SOUNDSCAPES FROM AN URBAN ENVIRONMENT BORDERING ON A GREEN SPACE

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1 Introduction

Acoustic recordings were made over several years in an urban setting bordering on a green space. Recording was 5 minutes every half hour, day and night, except for rainy weather and occasional gaps the order of one month. The recorder was a Wildlife Acoustics SM3 [1], vintage 2015, usually deployed using two microphones, one near ground level and another 10 m away, about 2 m off the ground. Figure 1 shows the dates of the recordings over the past 4 years. Only a cursory look at the data has been done to date. The dominant feature is of course the daily variation due to bird vocalizations, but seasonal and annual variations can be investigated. The latter are the focus of this note.

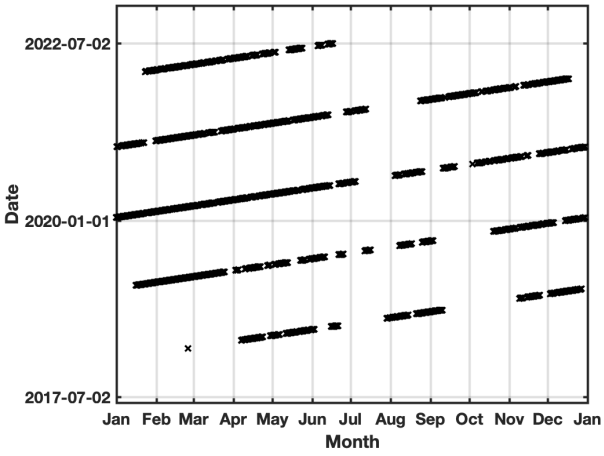

Figure 1: Recordings by month of year from 2018 to 2022.

2 Method

Five-minute recordings centred on the hour and half hour were made at sampling frequency 24 kHz, and the raw data archived as .WAV files. A two pole (12 dB per octave) high-pass filter at 220 Hz was applied to avoid clipping due to the low frequencies. A plot of a five-minute time series and spectrogram using the Audacity software [2] is shown in Fig. 2.

For more analysis, spectra in each 5-minute file were determined using the Matlab [3] command:

```
[S,F,T,P] = spectrogram(data,1024,512,1024,FS,'yaxis');
```

This takes chunks of 1024 points, Hamming window with 50% overlap, and forms the one-sided power spectral density `P` at 513 frequencies `F`. For `FS` = 24 kHz sampling, there are about 1380 time bins `T` of width 0.043 s; `S` is the complex spectrum. The average (P_{avg}) and median (P_{med}) power level of `P` in each bin (about 23.4 Hz wide) were obtained and saved as a compressed summary of the data.

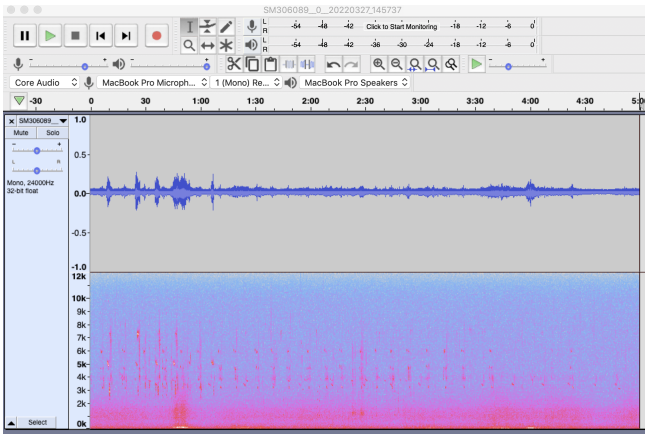

Figure 2: Five minute time series and spectrogram using Audacity [2] software. Note numerous bird calls in 3–8 kHz band.

3 Results

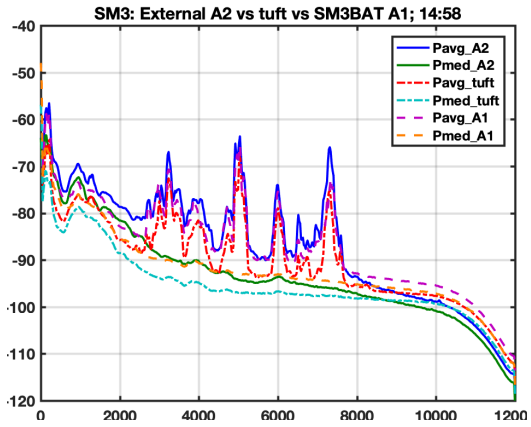

Figure 3: Spectrum of average and median power levels of (uncalibrated) on several microphones from 5-minute recording of Fig. 2.

Figure 3 compares the average and median power levels from a number of microphones placed within 30 cm of each other for the time interval shown in Fig. 2. The microphones were the internal ("tuft") microphone in the SM3 recorder, the SMM-A2 external microphone, and the SMM-A1 microphone in a SM3BAT recorder. The internal microphone should be equivalent to the SMM-A1 microphone. Note that these are uncalibrated. Nominal calibration levels are available [1] within 4 dB at 1 kHz, and approximate curves for other frequencies; however, discussion of calibration is beyond the scope of this note. Here we work with the uncalibrated spectral levels.

Figure 4 shows the average levels over 10-day intervals during January and June. On the display there are occasional gaps due to bad weather; during the gaps the last previous recording is repeated until recording was restarted.

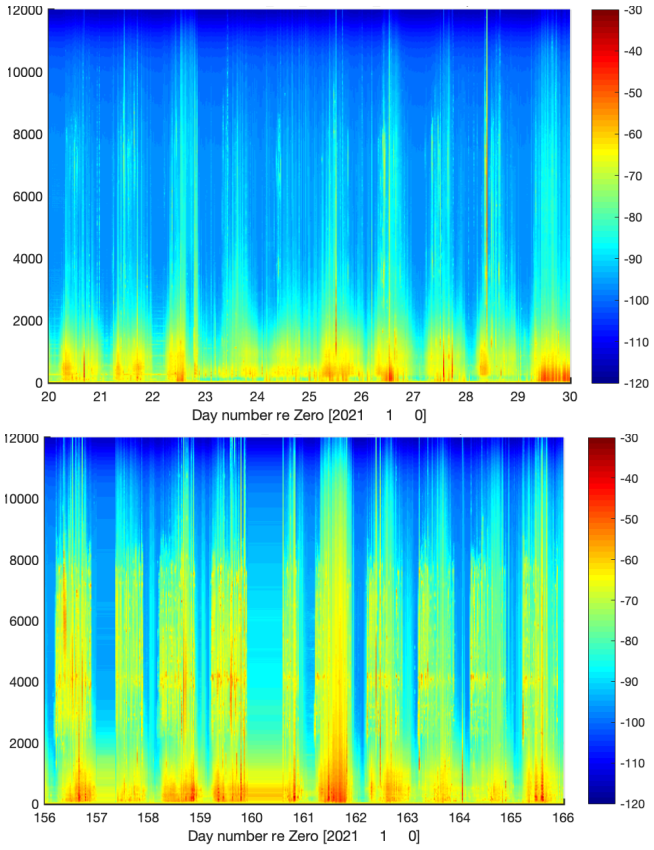

Figure 4: Spectrogram of average 5-minute levels over a 10-day interval in January (upper) and June (lower).

Figure 5 shows median levels for January to March 2019, 2020, and 2021 at four frequencies. The levels are smoothed with a Hann window over 100 recordings (about two days). One can see the day-to-day fluctuations on each plot, and year-to-year differences by comparing the upper, middle and lower plots. There is no obvious "Covid" effect in late March 2020.

4 Summary

This has just been a quick overview of the available data, and a look at the temporal dependence of median levels. More work needs to be done; e.g., calibrated spectra should be compared, and there are interesting features like spectra of individual bird calls that can be investigated.

Acknowledgments

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References

[1] Wildlife Acoustics. Song Meter SM3 BIOACOUSTICS RECORDER User Guide, 2020. SM3-USER-GUIDE-20200805.pdf. `https://www.wildlifeacoustics.com/resources/user-guides`; last accessed 2022 Apr 09.

[2] Audacity. *Audacity 2.4.1 Manual*, 2018. `https://manual.audacityteam.org`; last accessed 2022 Jul 29.

[3] The Mathworks, Natick, MA. *MATLAB*, 2017. Version R2017a.

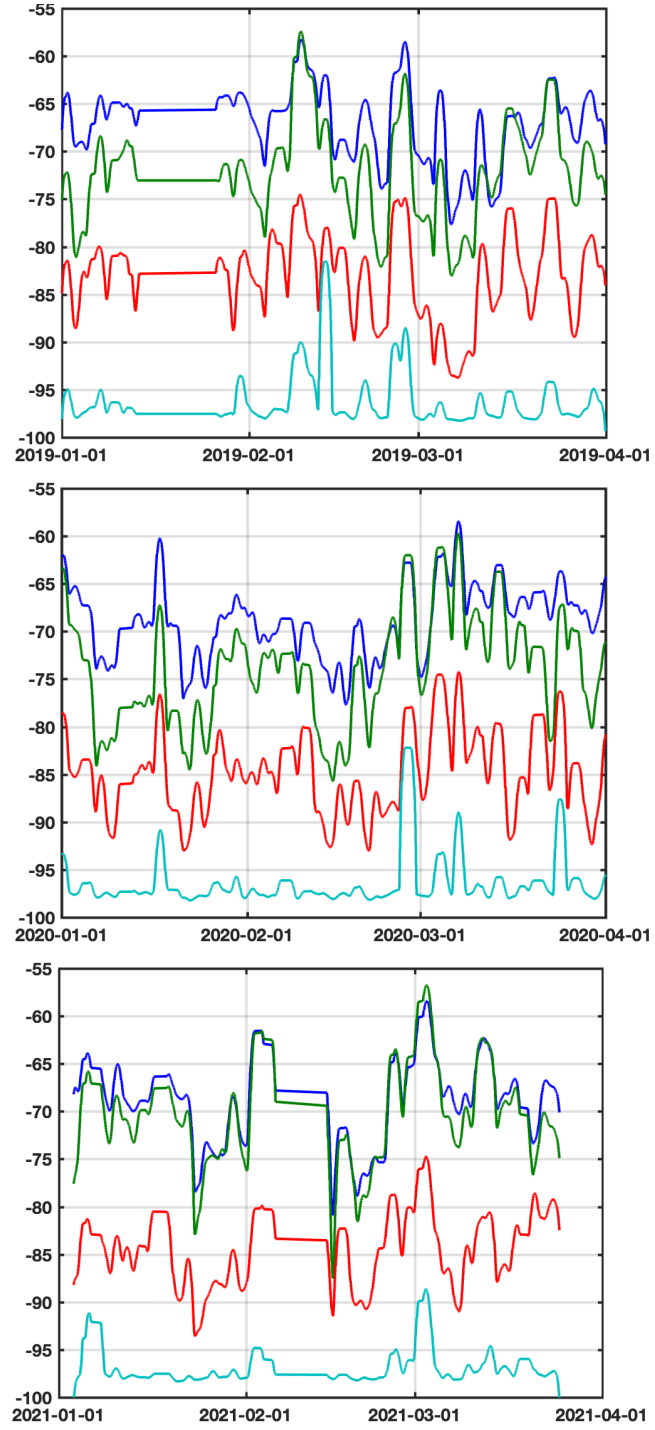

Figure 5: Median spectral levels for January-March in 2019, 2000, and 2001 at 4 frequencies: 117 (blue), 398 (green), 1500 (red), and 6000 (cyan) Hz.