Superior National Forest Sound Monitoring Projects 2008

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During the 2008 field season the Forest Monitoring Crew developed protocols and began to establish sites within the forest from which to monitor and record existing sound levels and potential new mechanized noise resulting from specific management decisions. Of primary concern are mechanical noises generated by management and recreational activities outside the wilderness intruding upon the wilderness character of the BWCAW. Below is a summary of the data and findings from each of the project areas. An Excel spreadsheet has also been created to track data collected at each of the project sites.

Methodology and data collection equipment

The process of sound data collection in 2008 involved:

- selection of an appropriate receptor site (lakeshore, riverbank or portage trail within the Wilderness),
- travel to the site on foot and by canoe,
- setting up the *Extech sound meter/datalogger* to record the sound pressure levels (dB) over a given set of time, usually 10, 20 or 60 minutes per sample,
- attended listening by a biological science technician observer (written document of sounds heard while the sound meter is recording), photographing site, and collecting GPS information,
- downloading sound pressure level data to computer for analysis and correlation with technician's attended listening form,
- creating map of receptor sites and location of noise source(s)

Although technically a relatively simple setup, a successful collection sample was dependent on a combination of favorable factors, including fair weather (calm winds, no rain), the active operation of mechanized equipment, particularly for timber harvest and minerals exploration, and the availability of monitoring crew assistance.

- ***Sound Meter - dBA datalogger*:** Records decibel (sound pressure) levels using an *Extech HD600* datalogger. Data is downloaded to computer software for graphing and correlation with observer listening forms.
- ***Observer log (attended listening form)*:** the written record of sounds heard by the technician while the datalogger is recording. Includes notes on site location, forest/habitat and terrain types, weather, wind speed and direction, and equipment setup.
- ***Receptor site*:** a wilderness recreation area, or other forest location where people may be affected by the mechanical noise generated by forest management activities (logging, mining) and off-highway recreational vehicles (ATVs, snowmobiles).
- ***Source noise**:* the sound generated by the specific mechanized equipment and vehicles that are the focus of the monitoring effort.
- ***Baseline data*:** existing ambient sound levels (natural and man-made before introduction of the specific source noise) recorded by the datalogger and observer during a specific amount of time at a receptor site.

- ***Activity data:*** datalogger and observer log recorded at the receptor site during operation of specific mechanized equipment.
- ***Recording interval and sample duration:*** specific time interval that the datalogger records the dBA, generally once every second, or once every 10 seconds. Duration of sample can be 15 seconds to 2 minutes for source noise, 10 to 60 minutes for baseline and activity data.

Data Collection Sites, Analysis and Results

A total of 640 minutes of sound monitoring data was collected between July and October 2008, all attended listening by a forest monitoring technician. 8 forest management locations within the Superior National Forest were chosen to begin sound monitoring efforts, with 15 data collection sites established. These monitoring sites where chosen based on the proximity to existing and proposed mechanized sound generating activities (generally within a 1 mile radius) and the site's accessibility to forest visitors. 11 sites are located on the shores of 7 lakes or rivers within the BWCAW, 2 are on trails within the BWCAW, and 2 are non-wilderness sites associated with a campground and seasonal cabins. 380 minutes of this total are baseline existing ambient sound data, 260 minutes are during mechanized activity (160 minutes ATV source; 75 minutes minerals drilling source; and 25 minutes timber harvest source).

Recreational All-terrain vehicles

Potential ATV noise intrusions have been monitored at five BWCAW receptor sites. In 2008 all ATV noise activity was created by Forest Service personnel on the following Forest Roads near the BWCAW. Most of the roads allowed ATV use, while FR 152 was closed to ATV use at the time of monitoring. Noise from ATV activity was heard clearly by the observer in the BWCAW during two sample collections, heard faintly at 2 sites, and not heard at 3 sites.

FR 439: North Kawishiwi River /Kawishiwi District: *Riverside site Sept. 25* – No ATV noise heard/detected. *10/03* - Engine noises heard by observer, mostly very faint and source indistinct. Datalogger did not distinguish between existing ambient and ATV activity. ATV was 0.36 – 0.5 mile north. Receptor site downwind ATV. Wind through leaves constant background sound. *Hunter's trail camp Sept.25* – Engine noise heard by observer, faint, indistinct, not detected by datalogger. ATV was 0.25 north, receptor site upwind from ATV. Wind through pines constant sound.

FR 1335: One Island Lake /Gunflint District: Oct. 21-22. ATV (0.25 mile north) not heard by observer. South wind strong, constant, wind through leaves constant background sound. Receptor upwind of ATV.

Ram Lake campsite

FR 152: Ram Lake/Gunflint District: Aug. 20. Distance/direction to ATV source noise: 0.7 mile east/NE. ATV heard by observer. Wind perpendicular to receptor – ATV.

Minimum dBA of all samples	Average dBA of baseline samples	Average dBA of all samples	Average dBA when ATV heard (Rank 2)
33.1	**39.2**	**38.2**	**35.3**

FR 376: Isabella Lake /Tofte District: Aug. 28. ATV source noise 0.5 mile south was heard by observer, faint yet distinct, data logger did not distinguish noise from ambient. Receptor downwind of ATV.

Minimum dBA of all samples	Average dBA of baseline samples	Average dBA of all samples	Average dBA when ATV heard (Rank 2)
33.6	**38.2**	**37.6**	**37.1**

Small island near south shore of Isabella Lake

FR 382: Bog Lake /Tofte District: Sept.28. ATV not heard by observer, west wind strong, constant, gusts to 25 mph, wind through leaves constant background sound, as well as wave action against shoreline. Receptor site was 1.4 miles downwind of ATV.

Minimum dBA of baseline samples	Average dBA of baseline samples	Minimum dBA ATV active samples	Average dBA ATV active samples
34.9	**39.7**	**34.7**	**39.2**

Snowmobiles

Royal River Sound Test –January/February 2009: Sound tests were conducted on the Royal River in the BWCAW on 3 separate occasions during January and February of 2009. The purpose was to measure the decibel level in the wilderness of a snowmobile's engine running outside the wilderness.

Summary of Test Results

1. The highest decibel level recorded for the snowmobile on Little John Lake was at Sound Point one. It was approximately 55 decibels at 300 meters.
2. The highest decibel level recorded for the snowmobile recording on the proposed snowmobile trail was at Sound Point 7. It was approximately 45 decibels at 400 meters.
3. The highest decibel level recorded for the snowmobile on North Fowl Lake was at Sound Point 10. It was approximately 55 decibels at 200 meters.
4. Ambient decibel level varied between 39 and 41 decibels at most Sound Points.

General Thoughts on the Test

1. The Royal River is difficult to snowshoe. Open water and thin ice prevented Forest Service personnel from sampling the entire river, especially the area between points 2 and 3(refer to map). One Forest Service employee broke through the ice on the river near Sound Point 3.
2. There were no human tracks or snowmobile tracks on the entire river.
3. Throughout the tests on February 5th a road grader could be heard on the Arrowhead Trail, but was not loud enough to be recorded on the Decibel Meter. Snowmobiles on McFarland Lake could also be heard throughout the tests, but were not loud enough to be recorded on the Decibel Meter.
4. Snowmobiles could be heard on the Fowl Lakes throughout the tests, but were not loud enough to be recorded on the Decibel Meter.

Timber harvest/management

Snake River Timber Sale: This sale consists of 7 payment units within 1 mile of the BWCAW boundary. Two nearby entry points, *Snake River* and *Little Isabella River*, provide travel corridors for wilderness visitors. Baseline ambient sound data has been collected at a site along the *Snake River*. We will return to this wilderness site to record active sound meter data and observations during timber harvest activity. Another site along the Little Isabella River should also be established before harvesting activity begins.

Nickel Timber Sale: This sale consists of 7 payment units within 1 mile or less of the BWCAW boundary, including *Little Gabbro Lake* within the wilderness. Baseline data has been collected at five sites on *Little Gabbro Lake*. One of these receptor sites was revisited in October and November 2008 during harvest activities. Mechanical noise was not heard by the observer nor detected by the sound meter during the October visit, but it should be noted that harvesting activity was minimal when the logging site was visited before going to the wilderness receptor site that day. During the November visit, noise generated by harvesting equipment (saws, vehicles) was heard by the observer, and his notes indicates that decibel readings on the sound meter did rise 2-6 dBA when harvest noise was heard. Unfortunately, the sound meter data was lost before it could be downloaded and correlated with the observer's notes.

Little Gabbro Lake campsite near entry point portage

Minerals Drilling

South Kawishiwi River: Sounds resulting from drilling operations have been monitored at 2 receptor sites outside the wilderness, one in the South Kawishiwi Campground and another along FR 186 closer to the drilling site in September 2008. At the campground, drilling operations were easily heard by the observer, faint but distinct, not detected by the sound meter. On FR 186, the observer notes that the drilling noise was clearly audible, quite loud, and occasionally dominating the existing ambient soundscape. The overall average dBA closer to the drilling site was 36.8, while at the campground the average overall average dBA was 33.8, a noticeable difference of 3 dBA, indicating that the sound meter did detect the noises from the drilling operation.

Sound Intensity Ranking System for Mechanical Sounds heard by the observer

0 = no mechanized or motorized noises heard
1 = Faint, barely audible, source not distinct from other existing mechanized sounds
2 = Faint yet specific noise source is distinct, masked occasionally by the existing ambient soundscape (wind, leaves, water, animals, human sounds)
3 = Clearly audible, specific source distinct, sound level not greater than existing ambient soundscape
4 = Noise dominant to existing ambient soundscape

Discussion

This first year of monitoring sound has given us the opportunity to develop protocols and methods for collecting, analyzing and reporting on the sounds of this Forest. The wind, as well as rain, is the major component contributing to the soundscape. Most often it is the effects of wind moving vegetation and water that constitutes most of the total sound pressure levels. Thus, at times when there is no wind or running water nearby, ambient levels can be 30 dBA or less, and all other types of sounds, both natural and manmade, can be heard even at considerable distances (1-5 miles). From our relatively meager sample set so far, the overall minimum and average sound pressure levels are approximately 34.7 dBA and 37.5 dBA, respectively. Other environmental variables contribute to the overall soundscape, including the proximity to running water (rapids, waterfalls), size of the lake or river, the type of shoreline (rocky vs sandy beach), and the local topography and vegetation near ground level. Squirrels and birds add transitory spikes within a localized area, as do humans. Understandably, wind direction is an important variable for moving sounds into the BWCAW. The data collected by observers in 2008 basically shows that sometimes mechanized noises generated outside the BWCAW can be heard in the wilderness and sometimes they can't, with the sound masking properties of wind and water the most obvious variables. The sound meter clearly registered snowmobile noise, but not ATV noise. More data samples from more varied locations throughout the year are needed to get a better grasp of how mechanized noises move about this forest, and how often and for how long they can be heard where people might be seeking a wilderness experience.

Recommendations

In 2008 we relied on a dBA sound meter/datalogger (to reduce the complex soundscape at a given moment to a single relative number), and human hearing (to identify the source(s) of sound at a given moment). While accurate, simple and relatively dependable, the data capture sample was of short duration (not more than an hour at a time, due to listener fatigue and concentration limitations) and skewed to mid-day (due to travel times to wilderness locations coinciding with the activity of mechanized noise generation). Thus, at least three variables must agree for a successful data capture: weather (no rain, calm wind), active mechanized noise generation, and ability of monitoring crew to be in the right place at the right time. While attending on-site listening by a technician is crucial component of the data sample, an unmanned field audio/dBA recorder placed at a wilderness site for extended periods (days) would greatly increase the range of ambient samples, activity times and weather variations. This would allow for hours and hours of recordings to be analyzed in a more streamlined, efficient manner. Also, a compact weather station would provide better wind data at the particular site than relying on airport data (often tens of miles distant). A better understanding of how often (percentage) the wind dominates the soundscape and obscures mechanized noises may help forest management decisions. Also, the duration of noises generated by target mechanical activity (a measure that was not recorded in 2008) would be helpful in establishing a percentage of time noise could be expected from that type of activity.

- *Digital Field Audio Recorder* – captures actual sounds over extended time periods (days), allowing for playback/analysis in lab setting.

- Add *duration of noise events* to Attended Listening Form (ALF), develop a *percent time audible* and *events per hour* calculation for noise events, as well as a *noise-free interval summation.*
- On-site wind and humidity datalogger.
- Establish a connection with the National Park Service/Natural Sounds Program for technical and methodology assistance. Collaborate with other Forest Service Sound Monitoring projects in standardizing protocols and results reporting (Tongass National Forest, etc).