Acoustical Monitoring in National Parks

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Natural Sounds and Night Skies Division

A survey of the American public revealed that 95 percent of respondents thought that providing opportunities to experience natural quiet and the sounds of nature was an important reason for having national parks. In fact, 72% of those respondents felt that it was very important (Haas & Wakefield, 1998).

How the Natural Sounds and Night Skies Division approaches sound

Analysis begins with the identification of sound sources and their characteristics which may affect the acoustical environment. For most sound sources, these characteristics include the location and movement of the source, its operational features, and how the sound is distributed over time. The sound sources themselves are defined or measured using various metrics. The Natural Sounds and Night Skies Division (NSNSD) measures sound pressure level (SPL) in dB across the frequency spectrum, divided into one third-octave bands. NSNSD also collects on-site audibility data and short sound recordings to assist in the identification of the sound sources. Such measurements allow us to calculate a variety of metrics including maximum SPL of an event, numbers of events, noise free intervals, audibility, and the area where the sound is audible. These metrics are then used to compile acoustic baseline data that is used for park planning support and analyses of the acoustical environment.

Interpreting Sound Levels

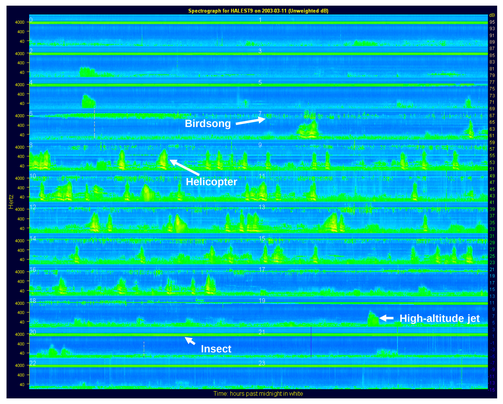
Note: 10dB represents a tenfold multiplication of energy

Park Sound Sources	Common Sound Sources	dBA
Volcano crater (Haleakala NP)	Human breathing at 3 m	10
Leaves rustling (Canyonlands NP)	Whispering	20
Crickets at 5 m (Zion NP)	Residential area at night	40
Conversation at 5 m (Whitman Mission National Historic Site)	Busy restaurant	60
Snowcoach at 30 m (Yellowstone NP)	Curbside of busy street	80
Thunder (Arches NP)	Jackhammer at 2 m	100
Military jet at 100 m AGL (Yukon – Charley Rivers National Preserve)	Train horn at 1 m	120

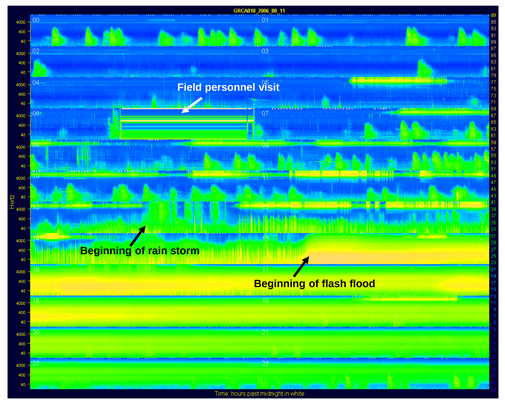
Distance from sound source is represented in meters

Acoustical Monitoring Results

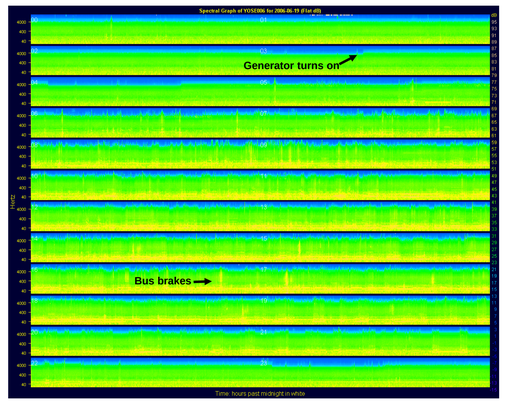
Spectrograms: 24-hour pictures of 1/3 octave sound levels



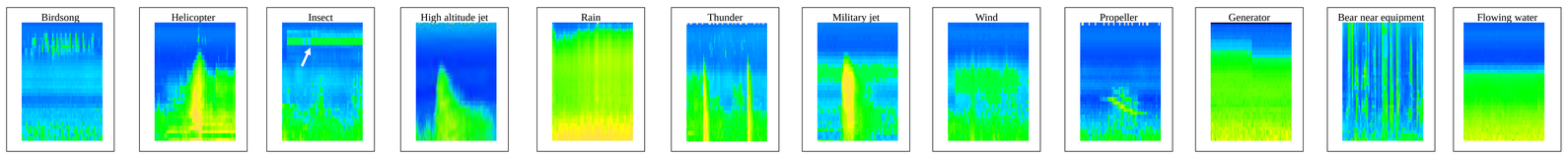
Upper Kipahulu Valley, Haleakala National Park



Separation Canyon, Grand Canyon National Park

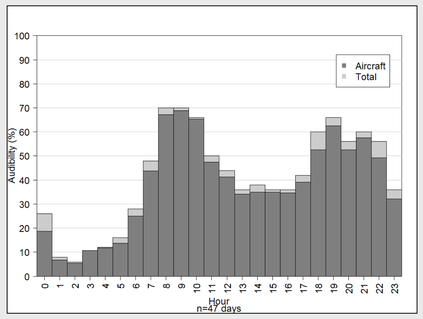


Yosemite Village, Yosemite National Park

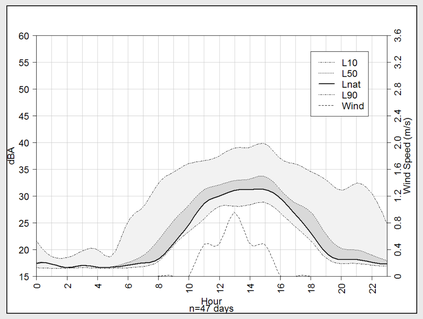


Acoustical Monitoring Example Snow Flats (Yosemite NP)

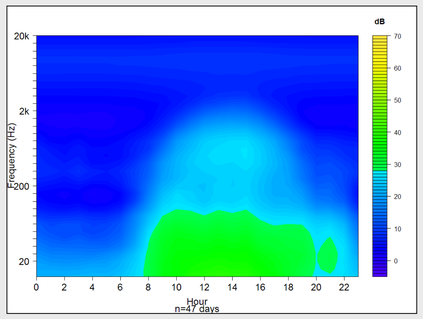
The Snow Flats acoustical monitoring site at Yosemite NP was located at 2679 meters of elevation in a subalpine forest vegetation zone. This natural backcountry site was monitored from July through October 2005.



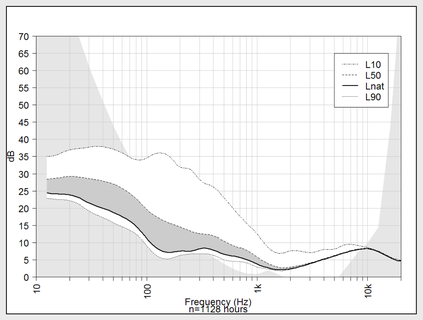
The total percent time extrinsic sounds (light gray) were audible in off-site listening sessions. Contributions from aircraft are shown in dark gray. Overall, extrinsic sounds were audible in 40.6 percent of the samples. From 0800-1000 hrs the percent time audible was 70 percent. Aircraft overflights were responsible for almost all of this extrinsic noise.



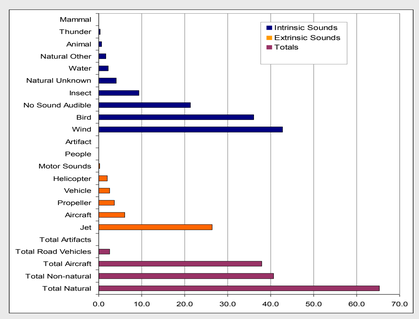
Exceedance levels (dBA) as a function of time. Nighttime levels are consistently near the noise floor of the monitoring systems. Over the course of the day, the dBA levels steadily rise, then fall, following the rise and fall of local wind speed. However, the L_{50} and L_{nat} differ most during the daylight hours. This suggests that the high percentage of aircraft audibility is having an effect on existing ambient levels at this site.



The variation in existing ambient dB across all frequencies by hour. Cooler colors denote lower dB values while warmer colors denote higher dB values. The two prominent, brightly colored areas are most likely caused by wind. The lower bloom which begins at 0800h and ends at about 1900h is the sound of wind turbulence, while the softer, higher frequency peak is the wind-induced noise of moving vegetation.



Median ambient sound pressure levels as a function of frequency (on a logarithmic scale). The limit of human hearing is represented by the light gray shading in the background. Note how close the median natural ambient level is to this threshold. There is a marked difference between the L_{nat} and the L_{10} at 150 Hz. This means that the maximum ambient level was considerably higher than the natural or existing ambient levels at that frequency.

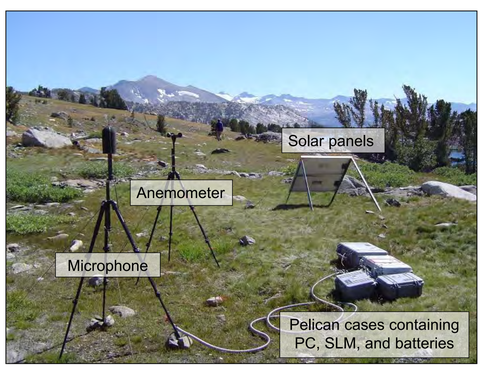


The percentage of time various sounds were audible. Percent time audible metrics are calculated through off-site listening efforts. These statistics are drawn from eight randomly selected sample days. The most frequently heard extrinsic sound was jet. The fact that there was “no sound audible” over 20 percent of the time indicates that it was typically quiet at this monitoring site.

Advances in Equipment

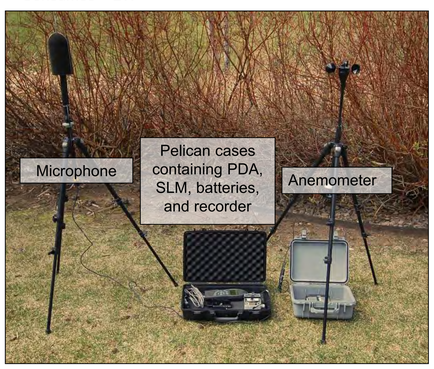
Old Equipment Set-Up

- Roughly 200 lbs
- Requires at least 4 people to set up in one trip
- High failure rate/Data loss
- Consumes 12W



New Equipment Set-Up

- Under 25 lbs
- Can be deployed by one person
- Virtually no data loss
- Consumes ~ 2W



National Park Service Natural Sounds and Night Skies Division

The NPS Natural Sounds Program was established in 2000 to help parks manage sounds in a way that balances access to the park with the expectations of park visitors and the protection of park resources. As of fiscal year 2011, the program has been elevated to a division, Natural Sounds and Night Skies Division (NSNSD). The NSNSD addresses acoustical issues raised by Congress, NPS Management Policies, and NPS Directors Orders. The division provides technical services to parks in the form of recreational planning assistance, acoustical monitoring, data collection and analysis, describing acoustical conditions, and research in acoustical and social science. 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.

Literature Cited

Haas, G. E., & Wakefield, T.J. (1998). National parks and the American Public: A national public opinion survey on the national park system. Washington D.C. and Fort Collins, CO.: National Parks and Conservation Association and Colorado State University

Further Information

http://www.nature.nps.gov/naturalsounds