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# Ambient noise levels due to dawn chorus at different habitats in Delhi

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**Abstract**

The characteristics that enable animals to live in urban environments are not well understood. A high level of ambient noise is a typical signature of an urban habitat, which makes vocal communication difficult for birds. The present study compares the noise levels due to dawn chorus of birds in semi-urban and forest habitats of Delhi region. The noise level measurements were carried out using Type I Sound Level Meter. Time series plots of noise levels at different 1/3rd octave frequency indicates a significant increase in the noise levels in the frequency range of 1-4 kHz during the time of chorus as compared to background noise levels of the site. It is also observed that the dawn chorus of the birds at different sites in Delhi is mainly dominated by two generalist species, i.e., *Corvus splendens (*House Crow) and *Acridotheres tristis (*Common Myna). Spectrogram of typical calls by these two species also indicates the dominance of 1-2 kHz in their calls. Whereas the maximum noise levels during the dawn chorus reached up to 70dB levels and even more. Our results show that bird communities vary greatly along the different studied habitats. It is further observed that the urban sites are mainly dominated by a very few species like common myna, house crow, rock blue pigeon, while the species diversity at ridge forest sites is found to be higher, and also includes bulbul, sunbirds and warblers etc. One of the reasons for significantly less number of species contributing to the dawn chorus could be harsh acoustic environments prevailing in the urban areas making the communication among the birds difficult. The results of this study would provide evidence for site dependent behavioral mechanism explaining noise dependent frequency use in bird chorus.

***Keywords:*** Bird chorus, ambient noise, vocalization frequency, house crow, common myna

## Introduction

Acoustic communication is one of the most crucial aspects of bird behavior having a bearing on the very survival of a species in a given habitat. Birds are one of the most vocal class of animal kingdom and depend on acoustic signals to attract mates, defend territories, synchronize behaviors and warn of dangers (Marler 2004; Catchpole and Slater 2008). However, their habitats can be noisy because of biotic and abiotic sounds, which interfere with signal detection and limit the range of communication (Klump 1996; Warren *et al* 2006). Therefore, the acoustic structure of the ambient environment at a habitat is one of the major factors influencing the effectiveness of the communication system among birds. Humans, through urbanization, have greatly altered the natural soundscapes of the bird habitat, thereby

causing interference in the communication activities of birds. Although a wide variety of habitats have been investigated for their impact on animal signal design, until recently these did not include the urban habitat(Warren *et al* 2006; Patricelli and Blickley 2006). The effects of urban landscape composition on avian habitat selection is quite favourable for birds like *Acridotheres tristis (*Common Myna), House Crow (*Corvus splendens*), eurasian collar dove (*Streptopelia decacoto*) and *Columba livia* (Blue rock pigeon), with higher breeding densities at urban park edges, probably due to their higher foraging opportunities (refuse, people leftovers, deliberate feeding) and nest site availability (Fern and Andez 2001).

One of the significant aspects of bird communication is that the singing activity of birds is at its peak during early hours in the morning- the phenomenon being popularly known as the dawn chorus. The acoustic transmission hypothesis states that birds vocalize most intensively at dawn because signals propagate effectively during this period of the day (Henwood and Fabrick 1979). Early morning microclimatic conditions are optimal for sound propagation with respect to the atmospheric attenuation. Many species of birds vary the time at which they vocalize to avoid interference with the neighboring bird and other sources of noise (Ficken *et al*. 1974). Some sources of urban noise are variable over time, and birds may be able to time their songs to take advantage of small gaps in noise (Lohr *et al*. 2003) or diel fluctuations in noise levels (Warren *et al*. 2006). Avoidance of acoustic interference is one of the hypotheses for the evolution of the dawn chorus, predicting that its timing may shift with the timing of rush hour traffic (Bergen and Abs 1997, Warren *et al*. 2006).

In the Indian context, very few investigations (Bhatt *et al* 2000 and Kumar 2003, 2004) have focussed on bird communication. Moreover, none of the study attempt to investigate the intense noise levels during dawn chorus of birds in this region. In the present study spectral charactersitics of noise levels of dawn chrous at various sites in Delhi have been examined to identify frequency intervals in which birds at urban habitats vocalize the most.

**Meterials and Method**

In the present study, noise levels were measured at 1/3 octave frequencies at different sites in Delhi. The sites were chosen on the basis of a preliminary field survey to identify prominent bird roosting sites in the study area. The sampling sites (figure-1) chosen for the study were Delhi University Nursery, Lodhi Garden, ISTM (JNU- old campus), Kamala Nehru Ridge Forest and Buddha Jyanti Ridge Forest. Of these sites Kamala Nehru Ridge Forest and Buddha Jyanti Ridge Forest are forested areas whereas, Delhi University Nursery, ISTM (JNU- old campus) are institutional areas and Lodhi Garden is a big park with a large number of dense canopy trees. At each site, the sound level measurements at 1/3 octave frequencies were made with a Type I SVAN 957 Sound Analyser, which was mounted on a tripod at a height of 1.5m above the ground in the vicinity of bird roosting site. The noise levels were measured at a sampling interval of one second for a minimum of 45 minutes during the dawn. The individual calls of the birds dominating the dawn chorus were also recorded with the help of a digital sound recorder (Sound Device T722). The bird calls were then analyzed using Avisoft acoustic analysis software.

**Results and Discussion**

In the present study, the sampling sites can be classified into two categories: (I) the sites where shrubs and bushes are absent and only large canopy trees provide the place for roosting, and (II) the sites where shrubs and bushes along with some large canopy trees provide the roosting place for the birds. Of the five sampling sites Delhi University Nursery, Lodhi Garden and ISTM (JNU Old Campus) come under the first category while Kamala Nehru Ridge Forest and Buddha Jyanti Ridge Forest belong to the second category. The large canopy trees provide the roosting sites for some of the most successful bird species in the urban environment. These roosting sites are generally inhabited by species such as house crow (*Corvus splendens)*, common myna *(Acridotheres tristis)*, eurasian collar dove (*Streptopelia orientalis*) etc. The shrubs and the bushes on the other hand, provide roosting sites for species such as red vented bulbul (*Pycnonotus cafer*), common tailorbird( *Orthotomus sutorius*), oriental magpie robin(*Copsychus saularis*), purple sunbird( Nectarinia asiatica) etc. The chorus observed at a given site is basically governed by the number of birds and the kind of species contributing to the chorus.

Figure 2 gives the time series plot of A-weighted sound levels due to dawn chorus at the Delhi University Nursery site. It may be seen that the sound levels due to the chorus attain peak above 70 dBA between 6:10 am to 6:40 am. The chorus however, comes to an end by 6:50 am when the sound levels reduce to less than 50 dBA. Figure 3 compares the sound levels at different 1/3 octave frequencies during the peak chorus activity with the after peak sound levels. It may be observed that the sound spectra during the peak period and after peak period do not differ significantly in the low frequency range (20Hz- 300Hz). However, the peak and the after peak noise spectra are significantly different from each other from 500 Hz onwards. It is observed that peak period noise levels are greater than the after peak noise levels by about 20 dB or even more. Thus it can be inferred that birds allocate the major part of their acoustic energy in the middle and high frequency region. Similar behavior of the dawn chorus is also observed at ISTM site (Figures 4 and 5) and Lodhi Garden site (Figures 6 and 7).

A common feature of the dawn chorus at all the above sites is that the peak chorus persists for a duration of about 30 minutes and that the chorus at these sites is mainly dominated by calls of common myna and common crow. The sound spectra plots reveal peaks around 3 kHz which indicates that a major portion of acoustic energy of the calls of common myna and common crow is concentrated in this region. Figures 8 and 9 depict the spectrograms of the individual calls of these species.

To investigate the contribution of these species to the chorus, the spectrograms of individual calls of these species were obtained (Figures 8 and 9). The figures reveal that a major portion of common myna calls is concentrated in the frequency interval of 1500Hz to 3500Hz. However, significant call elements can be seen up to 12 kHz. In case of common crow calls, it may be seen that the major portion of their call is concentrated in the frequency interval of 1000Hz to 2500Hz. At the same time, the spectrograms also reveal that common crow allocates significant amount of its acoustic energy in the high frequency range up to 15 kHz. The above observations are reflected clearly in the spectrogram of common myna-common crow dominated dawn chorus (Figure 10) as well as in the 1/3 octave noise spectra plots (Figures 3, 5, 7).

Figures 11 and 13 show the A-weighted noise levels due to dawn chorus at Kamala Nehru Ridge Forest site and Buddha Jyanti Ridge Forest respectively. It is seen that noise levels during the dawn remain steady around 40dB at Kamala Nehru Ridge Forest site and around 50 dB at Buddha Jyanti Ridge Forest site. It is worthwhile here to mention that the intensity of chorus at these sites was not high and the chorus was not continuous. Further, the chorus was not dominated by any one or two species at these sites. Even though a variety of species such as bulbul, jungle babblers, warbler, sunbird, magpie robin etc contribute to the chorus at these sites, their numbers are not very large. Further, the above mentioned birds are small sized and the amplitude of their calls is significantly lower than that of common myna and common crow calls. This is reflected in the typical spectrogram of dawn chorus (Figure 15) that is not dominated by common crow and common myna. Figures 12 and 14 give the 1/3 octave noise spectra at Kamala Nehru Ridge Forest site and Buddha Jyanti Ridge Forest site. The plots clearly reveal the low noise levels in the middle and high frequency regions. Unlike the common myna common crow dominated chorus, no significant peak is observed at these two Ridge Forest sites.

The results of the present study indicate that the intensity of dawn chorus at typical urban sites viz. Delhi University Nursery, ISTM (JNU old campus) and Lodhi Garden is very high on account of contributions from common myna and common crow. These two species vocalize in a broad frequency range at high amplitude which helps them to communicate effectively. Further, they are quite aggressive and successful in the urban setup and thrive on the grain, fruits and other discarded food items by humans. Large canopy trees are the preferred roosting sites for both these species, but since such trees in the urban built-up area are less in number, there is a general crowding at each roosting site. This crowding leads to high noise levels due to vocalization by large number of birds at the time of dawn chorus.

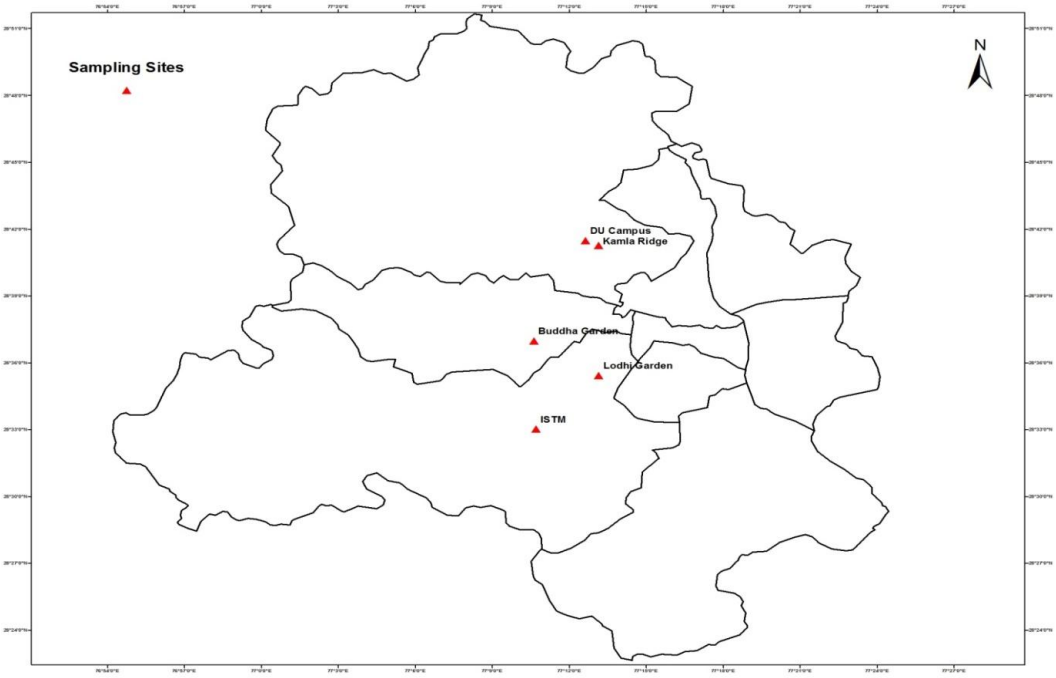


Figure 1 Sampling Sites for recording the dawn chorus

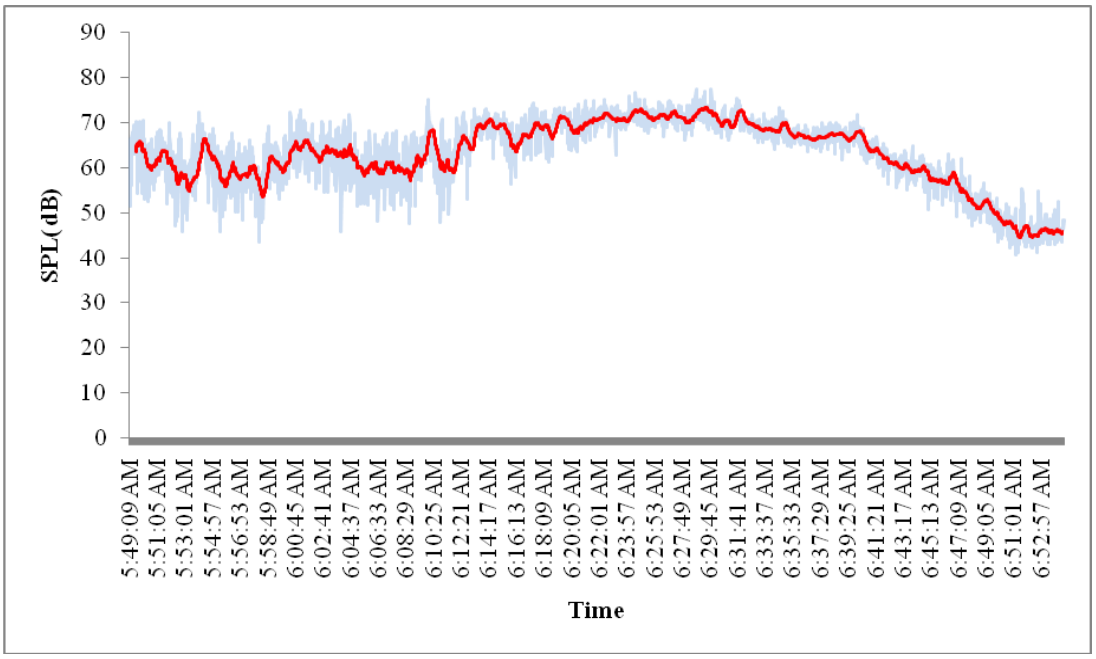


Figure 2 Time series plot of the dawn chorus at the Delhi University Nursery site. Red line show moving average of A-weighted Sound Pressure levels. Blue line represents the actual A-weighted dB levels.

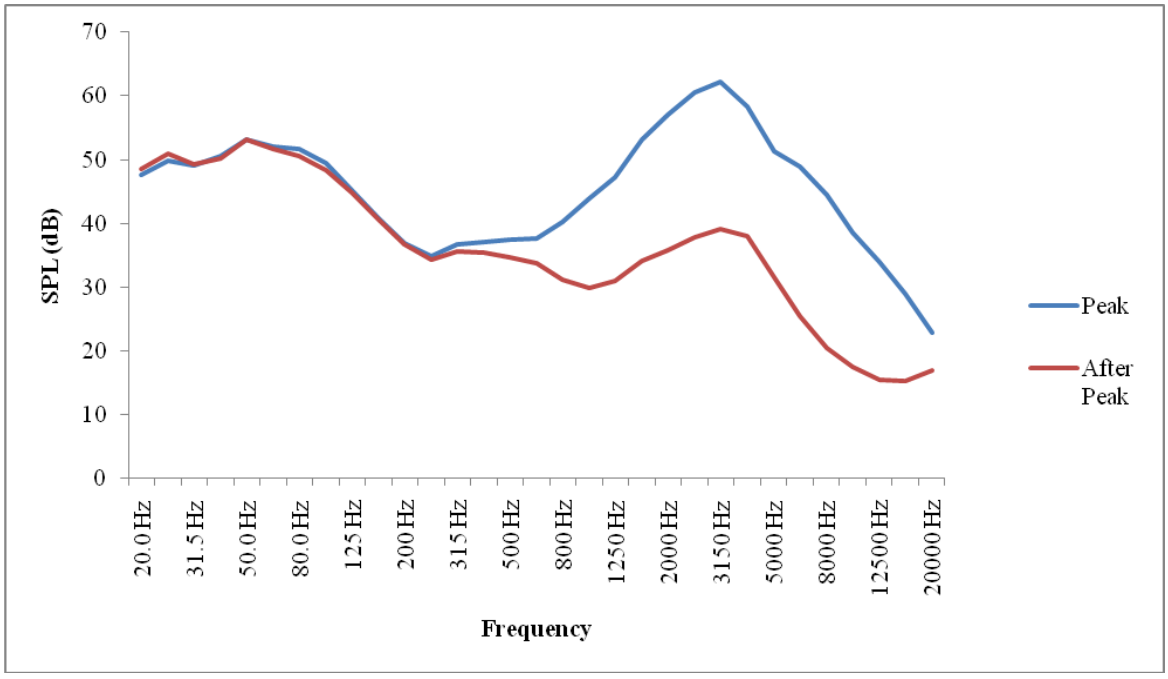


Figure 3 Power spectrum of Peak and after peak dB levels of dawn chorus at Delhi University Nursery Site

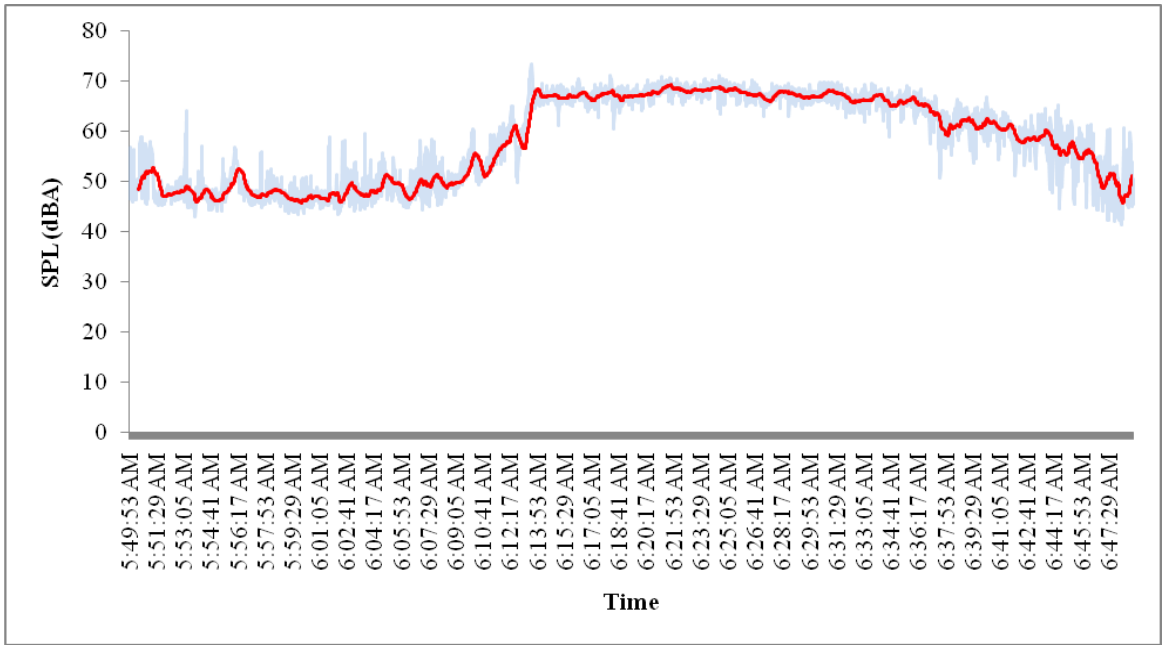


Figure 4 Time series plot of the dawn chorus at the ISTM (JNU Old campus) site. Red line shows moving average of A-weighted Sound Pressure levels. Blue line represents the actual A- weighted dB levels.

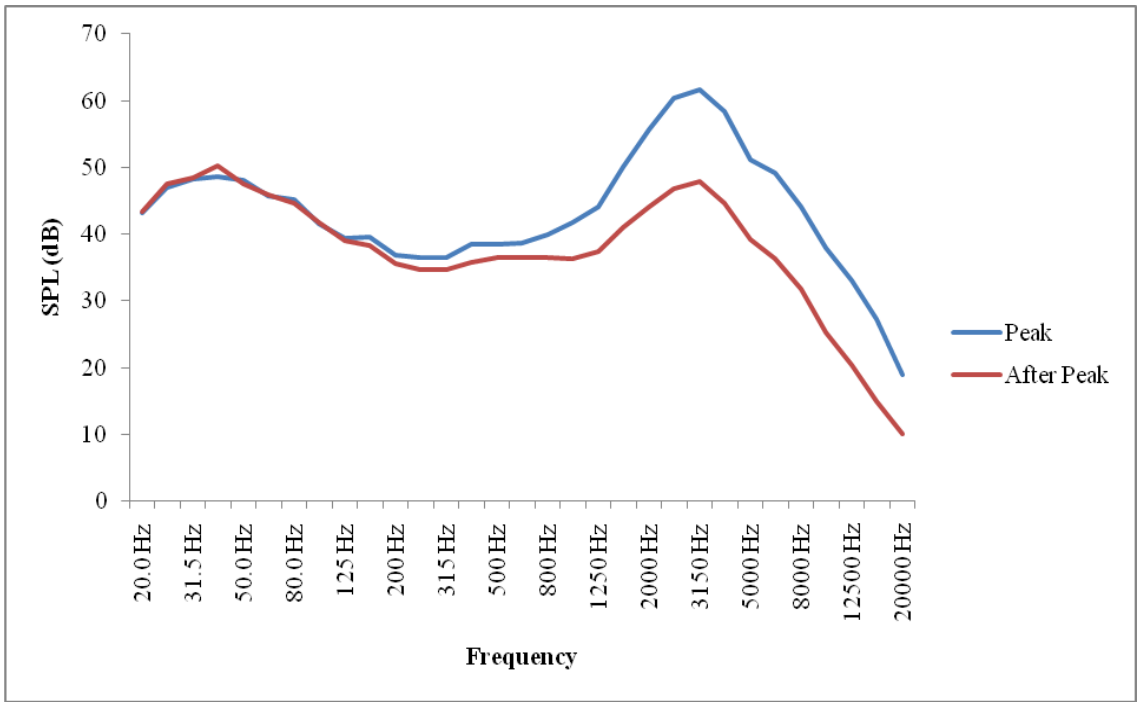


Figure 5 Power spectrum of Peak and after peak dB levels of dawn chorus at the ISTM (JNU Old campus) site.

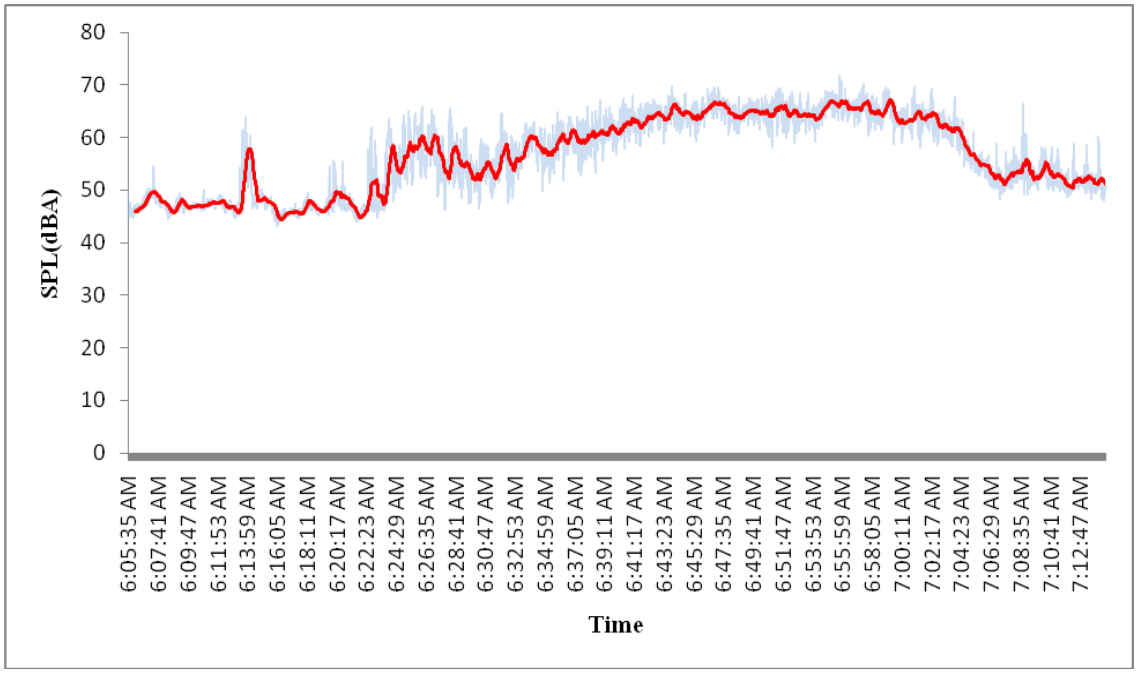


Figure 6 Time series plot of the dawn chorus at the Lodhi Garden site. Red line shows moving average of A-weighted Sound Pressure levels. Blue line represents the actual A- weighted dB levels.

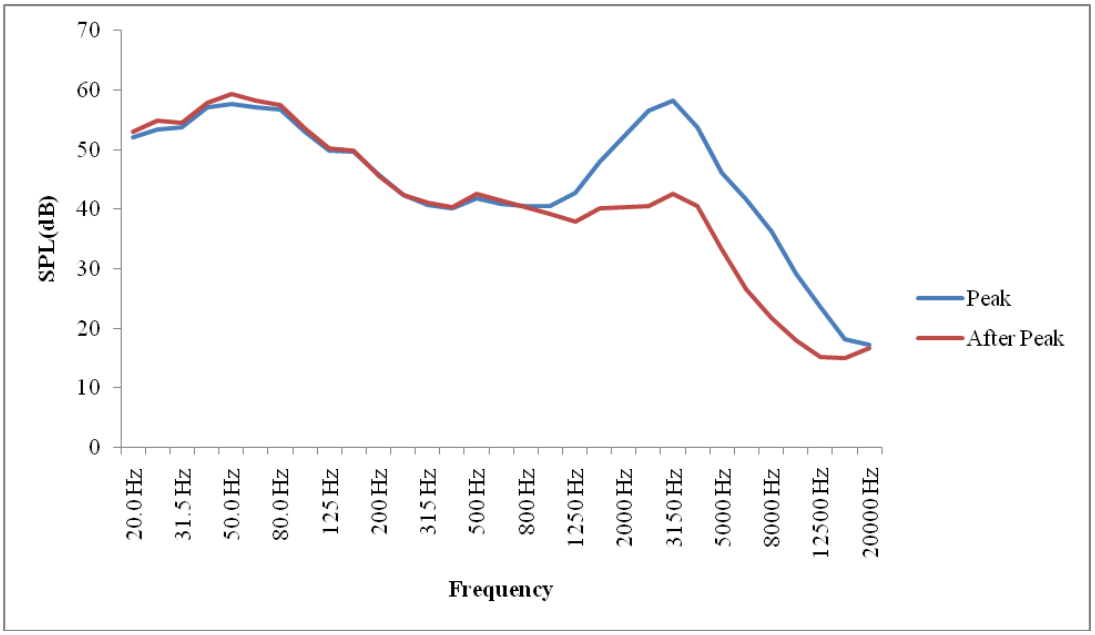


Figure 7 Power spectrum of Peak and after peak dB levels of dawn chorus at Lodhi Garden site

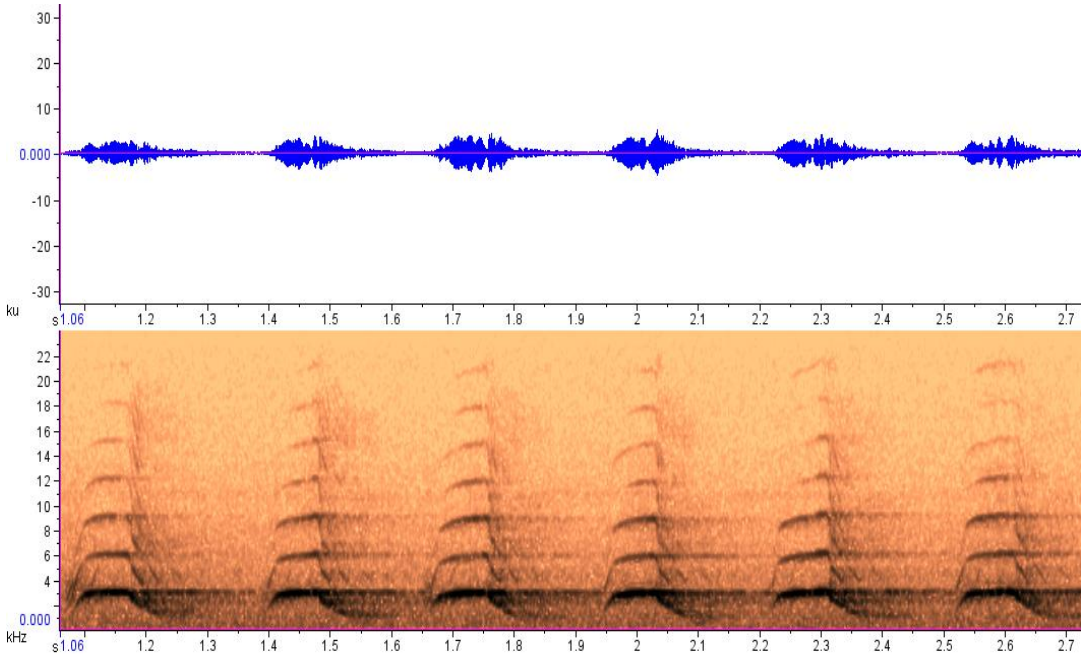


Figure 8 Waveform and Spectrogram of typical call of Common Myna during dawn chorus

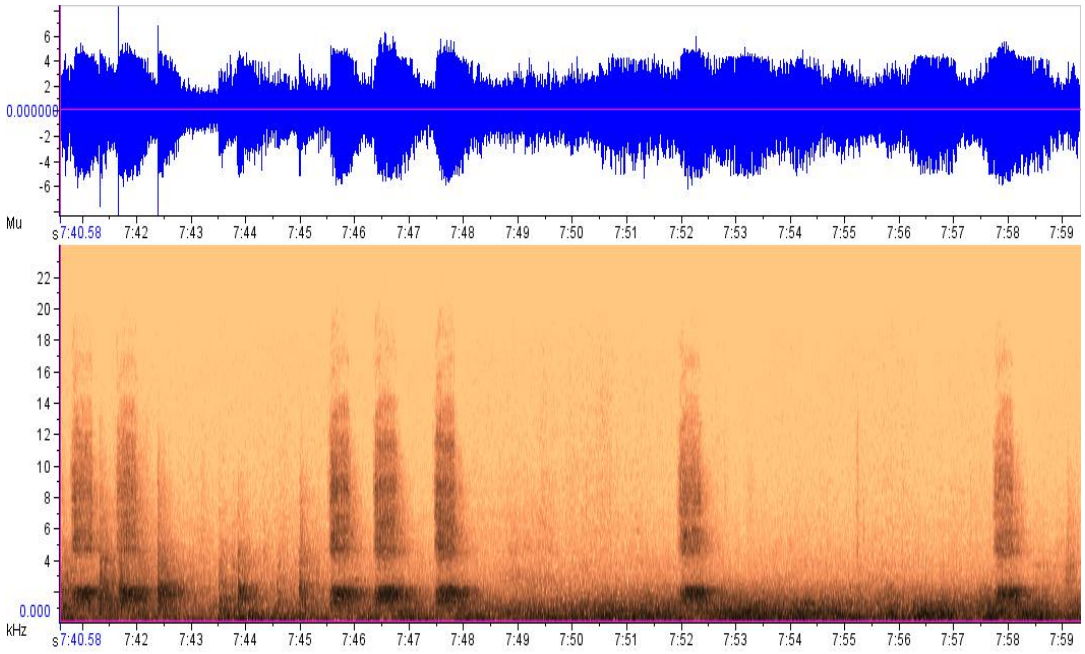


Figure 9 Waveform and Spectrogram of typical call of Common Crow during dawn chorus

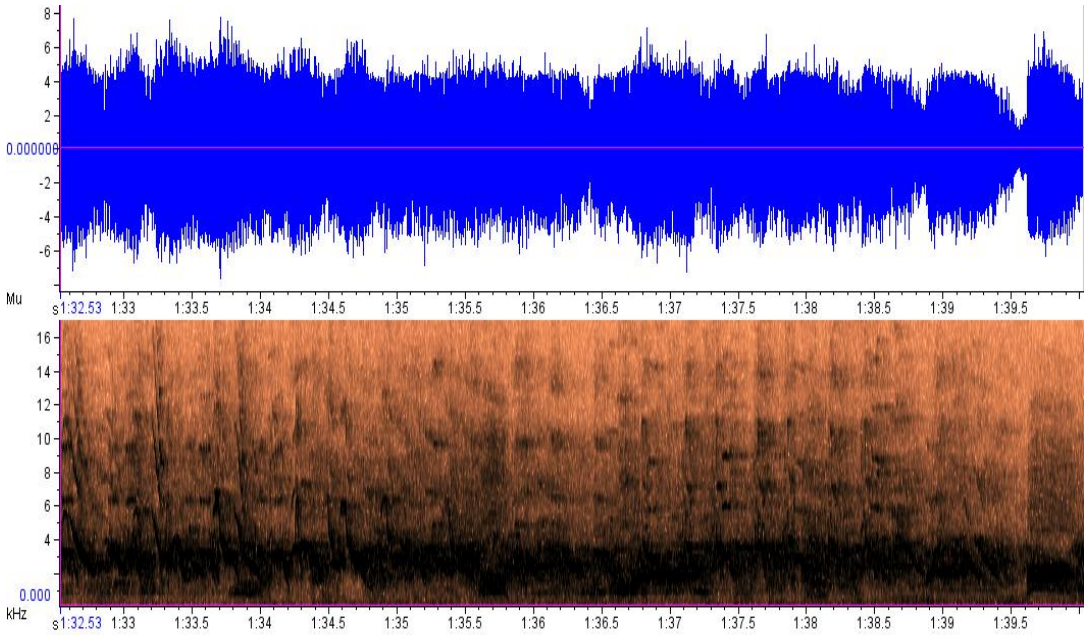


Figure 10 Waveform and spectrogram of common myna- common crow dominated dawn chorus.

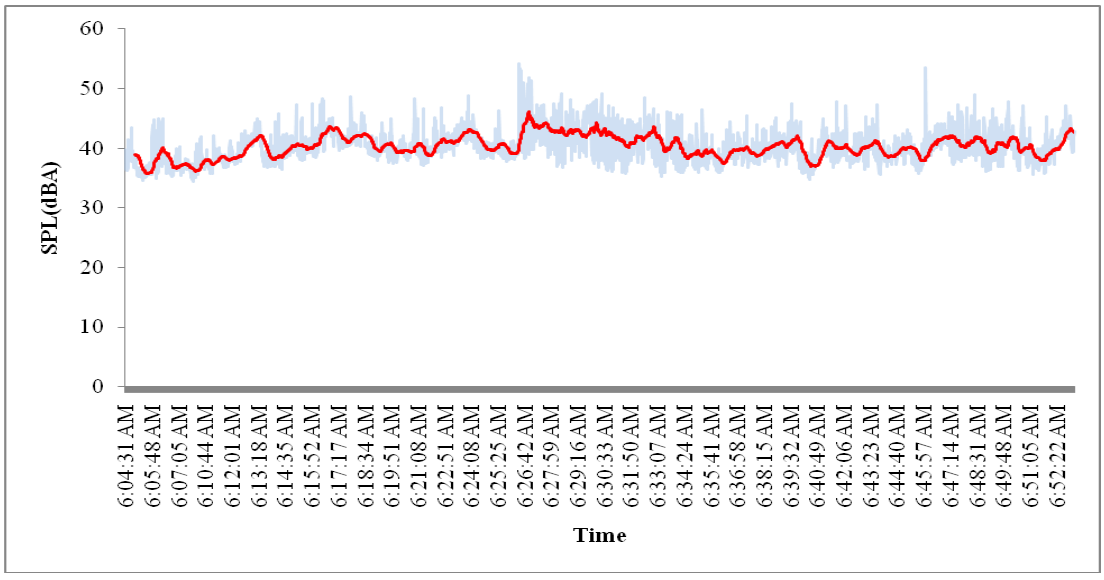


Figure 11Time series plot of the dawn chorus at the Kamala Nehru Ridge site Red line shows moving average of A-weighted Sound Pressure levels. Blue line represents the actual A- weighted dB levels.

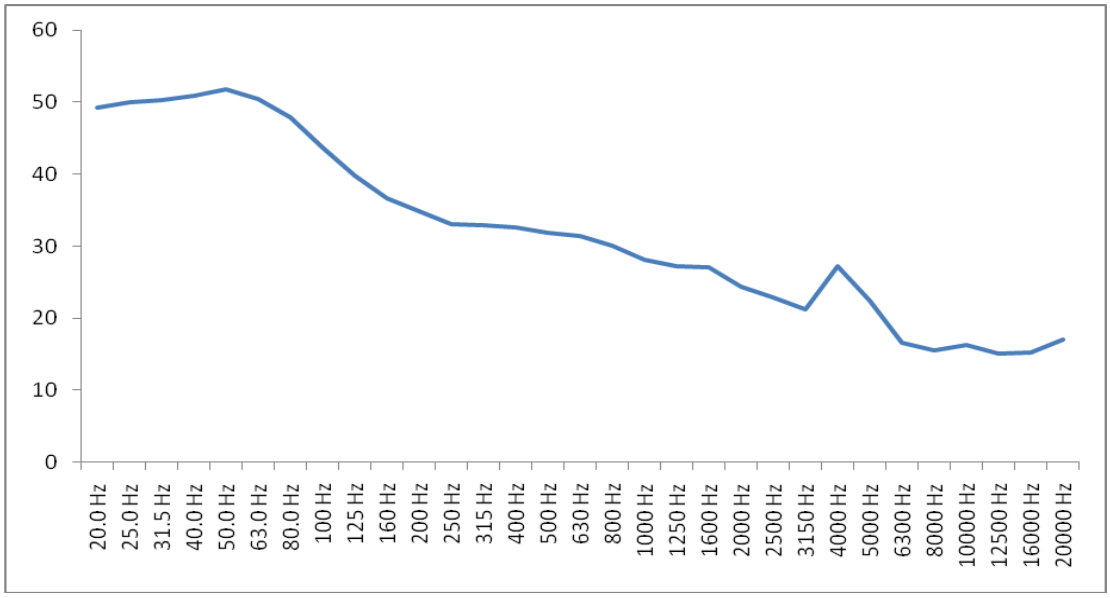


Figure 12 Power spectrum of average dB levels of dawn chorus at Kamala Nehru Ridge.

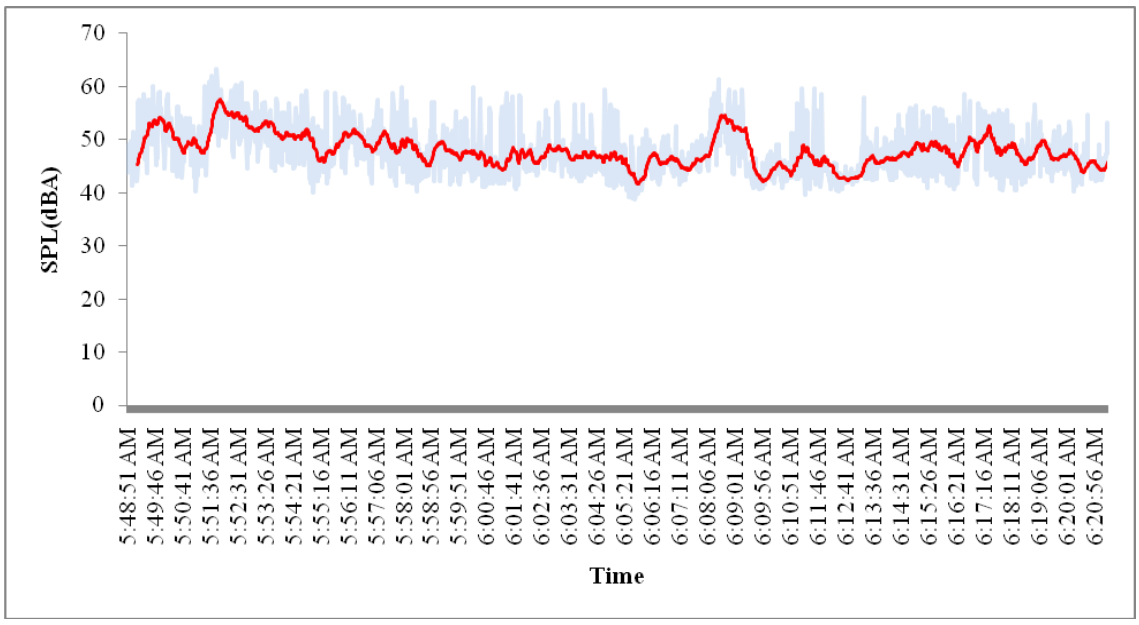


Figure 13 Time series plot of the dawn chorus at the Buddha Jyanti Garden site. Red line shows moving average of A-weighted Sound Pressure levels. Blue line represents the actual A-weighted dB levels.

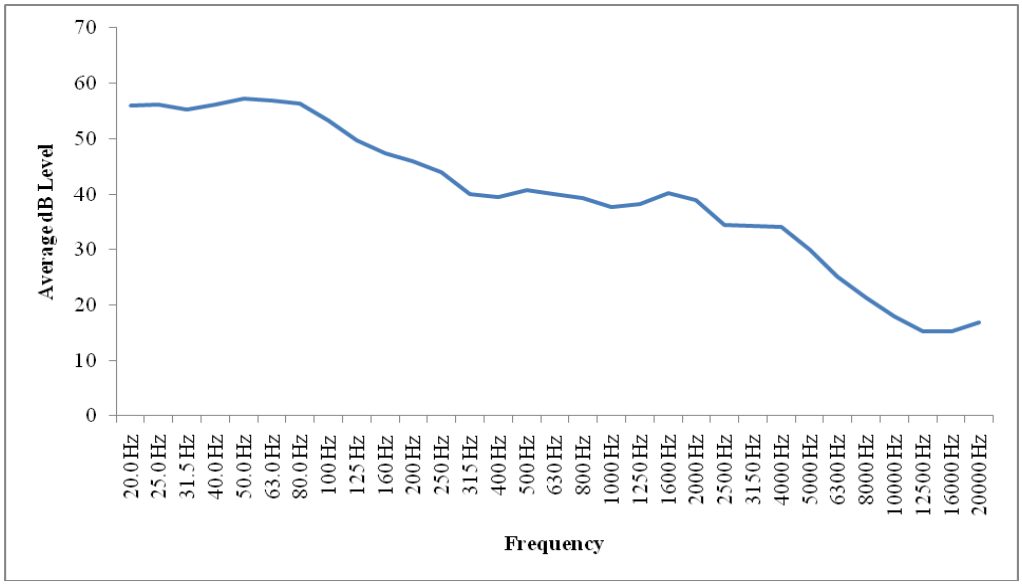


Figure 14 Power spectrum of average dB levels of dawn chorus of Buddha Jyanti Ridge Forest.

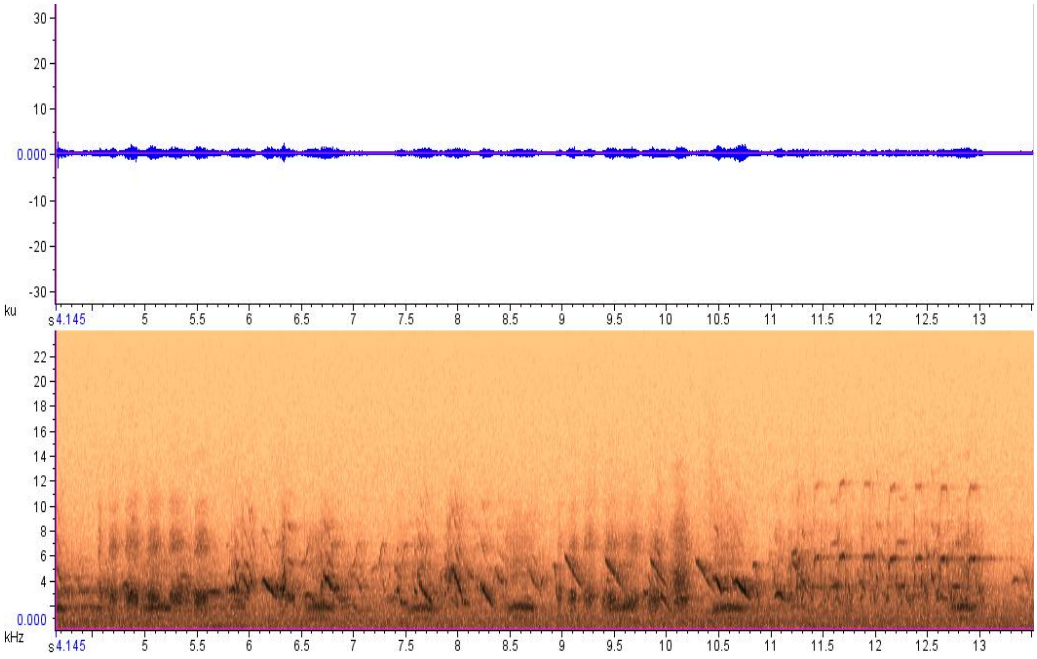


Figure 15 Waveform and spectrogram of Dawn chorus at Budhha Jyanti Ridge Forest.

At the ridge forest sites, however, the vegetation is mainly dominated by bushes and shrubs which are part of the scrub forest of the ridge. The bushes and shrubs provide favorable roosting and nesting sites for small birds such as warblers, red vented bulbul, oriental magpie robin etc. As there are ample roosting and nesting sites are available in the forest, no general crowding of birds is witnessed at the ridge forest sites and as a result, the intensity of vocalization at dawn chorus is less. At the same time, the availability of seeds, grains, fruits and other discarded food items by

humans is poor at these sites. Therefore crows and mynas are not present in large numbers at such sites. Not surprisingly, the contribution of crows and mynas to the dawn chorus is not significant at these sites.

## Conclusion

Based on the results of the present study, it can be inferred that common myna and common crow are the two most dominating species contributing to dawn chorus in Delhi, particularly at the sites where large dense canopy trees are available for bird roosting. A major part of the acoustic energy of their calls is distributed in the range of 1000Hz to 3500Hz. During the peak chorus activity which persists for about half an hour, the noise levels at 3150 Hz reach up to 60dB while the A-weighted noise levels may reach up to 70dB or even more at specific time instants. A completely different acoustic behavior is observed at the Ridge Forest sites, which are dominated by bushes and shrubs. At these sites, a variety of birds vocalize at dawn but none of the birds (including common myna and crow) is present in large numbers. As a result the dawn chorus is intermittent and its intensity is very low at these sites.

***Contribution:*** *Dr. Krishan Kumar (Associate Professor), Principal Investigator and corresponding author ,interpretated the data and design the manuscript; Prof. Vinod Kumar Jain Co-Investigator for the project, contributed in final editing of the manuscript; Miss. Puneeta Pandey (Assistant Professor) helped in preparing the manuscript; Mr. Manoj (Project fellow) carried out the sampling and analyzed the sound recording. Mr. Dinesh Kumar helped in the analysis of sound recording*.

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