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Soundscape Conservation in U.S. National Parks: Implications for Adjacent Land Use Planning

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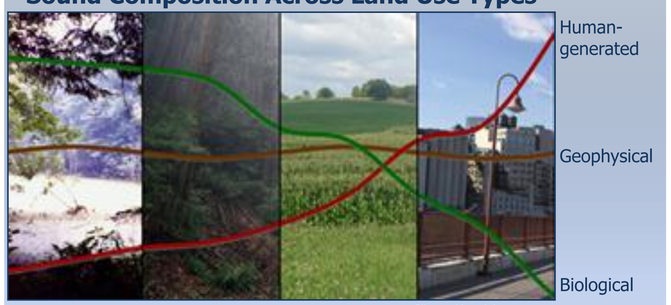
Abstract

Humans have altered the Earth's ecosystems and biodiversity significantly. With the conversion of land and the loss of biodiversity, the world loses its natural sounds. The loss of natural sounds is compounded by the growing intrusions of motorized noise. Noise pollution is a ubiquitous problem in cities around the world, but the issue is spreading to more remote areas due to expanding transportation networks, motorized recreation and urban sprawl. The U.S. National Park Service (NPS) recognizes park soundscapes, or entire acoustic environment of a given area, as resources just as air and water are resources. However, national park resources are only provided protection within a legally defined boundary separating it from surrounding land uses. To better understand the acoustic resources and noise issues in parks, the U.S. NPS Natural Sounds Program sent a survey to each of the park units (n=391) in 2009. There were 149 respondents representing 141 different park units. We analyzed the data using qualitative theme identification and quantitative analyses. The primary noise impacts for parks were from motorized noise sources (n=97), and specifically road noise was reported by 36 respondents. Adjacent land uses were identified as causing specific impacts by 15 respondents. We demonstrate how Geographic Information Systems can be used to quantify the noise impacts from surrounding development mentioned by park respondents. We buffered urban land use of responding park units using ArcGIS. The total urban area of each park unit was compared to survey results to determine if urban area correlated to parks conducting noise mitigation measures. Respondents (n=14) mentioned adjacent land use planning as a measure that they were using to mitigate noise impacts. The research findings from this study will help guide future soundscape conservation efforts by NPS.

Soundscapes Defined

•U.S. National Park Service definition: "All the natural sounds that occur in parks, including the physical capacity for transmitting those natural sounds and the interrelationships among park natural sounds of different frequencies and volumes" (NPS 2006).

Sound Composition Across Land Use Types



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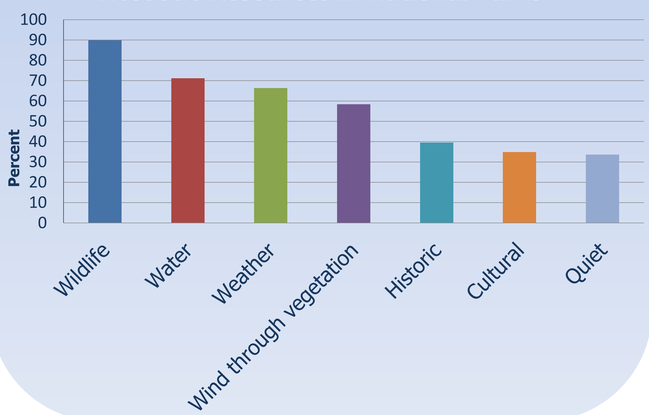
Acoustic Resources in National Parks



Methods

The National Park Service Study

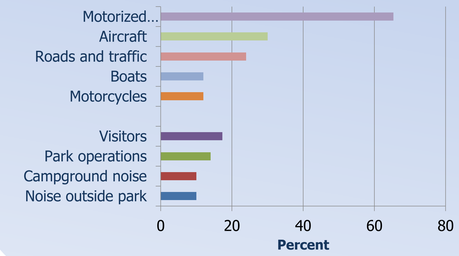
National Park Service Survey
Survey distributed to all parks
Four open-ended questions:
•Acoustic resources
•Noise sources
•Impacts
•Mitigation and conservation

149 responses representing 141 different park units
•Response rate of 36%

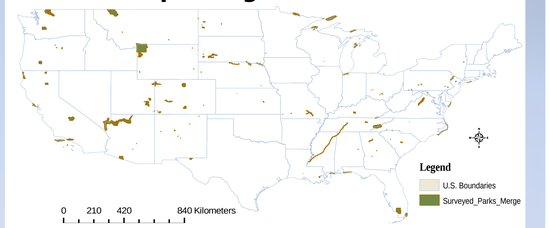
NPS Land and Use and Mapping

•ArcMap10 used for analysis
•Responding park units selected
-NPS boundary layer
•Created a 10 km buffer
Data used:
•NLCD 2001
•National Road data set (USGS 2006)
•National Airports (USGS)

Noise Sources Linked to Impacts at National Parks



Responding Park Units

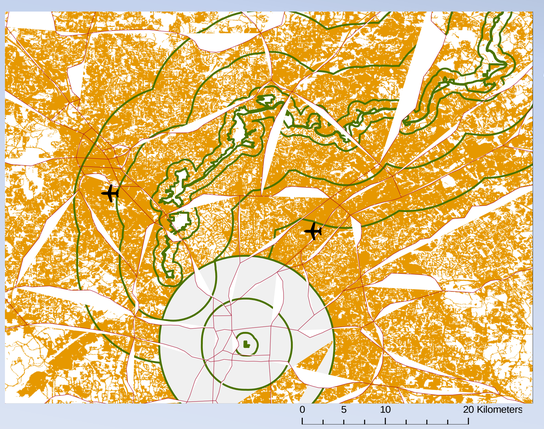


Land Use Mapping

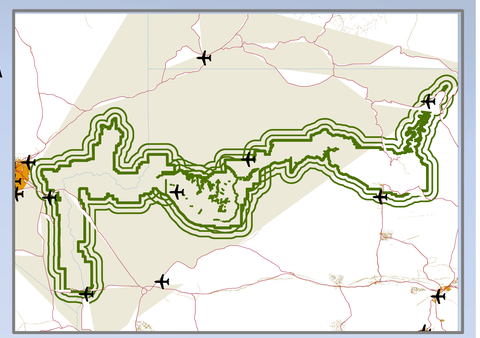
"Some very remote areas are highly impacted by low level air tour aircraft noise, causing consternation from wilderness users desiring an experience of solitude."

"Those seeking true natural experiences or tranquility in historic areas so as to separate their state of mind from the modern present can't do so when distracted by noises."

"Much of this noise drown out the natural sounds such as grass and trees rustling, sounds from running water, inability to hear wildlife sounds."



Responding park units showing high levels of urban land use as well as airports.



Responding park unit showing low levels of urban land use, but high numbers of airports.

Results

Park Mitigation Measures

- Aircraft regulations (n=29)
- Adjacent land use planning (n=14)
- Sound barriers (n=12)
- None (n=51)

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Land Use Analysis

Total urban area within 10 km is 143331.6 km^2
-(mean=1225.06 km^2, SD=1558.13 km^2)

Road Analysis

Total road area within 10 km is 435.1 km^2
-(mean= 3.82 km^2, SD=6.74 km^2)

Airport Analysis

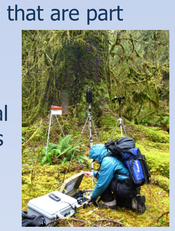
24 park units have airports within 10km
1 park has 4 airports

Mean difference analyses have no significant difference ($p>0.05$) between parks implementing mitigation measures and surrounding land use.

Conservation

1. Linking national park soundscapes with land use data aids in recognizing the impacts to this resource and the values associated with it. National park soundscapes are an important and relevant starting place to address soundscape conservation.
2. Park respondents indicated that noise generated outside park boundaries
3. Understanding the how the components of soundscapes change with land use and other factors, such as climate change is an important consideration for park managers

4. Park visitor expectations, goals, and experiences are important considerations for managing soundscapes.
5. Interactions of different park users, noise and wildlife, and land use and sounds are just a few of the many factors that are part of this issue.
6. The outcomes from the various interactions have led to initial conservation measures by the National Park Service. A better understanding of the issues can be achieved through acoustic monitoring and social science research.



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