The comparison of manual and software based species identification using acoustic recordings of bat vocalizations

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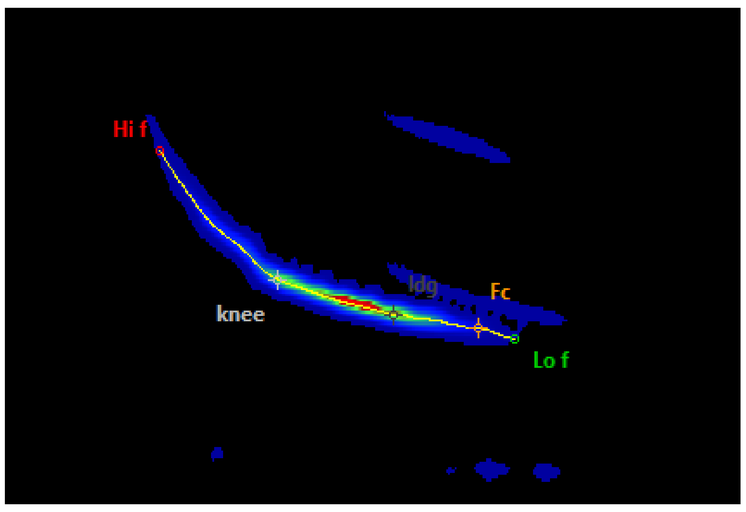

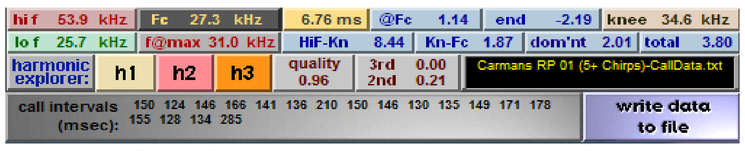

Figure 4: Snapshot of silver haired bat sonogram using SonoBat

Abstract

Automated species identification software has become a popular tool in the wildlife field for acoustic recordings of bat vocalization as part of bat management. Since accurately identifying bats is extremely important for bat management due to significant decreases in populations, an efficient identifying method is critical. In this paper, a comparative analysis between an automated bat identification software, SonoBat and the traditional manual identification method using spectrograms generated by the software SCAN'R was performed. Four years worth of data was used for this study. Comparison of the two methodologies resulted in no significant difference between the two methods.

Introduction

Bats generally use echolocation as an orientation system and for locating their prey (Schnitzler and Kalko, 2001). They emit signals of high frequency and analyze the returning echoes so that they can detect, characterize, and localize the reflected objected (Schnitzler and Kalko, 2001). Bats have species-specific signal types that can differ in frequency structure, duration, and sound level (Schnitzler and Kalko, 2001) . The signal type can vary by the task the bat is performing (Schnitzler and Kalko, 2001). Bats are generally hard to study because of their small size, nocturnal habits, and difficulty to capture (Jennings, Parsons and Pocock, 2008). However, acoustic monitoring has allowed biologists to study the level of use of habitat and their activity (Frick, 2013). An acoustic recording allows the identification of bat species by analyzing their echolocation calls.

Brookhaven National Laboratory (BNL) is using two methods to identify bat species. These two methods include the automated identification software, SonoBat ©, and a manual decision tree system using spectrographs generated by the software SCAN'R ©. Using both these methods has led to the question: which method is more accurate when identifying bat species? To address this question, a comparative analysis was performed using data collected from mobile surveys. It was hypothesized that SonoBat would have a higher identifying rate, higher rate at differentiating between big brown bat (*Eptesicus fuscus*) and silver haired bat (*Lasionycteris noctivagans*) and would have a lower unidentified rate than manually identifying using SCAN'R.

Acoustic recording device for mobile surveys. Photo taken by Amanda Vescovi.

Materials and Methods

After a mobile survey was completed, the files were processed through SCAN'R. The files identified were based upon the visual inspections of frequency and shape of calls. The files that had at least five calls were placed into the positive file list. The positive files were then run through SonoBat and manually identified through SCAN'R using a decision tree system and Humboldt State University bat lab's, "echolocation call characteristics of eastern US bats" table. Files that could not be identified were labeled "unknown". After both identification methods were complete the data was then imported into Excel for organization, and comparative analysis. These steps were used for each mobile survey.

To compare the identification methods, a mass Excel file was created using all data collected from 2011 through 2014. The Excel file was created to compare three main categories; number positively identified, number unidentified, and the ability to identify between big brown bat (*Eptesicus fuscus*) and silver haired bat (*Lasionycteris noctivagans*) using both SonoBat and SCAN'R. The average was calculated for each category for each year. The averages were then compiled into the statistic software, JMP ©, using the statistical test, ANOVA, to test for differences between the two methods.

Results

There was a total of 1022 files that were qualitatively identified to bat species. SonoBat identified a total of 533 files and SCAN'R identified a total of 682 files. The year 2014 had 211 files, 2013; 291 files, 2012; 323 files and 2011; 197 files.

•**Identified using SonoBat and SCAN'R:** $F_{1,6}$ = 4.2879, value = 0.0838 NSD

•**Identified between big brown bat and silver haired bat using SonoBat and SCAN'R:** $F_{1,6}$ = 0.0012, value = 0.9828 NSD

•**Unidentified using SonoBat and SCAN'R:** $F_{1,6}$ = 4.4929, value = 0.0783 NSD

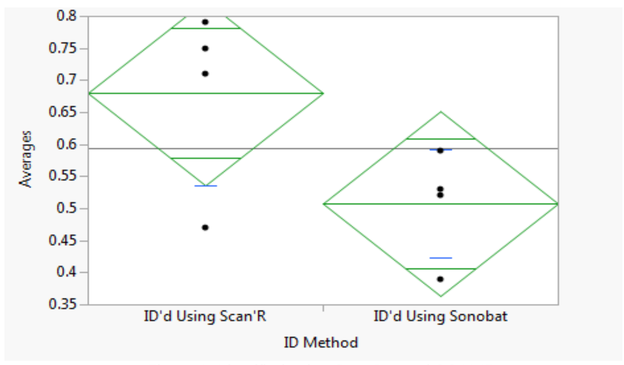

Figure 1: Identified using SonoBat and SCAN'R

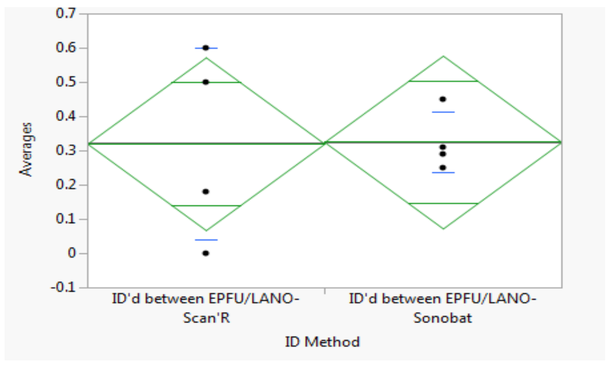

Figure 2: Identified between big brown bat and silver haired bat

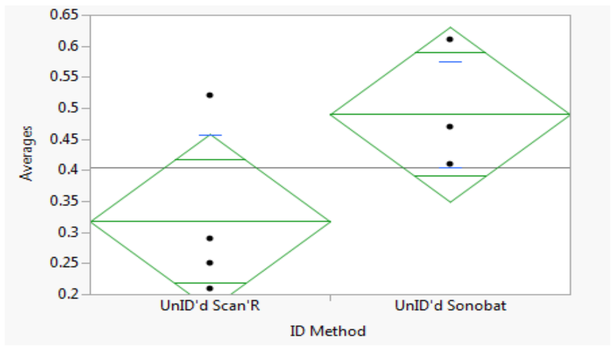

Figure 3: Unidentified using SonoBat and SCAN'R

Groups	*Count*	*Sum*	*Average*	*Variance*
ID'd Using Sonobat	4	2.030	0.508	0.007
ID'd Using Scan'R	4	2.727	0.682	0.020
ID'd between EPFU/LANO- Sonobat	4	1.299	0.325	0.008
ID'd between EPFU/LANO- Scan'R	4	1.286	0.321	0.077
UnID'd Sonobat	4	1.966	0.491	0.007
UnID'd Scan'R	4	1.264	0.316	0.019

Table 1: Averages

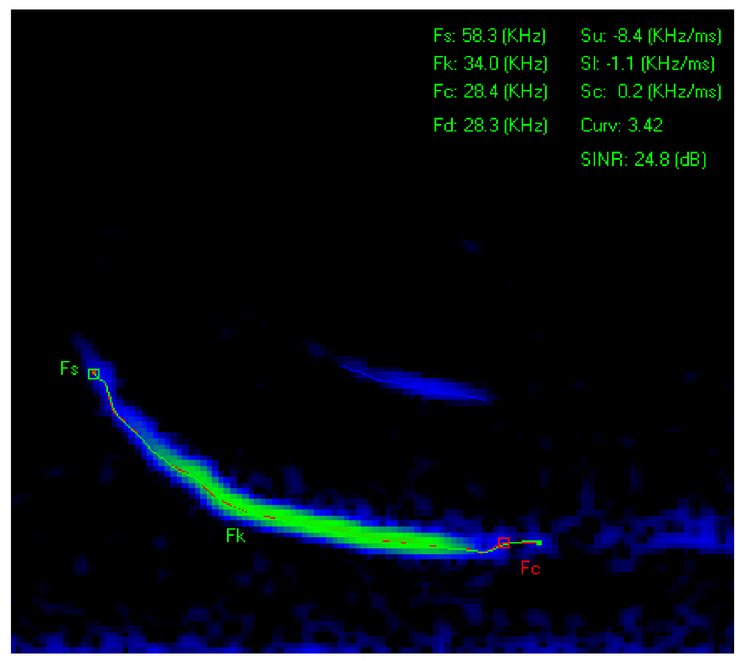

Figure 5: Snapshot of silver haired bat sonogram using SCAN'R

Discussion

The average number positively identified using SonoBat was 0.508 (51%) and SCAN'R was 0.682 (68%). The p-value was 0.0838; therefore there was no significant difference among SonoBat and SCAN'R when it comes to the number identified. The average number of times either method was able to differentiate between big brown bat and silver haired bat using SonoBat and SCAN'R was; 0.325 (33%) and 0.321 (32%), respectively. The p-value was 0.9828; suggesting there was no significant difference between the two methods. The averages for the amount unidentified using SonoBat and SCAN'R were; 0.491 (49%) and 0.316 (32%). The p-value was 0.0783; therefore there was no significant difference between each other.

Even though SonoBat and the manual method have proven to have the same capabilities, Through personal experience, SonoBat had an advantage over the manual method, which was its time efficiency. SonoBat is capable of analyzing large number of files within a reasonable time, while the manual method took at least two hours to identify around 80 files, because you have to look at several calls within each file to better identify the bat species.

Although there is no significant difference between the two methods, there is still a possibility that each file is mistakenly identified. It is extremely important that species are identified correctly because some bat species populations are being threatened by the, White-Nose Syndrome fungus (*Pseudogymnoascus destructans*), so it is suggested that each file is double checked using both methods simultaneous.

References

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Acknowledgments

I thank the following individuals and sponsors for their research assistance: Tim Green and Kathy Schwager (Mentors), Amanda Vescovi (Project Partner) and of course, the Brookhaven National Laboratory, The U.S. Department of Energy and The Brookhaven National Laboratory: Virginia Pond Scholarship.