Millersville University
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Department of Biology
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Automated Detection and Identification of Winter Bird Vocalizations

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INTRODUCTION

Diversity assessments for bird populations have typically been made by sending trained personnel into the field. Automated recording devices and automated identification software may allow surveying to occur without long hours in the field, however the accuracy of using computerized detection has been a subject of debate (Venier et al 2012; Lopes et al. 2011; Brandes 2008; Buxton & Jones 2012).

The objective of our study was to evaluate the efficiency of a fully automated process in determining bird diversity. We used the Wildlife Acoustic's Song Scope call recognition software with data collected from Wildlife Acoustics SM-2 automated call recorder (Figure 1) to evaluate the program's success at identifying four species of Pennsylvania winter birds.

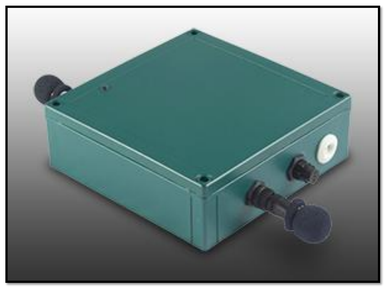

Figure 1 : The Song Meter SM-2 device.

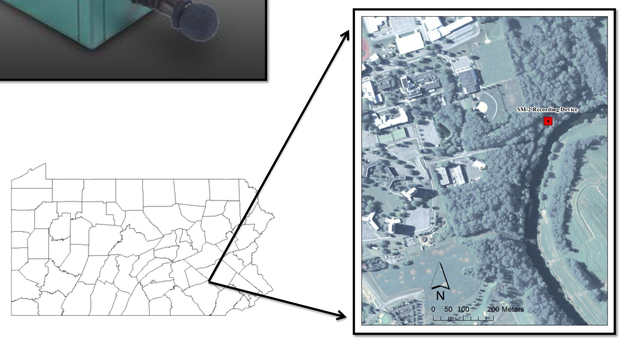

Figure 2 : Recording location along the Conestoga River on the Millersville University Campus, Millersville, PA.

METHODS

The four winter bird vocalizations chosen to test were the "jay" call of the Blue Jay, (*Cyanocitta cristata*), the basic song of the Carolina Wren (*Thryothorus ludovicianus)*, the "chick-a-dee-dee-dee" call of the Carolina Chickadee (*Poecile carolinensis*), and the high clear whistled song of the White-throated Sparrow (*Zonotrichia albicollis*).

Handheld recordings, Thayer's Bird Software, and three deployments of the SM-2 device were necessary to gather vocalizations to create a reference library for the four species used in the study (Figure 3). The Song Meter SM-2 was deployed along a forest edge habitat near Millersville, PA, within a close proximity to the Conestoga River (Figure 2).

Reference vocalizations were needed for the Song Scope software to create a model used to classify vocalizations. This model is called a 'recognizer' in Song Scope. Vocalizations from the Thayer's software and pre-recorded songs were annotated in the Song Scope Program, and then 'recognizer' or classifier models were created for each winter bird species (Figure 4). The highest quality vocalizations were used to develop each 'recognizer' model.

Figure 3 : Devices used to help produce a reference library of calls and songs.

The recognizers were then applied to eleven hours of test recordings. All test recordings were made by the SM-2 from December 12-23, 2013. Recordings were taken in 30 minute durations twice a day, once at 8:00 am and once at 3:30 pm. These sets of recordings were then screened for the four target vocalizations (figure 4) using the Song Scope Program.

When the software misses a target vocalization, which a human observer had identified, this is called a false-negative. When a vocalization is recognized as a target by the software but is not the true target upon review by personnel, it is called a false-positive. We evaluated the software based on false-positives.

Table 1. Song Scope results from the recognizer models used to identify the basic song of the Carolina Wren (*Thryothorus ludovicianus)*, the 'jay' call of the Blue Jay (*Cyanocitta cristata*), the chick-a-dee-dee-dee call of the Carolina Chickadee (*Poecile carolinensus*), and the song of the White-throated Sparrow (*Zonotrichia albicollis).* All results were based on Song Scope's recommended recognizer scores. *- *False negatives are not factored into this percentage.*

Song Scope Recognizer	Correct Vocalization True Positives	Incorrect Vocalization False Positives	% Vocalizations Correctly Identified by Software*	Overlooked Vocalization False Negatives
Carolina Wren	50	13	79.37%	33
Blue Jay	39	14	73.58%	131
Carolina Chickadee	53	235	18.40%	1
White-throated Sparrow	1	11	8.33%	4

RESULTS & DISCUSSION

We found that the SM-2 recording device produced good quality recordings of bird vocalizations. The Song Scope software identified the Blue Jay and Carolina Wren with accuracy similar to that advertised (~80%) by Wildlife Acoustics (Table 1). However, low accuracy was associated with the Carolina Chickadee and White-throated Sparrow, albeit there was a low sample size of White-throated Sparrow calls. The amount of time spent on annotating calls and testing species specific parameters for four species was on average five hours per species. The Song Scope interface has many options and settings which create the functioning parts of each recognizer model (Figure 4). The time spent with these models exceeded the time needed to do a 30-minute weekly survey of the area studied. Other scientists have made similar observations when using this software to survey amphibians (Waddle et al. 2009).

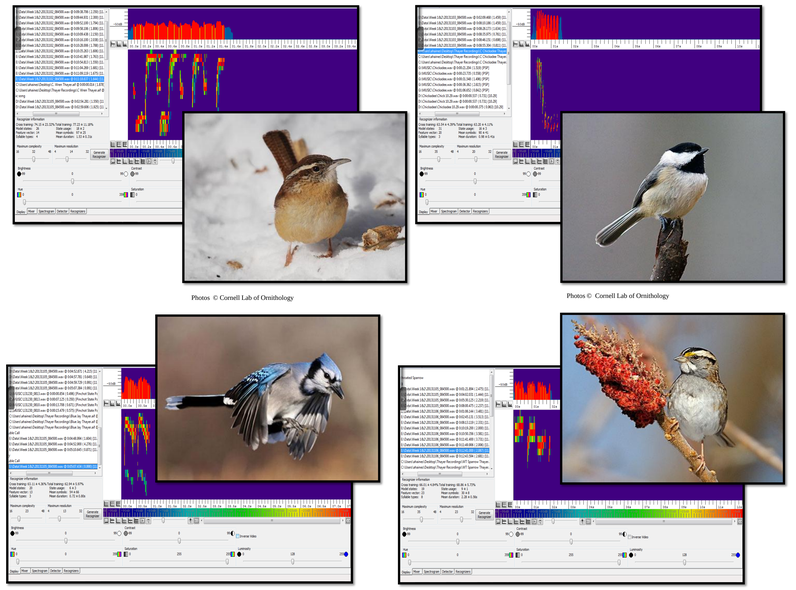

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Figure 4. The user interface for creating recognizer models in the Song Scope program for the four species tested in Millersville, PA. Notice the different structures of each call on the spectrogram as different types of notations pictured to the left of the spectrogram create each unique model for each species.

Wildlife Acoustics acknowledges that patience and trial & error are needed to create optimum settings when developing recognizer models. However, running the recognizer models through the Song Scope program made it easier to find species in ten hours of field recordings rather than playing the recording and waiting to hear a target species.

If a detailed database of effective species recognizer models were created, fully automated identification of vocal animal species would be more efficient. The development of a "recognizer database" for vocal species could then be used to screen automated recordings for biodiversity surveys.

The creation of a database by researchers would need to be a multi-regional collaborative effort. Many hours of recordings would be needed to create annotations and hours spent on finding the correct parameters in the software (the type of software would need to be agreed on & standardized). Certain species would require multiple recognizers based on regional variations in bird vocalizations. Regionally specific recognizers in the database could then be used by researchers. Researchers could then identify individual birds by matching vocalizations to specific geographic areas.

LITERATURE CITED

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