Using Electronic Field Recordings to Increase the Detectability of Bird Species at Point Count Sites

Deborah Cushman, Timothy Johnson, and Robert Keys

Cornerstone University

October 2013

ABSTRACT

Each year thousands of breeding bird point count surveys are conducted by field technicians (both volunteer and professional) to monitor the state of bird populations across North America. This data are then used to help manage and steward bird communities across the continent. The greatest limitation to this survey technique is the validity of the collected data based on the ability of the observers. This study sought to continue the monitoring of breeding bird populations at the Pierce Cedar Creek Institute while at the same time using an observer-electronic field recorder combination to determine if the accuracy of identifications and/or actual counts can be increased by having field observers compare their point count observations against electronic field recordings made at the same time the point count is being conducted. We hypothesized that observer accuracy and identification would become more acute by listening to and comparing field observer point count data with electronic field recordings as the field season progressed. We found that as the field season progresses field observer accuracy increased. The final point count series showed no significant difference between the field observers and the EFR.

INTRODUCTION

Importance of monitoring bird populations

Bird populations are often monitored to assess changes in population and habitat. Monitoring allows an estimation of the local density of species to be determined, what habitat these species prefer, and how the changes in habitat affect the bird's populations (Johnson, 1995). These changes are often a reflection of changing environmental and climatic conditions. In comparison to other organisms, birds are easier to count in the field and to follow in migration routes. This monitoring allows researchers to understand how changes in the environment are influencing populations. Early detection of changes allows for preventative measures to be put in place to limit further decline in the numbers of birds in an area. Frequent bird counts conducted in an area result in an increase of accuracy in the estimated bird populations and allow for a better detection of the changes occurring (Hostetler, 2011).

It has been observed that bird populations are on a northward shift (Niven et al. 2009). This is most evident in the winter months. Many species of birds are not wintering as far south as they did in the past and can now be found during the winter months in areas north of their previous habitats. One way these winter shifts have been monitored has been through Christmas Bird Counts conducted in late December and early January after the birds have migrated south, but before they begin to head north again. It is believed that these northward population shifts are due to changes in the climate (Hitch and Leberg, 2007). Winters have become increasingly warmer than they were in the past and many believe that this accounts for the observed increase of various winter bird populations in more northern zones. Although it is speculated that many birds are adapting to the changes in climate, more specialized species are the most vulnerable to this climate shift as they are not as able to find other areas of suitable habitat (Niven et al. 2009).

It has also been noted that many of these bird population declines have also resulted from the loss and fragmentation of habitats (Şekercioğlu et al. 2004). Many forest-nesting migratory birds are losing their habitat due to changes in land use. This loss of habitat has been implicated as a factor in the decline in population that has been observed within individual bird species (Donovan, 2002).

The limitations of human observers

It is necessary to understand why some species are undercounted in order to properly establish conservation plans (Gu et al. 2003). One of the most direct ways is to have observers in the field observing the birds. This method has several limitations. First, birds tend to avoid humans and often are not as visible or vocal when humans are nearby. However, research by Campbell and Francis (2011, 2012) showed that there was not a significant difference in birds observed between an observer conducting the point count and the use of an automatic recording unit (ARU). Though an observer conducting the point counts may cause birds to briefly pause from singing, most songbirds will resume singing shortly after the observer arrives at the site. The difference between the observer's point count and the ARU point count is not significant enough to make this a strong argument. A small population of birds in an area may also limit the accuracy of a point count. It is very common to miss members of a species in a survey when there are not many of that species in the area to counted (Gu et al. 2003).

Not only are population factors an issue, but it is also possible to misidentify bird calls in the field when one must make a quick identification without the aid of comparing the calls and taking more time to listen. Farmer et al. (2012) showed that when listening to calls at point count sites, many birds can be falsely identified due to the similarities that can exist between the calls of some birds. Often researchers with less experience in birding will identify a bird call as a more

common species, while a more experienced birder is more likely to error in calling the bird a less common species. Unfortunately, it is not always possible to have trained and experienced researchers in the field at the needed time (Hobson et al. 2002). Sometimes a species that is actually not in the area is incorrectly detected and recorded in the count. All observers, even those with experience, can mistakenly record species that are not present in the area. With all observers making these errors, the degree to which they are made and the consequence of even a small percent of false detections creates a valid concern in trusting the accuracy of the point count records (Miller et al. 2012).

At peak calling times it is easy to overlook a species. This can result when other bird calls interfere with the researcher's ability to detect a specific species that is in the area. Therefore, not all species are recorded during a typical point counts (Miller et al. 2012). Hutto et al. (2009) note that an observer is not always great at multitasking, making it likely that they will miss a species when multiple birds are singing at the same time. They are also more likely to miss species at the beginning of the point count. Species can also be overlooked when the observer simply cannot see them or hear them. Sometimes they are not heard because they are too far away for their song or call to be detected (Johnson, 2008). When this happens they may be in the point count range but their frequency is too low for recognition. Another difficulty is that census information may not be recorded accurately due to a lack of species movement in the area when an observer is present (Bibby, 2000).

It has been found that electronic field recorders aid in distinguishing individual calls. Because the equipment is simple and easily available, this is a suitable field method for detecting birds and other animals (Dawson et al. 2009). Automated digital recording systems have been shown to provide some additional advantages. These included a permanent record, 24 hour a day

data collection and the possible identification of species through automation (Acevedo et al. n.d.). Research has shown that when electronic field recording (EFR) occurred simultaneously with observer point counts and many species are calling together, the EFR had greater accuracy (Celis-Murillo et al. 2012).

Purpose of the study

These limitations are often inherent in conducting point count studies and the degree to which errors in misidentified or missed birds take part in many of these studies is frequently unmeasured. Our purpose was to test a methodology whereby field observers make use of electronic field recordings in tandem with their point counts to determine which bird species are most generally missed/incorrectly identified during point counts and if detection rates can be increased using electronic field recordings as a training device. We hypothesized that electronic field recordings will show that certain bird species are often less detectable in field point counts, but that training can increase the ability of observers in the detection of these missed species.

METHODS

Study Area

The research was conducted at the Pierce Cedar Creek Institute (PCCI), Barry County, Michigan USA from 11 May to 14 July 2013. PCCI includes a variety of habitat types including mixed woodlands, wetlands, and prairies. Thirty-two point count sites used by Oosterhouse et al. (2012) were used to provide a continuation of breeding bird monitoring at PCCI based on a continuum of horizontal and vertical vegetative structure.

Low detection species were defined as those species having detectability below 20% during the first point count series and having more than 20 observations of the species over the six series of point counts. This was to ensure that the probability of hearing the species was possible for more than one series.

Bird Point Counts

To document current abundance, distribution, and diversity of breeding birds on Pierce Cedar Creek Institute property we used point count methods developed by Ralph et al. (1993). This point count protocol was used in 2011 and 2012 at the same point count sites (Vander Geld et al. 2011; Oosterhouse et al. 2012). Point counts were conducted from 30 minutes prior to sunrise to no later than 1000 hours. Observers stood at the designated point count site for 5 minutes and recorded all birds seen and/or heard within a 75 m point count radius. Birds heard outside of the 75 m radius were also recorded to allow greater comparison to the electronic recording. Recording birds outside of the radius while in the field allowed for the comparison of observer detections with the EFR. Birds that were incorrectly recorded within range on the EFR could then be determined as actually outside of the 75 m radius. When possible, the sex was recorded. Other conditions such as time of day and weather were documented. Counts occurred only when weather conditions did not inhibit detection probability (Rigby & Johnson 2012). Diurnal point count training occurred during the migratory weeks of May with data collection at the point count sites from the end of May to July. Point count sites (32 sites) were observed once a week during the breeding and nesting season. Each site was observed at least six times during the field season. Observers conducted point counts in tandem with the electronic field recording. Both of the observer's point counts were used in the analysis.

Electronic Field Recording

On arriving at the point count location a portable field recording station consisting of a Zoom H4n field recorder (Zoom Corporation) connected to two ME62 Sennheiser omnidirectional microphones (Sennheiser Corporation USA) was established. The omnidirectional microphone/recorder was calibrated to record sounds < 80 dB at 100 m in open

field conditions. However, it must be noted that other research has indicated that each habitat is unique in the ability of EFR to detect birds at various distances (i.e., the range of detectability in a forest is significantly different than the detectability range in a field) (McCallum n.d.). After EFR equipment was erected, recording began with an announcement of the point count site number, date and time by one of the field observers. After the announcement, a one-minute period of silence was observed, to allow the birds time to resume singing, prior to commencing point count observations and a starting point on the field recording.

Laboratory Analysis

After morning point counts, field observers took field notes and the audio recordings back to the lab for analysis. Audio recordings were downloaded onto Raven Pro 1.5 (Cornell Laboratory of Ornithology) to analyze songs/calls recorded by the EFR. Field observers listened to the recordings for each point count and compared point count recordings of the other observer to the EFR. Analysis of observer point counts was assessed to determine if the bird was 1) correctly identified by the field observer and the present in the EFR; 2) incorrectly identified by the field observer, but present in the EFR; 3) identified by the field observer (sight/song/call), but missed by the EFR; and/or 4) missed by the field observer, but captured by the EFR.

Statistical Analysis

At the end of the field season, data from the field observations and laboratory activities were analyzed to determine if a) certain species of birds were significantly less detectable than other species, and b) how detectability changed throughout the field season. We used a Pearson's correlation to compare the degree to which detectability of low detection species changed between series. We also used paired t-tests for the five comparisons of accuracy to compare the

degree to which field observer detection accuracy improved throughout the field season and the degree to which field observer accuracy compared to that of the EFR.

RESULTS

During the breeding and nesting season, six point count series were conducted at all 32 point count sites. A total of 66 bird species (woodpeckers to passerines) were recorded based on a total of 2,832 individual observations.

Improvements in Field Observer Detectability Rates

In the six series, improvement was seen in the mean detection averages of the two field observers when compared to the actual number of birds observed (field observers correct identification + EFR observations). There were significant differences in the number of birds counted correctly between series 1 and 2 (n = 64, t = -1.79, P = 0.038); 2 and 3 (n = 64, t = -2.34, P = 0.010); and 3 to 6 (n = 64, t = - 4.14, P < 0.01); with smaller improvement in the series 3 to 6 (Figure 1).

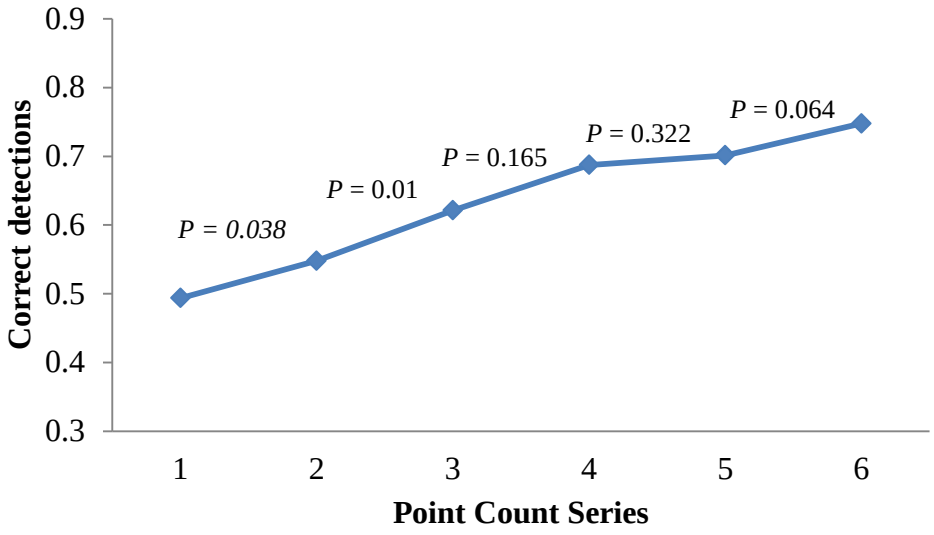

Figure 1. Observer detection accuracy and t values between series over six point count series at 32 point count sites at Pierce Cedar Creek Institute, Barry County, Michigan USA 27 May to 12 July 2013.

Detectability of Low Detection Species

There were a total of seven low detection species recorded. These species had a variety of songs and calls making it initially hard to learn and identify all the calls for a particular bird. Many of these birds also had calls which sounded similar to other bird species causing these birds to be easily misidentified. The Cedar Waxwing had such a high call that was often missed. Using the EFR for training, there was a strong correlation between field observers' detection and the increased detection of low detection species over the six point count series (Table 1, Figure 2).

Table 1. Pearson correlation between point count series and detection of seven low detection birds at Pierce Cedar Creek Institute, Barry County, Michigan USA, 27 May to 12 July 2013.

Species	% Low Detection	% High Detection	R^2
AMGO	9%	58%	0.70
BLJA	19%	100%	0.50
CEWA	13%	78%	0.95
HOWR	0%	70%	0.88
INBU	14%	65%	0.71
RBGR	0%	83%	0.59
WIFL	0%	50%	0.75

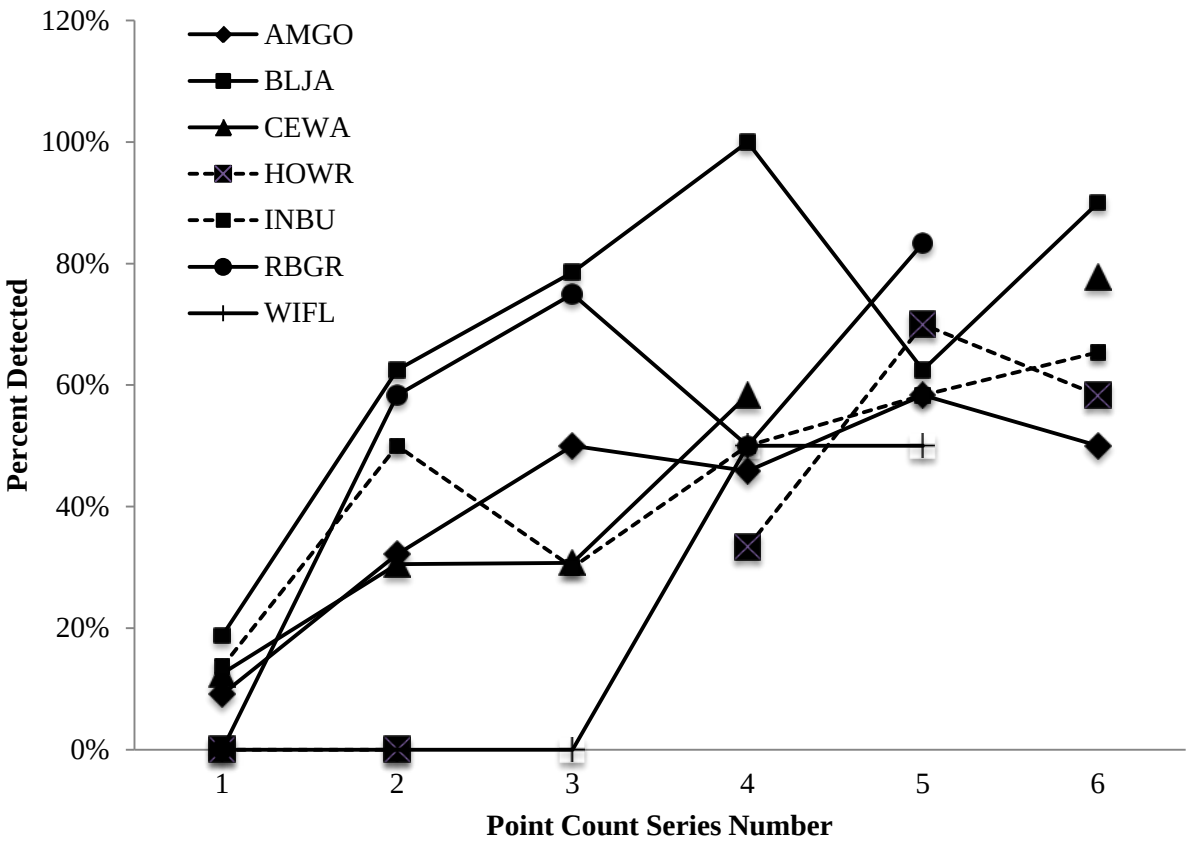

Figure 2. Changes in the detection of low detection species over six point count series at Pierce Cedar Creek Institute, Barry County, Michigan USA, 27 May to 12 July 2013).

Comparison of field observers to EFR

Using a t-test and an assumption of equal variance, there were significant differences between the number of birds counted correctly by the field observers and those recorded by the EFR in point count series 1-5 ($P < 0.05$). However, there was no significant difference between the two in the last series ($P = 0.35$) (Figure 3). The EFR detection never reached a detection rate greater than 90% of the total bird count on any of the weeks.

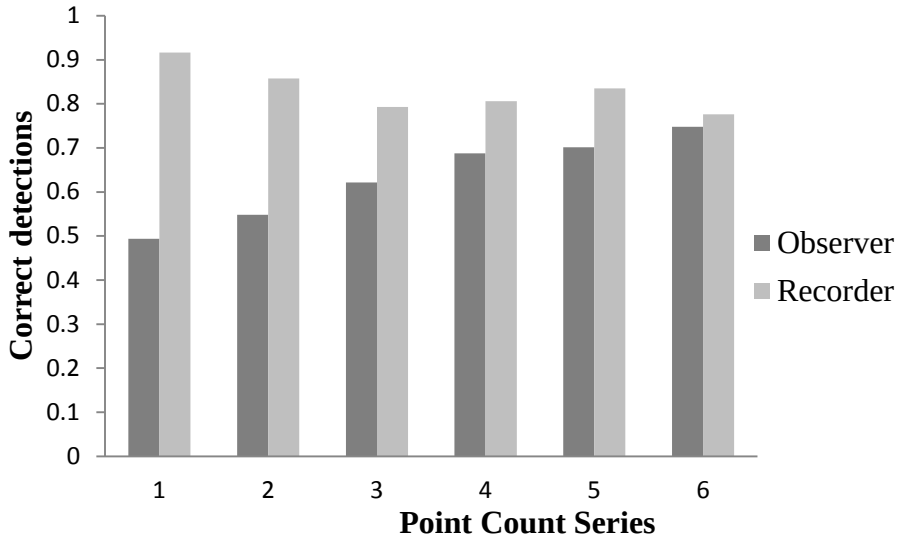

Figure 3. Ratio of observer and EFR detections compared to the actual number of birds present.

DISCUSSION

We found that as the field season progressed observer accuracy and identification became more acute by listening to EFR and comparing it to field observer point count data. In each series, field observers increased correct detections of bird species during point counts, usually significantly. This supported our hypothesis that use of EFR for training purposes would significantly increase the detection probability of the field observers. However, this could also be from the experience we gained over the length of the research and would need a comparative study to understand it better. The field recordings were important in assisting field observers in detecting species consistently missed and determining song variations being sung by low detection species, increasing detections in subsequent series.

Electronic field recordings were very important in assisting field observers in determining which bird species were less detectable in field point counts. This enabled the field observers to identify which birds were missed and enabled them to increase their ability to correctly detect these less detectable bird species in later point counts. This supported our hypothesis that use of the EFR would assist field observers in identifying and detecting low detectable species and that

field observers would increase detection rates of low detection species through the use of the EFR. While this did occur, it is important to note that most low detection species still had low detection (most less than 60%) even in the last point count series. Thus, the use of EFRs is important in detecting low detection species, even though field observers may have counts that do not significantly differ from the EFR (Campbell and Francis 2011, 2012).

The EFR has several advantages; however, it also has limitations that keep it from being completely accurate. When listening to the recordings from the EFR we found not all the bird calls were at a frequency that could be picked up by the EFR, also the EFR could not detect birds that are in the area and are not calling. While the EFR enabled the observers to identify birds that were missed frequently and birds that were commonly misidentified giving the observer a clear focus on what bird songs/calls they needed to focus on, its detectability was never greater than 90%. It would seem then that the conjunctive use of both field observers and EFR would result in the highest degree of detection of all species and provide the most accurate point count of sites being monitored for various studies.

This study showed that by the combined comparison and use of the EFR, field observer's accuracy was increased. This can be seen in the improvements in the detection accuracies over the course of the six series. However, the issue with determining improvements based on comparison accuracy over time is that improvement in observer accuracy would have been observed even without the use of the EFR. The question that then develops is how much of the improvement in accuracy can be attributed to the EFR. A follow-up study testing the relevance of observers without the use of an EFR within an equal time frame would be very beneficial to study this relationship. Separate sets of data would need to be collected by trained individuals

using an EFR and untrained individuals without the use of the EFR collecting information at the same time an at the same points.

This study found that observer detection accuracy increased with the use of the EFR. The EFR is very helpful in improving the detection of low detection species. This becomes particularly important when trying to determine bird species whose calls are less familiar to the observer. The EFR allows the observer to listen to the call until the correct species is determined instead of having to make a quick decision in the field or from trying to determine the call later from memory. While the EFR does not present a perfect solution to the limitations of bird point count sites it is very useful when used in tandem with field observers and for the training of field observers.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the generous financial support of the Willard and Jessie Pierce Foundation, the financial support of Cornerstone University and the assistance provided throughout this research by the staff of the Pierce Cedar Creek Institute.

LITERATURE CITED

Acevedo, M. A., & Villanueva-Rivera, L. J. Using automated digital recording systems as effective. *Wildlife Society Bulletin*, *34*(1), 211-214. Retrieved September 24, 2013

Bibby, C., Jones, M., & Marsden, S. (2000). *Expedition Field Techniques bird surveys* (p. 21). Cambridge: Bird Life International. Retrieved September 24, 2013

Campbell, M. and C. M. Francis. (2012). Using microphone arrays to examine effects of observers on birds during point count surveys. *Journal of Field Ornithology,* 83(4), 391-402.

Campbell, M. and C. M. Francis. (2011). Using stereo-microphones to evaluate observer variation in North American breeding bird survey point counts. *Auk*, 128(2), 303-312.

Celis-Murillo, A., Deppe, J. L., & Ward, M. P. (2012). Effectiveness and utility of acoustic recordings for surveying tropical birds. *Journal of Field Ornithology*, *83*(2), 166-179. doi:10.1111/j.1557-9263.2012.00366.x

Dawson, D. K., & Efford, M. G. (2009). Bird population density estimated from acoustic signals. *Journal of Applied Ecology*, *46*(6), 1201-1209. doi:10.1111/j.1365-2664.2009.01731.x

Donovan, T. M., & Flather, C. H. (2002). Relationships among North American songbird trends, habitat fragmentation, and landscape occupancy. *Ecological Applications*, *12*(2), 364-374. Retrieved September 24, 2013

Farmer, R. G., M. L. Leonard, and A. G. Horn. (2012). Observer effects and avian-call-count survey quality: rare-species biases and overconfidence. *Auk,* 129(1), 76-86.

Gu, W., & Swihart, R. K. (2003). Absent or undetected? Effects of non-detection of species occurrence on wildlife–habitat models. *Biological Conservation, 116*, 195-203. Retrieved September 24, 2013

Hitch, A. T. and P. L. Leberg. (2007) Breeding distributions of North American bird species moving north as a result of climate change. *Conservation Biology*, 21(2), 534-539.

Hobson, K. A., Rempel, R. S., Greenwood, H., Turnbull, B., & Van Wilgenburg, S. L. (2002). Acoustic surveys of birds using electronic recordings: new potential from an omnidirectional microphone system [Electronic version]. *Wildlife Society Bulletin*, *30*(3), 709-720.

Hostetler, M. E., & Main, M. B. (2011, June). Florida monitoring program: point count method to survey birds. In *University of Florida IFAS Extension*. Retrieved September 23, 2013. http://edis.ifas.ufl.edu/uw140

Hutto, R. L. and R. J. Stutzman. (2009). Humans versus autonomous recording units: a comparison of point-count results. *Journal of Field Ornithology,* 80(4), 387-398.

Johnson, D. H. (2008). In defense of indices: The case of bird surveys. *Journal of Wildlife Management* **72**:4, 857-868

Johnson, D. H. (1995). USGS. In *Point Counts of Birds: What Are We Estimating?* Retrieved September 24, 2013

McCallum, D.A. n.d. The pros and cons of audio-taping point counts: equipment considerations. http://www.appliedbioacoustics.com/research/reports/PatuxentAudioEquip.PDF

Miller, D. W., Weir, L. A., McClintock, B. T., Grant, E. C., Bailey, L. L., & Simons, T. R. (2012). Experiment investigation of false positive errors in auditory species occurrence surveys. *Ecological Applications*, *22*(5), 1665-1674.

Niven, D. K., Butcher, G. S., & Bancroft, G. T. (2009, October). Christmas bird counts and climate change: Northward shifts in early winter abundance [Electronic version]. *American Birds*, *63*, 10-15.

Oosterhouse, J. D., Vander Geld, A. L., Keys, R. S. (2012). Analysis of vegetative structure in the choice of nesting habitat by midwestern songbirds. Pierce Cedar Creek. http://www.cedarcreekinstitute.org/documents/VanderGeld-Oosterhouse-Keys_Vegetative_structure_breedingbirds_Final_11-16-12.pdf

Ralph, John C., G. R. Geupel, P. Pyle, T.E. Martin, D.F. DeSante. (1993). Handbook of field methods for monitoring landbirds. Lincoln, NE: USDA Forest Service-National Agroforestry Center, University of Nebraska.

Rigby, E. A. & D. H. Johnson. (2012). Factors affecting detection of recorded bird songs in mid-continent grasslands. Proceedings of the 2012 Midwest Fish and Wildlife Conference, Wichita, KS.

Şekercioğlu, Ç. H., Daily, G. C., & Ehrlich, P. R. (2004). Ecosystem consequences of bird declines. Proceeding of the National Academy of Science of the United States of America. Retrieved January 10, 2013.

Vander Geld, A. L., Oosterhouse, J. D., Keys, R. S. (2011). The effects of trophic cascading by Odocoileus virginianus on breeding songbird populations. Amber VanderGeld, Jason Oosterhouse and Dr. Robert Keys. 2011. Cornerstone University

Pierce Cedar Creek Institute. http://www.cedarcreekinstitute.org/documents/2011-TheeffectsoftrophiccascadingbyOdocoileusvirginianusonbreedingsongbirdpopulations.pdf

Zoom Corporation. 4-4-3 Kandasurugalai, Chiyoda-ku, Tokyo, Japan. http://www.zoom.co-jp.*8*