CRICKETS: TEMPERATURE DEPENDENT BACKGROUND SOUND

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1 Introduction

The acoustic environment outdoors is characterized by the sounds of human activity and the sounds of nature. Sound from human activity follows a common pattern [1] that is comparable to patterns in traffic volumes [2, 3]. The typical diurnal pattern in urban areas rises sharply between 0500h and 0700h, maintains slightly reduced levels until approximately 1900h, and then drops off to a minimum level between 0300h and 0400h. In contrast, the sounds of nature, largely driven by weather and animal activity, are more variable. Animal activities also follow patterns, but are more variable with their seasonal life cycles.

The impetus for this evaluation was an unusual pattern in long term sound measurements. The sound levels, which were much higher than expected, and minima which occurred at unusual times of day led to further investigation and identification of the source.

2 Results

2.1 Data Collection

Sound levels reported in this study were measured in rural southern Ontario. The primary location is sheltered by a stand of mature trees, with agricultural fields in the vicinity and a rural road at some distance. The sounds of nature dominate during nighttime, while a large increase in road traffic volume influences daytime sound levels.

Initial data from the primary location was led to comparison to evaluate variation year-to-year, seasonally, and by degree of urbanization. These smaller data sets are only addressed qualitatively here.

Measurements were conducted over several months using Larson Davis 820 and Bruel+Kjaer 2250 sound level meters, each equipped with their respective environmental protection kits. Minimum, maximum, average L_{EQ}, and statistics were recorded on an hourly basis. Manufacturers' specifications governed the validity of data collected. Where weather conditions were outside of meter's specified range, the data was excluded from consideration. Audio data was not available for the extended data set.

Meteorological data including temperature, wind speed, precipitation, and relative humidity were collected at the same time as the sound level measurements. Equipment collecting the meteorological information was located away from the stand of trees. Wind speeds therefore do not reflect the sheltering effect of the tree stand.

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2.2 Sample Data

The pattern of sound levels that initiated the investigation occurs overnight. Daytime hours are not notably different from an urban sound pattern. As shown in Figure 1, there is a sharp rise of approximately 10 dB that falls back to a similar minimum sound level 11 hours later. The pattern was most prominent between 45 and 55 dBA, although a range of 35 to 60 dBA was observed.

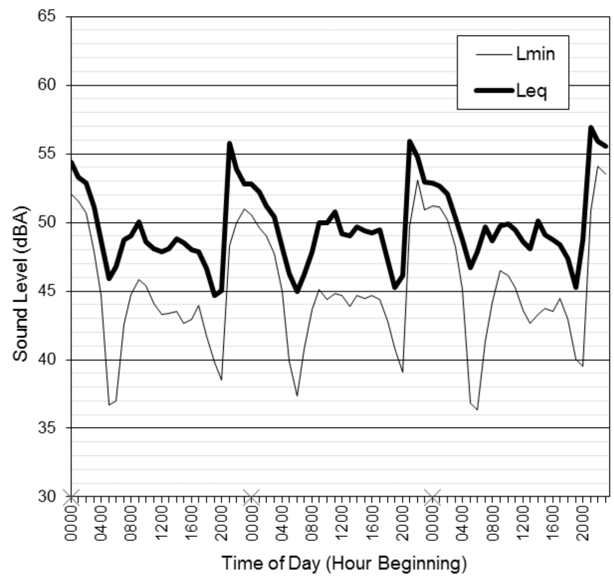

Figure 1: Typical Observed Sound Level Pattern by Time of Day.

Start and end times of the pattern are very consistent. The sharp rise occurs very consistently at 2000h and gradually falls off to a minimum at 0700h. These coincide with sunrise of 0730h and sunset of 1930h during the same period.

The pattern was observed as early as July 25th and as late as September 30th. Review of the statistical sound levels suggested that the source was present for large portions of each hour, and was not a short duration event.

2.3 Correlation with Temperature

In the absence of obvious mechanical sources of noise, correlation was sought with weather parameters: relative humidity, wind speed and temperature. Neither wind speed nor relative humidity showed a relationship with the sound level data. However, there was correlation with temperature.

Daytime sound levels showed no temperature correlation. Sound levels at the beginning and end of the pattern also were not as strongly correlated with temperature. The window beginning 2100h and ending at 0500h on the following morning was therefore used. The resulting correlation between sound level and temperature is show in Figure 2.

Analysis was based on the 400 remaining data points. The data shows a distinct rising trend. Sound levels rise by 5 dB for a temperature increase of 4 °C beginning around 10 °C and 40 dBA.

2.4 Comparison with Other Data Sets

The review of additional data sets looked for the pattern:

- at the same location in other years;
- at the same location in other seasons;
- at other locations in other seasons; and
- at more urban locations in the same season.

Comparison of the primary dataset with the same location at the same time in other years showed that the pattern was also present although the sound level did not always show as much increase with temperature. The pattern was not present in other seasons of the same year. A more wilderness site, measured earlier in the year, also did not show the pattern. Finally comparisons were made with a number of more urban sites. Late summer measurements made in the quieter yards, parks, and unmanaged lands in urban areas had sound levels that were in the upper range of levels observed in the main data set. A correlation between sound level and temperature was not observed.

2.5 Audio Data

A small amount of audio was collected during comparable measurements in a subsequent year. The chirping of crickets was the only audible sound present in the recording.

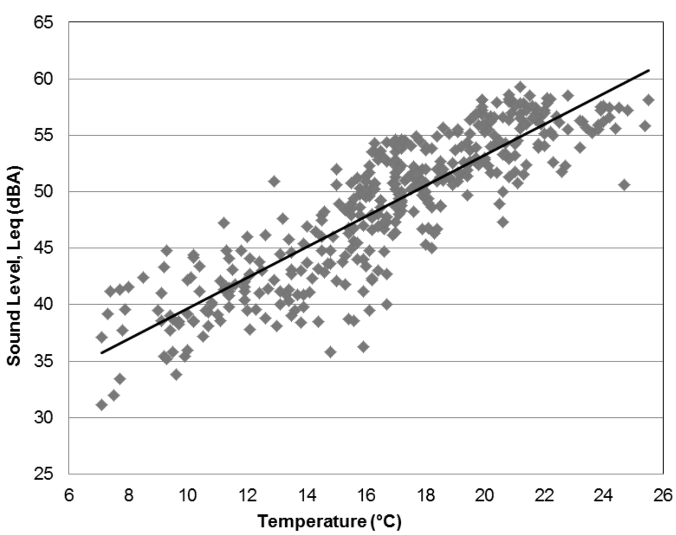

Figure 2: Correlation of Sound Level with Temperature.

3 Discussion

The acoustic environment away from urban activity is often described by the general term “sounds of nature”. The many elements that comprise the sounds of nature show significant variation. This study has briefly considered only one specific component of the natural acoustic environment.

Variation correlated with temperature has been identified, although time of day and season are also factors. After sunset, the warmer temperatures correspond with higher sound level. As the temperature falls during a night there is a corresponding drop in the sound levels. The occurrence for only a part of the year, as well as the nighttime-only aspect of the sound are undoubtedly due to the life cycle and activity of the cricket to which the sound has been attributed. The exercise illustrates the complexity that would be associated with predicting the sounds of nature.

The data illustrates a general correlation between temperature and sound level. However, for each temperature there the sound levels vary by about 5 dB from the median. One of the contributing factors is likely to be the difference in temperature measurement location. The temperature measurements were taken in air, at a few meters above the ground. Crickets on the other hand are located on the ground among the grasses. A temperature measurement at ground level is likely to produce a closer correlation.

Other factors that would influence the volume of sound are the specific varieties of cricket, and the number of crickets present in an area. Additional detail from the field of entomology would be needed.

This work highlights that measurement of background sound in the presence of dominant sounds of nature requires at least a basic understanding of local influences. In this case, cricket noise far exceeded the daytime sound level. Nighttime sound levels would not satisfy the Ontario Ministry of Environment requirement for times when the background is at its lowest level [4].

4 Conclusion

A pattern of sound levels between sunset and sunrise has been attributed to the sounds of nature. They correlate with temperature, even though sound levels during the remainder of the day are not temperature correlated. Audio indicates that this is due to crickets chirping.

During the late summer measurement period, sound levels in the area do not follow a typical diurnal pattern. The quietest hourly period does not fall during the normal 0300h to 0400h period.

References

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