Protecting soundscapes in U.S. national parks: Developing visitor simulation and noise exposure models

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Introduction

The majority of visitors consider opportunities to experience natural sounds as an important reason for protecting and visiting national parks, and many retreat to parks to experience the sounds of nature and natural quiet. Yet anthropogenic noise in and around these areas can mask natural sounds and negatively affect visitor experiences. Fortunately, policies and programs have been established to better protect these resources and social conditions, and specify that parks should integrate monitoring and planning efforts to protect soundscapes. For example, the National Park Service Natural Sounds and Night Skies Division (NSNSD), which is charged with protecting soundscapes, strives to improve resource and social monitoring and planning within parks. Collaborative efforts between the NSNSD, other federal agencies, research institutions like Colorado State University and the University of Vermont, and consulting firms such as the Resource Systems Group Inc. have fostered research initiatives that have advanced understanding of soundscape management in parks. The results of these efforts have been integrated into management processes, enabling managers to better monitor and manage acoustic resource and social conditions. This abstract provides a brief review of significant lessons-learned in the study of social aspects of sound management in parks.

Informing soundscape indicators and standards

The cyclical process by which park managers access and manage the protection of acoustic resources and related social conditions, involves establishing soundscape indicators and standards of quality. Generally, this development requires that descriptive (unbiased data) and evaluative (subjective measures) components be addressed, so that management objectives (desired conditions) and ensuing indicators and standards of quality can be established (Manning, 2007). Once soundscape indicators and standards are established, they can then be monitored, and if standards are reached or exceeded, management actions can be taken.

Case Studies

Establishing indicators and standards, role of motivations and education

Through research at Muir Woods National Monument (Pilcher et al., 2009; Marin et al., 2011; Stack et al., 2011), Yosemite, Sequoia and Kings Canyon (Newman, et al., In Review), and Rocky Mountain National Parks (Park, et al., 2010) effective methods of determining potential social soundscape indicators and standards have been developed. Furthermore, the results of research to inform these indicators and standards have discovered the role of visitor motivation, and effect of educational information in altering behaviors, perceptions and evaluations of park soundscapes. For example, visitor listening exercises followed by evaluations of sounds heard, can lead to viable social soundscape indicators. Additionally, audio recording evaluations can be used to determine acceptable and unacceptable levels of human-caused sounds such as voices, vehicles and aircraft, which are typically found to be annoying in park settings. Visitors that are highly motivated to hear natural sounds have been found to be less accepting of human-caused noise (Marin, et al., 2011). However, research suggests that educational messaging can decrease human-caused noise, such as loud voices (Pilcher et al., 2009, Stack et al., 2011), and alter visitor perceptions, expectations and normative evaluations of inevitable sounds such as those associated with aircraft overflights (Newman, et al., In Review).

Simulation and noise exposure modeling

In the popular areas surrounding Bear Lake in Rocky Mountain National Park and Tuolumne Meadows in Yosemite National Park, a systematic research approach was taken in order to produce predictive, time-lapsed visitor density and soundscape modeling to inform management actions. In the Bear Lake corridor, data was gathered to quantify and model the effects of shuttle bus and private vehicle noise on backcountry-users. This was accomplished by collecting traffic volume, sound level data, visitor hiking routes, and trailhead visitation monitored through GPS tracking and trail counters. These methods provided input for modeling outputs that informed visitor use patterns and estimated the potential condition of soundscape indicators. Results indicated that in order for visitors to reach natural quiet, they would have to walk over half a mile; on average, for approximately 36% of visitors, their total hiking experience was spent hearing vehicle noise (Park et al., 2010).

In Yosemite National Park, vehicle noise was measured along with topography and visitor use patterns within the Tuolumne Meadows area. Results of the exposure modeling suggest almost all hikers in the area reach locations of the park exposed to roadway noise levels below 35 dB, and nearly half reach areas below 25 dB at some point during their hikes, suggesting that many visitors experience sustained periods of "unimpaired" exposure to natural sounds while hiking there (Newman, et al., In Review). Together, understanding visitor motivations, the capabilities of educational messaging, and systematic simulation modeling at these parks have enabled managers to see current trends and

impacts related to visitor use and experience that may be affected by noise, and predict potential impacts as they plan for the future.

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