

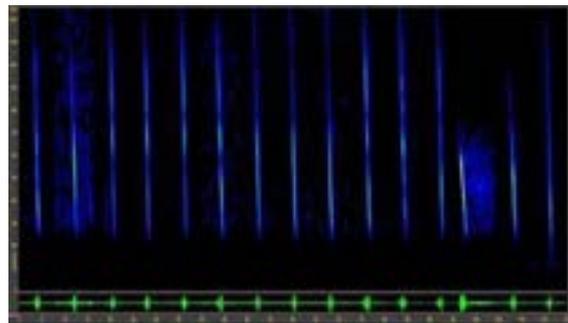


Acoustic Pipeline

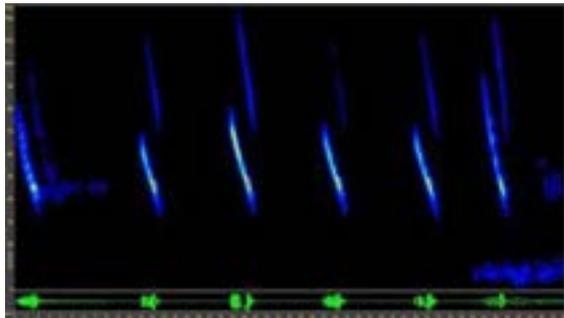


European Bat Sound Identification: Visual comparison of potential confusion species

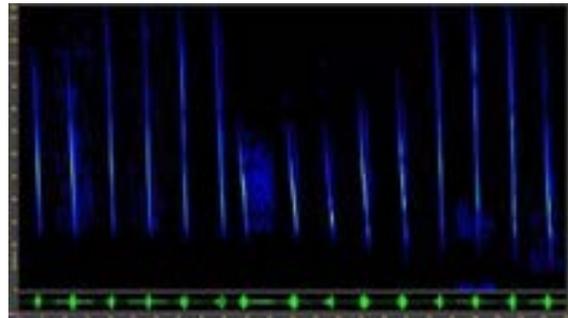
1. Daubenton's Bat *Myotis daubentonii* and Natterer's Bat *Myotis nattereri*



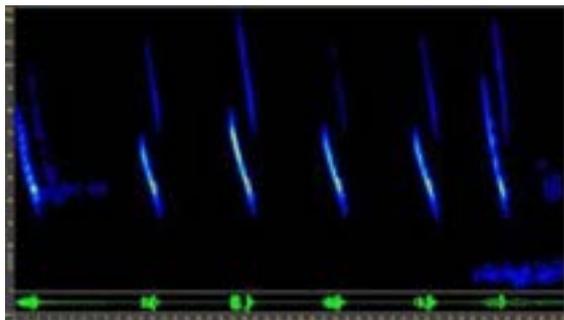
Daubenton's Bat - call duration up to 1.4 ms no examples Natterer's Bat - call duration up to 1.4 ms



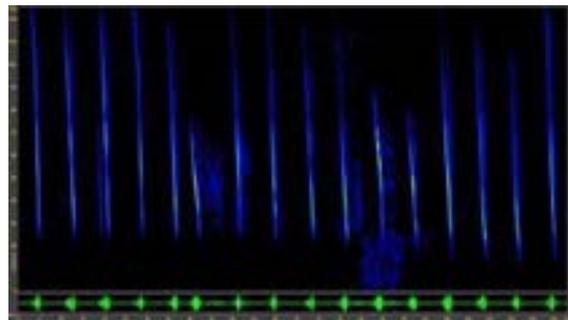
Daubenton's Bat - call duration 1.5-2.0 ms



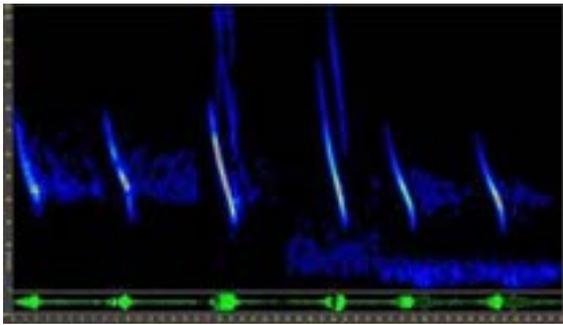
Natterer's Bat - call duration 1.5-2.0 ms



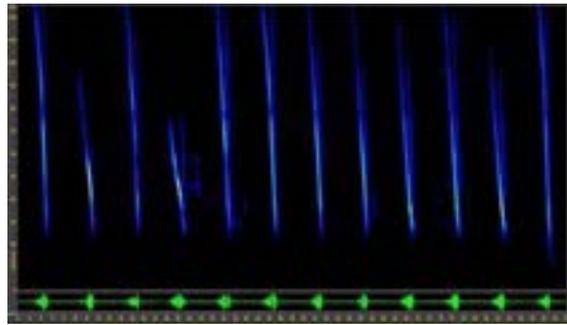
Daubenton's Bat - call duration 2.1-2.3 ms



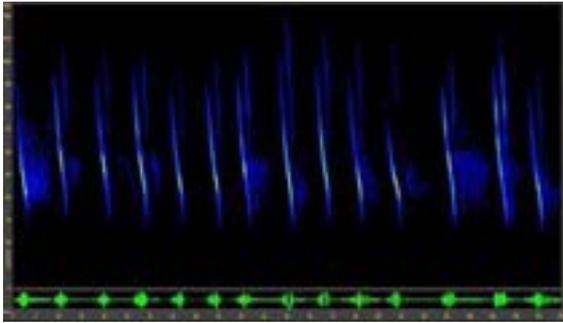
Natterer's Bat - call duration 2.1-2.3 ms



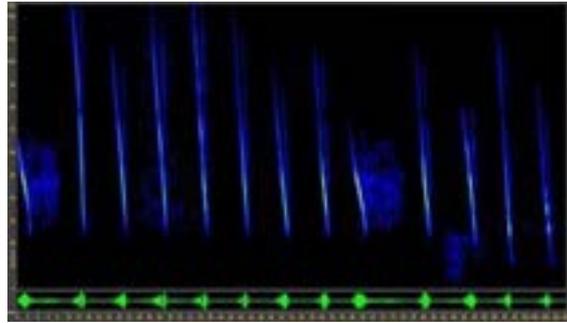
Daubenton's Bat - call duration 2.4-2.5 ms



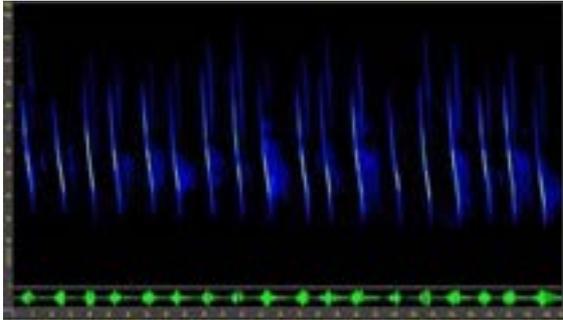
Natterer's Bat - call duration 2.4-2.5 ms



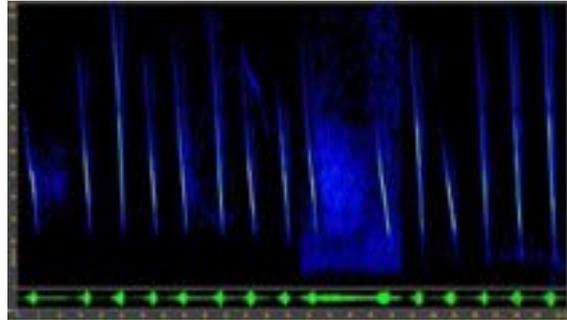
Daubenton's Bat - call duration 2.6-2.7 ms



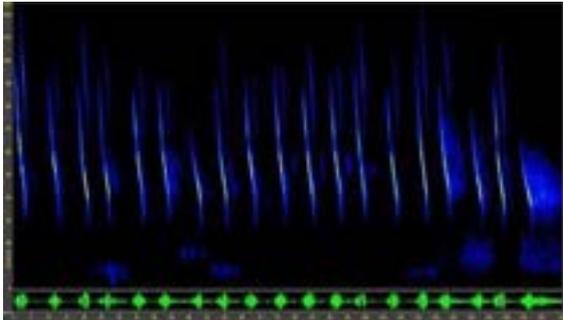
Natterer's Bat - call duration 2.6-2.7 ms



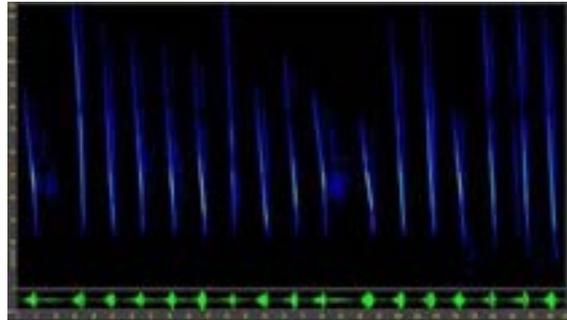
Daubenton's Bat - call duration 2.8-2.9 ms



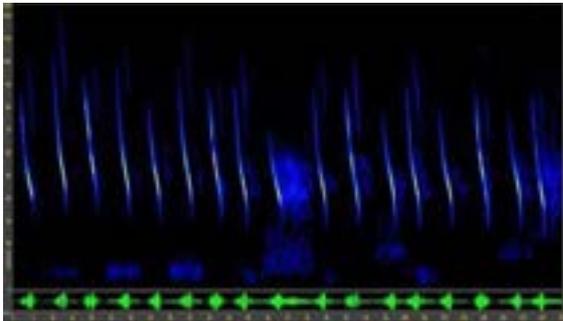
Natterer's Bat - call duration 2.8-2.9 ms



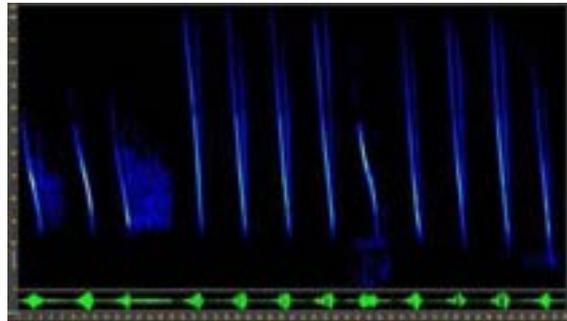
Daubenton's Bat - call duration 3.0-3.1 ms



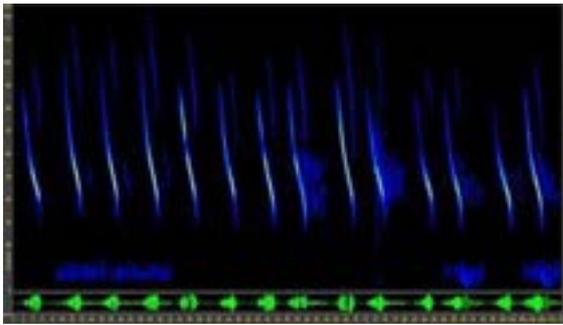
Natterer's Bat - call duration 3.0-3.1 ms



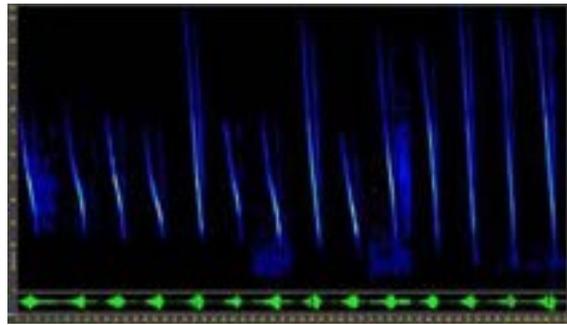
Daubenton's Bat - call duration 3.2-3.3 ms



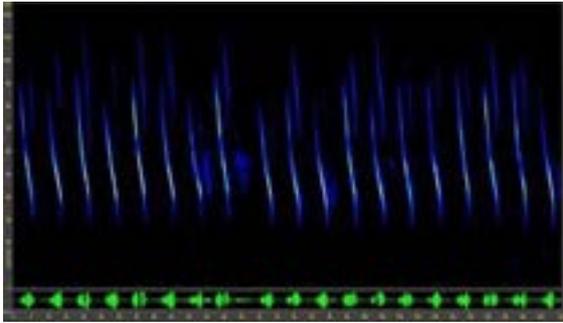
Natterer's Bat - call duration 3.2-3.3 ms



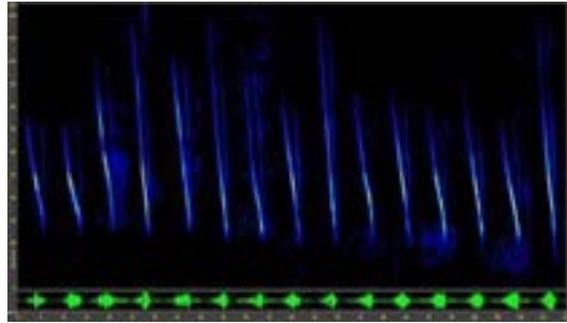
Daubenton's Bat - call duration 3.4-3.5 ms



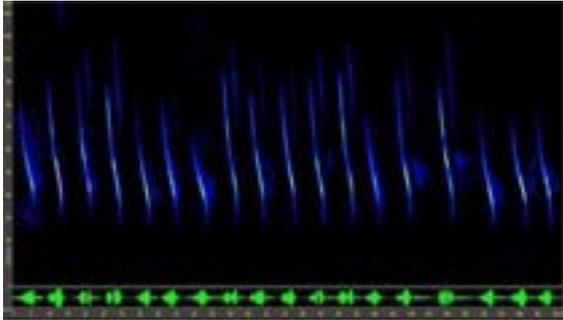
Natterer's Bat - call duration 3.4-3.5 ms



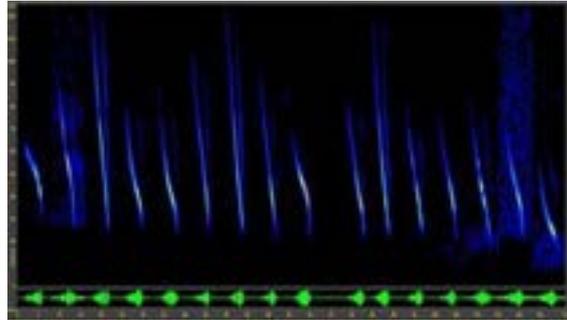
Daubenton's Bat - call duration 3.6-3.7 ms



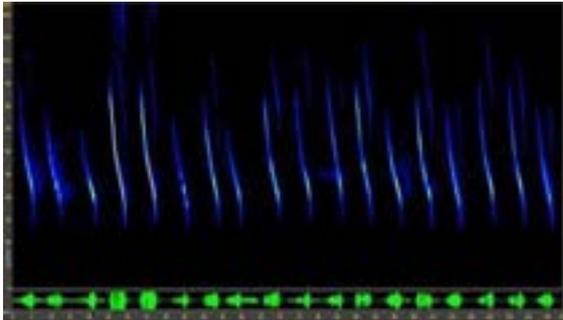
Natterer's Bat - call duration 3.6-3.7 ms



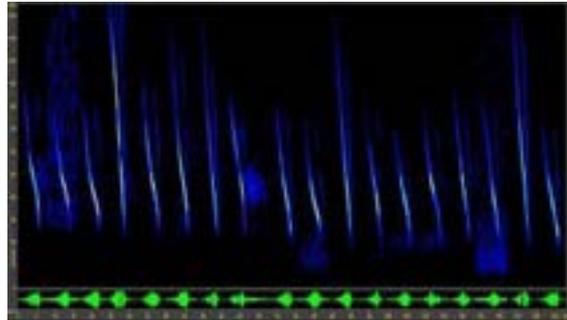
Daubenton's Bat - call duration 3.8-3.9 ms



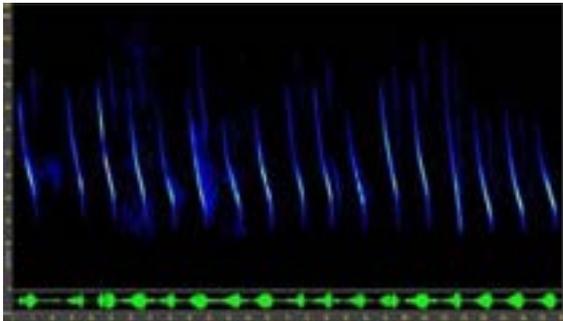
Natterer's Bat - call duration 3.8-3.9 ms



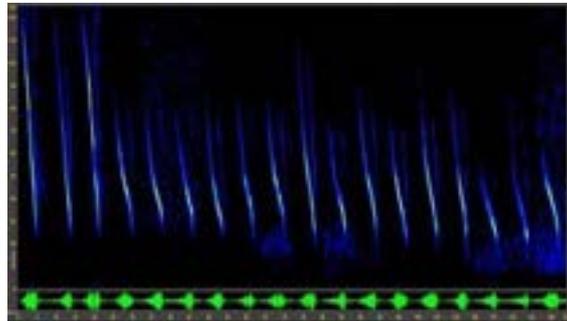
Daubenton's Bat - call duration 4.0-4.1 ms



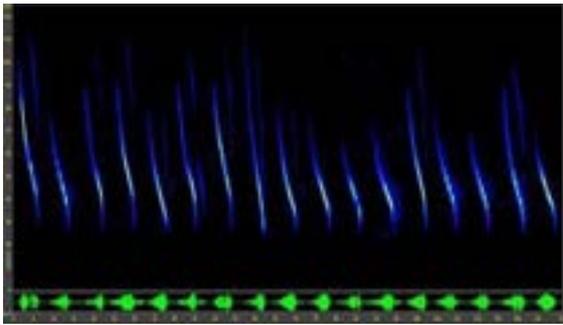
Natterer's Bat - call duration 4.0-4.1 ms



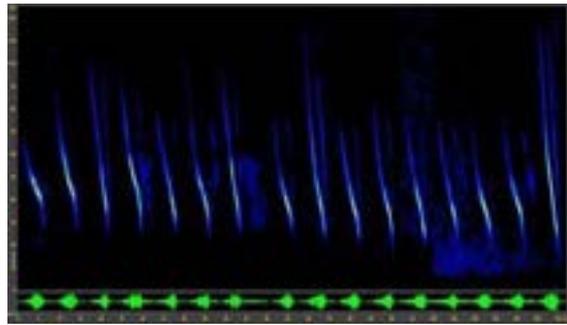
Daubenton's Bat - call duration 4.2-4.3 ms



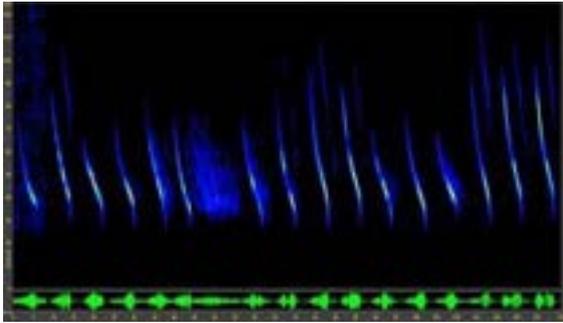
Natterer's Bat - call duration 4.2-4.3 ms



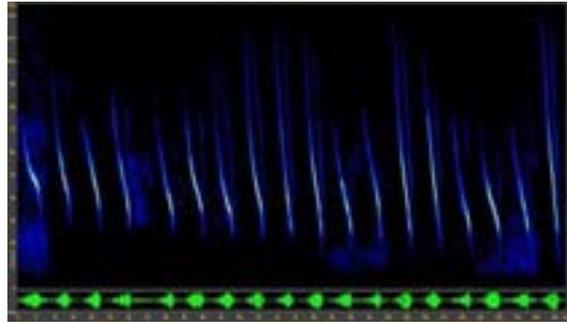
Daubenton's Bat - call duration 4.4-4.5 ms



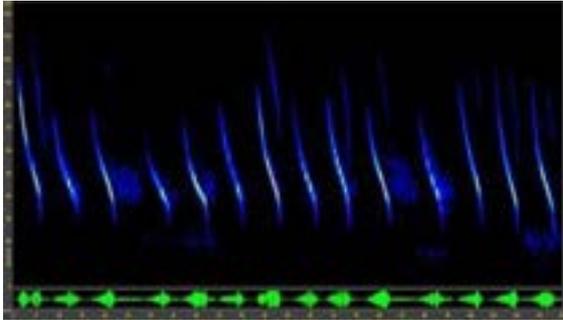
Natterer's Bat - call duration 4.4-4.5 ms



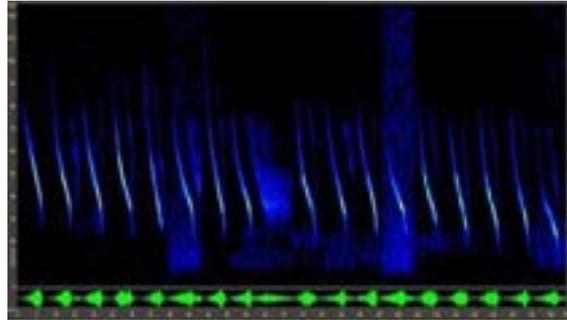
Daubenton's Bat - call duration 4.6-4.7 ms



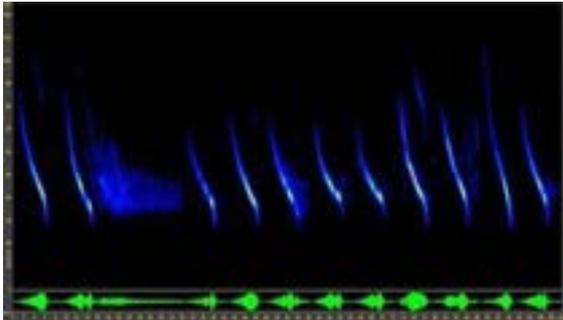
Natterer's Bat - call duration 4.6-4.7 ms



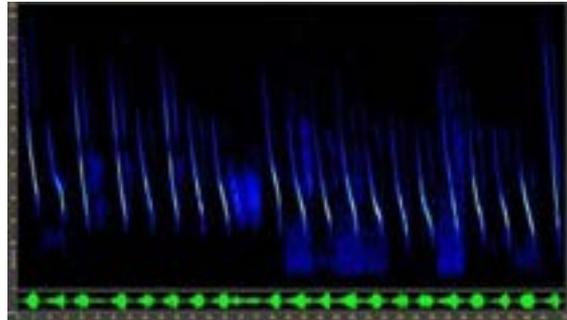
Daubenton's Bat - call duration 4.8-4.9 ms



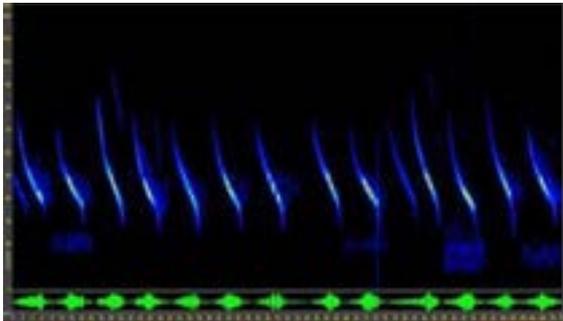
Natterer's Bat - call duration 4.8-4.9 ms



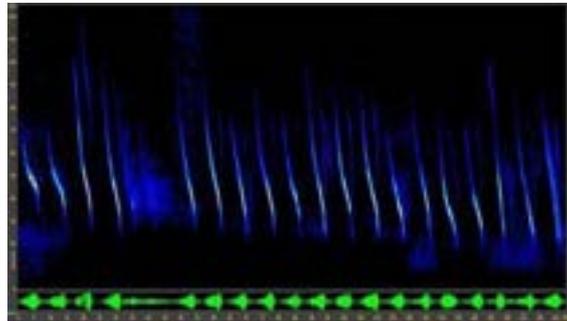
Daubenton's Bat - call duration 5.0-5.1 ms



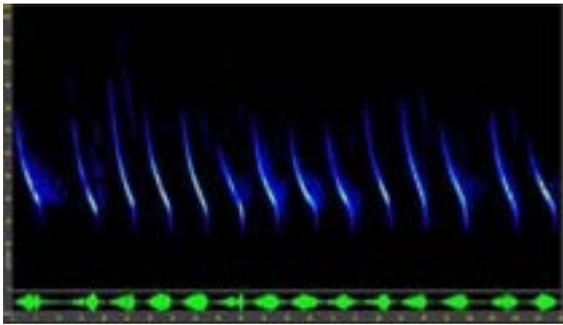
Natterer's Bat - call duration 5.0-5.1 ms



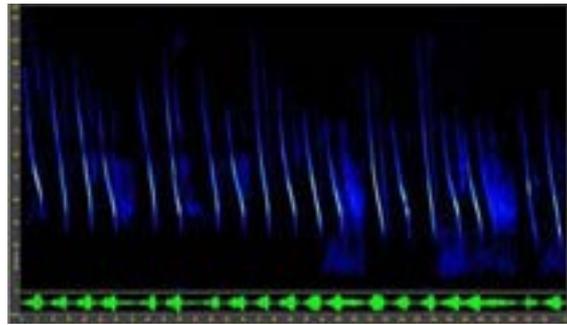
Daubenton's Bat - call duration 5.2-5.3 ms



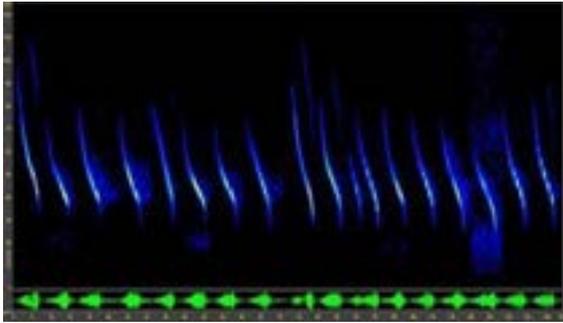
Natterer's Bat - call duration 5.2-5.3 ms



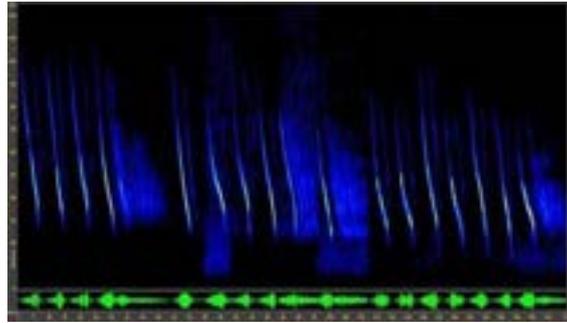
Daubenton's Bat - call duration 5.4-5.5 ms



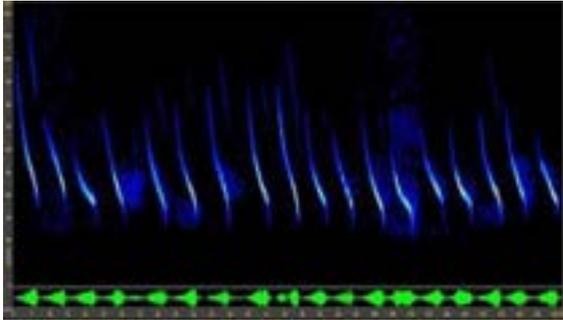
Natterer's Bat - call duration 5.4-5.5 ms



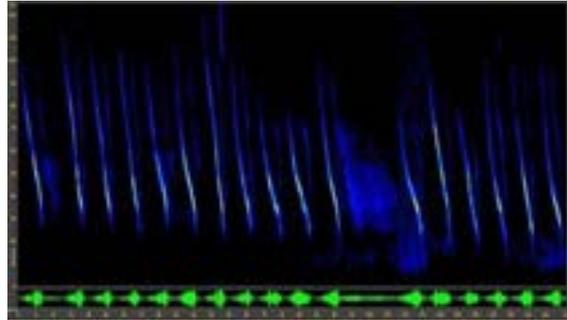
Daubenton's Bat - call duration 5.6-5.7 ms



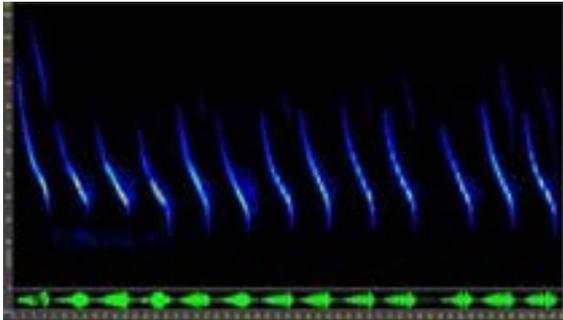
Natterer's Bat - call duration 5.6-5.7 ms



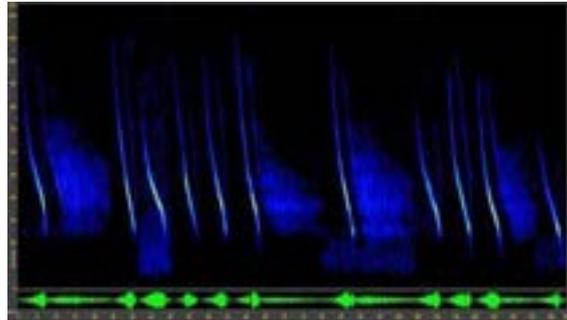
Daubenton's Bat - call duration 5.8-5.9 ms



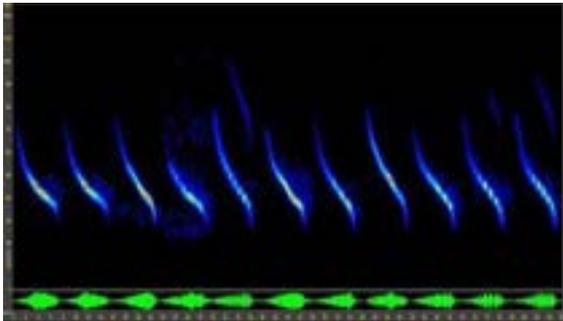
Natterer's Bat - call duration 5.8-5.9 ms



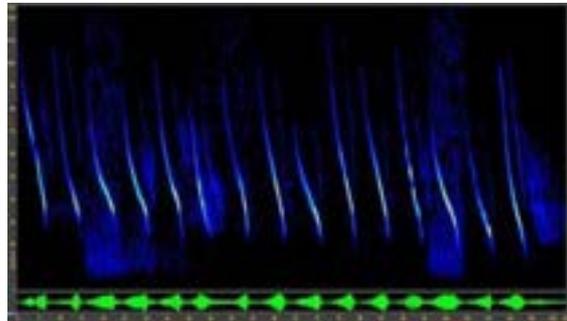
Daubenton's Bat - call duration 6.0-6.1 ms



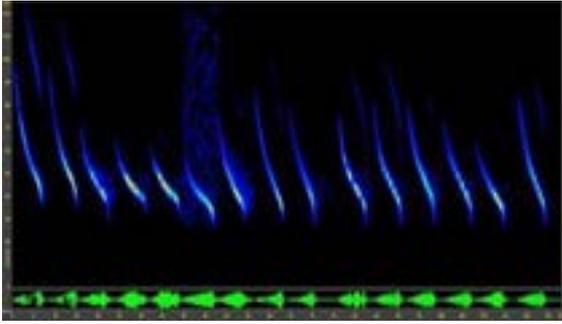
Natterer's Bat - call duration 6.0-6.1 ms



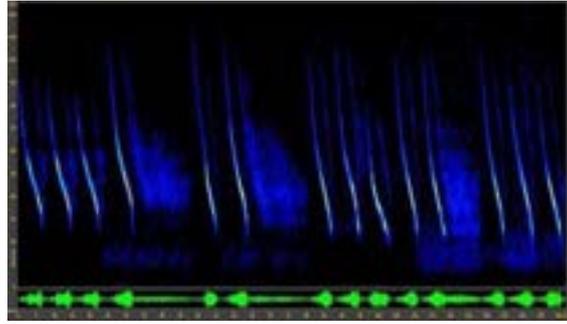
Daubenton's Bat - call duration 6.2-6.3 ms



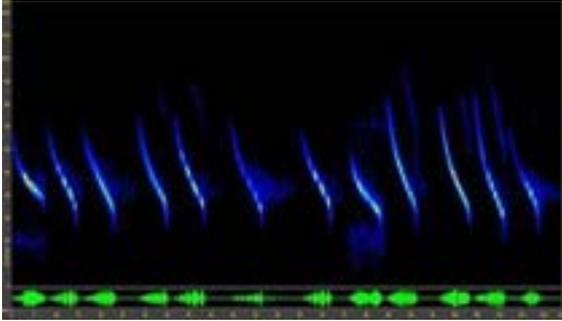
Natterer's Bat - call duration 6.2-6.3 ms



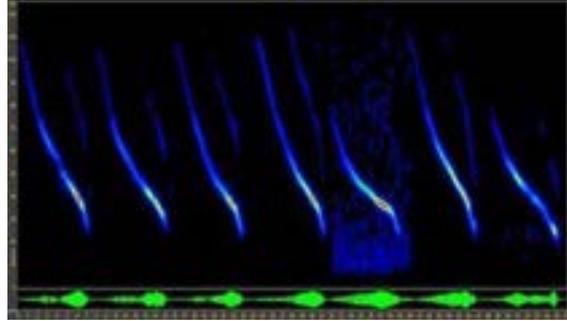
Daubenton's Bat - call duration 6.4-6.6 ms



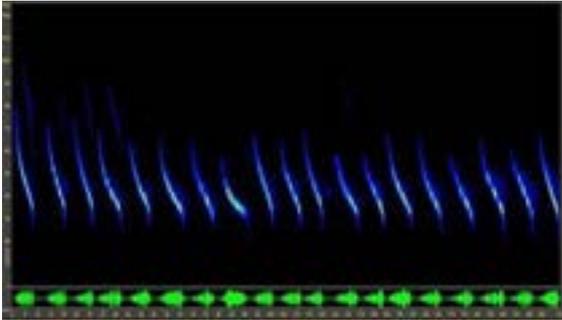
Natterer's Bat - call duration 6.4-6.6 ms



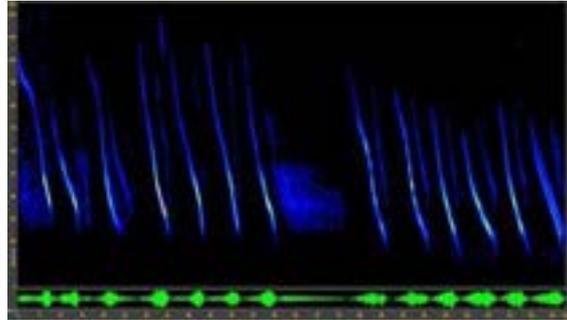
Daubenton's Bat - call duration 6.7-6.8 ms



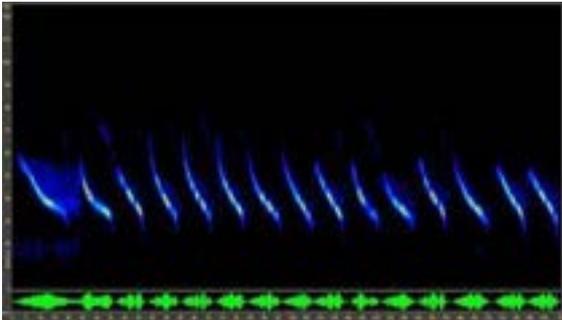
Natterer's Bat - call duration 6.7-6.8 ms



Daubenton's Bat - call duration 6.9-9.5 ms



Natterer's Bat - call duration 6.9-9.5 ms

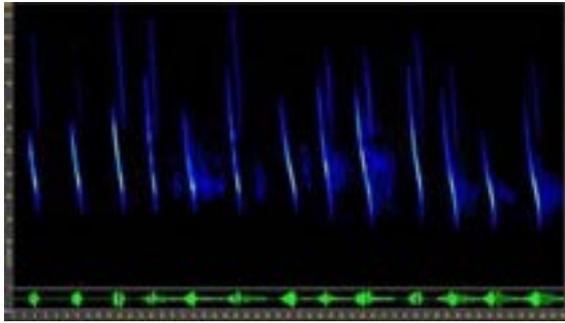


Daubenton's Bat - call duration 9.6-17.3 ms

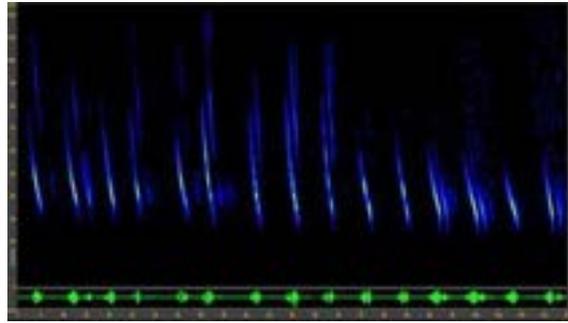
Natterer's Bat - call duration 9.6-17.3 ms no examples
Copy

2. Daubenton's Bat *Myotis daubentonii* and Pond Bat *Myotis dasycneme*

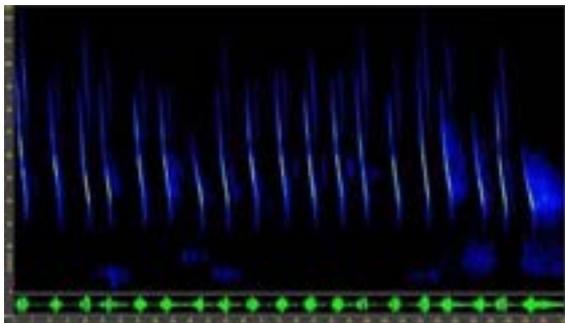
We are extremely grateful to Marc Van De Sijpe who provided material for *M. dasycneme*.



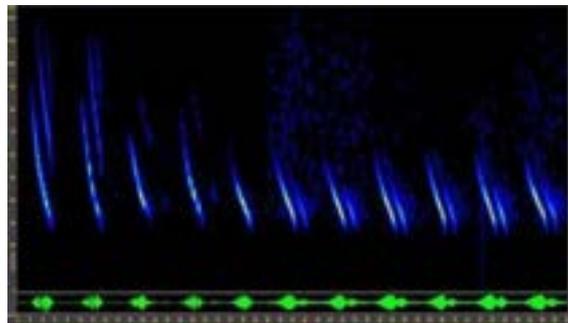
Daubenton's Bat - call duration 1.5-2.9 ms



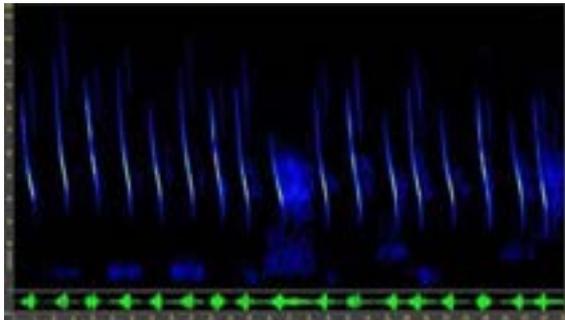
Pond Bat - call duration 1.5-2.9 ms



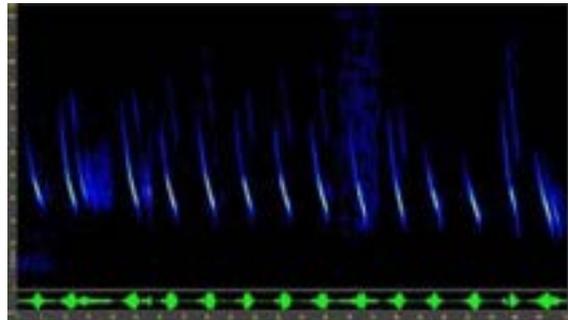
Daubenton's Bat - call duration 3.0-3.1 ms



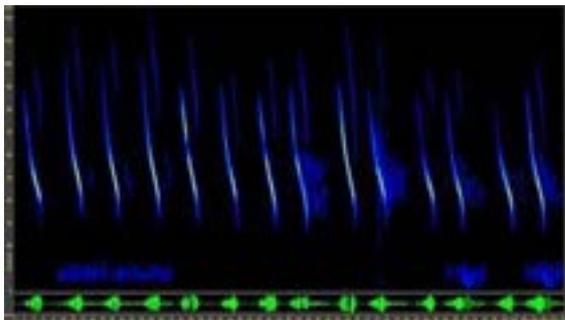
Pond Bat - call duration 3.0-3.1 ms



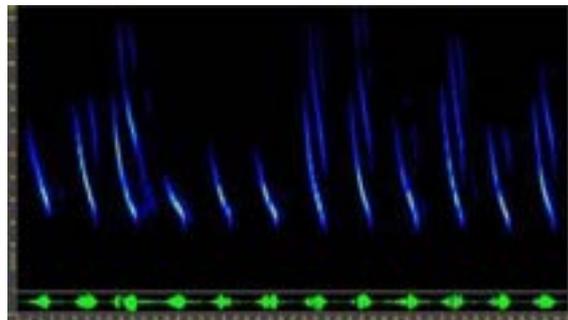
Daubenton's Bat - call duration 3.2-3.3 ms



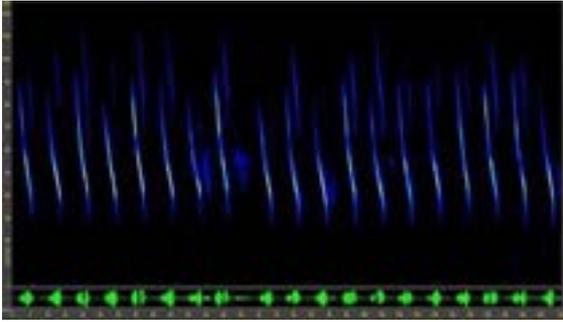
Pond Bat - call duration 3.2-3.3 ms



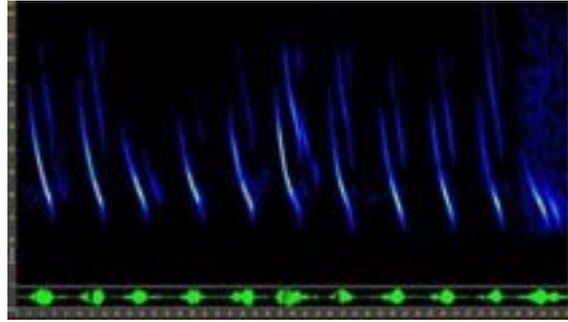
Daubenton's Bat - call duration 3.4-3.5 ms



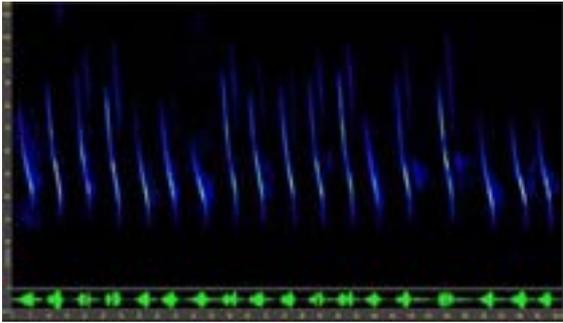
Pond Bat - call duration 3.4-3.5 ms



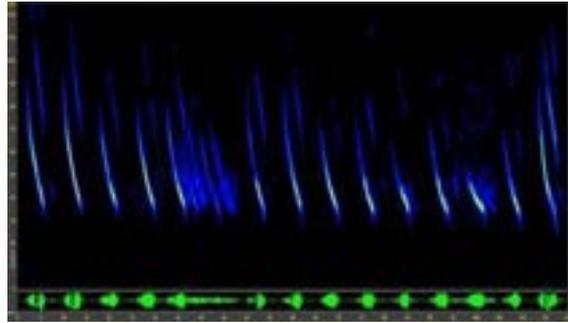
Daubenton's Bat - call duration 3.6-3.7 ms



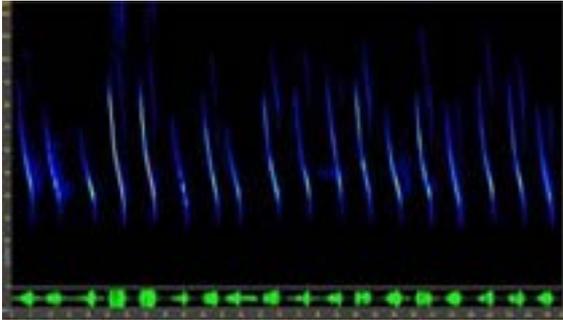
Pond Bat - call duration 3.6-3.7 ms



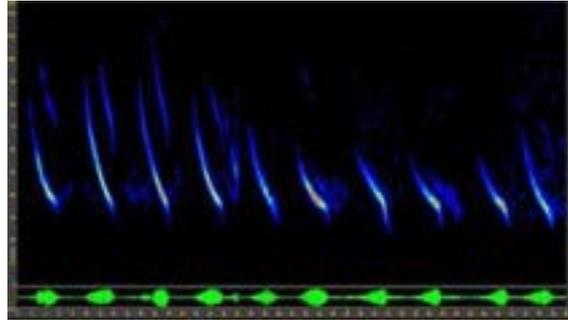
Daubenton's Bat - call duration 3.8-3.9 ms



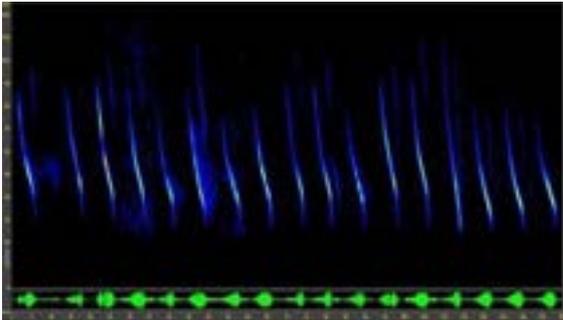
Pond Bat - call duration 3.8-3.9 ms



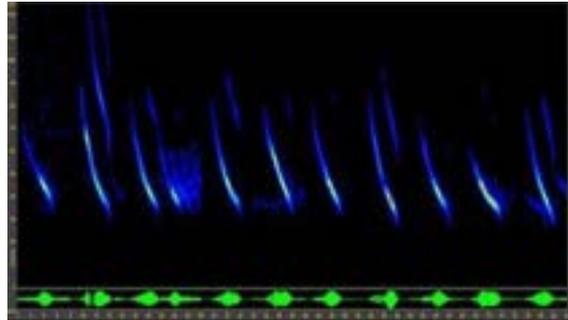
Daubenton's Bat - call duration 4.0-4.1 ms



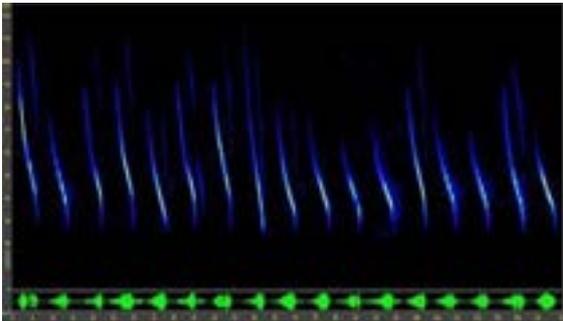
Pond Bat - call duration 4.0-4.1 ms



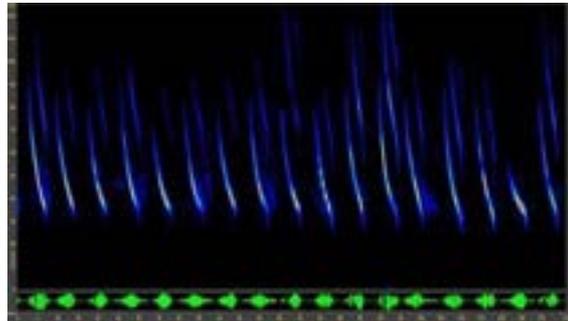
Daubenton's Bat - call duration 4.2-4.3 ms



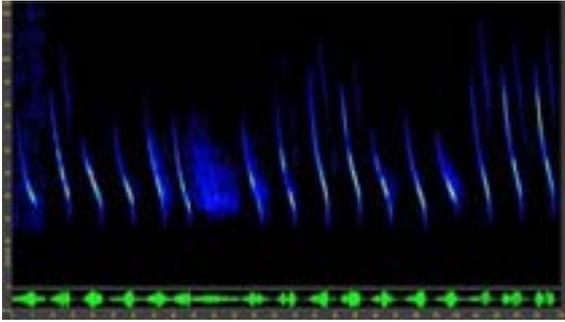
Pond Bat - call duration 4.2-4.3 ms



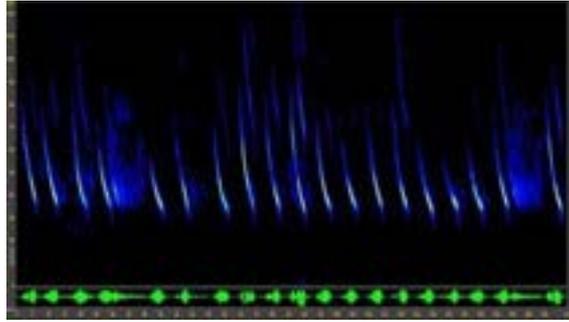
Daubenton's Bat - call duration 4.4-4.5 ms



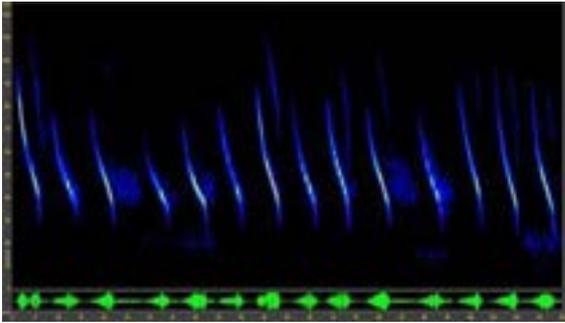
Pond Bat - call duration 4.4-4.5 ms



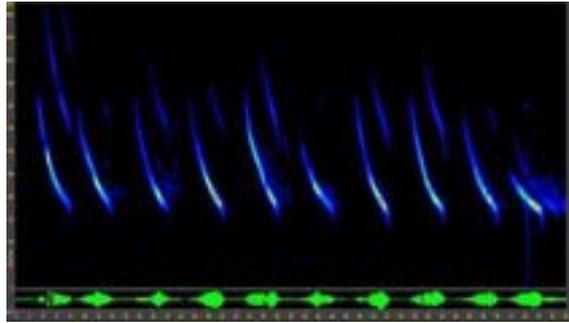
Daubenton's Bat - call duration 4.6-4.7 ms



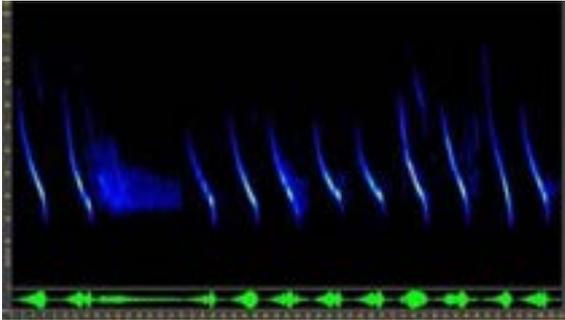
Pond Bat - call duration 4.6-4.7 ms



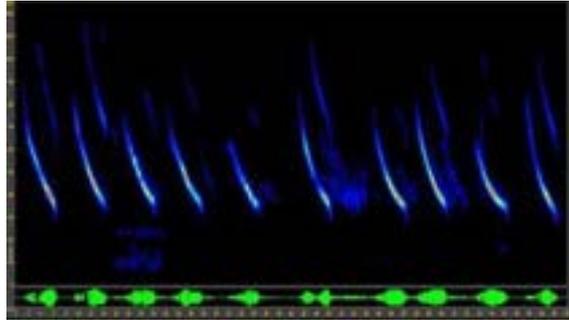
Daubenton's Bat - call duration 4.8-4.9 ms



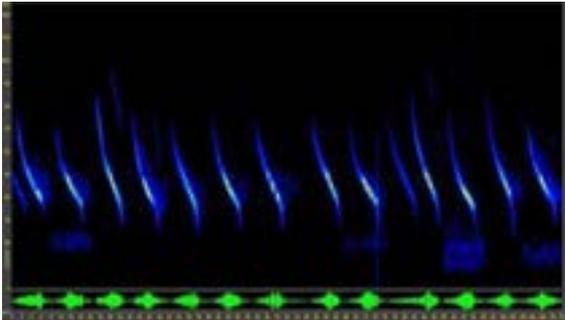
Pond Bat - call duration 4.8-4.9 ms



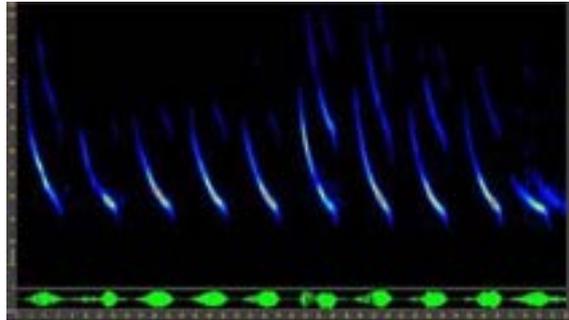
Daubenton's Bat - call duration 5.0-5.1 ms



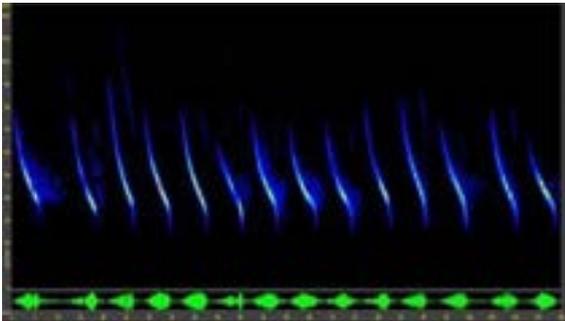
Pond Bat - call duration 5.0-5.1 ms



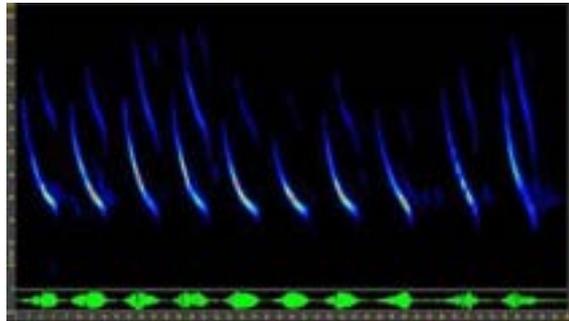
Daubenton's Bat - call duration 5.2-5.3 ms



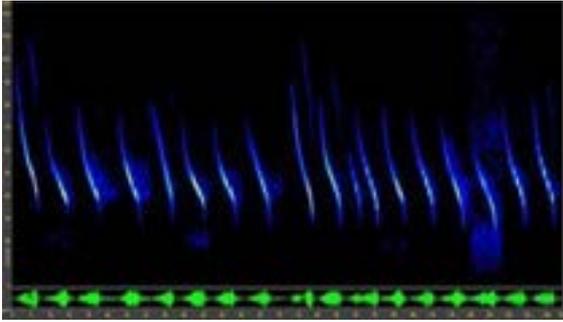
Pond Bat - call duration 5.2-5.3 ms



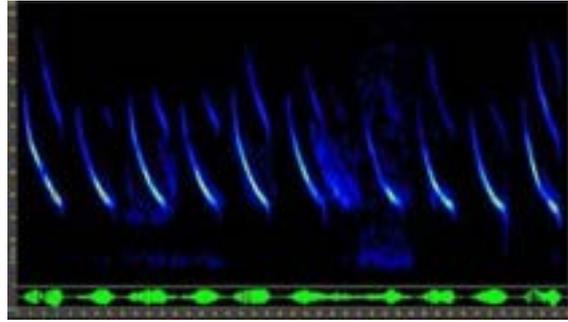
Daubenton's Bat - call duration 5.4-5.5 ms



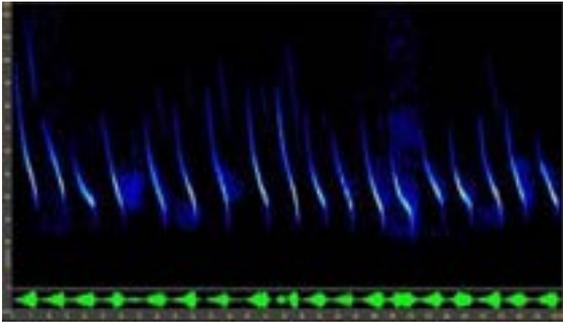
Pond Bat - call duration 5.4-5.5 ms



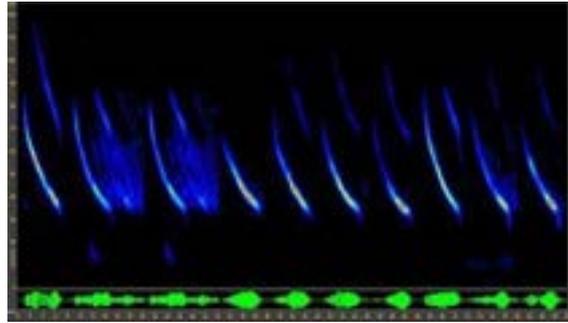
Daubenton's Bat - call duration 5.6-5.7 ms



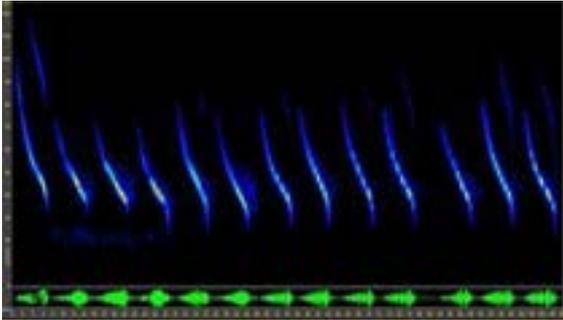
Pond Bat - call duration 5.6-5.7 ms



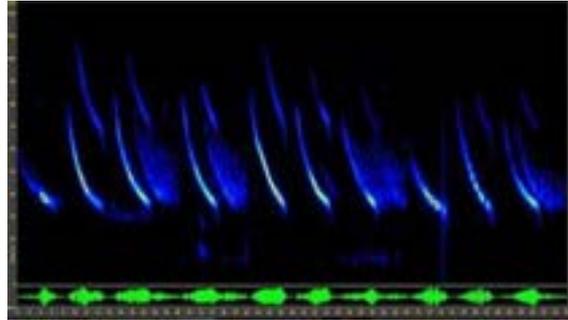
Daubenton's Bat - call duration 5.8-5.9 ms



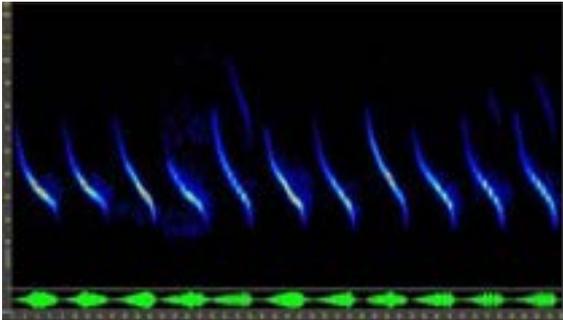
Pond Bat - call duration 5.8-5.9 ms



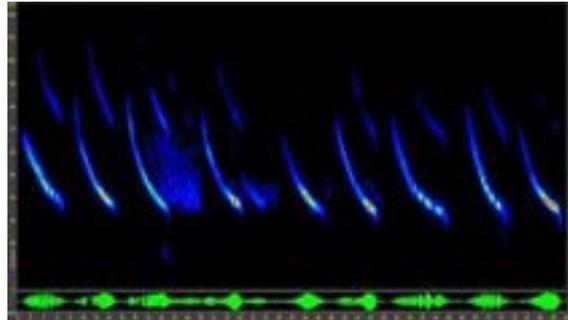
Daubenton's Bat - call duration 6.0-6.1 ms



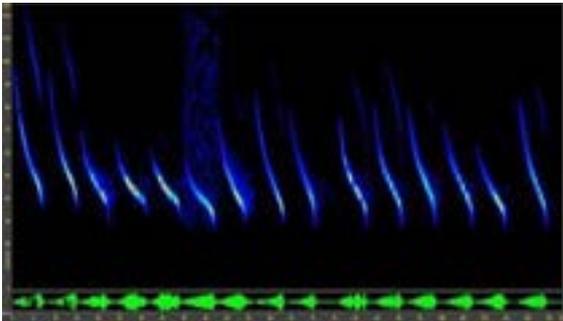
Pond Bat - call duration 6.0-6.1 ms



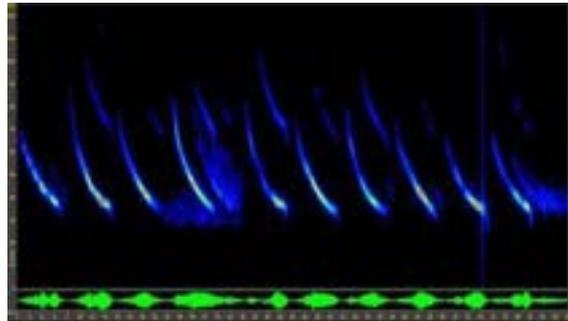
Daubenton's Bat - call duration 6.2-6.3 ms



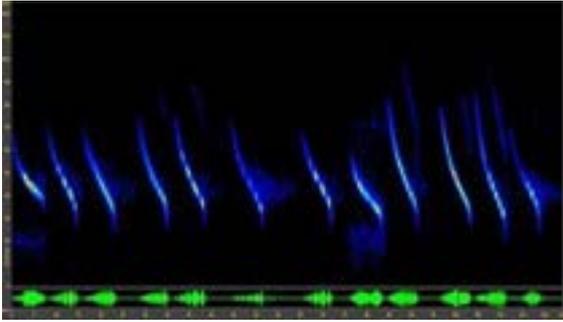
Pond Bat - call duration 6.2-6.3 ms



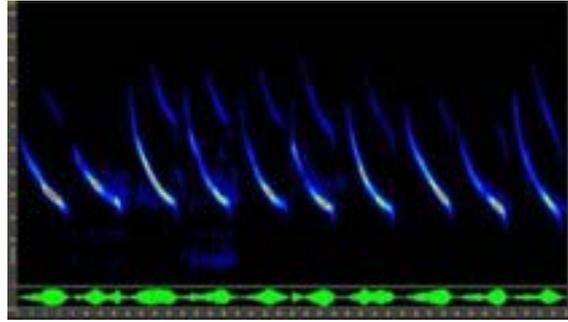
Daubenton's Bat - call duration 6.4-6.6 ms



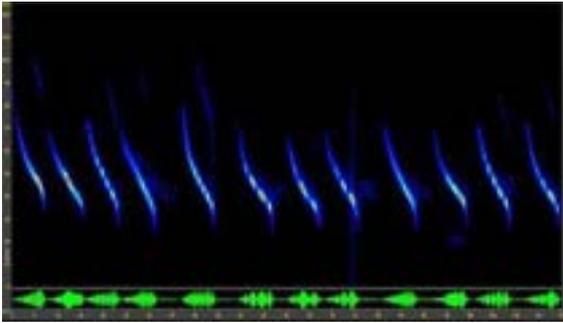
Pond Bat - call duration 6.4-6.6 ms



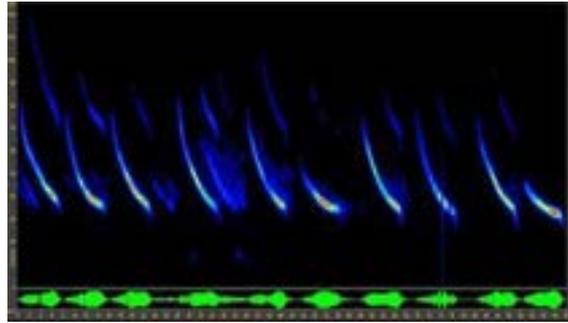
Daubenton's Bat - call duration 6.7-6.8 ms



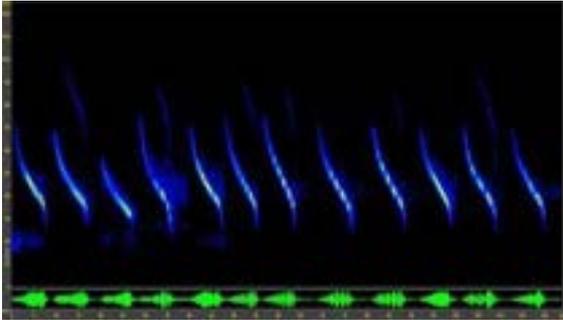
Pond Bat - call duration 6.7-6.8 ms



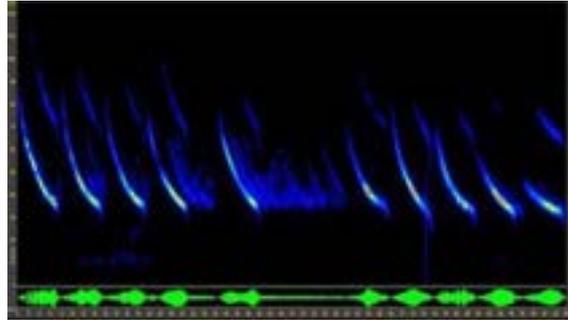
Daubenton's Bat - call duration 6.9-7.0 ms



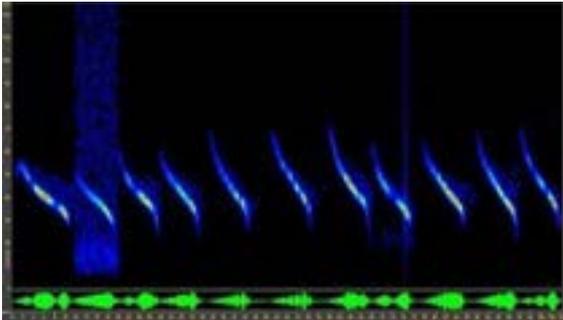
Pond Bat - call duration 6.9-7.0 ms



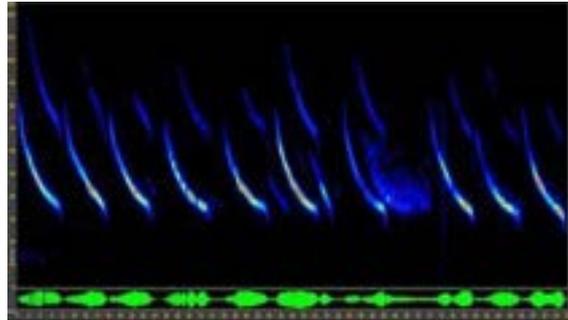
Daubenton's Bat - call duration 7.1-7.2 ms



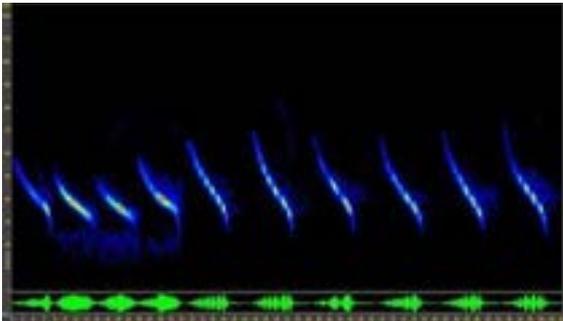
Pond Bat - call duration 7.1-7.2 ms



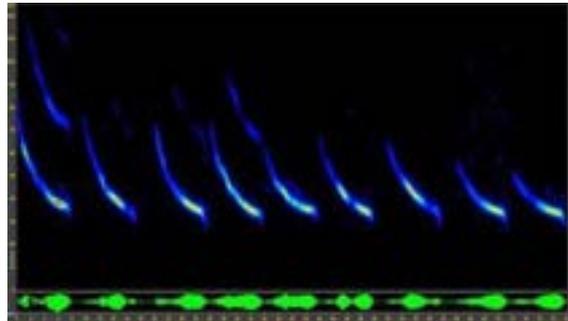
Daubenton's Bat - call duration 7.3-7.4 ms



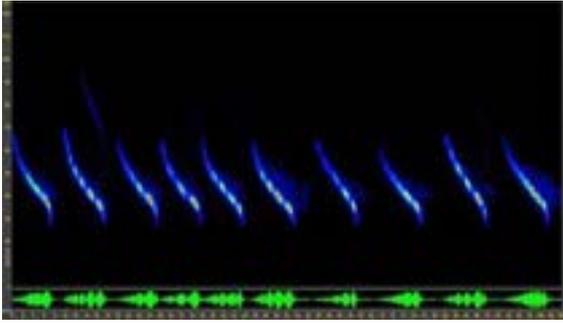
Pond Bat - call duration 7.3-7.4 ms



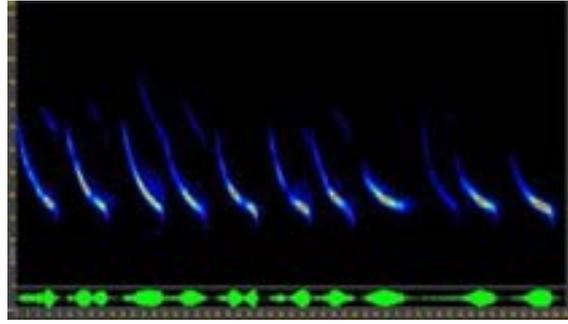
Daubenton's Bat - call duration 7.5-7.6 ms



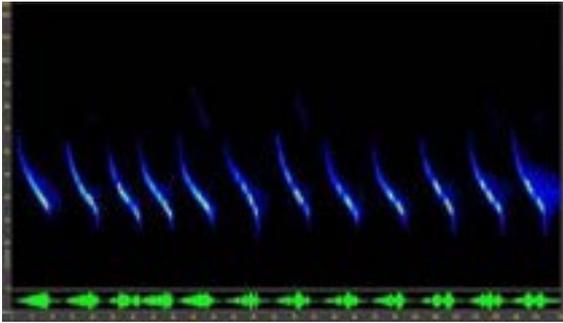
Pond Bat - call duration 7.5-7.6 ms



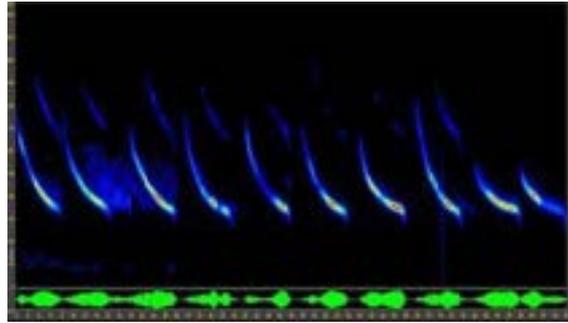
Daubenton's Bat - call duration 7.7-7.8 ms



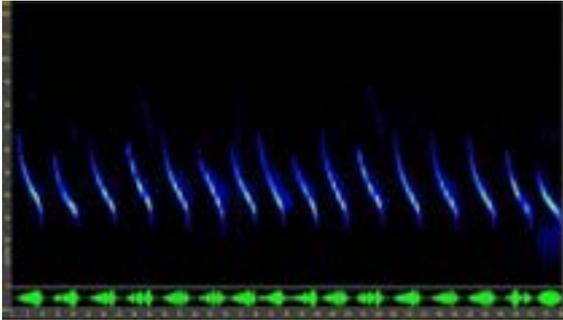
Pond Bat - call duration 7.7-7.8 ms



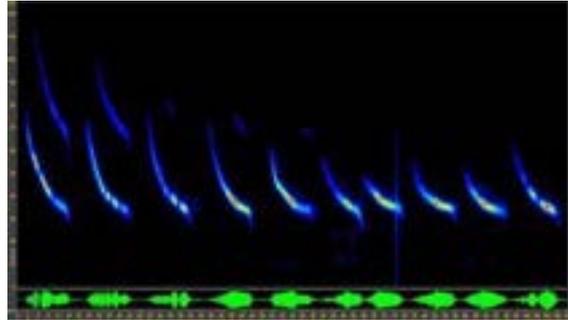
Daubenton's Bat - call duration 7.9-8.0 ms



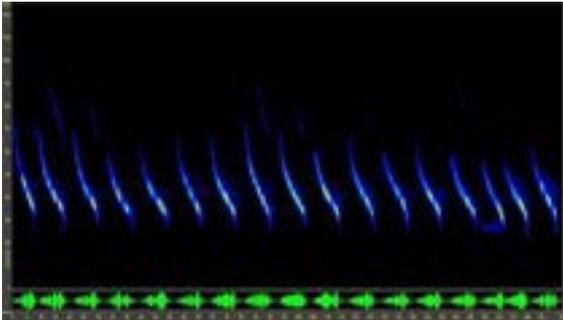
Pond Bat - call duration 7.9-8.0 ms



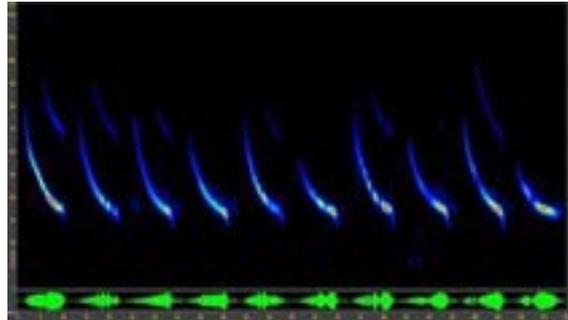
Daubenton's Bat - call duration 8.1-8.4 ms



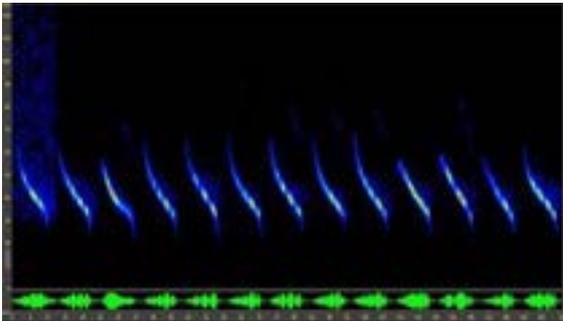
Pond Bat - call duration 8.1-8.4 ms



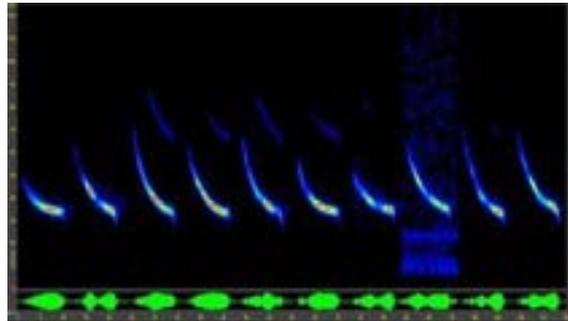
Daubenton's Bat - call duration 8.5-8.7 ms



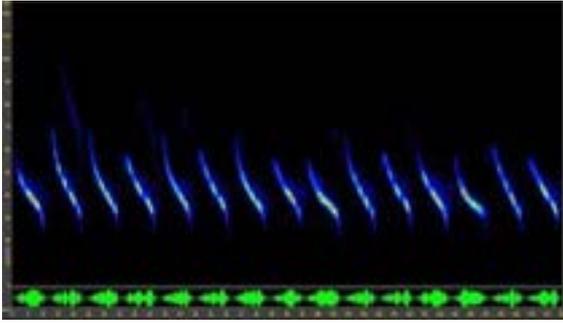
Pond Bat - call duration 8.5-8.7 ms



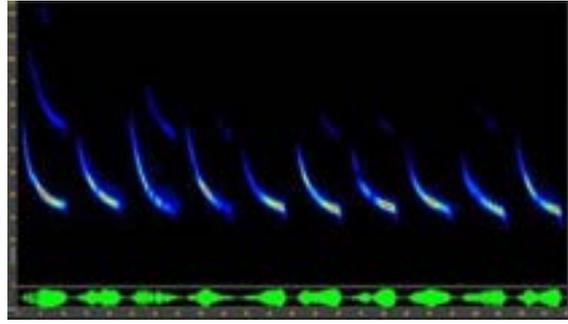
Daubenton's Bat - call duration 8.8-9.1 ms



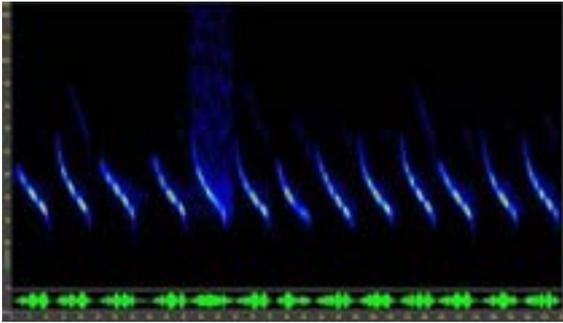
Pond Bat - call duration 8.8-9.1 ms



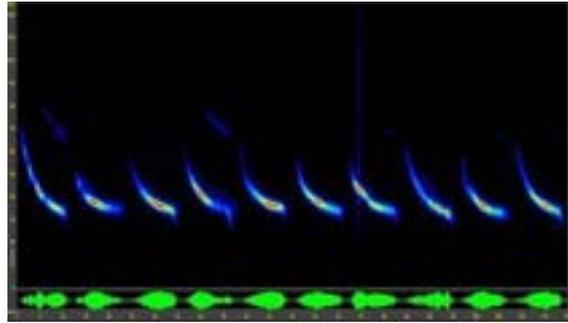
Daubenton's Bat - call duration 9.2-9.5 ms



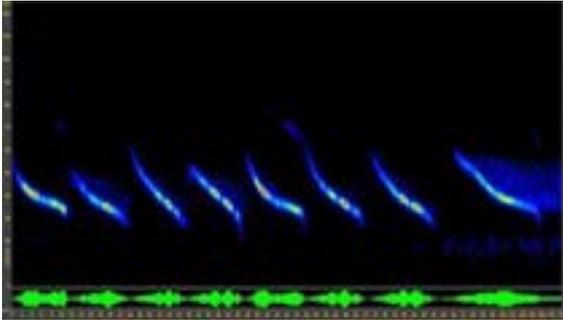
Pond Bat - call duration 9.2-9.5 ms



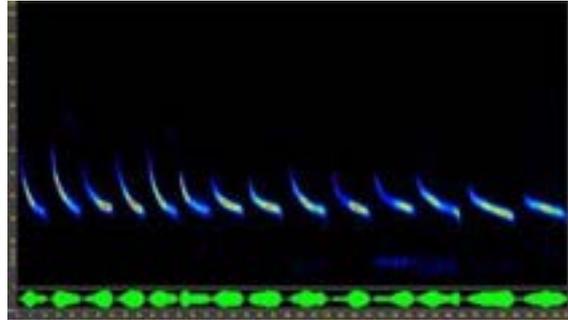
Daubenton's Bat - call duration 9.6-10.1 ms



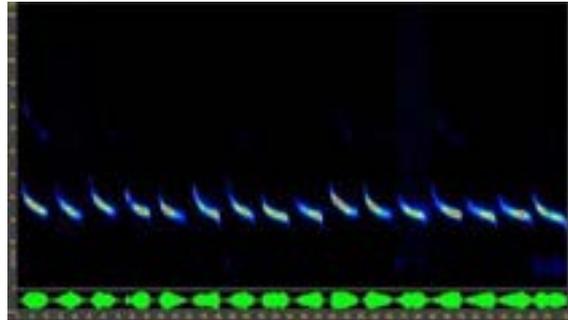
Pond Bat - call duration 9.6-10.1 ms



Daubenton's Bat - call duration 10.2-17.3 ms

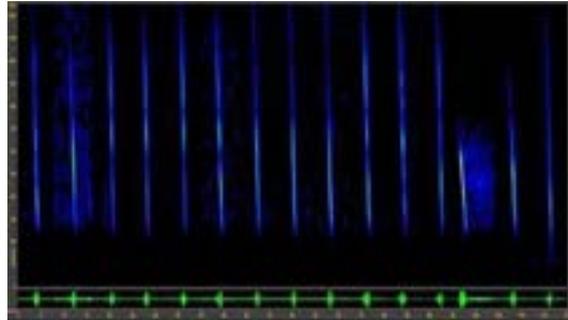


Pond Bat - call duration 10.2-17.3 ms

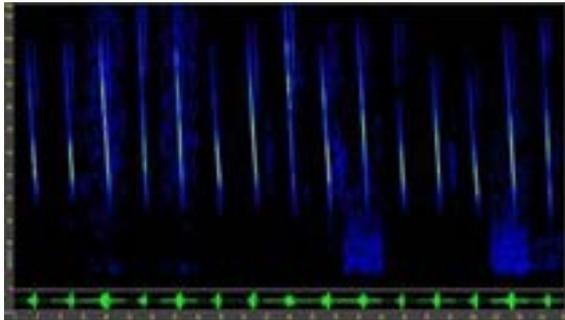


Daubenton's Bat - call duration 17.4-24.0 ms no examples Pond Bat - call duration 17.4-24.0 ms

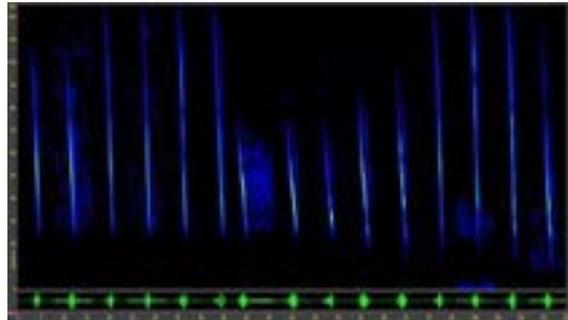
3. Bechstein's Bat *Myotis bechsteinii* and Natterer's Bat *Myotis nattereri*



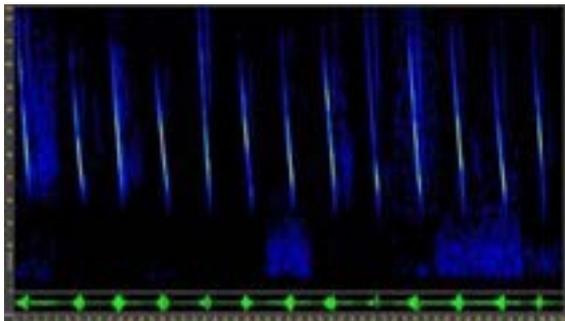
Bechstein's Bat - call duration up to 1.4 ms no examples Natterer's Bat - call duration up to 1.4 ms



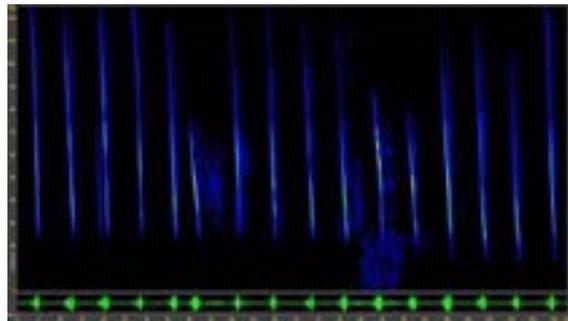
Bechstein's Bat - call duration 1.5-2.0 ms



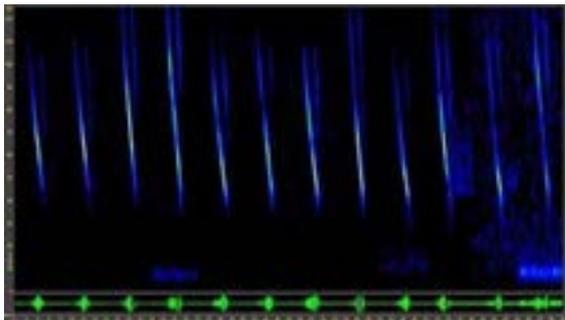
Natterer's Bat - call duration 1.5-2.0 ms



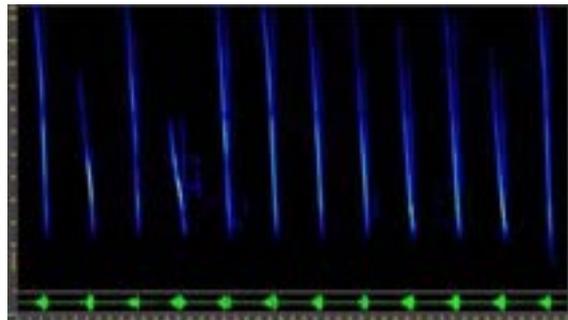
Bechstein's Bat - call duration 2.1-2.3 ms



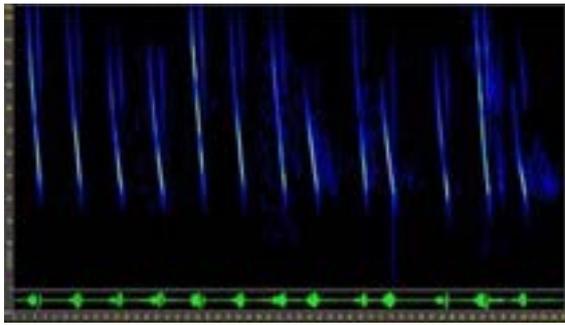
Natterer's Bat - call duration 2.1-2.3 ms



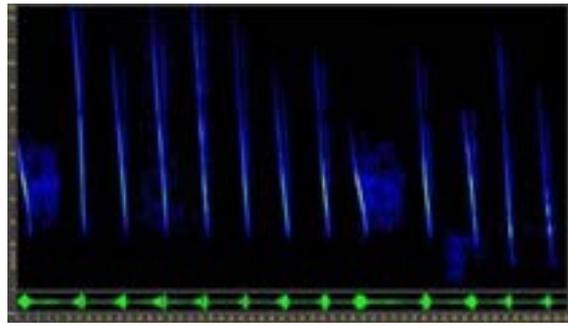
Bechstein's Bat - call duration 2.4-2.5 ms



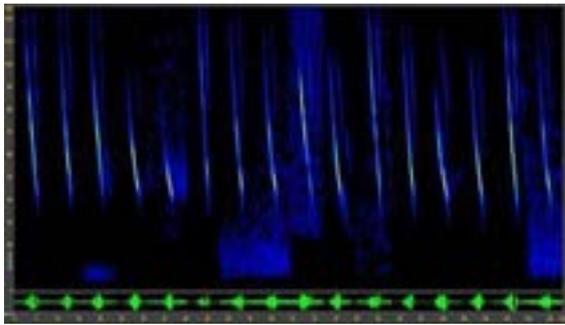
Natterer's Bat - call duration 2.4-2.5 ms



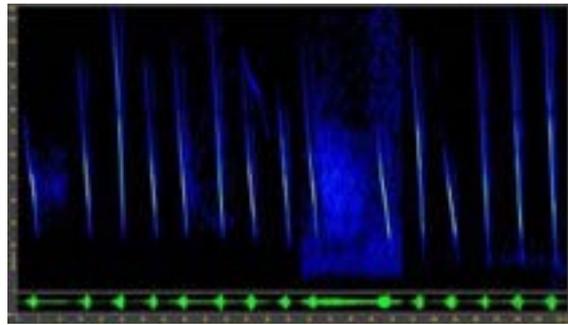
Bechstein's Bat - call duration 2.6-2.7 ms



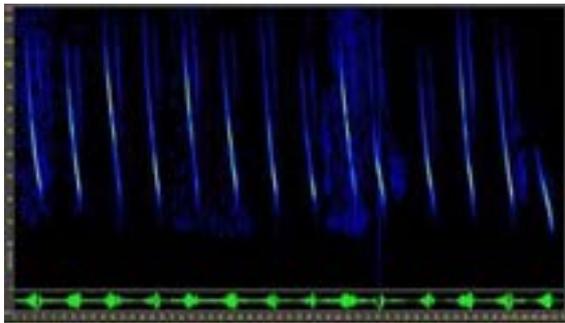
Natterer's Bat - call duration 2.6-2.7 ms



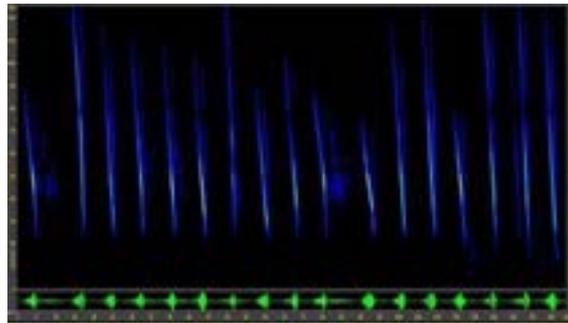
Bechstein's Bat - call duration 2.8-2.9 ms



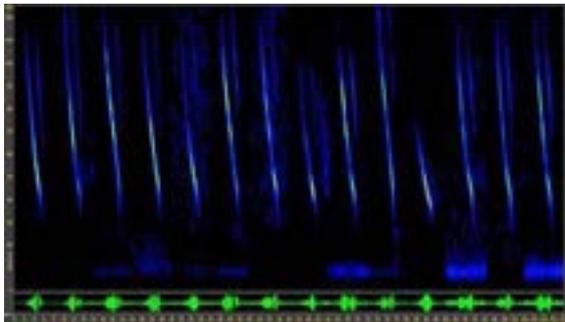
Natterer's Bat - call duration 2.8-2.9 ms



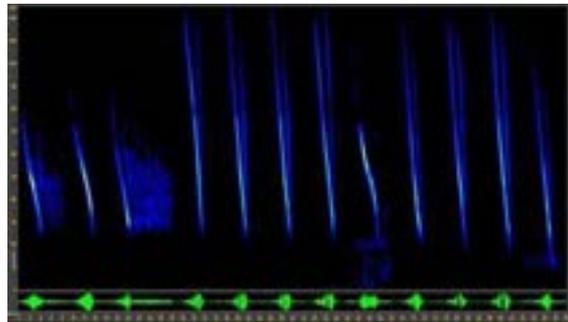
Bechstein's Bat - call duration 3.0-3.1 ms



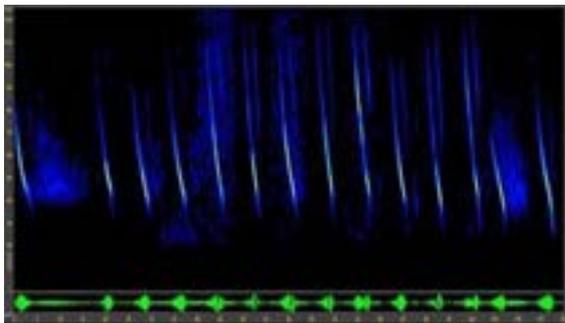
Natterer's Bat - call duration 3.0-3.1 ms



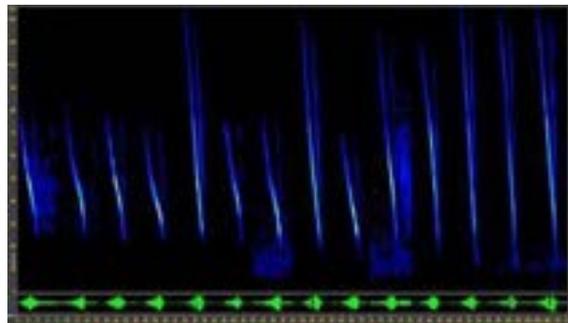
Bechstein's Bat - call duration 3.2-3.3 ms



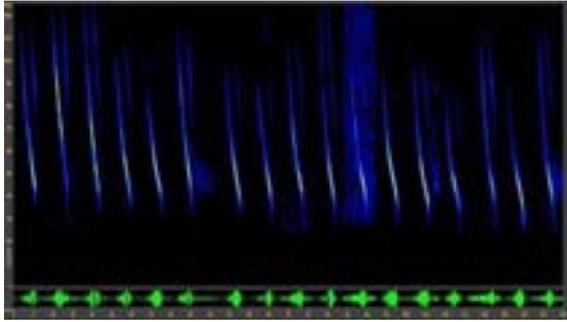
Natterer's Bat - call duration 3.2-3.3 ms



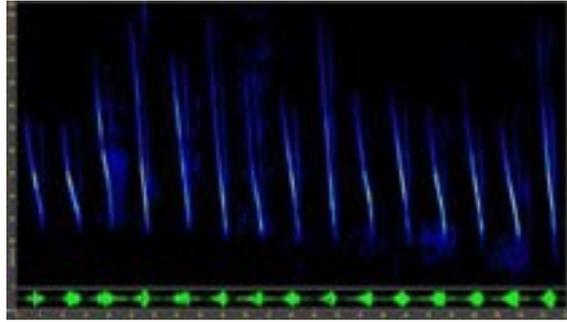
Bechstein's Bat - call duration 3.4-3.5 ms



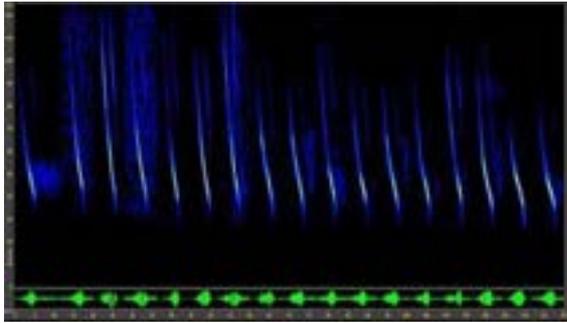
Natterer's Bat - call duration 3.4-3.5 ms



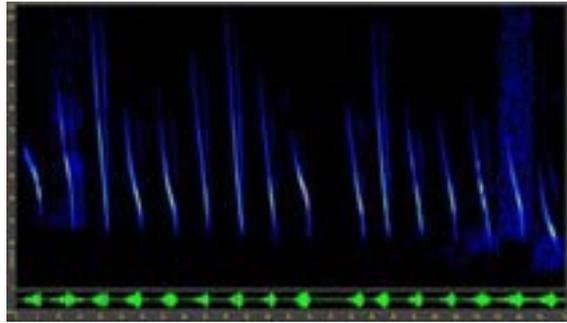
Bechstein's Bat - call duration 3.6-3.7 ms



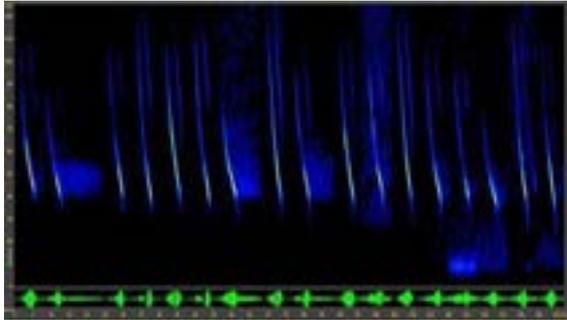
Natterer's Bat - call duration 3.6-3.7 ms



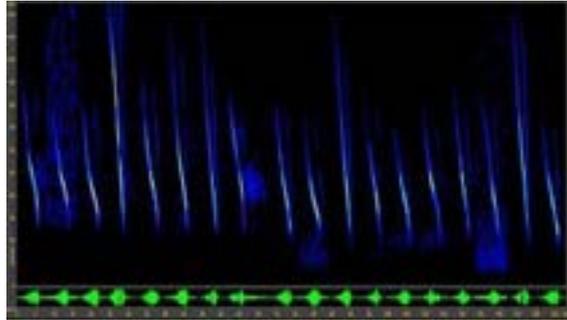
Bechstein's Bat - call duration 3.8-3.9 ms



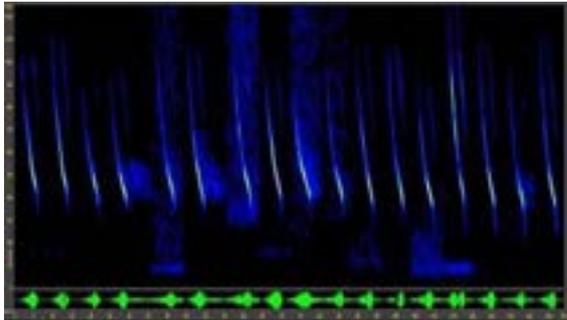
Natterer's Bat - call duration 3.8-3.9 ms



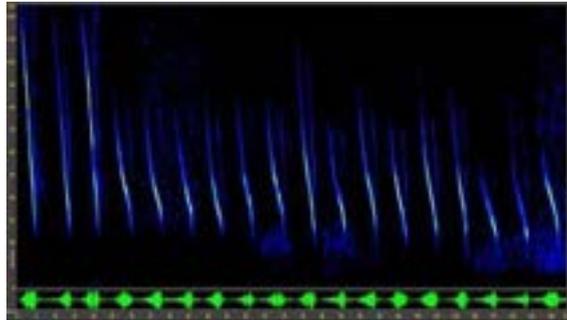
Bechstein's Bat - call duration 4.0-4.1 ms



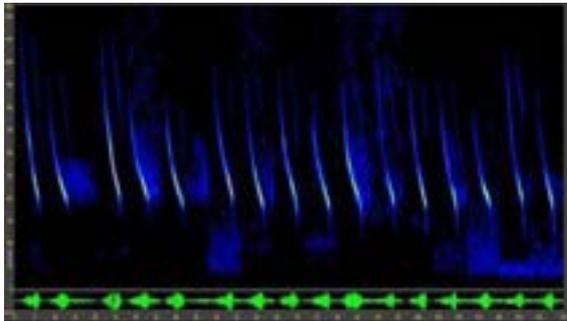
Natterer's Bat - call duration 4.0-4.1 ms



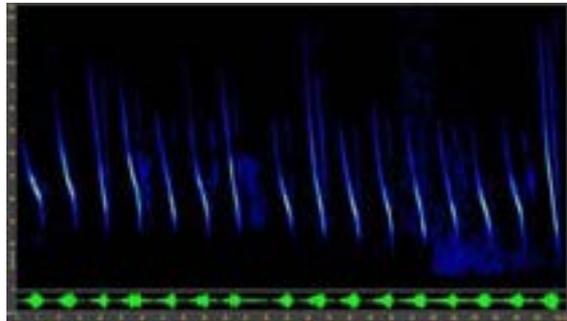
Bechstein's Bat - call duration 4.2-4.3 ms



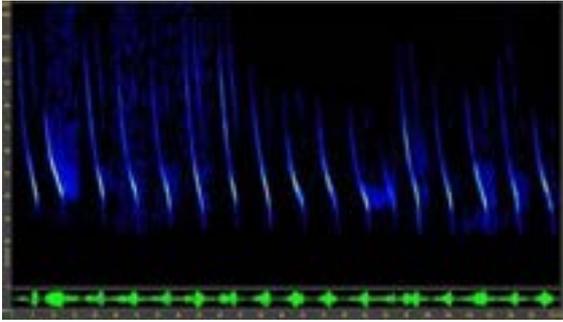
Natterer's Bat - call duration 4.2-4.3 ms



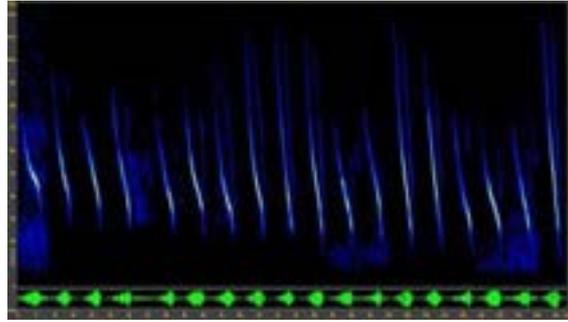
Bechstein's Bat - call duration 4.4-4.5 ms



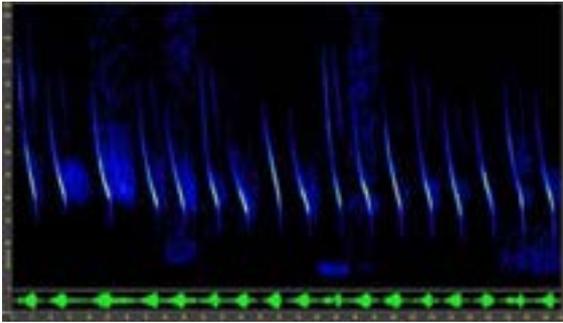
Natterer's Bat - call duration 4.4-4.5 ms



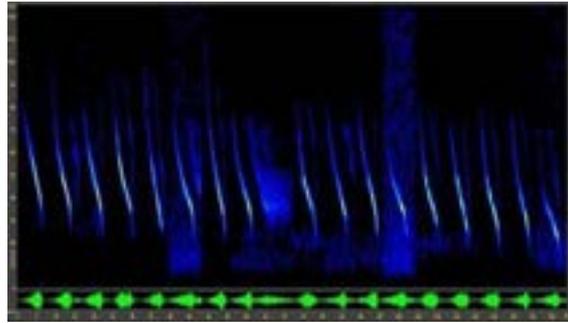
Bechstein's Bat - call duration 4.6-4.7 ms



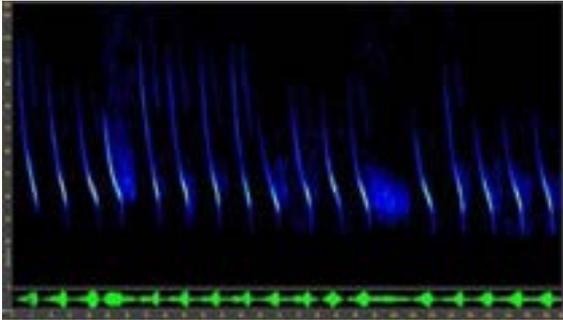
Natterer's Bat - call duration 4.6-4.7 ms



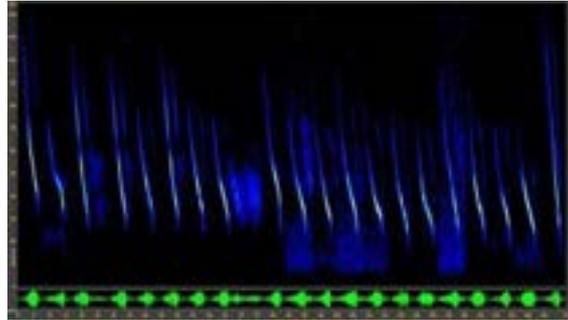
Bechstein's Bat - call duration 4.8-4.9 ms



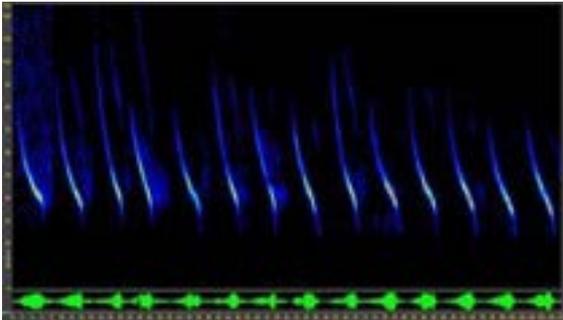
Natterer's Bat - call duration 4.8-4.9 ms



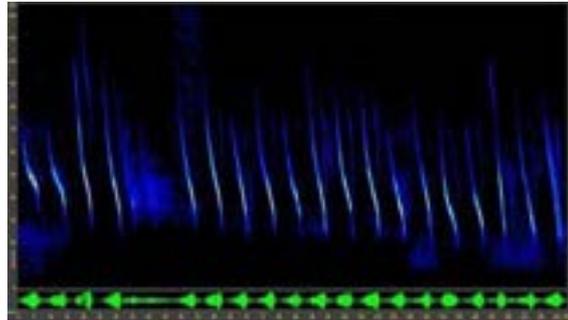
Bechstein's Bat - call duration 5.0-5.1 ms



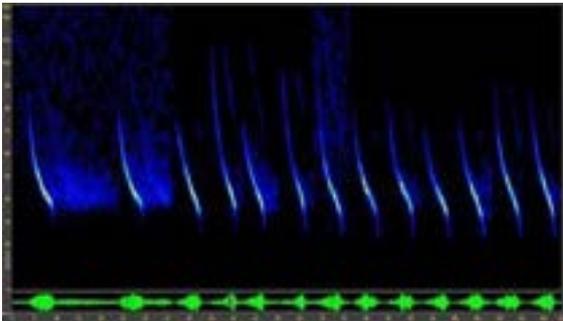
Natterer's Bat - call duration 5.0-5.1 ms



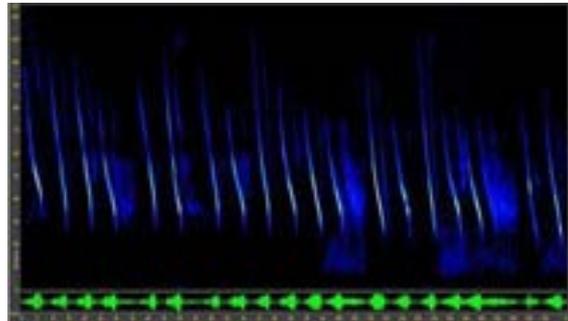
Bechstein's Bat - call duration 5.2-5.3 ms



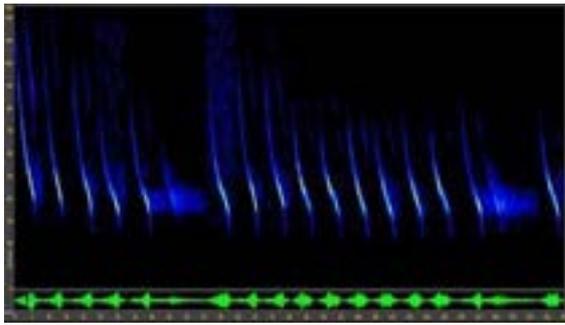
Natterer's Bat - call duration 5.2-5.3 ms



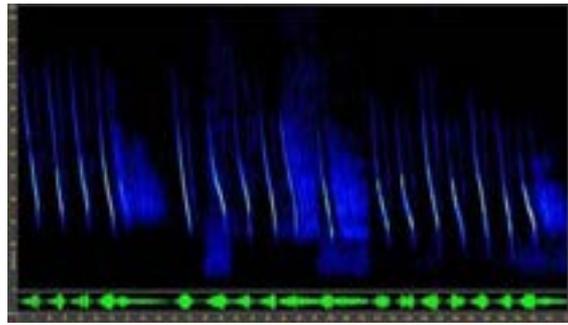
Bechstein's Bat - call duration 5.4-5.5 ms



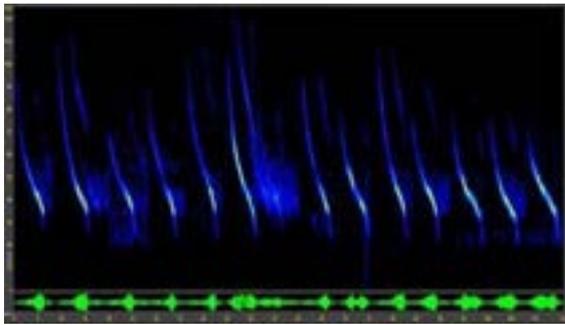
Natterer's Bat - call duration 5.4-5.5 ms



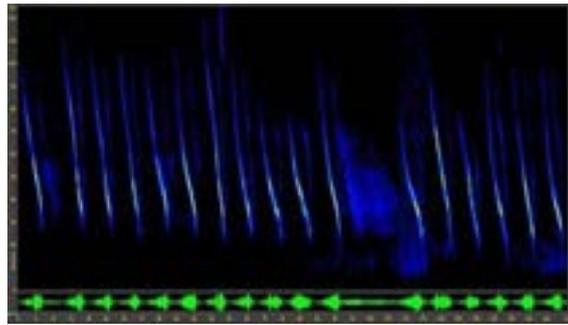
Bechstein's Bat - call duration 5.6-5.7 ms



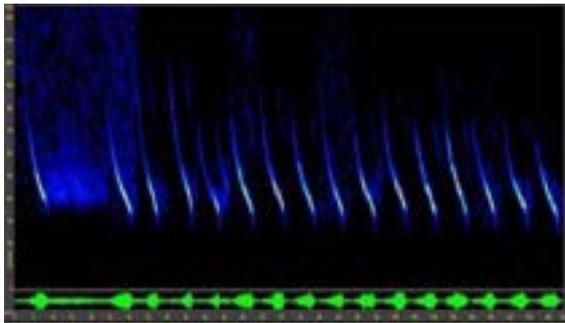
Natterer's Bat - call duration 5.6-5.7 ms



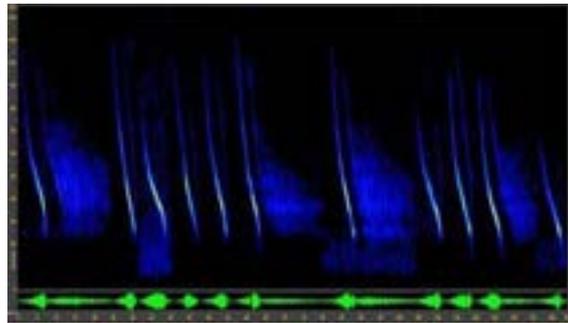
Bechstein's Bat - call duration 5.8-5.9 ms



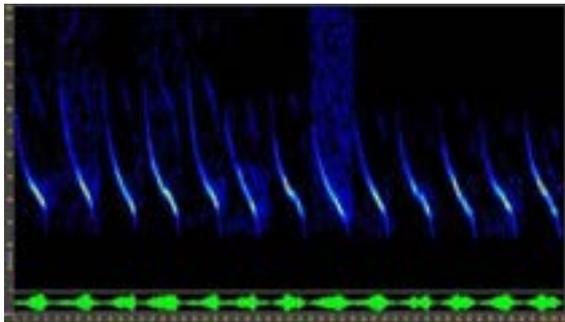
Natterer's Bat - call duration 5.8-5.9 ms



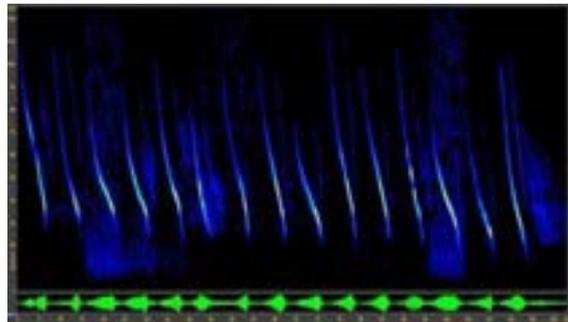
Bechstein's Bat - call duration 6.0-6.1 ms



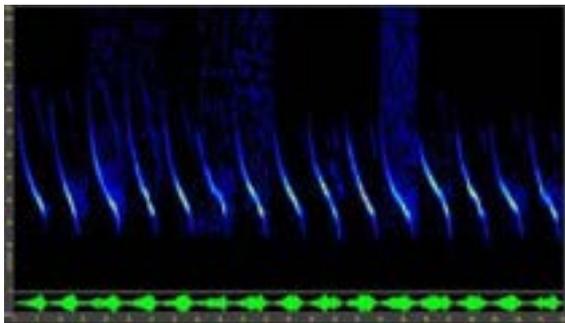
Natterer's Bat - call duration 6.0-6.1 ms



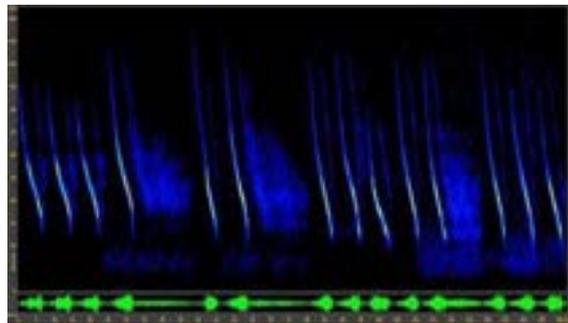
Bechstein's Bat - call duration 6.2-6.3 ms



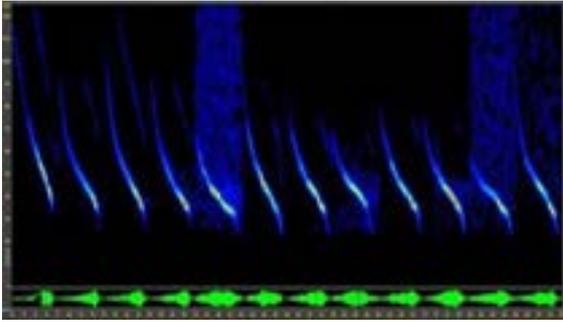
Natterer's Bat - call duration 6.2-6.3 ms



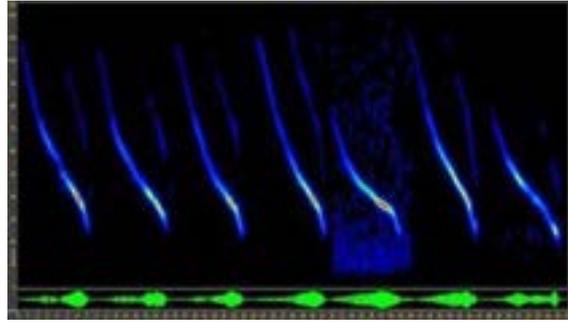
Bechstein's Bat - call duration 6.4-6.6 ms



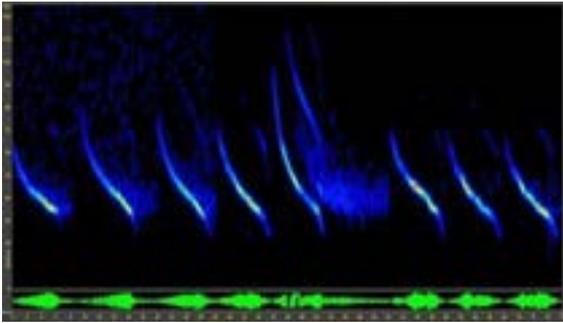
Natterer's Bat - call duration 6.4-6.6 ms



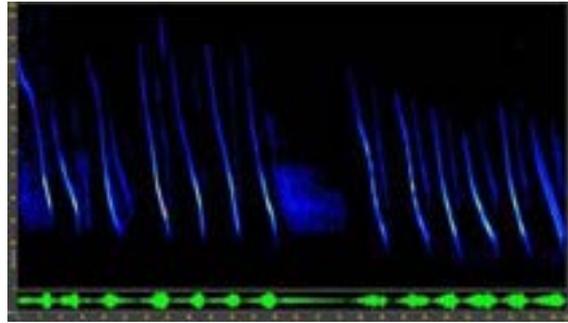
Bechstein's Bat - call duration 6.7-6.8 ms



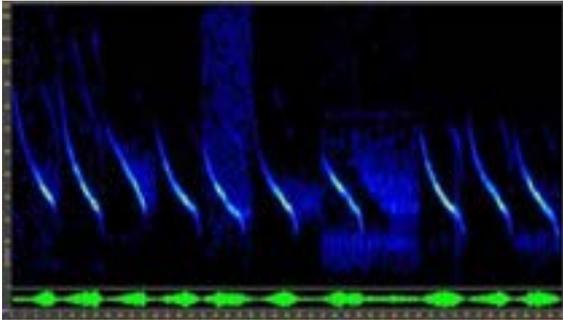
Natterer's Bat - call duration 6.7-6.8 ms



Bechstein's Bat - call duration 6.9-7.0 ms

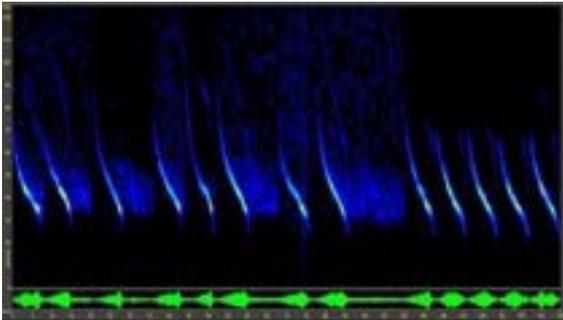


Natterer's Bat - call duration 6.9-9.9 ms



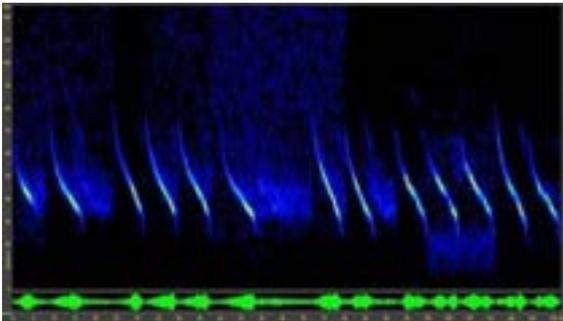
Bechstein's Bat - call duration 7.1-7.2 ms

Natterer's Bat - call duration 7.1-7.2 ms see above



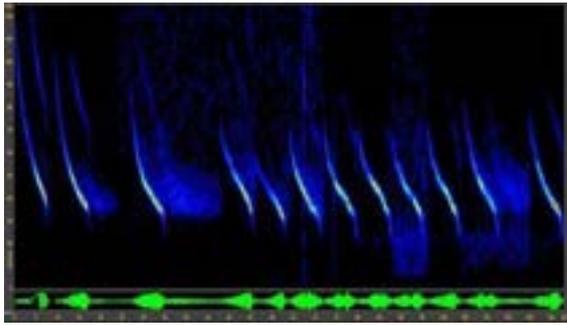
Bechstein's Bat - call duration 7.3-7.4 ms

Natterer's Bat - call duration 7.3-7.4 ms see above



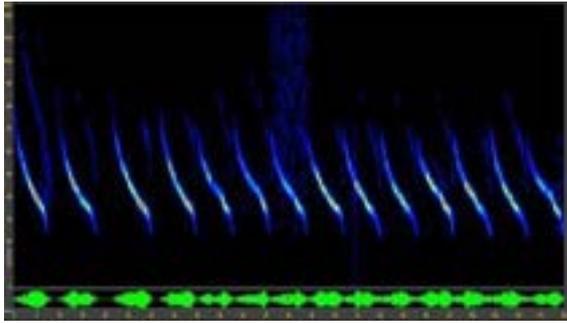
Bechstein's Bat - call duration 7.5-7.6 ms

Natterer's Bat - call duration 7.5-7.6 ms see above



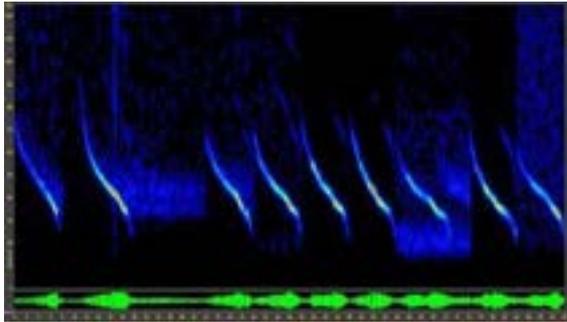
Bechstein's Bat - call duration 7.7-7.8 ms

Natterer's Bat - call duration 7.7-7.8 ms see above



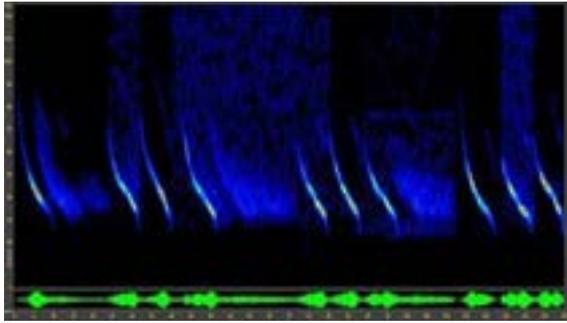
Bechstein's Bat - call duration 7.9-8.0 ms

Natterer's Bat - call duration 7.9-8.0 ms see above



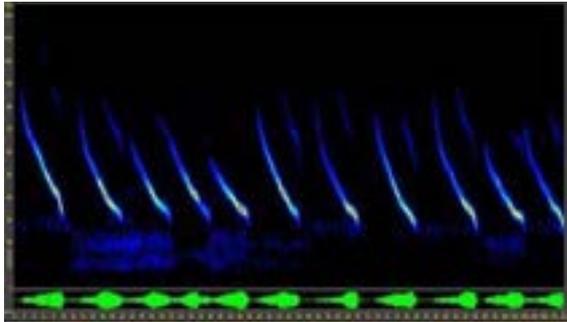
Bechstein's Bat - call duration 8.1-8.2 ms

Natterer's Bat - call duration 8.1-8.2 ms see above



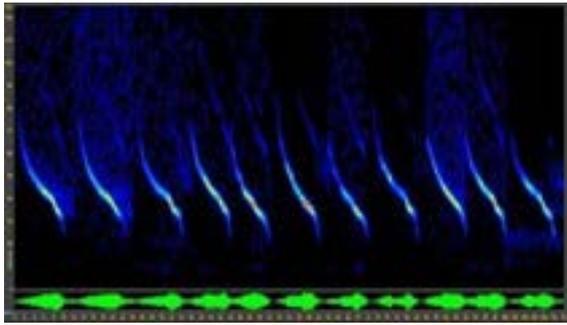
Bechstein's Bat - call duration 8.3-8.4 ms

Natterer's Bat - call duration 8.3-8.4 ms see above

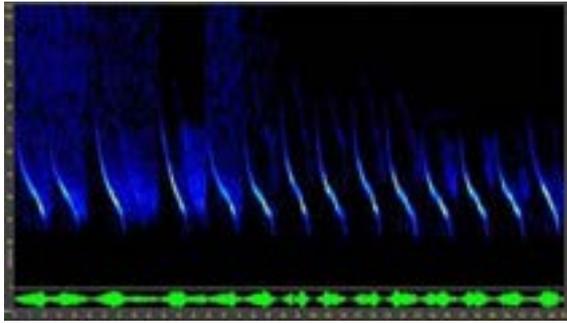


Bechstein's Bat - call duration 8.5-8.6 ms

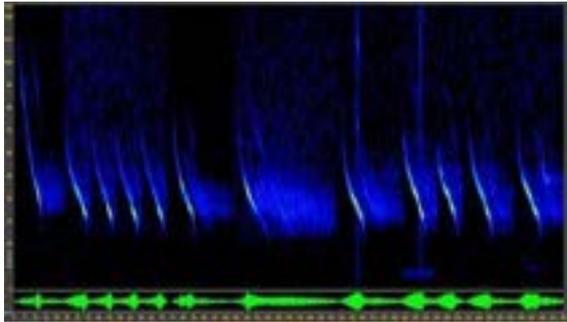
Natterer's Bat - call duration 8.5-8.6 ms see above



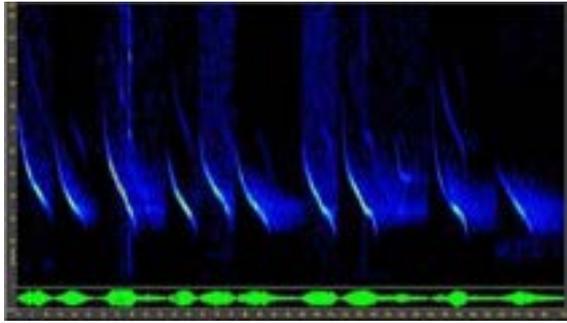
Bechstein's Bat - call duration 8.7-9.0 ms Natterer's Bat - call duration 8.7-8.8 ms see above



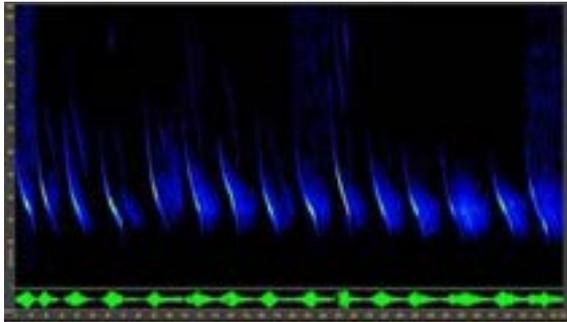
Bechstein's Bat - call duration 9.1-9.9 ms Natterer's Bat - call duration 9.1-9.9 ms see above



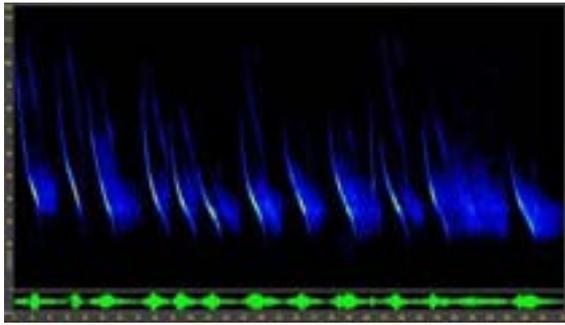
Bechstein's Bat - call duration 10.0-10.9 ms Natterer's Bat - call duration 10.0-10.9 ms no examples



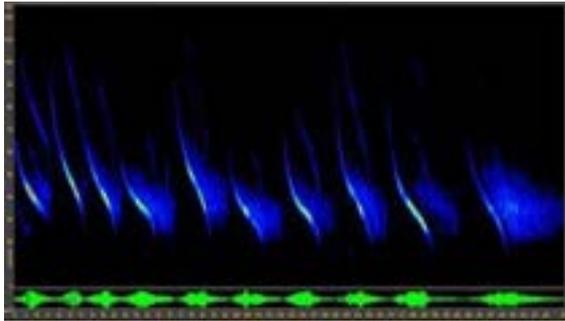
Bechstein's Bat - call duration 11.0-12.9 ms Natterer's Bat - call duration 11.0-12.9 ms no examples



Bechstein's Bat - call duration 13.0-14.2 ms Natterer's Bat call duration 13.0-14.2 ms no examples

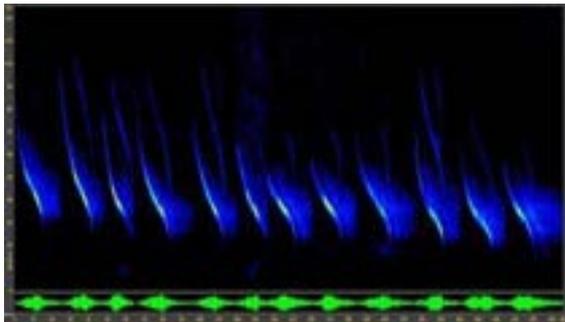


Bechstein's Bat - call duration 14.3-14.9 ms Natterer's Bat call duration 14.3-14.9 ms no examples



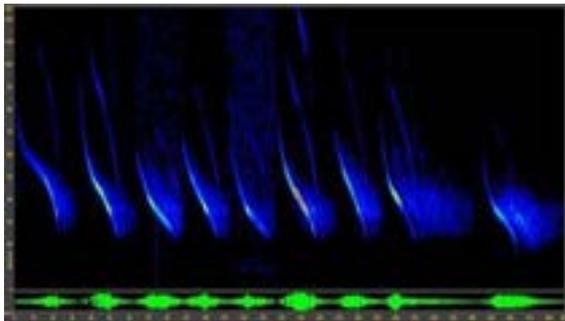
Bechstein's Bat - call duration 15.0-15.9 ms

Natterer's Bat call duration 15.0-15.9 ms no examples



Bechstein's Bat - call duration 16.0-17.5 ms

Natterer's Bat call duration 16.0-17.5 ms no examples



Bechstein's Bat - call duration 17.6-23.0 ms

Natterer's Bat call duration 17.6-23.0 ms no examples

4. Whiskered Bat *Myotis mystacinus* and Brandt's Bat *Myotis brandtii*

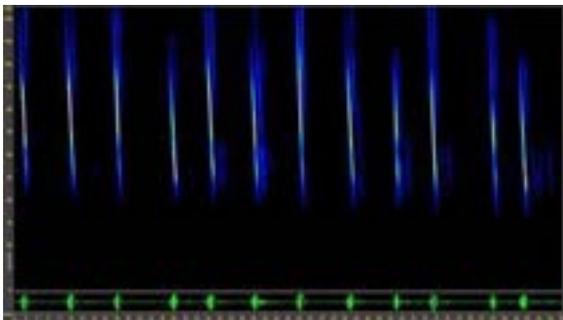
In the below we provide a visual comparison of echolocation calls of the same call duration of Whiskered Bat *Myotis mystacinus* and Brandt's Bat *Myotis brandtii* alongside each other. In producing these comparisons, we would like to explore whether there are any patterns of differences between the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

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

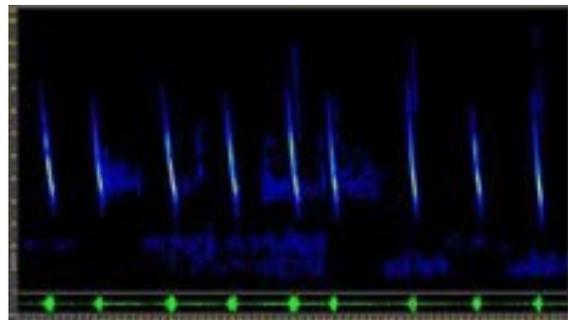
M. mystacinus and *M. brandtii* are two of the most difficult bat species in Europe to distinguish from their echolocation calls. For a given call duration, the echolocation calls of these species are visually extremely similar in frequency and shape.

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

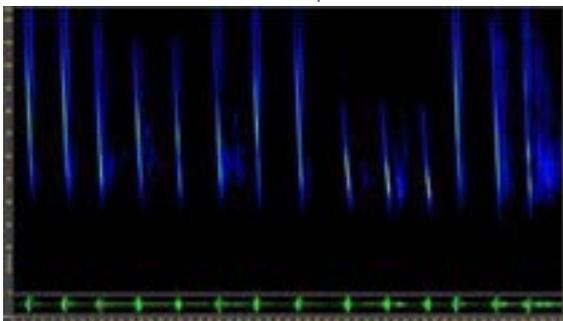
It is difficult to be sure that the recordings here are completely representative of *M. mystacinus* and *M. brandtii* to infer too much from this, but it was easy to find recordings of *M. mystacinus* of less 1.7 ms, but hard to find similar short duration calls of *M. brandtii*. This may suggest that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



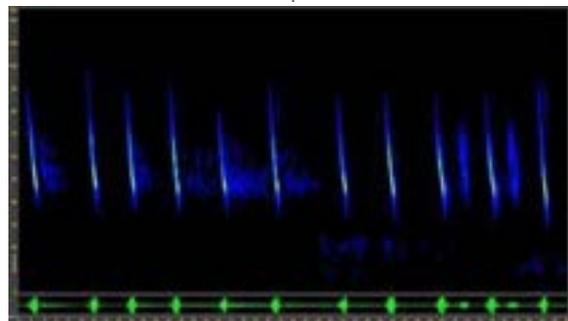
Whiskered Bat - call duration up to 1.3 ms



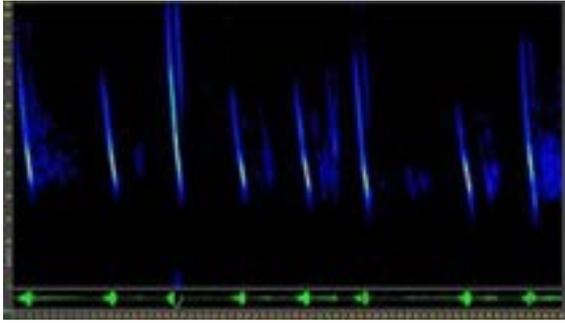
Brandt's Bat - call duration up to 1.3 ms



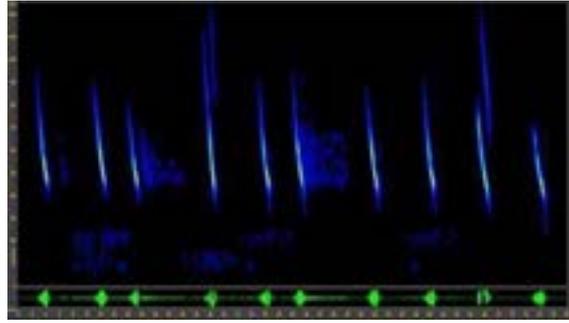
Whiskered Bat - call duration 1.4-1.5 ms



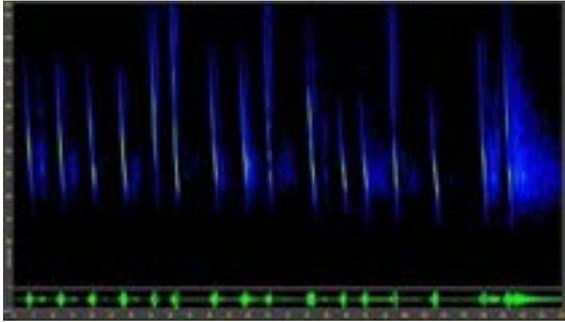
Brandt's Bat - call duration 1.4-1.5 ms



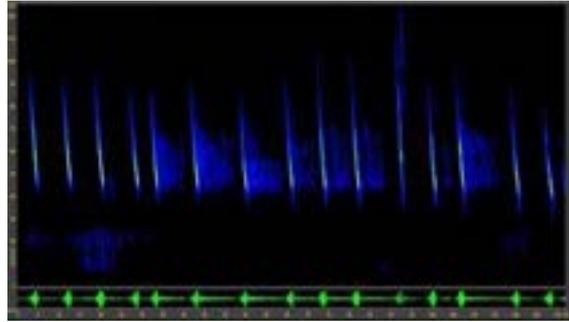
Whiskered Bat - call duration 1.6-1.7 ms



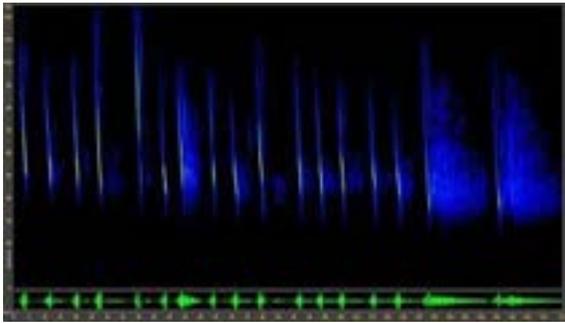
Brandt's Bat - call duration 1.6-1.7 ms



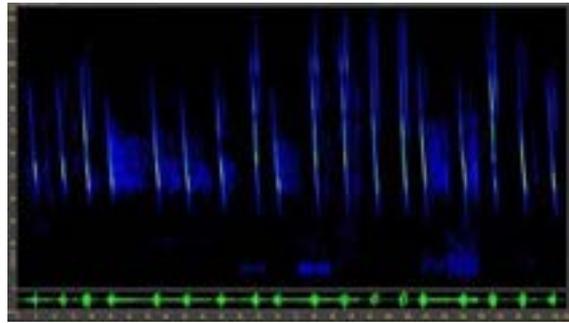
Whiskered Bat - call duration 1.8-1.9 ms



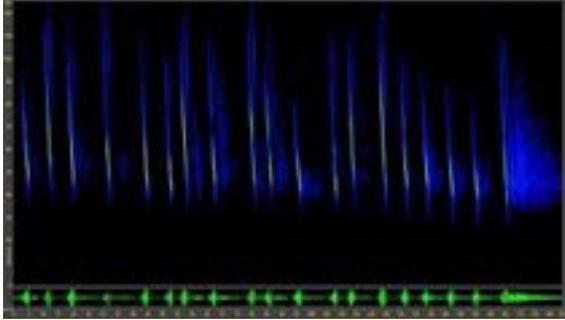
Brandt's Bat - call duration 1.8-1.9 ms



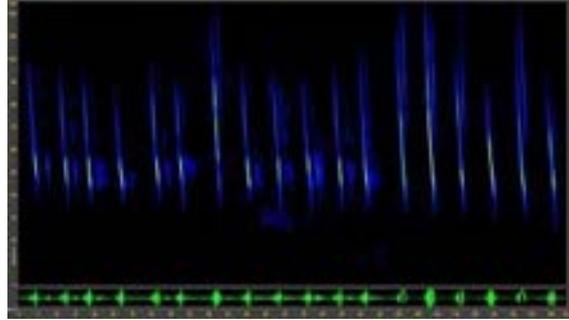
Whiskered Bat - call duration 2.0-2.1 ms



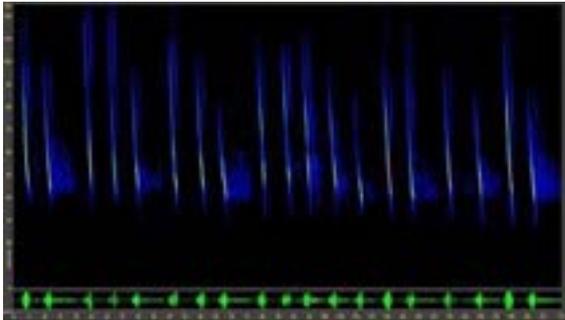
Brandt's Bat - call duration 2.0-2.1 ms



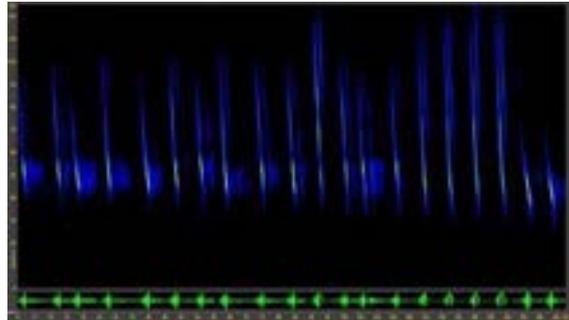
Whiskered Bat - call duration 2.2-2.3 ms



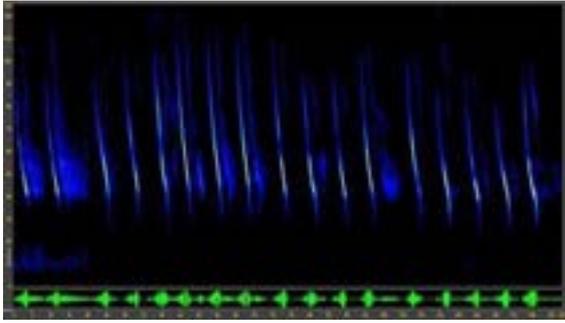
Brandt's Bat - call duration 2.2-2.3 ms



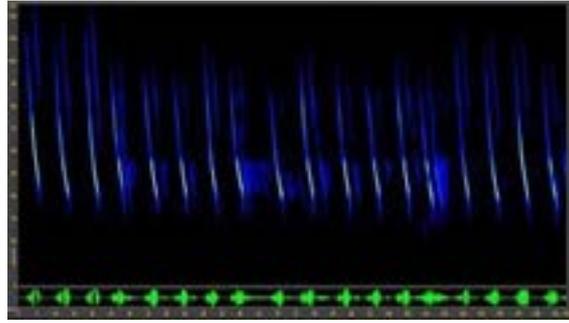
Whiskered Bat - call duration 2.4-2.5 ms



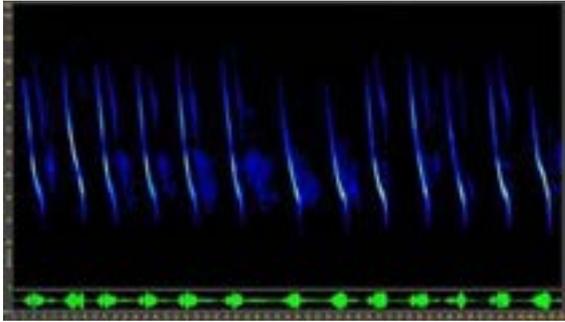
Brandt's Bat - call duration 2.4-2.5 ms



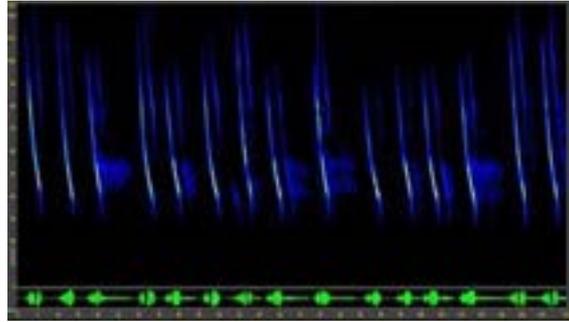
Whiskered Bat - call duration 3.6-3.7 ms



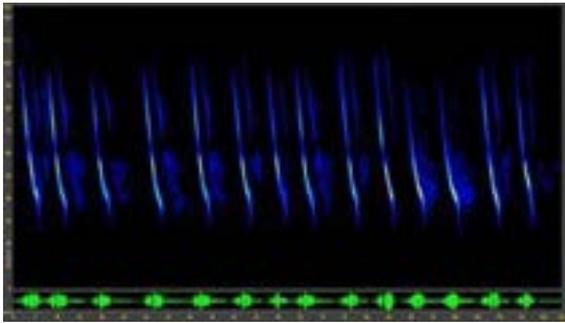
Brandt's Bat - call duration 3.6-3.7 ms



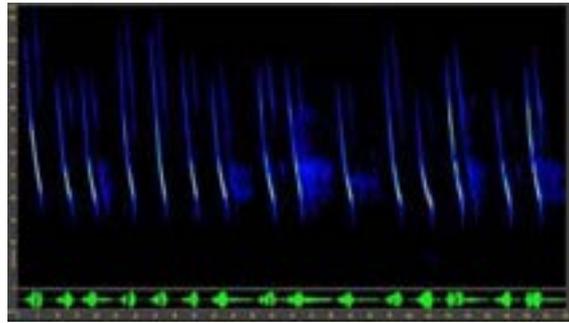
Whiskered Bat - call duration 3.8-3.9 ms



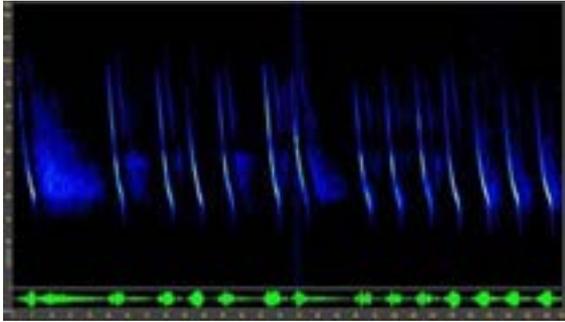
Brandt's Bat - call duration 3.8-3.9 ms



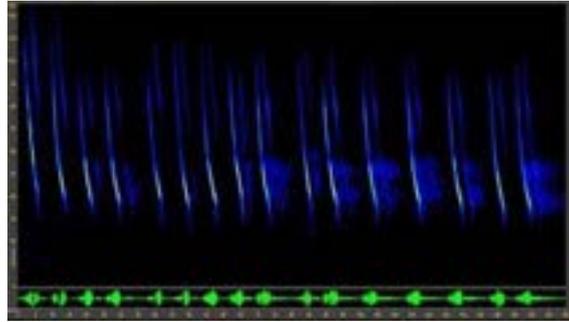
Whiskered Bat - call duration 4.0-4.1 ms



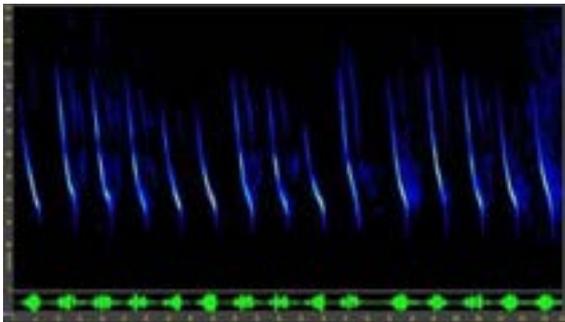
Brandt's Bat - call duration 4.0-4.1 ms



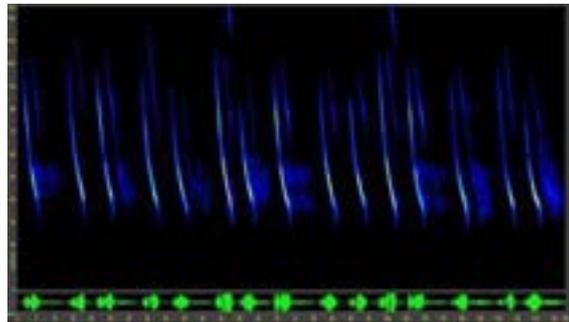
Whiskered Bat - call duration 4.2-4.3 ms



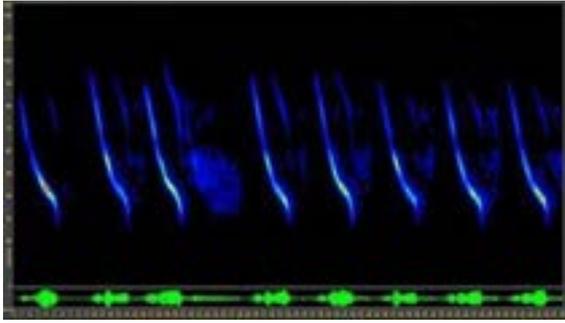
Brandt's Bat - call duration 4.2-4.3 ms



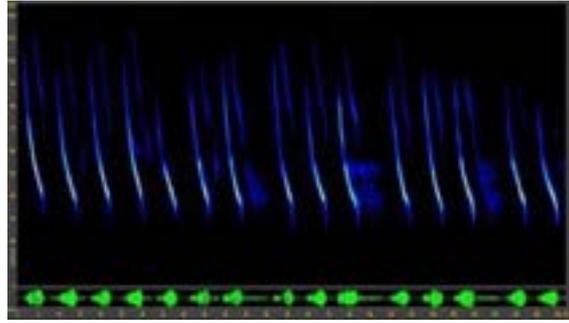
Whiskered Bat - call duration 4.4-4.5 ms



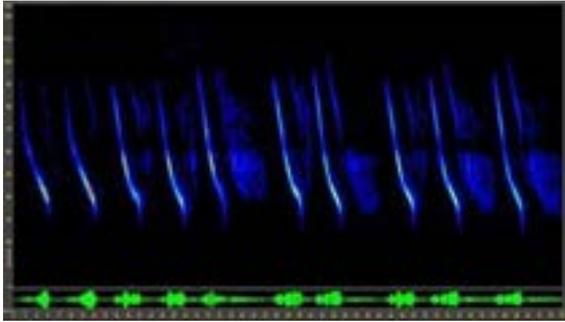
Brandt's Bat - call duration 4.4-4.5 ms



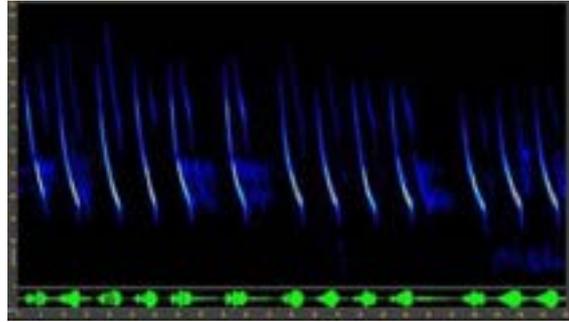
Whiskered Bat - call duration 4.6-4.7 ms



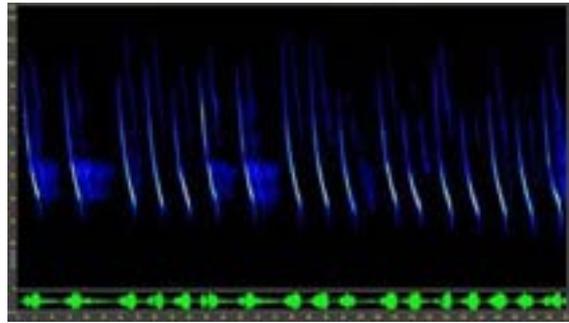
Brandt's Bat - call duration 4.6-4.7 ms



Whiskered Bat - call duration 4.8-5.1 ms

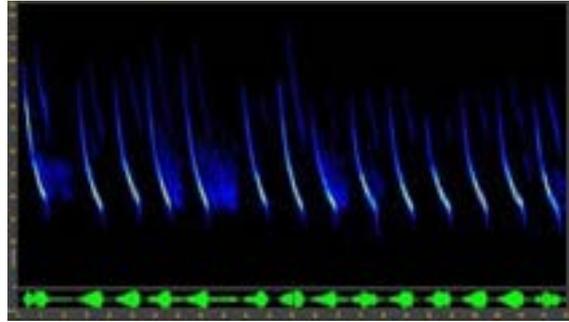


Brandt's Bat - call duration 4.8-5.1 ms



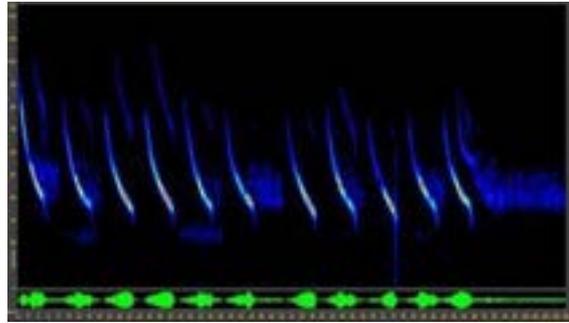
Whiskered Bat call duration 5.2-5.3 ms no examples

Brandt's Bat - call duration 5.2-5.3 ms



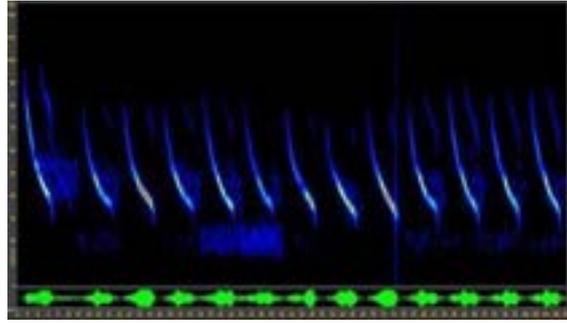
Whiskered Bat call duration 5.4-5.5 ms no examples

Brandt's Bat - call duration 5.4-5.5 ms



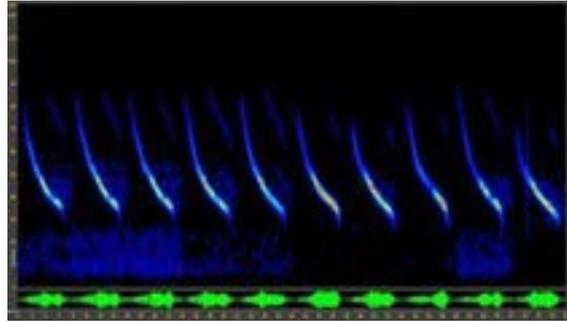
Whiskered Bat call duration 5.6-5.7 ms no examples

Brandt's Bat - call duration 5.6-5.7 ms



Whiskered Bat call duration 5.8-5.9 ms no examples

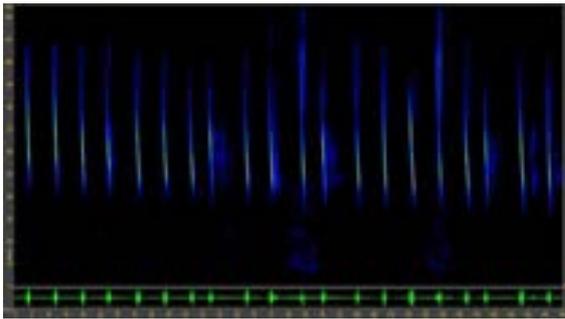
Brandt's Bat - call duration 5.8-5.9 ms



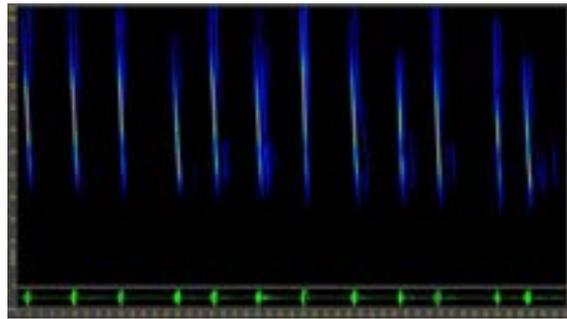
Whiskered Bat call duration 6.0-6.5 ms no examples

Brandt's Bat - call duration 6.0-6.5 ms

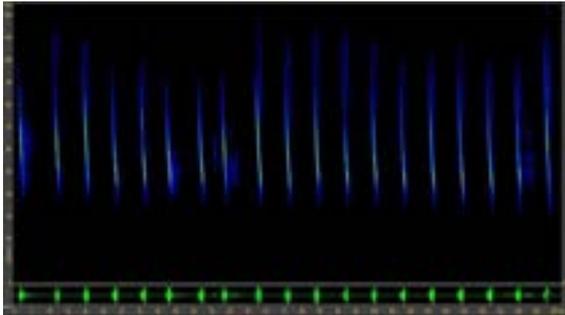
5. David's Myotis *Myotis davidii* and Whiskered Bat *Myotis mystacinus*



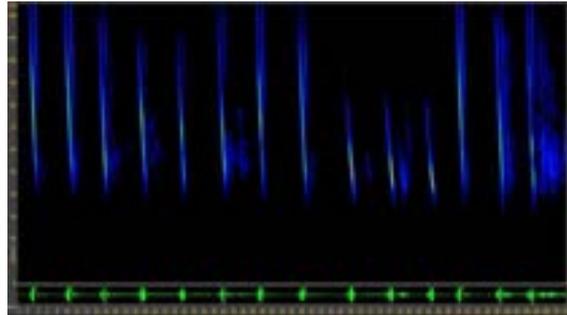
David's Myotis - call duration up to 1.3 ms



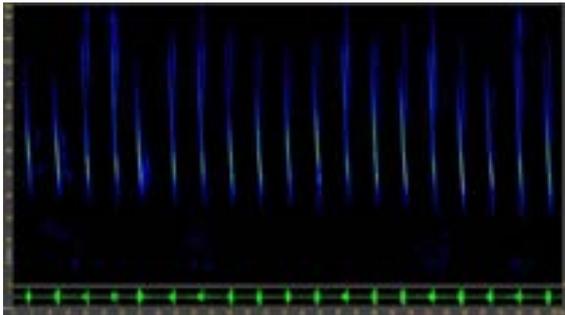
Whiskered Bat - call duration up to 1.3 ms



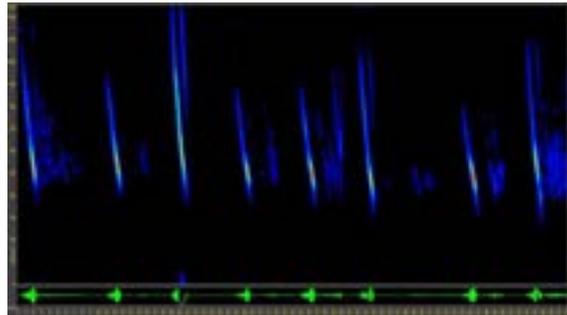
David's Myotis - call duration 1.4-1.5 ms



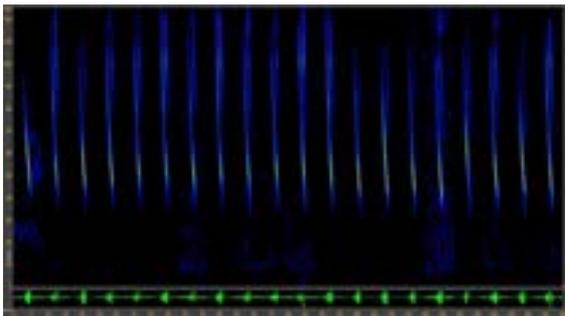
Whiskered Bat - call duration 1.4-1.5 ms



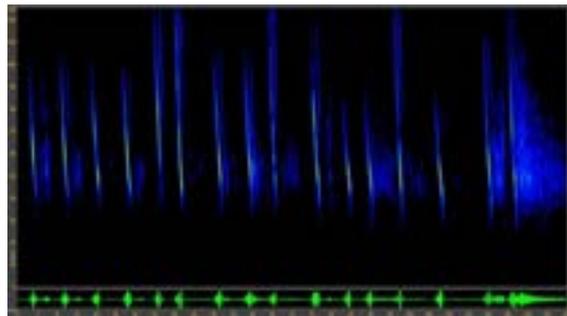
David's Myotis - call duration 1.6-1.7 ms



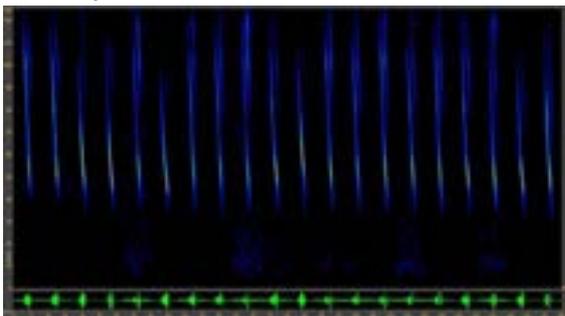
Whiskered Bat - call duration 1.6-1.7 ms



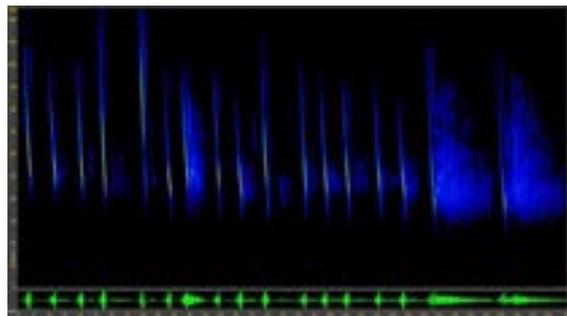
David's Myotis - call duration 1.8-1.9 ms



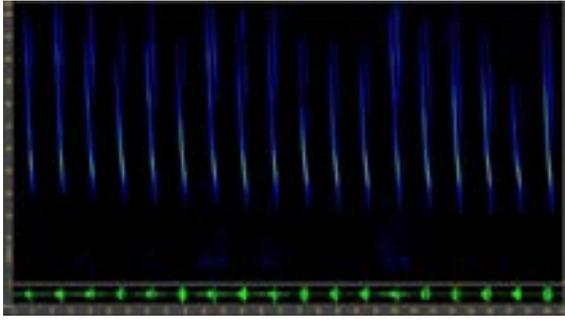
Whiskered Bat - call duration 1.8-1.9 ms



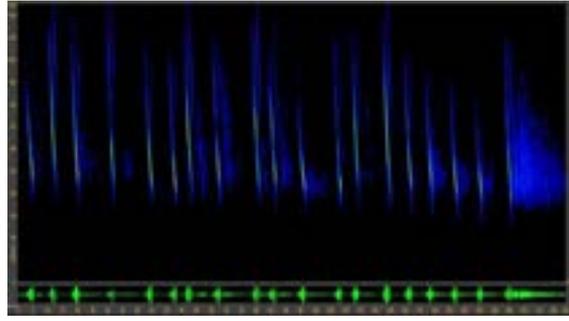
David's Myotis - call duration 2.0-2.1 ms



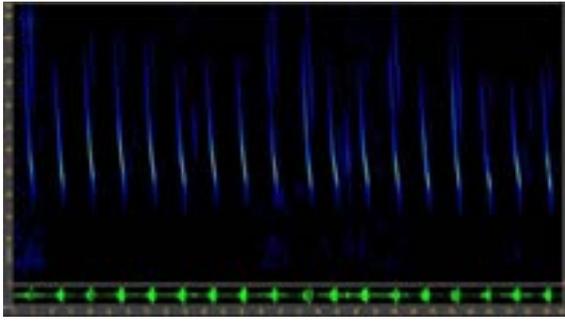
Whiskered Bat - call duration 2.0-2.1 ms



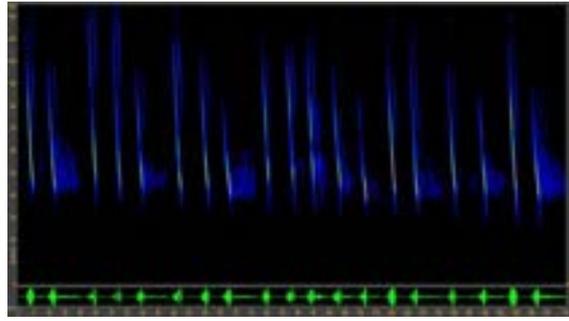
David's Myotis - call duration 2.2-2.3 ms



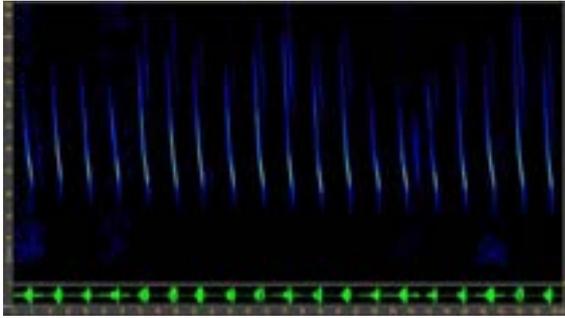
Whiskered Bat - call duration 2.2-2.3 ms



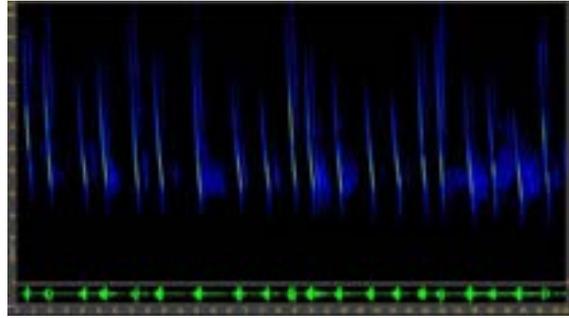
David's Myotis - call duration 2.4-2.5 ms



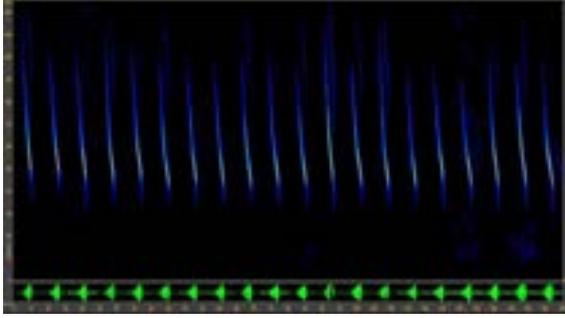
Whiskered Bat - call duration 2.4-2.5 ms



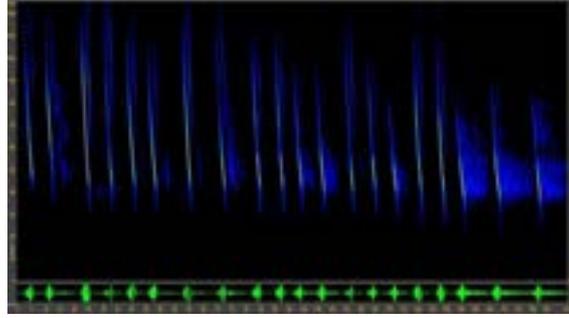
David's Myotis - call duration 2.6-2.7 ms



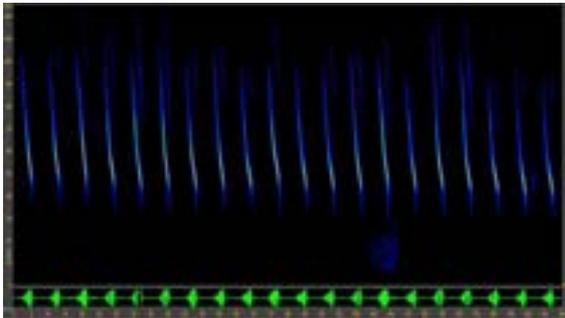
Whiskered Bat - call duration 2.6-2.7 ms



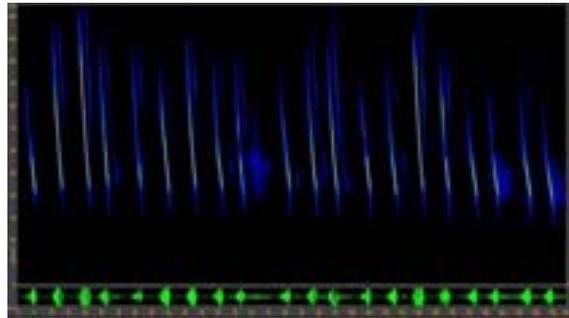
David's Myotis - call duration 2.8-2.9 ms



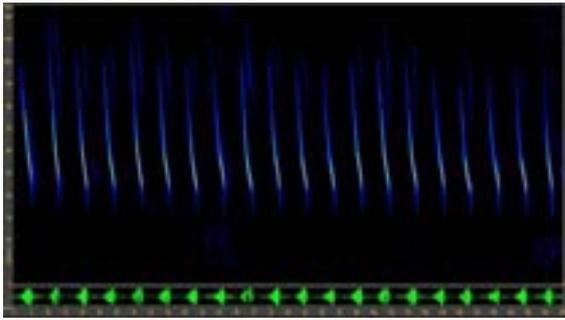
Whiskered Bat - call duration 2.8-2.9 ms



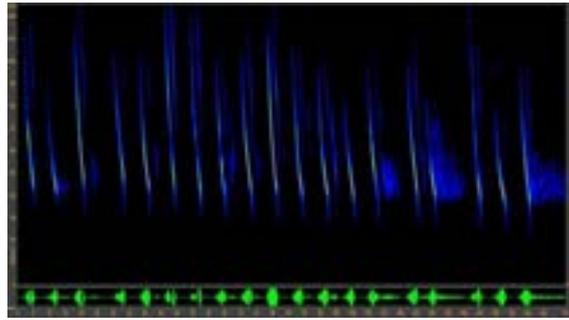
David's Myotis - call duration 3.0-3.1 ms



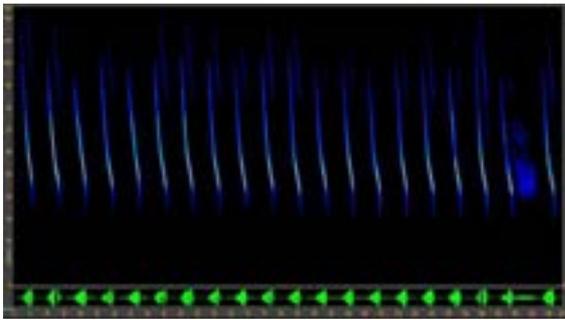
Whiskered Bat - call duration 3.0-3.1 ms



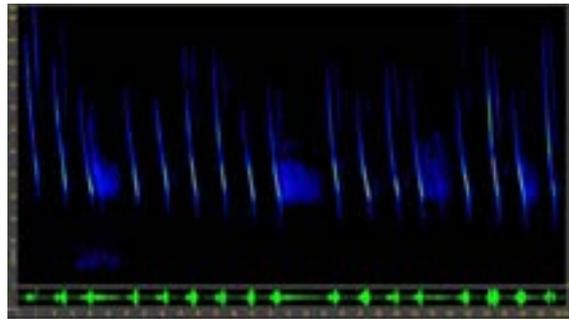
David's Myotis - call duration 3.2-3.3 ms



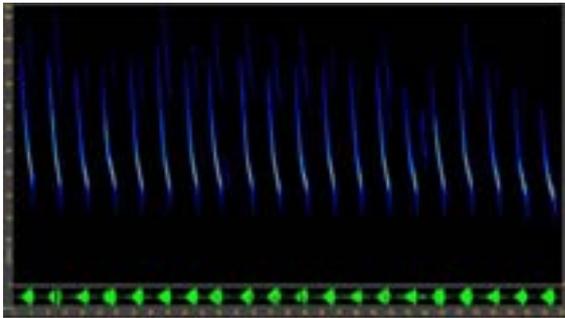
Whiskered Bat - call duration 3.2-3.3 ms



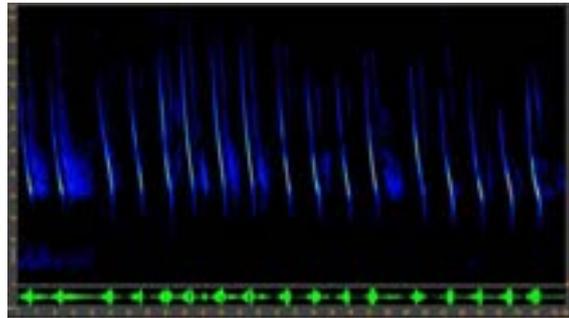
David's Myotis - call duration 3.4-3.5 ms



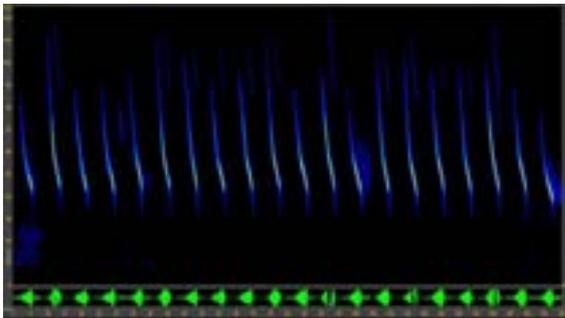
Whiskered Bat - call duration 3.4-3.5 ms



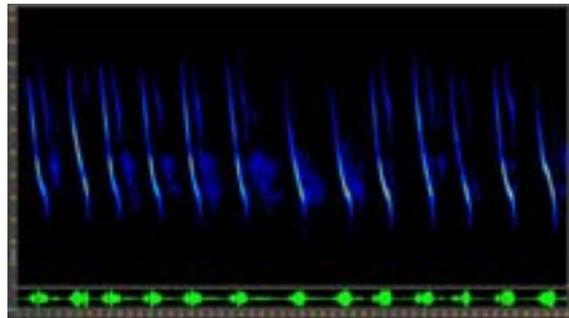
David's Myotis - call duration 3.6-3.7 ms



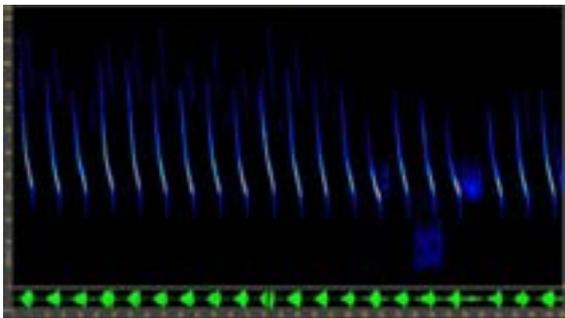
Whiskered Bat - call duration 3.6-3.7 ms



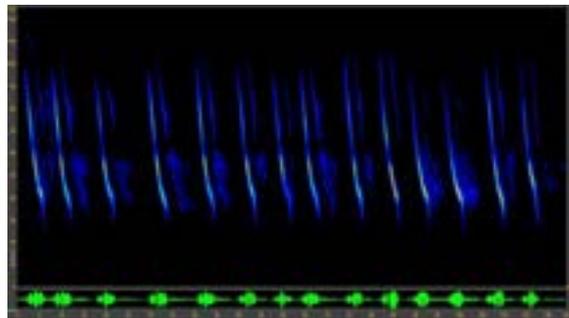
David's Myotis - call duration 3.8-3.9 ms



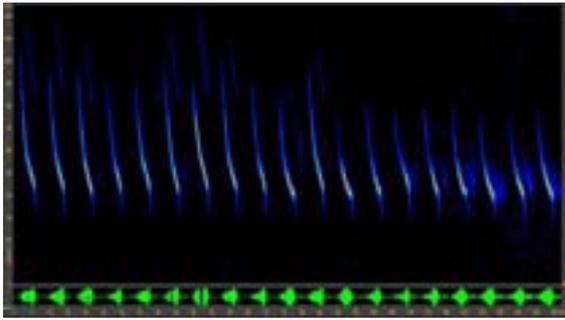
Whiskered Bat - call duration 3.8-3.9 ms



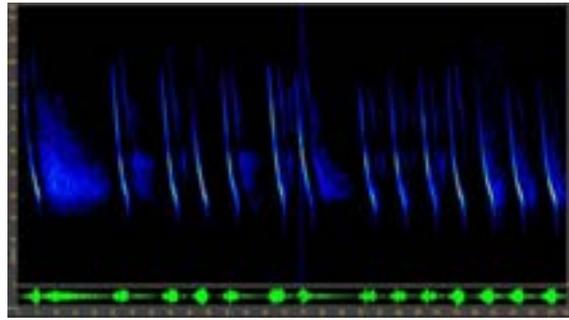
David's Myotis - call duration 4.0-4.1 ms



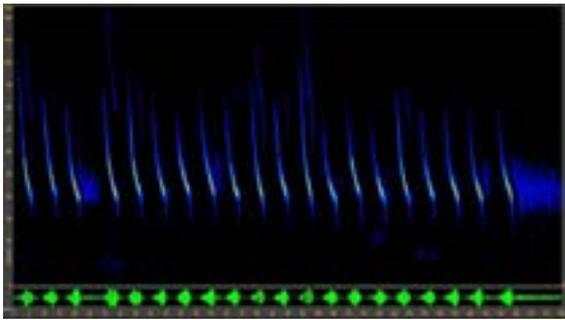
Whiskered Bat - call duration 4.0-4.1 ms



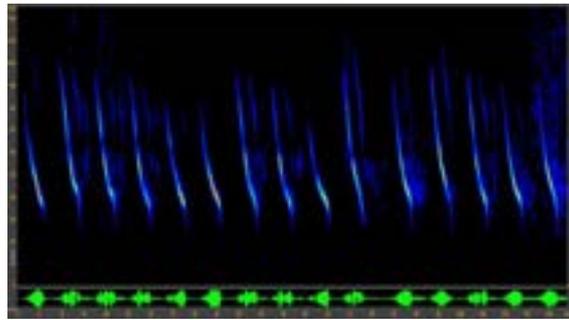
David's Myotis - call duration 4.2-4.3 ms



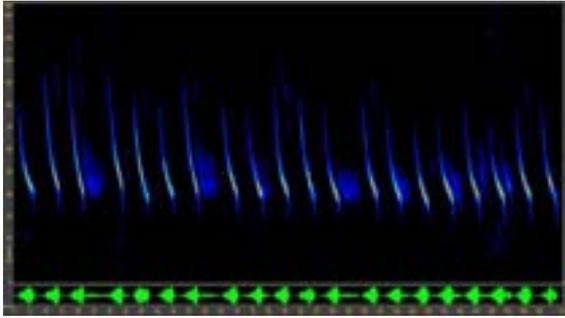
Whiskered Bat - call duration 4.2-4.3 ms



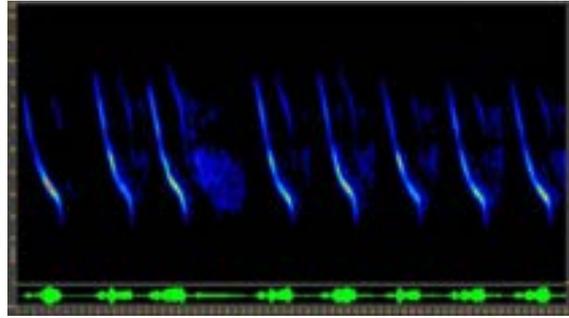
David's Myotis - call duration 4.4-4.5 ms



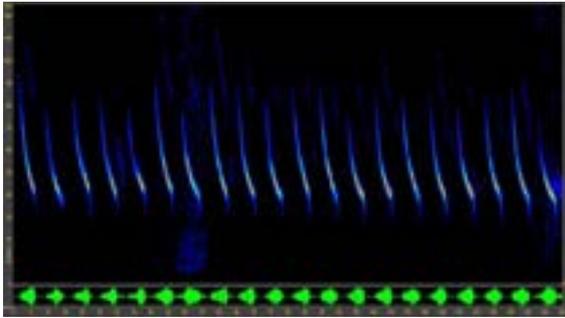
Whiskered Bat - call duration 4.4-4.5 ms



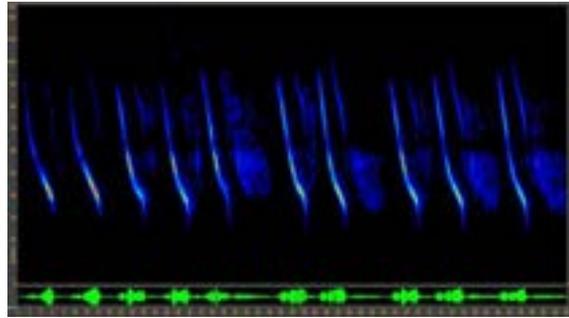
David's Myotis - call duration 4.6-4.7 ms



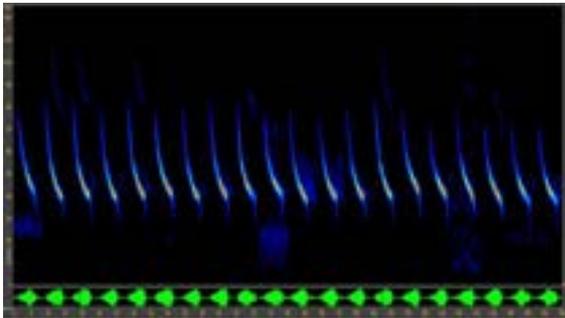
Whiskered Bat - call duration 4.6-4.7 ms



David's Myotis - call duration 4.8-5.1 ms

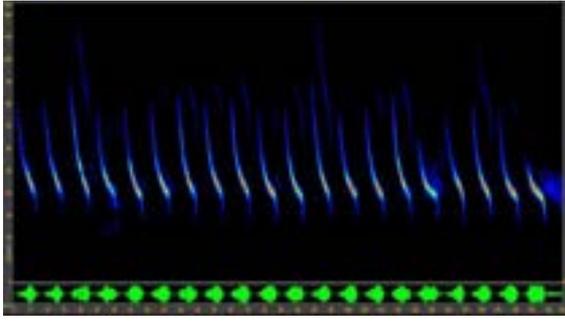


Whiskered Bat - call duration 4.8-5.1 ms



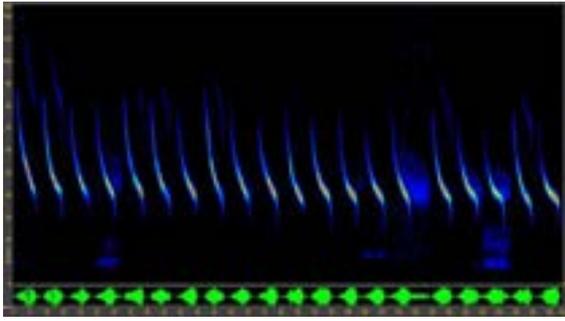
David's Myotis call duration 5.2-5.3 ms

Whiskered Bat - call duration 5.2-5.3 ms no examples



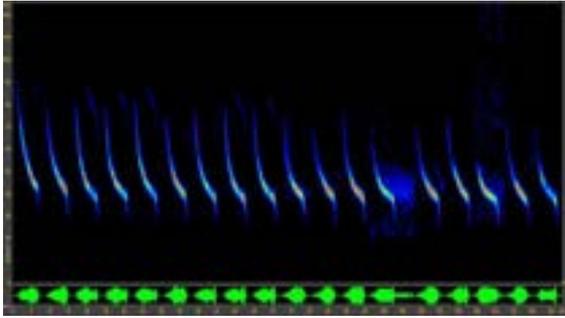
David's Myotis call duration 5.4-5.5 ms

Whiskered Bat - call duration 5.4-5.5 ms no examples



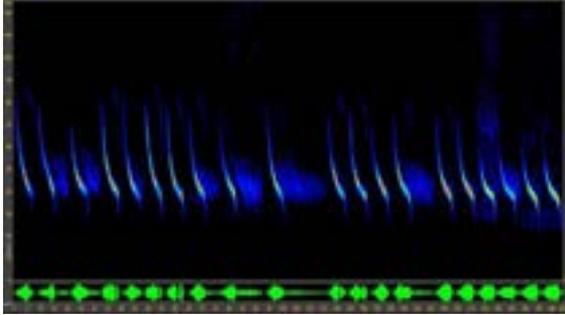
David's Myotis call duration 5.6-5.7 ms

Whiskered Bat - call duration 5.6-5.7 ms no examples



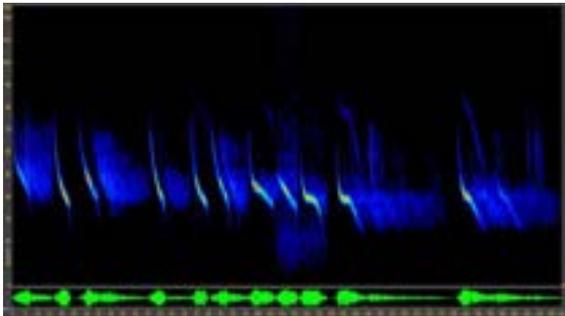
David's Myotis call duration 5.8-5.9 ms

Whiskered Bat - call duration 5.8-5.9 ms no examples



David's Myotis call duration 6.0-6.5 ms - Copy

Whiskered bat call duration 6.0-6.5 ms no examples



David's Myotis call duration 6.6-10.8 ms

Whiskered Bat call duration 6.6-10.8 ms no examples

6. Greater Mouse-eared Bat *Myotis myotis* and Lesser Mouse-eared Bat *Myotis blythii*

According to Russ (2021), it is generally considered that it is not possible to separate Greater Mouse-eared Bat *Myotis myotis* and Lesser Mouse-eared Bat *Myotis blythii* through their echolocation calls alone. In the below we provide a visual comparison between comparable echolocation calls of the same call duration of *M. myotis* and *M. blythii* alongside each other. In doing this, we would like the reader to look for general visual patterns of differences between the echolocation calls of these species for a given call duration (e.g. differences in frequency and shape), rather than taking a more typical approach to bat sound identification of taking individual call measurements, and seeing whether these are within the published range.

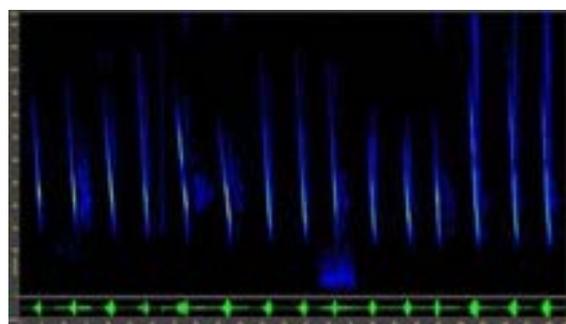
We do this by mining known recordings of *M. myotis* and *M. blythii* to look for examples of individual echolocation calls that cover the range of call durations that are observed across recordings, and then putting calls of similar duration together into 'compiled' recordings for a given range of call durations. For example, a compiled recording, may just contain examples of calls of between 3.5 and 3.6 ms. The spectrograms here were produced and shown in the software SonoBat (<https://www.sonobat.co.uk/>) (note: recording length not standardised).

The calls of both species for a given call duration are very variable in frequency and shape, and with some overlap between *M. myotis* and *M. blythii* where the calls are visually similar, distinguishing these species is not straightforward. However, there are some visual differences in the echolocation calls of these species that we would like to focus on, in an exploratory way.

There is tendency that for a given call duration, the echolocation calls of *M. myotis* are lower in frequency than *M. blythii*. This difference is greatest for long duration calls (> 7.7 ms) / when the bat is flying in the open, and in this situation, there is little overlap between the two species. With respect to species identification, this means that distinguishing these species should be easiest given longer duration calls.

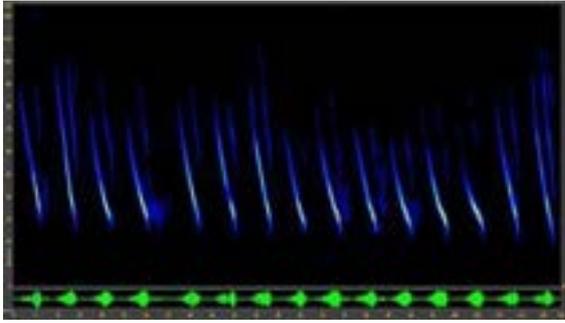
There is perhaps also a tendency for a given call duration, for the calls of *M. blythii* to be more broadband than those of *M. myotis* but using this is complicated by the level of variation in the calls of both species.

Targeted work on *M. blythii* and *M. myotis* was carried out in the Piedmont region Italy by Stuart Newson (BTO) in collaboration with Fabrizio Gili (University of Turin), and Elena Patriarca and Paolo Debernardi. For more information on this see <https://www.bto.org/community/blog/bto-goes-batty-how-our-acoustic-pipeline-project-contributing-bat-conservation-some>. This work was supported by the Endangered Landscapes Programme and managed by the Cambridge Conservation Initiative in partnership with Arcadia, a charitable fund of Lisbet Rausing and Peter Baldwin. We are also extremely grateful for Marc Van De Sijpe and Nils Bouillard, who provided additional material for *M. myotis*, and support.

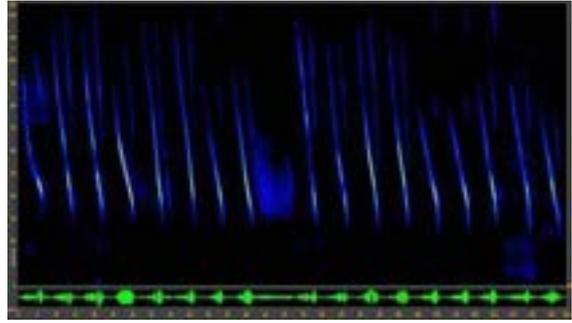


Greater Mouse-eared Bat - no examples

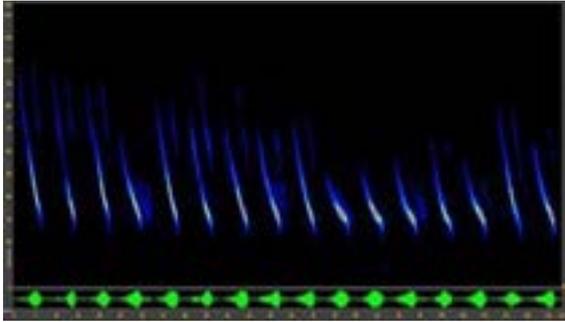
Lesser Mouse-eared Bat - call duration 1.2-2.4 ms



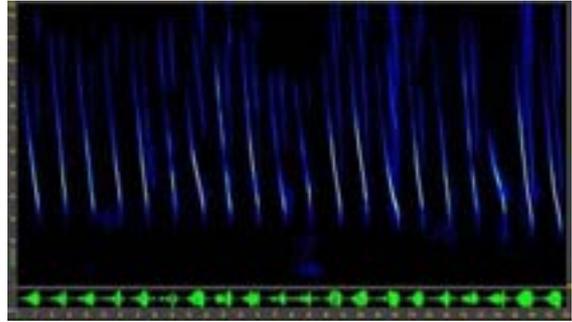
Greater Mouse-eared Bat - call duration 4.7-4.8 ms



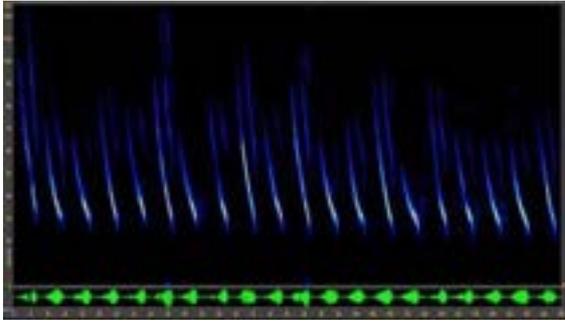
Lesser Mouse-eared Bat - call duration 4.7-4.8 ms



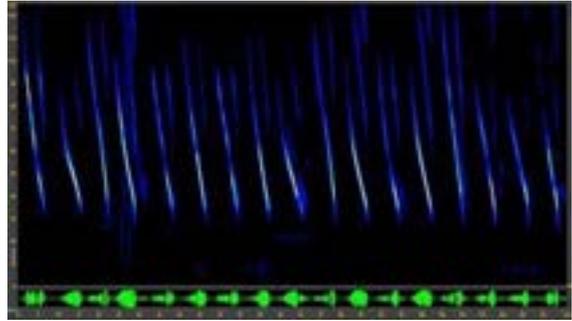
Greater Mouse-eared Bat - call duration 4.9-5.0 ms



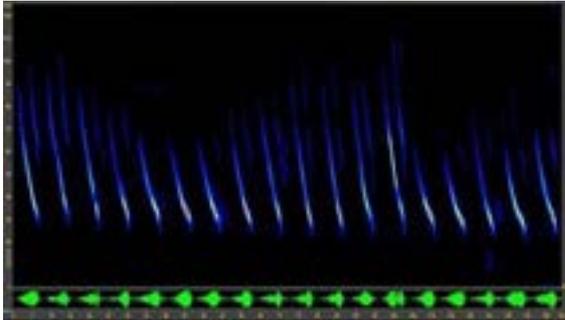
Lesser Mouse-eared Bat - call duration 4.9-5.0 ms



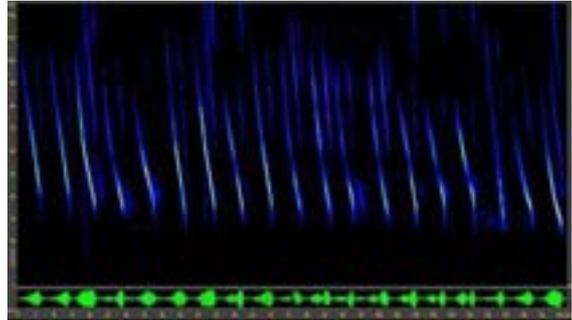
Greater Mouse-eared Bat - call duration 5.1-5.2 ms



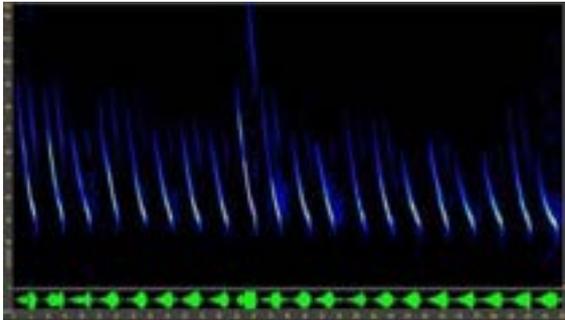
Lesser Mouse-eared Bat - call duration 5.1-5.2 ms



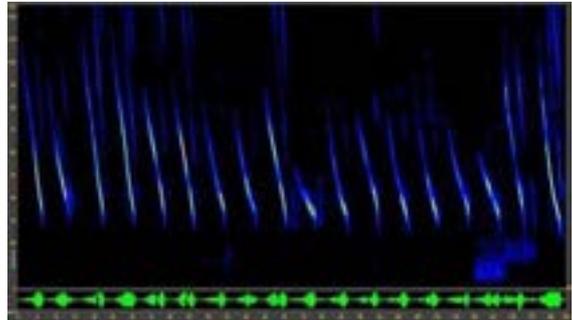
Greater Mouse-eared Bat - call duration 5.3-5.4 ms



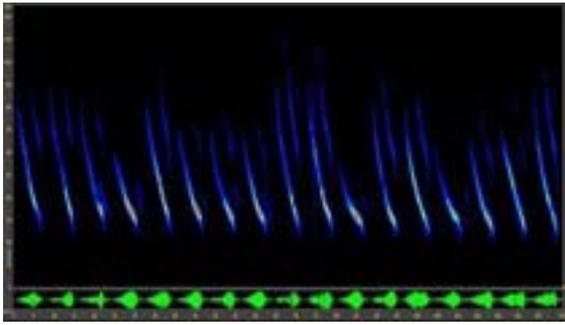
Lesser Mouse-eared Bat - call duration 5.3-5.4 ms



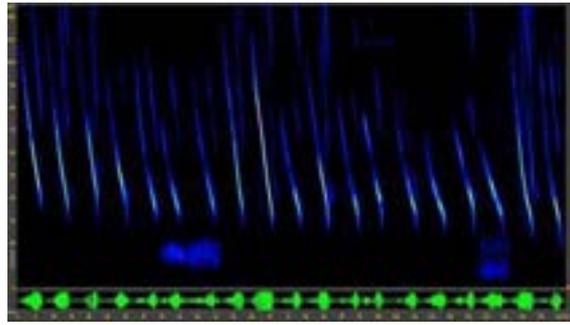
Greater Mouse-eared Bat - call duration 5.5-5.6 ms



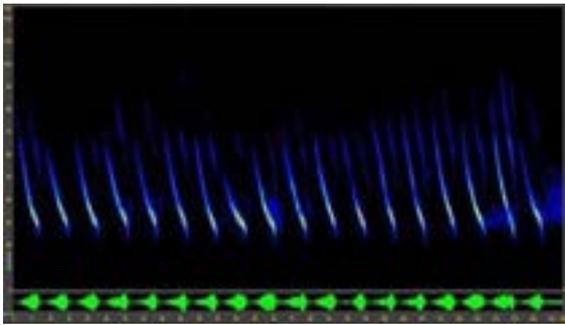
Lesser Mouse-eared Bat - call duration 5.5-5.6 ms



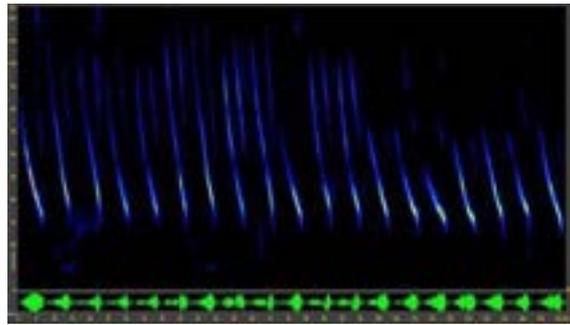
Greater Mouse-eared Bat - call duration 5.7-5.8 ms



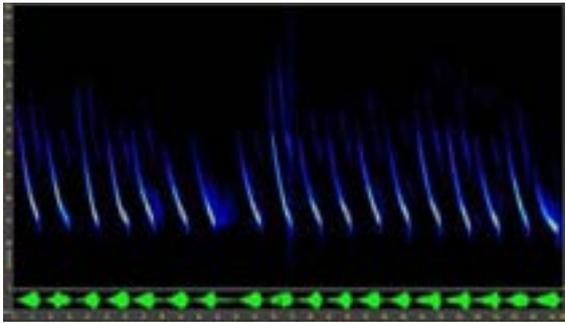
Lesser Mouse-eared Bat - call duration 5.7-5.8 ms



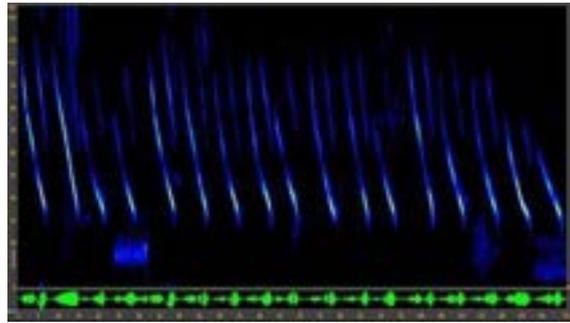
Greater Mouse-eared Bat - call duration 5.9-6.0 ms



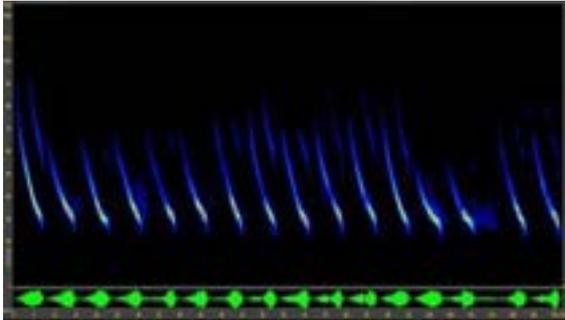
Lesser Mouse-eared Bat - call duration 5.9-6.0 ms



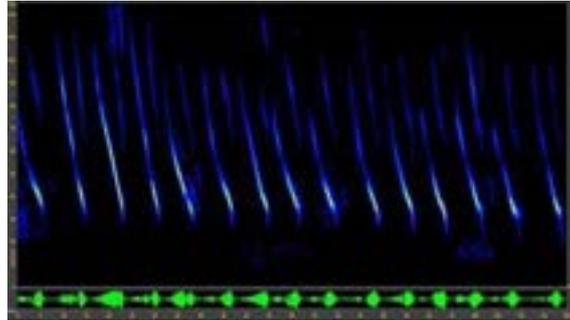
Greater Mouse-eared Bat - call duration 6.1-6.2 ms



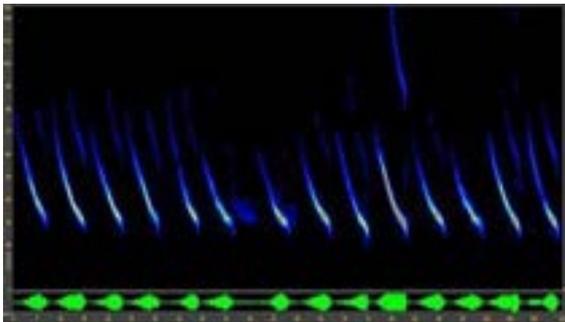
Lesser Mouse-eared Bat - call duration 6.1-6.2 ms



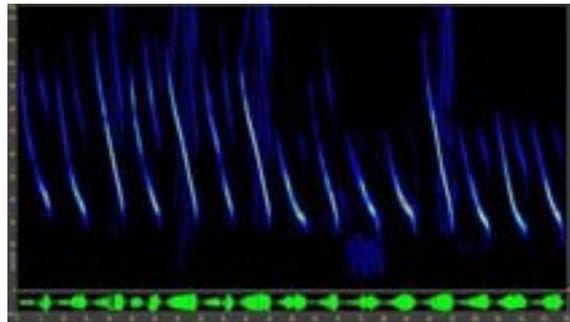
Greater Mouse-eared Bat - call duration 6.3-6.4 ms



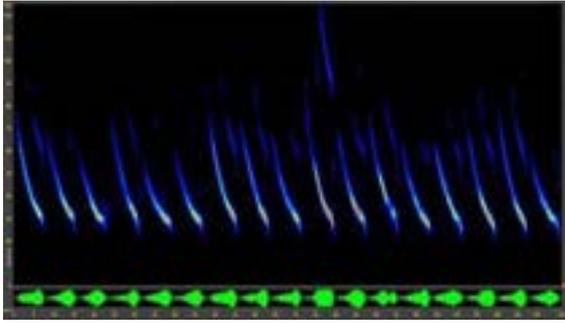
Lesser Mouse-eared Bat - call duration 6.3-6.4 ms



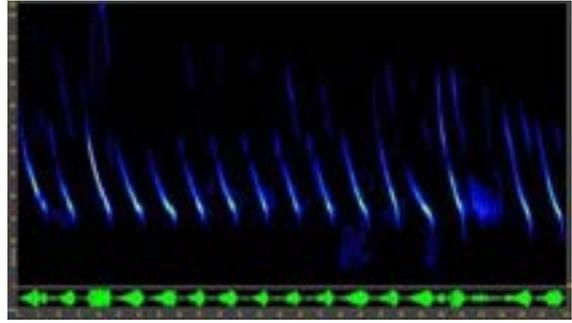
Greater Mouse-eared Bat - call duration 6.5-6.6 ms



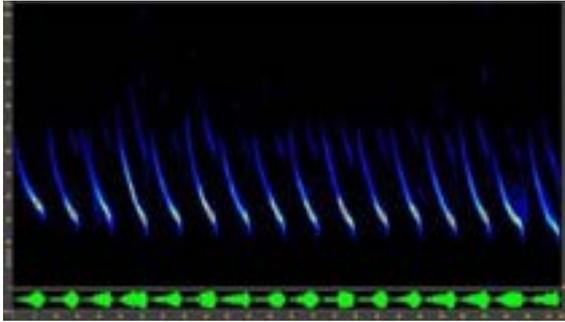
Lesser Mouse-eared Bat - call duration 6.5-6.6 ms



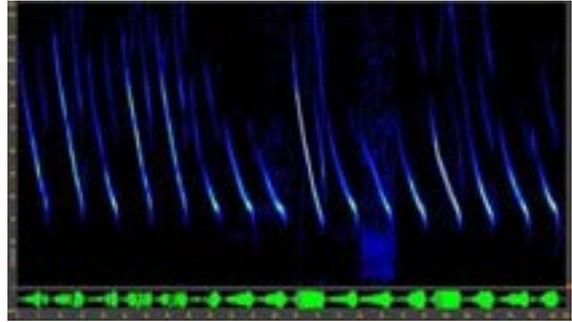
Greater Mouse-eared Bat - call duration 6.7-6.8 ms



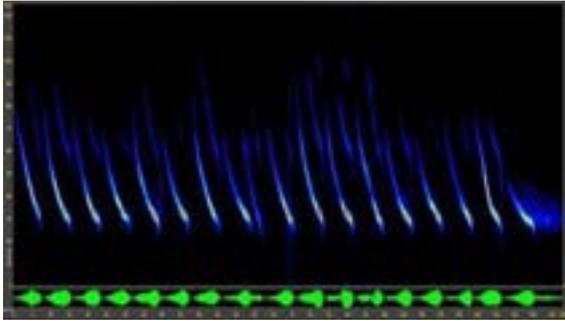
Lesser Mouse-eared Bat - call duration 6.7-6.8 ms



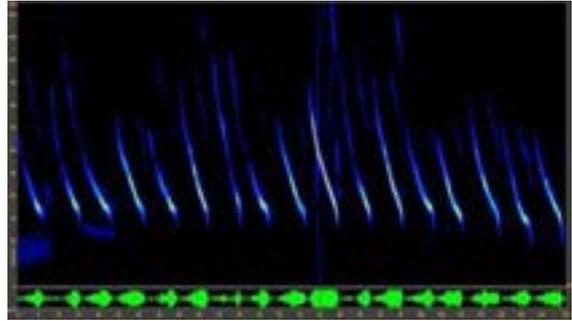
Greater Mouse-eared Bat - call duration 6.9-7.0 ms



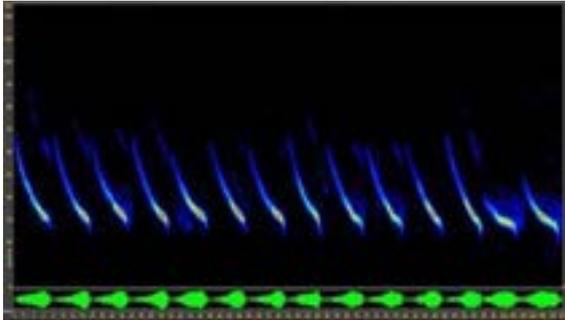
Lesser Mouse-eared Bat - call duration 6.9-7.0 ms



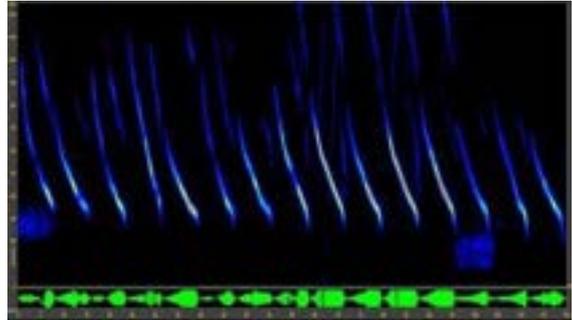
Greater Mouse-eared Bat - call duration 7.1-7.2 ms



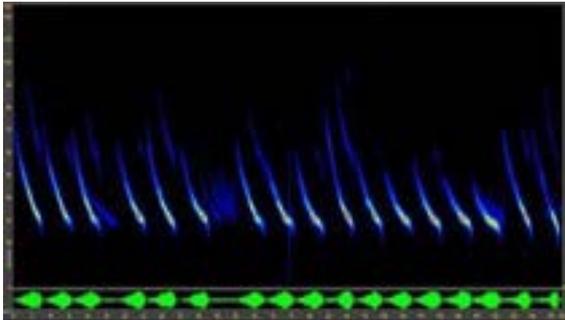
Lesser Mouse-eared Bat - call duration 7.1-7.2 ms



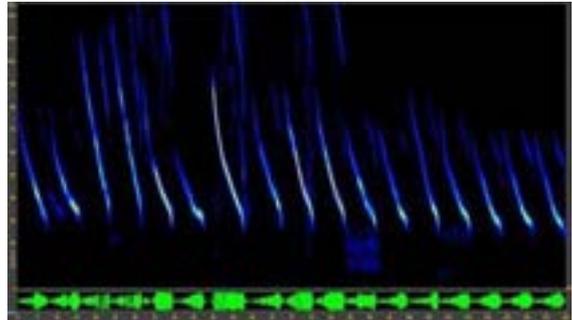
Greater Mouse-eared Bat - call duration 7.3-7.4 ms



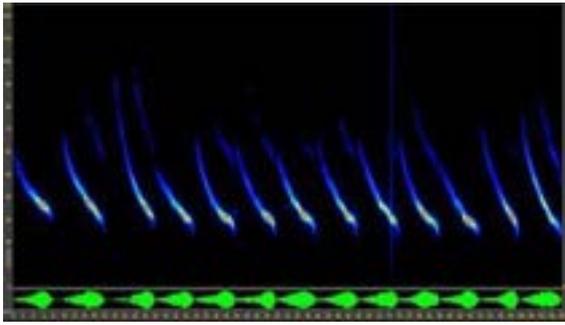
Lesser Mouse-eared Bat - call duration 7.3-7.4 ms



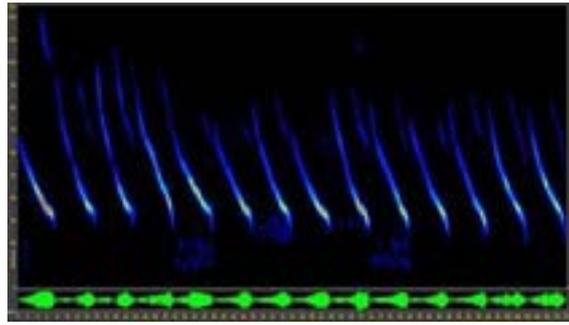
Greater Mouse-eared Bat - call duration 7.5-7.6 ms



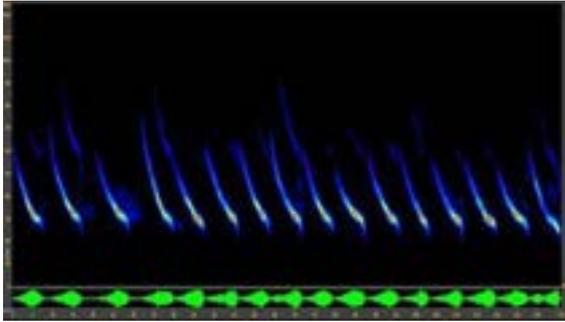
Lesser Mouse-eared Bat - call duration 7.5-7.6 ms



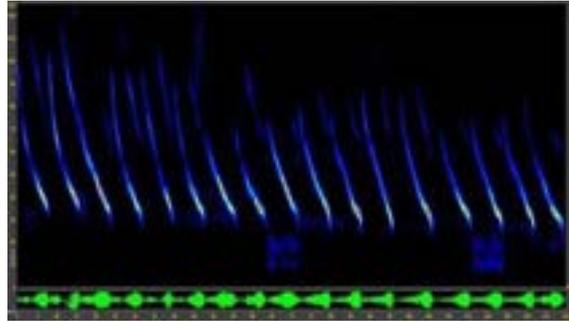
Greater Mouse-eared Bat - call duration 7.7-7.8 ms



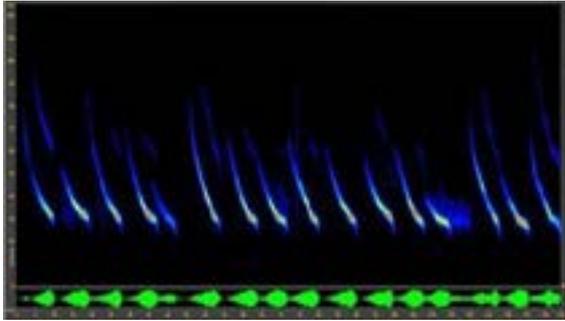
Lesser Mouse-eared Bat - call duration 7.7-7.8 ms



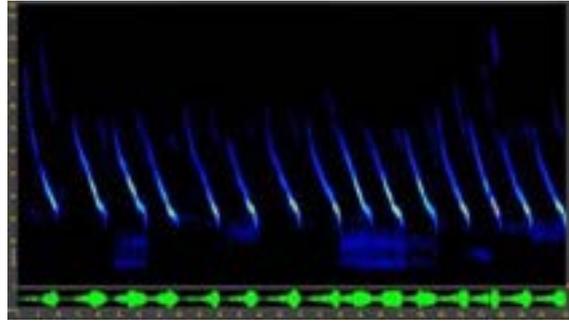
Greater Mouse-eared Bat - call duration 7.9-8.0 ms



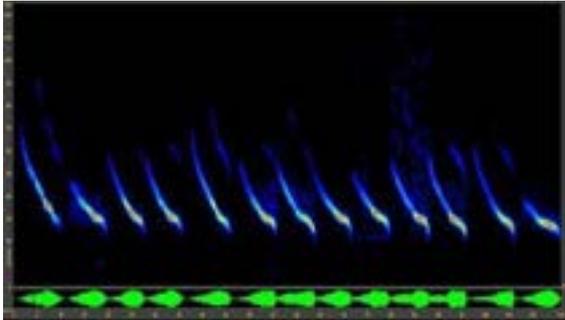
Lesser Mouse-eared Bat - call duration 7.9-8.0 ms



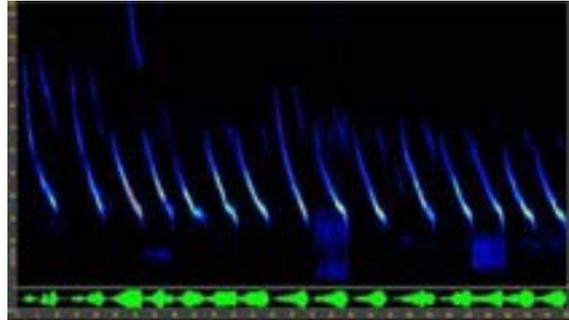
Greater Mouse-eared Bat - call duration 8.1-8.2 ms



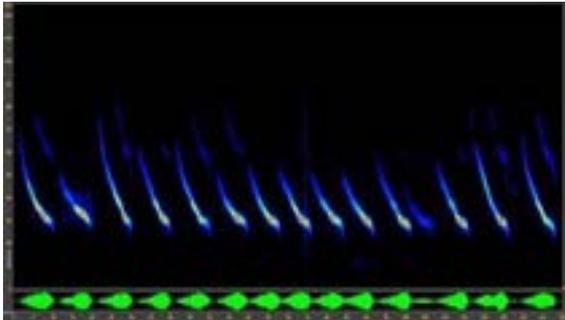
Lesser Mouse-eared Bat - call duration 8.1-8.2 ms



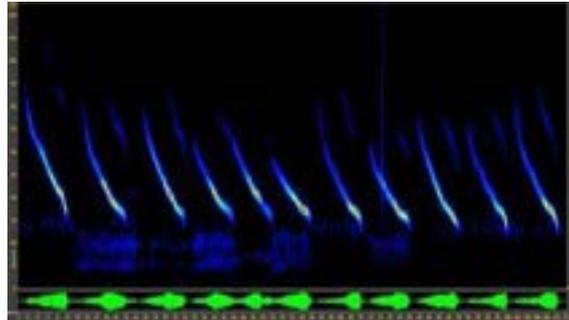
Greater Mouse-eared Bat - call duration 8.3-8.4 ms



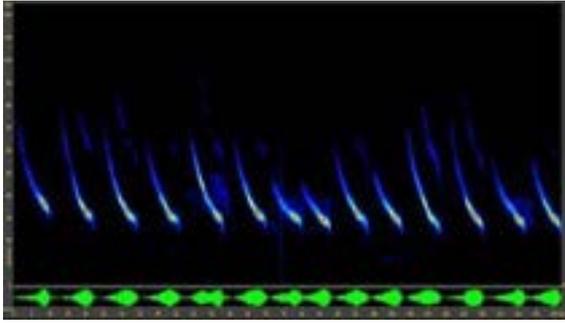
Lesser Mouse-eared Bat - call duration 8.3-8.4 ms



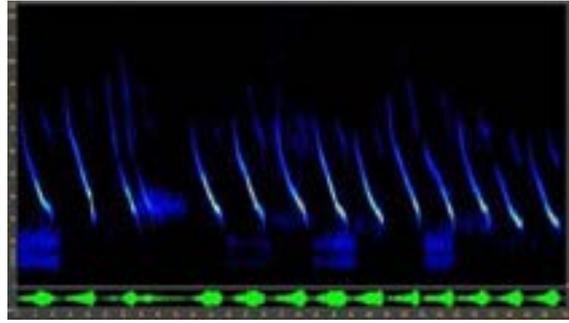
Greater Mouse-eared Bat - call duration 8.5-8.6 ms



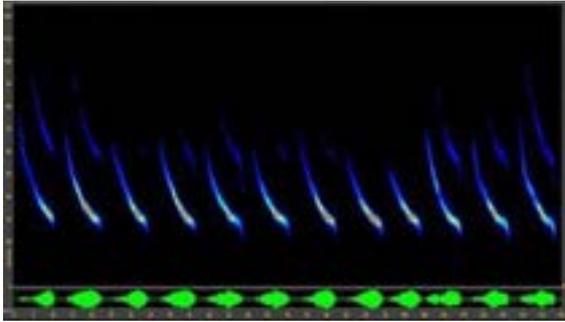
Lesser Mouse-eared Bat - call duration 8.5-8.6 ms



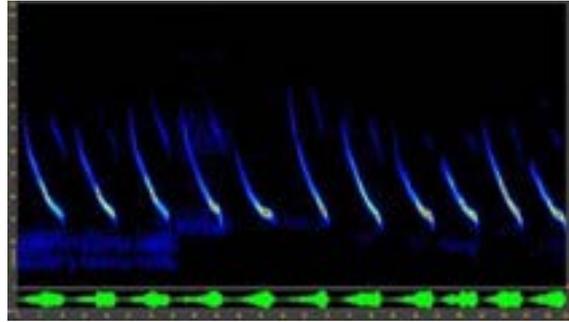
Greater Mouse-eared Bat - call duration 8.7-8.8 ms



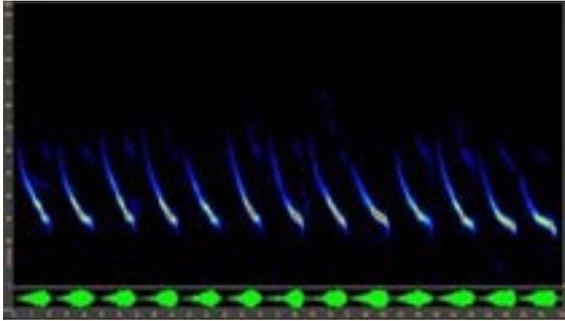
Lesser Mouse-eared Bat - call duration 8.7-8.8 ms



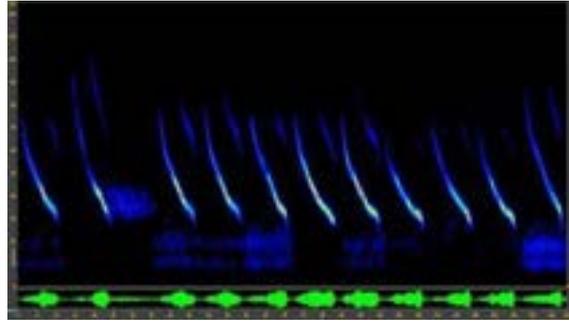
Greater Mouse-eared Bat - call duration 8.9-9.0 ms



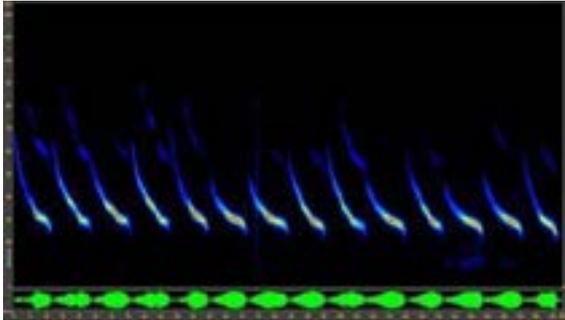
Lesser Mouse-eared Bat - call duration 8.9-9.0 ms



Greater Mouse-eared Bat - call duration 9.1-10.8 ms



Lesser Mouse-eared Bat - call duration 9.1-10.8 ms

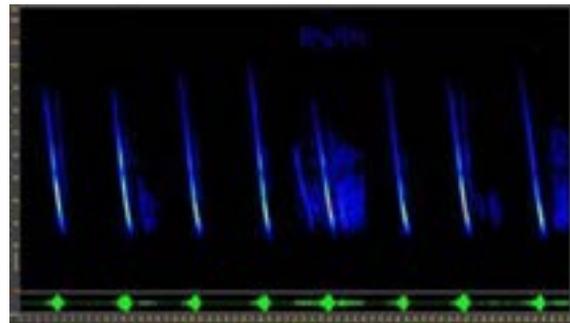


Greater Mouse-eared Bat - call duration 10.9-12.4 ms

Lesser Mouse-eared Bat - no examples

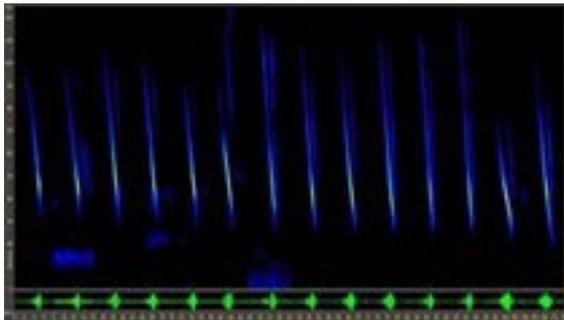
7. Greater Mouse-eared Bat *Myotis myotis* and Maghreb Mouse-eared Bat *Myotis punicus*

We are extremely grateful to Mauro Mucedda who provided material for *M. punicus* from Sardinia, which is used here. Targeted work on *M. myotis* was carried out in the Piedmont region Italy by Stuart Newson (BTO) in collaboration with Fabrizio Gili (University of Turin), and Elena Patriarca and Paolo Debernardi. For more information on this see <https://www.bto.org/community/blog/bto-goes-batty-how-our-acoustic-pipeline-project-contributing-bat-conservation-some>. This work was supported by the Endangered Landscapes Programme and managed by the Cambridge Conservation Initiative in partnership with Arcadia, a charitable fund of Lisbet Rausing and Peter Baldwin. We are also extremely grateful for Marc Van De Sijpe and Nils Bouillard, who provided additional material for *M. myotis*, and support.

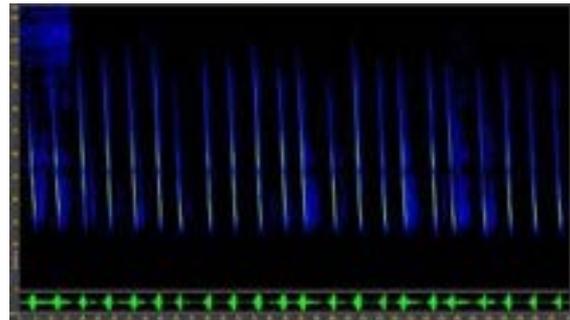


Maghreb Mouse-eared Bat - call duration 1.2-2.4 ms

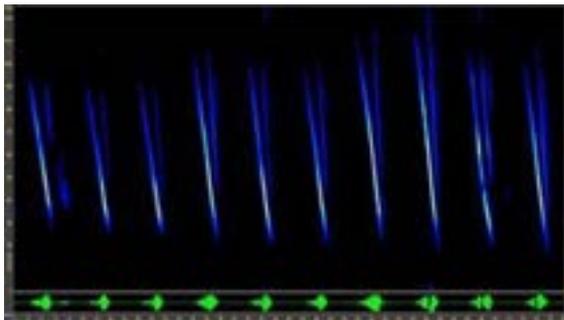
Greater Mouse-eared Bat - no examples



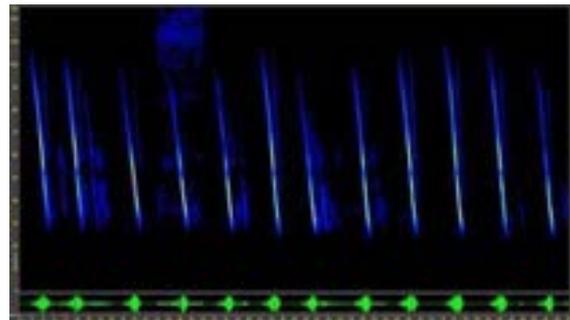
Greater Mouse-eared Bat - call duration 2.5-2.8 ms



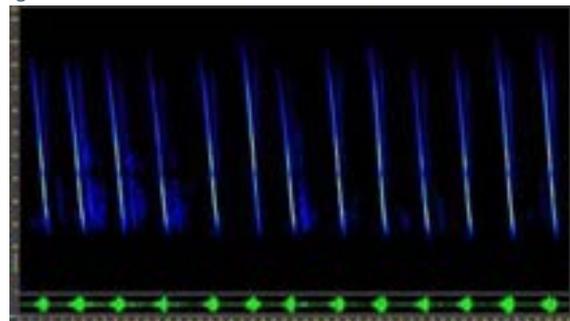
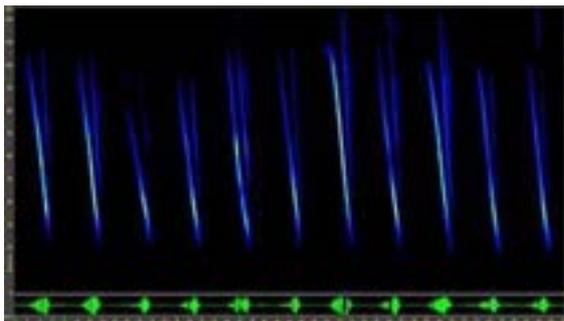
Maghreb Mouse-eared Bat - call duration 2.5-2.8 ms



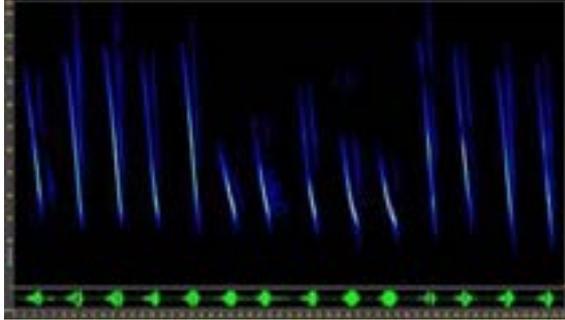
Greater Mouse-eared Bat - call duration 2.9-3.0 ms



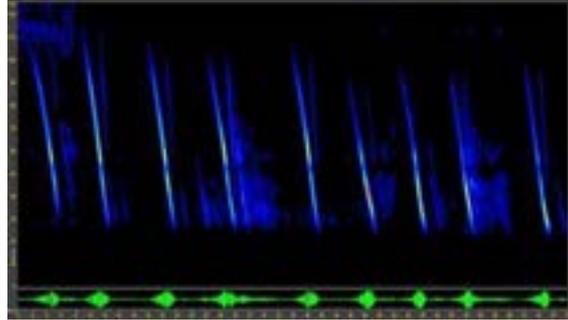
Maghreb Mouse-eared Bat - call duration 2.9-3.0 ms



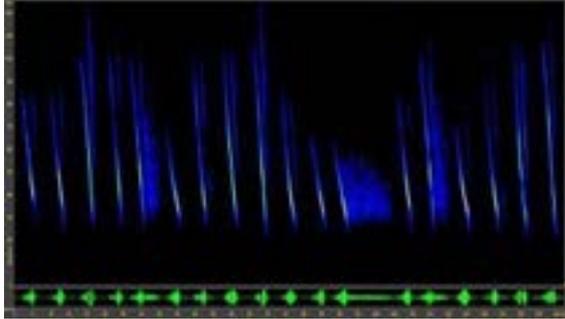
Greater Mouse-eared Bat - call duration 3.1-3.2 ms



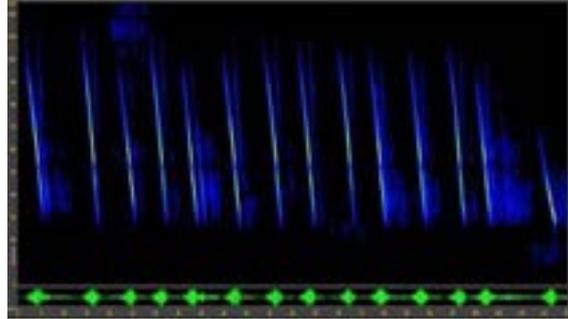
Maghreb Mouse-eared Bat - call duration 3.1-3.2 ms



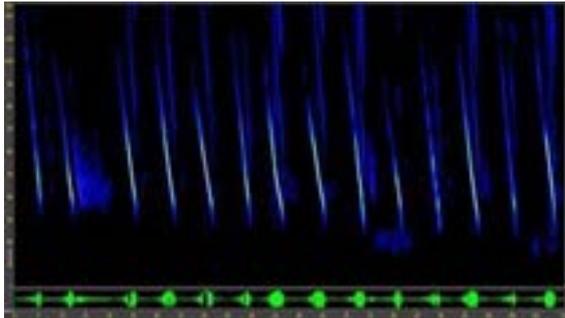
Greater Mouse-eared Bat - call duration 3.3-3.4 ms



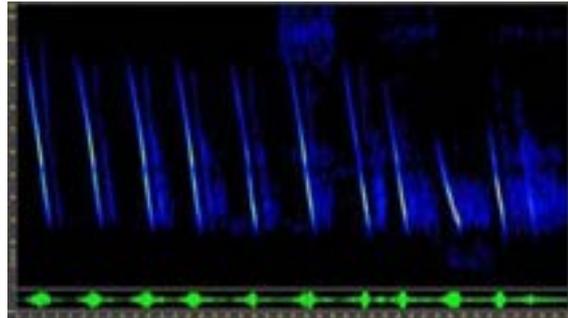
Maghreb Mouse-eared Bat - call duration 3.3-3.4 ms



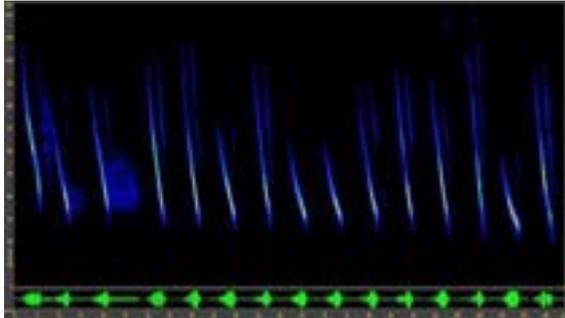
Greater Mouse-eared Bat - call duration 3.5-3.6 ms



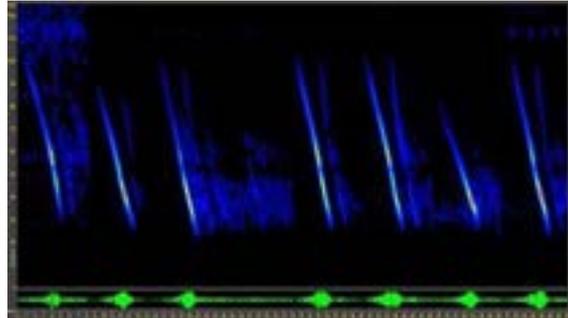
Maghreb Mouse-eared Bat - call duration 3.5-3.6 ms



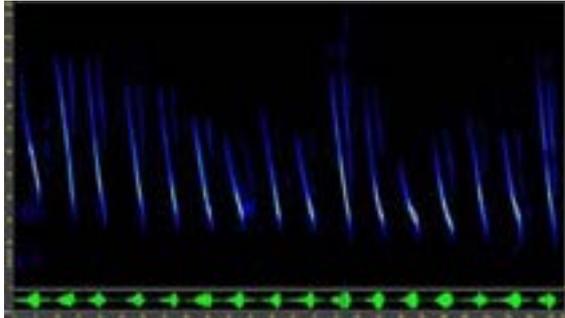
Greater Mouse-eared Bat - call duration 3.7-3.8 ms



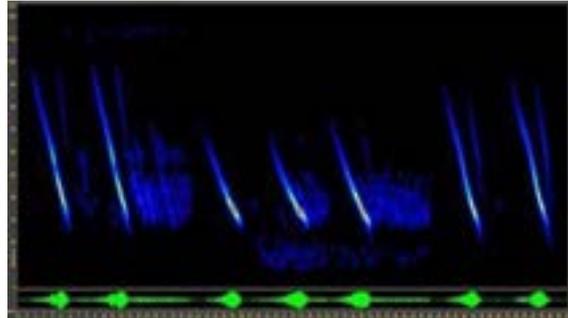
Maghreb Mouse-eared Bat - call duration 3.7-3.8 ms



Greater Mouse-eared Bat - call duration 3.9-4.0 ms



Maghreb Mouse-eared Bat - call duration 3.9-4.0 ms

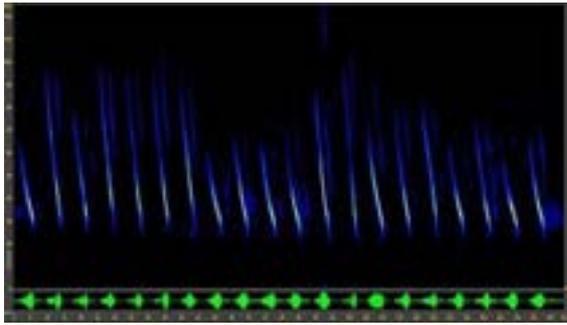


Greater Mouse-eared Bat - call duration 4.1-4.2 ms

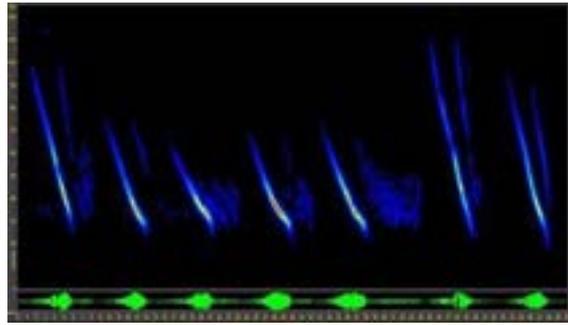


Maghreb Mouse-eared Bat - call duration 4.1-4.2 ms

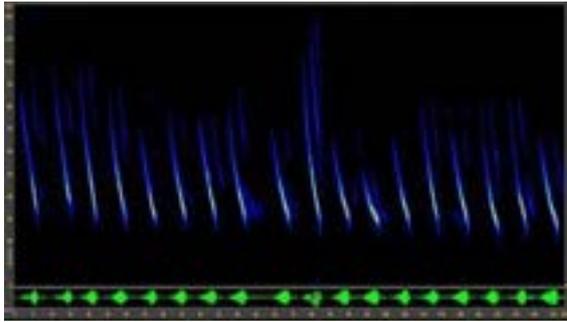




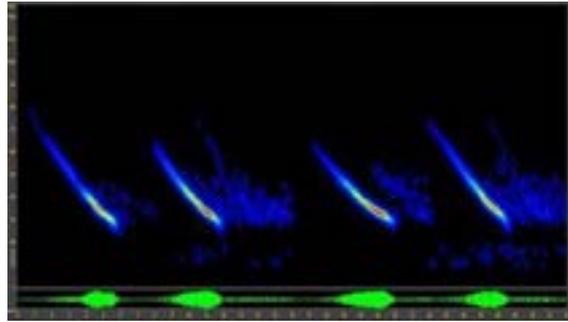
Greater Mouse-eared Bat - call duration 4.3-4.4 ms



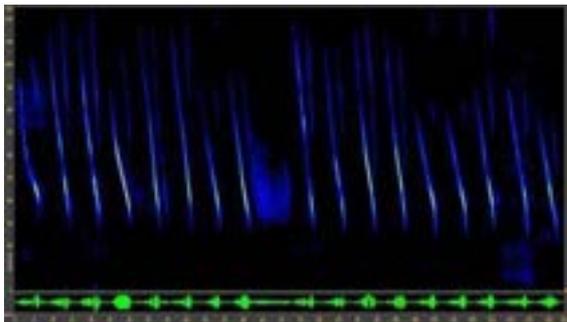
Maghreb Mouse-eared Bat - call duration 4.3-4.4 ms



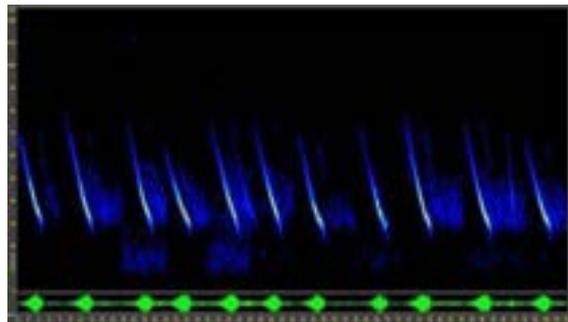
Greater Mouse-eared Bat - call duration 4.5-4.6 ms



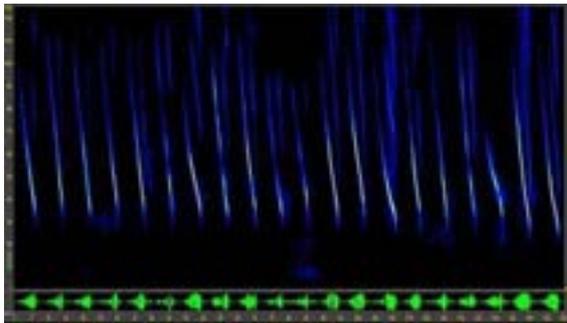
Maghreb Mouse-eared Bat - call duration 4.5-4.6 ms



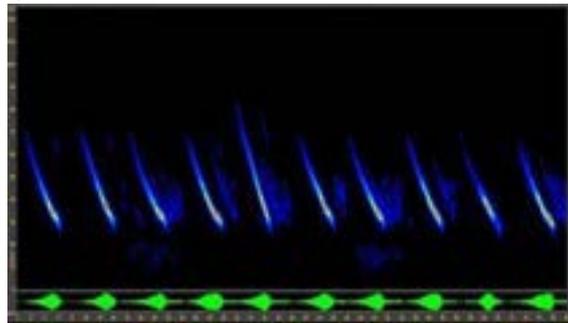
Greater Mouse-eared Bat - call duration 4.7-4.8 ms



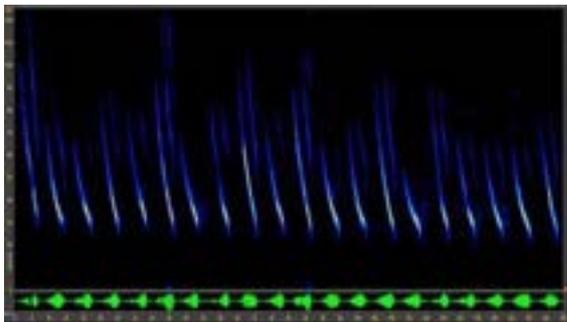
Maghreb Mouse-eared Bat - call duration 4.7-4.8 ms



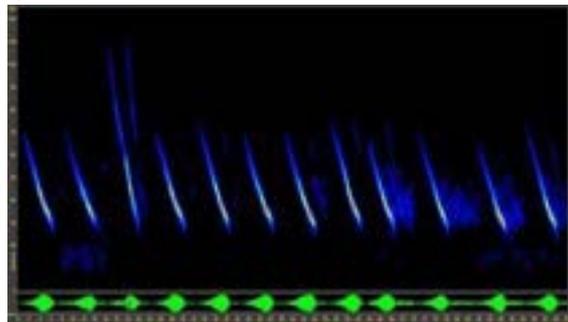
Greater Mouse-eared Bat - call duration 4.9-5.0 ms



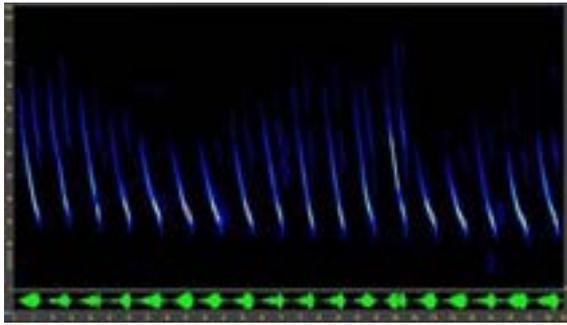
Maghreb Mouse-eared Bat - call duration 4.9-5.0 ms



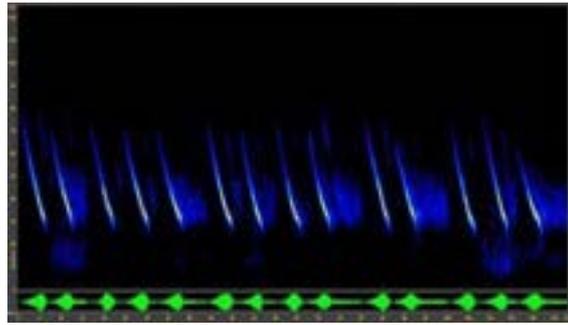
Greater Mouse-eared Bat - call duration 5.1-5.2 ms



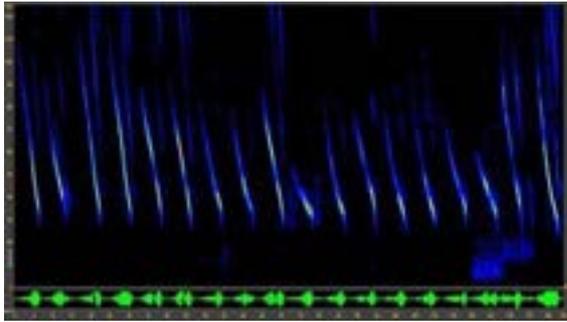
Maghreb Mouse-eared Bat - call duration 5.1-5.2 ms



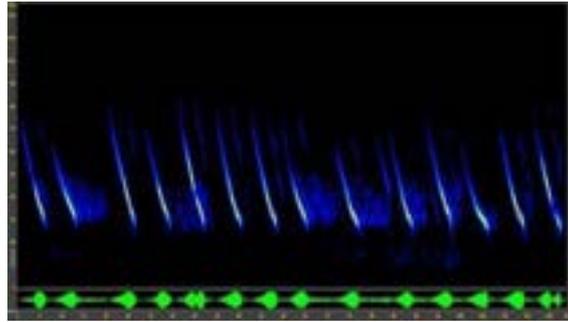
Greater Mouse-eared Bat - call duration 5.3-5.4 ms



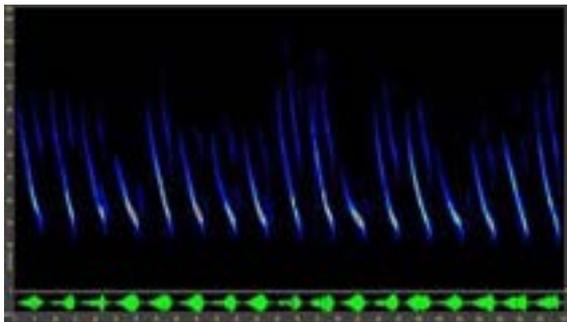
Maghreb Mouse-eared Bat - call duration 5.3-5.4 ms



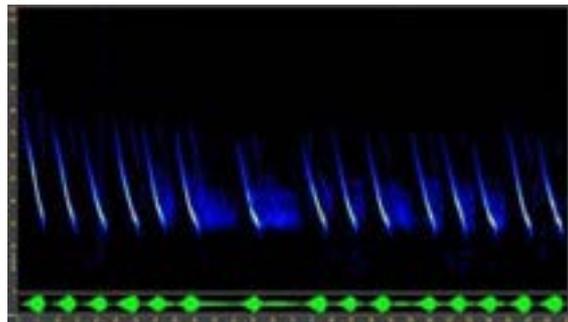
Greater Mouse-eared Bat - call duration 5.5-5.6 ms



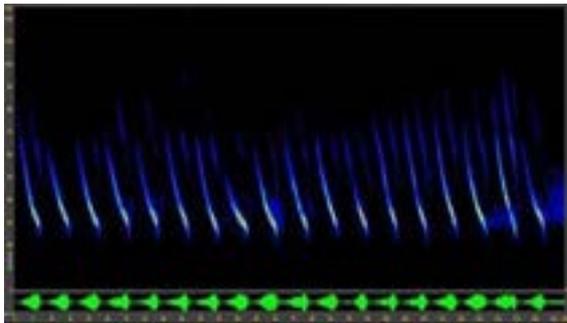
Maghreb Mouse-eared Bat - call duration 5.5-5.6 ms



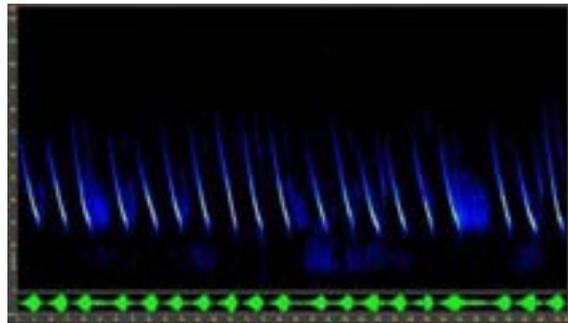
Greater Mouse-eared Bat - call duration 5.7-5.8 ms



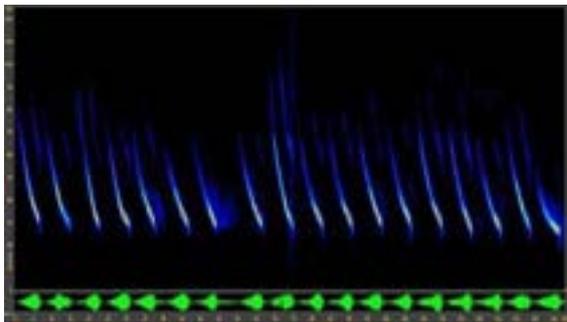
Maghreb Mouse-eared Bat - call duration 5.7-5.8 ms



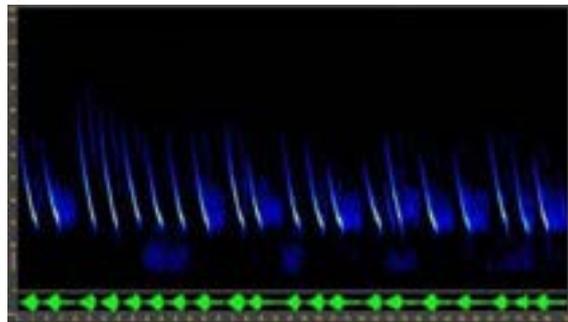
Greater Mouse-eared Bat - call duration 5.9-6.0 ms



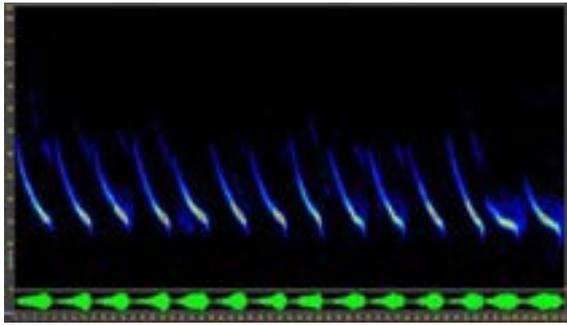
Maghreb Mouse-eared Bat - call duration 5.9-6.0 ms



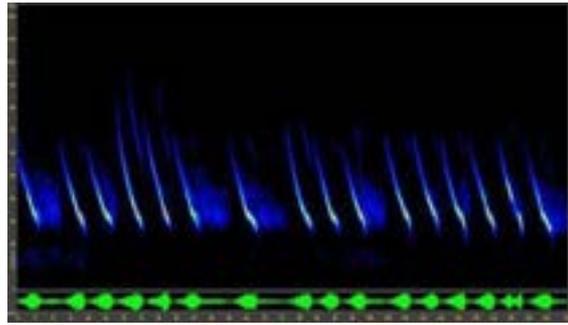
Greater Mouse-eared Bat - call duration 6.1-6.2 ms



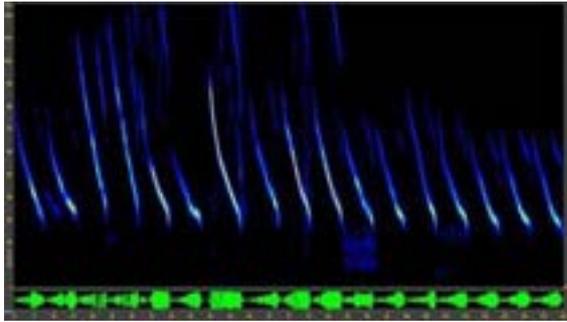
Maghreb Mouse-eared Bat - call duration 6.1-6.2 ms



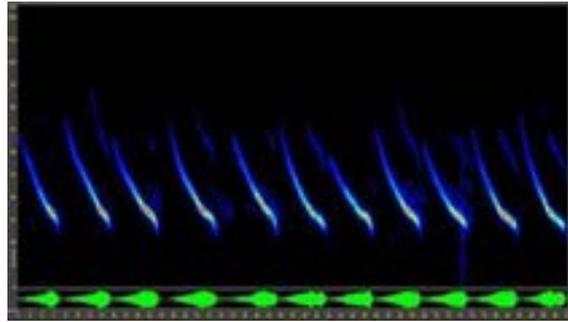
Greater Mouse-eared Bat - call duration 7.3-7.4 ms



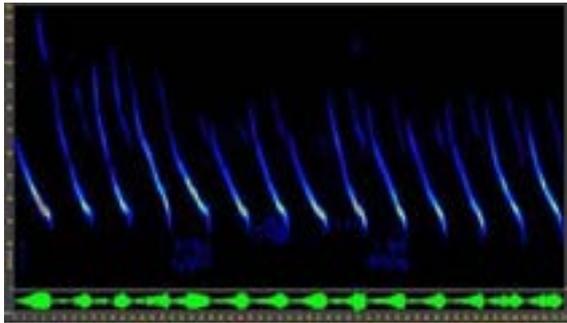
Maghreb Mouse-eared Bat - call duration 7.3-7.4 ms



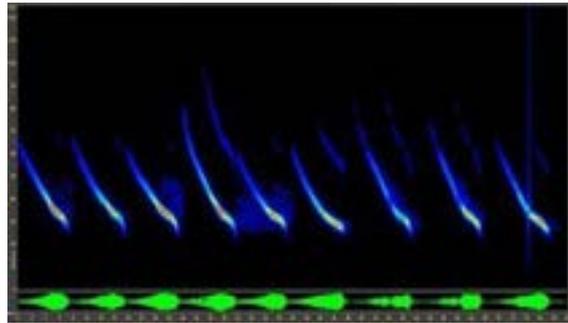
Greater Mouse-eared Bat - call duration 7.5-7.6 ms



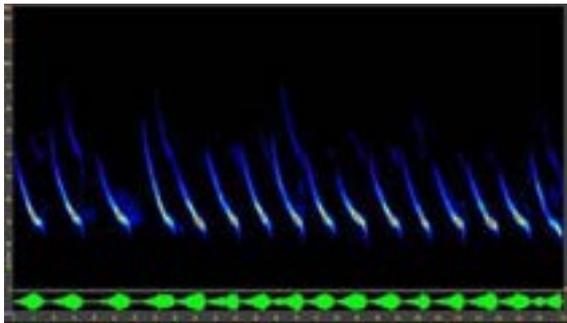
Maghreb Mouse-eared Bat - call duration 7.5-7.6 ms



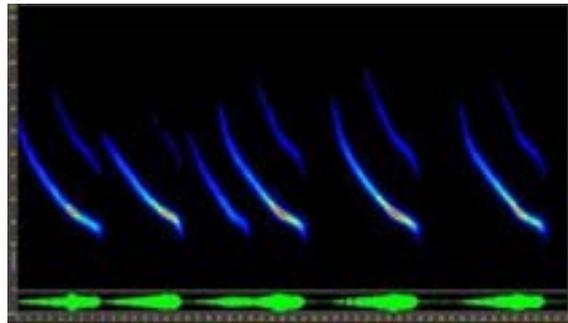
Greater Mouse-eared Bat - call duration 7.7-7.8 ms



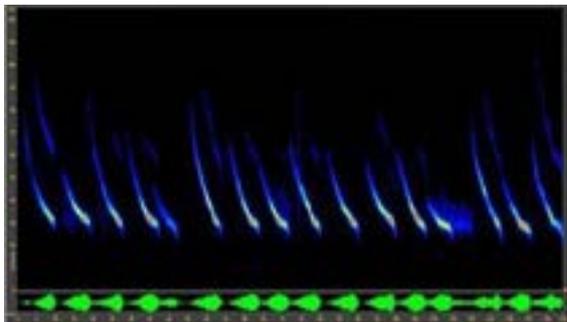
Maghreb Mouse-eared Bat - call duration 7.7-7.8 ms



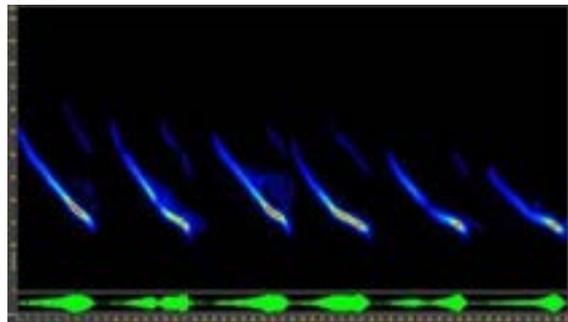
Greater Mouse-eared Bat - call duration 7.9-8.0 ms



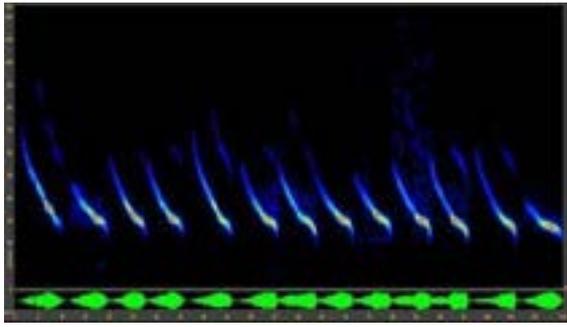
Maghreb Mouse-eared Bat - call duration 7.9-8.0 ms



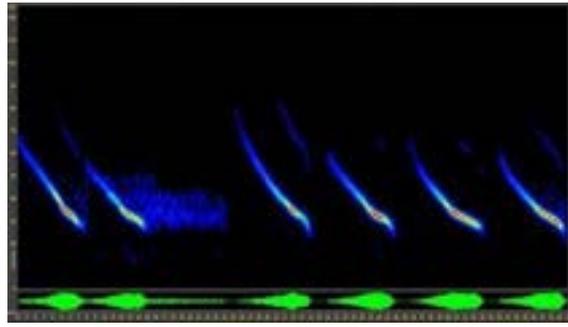
Greater Mouse-eared Bat - call duration 8.1-8.2 ms



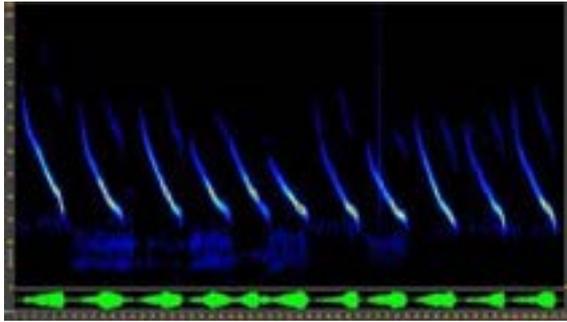
Maghreb Mouse-eared Bat - call duration 8.1-8.2 ms



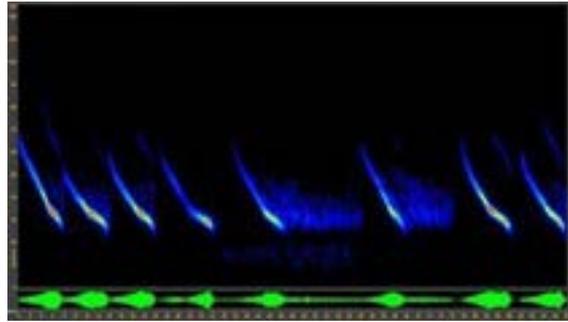
Greater Mouse-eared Bat - call duration 8.3-8.4 ms



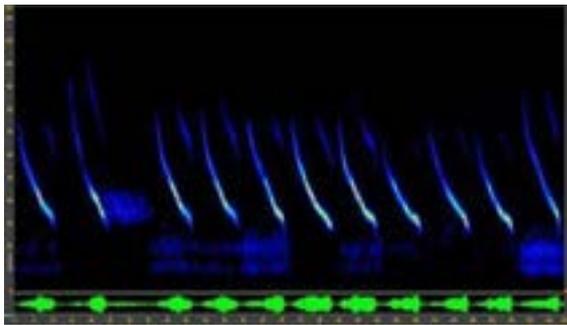
Maghreb Mouse-eared Bat - call duration 8.3-8.4 ms



Greater Mouse-eared Bat - call duration 8.5-9.0 ms

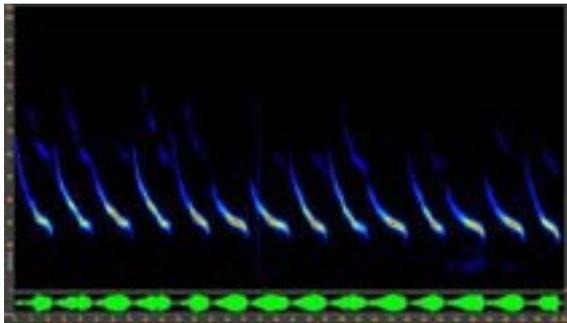


Maghreb Mouse-eared Bat - call duration 8.5-9.0 ms



Greater Mouse-eared Bat - call duration 9.1-10.8 ms

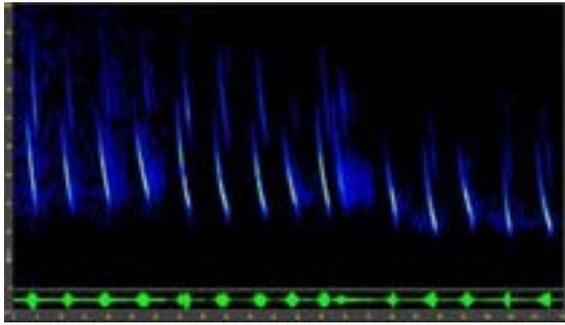
Maghreb Mouse-eared Bat - no examples



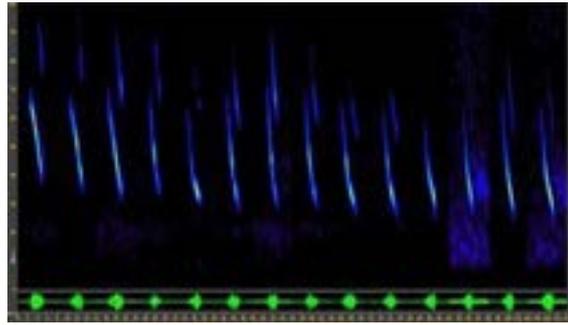
Greater Mouse-eared Bat - call duration 10.9-12.4 ms

Maghreb Mouse-eared Bat - no examples

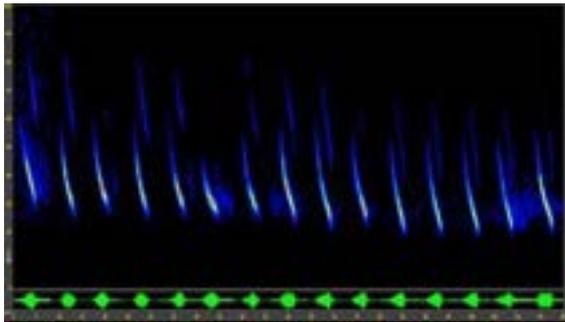
8. Common Noctule *Nyctalus noctula* and Leisler's Bat *Nyctalus leisleri*



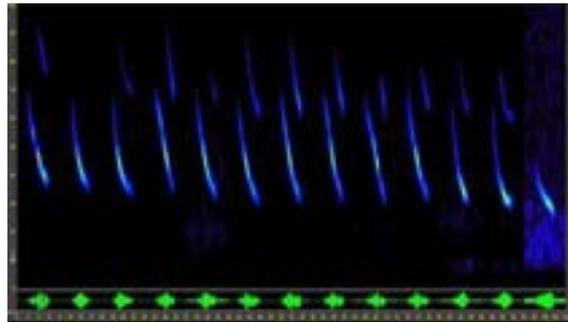
Common Noctule - call duration 1.4-3.0 ms



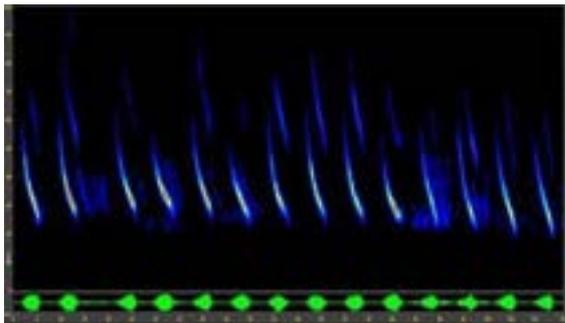
Leisler's Bat - call duration 1.4-3.0 ms



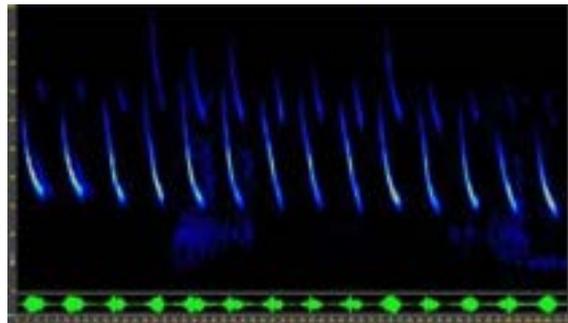
Common Noctule - call duration 3.1-3.7 ms



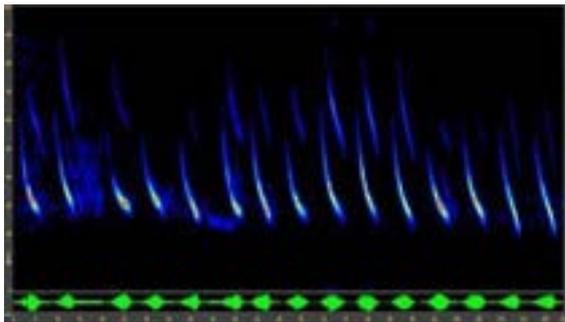
Leisler's Bat - call duration 3.1-3.7 ms



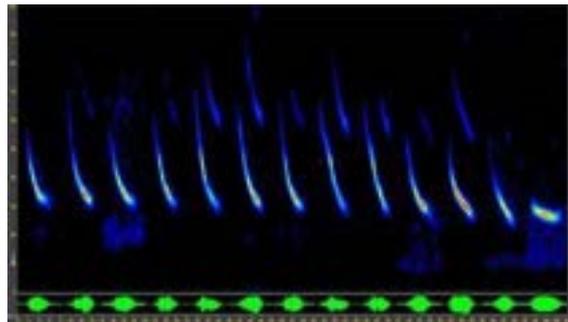
Common Noctule - call duration 3.8-4.3 ms



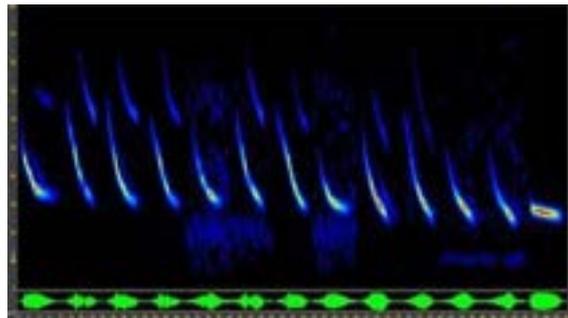
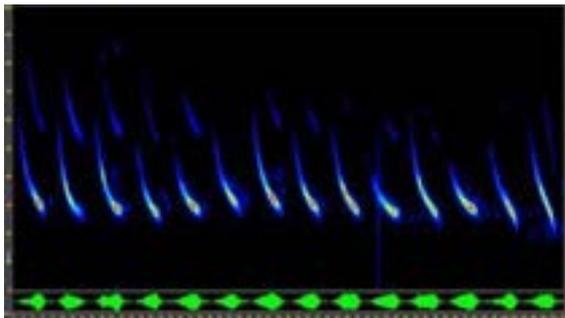
Leisler's Bat - call duration 3.8-4.3 ms



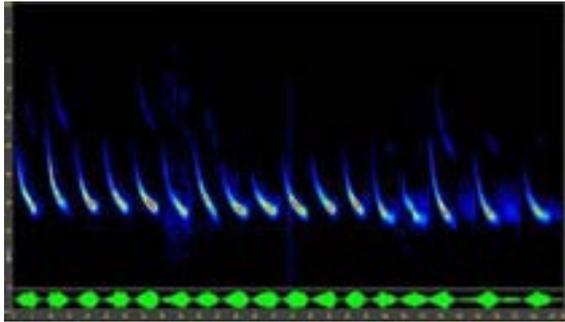
Common Noctule - call duration 4.4-4.9 ms



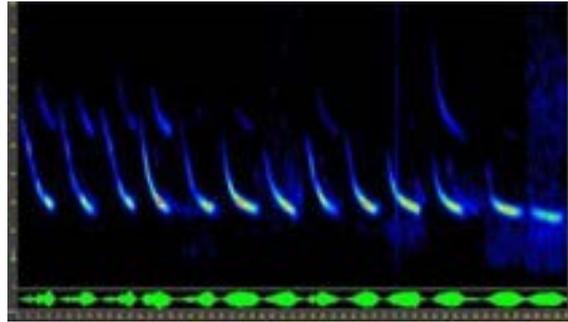
Leisler's Bat - call duration 4.4-4.9 ms



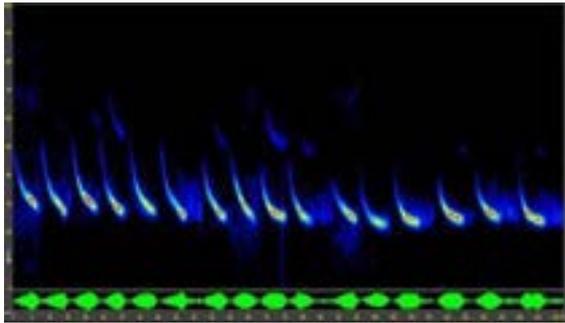
Common Noctule - call duration 5.0-5.9 ms



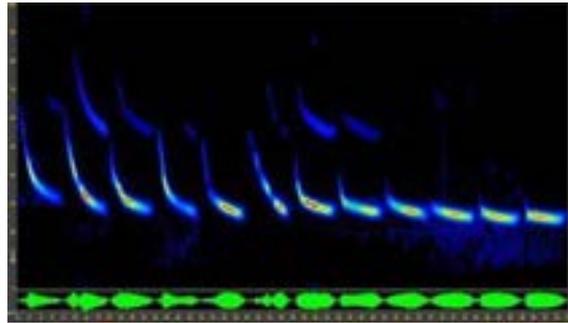
Leisler's Bat - call duration 5.0-5.9 ms



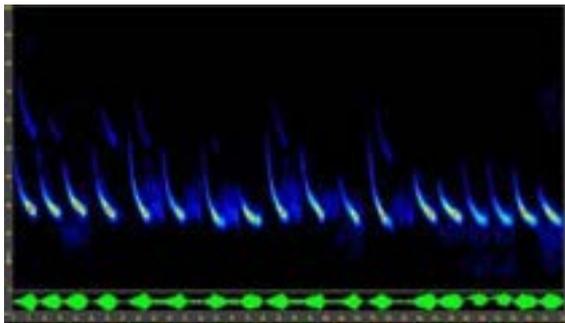
Common Noctule - call duration 6.0-6.8 ms



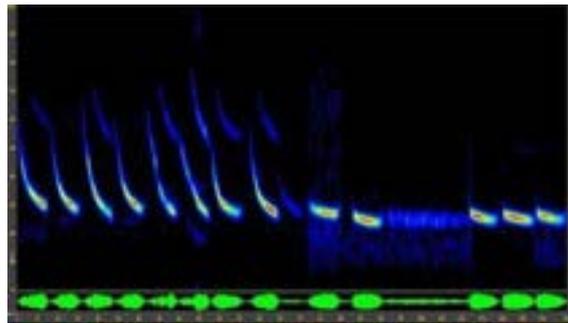
Leisler's Bat - call duration 6.0-6.8 ms



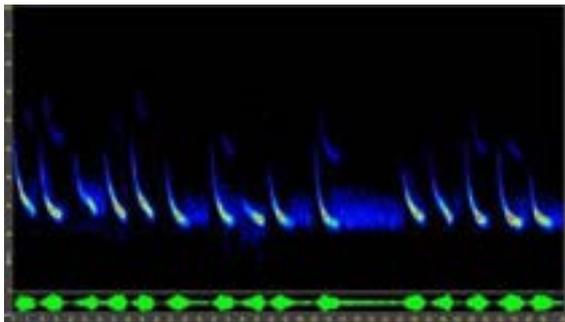
Common Noctule - call duration 6.9-7.2 ms



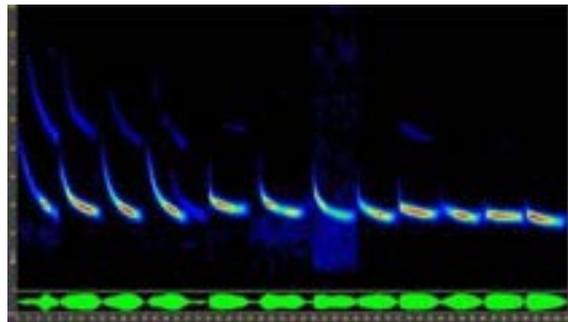
Leisler's Bat - call duration 6.9-7.2 ms



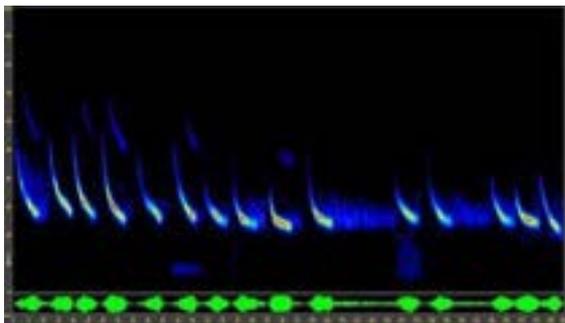
Common Noctule - call duration 7.3-7.6 ms



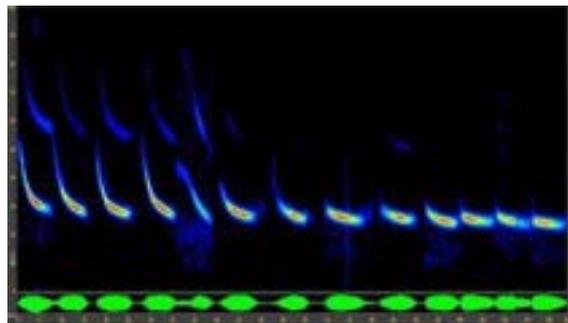
Leisler's Bat - call duration 7.3-7.6 ms



Common Noctule - call duration 7.7-7.8 ms



Leisler's Bat - call duration 7.7-7.8 ms

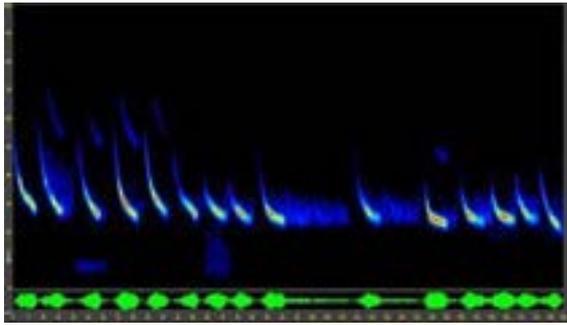


Common Noctule - call duration 7.9-8.0 ms

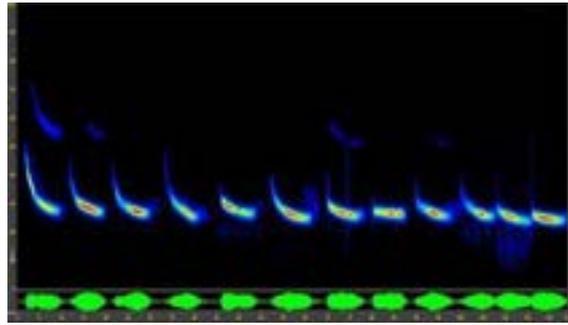


Leisler's Bat - call duration 7.9-8.0 ms

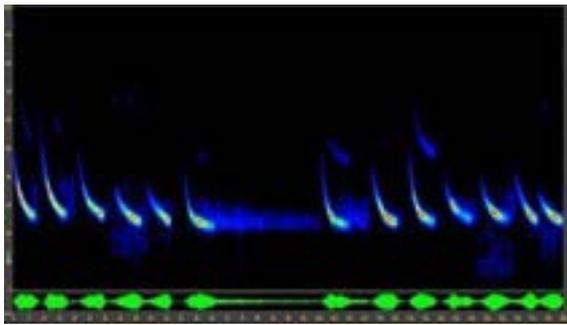




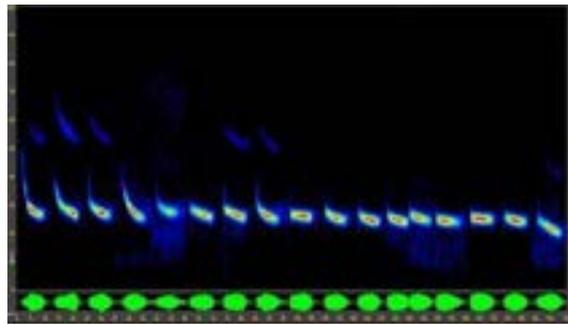
Common Noctule - call duration 8.1-8.3 ms



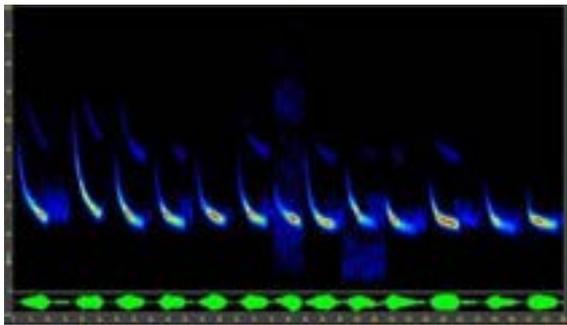
Leisler's Bat - call duration 8.1-8.3 ms



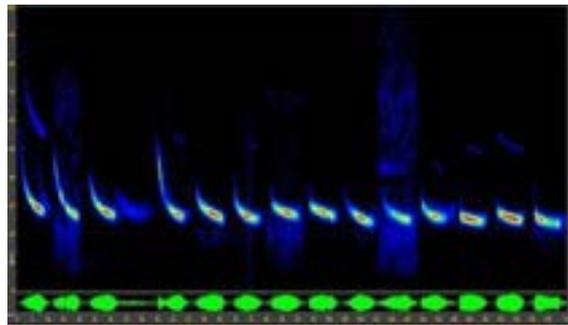
Common Noctule - call duration 8.4-8.5 ms



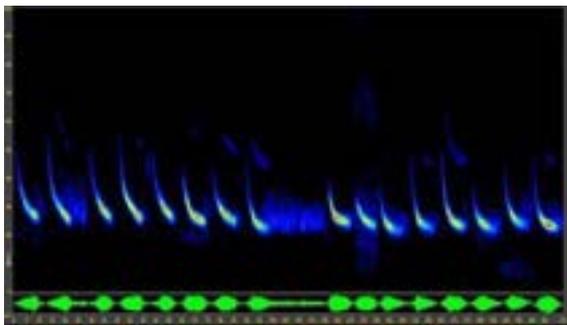
Leisler's Bat - call duration 8.4-8.5 ms



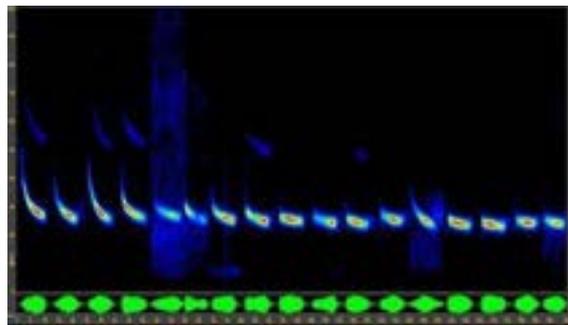
Common Noctule - call duration 8.6-8.7 ms



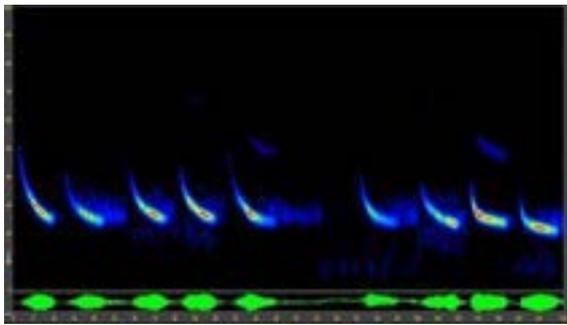
Leisler's Bat - call duration 8.6-8.7 ms



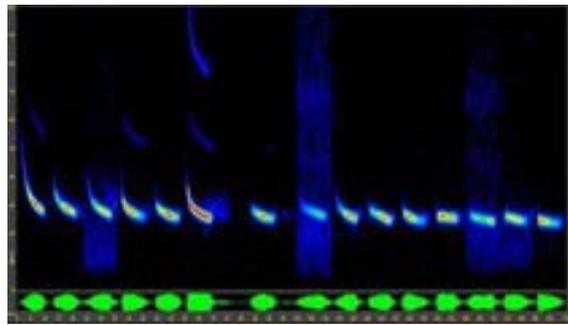
Common Noctule - call duration 8.8-8.9 ms



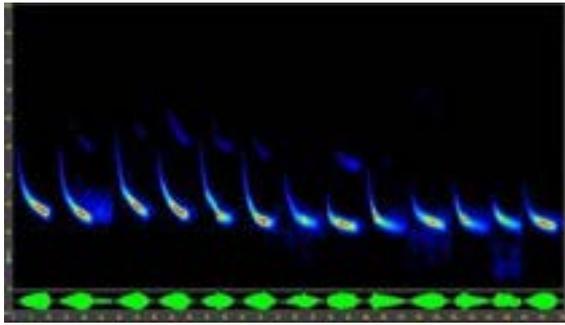
Leisler's Bat - call duration 8.8-8.9 ms



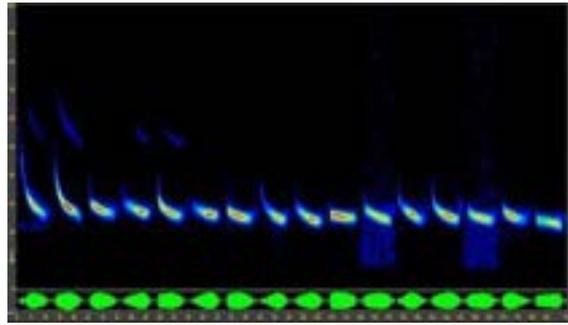
Common Noctule - call duration 9.0-9.1 ms



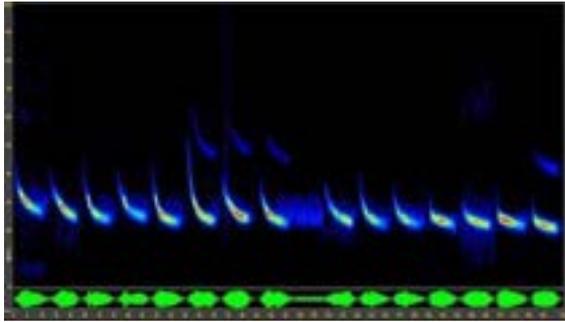
Leisler's Bat - call duration 9.0-9.1 ms



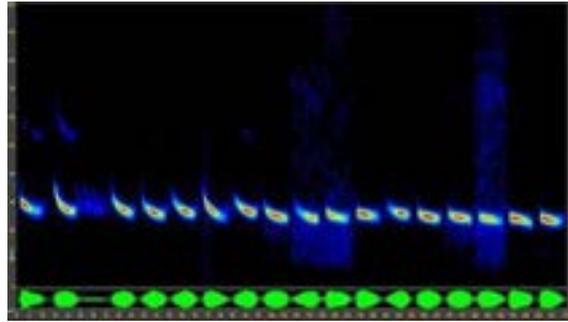
Common Noctule - call duration 9.2-9.3 ms



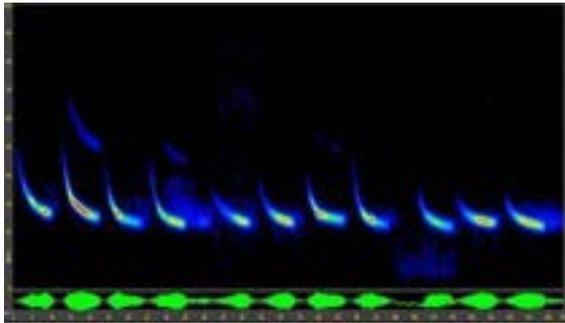
Leisler's Bat - call duration 9.2-9.3 ms



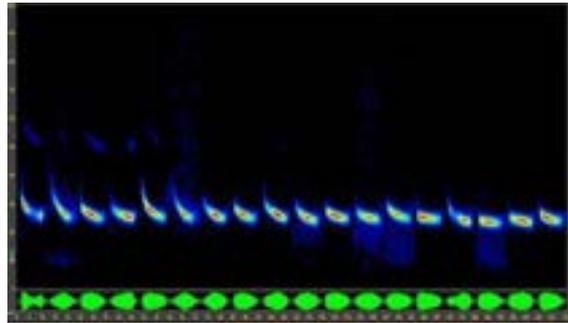
Common Noctule - call duration 9.4-9.5 ms



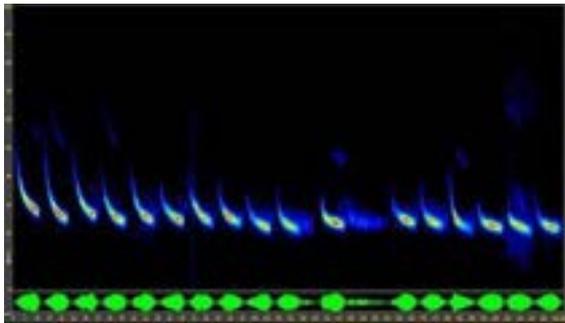
Leisler's Bat - call duration 9.4-9.5 ms



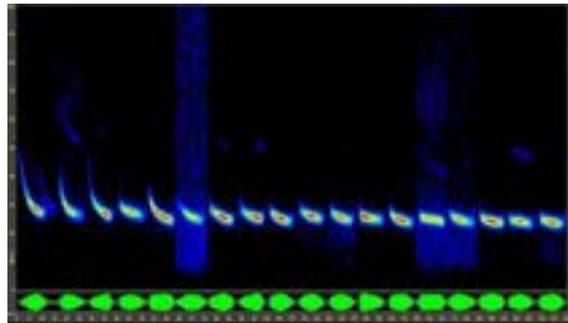
Common Noctule - call duration 9.6-9.7 ms



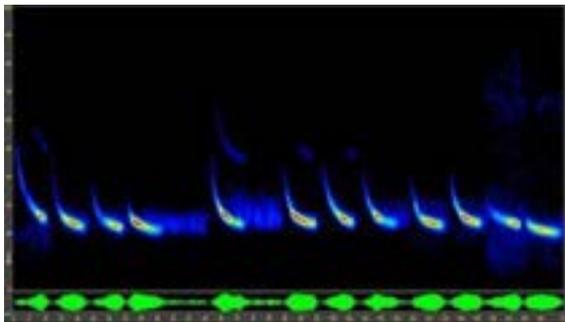
Leisler's Bat - call duration 9.6-9.7 ms



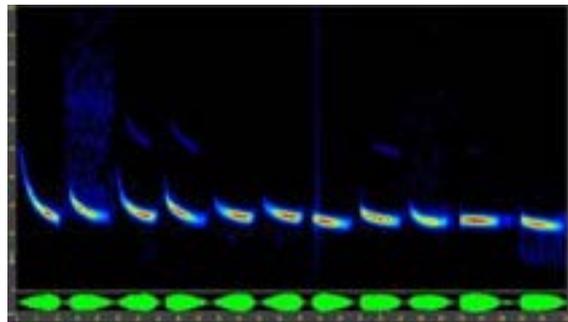
Common Noctule - call duration 9.8-9.9 ms



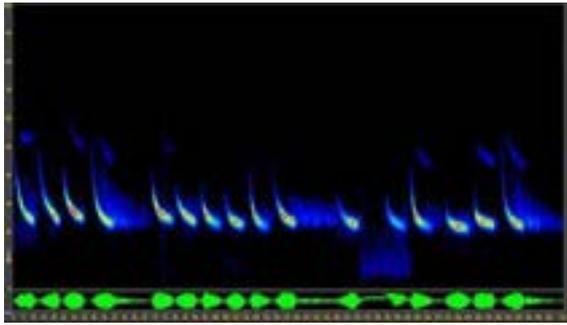
Leisler's Bat - call duration 9.8-9.9 ms



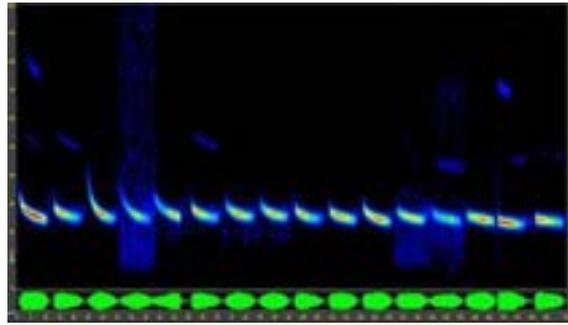
Common Noctule - call duration 10.0-10.1 ms



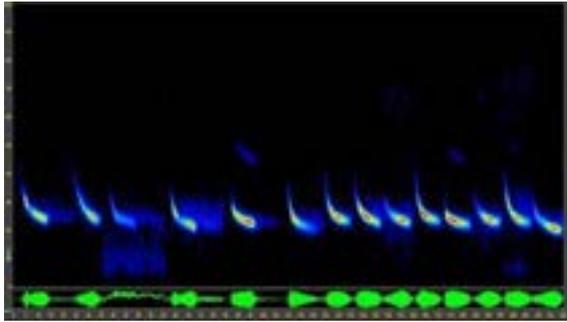
Leisler's Bat - call duration 10.0-10.1 ms



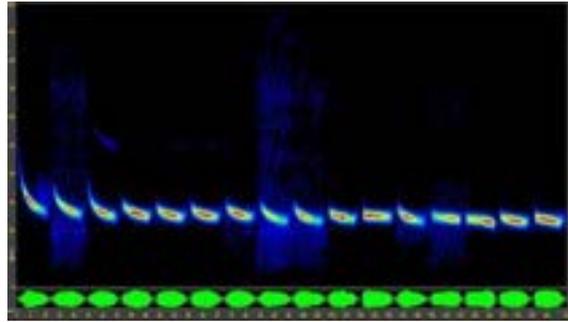
Common Noctule - call duration 10.2-10.3 ms



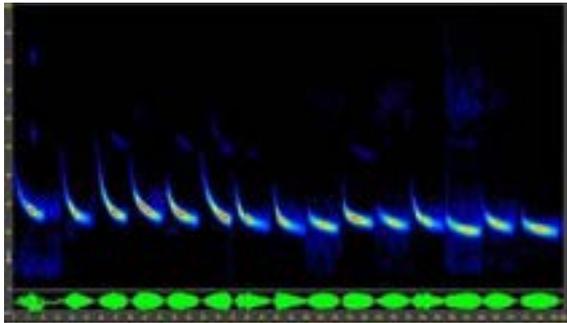
Leisler's Bat - call duration 10.2-10.3 ms



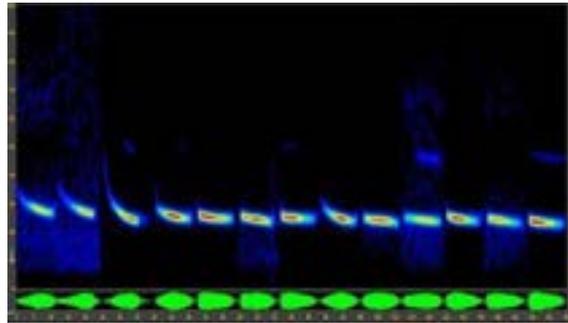
Common Noctule - call duration 10.4-10.5 ms



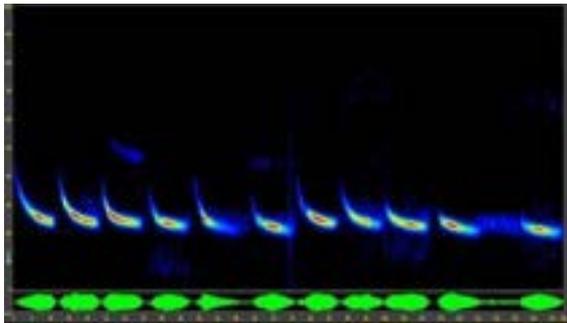
Leisler's Bat - call duration 10.4-10.5 ms



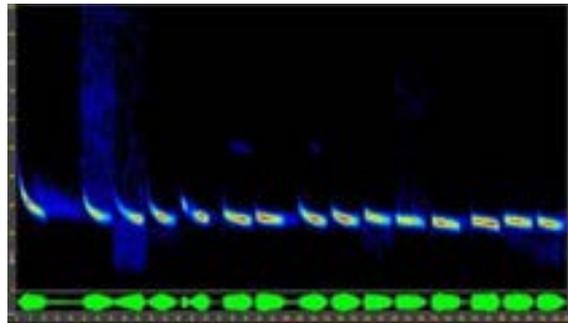
Common Noctule - call duration 10.6-10.7 ms



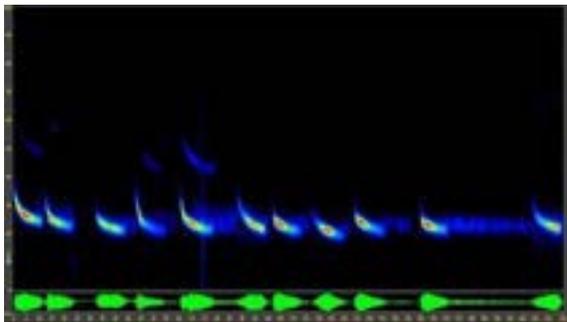
Leisler's Bat - call duration 10.6-10.7 ms



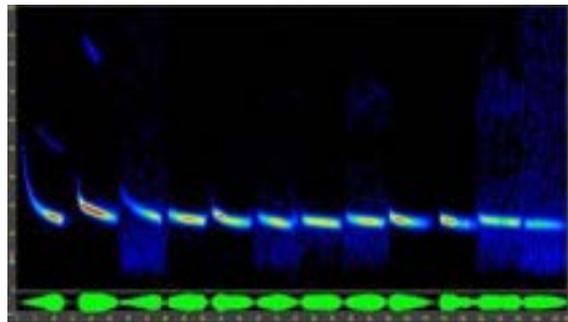
Common Noctule - call duration 10.8-10.9 ms



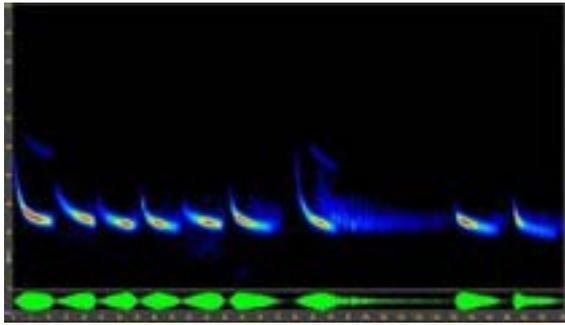
Leisler's Bat - call duration 10.8-10.9 ms



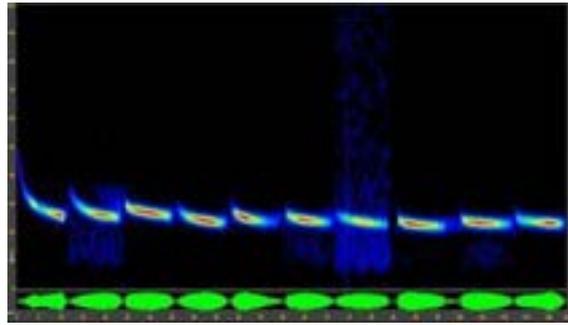
Common Noctule - call duration 11.0-11.1 ms



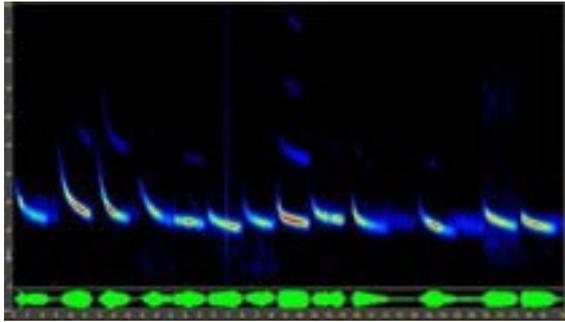
Leisler's Bat - call duration 11.0-11.1 ms



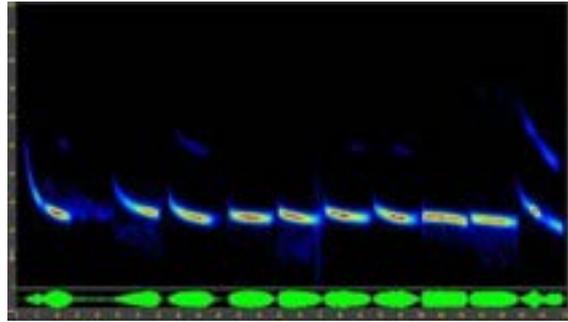
Common Noctule - call duration 11.2-11.3 ms



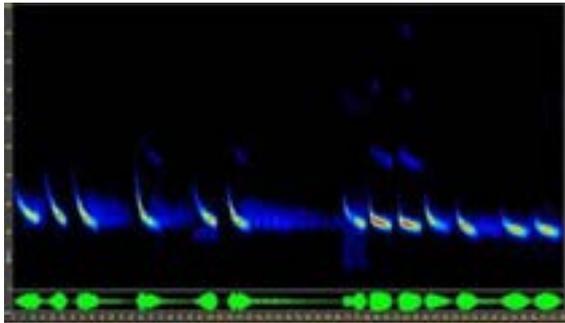
Leisler's Bat - call duration 11.2-11.3 ms



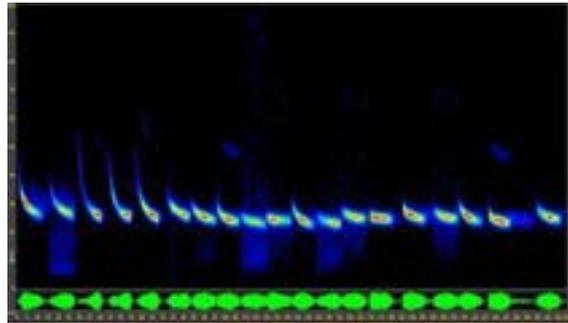
Common Noctule - call duration 11.4-11.5 ms



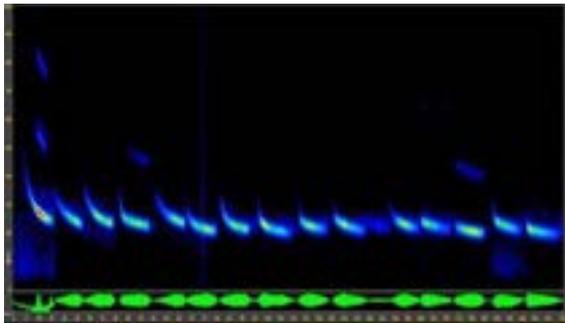
Leisler's Bat - call duration 11.4-11.5 ms



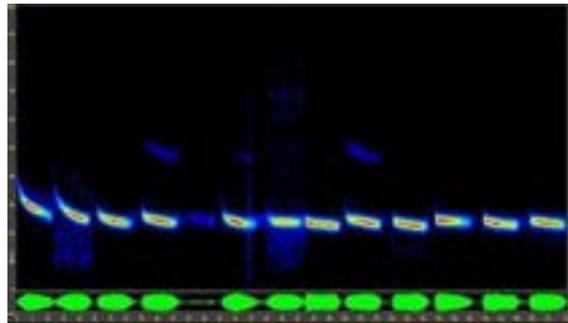
Common Noctule - call duration 11.6-11.7 ms



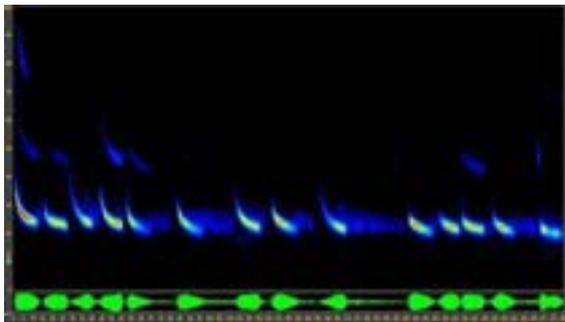
Leisler's Bat - call duration 11.6-11.7 ms



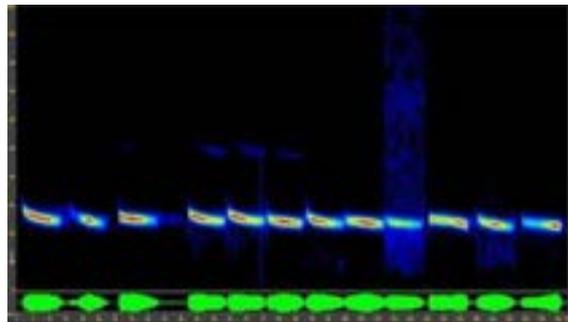
Common Noctule - call duration 11.8-11.9 ms



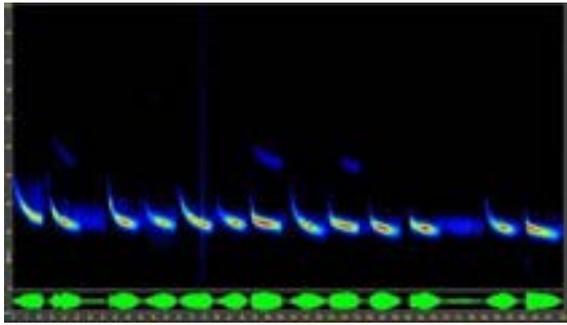
Leisler's Bat - call duration 11.8-11.9 ms



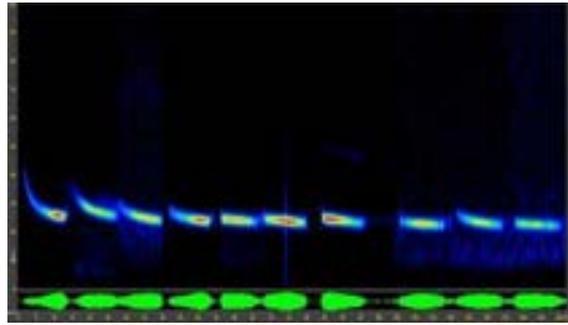
Common Noctule - call duration 12.0-12.2 ms



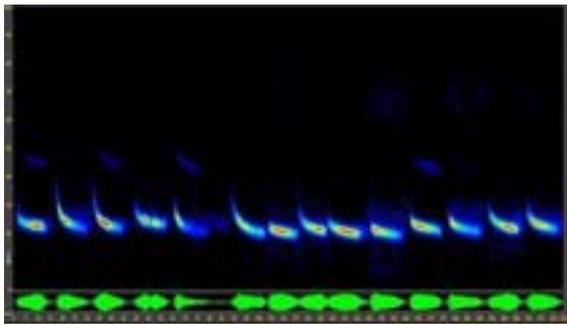
Leisler's Bat - call duration 12.0-12.2 ms



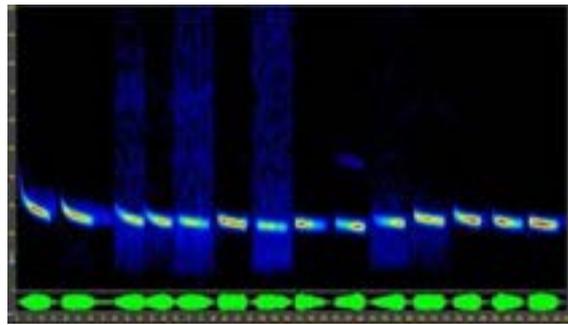
Common Noctule - call duration 12.3-12.4 ms



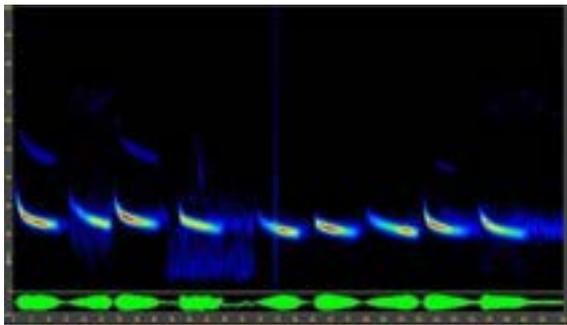
Leisler's Bat - call duration 12.3-12.4 ms



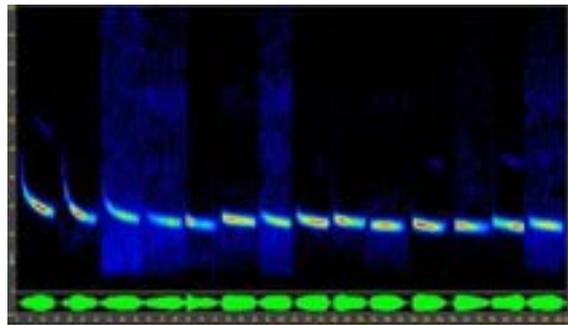
Common Noctule - call duration 12.5-12.7 ms



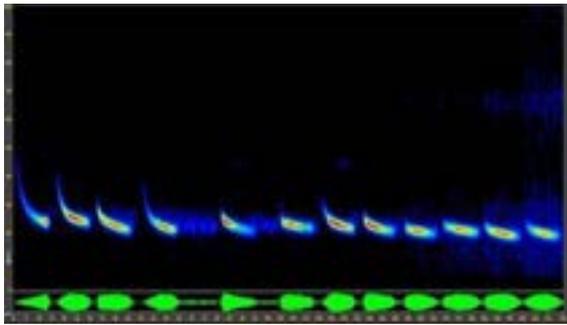
Leisler's Bat - call duration 12.5-12.7 ms



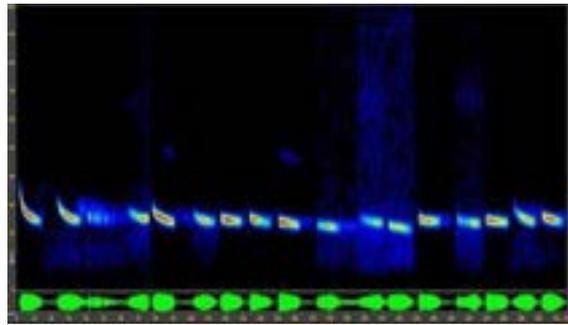
Common Noctule - call duration 12.8-12.9 ms



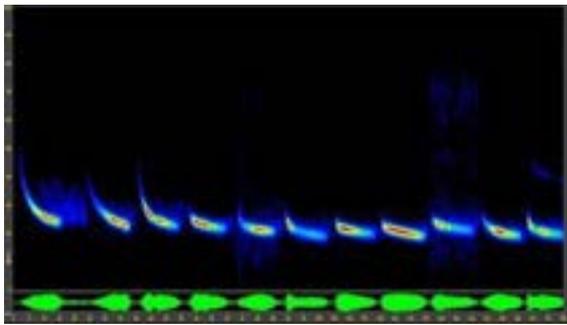
Leisler's Bat - call duration 12.8-12.9 ms



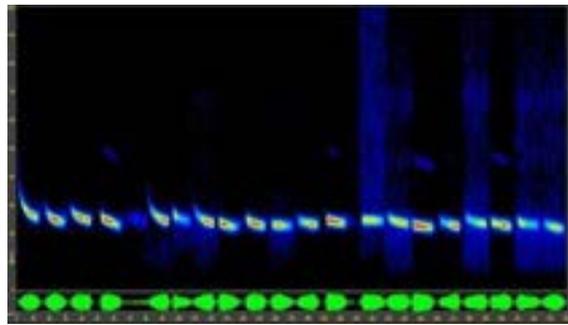
Common Noctule - call duration 13.0-13.1 ms



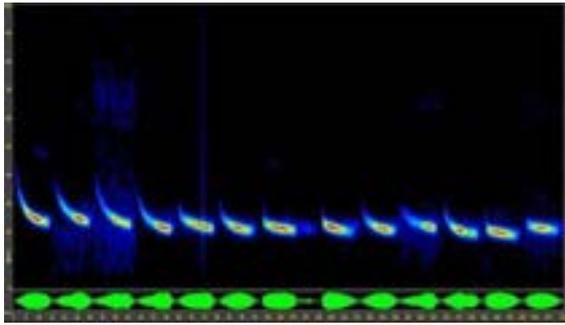
Leisler's Bat - call duration 13.0-13.1 ms



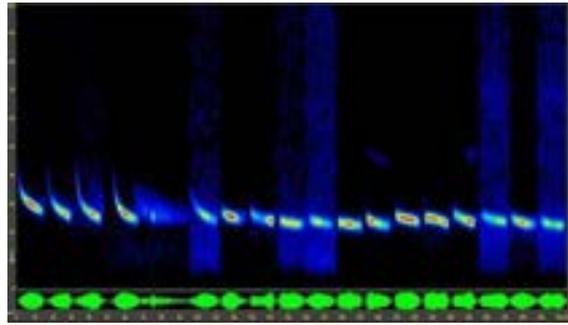
Common Noctule - call duration 13.2-13.3 ms



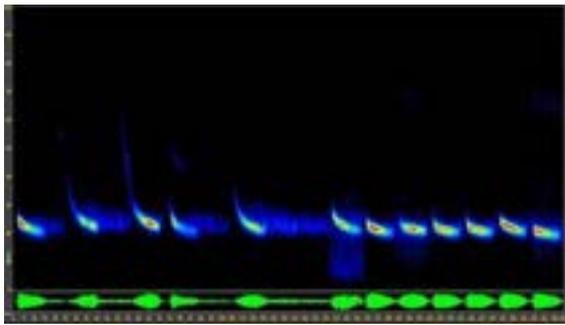
Leisler's Bat - call duration 13.2-13.3 ms



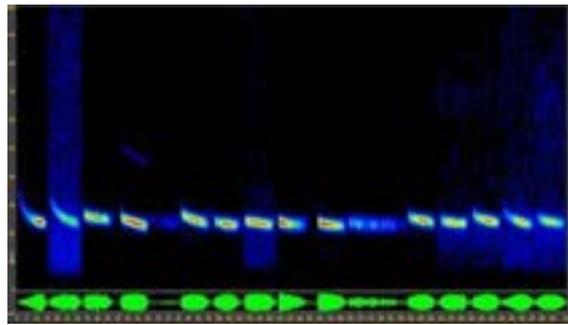
Common Noctule - call duration 13.4-13.5 ms



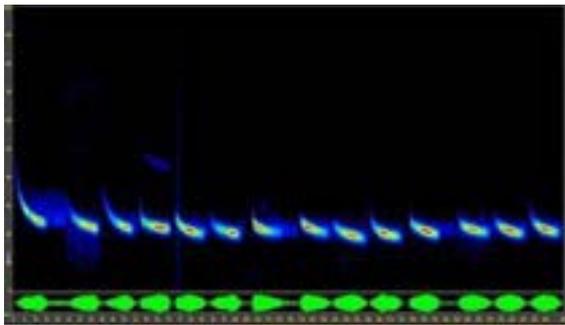
Leisler's Bat - call duration 13.4-13.5 ms



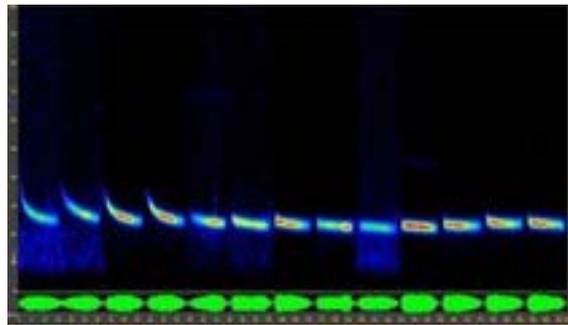
Common Noctule - call duration 13.6-13.7 ms



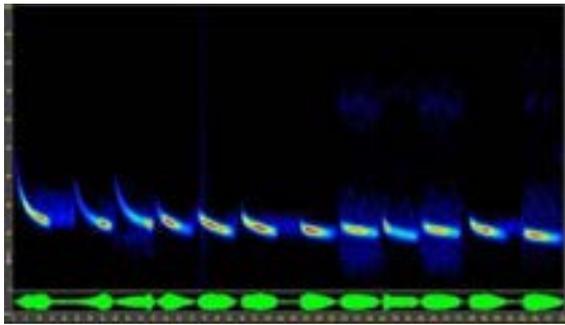
Leisler's Bat - call duration 13.6-13.7 ms



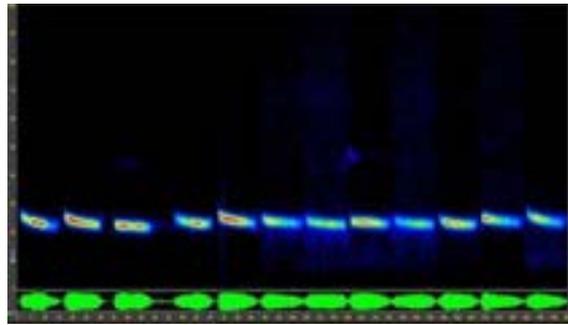
Common Noctule - call duration 13.8-14.0 ms



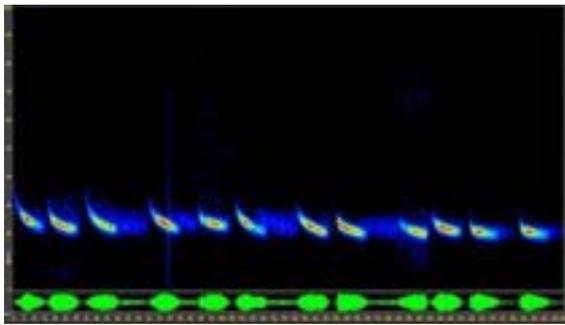
Leisler's Bat - call duration 13.8-14.0 ms



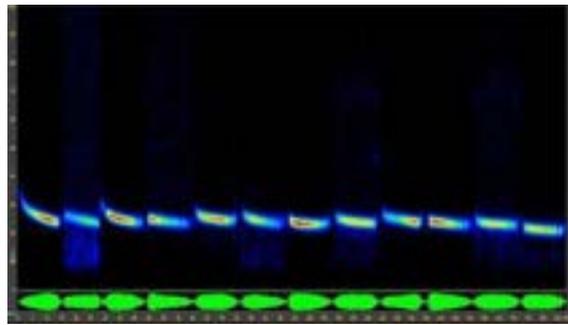
Common Noctule - call duration 14.1-14.3 ms



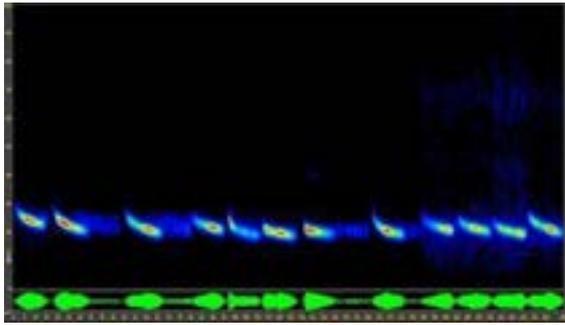
Leisler's Bat - call duration 14.1-14.3 ms



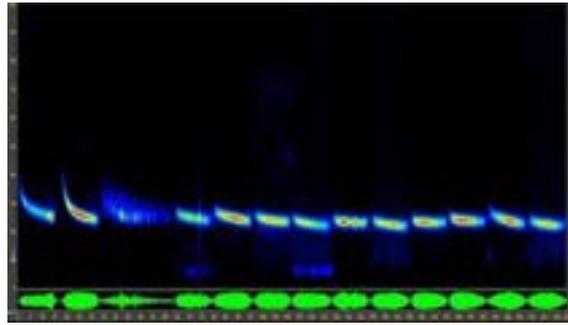
Common Noctule - call duration 14.4-14.5 ms



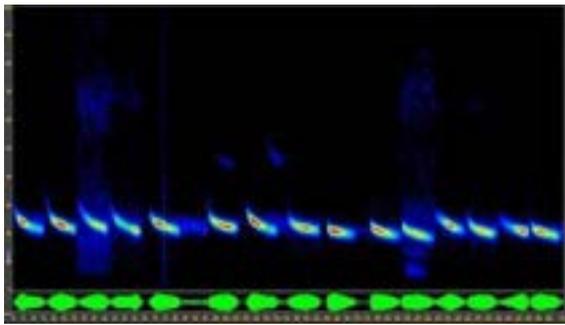
Leisler's Bat - call duration 14.4-14.5 ms



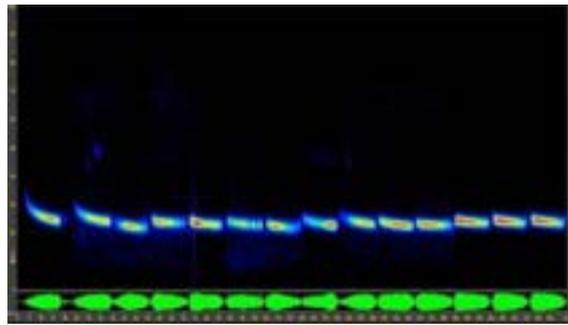
Common Noctule - call duration 14.6-14.8 ms



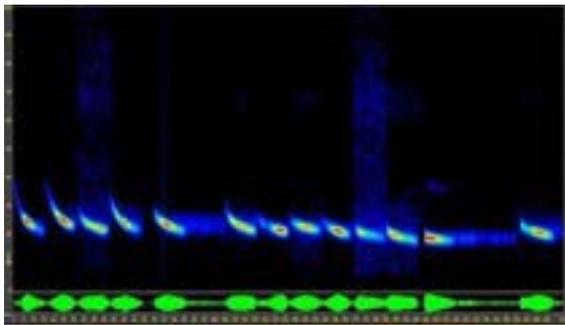
Leisler's Bat - call duration 14.6-14.8 ms



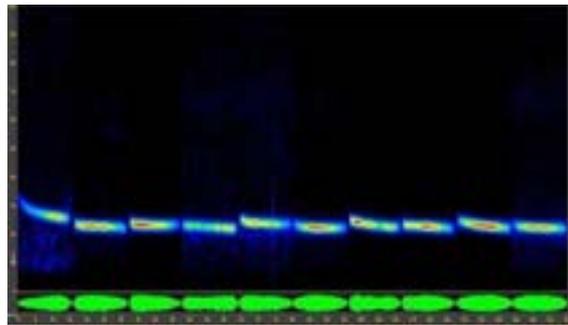
Common Noctule - call duration 14.9-15.1 ms



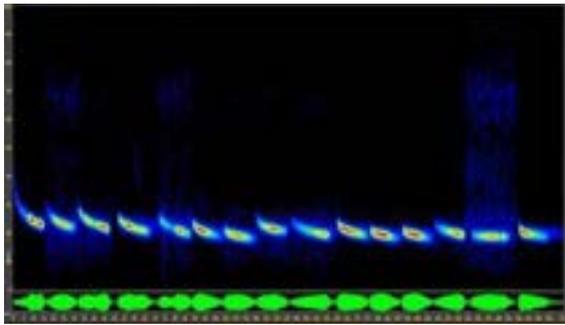
Leisler's Bat - call duration 14.9-15.1 ms



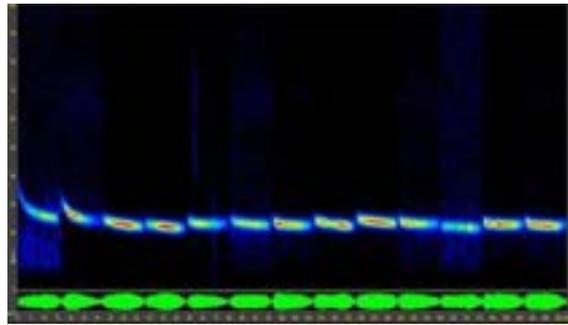
Common Noctule - call duration 15.2-15.3 ms



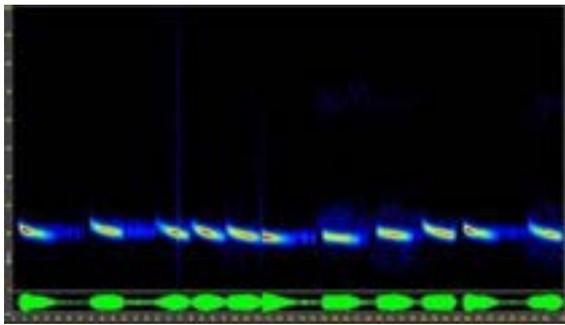
Leisler's Bat - call duration 15.2-15.3 ms



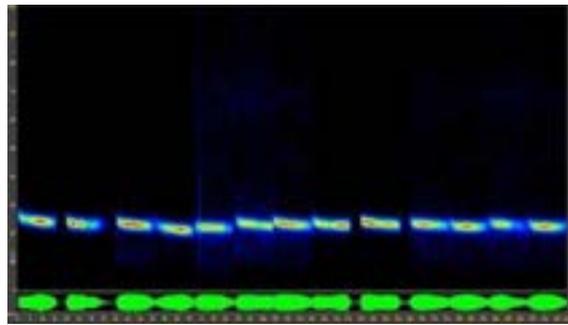
Common Noctule - call duration 15.4-15.7 ms



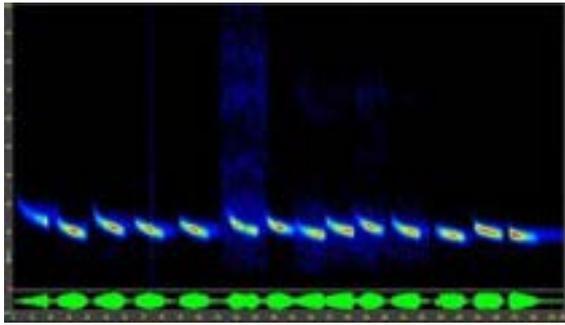
Leisler's Bat - call duration 15.4-15.7 ms



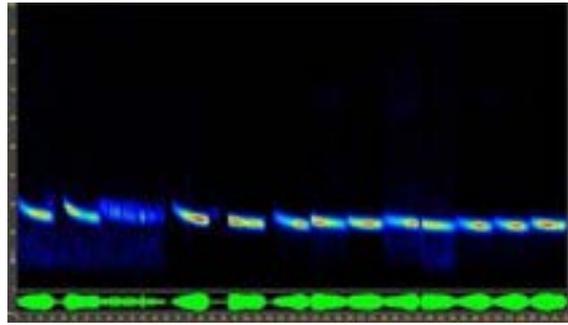
Common Noctule - call duration 15.8-16.0 ms



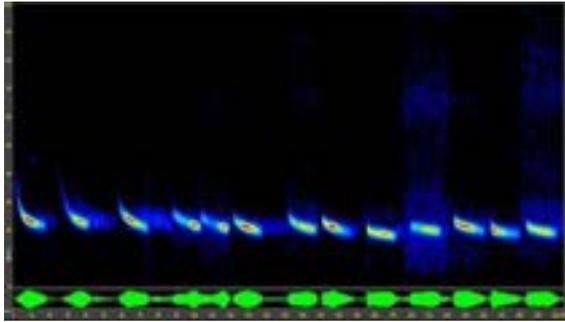
Leisler's Bat - call duration 15.8-16.0 ms



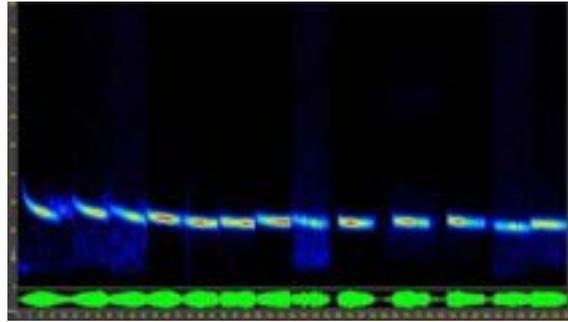
Common Noctule - call duration 16.1-16.3 ms



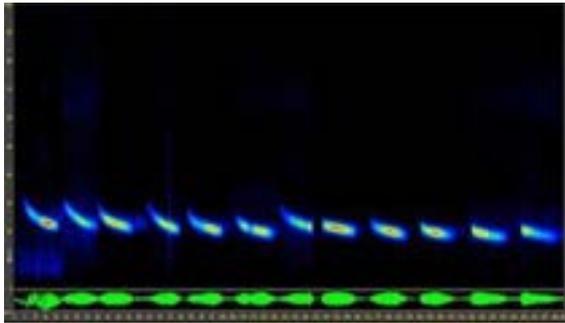
Leisler's Bat - call duration 16.1-16.3 ms



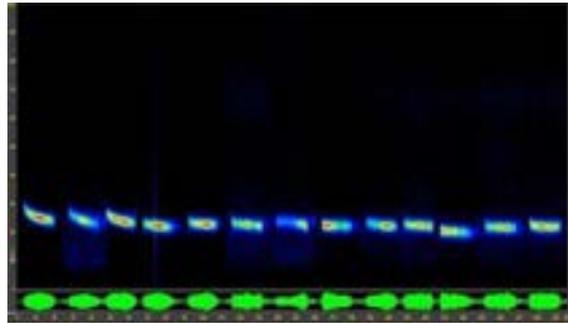
Common Noctule - call duration 16.4-16.6 ms



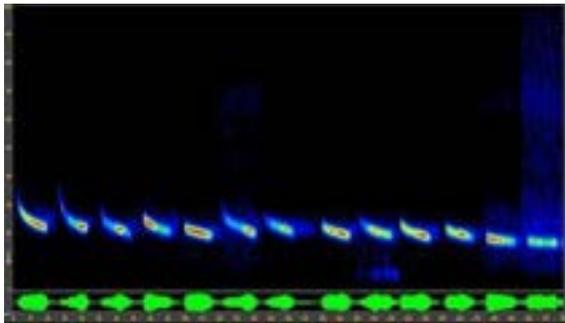
Leisler's Bat - call duration 16.4-16.6 ms



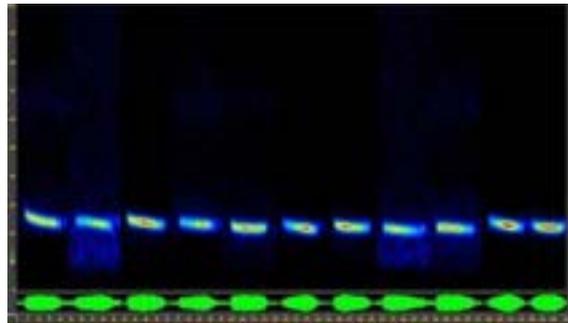
Common Noctule - call duration 16.7-17.0 ms



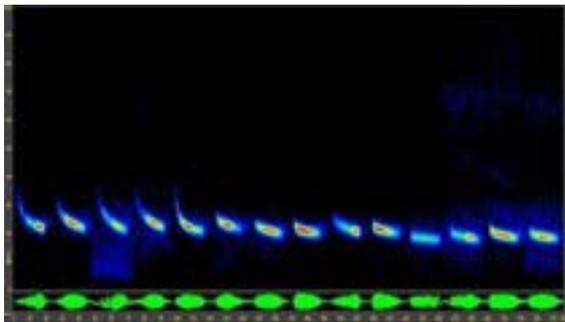
Leisler's Bat - call duration 16.7-17.0 ms



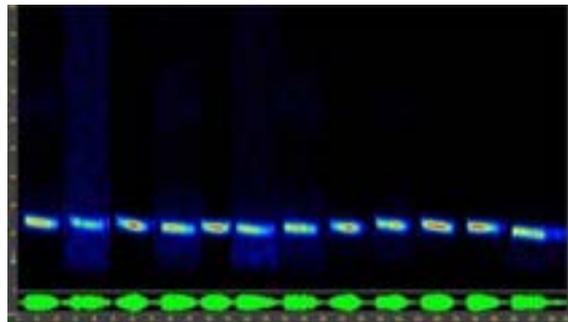
Common Noctule - call duration 17.1-17.2 ms



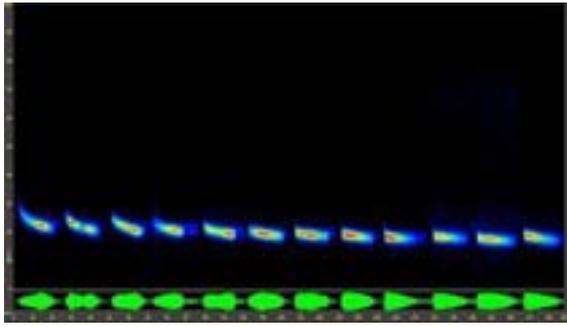
Leisler's Bat - call duration 17.1-17.2 ms



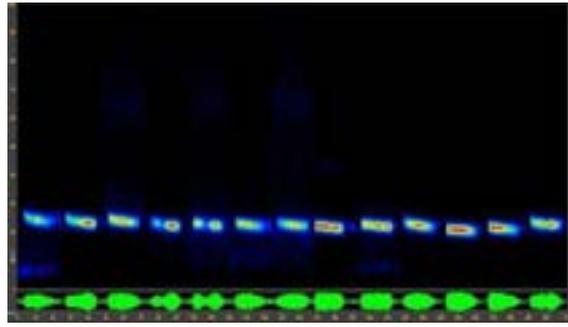
Common Noctule - call duration 17.3-17.4 ms



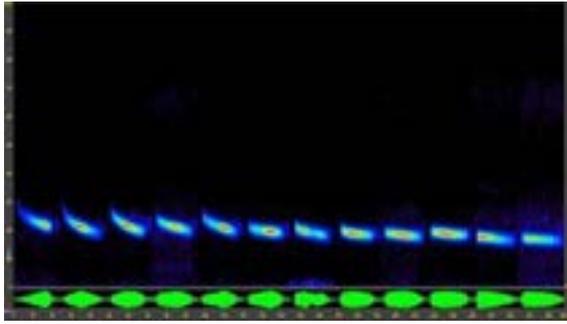
Leisler's Bat - call duration 17.3-17.4 ms



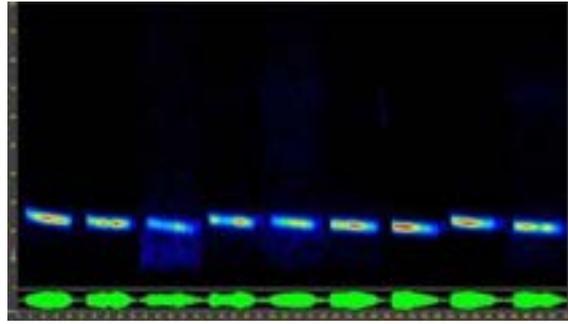
Common Noctule - call duration 17.5-18.2 ms



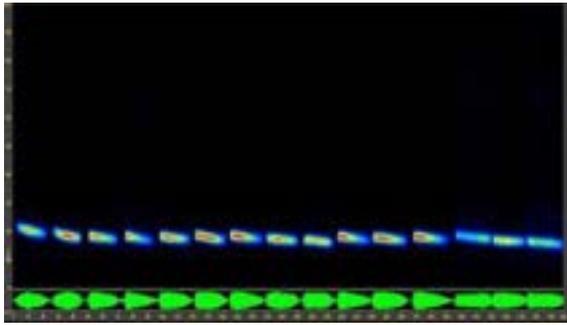
Leisler's Bat - call duration 17.5-18.2 ms



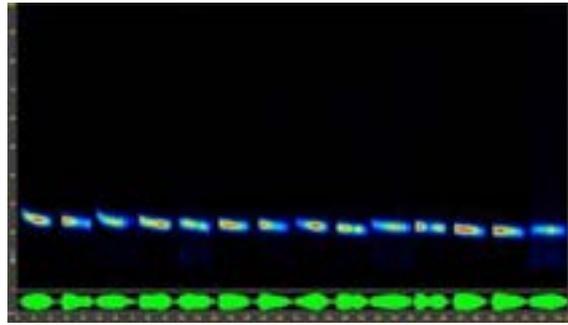
Common Noctule - call duration 18.3-18.7 ms



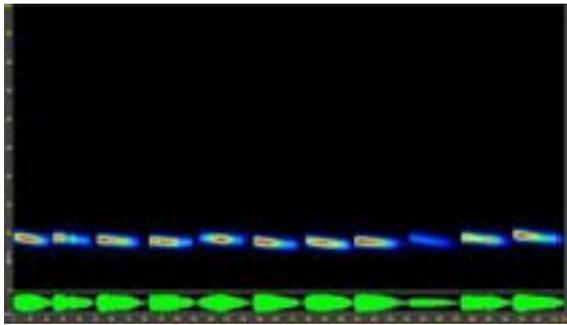
Leisler's Bat - call duration 18.3-18.7 ms



Common Noctule - call duration 18.8-24.0 ms



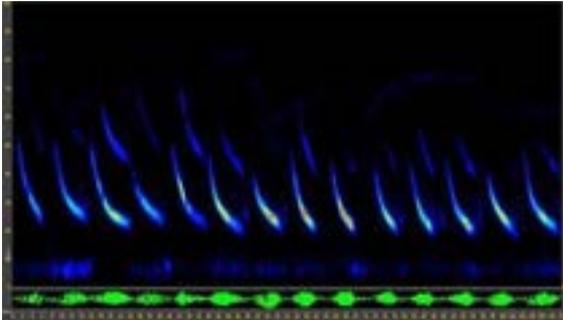
Leisler's Bat - call duration 18.8-24.0 ms



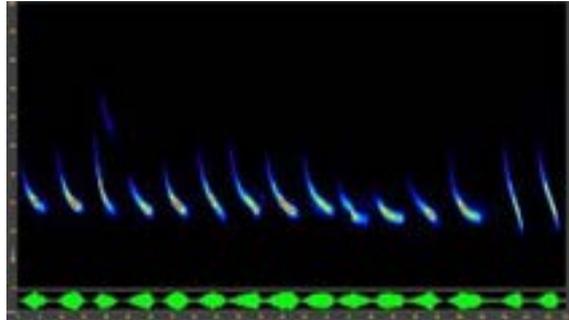
Common Noctule - call duration 24.1-31.7 ms

Leisler's Bat - no examples for this call duration

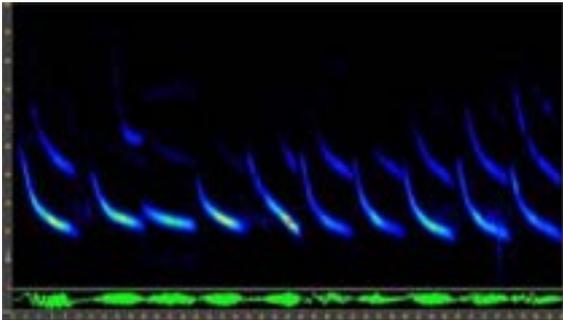
9. Greater Noctule *Nyctalus lasiopterus* and Common Noctule *Nyctalus noctula*



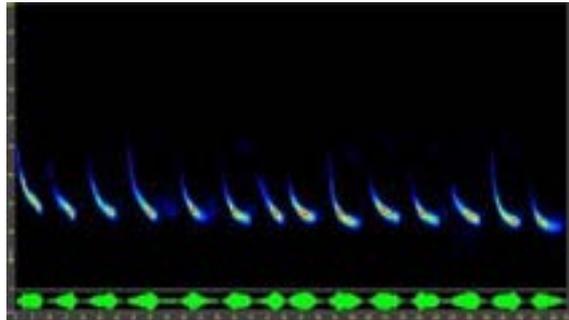
Greater Noctule - call duration 4.7-7.9 ms



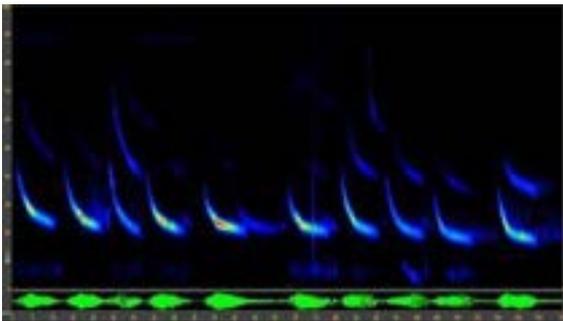
Common Noctule - call duration 4.7-7.9 ms



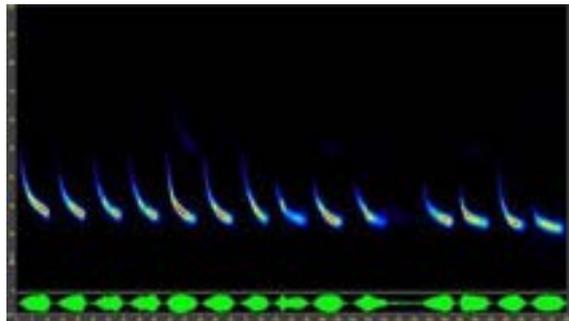
Greater Noctule - call duration 8.0-8.9 ms



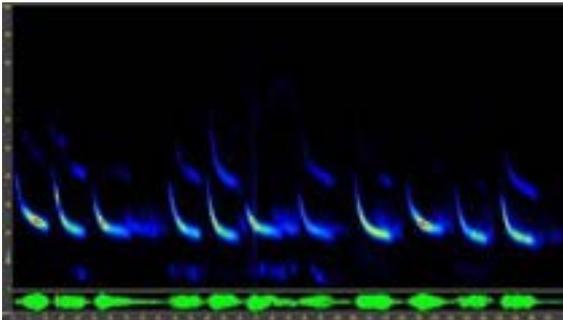
Common Noctule - call duration 8.0-8.9 ms



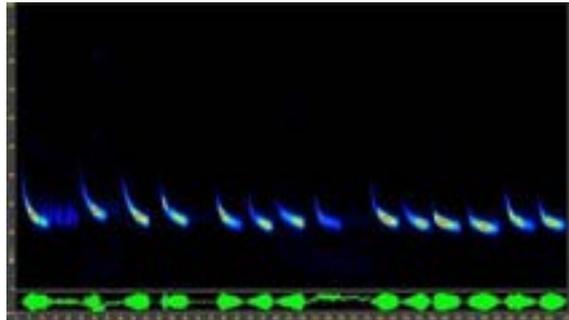
Greater Noctule - call duration 9.0-9.9 ms



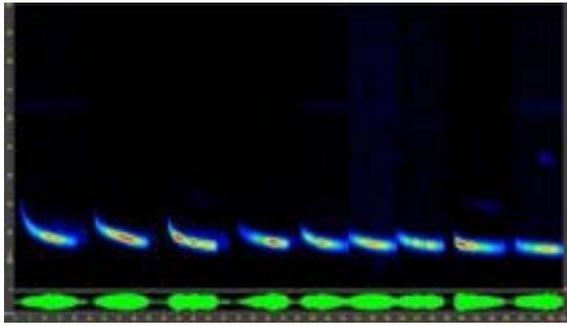
Common Noctule - call duration 9.0-9.9 ms



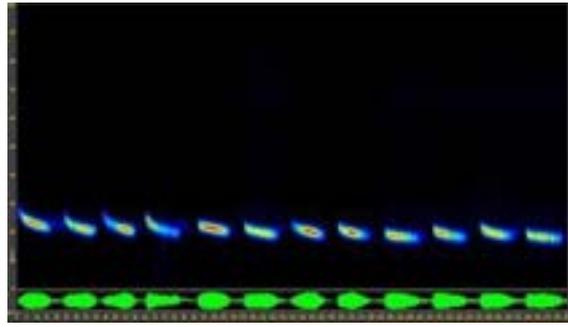
Greater Noctule - call duration 10.0-10.9 ms



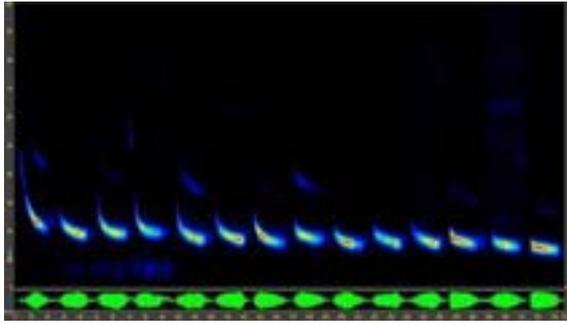
Common Noctule - call duration 10.0-10.9 ms



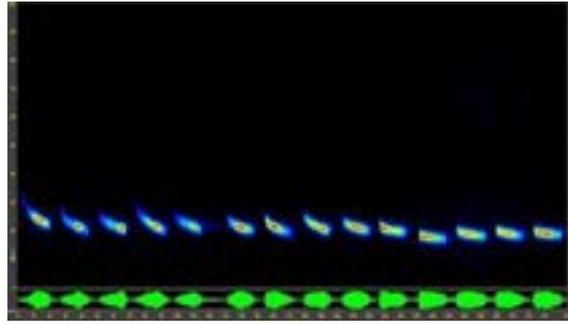
Greater Noctule - call duration 16.6-17.0 ms



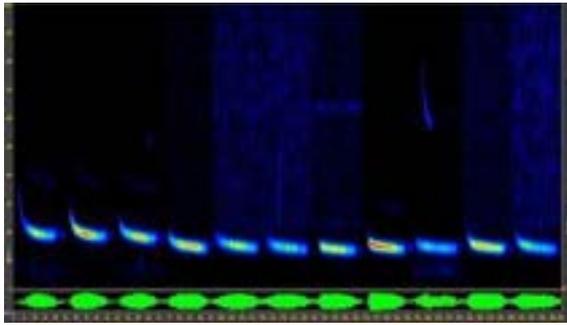
Common Noctule - call duration 16.6-17.0 ms



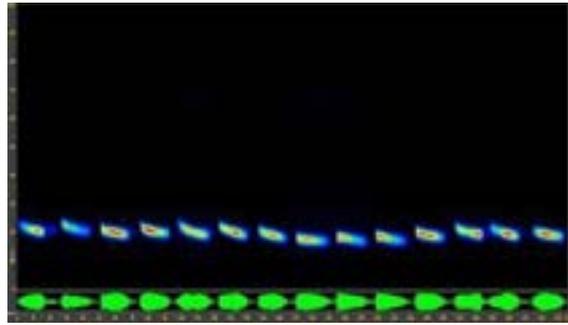
Greater Noctule - call duration 17.1-17.9 ms



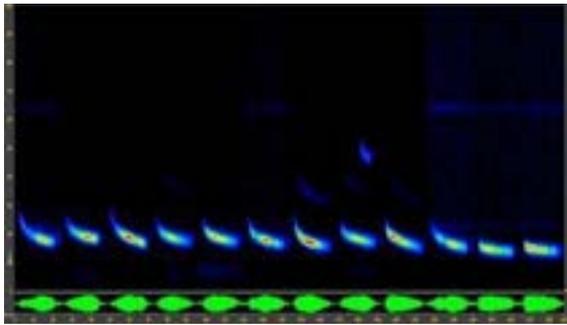
Common Noctule - call duration 17.1-17.9 ms



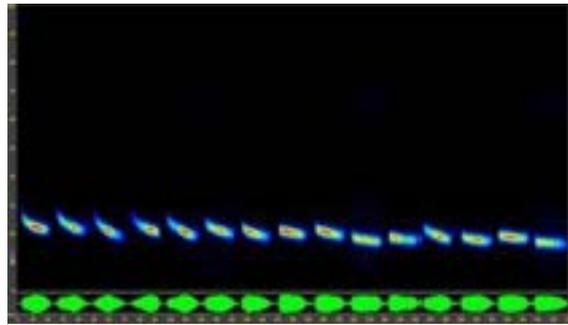
Greater Noctule - call duration 18.0-18.2 ms



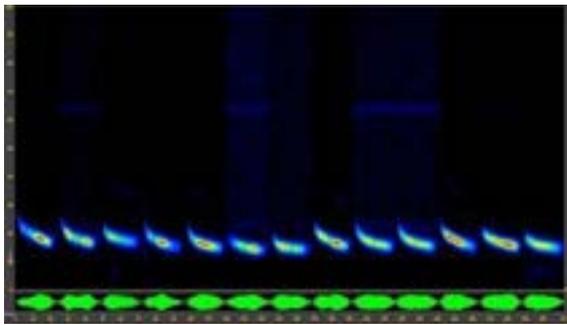
Common Noctule - call duration 18.0-18.2 ms



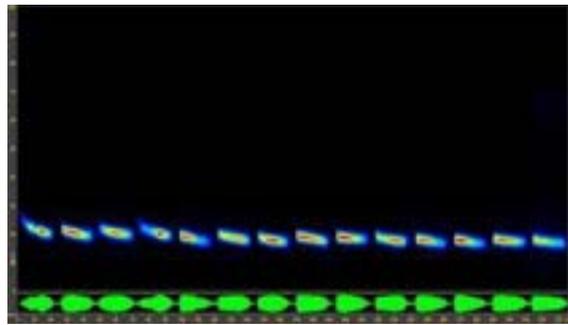
Greater Noctule - call duration 18.3-18.9 ms



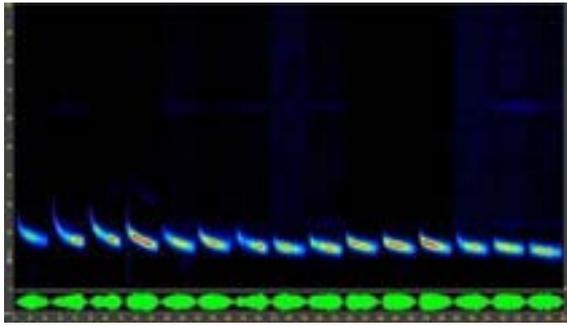
Common Noctule - call duration 18.3-18.9 ms



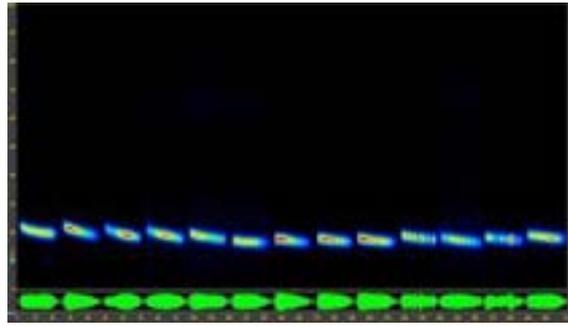
Greater Noctule - call duration 19.0-19.9 ms



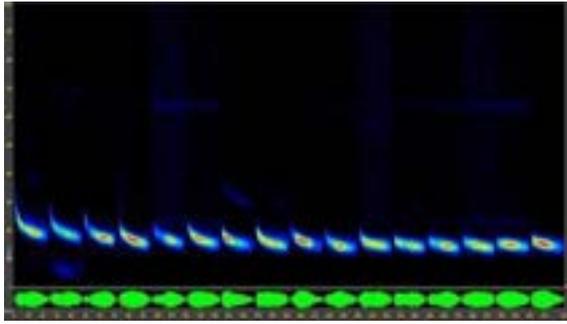
Common Noctule - call duration 19.0-19.9 ms



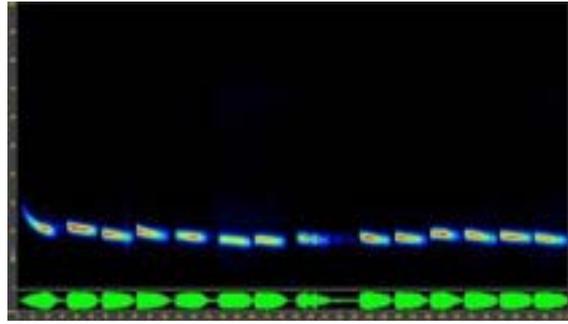
Greater Noctule - call duration 20.0-21.9 ms



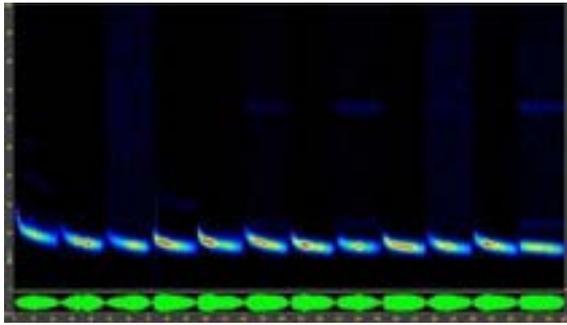
Common Noctule - call duration 20.0-20.9 ms



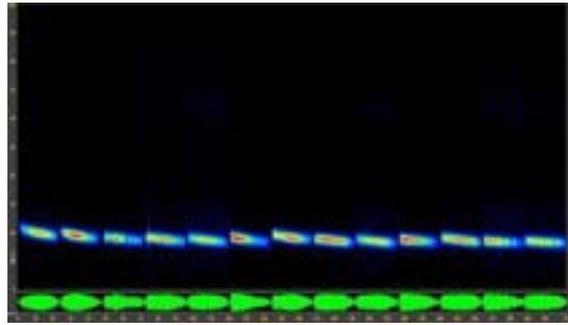
Greater Noctule - call duration 21.0-21.9 ms



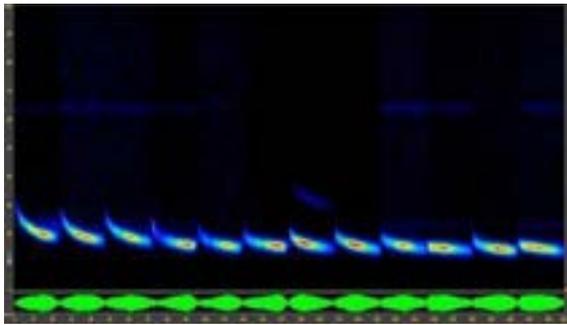
Common Noctule - call duration 21.0-21.9 ms



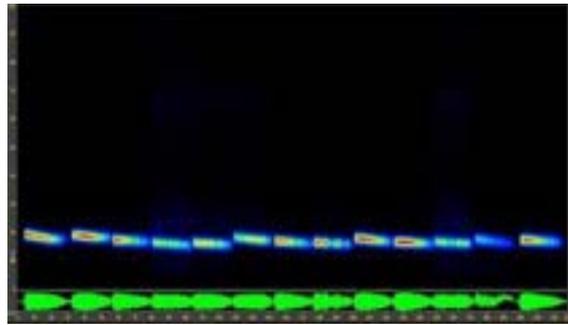
Greater Noctule - call duration 22.0-22.9 ms



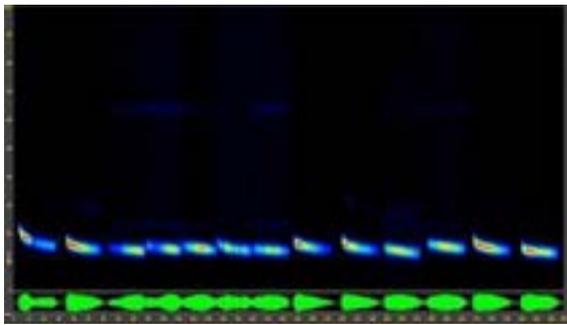
Common Noctule - call duration 22.0-22.9 ms



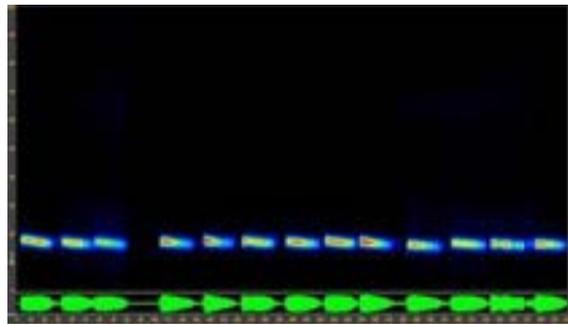
Greater Noctule - call duration 23.0-23.9 ms



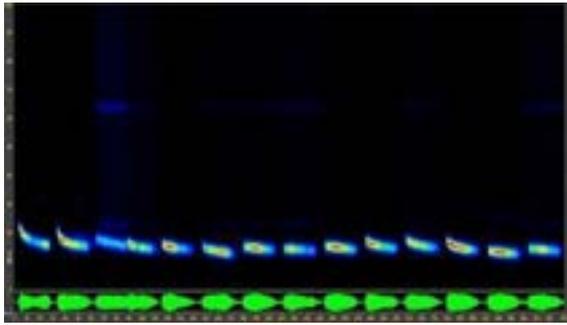
Common Noctule - call duration 23.0-23.9 ms



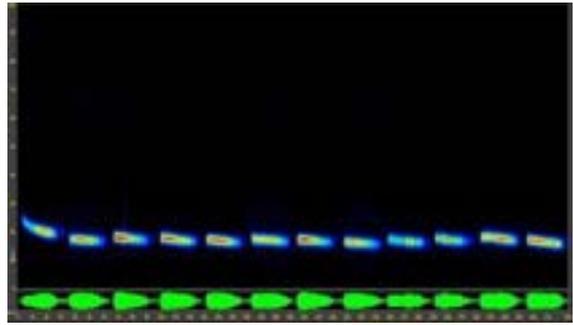
Greater Noctule - call duration 24.0-24.9 ms



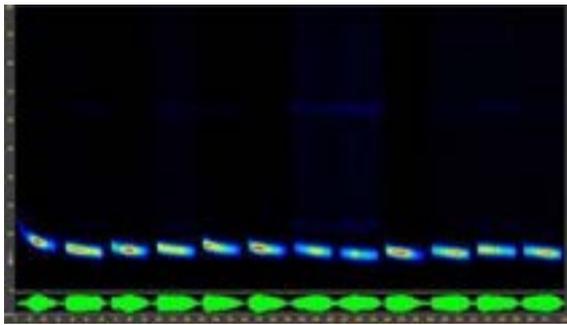
Common Noctule - call duration 24.0-24.9 ms



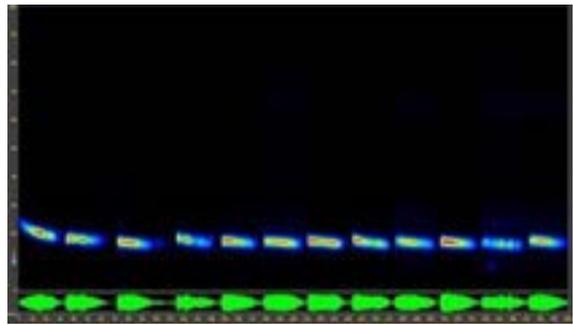
Greater Noctule - call duration 25.0-25.9 ms



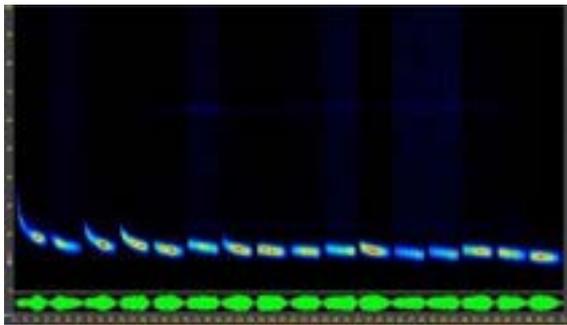
Common Noctule - call duration 25.0-25.9 ms



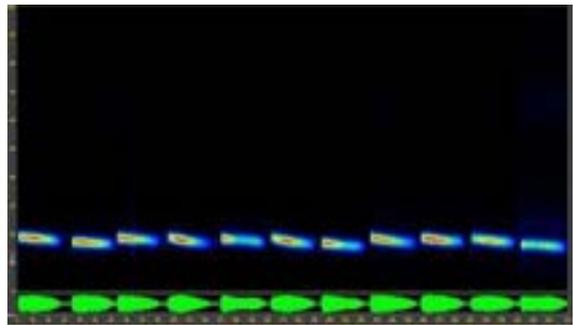
Greater Noctule - call duration 26.0-26.9 ms



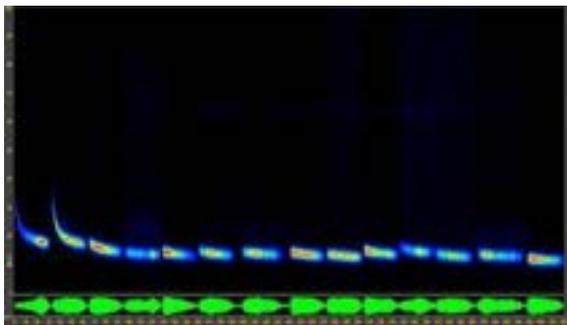
Common Noctule - call duration 26.0-26.9 ms



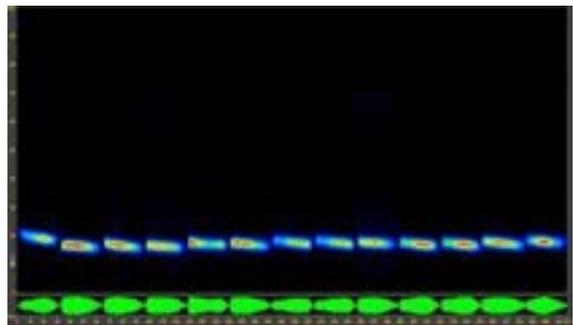
Greater Noctule - call duration 27.0-28.9ms



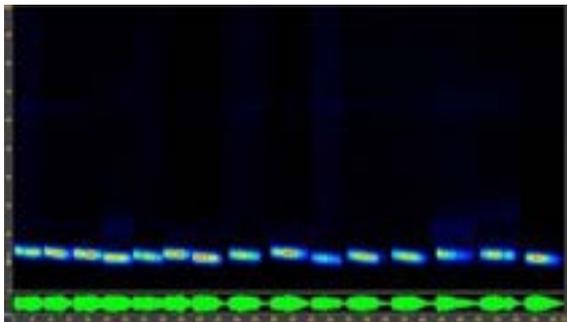
Common Noctule - call duration 27.0-28.9 ms



Greater Noctule - call duration 29.0-30.9 ms

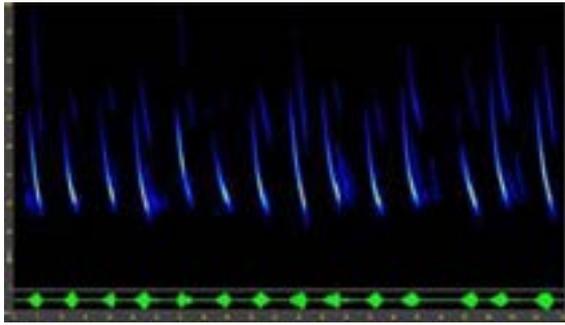


Common Noctule - call duration 29.0-30.9 ms

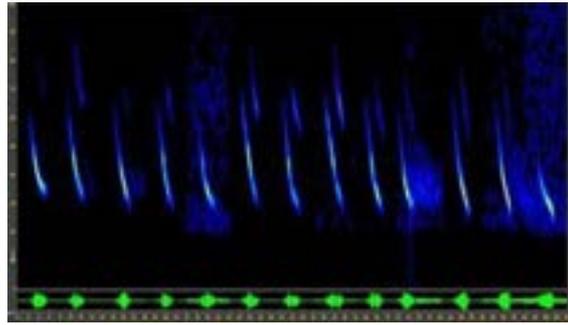


Greater Noctule - call duration 31.0-40.4 ms

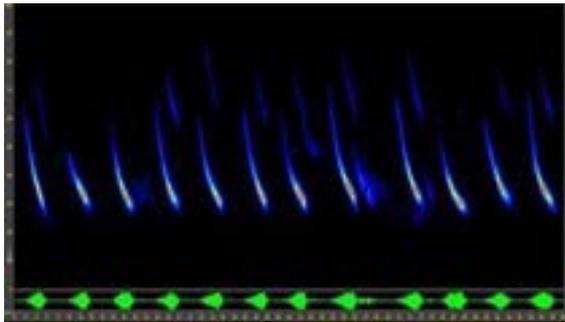
10. **Serotine** *Eptesicus serotinus* and **Leisler's Bat** *Nyctalus leisleri*



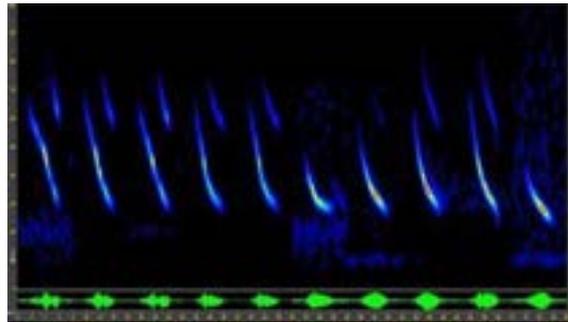
Serotine - call duration 2.7-3.0 ms



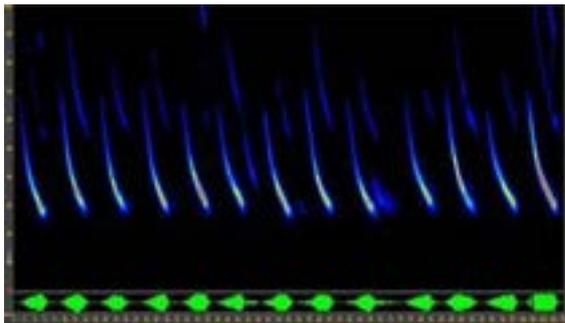
Leisler's Bat - call duration 2.7-3.0 ms



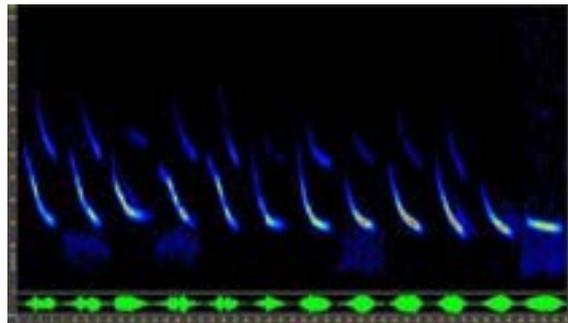
Serotine - call duration 4.0 ms



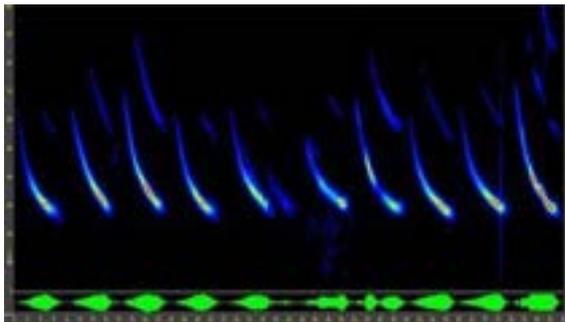
Leisler's Bat - call duration 4.0 ms



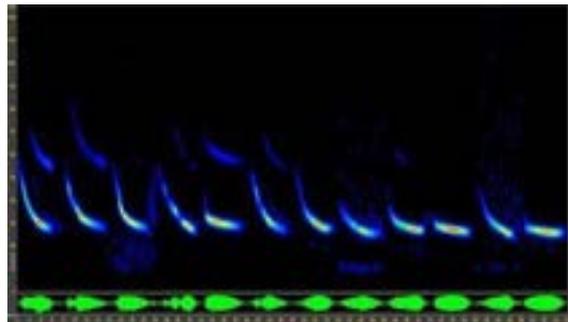
Serotine - call duration 5.0 ms



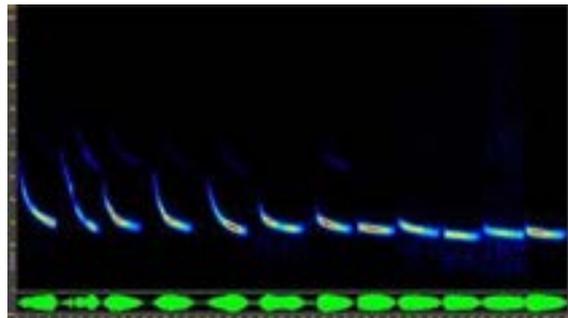
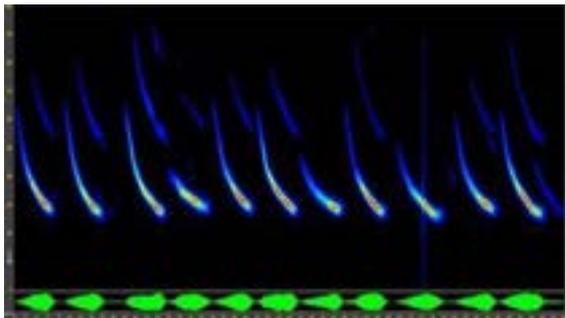
Leisler's Bat - call duration 5.0 ms

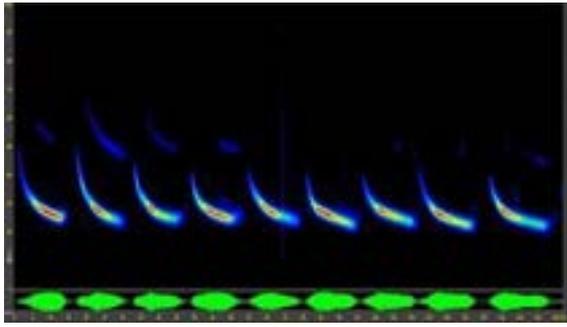


Serotine - call duration 6.0 ms

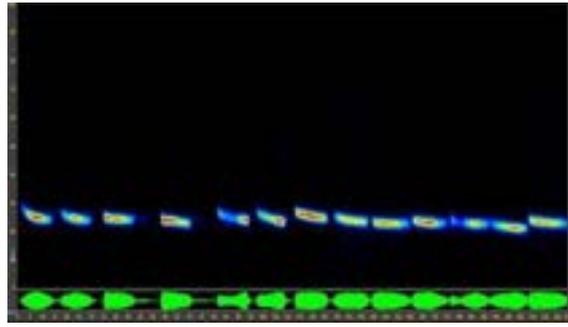


Leisler's Bat - call duration 6.0 ms

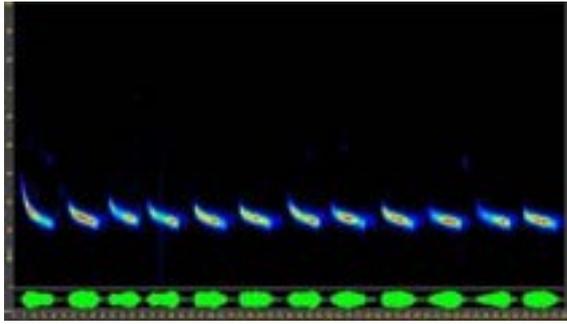




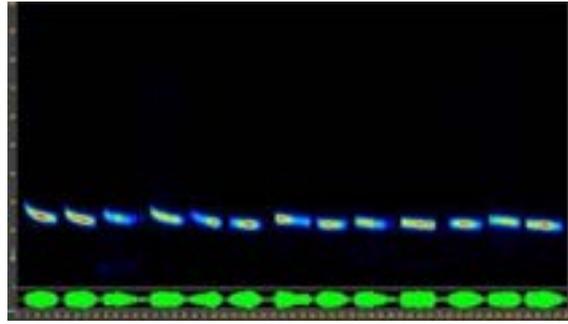
Serotine - call duration 13.0-16.0 ms



Leisler's Bat - call duration 13-16 ms

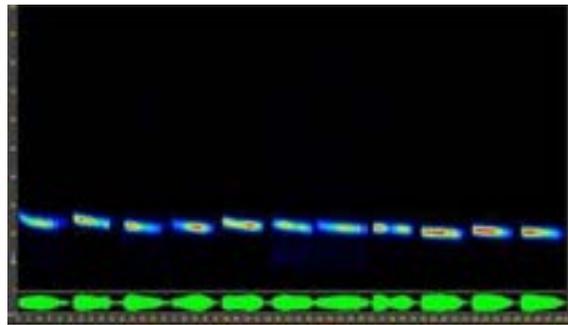


Serotine - call duration 17.0-18.0 ms



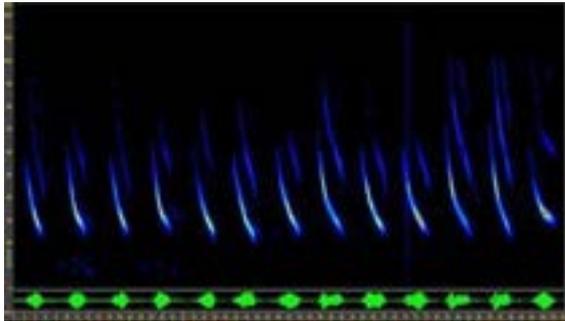
Leisler's Bat - call duration 17-18 ms

Serotine - no examples for this call duration

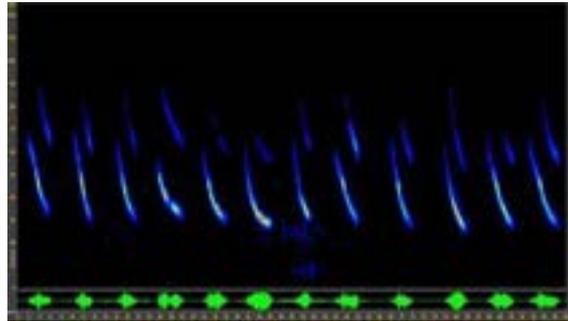


Leisler's bat - call duration 19-24 ms

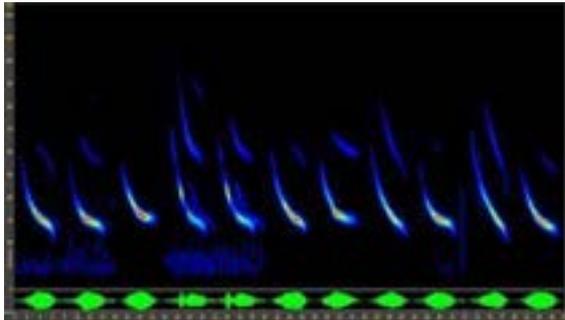
11. Parti-coloured Bat *Vespertilio murinus* and Leisler's Bat *Nyctalus leisleri*



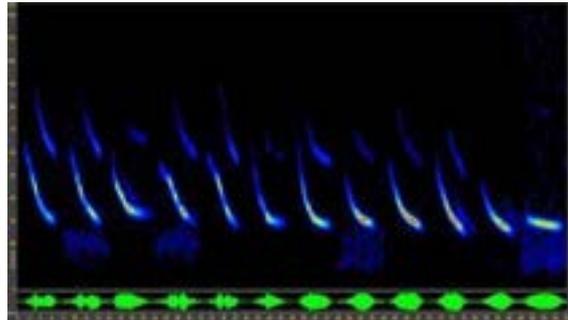
Parti-coloured Bat - call duration 3.0-4.0 ms



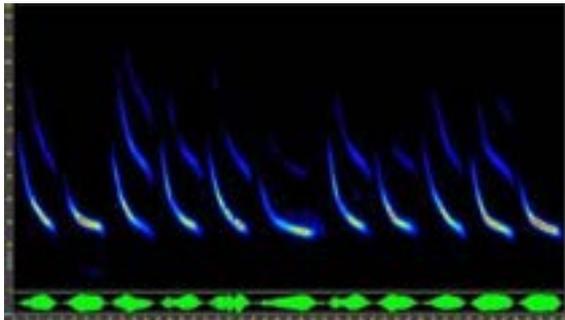
Leisler's Bat - call duration 3.0-4.0 ms



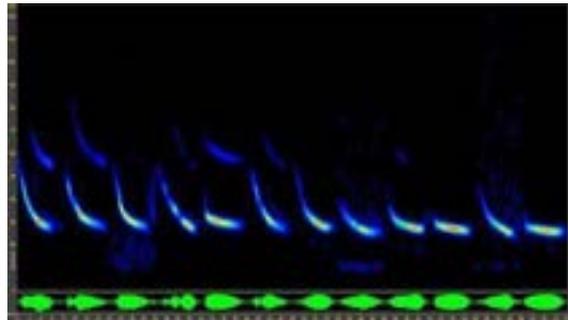
Parti-coloured Bat - call duration 5.0 ms



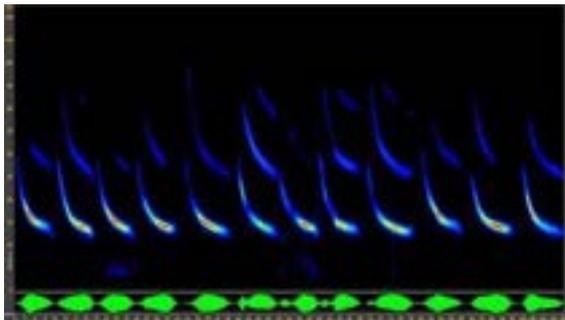
Leisler's Bat - call duration 5.0 ms



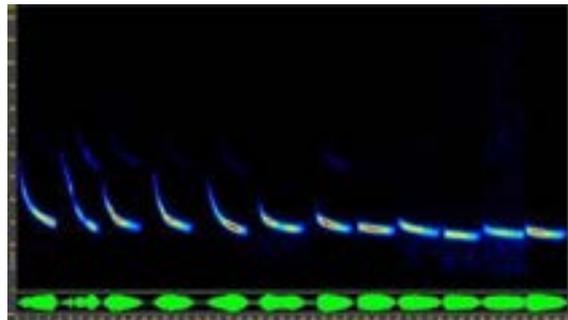
Parti-coloured Bat - call duration 6.0 ms



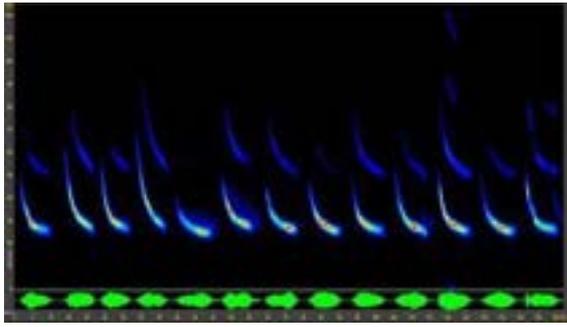
Leisler's Bat - call duration 6.0 ms



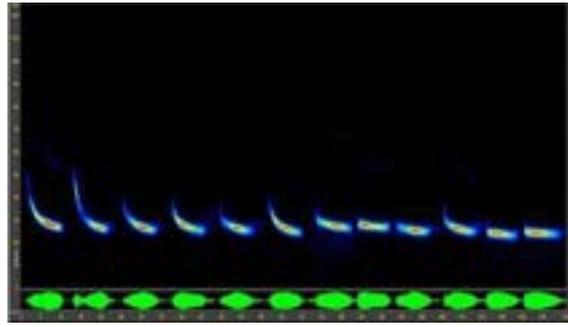
Parti-coloured Bat - call duration 7.0 ms



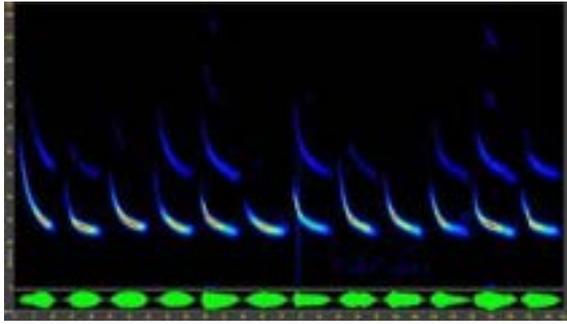
Leisler's Bat - call duration 7.0 ms



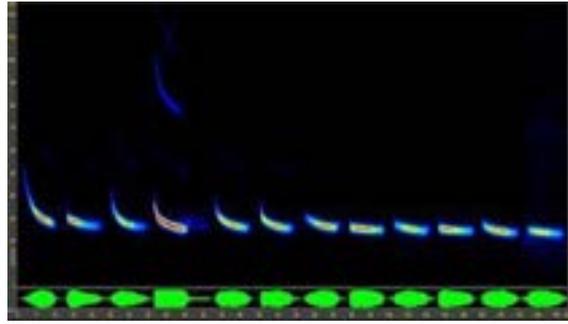
Parti-coloured Bat - call duration 8.0 ms



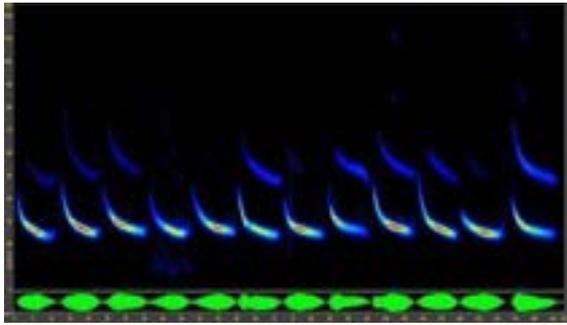
Leisler's Bat - call duration 8.0 ms



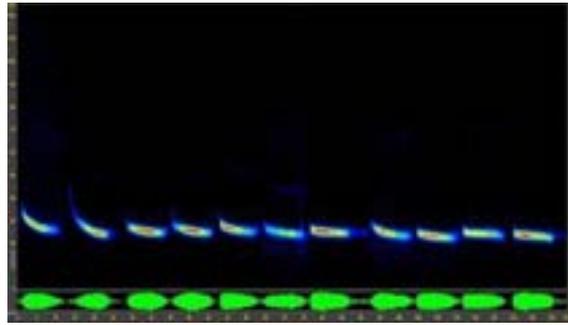
Parti-coloured Bat - call duration 9.0 ms



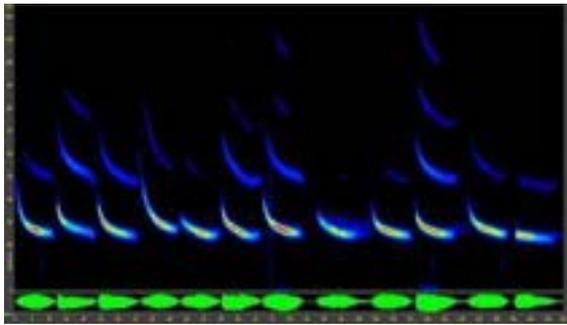
Leisler's Bat - call duration 9.0 ms



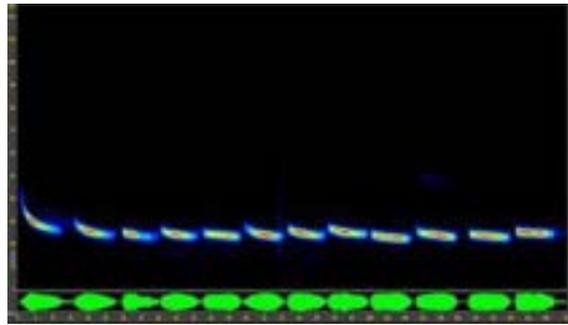
Parti-coloured Bat - call duration 10.0 ms



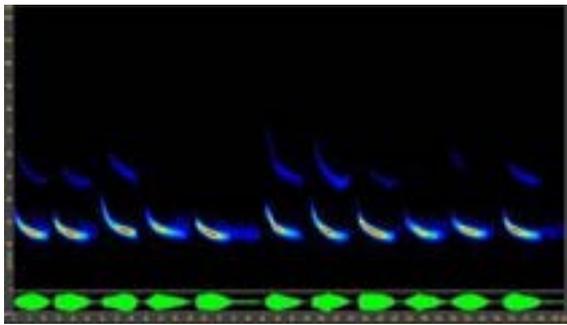
Leisler's Bat - call duration 10.0 ms



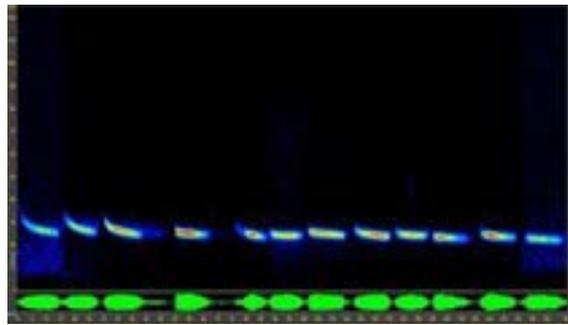
Parti-coloured Bat - call duration 11.0 ms



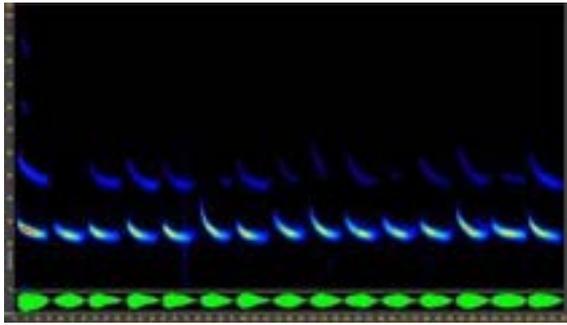
Leisler's Bat - call duration 11.0 ms



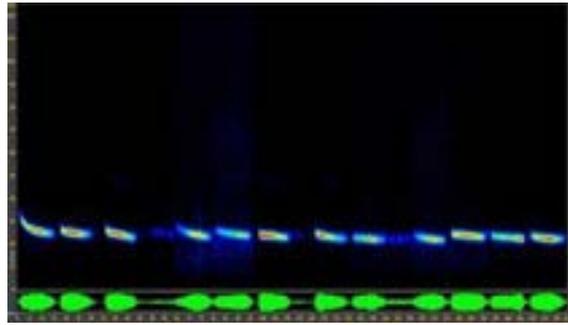
Parti-coloured Bat - call duration 12.0 ms



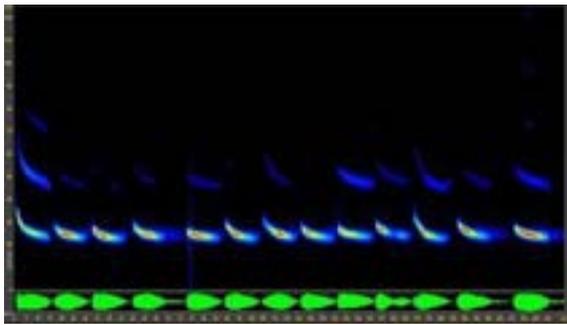
Leisler's Bat - call duration 12.0 ms



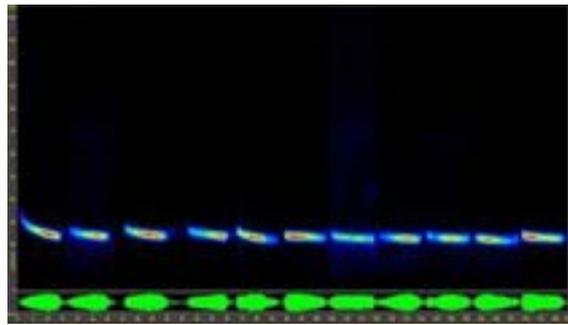
Parti-coloured Bat - call duration 13.0 ms



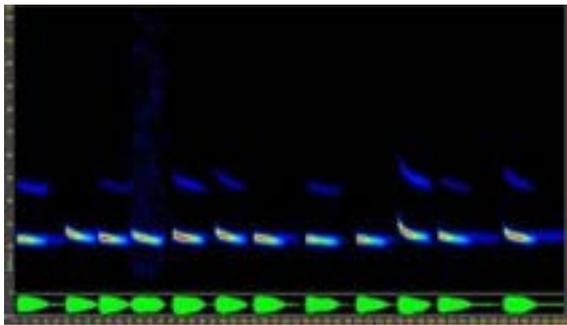
Leisler's Bat - call duration 13.0 ms



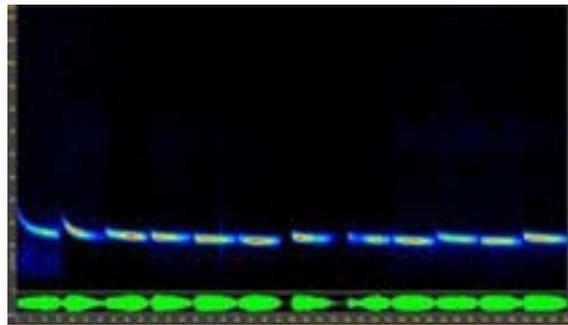
Parti-coloured Bat - call duration 14.0 ms



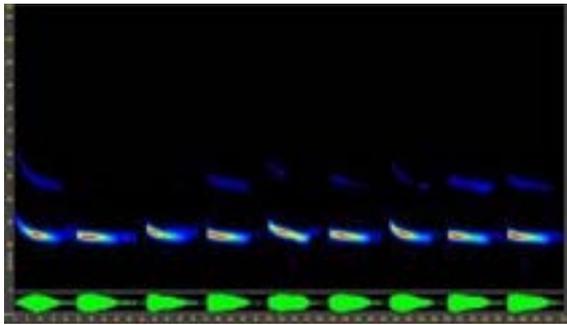
Leisler's Bat - call duration 14.0 ms



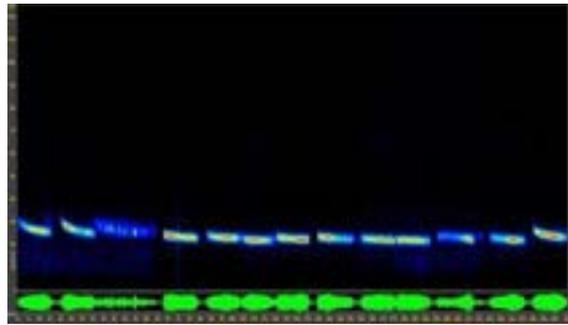
Parti-coloured Bat - call duration 15.0 ms



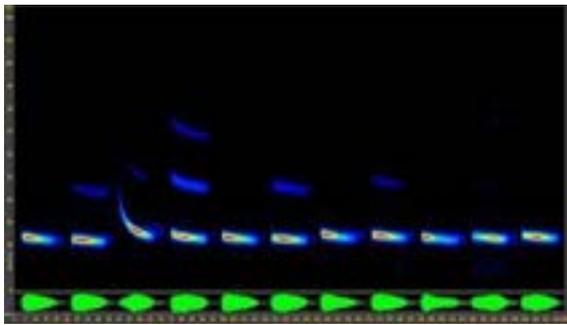
Leisler's Bat - call duration 15.0 ms



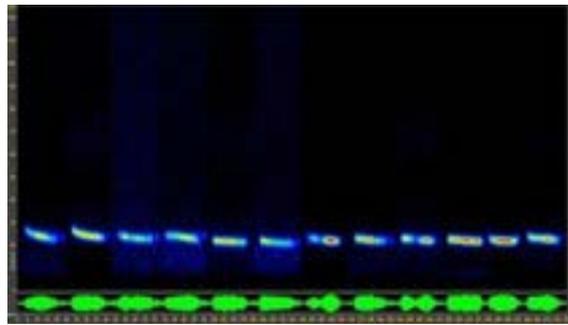
Parti-coloured Bat - call duration 16.0 ms



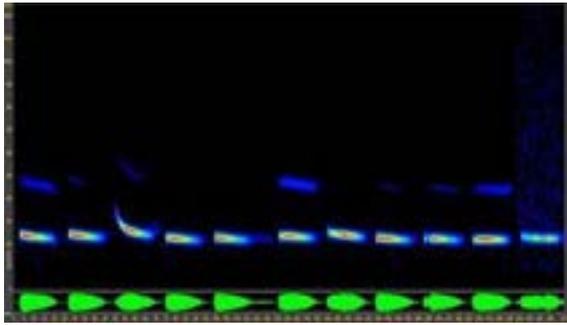
Leisler's Bat - call duration 16.0 ms



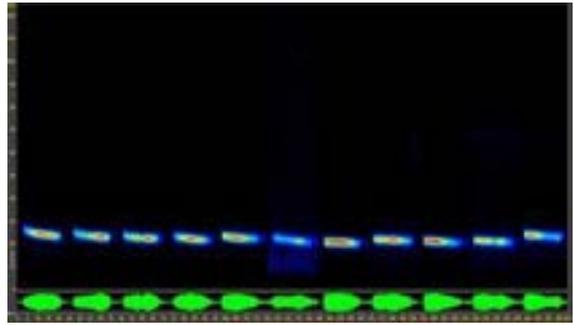
Parti-coloured Bat - call duration 17.0 ms



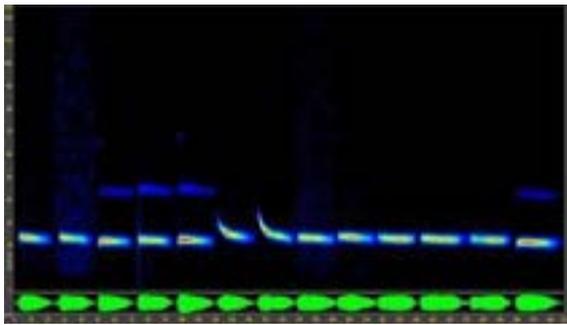
Leisler's Bat - call duration 17.0 ms



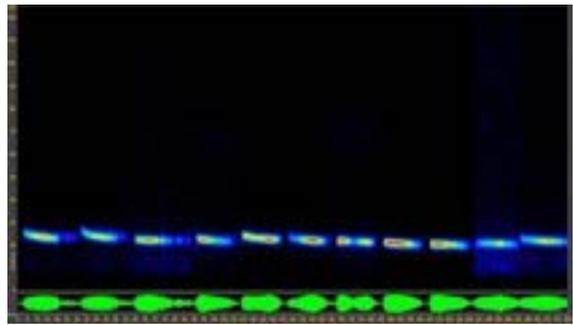
Parti-coloured Bat - call duration 18.0 ms



Leisler's Bat - call duration 18.0 ms



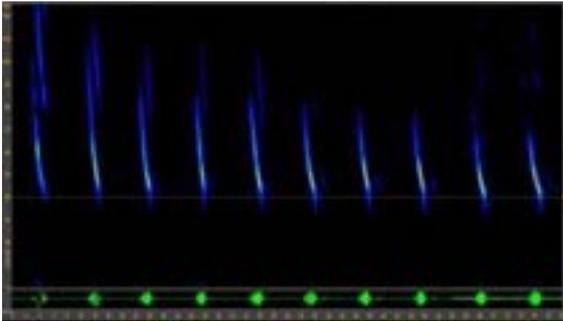
Parti-coloured Bat - call duration 19.0-24.0 ms



Leisler's Bat - call duration 19.0-24.0 ms

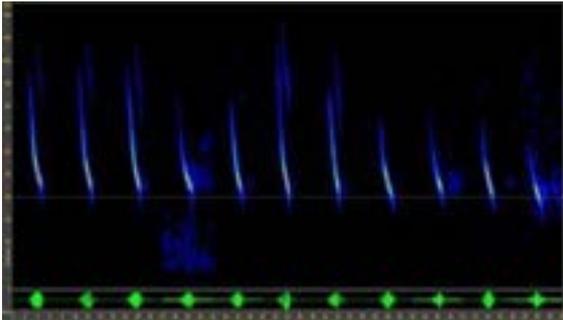
12. Kuhl's Pipistrelle *Pipistrellus kuhlii* and Nathusius' Pipistrelle *Pipistrellus nathusii*

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, for our own projects, we take a cautious approach and present the number of recordings of Nathusius' Pipistrelle and Kuhl's Pipistrelle combined.

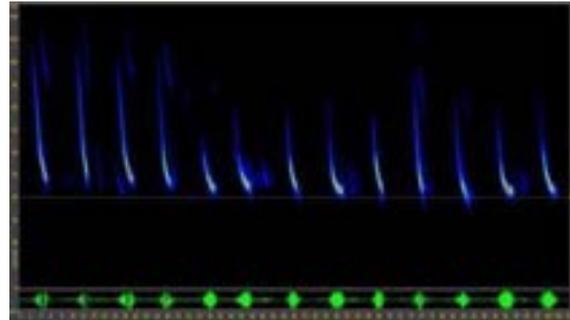


Kuhl's Pipistrelle - call duration 1.1-1.7 ms

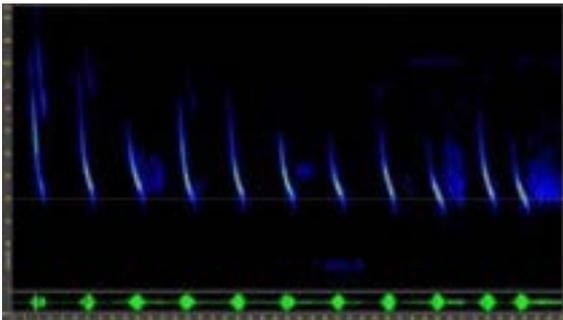
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 1.8-2.2 ms

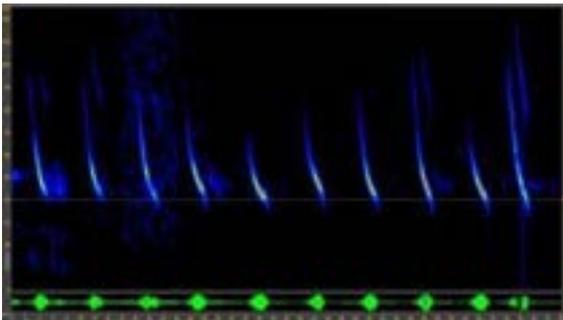


Nathusius' Pipistrelle - call duration 1.8-3.0 ms



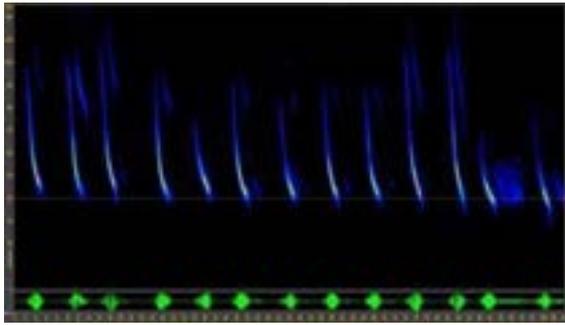
Kuhl's Pipistrelle - call duration 2.3-2.6 ms

Nathusius' Pipistrelle - fewer examples for this call duration



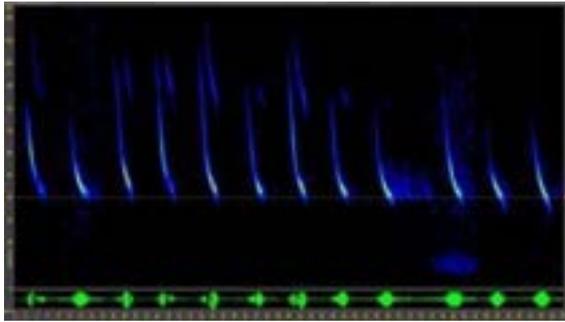
Kuhl's Pipistrelle - call duration 2.7-2.9 ms

Nathusius' Pipistrelle - fewer examples for this call duration

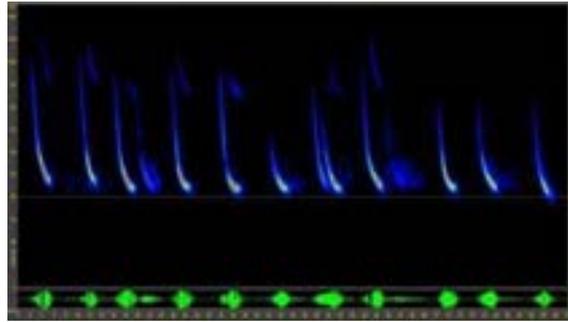


Kuhl's Pipistrelle - call duration 3.0-3.1 ms

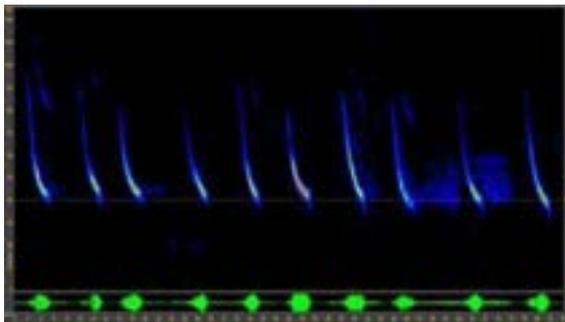
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 3.2-3.3 ms

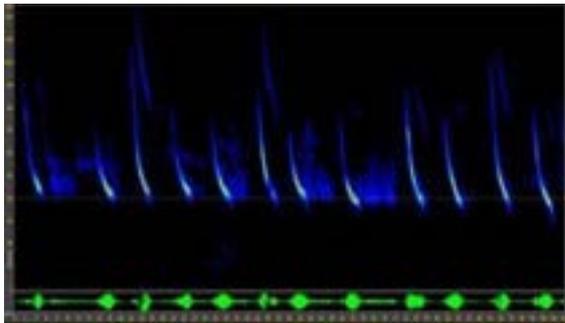


Nathusius' Pipistrelle - call duration 3.1-3.6 ms



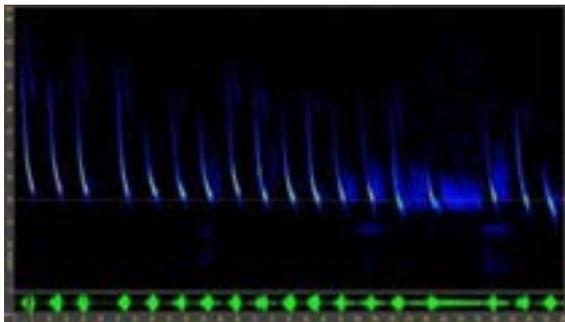
Kuhl's Pipistrelle - call duration 3.4-3.5 ms

Nathusius' Pipistrelle - fewer examples for this call duration

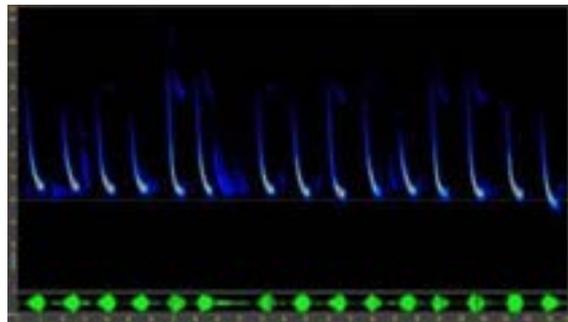


Kuhl's Pipistrelle - call duration 3.6-3.7 ms

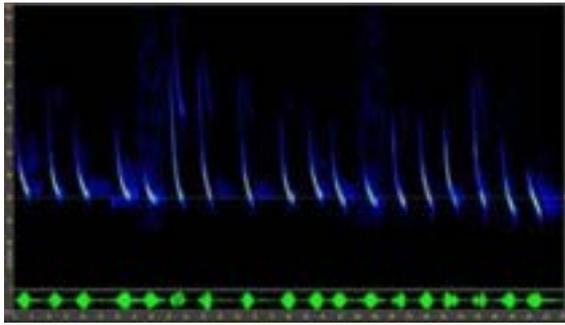
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 3.8-3.9 ms

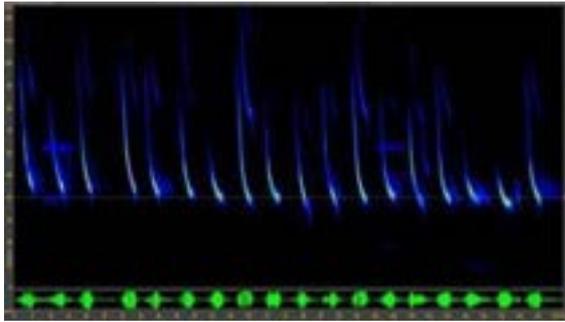


Nathusius' Pipistrelle - call duration 3.7-4.0 ms

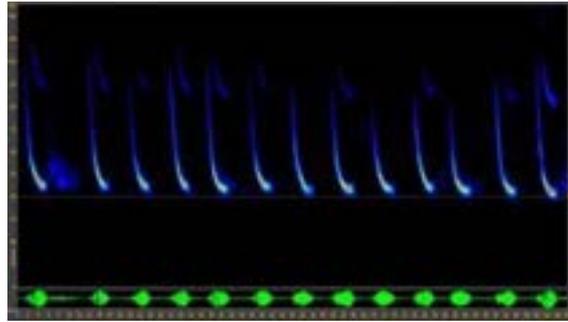


Kuhl's Pipistrelle - call duration 4.0-4.1 ms

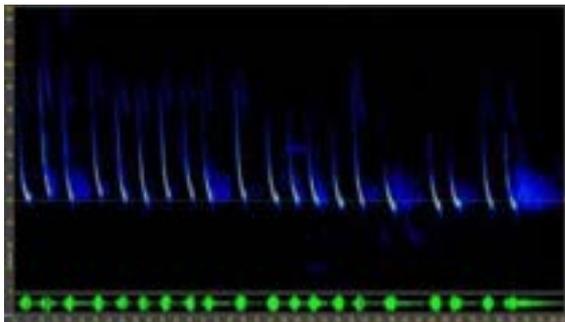
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 4.2-4.3 ms

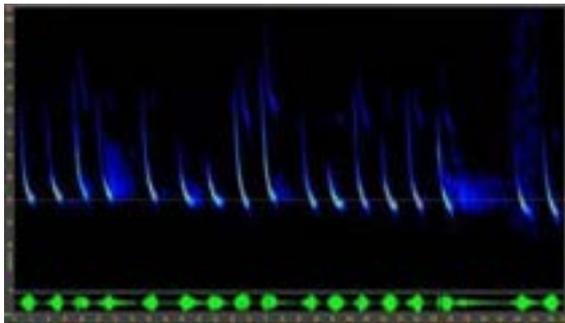


Nathusius' Pipistrelle - call duration 4.1-4.4 ms

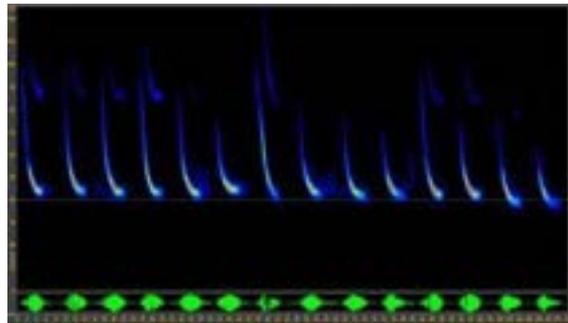


Kuhl's Pipistrelle - call duration 4.4-4.5 ms

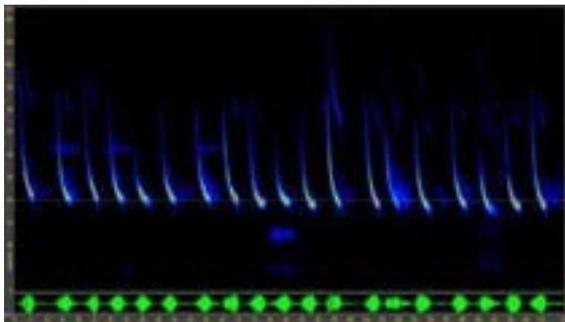
Nathusius' Pipistrelle - fewer examples for this call duration



Kuhl's Pipistrelle - call duration 4.6-4.7 ms

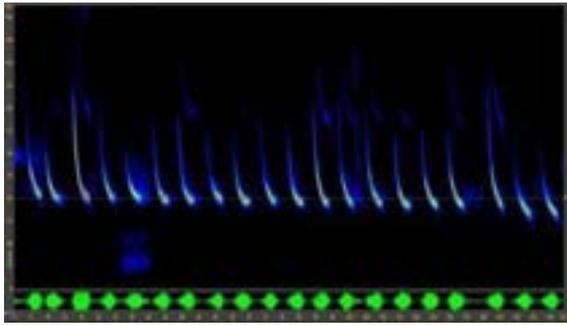


Nathusius' Pipistrelle - call duration 4.5-4.8 ms

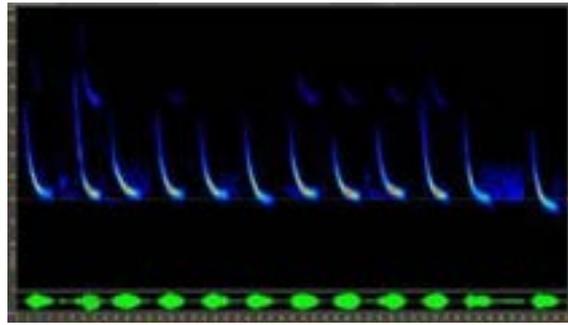


Kuhl's Pipistrelle - call duration 4.8-4.9 ms

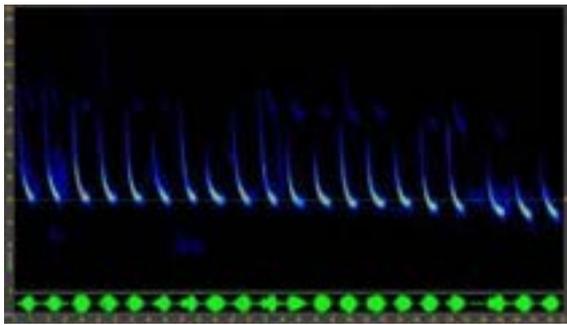
Nathusius' Pipistrelle - fewer examples for this call duration



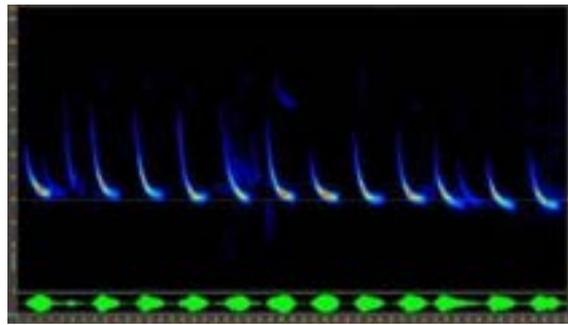
Kuhl's Pipistrelle - call duration 5.0-5.1 ms



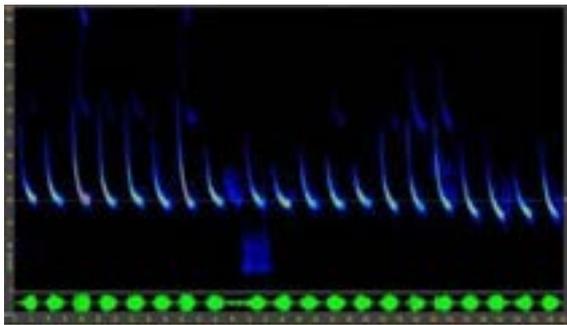
Nathusius' Pipistrelle - call duration 4.9-5.1 ms



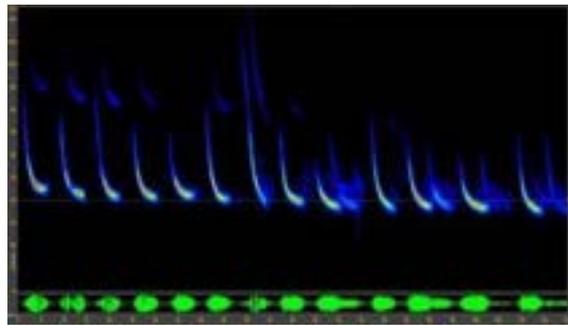
Kuhl's Pipistrelle - call duration 5.2-5.3 ms



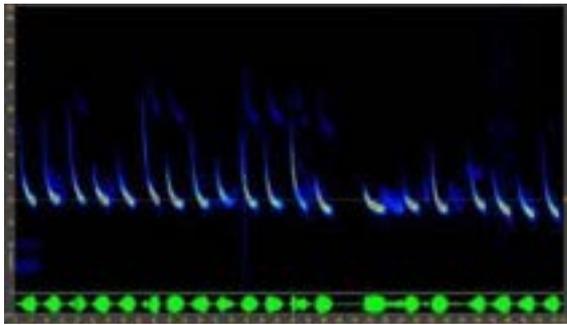
Nathusius' Pipistrelle - call duration 5.2-5.3 ms



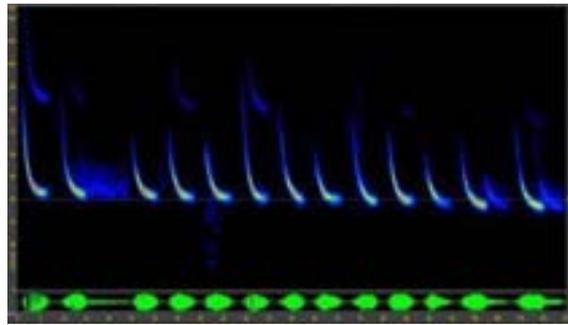
Kuhl's Pipistrelle - call duration 5.4-5.5 ms



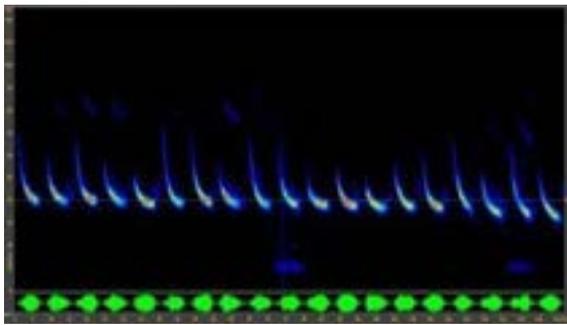
Nathusius' Pipistrelle - call duration 5.4-5.5 ms



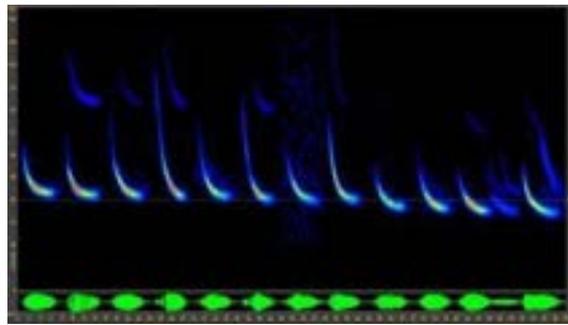
Kuhl's Pipistrelle - call duration 5.6-5.7 ms



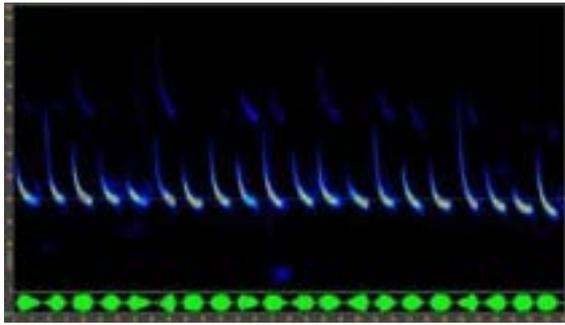
Nathusius' Pipistrelle - call duration 5.6-5.7 ms



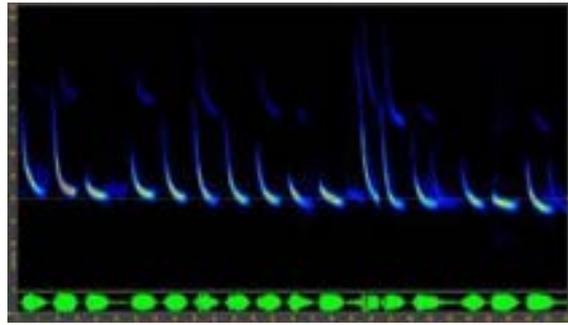
Kuhl's Pipistrelle - call duration 5.8-5.9 ms



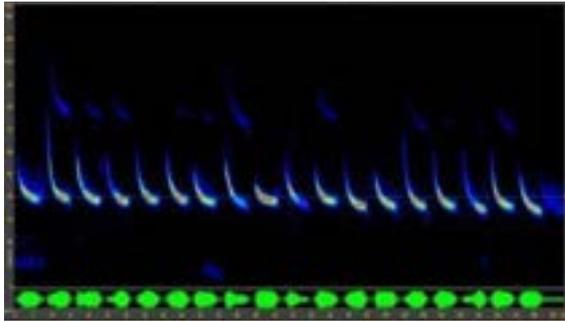
Nathusius' Pipistrelle - call duration 5.8-5.9 ms



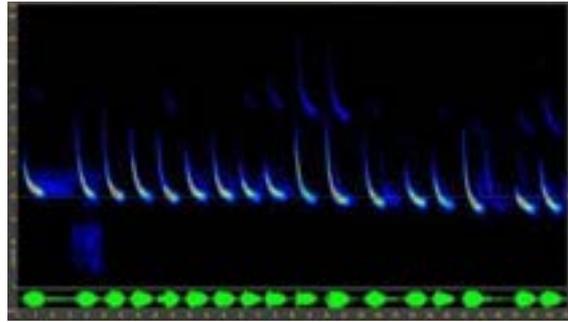
Kuhl's Pipistrelle - call duration 6.0-6.1 ms



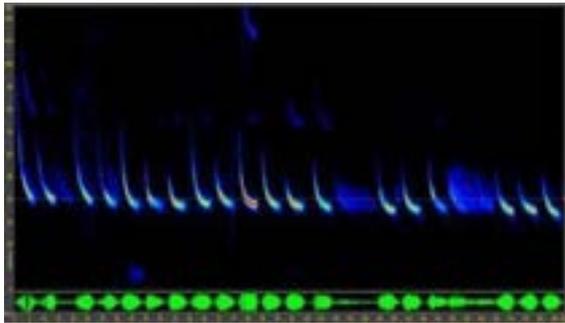
Nathusius' Pipistrelle - call duration 6.0-6.1 ms



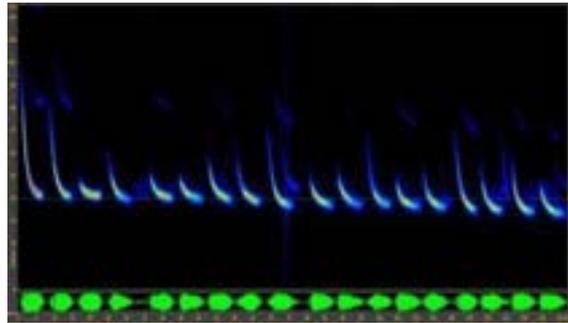
Kuhl's Pipistrelle - call duration 6.2-6.3 ms



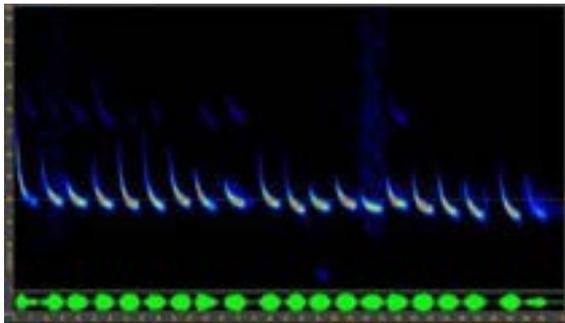
Nathusius' Pipistrelle - call duration 6.2-6.3 ms



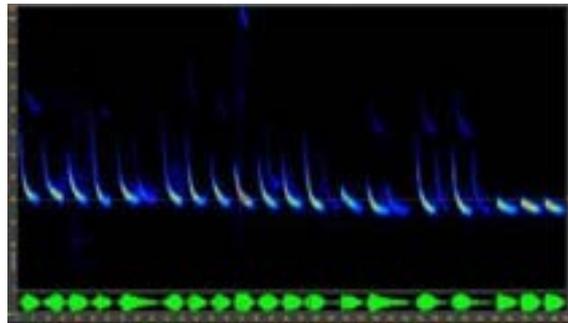
Kuhl's Pipistrelle - call duration 6.4-6.5 ms



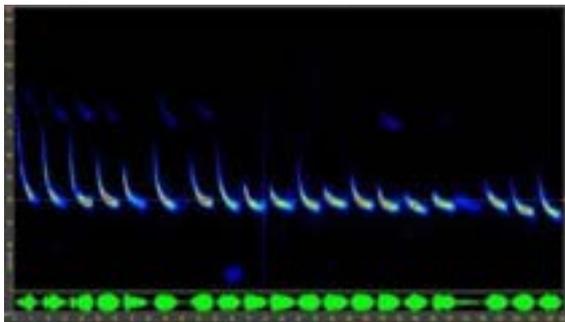
Nathusius' Pipistrelle - call duration 6.4-6.5 ms



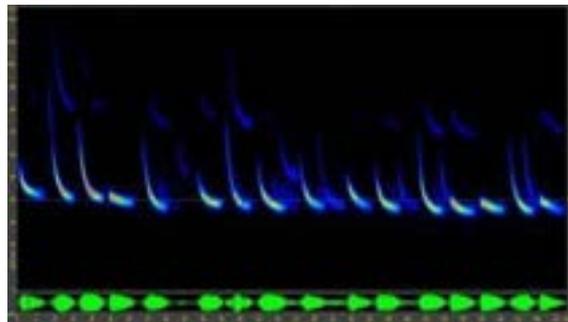
Kuhl's Pipistrelle - call duration 6.6-6.7 ms



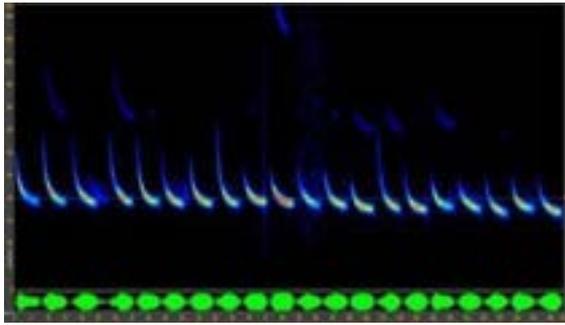
Nathusius' Pipistrelle - call duration 6.6-6.7 ms



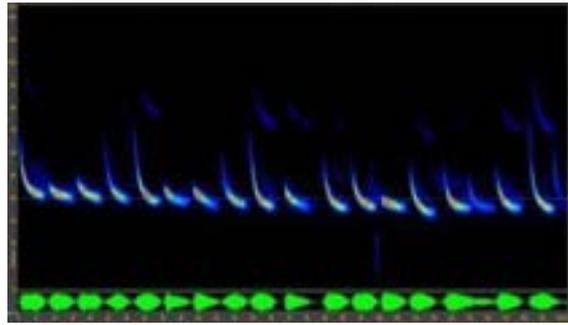
Kuhl's Pipistrelle - call duration 6.8-6.9 ms



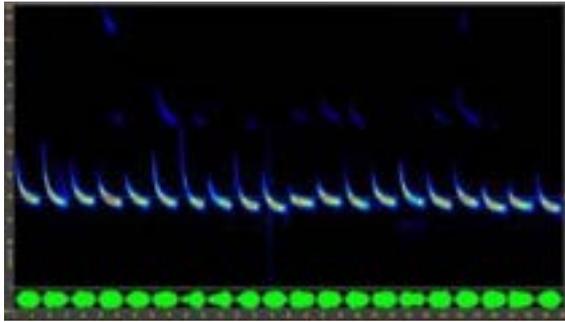
Nathusius' Pipistrelle - call duration 6.8-6.9 ms



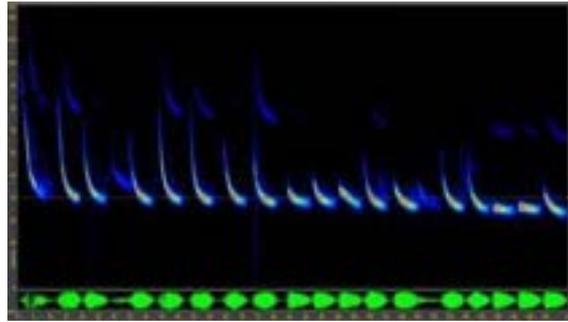
Kuhl's Pipistrelle - call duration 7.0-7.1 ms



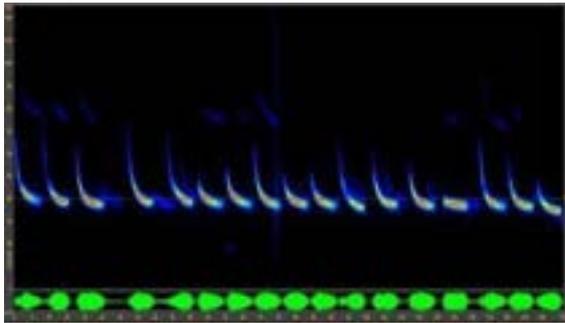
Nathusius' Pipistrelle - call duration 7.0-7.1 ms



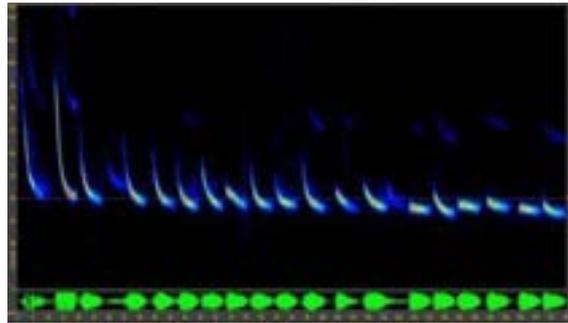
Kuhl's Pipistrelle - call duration 7.2-7.3 ms



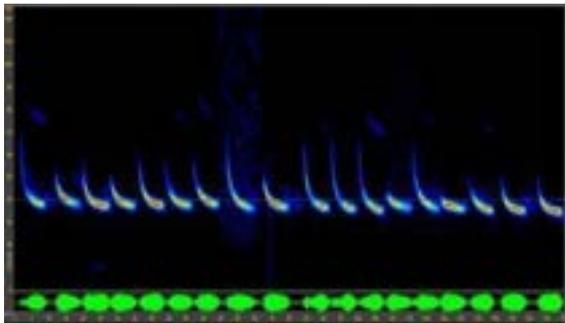
Nathusius' Pipistrelle - call duration 7.2-7.3 ms



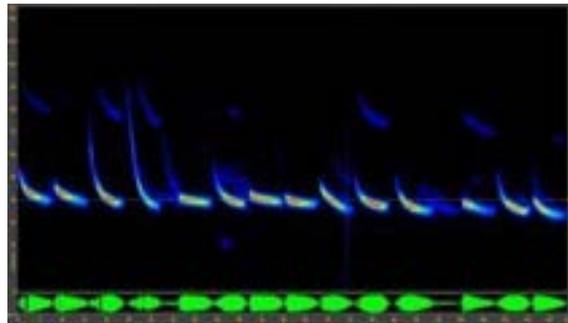
Kuhl's Pipistrelle - call duration 7.4-7.5 ms



Nathusius' Pipistrelle - call duration 7.4-7.5 ms



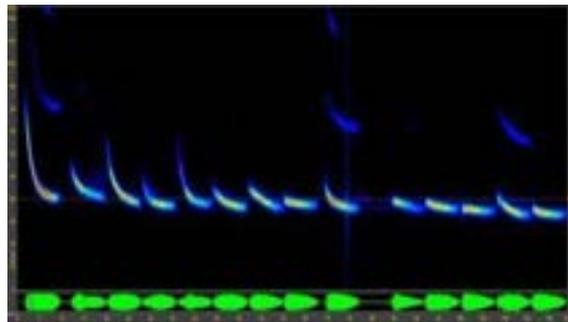
Kuhl's Pipistrelle - call duration 7.6-7.7 ms



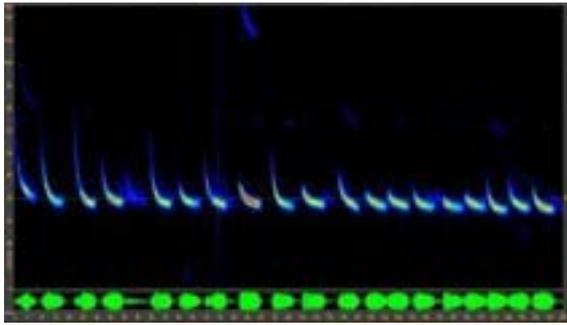
Nathusius' Pipistrelle - call duration 7.6-7.7 ms



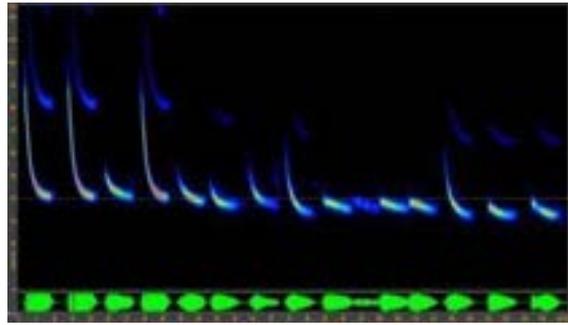
Kuhl's Pipistrelle - call duration 7.8-7.9 ms



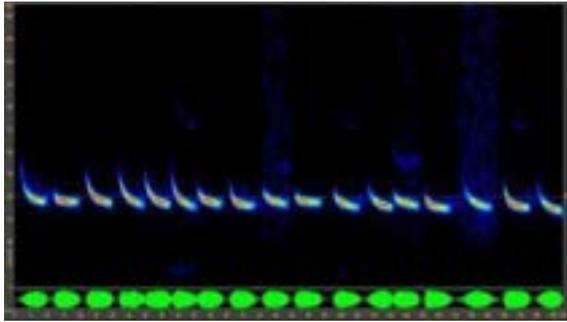
Nathusius' Pipistrelle - call duration 7.8-7.9 ms



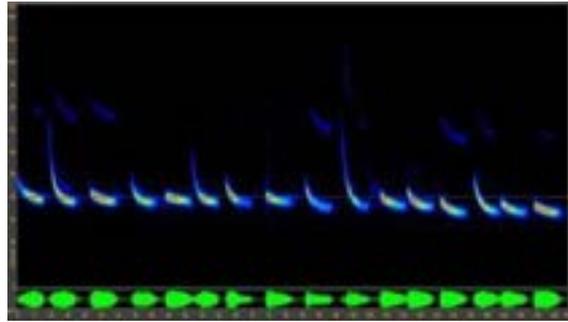
Kuhl's Pipistrelle - call duration 8.0-8.1 ms



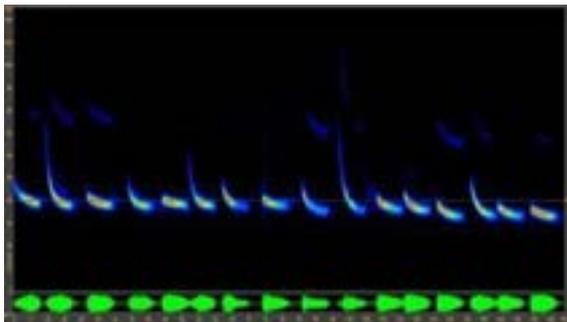
Nathusius' Pipistrelle - call duration 8.0-8.1 ms



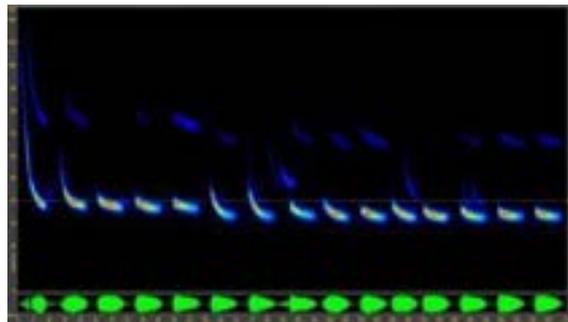
Kuhl's Pipistrelle - call duration 8.2-8.3 ms



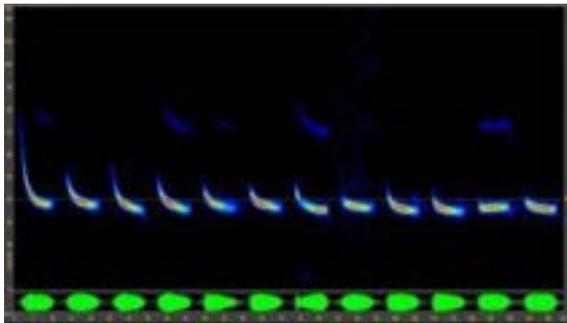
Nathusius' Pipistrelle - call duration 8.2-8.3 ms



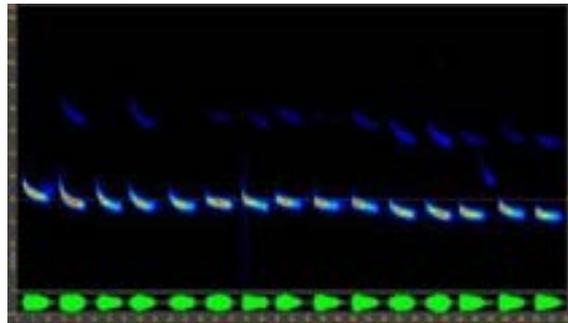
Kuhl's Pipistrelle - call duration 8.4-8.5 ms



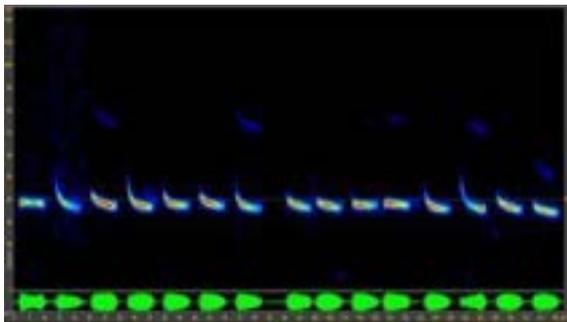
Nathusius' Pipistrelle - call duration 8.4-8.5 ms



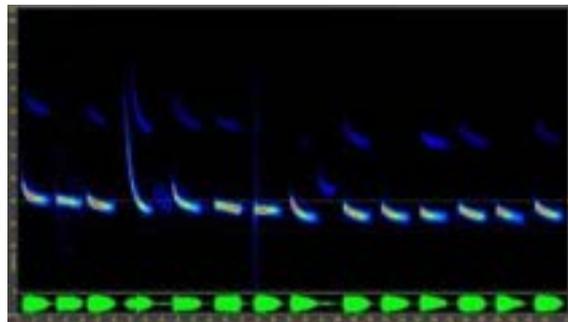
Kuhl's Pipistrelle - call duration 8.6-8.7 ms



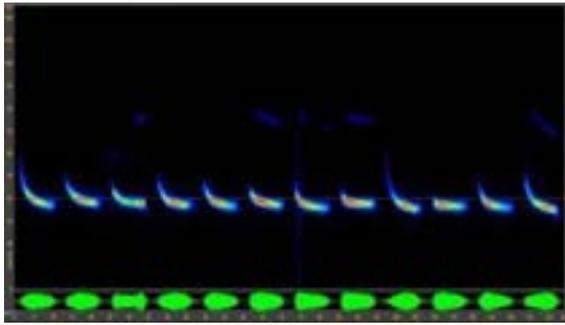
Nathusius' Pipistrelle - call duration 8.6-8.7 ms



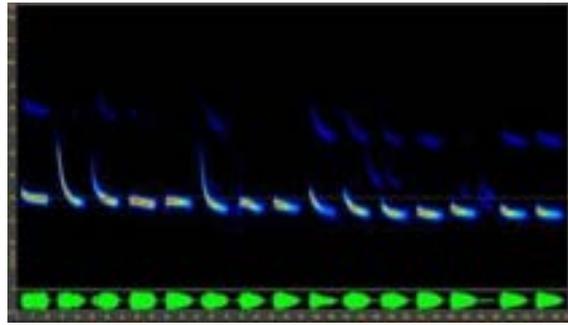
Kuhl's Pipistrelle - call duration 8.8-8.9 ms



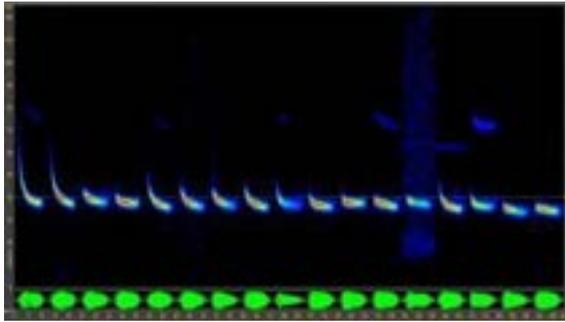
Nathusius' Pipistrelle - call duration 8.8-8.9 ms



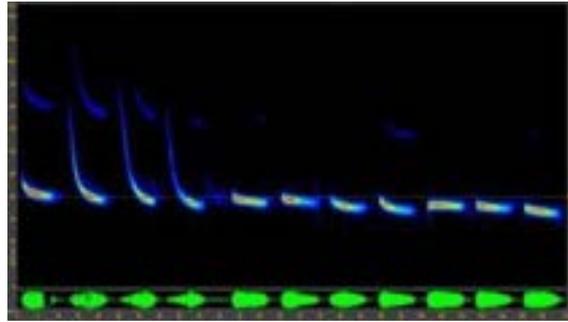
Kuhl's Pipistrelle - call duration 9.0-9.1 ms



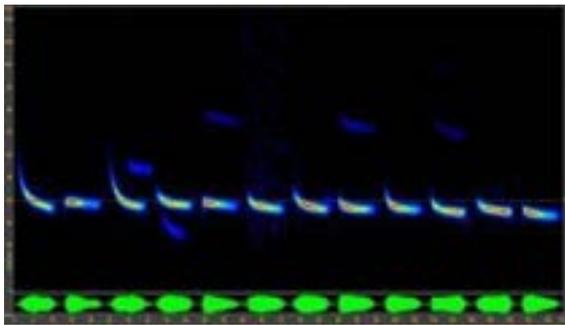
Nathusius' Pipistrelle - call duration 9.0-9.1 ms



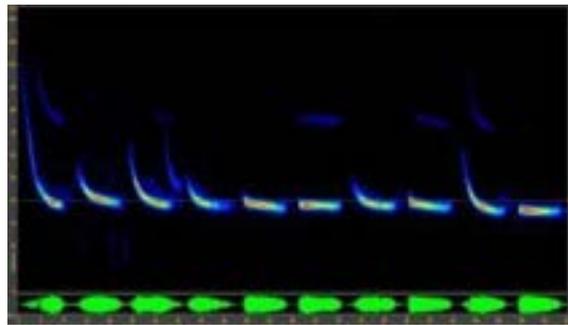
Kuhl's Pipistrelle - call duration 9.2-9.3 ms



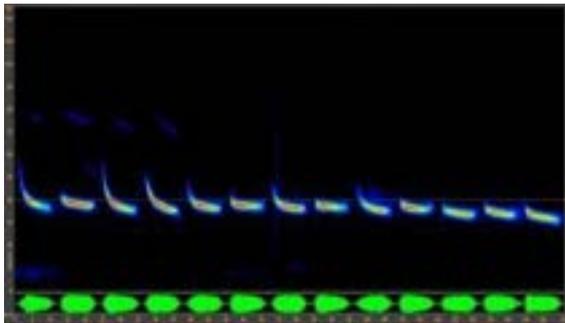
Nathusius' Pipistrelle - call duration 9.2-9.3 ms



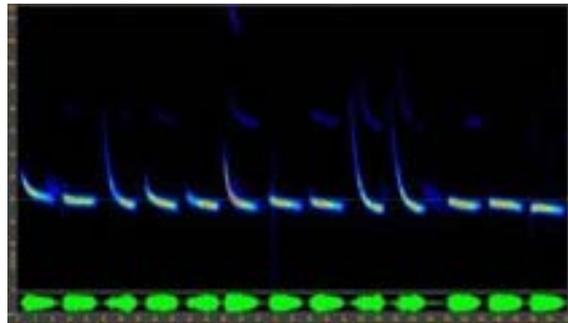
Kuhl's Pipistrelle - call duration 9.4-9.5 ms



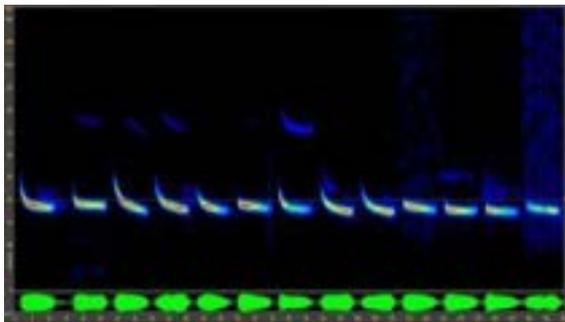
Nathusius' Pipistrelle - call duration 9.4-9.5 ms



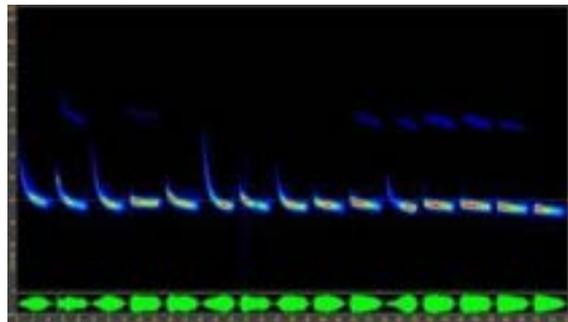
Kuhl's Pipistrelle - call duration 9.6-9.8 ms



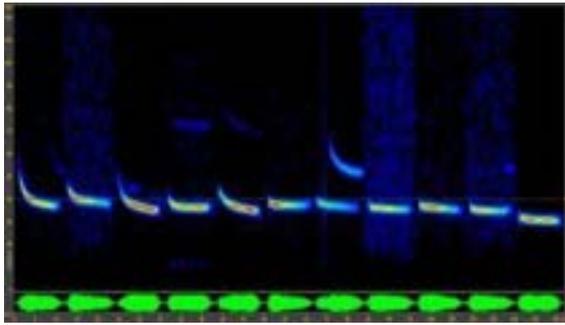
Nathusius' Pipistrelle - call duration 9.6-9.8 ms



Kuhl's Pipistrelle - call duration 9.9-10.1 ms

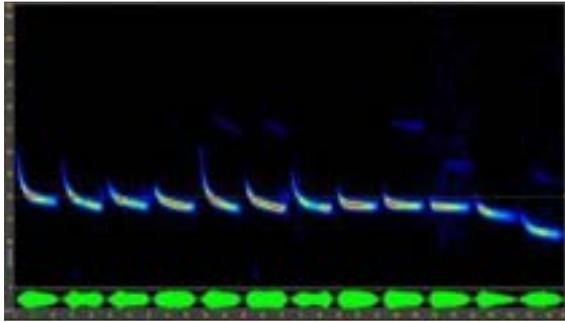


Nathusius' Pipistrelle - call duration 9.9-10.2 ms



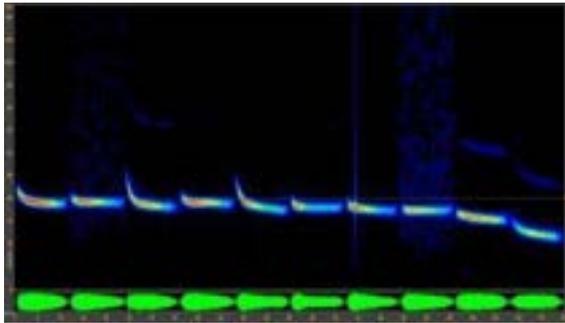
Kuhl's Pipistrelle - call duration 10.2-10.4 ms

Nathusius' Pipistrelle - fewer examples for this call duration

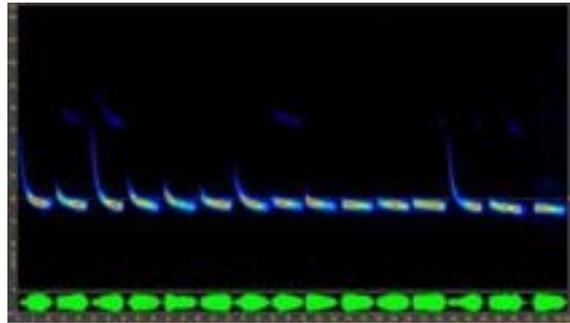


Kuhl's Pipistrelle - call duration 10.5-10.9 ms

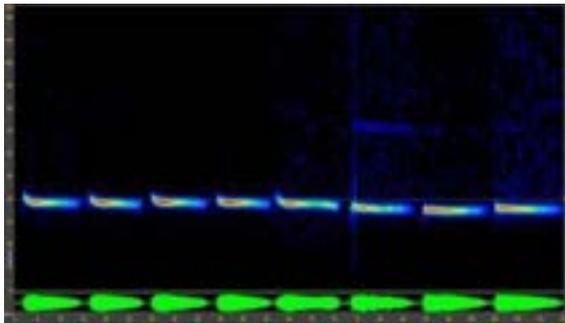
Nathusius' Pipistrelle - fewer examples for this call duration



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

13. Kuhl's Pipistrelle *Pipistrellus kuhlii* and Nathusius' Pipistrelle *Pipistrellus nathusii* social calls

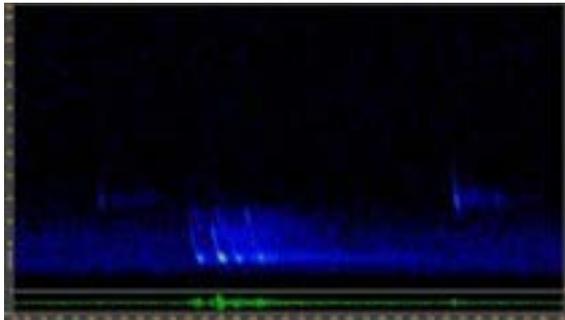
In addition to echolocation calls Kuhl's Pipistrelle and Nathusius' Pipistrelle also produce a range of social calls which can be assigned to species with confidence (observed variation in social calls shown below). Most of the observed social calls of Nathusius' Pipistrelle and Kuhl's Pipistrelle shown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



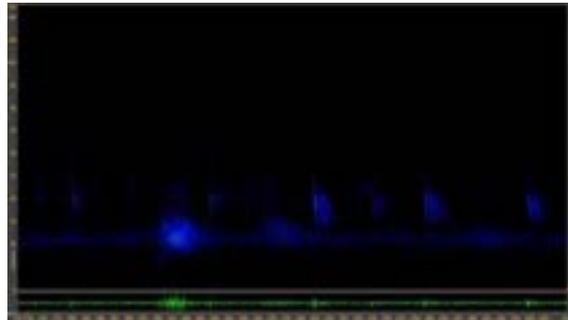
Nathusius' Pipistrelle male advertisement calls



Kuhl's Pipistrelle - three-component social call



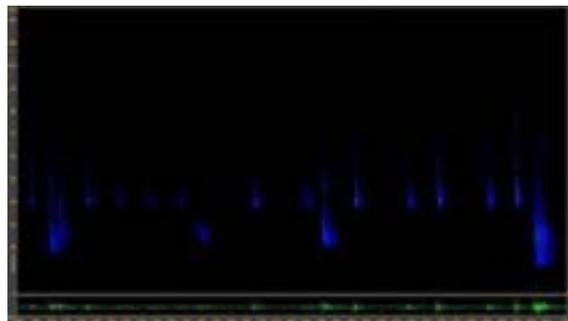
Kuhl's Pipistrelle - four-component social call



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



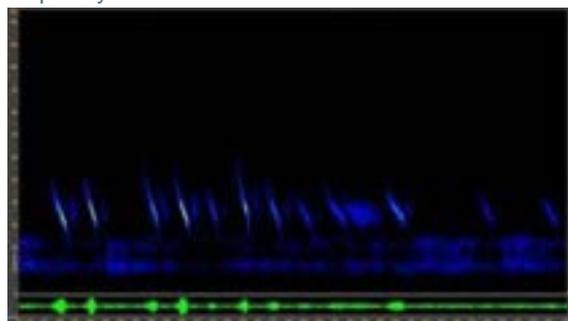
Kuhl's Pipistrelle - one-component social call



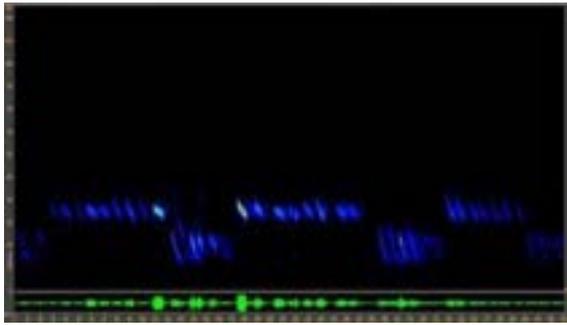
Kuhl's Pipistrelle - variation in social calls with different end frequency



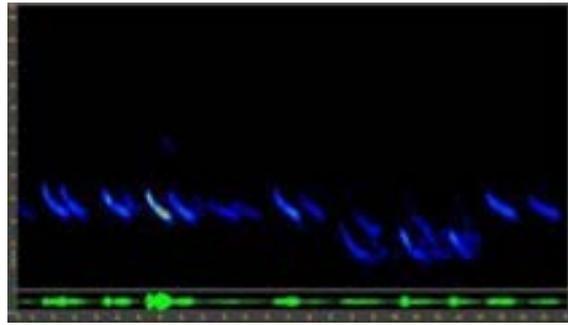
Kuhl's Pipistrelle - variation in social calls with different frequency



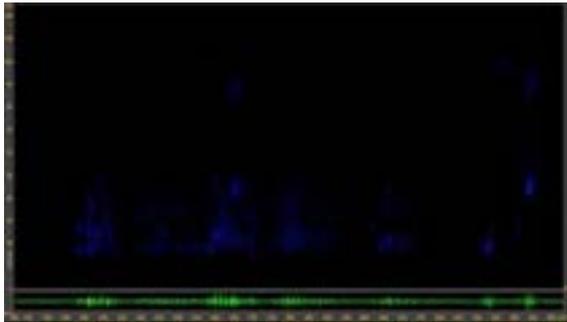
Kuhl's Pipistrelle - low frequency 'barbastelle-like' echolocation calls with social function



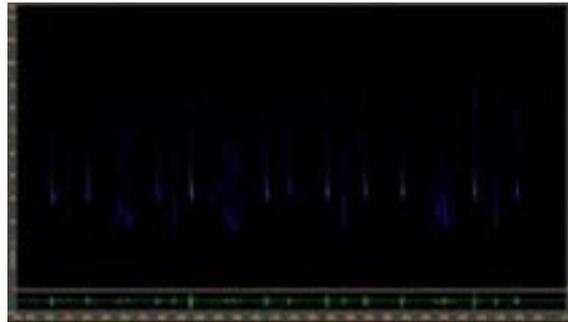
Kuhl's Pipistrelle - low frequency echolocation calls with social function and trills



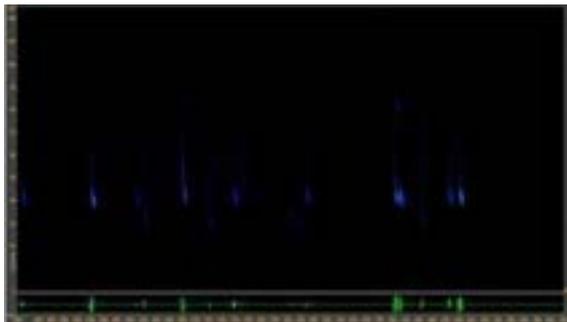
Kuhl's Pipistrelle - low frequency echolocation calls with social function and trills



Nathusius' Pipistrelle - male advertisement calls and other social calls



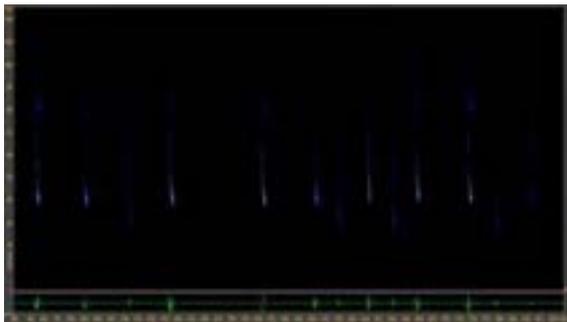
Nathusius' Pipistrelle - variation in social calls, including Plecotus-like calls



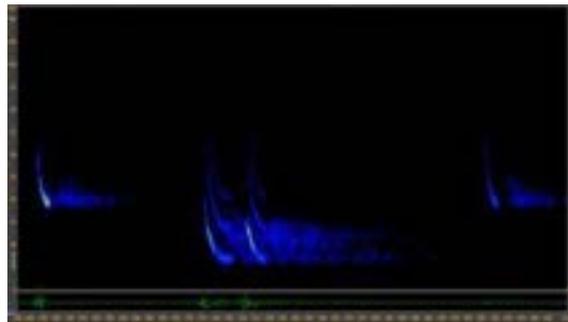
Nathusius' Pipistrelle - Plecotus-like social calls



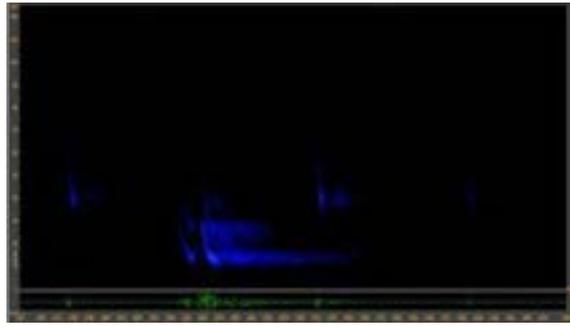
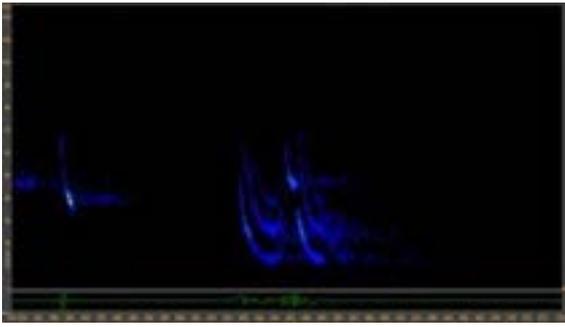
Nathusius' Pipistrelle - variation in social calls - potential confusion with Kuhl's Pipistrelle



Nathusius' Pipistrelle - Plecotus-like social calls

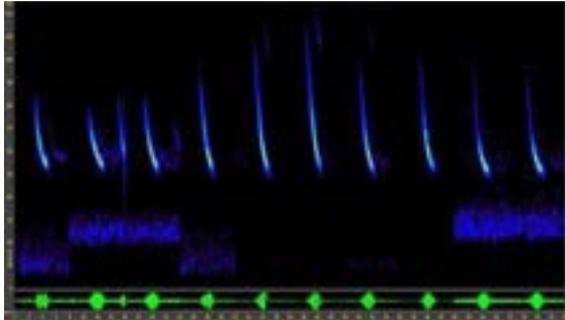


Kuhl's Pipistrelle - most common two-component social calls

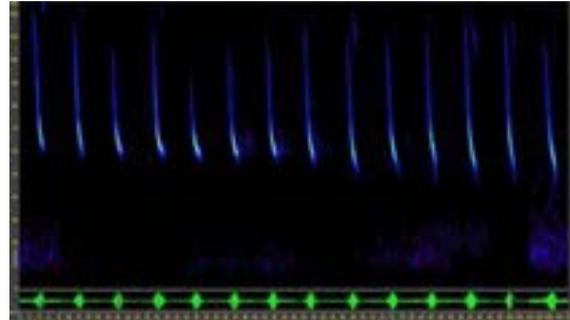


Kuhl's Pipistrelle - variation in two-component social calls Kuhl's Pipistrelle - variation in two-component social call

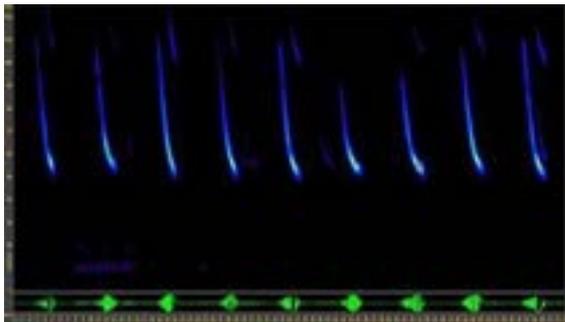
14. Schreibers' Bat *Miniopterus schreibersii* and Soprano Pipistrelle *Pipistrellus pygmaeus*



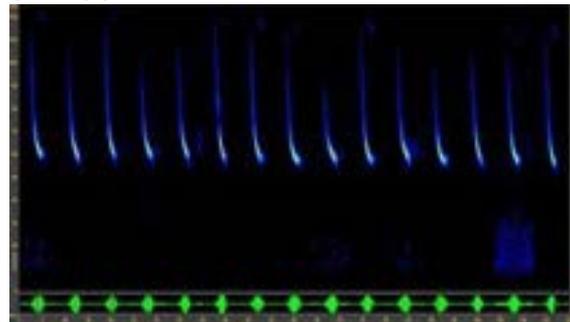
Schreibers' bat - call duration 1.9-2.3 ms



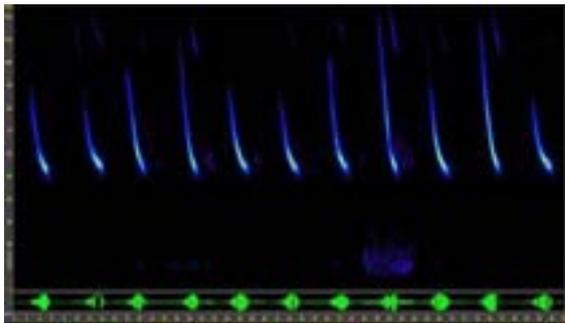
Soprano pipistrelle - call duration 1.9-2.3 ms



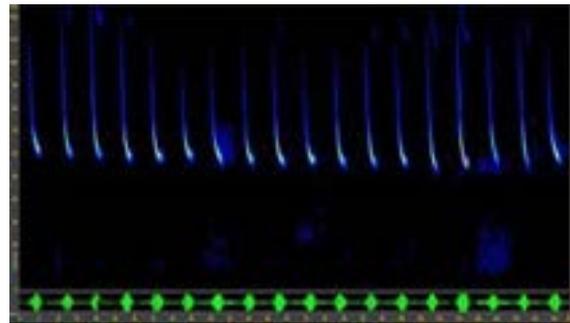
Schreibers' bat - call duration 2.4-2.9 ms



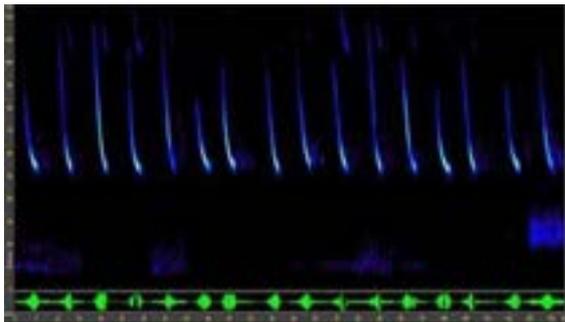
Soprano pipistrelle - call duration 2.4-2.9 ms



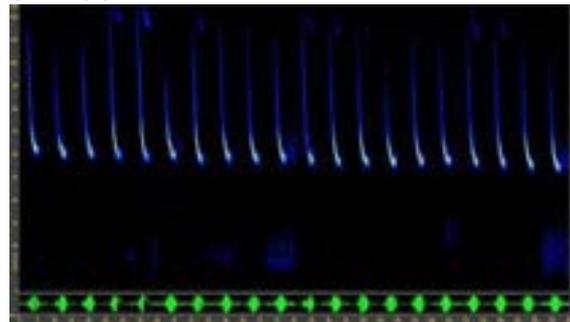
Schreibers' bat - call duration 3.0-3.1 ms



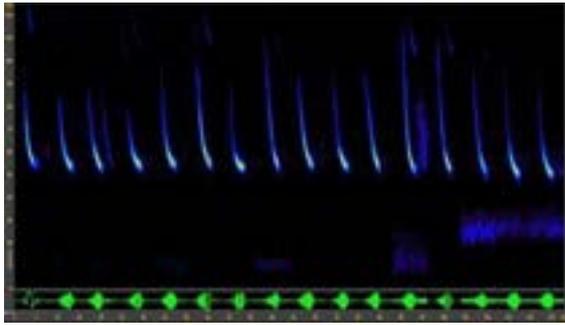
Soprano pipistrelle - call duration 3.0-3.1 ms



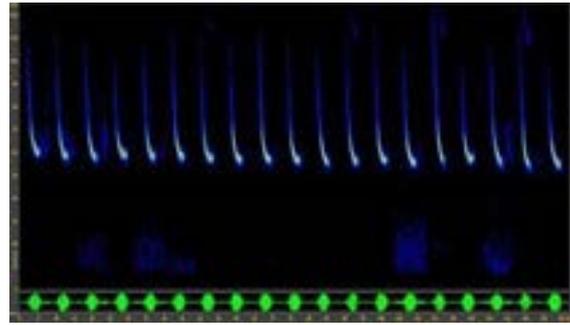
Schreibers' bat - call duration 3.2-3.3 ms



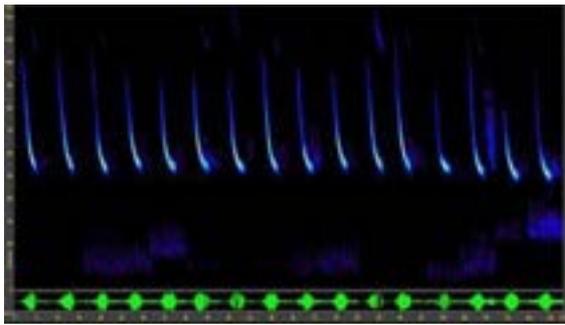
Soprano pipistrelle - call duration 3.2-3.3 ms



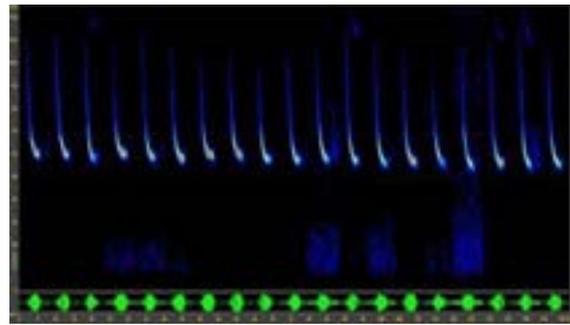
Schreibers' bat - call duration 3.4-3.5 ms



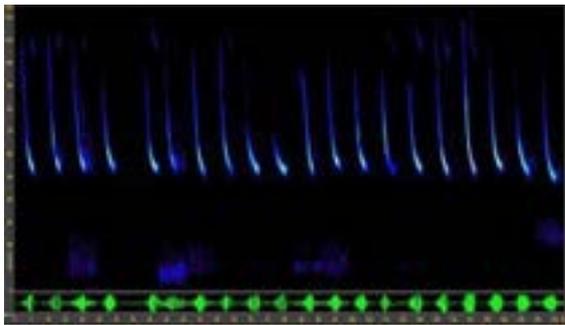
Soprano pipistrelle - call duration 3.4-3.5 ms



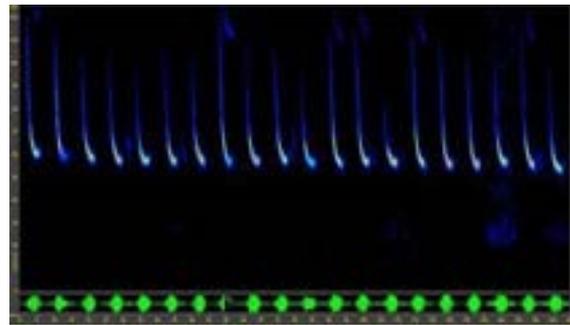
Schreibers' bat - call duration 3.6-3.7 ms



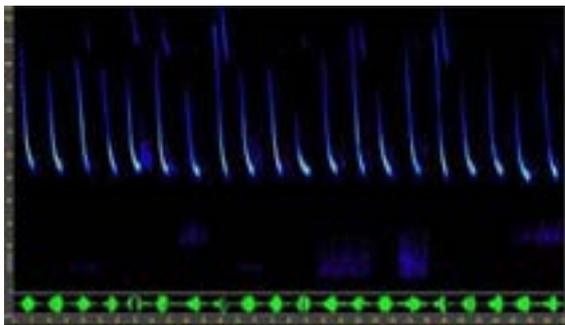
Soprano pipistrelle - call duration 3.6-3.7 ms



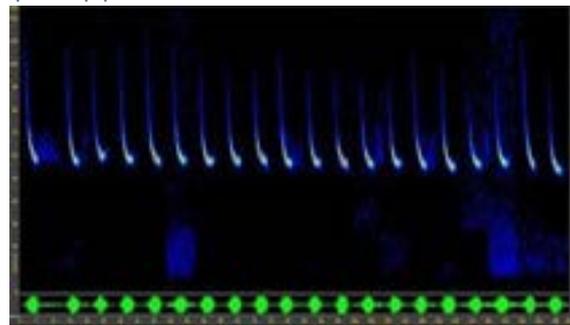
Schreibers' bat - call duration 3.8-3.9 ms



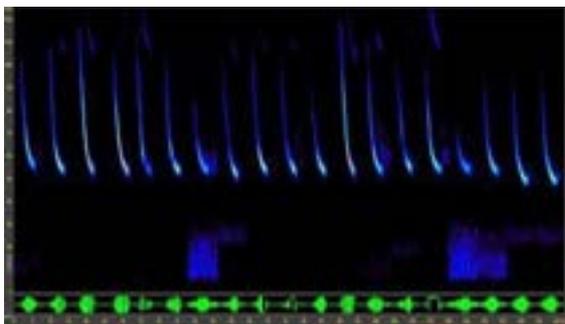
Soprano pipistrelle - call duration 3.8-3.9 ms



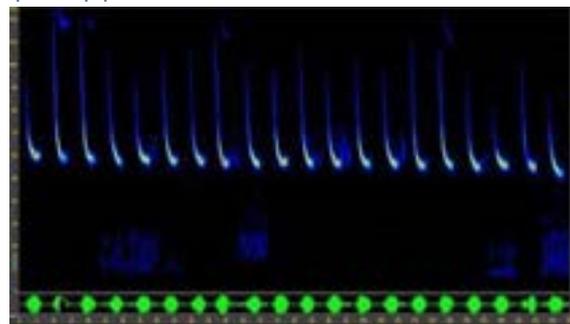
Schreibers' bat - call duration 4.0-4.1 ms



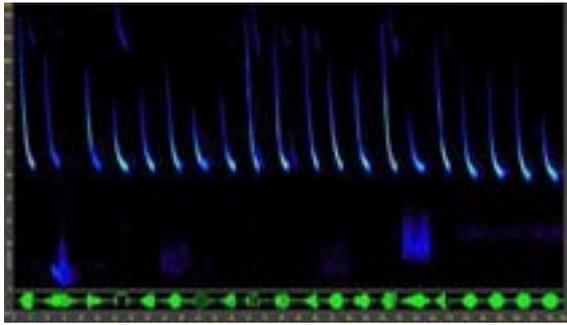
Soprano pipistrelle - call duration 4.0-4.1 ms



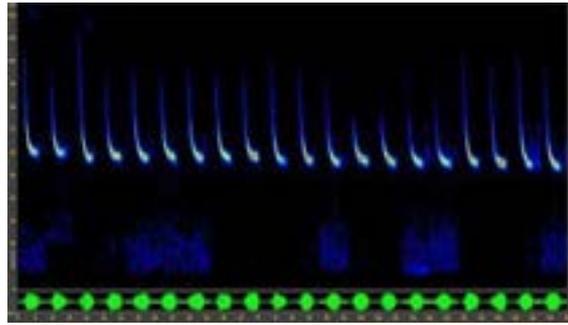
Schreibers' bat - call duration 4.2-4.3 ms



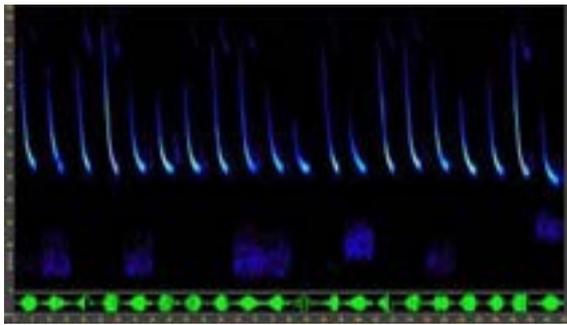
Soprano pipistrelle - call duration 4.2-4.3 ms



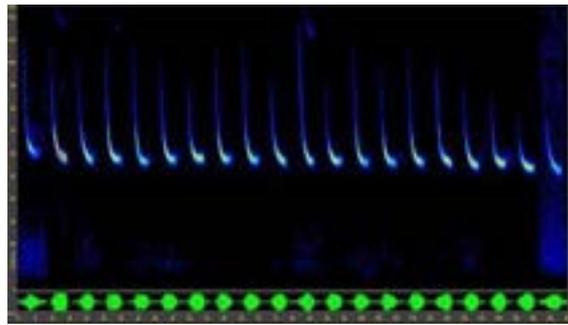
Schreibers' bat - call duration 4.4-4.5 ms



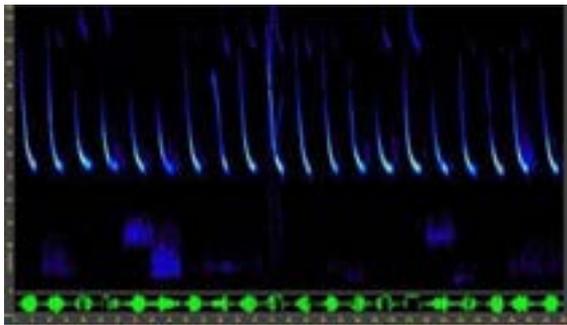
Soprano pipistrelle - call duration 4.4-4.5 ms



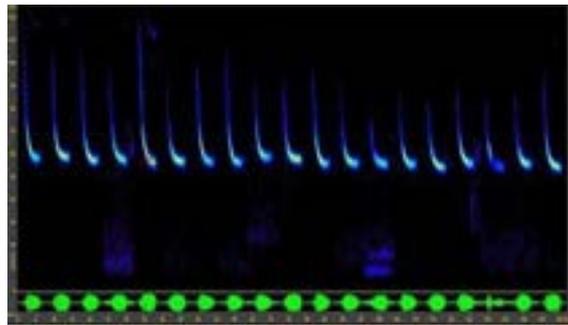
Schreibers' bat - call duration 4.6-4.7 ms



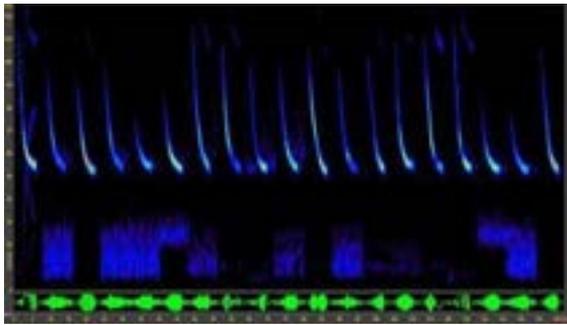
Soprano pipistrelle - call duration 4.6-4.7 ms



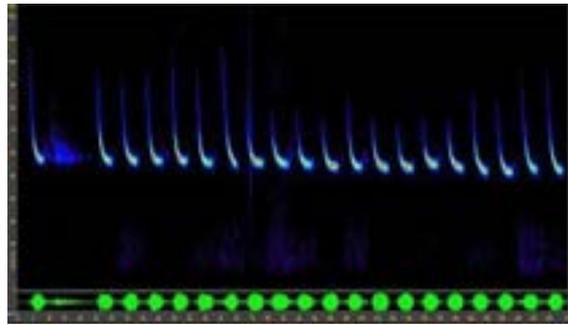
Schreibers' bat - call duration 4.8-4.9 ms



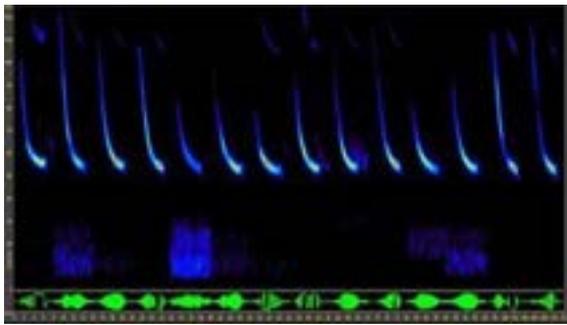
Soprano pipistrelle - call duration 4.8-4.9 ms



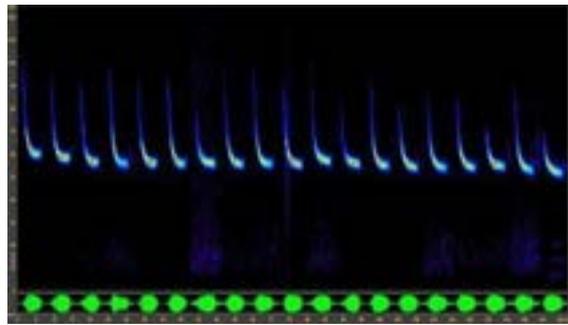
Schreibers' bat - call duration 5.0-5.1 ms



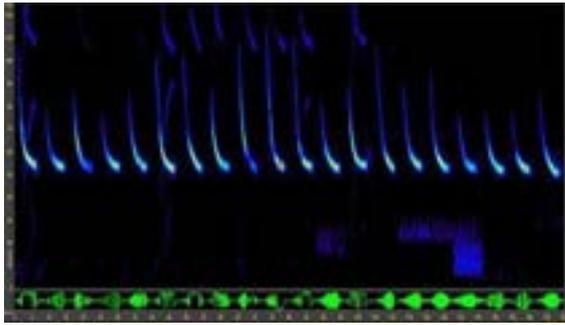
Soprano pipistrelle - call duration 5.0-5.1 ms



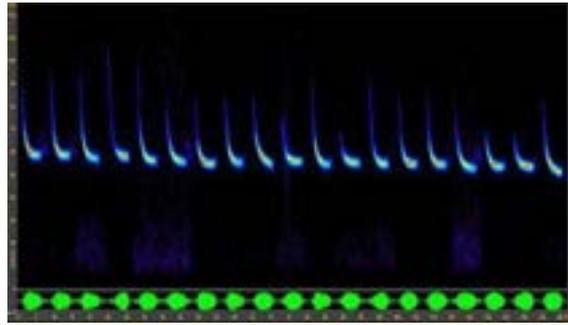
Schreibers' bat - call duration 5.2-5.3 ms



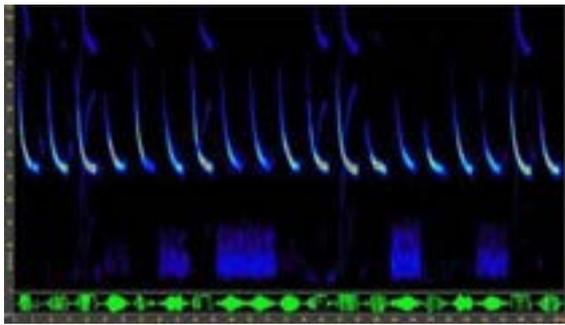
Soprano pipistrelle - call duration 5.2-5.3 ms



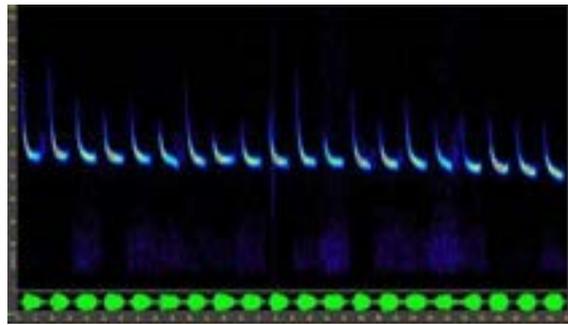
Schreibers' bat - call duration 5.4-5.5 ms



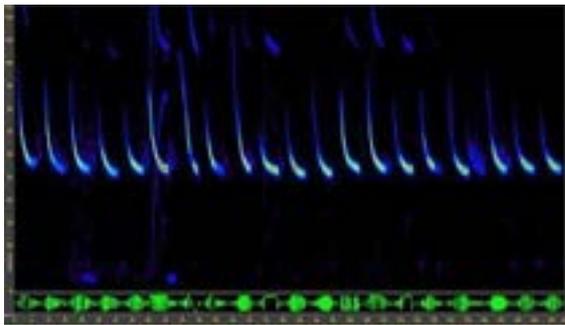
Soprano pipistrelle - call duration 5.4-5.5 ms



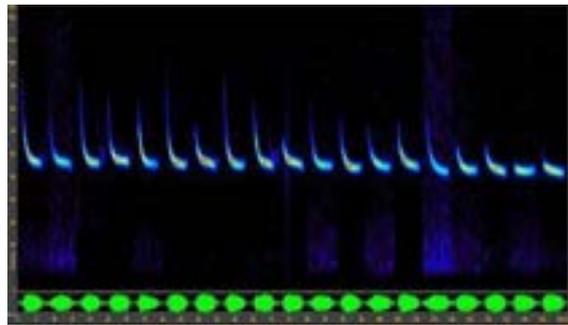
Schreibers' bat - call duration 5.6-5.7 ms



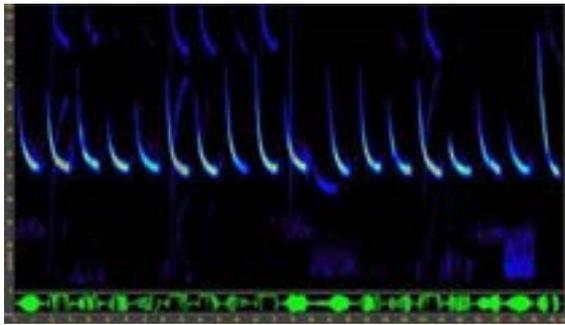
Soprano pipistrelle - call duration 5.6-5.7 ms



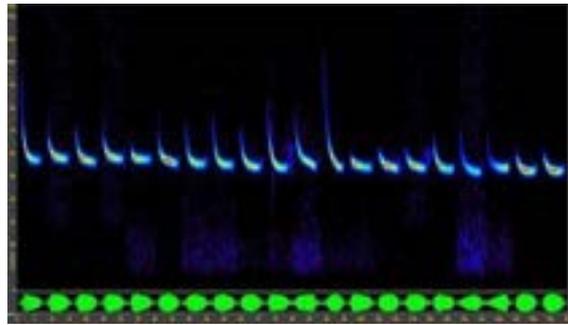
Schreibers' bat - call duration 5.8-5.9 ms



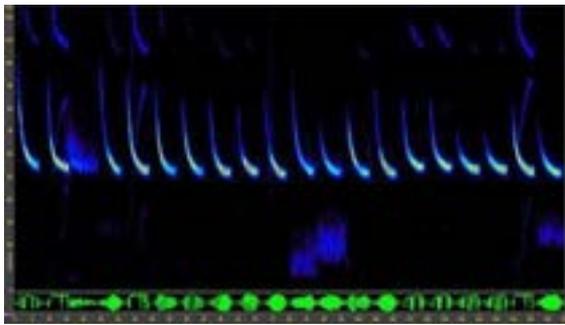
Soprano pipistrelle - call duration 5.8-5.9 ms



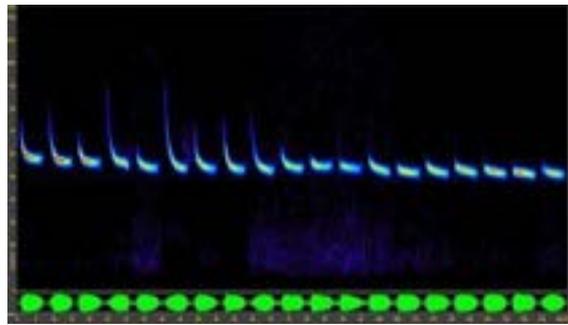
Schreibers' bat - call duration 6.0-6.1 ms



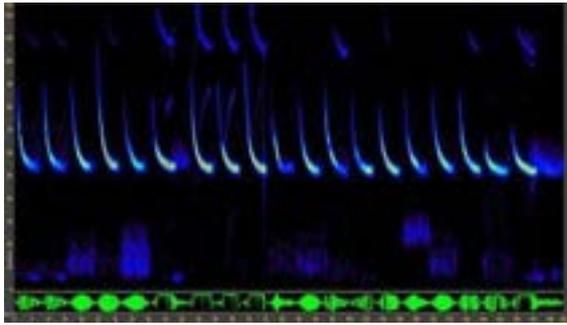
Soprano pipistrelle - call duration 6.0-6.1 ms



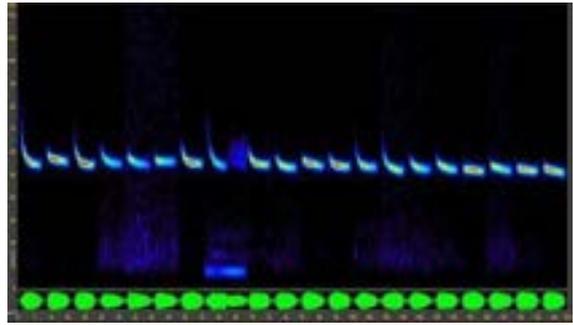
Schreibers' bat - call duration 6.2-6.3 ms



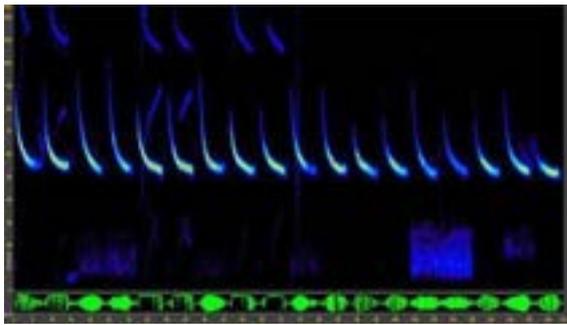
Soprano pipistrelle - call duration 6.2-6.3 ms



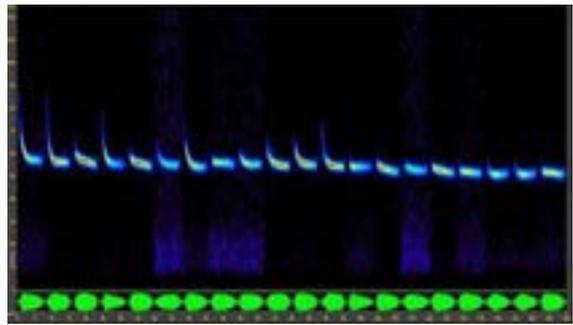
Schreibers' bat - call duration 6.4-6.5 ms



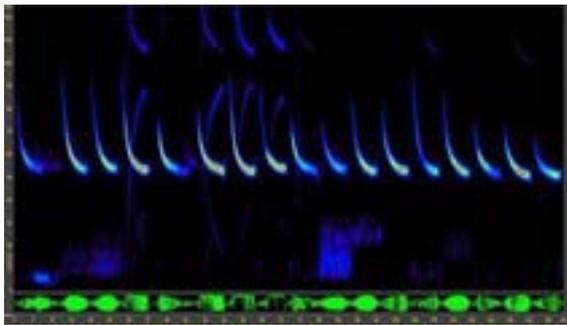
Soprano pipistrelle - call duration 6.4-6.5 ms



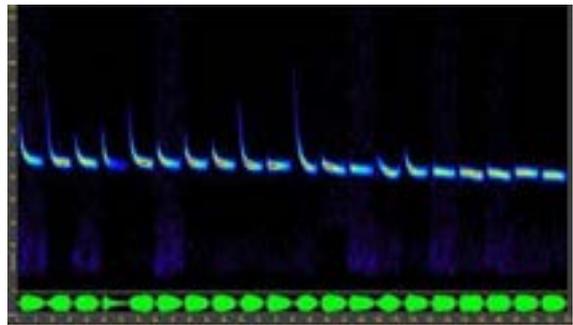
Schreibers' bat - call duration 6.6-6.7 ms



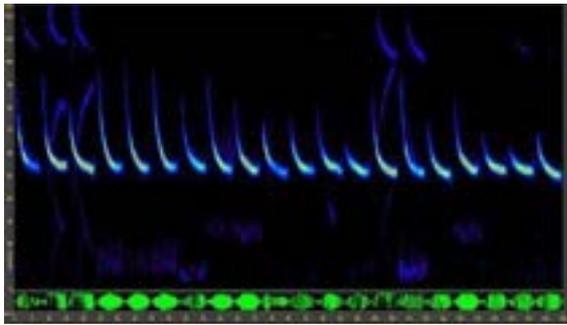
Soprano pipistrelle - call duration 6.6-6.7 ms



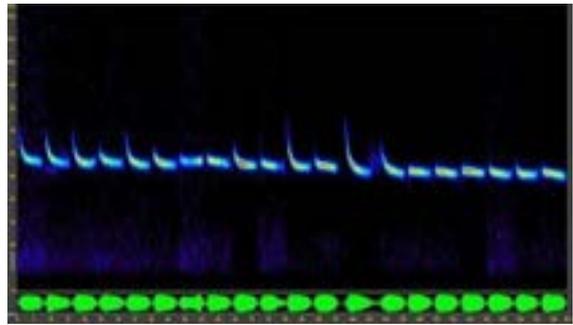
Schreibers' bat - call duration 6.8-6.9 ms



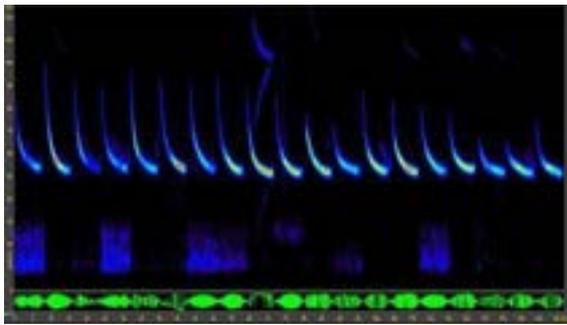
Soprano pipistrelle - call duration 6.8-6.9 ms



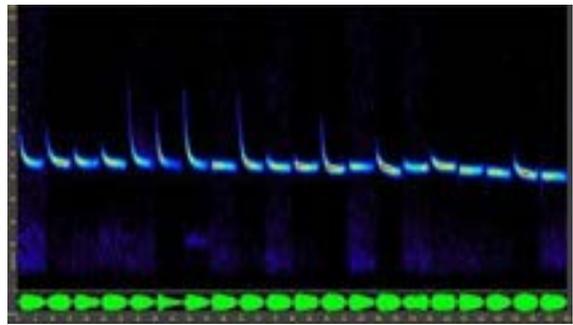
Schreibers' bat - call duration 7.0-7.1 ms



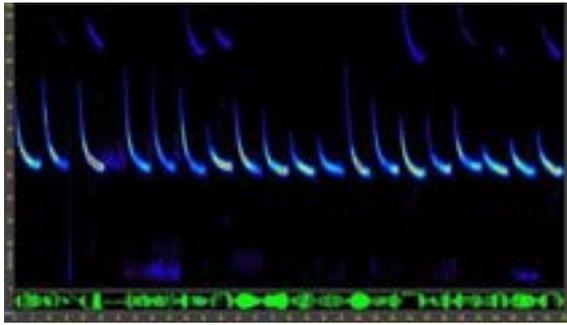
Soprano pipistrelle - call duration 7.0-7.1 ms



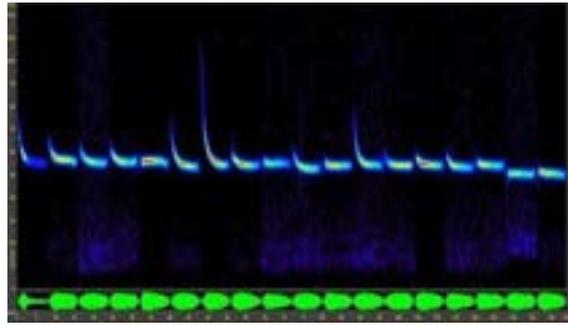
Schreibers' bat - call duration 7.2-7.3 ms



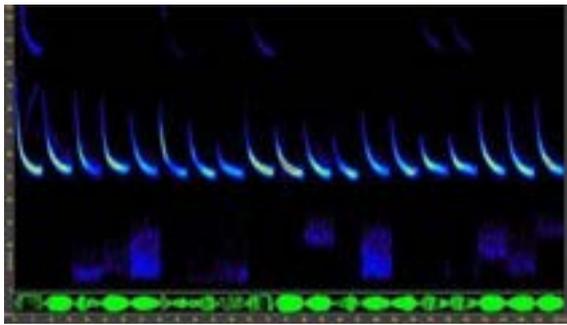
Soprano pipistrelle - call duration 7.2-7.3 ms



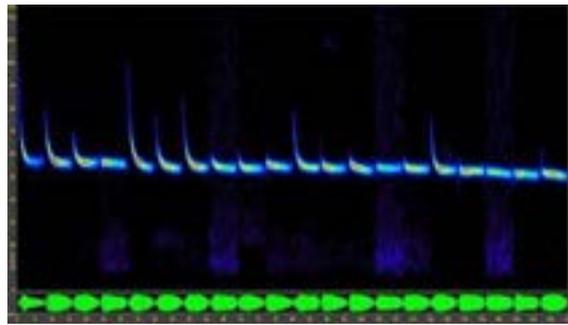
Schreibers' bat - call duration 7.4-7.5 ms



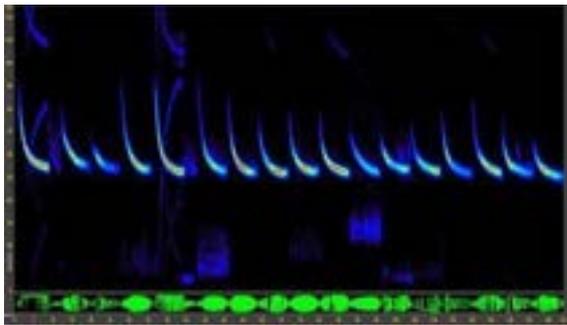
Soprano pipistrelle - call duration 7.4-7.5 ms



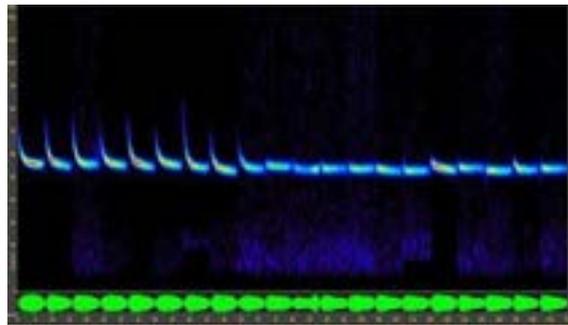
Schreibers' bat - call duration 7.6-7.7 ms



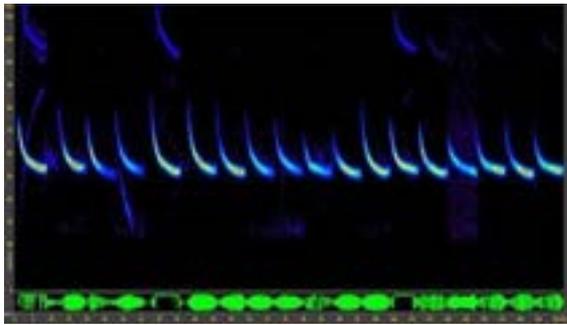
Soprano pipistrelle - call duration 7.6-7.7 ms



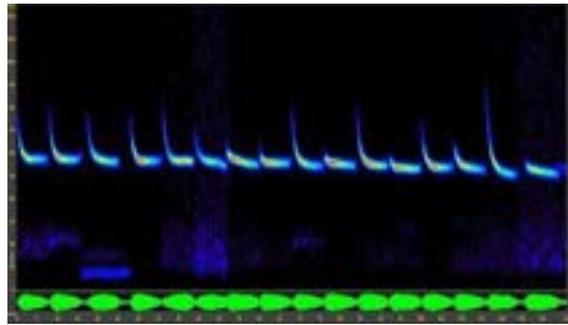
Schreibers' bat - call duration 7.8-7.9 ms



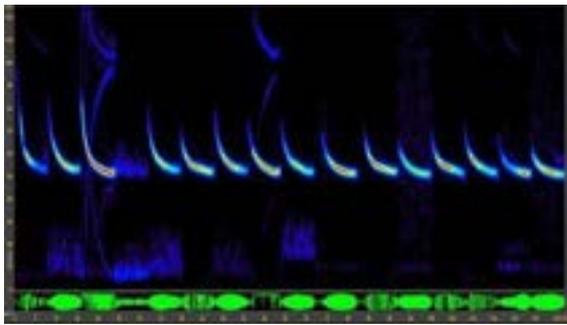
Soprano pipistrelle - call duration 7.8-7.9 ms



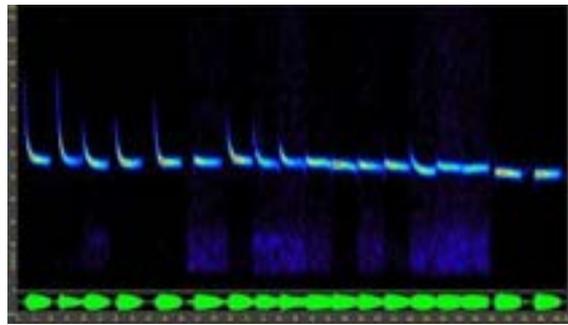
Schreibers' bat - call duration 8.0-8.1 ms



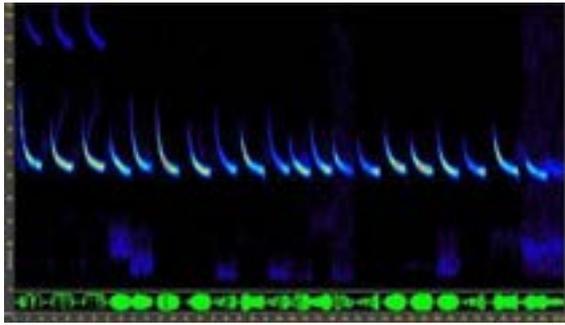
Soprano pipistrelle - call duration 8.0-8.1 ms



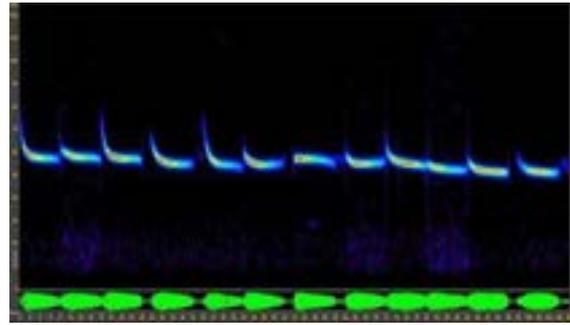
Schreibers' bat - call duration 8.2-8.3 ms



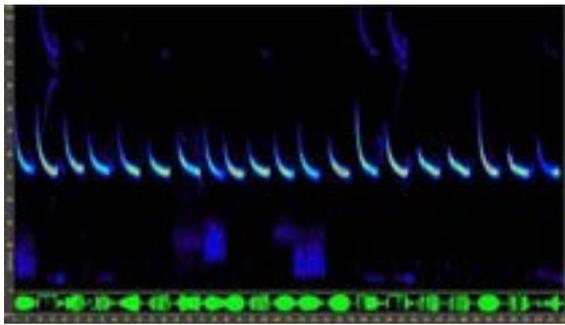
Soprano pipistrelle - call duration 8.2-8.3 ms



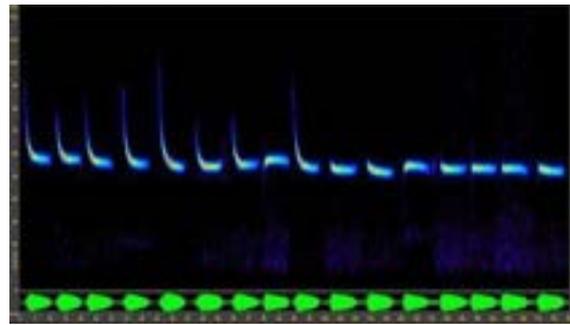
Schreibers' bat - call duration 8.4-8.5 ms



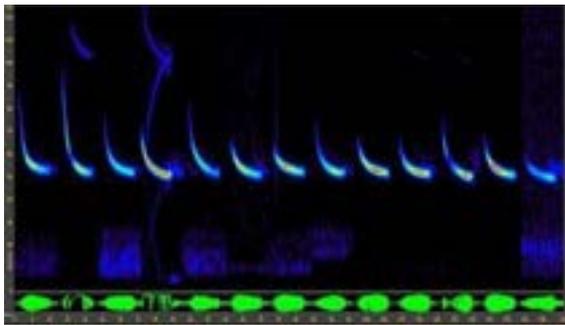
Soprano pipistrelle - call duration 8.4-8.5 ms



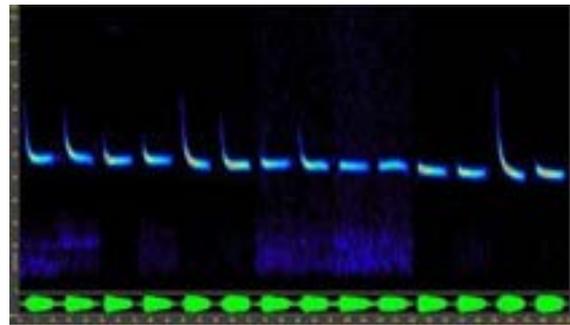
Schreibers' bat - call duration 8.6-8.7 ms



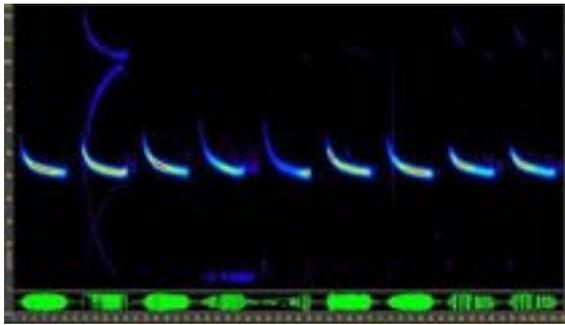
Soprano pipistrelle - call duration 8.6-8.7 ms



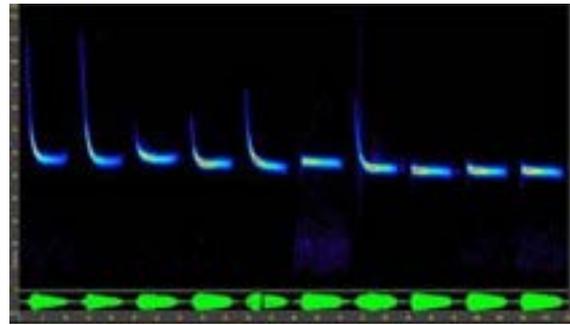
Schreibers' bat - call duration 8.8-8.9 ms



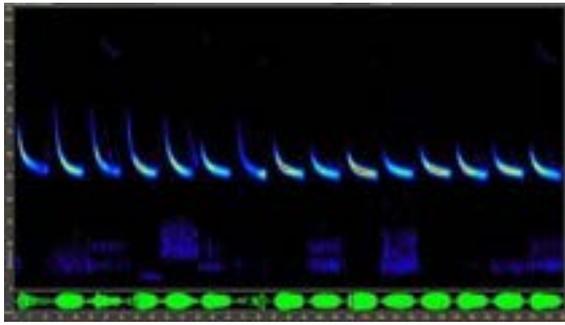
Soprano pipistrelle - call duration 8.8-8.9 ms



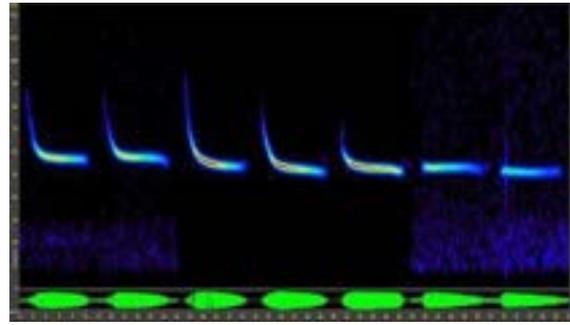
Schreibers' bat - call duration 9.0-9.1 ms



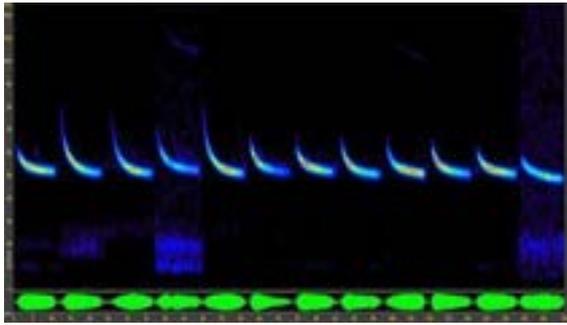
Soprano pipistrelle - call duration 9.0-9.1 ms



Schreibers' bat - call duration 9.2-9.9 ms



Soprano pipistrelle - call duration 9.2-9.9 ms

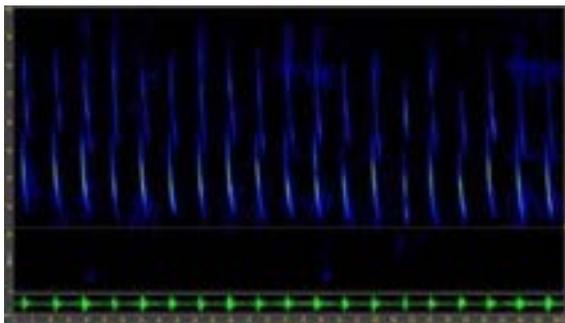


Schreibers' bat - call duration 10.0-12.1 ms

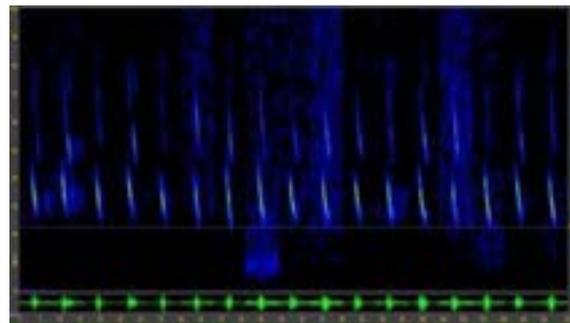
Soprano pipistrelle – no examples

15. Grey Long-eared Bat *Plecotus austriacus* and Brown Long-eared Bat *Plecotus auritus*

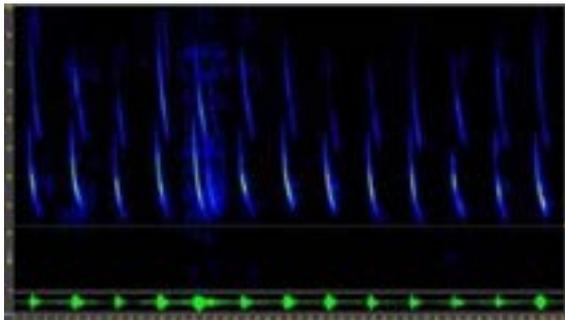
We are extremely grateful to Piers Sangan who provided material for *P. austriacus* from Jersey, which are used in combination with recordings collected by the author and through the Bailiwick Bat Survey. The echolocation and social calls of Grey Long-eared Bat are very similar to Brown Long-eared Bat,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



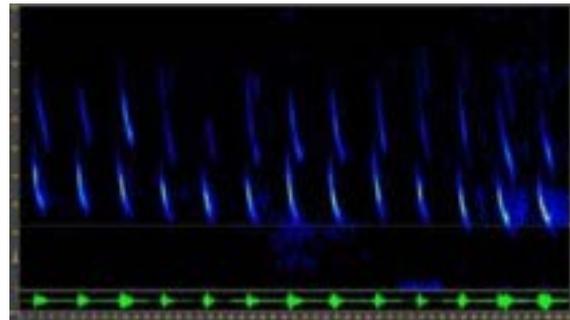
Brown Long-eared Bat - call duration 1.0-1.8 ms



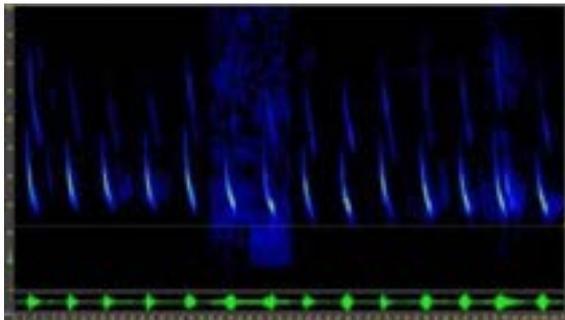
Grey Long-eared Bat - call duration 1.2-1.6 ms



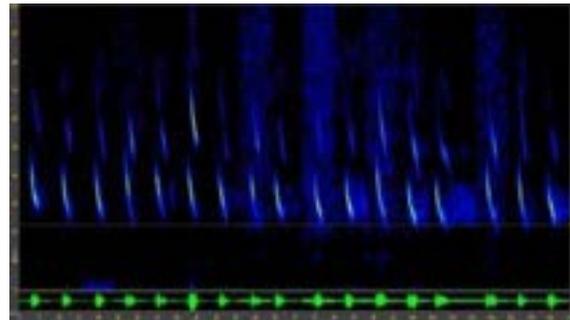
Brown Long-eared Bat - call duration 1.9-2.0 ms



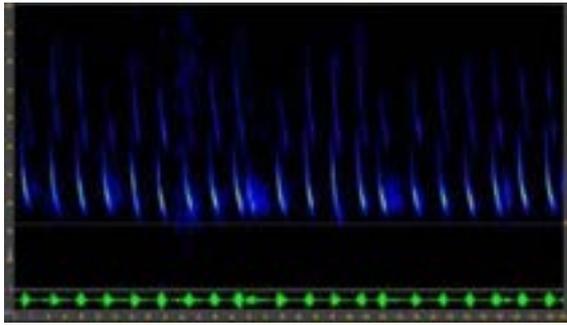
Grey Long-eared Bat - call duration 1.9-2.0 ms



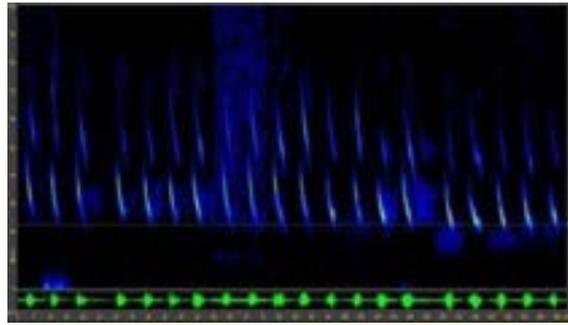
Brown Long-eared Bat - call duration 2.1-2.2 ms



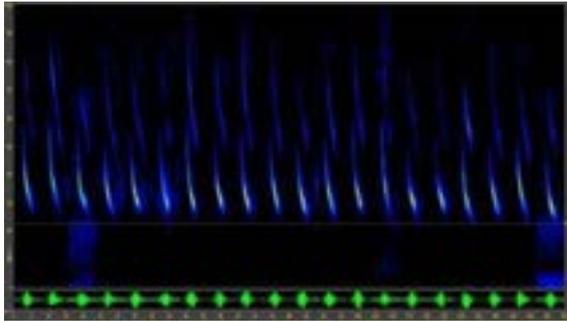
Grey Long-eared Bat - call duration 2.1-2.2 ms



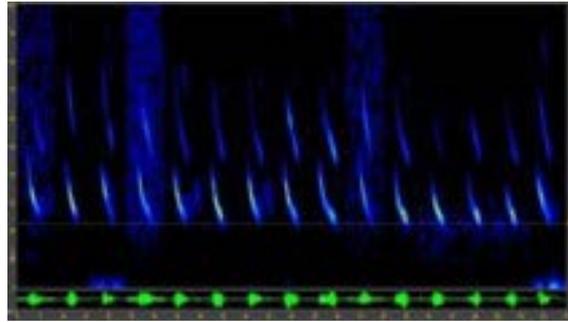
Brown Long-eared Bat - call duration 2.5-2.6 ms



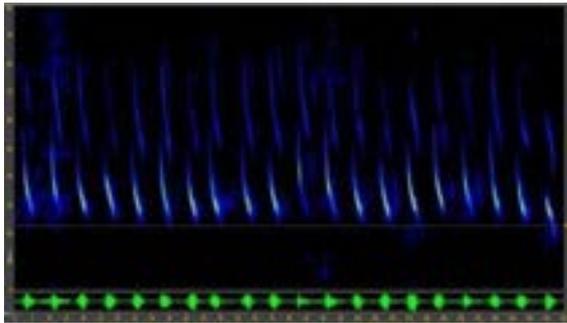
Grey Long-eared Bat - call duration 2.3-2.6 ms



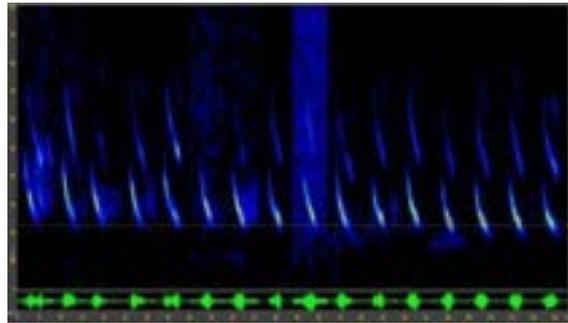
Brown Long-eared Bat - call duration 2.7-2.8 ms



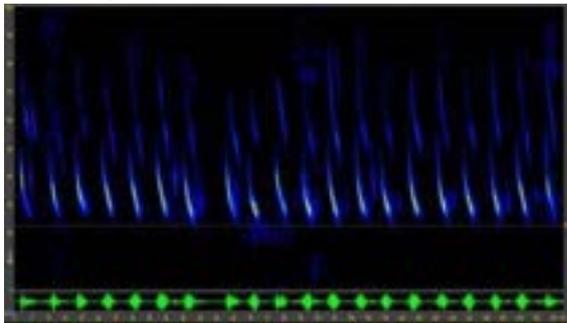
Grey Long-eared Bat - call duration 2.7-2.8 ms



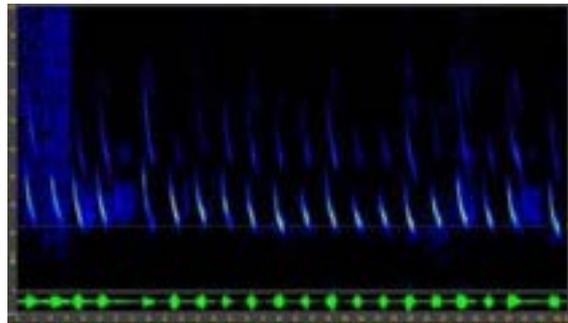
Brown Long-eared Bat - call duration 2.9-3.0 ms



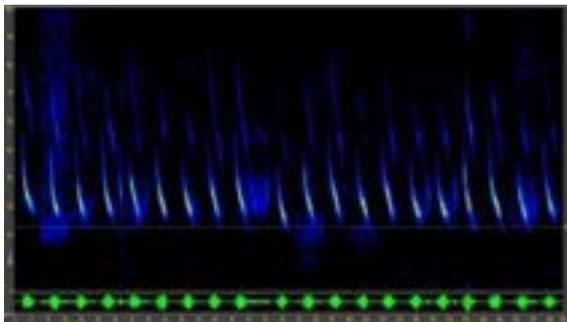
Grey Long-eared Bat - call duration 2.9-3.0 ms



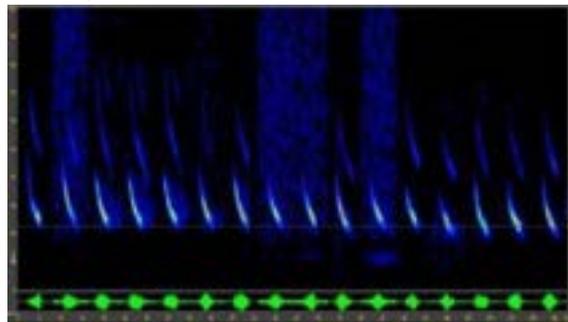
Brown Long-eared Bat - call duration 3.1-3.2 ms



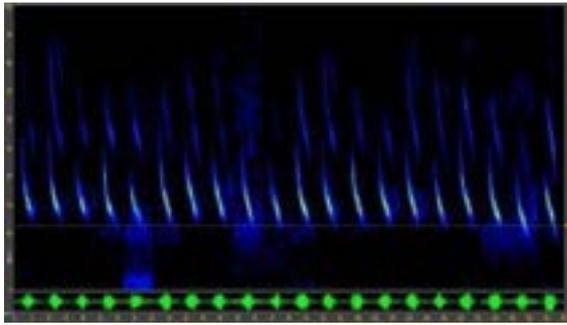
Grey Long-eared Bat - call duration 3.1-3.2 ms



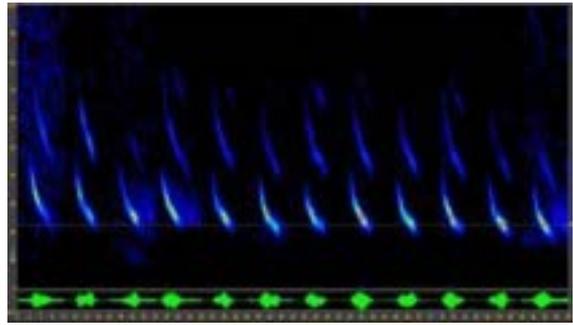
Brown Long-eared Bat - call duration 3.3-3.4 ms



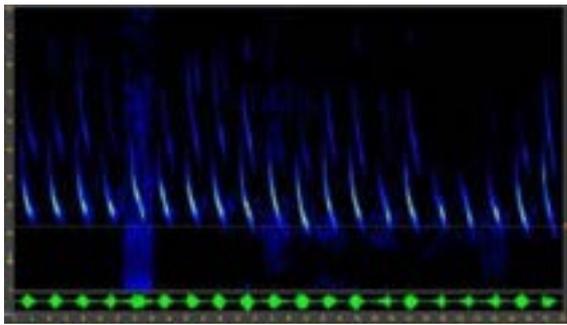
Grey Long-eared Bat - call duration 3.3-3.4 ms



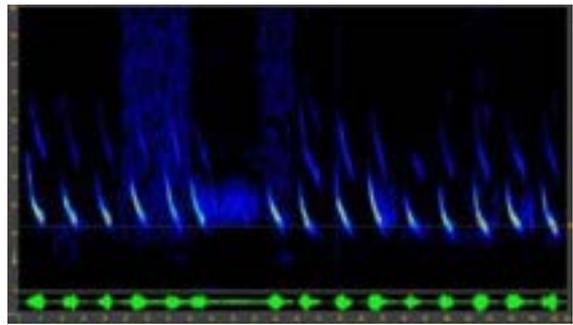
Brown Long-eared Bat - call duration 3.5-3.6 ms



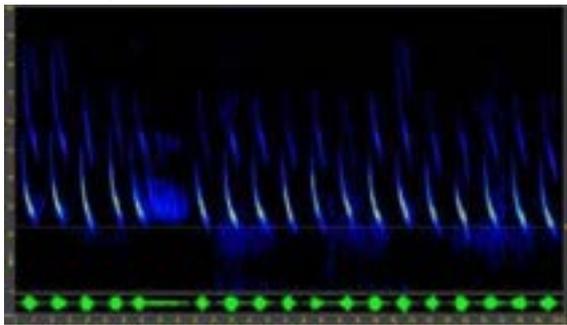
Grey Long-eared Bat - call duration 3.5-3.6 ms



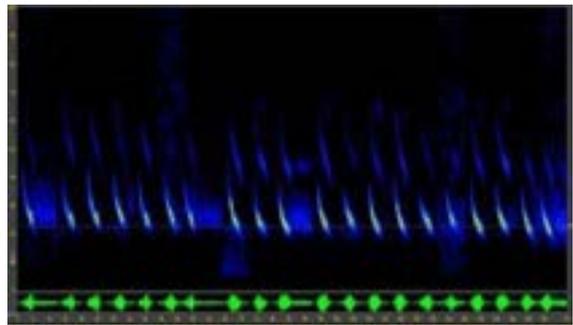
Brown Long-eared Bat - call duration 3.7-3.8 ms



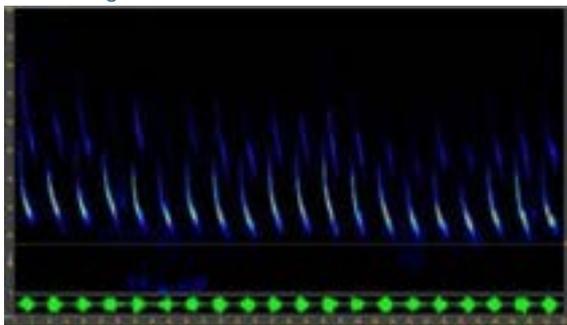
Grey Long-eared Bat - call duration 3.7-3.8 ms



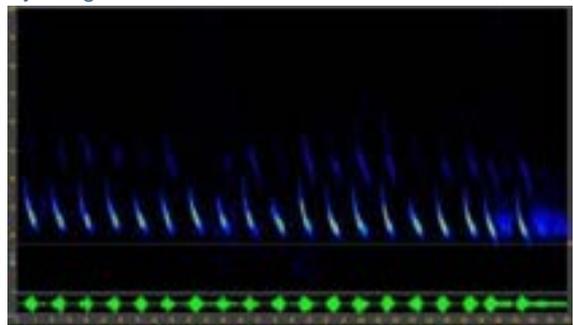
Brown Long-eared Bat - call duration 3.9-4.0 ms



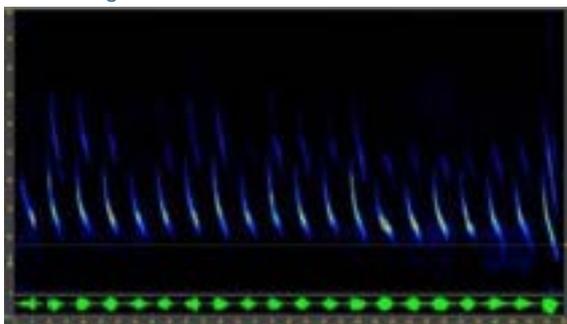
Grey Long-eared Bat - call duration 3.9-4.0 ms



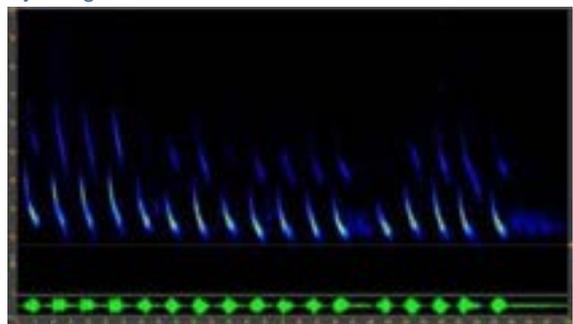
Brown Long-eared Bat - call duration 4.1-4.2 ms



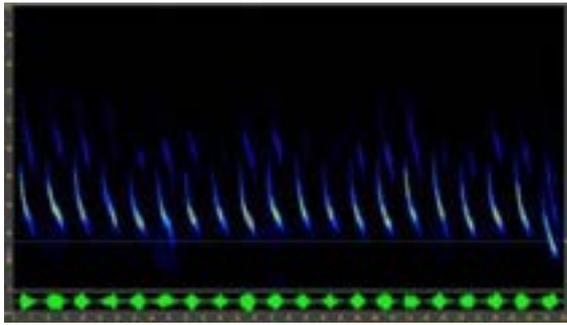
Grey Long-eared Bat - call duration 4.1-4.2 ms



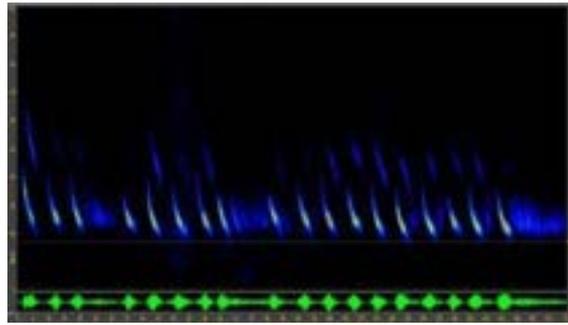
Brown Long-eared Bat - call duration 4.3-4.4 ms



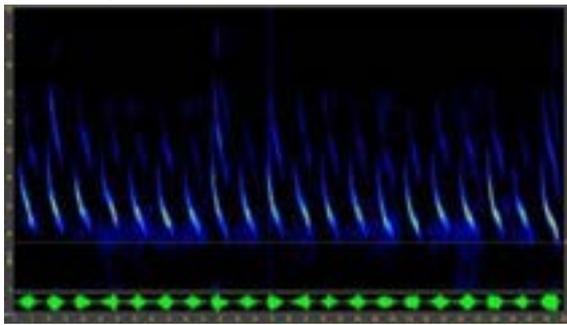
Grey Long-eared Bat - call duration 4.3-4.4 ms



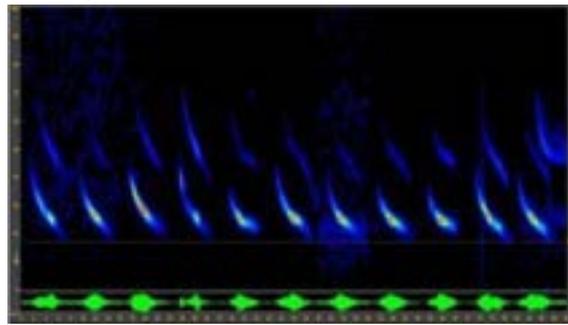
Brown Long-eared Bat - call duration 4.5-4.6 ms



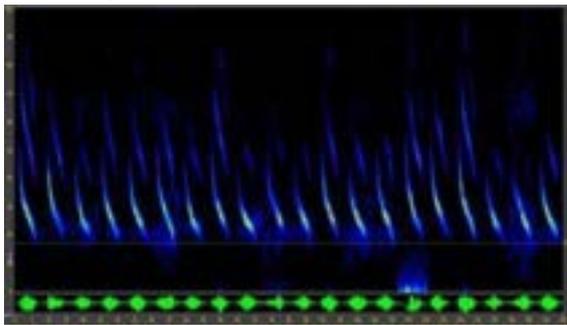
Grey Long-eared Bat - call duration 4.5-4.6 ms



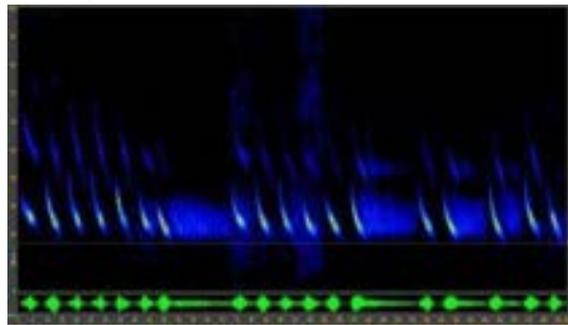
Brown Long-eared Bat - call duration 4.7-4.8 ms



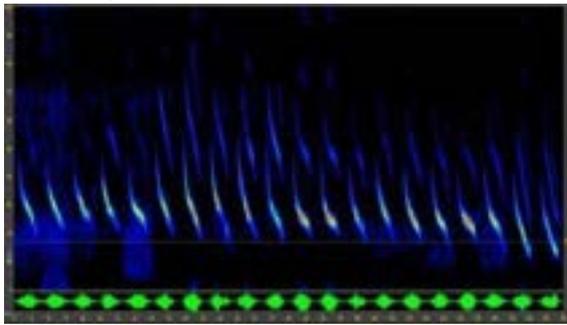
Grey Long-eared Bat - call duration 4.7-4.8 ms



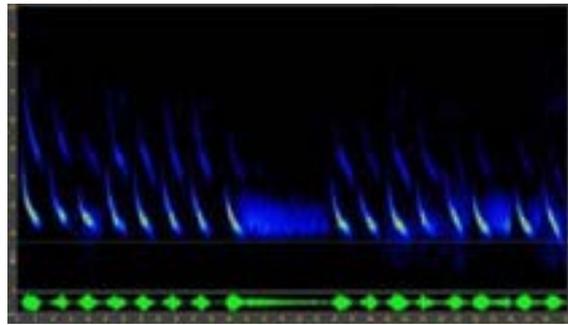
Brown Long-eared Bat - call duration 4.9-5.0 ms



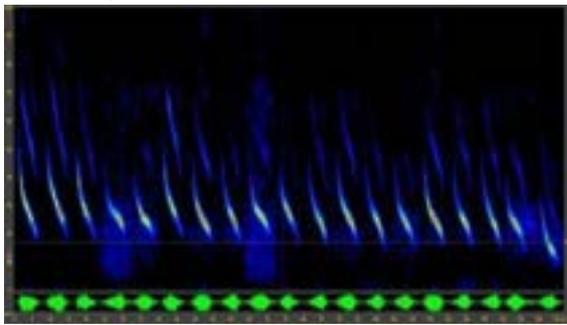
Grey Long-eared Bat - call duration 4.9-5.0 ms



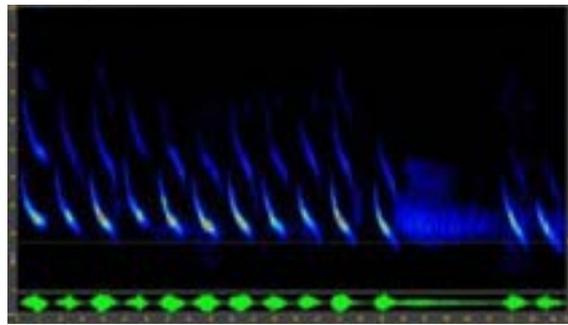
Brown Long-eared Bat - call duration 5.1-5.2 ms



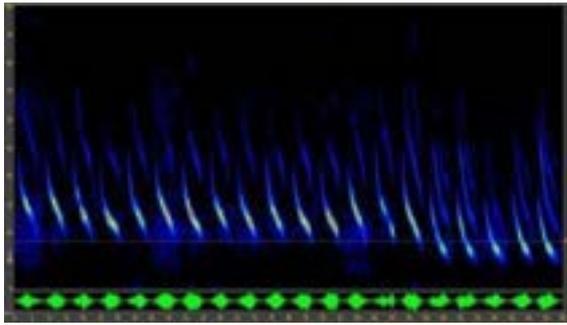
Grey Long-eared Bat - call duration 5.1-5.2 ms



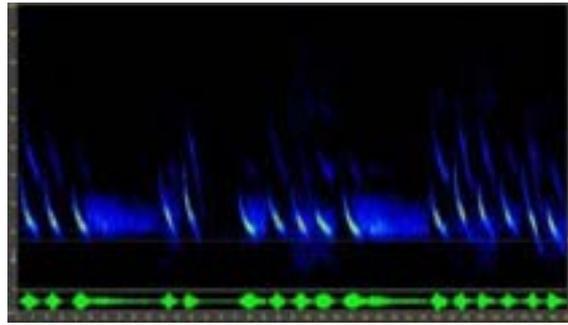
Brown Long-eared Bat - call duration 5.3-5.4 ms



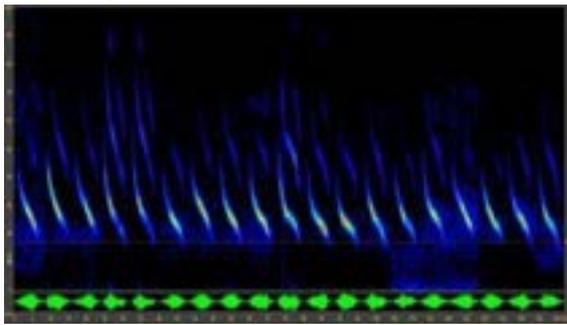
Grey Long-eared Bat - call duration 5.3-5.5 ms



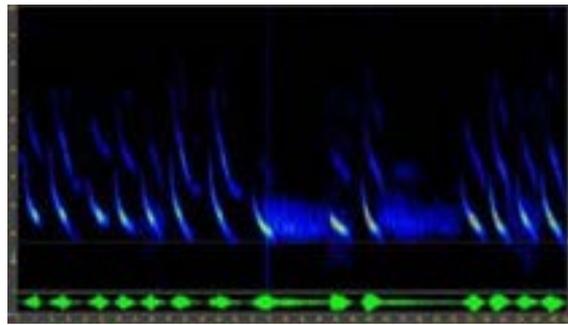
Brown Long-eared Bat - call duration 5.5-5.8 ms



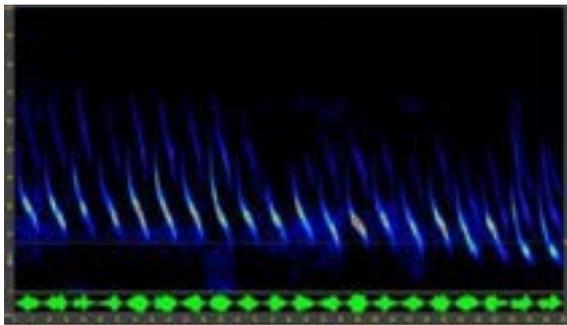
Grey Long-eared Bat - call duration 5.6-5.8 ms



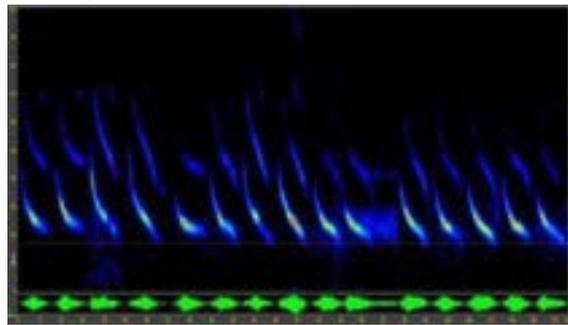
Brown Long-eared Bat - call duration 5.9-6.2 ms



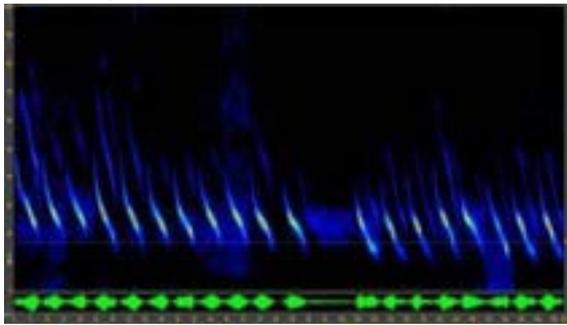
Grey Long-eared Bat - call duration 5.9-6.2 ms



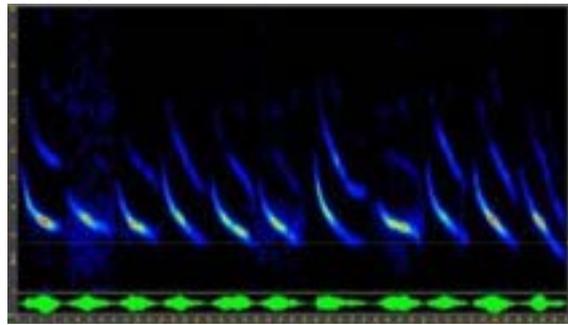
Brown Long-eared Bat - call duration 6.3-6.4 ms



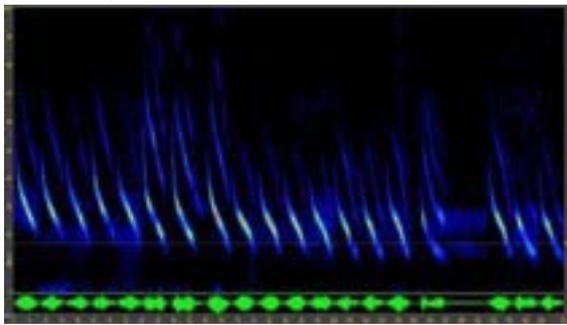
Grey Long-eared Bat - call duration 6.3-6.5 ms



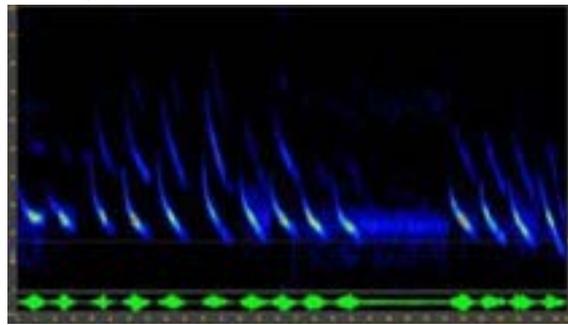
Brown Long-eared Bat - call duration 6.7-6.8 ms



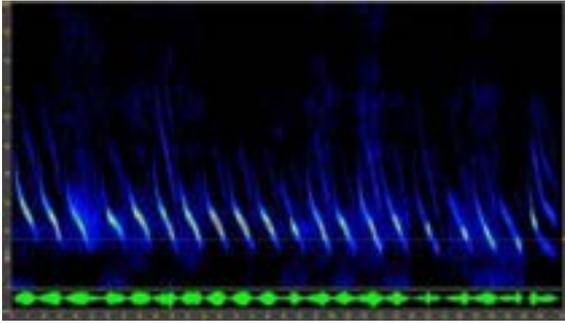
Grey Long-eared Bat - call duration 6.6-6.8 ms



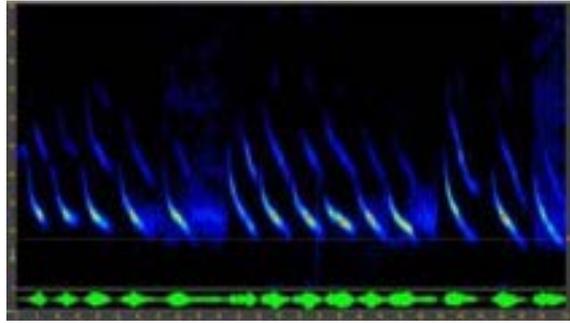
Brown Long-eared Bat - call duration 6.9-7.0 ms



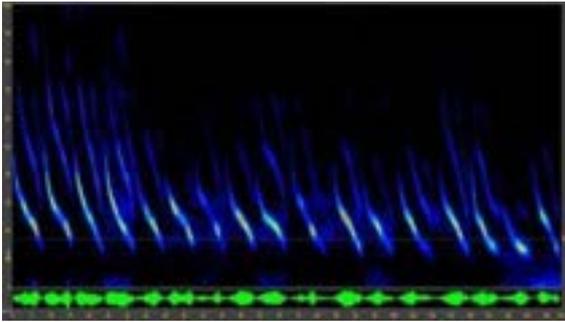
Grey Long-eared Bat - call duration 6.9-7.1 ms



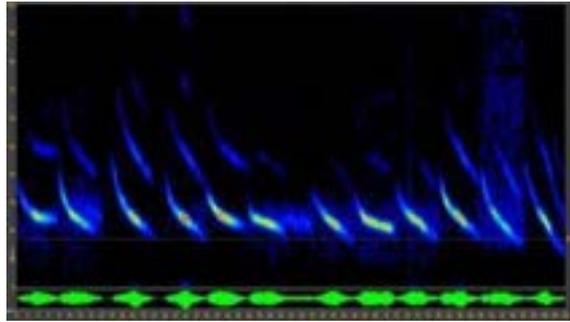
Brown Long-eared Bat - call duration 7.3-7.4 ms



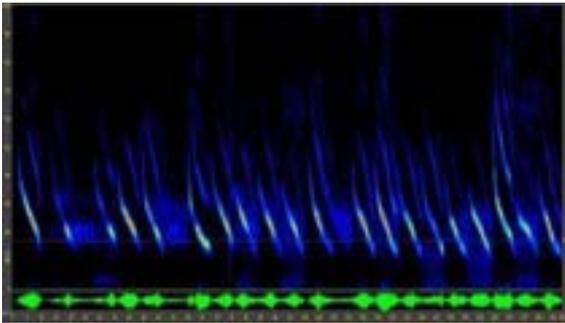
Grey Long-eared Bat - call duration 7.2-7.4 ms



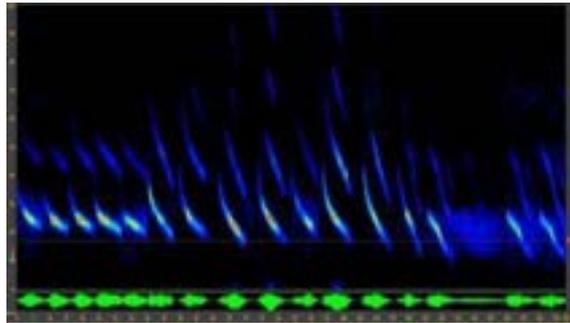
Brown Long-eared Bat - call duration 7.5-7.6 ms



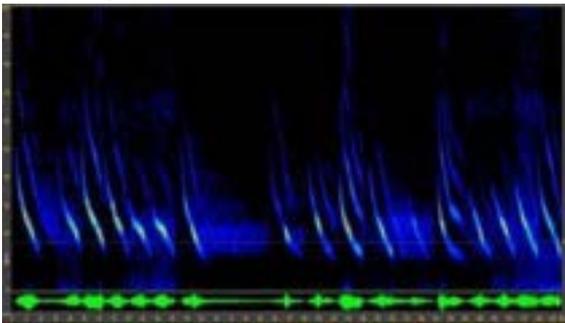
Grey Long-eared Bat - call duration 7.5-7.6 ms



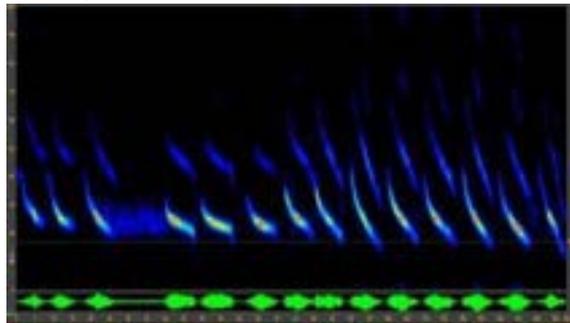
Brown Long-eared Bat - call duration 7.7-7.8 ms



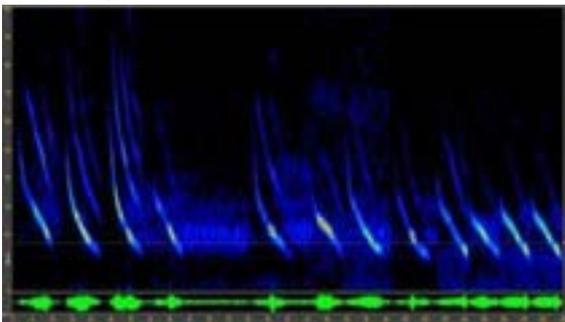
Grey Long-eared Bat - call duration 7.7-7.8 ms



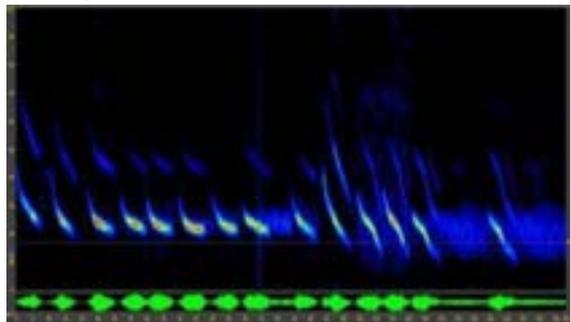
Brown Long-eared Bat - call duration 7.9-8.1 ms



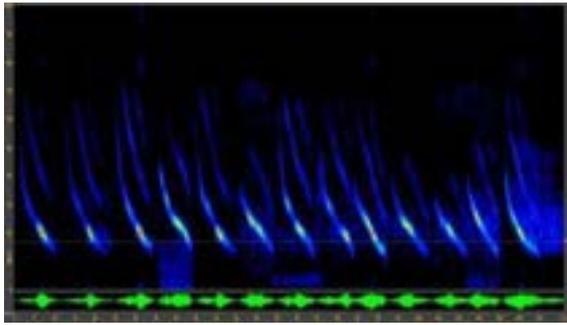
Grey Long-eared Bat - call duration 7.9-8.1 ms



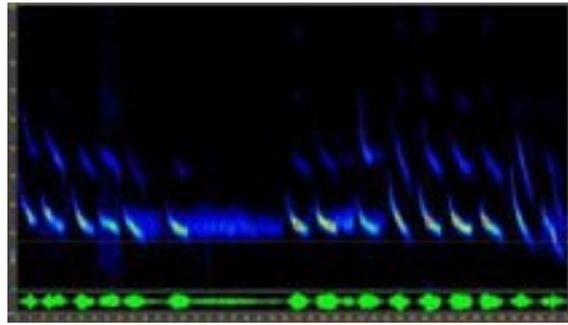
Brown Long-eared Bat - call duration 8.2-8.3 ms



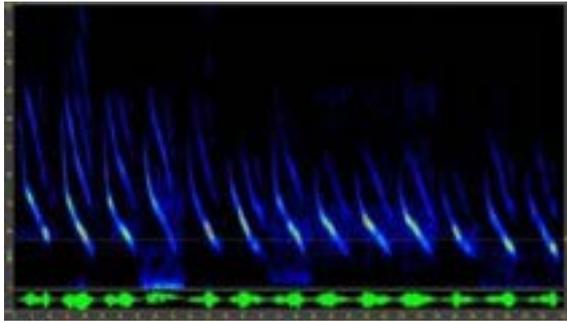
Grey Long-eared Bat - call duration 8.2-8.3 ms



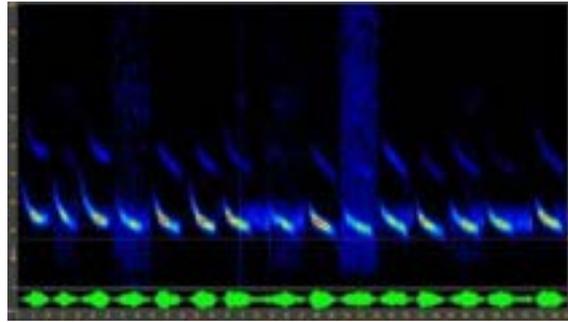
Brown Long-eared Bat - call duration 8.4-8.6 ms



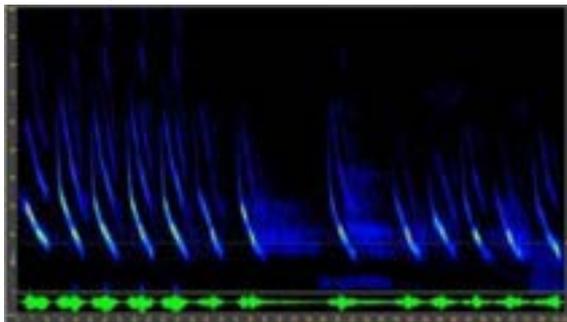
Grey Long-eared Bat - call duration 8.4-8.7 ms



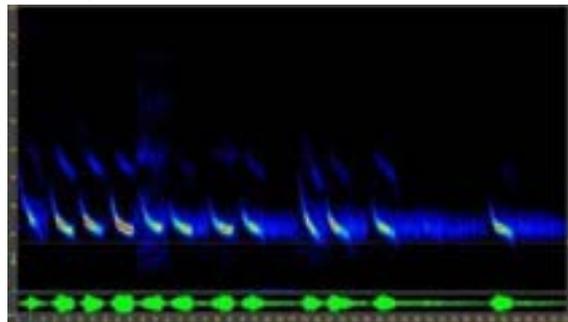
Brown Long-eared Bat - call duration 8.7-9.0 ms



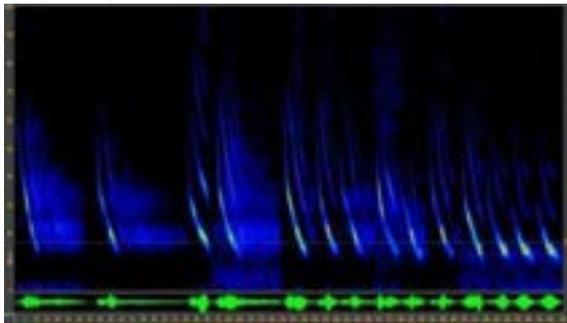
Grey Long-eared Bat - call duration 8.8-9.1 ms



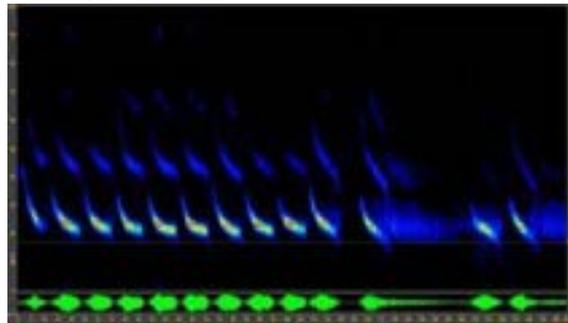
Brown Long-eared Bat - call duration 9.1-9.5 ms



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

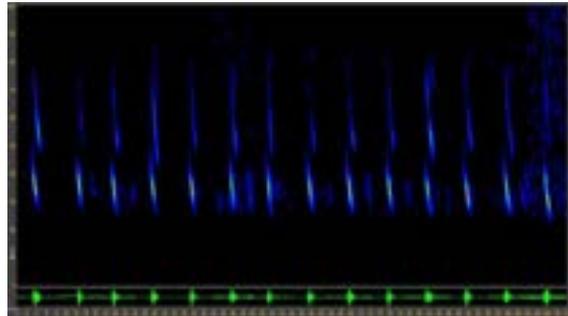
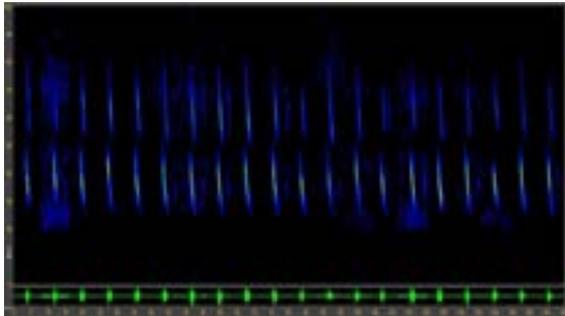


Brown Long-eared Bat - call duration 9.6-11.4 ms

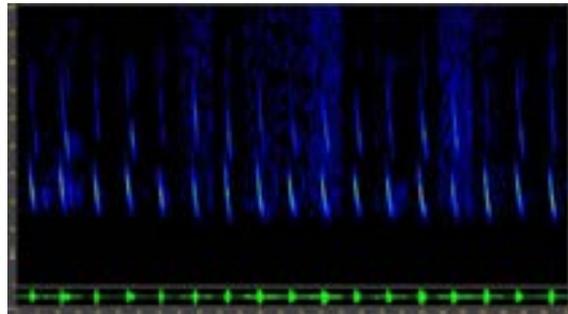
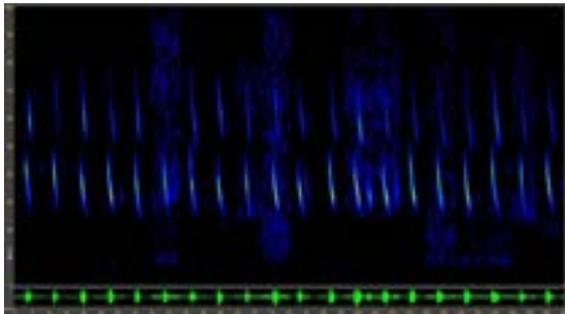


Grey Long-eared Bat - call duration 9.7-10.5 ms

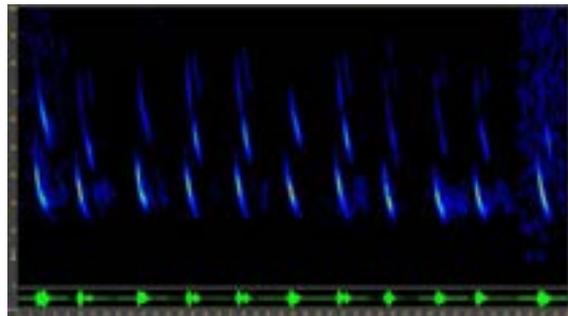
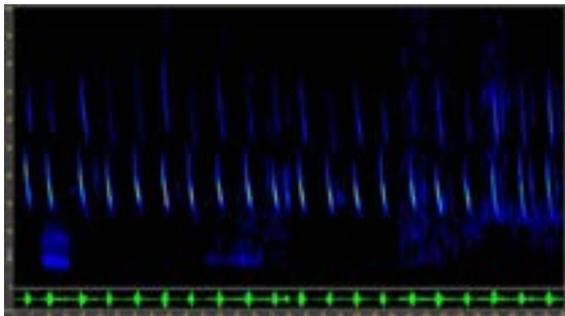
16. Mediterranean long-eared bat *Plecotus kolombatovici* and Grey Long-eared Bat *Plecotus austriacus*



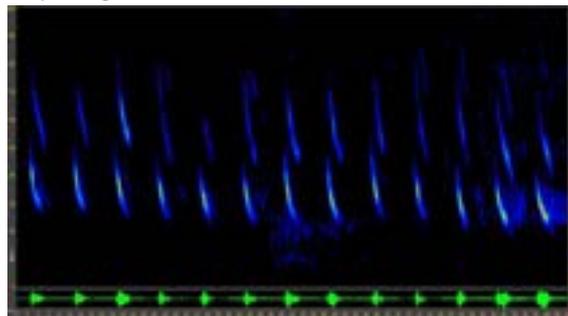
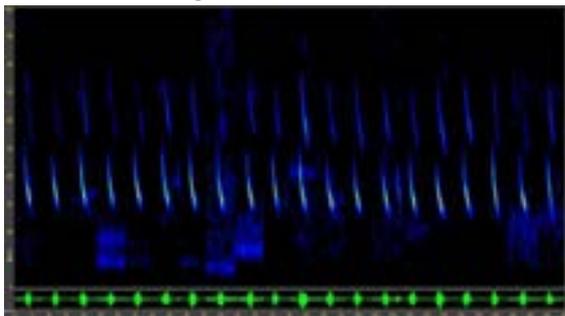
Mediterranean Long-eared Bat - call duration up to 1.1 ms Grey Long-eared Bat - up to 1.1 ms



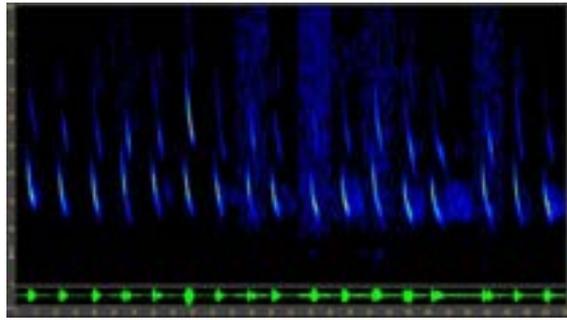
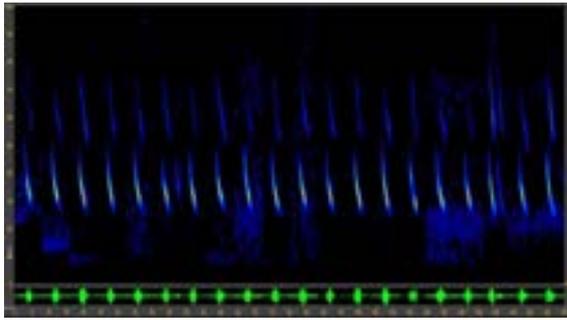
Mediterranean Long-eared Bat - call duration 1.2-1.6 ms Grey Long-eared Bat - call duration 1.2-1.6 ms



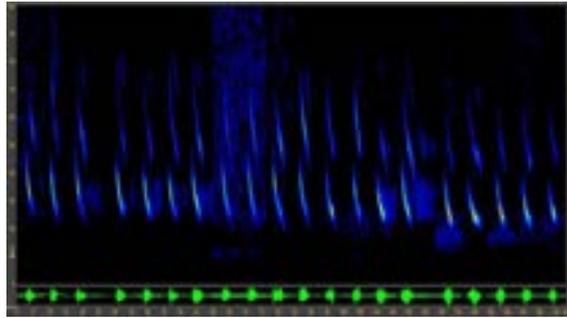
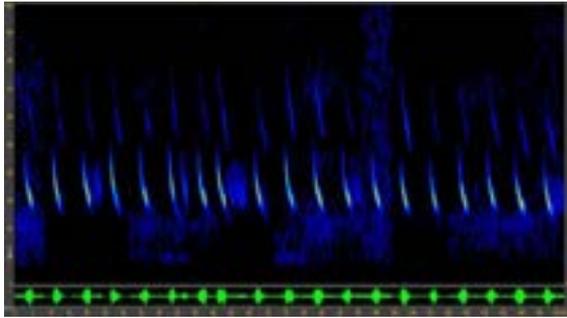
Mediterranean Long-eared Bat - call duration 1.7-1.8 ms Grey Long-eared Bat - call duration 1.7-1.8 ms



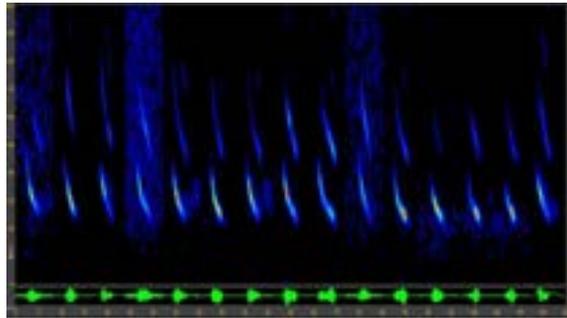
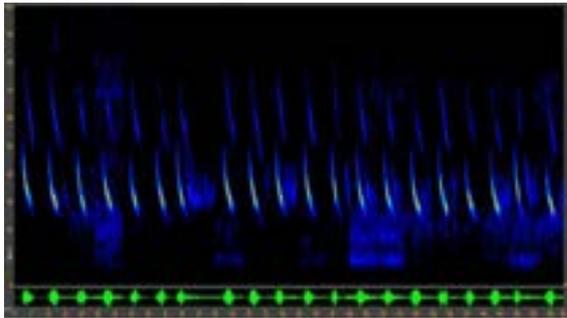
Mediterranean Long-eared Bat - call duration 1.9-2.0 ms Grey Long-eared Bat - call duration 1.9-2.0 ms



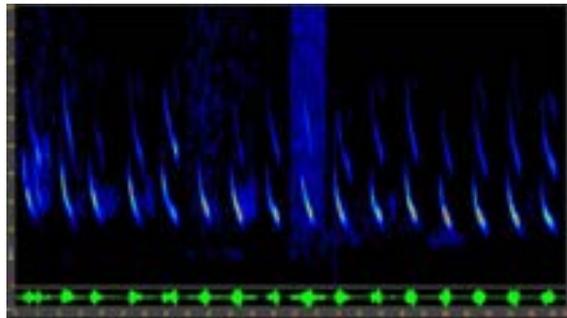
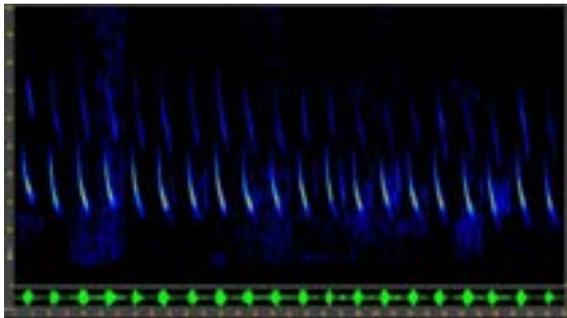
Mediterranean Long-eared Bat - call duration 2.1-2.2 ms Grey Long-eared Bat - call duration 2.1-2.2 ms



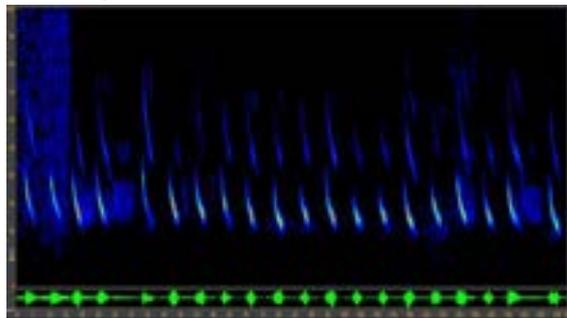
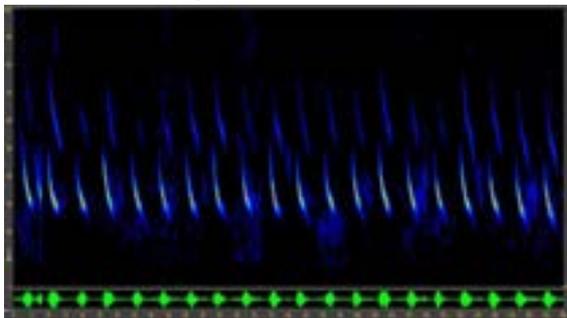
Mediterranean Long-eared Bat - call duration 2.3-2.6 ms Grey Long-eared Bat - call duration 2.3-2.6 ms



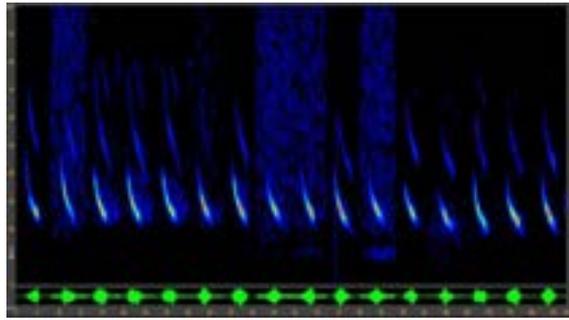
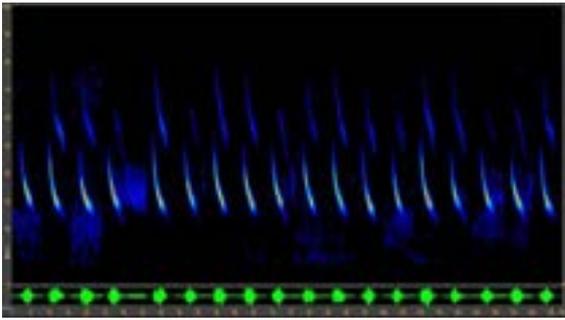
Mediterranean Long-eared Bat - call duration 2.7-2.8 ms Grey Long-eared Bat - call duration 2.7-2.8 ms



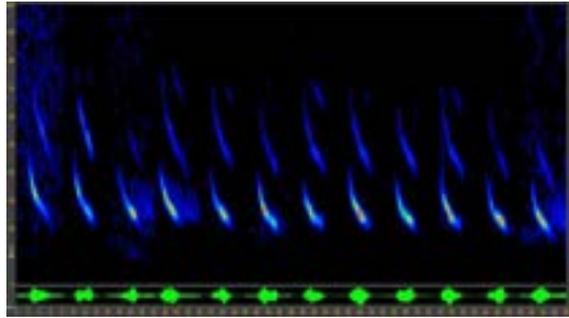
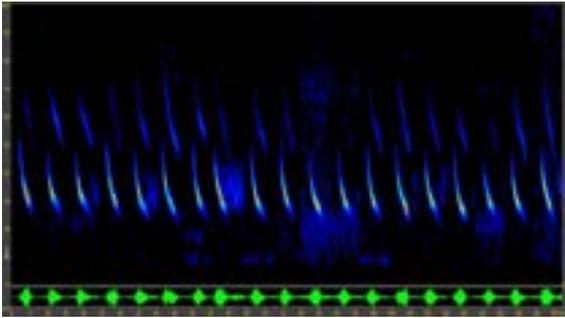
Mediterranean Long-eared Bat - call duration 2.9-3.0 ms Grey Long-eared Bat - call duration 2.9-3.0 ms



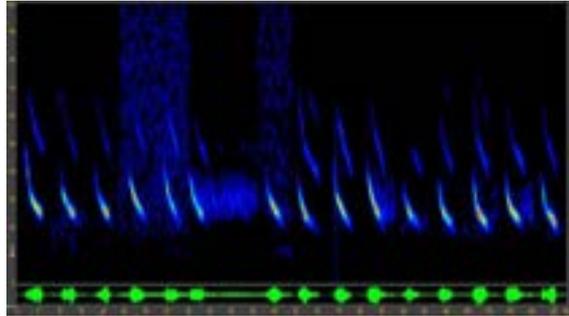
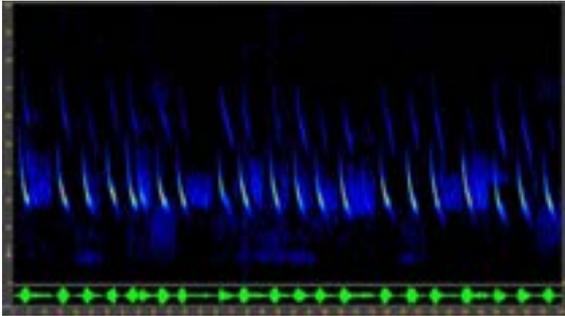
Mediterranean Long-eared Bat - call duration 3.1-3.2 ms Grey Long-eared Bat - call duration 3.1-3.2 ms



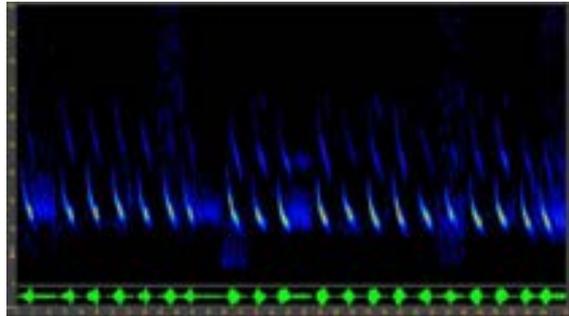
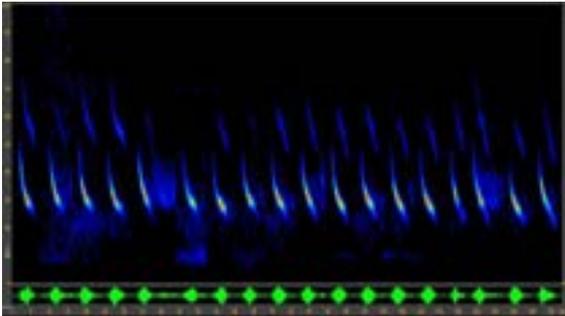
Mediterranean Long-eared Bat - call duration 3.3-3.4 ms Grey Long-eared Bat - call duration 3.3-3.4 ms



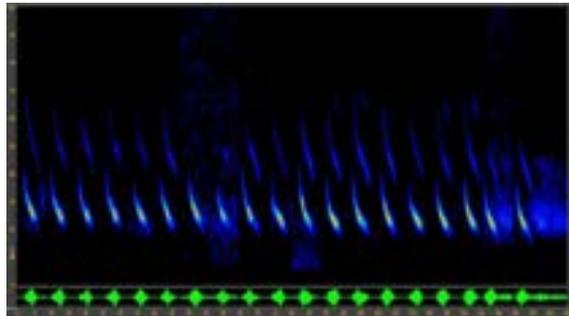
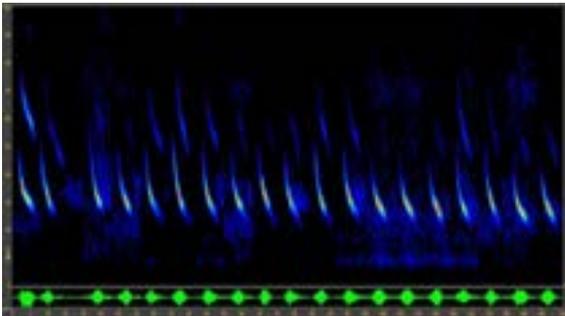
Mediterranean Long-eared Bat - call duration 3.5-3.6 ms Grey Long-eared Bat - call duration 3.5-3.6 ms



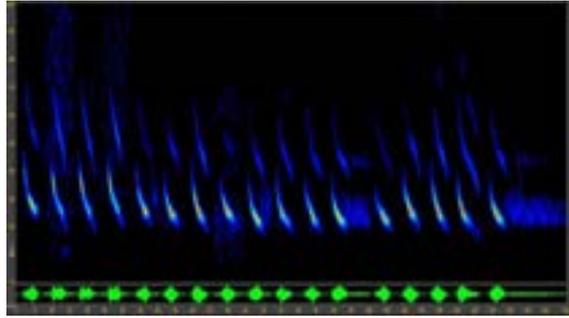
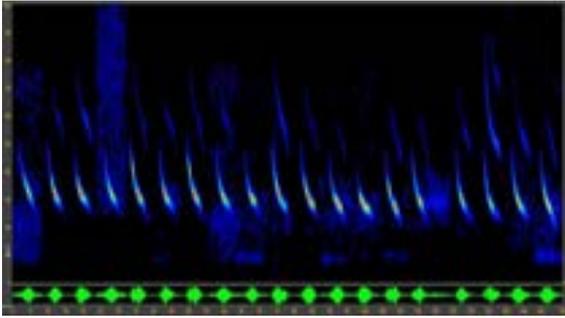
Mediterranean Long-eared Bat - call duration 3.7-3.8 ms Grey Long-eared Bat - call duration 3.7-3.8 ms



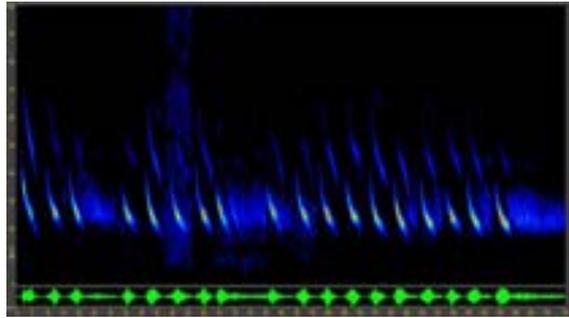
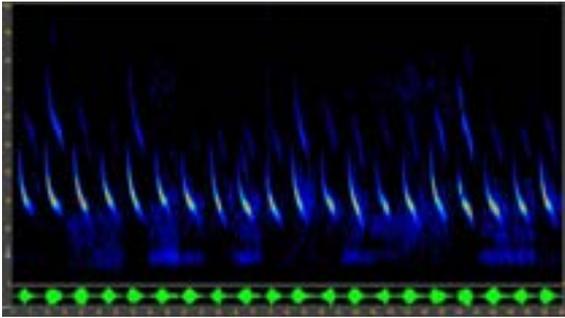
Mediterranean Long-eared Bat - call duration 3.9-4.0 ms Grey Long-eared Bat - call duration 3.9-4.0 ms



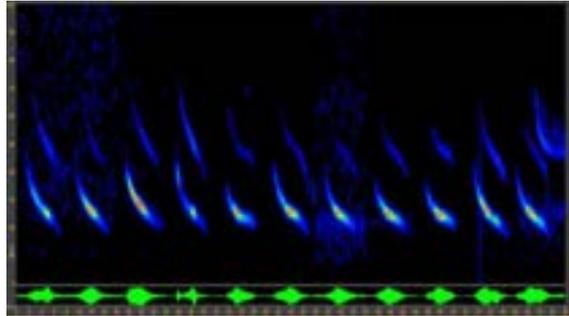
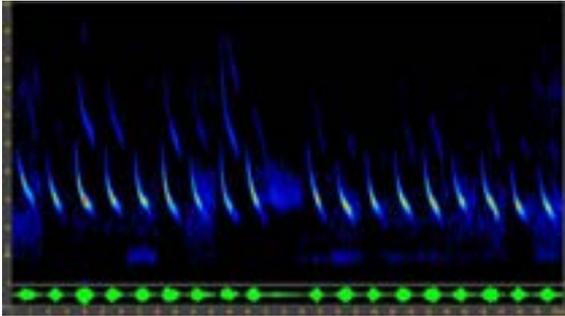
Mediterranean Long-eared Bat - call duration 4.1-4.2 ms Grey Long-eared Bat - call duration 4.1-4.2 ms



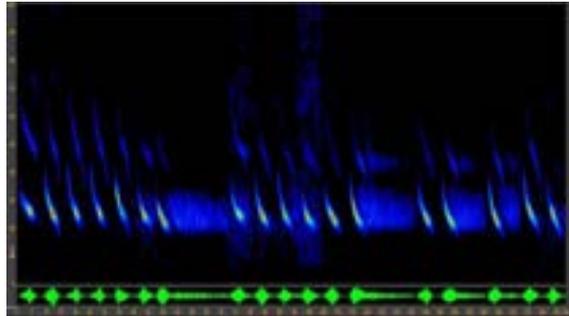
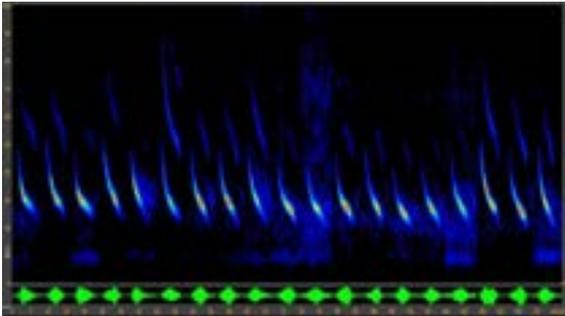
Mediterranean Long-eared Bat - call duration 4.3-4.4 ms Grey Long-eared Bat - call duration 4.3-4.4 ms



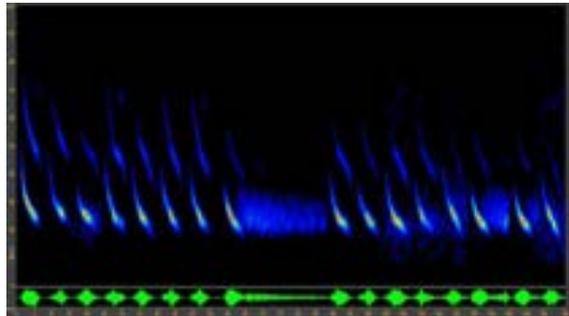
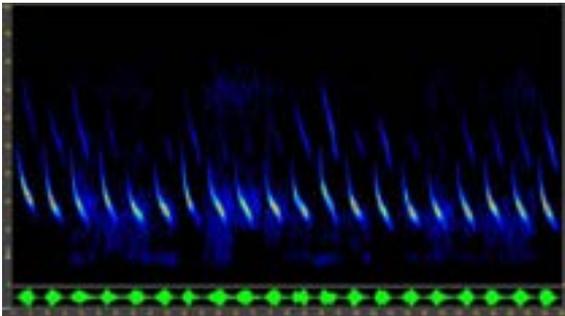
Mediterranean Long-eared Bat - call duration 4.5-4.6 ms Grey Long-eared Bat - call duration 4.5-4.6 ms



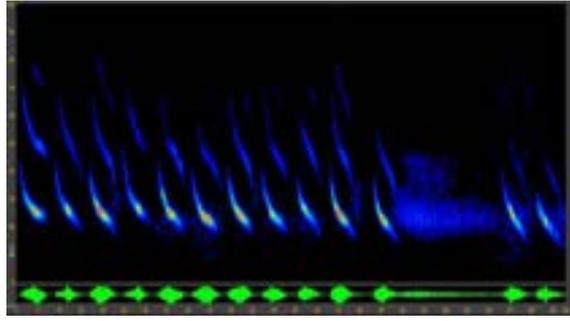
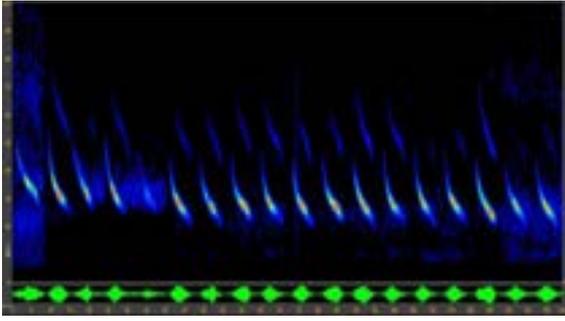
Mediterranean Long-eared Bat - call duration 4.7-4.8 ms Grey Long-eared Bat - call duration 4.7-4.8 ms



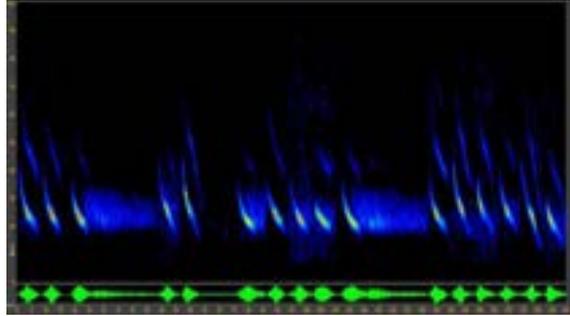
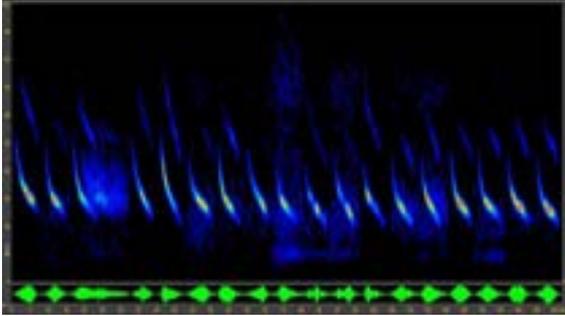
Mediterranean Long-eared Bat - call duration 4.9-5.0 ms Grey Long-eared Bat - call duration 4.9-5.0 ms



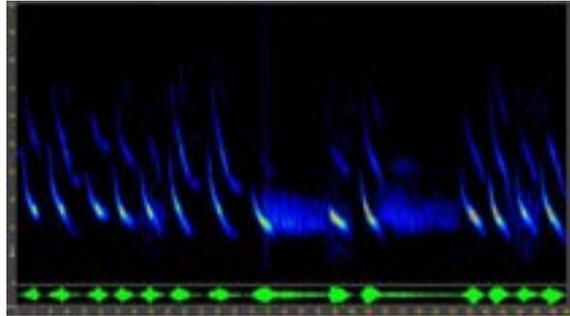
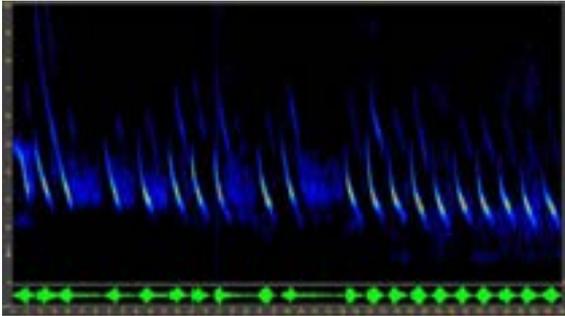
Mediterranean Long-eared Bat - call duration 5.1-5.2 ms Grey Long-eared Bat - call duration 5.1-5.2 ms



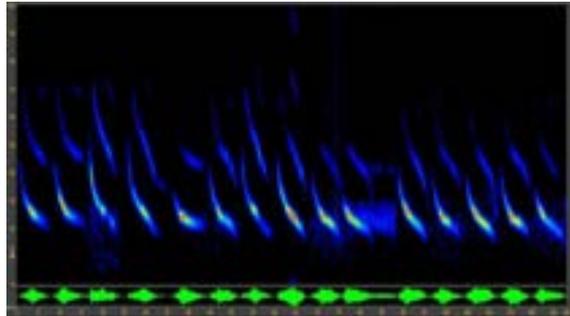
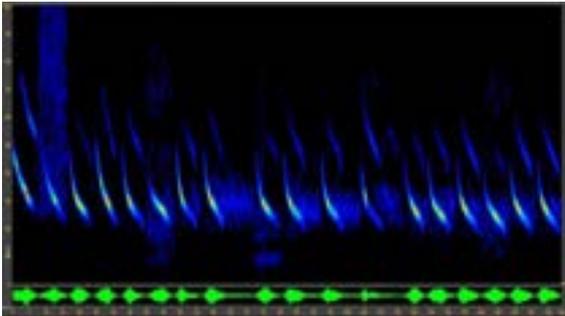
Mediterranean Long-eared Bat - call duration 5.3-5.5 ms Grey Long-eared Bat - call duration 5.3-5.5 ms



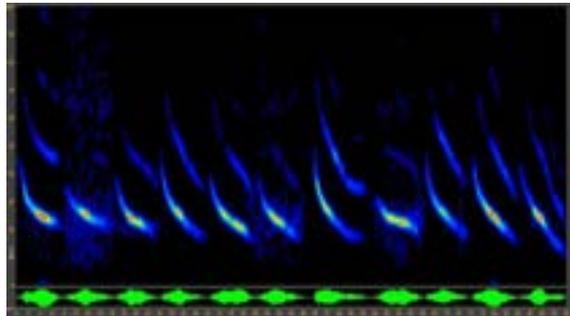
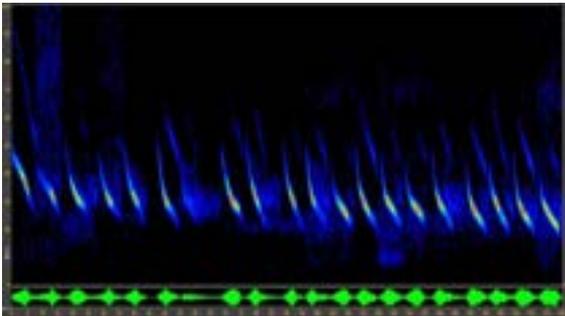
Mediterranean Long-eared Bat - call duration 5.6-5.8 ms Grey Long-eared Bat - call duration 5.6-5.8 ms



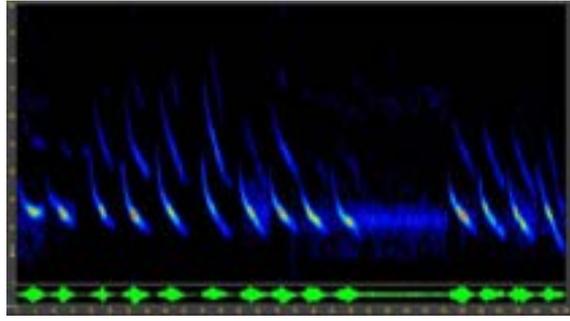
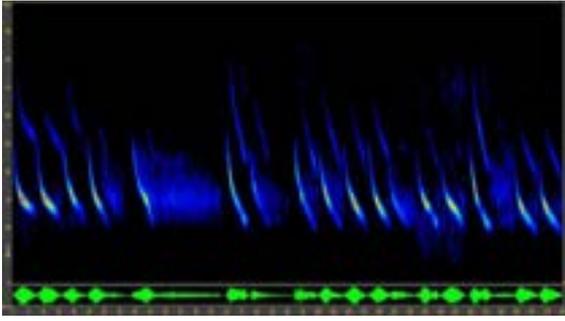
Mediterranean Long-eared Bat - call duration 5.9-6.2 ms Grey Long-eared Bat - call duration 5.9-6.2 ms



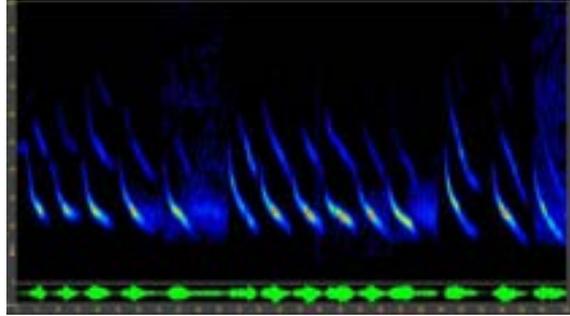
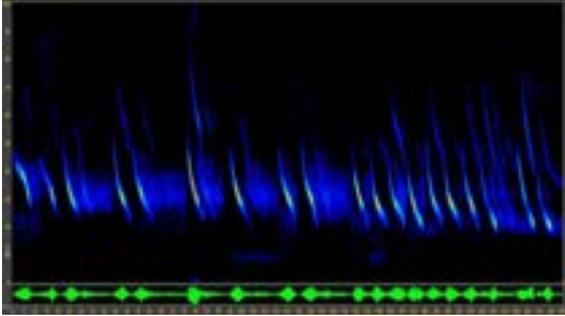
Mediterranean Long-eared Bat - call duration 6.3-6.5 ms Grey Long-eared Bat - call duration 6.3-6.5 ms



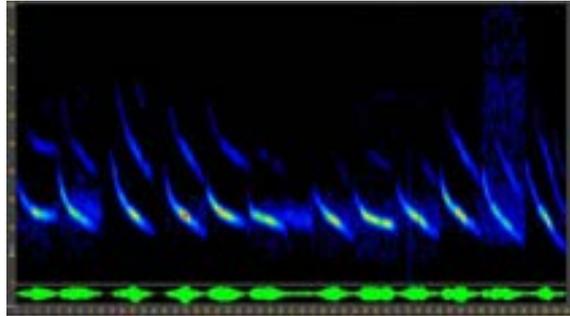
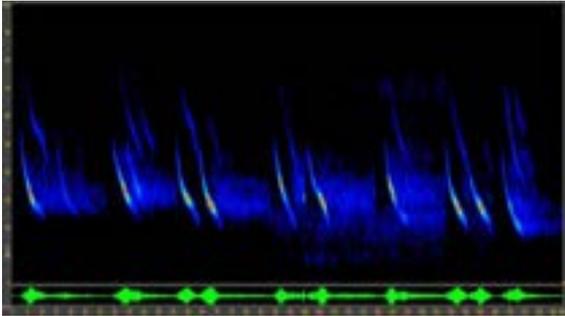
Mediterranean Long-eared Bat - call duration 6.6-6.8 ms Grey Long-eared Bat - call duration 6.6-6.8 ms



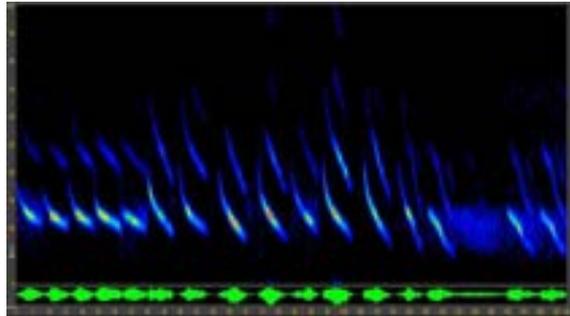
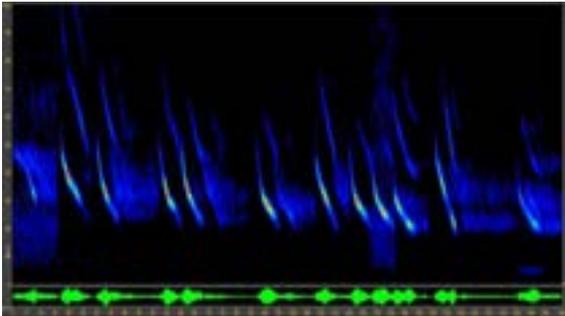
Mediterranean Long-eared Bat - call duration 6.9-7.1 ms Grey Long-eared Bat - call duration 6.9-7.1 ms



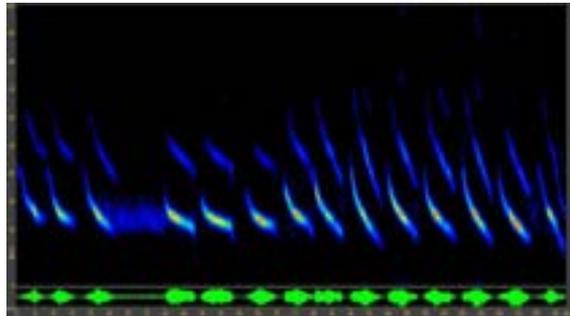
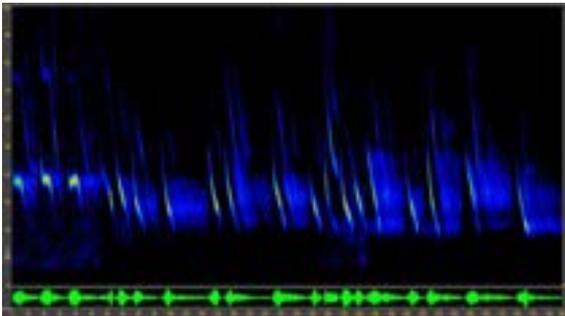
Mediterranean Long-eared Bat - call duration 7.2-7.4 ms Grey Long-eared Bat - call duration 7.2-7.4 ms



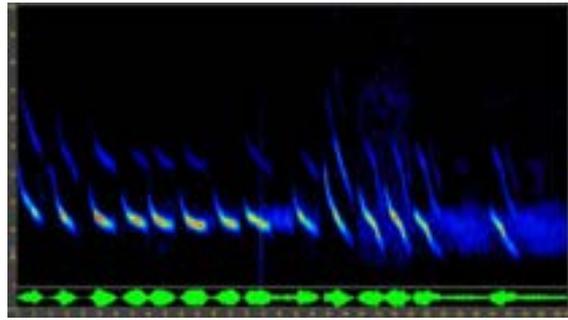
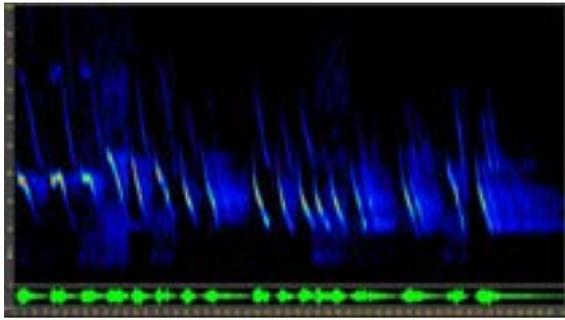
Mediterranean Long-eared Bat - call duration 7.5-7.6 ms Grey Long-eared Bat - call duration 7.5-7.6 ms



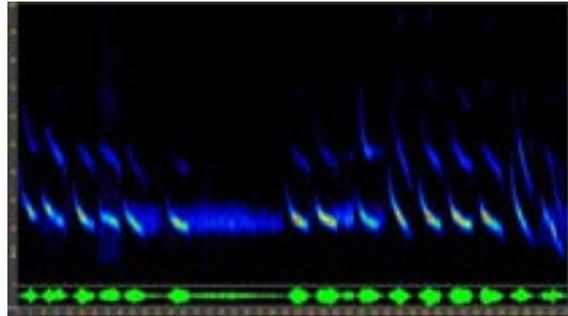
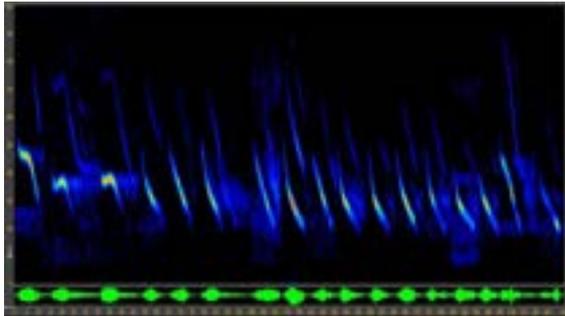
Mediterranean Long-eared Bat - call duration 7.7-7.8 ms Grey Long-eared Bat - call duration 7.7-7.8 ms



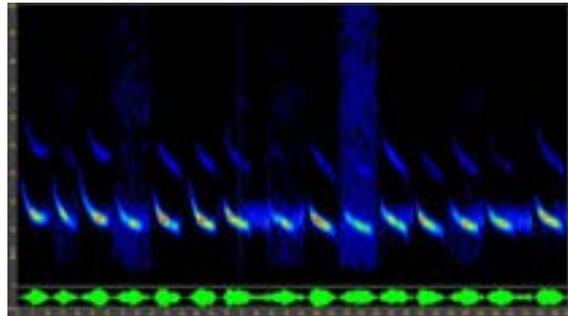
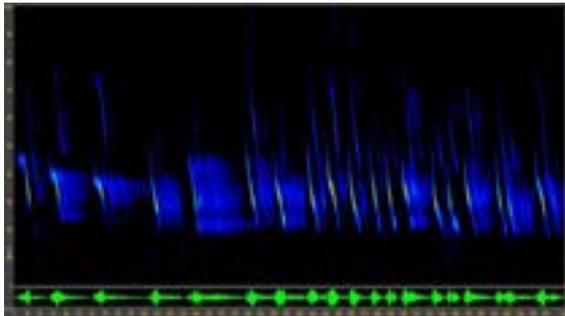
Mediterranean Long-eared Bat - call duration 7.9-8.1 ms Grey Long-eared Bat - call duration 7.9-8.1 ms



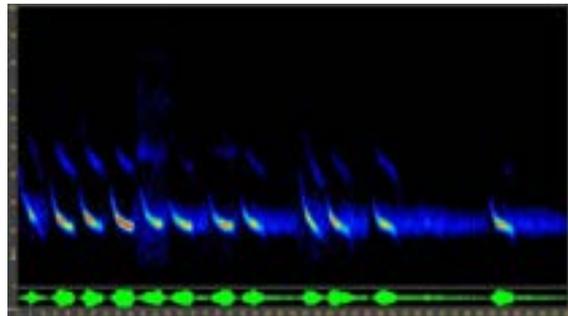
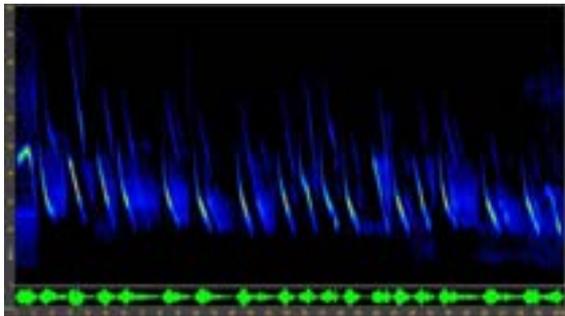
Mediterranean Long-eared Bat - call duration 8.2-8.3 ms Grey Long-eared Bat - call duration 8.2-8.3 ms



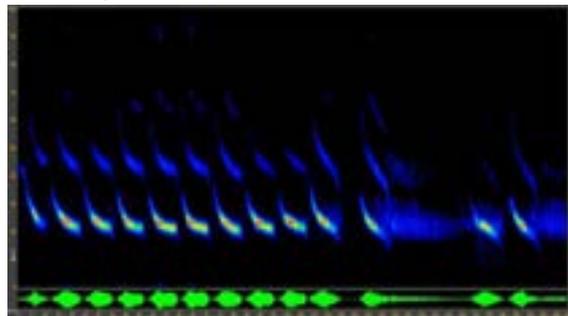
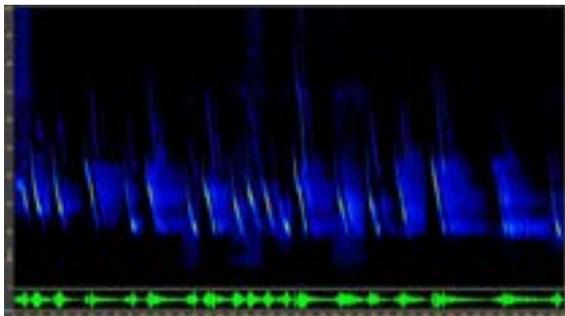
Mediterranean Long-eared Bat - call duration 8.4-8.7 ms Grey Long-eared Bat - call duration 8.4-8.7 ms



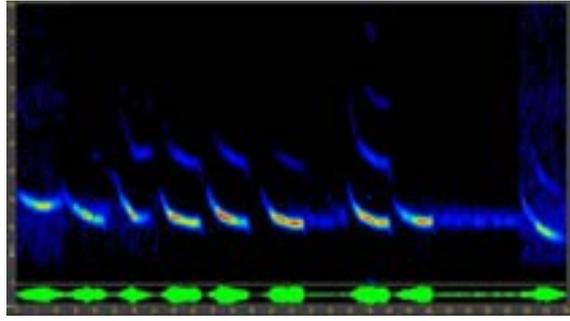
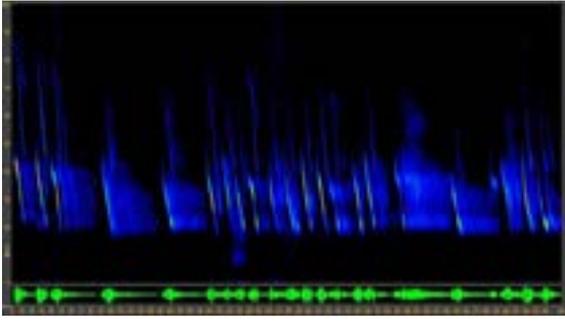
Mediterranean Long-eared Bat - call duration 8.8-9.1 ms Grey Long-eared Bat - call duration 8.8-9.1 ms



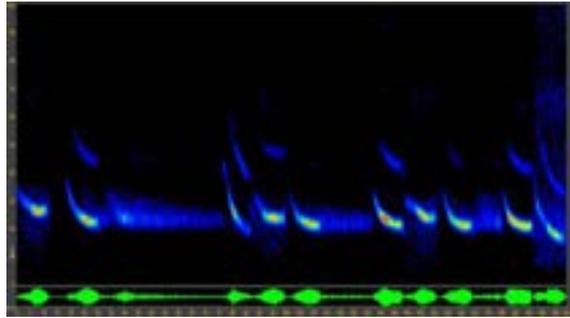
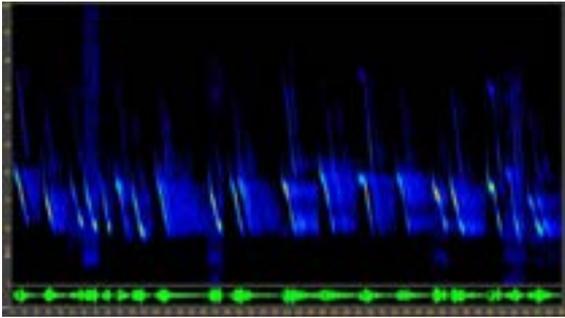
Mediterranean Long-eared Bat - call duration 9.2-9.6 ms Grey Long-eared Bat - call duration 9.2-9.6 ms



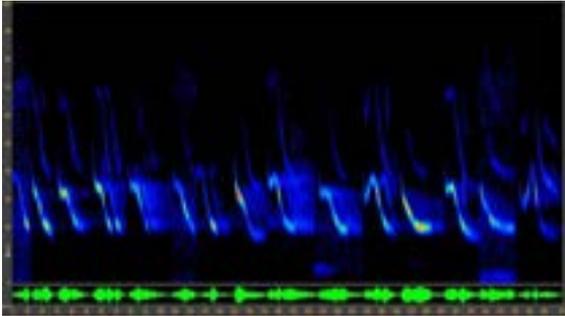
Mediterranean Long-eared Bat - call duration 9.7-10.5 ms Grey Long-eared Bat - call duration 9.7-10.5 ms



Mediterranean Long-eared Bat - call duration 10.6-11.0 ms Grey Long-eared Bat - call duration 10.6-11.0 ms

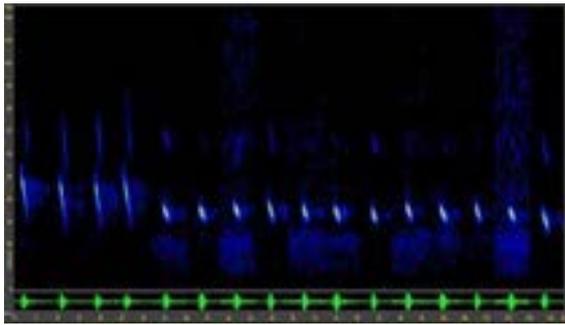


Mediterranean Long-eared Bat - call duration 11.1-12.8 ms Grey Long-eared Bat - call duration 11.1-12.8 ms

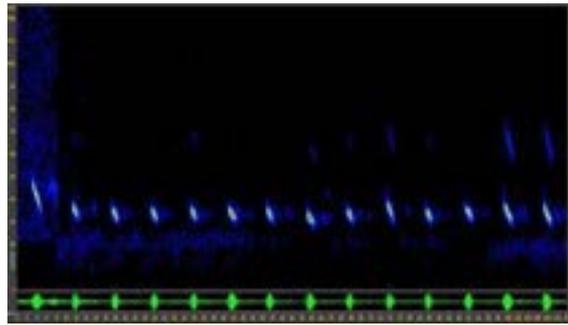


Mediterranean Long-eared Bat - call duration 11.1-12.8 ms Grey Long-eared Bat - call duration 12.9-25.0 ms – no examples

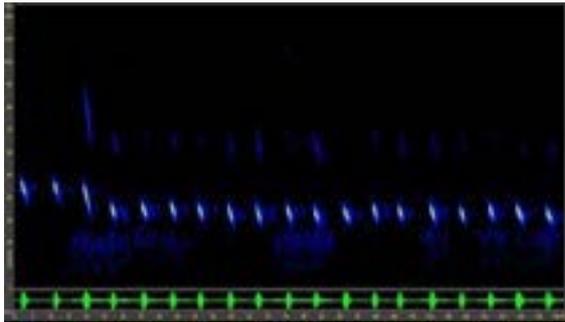
17. Barbastelle *Barbastella barbastellus* (only)



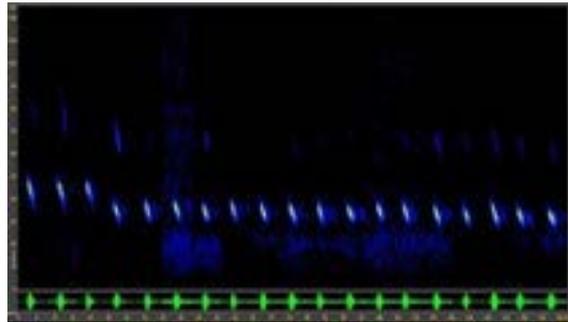
Barbastelle - call duration 1.3-1.6 ms



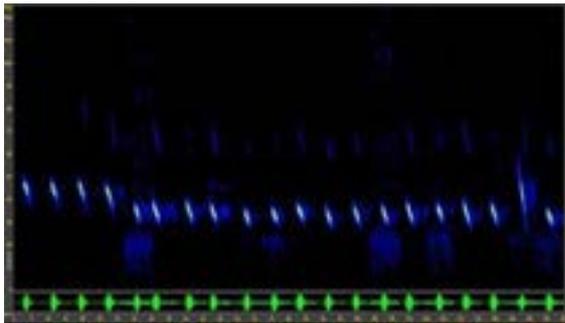
Barbastelle - call duration 1.7-1.8 ms



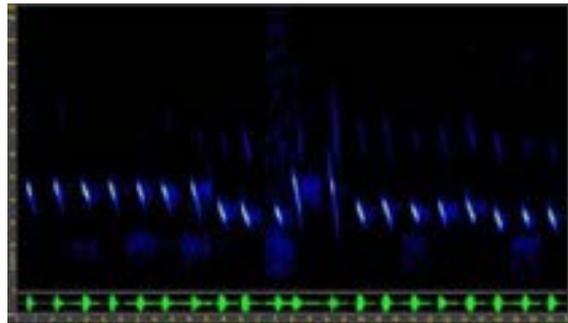
Barbastelle - call duration 1.9-2.0 ms



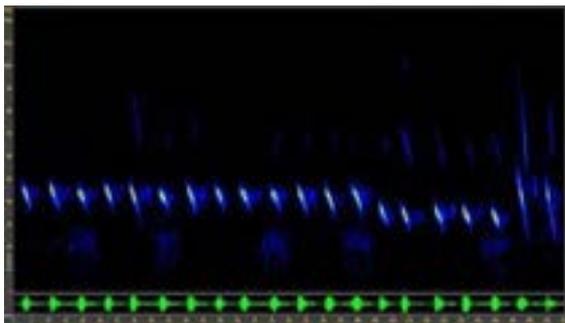
Barbastelle - call duration 2.1-2.2 ms



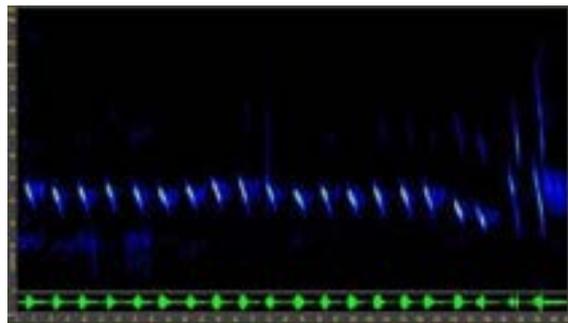
Barbastelle - call duration 2.3-2.4 ms



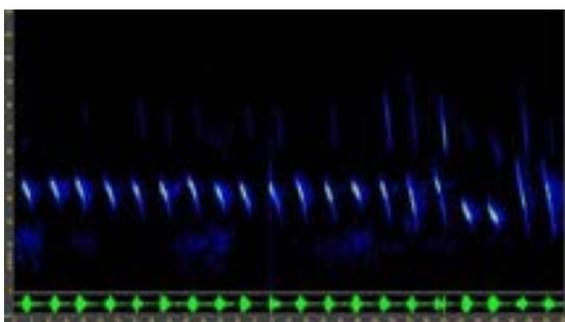
Barbastelle - call duration 2.5-2.6 ms



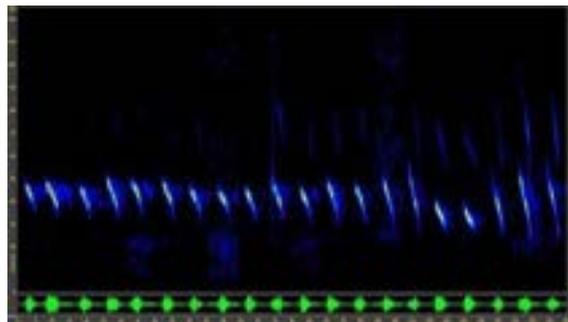
Barbastelle - call duration 2.7-2.8 ms



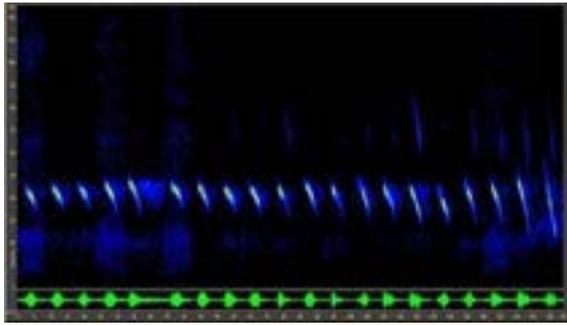
Barbastelle - call duration 2.9-3.0 ms



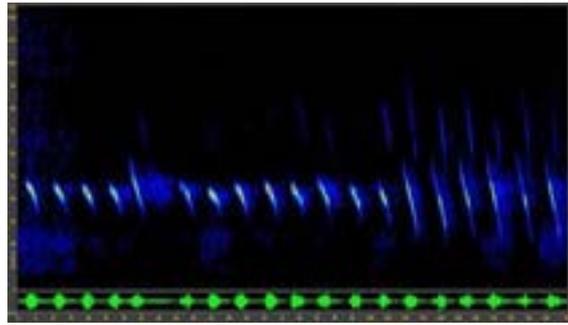
Barbastelle - call duration 3.1-3.2 ms



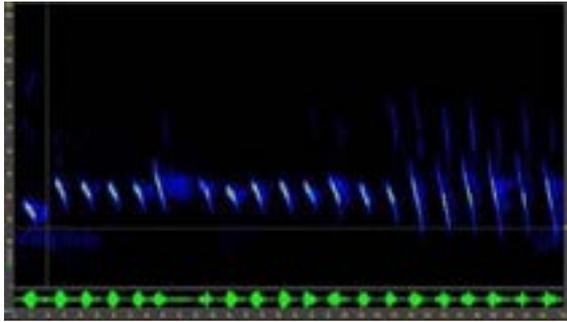
Barbastelle - call duration 3.3-3.4 ms



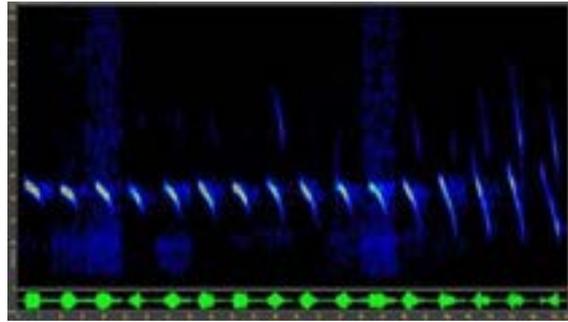
Barbastelle - call duration 3.5-3.6 ms



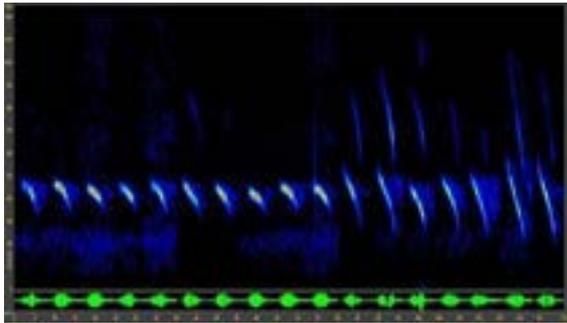
Barbastelle - call duration 3.7-3.8 ms



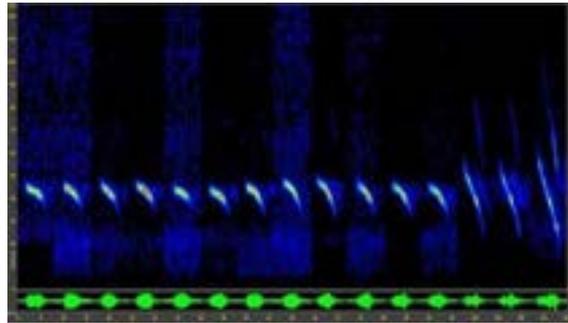
Barbastelle - call duration 3.7-3.8 ms



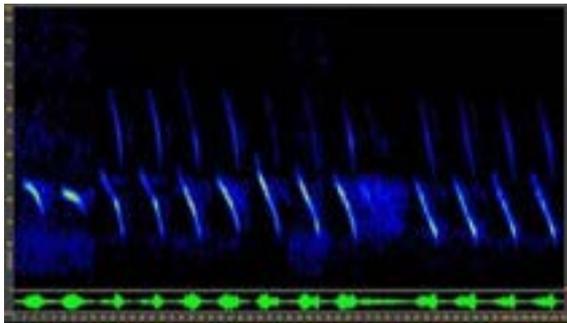
Barbastelle - call duration 3.9-4.0 ms



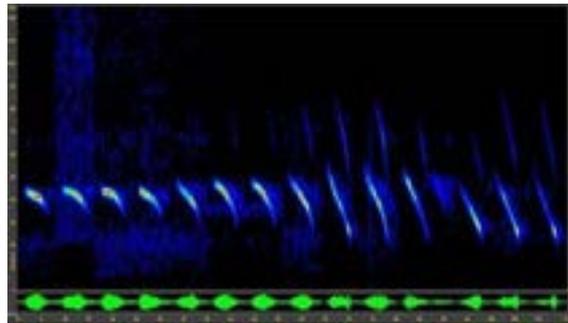
Barbastelle - call duration 4.1-4.2 ms



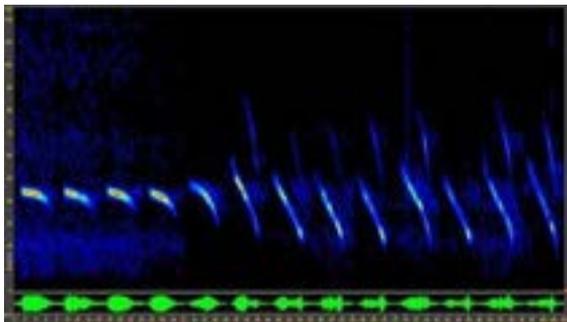
Barbastelle - call duration 4.3-4.4 ms



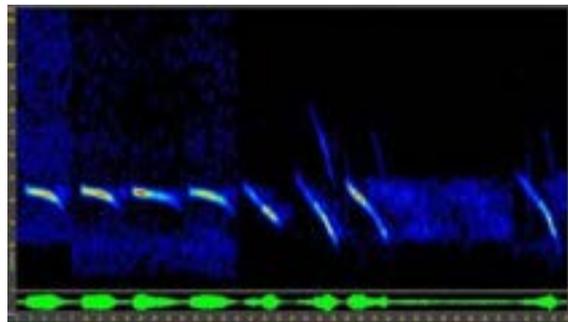
Barbastelle - call duration 4.5-4.7 ms



Barbastelle - call duration 4.8-5.1 ms



Barbastelle - call duration 5.2-5.6 ms



Barbastelle - call duration 5.7-7.0 ms