BTO RESEARCH REPORT 775

Ryevitalise – Bats and Ancient Trees 2020–2024 Report

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BTO Birds Science People

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SUMMARY

Background Working with a network of volunteers, static acoustic bat detectors were deployed over five survey seasons, 2020-2024, to provide bat data for the Ryevitalise Landscape Partnership Scheme area of the North York Moors National Park. This report provides an overview of the survey coverage and results from the project.

Coverage Between 2020 and 2024, 406 different locations across the Ryevitalise Landscape Partnership Scheme area were surveyed. Recording was undertaken on a minimum of 535 different nights mainly between May and the end of September each year, amounting to a total of 1,829 nights of recording effort across sites over the five survey seasons. Sound recordings were uploaded by volunteers or National Park 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 each survey season, a copy of the recordings was pulled back and manual auditing of the results / recordings carried out.

Results Overall, 2,210,993 recordings were collected over the five years of the project which, following analyses and validation, were found to include 1,235,773 bat recordings, and 1,066 small terrestrial mammal recordings. Bush-crickets and 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 10 bat species, 4 small mammal species, 3 species of bush-cricket, and 2 audible moth species. Through this project, we have significantly improved our understanding of the status of all species of bats across the Ryevitalise Landscape Partnership area, 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 Ryevitalise Bat Survey

The Ryevitalise Bat Survey ran over five survey seasons, from 2020 to 2024, with the main aim of documenting the distribution and activity of the different bat species that occur in the Ryevitalise Landscape Partnership Scheme area of the North York Moors National Park. Using a citizen science-based approach, over 25 volunteers took part in the project. Volunteers reserved a bat detector from the Sutton Bank National Park Centre, and were asked to place the detector in a location agreed by the landowner for at least 4 consecutive nights. On completion of the survey they, or staff at the National Park, 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. Over the five survey seasons, the presence of at least 10 bat species were confirmed. In 2024, we extended the results to identify social calls for a broader range of bat species, and feeding buzzes where this was possible 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 Ryevitalise Landscape Partnership Scheme area of the North York Moors National Park, and within this, the relative importance of different areas.

In addition to bats, small mammals, bush crickets and two species of moth that emit ultrasound which can be recorded as 'by-catch' during the bat surveys were also identified. Bush-crickets have been extending their range northwards into the North York Moors National Park in recent years, and were represented by Long-winged Conehead *Conocephalus fuscus* from 2022, Roesel's Bush-cricket *Roeseliana roeselii* from 2023, and Speckled Bush-cricket *Leptophyes punctatissima* in 2024. Two audible moth species Green Silver-lines *Pseudoips prasinana* and Bird Cherry Ermine *Yponomeuta evonymella* were also confirmed. 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 more than half of the terrestrial mammals that occur in North York Moors National Park. They are a key indicator of the environment, where it is important to establish baselines for key biodiversity groups to provide the National Park, 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, the Ryevitalise Bat Survey 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 throughout the year.

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 over five survey seasons, to provide extensive data for bats for the Ryevitalise Landscape Partnership Scheme area.

2. AIMS AND OBJECTIVES

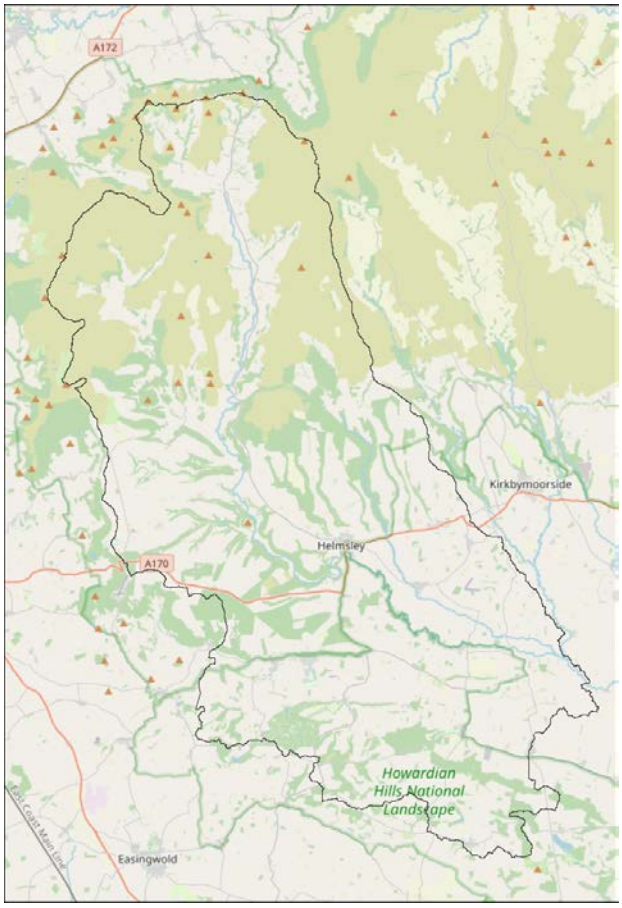
The Ryevitalise - Bats and Ancient Trees project capitalises on the interest and enthusiasm of volunteers to participate in biodiversity monitoring to systematically collect bat distribution and activity data across the Ryevitalise Landscape Partnership Scheme area, through a project that has ran over five survey seasons. This has resulted in a robust dataset, which has increased knowledge and understanding of bat distribution and activity across the Ryevitalise Landscape Partnership Scheme area.

Whilst the focus of this work is bats, results for small terrestrial mammals, bush-crickets and 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 across the five years of the project.

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

- Improve our understanding of the status, distribution and timing of occurrence of bats, bush-crickets if present and small mammal species that occur in the Ryevitalise Landscape Partnership Scheme area.
- 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.
- 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 Ryevitalise Landscape Partnership Scheme area.



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 Ryevitalise Landscape Partnership Scheme area 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 SM4Bat FS), 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 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 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 mainly ran from the beginning of May to the end of September in each year, but with a small amount of recording outside this period. A long survey season covers the main period of bat activity, and maximises use of the equipment during the year. However, survey effort was severely constrained in 2020, and during the first half of the 2021 season due to coronavirus lockdowns and restrictions.

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 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 in each year. For bush-crickets and 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.

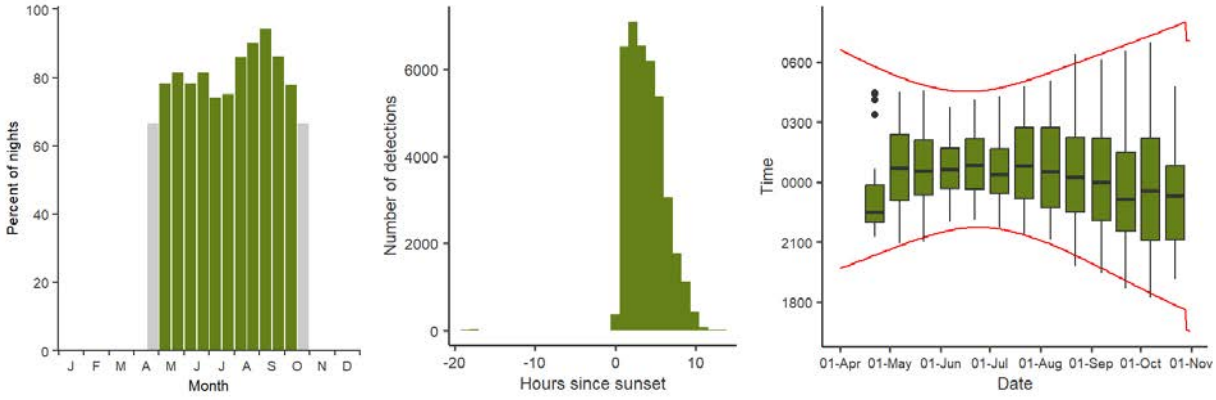
Verification of species identification was carried out through the manual checking of spectrograms using software SonoBat (http://sonobat.com/) which was used as an independent check of the original species identities assigned by pipeline. The spectrograms shown in this report, were also produced using 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 bush-crickets and audible moths, the results focus instead on species presence.

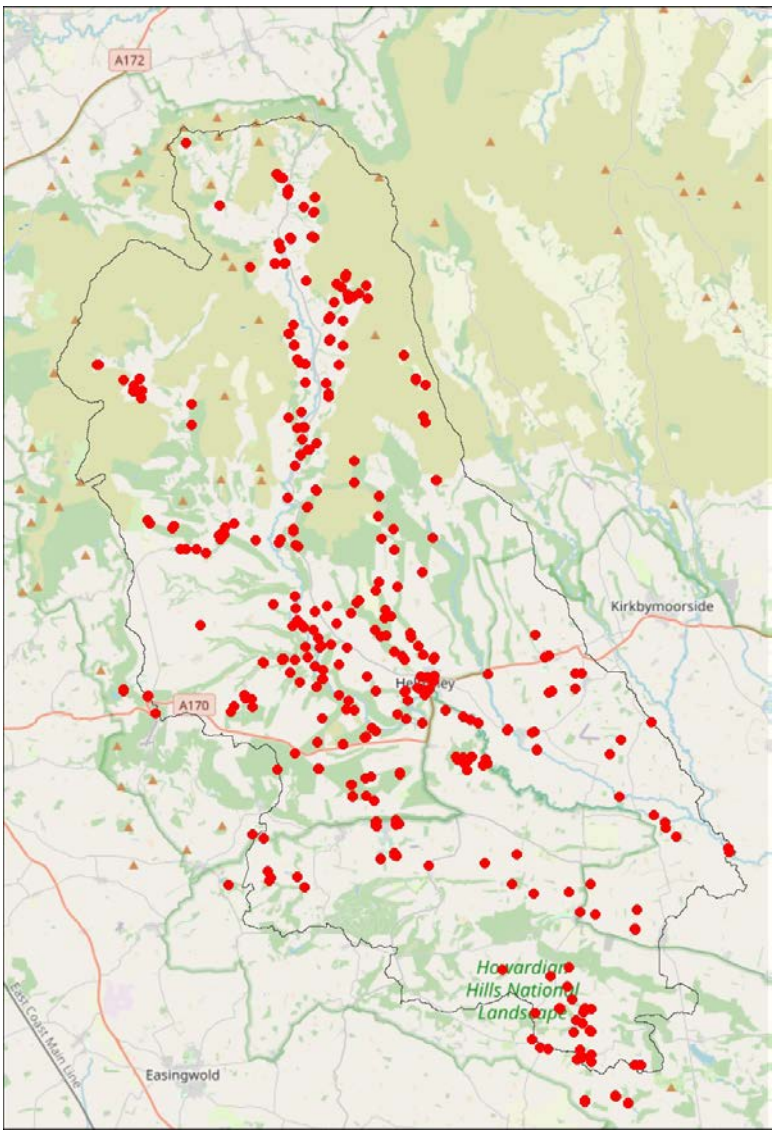
4. RESULTS

4.1 Survey coverage

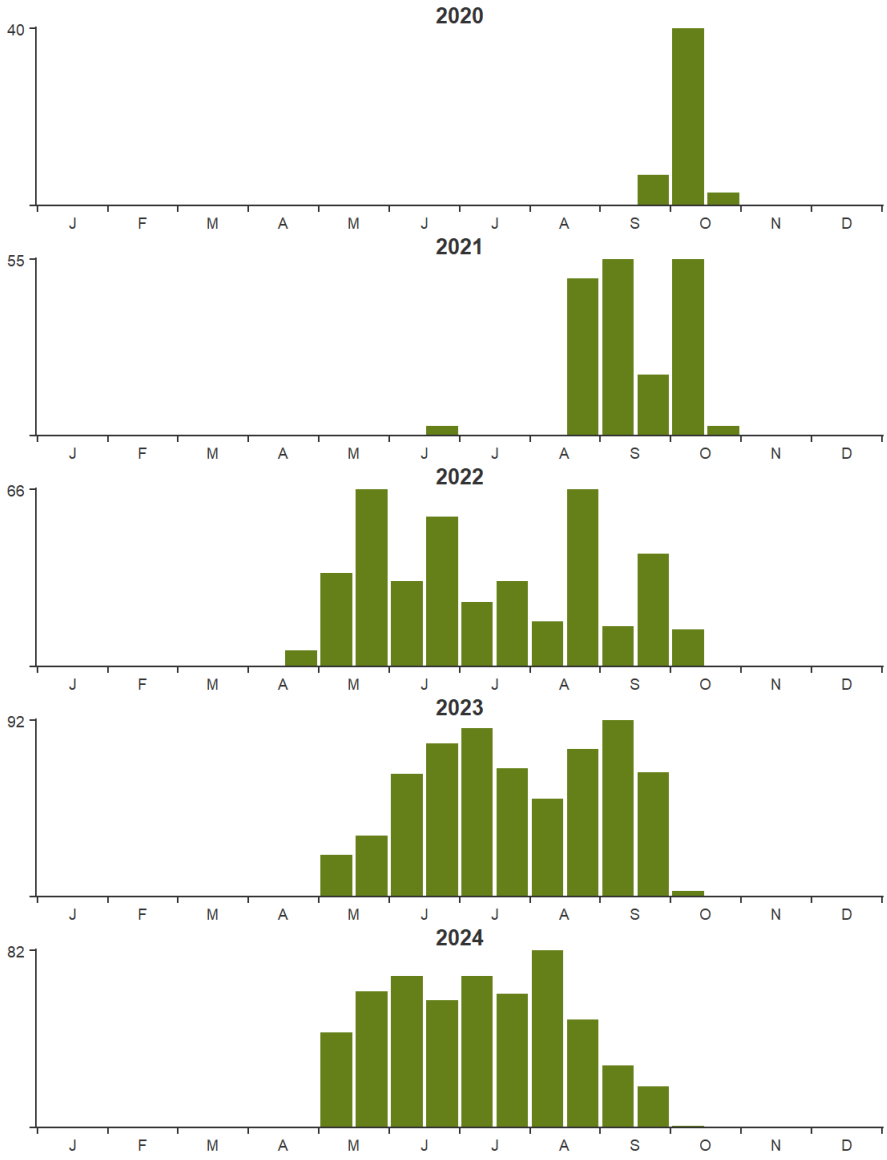
Between 2020 and 2024, 406 different locations were surveyed for bats across the Ryevitalise Landscape Partnership Scheme area. The distribution of these locations is shown below. Collectively across seasons and survey sites, 1,829 complete nights of recording effort was conducted. The recording effort spanned 535 different nights and 7 months of the year. The seasonal pattern of recording effort in each year of the project is shown on the next page. This shows how survey effort was constrained in 2020, and during the first half of the 2021 season due to coronavirus lockdowns and restrictions.

Manual checking of recordings was carried out for all species and recordings, except for Common Pipistrelle and Soprano Pipistrelle for which 1000 randomly selected recordings were checked each year. For these, less than 0.3% of Common Pipistrelle and 0.4% 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 each year.



4.2 General results

Overall, 2,210,993 recordings were collected which, following analyses and validation, were found to include 1,235,773 bat recordings, and 1,066 small terrestrial mammal recordings. In addition, two bush-cricket species and two species of audible moth species were recorded (see table below). Following validation, the presence of at least 10 bat species, 4 small mammal species, 3 bush-cricket 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)
Alcathoe Bat, *Myotis alcathoe*	29	7 (1.7%)
Daubenton's Bat, *Myotis daubentonii*	94848	379 (93.3%)

Species (/call type)	No. of recordings following validation	No. of different locations (% of total)
Daubenton's Bat feeding buzzes, *Myotis daubentonii*	1176	61 (15%)
Daubenton's Bat social calls, *Myotis daubentonii*	29	12 (3%)
Whiskered or Brandt's Bat, *Myotis mystacinus or M. brandtii*	138091	399 (98.3%)
Natterer's Bat, *Myotis nattereri*	38596	393 (96.8%)
Natterer's Bat social calls, *Myotis nattereri*	14	7 (1.7%)
Leisler's Bat, *Nyctalus leisleri*	3	2 (0.5%)
Common Noctule, *Nyctalus noctula*	28059	332 (81.8%)
Common Noctule feeding buzzes, *Nyctalus noctula*	193	44 (10.8%)
Common Noctule social calls, *Nyctalus noctula*	61	9 (2.2%)
Nathusius' Pipistrelle, *Pipistrellus nathusii*	58	9 (2.2%)
Common Pipistrelle, *Pipistrellus pipistrellus*	627389	404 (99.5%)
Common Pipistrelle feeding buzzes, *Pipistrellus pipistrellus*	27921	105 (25.9%)
Common Pipistrelle social calls, *Pipistrellus pipistrellus*	30762	104 (25.6%)
Soprano Pipistrelle, *Pipistrellus pygmaeus*	212330	393 (96.8%)
Soprano Pipistrelle feeding buzzes, *Pipistrellus pygmaeus*	2860	19 (4.7%)
Soprano Pipistrelle social calls, *Pipistrellus pygmaeus*	12101	86 (21.2%)
Brown Long-eared Bat, *Plecotus auritus*	21250	381 (93.8%)
Brown Long-eared Bat social calls, *Plecotus auritus*	3	3 (0.7%)

Small mammals

Species	No. of recordings following validation	No. of different locations (% of total)
Wood Mouse, *Apodemus sylvaticus*	4	3 (0.7%)
Brown Rat, *Rattus norvegicus*	361	11 (2.7%)
Common Shrew, *Sorex araneus*	432	99 (24.4%)
Eurasian Pygmy Shrew, *Sorex minutus*	269	63 (15.5%)

Bush-crickets

Species	No. of different locations (% of total)
Long-winged Conehead, *Conocephalus fuscus*	7 (1.7%)
Speckled Bush-cricket, *Leptophyes punctatissima*	2 (0.5%)
Roesel's Bush-cricket, *Roeseliana roeselii*	6 (1.5%)

Moths

Species	No. of different locations (% of total)
Green Silver-lines, *Pseudoips prasinana*	12 (3%)
Bird Cherry Ermine, *Yponomeuta evonymella*	93 (22.9%)

4.3 Species and call-type results

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

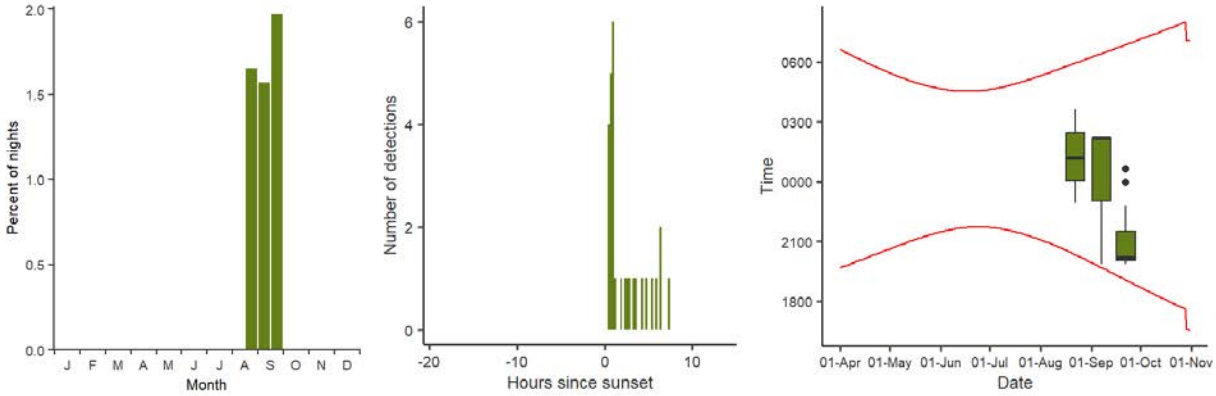
4.3.1 Bat species

Alcathoe Bat

Alcathoe Bat *Myotis alcathoe* was recorded on nine nights, from seven locations, giving a total of 29 recordings.

Spatial pattern of activity

Seasonal and nightly activity

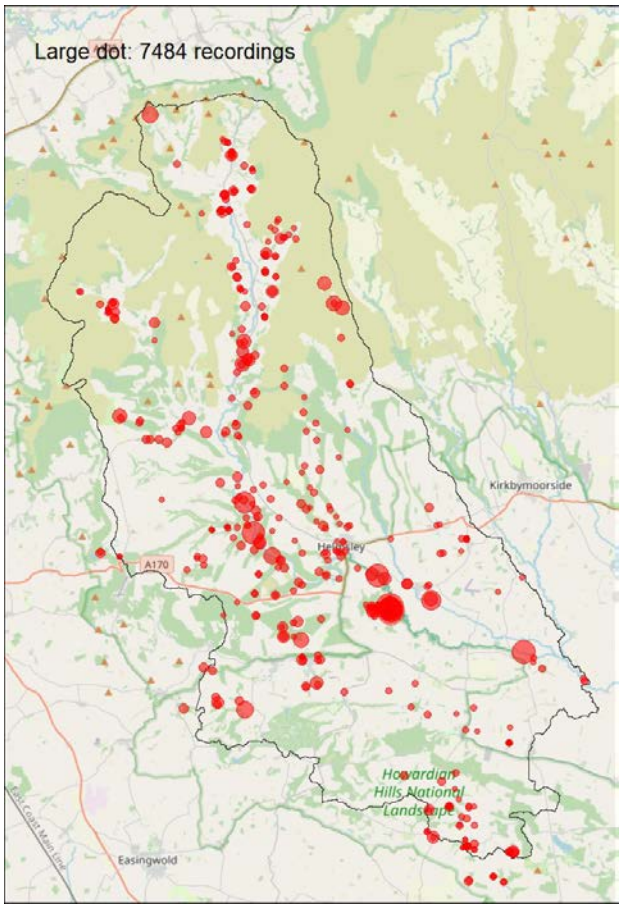


Alcathoe Bat. We believe that Alcathoe Bat is the most range restricted *Myotis* species present in Ryevitalise Landscape Partnership Scheme area. Of other *Myotis* species, the most likely confusion is with Whiskered Bat. As a general rule, comparable calls of the same duration tend to be higher in frequency in Alcathoe Bat than with Whiskered Bat, but in a cluttered environment, Whiskered Bat can exceptionally produce calls that end above 40 kHz. However, even in this situation, there is a difference in call shape between these two species which should still allow these species to be distinguished. See Identification appendix 1 for further information on the sound identification of Alcathoe Bat. 22 (81%) of the Alcathoe Bat recordings, were from a single location over three nights in 2022.

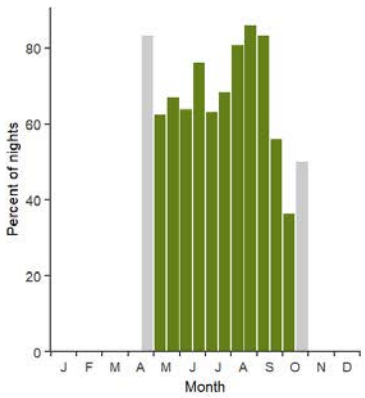
Daubenton's Bat

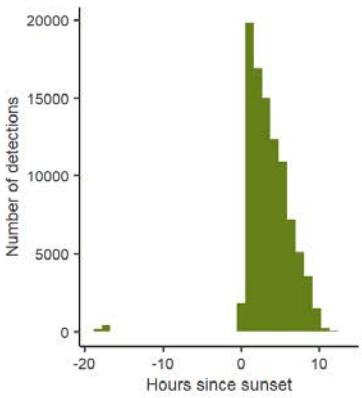
Daubenton's Bat *Myotis daubentonii* was recorded on 440 nights, from 379 locations, giving a total of 94,848 recordings.

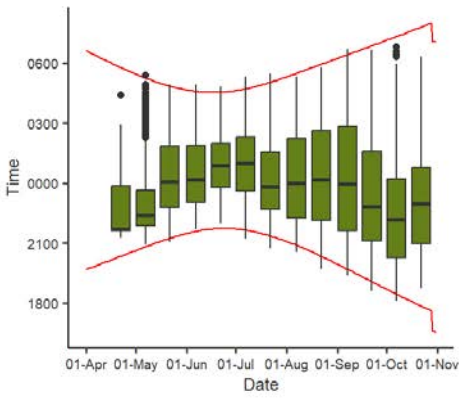
Spatial pattern of activity



Seasonal and nightly activity





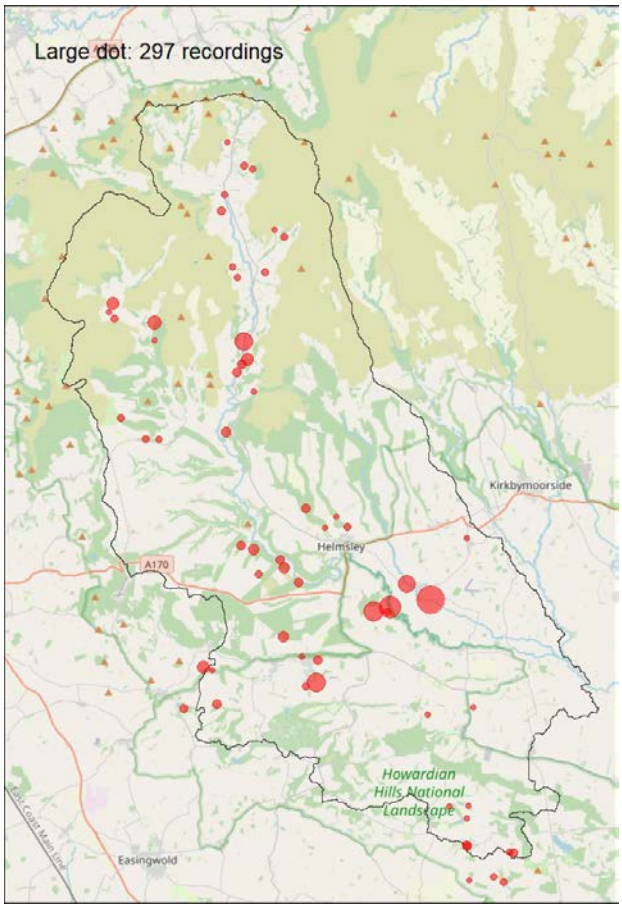


Daubenton's Bat was widely recorded every year, but with particularly high activity where detectors were left to record at locations along the Rivers Rye and Seph. There were over 2,500 Daubenton's recordings a night over three nights from a bat detector positioned along the River Rye between Nunnington and Helmsley, and 1,123 recordings from another location along the River Seph between Laskill and Fangdale Beck. See Identification appendix 2 for further information on the sound identification of Daubenton's Bat in comparison to the most likely confusion species Natterer's Bat.

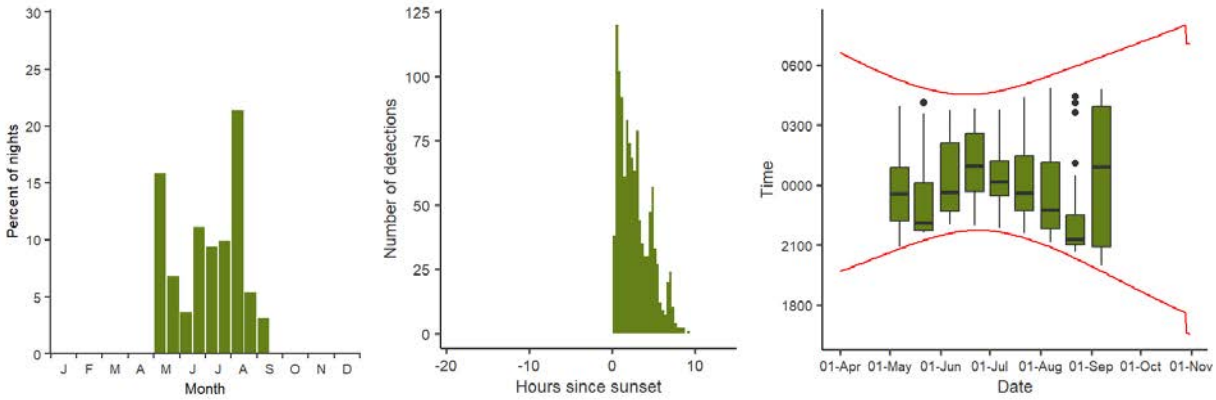
Daubenton's Bat feeding buzzes

Daubenton's Bat feeding buzzes *Myotis daubentonii* were recorded on 71 nights, from 61 locations, giving a total of 1,176 recordings.

Spatial pattern of activity



Seasonal and nightly activity

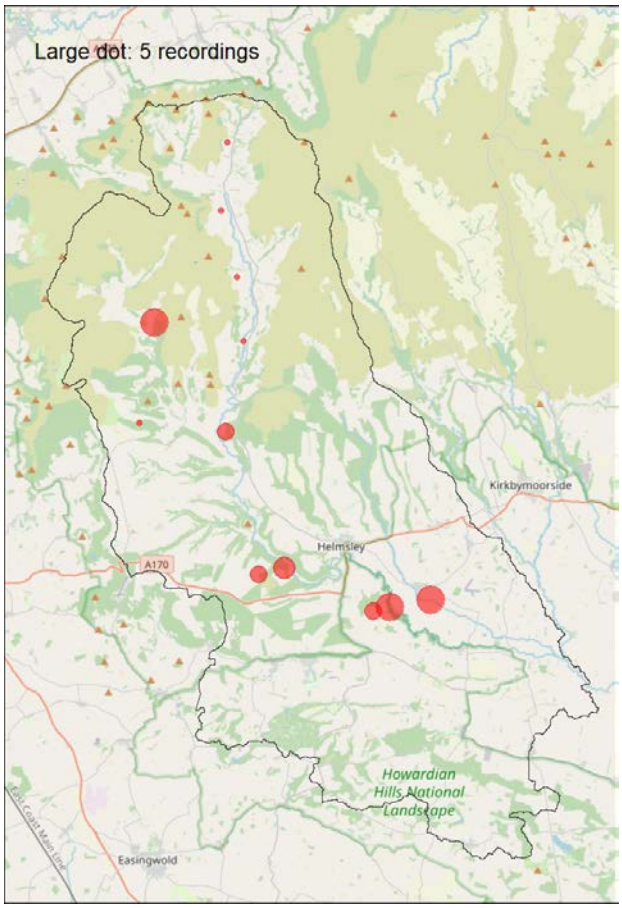


Daubenton's Bat feeding buzzes. Sequences containing Daubenton's Bat feeding buzzes were identified for the first time in 2024. In doing so, we are able to identify important feeding areas for Daubenton's Bat in 2024. Particularly notable were more than 50 recordings a night over several nights from a location along the River Rye north-west of Nunnington, and up to 137 recordings a night at a location north of Nunnington along the River Riccal.

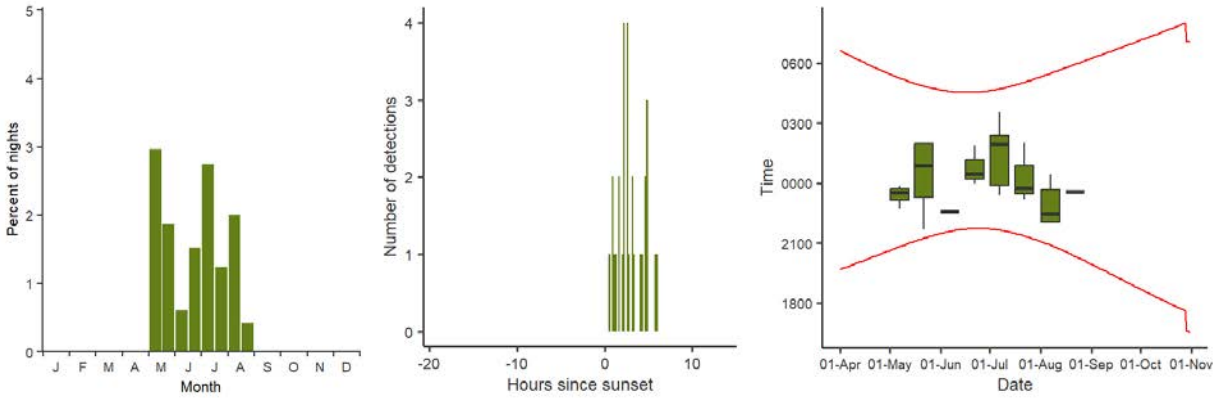
Daubenton's Bat social calls

Daubenton's Bat social calls *Myotis daubentonii* were recorded on 19 nights, from 12 locations, giving a total of 29 recordings.

Spatial pattern of activity



Seasonal and nightly activity

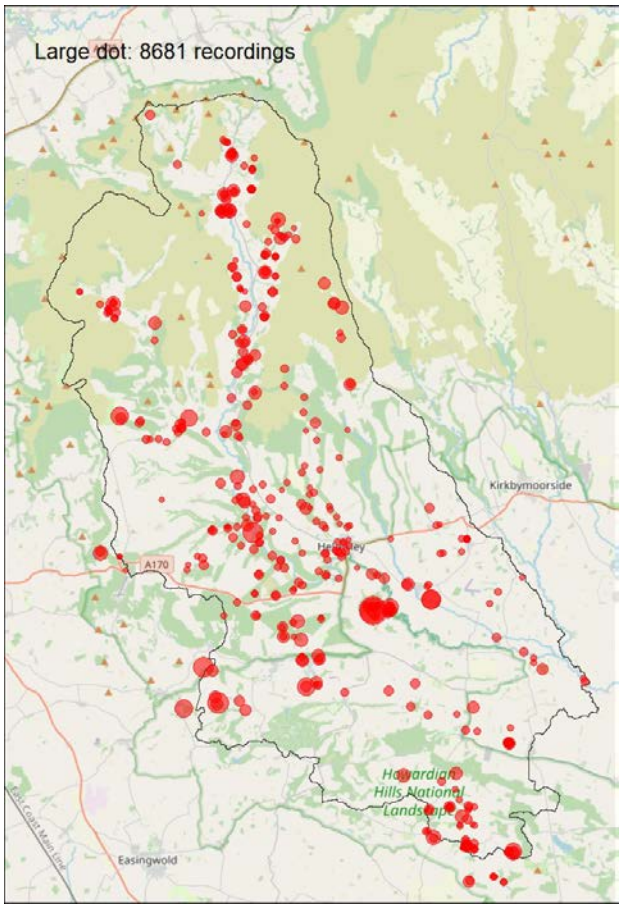


Daubenton's Bat social calls. Sequences containing Daubenton's Bat social calls were identified separately for the first time in 2024. Whilst Daubenton's Bat social calls can be recorded away from a roost, they are more commonly produced close to a roost. Daubenton's Bat social calls were recorded quite widely in 2024, although with a maximum of four recordings a night.

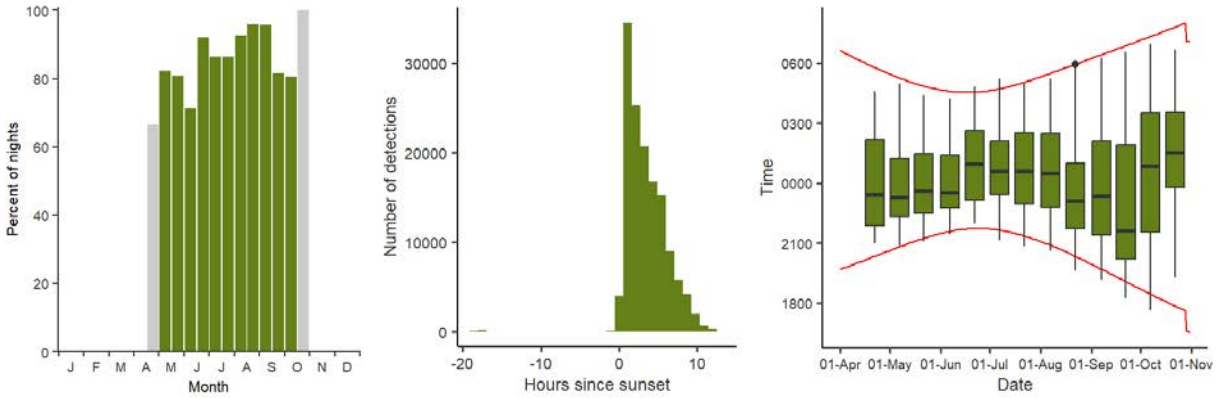
Whiskered or Brandt's Bat

Whiskered or Brandt's Bat *Myotis mystacinus or M. brandtii* was recorded on 505 nights, from 399 locations, giving a total of 138,091 recordings.

Spatial pattern of activity



Seasonal and nightly activity

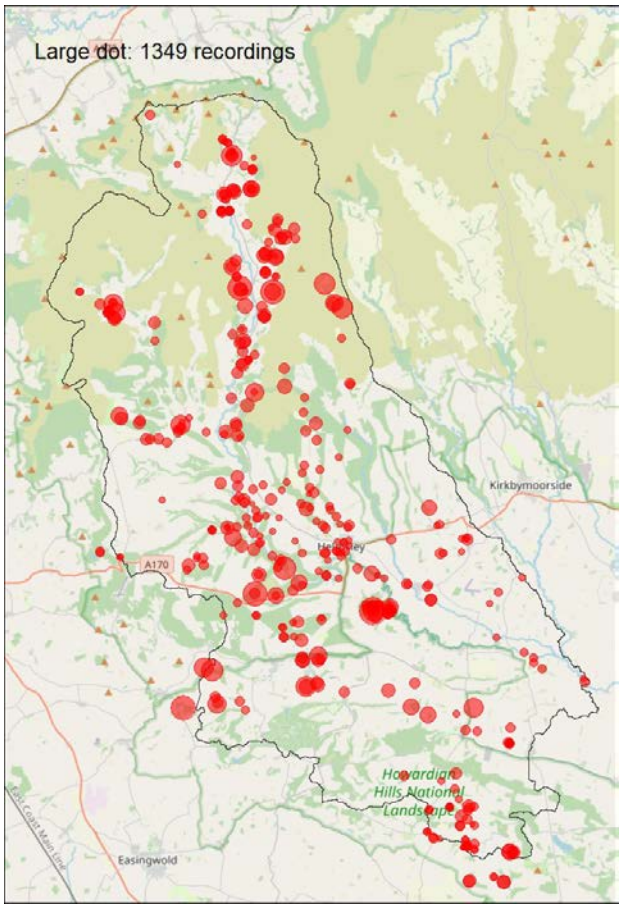


Whiskered or Brandt's Bat were very widely recorded. Different to Daubenton's Bat where the highest activity was recorded close to water, the highest activity of Whiskered or Brandt's bat was in the vicinity of woodland patches, with over 2,000 recordings a night over three nights at one location close to Sproxton in late August 2023 and a similar number of recordings a night from the same location in early August 2024. 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 3.

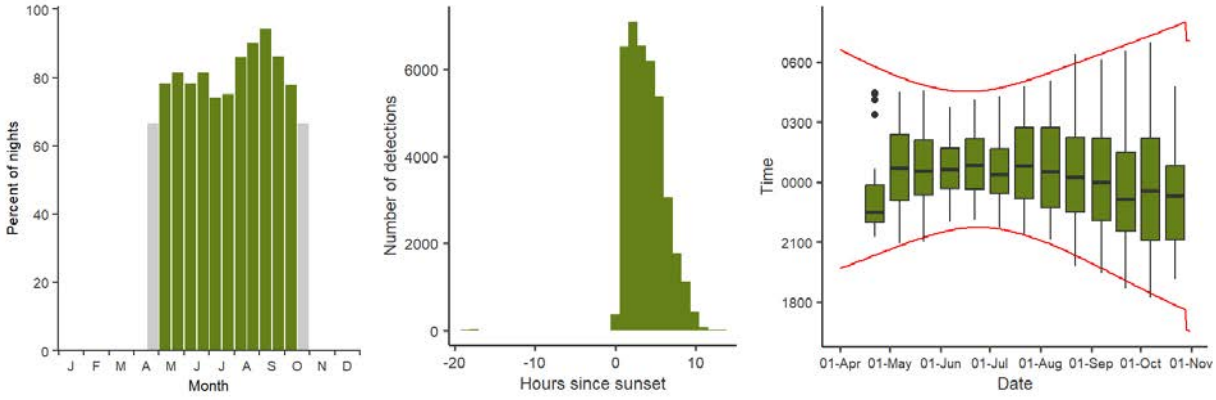
Natterer's Bat

Natterer's Bat *Myotis nattereri* was recorded on 496 nights, from 393 locations, giving a total of 38,596 recordings.

Spatial pattern of activity



Seasonal and nightly activity

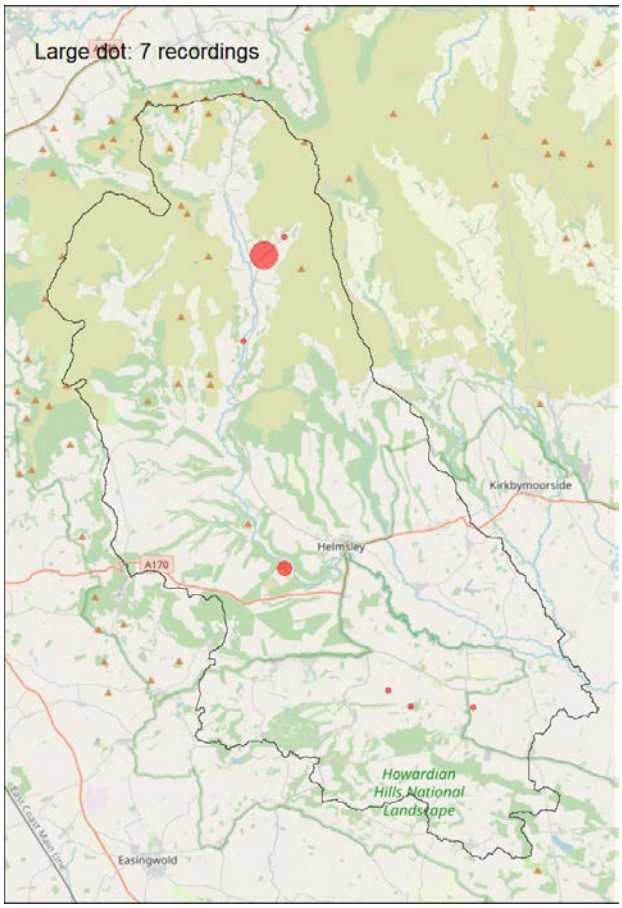


Natterer's Bat was widely recorded in every year. Compared with the other *Myotis* species, the highest activity of Natterer's Bat was recorded in more open grassland and arable areas, bordering moorland, with a maximum of 363 recordings a night recorded close to Ampleforth in July 2023. As with Whiskered 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 4 for further information on the sound identification of Natterer's Bat.

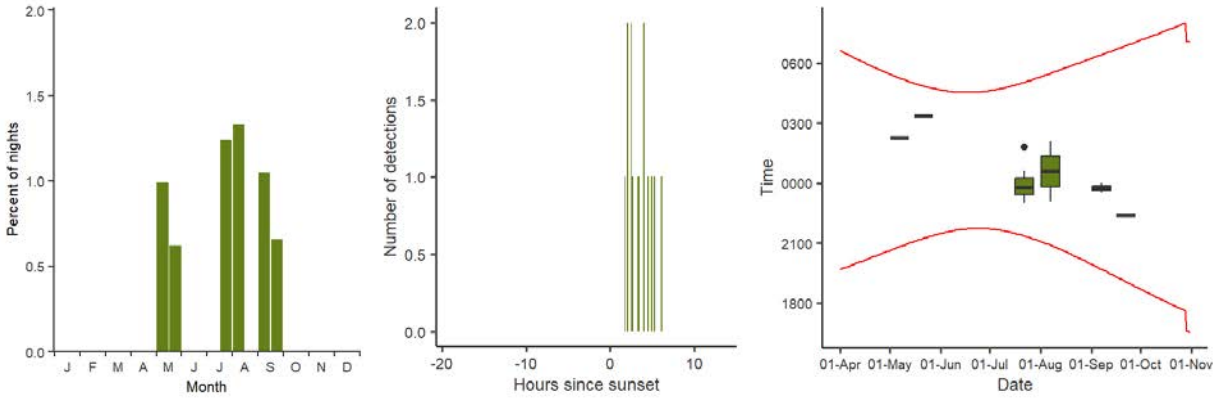
Natterer's Bat social calls

Natterer's Bat social calls *Myotis nattereri* were recorded on nine nights, from seven locations, giving a total of 14 recordings.

Spatial pattern of activity



Seasonal and nightly activity



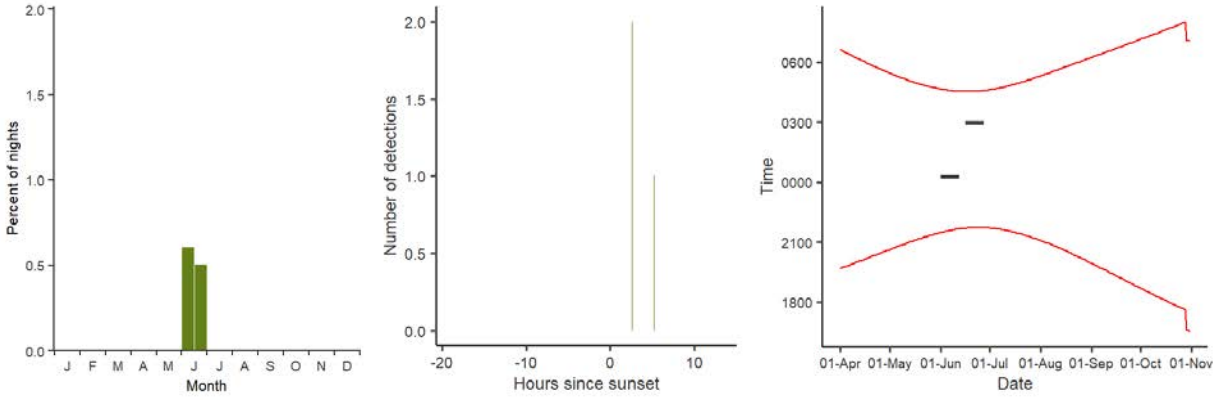
Natterer's Bat social calls. Social calls of bats are different from echolocation calls which they use to navigate their way around the landscape, in that they are often used when bats interact with one another. They are most likely to be produced in the vicinity of a roost, but not exclusively. Natterer's Bat social calls were identified for the first time for this project in 2024. Whilst Natterer's Bat social calls were recorded from seven locations, these were represented by single recordings a night, with the exception of six recordings from woodland at Ledge Beck.

Leisler's Bat

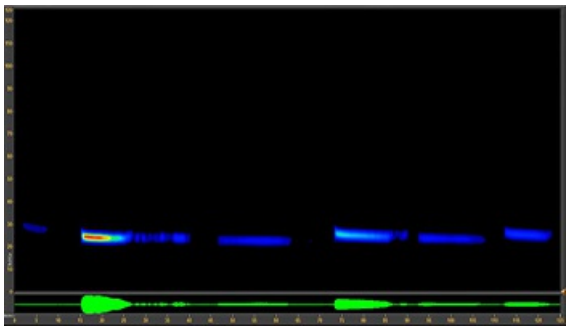
Leisler's Bat *Nyctalus leisleri* was recorded on two nights, from two locations, giving a total of 3 recordings.

Spatial pattern of activity

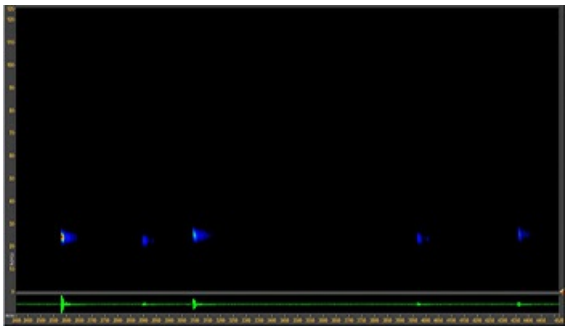
Seasonal and nightly activity



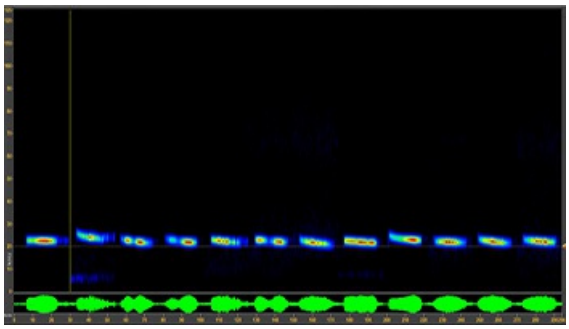
Leisler's Bat was recorded close to Chop Gate on the night of the 11th June 2022 (two recordings) and from a location north-west of Helmsley on the 27th June 2024 (one recording). In these recordings, there are alternating call frequencies, which is typical for *Nyctalus*. Narrowing down the identification further, given the call durations in the presumed Leisler's Bat recordings, it is clear the frequency of the calls, is higher than would be expected for Noctule given the flat call shape. In the spectrograms below, we include a comparison between the calls in one of the recordings with known Leisler's Bat and known Noctule calls of similar duration. This highlights that the calls here are very typical for Leisler's bat but are high in frequency for Leisler's Bat to be likely. See Identification appendix 5 for further information on the sound identification of Leisler's bat and Noctule. With just three recordings, we are unsure of the status of Leisler's Bat in the Ryevitalise survey area. If Leisler's Bat is a resident species, we believe that there are likely to be very few individuals.



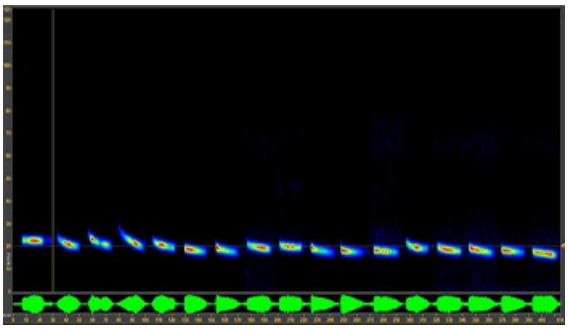
Leisler's Bat - Chop Gate, 11th June 2022



Leisler's Bat (same recording, different scale)



Leisler's Bat call (same recording left), against known Leisler's Bat calls (right)

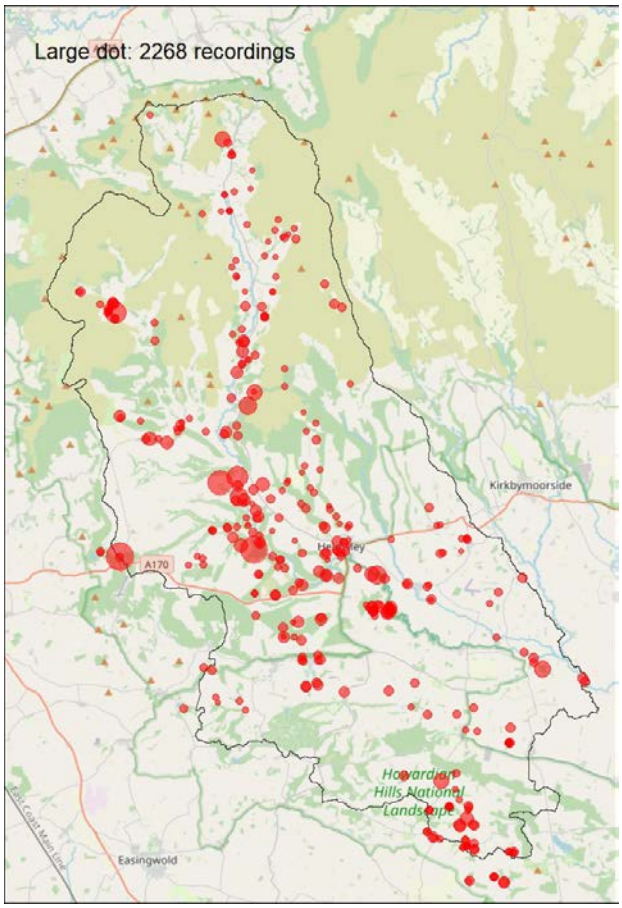


Leisler's Bat call (same recording left), against known Noctule calls (right)

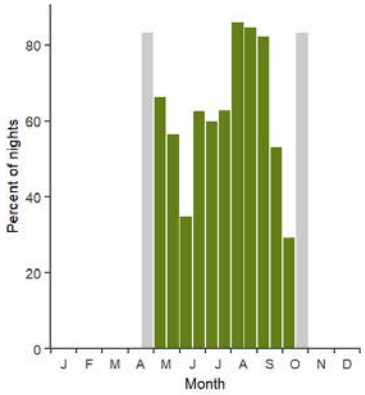
Common Noctule

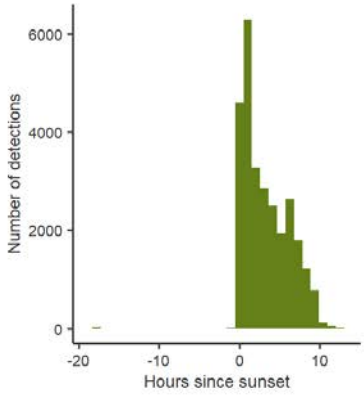
Common Noctule *Nyctalus noctula* was recorded on 413 nights, from 332 locations, giving a total of 28,059 recordings.

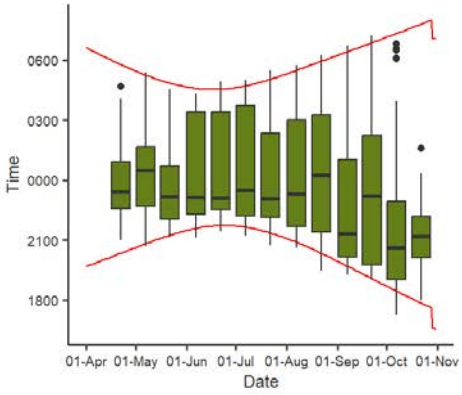
Spatial pattern of activity



Seasonal and nightly activity





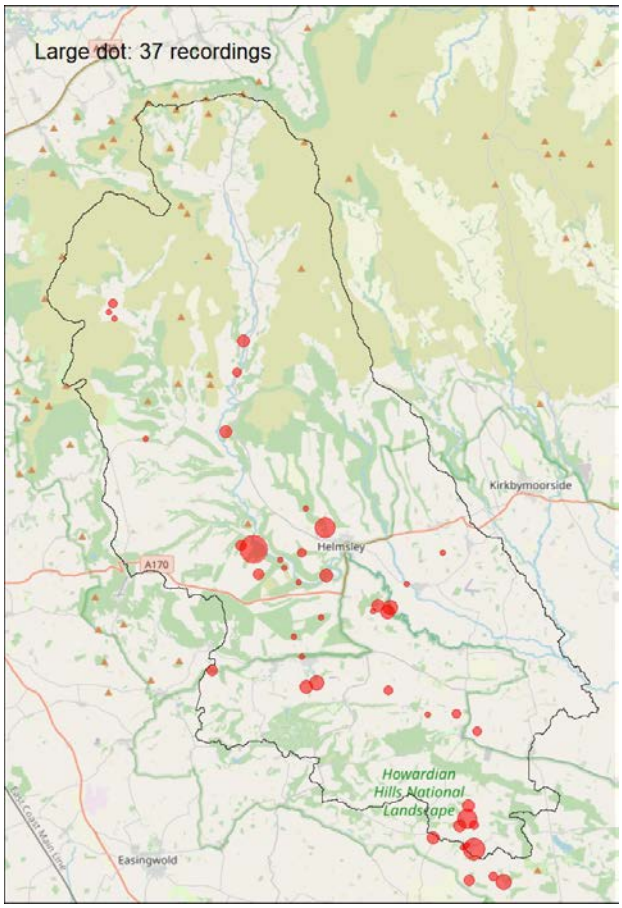


Common Noctule was widely recorded across the survey area, but there were a small number of locations where particularly high activity of Noctule was recorded. The maximum number of recordings of Noctule from a night was 1,376 recordings of Noctule from close to Sutton Bank National Park centre on the 1st May 2024, although a notable number of Noctule recordings were recorded from close to Rievaulx Abbey, with up 643 recordings on the 21st August 2023. See Identification appendix 5 for further information on the sound identification of Noctule and how it compares with the closely related Leisler's Bat.

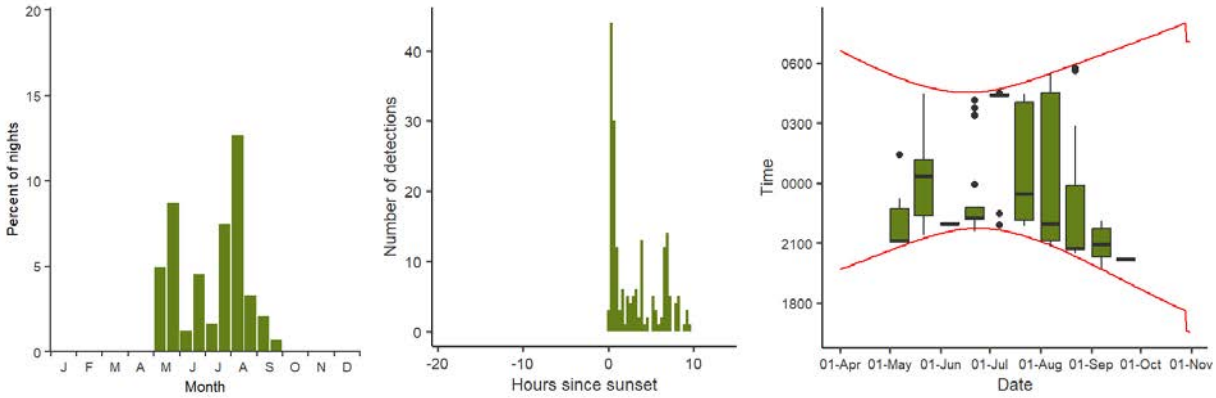
Common Noctule feeding buzzes

Common Noctule feeding buzzes *Nyctalus noctula* were recorded on 48 nights, from 44 locations, giving a total of 193 recordings.

Spatial pattern of activity



Seasonal and nightly activity

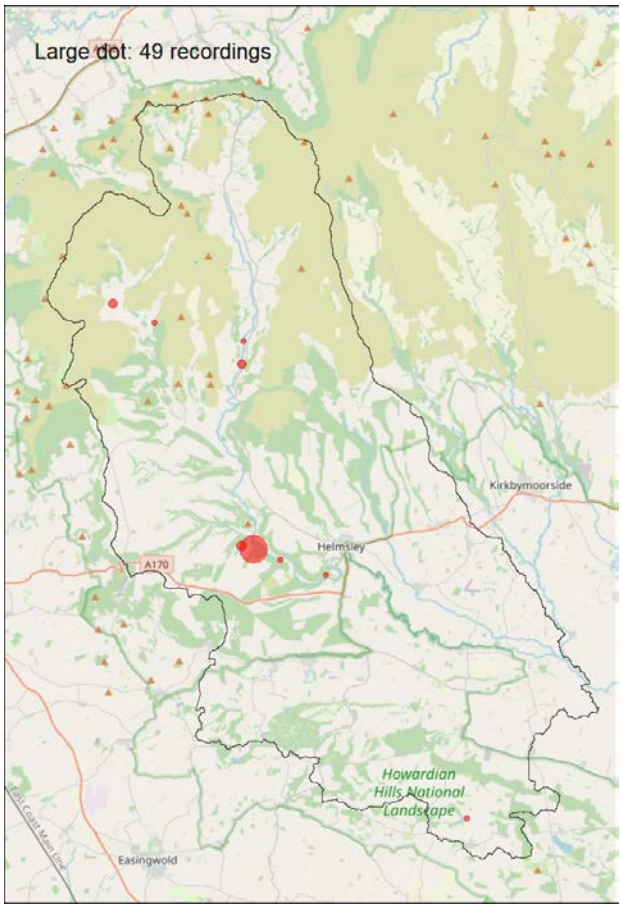


Common Noctule feeding buzzes were recorded for the frist time in 2024. The highest level of Noctule feeding activity was recorded from just south of Terrington, with a total of 19 recordings with feeding buzzes in one night.

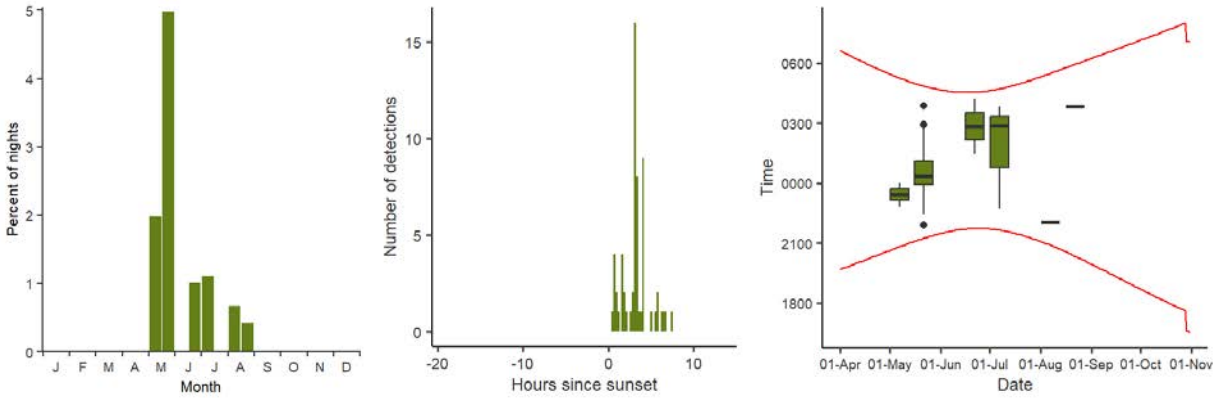
Common Noctule social calls

Common Noctule social calls *Nyctalus noctula* were recorded on 14 nights, from nine locations, giving a total of 61 recordings.

Spatial pattern of activity



Seasonal and nightly activity

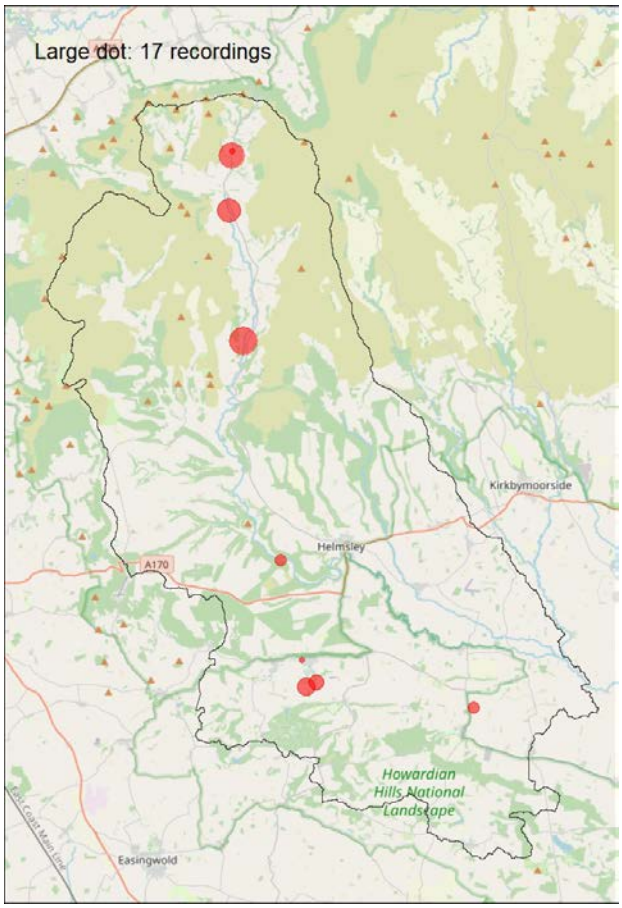


Common Noctule social calls were identified specifically for the first time in this project in 2024. They are most likely to be produced in the vicinity of a roost, but not exclusively. Whilst Noctule social calls were recorded from 19 locations in 2024. Particularly notable are double figure numbers of recordings a night with social calls close to Rievaulx Abbey in May 2024, which may suggest proximity to a roost.

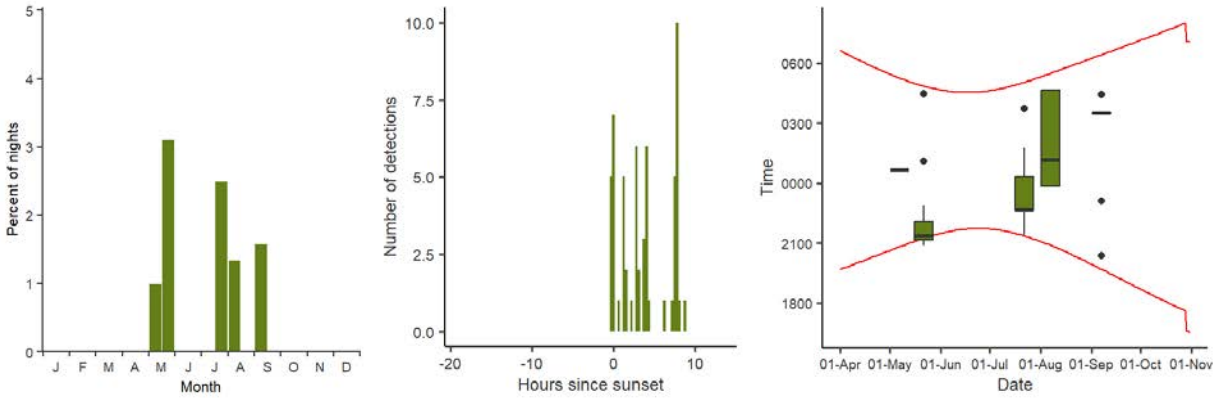
Nathusius' Pipistrelle

Nathusius' Pipistrelle *Pipistrellus nathusii* was recorded on 15 nights, from nine locations, giving a total of 58 recordings.

Spatial pattern of activity



Seasonal and nightly activity

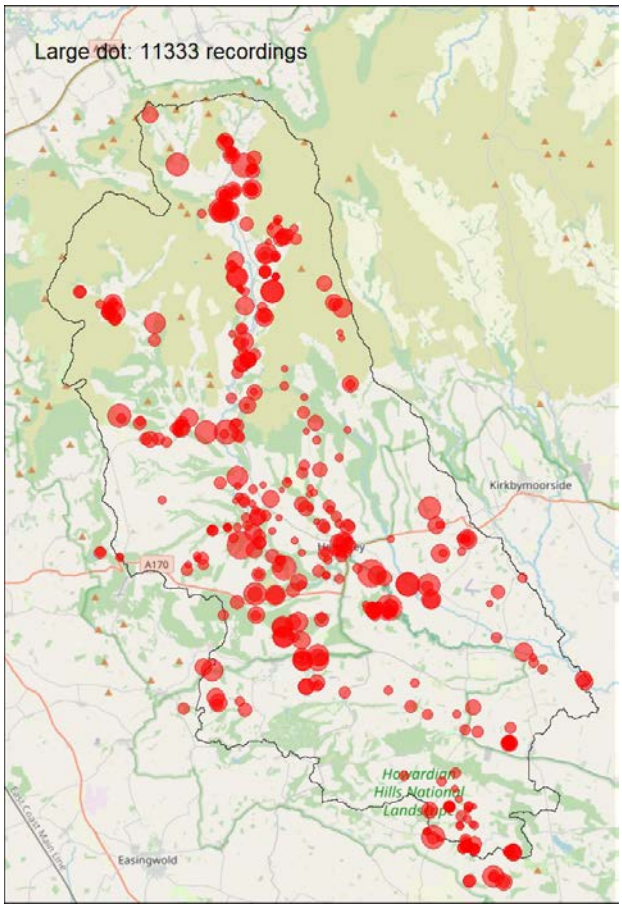


Nathusius' Pipistrelle was only recorded in 2021, 2023 and 2024. It is interesting that the largest number of recordings of Nathusius' Pipistrelle recordings from 2021, 2023 and 2024, were all from stretches along the River Seth. Considering the timing of records, in May and between late July and September, it is possible that these relate to migrants rather than this being a resident species in the Ryevitalise study area.

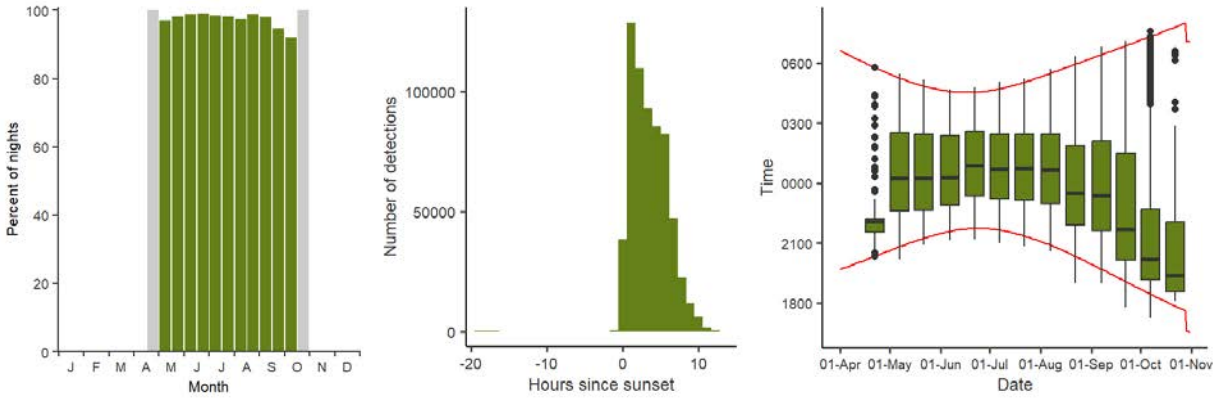
Common Pipistrelle

Common Pipistrelle *Pipistrellus pipistrellus* was recorded on 532 nights, from 404 locations, giving a total of 627,389 recordings.

Spatial pattern of activity



Seasonal and nightly activity



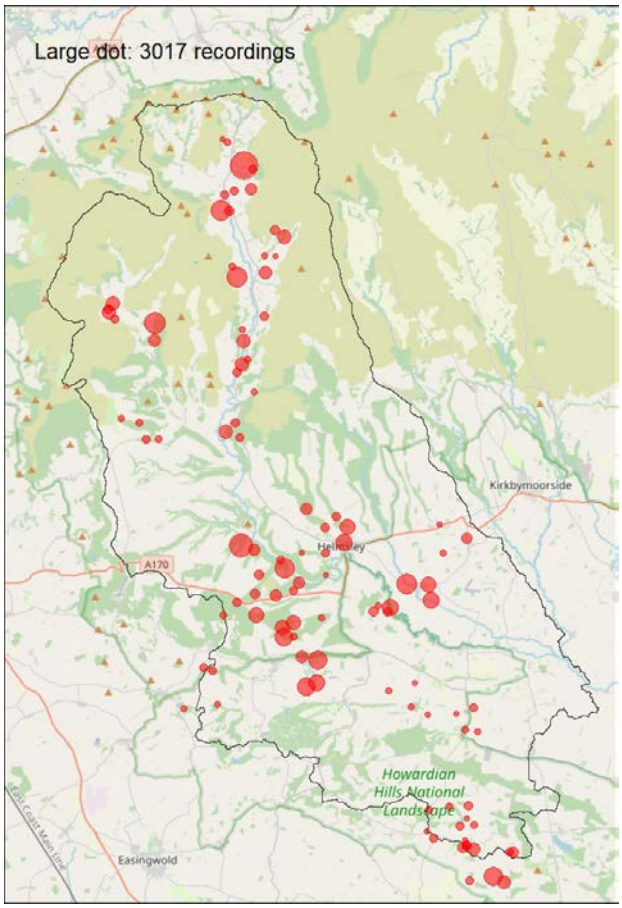
Common Pipistrelle was by far the most common and widely recorded bat species, with 627,389 recordings from 404 different locations (over 99% of survey locations).

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 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.

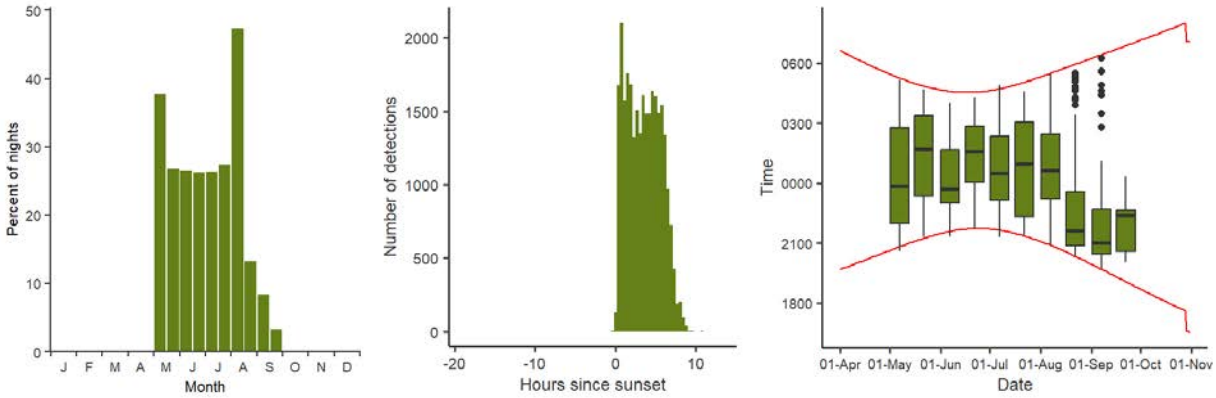
Common Pipistrelle feeding buzzes

Common Pipistrelle feeding buzzes *Pipistrellus pipistrellus* were recorded on 116 nights, from 105 locations, giving a total of 27,921 recordings.

Spatial pattern of activity



Seasonal and nightly activity

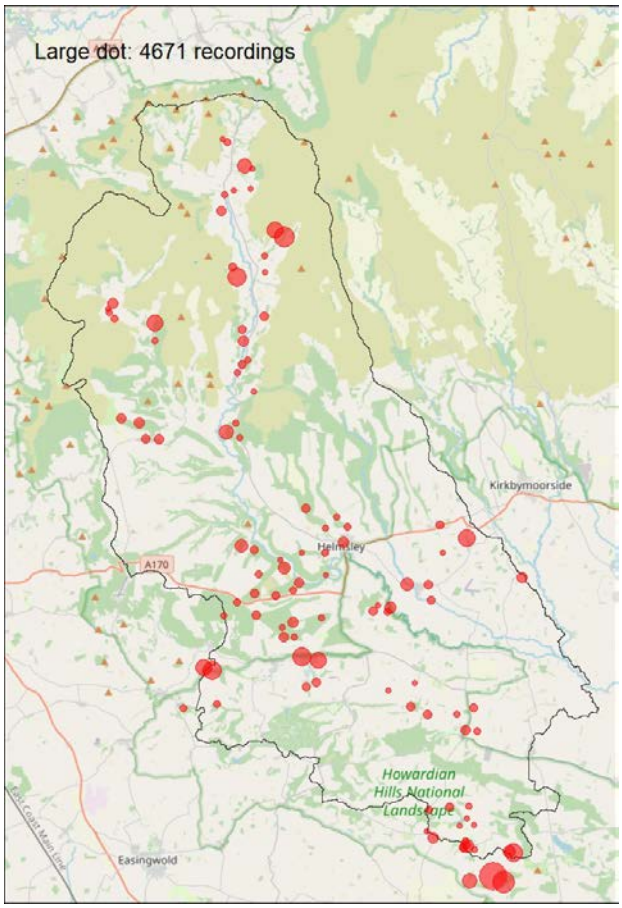


Common Pipistrelle feeding buzzes. 2024 is the first year that we have specifically identified Common Pipistrelle feeding buzzes. As illustrated above, there were peaks in feeding activity towards the start of the night and a clear increase in feeding activity towards the end of the night before returning to the roost.

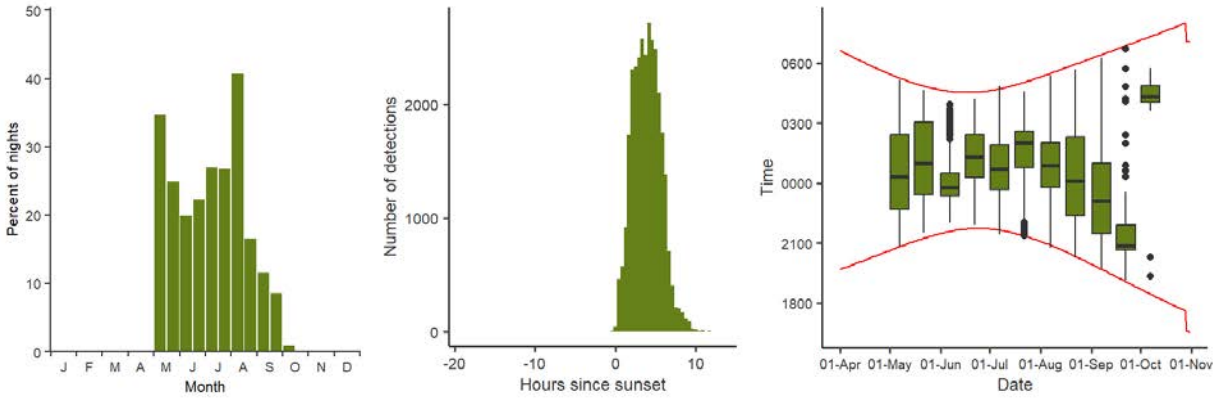
Common Pipistrelle social calls

Common Pipistrelle social calls *Pipistrellus pipistrellus* were recorded on 131 nights, from 104 locations, giving a total of 30,762 recordings.

Spatial pattern of activity



Seasonal and nightly activity

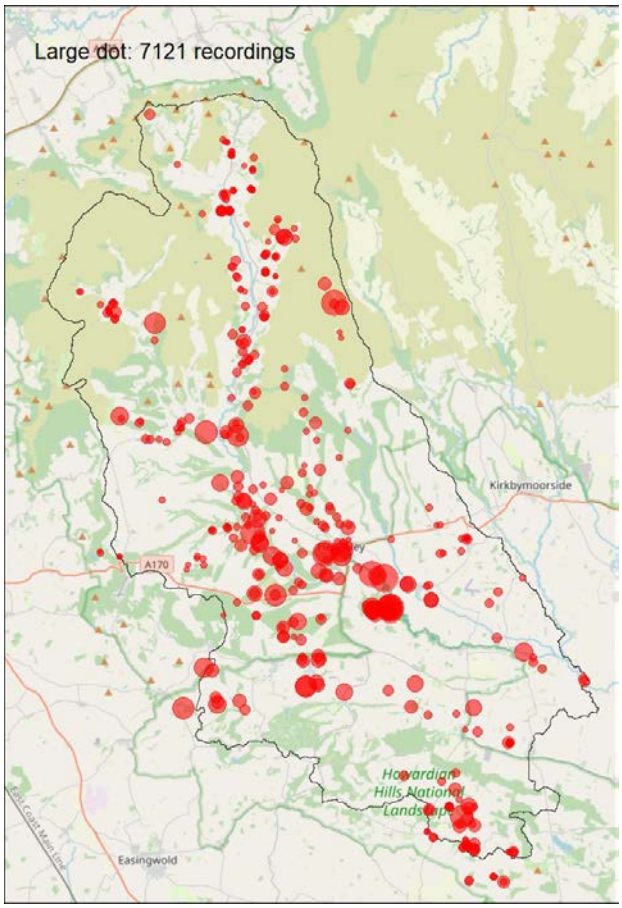


Common Pipistrelle social calls. 2024 is the first year that we have specifically identified Common Pipistrelle social calls. A range of social calls are produced by Common Pipistrelle, but most common are social trills often comprising of four calls. These can be produced in flight at any time of year, 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.

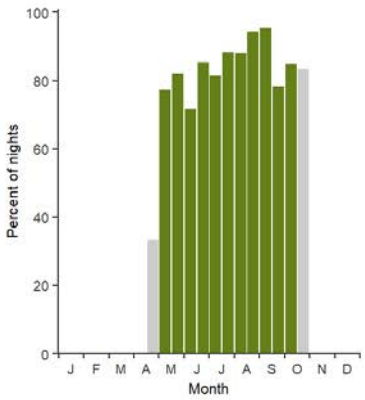
Soprano Pipistrelle

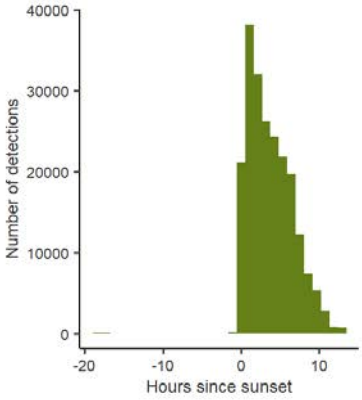
Soprano Pipistrelle *Pipistrellus pygmaeus* was recorded on 499 nights, from 393 locations, giving a total of 212,330 recordings.

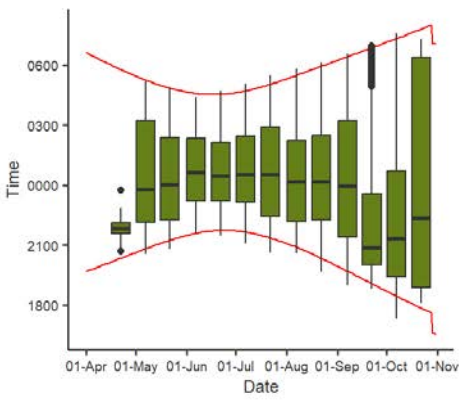
Spatial pattern of activity



Seasonal and nightly activity





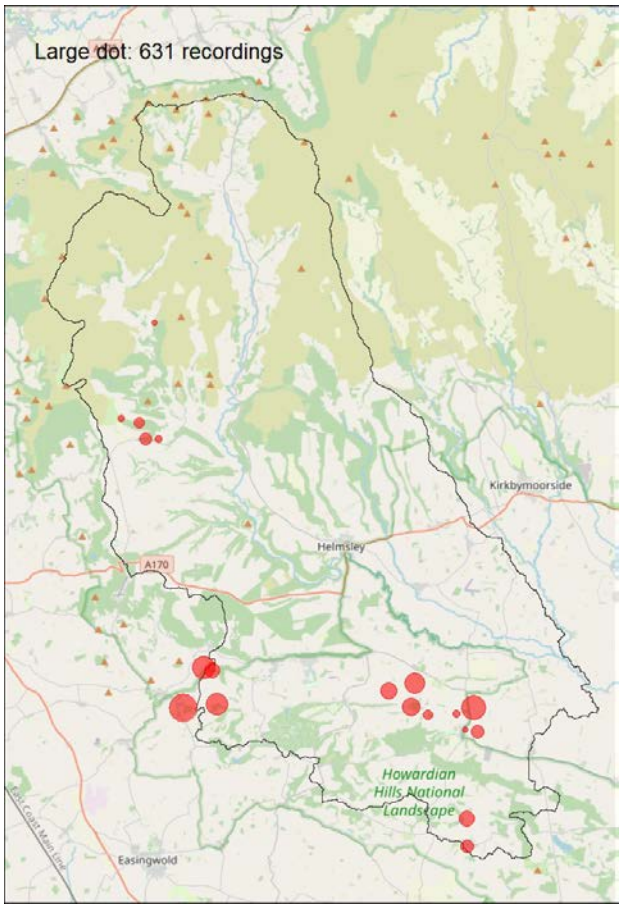


Soprano Pipistrelle was the second most common and widely recorded bat species, with 212,330 recordings from 393 different locations (over 96% of survey locations), but compared with Common Pipistrelle highest activity was more localised and centered around Hemsley. A maximum of 3,995 recordings of Soprano Pipistrelle were recorded east of Fangdale Beck along Bonfield Gill on the night of the 7th October 2021.

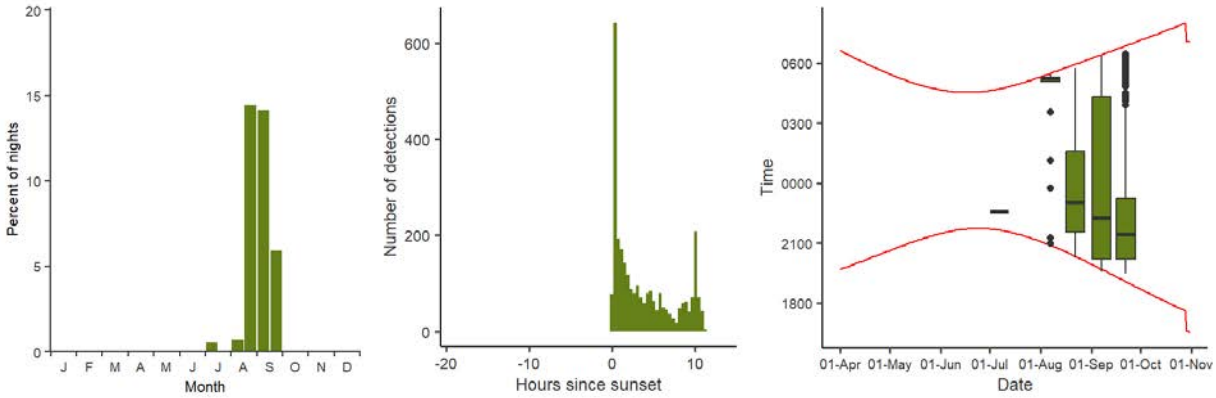
Soprano Pipistrelle feeding buzzes

Soprano Pipistrelle feeding buzzes *Pipistrellus pygmaeus* were recorded on 38 nights, from 19 locations, giving a total of 2,860 recordings.

Spatial pattern of activity



Seasonal and nightly activity

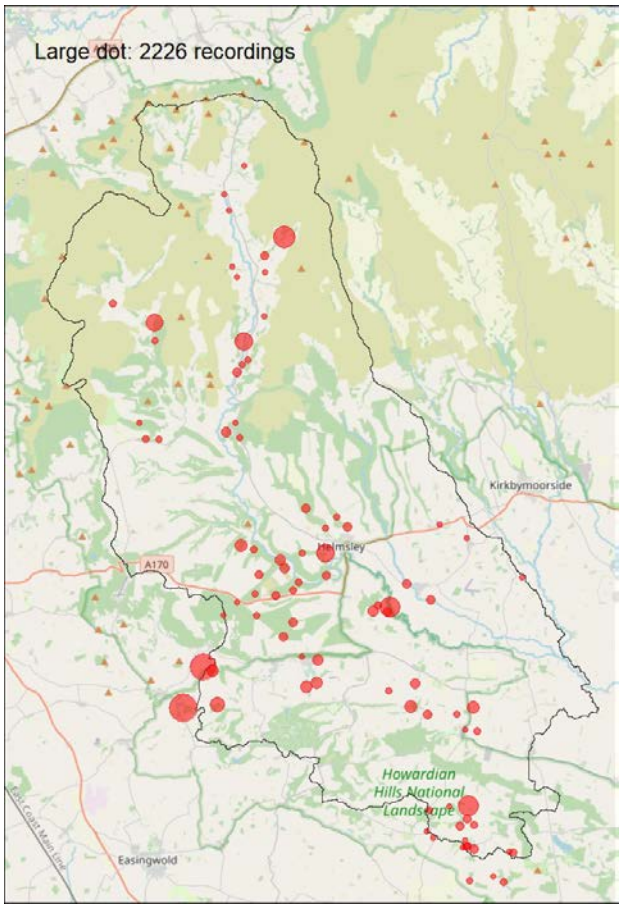


Soprano Pipistrelle feeding buzzes This is the first year that our bat classifiers have specifically identified Soprano Pipistrelle feeding buzzes. As illustrated above, there were peaks in feeding activity towards the start of the night and a clear increase in feeding activity towards the end of the night before returning to the roost.

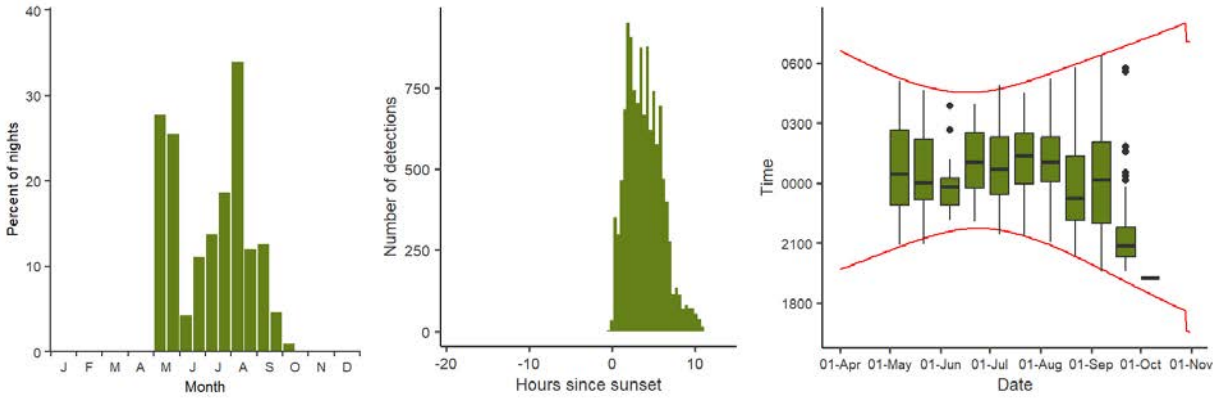
Soprano Pipistrelle social calls

Soprano Pipistrelle social calls *Pipistrellus pygmaeus* were recorded on 111 nights, from 86 locations, giving a total of 12,101 recordings.

Spatial pattern of activity



Seasonal and nightly activity

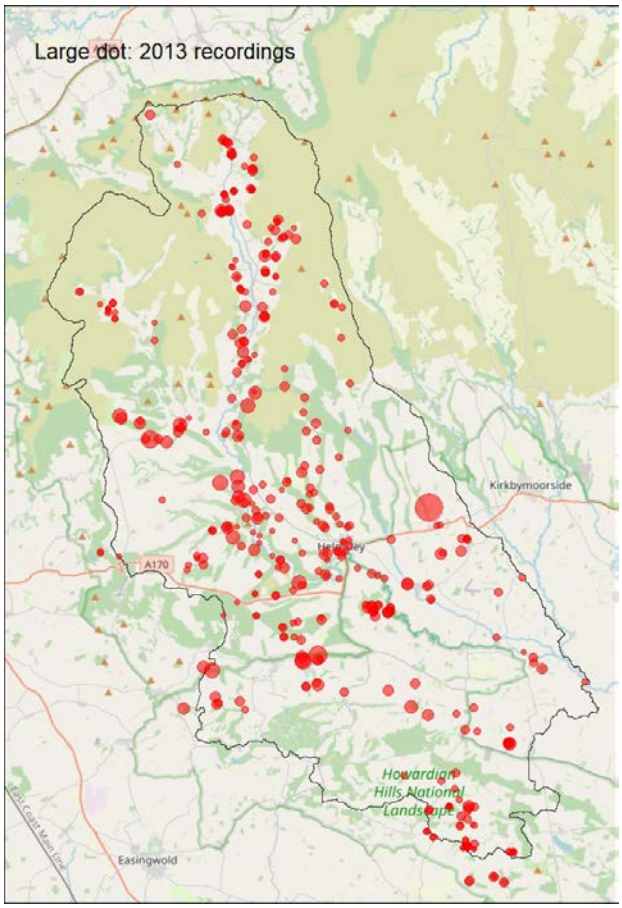


2024 is the first year that we have identified Soprano Pipistrelle social calls. A range of social calls are produced by Soprano Pipistrelle, but most common are social trills often comprising of three calls. These can be produced in flight at any time of year, but similar to Common Pipistrelle, there 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.

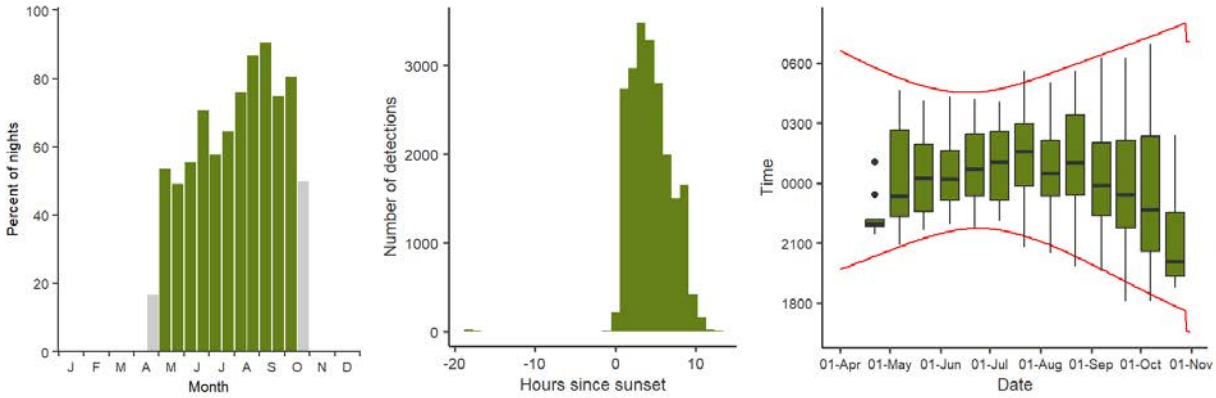
Brown Long-eared Bat

Brown Long-eared Bat *Plecotus auritus* was recorded on 455 nights, from 381 locations, giving a total of 21,250 recordings.

Spatial pattern of activity



Seasonal and nightly activity

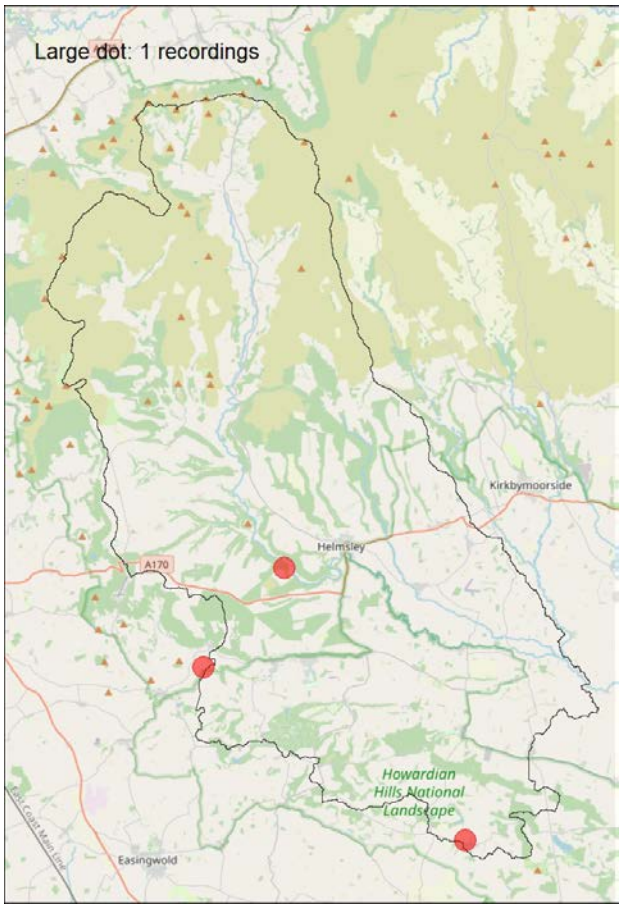


Brown Long-eared Bat was widely recorded across the survey area. The maximum number of recordings a night, 374, was from a bat detector adjacent to woodland, north of Beadlam on the 27th August 2022, with over 300 recordings a night from most other nights at this location.

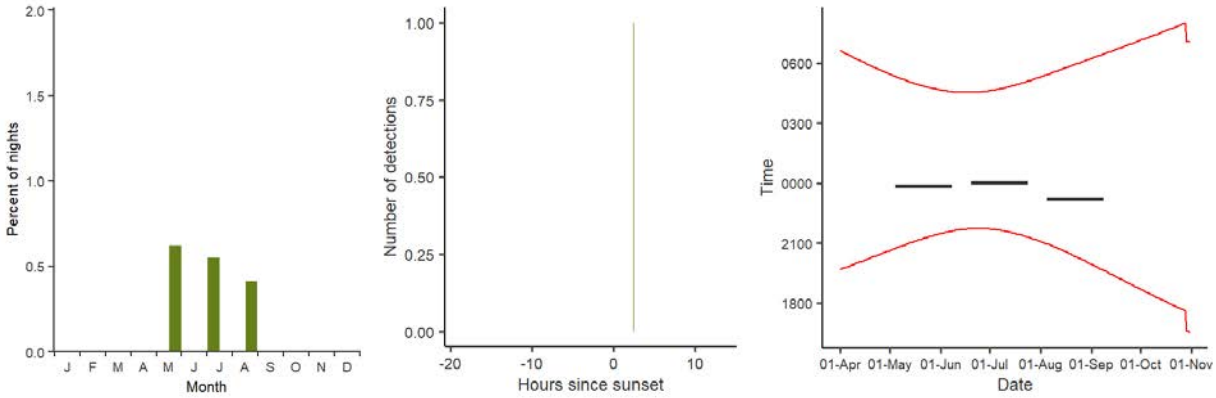
Brown Long-eared Bat social calls

Brown Long-eared Bat social calls *Plecotus auritus* were recorded on three nights, from three locations, giving a total of 3 recordings.

Spatial pattern of activity



Seasonal and nightly activity



Brown Long-eared Bat social calls. 2024 is the first year that we have specifically identified Brown Long-eared Bat social calls. In our categorisation of social calls for Brown Long-eared Bat, we have not included calls often defined as Type C social calls (Middleton *et al.* 2022) that are likely to have an echolocation and a social function. By excluding Type C social calls, the remaining social calls are more likely (but not exclusively) to be recorded in the vicinity of a roost. With just single recordings containing Brown Long-eared Bat social calls from the three locations, it is difficult to infer too much from these results.

4.3.2 Small terrestrial mammal species

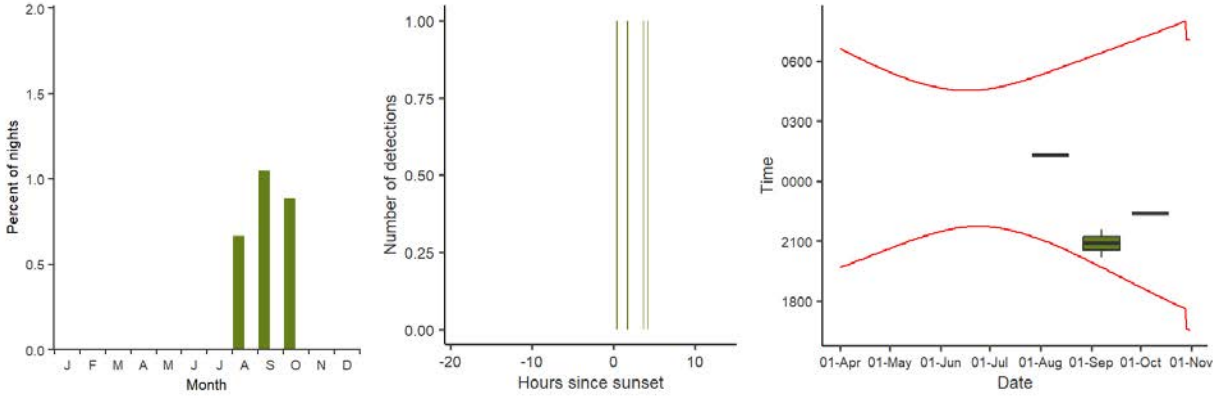
In this section we look at the recordings that we can assign to small terrestrial mammals.

Wood Mouse

Wood Mouse *Apodemus sylvaticus* was recorded on four nights, from three locations, giving a total of 4 recordings.

Spatial pattern of activity

Seasonal and nightly activity

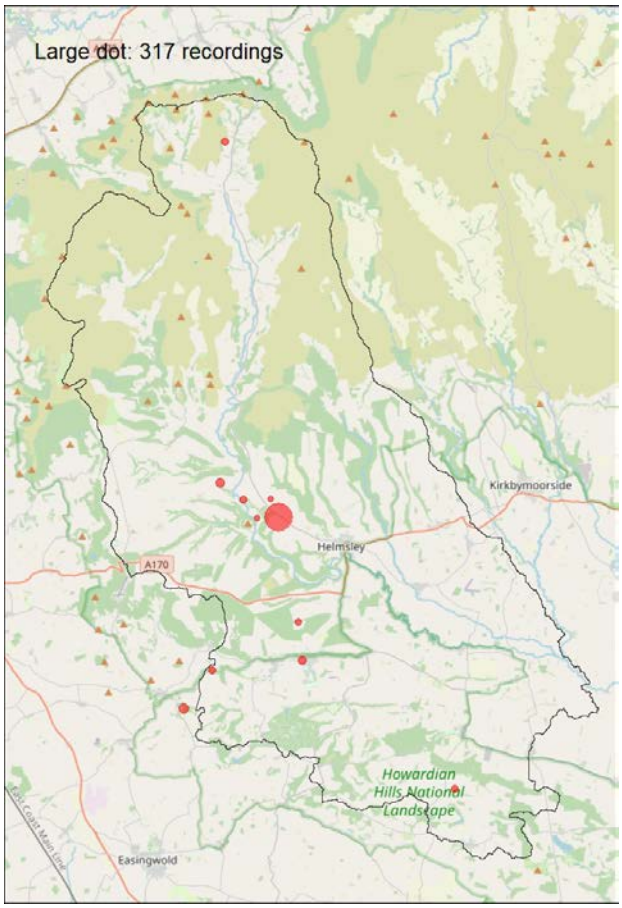


Wood Mouse Compared with the other small terrestrial mammal species here, the calls of Wood Mouse are not as loud, and so are likely to be under-recorded compared with shrews and rats. For more information on the sound identification of Wood Mouse see Newson *et al*. (2021) and Middleton *et al*. (2024).

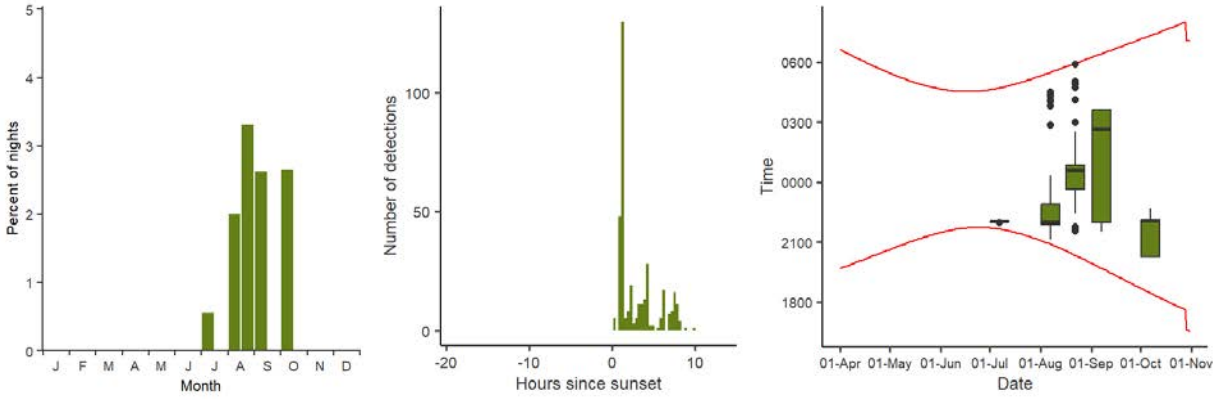
Brown Rat

Brown Rat *Rattus norvegicus* was recorded on 18 nights, from 11 locations, giving a total of 361 recordings.

Spatial pattern of activity



Seasonal and nightly activity

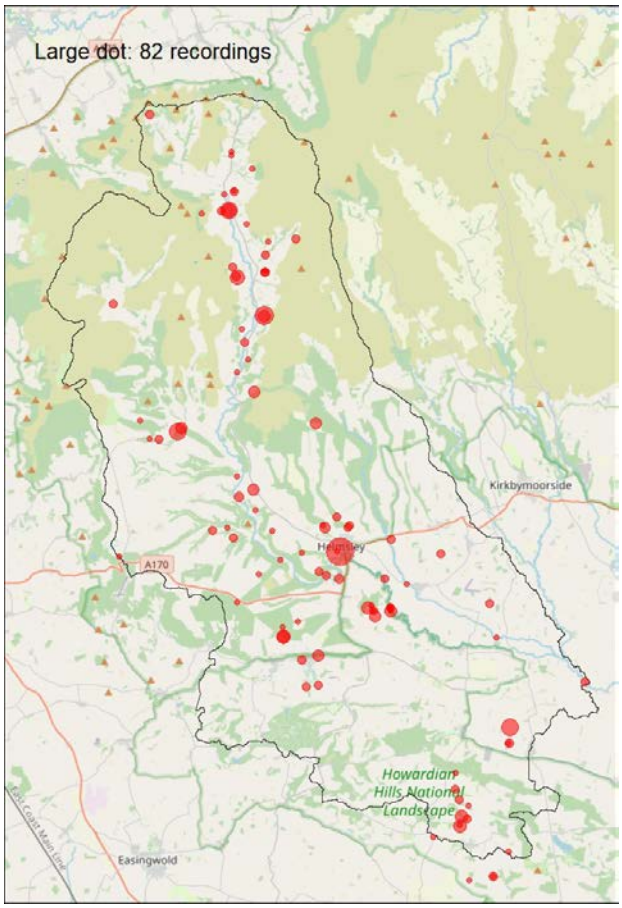


Brown Rat is a highly vocal species that is relative easy to detect using ultrasonic microphones and is regularly recorded incidentally during static bat detector surveys (Newson & Pearce 2022). This species was only recorded from a small number of locations, of which the maximum number of recordings a night was 173 from a location just east of Rievaulx Abbey.

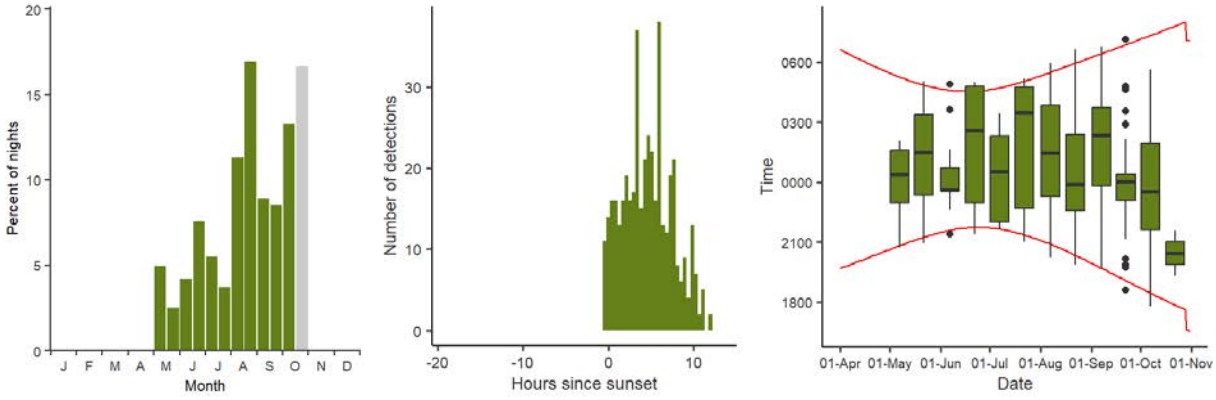
Common Shrew

Common Shrew *Sorex araneus* was recorded on 109 nights, from 99 locations, giving a total of 432 recordings.

Spatial pattern of activity



Seasonal and nightly activity

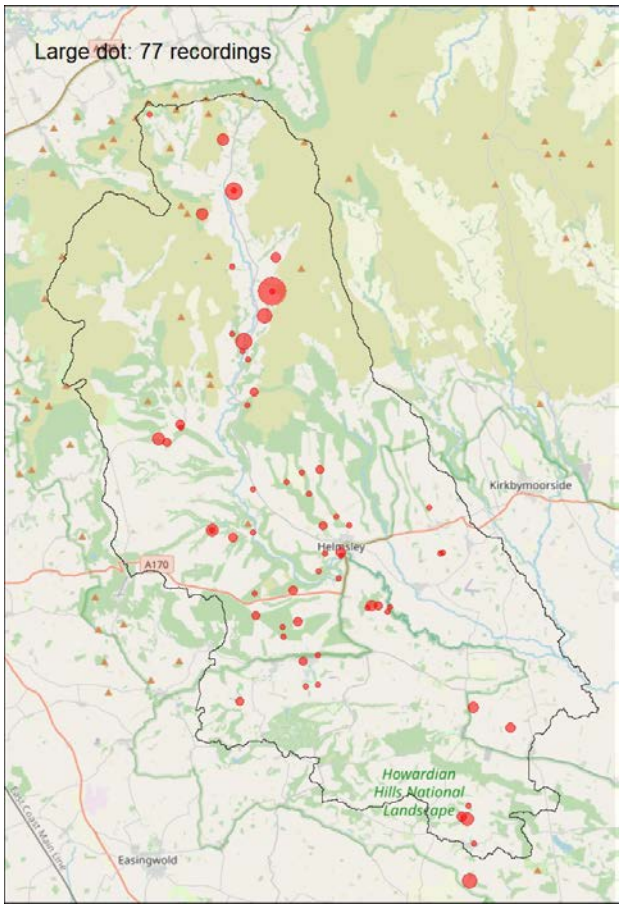


Common Shrew was recorded widely across the Ryevitalise Landscape Partnership Scheme area. Common and Pygmy Shrew produce calls that are notably different from those of Rodents in having multiple harmonics that when played slowed down, produces a warbling sound. In most cases it is possible to separate 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 recordings being quite the same. For more information on the sound identification of shrews, see Newson *et al*., (2021) and Middleton *et al*., (2024).

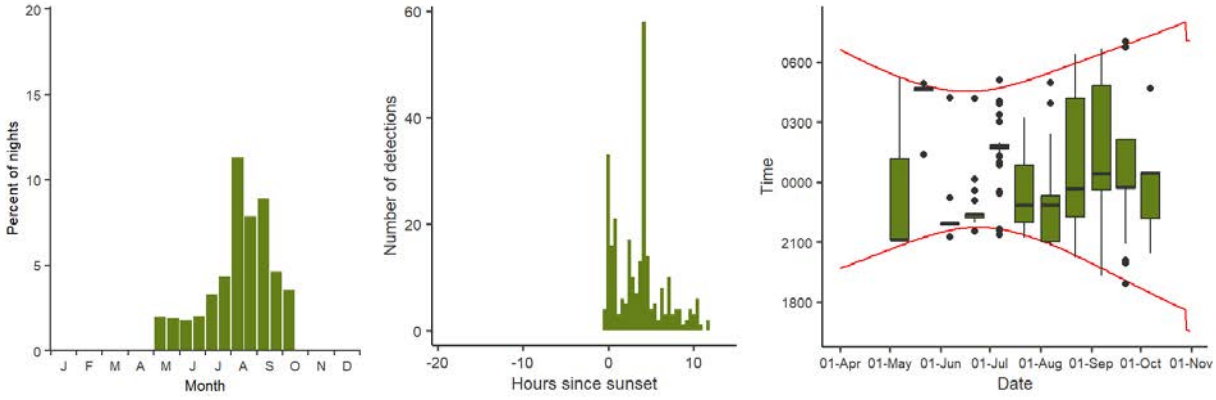
Eurasian Pygmy Shrew

Eurasian Pygmy Shrew *Sorex minutus* was recorded on 73 nights, from 63 locations, giving a total of 269 recordings.

Spatial pattern of activity



Seasonal and nightly activity



Pygmy Shrew was commonly recorded during the project, but particularly notable is one location, east of Fangdale Beck from which there were 78 recordings on 15th July 2022. 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.

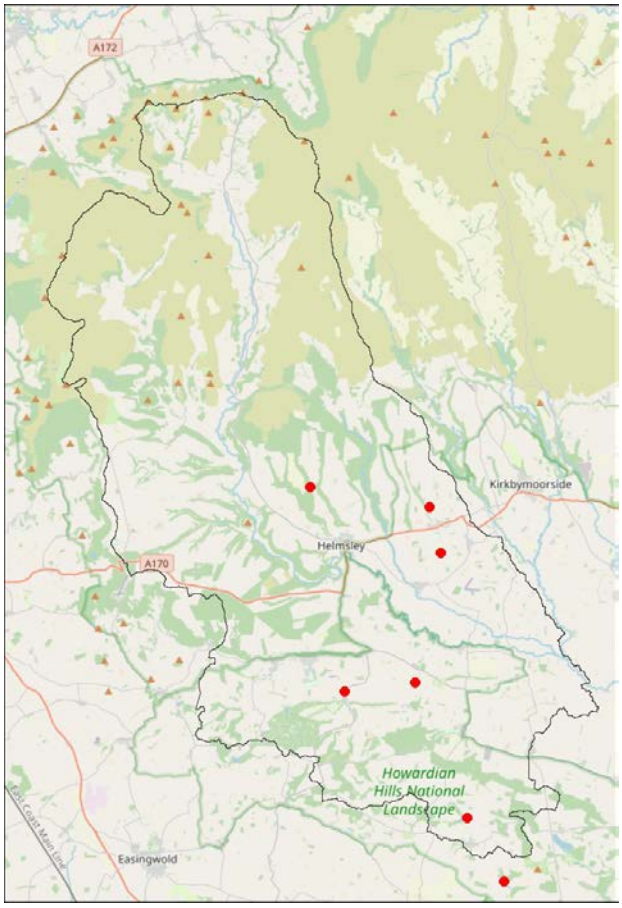
4.3.3 Bush-crickets

Being stationary, and calling for long periods, the number of recordings is not an informative measure of abundance. For this reason, bush-cricket data are shown as presence information rather than activity information.

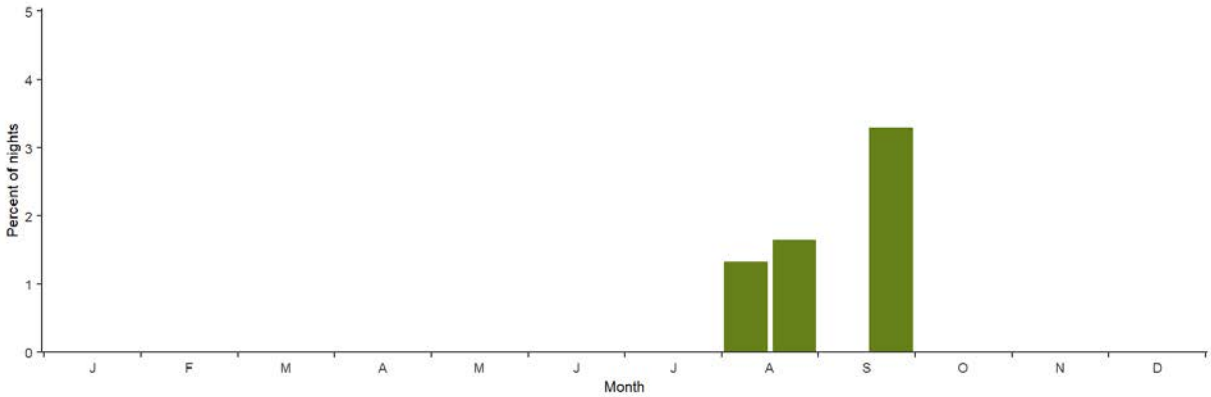
Long-winged Conehead

Long-winged Conehead *Conocephalus fuscus* was recorded on 11 nights, from seven locations.

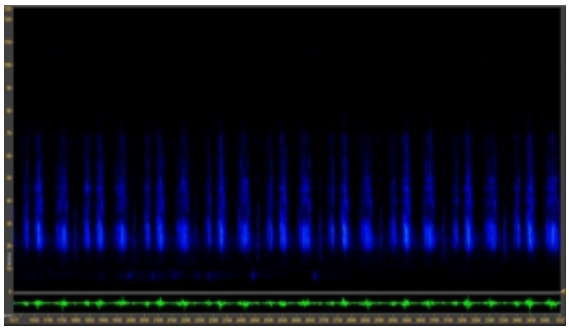
Spatial pattern of detections



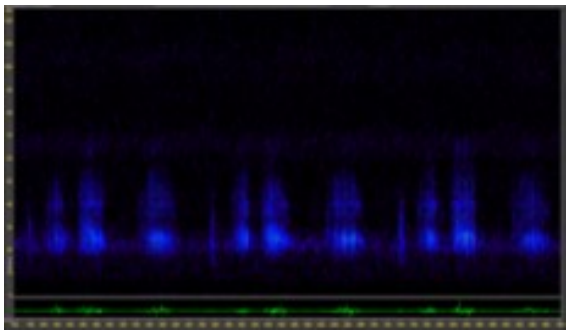
Seasonality



Long-winged Conehead was first recorded in 2022 from two locations, after which this species was recorded in every subsequent year. Long-winged Conehead produces 'calls' with a peak frequency about 26 kHz. It is most similar acoustically to Short-winged Conehead (Middleton 2020), which has not yet been recorded in the survey area, but Long-winged Conehead produces three-syllable calls (two short calls, pause, followed by one longer duration call).



Long-winged Conehead

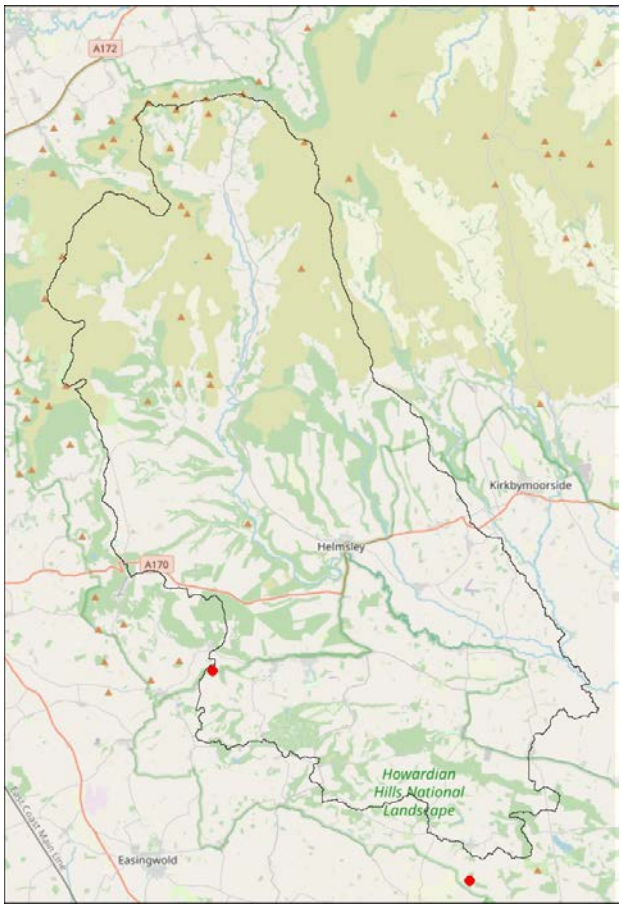


Long-winged Conehead (as left, different scale)

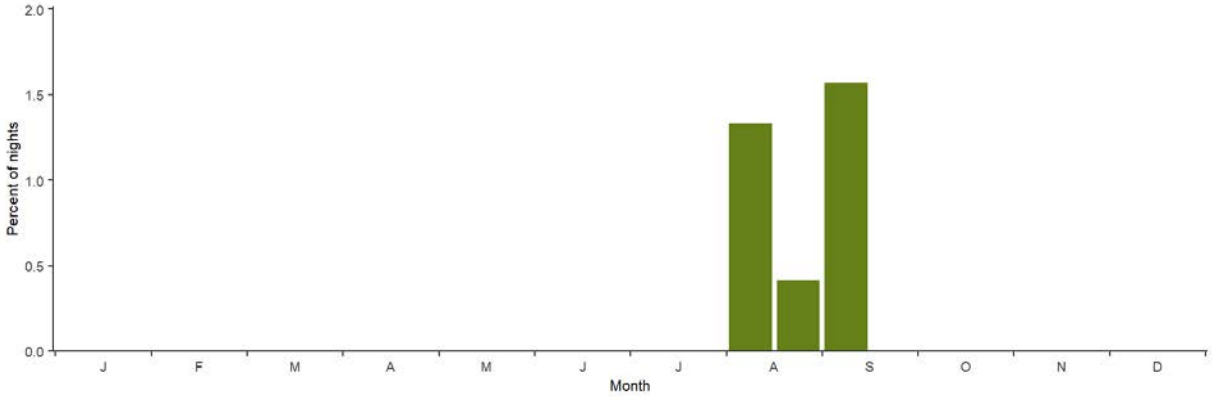
Speckled Bush-cricket

Speckled Bush-cricket *Leptophyes punctatissima* was recorded on six nights, from two locations.

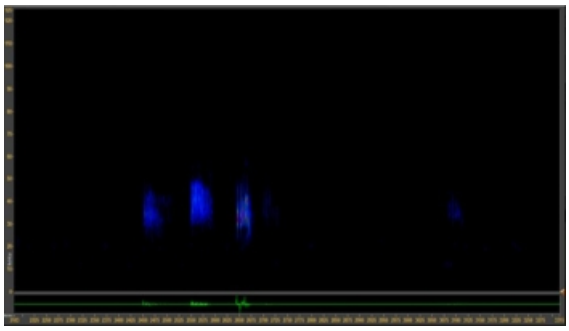
Spatial pattern of detections



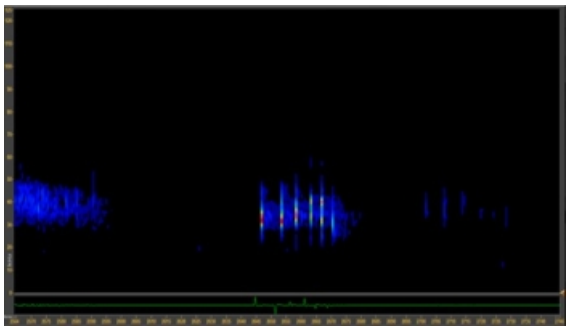
Seasonality



Speckled Bush-cricket. Similar to other bush-cricket species recorded here, Speckled Bush-cricket has been extending its range northwards, and was recorded for the first time in the project in 2024 from two locations. One of these locations was south of Wass where this species was recorded every night from the 31st August until the 3rd September. The second location was just outside the Ryevitalise Landscape Partnership Scheme area south of Terrington on the 12th and 13th August 2024. Speckled Bush-cricket produces distinctive multiple syllable calls. There are normally at least five of these, which are isolated, short and are at high frequency, 30-40 kHz. In this species, the female also calls in response to the male, but the calls normally comprise a shorter call sequence.



Speckled Bush-cricket

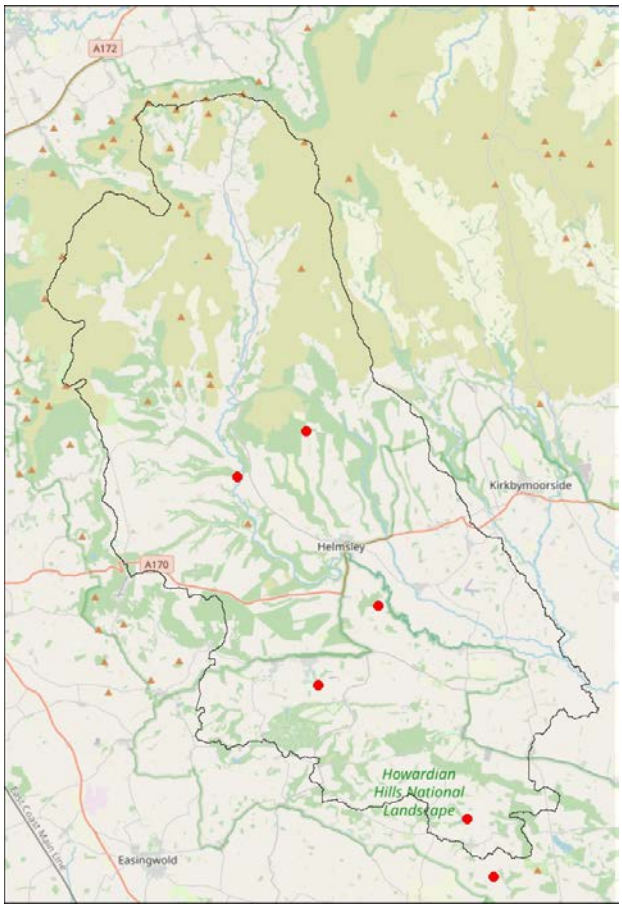


Speckled Bush-cricket (same recording, different scale)

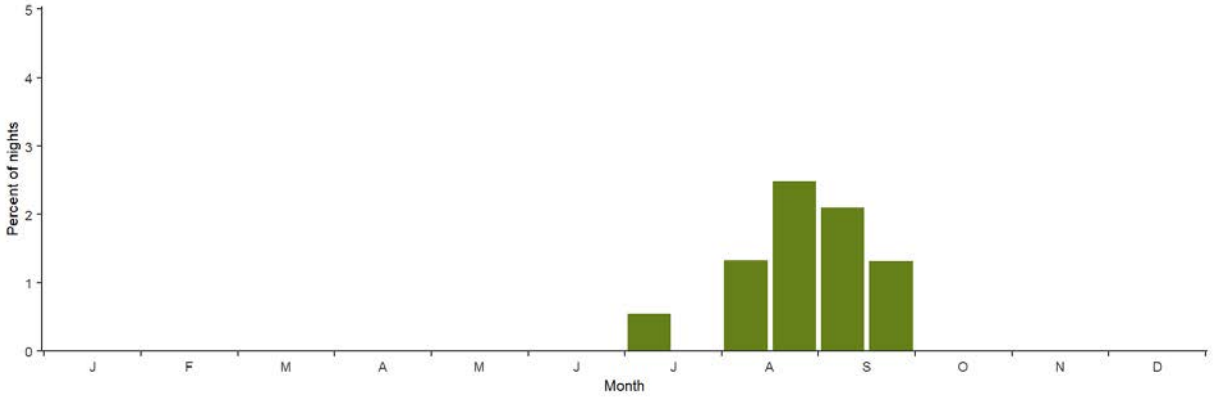
Roesel's Bush-cricket

Roesel's Bush-cricket *Roeseliana roeselii* was recorded on 15 nights, from six locations.

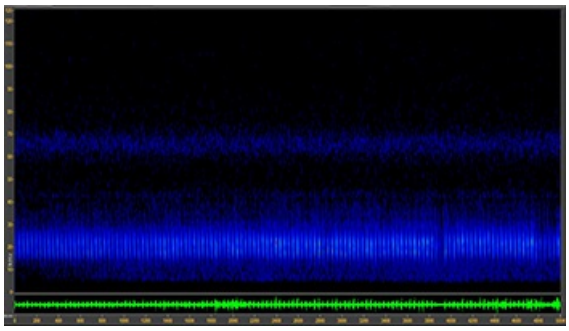
Spatial pattern of detections



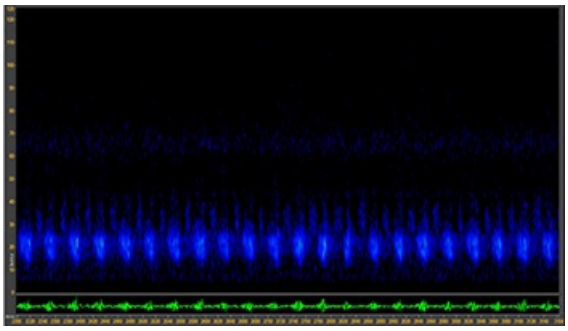
Seasonality



Roesel's Bush-cricket was first recorded from 2023, when it was recorded from four locations. In 2024, it was recorded from two different new locations. Roesel's Bush-cricket produces 'calls' with a peak frequency about 20 kHz. This species is distinctive in producing simple continuous / regular 'calls'. This species most commonly 'calls' between midday and mid-afternoon, but as here, it can be recorded during the evening and sometimes later in the night.



Roesel's Bush-cricket



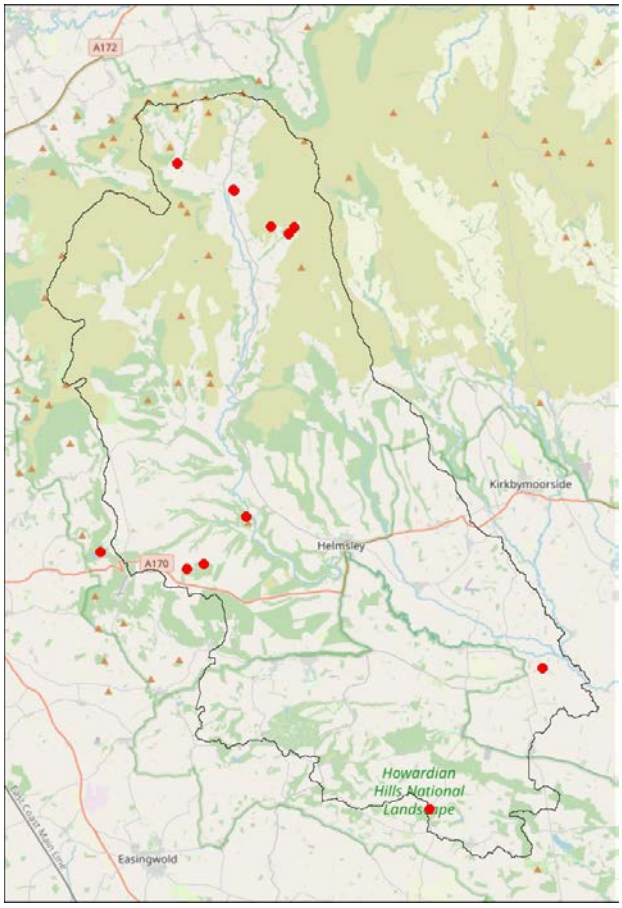
Roesel's Bush-cricket (as left, different scale)

4.3.4 Audible moth species

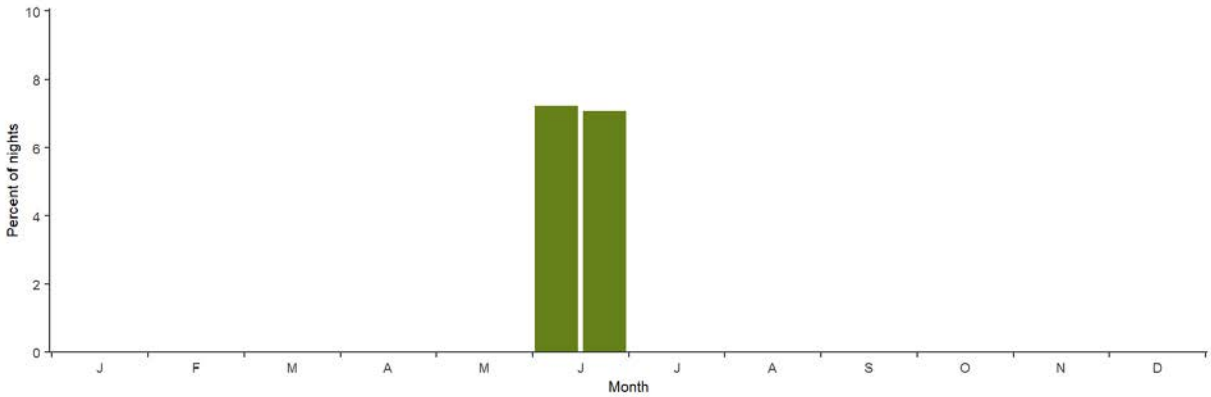
Green Silver-lines

Green Silver-lines *Pseudoips prasinana* was recorded on 19 nights, from 12 locations.

Spatial pattern of detections



Seasonality

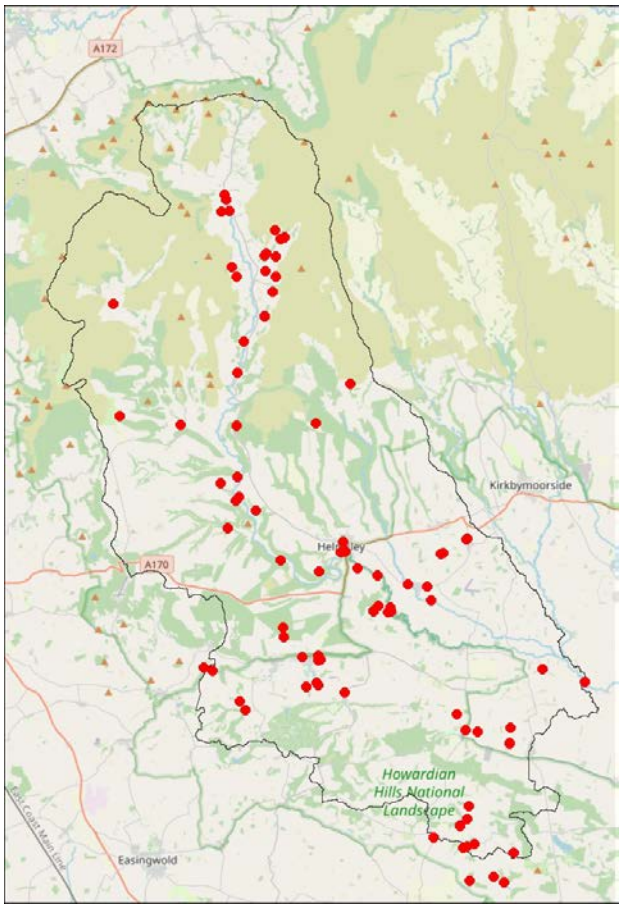


Green Silver-lines was recorded from 12 locations, all in June. Green Silver-lines produce 'calls' that form a very distinctive shape. See Barataud & Skals, (2018) for a description of the sound identification of Green Silver-lines.

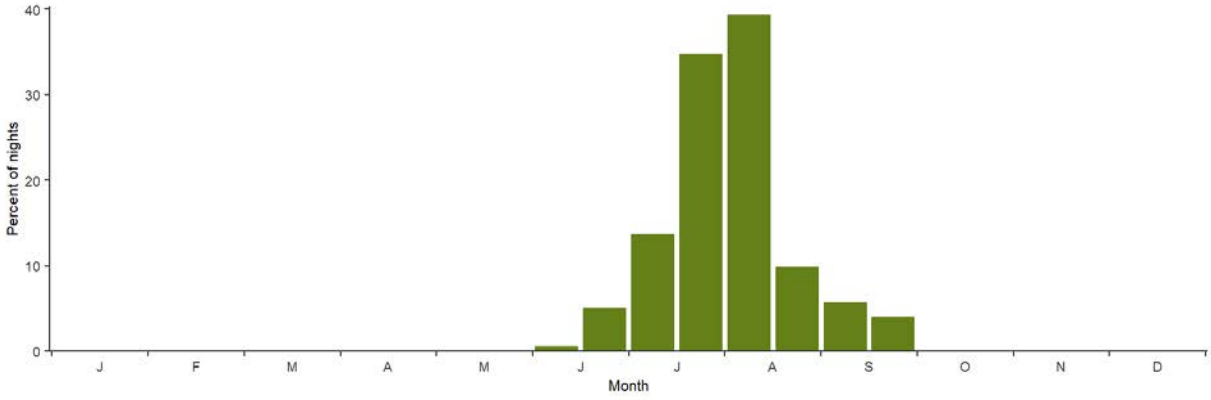
Bird Cherry Ermine

Bird Cherry Ermine *Yponomeuta evonymella* was recorded on 111 nights, from 93 locations.

Spatial pattern of detections



Seasonality



Bird Cherry Ermine The micro-moth Bird Cherry Ermine was widely recorded from 93 locations between mid-May and mid-September, with a peak in the first half of August. 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. In addition to recordings that we have assigned to the two moth species here, we believe that several other currently unidentifiable insect species (probably moths or beetle species), were also recorded.

5. DISCUSSION

The current dataset of 1,235,773 bat recordings from a total of 2,210,993 recordings collected over five survey seasons, has been very valuable in adding to our understanding of patterns of occurrence and activity of bats across the Ryevitalise Landscape Partnership Scheme area, but it also adds to our understanding of some other species groups that were recorded as 'by-catch' during bat surveys. During the project, the presence of at least 10 bat species were confirmed.

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 up to 100-m, compared with a detection distance of Brown Long-eared Bat in closed woodland which is about 5-m (Barataud 2015).

As discussed previously, Brandt's Bat is extremely similar acoustically to Whiskered Bat, so these species have been treated here as a species pair, but looking across recordings, we consider that Brandt's Bat is likely to be the most abundant *Myotis* species after Daubenton's Bat in this project. 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. Of the *Myotis* species, we believe that Alcathoe Bat is the most range restricted. To build on these findings, it would be useful to carry out some targeted work, to capture and ground-truth the identification of Brandt's Bat and Whiskered Bat, and more targeted work on Alcathoe Bat, to be able to better understand the relative status of these species. The data collected through this project could be used to identify sites to target, where there are a consistently large number of recordings a night.

In relation to other species groups recorded as 'by-catch' during bat surveys, four small terrestrial mammal species were recorded, comprising 433 recordings of Common Shrew, 269 recordings of Pygmy Shrew, 361 recordings of Brown Rat and 4 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 was recorded from 12 locations and the micro-moth Bird Cherry Ermine was also recorded from 93 locations. 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. Coinciding with their northward range expansion in England, three species of bush-crickets were also recorded during this project. Long-winged Conehead was first recorded in 2022, Roesel's Bush-cricket from 2023, and Speckled Bush-cricket in 2024.

Whilst it is important that a robust process of 'expert-in-the-loop' manual verification is included in any acoustic project, we demonstrate through this project, that with support from the BTO Acoustic Pipeline, how extensive bat survey data, in this case comprising over 2.2 million sound recordings collected across a 400 km^2 survey area, can be collected and processed. Collecting high-quality bat survey data at this scale, would be extremely challenging without such a system.

Important for the success of this project, has been having a National Park staff member, acting as a survey coordinator who could be the point of first contact for questions from volunteers and landowners each year. Early on in the planning of the project, it was decided that the National Park should liaise between landowners and volunteers over land access permissions and timing of visits. Taking this approach has been valuable for ensuring a good relationship between the National Park and landowners, but this approach has proved very time consuming. This would be an important consideration if the project were to be scaled up in the future, for example, to provide data from across the North York Moors National Park.

Through this project, the main aim was to provide large-scale baseline data on bat distribution and activity across the Ryevitalise Landscape Partnership Scheme area, but if the aim were instead to provide robust trends of change in bat populations over time, a different survey and sampling design would be recommended. For this, we would recommend a more structured survey, where survey locations would be chosen according to a random or stratified sampling design, and where the same locations would be surveyed at the same time/s a year, every year. However, comparable with the survey approach here, we would still recommend that detectors were deployed to record at these locations for a minimum of four complete nights. If producing trends in bat populations becomes an important aim in the future, the data collected here could be used in a power analysis to inform the level of survey effort needed to be able to detect a useful level change in bat distribution or activity.

6. ACKNOWLEDGEMENTS

We would like to thank all the volunteers and fieldworkers who took part in Ryevitalise - Bats and Ancient Trees project in 2020-2024, and to the landowners that gave access to their land. We would also like to thank the Sutton Bank National Park Centre for hosting bat detectors for the project. Lastly we would like to thank the National Lottery Heritage Fund for funding this project.

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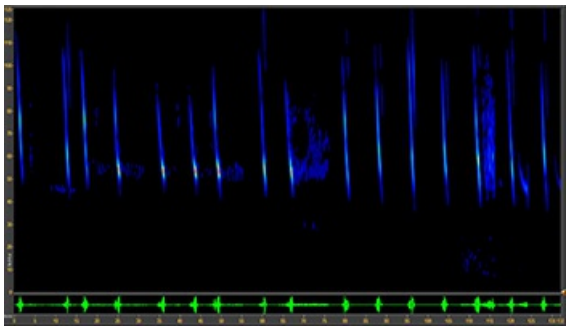
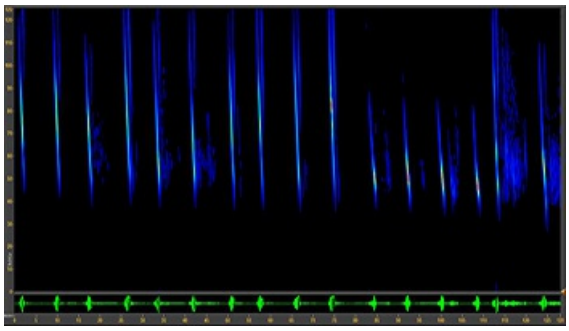
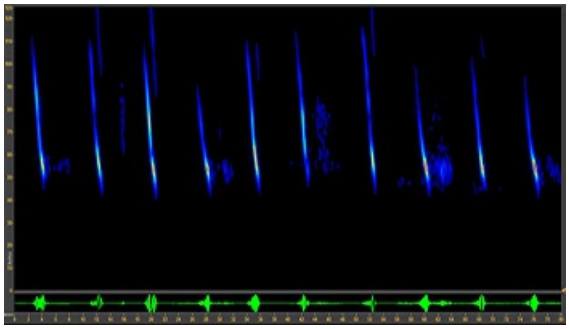
Identification appendix 1: Alcathoe Bat *Myotis alcathoe* and Whiskered Bat *Myotis mystacinus*



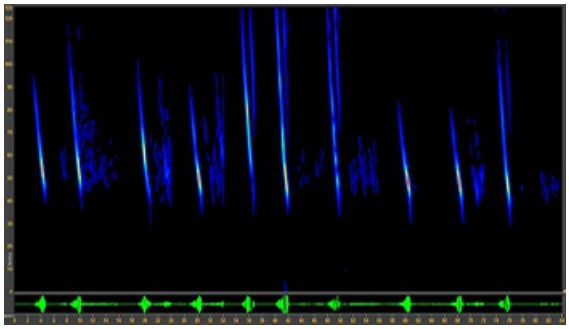
Alcathoe Bat - call duration 1.3-1.6 ms



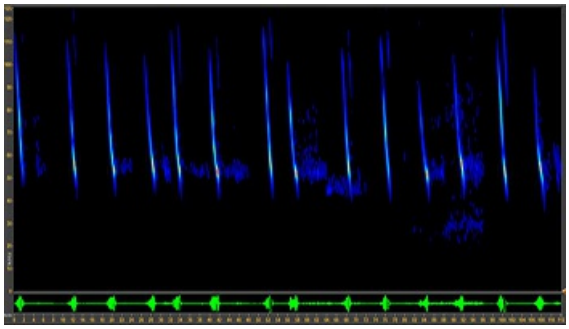
Whiskered Bat - call duration 1.3-1.6 ms



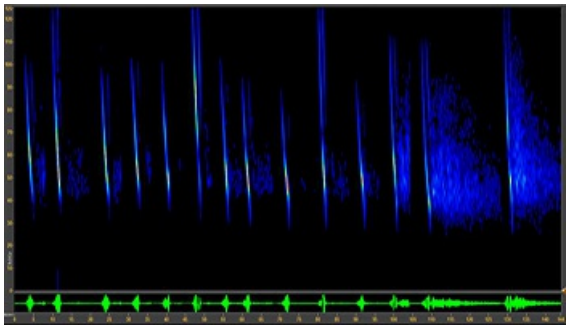
Alcathoe Bat - call duration 1.7-1.8 ms



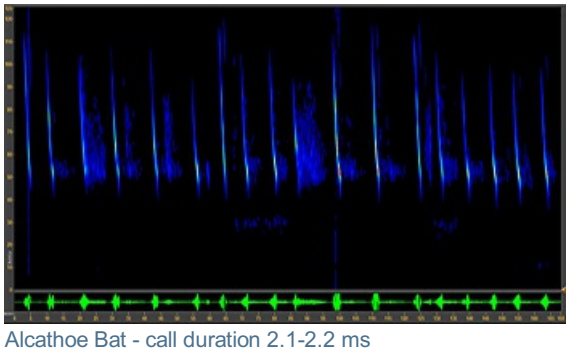
Whiskered Bat - call duration 1.7-1.8 ms



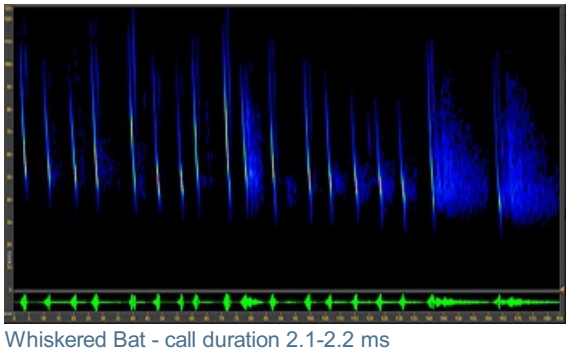
Alcathoe Bat - call duration 1.9-2.0 ms



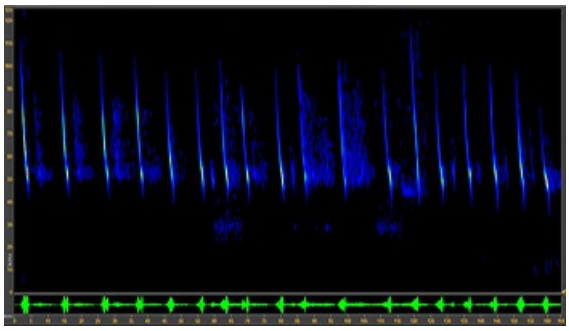
Whiskered Bat - call duration 1.9-2.0 ms



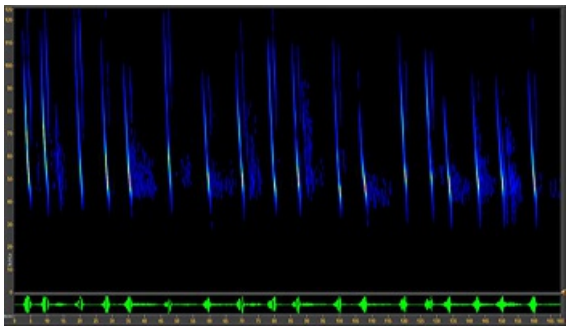
Alcathoe Bat - call duration 2.1-2.2 ms



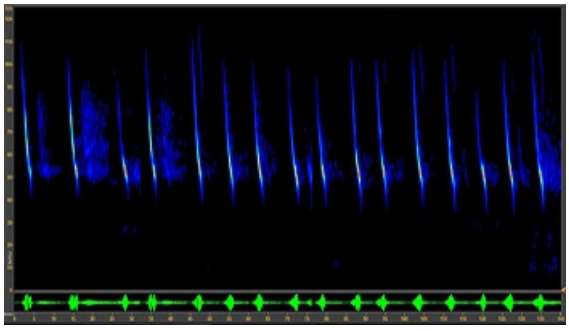
Whiskered Bat - call duration 2.1-2.2 ms



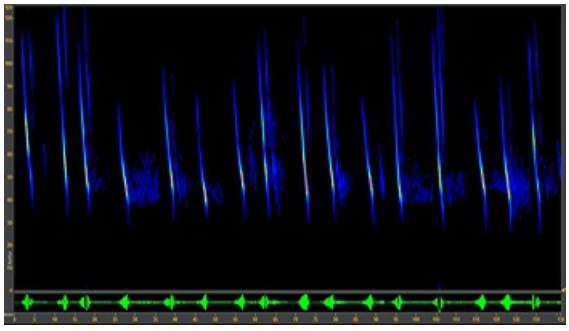
Alcathoe Bat - call duration 2.3-2.4 ms



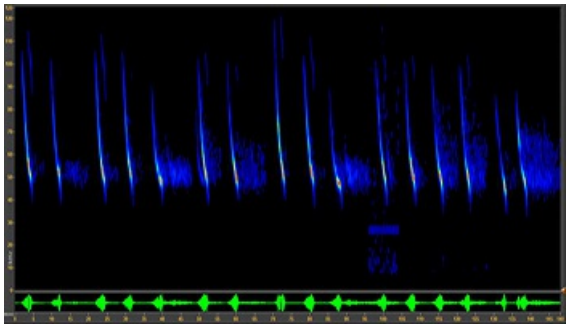
Whiskered Bat - call duration 2.3-2.4 ms



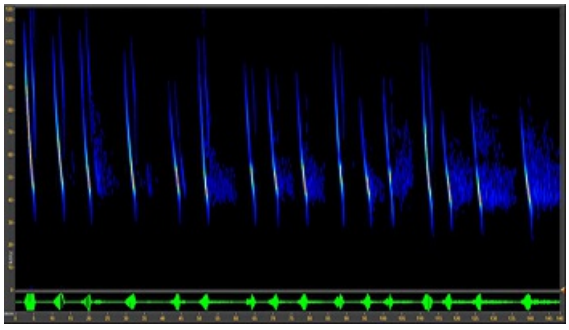
Alcathoe Bat - call duration 2.5-2.6 ms



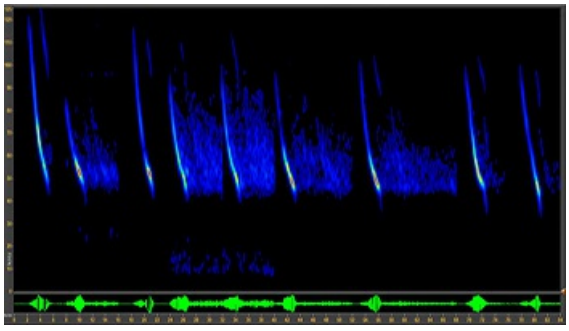
Whiskered Bat - call duration 2.5-2.6 ms



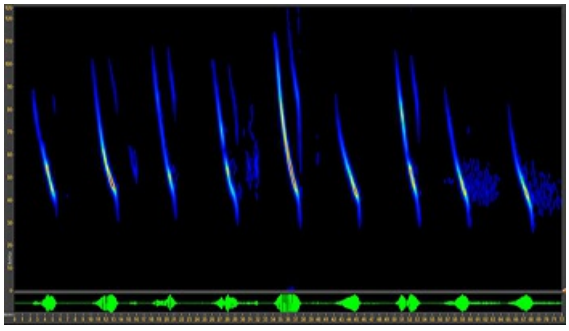
Alcathoe Bat - call duration 2.7-2.9 ms



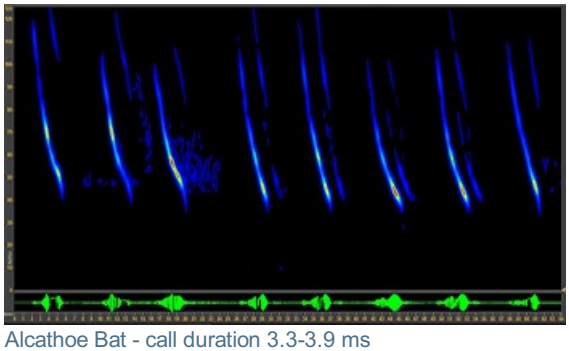
Whiskered Bat - call duration 2.7-2.9 ms



Alcathoe Bat - call duration 3.0-3.2 ms



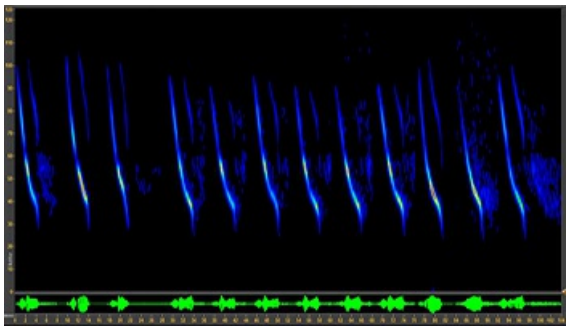
Whiskered Bat - call duration 3.0-3.2 ms



Alcathoe Bat - call duration 3.3-3.9 ms

Whiskered Bat - call duration 3.3-3.9 ms

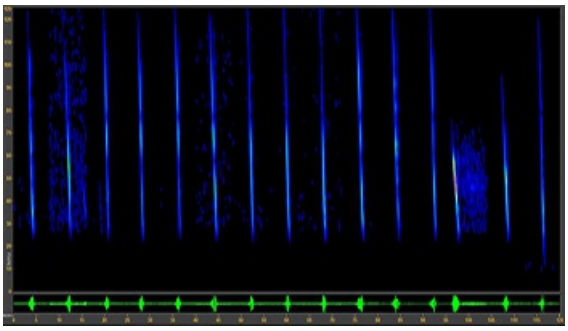
Alcathoe Bat - no examples for this call duration



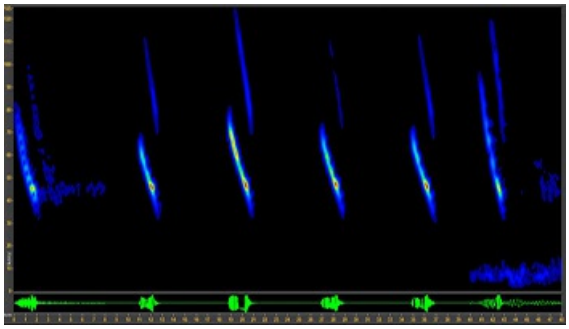
Whiskered Bat - call duration 4.0-5.1 ms

Identification appendix 2: Daubenton's Bat *Myotis daubentonii* and Natterer's Bat *Myotis nattereri*

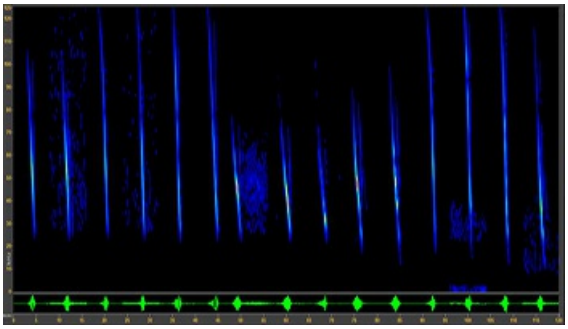
Daubenton's Bat - call duration up to 1.4 ms no examples



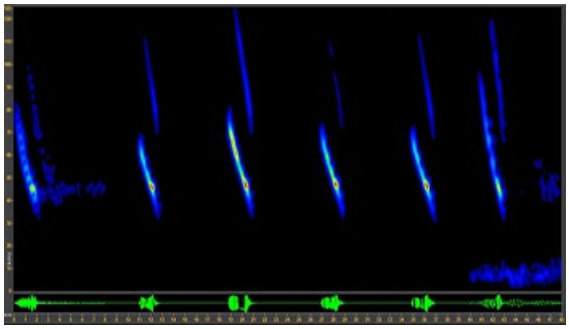
Natterer's Bat - call duration up to 1.4 ms



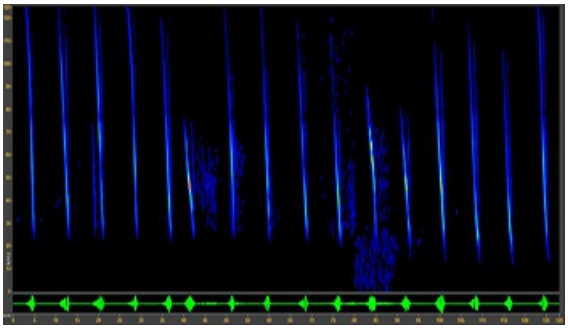
Daubenton's Bat - call duration 1.5-2.0 ms



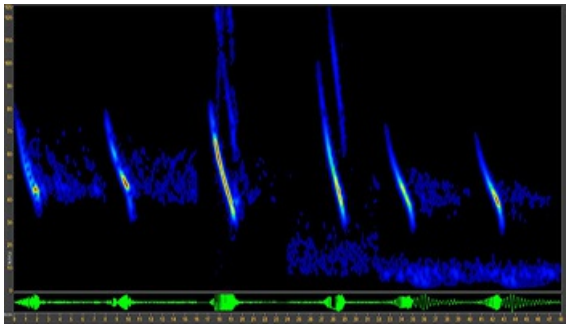
Natterer's Bat - call duration 1.5-2.0 ms



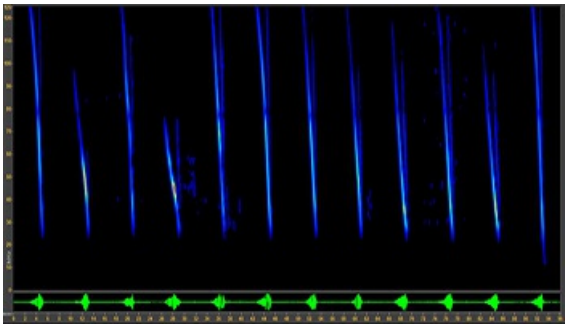
Daubenton's Bat - call duration 2.1-2.3 ms



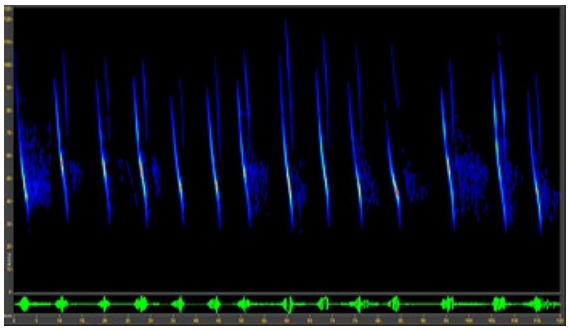
Natterer's Bat - call duration 2.1-2.3 ms



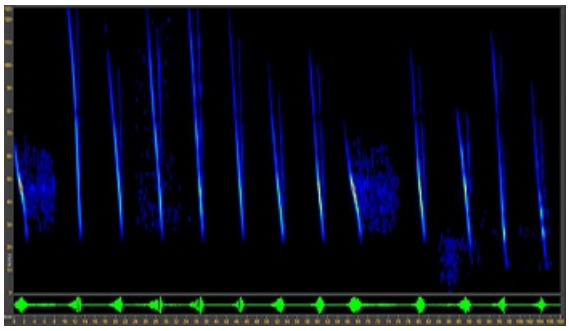
Daubenton's Bat - call duration 2.4-2.5 ms



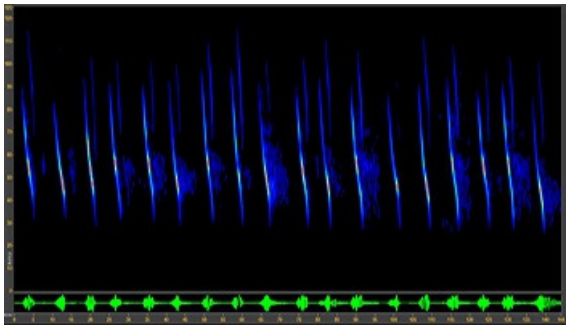
Natterer's Bat - call duration 2.4-2.5 ms



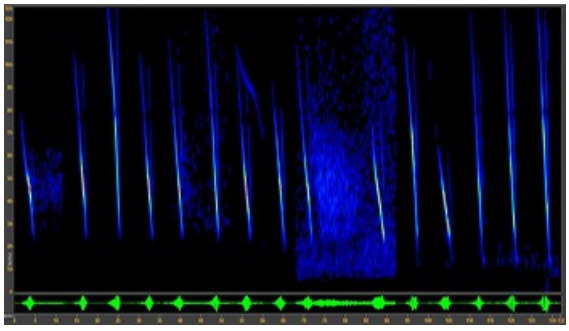
Daubenton's Bat - call duration 2.6-2.7 ms



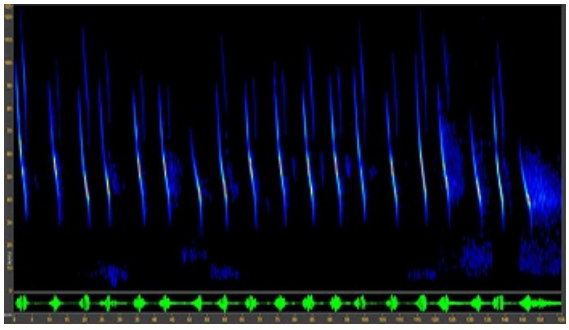
Natterer's Bat - call duration 2.6-2.7 ms



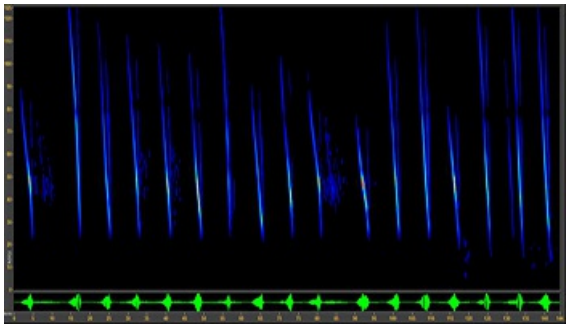
Daubenton's Bat - call duration 2.8-2.9 ms



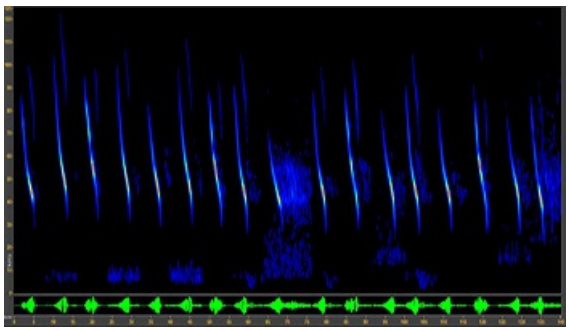
Natterer's Bat - call duration 2.8-2.9 ms



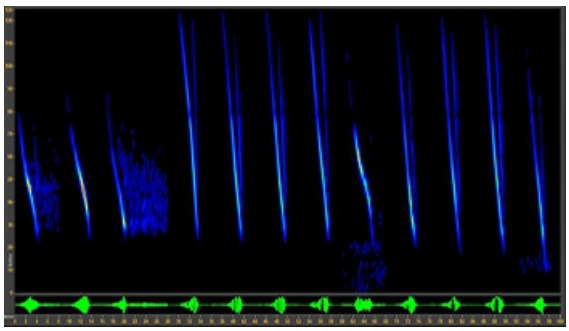
Daubenton's Bat - call duration 3.0-3.1 ms



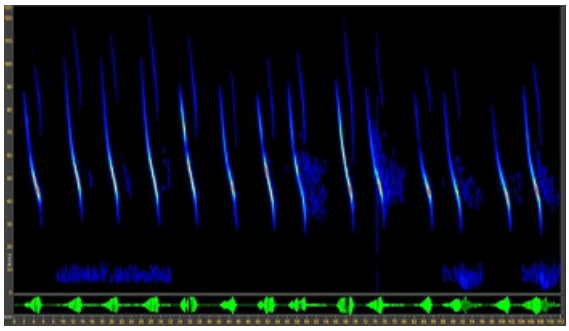
Natterer's Bat - call duration 3.0-3.1 ms



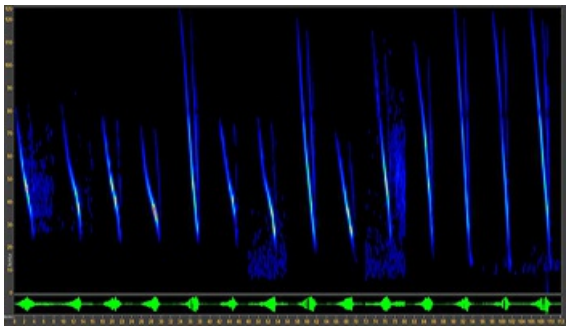
Daubenton's Bat - call duration 3.2-3.3 ms



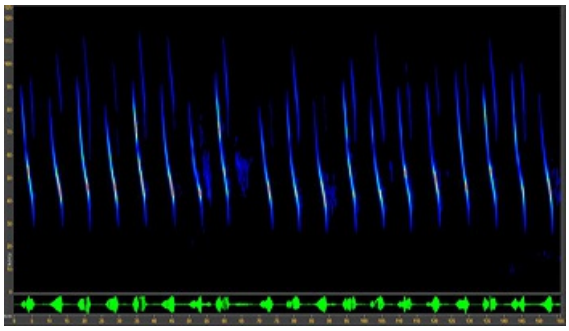
Natterer's Bat - call duration 3.2-3.3 ms



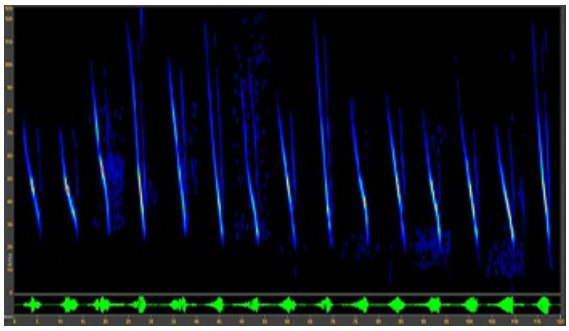
Daubenton's Bat - call duration 3.4-3.5 ms



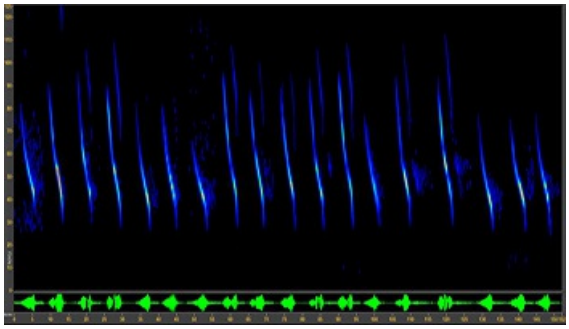
Natterer's Bat - call duration 3.4-3.5 ms



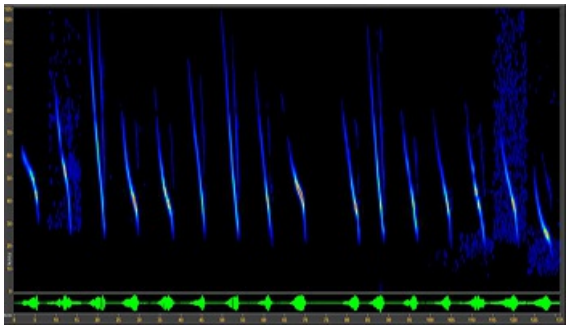
Daubenton's Bat - call duration 3.6-3.7 ms



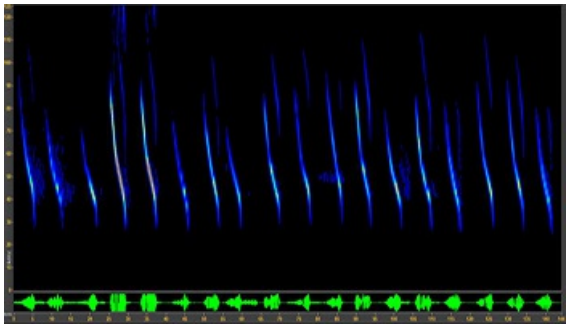
Natterer's Bat - call duration 3.6-3.7 ms



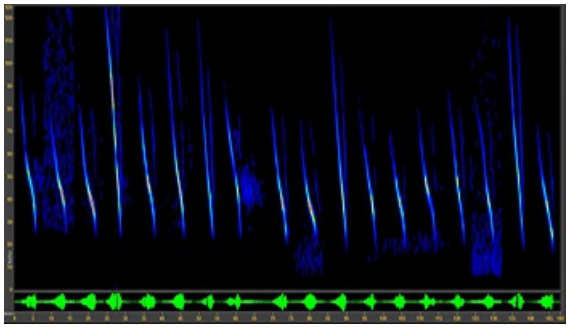
Daubenton's Bat - call duration 3.8-3.9 ms



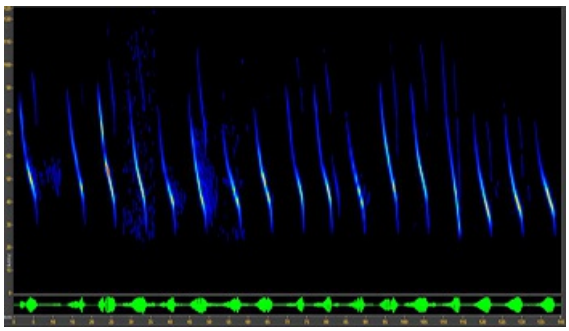
Natterer's Bat - call duration 3.8-3.9 ms



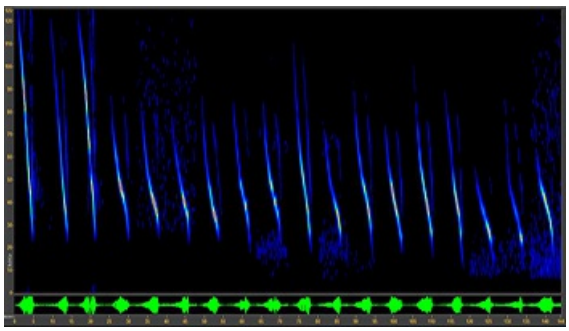
Daubenton's Bat - call duration 4.0-4.1 ms



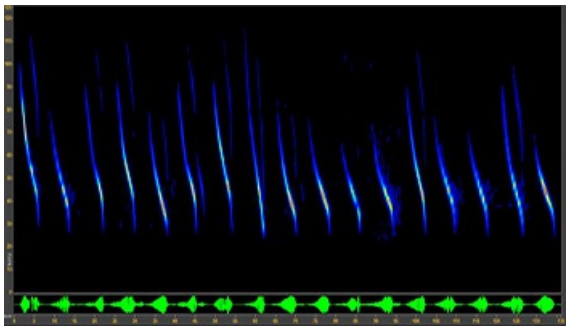
Natterer's Bat - call duration 4.0-4.1 ms



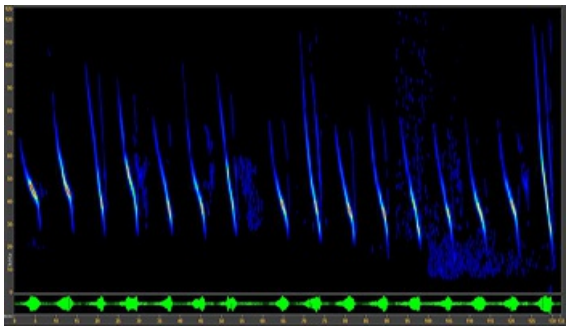
Daubenton's Bat - call duration 4.2-4.3 ms



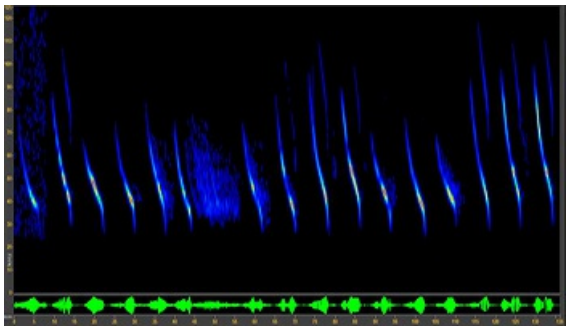
Natterer's Bat - call duration 4.2-4.3 ms



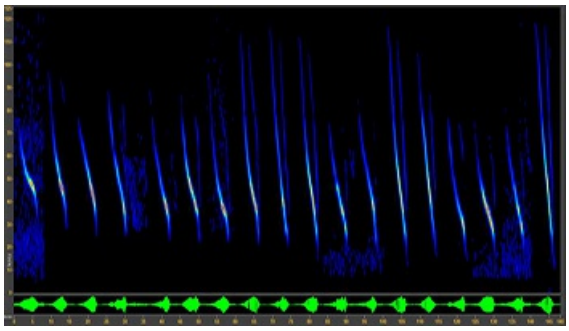
Daubenton's Bat - call duration 4.4-4.5 ms



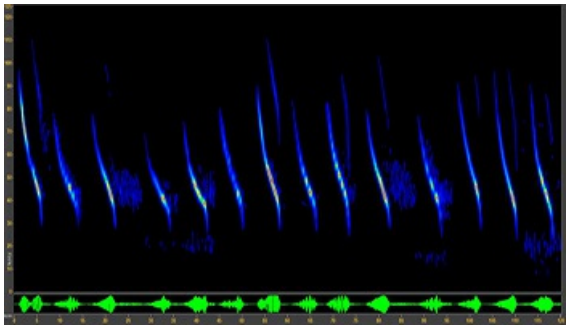
Natterer's Bat - call duration 4.4-4.5 ms



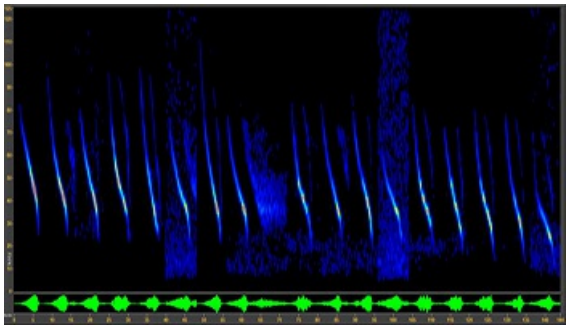
Daubenton's Bat - call duration 4.6-4.7 ms



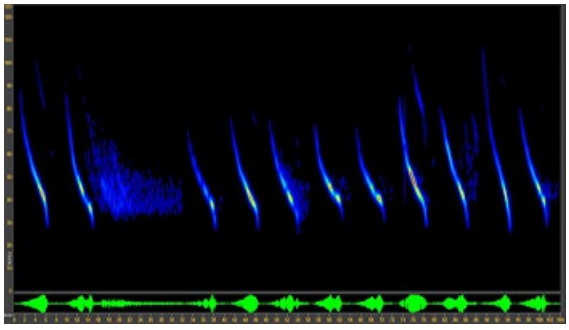
Natterer's Bat - call duration 4.6-4.7 ms



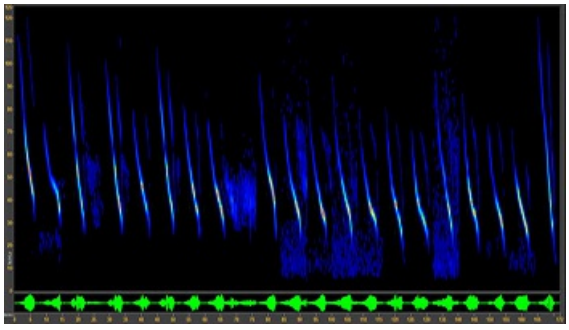
Daubenton's Bat - call duration 4.8-4.9 ms



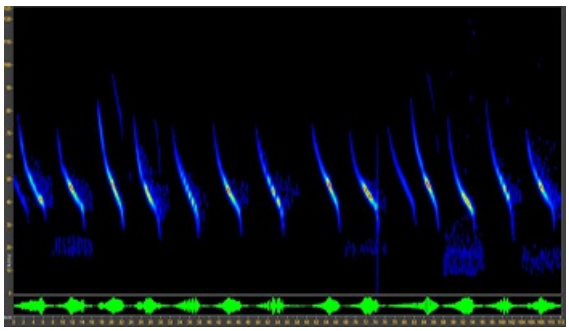
Natterer's Bat - call duration 4.8-4.9 ms



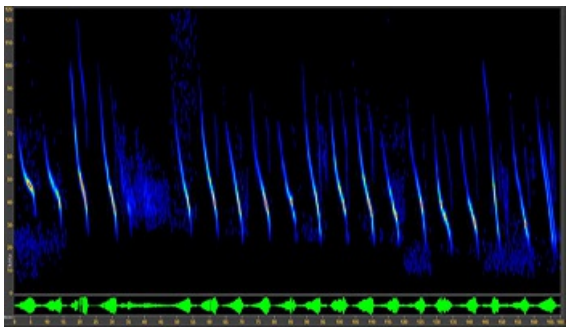
Daubenton's Bat - call duration 5.0-5.1 ms



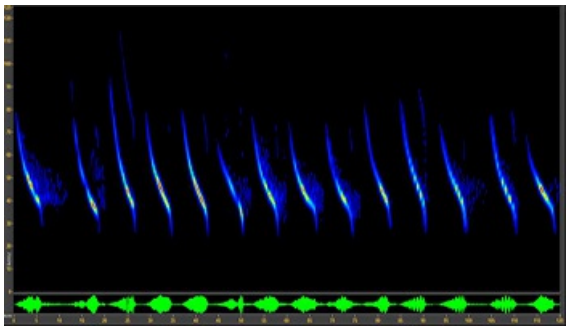
Natterer's Bat - call duration 5.0-5.1 ms



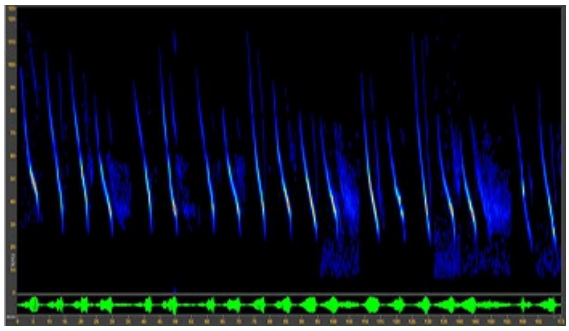
Daubenton's Bat - call duration 5.2-5.3 ms



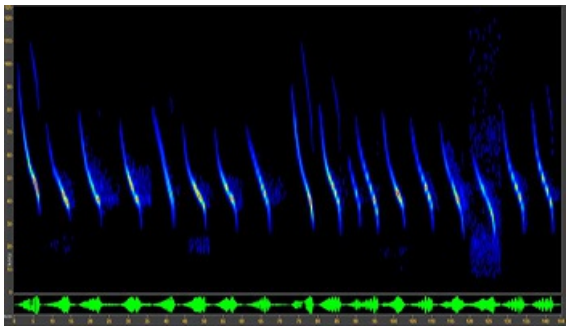
Natterer's Bat - call duration 5.2-5.3 ms



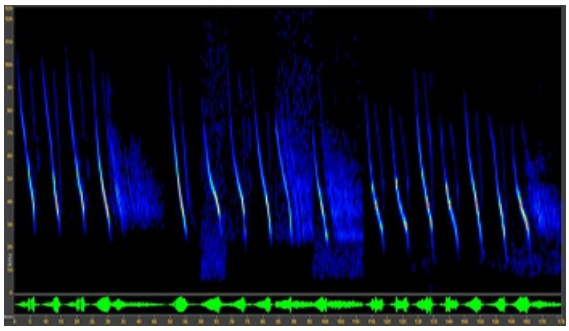
Daubenton's Bat - call duration 5.4-5.5 ms



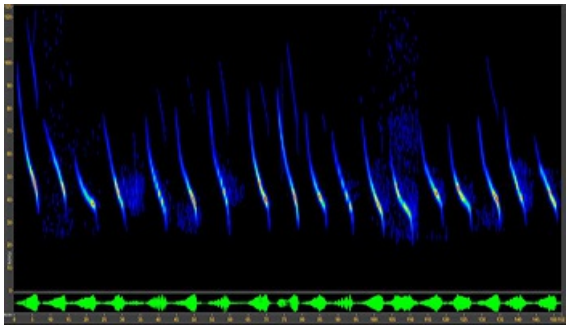
Natterer's Bat - call duration 5.4-5.5 ms



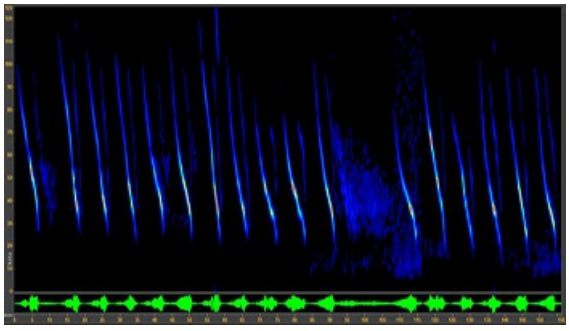
Daubenton's Bat - call duration 5.6-5.7 ms



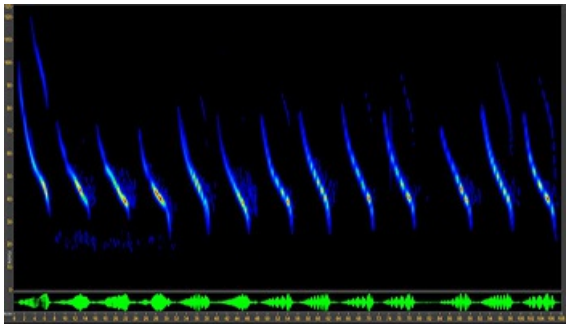
Natterer's Bat - call duration 5.6-5.7 ms



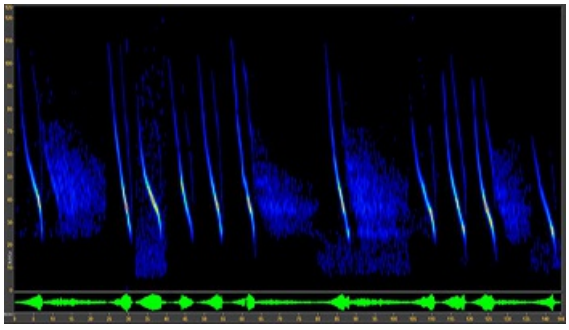
Daubenton's Bat - call duration 5.8-5.9 ms



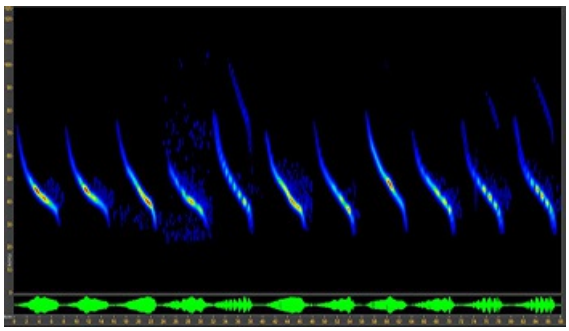
Natterer's Bat - call duration 5.8-5.9 ms



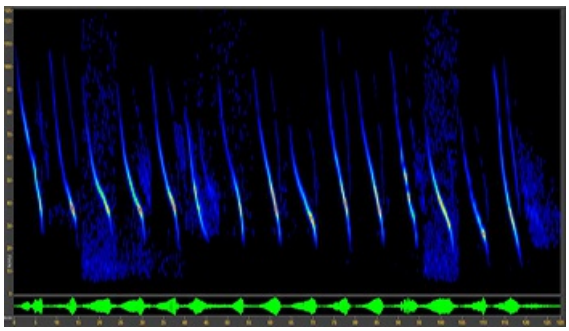
Daubenton's Bat - call duration 6.0-6.1 ms



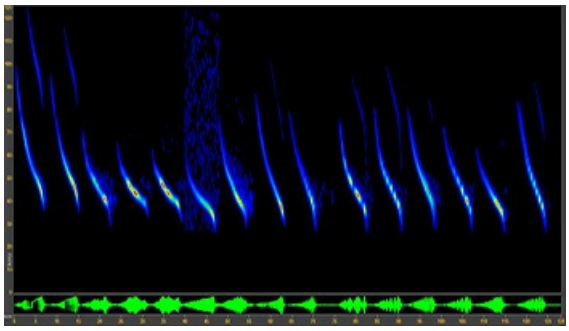
Natterer's Bat - call duration 6.0-6.1 ms



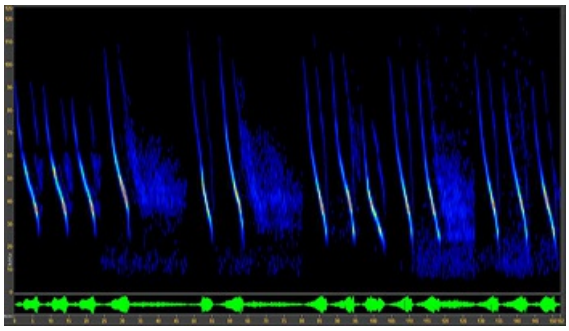
Daubenton's Bat - call duration 6.2-6.3 ms



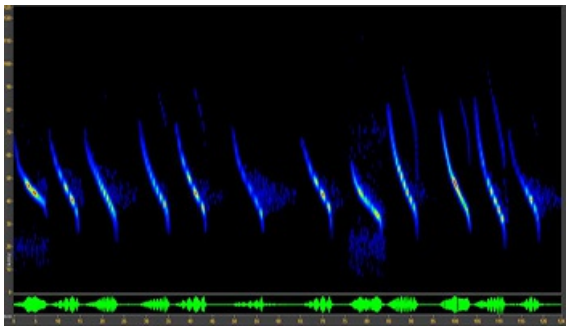
Natterer's Bat - call duration 6.2-6.3 ms



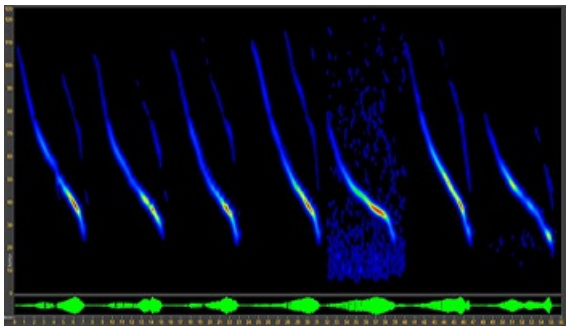
Daubenton's Bat - call duration 6.4-6.6 ms



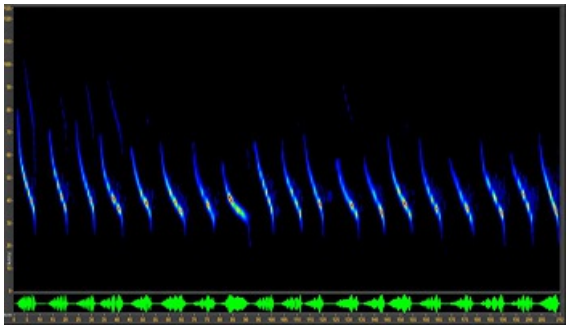
Natterer's Bat - call duration 6.4-6.6 ms



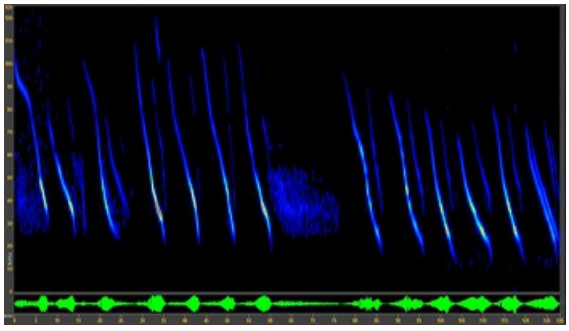
Daubenton's Bat - call duration 6.7-6.8 ms



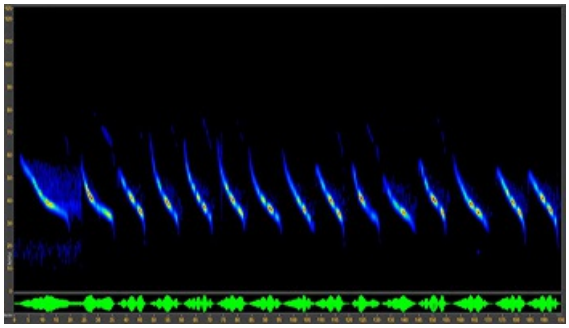
Natterer's Bat - call duration 6.7-6.8 ms



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

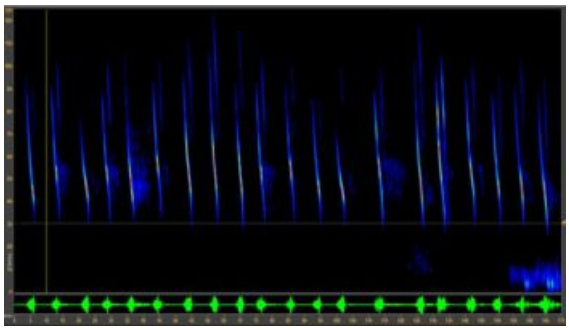
Identification appendix 3: Whiskered/Brandt's Bat *Myotis mystacinus/brandtii*

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.

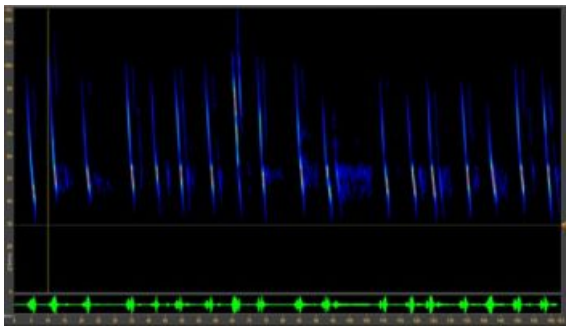
Given a *Myotis* recording, an important first consideration is the quality of the recording. Firstly, to consider whether there is significant overloading across calls that makes it difficult to determine the start and end of the calls. There is a bit of overloading in a few of the recordings of Whiskered 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.

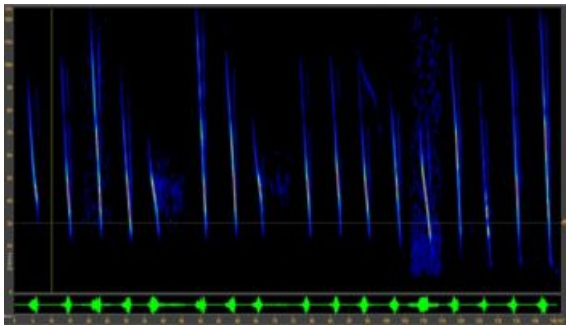
If the quality of the recordings and calls is good, we would normally expect to have a good idea of what species produced it, but it is helpful next to consider what you would expect calls of that species, given that call duration to look like, and to consider how this compares with other similar species. 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.



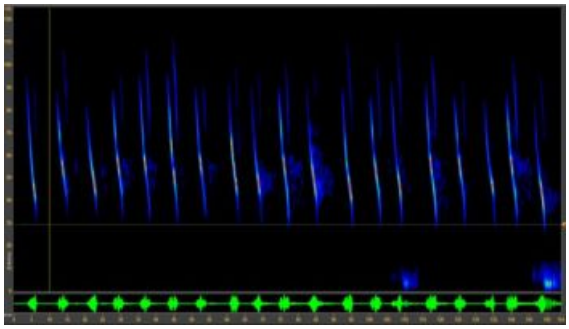
Whiskered or Brandt's Bat call (left), against known Whiskered calls (right)



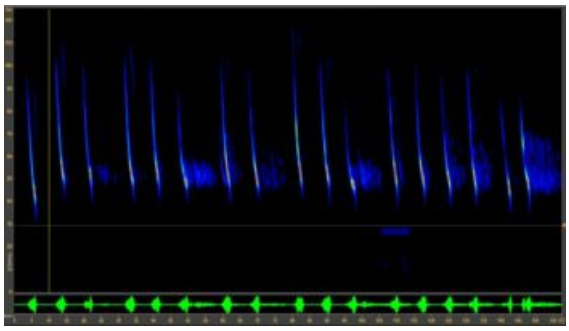
Whiskered or Brandt's Bat call (left), against known Brandt's Bat calls (right)



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



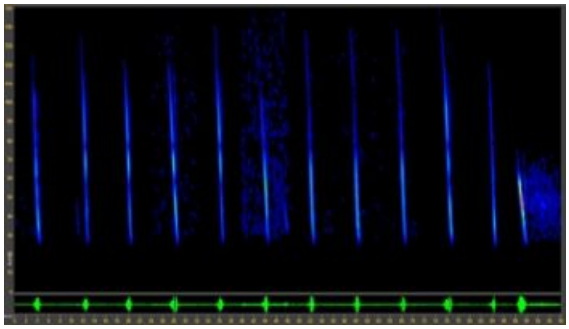
Whiskered or Brandt's Bat call (left), against known Daubenton's Bat calls (right)



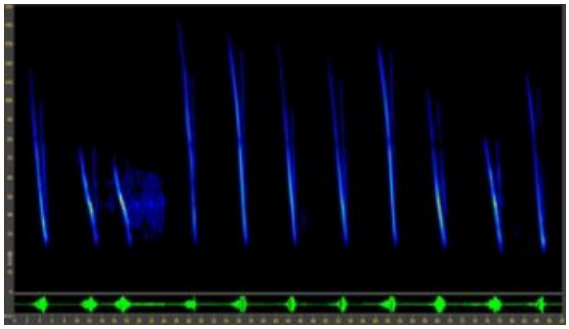
Whiskered or Brandt's Bat call (left), against known Alcathoe Bat calls (right)

Identification appendix 4: Natterer's Bat *Myotis nattereri*

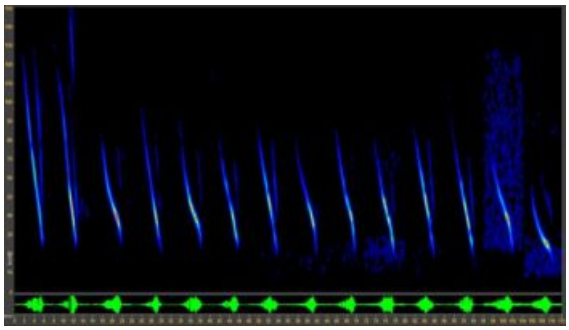
As with Whiskered and Brandt's Bat, the first consideration when looking at recordings is the quality of the recording, to consider whether the quality is good enough to try to assign the recording to species. Given a good recording, Natterer's Bat can occasionally produce atypical calls that could be 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.



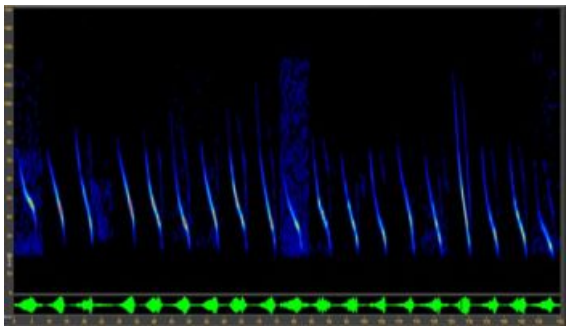
Natterer's Bat - call duration up to 1.2 ms



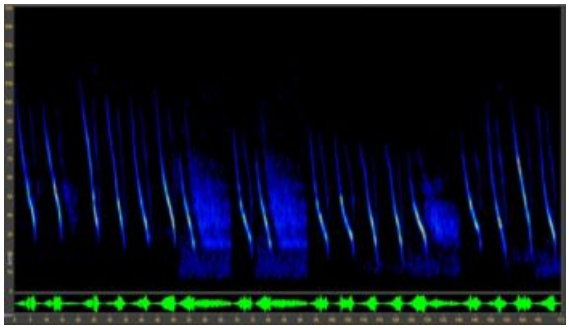
Natterer's Bat - call duration 2.7-2.8 ms



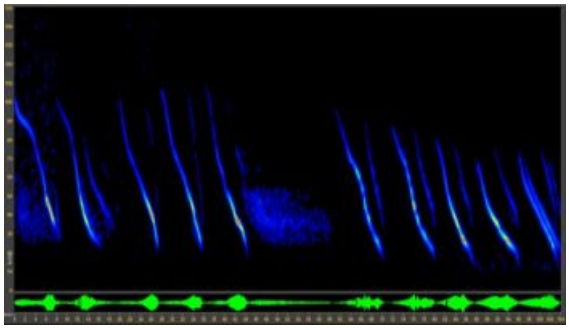
Natterer's Bat - call duration 3.9-4.0 ms



Natterer's Bat - call duration 4.9-5.0 ms

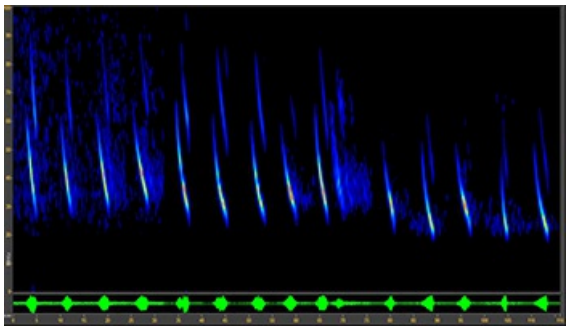


Natterer's Bat - call duration 5.9-6.0 ms

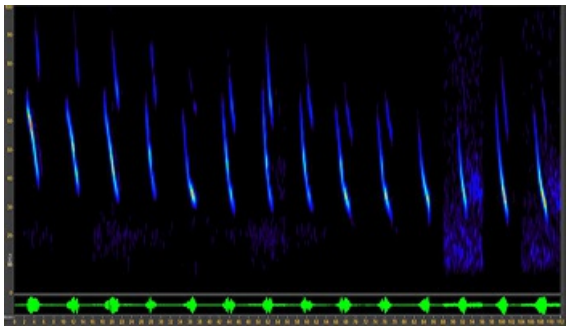


Natterer's Bat - call duration 7.1-9.4 ms

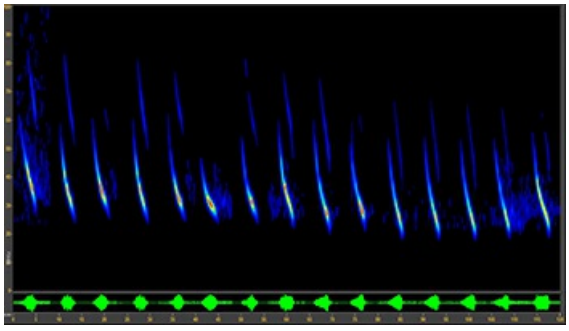
Identification appendix 5: Common Noctule *Nyctalus noctula* and Leisler's Bat *Nyctalus leisleri*



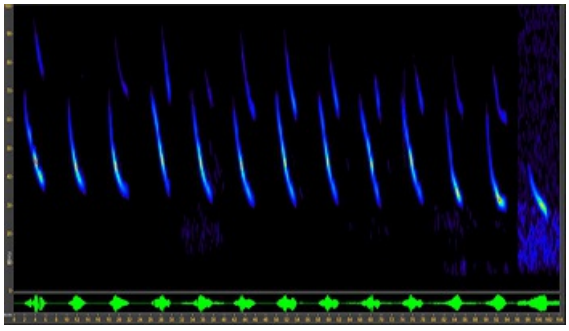
Common Noctule - call duration 1.4-3.0 ms



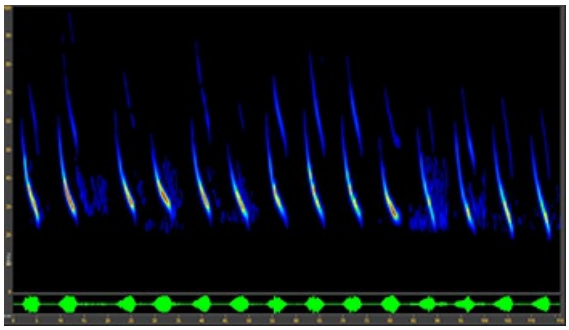
Leisler's Bat - call duration 1.4-3.0 ms



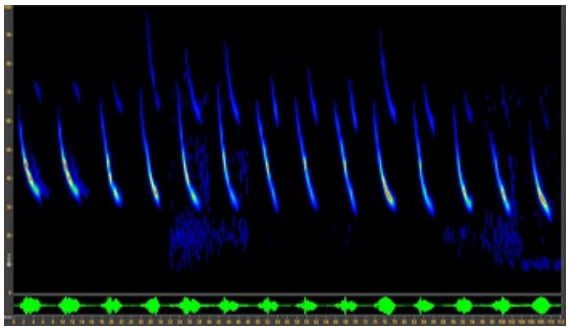
Common Noctule - call duration 3.1-3.7 ms



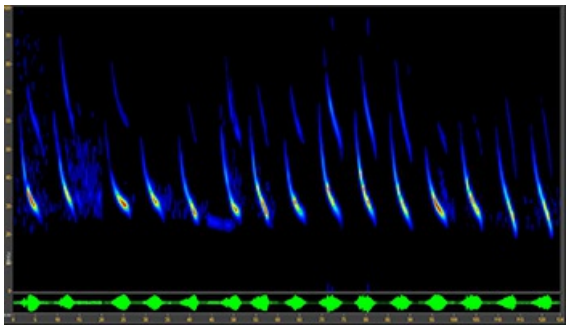
Leisler's Bat - call duration 3.1-3.7 ms



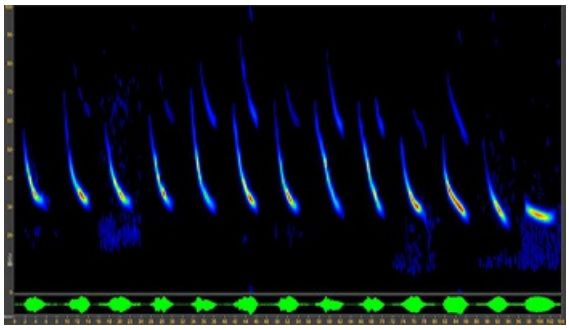
Common Noctule - call duration 3.8-4.3 ms



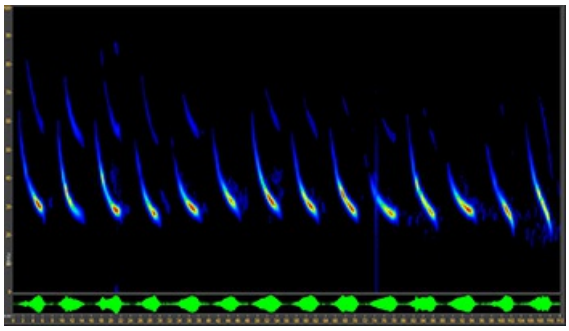
Leisler's Bat - call duration 3.8-4.3 ms



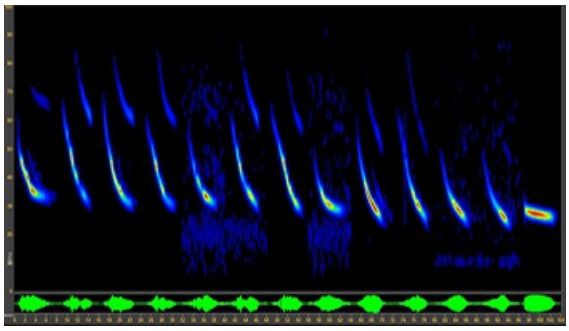
Common Noctule - call duration 4.4-4.9 ms



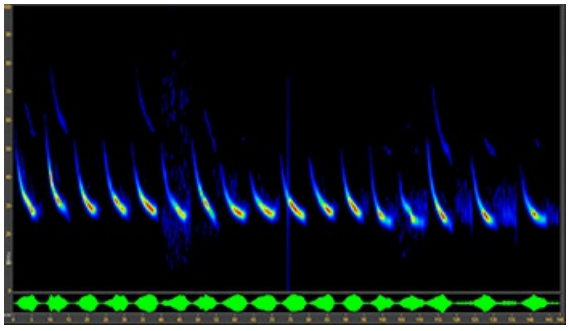
Leisler's Bat - call duration 4.4-4.9 ms



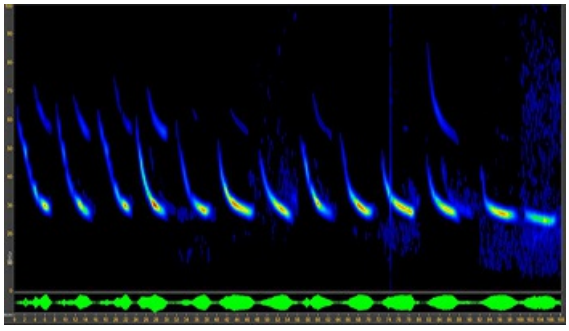
Common Noctule - call duration 5.0-5.9 ms



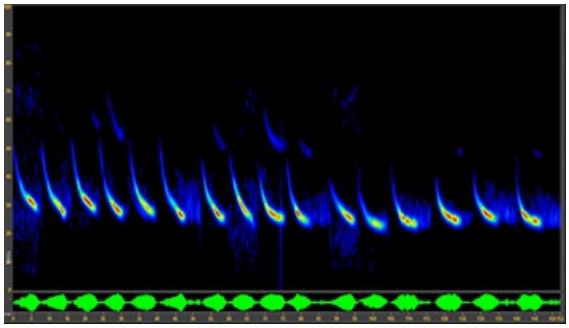
Leisler's Bat - call duration 5.0-5.9 ms



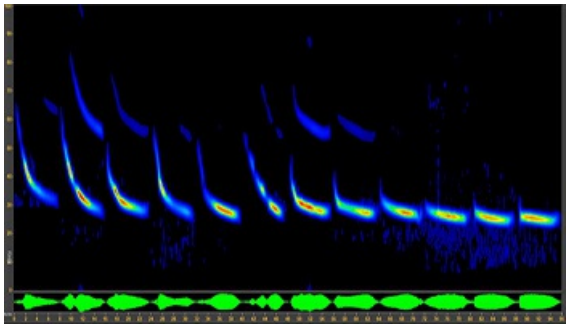
Common Noctule - call duration 6.0-6.8 ms



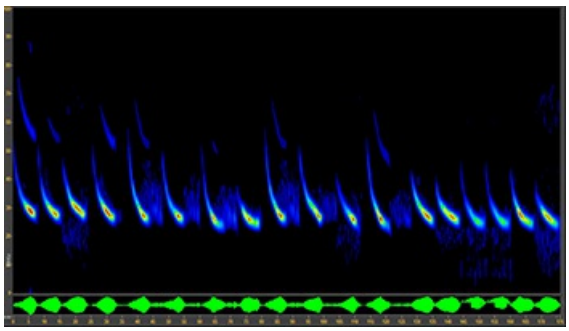
Leisler's Bat - call duration 6.0-6.8 ms



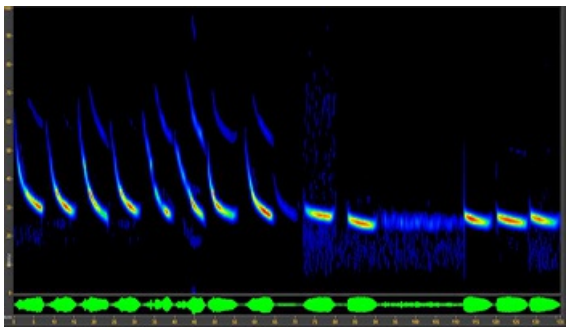
Common Noctule - call duration 6.9-7.2 ms



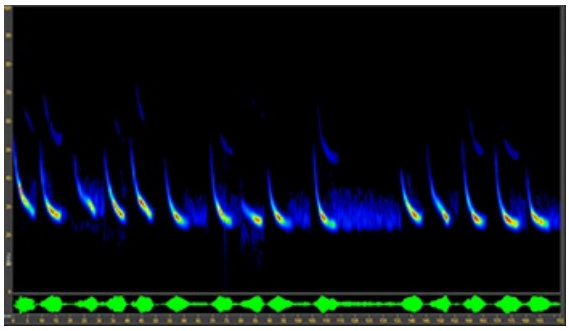
Leisler's Bat - call duration 6.9-7.2 ms



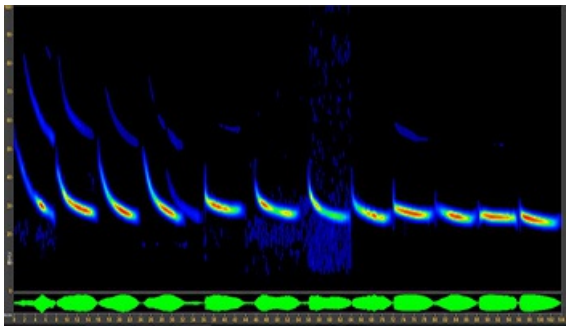
Common Noctule - call duration 7.3-7.6 ms



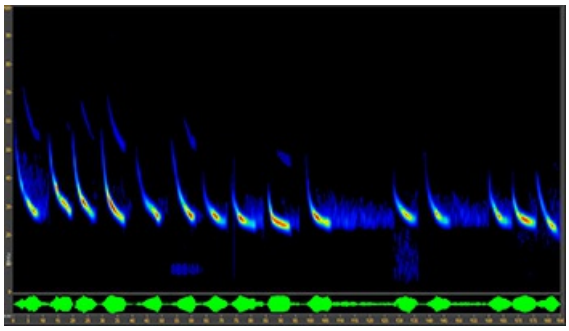
Leisler's Bat - call duration 7.3-7.6 ms



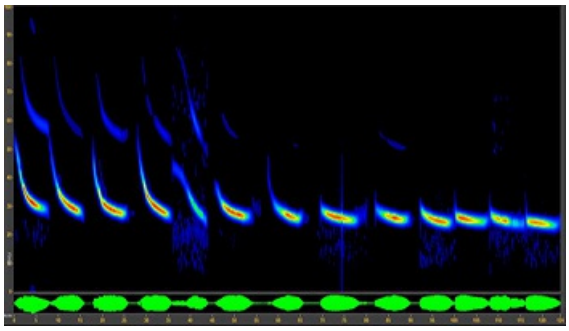
Common Noctule - call duration 7.7-7.8 ms



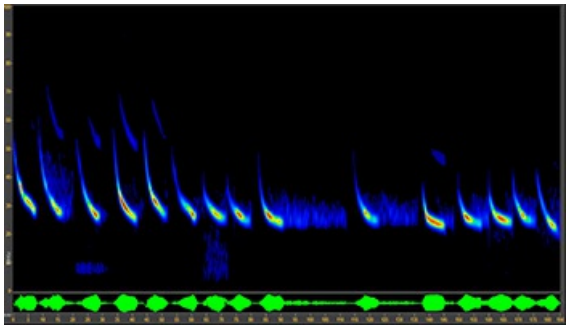
Leisler's Bat - call duration 7.7-7.8 ms



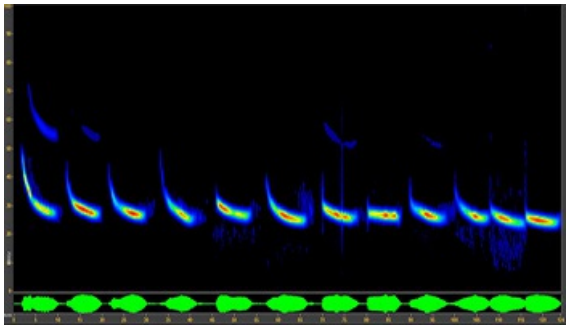
Common Noctule - call duration 7.9-8.0 ms



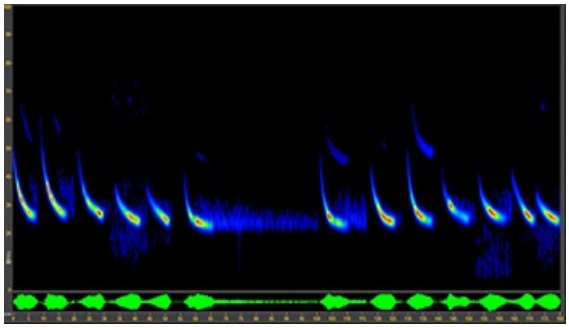
Leisler's Bat - call duration 7.9-8.0 ms



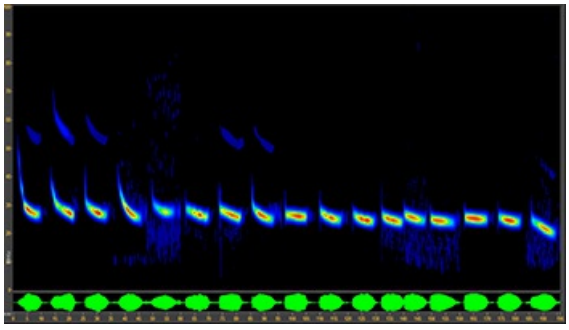
Common Noctule - call duration 8.1-8.3 ms



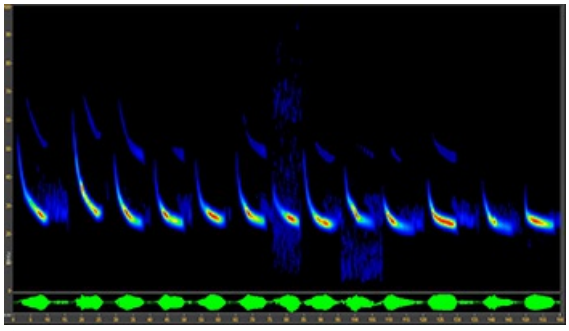
Leisler's Bat - call duration 8.1-8.3 ms



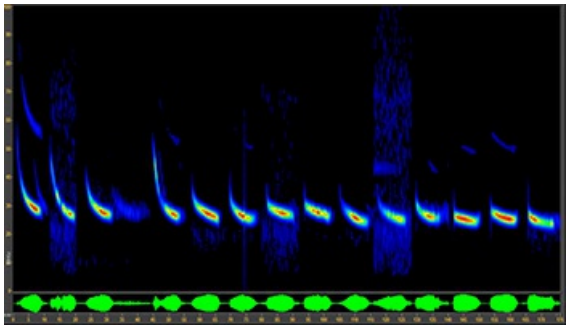
Common Noctule - call duration 8.4-8.5 ms



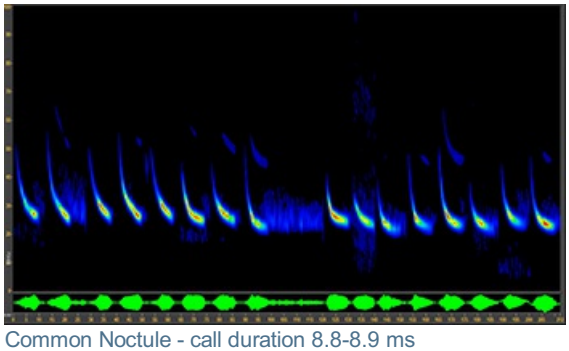
Leisler's Bat - call duration 8.4-8.5 ms



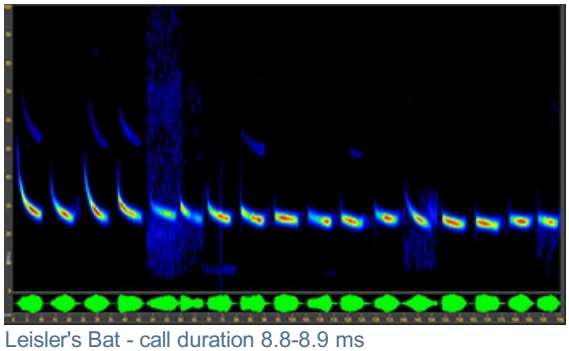
Common Noctule - call duration 8.6-8.7 ms



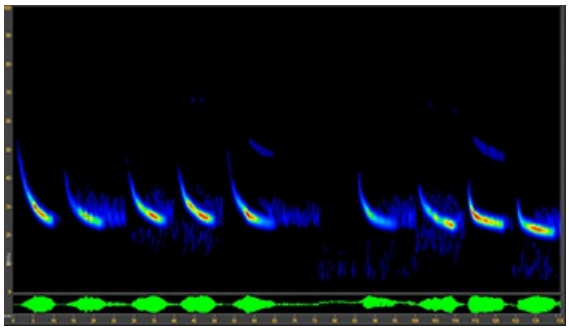
Leisler's Bat - call duration 8.6-8.7 ms



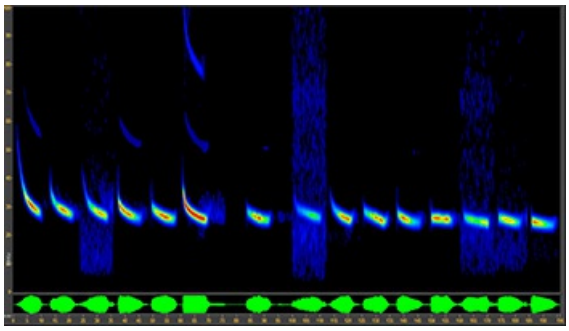
Common Noctule - call duration 8.8-8.9 ms



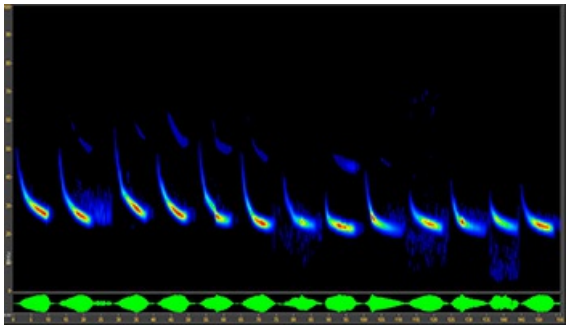
Leisler's Bat - call duration 8.8-8.9 ms



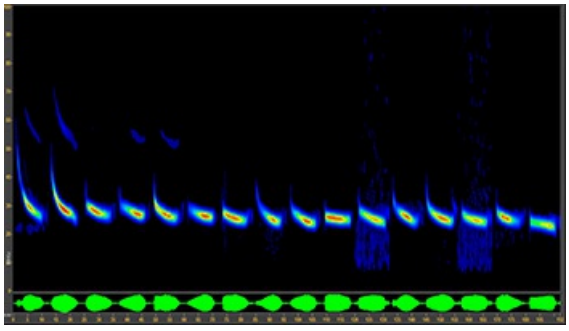
Common Noctule - call duration 9.0-9.1 ms



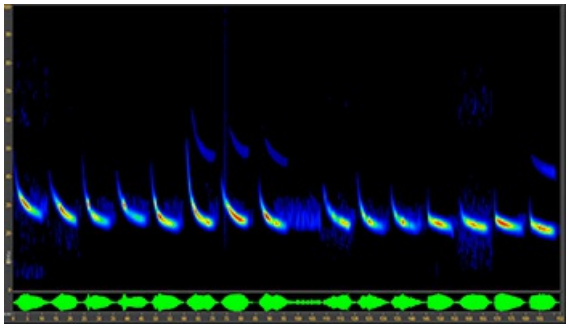
Leisler's Bat - call duration 9.0-9.1 ms



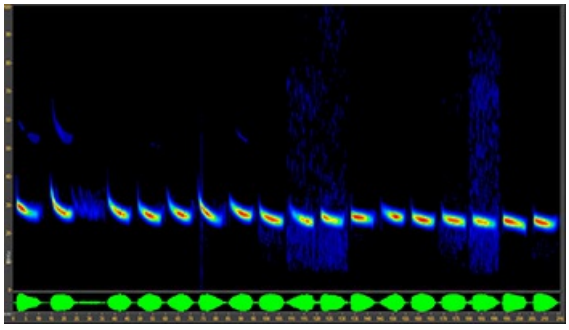
Common Noctule - call duration 9.2-9.3 ms



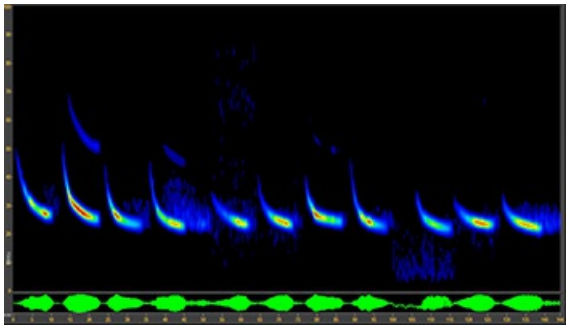
Leisler's Bat - call duration 9.2-9.3 ms



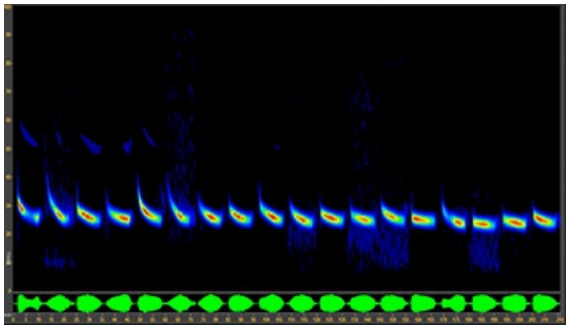
Common Noctule - call duration 9.4-9.5 ms



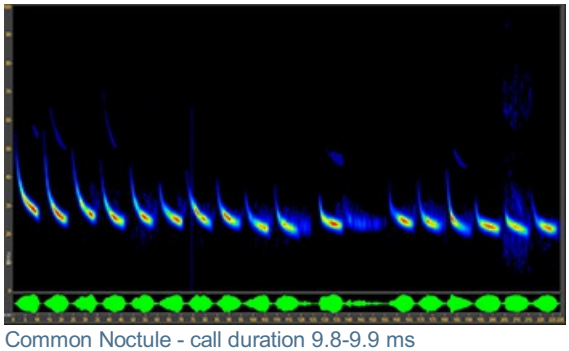
Leisler's Bat - call duration 9.4-9.5 ms



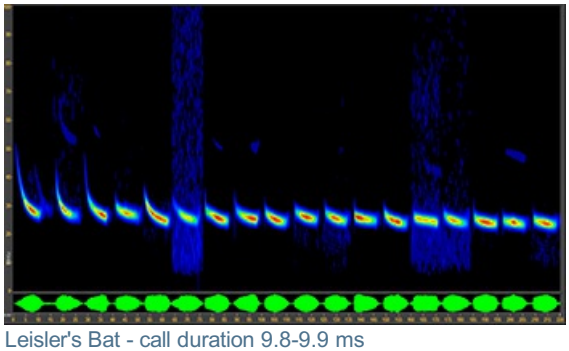
Common Noctule - call duration 9.6-9.7 ms



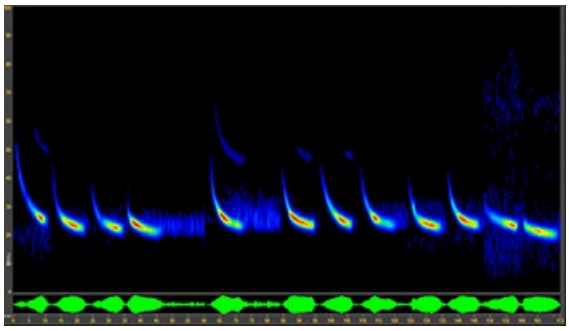
Leisler's Bat - call duration 9.6-9.7 ms



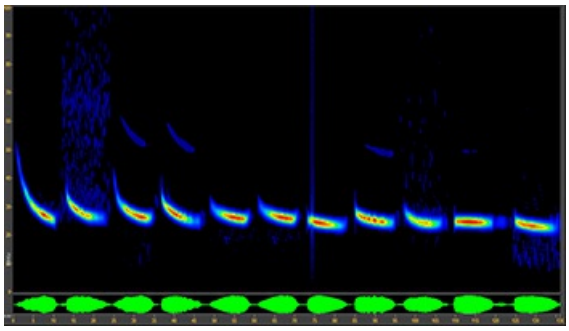
Common Noctule - call duration 9.8-9.9 ms



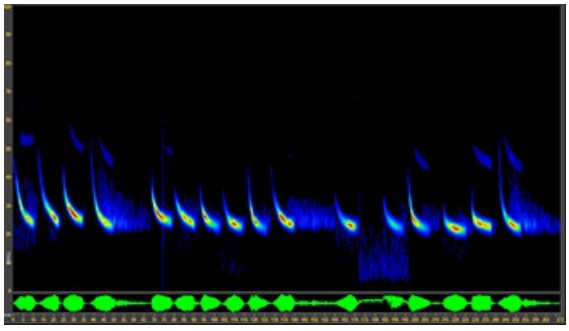
Leisler's Bat - call duration 9.8-9.9 ms



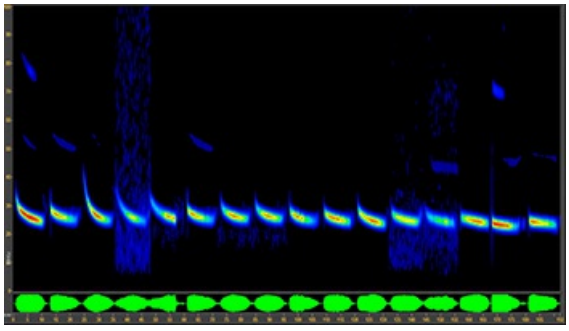
Common Noctule - call duration 10.0-10.1 ms



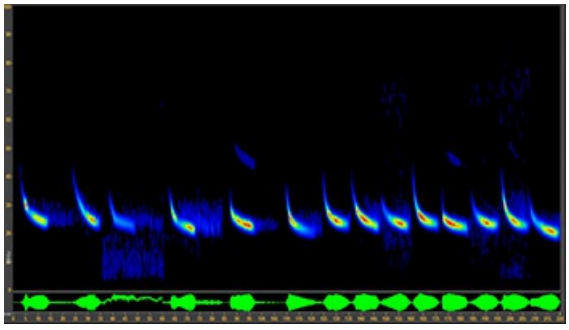
Leisler's Bat - call duration 10.0-10.1 ms



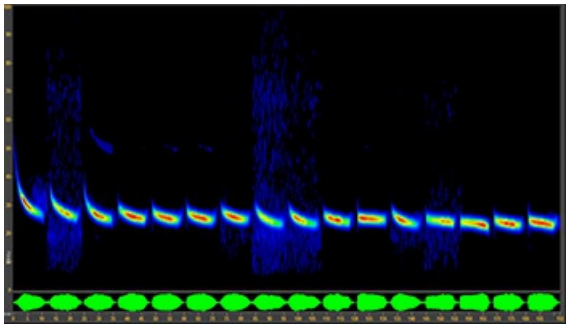
Common Noctule - call duration 10.2-10.3 ms



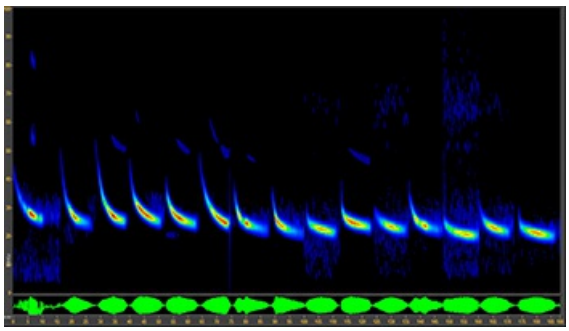
Leisler's Bat - call duration 10.2-10.3 ms



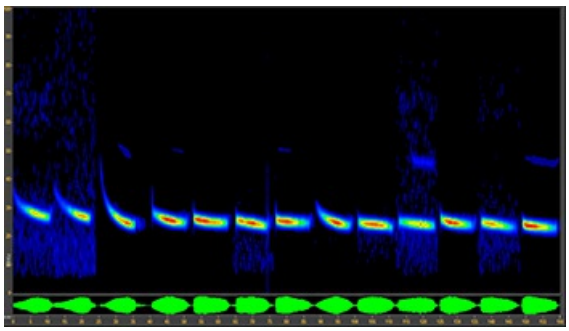
Common Noctule - call duration 10.4-10.5 ms



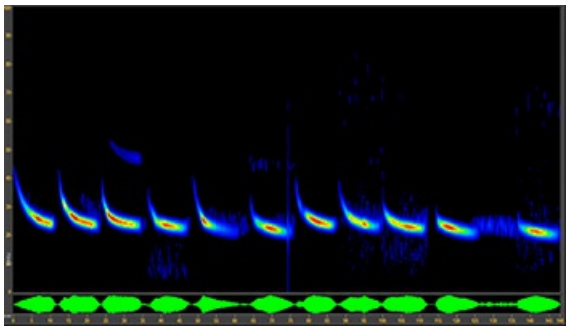
Leisler's Bat - call duration 10.4-10.5 ms



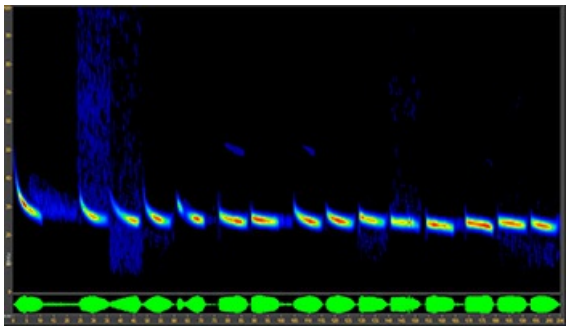
Common Noctule - call duration 10.6-10.7 ms



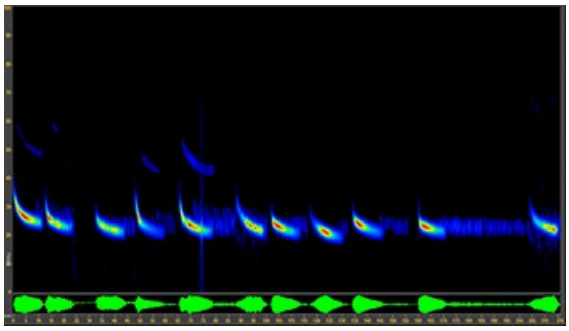
Leisler's Bat - call duration 10.6-10.7 ms



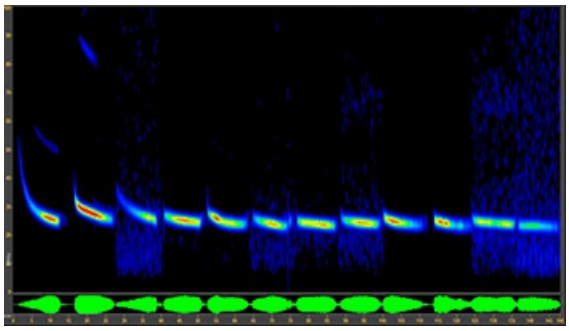
Common Noctule - call duration 10.8-10.9 ms



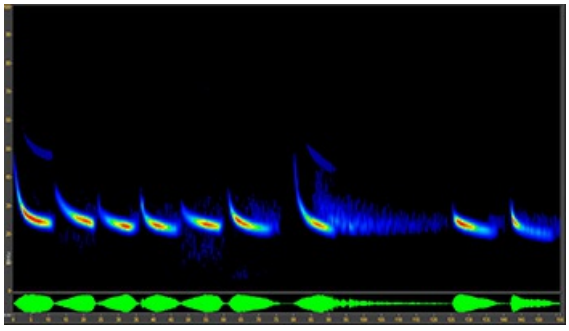
Leisler's Bat - call duration 10.8-10.9 ms



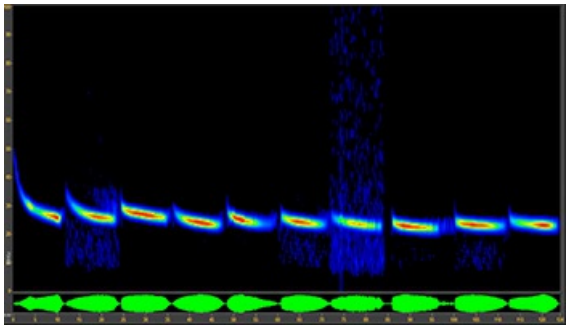
Common Noctule - call duration 11.0-11.1 ms



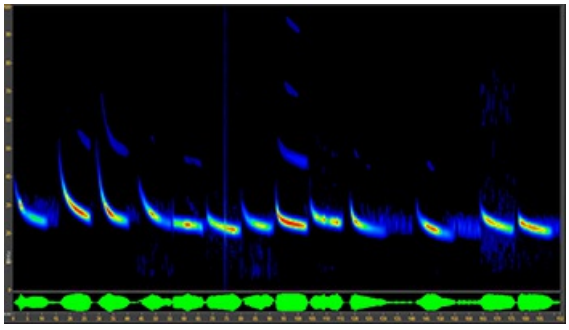
Leisler's Bat - call duration 11.0-11.1 ms



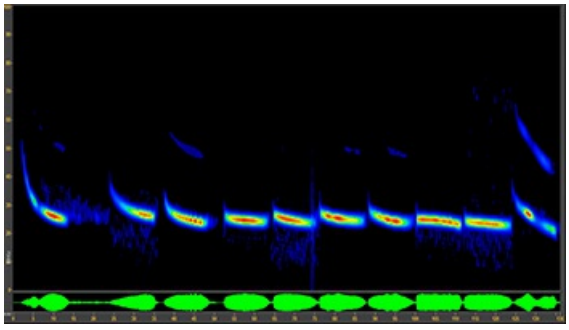
Common Noctule - call duration 11.2-11.3 ms



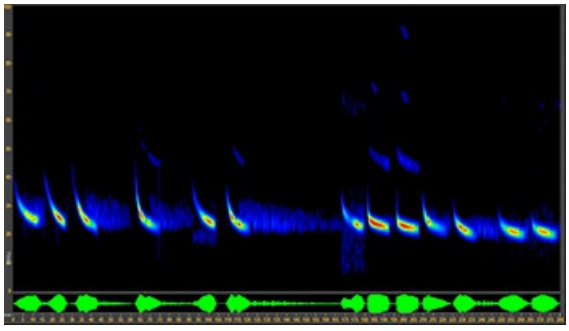
Leisler's Bat - call duration 11.2-11.3 ms



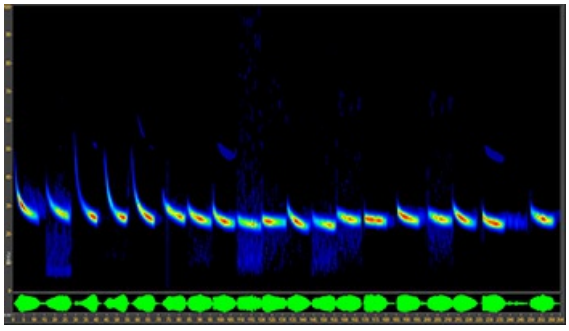
Common Noctule - call duration 11.4-11.5 ms



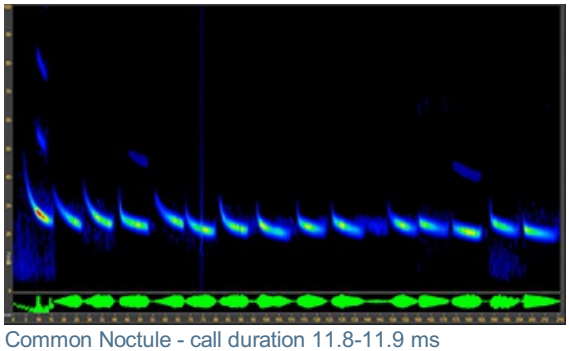
Leisler's Bat - call duration 11.4-11.5 ms



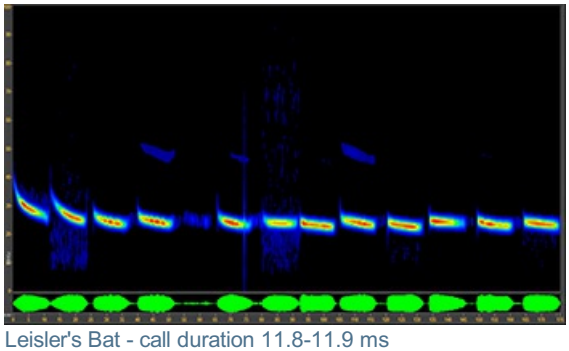
Common Noctule - call duration 11.6-11.7 ms



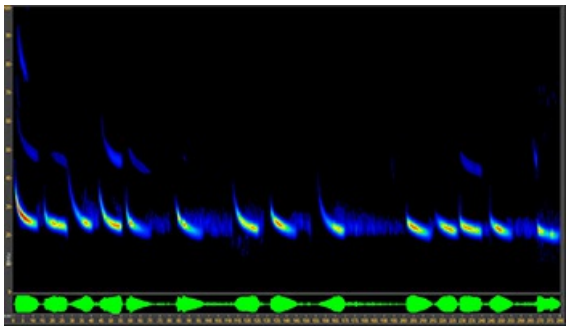
Leisler's Bat - call duration 11.6-11.7 ms



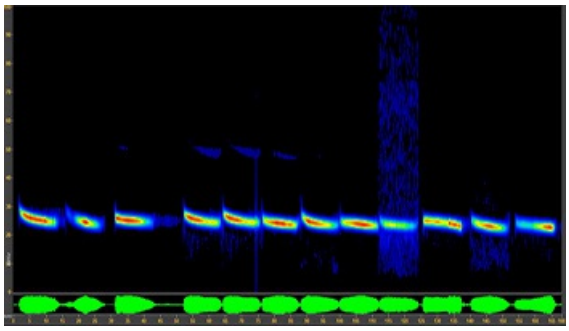
Common Noctule - call duration 11.8-11.9 ms



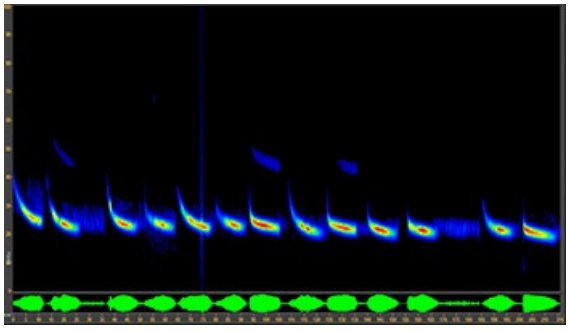
Leisler's Bat - call duration 11.8-11.9 ms



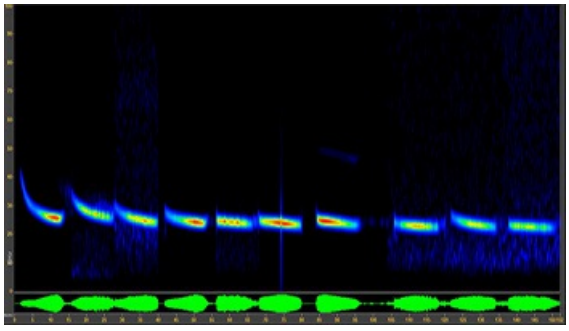
Common Noctule - call duration 12.0-12.2 ms



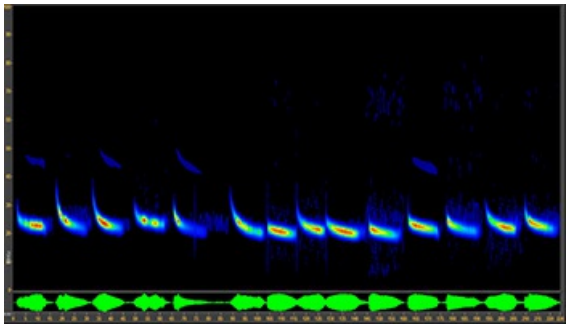
Leisler's Bat - call duration 12.0-12.2 ms



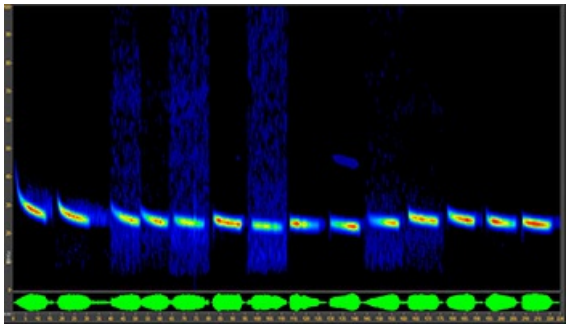
Common Noctule - call duration 12.3-12.4 ms



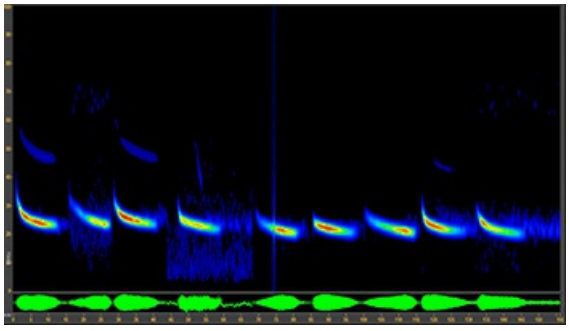
Leisler's Bat - call duration 12.3-12.4 ms



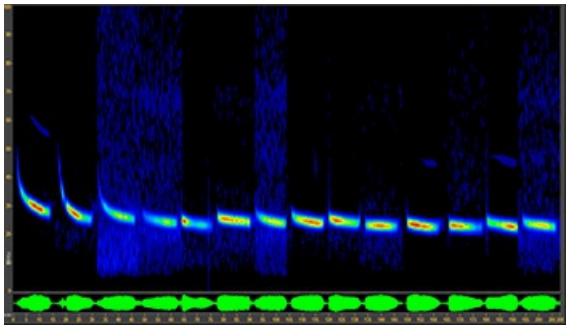
Common Noctule - call duration 12.5-12.7 ms



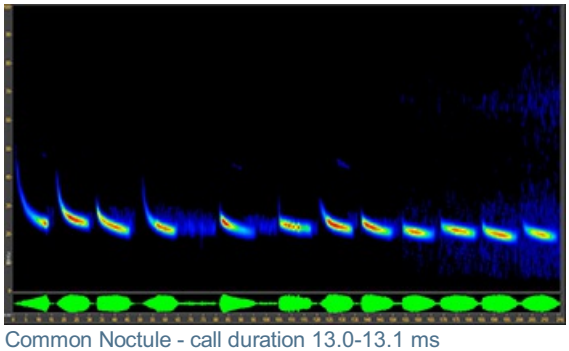
Leisler's Bat - call duration 12.5-12.7 ms



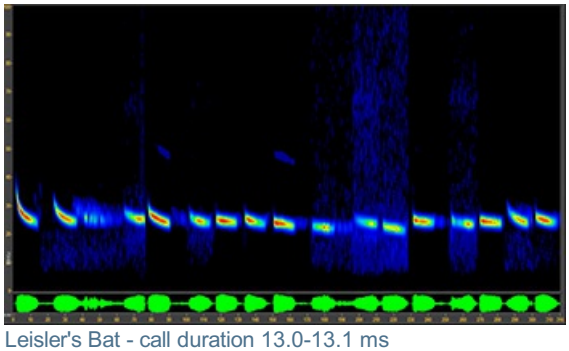
Common Noctule - call duration 12.8-12.9 ms



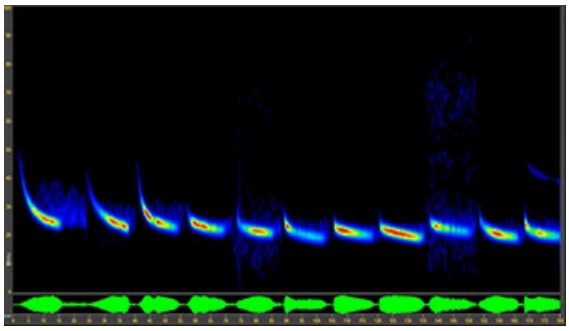
Leisler's Bat - call duration 12.8-12.9 ms



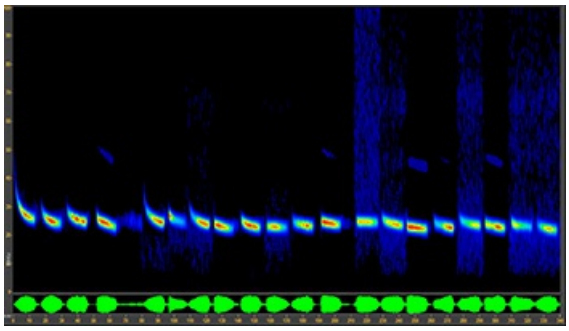
Common Noctule - call duration 13.0-13.1 ms



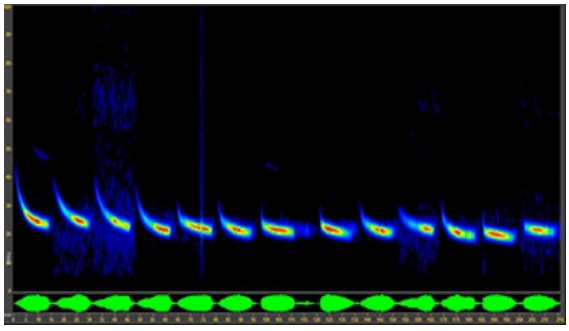
Leisler's Bat - call duration 13.0-13.1 ms



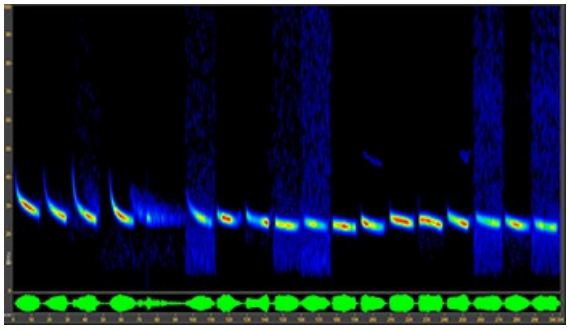
Common Noctule - call duration 13.2-13.3 ms



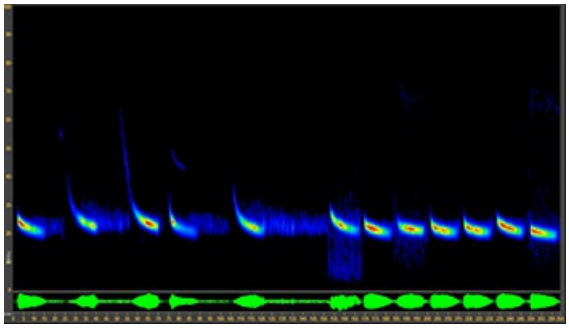
Leisler's Bat - call duration 13.2-13.3 ms



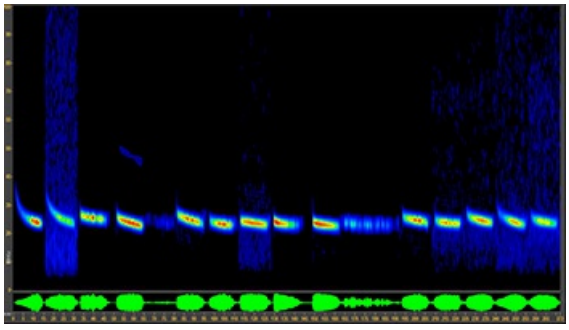
Common Noctule - call duration 13.4-13.5 ms



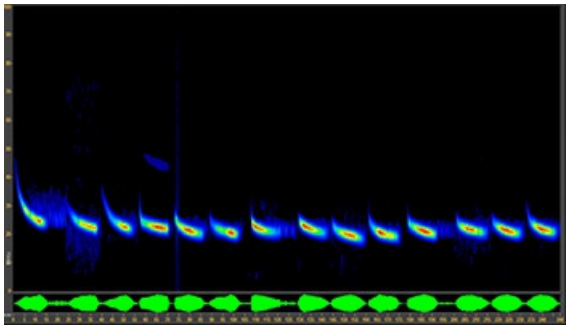
Leisler's Bat - call duration 13.4-13.5 ms



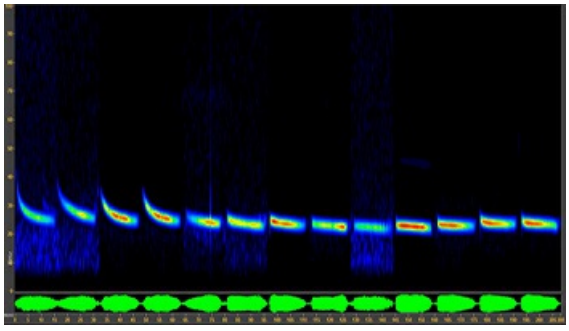
Common Noctule - call duration 13.6-13.7 ms



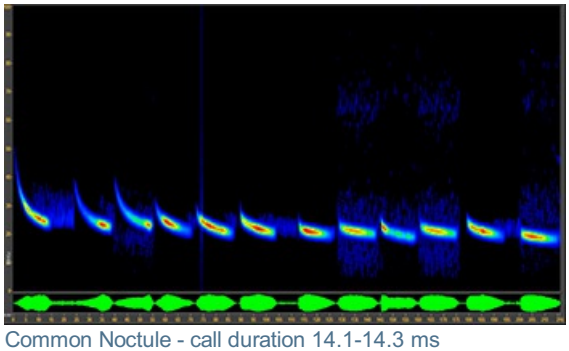
Leisler's Bat - call duration 13.6-13.7 ms



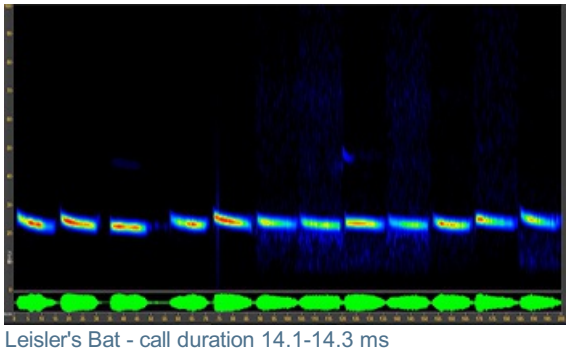
Common Noctule - call duration 13.8-14.0 ms



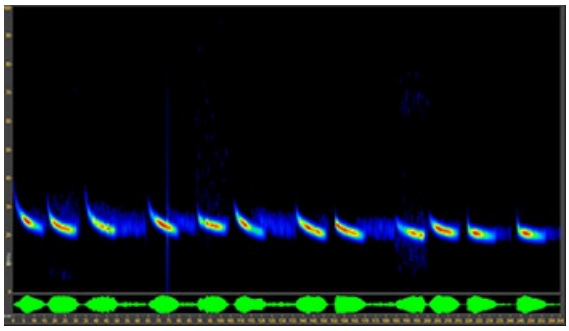
Leisler's Bat - call duration 13.8-14.0 ms



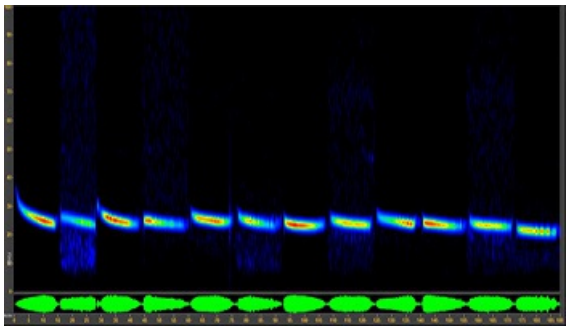
Common Noctule - call duration 14.1-14.3 ms



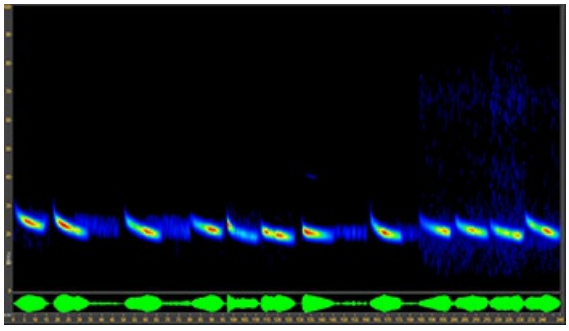
Leisler's Bat - call duration 14.1-14.3 ms



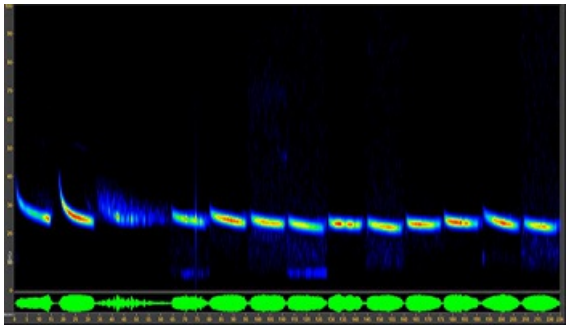
Common Noctule - call duration 14.4-14.5 ms



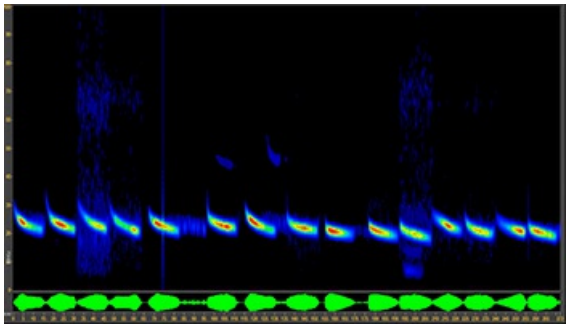
Leisler's Bat - call duration 14.4-14.5 ms



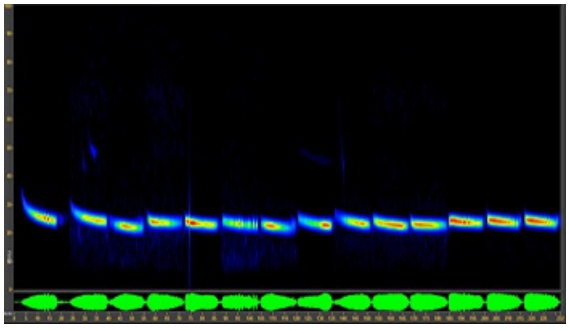
Common Noctule - call duration 14.6-14.8 ms



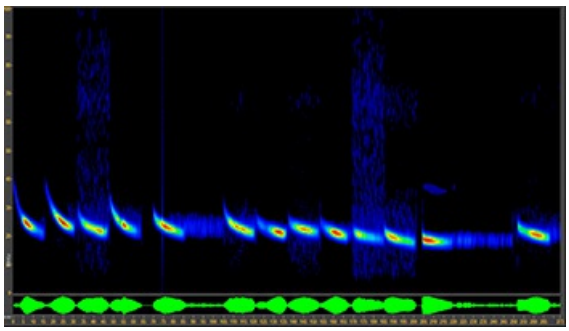
Leisler's Bat - call duration 14.6-14.8 ms



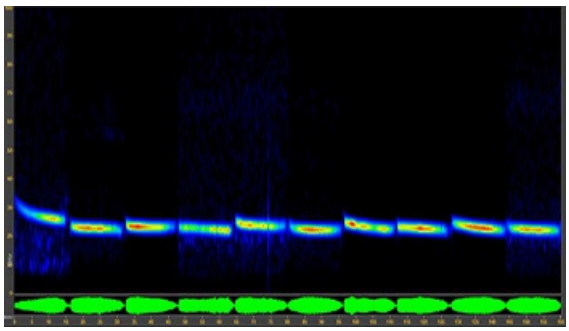
Common Noctule - call duration 14.9-15.1 ms



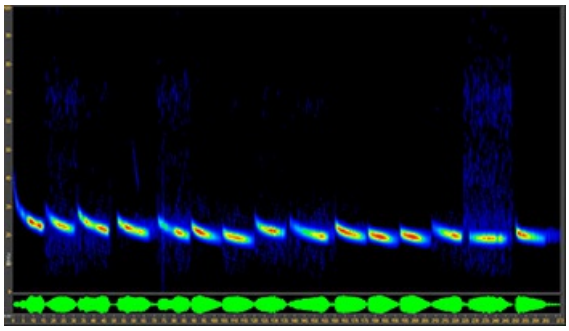
Leisler's Bat - call duration 14.9-15.1 ms



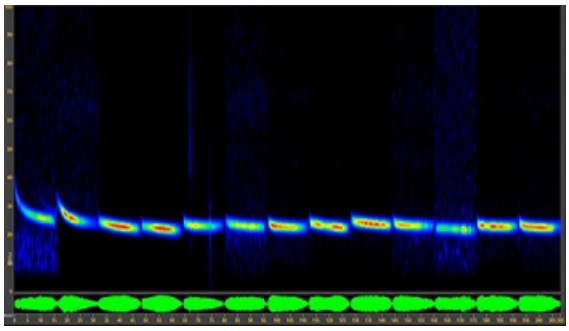
Common Noctule - call duration 15.2-15.3 ms



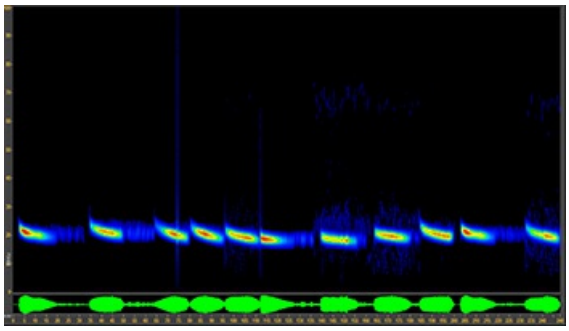
Leisler's Bat - call duration 15.2-15.3 ms



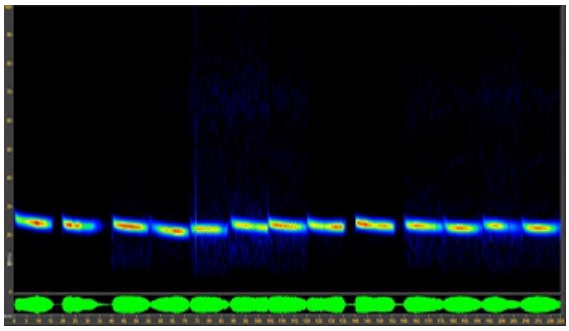
Common Noctule - call duration 15.4-15.7 ms



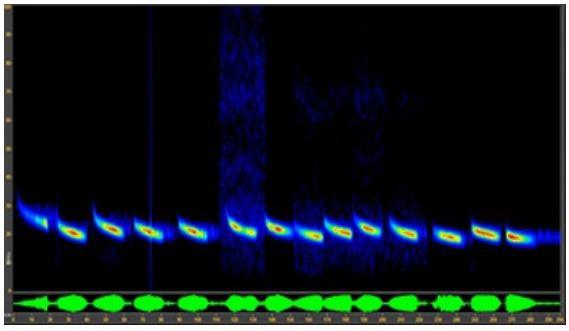
Leisler's Bat - call duration 15.4-15.7 ms



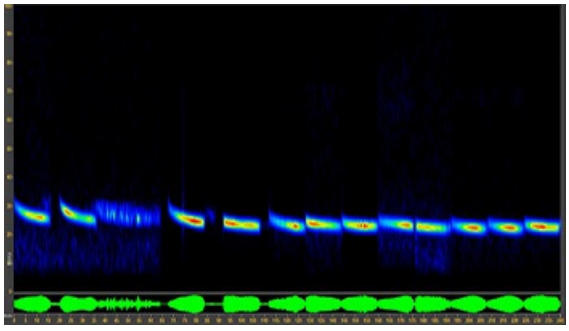
Common Noctule - call duration 15.8-16.0 ms



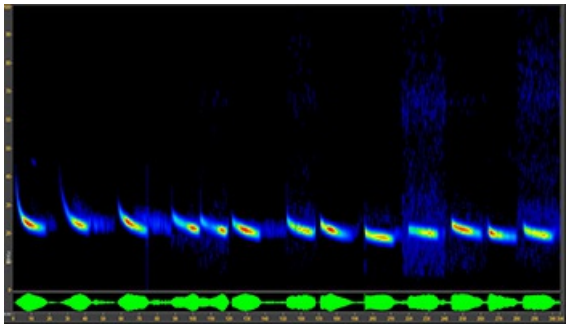
Leisler's Bat - call duration 15.8-16.0 ms



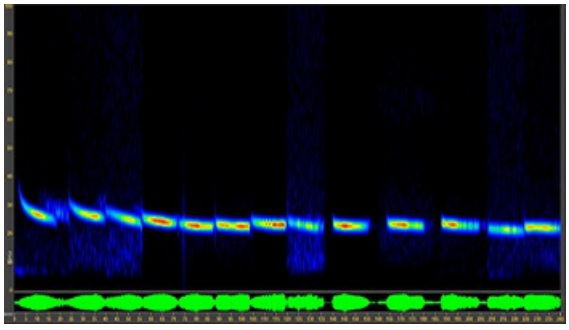
Common Noctule - call duration 16.1-16.3 ms



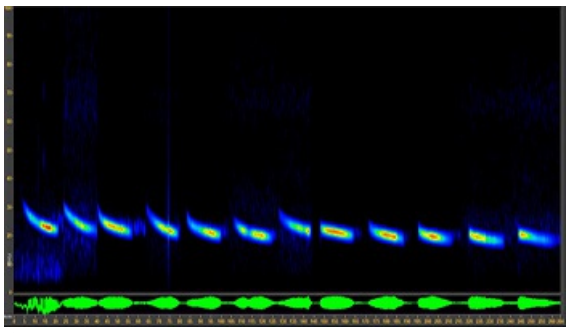
Leisler's Bat - call duration 16.1-16.3 ms



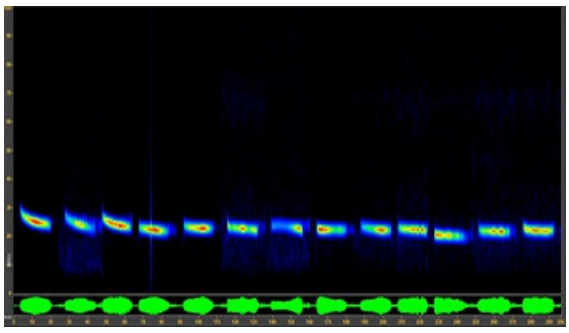
Common Noctule - call duration 16.4-16.6 ms



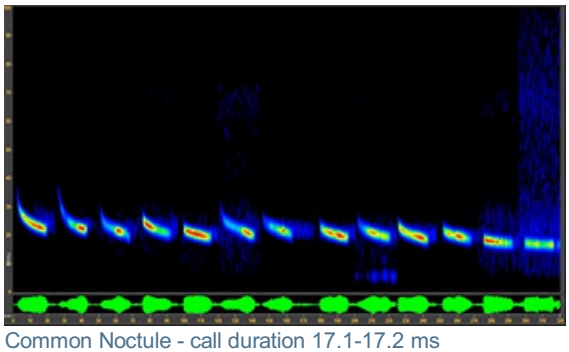
Leisler's Bat - call duration 16.4-16.6 ms



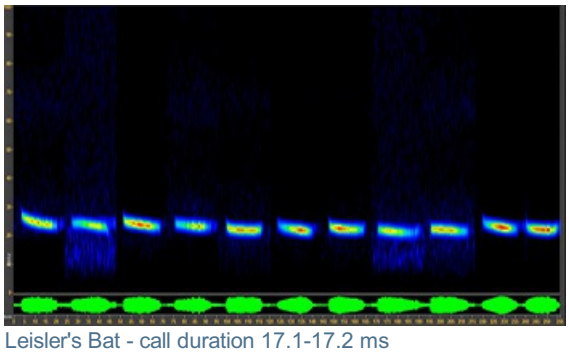
Common Noctule - call duration 16.7-17.0 ms



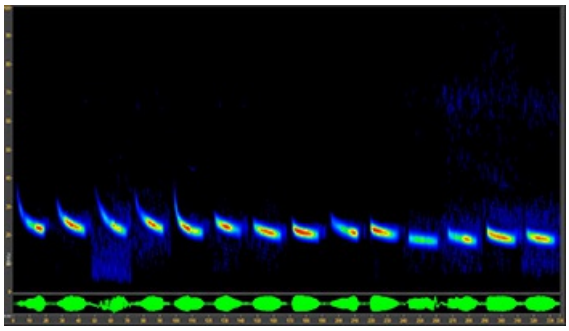
Leisler's Bat - call duration 16.7-17.0 ms



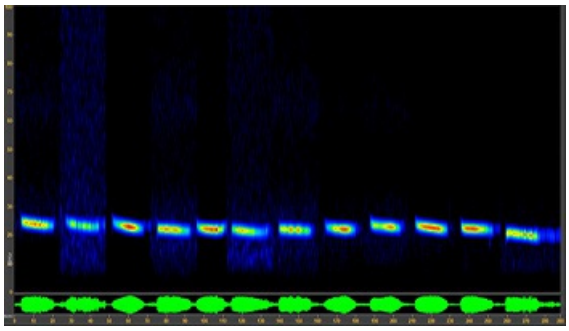
Common Noctule - call duration 17.1-17.2 ms



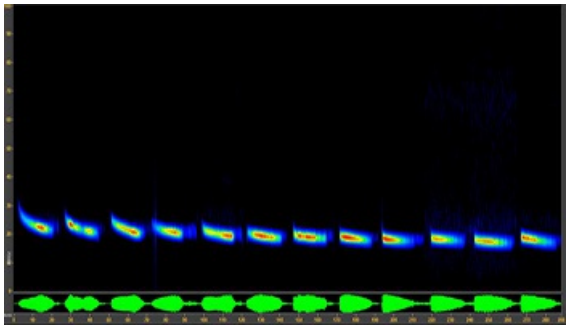
Leisler's Bat - call duration 17.1-17.2 ms



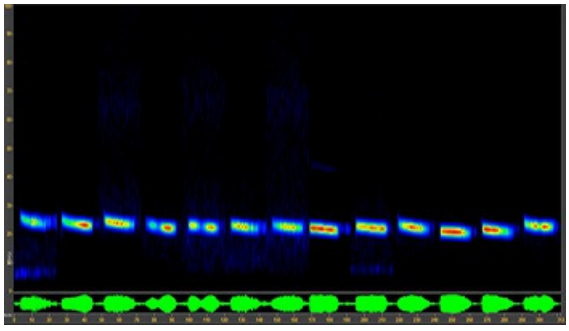
Common Noctule - call duration 17.3-17.4 ms



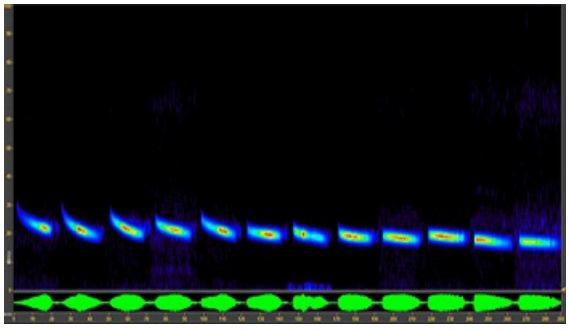
Leisler's Bat - call duration 17.3-17.4 ms



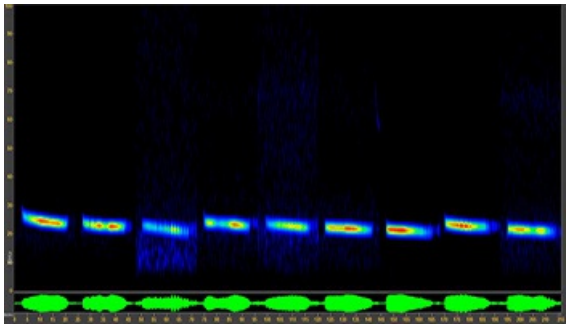
Common Noctule - call duration 17.5-18.2 ms



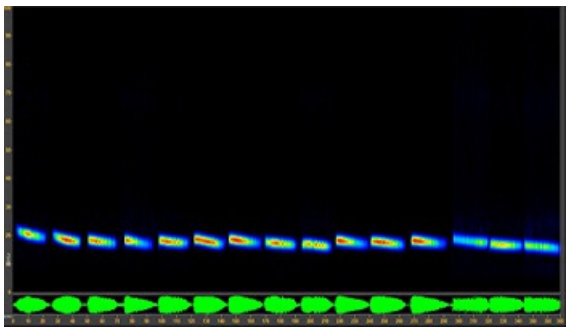
Leisler's Bat - call duration 17.5-18.2 ms



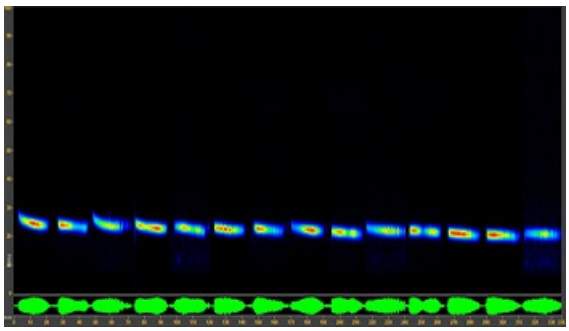
Common Noctule - call duration 18.3-18.7 ms



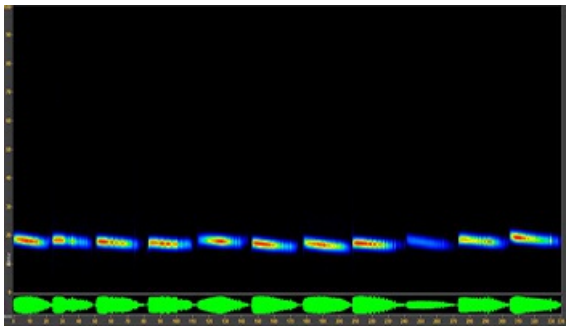
Leisler's Bat - call duration 18.3-18.7 ms



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; Speckled Bush-cricket, by Mike Toms; Green silver-lines, by Andy Musgrove.
Cover image: Brown Long-eared Bat, by C. Damant, Bernwood Ecology.

Ryevitalise – Bats and Ancient Trees, 2020–2024 Report

This report presents the main findings from survey work delivered using passive acoustic monitoring devices deployed across the Ryevitalise Landscape Partnership Scheme area. 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.

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