BTO RESEARCH REPORT 743

Bailiwick Bat Survey: 2021 Report

Newson, S.E., Allez, S.L., Coule, E.K., Gillings, S., Harper, J., Henney, J.M., Higgins, L., Simmons, M.C., Sweet, E., Whitelegg, D. & Atkinson, P.W.

BTO
Inspired by birds, informed by science

RECOMMENDED CITATION: Newson, S.E., Allez, S.L., Coule, E.K., Gillings, S., Harper, J., Henney, J.M., Higgins, L., Simmons, M.C., Sweet, E., Whitelegg, D. & Atkinson, P.W. 2022 . Bailiwick Bat Survey: 2021 season report. BTO Research Report 743, BTO, Thetford.

Graphs and mapping by S. Gillings

Cover design by M.P. Toms

SUMMARY

Background Working with a network of volunteers, static acoustic bat detectors were deployed over a long survey season, to provide the first extensive baseline data for bats for the islands of Guernsey, Alderney, Herm and Sark. This report provides an overview of the survey coverage and main results from 2021, the first season of the Bailiwick Bat Survey.

Coverage During 2021, 613 different locations across the Bailiwick of Guernsey were surveyed. Recording was undertaken on 234 different nights mainly between April and the end of October, amounting to a total of 2,221 nights of recording effort across sites. Sound recordings (wav files) were uploaded by volunteers to the BTO Acoustic Pipeline, where a first automated analyses was carried out and provisional results returned. Recordings were then moved to deep glacial storage for later auditing. At the end of the survey season, a copy of the recordings was pulled back, and manual auditing of the results / recordings carried out.

Results Overall, 720,011 recordings were collected which, following analyses and validation, were found to include 710,260 bat recordings, and 8,211 small terrestrial mammal recordings. Over 1.5 million recordings of bush-crickets and audible moth species were also recorded as 'by-catch', for which we report species presence on a site and night basis. Following validation, the study confirmed the presence of 12 bat species, 5 small mammal species, 6 species of bush-crickets, and 2 audible moth species. This includes the first records of Serotine *Eptesicus serotinus* for Guernsey, Alderney and Herm, the first Leisler's Bat *Nyctalus leisleri*, Common Noctule *Nyctalus noctula*, Lesser Horseshoe Bat *Rhinolophus hipposideros* and Whiskered or Brandt's Bat *Myotis mystacinus/brandtii* for Guernsey, and potentially the first records of Grey Long-eared Bat *Plecotus austriacus* for the islands of Herm, Sark, Jethou and Lihou. More generally, we have a much better understanding now of the status of all species of bats across the Bailiwick of Guernsey, and of the relative importance of different areas. In addition, the bush-cricket Large Conehead *Ruspolia nitidula* was recorded for the first time on Alderney, Guernsey and Lihou, which represent the first records of Large Conehead for the Channel Islands. Lastly, the project provides the first large-scale data on the distribution and activity of several species of small terrestrial mammals for 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

Bats are undoubtedly an important and poorly understood component of the Bailiwick of Guernsey's fauna and make up more than half of the terrestrial mammal species found in the islands. In 1989, when La Société Guernesiaise Bat Section was formed, only two resident species were thought to occur on Guernsey, Common Pipistrelle and Grey Long-eared Bat, and Greater Horseshoe Bat was known to have occurred in the past. Since then, the knowledge about bats has gradually grown, largely from grounded bats being found or those being found in buildings or trees during building work or arboricultural operations. In the ten years after the formation of the Bat Section, Nathusius' Pipistrelle, Brown Long-eared Bat and Greater Horseshoe Bat were added to the species list and Kuhl's Pipistrelle was added soon after in 2003. In the 2006 Transactions, Common Pipistrelle were described as common and widespread, Grey Long-eared Bats and Natterer's Bat as fairly common and widespread, Nathusius' Pipistrelle as rare migrant and winter visitor, and only a handful of records of Brown Long-eared Bat had been recorded.

Two major milestones have improved the knowledge about islands' bats. The first was the deployment of passive acoustic recorders which recorded the ultrasounds that bats make, and the development of automated software to help identify the species present based on the sounds they make. The second was the hosting of the Channel Islands Bat Conference in 2018. Experts from other islands and elsewhere visited Guernsey and trapping was carried out at several sites around the island. This confirmed Kuhl's Pipistrelle as a breeding species in Guernsey and also showed that Natterer's Bat was probably more widespread than previously thought, something that the Bat Section has confirmed through acoustic recordings. A single Greater Horseshoe Bat was also caught. By 2019, seven species were known to be present on Guernsey and there were also records of Whiskered, Brandt's Bat or Alcathoe Bat from Alderney in 2016 and 2017. Acoustic detectors deployed in different habitats and potential roost sites allowed some important sites to be identified. Soprano Pipistrelle was reported as occurring in Guernsey only in the 2013 Transactions and not since and further verification is probably needed; it has also has been reported on acoustic detectors in Alderney (Sydanmaa, 2019).

Alderney's bats were surveyed acoustically in 2019 by the Alderney Wildlife Trust in winter and spring/summer and they also undertook transect walks and trapping with support from Jersey bat workers. They confirmed the status of several species. A Brown Long-eared Bat was trapped on two occasions in 2019 during Alderney Bat Week. In terms of the acoustic recordings, they were not then able to differentiate between Grey and Brown Long-eared Bats, although 'long-eared' bats were frequently recorded across the island. An additional record of Barbastelle from September 2019 was a new species for the Bailiwick list of species.

Bats are 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 island's 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 will be 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 a network of volunteers, static acoustic bat detectors were deployed over a long survey season, to build on past work and provide the first extensive baseline data for bats for the islands.

2. AIMS AND OBJECTIVES

The Bailiwick Bat Survey capitalises on the interest and enthusiasm of volunteers to participate in biodiversity monitoring to systematically collect bat distribution and activity data across Guernsey, Alderney, Herm and Sark through a project that will run over four years. This will result in the production of a robust dataset, which will increase knowledge and understanding of bat distribution and activity across the Bailiwick of Guernsey. Based around 500 x 500-m squares, this project will provide a detailed description of the islands' bat fauna.

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

In addition to the above, the project has 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 will be to achieve survey coverage for all islands.

All maps reproduced in this report use map tiles by Stamen Design, under CC BY 3.0. Data by OpenStreetMap, under ODbL.

3. METHODS

3.1 Static detector protocol

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

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

Volunteers were directed to an online square sign-up tool, showing survey coverage (available 500-m x 500-m squares), through which they sign-up and reserve 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 reserve a bat detector from the most convenient 'bat centre', and details on how to set up a BTO Acoustic Pipeline account (see below). In this project, in 2021, the Guernsey Museum at Candie, the Guille-Allés library, Agriculture, Countryside and Land Management Services (ACLMS), Alderney Wildlife Trust and Sark School hosted bat detectors.

The bat detectors were set to record with a sample rate of 384 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 30 minutes before sunset until 30 minutes after sunrise the following day. The detector was mounted on 2-m poles to avoid ground noise and reduce recordings of reflected calls. Guidance was provided to volunteers on the placement of microphones should be deployed at least 1.5-m in any direction from vegetation, water or other obstructions.

3.2 Survey effort and timing

The survey period ran from the beginning of April to the end of October, but with a small amount of recording outside this period. A long survey season covers the main period of bat activity, and maximises use of the equipment during the year. 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), along with associated information on where the recording was carried out were uploaded by the volunteer to the BTO's Acoustic Pipeline http://bto.org/pipeline for processing. Volunteers have their own online user account, and desktop software through which they, or the local project organiser if needed, can upload recordings directly to the cloud-based 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 the survey season.

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

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

Our recommendation, which is supported in Barré *et al.* (2019), is that identifications with a probability of less than 0.5 (50%) are discarded. However, manually auditing of a sample of recordings (wav files) that are below this threshold, was carried out to be confident that we were losing very little by doing this.

For bats and small mammals where we were interested in producing a measure of activity, we manually checked all the recordings of a species. With the exception of the most common species, Common Pipistrelle *Pipistrellus pipistrellus*, we checked a random sample of 1,000 recordings to quantify the error rate in the dataset. For bush-crickets and audible moths where there can be a large number of recordings, often of the same individual, we instead focus on producing an inventory of species presence instead, where the three recordings with the highest probability for each site and night were selected for auditing.

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

It is important to note that the criteria for distinguishing Whiskered Bat *Myotis mystacinus* and Brandt's Bat *Myotis brandtii* are very subtle and poorly defined. We provide separate results for these two species in the results section, but these two species are extremely difficult to distinguish acoustically, and until further ground-truthing of the identification can be carried out, it would be best to treat these as a species pair.

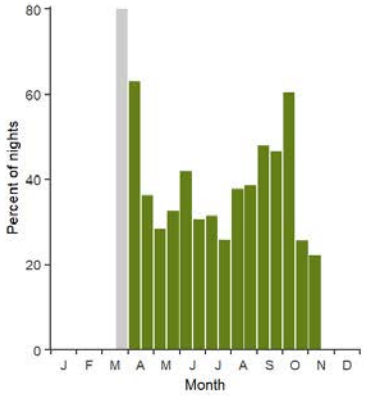
The echolocation calls of Kuhl's Pipistrelle and Nathusius' Pipistrelle are also extremely similar, but these two species produce social calls which can be assigned to species with confidence. For this reason, we treat recordings where there are only echolocation calls as "Kuhl's Pipistrelle or Nathusius'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

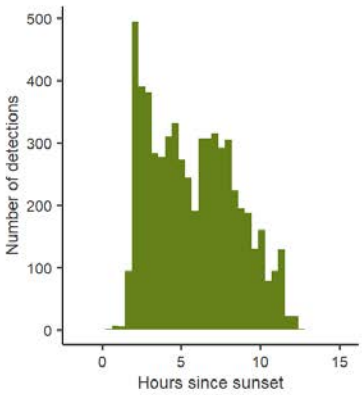
3.4 Seasonal and nightly patterns of activity

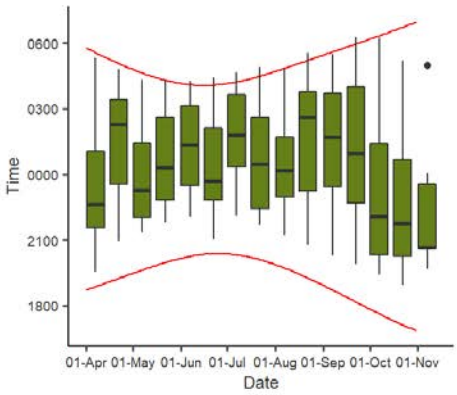
Important for improving our understanding of the species present, we examine how bat activity varied by time of night and by season. Nightly activity was determined for each half-month period and presented according to the percentage of survey nights on which each bat species was detected. Activity through 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 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. If present, pale grey bars represent periods with fewer than 10 nights of recording where accuracy of the reporting rate may be low. The middle plot shows the overall spread of recordings with respect to sunset time, calculated over the whole season. The right plot shows the spread of recordings with respect to sunset and sunrise times (red lines) summarised for each half-month through the season. For this last seasonal plot, the individual boxplot show quartiles (lower, median and upper) with lines extend to 1.5 times the interquartile range, and small dots show outliers. For the latter plot only, we exclude the small number of records

before the 1st April.







3.5 Spatial patterns of activity and distribution

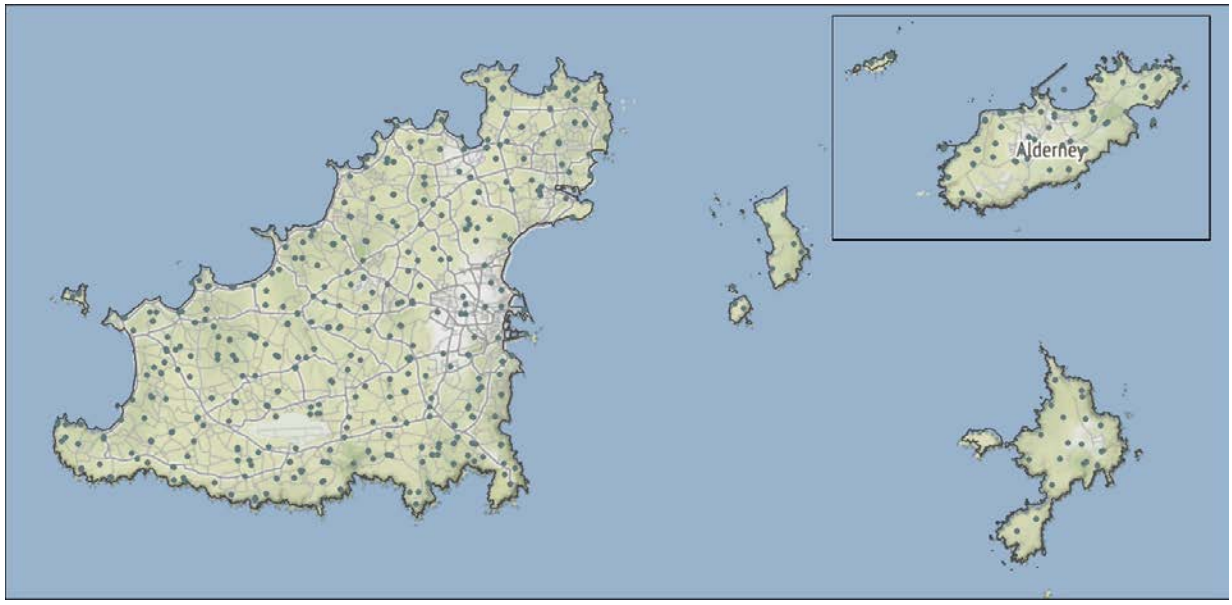
We produce maps of bat and small mammal activity. With these, dots are scaled according to the total number of recordings of this species at each location. Activity here represents usage of an area, which will be a combination of species abundance, and time spent in the area. For bush-crickets and audible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

4. RESULTS

4.1 Survey coverage

During 2021, 613 different locations were surveyed for bats, with all recordings uploaded and processed through the BTO Acoustic Pipeline. The distribution of these locations is shown below. Out of 360 500-m x 500-m survey squares originally identified, recording took place in 85% of them. Collectively across all these sites, 2,221 complete nights of recording effort was conducted. The recording effort spanned 234 different nights and 11 months. The seasonal pattern of recording effort is shown in the bottom figure.

Map of the study area showing locations where detectors were deployed in 2021.



Number of locations surveyed per half-month in 2021.

4.2 General results

Overall, 720,011 recordings were collected which, following analyses and validation, were found to include 710,260 bat recordings, and 8,211 small terrestrial mammal recordings. In addition, several species of bush-crickets and audible moth species were recorded (see table below). Manual checking of recordings was carried out for all species and recordings, except for Common Pipistrelle for which 1,000 randomly selected recordings were checked. Of these, no recordings were assigned to the wrong species. Following validation, the presence of 12 bat species, 5 small mammal species, 6 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, Eptesicus serotinus	84	31 (5.1%)
Whiskered or Brandt's Bat, Myotis mystacinus or M. brandtii	10	5 (0.8%)
Natterer's Bat, Myotis nattereri	6040	349 (56.9%)
Natterer's Bat Social Calls, Myotis nattereri	18	9 (1.5%)
Leisler's Bat, Nyctalus leisleri	22	5 (0.8%)
Common Noctule, Nyctalus noctula	11	2 (0.3%)
Kuhl's Pipistrelle or Nathusius' Pipistrelle, Pipistrellus kuhlii or P. nathusii	17379	469 (76.5%)
Kuhl's Pipistrelle Social Calls, Pipistrellus kuhlii	424	53 (8.6%)
Nathusius' Pipistrelle Social Calls, Pipistrellus nathusii	123	12 (2%)
Common Pipistrelle, Pipistrellus pipistrellus	665271	598 (97.6%)
Brown Long-eared Bat, Plecotus auritus	313	75 (12.2%)
Grey Long-eared Bat, Plecotus austriacus	20538	491 (80.1%)
Greater Horseshoe Bat, Rhinolophus ferrumequinum	25	10 (1.6%)
Lesser Horseshoe Bat, Rhinolophus hipposideros	2	1 (0.2%)

Small mammals

Species	No. of recordings following validation	No. of different locations (% of total)
Wood Mouse, Apodemus sylvaticus	23	5 (0.8%)
Greater White-toothed Shrew, Crocidura russula	1490	223 (36.4%)
Lesser White-toothed Shrew, Crocidura suaveolens	5	1 (0.2%)
Brown Rat, Rattus norvegicus	6642	172 (28.1%)
Black Rat, Rattus rattus	51	12 (2%)

Bush-crickets

Species	No. of different locations (% of total)
Short-winged Conehead, Conocephalus dorsalis	2 (0.3%)
Long-winged Conehead, Conocephalus fuscus	59 (9.6%)
Speckled Bush-cricket, Leptophyes punctatissima	141 (23%)
Grey Bush-cricket, Platycleis albopunctata	101 (16.5%)
Large Conehead, Ruspolia nitidula	3 (0.5%)
Great Green Bush-cricket, Tettigonia viridissima	271 (44.2%)

Moths

Species	No. of different locations (% of total)
Green Silver-lines, Pseudoips prasinana	22 (3.6%)
Bird Cherry Ermine, Yponomeuta evonymella	32 (5.2%)

4.3 Species and call-type results

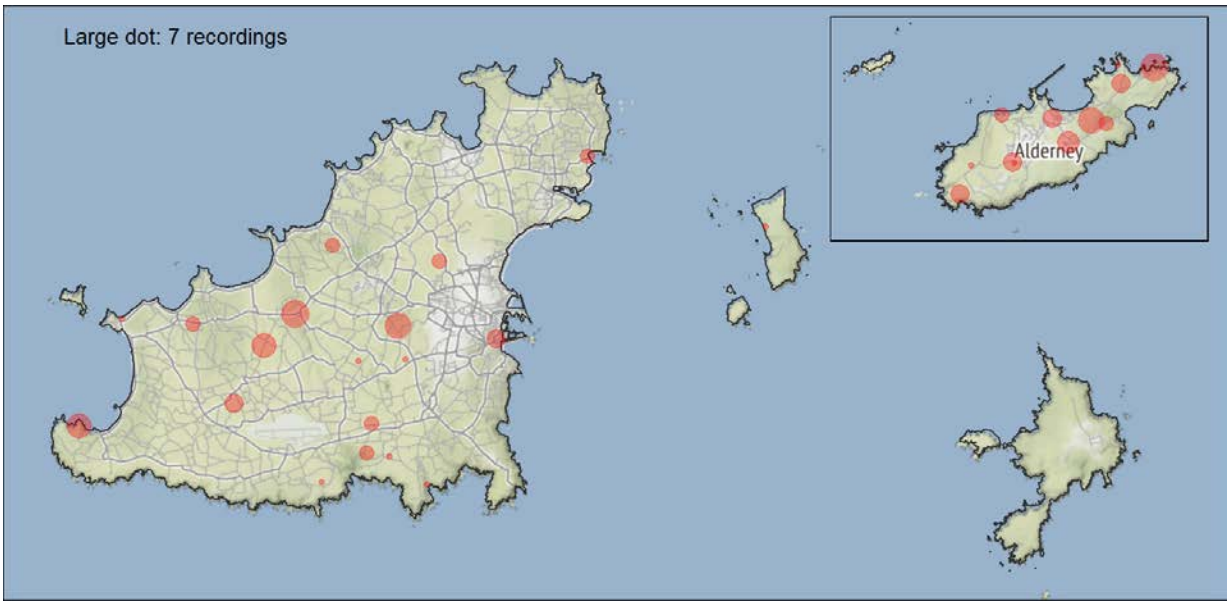
The following sections provide results for each species and/or call type.

4.3.1 Bat species

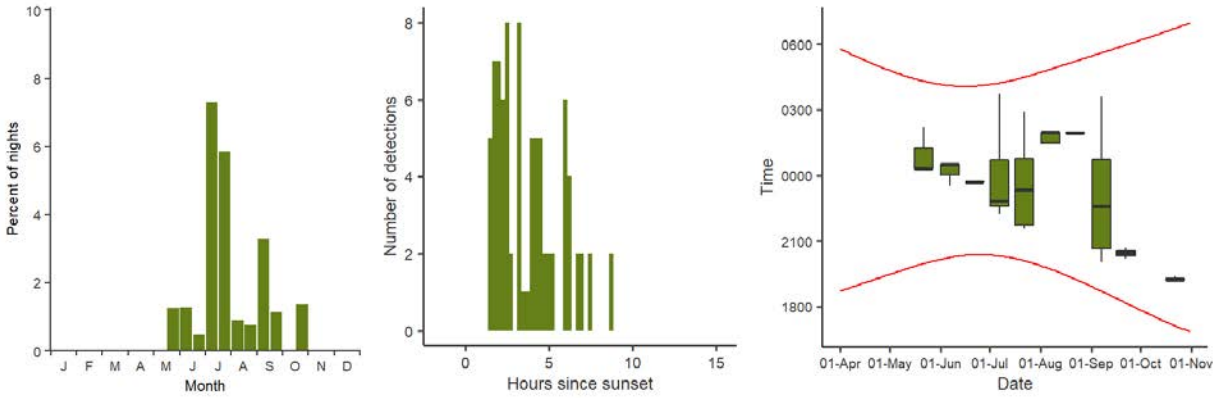
Serotine

Serotine *Eptesicus serotinus* was recorded on 33 nights, from 31 locations, giving a total of 84 recordings.

Spatial pattern of activity



Seasonal and nightly activity

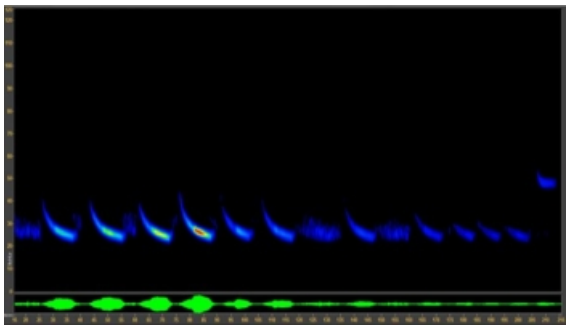


Serotine - new species for Guernsey, Alderney and Herm was first recorded on Alderney in the early hours of 20th May (two recordings), followed by a single recording from the same location on the 27th May. After these, there were an additional 33 recordings of Serotine from Alderney between late June and the end of September from a further eight locations. On Guernsey, Serotine was first recorded on the 5th June (two recordings at one location), and a single recording at a second location. This was followed by a further 49 recordings from 18 new locations in the second half of the season (four locations in June, a peak of eight in July, two in August, five in September and one in October). From Herm, there was a single recording from the 30th June.

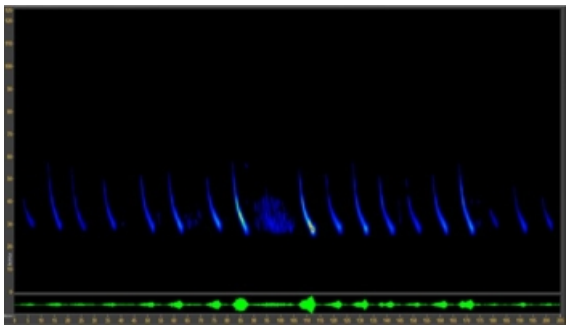
Serotine is typically a species of open country and its status in the islands is unclear. After an absence of records in April and May, there were a few in June and then, after a sudden late summer peak, numbers dropped back off again. It may be a rare resident or possibly a migrant. It is scarce in Jersey, and present on the adjacent coasts of France. Below, we show spectrograms from four 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

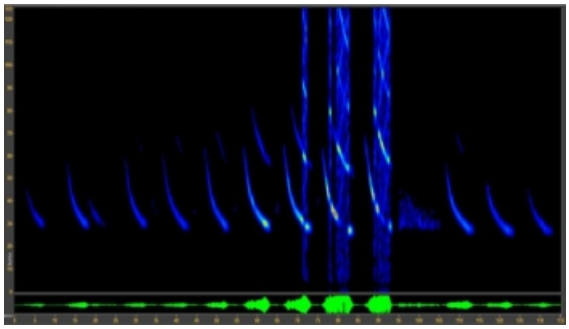
within a sequence of over 2 kHz, where such changes would be unusual for Serotine. One situation where it can be more difficult to distinguish Serotine/*Nyctalus* is in high clutter, but *Nyctalus* normally do not stay long in high clutter, so it would be exceptional to find consecutive steep calls of these species.



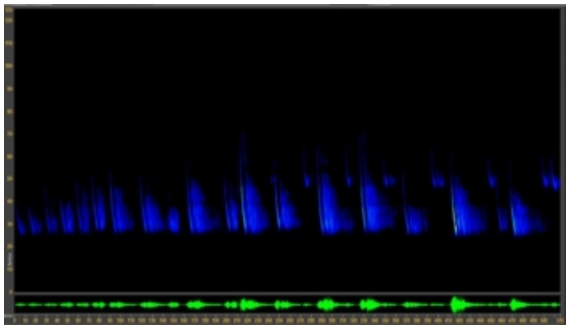
Serotine - Guernsey, 4th August



Serotine - Alderney, 3rd July



Serotine - Guernsey, 4th September

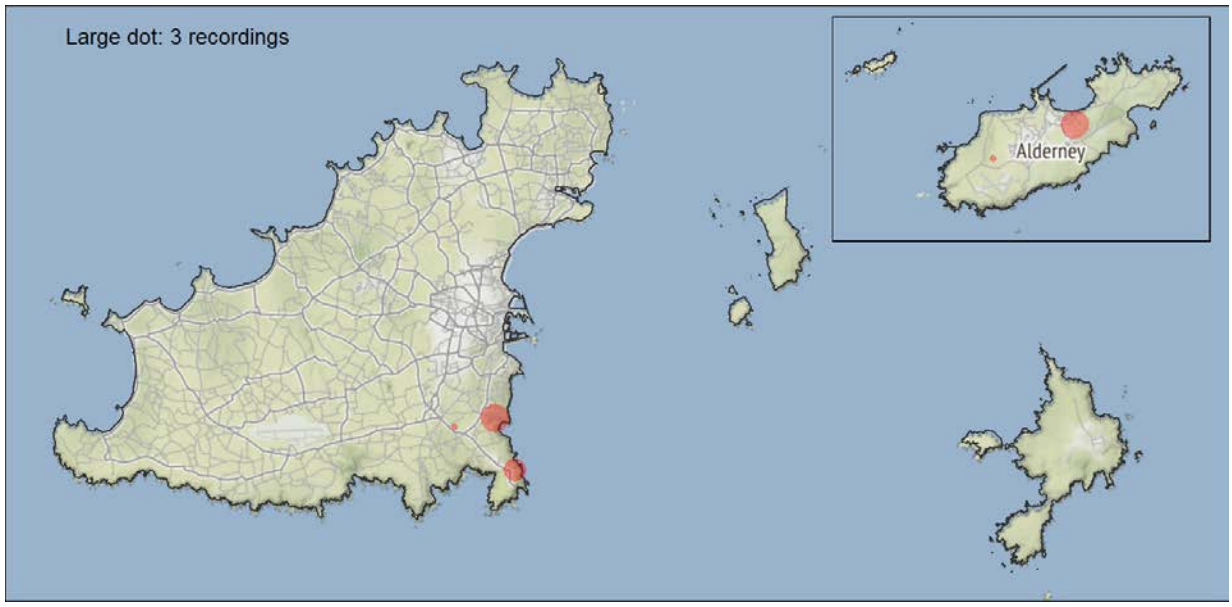


Serotine - Alderney, 3rd July

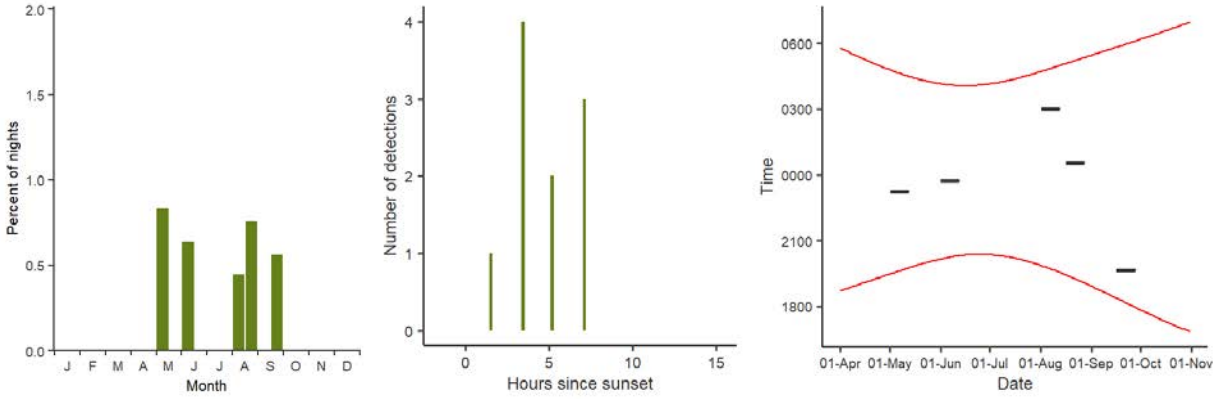
Whiskered or Brandt's Bat

Whiskered or Brandt's Bat *Myotis mystacinus or M. brandtii* was recorded on five nights, from five locations, giving a total of 10 recordings.

Spatial pattern of activity



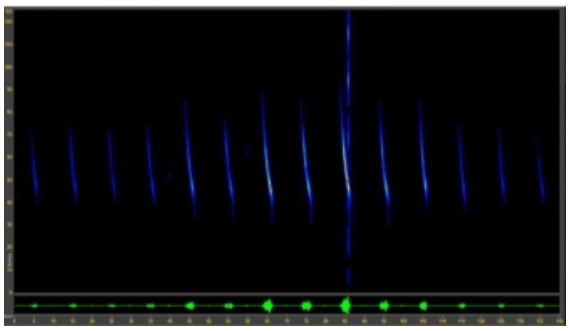
Seasonal and nightly activity



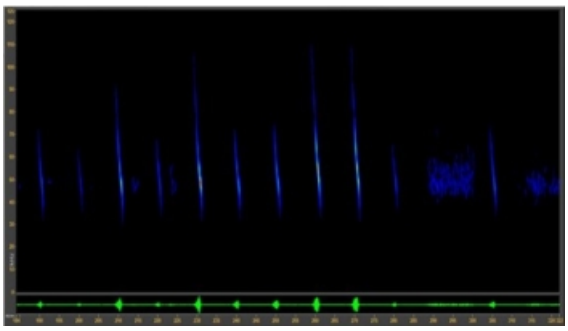
Whiskered or Brandt's Bat - new species for Guernsey and possibly Alderney (depending on species) At the current time, there are no good clear criteria for distinguishing Whiskered and Brandt's Bat acoustically with confidence, but either Whiskered or Brandt's Bat would be a new species for Guernsey. On Alderney, there is a single previous record of Whiskered, Brandt's or Alcathoe Bat *M. alcathoe*.

In 2021, we assigned eight recordings to Whiskered or Brandt's Bat. Four of these recordings were from Alderney (three recordings from the 13th May from the same location and night and being within ten seconds of each other are likely to relate to the same individual bat, and one recording from the 7th June). The remaining six recordings were from the south-east corner in Guernsey (three recordings on the 3rd August in woodland in Fermain valley, two recordings along a woodland edge above Divette and one inland recording on the opposite side of the road to the Co-op in St Martin on the 25th September). It is a species typical of open country, parks, gardens. The series of records from the south-east of Guernsey span a number of months (June, August and September), perhaps suggesting that this species is an extremely rare resident confined to this small area. For further discussion on our approach to the sound identification of *Myotis* see Identification appendix 1.

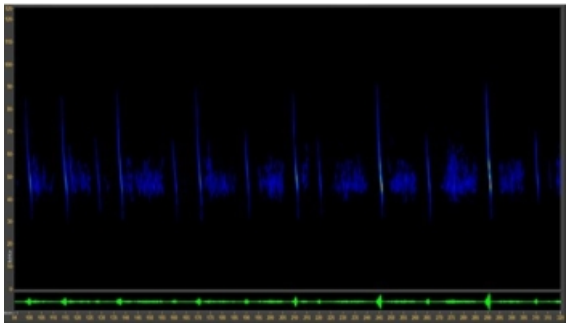
Brandt's Bat is rare or a vagrant in Jersey, while Whiskered Bat is considered to be very rare. In neighbouring France, Brandt's Bat is absent from Normandy and rare in Brittany. Whiskered Bat is much more common in both areas and, based on this evidence, the recordings may well be of this species, but this needs to be proven by some other means (e.g. DNA evidence or trapping).



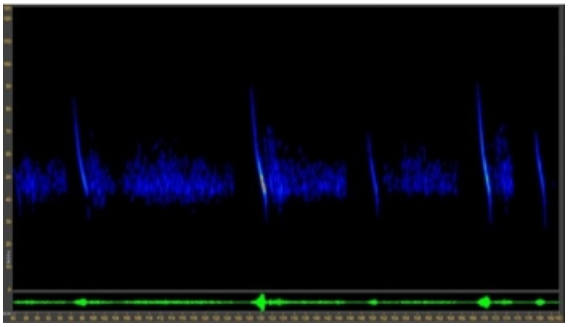
Whiskered or Brandt's Bat - Guernsey, 25th September



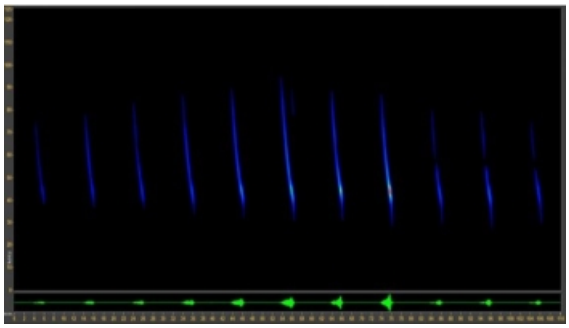
Whiskered or Brandt's Bat - Guernsey, 3rd August



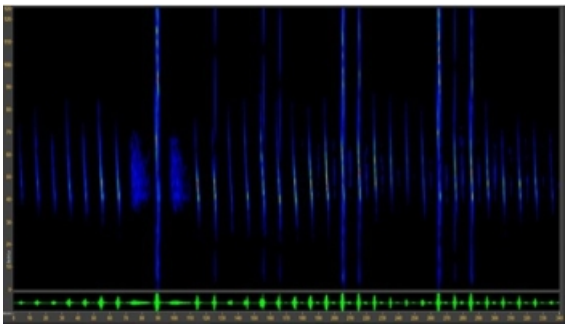
Whiskered or Brandt's Bat - Guernsey, 3rd August



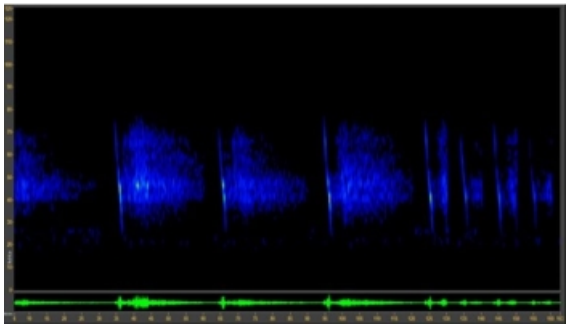
Whiskered or Brandt's Bat - Guernsey 3rd August



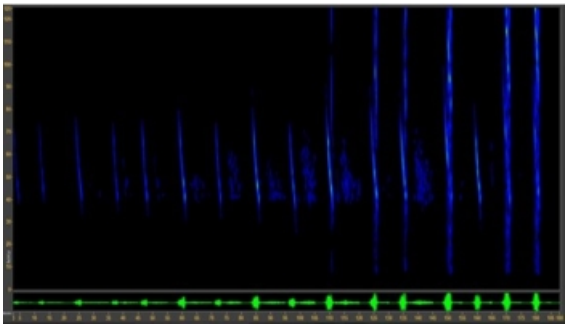
Whiskered or Brandt's Bat - Alderney, 7th June



Whiskered or Brandt's Bat - Alderney, 13th May



Whiskered or Brandt's Bat - Alderney, 13th May

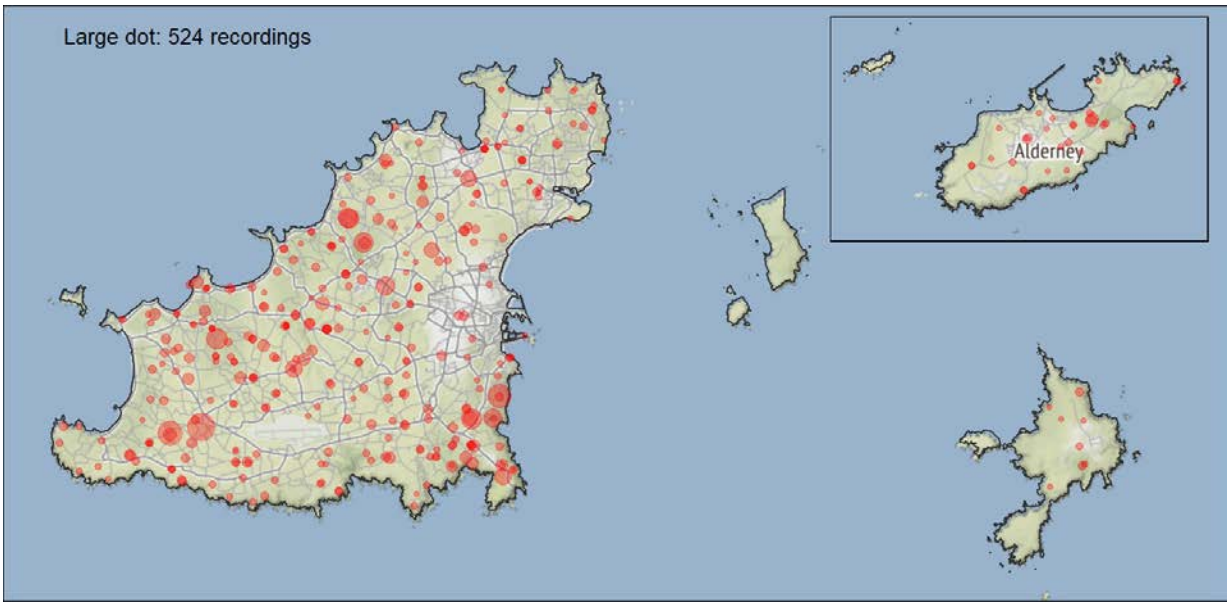


Whiskered or Brandt's Bat - Alderney, 13th May

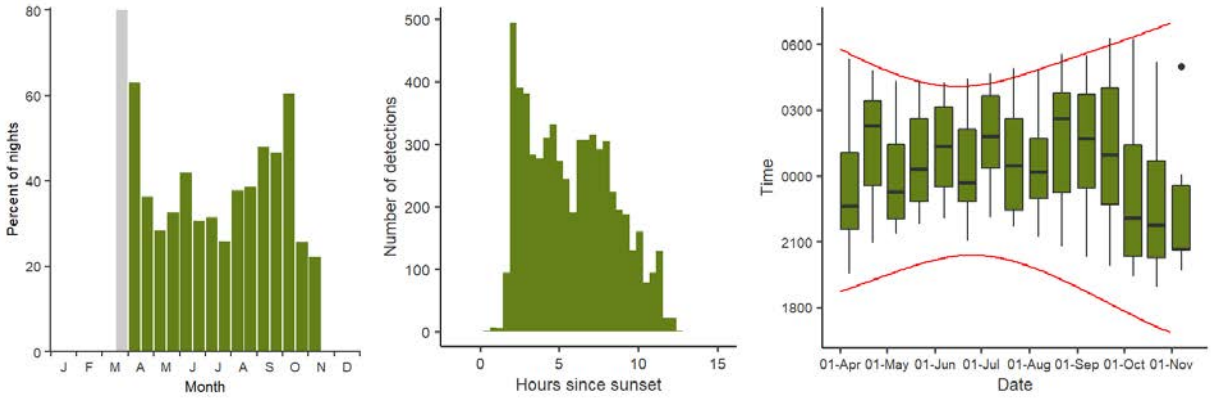
Natterer's Bat

Natterer's Bat *Myotis nattereri* was recorded on 209 nights, from 349 locations, giving a total of 6,040 recordings.

Spatial pattern of activity



Seasonal and nightly activity



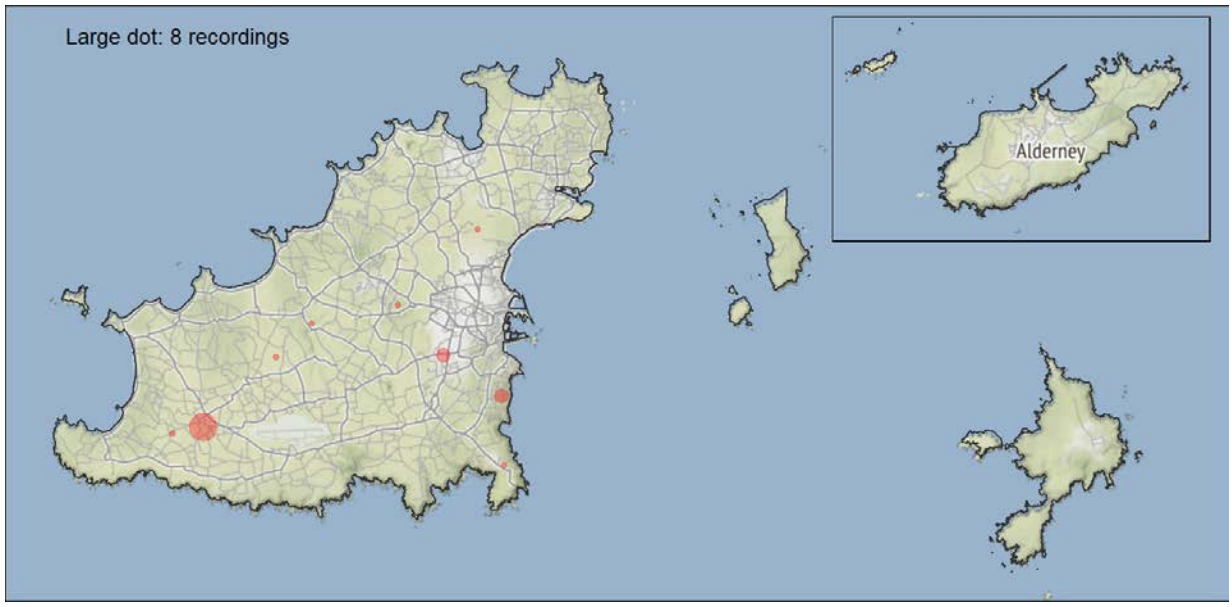
Natterer's Bat was widely recorded in 2021, with records from Guernsey, Sark and Alderney. In Guernsey it was widespread, but concentrations were found in the south-east corner of Guernsey and along a line going south-west from the Saumarez Nature Trail/Saumarez Park to the Reservoir and then down to an area along St Peter's church and an area at the top of the Quanteraine Valley. They forage around semi-natural broad-leaved woodland and open water sheltered by tree cover although they will use grassland too. This is reflected in the higher activity in areas with woodland and parkland as well as around the Reservoir. In Alderney it was widespread, but larger numbers of recordings were obtained in and around the Community Woodland.

As with Whiskered and Brandt's Bat above, the first consideration when looking at recordings is the quality of the recording, to consider whether the quality is good enough to try and assign the recording to species. This was the only other *Myotis* species that was identified through the project in 2021. On neighbouring Jersey, other *Myotis* species that have been recorded include Whiskered Bat, Brandt's Bat, Daubenton's Bat *M. daubentonii*, Alcathoe Bat *M. alcathoe* and Geoffroy's Bat *M. emarginatus* (Hall, 2021). See Identification appendix 2 for further information on the sound identification of Natterer's Bat. Some additional information on where social calls of Natterer's Bat, which may be associated with swarming in the vicinity of roost sites is given in the next section of the report.

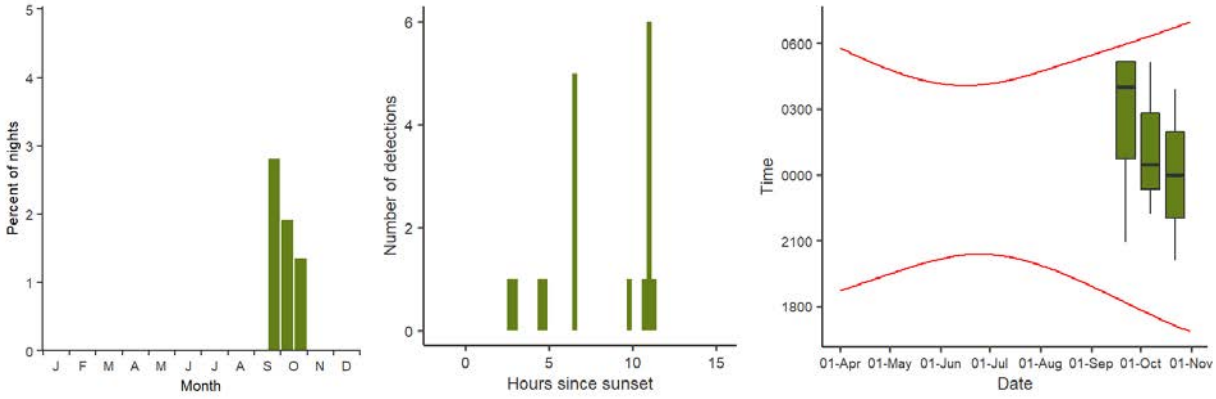
Natterer's Bat Social Calls

Natterer's Bat Social Calls *Myotis nattereri* was recorded on seven nights, from nine locations, giving a total of 18 recordings.

Spatial pattern of activity



Seasonal and nightly activity

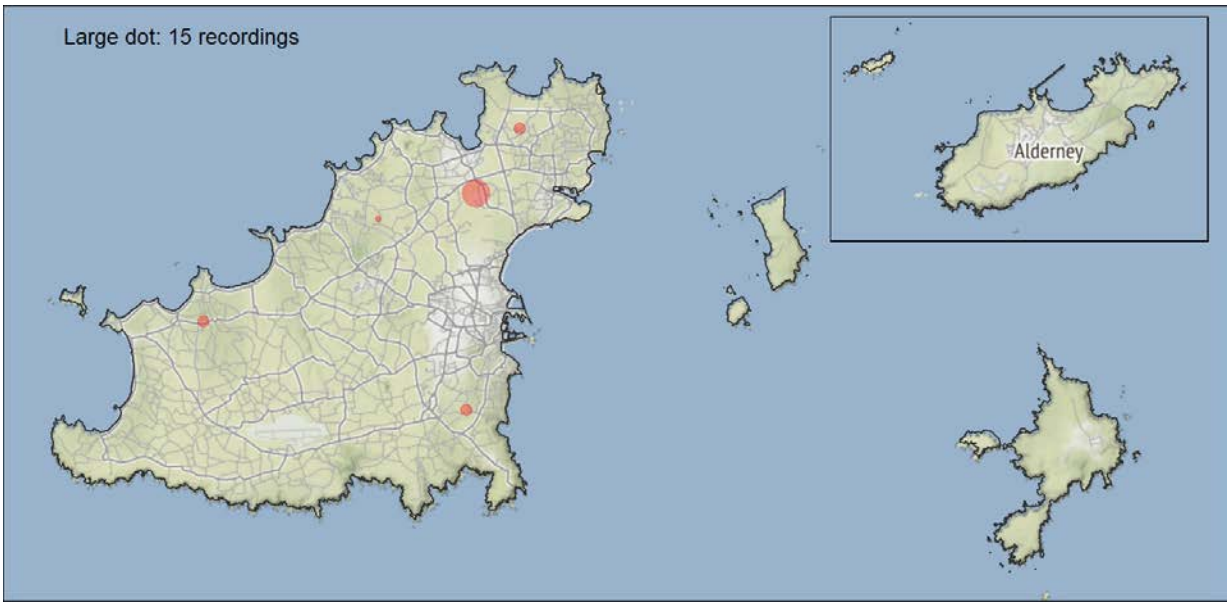


Natterer's Bat social calls. Social calls of bats are different from echolocation calls which they use to navigate their way around the landscape, in that they are often used when bats interact with one another. Natterer's Bat social calls in October or November may be associated with swarming in the vicinity of roost sites. By far the largest number of social calls were recorded in Saumarez Park and in the area below St Peter's church, and smaller numbers around Fermain, the Reservoir, the St Germain Nature Trail and in Talbots Valley. These all tended to be in or next to areas of broad-leaved woodland.

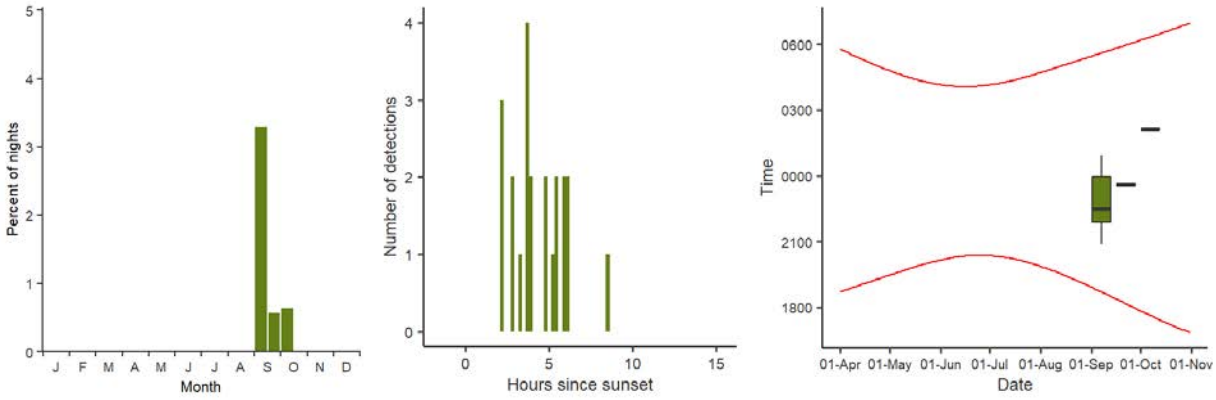
Leisler's Bat

Leisler's Bat *Nyctalus leisleri* was recorded on seven nights, from five locations, giving a total of 22 recordings.

Spatial pattern of activity

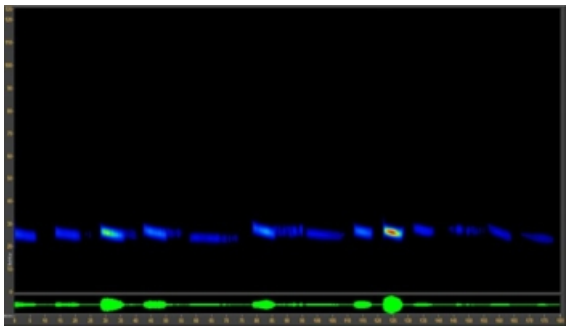


Seasonal and nightly activity

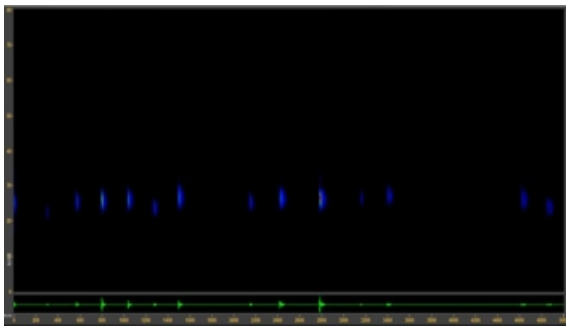


Leisler's Bat - new species for Guernsey was first recorded in the Les Effards area on Guernsey on the night of the 2nd/3rd September (two recordings), followed by two further nights (3rd/4th – four recordings and 4th/5th – nine recordings). On the latter night, the calls were spaced out from 21:36 to 23:43, a period of approximately 2 hours indicating the bat was using the area, presumably to forage in. After these first records, Leisler's Bat was recorded from a further four locations in Guernsey during September and early October (seven recordings). All of these other areas were fairly open and either in gardens or in areas of pasture and all consisted of one, or two recordings a few seconds apart, probably indicating the bat was passing through the area. It 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 (all in autumn) does suggest that it may be a rare migrant to the islands.

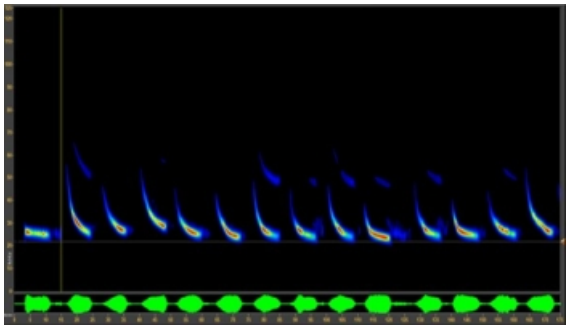
In most of the recordings, there are alternating call frequencies, which is typical for *Nyctalus*. Such alternating calls would be unexpected for Serotine, but also unlikely to be produced by Parti-coloured Bat *Vespertilio murinus*, which should probably be considered as a possible vagrant to the Channel Islands and produces 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. This is illustrated with an example below. This is observed across recordings that are very close in time and are likely to be the same bat.



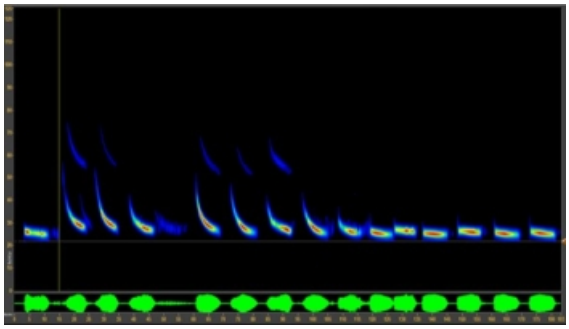
Guernsey, 3rd September



Leisler's Bat (same recording, different scale)



Leisler's Bat call from Guernsey (left), against known Leisler's Bat calls of the same duration (right)

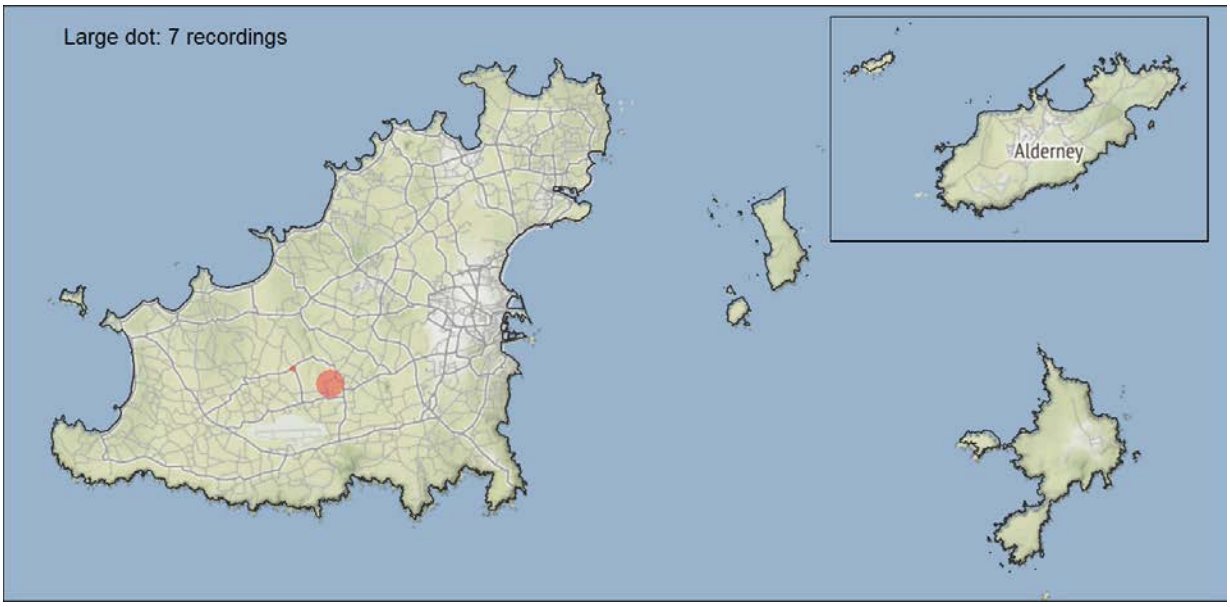


Leisler's Bat call from Guernsey (left), against known noctule calls (shown right) of the same duration

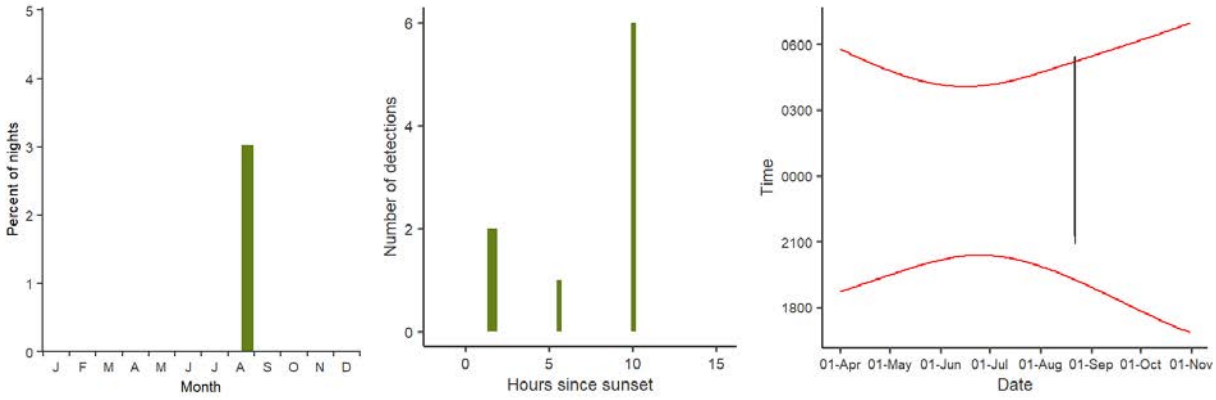
Common Noctule

Common Noctule *Nyctalus noctula* was recorded on three nights, from two locations, giving a total of 11 recordings.

Spatial pattern of activity

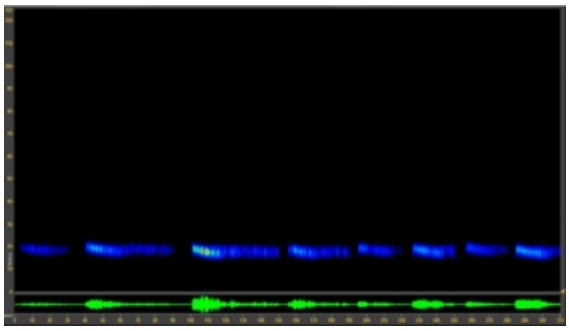


Seasonal and nightly activity

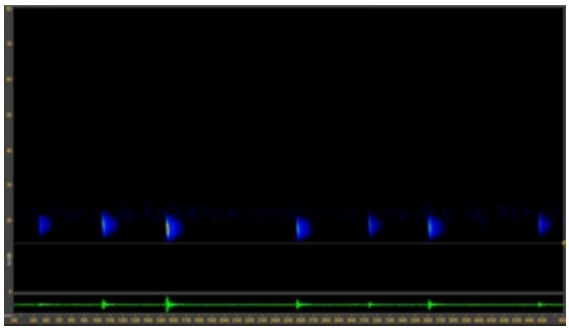


Common Noctule - new species for Guernsey was first recorded on Guernsey in a field next to Route du Hougets on the night of the 18th/19th August (two recordings, spaced seconds apart) and recorded again from the same location on the night of 19th/20th August. On this second night it was recorded at the first location at 00:55. The next three recordings were at 05:24 near the Little Chapel, followed by a recording at 05:26 at the first site and then subsequently back at the Little Chapel at 05:28. These sites were 900-m apart and considering the timing and location of these records, they may relate to a single individual. Common Noctule are rare in Normandy and Brittany and data deficient in Jersey, with only a few acoustic recordings and it is likely that this is a very rare resident or vagrant in Guernsey.

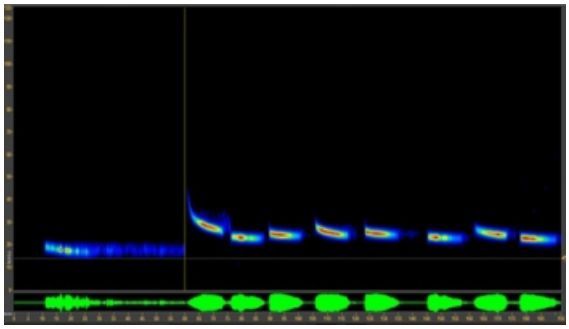
In the spectrograms below, we include a comparison between one of the better quality calls from the Noctule recordings, with known Leisler's Bat and known Noctule calls of similar duration. This highlights that the calls here are very typical for Noctule but are too low in frequency for Leisler's Bat to be likely.



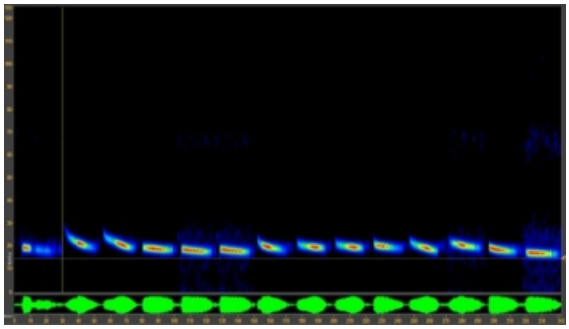
Noctule - Guernsey, 20th August



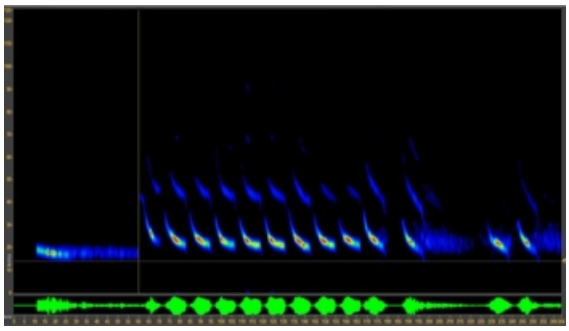
Noctule - same recording, different scale



Noctule call from Guernsey (left), against known Leisler's Bat calls of similar call duration (right)



Noctule call from Guernsey (left), against known Noctule calls of the same call duration (right)

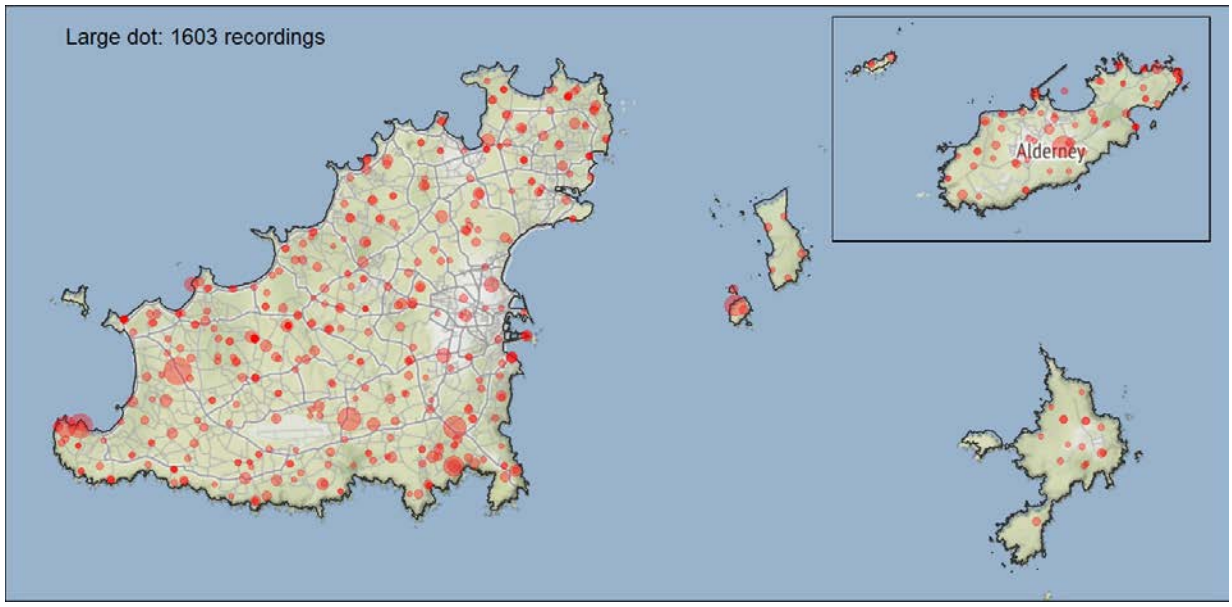


Noctule call from Guernsey (left), against known Grey long-eared Bat calls of the same call duration (right)

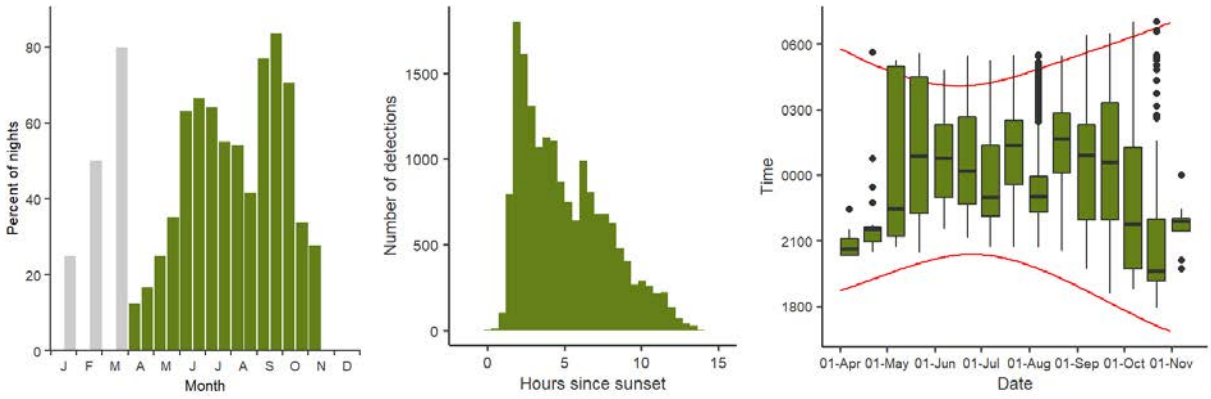
Kuhl's Pipistrelle or Nathusius' Pipistrelle

Kuhl's Pipistrelle or Nathusius' Pipistrelle *Pipistrellus kuhlii or P. nathusii* was recorded on 193 nights, from 469 locations, giving a total of 17,379 recordings.

Spatial pattern of activity



Seasonal and nightly activity



Nathusius' or **Kuhl's Pipistrelle**. 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 3) and are best treated as a species pair, although social calls are clearly different and are reliably identified (see separate sections below 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 in the region of about 10% for both species, but more work is needed to look at this.

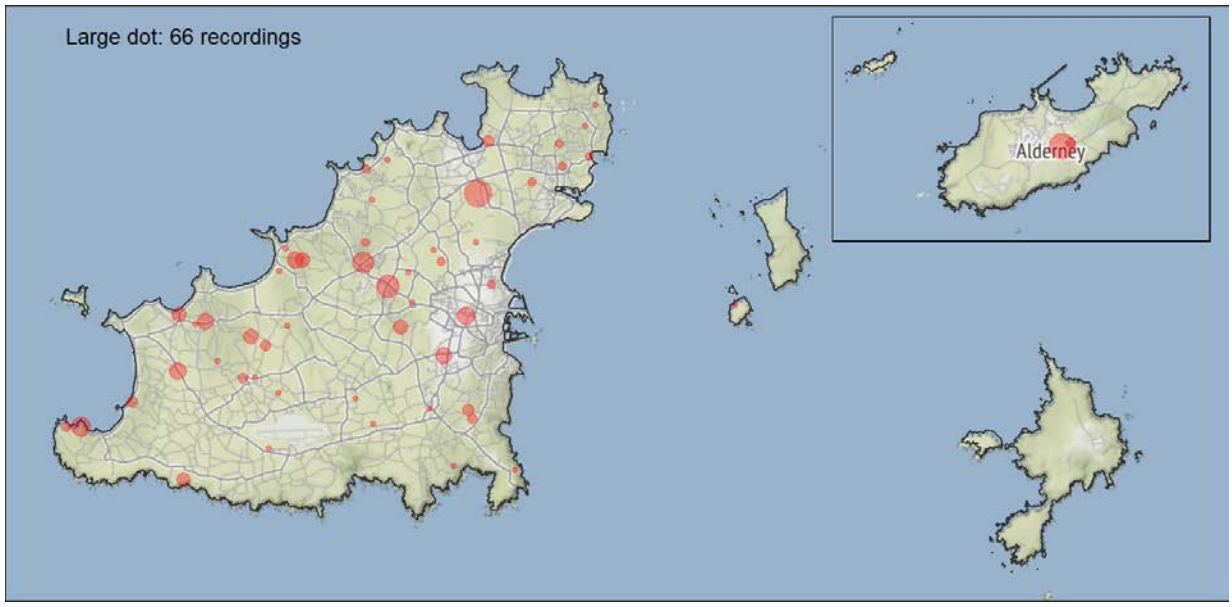
In the four months between April and July, the proportion of echolocation calls identified by the classifier was fairly consistent at approximately two-thirds Kuhl's and a third Nathusius'. In August there was a doubling in the number of detections of Kuhl's but numbers of Nathusius' plummeted to c. 5% of detections. In September, numbers of both rose and Nathusius' increased from about 5% to 24% and then dropped to 19% in October, well below the mid-summer proportions.

This species pair was recorded on every island where detectors were placed, with the exception of Lihou. It was extremely widespread with generally low numbers of recordings (95% of the detections at a site involved fewer than c. 40 recordings per site), although some sites such as Pezeries in Guernsey and Longis Road in Alderney held much larger numbers; the most recordings per night, exceeding 1,000, was in a field in Rue des Paysans in Guernsey.

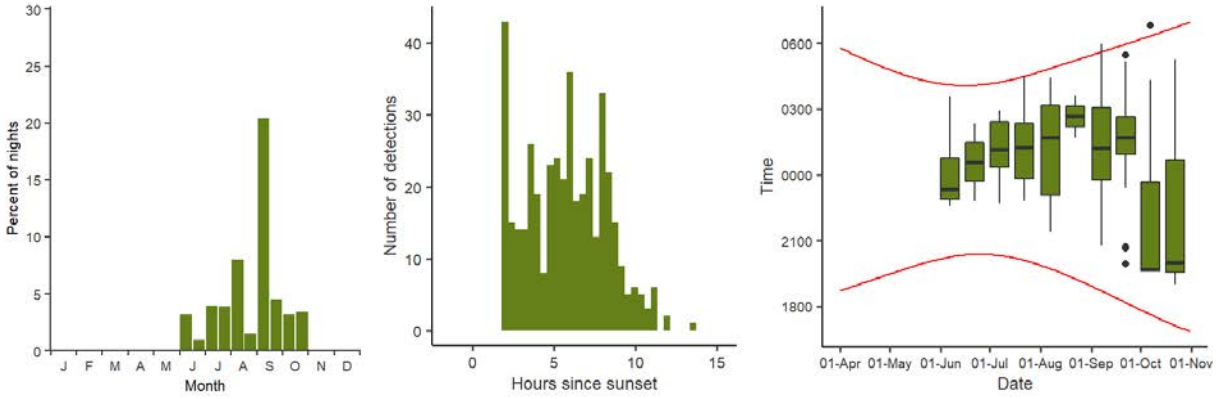
Kuhl's Pipistrelle Social Calls

Kuhl's Pipistrelle Social Calls *Pipistrellus kuhlii* was recorded on 60 nights, from 53 locations, giving a total of 424 recordings.

Spatial pattern of activity



Seasonal and nightly activity



Kuhl's Pipistrelle social calls were recorded on 60 nights, from 53 locations, giving a total of 424 recordings. In contrast to echolocation calls, social calls of Kuhl's Pipistrelle can be assigned to species with confidence (see Identification appendix 4).

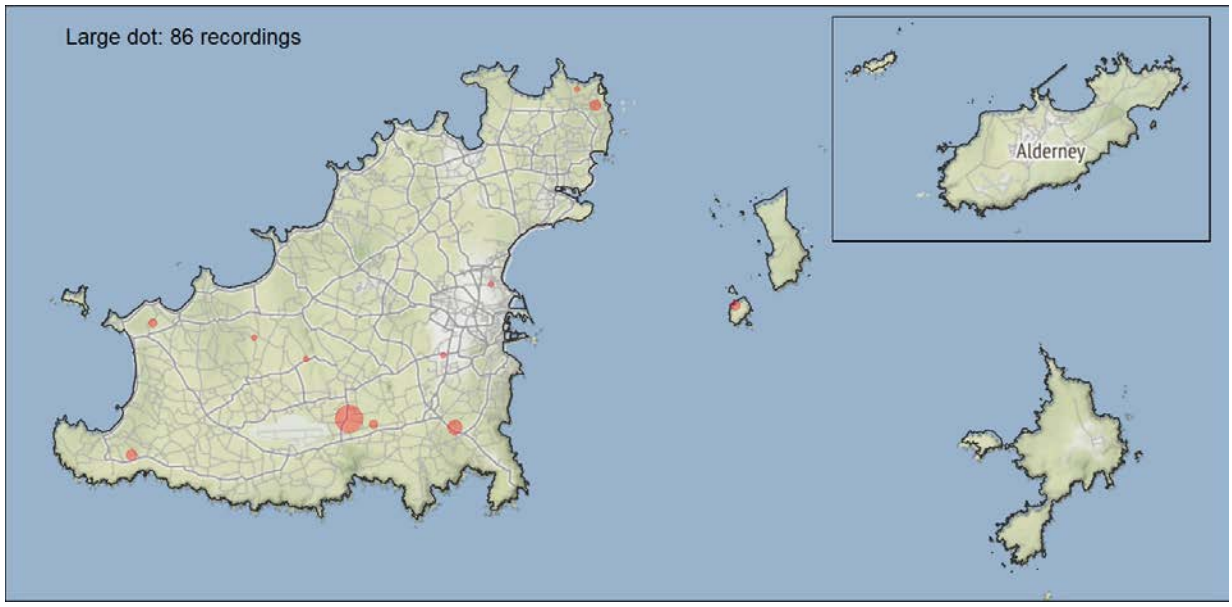
Kuhl's Pipistrelle social calls were recorded from June to October across multiple sites, whereas Nathusius' Pipistrelle social calls were only recorded from September onwards from many fewer sites. It is clear that Kuhl's Pipistrelle is a common and widespread breeding species on all the major islands in the Bailiwick. 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).

There was a tendency for Kuhl's Pipistrelle social calls to be produced late in the night between June until September, but there appears to be a change in behaviour in October and November, when social calls were produced early in the night. This change in behaviour fits with Russ *et al.*, (2021), which suggests that the function of social calls of Kuhl's Pipistrelle earlier in the season is often associated with the defence of resources, but later in the season, social calls may relate to mating activity.

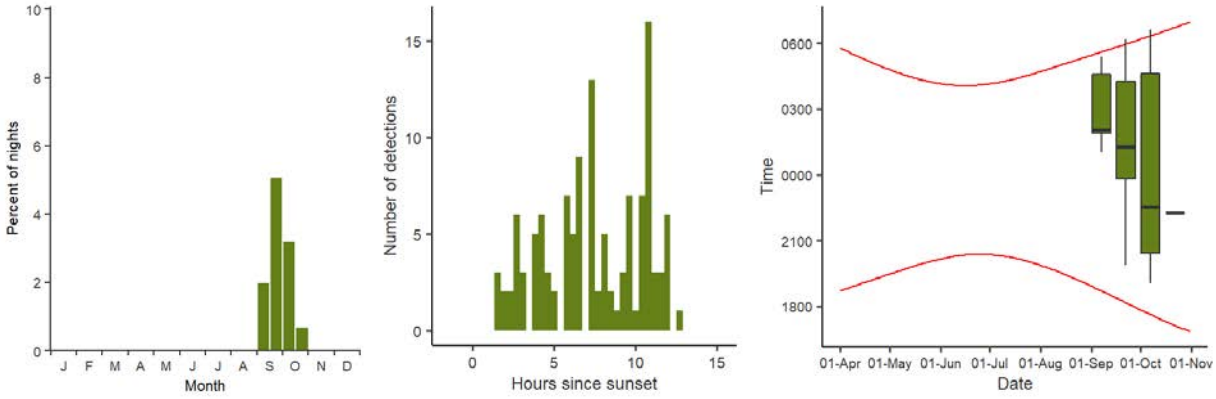
Nathusius' Pipistrelle Social Calls

Nathusius' Pipistrelle Social Calls *Pipistrellus nathusii* was recorded on 14 nights, from 12 locations, giving a total of 123 recordings.

Spatial pattern of activity



Seasonal and nightly activity

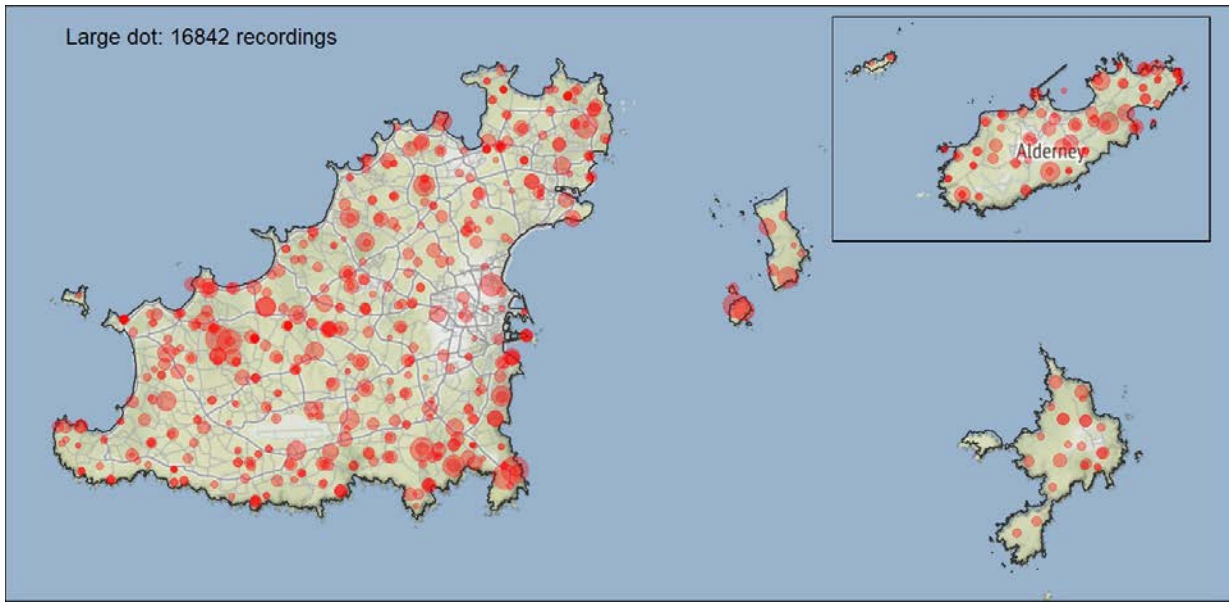


Nathusius' Pipistrelle In contrast to echolocation calls, social calls of Nathusius' Pipistrelle can be assigned to species with confidence (see Identification appendix 4). Social calls mainly comprised of male advertisement calls (i.e. they are calling for a female), but a small number of other Nathusius' Pipistrelle social calls were recorded during 2021. That they started in September fits in with what is known about when Nathusius' Pipistrelles mate, and the question is whether these are newly arrived migrants setting up territories in September, or individuals that are resident and who have not given out social calls prior to that. The distribution of social calls is much more restricted compared to Kuhl's, both spatially (12 vs 45 locations) and temporally (Kuhl's: June to October; Nathusius: September to October), and so it may be that Nathusius' is a migrant and winter visitor, or a resident and migrant. Further work is needed to understand this better. All previous records found and reported on in the *Transactions of La Société Guernesiaise* have been from September to April, which perhaps points to this being migrant and winter visitor.

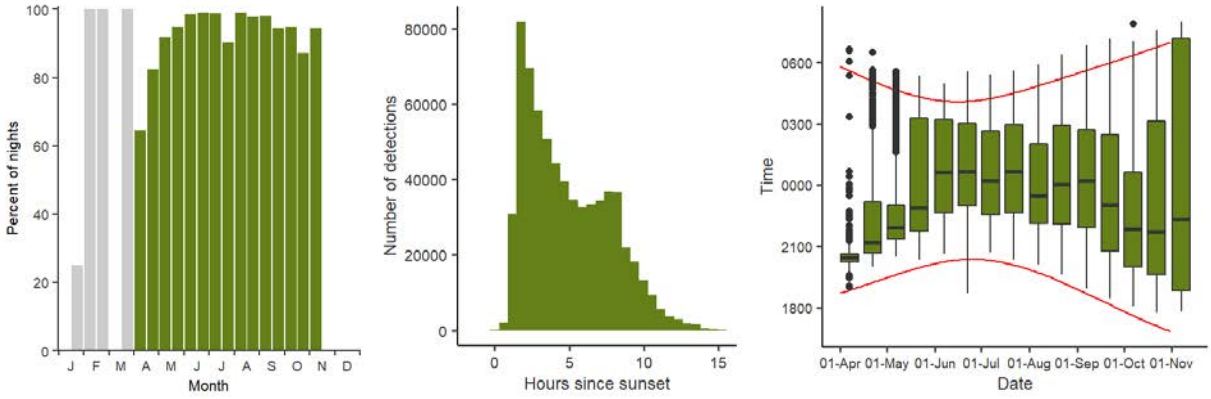
Common Pipistrelle

Common Pipistrelle *Pipistrellus pipistrellus* was recorded on 227 nights, from 598 locations, giving a total of 665,271 recordings.

Spatial pattern of activity



Seasonal and nightly activity



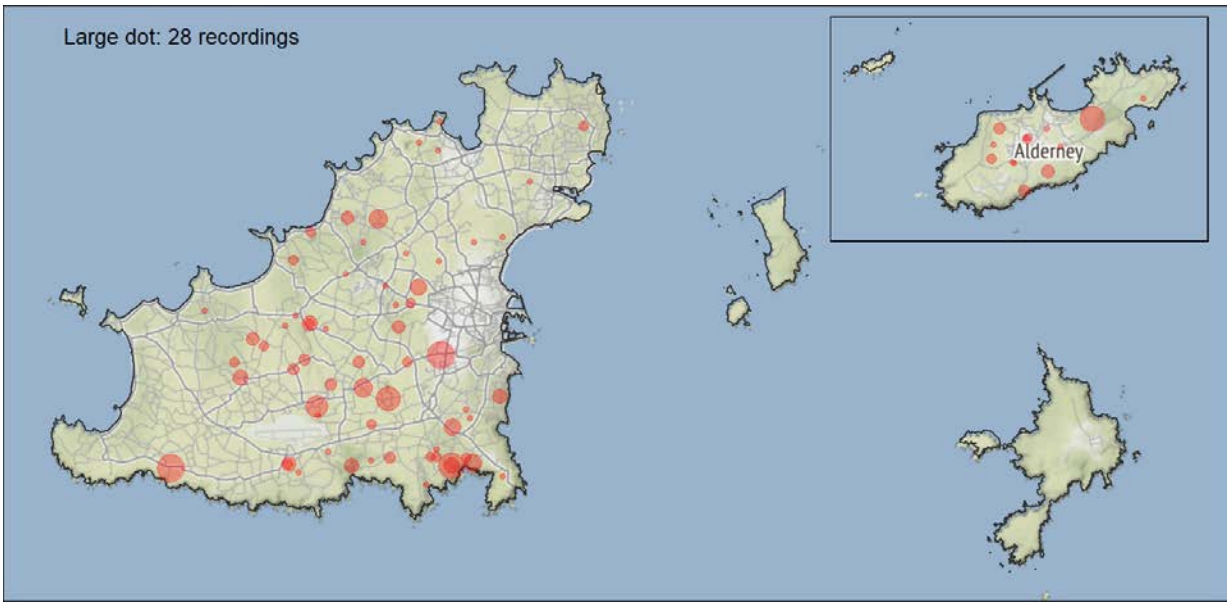
Common Pipistrelle was by far the most common and widely recorded bat species, with 664,743 recordings from 596 different locations (97% of survey locations) and a maximum of 5,512 recordings per night at an individual site. It was the only species of bat to be recorded on every island.

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. For example, considering the possibility for mis-identification with Soprano Pipistrelle in extreme clutter, Common Pipistrelle typically produces very short calls that are elevated in frequency, where they could be mis-identified as Soprano Pipistrelle. 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. It is normally possible to diagnose what is happening in most situations by looking at the sequence of calls, and if there are neighbouring recordings in close time of potentially the same bat. However, there will still be some occasions where this is not available and it is not possible to assign a recording to species. Despite looking carefully for Soprano Pipistrelle, we did not find any convincing evidence that it was recorded during 2021.

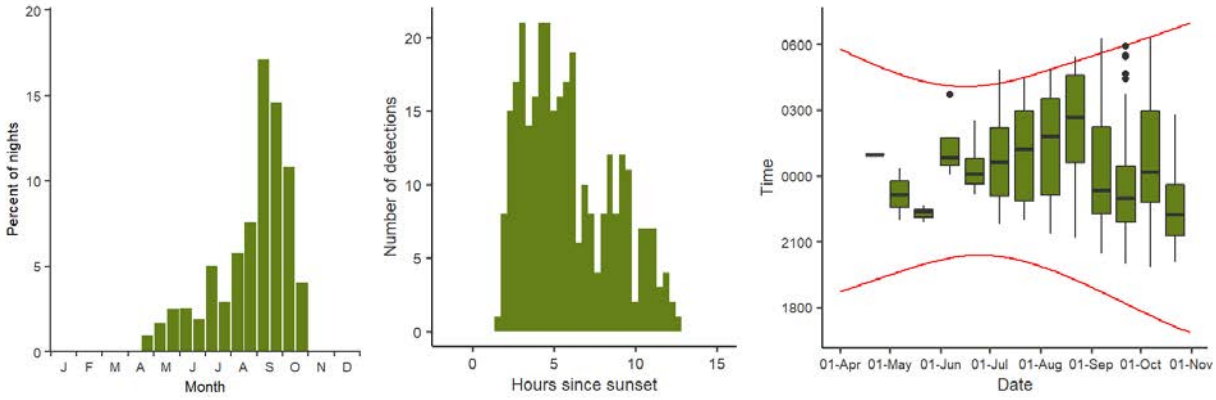
Brown Long-eared Bat

Brown Long-eared Bat *Plecotus auritus* was recorded on 79 nights, from 75 locations, giving a total of 313 recordings.

Spatial pattern of activity



Seasonal and nightly activity

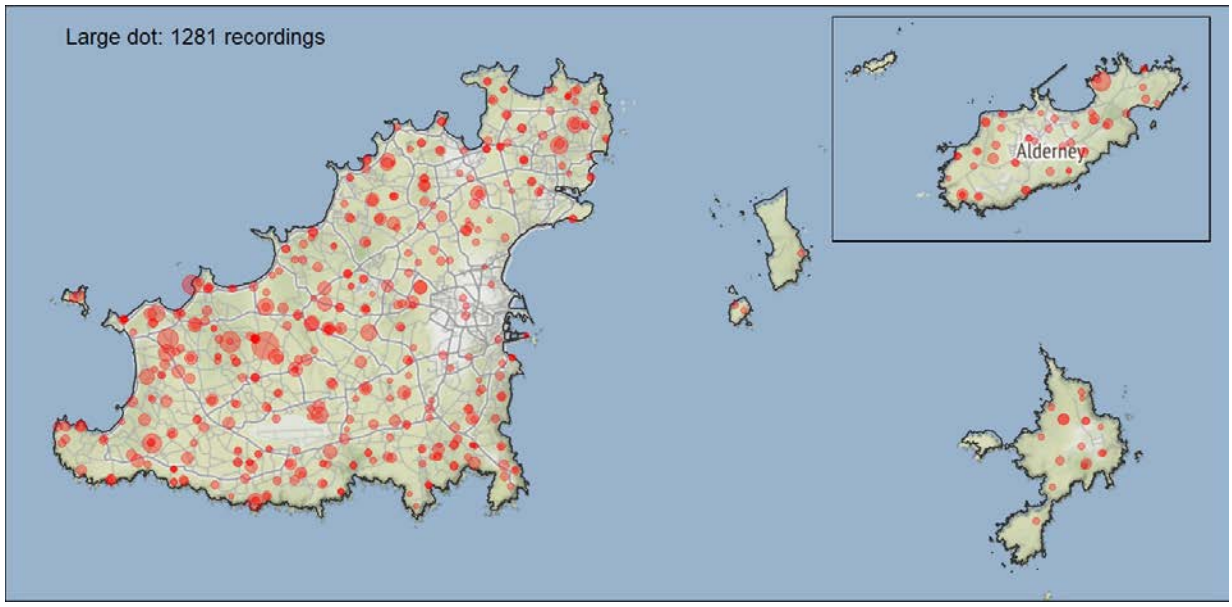


Brown Long-eared Bat was recorded from Guernsey and Alderney. Looking at the seasonal change in the proportion of nights that this species is recorded, suggests that Brown Long-eared Bat is recorded more widely between mid-September and the end of October than earlier in the season and could be related to a habitat shift away from a close association with woodland in summer to more open habitats in autumn. It will be interesting to see if this pattern holds across years. Brown Long-eared Bat is common in neighbouring France, but it is considered rare in Jersey (Binet & Walsh, 2020; Hall, 2021). Jersey Bat Group indicate that Brown Long-eared Bat is possibly under-recorded on Jersey (Hall, 2021).

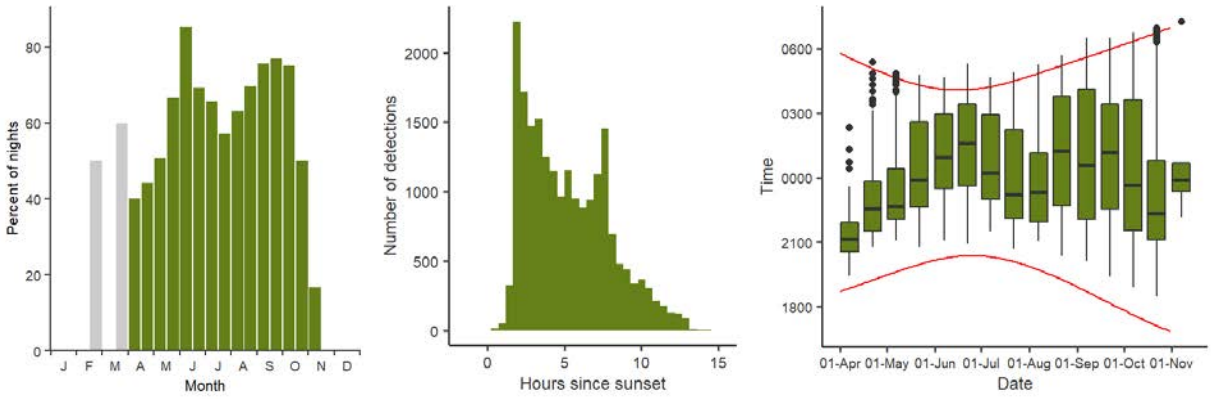
Grey Long-eared Bat

Grey Long-eared Bat *Plecotus austriacus* was recorded on 210 nights, from 491 locations, giving a total of 20,538 recordings.

Spatial pattern of activity



Seasonal and nightly activity



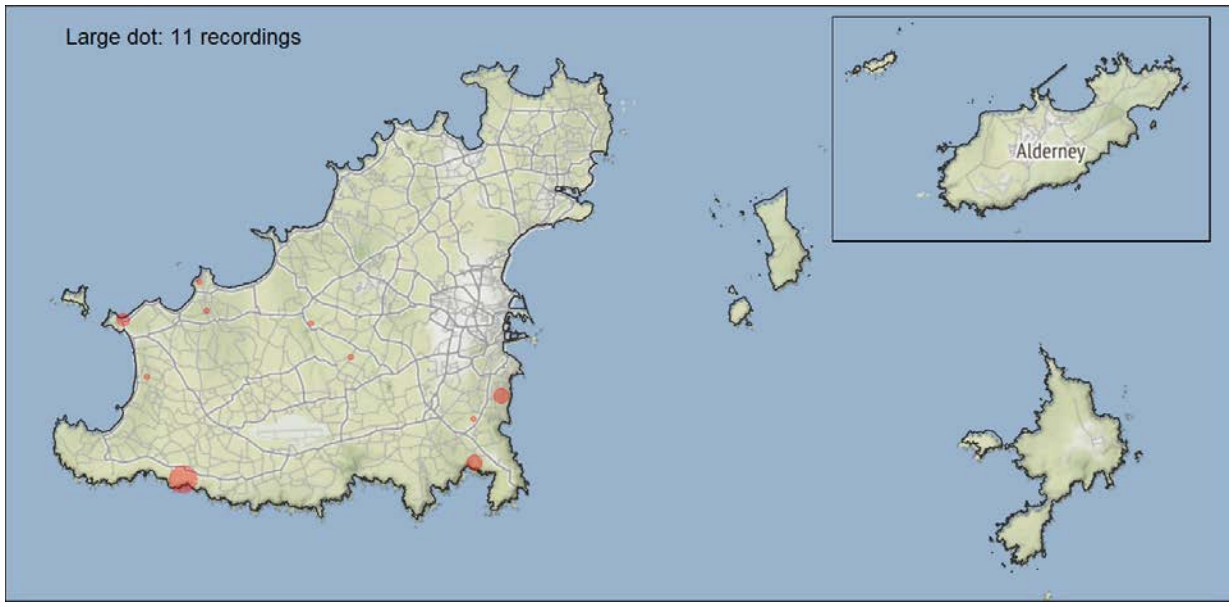
Grey Long-eared Bat. In contrast to the UK, Grey Long-eared Bat is the most common and widespread long-eared bat species on the islands. Of 20,839 *Plecotus* recordings which we assigned to species (where a recording was of sufficient quality, and where we were sufficiently confident to assign the recording to species), 20,526 recordings (98.5%) were assigned to Grey Long-eared Bat. Grey Long-eared Bat was recorded from 490 locations (80% of surveyed locations), and included recordings from Guernsey, Alderney, Herm, Sark, Jethou and Lihou. This may include the first records of Grey Long-eared Bat for the islands of Herm, Sark, Jethou and Lihou.

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 5.

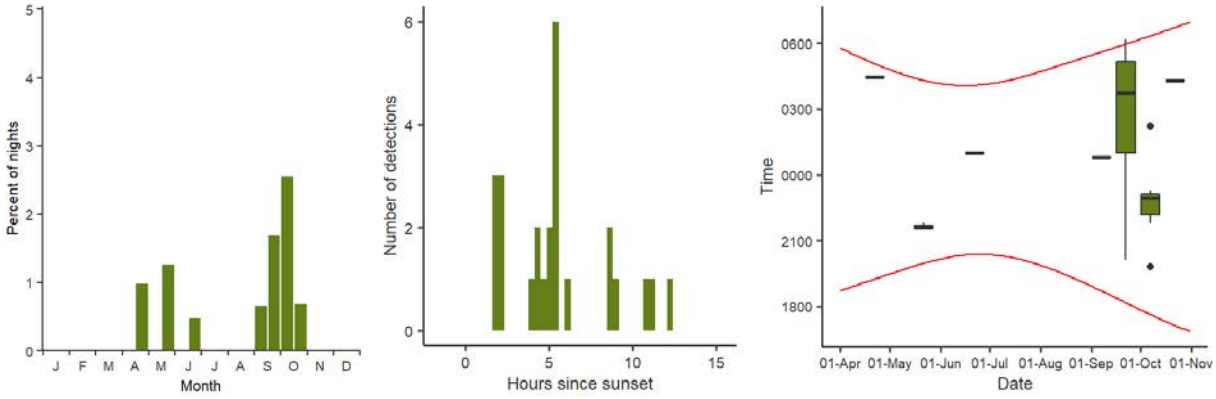
Greater Horseshoe Bat

Greater Horseshoe Bat *Rhinolophus ferrumequinum* was recorded on 12 nights, from 10 locations, giving a total of 25 recordings.

Spatial pattern of activity



Seasonal and nightly activity



Greater Horseshoe Bat. This is an iconic bat species that is a very rare resident in Guernsey. Although no breeding sites have been found in Guernsey, recent records include a single individual roosting in a watch tower. In other areas where they occur, they breed in old buildings, such as quiet undisturbed barns. During the winter they hibernate or spend time in 'torpor' in caves, old cellars and cold, damp places which are dark and undisturbed. In recent years, the Bat Section has recorded Greater Horseshoe Bat in the vicinity of a tunnel complex which is thought to be a possible hibernation site. The situation is similar in Jersey, with a small number of records across the island and one or two roost sites identified. Most other species of bats in north-west Europe will hibernate in tight nooks and crannies, but horseshoe bats (both species) hang freely upside down, wrapping their wings around them and it means they need good-sized spaces in which to hang.

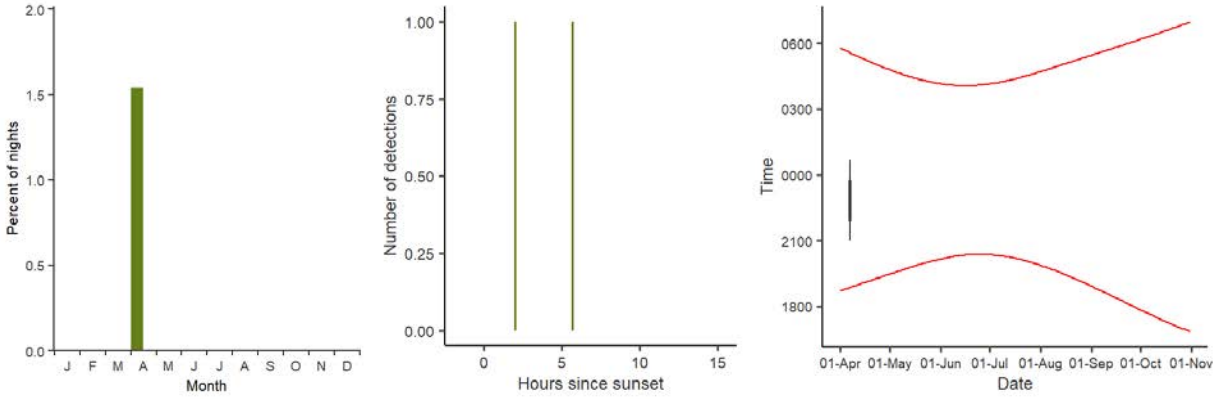
The recordings we received do not shed any light on breeding locations. We received records in April, May and June, none in July or August and they started to be recorded again in September and October. Females form maternity colonies in buildings which remain dark, undisturbed and warm throughout the 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. This could explain the late summer gap in records, although it is perhaps surprising, given the intensity of the coverage, that we did not pick up any individuals leaving the roost to forage. The only mid-summer record was at the end of June from Rue a L'Eau in the Talbots Valley. Bats will fly some distance to find good foraging areas so we can not infer too much from this. All of the records, apart from recordings from one location on the south coast, were of 1-2 recordings, indicating the bats were passing through and not spending large amounts of time in the areas we recorded them.

Lesser Horseshoe Bat

Lesser Horseshoe Bat *Rhinolophus hipposideros* was recorded on one night, from one location, giving a total of 2 recordings.

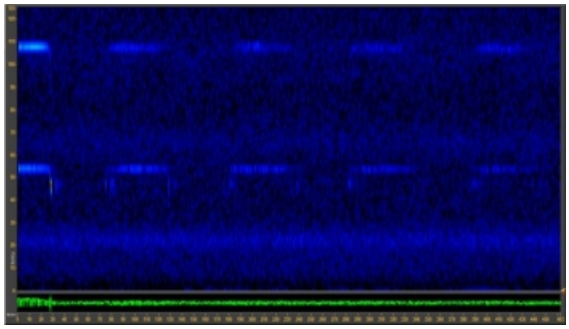
Spatial pattern of activity

Seasonal and nightly activity

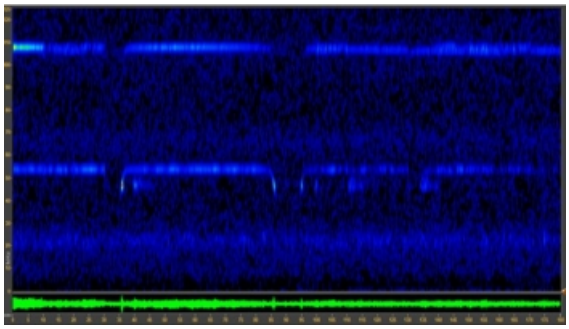


Lesser Horseshoe Bat - new species for Guernsey was recorded for the only time in St Martins, on the night of the 13th/14th April with two recordings.The first recording was at 21:00 and the second at 00:40. The location was a tree-lined border of a recently manured field, with little woodland close by. It was perhaps not unexpected as, although very rare, it has been recorded in Jersey and is present in neighbouring France. These were however the only two recordings we received for this species.

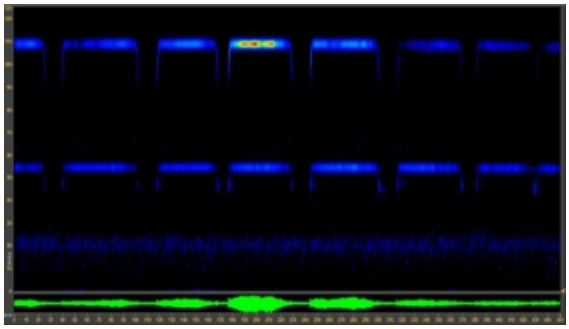
This species produces echolocation calls where the maximum (peak) energy is in the range of 107-114 kHz. The only likely confusion species is Greater Horseshoe Bat, but this produces calls with maximum energy in the range of 77-84 kHz.



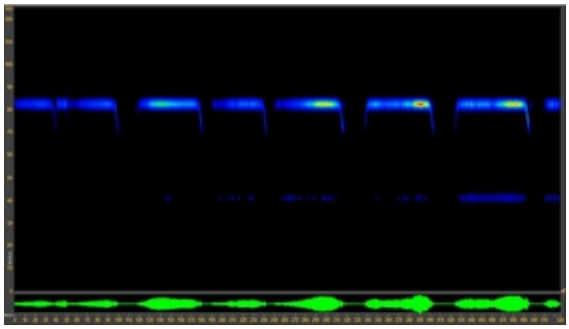
Lesser Horseshoe Bat - first recording, 13th April



Lesser Horseshoe Bat - second recording, 14th April



Lesser Horseshoe Bat, Devon 2021



Greater Horseshoe Bat, Devon 2020

4.3.2 Small terrestrial mammal species

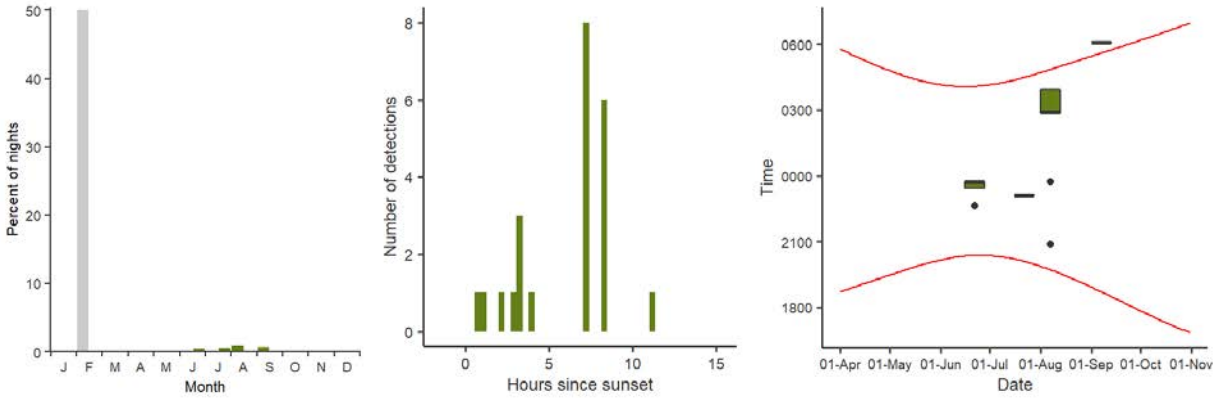
In this section we look at the recordings that we can assign to small terrestrial mammal species, but there was a small number of mammal recordings that we could not currently assign to species. These could represent unusual calls for the species here, or other species for which the ultrasonic vocalisations have not yet been described, such as for Ferrets *Mustela furo*. It is also possible that some recordings of other small terrestrial mammal species for which recordings have not been built into the acoustic pipeline, including the Guernsey Vole *Microtus arvalis sarnius* have been under-recorded. However, vole species seem to rely more on olfaction for communication (Newson *et al.*, 2021), so we think that if this is the case, that there are not likely to be many recordings that have been missed.

Wood Mouse

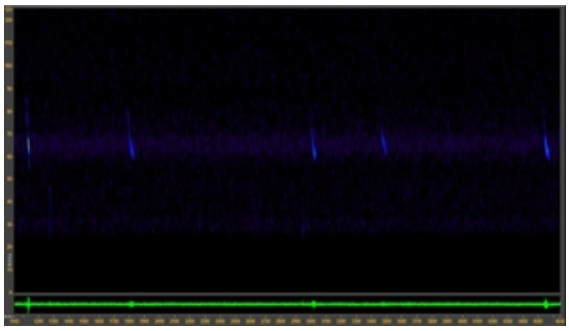
Wood Mouse *Apodemus sylvaticus* was recorded on six nights, from five locations, giving a total of 23 recordings.

Spatial pattern of activity

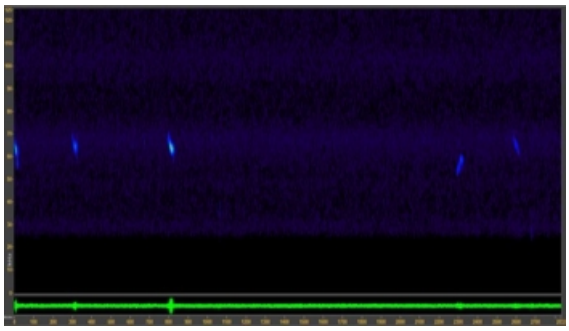
Seasonal and nightly activity



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



Wood Mouse - Guernsey, 7th August

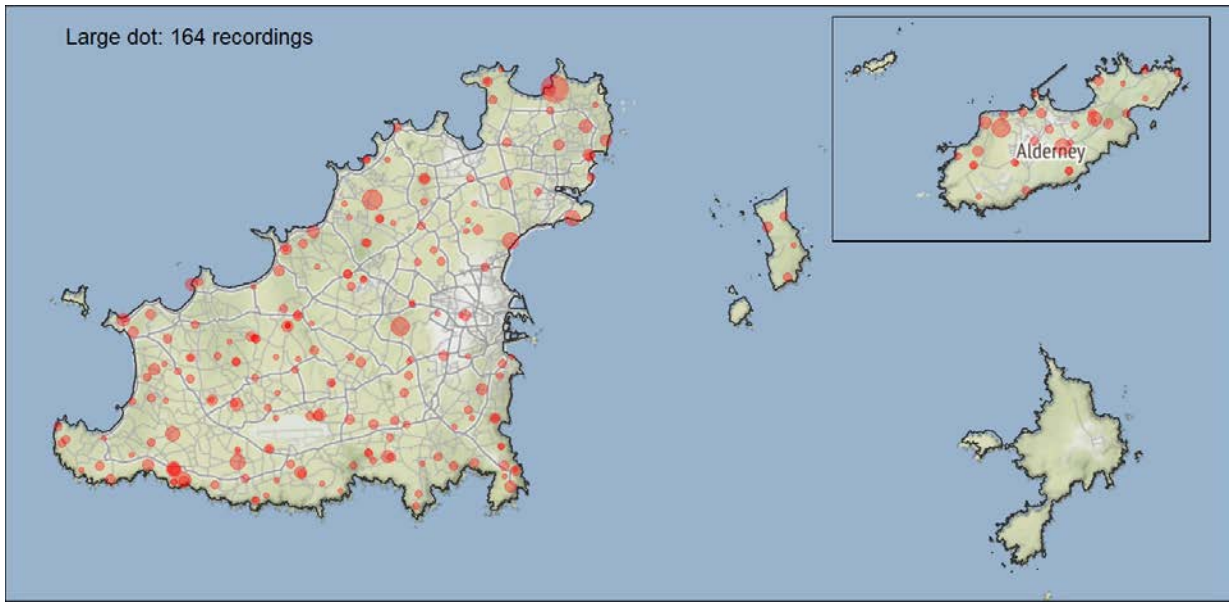


Wood Mouse - Guernsey, 18th June

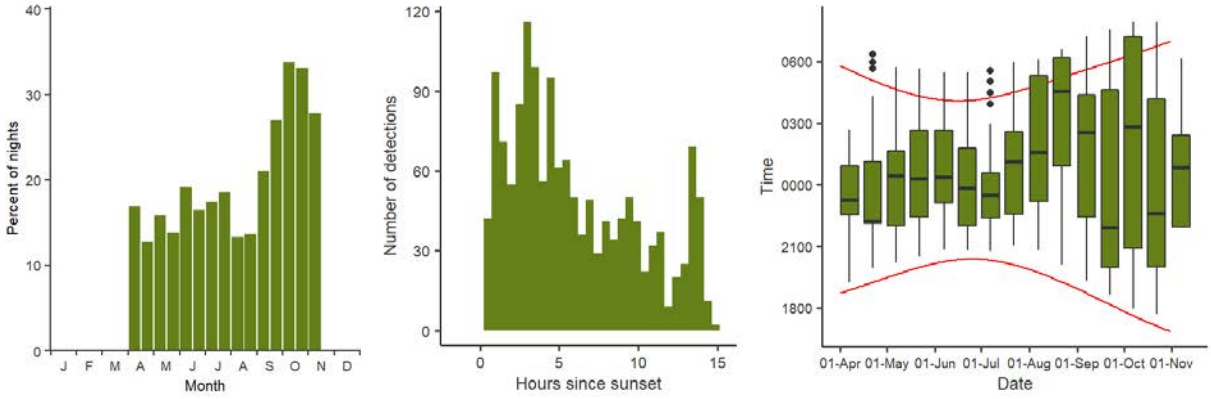
Greater White-toothed Shrew

Greater White-toothed Shrew *Crocidura russula* was recorded on 178 nights, from 223 locations, giving a total of 1,490 recordings.

Spatial pattern of activity

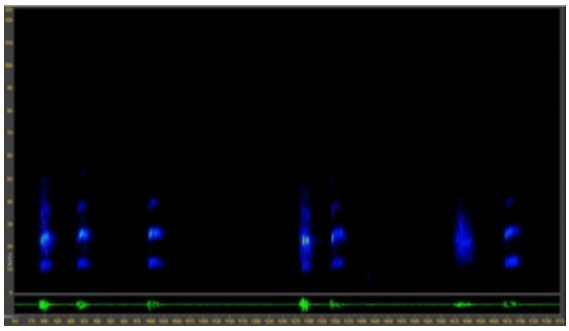


Seasonal and nightly activity

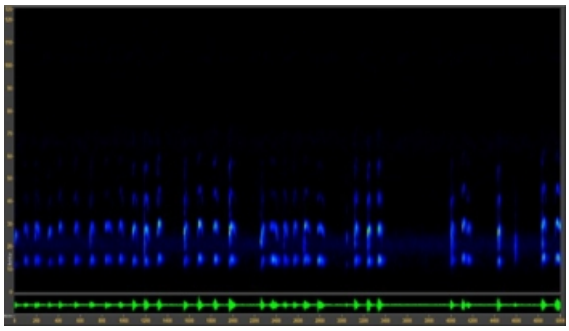


Greater White-toothed Shrew was recorded on Guernsey, Alderney and Herm. Greater White-toothed Shrew is the only shrew species that is believed to be present on these islands. The sound identification of Greater White-toothed Shrew has not previously been described anywhere before and this is the first time a Bailiwick distribution map for the species has been produced. They were extremely widespread and were present on three islands – Guernsey, Alderney and Herm. More analysis needs to be done but they seemed to be associated with farmlands and gardens. The reporting rate increased from 15-20% of nights from April to August to c. 35% in September and October. Numbers would have increased then as there will be large numbers of juveniles in autumn, but it might also signify a change in vocalisation behaviour at this time.

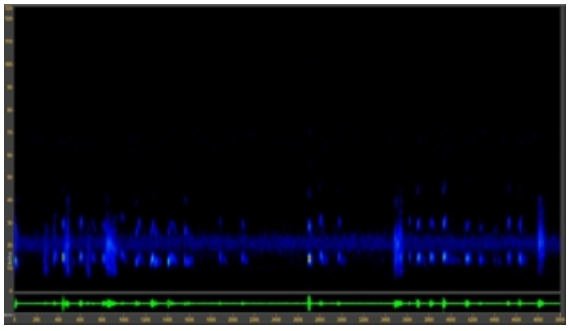
The calls sound quite different from those of Common Shrew *Sorex araneus*, Pygmy Shrew *Sorex minutus* and Water Shrew *Neomys fodiens* found on mainland UK and described in Newson *et al*., (2021). In particular, the calls are shorter in duration, which makes the calls sound more abrupt.



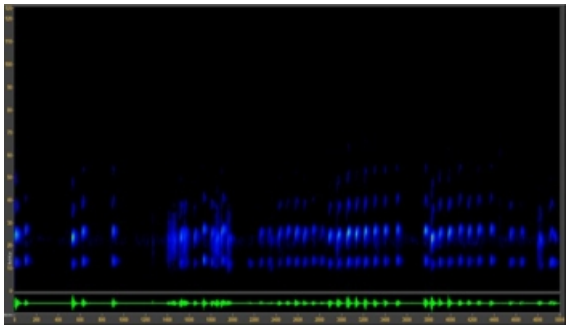
Greater White-toothed Shrew - Guernsey, 4th August



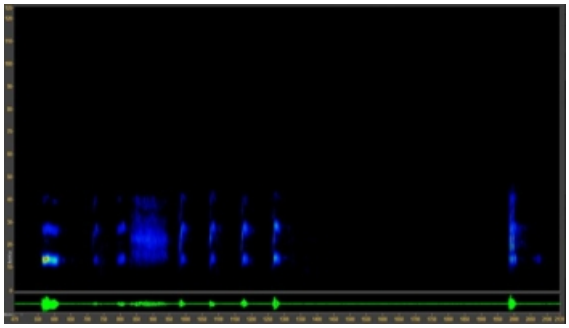
Greater White-toothed Shrew - Guernsey, 8th June



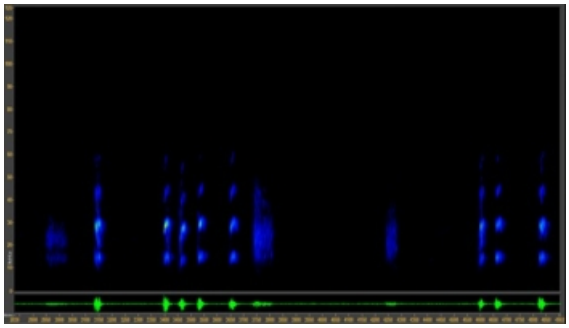
Greater White-toothed Shrew - Guernsey, 13th June



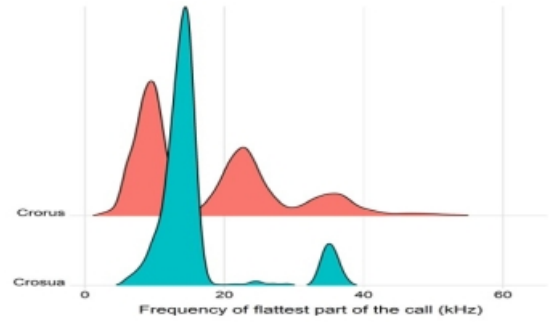
Greater White-toothed Shrew - Guernsey, 3rd October



Greater White-toothed Shrew - Guernsey, 26th September



Greater White-toothed Shrew - Guernsey, 7th August

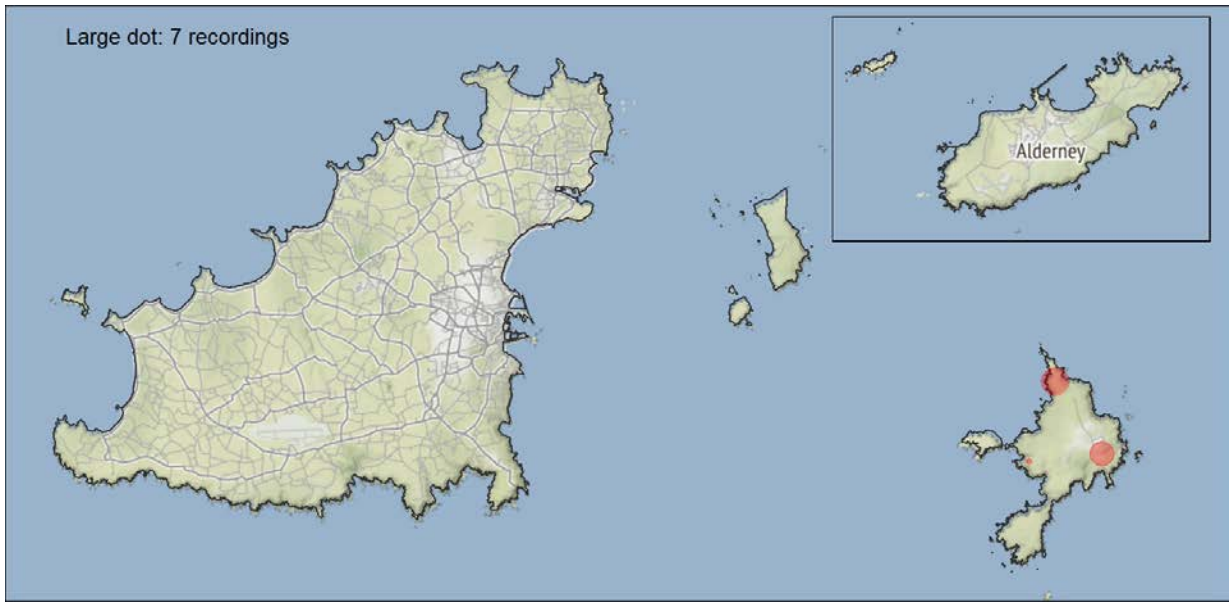


Frequency distribution of calls of Greater White-toothed Shrew (Crorus) and Lesser White-toothed Shrew (Crosua)

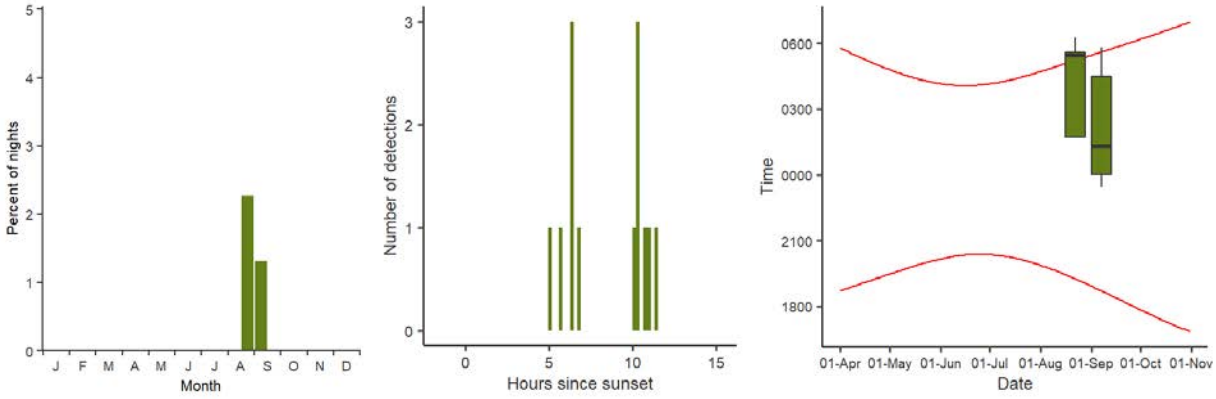
Lesser White-toothed Shrew

Lesser White-toothed Shrew *Crocidura suaveolens* was recorded on five nights, from three locations, giving a total of 13 recordings.

Spatial pattern of activity

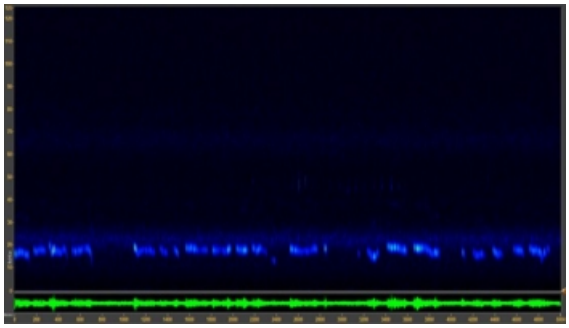


Seasonal and nightly activity

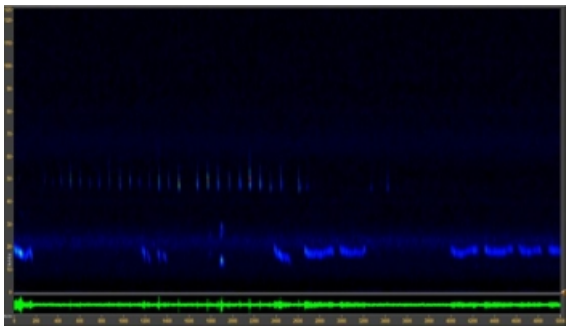


Lesser White-toothed Shrew was only recorded on Sark, where Lesser White-toothed Shrew is the only shrew species present. We only picked up seven recordings and, as with Greater White-toothed shrew, nothing has been written either on the sound identification of this species. If the small number of Lesser White-toothed Shrew recordings that we recorded on Sark are representative of this species, the calls of Lesser White-toothed shrew are higher in frequency than Greater White-toothed Shrew. We will hopefully pick up more calls in future years.

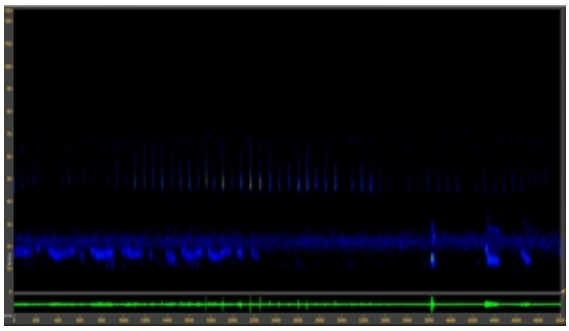
Lesser White-toothed Shrew - Sark, 16th September



Lesser White-toothed Shrew - Sark, 23rd August



Lesser White-toothed Shrew - 23rd August (also Common Pipistrelle)

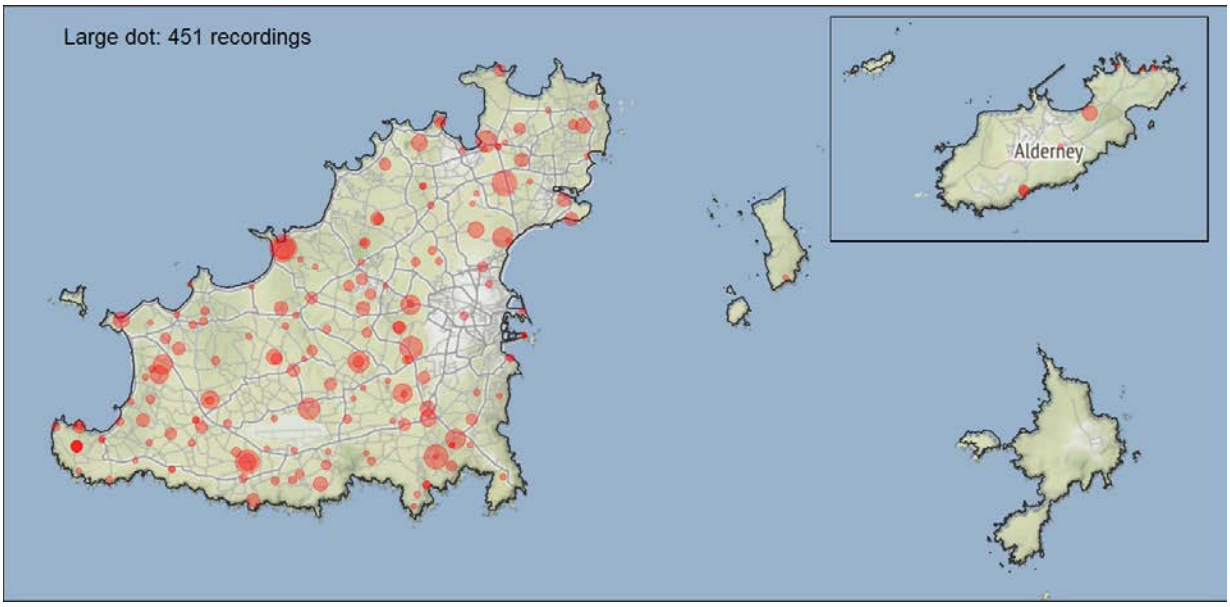


Lesser White-toothed Shrew - 23rd August (also Common Pipistrelle)

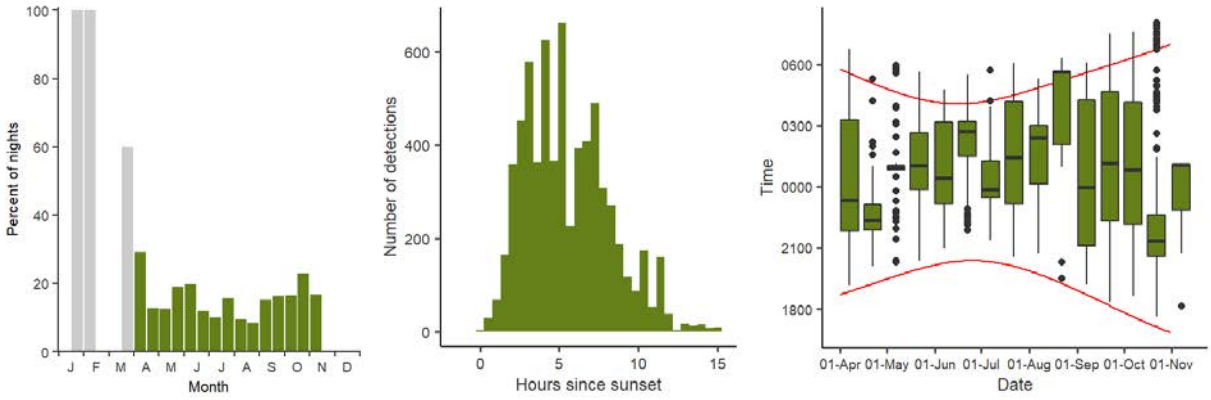
Brown Rat

Brown Rat *Rattus norvegicus* was recorded on 171 nights, from 172 locations, giving a total of 6,642 recordings.

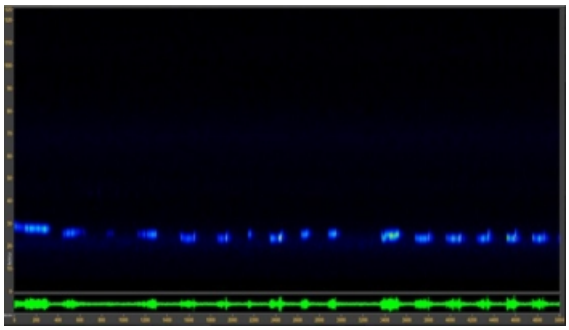
Spatial pattern of activity



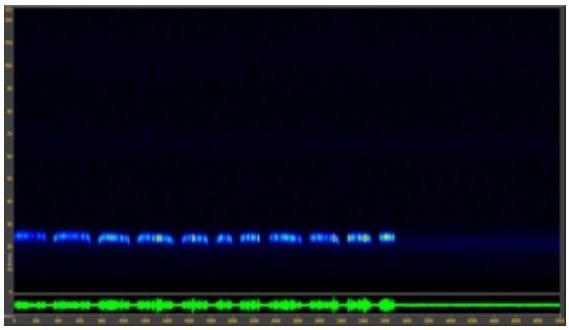
Seasonal and nightly activity



Brown Rat was recorded on Guernsey, Alderney and Herm. Brown Rat is extremely similar acoustically to Black Rat (see Newson *et al*., 2021). As would be expected, it was extremely widespread in Guernsey, but less so on the other islands.



Brown Rat - Alderney, 3rd July



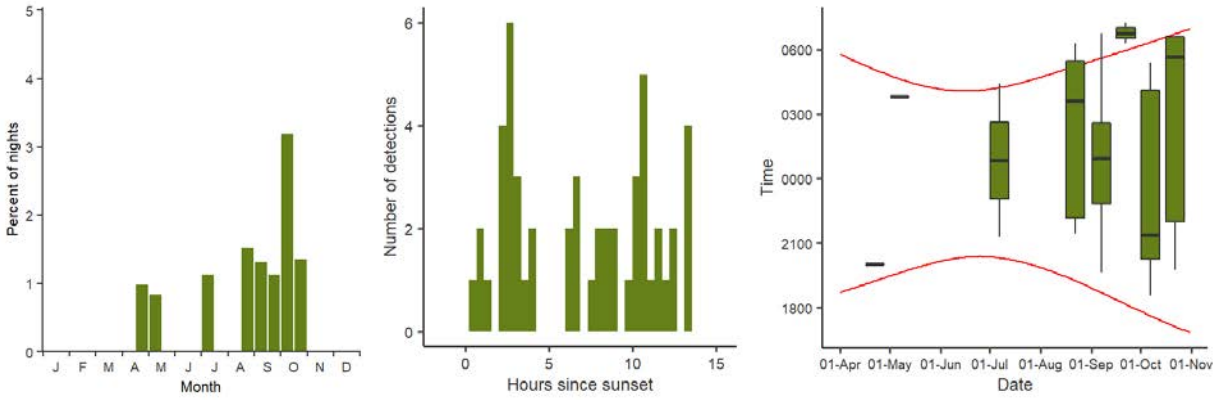
Brown Rat - Alderney, 13th October

Black Rat

Black Rat *Rattus rattus* was recorded on 17 nights, from 12 locations, giving a total of 51 recordings.

Spatial pattern of activity

Seasonal and nightly activity



Black Rat is extremely similar acoustically to Brown Rat (see Newson *et al*., 2021). Based on conversations with Sark residents, Black Rat is the most common species of rat present on Sark. The status of Brown Rat on Sark is uncertain, but it is possible that this species may also occur. Rats are, however, widespread in Sark and were recorded in most survey locations.

4.3.3 Bush-crickets

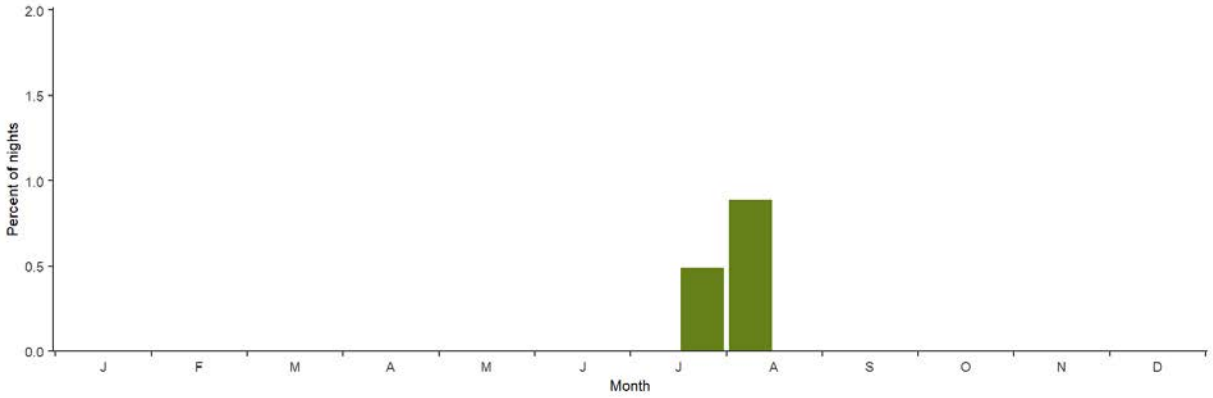
Being stationary, and calling for long periods, the number of recordings is not an informative measure of abundance. For this reason, bush-cricket data are shown as presence information rather than activity information.

Short-winged Conehead

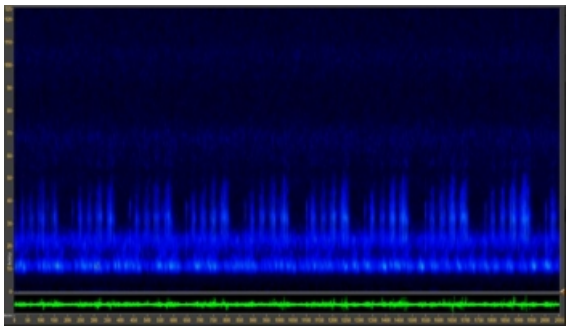
Short-winged Conehead *Conocephalus dorsalis* was recorded on three nights, from two locations.

Spatial pattern of detections

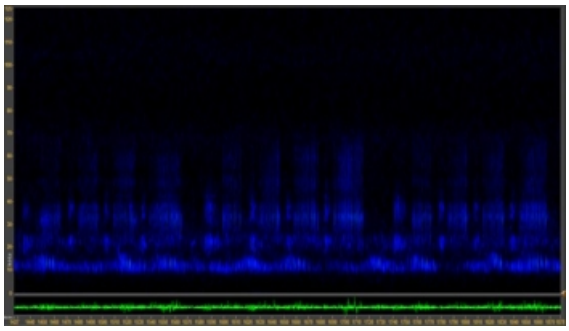
Seasonality



Short-winged Conehead - confirmation of species presence on Guernsey was recorded from two locations on Guernsey. The first of these was on the 17th July, 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. 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 (also Great Green Bush-cricket)

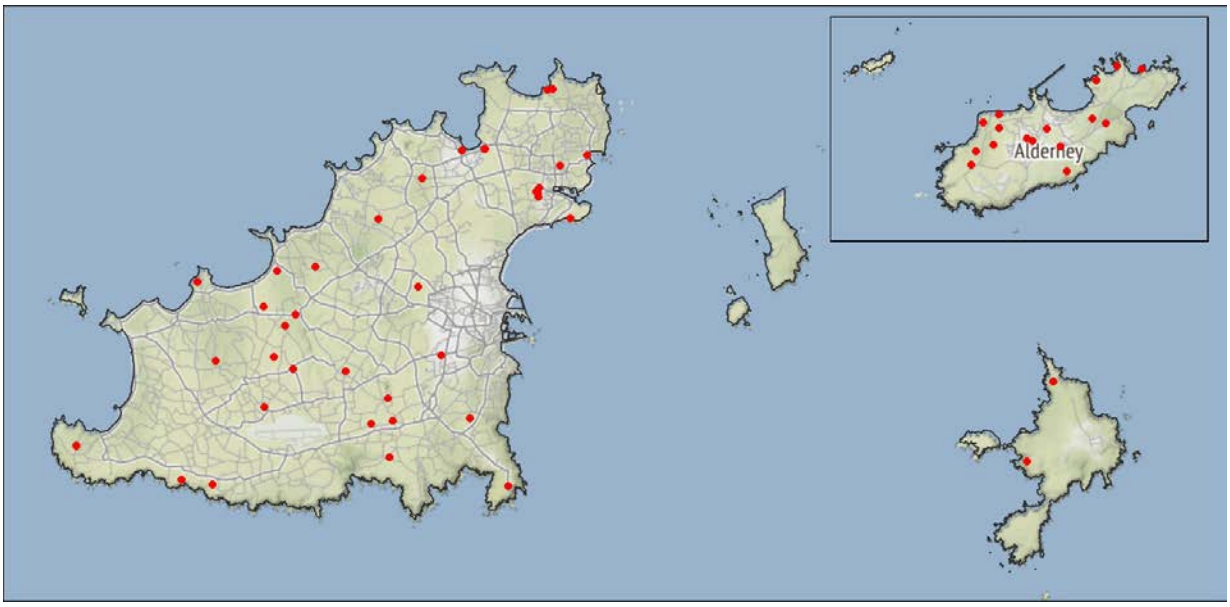


Short-winged Conehead - Guernsey, 17th July (same recording, different scale)

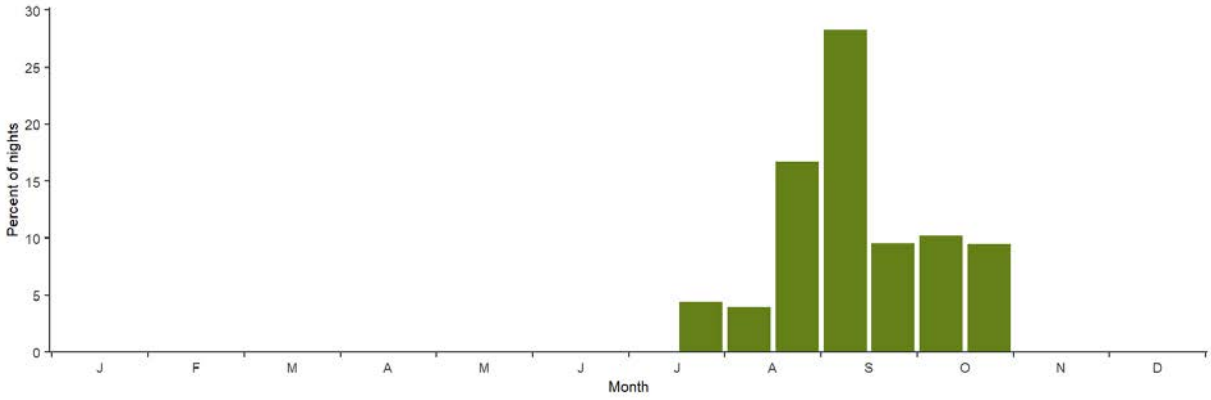
Long-winged Conehead

Long-winged Conehead *Conocephalus fuscus* was recorded on 56 nights, from 59 locations.

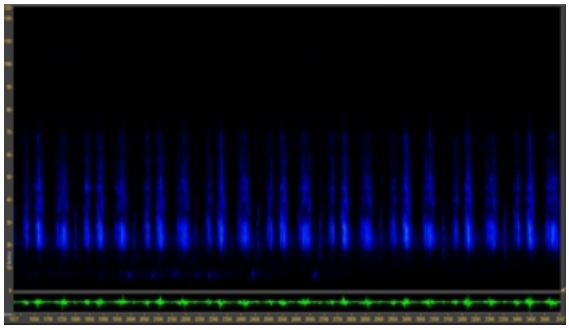
Spatial pattern of detections



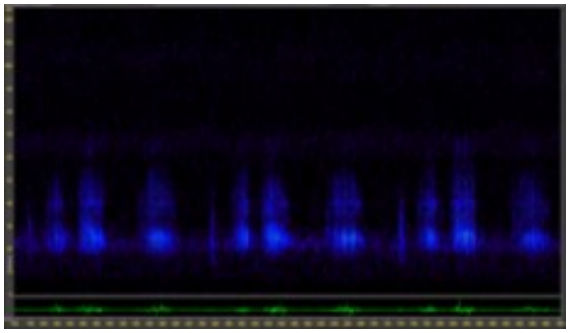
Seasonality



Long-winged Conehead were recorded from 59 locations between mid-July and the end of October with records from Guernsey, Alderney and Sark. Long-winged Conehead produces 'calls' with a peak frequency about 26 kHz. It is most similar acoustically to Short-winged Conehead, but it produces three-syllable calls (two short calls, pause, followed by one longer duration call).



Long-winged Conehead - Guernsey, 25th August

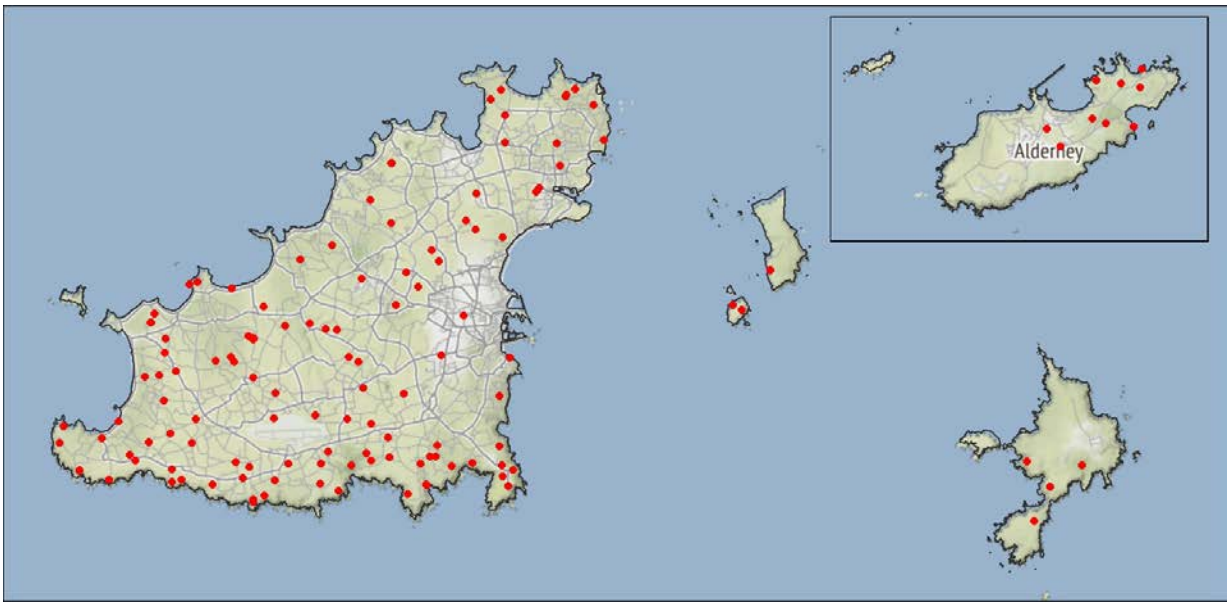


Long-winged Conehead (as left, different scale)

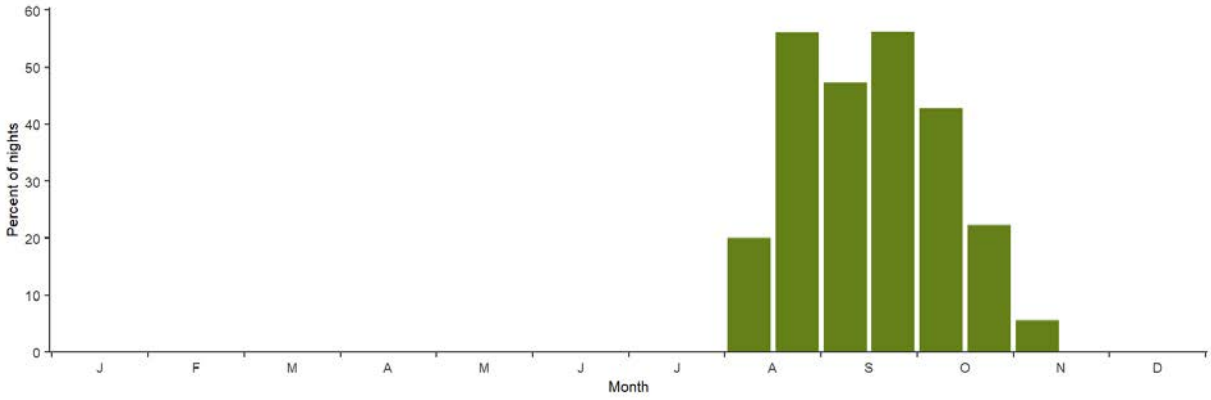
Speckled Bush-cricket

Speckled Bush-cricket *Leptophyes punctatissima* was recorded on 90 nights, from 141 locations.

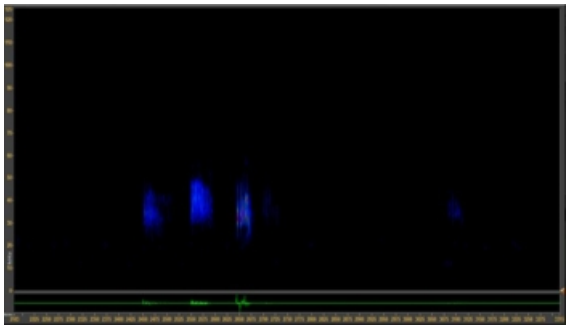
Spatial pattern of detections



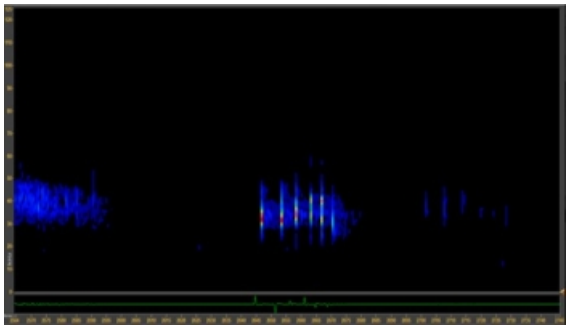
Seasonality



Speckled Bush-cricket were recorded from 141 locations between the beginning of August and mid-November, which included locations on Guernsey, Alderney, Sark, Herm 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 - Guernsey, 28th August

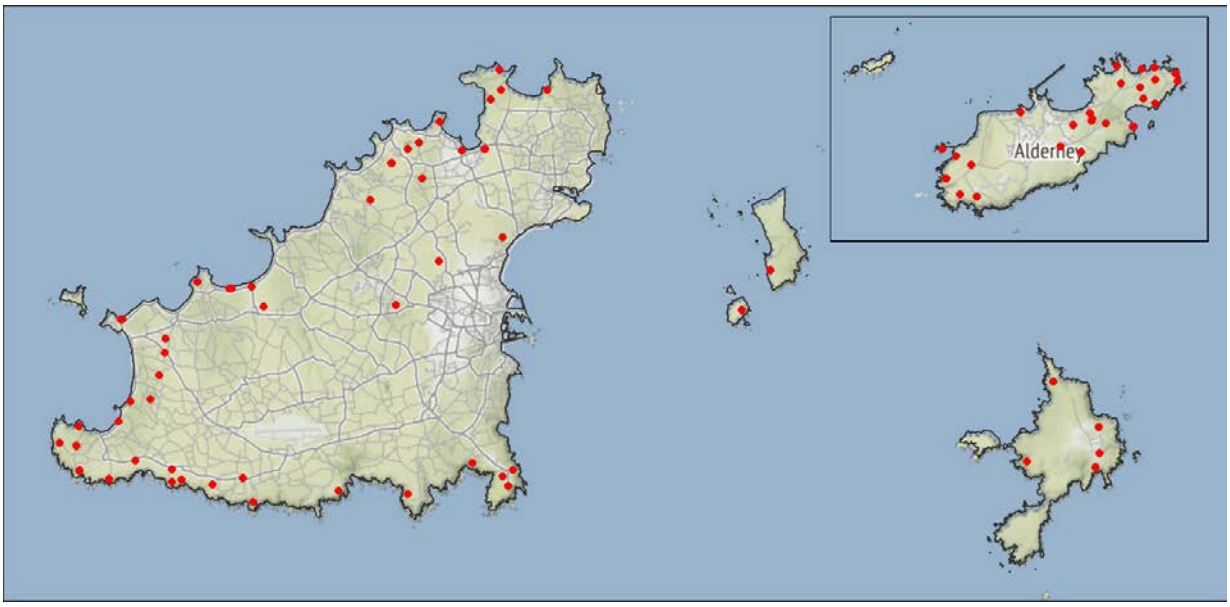


Speckled Bush-cricket (same recording, different scale)

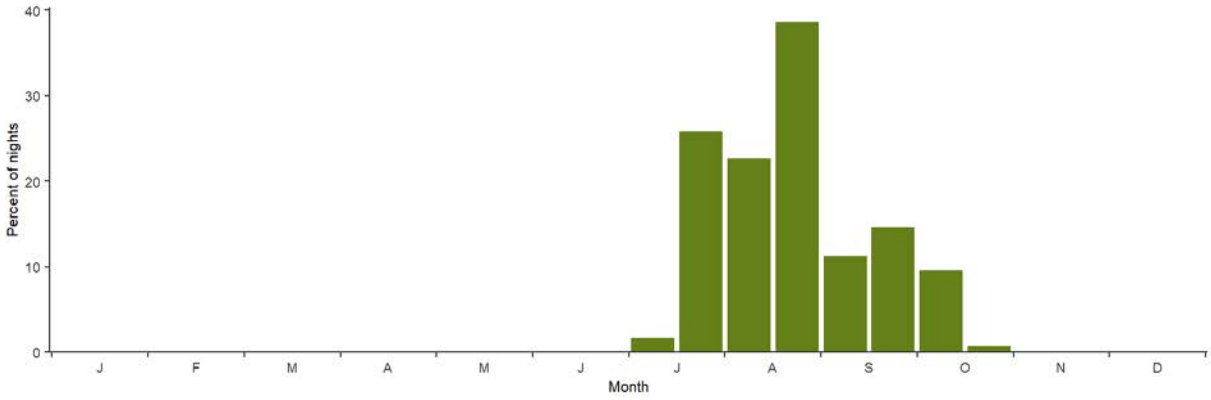
Grey Bush-cricket

Grey Bush-cricket *Platycleis albopunctata* was recorded on 85 nights, from 101 locations.

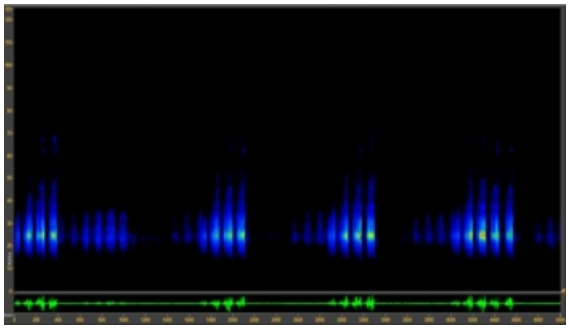
Spatial pattern of detections



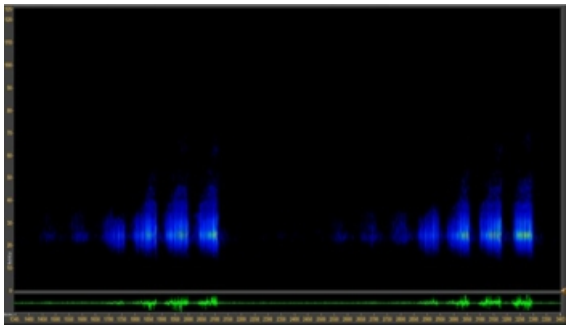
Seasonality



Grey Bush-cricket were recorded from 101 locations between the beginning of July and the end of October, which included locations on Guernsey, Alderney, Sark, Herm and Jethou. The map suggests that this species favours coastal areas on Guernsey. 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 - Guernsey, 18th August



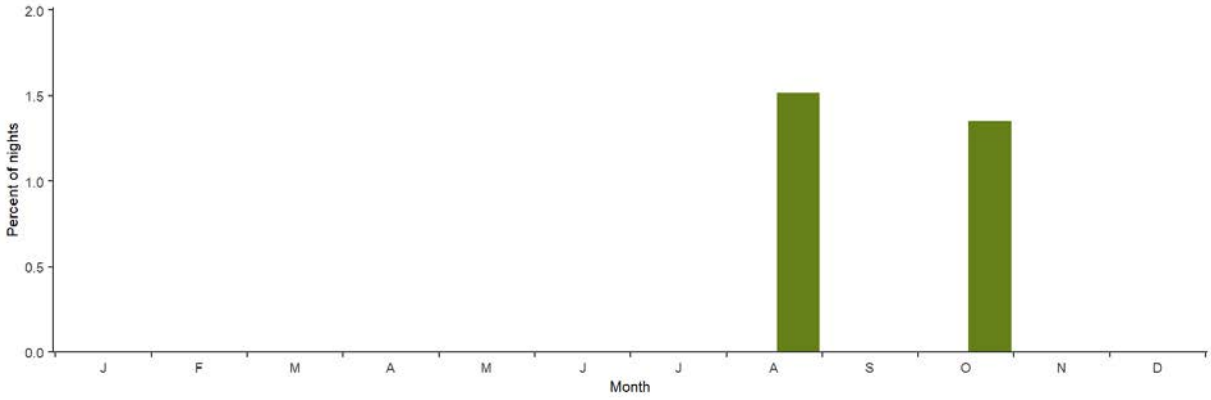
Grey Bush-cricket - same recording, different scale

Large Conehead

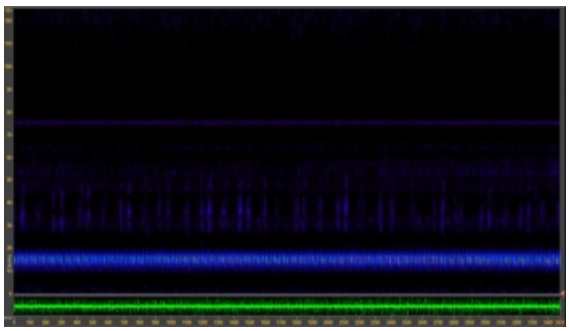
Large Conehead *Ruspolia nitidula* was recorded on four nights, from three locations.

Spatial pattern of detections

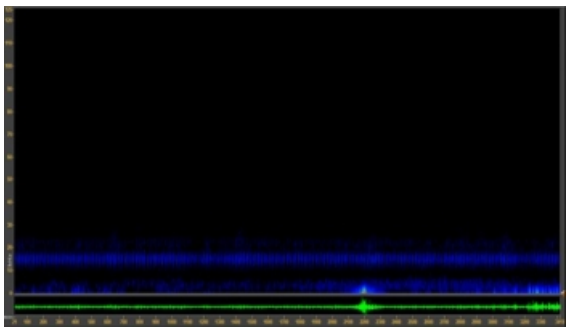
Seasonality



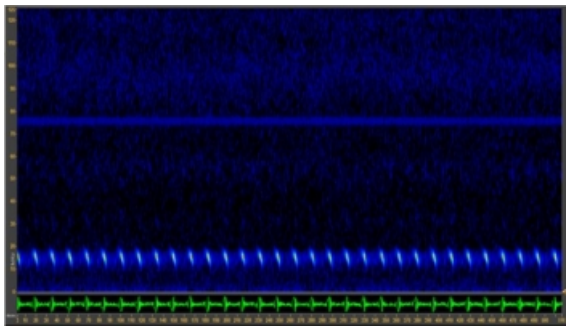
Large Conehead - new species for the Channel Islands was recorded as by-catch from single locations on Alderney on the 30th August, on Guernsey on the 29th August, and on Lihou on the 18th and 19th October. There were between 50 and 490 recordings of Large Conehead from each location.



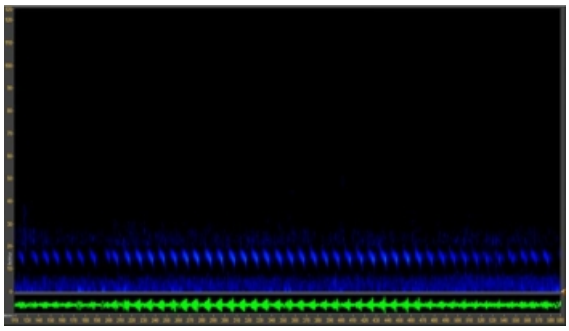
Large Conehead - recorded by Barry Yates in West Sussex, 31st August 2021



Large Conehead - Lihou, 18th October. Similar scale to recording on the left



Large Conehead (different scale to above) - recorded by Barry Yates in West Sussex, 31st August 2021

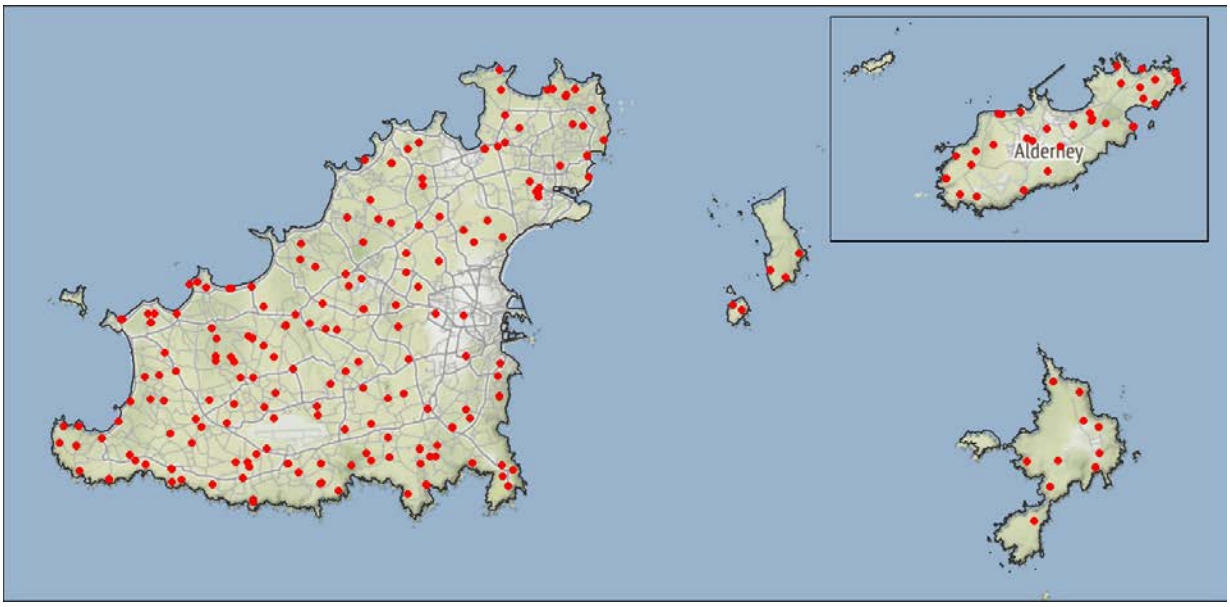


Large Conehead - Lihou, 18th October. Similar scale to recording on the left

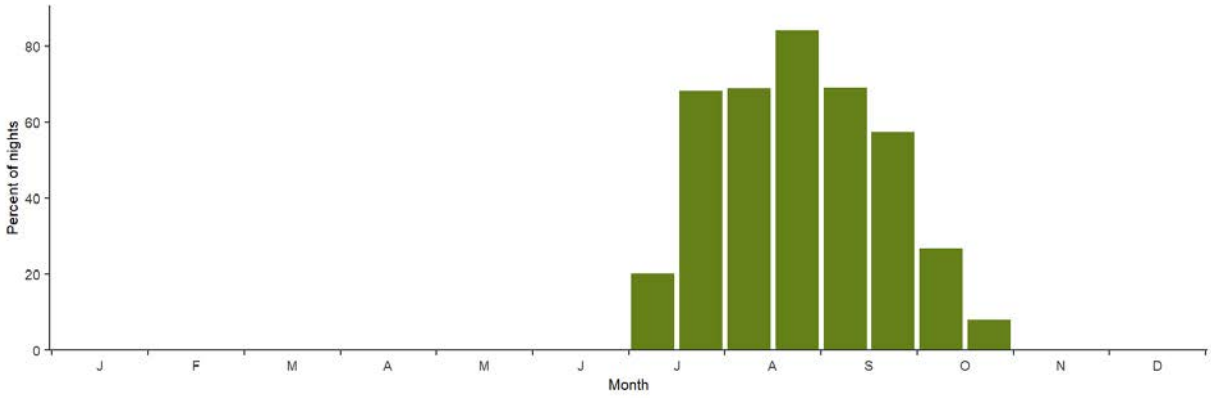
Great Green Bush-cricket

Great Green Bush-cricket *Tettigonia viridissima* was recorded on 104 nights, from 271 locations.

Spatial pattern of detections

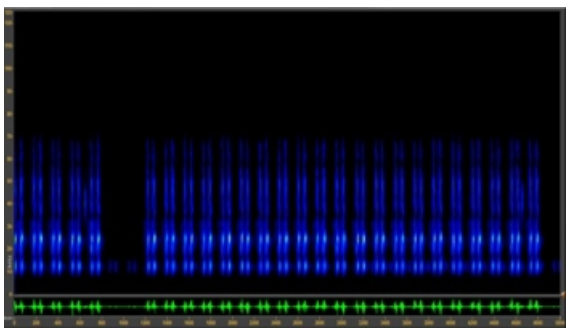


Seasonality

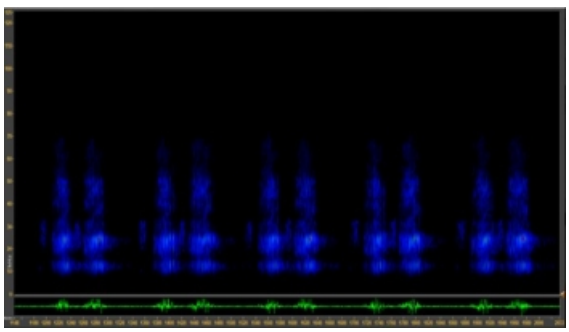


Great Green Bush-cricket were recorded form 271 locations between the beginning of July and the end of October, which includes records from Guernsey, Alderney, Sark, Herm and Jethou. Great Green Bush-cricket produces 'calls' with a peak frequency of about 10 kHz. The call syllables for this species are 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 detected in 2021. We are unsure whether the presence of these species has been confirmed on the islands.



Great Green Bush-cricket - Guernsey, 17th September



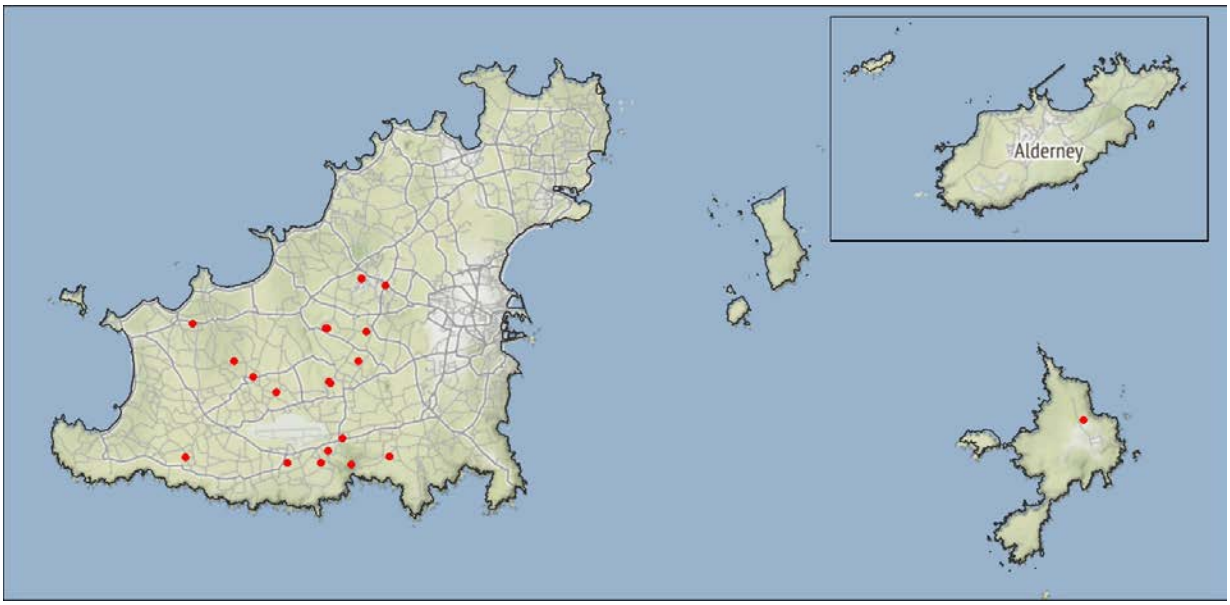
Great Green Bush-cricket - same recording, different scale

4.3.4 Audible moth species

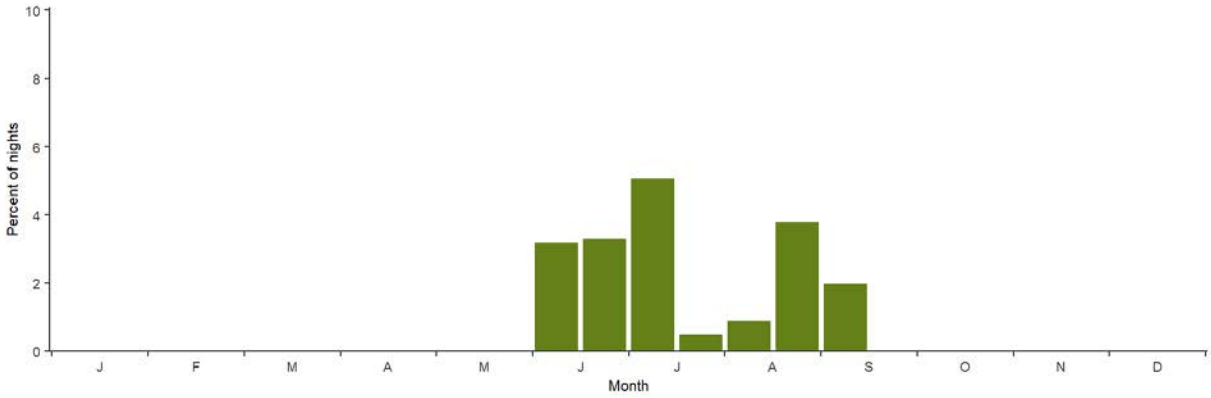
Green Silver-lines

Green Silver-lines *Pseudoips prasinana* was recorded on 29 nights, from 22 locations.

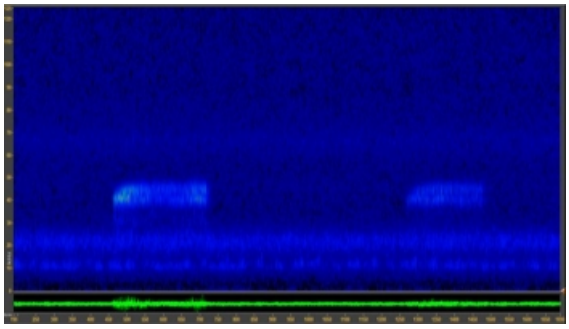
Spatial pattern of detections



Seasonality



Green Silver-lines was recorded from 22 locations, which included records from Guernsey and from one location on Sark. 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.

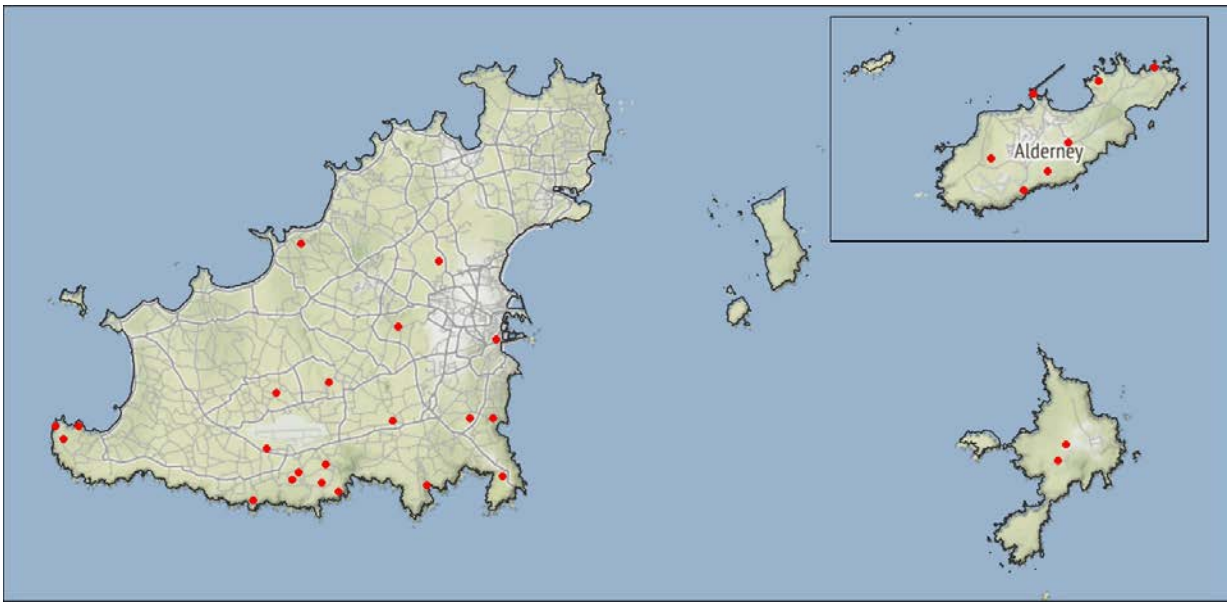


Green Silver-lines - Guernsey, 13th July

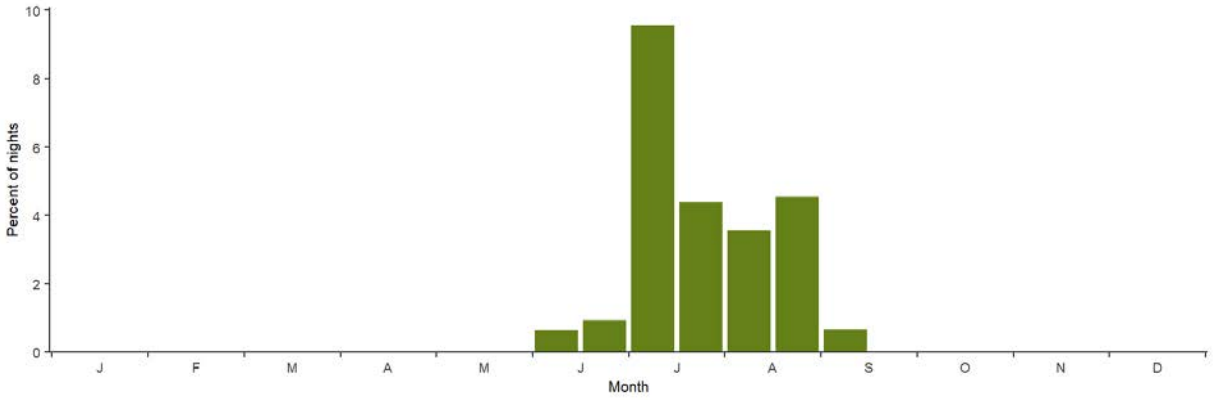
Bird Cherry Ermine

Bird Cherry Ermine *Yponomeuta evonymella* was recorded on 29 nights, from 32 locations.

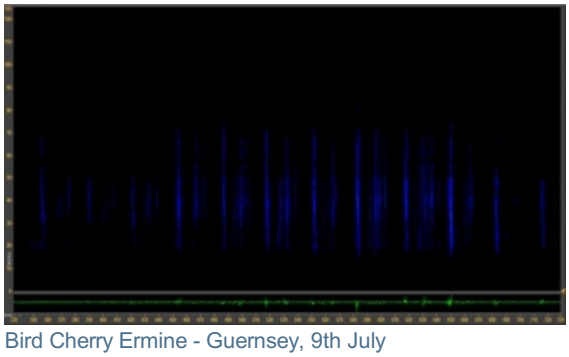
Spatial pattern of detections



Seasonality



Bird Cherry Ermine was recorded on Guernsey, Alderney and Sark. The micro-moth Bird Cherry Ermine was also recorded from 9 locations. This species of moth is deaf itself, but it produces ultrasonic clicks when it flies, to interfere with the echolocation of bats and reduce predation. The sound produced by the Bird Cherry Ermine is very different from Green Silver-lines. Whilst we have assigned all recordings like this to this species, we can not exclude the possibility that other closely related species produce similar sounds. In addition to recordings that we have assigned to the two moth species here, we believe that several other currently unidentifiable insect species (probably moths or beetle species), were also recorded in 2021.



Bird Cherry Ermine - Guernsey, 9th July

5. DISCUSSION

The current dataset of 710,260 bat recordings has been very valuable in adding to our understanding of patterns of occurrence and activity of bats across the Bailiwick of Guernsey, but it also adds to our understanding of some other species groups that were recorded as 'by-catch' during bat surveys. The results from this season include five species of bat that had not previously been recorded on Guernsey or other islands, and one new species of bush-cricket that was recorded on Guernsey, Alderney and Lihou which has not previously been found in the Channel Isles.

6. ACKNOWLEDGEMENTS

We would like to thank all the volunteers who took part in Bailiwick Bat Survey in 2021 and the landowners that gave volunteers access to their land. We would also like to thank the Guernsey Museum at Candie, the Guille-Allés library, Agriculture, Countryside and Land Management Services, Alderney Wildlife Trust and Sark School for hosting bat detectors for the project. We are also very grateful to Jack Bush, Roland Gauvain, Nicholas Roberts (Sark), Robert Leatherbarrow (Herm), Bill Bailey (Jethou) and Steve Sarre (Lihou), Piers Sangan, Amy Hall, Nicky Jee, Anni Binet and the bat section of La Société Guernesiaise for their help and support of this project. We would also like to thank Matt Baxter, Steve Pritchard from the BTO IS team for development and support of the online systems that were used in this project. Lastly we would like to thank the States of Guernsey for funding this project.

7. REFERENCES

Barataud, M. 2015. *Acoustic Ecology of European Bats: Species identification, study of their habitats and foraging behaviour*. Collection Inventaires et biodiversité, Biotope Editions, Mèze et Publications scientifiques du Muséum National d'Histoire Naturelle, Paris.

Barataud, M. & Skals, N. 2018. Émissions ultrasonores de communication sociale enregistrées en canopée : attribution au lépidoptère Pseudoips prasinana (L.) (Noctuoidea ; Nolidae ; Chloephorinae) grâce à une analyse bibliographique. *Plume de naturalistes* 2, 11-22. http://www.plume-de-naturalistes.fr/wp-content/uploads/2018/11/02_BARATAUD-M_05-2018_Emissions-ultrasonores-Pseudoips-prasinana_Plume2_11-22.pdf

Barré, K., Le Viol, I., Julliard, R., Pauwels, J., Newson, S.E., Julien, J.F., Fabien, C., Kerbiriou, C. & Bas, Y. 2019. Accounting for automated identification errors in acoustic surveys. *Methods in Ecology and Evolution*.

Thieurmel, B. & Elmarhraoui, A. 2019. suncalc: Compute Sun Position, Sunlight Phases, Moon Position and Lunar Phase. R package version 0.5.0. https://CRAN.R-project.org/package=suncalc.

Binet, A. & Walsh, L. 2020. British Islands Bats, Batting in the Channel. *British Islands Bats* 1, 6-14.

Hall, A.L. 2021. Bats of Jersey. Presentation for 2nd Channel Islands Bat Conference (updated 2021). Jersey Bat Group.

Jones, J.P.G. 2011. Monitoring species abundance and distribution at the landscape scale. *Journal of Applied Ecology* 48, 9-13.

Newson, S.E., Evans, H.E. & Gillings, S. 2015. A novel citizen approach for large-scale standardised monitoring of bat activity and distribution, evaluated in eastern England. *Biological Conservation* 191, 38-49.

Newson, S. E., Bas, Y., Murray, A. & Gillings, S. 2017b. Potential for coupling the monitoring of bush-crickets with established large-scale acoustic monitoring of bats. *Methods in Ecology and Evolution* 8, 1051-1062.

Newson, S.E., Evans, H.E., Gillings, S., Jarret, D., Raynor, R., Wilson, M.W. 2017a. Large-scale citizen science improves assessment of risk posed by wind farms to bats in southern Scotland. *Biological Conservation* 215, 61-71.

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

Pereira, H.M. & Cooper, H.D. 2006. Towards the global monitoring of biodiversity change. *Trends Ecology and Evolution* 21, 123-129.

Russ, J. (ed.) 2021. *Bat calls of Britain and Europe. A guide to species identification.* Pelagic Publishing.

Sydanmaa, L. 2919. Bats of Alderney 2019 report. Alderney Wildlife Trust.

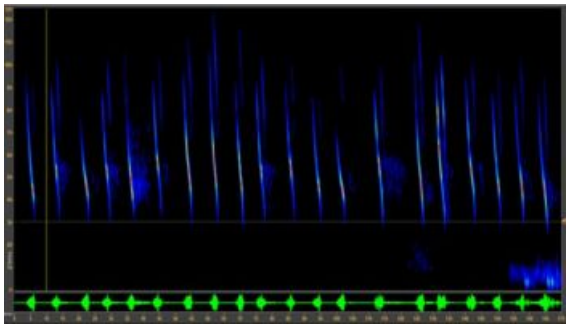
Identification appendix 1: Whiskered/Brandt's Bat *Myotis mystacinus/brandtii*

When it comes to the sound identification of bats in the genus *Myotis*, there is a common view that it is not possible to assign recordings to species, even among experienced bat workers. In the following, we would like to explain, with a recording of Whiskered Bat or Brandt's Bat from Alderney from the 7th June 2021, some of our thinking on how we approach an identification.

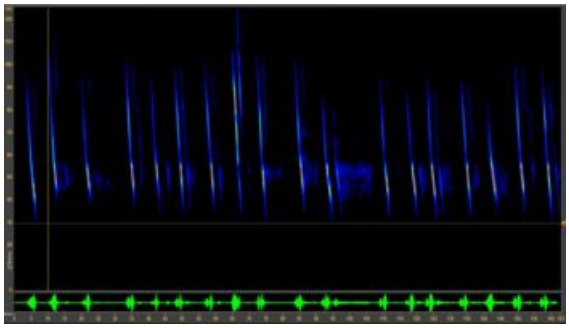
Given a *Myotis* recording, an important first consideration is the quality of the recording. Firstly, to consider whether there is significant overloading across calls that makes it difficult to determine the start and end of the calls. There is a bit of overloading in a few of the recordings of Whiskered or Brandt's Bat recordings shown in the main part of the report, but this is not extreme, and there are some good quality calls still in the sequence. If there is overloading across calls, it is normally necessary to stop at this point and to not go further with an identification. For us and this project, this is also a lesson for next season, for us to reduce the gain on the bat detector to reduce the chance of overloading seen here.

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

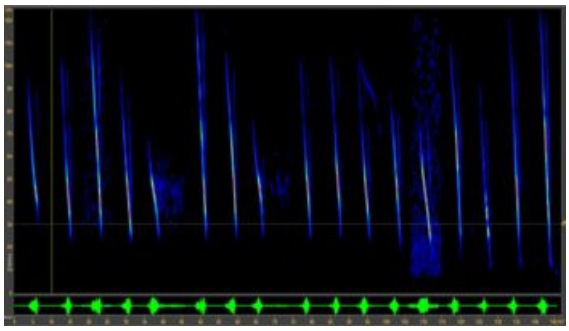
If the quality of the recordings and calls is good, we would normally expect to have a good idea of what species produced it, but it is helpful next to consider what you would expect calls of that species, given that call duration to look like, and to consider how this compares with other similar species. Just to illustrate, in the below I compare one good call from a recording of Whiskered Bat or Brandt's Bat from Alderney on the 7th June above (call shown left of the yellow vertical line in all the spectrograms below), with known calls for other *Myotis* species (compiled recordings made from known species recordings using the Sonobat Reference Compiler). Taking this approach for the recordings above, it is straightforward to see that the recordings above are well outside what you would expect for Natterer's Bat, Alcathoe bat and Geoffroy's Bat. The difference between short duration calls of Daubenton's Bat and the presumed Whiskered / Brandt's Bat is more subtle. In Whiskered / Brandt's Bat for calls of this duration there tends to be a long and steep neck to calls and kink in the calls towards the bottom. This can be seen in Daubenton's Bat, but it is not so typical for this species, and would be usual for such calls to present across a sequence of calls without some additional clues to the real identification. The chance of seeing atypical calls is less likely again, where there is more than one recording at almost the same time of what is likely to be the same bat as seen here.



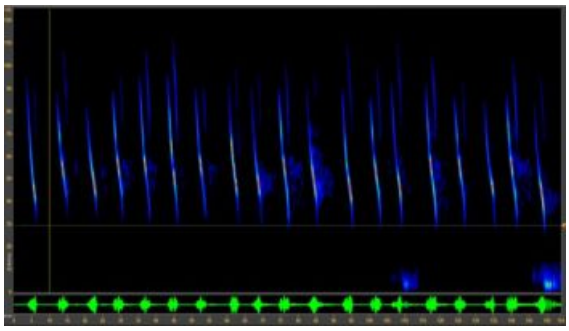
Whiskered or Brandt's Bat call (left), against known Whiskered calls (right)



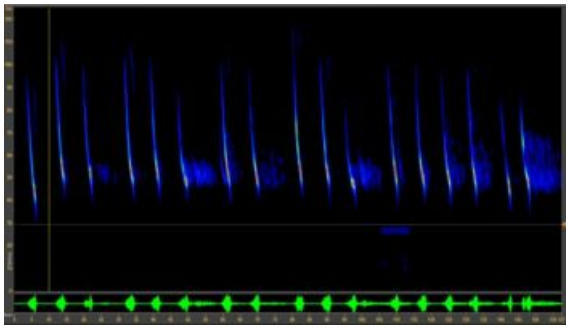
Whiskered or Brandt's Bat call (left), against known Brandt's Bat calls (right)



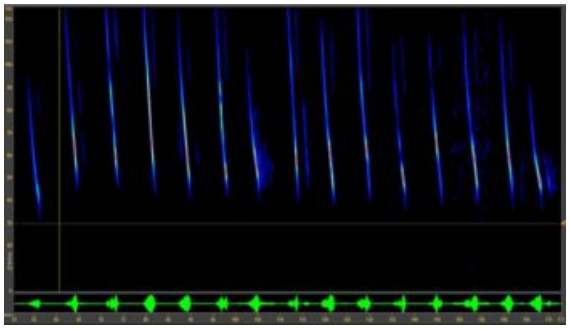
Whiskered or Brandt's Bat call (left), against Natterer's Bat calls (right)



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



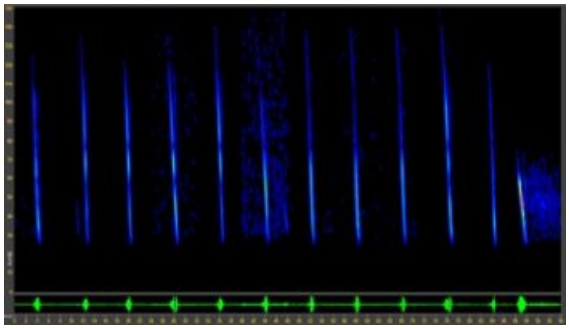
Whiskered or Brandt's Bat call (left), against known Alcathoe Bat calls (right)



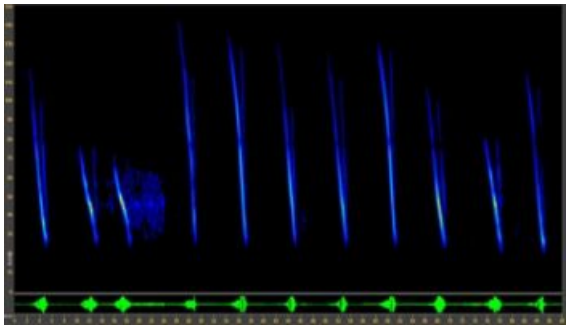
Whiskered or Brandt's Bat call (left), against known Geoffroy's Bat calls (right)

Identification appendix 2: Natterer's Bat *Myotis nattereri*

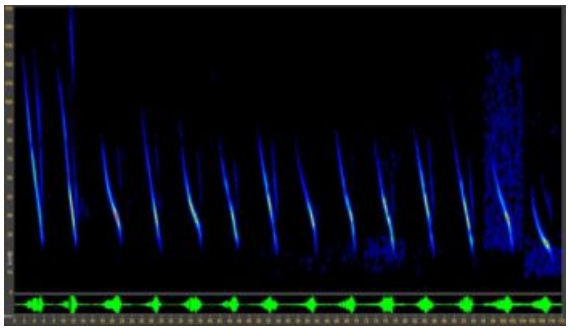
As with Whiskered and Brandt's Bat, the first consideration when looking at recordings is the quality of the recording, to consider whether the quality is good enough to try to assign the recording to species. Given a good recording, Natterer's Bat can occasionally produce atypical calls that could be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



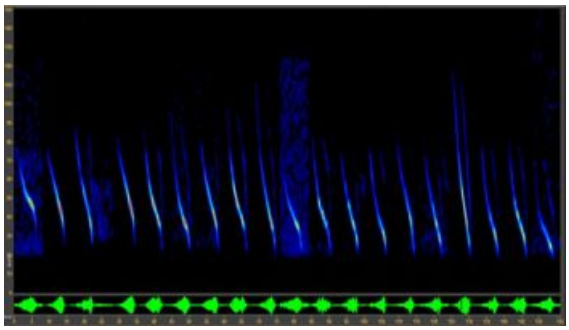
Natterer's Bat - call duration up to 1.2 ms



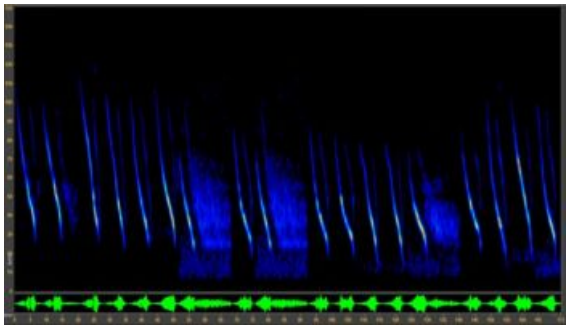
Natterer's Bat - call duration 2.7-2.8 ms



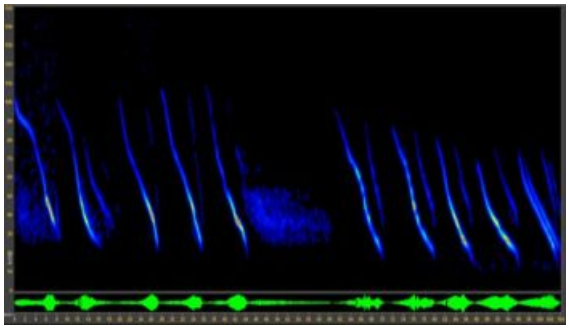
Natterer's Bat - call duration 3.9-4.0 ms



Natterer's Bat - call duration 4.9-5.0 ms



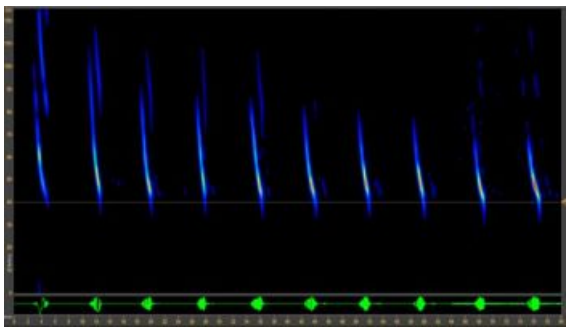
Natterer's Bat - call duration 5.9-6.0 ms



Natterer's Bat - call duration 7.1-9.4 ms

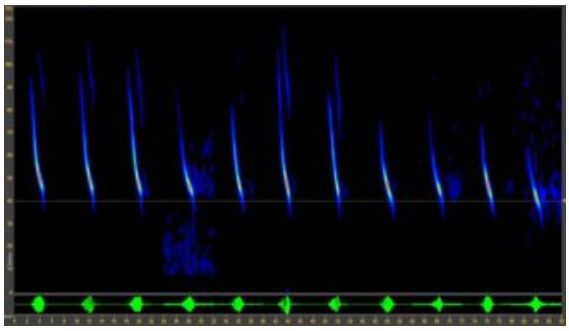
Identification appendix 3: Kuhl's Pipistrelle *Pipistrellus kuhlii* and Nathusius' Pipistrelle *Pipistrellus nathusii*

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.

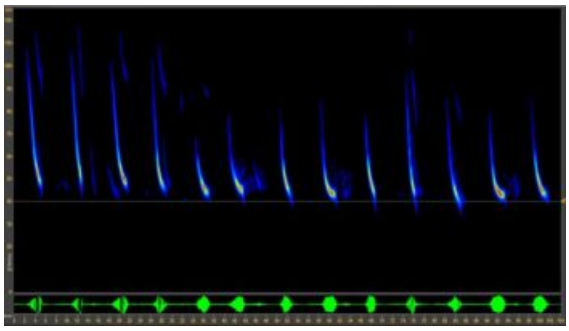


Kuhl's Pipistrelle - call duration 1.1-1.7 ms

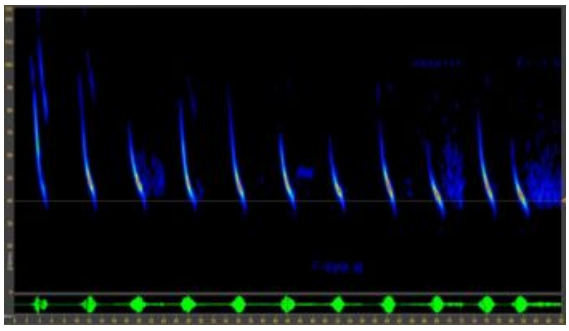
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 1.8-2.2 ms

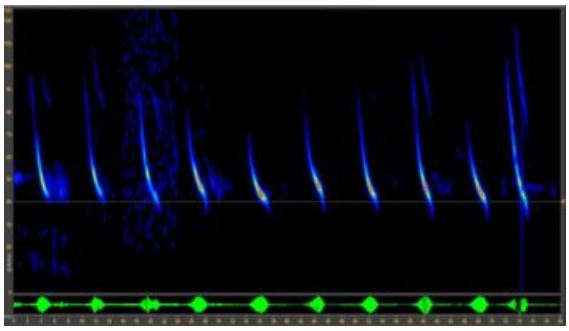


Nathusius' Pipistrelle - call duration 1.8-3.0 ms



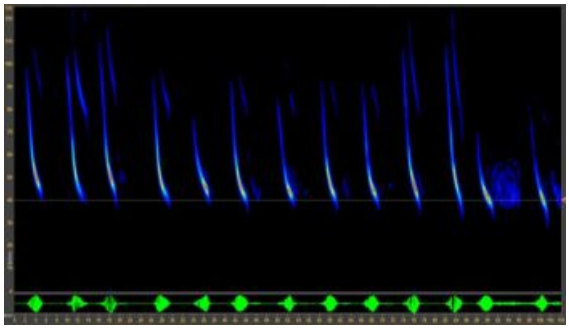
Kuhl's Pipistrelle - call duration 2.3-2.6 ms

Nathusius' Pipistrelle - fewer examples for this call duration



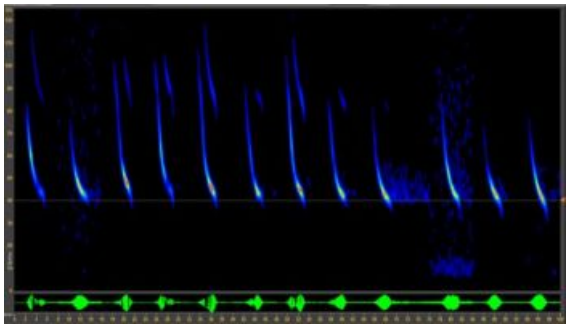
Kuhl's Pipistrelle - call duration 2.7-2.9 ms

Nathusius' Pipistrelle - fewer examples for this call duration

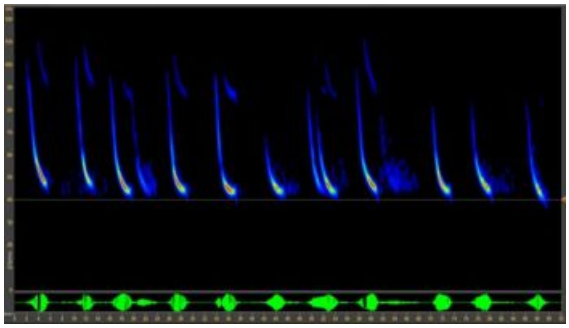


Kuhl's Pipistrelle - call duration 3.0-3.1 ms

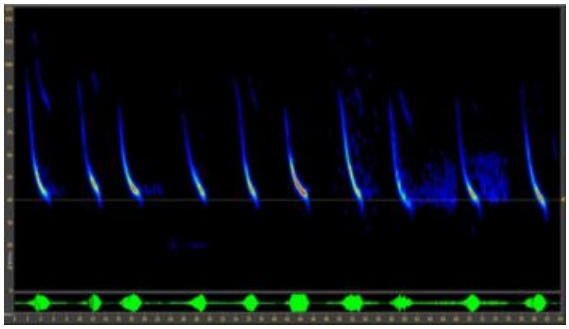
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 3.2-3.3 ms

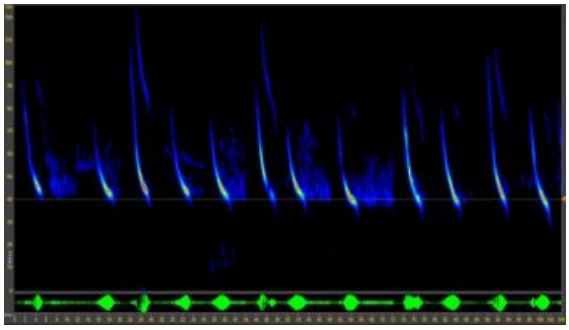


Nathusius' Pipistrelle - call duration 3.1-3.6 ms



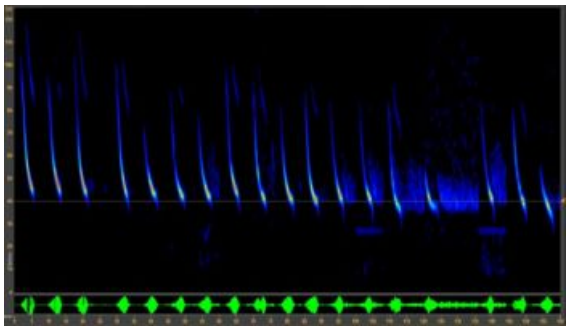
Kuhl's Pipistrelle - call duration 3.4-3.5 ms

Nathusius' Pipistrelle - fewer examples for this call duration

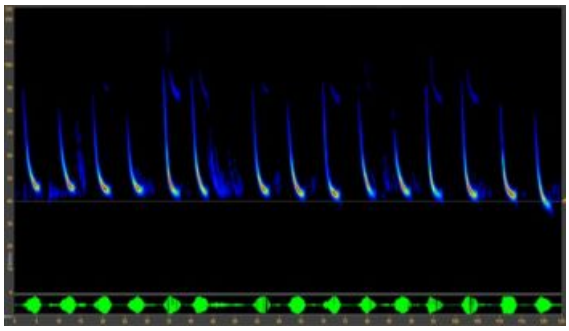


Kuhl's Pipistrelle - call duration 3.6-3.7 ms

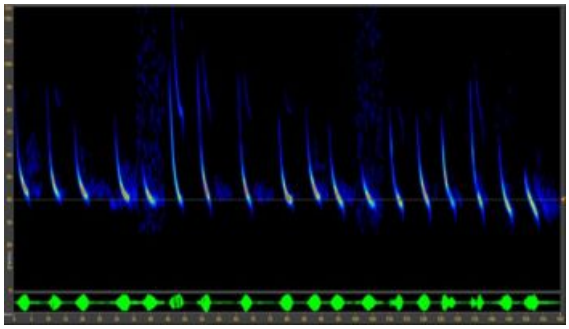
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 3.8-3.9 ms

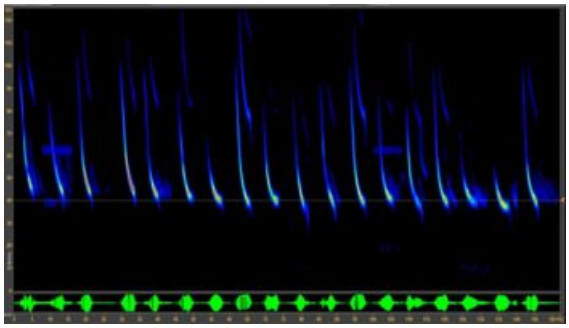


Nathusius' Pipistrelle - call duration 3.7-4.0 ms

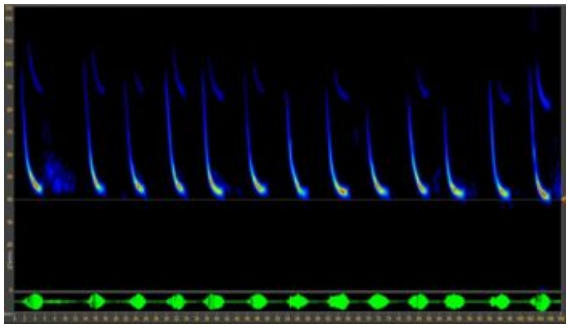


Kuhl's Pipistrelle - call duration 4.0-4.1 ms

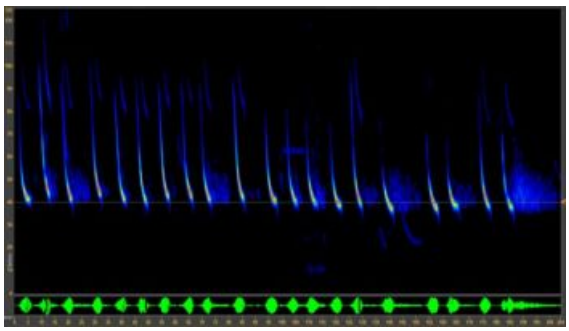
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 4.2-4.3 ms

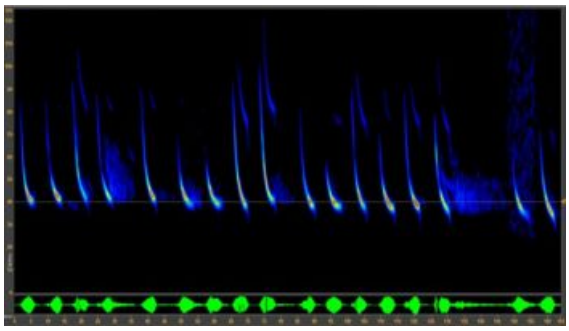


Nathusius' Pipistrelle - call duration 4.1-4.4 ms

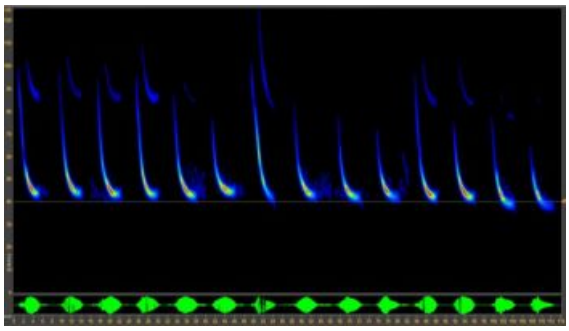


Kuhl's Pipistrelle - call duration 4.4-4.5 ms

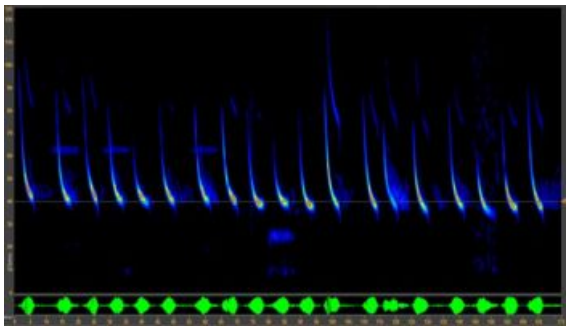
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 4.6-4.7 ms

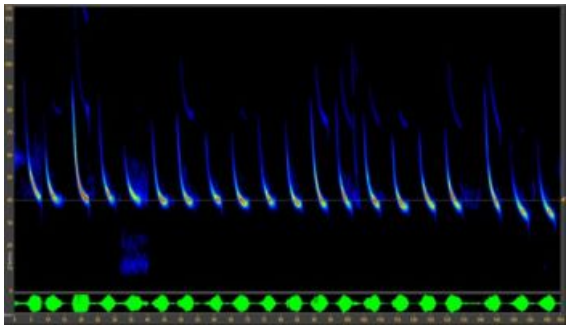


Nathusius' Pipistrelle - call duration 4.5-4.8 ms

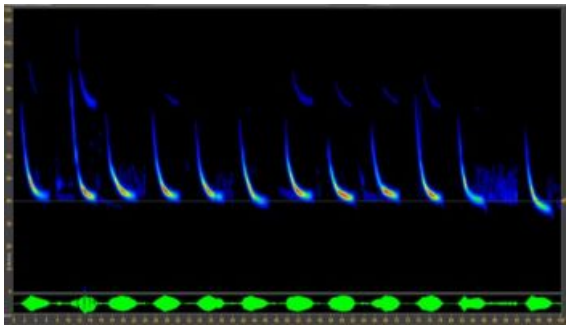


Kuhl's Pipistrelle - call duration 4.8-4.9 ms

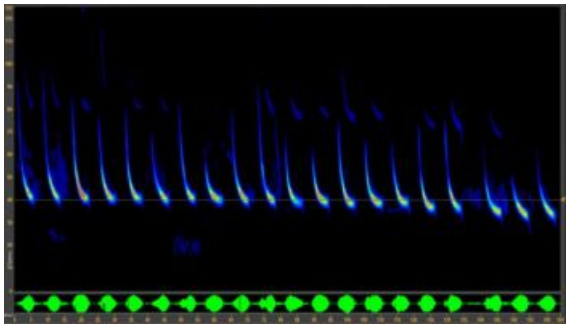
Nathusius' Pipistrelle - fewer examples for this call duration



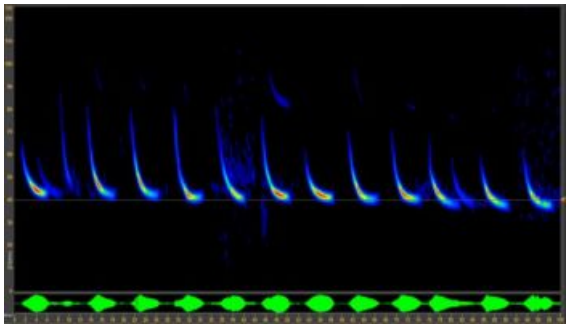
Kuhl's Pipistrelle - call duration 5.0-5.1 ms



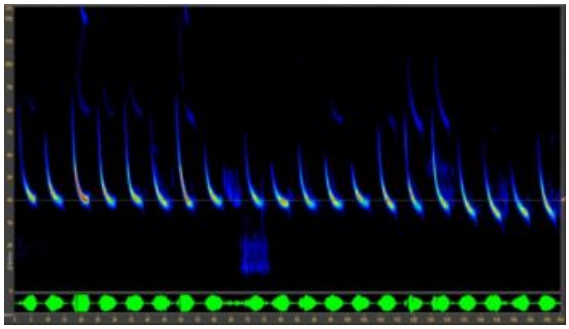
Nathusius' Pipistrelle - call duration 4.9-5.1 ms



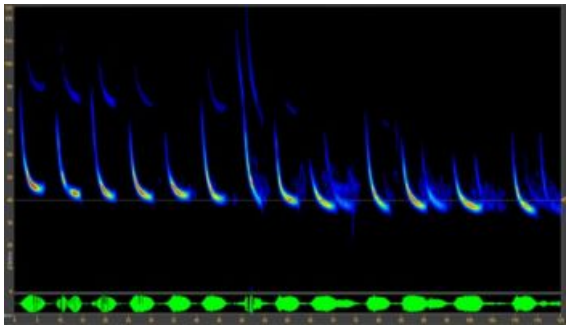
Kuhl's Pipistrelle - call duration 5.2-5.3 ms



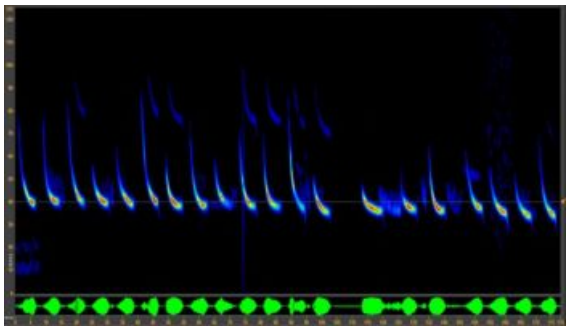
Nathusius' Pipistrelle - call duration 5.2-5.3 ms



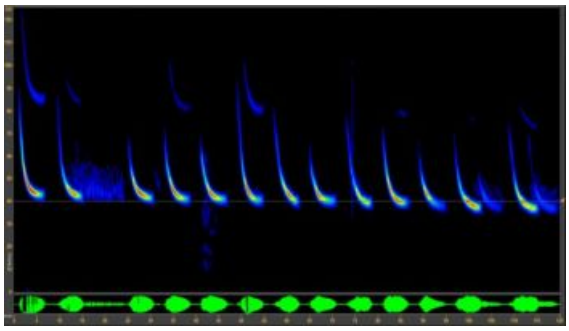
Kuhl's Pipistrelle - call duration 5.4-5.5 ms



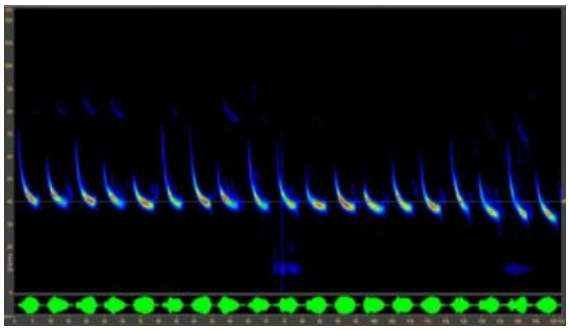
Nathusius' Pipistrelle - call duration 5.4-5.5 ms



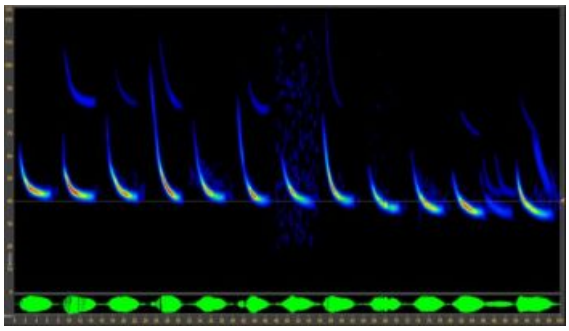
Kuhl's Pipistrelle - call duration 5.6-5.7 ms



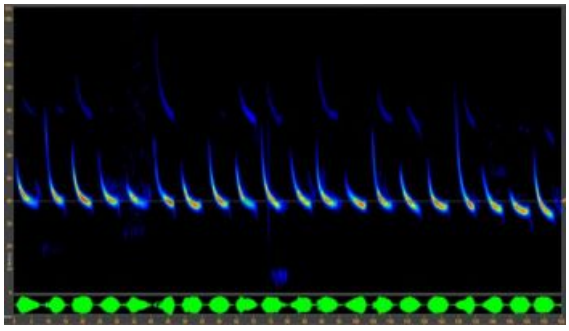
Nathusius' Pipistrelle - call duration 5.6-5.7 ms



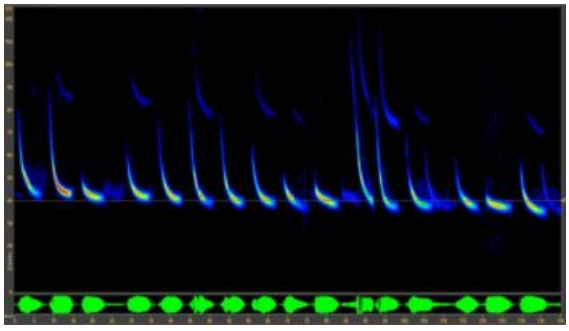
Kuhl's Pipistrelle - call duration 5.8-5.9 ms



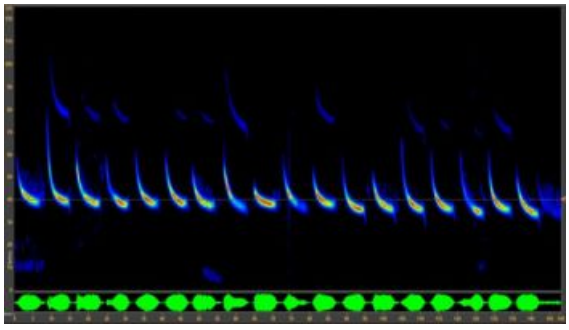
Nathusius' Pipistrelle - call duration 5.8-5.9 ms



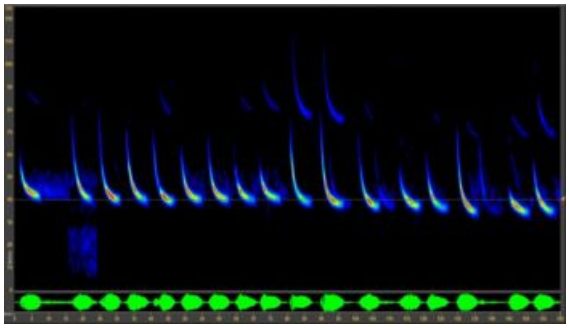
Kuhl's Pipistrelle - call duration 6.0-6.1 ms



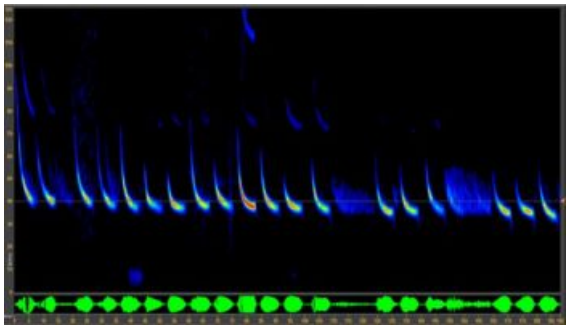
Nathusius' Pipistrelle - call duration 6.0-6.1 ms



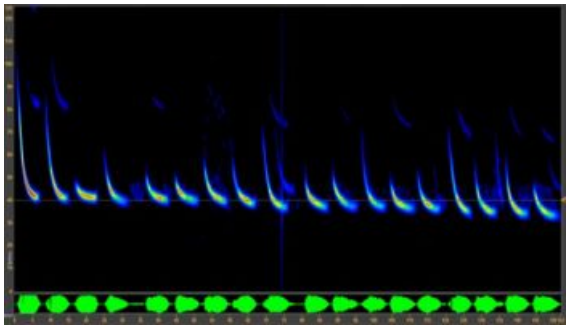
Kuhl's Pipistrelle - call duration 6.2-6.3 ms



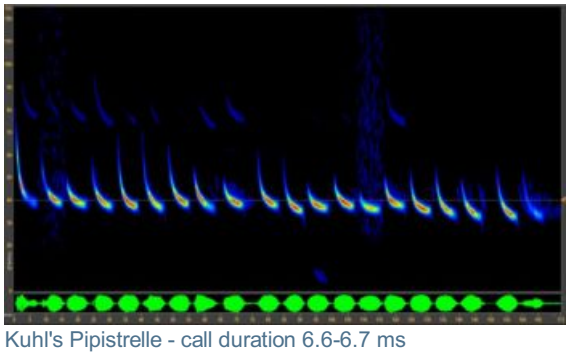
Nathusius' Pipistrelle - call duration 6.2-6.3 ms



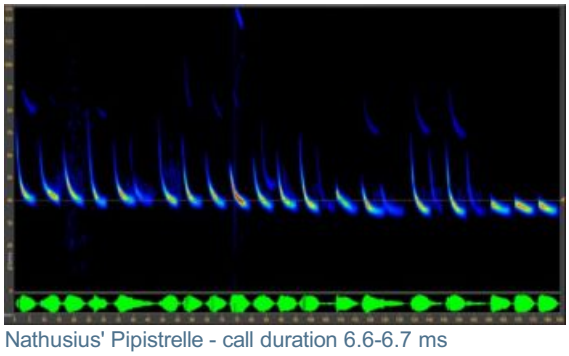
Kuhl's Pipistrelle - call duration 6.4-6.5 ms



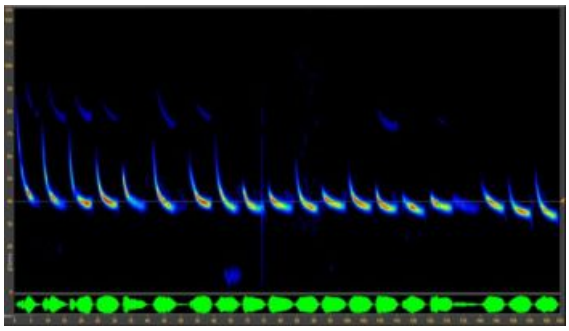
Nathusius' Pipistrelle - call duration 6.4-6.5 ms



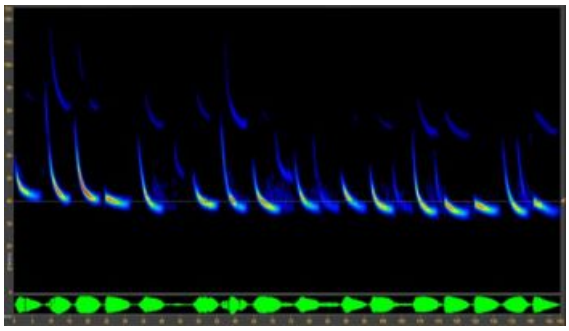
Kuhl's Pipistrelle - call duration 6.6-6.7 ms



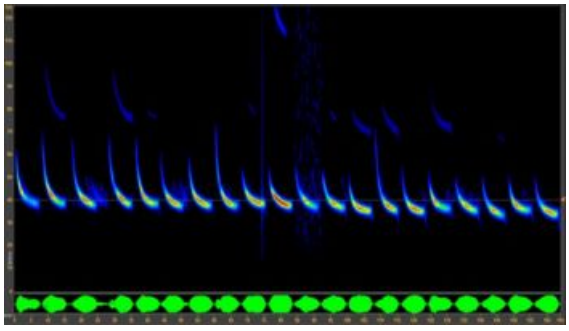
Nathusius' Pipistrelle - call duration 6.6-6.7 ms



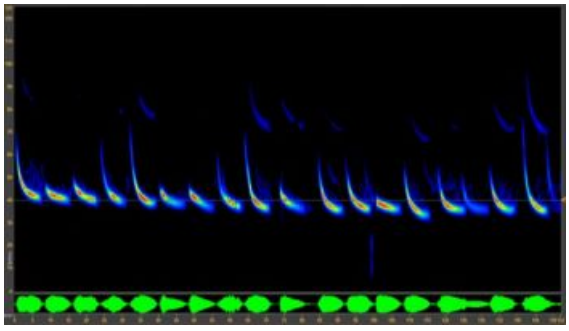
Kuhl's Pipistrelle - call duration 6.8-6.9 ms



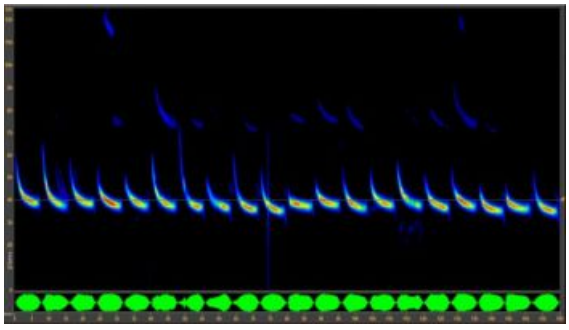
Nathusius' Pipistrelle - call duration 6.8-6.9 ms



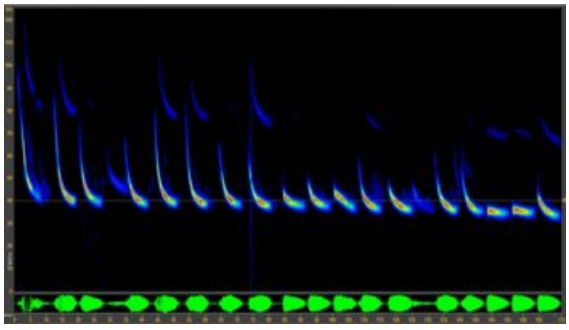
Kuhl's Pipistrelle - call duration 7.0-7.1 ms



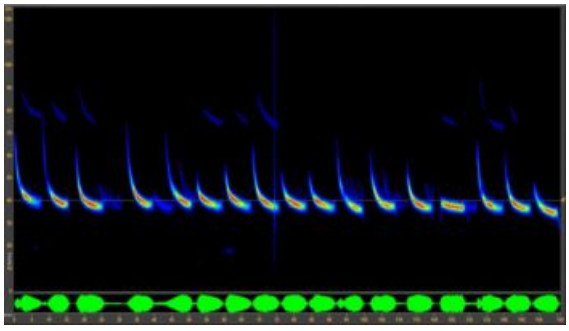
Nathusius' Pipistrelle - call duration 7.0-7.1 ms



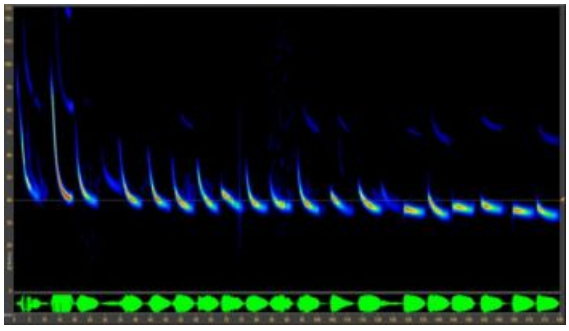
Kuhl's Pipistrelle - call duration 7.2-7.3 ms



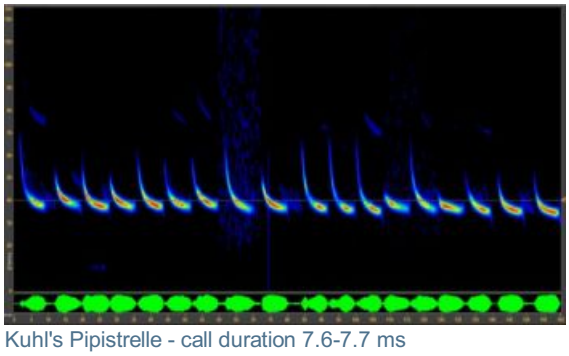
Nathusius' Pipistrelle - call duration 7.2-7.3 ms



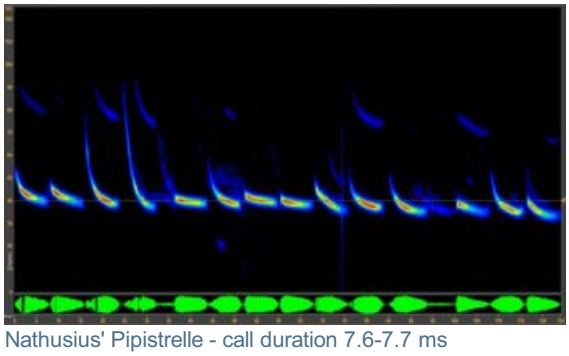
Kuhl's Pipistrelle - call duration 7.4-7.5 ms



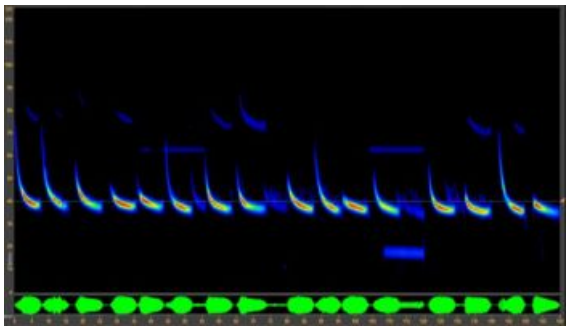
Nathusius' Pipistrelle - call duration 7.4-7.5 ms



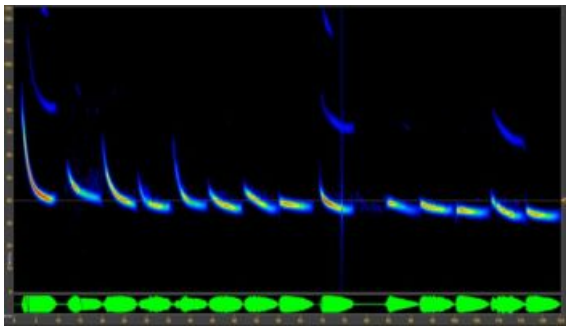
Kuhl's Pipistrelle - call duration 7.6-7.7 ms



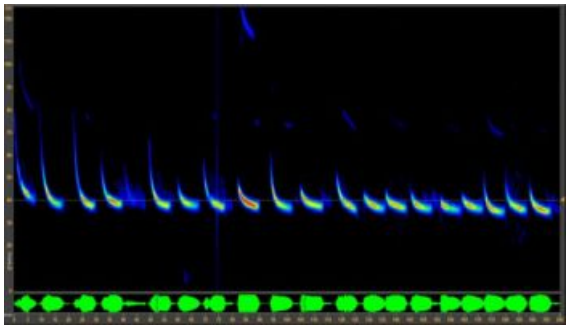
Nathusius' Pipistrelle - call duration 7.6-7.7 ms



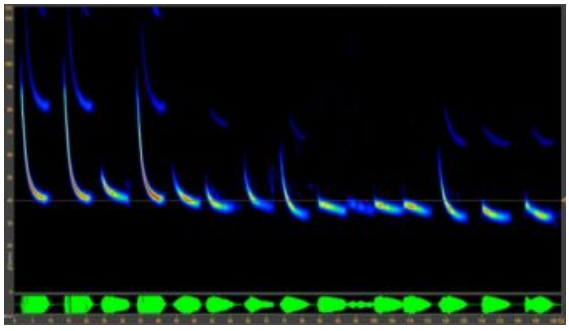
Kuhl's Pipistrelle - call duration 7.8-7.9 ms



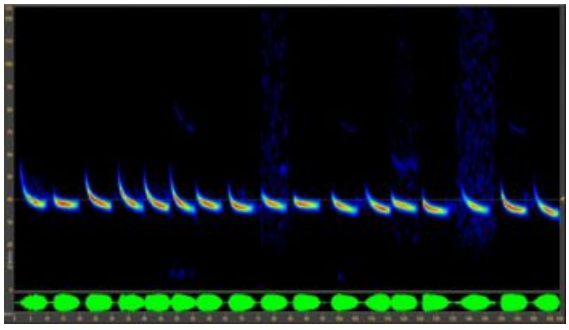
Nathusius' Pipistrelle - call duration 7.8-7.9 ms



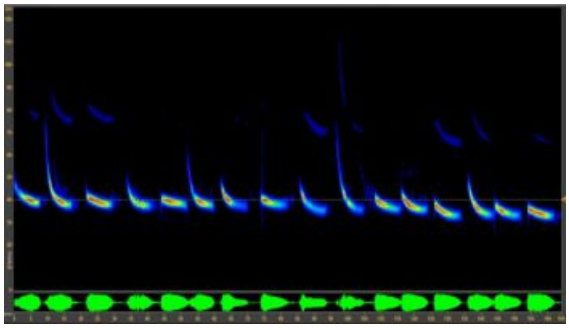
Kuhl's Pipistrelle - call duration 8.0-8.1 ms



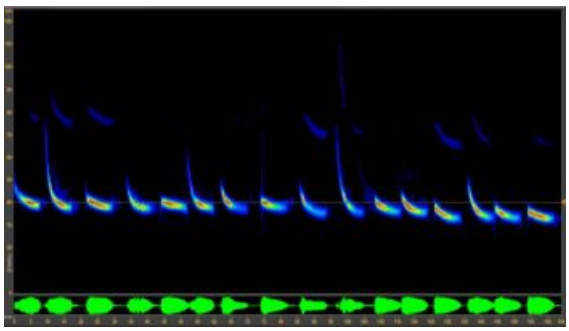
Nathusius' Pipistrelle - call duration 8.0-8.1 ms



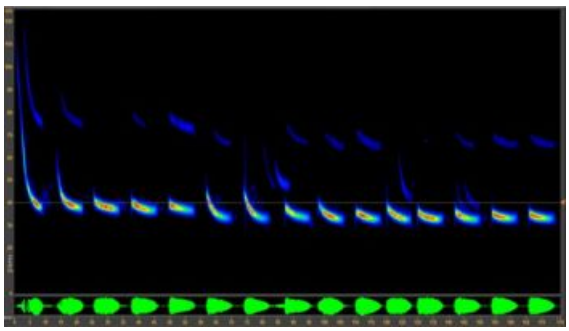
Kuhl's Pipistrelle - call duration 8.2-8.3 ms



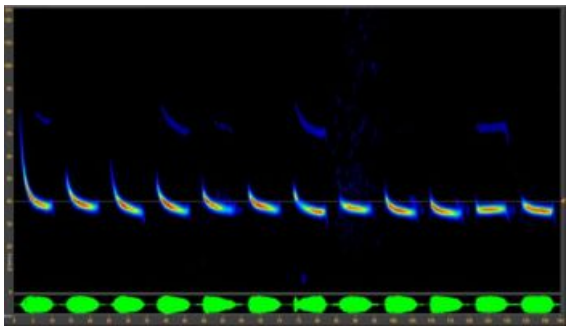
Nathusius' Pipistrelle - call duration 8.2-8.3 ms



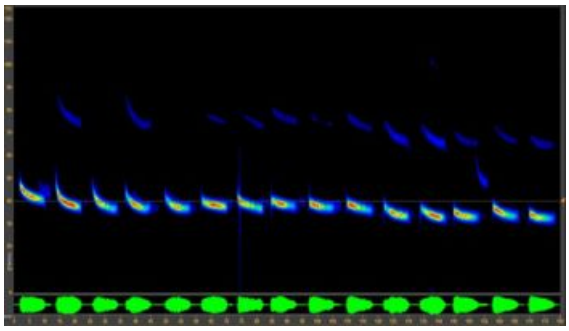
Kuhl's Pipistrelle - call duration 8.4-8.5 ms



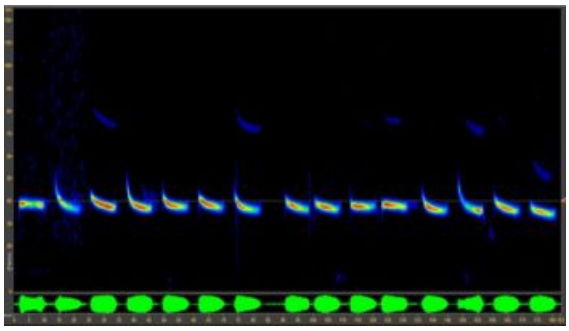
Nathusius' Pipistrelle - call duration 8.4-8.5 ms



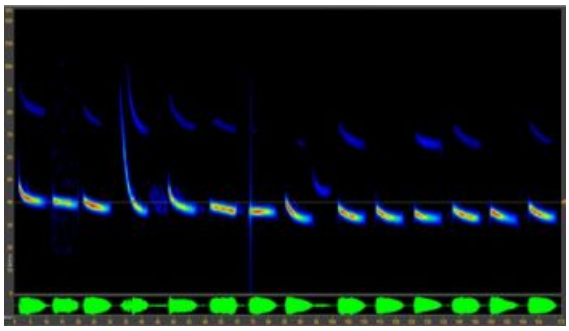
Kuhl's Pipistrelle - call duration 8.6-8.7 ms



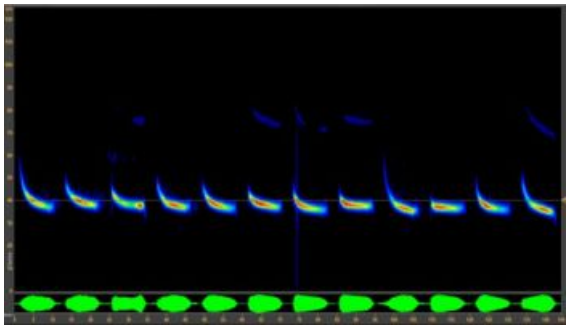
Nathusius' Pipistrelle - call duration 8.6-8.7 ms



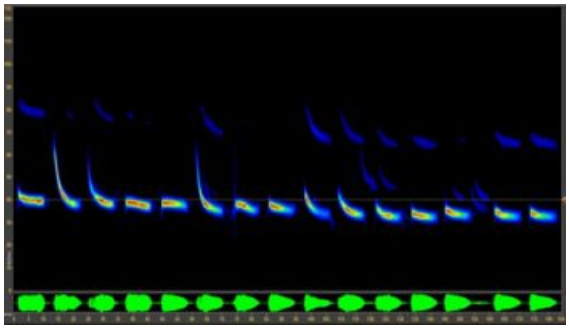
Kuhl's Pipistrelle - call duration 8.8-8.9 ms



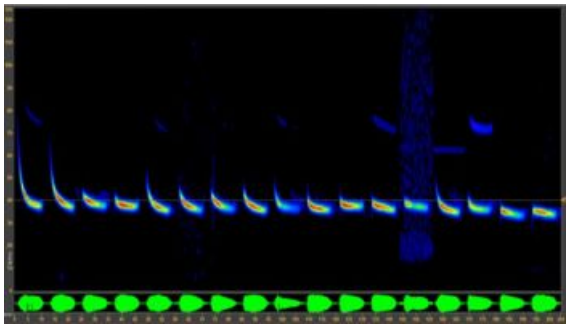
Nathusius' Pipistrelle - call duration 8.8-8.9 ms



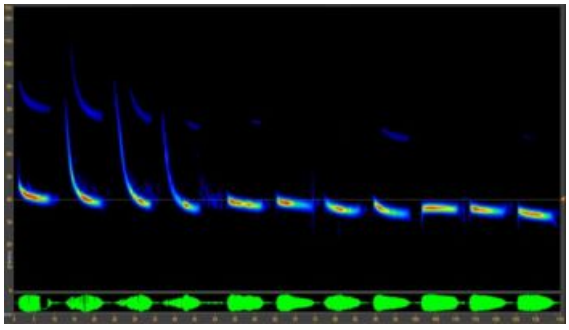
Kuhl's Pipistrelle - call duration 9.0-9.1 ms



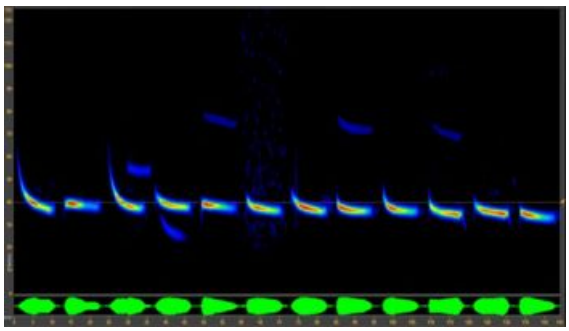
Nathusius' Pipistrelle - call duration 9.0-9.1 ms



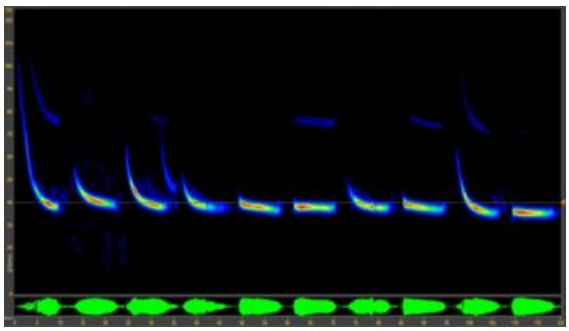
Kuhl's Pipistrelle - call duration 9.2-9.3 ms



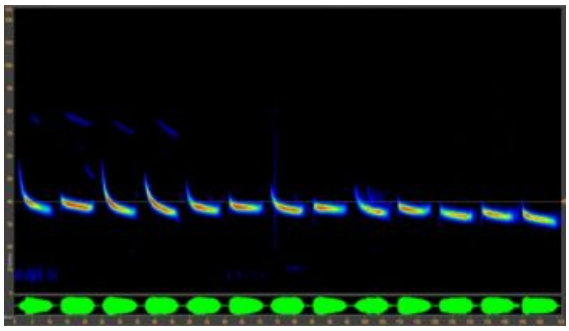
Nathusius' Pipistrelle - call duration 9.2-9.3 ms



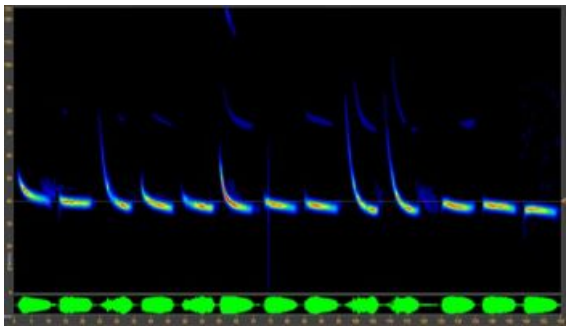
Kuhl's Pipistrelle - call duration 9.4-9.5 ms



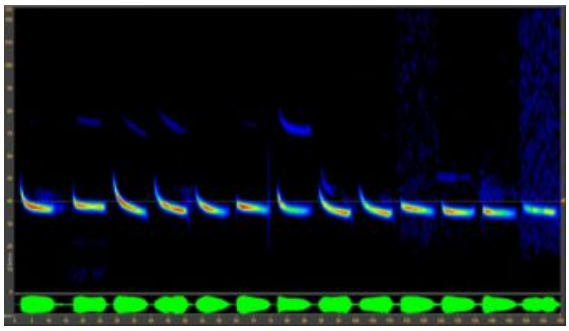
Nathusius' Pipistrelle - call duration 9.4-9.5 ms



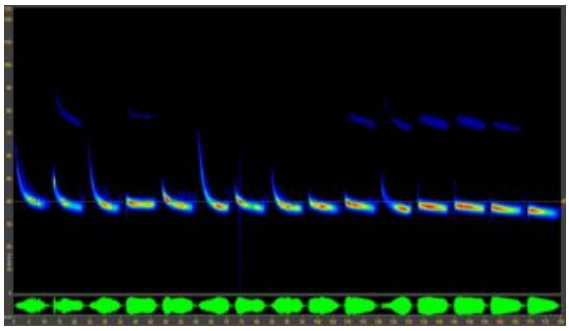
Kuhl's Pipistrelle - call duration 9.6-9.8 ms



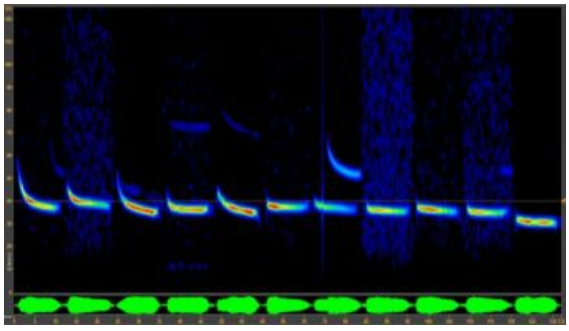
Nathusius' Pipistrelle - call duration 9.6-9.8 ms



Kuhl's Pipistrelle - call duration 9.9-10.1 ms

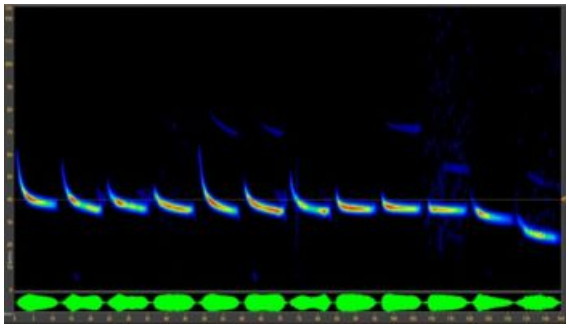


Nathusius' Pipistrelle - call duration 9.9-10.2 ms



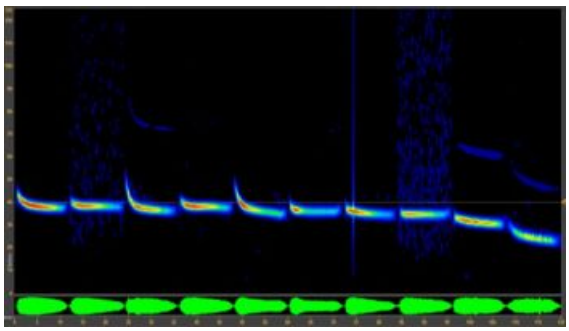
Kuhl's Pipistrelle - call duration 10.2-10.4 ms

Nathusius' Pipistrelle - fewer examples for this call duration

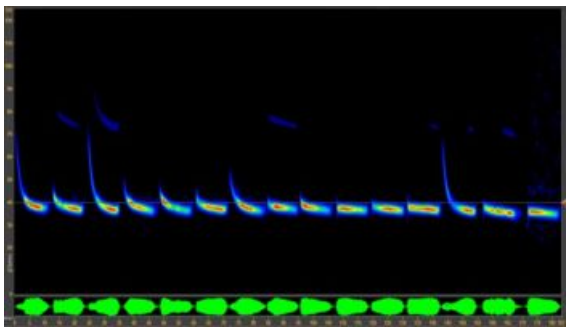


Kuhl's Pipistrelle - call duration 10.5-10.9 ms

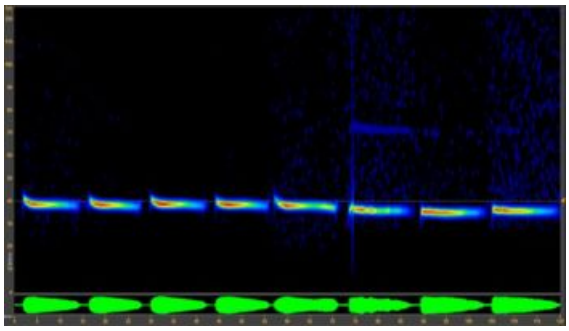
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 11.0-11.7 ms



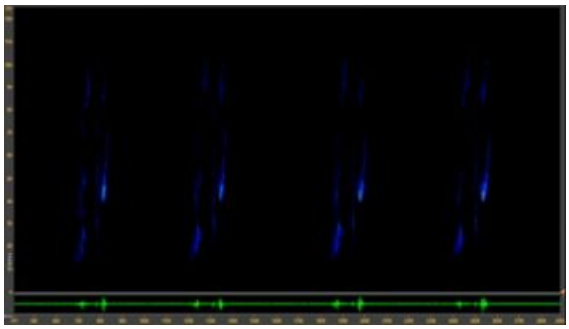
Nathusius' Pipistrelle - call duration 10.3-12.3 ms



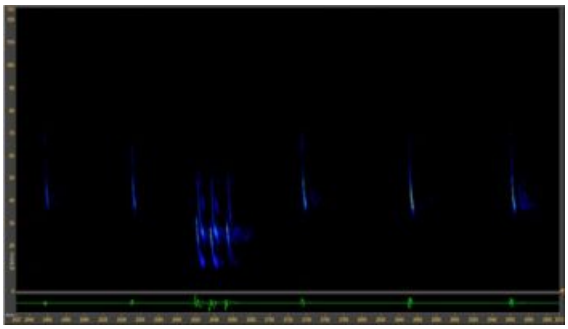
Kuhl's Pipistrelle - call duration 11.8-14.7 ms

Identification appendix 4: Kuhl's Pipistrelle *Pipistrellus kuhlii* and Nathusius' Pipistrelle *Pipistrellus nathusii* social calls

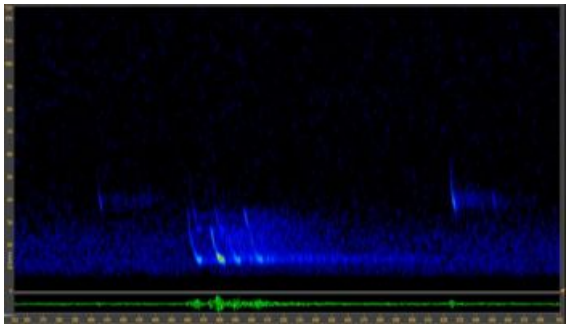
In addition to echolocation calls Kuhl's Pipistrelle and Nathusius' Pipistrelle also produce a range of social calls which can be assigned to species with confidence (observed variation in social calls shown below). Most of the observed social calls of Nathusius' Pipistrelle and Kuhl's Pipistrelle shown 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



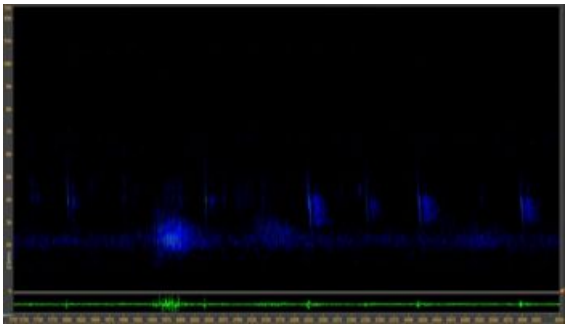
Nathusius' Pipistrelle male advertisement calls



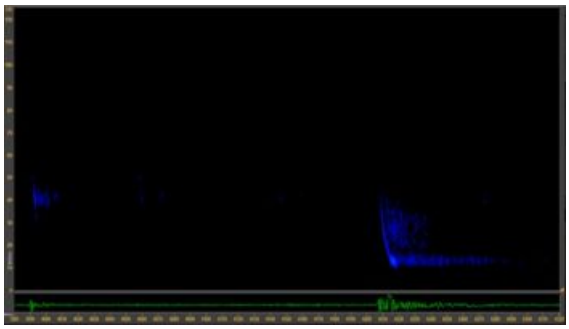
Kuhl's Pipistrelle - three-component social call



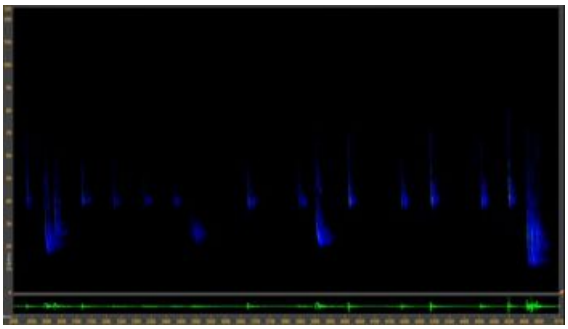
Kuhl's Pipistrelle - four-component social call



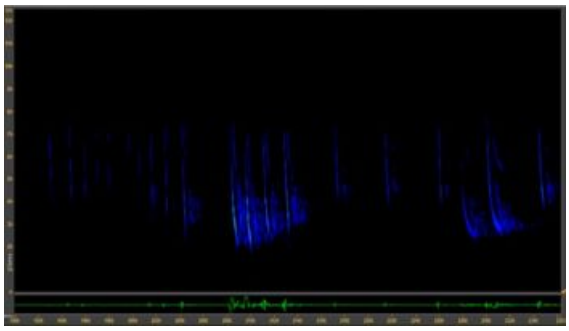
Kuhl's Pipistrelle - trills and low frequency 'myotis-like echolocation calls with social function



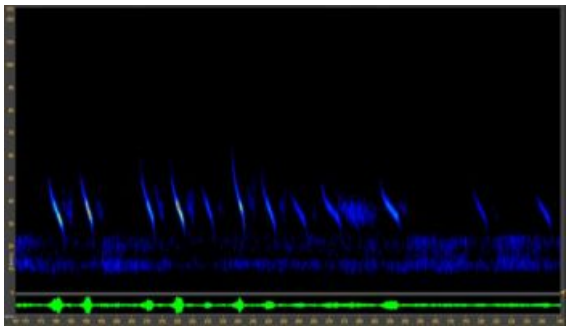
Kuhl's Pipistrelle - one-component social call



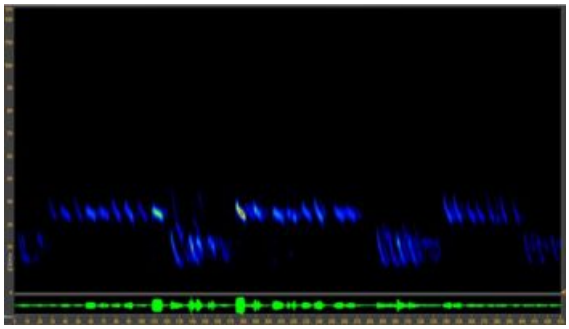
Kuhl's Pipistrelle - variation in social calls with different end frequency



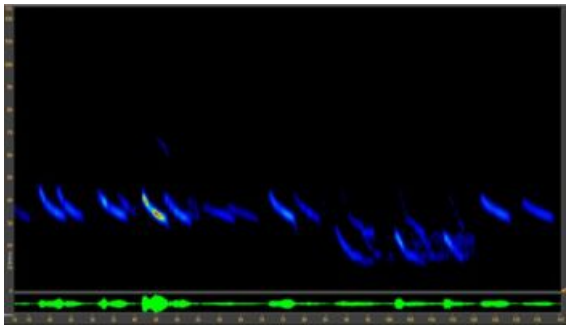
Kuhl's Pipistrelle - variation in social calls with different frequency



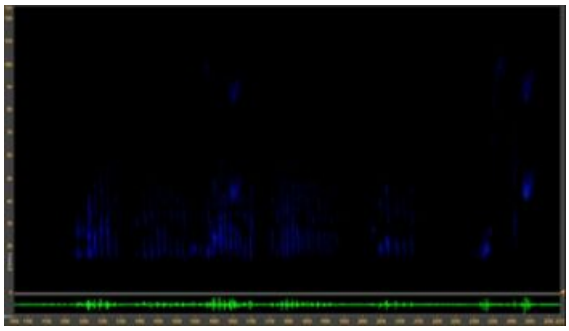
Kuhl's Pipistrelle - low frequency 'barbastelle-like' echolocation calls with social function



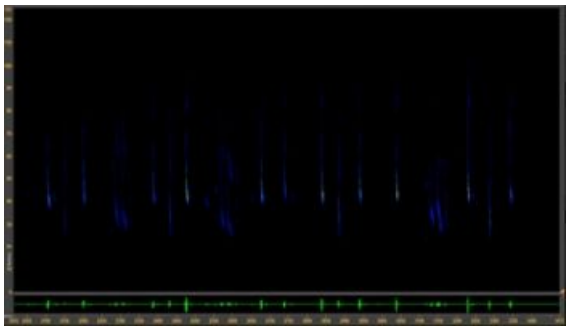
Kuhl's Pipistrelle - low frequency echolocation calls with social function and trills



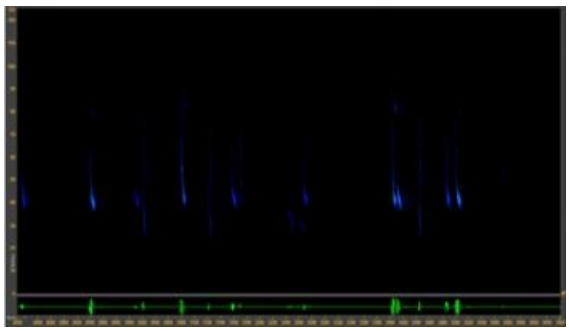
Kuhl's Pipistrelle - low frequency echolocation calls with social function and trills



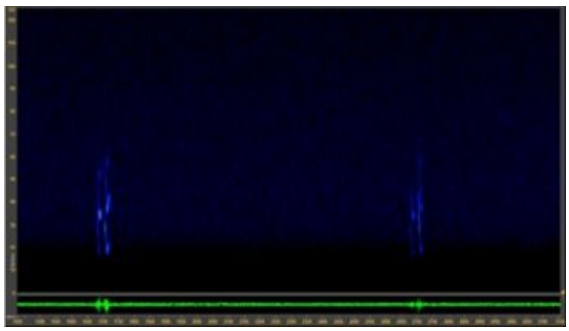
Nathusius' Pipistrelle - male advertisement calls and other social calls



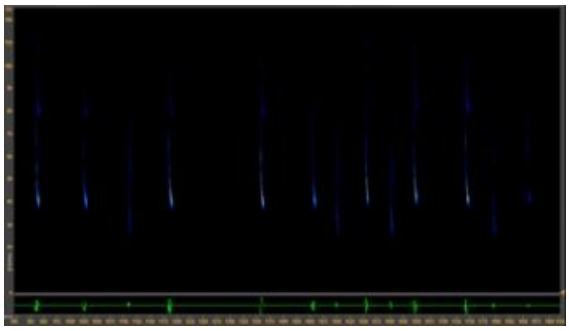
Nathusius' Pipistrelle - variation in social calls, including Plecotus-like calls



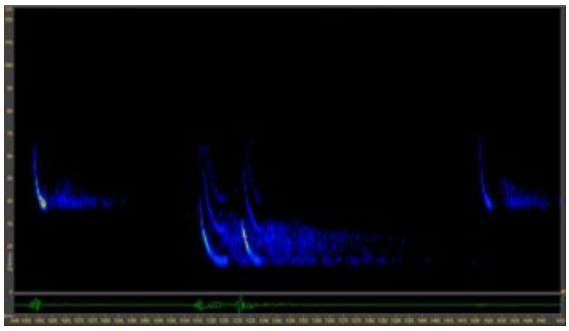
Nathusius' Pipistrelle - Plecotus-like social calls



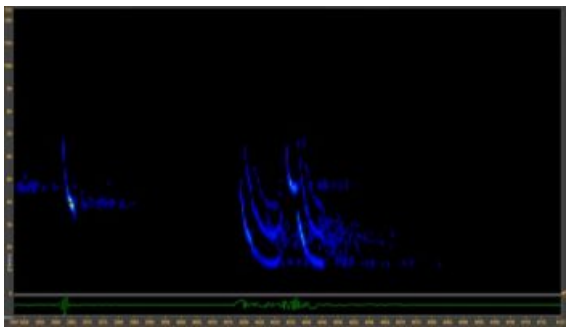
Nathusius' Pipistrelle - variation in social calls - potential confusion with Kuhl's Pipistrelle



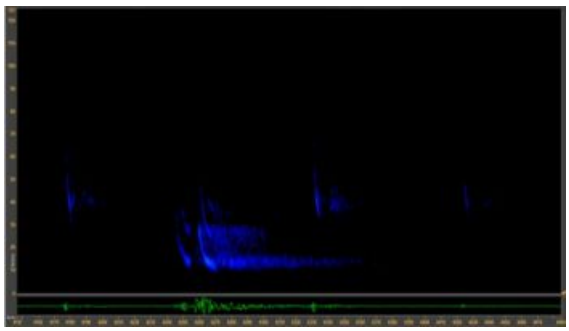
Nathusius' Pipistrelle - Plecotus-like social calls



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



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

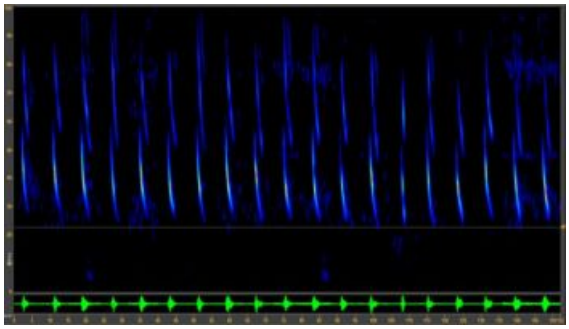


Kuhl's Pipistrelle - variation in two-component social call

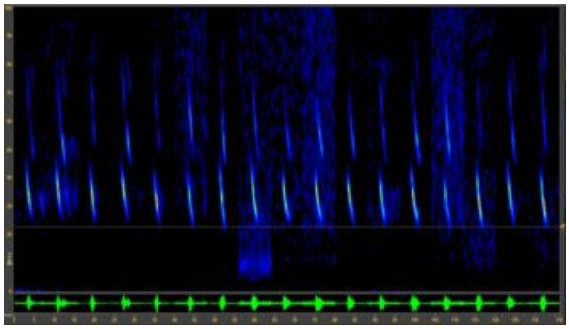
Identification appendix 5: Grey Long-eared Bat *Plecotus austriacus* and Brown Long-eared Bat *Plecotus auritus*

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.

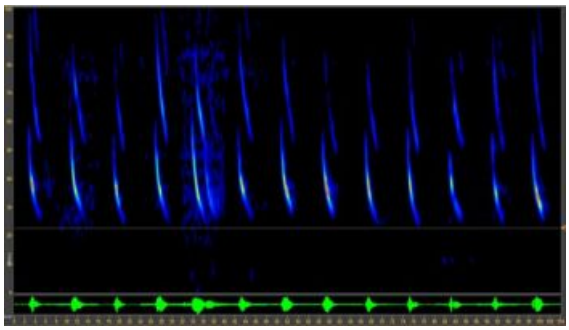
Despite this, it is very possible that a small number of Brown Long-eared Bat recordings will be missed, either in recordings not assigned to species (for example assigned instead to *Plecotus* species, and not considered in this report), or potentially to Grey Long-eared Bat in error. The latter is 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 those of Grey Long-eared Bat. Where an identification is not clear, we take a cautious approach and do not assign these to 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).



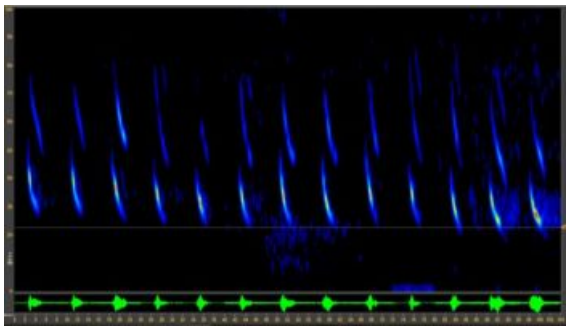
Brown Long-eared Bat - call duration 1.0-1.8 ms



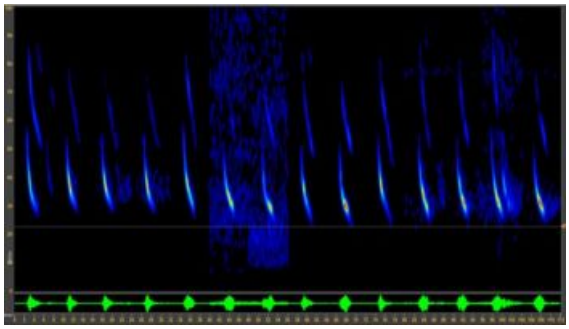
Grey Long-eared Bat - call duration 1.2-1.6 ms



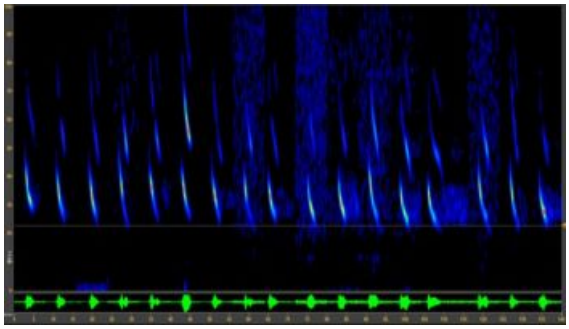
Brown Long-eared Bat - call duration 1.9-2.0 ms



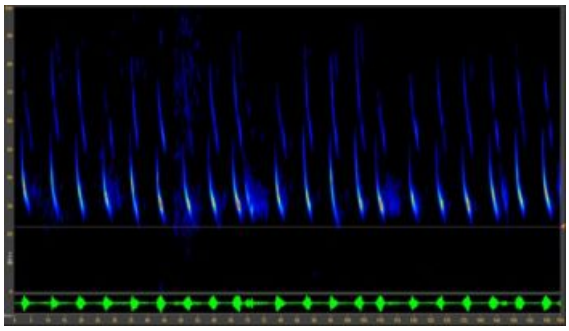
Grey Long-eared Bat - call duration 1.9-2.0 ms



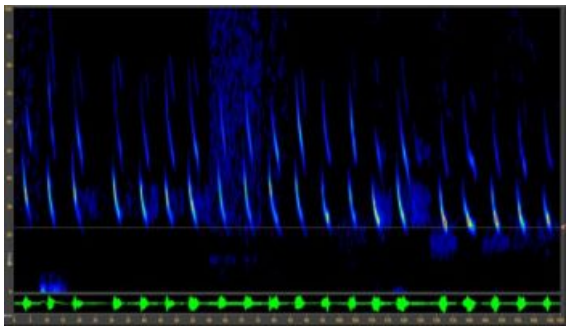
Brown Long-eared Bat - call duration 2.1-2.2 ms



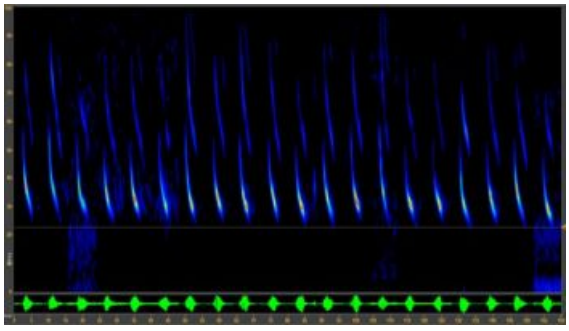
Grey Long-eared Bat - call duration 2.1-2.2 ms



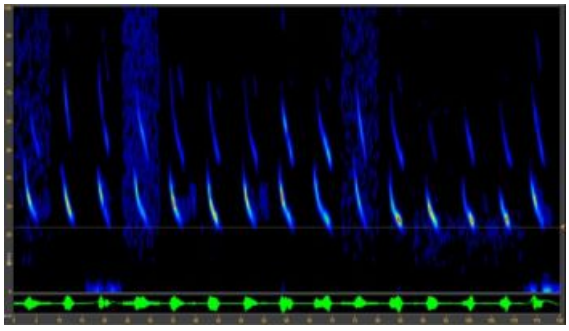
Brown Long-eared Bat - call duration 2.5-2.6 ms



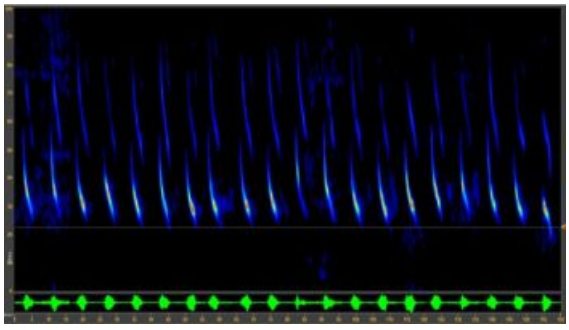
Grey Long-eared Bat - call duration 2.3-2.6 ms



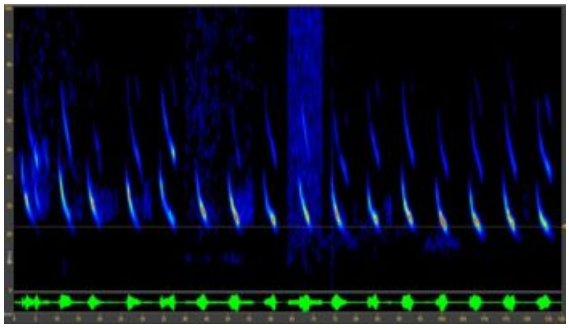
Brown Long-eared Bat - call duration 2.7-2.8 ms



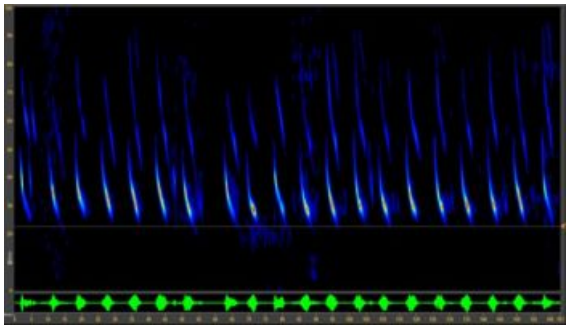
Grey Long-eared Bat - call duration 2.7-2.8 ms



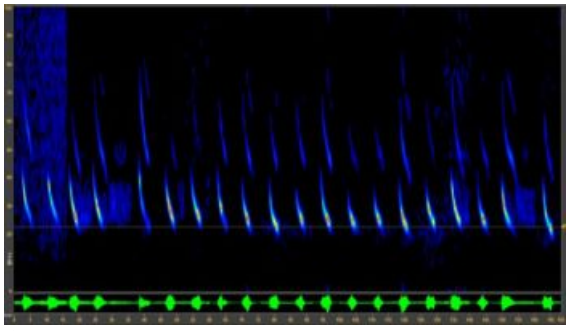
Brown Long-eared Bat - call duration 2.9-3.0 ms



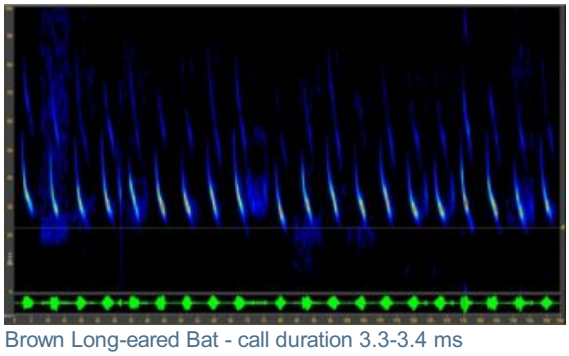
Grey Long-eared Bat - call duration 2.9-3.0 ms



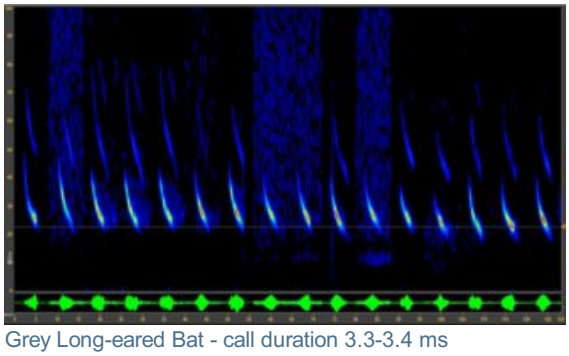
Brown Long-eared Bat - call duration 3.1-3.2 ms



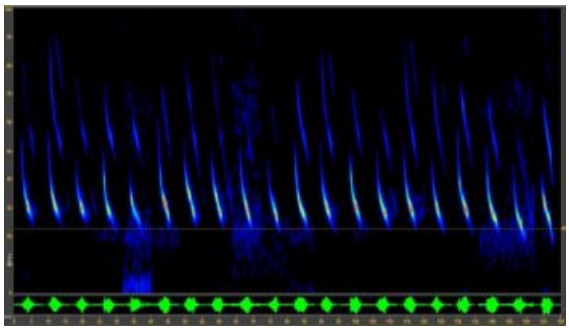
Grey Long-eared Bat - call duration 3.1-3.2 ms



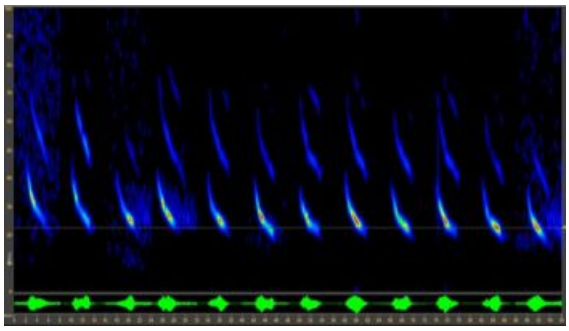
Brown Long-eared Bat - call duration 3.3-3.4 ms



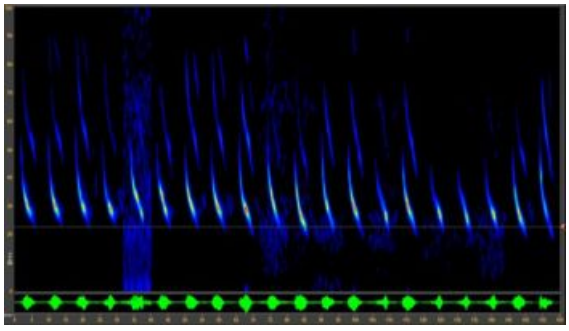
Grey Long-eared Bat - call duration 3.3-3.4 ms



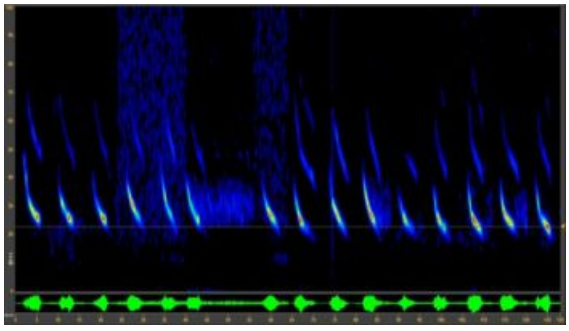
Brown Long-eared Bat - call duration 3.5-3.6 ms



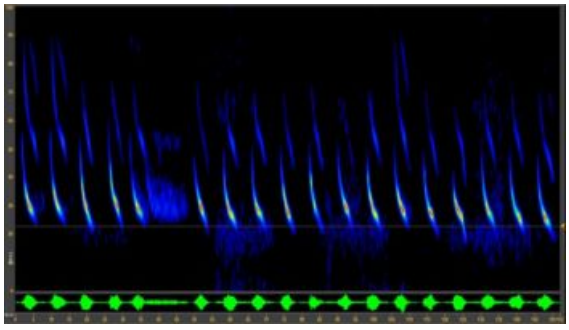
Grey Long-eared Bat - call duration 3.5-3.6 ms



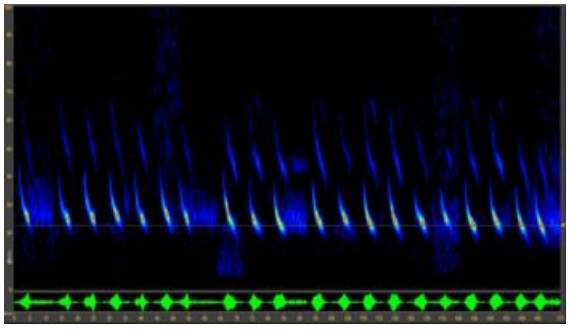
Brown Long-eared Bat - call duration 3.7-3.8 ms



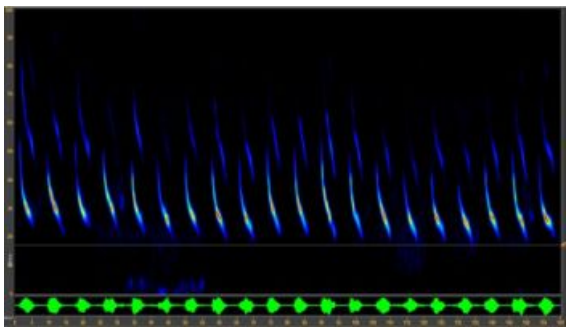
Grey Long-eared Bat - call duration 3.7-3.8 ms



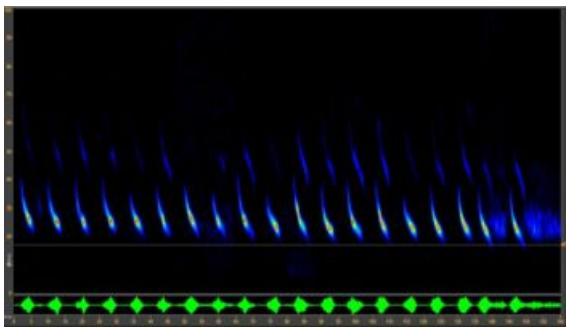
Brown Long-eared Bat - call duration 3.9-4.0 ms



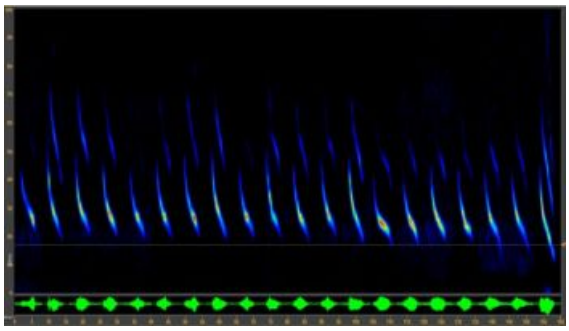
Grey Long-eared Bat - call duration 3.9-4.0 ms



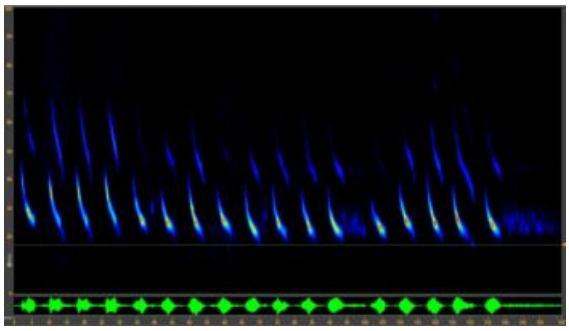
Brown Long-eared Bat - call duration 4.1-4.2 ms



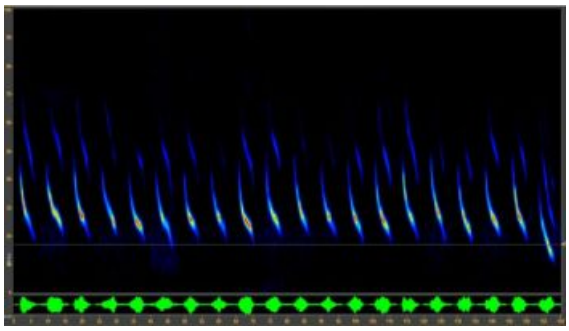
Grey Long-eared Bat - call duration 4.1-4.2 ms



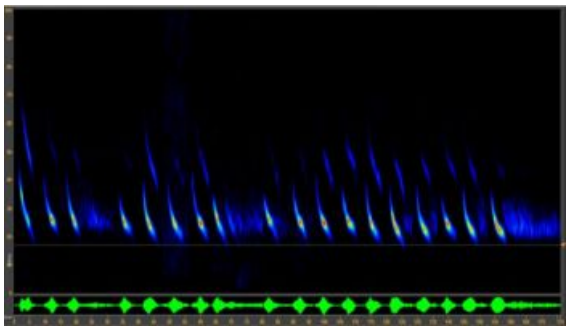
Brown Long-eared Bat - call duration 4.3-4.4 ms



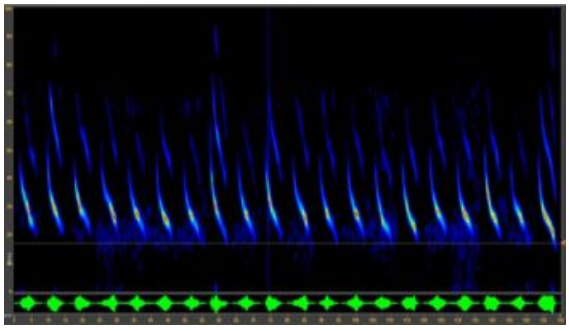
Grey Long-eared Bat - call duration 4.3-4.4 ms



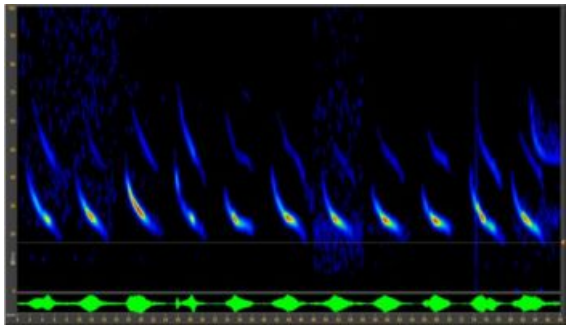
Brown Long-eared Bat - call duration 4.5-4.6 ms



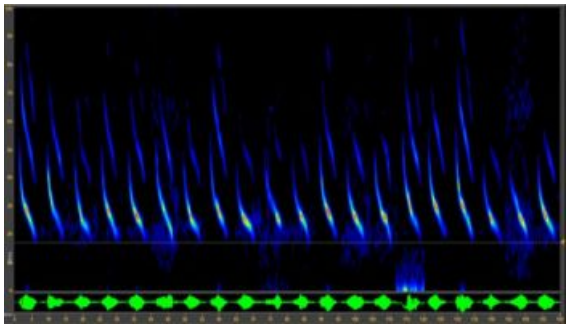
Grey Long-eared Bat - call duration 4.5-4.6 ms



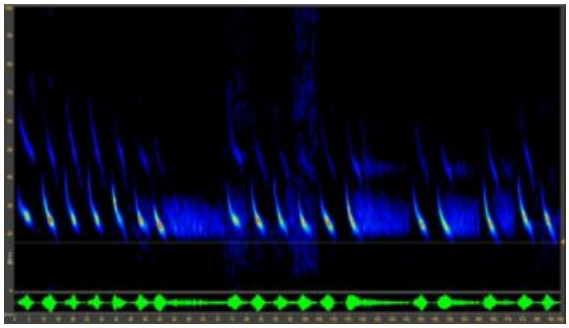
Brown Long-eared Bat - call duration 4.7-4.8 ms



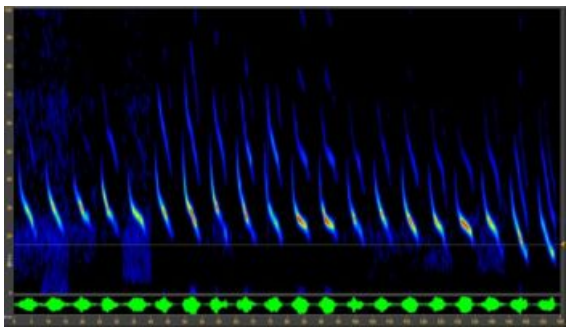
Grey Long-eared Bat - call duration 4.7-4.8 ms



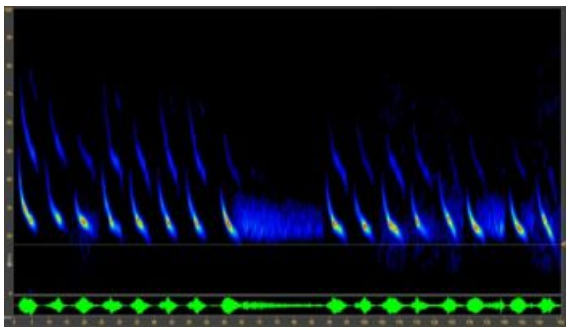
Brown Long-eared Bat - call duration 4.9-5.0 ms



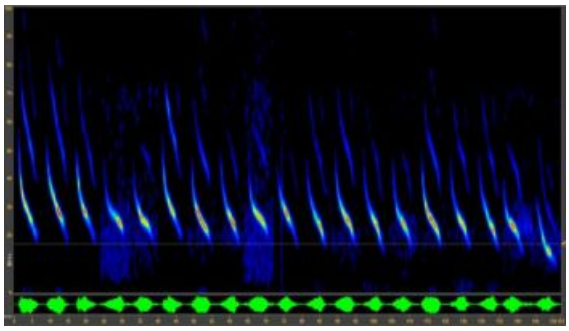
Grey Long-eared Bat - call duration 4.9-5.0 ms



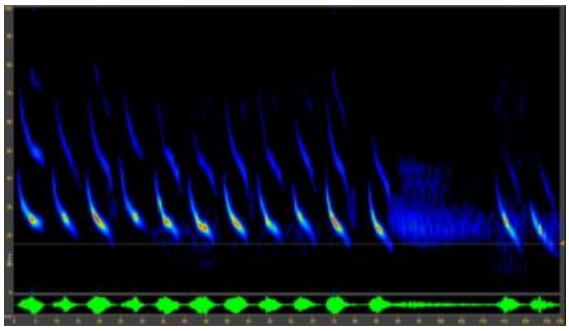
Brown Long-eared Bat - call duration 5.1-5.2 ms



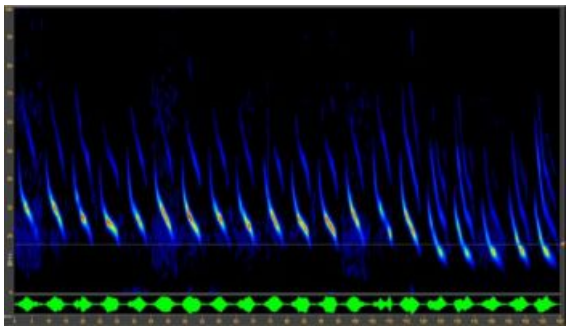
Grey Long-eared Bat - call duration 5.1-5.2 ms



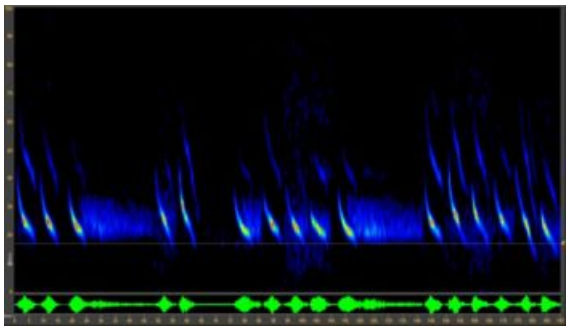
Brown Long-eared Bat - call duration 5.3-5.4 ms



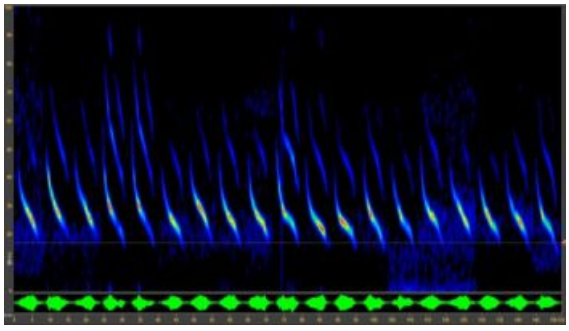
Grey Long-eared Bat - call duration 5.3-5.5 ms



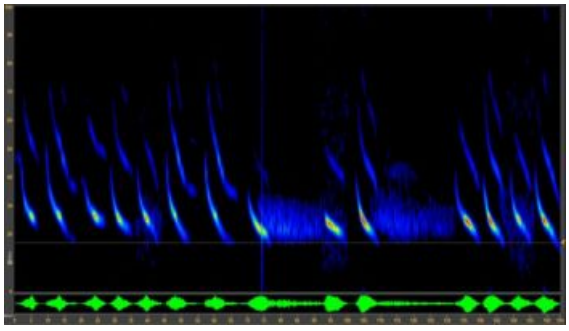
Brown Long-eared Bat - call duration 5.5-5.8 ms



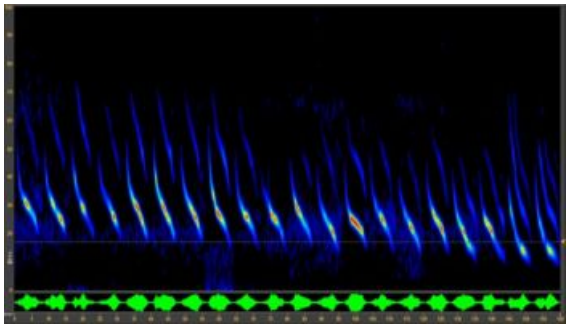
Grey Long-eared Bat - call duration 5.6-5.8 ms



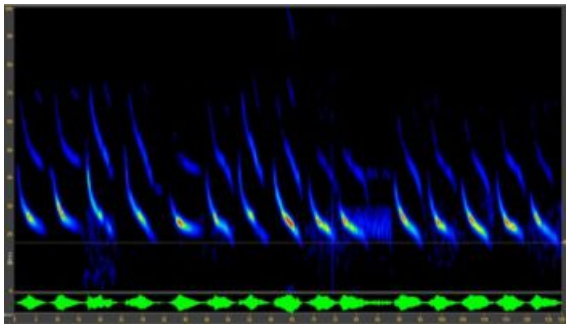
Brown Long-eared Bat - call duration 5.9-6.2 ms



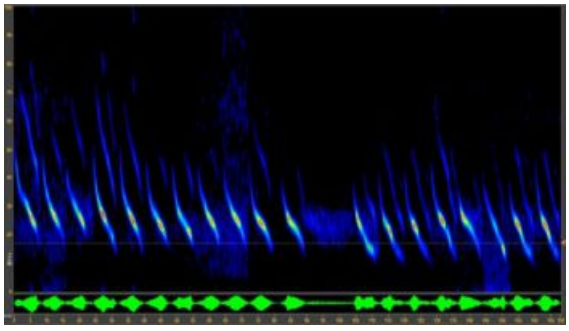
Grey Long-eared Bat - call duration 5.9-6.2 ms



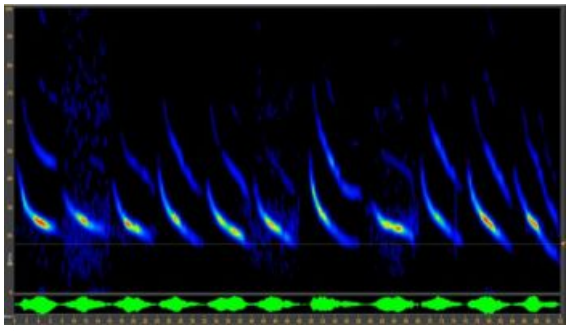
Brown Long-eared Bat - call duration 6.3-6.4 ms



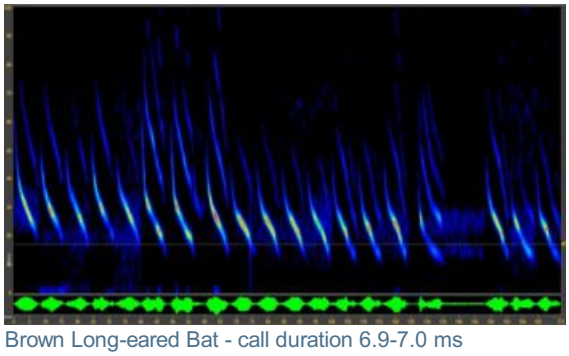
Grey Long-eared Bat - call duration 6.3-6.5 ms



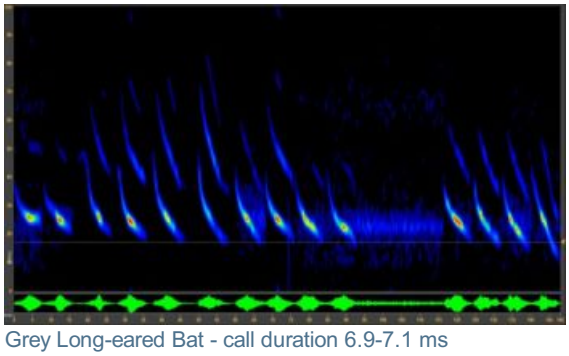
Brown Long-eared Bat - call duration 6.7-6.8 ms



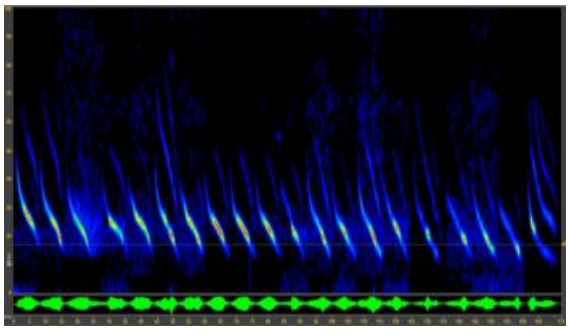
Grey Long-eared Bat - call duration 6.6-6.8 ms



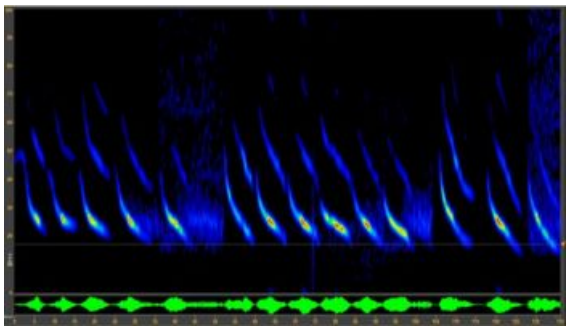
Brown Long-eared Bat - call duration 6.9-7.0 ms



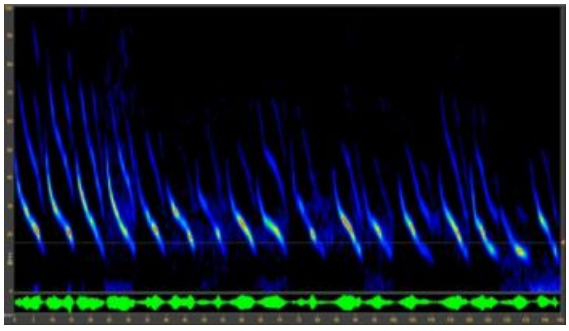
Grey Long-eared Bat - call duration 6.9-7.1 ms



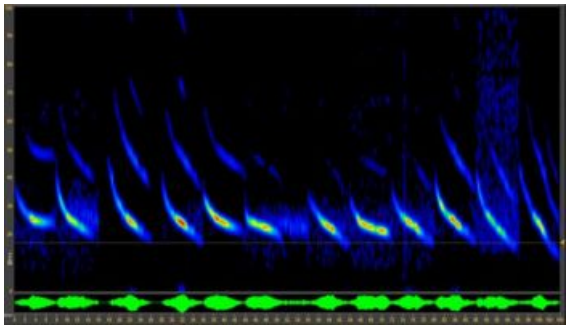
Brown Long-eared Bat - call duration 7.3-7.4 ms



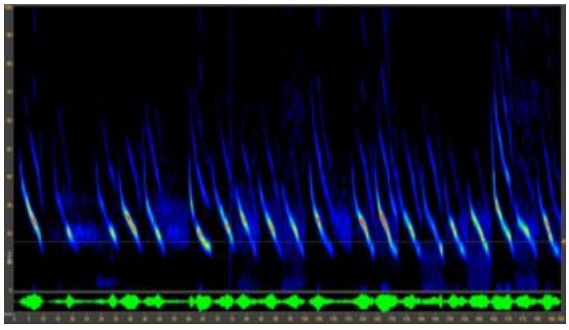
Grey Long-eared Bat - call duration 7.2-7.4 ms



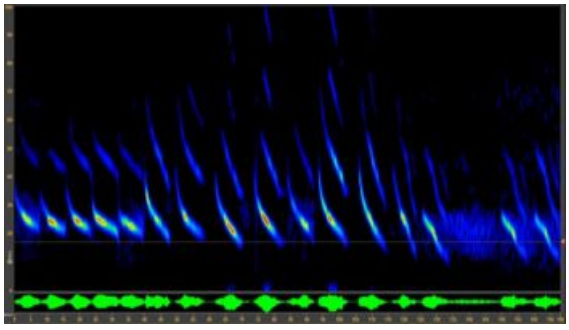
Brown Long-eared Bat - call duration 7.5-7.6 ms



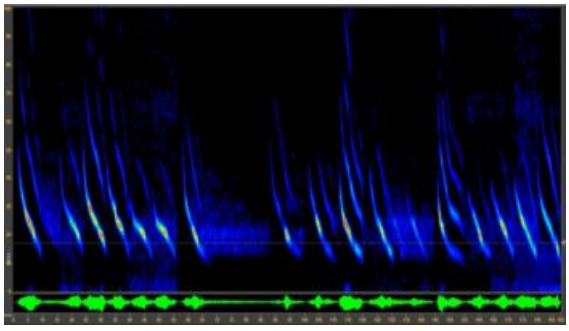
Grey Long-eared Bat - call duration 7.5-7.6 ms



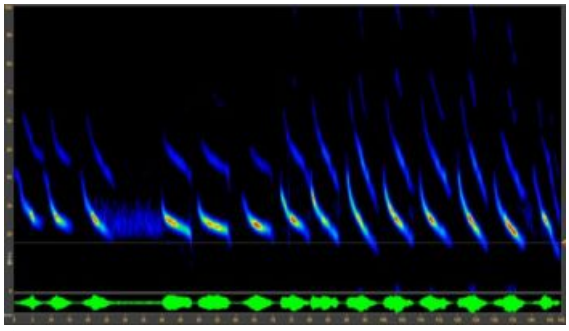
Brown Long-eared Bat - call duration 7.7-7.8 ms



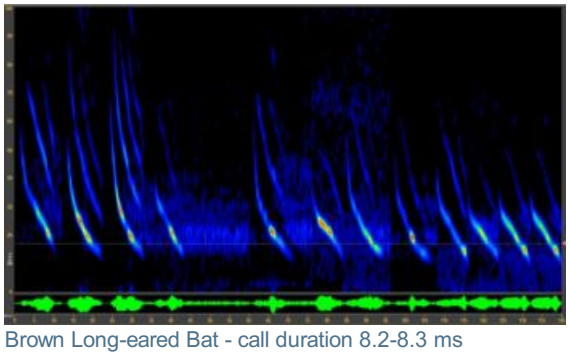
Grey Long-eared Bat - call duration 7.7-7.8 ms



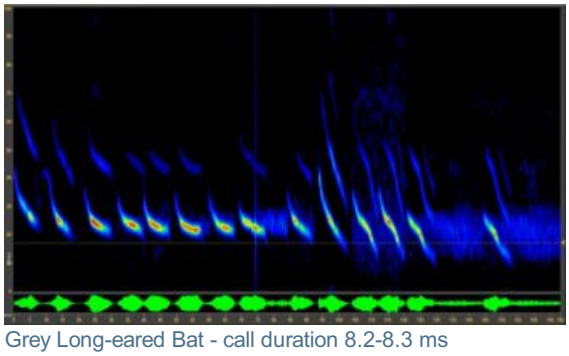
Brown Long-eared Bat - call duration 7.9-8.1 ms



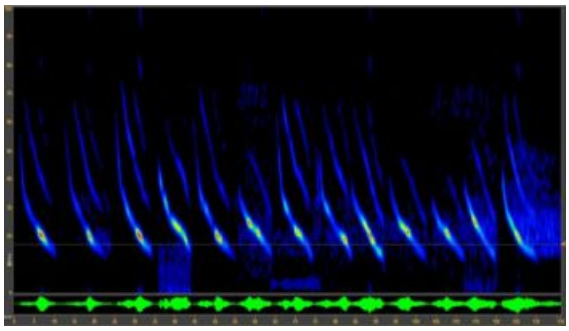
Grey Long-eared Bat - call duration 7.9-8.1 ms



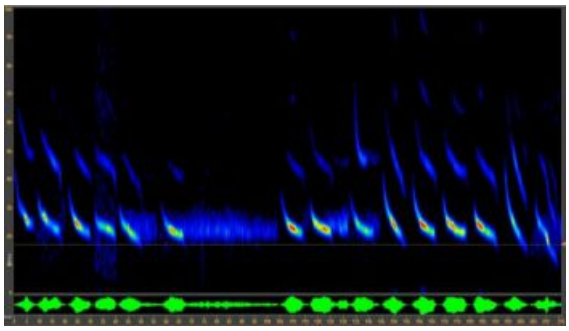
Brown Long-eared Bat - call duration 8.2-8.3 ms



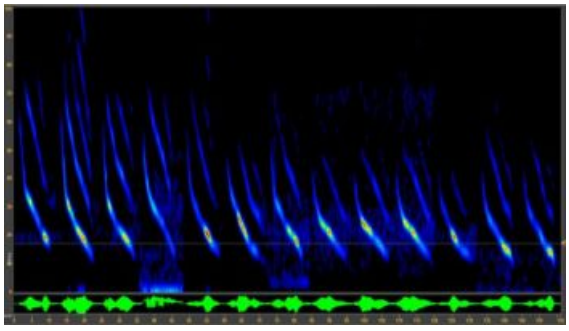
Grey Long-eared Bat - call duration 8.2-8.3 ms



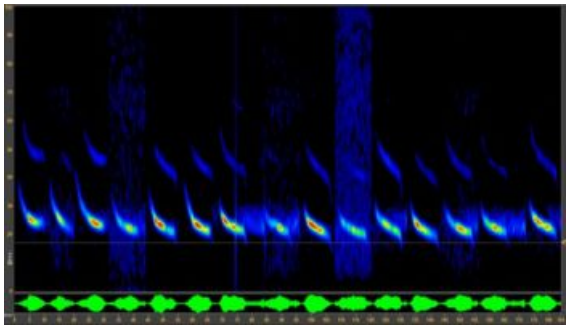
Brown Long-eared Bat - call duration 8.4-8.6 ms



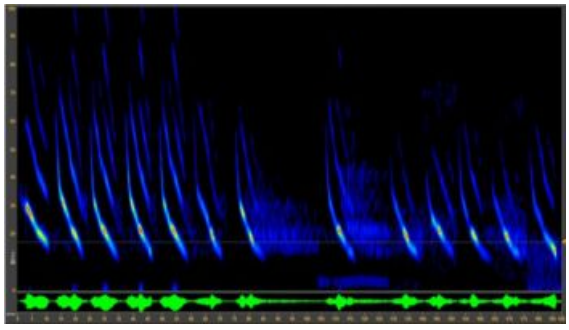
Grey Long-eared Bat - call duration 8.4-8.7 ms



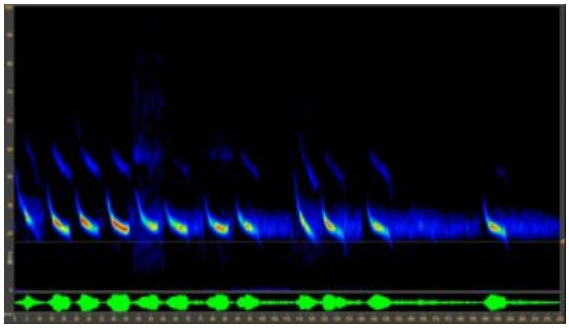
Brown Long-eared Bat - call duration 8.7-9.0 ms



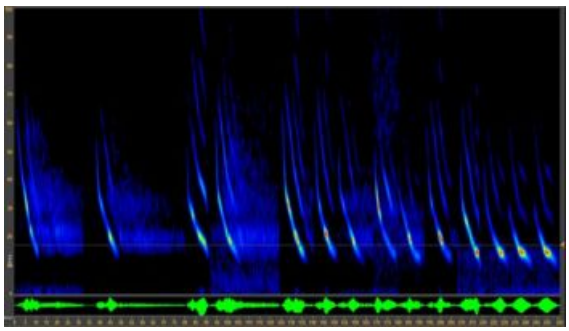
Grey Long-eared Bat - call duration 8.8-9.1 ms



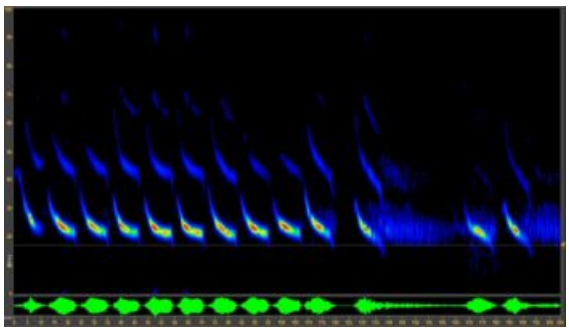
Brown Long-eared Bat - call duration 9.1-9.5 ms



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




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: Sarah Allez

Bailiwick Bat Survey: 2021 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., Gillings, S., Harper, J., Henney, J.M., Higgins, L., Simmons, M.C., Sweet, E., Whitelegg, D. & Atkinson, P.W. (2022). Bailiwick Bat Survey: 2021 Report. BTO Research Report 743, BTO, Thetford, UK.

ISBN 978-1-912642-34-2