

# Urban vs. Natural Sounds in Sendai city : A Comparative Study

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**Abstract :** In an attempt to characterize the soundscape in areas of Sendai City, we have studied sound pressure levels at 9 different points differing in degree of urbanization and representing different sound environments. Results indicates that larger sound amplitudes in each site correspond to the nature of its environment. In urban zones with few natural elements, manmade sounds are the most intense, and areas with less degree of urbanization or a more natural environment, the predominant sounds were all natural except in case of sound contamination from a loud source such as a helicopter flying in the distance.

**Keywords :** natural sounds, soundscape, urban, sound amplitude

## 1. Introduction

The amount of urban vs. natural sounds that we experience on daily basis is an interesting question seldom addressed in environmental education studies in the Tohoku area, northeast Japan, a dynamic socioeconomic region where cities are constantly growing and changing. As in every other place on earth, cities in this region grow by drastically changing the natural landscape, and the soundscape associated with natural spaces changes along as these are absorbed by the urbanization process. This change in the soundscape associated with urbanization has proven to have important biological and evolutionary consequences in birds adapting to live in urban areas (Potvin *et al.*, 2010), and may also affect our perception of concepts associated with sounds such as “noise” and “quiet” (Echenique-Diaz and Saito, 2010). In order to compare the dominant sounds in areas with different degrees of urbanization, we have carried out a preliminary study of the soundscape in Sendai city, and report here our results with a brief discussion of its implications.

## 2. Materials and Methods

Recording points were only a few compared to the diversity of environments associated with Sendai City (Fig. 1). Five different environments were chosen in suburban and urban areas (Fig. 2). Points 1 and 2 are within local University campuses with scattered trees around them and relatively close to large patches of forests. Points 4 and 5 are within large forested patches and relatively close to streams. Points 5 to 7 are in the downtown of the city, around and at Sendai Station. Point 8 in a residential area in the suburbs, and point 9 in a suburban paddy rice field (see details in Table 1). Recordings were performed with an Olympus PCM recorder (SL-11) and a LiSN parabolic microphone (Fuji Planning Co., <http://www.din.or.jp/~fpc/Ls/indexLs.htm>) for 3 to 5 minutes between 7:00 and 9:00 am at points 1 to 7, and between 7:00 and 8:00 pm at points 8 and 9, across 4 months (May to August) in 2011. We chose to always point the parabolic microphone to the north in every recording point, and hold it about 1.5 m from the ground.

Recordings were visualized in Audacity 2.0.3, a non-commercial, freely available software popular among

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music lovers, but equally useful in the edition and simple analysis of any kind of sound. A simple edition was performed as follows: the first 15 seconds of each recording was cut to eliminate any noise resulting from movements of the recording person, leaving one minute of recording intact and deleting the rest. Therefore, edited recordings were left at 1 minute of length. In the analysis, sound amplitudes relative to the frequency components in each recording as a measure directly related to the acoustic energy or intensity of a sound was obtained from Plot Spectrum analysis, where the selected audio (which is a set of sound pressure values at points in time) is converted to a graph of frequencies (given in Hz in the x axes) against amplitude (given in decibels, dB, in the y axes). The nature (urban or manmade vs. natural) of the dominant sound (showing the largest amplitude) in each recording site was determined to compare the soundscape in each point.

Changes in the soundscape relatively to season changes (for instance, different type of animals singing from late spring to summer) were ignored in this preliminary report given that our goals were to document and compare sound pressure levels and the nature of the sounds (natural vs. manmade) at any given time in different parts of the city.

### 3. Results and Discussions

Dominant sounds that were urban or manmade in nature in this study were found at points 4 to 8 (Table 2, Fig. 3). Among these, point 4 was in a large patch of forest relatively isolated from the more urbanized areas of Sendai. However, the sound of a helicopter flying in the distance totally dominated the soundscape here even though some forest birds were also singing. Natural sounds dominating the soundscape were found in the remaining recording points. Points 1 and 2 are located at places where usually urban sounds predominates (cars, construction machinery, etc.), however, the presence of trees and closeness to forested patches makes it possible

for animals to easily wander around these areas. In the case of point 1 for instance, at the time of the recording a masked palm civet (*Paguma larvata*) was spotted walking between buildings. At point 2 a chorus of frogs totally dominated the soundscape even though there were some car sounds in the background. It is possible that given that the fountain found in this park is the only water body in a hundred meters radio around it, a higher than usual density of frogs resulted in a louder sound. However, saturation in this track may be the result of a recording done too close to singing frogs using a parabolic microphone. In this regard, in 3 occasions when citizens were played these recordings, sounds from points 1 and 2 were considered as “nice” but very noisy, and that from point 5 as simply “very noisy”. However, point 5 is a recording inside a moving bus, a soundscape that we experience normally in our lives, and that doesn’t seem to irritate that much. In fact, Japanese people prize silence inside a bus (not talking) even though this is already a very noisy ambient per se. On the other hand, at point 7 in the downtown of Sendai, on the 31<sup>st</sup> floor in AER building, a quiet environment where people talking were the dominant sound, the soundscape was still full of car sounds, despite the height at which it was recorded. In general, the 9 recordings in our study show a clear trend where natural sounds are dominant in sites away from the urbanized areas. This seemingly obvious result is in fact an indicator that our modern lifestyle disconnect us from nature, where we create our own environment, with its own unnatural soundscape that ends up being the norm. We believe that in order for Environmental Education in the XXI century to change and generate new attitudes towards nature, this disconnection should disappear.

### Acknowledgment

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References

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Table 1: Recording points around Sendai City.

Point	Description
1	Parking lot in Kawauchi campus, Tohoku University
2	Park in front of Miyagi University of Education COOP
3	Stream in the forest in Kadan
4	Aoba no Mori (the forest of Aoba Hill)
5	Inside a bus at Aoba Avenue
6	In front of Sendai Station
7	AER building's observation deck, 31 <sup>st</sup> floor
8	Yoshinari 1 chome residential area
9	Rice fields next to Saikachi Dam, Nishikigaoka

Table 2: Peak amplitude for recordings at points 1 to 9 around Sendai City, and the nature of the sound corresponding to that amplitude (natural\* or manmade).

Point	Peak amplitude	Corresponding sound
1	-39.2 dB	Cicada*
2	-17.4 dB	Frogs*
3	-30.6 dB	Forest birds*
4	-17.2 dB	Helicopter pass
5	-14.0 dB	Bust stop announced on speakers
6	-12.1 dB	Car sounds
7	-30.9 dB	People talking
8	-11.5 dB	Car pass
9	- 32.5 dB	Frogs*

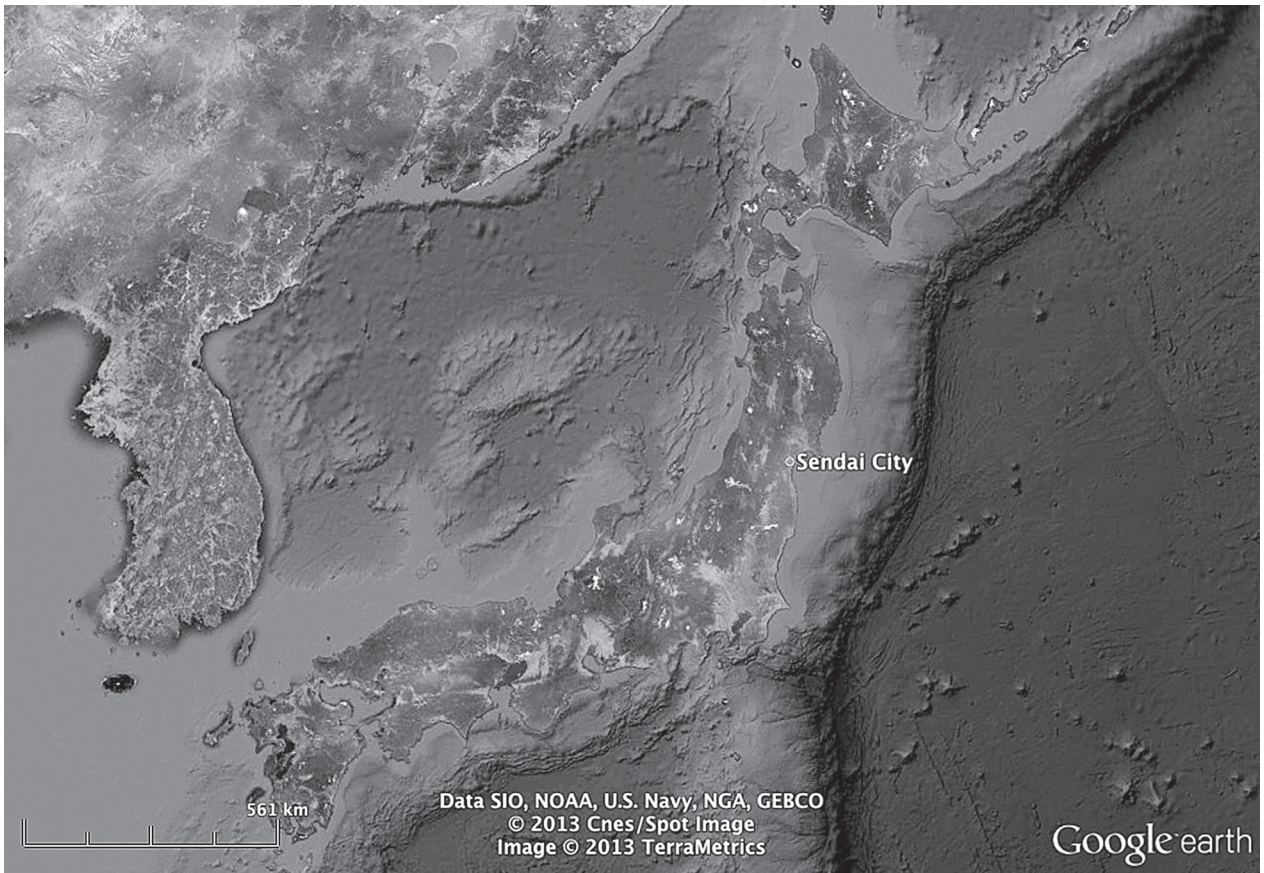


Figure 1. Sendai City on the northeast of Japan.



Figure 2. Recording points around Sendai City.

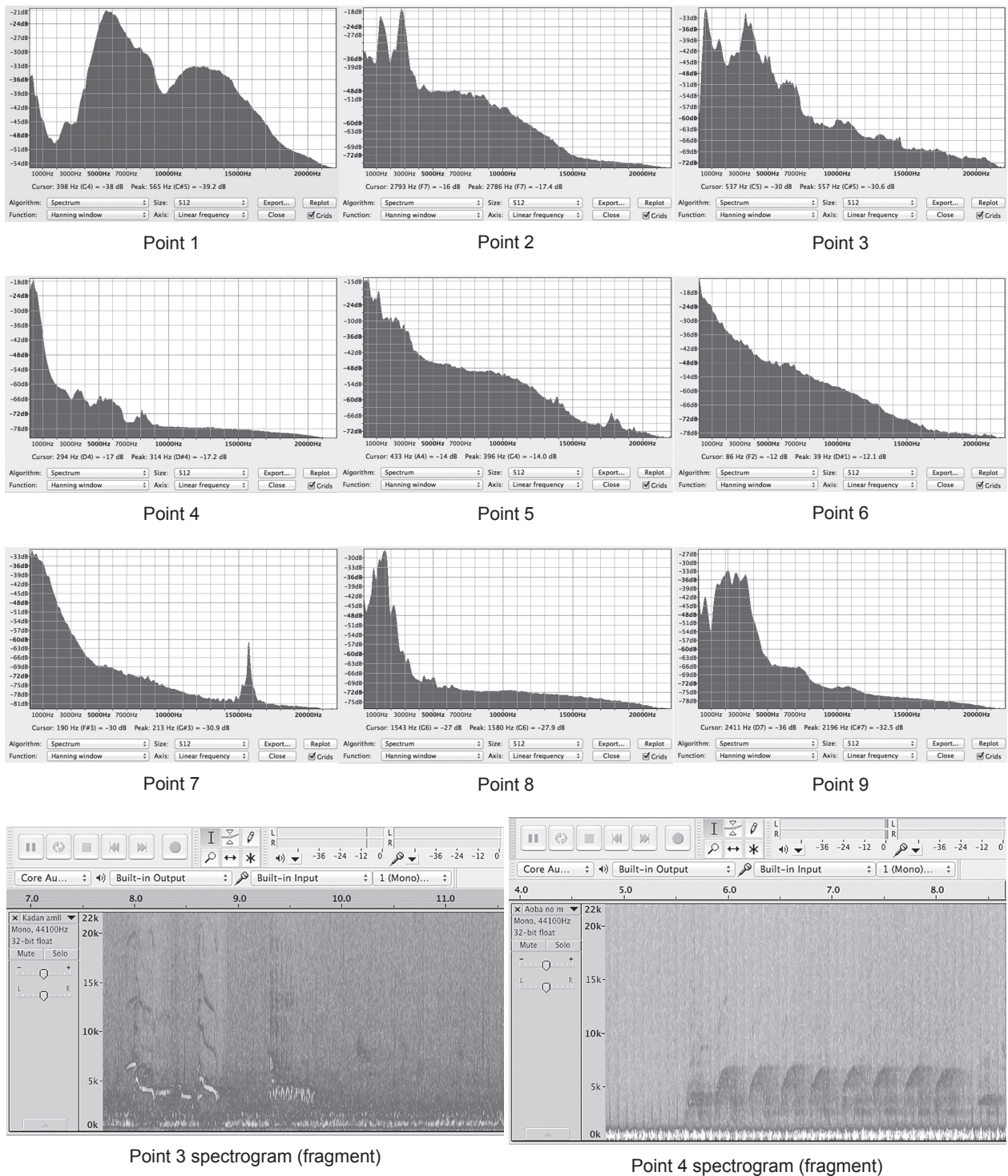


Figure 3. Plot Spectrum of recordings at points 1 to 9 around Sendai City, and two spectrogram fragments for point 3 (forest birds singing) and 4 (helicopter pass and forest birds singing). In the Plot Spectrum the higher peak value in the y axes (amplitude) was taken as the maximum amplitude reported in Table 2. In the spectrograms, the closer the color gets to white, the larger the amplitude. At point 3, birds dominate the soundscape. At point 4, a helicopter sound is dominant.

