

The Effects of Weatherproofing on Acoustic Bat Detection

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Introduction

Acoustic bat surveys provide an efficient method for monitoring bat activity that can be relatively easy to setup and may be less labor intensive over long-term monitoring programs than other trapping techniques (O'Farrell 1997). While ultrasonic bat detectors were first developed to allow researchers to listen for bats from ground level, the need for long-term passive bat acoustic monitoring at elevated heights has pushed the functional limits of commercially available bat detectors. Long-term passive acoustic monitoring is the survey method most often used during preconstruction bat surveys at proposed wind energy facilities (Kunz et al. 2007). Bat detectors are often deployed on meteorological towers or other tall structures within a project area and left unattended for long periods while recording bat echolocation data. Under these circumstances, bat detectors are exposed to wind, rain, condensation, and temperature extremes and require protection. Weatherproofing can alter acoustic data quality and quantity, and it is important for researchers to understand these effects when designing a bat acoustic monitoring study to allow accurate interpretation of the data. A study conducted by Britzke et al. (2010) using Anabat detectors indicated that the use of a PVC elbow results in performance similar to unprotected bat detectors and that the reflector plate configuration commonly used in the BatHat (PVC housing pointed down at an acrylic-glass plate) was outperformed by all other treatments used in the study. To understand the effects of weatherproofing on acoustic data collected with Normandeau's Remote Bat Acoustic Technology System (ReBAT™), we investigated detection performance of the detector in both a weatherproof housing with reflector plate and PVC elbow configuration using both ultrasonic playback trials (Figure 1) and field trials (Figure 2).



Figure 1. Avisoft (ultrasonic playback) Trials



Figure 2. Field Trials

Results

Avisoft Test Results

The detector in the reflector plate detected more total bat passes than the detector in the PVC elbow ($z = 22.5, p < 0.001$) (Figure 3). In addition, the detectors in the forward direction recorded more bat passes than either the sideways ($z = 25.89, p < 0.001$) or backwards ($z = 12.12, p < 0.001$) orientations. There were more passes recorded in the sideways orientation than the backwards orientation ($z = 5.38, p < 0.001$).

There were more high frequency bat passes recorded in the reflector plate housing than the PVC elbow ($z = 6.82, p < 0.001$) (Figure 4). The sample size of high frequency passes in each orientation was insufficient to statistically examine trends among direction orientations.

Field Test Results

When considering all habitats together, the PVC elbow recorded more total bat passes than the reflector plate ($t = 4.30, df = 27, p < 0.001$). However, when considering each habitat separately, the open habitat was the only habitat where the PVC elbow recorded significantly more bat passes than the reflector plate ($t = -8.44, p < 0.001$). There were no differences in the total number of bat passes recorded between the PVC elbow and the reflector plate in both the cluttered habitat ($t = -2.39, p = 0.062$) and edge habitat ($t = -0.67, p = 0.53$; Figure 5).

The same relationship was true when looking at just the high frequency passes: the PVC elbow recorded more high frequency bat calls than the reflector plate at all habitats combined ($t = 3.19, p < 0.0$). When we looked at the effect of each weatherproofing method in each habitat separately, the PVC elbow housing detected more passes than the reflector plate ($t = -3.74, p < 0.05$). There was no difference in the number of high frequency bat passes detected between housing types in the cluttered habitat ($t = -1.76, p = 0.14$) and the edge habitat ($t = -0.429, p = 0.69$; Figure 6).

References

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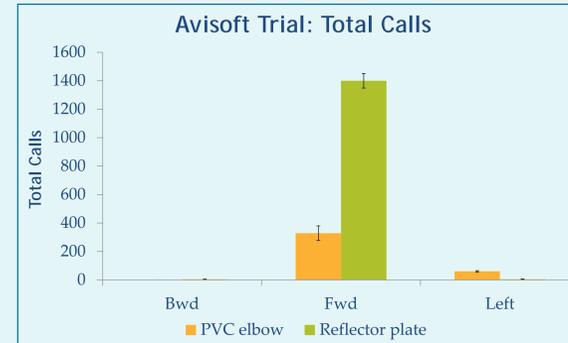


Figure 3. Total calls recorded during the Avisoft trials.

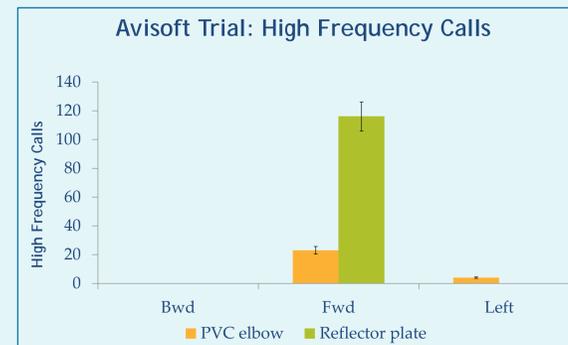


Figure 4. Total high frequency calls recorded during the Avisoft trials.

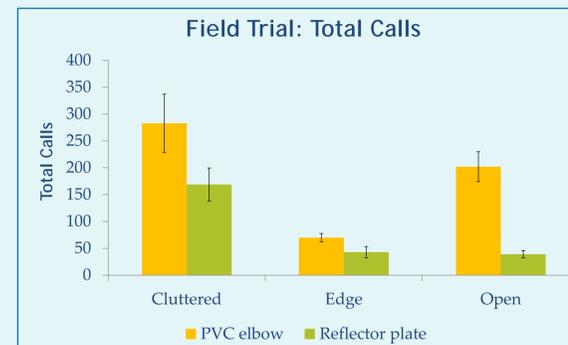


Figure 5. Total calls recorded during the field trials.

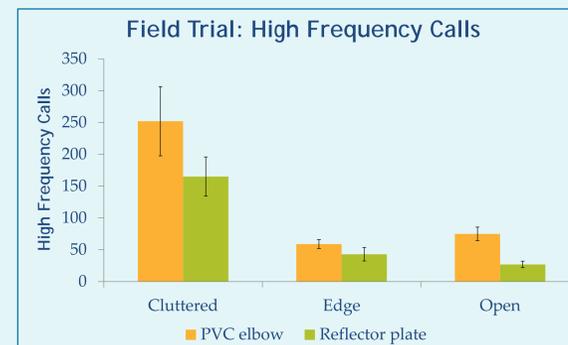


Figure 6. Total high frequency calls recorded during the field trials.

Discussion

Consistent with what has been demonstrated in previous studies (Britzke et al. 2010), our results demonstrate that weatherproofing can impact bat detection performance. However, there were differences in results between the playback trials and the field trials. These differences were likely due to differences in the orientation of the zone of detection between the two weatherproofing methods. The reflector plate has a zone of detection that extends from the housing approximately parallel to the ground, while the PVC has a more vertical zone of detection (Figure 7). The playback trial configuration allowed for testing within the reflector plate optimum zone of detection, approximately 1 m above the weatherproofing treatments parallel to the ground. The overlap between the emitted ultrasonic sound and the reflector plate zone of detection remained high as the distance between the sound source and the detector increased, leading to a higher distance of detection in the reflector plate. As the distance between the ultrasonic speaker and the PVC increased, the overlap between the ultrasonic sound and the PVC housing's more vertical zone of detection decreased, leading to a decreased zone of detection in this configuration.

The field trials conducted in the three habitat types allowed a closer examination of differences between the two weatherproofing methods in zone of detection. During the field trials, the PVC elbow recorded more total bat passes. The largest differences (and only significant) in bat passes detected were observed in the open habitat, likely due to the spatial distribution of bats relative to the microphone. In the open area, bats are likely flying higher above the ground than bats in the more cluttered habitat of the stream and forest edge. From these results it appears that the zone of detection of the PVC elbow is more effective at detecting bats from ground level.

Ultimately, the position of the bats relative to the detector will determine how effective a detector within a specific weatherproofing type is at detecting bat echolocation calls. These preliminary results indicate that for acoustic deployments at ground level at which bat activity will be concentrated above the detector, the PVC elbow may be more appropriate. It is possible that when detectors are deployed high above the ground on a meteorological tower, detection performance between the two weatherproofing methods may be different than what was found in the ground based trials as bats may be distributed differently in space relative to the detectors (i.e., at 150 ft above ground level, bats may be flying more within the reflector plate zone of detection rather than higher within the PVC elbow zone of detection). Further studies are needed to better understand the effects of weatherproofing on detection rate of bats by detectors deployed on meteorological towers or other tall structures. Additionally, there is also a need for studies that better characterize the zone of detection for each weatherproofing method.

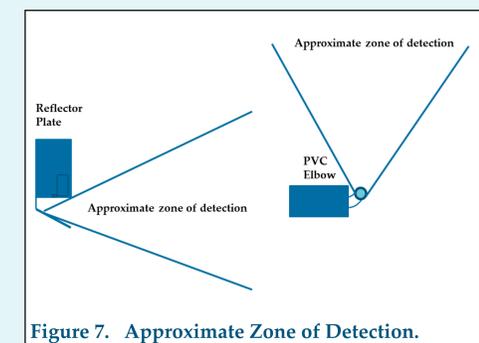


Figure 7. Approximate Zone of Detection.