



Zion National Park

Acoustical Monitoring Snapshot

January 2009

Background Information

The Natural Sounds Program received a technical assistance request from Zion National Park (ZION) for FY08 to develop a soundscape management plan. Quantifying the difference in traffic noise between areas where all vehicles are allowed and areas that only buses are allowed is part of this plan. To provide data for this objective, one monitoring site was set up near the Canyon Junction along Zion Canyon Scenic Drive where all vehicles are allowed, and one monitoring site was set up at the base of the Great White Throne, further up the same road, but where only buses are allowed. This briefing serves as a preliminary snapshot of the acoustical conditions at the sites monitored. A full acoustical monitoring report will follow, pending further data analysis. Table 1 describes the location and characteristics of the monitoring sites.

Table 1. Study area

Site	Site Name	Dates Deployed	Vegetation and surroundings	Elevation	Latitude	Longitude
ZION001	Great White Throne	July 29, 2008 – August 21, 2008	Oakbrush. Uphill from the road, about 50 yds from road at base of GWT.	1328 m	37.26470	112.94664
ZION002	Pine Creek	July 28, 2008 – August 21, 2008	Pinion juniper, sand. Park housing ~100 yds away. LOS to park road downhill ~70 yds away.	1240 m	37.21713	112.97708

Metrics

In order to understand the implications of the acoustic data fully, it is important to describe the distribution of sound levels in relation to potential functional effects. Table 2 presents park sound sources and common sound sources with their corresponding A-weighted decibel levels (dBA). The dBA is a logarithmic measure of sound energy that approximates human hearing sensitivity (Harris, 1998, p. 1.16).

Table 2. Interpreting sound levels

Park Sound Sources	Common Sound Sources	dBA
Volcano crater (HALE)	Human breathing at 3m	10
Leaves rustling (CANY)	Whispering	20
Crickets at 5m (ZION)	Residential area at night	40
Conversation at 5m (WHMI)	Busy restaurant	60
Snowcoach at 30m (YELL)	Curbside of busy street	80
Thunder (ARCH)	Jackhammer at 2m	100
Military jet at 100m AGL(YUCH)	Train horn at 1m	120

Note: An increase of 10dBA represents a tenfold multiplication of energy

Table 3 summarizes sound level values that relate to human health and speech, as documented in the scientific literature. Human responses can serve as a proxy for potential impacts to other vertebrates because humans have more sensitive hearing at low frequencies than most species (Dooling and Popper, 2007, p. 5).

Table 3. Explanation of sound level values

Sound Levels (dBA)	Relevance
35	Blood pressure and heart rate increase in sleeping humans (Haralabidis et al., 2008)
45	World Health Organization's recommendation for maximum noise levels inside bedrooms (Berglund, Lindvall, and Schwela, 1999)
52	Speech interference for interpretive programs (U.S. Environmental Protection Agency, 1974)
60	Speech interruption for normal conversation (U.S. Environmental Protection Agency, 1974)

Table 4 reports the percent of time that measured levels were above the values in Table 3. The top value in each cell focuses on frequencies affected by transportation noise whereas the lower values use the conventional full frequency range.

Table 4. Percent time above metrics

Site	% Time above sound level: 0700 to 1900				% Time above sound level: 1900 to 0700			
	35 dBA	45 dBA	52 dBA	60 dBA	35 dBA	45 dBA	52 dBA	60 dBA
ZION001	61.03	10.75	2.92	0.01	62.16	2.25	0.63	0.00
	99.53	13.07	3.58	0.02	100	3.12	0.83	0.00
ZION002	93.21	11.18	0.79	0.02	65.30	1.69	0.07	0.00
	99.84	34.57	1.67	0.04	100	32.80	2.92	0.00

Exceedence levels (L_x) are metrics used to describe acoustical data. They represent the dBA exceeded x percent of the time during the given measurement period (e.g. L_{90} is the dBA that has been exceeded 90% of the time). Table 5 reports the L_{90} , L_{50} , and L_{10} values for the sites measured in ZION. The top value in each cell focuses on frequencies affected by transportation noise whereas the lower values use the conventional full frequency range.

Table 5. Exceedence levels for existing conditions

Site	Exceedence levels (dBA): 0700 to 1900			Exceedence levels (dBA): 1900 to 0700		
	L_{90}	L_{50}	L_{10}	L_{90}	L_{50}	L_{10}
ZION001	33.5	35.5	45.7	34.1	35.3	38.4
	37.1	38.8	46.7	38.5	39.8	42.0
ZION002	35.9	40.1	45.2	34.6	36.2	39.2
	39.1	42.9	47.5	40.6	42.8	46.5

Figures 1 and 2 plot the dB levels for 33 one-third octave band frequencies over the day and night periods at both monitoring sites. The grayed area represents sound levels outside of the typical range of human hearing. The typical frequency levels for transportation, conversation and songbirds are presented on the figure as examples for interpretation of the data. These ranges are estimates and are not vehicle-, species-, or habitat- specific.

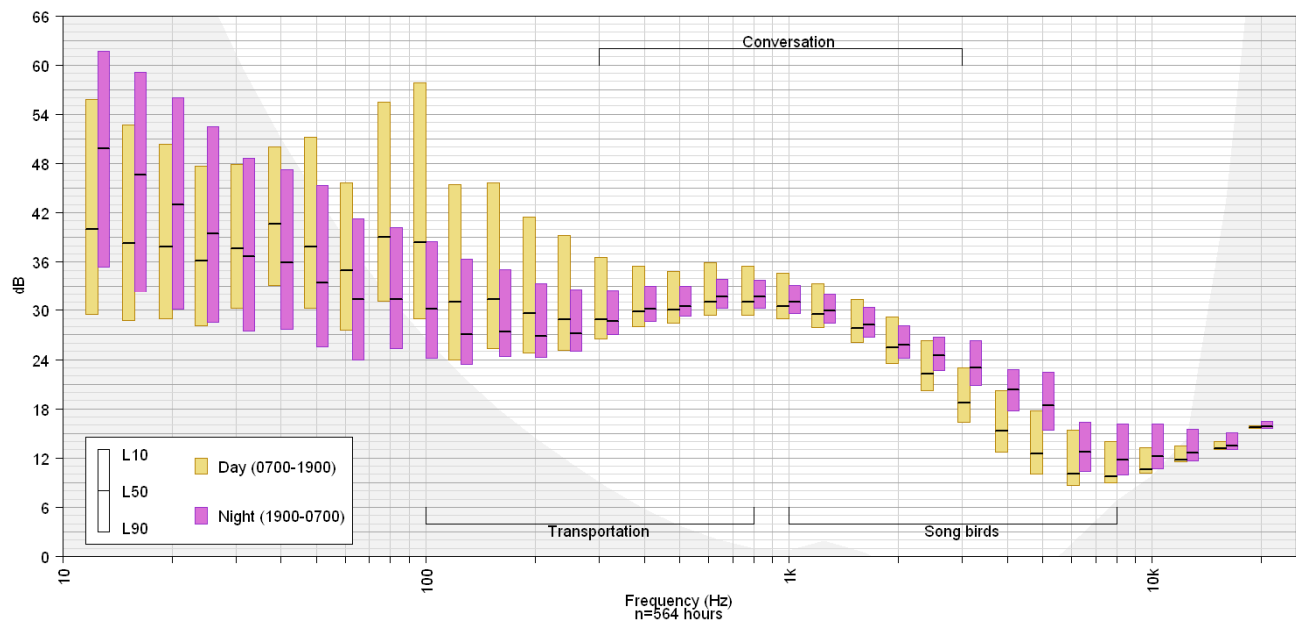


Figure 1. Day and night dB levels for 33 one-third octave bands at ZION001

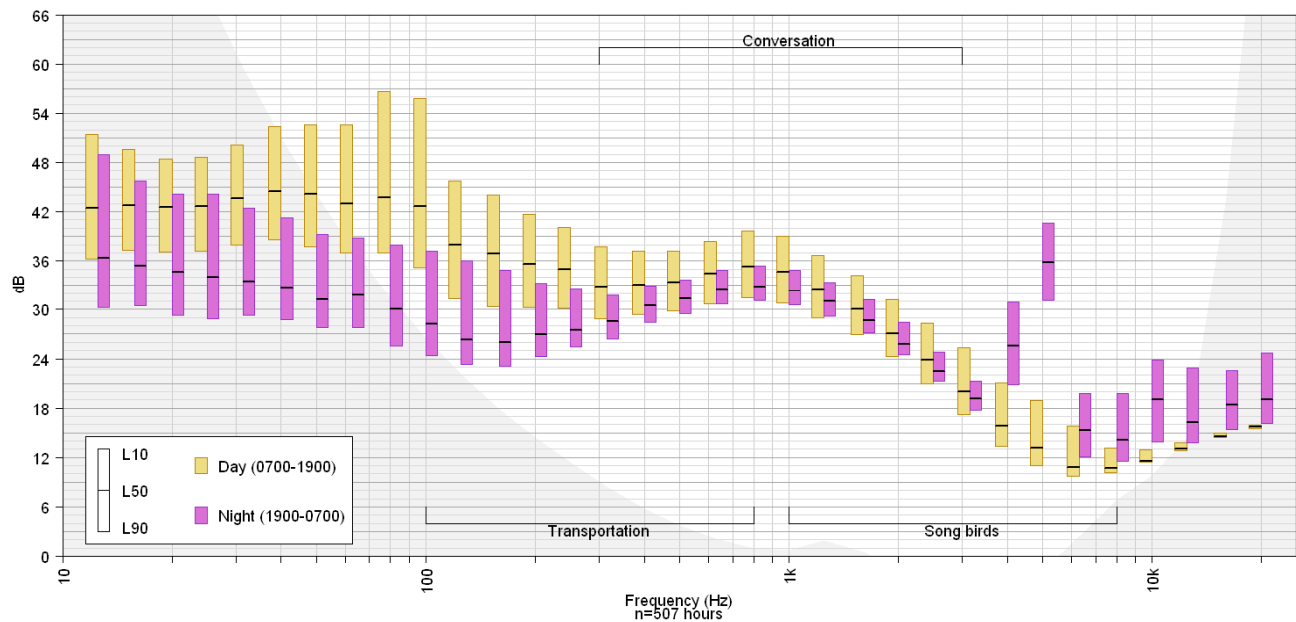


Figure 2. Day and night dB levels for 33 one-third octave bands at ZION002

Please note that this is a preliminary snapshot designed to get salient acoustical information back to the park as quickly as possible. This does not replace a full acoustical report, which will follow, pending further data analysis. If there are any questions or concerns about the information in this document, please contact the Natural Sounds Program. Thank you for your interest and participation in acoustical resource monitoring.

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