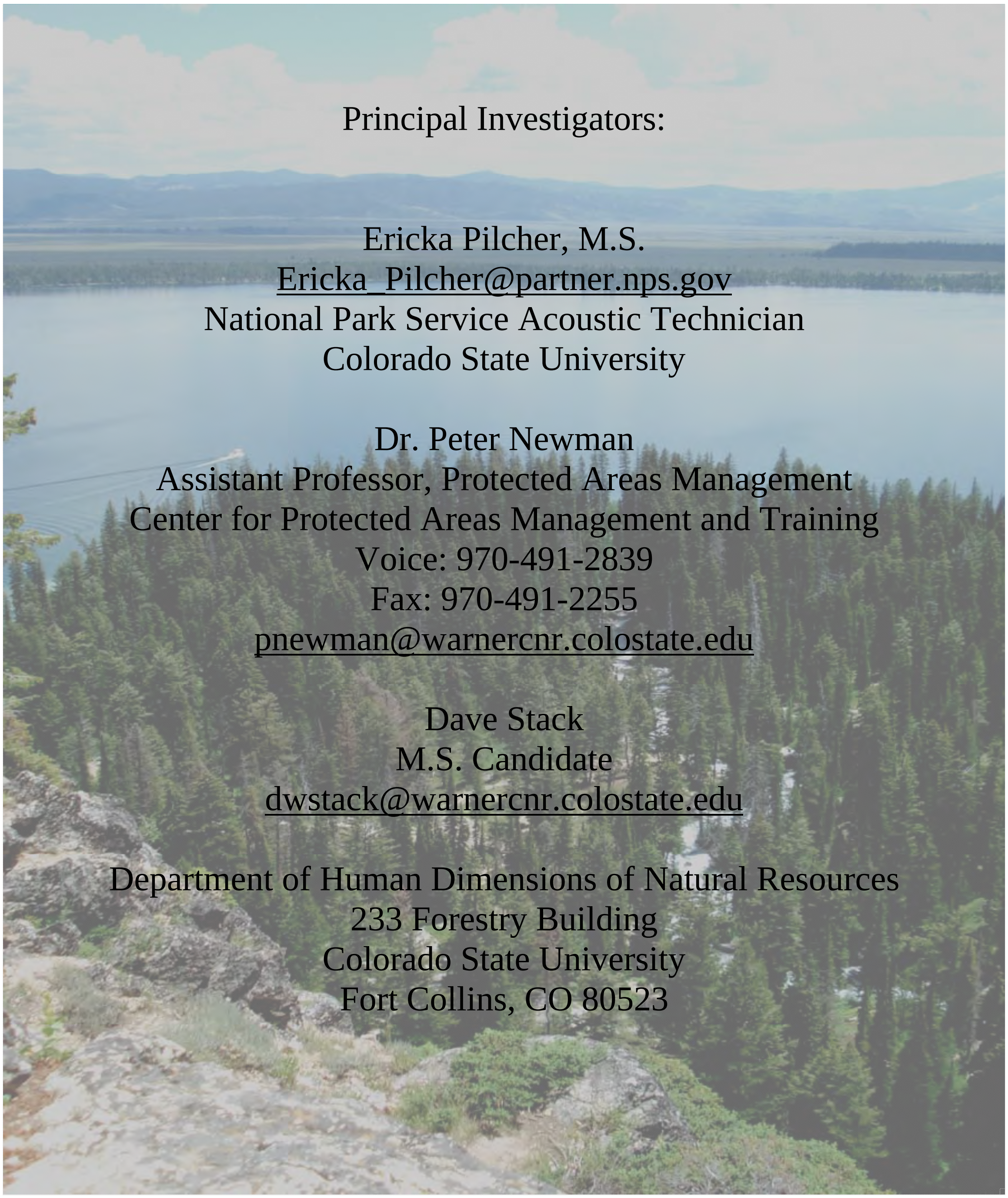
GRAND TETON NATIONAL PARK

SOUNDSCAPE REPORT
2006-2007



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BOYD EVISON FELLOWSHIP: GRAND TETON NATURAL HISTORY ASSOCIATION

The Grand Teton Natural History Association (GTNHA) awarded the second Boyd Evison fellowship to Ericka Pilcher in the spring of 2006. This report is the culmination of the research supported by that generous fellowship. Ericka completed her MS degree in the spring of 2006 and is now an acoustic technician for the National Park Service, Natural Sounds Program in Fort Collins, CO.

The fellowship honors the memory and life work of Boyd Evison, who, after his retirement from the National Park Service1994, served as executive director of the (GTNHA). Before his retirement, Evison lead an exemplary 42-year career with the National Park Service. Starting as a seasonal employee in Grand Teton National Park, Evison's work took him to places across the NPS, including Petrified Forest National Monument, Lake Meade National Recreation Area, Hot Springs National Park, Grand Canyon National Park, Great Smoky Mountains National Park, Washington, D.C. Sequoia-Kings Canyon National Park, and the Alaska Region. Boyd Evison passed away in October of 2002, but his memory and legacy live on in the research supported by this fellowship(NPS, 2006; Skaggs, 2002). Boyd Evison was clearly ahead of his time and he was an early advocate for the protection of soundscapes.

"I know how far the first pre-dawn croaks of a raven can carry in the utter stillness of a cool morning. I know the incredible cascading clarity of the song of the canyon wren, in the heat of a windless day. I know the heart stopping rip of wings of a white-throated swift shooting past me as I round a bend on a side-canyon promontory. I've heard a tiny avalanche started by – what? A lizard? A ringtail? A feeding bighorn? – half a canyon away. Sounds not drowned out by an engine. . .

If we understand that planet Earth is the home of humankind – and it surely is – then we can think of national parks as 'special rooms' in that home. Most of the Earth is not in national parks. It's in 'rooms' put to a lot of uses that wouldn't be suitable in national parks. Special qualities are protected in parks – and 'pretty good' is not enough.

You don't put a toilet in your kitchen, or a bench lathe and power saw in your bedroom. You don't park your car in your living room.

. . . in this room of the home of humankind, we are to provide natural quiet."

- Boyd Evison, March 16, 1994

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EXECUTIVE SUMMARY

Protecting natural sounds is an important goal set by the National Park Service (NPS) in Management Policy 4.9. In order to manage properly soundscapes in national parks, scientifically credible and standardized approaches are essential for measuring and managing soundscapes (Ambrose & Burson, 2004). Developing a study that acknowledges and measures potential impacts to the natural soundscape can provide NPS Grand Teton National Park (GTNP) managers with information that they can use to protect highly valued experiences such as natural quiet.

This study specifically addressed the following objectives: 1) Identify the sounds visitors are hearing at specific study locations in GTNP; 2) Understand the emotions, feelings, or thoughts visitors associate with hearing specific sounds; 3) Create a reliable study instrument that will contribute to the understanding of visitors preferences for soundscape settings in National Parks; 4) Provide information that will inform the formulation of indicators and standards of quality for soundscapes in GTNP.

Results from the visitor surveys (n=306) indicated that loud people were rated as annoying and unacceptable, and were heard by a majority of visitors (53%). *Loud groups* were heard by 15% of respondents, while 15% stated that they heard *loud adults*, and 23% reported hearing *loud children*. These sounds represent a 1st priority for management to consider because these sounds had negative perceptions and were heard by a majority of the visitors. Motorized boat sounds were heard by 41% of visitors, and were given neutral ratings for both personal interpretation and acceptability; therefore neither effecting visitor experience positively or negatively. Sounds associated with

technology (*cell phones, cameras, radios/headsets*, etc.) were heard by 27% of respondents. Both of these categories were ranked negatively in both the personal interpretation and acceptability categories, except *camera,* which was neutral in personal interpretation and positive in acceptability. These sounds should be considered 2nd priority for management. A majority of respondents heard *water* (97%), *wind* (73%), *bird song* (71%), *bird chatter* (61%), *voices* (92%) *and walking sounds* (91%). Although visitors rated all of these sounds as acceptable, only the natural sounds were rated as pleasing. Voices and walking sounds were given a neutral rating. This is important information as it provides empirical evidence that people appreciate hearing natural sounds. More over, visitors rated all natural sounds as acceptable, while all but one natural sound (*insects,* which received a neutral rating) were rated as being pleasing.

INTRODUCTION

This document reports on the soundscape research conducted by Colorado State University researchers in Grand Teton National Park over the summer of 2006. It will first review the purpose of the research as well as the research questions. The methodology, including descriptions of the respondents, the research design, and implementation, will then be discussed. Analysis, results, and discussion of the findings will follow. Finally, appendices including graphs and tables describing the data, the survey tool, as well as a literature review related to the measurement of sounds and soundscapes are included at the end of the document.

Protecting natural sounds is an important goal set by the National Park Service (NPS) in Management Policy 4.9: "The National Park Service will preserve, to the greatest extent possible, the natural soundscapes of parks. Natural soundscapes exist in the absence of human-caused sound. The natural soundscape is the aggregate of all the natural sounds that occur in parks, together with the physical capacity for transmitting sounds. Natural sounds occur within and beyond the range of sounds that humans can perceive, and can be transmitted through air, water, or solid materials. The Service will restore degraded soundscapes to the natural condition wherever possible, and will protect natural soundscapes from degradation due to noise (undesirable human-caused noise)" (NPS, 2000; Ambrose & Burson, 2004).

In order to properly manage soundscapes in national parks, scientifically credible and standardized approaches are essential for measuring and managing soundscapes (Ambrose & Burson, 2004). However, creating standards can be challenging when trying to reach goals that are defined with subjective terms such as undesirable, inappropriate, or excessive. The purpose of this research was to provide information about the types of sounds visitors heard during their visit to the Inspiration Point area in GTNP, visitor perceptions of those sounds, and the frequency that each of the sounds was heard.

PURPOSE AND RESEARCH QUESTIONS

The specific objectives of research in GTNP are:

1. Identify the sounds visitors are hearing at specific study locations in GTNP.
2. Understand the emotions, feelings, or thoughts visitors associate with hearing specific sounds.
3. Create a reliable study instrument that will contribute to the understanding of visitors' preferences for soundscape settings in National Parks.
4. Provide information that will inform the formulation of indicators and standards of quality for soundscapes in GTNP.

Results from the GTNP "listening exercise" could support the development of questions to be used in a future visitor experience survey for GTNP and to explore sounds heard at two study locations in the Inspiration Point area.

Specific questions for GTNP 1 research include:

1. What sounds are visitors hearing?
2. Are those sounds pleasing or annoying to visitors?
3. Are those sounds acceptable or unacceptable to visitors?
4. Do visitors attribute certain emotions, feelings, or thoughts with specific sounds heard?

METHODOLOGY

A. PARTICIPANTS

GTNP visitors (n = 306) participated in listening exercises from June 29th to July 2nd and July 6th-10th 2006. Visitors, 18 years of age and older, were asked if they would be willing to stop and participate in the listening exercise as they walked past specified study locations near the Jenny Lake shuttle boat dock and Inspiration Point (see Figure 1). Both study sites were located within the Inspiration Point area of the park. These study locations were recommended by GTNP staff, as they represent key visitor use areas in that area of the park and feature a diversity of natural and human-made sounds. Using a random start, the surveyors approached the first eligible group or visitor to pass the site and asked them to participate in the survey. After completing this contact, the surveyor asked the next eligible group or visitor to participate in the survey. This process continued throughout the sampling day. Only one individual or one group was asked to participate at a time. Therefore, the surveyor did not distract listeners by talking to people passing by. When the visitors were relaxed and ready to listen, the surveyors instructed them to close their eyes and listen to the sounds around them, including both human and natural sounds. The participants were instructed to open their eyes when they had heard all of the sounds they thought they could hear with in 3 minutes, and then complete the visitor survey. Instructions for the visitor survey were posted on the front page of the survey; however the surveyors also explained these instructions before passing out the survey (Appendix 2).

Figure 1. Map of Jenny Lake Area (National Park Service, 2005)

Inspiration Point study site

Boat Dock study site

B. LISTENING EXERCISE DESIGN.

Based on previous research by Kariel (1990), the listening exercises were designed to focus on the physical characteristics of sounds and how visitors interpreted them on a nine point scale from (-4) very annoying to (+ 4) very pleasing. The personal interpretation categories of the visitor “listening exercise” were the same or similar to that used by Kariel (1990). However, and additional response scale was added for understand the acceptability of sounds. For example, just because a sound is annoying does not mean that is unacceptable. For example, some visitors found the sound of mosquitoes buzzing in their ears to be very annoying. However, this sound could still be rated “acceptable” for park setting. Therefore, another nine point scale was added to the visitor survey to gain a broader understanding of how visitors were responding to certain sounds. This scale was also a nine point scale, ranging from (-4) very unacceptable to (+4) very acceptable. This type of nine point scale has been widely adopted by researchers studying the issue of crowding in outdoor recreation. Since its inception in the early 1970’s over one-hundred and eighty-one surveys have used this type of scale. (Vaske & Shelby, In Review) The sounds listed on the exercise were representative of those used in standard *NPS Attended Logging Exercises*, and were approved by staff at GTNP.

C. Implementation and Quality Control.

The listening exercises were created and implemented by Colorado State University Department of Human Dimensions of Natural Resources, with input from NPS staff. The “listening exercises” were conducted by two researchers. Each researcher followed the directions on page 1 of the “listening exercise” (Appendix 2). One researcher worked full time on the project and also trained volunteers and park staff. Researchers aimed at obtaining equal samples from each site. One researcher was located at each of the two study locations on all sampling days.

ANALYSIS, RESULTS, AND DISCUSSION

All data was coded into Microsoft Excel and then into Statistical Packages for the Social Sciences (SPSS) version 15.0 for data analysis. In order to answer the listed research questions, the following procedures were conducted:

A. WHAT SOUNDS ARE VISITORS HEARING?

Using SPSS, a cross-tabulation (crosstabs) was run for each *sound* heard by *location* (Boat Dock, Inspiration Point, and both study locations combined) (see Appendices 3 through 10 for results). The output represents the frequency that each sound was heard at all locations.

B. ARE THOSE SOUNDS PLEASING OR ANNOYING TO VISITORS?

Using SPSS, each sound variable was individually filtered in order to run crosstabs for *location* by *personal interpretation* of sounds. *Personal interpretation* ratings ranged from -4 as very annoying to + 4 as very pleasing. Descriptive statistics for the mean and median ratings of each sound variable were performed (see Appendices 11 & 12).

C. ARE THOSE SOUNDS ACCEPTABLE OR UNACCEPTABLE TO VISITORS?

Using SPSS, each sound variable was individually filtered in order to run crosstabs for *location* by *acceptability* of sounds. Acceptability ratings ranged from -4 as very unacceptable to + 4 as very acceptable. Descriptive statistics for the mean and median ratings of each sound variable were performed (see Appendices 13 & 14).

D. Do visitors attribute certain emotions, feelings, or thoughts to specific sounds heard?

Using SPSS, each sound variable was individually filtered in order to compile the visitor responses under the *associated feelings* column of the listening exercises. All visitor comments are listed along with its' corresponding frequency (see Appendix 15).

E. Discussion of results pertinent to study objectives:

This study had four objectives: 1) Identify the sounds visitors are hearing at specific study locations in GTNP; 2) Understand the emotions, feelings, or thoughts visitors associate with hearing specific sounds; 3) Create a reliable study instrument that will contribute to the understanding of visitors preferences for soundscape settings in National Parks; 4) Provide information that will inform the formulation of indicators and standards of quality for soundscapes in GTNP.

In order to understand the visitor perceptions of soundscape in GTNP National Park, researchers identified the percentage of visitors that were able to hear specific sounds and visitors' feelings about those sounds. When examined together, these data provided information that will enable the formulation of "soundscape" vignettes to use for a future research project. These data also provide important management information.

Figure 2 displays the median ratings of each sound heard by visitors (-4 very annoying through +4 very pleasing) and the percentage of visitors that heard the sounds. Figure 3 displays the median ratings of each sound heard by visitors (-4 very unacceptable through +4 very acceptable) and the percentage of visitors that heard the sounds. The results are displayed using a concept similar to the

“Importance/Performance” figure presented by Hollenhorst and Gardner (1994). Importance/Performance provides a graphic representation of the relationship between importance and performance and provides information as to where management action should be directed (Manning, 1999). It is broken into four quadrants, with the percentage of people hearing sounds listed on the Y axis, and the median ratings of those sounds listed on the X axis.

The upper left quadrant of Figures 2 and 3 represent sounds that were rated negatively and heard frequently. Since none of the negatively rated sounds were heard more than 50% of the time, nothing appears in this quadrant. The lower left quadrant contains sounds that were rated negatively, but were heard by less than 50% of the people; none of the sounds in this quadrant were heard by more than 25% of the people. Loud people (*loud groups, loud adults,* and *loud children*), however, were heard by 53% of the people. None of these sounds received a median rating higher than -2 in either personal interpretation or acceptability. Although the data were collected in a high-use area, loud people should be considered a first priority for management consideration. Motorized boat sounds were heard by 41% of visitors, and were given neutral ratings for both personal interpretation and acceptability; therefore neither effecting visitor experience positively or negatively. Sounds associated with technology (*cell phones, cameras, radios/headsets*, etc.) were heard by 27% of respondents. Both of these categories were ranked negatively in both the personal interpretation and acceptability categories, except *camera,* which was neutral in personal interpretation and positive in acceptability. These sounds should be considered 2nd priority for management. Notice the difference in the right quadrants in Figures 2 and 3. These sounds represent the natural soundscape, along with some of the less intrusive human made sounds. A majority of respondents heard *water* (97%), *wind* (73%), *bird song* (71%), *bird chatter* (61%), *voices* (92%) *and walking sounds* (91%). Although all of these sounds were rated as acceptable, only the natural sounds were rated as pleasing. Voices and walking sounds were given a neutral rating. Associated feelings, thoughts, and emotions (Appendix 15) written in by visitors reveals that some types of and level of voices and conversation are acceptable to many visitors. The lower right quadrants contain sounds that visitors rated positively but did not hear as often. This is important information as it provides empirical evidence that people appreciate hearing natural sounds. More over, all natural sounds were rated by visitors as acceptable, while all but one natural sound (*insects*, which received a neutral rating) were rated as being pleasing.

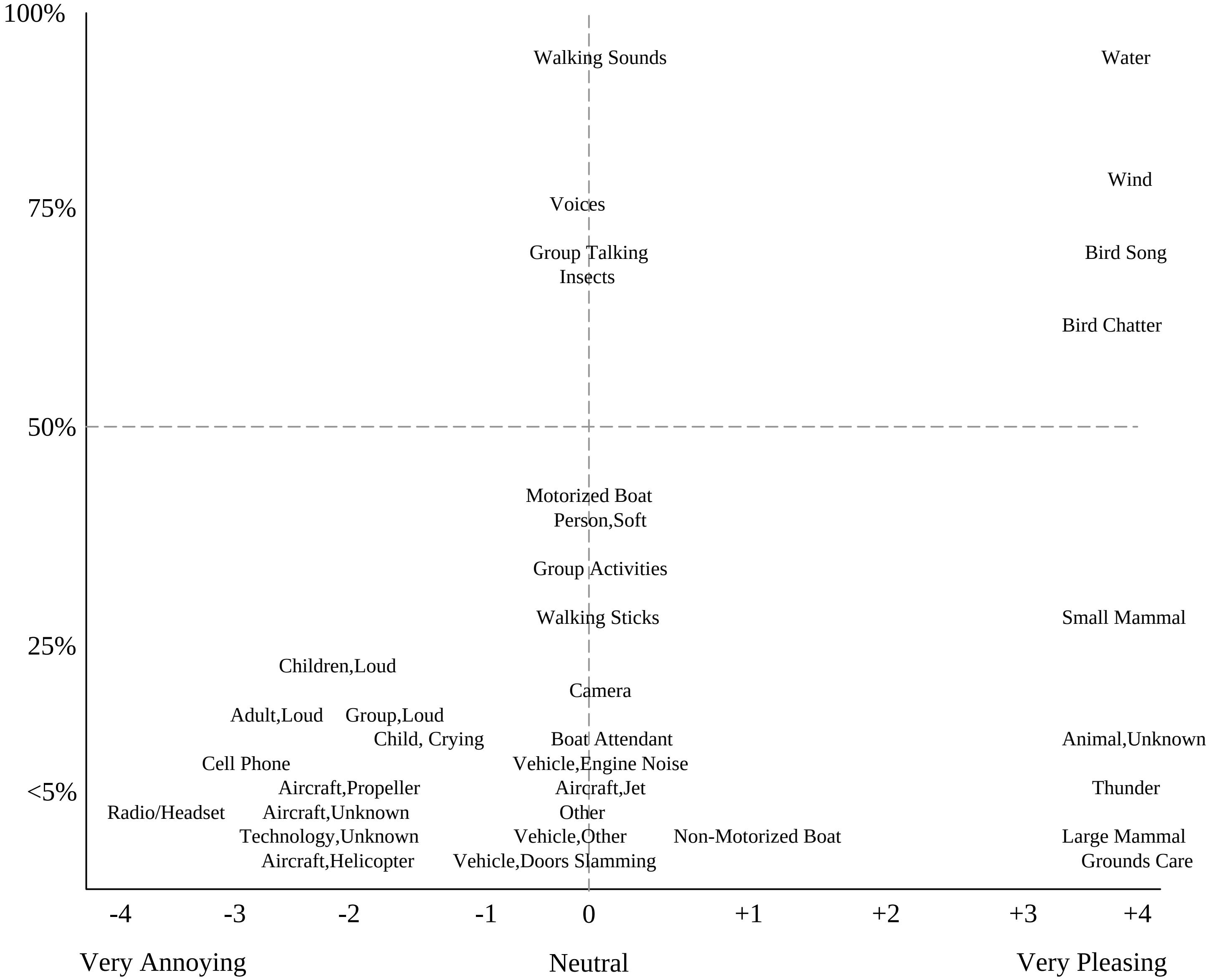


Figure 2. The median ratings of each sound heard by visitors (-4 very annoying through +4 very pleasing) by the percentage of visitors that heard the sounds. The following sound events were not included because visitors did not hear them: Vehicle car alarm, motorcycle, concession.

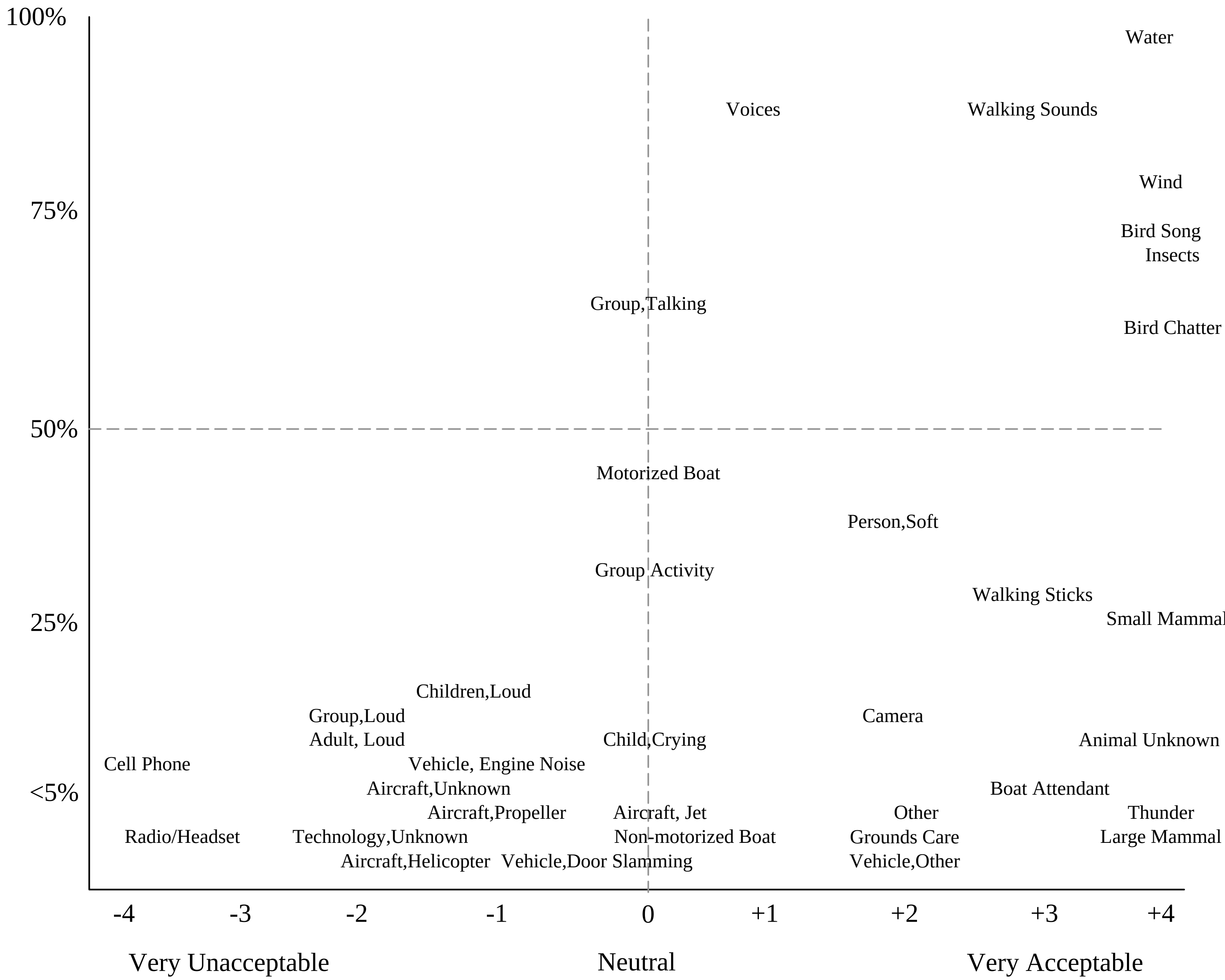


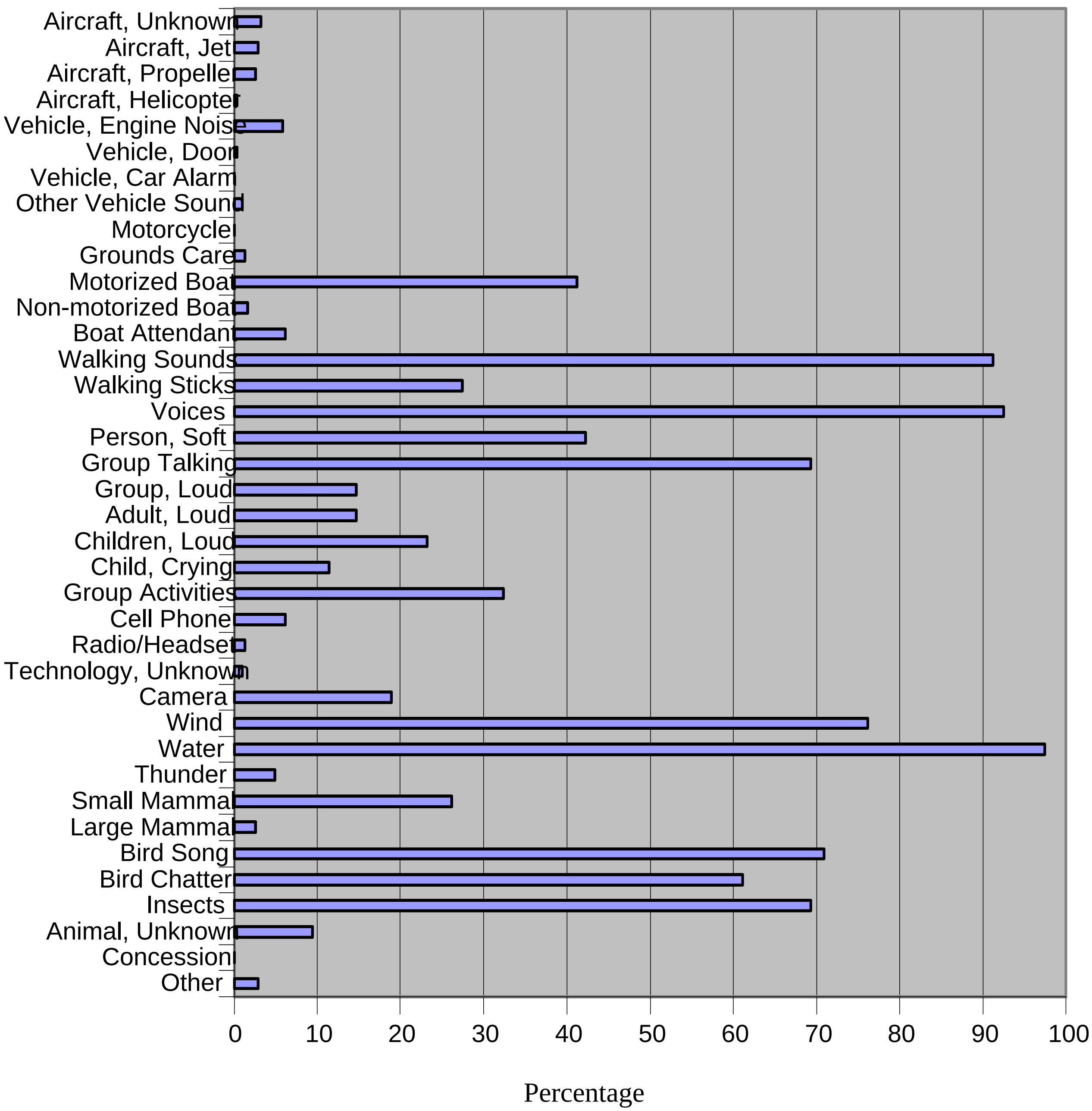
Figure 3. The median ratings of each sound heard by visitors (-4 very unacceptable through +4 very acceptable) by the percentage of visitors that heard the sounds. The following sound events were not included because visitors did not hear them: Vehicle car alarm, motorcycle, concession.

F. Future considerations:

An important objective of this research is to provide data to inform the development of a future visitor survey. During the future survey, researchers would give visitors the opportunity to listen to five sound segments. Developed by an acoustician using sounds recorded at the various study locations, these sound segments would have a baseline of natural sounds with each subsequent segment playing an increasing level of human-caused noise. The objective of the future research would be to inform thresholds related that indicate when visitor caused noise begins to become unacceptable and therefore affect the visitor experience.

APPENDIX 1. PERCENTAGE OF PEOPLE THAT HEARD LISTED SOUNDS AT BOTH STUDY LOCATIONS

SAMPLING DATES: JUNE 29TH-30TH, AND JULY 1ST, 2ND, 6TH – 9TH, 10TH 2006
(N=306)



Survey # _____
Soundscape Min_______-Max_______

Date: _______
Time: _______
Location: _______

APPENDIX 2.

"Understanding and Managing Soundscapes in National Parks: Grand Teton National Park Visitor Use Survey"

Today we are conducting a visitor survey that includes a listening portion which directs your attention to the sounds of the park. If you are interested in participating, you will be asked to fill out a checklist to identify sounds you heard today. This survey will be used to help management understand the effects of natural and human sounds in the park. This exercise is voluntary and strictly confidential. It will take approximately 5-10 minutes to complete.

Step 1: The listening portion of this survey will be lead by an NPS volunteer. Remember that all sounds are included, both human and natural.

Step 2: Close your eyes and relax, and keep track of each individual sound that you heard.

Step 3: While holding your concentration, focus on the sounds you have heard. Now, please take a moment to fill out the attached sheet before speaking with other participants about what you have heard. This exercise begins on the next page.

Step 4: Please put a √ check mark next to each sound that you heard during the exercise. If the sound is not listed, please write the sound(s) in the blank spaces provided at the bottom of the SOUNDS column on page 4.

Step 5: Under the FEELINGS OR EMOTIONS ASSOCIATED WITH SOUNDS column, please list any feelings or emotions that you associated with each of the sounds you checked√.

Examples: I felt relaxed because the stream was soothing to me.
I felt annoyed because the bird was beeping like an alarm clock.
I felt frustrated because the dog was barking when I wanted peace and quiet.

Step 6: Under the ACCEPTABILITY OF SOUNDS AT THIS LOCATION column, please circle one number which best describes how unacceptable or acceptable the sound was for this location in the park: The scale is on a continuum from: - 4 as very unacceptable, - 2 as slightly unacceptable, 0 as neutral, +2 as slightly acceptable, and + 4 as very acceptable.

Step 7: Under the PERSONAL INTERPRETATION column, please circle one number which best describes how pleasing or annoying the sound was to you: The scale is on a continuum from: -4 as very annoying, - 2 as slightly annoying, 0 as neutral, +2 as slightly pleasing, and + 4 as very pleasing.

Step 8: Please answer a few questions about yourself and your group on page 5.

Thank you for your participation

Survey # _____
Soundscape Min_______-Max_______

Date: _______
Time: _______
Location: _______

SOUNDS	√	FEELINGS OR EMOTIONS ASSOCIATED WITH SOUND	ACCEPTABILITY OF SOUND AT THIS LOCATION									PERSONAL INTERPRETATION OF SOUND								
			Very unacceptable		Slightly unacceptable		Neutral		Slightly acceptable		Very acceptable	Very annoying		Slightly annoying		Neutral		Slightly pleasing		Very pleasing
Aircraft, Unknown			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Aircraft, Jet			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Aircraft, Propeller			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Aircraft, Helicopter			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Vehicle			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Motorcycle			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Grounds Care (trail work, dock maintenance etc.)			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Motorized boat			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Non-motorized boat			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Boat attendants			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
People			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Walking sounds			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Walking sticks			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4

Survey # _____
Soundscape Min_______-Max_______

Date: _______
Time: _______
Location: _______

SOUNDS	√	FEELINGS OR EMOTIONS ASSOCIATED WITH SOUND	ACCEPTABILITY OF SOUND AT THIS LOCATION									PERSONAL INTERPRETATION OF SOUND								
			Very unacceptable		Slightly unacceptable		Neutral		Slightly acceptable		Very acceptable	Very annoying		Slightly annoying		Neutral		Slightly pleasing		Very pleasing
Voices			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Person, soft voice, whisper			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Group, talking			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Group, loud or yelling			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Adult, loud or yelling			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Children, loud or yelling			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Child, crying			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Group activities (gathering or shuffling)			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Technology, cell phone			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Technology, radio headset or IPOD			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Technology Sounds, Unknown			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Camera			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4

Survey # _____
Soundscape Min_______-Max_______

Date: _______
Time: _______
Location: _______

SOUNDS	√	FEELINGS OR EMOTIONS ASSOCIATED WITH SOUND	ACCEPTABILITY OF SOUND AT THIS LOCATION									PERSONAL INTERPRETATION OF SOUND								
			Very unacceptable		Slightly unacceptable		Neutral		Slightly acceptable		Very acceptable	Very annoying		Slightly annoying		Neutral		Slightly pleasing		Very pleasing
Wind			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Water (falls, river, waves)			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Thunder			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Mammal, small (e.g. squirrel)			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Mammal, large (e.g. moose)																				
Bird song			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Bird chatter (e.g. Jay)			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Insect (s)			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Animal, unknown			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Concession/cafe, (dishes, cash register, bottles or other; note)			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
Add other(s):			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4
			-4	-3	-2	-1	0	+1	+2	+3	+4	-4	-3	-2	-1	0	+1	+2	+3	+4

Survey # _____
Soundscape Min_______-Max_______

Date: _______
Time: _______
Location: _______

<Topic Area 2 – Trip/Visit Characteristics>

1. Have you visited Grand Teton National Park before? (Check one.)

❑ Yes
❑ No (Skip to question 3.)

2. Approximately how many times have you visited Grand Teton National Park?

Approximate number of visits: __________

3. Approximately how long did you visit Grand Teton National Park today?

Approximate length of visit: __________

4. How many people were in your group today?

Group size: __________

5. How would you describe your group? (Check one.)

❑ Family
❑ Friends
❑ Family and friends
❑ Organized group (e.g., club, educational group)
❑ Commercial tour group
❑ Other (Please specify: ____)

6. What is your gender? (Check one.)

❑ Male
❑ Female

7. In what year were you born? Year born: __________

8. Do you live in the United States? (Check one.)

❑ Yes (What is your zip code? __________)
❑ No (What country do you live in? ______________________________)

9. What category best describes the location where you live? _______________
❑ rural areas outside town or city
❑ town less than 5,000
❑ town 5,000 to 9,999
❑ small city 10,000 to 49,999
❑ medium sized city 50,000 to 500,000
❑ large city over 500,000

10. What is the highest level of formal education you have completed? (Check one.)

❑ Less than high school
❑ High school graduate
❑ Vocational/trade school certificate
❑ Some college
❑ Two-year college degree
❑ Four-year college degree
❑ Graduate degree

11. Did you ride a boat across Jenny Lake or hike to this location today? (Check one.)

❑ Boat
❑ Hike

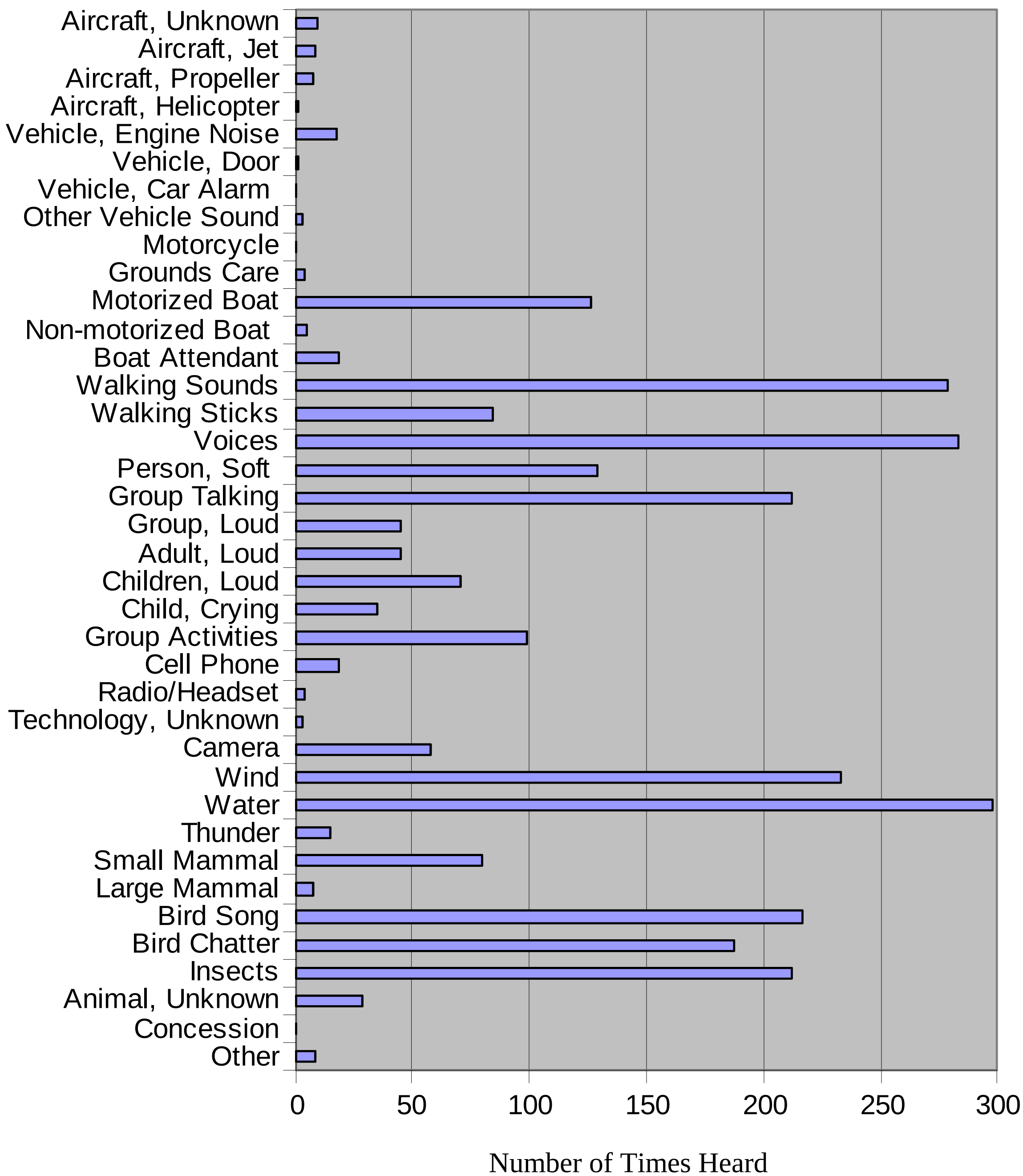
Thank you for your participation.

APPENDIX 3. FREQUENCY OF SOUNDS HEARD AT BOTH STUDY LOCATIONS

Sound	Number of Times Heard
Aircraft, Unknown	10
Aircraft, Jet	9
Aircraft, Propeller	8
Aircraft, Helicopter	1
Vehicle, Engine Noise	18
Vehicle, Door Slamming	1
Vehicle, Car Alarm	0
Other Vehicle Sound	3
Motorcycle	0
Grounds Care	4
Motorized Boat	126
Non-motorized Boat	65
Boat Attendant	19
Walking Sounds	279
Walking Sticks	84
Voices	283
Person, Soft	129
Group Talking	212
Group, Loud	45
Adult, Loud	45
Children, Loud	71
Child, Crying	35
Group Activities	99
Cell Phone	19
Radio/Headset	4
Technology, Unknown	3
Camera	58
Wind	233
Water	298
Thunder	15
Small Mammal	80
Large Mammal	8
Bird Song	217
Bird Chatter	187
Insects	212
Animal, Unknown	29
Concession	0
Other	9

APPENDIX 4. FREQUENCY OF PEOPLE THAT HEARD LISTED SOUNDS AT BOTH STUDY LOCATIONS

SAMPLING DATES: JUNE 29TH - 30TH, AND JULY 1ST - 2ND, 6TH – 10TH, 2006 (N=306)

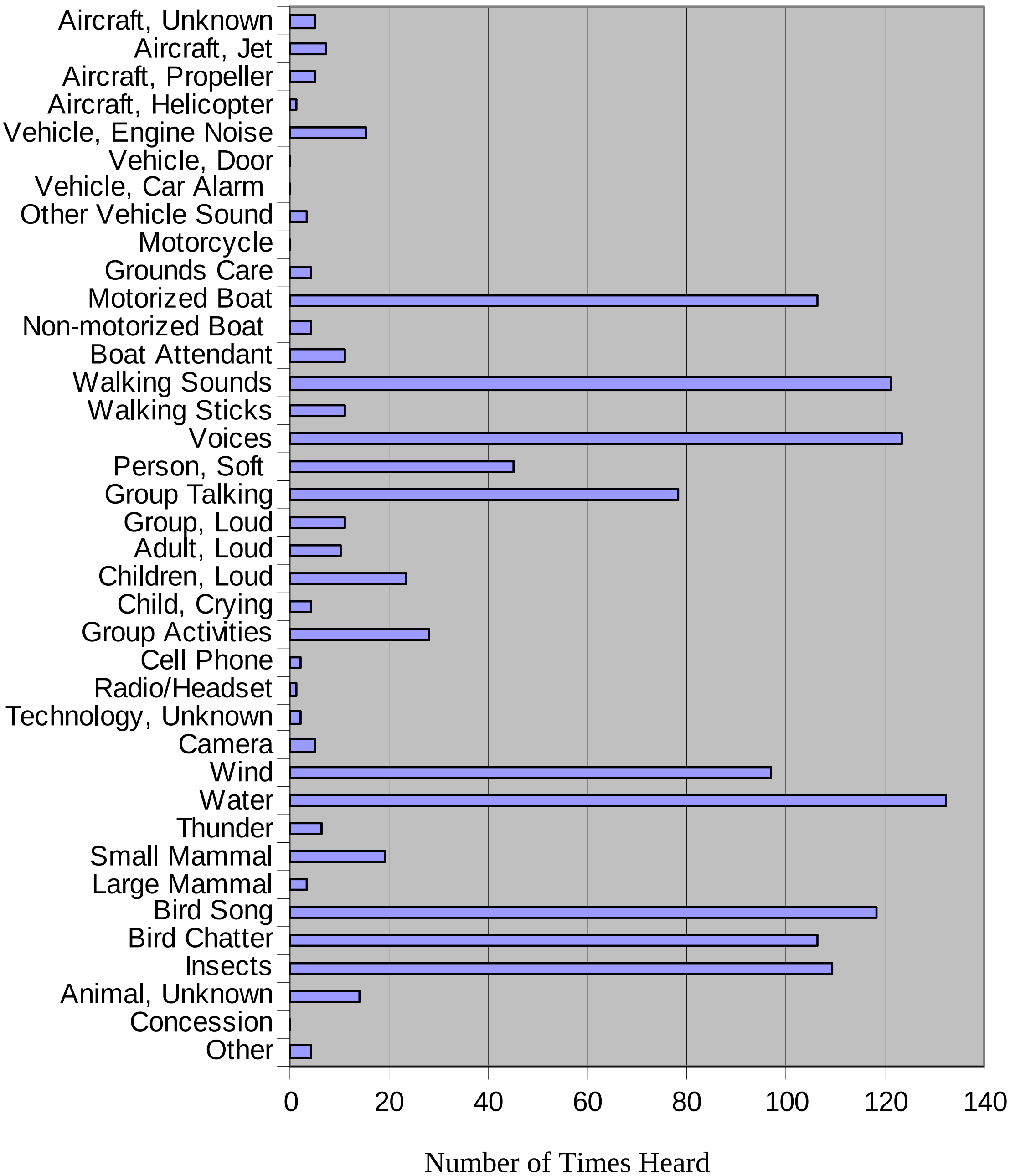


APPENDIX 5. FREQUENCY OF SOUNDS HEARD AT THE BOAT DOCK

Sound	Number of Times Heard
Aircraft, Unknown	5
Aircraft, Jet	7
Aircraft, Propeller	5
Aircraft, Helicopter	1
Vehicle, Engine Noise	15
Vehicle, Door Slamming	0
Vehicle, Car Alarm	0
Other Vehicle Sound	3
Motorcycle	0
Grounds Care	4
Motorized Boat	106
Non-motorized Boat	4
Boat Attendant	11
Walking Sounds	121
Walking Sticks	11
Voices	123
Person, Soft	45
Group Talking	78
Group, Loud	11
Adult, Loud	10
Children, Loud	23
Child, Crying	4
Group Activities	28
Cell Phone	2
Radio/Headset	1
Technology, Unknown	2
Camera	5
Wind	97
Water	132
Thunder	6
Small Mammal	19
Large Mammal	3
Bird Song	118
Bird Chatter	106
Insects	109
Animal, Unknown	14
Concession	0
Other	4

APPENDIX 6. FREQUENCY OF PEOPLE THAT HEARD LISTED SOUNDS AT THE BOAT DOCK

SAMPLING DATES: JUNE 29TH - 30TH, AND JULY 1ST - 2ND, 6TH – 10TH, 2006 (n=138)

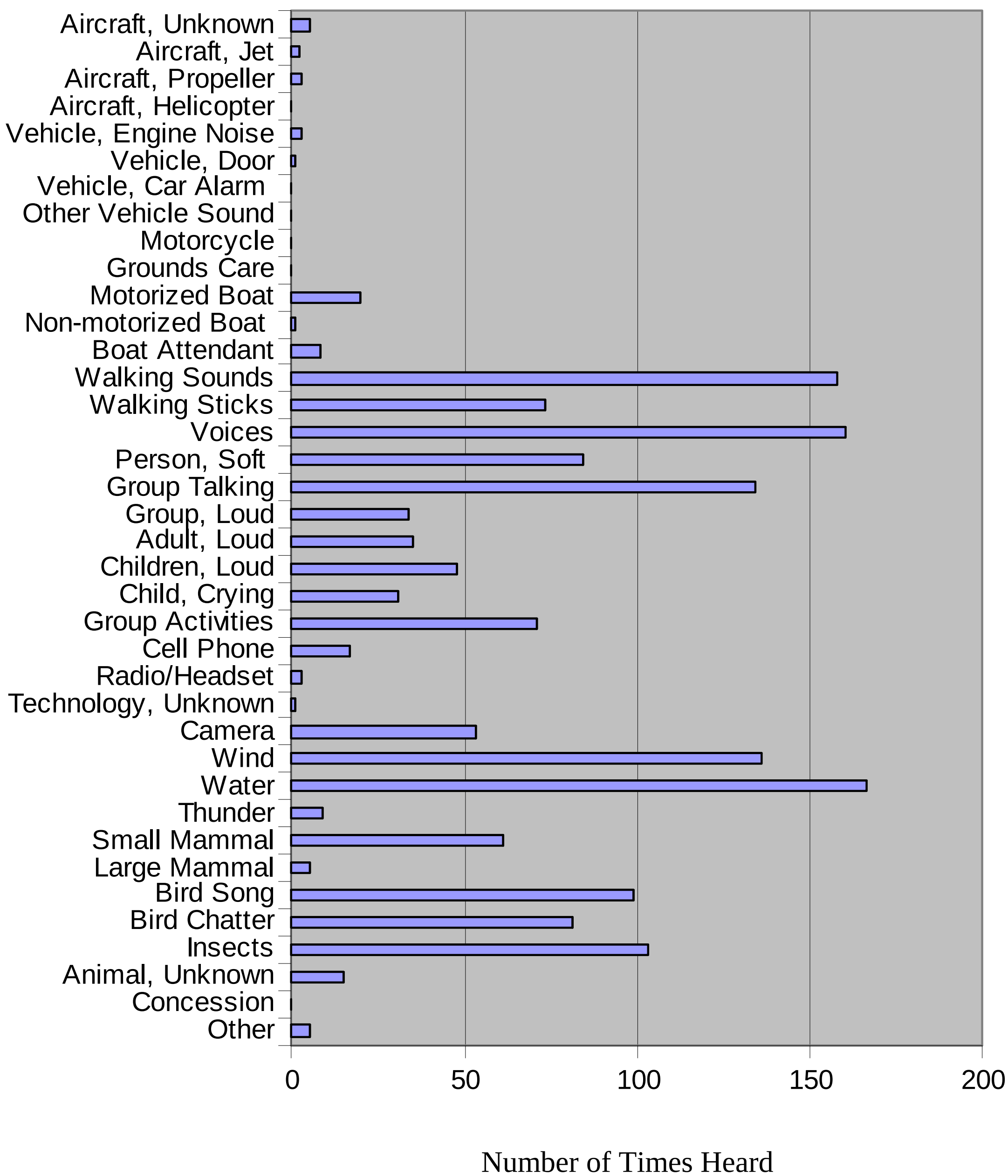


APPENDIX 7. FREQUENCY OF SOUNDS HEARD AT INSPIRATION POINT

Sound	Number of Times Heard
Aircraft, Unknown	5
Aircraft, Jet	2
Aircraft, Propeller	3
Aircraft, Helicopter	0
Vehicle, Engine Noise	3
Vehicle, Door Slamming	1
Vehicle, Car Alarm	0
Other Vehicle Sound	0
Motorcycle	0
Grounds Care	0
Motorized Boat	120
Non-motorized Boat	1
Boat Attendant	8
Walking Sounds	158
Walking Sticks	73
Voices	160
Person, Soft	84
Group Talking	134
Group, Loud	34
Adult, Loud	35
Children, Loud	48
Child, Crying	31
Group Activities	71
Cell Phone	17
Radio/Headset	3
Technology, Unknown	1
Camera	53
Wind	136
Water	166
Thunder	9
Small Mammal	61
Large Mammal	5
Bird Song	99
Bird Chatter	81
Insects	103
Animal, Unknown	15
Concession	0
Other	5

APPENDIX 8. FREQUENCY OF PEOPLE THAT HEARD LISTED SOUNDS AT INSPIRATION POINT

SAMPLING DATES: JUNE 29TH - 30TH, AND JULY 1ST - 2ND, 6TH – 10TH, 2006 (n=168)



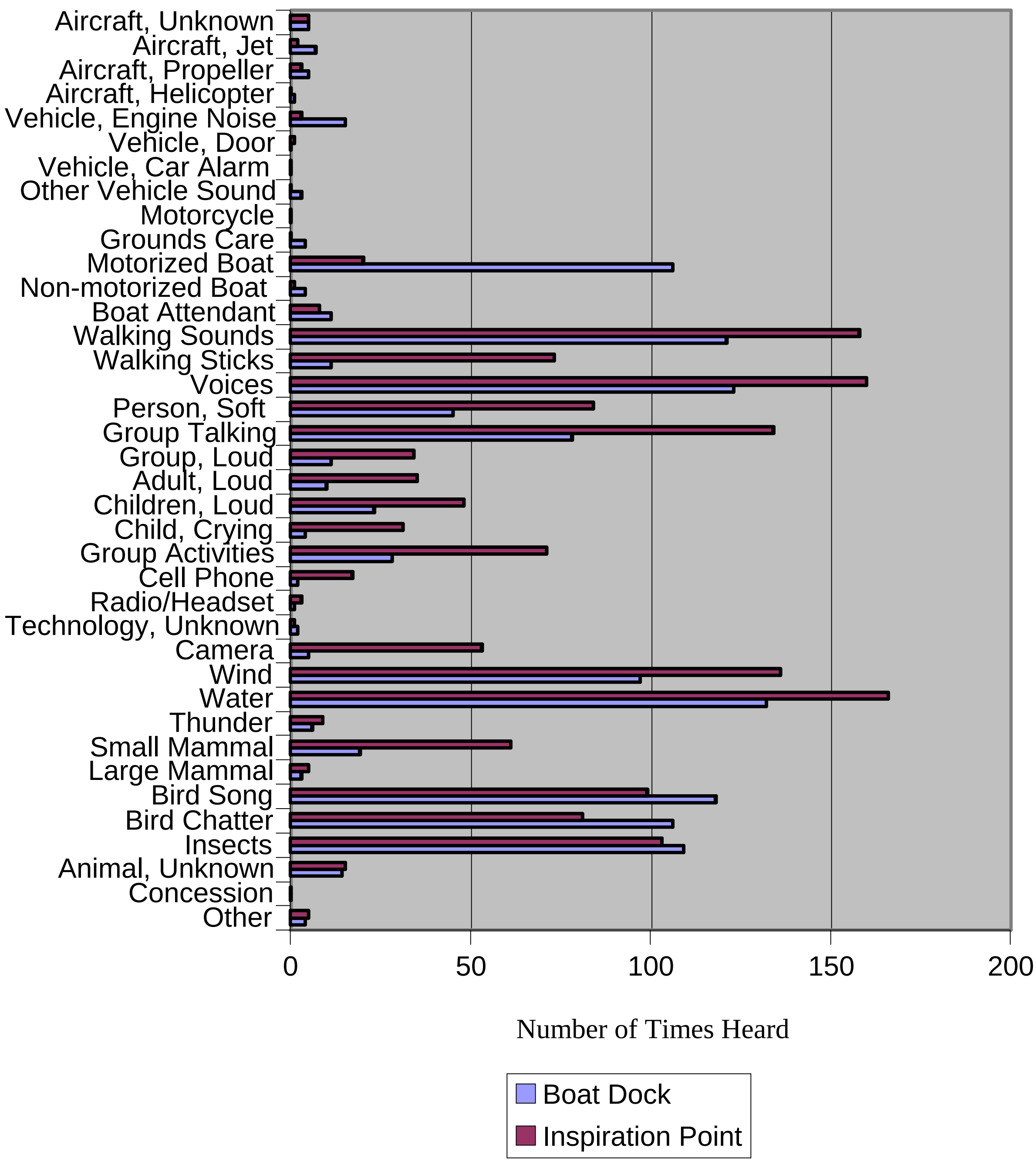
APPENDIX 9. FREQUENCY OF SOUNDS HEARD AT BOAT DOCK, INSPIRATION POINT, & FREQUENCY AND PERCENTAGE OF SOUNDS HEARD AT BOTH STUDY LOCATIONS COMBINED

BOAT DOCK : n=138; INSPIRATION POINT: n=168; BOTH LOCATIONS: n=306

Sounds	Boat Dock	Inspiration Point	Both	Percentage for Both
Aircraft, Unknown	5	5	10	3%
Aircraft, Jet	7	2	9	3%
Aircraft, Propeller	5	3	8	3%
Aircraft, Helicopter	1	0	1	.5%
Vehicle, Engine Noise	15	3	18	6%
Vehicle, Door Slamming	0	1	1	.5%
Vehicle, Car Alarm	0	0	0	0%
Other Vehicle Sound	3	0	3	1%
Motorcycle	0	0	0	0%
Grounds Care	4	0	4	1%
Motorized Boat	106	20	126	41%
Non-motorized Boat	4	1	5	2%
Boat Attendant	11	8	19	6%
Walking Sounds	121	158	279	91%
Walking Sticks	11	73	84	27%
Voices	123	160	283	92%
Person, Soft	45	84	129	42%
Group Talking	78	134	212	69%
Group, Loud	11	34	45	15%
Adult, Loud	10	35	45	15%
Children, Loud	23	48	71	23%
Child, Crying	4	31	35	11%
Group Activities	28	71	99	32%
Cell Phone	2	17	19	6%
Radio/Headset	1	3	4	1%
Technology, Unknown	2	1	3	1%
Camera	5	53	58	19%
Wind	97	136	223	73%
Water	132	166	298	97%
Thunder	6	9	15	5%
Small Mammal	19	61	80	26%
Large Mammal	3	5	8	3%
Bird Song	118	99	217	71%
Bird Chatter	106	81	187	61%
Insects	109	103	212	69%
Animal, Unknown	14	15	29	9%
Concession	0	0	0	0%
Other	4	5	9	3%

Appendix 10. Frequency of Sounds Heard at Boat Dock Compared to Inspiration Point Site

Sampling dates: June 29th - 30th, and July 1st - 2nd, 6th – 10th, 2006 (N=306)

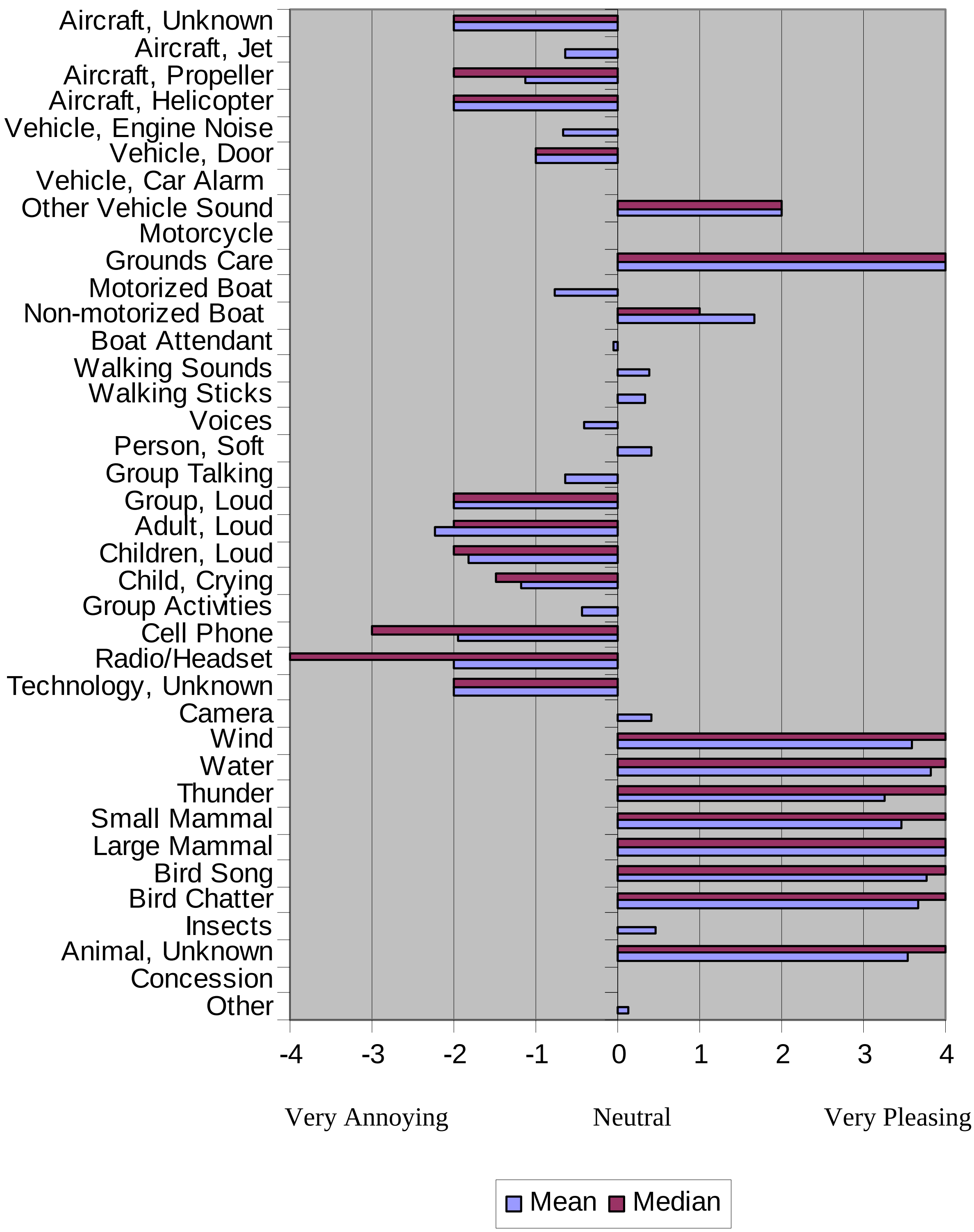


Appendix 11. Mean & Median Ratings for Personal Interpretation of Sounds at Both Study Locations Combined

Sounds	Mean	Median
Aircraft, Unknown	-2	-2
Aircraft, Jet	-.63	0
Aircraft, Propeller	-1.14	-2
Aircraft, Helicopter	-2	-2
Vehicle, Engine Noise	-.67	0
Vehicle, Door Slamming	-1	-1
Vehicle, Car Alarm	0	0
Other Vehicle Sound	0	0
Motorcycle	2	2
Grounds Care	4	4
Motorized Boat	-.77	0
Non-motorized Boat	1.67	1
Boat Attendant	-.06	0
Walking Sounds	0.38	0
Walking Sticks	0.33	0
Voices	-.41	0
Person, Soft	0.41	0
Group Talking	-0.63	0
Group, Loud	-2	-2
Adult, Loud	-2.24	-2
Children, Loud	-1.83	-2
Child, Crying	-1.17	-1.5
Group Activities	-.43	0
Cell Phone	-1.94	-3
Radio/Headset	-2	-4
Technology, Unknown	-2	-2
Camera	.4	0
Wind	3.58	4
Water	3.82	4
Thunder	3.25	4
Small Mammal	3.47	4
Large Mammal	4	4
Bird Song	3.78	4
Bird Chatter	3.67	4
Insects	.45	0
Animal, Unknown	3.54	4
Concession	0	0
Other	.14	0

APPENDIX 12. MEAN & MEDIAN RATINGS FOR PERSONAL INTERPRETATION OF SOUNDS AT BOTH STUDY LOCATIONS COMBINED

SAMPLING DATES: JUNE 29TH - 30TH, AND JULY 1ST - 2ND, 6TH – 10TH, 2006
(N=306)

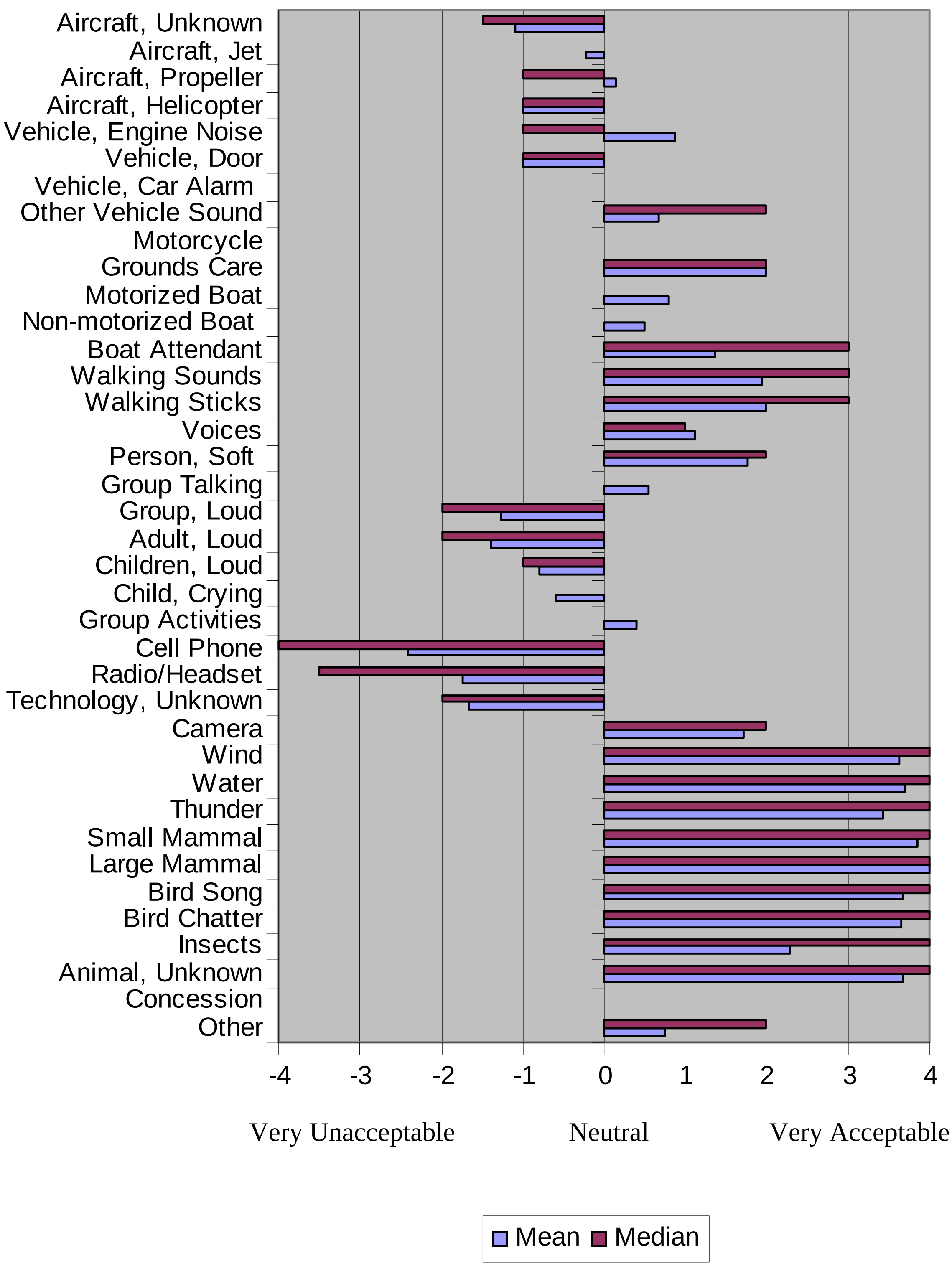


APPENDIX 13. MEAN & MEDIAN RATINGS FOR ACCEPTABILITY OF SOUNDS AT BOTH STUDY LOCATIONS COMBINED

Sounds	Mean	Median
Aircraft, Unknown	-1.10	-1.5
Aircraft, Jet	-.22	0
Aircraft, Propeller	.14	-1
Aircraft, Helicopter	-1	-1
Vehicle, Engine Noise	.88	-1
Vehicle, Door Slamming	1	1
Vehicle, Car Alarm	0	0
Other Vehicle Sound	.67	2
Motorcycle	0	0
Grounds Care	2	2
Motorized Boat	.80	0
Non-motorized Boat	.50	0
Boat Attendant	1.37	3
Walking Sounds	1.93	3
Walking Sticks	2	3
Voices	1.11	1
Person, Soft	1.76	2
Group Talking	.54	0
Group, Loud	-1.27	-2
Adult, Loud	-1.38	-2
Children, Loud	-0.79	-1
Child, Crying	-0.6	0
Group Activities	.40	0
Cell Phone	-2.42	-4
Radio/Headset	-1.75	-3.50
Technology, Unknown	-1.67	-2
Camera	1.72	2
Wind	3.62	4
Water	3.71	4
Thunder	3.43	4
Small Mammal	3.85	4
Large Mammal	4	4
Bird Song	3.67	4
Bird Chatter	3.66	4
Insects	2.29	4
Animal, Unknown	3.68	4
Concession	0	0
Other	.75	2

APPENDIX 14. MEAN & MEDIAN RATINGS FOR PERSONAL ACCEPTABILITY OF SOUNDS AT BOTH STUDY LOCATIONS COMBINED

SAMPLING DATES: JUNE 29TH - 30TH, AND JULY 1ST - 2ND, 6TH – 10TH, 2006 (N=306)



APPENDIX 15. EMOTIONS, FEELINGS, OR THOUGHTS THAT VISITORS ATTRIBUTED TO SOUNDS

Sound	Visitor Comments	Frequency
Aircraft, Unknown	angry	1
	okay	1
Aircraft, Jet	intrusive	1
	okay	1
	tense	1
Aircraft, Propeller	distracted, curious	1
Aircraft, Helicopter	Near cars, sadness	1
Vehicle, Engine Noise	bad	1
	expected	1
	low rumble	1
	necessity	1
	ok near parking lot	1
	too loud, annoying	1
Vehicle, Doors Slamming		
Vehicle, Car Alarm		
Other Vehicle Sound	ok near parking lot	1
Motorcycle		
Grounds Care		
Motorized Boat	acceptable sound due to surroundings but could do without	1
	annoyed	1
	annoyed (sort of)	1
	annoying	1
	annoying, but needed for boat ride	1
	boat - I would prefer not to hear it	1
	brought us here- relaxing ride	1
	but only in this type of setting and purpose	1
	calm	1
	expected	1
	fine- ferry	1
	good transportation across lake after a long hike	1
	invaded	1
	irritating	1
	Irritating	1
	necessity	1

	need it to get here	1
	neutral	2
	ok	2
	ok neutral	1
	park service	1
	reassuring	1
	recreational	1
	relaxing close to civilization	1
	sad to hear in a natural backcountry area	1
	sadness	1
	slower speed leaving the dock	1
	too noisy	1
	understanding the need	1
	way back	1
	welcomed	1
Non-motorized Boat		
Boat Attendant	joyful	1
Walking Sounds	acceptable	1
	acceptable because are part of a guided tour	1
	ambivalent	1
	annoying	1
	comes with the experience	1
	cool that father and kid walk together	1
	crowded	1
	distracted	1
	expected	1
	expected but feel "crowded"	1
	fine	1
	folks happy out having fun	1
	frustration	1
	good, people enjoying	1
	happy	2
	Happy	1
	happy, people using trail	1
	I am not alone	1
	inspiration point is a place of sharing the beauty with people, so such noises are acceptable	1
	interest	1
	irritating	1
	joy at natural fit between	1

	man and nature	
	lets me know people are using the park	1
	made me feel late	1
	mixed emotions	1
	necessary	1
	neutral	1
	neutral feelings	1
	none	1
	normal	1
	ok	2
	part of experience	1
	people nearby	1
	quite hypnotic sound	1
	relaxed	2
	somewhat distracted but also rhythmic	1
	soothing	1
	sounds like people hiking, not really an emotion	1
	That's what I'm here for.	1
	too many people	2
	understanding	1
	usually don't even notice	1
	Where are they going?	1
Walking Sticks	happy, people using trail	1
	I hate them (ok for the blind lady, though)	1
	normal	1
	Pleasant, people enjoying nature	1
	pleased	1
Voices	abrasive to nature	1
	acceptable	1
	actually irritating when trying to focus	1
	annoyed	1
	annoyed slightly	1
	annoying	2
	annoying when you close ones eyes to listen to the natural sounds	1
	cheerful, friendly	1
	crowded, annoyed	1
	didn't like	1
	distracting	2

	embarrassed	1
	enjoy	1
	fine	1
	fortunately they were in distant- just awareness of others out in the wilderness	1
	general conversation passing by	1
	happy	1
	happy families enjoying the park	1
	happy other people came	1
	happy, people using trail	1
	have to live with it	1
	I'm not alone	1
	I always want to be here alone	1
	interest	1
	joy - gathers on holiday	1
	large crowds	1
	loud	1
	many voices	1
	neutral	1
	none	3
	normal	1
	ok - quiet	1
	ok	3
	other teachers, neutral	1
	people nearby	1
	pleased	1
	rather have quiet	1
	relaxed	1
	slightly unacceptable when too loud	1
	some distance away	1
	somewhat distracting	1
	too loud	1
	too many	1
	too many people	1
	too many talkers	1
Person, Soft	acceptable	1
	better, we like it more	1
	distracted, annoyed	1
	family, pleasing	1
	more tolerable	1
	ok	3

	people nearby	1
	relaxed	1
	respect for surroundings	1
	too many talkers	1
Group Talking	annoyed	2
	annoying when you close ones eyes to listen to the natural sounds	1
	communication	1
	crowded, annoyed	1
	didn't like	1
	disruptive to peace	1
	distracting	2
	embarrassed	1
	family and children ok	1
	from boat	1
	happy families enjoying the park	1
	happy they are enjoying	1
	happy, people using trail	1
	have to live with it	1
	interruptive to nature	1
	lesser ok	1
	many groups	1
	neutral	1
	ok	1
	ok, if not too loud	1
	okay	1
	people are enjoying the park	1
	people nearby	1
	they shouldn't talk as loud	1
	too loud	1
	too many talkers	1
Group Loud	annoyance	1
	from boat	1
	need muzzles	1
	not ok	1
Adult, Loud	annoyance	1
	annoying	1
	crowded, annoyed	1
	distracted	1
	disturbing	1
	family, pleasing	1
	not ok	1
	unacceptable	1
	uncomfortable, annoyed by	1

	unnecessary disturbance very intrusive	1
Children, Loud	annoying	1
	control your children	1
	distracted, annoyed slightly	1
	family, pleasing	1
	happy	1
	irritating	1
	not ok	1
	unacceptable	1
	understanding	1
	very intrusive	1
Child, Crying	Frustrated	1
	no attempt to console	1
	not ok	1
	typical kids	1
	Why would you bring an infant?	1
Group Activities	alright	1
	annoying when you close ones eyes to listen to the natural sounds	1
	blocked other sounds of nature	1
	disruptive	1
	distracting	1
	happy	1
	need to be organized	1
	ok	1
	on boat	1
	relaxing	1
	slightly annoying	1
	somewhat distracting	1
	too much group gathering	1
Cell Phone	hate	1
	ick, ok for emergency	1
	Shouldn't belong here	1
	Why in God's name use a cell phone here?	1
Radio/Headset		
Technology, Unknown		
Camera	good, enjoying nature	1
	happy	1
	neutral	1
	normal	1
	ok	1

	part of process	1
	reminder that can't escape civilization	1
Wind	any nature sound is beautiful	1
	awesome	1
	beauty, awe	1
	calm	1
	calming	3
	felt wonderful/sounds wonderful	1
	fine	1
	gentle	1
	liked it	1
	love it	1
	loved the smell	1
	mixed	1
	natural	1
	nice	1
	Nice Breeze	1
	ok	1
	peaceful	2
	peaceful, refreshing	1
	pleasant	2
	pleased	1
	pleasing	2
	refreshing	1
	relax	1
	relaxation	1
	relaxed	2
	relaxes	1
	relaxing	5
	slight breeze relaxing	1
	solace, natural, cool	1
	soothed	1
	soothing	3
	soothing and relaxed	1
	That's what I'm here for.	1
	the noises are part of the movie- picture perfect with sound recording!	1
	tranquil	1
	Tranquil	1
	very happy	1
	very pleasant and relaxing	1
	very pleasing	1

Water	ambience	1
	awe inspiring	1
	awesome	2
	blissful, relaxing, pleasant	1
	calm	2
	calm, happy	1
	calmed	1
	calming	1
	calming and yet exciting	1
	constant	1
	energizing, peaceful, overwhelming	1
	freshness	1
	good	3
	great	1
	great, calm, soothing	1
	happy	1
	happy relaxing	1
	hypnotizing, relaxed	1
	liked it very much	1
	loud, blocks out other sounds	1
	love	1
	love it	2
	loved being in mountains and hearing water sounds	1
	natural	1
	nice	2
	nice relaxing	1
	peaceful	5
	pleasant	1
	pleasing	2
	pretty, calm	1
	really pleasant	1
	relax	1
	relaxation	1
	relaxed	1
	relaxing	9
	Relaxing	2
	relaxing, rushing water	1
	relaxing, soothing	1
	serenity	1
	soothing	7
	soothing, calming	1
	That's what I'm here for.	1
	very calming	1

	very inspiring	1
	very pleasant and relaxing	1
	Very Pronounced	1
	very relaxing	1
	very soothing	1
	waterfalls - awesome	1
	wonderful	1
Thunder	not nice	1
Small Mammal	awesome	1
	cute	1
	enjoyed listening to their language	1
	excellent	1
	funny	1
	happy	1
	hopeful, happy	1
	humorous	1
	intrigued with chipmunk	1
	part of nature	1
	pleased	1
	seen not heard	1
	very quiet	1
Large Mammal	excellent	1
	love it	1
Bird Song	annoying, sounded like a car alarm	1
	awesome	1
	beautiful	2
	calm	1
	calming	3
	disguised/covered by voices of crowd	1
	enjoyable	1
	excellent	1
	fun	1
	fun tuning into different songs	1
	good	2
	happy	3
	happy and enjoyable	1
	happy, calming	1
	hopeful, happy	1
	intriguing	1
	love it	1
	love the sound of wildlife	1
	lovely	2

	natural	1
	nice	3
	peace	2
	peaceful	1
	pleasant	1
	pleasant, joyful	1
	pleasure hearing the different species	1
	really beautiful sound	1
	relax	1
	relaxing	1
	relaxing and tranquil	1
	relaxing, feeling close to nature	1
	soothing	2
	That's what I'm here for.	1
	too little, want more	1
	very nice	1
	very pleasant	1
	very pleasant and relaxing	1
	wonderful	1
Bird Chatter	a natural voice, pleasing	1
	awesome	1
	beautiful	1
	calm	1
	calming	2
	curious	1
	excellent	1
	good	4
	happy	2
	Happy	1
	happy, calming	1
	hopeful, happy	1
	humorous	1
	interesting	1
	intriguing	1
	love it	1
	made me feel happy	1
	natural	1
	ok	1
	peace	2
	peaceful	2
	pleasant	1
	pleasing	1
	relax	1
	relaxing	3

	relaxing and tranquil	1
	soothing	1
	very nice	1
Insects	a natural voice, pleasing	1
	annoyed	2
	annoyed by flies	1
	annoyed with bug flying around	1
	annoyed, afraid of being bitten	1
	annoying	5
	annoying but fine	1
	annoying fly	1
	awesome	1
	bees and flies, annoying	1
	bothersome off and on	1
	buzzing nice	1
	calm	1
	disconcerting	1
	don't like it	1
	fascinating	1
	flied-bad	1
	good	2
	I hope it doesn't sting	1
	interesting	1
	interesting	1
	love it	1
	mosquito	1
	mosquitoes	1
	mosquitoes buzzing	1
	natural	3
	necessary evil	1
	nice	1
	not nice	1
	ok	1
	ok other than the trepidation about getting bitten by the darn flies	1
	ooh!	1
	peace	1
	pleasant	2
	pleasing	1
	relaxing and tranquil	1
	slap it!	1
	soothing	1
	supposed to be part of	1

	nature	
	tense, fear, itchy, fly buzz, mosquito buzz	1
	very pleasant and relaxing	1
Animal, Unknown	birds unknown	1
	great	2
	happy	1
	intrigued	1
Concession		
Other	super	1

*Blank responses for associated feelings did not receive visitor commentary for the specified sound.

Appendix 16. Literature Review

This study report is focused primarily on soundscape issues as they pertain to visitor experiences in parks and protected areas. However, the majority of studies related to sound and noise issues have not focused on recreation or natural areas, but rather have focused on urban environments and traffic noise. Therefore, the following literature review will begin with information pertaining to soundscape research in general, and will conclude with specific literature relevant to soundscape and recreation research literature. The following topic areas will be covered: 1) the value of natural sounds, 2) the effects of noise/sound on humans, 3) the effects of noise/sound on wildlife, 4) policy, 5) aircraft and transportation noise; 6) sound research in recreational settings, 7) recreation research literature.

The Value of Natural Sounds

Today, many people value relaxing in quiet environments with natural sounds. A 1998 study by Colorado State University found that 72 percent of Americans surveyed regarded opportunities to experience natural peace and the sounds of nature as a very important reason for preserving national parks. However, to what extent can this value be assessed? The following papers discuss several ways in which researchers have attempted to place measurable values on soundscapes, noise reduction, or enhancement of natural sounds.

Miller (2003) examined the value that U.S. society placed on managing, restoring, and preserving natural soundscapes. Miller stated that there is currently no national consensus on the value of natural soundscapes. Although the U.S. Congress and other federal agencies support the preservation of natural soundscapes, and although there are noise reduction and abatement policies throughout the U.S., only the following federal areas are subject to soundscape management: national parks, national seashores, wild and scenic rivers, designated wilderness areas, and potential wilderness areas. Some businesses that provide motorized activities believe that preservation of natural soundscapes could prevent their businesses from providing recreational activities to fit visitor needs in recreation areas (Miller, 2003).

Bell, Malm, Loomis, and McGlothin (1985) considered the value of clear views in National Parks. They used an ordered logit utility model to assess impacts due to impairment of visibility on visitor enjoyment in Grand Canyon National Park. Results indicated that visitors were willing to make trade-offs in terms of driving time if this ensured better visibility. Visitors were willing to spend an hour more in driving time or half an hour more in waiting time to ensure a one-unit increase in visibility of the area.

Like viewscapes, some studies have begun to consider what visitors would be willing to trade-off to listen to unimpaired soundscapes. For example, Komanoff and Shaw (2000) reported that beachgoers in the United States did not like noise from jet skis and would be willing to pay to avoid it. The authors used a quantitative model to estimate the monetary value of lost enjoyment due to jet ski noise (Komanoff & Shaw, 2000). Similarly, Bjorner (2004) used socio-acoustic surveys linked with contingent valuation methods to assess respondents' self-reported willingness to pay (WTP) to avoid noise annoyance in urban settings. Willingness to pay to avoid annoyance increased with increasing annoyance levels, household income, and number of children in household. Willingness to pay per decibel (dB) reduction was calculated by combining exposure-annoyance relationships with WTP to avoid noise. Note that the value of noise reduction was affected by the initial dB level of noise (Bjorner, 2004).

Schwer, Gazel, and Daneshvary (2000) examined the economic effects of Grand Canyon air tours on the southern Nevada economy, where the tours originated. Their model estimated the difference between the present business economy and the hypothesized economy without air tours. Findings showed that most visitors using the Nevada air tour operations were foreigners, perhaps trying to make the most of their visit to the area. Results indicated that eliminating air tours would have a substantial effect on the southern Nevada economy, causing great losses in revenue (Schwer, Gazel, & Daneshvary, 2000).

Riddel and Schwer (2001) examined the challenges of placing value on non-market goods such as clean air, water, or in this case, soundscapes. Because market prices do not exist for these goods, outside forces like the government have to step in to allocate these goods based on estimates of their worth. Other issues such as political concern and legal directives may also come into play. Most often, government regulations produce environmental quotas so damages to the resources do not exceed a given level. According to the authors, command and control approaches requiring specific standards were often inefficient for the allocation of non-market goods for two reasons. First, there were no incentives for agencies to further reduce damages once the standards were met. Second, setting standards that require costly improvements may exceed the overall benefits to society. While discussing an example from the Federal Aviations Administration's (FAA) regulations surrounding air tours at Grand Canyon National Park, the authors suggested that the government failed to set sufficient environmental regulations due to command and control approaches. The authors claimed that incentive based strategies could have provided the same level of noise reduction as a quota system (Riddel & Schwer, 2001).

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The Effects of Noise/Sound on Humans

Because noise exposure is increasing in our society, many researchers are concerned with its effect on human health, both physically and mentally. Studies have shown that noise can have negative impacts on cognition, emotion, motivation, sleep patterns, reading concentration, and health in general (Hatfield, Job, Hede, Carter, Peploe, Taylor, & Morrell, 2002). It has also been suggested that perceived control over noise events can be an important factor in noise-related impairments (Hatfield et al., 2002). Studies specific to aircraft noise have shown effects such as raised blood pressure, stress, and induced fatigue. Further, decreased learning has been reported due to aircraft noise near schools (Sheikh & Uhl, 2004). The following paragraphs will highlight findings from several studies that focused on the effects of noise/sound on humans in society.

Noise has been defined as an ambient stressor, or a stressing environmental condition that exists in the daily living environment. As opposed to a daily hassle, which is a single stressful event, ambient stressors such as noise are chronic, negatively valued, non-urgent, and physically perceptible. However, whether or not environmental phenomena such as noise are defined as environmental stressors depends on the cognitive evaluation of them. Individual psychological factors such as attitudes, noise sensitivity, and cost-benefit analysis have been shown to account for more variation in reaction to noise than noise exposure itself. Studies have also shown that physiological and health effects are strongly related to subjective reactions to noise. In fact, there is growing agreement that adverse effects of noise (e.g., annoyance) are determined by mediating processes (Wallenius, 2004). To investigate the interactive effect of noise stress on subjective health, Wallenius used the adaptive cost model of stress. This model asserted that the negative consequence of one stressor is the diminished ability to cope with another stressor. Wallenius hypothesized that environmental noise would have the strongest relationship to subjective health when project stress was high. Results revealed that noise annoyance was related most strongly to poorer subjective health when personal project stress was perceived as being very high (Wallenius, 2004).

Substantial evidence has suggested that environmental stressors (e.g., crowding, community noise, and air pollution) can cause stress in large groups of people. Stress was defined as “the process by which an individual responds psychologically, physically, and often with behaviors, to a situation that challenges or threatens well being” (Ulrich et al., 1991, p. 202). Restorative effects of natural environments were considered after stressful situations had occurred. Restoration from stress included positive responses such as changes in psychological states, levels of activity in physiological systems, behaviors, cognition and performance. Positive changes associated with the psychological component of restoration included reduced negative feelings (e.g., fear or anger) and increased positive feelings. These findings supported the premise that restoration occurred more quickly when subjects were exposed to natural settings rather than urban environments (Ulrich, Simons, Losito, Fiorito, Miles, & Zelson, 1991).

While Ulrich et al. focused on restoration from stress, Job and Hatfield (2001) discussed community reactions to noise. Reactions such as dissatisfactions, annoyance, anger, frustration, disappointment, and distress are all considered impacts of noise exposure. These reactions are taken seriously because they can reduce quality of life and contribute to negative health effects. If a particular portion of the population is “highly annoyed” or “seriously affected” the noise exposure may be considered unacceptable. As a result of this, noise regulations are often based on predicted reactions to noise. Findings such as these often originate from dose-response studies that relate noise exposure to reaction. Dose-response methods refer to the process of estimating the amount (the dose) of noise an individual was exposed to, and then documenting the individual’s reaction to that dose of noise (Fidell et al., 1996). Job and Hatfield (2001) suggested that regulation of noise should be based on more than simple noise exposure reactions. They suggested that certain features of noise might have a greater impact on reaction to noise than noise exposure alone. These features included number of events, impulsivity, and frequency. Furthermore, Job and Hatfield concluded that pure tone noises and noises from various other sources can cause different reactions. For example, railway noises at the same noise level as aircraft noises may cause a less negative reaction. External factors other than the noise may also influence reactions. Job and Hatfield placed these factors into three categories: soundscape, enviroscape, and psychscape. They defined soundscape as the total acoustical environment in which a noise occurs. Enviroscape was defined as the non-acoustical features of the physical environment. For example, air pollution would be part of the enviroscape. Finally, psychscape was defined as features of an individual’s hearing that influences his or her reaction to sound. For example, a person with a negative attitude towards a particular noise source may have a more negative reaction when hearing that particular noise. These negative reactions to sound are often interpreted as annoyance (Job & Hatfield, 2001).

Annoyance has been one of the most studied reactions to noise events (Vastfjall, 2002). In fact, the Federal Interagency Committee on Noise used noise-induced annoyance as an indication of community response while assessing for future noise exposure possibilities. However, Fidell and Pearsons (2003) believe that measures such as annoyance are not reliable because they fail to assess the origin of the annoyance. In their study, they determined that annoyance prevalence rates were not proportionate to differences in noise exposure levels. Some studies even suggest that mood and noise sensitivity can have an effect on judgments of annoyance (Vastfjall, 2002).

Ouis (2001) reviewed the effects of road traffic noise in terms of respondent annoyance. Like Hatfield, Ouis pointed out that noise was a real danger to people's health in terms of physical and psychological stress. Some of the most obvious effects of noise on awake subjects were annoyance, interference with speech communication, concentration, and performance of tasks. Because the noise-annoyance relationship has many dimensions besides the physically measurable acoustical variables, understanding the effects of traffic noise should consider socio-cultural position, attitudes, noise sensitivity, and other subjective judgments (Ouis, 2001).

Pederson and Waye (2004) also used dose-response relationships to examine the effects of noise on local communities in Sweden. The purpose of the study was to examine the relationship of wind turbine noise and annoyance, to consider sound characteristics, and to better understand subjective variables such as attitude and noise sensitivity. Results indicated a significant relationship between turbine noise and annoyance. That being said, the authors acknowledged that attitudinal, visual factors, and sound characteristics may have impacted their results (Pedersen & Waye, 2004).

Because of complexities involved in understanding the effects of sound character versus other subjective variables, many authors have focused primarily on methodological issues associated with characterizing or monitoring soundscapes. For example, Zimmer and Ellemeier (2003) elaborated on methodology that revealed the dimensional structure behind psychoacoustic judgments. As opposed to using verbal ratings or methods of magnitude estimation, the authors used indirect scaling as a preferred method for sound-quality evaluations. The authors chose indirect scaling methods because they require simple preference judgments from listeners, and leave scaling of attributes to modeling and statistical analysis. While using preference judgments, the listener was directed to choose one stimulus as being preferred over another. For example, the listener was asked to judge which sound was more annoying, high-pitched, or natural. The listener then chose the two sounds that were most annoying from several sets of paired sounds. The cognitive structure for those judgments was then inferred by fitting a mathematical choice model to the paired comparison data for the group. This indirect methodology, using stated choice modeling, was advantageous because it formulated qualitative conditions where measurement was possible, and provided a scale-type outcome (Zimmer & Ellermeier, 2003).

Newman, Marion, and Cahill (2001) emphasized the importance of using models that assessed tradeoffs and considered resource, social, and managerial indicators of quality in parks. They suggested the use of choice models (e.g., conjoint analysis or stated choice analysis) to measure visitor preferences for different levels of access to protected areas, resource impacts, crowding, conflict, site development, and visitor regulation (Newman, Marion, & Cahill, 2001). Integrative models, such as these, may also be useful tools for informing managers of tradeoffs that visitors would be willing to make in order to obtain naturally quiet conditions. For example, Wardman and Bristow (2004) used choice models to estimate the value of changes in traffic related noise levels.

Zimmer, Ellermeier, and Schmid (2004) also used choice models to examine auditory unpleasantness, suggesting that conventional direct scaling methods using verbal or numerical categories, or visual analogue scales were not adequate when answering questions pertaining to the following: consistent measures of overall quality, uni-dimensional measures, single decision criterion, and overall quality relating to sound character (Zimmer, Ellermeier, & Schmid, 2004). They emphasized the importance of distinguishing between *specific qualities* possessed by sounds compared to the *overall sound quality*. *Specific qualities* may be described with psychoacoustic attributes such as loudness, roughness, or tonalness. In contrast, *overall sound quality* can be interpreted as auditory unpleasantness, product-sound quality, or reproduced sound quality. Because of confusion in terminology, some have suggested using *sound character* to define specific qualities of sound, and reserving the term *sound quality* for describing its overall appreciation (Zimmer et al., 2004).

The Effects of Noise/Sound on Wildlife

Up to this point, the literature review has addressed noise issues pertaining to general society and human health. Because the context for the thesis is parks or protected areas where there is often abundant wildlife, it is also important to note the effects of sound/noise on wildlife. Research examining the many effects of noise on wildlife has been growing since the 1970's. Today, most researchers agree that entire ecosystems can be disturbed by intrusive noise, which causes changes in animal behavior and/or physiology, energy budget, reproductive success, and long term survival. Chronic stress, changes in metabolism and hormone levels, and increased heart rate have all been reported as effects of unnatural noise on wildlife (Radle, 2003; Sheikh & Uhl, 2004).

Krause and Gage (2003) conducted a soundscape study at Sequoia National Park and examined sound signatures. These signatures are comprised of two natural components, biophony and geophony, and one human component, anthrophony. Biophony is comprised of the combined sound of living organisms in a particular habitat, such as the sound of elk bugling during mating season. Geophony is comprised of geophysical sounds in the environments, such as wind in the grass, thunder, earth movement, or water flowing. Anthrophony is comprised of human-generated mechanical sounds, such as automobiles or generators (Krause & Gage, 2003).

Krause (1999) also focused on understanding the effects of human-caused noise on animal stress behavior and habitat damage. One example from Krause's research deals with the symbiotic chorus of Western Spadefoot toads (*Scaphiopus hammondi*) at Mono Lake Basin. As a protective mechanism, Western Spadefoot toads synchronize vocalizations so that predators cannot detect the origin of just a single toad. When a low-flying military jet flew over Mono Lake Basin, a spectrogram (visual demonstration of sound chorus) showed a drop off in toad vocalizations as well as breaks in synchronicity. Krause observed that owls and coyotes took advantage of this break in chorus as they moved in and preyed on the few remaining vocalizing toads. After the overflights, it took forty-five minutes for the toads to resume synchronicity (Krause, 1999). Other examples of human-made noise affecting animals include increased calving mortality rates in woodland caribou *(Rangifer tarandus*) due to aircraft noise and birds abandoning nests as a result of aircraft sounds (Radle, 2003; Sheikh & Uhl, 2004). These are only a few examples of noise induced stress on wildlife. Because this study report is focused on the visitor experiences in national parks, the review will not elaborate any further on wildlife issues.

Policy

The previous section focused on the importance of natural soundscapes to maintain ecosystem and wildlife health in parks and protected areas. The following section will focus on policy that has protected diverse soundscapes, particularly in national parks. In 1972, the Noise Control Act required that the federal government establish and enforce noise control standards in aircraft, the workplace, rural areas, and national parks. Subsequent legislation to limit air tours and enforce specified flight altitudes was enacted in parks such as Grand Canyon and Hawaii Volcanoes. Legislation from the 108th Congress also limited snowmobile use at Yellowstone National Park and snowplane use at Grand Teton National Park. Because of acoustical monitoring efforts, changes in snowmobile regulation and technology have occurred and acoustical standards have been outlined in their Winter Use Plan (WUP). Reduced audibility levels have occurred as a result of diminished use of snowmobiles and the change from two to four stroke engine technology (Burson, 2004; 2005; Menge & Ross, 2000). Additional legislation has assisted with the development of technologies that create lower levels of aircraft noise, emissions, and fuel consumption in several parks (Sheikh & Uhl, 2004).

In 1987, the National Parks Overflights Act became Public Law 100-91, and required assessment of noise impacts of aircraft overflights in National Parks. In response, Grand Canyon National Park established an air tour management plan to ensure safety of flights and to restore natural quiet. As defined by the NPS , substantial restoration of Grand Canyon National Park meant 50% of the park's air space must be free of aircraft noise for 75% to100% of the day, that minimum flight altitudes would be set, and that special routes would be provided for air tour operators (Schwer et al., 2000).

In 1995, a Report to Congress provided the U.S. Department of Interior with a response to Public Law 100-91, the National Parks Overflights Act of 1987. This report concluded that aircraft overflights could cause impacts to park resources and values. In certain situations, there was also potential for overflights to impact natural and cultural resources, visitor experiences, solitude, and tranquility. The report suggested that the real issue concerned the amount of impact that would occur before the FAA took action (NPS, 1995). This report specifically addressed the effects of aircraft overflights on the following: 1) natural quiet, 2) cultural resources, 3) wildlife, 4) park visitors, and 5) safety (NPS, 1995). Furthermore, the National Parks Overflights Act of 1997 continued regulation of flights over national parks and addressed issues such as the preservation of natural quiet, flight free zones and restrictions, flight altitudes, quiet aircraft technology, and prioritization of research implementation ("National parks overflights act of 1997", 1997). And in 2000, Public Law 106-181, the National Parks Air Tour Management Act of 2000 was enacted. This law prohibited commercial air tour operators from conducting commercial air tour operations over a national park or tribal lands ("National parks air tour management act of 2000 (p.L. 106-181)", 2000).

In support of the National Parks Overflights Act, the FAA and the Acoustics Facility at the United States Department of Transportations John A. Volpe National Transportation Systems Center worked to develop an ambient noise measurement protocol for low-level environments such as national parks. Ambient noise has been defined as “The composite, all-inclusive sound that is associated with a given environment (usually from many sound sources), excluding the analysis system’s electrical noise and the sound of interest” (Fleming, Roof, & Reed, 1998). In many cases the sound of interest has been aircraft noise (Fleming et al., 1998).

In addition, Director’s Order # 47 provided policy for management, preservation, and restoration of park soundscapes. The purpose of Director’s Order # 47 was “ to articulate National Park Service operational policies that will require, to the fullest extent practicable, the protection, maintenance, or restoration of the natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources" (NPS, 2000). Director's Order # 47 addressed the following topics: 1) applicable policies, 2) reference manuals for parks, 3) soundscape preservation and noise management planning, 4) interim noise management measures, 5) inventorying and monitoring soundscapes, 6) establishing soundscape preservation objectives, 7) defining impacts on park soundscapes, 8) constructive engagement, 9) air tour management planning, 10) interpreting the soundscape to visitors, 11) national program steering committee (NPS, 2000).

Aircraft and Transportation Noise

Just as policy and law have most often focused on aircraft regulation, most of the literature concerning noise in outdoor recreation settings has focused on aircraft overflight issues (Krog & Engdahl, 2005). The following section will explicitly focus on the effects of aircraft and transportation noise in society and in parks and protected areas.

Sheikh and Uhl (2004) stated that noise is a form of pollution that is often overlooked in our society and have defined noise as unwanted or undesired sound. Although our society may accept noise as a tradeoff for modern conveniences, many people look to parks and natural areas as places to seek solitude and natural quiet. Before legislation or restriction on aircraft use can be implemented in parks, soundscapes must first be monitored and aircraft noise must be quantified. Shiekh and Uhl (2004) recorded aircraft overflights and noise duration in state parks in central Pennsylvania, USA. Results indicated that aircraft noise was heard 18% to 70% of the time. The authors emphasized that noise was a greater disturbance in parks than in urban areas because parks start with lower ambient levels, and because people expect noise in urban areas (Sheikh & Uhl, 2004).

Voorhees and Krey (1999) conducted a survey of NPS superintendents to understand how park soundscapes have degraded over time. The authors pointed out that recreational noise has negatively impacted visitor experiences in protected areas worldwide. While U.S. park landscapes have been protected so that they resemble the park landscapes of centuries ago, soundscapes have not garnered this much attention. Due to invasive mechanical and recreational noise, soundscapes are degrading more quickly with few parks having the same level of natural sounds as they did a decade ago. Aircraft noise is a particularly complicated issue because it is hard to obstruct or localize the effects of noise. To combat this issue, the National Parks and Conservation Association (NPCA) conducted a survey to evaluate the seriousness of overflight issues in national parks. Despite the fact that this study was not scientific in nature, it reached superintendents at over 150 national parks. Results indicated that 88% of National Park units surveyed (n=249 units) sustained overflights of some kind. Park managers, who claimed they sustained overflights of some kind, were concerned that airport expansions near parks could increase severity of noise. Those managers have received either formal or informal complaints about overflight activity in the park units. Comparison between a 1996 survey and the 1998 survey showed trends of upward visitor use, higher intensity of use, and more noise from overflights in the entire park system (Voorhees & Krey, 1999).

Dose-Response and Annoyance Measures

As mentioned previously, dose-response studies have been used in a variety of soundscape studies. Fidell et al. (1996) used on-site and telephone surveys to assess annoyance due to aircraft in twelve wilderness areas. This study was undertaken as an initial effort to provide a link between aircraft noise and visitor reactions specifically for outdoor recreation settings. Prior literature had focused on either laboratory or residential settings. Dosage-response methods were utilized and refer to the process of estimating the amount (the dose) of noise an individual was exposed to, and then documenting the individual's reaction to that dose of noise (Fidell, Silvati, Howe, Pearsons, Tabachnick, Knopf, Gramann, & Buchanan, 1996). Despite the fact that technology did not allow for accurate or cost effective estimates of those relationships at that time, it was possible to create rough relationships between noise and annoyance for the on-site portion of this study. Findings from this two-part study generally concluded that most respondents did not report annoyance as a result of aircraft overflights. However, the greatest impact on visitors' experiences from aircraft overflights was related to noise, rather than their visibility or condensation trails. Imprecise physical measures of noise exposure were more reliable at predicting visitor reactions than were self-reports of sighted aircraft. Military aircraft or aircraft producing high noise levels were typically more annoying than smaller aircraft or high altitude jets. Only 1% of visitors mentioned aircraft as the aspect that was liked least about the trip. Finally, there was little evidence that aircraft noise diminished overall satisfaction or intent to return. The authors suggested that producing more reliable dose-response methods was a research priority. Noise-induced annoyance was cited as a robust measure capable of producing predictable reactions of visitors in wilderness and recreation areas (Fidell et al., 1996).

In response, Staples (1998) criticized the incongruities in Fidell et al.'s research. First, Staples commented that dose-response methods failed to address questions caused by disparities in individuals' appraisal of environmental noise. Even though Fidell et al.

made valuable modifications to the traditional dose-response methods used in residential settings, Staples stated that research needs to look further than modeling annoyance as a function of physical noise levels. Second, Staples commented that there were issues with using annoyance as a measure of human response to noise because management decisions need to be made based on how visitors conceptualize a natural environment. In other words, just because visitors said they were not annoyed does not mean there was no deterioration to the environment. Staples believed that if annoyance was used as a measure, then researchers must be careful to observe demographics during certain situations when visitors were dissatisfied with the loss of natural quiet. Stated simply, these studies should be context specific. Staples clarified that the use of setting was an important determinant in whether or not aircraft noise will be annoying to visitors, and suggested the use of dose-response curves that correspond to the intended recreational use of visitors. Finally, Staples found the measure "enjoyment of visit" to be problematic since findings from recreation literature defined visitor satisfaction as a measure which lacked variability and specificity. Therefore, Staples suggested using additional response measures such as interference with natural quiet, or using different response curves based on specific recreation settings as an improvement to the conventional dose-response relationship (Staples, 1998).

Consequently, Fidell, Gramann, Kropf, and Pearson (1998) replied to Staples' comments by retorting that the authors' comments deal with personal beliefs about proper interpretation of aircraft noise. It should be noted that Fidell et al. (1998) acknowledged that Staples brought up interesting issues related to technical expertise and noise-related policy analysis.

More than a decade ago, the U.S. Federal Interagency Committee on Noise (FICON) identified annoyance as its preferred summary measure of adverse reaction of people to noise (Fidell & Silvati, 2004). However, FICON's dose-response relationship between noise, (defined as Day-Night Average Sound Levels (DNL)), and community reaction may not be a reliable predictive measure. Therefore, the authors concluded that it was difficult to rely on FICON's measure as a basis for aircraft noise-related policy decisions (Fidell & Silvati, 2004).

In his study, Miller (1999) declared that aircraft overflights have become a source of sound intrusion at national parks, and summarized two studies pertaining to these impacts. Dose-response studies were conducted at Grand Canyon, Hawaii Volcanoes, and Haleakala National Parks, and a cognitive survey was conducted in White Sands National Monument. The author emphasized that the effects of aircraft overflights were judged by visitors themselves, even though public comments were only one dimension of concern for park management. Because visitors may not be aware of park policies or management objectives, visitor reactions should not be the only determinant in deciding if aircraft overflights are acceptable for certain parks. The author explained that dose-response and cognitive studies have different objectives. Dose-response studies relate visitor judgments of aircraft overflights to quantitative measures of the sounds the visitor may have heard. On the other hand, the cognitive survey was not statistical or quantitative, but rather clarified the thought processes visitors used for evaluating the effects of aircraft. Logistic regression was used to predict visitor response for specified doses of sound. Results from the dose-response study revealed interesting findings in terms of site sensitivity, visitor perception of annoyance versus interference, and relation of sites to one another. The author suggested that dose-response measures are useful for mangers because they provide guidance for setting limits to minimize visitor judgments of interference to natural quiet. The cognitive survey revealed that visitors shared a general definition of the terms natural quiet, interference, and annoyance. Natural quiet was generally understood to mean absence of human made sounds. Interference was considered to be more objective in nature than the term annoyance. Whereas interference was something that prevented visitors from achieving what they set out to do, annoyance was perceived as having an emotional and evaluative component. Beyond this, interference was more of a short term effect, but annoyance can be longer lasting (Miller, 1999).

Numerous researchers have been interested in studying dose-response relationships and predicted annoyance (Krog & Engdahl, 1999). In 1998, Norway's main airport at Fornebu moved to a new location at Gardermoen, providing an ample opportunity to survey visitors at nearby recreation areas about impacts from aircraft noise. Prior to the transition, telephone surveys and a field study were conducted. The main purpose of the study was to gain a better understanding of aircraft noise impacts on visitors' well-being. The study established a dose-response relationship and looked at parameters to predict annoyance. The study was a first step at analyzing impacts before the move of the airports (Krog & Engdahl, 1999).

A follow up study by Krog and Engdahl (2004) pointed out that not many socioacoustic studies have examined the effect of noise on outdoor recreationists, and the studies that have looked at noise in outdoor settings focused on visitors in mountain or wilderness areas. To broaden the research base, the authors examined the effect of aircraft noise on local recreation areas experiencing decreased or increased noise exposure as a result of the move in the main airport at Fornebu, Norway. Results showed a strong effect at both locations. The size of the effect was influenced by the exposure variable at one of these areas. Results indicated that it was not sufficient to simply calculate the relationship between noise exposure and a reaction measure without taking context variables into careful consideration. The authors pointed to the importance of choosing dose parameters that correspond best with annoyance and other characteristics of change for future studies. The authors suggested that future studies should investigate the importance of initial noise levels, and the size and direction of change in those levels (Krog & Engdahl, 2004).

A follow up paper by Krog and Engdahl (2005) showed that many socioacoustic studies have focused on noise-exposed populations in residential settings. Also related to the relocation of the main airport in Norway, this study related aircraft annoyance in outdoor recreation areas to respondents' perceptions of noise at home. Authors assumed that reaction to noise, in other situations, may influence how visitors respond to noise in recreation areas. Of equal importance, the authors considered aircraft exposure at home, situational variables related to before/after the move of the airport, context, and demographic variables. The study combined survey data with acoustical measurements from two recreation areas. Results indicated that people annoyed by aircraft at home were more annoyed with aircraft in recreation areas than other recreationists. Future studies examining individuals' noise context at home as compared with recreation areas are warranted (Krog & Engdahl, 2005).

As all the aforementioned studies indicated, knowledge of the human perception of noise is limited. The relationship between noise indicators and subjective response to aircraft noise adds another dimension to existing research (Aasvang & Engdahl, 1999). The study occurred near Fornebu airport in Norway, and combined both field and laboratory techniques. Aasvang and Engdahl (1999) stated that people expect lower noise levels in outdoor recreational settings than in urban environments. Thus, expectations influence noise-induced annoyance. Like others, they believe that further research is needed to examine the relationship between noise and annoyance in recreation areas (Aasvang & Engdahl, 1999). Results from yet another study indicated a high correlation between annoyance and acceptability responses for single noise events in a recreational setting. Subjects responded similarly for the field and laboratory portions of the study. Findings showed that subjective response to noise was significantly related to personal attitudes, but not to noise sensitivity. There was also a significant relationship between immediate acceptability and total annoyance, suggesting that the number of noise events above a certain noise level may be a determinant of annoyance responses for recreational settings (Aasvang & Engdahl, 2004).

Research conducted by the New Zealand Department of Conservation produced methods for monitoring the effects of aircraft activity on recreationists in natural settings (Booth, 1999). Qualitative interviews were conducted at two field sites at Fiordland National Park, New Zealand. Results indicated that the primary effects from aircraft in the park were related to noise. Because many factors can influence visitors' reactions to overflights, the author suggested that further research is needed to explain the relationship between site attributes and visitor characteristics, and impacts from overflights (Booth, 1999). Similarly, Hunt's (1999) study considered methods to manage conflict between recreation users and the air-tourism industry at Fiordland National Park, New Zealand. In this study, noise was defined as *unwanted sound*. The study investigated controlling total noise and modeling aircraft noise impacts over the walking tracks in the park. Noise levels were projected for walking terrain in the park, resulting in noise management initiatives based on separation of aircraft flight tracks and popular tourist areas.

Sutton (2001) conducted research at Fox Glacier and Franz Joseph Glacier at Westland National Park, two popular tourist destinations on the west coast of New Zealand's South Island. This study investigated social impacts of aircraft overflight in terms of annoyance. Because managers only had anecdotal information about the effects of aircraft overflights on visitors to the park, soundscape research was needed. Respondents reacted more negatively as aircraft presence increased. The authors suggested that results of the study allow standards to be set when the level of annoyance has reached an unacceptable level. Negative reactions increased rapidly after 25% annoyance was reached and over 18 aircrafts per hour were encountered (Sutton, 2001).

A study by Tarrant, Haas, and Manfredo (1995) used mail-back surveys to assess visitor reactions to overflights at Wyoming wilderness areas. They specifically considered the effect of visitor characteristics and aircraft dose on visitors' evaluations. Characteristics of visitors included recreation motives, past experience, attitudes, and tolerance for encountering overflights. Aircraft dose represented the number, type, proximity, and noise levels of overflights. Less than a third of visitors were not annoyed at all by overflights. Measures of tranquility and solitude were more strongly affected by overflights than measures of annoyance. Both visitor characteristics and dose measures were strongly related to evaluations of overflights (Tarrant, Haas, & Manfredo, 1995). Therefore, future studies should use a multidimensional measurement approach which includes terms such as tranquility, solitude, and annoyance.

Sound Research in Recreational Settings

Up to this point, the literature review has addressed soundscape issues in a variety of contexts and settings. This section will focus on soundscape issues in outdoor recreation settings, specifically national parks. Research has suggested that everyday stressors such as work pressure and urban noise often cause people to seek relief with outdoor recreation activities (Hartig, Evans, Jamner, Davis, & Garling, 2003). Therefore, excessive or out of place noise in national parks can become a source of conflict for recreation users and a problem for park managers (Beal, 1994). For example, Stokes, Leese, and Montgomery (1999) identified the inappropriate nature of aircraft sounds at national parks in Hawaii, many of which have large portions of designated wilderness. Vitterso, Chipeniuk, Skar, and Vistad (2004) examined the subjective response of cross country skiers exposed to snowmobile noise versus those not exposed. Emotional quality of the experience was reduced for those exposed to the noise. Sutherland (1999) mentioned dirt bikes, snowmobiles, jet skis, and motor boats as sources of environmental noise degradation in or near parks.

In 1980, the U.S. Forest Service/ U.S. Department of Agriculture completed a report that predicted the impacts of noise on recreationists (Harrison, Clark, & Stankey, 1980). They emphasized the point that noise is merely an interpretation of sound for a particular context or setting. One person’s definition of noise may be entirely different than another person’s definition of noise. Thus, there are times when visitor expectations themselves can be inappropriate or unrealistic. Therefore, standards based on visitor perception of noise need to established only in terms of specified situations (Harrison, Clark, & Stankey, 1980). The report suggests the use of the SPreAD (System for Prediction of Acoustic Detectability) method for predicting acoustic impact. SPreAD is a method for calculating 1) sound energy losses that occur as sound travels through the air, and 2) the estimated acoustic impact of the sound source at a distant listener location. Finally, the authors suggest that the Outdoor Recreation Opportunity Spectrum could be helpful for making judgments about acceptable noise impacts.

Fidell, Sneddon, Pearson, and Howe (2002) investigated the sufficiency of frequency-weighted noise metrics as predictors of annoyance. They used pairs of sounds that are indistinguishable to a sound level meter, yet were easily distinguished by the human ear. These findings emphasize the limitations of using common noise metrics as predictors of annoyance. Therefore, the study suggested that predictions of annoyance based on acoustic information alone have many limitations (Fidell, Sneddon, Pearsons, & Howe, 2002).

Ellemeier, Mader, and Daniel (2004) used the BTL (Bradley-Terry-Luce) model to examine problems in auditory perception and to derive subjective representations from preference or similarity ratings. Rather than expecting these representations to come directly from subjects' judgments, this model prevents false scaling, obtains paired comparisons, and leads to a ratio-scale of objects studied (Ellermeier, Mader, & Daniel, 2004). The authors pointed out that researchers often try to compute attributes such as loudness, annoyance, or tonal character while making assumptions about the ratio-scale measure they use. In their study, they chose unpleasantness as the attribute to be judged. Findings showed that roughness and sharpness accounted for more than 94% of variance in perceived unpleasantness (Ellermeier et al., 2004).

Miedema and Vos (1999) investigated the effects of demographic and attitudinal factors that modified annoyance from transportation noise. Findings showed that demographic variables are less important than attitudinal variables when examining annoyance response to noise. Fear and sensitivity of noise had the largest impact on annoyance response (Miedema & Vos, 1999). Miedema and Vos (2003) concur with past research efforts stating that there is a strong association between noise sensitivity and annoyance, but a weak to no relationship between noise sensitivity and noise exposure. This suggests that noise sensitivity and noise exposure are separate factors altogether, both of which can affect noise annoyance (Miedema & Vos, 2003).

Like U.S. National Parks, New Zealand National Parks have recognized soundscapes as a resource to be protected and managed. Similar to the U.S. NPS, the New Zealand Department of Conservation (DOC) views natural quiet as a tangible social and environmental value (Cessford, 1999). The following management strategies have been suggested for use by park managers when jurisdictional limits apply and management action is required: 1) managed separation, 2) reduced noise effect, 3) improved visitor expectations (Cessford, 1999). Managed separation meant reduced contact between noise generation and reception including using actions such as zoning, use seasons, and time of day regulations. Reduced noise effect included changing emission and reception characteristics of the noise. Finally, it was suggested that managers inform visitors of what sound situations should be expected in specific areas of the park, thus allowing them to make proactive decisions about the type of sounds they will encounter (Cessford, 1999).

Another study in New Zealand considered effects of commercial jet boats on the experiences of recreationists in natural settings at the Dart River (Graham, 1999). Results suggested that noise was the first sign of jet boat presence and that a significant increase in jet boat use would not be tolerated by visitors. Increase of jet boat use on the river would lead to an expected loss of enjoyment for visitors (Graham, 1999).

In an effort to study sound in recreation settings, Beal (1994) examined campers' attitudes towards noise and regulation at three Queensland National Parks, Australia. Findings showed that visitors liked natural noises, tolerated quiet people sounds, but found loud technological sounds to be annoying (Beal, 1994).

Recreation Research Literature

Recreation experiences have long been thought of as having social, ecological and managerial dimensions. Guiding legislation from the NPS demands that both resources and the experiences they provide be protected in perpetuity. These mandates have been described as paradoxical. They challenge the NPS to balance use and preservation. Managing for these mandates can be achieved through the formulation of management objectives and associated indicators and standards of quality. Management objectives have been defined as broad narrative statements representing the recreation experience to be provided and the future desired condition of the resource. Indicators of quality are measurable, manageable variables reflecting the essence of management objectives. Standards of quality represent the minimum acceptable condition of indicator variables (Manning, 1999).

Any amount of use has impact. These impacts can range from ecological impacts (e.g., campsite impacts, trail impacts, wildlife disturbance) to social impacts (e.g., sound/noise related to a high density of people, crowding and conflicting uses). Developing a study that acknowledges and measures potential impacts to the natural soundscape provides Grand Teton National Park managers with information that can be used to protect highly-valued experiences such as natural quiet. It can also inform elements of carrying capacity-related frameworks such as Visitor Experience Resource Protection (VERP) or Limits of Acceptable Change (LAC).

Over the last three decades, research evaluating visitor preferences for outdoor recreation amenities has provided land managers with empirical data from which carrying capacity-related decisions have been made. Carrying capacity has been described as having two components: a descriptive component and an evaluative component (Shelby et al 1996; Manning, Valliere, Wang, Lawson & Newman, 2003). Objective and factual data are the focus of the descriptive component, whereas personal evaluations of what is acceptable comprise the subjective component (Manning & Lawson, 2002). In terms of soundscape monitoring, decibel levels could be considered objective data, and therefore would comprise the descriptive component. However, the question of how much noise is too much noise for visitors is the evaluative component. The latter component can be measured with subjective terms such as acceptability of noise, preference of sound levels, and may comprise what is referred to in the literature as annoyance (Mace, Bell, & Loomis, 1999). Shelby, Vaske, & Donnelly (1996) suggested that the evaluative component is the more challenging element for making management decisions. Normative models such as Jackson's return potential curves are suggested to help inform and describe management decisions regarding visitor preferences (Shelby et al., 1996).

In 1965, social psychologist Jay Jackson developed the return potential model, also called an impact acceptability curve, or norm curve. In this model, individual norms were averaged and graphically illustrated to explain social norms (Manning, Lime, Freimund, & Pitt, 1996; McDonald, 1996; Heywood, 1996; Shelby, et al., 1996). In other words, social norms were inferred from what is known about personal norms (Figure 16.1). Norms have been defined by Manning, Lawson, Newman, Laven, and Valliere

(2002) as standards used by individuals and groups for evaluating behavior and social and environmental conditions.

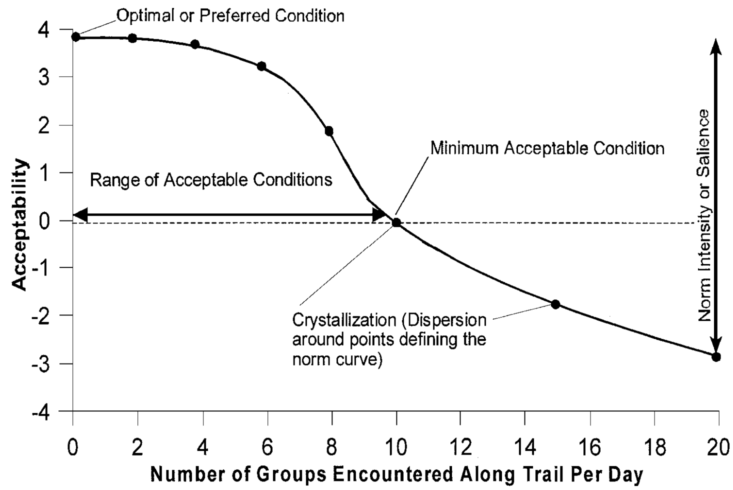

Figure 16.1 Hypothetical Norm Curve (Manning et al., 1999)

The norm curve in Figure 16.1 describes the acceptability of encounters on a trail, with the number of encounters on the horizontal axis and acceptability on the vertical axis. Encounters increased from left to right, and acceptability had a neutral point in the middle, with positive assessments (1 through 4) at the top and negative assessments (-1 through -4) on the bottom. The highest point on the curve was the most acceptable number of encounters, whereas the lowest point on the curve is the least acceptable number of encounters. Norm intensity was illustrated by the distance of the curve above or below the neutral line (Shelby et al., 1996). Intensity has been described by how strongly a norm is held. In comparison, crystallization refers to the amount of agreement about the norm (Inglis, Johnson, & Ponte, 1999).

Shelby et al. (1996) described a variety of ways in which normative information can be used in a management setting. First, norms can help establish desired management goals. Second, norms can help define the characteristics for preferred recreation settings. Third, standards can be defined by gaining information about acceptable levels of impact.

Fourth, minimal and optimal conditions can be characterized through the use of norm curves. Fifth, defining how strongly people hold norms can be explained with norm intensity. As a final point, normative information signifies how much consensus for norms was held among different user groups (Shelby et al., 1996). Actual management objectives can be achieved using the NPS VERP planning process.

Normative Theory Applied to Crowding Research

The normative theory has been used in an array of outdoor recreation situations, but most focus has been placed on crowding and encounter issues (McDonald, 1996). Vaske and Donnelly have clarified the difference between encounters and crowding (2002). Recreation encounters referred to the number of other visitors an individual remembers seeing. In comparison, crowding referred to the negative evaluation of those encounters. As discussed previously, because it can be objectively measured, the descriptive component refers to the density of the encounters. By contrast, because perceived crowding is a subjective concept, it is the evaluative component (Vaske & Donnelly, 2002).

Effects of Noise on the Visitor Experience

Although many studies have used a visual approach to assess crowding, few studies have explored how noise actually affects the visitor experience. Mace, Bell, and Loomis (1999) questioned whether typical helicopter noise found at national parks would influence perceived aesthetic quality of those landscapes. They also examined effects of helicopter noise on feelings of tranquility and solitude. The independent variable was effect of aircraft noise, while the dependent variables included several evaluative components that were subjective in nature. The evaluative components were as follows: annoyance, scenic beauty, naturalness, preference, solitude, tranquility, freedom, and affect. When sounds were considered inappropriate for a specific area, the noise would become annoying and likely detract from other experiences such as enjoyment of nature (Mace et al., 1999). Noise was defined as unwanted sound, and affect was defined as emotion. The authors hypothesized that even low levels of helicopter noise would affect the dependent variables. Results supported this hypothesized relationship, with the strongest effect on annoyance, solitude, and tranquility (Mace et al., 1999). Mace, Bell, Loomis, and Haas (2003) examined respondent reactions to helicopter noise for different scenes of national parks. Because attribution theory suggests that the source of a noise may moderate its effects, respondents were given three scenarios explaining the purpose of the helicopters' presence. These explanations included tourists' overflights, backcountry maintenance, and rescue missions for a backcountry hiker. Findings showed that 60 dB(A) of helicopter noise caused lower ratings for the following attributes: scenic beauty, solitude, tranquility, freedom, naturalness, and preference regardless of the purpose of the noise. Higher ratings of annoyance were reported in all cases (Mace, Bell, Loomis, & Haas, 2003). It should be noted that dB(A) represents decibels that have been A-filtered. This allows lower frequency sounds to have a lighter weight than high frequency sounds. In other words, it is translated into meaningful quantities according to the sensitivity of the human ear (Ouis, 2001).

As mentioned previously, many researchers have suggested that simply investigating sound levels alone may not get at the true nature of annoyance with those sounds. Kariel (1990) suggested that understanding the physical characteristics and their socio-psychological characteristics, along with sound levels may be a better way to predict whether sounds will be deemed as annoying, pleasing, or acceptable. For example, high-pitched sounds were usually deemed more annoying than low-pitched sounds, and rhythmic sounds such as an engine were generally considered more annoying than continuous sounds. However, because many sensory experiences occur along with sound, it is important to consider the larger context of the setting. Because many people tend to visit natural areas to get away, enjoy nature, and relax, sounds that interfere with these goals may also be deemed as annoying (Kariel, 1990).

Bell, Greene, Fisher, and Baum (2001) have suggested that volume, predictability and perceived control also have major influences on subjective evaluations of annoyance. They have suggested that annoyance will increase if: 1) the noise is perceived as unnecessary, 2) the people making the noise seem unconcerned about the welfare of others, 3) the noise is perceived as hazardous to health, 4) the noise is associated with fear, and 5) the person is dissatisfied with other aspects of the environment as well (Bell et al., 2001).

Aasvang and Engdahl (2004) examined the relationship between noise indicators and subjective responses to aircraft noise. The purpose of their study was to develop noise indicators for use in recreation areas. The study was conducted near an airport in Oslo, Norway using both field and laboratory settings. Respondents rated perceived annoyance and acceptability of actual flyovers and simulated flyovers in a laboratory setting. Respondents reacted similarly in both settings. Although laboratory settings allow for high control over variables, they may also be unrealistic (Aasvang & Engdahl, 2004).

Freimund, Vaske, Donnelly, and Miller (2002) used video surveys to assess visitor norms for sounds from aircraft and motorized boats in three setting contexts. The study addressed visitor tolerance for the number of times hearing aircraft or motorized boats in access areas, attraction sites, and wild places. As expected, tolerance was higher for sounds in frontcountry areas than for backcountry areas. From a practical standpoint, sending video surveys by mail was a cost effective way to study visitor norms (Freimund et al., 2002).

Ruddell and Gramann (1994) examined noise induced conflict among winter visitors to Padre Island National Seashore, Texas. Using Jacob and Schreyer's (1980) theory of recreation conflict, they examined visitors' perceived interference from loud radios depending on the subjects' goals for the day. The authors also examined visitor norms for noise in the area. Norms were defined as "shared standards of behavior for specific recreation places"(Ruddell & Gramann, 1994). In their study, norms represented the appropriate level of human caused noise. According to the recreation opportunity spectrum, tolerance of noise was hypothesized to be greatest in developed campground and low in wilderness areas. Study findings reinforced the idea that goal orientation is often related to perceived interference with recreation activities. Visitors with less tolerant personal norms than the social norms were more likely to experience goal interference from loud radios (Ruddell & Gramann, 1994).

Computer Simulation Modeling

Computer simulation modeling has been described as the imitation of the operation of a real-world process or system over a specified amount of time (Lawson et al., 2003). Computer simulation modeling is a feasible way of duplicating noise events for a variety of sound environments. As technology and computational abilities increase, more accurate noise exposure calculations become available. Yet, the shortcoming of current aviation noise models is that they use exposure assumptions which limit the ability to accurately model effects of terrain, barriers, weather, and aircraft directivity.

Alternatively, noise simulation models can provide accurate exposure calculations with more metrics (Downing, 2004).

Plotkin (2001) explained the difference between traditional aircraft noise models and more elaborate simulation models. Traditional aircraft models used a database of SEL (sound exposure level) from complete flyovers. However, simulation models were capable of computing the actual time history of noise at each receptor. Plotkin suggested NMSIM, a computer simulation model, for use in examining effects of wind and temperature gradients on noise (Plotkin, 2001).

Lawson, Manning, Valliere, and Wang (2003) have suggested monitoring coupled with computer simulation modeling of use levels. Because computer simulation modeling estimates the amount of use that would cause standards to be violated, it could be used as a preventative measure to ensure that violations would not occur in the future (Lawson et al., 2003). It was first used for outdoor recreation in the 1970s but fell out of use by the mid-1980s because it was a costly operation. Today, as technology continues to advance, simulation modeling is a more feasible and less expensive undertaking. In recent years, computer simulation modeling has been applied at several national parks and protected areas. It has been used to track visitor travel routes, and to support managers in monitoring social carrying capacity (Lawson et al., 2003). This type of modeling could also be applied in the context of sound research.

Several studies on carrying capacity at national parks have indicated that computer simulation modeling can be applied as a proactive solution for protecting standards of quality (Lawson et al., 2003; Manning et al., 2003a, 2003b; Wang & Manning 1999). Simulation modeling can assist in monitoring indicators and standards of quality, while predicting conditions at which standards would be violated. Although computer simulation modeling has potential to be a powerful management tool, more research is warranted for model validity (Lawson et al., 2003; Wang & Manning, 1999).

Lawson and Manning (2003a, 2003b) conducted prescriptive and descriptive research to guide management of backcountry camping at Isle Royal National Park. Using computer simulation modeling as a management tool, researchers were able to assist in monitoring indicators and standards of quality for camping resources and predicted conditions for which standards were violated (Lawson & Manning, 2003). Benefits of using computer simulation modeling as a management tool are that it is cost effective, less labor intensive, very comprehensive, and less politically risky than trial and error approaches conducted within parks (Lawson & Manning, 2003). In a later study, Lawson (2006) indicated four major ways in which simulation modeling can assist with sustainable tourism in natural areas. These include: 1) describing visitor use flows, 2) monitoring the condition of indicator variables, 3) testing the effectiveness of alternative visitor use management practices, and 4) guiding the design of research on public attitudes (Lawson, 2006).

Measurements Approaches for Sound Studies

Gramann (1999) reviewed the effects of mechanical noise and natural sounds on visitor experiences at national parks, stating that the effects of mechanical noise have been researched using three theoretical approaches. These include: 1) a psychological approach that investigates people's valuation of sounds, 2) acoustical research that examines properties of noise that affect people's well being, and 3) psychoacoustical research which looks at the relationship between objective noise measurements and subjective evaluations of that noise. In this overview, it was important to clarify the difference between sound, noise, and natural quiet. As defined in the field of psychology, "sound is usually defined as a physical concept referring to the fluctuation in atmospheric pressure that is capable of producing audible sensation in the ear" (Gramann, 1999). In contrast, "noise is a psychological evaluation of a sound," often referred to as unwanted sound (Gramann, 1999). Natural quiet was defined in the NPS 1995 report to Congress on aircraft overflights as natural ambient sound plus the self-generated noise made by visitors doing non-mechanized activities. However, natural ambient sound does not include self-generated noise of visitors, but only natural sounds such as wind, water, and animals (Gramann, 1999).

The following paragraphs will discuss some of the basic acoustical metrics that are often used in the literature. For example, L_{eq} (Equivalent Continuous Sound Level) is the noise index that appears most often pertaining to noise annoyance relationships, although this metric should be used cautiously if making generalizations (Ouis, 2001). Equivalent Continuous Sound Level (L_{eq}) is one of the simplest measures and has been defined as the "A-weighted SPL (sound pressure level) over a specified time of measurement T (averaging time)" (Ouis, 2001). Sound pressure has been defined as "pressure due to the passage of the wave in air that oscillates above and bellow ambient pressure" (Ouis, 2001). Even at limits of ear pain, the sound pressure is small compared to static air pressure. Several scales have been developed that qualitatively assess noise exposure. It should be noted that higher frequency sounds tend to sound louder than lower frequency sounds at the same sound pressure level. Therefore, it is important for measured quantities of sounds to be translated into meaningful quantities according to the sensitivity of the human ear. This is accomplished by A-filtering the pressure. Under this system, lower frequency sounds have a lighter weight than higher frequency sounds.

When this A-filtering system is applied to decibel metrics, the sound level is then represented as “dB(A)” (Ouis, 2001).

(Makarewicz & Wojciechowska, 2003) wrote a technical article about acoustical measurement of aircraft sound in national parks, and pointed out that P (percentage of time an aircraft is audible) can be used to supplement the DNL (day night average sound level), where DNL’s are equivalent to L_{eq} for a 24 hour day with an extra 10 dB (decibels) weighting for noise occurring between 2200h and 0700h to account for extra nocturne noise annoyance. The paper presented detailed formulas for measurement and modeling of sound sources (Makarewicz & Wojciechowska, 2003).

Yang and Kang (2005) evaluated acoustic comfort levels for 14 urban spaces across Europe. With 9,200 interviews conducted across four seasons, results indicated that subjective evaluation of sound related well with mean L_{eq}. However, there were differences in how subjects evaluated sound levels versus acoustic comfort. For example, introduction of a pleasant sound such as music or water to mask less pleasant sounds could increase acoustic comfort at the same time that sound level is actually increasing. This could be the case in many natural areas as well. For example, as people walk past a mountain stream, they may only hear the sounds of rushing water. At this time, sounds of planes and other people may be masked. The study also revealed that background sound level tended to be an important index for evaluating urban soundscapes. Therefore, the authors concluded that it was important to reduce background noise in order to create comfortable acoustic environments (Yang & Kang, 2005).

In addition to audibility and acoustical measurements, attended audibility logging efforts have been identified as viable methods for enhancing results of soundscape inventory and monitoring efforts at national parks. The National Park Service Natural

Sounds Program has introduced Personal Digital Assistants (PDAs) for volunteers and/or park employees to use while collecting audibility data. During timed sampling blocks, the listener uses these small palm pilots to create records of sounds heard during the sampling period. Before the use of PDAs, paper data forms were used to log sounds (Lynch & Schirokauer, 2005).

Newman, Pilcher, and Manning (2005) suggested normative models such as Jackson's return potential curves to help inform and describe management decisions regarding visitor preferences for park soundscapes (Shelby et al., 1996). Because norms identify what visitors believe ought to be, or what should be, they can be considered as direct measures of visitor standards (Vaske & Donelly, 2002). Although there have been a plethora of normative studies conducted on crowding issues, few studies specifically addressed how noise affects the visitor experience (Newman, Pilcher, & Manning, 2005).

In most parks today, soundscape management standards are likely to rely on the following: percentage of time that human caused noise is audible, the level of human-caused noise when it is audible, and the interval without human caused noise (Ambrose & Burson, 2004). In terms of VERP, the current acoustic monitoring efforts are extremely important because they create descriptive baseline data, which can be compared to future conditions. However, as described in the preceding paragraphs, the evaluative component is also important when considering visitor standards. Normative theory can help with the formulation of these standards and suggests that if recreationists have normative standards for their experiences, then these norms can be applied to the formulation of standards of quality (Manning et al. 1996, 2002). Because norms identify what visitors believe ought to be, or what should be, they can be considered as direct measures of visitor standards (Vaske & Donelly, 2002).

Implications of the Literature

Concern about the adverse effects of noise in protected areas is on the rise. However, few studies have been able combine survey data with acoustical measurements from recreation areas (Krog & Engdahl, 2005). Because understanding the quantitative and qualitative aspects of sound depends upon various disciplines and areas of expertise, a synthesis of work is necessary (Marquis-Favre, Premat, Aubree, & Vallet, 2005; (Marquis-Favre, Premat, & Aubree, 2005).

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