



City of Rocks National Reserve

Acoustical Monitoring Report



ON THE COVER

(Inner City from Bath Rock, City of Rocks National Reserve)

NPS Photo

City of Rocks National Reserve

Acoustic Monitoring 2008-2009

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Executive Summary

Throughout 2008 and 2009, park staff at City of Rocks National Reserve gathered acoustical data at nine sites. Each site was deployed for at least 25 days. Each site was located in one of four management zones: California Trail (Cal Trail), Recreation (Rec), Natural, or Historic Rural Setting (HRS). The data collected at each of the nine sites will be used to inform an upcoming revision of the park's general management plan. The zones were defined in a 1995 management document (Comprehensive Management Plan, 1995).

In determining the current conditions of an acoustic environment, it is informative to examine how often sound pressure levels exceed certain values because variations in levels can be observed over time (or between sites). These values are useful for making comparisons, but should not be construed as thresholds of impact. Table 1 reports the percent of time that measurements were above four key sound pressure levels for two frequency ranges. The top value in each split-cell of Table 1 reports the *percent time above* for the 20 – 1,250 Hz range. It is useful to look at this low-frequency range because it includes transportation noise while excluding higher-frequency bird and insect sounds. Transportation is often a major contributor of low frequency sound, but the 20 – 1,250 Hz range does not correspond to a specific vehicle or type of transportation. Note that natural sources such as flowing water also produce low frequency sounds. The bottom *percent time above* value in each split-cell is calculated from the full 12.5-20,000 Hz range.

The first percent time above value in Table 1 is taken from recent studies which suggest that sound events as low as 35 dB can have adverse effects on blood pressure in sleeping humans (Haralabidis, 2008). The second value addresses the World Health Organization's recommendations that noise levels inside bedrooms remain below 45 dBA (Berglund et al., 1999). This level also serves as a close proxy for speech interference for rock climbers. Climbers 25 meters apart communicating in raised voices will begin to experience speech interruption around 44 dBA. The third value, 52 dBA, is based on the EPA's speech interference threshold for speaking in a raised voice to an audience at 10 meters. This value addresses the effects of sound on interpretive presentations in parks. The final value, 60 dBA, provides a basis for estimating impacts on normal voice communications at 1 meter. Hikers and visitors viewing scenic vistas in the park would likely be conducting such conversations.

Table 1. Percent time above metrics for acoustical monitoring sites at CIRO

Site	Frequency (Hz)	% Time above sound level 07h00 to 19h00				% Time above sound level 19h00 to 07h00			
		35dBA	45 dBA	52 dBA	60 dBA	35 dBA	45 dBA	52 dBA	60 dBA
CIRO001	20-1,250	4.20	0.29	0.04	0.00	1.35	0.08	0.00	0.00
	12.5-20,000	11.09	0.95	0.14	0.01	4.72	0.46	0.08	0.00
CIRO002	20-1,250	5.05	0.35	0.06	0.00	0.93	0.05	0.00	0.00
	12.5-20,000	10.07	0.56	0.07	0.00	39.89	8.54	0.00	0.00
CIRO003	20-1,250	4.97	0.47	0.07	0.00	0.84	0.03	0.00	0.00
	12.5-20,000	12.72	0.78	0.10	0.00	8.93	0.32	0.00	0.00
CIRO004	20-1,250	3.87	0.33	0.04	0.00	6.45	0.67	0.06	0.00
	12.5-20,000	4.26	0.39	0.06	0.00	9.26	0.88	0.10	0.00
CIRO005	20-1,250	12.96	1.57	0.14	0.01	2.78	0.26	0.01	0.00
	12.5-20,000	17.97	1.92	0.29	0.01	4.57	0.40	0.02	0.00
CIRO006	20-1,250	5.12	0.60	0.14	0.02	1.46	0.05	0.00	0.00
	12.5-20,000	10.22	0.98	0.27	0.06	3.23	0.13	0.01	0.00
CIRO007	20-1,250	6.45	0.54	0.10	0.00	2.06	0.17	0.01	0.00
	12.5-20,000	17.13	2.76	0.26	0.02	10.77	1.92	0.15	0.00
CIRO008	20-1,250	5.94	0.67	0.14	0.01	1.24	0.15	0.01	0.00
	12.5-20,000	12.78	1.17	0.21	0.01	3.40	0.25	0.01	0.00
CIRO009	20-1,250	6.54	0.60	0.12	0.01	0.92	0.08	0.01	0.00
	12.5-20,000	13.10	0.88	0.13	0.02	57.20	13.22	0.04	0.00

Table 2 shows results from in-depth, off-site analysis. The first two columns report the percent of time that certain sound sources were audible during eight continuous days of sound source analysis. During analysis, technicians identify each audible sound source and compile overall audibility statistics by hour. The remaining columns report existing sound levels as well as estimated natural ambient sound levels. This study indicated that human-caused sounds are audible infrequently at CIRO. Please see methods and results section for detailed explanation of findings.

Table 2. Mean percent time audible for extrinsic sounds and aircraft sounds

Site Location	Mean % time audible (all hours)		Median Existing Ambient (in dBA)		Median Natural Ambient (in dBA)	
	All Extrinsic sounds	All Aircraft sounds	Day	Night	Day	Night
CIRO001	20.2	18.6	28.0	24.9	27.1	24.4
CIRO002	10.8	10.7	25.3	31.4	24.6	31.2
CIRO003	7.5	4.8	24.8	22.3	24.2	22.1
CIRO004	5.5	4.5	21.5	18.7	21.2	18.7
CIRO005	3.5	3.2	25.7	21.6	25.4	21.6
CIRO006	2.6	2.6	23.5	19.2	23.3	19.2
CIRO007	4.6	1.8	27.2	20.2	26.9	20
CIRO008	2.6	2.2	25.2	19.4	24.9	19.3
CIRO009	1.9	1.8	26.3	37.3	26.2	37.3

Introduction

A 1998 survey of the American public revealed that 72 percent of respondents thought that providing opportunities to experience natural quiet and the sounds of nature was a very important reason for having national parks, while another 23 percent thought that it was somewhat important (Haas Wakefield 1998). In another survey specific to park visitors, 91 percent of respondents considered enjoyment of natural quiet and the sounds of nature as compelling reasons for visiting national parks (McDonald et. al 1995). Acoustic monitoring provides a scientific basis for assessing the current status of acoustic resources, identifying trends in resource conditions, quantifying impacts from other actions, assessing consistency with park management objectives and standards, and informing management decisions regarding desired future conditions.

City of Rocks National Reserve was designated as “Cassia Silent City of Rocks,” a National Natural Landmark in 1974. Existing protections for this area include a Cassia County noise ordinance which states in Title 7-1-3 that “it shall be unlawful and a misdemeanor for any person upon lands located within the City of Rocks National Reserve to operate a motor vehicle, motorized toy, or an audio device... in a manner that makes noise which is unreasonable considering the nature and purpose of the actor’s conduct, location, time of day or night, purpose for which the area was established, impact on park users, impact upon wildlife, and other factors...” (Cassia County Code, 2010).

National Park Service Natural Sounds Program

The NPS Natural Sounds Program (NSP) helps parks manage sounds in a way that balances access to the park with the expectations of park visitors and the protection of park resources. The NSP addresses acoustical issues raised by Congress, NPS Management Policies, and NPS Director’s Orders. An important element of this mission is working with the Federal Aviation Administration (FAA) to implement the National Parks Air Tour Management Act. Congress mandated that FAA and NPS jointly develop Air Tour Management Plans (ATMPs) for more than 106 parks where commercial air tours operate. The program also provides technical assistance to parks in the form of acoustic monitoring, data processing, park planning support, and comparative analyses of acoustic environments throughout the national park system.

Soundscape Planning Authorities

The National Park Service Organic Act of 1916 states that the purpose of national parks is "... to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." In addition to the NPS Organic Act, the Redwoods Act of 1978 affirmed that, "the protection, management, and administration of these areas shall be conducted in light of the high value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress."

Direction for management of natural soundscapes¹ is represented in 2006 Management Policy 4.9:

The Service will restore to the natural condition wherever possible those park soundscapes that have become degraded by unnatural sounds (noise), and will protect natural soundscapes from unacceptable impacts. Using appropriate management planning, superintendents will identify what levels and types of unnatural sound constitute acceptable impacts on park natural soundscapes. The frequencies, magnitudes, and durations of acceptable levels of unnatural sound will vary throughout a park, being generally greater in developed areas. In and adjacent to parks, the Service will monitor human activities that generate noise that adversely affects park soundscapes [acoustic resources], including noise caused by mechanical or electronic devices. The Service will take action to prevent or minimize all noise that through frequency, magnitude, or duration adversely affects the natural soundscape [acoustic resource] or other park resources or values, or that exceeds levels that have been identified through monitoring as being acceptable to or appropriate for visitor uses at the sites being monitored (NPS 2006a).

It should be noted that “the natural ambient sound level—that is, the environment of sound that exists in the absence of human-caused noise—is the baseline condition, and the standard against which current conditions in a soundscape [acoustic resource] will be measured and evaluated” (NPS 2006b). However, the desired acoustic condition may also depend upon the resources and the values of the park. For instance, “culturally appropriate sounds are important elements of the national park experience in many parks” (NPS 2006b). In this case, “the Service will preserve soundscape resources and values of the parks to the greatest extent possible to protect opportunities for appropriate transmission of cultural and historic sounds that are fundamental components of the purposes and values for which the parks were established” (NPS 2006b).

¹ The 2006 Management Policy 4.9 and related documents refer to “soundscapes” instead of “acoustic resources.” When quoting from this authority, it is advisable to note that the term often refers to resources rather than visitor perceptions.

Study Area

Nine acoustical monitors were deployed between the summer of 2008 and the fall of 2009. These sites were selected because they were representative of either the dominant vegetation zones or management zones in the park. The CIRO004 and CIRO007 datasets were collected in the same locale, but in different seasons. The four management zones are as follows: California Trail (Cal Trail), Recreation (Rec), Natural, and Historic Rural Setting (HRS). The zones were defined in a 1996 management document (Comprehensive Management Plan, 1996).

Table 3. Site locations

Site	Site Name	Dates	Vegetation	Elev (m)	Latitude	Longitude	Zone
CIRO001	NE of Indian Grove	6/3/08-8/8/08	pinon pine	2,297	42.115556	-113.72444	Natural
CIRO002	Geo-Watt Trail	8/9/08-9/17/08	sage and bitterbrush 70% pinon pine 20%	1937	42.095000	-113.69722	Natural
CIRO003	Camp Rock	9/17/08-10/21/08	sagebrush (80%) pinon pine (10%) bitterbrush (1%)	1809	42.071111	-113.68944	Cal Trail
CIRO004	Campsite 27	11/20/08-12/17/08	sagebrush, scattered pinon pine, juniper.	1893	42.070833	-113.71306	Rec
CIRO005	Bath Rock, 300 m w of Bath Rock	3/31/09-5/5/09	low scrub sagebrush some juniper	2010	42.07476	-113.72601	Rec
CIRO006	Smoky Mountain	5/13/09-6/12/09	pinon/juniper forest	1933	42.05754	-113.69143	Natural
CIRO007	Campsite 27, same locale as CIRO004	6/12/09-7/23/09	sagebrush scattered pinon pine and juniper	1893	42.07101	-113.71325	Rec
CIRO008	SW corner of park	7/24/09-8/24/09	burned pinon juniper 70% grasses and forbs	1966	42.03599	-113.73206	HRS
CIRO009	Pinnacle Pass	8/26/09-9/29/09	open sagebrush steppe w/ scattered pinon/juniper	1883	42.04024	-113.71045	Cal Trail



Figure 1. An example of an acoustical monitoring set-up at CIRO002, Geo-Watt Trail, in the park's natural area. Solar panel is seen in foreground. The microphone (left) and anemometer (right) are seen in the background.

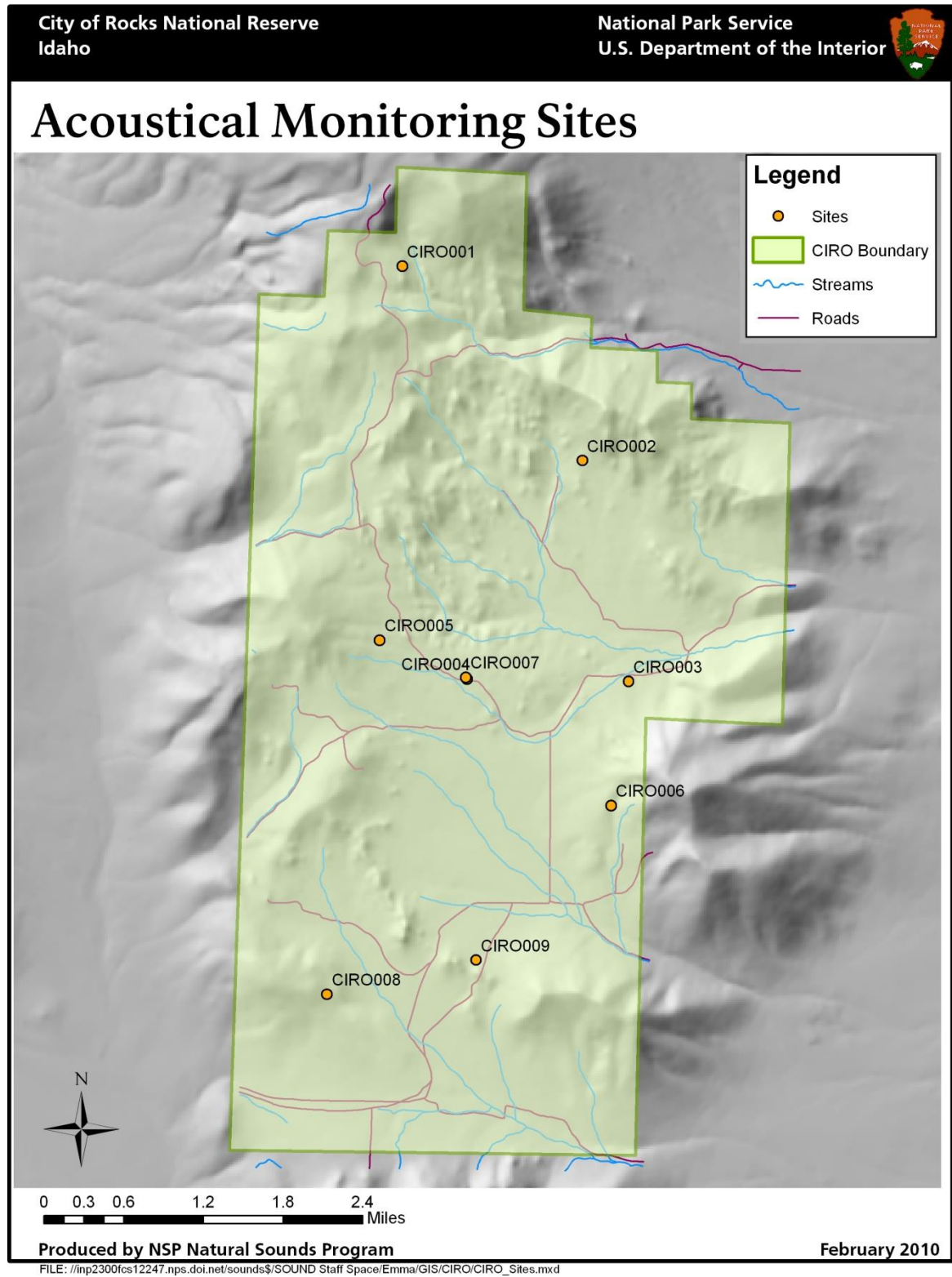


Figure 2. Location of acoustical monitoring systems in CIRO.

Methods

Automatic Monitoring

A Larson Davis 824 sound level meter (SLM) was employed at each monitoring site in CIRO. The Larson Davis SLM is a hardware-based, real-time analyzer which constantly records one second sound pressure level (SPL) and 1/3 octave band data, and exports these data to a PDA for storage. This Larson Davis-based site met American National Standards Institute (ANSI) Type 1 standards.

The Larson Davis sampling station consisted of:

- Microphone with preamplifier and environmental shroud
- One gel cell 35 Ah lead acid battery
- Solar panel
- Anemometer
- Edirol R09 MP3 recorder
- Meteorological data logger

The acoustic sampling station collected:

- SPL data in the form of A-weighted decibel readings (dBA) every second
- Continuous digital audio recordings (64 Kbps mp3)
- One third octave band data every second ranging from 12.5 Hz – 20,000 Hz

Off-Site Listening



Because fully analyzing 30 days of continuous data for nine monitoring stations would take far too long, NSP examines a subset of SPL and audio data. For each site, Natural Sounds Program (NSP) staff visually analyzed eight days of spectral data in order to identify durations of audible sound sources. See Example of Visual Analysis at the end of this report for more information on this method. Audio data were employed to confirm identification. Bose Quiet Comfort Noise Canceling headphones were used for off-site audio playback to minimize limitations imposed by the office acoustic environment. Analyzing this number of days out of a 30 day monitoring period assures a statistically strong prediction of sound source audibility. The total percent time extrinsic sounds were audible was used to calculate the natural ambient sound level for each hour.



On-Site Listening

On-site listening is the practice of placing an observer near the acoustic monitoring station with a handheld Personal Digital Assistant (PDA). The observer listens for a designated period of time (generally, one hour), and identifies all sound sources and their durations. On-site listening takes full advantage of human binaural hearing capabilities, and closely matches the experience of park visitors. Logistic constraints prevent comprehensive sampling by this technique, but selective samples of on-site listening provide a basis for relating the results of off-site listening to the probable auditory perception of events by park visitors and wildlife.

On-site listening sessions are also an excellent screening tool for parks initiating acoustic environment studies. They produce an extensive inventory of sound sources, require little equipment or training, and can help educate park staff and volunteers.

Thus, numerous periods of on-site listening were conducted in order to discern the type, timing, and duration during sound-level data collection at CIRO. Staff recorded the beginning and ending times of all audible sound sources using custom-designed PDA software. These on-site listening sessions provided the basis for the calculation of metrics, including the period of time between noise events (average noise free interval [NFI]), percent time each sound source was audible, and maximum, minimum, and mean length (in seconds) of sound source events.

Calculation of Metrics

The current status of the acoustic environment can be characterized by spectral measurements, durations, and overall sound levels (intensities). The NSP uses descriptive figures and metrics to interpret these characteristics. Two fundamental descriptors are existing and natural ambient sound levels. Existing ambient (L_{50}) is characterized by spectra (in dB) drawn from uncensored data, and encompasses all sound sources. Natural ambient (L_{nat}) is an estimate that attempts to remove the sound energy contributed by all extrinsic or anthropogenic noises from the existing ambient. For a given hour (or other specified time period), L_{nat} is calculated to be the decibel level exceeded x percent of the time, where x is defined by the equation

$$x = \frac{100 - P_H}{2} + P_H ,$$

and P_H is the percentage of samples containing extrinsic or anthropogenic sounds for the hour. For example, if human caused sounds are present 30% of the hour, $x = 65$, and the L_{nat} is equal to the L_{65} , or the level exceeded 65% of the time. Note: all samples with local wind speed greater than 5 m/s are excluded from analysis for natural and existing ambient. To see the results of these calculations, please see Figure 3 through Figure 11.

Results

On-site Listening

Table 4 through Table 12 below display the combined results of on-site listening sessions at each site. They are essentially an inventory of the sounds one is likely to hear at or near each location. Each audible sound source is listed in the first column. Percent time audible, or %TA, is the second column. The third column, Max event length, reports the maximum event length (in seconds) among the sessions for each sound source. Likewise, mean event length and min event length columns report the mean and minimum length of events. SD event length reports the standard deviation among event lengths, and count reports the total number of times each sound source was audible. The last row in the table, noise free interval (NFI), is a metric which describes the length of time between extrinsic or human-caused events. Event lengths are reported in seconds.

The results of these daytime on-site listening sessions reveal that at nearly every site, the most dominant non-natural sound is jet aircraft. The exception to this case is CIRO007, the summer site at campsite 27, where vehicles were heard more often than jets.

The longest mean noise free interval (NFI) of all sites was 315 seconds (5 min 15 sec), recorded at Campsite 27 during the winter (CIRO004). The longest maximum NFI of all sites was 1,441 seconds (24 min), and was recorded at Bath Rock (CIRO005). Most of the attended logging sessions were performed during the day when human-caused sound is generally highest. Therefore, it is likely that an attended logging sessions performed at night or very early in the morning would produce an even longer NFI.

Table 4. Summary of on-site audibility of sound sources at CIRO001 n=10.

Sound ID	Sound Source	%TA	Max Event Length	Mean Event Length	Min Event Length	SD Event Length	# Events
1	Aircraft	0.0	8	8	7	1	2
1.1	Jet	18.0	176	51	4	55	52
1.2	Aircraft, Propeller	8.0	202	54	3	58	22
6	Motor	0.0	26	16	7	13	2
9	Domestic Animal	4.0	20	5	1	4	102
9.2	Cow	0.0	3	2	1	1	2
20	Non-natural Unknown	0.0	8	8	8		1
21	Wind	60.0	1,227	93	2	171	94
22.2	Flowing Water	8.0	461	126	4	155	9
23	Thunder	6.0	82	23	4	18	37
25	Bird	62.0	936	59	1	119	154
28	Insect	79.0	1,621	43	1	135	270
G0100	All Aircraft	25.7					
G2000	All Non-natural Sources	28.8					
G4000	All Natural Sources	96.8					
NFI	Noise Free Interval	71.3	839	69	1	127	153

Table 5. Summary of on-site audibility of sound sources at CIRO002 n=7

Sound ID	Sound Source	%TA	Max Event Length	Mean Event Length	Min Event Length	SD Event Length	# Events
1	Aircraft	1.0	23	16	14	4	4
1.1	Jet	24.0	204	97	8	68	32
1.2	Aircraft, Propeller	10.0	306	102	8	93	12
2	Vehicle	6.0	143	30	3	33	24
8	People	0.0	7	7	7		1
8.5	Gunshot	0.0	2	2	2		1
21	Wind	52.0	1,116	178	14	264	37
22.1	Rain/Fog Drip	3.0	328	328	328		1
25	Bird	64.0	901	101	0	175	80
28	Insect	98.0	1,799	516	17	640	24
40	Natural Unknown	0.0	6	5	3	2	3
G0100	All Aircraft	32.9					
G0200	All Road Vehicles	5.7					
G2000	All Non-natural Sources	37.8					
G4000	All Natural Sources	99.5					
NFI	Noise Free Interval	62.2	1,108	121	1	198	65

Table 6. Summary of on-site audibility of sound sources at CIRO003 n=7

Sound ID	Sound Source	%TA	Max Event Length	Mean Event Length	Min Event Length	SD Event Length	# Events
1.1	Jet	24.0	812	99	1	157	32
1.2	Aircraft, Propeller	9.0	205	105	1	73	11
2	Vehicle	17.0	260	75	5	71	29
2.5	Heavy Equipment	11.0	1,372	1,372	1,372		1
8.5	Gunshot	0.0	3	3	3		1
9	Domestic Animal	0.0	11	5	2	3	11
20	Non-natural Unknown	0.0	7	5	3	2	3
21	Wind	26.0	1,349	95	8	230	35
24.1	Squirrel	0.0	9	9	9		1
24.3	Coyote	1.0	99	99	99		1
25	Bird	64.0	826	97	0	143	85
27	Amphibian	5.0	111	17	0	21	40
28	Insect	86.0	1,799	359	5	553	31
40	Natural Unknown	0.0	6	6	6		1
G0100	All Aircraft	32.6					
G0200	All Road Vehicles	27.3					
G2000	All Non-natural Sources	51.7					
G4000	All Natural Sources	95.6					
NFI	Noise Free Interval	48.4	756	114	1	163	55

Table 7. Summary of on-site audibility of sound sources at CIRO004 n=5

Sound ID	Sound Source	%TA	Max Event Length	Mean Event Length	Min Event Length	SD Event Length	# Events
1.1	Jet	13.0	199	92	9	69	13
1.2	Aircraft, Propeller	2.0	137	137	137		1
2	Vehicle	1.0	44	24	10	14	5
21	Wind	99.0	1,798	593	26	516	15
25	Bird	15.0	160	31	0	33	44
40	Natural Unknown	0.0	10	10	10		1
G0100	All Aircraft	14.8					
G0200	All Road Vehicles	1.4					
G2000	All Non-natural Sources	16.2					
G4000	All Natural Sources	98.8					
NFI	Noise Free Interval	83.8	1,029	315	1	324	24

Table 8. Summary of on-site audibility of sound sources at CIRO005 n=8

Sound ID	Sound Source	%TA	Max Event Length	Mean Event Length	Min Event Length	SD Event Length	# Events
1.1	Jet	26.0	310	89	5	87	42
1.2	Aircraft, Propeller	5.0	155	74	0	58	10
2	Vehicle	2.0	80	45	3	36	7
8	People	4.0	92	21	4	20	30
9	Domestic Animal	0.0	13	8	4	5	3
20	Non-natural Unknown	0.0	6	6	6		1
21	Wind	92.0	1,799	836	52	799	16
22.1	Rain/Fog Drip	1.0	95	95	95		1
25	Bird	79.0	1,009	112	1	139	103
28	Insect	12.0	175	18	0	23	97
40	Natural Unknown	0.0	23	15	7	11	2
G0100	All Aircraft	30.6					
G0200	All Road Vehicles	2.2					
G2000	All Non-natural Sources	35.1					
G4000	All Natural Sources	99.1					
NFI	Noise Free Interval	64.9	1,441	122	2	232	77

Table 9. Summary of on-site audibility of sound sources at CIRO006 n=6

Sound ID	Sound Source	%TA	Max Event Length	Mean Event Length	Min Event Length	SD Event Length	# Events
1.1	Jet	27.0	344	107	4	102	27
1.2	Aircraft, Propeller	4.0	258	161	16	128	3
9	Domestic Animal	2.0	53	26	10	17	7
20	Non-natural Unknown	0.0	15	15	15		1
21	Wind	57.0	1,798	306	1	552	20
22.1	Rain/Fog Drip	1.0	41	18	6	13	7
25	Bird	94.0	1,799	350	8	587	29
28	Insect	43.0	747	45	2	108	104
G0100	All Aircraft	31.0					
G2000	All Non-natural Sources	32.6					
G4000	All Natural Sources	99.7					
NFI	Noise Free Interval	67.5	1,225	203	1	298	36

Table 10. Summary of on-site audibility of sound sources at CIRO007 n=4

Sound ID	Sound Source	%TA	Max Event Length	Mean Event Length	Min Event Length	SD Event Length	# Events
1	Aircraft	8.0	290	115	13	117	5
1.1	Jet	25.0	222	87	0	81	21
1.2	Aircraft, Propeller	4.0	104	42	12	30	7
2	Vehicle	34.0	161	38	1	44	65
2.2	Motorcycle	1.0	52	24	15	19	4
7.4	Dumpster / Trashcan	0.0	3	2	1	1	4
8	People	26.0	446	41	0	97	47
9	Domestic Animal	1.0	14	2	0	3	18
20	Non-natural Unknown	1.0	16	6	1	6	12
21	Wind	28.0	672	72	4	157	29
25	Bird	90.0	1,799	155	1	407	43
27	Amphibian	0.0	3	3	3		1
28	Insect	52.0	602	43	1	95	91
40	Natural Unknown	0.0	1	1	1		1
G0100	All Aircraft	36.1					
G0200	All Road Vehicles	34.4					
G2000	All Non-natural Sources	70.6					
G4000	All Natural Sources	96.5					
NFI	Noise Free Interval	30.2	371	30	1	51	75

Table 11. Summary of on-site audibility of sound sources at CIRO008 n=7

Sound ID	Sound Source	%TA	Max Event Length	Mean Event Length	Min Event Length	SD Event Length	# Events
1.1	Jet	24.0	341	116	6	92	26
1.2	Aircraft, Propeller	10.0	268	80	4	85	16
2	Vehicle	2.0	46	32	9	18	6
9	Domestic Animal	3.0	33	13	3	8	26
21	Wind	73.0	938	138	5	195	67
22.1	Rain/Fog Drip	4.0	206	83	16	74	6
23	Thunder	7.0	290	72	17	89	12
25	Bird	67.0	708	118	6	151	72
28	Insect	94.0	1,697	543	21	520	22
40	Natural Unknown	0.0	6	6	6		1
G0100	All Aircraft	31.8					
G0200	All Road Vehicles	1.5					
G2000	All Non-natural Sources	34.9					
G4000	All Natural Sources	99.1					
NFI	Noise Free Interval	65.1	916	131	1	192	63

Table 12. Summary of on-site audibility of sound sources at CIRO009 n=6

Sound ID	Sound Source	%TA	Max Event Length	Mean Event Length	Min Event Length	SD Event Length	# Events
1.1	Jet	17.0	262	103	9	81	24
1.2	Aircraft, Propeller	9.0	310	95	9	87	14
2	Vehicle	7.0	242	53	11	70	18
20	Non-natural Unknown	1.0	30	16	2	8	13
21	Wind	51.0	950	124	6	178	60
25	Bird	79.0	3,598	168	0	455	68
28	Insect	100.0	3,599	1,797	116	1,262	8
G0100	All Aircraft	24.1					
G0200	All Road Vehicles	6.7					
G2000	All Non-natural Sources	31.6					
G4000	All Natural Sources	99.7					
NFI	Noise Free Interval	69.7	1,109	210	1	253	48

Off-Site analysis: Audibility Results

Table 14 through Table 21 show the percent time that certain sound sources were audible during eight days of off-site, visual analysis. The most frequently identified extrinsic sound source was commercial jets. CIRO007, Campsite 27, is an exceptional case because vehicles were audible most frequently during the summer. Off-site results mirror the results of on-site observations, as discussed in the on-site analysis section. Only extrinsic noise events were logged during visual analysis. However, a number of recognizable biologic sounds were noted in the process, such as: great horned owls, coyotes, common poorwills, common nighthawks, western scrub jays, and black capped chickadees. In addition, the acoustical monitoring systems recorded thunderstorms and rock fall events. These recordings will be added to the Natural Sounds Program archive and will be made available to the park.

Because the park expressed particular interest in the frequency of military jet overflights, all days from all sites were scanned for military jet events. In total, 21 events were detected at various sites: CIRO001, CIRO003, CIRO005, CIRO006, CIRO008, and CIRO009. The median event length for military jet overflight events was 78 seconds, and the median maximum sound pressure level was 81.9 dBA. The overall maximum sound pressure level of recorded military jets, 98.2, occurred on 8/11/2009 at CIRO008. See Table 13 below for additional information.

Table 13. All detected military overflights for all days at all sites.

Site	Date	Hour	Event Length (s)	Max SPL
CIRO001	7/25/2008	17	41	75.6
CIRO003	9/19/2008	9	31	50.5
CIRO003	9/19/2008	9	93	66.5
CIRO003	9/23/2008	16	123	96.2
CIRO003	10/21/2008	17	55	88.3
CIRO005	5/1/2009	13	165	87.5
CIRO006	5/14/2009	10	173	74.4
CIRO008	8/11/2009	16	17	96.0
CIRO008	8/11/2009	16	82	98.2
CIRO008	8/13/2009	16	24	89.0
CIRO008	8/13/2009	16	41	81.9
CIRO008	8/13/2009	10	110	67.1
CIRO008	8/14/2009	10	108	71.7
CIRO008	8/14/2009	13	24	63.8
CIRO008	8/14/2009	13	49	85.1
CIRO008	8/14/2009	14	72	94.6
CIRO008	8/17/2009	9	78	72.1
CIRO008	8/18/2009	12	66	97.3
CIRO009	9/1/2009	12	107	79.5
CIRO009	9/18/2009	12	124	93.6
CIRO009	9/28/2009	10	162	62.1

Table 14. Summary of off-site, visual analysis of audible sound sources at CIRO001.

Sound Source	% Time Audible Daytime (07-18h)	% Time Audible Nighttime (19h-06h)	% Time Audible Daily (00-23h)	Mean # Daily Events
Aircraft, Unknown	0	0.1	0.1	0.1
Jet	16.9	8.7	12.8	57.8
Propeller	9.4	2.3	5.9	23.9
Non Natural Unknown	0.4	0.7	0.6	2.6
Cow	1	1.3	1.1	7.5
Total Aircraft	26	11.2	18.6	81.8
Total Non Natural Unknown	0.4	0.7	0.6	2.6
Total Domestic Animal	1	1.3	1.1	7.5
Total Non Natural	27.3	13	20.2	91.9

Table 15. Summary of off-site, visual analysis of audible sound sources at CIRO002.

Sound Source	% Time Audible Daytime (07-18h)	% Time Audible Nighttime (19h-06h)	% Time Audible Daily (00-23h)	Mean # Daily Events
Jet	9.6	3.8	6.7	28.3
Propeller	6.1	2	4	14.9
Helicopter	0	0	0	0.1
Non Natural Unknown	0.1	0.2	0.1	0.4
Total Aircraft	15.6	5.8	10.7	43.2
Total Non Natural Unknown	0.1	0.2	0.1	0.4
Total Non Natural	15.8	5.9	10.8	43.6

Table 16. Summary of off-site, visual analysis of audible sound sources at CIRO003.

Sound Source	% Time Audible Daytime (07-18h)	% Time Audible Nighttime (19h-06h)	% Time Audible Daily (00-23h)	Mean # Daily Events
Jet	4.5	2.3	3.4	17.7
Propeller	2.2	0.6	1.4	5.5
Helicopter	0	0	0	0.1
Vehicle	4.1	1.4	2.8	20.4
Motorcycle	0	0	0	0.1
Non Natural Unknown	0	0	0	0.1
Total Aircraft	6.7	2.9	4.8	23.3
Total Vehicle	4.1	1.4	2.8	20.5
Total Non Natural Unknown	0	0	0	0.1
Total Non Natural	10.7	4.3	7.5	43.9

Table 17. Summary of off-site, visual analysis of audible sound sources at CIRO004.

Sound Source	% Time Audible Daytime (07-18h)	% Time Audible Nighttime (19h-06h)	% Time Audible Daily (00-23h)	Mean # Daily Events
Jet	4.4	2.5	3.4	16.8
Propeller	1.7	0.5	1.1	4.3
Vehicle	1.7	0.2	1	7.2
People, Voices	0	0	0	0.1
Total Aircraft	6.1	3	4.5	21.1
Total Vehicle	1.7	0.2	1	7.2
Total People	0	0	0	0.1
Total Non Natural	7.7	3.2	5.5	28.5

Table 18. Summary of off-site, visual analysis of audible sound sources at CIRO005.

Sound Source	% Time Audible Daytime (07-18h)	% Time Audible Nighttime (19h-06h)	% Time Audible Daily (00-23h)	Mean # Daily Events
Jet	3	1.4	2.2	11.8
Propeller	1.7	0.5	1.1	4.4
Vehicle, Unknown	0	0	0	0.1
Vehicle	0	0	0	0.3
Non Natural Unknown	0.1	0	0	0.2
People, Voices	0.3	0.1	0.2	0.6
Total Aircraft	4.7	1.8	3.2	16.2
Total Vehicle	0.1	0	0.1	0.4
Total Non Natural Unknown	0.1	0	0	0.2
Total People	0.3	0.1	0.2	0.6
Total Non Natural	5.1	1.9	3.5	17.5

Table 19. Summary of off-site, visual analysis of audible sound sources at CIRO006.

Sound Source	% Time Audible Daytime (07-18h)	% Time Audible Nighttime (19h-06h)	% Time Audible Daily (00-23h)	Mean # Daily Events
Jet	2.4	1.2	1.8	11.4
Propeller	1.2	0.4	0.8	3.9
Non Natural Unknown	0	0	0	0.1
Dog	0.1	0	0	0.1
Total Aircraft	3.5	1.6	2.6	15.3
Total Non Natural Unknown	0	0	0	0.1
Total Domestic Animal	0.1	0	0	0.1
Total Non Natural	3.6	1.6	2.6	15.5

Table 20. Summary of off-site, visual analysis of audible sound sources at CIRO007.

Sound Source	% Time Audible Daytime (07-18h)	% Time Audible Nighttime (19h-06h)	% Time Audible Daily (00-23h)	Mean # Daily Events
Jet	1.6	0.7	1.2	8.4
Propeller	1.1	0.3	0.7	3.2
Vehicle	2.6	1.2	1.9	14.2
Non Natural Unknown	0.1	0	0	0.1
People, Voices	0.6	1.3	0.9	2.6
Dog	0	0	0	0.1
Cow	0.1	0.1	0.1	0.6
Total Aircraft	2.7	1	1.8	11.6
Total Vehicle	2.6	1.2	1.9	14.2
Total Non Natural Unknown	0.1	0	0	0.1
Total People	0.6	1.3	0.9	2.6
Total Domestic Animal	0.1	0.1	0.1	0.6
Total Non Natural	5.8	3.4	4.6	29.2

Table 20. Summary of off-site, visual analysis of audible sound sources at CIRO008.

Sound Source	% Time Audible Daytime (07-18h)	% Time Audible Nighttime (19h-06h)	% Time Audible Daily (00-23h)	Mean # Daily Events
Jet	1.9	0.8	1.4	9.6
Propeller	1.3	0.4	0.9	4
Vehicle	0.1	0.1	0.1	0.5
Cow	0.2	0.5	0.4	0.9
Total Aircraft	3.2	1.2	2.2	13.6
Total Vehicle	0.1	0.1	0.1	0.5
Total Domestic Animal	0.2	0.5	0.4	0.9
Total Non Natural	3.4	1.8	2.6	15

Table 21. Summary of off-site, visual analysis of audible sound sources at CIRO009.

Sound Source	% Time Audible Daytime (07-18h)	% Time Audible Nighttime (19h-06h)	% Time Audible Daily (00-23h)	Mean # Daily Events
Jet	1.5	0.7	1.1	6.8
Propeller	1	0.3	0.7	3.1
Vehicle	0.2	0.1	0.2	0.7
Total Aircraft	2.5	1	1.8	9.9
Total Vehicle	0.2	0.1	0.2	0.7
Total Non Natural	2.7	1.1	1.9	10.6

Off-Site Analysis: Metrics

In order to determine the effect extrinsic noise audibility has on the acoustic environment, it is useful to examine the median hourly exceedence metrics. Figure 3 through 11 show existing ambient levels and natural ambient levels for each site. They are plotted with identical y axes to facilitate site-to-site comparison. The existing ambient (or median) level for each hour is marked by the upper limit of the gray boxes while natural ambient levels (L_{nat}) are marked by the lower limit of the gray boxes. The height of the box is a measure of the contribution of anthropogenic noise to the existing ambient sound levels per hour. Thus, the size of these boxes is directly related to the percent time that human caused sounds are audible. When boxes do not appear, the natural and existing ambient levels were either very close to each other, or equal for that hour.

As is evident in the following figures, human-caused sounds raised the natural ambient levels more during the daytime hours than at night. Overall, human-caused sounds raised the existing ambient levels only slightly. This figure also shows exceedence metrics L_{10} and L_{90} , which essentially mark the average maximum and minimum levels over each 30 day monitoring period. At sites where nighttime sound levels exceeded daytime sound levels (CIRO003 or CIRO009, for instance), an evening insect chorus was present. Likewise, when dBA vs. Hour graphs show a dominant spike in dBA in morning hours (CIRO007), a morning bird chorus was present. See Methods section or Glossary for definitions of L_{10} , L_{nat} , L_{50} , and L_{90} .

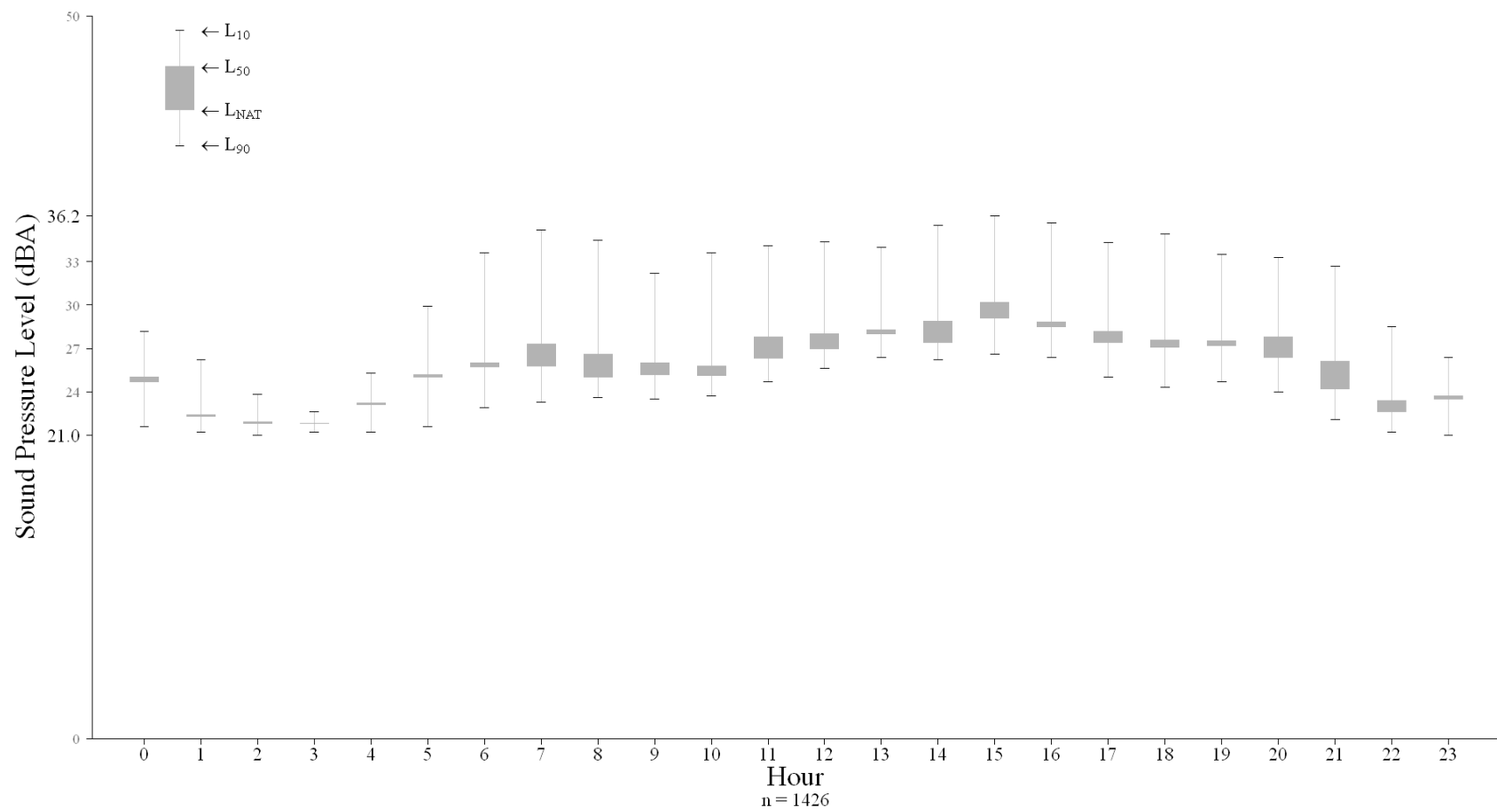


Figure 3. Median hourly exceedence metrics at CIRO001 in dBA

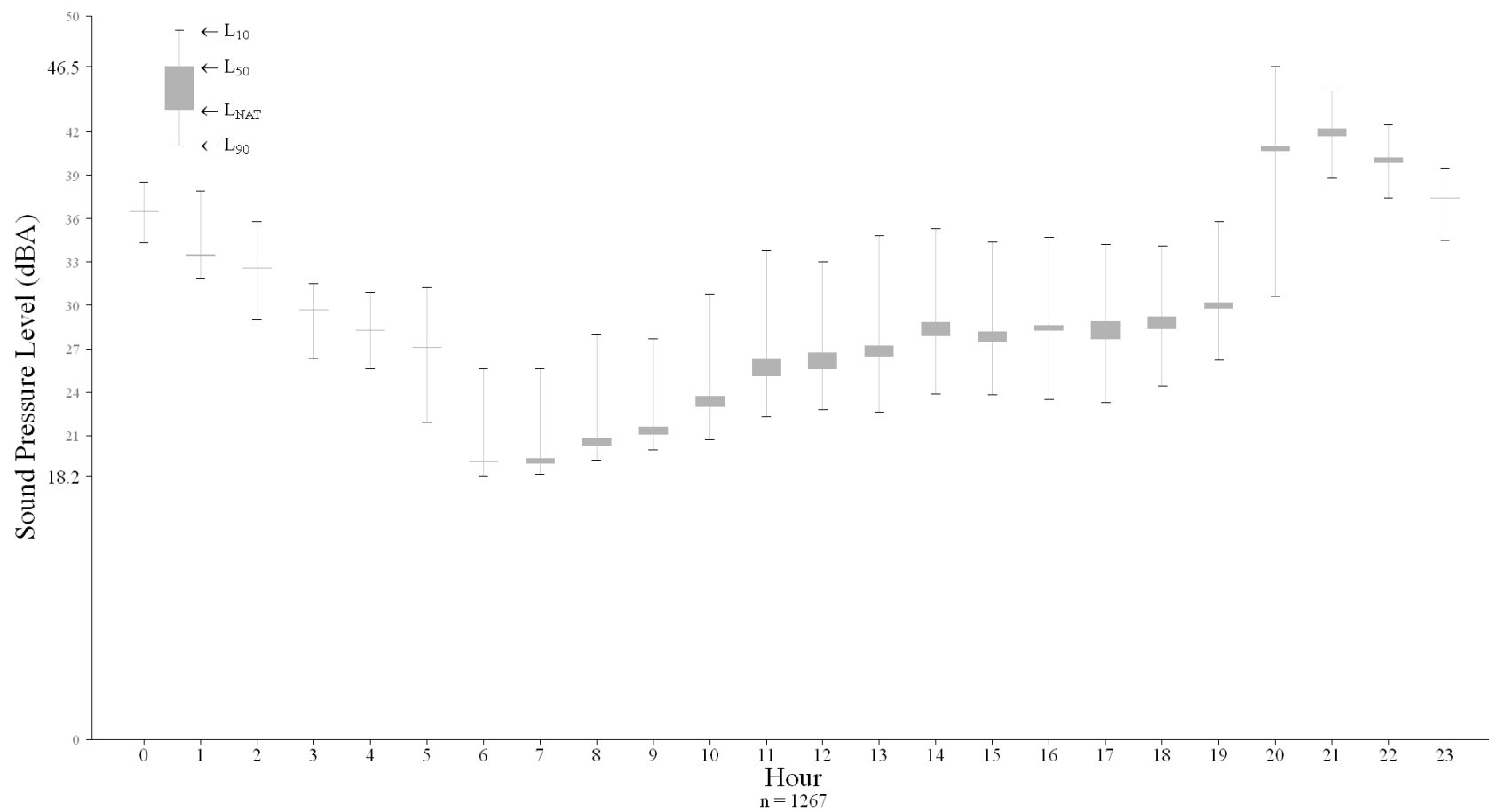


Figure 4. Median hourly exceedence metrics at CIRO002 in dBA

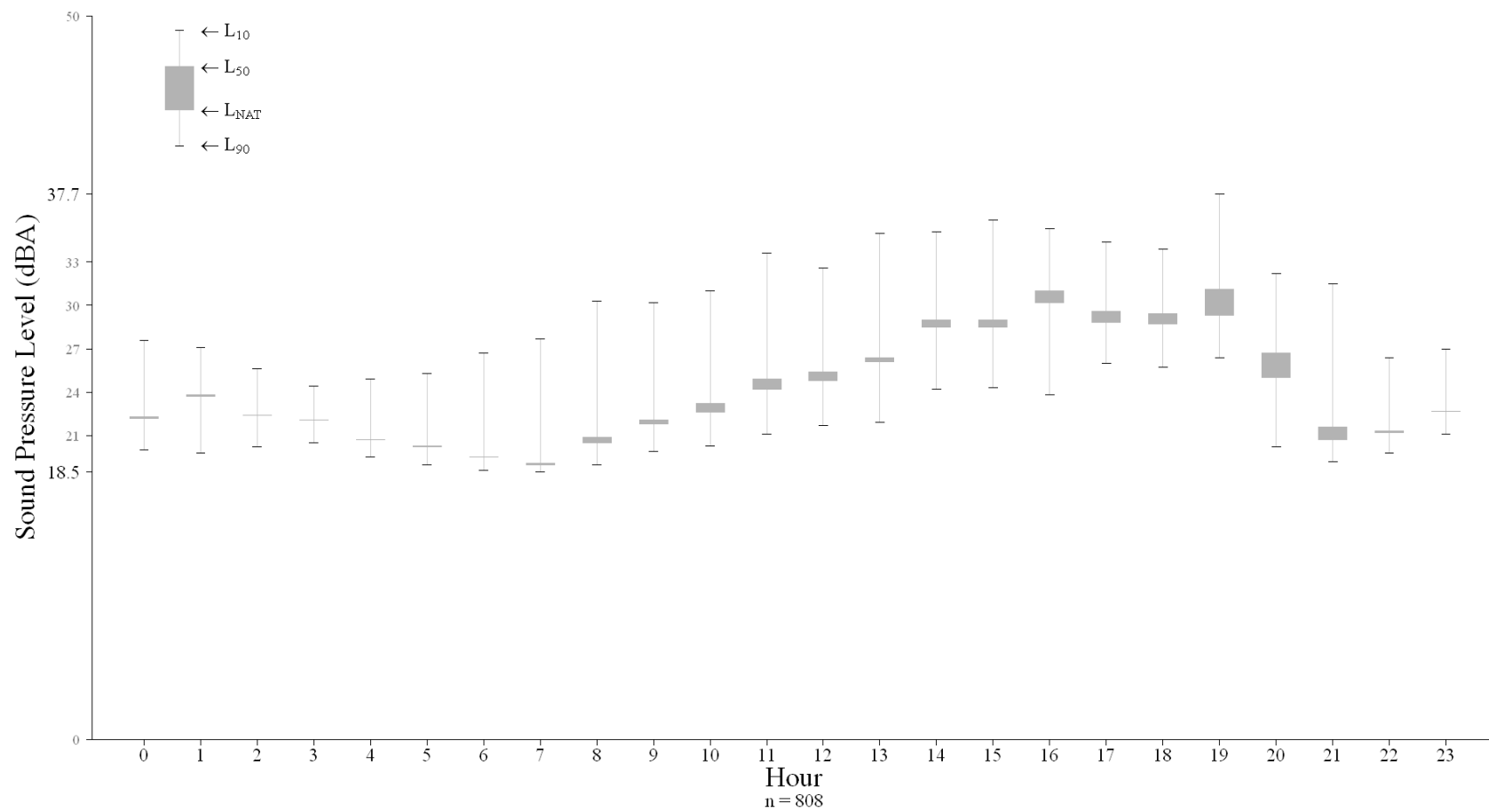


Figure 5. Median hourly exceedence metrics at CIRO003 in dBA

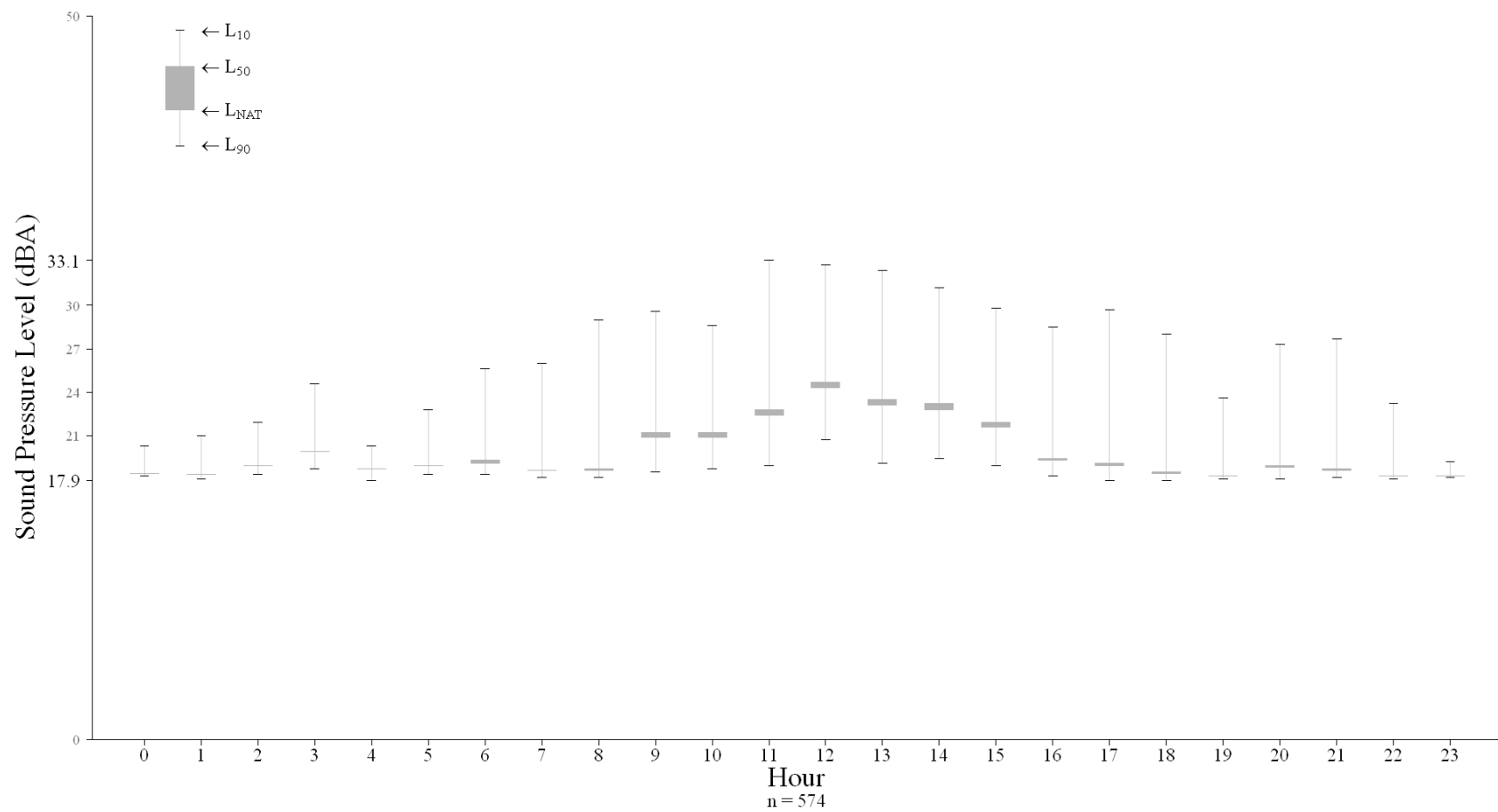


Figure 6. Median hourly exceedence metrics at CIRO004 in dBA

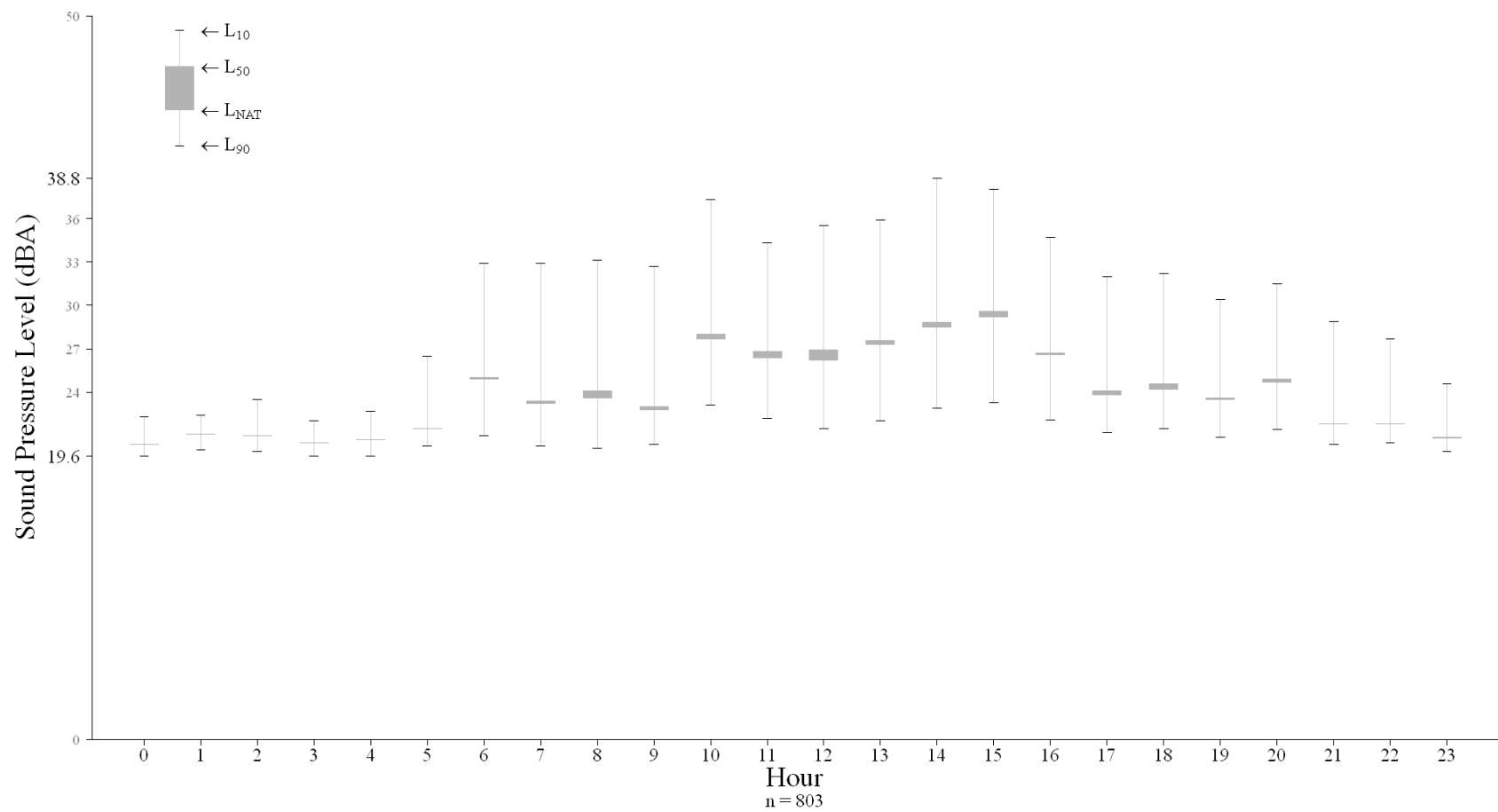


Figure 7. Median hourly exceedence metrics at CIRO005 in dBA

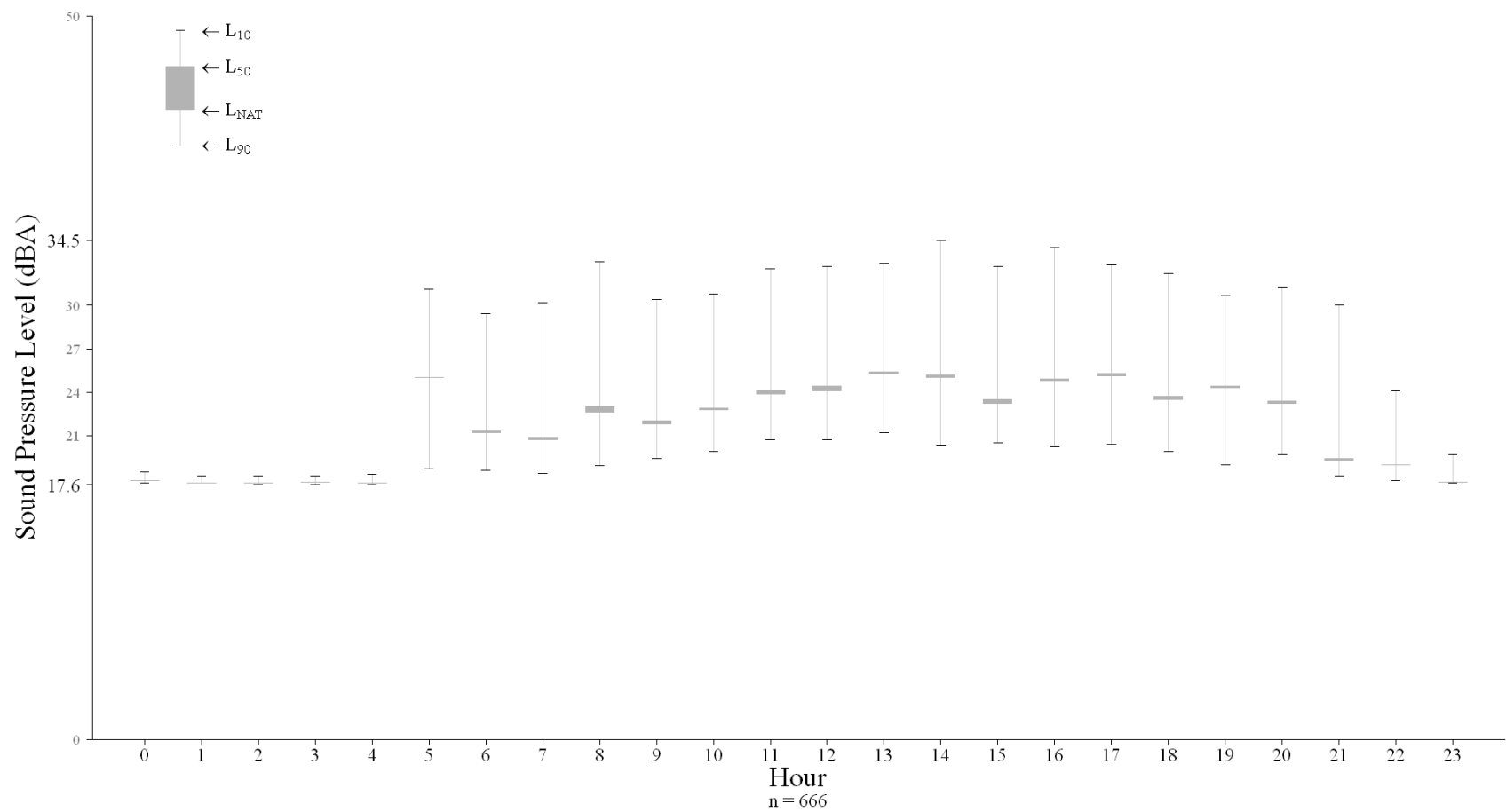


Figure 8. Median hourly exceedence metrics at CIRO006 in dBA

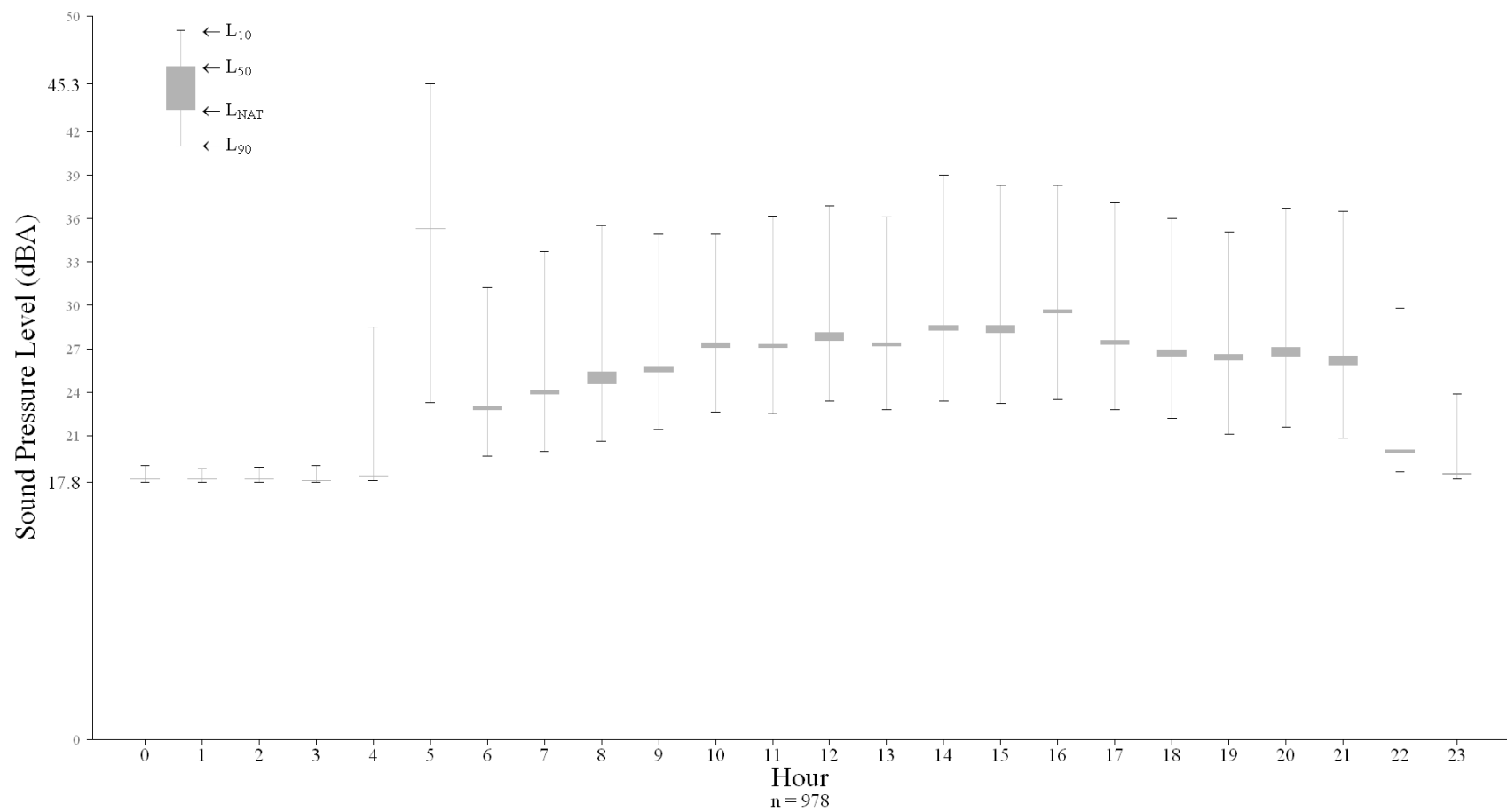


Figure 9. Median hourly exceedence metrics at CIRO007 in dBA

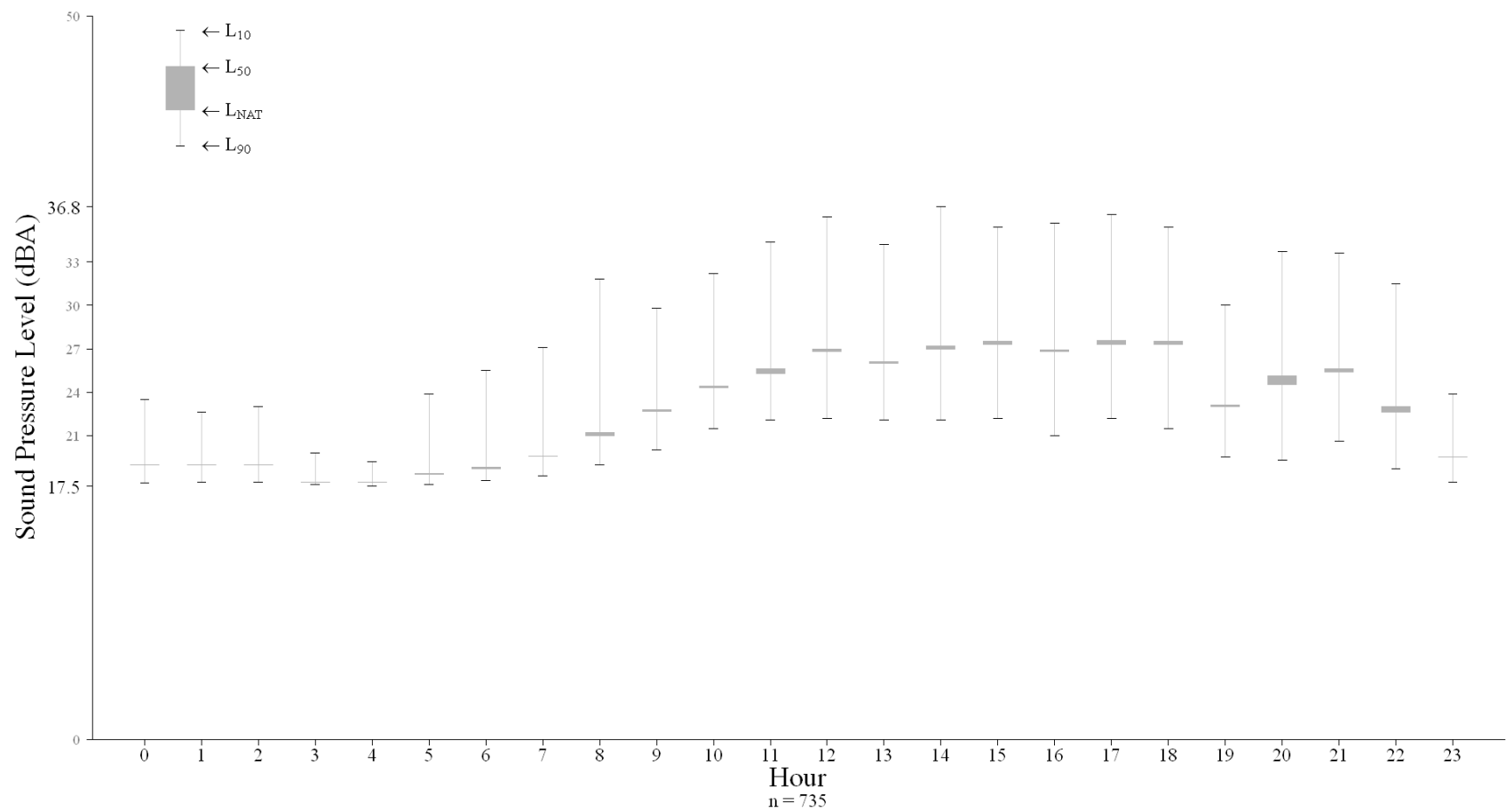


Figure 10. Median hourly exceedence metrics at CIRO008 in dBA

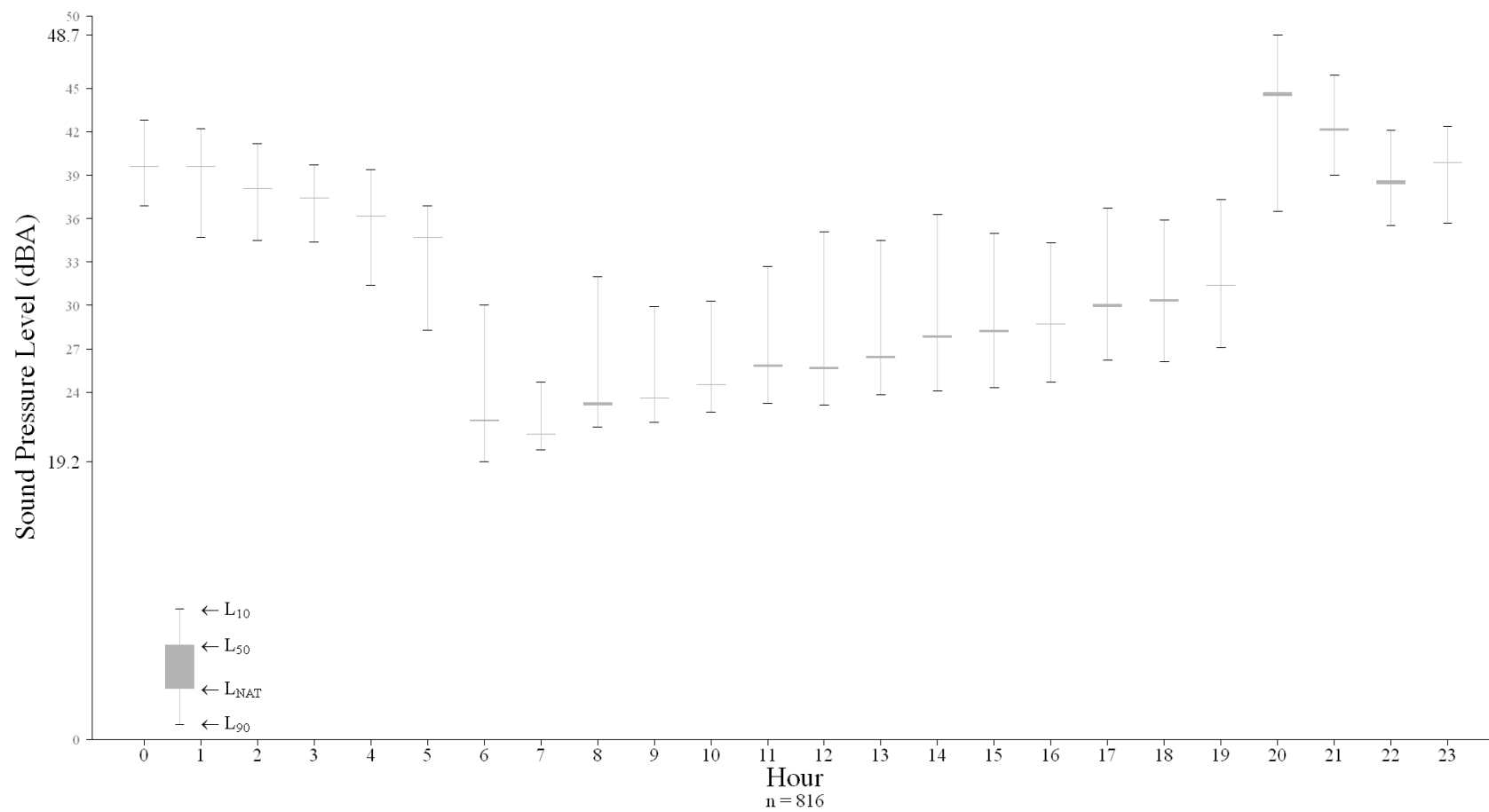


Figure 11. Median hourly exceedence metrics at CIRO009 in dBA

Both on-site and off-site listening results suggested that the most frequent human-caused sound during the monitoring period at CIRO was jets. Figure 12 through 19 illustrate this by showing how much aircraft (both jet and propeller) contribute to the total percent time audible of non-natural sources. The density of aircraft is greatest during the daytime hours. In cases where the total and aircraft audibility differ, vehicles and people talking were generally the cause.

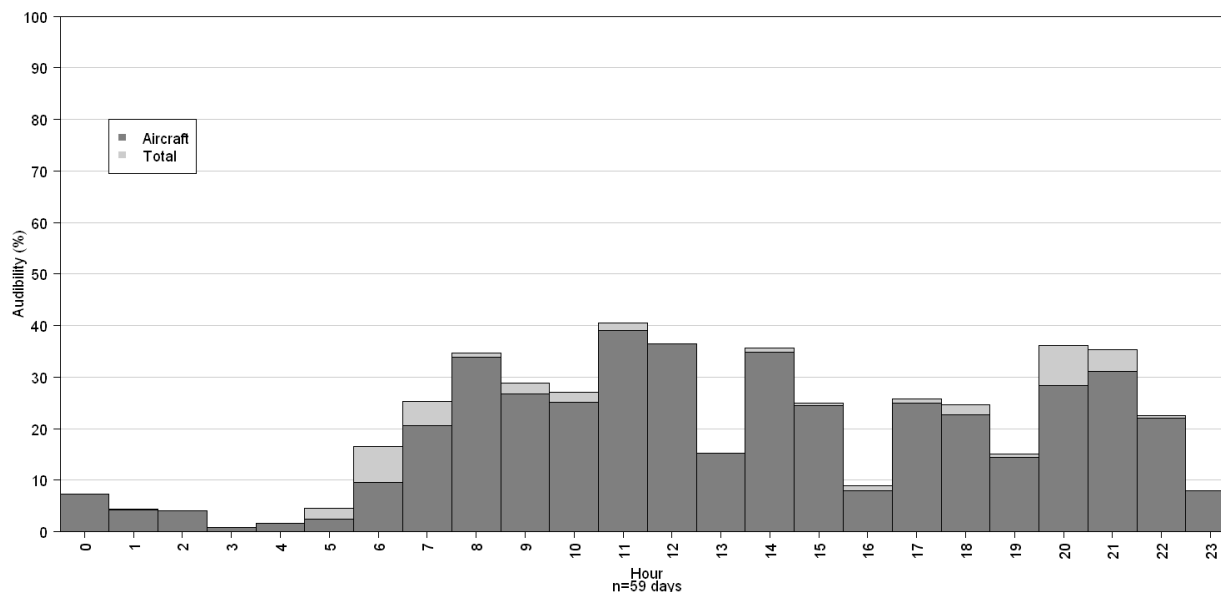


Figure 12. Hourly percent time audibility of extrinsic noises and aircraft noises at CIRO001.

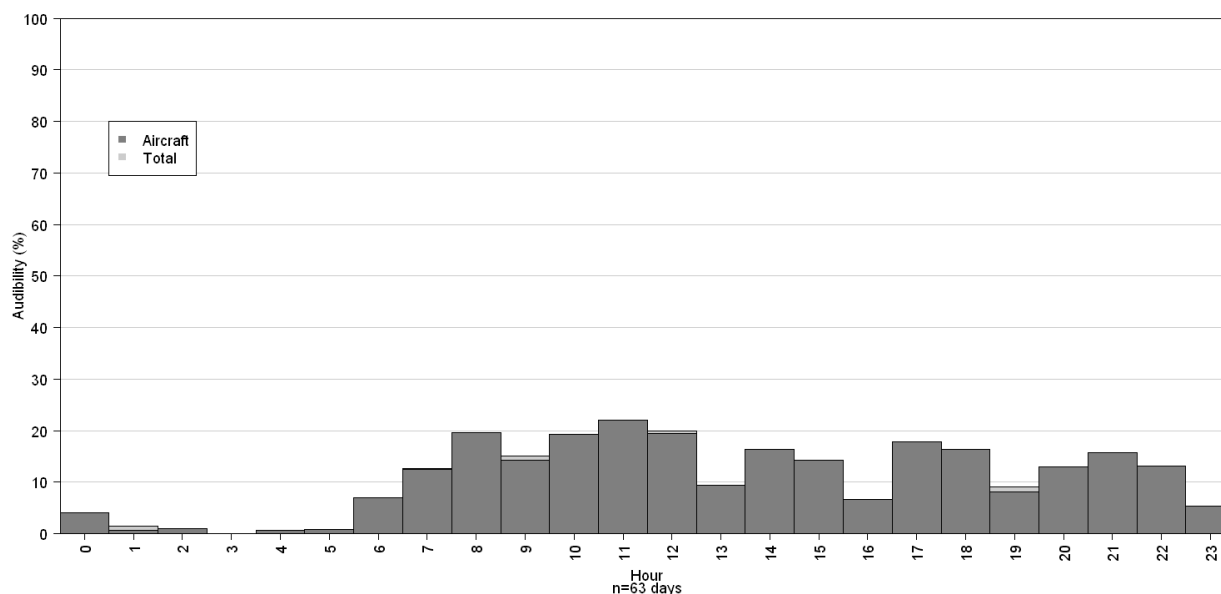


Figure 13. Hourly percent time audibility of extrinsic noises and aircraft noises at CIRO002.

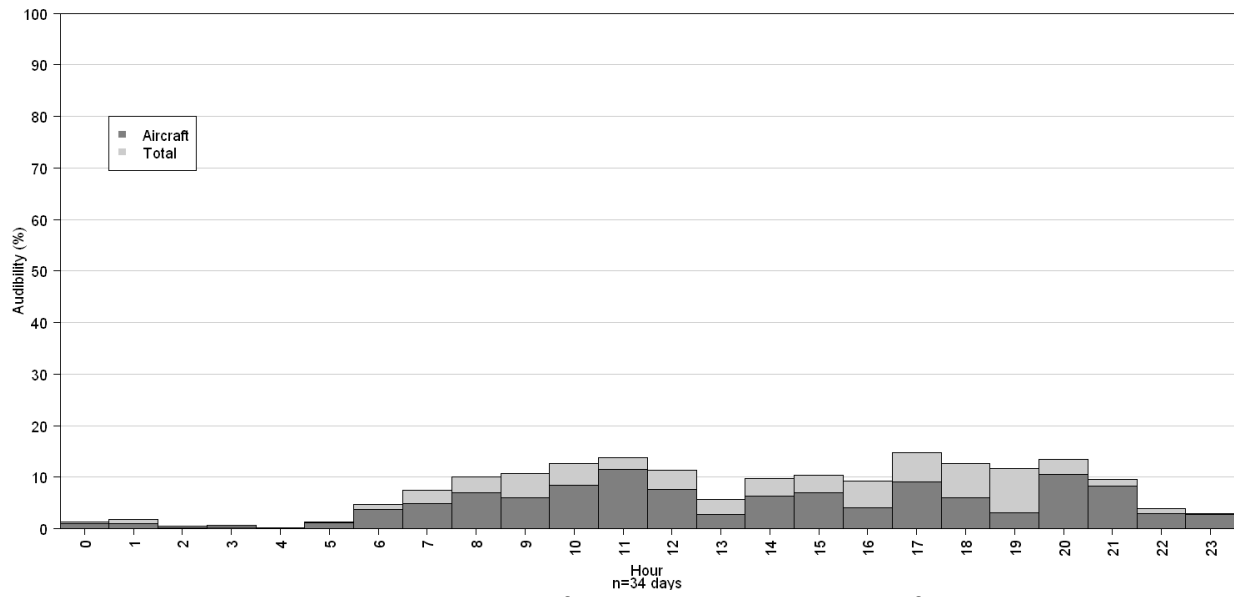


Figure 14. Hourly percent time audibility of extrinsic noises and aircraft noises at CIRO003.

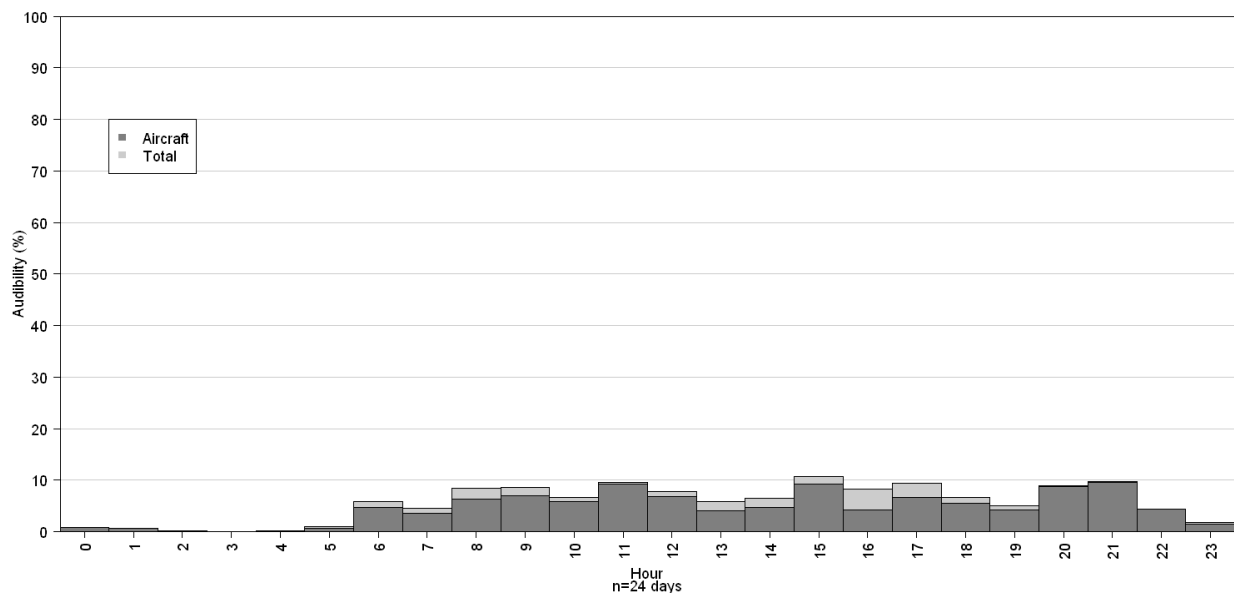


Figure 15. Hourly percent time audibility of extrinsic noises and aircraft noises at CIRO004.

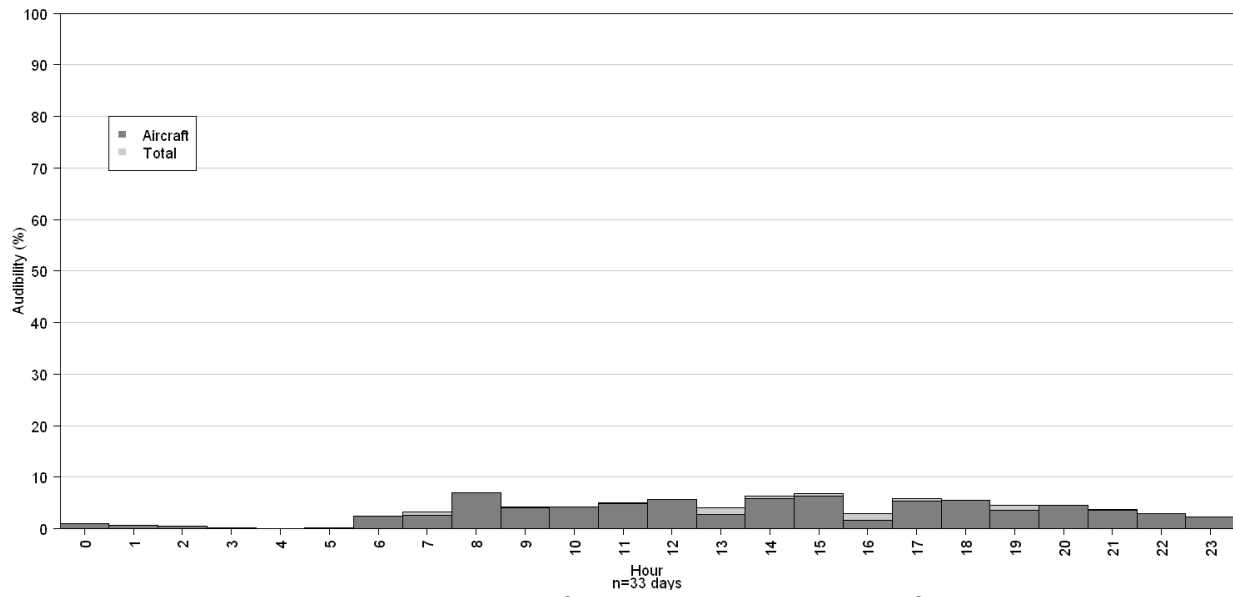


Figure 16. Hourly percent time audibility of extrinsic noises and aircraft noises at CIRO005.

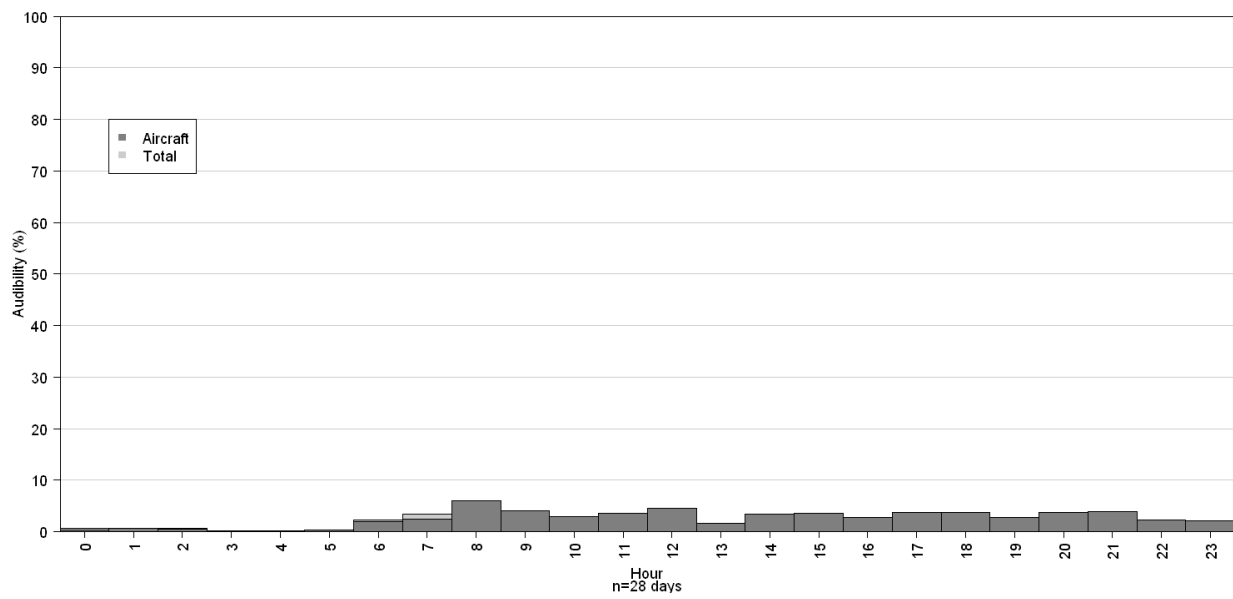


Figure 17. Hourly percent time audibility of extrinsic noises and aircraft noises at CIRO006.

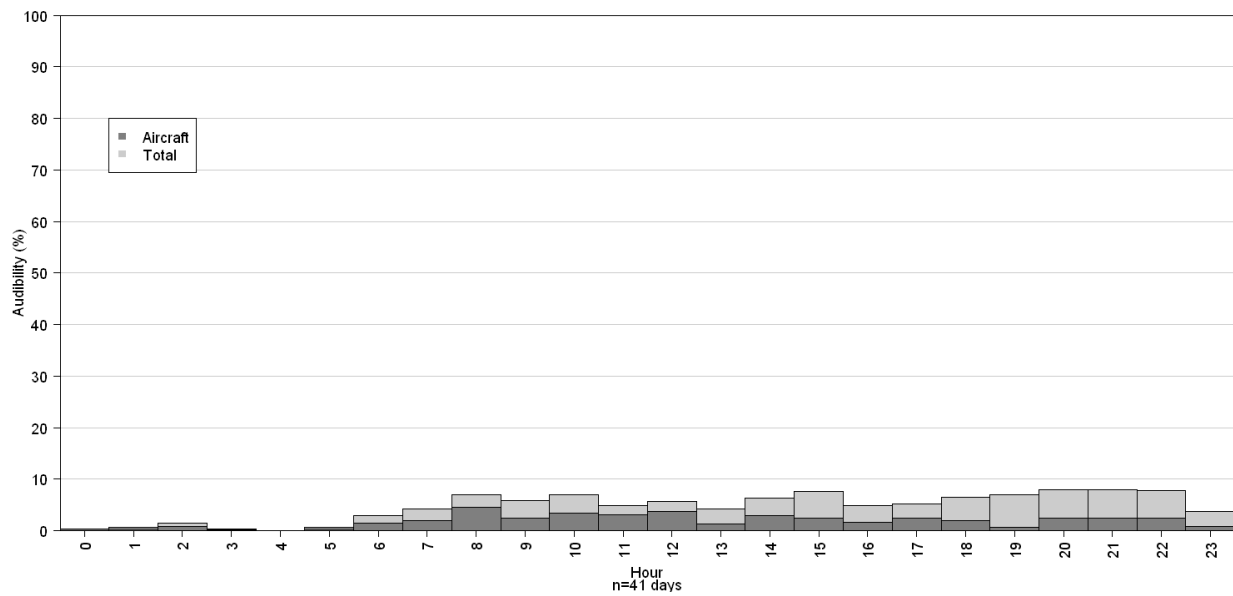


Figure 18. Hourly percent time audibility of extrinsic noises and aircraft noises at CIRO007.

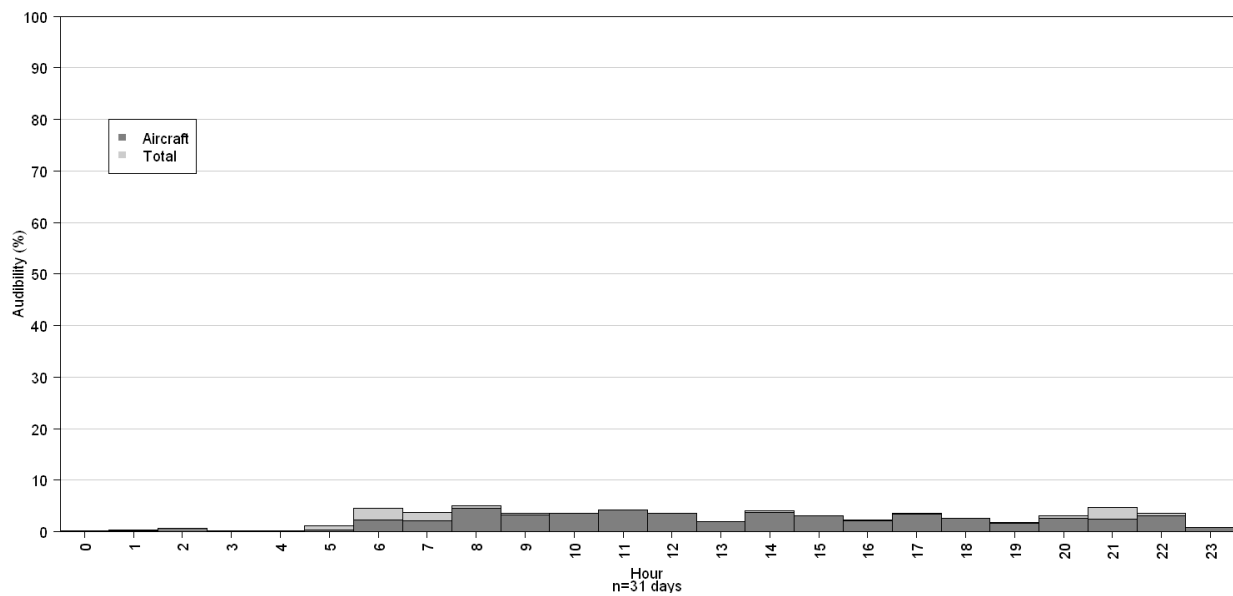


Figure 19. Hourly percent time audibility of extrinsic noises and aircraft noises at CIRO008.

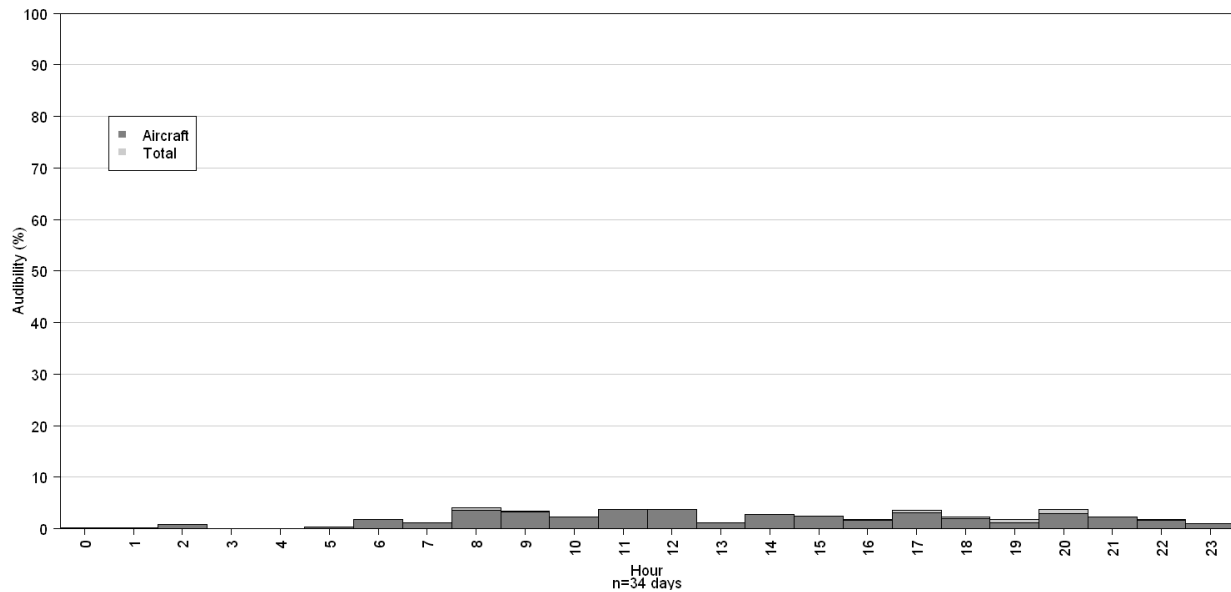


Figure 20. Hourly percent time audibility of extrinsic noises and aircraft noises at CIRO009.

Conclusion

Acoustic monitoring in national park units not only permits us to gain insight into biologic activity, but also allows us to determine the prevalence of extrinsic noise, and perhaps estimate its effects. This study was successful in determining current acoustical conditions at City of Rocks National Reserve. Results included measures of existing ambient levels, calculations of sound source durations, and estimates of natural ambient levels. We determined that human-caused sounds were audible between 1.9% and 20.2%, depending on the site. More specifically, jets were audible between 1.8% and 18.6%. Aircraft was the largest contributor of human-caused sound, but vehicles, voices, and domestic animals were also frequently audible.

The reserve's recently-developed Foundation Statement states, "the audible aesthetic sensations experienced by visitors" enhance the "stunning scenery of the Reserve." As shown by the relative infrequency of human-caused sound events at night (and in some cases, during the day), there remain significant periods of time at CIRO where visitors can experience tranquility and solitude. The information presented in this report will be used to inform park managers in their revision of the General Management Plan, but it will also serve as a permanent record of what different areas in the reserve sounded like in 2008 and 2009. Sound pressure level data as well as continuous digital audio recordings will be stored at the Natural Sounds Program office for archiving purposes.

Literature Cited

Berglund, B., Lindvall, T. and Schwela, D.H (Eds.). 1999. HWO. Guidelines for community noise. World Health Organization, Geneva.

Cassia County Code. 2010. Title 7, Chapter 1: City of Rocks National Reserve. Cassia County, Idaho. Published online:
http://www.cassiacounty.org/countycode/publications/title7/Title7_Chapter1.pdf

Haralabidis Alexandros S., et. al. 2008. “Acute effects of night-time noise exposure on blood pressure in populations living near airports” European Heart Journal Advance Access. Published online February 12, 2008.

National Park Service. 1996. Comprehensive Management Plan: City of Rocks National Reserve. Cassia County, Idaho. Published online:
<http://www.nps.gov/ciro/parkmgmt/planning.htm>

National Park Service. 2005. Acoustic and Soundscape Studies in National Parks: Draft. Fort Collins, CO: NPS Natural Sounds Program.

National Park Service. 2007. City of Rocks National Reserve Foundation Statement.

National Park Service. 2006a. Management Policy 4.9: Soundscape Management.

National Park Service. 2006b. Management Policy 8.2.3: Use of Motorized Equipment.

Wyle Laboratories. 2005. California Off-Highway Vehicle Noise Study. A Report to the California Legislature As Required by Public Resources Code Section 5090.32(o). Prepared for: State of California Department of Parks and Recreation Off-Highway Motor Vehicle Recreation Division.

Glossary of Acoustical Terms

Acoustical Environment

The actual physical sound resources, regardless of audibility, at a particular location.

Amplitude

The instantaneous magnitude of an oscillating quantity such as sound pressure. The peak amplitude is the maximum value.

Audibility

The ability of animals with normal hearing, including humans, to hear a given sound. Audibility is affected by the hearing ability of the animal, the masking effects of other sound sources, and by the frequency content and amplitude of the sound.

dBA

A-weighted decibel. A-Weighted sum of sound energy across the range of human hearing. Humans do not hear well at very low or very high frequencies. Weighting adjusts for this.

How to interpret 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

Decibel

A logarithmic measure of acoustic or electrical signals. The formula for computing decibels is: $10(\log_{10}(\text{sound level}/\text{reference sound level}))$. 0 dB represents the lowest sound level that can be perceived by a human with healthy hearing. Conversational speech is about 65 dB.

Diel

A 24-hour period usually consisting of a day and the adjoining night.

Extrinsic Sound

Any sound not forming an essential part of the park unit, or a sound originating from outside the park boundary.

Frequency

The number of times per second that the sine wave of sound repeats itself. It can be expressed in cycles per second, or Hertz (Hz). Frequency equals Speed of Sound/ Wavelength.

Hearing Range (frequency)

By convention, an average, healthy, young person is said to hear frequencies from approximately 20Hz to 20000 Hz.

Hertz

A measure of frequency, or the number of pressure variations per second. A person with normal hearing can hear between 20 Hz and 20,000 Hz.

Human-Caused Sound

Any sound that is attributable to a human source.

Intrinsic sound

A sound which belongs to a park by its very nature, based on the park unit purposes, values, and establishing legislation. The term “intrinsic sounds” has replaced “natural sounds” in order to incorporate both cultural and historic sounds as part of the acoustic environment of a park.

Listening Horizon

The range or limit of one’s hearing capabilities. Just as smog limits the visual horizon, so noise limits the acoustic horizon.

L_{eq}

Energy Equivalent Sound Level. The level of a constant sound over a specific time period that has the same sound energy as the actual (unsteady) sound over the same period.

L_x

A metric used to describe acoustic data. It represents the level of sound exceeded x percent of the time during the given measurement period.

Masking

The process by which the threshold of audibility for a sound is raised by the presence of another sound.

Noise-Free Interval

The period of time between noise events (not silence).

Noise

Sound which is unwanted, either because of its effects on humans, its effect on fatigue or malfunction of physical equipment, or its interference with the perception or detection of other sounds (Source: McGraw Hill Dictionary of Scientific and Technical Terms).

Off-site Listening

The systematic identification of sound sources using digital recordings previously collected in the field.

On-site Listening

The systematic identification of sound sources at a specific monitoring site using a personal digital assistant (PDA). Custom PDA software records begin and end times of audible sound sources. These sessions often last for one hour.

Sound

Variations in local pressure that propagate through a medium (e.g. the atmosphere) in space and time.

Soundscape

Human perception of the acoustical environment.

Sound Pressure

The difference between instantaneous pressure and local barometric pressure. Measured in Pascals (Pa), Newtons per square meter, which is the metric equivalent of pounds per square inch.

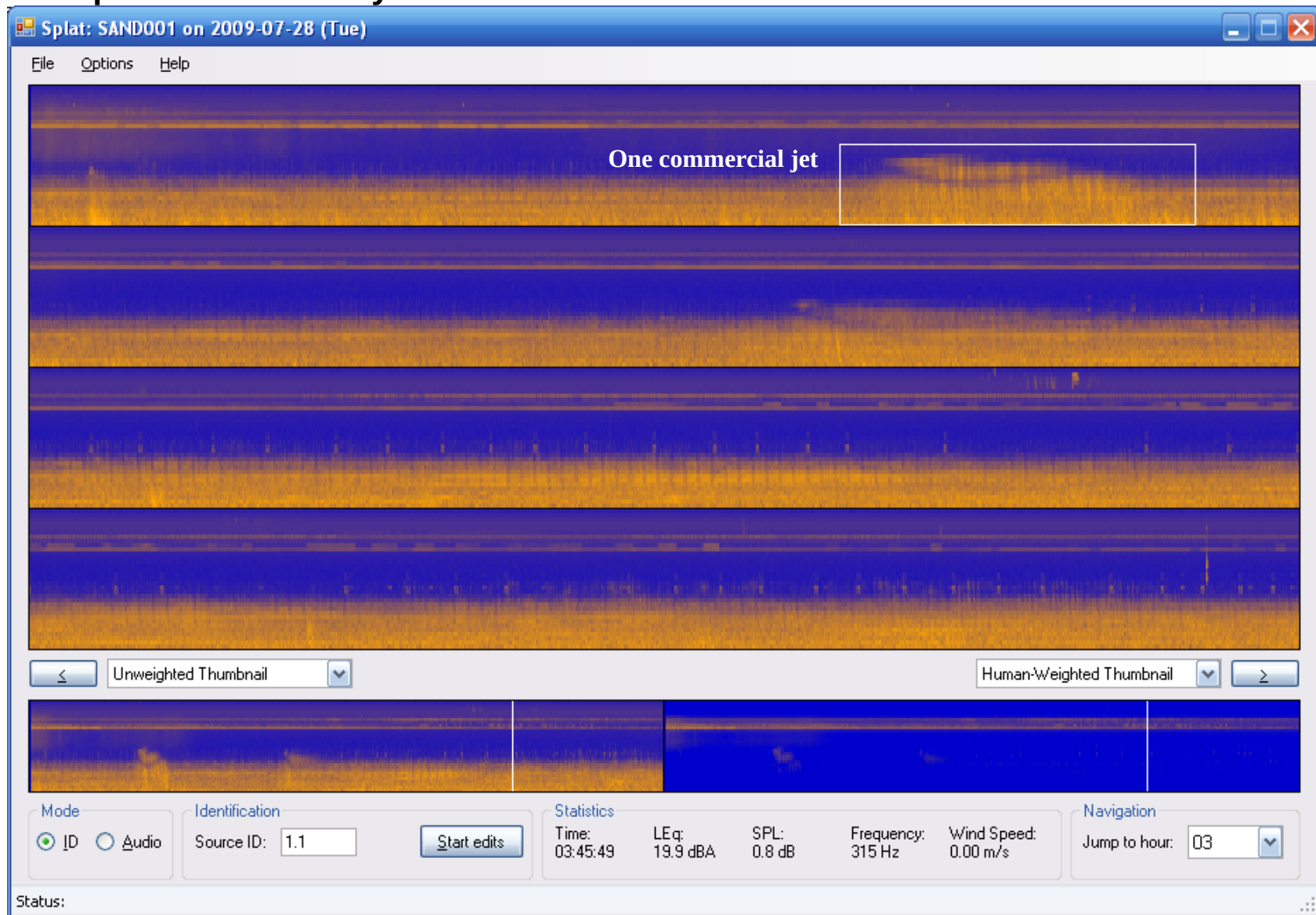
Sound Pressure Level (SPL)

A calibrated measure of sound level, expressed in decibels, and referred to an atmospheric standard of 20 micro Pascals.

Time Audible

The amount of time that a sound source is audible to an animal with normal hearing.

Example of Visual Analysis



Appendix A: On-site logging results

Soundscape Audibility Report

CIRO001

Sessions:	Duration as seconds: 14,710	Duration as minutes: 245.17	AudRpt ID: 44
Session ID: 7778315	Date: 6/26/2008	Name: Second User	
Site: CIRO001	Start Time: 2:19 PM	Address:	
SubSite ID:	End Time: 2:39 PM	Phone:	Wind:
Park: CIRO	Time Group: 0	Palm ID: PN5BMCL4V3	Weather: Sunny
Comments			
Session ID: 7778316	Date: 7/1/2008	Name: Second User	
Site: CIRO001	Start Time: 10:36 AM	Address:	
SubSite ID:	End Time: 10:58 AM	Phone:	Wind:
Park: CIRO	Time Group: 0	Palm ID: PN5BMCL4V3	Weather: Sunny
Comments			
Session ID: 7778317	Date: 7/7/2008	Name: Second User	
Site: CIRO001	Start Time: 11:58 AM	Address:	
SubSite ID:	End Time: 12:18 PM	Phone:	Wind:
Park: CIRO	Time Group: 2	Palm ID: PN5BMCL4V3	Weather: Sunny
Comments			
Session ID: 7778318	Date: 7/25/2008	Name: First User	
Site: CIRO001	Start Time: 2:06 PM	Address:	
SubSite ID:	End Time: 2:26 PM	Phone:	Wind: 1
Park: CIRO	Time Group: 0	Palm ID: PN5BMCL4V3	Weather: Sunny
Comments Cattle nearby: lots of mooing. A few slight gusts of wind out of the south. Lots of insects buzzing in the sun.			
Session ID: 7778319	Date: 7/25/2008	Name: First User	
Site: CIRO001	Start Time: 4:13 PM	Address:	
SubSite ID:	End Time: 4:33 PM	Phone:	Wind: 1
Park: CIRO	Time Group: 2	Palm ID: PN5BMCL4V3	Weather: Sunny
Comments Conditions similar to session conducted earlier today.			
Session ID: 7778320	Date: 7/29/2008	Name: Second User	
Site: CIRO001	Start Time: 11:12 AM	Address:	
SubSite ID:	End Time: 11:33 AM	Phone:	Wind:
Park: CIRO	Time Group: 2	Palm ID: PN5BMCL4V3	Weather: Sunny
Comments			
Session ID: 7778321	Date: 7/31/2008	Name: First User	
Site: CIRO001	Start Time: 1:47 PM	Address:	
SubSite ID:	End Time: 2:17 PM	Phone:	Wind: 2
Park: CIRO	Time Group: 2	Palm ID: PN5BMCL4V3	Weather: Partly Cloudy
Comments Difficult to distinguish between wind and jets at times.			
Session ID: 7778322	Date: 8/7/2008	Name: First User	
Site: CIRO001	Start Time: 1:43 PM	Address:	
SubSite ID:	End Time: 2:13 PM	Phone:	Wind: 2
Park: CIRO	Time Group: 2	Palm ID: PN5BMCL4V3	Weather: Sunny
Comments Lots of flies buzzing on and around me, masking other sounds such as birds. Approaching thunderstorm with lots of rolling thunder. Very little wind in this calm before the storm.			
Session ID: 7778323	Date: 8/7/2008	Name: First User	
Site: CIRO001	Start Time: 6:27 PM	Address:	
SubSite ID:	End Time: 6:57 PM	Phone:	Wind: 1
Park: CIRO	Time Group: 3	Palm ID: PN5BMCL4V3	Weather: Cloudy
Comments Evening: clouds dissipating, wind gusts, birds becoming more vocal, insect activity is more sporadic. Difficult to distinguish between wind in the trees from jet aircraft,			
Session ID: 7778324	Date: 8/8/2008	Name: First User	
Site: CIRO001	Start Time: 10:08 AM	Address:	
SubSite ID:	End Time: 10:39 AM	Phone:	Wind: 1
Park: CIRO	Time Group: 2	Palm ID: PN5BMCL4V3	Weather: Partly Cloudy
Comments Wind picked up considerably during the session. Again I am having difficulty discerning between wind in the trees and the initial sound of an approaching jet.			

Sound Source Audibility (PA: Percentage of period audible, Events reported as seconds)

Sound ID	Sound Source Description	PA	Max Event	Mean Event	Min Event	SD Event	Count
1	Aircraft	0.0	8	8	7	1	2
1.1	Jet	18.0	176	51	4	55	52
1.2	Aircraft, Propeller	8.0	202	54	3	58	22
6	Motor	0.0	26	16	7	13	2
9	Domestic Animal	4.0	20	5	1	4	102
9.2	Cow	0.0	3	2	1	1	2
20	Non-natural Unknown	0.0	8	8	8		1
21	Wind	60.0	1,227	93	2	171	94
22.2	Flowing Water	8.0	461	126	4	155	9
23	Thunder	6.0	82	23	4	18	37
25	Bird	62.0	936	59	1	119	154
28	Insect	79.0	1,621	43	1	135	270
G0100	All Aircraft	25.7					
G2000	All Non-natural Sources	28.8					
G4000	All Natural Sources	96.8					
NFI	Noise Free Interval	71.3	839	69	1	127	153

Soundscape Audibility Report

CIRO002

Sessions: Duration as seconds: 12,647 Duration as minutes: 210.78 AudRpt ID: 45

Session ID: 7778325 Date: 8/9/2008 Name: First User
 Site: CIRO002 Start Time: 2:44 PM Address:
 SubSite ID: End Time: 3:14 PM Phone: Wind: 2
 Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Partly Cloudy
 Comments First logging of sounds at CIRO-002. It was apparently much easier for me to correctly discern the sound of a jet at this site than it was at CIRO-001. Perhaps this was because there is apparently less wind noise here. A brief summer rain shower passed through during the session.

Session ID: 7778327 Date: 8/20/2008 Name: First User
 Site: CIRO002 Start Time: 12:10 PM Address:
 SubSite ID: End Time: 12:40 PM Phone: Wind: 2
 Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
 Comments Difficulty discerning sounds, especially jets and birds, when the wind picked up.

Session ID: 7778328 Date: 8/28/2008 Name: First User
 Site: CIRO002 Start Time: 9:35 AM Address:
 SubSite ID: End Time: 10:05 AM Phone: Wind: 2
 Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
 Comments Wind gusting from several directions, and at times quite audible. At other times, it was calm.

Session ID: 7778329 Date: 8/28/2008 Name: First User
 Site: CIRO002 Start Time: 11:28 AM Address:
 SubSite ID: End Time: 11:58 AM Phone: Wind: 2
 Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
 Comments Lots of flies buzzing around me got so loud that I had to pause the session to shoo them away. Ravens overhead were audible almost constantly. Aircraft traffic picked up dramatically during the session, becoming almost constant, one plane after another. This continued for quite some time after the end of the session.

Session ID: 7778331 Date: 9/16/2008 Name: First User
 Site: CIRO002 Start Time: 4:27 PM Address:
 SubSite ID: End Time: 4:57 PM Phone: Wind: 2
 Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
 Comments Lots of buzzing flies masked other sounds at times.

Session ID: 7778332 Date: 9/16/2008 Name: First User
 Site: CIRO002 Start Time: 7:55 PM Address:
 SubSite ID: End Time: 8:25 PM Phone: Wind: 0
 Park: CIRO Time Group: 3 Palm ID: PN5BMCL4V3 Weather: Sunny
 Comments Crickets were chirping constantly, to the point that I was unsure if they were masking other

Session ID: 7778333 Date: 9/17/2008 Name: First User
 Site: CIRO002 Start Time: 8:30 AM Address:
 SubSite ID: End Time: 9:00 AM Phone: Wind: 1
 Park: CIRO Time Group: 1 Palm ID: PN5BMCL4V3 Weather: Sunny
 Comments Buzzing flies became a distraction toward end of session. Only the slightest breeze - mostly calm.

Sound Source Audibility (PA: Percentage of period audible, Events reported as seconds)

Sound ID	Sound Source Description	PA	Max Event	Mean Event	Min Event	SD Event	Count
1	Aircraft	1.0	23	16	14	4	4
1.1	Jet	24.0	204	97	8	68	32
1.2	Aircraft, Propeller	10.0	306	102	8	93	12
2	Vehicle	6.0	143	30	3	33	24
8	People	0.0	7	7	7		1
8.5	Gunshot	0.0	2	2	2		1
21	Wind	52.0	1,116	178	14	264	37
22.1	Rain/Fog Drip	3.0	328	328	328		1
25	Bird	64.0	901	101	0	175	80
28	Insect	98.0	1,799	516	17	640	24
40	Natural Unknown	0.0	6	5	3	2	3
G0100	All Aircraft	32.9					
G0200	All Road Vehicles	5.7					
G2000	All Non-natural Sources	37.8					
G4000	All Natural Sources	99.5					
NFI	Noise Free Interval	62.2	1,108	121	1	198	65

Soundscape Audibility Report

CIRO003

Sessions: Duration as seconds: 12,921 Duration as minutes: 215.35 AudRpt ID: 43

Session ID: 7778334 Date: 9/18/2008 Name: First User
Site: CIRO003 Start Time: 7:24 AM Address:
SubSite ID: End Time: 7:54 AM Phone: Wind: 0
Park: CIRO Time Group: 1 Palm ID: PN5BMCL4V3 Weather: Partly Cloudy
Comments Several new sounds and much more variety, made logging more of a challenge for me. Very still morning: no interference from wind. Great sunrise, too.

Session ID: 7778336 Date: 9/23/2008 Name: First User
Site: CIRO003 Start Time: 8:57 AM Address:
SubSite ID: End Time: 9:28 AM Phone: Wind: 0
Park: CIRO Time Group: 1 Palm ID: PN5BMCL4V3 Weather: Sunny
Comments Initial sound of a buzzing insect as it approaches is similar to a distant cow moo. I probably missed a few cows.

Session ID: 7778337 Date: 9/23/2008 Name: First User
Site: CIRO003 Start Time: 10:40 AM Address:
SubSite ID: End Time: 11:10 AM Phone: Wind: 2
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
Comments Wind gusts and buzzing flies at times masked other sounds. Wind much more of a factor now than just two hours earlier.

Session ID: 7778338 Date: 9/26/2008 Name: First User
Site: CIRO003 Start Time: 9:00 AM Address:
SubSite ID: End Time: 9:30 AM Phone: Wind: 0
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
Comments Buzzing flies and other insects began to interfere with my hearing of other sounds as the time

Session ID: 7778339 Date: 9/26/2008 Name: First User
Site: CIRO003 Start Time: 11:15 AM Address:
SubSite ID: End Time: 11:48 AM Phone: Wind: 2
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
Comments Lots of buzzing flies were a real test of patience listening. Heavy equipment operating on Nicholson Ranch nearby was noisy.

Session ID: 7778340 Date: 10/9/2008 Name: First User
Site: CIRO003 Start Time: 11:20 AM Address:
SubSite ID: End Time: 11:50 AM Phone: Wind: 2
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
Comments Almost constant procession of jets: as soon as one would start to fade, another would begin to be audible. I wonder if these are military jets from Hill Air Force Base? Wind picked up during

Session ID: 7778341 Date: 10/20/2008 Name: First User
Site: CIRO003 Start Time: 6:22 PM Address:
SubSite ID: End Time: 6:52 PM Phone: Wind: 0
Park: CIRO Time Group: 3 Palm ID: PN5BMCL4V3 Weather: Partly Cloudy
Comments Almost no wind. Great coyote chorus. Great sunset. A few drops of rain.

Sound Source Audibility (PA: Percentage of period audible, Events reported as seconds)

Sound ID	Sound Source Description	PA	Max Event	Mean Event	Min Event	SD Event	Count
1.1	Jet	24.0	812	99	1	157	32
1.2	Aircraft, Propeller	9.0	205	105	1	73	11
2	Vehicle	17.0	260	75	5	71	29
2.5	Heavy Equipment	11.0	1,372	1,372	1,372		1
8.5	Gunshot	0.0	3	3	3		1
9	Domestic Animal	0.0	11	5	2	3	11
20	Non-natural Unknown	0.0	7	5	3	2	3
21	Wind	26.0	1,349	95	8	230	35
24.1	Squirrel	0.0	9	9	9		1
24.3	Coyote	1.0	99	99	99		1
25	Bird	64.0	826	97	0	143	85
27	Amphibian	5.0	111	17	0	21	40
28	Insect	86.0	1,799	359	5	553	31
40	Natural Unknown	0.0	6	6	6		1
G0100	All Aircraft	32.6					
G0200	All Road Vehicles	27.3					
G2000	All Non-natural Sources	51.7					
G4000	All Natural Sources	95.6					
NFI	Noise Free Interval	48.4	756	114	1	163	55

Soundscape Audibility Report

CIRO004

Sessions: Duration as seconds: 9,005 Duration as minutes: 150.08 AudRpt ID: 46

Session ID: 7778342 Date: 11/20/2008 Name: First User
Site: CIRO004 Start Time: 3:15 PM Address:
SubSite ID: End Time: 3:45 PM Phone: Wind: 2-3
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
Comments Very windy. Sounds such as two vehicles that I saw on the nearby road were being masked by the

Session ID: 7778343 Date: 12/9/2008 Name: First User
Site: CIRO004 Start Time: 10:10 AM Address:
SubSite ID: End Time: 10:40 AM Phone: Wind: 2
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
Comments Clear skies. Cold. Moderate wind. About 4 inches of snow, most of which must have fallen yesterday. Very few sounds other than wind.

Session ID: 7778344 Date: 12/9/2008 Name: First User
Site: CIRO004 Start Time: 12:50 PM Address:
SubSite ID: End Time: 1:20 PM Phone: Wind: 2
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
Comments Sunny and cold, with about 4 inches of snow on the ground. Moderate wind out of the NNW. Vehicle traffic on road is mostly ATV (four-wheelers).

Session ID: 7778345 Date: 12/17/2008 Name: First User
Site: CIRO004 Start Time: 12:35 PM Address:
SubSite ID: End Time: 1:05 PM Phone: Wind: 2
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
Comments Sunny and cold. About 6 inches of snow on the ground.

Session ID: 7778346 Date: 12/17/2008 Name: First User
Site: CIRO004 Start Time: 1:50 PM Address:
SubSite ID: End Time: 2:20 PM Phone: Wind: 2
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
Comments Conditions much the same as those of previous session.

Sound Source Audibility (PA: Percentage of period audible, Events reported as seconds)

Sound ID	Sound Source Description	PA	Max Event	Mean Event	Min Event	SD Event	Count
1.1	Jet	13.0	199	92	9	69	13
1.2	Aircraft, Propeller	2.0	137	137	137		1
2	Vehicle	1.0	44	24	10	14	5
21	Wind	99.0	1,798	593	26	516	15
25	Bird	15.0	160	31	0	33	44
40	Natural Unknown	0.0	10	10	10		1
G0100	All Aircraft	14.8					
G0200	All Road Vehicles	1.4					
G2000	All Non-natural Sources	16.2					
G4000	All Natural Sources	98.8					
NFI	Noise Free Interval	83.8	1,029	315	1	324	24

Soundscape Audibility Report

CIRO005

Sessions: Duration as seconds: 14,496 Duration as minutes: 241.60 AudRpt ID: 44

Session ID: 7778347 Date: 4/8/2009 Name: First User

Site: CIRO005 Start Time: 10:32 AM Address:

SubSite ID: End Time: 11:03 AM Phone: Wind: 1

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Partly Cloudy

Comments Natural unknown may have been a coyote. There were only a few fleeting howls or moans.

People sounds were voices of fencing contractors working near Bath Rock. I heard at least five distinctly different bird sounds including woodpecker drumming and the sound of wings.

Session ID: 7778348 Date: 4/8/2009 Name: First User

Site: CIRO005 Start Time: 1:48 PM Address:

SubSite ID: End Time: 2:18 PM Phone: Wind: 1

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Partly Cloudy

Comments The wind really picked up right after I started the session. Wind made it difficult to hear other sounds.

Session ID: 7778349 Date: 4/17/2009 Name: First User

Site: CIRO005 Start Time: 11:00 AM Address:

SubSite ID: Bath Rock End Time: 11:30 AM Phone: Wind: 2

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny

Comments About 4 inches of snow on ground, most of which probably fell over last two days. Some wind gusts masked other sounds briefly.

Session ID: 7778350 Date: 4/17/2009 Name: First User

Site: CIRO005 Start Time: 12:45 PM Address:

SubSite ID: End Time: 1:15 PM Phone: Wind: 2

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Partly Cloudy

Comments Wind gusting out of NNW made other sounds difficult to distinguish at times.

Session ID: 7778351 Date: 4/22/2009 Name: First User

Site: CIRO005 Start Time: 1:20 PM Address:

SubSite ID: End Time: 1:50 PM Phone: Wind: 2 - 3

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny

Comments First warm, almost hot, day of logging sounds. Insects are now much more a part of the soundscape. Wind gusts made it difficult to hear and distinguish sounds at times. The ground is now snow-free and almost dry.

Session ID: 7778352 Date: 4/22/2009 Name: First User

Site: CIRO005 Start Time: 3:05 PM Address:

SubSite ID: End Time: 3:35 PM Phone: Wind: 2 - 3

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Cloudy

Comments Wind shifted from out of the SW to out of the NW and picked up in intensity during the session. Frequent gusts made it difficult to distinguish some sounds, jet aircraft, for example.

Session ID: 7778353 Date: 5/5/2009 Name: First User

Site: CIRO005 Start Time: 1:00 PM Address:

SubSite ID: End Time: 1:30 PM Phone: Wind: 2

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Light Rain

Comments Extremely variable weather: winds gusty but occasionally near-calm, sun, clouds, and rain. Vehicle driving on road was pulling a noisy trailer with what sounded like sheet metal clanking over the bumps. Domestic animals were cows in the distance.

Session ID: 7778354 Date: 5/5/2009 Name: First User

Site: CIRO005 Start Time: 3:25 PM Address:

SubSite ID: End Time: 3:55 PM Phone: Wind: 1-2

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Partly Cloudy

Comments Highly variable wind: gusty and shifting from NW to SW. Gusts made it difficult to distinguish the sound of jets, especially when fading in and out. People sounds were the voices of rock climbers on Bath Rock.

Sound Source Audibility (PA: Percentage of period audible, Events reported as seconds)

Sound ID	Sound Source Description	PA	Max Event	Mean Event	Min Event	SD Event	Count
1.1	Jet	26.0	310	89	5	87	42
1.2	Aircraft, Propeller	5.0	155	74	0	58	10
2	Vehicle	2.0	80	45	3	36	7
8	People	4.0	92	21	4	20	30
9	Domestic Animal	0.0	13	8	4	5	3
20	Non-natural Unknown	0.0	6	6	6		1
21	Wind	92.0	1,799	836	52	799	16
22.1	Rain/Fog Drip	1.0	95	95	95		1
25	Bird	79.0	1,009	112	1	139	103
28	Insect	12.0	175	18	0	23	97
40	Natural Unknown	0.0	23	15	7	11	2
G0100	All Aircraft	30.6					
G0200	All Road Vehicles	2.2					
G2000	All Non-natural Sources	35.1					
G4000	All Natural Sources	99.1					
NFI	Noise Free Interval	64.9	1,441	122	2	232	77

Soundscape Audibility Report

CIRO006

Sessions: Duration as seconds: 10,806 Duration as minutes: 180.10 AudRpt ID: 45

Session ID: 7778355 Date: 5/13/2009 Name: First User
Site: CIRO006 Start Time: 4:36 PM Address:
SubSite ID: End Time: 5:06 PM Phone: Wind: 1-2
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Partly Cloudy
Comments Wind gusting high up on the mountain and ridges sounded like a jet at times. Difficult to discern the real thing. Although wind could be heard on the mountain almost continually, gusts at the site only occurred intermittently.

Session ID: 7778356 Date: 5/22/2009 Name: First User
Site: CIRO006 Start Time: 1:28 PM Address:
SubSite ID: End Time: 1:58 PM Phone: Wind: 0-1
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Partly Cloudy
Comments One of the calmest (wind) and quietest days I have sampled at CIRO.

Session ID: 7778357 Date: 6/3/2009 Name: First User
Site: CIRO006 Start Time: 9:45 AM Address:
SubSite ID: End Time: 10:15 AM Phone: Wind: 0
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
Comments Almost calm wind, except for one gust. Domestic animals were cows in the distance. Very quiet session.

Session ID: 7778358 Date: 6/3/2009 Name: First User
Site: CIRO006 Start Time: 11:55 AM Address:
SubSite ID: End Time: 12:25 PM Phone: Wind: 1
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
Comments Wind a bit more audible than during session earlier today. Still mostly quiet except for aircraft.

Session ID: 7778359 Date: 6/11/2009 Name: First User
Site: CIRO006 Start Time: 2:30 PM Address:
SubSite ID: End Time: 3:00 PM Phone: Wind: 0
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Cloudy
Comments Dead calm at beginning of session. Wind picked up a bit toward end. Domestic animals were probably cows barely audible in the far distance. Rain was drops falling from tree branches when shaken loose by the wind.

Session ID: 7778360 Date: 6/12/2009 Name: First User
Site: CIRO006 Start Time: 9:05 AM Address:
SubSite ID: End Time: 9:35 AM Phone: Wind: 1
Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny
Comments Wind picked up considerably shortly after starting the session. Wind sounds came from the tree tops. Winds at ground level were moderate.

Soundscape Audibility Report

Sound Source Audibility (PA: Percentage of period audible, Events reported as seconds)

Sound ID	Sound Source Description	PA	Max Event	Mean Event	Min Event	SD Event	Count
1.1	Jet	27.0	344	107	4	102	27
1.2	Aircraft, Propeller	4.0	258	161	16	128	3
9	Domestic Animal	2.0	53	26	10	17	7
20	Non-natural Unknown	0.0	15	15	15		1
21	Wind	57.0	1,798	306	1	552	20
22.1	Rain/Fog Drip	1.0	41	18	6	13	7
25	Bird	94.0	1,799	350	8	587	29
28	Insect	43.0	747	45	2	108	104
G0100	All Aircraft	31.0					
G2000	All Non-natural Sources	32.6					
G4000	All Natural Sources	99.7					
NFI	Noise Free Interval	67.5	1,225	203	1	298	36

Soundscape Audibility Report

CIRO007

Sessions: Duration as seconds: 7,435 Duration as minutes: 123.92 AudRpt ID: 46

Session ID: 7778361 Date: 6/12/2009

Name: First User

Site: CIRO007 Start Time: 5:15 PM

Address:

SubSite ID: End Time: 5:45 PM

Phone: Wind: 0

Park: CIRO Time Group: 2

Palm ID: PN5BMCL4V3 Weather: Cloudy

Comments Lots of activity and sounds. Most of the PEOPLE sounds were from a bunch of kids playing and talking in the nearby campground. The sound I coded as DUMPSTER was probably the outhouse door slamming. It is Friday evening on a busy camping weekend in June.

Session ID: 7778363 Date: 6/26/2009

Name: Second User

Site: CIRO007 Start Time: 11:43 AM

Address:

SubSite ID: End Time: 12:16 PM

Phone: Wind: 1

Park: CIRO Time Group: 2

Palm ID: PN5BMCL4V3 Weather: Sunny

Comments UNKNOWN 1 MAY BE JET. UNKNOWN 2,3,4 WERE MISTAKES-NO SOUND.

Session ID: 7778364 Date: 7/1/2009

Name: Second User

Site: CIRO007 Start Time: 8:44 AM

Address:

SubSite ID: End Time: 9:14 AM

Phone: Wind: 1

Park: CIRO Time Group: 0

Palm ID: PN5BMCL4V3 Weather: Sunny

Comments cow and a bit off dog near the end. the unknown may have been a door of some kind the motorcycle was far away.

Session ID: 7778365 Date: 7/8/2009

Name: Second User

Site: CIRO007 Start Time: 3:37 PM

Address:

SubSite ID: End Time: 4:07 PM

Phone: Wind: 2

Park: CIRO Time Group: 2

Palm ID: PN5BMCL4V3 Weather: Sunny

Comments wind almost constant made it difficult to hear vehicles fading out. at end of session there was a non domestic animal in the distance

Sound Source Audibility (PA: Percentage of period audible, Events reported as seconds)

Sound ID	Sound Source Description	PA	Max Event	Mean Event	Min Event	SD Event	Count
1	Aircraft	8.0	290	115	13	117	5
1.1	Jet	25.0	222	87	0	81	21
1.2	Aircraft, Propeller	4.0	104	42	12	30	7
2	Vehicle	34.0	161	38	1	44	65
2.2	Motorcycle	1.0	52	24	15	19	4
7.4	Dumpster / Trashcan	0.0	3	2	1	1	4
8	People	26.0	446	41	0	97	47
9	Domestic Animal	1.0	14	2	0	3	18
20	Non-natural Unknown	1.0	16	6	1	6	12
21	Wind	28.0	672	72	4	157	29
25	Bird	90.0	1,799	155	1	407	43
27	Amphibian	0.0	3	3	3		1
28	Insect	52.0	602	43	1	95	91
40	Natural Unknown	0.0	1	1	1		1
G0100	All Aircraft	36.1					
G0200	All Road Vehicles	34.4					
G2000	All Non-natural Sources	70.6					
G4000	All Natural Sources	96.5					
NFI	Noise Free Interval	30.2	371	30	1	51	75

Soundscape Audibility Report

CIRO008

Sessions: Duration as seconds: 12,685 Duration as minutes: 211.42 AudRpt ID: 47

Session ID: 7778366 Date: 7/24/2009 Name: First User

Site: CIRO008 Start Time: 1:27 PM Address:

SubSite ID: End Time: 1:57 PM Phone: Wind: 1

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Cloudy

Comments Fairly quiet. Occasional wind on leafy ground vegetation made it difficult to hear some other

Session ID: 7778367 Date: 7/29/2009 Name: First User

Site: CIRO008 Start Time: 11:10 AM Address:

SubSite ID: End Time: 11:40 AM Phone: Wind: 1

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny

Comments I accidentally hit the SILENCE button for a few seconds at 11:25 AM. The domestic animal was a cow mooing.

Session ID: 7778368 Date: 7/29/2009 Name: First User

Site: CIRO008 Start Time: 12:20 PM Address:

SubSite ID: End Time: 12:50 PM Phone: Wind: 1

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny

Comments Domestic animals were cows mooing.

Session ID: 7778369 Date: 8/10/2009 Name: First User

Site: CIRO008 Start Time: 2:45 PM Address:

SubSite ID: End Time: 3:16 PM Phone: Wind: 0-2

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny

Comments Wind fluctuated from calm to loud enough to mask other sounds. Domestic animals were cows in the distance. Very few bird sounds.

Session ID: 7778370 Date: 8/10/2009 Name: First User

Site: CIRO008 Start Time: 4:20 PM Address:

SubSite ID: End Time: 4:50 PM Phone: Wind: 0-2

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny

Comments Wind varied from calm to strong gusts from multiple directions. Domestic animals were cows in the distance.

Session ID: 7778371 Date: 8/24/2009 Name: First User

Site: CIRO008 Start Time: 12:20 PM Address:

SubSite ID: End Time: 12:50 PM Phone: Wind: 1-2

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Partly Cloudy

Comments Wind gusts made it difficult to discern other sounds, especially jets.

Session ID: 7778372 Date: 8/24/2009 Name: First User

Site: CIRO008 Start Time: 1:55 PM Address:

SubSite ID: End Time: 2:25 PM Phone: Wind: 1-2

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Partly Cloudy

Comments A passing thunderstorm, wind, jets, and some light rain made for a very interesting and constantly changing soundscape. Domestic animals were cows in the distance.

Sound Source Audibility (PA: Percentage of period audible, Events reported as seconds)

Sound ID	Sound Source Description	PA	Max Event	Mean Event	Min Event	SD Event	Count
1.1	Jet	24.0	341	116	6	92	26
1.2	Aircraft, Propeller	10.0	268	80	4	85	16
2	Vehicle	2.0	46	32	9	18	6
9	Domestic Animal	3.0	33	13	3	8	26
21	Wind	73.0	938	138	5	195	67
22.1	Rain/Fog Drip	4.0	206	83	16	74	6
23	Thunder	7.0	290	72	17	89	12
25	Bird	67.0	708	118	6	151	72
28	Insect	94.0	1,697	543	21	520	22
40	Natural Unknown	0.0	6	6	6		1
G0100	All Aircraft	31.8					
G0200	All Road Vehicles	1.5					
G2000	All Non-natural Sources	34.9					
G4000	All Natural Sources	99.1					
NFI	Noise Free Interval	65.1	916	131	1	192	63

Soundscape Audibility Report

CIRO009

Sessions: Duration as seconds: 14,430 Duration as minutes: 240.50 AudRpt ID: 48

Session ID: 7778373 Date: 8/26/2009 Name: First User

Site: CIRO009 Start Time: 12:15 PM Address:

SubSite ID: End Time: 12:45 PM Phone: Wind: 1-2

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny

Comments Lots of buzzing flies, especially around my head, made it difficult to concentrate on other sounds.
Wind gusts masked other sounds.

Session ID: 7778374 Date: 9/11/2009 Name: First User

Site: CIRO009 Start Time: 11:40 AM Address:

SubSite ID: End Time: 12:10 PM Phone: Wind: 1-2

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny

Comments Lots of buzzing insects made it difficult to discern other sounds.

Session ID: 7778375 Date: 9/11/2009 Name: First User

Site: CIRO009 Start Time: 12:14 PM Address:

SubSite ID: End Time: 12:45 PM Phone: Wind: 1-2

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny

Comments Lots of buzzing flies made it difficult to distinguish other sounds.

Session ID: 7778376 Date: 9/16/2009 Name: First User

Site: CIRO009 Start Time: 10:15 AM Address:

SubSite ID: End Time: 11:15 AM Phone: Wind: 0-2

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Sunny

Comments Excellent listening conditions. Wind, although present, was not an issue. Very few aircraft.

Session ID: 7778377 Date: 9/29/2009 Name: First User

Site: CIRO009 Start Time: 9:50 AM Address:

SubSite ID: End Time: 10:50 AM Phone: Wind: 0

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Cloudy

Comments Very still morning; almost no wind. Able to hear vehicles approaching from a much greater distance than usual. Sometimes vehicles were audible because of their sound echoing off the nearby rock formations. Very few aircraft.

Session ID: 7778378 Date: 9/29/2009 Name: First User

Site: CIRO009 Start Time: 1:35 PM Address:

SubSite ID: End Time: 2:05 PM Phone: Wind: 0-1

Park: CIRO Time Group: 2 Palm ID: PN5BMCL4V3 Weather: Cloudy

Comments Wind has picked up a bit since this morning. No wind speeds of any consequence, but it does make vehicles much less audible at a distance.

Sound Source Audibility (PA: Percentage of period audible, Events reported as seconds)

Sound ID	Sound Source Description	PA	Max Event	Mean Event	Min Event	SD Event	Count
1.1	Jet	17.0	262	103	9	81	24
1.2	Aircraft, Propeller	9.0	310	95	9	87	14
2	Vehicle	7.0	242	53	11	70	18
20	Non-natural Unknown	1.0	30	16	2	8	13
21	Wind	51.0	950	124	6	178	60
25	Bird	79.0	3,598	168	0	455	68
28	Insect	100.0	3,599	1,797	116	1,262	8
G0100	All Aircraft	24.1					
G0200	All Road Vehicles	6.7					
G2000	All Non-natural Sources	31.6					
G4000	All Natural Sources	99.7					
NFI	Noise Free Interval	69.7	1,109	210	1	253	48

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NPS D-XXX, Month Year

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