VOLUME 19, NO. 4 Winter 2001

View PDF version [5.75 MB]

BatSound

Lars Pettersson

Suddenly the bat detector emits a series of faint clicks. The clicks grow stronger, the repetition rate increases, and the series of clicks ends with a buzzing sound, “ZZHHHHTTTTT.” The bat just caught an insect! Hearing a bat for the first time is a fascinating experience, and a murmur goes through the workshop participants gathered around our bat detector.

Thanks to bat detectors, small electronic devices that make ultrasonic sounds audible to humans, we can “eavesdrop” on bats that use high-frequency sounds (echolocation calls) to maneuver and catch prey in the darkness. Using detectors, we can usually tell where the bat is and, often, what it is doing. We also gather clues that help us determine its identity. Each species makes unique calls identifiable by differences in frequency and rhythm. However, it is always a good idea to use all available information, including visual observations of flight style, when identifying bats with detectors. Complex bat calls may need to be further analyzed using special sound analysis programs on personal computers. Recent advances in technology have been instrumental in helping scientists identify new species that look very similar but make different sounds [BATS, Winter 2000]. Without a bat detector, this would have been extremely difficult.

There are a number of different methods for converting ultrasound into audible sound; therefore there are different types of bat detectors. The most common detector types are heterodyne, frequency division, and time expansion, each with advantages and disadvantages. A heterodyne bat detector converts a limited range of the full ultrasonic information into audible sounds. Just like a radio receiver, a tuning control is used to select the frequency. Relatively inexpensive yet sensitive, heterodyne detectors are able to detect bats at long distances. The sound from a heterodyne detector can have tonal qualities, which means that a call may sound like a “plip” or a “plop,” which helps determine the type of call. With a heterodyne detector, it is also possible to immediately determine the approximate frequency of the ultrasound. One disadvantage is that you will only be able to cover a limited range of frequencies for each setting of the tuning control. If there is a signal outside of this range, you will miss it.

In contrast to a heterodyne detector, a frequency division detector does not have to be tuned-- it is a broadband type. It converts the entire ultrasonic range into a convenient, audible, frequency range. A frequency division detector is less sensitive than a heterodyne detector, so the bats must be closer to the detector in order to be heard. The name “frequency division” stems from the fact that the frequency of the converted signal is a fixed fraction (e.g., one-tenth) of that of the original signal. There are subtypes of frequency division detectors: those that retain the amplitude, or range, of the original signal and those that do not.

Time expansion detectors also use a broadband technique, although the sensitivity of such detectors is higher than that of a frequency division detector, which records the signal, then plays it back at a slower speed (e.g., ten times slower). Time expansion bat detectors use digital memory rather than magnetic tape, but the principle is the same. This means that the

signal you hear is actually the original (slowed down) signal. Using the original signal is particularly important if you intend to analyze the signal on a computer. In such cases, time-expanded signals are very useful. The fact that the signal is slowed makes it possible to hear the tiniest details of the sound, which are not audible with other conversion techniques. This helps when identifying the species. Because digital memories are limited in size, it is only possible to work with a small segment of the signal with this method. A storage time of a few seconds is common with time expansion detectors, but this is usually sufficient to allow a detailed analysis in the field or on the computer. Many detectors offer more than one conversion option. For example, with stereo headphones it is possible to listen to a heterodyne signal with one ear and a time expansion signal with the other.

Although it is advisable to do as much of the species identification work as possible in the field, some species may require further analysis for a positive identification. The most common method is to use a cassette tape recorder to record the audible output of the bat detector then analyze these signals in the laboratory. This is a compact and lightweight solution suitable for fieldwork. It is also possible to use a laptop computer for immediate analysis in the field. In either case, you must use a suitable sound analysis program. Such a program can analyze signals in a variety of ways. For instance, the signal can be displayed as a spectrogram (sonogram), in which the frequency of the signal is shown versus. time. The spectrogram also contains information on the sound level, represented by different colors or shades of gray. An oscillogram shows amplitude variations versus time.

From the spectrogram and oscillogram, many call parameters can be extracted, such as maximum and minimum frequencies, the frequency at the energy peak of the signal, the signal duration, and the interval between pulses. These parameters can help in distinguishing different species. Some programs are able to extract these parameters automatically, while in others, it must be done manually. There are also a number of advanced capabilities, such as automatic recording systems for remote collection of bat calls and systems recording the original, ultrasonic signals, which are not covered here.

Bat detectors are important tools for researchers, but they can be fun and easy to use for any bat enthusiast. Inexpensive models are available through the BCI catalog. Every year, BCI's Bat Conservation and Management Workshops provide participants with first-hand field experience and a chance to experience the nocturnal world of bats with their ears. For more information on bat detectors and workshops, visit the BCI Web site: www.batcon.org, or call 512-327-9721.

Lars Pettersson lives in Sweden and owns Pettersson Elektronik, which sells a variety of bat detectors and BatSound acoustical software for analyzing echolocation calls. He is one of BCI's 2001 Distinguished Service Award recipients and helped lead BCI's BatSound-Acoustic Monitoring Workshop in Arizona in 2000. He is also an Assistant Professor in Electrical Engineering and Signal Processing at the University of GÃ¤vle, Sweden.

All articles in this issue: