A structured interview with a bat expert

A structured conversation was conducted in support of this research with Mr Bob Cornes on 20th August 2019. Bob is an officer of the Bedfordshire Bat Group (<http://www.bedsbatgroup.org.uk/wordpress/>), and is an expert in the identification and ecology of bats in the UK and has many years of experience working with bats. He was asked to discuss and comment on the research conducted and to offer advice.

1. **What are the popular software and hardware tools used in bat detection?**

Popular systems include, Hardware: Wildlife Acoustics SM4 detector (<https://www.wildlifeacoustics.com/>); AudioMoth ([www.openacousticdevices.info](https://urldefense.proofpoint.com/v2/url?u=http-3A__www.openacousticdevices.info&d=DwMFaQ&c=KveGjKEXiH4bMFgGs-LRbCbewnnyGW6-rJ0JK7ViA_E&r=x_69-FlyLj8N7N87W4RRsWqnkjze4yUbpAgwmbZjWY4&m=PQeubaec3SJsR7rZynp0u6cDluKQnekaU-VSwlbUaiA&s=W5LsgbduLolm_igm_xPGzKqMMbzRuUC7wk0M-Vv2-4g&e=)). Software: Wildlife Acoustics Kalidescope (<https://www.wildlifeacoustics.com/>); Bat Classifier ([http://conservationfirst.co.uk/work/woodland-bat-survey-methods-for-defra/](https://urldefense.proofpoint.com/v2/url?u=http-3A__conservationfirst.co.uk_work_woodland-2Dbat-2Dsurvey-2Dmethods-2Dfor-2Ddefra_&d=DwMFaQ&c=KveGjKEXiH4bMFgGs-LRbCbewnnyGW6-rJ0JK7ViA_E&r=x_69-FlyLj8N7N87W4RRsWqnkjze4yUbpAgwmbZjWY4&m=lEYEMS9Fzh5lRCKbwZFmlgE7Emz_81v7Q1zlhueDQPI&s=QI-TmZIsvaLucydllbdbsAEFFkV3PGzG-Lud4KUcp9U&e=)); BatScope 4 (<https://www.wsl.ch/en/services-and-products/software-websites-and-apps/batscope-4.html>); Sonobat (<https://sonobat.com/>).

1. **What bat species are we likely to encounter in Bedfordshire, here at Cranfield?**

There are a number of species that are likely candidates that may be encountered, they are:

*Barbastella barbastellus* (Barbastelle)

*Eptesicus serotinus* (Serotine) – unlikely but possible

*Myotis brandtii* (Brandt’s bat)

Myotis daubentonii (Daubenton’s bat)

*Myotis mystacinus* (Whiskered bat)

*Myotis nattereri* (Natterer’s bat)

*Nyctalus leisleri* (Leisler’s bat) – although rare

Nyctalus noctula (Noctule)

*Pipistrellus nathusii* (Nathusius’ pipistrelle)

*Pipistrellus pipistrellus* (Pipistrelle)

*Pipistrellus pygmaeus* (Soprano pipistrelle)

*Plecotus auritus* (Brown long-eared bat) – very quiet calls

1. **In evaluating bat presence/absence is it best to use sequences or calls?**

Ideally, combining both is better. The sequences with high confidence need to interpret with calls to better identify the species.

1. **How many calls do I need for presence/absence survey?**

One can be enough if that one has a very high confidence (near 100% and with a distinct spectrogram), but normally it needs more calls to confirm the presence/absence. A rule of thumb is where there are four or more distinct calls in a row the confidence is acceptable.

1. **How much confidence is reliable?**

For the widely accepted statistical test, it is suggested you use 95% (1 in 20). However, 90% is also okay in some cases, it depends on the interpretation of spectrogram. Confidence levels below 90% do not qualify.

1. **What is the role of automatic versus manual bat identification from sonograms?**

For the best results, combine auto-identification with a degree of manual intervention and interpretation. An expert can assess some 400 sonograms/spectrograms in a few minutes. A systematic approach would be much slower.

1. **In what ways should AI approaches be improved in bat detection?**

There are two stages for future development: First is the identification of ‘bat / not bat’ – rather a filtering. Automated approaches can generate vast datasets and these need filtering. Second is the actual improvement in species recognition.

Note that filtering involves thresholds and that the choice of thresholds is always contentious as one will potentially be removing some number of bat calls, for example for *Plecotus auritus*, the Brown long-eared bat whose calls can be very quiet. The threshold depends on the application.

1. **How best should one evaluate and interpret the provisional results of rare/ hard-to-detect species?**

It may take months of work to check the spectrograms fully, combining it with the statistical analysis depending on the amount of data – a long process.

1. **For the survey, is one sequence with very high confidence (above 95%) or more sequences (such as 20 or 30) with comparatively good confidence (above 80%) qualified for the survey?**

It depends on the purpose. If the survey is a presence/absence survey one sequence with high confidence is better, but more sequences with middle confidence are better for the population evaluation.

1. **Did you ever find any issues when you used the classification software before? What suggestions do you have to developers as a user/ecologist?**

The software often generates wrong results and does not distinguish bats and non-bat sounds well. Software can also have problems classifying social calls between bats as opposed to hunting echo-location. Sometimes the devices will record two bats’ calls at the same moment, but the software can only interpret the one with louder sounds, which makes the automatic results interpretation tricky, and manual intervention is needed.

1. **Do you have any suggestions to the developers of automated approaches?**

It is important to realise that the confidence/precision of the outcome does not represent the accuracy. The technical problems are significant actually. For instance, one species may have different calls in different regions (‘accents of bats’), and the same species in the same areas may also have different sounds because of echos, reflections or different landscapes (woodlands, walls, etc.) All those factors above improve the difficulty to establish classifiers, and even all those factors above are considered by the developers, it may also have new issues to hamper the interpretation. This is also the reason why the manually interpretation still exist, and experienced bat biologists are necessary in this field. It is quite important for the developers to know the limitations.

The importance of training datasets of confidence is key. Researchers have a number of ways of ensuring confidence, these include making recordings: 1. of known species roosts when the bats exit/emerge; 2. Using mist nets to capture species and record on release (may not lead to natural recordings); 3. Tether known bat species to a ‘zipline’ and record its calls (may not lead to natural recordings); 4. Capture and paint a luminescent spot on a known species and record noting it flying around freely.

1. **Where should bat detectors be best sited?**

Holding detectors manually is fine, human presence does not usually put off hunting bats – although bright lights can affect hunting patterns. To remotely site a detector one can mount on a pole about 1m off the ground (perhaps disguised to prevent theft etc). Some bat enthusiasts mount their detectors on poles 3-4 m high. Note that some trees can cause echos, so some argue to place detectors in open pathways and bridleways. Bats will use hedgerows as commuting routes to connect up habitat areas.

One should also note the differing flying and hunting habitats of each species when siting detectors. For example *Plecotus auritus*, the Brown long-eared bat, has calls that can be very quiet and one must be proximal to hear. *Nyctalus noctula* (Noctule bat) tends to fly high, and can range over long distances (some kilometres). *Nyctalus noctula* can also be hard to distinguish from *Nyctalus leisleri* (Leisler’s bat), especially near trees where echos can affect the sonogram. It has also been noted that *Nyctalus noctula* can sometimes adjust its calls to mimic *Nyctalus leisleri*.

1. **What bats should we expect and how best to train the automatic tools for these?**

The choice of the training datasets used for automatic identification is the key. These should be based on the local species expected. Some databases may have bats from Southern Europe etc. which are not present here – leading to potential misclassification. Also some bats that ‘could’ be here have not been detected yet in Bedfordshire, such as *Eptesicus nilssonii* (Northern bat). Some habitats are also very localised – for example, 25km to the West of here *Myotis bechsteinii* (Bechstein’s bat) has been recorded, but not yet in Bedfordshire.

1. **Other points of interest?**
2. We should be aware of the National Charity, the Bat Conservation Trust, who runs the ‘National Bat Monitoring Scheme’. This is a good overview of bats, although there are issues of recordings in woodlands to be aware of.
3. Note that some materials and especially metals (like the banging of a metal zip on a haversack) can lead to false recordings in the bat frequencies, and in particular with *Nyctalus*.
4. If you want a signature species as an indicator of change, best not to choose *Pipistrelle* as it is common and exists widely in all environments. A rarer bat would be better.
5. A good reference book is John Russ’ ‘British Bat Calls’.
6. **Several critical points emerged from examining the sequences with confidence higher than 90%:**
7. All recordings seemed to have low frequency noise peaking around 27 kHz. There are two possible explanations for this - (a) there is environmental noise at this frequency around the campus or (b) the circuits in your device are generating noise. All bat detectors have some built-in noise of this type, which causes few problems when analysing sonograms by hand. The ID software, however, is influenced by the noise and may give false identifications.
8. Quite a few files had insect calls in them and it always causes difficulties with recording made in England in August. Several species of insect (particularly bush-crickets) call loudly and repeatedly. The ID software is easily confused by these because they have similar frequencies to some bat calls. Insect calls on seemed to have caused most of the false identifications of Barbastella barbastellus.
9. There are no false positives for Pipistrellus pipistrellus identifications. The software seems to identify the species correctly. There were some false negatives, however. Some files that had been identified as containing other species in fact contained P. pipistrellus calls. Some of these missed calls were faint (because the bat was some distance away from the detector), but others were not. It is difficult to estimate from the sample what proportion of calls might have been missed.
10. One file had two species of pipistrelle (P. pipistrellus and P. pygmaeus). Most ID software tends to miss a species when two species' calls are present in the same file, and that seems to have happened in this case.

*Mr Cornes was thanked for his participation*