Ryevitalise: Bats and Ancient Trees 2021

A survey of bat species across the Ryevitalise Landscape Partnership Scheme area

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Graphics and design by S. Gillings.

1. BACKGROUND

To be able to minimise the impact of future building and other developments on bats, it is important to identify key areas for different species. This requires surveys and analyses that are able to provide a robust understanding of large-scale patterns in species' distributions and abundance (Pereira & Cooper, 2006; Jones, 2011). Provision of the necessary data is particularly challenging for bats, because most species are nocturnal, wide ranging and difficult to identify. As a consequence, the majority of published studies on bats have used presence-only data (i.e. where there is no direct information collected about either real absence or non-detection), collected through unstructured opportunistic sampling. With developments in passive bat detectors, software to aid the analysis of sound files and improving knowledge of species identification (Barataud, 2015; Russ 2021), it is now possible to conduct large-scale representative acoustic assessment of bat species' distributions using presence-absence data and information on activity as a measure of abundance (e.g. Newson *et al.*, 2015). This can be achieved with non-professional volunteers, where the use of autonomous recording devices and standardised protocols for deploying detectors has proven potential to provide data that is comparable in quality to that collected by bat specialists, but at a fraction of the cost (Newson *et al.*, 2015).

2. AIMS AND OBJECTIVES

This study capitalises on the enthusiasm of volunteers to participate in biodiversity monitoring to collect systematic bat distribution and activity data across the Ryevitalise Landscape Partnership Scheme area to run over four years. This will result in the production of a robust dataset, which will increase knowledge and understanding of key bat population distribution and activity across the Ryevitalise survey area. Whilst the focus of this work is bats, results for small terrestrial mammals and insects which may be recorded as 'by-catch' during bat survey work are also returned (Newson *et al.*, 2017b; Newson *et al.*, 2021). In this report we present results from the second survey season of 2021.

In addition to the above, the project has the following objectives:

1. Improve our understanding of the status, distribution and timing of occurrence of the different species that occur in the Ryevitalise survey area.

2. Involve and inspire a large section of the wider community to connect and engage with an aspect of nature that is poorly known and understood.

3. Develop an awareness of what bats do for us and why it is important to conserve them.

4. Recruit a large number of citizen scientists who do not require specialist knowledge to undertake the survey.

3. METHODS

3.1 Static detector protocol

Our survey approach is based on the Norfolk Bat Survey and Southern Scotland Bat Survey (Newson *et al.* 2015; Newson *et al.*, 2017a) which was set up to assess the season-wide status of bat species throughout large regions – something only realistically achievable on this scale by working with members of the public. Our protocol enables members of the public to have access to passive real-time bat detectors which they could leave outside to automatically trigger and record the calls to a memory card every time a bat passes throughout a night.

Bat detectors (the SM4Bat FS), were left out to record for a minimum of four consecutive nights at each location. The recommendation of four nights, follows analyses of bat data carried out by ourselves as part of a Defra funded project to inform the most cost-effective sampling regime for detecting the effect of local land-use and land management. Multiple nights of recording are likely to smooth over stochastic and weather-related variation, whilst also being easy to implement logistically (once a detector is on site, it is easy to leave it in situ for multiple nights).

Volunteers were directed to an online square sign-up tool, showing survey coverage (available 1km squares), through which they sign-up and reserved a square or squares for survey. The survey map was updated throughout the survey season allowing uptake and coverage during the survey season to be assessed. After reserving a 1km square for the survey, volunteers were automatically emailed a web link through which they can reserve out a bat detector from the most convenient 'bat monitoring centre', and details on how to set up a BTO Acoustic Pipeline account (see below). In this project, Sutton Bank National Park Centre was used as a hosting centres for bat detectors.

The bat detectors were set to use a high pass filter of 8 kHz which defined the lower threshold of the frequencies of interest for the triggering mechanism. Recording was set to continue until no trigger is detected for a two second period up to a maximum of 5 seconds. Detectors were deployed before sunset and detectors set to switch on and record for 30 minutes before sunset until 30 minutes after sunrise the following day. The microphone was mounted on 2m poles to avoid ground noise and reduce recordings of reflected calls. Guidance was provided to volunteers on the placement of microphones which should be deployed at least 1.5 meters in any direction from vegetation, water or other obstructions.

3.2 Survey effort and timing

The survey period will normally run from May to the end of September, but the survey started a little later this season due to covid considerations. A long survey season covers the main period of bat activity, and maximises use of the equipment during the year. Volunteers were encourage to choose specific 1km squares to survey, but some flexibility was allowed to encourage volunteer uptake.

3.3 Processing recordings and species identification

Automated passive real-time detectors are triggered when they detect sound within a certain frequency range. Monitoring on this scale can generate a very large volume of recordings, efficient processing of which is greatly aided by a semi-automated approach for assigning recordings to species.

At the end of a four-day recording session, the wav files recorded by the bat detector, along with associated information on where the recording was carried out were uploaded by the volunteer to the BTO's Acoustic Pipeline http://bto.org/pipeline for processing. Volunteers have their own online user account, and desktop software through which they, or the local project organiser if needed can upload recordings directly to the cloud-based pipeline for processing. This system captures the metadata (name and email address of the person taking part, the survey dates and locations at which the detectors were left out to record), which are matched automatically to the bat results. Once a batch of recordings is processed, the user is emailed automatically, and the raw results are then be downloadable through the user account as a csv file. These first results are provided with the caveat that additional auditing of the results and recordings is carried out at the end of the survey season.

Because the cost of cloud processing and storage is expensive, and there is a significant cost every time data is pulled out or moved, particularly if it is in the most accessible storage tier, recordings were automatically moved to deep glacial storage after processing. The recordings are then not easily accessible during the survey season itself, but a complete copy of the recordings was pulled back at the end of the survey season for auditing.

The classifier allows up to four different "identities" to be assigned to a single recording, according to probability distributions between detected and classified sound events. From these, species identities are assigned by the classifier, along with an estimated probability of correct classification. Specifically this is the false positive rate, which is the probability that the pipeline has assigned an identification to the wrong species. However, we scale the probability, so that the higher the probability, the lower the false positive rate. To give an example, given a species identification with a probability of 0.9, there is a 10% chance that the identification is wrong.

Our recommendation, which is supported in Barre *et al.* (2019), is that identifications with a probability of less than 0.5 (50%) are discarded. However, manually auditing of a sample of recordings (wav files) that are below this threshold, were carried out to be confident that little that could be assigned to species by any means is lost by doing this.

For bats and small mammals where we were interested in producing a measure of activity, we manually checked all the recordings of a species. For the most common species common pipistrelle and soprano pipistrelle, we checked a random sample of 1,000 recordings to quantify the error rate in the dataset. For insects which are not very mobile, our general approach is to check all recordings where there is a small number of recordings, but where there are a large number of recordings, often of the same individual, we instead focus on

producing an inventory of species present (species presence), where the three recordings with the highest probability for each site and night were selected for auditing.

Verification of species identification was carried through the manual checking of spectrograms using software SonoBat (http://sonobat.com/) which was used as an independent check of the original species identities assigned by pipeline. All subsequent analyses use final identities upon completion of the above inspection and (where necessary) correction steps.

It is important to note that the criteria for distinguishing whiskered and Brandt's bat are very subtle and currently poorly defined. We provide separate results for these two species where recorded, but with a big caveat that these species are extremely difficult to distinguish acoustically, and for any future use of the data should be treated as a species pair.

3.4 Nightly patterns of activity

Important for improving our understanding of the species present, we examine how bat activity varied by time of night and by season. Nightly activity was determined for each half-month period and presented according to the percentage of sample squares on which each bat species was detected. Where sample squares were surveyed more than once in a period, the study combined data across visits. Activity through the night was analysed by first converting all bat pass times to time since sunset based on the location and date and calculated using the R package suncalc (https://github.com/datastorm-open/suncalc) and then assessing the frequency distribution of passes relative to sunset for the whole season and in half-month periods.

3.5 Spatial patterns of activity and distribution

We produce maps of bat and small mammal activity showing the maximum number of recordings of each species per night. Activity here represents usage of an area, which will be a combination of species abundance, and time spent in the area.

4. RESULTS

4.1 Survey coverage

Data from 47 different locations were surveyed for bats and uploaded through the pipeline. This sample comprised 70 complete nights of recording. Overall, 137459 recordings were collected which, following analyses and validation, were found to include 137112 bat recordings, 331 small terrestrial mammal recordings and 16 moth recordings (Table 1). Maps of activity showing the number of recordings of each species per night are presented in Fig. 1. Manual checking of recording was carried out for all species and recordings,

except for common pipistrelle and soprano pipistrelle for which 1000 randomly selected recordings were checked. Of these, 6 (0.6%) and 0 (0%) recordings were assigned to the wrong species.

Figure 1. Seasonal pattern of recording effort, summarised by halfmonth.

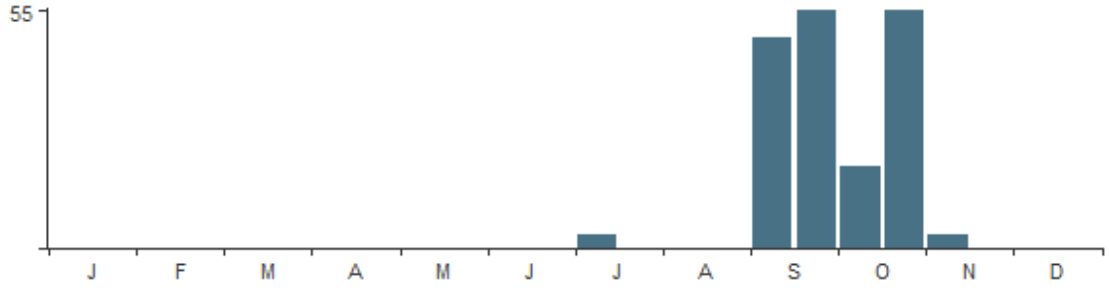
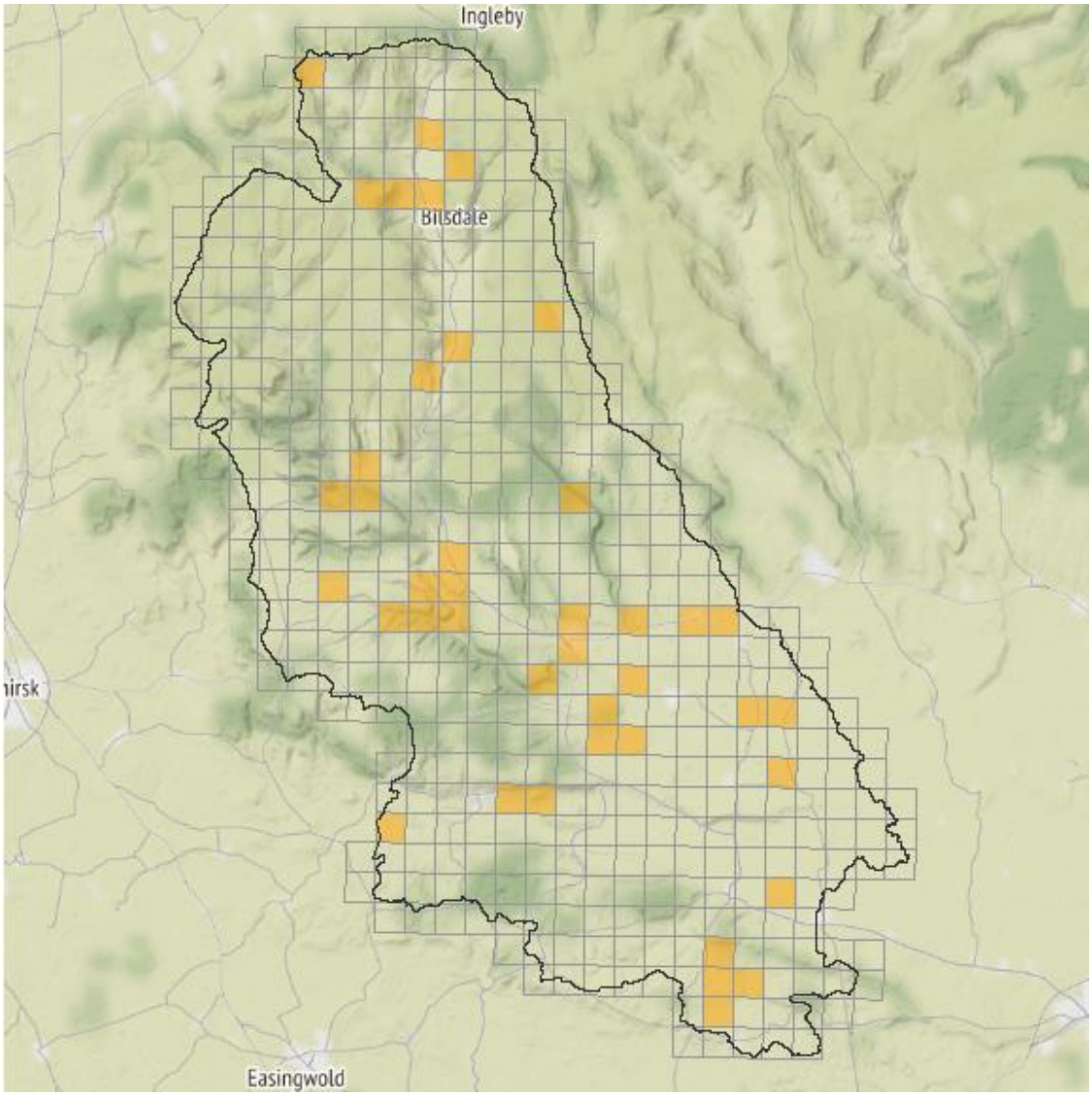


Figure 1. Map of the study area showing 1km squares surveyed in 2021.



4.2 General results

Table 1 gives the number of sites where each species was detected and the total number of detections of each species.

Table 1. Species detected, number of recordings of each species following validation and a summary of the scale of recording.

Species group	Species	No. of recordings following validation	No. of different locations (% of total)
bat	Alcathoe bat, Myotis alcathoe	6	5 (10.6%)
bat	Brandt's bat, Myotis brandtii	8,270	45 (95.7%)
bat	Daubenton's bat, Myotis daubentonii	10,363	42 (89.4%)
bat	Whiskered bat, Myotis mystacinus	5,202	47 (100%)
bat	Natterer's bat, Myotis nattereri	3,868	47 (100%)
bat	Common noctule, Nyctalus noctula	2,078	39 (83%)
bat	Nathusius' pipistrelle, Pipistrellus nathusii	11	1 (2.1%)
bat	Common pipistrelle, Pipistrellus pipistrellus	66,458	47 (100%)
bat	Soprano pipistrelle, Pipistrellus pygmaeus	36,469	47 (100%)
bat	Brown long-eared bat, Plecotus auritus	4,387	46 (97.9%)
moth	Bird cherry ermine, Yponomeuta evonymella	16	9 (19.1%)
small mammal	Wood mouse, Apodemus sylvaticus	3	2 (4.3%)
small mammal	Brown rat, Rattus norvegicus	8	3 (6.4%)
small mammal	Common shrew, Sorex araneus	268	31 (66%)
small mammal	Eurasian pygmy shrew, Sorex minutus	52	14 (29.8%)

4.3 Species results

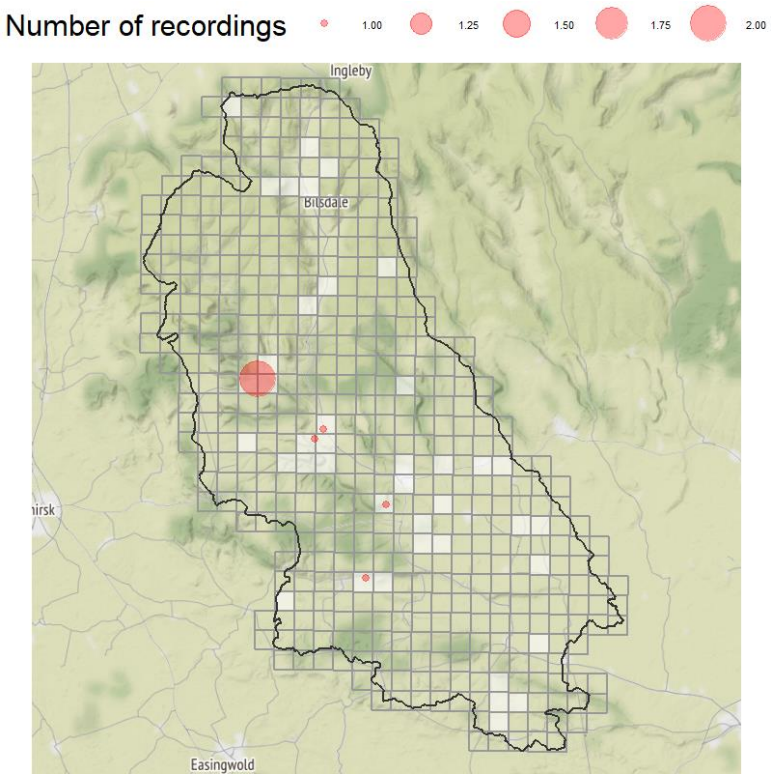
The following sections provide results for each species. In the seasonal activity plots, the individual boxplot show quartiles (lower, median and upper) with lines extend to 1.5 times the interquartile range, and small dots show outliers.

Alcathoe bat

Alcathoe bat (*Myotis alcathoe*) was recorded on 5 nights, from 5 locations, giving a total of 6 recordings. There was not sufficient data to summarise seasonality or activity patterns, but we provide a distribution map for this species.

Distribution map

Map showing the locations where Alcathoe bat was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.

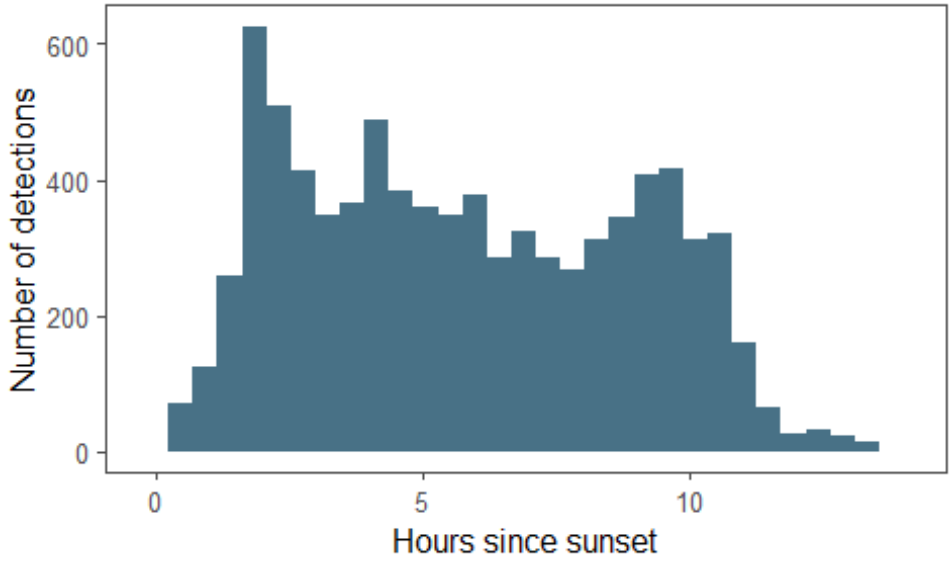

Number of recordings
1.00
1.25
1.50
1.75
2.00
Ingleby
Bilsdale
Easingwold

Brandt's bat

Brandt's bat (*Myotis brandtii*) was recorded on 60 nights, from 45 locations, giving a total of 8270 recordings. Below are some graphics summarising the seasonality, activity patterns and distribution of this species.

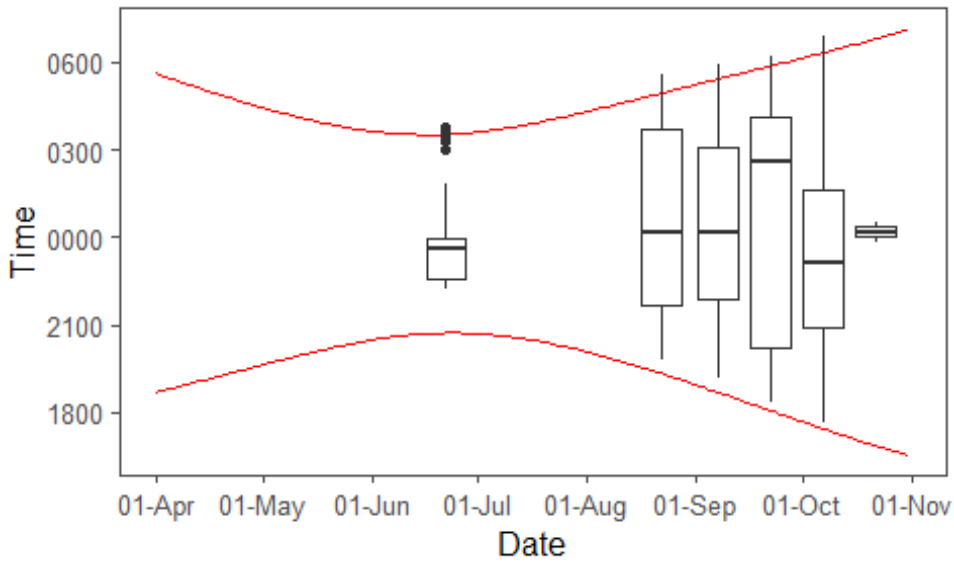
Nightly activity

The spread of detections with respect to sunset time, calculated over the whole season.



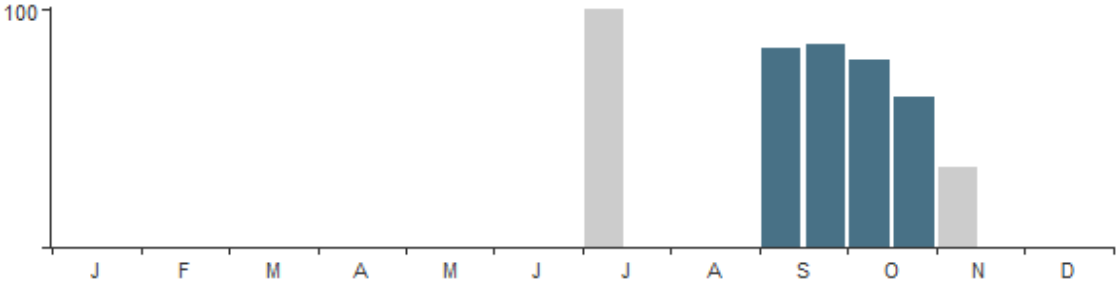
Nightly activity through the season

The spread of detections with respect to sunset and sunrise times (red lines) summarised for each halfmonth through the season.



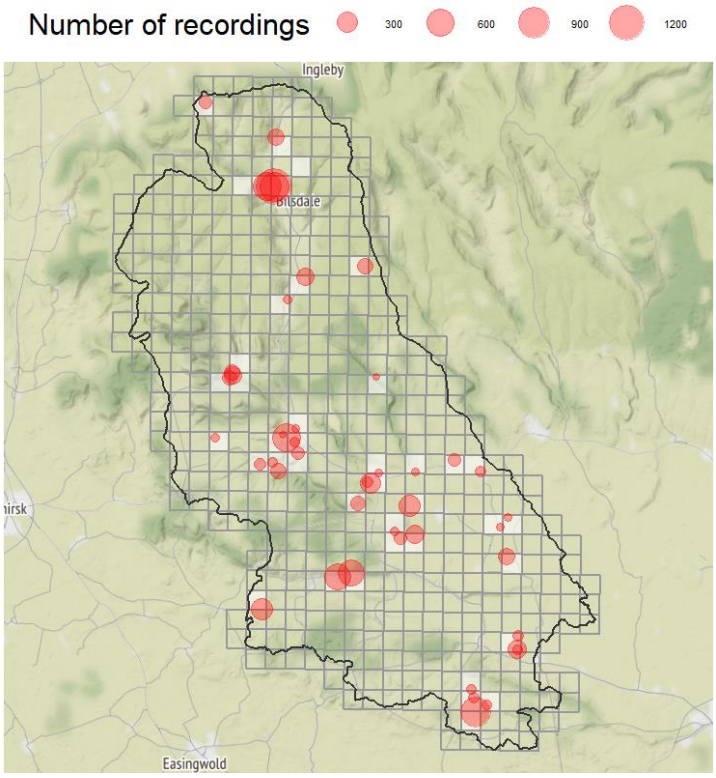
Reporting rates

The percentage of nights on which Brandt's bat was detected every halfmonth through the season. Pale grey bars represent periods with fewer than 10 visits where accuracy of the reporting rate may be low.



Distribution map

Map showing the locations where Brandt's bat was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.

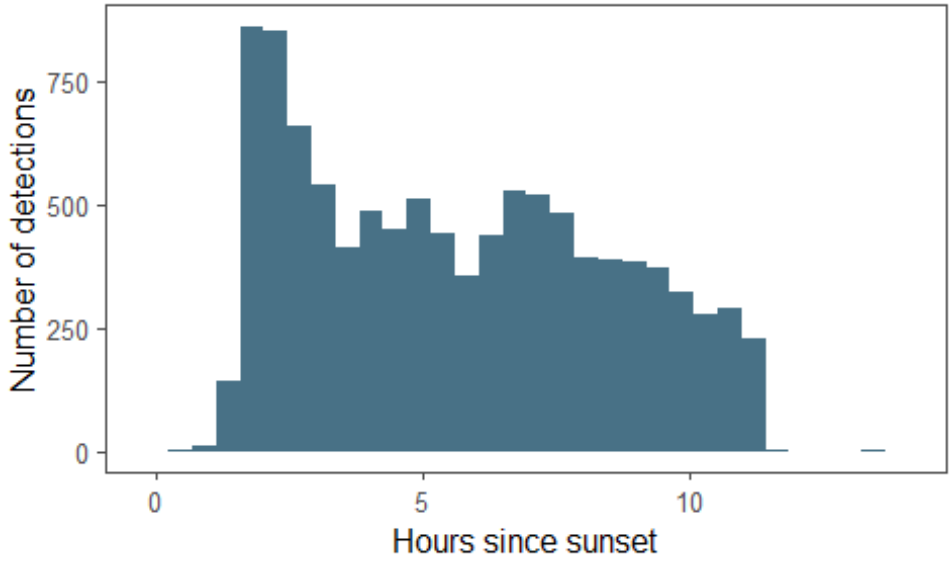


Daubenton's bat

Daubenton's bat (*Myotis daubentonii*) was recorded on 54 nights, from 42 locations, giving a total of 10363 recordings. Below are some graphics summarising the seasonality, activity patterns and distribution of this species.

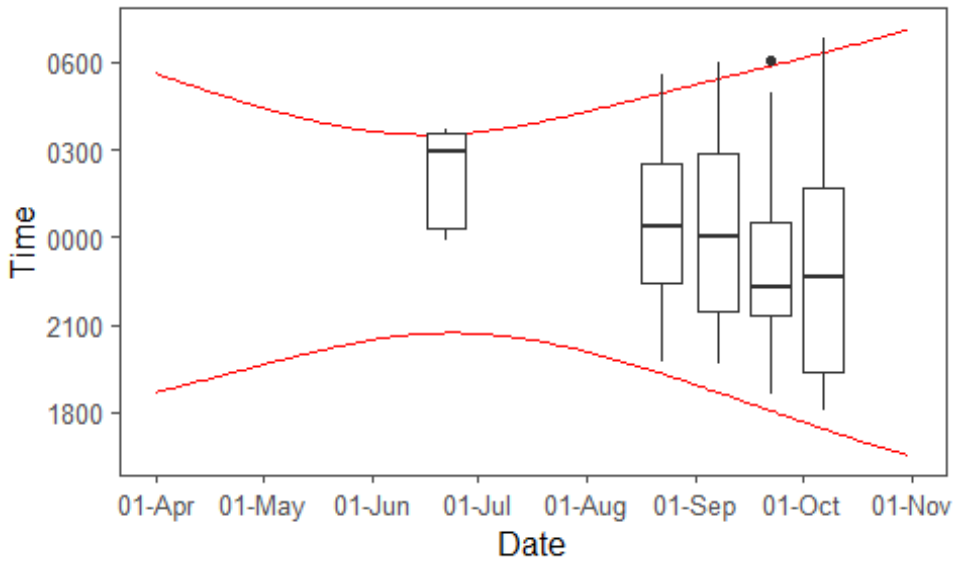
Nightly activity

The spread of detections with respect to sunset time, calculated over the whole season.



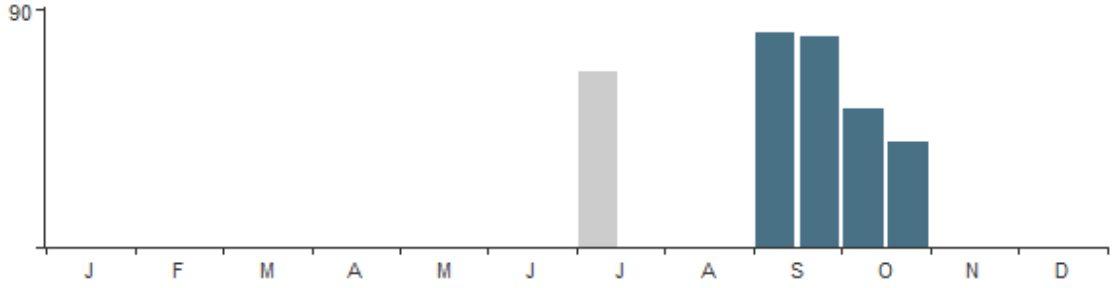
Nightly activity through the season

The spread of detections with respect to sunset and sunrise times (red lines) summarised for each halfmonth through the season.



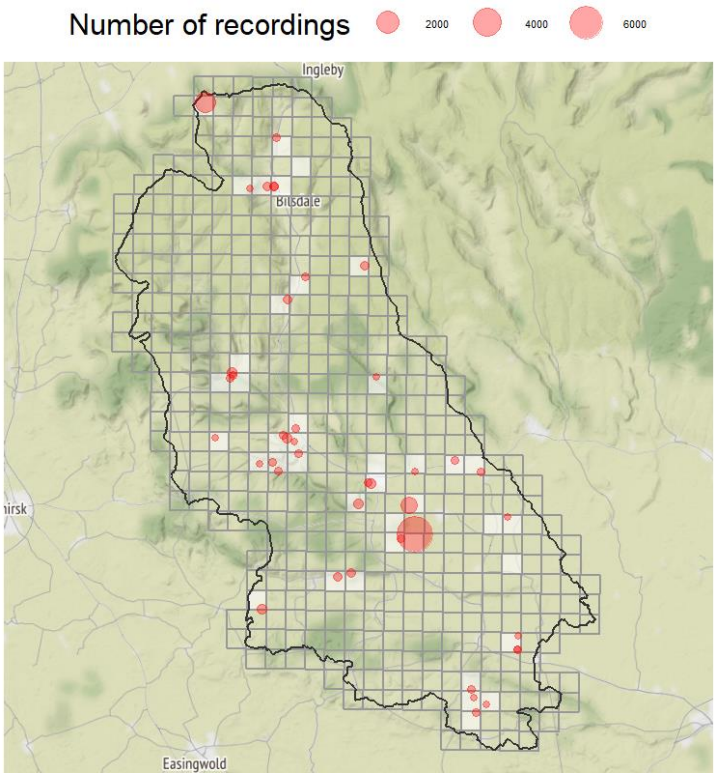
Reporting rates

The percentage of nights on which Daubenton's bat was detected every halfmonth through the season. Pale grey bars represent periods with fewer than 10 visits where accuracy of the reporting rate may be low.



Distribution map

Map showing the locations where Daubenton's bat was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.

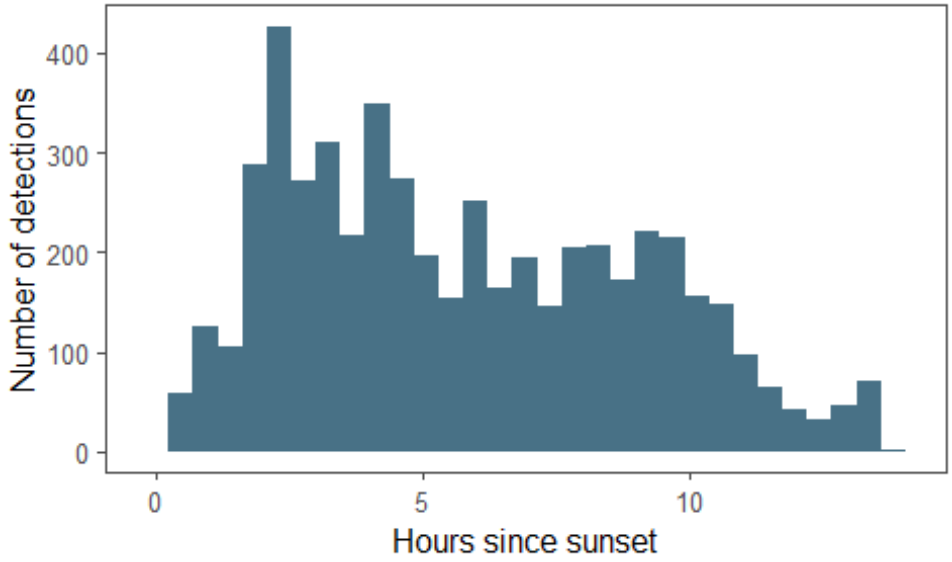


Whiskered bat

Whiskered bat (*Myotis mystacinus*) was recorded on 64 nights, from 47 locations, giving a total of 5202 recordings. Below are some graphics summarising the seasonality, activity patterns and distribution of this species.

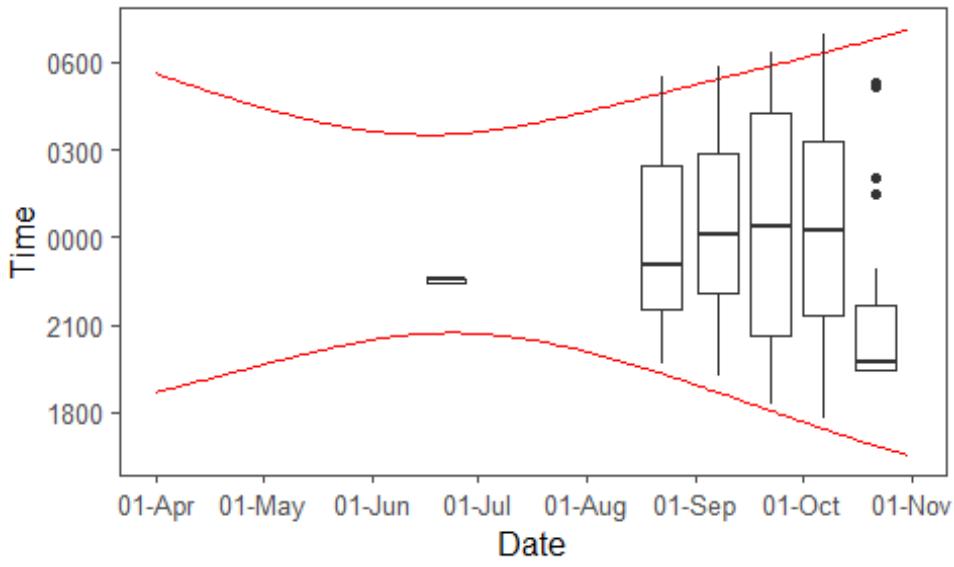
Nightly activity

The spread of detections with respect to sunset time, calculated over the whole season.



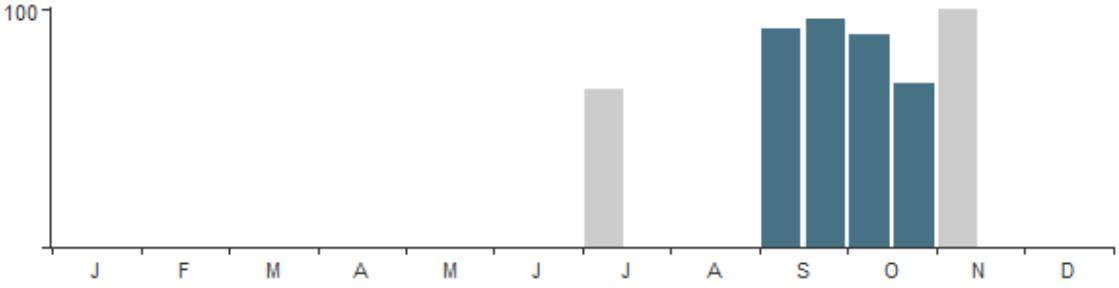
Nightly activity through the season

The spread of detections with respect to sunset and sunrise times (red lines) summarised for each halfmonth through the season.



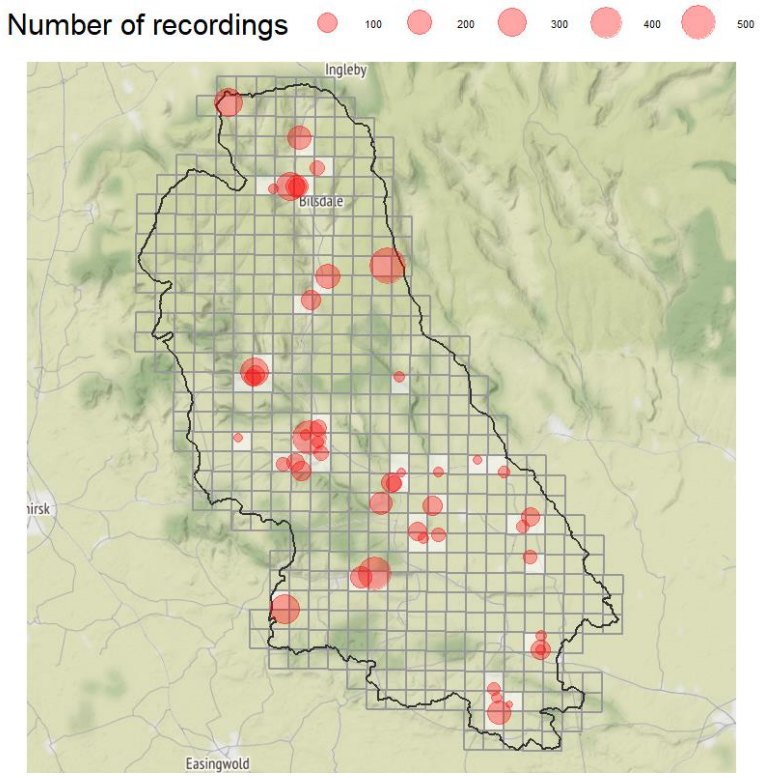
Reporting rates

The percentage of nights on which Whiskered bat was detected every halfmonth through the season. Pale grey bars represent periods with fewer than 10 visits where accuracy of the reporting rate may be low.



Distribution map

Map showing the locations where Whiskered bat was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.

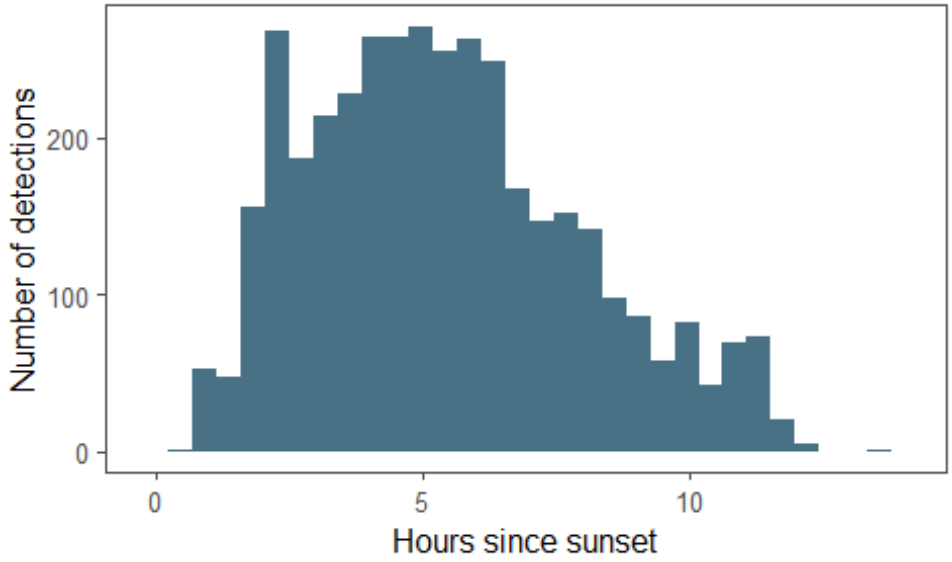


Natterer's bat

Natterer's bat (*Myotis nattereri*) was recorded on 65 nights, from 47 locations, giving a total of 3868 recordings. Below are some graphics summarising the seasonality, activity patterns and distribution of this species.

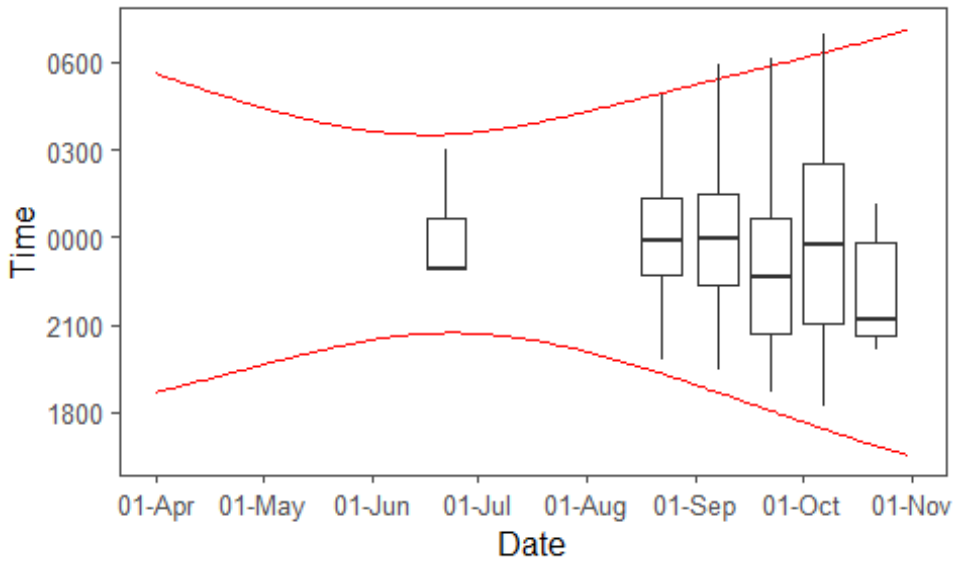
Nightly activity

The spread of detections with respect to sunset time, calculated over the whole season.



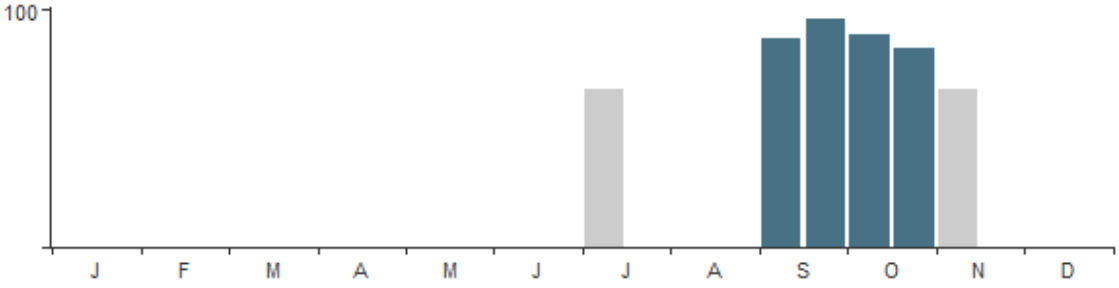
Nightly activity through the season

The spread of detections with respect to sunset and sunrise times (red lines) summarised for each halfmonth through the season.



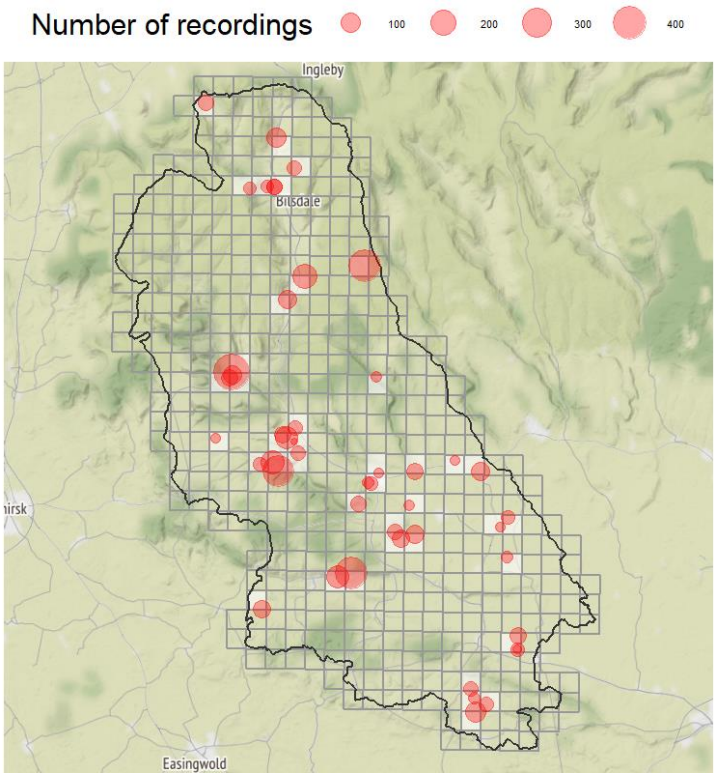
Reporting rates

The percentage of nights on which Natterer's bat was detected every halfmonth through the season. Pale grey bars represent periods with fewer than 10 visits where accuracy of the reporting rate may be low.



Distribution map

Map showing the locations where Natterer's bat was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.

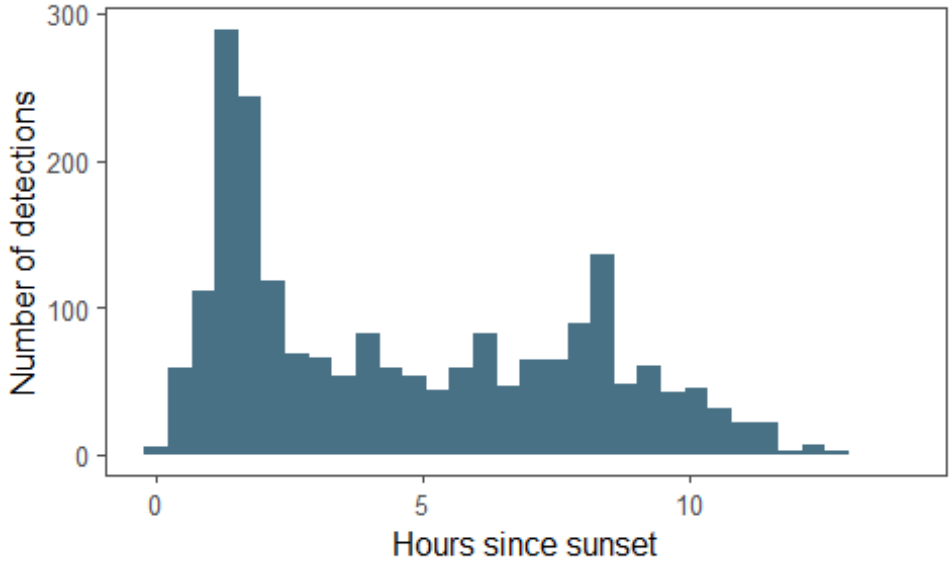


Common noctule

Common noctule (*Nyctalus noctula*) was recorded on 51 nights, from 39 locations, giving a total of 2078 recordings. Below are some graphics summarising the seasonality, activity patterns and distribution of this species.

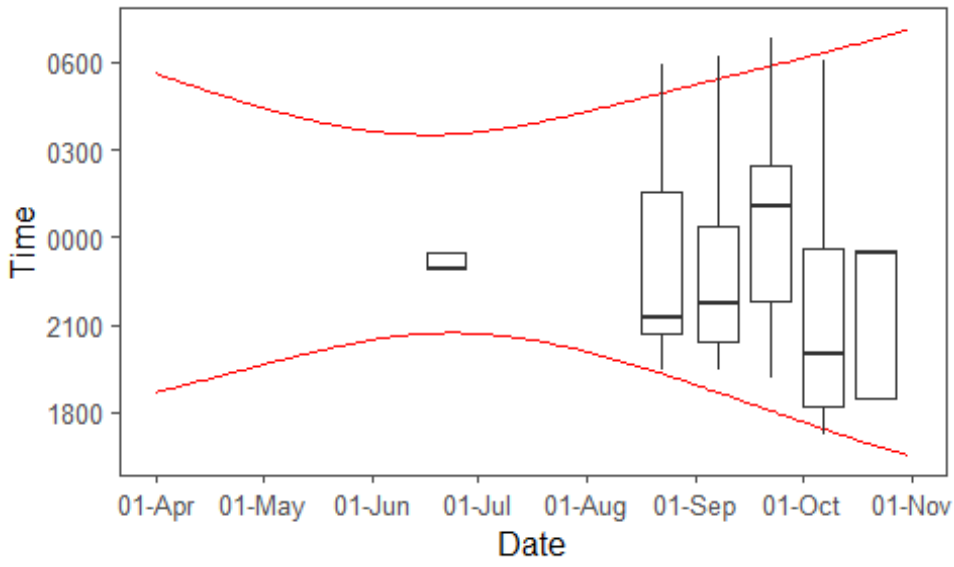
Nightly activity

The spread of detections with respect to sunset time, calculated over the whole season.



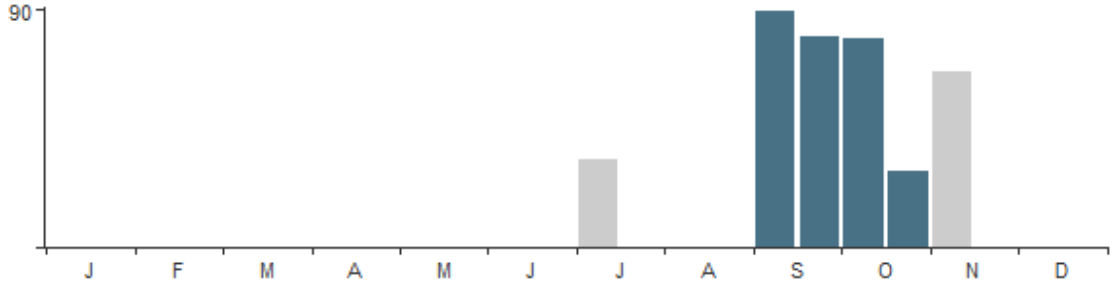
Nightly activity through the season

The spread of detections with respect to sunset and sunrise times (red lines) summarised for each halfmonth through the season.



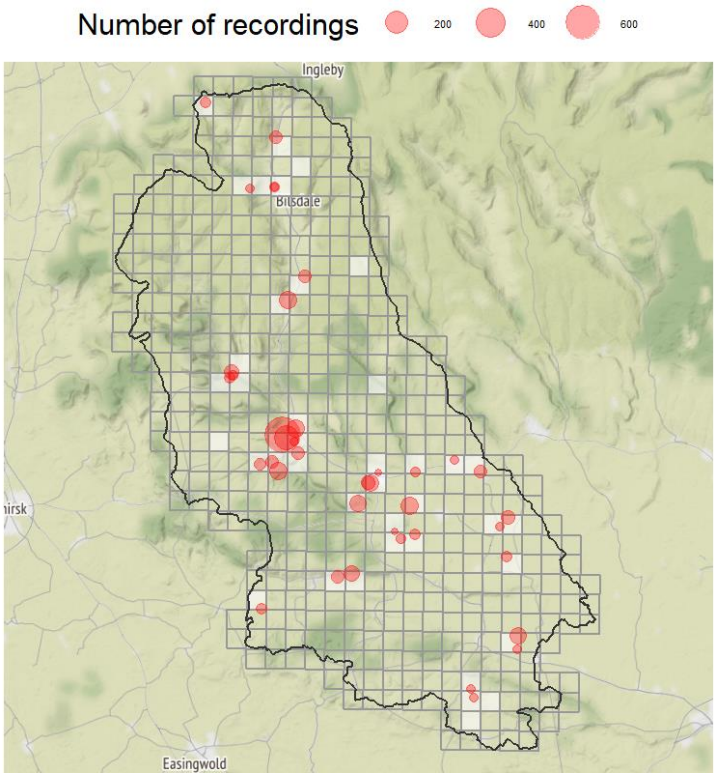
Reporting rates

The percentage of nights on which Common noctule was detected every halfmonth through the season. Pale grey bars represent periods with fewer than 10 visits where accuracy of the reporting rate may be low.



Distribution map

Map showing the locations where Common noctule was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.

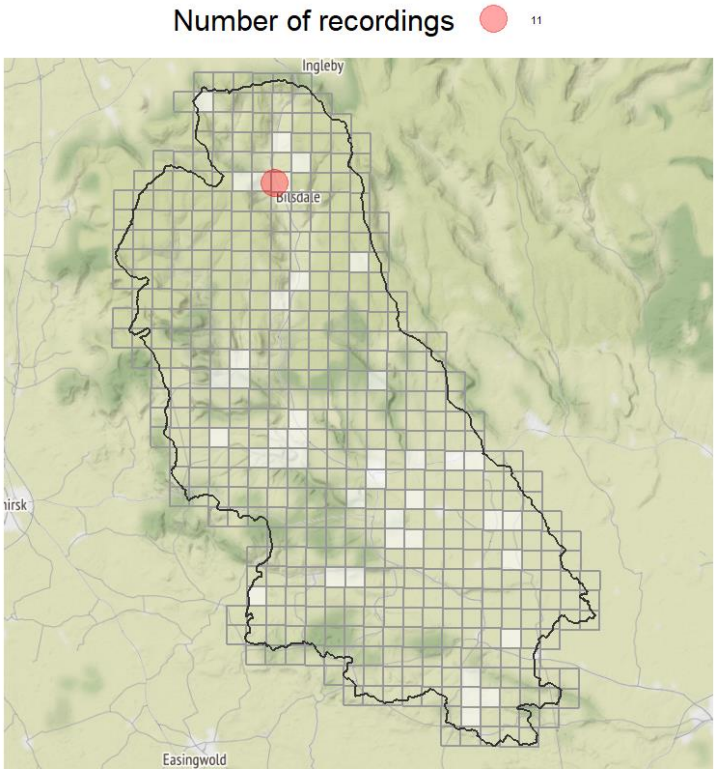


Nathusius' pipistrelle

Nathusius' pipistrelle (*Pipistrellus nathusii*) was recorded on 1 nights, from 1 locations, giving a total of 11 recordings. There was not sufficient data to summarise seasonality or activity patterns, but we provide a distribution map for this species.

Distribution map

Map showing the locations where Nathusius' pipistrelle was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.

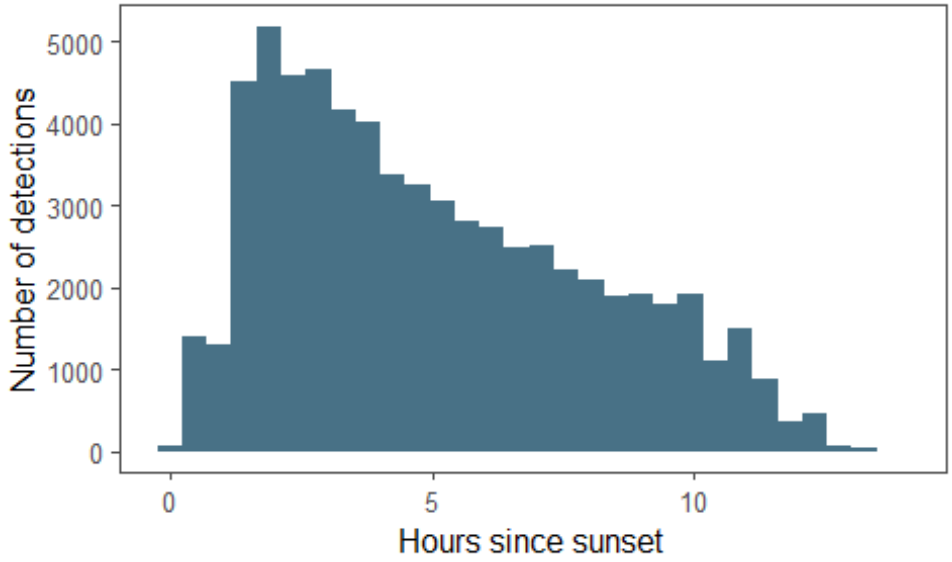


Common pipistrelle

Common pipistrelle (*Pipistrellus pipistrellus*) was recorded on 70 nights, from 47 locations, giving a total of 66458 recordings. Below are some graphics summarising the seasonality, activity patterns and distribution of this species.

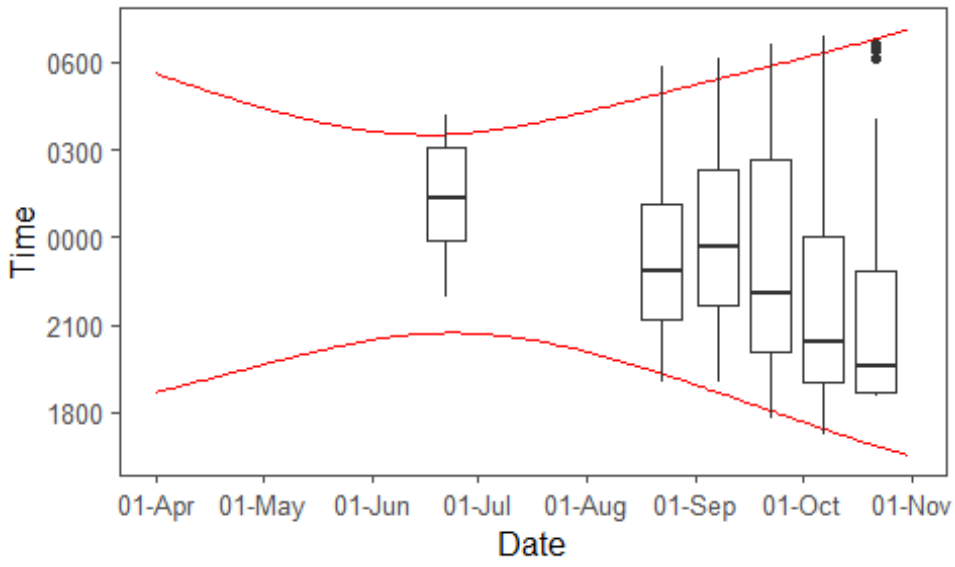
Nightly activity

The spread of detections with respect to sunset time, calculated over the whole season.



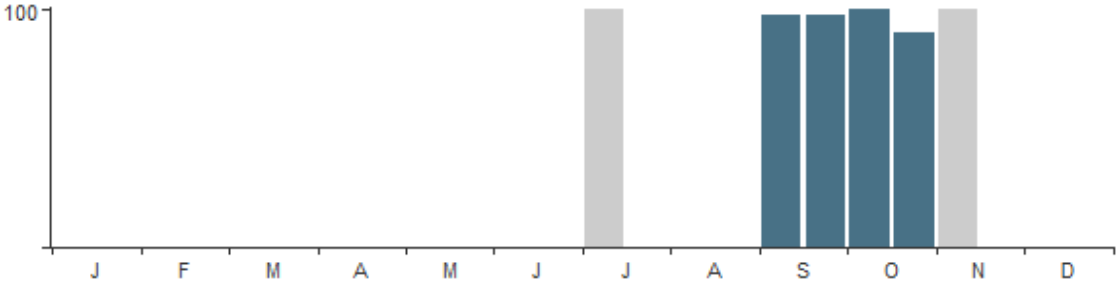
Nightly activity through the season

The spread of detections with respect to sunset and sunrise times (red lines) summarised for each halfmonth through the season.



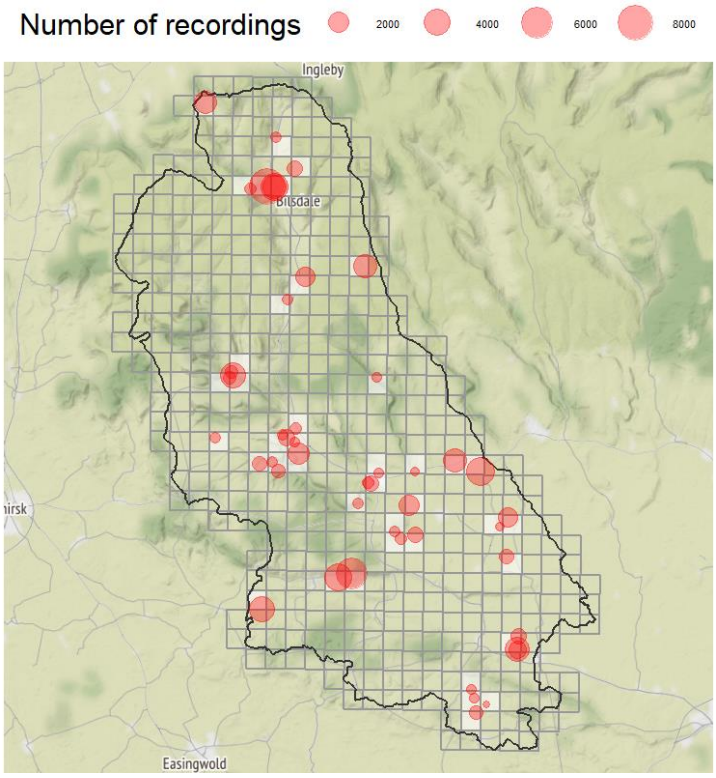
Reporting rates

The percentage of nights on which Common pipistrelle was detected every halfmonth through the season. Pale grey bars represent periods with fewer than 10 visits where accuracy of the reporting rate may be low.



Distribution map

Map showing the locations where Common pipistrelle was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.

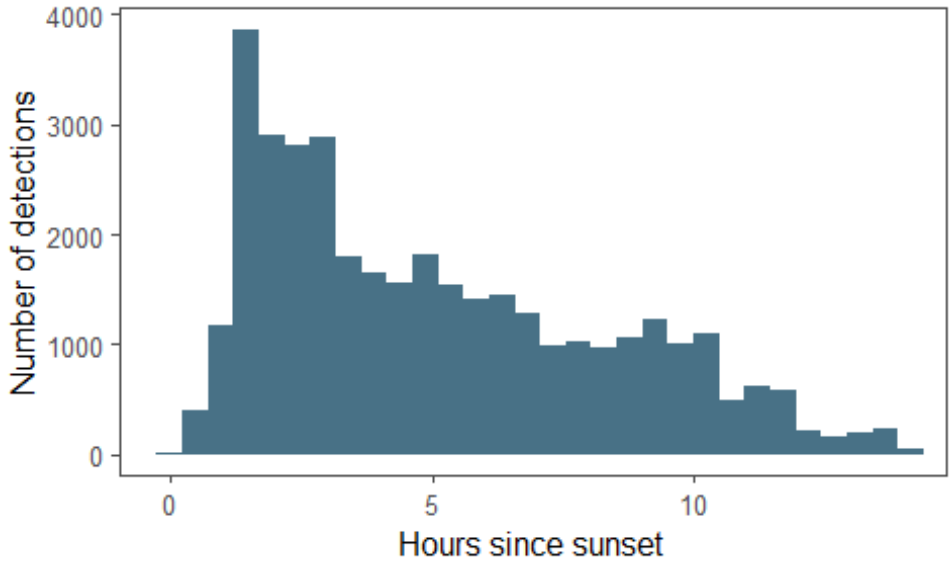


Soprano pipistrelle

Soprano pipistrelle (*Pipistrellus pygmaeus*) was recorded on 67 nights, from 47 locations, giving a total of 36469 recordings. Below are some graphics summarising the seasonality, activity patterns and distribution of this species.

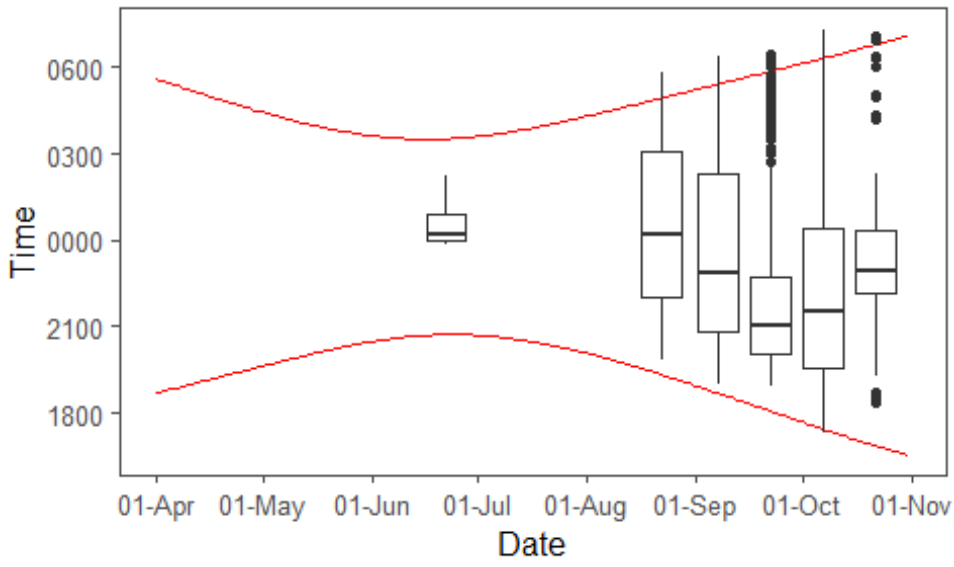
Nightly activity

The spread of detections with respect to sunset time, calculated over the whole season.



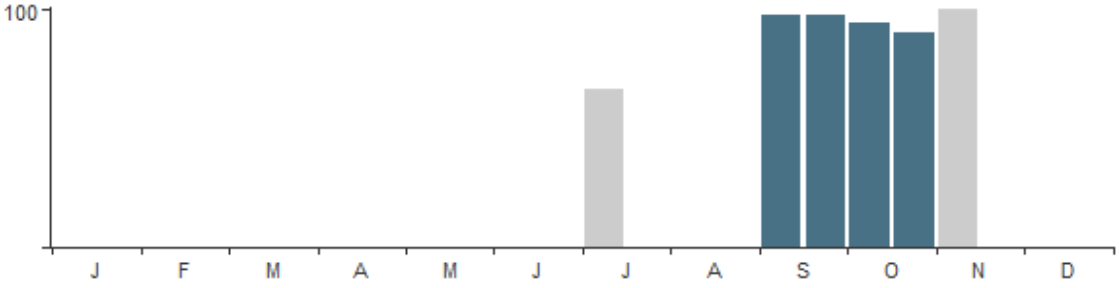
Nightly activity through the season

The spread of detections with respect to sunset and sunrise times (red lines) summarised for each halfmonth through the season.



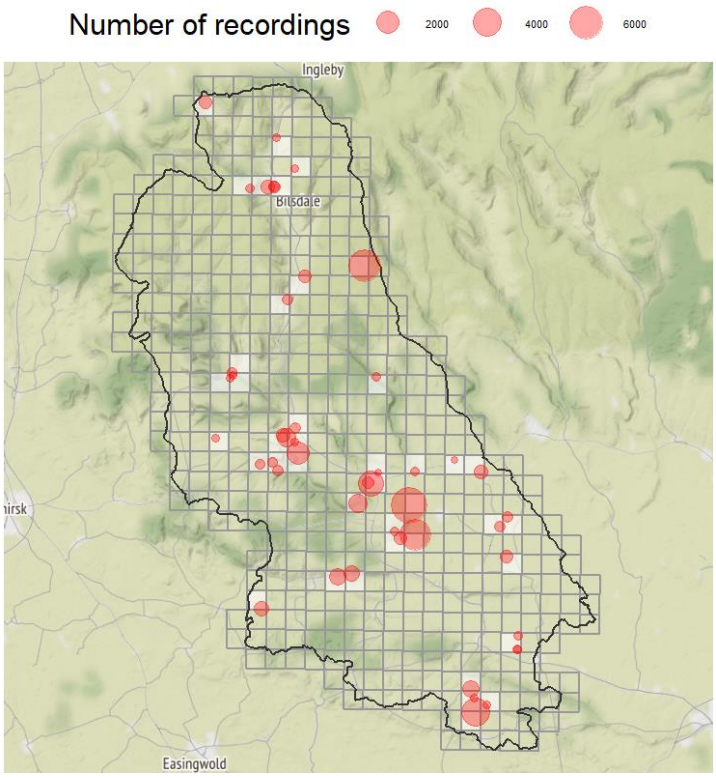
Reporting rates

The percentage of nights on which Soprano pipistrelle was detected every halfmonth through the season. Pale grey bars represent periods with fewer than 10 visits where accuracy of the reporting rate may be low.



Distribution map

Map showing the locations where Soprano pipistrelle was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.

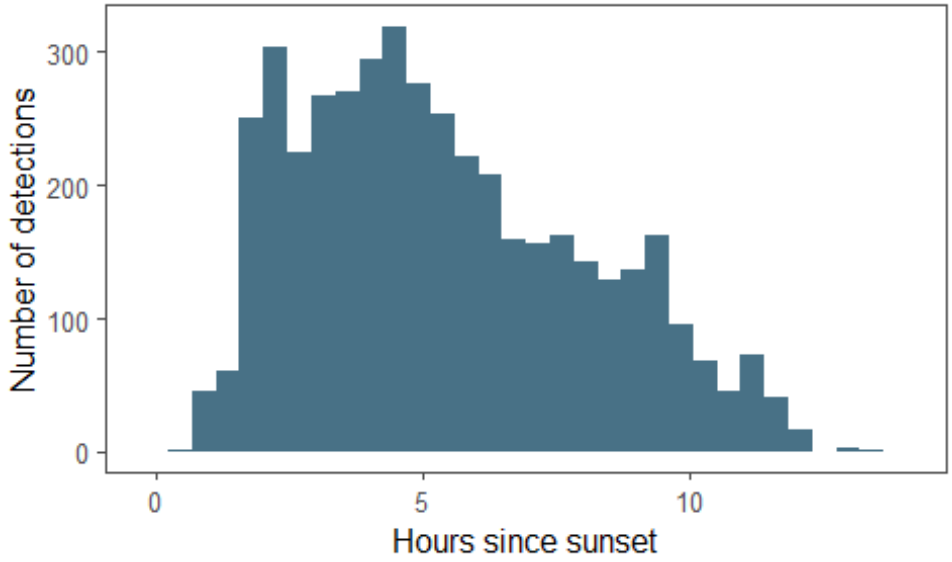


Brown long-eared bat

Brown long-eared bat (*Plecotus auritus*) was recorded on 64 nights, from 46 locations, giving a total of 4387 recordings. Below are some graphics summarising the seasonality, activity patterns and distribution of this species.

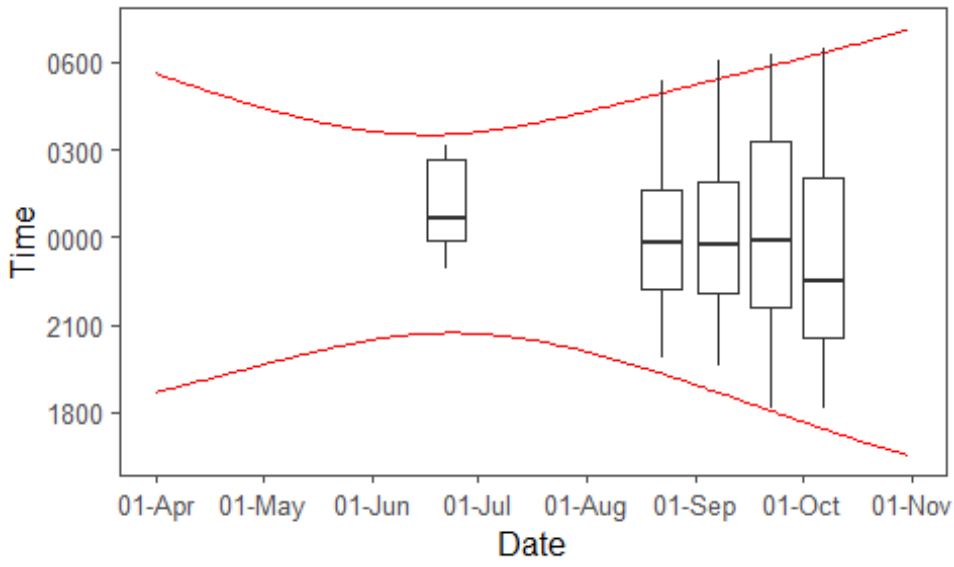
Nightly activity

The spread of detections with respect to sunset time, calculated over the whole season.



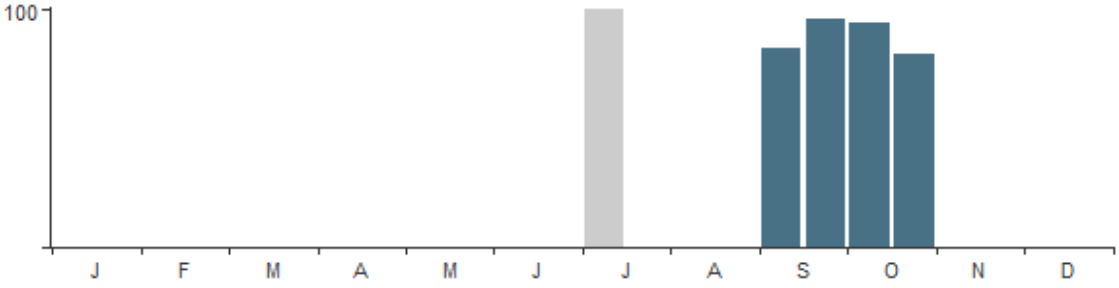
Nightly activity through the season

The spread of detections with respect to sunset and sunrise times (red lines) summarised for each halfmonth through the season.



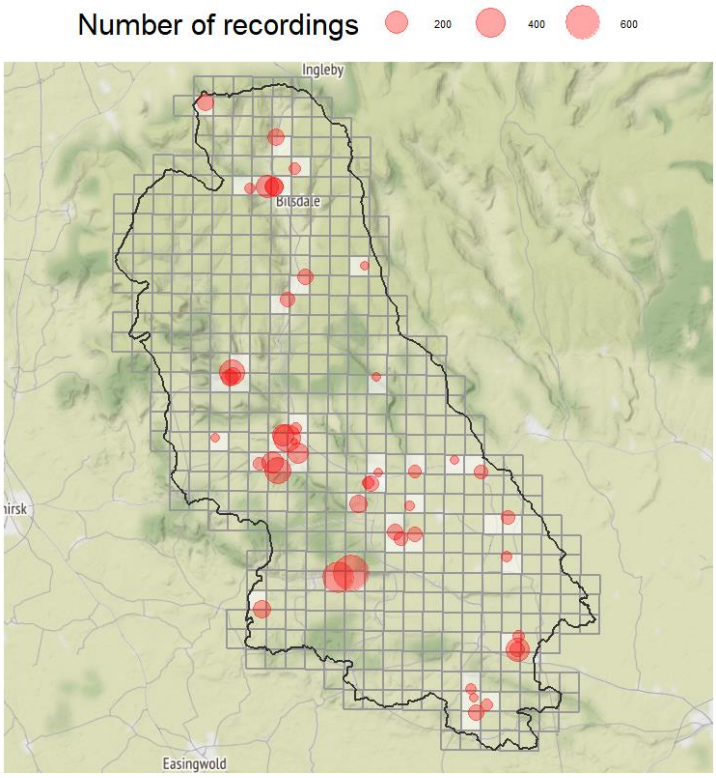
Reporting rates

The percentage of nights on which Brown long-eared bat was detected every halfmonth through the season. Pale grey bars represent periods with fewer than 10 visits where accuracy of the reporting rate may be low.



Distribution map

Map showing the locations where Brown long-eared bat was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.

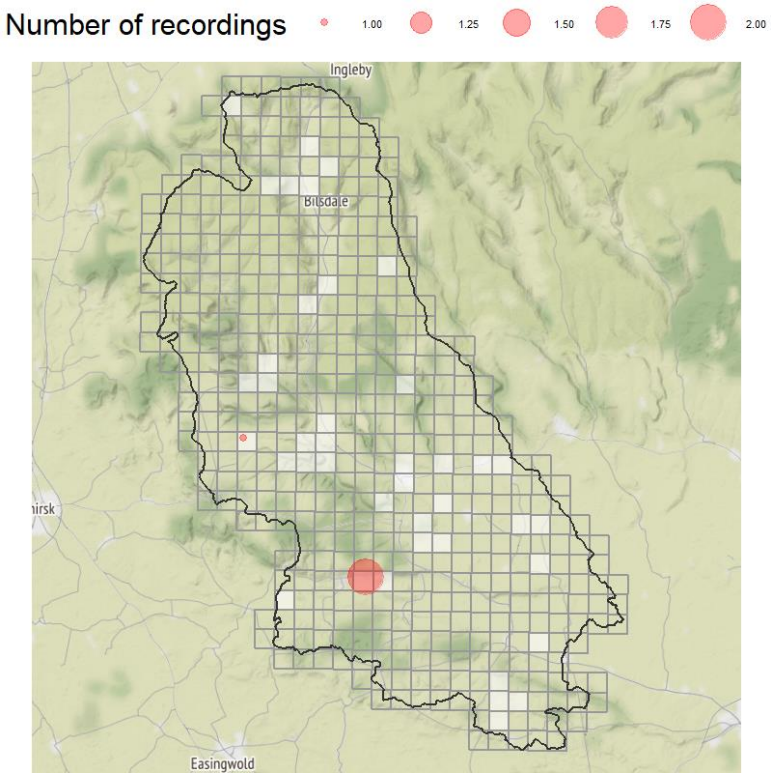


Wood mouse

Wood mouse (*Apodemus sylvaticus*) was recorded on 3 nights, from 2 locations, giving a total of 3 recordings. There was not sufficient data to summarise seasonality or activity patterns, but we provide a distribution map for this species.

Distribution map

Map showing the locations where Wood mouse was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.

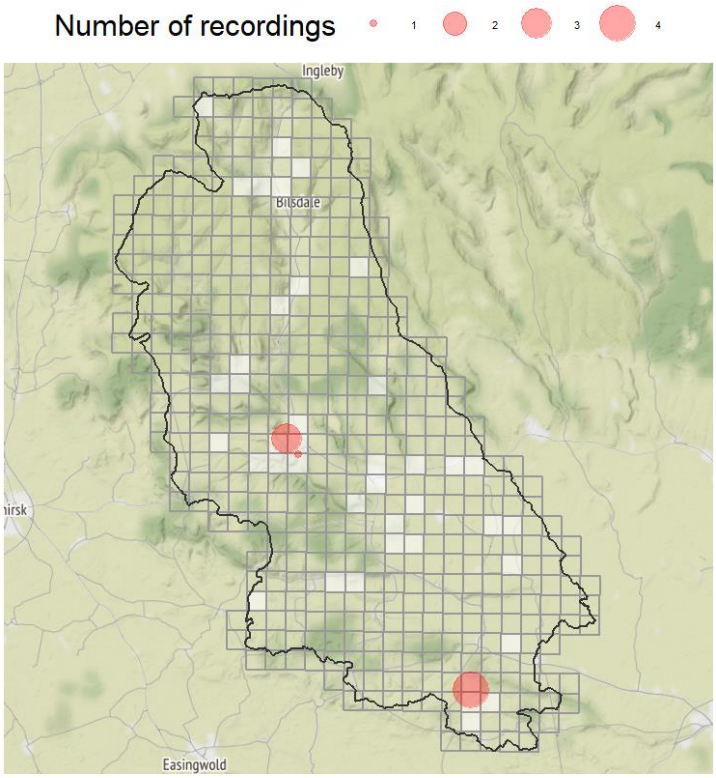


Brown rat

Brown rat (*Rattus norvegicus*) was recorded on 4 nights, from 3 locations, giving a total of 8 recordings. There was not sufficient data to summarise seasonality or activity patterns, but we provide a distribution map for this species.

Distribution map

Map showing the locations where Brown rat was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.

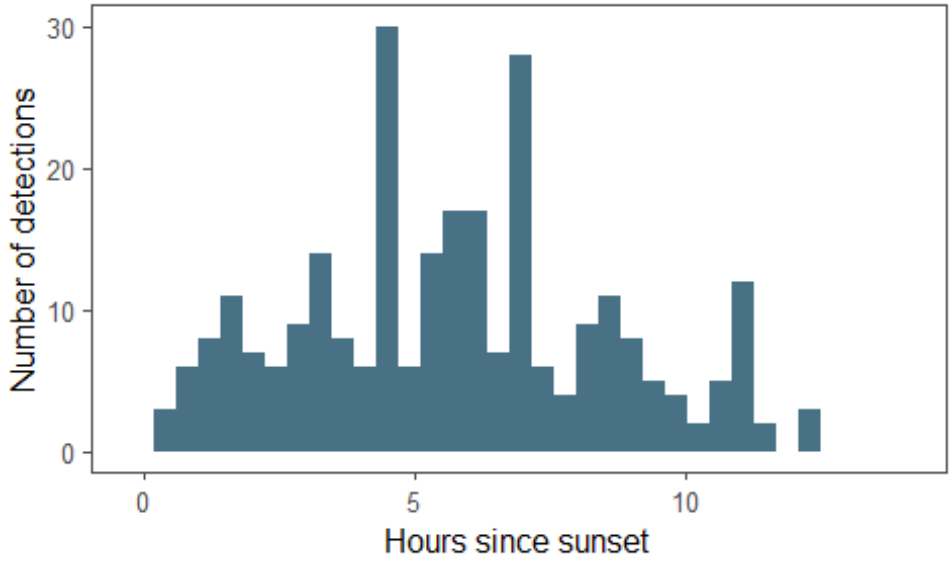


Common shrew

Common shrew (*Sorex araneus*) was recorded on 34 nights, from 31 locations, giving a total of 268 recordings. Below are some graphics summarising the seasonality, activity patterns and distribution of this species.

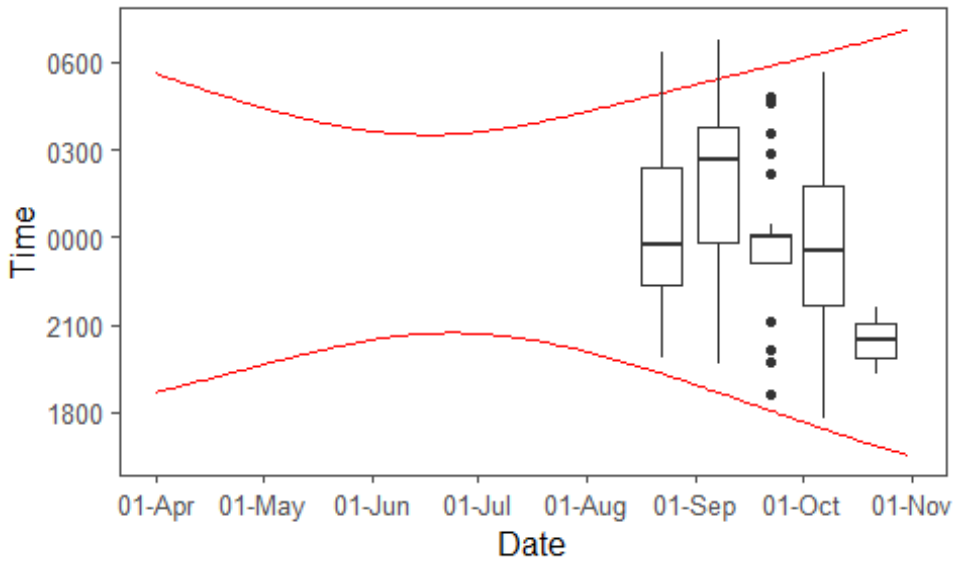
Nightly activity

The spread of detections with respect to sunset time, calculated over the whole season.



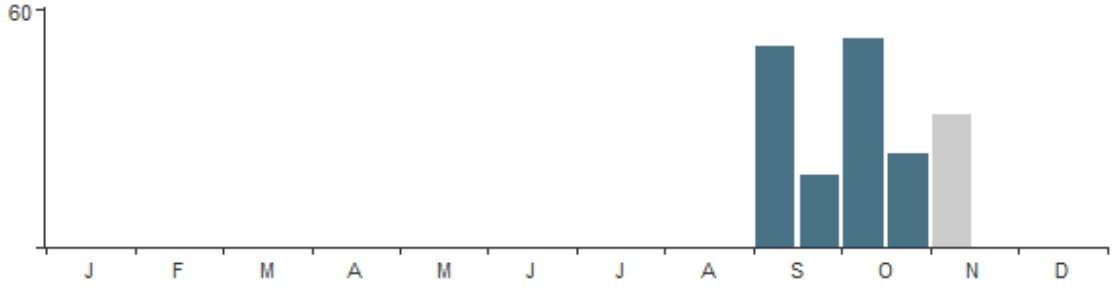
Nightly activity through the season

The spread of detections with respect to sunset and sunrise times (red lines) summarised for each halfmonth through the season.



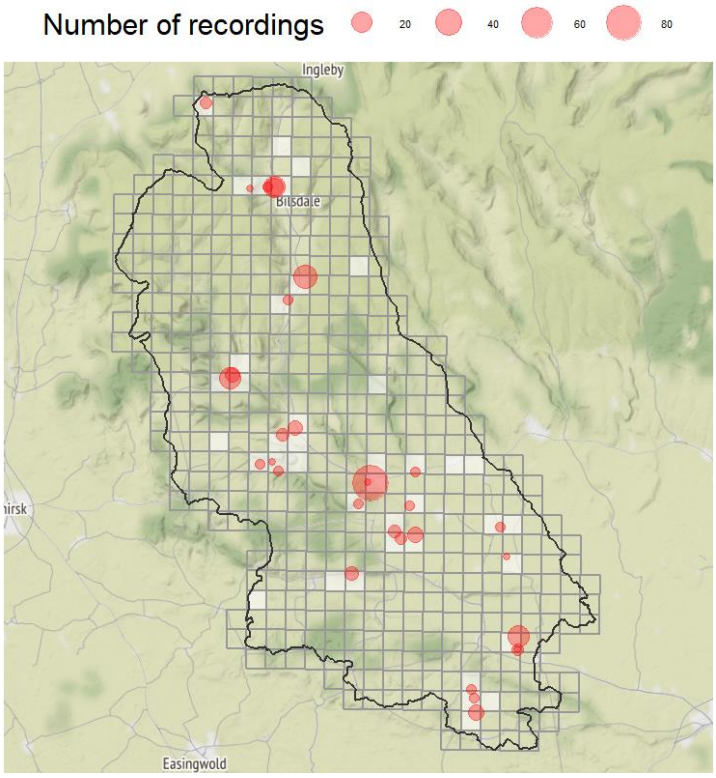
Reporting rates

The percentage of nights on which Common shrew was detected every halfmonth through the season. Pale grey bars represent periods with fewer than 10 visits where accuracy of the reporting rate may be low.



Distribution map

Map showing the locations where Common shrew was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.

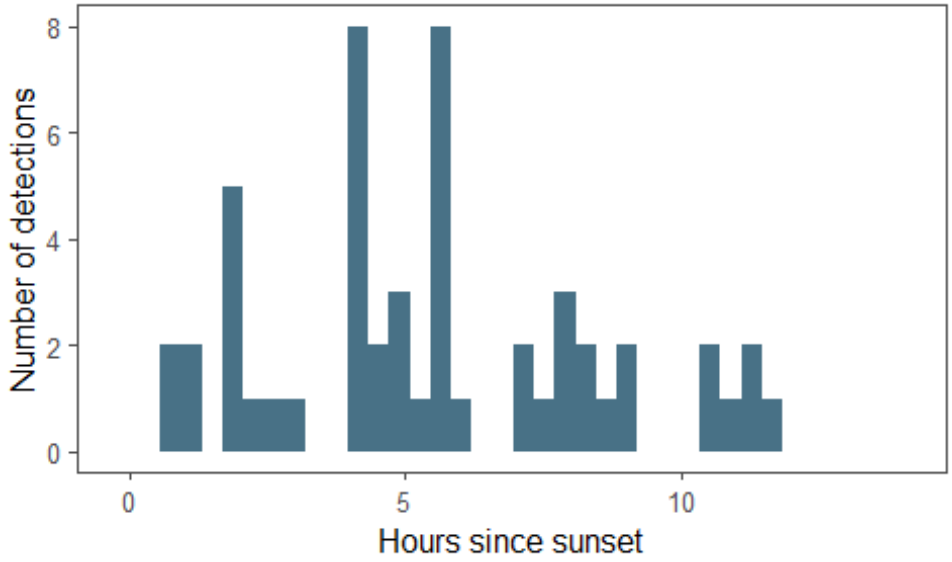


Eurasian pygmy shrew

Eurasian pygmy shrew (*Sorex minutus*) was recorded on 18 nights, from 14 locations, giving a total of 52 recordings. Below are some graphics summarising the seasonality, activity patterns and distribution of this species.

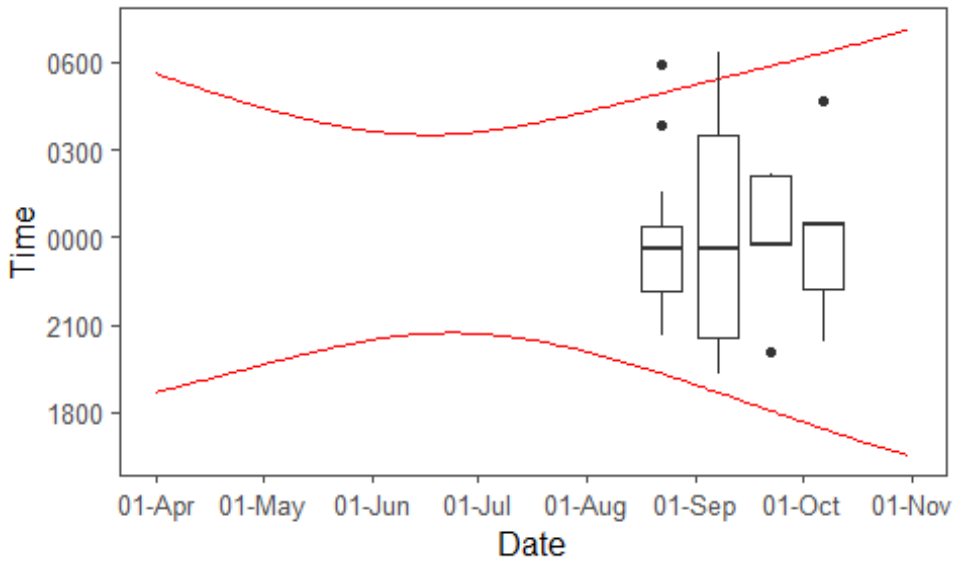
Nightly activity

The spread of detections with respect to sunset time, calculated over the whole season.



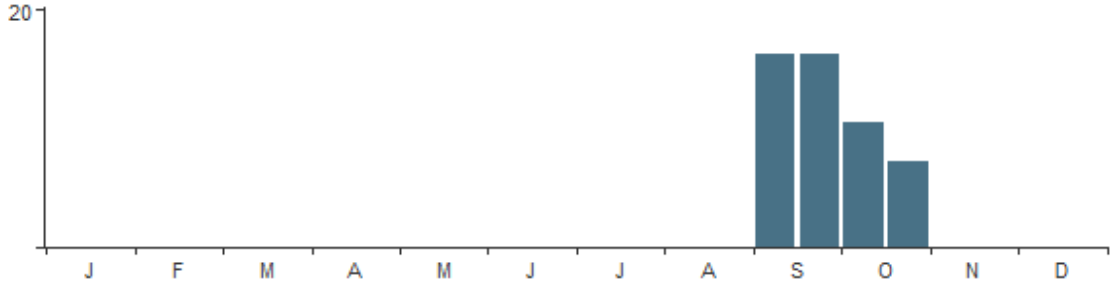
Nightly activity through the season

The spread of detections with respect to sunset and sunrise times (red lines) summarised for each halfmonth through the season.



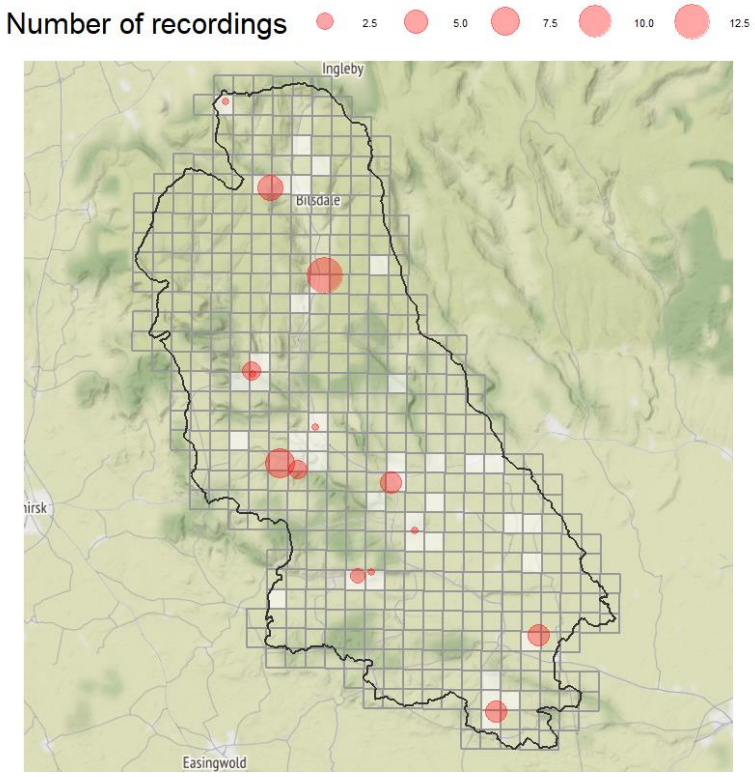
Reporting rates

The percentage of nights on which Eurasian pygmy shrew was detected every halfmonth through the season. Pale grey bars represent periods with fewer than 10 visits where accuracy of the reporting rate may be low.



Distribution map

Map showing the locations where Eurasian pygmy shrew was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.

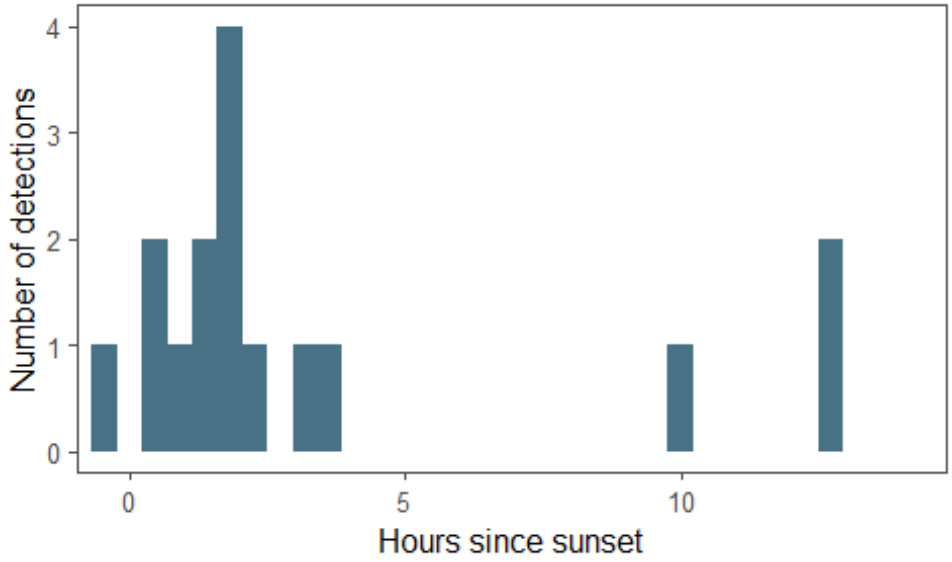


Bird cherry ermine

Bird cherry ermine (*Yponomeuta evonymella*) was recorded on 12 nights, from 9 locations, giving a total of 16 recordings. Below are some graphics summarising the seasonality, activity patterns and distribution of this species.

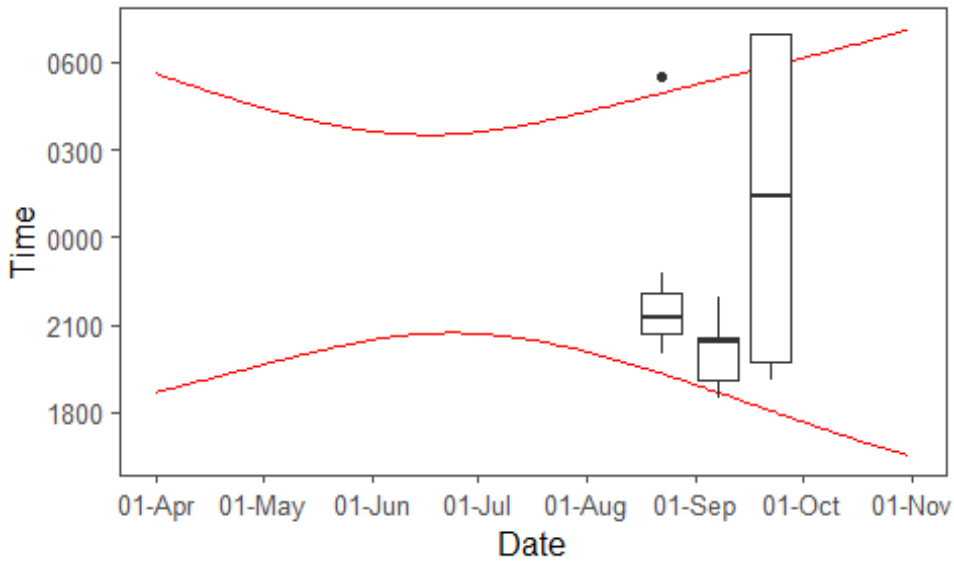
Nightly activity

The spread of detections with respect to sunset time, calculated over the whole season.



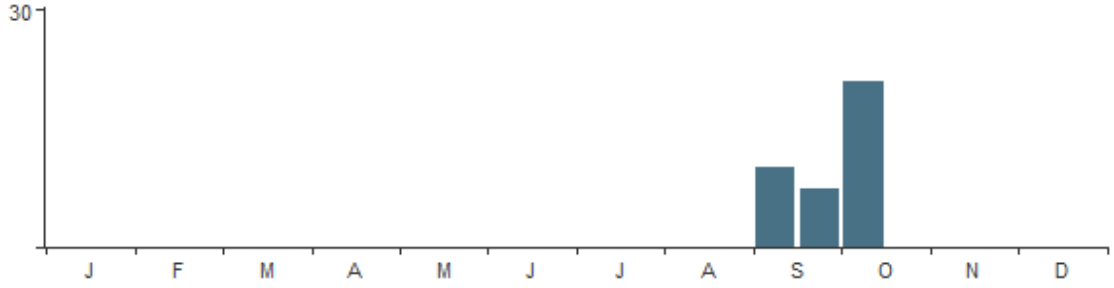
Nightly activity through the season

The spread of detections with respect to sunset and sunrise times (red lines) summarised for each halfmonth through the season.



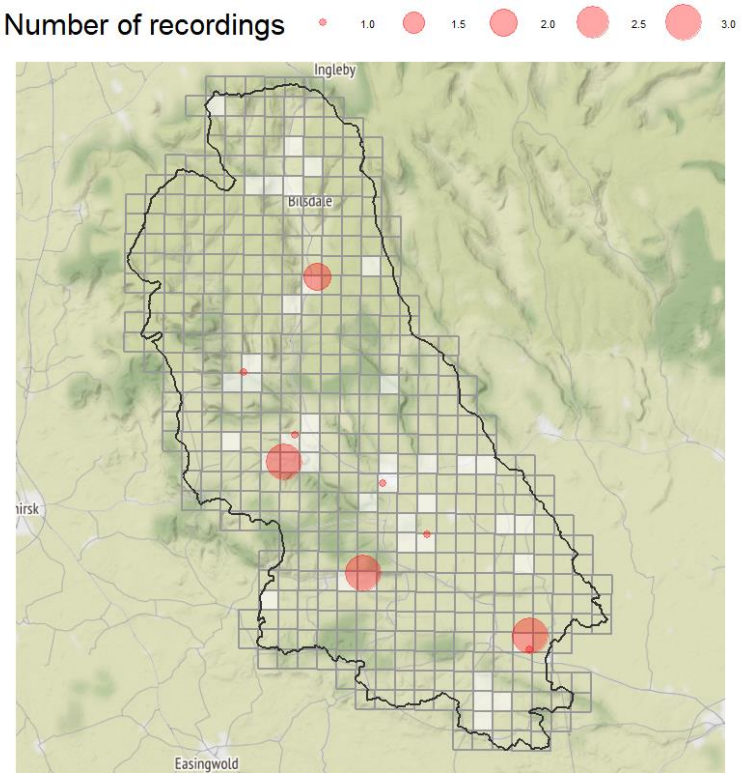
Reporting rates

The percentage of nights on which Bird cherry ermine was detected every halfmonth through the season. Pale grey bars represent periods with fewer than 10 visits where accuracy of the reporting rate may be low.



Distribution map

Map showing the locations where Bird cherry ermine was recorded. Dots are scaled according to the total number of recordings of this species at each location. Surveyed 1-km squares are shown as white squares.



5. DISCUSSION

The current dataset of 137112 bat recordings has been very valuable in adding to our understanding of patterns of bat occurrence and activity with the survey area.

As a new bat species for the project, Nathusius' pipistrelle was recorded alongside the River Seph close to Chop Gate on the 11th September. This comprised 11 recordings of what was likely to be the same bat, within a two minute period. Considering that we have not recorded this species previously in the Ryevitalise survey area (Newson & Berthinussen 2019), we think that this is most likely to have been a migrant.

Compared with other studies that we have been involved with in other parts of the country, the activity of bats of the genus Myotis, which includes Daubenton's, Natterer's, whiskered, Brandt's and Alcathoe bats, was very high. Bat activity can be used as a proxy for relative abundance that can be used within species, with high levels of activity typically occurring where the species is most abundant. However, bat activity cannot be compared between species. This is because the distance at which different species are detected is very different. For example, at two extremes, the detection distance of noctule flying in an open to semi-open environment can be in the region of about 100m, compared with a detection distance of brown long-eared bat in closed woodland which is about 5m (Barataud 2015).

Supporting our findings from last season, we believe that Brandt's bat is perhaps the most abundant Myotis species after Daubenton's bat. Nationally Brandt's bat is thought of as one of the most range restricted Myotis species in England, but there is some support for the view that the abundance of this species increases from south-west to north-east England. As discussed previously, Brandt's bat is extremely similar acoustically to whiskered bat, so this is presented with the caveat that ideally additional ground-truthing would need be carried out to confirm this. We recommend that the results for whiskered and Brandt's bat are treated as a species pair for the timing being. Of the Myotis species, we believe that Alcathoe bat, which was recorded from 5 locations this season is the most range restricted.

In relation to other species groups recorded as 'by-catch' during bat surveys, for small terrestrial mammal species were recorded, comprising 268 recordings of common shrew, 52 recordings of pygmy shrew, 8 recordings of brown rat and 3 recordings of wood mouse. For further information on the sound identification of terrestrial small mammals in Britain see Newson et al. (2020). The micro-moth bird cherry ermine was also recorded from 9 locations. This species of moth is deaf itself, but it produces ultrasonic clicks when it flies, to interfere with the echolocation of bats and reduce predation. We looked at the birds recorded during the night 10pm-3am, but the current bat detector settings used meant that the small number of bird recordings were made up of the calls of passerines, mainly wren and blackbird, and not nocturnal species, such as nightjar and tawny owl which would be of most interest. Reducing the trigger frequency would increase the number of bird recordings, but this would result in a very large increase in the number of volume of recordings, would make uploading the recordings impractical for most volunteers.

In relation to specific recommendations for the 2022 survey season, a decision was made by the North York Moors National Park to extend the detector booking to be one week long,

starting at a weekend, to give volunteers more flexibility and time to upload recordings. There were some challenges with internet speed for some volunteers, and the time needed to upload the recordings, but the feedback received suggested that the experience of the BTO Acoustic Pipeline was a positive one.

6. REFERENCES

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