	11/10/2009	Torriegorrie	NH3763	2 Count	
Pipistrelle spp.	12/10/2009	Torriegorrie	NH3763	2 Count	
Pipistrelle spp.	15/03/2009	Torriegorrie	NH3763	2 Count	
Pipistrelle spp.	21/06/2009	Torriegorrie	NH3763	1 Count	Dead - may be cat victim.
Common Pipistrelle	23/10/2016	Torriegorrie	NH3763	1+ Count	Foraging; Elekon batscanner.
Common Pipistrelle	14/11/2016	Torriegorrie	NH3763	1+ Count	Foraging; Elekon batscanner.
Common Pipistrelle	26/07/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Common Pipistrelle	19/08/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Common Pipistrelle	05/06/2014	Torriegorrie	NH3763	2 Count	Foraging - Elekon batscanner.
Common Pipistrelle	17/07/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Common Pipistrelle	04/07/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Common Pipistrelle	15/02/2019	Torriegorrie	NH3763	1 Count	Peersonic detector.
Common Pipistrelle	14/08/2016	Torriegorrie	NH3763	1+ Count	Foraging; Elekon batscanner.
Common Pipistrelle	25/07/2016	Torriegorrie	NH3763	1 Count	Elekon batscanner.
Common Pipistrelle	13/10/2009	Torriegorrie	NH3763	1 Count	
Soprano Pipistrelle	21/03/2012	Torriegorrie	NH3763	1 Count	Detector and sonogram.
Soprano Pipistrelle	24/03/2012	Torriegorrie	NH3763	6 Count	Emerging from roost. Detector and sonogram.
Soprano Pipistrelle	23/10/2016	Torriegorrie	NH3763	1+ Count	Foraging; Elekon batscanner.
Soprano Pipistrelle	13/11/2016	Torriegorrie	NH3763	1+ Count	Foraging; Elekon batscanner.
Soprano Pipistrelle	19/08/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.

Species	Date	Location	Sample Spatial Reference	Abundances	Comment
Soprano Pipistrelle	04/09/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Soprano Pipistrelle	17/09/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Soprano Pipistrelle	26/07/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Soprano Pipistrelle	11/08/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Soprano Pipistrelle	20/08/2010	Torriegorrie	NH3763	4 Count	Emerging from roost.
Soprano Pipistrelle	10/09/2010	Torriegorrie	NH3763	2 Count	Either courting or fighting - a bat dance.
Soprano Pipistrelle	08/10/2010	Torriegorrie	NH3763	1 Count	Bat detector.
Soprano Pipistrelle	13/10/2009	Torriegorrie	NH3763	1+ Count	
Soprano Pipistrelle	05/04/2014	Torriegorrie	NH3763	1 Count	Foraging - Elekon batscanner.
Soprano Pipistrelle	08/04/2014	Torriegorrie	NH3763	1 Count	Foraging - Elekon batscanner.
Soprano Pipistrelle	05/06/2014	Torriegorrie	NH3763	1 Count	Foraging - Elekon batscanner.
Soprano Pipistrelle	17/07/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Soprano Pipistrelle	04/07/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Soprano Pipistrelle	25/07/2016	Torriegorrie	NH3763	1 Count	Elekon batscanner; emerging from roost.
Soprano Pipistrelle	14/08/2016	Torriegorrie	NH3763	1+ Count	Foraging; Elekon batscanner.
Soprano Pipistrelle	21/02/2019	Torriegorrie	NH3763	1 Count	Peersonic detector.
Soprano Pipistrelle	27/02/2019	Torriegorrie	NH3763	2 Count	Peersonic detector.
Brown Long-eared Bat	04/07/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Brown Long-eared Bat	11/08/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Brown Long-eared Bat	26/07/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Brown Long-eared Bat	17/09/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Brown Long-eared Bat	04/09/2017	Torriegorrie	NH3763	9 Count	Emerging from roost.
Brown Long-eared Bat	19/08/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.

Species	Date	Location	Sample Spatial Reference	Abundances	Comment
Brown Long-eared Bat	21/08/2017	Torriegorrie	NH3763	7 Count	Emerging from roost.
Brown Long-eared Bat	17/07/2017	Torriegorrie	NH3763	1+ Count	Peersonic detector.
Brown Long-eared Bat	25/04/2009	Loch Luichart	NH3363		
Brown Long-eared Bat	20/07/2008	Lochluichart	NH3363	1 Count	Inside house.

ANNEX 3: ECOBAT TOOL OUTPUT REPORT

Bat Activity Analysis

Site Name: Lochluichart Extension II

Author: Andrew Hulme

24/09/2021

4 SUMMARY

Bats were detected on **27** nights between **2021-05-25** and **2021-08-30**, using **5** static bat detectors. Throughout this period **5** species were recorded. **Table 1.** Detectors were placed at the following locations:

Detector ID	Latitude	Longitude
LOC 1	57.67804	-4.785321
LOC 2	57.67772	-4.797728
LOC 5	57.67986	-4.815945
LOC 4	57.67892	-4.818505
LOC 3	57.67600	-4.808247

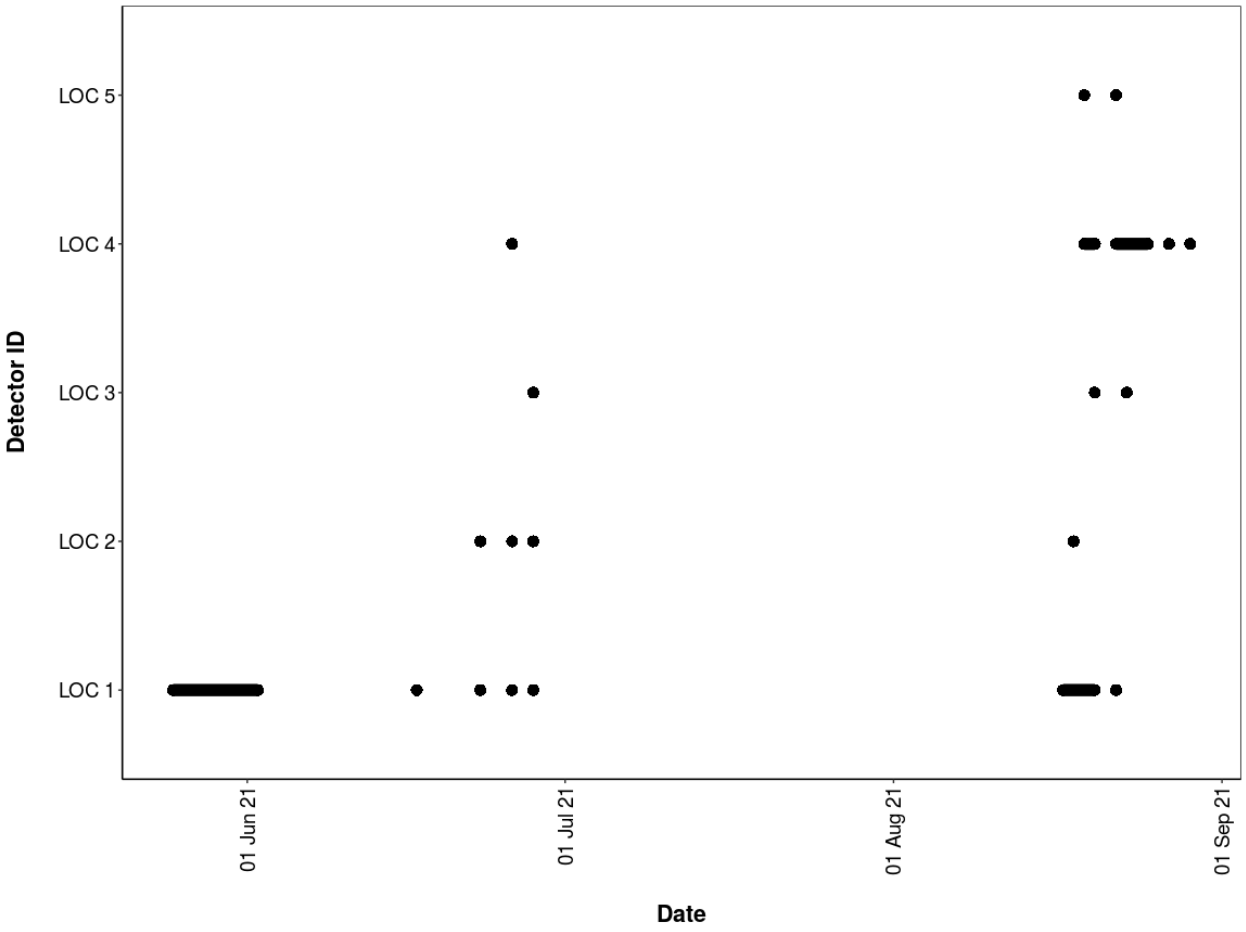
5 SURVEY NIGHTS

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
LOC 1	26
LOC 2	16
LOC 3	4
LOC 4	9
LOC 5	7

6 SURVEY NIGHTS

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



6.1 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.

6.2 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
LOC 1	*Myotis*	0	0	0	6	11
LOC 1	*Nyctalus noctula*	0	0	0	1	6
LOC 1	*Pipistrellus pipistrellus*	2	3	2	7	4
LOC 1	*Pipistrellus pygmaeus*	2	3	1	3	10
LOC 1	*Plecotus auritus*	0	0	0	2	3
LOC 2	*Myotis*	0	0	0	4	3
LOC 2	*Nyctalus noctula*	0	0	1	0	3
LOC 2	*Pipistrellus pipistrellus*	0	4	1	4	2
LOC 2	*Pipistrellus pygmaeus*	0	4	4	0	5
LOC 2	*Plecotus auritus*	0	0	0	0	1
LOC 3	*Pipistrellus pipistrellus*	0	1	1	0	0
LOC 3	*Pipistrellus pygmaeus*	0	0	0	1	3
LOC 3	*Plecotus auritus*	0	0	0	0	1
LOC 4	*Myotis*	0	0	0	0	2
LOC 4	*Nyctalus noctula*	0	0	0	0	4
LOC 4	*Pipistrellus pipistrellus*	0	0	2	0	2

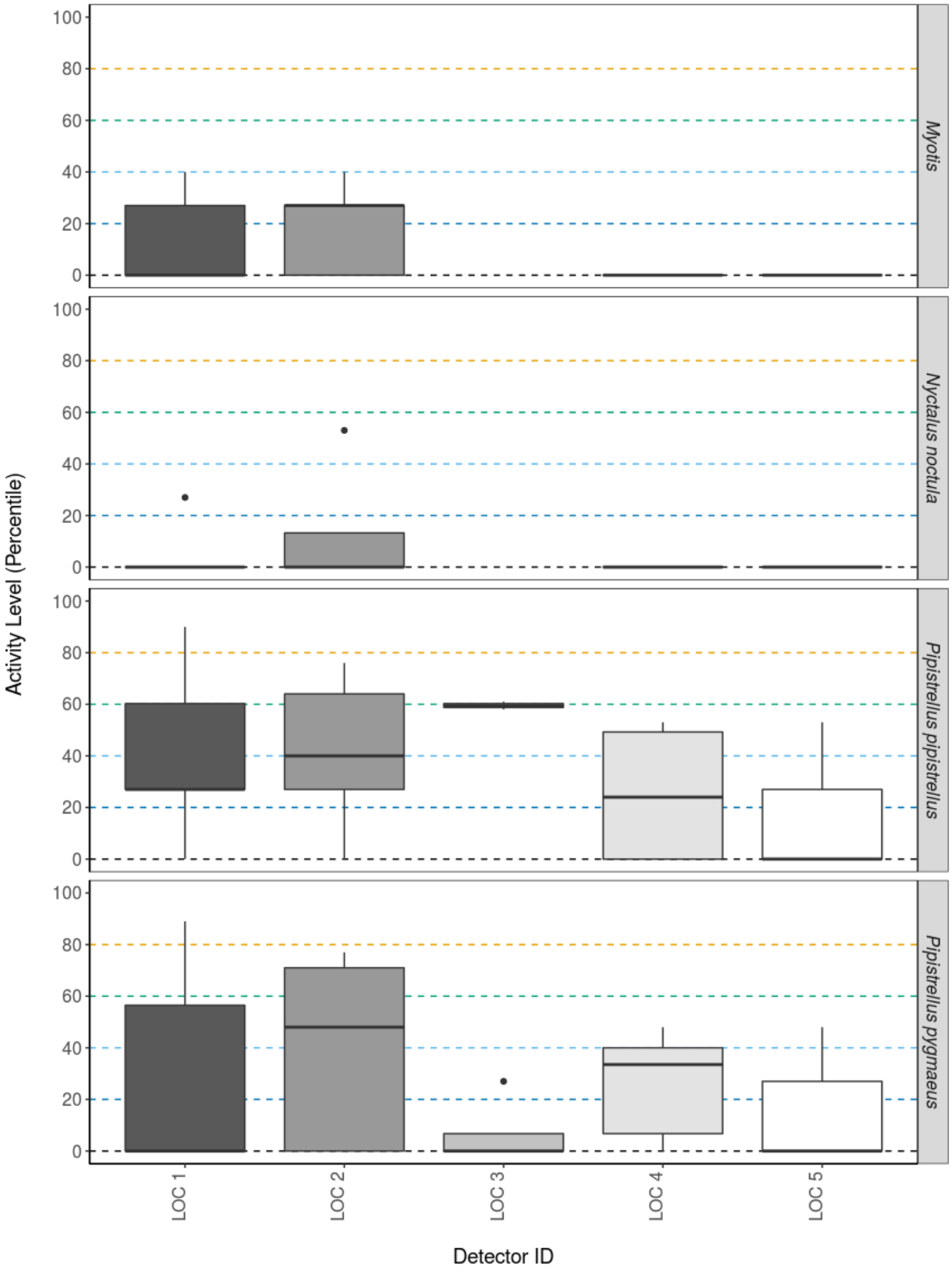
LOC 4	*Pipistrellus pygmaeus*	0	0	1	3	2
LOC 4	*Plecotus auritus*	0	0	0	0	1
LOC 5	*Myotis*	0	0	0	0	2
LOC 5	*Nyctalus noctula*	0	0	0	0	2
LOC 5	*Pipistrellus pipistrellus*	0	0	1	1	3
LOC 5	*Pipistrellus pygmaeus*	0	0	1	1	3

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
LOC 1	*Myotis*	0	27 - 27	40	17	278
LOC 1	*Nyctalus noctula*	0	0 - 0	27	7	158
LOC 1	*Pipistrellus pipistrellus*	27	33.5 - 60	90	18	1215
LOC 1	*Pipistrellus pygmaeus*	0	40 - 78	89	19	550
LOC 1	*Plecotus auritus*	0	0 - 0	27	5	41
LOC 2	*Myotis*	27	27 - 27	40	7	278
LOC 2	*Nyctalus noctula*	0	0 - 0	53	4	158
LOC 2	*Pipistrellus pipistrellus*	40	27 - 68.5	76	11	1215
LOC 2	*Pipistrellus pygmaeus*	48	50.5 - 76	77	13	550
LOC 2	*Plecotus auritus*	0	0	0	1	41
LOC 3	*Pipistrellus pipistrellus*	60	59.5 - 59.5	61	2	1215
LOC 3	*Pipistrellus pygmaeus*	0	0 - 0	27	4	550
LOC 3	*Plecotus auritus*	0	0	0	1	41
LOC 4	*Myotis*	0	0 - 0	0	2	278
LOC 4	*Nyctalus noctula*	0	0 - 0	0	4	158
LOC 4	*Pipistrellus pipistrellus*	24	50.5 - 50.5	53	4	1215
LOC 4	*Pipistrellus pygmaeus*	34	33.5 - 44	48	6	550
LOC 4	*Plecotus auritus*	0	0	0	1	41

LOC 5	*Myotis*	0	0 - 0	0	2	278
LOC 5	*Nyctalus noctula*	0	0 - 0	0	2	158
LOC 5	*Pipistrellus pipistrellus*	0	40 - 40	53	5	1215
LOC 5	*Pipistrellus pygmaeus*	0	37.5 - 37.5	48	5	550

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)


Activity Level (Percentile)
100
80
60
40
20
0
Myotis
Nyctalus noctula
Pipistrellus pipistrellus
Pipistrellus pygmaeus
LOC 1
LOC 2
LOC 3
LOC 4
LOC 5
Detector ID

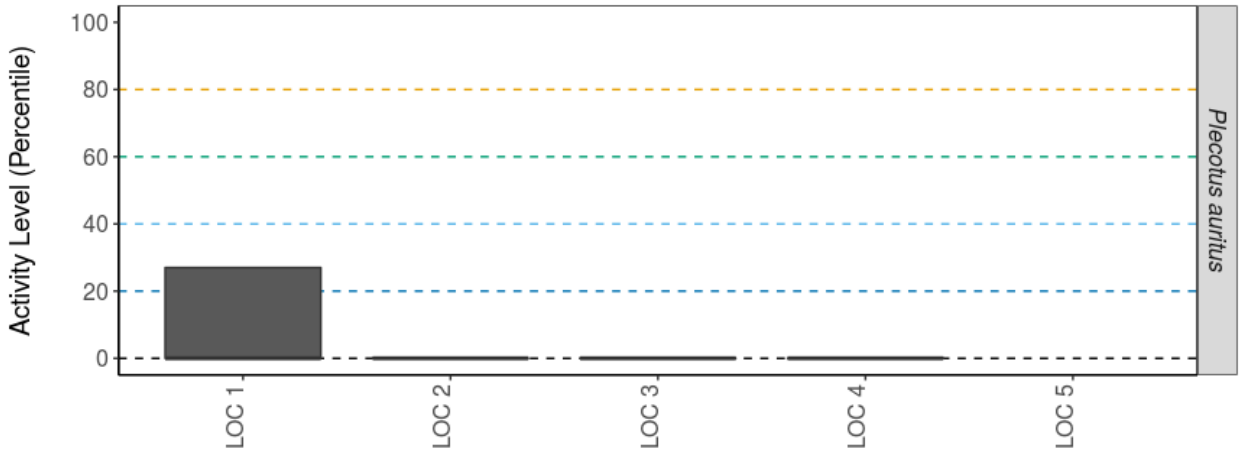
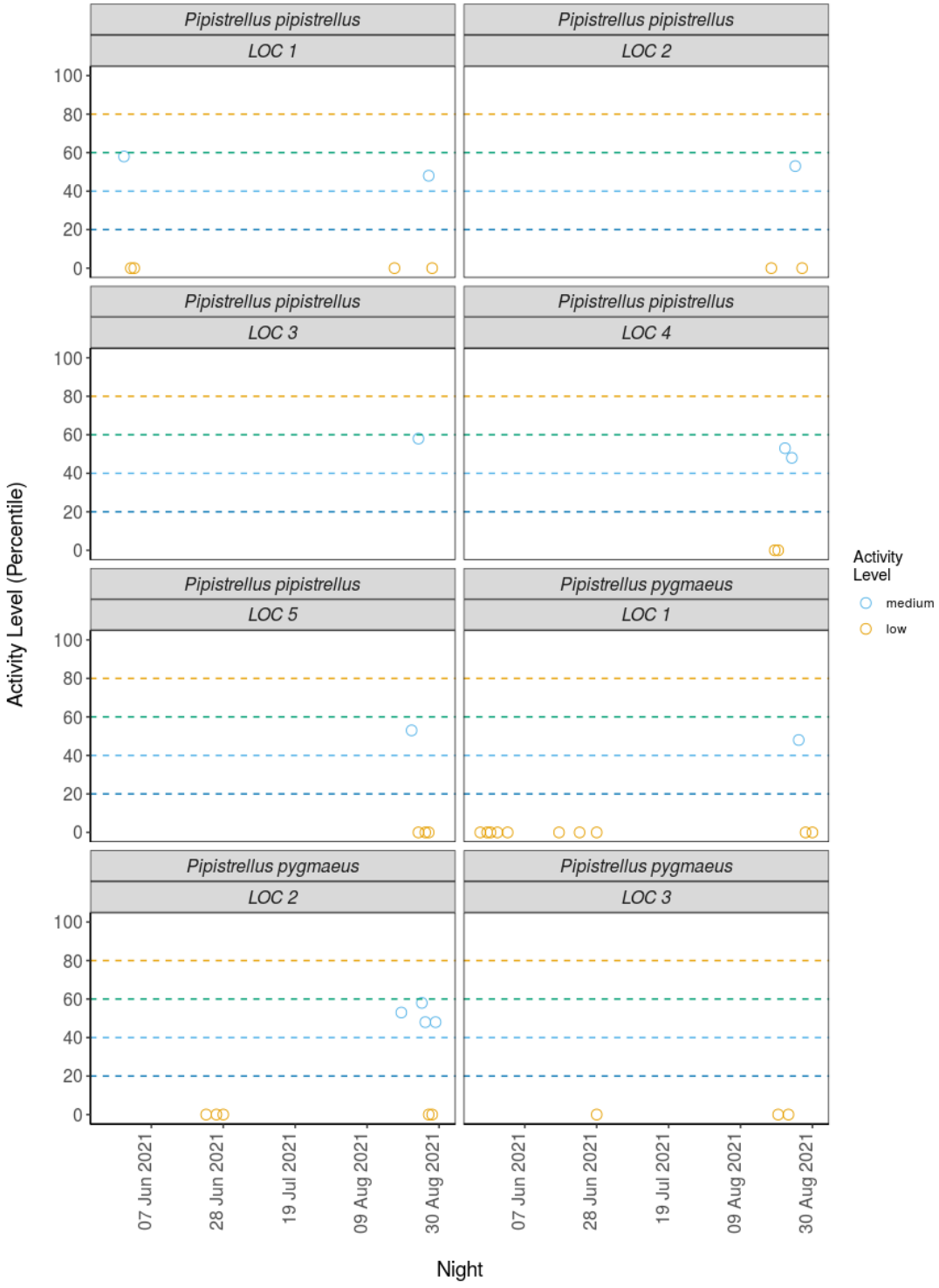
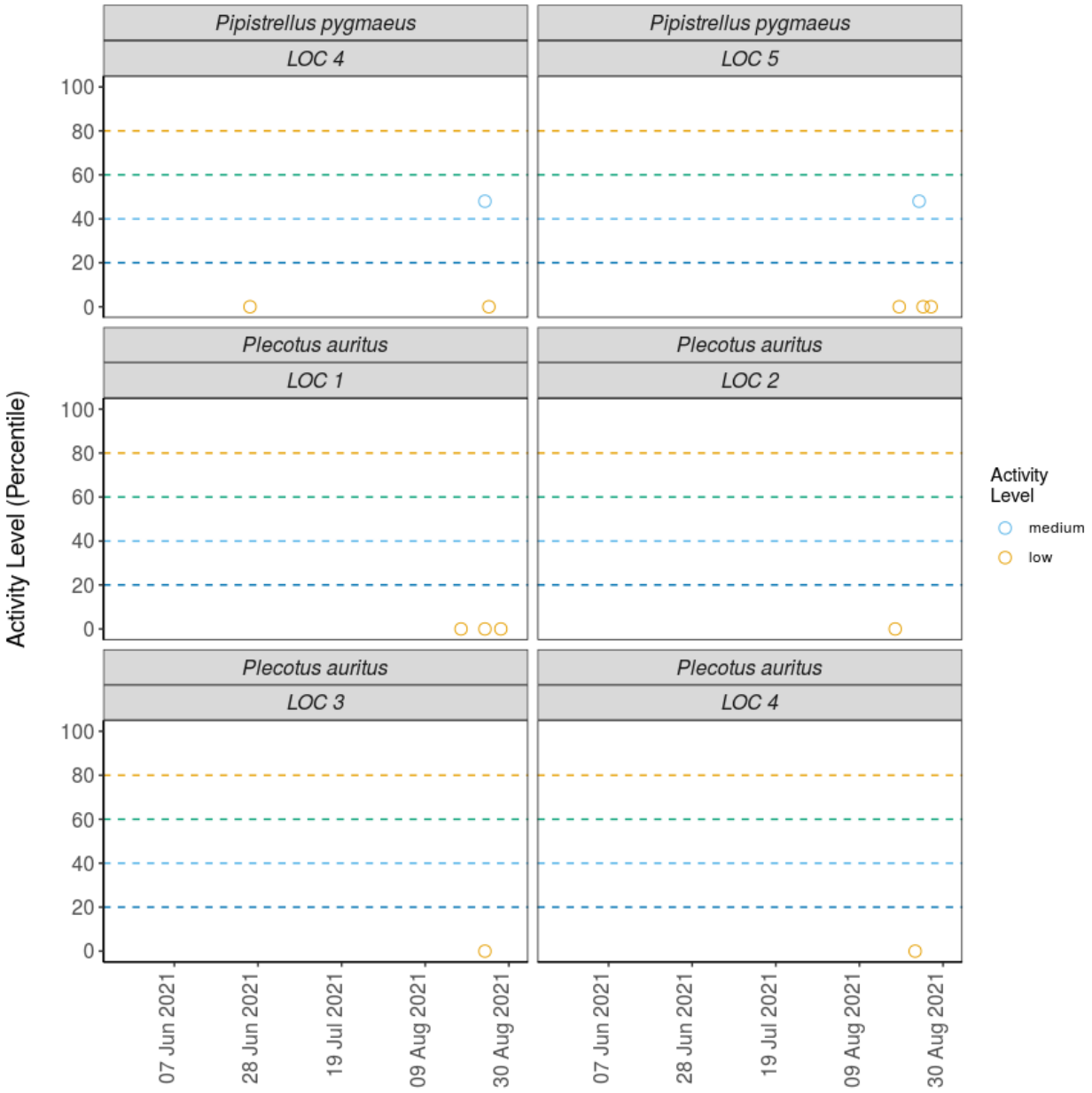

Activity Level (Percentile)
100
80
60
40
20
0
LOC 1
LOC 2
LOC 3
LOC 4
LOC 5
Plecotus auritus
Detector ID

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




Pipistrellus pygmaeus
LOC 4
Pipistrellus pygmaeus
LOC 5
Plecotus auritus
LOC 1
Plecotus auritus
LOC 2
Plecotus auritus
LOC 3
Plecotus auritus
LOC 4
Activity Level (Percentile)
100
80
60
40
20
0
07 Jun 2021
28 Jun 2021
19 Jul 2021
09 Aug 2021
30 Aug 2021
Activity Level
medium
low
Night

6.3 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
LOC 1	*Myotis*	May	0	0	0	0	6
LOC 1	*Myotis*	Jun	0	0	0	2	1
LOC 1	*Myotis*	Aug	0	0	0	4	4
LOC 1	*Nyctalus noctula*	Aug	0	0	0	1	6
LOC 1	*Pipistrellus pipistrellus*	May	0	0	1	3	0
LOC 1	*Pipistrellus pipistrellus*	Jun	0	0	0	1	2
LOC 1	*Pipistrellus pipistrellus*	Aug	2	3	1	3	2
LOC 1	*Pipistrellus pygmaeus*	May	0	0	0	1	4
LOC 1	*Pipistrellus pygmaeus*	Jun	0	0	0	0	4
LOC 1	*Pipistrellus pygmaeus*	Aug	2	3	1	2	2
LOC 1	*Plecotus auritus*	Aug	0	0	0	2	3
LOC 2	*Myotis*	Jun	0	0	0	0	2
LOC 2	*Myotis*	Aug	0	0	0	4	1
LOC 2	*Nyctalus noctula*	Aug	0	0	1	0	3
LOC 2	*Pipistrellus pipistrellus*	Aug	0	4	1	4	2
LOC 2	*Pipistrellus pygmaeus*	Jun	0	0	0	0	3
LOC 2	*Pipistrellus pygmaeus*	Aug	0	4	4	0	2
LOC 2	*Plecotus auritus*	Aug	0	0	0	0	1
LOC 3	*Pipistrellus pipistrellus*	Aug	0	1	1	0	0
LOC 3	*Pipistrellus pygmaeus*	Jun	0	0	0	0	1
LOC 3	*Pipistrellus pygmaeus*	Aug	0	0	0	1	2

LOC 3	*Plecotus auritus*	Aug	0	0	0	0	1
LOC 4	*Myotis*	Aug	0	0	0	0	2
LOC 4	*Nyctalus noctula*	Aug	0	0	0	0	4
LOC 4	*Pipistrellus pipistrellus*	Aug	0	0	2	0	2
LOC 4	*Pipistrellus pygmaeus*	Jun	0	0	0	0	1
LOC 4	*Pipistrellus pygmaeus*	Aug	0	0	1	3	1
LOC 4	*Plecotus auritus*	Aug	0	0	0	0	1
LOC 5	*Myotis*	Aug	0	0	0	0	2
LOC 5	*Nyctalus noctula*	Aug	0	0	0	0	2
LOC 5	*Pipistrellus pipistrellus*	Aug	0	0	1	1	3
LOC 5	*Pipistrellus pygmaeus*	Aug	0	0	1	1	3

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
LOC 1	*Myotis*	May	0	27 - 27	0	6
LOC 1	*Myotis*	Jun	27	27 - 27	27	3
LOC 1	*Myotis*	Aug	14	27 - 27	40	8
LOC 1	*Nyctalus noctula*	Aug	0	0 - 0	27	7
LOC 1	*Pipistrellus pipistrellus*	May	27	33.5 - 60	58	4
LOC 1	*Pipistrellus pipistrellus*	Jun	0	33.5 - 60	27	3
LOC 1	*Pipistrellus pipistrellus*	Aug	48	33.5 - 60	90	11
LOC 1	*Pipistrellus pygmaeus*	May	0	40 - 78	40	5
LOC 1	*Pipistrellus pygmaeus*	Jun	0	40 - 78	0	4
LOC 1	*Pipistrellus pygmaeus*	Aug	57	40 - 78	89	10
LOC 1	*Plecotus auritus*	Aug	0	0 - 0	27	5
LOC 2	*Myotis*	Jun	0	27 - 27	0	2
LOC 2	*Myotis*	Aug	27	27 - 27	40	5
LOC 2	*Nyctalus noctula*	Aug	0	0 - 0	53	4
LOC 2	*Pipistrellus pipistrellus*	Aug	40	27 - 68.5	76	11
LOC 2	*Pipistrellus pygmaeus*	Jun	0	50.5 - 76	0	3
LOC 2	*Pipistrellus pygmaeus*	Aug	56	50.5 - 76	77	10
LOC 2	*Plecotus auritus*	Aug	0	0	0	1
LOC 3	*Pipistrellus pipistrellus*	Aug	60	59.5 - 59.5	61	2
LOC 3	*Pipistrellus pygmaeus*	Jun	0	0 - 0	0	1
LOC 3	*Pipistrellus pygmaeus*	Aug	0	0 - 0	27	3
LOC 3	*Plecotus auritus*	Aug	0	0	0	1
LOC 4	*Myotis*	Aug	0	0 - 0	0	2
LOC 4	*Nyctalus noctula*	Aug	0	0 - 0	0	4
LOC 4	*Pipistrellus pipistrellus*	Aug	24	50.5 - 50.5	53	4

LOC 4	*Pipistrellus pygmaeus*	Jun	0	33.5 - 44	0	1
LOC 4	*Pipistrellus pygmaeus*	Aug	40	33.5 - 44	48	5
LOC 4	*Plecotus auritus*	Aug	0	0	0	1
LOC 5	*Myotis*	Aug	0	0 - 0	0	2
LOC 5	*Nyctalus noctula*	Aug	0	0 - 0	0	2
LOC 5	*Pipistrellus pipistrellus*	Aug	0	40 - 40	53	5
LOC 5	*Pipistrellus pygmaeus*	Aug	0	37.5 - 37.5	48	5

6.4 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	0	0	0	10	18
Nyctalus noctula	0	0	1	1	15
Pipistrellus pipistrellus	2	8	7	12	11
Pipistrellus pygmaeus	2	7	7	8	23
Plecotus auritus	0	0	0	2	6

Page Break

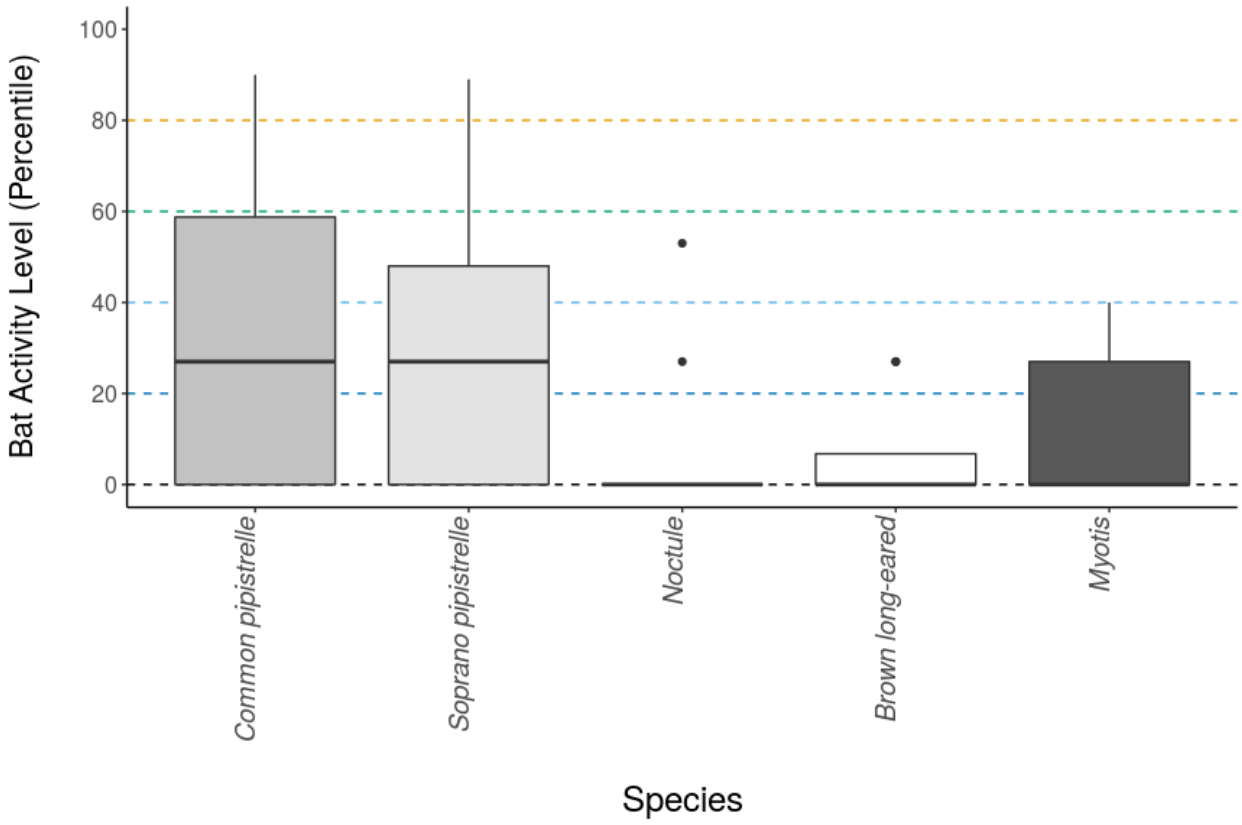
Table 8. Summary table showing key metrics for each species recorded.

Species/Species Group	Median Percentile	95% CIs	Max Percentile	Nights Recorded
Myotis	0	27 - 27	40	28
Nyctalus noctula	0	0 - 0	53	17
Pipistrellus pipistrellus	27	59.5 - 59.5	90	40
Pipistrellus pygmaeus	27	50.5 - 76	89	47
Plecotus auritus	0	0 - 0	27	8

Page Break

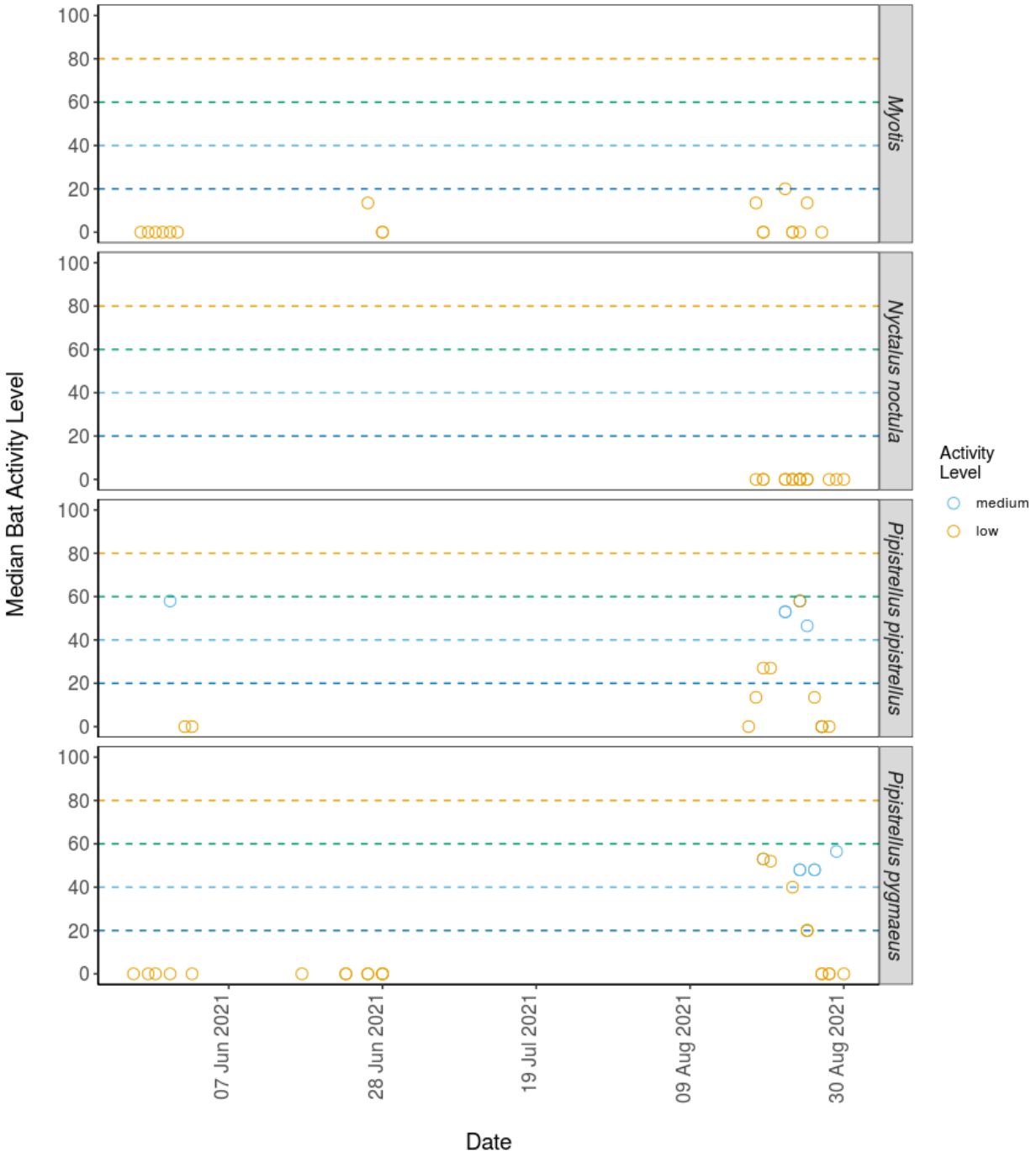
###Figures

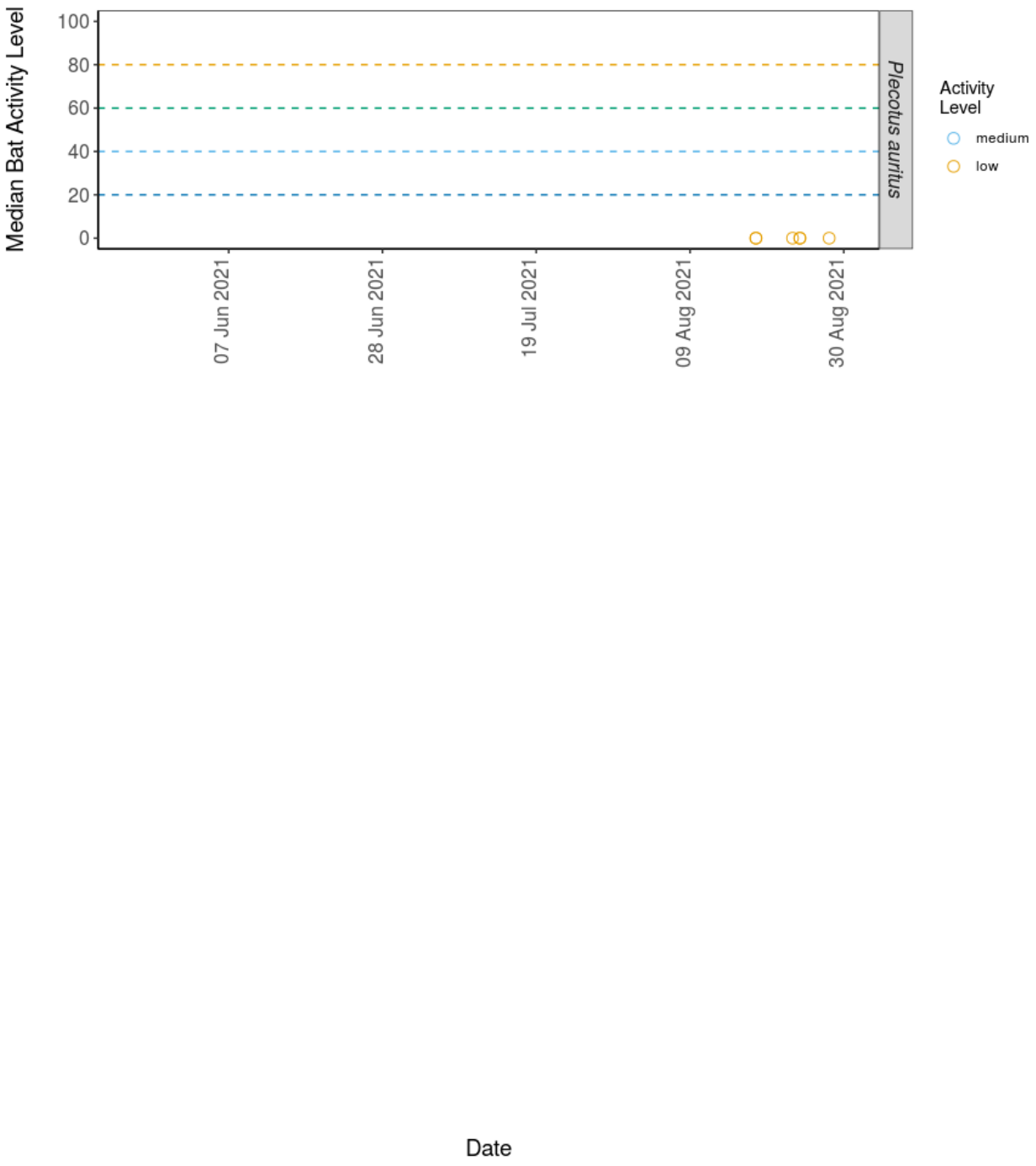
Figure 4. The activity level (percentile) of bats recorded across each night of the bat survey for the **entire site**.



Page Break

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


Median Bat Activity Level
100
80
60
40
20
0
Myotis
Nyctalus noctula
Pipistrellus pipistrellus
Pipistrellus pygmaeus
07 Jun 2021
28 Jun 2021
19 Jul 2021
09 Aug 2021
30 Aug 2021
Date
Activity Level
medium
low


Median Bat Activity Level
100
80
60
40
20
0
07 Jun 2021
28 Jun 2021
19 Jul 2021
09 Aug 2021
30 Aug 2021
Date
Plecotus auritus
Activity Level
medium
low

6.5 PER SITE, PER MONTH

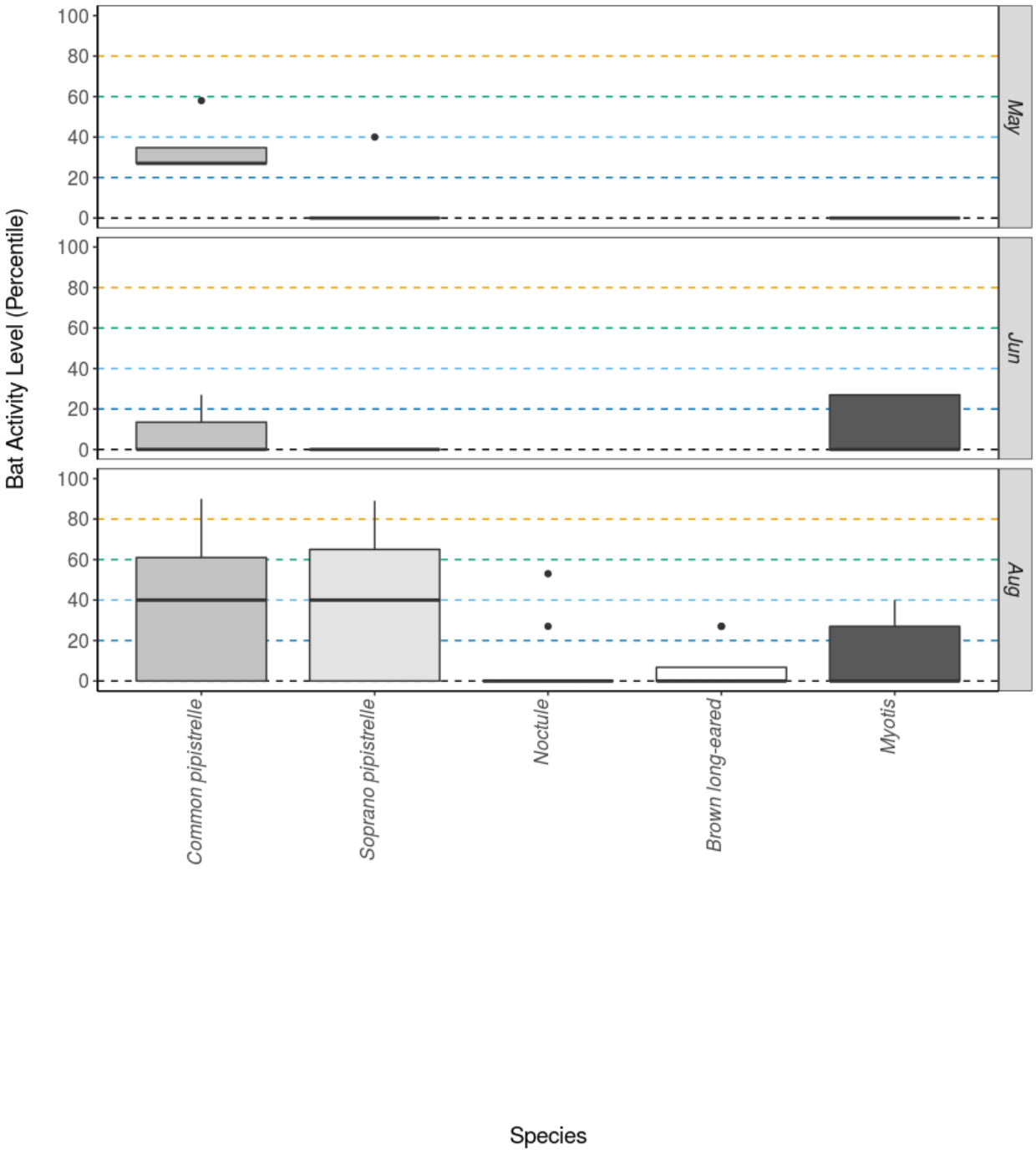
Table 9. Summary table showing the number of nights recorded bat activity fell into each activity band for each species during each month.

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	0	0	0	6
Myotis	Jun	0	0	0	2	3
Myotis	Aug	0	0	0	8	9
Nyctalus noctula	Aug	0	0	1	1	15
Pipistrellus pipistrellus	May	0	0	1	3	0
Pipistrellus pipistrellus	Jun	0	0	0	1	2
Pipistrellus pipistrellus	Aug	2	8	6	8	9
Pipistrellus pygmaeus	May	0	0	0	1	4
Pipistrellus pygmaeus	Jun	0	0	0	0	9
Pipistrellus pygmaeus	Aug	2	7	7	7	10
Plecotus auritus	Aug	0	0	0	2	6

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	0	27 - 27	0	6
Myotis	Jun	0	27 - 27	27	5
Myotis	Aug	0	27 - 27	40	17
Nyctalus noctula	Aug	0	0 - 0	53	17
Pipistrellus pipistrellus	May	27	33.5 - 60	58	4
Pipistrellus pipistrellus	Jun	0	33.5 - 60	27	3
Pipistrellus pipistrellus	Aug	40	59.5 - 59.5	90	33
Pipistrellus pygmaeus	May	0	40 - 78	40	5
Pipistrellus pygmaeus	Jun	0	50.5 - 76	0	9
Pipistrellus pygmaeus	Aug	40	50.5 - 76	89	33
Plecotus auritus	Aug	0	0 - 0	27	8

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



6.6 PART 2: Nightly Analysis

7 ENTIRE SURVEY PERIOD

7.1 Sunrise and Sunset Times

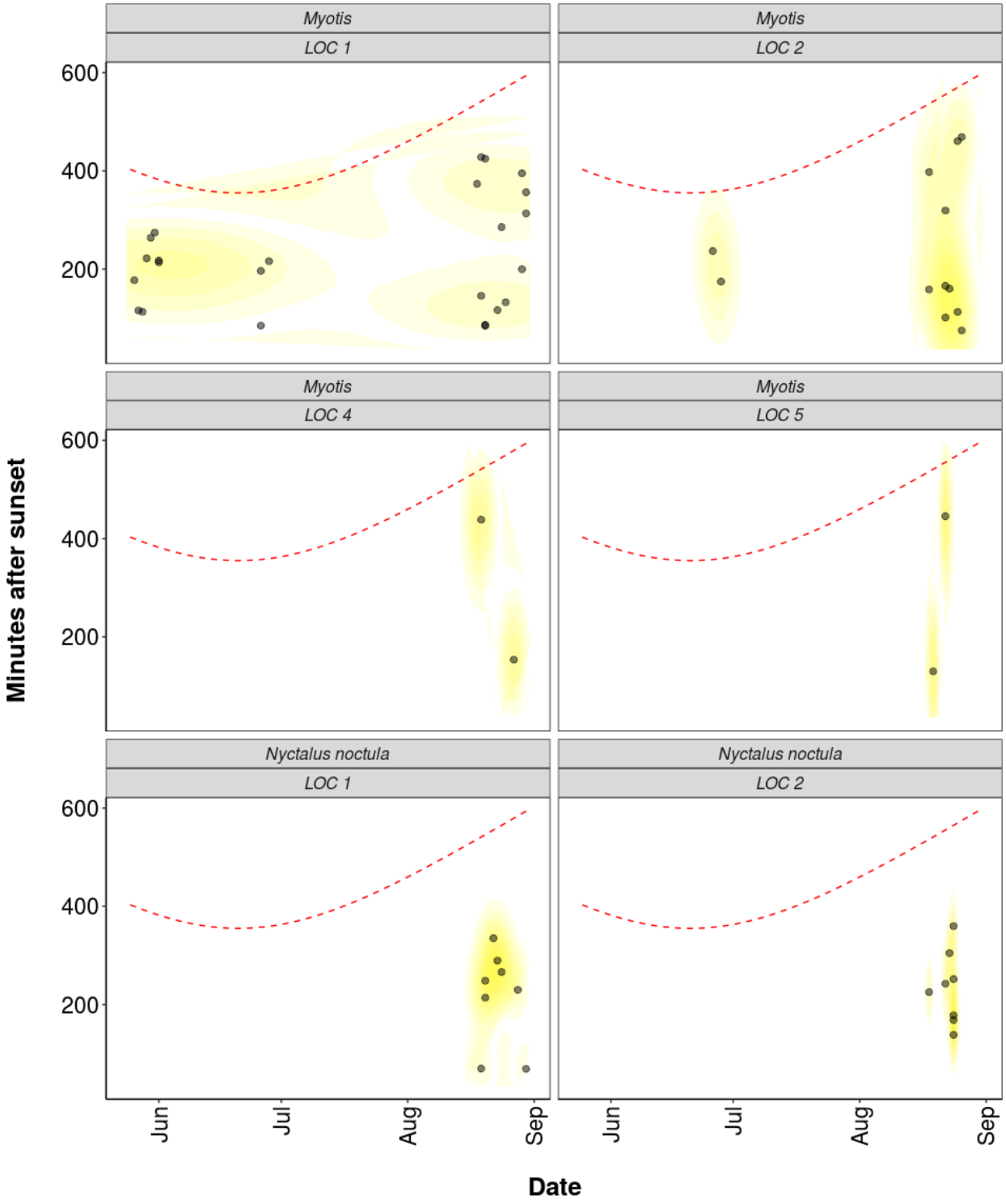
Table 11. The times of sunset and sunrise the following morning for surveys beginning on the date shown.

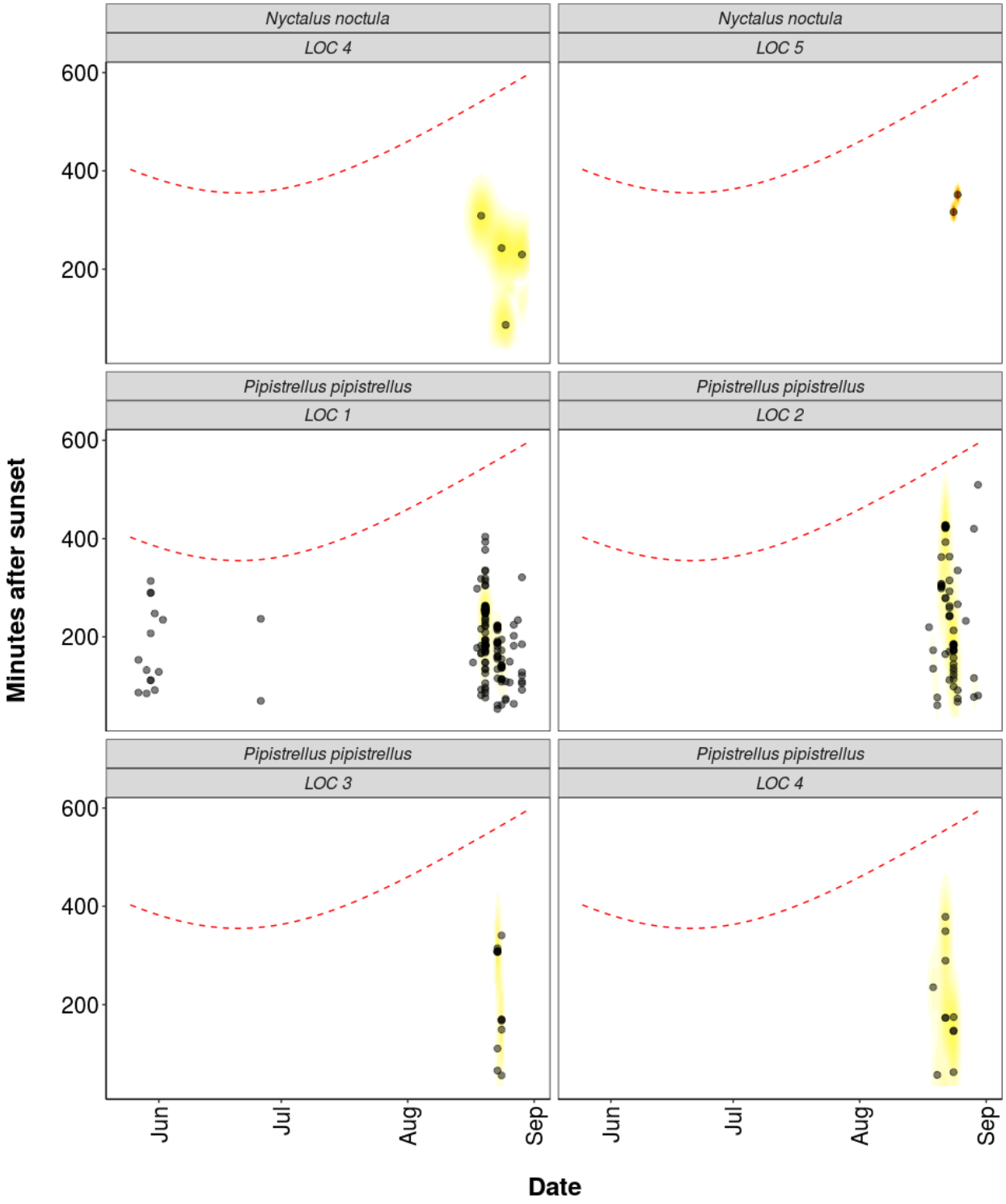
Night (y-m-d)	Sunset (hh:mm)	Sunrise (hh:mm)	Night Length (hours)
2021-05-25	21:55	04:38	6.7
2021-05-26	21:57	04:36	6.7
2021-05-27	21:58	04:35	6.6
2021-05-28	22:00	04:33	6.6
2021-05-29	22:02	04:32	6.5
2021-05-30	22:03	04:31	6.5
2021-05-31	22:05	04:30	6.4
2021-06-01	22:06	04:28	6.4
2021-06-02	22:08	04:27	6.3
2021-06-17	22:23	04:19	5.9
2021-06-23	22:24	04:20	5.9
2021-06-26	22:24	04:22	6.0
2021-06-28	22:24	04:23	6.0
2021-08-17	20:59	05:51	8.9
2021-08-18	20:57	05:53	8.9
2021-08-19	20:54	05:55	9.0
2021-08-20	20:52	05:57	9.1
2021-08-21	20:49	06:00	9.2
2021-08-22	20:46	06:02	9.3
2021-08-23	20:44	06:04	9.3
2021-08-24	20:41	06:06	9.4
2021-08-25	20:38	06:08	9.5
2021-08-26	20:36	06:10	9.6
2021-08-27	20:33	06:12	9.7
2021-08-28	20:30	06:15	9.7
2021-08-29	20:28	06:17	9.8
2021-08-30	20:25	06:19	9.9

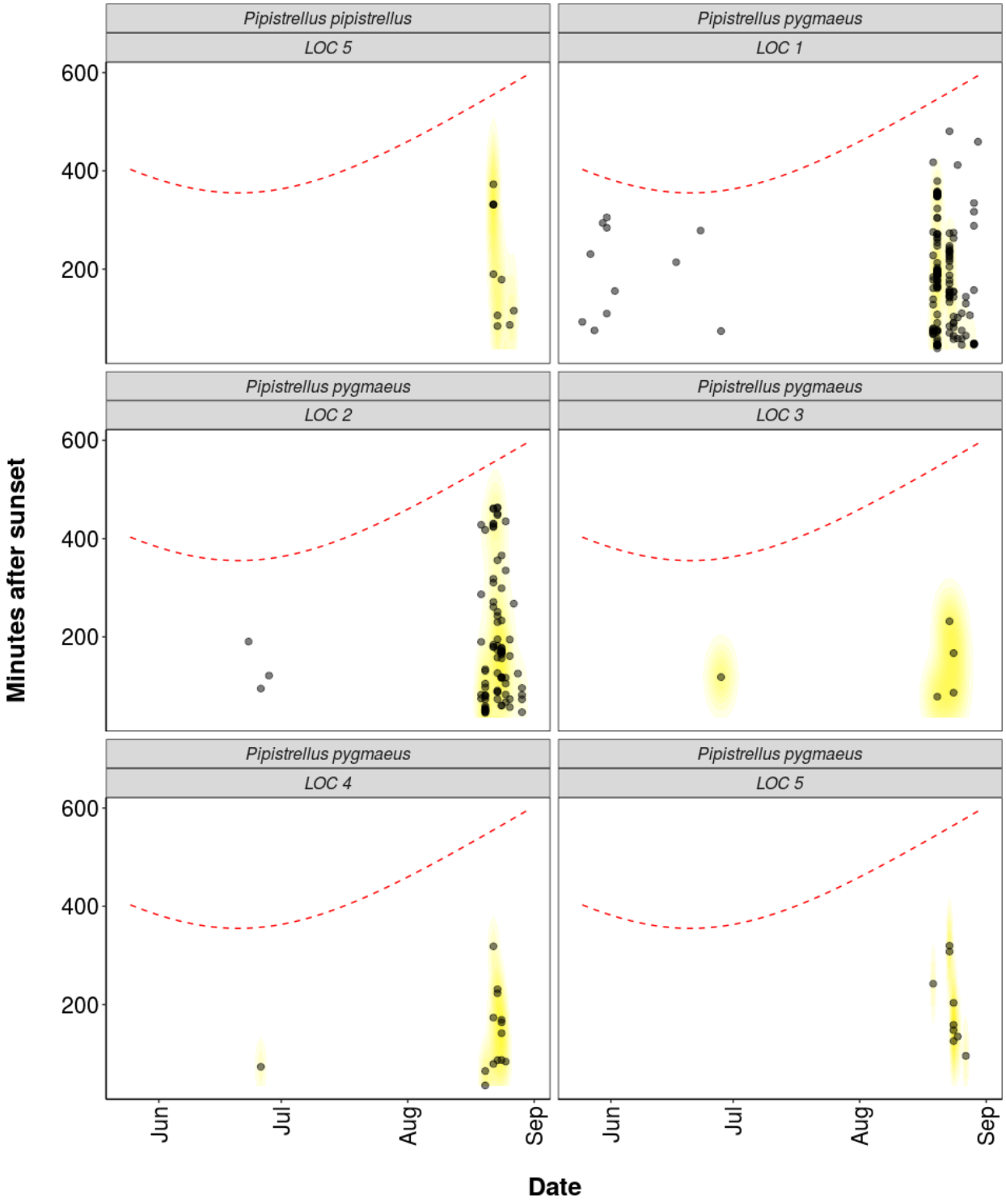
8 DISTRIBUTION OF BAT ACTIVITY ACROSS THE NIGHT THROUGH TIME

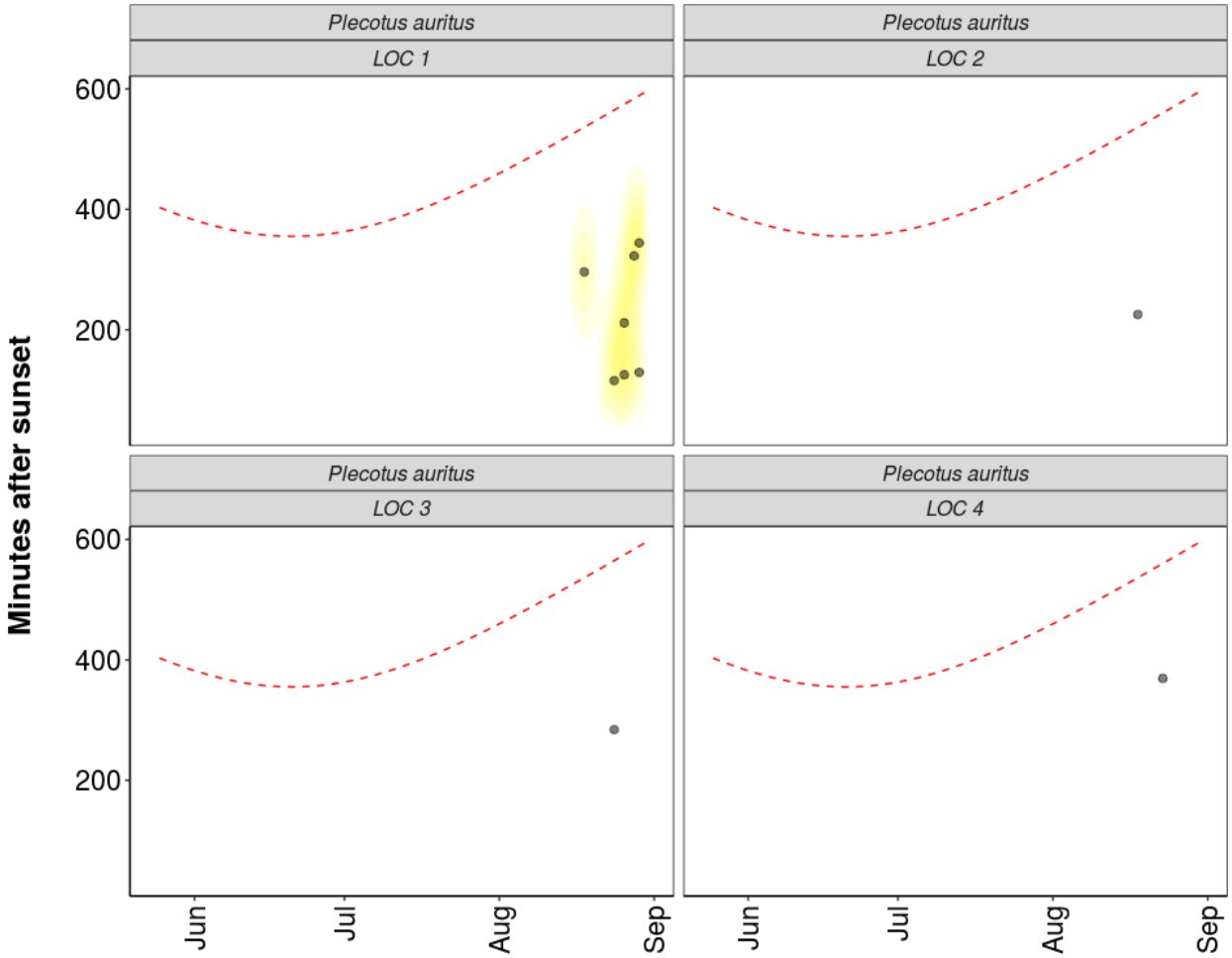
8.1 Per Detector

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
LOC 1
Myotis
LOC 2
Myotis
LOC 4
Myotis
LOC 5
Nyctalus noctula
LOC 1
Nyctalus noctula
LOC 2
600
400
200
Minutes after sunset
Jun
Jul
Aug
Sep
Date


Nyctalus noctula
LOC 4
Nyctalus noctula
LOC 5
Pipistrellus pipistrellus
LOC 1
Pipistrellus pipistrellus
LOC 2
Pipistrellus pipistrellus
LOC 3
Pipistrellus pipistrellus
LOC 4
Minutes after sunset
600
400
200
Jun
Jul
Aug
Sep
Date


Pipistrellus pipistrellus
LOC 5
Pipistrellus pygmaeus
LOC 1
Pipistrellus pygmaeus
LOC 2
Pipistrellus pygmaeus
LOC 3
Pipistrellus pygmaeus
LOC 4
Pipistrellus pygmaeus
LOC 5
600
400
200
Minutes after sunset
Jun
Jul
Aug
Sep
Date


Plecotus auritus
LOC 1
Plecotus auritus
LOC 2
Plecotus auritus
LOC 3
Plecotus auritus
LOC 4
Minutes after sunset
600
400
200
Jun
Jul
Aug
Sep
Date

9 ROOST EMERGENCE TIME AND BAT OBSERVATION

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

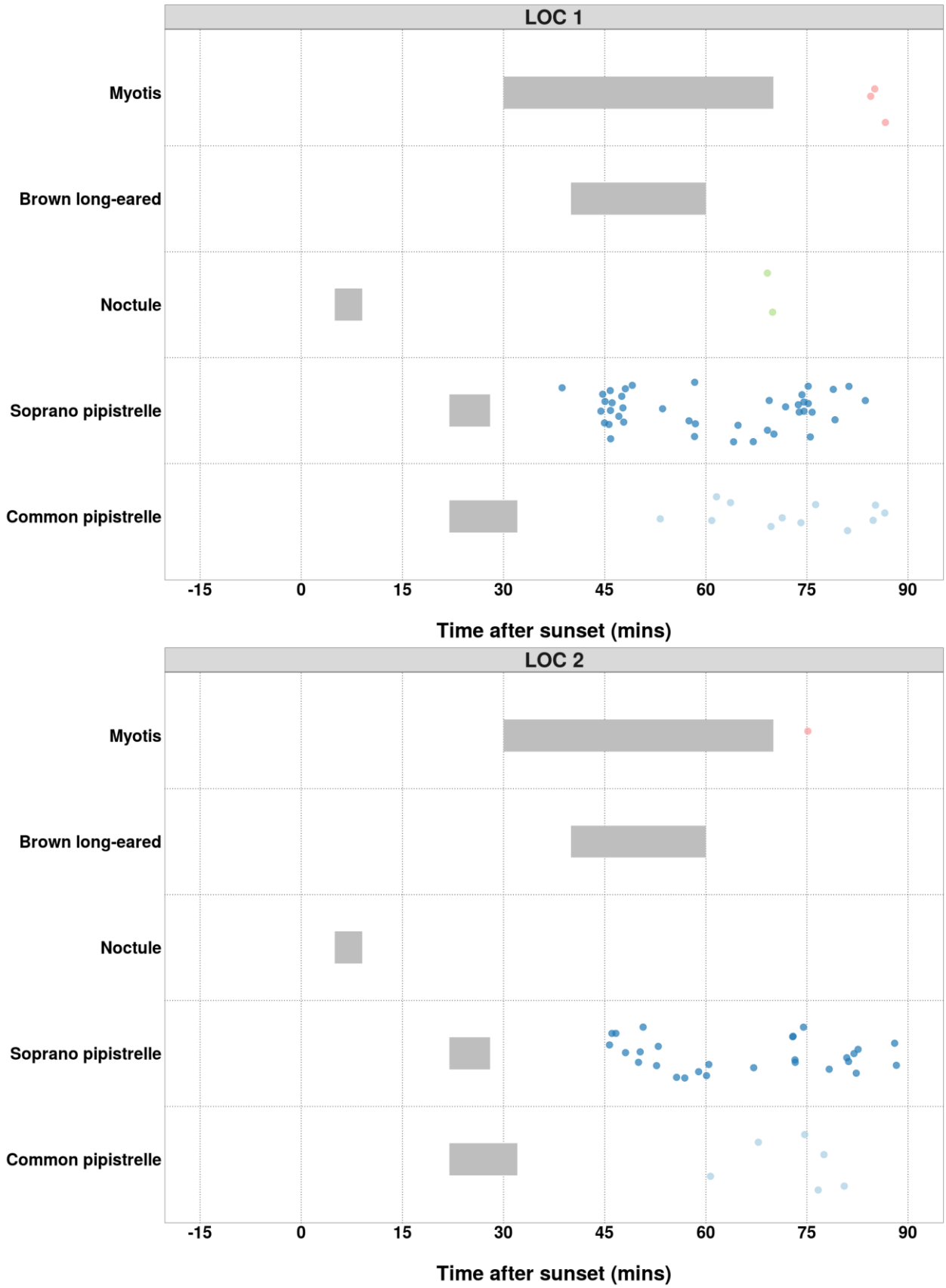
For more information see https://rbats-blog.updog.co/2018/05/29/bat-emergence/

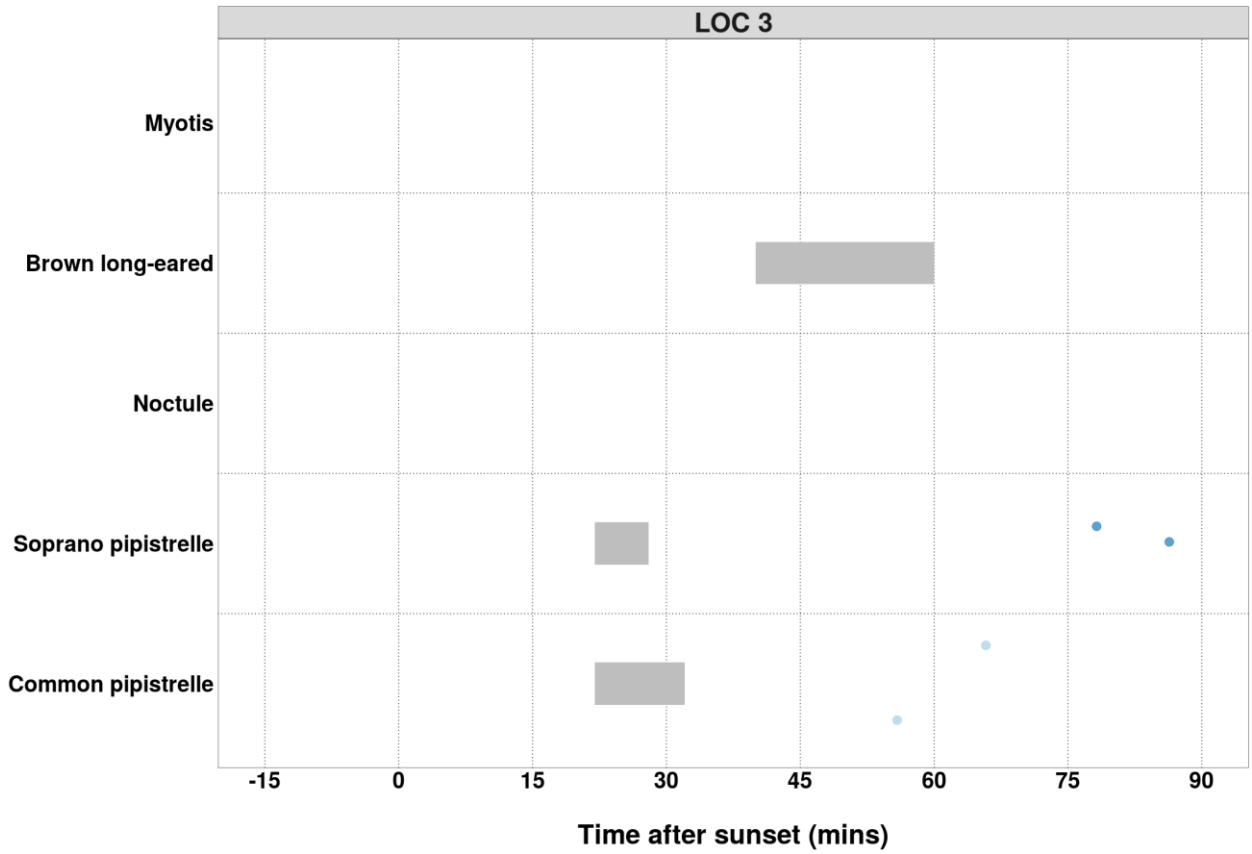
9.1 Bat Passes Potentially Indicating Close Proximity to a Roost (Russ 2012) - Table

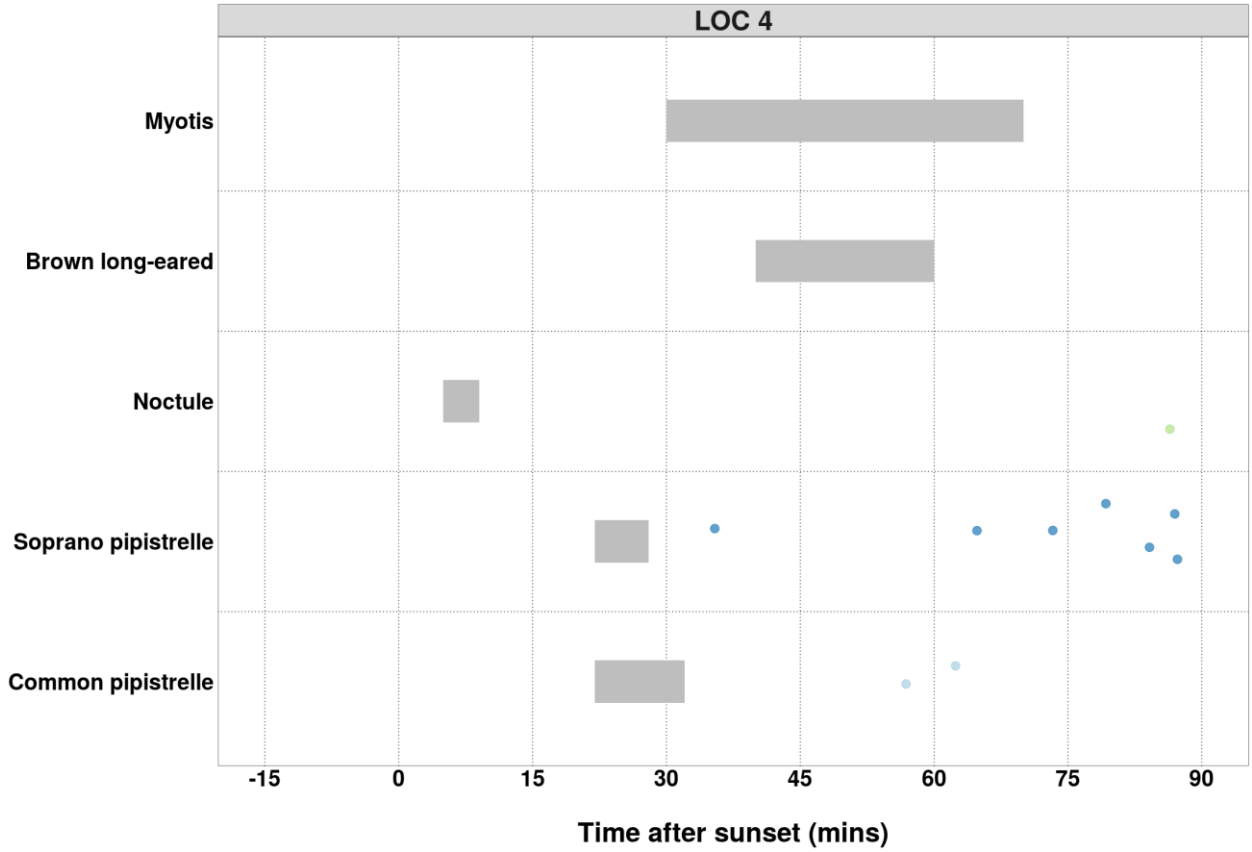
Table 12. Number of bat calls recorded before the upper time of the species-specific emergence time range, and which therefore may potentially indicate the presence of a nearby roost.

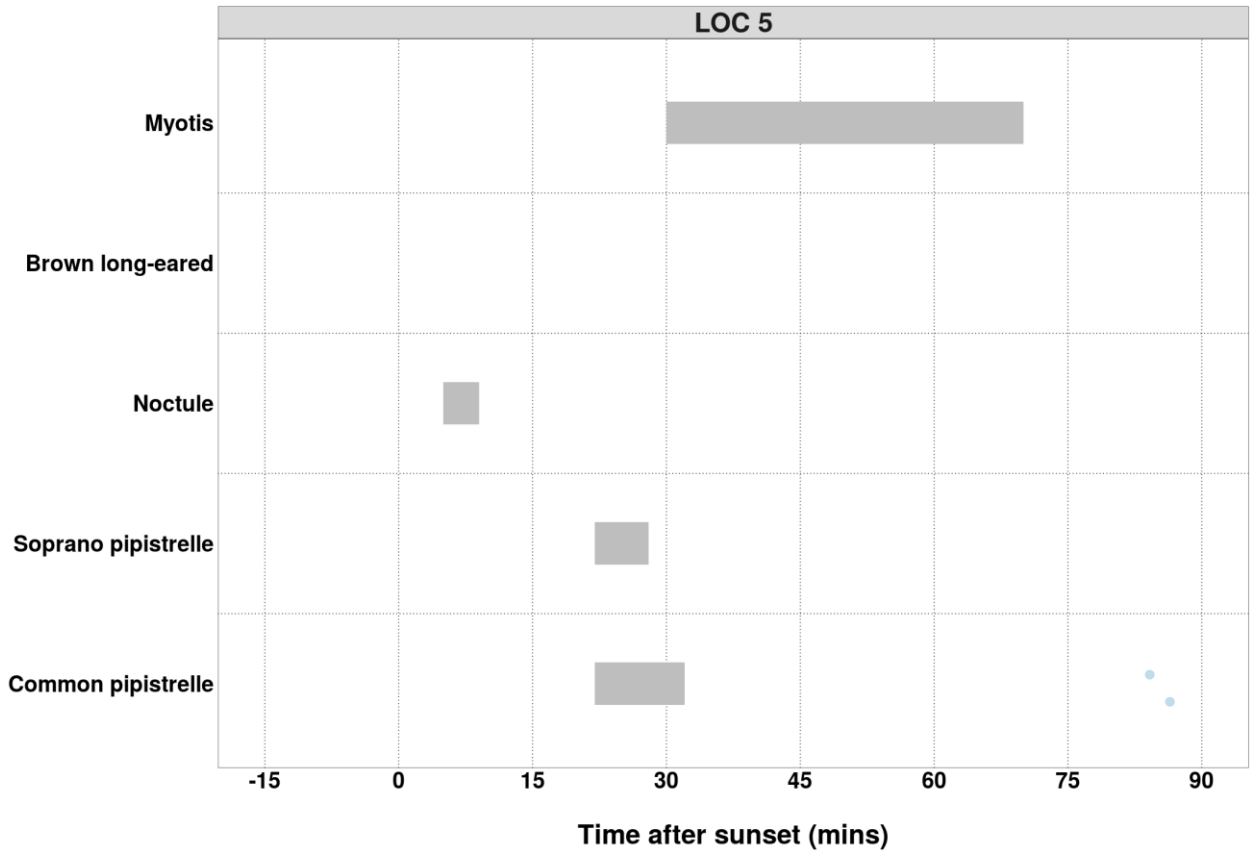
Species	Detector ID

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.




LOC 3
Myotis
Brown long-eared
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)


LOC 4
Myotis
Brown long-eared
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)


LOC 5
Myotis
Brown long-eared
Noctule
Soprano pipistrelle
Common pipistrelle
-15
0
15
30
45
60
75
90
Time after sunset (mins)

10 COUNTS OF BAT PASSES

10.1 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	265	43.4
Soprano pipistrelle	274	44.8
Noctule	22	3.6
Brown long-eared	10	1.6
Myotis	40	6.5
Total	611	99.9

11 COUNTS OF BAT PASSES

11.1 Per Detector

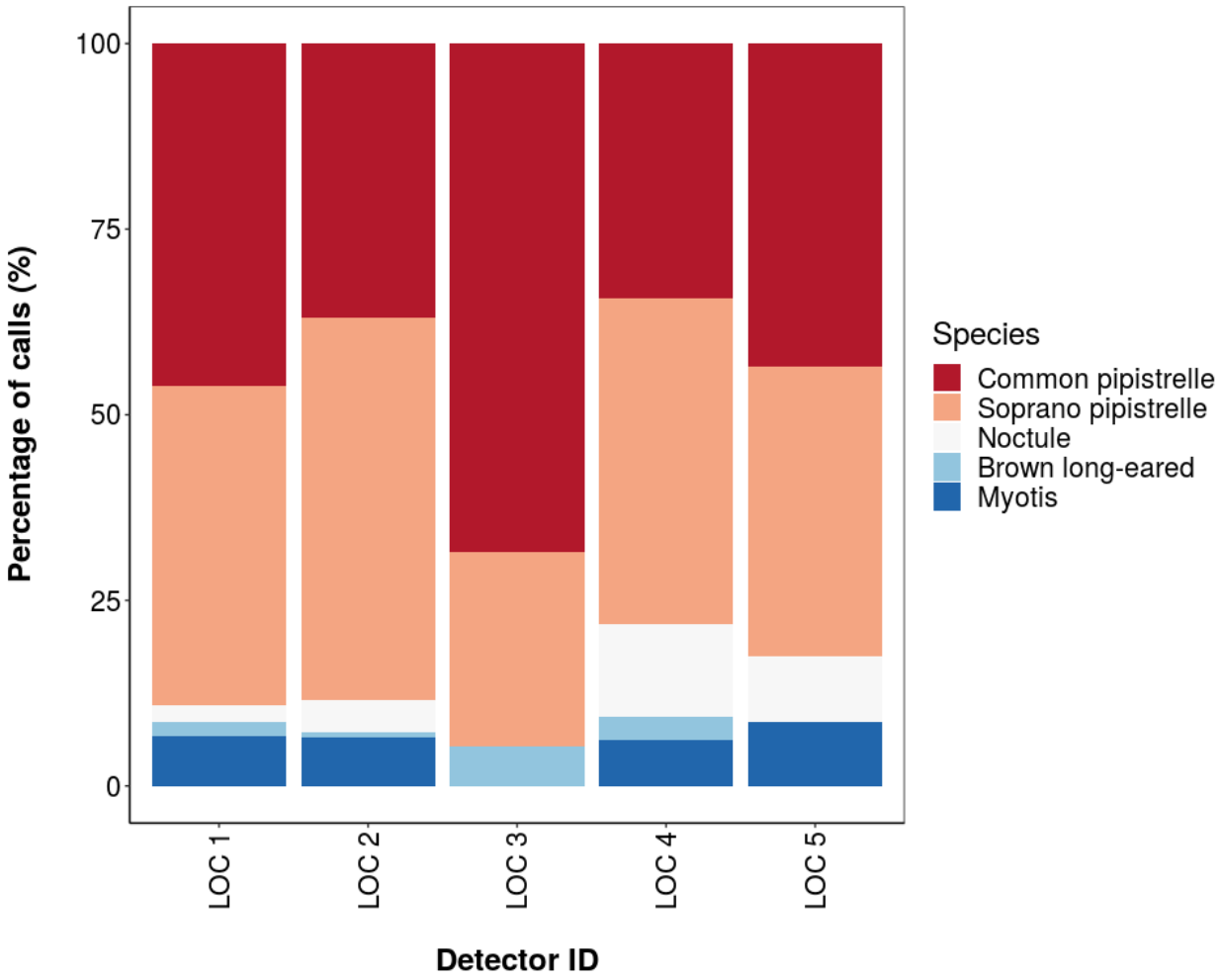
Table 15. The number of passes recorded for each species at each detector.

Species	Detector ID	Count (No)	Percentage by Detector (%)
Common pipistrelle	LOC 1	164	46.1
Common pipistrelle	LOC 2	67	37.0
Common pipistrelle	LOC 3	13	68.4
Common pipistrelle	LOC 4	11	34.4
Common pipistrelle	LOC 5	10	43.5
Soprano pipistrelle	LOC 1	153	43.0
Soprano pipistrelle	LOC 2	93	51.4
Soprano pipistrelle	LOC 3	5	26.3
Soprano pipistrelle	LOC 4	14	43.8
Soprano pipistrelle	LOC 5	9	39.1
Noctule	LOC 1	8	2.2
Noctule	LOC 2	8	4.4
Noctule	LOC 4	4	12.5
Noctule	LOC 5	2	8.7
Brown long-eared	LOC 1	7	2.0
Brown long-eared	LOC 2	1	0.6
Brown long-eared	LOC 3	1	5.3
Brown long-eared	LOC 4	1	3.1
Myotis	LOC 1	24	6.7

Myotis	LOC 2	12	6.6
Myotis	LOC 4	2	6.2
Myotis	LOC 5	2	8.7

12 SPECIES COMPOSITION

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



12.1 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.

12.2 Nightly Bat Pass Rate (Bat passes per hour)

13 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	LOC 1	0.3
Common pipistrelle	LOC 2	0.3
Common pipistrelle	LOC 3	0.7
Common pipistrelle	LOC 4	0.3
Common pipistrelle	LOC 5	0.1
Soprano pipistrelle	LOC 1	0.2
Soprano pipistrelle	LOC 2	0.4
Soprano pipistrelle	LOC 3	0.1
Soprano pipistrelle	LOC 4	0.3
Soprano pipistrelle	LOC 5	0.1
Noctule	LOC 1	0.1
Noctule	LOC 2	0.1
Noctule	LOC 4	0.1
Noctule	LOC 5	0.1
Brown long-eared	LOC 1	0.1
Brown long-eared	LOC 2	0.1
Brown long-eared	LOC 3	0.1
Brown long-eared	LOC 4	0.1
Myotis	LOC 1	0.2
Myotis	LOC 2	0.2
Myotis	LOC 4	0.1
Myotis	LOC 5	0.1

13.1 Nightly Bat Pass Rate (Bat passes per hour)

14 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.

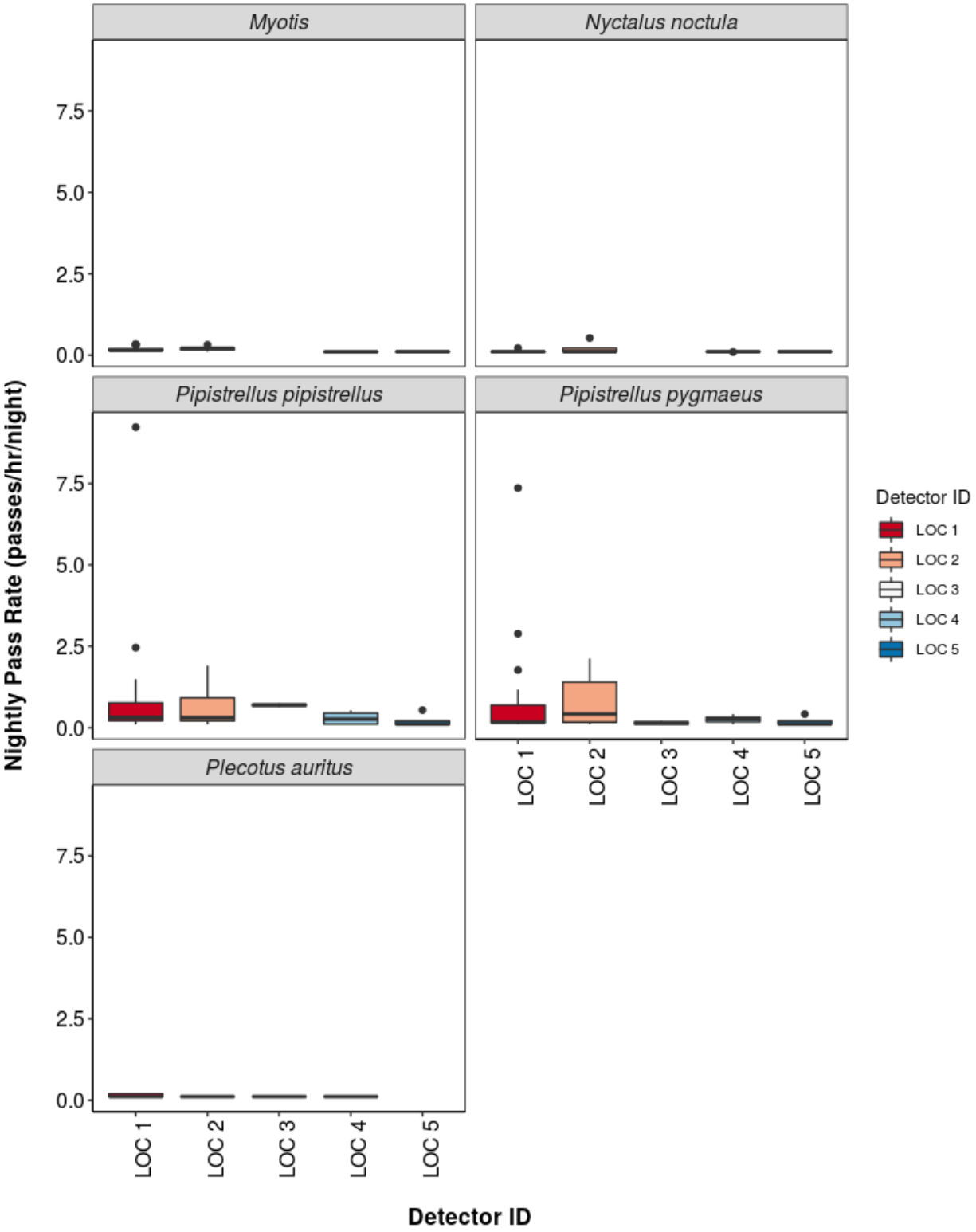
Species	Detector ID	Mean Pass Rate
Common pipistrelle	LOC 1	1.0
Common pipistrelle	LOC 2	0.7
Common pipistrelle	LOC 3	0.7
Common pipistrelle	LOC 4	0.3
Common pipistrelle	LOC 5	0.2
Soprano pipistrelle	LOC 1	0.9
Soprano pipistrelle	LOC 2	0.8
Soprano pipistrelle	LOC 3	0.2
Soprano pipistrelle	LOC 4	0.3
Soprano pipistrelle	LOC 5	0.2
Noctule	LOC 1	0.1
Noctule	LOC 2	0.2
Noctule	LOC 4	0.1
Noctule	LOC 5	0.1
Brown long-eared	LOC 1	0.1
Brown long-eared	LOC 2	0.1
Brown long-eared	LOC 3	0.1
Brown long-eared	LOC 4	0.1
Myotis	LOC 1	0.2
Myotis	LOC 2	0.2
Myotis	LOC 4	0.1
Myotis	LOC 5	0.1

15 NIGHTLY BAT PASSES (BAT PASSES PER HOUR)

15.1 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.



16 SPLIT BY MONTH

17 TOTAL BAT PASSES PER DETECTOR, EACH MONTH

17.1 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	Aug
Common pipistrelle	LOC 1	12	4	148
Common pipistrelle	LOC 2	0	0	67
Common pipistrelle	LOC 3	0	0	13
Common pipistrelle	LOC 4	0	0	11
Common pipistrelle	LOC 5	0	0	10
Soprano pipistrelle	LOC 1	7	4	142
Soprano pipistrelle	LOC 2	0	3	90
Soprano pipistrelle	LOC 3	0	1	4
Soprano pipistrelle	LOC 4	0	1	13
Soprano pipistrelle	LOC 5	0	0	9
Noctule	LOC 1	0	0	8
Noctule	LOC 2	0	0	8
Noctule	LOC 4	0	0	4
Noctule	LOC 5	0	0	2
Brown long-eared	LOC 1	0	0	7
Brown long-eared	LOC 2	0	0	1
Brown long-eared	LOC 3	0	0	1
Brown long-eared	LOC 4	0	0	1
Myotis	LOC 1	6	5	13
Myotis	LOC 2	0	2	10
Myotis	LOC 4	0	0	2
Myotis	LOC 5	0	0	2

18 SURVEY EFFORT

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

Month	Detector ID	No. of Survey Nights
May	LOC 1	7
Jun	LOC 1	6
Jun	LOC 2	3
Jun	LOC 3	1
Jun	LOC 4	1
Aug	LOC 1	13
Aug	LOC 2	13
Aug	LOC 3	3
Aug	LOC 4	8
Aug	LOC 5	7

18.1 Nightly Bat Pass Rate for each Month

19 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	Aug
Common pipistrelle	LOC 1	0.3	0.2	0.4
Common pipistrelle	LOC 2	NA	NA	0.3
Common pipistrelle	LOC 3	NA	NA	0.7
Common pipistrelle	LOC 4	NA	NA	0.3
Common pipistrelle	LOC 5	NA	NA	0.1
Soprano pipistrelle	LOC 1	0.2	0.2	0.7
Soprano pipistrelle	LOC 2	NA	0.2	0.6
Soprano pipistrelle	LOC 3	NA	0.2	0.1
Soprano pipistrelle	LOC 4	NA	0.2	0.3
Soprano pipistrelle	LOC 5	NA	NA	0.1
Noctule	LOC 1	NA	NA	0.1
Noctule	LOC 2	NA	NA	0.1
Noctule	LOC 4	NA	NA	0.1

Noctule	LOC 5	NA	NA	0.1
Brown long-eared	LOC 1	NA	NA	0.1
Brown long-eared	LOC 2	NA	NA	0.1
Brown long-eared	LOC 3	NA	NA	0.1
Brown long-eared	LOC 4	NA	NA	0.1
Myotis	LOC 1	0.2	0.3	0.2
Myotis	LOC 2	NA	0.2	0.2
Myotis	LOC 4	NA	NA	0.1
Myotis	LOC 5	NA	NA	0.1

19.1 Nightly Bat Pass Rate for each Month

20 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.

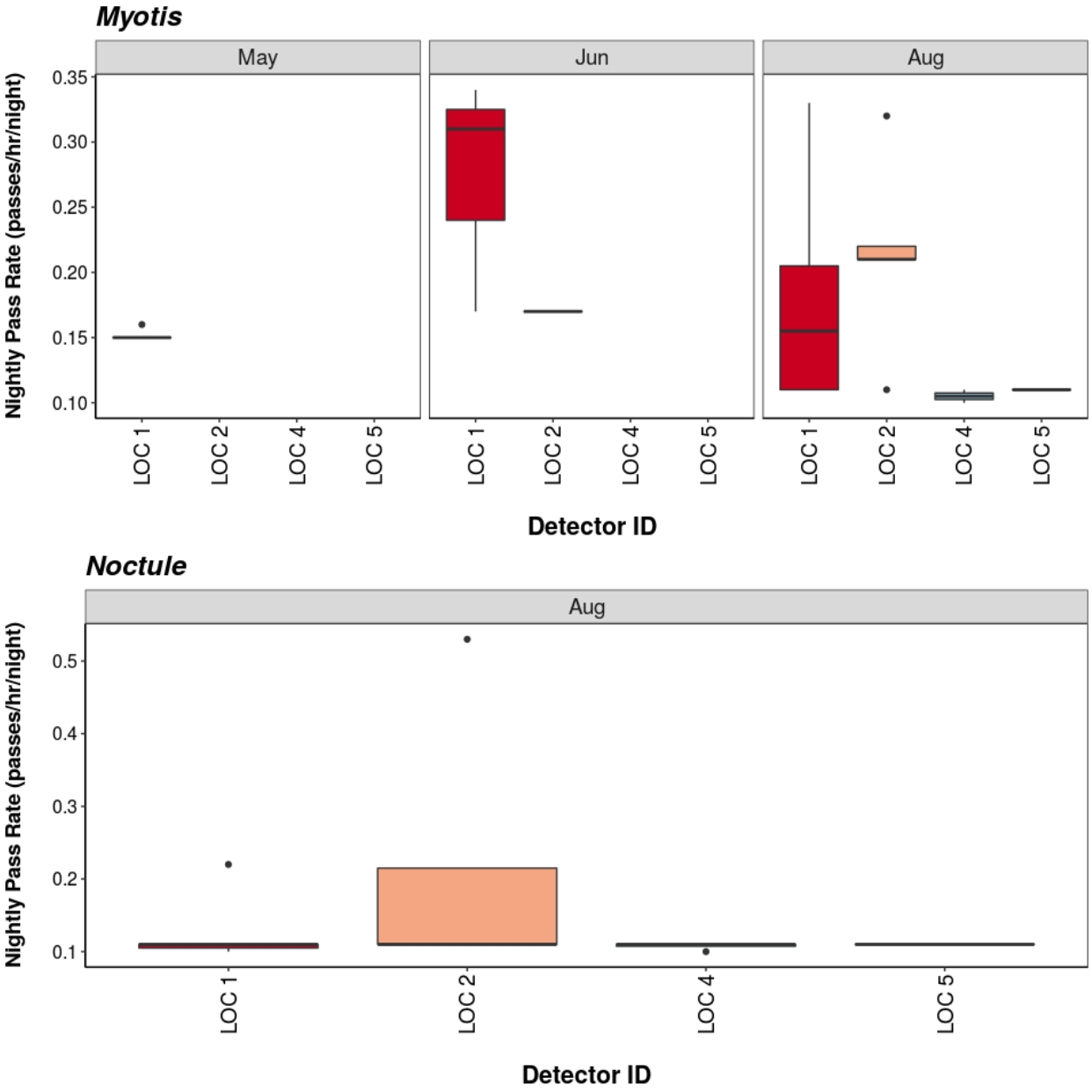
Species	Detector ID	May	Jun	Aug
Common pipistrelle	LOC 1	0.5	0.2	1.5
Common pipistrelle	LOC 2	NA	NA	0.7
Common pipistrelle	LOC 3	NA	NA	0.7
Common pipistrelle	LOC 4	NA	NA	0.3
Common pipistrelle	LOC 5	NA	NA	0.2
Soprano pipistrelle	LOC 1	0.2	0.2	1.5
Soprano pipistrelle	LOC 2	NA	0.2	1.0
Soprano pipistrelle	LOC 3	NA	0.2	0.1
Soprano pipistrelle	LOC 4	NA	0.2	0.3
Soprano pipistrelle	LOC 5	NA	NA	0.2
Noctule	LOC 1	NA	NA	0.1
Noctule	LOC 2	NA	NA	0.2
Noctule	LOC 4	NA	NA	0.1
Noctule	LOC 5	NA	NA	0.1
Brown long-eared	LOC 1	NA	NA	0.1
Brown long-eared	LOC 2	NA	NA	0.1
Brown long-eared	LOC 3	NA	NA	0.1
Brown long-eared	LOC 4	NA	NA	0.1
Myotis	LOC 1	0.2	0.3	0.2
Myotis	LOC 2	NA	0.2	0.2
Myotis	LOC 4	NA	NA	0.1

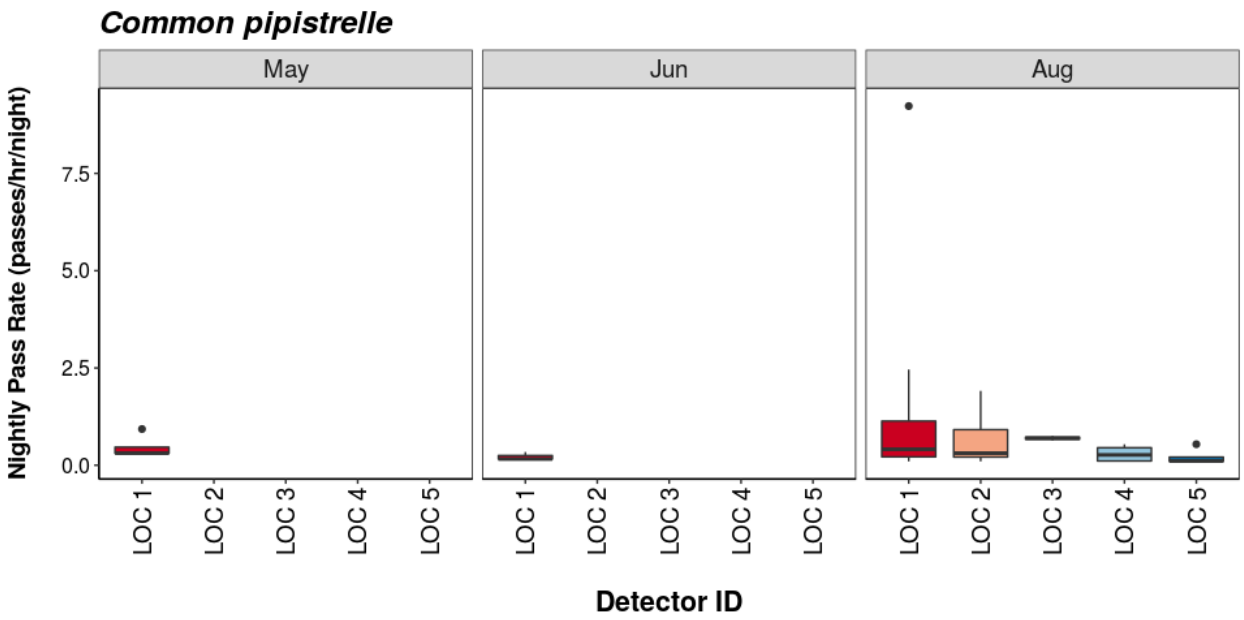
Myotis	LOC 5	NA	NA	0.1

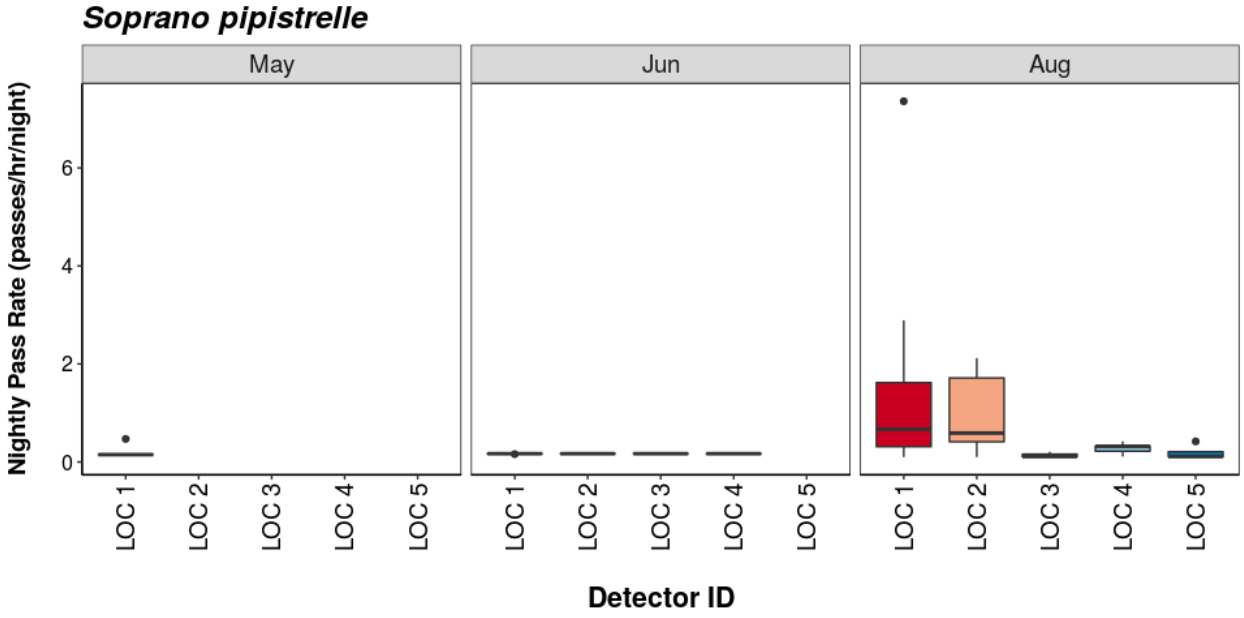
20.1 Nightly Bat Pass Rate for each Month

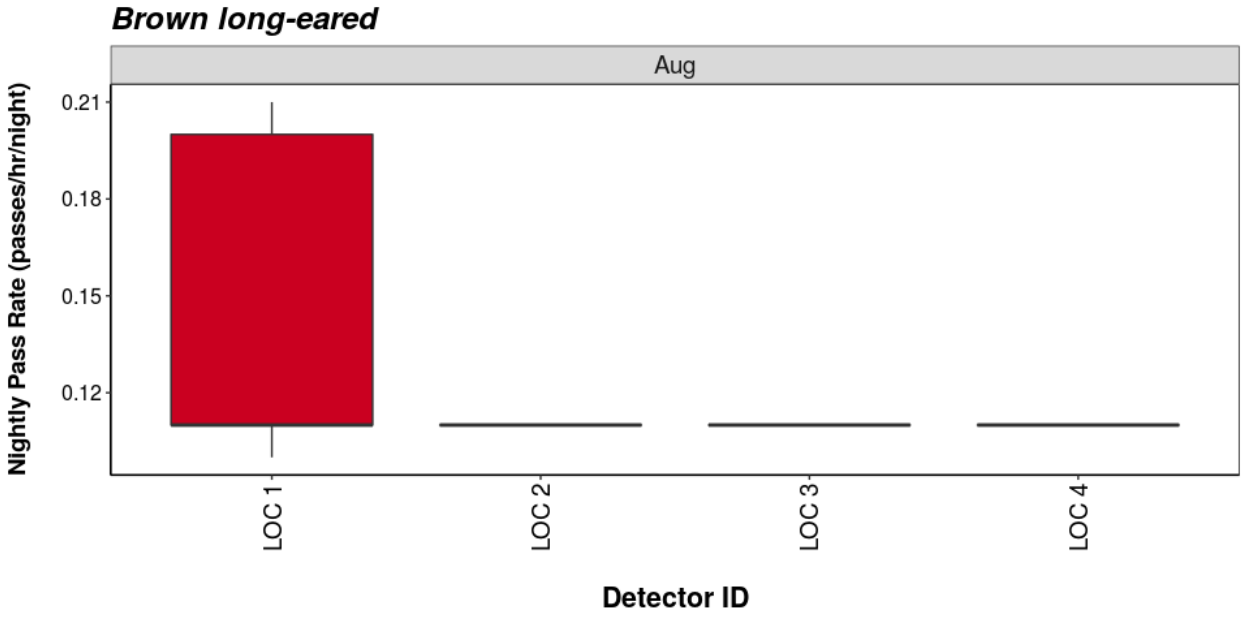
20.2 Per Detector - Figures

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.




Common pipistrelle
May
Jun
Aug
Nightly Pass Rate (passes/hr/night)
0.0
2.5
5.0
7.5
LOC 1
LOC 2
LOC 3
LOC 4
LOC 5
Detector ID


Soprano pipistrelle
May
Jun
Aug
Nightly Pass Rate (passes/hr/night)
0
2
4
6
LOC 1
LOC 2
LOC 3
LOC 4
LOC 5
Detector ID


Brown long-eared
Aug
Nightly Pass Rate (passes/hr/night)
0.12
0.15
0.18
0.21
LOC 1
LOC 2
LOC 3
LOC 4
Detector ID

21 BAT ACTIVITY PER DETECTOR LOCATION

Figure 13. Detector ID reference:

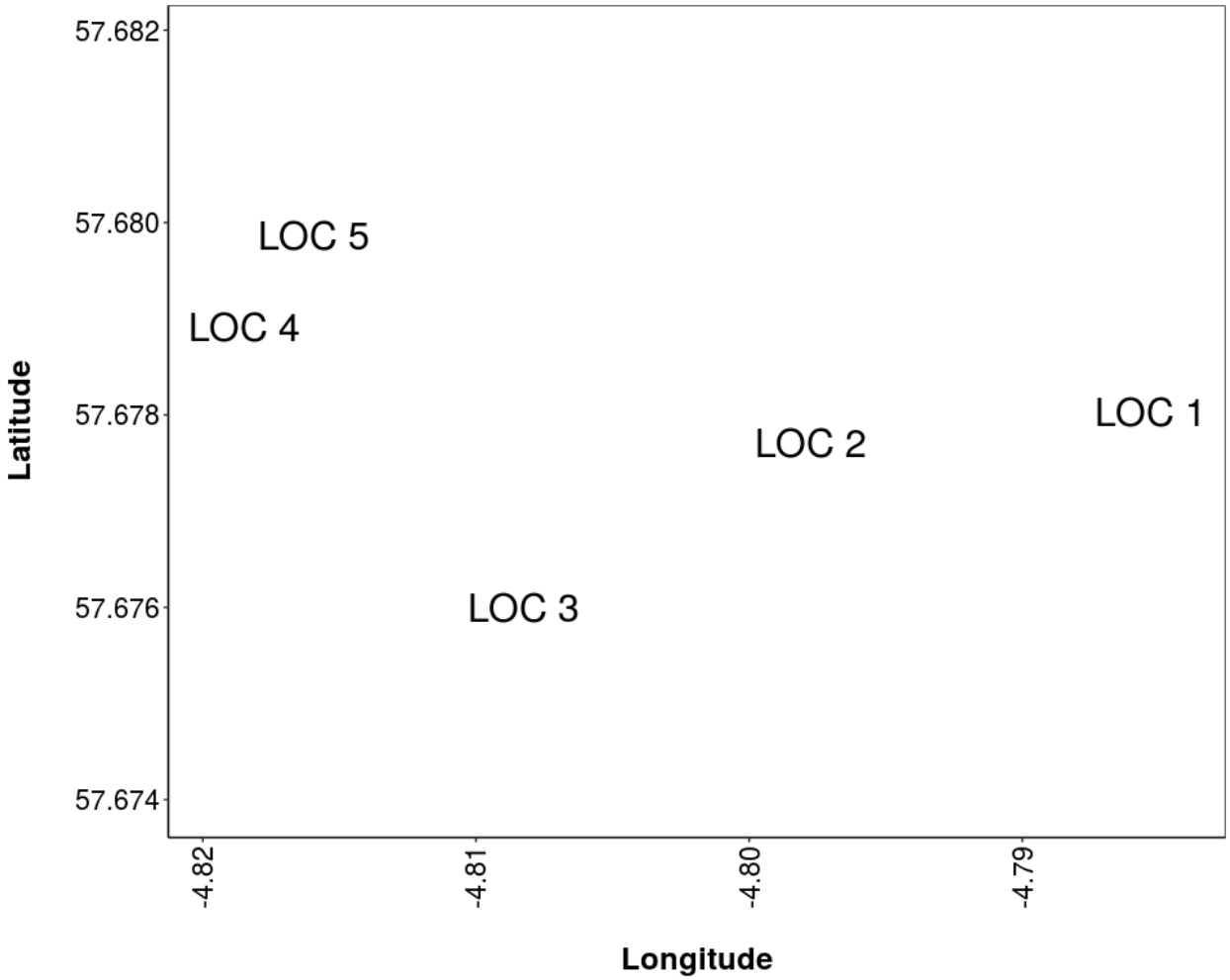


Figure 14. Median Nightly Pass Rate (bat passes/hr/night) throughout the survey period - represented by the size and colour of the point at each detector location.

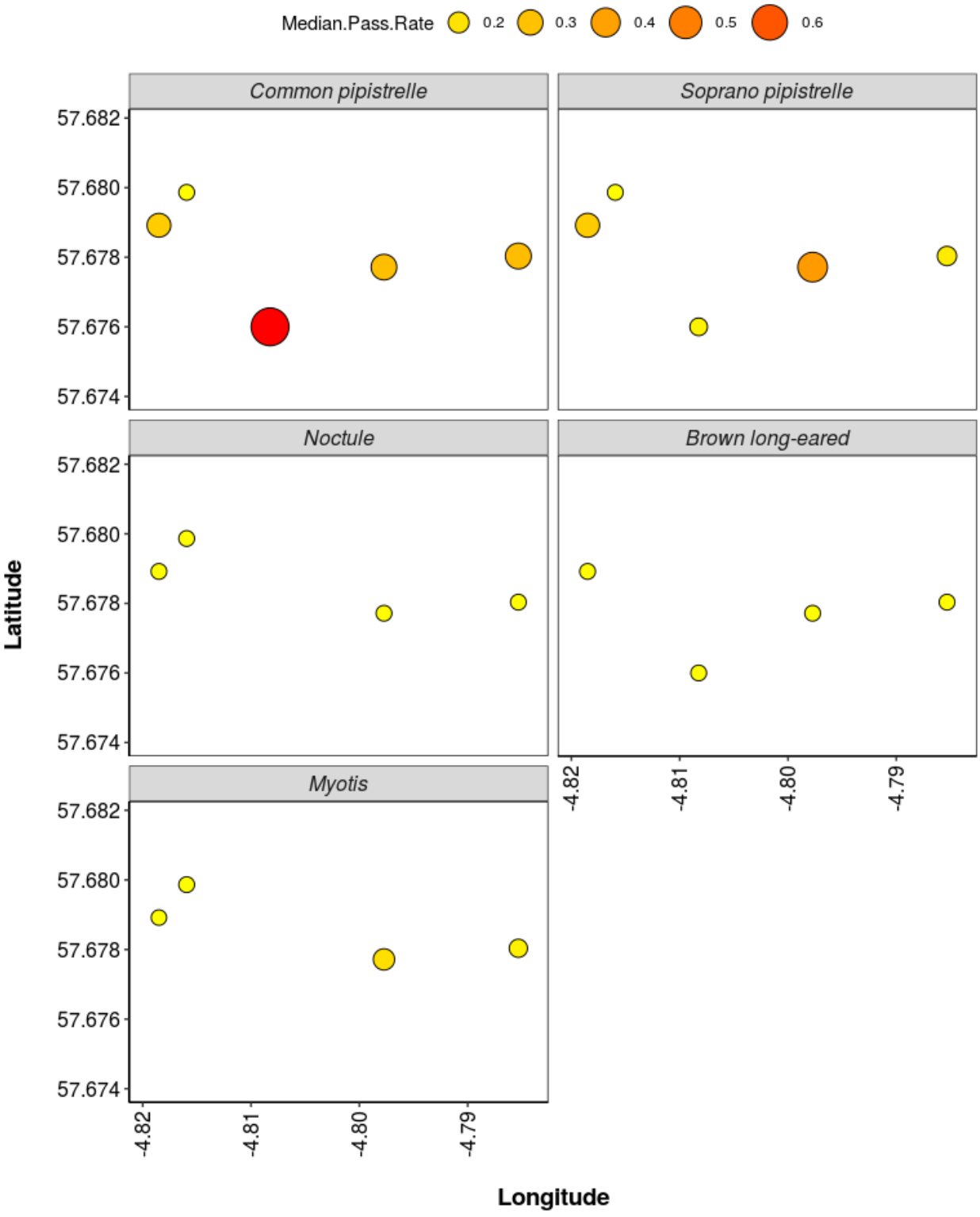
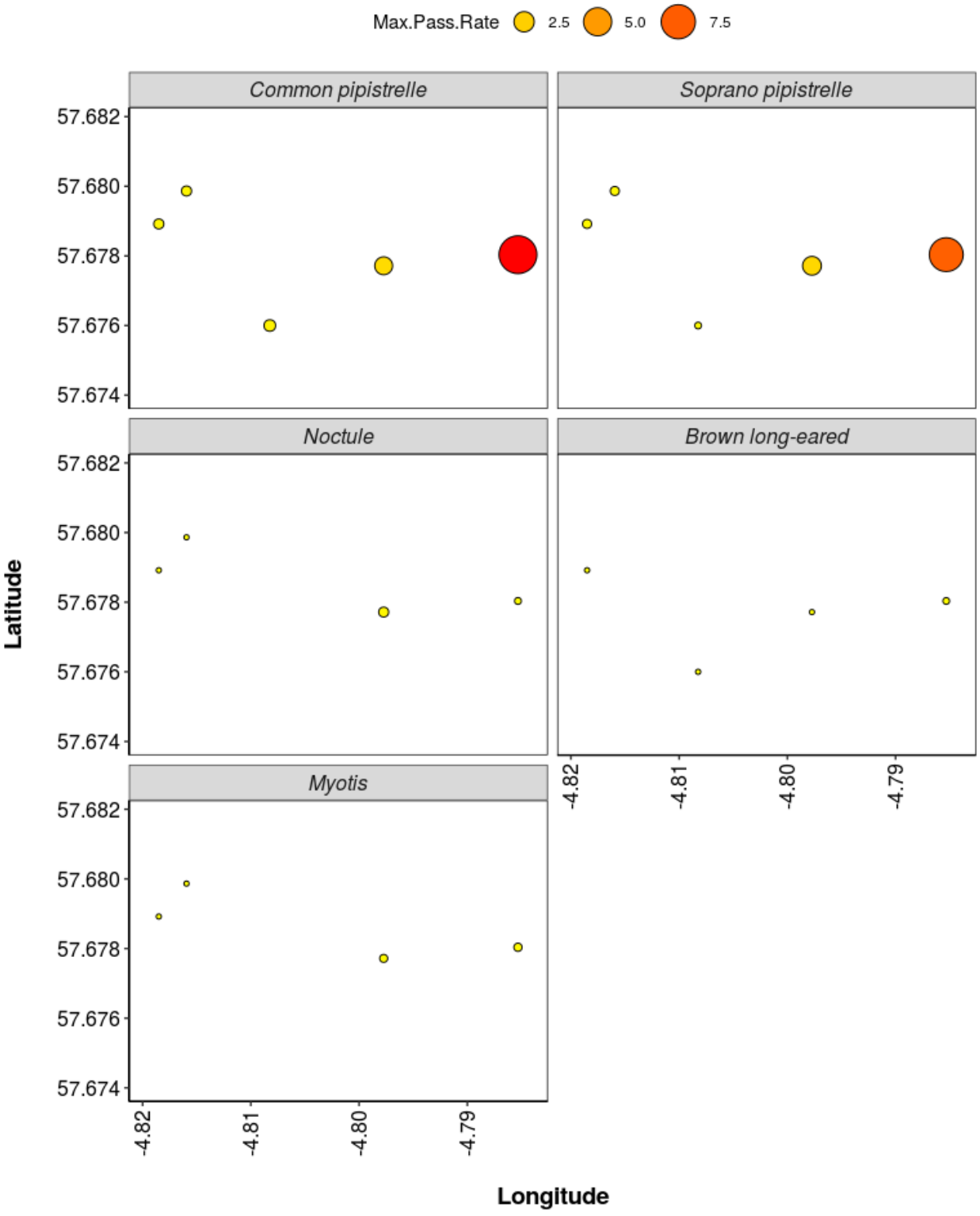


Figure 15. Maximum Nightly Pass Rate (bat passes/hr/night) recorded in a single night throughout the survey period - represented by the size and colour of the point at each detector location.



21.1 PART 2B: Includes absences

THE NEXT SECTION OF THE REPORT FEATURES THE DATA SUPPLIED TO ECOBAT BUT TAKES INTO ACCOUNT SPECIES ABSENCES, AND THEREFORE INCLUDES 'ZERO DATA' FOR WHEN SPECIES WERE NOT DETECTED AT EACH DETECTOR ON A NIGHT. THIS DRAMATICALLY LOWERS THE MEANS AND MEDIANS OF THE DATA PRESENTED.

21.2 Nightly Bat Pass Rate (Bat passes per hour)

22 MEDIAN PER DETECTOR

Table 22. 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
Brown long-eared	LOC 1	0.0
Brown long-eared	LOC 2	0.0
Brown long-eared	LOC 3	0.0
Brown long-eared	LOC 4	0.0
Brown long-eared	LOC 5	0.0
Common pipistrelle	LOC 1	0.2
Common pipistrelle	LOC 2	0.2
Common pipistrelle	LOC 3	0.3
Common pipistrelle	LOC 4	0.0
Common pipistrelle	LOC 5	0.1
Myotis	LOC 1	0.1
Myotis	LOC 2	0.0
Myotis	LOC 3	0.0
Myotis	LOC 4	0.0
Myotis	LOC 5	0.0
Noctule	LOC 1	0.0
Noctule	LOC 2	0.0
Noctule	LOC 3	0.0
Noctule	LOC 4	0.0
Noctule	LOC 5	0.0
Soprano pipistrelle	LOC 1	0.2
Soprano pipistrelle	LOC 2	0.3
Soprano pipistrelle	LOC 3	0.1

Soprano pipistrelle	LOC 4	0.2
Soprano pipistrelle	LOC 5	0.1

22.1 Nightly Bat Pass Rate (Bat passes per hour)

23 MEAN PER DETECTOR

Table 23. The mean Nightly Pass Rate (bat passes per hour, per night) of each species at each detector. Values are given to 1 decimal place.

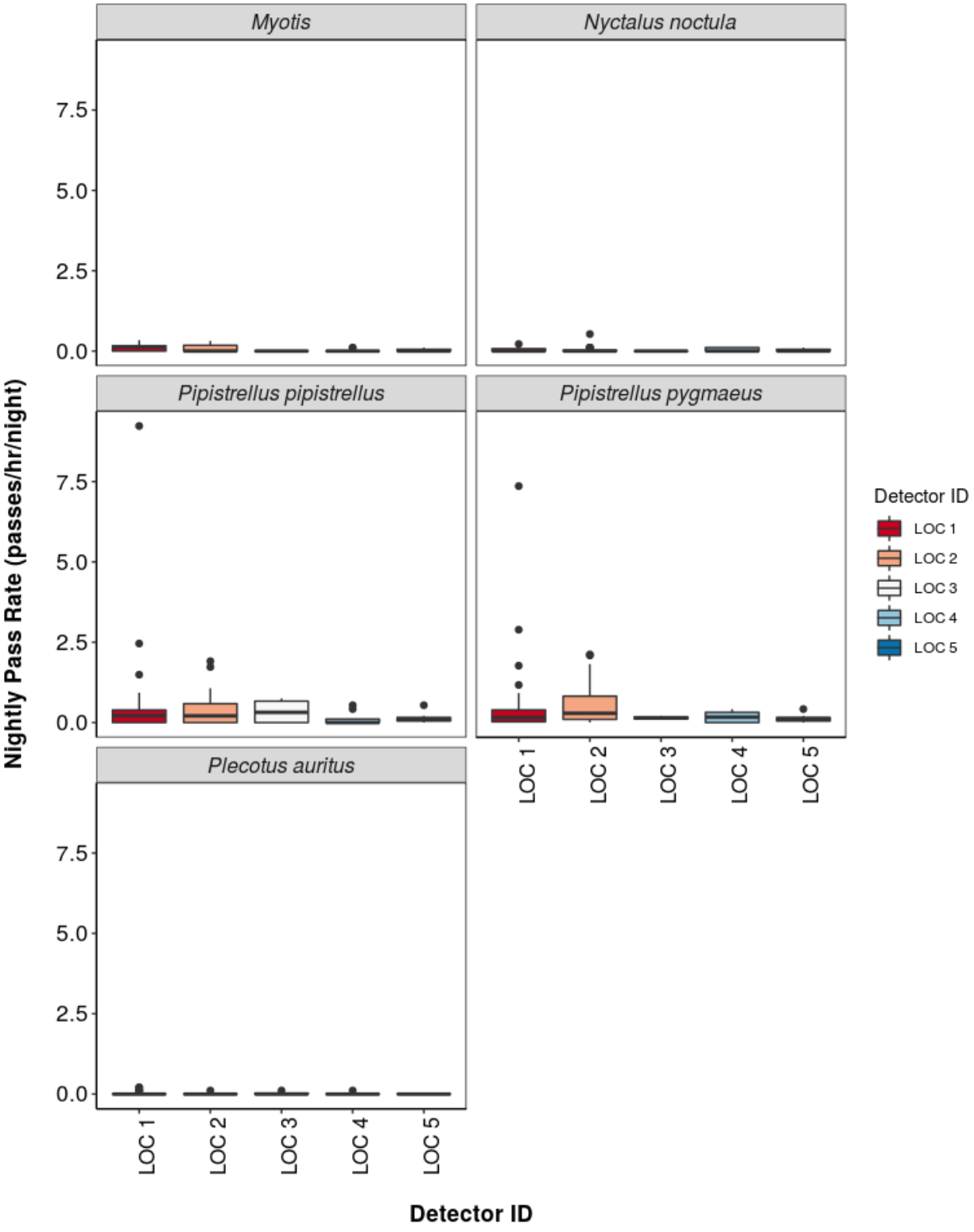
We recommend using the median values given above, for the reasons stated above, but provide the mean values in the table below.

Species	Detector ID	Mean Pass Rate
Brown long-eared	LOC 1	0.0
Brown long-eared	LOC 2	0.0
Brown long-eared	LOC 3	0.0
Brown long-eared	LOC 4	0.0
Brown long-eared	LOC 5	0.0
Common pipistrelle	LOC 1	0.7
Common pipistrelle	LOC 2	0.4
Common pipistrelle	LOC 3	0.3
Common pipistrelle	LOC 4	0.1
Common pipistrelle	LOC 5	0.2
Myotis	LOC 1	0.1
Myotis	LOC 2	0.1
Myotis	LOC 3	0.0
Myotis	LOC 4	0.0
Myotis	LOC 5	0.0
Noctule	LOC 1	0.0
Noctule	LOC 2	0.1
Noctule	LOC 3	0.0
Noctule	LOC 4	0.0
Noctule	LOC 5	0.0
Soprano pipistrelle	LOC 1	0.7
Soprano pipistrelle	LOC 2	0.6
Soprano pipistrelle	LOC 3	0.2
Soprano pipistrelle	LOC 4	0.2
Soprano pipistrelle	LOC 5	0.1

24 NIGHTLY BAT PASSES (BAT PASSES PER HOUR)

24.1 Per Detector - Figures

Figure 16. Figures show 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.


Myotis
Nyctalus noctula
Pipistrellus pipistrellus
Pipistrellus pygmaeus
Plecotus auritus
Nightly Pass Rate (passes/hr/night)
0.0
2.5
5.0
7.5
LOC 1
LOC 2
LOC 3
LOC 4
LOC 5
Detector ID
Detector ID

25 SURVEY EFFORT

Table 24. The number of nights bats were detected per month per detector.

Month	Detector ID	No of Survey Nights
May	LOC 1	7
Jun	LOC 1	6
Jun	LOC 2	3
Jun	LOC 3	1
Jun	LOC 4	1
Aug	LOC 1	13
Aug	LOC 2	13
Aug	LOC 3	3
Aug	LOC 4	8
Aug	LOC 5	7

25.1 Nightly Bat Pass Rate for each Month

26 MEDIAN PER DETECTOR

Table 25. 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	Aug	Jun	May
Brown long-eared	LOC 1	0.0	0.0	0.0
Brown long-eared	LOC 2	0.0	0.0	NA
Brown long-eared	LOC 3	0.0	0.0	NA
Brown long-eared	LOC 4	0.0	0.0	NA
Brown long-eared	LOC 5	0.0	NA	NA
Common pipistrelle	LOC 1	0.3	0.1	0.3
Common pipistrelle	LOC 2	0.2	0.0	NA
Common pipistrelle	LOC 3	0.6	0.0	NA
Common pipistrelle	LOC 4	0.1	0.0	NA
Common pipistrelle	LOC 5	0.1	NA	NA
Myotis	LOC 1	0.1	0.1	0.2
Myotis	LOC 2	0.0	0.2	NA
Myotis	LOC 3	0.0	0.0	NA

Myotis	LOC 4	0.0	0.0	NA
Myotis	LOC 5	0.0	NA	NA
Noctule	LOC 1	0.1	0.0	0.0
Noctule	LOC 2	0.0	0.0	NA
Noctule	LOC 3	0.0	0.0	NA
Noctule	LOC 4	0.0	0.0	NA
Noctule	LOC 5	0.0	NA	NA
Soprano pipistrelle	LOC 1	0.3	0.2	0.2
Soprano pipistrelle	LOC 2	0.4	0.2	NA
Soprano pipistrelle	LOC 3	0.1	0.2	NA
Soprano pipistrelle	LOC 4	0.2	0.2	NA
Soprano pipistrelle	LOC 5	0.1	NA	NA

26.1 Nightly Bat Pass Rate for each Month

27 MEAN PER DETECTOR

Table 26. The mean Nightly Pass Rate (bat passes per hour, per night) of each species throughout each month. Values are given to 1 decimal place.

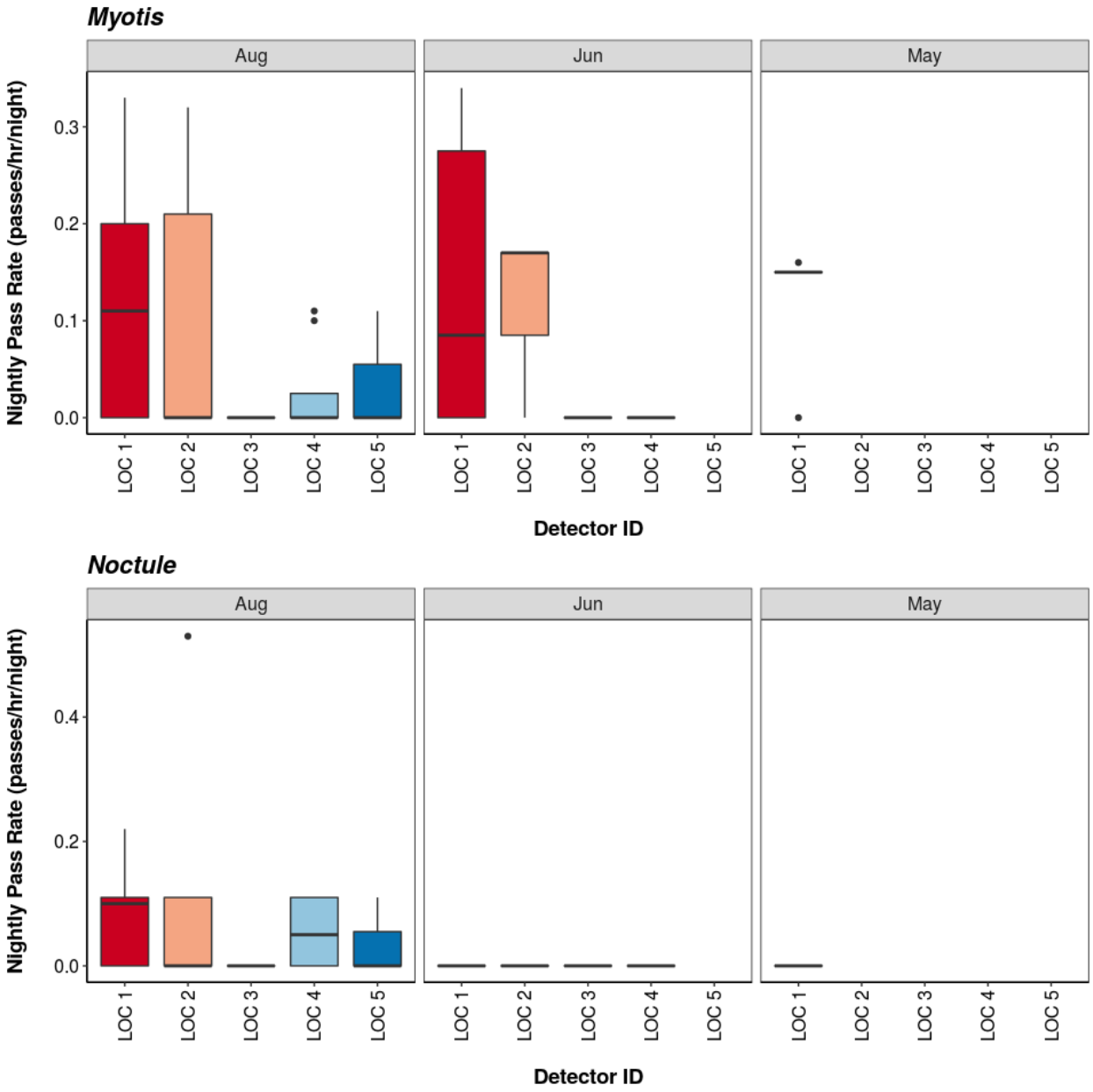
We recommend using the median values given above, for the reasons stated above, but provide the mean values in the table below.

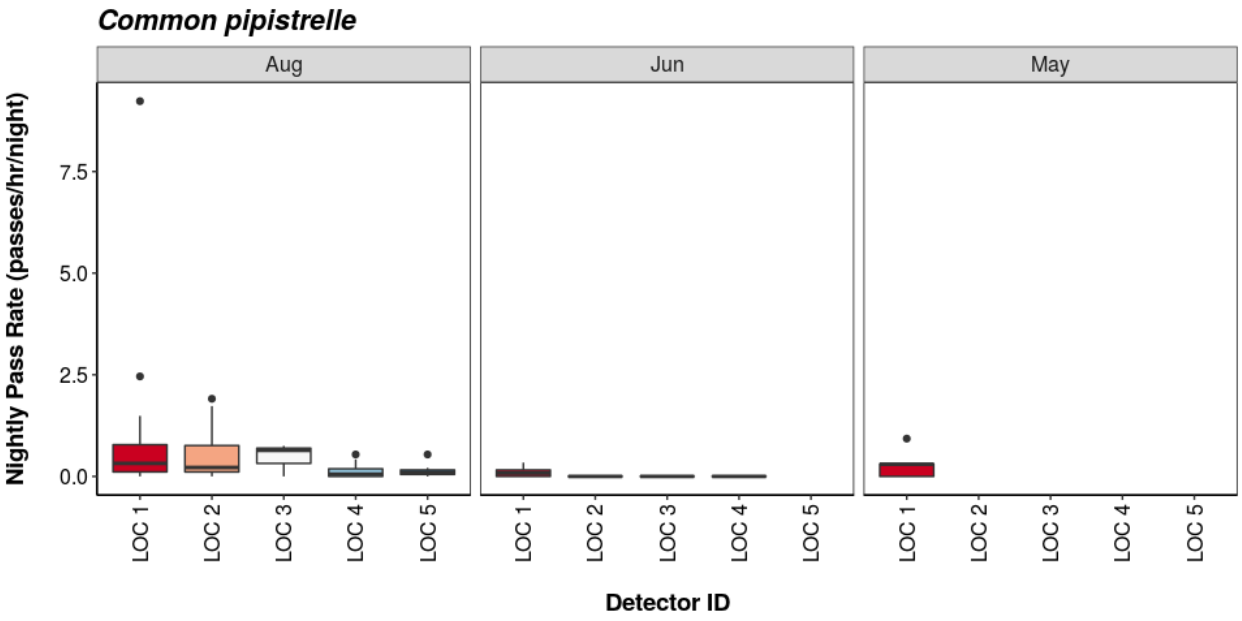
Species	Detector ID	Aug	Jun	May
Brown long-eared	LOC 1	0.1	0.0	0.0
Brown long-eared	LOC 2	0.0	0.0	NA
Brown long-eared	LOC 3	0.0	0.0	NA
Brown long-eared	LOC 4	0.0	0.0	NA
Brown long-eared	LOC 5	0.0	NA	NA
Common pipistrelle	LOC 1	1.2	0.1	0.3
Common pipistrelle	LOC 2	0.6	0.0	NA
Common pipistrelle	LOC 3	0.5	0.0	NA
Common pipistrelle	LOC 4	0.1	0.0	NA
Common pipistrelle	LOC 5	0.2	NA	NA
Myotis	LOC 1	0.1	0.1	0.1
Myotis	LOC 2	0.1	0.1	NA
Myotis	LOC 3	0.0	0.0	NA
Myotis	LOC 4	0.0	0.0	NA
Myotis	LOC 5	0.0	NA	NA
Noctule	LOC 1	0.1	0.0	0.0
Noctule	LOC 2	0.1	0.0	NA
Noctule	LOC 3	0.0	0.0	NA
Noctule	LOC 4	0.1	0.0	NA
Noctule	LOC 5	0.0	NA	NA
Soprano pipistrelle	LOC 1	1.2	0.1	0.2
Soprano pipistrelle	LOC 2	0.7	0.2	NA
Soprano pipistrelle	LOC 3	0.1	0.2	NA
Soprano pipistrelle	LOC 4	0.2	0.2	NA
Soprano pipistrelle	LOC 5	0.1	NA	NA

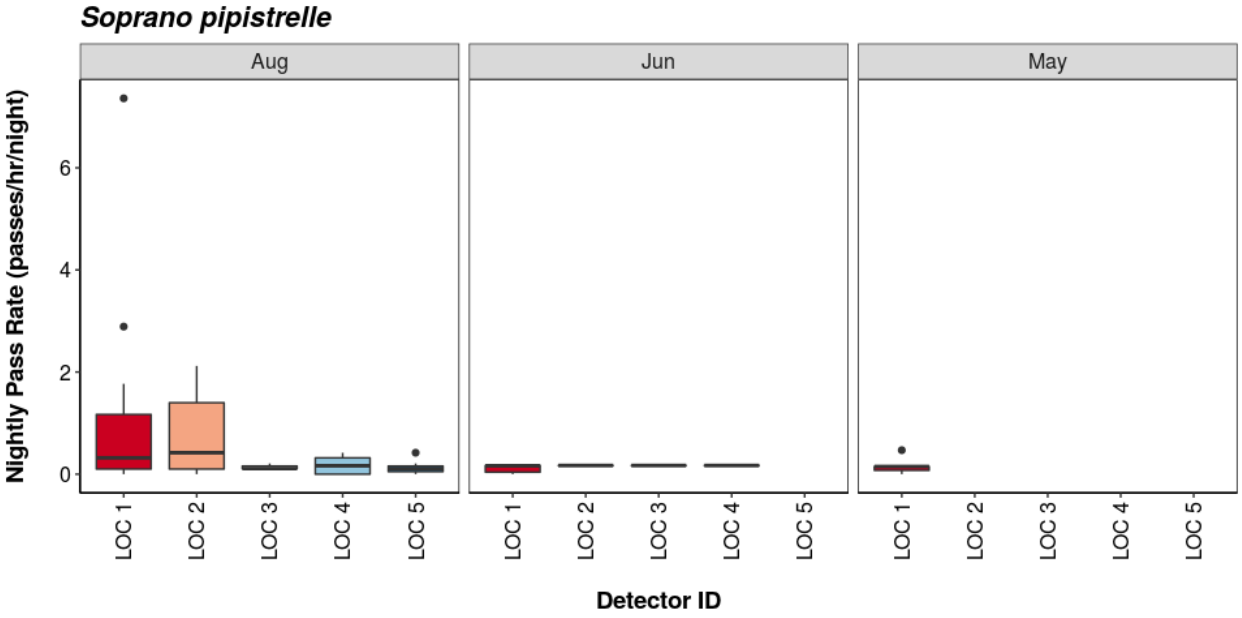
27.1 Nightly Bat Pass Rate for each Month

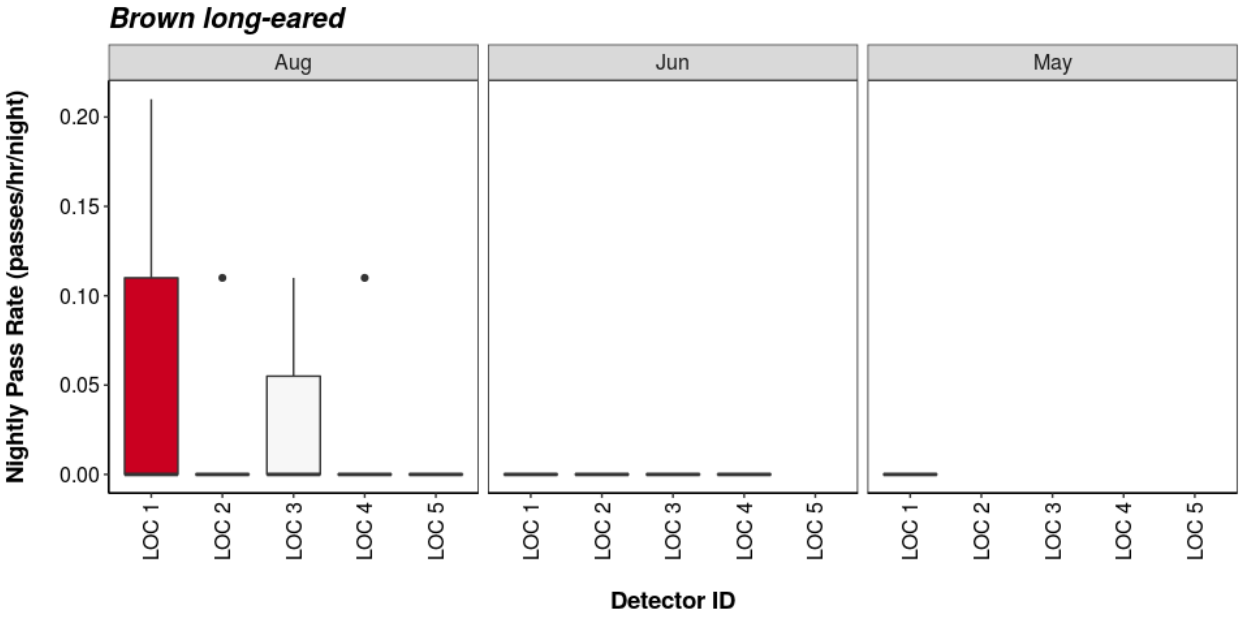
27.2 Per Detector - Figures

Figure 17. 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.




Common pipistrelle
Aug
Jun
May
Nightly Pass Rate (passes/hr/night)
7.5
5.0
2.5
0.0
LOC 1
LOC 2
LOC 3
LOC 4
LOC 5
Detector ID


Soprano pipistrelle
Aug
Jun
May
Nightly Pass Rate (passes/hr/night)
6
4
2
0
LOC 1
LOC 2
LOC 3
LOC 4
LOC 5
Detector ID


Brown long-eared
Aug
Jun
May
Nightly Pass Rate (passes/hr/night)
0.20
0.15
0.10
0.05
0.00
LOC 1
LOC 2
LOC 3
LOC 4
LOC 5
Detector ID

28 BAT ACTIVITY PER DETECTOR LOCATION

Figure 18. Detector ID reference:

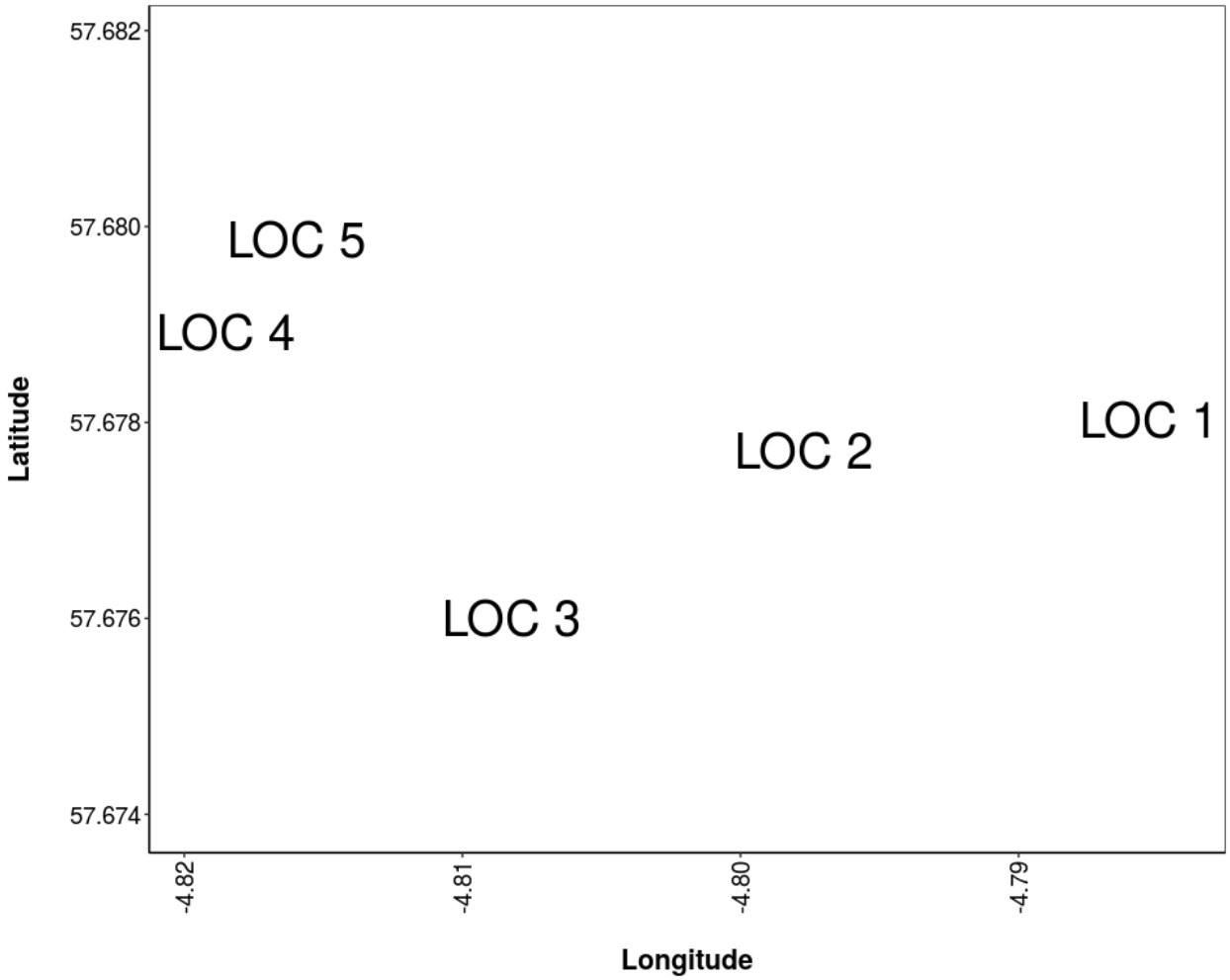


Figure 19. Median Nightly Pass Rate (bat passes/hr/night) throughout the survey period - represented by the size and colour of the point at each detector location.

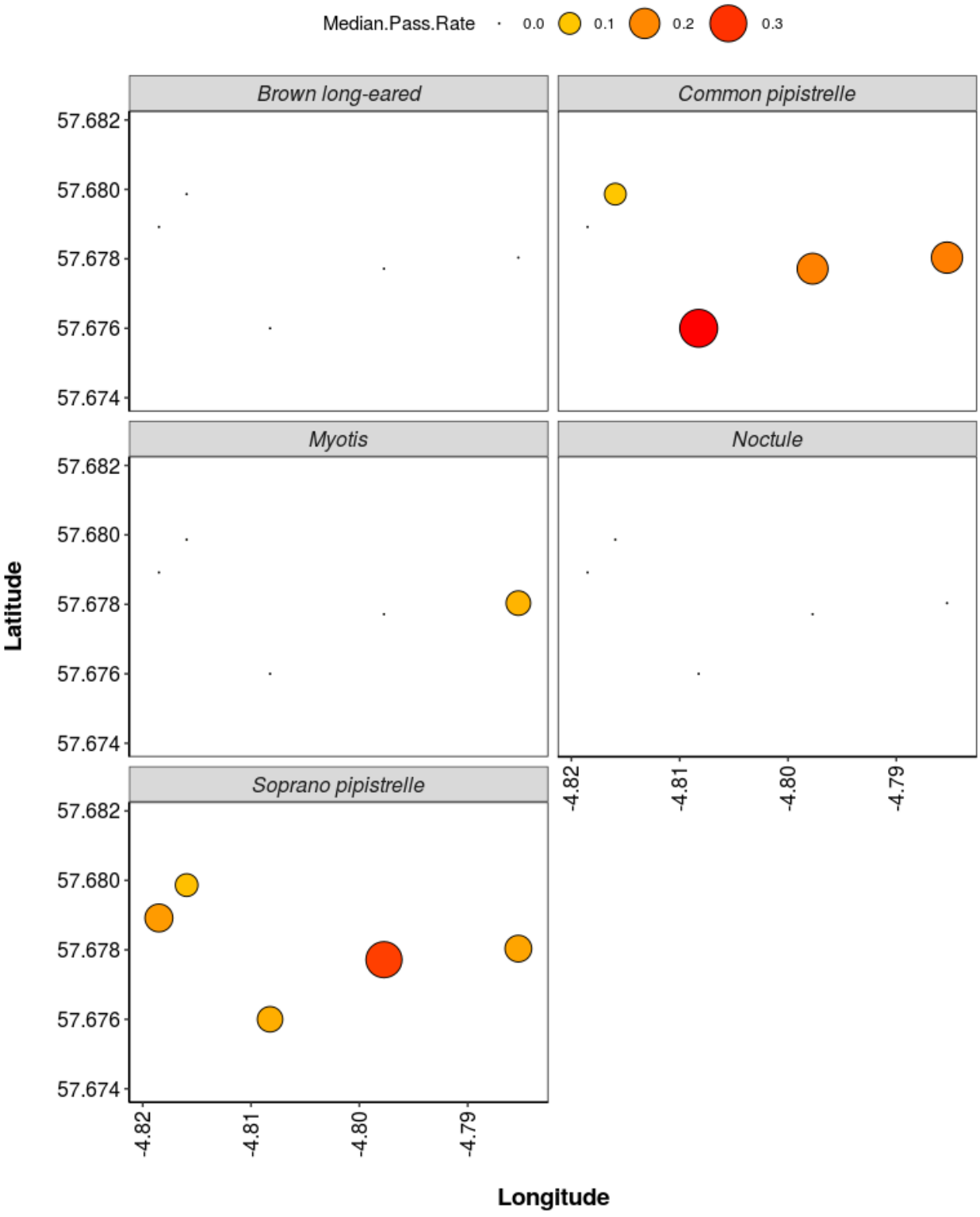
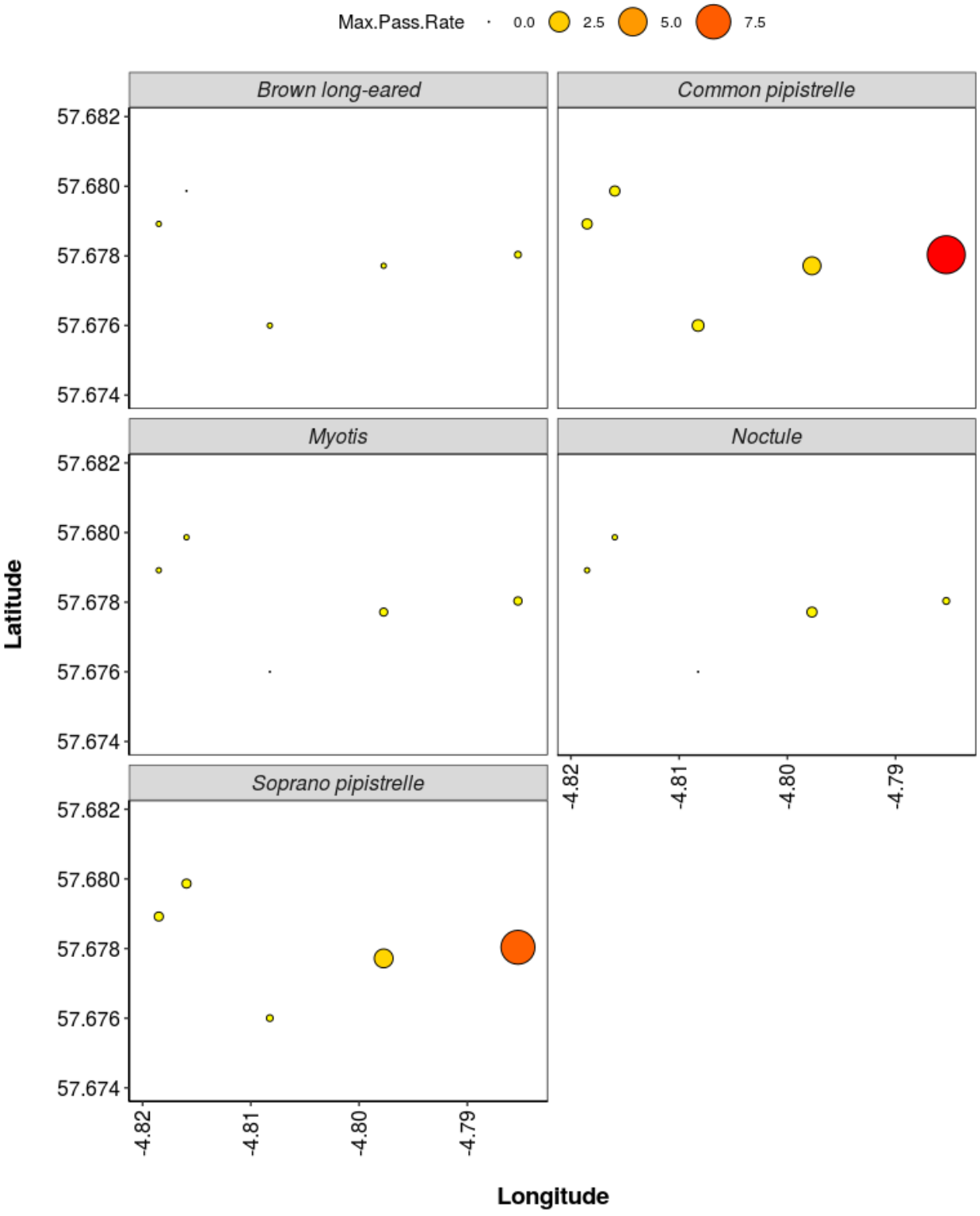


Figure 20. Maximum Nightly Pass Rate (bat passes/hr/night) recorded in a single night throughout the survey period - represented by the size and colour of the point at each detector location.



Thank you for using Ecobat! If you have any questions please email info@themammalsociety.org.uk