



Noise and Natural Sounds in America's National Parks

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PHOTO: VOLPE CENTER

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(Photo above:) Aircraft overflight, Zion National Park.

In comparison with the built environment, parks and other natural settings offer a measurable difference in air quality, sounds, and open spaces. Research has shown that time spent in natural settings can improve a person's mood and sense of well-being, can increase cognitive performance and sleep quality, and can attenuate stress or response to pain. Park visitors and wildlife, however, can suffer from the adverse effects of noise from on- and off-road vehicles, as well as from military and commercial aircraft, including air tours over parks.

The National Park Service, the Federal Aviation Administration, and other organizations have been working to understand and reduce these transportation noise sources to protect the sound environments in parks. Recent work includes the following:

- ◆ Conducting research to help parks assess, predict, and minimize road noise;
- ◆ Evaluating the impact of aviation noise on a park visitor's experience; and
- ◆ Outlining a comprehensive program to evaluate the potential health benefits of the natural sounds potentially masked by road noise and aviation noise.

More information on each topic is available through the Natural Sounds and Night Skies Division of the National Park Service¹ and the U.S. Department of Transportation's Volpe Center.²

¹www.nature.nps.gov/sound_night/.

²www.volpe.dot.gov/coi/ees/index.html.

Motorcycles and Pavements

To help parks assess, predict, and minimize road noise in the park environment, research has focused on motorcycle noise and on quieter pavements. Motorcycle noise was measured on the side of the road and in noise-sensitive locations at Blue Ridge Parkway National Park. Motorcycles were classified into five categories for inclusion in a special research version of the Federal Highway Administration's Traffic Noise Model (TNM). The model has helped in examining and understanding motorcycle noise and its effects and has contributed to informed decision making about ways to reduce motorcycle noise in a park setting.

Two documents were written to guide the use of quieter pavement types and quieter, bicycle-friendly



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Motorcycle traffic was studied as a potential source of controllable noise in national parks.



Vehicle equipped for research on tire-pavement noise on a roadway in Death Valley National Park.

rumble strips. Another research version of TNM was generated for quieter pavements and included the noise effects of various pavement types. Tire-pavement and sensitive receiver-location noise measurements were conducted at Death Valley National Park; the measured sound levels were used with the model to demonstrate the potential effectiveness of quieter pavement in a park environment. This type of analysis can be applied to any park to determine potential noise reductions and to help in making roadway paving decisions that benefit the acoustic environment.

Judging Aviation Noise

The potential impact of aviation noise on a park visitor's experience will likely be assessed with both quantitative and qualitative criteria. Qualitative visitor responses can be related to quantitative noise exposure through mathematical expressions developed to describe the relationship between the noise exposure during a park visit and the visitor's judgment about the impact of the exposure on the quality of the experience, as stated in an on-site survey.

To develop these criteria, experts in the social sciences, natural resource management, and acoustics collaborated on the research strategies, data collection methods, and survey instruments. During the summer of 2011, more than 4,500 visitor surveys and corresponding measurements of the soundscape and aircraft noise were collected at seven backcountry locations in four national parks. In conjunction with similar data collected in the 1990s, the results were used to examine the correlation between noise exposure and subjective visitor responses.

Dose-response relationships were developed that showed the following:

- ◆ Noise exposure, described in terms of the equivalent sound level from aircraft during the visit,

correlated well with visitor response.

- ◆ The visit context strongly influenced the response—visitor activity, opinion on the importance of natural quiet, time spent at the site, familiarity with the site, and the presence of children in the group were important factors.

- ◆ The types of aircraft generating the noise exposure dose were important—visitors reacted more negatively to helicopters than to fixed-wing aircraft, propeller planes, and high-altitude jets.

Benefits of Natural Sounds

To determine the potential benefit of natural sounds, a research approach must characterize the underlying value of the acoustical environment. This can be done through a comprehensive program based on investigation of objective, physiological outcomes, such as cognitive performance, attention, anxiety, fatigue, heart rate, blood pressure, increased productivity, and more. The aim of the program would be to

- ◆ Identify the physiological and behavioral responses associated with exposure to natural sounds, such as sounds of the ocean, the forest, and the desert;

- ◆ Evaluate the therapeutic potential of exposure to natural sounds for vulnerable populations such as veterans with posttraumatic stress or children with attention-deficit hyperactivity disorder; and

- ◆ Build a comprehensive base of evidence to support public policy decisions directly related to the management of soundscapes in national parks and indirectly related to health care services, air traffic management, and urban planning, among other things.

The target research population would be those who could benefit, including children, backpackers, veterans, and workers exposed to natural sounds.



National park visitors complete a survey on the impact of aviation noise on their park experience.