5-2014

Birding by Ear: A Study of Recreational Specialization and Soundscape Preference

Zachary D. Miller
Clemson University

BIRDING BY EAR: A STUDY OF RECREATIONAL SPECIALIZATION AND SOUNDSCAPE PREFERENCE

A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
Parks, Recreation, and Tourism Management

---

by
Zachary D. Miller
May 2014

Accepted by:
Dr. Jeffrey C. Hallo, Committee Chair
Dr. Julia L. Sharp
Dr. Robert B. Powell
Dr. J. Drew Lanham

ABSTRACT

Soundscapes have become recognized as an important natural resource. The traditional human-made versus natural soundscape comparison currently used in recreational resource management is challenged by borrowing soundscape components (i.e., biophony, anthrophony, and geophony) from soundscape ecology. This study is designed to evaluate the soundscape preference of birders. A three-component model of recreational specialization was used to evaluate how recreationists may differ in their preference for soundscape components. Data from in-person surveys collected at The Audubon Center and Sanctuary at Francis Beidler Forest in Harleyville, South Carolina were used in combination with surveys from online birding list servers to obtain a sample of 415 individuals with varying levels of specialization. The findings suggest that soundscape preference exists as biophony, geophony, and anthrophony and that preference for geophony differs among specialization segments.

Keywords: recreational specialization, soundscapes, biophony, geophony, anthrophony, birders, bird watching

ACKNOWLEDGMENTS

This research project would not have been possible without the contributions of many people. Specifically, I would like to thank Dr. Hallo for his time, effort, and investment in not only this research project, but also in my academic career. I would also like to thank the committee members: Drs. Sharp, Powell, and Lanham. It takes a special kind of patience and talent for professors to be able to mold a student during their first research project. I hope to return these investments to future students.

I would also like to thank The Audubon Center and Sanctuary at Francis Beidler Forest, specifically Mike Dawson, for allowing me to conduct research at the sanctuary. Thank you for being so accommodating to this research project.

Additionally, I would like to take a moment to be grateful that there are still quiet places in the world. If ever a day comes where on a spring morning, still cool from winter's last breaths, the ethereal call of the hermit thrush near a small brook cannot be heard in peace, it will be a sad day indeed.

Lastly, thank you Rusty. The guidance and lessons you have taught me have helped me get to where I am today. I will always be indebted to you.

TABLE OF CONTENTS

Page

TITLE PAGE i

ABSTRACT ii

ACKNOWLEDGMENTS iii

LIST OF TABLES vi

MANUSCRIPT 1

Introduction 2

Literature review 5

Recreational specialization 5

Soundscapes 7

Methods 12

Sample 12

Data instrument 14

Analysis 16

Results 18

Demographics 18

Cluster analysis 18

Principal components analysis 19

Specialization and soundscape component preference 19

Individual specialization components and soundscape component preference 20

Discussion 20

Conclusion 26

References 28

Tables 35

REFLECTION 40
APPENDICES 46
Questionnaire 47

LIST OF TABLES

Table Page

1 Means of specialization variables for specialization segments....................35

2 Demographic differences among specialization segments 36

3 Principal components analysis with varimax rotation for soundscape preference components 37

4 Adjusted means for geophony, biophony, and anthrophony preference among specialization segments..38

5 Specialization component contribution to geophony soundscape preference..39

BIRDING BY EAR: A STUDY OF RECREATIONAL SPECIALIZATION AND SOUNDSCAPE PREFERENCE

Zachary D. Miller[1], Dr. Jeffrey C. Hallo[1], Dr. Julia L. Sharp[2], Dr. Robert B. Powell[1,3], and Dr. J. Drew Lanham[3]

[1]Department of Parks, Recreation, and Tourism Management

[2]Department of Mathematical Sciences

[3]Department of Forestry and Natural Resources

Clemson University

Clemson, SC USA

INTRODUCTION

A birder, or birdwatcher, is a specific type of wildlife user that has a special interest in or tries to identify birds (U.S. Department of the Interior [US DOI], U.S. Fish and Wildlife Service & U.S. Department of Commerce, U.S. Census Bureau, 2011). Bird watching, or birding, is the most popular wildlife based activity in the United States (US DOI et al., 2011). Nearly one-third of the people in the United States participate in wildlife watching as a recreational activity (US DOI et al., 2011).

Birders' recreational pursuits have a substantial economic impact. Local communities that provide amenities and recreational opportunities for birders have seen positive economic contributions (Kerlinger, 1993). Nationwide, wildlife watchers, 92% of which observe birds, spent $56 billion on their recreational activities; more than either hunters or anglers (US DOI et al., 2011). Given that birding can be a low-cost activity with easy physical demands, participation has continued to increase in the past decades (Eubanks, Stoll, & Ditton, 2004). Resource managers looking to provide opportunities for this burgeoning population need to understand the desires, motivations, and preferences of this diverse group.

As a form of non-consumptive wildlife use (Duffus & Dearden, 1990), birding can produce negative consequences to both environmental and social resources. Wildlife observation and photography may produce particularly large negative consequences for avian wildlife (Boyle & Samson, 1985), such as nest predation (Bart, 1977; Lenington, 1979), making it difficult for sensitive species to hunt (Burger, Gochfeld, & Niles, 1995), and changing the distribution of certain species in local areas (Burger et al., 1995).

Additionally, popular birding sites can experience periods of over-crowding (Baicich, Butcher, & Green, 1999) that may cause "exhaust fumes, noise, parking, and collisions with wildlife" (Knight & Gutzwiller, 1995, p. 276) to be a concern of residents in the area.

One natural resource that birders may be particularly reliant on is the soundscape. The soundscape can be defined as all the sounds in a particular area at a specified time (Krause, 1987; Pijanowski, Farina, Gage, Dumyahn, & Krause, 2011). Soundscapes are just beginning to gain worldwide recognition as a valuable part of the environment (Dumyahn & Pijanowski, 2011) for both wildlife and recreationists. For example, the U.S. National Park Service (NPS) has recently incorporated into their work the desire to "preserve, to the greatest extent possible, the natural soundscapes of parks" (NPS, 2006, p. 56).

Recreational resource managers have traditionally considered the soundscape to consist of natural and human-made sounds (Pilcher, Newman, & Manning, 2009; Saxen, 2008). However, considering sounds as either human-made or natural may reduce the ability to determine how specific types of sounds are associated with outdoor recreation. Borrowing ideas from soundscape ecology, recreational soundscape resources may be more completely understood by soundscape categories described as biophony, geophony, and anthrophony (Krause, 1987; Pijanowski et al., 2011). Biophony is defined as all of the sounds from living organisms, not including humans, in a particular area (Pijanowski et al., 2011). Geophony is defined as all of the sounds from abiotic, natural elements: wind, water, thunder, and other earth-based sounds (Pijanowski et al., 2011).

Anthrophony consists of all sounds coming from a human-made source (Pijanowski et al., 2011). Anthrophony includes cars, air conditioning units, footsteps on a wooden bridge, and airplanes. From a recreational resource consideration, anthrophony includes vocal human sounds; talking, coughing, and sneezing are also considered anthrophony.

Recreational specialization has been described as a process of progression in an activity through time (Lee & Scott, 2006). Originally developed by Bryan (1977), recreational specialization has since been applied to many diverse recreational groups (Bricker & Kerstetter, 2000; Chipman & Helfrich, 1988; Cole & Scott, 1999; Hvenegaard, 2002; McFarlane, 1994). Recreational specialization is related to motivations (McFarlane, 1994), conservation organization membership (Hvenegaard, 2002), and physical setting preferences (Martin, 1997) in birders and wildlife viewers. A three-component specialization model (originally called a three-dimensional model) consisting of skill and knowledge, commitment, and behavior as independent components is used in this study (Lee & Scott, 2004; Scott & Shafer, 2001).

It has been speculated that more specialized birders depend heavily on the soundscape (Scott & Shafer, 2001). This is suspected because highly skilled birders want to observe more bird species (McFarlane, 1994) and they can record species by using bird vocalizations (American Birding Association, 2010). No studies have empirically examined this suggested association between the recreational specialization of birders and soundscape preference.

The purpose of this study is to examine the soundscape preference of birders with different levels of specialization using the three soundscape components found in soundscape ecology: biophony, anthrophony, and geophony. A greater understanding of birders' relationship to the soundscape resource will allow for better management of these resources, recreational birding, and possibly the mitigation of damages to the environment related to birding.

LITERATURE REVIEW

Recreational specialization

The theory of recreational specialization can be traced back to a study conducted by Bryan in 1977. Recreational specialization was defined as "a continuum of behavior from the general to the particular, reflected by equipment and skills used in the sport and activity setting preference" (Bryan, 1977, p. 175). Bryan concluded that recreationist progress along a grade of specialization that influences their relationship to the activity. Bryan's (1977) findings gave resource managers a new set of tools to work with. Knowing the preferences of recreationists based on their level of specialization can allow managers to provide better opportunities for recreationists (Bryan, 1977). The results Bryan (1977) found in trout anglers have been widely accepted and adapted since his original publication (see Manning, 2011 for a review).

McFarlane (1994) offered the first comprehensive evaluation of recreational specialization and its application to birders. The contributing components to specialization in the research were past experience, economic commitment, and centrality-to-lifestyle (McFarlane, 1994). The study lacked skill level as one of the components, which is the component that contributes the most to the specialization of birders (Lee & Scott, 2004). Birders were segmented into four specialization groups: casual, novice, intermediate, and advanced (McFarlane, 1994).

McFarlane (1994) found that recreational specialization was correlated with motivations in birders. The motivations McFarlane (1994) evaluated were affiliation, achievement, conservation, and appreciation (originally called "appreciative"). Birders differed in their motivations among specialization segments. Casual birders' primary motivation was appreciation, novice and intermediate birders' primary motivation was conservation, and advanced birders' was achievement (McFarlane, 1994). Conservation was determined to be the overall main motivation of birders who had a primary motivation (McFarlane, 1994).

Research on recreational specialization was advanced by Scott and Shafer (2001) when they introduced a standardized three-component model of recreational specialization. The three components evaluated in the model were skill and knowledge, behavior, and commitment (Scott & Shafer, 2001). The independence of these components adhere to Bryan's (1977) original view that recreational specialization is a developmental process that occurs over time (Scott & Shafer, 2001); progression in each component does not occur in "lock-step" (Scott & Shafer, 2001, p. 338). Using the three-component model proposed by Scott and Shafer (2001) produces accuracy and consistency among researchers when evaluating recreational specialization.

Lee and Scott (2004) validated Scott and Shafer's (2001) theory in a research project studying highly specialized birders. The three-component model they tested more accurately measured recreational specialization than an additive model. Lee and Scott

(2004) also found that although there is some association between each of the components contributing to specialization, they "are not always iterative and mutually reinforcing" (Lee & Scott, 2004, p. 257). Lee and Scott (2004) suggested that additional research needed to be done relating individual specialization components to other variables.

Recreational specialization can alter the resources that an individual prefers. Wildlife viewers preferred different settings for their recreational activity based on their level of specialization (Martin, 1997). Highly specialized wildlife viewers favored primitive settings (Martin, 1997). Less specialized wildlife viewers preferred well-developed areas with camper hook-ups, restrooms, picnic areas, and other human-made amenities (Martin, 1997). Learning the preferences of users based on their level of specialization can allow managers to provide a variety of opportunities for a diverse group of recreationists.

Soundscapes

A soundscape is defined as the combination of all the sounds in a designated area during a specified time (Pijanowski et al., 2011). All environments have some kind of soundscape. An office environment has a soundscape: the whirring of the computer fans, the typing on a keyboard, doors opening and closing, far off voices, and the sound of heels on a floor. The sound of water moving in a stream, wind blowing through the trees, birds singing, and the bugling elk may make up a natural soundscape. In natural areas, the soundscape could also include the sounds of people and the rumble of vehicles.

Soundscapes have temporal and spatial aspects to them (Pijanowski et al., 2011). Movement in time through the day or year can produce a drastically different soundscape. The Sierra Nevada Mountains ring loud with the calls of neotropical migrants in the summer. By January, mountain chickadees (*Poecile gambeli*) and Steller's jays (*Cyanocitta stelleri*) have become the dominant sound, punctuated only by the wind through conifers and the thud of snow sloughing off of boughs. Nighttime can offer a unique cast of animals that are not active during the day (Beeco, Hallo, Baldwin, & McGuire, 2011), like Pacific tree-frogs (*Pseudacris regilla)* and coyotes (*Canis latrans)*. Changes in the landscape may produce a change in the distribution of species that contribute to a soundscape. Where an oak forest once existed before a wildfire, the wind may more easily move through a scrub-forest a few years later. The disappearance of a species can change a soundscape as well. The noisy chatter of the Carolina parakeet (*Conuropsis carolinesis)* will never be heard in any soundscape again; in its place can now be heard the European starling (*Sturnus vulgaris*).

Soundscapes are an important ecological component in the environment. The acoustical niche hypothesis (Krause, 1987) states that healthy ecosystems should have a diverse set of biophonic sounds filling the available frequencies and temporal periods. Hooper and others (2005) found that the natural sounds in an area become a functional part of the ecosystem. The introduction of anthrophony to a natural soundscape can be deleterious to the environment. Anthrophony can interfere with an animal's ability to detect predators, find prey, or communicate with others of its species (Barber, Crooks, & Fistrup, 2010). The diversity and density of birds can become reduced if anthropogenic sounds become too invasive (Reinjen, Foppen, & Veenbaas, 1997; Stone, 2000). In fact, in some areas anthropogenic sounds (e.g., gunshots, recorded sounds) are intentionally used to reduce nuisance bird populations. The deleterious results of anthrophony on natural soundscapes have a real cost to wildlife and related recreation in those environments.

Soundscapes have also been acknowledged for their value as a recreational resource. The NPS has recognized that soundscapes need to be managed and protected like other natural resources (NPS, 2006). Manning and others (2010) have found that visitors at Muir Woods National Monument, an NPS site in California, enjoyed hearing natural sounds; bird song and water were the two most pleasing sounds they heard (Pilcher et al., 2009). Sound is the most positively anticipated sensory experience to visitors at Rocky Mountain National Park when compared to smell and touch (Taylor & Grandjean, 2007). Natural sounds have a substantial role in shaping the experience of wilderness for hikers and backpackers (Hammit & Madden, 1989). Even the background sounds that may go unnoticed have an impact on an individual's sense of place (Dumyahn & Pijanowski, 2011). In an interview with Kurt Fristrup, an acoustical scientist, Selleck and KellerLynn (2010) reported that paying attention to soundscapes could enrich the experience of visitors at national parks.

In an outdoor setting, anthrophony is often unwanted and can detract from the experience of recreationists (Burson, 2006; Hammit & Madden, 1989; Pilcher et al., 2009). For instance, the sound of aircraft over wilderness settings can degrade the experience of the user (Fidell et al., 1996; Miller, 2008). At Muir Woods National

Monument, it was only anthropogenic sounds that visitors reported as annoying (Pilcher et al., 2009). The negative experience of snowmobile sounds on recreationists at Yellowstone National Park has also been well documented (Burson, 2006; Miller, 2008; Saxen, 2008). In addition, the increased use of an area brings an increased probability that anthrophony will detract from the activities of outdoor recreationists (Stack, Newman, Manning, & Fristrup, 2011). Proper management of anthropogenic soundscapes is essential to maintaining the quality of the recreational experience in natural areas.

Most researchers dealing with soundscapes as a natural resource in recreation have divided soundscapes into natural (biophonic and geophonic) and human-made (anthropogenic) sounds (Pilcher et al., 2009; Saxen, 2008; Selleck & KellerLynn, 2010; Stack et al., 2011). Pilcher and others (2009) came close to categorizing sounds into the three soundscape components as defined by Krause (1987) and Pijanowski and others (2011) by including measured items from all three soundscape components. These soundscape components may shape the experiences of recreationists in different ways. For this reason, it is important to remove the dichotomy of human-made versus natural sounds in order to better understand how soundscapes are related to the recreational experience. Therefore, we seek to explore the following research question:

R_1: Can soundscape preferences for birders be described as biophony, geophony, and anthrophony?

Birds are the main contributors to biophony (Farina, Lattanzi, Malavasi, Pieretti, & Piccioli, 2011). Listening to the soundscape can help birders locate birds. The main body that governs birding by-laws states that "diagnostic field-marks…sufficient to identify to species, must have been seen and/or heard" (American Birding Association, 2010, p. 61) for a bird to be considered observed. This means that bird sounds may be used as a fundamental means of identification in birding. Scott and Shafer (2001) suspected that "highly skilled birdwatchers rely a great deal on listening skills" (p. 339), possibly because highly specialized birders want to see more species of birds (McFarlane, 1994). The suggestion that skilled birders need to be good listeners infers that they may be acutely dependent on soundscape resources. Recreational specialization of birders has not been studied in relationship to soundscape preference. Given this, we seek to explore the following research question:

R_2: Does soundscape preference for each individual soundscape component (biophony, geophony, anthrophony) differ among overall specialization segments (casual, novice, intermediate, advanced)?

In addition to overall specialization, Lee and Scott (2004) suggested that research "need[s] to explore how the three dimensions of recreational specialization are individually related to other facets of involvement" (p. 258). Research shows that the skill and knowledge component of specialization represented overall specialization in birders better than either the behavior or commitment components (Lee & Scott, 2004). Therefore, we seek to explore the following:

R_3: Which of the specialization components in birders best explains the variation in soundscape preference?

METHODS

Sample

Sampling birders can be problematic. McFarlane (1994) pointed out that birders are not an easy group to identify; they do not need to obtain any special license for their activity, require no special facilities, and would not be reachable in any decent numbers with a general population sample. Lee & Scott (2006) found that less specialized birders are especially difficult to sample, as they are unlikely to join bird clubs or organizations. Therefore, a sampling strategy containing two different subgroups was used to access birders from the high to low spectrum of recreational specialization.

The first subgroup was designed to sample birders who were more casual in their birding activities. The National Audubon Society's Francis Beidler Forest in Harleyville, South Carolina attracts a variety of wildlife users to their preserve. Francis Beidler Forest is one of the largest virgin forests in the southeast (National Audubon Society, Inc., 2013) and is known for easy viewing of wildlife, particularly birds. A researcher intercepted visitors as they entered a rain shelter on the elevated boardwalk. Participants were qualified by asking them if they had a special interest in or try to identify birds (US DOI, 2011). A paper questionnaire was issued to all willing participants. Out of 124 qualified visitors, 99 agreed to participate resulting in a response rate of 80%.

To reach more specialized birders, a sample was obtained from online list servers as the second subgroup (including VA-birds, PABirds, AZNMBirds, Texbirds, ARBird, VTbird, and Carolinabirds). List servers are an opt-in mass email list. Birders that subscribe to list servers talk about a variety of subjects, from backyard bird feeders to rare bird alerts all over the country. List servers have been cited as an important resource for more specialized birders (Cole & Scott, 1999). Online samples have been recently used to reach other individuals of specialized, hard to find, or unknown populations (Hudson, Walker, Simpson, & Hitch, 2013; Sexton, Miller, & Dietsch, 2011; Wu, Scott, & Yang, 2013).

Voluntary participation was requested from list server subscribers after receiving permission from the administrator to contact the group for research purposes. Participants were entered into a drawing for a free bird field guide if they completed a questionnaire. After initial contact, respondents were emailed a personalized link that only they could access. Their email address was recorded to avoid any chance of duplicate responses. After one week, birders who did not complete the survey were issued a reminder. This sampling approach yielded 346 respondents. Response rates for this group cannot be calculated because it is unknown how many people the request reached.

The online and in-person groups were compared to look for substantial differences. There were no significant differences (p<0.05) between the online and in-person subgroups for race, income, or gender. Because the two subgroups were relatively homogenous, we concluded that it was appropriate to pool the two subgroups together for further analysis. By combining the two subgroups together, there was a total sample of 445 birders in the study, of which 415 were used in this study after removing incomplete questionnaires.

The two subgroups did differ in two ways: level of education and age. The online group was more likely to have a higher education level and was also more likely to be older. Although research on demographic variables that are associated with higher levels of specialization in birders is inconclusive, both higher education level and older age have been found to be associated with specialization level in several studies (Butler & Fenton, 1987; Cole & Scott, 1999; Hvenegaard & Dearden, 1998; Kellert 1985; Scott & Thigpen, 2003). Because a purposive sampling technique was used to find more specialized birders, we expected some differences in the online group that could be explained by their higher level of specialization. Furthermore, the intention of the sampling scheme was to have a high level of variation in specialization to explore birders' preference for the soundscape components. Additionally, the differences between the mean age of online (54) and in-person (47) subgroups was not substantive, as they are both considered middle-aged (McFarlane, 1994).

Data instrument

A questionnaire was designed to collect information from both birder subgroups. Feedback from a pretest was incorporated into the final questionnaire. The recreational specialization portion of the survey was taken directly from Lee and Scott (2004). Lee and Scott (2004) were the first researchers to test the three-component specialization model theorized in an earlier paper (Scott & Shaffer, 2001). This specialization model was found to be the most accurate and consistent way to measure the three components of recreational specialization: behavior, skill and knowledge, and commitment (Lee & Scott, 2004). The behavior component is measured by two open-ended questions: trips taken of more than one mile from home that including birding as an activity in the last year and days spent birding on trips of more than one mile from home in the last year. The skill and knowledge component is measured by two open-ended questions and one close-ended question. The two open-ended questions measure the number of birds that can be identified by sight without a field guide and the number of birds that can be identified by sound. The one close-ended question is a self-rated skill level from novice to expert on a 7-point scale. The commitment component is measured with four 7-point Likert-type questions that range from strongly disagree to strongly agree with a central point of neutral. The four statements are: other leisure activities do not interest me as much as birding; I would rather go birding than do most anything else; if I stopped birding, I would probably lose touch with a lot of my friends; if I could not go birding, I am not sure what I would do. For a full review of the specialization model, see Lee and Scott (2004).

Soundscape preference was measured using variables on a 7-point Likert-type scale. Participants were asked to indicate their preference level (ranging from highly annoying to highly preferred with a neutral point of neither annoying nor preferred) for variables contributing to each soundscape component. The order of the variables measuring soundscape preference was randomized.

The variables contributing to geophony preference are wind blowing, flowing water, rain, and thunder. Wind blowing, flowing water, and thunder are all identified as part of the geophonic soundscape as described by Brown, Kang, and Gjestland (2011). The measure of rain can be derived from Pijanowski and others' (2011) description of geophony. Human vocalizations, motorized transport, human movement, and mechanical sounds are all variables of anthrophony (Brown et al., 2011). Bird song and chatter, insect calls, reptile and amphibian calls, mammal vocalizations, and animal movements comprised the biophony variables. Bird song and chatter and insect calls were items adapted from Pilcher and others (2009). Amphibians were identified by Krause (1987) as contributors to the soundscape. The idea of amphibians as soundscape contributors was extended to reptiles as well, a group traditionally considered collectively as “herps”. The mammal vocalizations variable was an adaptation from Pilcher and other’s (2009) study where they indicated small mammals as sounds in the environment. Animal movement was an extension of Brown and other’s (2011) concept of human movement as an anthrophony variable. Some of the variables have short, generalized descriptions to define the variables in a clear way to the respondent.

Analysis

Similar to other studies, the variables for each specialization component were standardized to reduce the influence of measurement technique (Lee, Graefe, & Li, 2007; Needham & Vaske, 2013). Values were then averaged to produce a single score for each specialization component (Lee et al., 2007; Needham & Vaske, 2013). As done in previous literature (Hvenegaard, 2002; McFarlane, 1994; Needham & Vaske, 2013), we used the three specialization components (i.e., skill and knowledge, behavior, and commitment) in a k-means cluster analysis to segment participants into four specialization categories (i.e., casual, novice, intermediate, and advanced). A four cluster solution has been used in the past when conducting a cluster analysis with specialization and birders (McFarlane, 1994). An analysis of variance was used to look for differences among specialization segments in relation to variables measuring specialization to ensure the groups made logical sense. Groups were named using McFarlane's (1994) segment labels.

Principal components analysis with varimax rotation was used to look for underlying dimensions of soundscape preference. Assumptions were checked using Bartlett's test of sphericity ($p<0.05$) and Kaiser-Meyer-Olkin statistic (>0.50) to ensure principal components analysis was appropriate. Soundscape components with eigenvalues greater than 1.0 were extracted. A minimum factor loading of <0.40 was used to identify variables belonging to a soundscape component. Cronbach's alpha was used to measure scale reliability for each extracted soundscape component ($\alpha>0.7$ for each soundscape component). An index was created for each extracted soundscape component by averaging the sound variables belonging to each soundscape component (i.e., biophony, geophony, anthrophony).

An analysis of variance was conducted to look for differences among specialization segments for each of the extracted soundscape preference components. A *p*-value of less than 0.05 was considered significant. Bonferonni post-hoc analysis was used for pairwise comparisons.

Multiple linear regression models were used to determine which specialization component (i.e., skill and knowledge, behavior, commitment) explained the most variation in each soundscape preference component (i.e., biophony, geophony, anthrophony). Specialization components were used as independent variables in each model. Each soundscape preference component was used as a dependent variable in separate models, resulting in a total of three models (one for biophony, one for geophony, and one for anthrophony). A *p*-value of less than 0.05 was considered significant.

RESULTS

Demographics

The demographic data supported previous research that birders tend to be white, wealthy, educated, and older. Eighty-two percent of birders in this study had at least a bachelor's degree or a graduate/professional degree. Thirty-four percent of birders reported annual household income greater than $100,000, and 30% said their annual household income was between $60,000 and $99,999. Half (50%) of the respondents were between the ages of 46 and 65, and 21% were 66 years of age or older. Ninety-three percent of participants identified as white. Fifty-seven percent of birders in this study were male.

Cluster Analysis

Similar to Lee and Scott's (2004) findings, number of trips taken, number of days spent birding, number of birds identified by sight, and number of birds identified by sound were all positively skewed. Natural log transformations were performed on these variables to normalize the data set and reduce the influence of outliers (Lee & Scott, 2004). The transformed values were used for the cluster analysis. One-way analysis of variance supported that a four-cluster solution made not only theoretical sense, but also logical sense based on recreational specialization theory (Table 1). There were differences among specialization segments for two demographic variables: more specialized birders were more likely to be male and casual birders were more likely to be younger (Table 2).

Principal components analysis

Principal components analysis assumptions were satisfied: Bartlett's test of sphericity ($p<0.001$) and Kaiser-Meyer-Olkin statistic (0.79). Three components were identified (Table 3) with eigenvalues greater than one and explained a cumulative 62.36% of the variance. All of the abiotic, natural soundscape variables loaded onto component 1 (geophony) which had an overall mean preference of 3.99, an eigenvalue of 3.89, and explained 29.94% of the variance. All of the soundscape variables that had an anthropogenic source loaded onto component 2 (anthrophony) which had an overall mean preference of 2.09, an eigenvalue of 2.68, and explained 20.59% of the variance. All of the biotic, natural soundscape variables loaded onto component 3 (biophony) which had an overall mean preference of 5.01, an eigenvalue of 1.54, and explained 11.83% of the variance.

Specialization and soundscape component preference

Significant differences existed among specialization segments in regards to gender and age. Both variables were controlled for in the analysis of variance. There was a significant difference among specialization segments in relation to geophony preference, but not biophony preference or anthrophony preference (Table 4). All birders had a slight preference for biophony (mean = 5.01). Anthrophony was considered annoying to all segments of birders (mean = 2.09). Less specialized birders (casual and novice) found geophony somewhat preferable (mean > 4.0) as compared to more specialized birders (intermediate and advanced) who found it to be somewhat annoying (mean < 4.0).

Individual specialization components and soundscape component preference

None of the specialization components were significant predictors of biophony preference (p = 0.291). Similar to the results from the model with biophony as the dependent variable, none of the specialization components were significant predictors of anthrophony preference (p = 0.067). At least one of the specialization components significantly predicted geophony preference (F (3, 411) = 28.56, p <0.001, adj. R^2= 0.166) and 16.6% of the variance was explained by the model (Table 5). The knowledge and skill component of specialization significantly (p<0.05) predicted geophony preference and uniquely explained 8.5% of the variance.

DISCUSSION

The three research questions explored in this study were: 1) can soundscape preferences for birders be described as biophony, geophony, and anthrophony, 2) does soundscape preference for each individual soundscape component (biophony, geophony, anthrophony) differ among overall specialization segments (casual, novice, intermediate, advanced), and 3) which of the specialization components in birders best explains the variation in soundscape preference?

The first research question was explored through a principal components analysis. The results suggest that recreational soundscape resources should be considered in the same way as in soundscape ecology: biophony, geophony, and anthrophony. Soundscapes have been shown to be an important aspect of the outdoor recreation experience. Evaluating and managing sounds as either human-made or natural, as done in previous literature, may be presenting resource managers with a false dichotomy that does not explore soundscapes in the depth necessary to understand how the recreational experience is shaped by sounds. Like other resources, the sounds in an environment can have a negative or a positive effect on the recreational experience, regardless if they're natural or human-made.

Understanding soundscapes as biophony, geophony, and anthrophony allows more depth of knowledge than the traditional human-made versus natural concept without the complications of evaluating an overwhelmingly large number of sounds. Further segmentation of soundscape components beyond the ones found in this study (biophony, geophony, anthrophony) may determine how *specific* sounds (e.g., specific types of mammals, specific types of human movements) are associated with the recreational experience. Likewise, some individual sounds within the categories used in this study may be better grouped into subcategories (e.g. anthrophony – word vocalizations, non-word vocalizations, machinery/equipment).

The results from the second research question found that there was a significant difference among specialization segments for geophony, but not biophony or anthrophony. This suggests that as birders progress in their level of specialization, they become more annoyed with geophony. It has been shown that these more specialized individuals rely more on bird sounds for identification (Scott & Shafer, 2001), so they may have trouble hearing birds if there is an abundance of geophony in an area.

Identifying more birds (achievement) becomes more important than the appreciation of nature, including geophony, for highly specialized birders (McFarlane, 1994).

It should come as no surprise that birders enjoyed biophony; birds are the main contributor to biophony (Farina et al., 2011). However, the finding that all birders disliked anthrophony the same amount was surprising. Given that anthrophony could also mask bird sounds, it would seem that more specialized birders would dislike anthrophony more than less specialized birders. This was not the case. Although the reason for this is unknown, it may be that more specialized birders enjoy the social aspect of birding (part of the commitment component of specialization) and are willing to tolerant anthrophony that is generated by their companions in the field.

In a broader sense, the findings from the second research question suggest that people perceive soundscapes in diverse ways, even when participating in the same activity. In outdoor recreation activities where motivations or skill levels can be considerably different among participants, soundscape preference may also be considerably different. This may be particularly salient in activities where sound plays a central role. For instance, wilderness users, nighttime recreationists, and even hunters (gun versus bow, for instance) may have different levels of biophony, geophony, and anthrophony preference. Importantly, not all natural soundscape components were considered “good” or “pleasurable” to all segments of birders. For example, more specialized birders found geophony to be slightly annoying, compared to less specialized birders who found geophony to be preferred. Studying and managing soundscapes as biophony, geophony, and anthrophony can reveal diverse soundscape preference in other populations of recreationists as well.

Research question three looked at the relationship between specialization components (behavior, skill and knowledge, and commitment) and soundscape component preference (biophony, geophony, anthrophony) through a series of multiple regression models. The model for specialization components and biophony and for specialization components and anthrophony did not find any of the specialization components to be the only significant predictor of preference; the model for specialization components and geophony did find the skill and knowledge component to be a significant predictor for geophony preference. This supports Lee and Scott's (2004) finding that recreational specialization in birders needs to be understood first and foremost from the skill and knowledge component. For recreational resource managers, this means that a birder's skill and knowledge is the most important aspect to consider when managing soundscapes for birding. It is possible that the prevalence of the skill and knowledge component only applies to skill-based aspects of an activity. For instance, the behavior component may better explain what types of amenities birders prefer when traveling. Research efforts should continue to relate individual specialization components to other aspects of an activity (Lee & Scott, 2004).

One of the major limitations of this study was finding an appropriate sample. Generalizing from this study, or any one group of birders, may be problematic; nonetheless, this research provides a good theoretical basis for soundscape evaluation moving into the future. It is also recognized that the list servers used may also have regional differences. Additionally, the hearing ability of participants was unaccounted for and may also influence soundscape preference. The consistent struggle to identify and research birders in the United States should reaffirm that a nationwide, large-scale study focused on birding needs to be conducted (Eubanks et al., 2004)

Recreational resource managers can use the information from this study to provide better opportunities for birders. All segments of birders have a preference for biophony in the soundscape, but there is little resource managers can do to increase the amount of biophony in an area. However, birders prefer less anthrophony while they are birding. Resource managers can make efforts to decrease the amount of anthrophony in an area. At Muir Woods National Monument, quiet zones have been established to reduce the amount of anthropogenic sound present in an area (Manning et al., 2010). Resource managers may be able to use similar techniques to give birders opportunities to participate in their activity with reduced anthrophony interference. In addition, many birding areas, like some parts of the Great Coastal Birding Trail in Texas, have trails and platforms that are located right along the road resulting in an abundance of anthrophony. Providing birders with the opportunity for recreation in an area with reduced anthrophony would be more favorable.

Reducing anthrophony in natural environments also benefits wildlife. In areas that are especially busy or have sensitive species present, a permitting system (not unlike wilderness permits) could be implemented to ensure soundscape quality for wildlife and recreationists. If an increase in visitors makes it more likely that anthrophony will become more prevalent (Stack et al., 2011), it would seem that reducing the number of visitors in a specific zone may decrease the amount of anthrophony.

Importantly, the differences in geophony preference among birders reinforce previous research that birders are a diverse group. As this group continues to grow, resource managers seeking to attract this population need to present an abundance of different opportunities, including diverse soundscape management. Most birders are not the highly specialized individuals commonly associated with birding. However, resource managers should try to move beyond the generalized “nature trail” to provide more focused opportunities for this diverse population. This includes areas with access to - as well as areas with shelter from - geophony. Although some birds inevitably will be found near running water or other geophony sources, resource managers looking to attract a diversity of birders may be able to reduce geophony in some areas for more specialized birders by placing bird blinds away from running water, or by creating trails that are in a wind-sheltered areas.

These findings support the use of segmenting birders into groups based on recreational specialization, specifically the model developed by Lee and Scott (2004). The birders in this study exhibited a wide range of behavior, skill and knowledge, and commitment. This also supports that recreational specialization theory is useful for evaluating a variety of settings preferences in birders. The authors agree that “the utility of the specialization framework lies in its ability to elucidate different styles of involvement within a given leisure activity system” (Scott & Thigpen, 2003, pg. 18).

Future research efforts on specialization in birders should inquire about the desire of individuals to progress in the activity. It may be that the competitive motivations of highly specialized birders, who consider geophony slightly annoying, are antithetical to the desires of less specialized birders, who prefer geophony, to connect with nature.

Research needs to be done to validate the three components of soundscape preference found here in other populations of highly soundscape-dependent recreationists, such as wilderness users and nighttime recreationists. Further understanding of how soundscapes are perceived and used by a variety of recreationists can help practitioners move beyond the human-made versus natural soundscape dichotomy, allowing recreationists to have better opportunities in the future. Also, research has largely ignored the temporal aspect of soundscapes. The preference for each soundscape component may change depending on the time of day or the time of year. Recreationists may be more or less tolerant of specific soundscape components during the evening, morning, or afternoon. Some activities, like skiing, necessarily occur in a narrow window of time and could only be studied during that period. However, many recreational activities can occur year round in the same locality. Recreationists may have different soundscape preferences at different times of the year as well. Future research on recreational soundscapes should explore the temporal aspect of soundscapes.

CONCLUSION

The theory of recreational specialization has shown that birders are not a uniform group. Research supports that birders engage in their activity in different ways based on their level of specialization. Recognizing that birders' level of skill and knowledge must first and foremost be considered, resource managers can use recreational specialization to provide better opportunities for a wider variety of birders.

Soundscapes are a critical component in shaping the experience of outdoor recreationists. To properly manage soundscapes as a recreational resource, practitioners need to understand how outdoor recreationists perceive them. The research here supports that the traditional view of soundscapes as human-made or natural is not the way that birders perceive soundscapes. Soundscapes are better understood as biophony, geophony, and anthrophony. By recognizing the greater diversity of soundscapes as a recreational resource, managers may be able to offer better opportunities to recreationists.

Soundscape management can produce a win-win situation for both birders and wildlife. Birders have shown preference for reducing anthrophony in the environment. Wildlife has also been shown to suffer deleterious effects from anthrophony introduction into natural soundscapes. By reducing anthrophony in an area, managers may be able to provide better habitat for wildlife and better opportunities for birders.

REFERENCES

American Birding Association. (2010). *ABA Recording Rules and Interpretations.* (pp. 61–62).

Baicich, P.J., Butcher, G.S., and Green, P. (1999). Trends and issues in birding. In K. Cordell, C.J. Betz, J.M. Bower, D.B.K. English, S.H. Mou, J.C. Bergstrom, R.J. Teasley, M.A. Tarrant, J. Loomis (Comps.), *Outdoor recreation in American life: A national assessment of demand and supply trends.* (pp. 242-245). Champaign, IL: Sagamore Publishing.

Barber, J.R., Crooks, K.R., Fristrup, K.M. (2010). The cost of chronic noise exposure for terrestrial organisms. *Trends in Ecology & Evolution*, *25*. 180 – 189.

Bart, J. (1977). Impact of human visitations on avian nesting success. *Living Bird, 16,* 186-192.

Beeco, J. A., Hallo, J. C., Baldwin, E. D., & McGuire, F. A. (2011). An examination of the guided night hiking experience in parks and protected areas. *Journal of Park and Recreation Administration*, *29*(4), 72–88.

Boyle, S. A., & Samson, F. B. (1985). Effects of nonconsumptive recreation on wildlife: A review. *Wildlife Society Bulletin*, *13*(2), 110–116.

Bricker, K. S., & Kerstetter, D. L. (2000). Level of specialization and place attachment: An exploratory study of whitewater recreationists. *Leisure Sciences*, *22*(4), 233–257.

Brown, A. L., Kang, J., & Gjestland, T. (2011). Towards standardization in soundscape preference assessment. *Applied Acoustics*, *72*(6), 387–392.

Bryan, H. (1977). Leisure value systems and recreational specialization: The case of the trout fisherman. *Journal of Leisure Research*, *9*(3), 174–187.

Burger, J., Gochfeld, M., & Niles, L. J. (1995). Ecotourism and birds in coastal New Jersey: Contrasting responses of birds, tourists, and managers. *Environmental Conservation*, *22*(1), 56–65.

Burson, S. (2006). *Natural soundscape monitoring in Yellowstone National Park December 2004-March 2005.* (Grand Teton National Park soundscape program report no. 200502).

Butler, J. R., & Fenton, G. D. (1987). Bird watchers of Point Pelee National Park, Canada: Their characteristics and activities with special consideration to their social and resource impacts. *Alberta Naturalist*, *17*(3), 135–146.

Cole, J. S., & Scott, D. (1999). Segmenting participation in wildlife watching: A comparison of casual wildlife watchers and serious birders. *Human Dimensions of Wildlife: An International Journal, 4*(4), 44–61.

Duffus, D. A., & Dearden, P. (1990). Non-consumptive wildlife-oriented recreation: A conceptual framework. *Biological Conservation*, *53*, 213–231.

Dumyahn, S. L., & Pijanowski, B. C. (2011). Soundscape conservation. *Landscape Ecology*, *26*, 1327–1344.

Eubanks Jr., T. L., Stoll, J. R., & Ditton, R. B. (2004). Understanding the diversity of eight birder sub-populations: Socio-demographic characteristics, motivations, expenditures and net benefits. *Journal of Ecotourism*, *3*(3), 151–172.

Farina, A., Lattanzi, E., Malavasi, R., Pieretti, N., & Piccioli, L. (2011). Avian soundscapes and cognitive landscapes: Theory, application, and ecological perspectives. *Landscape Ecology*, *26*, 1257–1267.

Fidell, S., Silvati, L., Howe, R., Pearsons, K. S., Tabachnick, B., Knopf, R. C., Gramann, J., et al. (1996). Effects of aircraft overflights on wilderness recreationists. *The Journal of the Acoustical Society of America*, *100*(5), 2909–2918.

Hammit, W.E., Madden, M.A. (1989). Cognitive dimensions of wilderness privacy: A field test and further explanation. *Leisure Sciences, 11,* 293-301.

Hooper, D. U., Chappin III, F. S., Ewel, J. J., Hector, P., P, I., Lavorel, S., Lawton, J. H., ... Wardle, D.A. (2005). Effects of biodiversity on ecosystem functioning: A consensus of current knowledge. *Ecological Monographs*, *75*(1), 3–35.

Hudson, S., Walker, G. J., Simpson, B., & Hinch, T. (2013). The influence of ethnicity and self-construal on leisure constraints. *Leisure Sciences*, *35*(2), 145–166.

Hvenegaard, G. (2002). Birder specialization differences in conservation involvement, demographics, and motivations. *Human Dimensions of Wildlife: An International Journal*, *7*(1), 21–36.

Hvenegaard, G. T., & Dearden, P. (1998). Ecotourism versus tourism in a Thai national park. *Annals of Tourism Research, 25*(3), 700–720.

Kellert, S. R. (1985). Birdwatching in American Society. *Leisure Sciences*, *7*(3), 343–360.

Kerlinger, P. (1993). Birding economics and birder demographic conservation tools. *Status and management of neotropical migratory birds* (pp. 32-38). Rocky

Mountain Forest and Range Experiment Station, US Department of Agriculture, Forest Service.

Knight, L.R., & Gutzwiller, K.J. (1995). *Wildlife and recreationist: Coexistence through management and research*. Chicago: Island Press. 271-280.

Krause, B. B. L. (1987). Bioacoustics, habitat ambience in ecological balance. *Whole Earth Review*, *57*, 14–18.

Lee, J.H., & Scott, D. (2004). Measuring birding specialization: A confirmatory factor analysis. *Leisure Sciences*, *26*(3), 245–260.

Lee, J.H., & Scott, D. (2006). For Better or Worse? A Structural Model of the Benefits and Costs Associated with Recreational Specialization. *Leisure Sciences*, *28*(1), 17–38.

Lee, S.-H., Graefe, A. R., & Li, C.-L. (2007). The Effects of specialization and gender on motivations and preferences for site attributes in paddling. *Leisure Sciences*, *29*(4), 355–373.

Lenington, S. (1979). Predators and blackbirds: The "uncertainty principle" in field biology. *Auk*, *96*, 190-192.

Manning, R. (2011). *Studies in Outdoor Recreation: Search and Research for Satisfaction* (3rd ed.). Oregon State University Press: Corvallis, OR.

Manning, R., Newman, P., Fristrup, K., Stack, D., & Pilcher, E. (2010). A program of research to support management of visitor-caused noise at Muir Woods National Monument. *Park Science*, *26*(3).

Martin, S. R. (1997). Specialization and differences in setting preferences among wildlife viewers. *Human Dimensions of Wildlife: An International Journal, 2*(1), 1–18.

McFarlane, B. L. (1994). Specializations and motivations of birdwatchers. *Wildlife Society Bulletin*, *22*(3), 361–370.

Miller, N. P. (2008). US National Parks and management of park soundscapes: A review. *Applied Acoustics*, *69*(2), 77–92.

National Audubon Society. (2013). Audubon Beidler Forest: Overview. Retrieved from http://beidlerforest.audubon.org/overview-2

National Park Service. (2006). *Management Policies 2006.* Washington, D.C.: National Park Service. U.S. Government Printing Office.

Needham, M. D., & Vaske, J. J. (2013). Activity substitutability and degree of specialization among deer and elk hunters in multiple states. *Leisure Sciences*, *35*(3), 235–255.

Pijanowski, B. C., Farina, A., Gage, S. H., Dumyahn, S. L., & Krause, B. L. (2011). What is soundscape ecology? An introduction and overview of an emerging new science. *Landscape Ecology*, *26*(9).

Pilcher, E. J., Newman, P., & Manning, R. E. (2009). Understanding and managing experiential aspects of soundscapes at Muir Woods National Monument. *Environmental Management*, *43*, 425–435.

Reinjen, R., Foppen, R., & Veenbaas, G. (1997). Disturbance by traffic of breeding birds: Evaluation of the effect and consideration in planning and managing road corridors. *Biodiversity Conservation, 6*, 567-581.

Saxen, S. W. (2008). *Park visitors and the natural soundscape: Winter experience dimensions in Yellowstone National Park*. (Doctoral dissertation). University of Montana.

Scott, D. & Shaffer, C. S. (2001). Recreational specialization: A critical look at the construct. *Journal of Leisure Research*, *33*(3), 319-343.

Scott, D., & Thigpen, J. (2003). Understanding the birder as tourist: Segmenting visitors to the Texas Hummer / Bird Celebration. *Human Dimensions of Wildlife : An International Journal*, *8*(3), 199–218.

Selleck, J., & KellerLynn, K. (2010). Special issue: From landscapes to soundscapes. *Park Science: Integrating Research and Resource Management in the National Parks, 26*(3), 11-13.

Sexton, N., Miller, H. M. and Dietsch, A.M. 2011. Appropriate uses and considerations for online surveying in human dimensions research. *Human Dimensions of Wildlife: An International Journal*, *16(*3), 154–163.

Stack, D. W., Newman, P., Manning, R. E., & Fristrup, K. M. (2011). Reducing visitor noise levels at Muir Woods National Monument using experimental management. *The Journal of the Acoustical Society of America*, *129*(3), 1375–1380.

Stone, E. (2000). Separating the noise from the noise: A finding in support of the “niche hypothesis”, that birds are influenced by human induced noise in natural habitats. *Anthrozoos, 13*, 225-231.

Taylor, P., & Grandjean, B. D. (2007). Sensing the parks: The importance of sound, smell, and touch to visitor experience at Rocky Mountain National Park. In Weber, Samantha, and D. Harmon, (Eds.), *Rethinking Protected Areas in a Changing World: Proceedings of the 2007 GWS Biennial Conference on Parks, Protected Areas, and Cultural Sites*. Paper presented at The George Wright Society Biennial Conference: Rethinking Protected Areas In a Changing World. St. Paul, MN, 16-20 April (pp. 162-166). Hancock, Michigan: The George Wright Society.

U.S. Department of the Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. (2011). *2011 National survey of fishing, hunting, and wildlife-associated recreation.*

Wu, T.-C., Scott, D., & Yang, C.-C. (2013). Advanced or addicted? Exploring the relationship of recreation specialization to flow experiences and online game addiction. *Leisure Sciences*, *35*(3), 203–217.

TABLES

Table 1

Means of specialization variables for specialization segments

Variable[1]	Casual *n*=56	Novice *n*=94	Intermediate *n*=131	Advanced *n*=134	Total *n*=415	*p* value
Trips	4^a	19^a	53^b	94^c	51	***
Days	4^a	20^a	59^b	106^c	58	***
Sight	16^a	87^b	379^c	467^c	294	***
Sound	4^a	23^a	154^b	191^b	119	***
Level	1.29^a	3.06^b	4.97^c	5.16^c	4.11	***
Interest	2.57^a	3.67^b	4.35^c	6.07^d	4.52	***
Rather go	2.2^a	3.54^b	4.34^c	6.10^d	4.44	***
Friends	1.29^a	1.97^b	2.39^b	4.51^c	2.85	***
Not sure	1.41^a	1.98^b	2.08^b	4.47^c	2.76	***

Means with different superscript letters in the same row are significantly different ($p<.05$) using Bonferonni post-hoc tests. ***$p<0.001$.

[1]See the data instrument section to view the full specialization variable descriptions.

Table 2

Demographic differences among specialization segments

Variable		Casual	Novice	Intermediate	Advanced	Total	F or χ^2	p-value
Mean age		40.56^{a}	53.52^{b}	53.54^{b}	55.58^{b}	52.38	$F(3, 378) = 14.05$	***
Gender frequency	Male	26 (48.1%)	37 (40.2%)	87 (66.9%)	84 (62.7%)	234 (57.1%)	$\chi^2 = 19.29$	***
	Female	28 (51.9%)	55 (59.8%)	43 (33.1%)	50 (37.3%)	176 (42.9%)		

Means with different superscripts in the same row are significantly different ($p<0.05$) using Bonferonni post-hoc tests.
***$p<0.001$

Table 3

Principal components analysis with varimax rotation for soundscape preference components

Component	Variable	Loading	Mean[1] (*SD*)
Component 1 (geophony)	Wind blowing	0.752	3.56 *(1.45)*
α = 0.80	Flowing water	0.709	4.85 *(1.43)*
	Rain	0.839	3.48 *(1.40)*
	Thunder	0.765	4.07 *(1.40)*
Component 2 (anthrophony)			
α = 0.81	Human vocalizations[3]	0.806	2.21 *(0.97)*
	Motorized Transportation[4]	0.837	1.69 *(0.87)*
	Human movement[5]	0.723	2.66 *(0.97)*
	Mechanical[6]	0.836	1.78 *(0.90)*
Component 3 (biophony)			
α =0.82	Bird song and chatter	0.662	6.14 *(1.04)*
	Insect calls	0.725	4.35 *(1.22)*
	Reptile and amphibian calls	0.802	4.96 *(1.20)*
	Mammal vocalizations	0.792	4.66 *(1.23)*
	Animal movement[2]	0.731	4.93 *(1.82)*

[1]All soundscape variables were measured on a 7-point Likert-type scale where 1=highly annoying, 4=neither annoying nor preferred, and 7=highly preferred.
Descriptions were included beneath the sound variable on the questionnaire as indicated by superscripts:
[2]animals foraging, flying, walking, swimming, etc.
[3]speech, laughter, coughing, etc.
[4]roadway traffic, air traffic, rail traffic, marine traffic, etc.
[5]footsteps, running, walking across a bridge, etc.
[6] ventilation systems, construction, agriculture, etc.

Table 4

Adjusted means[1] for geophony, biophony, and anthrophony preference among specialization segments

Component	Gender	Casual	Novice	Intermediate	Advanced	Total	*p*-value
Geophony	Male	4.985[a]	4.153[b]	3.716[c]	3.713[c]	4.02	***
	Female	5.057[a]	4.224[b]	3.788[c]	3.784[c]		
Biophony	Male	5.028[a]	4.928[a]	5.069[a]	4.976[a]	5.01	0.702
	Female	5.044[a]	4.944[a]	5.085[a]	4.992[a]		
Anthrophony	Male	2.144[a]	2.186[a]	2.171[a]	1.945[a]	2.09	0.058
	Female	2.148[a]	2.190[a]	2.175[a]	1.949[a]		

[1]Adjusted means were evaluated at an average age of 52.377.
All soundscape preference variables were measured on a 7-point Likert-type scale where 1=highly annoying, 4=neither annoying nor preferred, and 7=highly preferred. All soundscape component means with different superscripts in each row are significantly different ($p<.05$) using Bonferonni post-hoc tests.
*** $p<.001$

Table 5

Specialization component contribution to geophony soundscape preference

Specialization component	Standardized coefficient	Unique variance explained	*p*-value
Behavior	0.078	<1%	0.254
Skill and knowledge	-0.416	8.5%	***
Commitment	-0.087	<1%	0.126

*** p<.001

REFLECTION

The intent of this research was to explore soundscapes in recreation. Soundscapes are an omnipresent resource in all environments and are of particular importance in outdoor recreation. As quality soundscape resources continue to be diminished in the world, their importance will also grow. As resource managers seek to find methods, tools, and the ability to manage soundscape resources, a greater conceptual understanding of soundscapes will allow for better decisions in the future.

As an important first step, biophony, geophony, and anthrophony are words that should enter the lexicon of resource managers. Defining sounds as either natural or human-made is *not* incorrect, but it is *less* correct; at best it is too limiting and at worst it is inaccurate. It is less correct because it portrays variables as either sound or noise by presenting natural sounds as beneficial (sound) and human-made sounds as negative (noise). Even natural sounds (like geophony), which are traditionally desired by outdoor recreationists, can be considered annoying to some groups. Even if both biophony and geophony are found to be preferred by a population, one component may be more important to the participants in an activity than the other. An example of this of this would be the wilderness soundscape. Geophony may contribute more than biophony to the wilderness experience, even though both may be considered desirable. Many people can hear crickets, birds, and squirrels chattering in their front yard. Few people can hear a waterfall or the wind sweeping through open country while home. At the very least, soundscape researchers and managers need to consider multiple sounds from each soundscape component.

Soundscapes are both an ecological and a social resource. Ecologically, every sound fits neatly into one of the three components. A frog is a source of biophony, wind is a source of geophony, and a vehicle rumbling is a source of anthrophony. However, sounds are full of meaning, and these meanings can change depending on the population. For instance, a flock of sheep in the backcountry of the Sierra Nevada Mountains would almost certainly be considered anthrophony to hikers. For hikers in Europe, a flock of sheep may be considered biophony. Additionally, the role of "natural quiet", frequently cited in recreational soundscape studies, has yet to be determined for the biophony/geophony/anthrophony concept. It is possibly a part of geophony, but may also represent a separate aspect of soundscape perception. Recreational resource managers should continue to focus on the social aspects of soundscapes.

This study used the theory of recreational specialization to evaluate how soundscape preference differs among groups of recreationists, in this case birders. Birders were used because their engagement of birding is diverse and their activities are highly soundscape dependent. A variety of different theories could have been used to study soundscape preference, including recreation motivations and serious/casual leisure. Recreational specialization was used because a good model had been established and would segment the sample into multiple groups that were truly different from each other. Previous research suggests that the value of using recreational specialization is in its ability to segment the sample into groups that illustrates how they participate in an activity in different ways (Scott & Thigpen, 2003). This makes recreational specialization an excellent choice for evaluating soundscape preference.

The results from this study suggest that birders differ in soundscape preference among groups according to their level of specialization. This may occur because these segments may have different motivations, or perhaps they have different "tool-sets" to find birds that can only be used under certain conditions. Resource managers cannot flip a switch and have birds appear for visitors – nor would this be desirable. However, resource managers can manage the experience of birding. Soundscape management is an important component of managing the birding experience. An area, either a particular recreation area or a network of different areas, can provide a multitude of opportunities for birders based on their level of specialization with special attention paid to skill level. This is no different than snowsport enthusiasts selecting a trail (green, blue, black, double black, backcountry) based on their level of specialization.

Future park and protected area management should incorporate both the social and ecological aspects of soundscapes into existing management frameworks. As soundscapes are defined as being of a particular area at a designated time, site-specific planning efforts are important. Resource managers can integrate soundscape preference into Visitor Experience and Resource Protection (VERP) framework and/or Limits of Acceptable Change (LAC) techniques to inform management action at site-specific locations. Additionally, the soundscape components should be validated in other populations in a variety of areas, including wilderness users, nighttime recreationists, and general outdoor recreationists as well.

In an over-stimulating modern world, soundscapes allow us to reconnect ourselves to the natural world in a visceral way. Soundscape research and management will continue to grow in importance as people seek alternatives to the sound of urbanization. As use increases in parks and protected areas, the protection and management of the soundscape resource will continue to become increasingly important for outdoor recreation. Defining the soundscape resource as biophony, geophony, and anthrophony will allow resource managers and researchers to better understand how recreationists perceive sounds in the outdoor environment.

Graduate school has been both challenging and rewarding. Academically, I have been pressed by content and professors to go beyond my previous boundaries and further develop my skills as an academic. Personally, graduate school has demanded me to be more focused on time management. The experiences I have had thus far at Clemson University will help me become successful not only in academia, but also in life.

Upon entering graduate school, I was focused on getting an M.S. with the possibility of a Ph.D. in the future. I realized that I loved learning at an early age, and teaching at the college level would help me feel personally fulfilled in the workplace while being able to contribute to society. Therefore, my intent was to obtain a degree that would allow me to teach in the college setting. However, as I progressed along in my first semester, I was “bitten” by the research bug. Research allows me to engage the pursuit of knowledge at a level I have never been able to previously. In leisure philosophy, we talk about the experience of “flow”. I find myself able to achieve a flow state through research endeavors.

I also took notice of a divide among professors: those who are practiced based and those who are theoretical. Although these are not mutually exclusive, it seems that most professors fall into one of the two camps. Personally, I discovered that I enjoy both aspects. Theory allows my mind to wander, explore, and expand to help me better conceptualize content. Practice gives purpose to theory; it enables us to put to use the ideas we conceptualize, with the end result being (hopefully) better management and better possibilities. To me, practice is the body which gives ability to the spirit that is theory.

Importantly, I learned that research *is* collaboration. It should not, and possibly cannot, be done well in isolation. It takes a group of individuals to construct a well-designed and executed research project. I saw this as a very conspicuous pattern that emerged in every project I worked on. On my own thesis work, it took a diverse group of individuals to form a committee and complete the project. This included not only the guidance and advice of my committee, but also the input of my peers and the contributions of office staff. In Kenya, I saw collaboration between different offices to ensure the safety of the research team that was abroad. I also watched Dr. Quigley and Dr. Dogbey build on each other's strengths and support each other where they may have been less strong. While traveling this summer and collecting data for Clemson University on the coast of South Carolina, I saw graduate students pull together their knowledge and skill to accomplish tasks. I also saw that academia, even and maybe more so among graduate students, can sometimes feel competitive. I do not think that this is justified or desirable. To address this, I will consciously try to support my peers as needed and draw upon them myself when in need of help as I move forward in my career.

Additionally, I discovered that doing research makes professors better at teaching. Professors are more current and engaged with their field when they conduct research. This is a stark difference from my undergraduate institution I found at Clemson. Although I instruct classes at Clemson, I hope to be able to facilitate classes with more of an academic basis in the future. Instruction of academic classes would be an area I would like to continue to develop in as I move onto a Ph.D.

I think I gleaned my first piece of adult wisdom during my first year at Clemson. Leaving my undergraduate degree, I felt that I had experienced a lot in life and knew quite a bit in regards to my academics. As I undertook courses and conversed with professors at Clemson, I realized that I really did not know much of anything; there is so much to learn in the world still. As Thoreau quotes Confucius in *Walden*, "To know that we know what we know, and that we do not know what we do not know, that is true knowledge." That is a relevant, humbling, and encouraging thought.

I was very fortunate to find a focus early on in my career. At age 18, I learned that people do not do what they know about; people tend to do what they care about. This personally philosophy has continued to drive me in life. In conservation and natural resource management, topics need to be *relevant* to people. It is the study of beliefs, value, perception, and a multitude of other socially constructed resources that allow quality, impactful, informed decisions to be made. The field of parks and protected area management allows me to address conservation management from an interdisciplinary lens. As I progress through my M.S. and onto a Ph.D., I am glad that I have chosen this field.

APPENDICES

Francis Beidler Forest

Birder Survey

CLEMSON UNIVERSITY

Conducted by the Clemson University Department of Parks, Recreation, and Tourism Management

Date: ____________ **Time:** ____________ **Location:** ______________ **Initials:** _________

(The first page is for the surveyor to complete before giving the survey to the respondent)

1. How many trips of more than 1 mile from home have you taken in the last year that included birding as an activity?

   (enter a number) ______________

2. About how many days did you go on a trip of more than 1 mile from home that included birding in the last year?

   (enter a number) ______________

3. How many birds can you identify by sight without a field guide? *(enter a number)*

   ____

4. How many birds can you identify by sound? *(enter a number)*

   ____

5. How would you rate your skill level compared to other birders? (*circle one below*)

Novice ⟵						⟶ **Expert**
1	**2**	**3**	**4**	**5**	**6**	**7**

6. Please indicate the extent to which you agree or disagree with the following statements (*circle one for each statement below)*

Statement	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
Other leisure activities do not interest me as much as birding.	1	2	3	4	5	6	7
I would rather go birding than do most anything else.	1	2	3	4	5	6	7
If I stopped birding, I would probably lose touch with a lot of my friends.	1	2	3	4	5	6	7
If I could not go birding, I am not sure what I would do.	1	2	3	4	5	6	7

Please continue on to the next page ⟶

7. Please indicate your level of preference for the following **sounds** while you're birding (*circle one for each sound below)*

Sound	Highly annoying	Annoying	Slightly annoying	Neither annoying nor preferred	Slightly preferred	Preferred	Highly preferred
Mammal vocalizations	1	2	3	4	5	6	7
Insect calls	1	2	3	4	5	6	7
Wind blowing	1	2	3	4	5	6	7
Animal movement (animals foraging, flying, walking, swimming, etc.)	1	2	3	4	5	6	7
Human movement (footsteps, running, walking across a bridge, etc.)	1	2	3	4	5	6	7
Rain	1	2	3	4	5	6	7
Bird song and chatter	1	2	3	4	5	6	7
Reptile and amphibian calls	1	2	3	4	5	6	7
Motorized transport (roadway traffic, air traffic, rail traffic, marine traffic, etc.)	1	2	3	4	5	6	7
Human vocalizations (speech, laughter, coughing, etc.)	1	2	3	4	5	6	7
Mechanical (ventilation systems, construction, agriculture, etc.)	1	2	3	4	5	6	7
Flowing water (river, waterfall, stream, etc.)	1	2	3	4	5	6	7
Thunder	1	2	3	4	5	6	7

Please continue on to the next page →

8. In what year were you born? (*enter a number*)

____

9. What is your gender? (*check one*)

☐ Male ☐ Female

10. Please indicate your highest level of education completed (*check one*)

☐ None ☐ Some high school or lower ☐ High school diploma

☐ Some college, no degree ☐ Associate's degree ☐ Bachelor's degree

☐ Graduate or professional degree

11. What is your race/ethnicity? (*check all that apply*)

☐ American Indian or Alaska Native ☐ Hawaiian or Pacific Islander ☐ Other (please specify):

☐ Asian ☐ Hispanic or Latino/Latina _________________________________

☐ Black or African-American ☐ White ☐ Prefer not to answer

12. What is your annual household income? (*check one*)

☐ Less than $10,000 ☐ $10,000 - $19,999 ☐ $20,000 - $29,999 ☐ $30,000 - $39,999

☐ $40,000 - $49,999 ☐ $50,000 - $59,999 ☐ $60,000 - $69,999 ☐ $70,000 - $79,999

☐ $80,000 - $89,999 ☐ $90,000 - $99,999 ☐ $100,000 - $149,999 ☐ $150,000 or more

Thank you!

The information your provide can help provide better recreational opportunities and assist with consevation management

Please return this survey to the person administering the survey

If you have questions about this survey, please contact:

Jeffrey Hallo
Associate Professor
Clemson University
Department of Parks, Recreation, and Tourism Management
280B Lehotsky Hall
(864) 656 - 3237
jhallo@clemson.edu