U.S. National Science Foundation

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CNH: Sound as an Element in Coupled Natural and Human Systems

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History of Investigator:	Jesse Barber (Principal Investigator) jessebarber@boisestate.edu Clinton Francis (Co-Principal Investigator) Peter Newman (Co-Principal Investigator) Christopher Monz (Co-Principal Investigator) Michael Giamellaro (Former Co-Principal Investigator)
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ABSTRACT

Recent scientific research has demonstrated that human-generated sound can have a significant impact on the functioning and character of natural ecosystems and on human well-being. This interdisciplinary research project will study the interactions between natural and human systems as they are influenced by human-generated sound through analyses of the role of acoustics in affecting the number and diversity of birds and related human activity. The project will enhance basic understanding of the interactive effects that noise has on bird diversity and on the perceptions and actions of people. The project will provide a test of the hypothesis that as bird diversity declines when human-made noise fills the soundscape, individual and group valuation of wildlife and the acoustic environment decline, thereby reducing support for nature conservation, which ratchets declines in bird diversity further downward. The project also will test the corollary hypothesis that when

natural sounds are a dominant input to the acoustic environment, the natural sounds have positive effects though the maintenance of biodiversity and more positive human perceptions of the natural world and the overall human experience with nature. Because the research will be conducted by an interdisciplinary team of researchers drawn from a diverse set of fields, including ecology, zoology, economics, resource management, human-environmental interactions, engineering, and education, it will advance the integration of social and ecological sciences to better assess and explore varied management approaches to contribute to the effective management of natural areas. The investigators will further the project's impact by actively employing citizen scientists in the collection of data, thereby increasing knowledge, awareness, and understanding of scientific concepts and techniques among those involved in the research effort. The project also will provide special interdisciplinary education and training opportunities for undergraduate and graduate students and for post-doctoral researchers. This project is supported by the NSF Dynamics of Coupled Natural and Human Systems (CNH) Program.

The investigators will conduct this project at both local and regional scales. At the local-scale, they will conduct playback experiments of the natural and human-related components of acoustic environments to examine sensory awareness gauged through changes in bird diversity, the use of space by people, and human well-being. They will experimentally examine the relationship between background sound level and urban biodiversity as well as its coupled relationship with human experience in nature. They will manipulate the soundscape of local natural areas using arrays of speakers. In one set of experiments, they will artificially elevate noise levels in natural areas by adding additional traffic noise to assess its impact on bird biodiversity and human perceptions. They also will experiment with the playback of bird choruses containing varying numbers of bird species but the same acoustic power in laboratory and city park settings, coupling data from these experiments with data from surveys and biomarkers to measure the psychological benefits and physiological response to different sound stimuli. At the regional scale, the investigators will evaluate how sound-management strategies affect space use by birds and people in Grand Teton National Park, and they will assess the human valuation of their experiences under different strategies.

PUBLICATIONS PRODUCED AS A RESULT OF THIS RESEARCH

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PROJECT OUTCOMES REPORT

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This Project Outcomes Report for the General Public is displayed verbatim as submitted by the Principal Investigator (PI) for this award. Any opinions, findings, and conclusions or recommendations expressed in this Report are those of the PI and do not necessarily reflect the

views of the National Science Foundation; NSF has not approved or endorsed its content.

Research at the interface of social science and conservation biology has begun to reveal the importance of the acoustic environment as a force shaping the behavior of people and wildlife. Soundscapes dominated by natural sounds provide benefits to both human experiences in nature and to wildlife. As world population and activity has grown, so has the influence of human-created (anthropogenic) noise. In this collaborative project, we examined the effects of anthropogenic noise on wildlife and people. For example, we found diverse and markedly negative effects of noise on birds including substantial changes to abundance, age structure, body condition, habitat selection, stress signaling, communication behavior, and fitness. Our work on humans has revealed that reducing noise substantively increases positive classification of soundscape pleasantness, improves people's abilities to perceive natural sounds such as birdsong, and that natural sounds advance attentional restoration from mental fatigue. Our team's combined work on human and natural systems in protected areas has found that signage mitigation strategies can lower sound levels, which enlarges the listening areas of people, increases the number of birds perceived by people, elevates rankings of soundscape pleasantness, and importantly, increases preferences for soundscape management. This positive feedback cycle may lead to amplified conservation support in a time when the extinction of nature experience looms.

To disseminate our work, the team has given several talks to the general public at high schools and community centers in addition to dozens of presentations to scientific audiences at conferences and universities. We have designed and taught workshops for wildlife managers and early-career professionals on the effects of anthropogenic noise on people and wildlife and created a citizen science project to study urban soundscapes and how individuals are impacted by them.

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