Understanding Oversnow Vehicle Noise Impacts

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Introduction

The 2006 National Park Service *Management Policies* (NPS 2006) state that natural soundscapes are to be preserved or restored as is practicable because the unimpaired sounds of nature (natural soundscapes) are a valued resource at national parks. Historical numbers of oversnow vehicle usage in Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr. Memorial Parkway created unacceptable adverse impacts on natural soundscapes (NPS 2000; NPS 2003). The 2004 temporary winter use plans environmental assessment reaffirmed these conclusions and established acoustical indicators and standards to mitigate the impact of noise from oversnow vehicles on the natural soundscape (NPS 2004).

The winter soundscape at Yellowstone and Grand Teton National Parks consists of natural and non-natural sounds, although extreme quiet also can be experienced in both parks. Natural soundscapes are often important for wildlife survival due to the use of acoustic communication during breeding and predator/prey interactions. Common natural sounds include bird calls, mammal vocalizations, flowing water, wind, and thermal activity. Non-natural sounds include wheeled vehicles, aircraft, and the sounds associated with other human activity and facility utilities in visitor and employee developed areas. The subject of this paper, however, is the sound of oversnow vehicles (snowmobiles, snowcoaches, and snowgroomers).

Extensive information on the impacts of oversnow vehicles on the natural soundscapes of Yellowstone and Grand Teton National Parks has been gathered through intensive acoustical monitoring, modeling, and targeted research the past four years. Direct measurements of oversnow vehicle pass-bys, continuous acoustic monitoring throughout the winter, and sophisticated computer modeling all estimate the sound levels and percent of time that snowmobiles and snowcoaches are audible. A few details of these different approaches follow.

Monitoring

Extensive acoustic data were collected at 29 locations during the winter season in Yellowstone and Grand Teton. These automated acoustic monitors, following the protocol of Ambrose and Burson (2004), collected continuous one-second sound levels, digital recordings using a systematic sampling scheme, and recordings triggered by loud sounds. Monitoring was conducted at both the most heavily visited frontcountry sites and remote backcountry areas (Burson 2006). Monitoring data provided information on the sound levels of oversnow vehicles and the percent time they were audible and was useful to assess how actual oversnow vehicle noise related to the acoustic standards set in the winter use planning documents. Monitoring data also was used to partially validate the computer acoustic modeling.

Targeted research

Sound levels of oversnow vehicles were directly measured using standardized controlled pass-by test procedures. These measurements provided information on the relative sound levels of several snowmobile and snowcoach models and how the levels varied by speed. These data were then used as input variables for computer modeling.

Additional information was gathered in person with many hours of oversnow vehicle classification and audibility logging. These data provided information on the composition of oversnow vehicle use (visitors versus employee usage) and numbers, timing, distribution, and the interval between audible oversnow vehicles (the noise-free interval). This observational information was also used to validate the monitoring data.

Modeling

Computer modeling was used during winter use planning in Yellowstone and Grand Teton to estimate the impact of oversnow vehicle noise (HMMH 2002; Hastings et al. 2006). The most recent modeling calculated the expected sound levels and percent time oversnow vehicles would be audible for a number of hypothetical oversnow vehicle traffic patterns. The main advantage of using computer modeling to estimate oversnow vehicle noise impacts is that modeling can provide internally consistent estimates using hypothetical oversnow vehicle use patterns. This is particularly useful during management planning processes.

Results

The complexity of the oversnow vehicle noise impact topic is illustrated in the answers to the following basic questions. How loud are oversnow vehicles? Generally, oversnow vehicles sound levels range from a roar at 50 feet (up to 85 dBA for the loudest snowcoaches and 75 dBA for four-stroke snowmobiles) to a distant hum at several miles away (below the ambient sound level) (Burson 2006). Oversnow vehicle sound levels also depend on how fast they are going, the type of oversnow vehicle, topography, the speed and direction of wind and other atmospheric and ground cover conditions, and how far they are from the listener. See Table 1 for reference sound levels of common sources of sound.

How often can you hear oversnow vehicles? In most of Grand Teton and the backcountry of Yellowstone, oversnow vehicles are rarely heard, but in developed areas and along busy travel corridors oversnow vehicles can be continuously audible during some hours. Snowmobiles on Jackson Lake in Grand Teton are audible for an average of less than 5% of the day. At Flagg Ranch, in the John D. Rockefeller, Jr. Memorial Parkway, a staging area for Yellowstone, oversnow vehicles are audible an average of 28% of the day. In Yellowstone at Old Faithful, oversnow vehicles are audible about 70% of the day (Burson 2006). How often oversnow vehicles are heard depends on where the listener is, how many oversnow vehicles are operating in the area, how quiet the natural ambient sound level is, and other nearby natural and non-natural sounds.

Why conduct both modeling and monitoring? Modeling allows the National Park Service to compare various hypothetical oversnow vehicle use pattern management schemes; monitoring measures current conditions and can partially validate modeling results. Both are useful means of exploring the impacts of oversnow vehicle sounds. When used in combina-

dBA	Perception	Outdoor Sounds	Indoor Sounds
130	Painful		
120	Intolerable	Jet aircraft at 50 ft	Oxygen torch
110	Uncomfortable	Turbo-prop at 200 ft	Rock Band
100		Jet flyover at 1,000 ft	Blood-curdling scream
90	Very noisy	Lawn mower	Hair dryer
		Straight pipe motorcycle at 100 ft	
80		Diesel truck 50 mph at 50 ft	Food blender
70	Noisy	2-stroke snowmobile 30 mph at 50 ft	Vacuum cleaner
60		4-stroke snowmobile 30 mph at 50 ft	Conversation
50	Moderate	Raven croaking flyover at 200 ft	Office
40		Quiet urban nightime	Average living room
30	Quiet	Snake River at 300 ft	Quiet bedroom
20	Very quiet	Quiet rural nightime	Recording studio
			"Sound-proof chamber"
10	Just audible		Faint whisper
0	Limit of Human Hearing	Winter wilderness	

Table 1. Reference levels for common sources of sound.

tion, managers can better understand the impacts of oversnow vehicles on the natural soundscape.

Is there too much oversnow vehicle noise? Science, monitoring, modeling and targeted studies can only describe acoustical conditions; setting desired and acceptable conditions are value-based management decisions (Figure 1).

Conclusions

Several general conclusions can be made from the information collected over the past several years.

- Fewer oversnow vehicles as a whole, and fewer traveling in groups, reduces the noise impact on the natural soundscape.
- The unmodified Bombardier technology snowcoaches, employee two-stroke snowmobiles, and snow-groomers are the loudest oversnow vehicles being used in the parks.

Figure 1. Snowmobiles lined up at Old Faithful, Yellowstone National Park.

- Employee oversnow vehicle use is a sizeable component of the oversnow vehicle noise impact on natural soundscapes.
- Environmental conditions, such as weather, topography, and natural sound sources make a big difference in how oversnow vehicles affect the natural soundscapes.
- Noise impacts from current oversnow vehicle use exceed some of the soundscape thresholds set by park management, suggesting the need for further mitigation.

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