Bat distribution and activity in the Skell Valley catchment, 2024 Report

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SUMMARY

Background Working with a network of volunteers, static acoustic bat detectors were deployed in 2024, to provide data on bat distribution and activity for the Skell Valley. This report provides an overview of the survey coverage and results from the project.

Coverage In 2024, 66 different locations across the Skell Valley were surveyed. Recording was undertaken on a minimum of 155 different nights mainly between April and mid-August, amounting to a total of 295 nights of recording effort across sites. Sound recordings were uploaded by volunteers or National Trust staff to the BTO Acoustic Pipeline, through which a first automated analyses was carried out and provisional results returned. Recordings were then moved to deep glacial storage for later auditing. At the end of the survey season, a copy of the recordings were pulled back and manual auditing of the results / recordings carried out.

Results Overall, 228,254 recordings were collected over the project which, following analyses and validation, were found to include 130,460 bat recordings, and 202 small terrestrial mammal recordings. Audible moth species were also recorded as 'by-catch', for which we report species presence on a site and night basis. Following validation, the study confirmed the presence of at least 7 bat species, 4 small mammal species, species of 2 audible moth species. Through this project, we have significantly improved our understanding of the status of all species of bats within the Skell Valley, and of the relative importance of different areas. Lastly, the project provides data on the distribution and activity of several species of small terrestrial mammals. The report includes a full species-by-species breakdown of spatial, seasonal, and through-the-night patterns of activity.

1. BACKGROUND

1.1 Skell Valley Bat Project

This project, which was carried out in 2024 as part of the larger Skell Valley Project, had the main aim of providing baseline data on the distribution and activity of the different bat species that occur in the Skell Valley catchment. Using a citizen science-based approach, over ten volunteers took part in the project. Volunteers borrowed a bat detector from the National Trust, and were asked to place the detector to record in a location for at least 4 consecutive nights. On completion of the survey they, or staff at the National Trust, uploaded recordings to the BTO Acoustic Pipeline where an initial automated analysis was carried out to identify the species present. This was followed by a process of manual species verification after the end of the survey season. During 2024, the presence of at least 7 bat species were confirmed. In addition to identifying bat echolocation calls, social calls and feeding buzzes were also identified, to provide additional behavioural insights for bats. The data collected through this project has contributed towards a better understanding of the status of all species of bats within the Skell Valley, and the importance of different areas within the Skell Valley catchment for bats.

In addition to bats, small mammals, and two species of moth that emit ultrasound which can be recorded as 'by-catch' during the bat surveys were also identified. Small mammals identified include Wood Mouse *Apodemus sylvaticus*, Pygmy Shrew *Sorex minutes*, Common Shrew *Sorex araneus* and Brown Rat *Rattus norvegicus*.

1.2 The importance of robust baseline data

Bats are poorly understood, despite making up a significant proportion of the terrestrial mammals that occur in the Skell Valley. They are a key indicator of the environment, where it is important to establish baselines for key biodiversity groups to provide the National Trust, other policy makers and practitioners with the information required for good decision making. At the same time, it is important to increase community awareness of, and involvement in nature, and its health and well-being benefits. Funded by the National Lottery Heritage Fund, this project was devised with this in mind and relies on the interest and goodwill of landowners and citizen scientists to help survey the bats and identify the species that are present, and the important areas and habitats for them.

Good decision making on managing the built and natural environment is enabled by identifying key areas and habitats for different species. This requires surveys and analyses that provide a robust understanding of large-scale patterns in species' distributions and abundance (Pereira & Cooper, 2006; Jones, 2011). This 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. Working with our network of volunteers, acoustic bat detectors were deployed, to provide extensive data on bat distribution and activity for the Skell Valley catchment.

2. AIMS AND OBJECTIVES

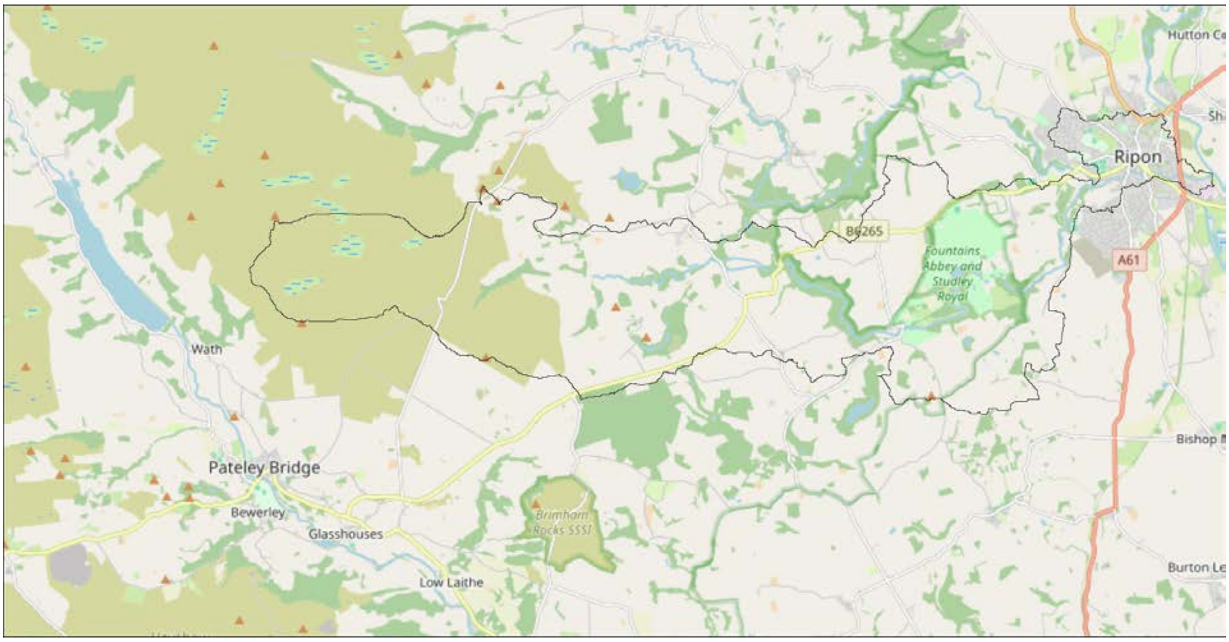
The Skell Valley Bat Project project capitalises on the interest and enthusiasm of volunteers to participate in biodiversity monitoring to systematically collect bat distribution and activity data across the Skell Valley, through a project that ran over seven months in 2024. This has resulted in a robust dataset, which has increased knowledge and understanding of bat distribution and activity across the Skell Valley.

Whilst the focus of this work is bats, results for small terrestrial mammals, audible moths which are recorded as ‘by-catch’ during bat surveys were also returned (Newson *et al*., 2017b; Newson *et al*., 2021; Middleton *et al*., 2024). In this report we present results from 2024.

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

- Improve our understanding of the status, distribution and timing of occurrence of bats and small mammal species that occur in the Skell Valley.
- Involve and inspire a section of the wider community to connect and engage with an aspect of nature that is poorly known and understood.
- Help develop a community awareness of what bats do for us, what they require, and why it is important to conserve them.

Map of the Skell Valley catchment.



All maps in this report use the maptiles R package (Giraud 2023) with data copyright OpenStreetMap contributors.

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. Our protocol enabled volunteers in the Skell Valley to have access to passive real-time bat detectors which they left outside to automatically trigger and record the calls to a memory card every time a bat passes throughout a night.

Bat detectors (the Song Meter Mini Bat), were placed 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 (BTO, unpublished data). 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).

The bat detectors were set to record with a sample rate of 384 kHz and to use a high pass filter of 13 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 2 second period up to a maximum of 5 seconds. Detectors were deployed before sunset and detectors set to switch on and record 30 minutes before sunset until 30 minutes after sunrise the following day. The microphone was mounted on 2-m poles to avoid ground noise and reduce recordings of reflected calls. Guidance was provided to volunteers on the placement of microphones should be deployed at least 1.5-m in any direction from vegetation, water or other obstructions.

3.2 Survey effort and timing

The survey period ran from the beginning of April to mid-October 2024. A long survey season covers the main period of bat activity, and maximises use of the equipment during the year.

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 recording session, the files recorded by the bat detector (uncompressed wav format), along with associated information on where the recording was carried out were uploaded by the volunteer or by National Trust staff to the BTO's Acoustic Pipeline http://bto.org/pipeline for processing. With this, the volunteer had their own online user account, and desktop software through which they could upload recordings directly to the cloud-based BTO Acoustic 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 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 each 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 were then not easily accessible during the survey season itself, but a complete copy of the recordings was pulled back at the end of each survey season for auditing.

The BTO Acoustic Pipeline applies machine learning algorithms to classify sound events in the uploaded recordings. 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 Barré *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, was carried out to be confident that we were losing very little 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. With the exception of the most common species, Common Pipistrelle *Pipistrellus pipistrellus* and Soprano pipistrelle *Pipistrellus pygmeaus*, we checked a random sample of 1,000 recordings to quantify the error rate in the dataset. For audible moths where there can be a large number of recordings, often of the same individual, we instead focus on producing an inventory of species presence instead, where the three recordings with the highest probability for each site and night were selected for auditing.

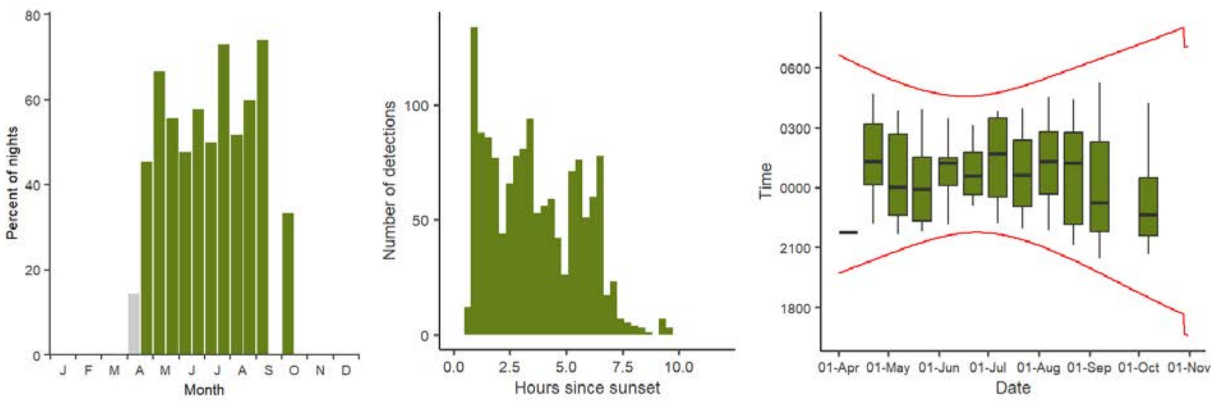
Verification of species identification was carried out through the manual checking of spectrograms using software SonoBat (http://sonobat.com/) which was used as an independent check of the original species identities assigned by pipeline. The spectrograms shown in this report, were also produced using SonoBat. 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 Bat *Myotis mystacinus* and Brandt's Bat *Myotis brandtii* are very subtle and poorly defined. For this reason, until further ground-truthing of the identification can be carried out, we treat these two species as a species pair.

3.4 Seasonal and 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 survey nights on which each bat species was detected. 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 (Thieurmel & Elmarhraoui, 2019) and then assessing the frequency distribution of passes relative to sunset for the whole season and in half-month periods. By looking at nightly activity in this way, it allows us to visualise general patterns in activity for a species according to time of night and season, accepting that activity on any given night will be influenced by weather and potentially other factors.

To explain the figures in the following results section, we show an example below for Natterer's Bat, in which the figures are produced by combining data across survey seasons. The left plot shows the percentage of nights on which the species was detected every half-month through the season, showing the periods of main activity for this species. If present, pale grey bars represent periods with fewer than 10 nights of recording where accuracy of the reporting rate may be low. The middle plot shows the overall spread of recordings with respect to sunset time, calculated over the whole season . The right plot shows the spread of recordings with respect to sunset and sunrise times (red lines) summarised for each half-month through the season. For this last seasonal plot, the individual boxplot show quartiles (lower, median and upper) with lines extend to 1.5 times the interquartile range, and small dots show outliers.



3.5 Spatial patterns of activity and distribution

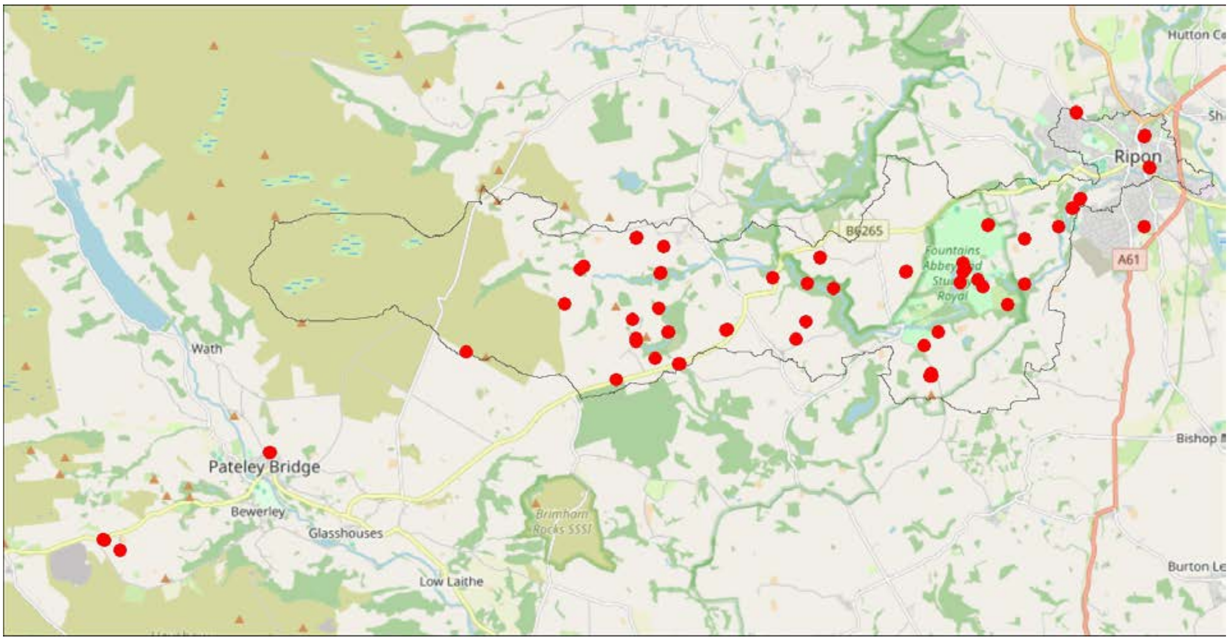
We produce maps of bat and small mammal activity. With these, dots are scaled according to the total number of recordings of this species at each location. Activity here represents usage of an area, which will be a combination of species abundance, and time spent in the area. For audible moths, the results focus instead on species presence.

4. RESULTS

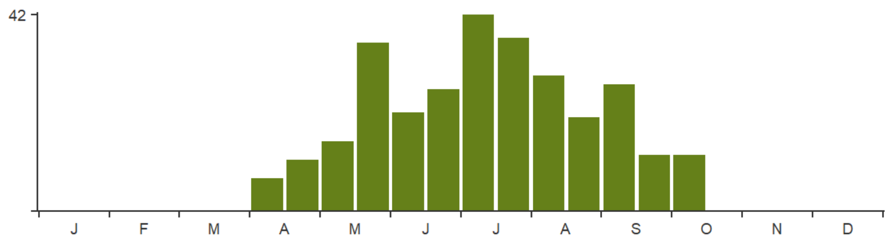
4.1 Survey coverage

During 2024, 66 different locations were surveyed for bats across the Skell Valley. The distribution of these locations is shown below. Collectively across survey sites, 295 complete nights of recording effort was conducted. The recording effort spanned 155 different nights and 7 months of the year. Some additional testing of the recording equipment was carried out at two locations that were well outside the Skell Valley catchment, where we have not included the results here. However, due to their proximity to the Skell Valley catchment, we retained data from three closer locations. Manual checking of recordings was carried out for all species and recordings, except for Common Pipistrelle and Soprano Pipistrelle for which 1,000 randomly selected recordings were checked each year. For these, less than 0.2% of Common Pipistrelle and 0.3% of Soprano Pipistrelle identification were the wrong species, normally to the other species of this pair.

Map of the study area showing locations where detectors were deployed.



Number of locations surveyed per half-month in 2024.



4.2 General results

Overall, 228,254 recordings were collected which, following analyses and validation, were found to include 130,460 bat recordings, comprising at least 7 species of bats, and 202 small terrestrial mammal recordings. In addition, two species of audible moth species were recorded (see table below). Following validation, the presence of at least 4 small mammal species, and 2 audible moth species can be confirmed.

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

Bats

Species (/call type)	No. of recordings following validation	No. of different locations (% of total)
Daubenton's Bat, *Myotis daubentonii*	10940	45 (68.2%)
Daubenton's Bat feeding buzzes, *Myotis daubentonii*	1850	12 (18.2%)
Daubenton's Bat social calls, *Myotis daubentonii*	131	7 (10.6%)
Whiskered or Brandt's Bat, *Myotis mystacinus or M. brandtii*	2643	57 (86.4%)
Natterer's Bat, *Myotis nattereri*	1402	54 (81.8%)
Natterer's Bat social calls, *Myotis nattereri*	3	2 (3%)
Common Noctule, *Nyctalus noctula*	3798	66 (100%)
Common Noctule feeding buzzes, *Nyctalus noctula*	74	24 (36.4%)
Common Noctule social calls, *Nyctalus noctula*	15	7 (10.6%)
Common Pipistrelle, *Pipistrellus pipistrellus*	49265	66 (100%)
Common Pipistrelle feeding buzzes, *Pipistrellus pipistrellus*	5713	57 (86.4%)
Common Pipistrelle social calls, *Pipistrellus pipistrellus*	7298	54 (81.8%)
Soprano Pipistrelle, *Pipistrellus pygmaeus*	35712	65 (98.5%)
Soprano Pipistrelle feeding buzzes, *Pipistrellus pygmaeus*	240	34 (51.5%)
Soprano Pipistrelle social calls, *Pipistrellus pygmaeus*	10303	57 (86.4%)
Brown Long-eared Bat, *Plecotus auritus*	1073	58 (87.9%)

Small mammals

Species	No. of recordings following validation	No. of different locations (% of total)
Wood Mouse, *Apodemus sylvaticus*	8	4 (6.1%)
Brown Rat, *Rattus norvegicus*	93	5 (7.6%)
Common Shrew, *Sorex araneus*	88	22 (33.3%)
Eurasian Pygmy Shrew, *Sorex minutus*	13	7 (10.6%)

Moths

Species	No. of different locations (% of total)
Green Silver-lines, *Pseudoips prasinana*	1 (1.5%)
Bird Cherry Ermine, *Yponomeuta evonymella*	11 (16.7%)

4.3 Species and call-type results

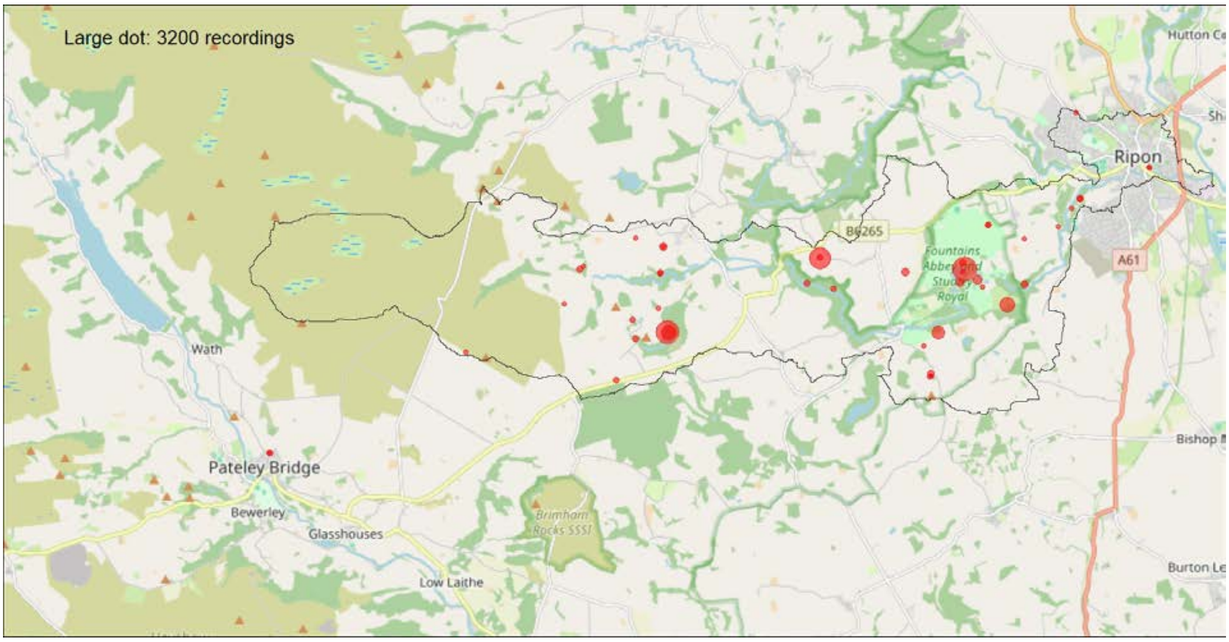
The following sections provide results for each species and/or call type.

4.3.1 Bat species

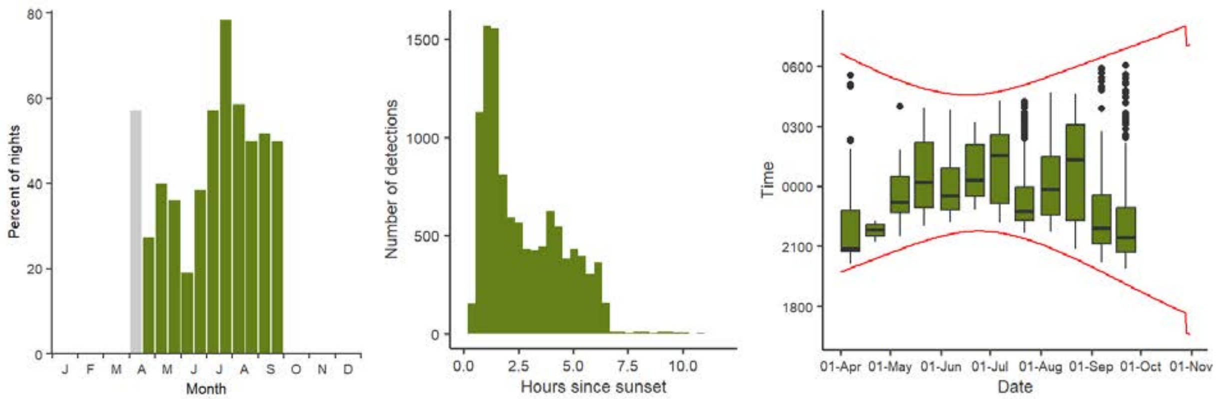
Daubenton's Bat

Daubenton's Bat *Myotis daubentonii* was recorded on 93 nights, from 45 locations, giving a total of 10,940 recordings.

Spatial pattern of activity



Seasonal and nightly activity

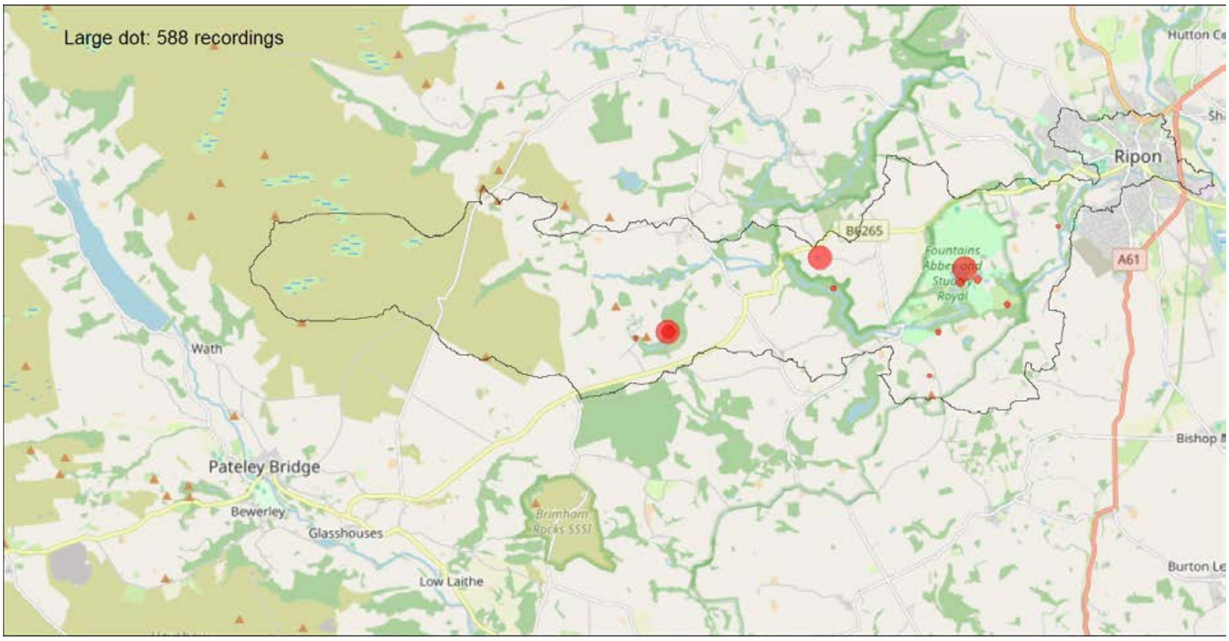


Daubenton's Bat. The Skell Valley catchment is clearly very important for Daubenton's Bat. This species was widely recorded within the catchment, but but with particularly high activity where detectors were left to record at locations adjacent to large bodies of water. Particularly notable were over 500 recordings a night from Eavestone Lake, and lakes close to Aldfield, and at Studley Royal Park. The maximum number of recordings a night was 1,329 recordings on the 22nd July from Eavestone Lake on the 22nd July, but with 1,107 recordings from close to Aldfield on the 5th July, and 763 recordings from Studley Royal Park on the 29th May. See Identification appendix 1 for further information on the sound identification of Daubenton's Bat in comparison to the most likely confusion species Natterer's Bat.

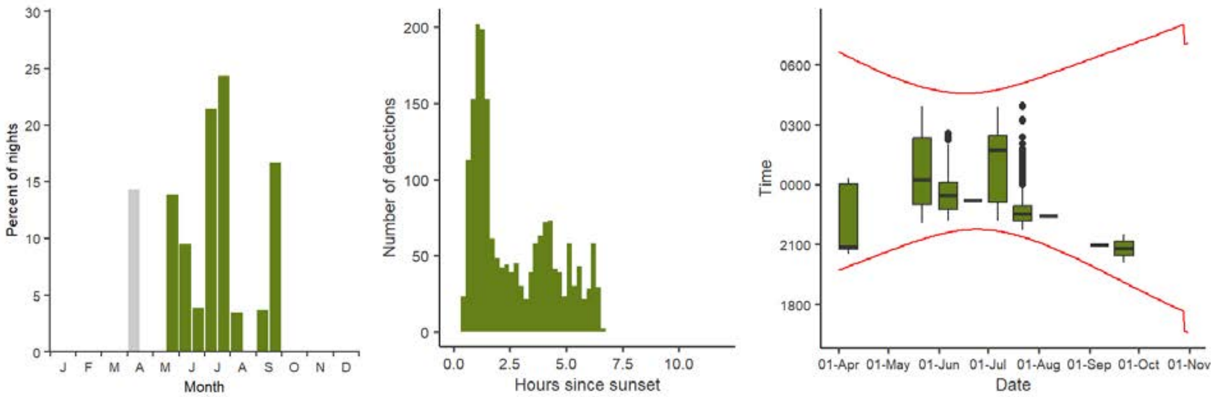
Daubenton’s Bat feeding buzzes

Daubenton’s Bat feeding buzzes *Myotis daubentonii* were recorded on 29 nights, from 12 locations, giving a total of 1,850 recordings.

Spatial pattern of activity



Seasonal and nightly activity

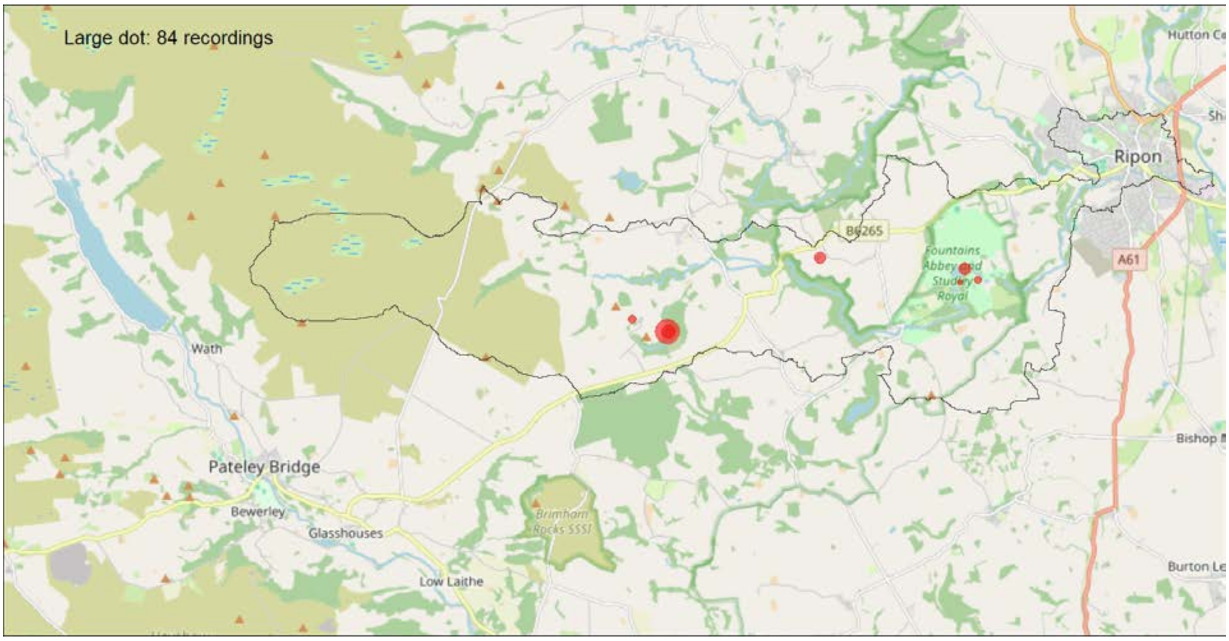


Daubenton’s Bat feeding buzzes. By identifying sequences containing Daubenton’s Bat feeding buzzes, we are able to identify important feeding areas for this species. Particularly notable were over 100 recordings a night with feeding buzzes from the lakes west of Aldfield, at Royal Studley Park, and at Eavestone Lake.

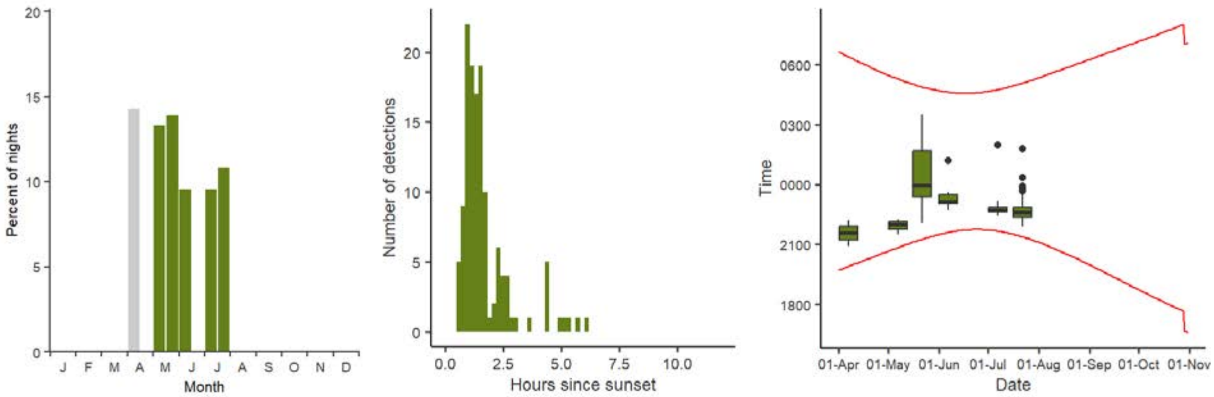
Daubenton's Bat social calls

Daubenton's Bat social calls *Myotis daubentonii* were recorded on 18 nights, from seven locations, giving a total of 131 recordings.

Spatial pattern of activity



Seasonal and nightly activity

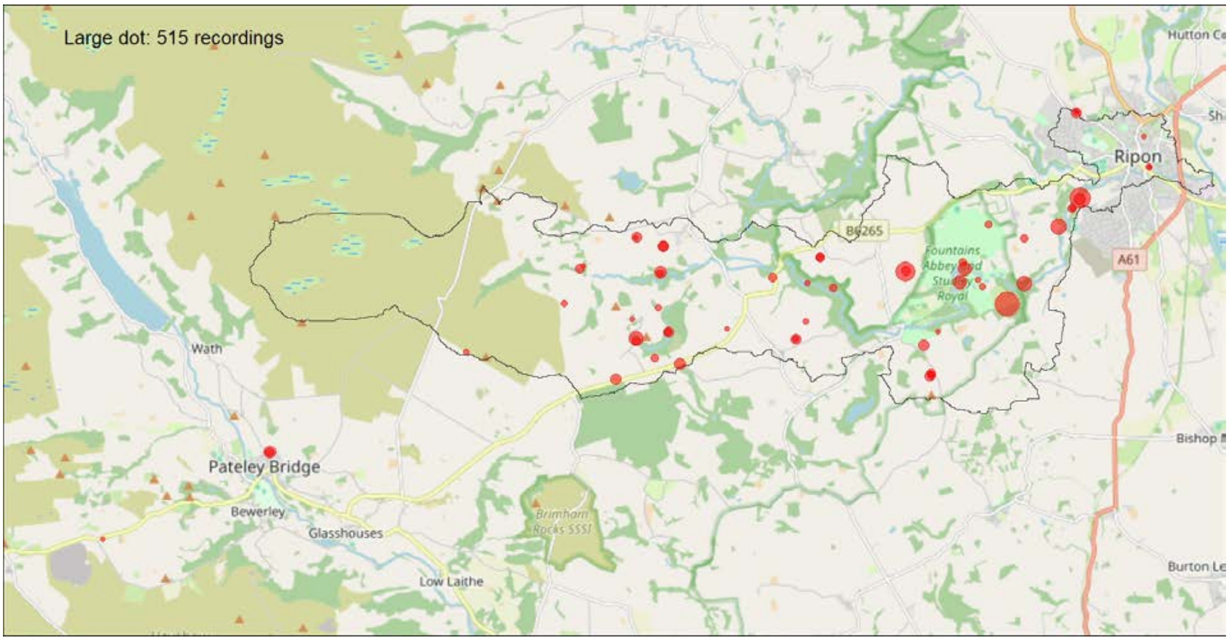


Daubenton's Bat social calls. Social calls of bats are different from echolocation calls which they use to navigate their way around the landscape, in that they are often used when bats interact with one another. Whilst Daubenton's Bat social calls can be recorded away from a roost, they are more commonly produced close to a roost site. With this in mind, it is particularly notable here were double figure numbers of Daubenton's Bat recordings with social calls from several nights from Eavestone Lake in May and July.

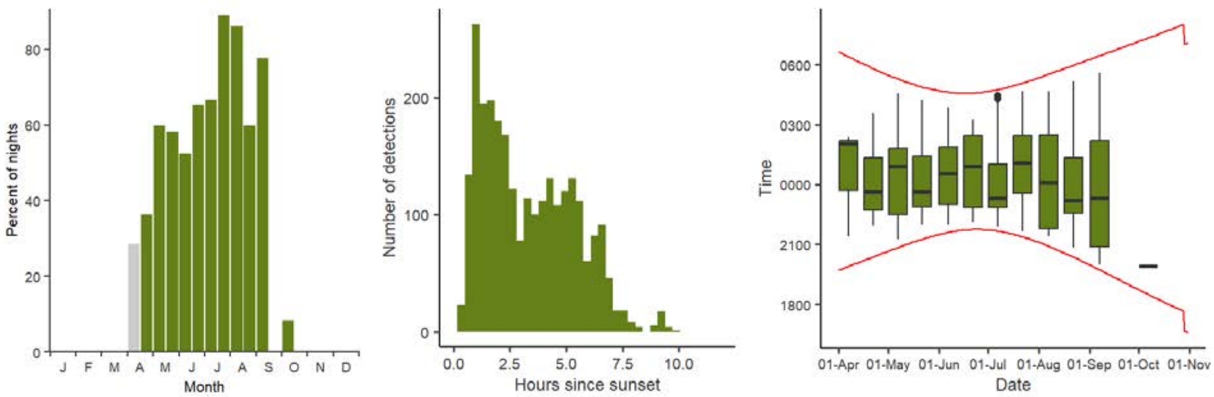
Whiskered or Brandt's Bat

Whiskered or Brandt's Bat *Myotis mystacinus or M. brandtii* was recorded on 107 nights, from 57 locations, giving a total of 2,643 recordings.

Spatial pattern of activity



Seasonal and nightly activity

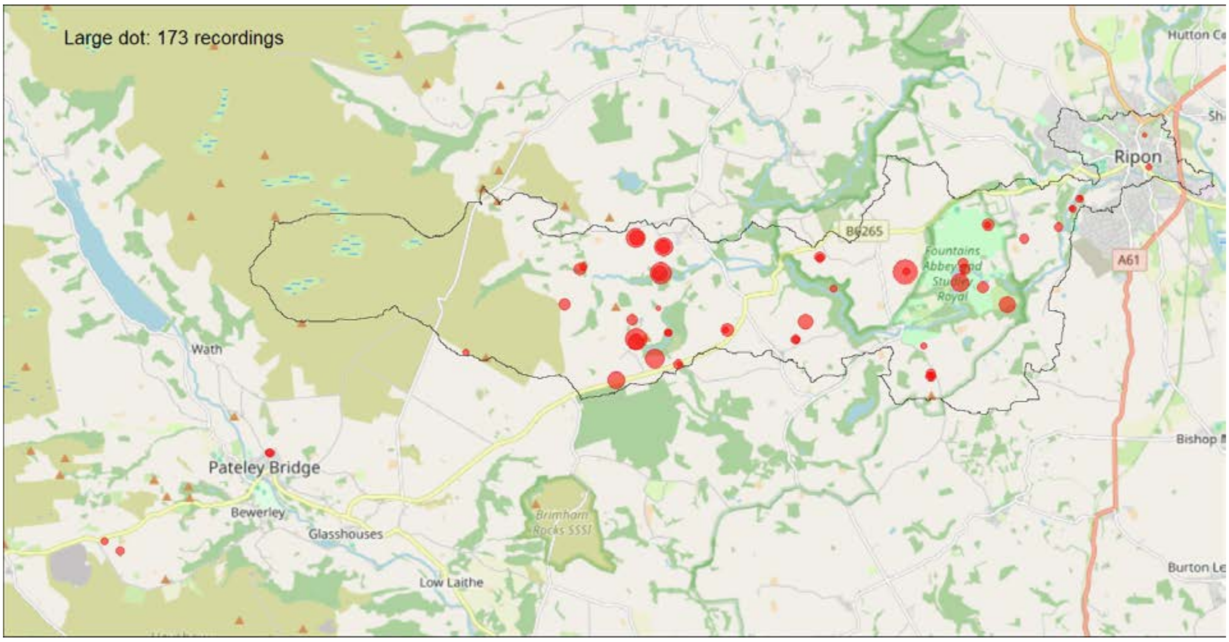


Whiskered or Brandt's Bat were widely recorded within the Skell Valley catchment. Different to Daubenton's Bat where the highest activity was recorded close to water, the highest activity of Whiskered or Brandt's bat was in the vicinity of woodland patches, with up to 277 recordings on the 30th July from a woodland block just east of Studley Royal Park, and up to 194 recordings on the 29th July from woodland close to the River Skell west of Ripon. At the current time, there are no good clear criteria for distinguishing Whiskered and Brandt's Bat acoustically with confidence. Looking across recordings there is an indication from the call measurements and social calls that Brandt's Bat is likely to be the most common and widespread of the two species, but this would need to be proven by some other means (e.g. DNA evidence or trapping). For further discussion on our approach to the sound identification of *Myotis* see Identification appendix 2.

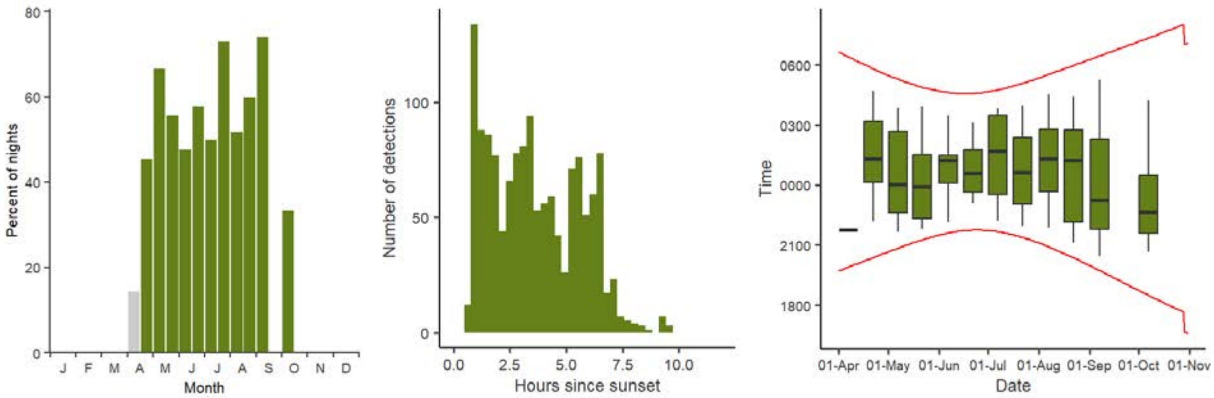
Natterer's Bat

Natterer's Bat *Myotis nattereri* was recorded on 100 nights, from 54 locations, giving a total of 1,402 recordings.

Spatial pattern of activity



Seasonal and nightly activity

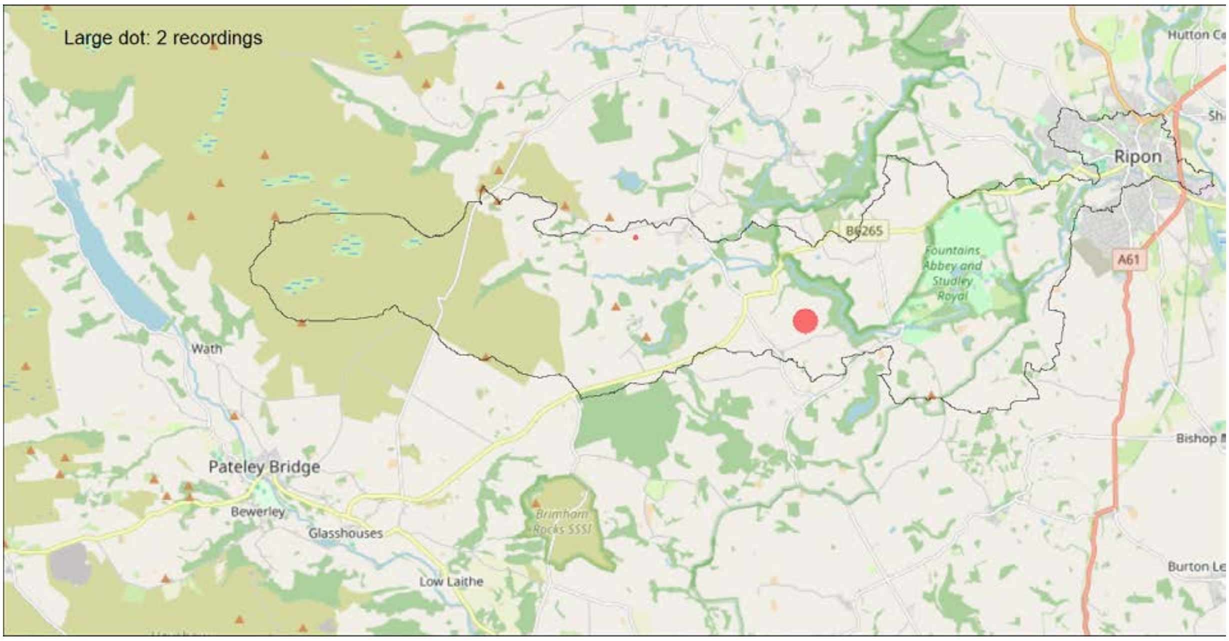


Natterer's Bat was widely recorded, but witha fairly modest number of recordings across the Skell Valley catchment. The highest activity of Natterer's Bat was recorded in woodland areas, with a maximum of 43 recordings from woodland bordering Eavestone Lake on the 26th July. Also notable were over 40 recordings recorded from two nights, along a hedgerow, presumably a commuting route between Studley Royal Park and Aldfield. As with Whiskered and Brandt's Bat above, the first consideration when looking at recordings is the quality of the recording, to consider whether the quality is good enough to try and assign the recording to species. See Identification appendix 3 for further information on the sound identification of Natterer's Bat.

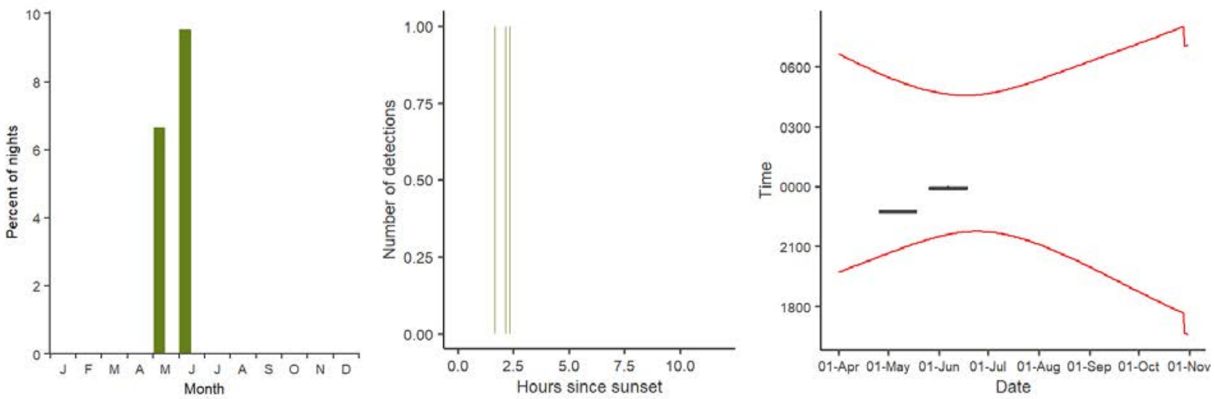
Natterer's Bat social calls

Natterer's Bat social calls *Myotis nattereri* were recorded on three nights, from two locations, giving a total of 3 recordings.

Spatial pattern of activity



Seasonal and nightly activity

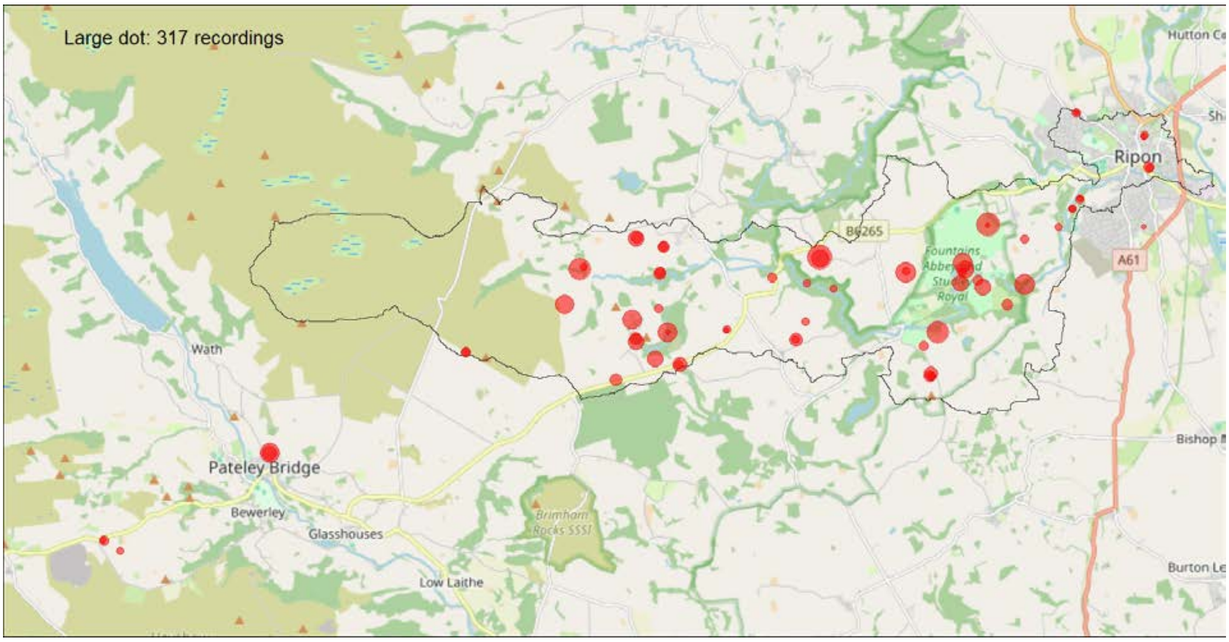


Natterer's Bat social calls. Natterer's Bat social calls are often produced in the vicinity of a roost, so it can be helpful to identify these separately. Natterer's Bat social calls were recorded from two locations, from a location close to Risplith from the 10th and 11th June, and from close to Low Green Farm between Grantley and Skelding on the 14th May.

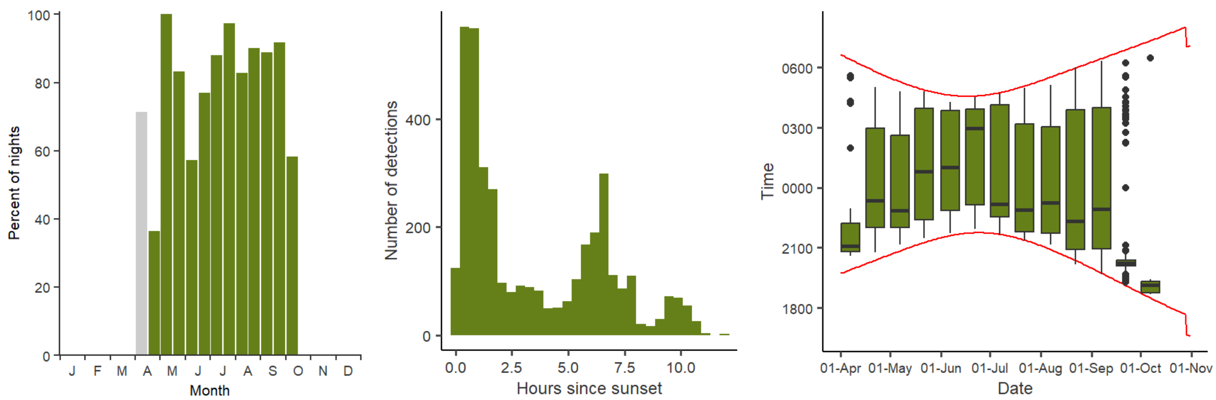
Common Noctule

Common Noctule *Nyctalus noctula* was recorded on 133 nights, from 66 locations, giving a total of 3,798 recordings.

Spatial pattern of activity



Seasonal and nightly activity



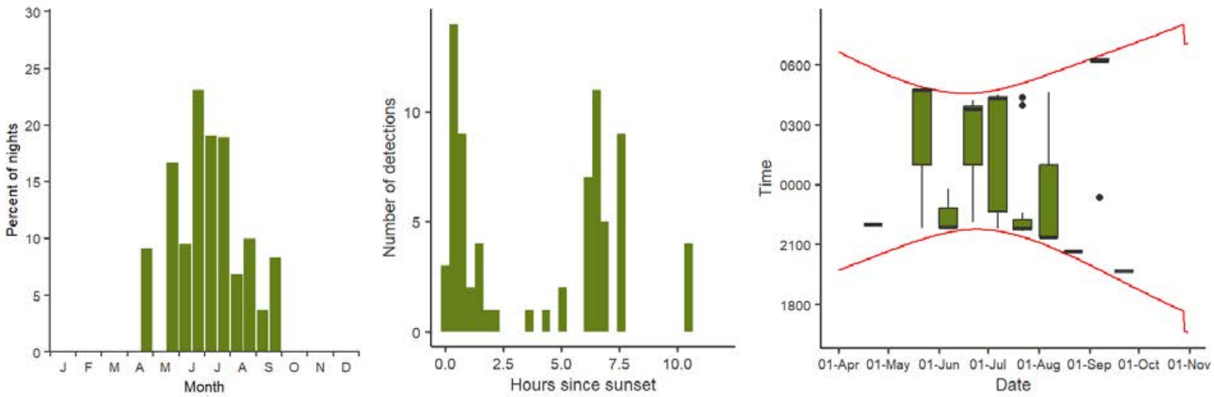
Common Noctule was commonly recorded across the survey area, with a double figure number of recordings from most many location where this species was recorded. The maximum number of recordings of Noctule from a night was 151 recordings of Noctule from a lake just west of Aldfield on the 28th August, followed by 137 recordings from a location close to Fountains Abbey on 17th September. See Identification appendix 4 for further information on the sound identification of Noctule and how it compares with the closely related Leisler's Bat.

Common Noctule feeding buzzes

Common Noctule feeding buzzes *Nyctalus noctula* were recorded on 32 nights, from 24 locations, giving a total of 74 recordings.

Spatial pattern of activity

Seasonal and nightly activity



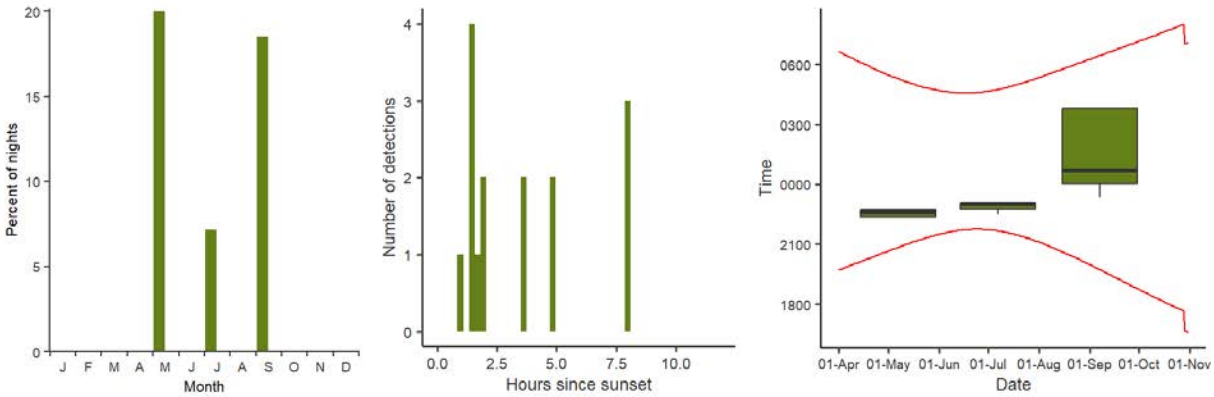
Common Noctule feeding buzzes. The highest level of recorded Noctule feeding activity was at Studley Royal Deer Park, with a total of 7 recordings on the 2nd July. There were also 7 recordings with feeding buzzes from a location close to Eavestone Lake on the 16th May.

Common Noctule social calls

Common Noctule social calls *Nyctalus noctula* were recorded on nine nights, from seven locations, giving a total of 15 recordings.

Spatial pattern of activity

Seasonal and nightly activity

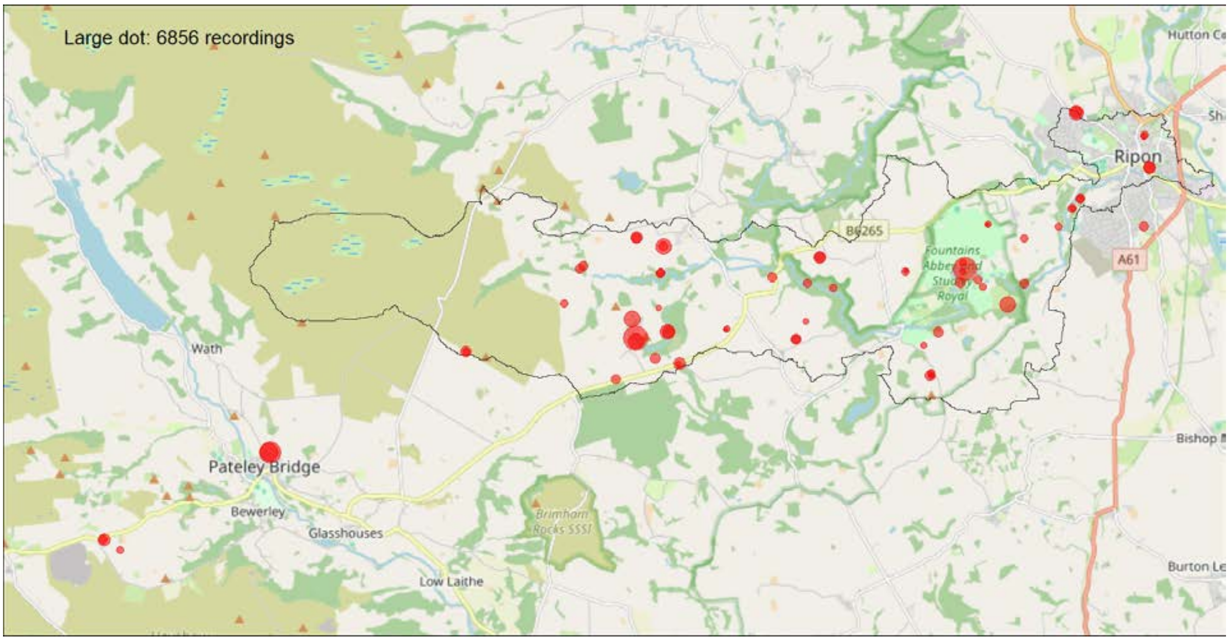


Common Noctule social calls are often produced in the vicinity of a roost, so it can be useful to identify these. Perhaps most interesting is a location on the edge of Pateley Bridge where social calls were recorded on the 5th and 6th May.

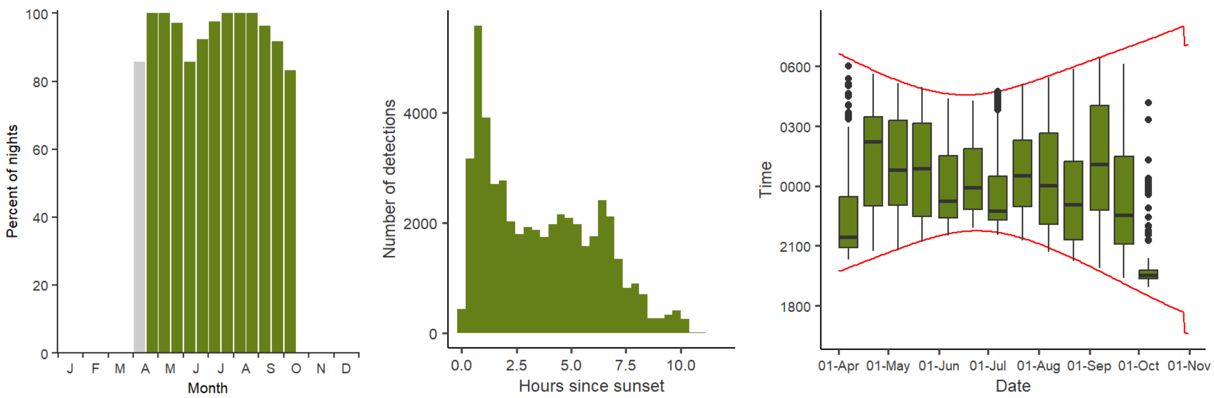
Common Pipistrelle

Common Pipistrelle *Pipistrellus pipistrellus* was recorded on 151 nights, from 66 locations, giving a total of 49,265 recordings.

Spatial pattern of activity



Seasonal and nightly activity



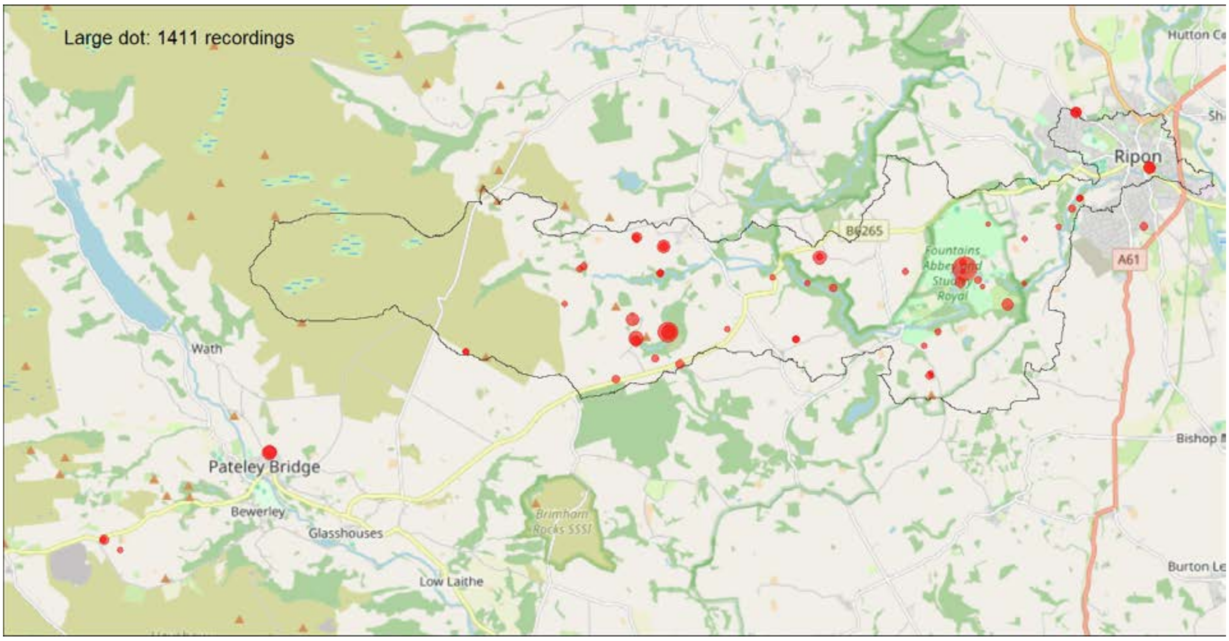
Common Pipistrelle was by far the most common and widely recorded bat species, with 49,265 recordings from 66 different locations (100% of survey locations). A maximum of 2,350 recordings of Common Pipistrelle was recorded from a location on the edge of Pateley Bridge on the night of the 6th September.

Common Pipistrelle is normally straightforward to identify acoustically, but particular care is needed given calls at the low or high frequency end of the range for this species, which in the UK could be mis-identified as Nathusius' Pipistrelle or Soprano Pipistrelle respectively. For these it is important to consider the call duration, and not just the peak or end frequency of the calls.

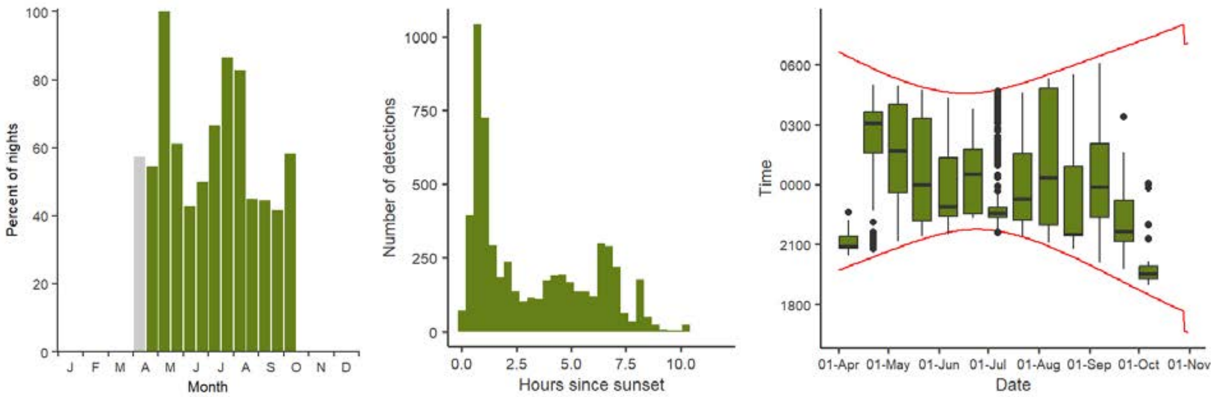
Common Pipistrelle feeding buzzes

Common Pipistrelle feeding buzzes *Pipistrellus pipistrellus* were recorded on 114 nights, from 57 locations, giving a total of 5,713 recordings.

Spatial pattern of activity



Seasonal and nightly activity



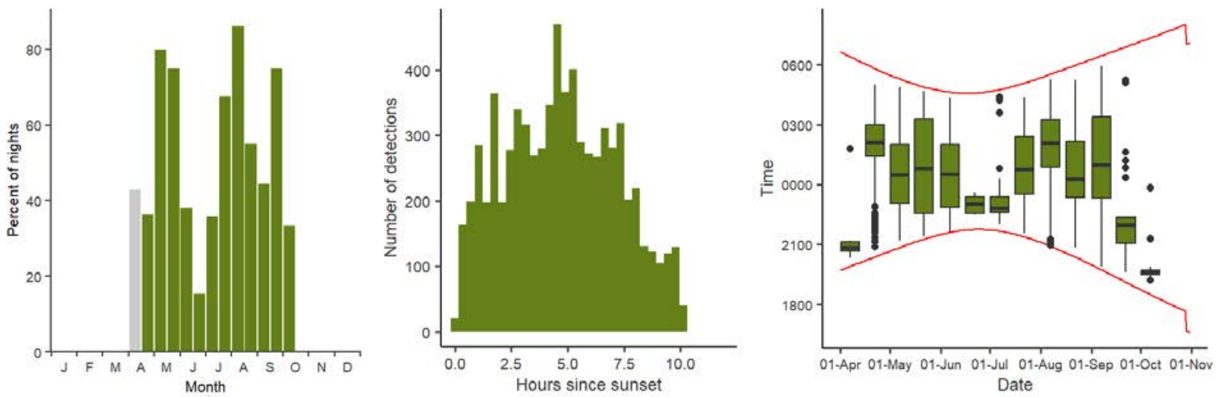
Common Pipistrelle feeding buzzes. As illustrated above, there were peaks in feeding activity towards the start of the night and a clear increase in feeding activity towards the end of the night before returning to the roost.

Common Pipistrelle social calls

Common Pipistrelle social calls *Pipistrellus pipistrellus* were recorded on 107 nights, from 54 locations, giving a total of 7,298 recordings.

Spatial pattern of activity

Seasonal and nightly activity

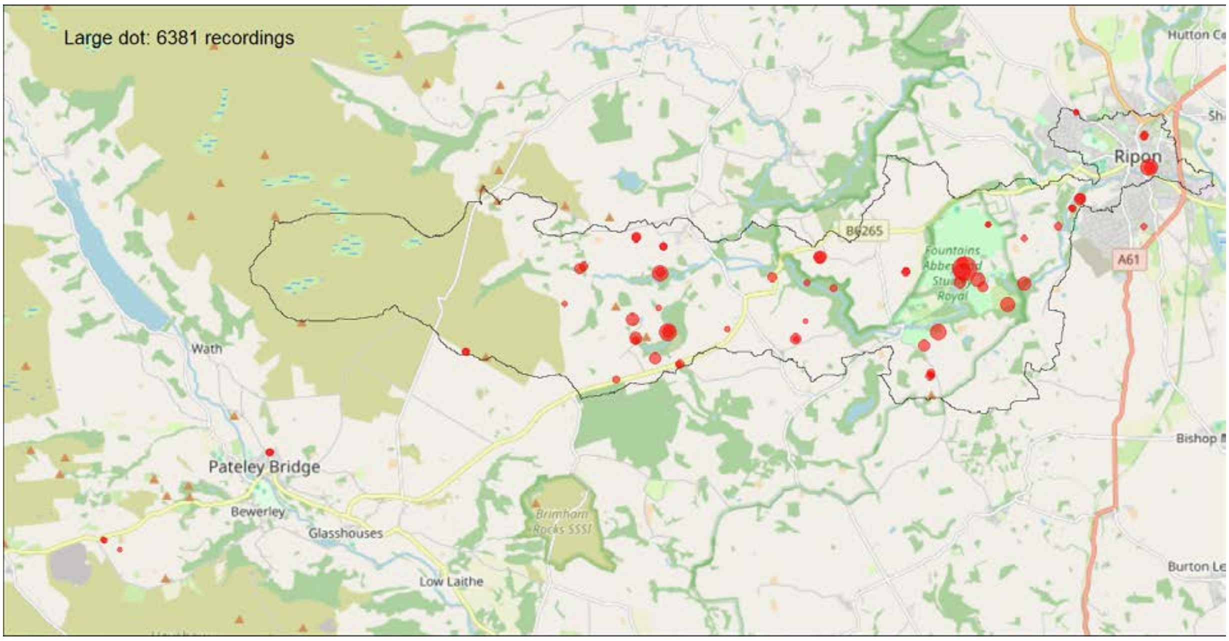


Common Pipistrelle social calls. A range of social calls are produced by Common Pipistrelle, but most common are social trills often comprising of four calls. These can be produced in flight at any time of year, but as illustrated here, there are often peaks in the number of social calls early in the season / pre-breeding, and then an increase in the percent of nights recording Common Pipistrelle social calls during the late summer, into the autumn mating period.

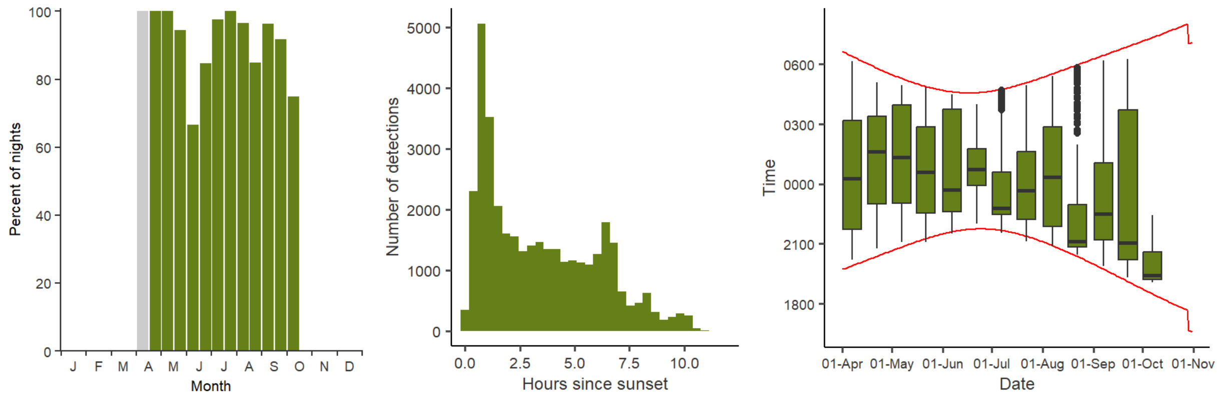
Soprano Pipistrelle

Soprano Pipistrelle *Pipistrellus pygmaeus* was recorded on 148 nights, from 65 locations, giving a total of 35,712 recordings.

Spatial pattern of activity



Seasonal and nightly activity

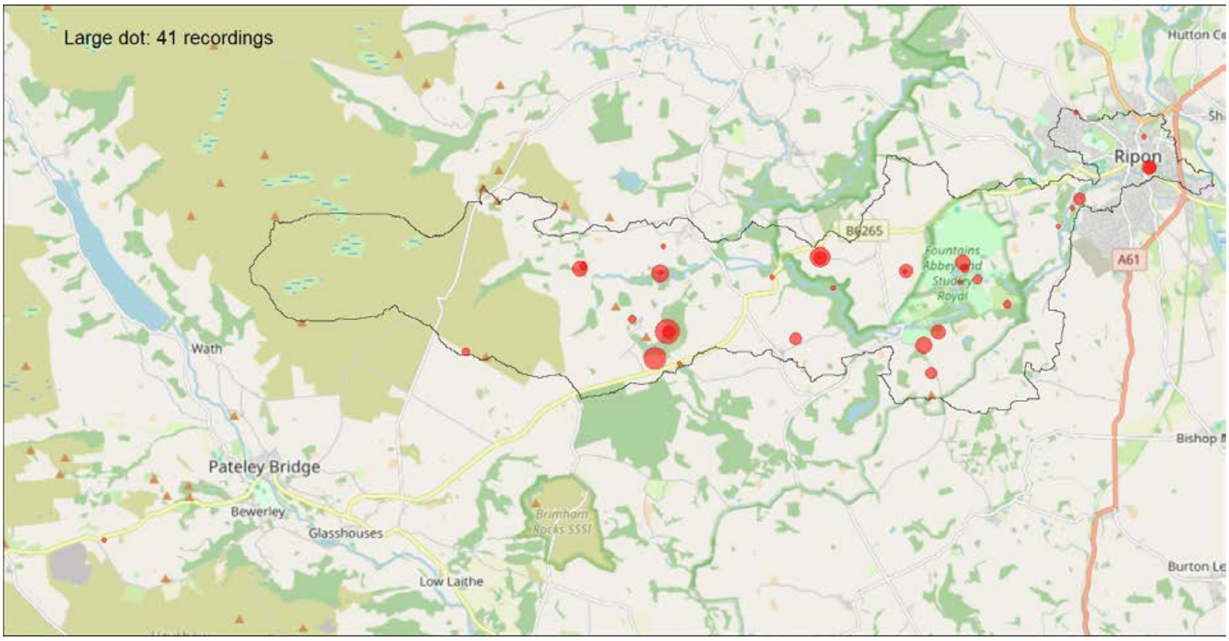


Soprano Pipistrelle was the second most common and widely recorded bat species, with 35,712 recordings from 65 different locations (over 98% of survey locations). A maximum of 1,539 recordings of Soprano Pipistrelle were recorded from the lake at Studley Royal Park on the night of the 29th May. Compared with Common Pipistrelle which is more of a habitat generalist, Soprano Pipistrelle has a strong association with areas of freshwater.

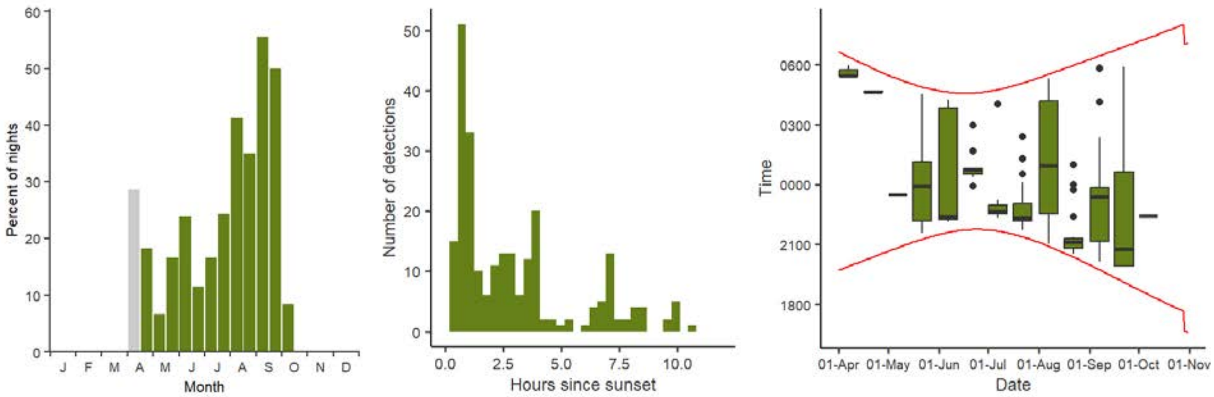
Soprano Pipistrelle feeding buzzes

Soprano Pipistrelle feeding buzzes *Pipistrellus pygmaeus* were recorded on 62 nights, from 34 locations, giving a total of 240 recordings.

Spatial pattern of activity



Seasonal and nightly activity

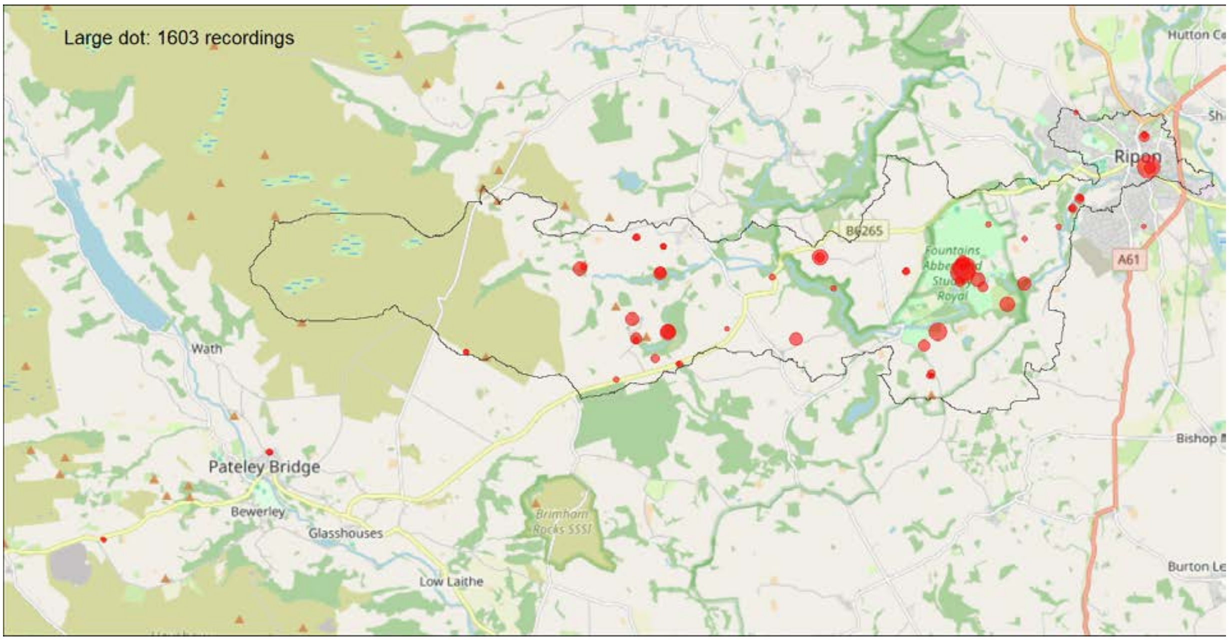


Soprano Pipistrelle feeding buzzes As illustrated above, there were peaks in feeding activity towards the start of the night and a clear increase in feeding activity towards the end of the night before returning to the roost.

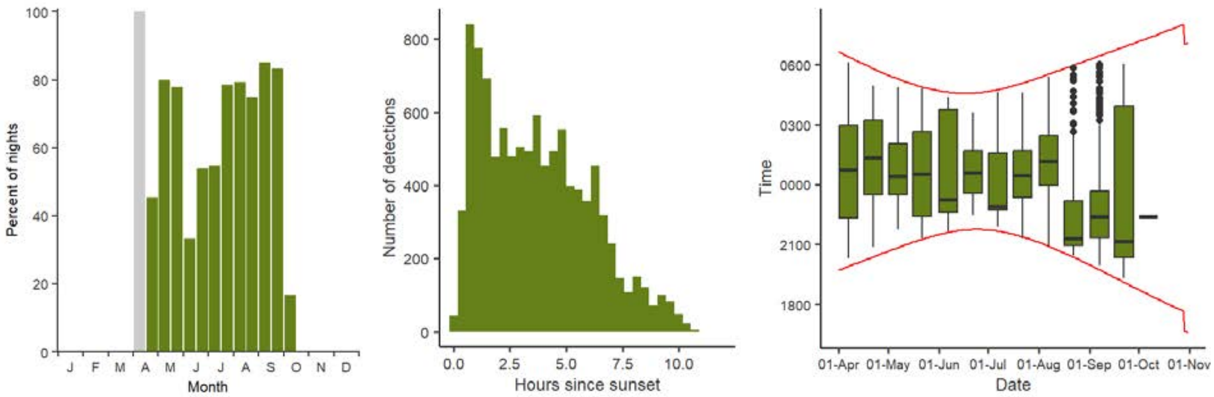
Soprano Pipistrelle social calls

Soprano Pipistrelle social calls *Pipistrellus pygmaeus* were recorded on 120 nights, from 57 locations, giving a total of 10,303 recordings.

Spatial pattern of activity



Seasonal and nightly activity

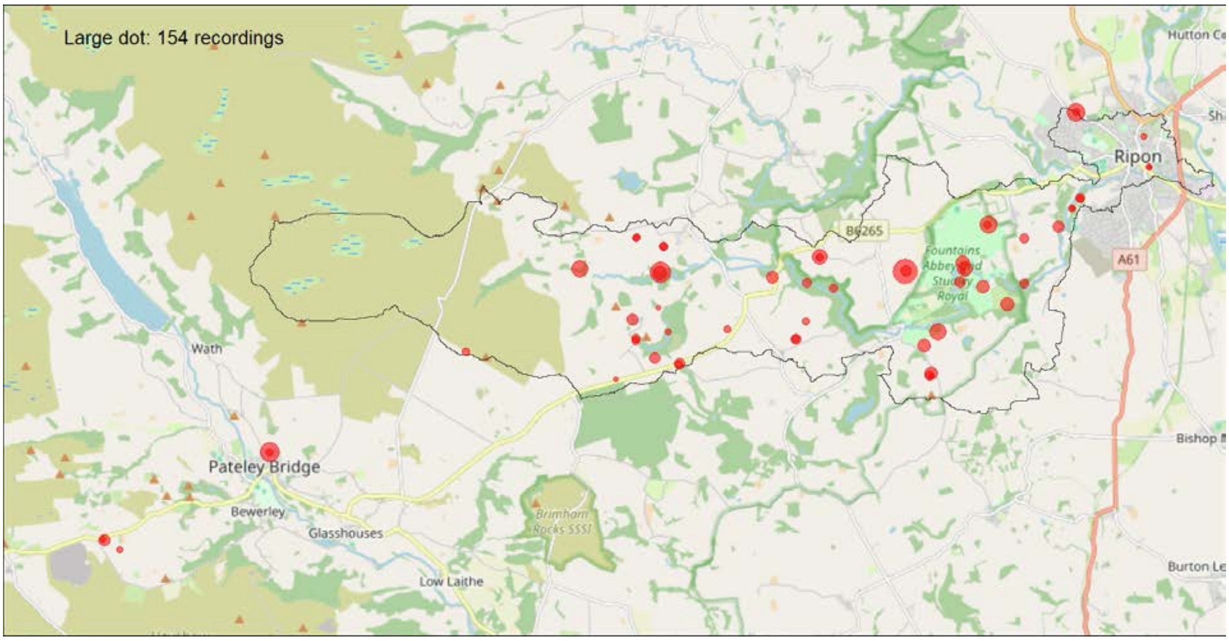


Soprano Pipistrelle social calls. A range of social calls are produced by Soprano Pipistrelle, but most common are social trills often comprising of three calls. These can be produced in flight at any time of year, but similar to Common Pipistrelle, there are often peaks in the number of social calls early in the season / pre-breeding, and then an increase in the percent of nights recording Soprano Pipistrelle social calls during the late summer, into the autumn mating period as seen in the figure above.

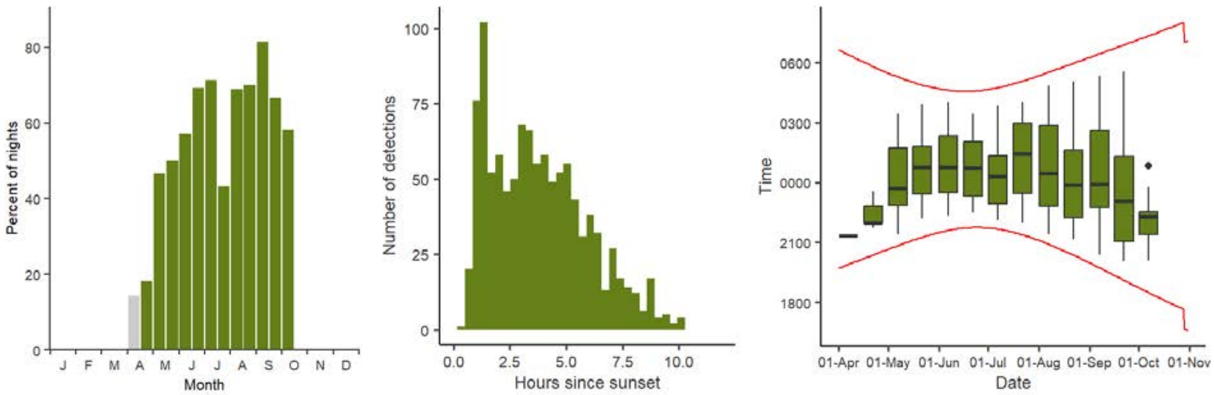
Brown Long-eared Bat

Brown Long-eared Bat *Plecotus auritus* was recorded on 109 nights, from 58 locations, giving a total of 1,073 recordings.

Spatial pattern of activity



Seasonal and nightly activity



Brown Long-eared Bat was widely recorded across the survey area. There were double figure numbers of recordings a night from many of the locations where Brown Long-eared Bat was recorded. The maximum number of recordings a night, 40, was from a location on the edge of Pateley Bridge on the 7th September. Also notable were over 30 recordings a night recorded over several nights along a hedgerow between Studley and Aldfield which presumably is being used as a commuting route.

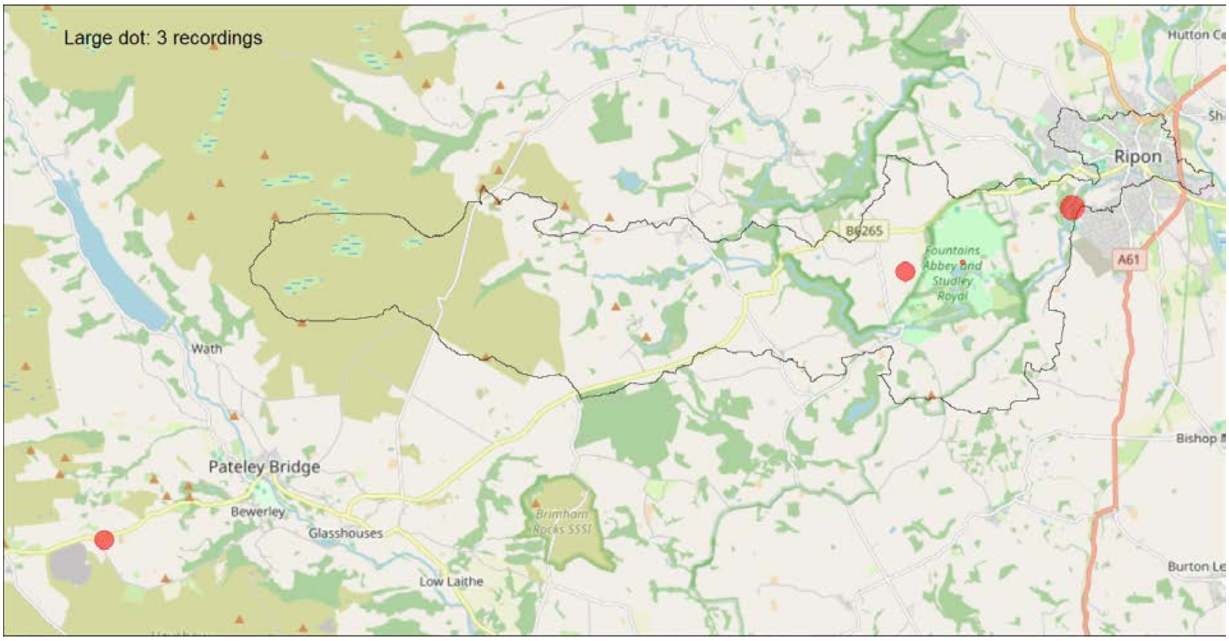
4.3.2 Small terrestrial mammal species

In this section we look at the recordings that we can assign to small terrestrial mammals.

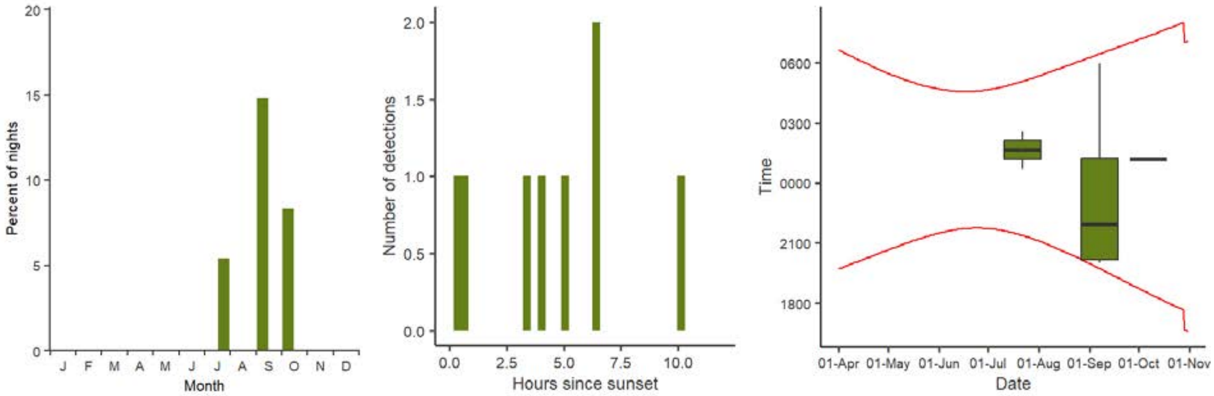
Wood Mouse

Wood Mouse *Apodemus sylvaticus* was recorded on seven nights, from four locations, giving a total of 8 recordings.

Spatial pattern of activity



Seasonal and nightly activity

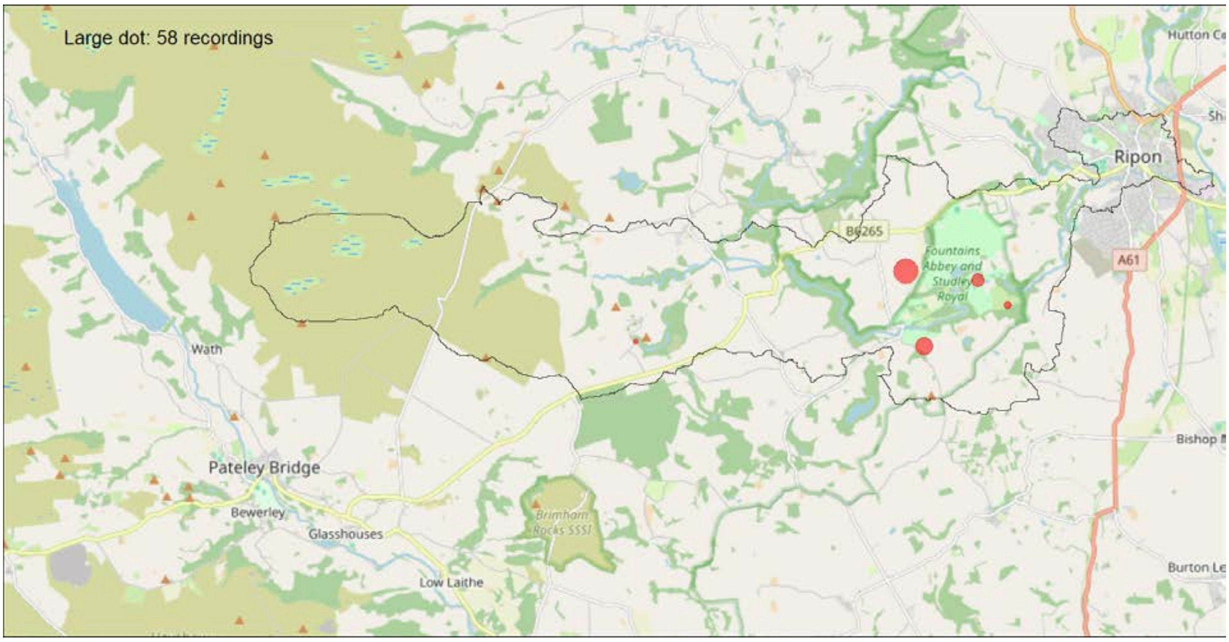


Wood Mouse Compared with the other small terrestrial mammal species here, the calls of Wood Mouse are not as loud, and so are likely to be under-recorded compared with shrews and rats. For more information on the sound identification of Wood Mouse see Newson *et al*., (2021)

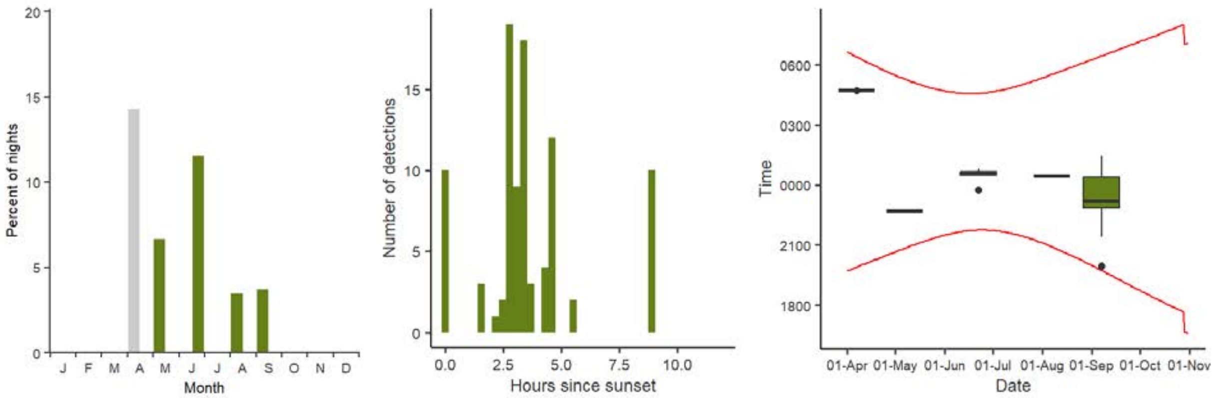
Brown Rat

Brown Rat *Rattus norvegicus* was recorded on seven nights, from five locations, giving a total of 93 recordings.

Spatial pattern of activity



Seasonal and nightly activity



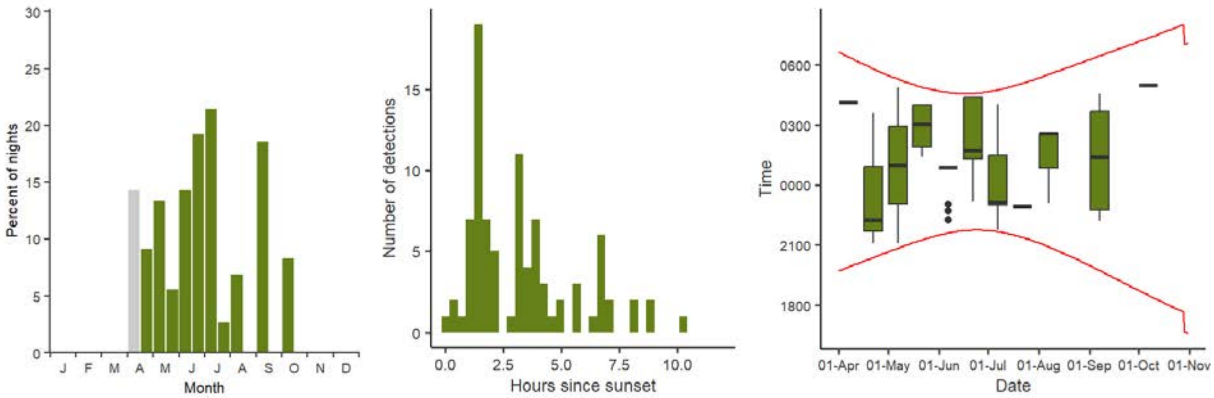
Brown Rat is a highly vocal species that is relatively easy to detect using an ultrasonic microphone and is regularly recorded incidentally during static bat detector surveys (Newson & Pearce 2022). The maximum number of recordings a night was 58 recordings along a hedgerow between Studley Royal Park and Aldfield on the 2nd September.

Common Shrew

Common Shrew *Sorex araneus* was recorded on 27 nights, from 22 locations, giving a total of 88 recordings.

Spatial pattern of activity

Seasonal and nightly activity

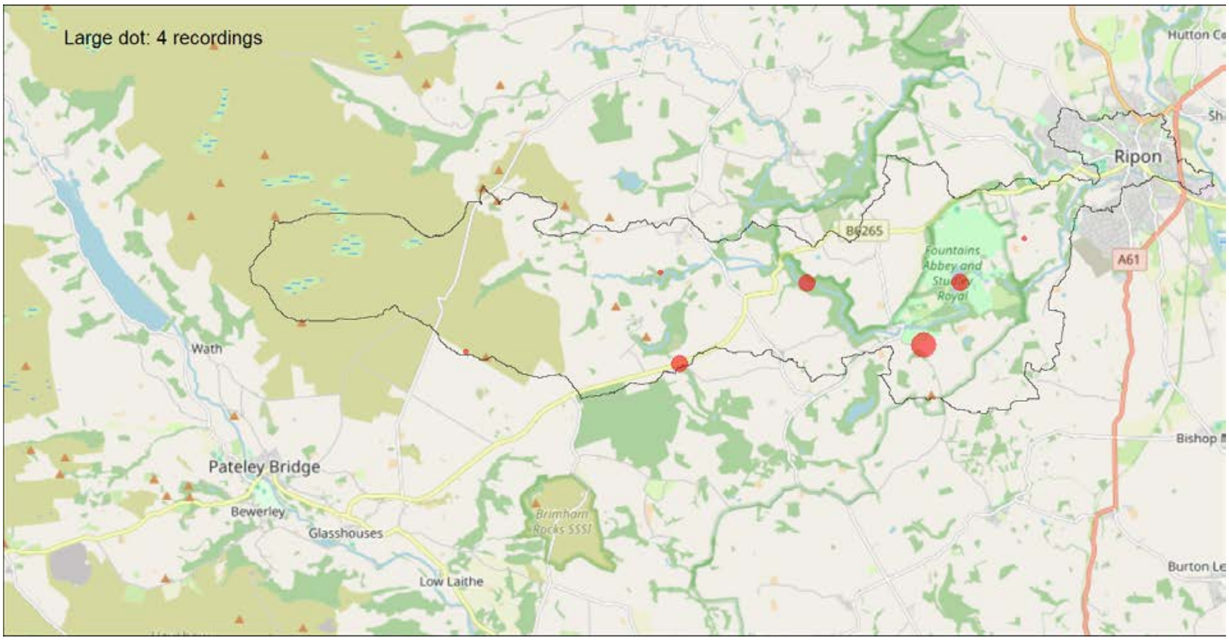


Common Shrew was recorded widely across the Skell Valley, with a maximum of 18 recordings from woodland close to the River Skell west of Fountains Abbey on the night of the 2nd July. Common and Pygmy Shrew produce calls that are notably different from those of Rodents in having multiple harmonics that when played slowed down, produces a warbling sound. In most cases it is possible to separate Common Shrew and Pygmy Shrew, the former producing quite simple calls with much less variability in frequency and call structure than the latter. In the case of Common Shrew, the first harmonic (i.e. the fundamental) of the call (if present) ends at around 10 kHz, while the often stronger second harmonic ends at double the frequency to the first (i.e. about 20 kHz). Up to three further harmonics may be recorded, depending on how close the shrew is to the microphone. The complex calls of the Pygmy Shrew, in contrast, often include five or more harmonics, where no two calls in a single recording being quite the same. For more information on the sound identification of shrews, see Newson *et al*., (2021) and Middleton *et al*., (2024).

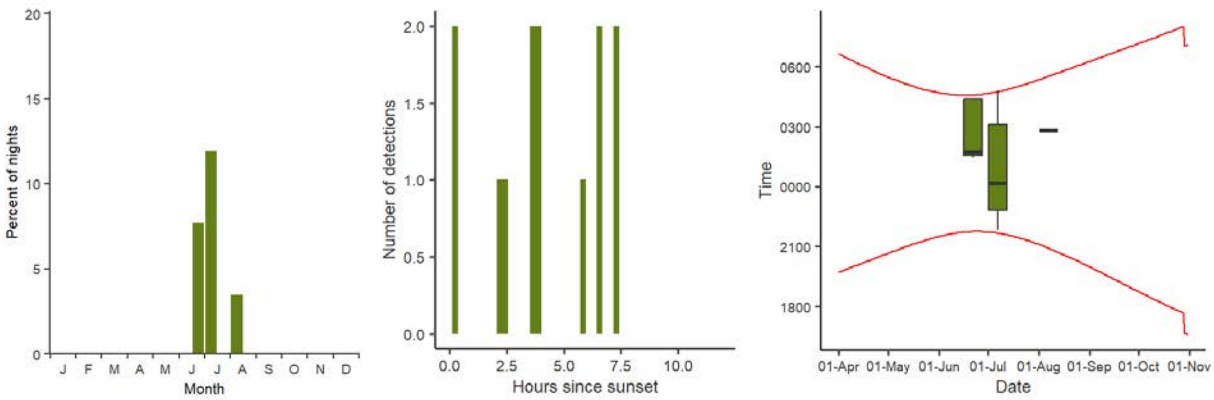
Eurasian Pygmy Shrew

Eurasian Pygmy Shrew *Sorex minutus* was recorded on seven nights, from seven locations, giving a total of 13 recordings.

Spatial pattern of activity



Seasonal and nightly activity



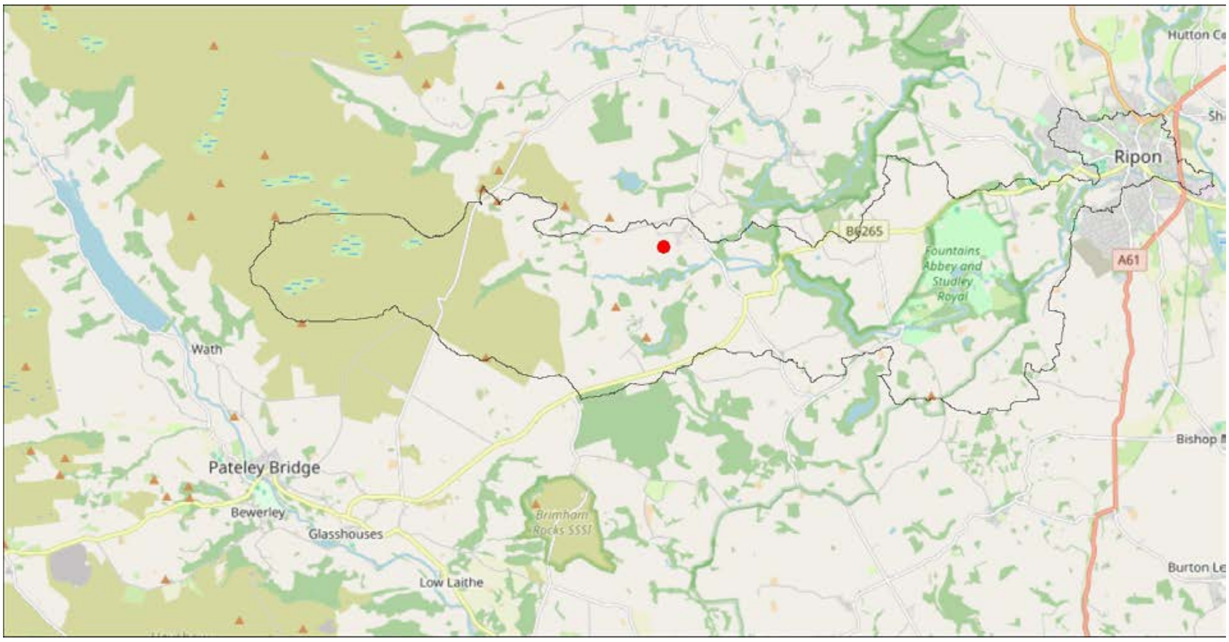
Pygmy Shrew was recorded less widely than Common Shrew (7 locations compared to 22 for Common Shrew) during the project. As discussed in the previous section (and see Newson *et al.*, 2021; Middleton *et al.* 2024), it is normally straightforward to distinguish this species acoustically from Common Shrew.

4.3.3 Audible moth species

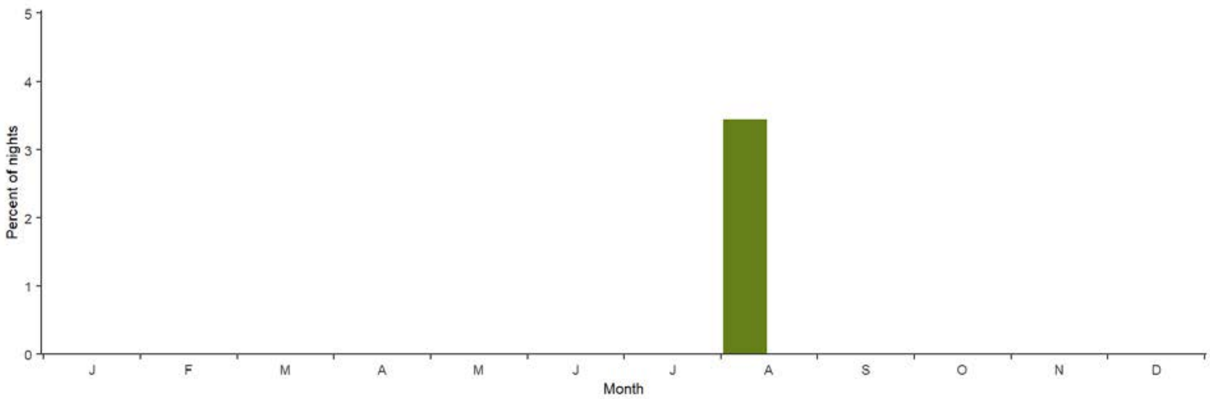
Green Silver-lines

Green Silver-lines *Pseudoips prasinana* was recorded on one night, from one location.

Spatial pattern of detections



Seasonality

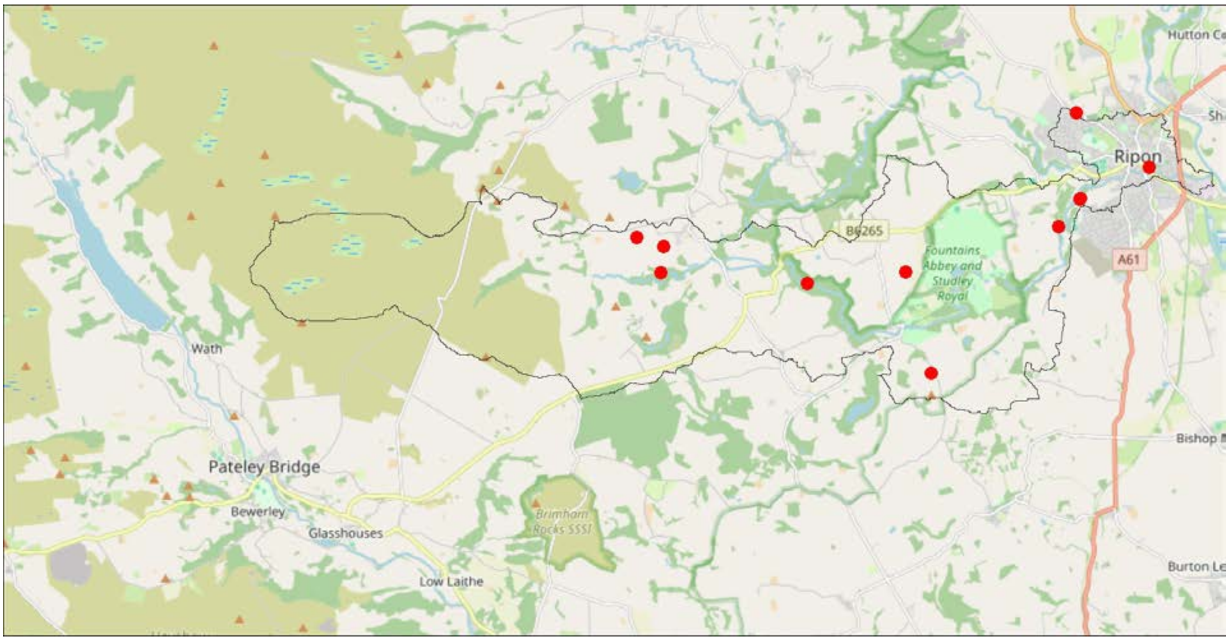


Green Silver-lines. Green Silver-lines produce 'calls' that form a very distinctive shape. See Barataud & Skals, (2018) for a description of the sound identification of Green Silver-lines.

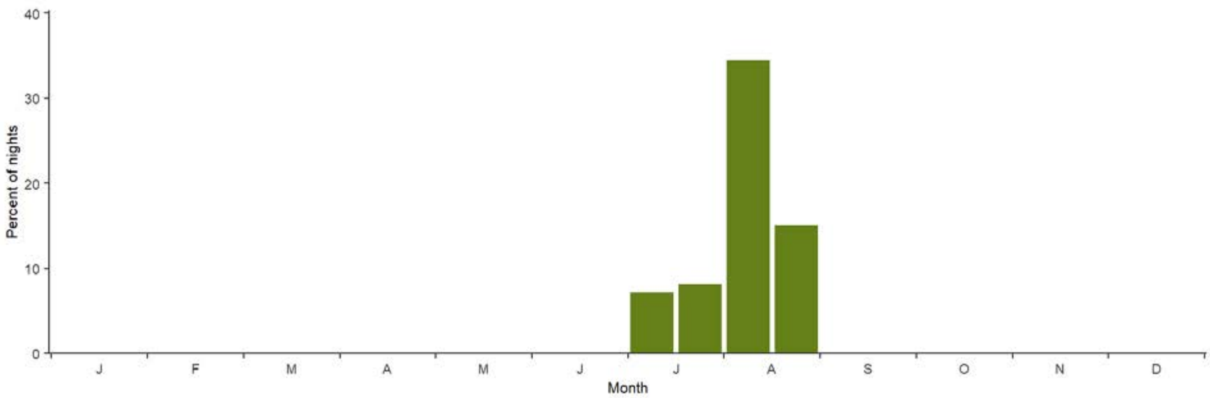
Bird Cherry Ermine

Bird Cherry Ermine *Yponomeuta evonymella* was recorded on 15 nights, from 11 locations.

Spatial pattern of detections



Seasonality



Bird Cherry Ermine The micro-moth Bird Cherry Ermine was recorded from 11 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. The sound produced by the Bird Cherry Ermine is very different from Green Silver-lines. Whilst we have assigned all recordings like this to this species, we can not exclude the possibility that other closely related species produce similar sounds.

5. DISCUSSION

The current dataset of 130,460 bat recordings from a total of 228,254 recordings, has been very valuable in adding to our understanding of patterns of occurrence and activity of bats across the Skell Valley, but it also adds to our understanding of some other species groups that were recorded as 'by-catch' during bat surveys.

In relation to other species groups recorded as 'by-catch' during bat surveys, four small terrestrial mammal species were recorded, comprising 88 recordings of Common Shrew, 13 recordings of Pygmy Shrew, 93 recordings of Brown Rat and 8 recordings of Wood Mouse. For further information on the sound identification of terrestrial small mammals in Britain see Newson *et al*. (2020) and Middleton *et al* (2023). The macro-moth Green Silver-lines and the micro-moth Bird Cherry Ermine were also recorded. This second species of moth is deaf itself, but it produces ultrasonic clicks when it flies, to interfere with the echolocation of bats and reduce predation.

6. ACKNOWLEDGEMENTS

We are very grateful to the landowners of the Skell Valley who have allowed us onto their land that made this project possible, and to everyone who helped with the fieldwork or planning of the project, with special mention to Nabil Abbas, Robin Clewer, Ray Davies, Bob Surtees, Jo Salisbury, Jan Moss, Robin Clewer and Chris Taylor. Lastly we would like to thank the National Lottery Heritage Fund and Farming in Protected Landscapes for funding this project as part of the Skell Valley Project led by the Nidderdale National Landscapes and the National Trust.

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Newson, S.E., Middleton, N., & Pearce, H. 2020. The acoustic identification of small terrestrial mammals in Britain. *British Wildlife* 32, 186-194

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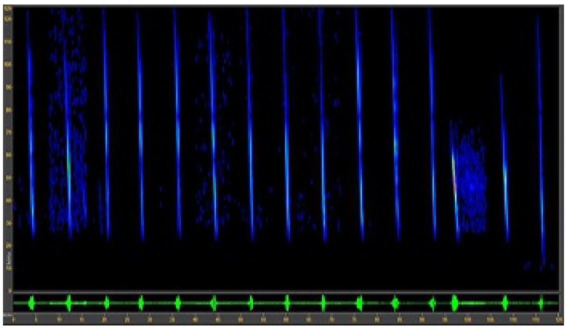
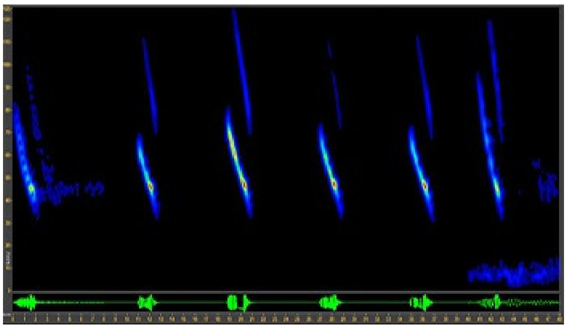
Identification appendix 1: Daubenton’s Bat *Myotis daubentonii* and Natterer’s Bat *Myotis nattereri*

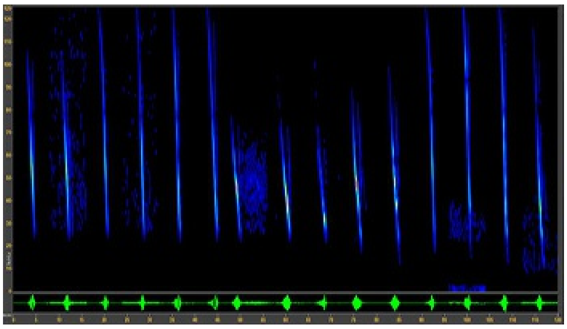


Daubenton's Bat - call duration up to 1.4 ms no examples

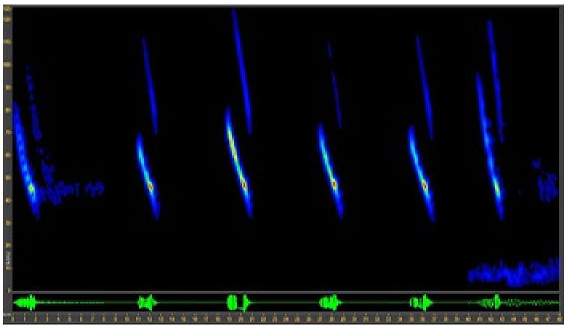
Natterer's Bat - call duration up to 1.4 ms



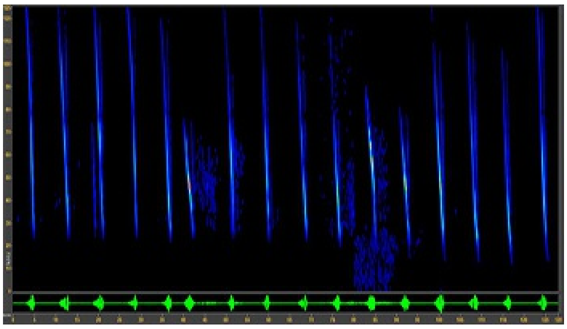
Daubenton's Bat - call duration 1.5-2.0 ms



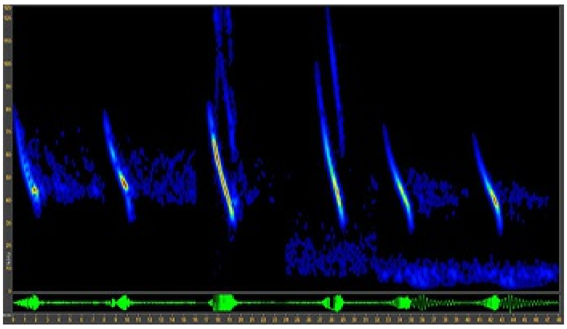
Natterer's Bat - call duration 1.5-2.0 ms



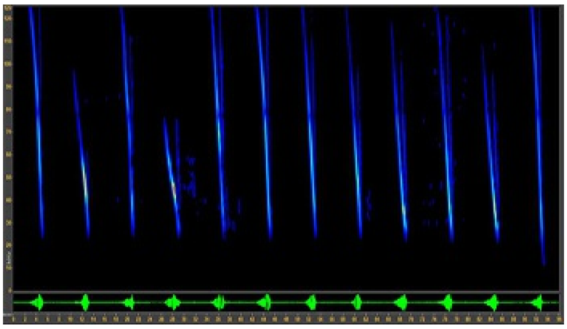
Daubenton's Bat - call duration 2.1-2.3 ms



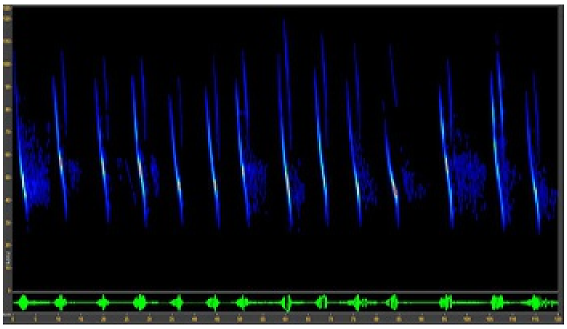
Natterer's Bat - call duration 2.1-2.3 ms

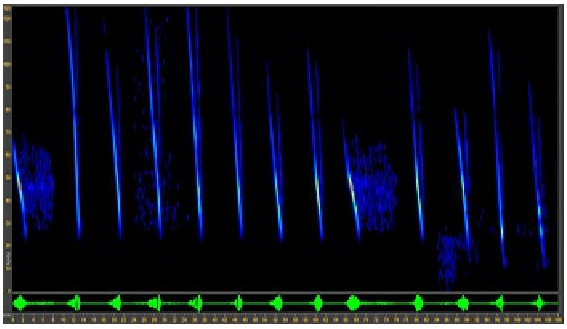


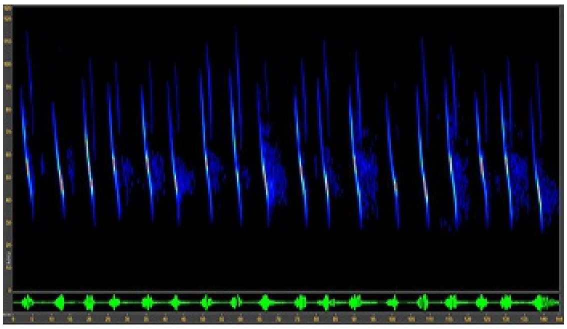
Daubenton's Bat - call duration 2.4-2.5 ms

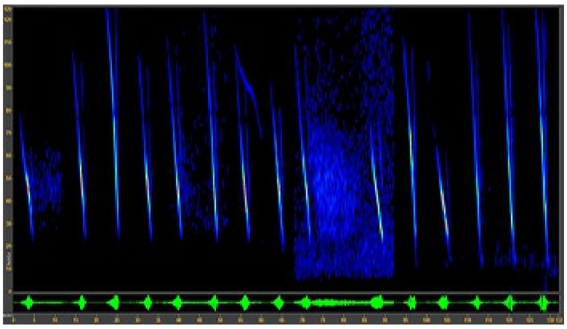


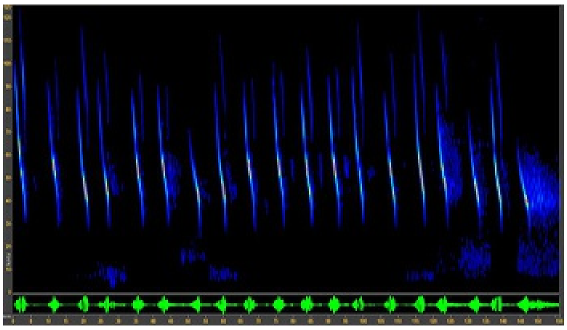
Natterer's Bat - call duration 2.4-2.5 ms

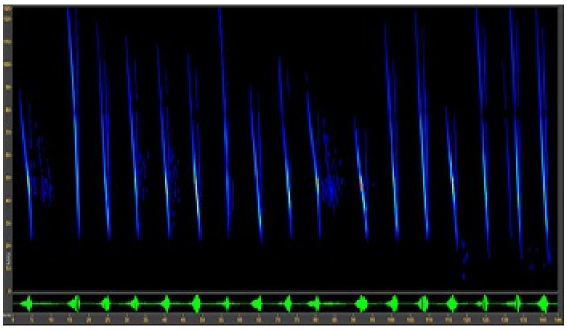

Daubenton's Bat - call duration 2.6-2.7 ms

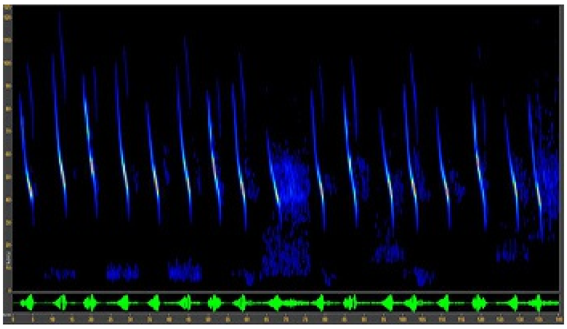

Natterer's Bat - call duration 2.6-2.7 ms

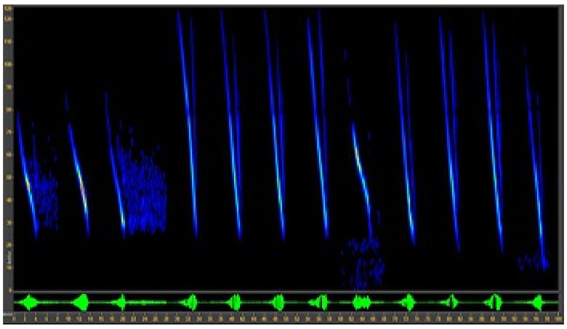

Daubenton's Bat - call duration 2.8-2.9 ms

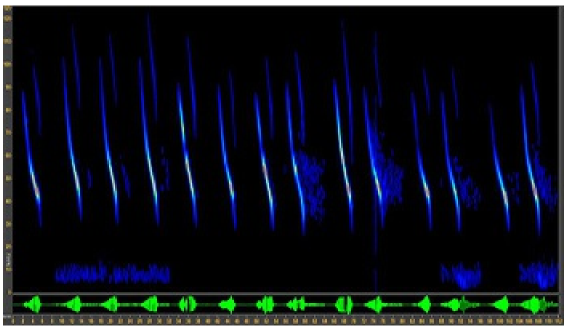

Natterer's Bat - call duration 2.8-2.9 ms

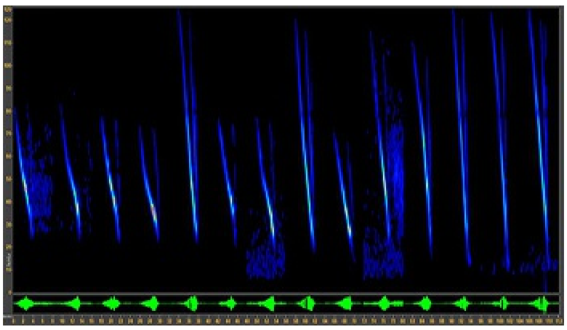

Daubenton's Bat - call duration 3.0-3.1 ms

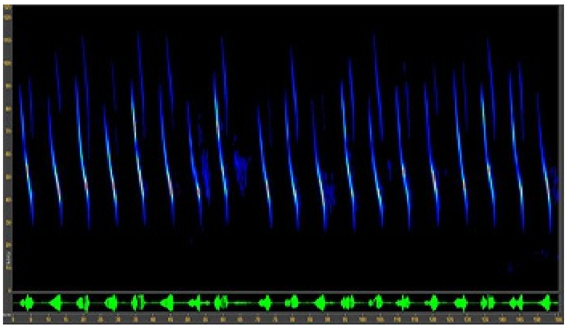

Natterer's Bat - call duration 3.0-3.1 ms

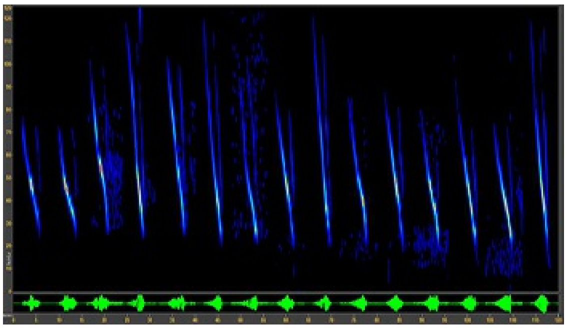

Daubenton's Bat - call duration 3.2-3.3 ms

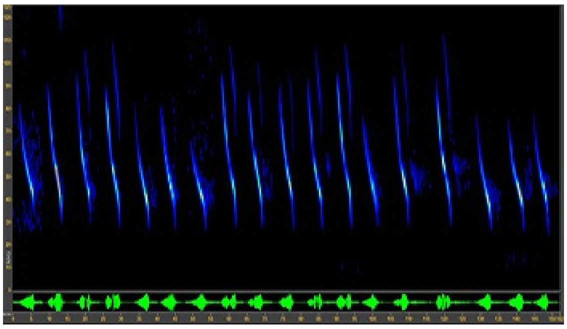

Natterer's Bat - call duration 3.2-3.3 ms

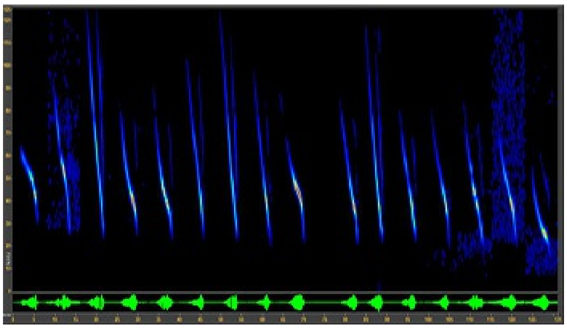

Daubenton's Bat - call duration 3.4-3.5 ms

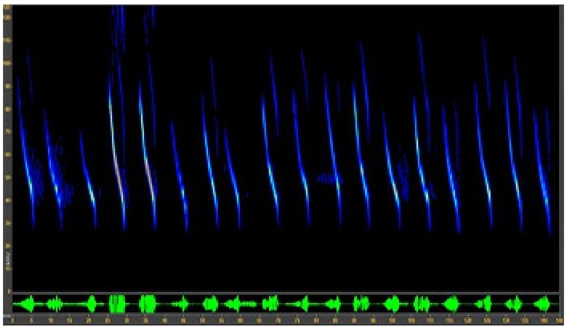

Natterer's Bat - call duration 3.4-3.5 ms

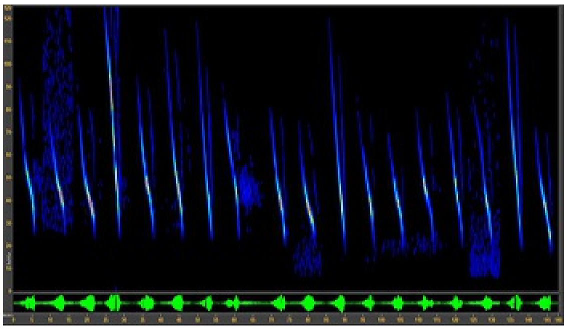

Daubenton's Bat - call duration 3.6-3.7 ms

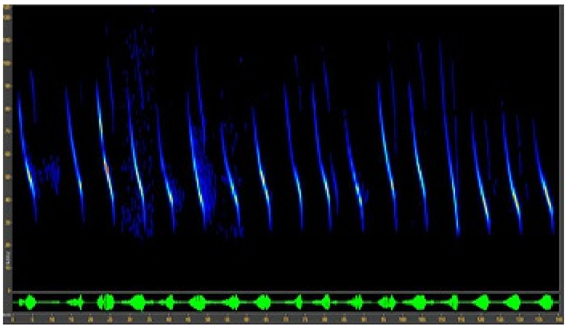

Natterer's Bat - call duration 3.6-3.7 ms

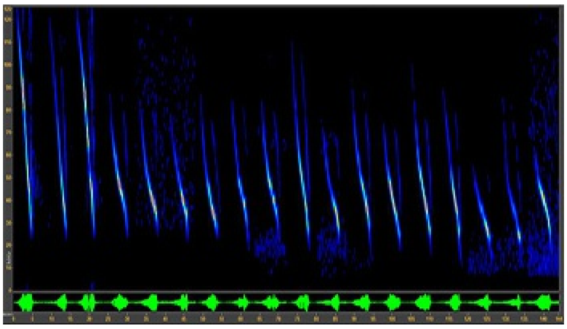

Daubenton's Bat - call duration 3.8-3.9 ms

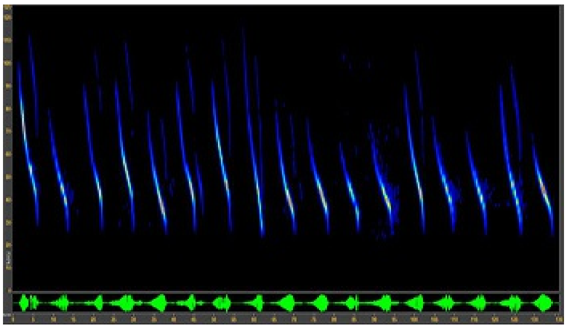

Natterer's Bat - call duration 3.8-3.9 ms

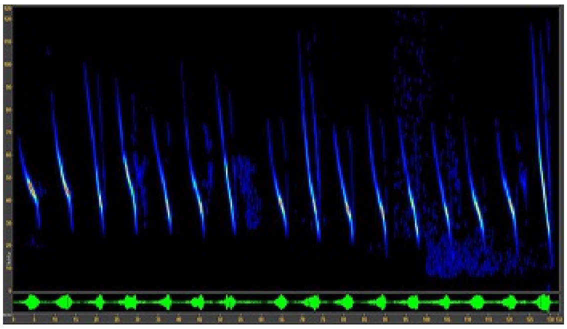

Daubenton's Bat - call duration 4.0-4.1 ms

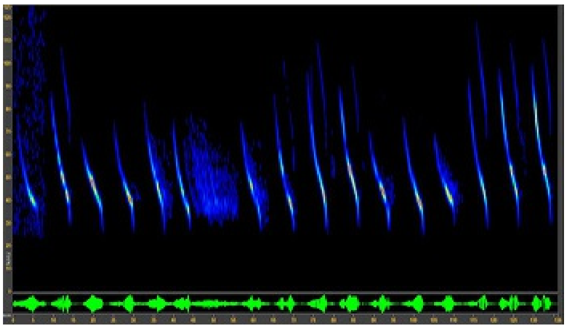

Natterer's Bat - call duration 4.0-4.1 ms

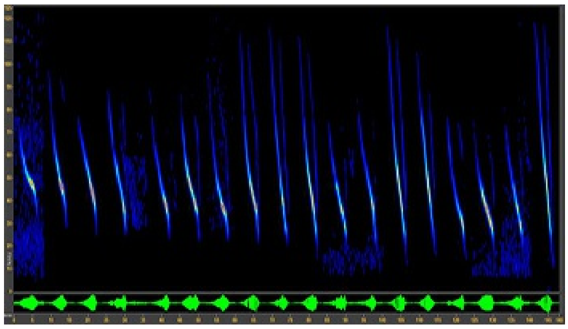

Daubenton's Bat - call duration 4.2-4.3 ms

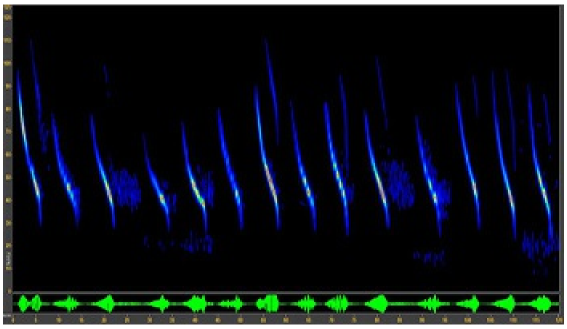

Natterer's Bat - call duration 4.2-4.3 ms

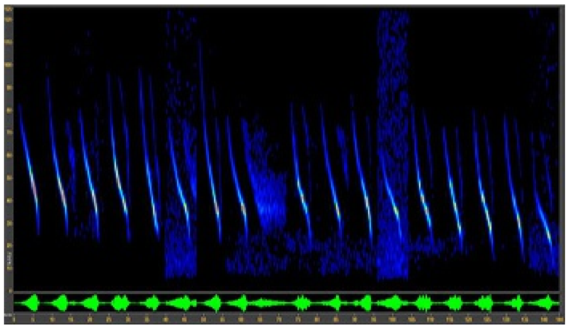

Daubenton's Bat - call duration 4.4-4.5 ms

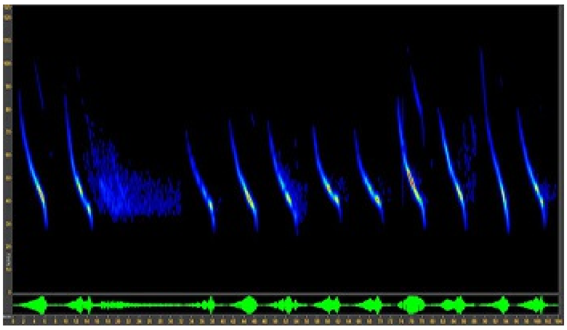

Natterer's Bat - call duration 4.4-4.5 ms

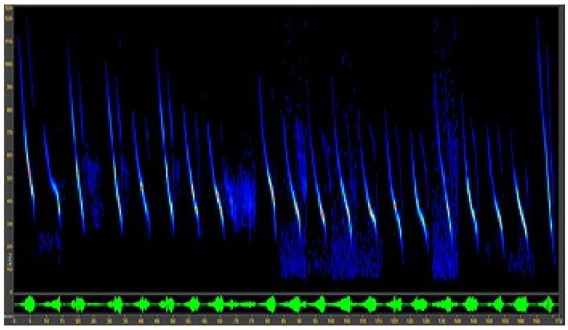

Daubenton's Bat - call duration 4.6-4.7 ms

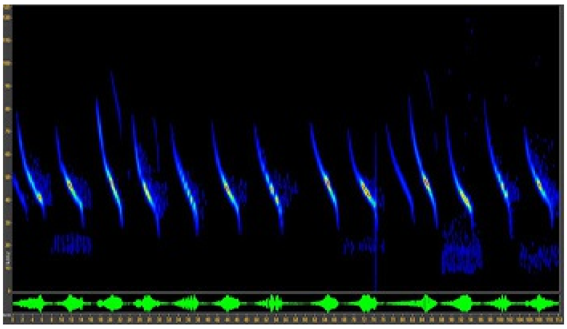

Natterer's Bat - call duration 4.6-4.7 ms

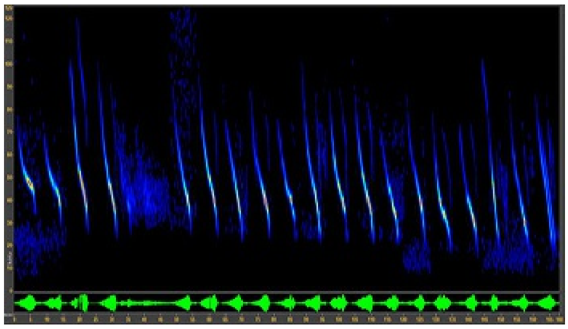

Daubenton's Bat - call duration 4.8-4.9 ms

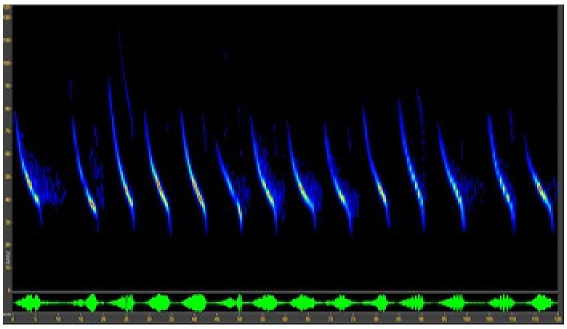

Natterer's Bat - call duration 4.8-4.9 ms

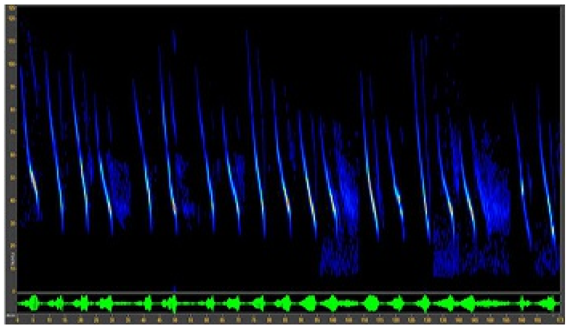

Daubenton's Bat - call duration 5.0-5.1 ms

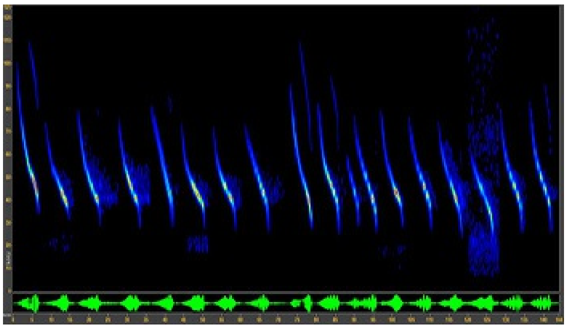

Natterer's Bat - call duration 5.0-5.1 ms

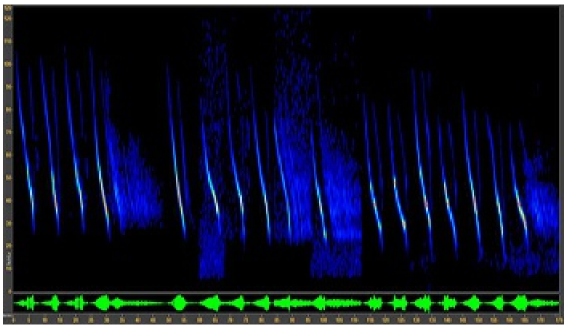

Daubenton's Bat - call duration 5.2-5.3 ms

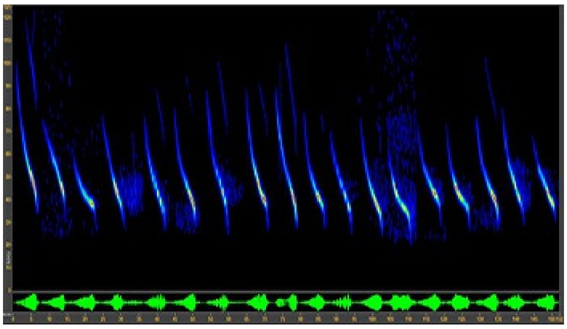

Natterer's Bat - call duration 5.2-5.3 ms

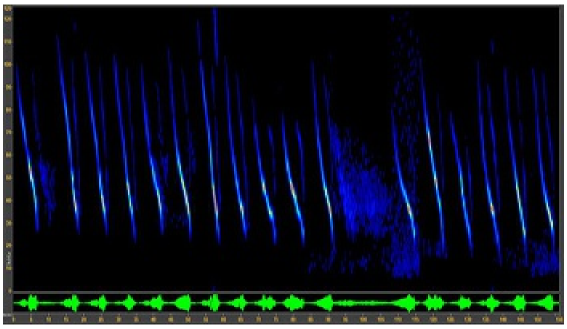

Daubenton's Bat - call duration 5.4-5.5 ms

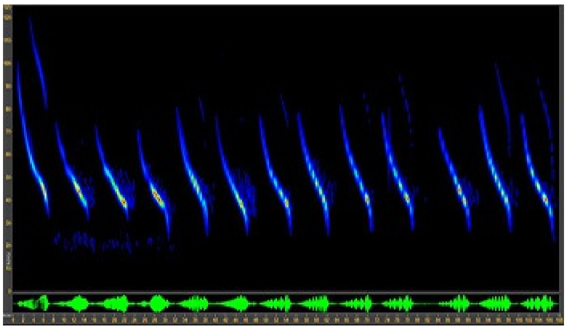

Natterer's Bat - call duration 5.4-5.5 ms

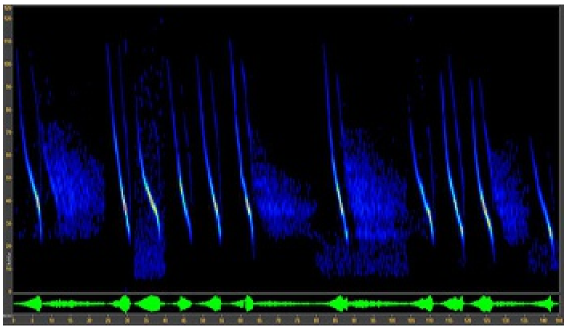

Daubenton's Bat - call duration 5.6-5.7 ms

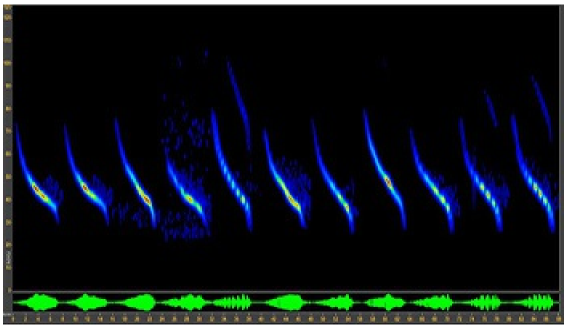

Natterer's Bat - call duration 5.6-5.7 ms

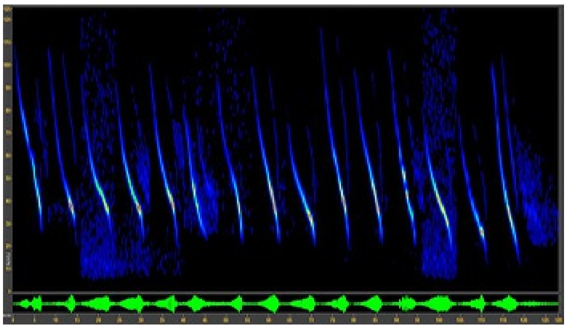

Daubenton's Bat - call duration 5.8-5.9 ms

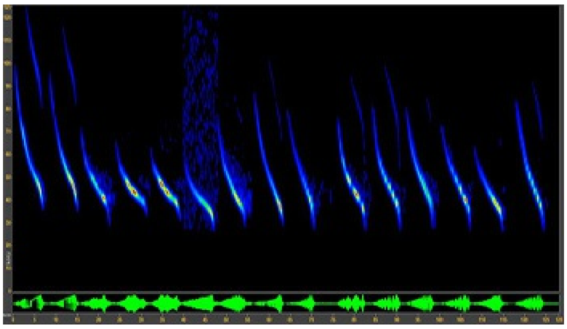

Natterer's Bat - call duration 5.8-5.9 ms

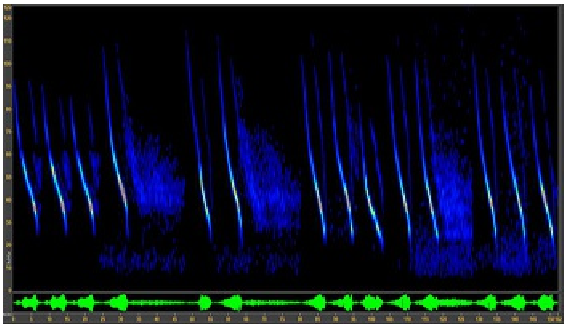

Daubenton's Bat - call duration 6.0-6.1 ms

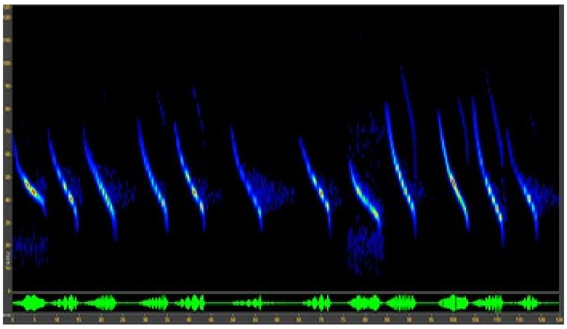

Natterer's Bat - call duration 6.0-6.1 ms

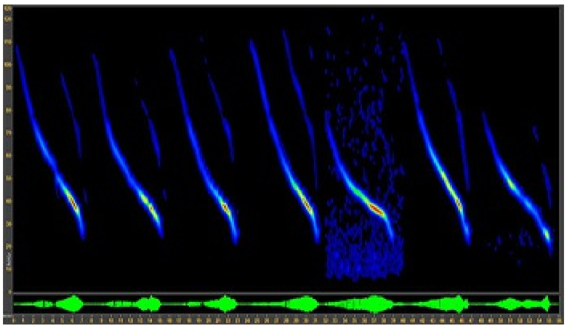

Daubenton's Bat - call duration 6.2-6.3 ms

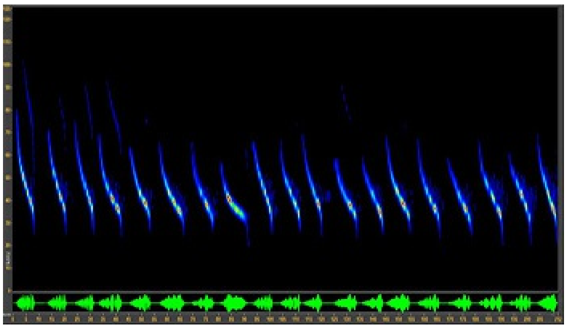

Natterer's Bat - call duration 6.2-6.3 ms

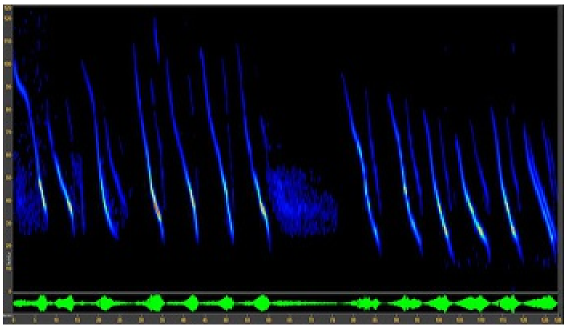

Daubenton's Bat - call duration 6.4-6.6 ms

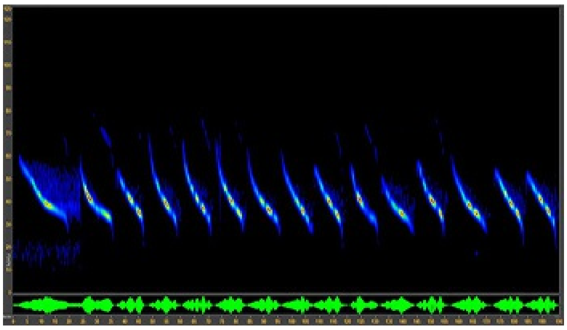

Natterer's Bat - call duration 6.4-6.6 ms


Daubenton's Bat - call duration 6.7-6.8 ms


Natterer's Bat - call duration 6.7-6.8 ms


Daubenton's Bat - call duration 6.9-9.5 ms


Natterer's Bat - call duration 6.9-9.5 ms


Daubenton's Bat - call duration 9.6-17.3 ms

Natterer's Bat - call duration 9.6-17.3 ms no examples

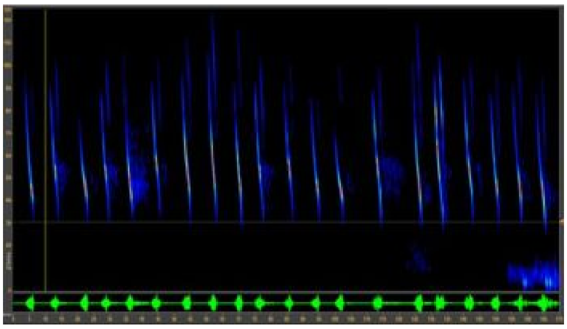
Identification appendix 2: Whiskered/Brandt's Bat *Myotis mystacinus/brandtii*

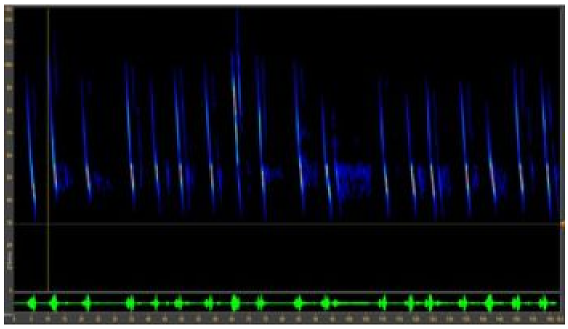
When it comes to the sound identification of bats in the genus *Myotis*, there is a common view that it is not possible to assign recordings to species, even among experienced bat workers. In the following, we would like to explain, with a recording of Whiskered Bat or Brandt's Bat, some of our thinking on how we approach an identification.

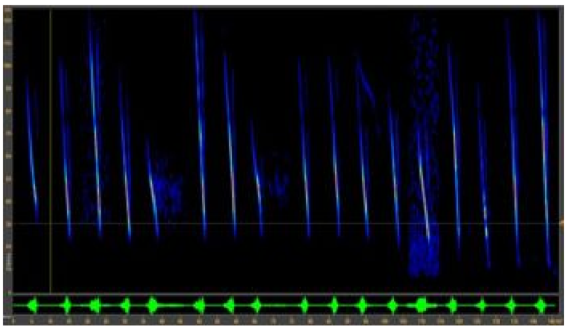
Given a *Myotis* recording, an important first consideration is the quality of the recording. Firstly, to consider whether there is significant overloading across calls that makes it difficult to determine the start and end of the calls. There is a bit of overloading in a few of the recordings of Whiskered or Brandt's Bat recordings shown in the main part of the report, but this is not extreme, and there are some good quality calls still in the sequence.

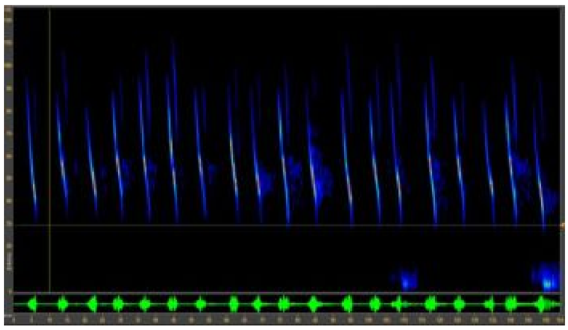
The next important consideration is to look at the ends of the calls, and to determine whether there is important attenuation of the weaker ends of the calls - in other words, whether you are missing the ends of the calls. Where there is attenuation of the calls, the apparent ends of the calls may appear to be higher in frequency than is really the case, and the start of the calls lower in frequency than is really the case. If there is important attenuation of the calls, it is often necessary to stop at this point and to not go further with an identification.

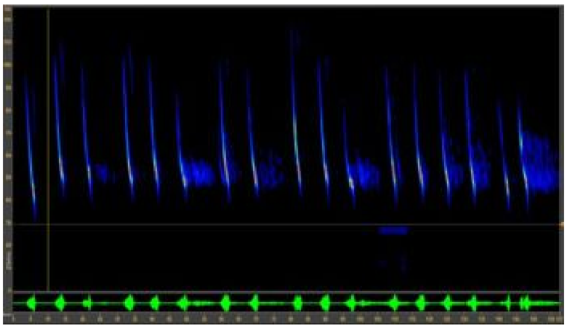
If the quality of the recordings and calls is good, we would normally expect to have a good idea of what species produced it, but it is helpful next to consider what you would expect calls of that species, given that call duration to look like, and to consider how this compares with other similar species. Just to illustrate, in the below I compare one good call from a recording of Whiskered Bat or Brandt's Bat (call shown left of the yellow vertical line in all the spectrograms below), with known calls for other *Myotis* species (compiled recordings made from known species recordings using the Sonobat Reference Compiler). Taking this approach for the recordings above, it is straightforward to see that the recordings above are well outside what you would expect for Natterer's Bat and Alcathoe bat. The difference between short duration calls of Daubenton's Bat and the presumed Whiskered / Brandt's Bat is more subtle. In Whiskered / Brandt's Bat for calls of this duration there tends to be a long and steep neck to calls and kink in the calls towards the bottom. This can be seen in Daubenton's Bat, but it is not so typical for this species, and would be usual for such calls to present across a sequence of calls without some additional clues to the real identification. The chance of seeing atypical calls is less likely again, where there is more than one recording at almost the same time of what is likely to be the same bat as seen here.


Whiskered or Brandt's Bat call (left), against known Whiskered calls (right)


Whiskered or Brandt's Bat call (left), against known Brandt's Bat calls (right)


Whiskered or Brandt's Bat call (left), against Natterer's Bat calls (right)

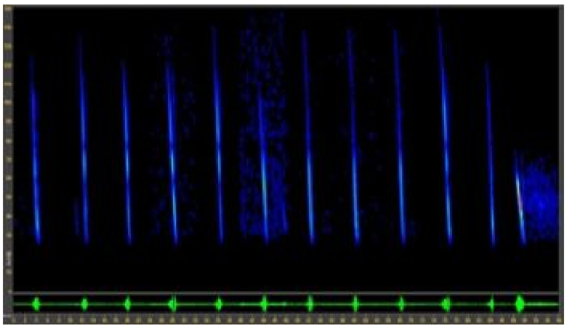

Whiskered or Brandt's Bat call (left), against known Daubenton's Bat calls (right)

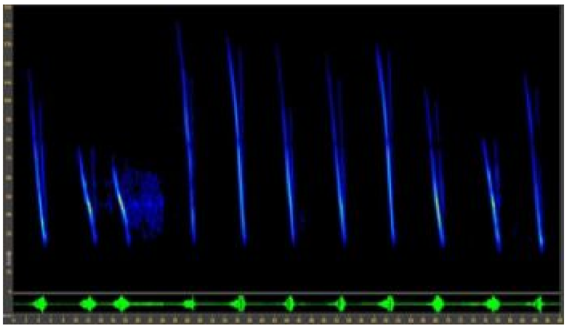


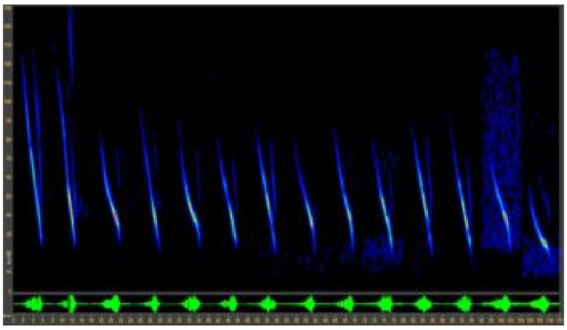
Whiskered or Brandt's Bat call (left), against known Alcathoe Bat calls (right)

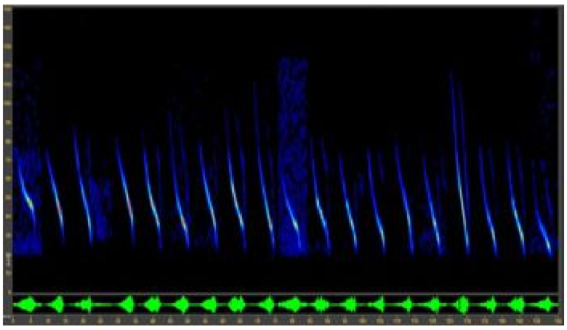
Identification appendix 3: Natterer's Bat *Myotis nattereri*

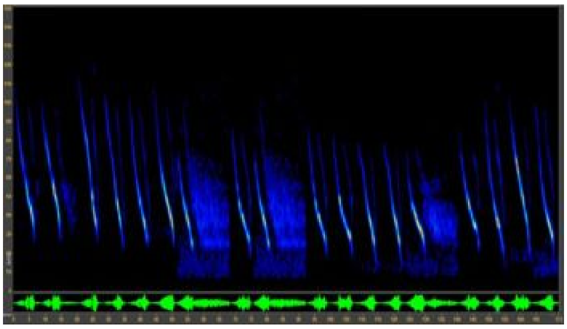
As with Whiskered and Brandt's Bat, the first consideration when looking at recordings is the quality of the recording, to consider whether the quality is good enough to try to assign the recording to species. Given a good recording, Natterer's Bat can occasionally produce atypical calls that could be mistaken for other *Myotis* species. However, such unusual calls rarely continue for long, and careful consideration of these, and in relation to neighbouring recordings where these are present to understand what is going on, should be sufficient in most cases to be able to assign these to species. In the below, we illustrate some of the range of variation in calls of Natterer's Bat from very short calls produced when flying in extreme clutter to long duration calls produced when flying in the open.

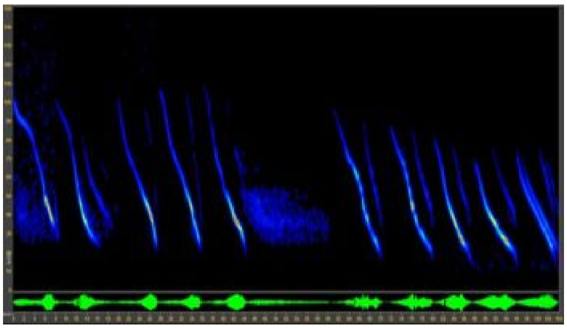

Natterer's Bat - call duration up to 1.2 ms


Natterer's Bat - call duration 2.7-2.8 ms

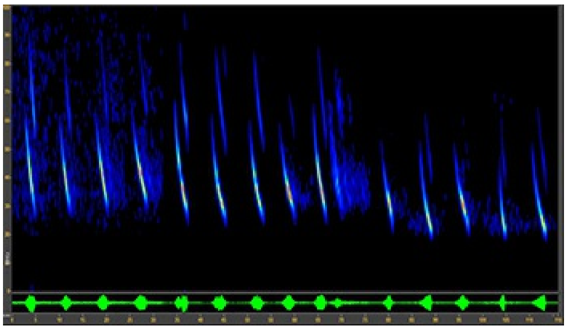

Natterer's Bat - call duration 3.9-4.0 ms

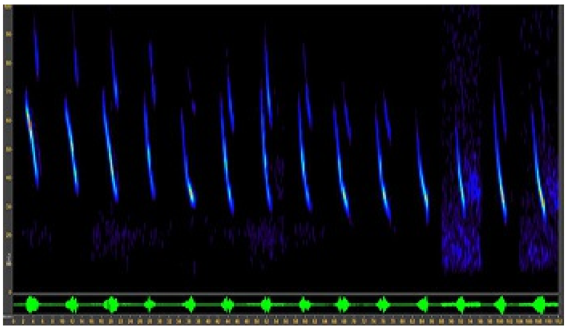

Natterer's Bat - call duration 4.9-5.0 ms

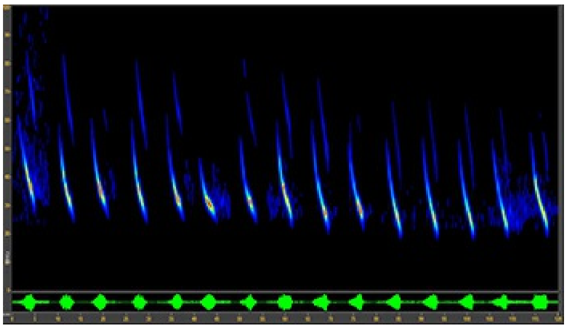

Natterer's Bat - call duration 5.9-6.0 ms

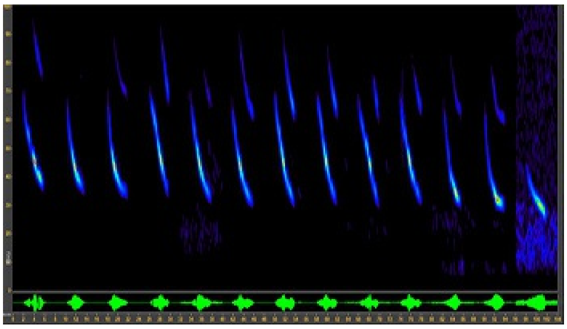

Natterer's Bat - call duration 7.1-9.4 ms

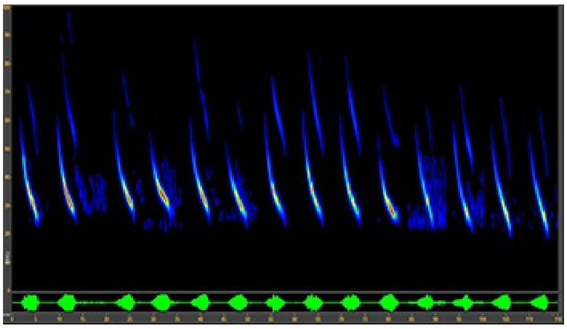
Identification appendix 4: Common Noctule *Nyctalus noctula* and Leisler's Bat *Nyctalus leisleri*

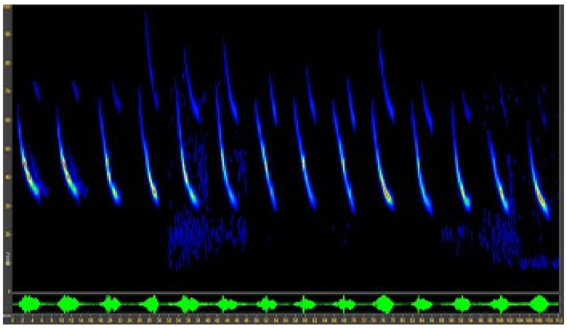

Common Noctule - call duration 1.4-3.0 ms

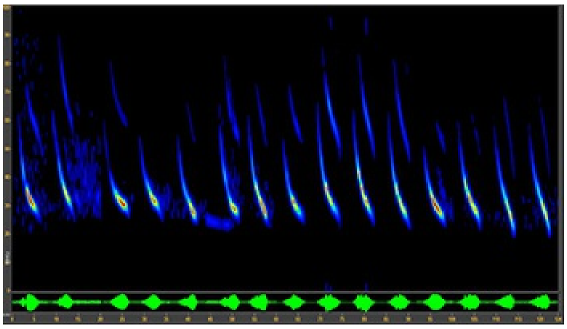

Leisler's Bat - call duration 1.4-3.0 ms

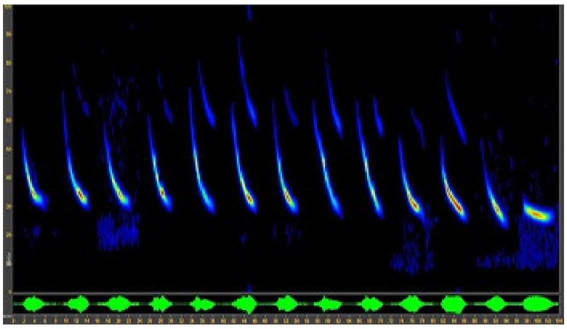

Common Noctule - call duration 3.1-3.7 ms

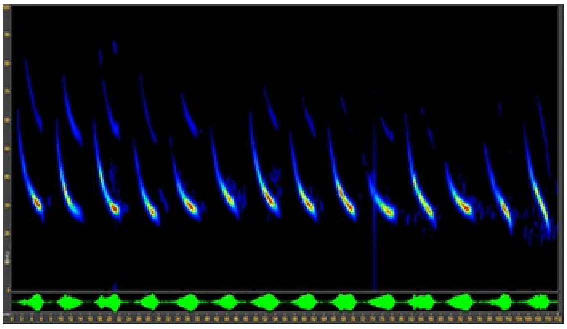

Leisler's Bat - call duration 3.1-3.7 ms

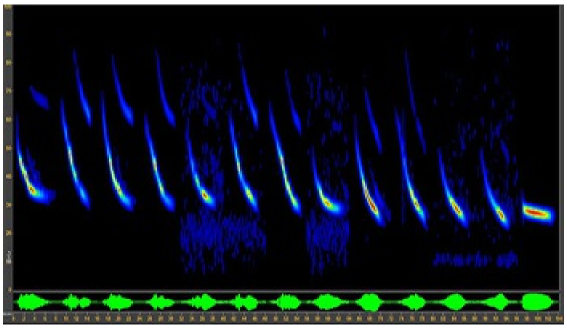

Common Noctule - call duration 3.8-4.3 ms

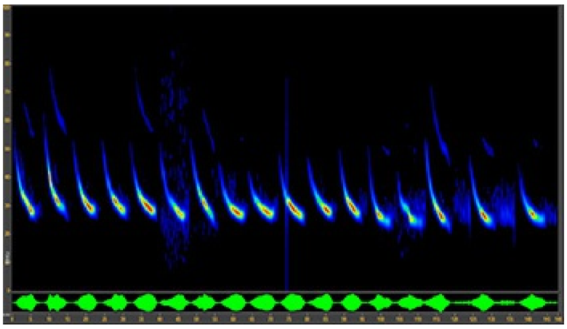

Leisler's Bat - call duration 3.8-4.3 ms

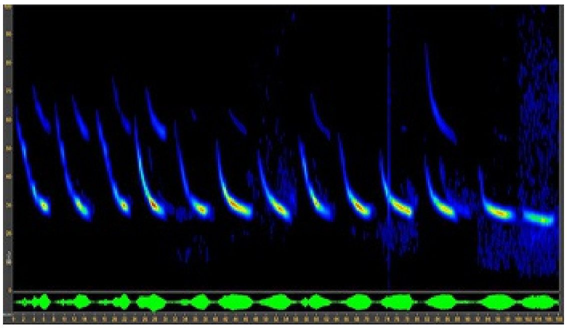

Common Noctule - call duration 4.4-4.9 ms

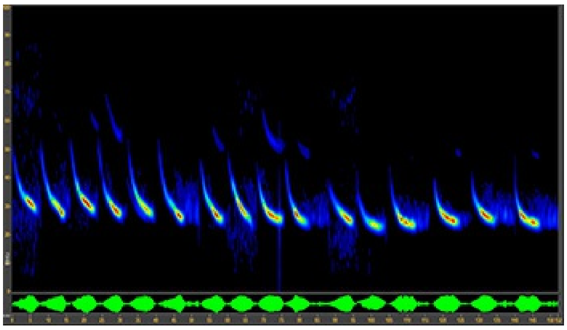

Leisler's Bat - call duration 4.4-4.9 ms

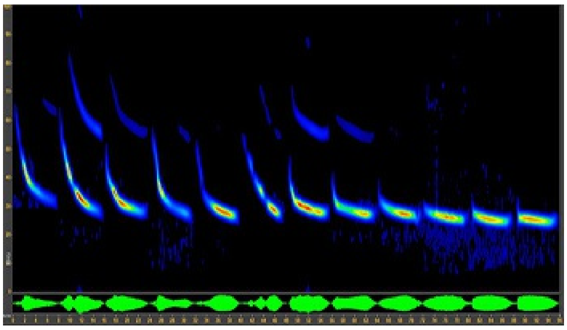

Common Noctule - call duration 5.0-5.9 ms

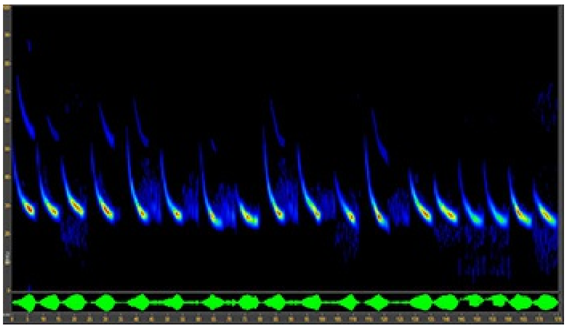

Leisler's Bat - call duration 5.0-5.9 ms

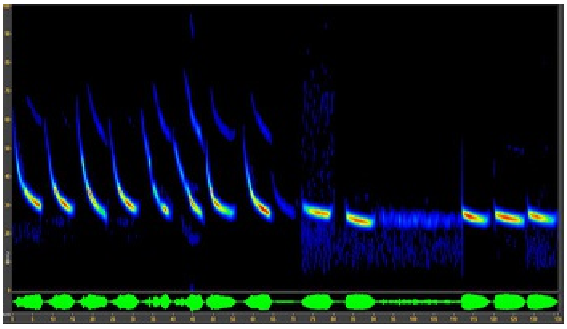

Common Noctule - call duration 6.0-6.8 ms

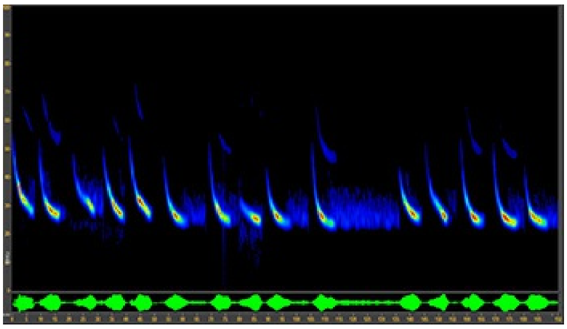

Leisler's Bat - call duration 6.0-6.8 ms

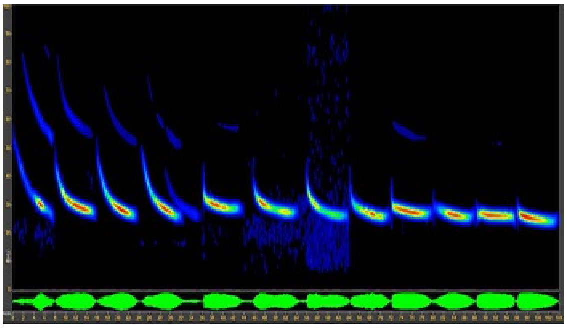

Common Noctule - call duration 6.9-7.2 ms

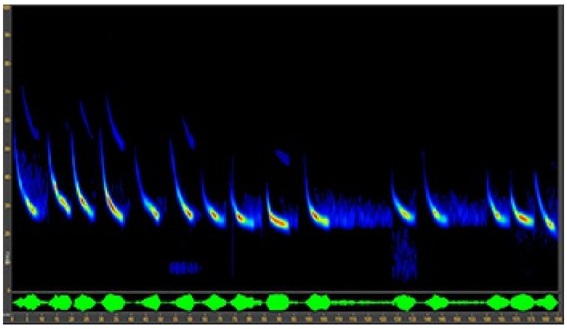

Leisler's Bat - call duration 6.9-7.2 ms

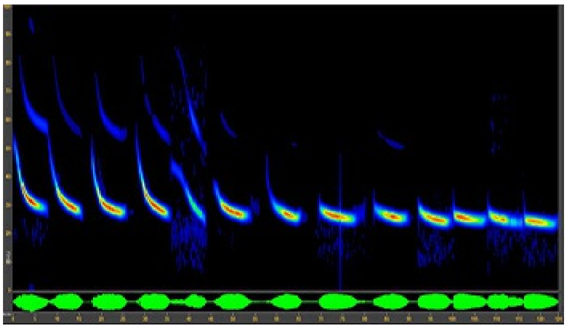

Common Noctule - call duration 7.3-7.6 ms

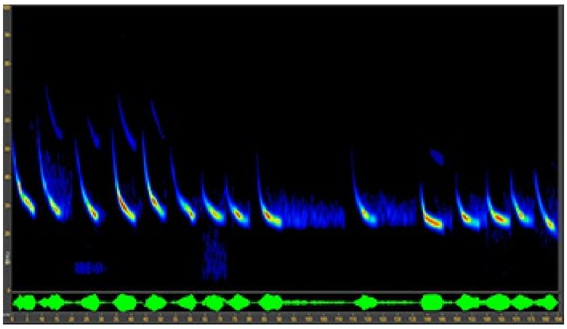

Leisler's Bat - call duration 7.3-7.6 ms

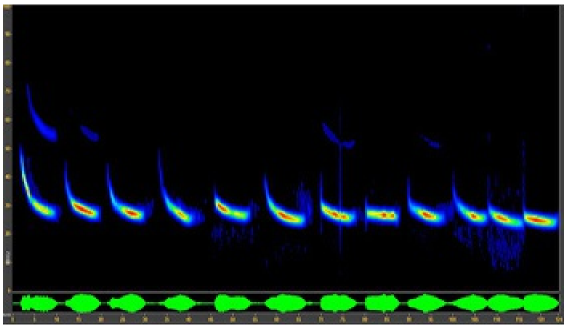

Common Noctule - call duration 7.7-7.8 ms

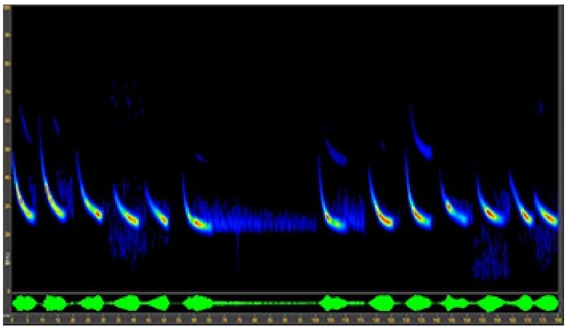

Leisler's Bat - call duration 7.7-7.8 ms

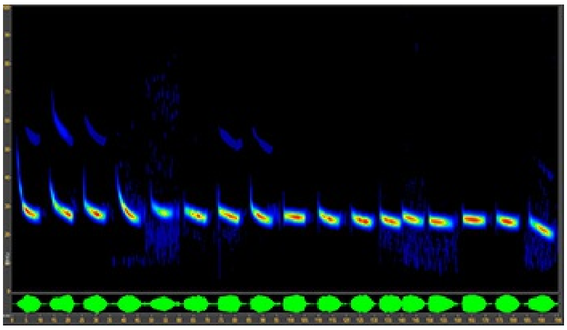

Common Noctule - call duration 7.9-8.0 ms

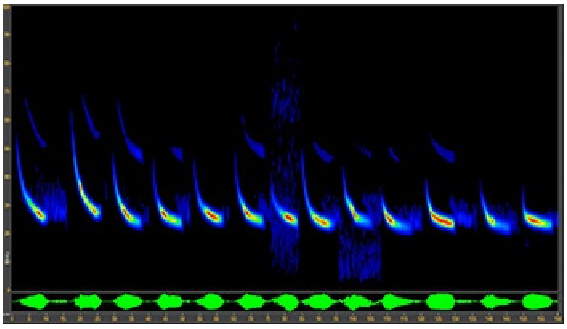

Leisler's Bat - call duration 7.9-8.0 ms

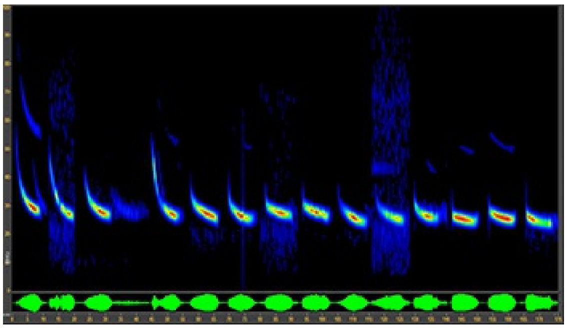

Common Noctule - call duration 8.1-8.3 ms

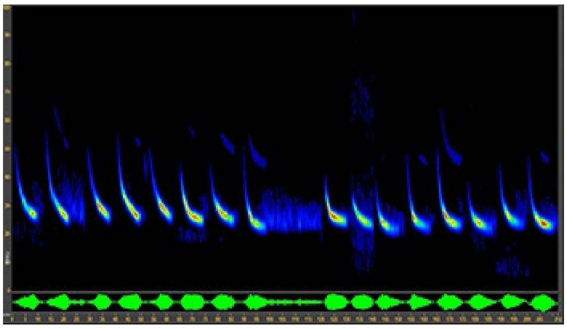

Leisler's Bat - call duration 8.1-8.3 ms

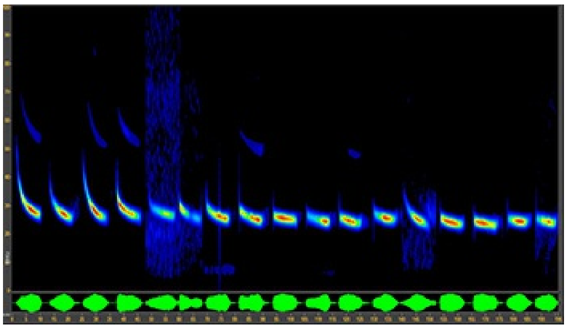

Common Noctule - call duration 8.4-8.5 ms

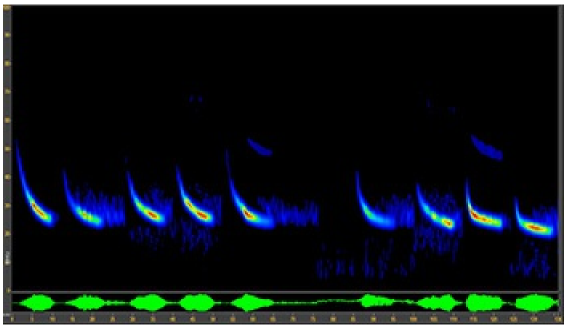

Leisler's Bat - call duration 8.4-8.5 ms

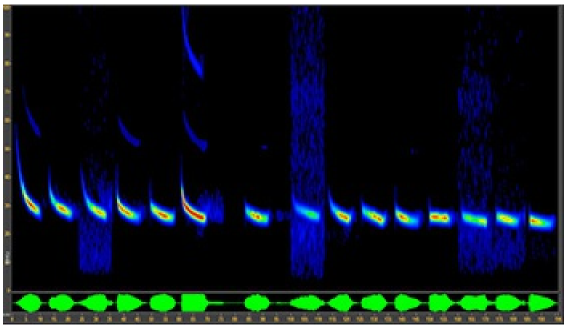

Common Noctule - call duration 8.6-8.7 ms

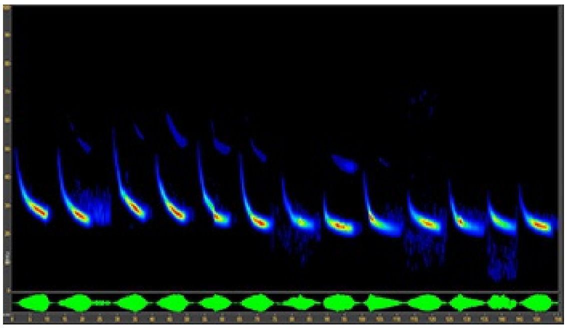

Leisler's Bat - call duration 8.6-8.7 ms

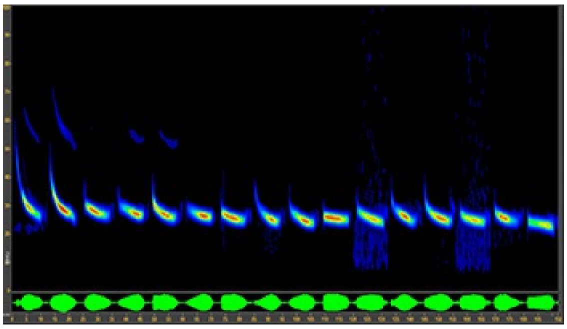

Common Noctule - call duration 8.8-8.9 ms

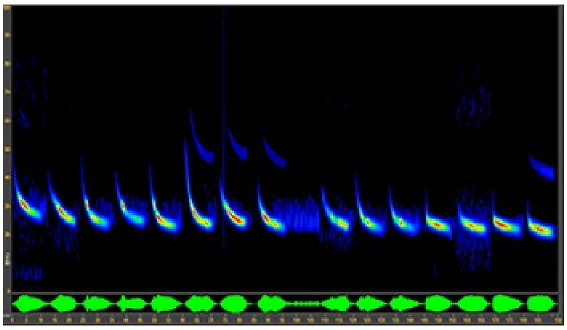

Leisler's Bat - call duration 8.8-8.9 ms

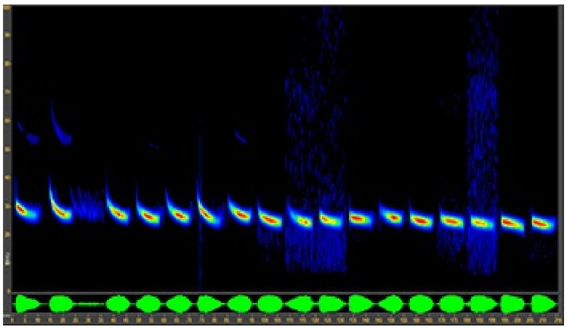

Common Noctule - call duration 9.0-9.1 ms

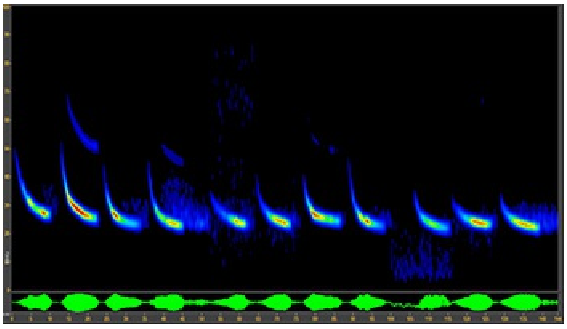

Leisler's Bat - call duration 9.0-9.1 ms

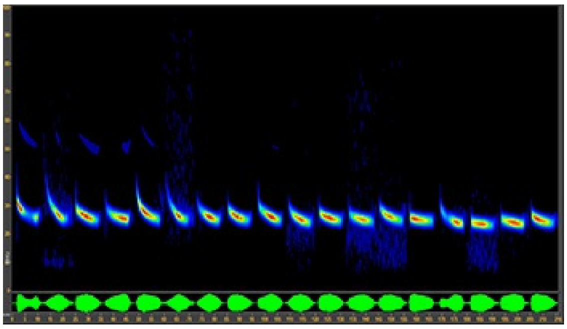

Common Noctule - call duration 9.2-9.3 ms

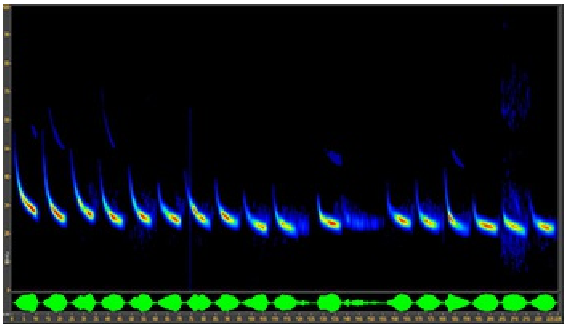

Leisler's Bat - call duration 9.2-9.3 ms

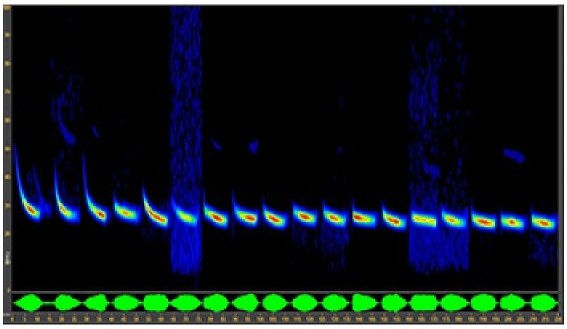

Common Noctule - call duration 9.4-9.5 ms

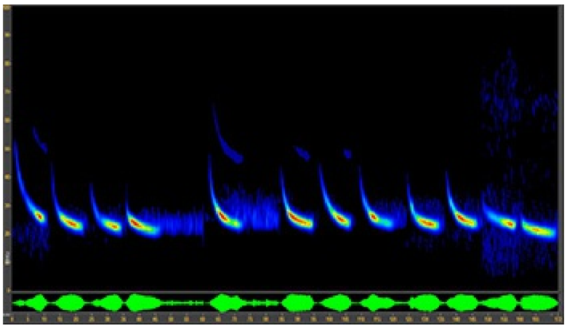

Leisler's Bat - call duration 9.4-9.5 ms

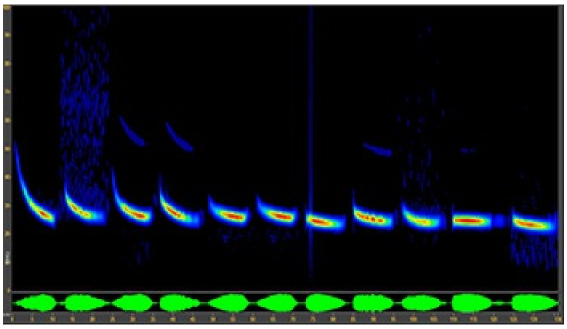

Common Noctule - call duration 9.6-9.7 ms

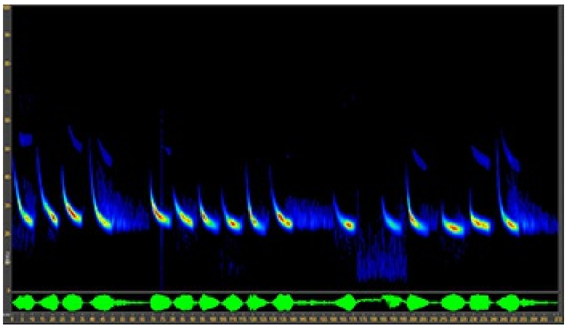

Leisler's Bat - call duration 9.6-9.7 ms

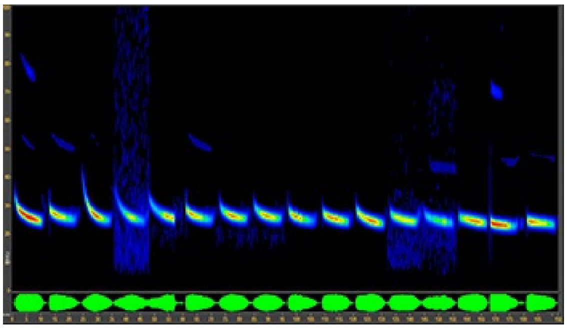

Common Noctule - call duration 9.8-9.9 ms

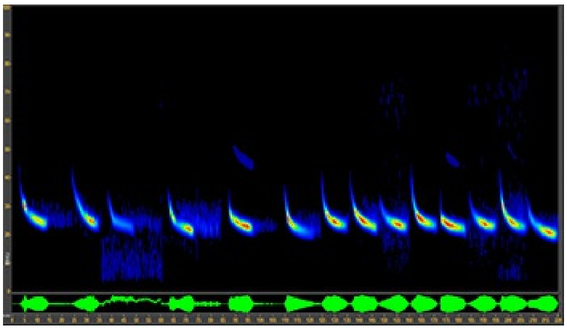

Leisler's Bat - call duration 9.8-9.9 ms

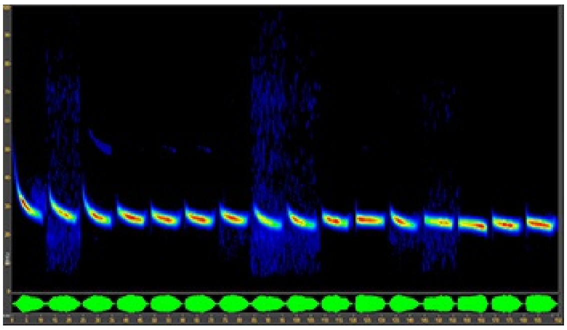

Common Noctule - call duration 10.0-10.1 ms


Leisler's Bat - call duration 10.0-10.1 ms


Common Noctule - call duration 10.2-10.3 ms


Leisler's Bat - call duration 10.2-10.3 ms


Common Noctule - call duration 10.4-10.5 ms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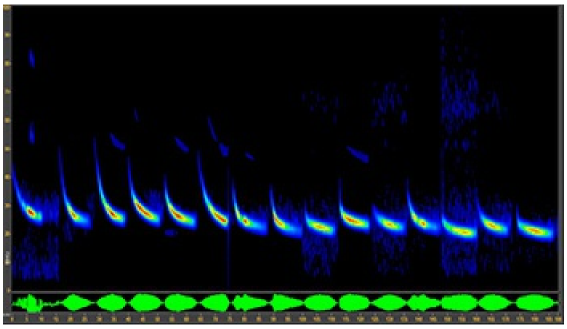
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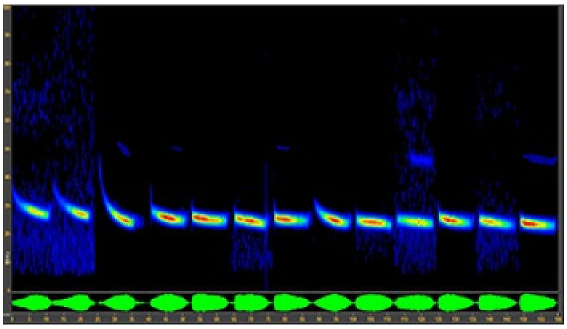
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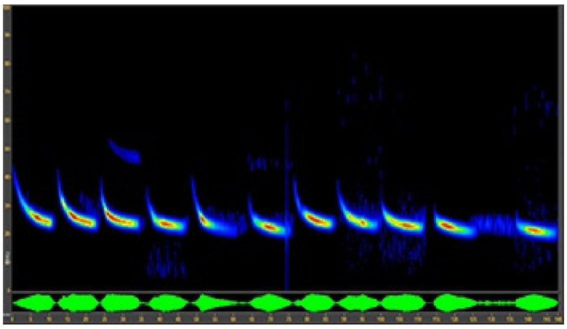
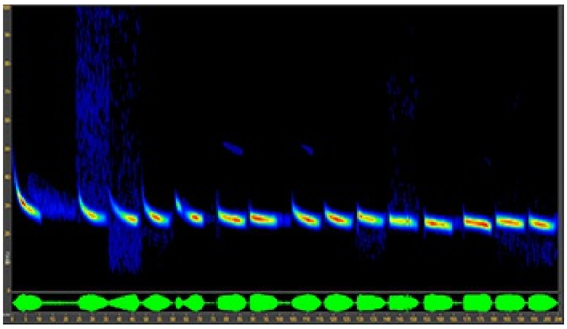

Common Noctule - call duration 10.8-10.9 ms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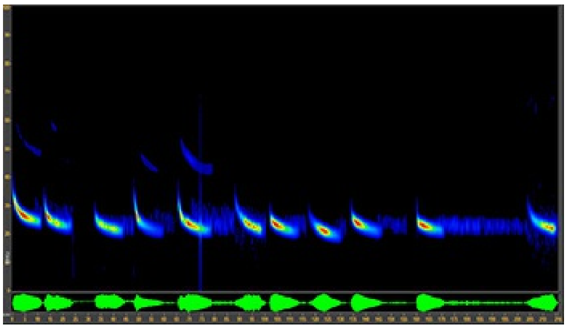
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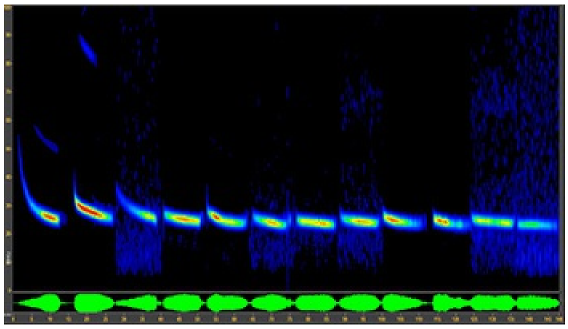
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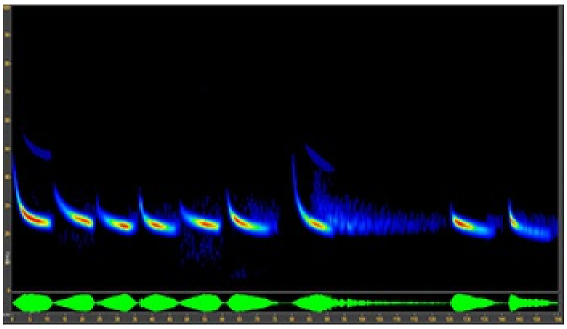
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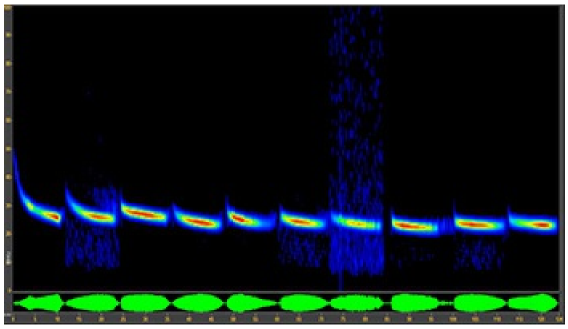
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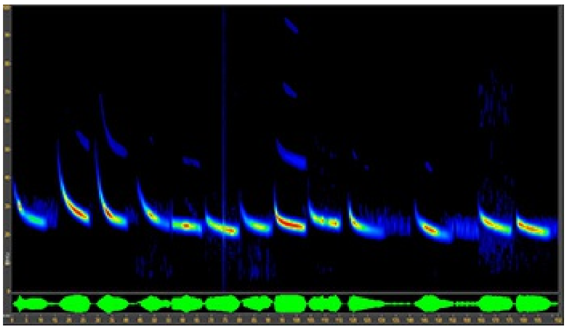
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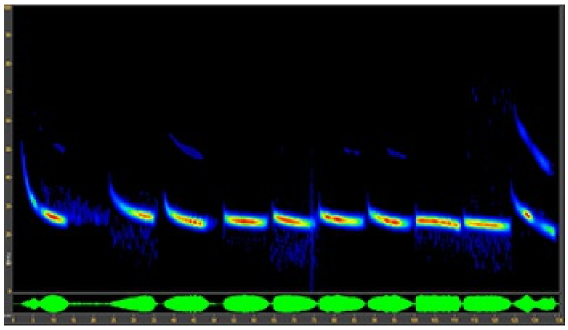
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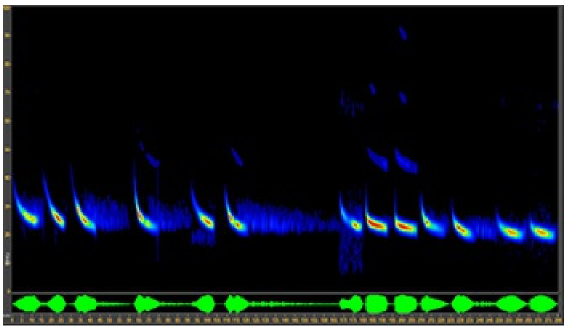
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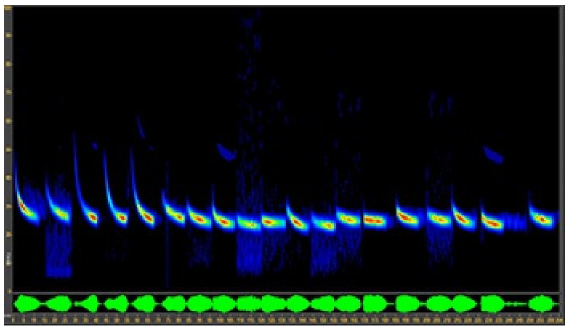
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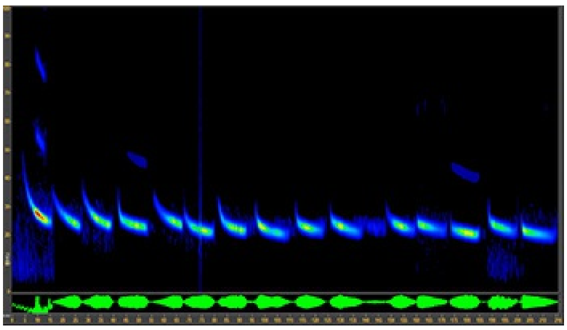
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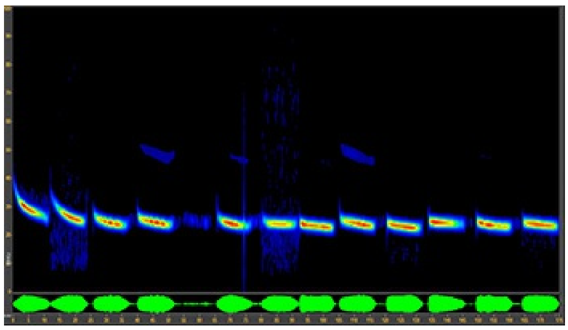
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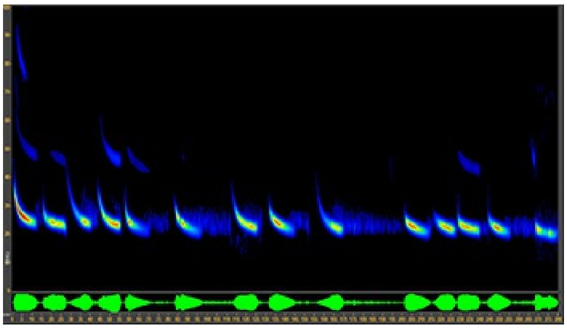
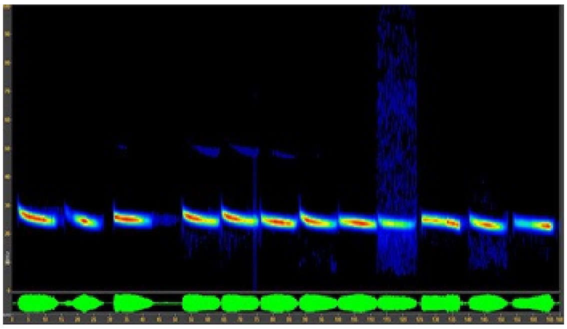

Common Noctule - call duration 12.0-12.2 ms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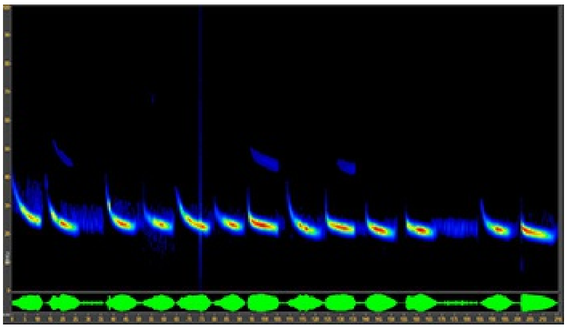
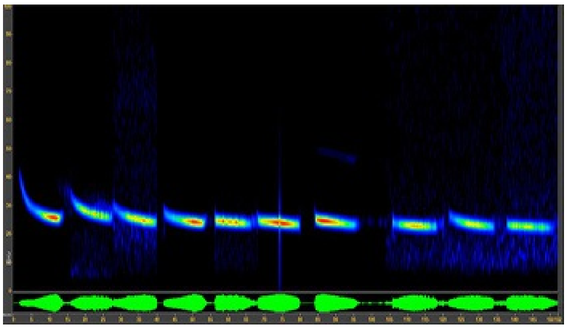
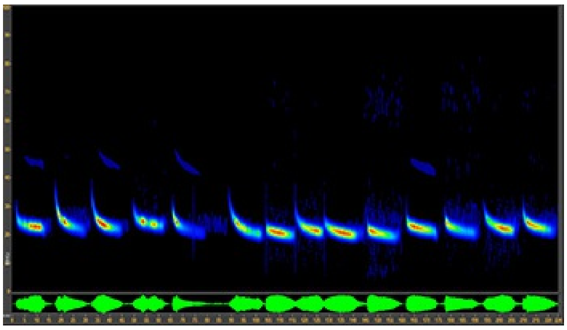
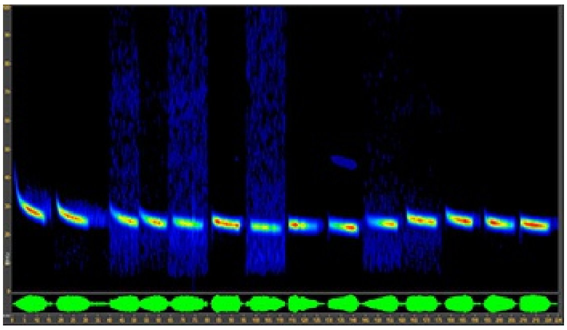
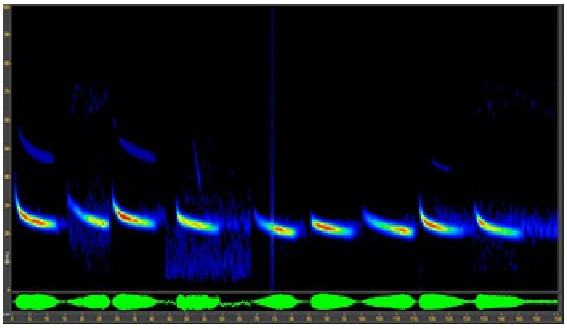

Common Noctule - call duration 12.3-12.4 ms


Leisler's Bat - call duration 12.3-12.4 ms


Common Noctule - call duration 12.5-12.7 ms


Leisler's Bat - call duration 12.5-12.7 ms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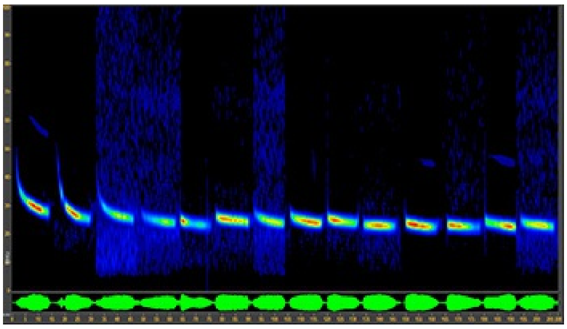
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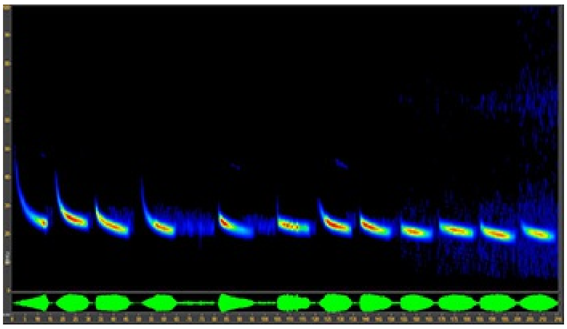
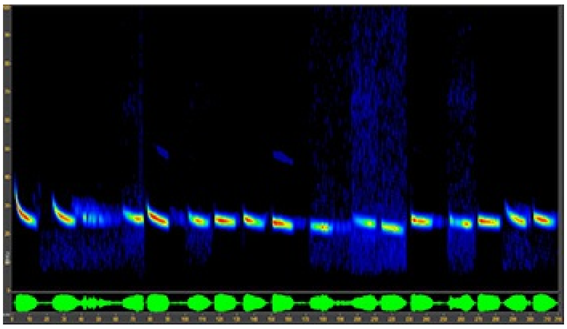

Common Noctule - call duration 13.0-13.1 ms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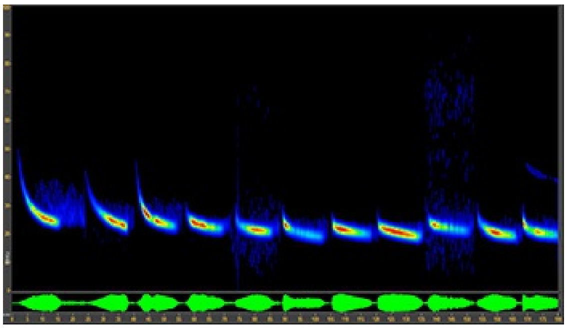
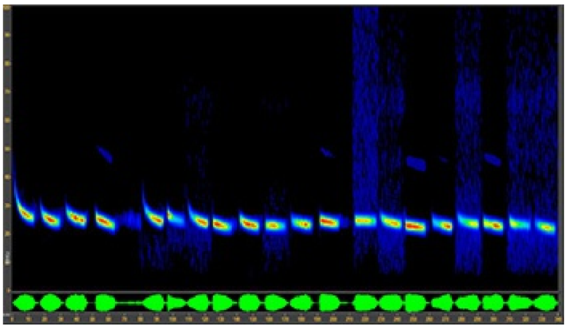

Common Noctule - call duration 13.2-13.3 ms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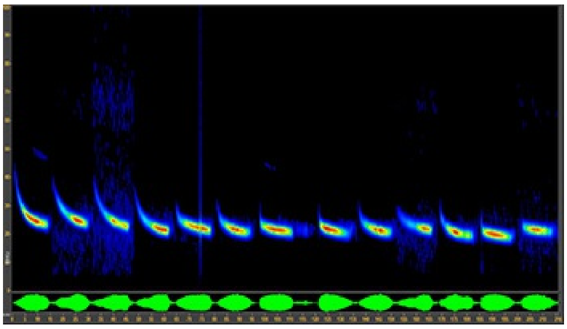
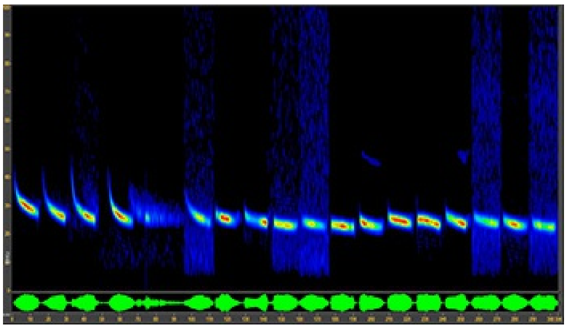

Common Noctule - call duration 13.4-13.5 ms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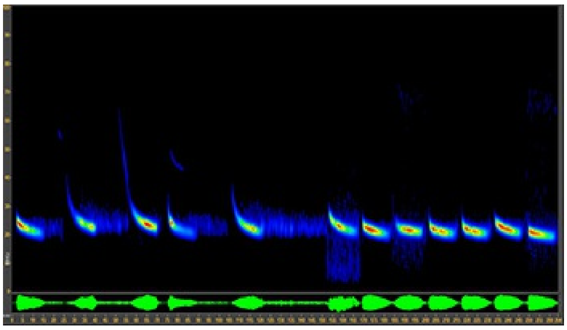
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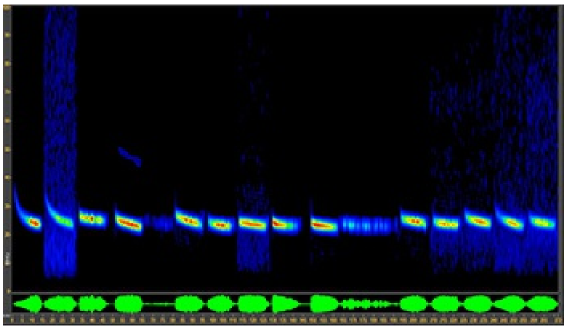
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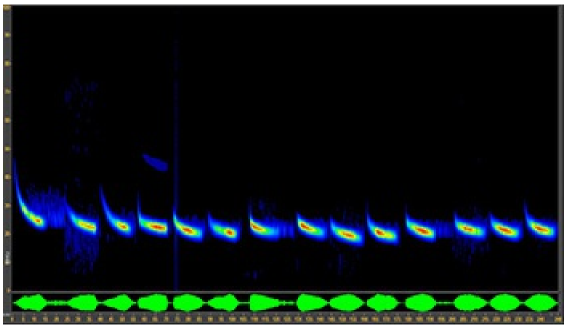
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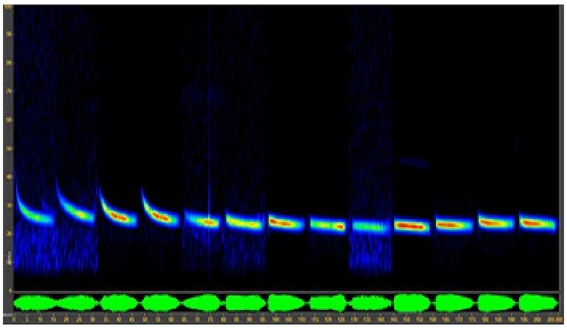
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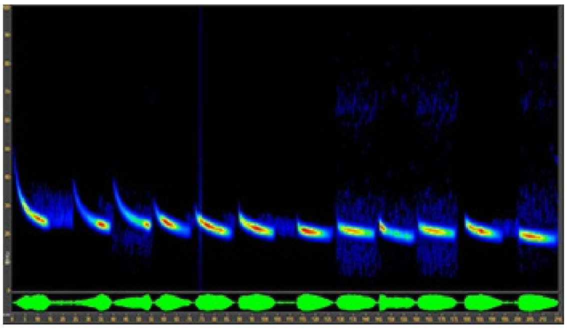
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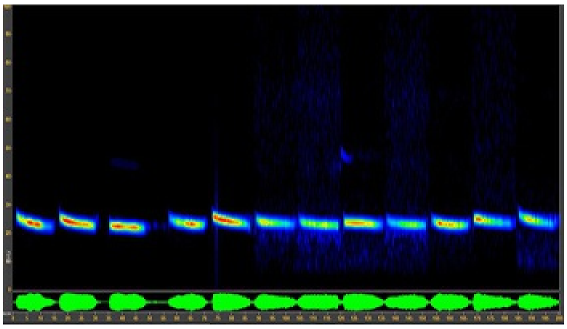
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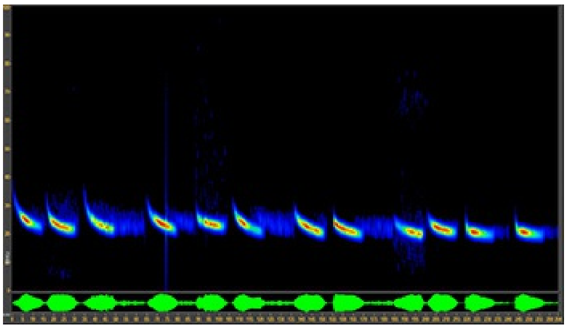
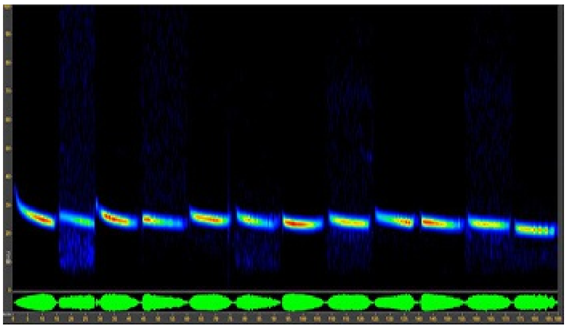
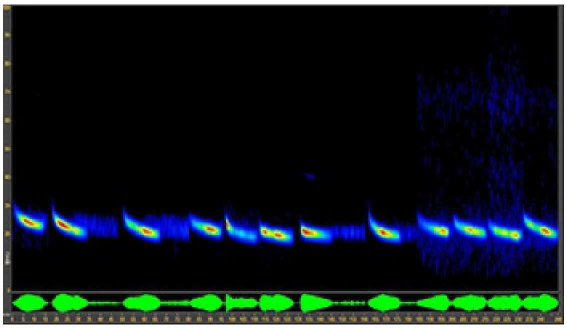


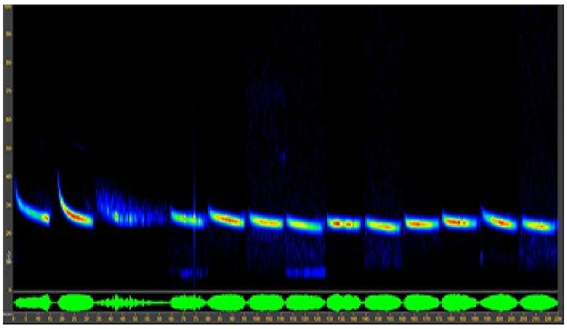
Common Noctule - call duration 14.4-14.5 ms



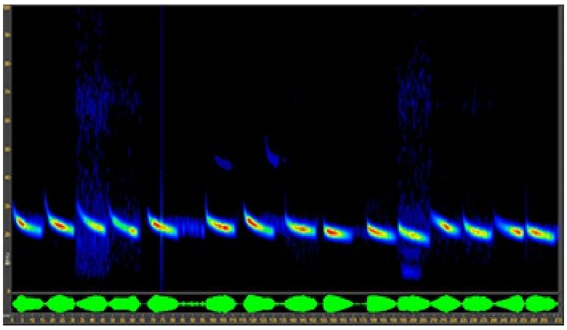
Leisler's Bat - call duration 14.4-14.5 ms



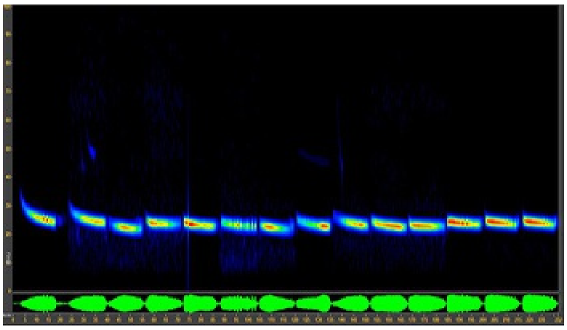
Common Noctule - call duration 14.6-14.8 ms



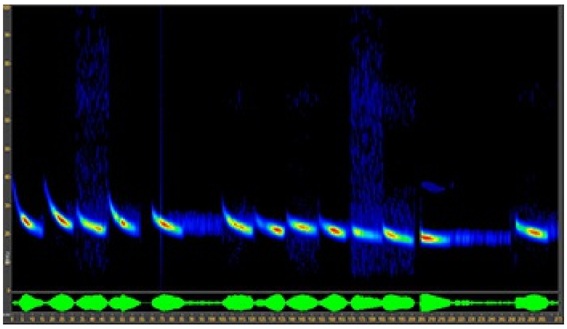
Leisler's Bat - call duration 14.6-14.8 ms



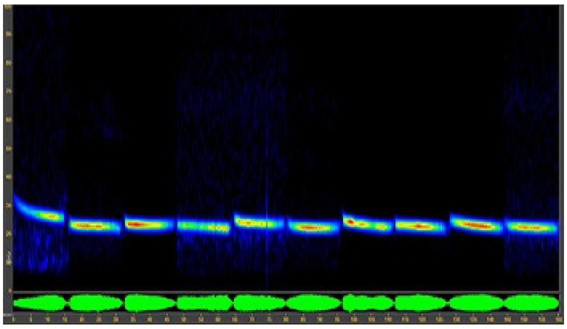
Common Noctule - call duration 14.9-15.1 ms



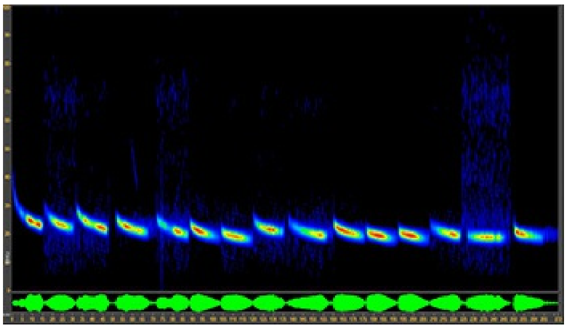
Leisler's Bat - call duration 14.9-15.1 ms



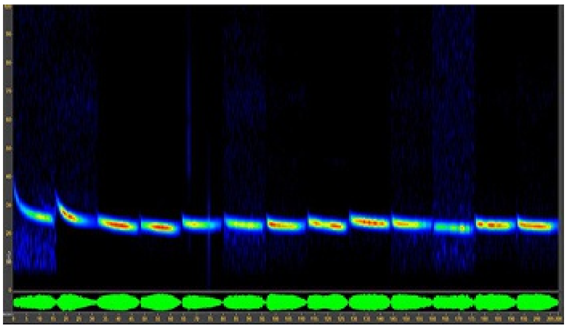
Common Noctule - call duration 15.2-15.3 ms



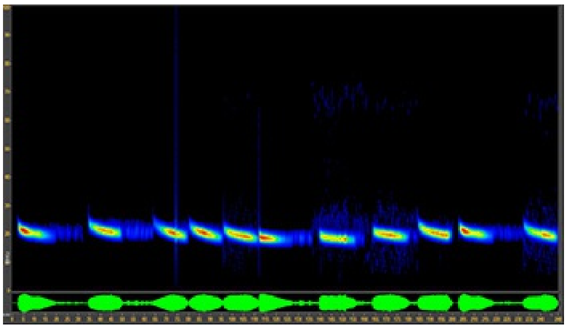
Leisler's Bat - call duration 15.2-15.3 ms

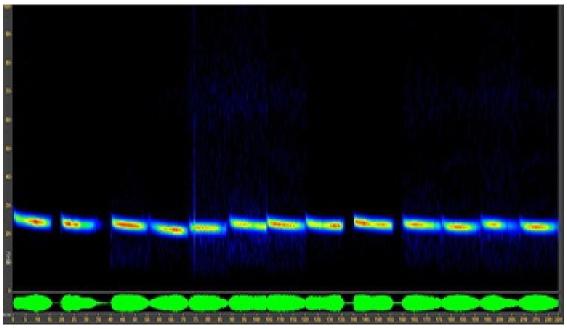


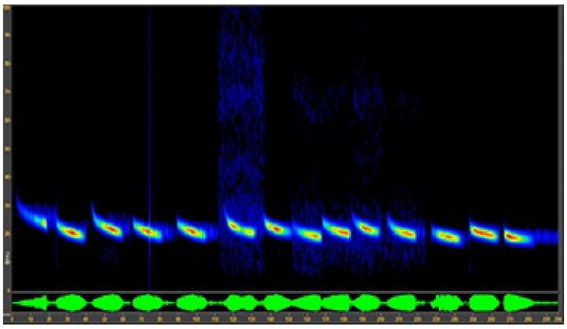
Common Noctule - call duration 15.4-15.7 ms

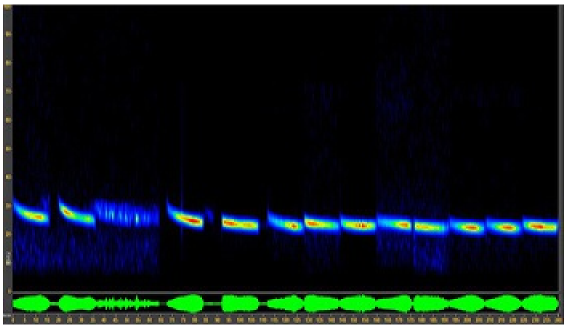


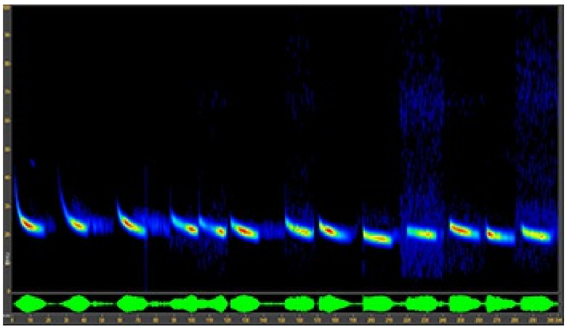
Leisler's Bat - call duration 15.4-15.7 ms

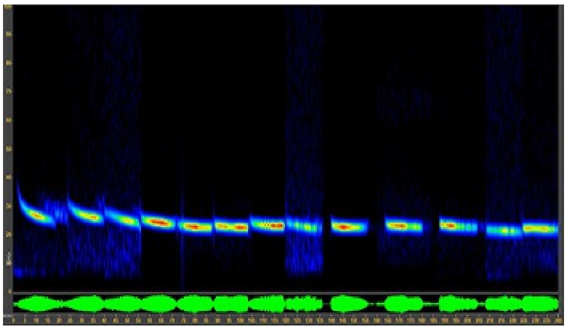

Common Noctule - call duration 15.8-16.0 ms

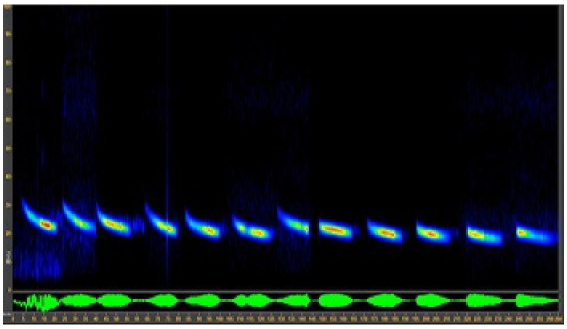

Leisler's Bat - call duration 15.8-16.0 ms

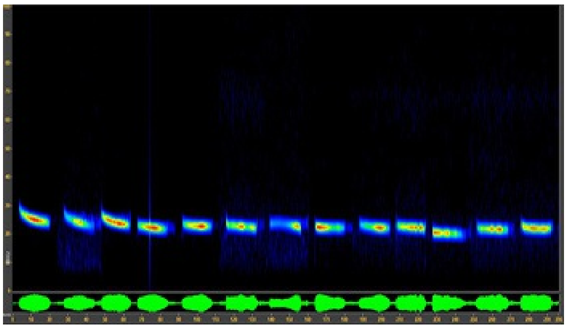

Common Noctule - call duration 16.1-16.3 ms

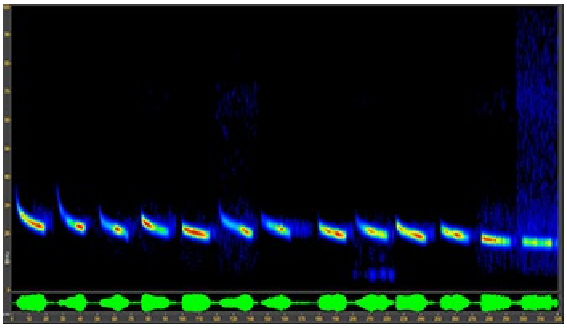

Leisler's Bat - call duration 16.1-16.3 ms

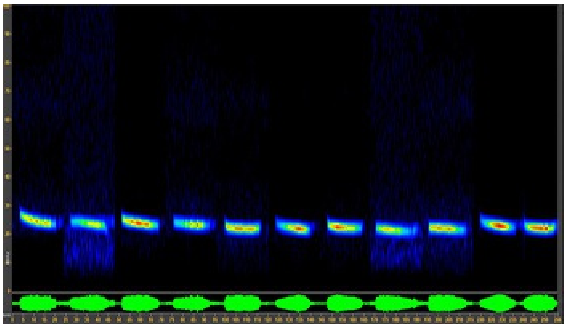

Common Noctule - call duration 16.4-16.6 ms

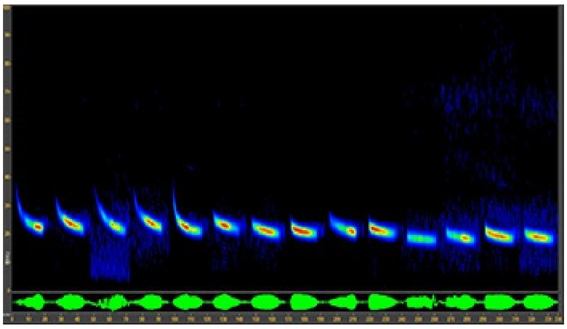

Leisler's Bat - call duration 16.4-16.6 ms

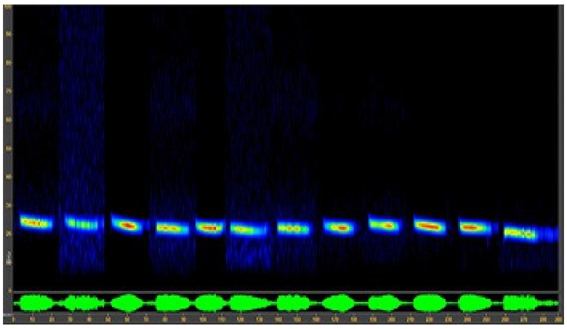

Common Noctule - call duration 16.7-17.0 ms

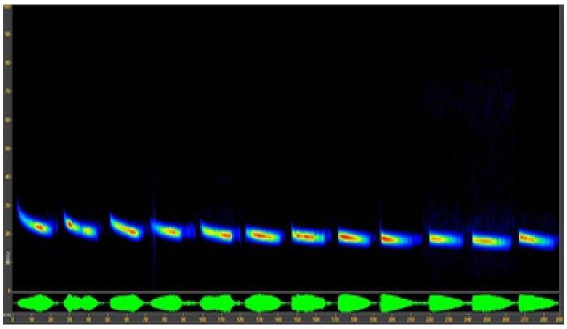

Leisler's Bat - call duration 16.7-17.0 ms

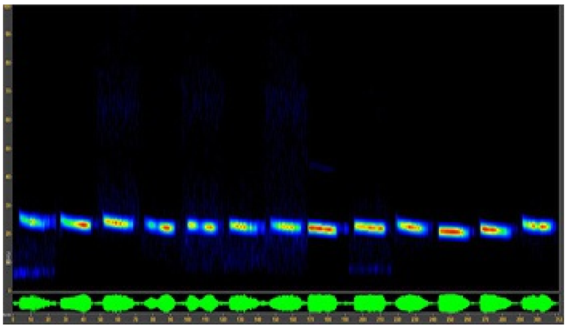

Common Noctule - call duration 17.1-17.2 ms

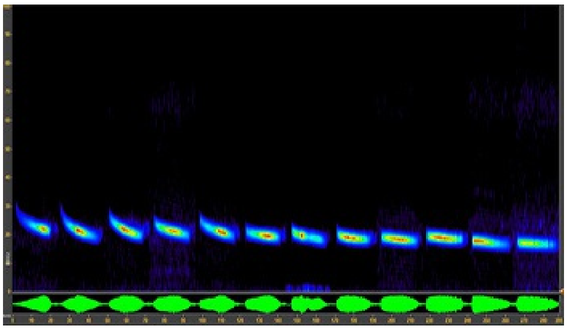

Leisler's Bat - call duration 17.1-17.2 ms

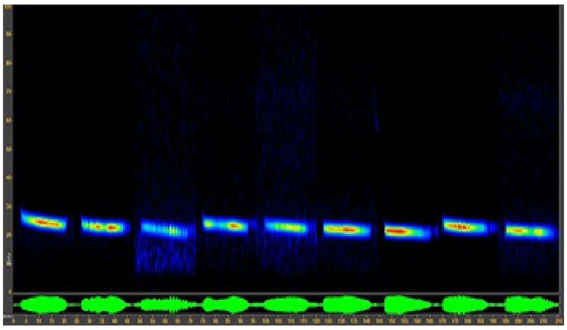

Common Noctule - call duration 17.3-17.4 ms

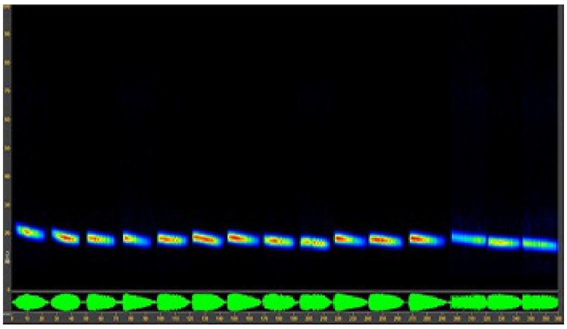

Leisler's Bat - call duration 17.3-17.4 ms

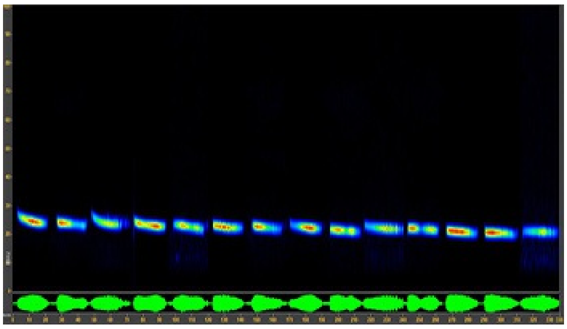

Common Noctule - call duration 17.5-18.2 ms

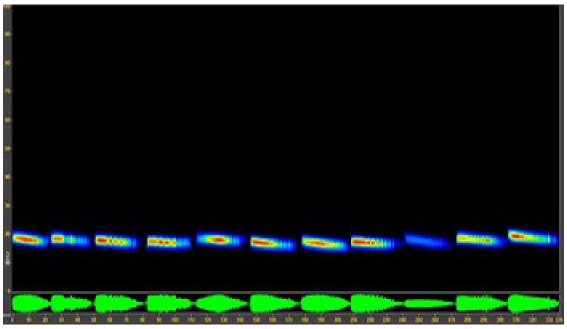

Leisler's Bat - call duration 17.5-18.2 ms


Common Noctule - call duration 18.3-18.7 ms


Leisler's Bat - call duration 18.3-18.7 ms


Common Noctule - call duration 18.8-24.0 ms


Leisler's Bat - call duration 18.8-24.0 ms


Common Noctule - call duration 24.1-31.7 ms

Leisler's Bat - no examples for this call duration

Images: Common Pipistrelle, by John Black; Wood Mouse, by Moss Taylor; Natterer's Bat, by C. Damant, Bernwood Ecology; Green silver-lines, by Andy Musgrove.
Cover image: Brown Long-eared Bat, by C. Damant, Bernwood Ecology.

Bat distribution and activity in the Skell Valley catchment, 2024 Report

This report presents the main findings from survey work delivered using passive acoustic monitoring devices deployed across the Skell Valley catchment. Through the surveys that we support we aim to improve knowledge and understanding of species distribution and activity, covering a range of taxonomic groups, including birds, bats, small terrestrial mammals and insects. Through the approach we provide robust datasets that can be used to inform better decision-making processes.

The use of acoustic monitoring can be particularly useful for species that are rare or unexpected in the survey area, or that are traditionally regarded as too difficult to identify (such as bats in the genera *Myotis* or *Nyctalus*). Where such species are recorded, we provide additional information to support their identification, inspiring a culture of critical thinking and the use of emerging technologies to improve the current knowledge base.

Newson, S.E. & Crisp, G. (2024). Bat distribution and activity in the Skell Valley catchment, 2024 Report. *BTO Research Report* **776**, BTO, Thetford, UK.

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