

The Effects of Urbanization on Suboscine and Oscine Birds

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Abstract

Male birds utilize song to attract mates and to defend their territories from other males. As certain aspects of song are preferred by females, song traits such as time spent singing, song rate, and the length or type of song syllables are key to an individual male's reproductive success. However, past research has shown that some songbird species change their songs in noisy urban environments, while others do not. These changes or lack of changes may affect a species' ability to survive and reproduce in both cities and natural environments. The world is becoming exponentially more urbanized, so studying how birds respond to urbanization will be critical for predicting the future success of bird species and may provide information on how to design future cities to help reduce the affect of urbanization on bird species.

This study was designed to identify differences in birdsong characteristics between urban and rural environments to better understand the effects of urbanization on North American bird species. We hypothesized that oscines, birds species which produce complex songs that must be learned, would show significant variation between rural and urban environments, while suboscines, bird species with simple songs that are largely innate, would not. Specifically, we looked for changes in the maximum and minimum syllable frequencies, silence intervals between syllables, number of syllables, and time of performance.

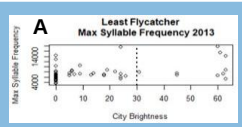
Methodology

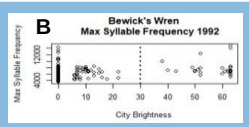
Raw birdsong recordings for each bird species were obtained from the citizen science database *xeno-canto*. The audio files were first parsed into bouts using the program Audacity. Each parsed bout was then analyzed using the computer program Chipper to further parse the bouts into syllables for song trait analysis. The song units that constituted bouts and syllables were determined for each individual species by comparing the raw audio files to examples of typical species' vocalization patterns provided by the database *Birds of North America*.

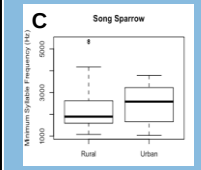
The geographic coordinates of each bird song recording were provided in the metadata from *xeno-canto*. To assess the level of urbanization at each coordinate pair, we used annual average night light maps of North America from 1992 and 2013, obtained from *NASA*. Higher levels of light output at night were assumed to be correlated with an urban environment due to the large amount of light production in cities. The light level data scaled from 0-63, and birds that sang in an area with a brightness greater than 30 were designated "urban", while locations with a brightness less than 30 were labeled as "rural". Based images from Google Earth, areas with brightness levels of 30 tended to look rural, but were surrounded with interfering light data from nearby cities.

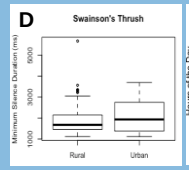
Observed Birds

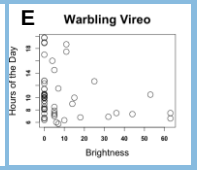
In this experiment, we examined passeriformes from one of two suborders, oscines (Passeri) and suboscines (Tyranni)*. Species studied are as follows: the Alder Flycatcher*, Plumbeous Vireo, Say's Phoebe*, Fox Sparrow, Warbling Vireo, Least Flycatcher*, Western Meadowlark, Bewick's Wren, Black Phoebe*, Red-Winged Black Bird, Hermit Thrush, Northern Cardinal, Willow Flycatcher*, Baltimore Orioles, Eastern Phoebe*, Scott's Oriole, Swainson's Thrush, and Song Sparrow.

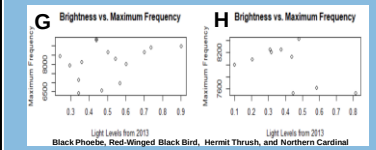


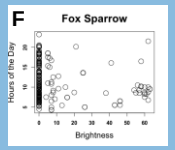


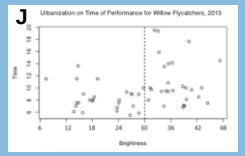


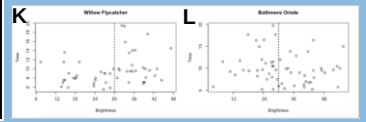


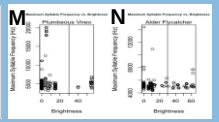












Methodology (cont.)

The programming language, R was used to assess the following song attributes: minimum syllable frequency, minimum silence duration, and recording time. A two-tailed t-test of means was used to test for significance differences between rural and urban birds. Bonferroni corrections were used to control for multiple testing as necessary.

Discussion

Unexpectedly, a couple species of suboscines showed significant differences between rural and urban populations. For example, Least Flycatchers sang at higher frequencies in urban environments (A), and Willow Flycatchers sang significantly earlier in urban environments (J). Oscines, on the other hand, demonstrated the expected differences in categories such as time of performance (Fox Sparrow (E) and Warbling Vireo (F)), maximum syllable frequencies (Bewick's Wren (B)), minimum syllable frequency (Song Sparrow (C)). Past studies had been done on some of these species, and our results confirmed what past research had shown in those species. Together, our results show that not only are oscines are widely affected by increasingly urban areas, but even some suboscine species can adapt in the face of human activity and ambient noise.

Future Questions

- Do birds change their flight or nesting patterns in increasingly urban areas?
- Do urbanized birds adjust their singing habits in accordance with human schedules to increase their chances of being heard?
- Is it possible to predict bird song and behavioral changes?
- How does urbanization-induced changes in adult birds affect song-learning in their progeny?
- How would the results change if Chipper analysis was automated?

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