



Mount Rainier National Park

Acoustical Monitoring Snapshot

April 2009

Background Information

The Natural Sounds Program received a technical assistance request from the North Coast and Cascades Network (NCCN) in FY05 for a workshop in Soundscape Management Planning. After the workshop, Mount Rainier National Park (MORA) set up a Cooperative Ecosystem Studies Unit (CESU) with Colorado State University to conduct acoustical monitoring. The purpose of this monitoring effort was to characterize current existing sound levels and estimate natural ambient sound levels, as well as identify audible sound sources. This data will be used to inform the park about current sound level conditions for park management purposes. To meet this objective, six sites were monitored during 2006 and 2007. 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	Elevation	Latitude	Longitude
MORA001	Trail of Shadows	8/30/2006 – 3/14/2007 8/31/2006 – 10/7/2006 & 6/7/2006 –	Moderately wet forest: Western Hemlock 90%	851 m	46.75227	-121.81490
MORA002	Green Lake	7/31/2007	Dense wet forest: Western Red Cedar	999 m	46.97857	-121.85757
MORA003	Crystal Mountain	9/2/2006 – 10/9/2006	Dense Subalpine 90%: adjacent to an open scree slope	1951 m	46.93457	-121.50273
MORA004	Shriner's Trail	6/15/2007 – 7/30/2007 8/2/2007 –	Douglas Fir	750 m	46.80028	-121.55295
MORA005	Lakes Trail	9/12/2007	Subalpine meadow	1538 m	46.77542	-121.71903
MORA006	Sunrise Ridge	8/4/2007 – 9/2/2007	Dense pine: Mixed Conifer 300 ft below ridgeline	1746 m	46.92060	-121.58393

Metrics

Since sound levels fluctuate, the Natural Sounds Program (NSP) uses several metrics to provide some detail about the characteristics of the acoustical environment. In order to fully understand the implications of the acoustical data, it is important to describe the distribution of sound levels in relation to potential functional effects since this information may be useful in resource management decisions. The A-weighted decibel (dBA) is a logarithmic measure of sound energy that approximates human hearing sensitivity (Harris, 1998, p. 1.16). As decibel measures may

not be easily comprehended by the layperson, Table 2 presents park sound sources and common sound sources with their corresponding A-weighted decibel levels (dBA) to provide a frame of reference.

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)

Time above metrics provide information about how much time sound levels are above specified dBA levels. By comparing the amount of time that sound levels are above certain values, variations in sound levels can be illustrated. Table 4 reports the percentage of time that measured levels were above the values in Table 3. These values should not be construed as thresholds of impact.

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
MORA001	26.80 ¹	0.93	0.09	0.00	7.28	0.20	0.01	0.00
	72.81 ²	1.74	0.17	0.00	44.13	0.40	0.02	0.00
MORA002	27.45	0.28	0.04	0.00	25.55	0.02	0.00	0.00
	90.83	0.77	0.12	0.00	96.08	0.19	0.01	0.00
MORA003	0.91	0.12	0.02	0.00	0.21	0.00	0.00	0.00
	2.01	0.29	0.06	0.00	5.30	0.10	0.00	0.00
MORA004	30.41	0.19	0.00	0.00	9.83	0.00	0.00	0.00
	52.13	1.57	0.04	0.00	55.12	15.15	5.77	0.13
MORA005	2.13	0.44	0.11	0.00	0.52	0.07	0.00	0.00
	5.35	0.59	0.14	0.01	19.15	0.51	0.00	0.00
MORA006	0.51	0.10	0.01	0.00	0.10	0.00	0.00	0.00
	3.84	0.64	0.06	0.00	17.59	0.30	0.03	0.00

1. The top value in each cell focuses on frequencies affected by transportation, which approximately correspond to 100-800 hertz. This range does not correspond to a specific vehicle or type of transportation.

2. The bottom value in each cell uses the full frequency spectrum, from 12.5-20,000 hertz.

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 MORA.

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}
MORA001	31.4 ¹	33.3	37.2	30.5	31.3	32.8
	34.5 ²	36.3	40.2	33.3	34.0	35.8
MORA002	33.8	34.6	35.5	35.1	35.7	36.4
	36.8	37.3	38.5	37.5	38.2	39.0
MORA003	19.2	20.9	23.9	20.4	21.9	23.6
	22.1	23.4	27.0	23.1	24.5	26.4
MORA004	31.0	32.7	35.2	32.2	32.9	33.6
	33.2	34.6	37.7	34.5	35.3	36.6
MORA005	20.8	23.0	27.2	15.5	16.9	19.8
	23.7	25.8	31.0	20.3	23.7	29.6
MORA006	17.5	19.3	22.9	11.0	12.2	14.9
	21.2	23.2	28.4	17.9	21.2	27.0

1. The top value in each cell focuses on frequencies affected by transportation, which approximately correspond to 100-800 hertz. This range does not correspond to a specific vehicle or type of transportation.

2. The bottom value in each cell uses the full frequency spectrum, from 12.5-20,000hertz.

Figure 1-6 plot the dB levels for 33 one-third octave band frequencies over the day and night periods at the six 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.

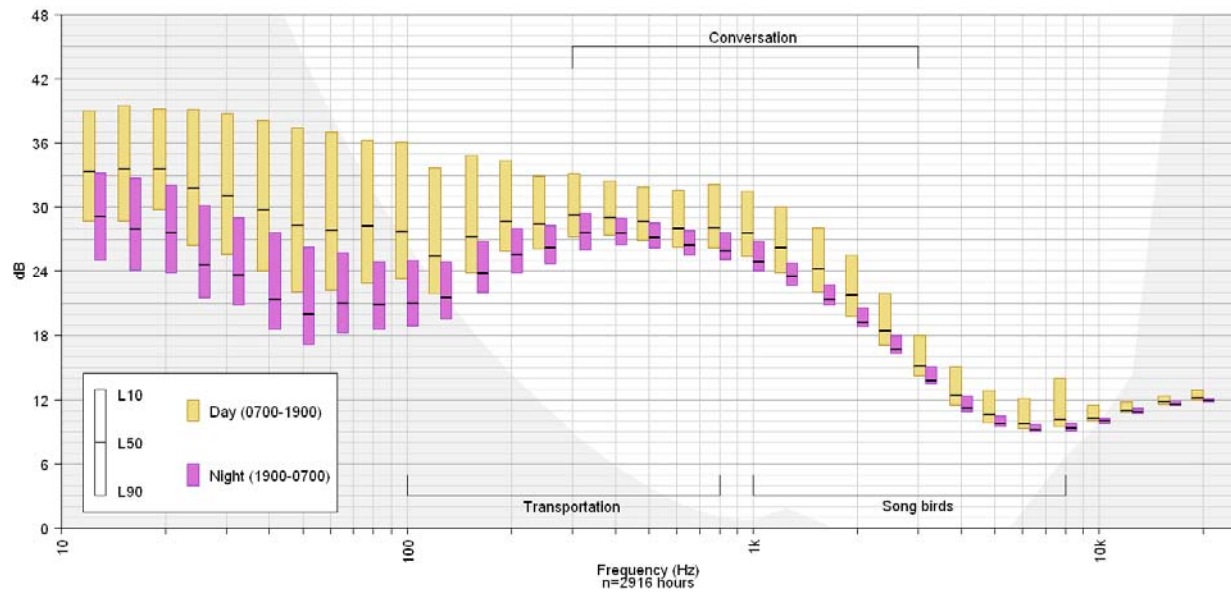


Figure 1. Day and night dB levels for 33 one-third octave bands at MORA001

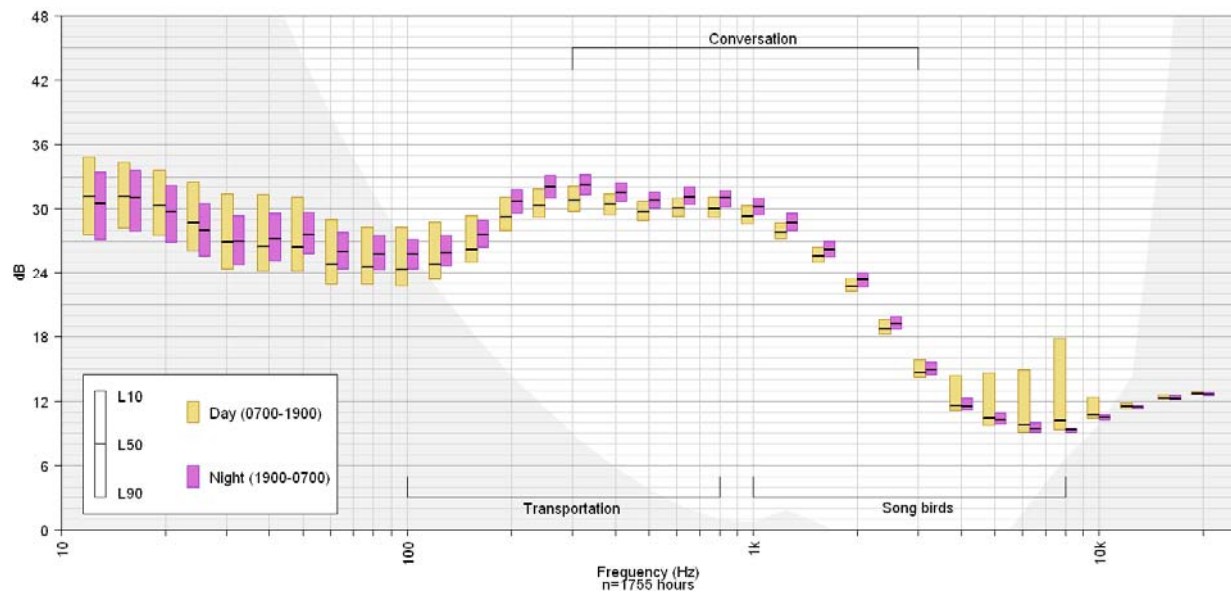


Figure 2. Day and night dB levels for 33 one-third octave bands at MORA002

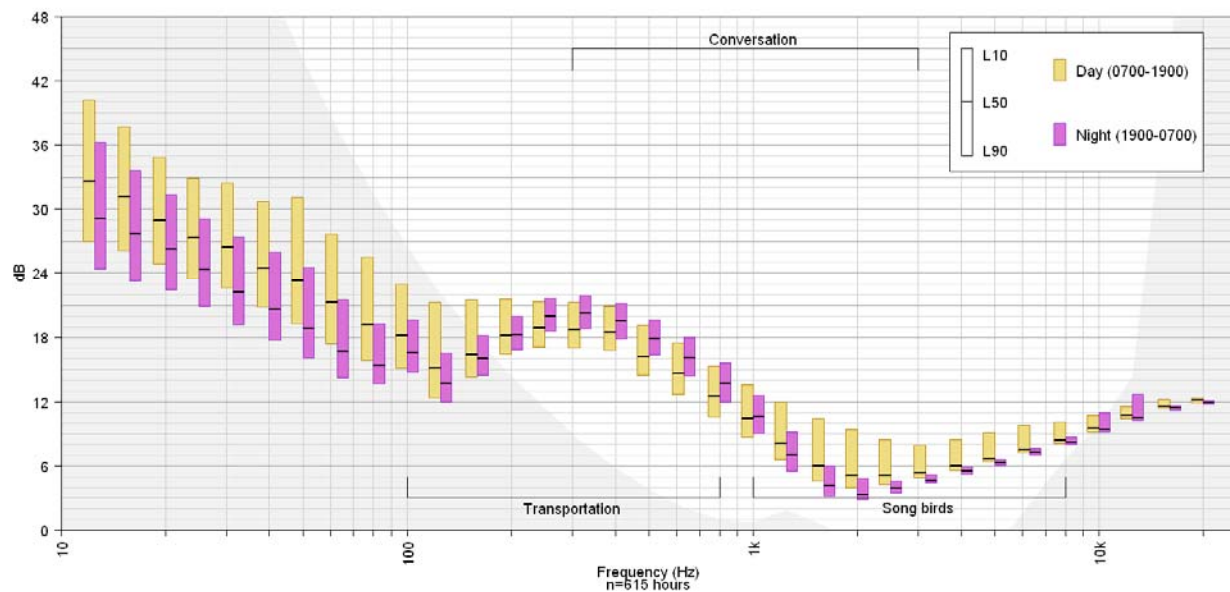


Figure 3. Day and night dB levels for 33 one-third octave bands at MORA003

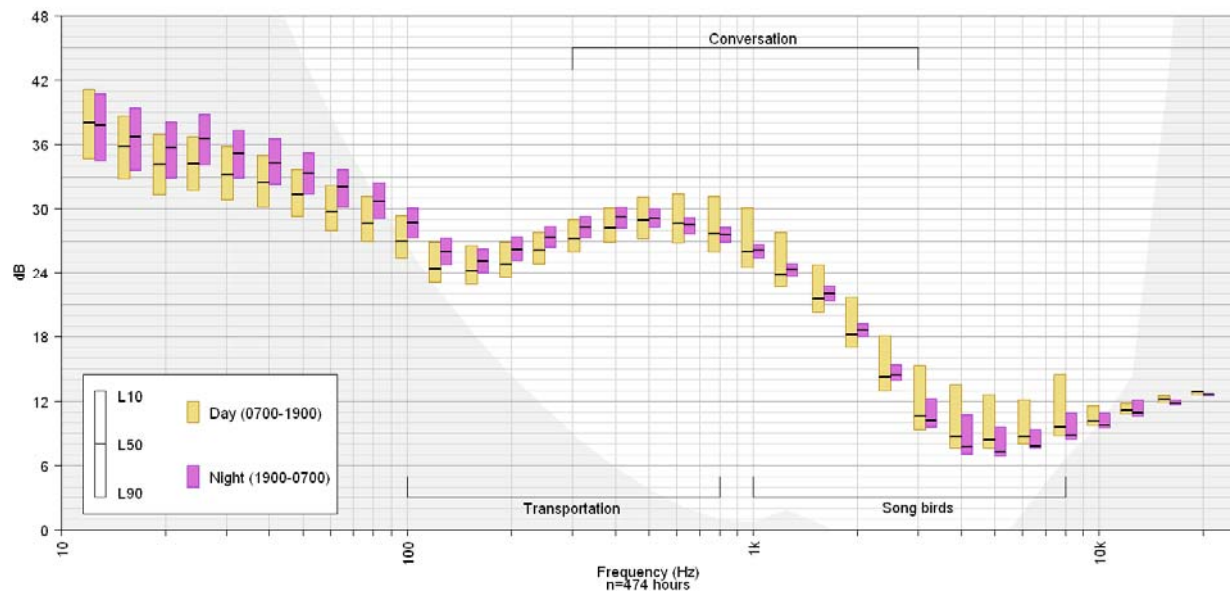


Figure 4. Day and night dB levels for 33 one-third octave bands at MORA004

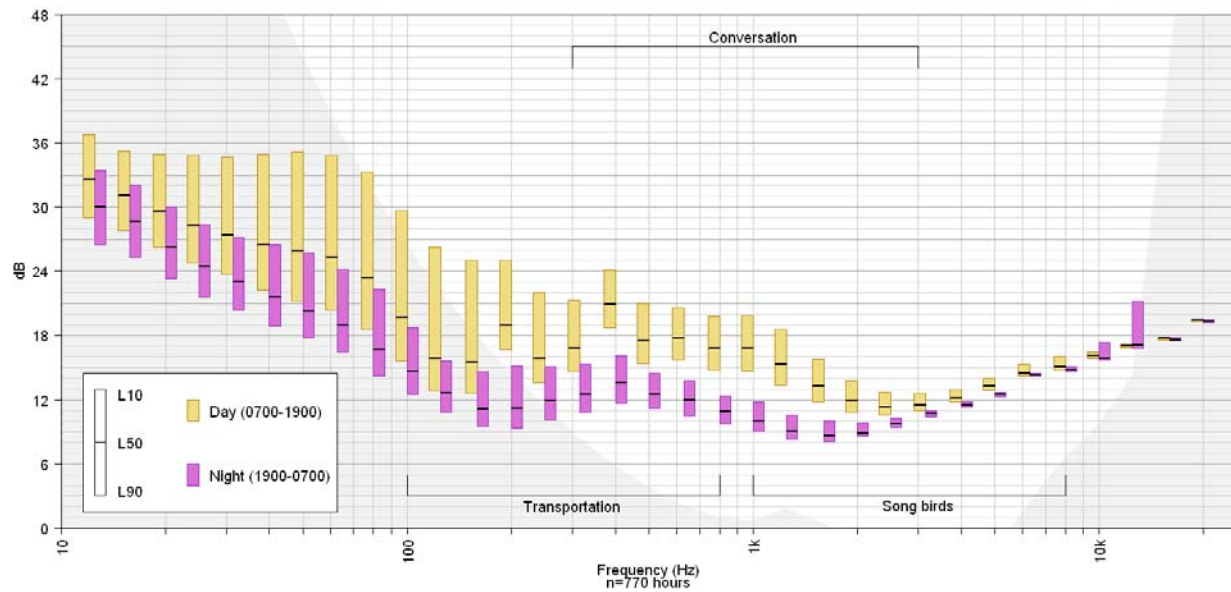


Figure 5. Day and night dB levels for 33 one-third octave bands at MORA005

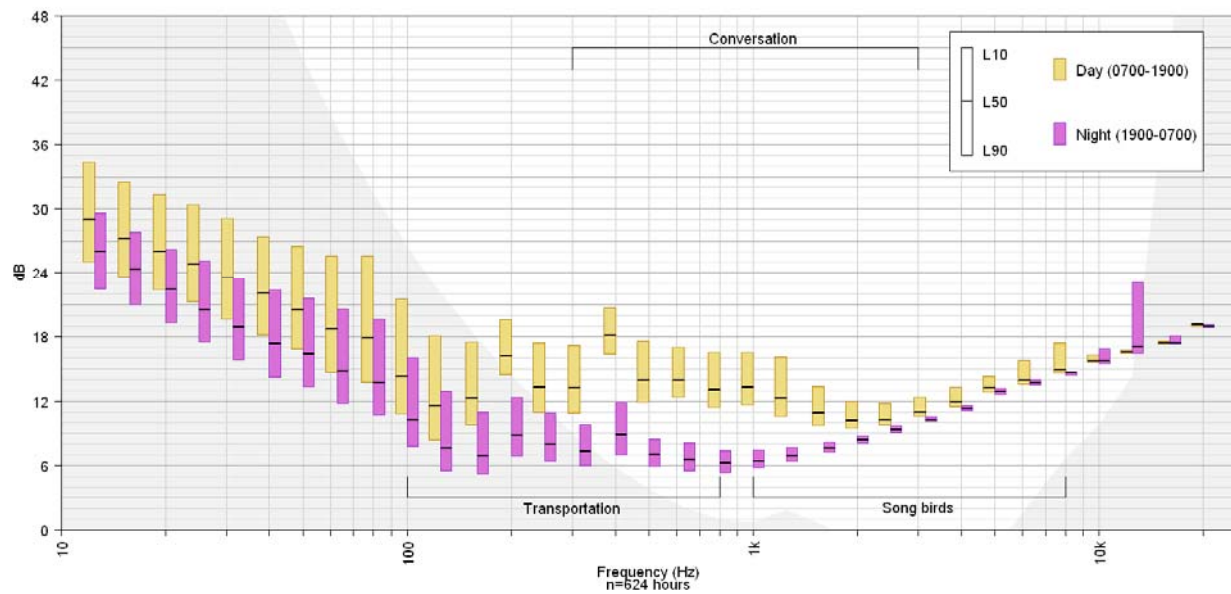


Figure 6. Day and night dB levels for 33 one-third octave bands at MORA006

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.

Natural Resource Program Center

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