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Bailiwick Bat Survey: 2021–2024 Report

Newson, S.E., Allez, S.L., Coule, E.K., Guille, A.W., Harper, J., Henney, J.M., Higgins, L., Lewis, M., McLellan, G.D., Simmons, M.C., Sweet, E., Whitelegg, D. & Atkinson, P.W.

BTO Birds Science People

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Graphs and mapping by S. Gillings

Cover design by M.P. Toms

Cover photo by C. Damant - Whiskered bat

SUMMARY

Background Working with a network of volunteer fieldworkers, static acoustic bat detectors were deployed over four survey seasons (2021-2024) to provide baseline data for bats for the islands of Guernsey, Alderney, Herm, Sark, Brecqhou, Burhou, Crevichon, Jethou and Lihou. This report provides an overview of the survey coverage and main results from the project.

Coverage Over four survey seasons, from 2021 to 2024, 2,364 different locations across the Bailiwick of Guernsey were surveyed. Recording was undertaken on 879 different nights mainly between April and the end of October in each year, amounting to a total of 9,426 nights of recording effort across sites.

Results Overall, 16,192,045 five second triggered recordings were collected which, following analyses and validation, were found to include 4,019,529 bat identifications and 35,354 small terrestrial mammal identifications. There were also over 8 million identifications of bush-crickets as 'by-catch', for which we report species presence on a site and night basis.

Following a process of manual species validation, the study confirmed the presence of at least 14 bat species, 5 small mammal species, and 7 species of bush-crickets. This included 6 bat species that had not previously been recorded on any island in the Bailiwick of Guernsey, including Serotine *Eptesicus serotinus*, Leisler's Bat *Nyctalus leisleri*, Common Noctule *Nyctalus noctula*, Lesser Horseshoe Bat *Rhinolophus hipposideros*, Whiskered or Brandt's Bat *Myotis mystacinus* or *M. brandtii* and Parti-coloured Bat *Vespertilio murinus*.

In addition to bats, the project highlights the value of identifying other species groups as 'by-catch' during bat surveys. This includes the discovery of a new species of bush-cricket for the Channel Islands, Large Conehead *Ruspolia nitidula*, which was recorded on several islands. Whilst not initially discovered through this project, Brown-Spotted Bush-cricket *Tessellana tessellata* was also recorded on Guernsey, as a new species for the Channel Islands. As a consequence of the Bailiwick Bat Survey, we have a much better understanding now of the status of bats, small mammals and bush-crickets across the Bailiwick of Guernsey.

The report includes a full species-by-species breakdown of spatial, seasonal, and through-the-night patterns of activity.

1. BACKGROUND

1.1 Bailiwick Bat Survey

Since 2021, the Bailiwick Bat Survey (BBS) has set out to document the distribution and activity of the different bat species that occur in the Bailiwick of Guernsey, comprising the islands of Guernsey, Alderney, Sark, Herm, Brecqhou, Burhou, Crevichon, Jethou and Lihou. Using a citizen science-based approach, over 400 volunteers, many of whom were new to biological recording, chose one or more 500 x 500-m squares to survey. Volunteers reserved a bat detector from one of the centres hosting bat detectors across the islands, and were asked to place the detector in their chosen square(s) for at least 4 consecutive nights, once between 1 April and 15 July and once between 16 July and 31 October. On completion of the survey they, or the Bat Survey Coordinator, uploaded recordings to the BTO Acoustic Pipeline where an initial automated analysis was carried out to identify the species present and the results were made available to the surveyor. This was followed by a process of manual species verification after the end of the survey season.

Between 2021 and 2024, surveys were carried out in all 500 x 500 meter squares in one or more year. Through this, the presence of at least 14 bat species, 5 small mammal species, 7 species of bush-crickets, and 2 audible moth species were confirmed. This included 6 bat species that had not previously been recorded on any island in the Bailiwick of Guernsey, including Serotine *Eptesicus serotinus*, Leisler's Bat *Nyctalus leisleri*, Common Noctule *Nyctalus noctula*, Lesser Horseshoe Bat *Rhinolophus hipposideros*, Whiskered or Brandt's Bat *Myotis mystacinus* or *M. brandtii* and Parti-coloured Bat *Vespertilio murinus*. There had been no previous records of Parti-coloured Bat for the Channel Islands. In addition, by separately identifying bat social calls and feeding buzzes for a broad range of bat species, it provided additional behavioural insights for bats.

Two of the bat detectors set up in Guernsey (Image credit: Sarah Allez).

In addition to the bat recording, we recorded and identified small mammals, the presence of bush crickets and two species of moth that emit ultrasound. Bush-crickets included Large Conehead *Ruspolia nitidula*, which was recorded on several islands, but prior to this project, this species had not been recorded in the Channel Islands. Whilst not initially discovered through this project, Brown-spotted Bush-cricket *Tessellana tessellata* was also recorded on Guernsey, as a new species for the Channel Islands. In 2021, Short-winged Conehead *Conocephalus dorsalis* was

recorded in two suitable wetland sites, but it was not found in subsequent years.

One of the most interesting outputs has been a map of the distribution of the Greater White-toothed Shrew *Crocidura russula* on Guernsey, Alderney and Herm (but not Brecqhou, Burhou, Crevichon, Jethou or Lihou) and the Lesser White-toothed Shrew *Crocidura suaveolens* on Sark. It showed the Greater White-toothed Shrew to be extremely widespread across the islands where it occurs, and was recorded in gardens, farmland and in semi-natural habitats.

1.2 The importance of robust baseline data

This project was supported and funded by the Agriculture, Countryside and Land Management Services (ACLMS) of the States of Guernsey. Bats are poorly understood, despite making up more than half of the terrestrial mammals that occur in the Bailiwick. They are a key indicator species of the islands' environment and Guernsey's Strategy for Nature provides a clear direction to establish baselines for key biodiversity groups to provide government, other policy makers and practitioners the information required for good decision making (www.gov.gg/strategyfornature). Part of the Strategy also emphasises the need to increase community awareness of, and involvement in nature, and its health and wellbeing benefits. The Bailiwick Bat Survey was devised with this in mind and relies on the interest and goodwill of citizen scientists to help survey the islands' bats and identify the species that are present on the islands, 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, surveys were carried over four seasons, 2021 to 2024, where static acoustic bat detectors were deployed over a 8-month long survey season (April - October) each year.

2. AIMS AND OBJECTIVES

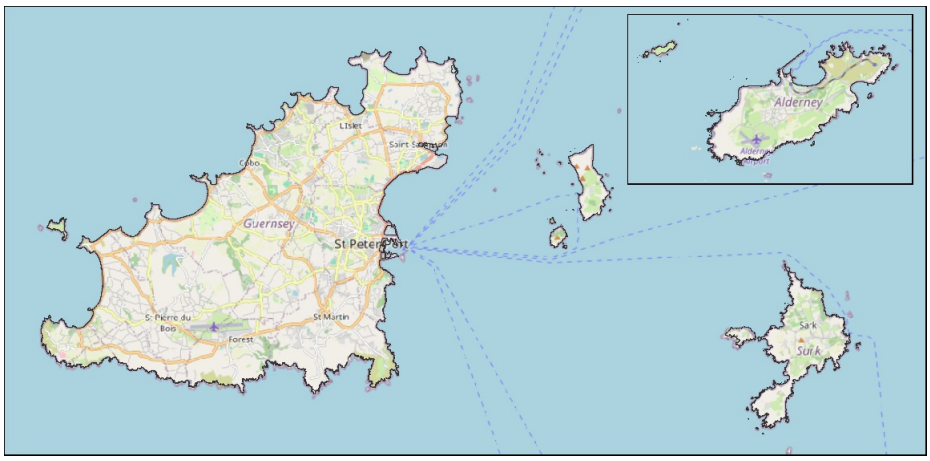
The Bailiwick Bat Survey capitalised on the interest and enthusiasm of volunteers to participate in biodiversity monitoring to systematically collect bat distribution and activity data across Guernsey, Alderney, Herm, Sark, Brecqhou, Burhou, Crevichon, Jethou and Lihou through a project that ran over four years. This resulted in the production of a robust dataset, which increased knowledge and understanding of bat distribution and activity across the Bailiwick of Guernsey. Based around 500 x 500-m squares, this project provides a detailed description of the islands' bat fauna.

Whilst the focus of this work was 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). In this report we present results from across the four years of the project.

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

- Improve our understanding of the status, distribution and timing of occurrence of bat, bush-cricket and small mammal species that occur in the Bailiwick of Guernsey.
- 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, why it is important to conserve them and how landowners and householders can enhance their properties for bats.

Map of the Bailiwick of Guernsey, comprising the islands of Guernsey, Herm, Sark, Alderney, and their associated smaller islands. The aim was to achieve survey coverage for all islands.



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 protocol enabled members of the public to have access to passive real-time bat detectors which they leave outside to automatically trigger and record the calls to a memory card every time a bat passes throughout a night.

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

Volunteers were directed to an online square sign-up tool, showing survey coverage (available 500-m x 500-m squares), through which they signed-up and reserved a square or squares for survey. The survey map was updated throughout the survey season allowing uptake and coverage during the survey season to be assessed. After reserving a 500-m x 500-m square for the survey, volunteers were automatically emailed a web link through which they reserved out a bat detector from the most convenient 'bat centre', and received details on how to set up a BTO Acoustic Pipeline account (see below). In this project, the Fort Grey Shipwreck Museum, the Guille-Allés library, Agriculture, Countryside and Land Management Services (ACLMS), Alderney Wildlife Trust and Société Sercquaise, Société Guernesiaise, Nature Commission, Priaulx Library, Sir Charles Frossard House, the Guernsey Museum at Candie and Sark School were bat centres in one or more year or the project.

The bat detectors were set to record with a sample rate of 256 kHz and to use a high pass filter of 12 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 from sunset until sunrise the following day. Detectors were 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 which were to be deployed at least 1.5-m in any direction from vegetation, water or other obstructions.

3.2 Survey effort and timing

The survey period ran from the beginning of April to the end of October in each year, but there was a small amount of recording outside this period in each year. A long survey season covers the main period of bat activity, and maximises the use of the equipment during the year. Volunteers were encouraged to choose specific 500-m squares to survey, but some flexibility was allowed to encourage volunteer uptake.

3.3 Processing recordings and species identification

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

At the end of a four-day recording session, the files recorded by the bat detector (uncompressed wav format), were uploaded by the volunteer to the BTO's Acoustic Pipeline http://bto.org/pipeline for processing. Volunteers have their own online user account, and desktop software through which they, or the local project organiser if needed, can upload recordings directly to the cloud-based 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.

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 the 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. In 2023 and 2024, we applied an update to the Acoustic Pipeline classifiers, which provides separate results for echolocation calls, feeding buzzes and social calls, where these are produced and can be identified. Before 2023, we only separately identified social calls, during manual verification for species where the social calls are useful for species identification (e.g. distinguishing Kuhl's Pipistrelle *Pipistrellus kuhlii* and Nathusius' Pipistrelle *Pipistrellus nathusii*). In 2024, we also reprocessed Brown Long-eared Bat *Plecotus auritus* and Grey Long-eared Bat *Plecotus austriacus* recordings from 2021 and 2022, to look for social calls (specifically D-type social calls - see Middleton *et al*. 2022), which are often associated with proximity to the roost, so are particularly useful in this respect.

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 a sample of recordings (wav files) that were 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. For the most common species, Common Pipistrelle, we checked a random sample of 1,000 recordings each year to quantify the error rate for these species in the dataset. For this species less than 0.02% of recordings were assigned to the wrong species, almost entirely to Soprano Pipistrelle in error. As all Soprano Pipistrelle identifications were manually checked, we expect that the error rate for Common Pipistrelle identification following species verification (discussed below) would be close to zero. For bush-crickets and audible moths where there can be a large number of recordings, often of the same individual recorded over a night, we instead focus on producing an inventory of species presence only 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 and Brandt's Bat 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.

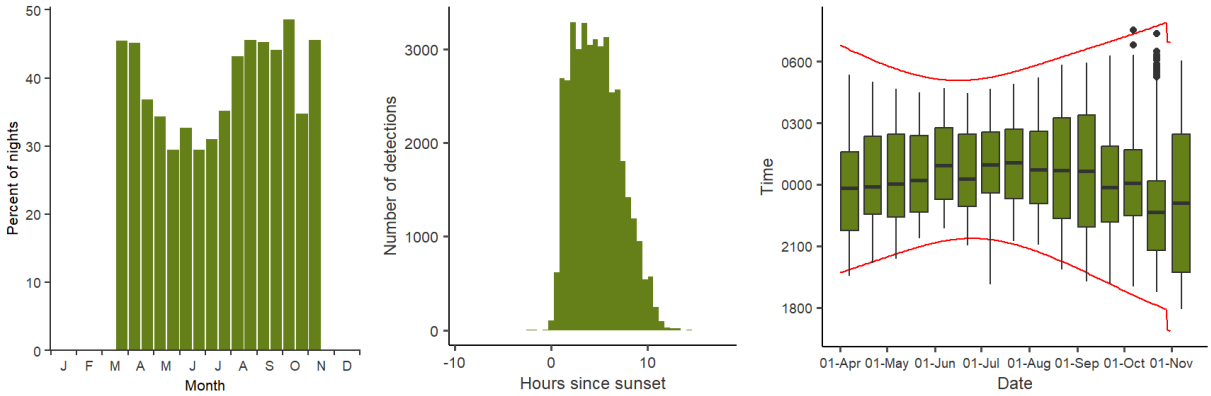
The echolocation calls of Kuhl's Pipistrelle and Nathusius' Pipistrelle are also extremely similar, but these two species produce social calls which can be assigned to species with confidence. For this reason, we treat recordings where there are only echolocation calls as "Kuhl's Pipistrelle or Nathusius' Pipistrelle", and present the results separately where there are social calls in recordings i.e., where we can be confident with the identification

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. 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. 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 extended to 1.5 times the interquartile range, and small dots show outliers. For the latter plot only, we exclude the small number of records before the 1st April.



3.5 Spatial patterns of activity and distribution

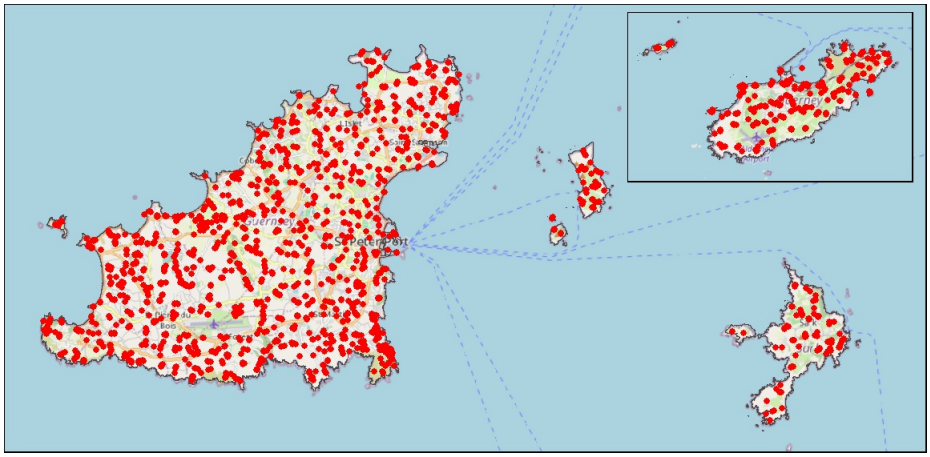
We produced maps of bat and small mammal activity. With these, dots are scaled according to the total number of recordings of this species at each location. Activity here represents usage of an area, which will be a combination of species abundance, and time spent in the area. For bush-crickets and audible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

4. RESULTS

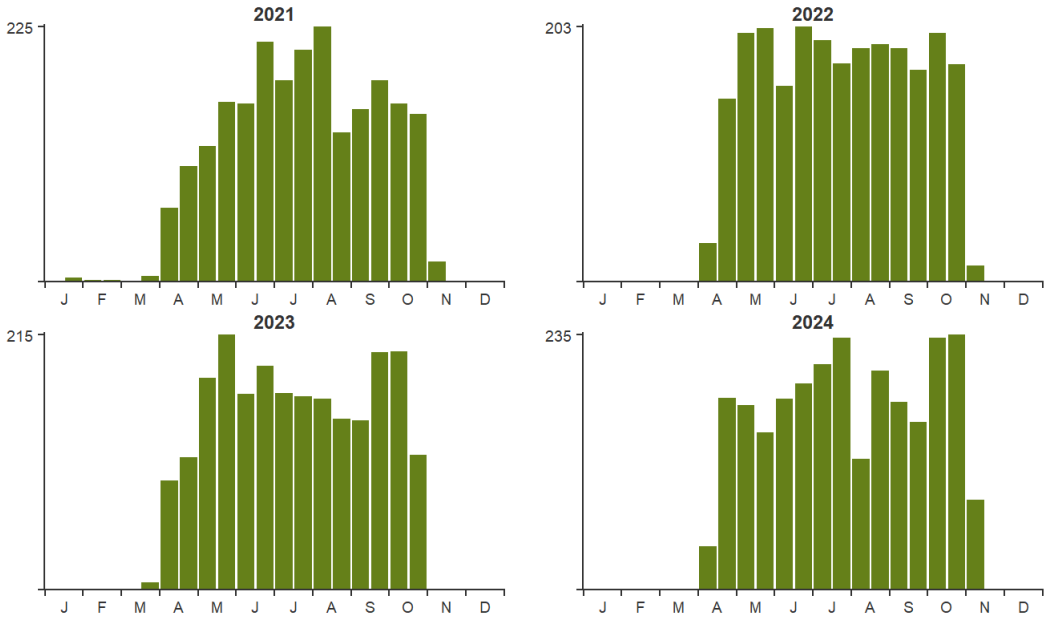
4.1 Survey coverage

Over the four survey seasons, 2021-2024, 2,364 different locations were surveyed for bats, with all recordings uploaded and processed through the BTO Acoustic Pipeline. Each location had a unique latitude and longitude, some of which may only have differed by a few metres. The distribution of these locations is shown below. Collectively across all these sites, 9,426 complete nights of recording effort was conducted. The recording effort spanned 879 different nights and 11 months. The seasonal pattern of recording effort in each year of the project is shown below.

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



Number of locations surveyed each year.



4.2 General results

Over the four survey seasons, 16,192,045 recordings were collected which, following analyses and validation, were found to include 4,019,529 bat recordings, and 35,354 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 14 bat species, 5 small mammal species, 7 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)
Serotine echolocation calls, *Eptesicus serotinus*	156	49 (2.1%)
Whiskered or Brandt's Bat echolocation calls, *Myotis mystacinus or M. brandtii*	1,219	38 (1.6%)
Natterer's Bat echolocation calls, *Myotis nattereri*	39,949	1,437 (60.8%)
Natterer's Bat feeding buzzes, *Myotis nattereri*	2	2 (0.1%)
Natterer's Bat social calls, *Myotis nattereri*	1,021	57 (2.4%)
Leisler's Bat echolocation calls, *Nyctalus leisleri*	158	68 (2.9%)
Common Noctule echolocation calls, *Nyctalus noctula*	28	7 (0.3%)
Kuhl's Pipistrelle or Nathusius' Pipistrelle echolocation calls, *Pipistrellus kuhlii or P. nathusii*	107,838	1,690 (71.5%)
Kuhl's Pipistrelle feeding buzzes, *Pipistrellus kuhlii*	65	12 (0.5%)
Kuhl's Pipistrelle social calls, *Pipistrellus kuhlii*	6,196	321 (13.6%)
Nathusius' Pipistrelle social calls, *Pipistrellus nathusii*	387	32 (1.4%)
Common Pipistrelle echolocation calls, *Pipistrellus pipistrellus*	3,383,382	2,334 (98.7%)
Common Pipistrelle feeding buzzes, *Pipistrellus pipistrellus*	169,202	979 (41.4%)
Common Pipistrelle social calls, *Pipistrellus pipistrellus*	223,606	955 (40.4%)
Soprano Pipistrelle echolocation calls, *Pipistrellus pygmaeus*	59	11 (0.5%)
Soprano Pipistrelle social calls, *Pipistrellus pygmaeus*	1	1 (0%)
Brown Long-eared Bat echolocation calls, *Plecotus auritus*	6,445	537 (22.7%)
Brown Long-eared Bat social calls, *Plecotus auritus*	34	10 (0.4%)
Grey Long-eared Bat echolocation calls, *Plecotus austriacus*	78,937	1,935 (81.9%)
Grey Long-eared Bat social calls, *Plecotus austriacus*	88	30 (1.3%)
Greater Horseshoe Bat echolocation calls, *Rhinolophus ferrumequinum*	689	70 (3%)
Lesser Horseshoe Bat echolocation calls, *Rhinolophus hipposideros*	18	11 (0.5%)
Parti-coloured Bat echolocation calls, *Vespertilio murinus*	41	2 (0.1%)
Parti-coloured Bat feeding buzzes, *Vespertilio murinus*	8	1 (0%)

Small mammals

Species	No. of recordings following validation	No. of different locations (% of total)
Wood Mouse, *Apodemus sylvaticus*	43	12 (0.5%)
Greater White-toothed Shrew, *Crocidura russula*	7572	964 (40.8%)
Lesser White-toothed Shrew, *Crocidura suaveolens*	185	37 (1.6%)
Brown Rat, *Rattus norvegicus*	26589	576 (24.4%)
Black Rat, *Rattus rattus*	965	30 (1.3%)

Bush-crickets

Species	No. of different locations (% of total)
Short-winged Conehead, *Conocephalus dorsalis*	2 (0.1%)
Long-winged Conehead, *Conocephalus fuscus*	304 (12.9%)
Speckled Bush-cricket, *Leptophyes punctatissima*	592 (25%)
Grey Bush-cricket, *Platycleis albopunctata*	358 (15.1%)
Large Conehead, *Ruspolia nitidula*	14 (0.6%)

Species	No. of different locations (% of total)
Brown-spotted Bush-cricket, *Tessellana tessellata*	1 (0%)
Great Green Bush-cricket, *Tettigonia viridissima*	944 (39.9%)

Moths

Species	No. of different locations (% of total)
Green Silver-lines, *Pseudoips prasinana*	71 (3%)
Bird Cherry Ermine, *Yponomeuta evonymella*	143 (6%)

In the following table, we look at what species (and call type for bats) were detected on each island, and the number of seasons, up to a maximum of four, that each was recorded in. The islands of Guernsey, Lihou, Herm, Jethou, Crevichon, Sark and Alderney and were surveyed in all four years, whilst Burhou was only surveyed in 2021 and 2024, and Brecqhou only in 2022.

Number of survey seasons by island on which each species (/ call type) was detected.

Species	Group	Guernsey	Lihou	Herm	Jethou	Crevichon	Sark	Brecqhou	Alderney	Burhou
Brown Long-eared Bat echolocation calls	bat	4	0	1	0	0	2	0	4	0
Brown Long-eared Bat social calls [1]	bat	3	0	0	0	0	0	0	2	0
Common Noctule echolocation calls	bat	2	0	0	0	0	0	0	1	0
Common Pipistrelle echolocation calls	bat	4	4	4	4	4	4	1	4	2
Common Pipistrelle feeding buzzes [2]	bat	3	1	2	2	2	2	0	2	0
Common Pipistrelle social calls [2]	bat	3	1	2	2	2	2	0	2	0
Greater Horseshoe Bat echolocation calls	bat	4	0	0	0	0	0	0	0	0
Grey Long-eared Bat echolocation calls	bat	4	3	4	4	1	4	1	4	1
Grey Long-eared Bat social calls [1]	bat	3	0	0	0	0	1	0	0	0
Kuhl's Pipistrelle feeding buzzes [3]	bat	1	0	1	0	0	0	0	0	0
Kuhl's Pipistrelle or Nathusius' Pipistrelle echolocation calls	bat	4	2	4	4	3	4	0	4	2
Kuhl's Pipistrelle social calls	bat	4	0	0	3	0	1	0	4	0
Leisler's Bat echolocation calls	bat	4	0	1	0	0	2	0	3	0
Lesser Horseshoe Bat echolocation calls	bat	3	0	0	0	0	0	0	0	0
Nathusius' Pipistrelle social calls	bat	4	0	0	1	0	1	0	2	0
Natterer's Bat echolocation calls	bat	4	1	1	0	0	4	1	4	0
Natterer's Bat feeding buzzes [4]	bat	1	0	0	0	0	0	0	1	0
Natterer's Bat social calls	bat	4	0	0	0	0	0	0	3	0
Parti-coloured Bat echolocation calls	bat	1	0	1	0	0	0	0	0	0
Parti-coloured Bat feeding buzzes	bat	0	0	1	0	0	0	0	0	0
Serotine echolocation calls	bat	4	0	1	1	0	0	0	4	0
Soprano Pipistrelle echolocation calls	bat	1	0	0	0	0	1	0	2	0
Soprano Pipistrelle social calls	bat	0	0	0	0	0	0	0	1	0
Whiskered or Brandt's Bat echolocation calls	bat	4	0	1	0	0	0	0	4	0

Species	Group	Guernsey	Lihou	Herm	Jethou	Crevichon	Sark	Brecqhou	Alderney	Burhou
Brown-spotted Bush-cricket	bush-cricket	1	0	0	0	0	0	0	0	0
Great Green Bush-cricket	bush-cricket	4	2	3	3	0	4	0	4	0
Grey Bush-cricket	bush-cricket	4	2	2	3	1	4	0	4	0
Large Conehead	bush-cricket	3	1	2	0	0	1	0	3	0
Long-winged Conehead	bush-cricket	4	2	1	1	1	4	0	4	0
Short-winged Conehead	bush-cricket	1	0	0	0	0	0	0	0	0
Speckled Bush-cricket	bush-cricket	4	0	4	3	2	3	0	4	0
Bird Cherry Ermine	moth	4	0	1	0	1	4	0	4	0
Green Silver-lines	moth	4	0	0	0	0	4	1	0	0
Black Rat	small mammal	0	0	0	0	0	4	0	0	0
Brown Rat	small mammal	4	1	3	0	0	0	0	4	0
Greater White-toothed Shrew	small mammal	4	0	4	0	0	0	0	4	0
Lesser White-toothed Shrew	small mammal	0	0	0	0	0	4	0	0	0
Wood Mouse	small mammal	4	0	0	0	0	0	0	1	0

[1] Brown and Grey Long-eared Bat. We focused on Type D social calls only, which are often associated with vicinity to a roost.

[2] Common Pipistrelle. Social calls and feeding buzzes were not identified by the Acoustic Pipeline before 2023. A small number of records prior to 2023 are included in the dataset, but the number of seasons reporting these is likely to be an underestimate.

[3] Kuhl's Pipistrelle and Nathusius' Pipistrelle. Difficult to distinguish acoustically in the absence of social calls. For this reason, the number of seasons reporting feeding buzzes of these two species (only for Kuhl's Pipistrelle here) is likely to be an underestimate.

[4] Natterer's Bat and for Whiskered or Brandt's Bat. We had not extended the Acoustic Pipeline to separately identify feeding buzzes of these species at the point of writing. This means that the number of seasons reporting these (only for Natterer's Bat here) is likely to be an underestimate.

4.3 Species and call-type results

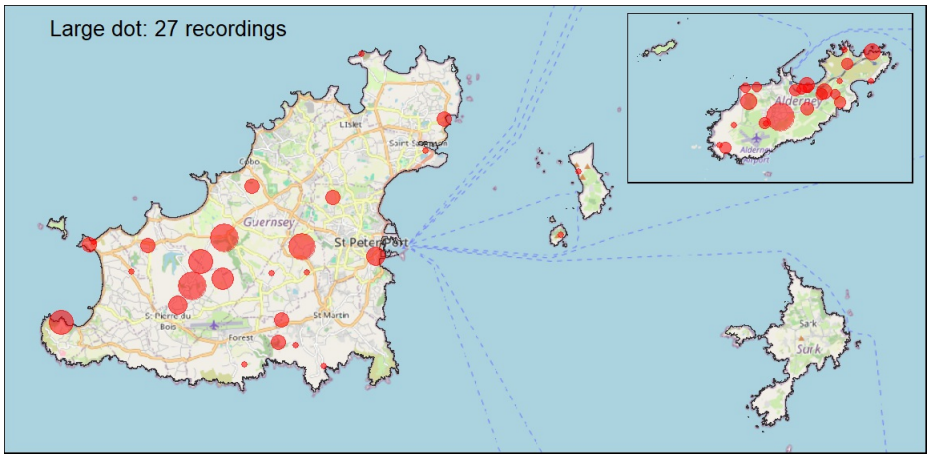
The following sections covering the four survey seasons of the Bailiwick Bat Survey combined, provide results for each species and/or call type.

4.3.1 Bat species

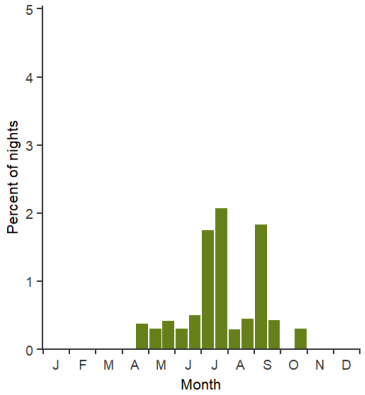
Serotine echolocation calls

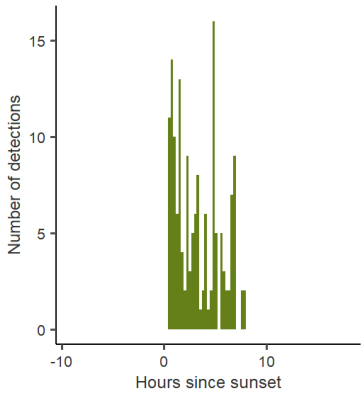
Serotine echolocation calls *Eptesicus serotinus* was recorded on 55 nights, from 49 locations, giving a total of 156 recordings.

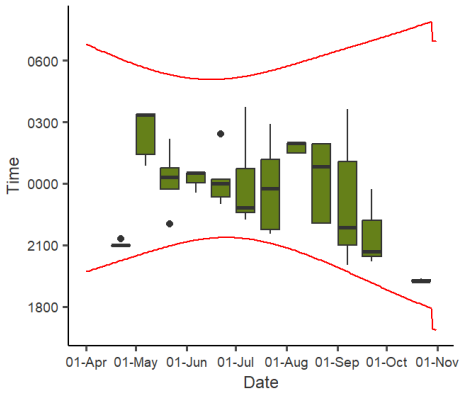
Spatial pattern of activity



Seasonal and nightly activity







Serotine echolocation calls - new species for Guernsey, Alderney, Herm and Jethou. Prior to this project, there were no records of Serotine for the Bailiwick of Guernsey.

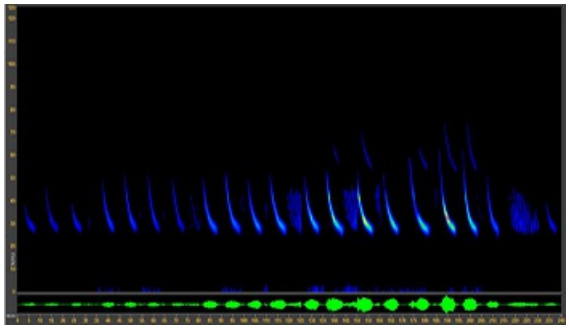
Serotine was recorded every year on Guernsey and Alderney. Apart from these two islands, the only other recordings of Serotine were from Herm (single recording, 30th June 2021), and from Jethou (single recording, 22nd September 2022).

Looking at the timing of recordings, with a peak in late summer and autumn, we consider that it is likely that Serotine is a regular visitor to the Bailiwick of Guernsey. With a small breeding population in Jersey and being widespread in neighbouring France, there is an established population close by from which individuals could originate. Considering the large amount of survey effort, it seems unlikely that if Serotine were a breeding species in Guernsey there would be more than three recordings from Alderney and Guernsey combined in 2022, all in September.

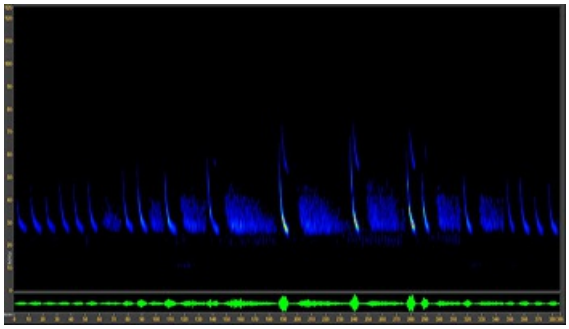
Below, we show spectrograms from six example recordings to show examples across a range of call durations. Spectrograms in this report provide a visual representation of the spectrum of frequencies (in kHz) produced by an animal as they vary with time.

Acoustically, it is normally straightforward to distinguish Serotine from *Nyctalus* species, of which Common Noctule and Leisler's Bat are the most likely confusion species here. In contrast to Serotine, *Nyctalus* species often show strong alternating frequencies in the calls within a sequence. Leisler's Bat often shows sharp frequency changes within a sequence of over 2 kHz, where such changes would be unusual for Serotine. One situation where it can be more difficult to distinguish Serotine/*Nyctalus* is in high clutter, but *Nyctalus* normally do not stay long in high clutter, so it would be exceptional to find consecutive steep calls of these species. For a visual comparison of the calls of

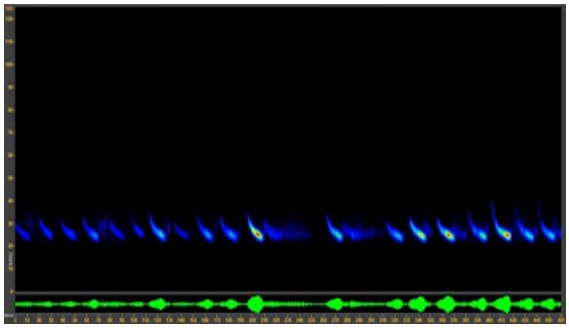
Serotine and Leisler's Bat see Identification Appendix 1. See also Appendix 8 for the description and comments on a 'big bat' species, possibly Serotine recorded on Sark in September, but which was not assigned to species.



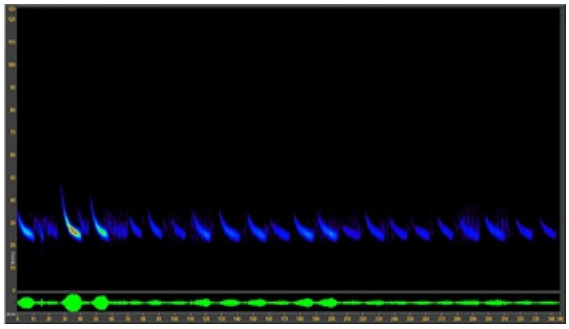
Serotine



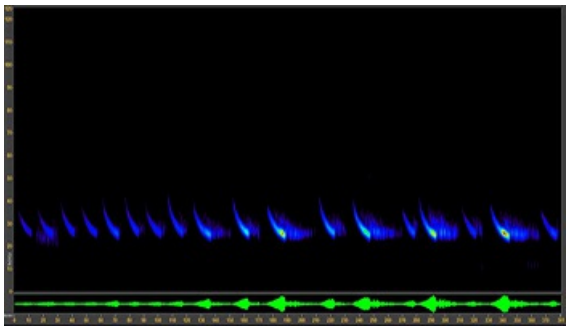
Serotine



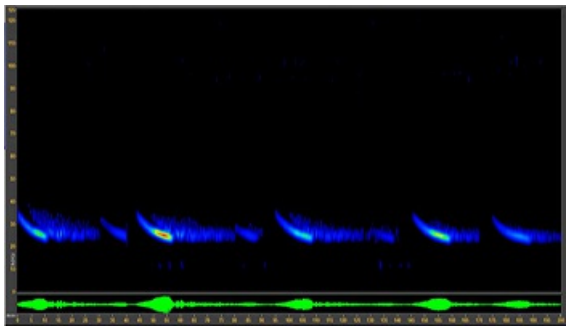
Serotine



Serotine



Serotine

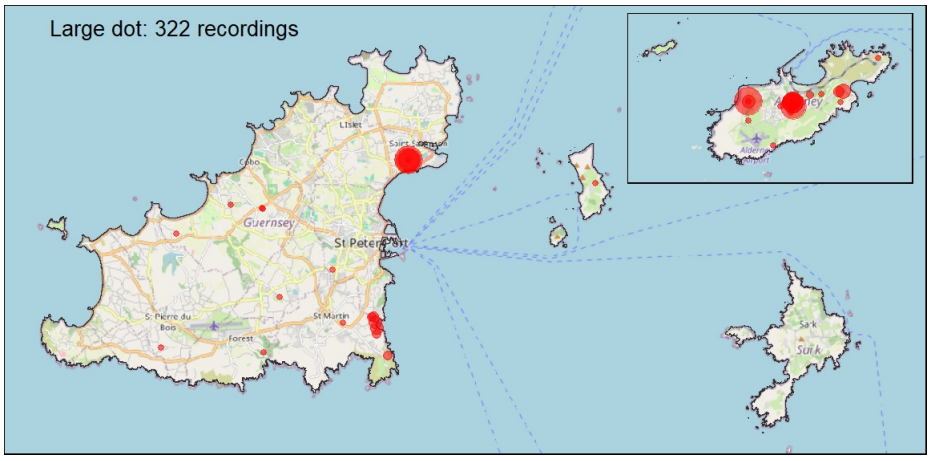


Serotine

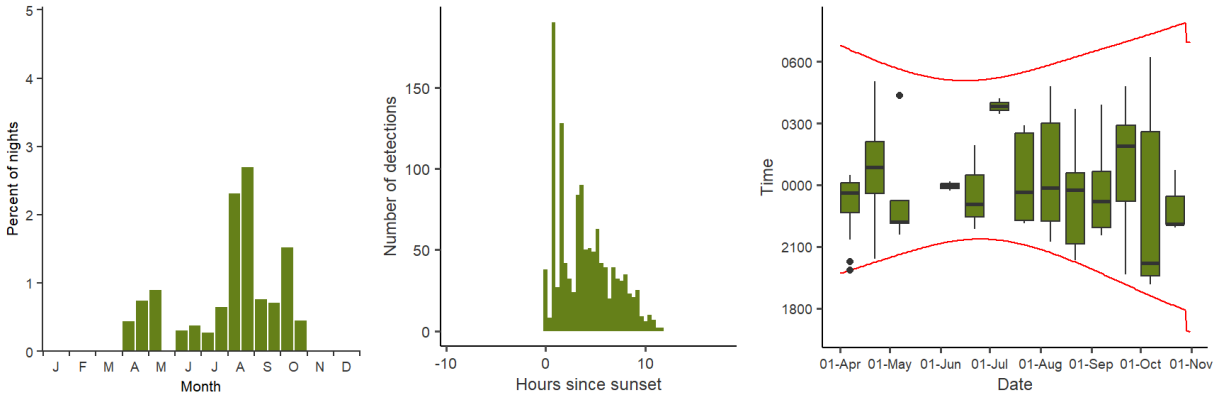
Whiskered or Brandt's Bat echolocation calls

Whiskered or Brandt's Bat echolocation calls *Myotis mystacinus or M. brandtii* was recorded on 66 nights, from 38 locations, giving a total of 1,219 recordings.

Spatial pattern of activity



Seasonal and nightly activity

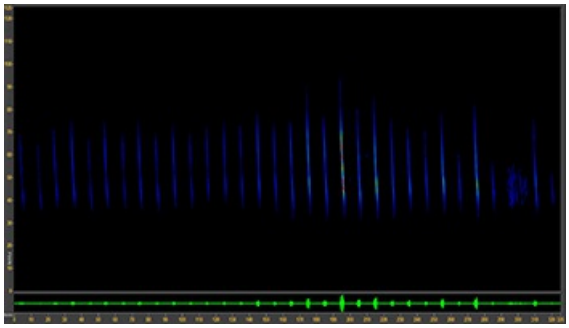


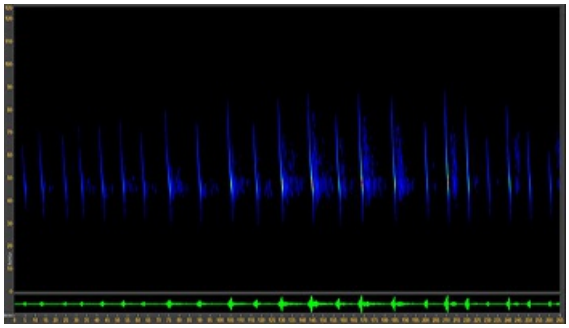
Whiskered or Brandt's Bat echolocation calls - new species for Guernsey, Herm, and possibly Alderney (depending on species) At the current time, there are no good, clear criteria for distinguishing Whiskered and Brandt's Bat acoustically with confidence (see Identification Appendix 2). We found this species pair on Guernsey for the first time in 2021 and also Alderney where an unknown small *Myotis* species, or Alcathoe Bat *M. alcathoe* had been recorded previously. The pattern of records in the Bailiwick Bat Survey, along with the discovery of a winter roost in a tunnel on Guernsey and previously known roosts in Alderney in two tunnel structures, show that this is a rare resident in the two largest islands in the Bailiwick.

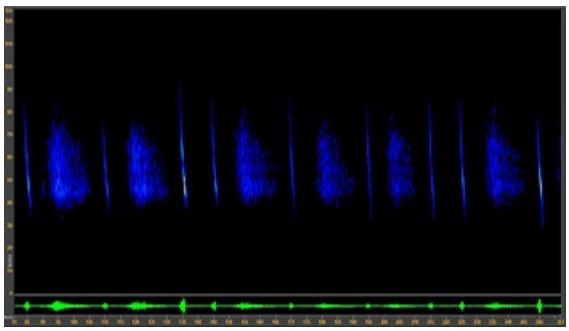
The highest number of recordings were from Alderney (over 100 recordings a night from a few locations), perhaps most notably recorded over several years from a location in woodland close to the edge of the town alongside Val Reuters and Val Fontaine which is a known roost. The maximum count from Guernsey was 11 recordings from the north of the island in 2023 and 2024 from a roost site near Delancy Park, but it looks like there is a second area on Guernsey that appears to be consistently important for this species at Jerbourg. There is no evidence of a roost near this site and it is likely it was being used as a feeding area. There was a single recording from Herm from the 27th June 2023. In relation to the recordings from the north of the island, where there were most recordings during late August and September, we know from winter roost surveys, that an underground structure that is used by this species is close by.

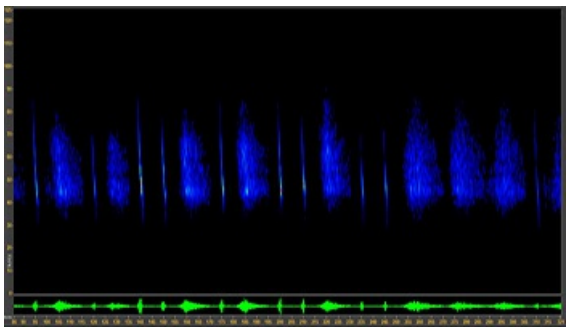
On Jersey, Whiskered Bat is considered to be very rare, whilst the status of Brandt's bat on Jersey is uncertain. In neighbouring France, Brandt's Bat is absent from Normandy and rare in Brittany. Based on this evidence, we always considered that the recordings of Whiskered or Brandt's bat, were most likely to be of Whiskered Bat. On the 18th August 2024, under licence from the States of Guernsey, trapping using a harp trap with no lures was carried out at the north entrance on Grande Maisons Road by Piers Sangan, Amy Hall and Richard Crompton caught a Whiskered Bat. A radio-tag allowed this individual to be tracked back to its roost in a house at Delancey, where this was the only

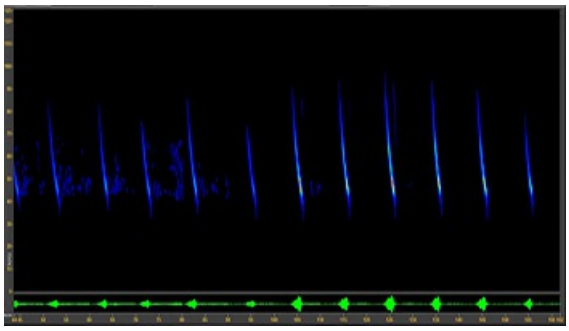
individual to emerge the following night. It was considered that this may have been a transition roost, of an individual perhaps arriving back early to the Grande Maisons Road tunnels for swarming. Further trapping or DNA evidence may allow us to determine whether *M. brandtii* is also present on Guernsey, and / or Alderney, but we know now that Whiskered Bat is present on Guernsey.

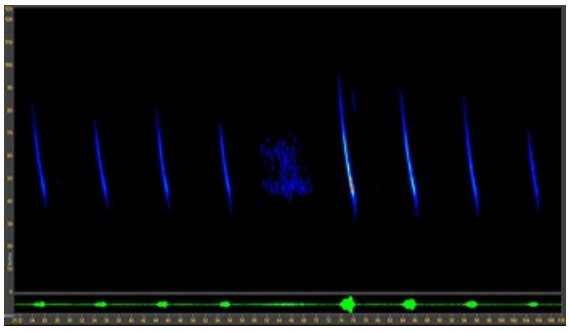

Whiskered or Brandt's Bat

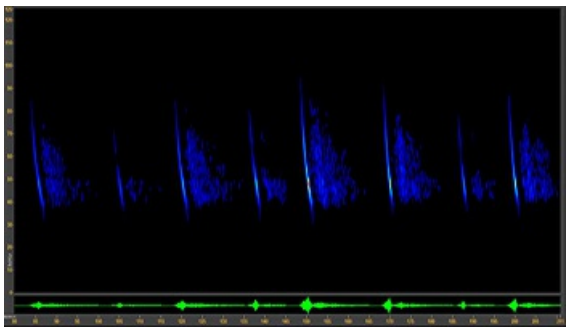

Whiskered or Brandt's Bat

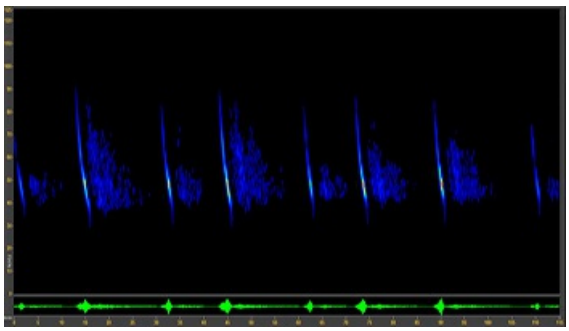

Whiskered or Brandt's Bat


Whiskered or Brandt's Bat


Whiskered or Brandt's Bat


Whiskered or Brandt's Bat

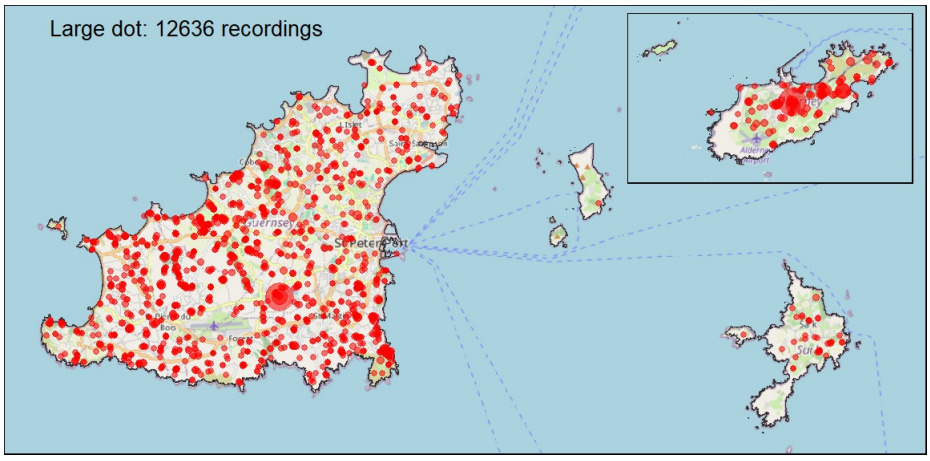

Whiskered or Brandt's Bat


Whiskered or Brandt's Bat

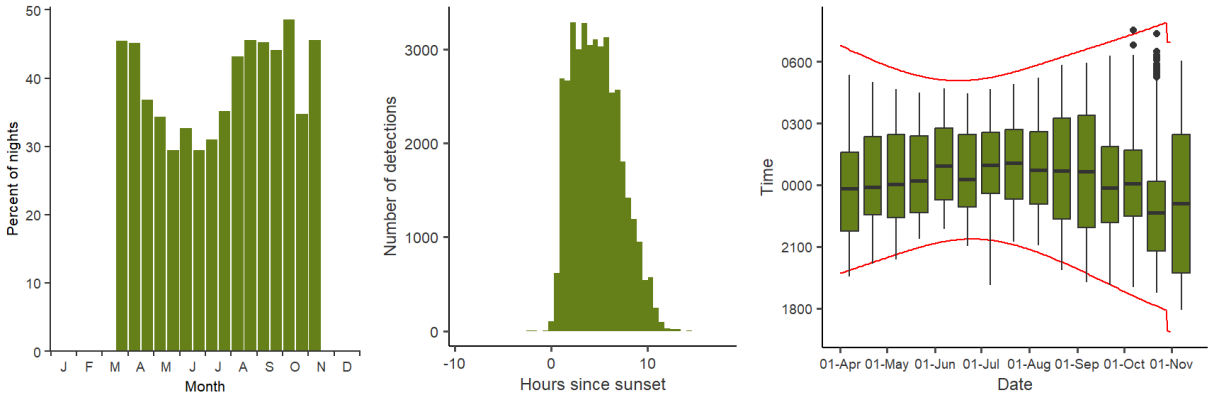
Natterer's Bat echolocation calls

Natterer's Bat echolocation calls *Myotis nattereri* was recorded on 817 nights, from 1,437 locations, giving a total of 39,949 recordings.

Spatial pattern of activity



Seasonal and nightly activity

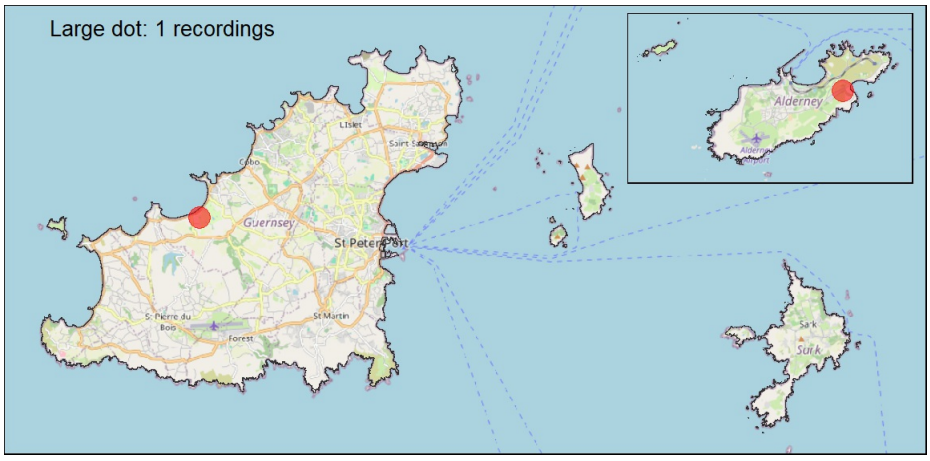


Natterer's Bat echolocation calls was recorded every year on Guernsey and Alderney, but in only 2024 for Herm and Lihou. Natterer's bat was also recorded on Brecqhou in 2022, which was the only year that surveys were carried out on this island. Of Guernsey and Alderney, Guernsey is a stronghold, with up to 1,841 recordings a night in the vicinity of the German Underground Hospital. We know from previous winter roost surveys, that the German Underground Hospital and the tunnels under St Saviour's Church are extremely important for Natterer's Bat for swarming and/or use as hibernation roosts. On Alderney, up to 41 recordings a night were recorded from an area that is also important for Whiskered or Brandt's Bat around the tunnel entrance in woodland alongside Val Reuters and Val Fontaine. See Identification Appendix 3 for more information on the sound identification of Natterer's Bat.

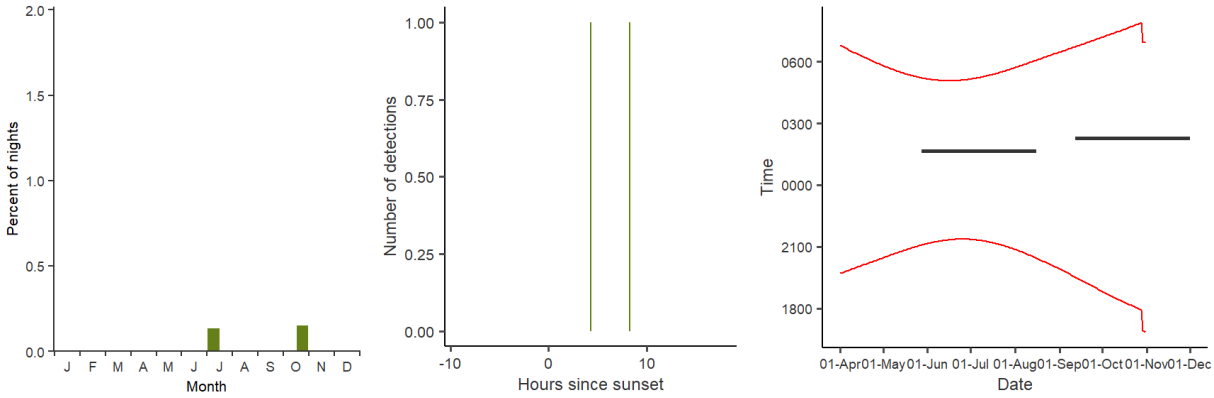
Natterer's Bat feeding buzzes

Natterer's Bat feeding buzzes *Myotis nattereri* were recorded on two nights, from 2 locations, giving a total of 2 recordings.

Spatial pattern of activity



Seasonal and nightly activity

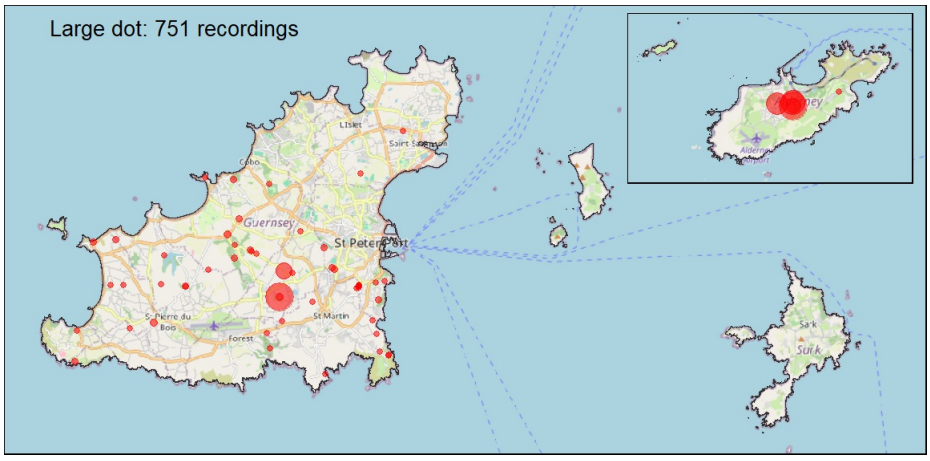


Natterer's Bat feeding buzzes One feeding buzz was recorded from Guernsey and Alderney, but because, during this project we did not have a species classifier for Natterer's bat feeding buzzes, and the data was not specifically manually checked for these, Natterer's Bat feeding buzzes are likely to have been under-recorded.

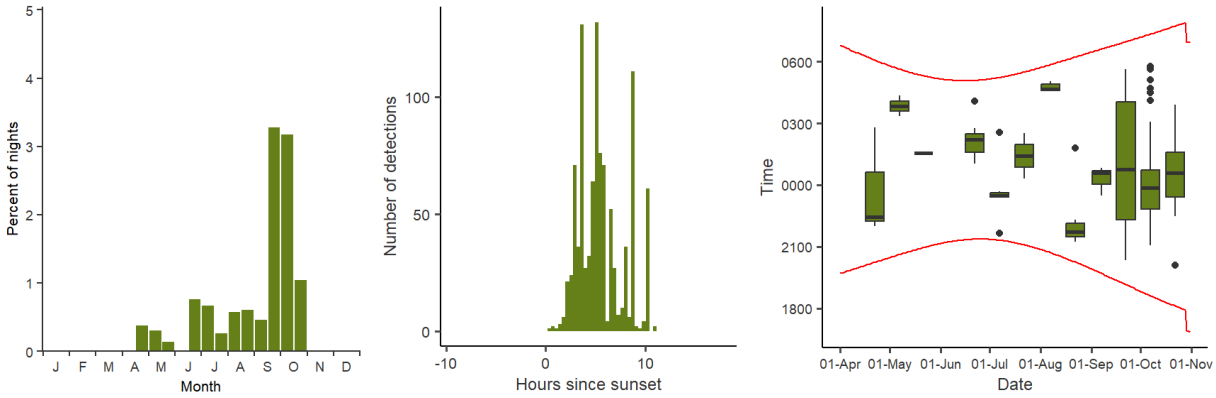
Natterer's Bat social calls

Natterer's Bat social calls *Myotis nattereri* were recorded on 62 nights, from 57 locations, giving a total of 1,021 recordings.

Spatial pattern of activity



Seasonal and nightly activity

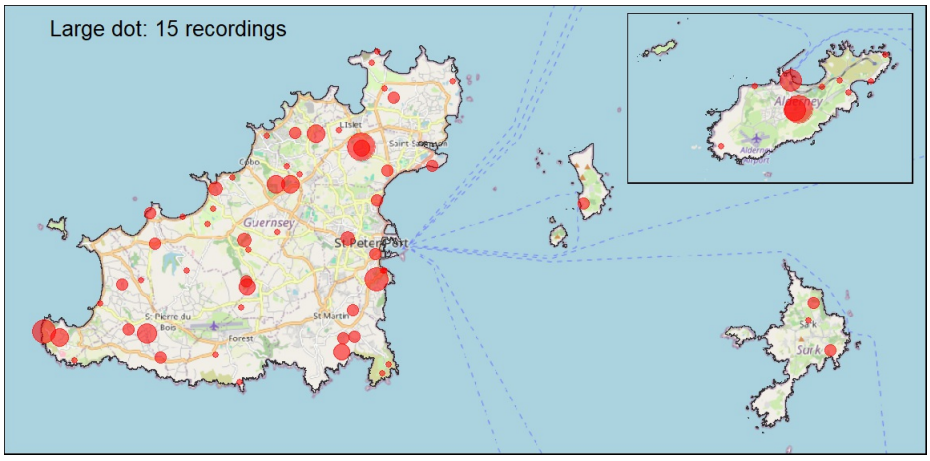


Natterer's Bat social calls Social calls of bats are different from echolocation calls, which they use to navigate their way around the landscape, in that they are often used when bats interact with one another. Natterer's Bat social calls in October or November may be associated with swarming in the vicinity of roost sites, so for this reason, it can be useful to identify these separately. Natterer's bat social calls were recorded on Guernsey and Alderney. On Alderney, recordings with social calls, up to a maximum of four recordings a night, were recorded across more than one year near a tunnel in woodland next to Val Reuters and Val Fontaine. On Guernsey, up to 240 recordings a night were recorded from close to the German Underground Hospital, which we know is an important wintering structure for Natterer's Bat, with the highest count of recordings with social calls from September and October.

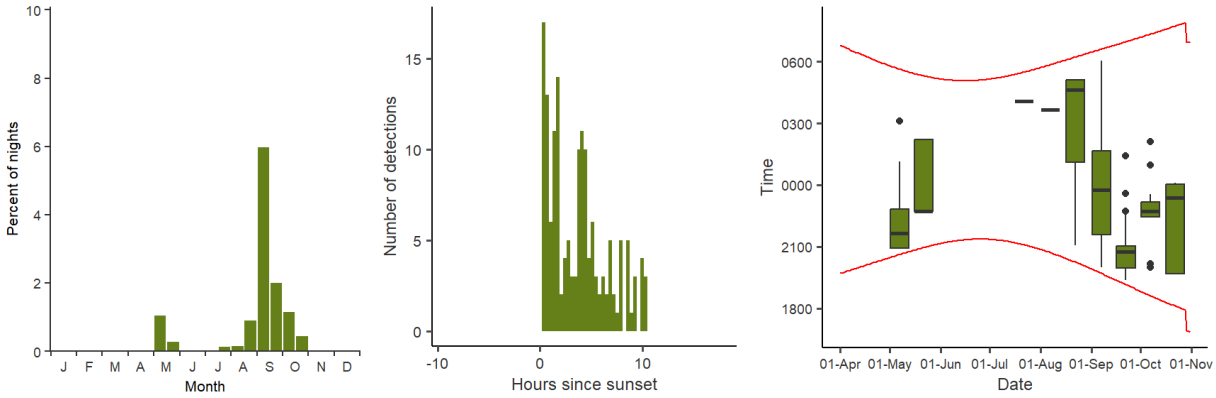
Leisler's Bat echolocation calls

Leisler's Bat echolocation calls *Nyctalus leisleri* was recorded on 52 nights, from 68 locations, giving a total of 158 recordings.

Spatial pattern of activity



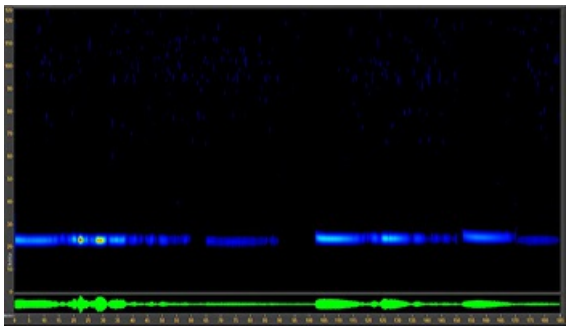
Seasonal and nightly activity



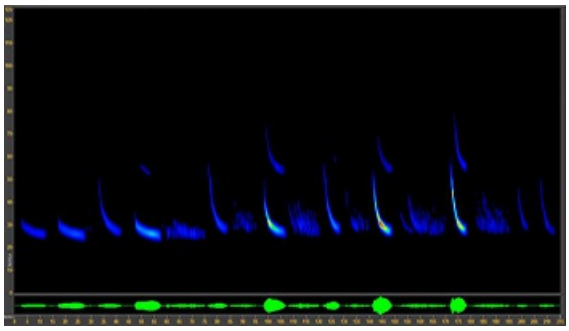
Leisler's Bat echolocation calls - new species for Guernsey, Alderney, Herm and Sark. Prior to this project, there were no records of Leisler's Bat for the Bailiwick of Guernsey. Leisler's bat was recorded in three of the four survey seasons on Alderney, with a maximum of two recordings a night. Most recordings of Leisler's bat on Alderney were post-breeding between late August and the end of October, but this species was also recorded on two dates early in the season (2nd and 4th May) in 2024. On Guernsey, there was a similar seasonal pattern of recordings, with most recordings between late August and the end of October, but again with a small number of records in May in 2023 (24th May), and a cluster of recordings from different locations in 2024 (11th, 12th, 15th and 16th May). Leisler's Bat was recorded as a new species for Herm in 2022 (2 recordings on the 11th October), and as a new species for Sark on the 11th October 2023, with further recordings from Sark the following year on the 28th July 2024 and 19th October 2024.

Leisler's Bat is very rare in Jersey and very localised on the nearby coasts of France. Leisler's Bat are known to be migratory and the pattern of records (mainly in autumn) indicates that this species is a rare, but regular migrant to the islands.

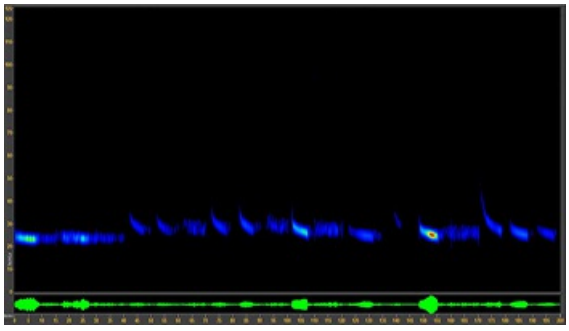
In most of the recordings, there are alternating call frequencies, which is typical for *Nyctalus*. Such alternating calls would not be unexpected for Serotine, but also unlikely to be produced by Parti-coloured Bat *Vespertilio murinus*, which produces echolocation calls which are otherwise extremely similar to Leisler's Bat. 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. For more information on the sound identification of Leisler's Bat see Identification Appendix 4. See also Appendix 8 for the description and comments on an additional 'big bat' species, possibly Leisler's Bat recorded on Sark in early September, but which was not assigned to species.



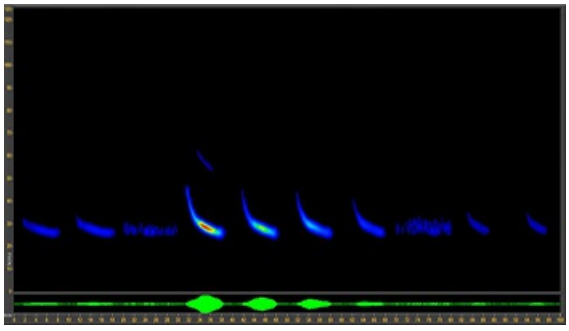
Leisler's Bat



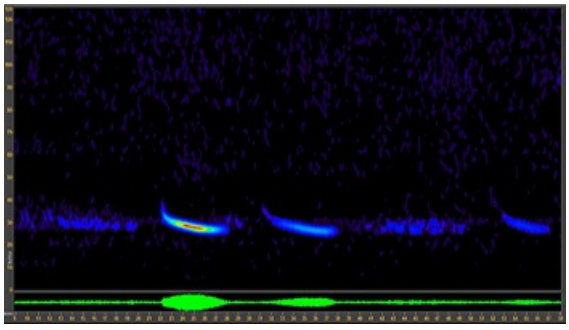
Leisler's Bat



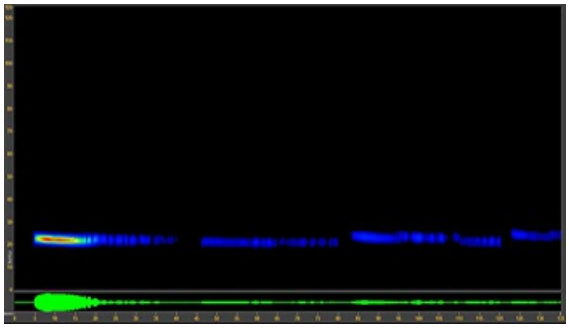
Leisler's Bat



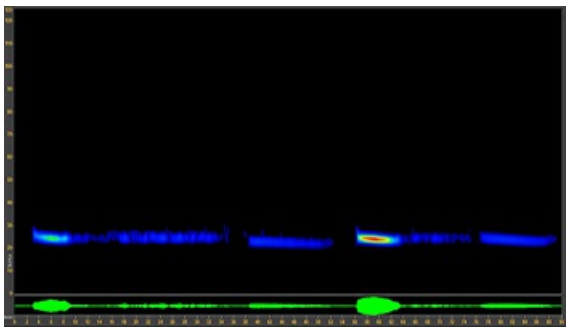
Leisler's Bat



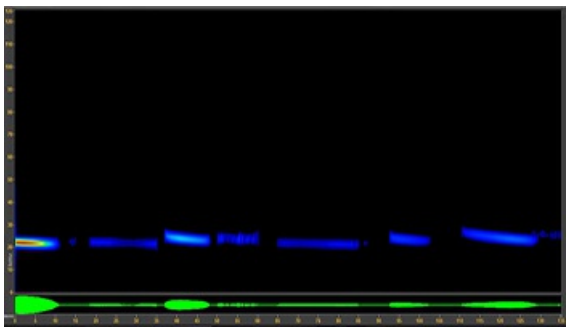
Leisler's Bat



Leisler's Bat



Leisler's Bat

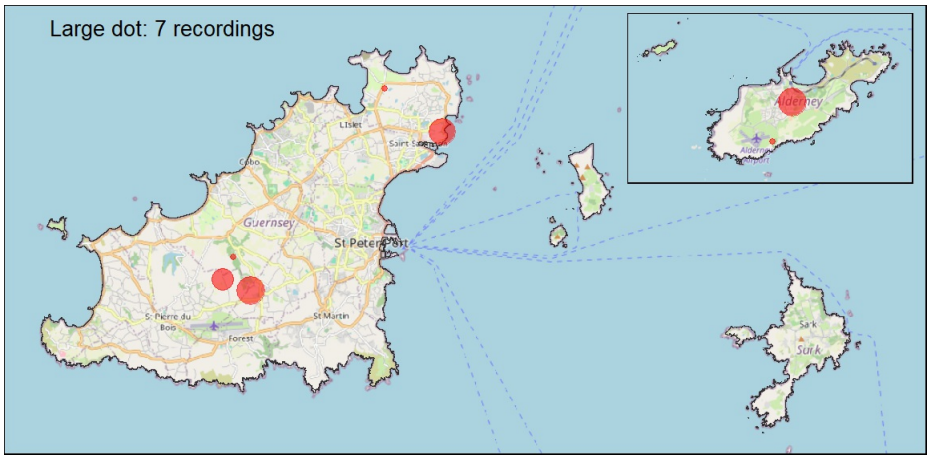


Leisler's Bat

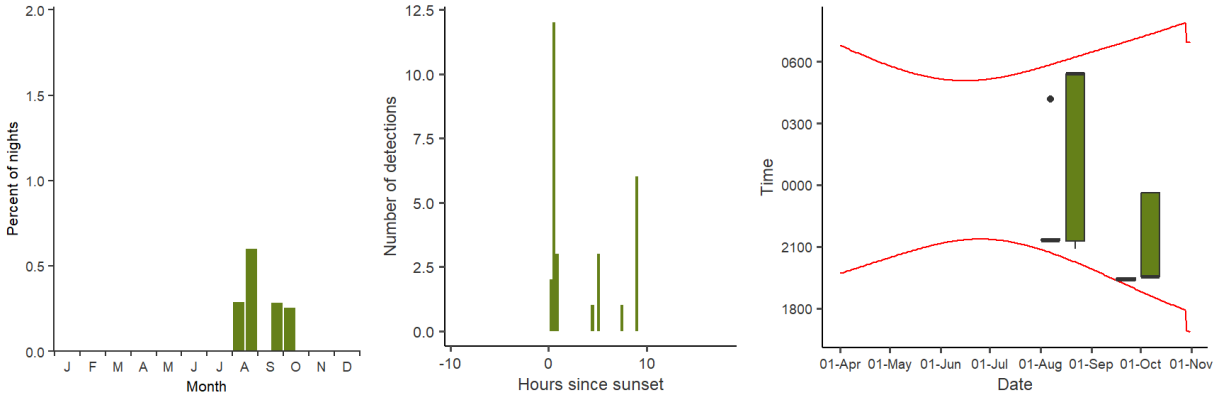
Common Noctule echolocation calls

Common Noctule echolocation calls *Nyctalus noctula* was recorded on nine nights, from 7 locations, giving a total of 28 recordings.

Spatial pattern of activity

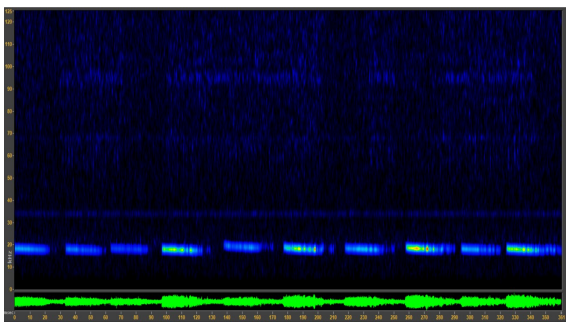


Seasonal and nightly activity

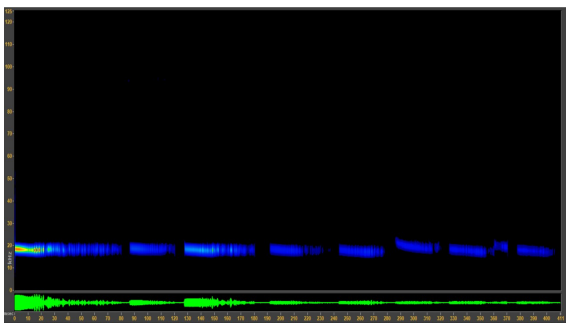


Common Noctule echolocation calls - new species for Guernsey and Alderney. Common Noctule was recorded as a new species for Alderney on the 11th August 2022 (1 recording), and an additional five recordings from the same location the following night. Common Noctule was recorded again from Alderney on the 9th October 2022. On Guernsey, Common Noctule was recorded as a new species for the island on the 18th August 2022, and recorded between that and another location close by until the 20th August 2022. The only other recordings of Common Noctule from Guernsey were from the 25th and 29th September 2023 from two locations.

Common Noctule are rare in Normandy and Brittany and data deficient in Jersey, with only a few acoustic recordings. Combined with the data from 2021 (likely a record of a single bat over 2 nights in Guernsey) and from 2022 where Noctule was recorded as a new species for Alderney (recorded on two dates, in late August and October), it is likely that this is a very rare migrant in the Bailiwick. In the figures below, we show spectrograms of some of the sequences recorded. The calls here are very typical for Common Noctule and are too low in frequency for Leisler's Bat to be likely.



Noctule

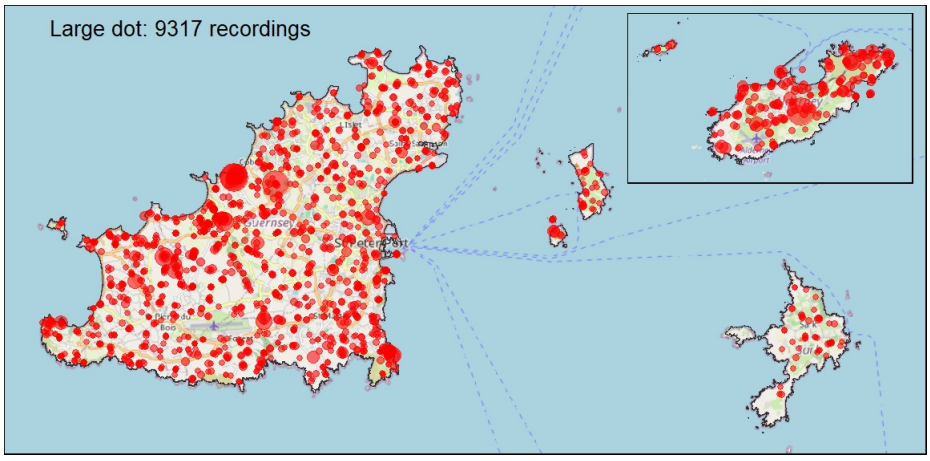


Noctule

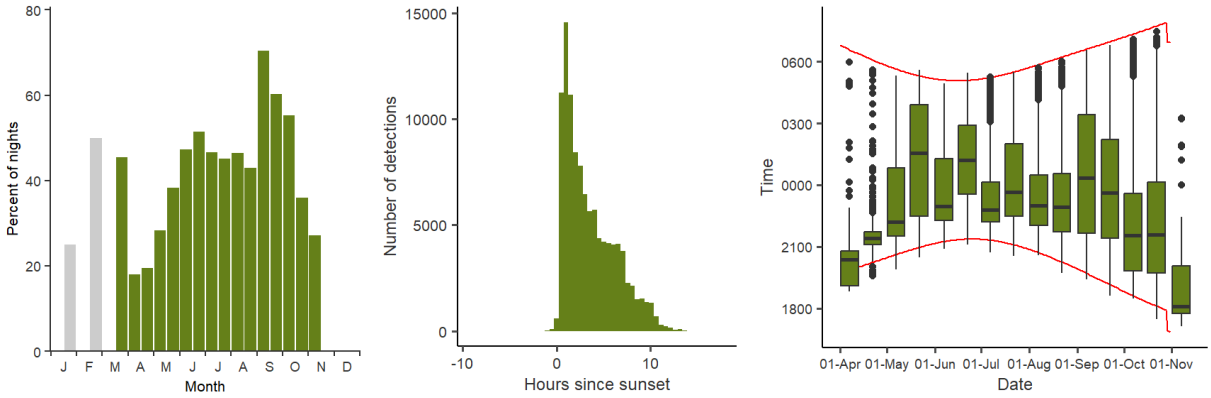
Kuhl's Pipistrelle or Nathusius' Pipistrelle echolocation calls

Kuhl's Pipistrelle or Nathusius' Pipistrelle echolocation calls *Pipistrellus kuhlii or P. nathusii* was recorded on 781 nights, from 1,690 locations, giving a total of 107,838 recordings.

Spatial pattern of activity



Seasonal and nightly activity



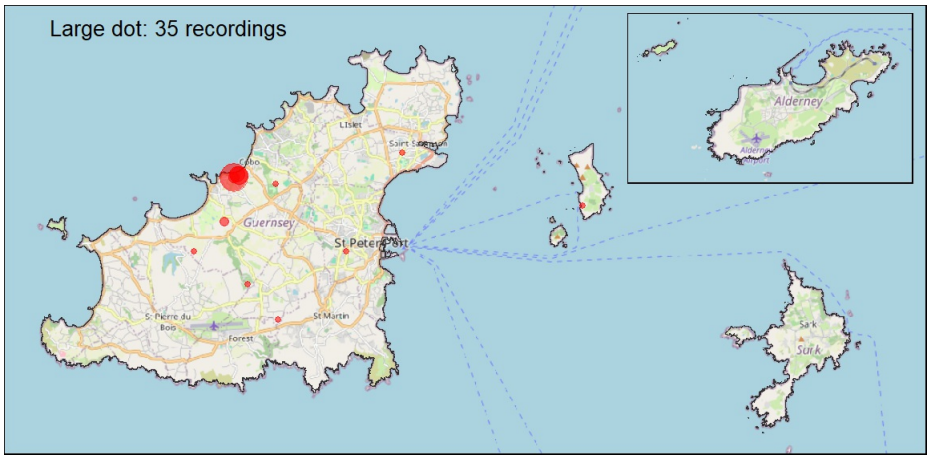
Nathusius' or **Kuhl's Pipistrelle echolocation calls**. We present here results for Kuhl's Pipistrelle and Nathusius' Pipistrelle combined. These two species are extremely difficult to distinguish from their echolocation calls (see Identification Appendix 6) and are best treated as a species pair, although social calls are clearly different and are reliably identified (see separate sections on social calls). Testing of the current BTO Acoustic Pipeline classifier for the Channel Islands with independent known species recordings, suggests that the error rate for echolocation calls is about 10% for both species, which is relatively low, but more work is needed to look at this. The classifier initially assigned over 90% of Kuhl's Pipistrelle or Nathusius' Pipistrelle echolocation calls to Kuhl's Pipistrelle.

This species pair has been recorded on Guernsey, Alderney, Burhou, Sark, Herm, Jethou, Lihou and Crevichon. We know from trapping work, that Kuhl's Pipistrelle is likely to be a common resident species. We know that Nathusius' Pipistrelle is present in the Bailiwick of Guernsey in the autumn, when male advertisement calls are recorded. We consider that it most likely that the majority of the echolocation calls here belong to Kuhl's Pipistrelle, particularly outside of autumn.

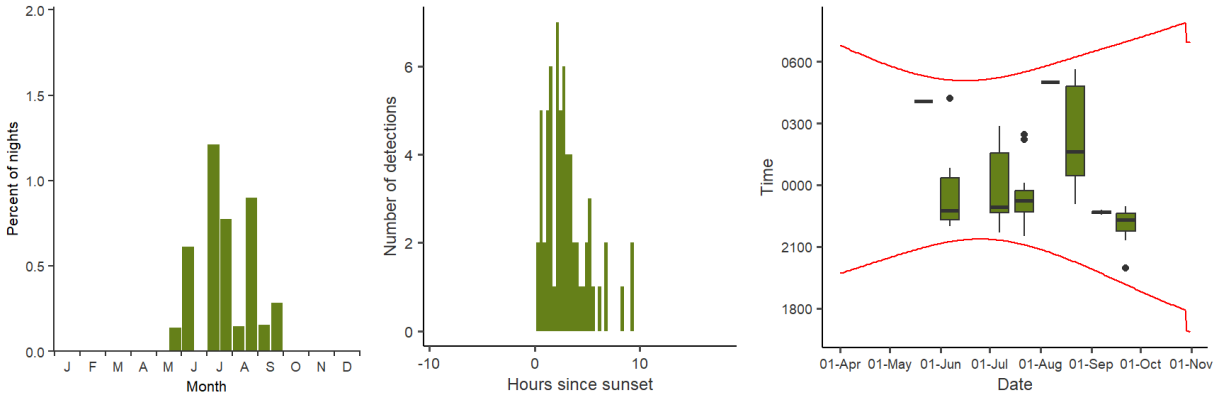
Kuhl's Pipistrelle feeding buzzes

Kuhl's Pipistrelle feeding buzzes *Pipistrellus kuhlii* were recorded on 27 nights, from 12 locations, giving a total of 65 recordings.

Spatial pattern of activity



Seasonal and nightly activity

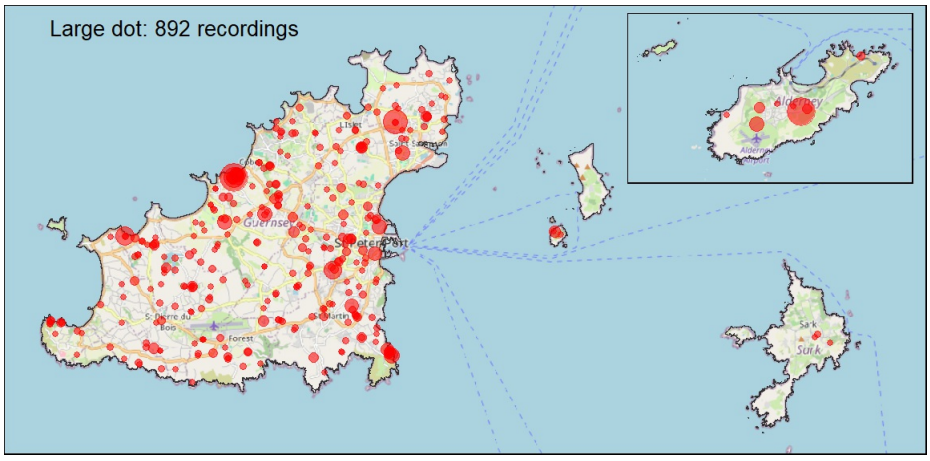


Kuhl's Pipistrelle feeding buzzes were not separately identified by the Acoustic Pipeline species classifiers, or comprehensively identified during the manual species verification, so we know that these were under-recorded. Feeding buzzes were recorded from Guernsey and Herm.

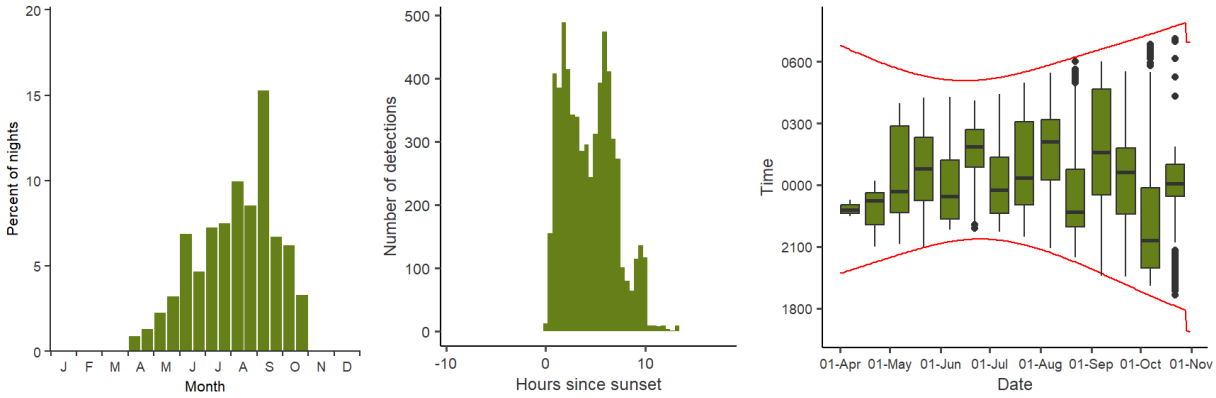
Kuhl's Pipistrelle social calls

Kuhl's Pipistrelle social calls *Pipistrellus kuhlii* were recorded on 381 nights, from 321 locations, giving a total of 6,196 recordings.

Spatial pattern of activity



Seasonal and nightly activity



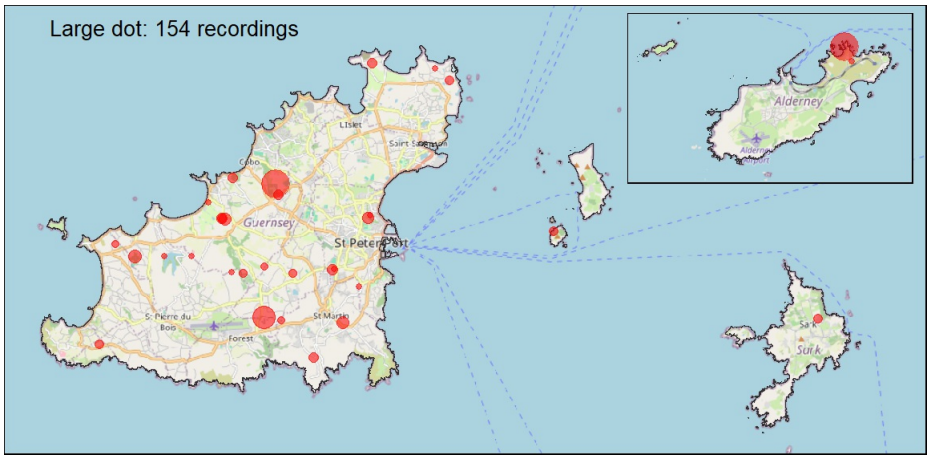
Kuhl's Pipistrelle social calls It is clear that Kuhl's Pipistrelle is a common and widespread species on Guernsey, Alderney, Sark and Jethou. This builds on evidence from Guernsey, where in 2018, three juvenile Kuhl's Pipistrelle's were caught, and one radio-tracked to a roost on Guernsey (Binet & Walsh, 2020). Because the social calls of Kuhl's Pipistrelle are very different from the social calls of other bat species, including Nathusius' Pipistrelle, we can assign these calls to Kuhl's Pipistrelle with confidence (see Identification Appendix 5).

On Alderney, a maximum of 30 recordings with Kuhl's Pipistrelle social calls a night were recorded on the 4th October 2021 from the south-east edge of the town alongside Longis Lane. On Guernsey, the maximum recorded was 403 recordings on the 18th August 2024 from the Pine Forest at Le Guet. Kuhl's Pipistrelle social calls were also recorded from several locations on Sark and on Jethou.

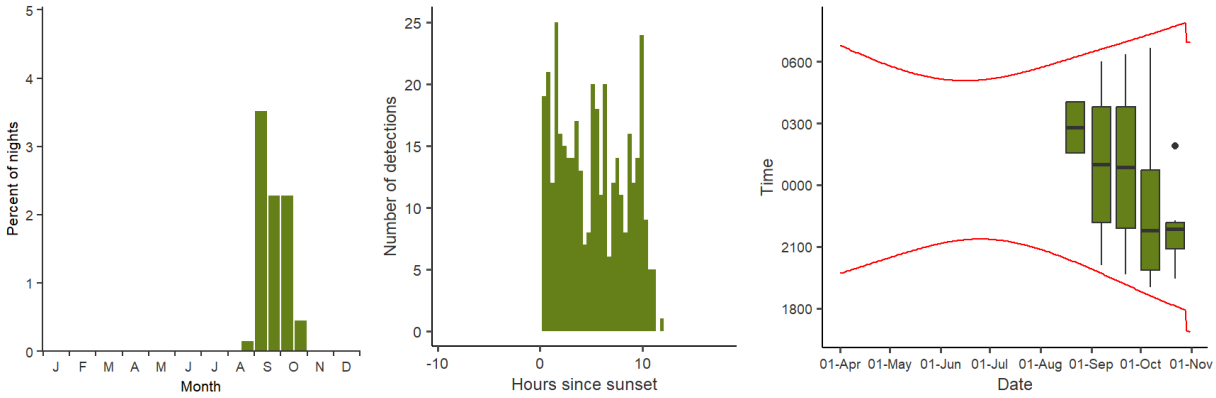
Nathusius' Pipistrelle social calls

Nathusius' Pipistrelle social calls *Pipistrellus nathusii* were recorded on 51 nights, from 32 locations, giving a total of 387 recordings.

Spatial pattern of activity



Seasonal and nightly activity



Nathusius' Pipistrelle social calls In contrast to echolocation calls, social calls of Nathusius' Pipistrelle can be assigned to species with confidence (see Identification Appendix 5). The social calls recorded, comprised male advertisement calls (i.e. they are calling for a female).

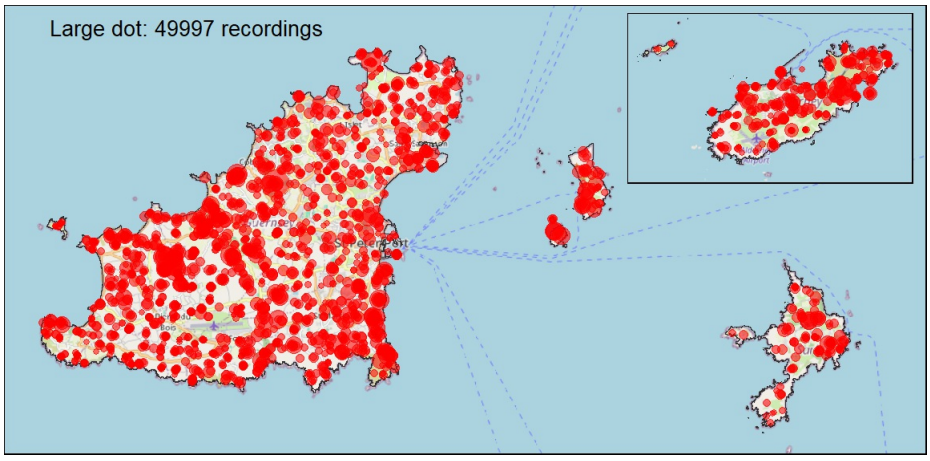
Male advertisement calls of Nathusius' pipistrelle were recorded from Alderney on the 8th October 2022 and 17th October 2023 in both years from close to Arch beach, in the north-east of the island. On Guernsey, male advertisement calls were recorded at a number of locations, but with a maximum of 88 recordings on the 8th September 2024 from Saumarez Park. Male advertisement calls of Nathusius' Pipistrelle were also recorded from Jethou on the 7th September 2021, from Sark on the 7th and 9th September 2023, and from close to the Clos de Ménage B&B.

The timing of the male advertisement calls fits in with what is known about when Nathusius' Pipistrelles mate, and the question is whether these are newly arrived migrants setting up territories to attract females, or whether they are individuals that are resident, but are being overlooked because they have not given out social calls prior to this. As in previous years, the distribution of social calls is much more restricted compared to Kuhl's, both spatially and temporally (Kuhl's: April to October; Nathusius': September-October only). All previous records of Nathusius' Pipistrelle in the *Transactions of La Société Guernesiaise* have been from September to April, which perhaps points to this being a migrant and winter visitor. Intriguingly a juvenile Nathusius' Pipistrelle was trapped on 28th August 2022. This could still be a migrant and further work is needed to understand the status of this species better, i.e. is it a rare resident, or solely a migrant and winter visitor.

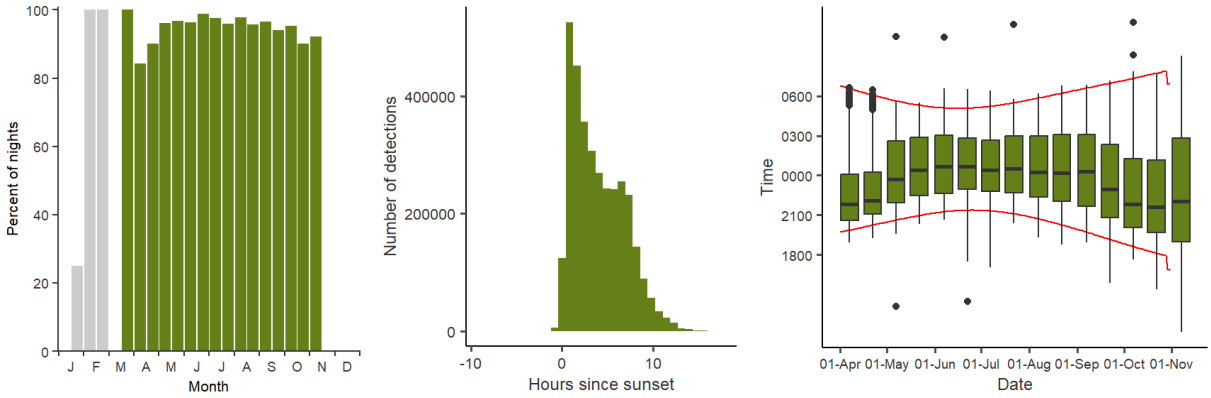
Common Pipistrelle echolocation calls

Common Pipistrelle echolocation calls *Pipistrellus pipistrellus* was recorded on 870 nights, from 2,334 locations, giving a total of 3,383,382 recordings.

Spatial pattern of activity



Seasonal and nightly activity



Common Pipistrelle echolocation calls. Common Pipistrelle was by far the most common and widely recorded bat species, with 3,383,382 recordings from 2,334 different locations (99% of survey locations). It was the only species of bat that was recorded on every island surveyed.

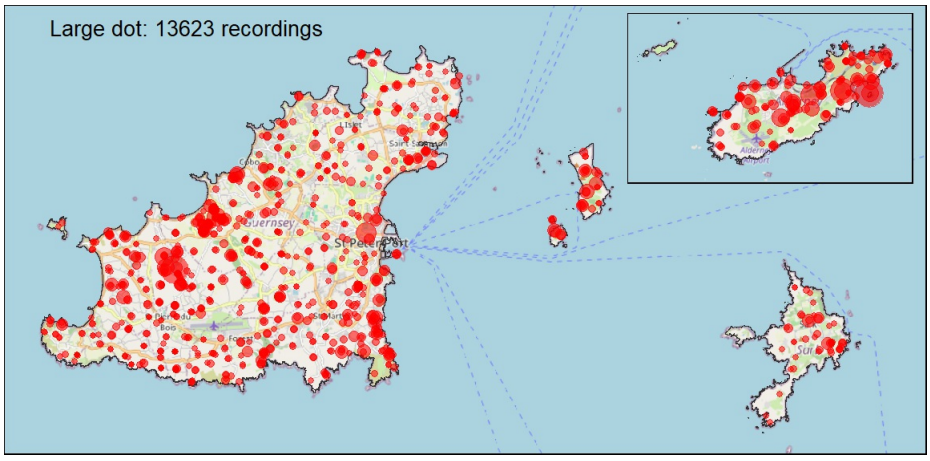
By island, the maximum number of recordings a night were: Guernsey (6,056 recordings on the 24th August 2021 from Jerbourg), Lihou (345 from Lihou on the 5th October 2024), Herm (3,471 on the 4th August 2021), Jethou (3,941 on 5th June 2024), Crevichon (563 recordings on 1st July 2023), Sark (3,755 on 30th July 2022), Brecqhou (588 on the 16th June 2022), Alderney (6,588 on 22nd October 2024) and a maximum of 1 recording a night from Burhou on several nights in 2021 and from 2024.

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. In addition, where there are multiple individuals of the same species present, there can be frequency shifting as one or both individuals 'shift' their frequencies to avoid acoustic interference, which again can result in some calls in a sequence that are higher in frequency than would be typical for the species.

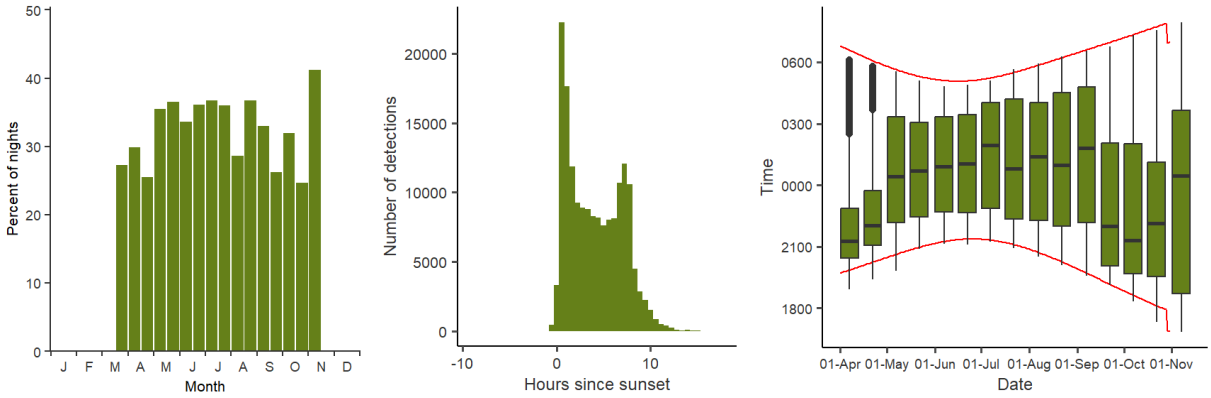
Common Pipistrelle feeding buzzes

Common Pipistrelle feeding buzzes *Pipistrellus pipistrellus* were recorded on 432 nights, from 979 locations, giving a total of 169,202 recordings.

Spatial pattern of activity



Seasonal and nightly activity



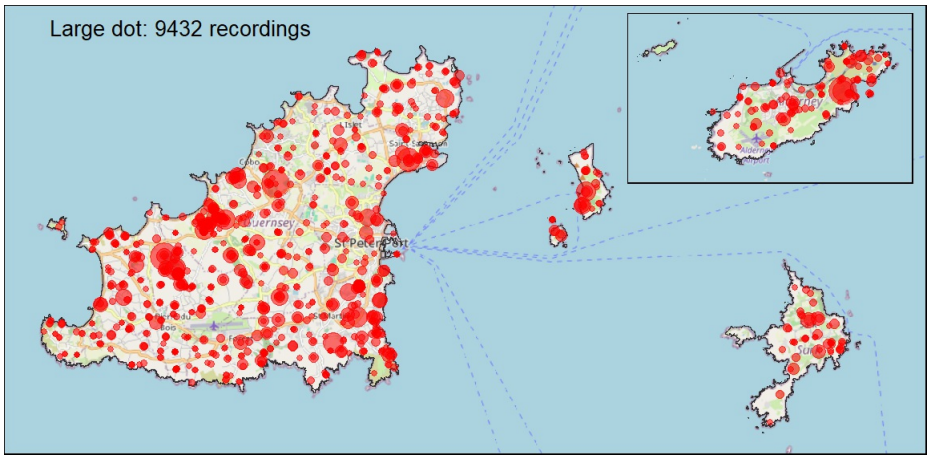
Common Pipistrelle feeding buzzes. Common Pipistrelle feeding buzzes were recorded widely across islands, with on Alderney, a maximum of 734 recordings with feeding buzzes on the 8th July 2023 from Raz Island, and from Guernsey a maximum of 3,830 recordings with feeding buzzes on the 10th May 2024 from Saint Saviour's Reservoir. On Herm a maximum of 628 recordings with feeding buzzes were recorded on the 22nd June 2023, from Valley Garden, 938 from Jethou on the 5th June 2024, only 1 recording a night with feeding buzzes from Lihou on the 4th and 5th October 2024, and from Sark, a maximum of 446 recordings with feeding buzzes on the 10th June 2024 from close to Close de Ménage B&B.

As illustrated above, feeding buzzes are produced across the year, with 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. During the colder start and end of the project, feeding activity was more concentrated towards the early part of the night.

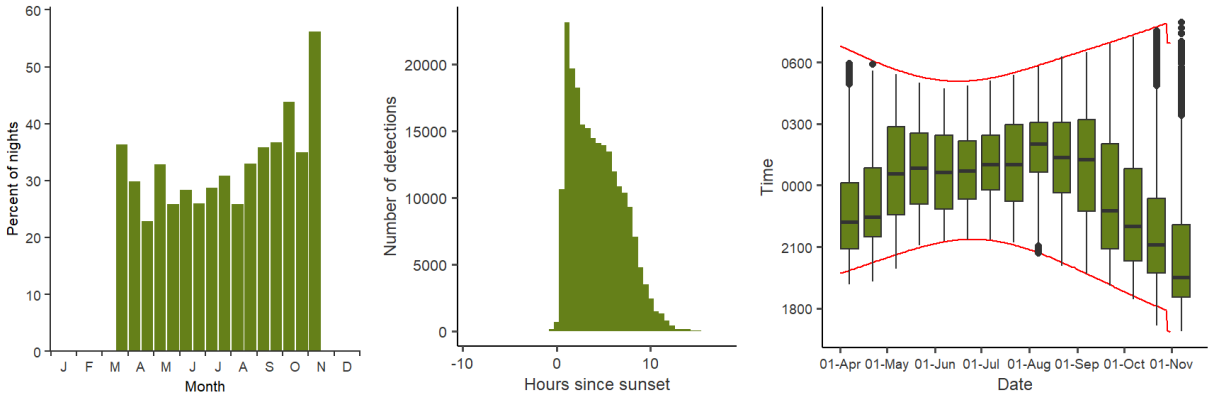
Common Pipistrelle social calls

Common Pipistrelle social calls *Pipistrellus pipistrellus* were recorded on 429 nights, from 955 locations, giving a total of 223,606 recordings.

Spatial pattern of activity



Seasonal and nightly activity



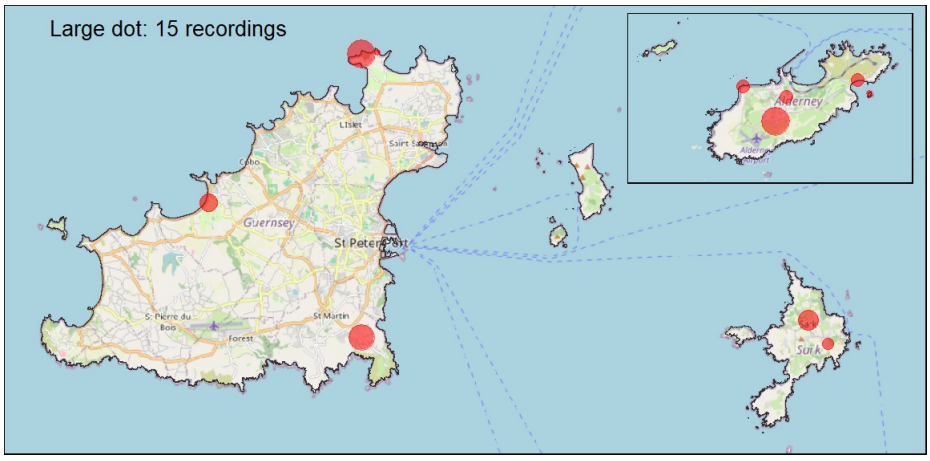
Common Pipistrelle social calls. Common Pipistrelle social calls were recorded widely across the islands with the following maxima per night: Guernsey (3,799 recordings on 2nd May 2024), Lihou (10 recordings on 4th October 2024), Herm (756 recordings on 11th October 2024), Jethou (283 recordings on 10th May 2023), Sark (919 recordings on 9th October 2024) and Alderney (2,111 on 22nd October 2024).

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 above, there is an increase in the percent of nights recording Common Pipistrelle social calls during the late summer / autumn mating period.

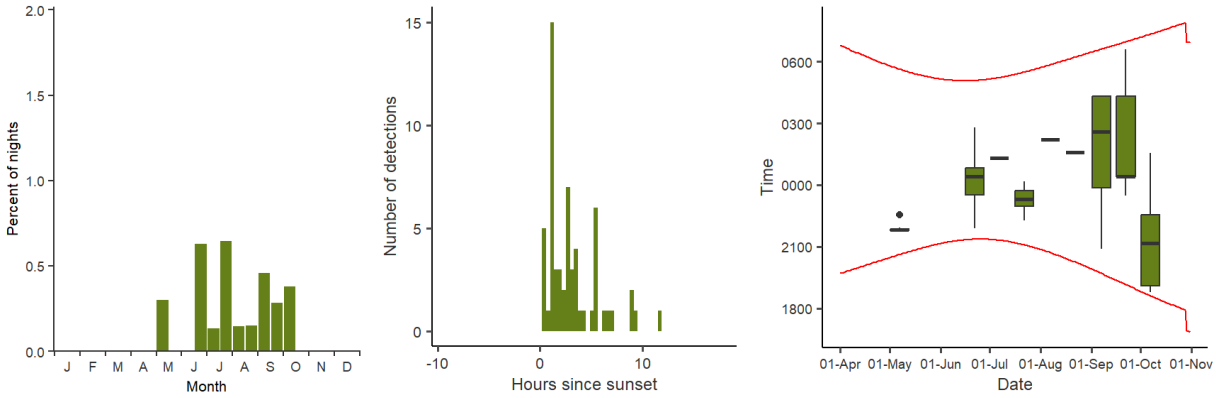
Soprano Pipistrelle echolocation calls

Soprano Pipistrelle echolocation calls *Pipistrellus pygmaeus* was recorded on 23 nights, from 11 locations, giving a total of 59 recordings.

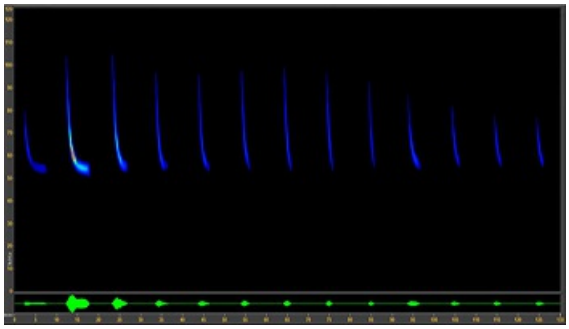
Spatial pattern of activity



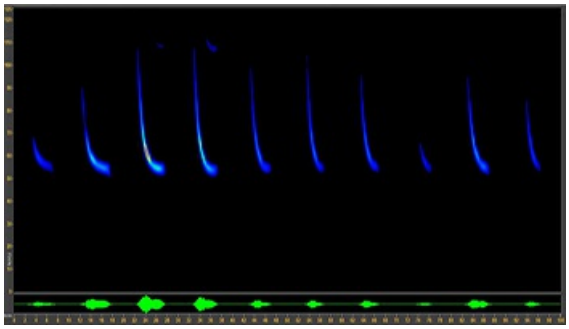
Seasonal and nightly activity



Soprano Pipistrelle echolocation calls. We consider that Soprano Pipistrelle is a rare species in the Bailiwick of Guernsey. On Alderney, there were a number of recordings of Soprano Pipistrelle from several locations across years, including between June and early July, which makes us consider that Soprano Pipistrelle may be a rare breeding species on Alderney. Of particular note, is one location in the town, close to Le Colimbot Road where this species was recorded from in more than one year during these summer months. On Guernsey, there is less support for this being a resident species. Despite a lot of survey effort, the small number of records of Soprano Pipistrelle were in early May, or in September and October. On Sark, the only recordings were from 2024, between the 19th July and 1st August. Given the amount of survey effort on Sark, and with these being the only recordings, we consider that it is unlikely that Soprano Pipistrelle is a resident species there.



Soprano Pipistrelle

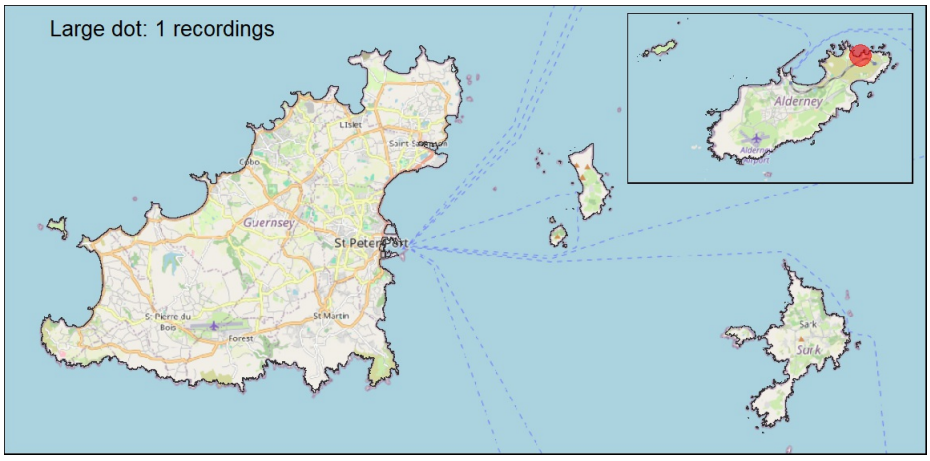


Soprano Pipistrelle

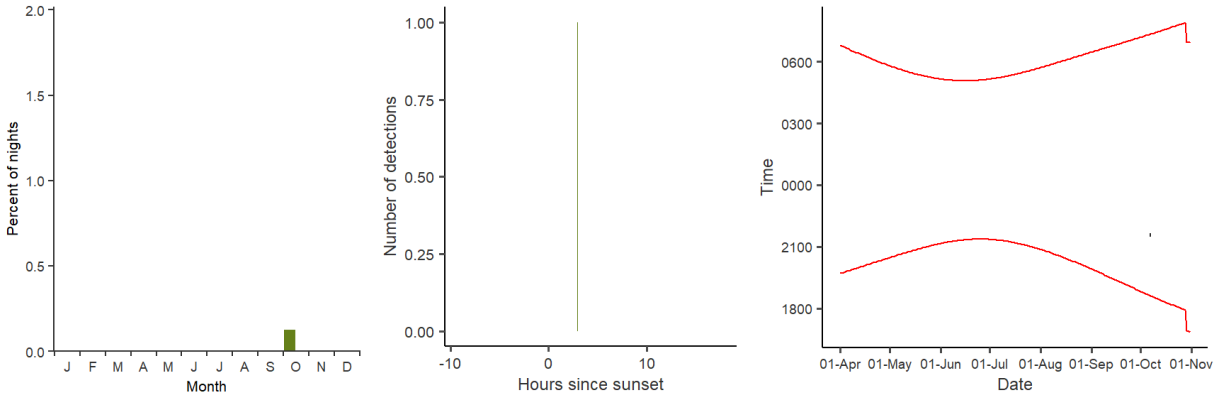
Soprano Pipistrelle social calls

Soprano Pipistrelle social calls *Pipistrellus pygmaeus* were recorded on one night, from 1 location, giving a total of 1 recording.

Spatial pattern of activity



Seasonal and nightly activity

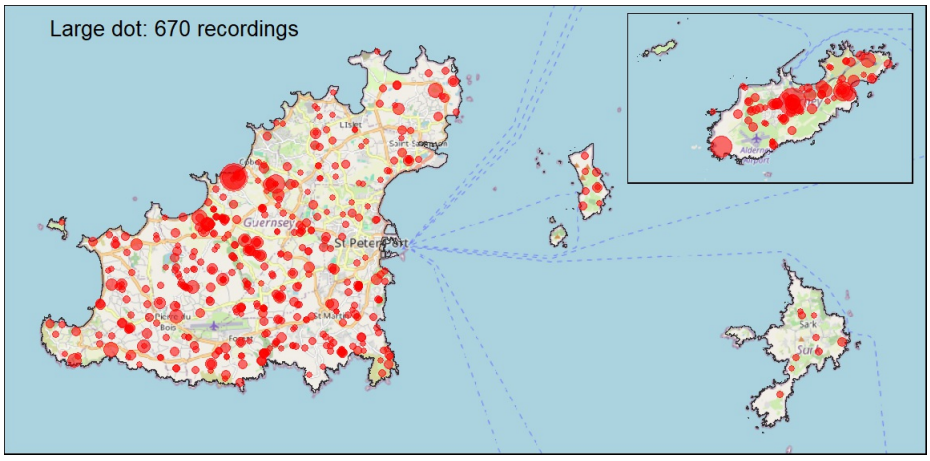


Soprano Pipistrelle social calls. Given the small number of recordings of Soprano Pipsitrelle more generally, there are correspondingly few recordings with social calls. There was only a single Soprano Pipsitrelle recording with social calls from Alderney on the 7th October 2023.

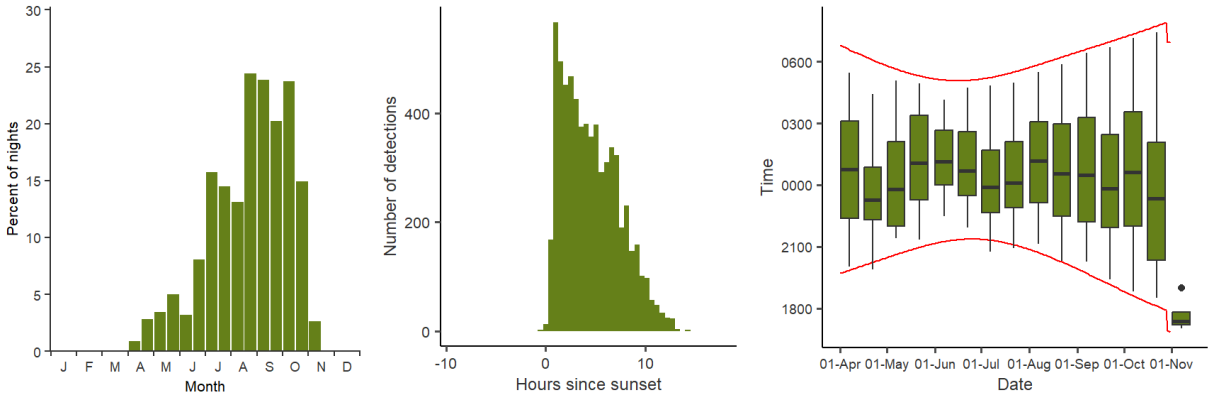
Brown Long-eared Bat echolocation calls

Brown Long-eared Bat echolocation calls *Plecotus auritus* was recorded on 448 nights, from 537 locations, giving a total of 6,445 recordings.

Spatial pattern of activity



Seasonal and nightly activity



Brown Long-eared Bat echolocation calls Before this project, the status of Brown Long-eared Bat in the Bailiwick of Guernsey was uncertain. Brown Long-eared Bat was recorded quite widely and in every year on Guernsey and Alderney. Compared with Grey Long-eared Bat which is the most commonly recorded species after Common Pipistrelle and Kuhl's (or Nathusius') Pipistrelle in the Bailiwick of Guernsey, this species is considerably more localised. Whilst we have not yet carried out a formal analysis of habitat associations of the bats in the Bailiwick, it seems quite predictable when you look at the locations where this species was recorded, that the larger concentrations of recordings are associated with woodland patches. This is in contrast with Grey Long-eared Bat, which is recorded across the wider landscape. Brown Long-eared Bat was also recorded on Herm in 2022 and 2024 across several months including in July, where we are unsure of the status of this species on the island. On Sark, this species was only recorded in 2024, with a single recording on the 19th May 2024, but then an additional 42 recordings from several locations across the island between 11th October and 29th October 2024. We consider that Brown Long-eared Bat is probably not a resident species on Sark.

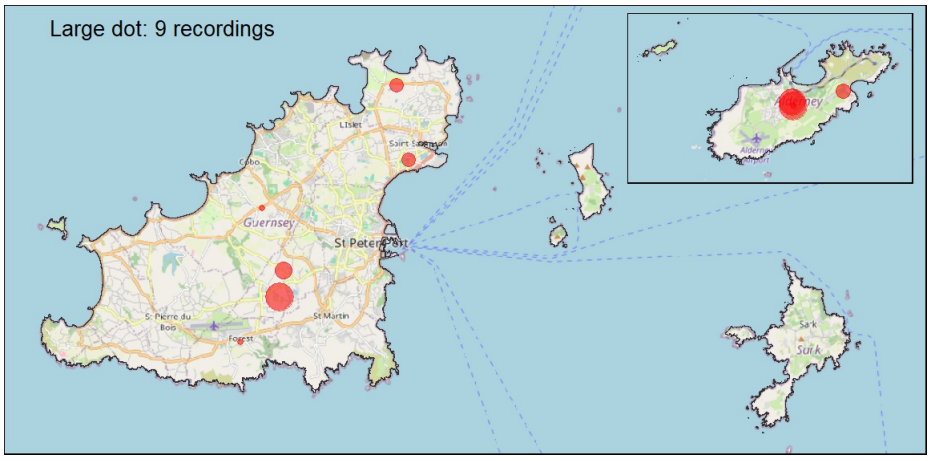
As shown in the plot above, Brown Long-eared Bat was recorded more widely between mid-August and November than earlier in the season. We suggest that this could be related to a habitat shift away from a close association with woodland in summer to more open habitats in autumn.

Brown Long-eared Bat is common in neighbouring France, but it is considered rare in Jersey (Binet & Walsh, 2020; Hall, 2021). Jersey Bat Group considers that Brown Long-eared Bat is possibly under-recorded on Jersey (Hall, 2021).

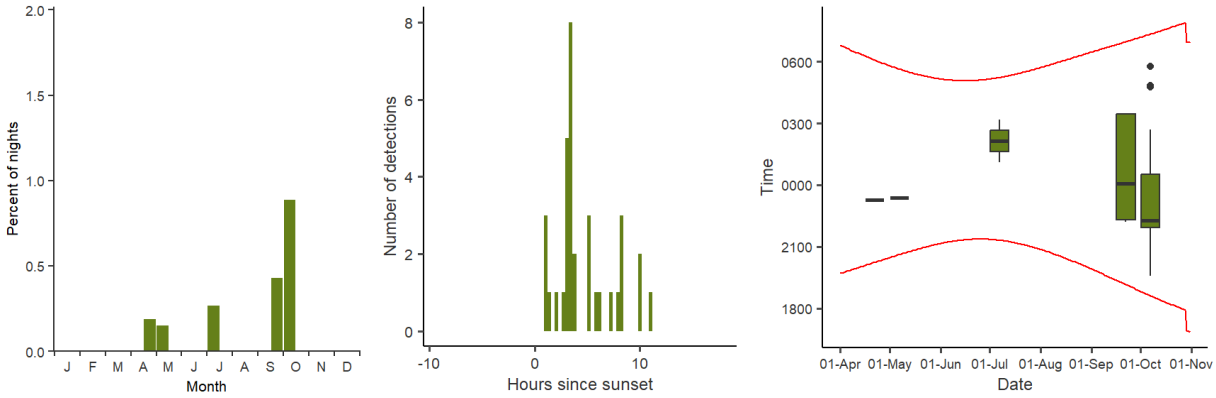
Brown Long-eared Bat social calls

Brown Long-eared Bat social calls *Plecotus auritus* were recorded on 12 nights, from 10 locations, giving a total of 34 recordings.

Spatial pattern of activity



Seasonal and nightly activity



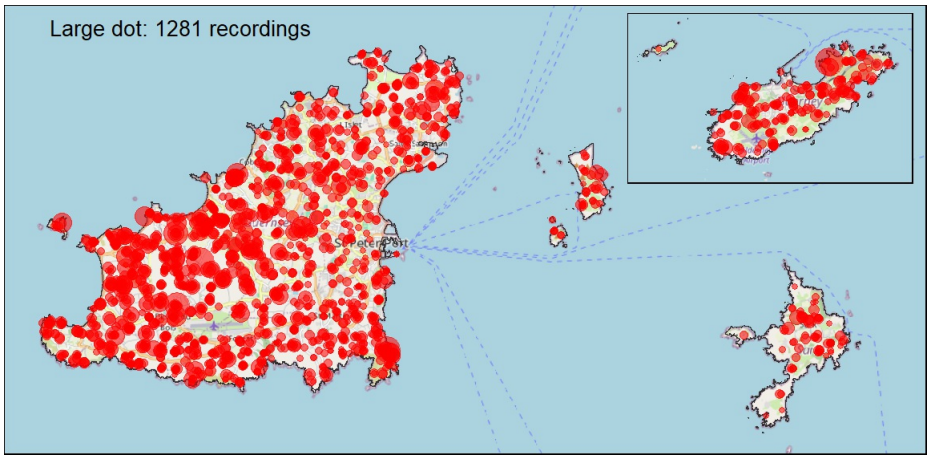
Brown Long-eared Bat social calls. In this project, we focused specifically on identifying Type D Brown Long-eared Bat social calls (Middleton *et al*. 2022), which are often associated with proximity to a roost, depending on the time of year, a maternity roost, for swarming or wintering site. On Alderney, Brown Long-eared Bat social calls were recorded consistently from two locations in early October, so potentially associated with a swarming or wintering site. One of these is by a tunnel entrance in woodland close in the east of the island on Barrackmasters Lane close to Old Barn Restaurant, and the second site is also by a tunnel entrance in woodland in the centre of the island, close to Val Reuters, which we have highlighted elsewhere in this report. This latter area is also important for Whiskered or Brandt's Bat, and Natterer's Bat.

On Guernsey, the largest number of recordings with Brown Long-eared Bat social calls were recorded from close to the German Underground Hospital in the early October across years, which we know is used as an important wintering structure for this species. In addition to this, a small number of Brown Long-eared Bat social calls were recorded from a number of other locations, early or during the maternity season, where further targeted work may be used for establishing the likelihood of there being a maternity roost associated with these close by.

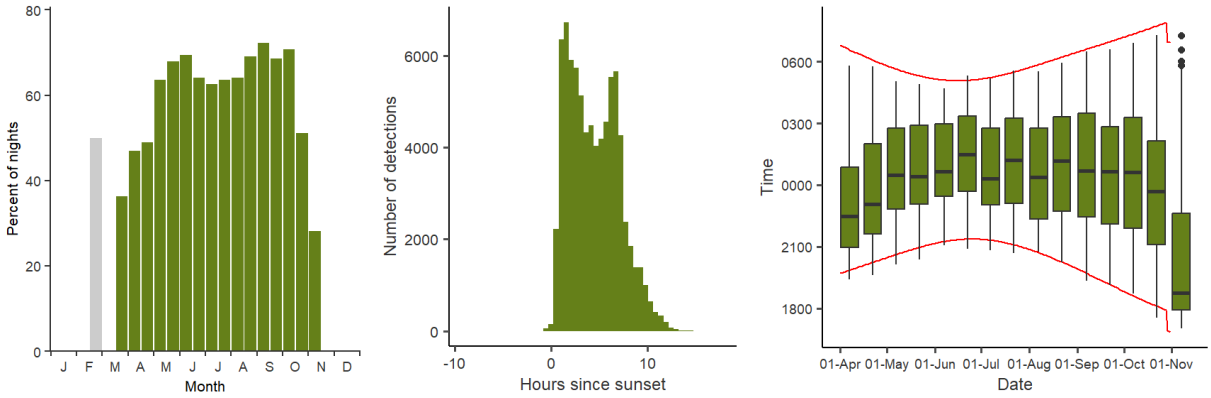
Grey Long-eared Bat echolocation calls

Grey Long-eared Bat echolocation calls *Plecotus austriacus* was recorded on 840 nights, from 1,935 locations, giving a total of 78,937 recordings.

Spatial pattern of activity



Seasonal and nightly activity



Grey Long-eared Bat echolocation calls. After Common Pipistrelle and Kuhl's (or Nathusius') Pipistrelle, Grey Long-eared Bat was the third most commonly recorded bat species in the Bailiwick of Guernsey, with over 78,000 recordings collected during the course of the project. It was widely recorded across years on Guernsey, Alderney, Herm, Sark and Jethou. Grey Long-eared Bat was also recorded from Brecqhou in 2022, from Crevichon in 2023, and from Burhou in 2024.

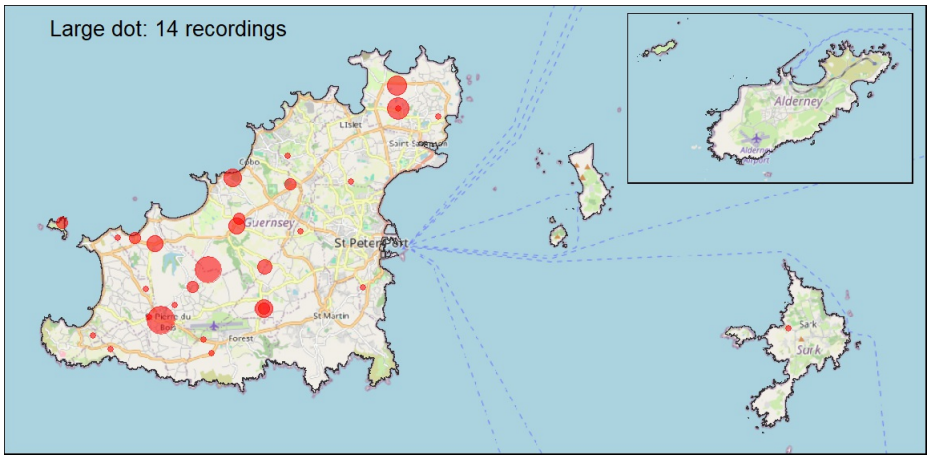
By island, the maximum number of recordings a night were: Guernsey (1,027 on 24th July 2022 from woodland at Jerbourg), Herm (97 recordings on 10th May 2022 close to Belvoir beach), Sark (93 on 3rd October 2021 from La Seigneurie gardens) and Alderney (203 on the 8th July 2021 next to Fort Albert).

For a visual comparison of the calls of Brown Long-eared Bat and Grey Long-eared Bat of the same call duration (i.e. comparing like with like) see Identification Appendix 7.

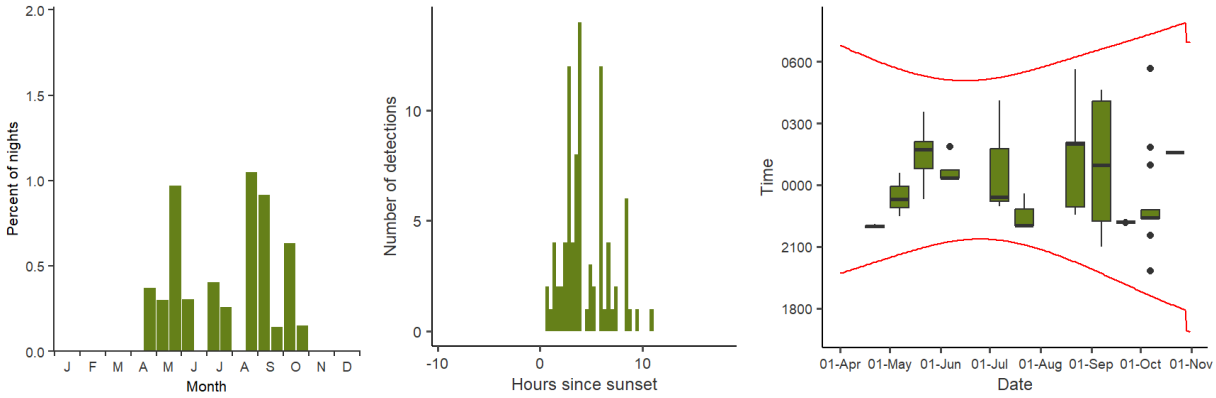
Grey Long-eared Bat social calls

Grey Long-eared Bat social calls *Plecotus austriacus* were recorded on 34 nights, from 30 locations, giving a total of 88 recordings.

Spatial pattern of activity



Seasonal and nightly activity

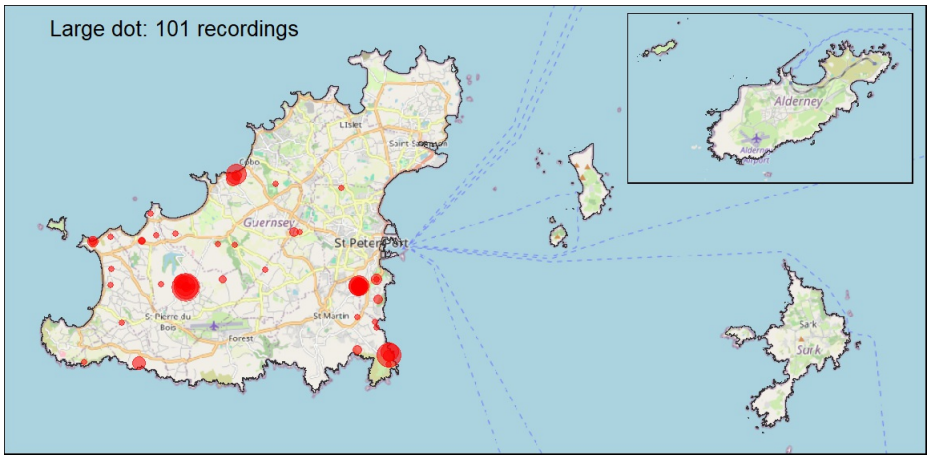


Grey Long-eared Bat social calls. As with Brown Long-eared Bat, we have focused on identifying Type D Grey Long-eared Bat social calls (Middleton *et al*. 2022), which are often associated with proximity to a roost. Grey Long-eared Bat social calls were only recorded from Guernsey and Sark. On Guernsey, social calls were recorded from a number of locations across the island, including a number during late May and June where further targeted work may be useful for determining whether these relate to vicinity to a maternity roost.

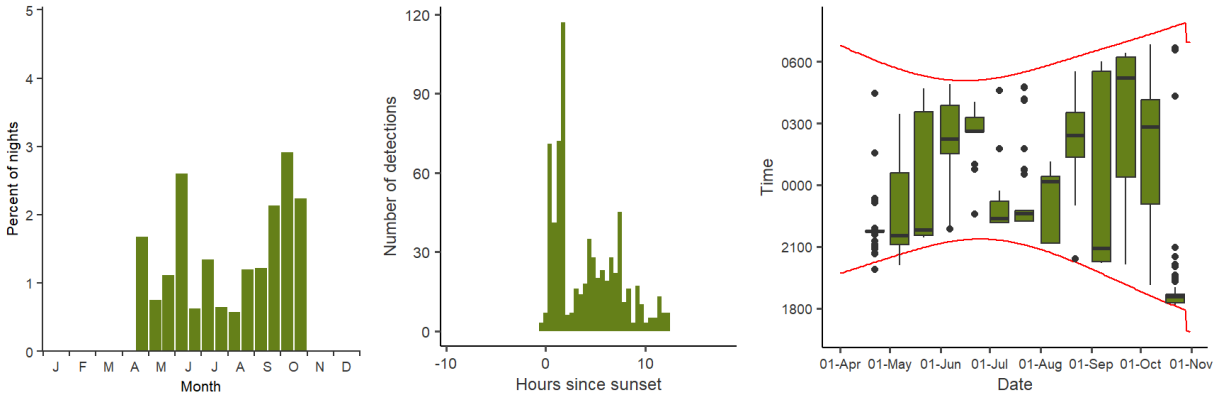
Greater Horseshoe Bat echolocation calls

Greater Horseshoe Bat echolocation calls *Rhinolophus ferrumequinum* was recorded on 110 nights, from 70 locations, giving a total of 689 recordings.

Spatial pattern of activity



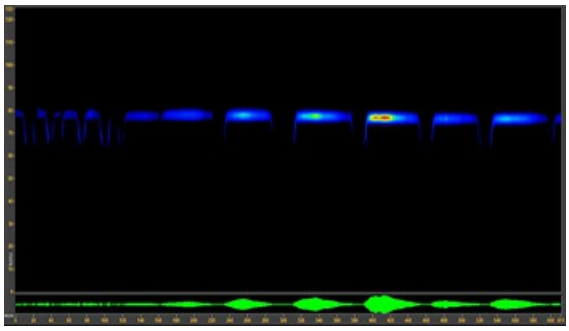
Seasonal and nightly activity



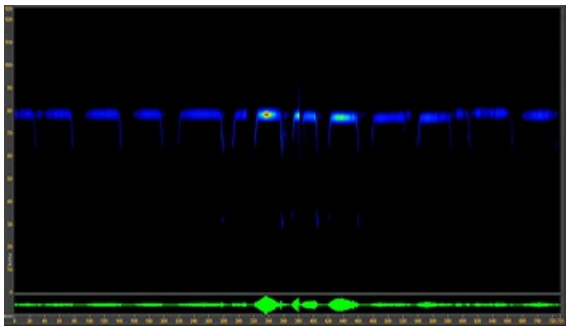
Greater Horseshoe Bat echolocation calls Greater Horseshoe Bat was only recorded on Guernsey during the project. The maximum number of recordings a night was 69 recordings early in the season on the 17th April 2022 in woodland at Jerbourg, but more generally this seems to be an important area for this species. Other particularly notable sites with a double figure number of recordings a night came from woodland close to St. Saviour's Parish Church. We know from previous work and contemporary recording in the winter that the tunnels under the church are used by Greater Horseshoe Bats. A notable number of recordings a night were also noted from Havilland Vale, where there are also tunnels that we know are used in the winter by Greater Horseshoe Bat, and from woodland at Le Guet, another known wintering site.

No breeding sites have been found to date in Guernsey. Horseshoe bats are obvious when roosting – they hang freely from the ceiling and wrap their wings around themselves. Other species will hide away in cracks in buildings and old trees. In other areas where they occur, they breed in old buildings, such as quiet undisturbed barns and require free access to the space as they will fly straight in and not alight and crawl into cracks as other species do. A gap the size of a large letter box is sufficient.

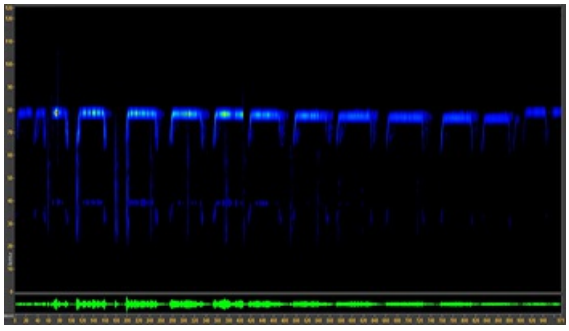
During the winter they hibernate or spend time in 'torpor' in caves, old cellars and cold, damp places which are dark and undisturbed. Over two winters, we have surveyed a number of German tunnels and found Greater Horseshoe Bats in one known site and in another newly surveyed tunnel complex. There are clearly a number of Greater Horseshoe Bats present on the island year-round and, while the number of hibernation sites is limited and reasonably well known, there are a lot of buildings which might be suitable for maternity colonies. Females form maternity colonies in buildings which remain dark, undisturbed and warm throughout the summer – old barns with slate roofs are ideal. They give birth in late June up until the end of July and pups are weaned c. 6-7 weeks later.



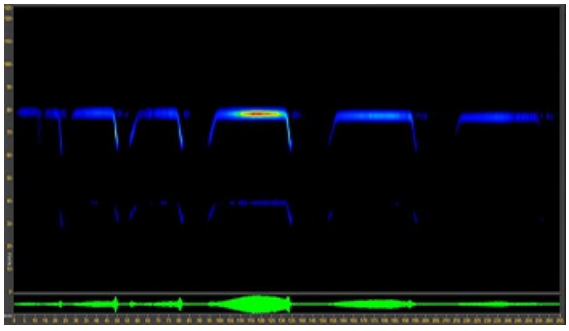
Greater Horseshoe Bat



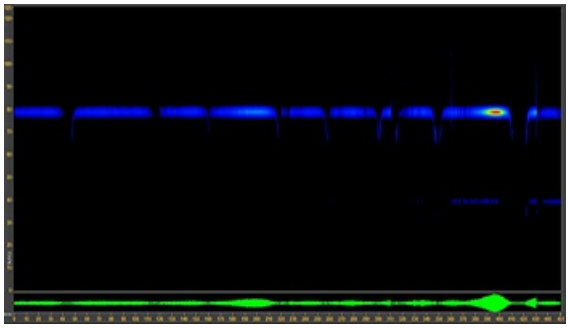
Greater Horseshoe Bat



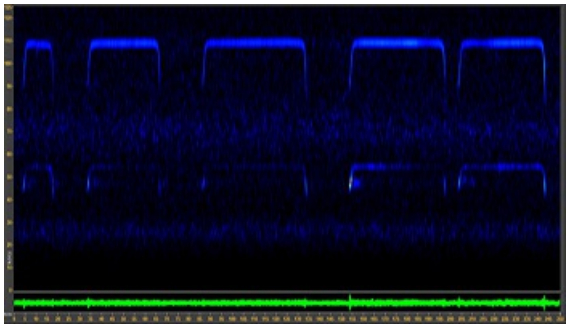
Greater Horseshoe Bat



Greater Horseshoe Bat



Greater Horseshoe Bat

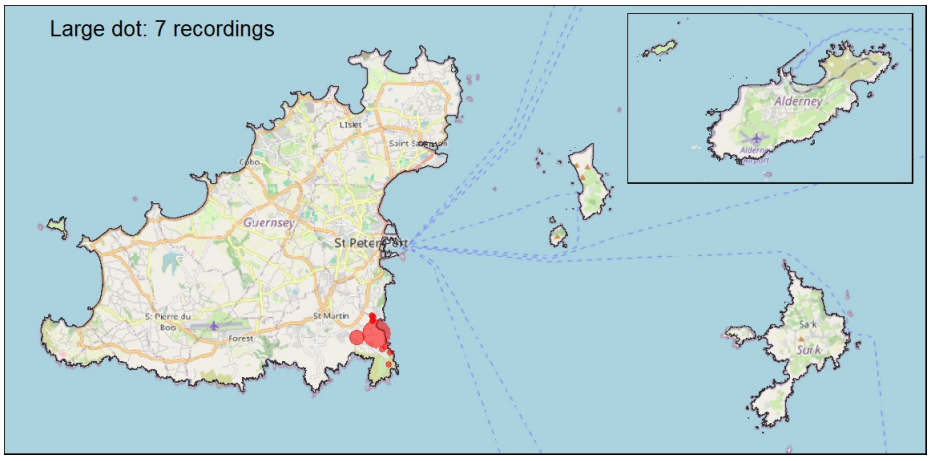


Lesser Horseshoe Bat

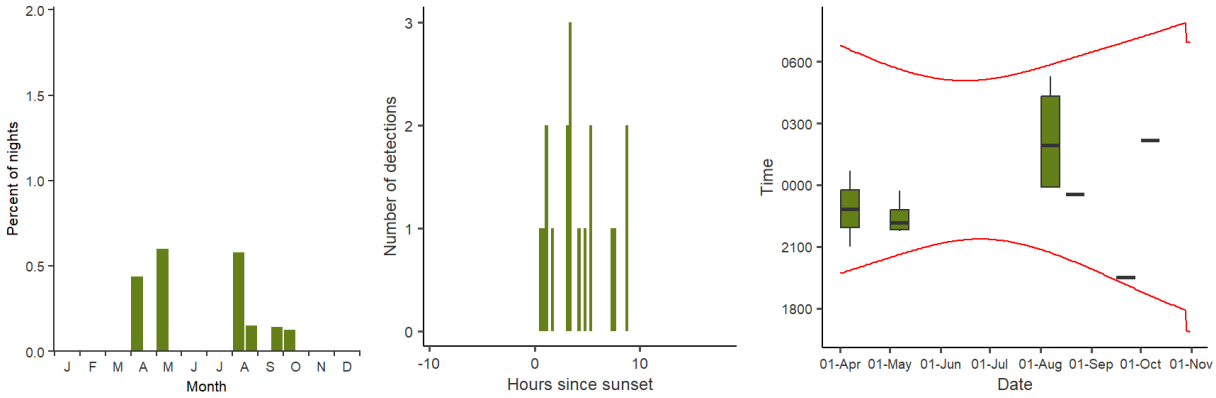
Lesser Horseshoe Bat echolocation calls

Lesser Horseshoe Bat echolocation calls *Rhinolophus hipposideros* was recorded on 10 nights, from 11 locations, giving a total of 18 recordings.

Spatial pattern of activity



Seasonal and nightly activity



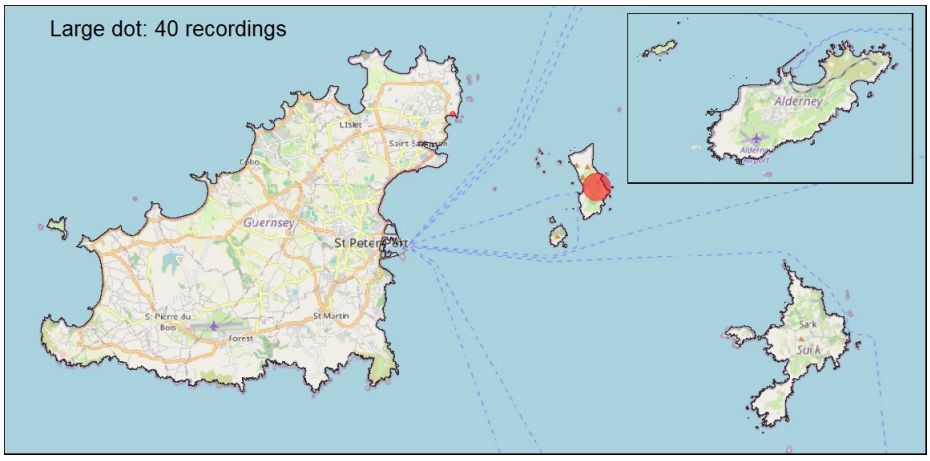
Lesser Horseshoe Bat echolocation calls - new species for Guernsey Lesser Horseshoe Bat was only recorded on Guernsey, where it was recorded in the Jerbourg area as a new species for Guernsey on the 13th April 2021. Lesser Horseshoe Bat was subsequently recorded on several nights in 2022 and 2023, where interestingly all 19 recordings were from the same Jerbourg area. These recordings came from across most months, but there were no recordings between late May and mid-July in any year, when, if there is a maternity roost somewhere, it would be associated with. It is possible that the recordings are from a single individual, at least we have no evidence at present that there is more than one individual.

This species produces echolocation calls where the maximum (peak) energy is in the range of 107-114 kHz. The only likely confusion species is Greater Horseshoe Bat, but this produces calls with maximum energy in the range of 77-84 kHz.

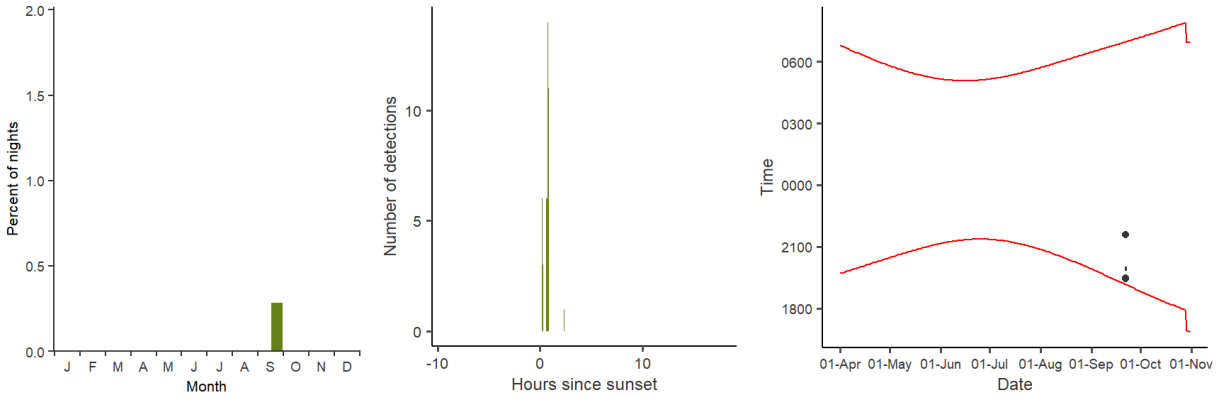
Parti-coloured Bat echolocation calls

Parti-coloured Bat echolocation calls *Vespertilio murinus* was recorded on two nights, from 2 locations, giving a total of 41 recordings.

Spatial pattern of activity



Seasonal and nightly activity



Parti-coloured Bat echolocation calls - new species for Guernsey and Herm All recordings of Serotine, Leisler's Bat and Noctule that were collected during the project were scrutinised during the project - always keeping in mind the possibility of recording a vagrant Parti-coloured bat, for which there had been no previous records for the Channel Islands.

In 2023, a number of recordings of a 'big-bat' species was recorded on Sark, a description of which is given in Appendix 8. Whilst for some people reviewing the recordings it presented good evidence for the presence of Parti-coloured Bat, there was not a consensus on this identification, and as a result the identification remained undetermined.

On the 21st September 2024, 48 recordings of a 'big-bat' species were recorded on Herm by Andrew Guille. Prior to this, the only recordings of a 'big-bat' species on Herm had been a single recording of Serotine on the 30th June 2021, and a recording of Leisler's Bat on the 10th July 2024. In the commentary below, Stuart Newson presents his thoughts on these recordings, together with comments from Thierry Disca and Bram Aarts.

- There was no evidence of alternation in the frequency of the calls ('clip-clop' sound when played), which is normally seen / heard in a sequence of calls produced by Leisler's bat or Common Noctule. It would be unusual not to see clear alternation in the frequency of calls in all 48 recordings, if these were produced by Leisler's bat (or Noctule).
- We excluded Noctule as a possibility because the calls, given the observed call duration, were higher in frequency than expected for Noctule.
- Serotine and Parti-coloured Bat (a potential vagrant to the Channel Islands) do not produce calls that alternate in frequency. In support of Parti-coloured bat, we consider that sequences of longer duration calls would be unusual for Serotine, but that comparable calls of Serotine (of the same call duration) would be higher in frequency.

- The shape of many of the calls were very similar to calls commonly produced by Parti-coloured Bat based on known recordings of this species. In particular, there is a continuous curvature to many of the calls, which is typical for Parti-coloured Bat (reminiscent of the curvature of calls seen in European Free-tailed Bat *Tadarida teniotis*), where comparable calls of Leisler's Bat tend more typically to be straighter. This difference can be seen in the comparisons between known Parti-coloured Bat and Leisler's Bat calls in Appendix 9.
- In several of the sequences, there are feeding buzzes, where the terminal buzz in Parti-coloured Bat falls below the end frequency of the proceeding echolocation calls. This is typical for Parti-coloured Bat (and for *Eptesicus* species including Serotine). In Leisler's bat and Noctule, the terminal buzz ends at a similar frequency or higher in frequency than the end frequency of the proceeding echolocation calls, although there is a suggestion that the terminal buzz may end lower, but that the gain on the bat detector would need to be set very high to detect these weak terminal calls in Leisler's Bat.

As an interesting twist to the story, is that there was an additional recording from the previous night (20th September 2024) from Bordeaux in Guernsey (next to Blake's Beach), which is the closest land point to Herm (a distance of just over 2-km), which also looks like Parti-coloured Bat.

Thierry Disca

These recordings most certainly *Vespertilio murinus*. With all your recordings:

- in active hunting, there is no alternation in the frequency of the calls of > 1.5 kHz (alternating between quasi-constant frequency and frequency modulated quasi-constant frequency calls), that you would expect for *Nyctalus* (Leisler's Bat or Common Noctule).
- The rhythm of the calls when played is regular and not jerky like *Nyctalus*.
- In approach phases (i.e. approaching prey), the frequency of maximum energy increases progressively leading into feeding buzzes with harmonics and a low end frequency (<20 kHz), which is typical for *V. murinus*, but not for *Nyctalus*.

Bram Aarts

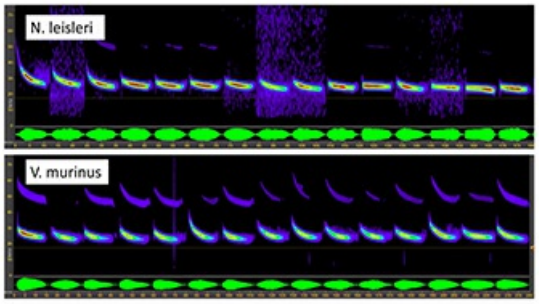
- These recordings show many similarities to recordings of known Parti-coloured Bat recorded in the Netherlands.
- An additional characteristic of Parti-coloured Bat not mentioned above, that is seen in several of your recordings, is that several sequences show a tendency to add a downward S-curve to the calls, which would be unusual for Serotine and Leisler's Bat. (eds: on this point see the spectrograms in Appendix 8 of the unidentified 'big-bat' species on Sark in 2023 which show this feature).
- The feeding buzzes in the single recording from Guernsey also show characteristics of Parti-coloured Bat. The very abrupt changes from normal echolocation pulses to thin frequency modulated (broadband) pulses, and the pulses in the feeding buzzes are grouped into triplets or quadruplets, which gives them a 'hesitant' impression to the sound.

Summary

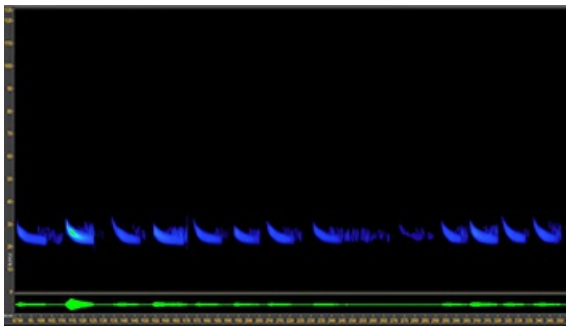
- Parti-coloured bat is one of the most difficult bat species in Europe to identify given echolocation calls alone, particularly to distinguish this species from Leisler's Bat (see e.g. Russ 2021).
- In this sequence of recordings, we were extremely fortunate to have 48 recordings from Herm that were produced by what was likely to be the same bat. These contained a broad range of calls from short to long duration calls, and on both Guernsey and Herm included feeding buzzes.

Thierry Disca, Bram Aarts are in agreement with our initial thinking that these recordings could only have been produced by Parti-coloured Bat.

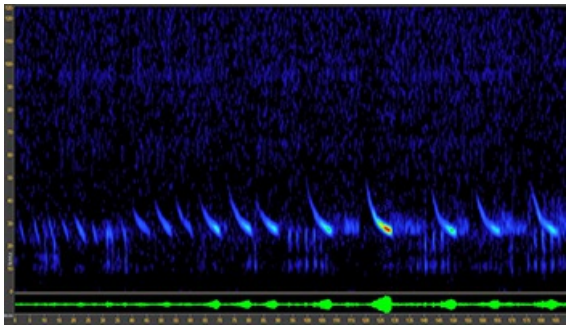
For more information on the sound identification of Parti-coloured Bat see Identification Appendix 10.



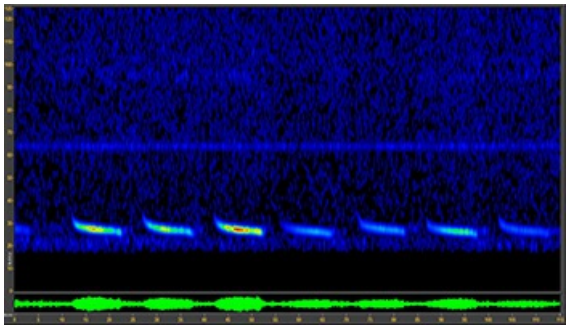
call shape comparison



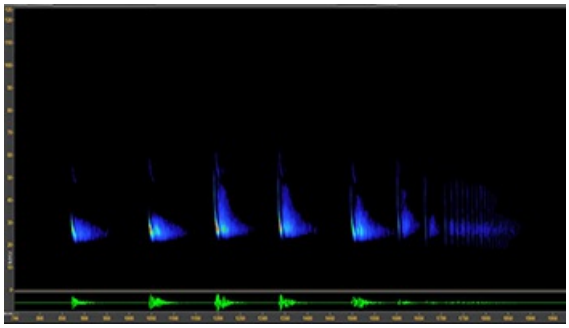
Herm



Herm



Guernsey s-shape calls



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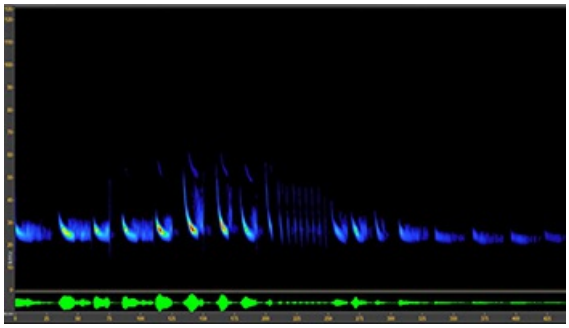
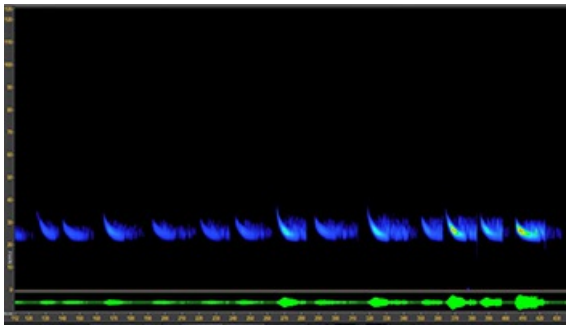
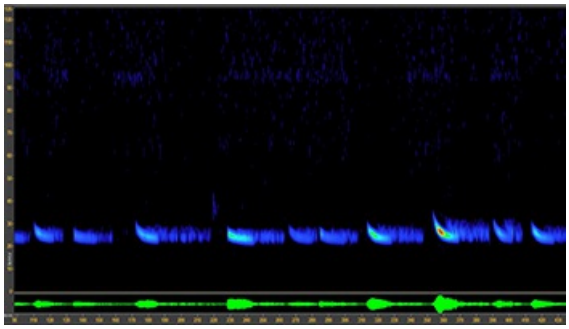


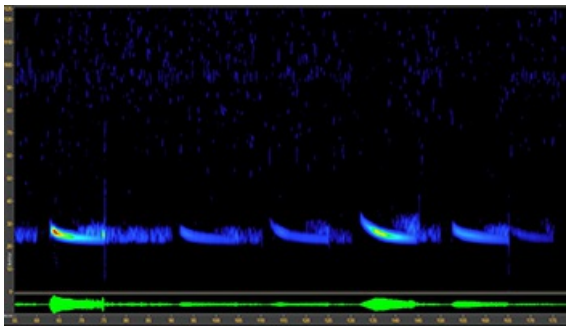
Herm



Herm



Herm



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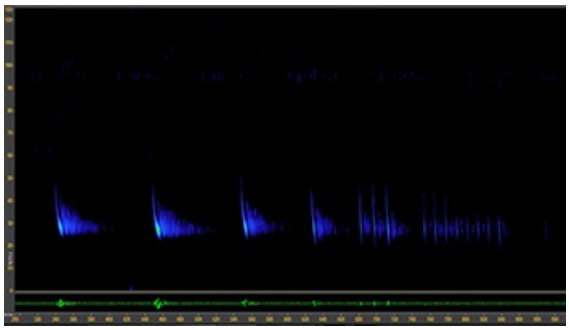
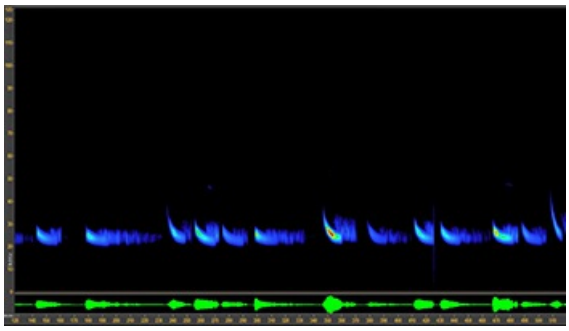
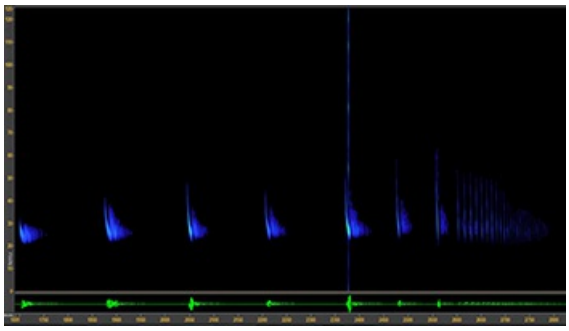


Herm



Herm

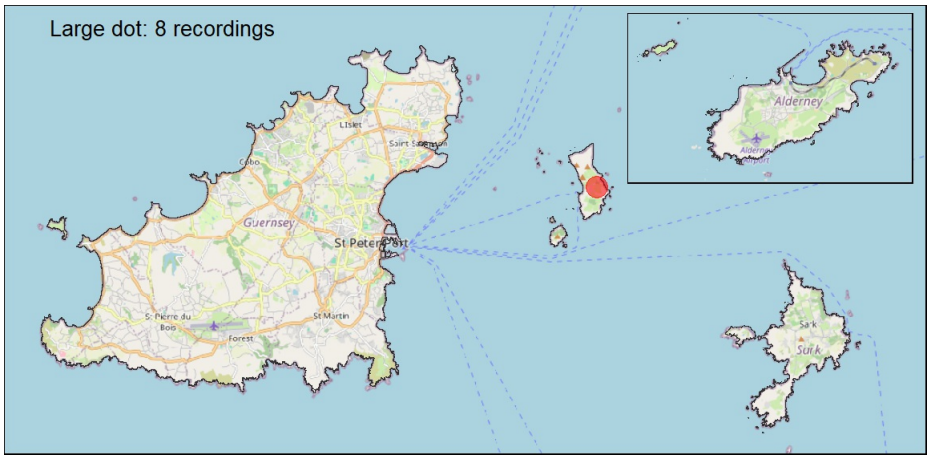


Herm

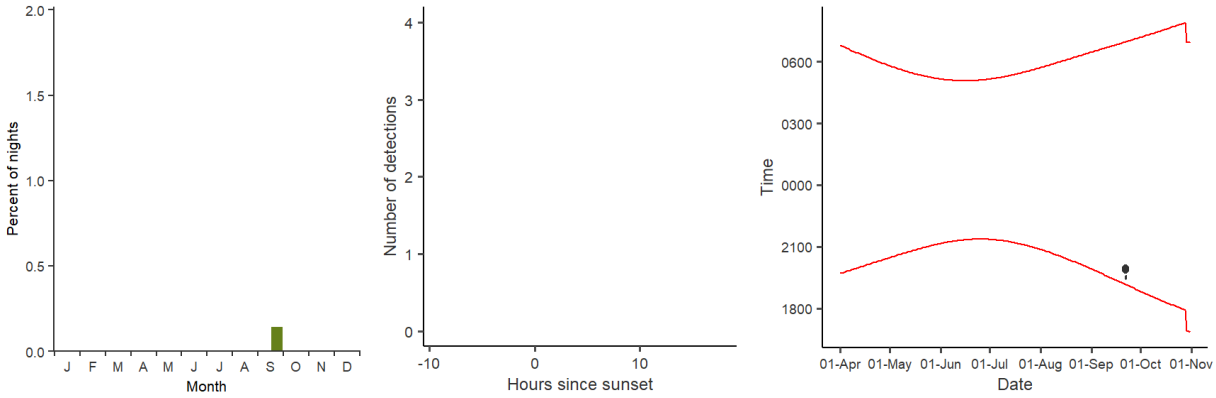
Parti-coloured Bat feeding buzzes

Parti-coloured Bat feeding buzzes *Vespertilio murinus* were recorded on one night, from 1 location, giving a total of 8 recordings.

Spatial pattern of activity



Seasonal and nightly activity



Parti-coloured Bat - new species for Guernsey A number of sequence of Parti-coloured Bat feeding buzzes were recorded on Guernsey on the 21st September 2024. For further discussion on Parti-coloured Bat, and how the feeding buzzes of this species differ from those of *Nyctalus* species (Leisler's Bat and Common Noctule), where Leisler's Bat is the most likely confusion species, see the discussion in the Parti-coloured Bat section above.

4.3.2 Small terrestrial mammal species

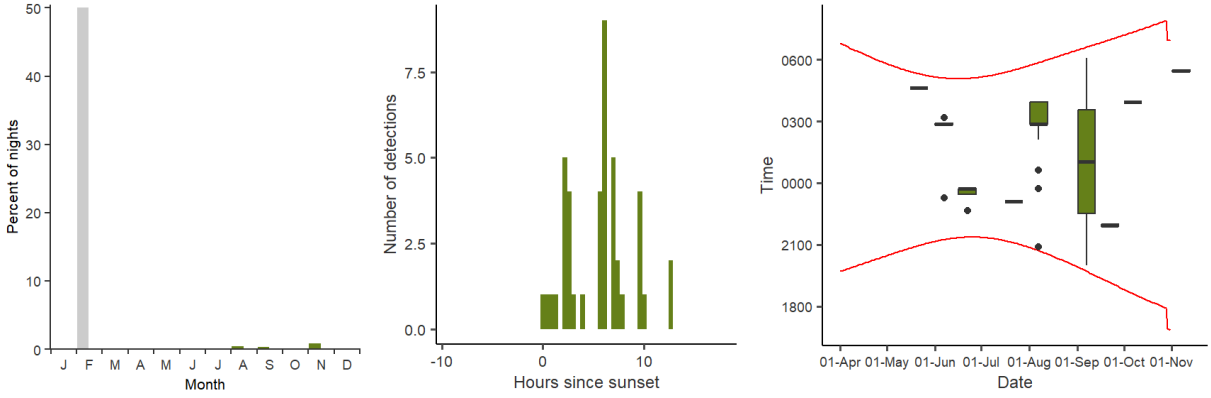
In this section we look at the recordings that we can assign to small terrestrial mammals.

Wood Mouse

Wood Mouse *Apodemus sylvaticus* was recorded on 13 nights, from 12 locations, giving a total of 43 recordings.

Spatial pattern of activity

Seasonal and nightly activity

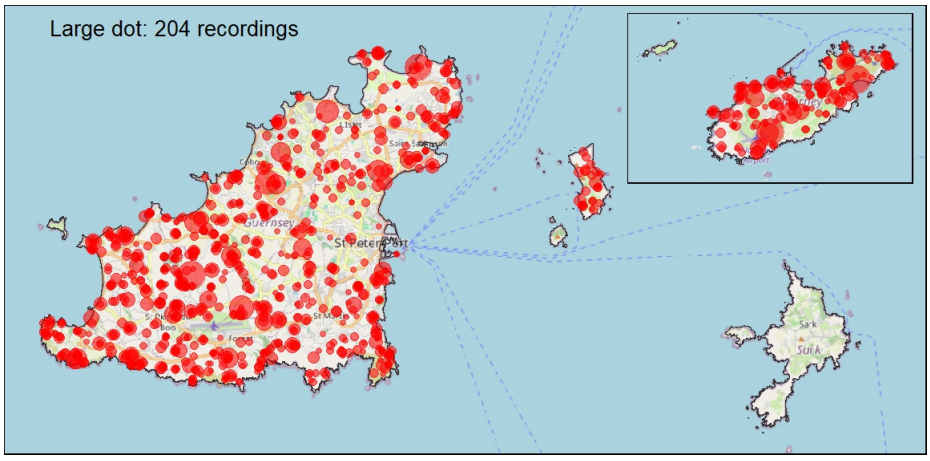


Wood Mouse was recorded from Guernsey and Alderney. Compared with the other small terrestrial mammal species here, the calls of Wood Mouse are not as loud, and so are under-recorded compared with shrews and rats. The detection distance of Wood Mouse is only about 1.5-m and so mounting the detector high on a pole, whilst ideal for bats, will under-record this species (Newson *et al.* 2022). For more information on the sound identification of Wood Mouse see Newson *et al*., (2021) and Middleton *et al*., (2024).

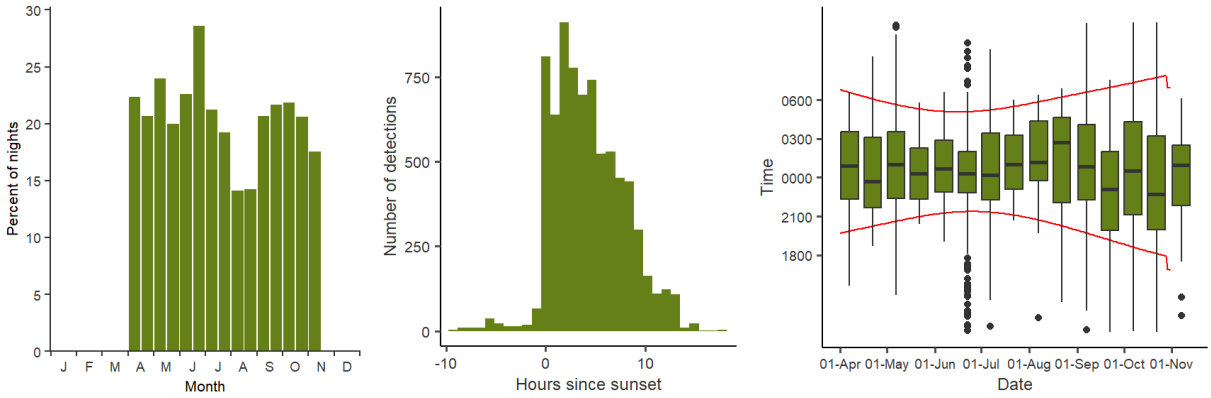
Greater White-toothed Shrew

Greater White-toothed Shrew *Crocidura russula* was recorded on 746 nights, from 964 locations, giving a total of 7,572 recordings.

Spatial pattern of activity

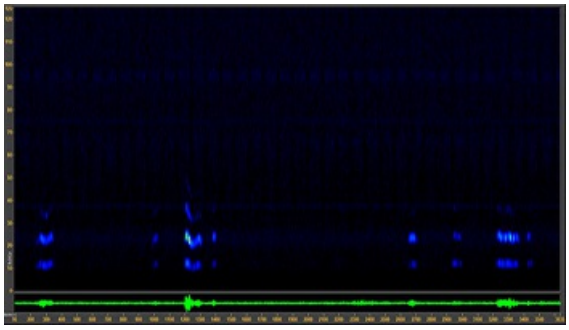


Seasonal and nightly activity

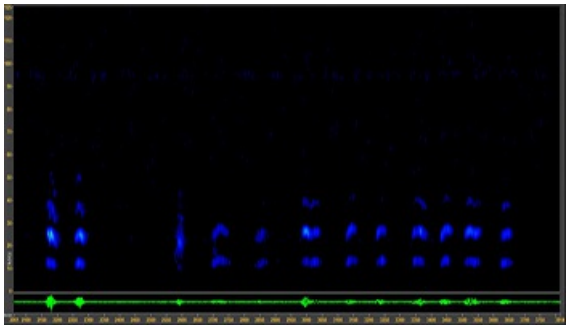


Greater White-toothed Shrew was recorded on Guernsey, Alderney and Herm and it is not present on the smaller islands. Lesser White-toothed Shrew replaces this species on Sark. They were extremely widespread on all three islands, being associated with farmland and gardens. This is the first project that has provided such a comprehensive map of small mammal activity for the islands, and with so much data it provides an ideal opportunity to look at habitat use of this poorly known species.

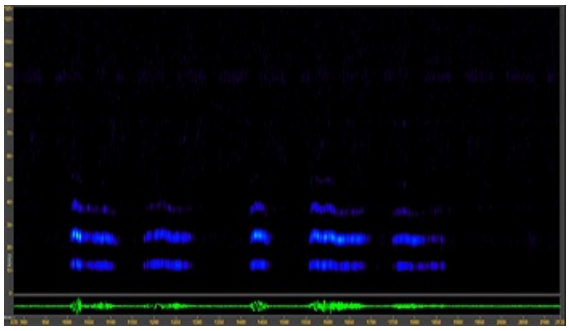
The calls sound quite different from those of Common Shrew *Sorex araneus*, Pygmy Shrew *Sorex minutus* and Water Shrew *Neomys fodiens* found on mainland UK and described in Newson *et al*., (2021). In particular, the calls are shorter in duration, which makes the calls sound more abrupt.



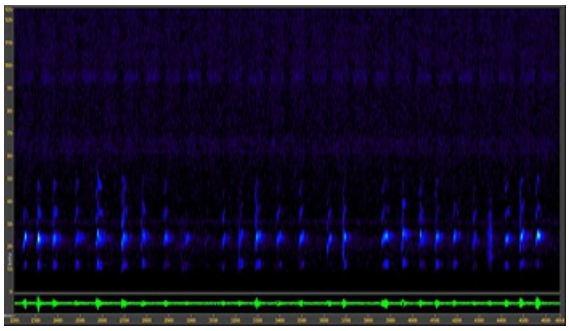
Greater White-toothed Shrew



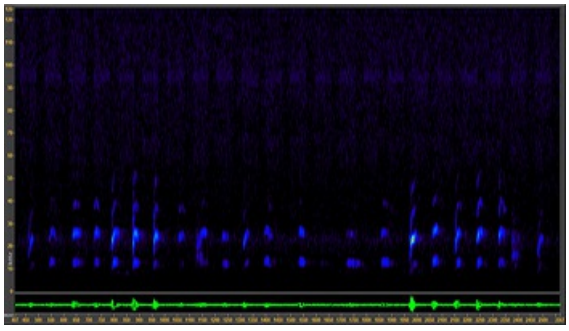
Greater White-toothed Shrew



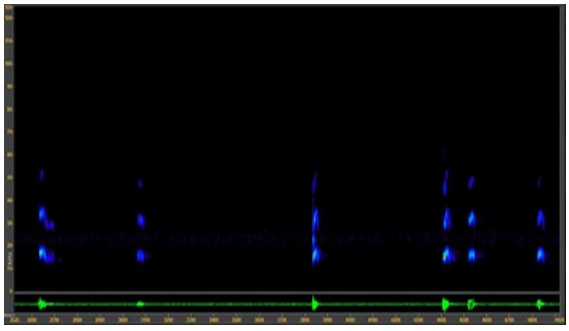
Greater White-toothed Shrew



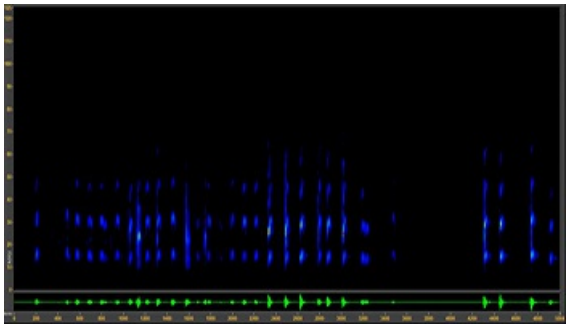
Greater White-toothed Shrew



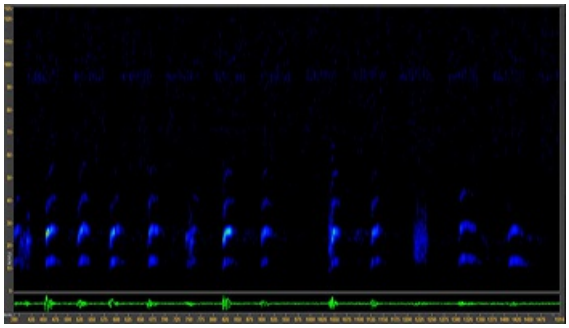
Greater White-toothed Shrew



Greater White-toothed Shrew



Greater White-toothed Shrew

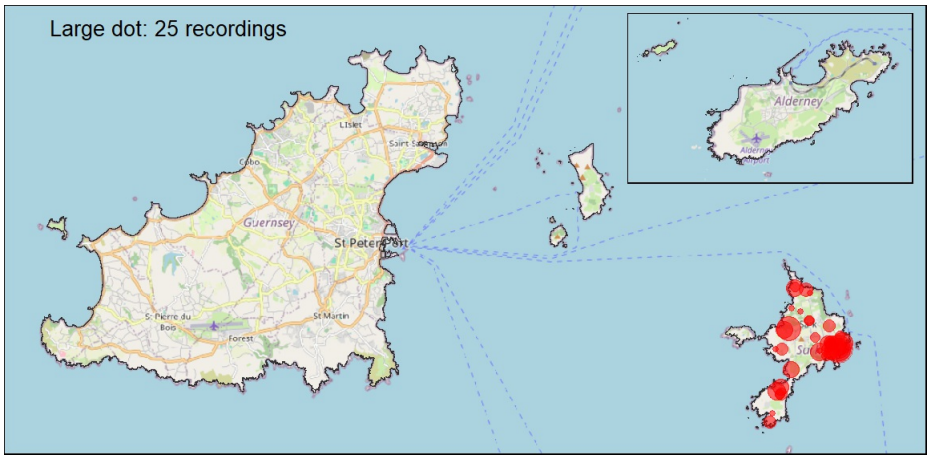


Greater White-toothed Shrew

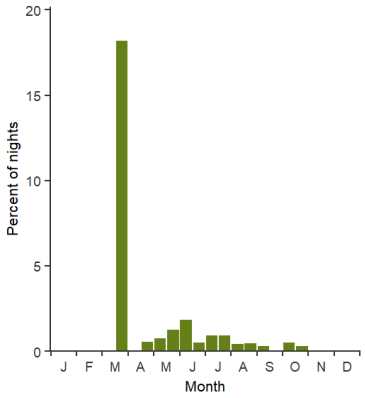
Lesser White-toothed Shrew

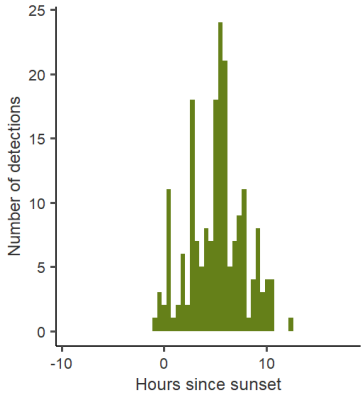
Lesser White-toothed Shrew *Crocidura suaveolens* was recorded on 61 nights, from 39 locations, giving a total of 193 recordings.

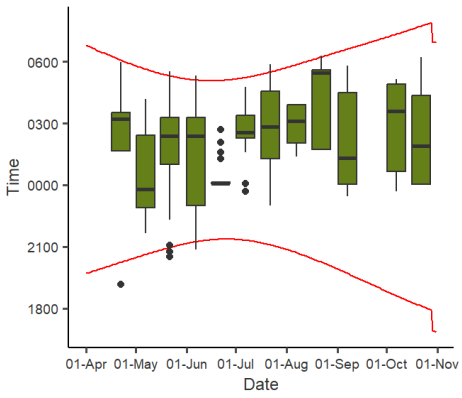
Spatial pattern of activity



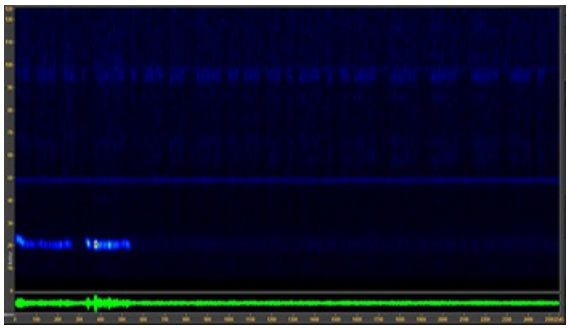
Seasonal and nightly activity



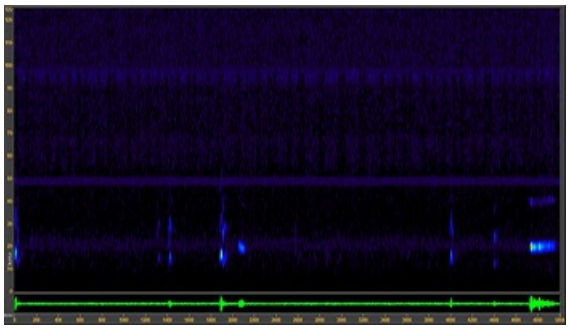




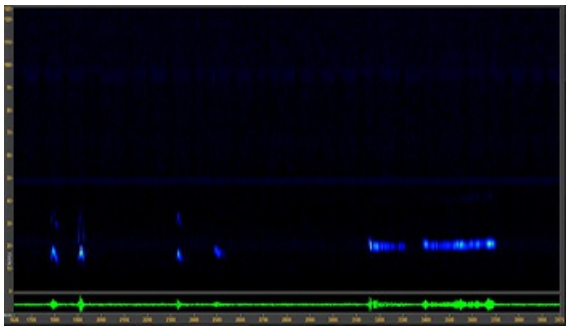
Lesser White-toothed Shrew was only recorded on Sark, where Lesser White-toothed Shrew is the only shrew species present. Thanks to the collection of a large reference library of sound recordings of Lesser White-toothed Shrew from the Isles of Scilly, we have a good understanding of the range of calls produced by this species (Middleton *et al.*, 2024). Lesser White-toothed Shrew and Greater White-toothed shrew do not occur together on any island in the Channel Islands.



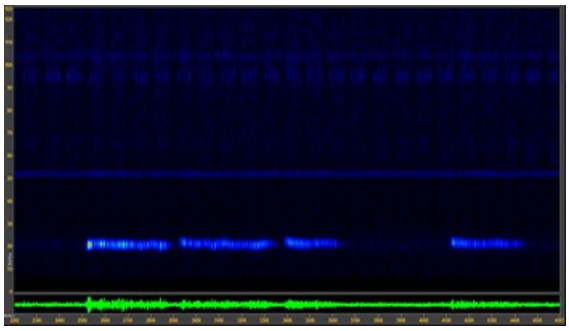
Lesser White-toothed Shrew



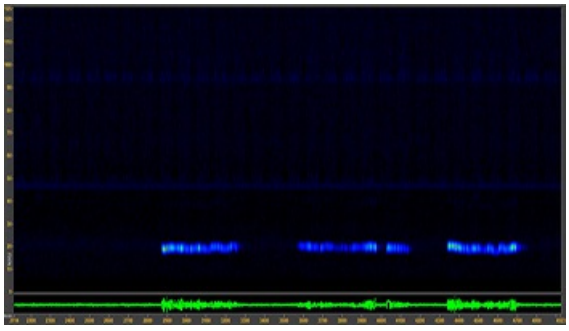
Lesser White-toothed Shrew



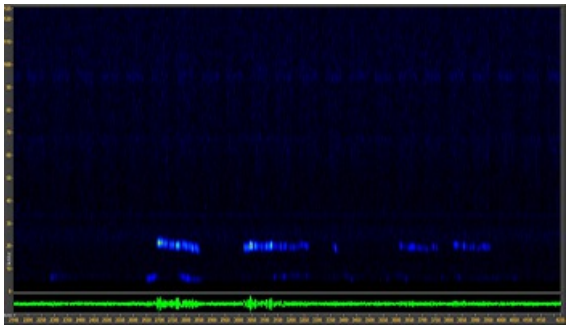
Lesser White-toothed Shrew



Lesser White-toothed Shrew



Lesser White-toothed Shrew

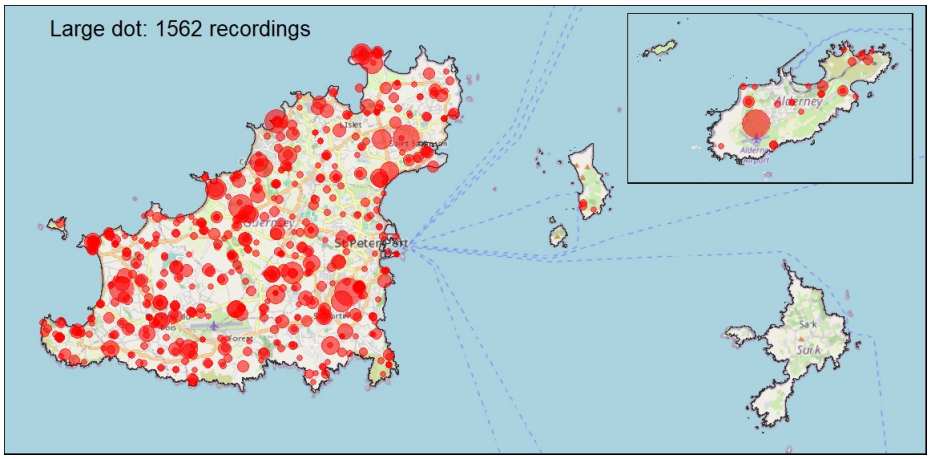


Lesser White-toothed Shrew

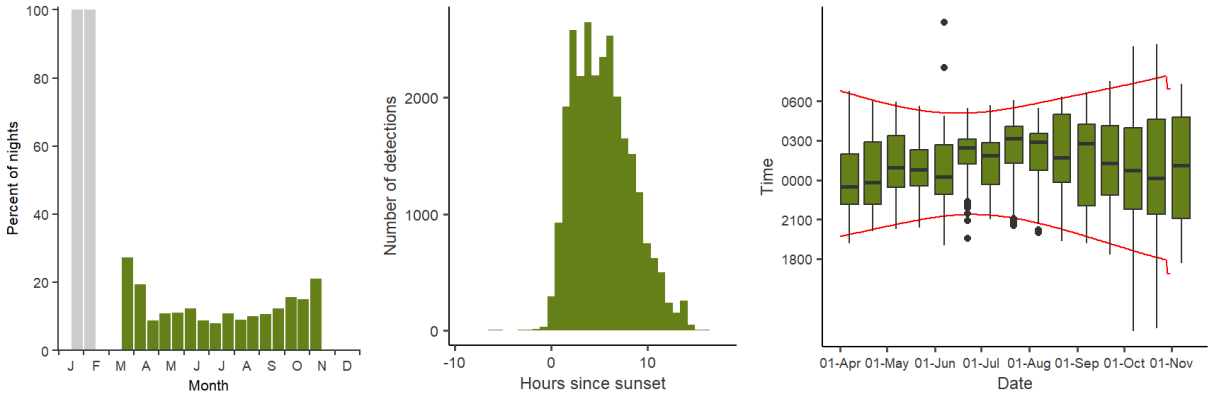
Brown Rat

Brown Rat *Rattus norvegicus* was recorded on 596 nights, from 576 locations, giving a total of 26,589 recordings.

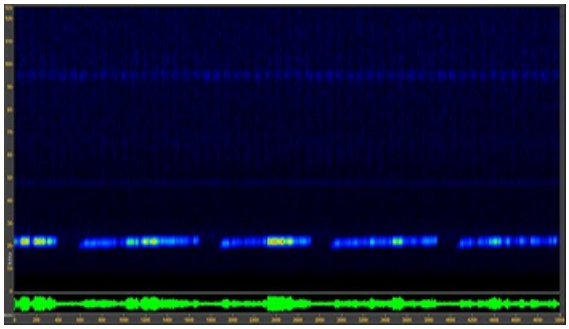
Spatial pattern of activity



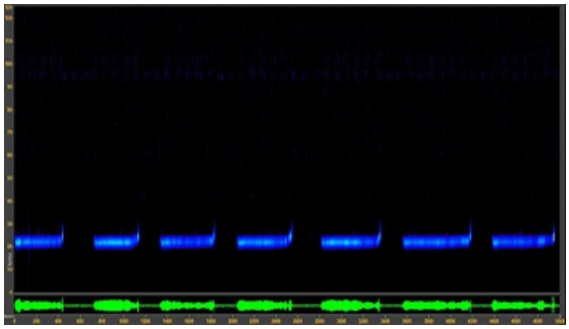
Seasonal and nightly activity



Brown Rat was recorded on Guernsey, Alderney, Herm and Lihou. Brown Rat is similar acoustically to Black Rat (see Newson *et al*., 2021 and Middleton *et al*., 2024). As would be expected, it was extremely widespread.



Brown Rat

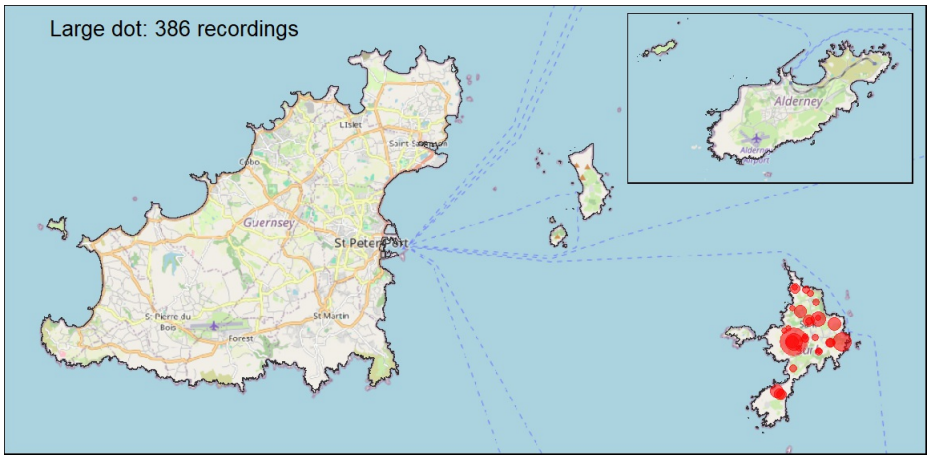


Brown Rat

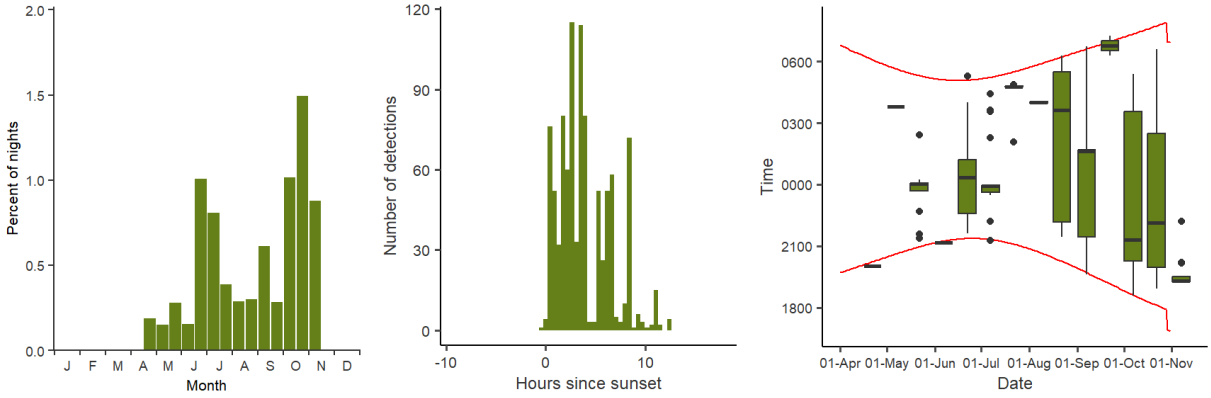
Black Rat

Black Rat *Rattus rattus* was recorded on 49 nights, from 30 locations, giving a total of 965 recordings.

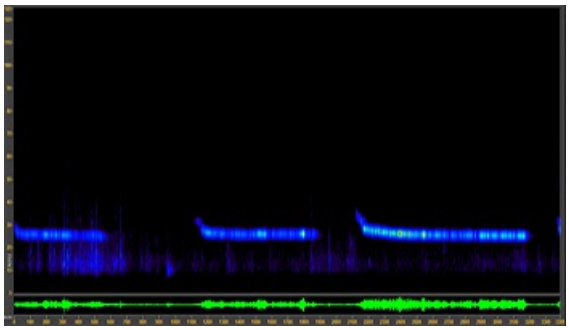
Spatial pattern of activity



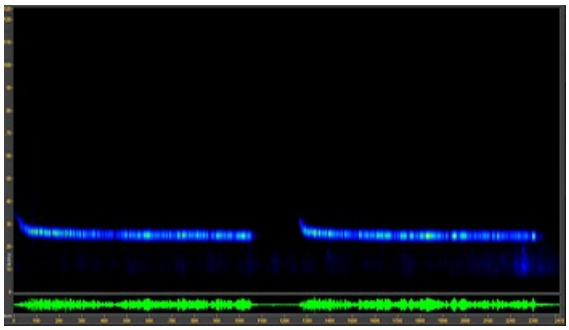
Seasonal and nightly activity



Black Rat is similar acoustically to Brown Rat (see Newson *et al.*, 2021 and Middleton *et al.*, 2024), but the frequency of Black Rat calls tends to be higher in frequency than would be typical for Brown Rat. From the Hornsea Project Four predator eradication implementation study, only Black Rats were found on Sark (GoBe Consultants Limited, 2022). This is supported by the analysis here of the calls. Black Rat and Brown Rat are also known to be present on Alderney (GoBe Consultants Limited, 2022), although we did not find any calls that were clearly of Black Rat in this project. Our understanding, and likely explanation for this comes from Matt Lewis and Alex (*Pers. comm.*), in that on Alderney, Brown Rats occur inland, whilst Black Rats are confined to the cliff edges, and are most likely to be recorded at the bottom of sea cliffs.



Black Rat



Black Rat

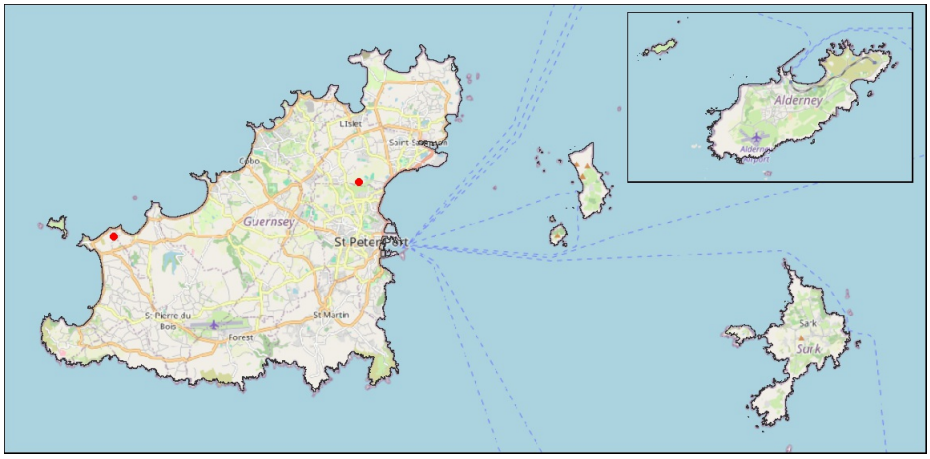
4.3.3 Bush-crickets

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.

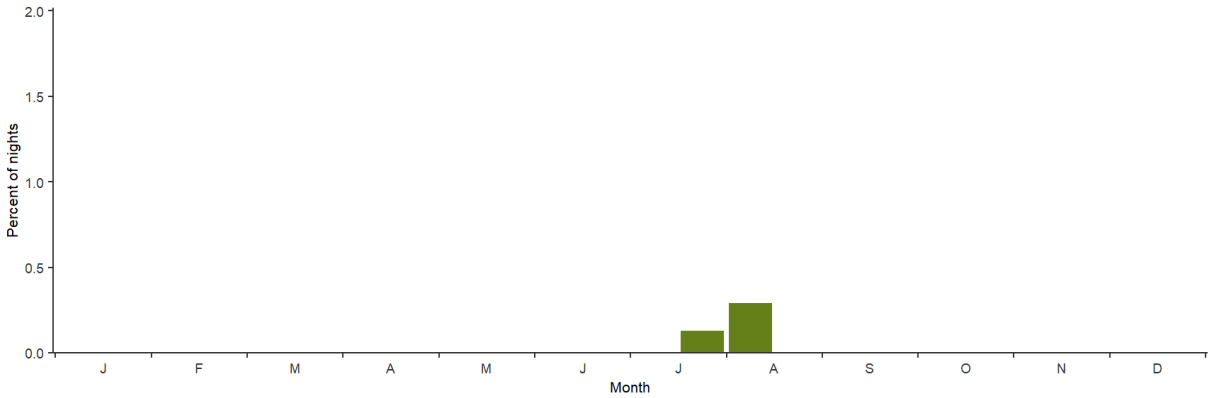
Short-winged Conehead

Short-winged Conehead *Conocephalus dorsalis* was recorded on three nights, from two locations.

Spatial pattern of detections



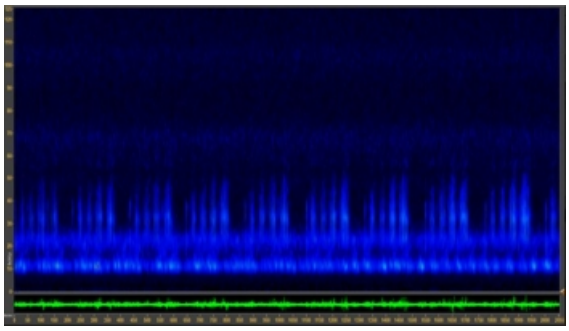
Seasonality



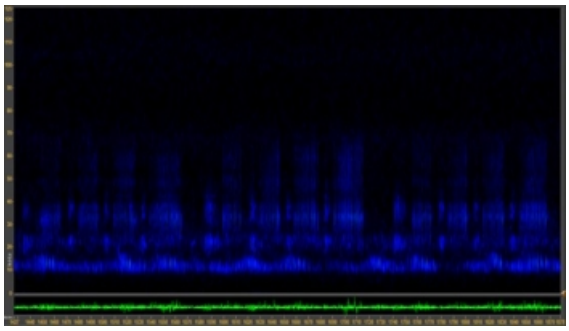
Short-winged Conehead - confirmation of species presence on Guernsey was recorded from two suitable wetland locations on Guernsey in 2021. The first of these was on the 17th July 2021, and the second on the 3rd and 4th August 2021. This is not recorded as a new species for Guernsey, but there were some doubts over the certainty of previous records.

Having run the project for a further three survey seasons, and not recording Short-winged Conehead again, we revisited the original recordings from 2021 again, to look again at the evidence that the 2021 recordings were definitely of this species. Having done this, we are certain that the recordings were correctly identified as Short-winged Conehead.

Short-winged Conehead produces 'calls' with a peak frequency of about 33 kHz and is straightforward to distinguish acoustically from Long-winged Conehead because it produces four-syllable calls (of equal duration). These are often given for an extended period, followed by a short sequence of single calls.



Short-winged Conehead - Guernsey, 17th July 2021 (also Great Green Bush-cricket)

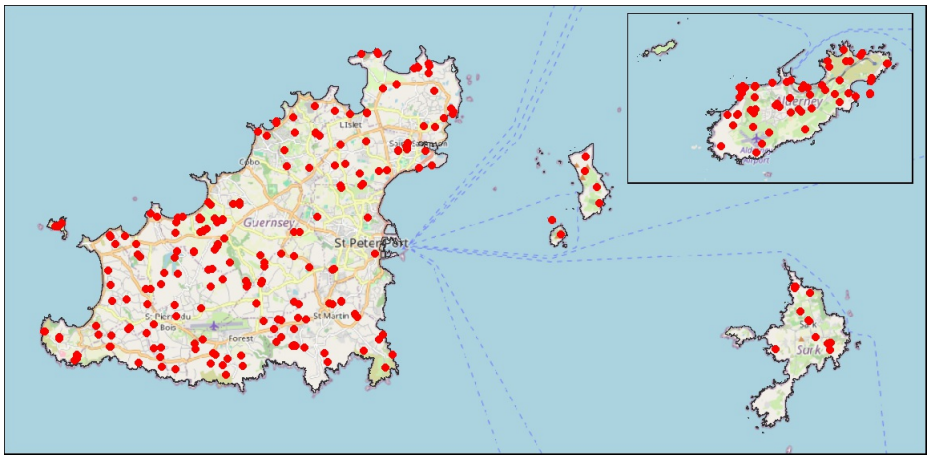


Short-winged Conehead (as left, different scale)

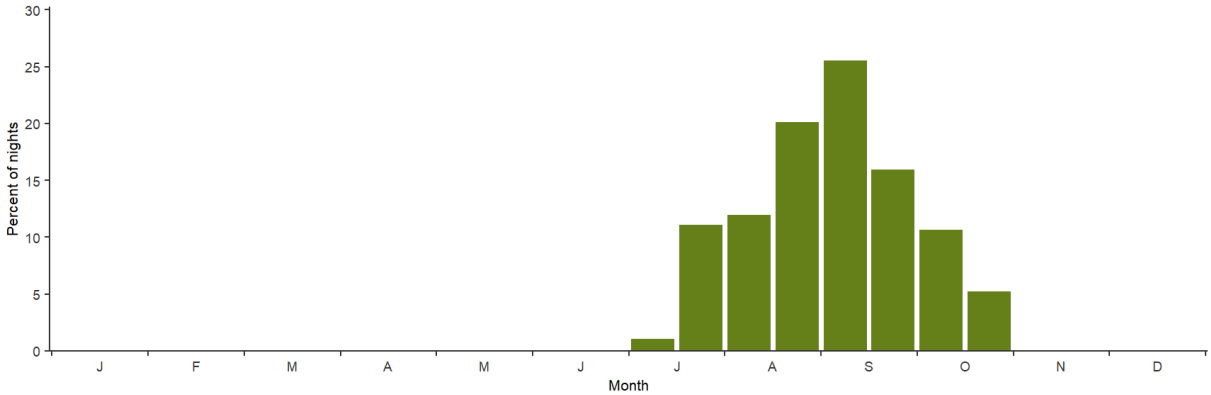
Long-winged Conehead

Long-winged Conehead *Conocephalus fuscus* was recorded on 283 nights, from 304 locations.

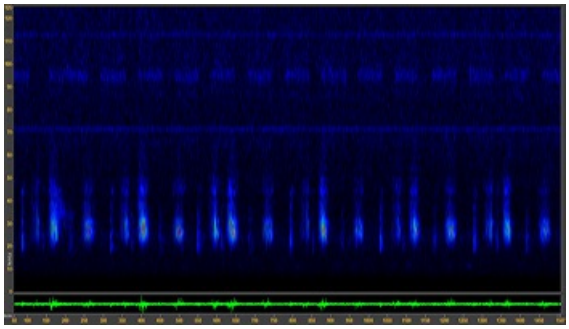
Spatial pattern of detections



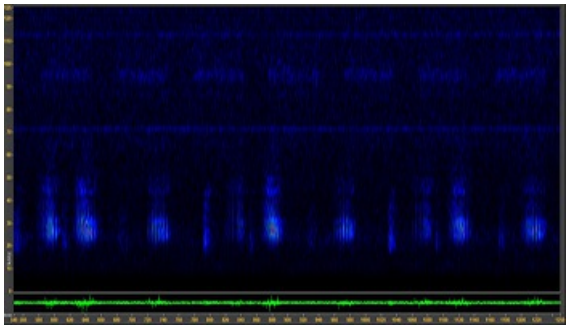
Seasonality



Long-winged Conehead was recorded from 304 locations between July and the end of October each year with records from Guernsey, Alderney, Sark, Herm, Jethou and Lihou. Long-winged Conehead produces 'calls' with a peak frequency about 26 kHz. It is most similar acoustically to Short-winged Conehead which was only recorded in 2021, but it produces three-syllable calls (two short calls, pause, followed by one longer duration call).



Long-winged Conehead

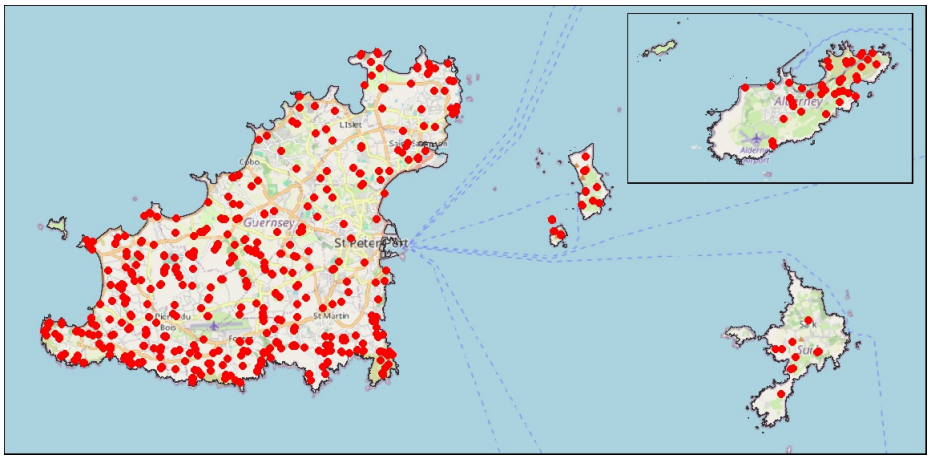


Long-winged Conehead (as left, different scale)

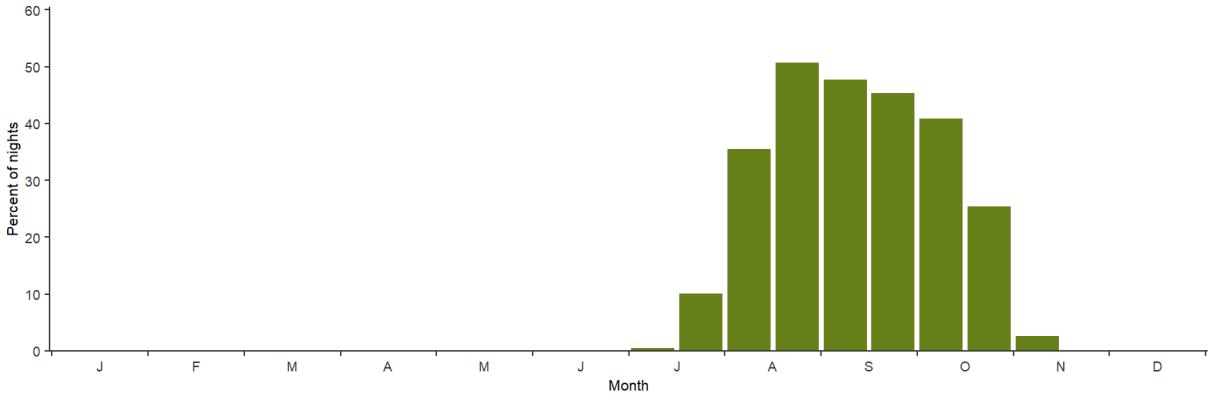
Speckled Bush-cricket

Speckled Bush-cricket *Leptophyes punctatissima* was recorded on 397 nights, from 592 locations.

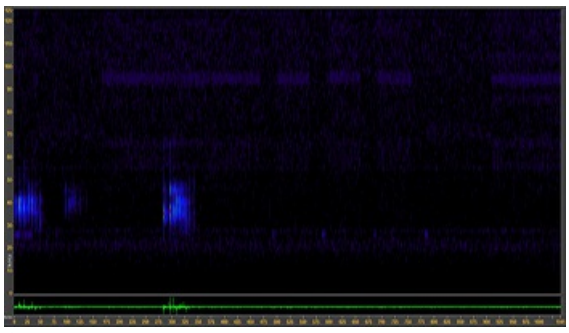
Spatial pattern of detections



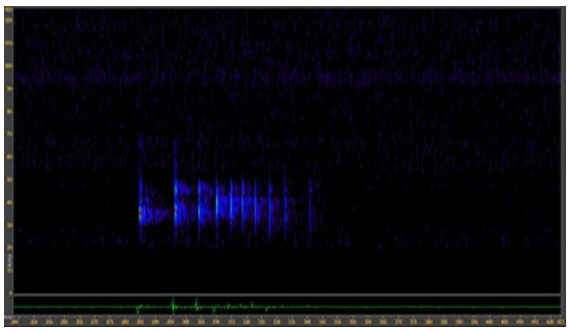
Seasonality



Speckled Bush-cricket were recorded from 592 locations between July and the end of October each year, which included locations on Guernsey, Alderney, Herm, Sark and Jethou. 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

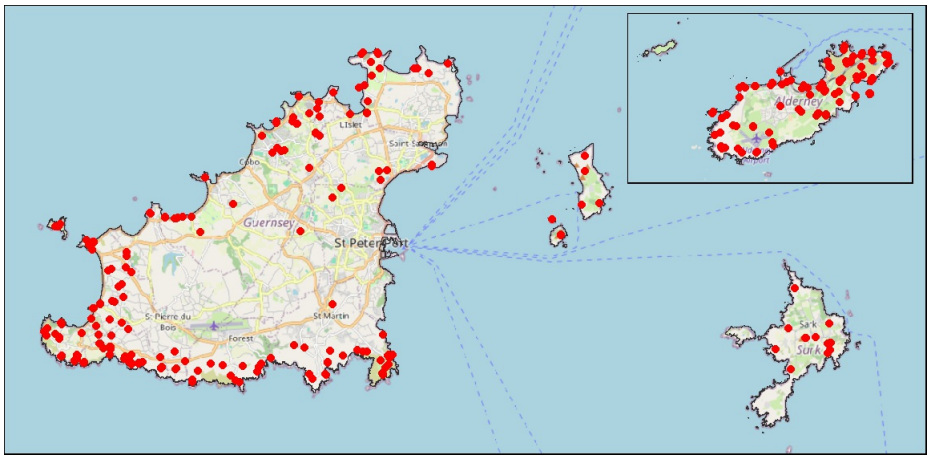


Speckled Bush-cricket (as left, different scale)

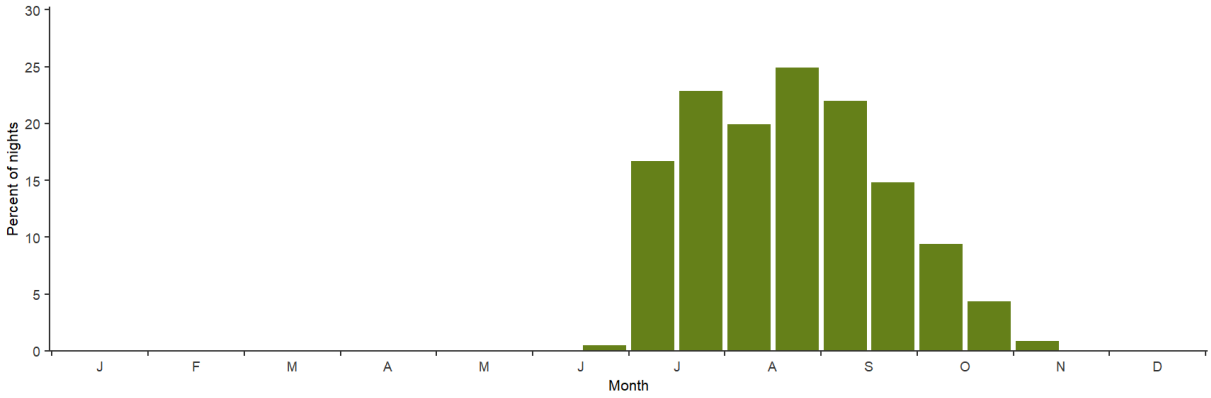
Grey Bush-cricket

Grey Bush-cricket *Platycleis albopunctata* was recorded on 394 nights, from 358 locations.

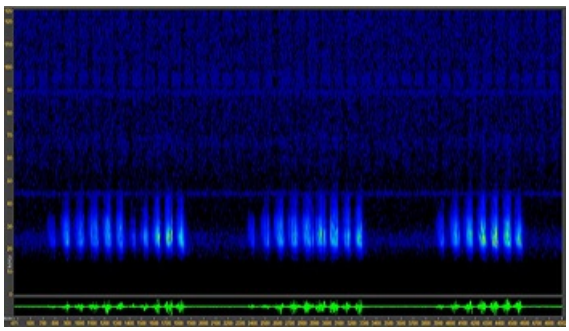
Spatial pattern of detections



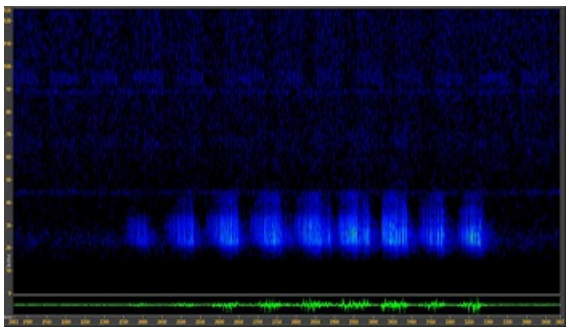
Seasonality



Grey Bush-crickets were recorded from 358 locations between the beginning of July and the end of October in each year, which included locations on Guernsey, Alderney, Sark, Herm, Jethou and Lihou. This species favours coastal areas on Guernsey, particularly the south coast cliffs, but there were also some records from inland low-lying areas. In Alderney, it was distributed quite widely across the island away from the town. Grey Bush-cricket produces 'calls' with a peak frequency of about 23 kHz. There are normally four or five grouped syllables, followed by a pause in a repeated sequence, where the syllables tend to show an increasing intensity across the sequence.



Grey Bush-cricket

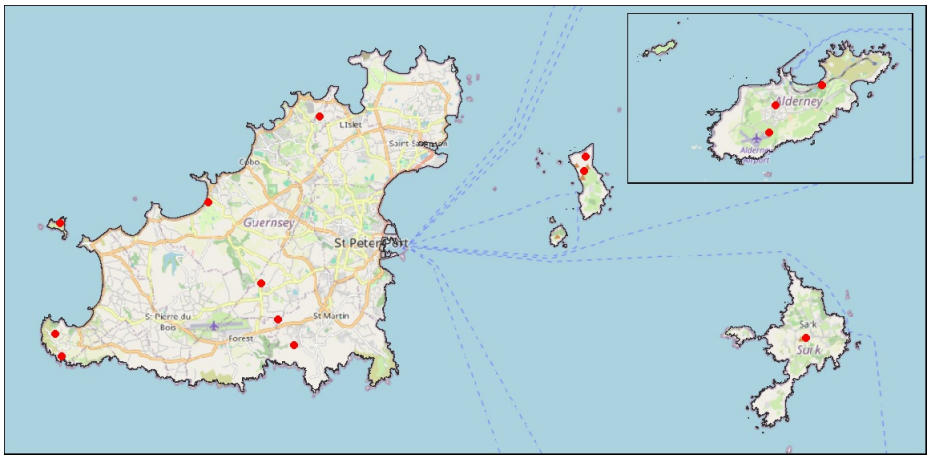


Grey Bush-cricket

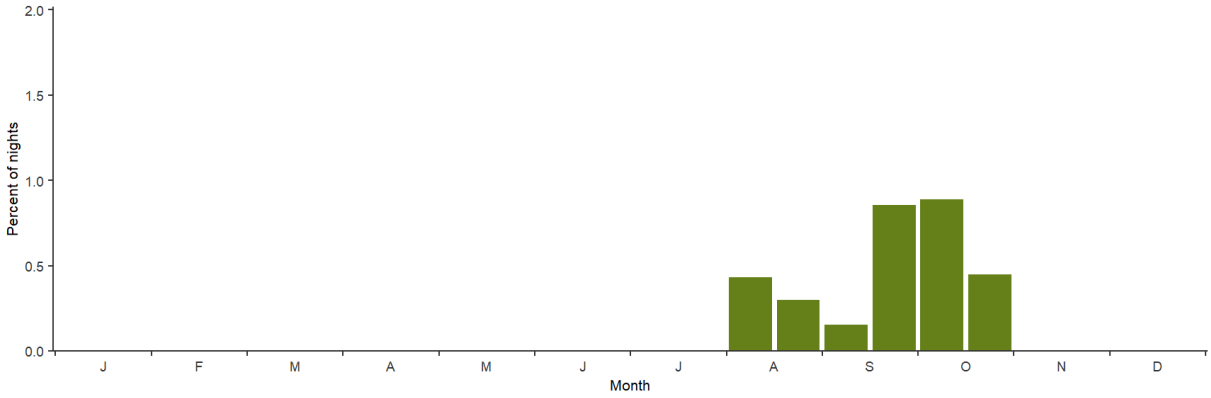
Large Conehead

Large Conehead *Ruspolia nitidula* was recorded on 21 nights, from 14 locations.

Spatial pattern of detections

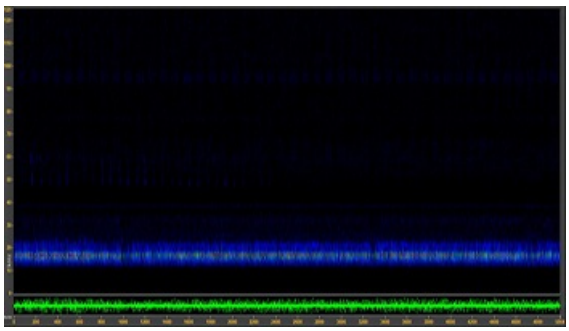


Seasonality

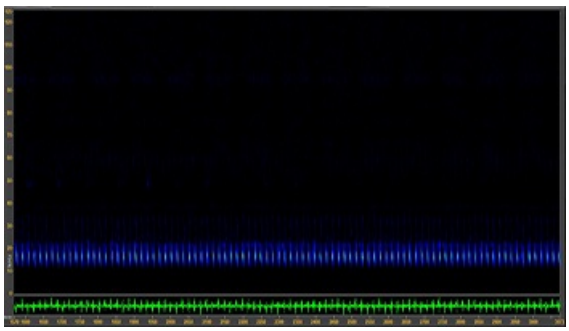


Large Conehead - new species for the Channel Islands. This species has been recorded now from Alderney, Guernsey, Herm, Sark and Lihou. This species was recorded for the first time in 2021, with single locations on Alderney on the 30th August 2021, on Guernsey on the 29th August 2021, and on Lihou on the 18th and 19th October 2022. In 2022, Large Conehead was recorded for the first time on Herm over four nights, and again from Guernsey for the second year running, but from two new locations, spaced widely apart. In 2023, Large Conehead was recorded from just a single new location on Alderney, east of the town and just south of the Rue de Beaumont. In 2024, this species was recorded from five new locations on Guernsey, from a second new location on Herm, and recorded for the first time from Sark.

This is a continental species that is spreading northwards. Previously an occasional migrant to the UK, breeding colonies were discovered in 2020 at Dungeness in Kent and it is likely to become more widespread in the Channel Islands as its colonisation northwards continues.



Large Conehead

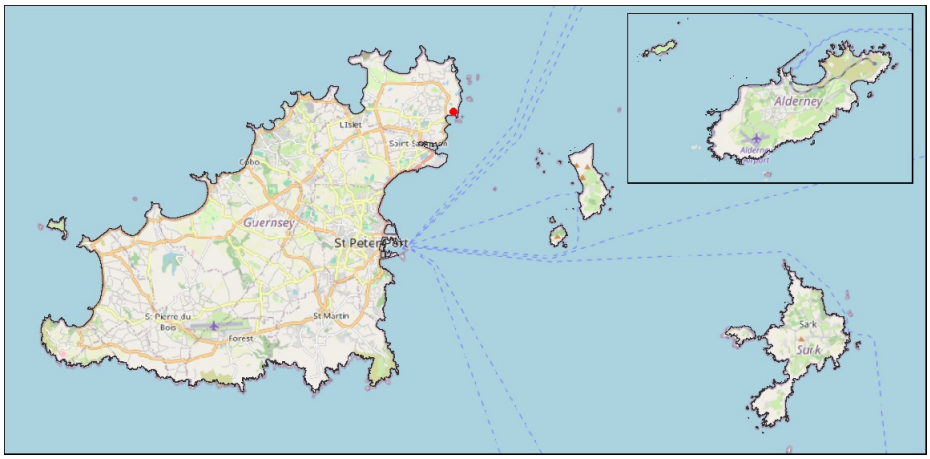


Large Conehead (as left, different scale

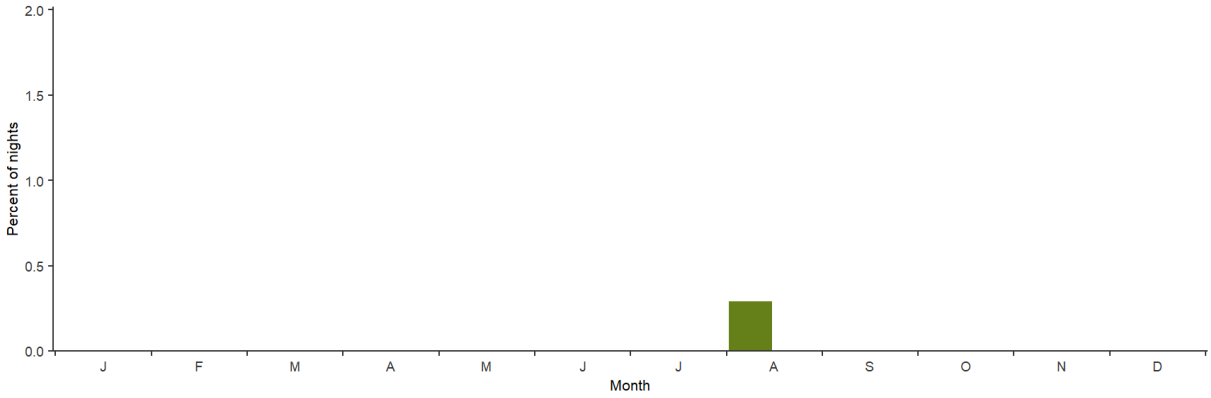
Brown-spotted Bush-cricket

Brown-spotted Bush-cricket *Tessellana tessellata* was recorded on two nights, from one location.

Spatial pattern of detections



Seasonality



Brown-spotted Bush-cricket - new species for Guernsey and the Channel Islands The Bailiwick Bat Survey cannot take credit for the discovery of Brown-spotted Bush-cricket *Tessellana tessellata*.

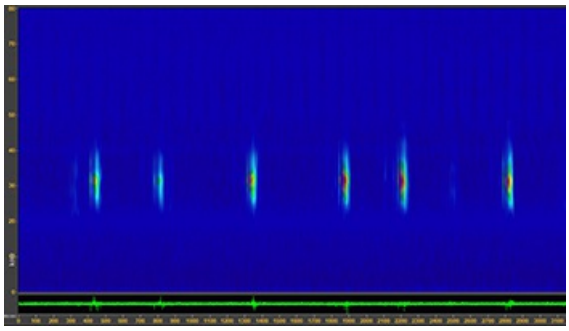
This species was discovered through a joint effort between an unnamed child, Trevor Bourgaize and Andy Smith during the summer of 2024. It was originally found by the child in an organised 'Bug Hunt' at Bordeaux at the north-east end of Guernsey. Andy Smith recognised it as being an early instar specimen of something 'different', and using the ObsIdentify app on photographs, it suggested *Tessellana tessellata*.

After speaking to the Bailiwick Bat Survey team, Andy deployed a bat detector at this location to record over several nights in August. Further investigations later in the season showed that there appeared to be an established population of Brown-spotted Bush-cricket present at that site, and a voucher specimen was obtained by Trevor Bourgaize, which was sent to experts for confirmation. Parallel to this, analysis of the sound recordings collected from the location revealed several hundred recordings of *T. tessellata*. Stuart Newson had previously worked on the sound identification of this species overseas, but additional confirmation that these were produced by *T. tessellata* was provided by Yves Bas from the Muséum National d'Histoire Naturelle, Paris.

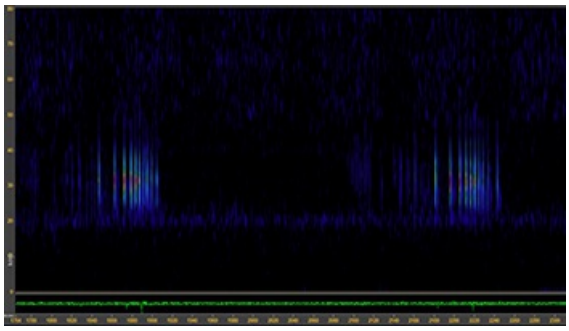
To date, this is the only location where this species has been found, but it is considered that its habitat requirements are not likely to be limiting. Visually, it could easily be overlooked due to its similarity with Grey Bush-cricket, where acoustics could offer a useful opportunity for detecting this species.

After its discovery in August 2024, a new Acoustic Pipeline classifier for the Bailiwick of Guernsey was built that included *T. tessellata*, but no additional recordings of this species were found elsewhere. An obvious question is whether this species could have been recorded previously by the Bailiwick Bat Survey, but overlooked. We consider it possible that if there were only a small number of recordings from a site, this is possible. However, if there were several hundred recordings, as in August 2024, where before *T. tessellata* was added to the Pipeline classifier, these would have been assigned to a range of insect species in error, where it would have been difficult to have overlooked these, during the manual species verification process.

Brown-spotted Bush-cricket produces call syllables with a series of accelerating clicks which can be seen in the spectrograms below.



Brown-spotted Bush-cricket

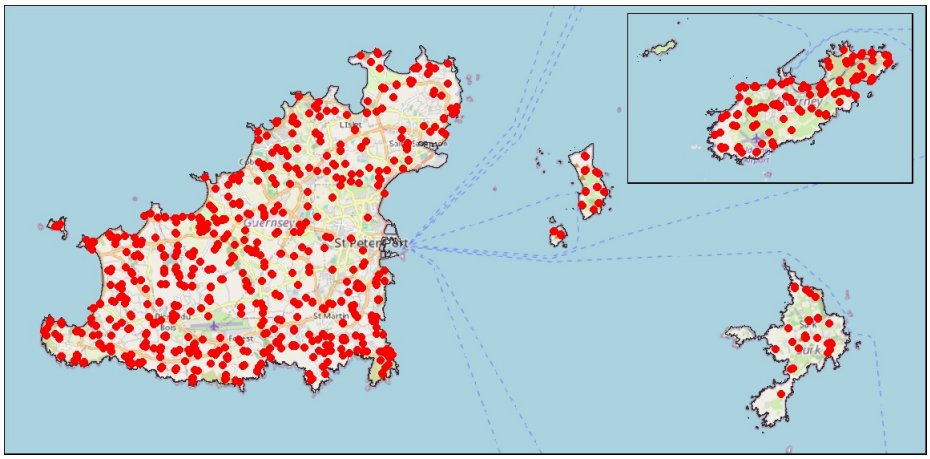


Brown-spotted Bush-cricket (as left, different scale)

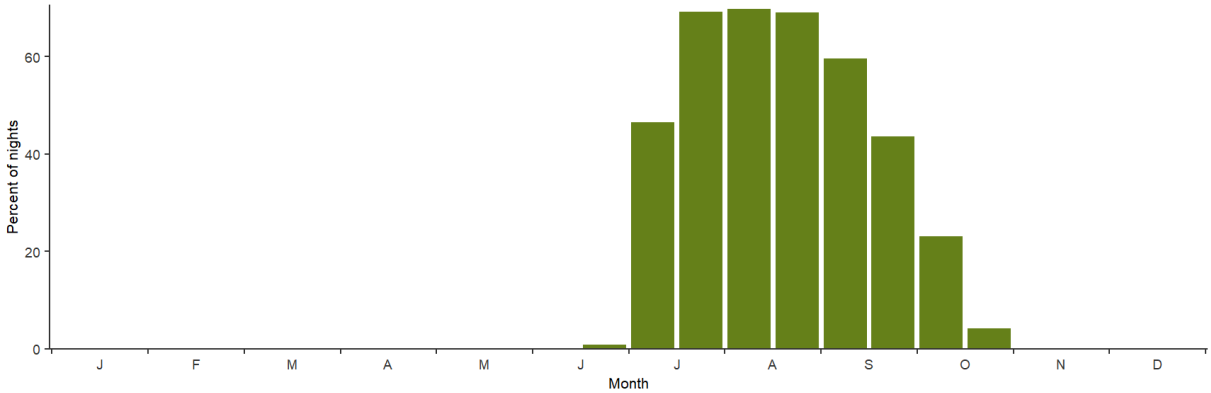
Great Green Bush-cricket

Great Green Bush-cricket *Tettigonia viridissima* was recorded on 420 nights, from 944 locations.

Spatial pattern of detections

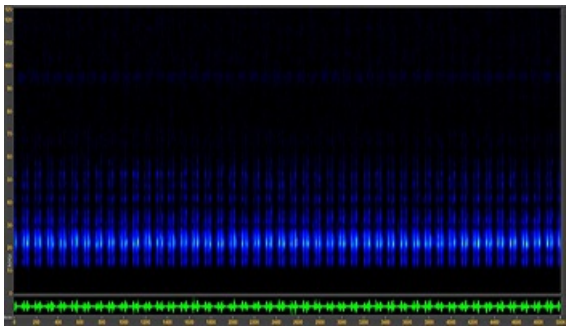


Seasonality

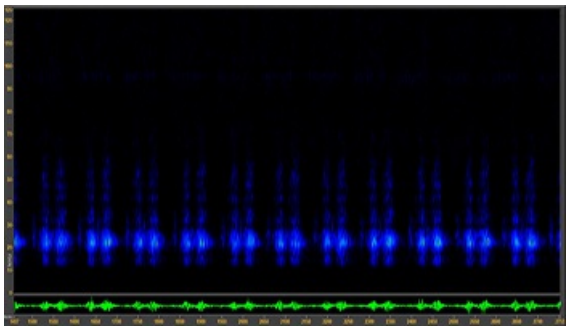


Great Green Bush-cricket were recorded from 944 locations between the beginning of July and mid-October in each year, which includes records from Guernsey, Alderney, Herm, Sark, Jethou and Lihou. This is the most ubiquitous bush-cricket species present on the islands. Great Green Bush-cricket produces 'calls' with a peak frequency of about 10 kHz. The call syllables for this species are grouped into twos.

Despite looking carefully through recordings for these species, we did not find any evidence that Dark Bush-cricket *Pholidoptera griseoaptera* or Roesel's Bush-cricket *Roeseliana roeselii* were recorded in any year of the project.



Great Green Bush-cricket



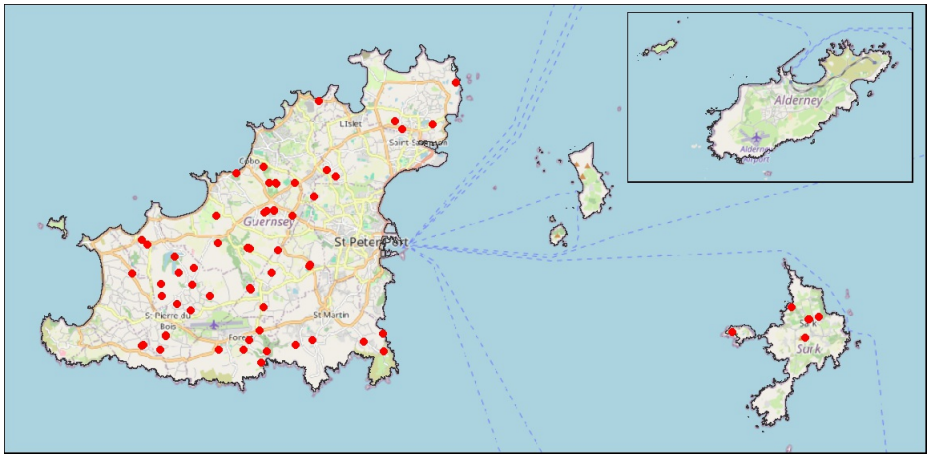
Great Green Bush-cricket (as left, different scale)

4.3.4 Audible moth species

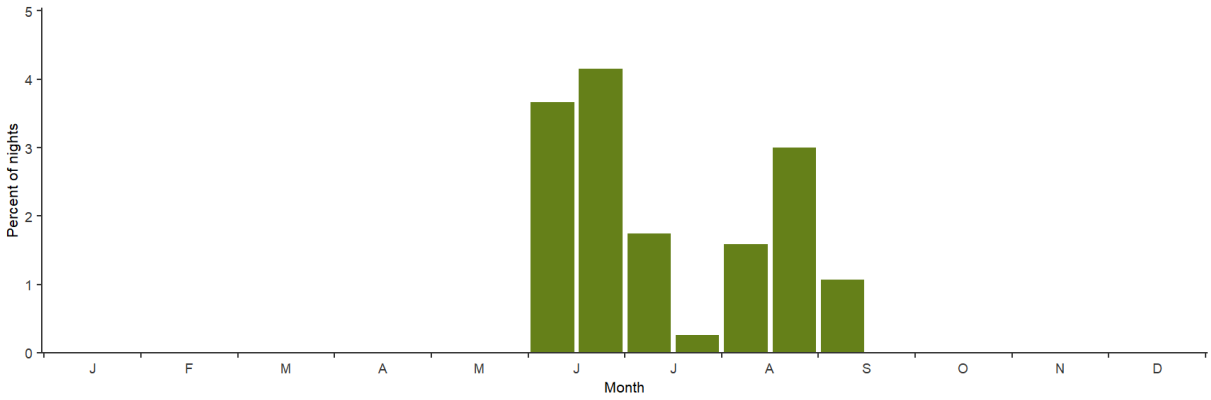
Green Silver-lines

Green Silver-lines *Pseudoips prasinana* was recorded on 91 nights, from 71 locations.

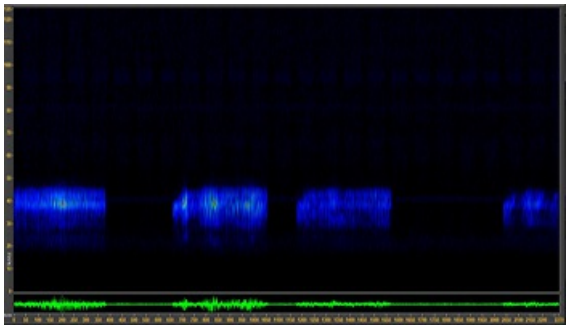
Spatial pattern of detections



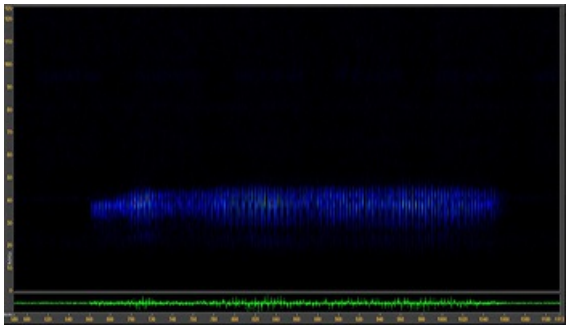
Seasonality



Green Silver-lines was recorded from 71 locations, which included records from Guernsey, from five locations on Sark and from one location on Brecqhou. 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.



Green Silver-lines

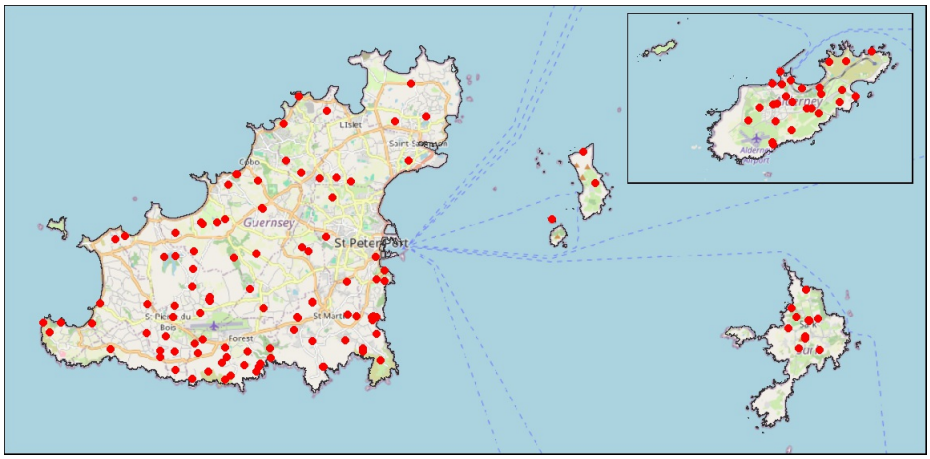


Green Silver-lines

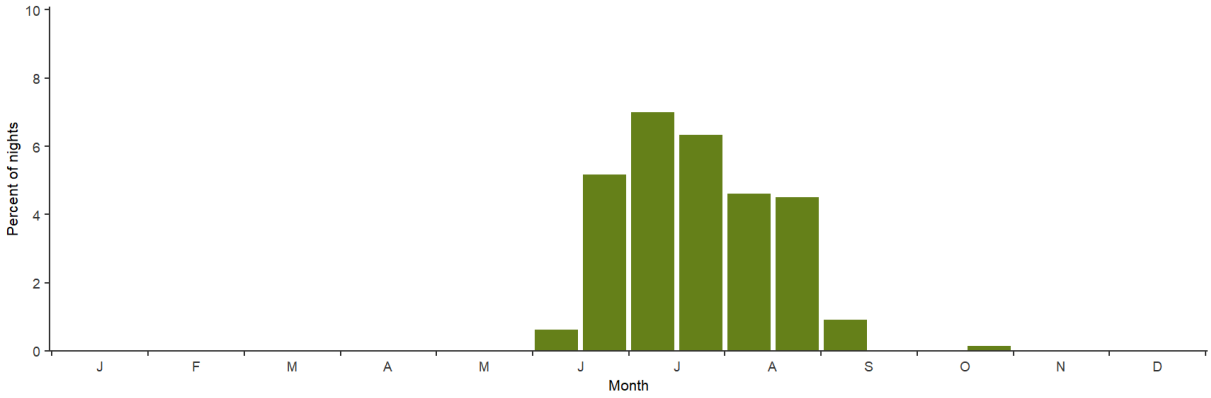
Bird Cherry Ermine

Bird Cherry Ermine *Yponomeuta evonymella* was recorded on 146 nights, from 143 locations.

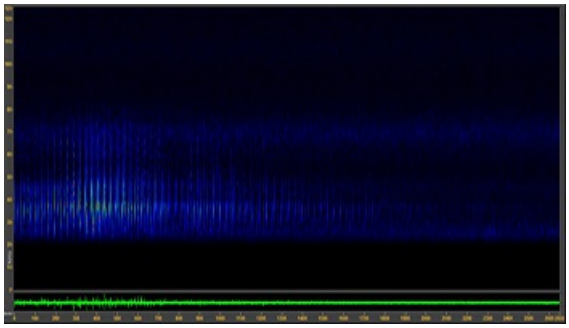
Spatial pattern of detections



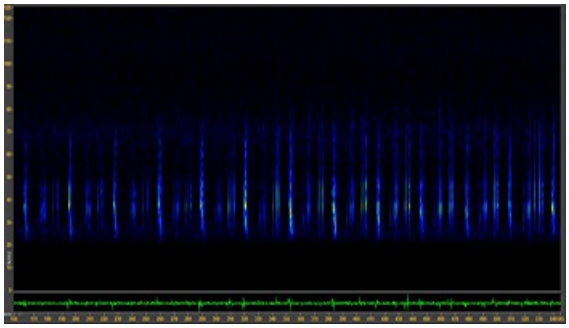
Seasonality



Bird Cherry Ermine was recorded on Guernsey, Alderney, Herm, Sark and Jethou. The micro-moth Bird Cherry Ermine was recorded from 143 locations. This species of moth is deaf itself, but it produces ultrasonic clicks when it flies, to interfere with the echolocation of bats and reduce predation. The sound produced by the Bird Cherry Ermine is very different from Green Silver-lines. Whilst we have assigned all recordings like this to this species, we cannot 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 in most years.



Bird Cherry Ermine



Bird Cherry Ermine (as left, different scale)

5. DISCUSSION

5.1 Headline results of the four-year project

The current dataset of 4,019,529 bat identifications, including the separate identification of social calls and feeding buzzes, has undoubtedly rewritten our understanding of the status of all species of bats, and the relative importance of different areas, and as 'by-catch', a number of other species groups across the Bailiwick of Guernsey.

The presence of at least 14 bat species, 5 small mammal species, 7 species of bush-crickets, and 2 audible moth species were confirmed. This included 6 bat species that had not previously been recorded in the Bailiwick of Guernsey, including Serotine *Eptesicus serotinus*, Leisler's Bat *Nyctalus leisleri*, Common Noctule *Nyctalus noctula*, Lesser Horseshoe Bat *Rhinolophus hipposideros*, Whiskered or Brandt's Bat *Myotis mystacinus* or *M. brandtii* and Parti-coloured Bat *Vespertilio murinus*. In addition, by separately identifying bat social calls for a broad range of bat species, and feeding buzzes, it provided additional behavioural insights for bats.

Five small terrestrial mammal species were recorded, comprising a total of 35,354 verified identifications. This highlights the value of acoustics, in providing here the first large-scale baseline data for the presence and activity of some of the more vocal and louder small mammal species across the islands. The macro-moth Green Silver-lines was recorded from 73 locations and the micro-moth Bird Cherry Ermine was also recorded from 143 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.

Seven species of bush-crickets were also recorded during this project. These included Large Conehead *Ruspolia nitidula*, which was recorded on five islands, and Brown-spotted Bush-cricket *Tessellana tessellata*, which was discovered on Guernsey in 2024. Both bush-cricket species were new for the Bailiwick of Guernsey and for the Channel Islands.

5.2 Comparison of the coverage achieved compared with the original survey design

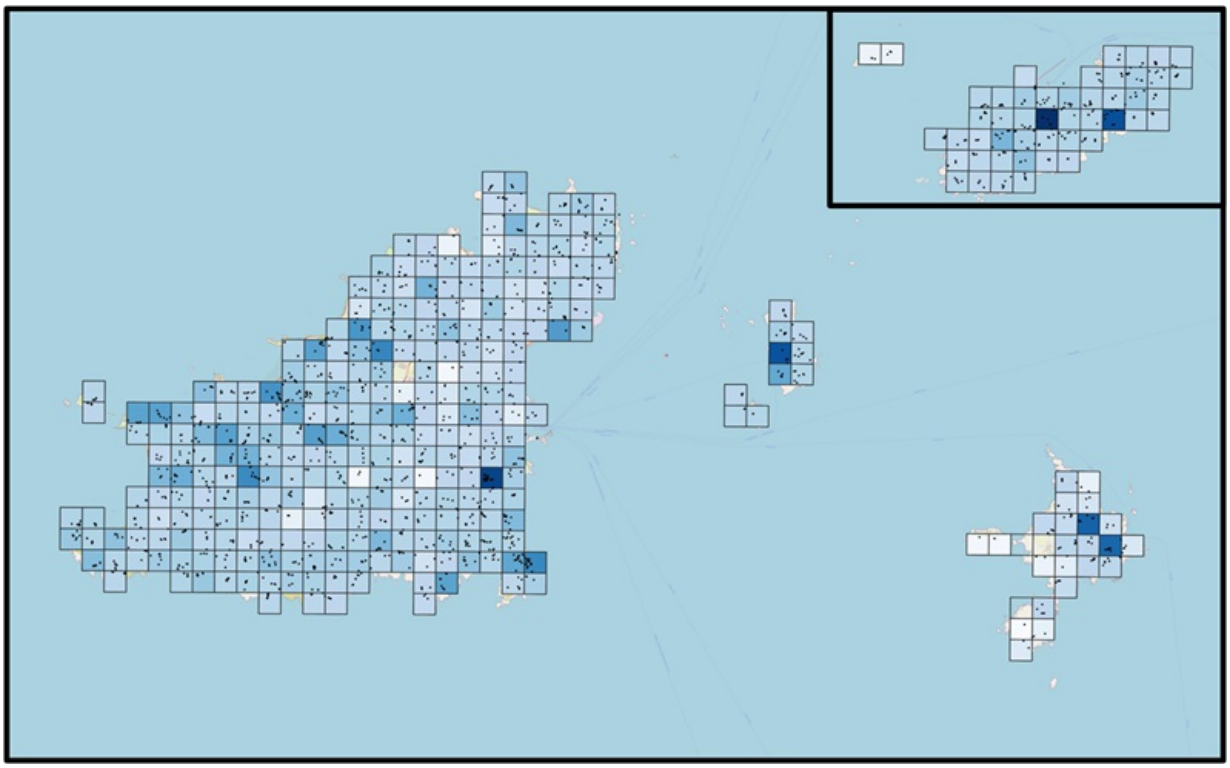
At the outset, the islands were divided up into a 500 x 500-m grid generated from ED_1950_UTM_Zone_30N (EPSG:23030), datum = D_European_1950. Squares were accepted for survey if they contained at least 25% land cover in the square. A total of 360 squares were selected across the islands, of which 356 were surveyed. One square in Guernsey and 3 in Sark were not covered, although, 5 additional squares outside the original stratification were surveyed, 4 in Guernsey and 1 from a boat moored in Alderney harbour.

An average of 84% of squares were surveyed each year (77.6-89.2%), which in total achieved 98.9% coverage of the squares originally selected. Approximately 65% of squares have data from each month between May and October, but coverage during April was lower at 40%, largely because the start date varied between years, but mainly during the second week of April.

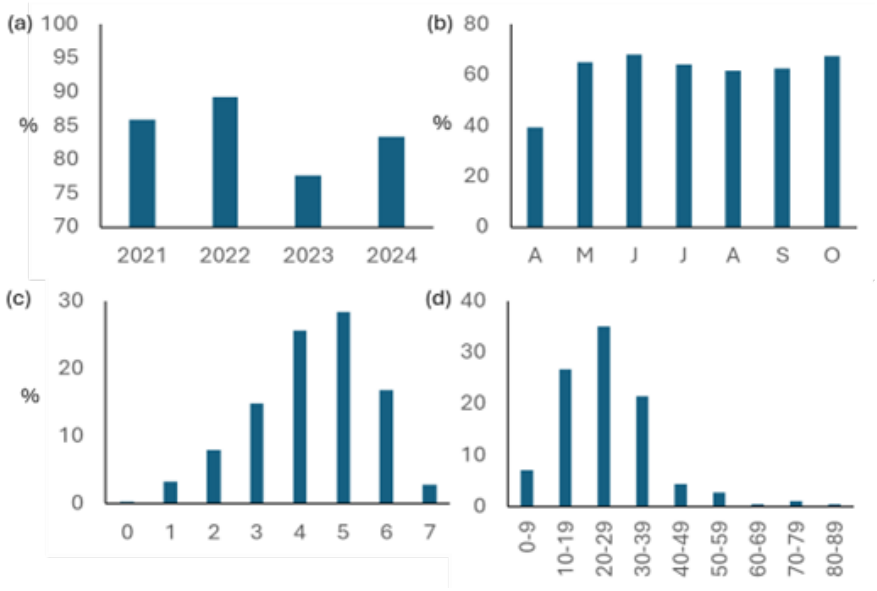
To try and ensure a reasonable temporal coverage of the survey squares, we asked volunteers if they could to undertake two surveys per year, one between 1 April and 15 July, and one between 16 July and 31 October. Around three quarters of the surveyed squares had survey effort from between 4-7 different months, and so most squares had data from more that 50% of possible survey months.

A total of 9,149 complete nights of surveys were carried over the 4 years. Most 500 x 500-m squares were surveyed for between 10-39 nights (83.2% of squares). The median number of nights of survey per square was 24. We originally asked for 8 nights per year (4 spring, 4 autumn; 4 years) which makes a total of 32.

Map showing the original 500 x 500-m survey squares and the location from which recordings were received. The shading of the squares reflects the number of nights of recordings that were received for each square.



Frequency distribution of (a) the % of squares covered each year (range: 77.6-89.2%), (b) the % of squares for which recordings were received each month over the 4-year survey period, (c) the number of months in which each square was surveyed and (d) the number of survey nights per sample square.



5.3 The importance of underground structures and other roost sites

The Bailiwick Bat Survey, and additional fieldwork carried out around the survey, have identified the importance of underground structures for swarming and providing suitable conditions for certain species of bats to overwinter. In most cases, these are tunnels created during the WWII occupation of the Channel Islands but also include a sea

cave.

Entrances to tunnels seem to be important for swarming in autumn. In particular the German Underground Hospital and the tunnels under St Saviour's church are important swarming sites. In the Bailiwick Bat Survey, encountering more than 10-20 recordings of Natterer's Bat a night at a location is unusual, but at the peak of swarming, it was possible to encounter more than 1,000 recordings a night indicating that the tunnels are extremely important for this species. Similarly, the Brown Long-eared Bat, social calls were almost exclusively recorded at entrances to tunnels at the German Underground Hospital, Grandes Maisons Road and La Monnaie. Whiskered Bat or Brandt's Bat were only found roosting in a tunnel along Grandes Maisons Road, and a Whiskered Bat was trapped there in 2024. The situation was similar in Alderney, with the tunnel complex along Val Reuters, and the tunnel at the bottom of Barrackmaster's Lane being important for Brown Long-eared Bat, Natterer's Bat and Whiskered Bat (and potentially Brandt's Bat). The result of this is that underground structures such as tunnels and sea caves are home to some of the Bailiwick's rarest species of bats. Many, if not all of these, are in private ownership and working with landowners and built heritage organisations such as Festung Guernsey to secure their long-term future must be a priority. The loss of even one of these structures would have a major impact on one or more of the Bailiwick's bat species.

Recordings at tunnel entrances tended to under-represent Common Pipistrelle, which was by far the commonest species recorded more widely in the Bailiwick Bat Survey (95% of recordings were of this species), which reflects differences in the ecology and habitat preferences between the different species. Common Pipistrelles tend to roost and hibernate more in buildings, often in roofs, or behind soffits and sympathetic building techniques are recommended when re-roofing or improving houses to allow them to roost. Other species will spend the winter in torpor in tree cracks and crevices.

It was not the aim of the Bailiwick Bat Survey to identify maternity roosts, but it had some small successes in doing so. Grey Long-eared Bat often produce what is known as D-type social calls in the vicinity of roosts. Looking at the Bailiwick Bat Survey dataset, the presence of social calls identified a potential roost in a school on Guernsey, which was confirmed during a training visit by Sangan Island Conservation from Jersey.

Despite being regularly recorded at winter roost sites, and having scattered records elsewhere, we did not discover any maternity roosts for Greater Horseshoe Bat. This species was occasionally recorded away from the wintering roost sites, but whilst a number of potentially suitable buildings were surveyed, no Greater Horseshoe Bats found.

The Lesser Horseshoe Bat remains a bit of a mystery. It was regularly recorded in the extreme southeast of Guernsey, but we were not able to find where it roosted. It may just be one bat, but it was tracked travelling over a few km using a grid of recorders across the area. Records came from very close to dawn, where it is likely that the roosting site was nearby.

5.4 Developing a monitoring plan, bat worker skills & raising awareness of bat requirements for breeding, feeding and roosting

This project sets a baseline which has described the bat species that occur in the Bailiwick. It is important to build on this knowledge and the willingness of the volunteers who made this possible.

Developing an ongoing monitoring scheme, ideally a Channel Island-wide one, is important. This will likely involve a mix of recording at a number of sites in the wider environment using a stratified randomised approach, i.e. to divide up the islands into different habitat types and sample random sites with these habitat strata, as well as targeted surveys at known roost and swarming sites to better understand the seasonal use of these. To enable this to happen, we recommend that an analysis of Bailiwick Bat Survey data is undertaken to determine the number of sites and nights that would be required in an effective monitoring scheme.

Passive acoustic recording can only tell us so much, and there is a lot more that could be done to build on the knowledge that we have gained through this project. For example, we know very little about roost sites for species that prefer roosting in trees and buildings, but we do know from the UK and Europe how to enhance the built and natural environment for the species that occur in the Bailiwick. This could include working with planners, builders and developers to put bat-friendly features into buildings (e.g. hollow soffits, bat boxes), but the natural environment can also be enhanced. Trees are important roost sites and tree cover in the Bailiwick is at its highest since WWII. Bats use holes, crevices, loose bark and splits in trees as roost sites but features such as these tend to occur on old trees which there is a lack of on the island as much of the woodland has grown up since the 1940s. There are new methods

being used to create bat roosts in living trees by cutting cracks and creating voids in living trees. The tree will heal around these, leaving suitable bat roost features and this could be a way to enhance the relatively new woodland on the islands for bats.

Foraging habitats are also key and understanding seasonal use of different habitats, and the role of boundary features will be possible with the data that has been collected over the past four years. This piece of work is a clear priority, as it will highlight the most valuable habitats at different times of year and could lead to important land management recommendations. Our knowledge about habitat use by the majority of the species recorded through this project is extremely limited.

The scale at which this survey was undertaken would not have been possible without keen volunteers placing the detectors in their chosen squares and uploading the recordings to the BTO Acoustic Pipeline. The rapid turnaround of the automated analysis was appreciated by volunteers and contributed to the continuing participation by many volunteers, most of whom were new to biological recording. We reached a different range of sectors of society with children taking part with their parents or youth groups, with the age range of those taking part being between 8-80. With over 9,000 complete nights of survey undertaken, it would have taken one person with one detector over 45 years to achieve the same result. At a (conservative) professional ecologist's rate of £250 per night for a bat survey, the added value of volunteer fieldworkers is immediately clear, with the fieldwork here costing between £1.5-2 million over the course of the project.

5.5 Recommendations

This 4-year study has provided a baseline data set that has identified new species, new and important sites for different species, and has provided a set of data which can continue to be analysed. We recommend that:

- The Bailiwick Bat Survey data is used to design a volunteer-based monitoring scheme that includes (1) long-term stratified random sampling of habitats over time, and (2) long-term surveys of important swarming and winter roost sites, especially underground sites that are important for the Bailiwick's scarcer species of bats. Several species of bat (Greater Horseshoe Bat, Natterer's Bat, Whiskered Bat, Brown Long-eared Bat) are entirely reliant on these structures at particular times of year and, as such, are extremely vulnerable to any change. It must be a priority for not only the environmental NGOs but also the government (States of Guernsey and Alderney, and Chief Pleas in Sark) to work with landowners to secure long term protection for key sites. The use of Song Meter Mini Bat 2 devices with lithium-ion batteries (or similar recorder) would allow for the long-term deployment of devices.
- An analysis is carried out of the relative use of different habitats in space and time to look at habitat and boundary feature use by season. The data here would allow for this, but the funding needs to be secured to enable this to happen. There is a limited window where analyses of these data will become less relevant as it ages.
- Through the Bailiwick Bat Survey, we have an improved understanding of the use of underground structures for swarming and roosting in winter, but few maternity roosts are known. It would be particularly useful to try and identify the maternity roost/s of the Bailiwick's rarest bat species, Greater Horseshoe Bat, Lesser Horseshoe Bat and Whiskered Bat. This would be most easily achieved through targeted trapping and radio-tracking.
- As a lower priority, radio-tracking work could also be used to identify the types of roost features used by tree-roosting bats (e.g. Natterer's Bat). Woodland is a scarce but increasing resource in the Bailiwick, but the tree stock is still relatively young. Understanding use of different tree structures will enable the possible habitat enhancement measures to be carried out. These could include making artificial roosts in trees by cutting out cavities, fissures and cracks in living trees to create new roosting opportunities.
- This project has seen a great deal of engagement from both the public and environmental NGOs and this work has highlighted just how much support there is for the islands' bats. Continued engagement will be necessary to secure the support for future conservation measures.
- One of the major threats facing bats is the changes that are being made to their natural and anthropogenic habitats. We recommend running specific workshops for developers and planners, builders and arboriculturalists on the islands to both protect and enhance bat habitats (e.g. using bat-friendly building techniques). Codes of conduct should be developed or adopted from elsewhere so that operators can be said to be 'bat-friendly'.

Derrible Head on Sark where Leisler's Bat was recorded in 2023 for the first time on the island (Image credit: Lynda Higgins).

6. ACKNOWLEDGEMENTS

We would like to thank all the fieldworkers who took part in the Bailiwick Bat Survey and the landowners that gave volunteers access to their land. Without you, none of this would have been possible.

We would also like to thank the Fort Grey Shipwreck Museum, the Guille-Allés library, Sir Charles Frossard House reception staff, La Société Guernesiaise, Alderney Wildlife Trust and La Société Sercquaise, Agriculture, Countryside and Land Management Services (ACLMS), Alderney Wildlife Trust, Nature Commission, Priaulx Library, the Guernsey Museum at Candie, and the Sark School for hosting bat detectors in one or more seasons for the project.

We are also very grateful to Roland Gauvain, Daniel Whitelegg and Tara Cox (Alderney), Roger Thresher (Herm), Bill Bayley (Jethou), Aidan Monaghan (Brecqhou) and Steve Sarre (Lihou), Piers Sangan, Amy Hall and the Bat Section of La Société Guernesiaise for their help and support of this project. We would also like to thank Matt Baxter, Ollie Barratt, Steve Pritchard and Hazel McCambridge from the BTO for development and support of the online systems that were used in this project. We are also extremely grateful to Marc Van de Sijpe, Alex Lefevre and Chris Corben for providing their thoughts on the identification of a series of 'big bat' recordings from Sark, and to Bram Aarts and Thierry Disca for their comments on a series of Parti-coloured Bat recordings from Herm and Guernsey.

Lastly, we would like to thank the States of Guernsey for funding this project and Andrew McCutcheon and James Robinson for their support.

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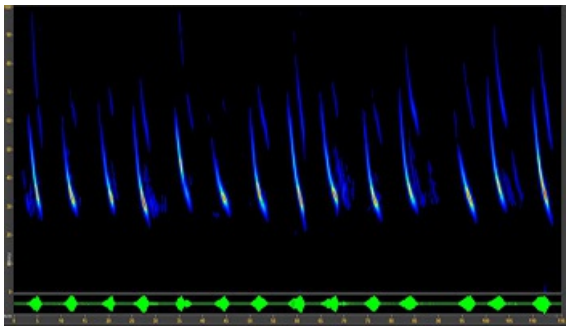
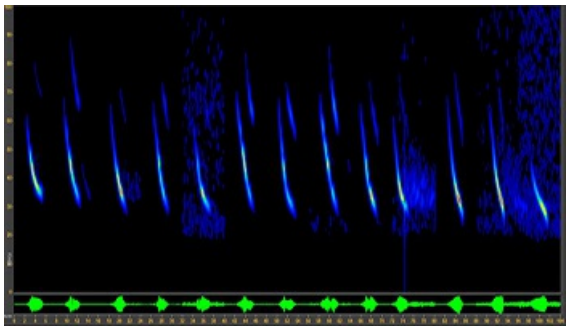
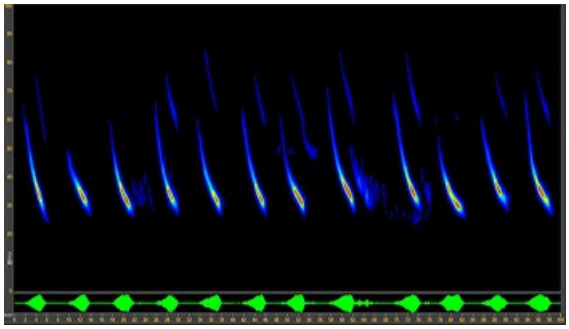
Identification appendix 1: Serotine *Eptesicus serotinus* and Leisler's Bat *Nyctalus leisleri*



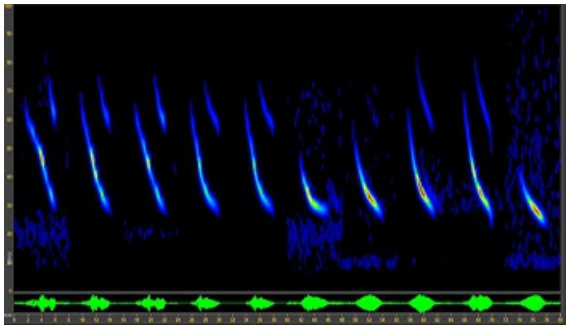
Serotine - call duration 2.7-3.0 ms



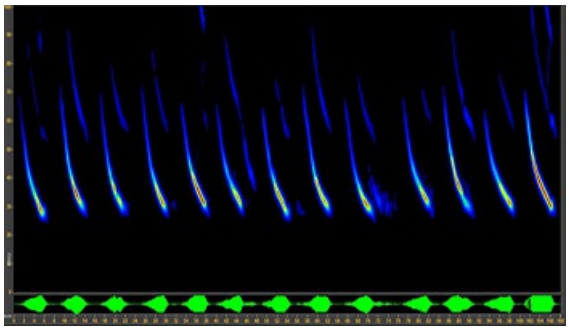
Leisler's Bat - call duration 2.7-3.0 ms



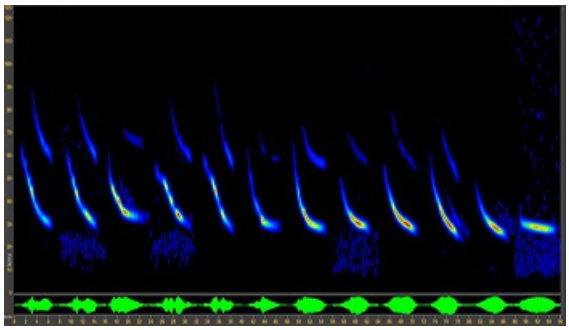
Serotine - call duration 4.0 ms



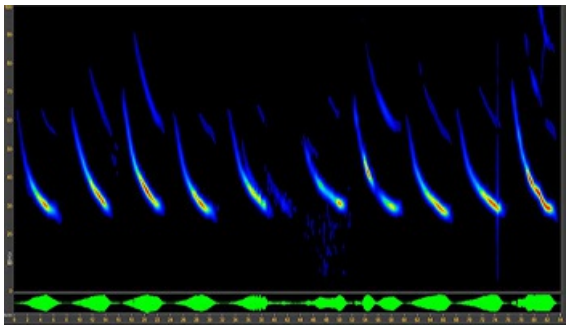
Leisler's Bat - call duration 4.0 ms



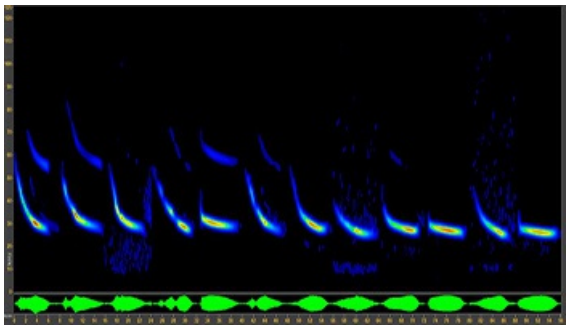
Serotine - call duration 5.0 ms



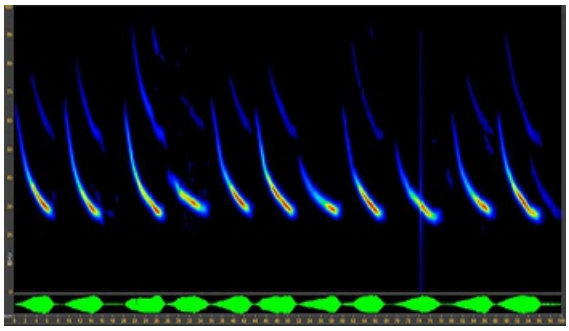
Leisler's Bat - call duration 5.0 ms



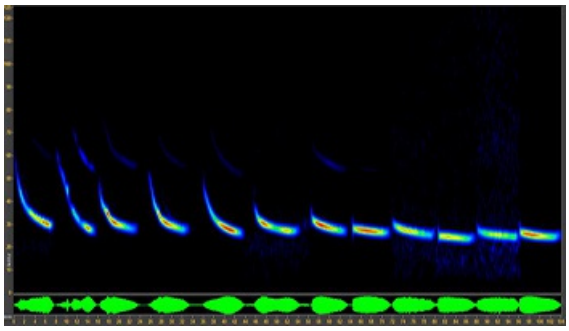
Serotine - call duration 6.0 ms



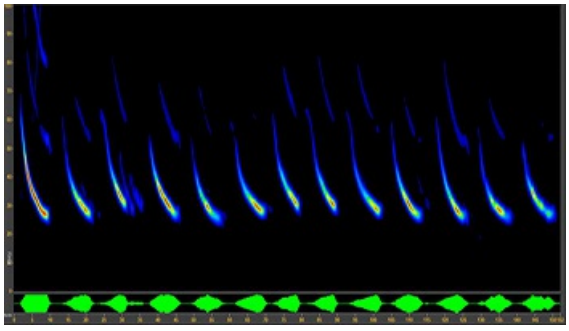
Leisler's Bat - call duration 6.0 ms



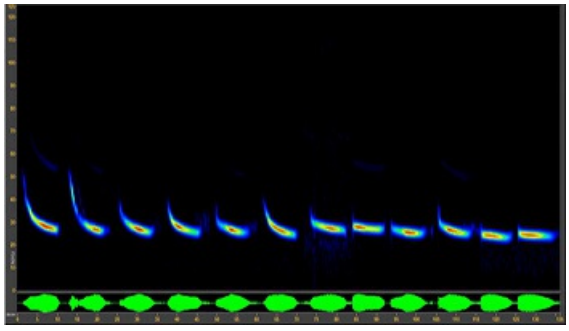
Serotine - call duration 7.0 ms



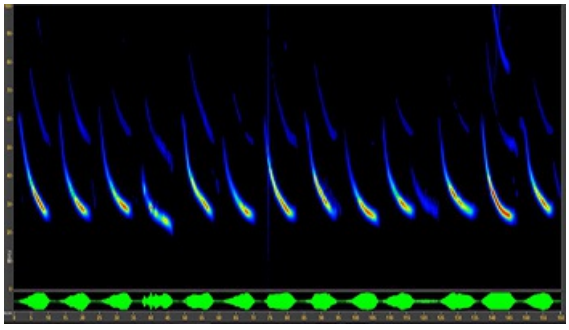
Leisler's Bat - call duration 7.0 ms



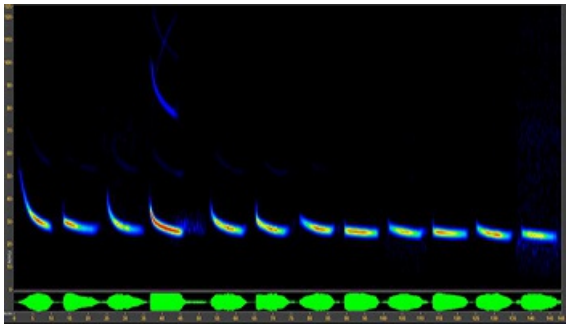
Serotine - call duration 8.0 ms



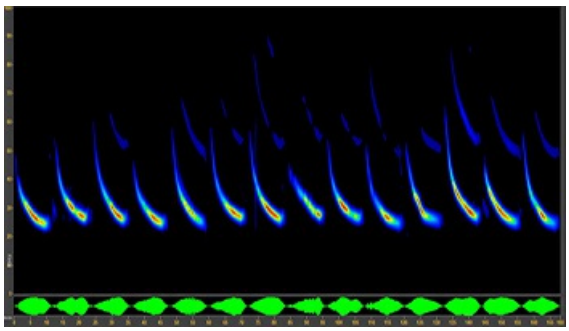
Leisler's Bat - call duration 8.0 ms



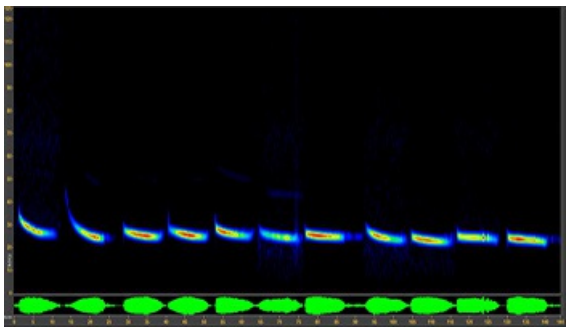
Serotine - call duration 9.0 ms



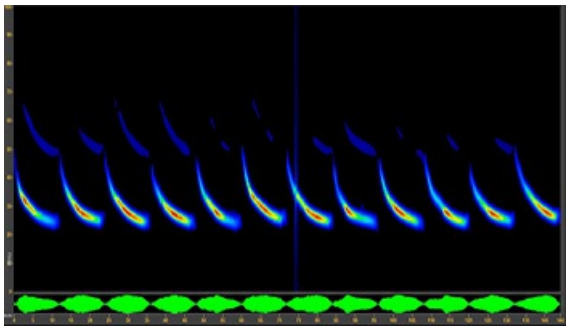
Leisler's Bat - call duration 9.0 ms



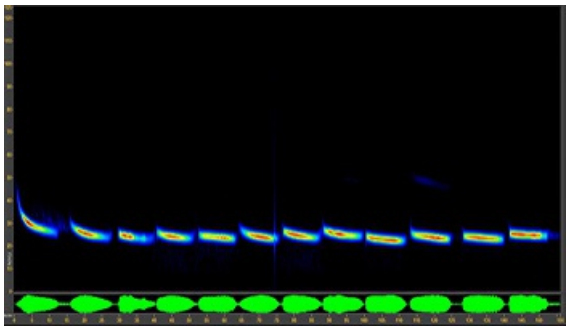
Serotine - call duration 10.0 ms



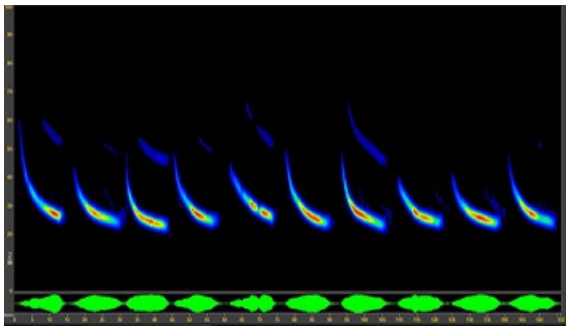
Leisler's Bat - call duration 10.0 ms



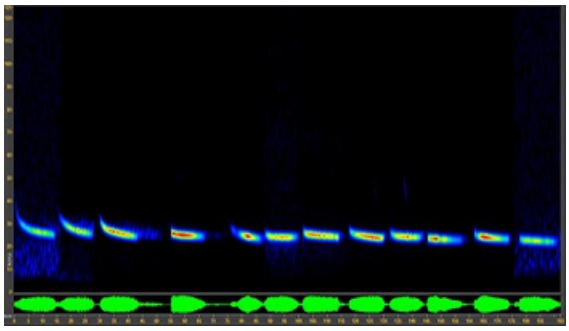
Serotine - call duration 11.0 ms



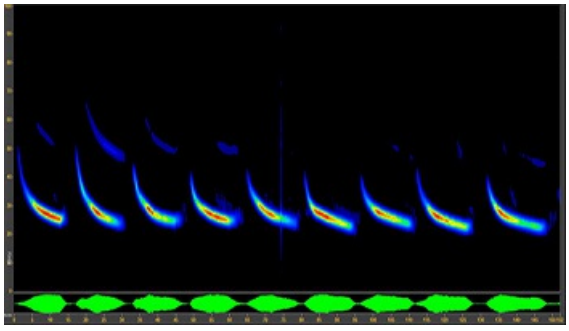
Leisler's Bat - call duration 11.0 ms



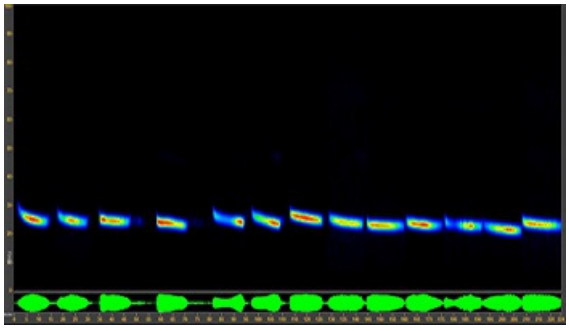
Serotine - call duration 12.0 ms



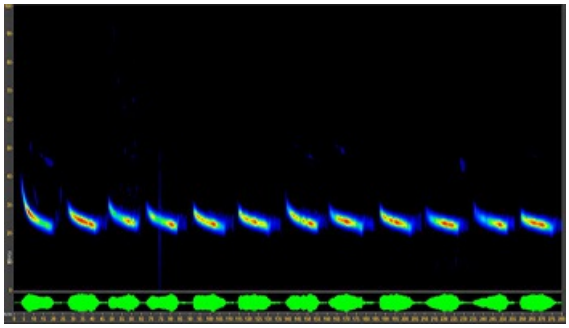
Leisler's Bat - call duration 12.0 ms



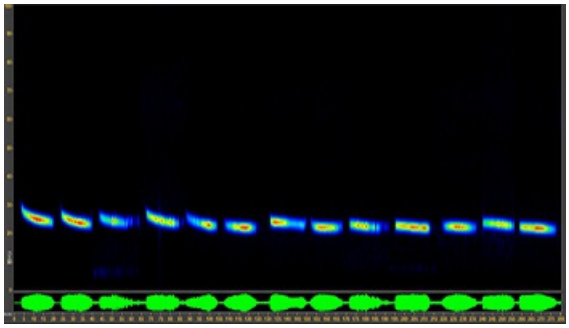
Serotine - call duration 13.0-16.0 ms



Leisler's Bat - call duration 13-16 ms

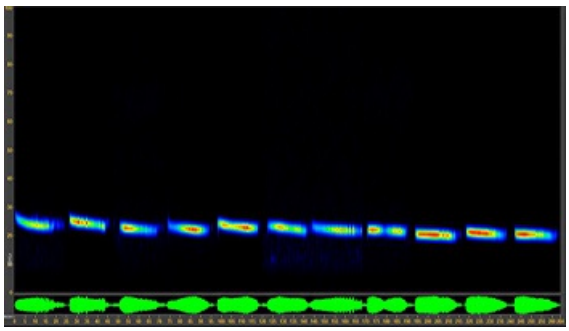


Serotine - call duration 17.0-18.0 ms



Leisler's Bat - call duration 17-18 ms

Serotine - no examples for this call duration



Leisler's bat - call duration 19-24 ms

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

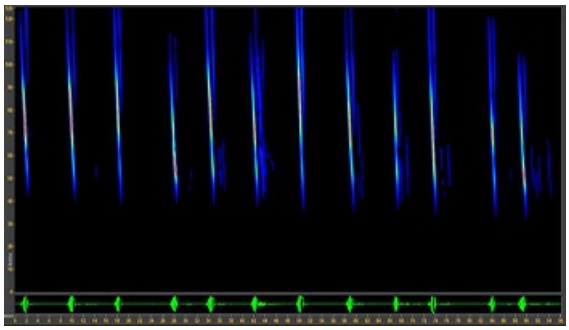
In the below we provide a visual comparison of echolocation calls of the same call duration of Whiskered Bat *Myotis mystacinus* and Brandt's Bat *Myotis brandtii* alongside each other. In producing these comparisons, we would like to explore whether there are any patterns of differences between the calls of these species that could be useful for species identification (e.g. differences in frequency or shape).

We do this by mining known recordings of *M. mystacinus* and *M. brandtii* to look for examples of individual echolocation calls that cover the range of observed call durations, and then putting calls of similar duration together into 'compiled' recordings for a given range of call durations. For example, a compiled recording, may just contain examples of calls of between 3.5 and 3.6 ms.

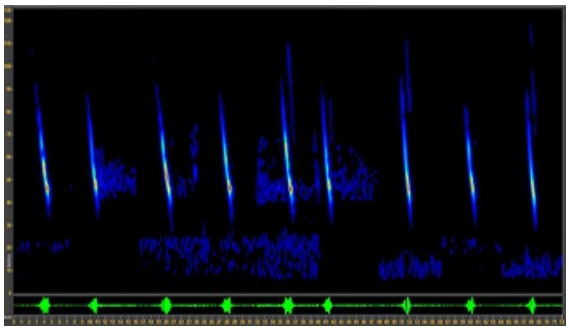
M. mystacinus and *M. brandtii* are two of the most difficult bat species in Europe to distinguish from their echolocation calls. For a given call duration, the echolocation calls of these species are visually extremely similar in frequency and shape.

Looking at the visualisations below, there is perhaps an indication here that for a given call duration, the calls of *M. mystacinus* are more likely to have a lower end frequency than *M. brandtii*.

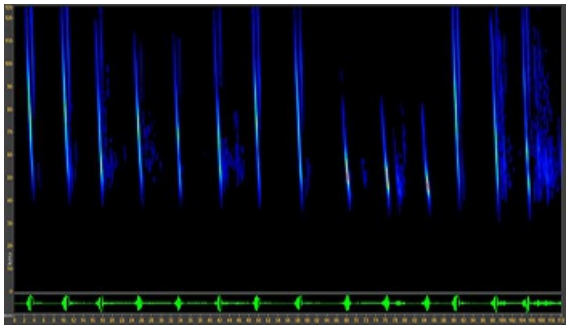
It is difficult to be sure that the recordings here are completely representative of *M. mystacinus* and *M. brandtii* to infer too much from this, but it was easy to find recordings of *M. mystacinus* of less 1.7 ms, but hard to find similar short duration calls of *M. brandtii*. This may suggest that *M. mystacinus* is more likely to produce shorter duration calls than *M. brandtii*. Conversely, it was easy to find long duration calls of greater than 5.0 ms of *M. brandtii* (up to 6.5 ms), but it was difficult to find calls of *M. mystacinus* of greater than 5.0 ms, perhaps suggesting that *M. brandtii* is more likely to produce long duration calls than *M. mystacinus*. Potentially supporting this, Lefevre & Van de Sijpe (in Russ, 2021) made a comment that under comparable conditions, the calls of *M. mystacinus* are higher with shorter calls than those of *M. brandtii*.



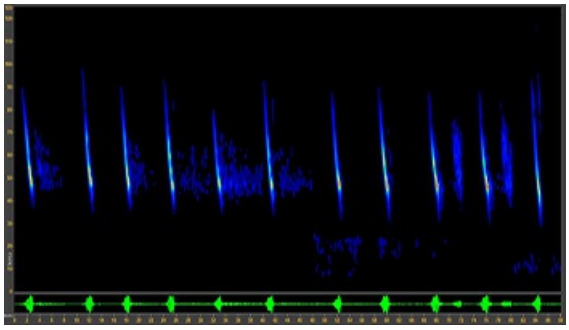
Whiskered Bat - call duration up to 1.3 ms



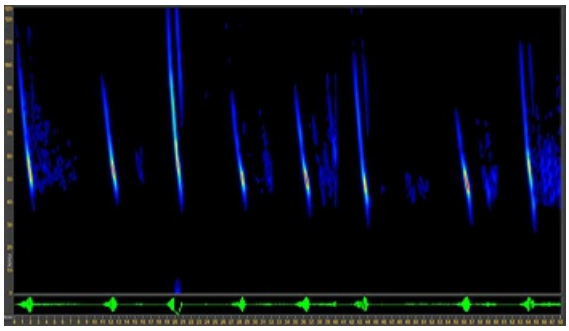
Brandt's Bat - call duration up to 1.3 ms



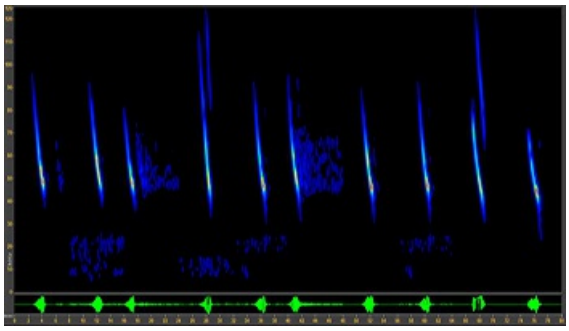
Whiskered Bat - call duration 1.4-1.5 ms



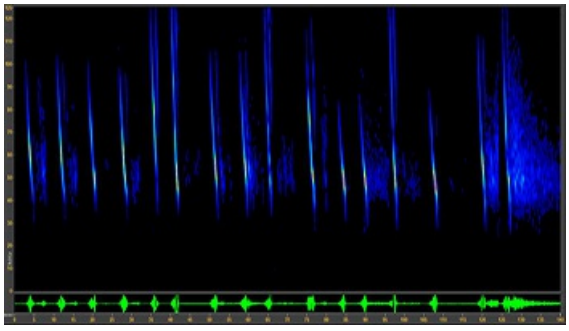
Brandt's Bat - call duration 1.4-1.5 ms



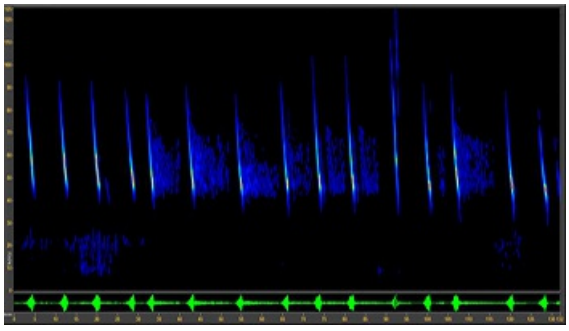
Whiskered Bat - call duration 1.6-1.7 ms



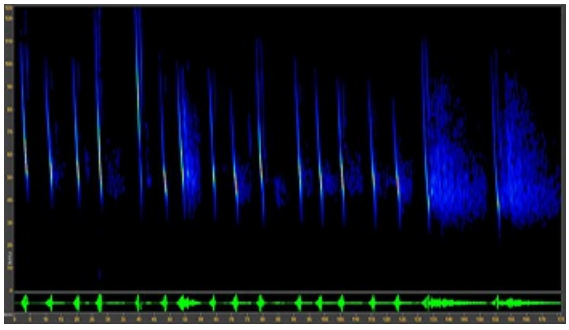
Brandt's Bat - call duration 1.6-1.7 ms



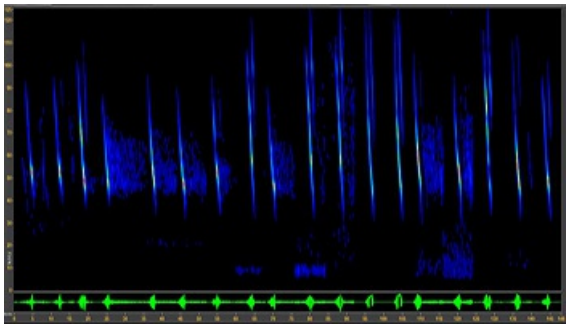
Whiskered Bat - call duration 1.8-1.9 ms



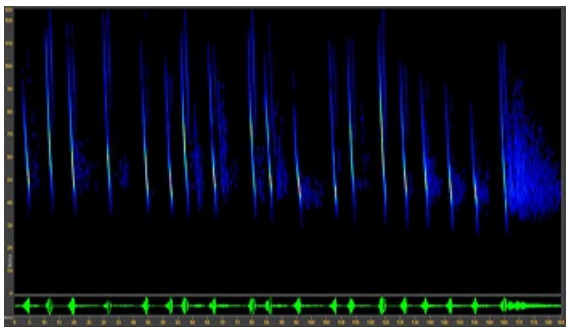
Brandt's Bat - call duration 1.8-1.9 ms



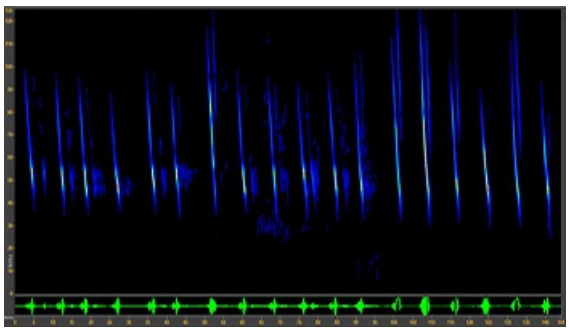
Whiskered Bat - call duration 2.0-2.1 ms



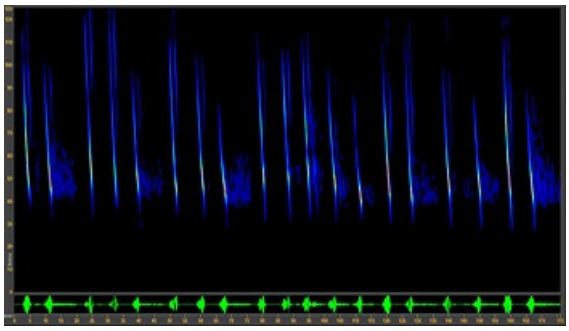
Brandt's Bat - call duration 2.0-2.1 ms



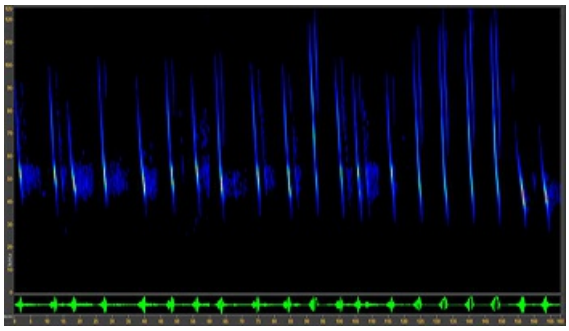
Whiskered Bat - call duration 2.2-2.3 ms



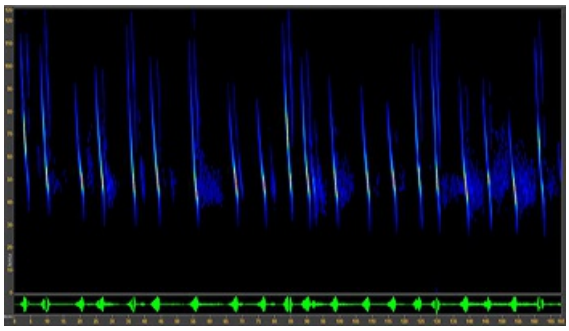
Brandt's Bat - call duration 2.2-2.3 ms



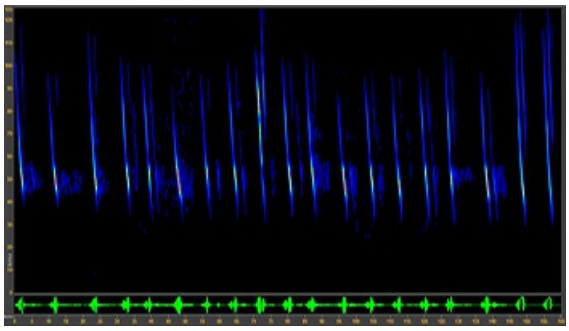
Whiskered Bat - call duration 2.4-2.5 ms



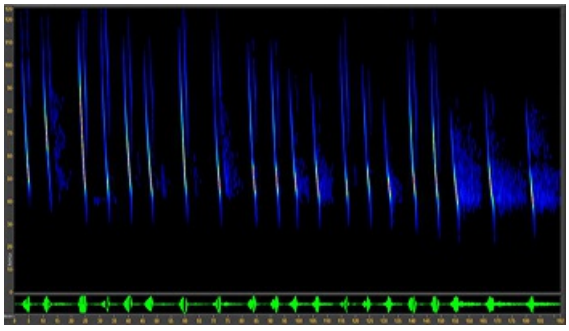
Brandt's Bat - call duration 2.4-2.5 ms



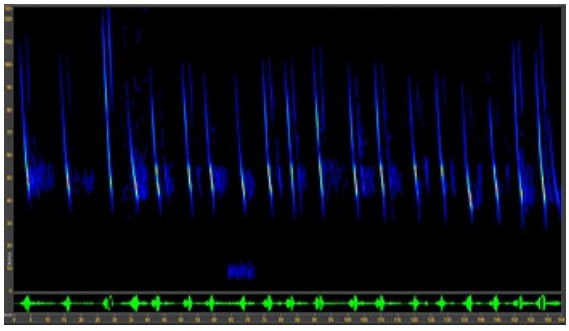
Whiskered Bat - call duration 2.6-2.7 ms



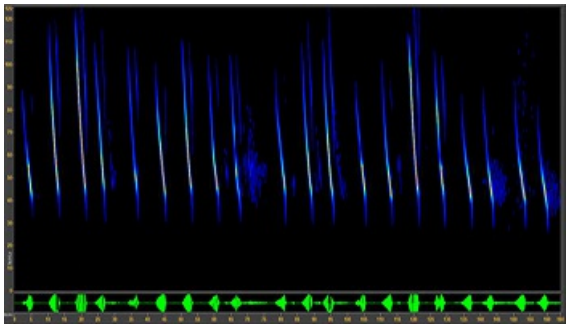
Brandt's Bat - call duration 2.6-2.7 ms



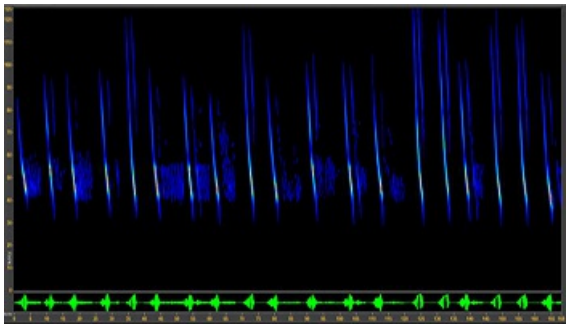
Whiskered Bat - call duration 2.8-2.9 ms



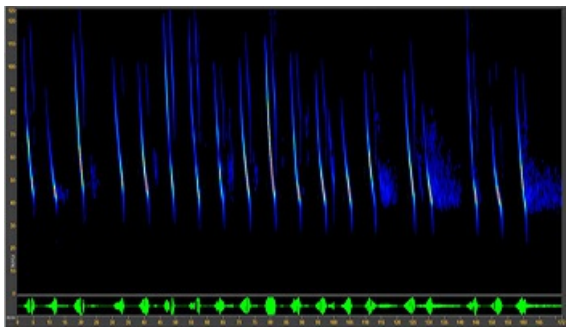
Brandt's Bat - call duration 2.8-2.9 ms



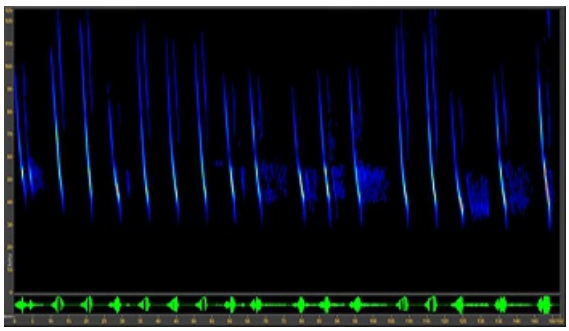
Whiskered Bat - call duration 3.0-3.1 ms



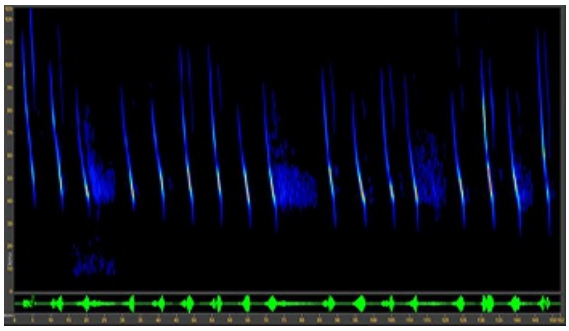
Brandt's Bat - call duration 3.0-3.1 ms



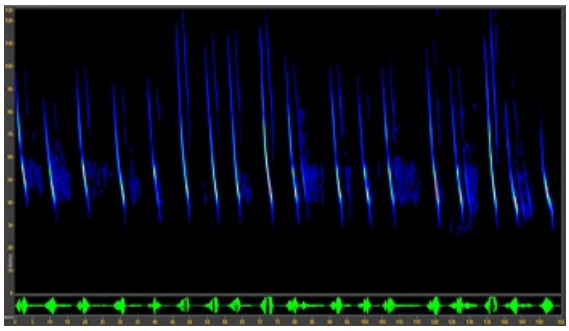
Whiskered Bat - call duration 3.2-3.3 ms



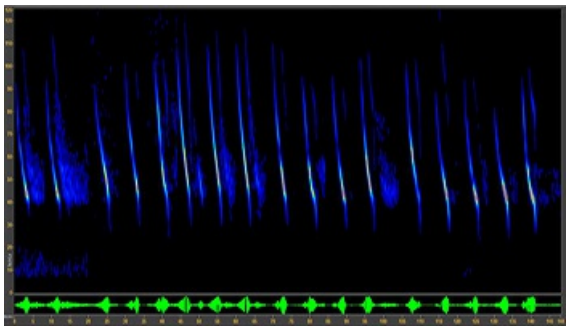
Brandt's Bat - call duration 3.2-3.3 ms



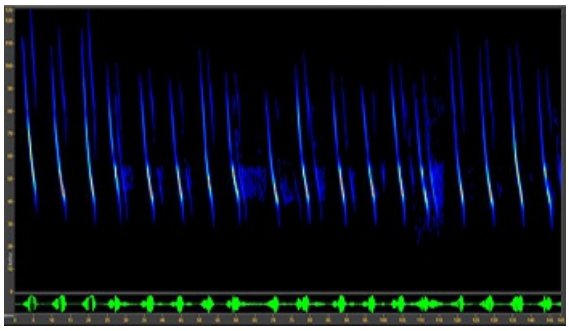
Whiskered Bat - call duration 3.4-3.5 ms



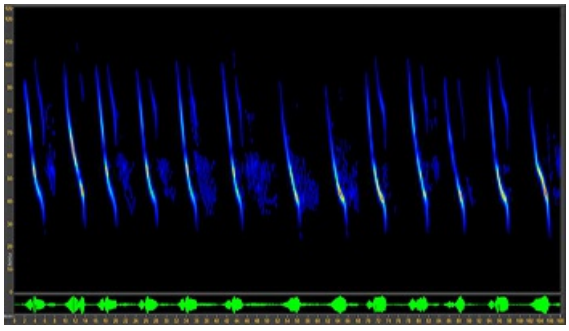
Brandt's Bat - call duration 3.4-3.5 ms



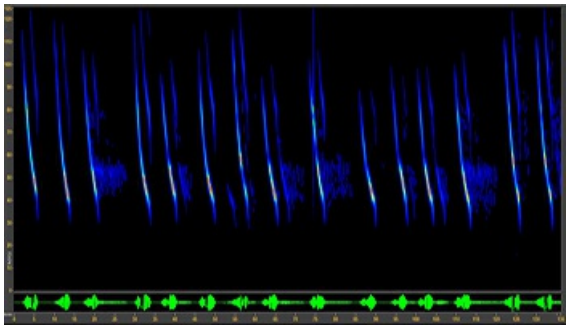
Whiskered Bat - call duration 3.6-3.7 ms



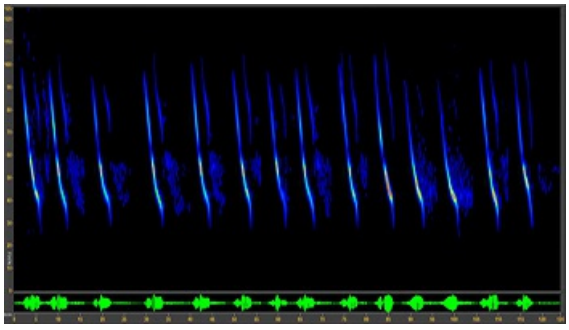
Brandt's Bat - call duration 3.6-3.7 ms



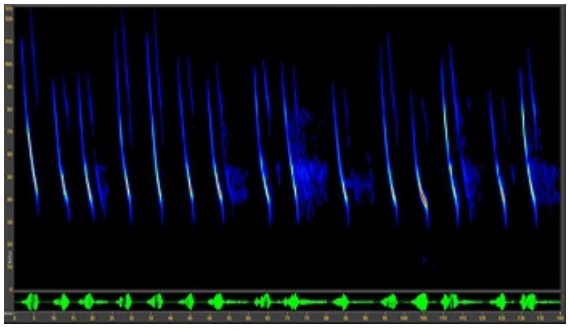
Whiskered Bat - call duration 3.8-3.9 ms



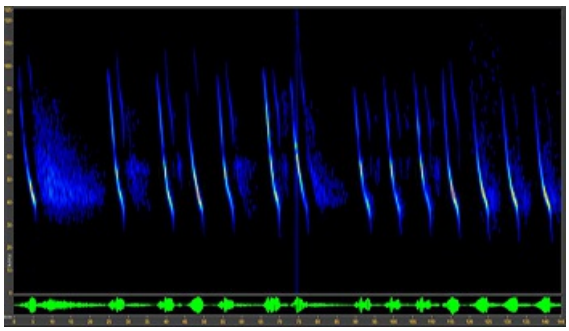
Brandt's Bat - call duration 3.8-3.9 ms



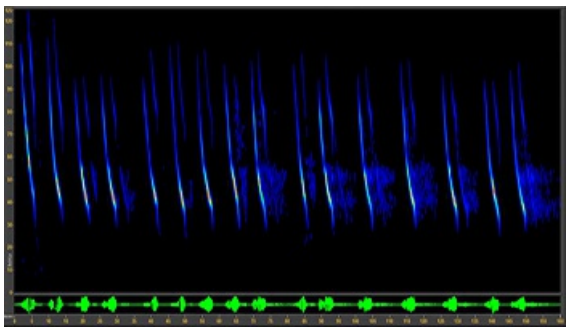
Whiskered Bat - call duration 4.0-4.1 ms



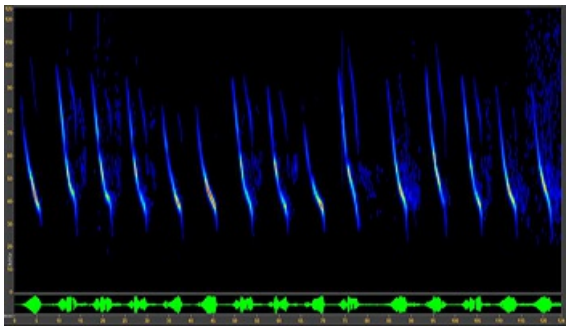
Brandt's Bat - call duration 4.0-4.1 ms



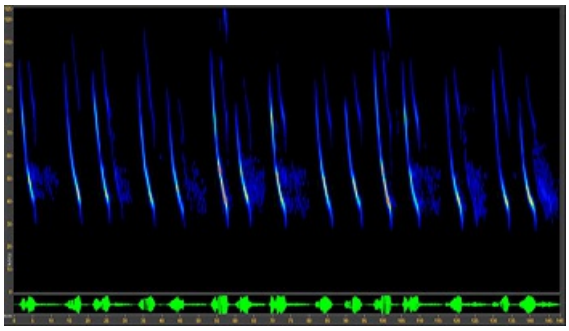
Whiskered Bat - call duration 4.2-4.3 ms



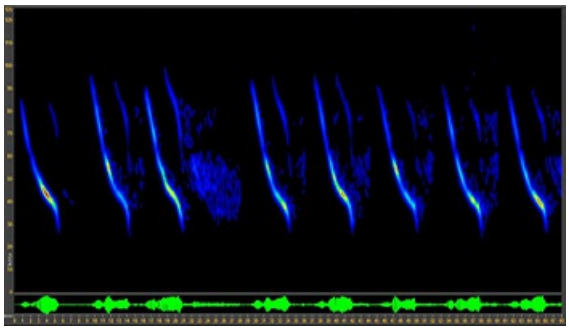
Brandt's Bat - call duration 4.2-4.3 ms



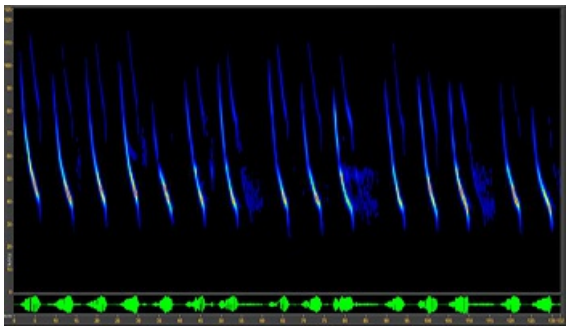
Whiskered Bat - call duration 4.4-4.5 ms



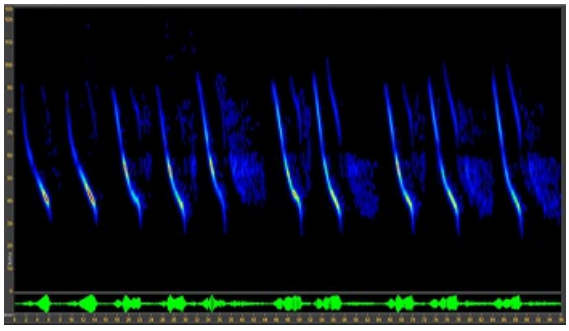
Brandt's Bat - call duration 4.4-4.5 ms



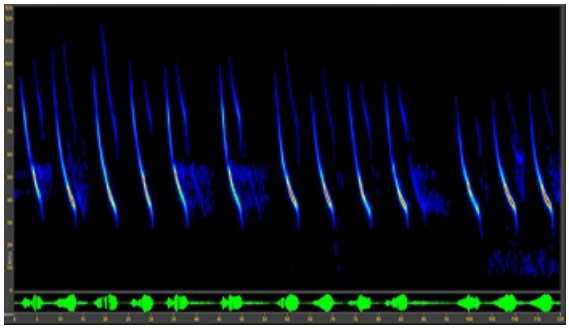
Whiskered Bat - call duration 4.6-4.7 ms



Brandt's Bat - call duration 4.6-4.7 ms

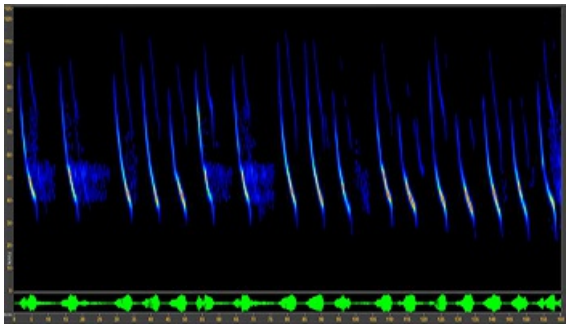


Whiskered Bat - call duration 4.8-5.1 ms



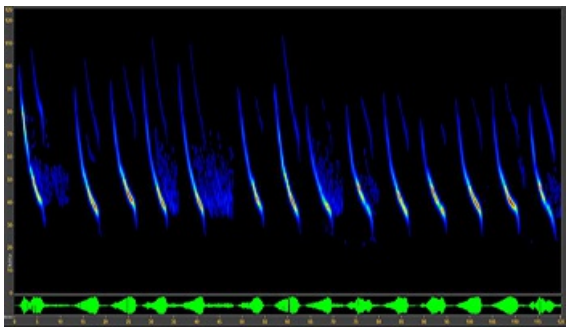
Brandt's Bat - call duration 4.8-5.1 ms

Whiskered Bat call duration 5.2-5.3 ms no examples



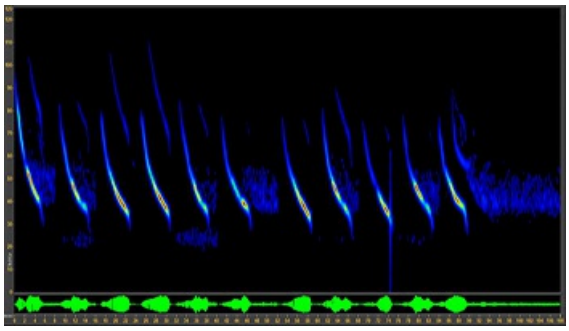
Brandt's Bat - call duration 5.2-5.3 ms

Whiskered Bat call duration 5.4-5.5 ms no examples

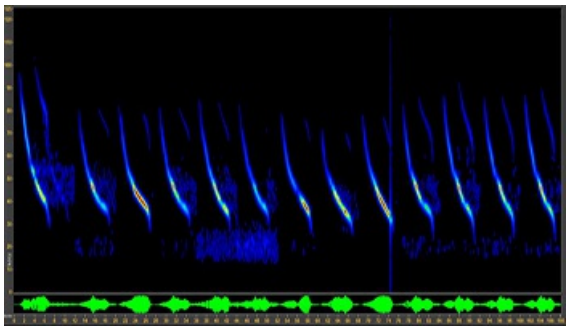


Brandt's Bat - call duration 5.4-5.5 ms

Whiskered Bat call duration 5.6-5.7 ms no examples

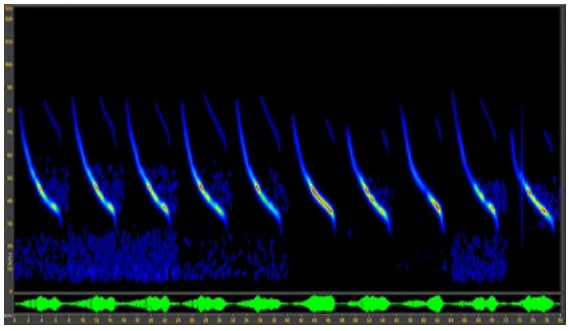


Brandt's Bat - call duration 5.6-5.7 ms



Whiskered Bat call duration 5.8-5.9 ms no examples

Brandt's Bat - call duration 5.8-5.9 ms

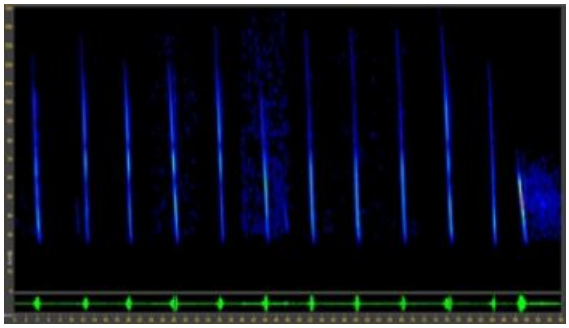


Whiskered Bat call duration 6.0-6.5 ms no examples

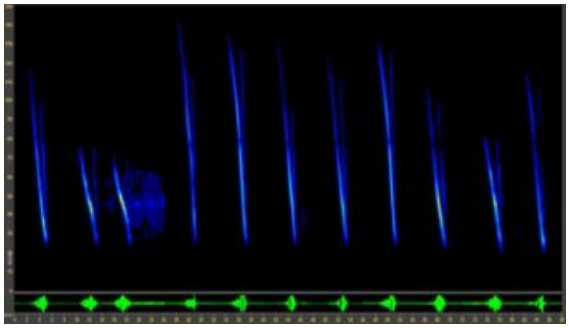
Brandt's Bat - call duration 6.0-6.5 ms

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

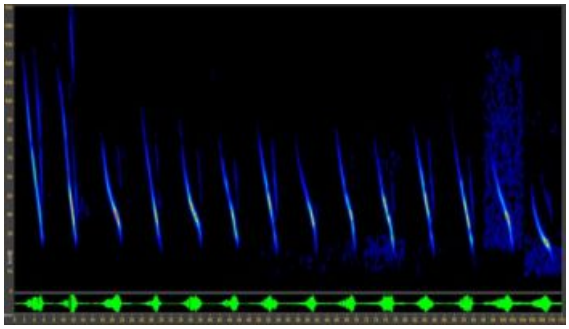
As with Whiskered and Brandt's Bat, the first consideration when looking at recordings is the quality of the recording, to consider whether the quality is good enough to try to assign the recording to species. Given a good recording, Natterer's Bat can occasionally produce atypical calls that could be mistaken for other *Myotis* species, however, such unusual calls rarely continue for long. Where neighbouring recordings are present, these can provide context to understand what is going on. By carefully considering the atypical calls in a recording in relation to the calls in neighbouring recordings, it should be possible to assign most of these still to species with confidence. 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 (a very closed habitat or environment) to long duration calls produced when flying in the open.



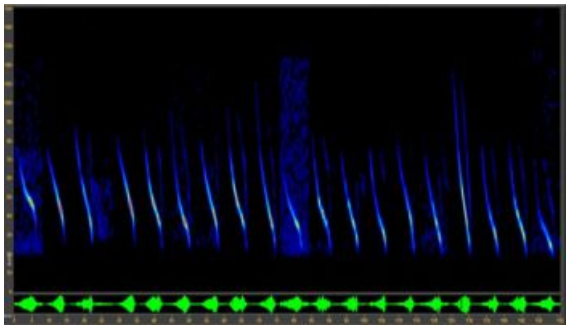
Natterer's Bat - call duration up to 1.2 ms



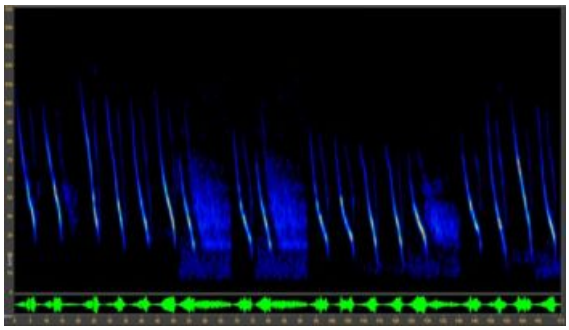
Natterer's Bat - call duration 2.7-2.8 ms



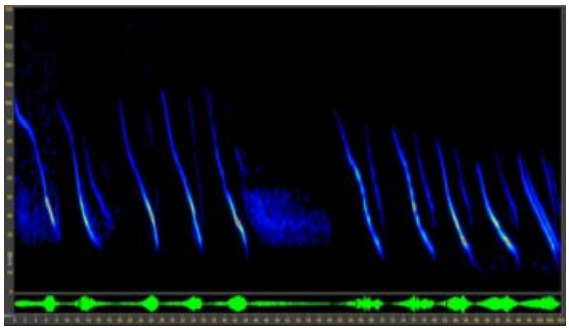
Natterer's Bat - call duration 3.9-4.0 ms



Natterer's Bat - call duration 4.9-5.0 ms

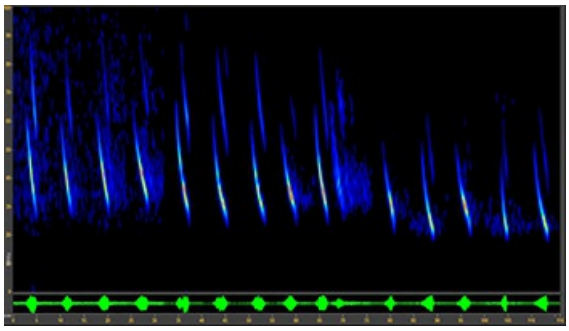


Natterer's Bat - call duration 5.9-6.0 ms

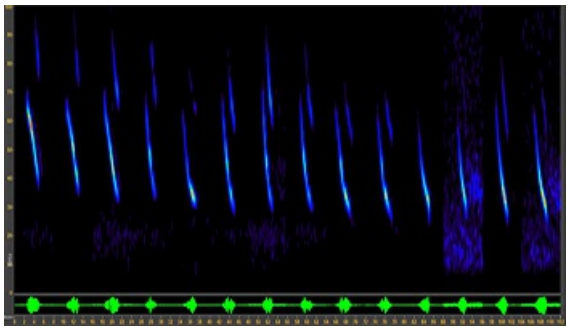


Natterer's Bat - call duration 7.1-9.4 ms

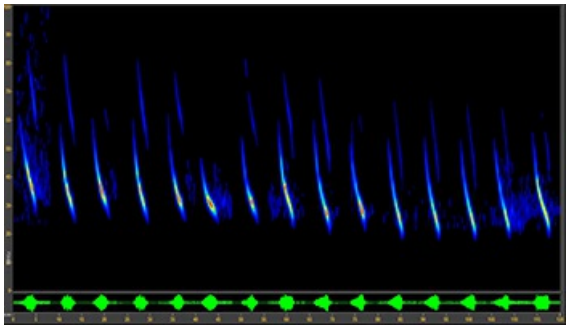
Identification appendix 4: Common Noctule *Nyctalus noctula* and Leisler's Bat *Nyctalus leisleri*



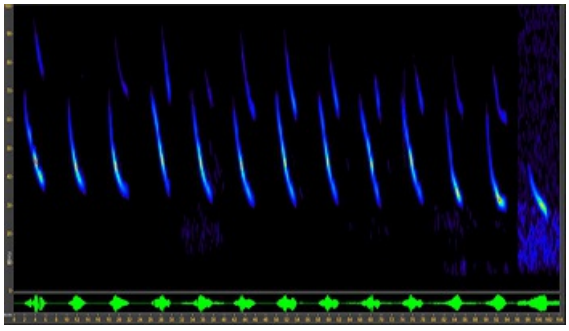
Common Noctule - call duration 1.4-3.0 ms



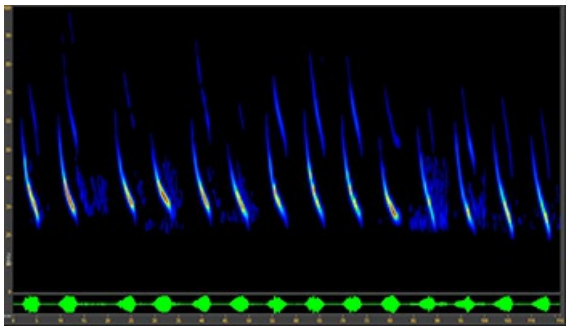
Leisler's Bat - call duration 1.4-3.0 ms



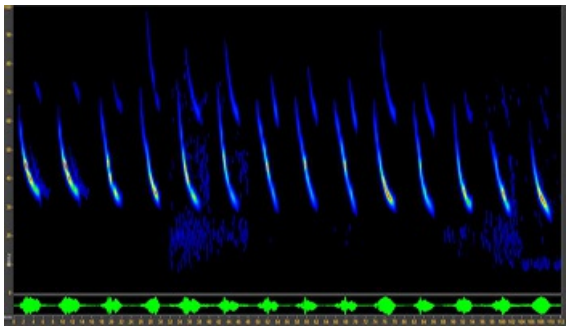
Common Noctule - call duration 3.1-3.7 ms



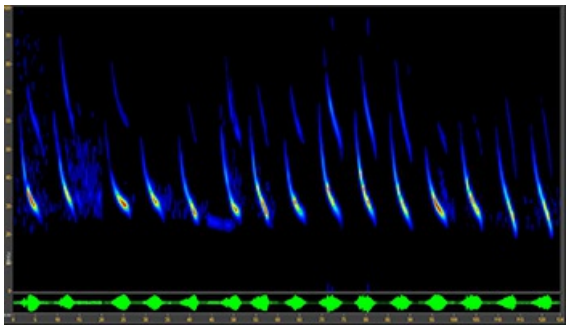
Leisler's Bat - call duration 3.1-3.7 ms



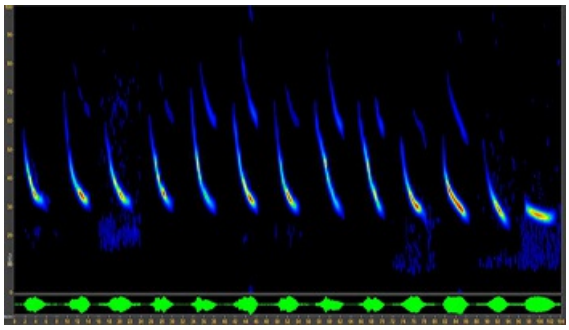
Common Noctule - call duration 3.8-4.3 ms



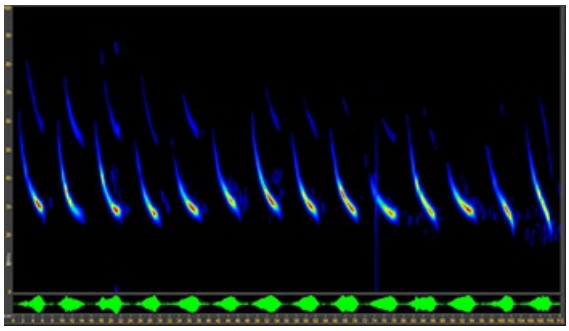
Leisler's Bat - call duration 3.8-4.3 ms



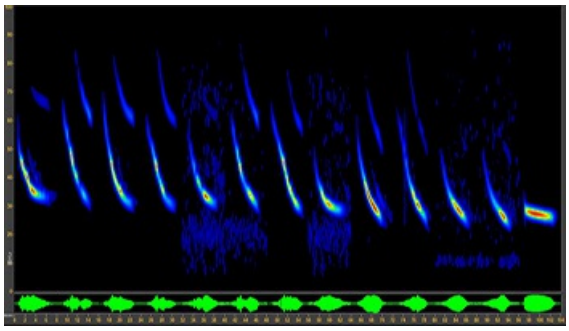
Common Noctule - call duration 4.4-4.9 ms



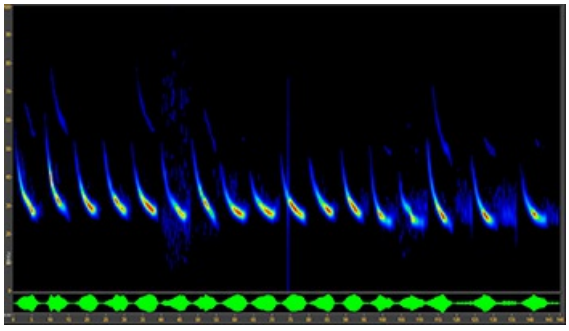
Leisler's Bat - call duration 4.4-4.9 ms



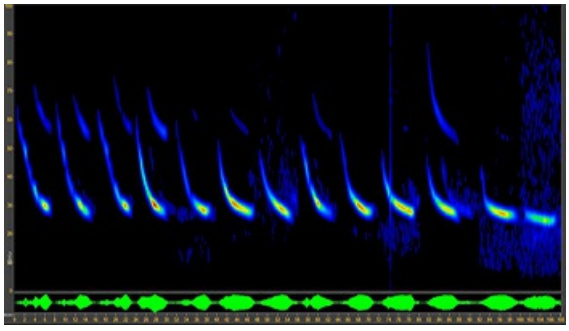
Common Noctule - call duration 5.0-5.9 ms



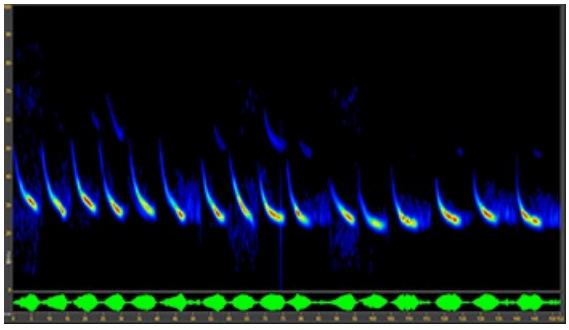
Leisler's Bat - call duration 5.0-5.9 ms



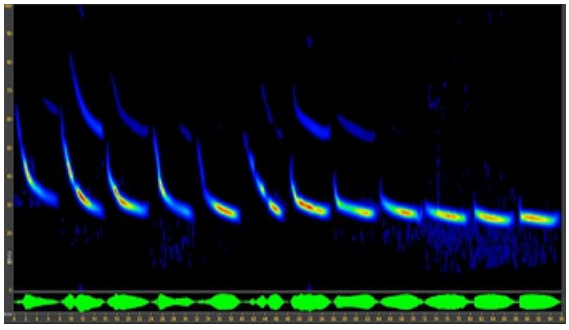
Common Noctule - call duration 6.0-6.8 ms



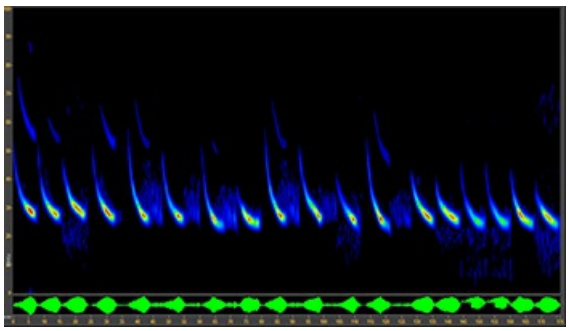
Leisler's Bat - call duration 6.0-6.8 ms



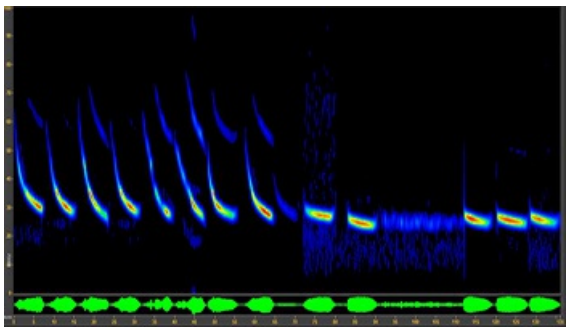
Common Noctule - call duration 6.9-7.2 ms



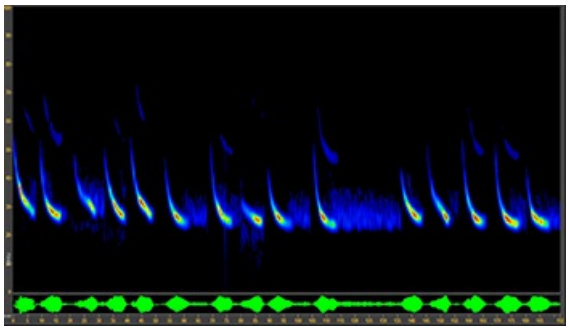
Leisler's Bat - call duration 6.9-7.2 ms



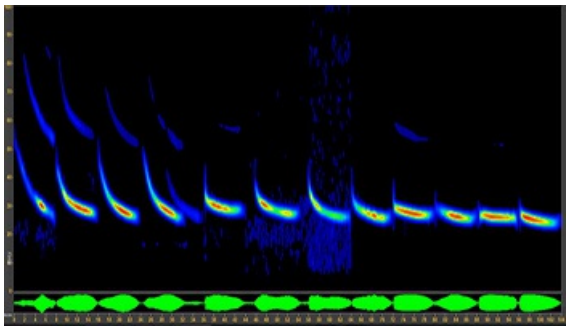
Common Noctule - call duration 7.3-7.6 ms



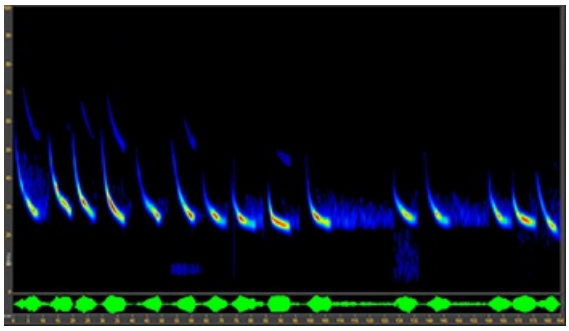
Leisler's Bat - call duration 7.3-7.6 ms



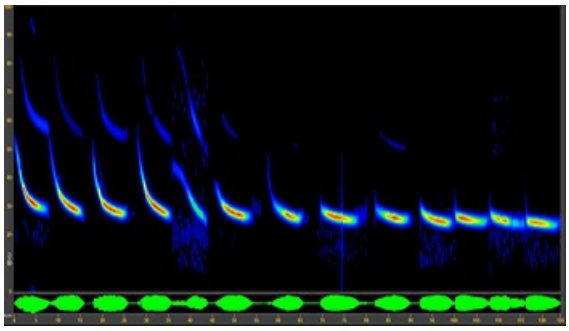
Common Noctule - call duration 7.7-7.8 ms



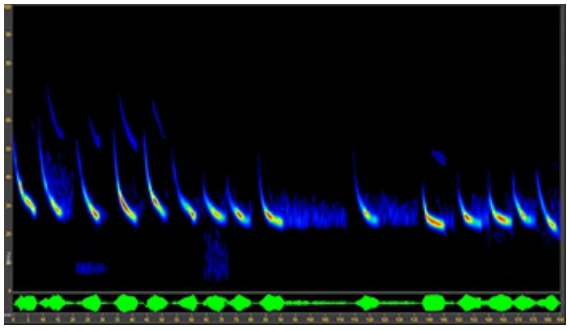
Leisler's Bat - call duration 7.7-7.8 ms



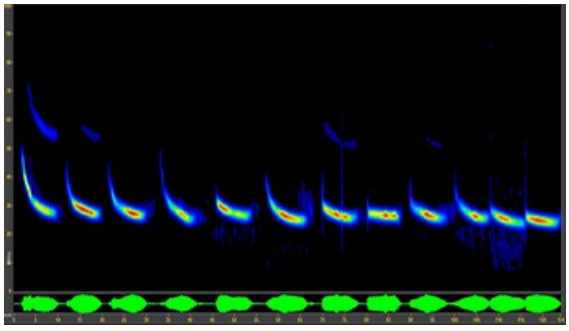
Common Noctule - call duration 7.9-8.0 ms



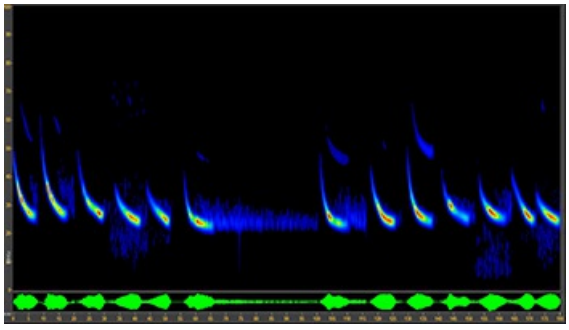
Leisler's Bat - call duration 7.9-8.0 ms



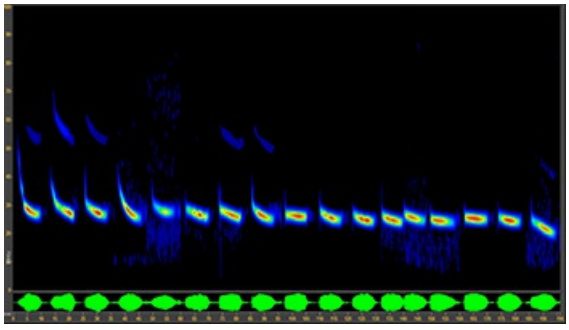
Common Noctule - call duration 8.1-8.3 ms



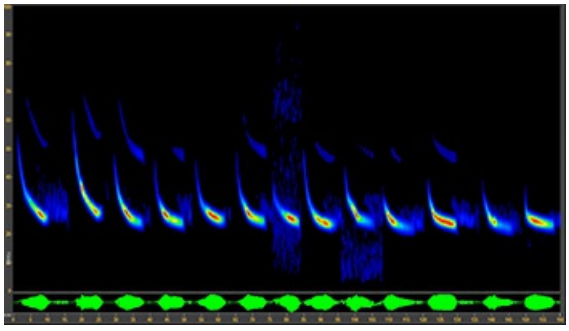
Leisler's Bat - call duration 8.1-8.3 ms



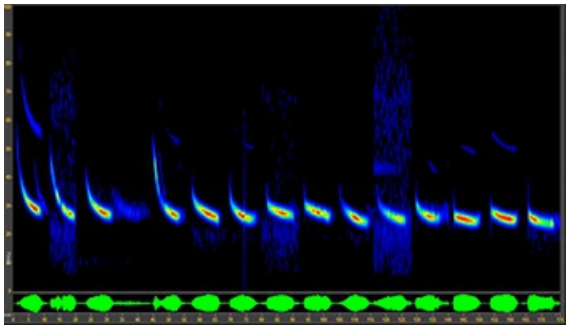
Common Noctule - call duration 8.4-8.5 ms



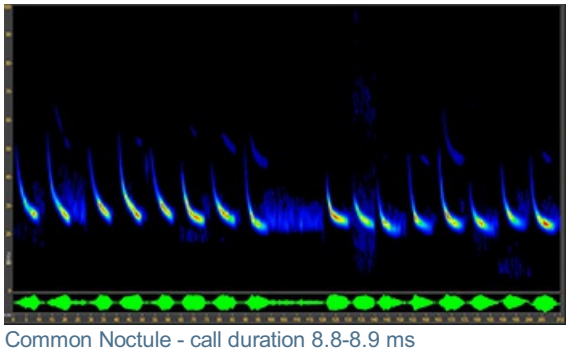
Leisler's Bat - call duration 8.4-8.5 ms



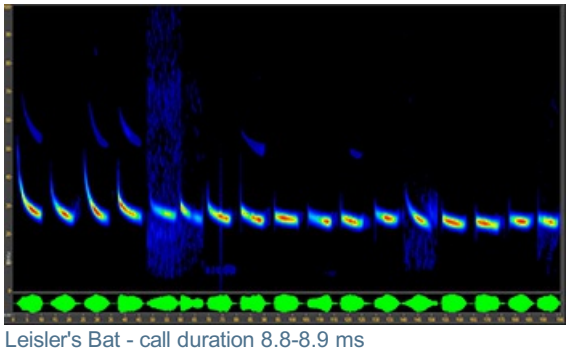
Common Noctule - call duration 8.6-8.7 ms



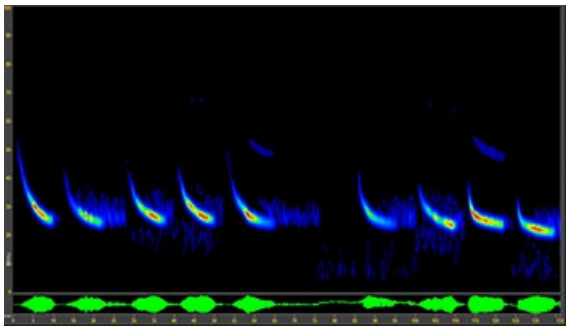
Leisler's Bat - call duration 8.6-8.7 ms



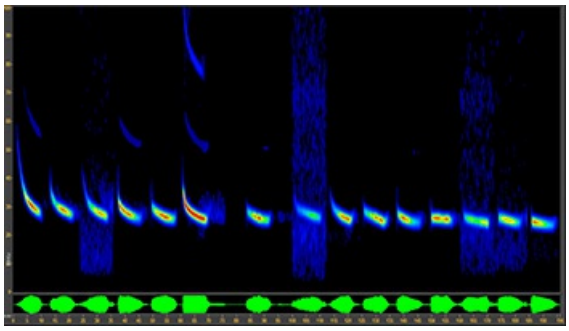
Common Noctule - call duration 8.8-8.9 ms



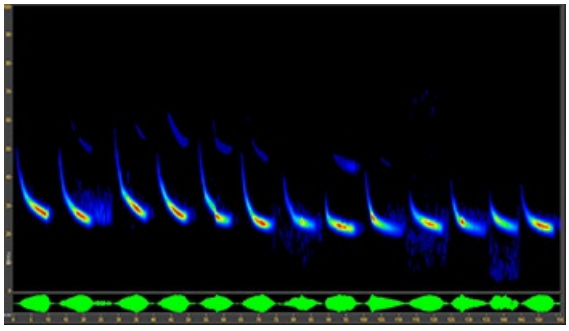
Leisler's Bat - call duration 8.8-8.9 ms



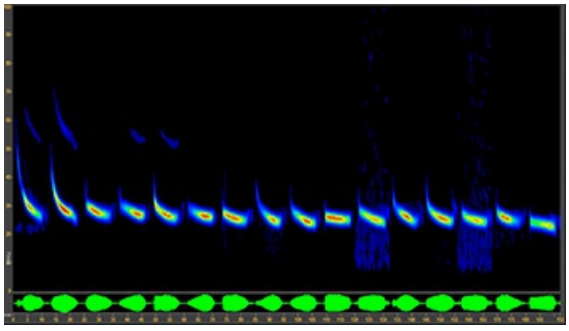
Common Noctule - call duration 9.0-9.1 ms



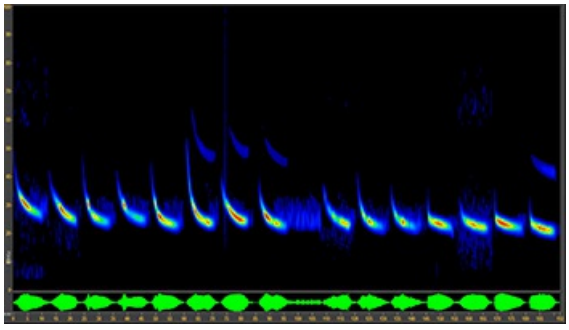
Leisler's Bat - call duration 9.0-9.1 ms



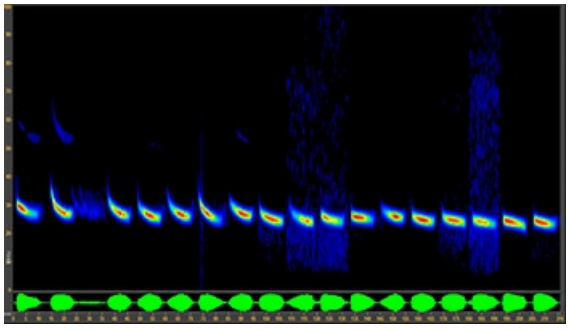
Common Noctule - call duration 9.2-9.3 ms



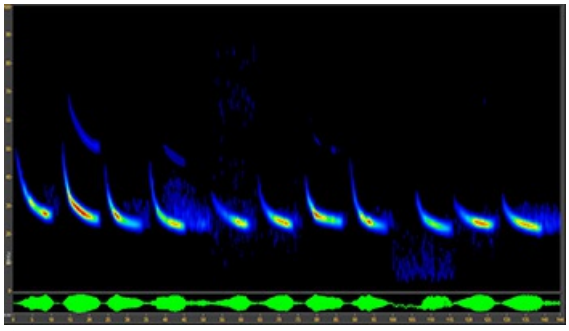
Leisler's Bat - call duration 9.2-9.3 ms



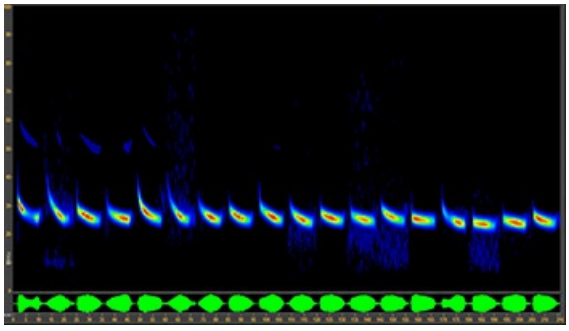
Common Noctule - call duration 9.4-9.5 ms



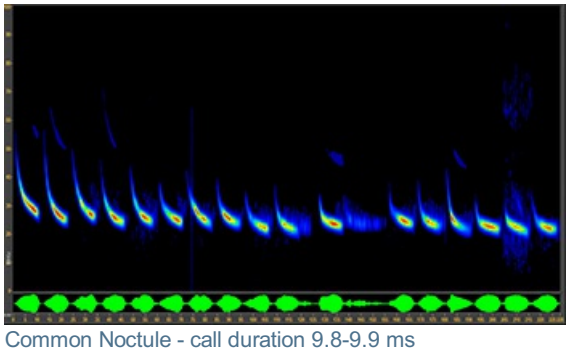
Leisler's Bat - call duration 9.4-9.5 ms



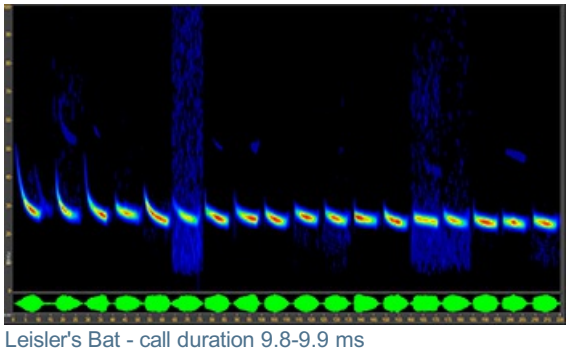
Common Noctule - call duration 9.6-9.7 ms



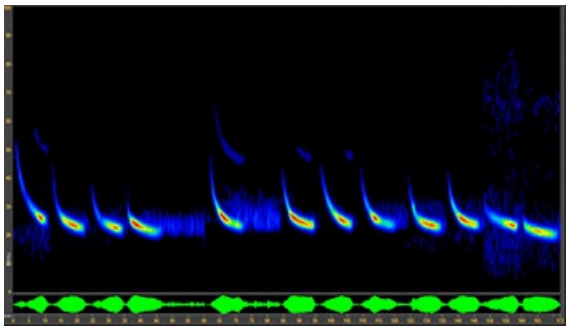
Leisler's Bat - call duration 9.6-9.7 ms



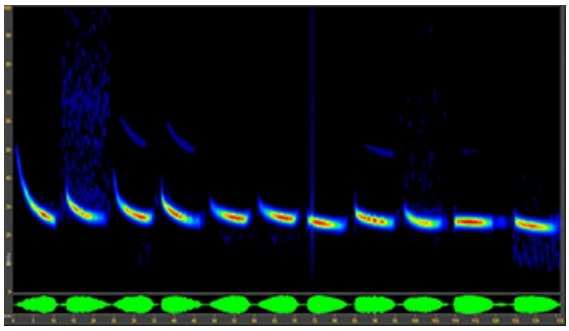
Common Noctule - call duration 9.8-9.9 ms



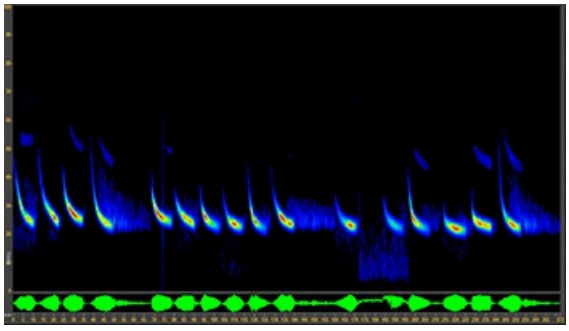
Leisler's Bat - call duration 9.8-9.9 ms



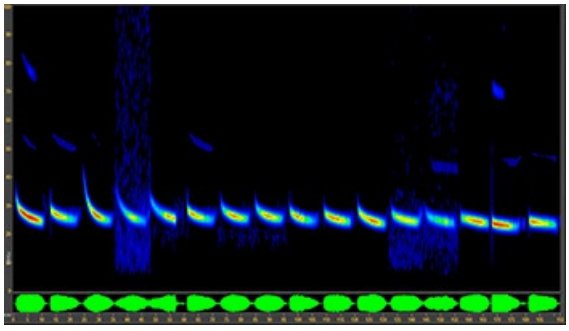
Common Noctule - call duration 10.0-10.1 ms



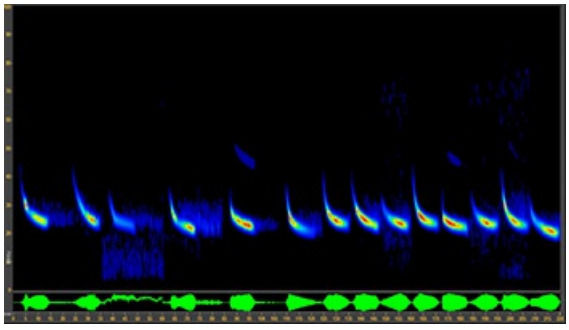
Leisler's Bat - call duration 10.0-10.1 ms



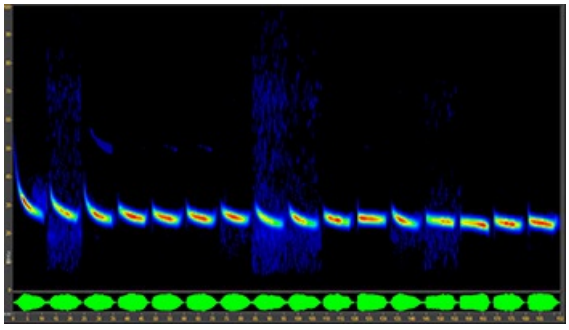
Common Noctule - call duration 10.2-10.3 ms



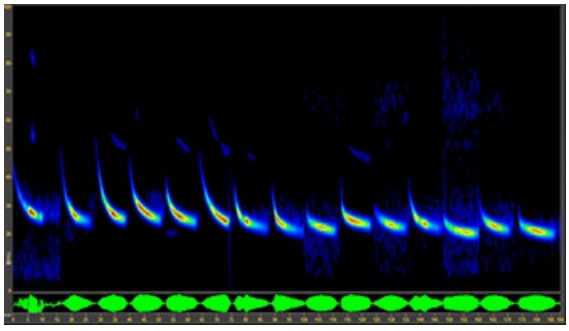
Leisler's Bat - call duration 10.2-10.3 ms



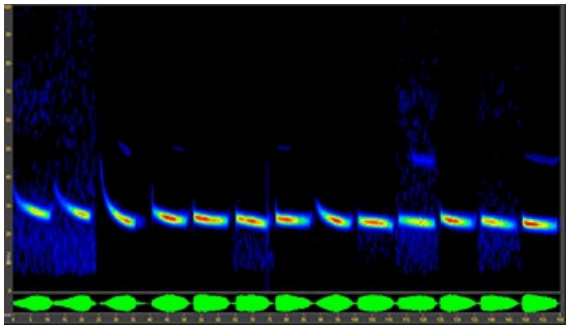
Common Noctule - call duration 10.4-10.5 ms



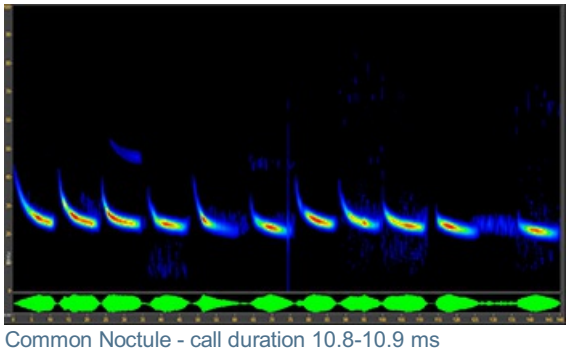
Leisler's Bat - call duration 10.4-10.5 ms



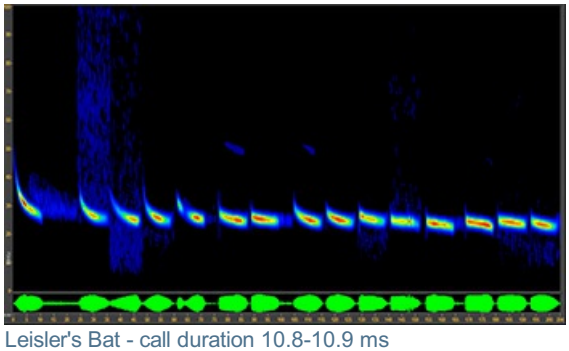
Common Noctule - call duration 10.6-10.7 ms



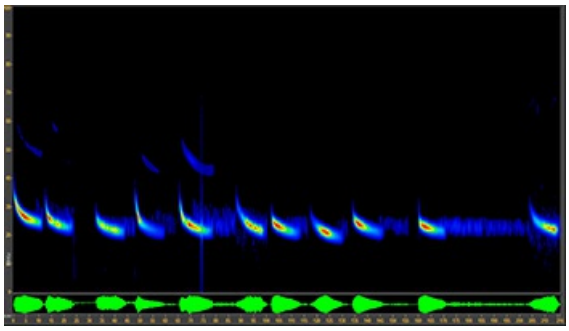
Leisler's Bat - call duration 10.6-10.7 ms



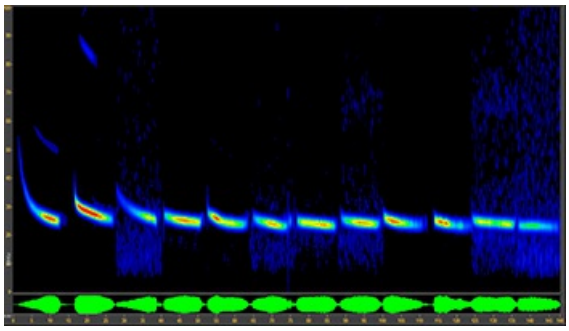
Common Noctule - call duration 10.8-10.9 ms



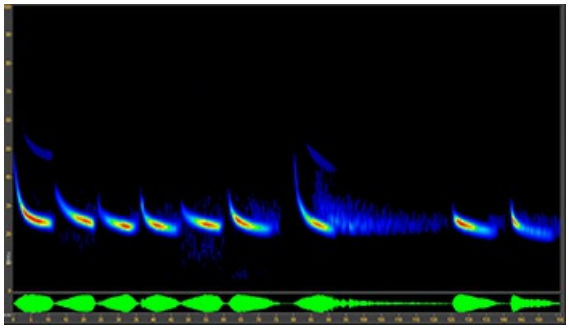
Leisler's Bat - call duration 10.8-10.9 ms



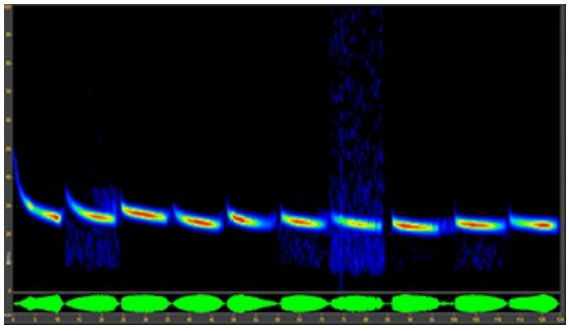
Common Noctule - call duration 11.0-11.1 ms



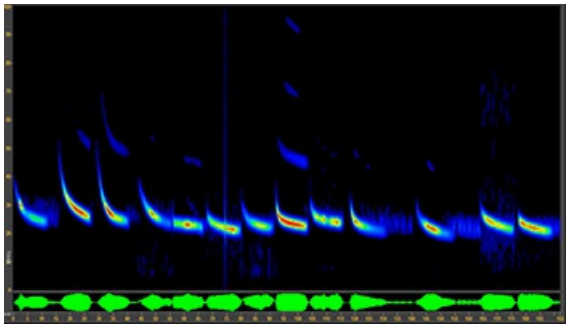
Leisler's Bat - call duration 11.0-11.1 ms



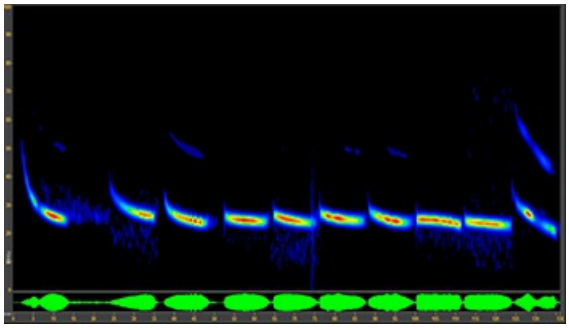
Common Noctule - call duration 11.2-11.3 ms



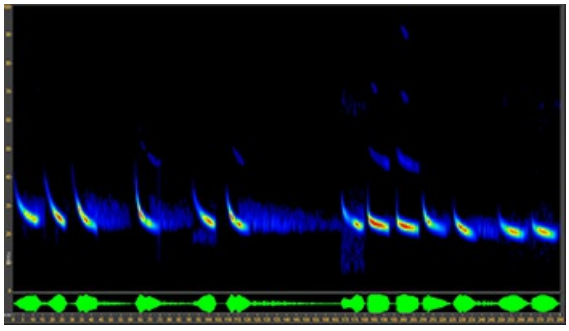
Leisler's Bat - call duration 11.2-11.3 ms



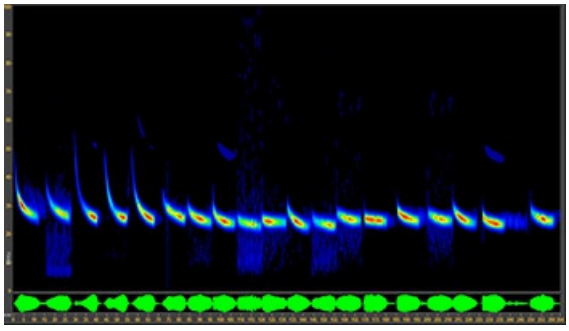
Common Noctule - call duration 11.4-11.5 ms



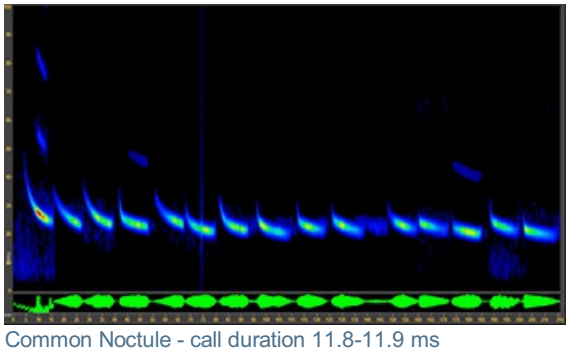
Leisler's Bat - call duration 11.4-11.5 ms



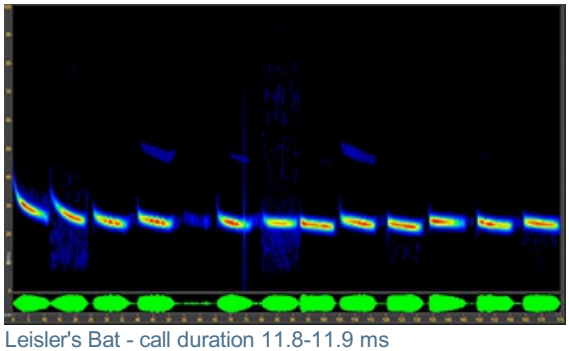
Common Noctule - call duration 11.6-11.7 ms



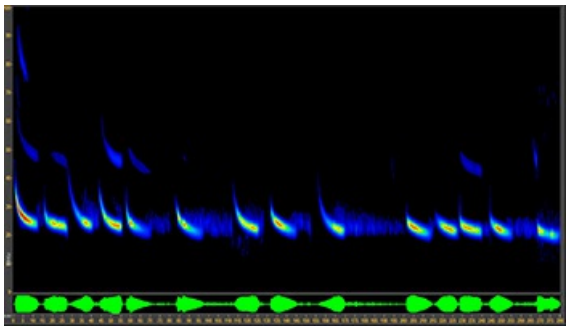
Leisler's Bat - call duration 11.6-11.7 ms



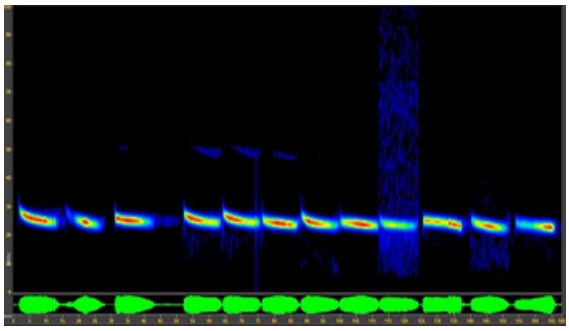
Common Noctule - call duration 11.8-11.9 ms



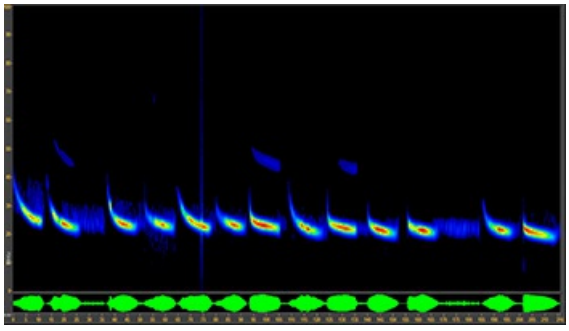
Leisler's Bat - call duration 11.8-11.9 ms



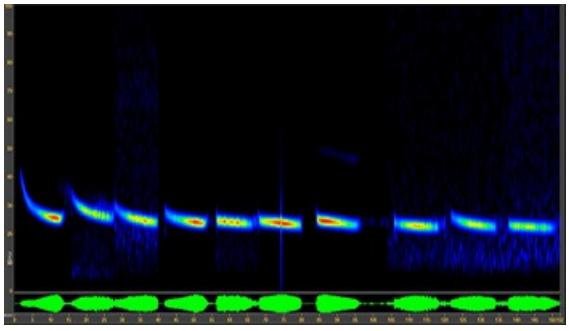
Common Noctule - call duration 12.0-12.2 ms



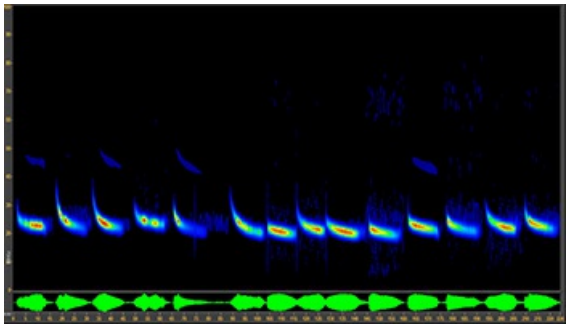
Leisler's Bat - call duration 12.0-12.2 ms



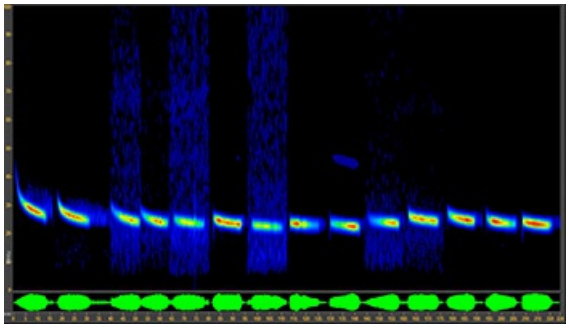
Common Noctule - call duration 12.3-12.4 ms



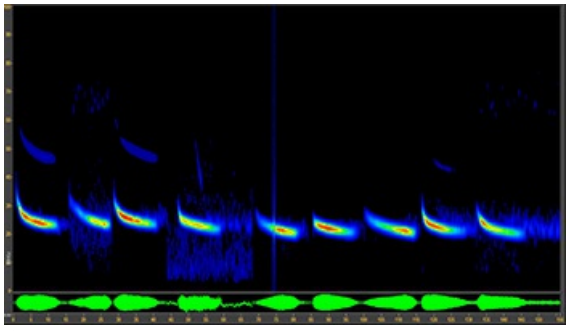
Leisler's Bat - call duration 12.3-12.4 ms



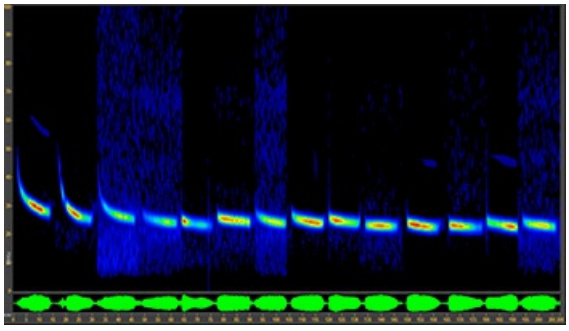
Common Noctule - call duration 12.5-12.7 ms



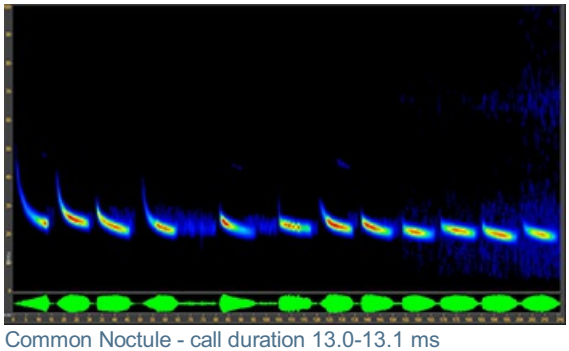
Leisler's Bat - call duration 12.5-12.7 ms



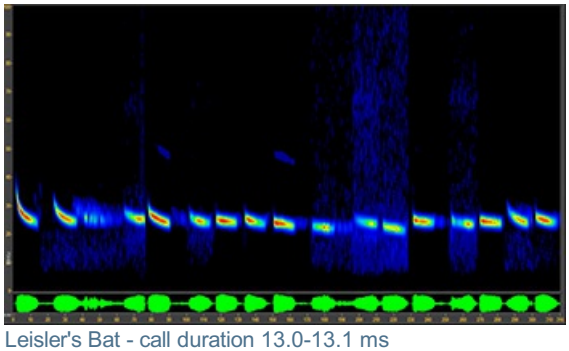
Common Noctule - call duration 12.8-12.9 ms



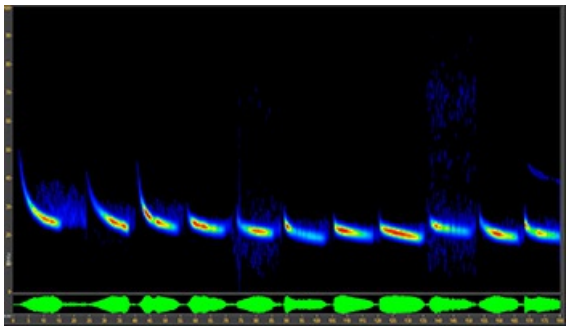
Leisler's Bat - call duration 12.8-12.9 ms



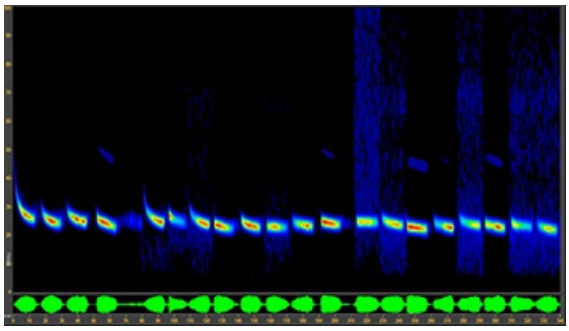
Common Noctule - call duration 13.0-13.1 ms



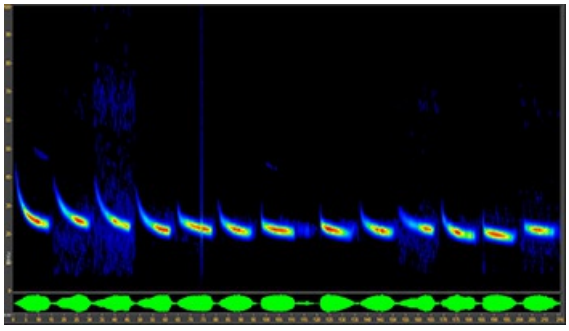
Leisler's Bat - call duration 13.0-13.1 ms



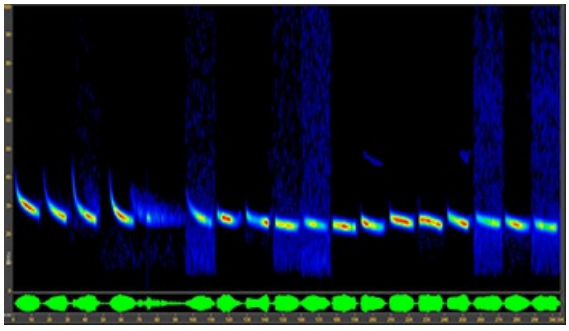
Common Noctule - call duration 13.2-13.3 ms



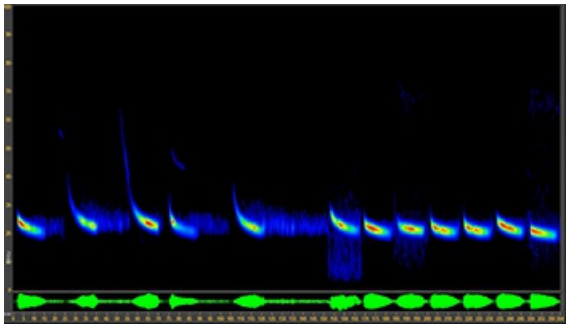
Leisler's Bat - call duration 13.2-13.3 ms



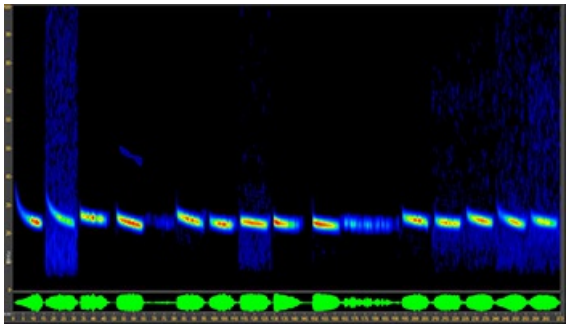
Common Noctule - call duration 13.4-13.5 ms



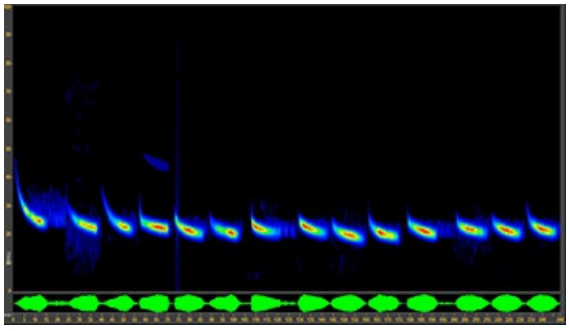
Leisler's Bat - call duration 13.4-13.5 ms



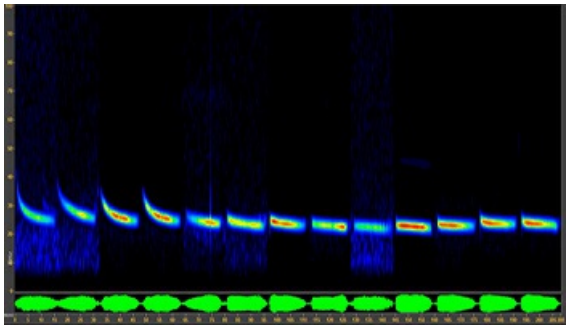
Common Noctule - call duration 13.6-13.7 ms



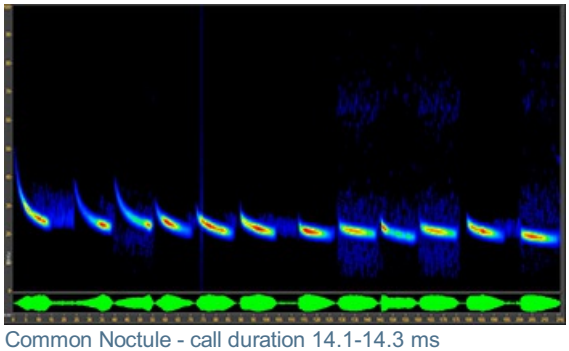
Leisler's Bat - call duration 13.6-13.7 ms



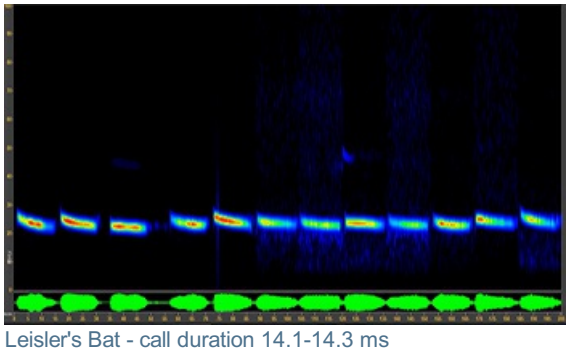
Common Noctule - call duration 13.8-14.0 ms



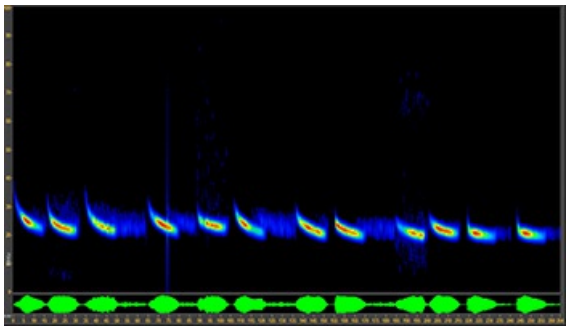
Leisler's Bat - call duration 13.8-14.0 ms



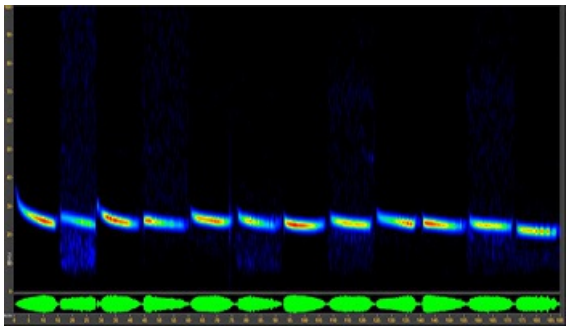
Common Noctule - call duration 14.1-14.3 ms



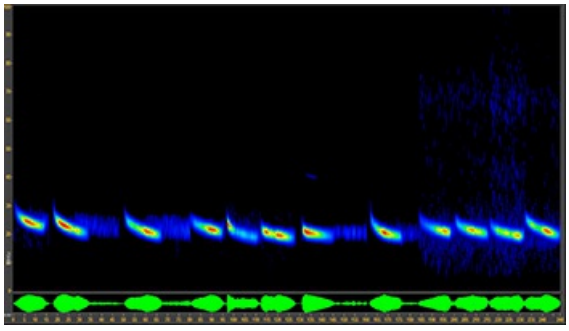
Leisler's Bat - call duration 14.1-14.3 ms



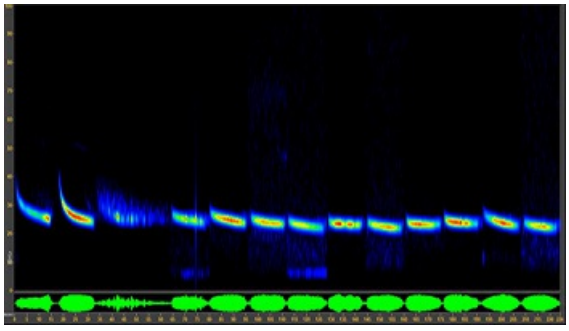
Common Noctule - call duration 14.4-14.5 ms



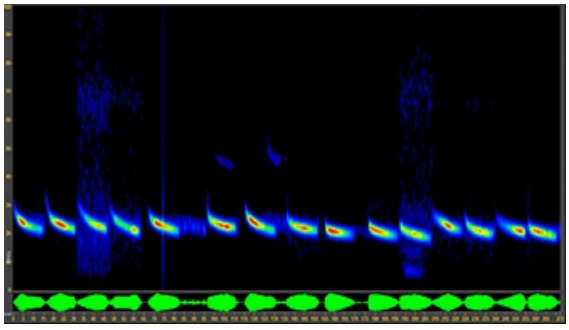
Leisler's Bat - call duration 14.4-14.5 ms



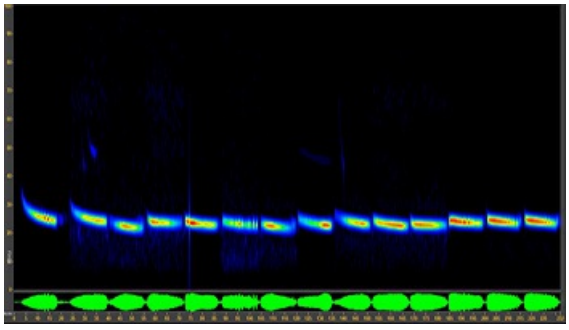
Common Noctule - call duration 14.6-14.8 ms



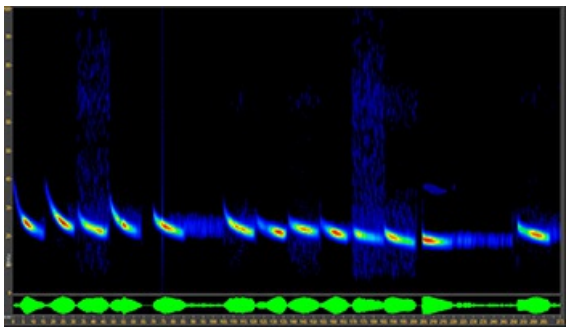
Leisler's Bat - call duration 14.6-14.8 ms



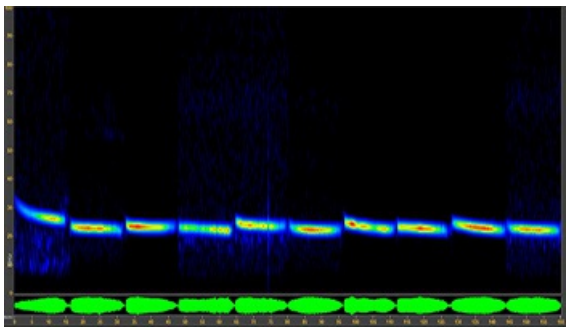
Common Noctule - call duration 14.9-15.1 ms



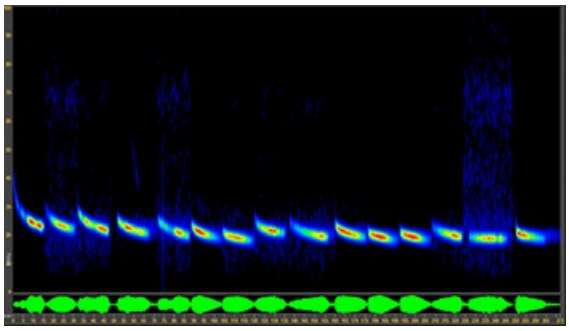
Leisler's Bat - call duration 14.9-15.1 ms



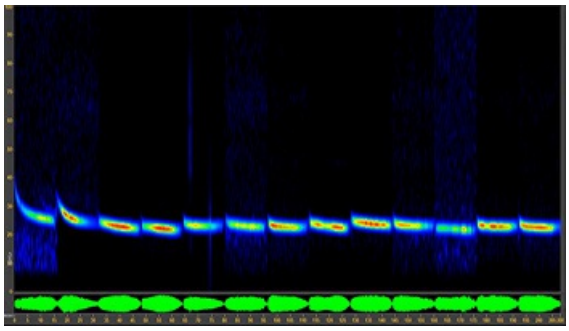
Common Noctule - call duration 15.2-15.3 ms



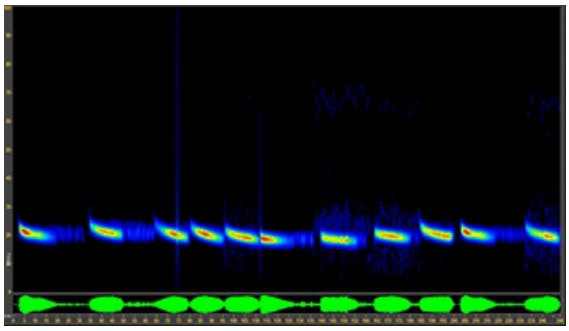
Leisler's Bat - call duration 15.2-15.3 ms



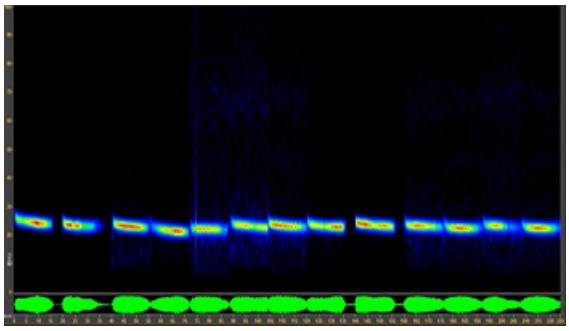
Common Noctule - call duration 15.4-15.7 ms



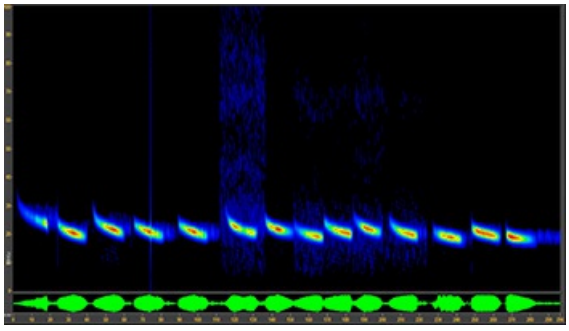
Leisler's Bat - call duration 15.4-15.7 ms



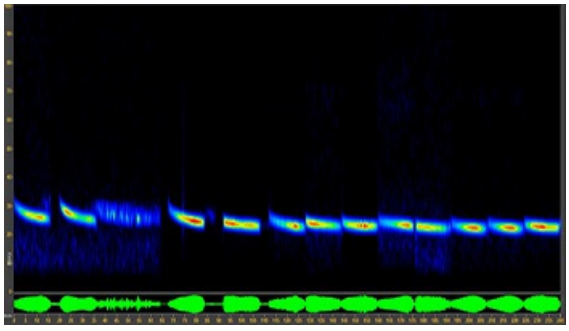
Common Noctule - call duration 15.8-16.0 ms



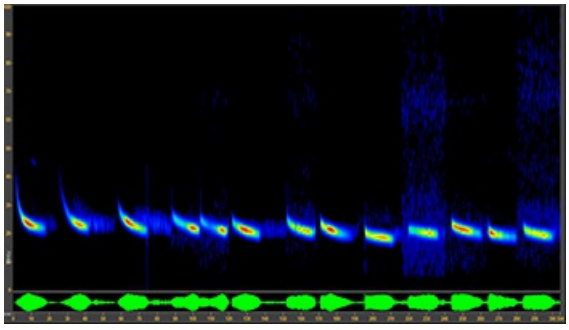
Leisler's Bat - call duration 15.8-16.0 ms



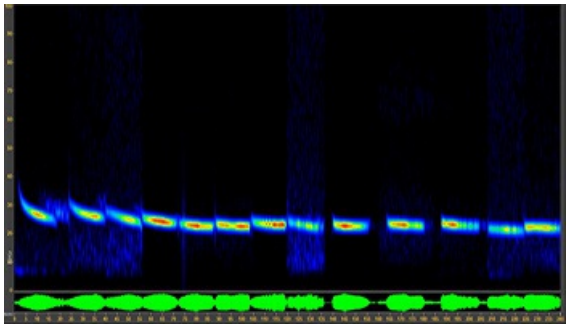
Common Noctule - call duration 16.1-16.3 ms



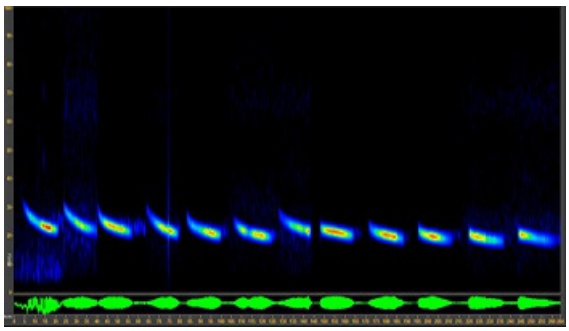
Leisler's Bat - call duration 16.1-16.3 ms



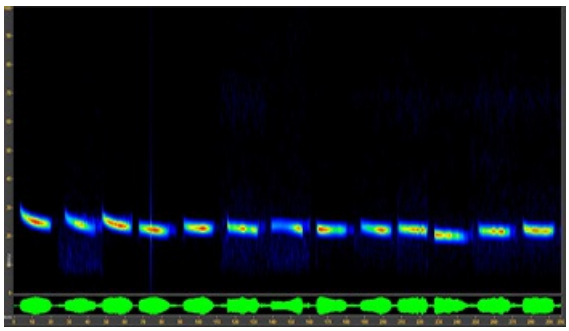
Common Noctule - call duration 16.4-16.6 ms



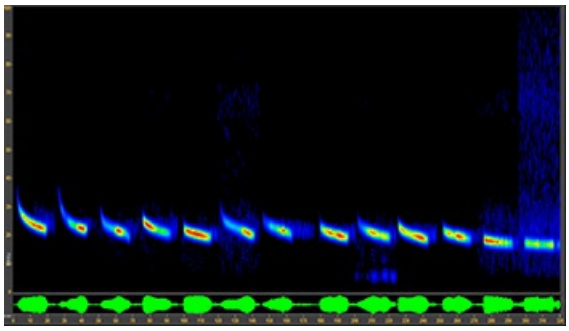
Leisler's Bat - call duration 16.4-16.6 ms



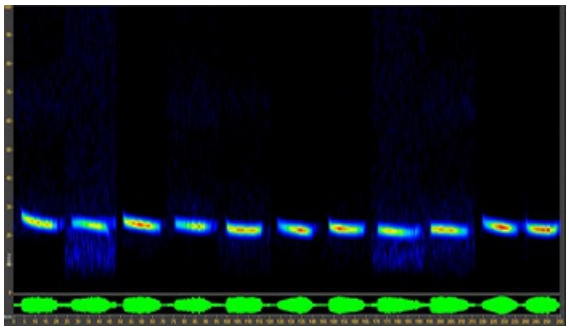
Common Noctule - call duration 16.7-17.0 ms



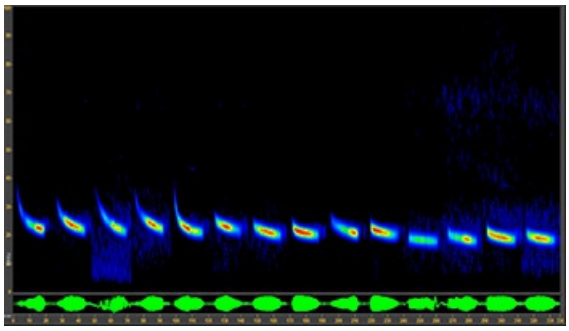
Leisler's Bat - call duration 16.7-17.0 ms



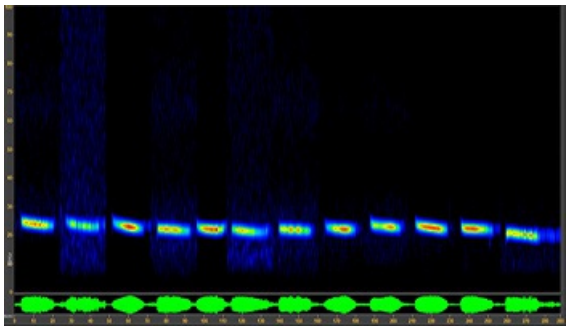
Common Noctule - call duration 17.1-17.2 ms



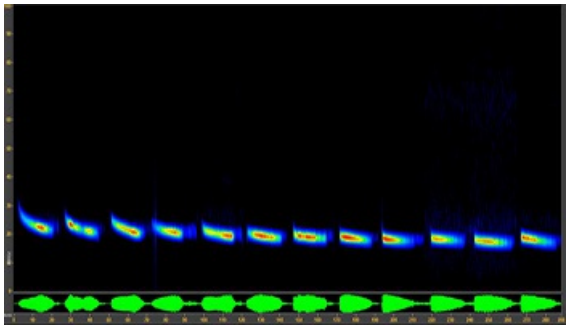
Leisler's Bat - call duration 17.1-17.2 ms



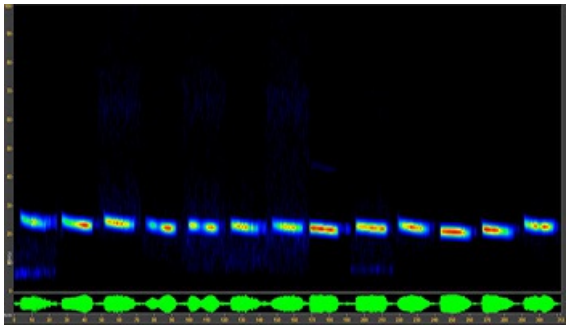
Common Noctule - call duration 17.3-17.4 ms



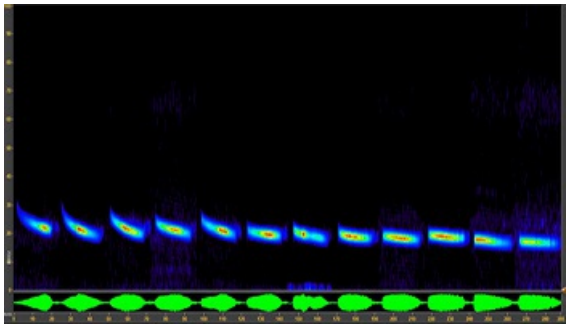
Leisler's Bat - call duration 17.3-17.4 ms



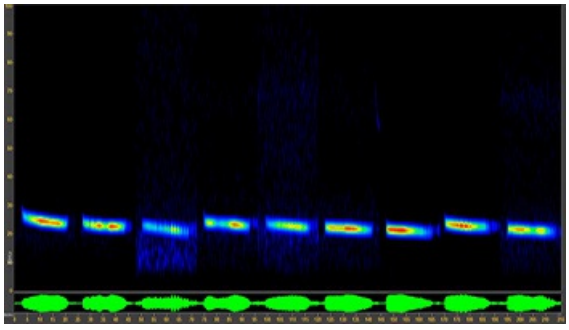
Common Noctule - call duration 17.5-18.2 ms



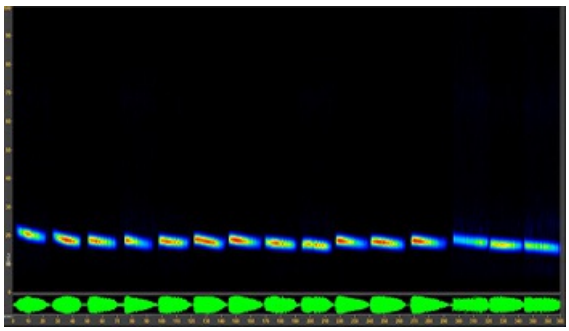
Leisler's Bat - call duration 17.5-18.2 ms



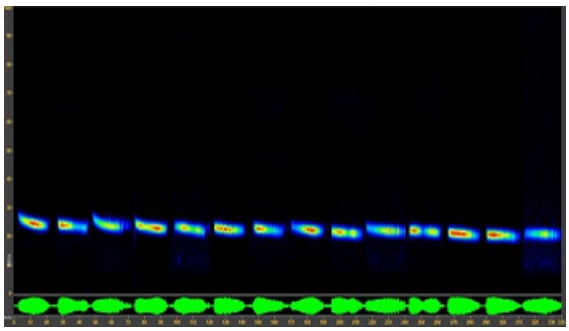
Common Noctule - call duration 18.3-18.7 ms



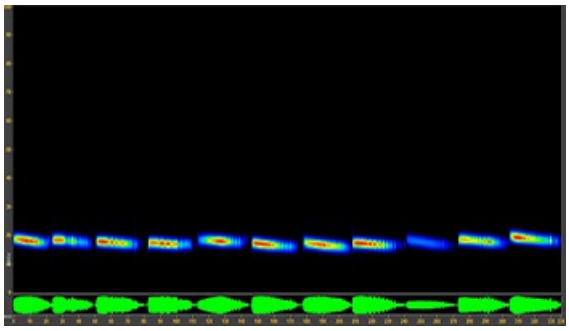
Leisler's Bat - call duration 18.3-18.7 ms



Common Noctule - call duration 18.8-24.0 ms



Leisler's Bat - call duration 18.8-24.0 ms

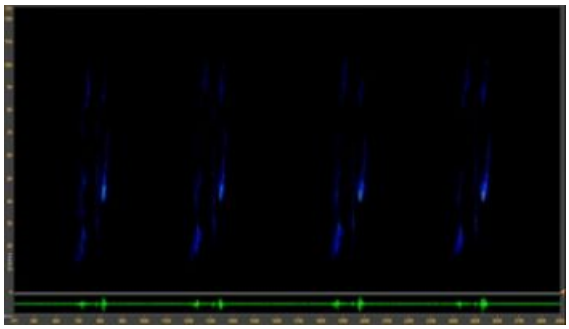


Common Noctule - call duration 24.1-31.7 ms

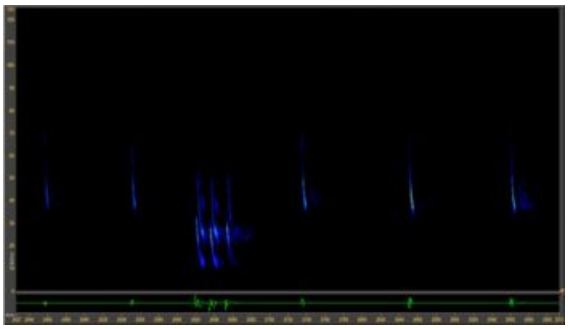
Leisler's Bat - no examples for this call duration

Identification appendix 5: Kuhl's Pipistrelle *Pipistrellus kuhlii* and Nathusius' Pipistrelle *Pipistrellus nathusii* social calls

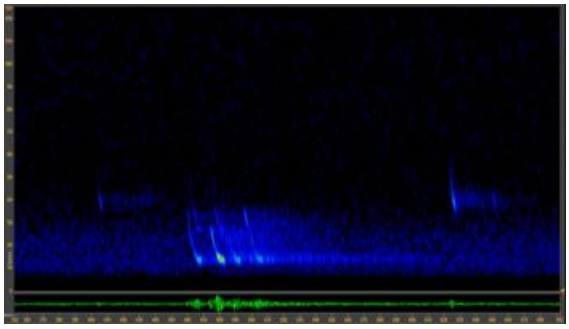
In addition to echolocation calls Kuhl's Pipistrelle and Nathusius' Pipistrelle also produce a range of social calls which can be assigned to species with confidence (observed variation in social calls shown below). Most of the observed social calls of Nathusius' Pipistrelle and Kuhl's Pipistrelle shown below are documented in Middleton *et al.*, (2014), Russ, (2021). Some of the more unusual social calls of Kuhl's Pipistrelle below are described at http://ecologieacoustique.fr/wp-content/uploads/Edition3_Addendum1_janvier2019_P-kuhlii_signaux-sigmoides.pdf



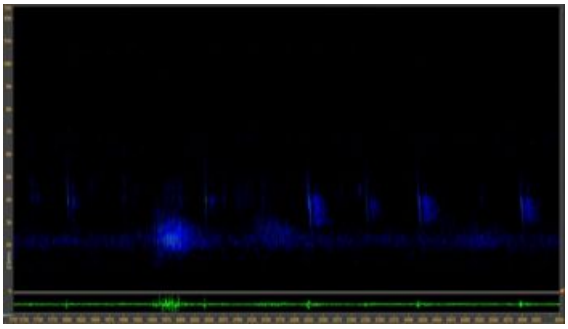
Nathusius' Pipistrelle male advertisement calls



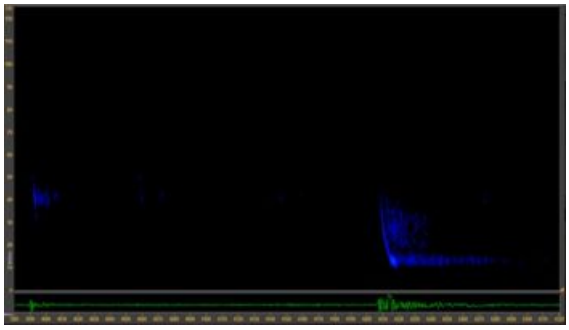
Kuhl's Pipistrelle - three-component social call



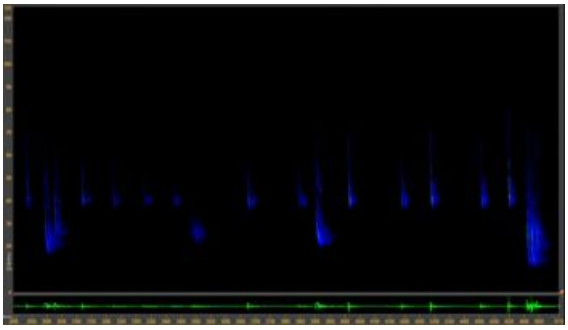
Kuhl's Pipistrelle - four-component social call



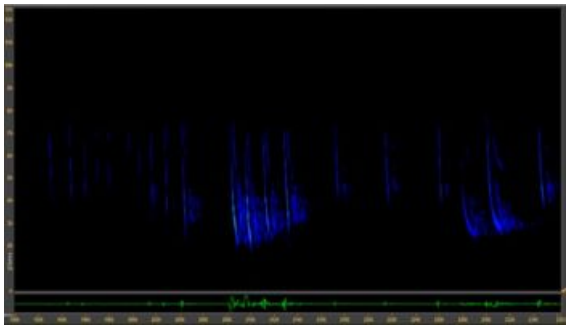
Kuhl's Pipistrelle - trills and myotis-like social calls



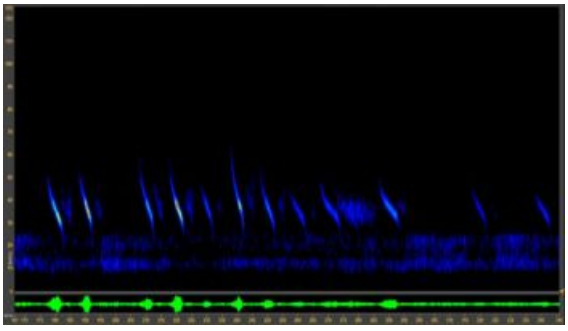
Kuhl's Pipistrelle - one-component social call



Kuhl's Pipistrelle - variation in social calls with different end frequency

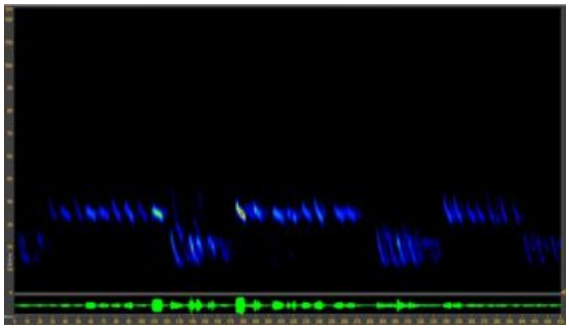


Kuhl's Pipistrelle - variation in social calls with different

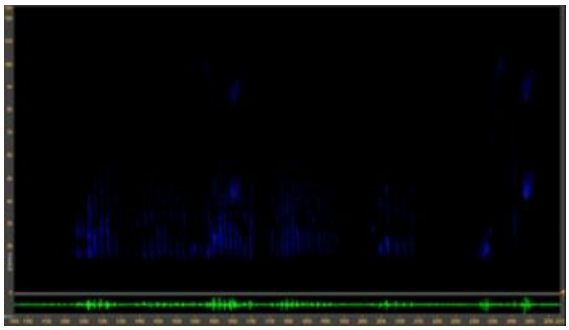


Kuhl's Pipistrelle - low frequency 'barbastelle-like'

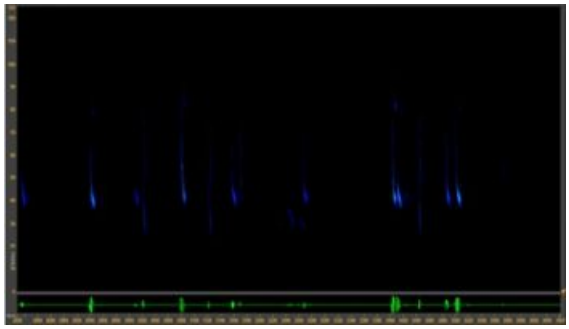
frequency



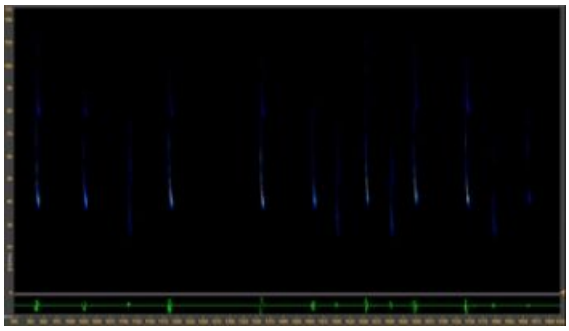
Kuhl's Pipistrelle - low frequency echolocation calls with social function and trills



Nathusius' Pipistrelle - male advertisement calls and other social calls

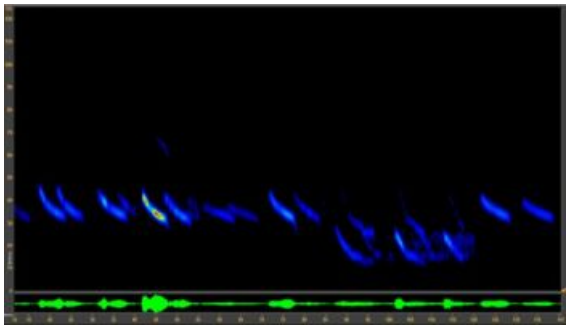


Nathusius' Pipistrelle - Plecotus-like social calls

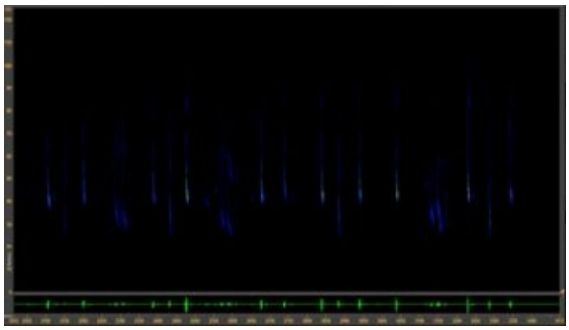


Nathusius' Pipistrelle - Plecotus-like social calls

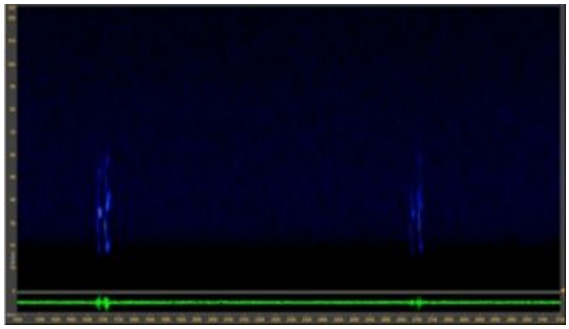
echolocation calls with social function



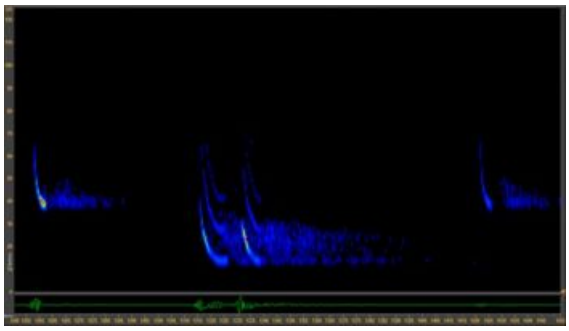
Kuhl's Pipistrelle - low frequency echolocation calls with social function and trills



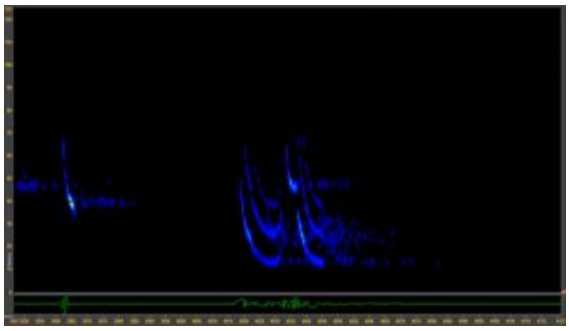
Nathusius' Pipistrelle - variation in social calls, including Plecotus-like calls



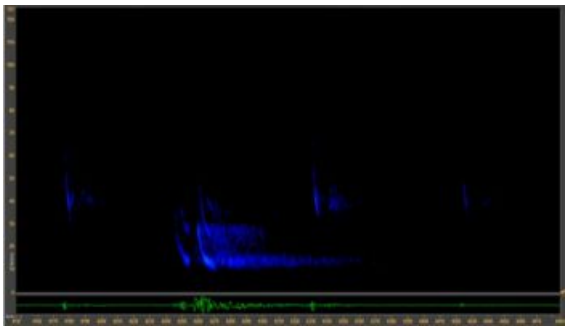
Nathusius' Pipistrelle - variation in social calls - potential confusion with Kuhl's Pipistrelle



Kuhl's Pipistrelle - most common two-component social calls



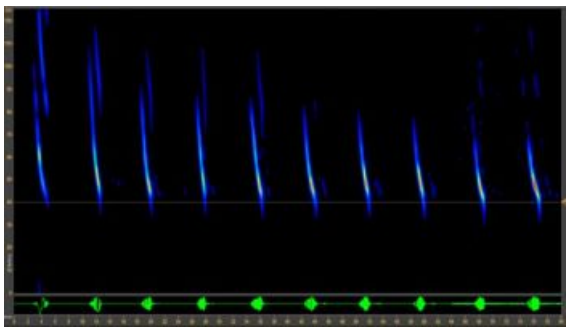
Kuhl's Pipistrelle - variation in two-component social calls



Kuhl's Pipistrelle - variation in two-component social call

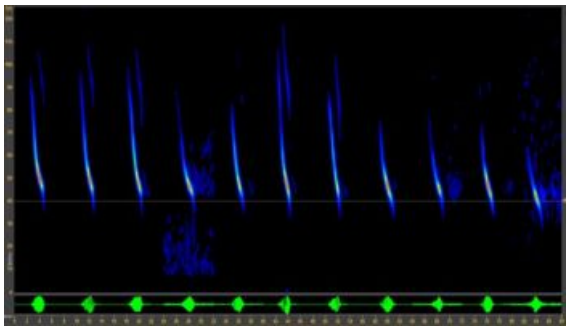
Identification appendix 6: Kuhl's Pipistrelle *Pipistrellus kuhlii* and Nathusius' Pipistrelle *Pipistrellus nathusii*

Nathusius' Pipistrelle and Kuhl's Pipistrelle are two of the most difficult species in Europe to identify acoustically from their echolocation calls. Here we provide a comparison of known Nathusius' Pipistrelle and Kuhl's Pipistrelle calls of the same call duration alongside each other to illustrate this. However, for a given call duration, Kuhl's Pipistrelle calls tend to be lower in frequency and Kuhl's Pipistrelle calls also often have a downward hook, with a larger bandwidth that can be larger than 5 kHz, which is not seen in Nathusius' Pipistrelle. This highlights that there is scope to look across recordings to get an idea of the likely proportion of Nathusius' Pipistrelle and Kuhl's Pipistrelle. For the time being, we take a cautious approach and present the number of recordings of Nathusius' Pipistrelle and Kuhl's Pipistrelle combined.

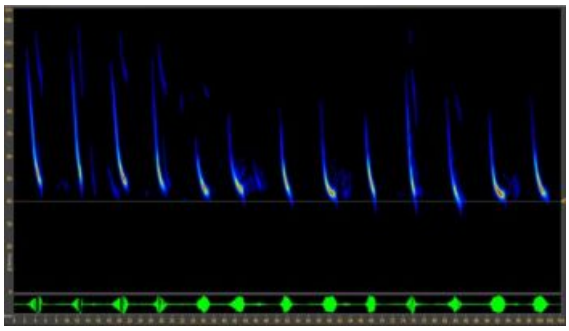


Kuhl's Pipistrelle - call duration 1.1-1.7 ms

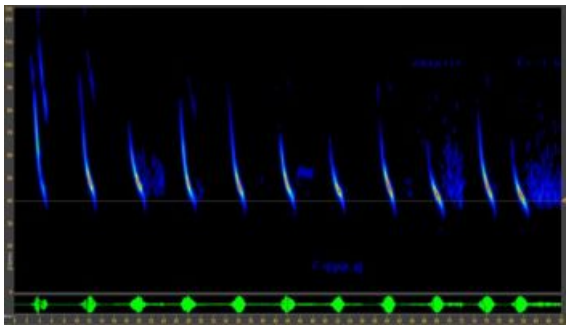
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 1.8-2.2 ms

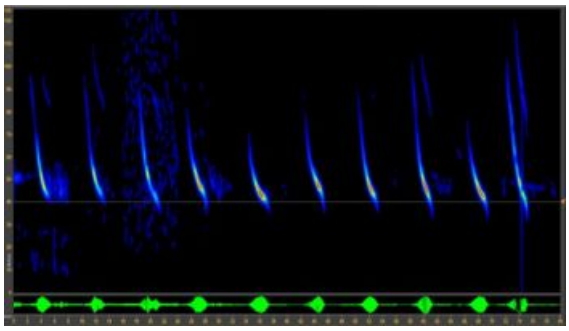


Nathusius' Pipistrelle - call duration 1.8-3.0 ms



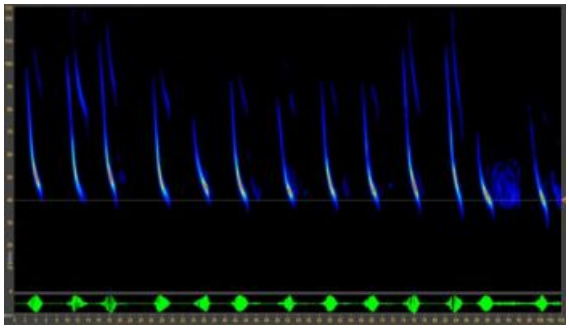
Kuhl's Pipistrelle - call duration 2.3-2.6 ms

Nathusius' Pipistrelle - fewer examples for this call duration



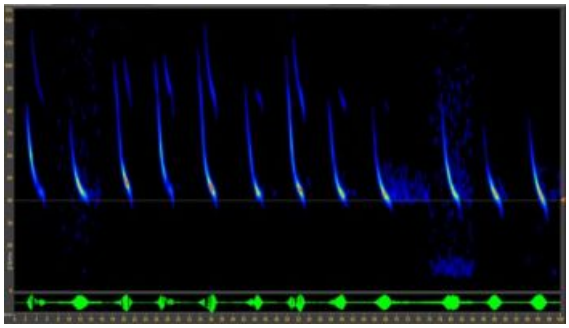
Kuhl's Pipistrelle - call duration 2.7-2.9 ms

Nathusius' Pipistrelle - fewer examples for this call duration

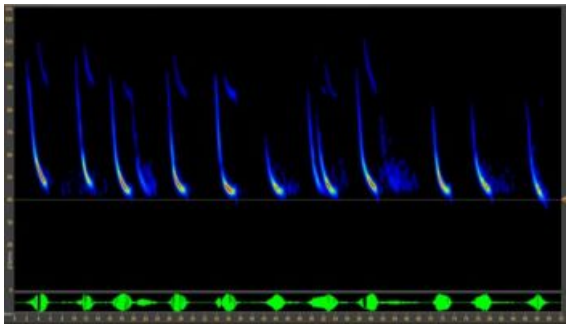


Kuhl's Pipistrelle - call duration 3.0-3.1 ms

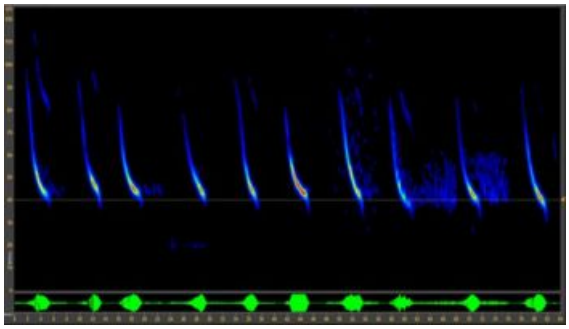
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 3.2-3.3 ms

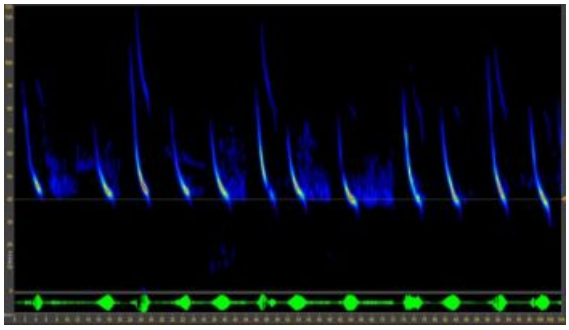


Nathusius' Pipistrelle - call duration 3.1-3.6 ms



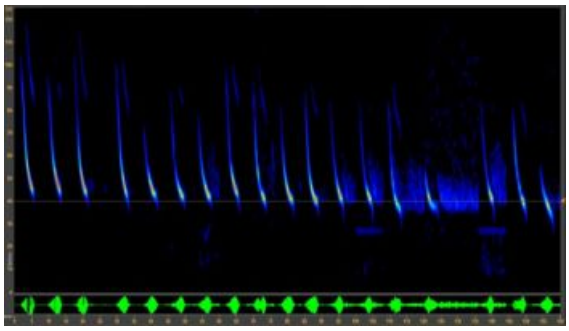
Kuhl's Pipistrelle - call duration 3.4-3.5 ms

Nathusius' Pipistrelle - fewer examples for this call duration

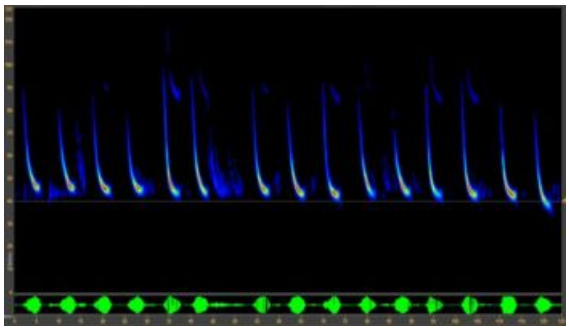


Kuhl's Pipistrelle - call duration 3.6-3.7 ms

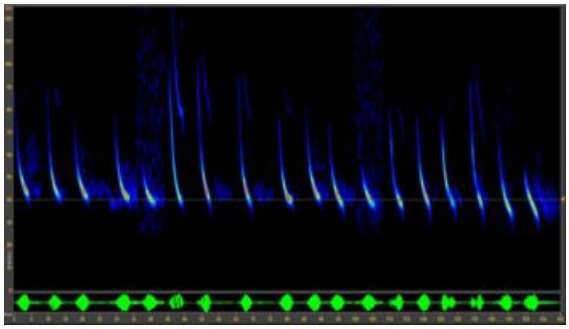
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 3.8-3.9 ms

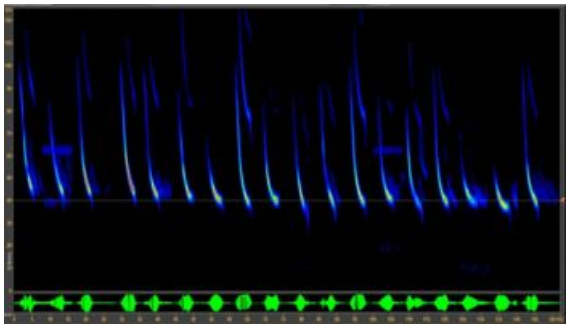


Nathusius' Pipistrelle - call duration 3.7-4.0 ms

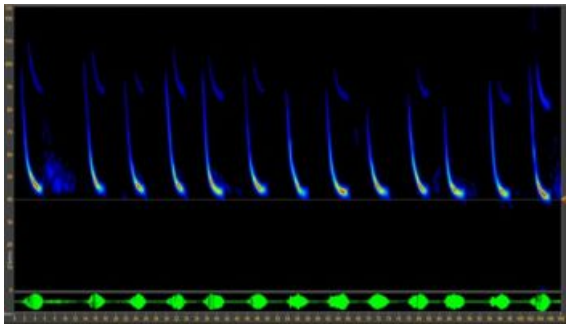


Kuhl's Pipistrelle - call duration 4.0-4.1 ms

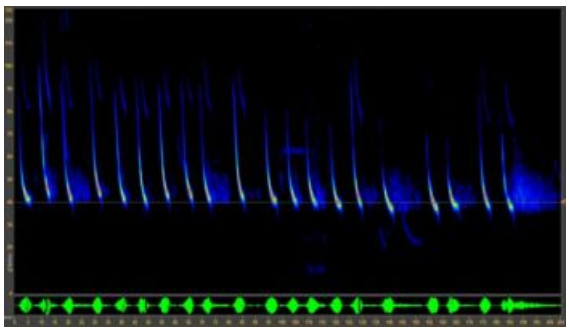
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 4.2-4.3 ms

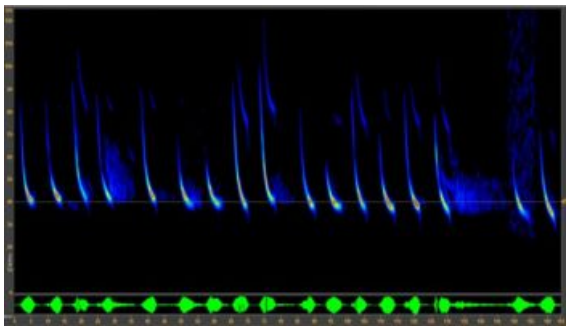


Nathusius' Pipistrelle - call duration 4.1-4.4 ms

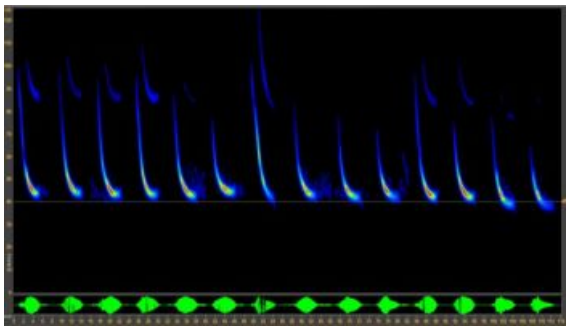


Kuhl's Pipistrelle - call duration 4.4-4.5 ms

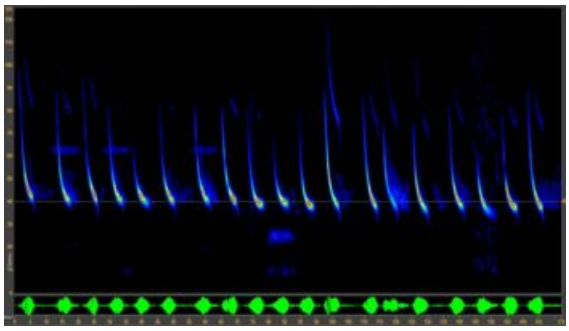
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 4.6-4.7 ms

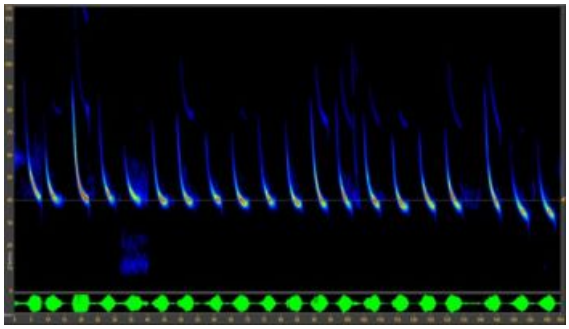


Nathusius' Pipistrelle - call duration 4.5-4.8 ms

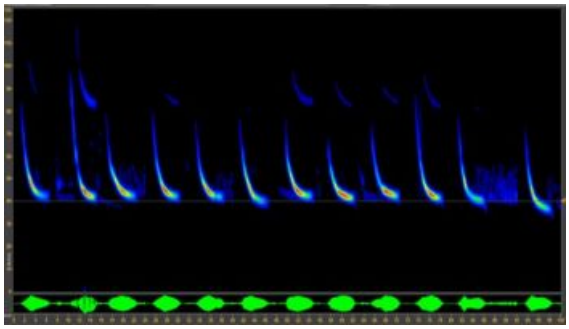


Kuhl's Pipistrelle - call duration 4.8-4.9 ms

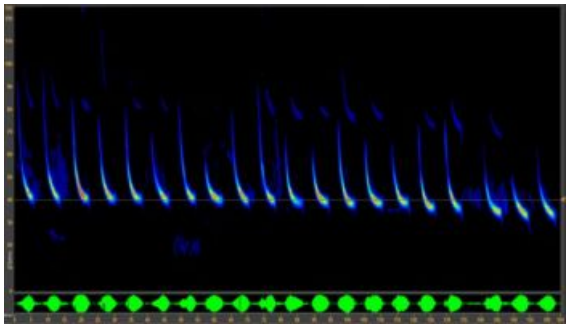
Nathusius' Pipistrelle - fewer examples for this call duration



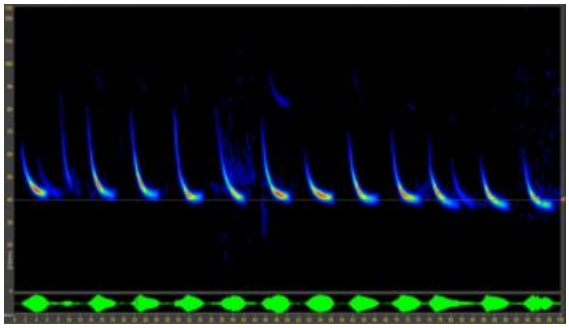
Kuhl's Pipistrelle - call duration 5.0-5.1 ms



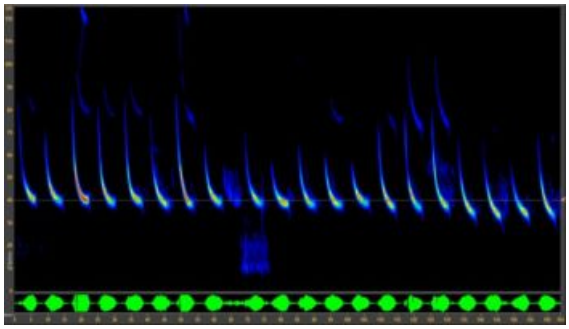
Nathusius' Pipistrelle - call duration 4.9-5.1 ms



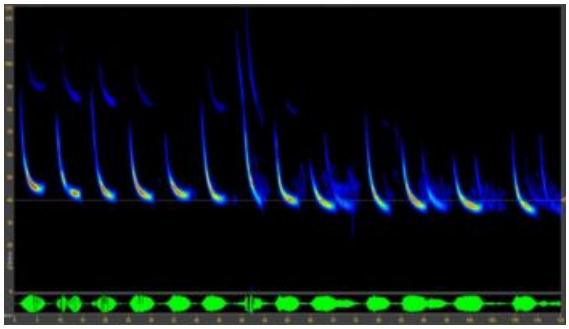
Kuhl's Pipistrelle - call duration 5.2-5.3 ms



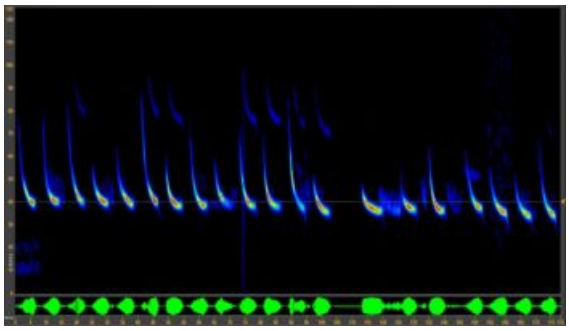
Nathusius' Pipistrelle - call duration 5.2-5.3 ms



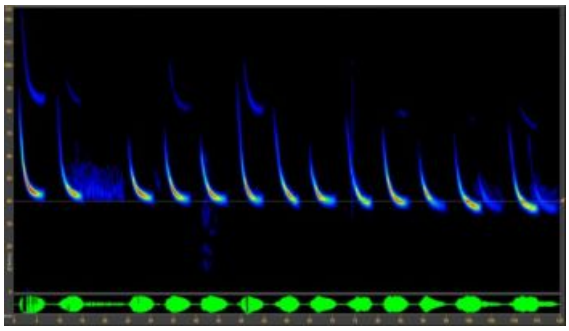
Kuhl's Pipistrelle - call duration 5.4-5.5 ms



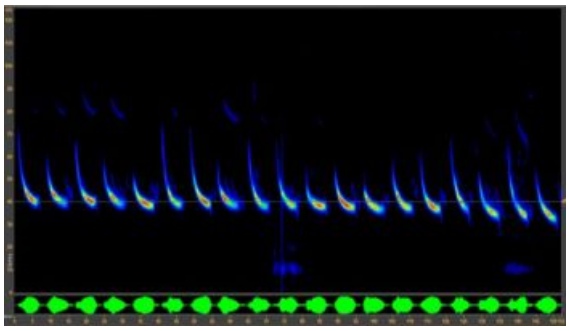
Nathusius' Pipistrelle - call duration 5.4-5.5 ms



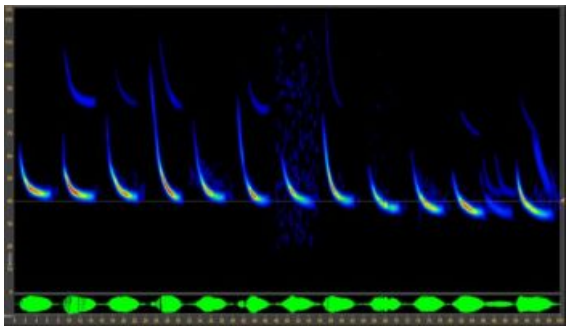
Kuhl's Pipistrelle - call duration 5.6-5.7 ms



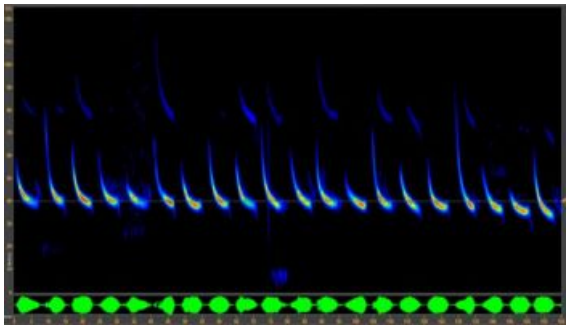
Nathusius' Pipistrelle - call duration 5.6-5.7 ms



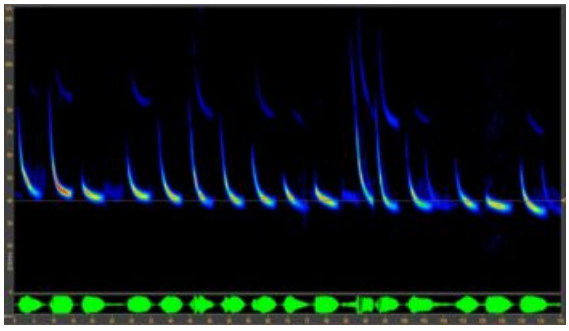
Kuhl's Pipistrelle - call duration 5.8-5.9 ms



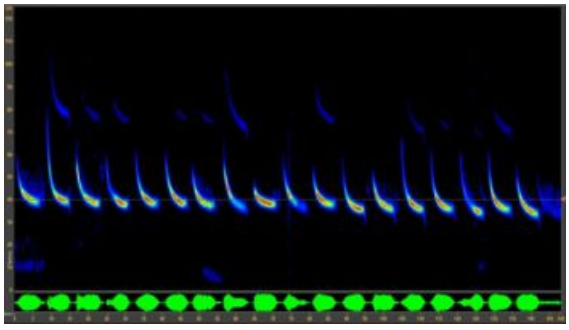
Nathusius' Pipistrelle - call duration 5.8-5.9 ms



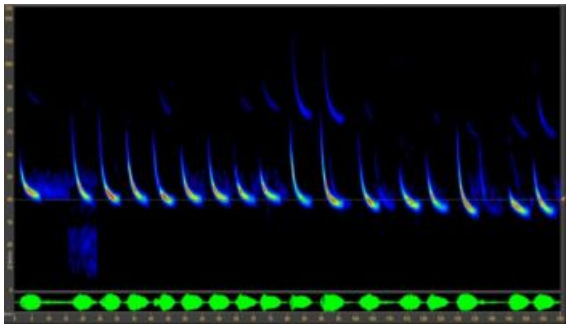
Kuhl's Pipistrelle - call duration 6.0-6.1 ms



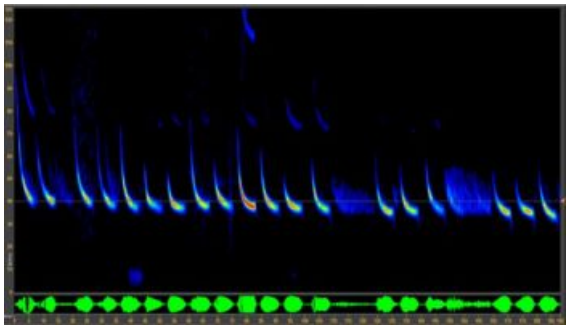
Nathusius' Pipistrelle - call duration 6.0-6.1 ms



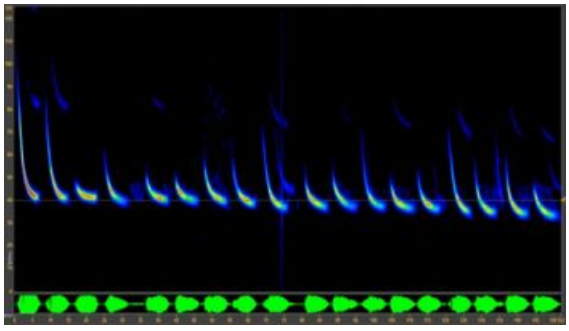
Kuhl's Pipistrelle - call duration 6.2-6.3 ms



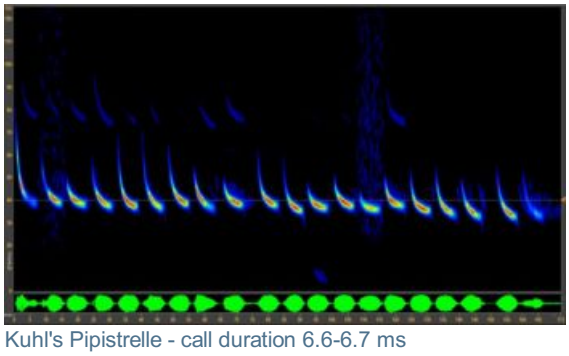
Nathusius' Pipistrelle - call duration 6.2-6.3 ms



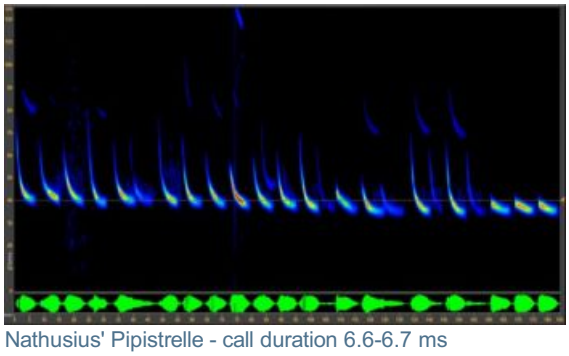
Kuhl's Pipistrelle - call duration 6.4-6.5 ms



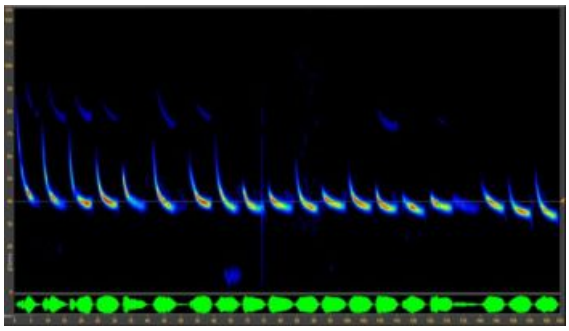
Nathusius' Pipistrelle - call duration 6.4-6.5 ms



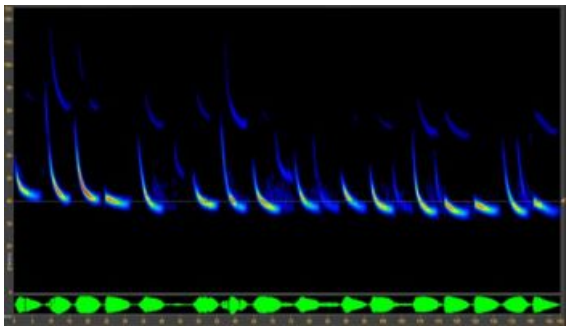
Kuhl's Pipistrelle - call duration 6.6-6.7 ms



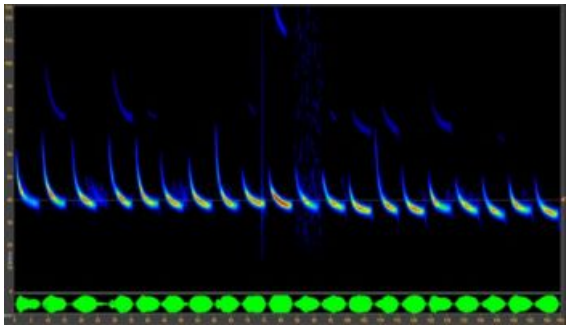
Nathusius' Pipistrelle - call duration 6.6-6.7 ms



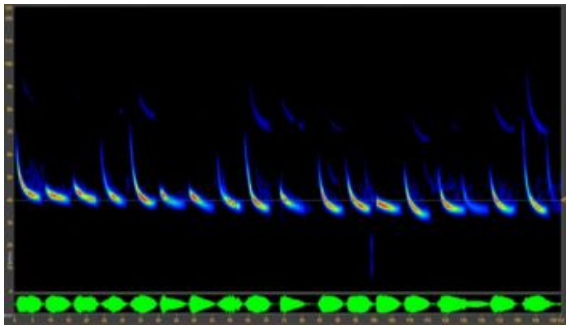
Kuhl's Pipistrelle - call duration 6.8-6.9 ms



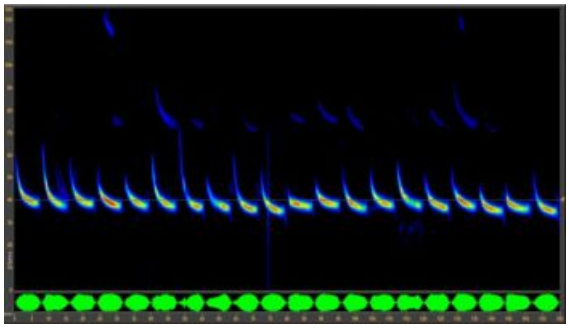
Nathusius' Pipistrelle - call duration 6.8-6.9 ms



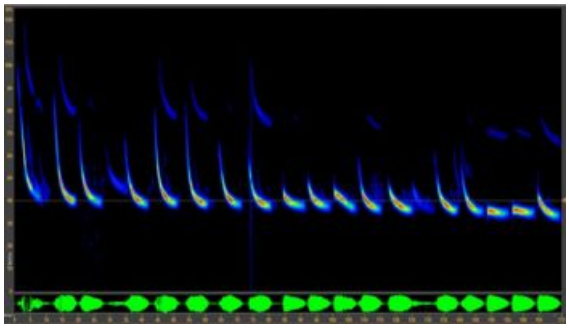
Kuhl's Pipistrelle - call duration 7.0-7.1 ms



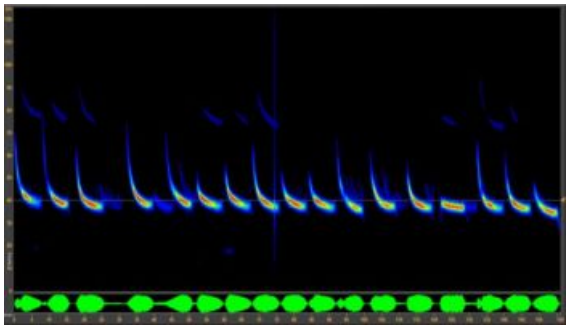
Nathusius' Pipistrelle - call duration 7.0-7.1 ms



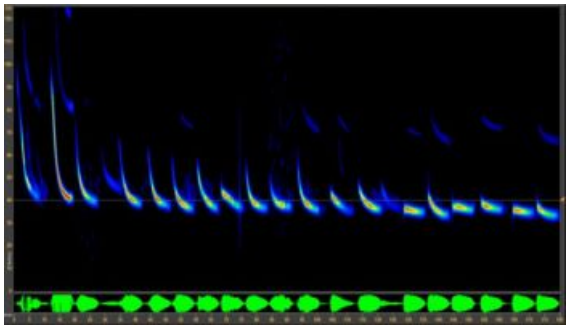
Kuhl's Pipistrelle - call duration 7.2-7.3 ms



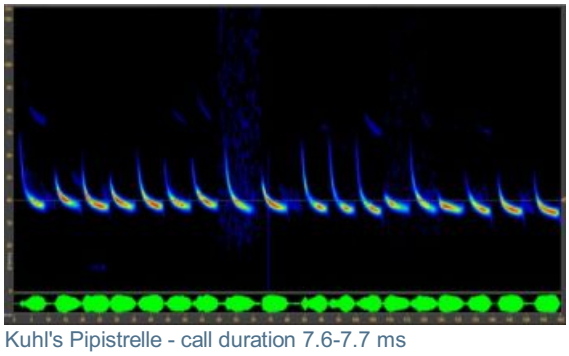
Nathusius' Pipistrelle - call duration 7.2-7.3 ms



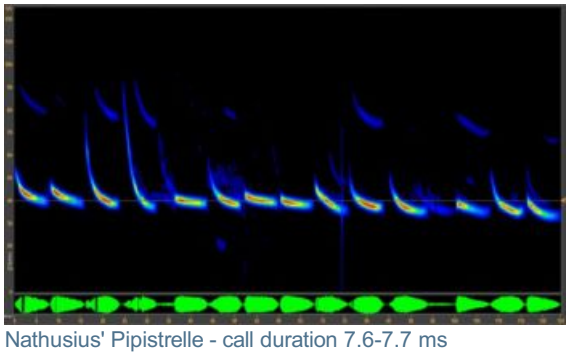
Kuhl's Pipistrelle - call duration 7.4-7.5 ms



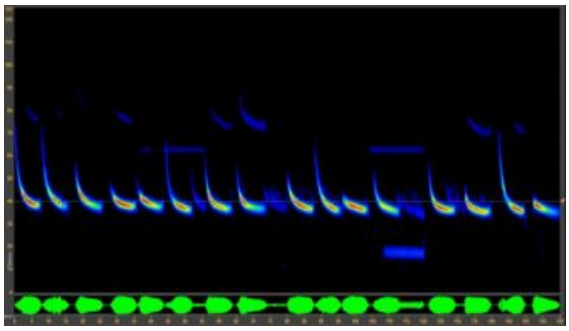
Nathusius' Pipistrelle - call duration 7.4-7.5 ms



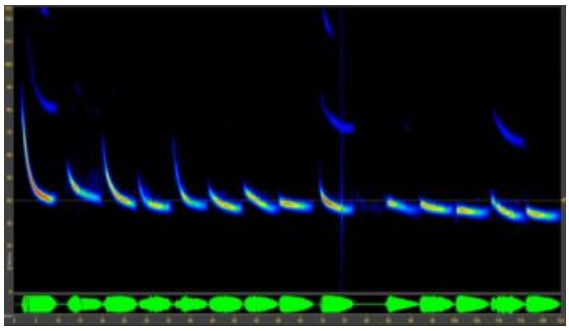
Kuhl's Pipistrelle - call duration 7.6-7.7 ms



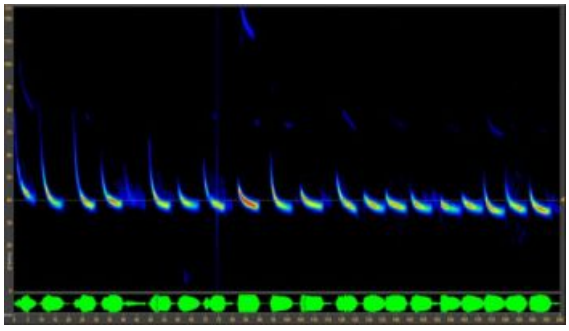
Nathusius' Pipistrelle - call duration 7.6-7.7 ms



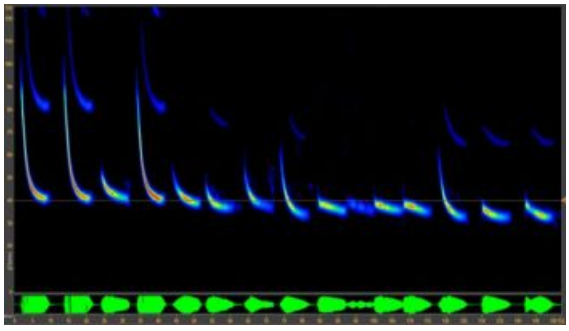
Kuhl's Pipistrelle - call duration 7.8-7.9 ms



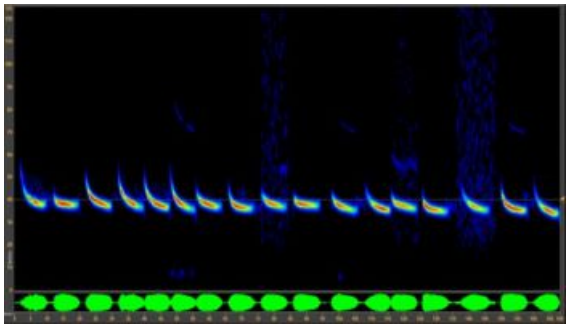
Nathusius' Pipistrelle - call duration 7.8-7.9 ms



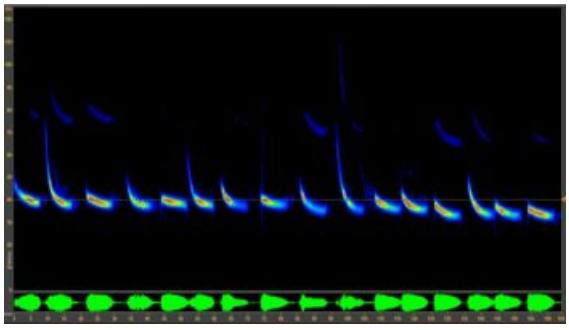
Kuhl's Pipistrelle - call duration 8.0-8.1 ms



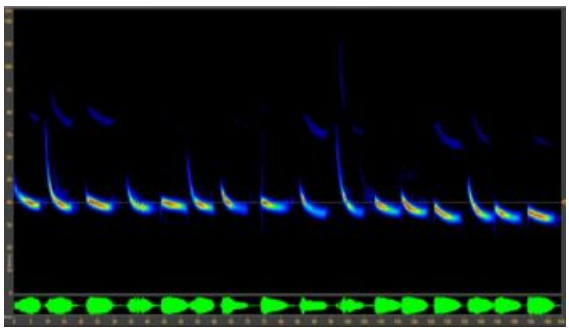
Nathusius' Pipistrelle - call duration 8.0-8.1 ms



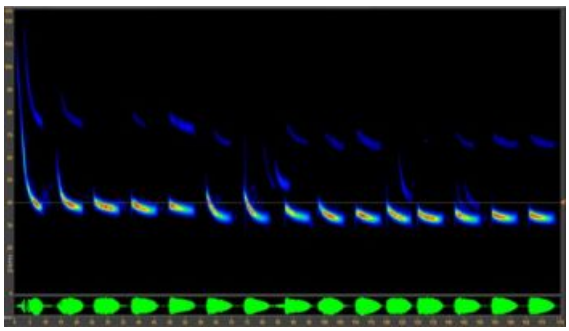
Kuhl's Pipistrelle - call duration 8.2-8.3 ms



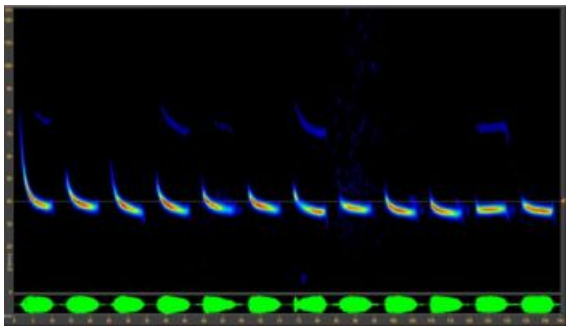
Nathusius' Pipistrelle - call duration 8.2-8.3 ms



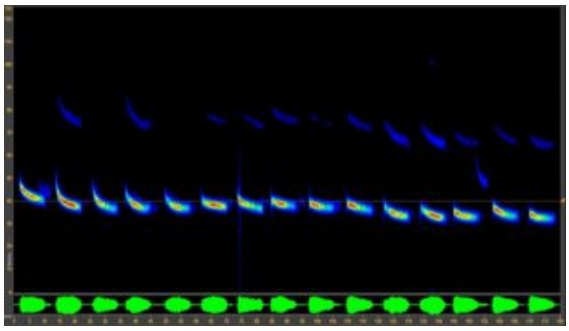
Kuhl's Pipistrelle - call duration 8.4-8.5 ms



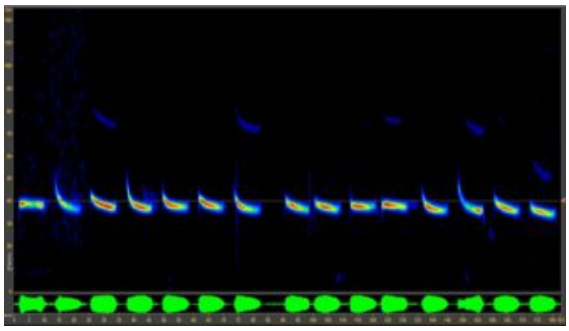
Nathusius' Pipistrelle - call duration 8.4-8.5 ms



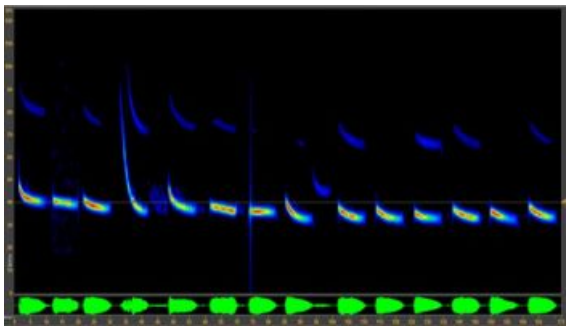
Kuhl's Pipistrelle - call duration 8.6-8.7 ms



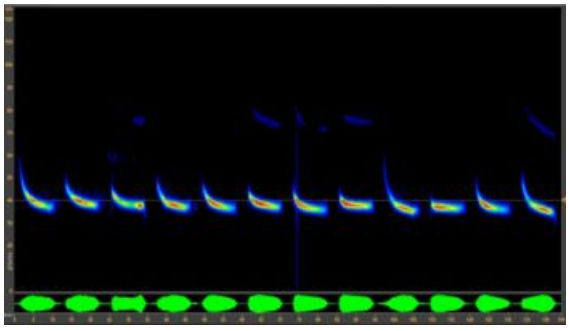
Nathusius' Pipistrelle - call duration 8.6-8.7 ms



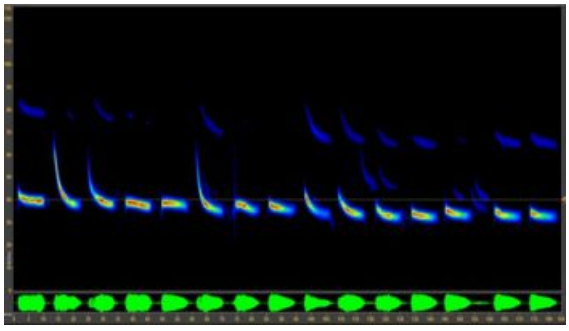
Kuhl's Pipistrelle - call duration 8.8-8.9 ms



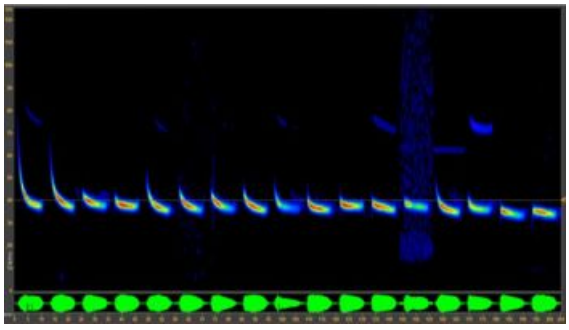
Nathusius' Pipistrelle - call duration 8.8-8.9 ms



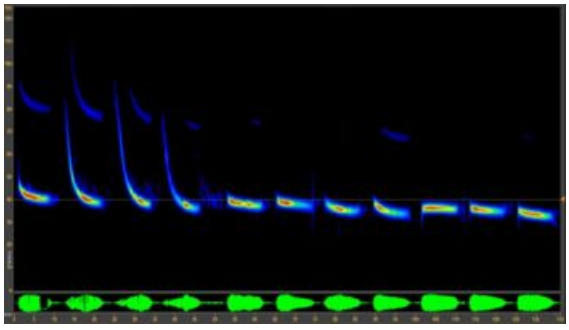
Kuhl's Pipistrelle - call duration 9.0-9.1 ms



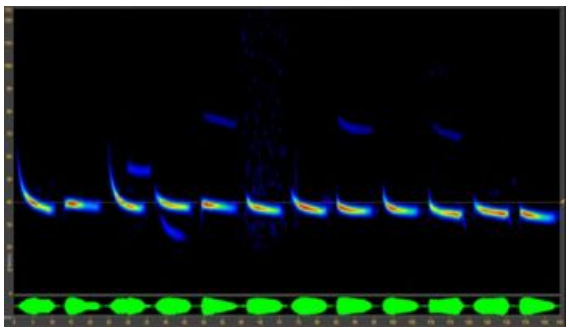
Nathusius' Pipistrelle - call duration 9.0-9.1 ms



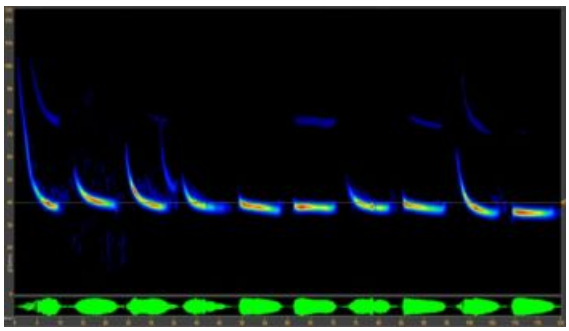
Kuhl's Pipistrelle - call duration 9.2-9.3 ms



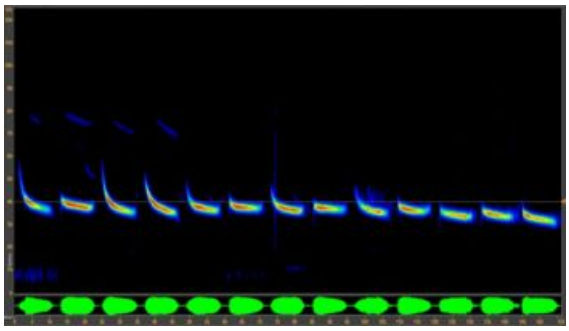
Nathusius' Pipistrelle - call duration 9.2-9.3 ms



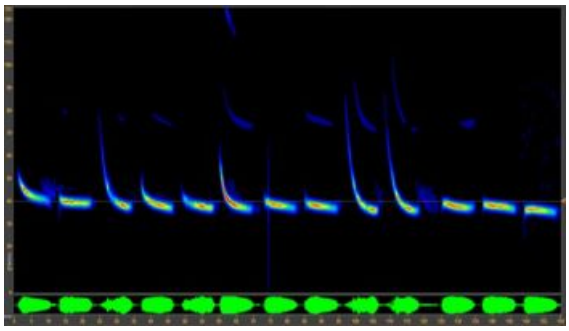
Kuhl's Pipistrelle - call duration 9.4-9.5 ms



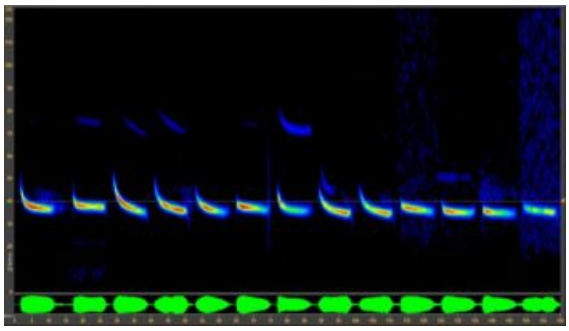
Nathusius' Pipistrelle - call duration 9.4-9.5 ms



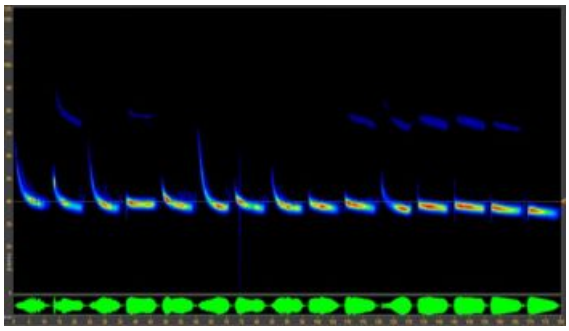
Kuhl's Pipistrelle - call duration 9.6-9.8 ms



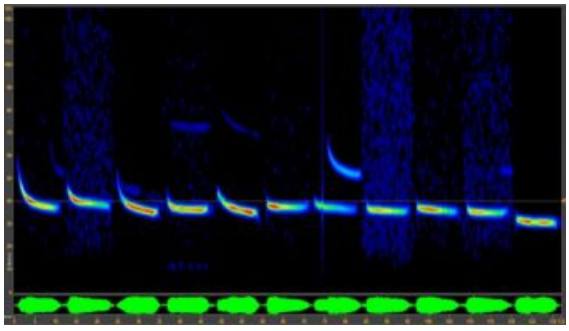
Nathusius' Pipistrelle - call duration 9.6-9.8 ms



Kuhl's Pipistrelle - call duration 9.9-10.1 ms

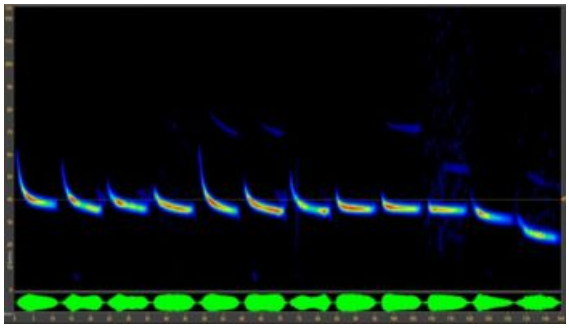


Nathusius' Pipistrelle - call duration 9.9-10.2 ms



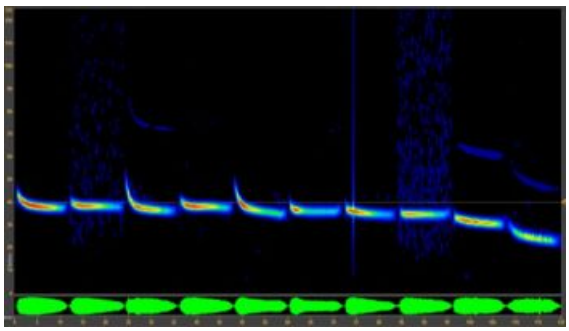
Kuhl's Pipistrelle - call duration 10.2-10.4 ms

Nathusius' Pipistrelle - fewer examples for this call duration

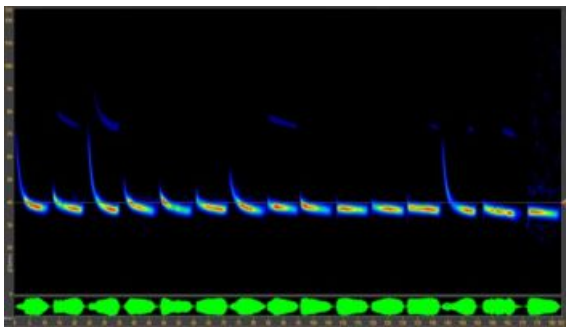


Kuhl's Pipistrelle - call duration 10.5-10.9 ms

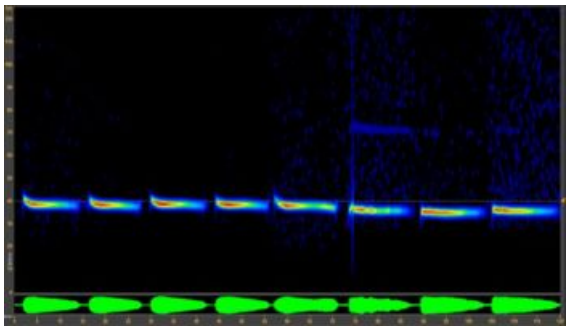
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 11.0-11.7 ms



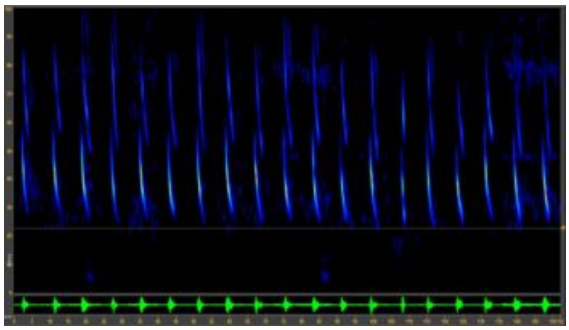
Nathusius' Pipistrelle - call duration 10.3-12.3 ms



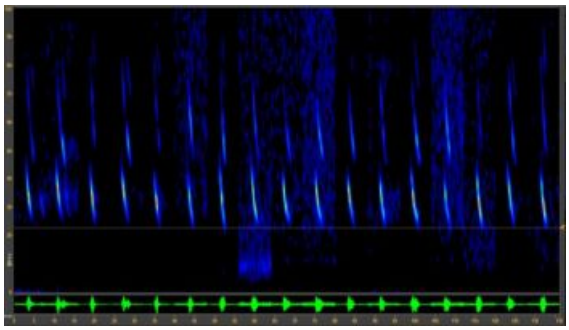
Kuhl's Pipistrelle - call duration 11.8-14.7 ms

Identification appendix 7: Grey Long-eared Bat *Plecotus austriacus* and Brown Long-eared Bat *Plecotus auritus*

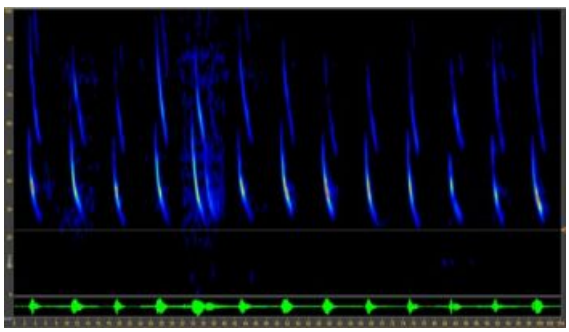
The echolocation and social calls of Grey Long-eared Bat are very similar to Brown Long-eared Bat, but given good recordings and an understanding of what the calls of the two species should look like given the call duration, it should be possible to assign a majority of recordings to species. To illustrate we provide a visual comparison below of similar duration echolocation and type c social calls of known Grey Long-eared Bat and Brown Long-eared Bat (Middleton *et al*. 2022). Despite this, it is very possible that a small number of Brown Long-eared Bat recordings will be missed, either in recordings not assigned to species (for example assigned instead to *Plecotus* species, and not considered in this report), or potentially to Grey Long-eared Bat in error. The latter is most likely where there is attenuation of the weaker ends of the calls of Brown Long-eared Bat, making the calls look less broadband than they really are, but in most cases, it should be clear where there are problems with the quality of a recording, so we expect that the error will be small. Some, but not all social calls of Brown Long-eared Bat, can also look very similar to those of Grey Long-eared Bat. Where an identification is not clear, we take a cautious approach and do not assign these to a species. As a general point, the chance of misidentifying of Grey Long-eared Bat as Brown Long-eared is less likely. Whilst Grey Long-eared Bat is not an obvious confusion species for *Nyctalus*, it is worth noting that this species commonly produces long duration calls of 7-10ms in open areas, which are longer than have been documented elsewhere (Barataud, 2015; Russ, 2021).



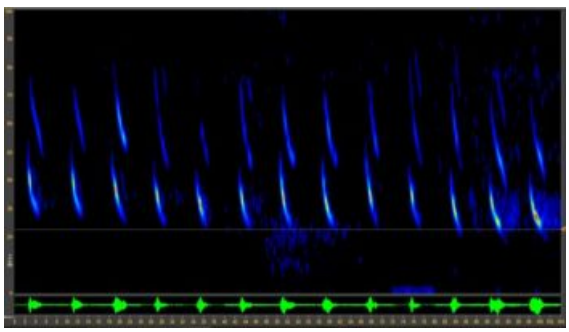
Brown Long-eared Bat - call duration 1.0-1.8 ms



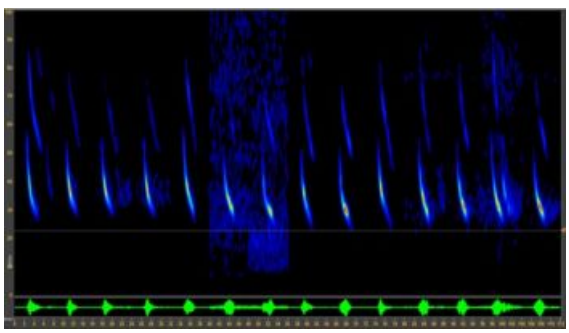
Grey Long-eared Bat - call duration 1.2-1.6 ms



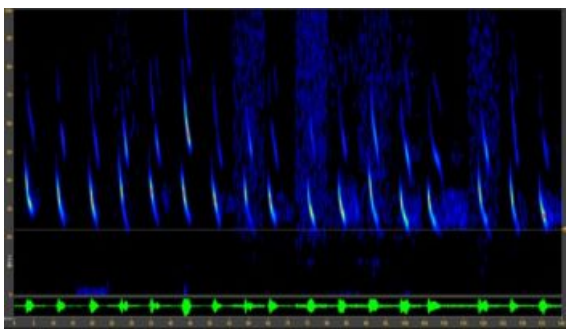
Brown Long-eared Bat - call duration 1.9-2.0 ms



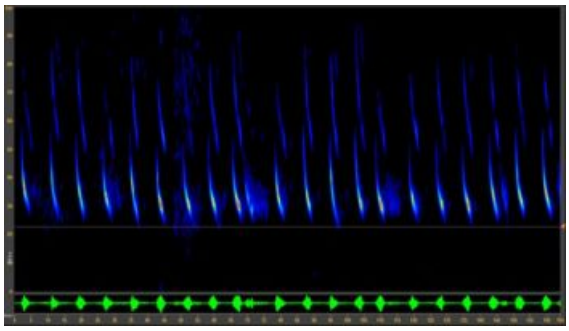
Grey Long-eared Bat - call duration 1.9-2.0 ms



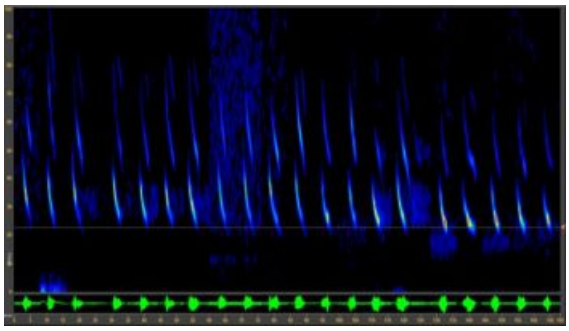
Brown Long-eared Bat - call duration 2.1-2.2 ms



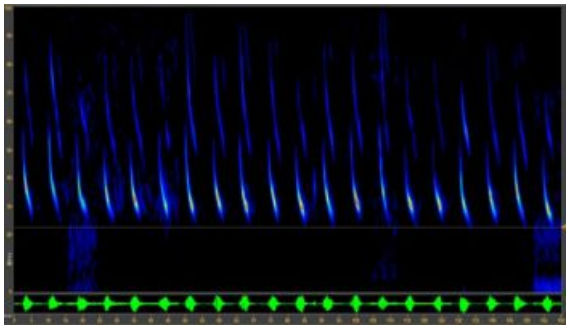
Grey Long-eared Bat - call duration 2.1-2.2 ms



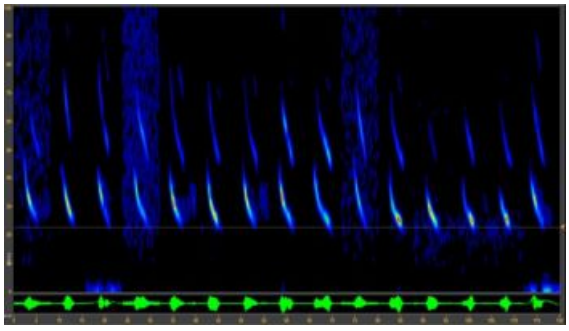
Brown Long-eared Bat - call duration 2.5-2.6 ms



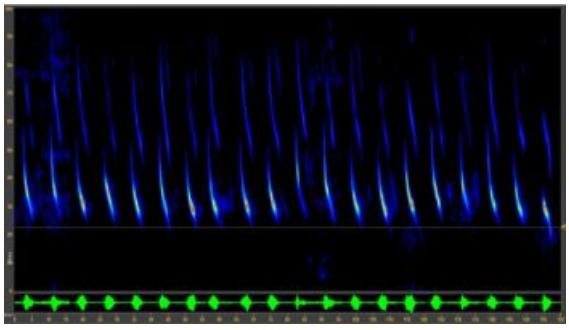
Grey Long-eared Bat - call duration 2.3-2.6 ms



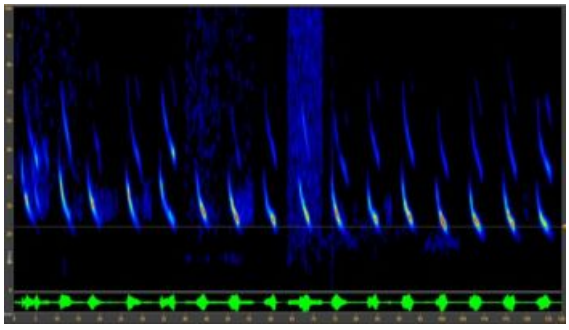
Brown Long-eared Bat - call duration 2.7-2.8 ms



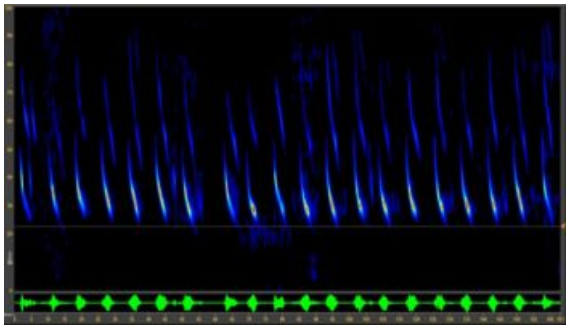
Grey Long-eared Bat - call duration 2.7-2.8 ms



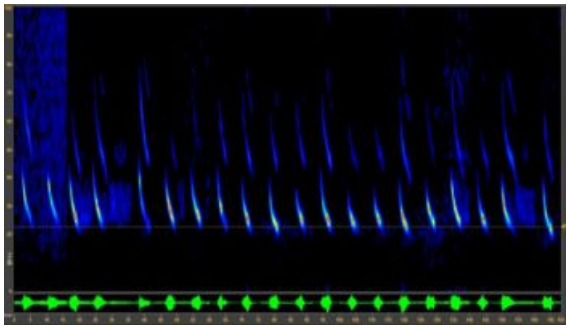
Brown Long-eared Bat - call duration 2.9-3.0 ms



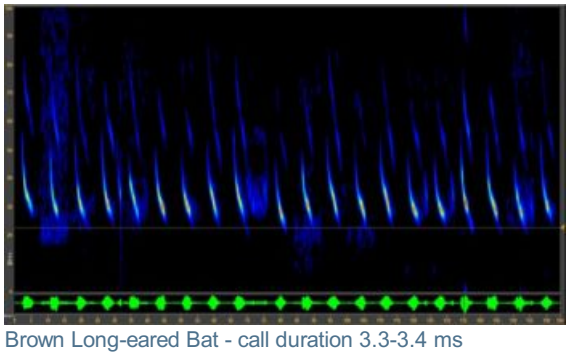
Grey Long-eared Bat - call duration 2.9-3.0 ms



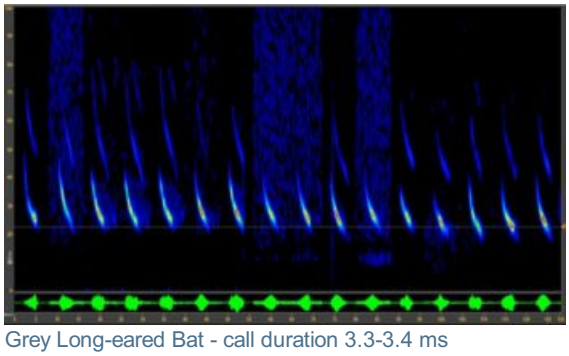
Brown Long-eared Bat - call duration 3.1-3.2 ms



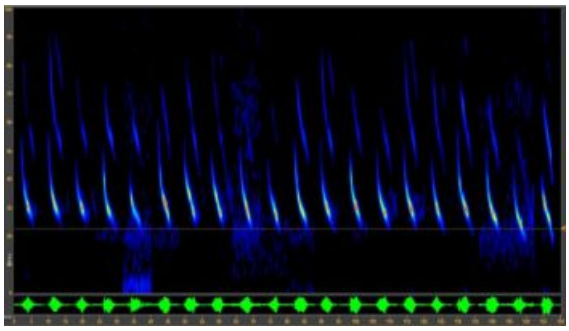
Grey Long-eared Bat - call duration 3.1-3.2 ms



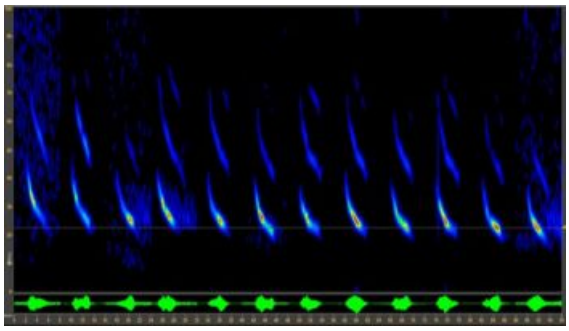
Brown Long-eared Bat - call duration 3.3-3.4 ms



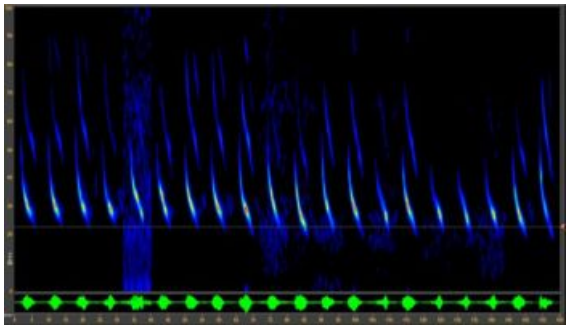
Grey Long-eared Bat - call duration 3.3-3.4 ms



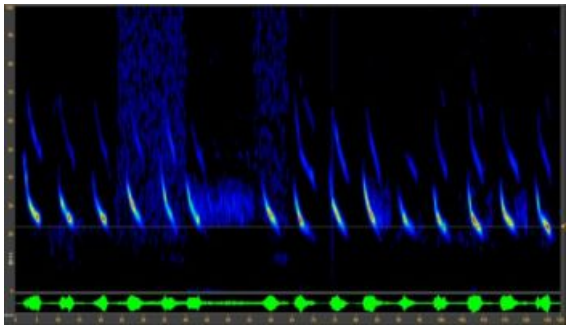
Brown Long-eared Bat - call duration 3.5-3.6 ms



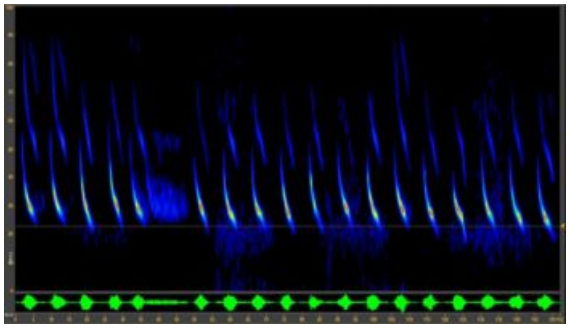
Grey Long-eared Bat - call duration 3.5-3.6 ms



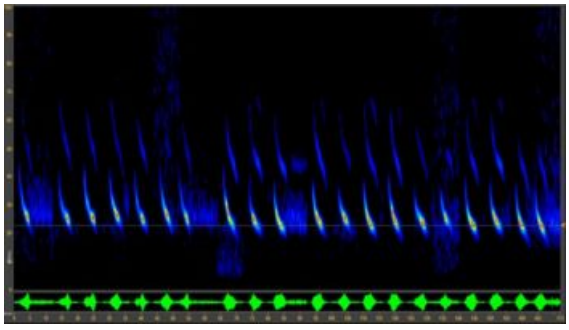
Brown Long-eared Bat - call duration 3.7-3.8 ms



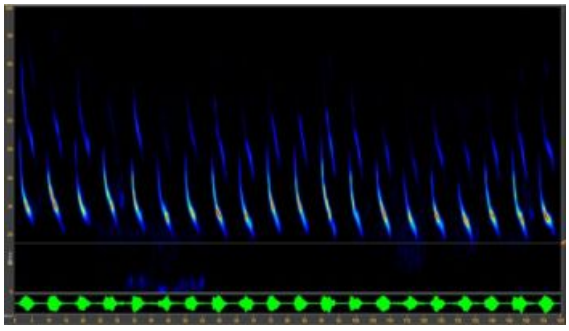
Grey Long-eared Bat - call duration 3.7-3.8 ms



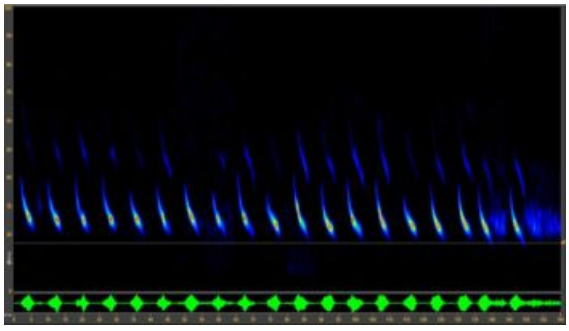
Brown Long-eared Bat - call duration 3.9-4.0 ms



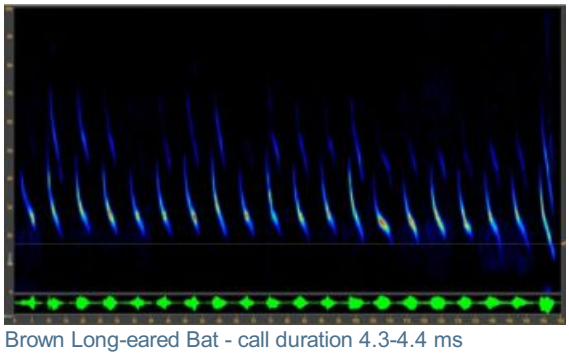
Grey Long-eared Bat - call duration 3.9-4.0 ms



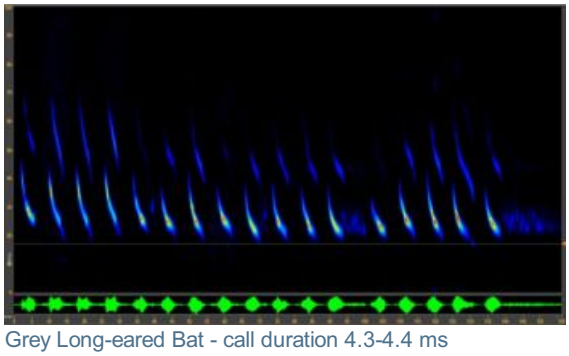
Brown Long-eared Bat - call duration 4.1-4.2 ms



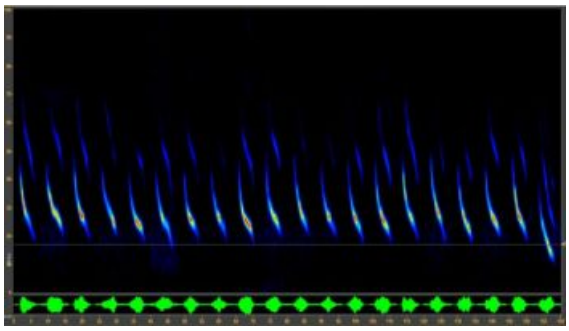
Grey Long-eared Bat - call duration 4.1-4.2 ms



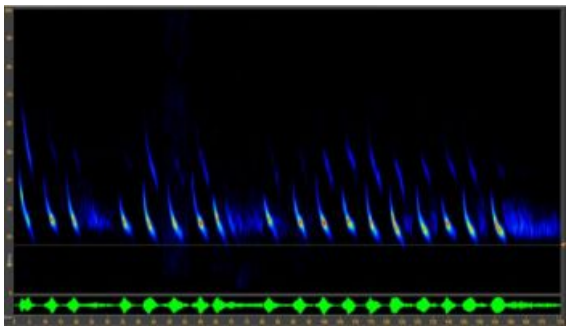
Brown Long-eared Bat - call duration 4.3-4.4 ms



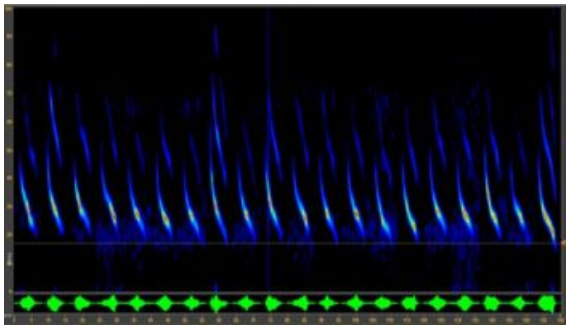
Grey Long-eared Bat - call duration 4.3-4.4 ms



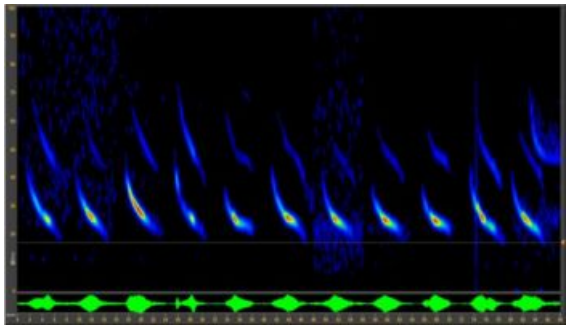
Brown Long-eared Bat - call duration 4.5-4.6 ms



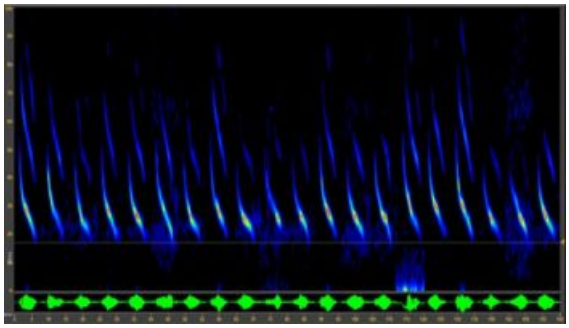
Grey Long-eared Bat - call duration 4.5-4.6 ms



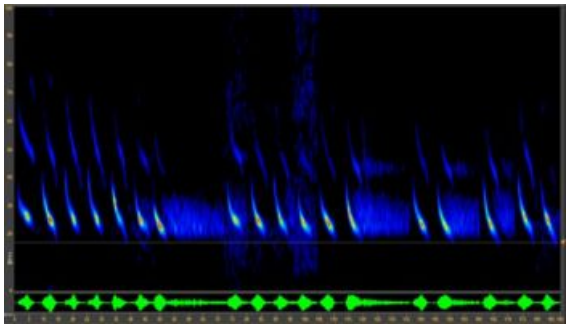
Brown Long-eared Bat - call duration 4.7-4.8 ms



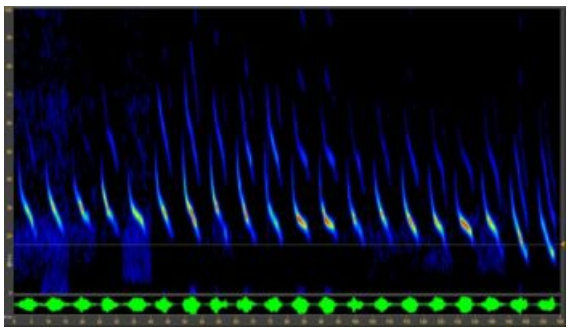
Grey Long-eared Bat - call duration 4.7-4.8 ms



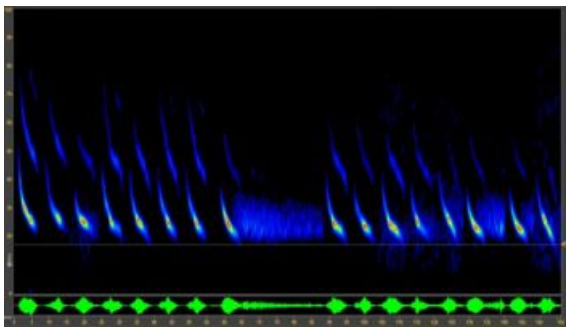
Brown Long-eared Bat - call duration 4.9-5.0 ms



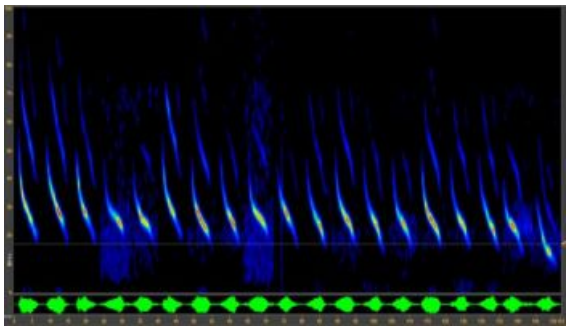
Grey Long-eared Bat - call duration 4.9-5.0 ms



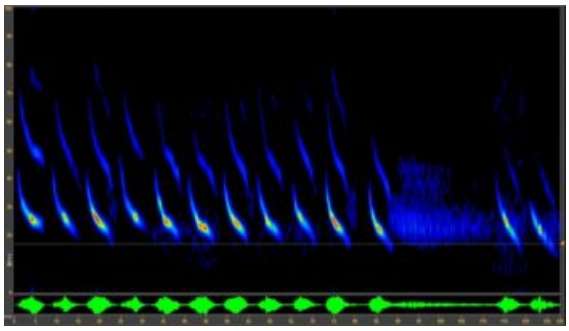
Brown Long-eared Bat - call duration 5.1-5.2 ms



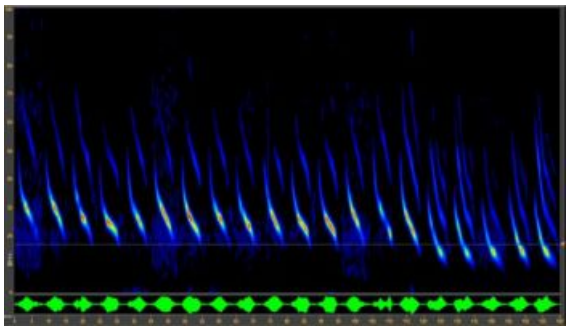
Grey Long-eared Bat - call duration 5.1-5.2 ms



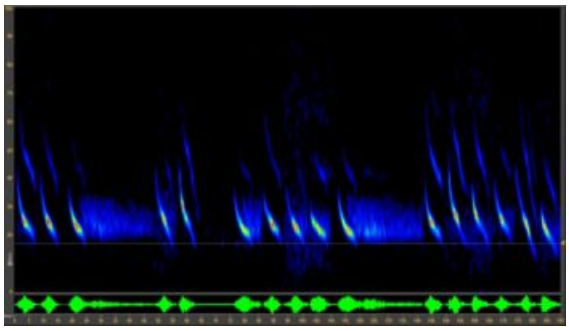
Brown Long-eared Bat - call duration 5.3-5.4 ms



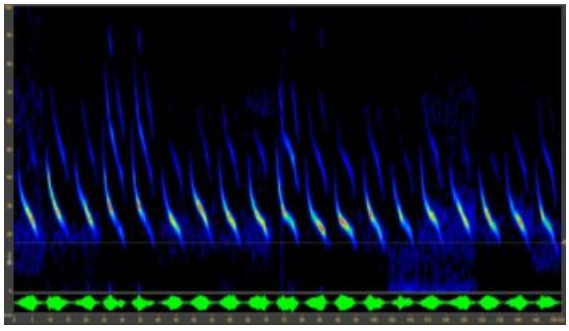
Grey Long-eared Bat - call duration 5.3-5.5 ms



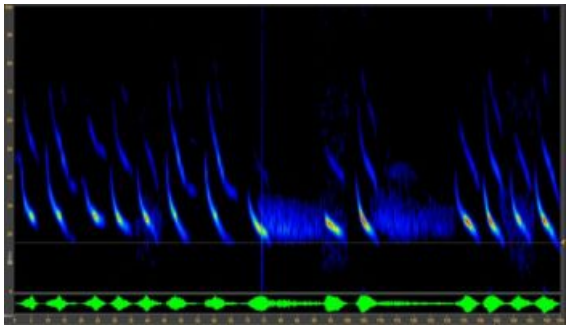
Brown Long-eared Bat - call duration 5.5-5.8 ms



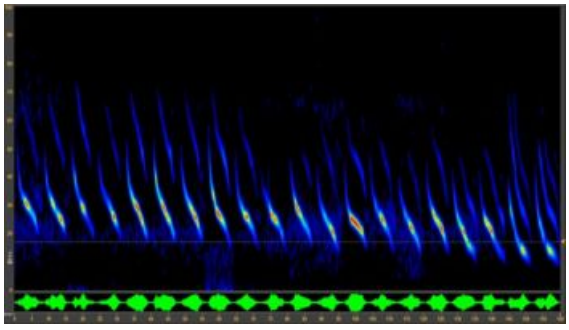
Grey Long-eared Bat - call duration 5.6-5.8 ms



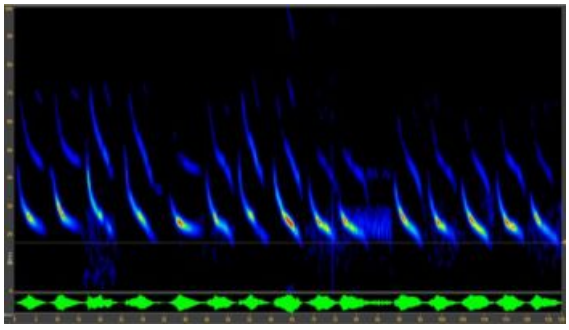
Brown Long-eared Bat - call duration 5.9-6.2 ms



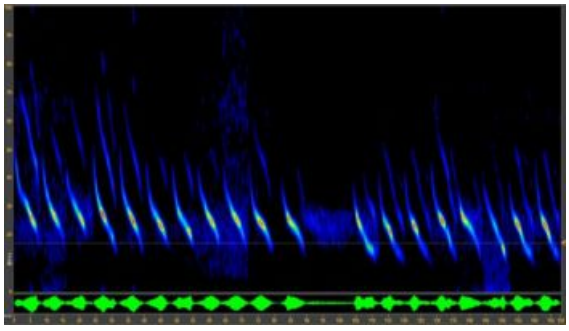
Grey Long-eared Bat - call duration 5.9-6.2 ms



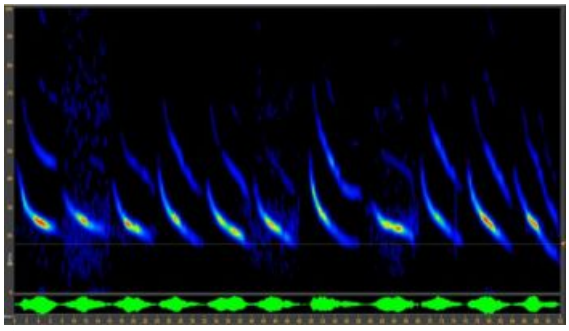
Brown Long-eared Bat - call duration 6.3-6.4 ms



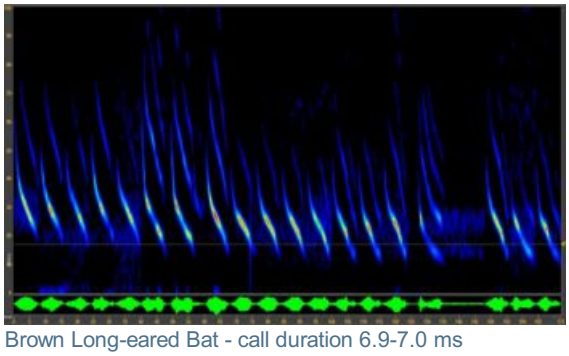
Grey Long-eared Bat - call duration 6.3-6.5 ms



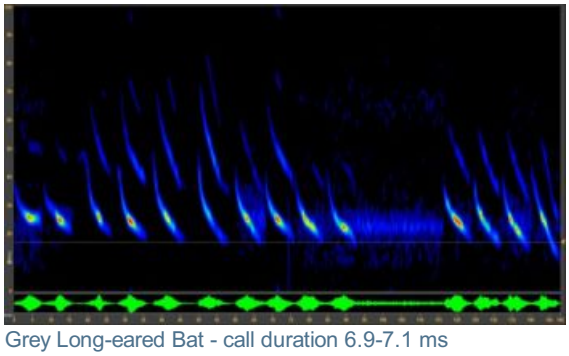
Brown Long-eared Bat - call duration 6.7-6.8 ms



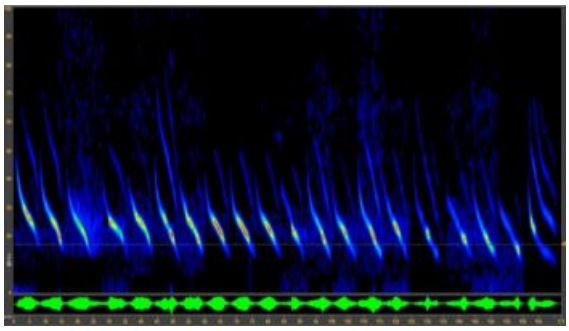
Grey Long-eared Bat - call duration 6.6-6.8 ms



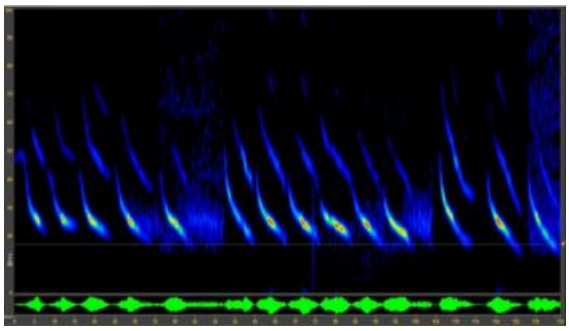
Brown Long-eared Bat - call duration 6.9-7.0 ms



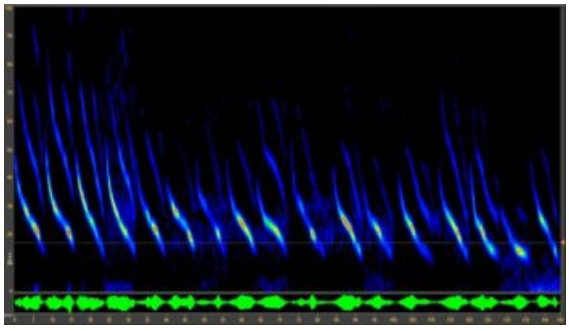
Grey Long-eared Bat - call duration 6.9-7.1 ms



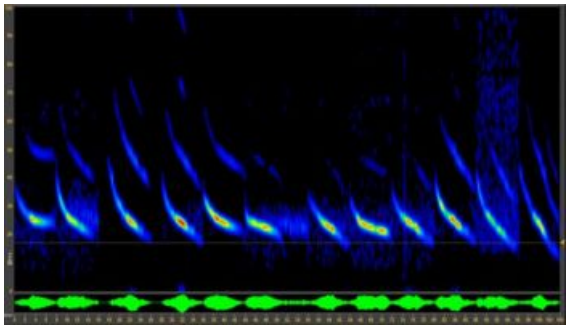
Brown Long-eared Bat - call duration 7.3-7.4 ms



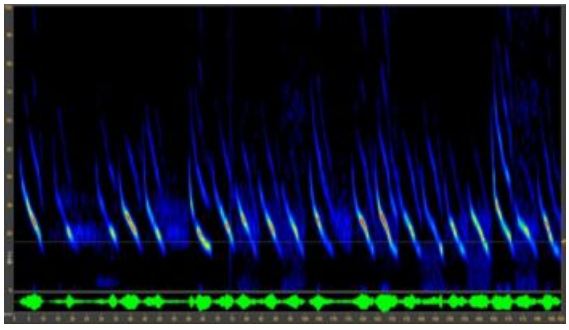
Grey Long-eared Bat - call duration 7.2-7.4 ms



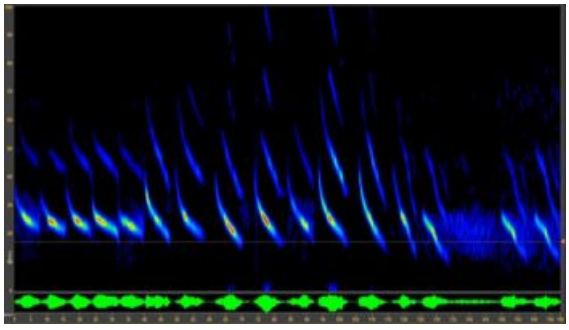
Brown Long-eared Bat - call duration 7.5-7.6 ms



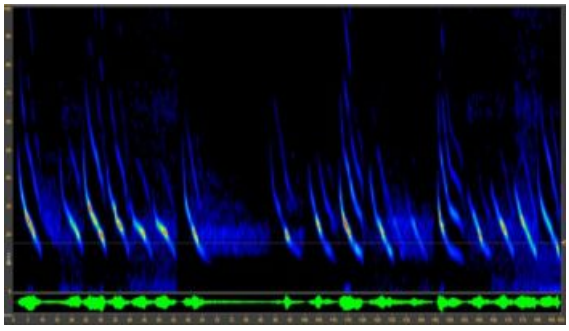
Grey Long-eared Bat - call duration 7.5-7.6 ms



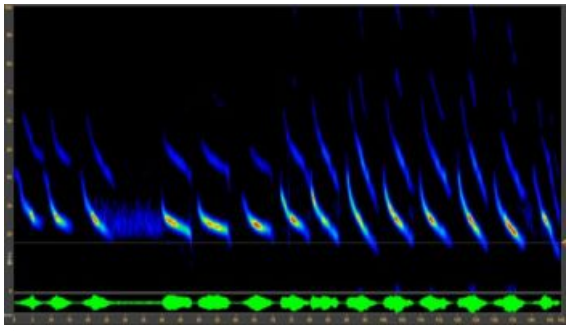
Brown Long-eared Bat - call duration 7.7-7.8 ms



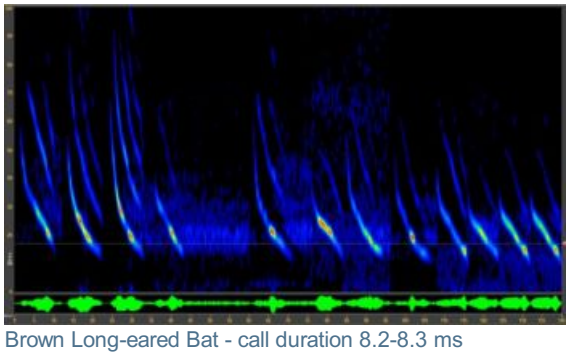
Grey Long-eared Bat - call duration 7.7-7.8 ms



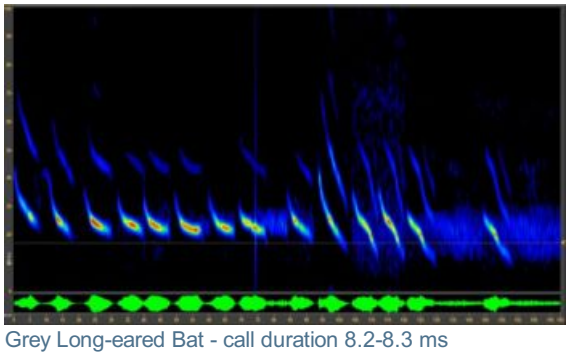
Brown Long-eared Bat - call duration 7.9-8.1 ms



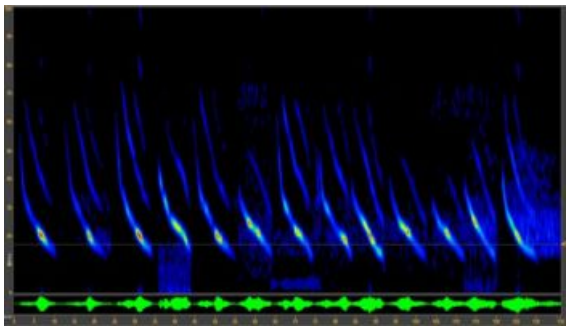
Grey Long-eared Bat - call duration 7.9-8.1 ms



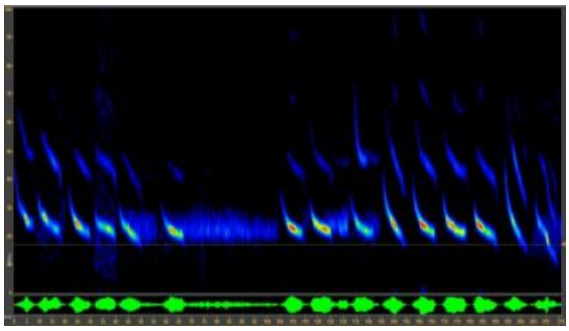
Brown Long-eared Bat - call duration 8.2-8.3 ms



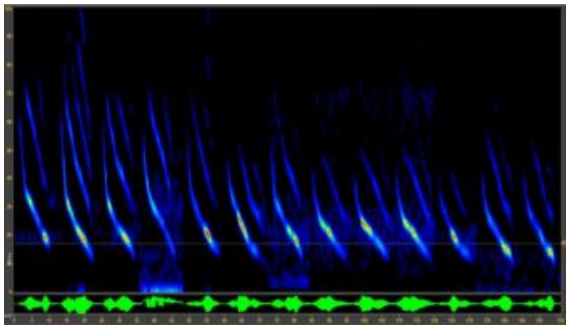
Grey Long-eared Bat - call duration 8.2-8.3 ms



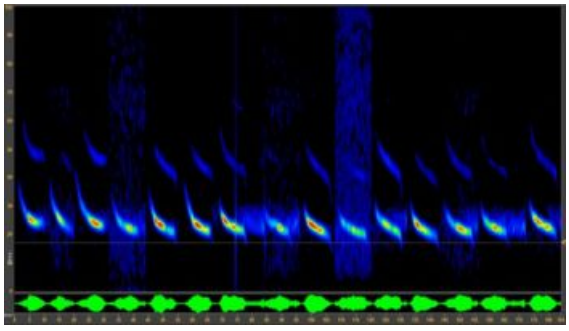
Brown Long-eared Bat - call duration 8.4-8.6 ms



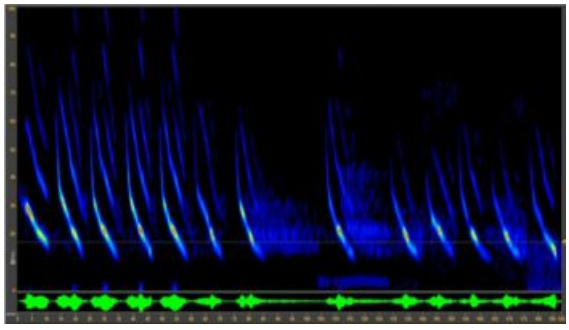
Grey Long-eared Bat - call duration 8.4-8.7 ms



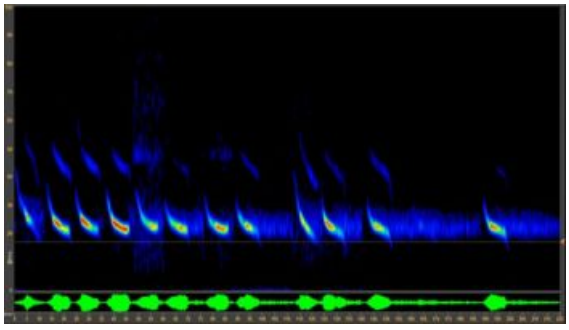
Brown Long-eared Bat - call duration 8.7-9.0 ms



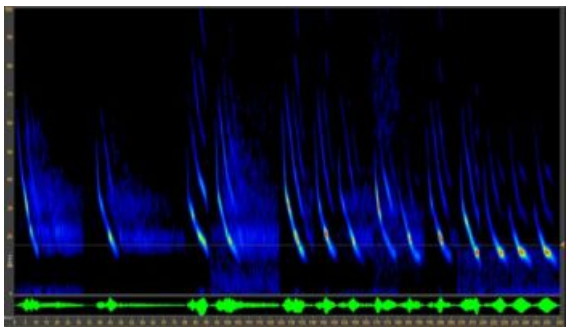
Grey Long-eared Bat - call duration 8.8-9.1 ms



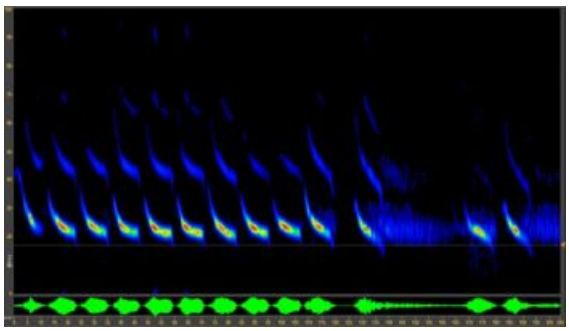
Brown Long-eared Bat - call duration 9.1-9.5 ms



Grey Long-eared Bat - call duration 9.2-9.6 ms



Brown Long-eared Bat - call duration 9.6-11.4 ms



Grey Long-eared Bat - call duration 9.7-10.5 ms

Identification appendix 8: Unidentified ‘big bat’ on Sark in 2023

A series of 11 recordings of an interesting ‘big bat’ species were made on Sark from the same location (49.43643, -2.35531) over three consecutive nights between the 7-9th September 2023.

- There was no evidence of alternation in the frequency of the calls (‘clip-clop’ sound when played), which is normally seen / heard in a sequence of calls produced by Leisler’s bat or Noctule. It would be unusual not to see clear alternation in the frequency of calls in all 11 recordings, if these were produced by Leisler’s bat (or Noctule).
- We excluded Noctule as a possibility because the calls, given the observed call duration, were higher in frequency than expected for Noctule.
- Serotine and Parti-coloured Bat (a potential vagrant to the Channel Islands) do not produce calls that alternate in frequency. In support of Parti-coloured bat, some sequences of longer duration calls, would also be very unusual for Serotine.
- The shape of some of the calls were very similar to calls commonly produced by Parti-coloured Bat based on known recordings of this species. For example, see the shape of the calls in the recording from the 7th September at 00:39:04.

Marc Van de Sijpe and Alex Lefevre

We think that these recordings are interesting and intriguing.

- There are no long narrow-band quasi-constant frequency calls indicative of a bat in high flight in the open.
- Many calls are quite short.
- The frequencies are generally high.
- Some broadband calls here have quite high-end frequencies (some around 30 kHz) combined with a duration of almost 10 ms. Other calls have lower end frequencies around 25-26.
- We also listened to these calls in heterodyne as well as using ‘virtual bat’ in the software BatSound.

We do not believe that these calls were produced by a *Nyctalus* species (Leisler’s Bat or Noctule). We also do not think that these were produced by Serotine. We believe that Parti-coloured Bat is the most probable species.

Chris Corben

- The following four wav files look like Serotine. Looking at the timing, these files depict two events two nights apart (7th September 00:39:04 and 0039:09, and 9th September 03:05:56 and 03:05:01).
- The next five files all happened in 8 minutes, and so are likely to be the same bat. They also show similar features, which are consistent with Leisler’s Bat or Noctule. I consider that Leisler’s Bat is more likely, because a large part of the calls are above 25 kHz (9th September 05:04:03, 05:11:33, 05:11:57, 05:12:02, 05:12:14).
- My guess is that Parti-coloured Bat does not often produce calls like these. I watched a Parti-coloured Bat for hours in Vilnius, and the thing which struck me most, is that its behaviour reminded me more of Pipistrelle species in some ways. So, the rapid changes in frequency were short duration events in long strings of similar low slope calls. Think of a bat hunting fairly close to trees, but rather quickly dropping back to produce low clutter type calls (long narrow band calls) between each attack event, apparently not sensing clutter from as far as a *Nyctalus*, and perhaps from not even so far as Serotine.
- The following two files are different (9th September 04:19:01 and 8th September 02:54:18). The first of these could be Serotine in a lot of clutter. In this case, I do not have any recordings of Serotine which look quite like this file. This might just be a weird Leisler’s Bat, for example, but I think extended sequences of high clutter calls is more an *Eptesicus* thing than *Nyctalus*. The second file from the 8th September is the only file from that night. The pulses are similar in duration to most of the pulses in your 11 files, but a lot lower in slope. I could imagine similar pulses being made by Leisler’s Bat or Parti-coloured Bat.

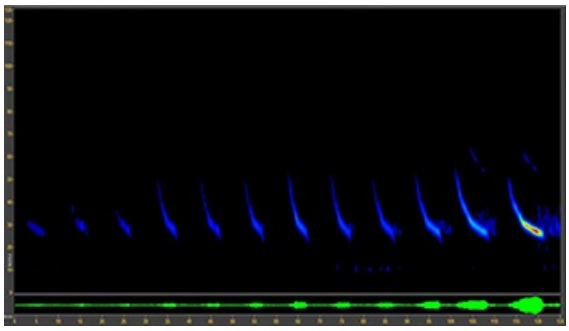
I suppose a subject worth thinking about is what effect vagrancy has on a bat. What happens if a bat finds itself somewhere very unfamiliar? This is one of the things I love about vagrancy. They give you the chance to see what a single individual can get up to. And that also relates to your point about these Sark recordings. If one bat turns up somewhere unusual in a vagrancy event, why couldn’t others also? So, my suggestion is that you have two bats in these files rather than just one, and maybe these last two recordings are of another. But overall, you have 5 events,

two of which seem very similar. Maybe they are all the same bat, but I think it makes more sense if there were at least two.

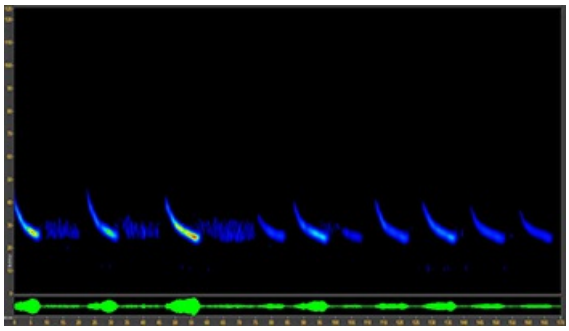
Summary

- Parti-coloured bat is one of the most difficult bat species in Europe to identify given echolocation calls alone, particularly to distinguish this species from Leisler's Bat (see e.g. Russ 2021).
- Marc Van de Sijpe and Alex Lefevre are in agreement with our initial thinking that these recordings are unusual, and were most likely to have been produced by Parti-coloured Bat. In contrast, Chris Corben considered that the most likely possibility was that the recordings were produced by more than one bat, of two species, Serotine (and most likely) Leisler's Bat.
- More typical sequences of Leisler's Bat (as a new species for Sark) calls were recorded on Sark about a month later, but there is a question around how likely is it that two new species for Sark - Leisler's Bat and Serotine, were recorded at the same location within a day of each other? As both species are likely to be migrants, perhaps this is possible given similar weather conditions?

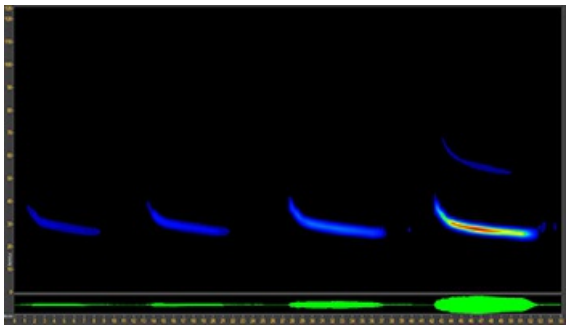
Given the above comments, we agree with Chris Corben, that it is conceivable that the recordings were produced by two bat species – Serotine and Leisler's Bat. However, there are still some unexpected characters that initially led us to consider Parti-coloured Bat, where we are still not confident to assign these to Serotine and Leisler's Bat.



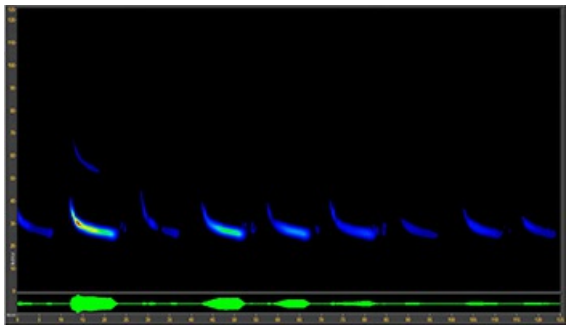
Unidentified - 7th Sept 003904



Unidentified - 7th Sept 035201



Unidentified - 9th Sept 030556



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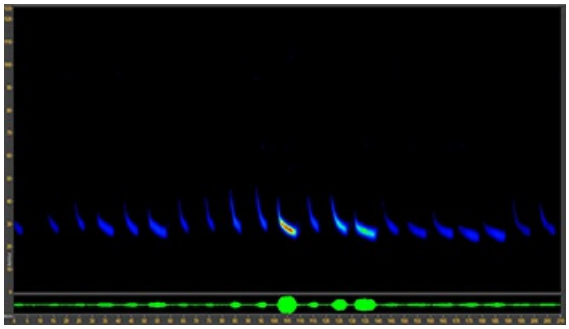

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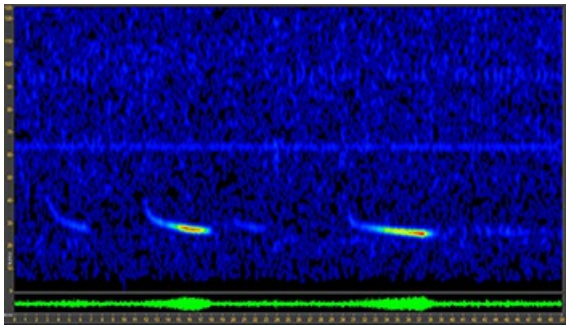
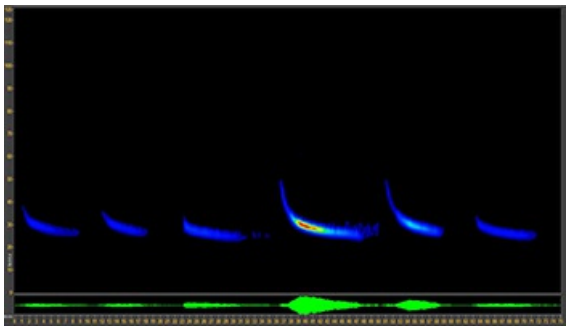
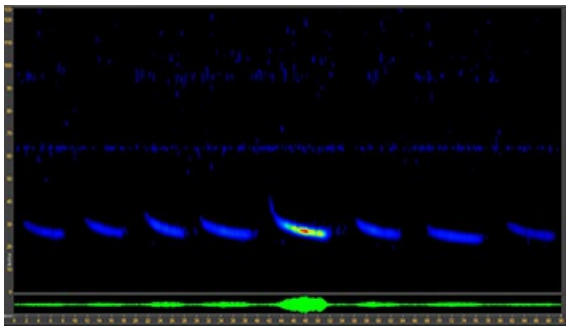


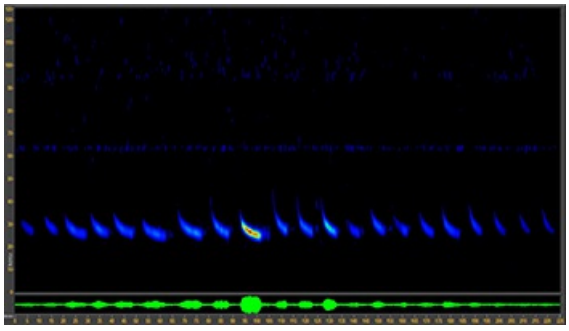
Unidentified - 9th Sept 051133



Unidentified - 9th Sept 051157



Unidentified - 9th Sept 051202



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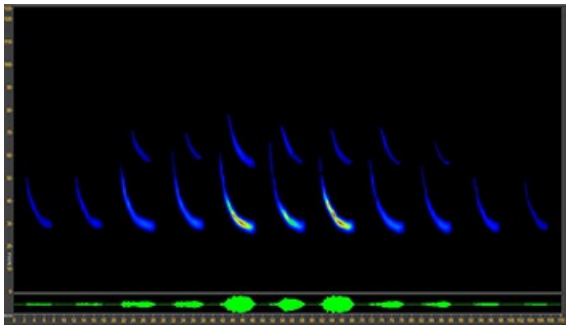

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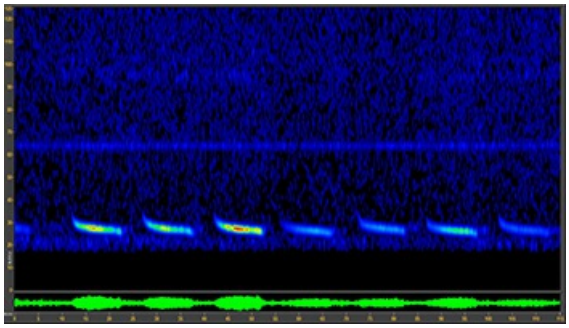
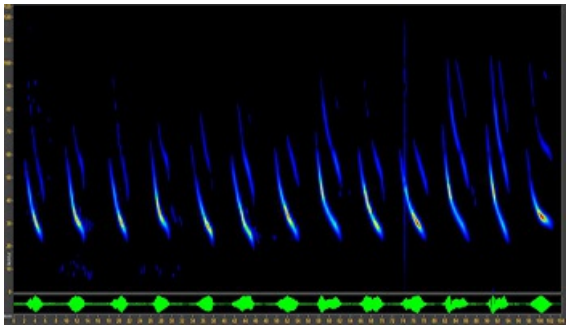
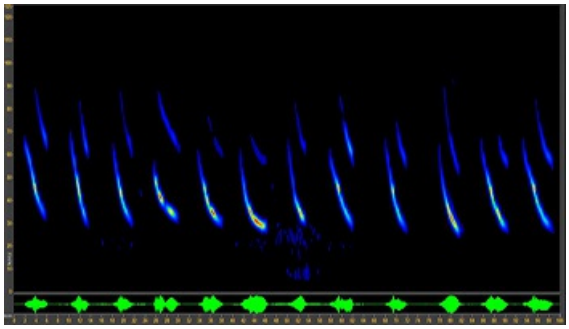


Unidentified - 8th Sept 025418

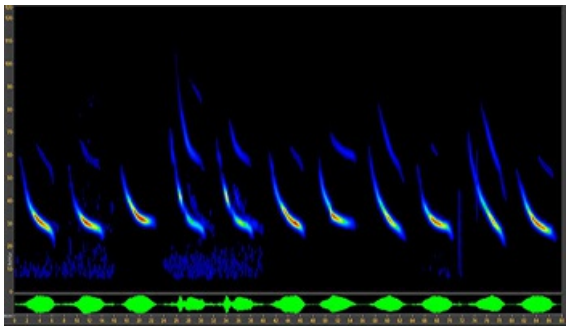
Identification appendix 9: Parti-coloured Bat *Vespertilio murinus* and Leisler's Bat *Nyctalus leisleri*



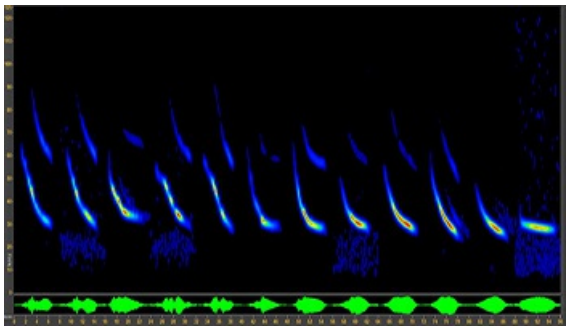
Parti-coloured Bat - call duration 3.0-4.0 ms



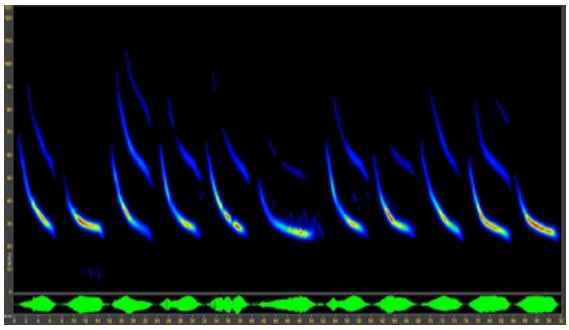
Leisler's Bat - call duration 3.0-4.0 ms



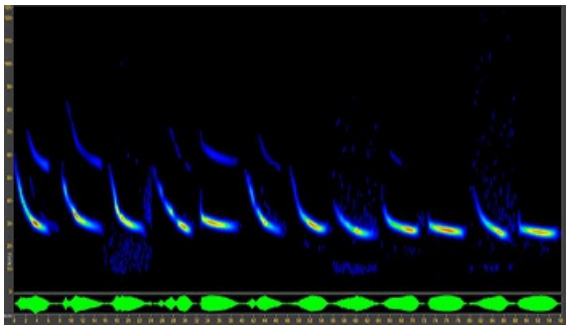
Parti-coloured Bat - call duration 5.0 ms



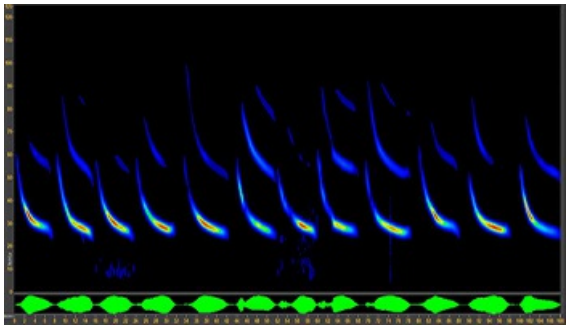
Leisler's Bat - call duration 5.0 ms



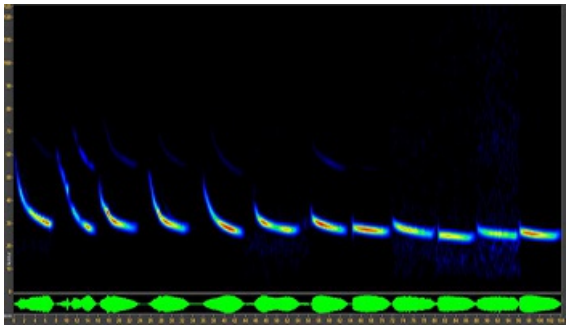
Parti-coloured Bat - call duration 6.0 ms



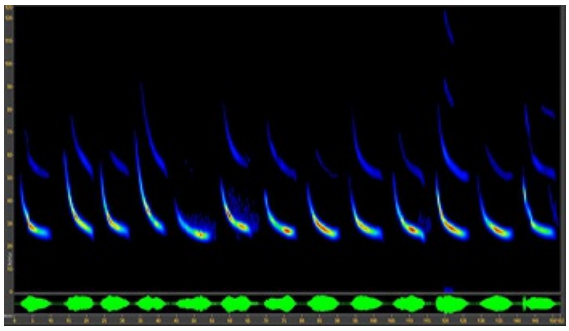
Leisler's Bat - call duration 6.0 ms



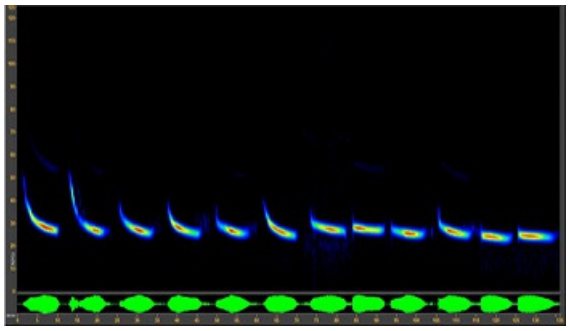
Parti-coloured Bat - call duration 7.0 ms



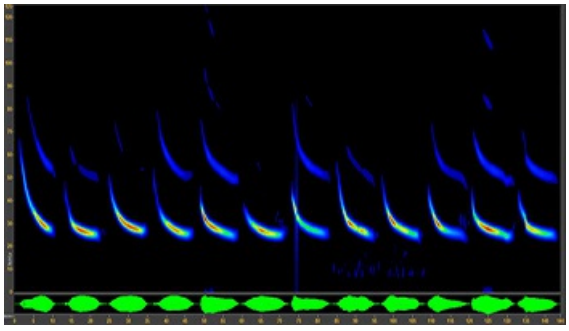
Leisler's Bat - call duration 7.0 ms



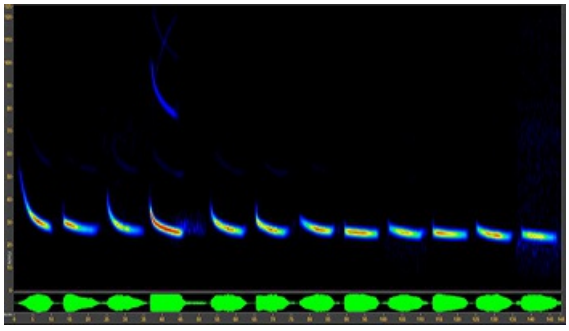
Parti-coloured Bat - call duration 8.0 ms



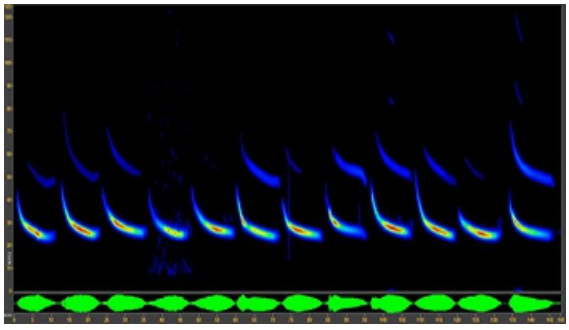
Leisler's Bat - call duration 8.0 ms



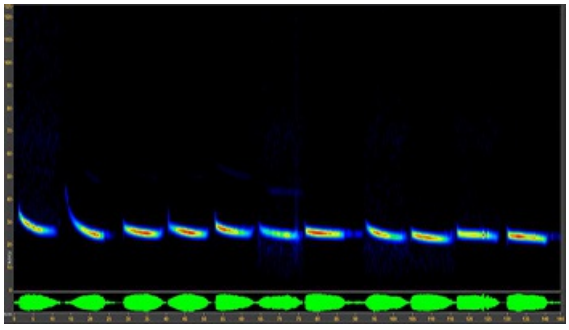
Parti-coloured Bat - call duration 9.0 ms



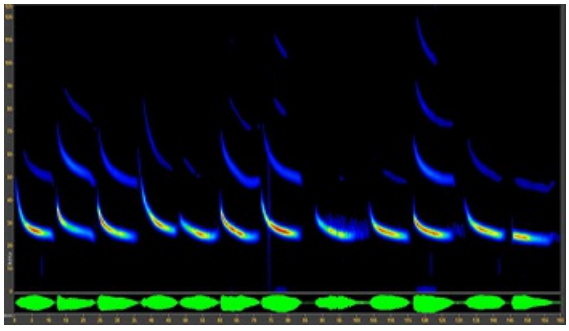
Leisler's Bat - call duration 9.0 ms



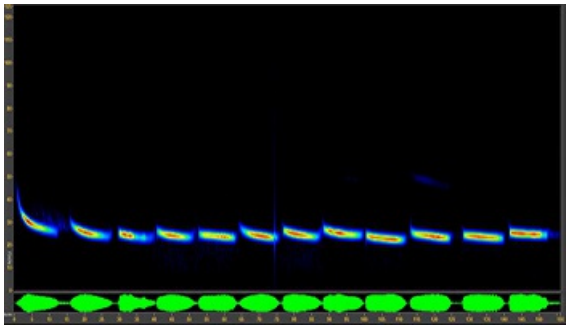
Parti-coloured Bat - call duration 10.0 ms



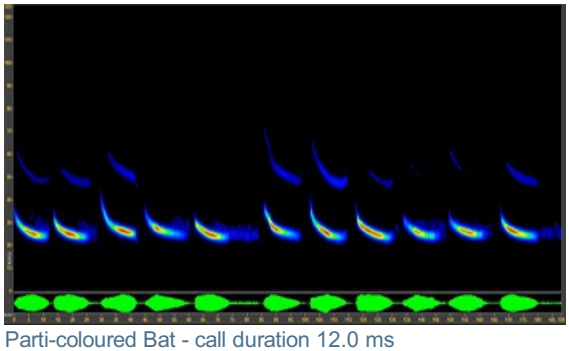
Leisler's Bat - call duration 10.0 ms



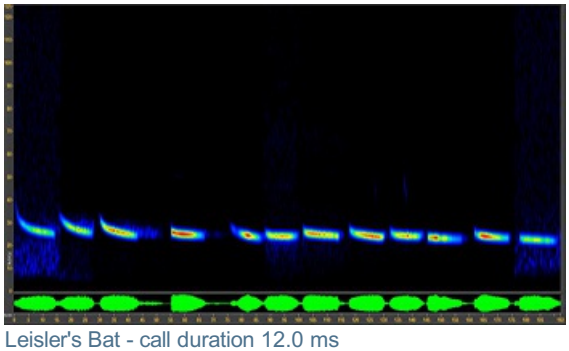
Parti-coloured Bat - call duration 11.0 ms



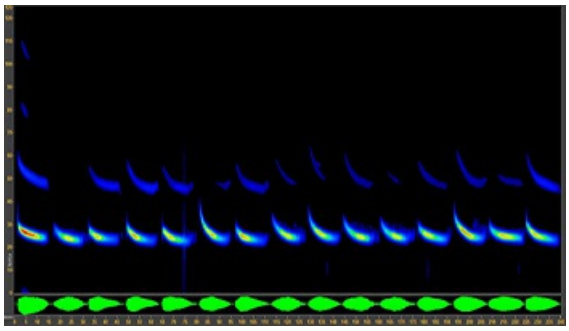
Leisler's Bat - call duration 11.0 ms



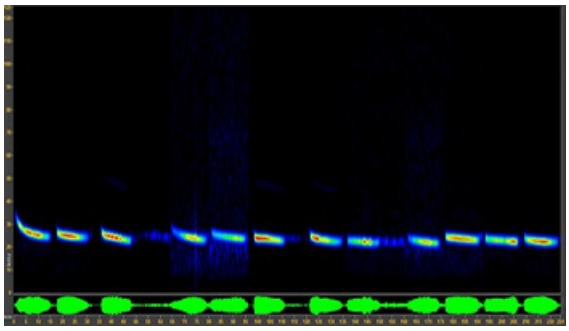
Parti-coloured Bat - call duration 12.0 ms



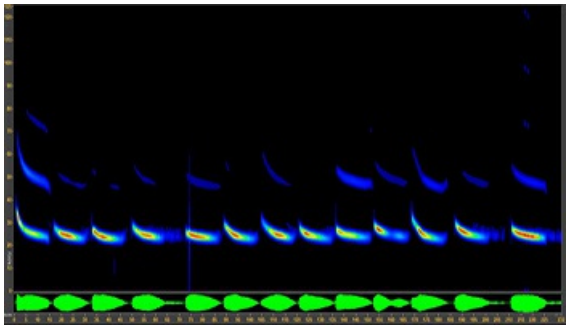
Leisler's Bat - call duration 12.0 ms



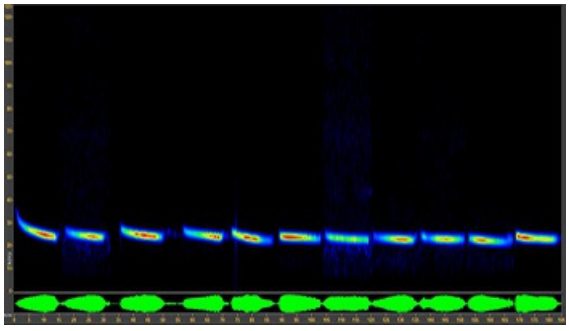
Parti-coloured Bat - call duration 13.0 ms



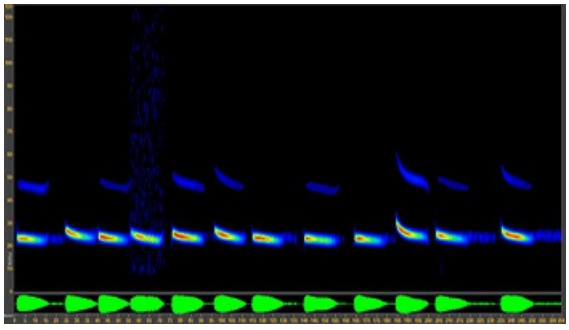
Leisler's Bat - call duration 13.0 ms



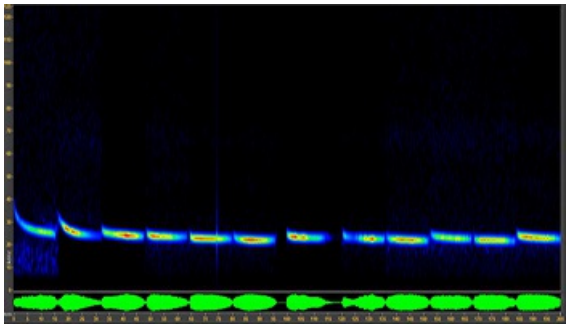
Parti-coloured Bat - call duration 14.0 ms



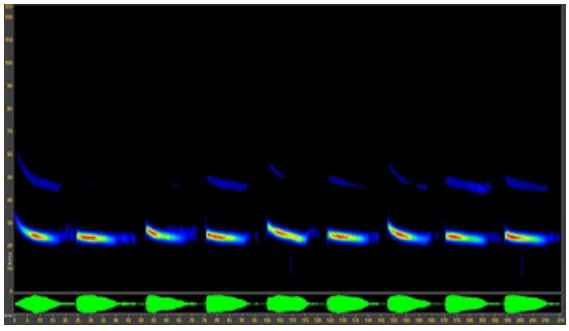
Leisler's Bat - call duration 14.0 ms



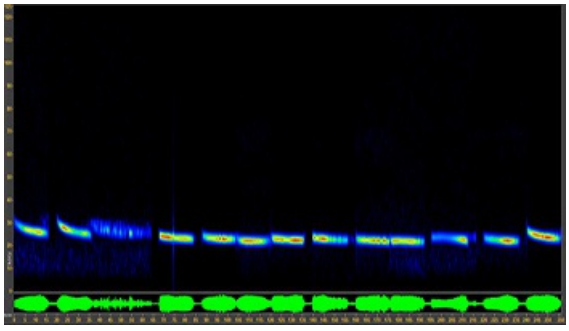
Parti-coloured Bat - call duration 15.0 ms



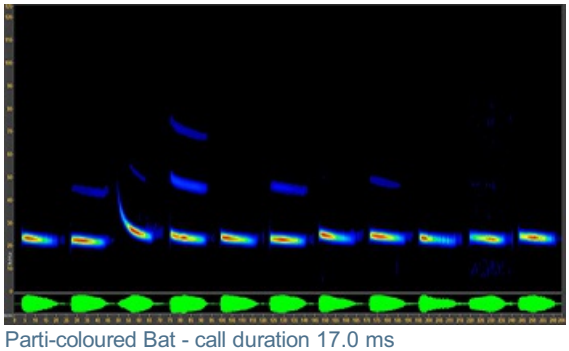
Leisler's Bat - call duration 15.0 ms



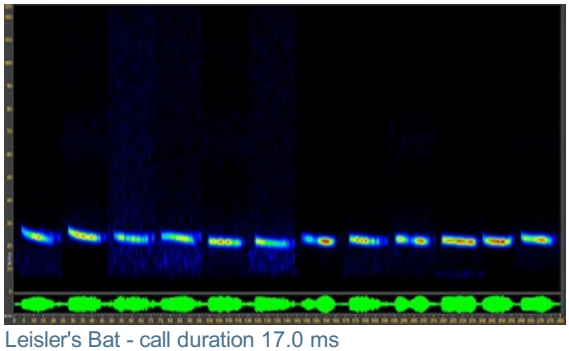
Parti-coloured Bat - call duration 16.0 ms



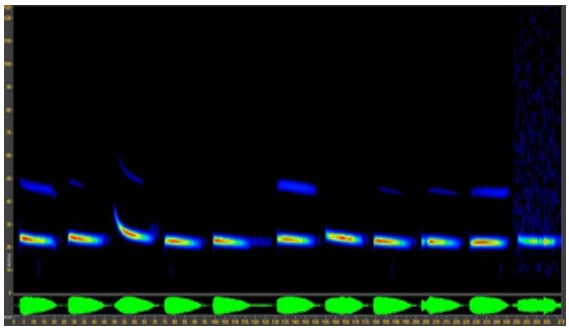
Leisler's Bat - call duration 16.0 ms



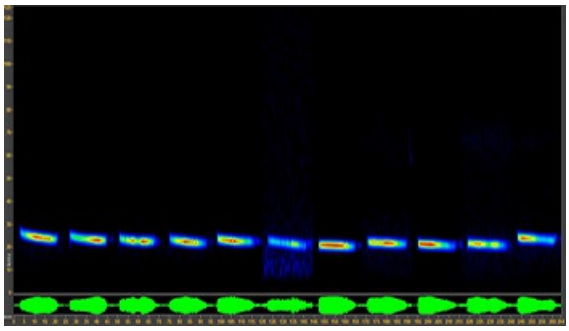
Parti-coloured Bat - call duration 17.0 ms



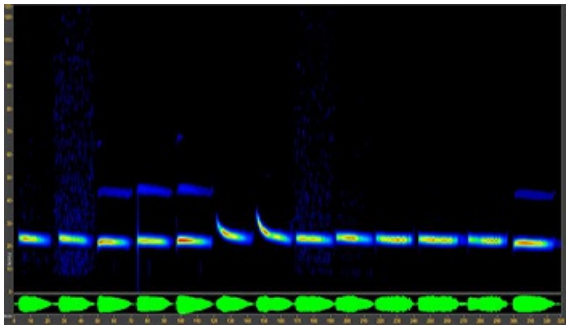
Leisler's Bat - call duration 17.0 ms



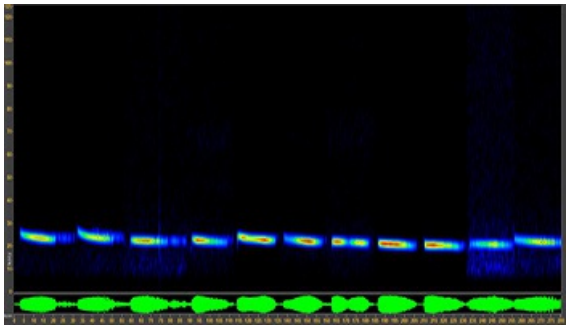
Parti-coloured Bat - call duration 18.0 ms



Leisler's Bat - call duration 18.0 ms



Parti-coloured Bat - call duration 19.0-24.0 ms



Leisler's Bat - call duration 19.0-24.0 ms




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: Whiskered Bat, by Chris Damant.

Bailiwick Bat Survey: 2021–2024 Report

This report presents the main findings from survey work delivered using passive acoustic monitoring devices deployed across the Bailiwick of Guernsey. 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 bats, small terrestrial mammals and insects. Through this 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*, *Plecotus* or *Nyctalus*/*Eptesicus*). Where such species are recorded, we provide additional information to support their identification. A secondary aim of our work is to improve the wider understanding of species identification, inspiring a culture of critical thinking and the use of emerging technologies to improve the current knowledge base.

Newson, S.E., Allez, S.L., Coule, E.K., Guille, A.W., Harper, J., Henney, J.M., Higgins, L., Lewis, M., McLellan, G.D., Simmons, M.C., Sweet, E., Whitelegg, D. & Atkinson, P.W. (2025). Bailiwick Bat Survey: 2021–2024 report. *BTO Research Report* **777**, BTO, Thetford, UK.

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