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Blue Jay Call Profile in Disparate Environments

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BLUE JAY CALL PROFILE IN DISPERATE ENVIORMETS

ALTERATION IN BLUE JAY COMMUNICATION DUE TO ENVIORMETNAL CONDITIONS

ABSTRACT

Understanding how the environment affects communication in urban environments is of ever-increasing importance due to human encroachment and the significance communication has on organisms survival. Many species of birds have been observed to develop higher-pitched calls in urban environments; several tropical birds and Great Tits in Britain exhibit this alteration in their calls(Mockford & Marshall, 2009). There are, however, fewer researched examples of local analogs to this phenomenon. Blue Jays are endemic to the local environment and are well adapted to modulate their calls, making the species the most likely to accommodate diverse sound environments. Thus, if the urban environment's high noise pollution does impose a significant fitness challenge, then the Blue Jay calls will be different (higher) compared to rural Jay(Parris & Schneider, 2009). A series of recordings were taken in rural and urban environments using a directional microphone to collect Jay's jeers' as examples. The calls were annotated to determine if there was a significant change between the environments, examining each maximum kHz, minimum kHz, duration, and kHz range. There was, in fact, a significant increase in both maximum and minimum kHz in urban jays in comparison to rural jays. These results suggest that blue jays alter their calls to accommodate the environmental factors in urban settings in a similar pattern to ways tropics and great tit papers suggest.

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Introduction

Communication Is Key Effects on Fitness

The capacity for communication is a major measure of fitness for the majority of life on earth. Either in chemical signaling in microbes, display patterns in gorillas, or infrasonic hums from elephants over kilometers, the ability to communicate in its simplest form it is the exchange of information between senders and receivers (Suzuki, 2013). Communication in birds, especially songbirds, is vital to their fitness due to the quantity of information that their calls transmit four matting songs to aggressive jeers. Bird calls, in general, are the result of natural selection predisposing specific meaning vital to survival into several general call structures and social learning, refining the value and profile of possible calls, making a local dialect that is unique to a region (Durlauf, 2020; Nevada, 2001). Some of the most important forms of communication occurs between individuals of the same species, such as alert signals for predators. In social birds such as Blue Jay, one of the most important to survival is mobbing behavior as a defensive measure (Catchpole et al., 2010). Mobbing is a behavior to removes the element of surprise and overwhelm predators via numbers increasing individual fitness of themselves and the flock as a whole. (Durlauf, 2020). The mobbing call can be general or specific to the threat allowing preparation or warning for various possible predators based on the local dialect the birds develop (Durlauf, 2020; Suzuki, 2013). This places a premium on communication fidelity for bird fitness.

Birds can produce alarm calls to communicate specific concepts that allow them to respond to possible threats more accurately and safer. An example of this is the Japanese Great Tits that are capable of producing several unique calls' jars' and 'chicka' that match up to snakes, martens, or crows(Suzuki, 2013). Each predator has a different behavioral pattern that calls for specific defensive measures, making the ability to communicate concepts vital to their survival(Suzuki, 2013). Even general calls are vital and are a common occurrence between the great tits and other social birds (Suzuki, 2013). Familiar sources of fitness loss in social organisms are transmission interruption, tenuousness, or misunderstanding witch are common in urban environments(Luther & Baptista, 2010; Oden et al., 2020). Anthropogenic noise easily interferes with communication as such birds in this environment need to learn and evolve to counteract this interruption (Luther & Baptista, 2010; Mockford et al., 2011).

Blue Jay as a subject of interest

Blue Jays or Cyanocitta crista are one of the more well-known and conspicuous birds found throughout the New England area due in part to their bright blue coloration and loud vocalizations. Out of the many breeds of songbirds in North America, blue jays witch traditionally inhabit forests and wooded thickets, have adapted very well to suburban areas and even have a presence in populated urban areas (Plover, 1986). Jays are very active birds throughout the year and are one of the few songbirds that maintain a presence in Massachusetts year-round despite a large number of the population migrating throughout March into May (Plover, 1986). Blue jays produce many

call the 'wheedle' or 'whisper' along with the calls of local birds and hawks that the jays are able to mimic, but despite their range, the most important of their calls is there 'jay' or 'jeer' witch is its mobbing call indicating to other that there is something that is making the jay feel threatened; generally 'jeers' are very harsh, loud and lack any musical quality is that their other calls make, however, 'jeers' have excellent harmonics allowing them to reverberate farther (Heinen & Stephens, 2015; *The Blue Jay – Vocalizations* |, n.d.). Due to the cleanness of the call and the fact that blue jays have such wide vocalization ranges, they were selected as an appropriate model animal for studying the effect urban environments have on their vocalization profile.

Effect of Humans on Nature

Humanity's impact on the environment is extensive as many environmentalists studying these changes are needing to change the terms of climatic factors due to human created environments based on human habitation density and how drastic the changes (Dinerstein et al., 2017). With up to 96% of the ecoregions on earth have been converted into an anthropogenic purpose, with so much of the environment converted for the use of people, there are many cascading effects on the organisms that reside there (Dinerstein et al., 2017). Birds are well suited to extending their range to heavily modified regions like cities due to many inate advantages to their foraging and scavenging strategies(Fraixedas et al., 2020). Just as birds have adaptative advantages, there are aspects of cities that impose significant negative fitness challenges to individuals (Briefer et al., 2010; Tolentino et al., 2018). Communication, in particular, is the greatest challenge for Blue jays in the city's due to noise pollution acting as coemption and the environmental factors depredating the signaling of the birds(Tolentino et al., 2018) The attenuation, the range of individual calls can be heard, is more significant in an open space with few structures that can break the sound such as trees and foliage as such urban environments should be perfect environments for bird calls to travel far however that is not the cause (Morse, 1978; Tolentino et al., 2018). Bird calls in urban environments in many species have a much lower distance range in comparison to rural birds due to interference and computation (Tolentino et al., 2018). The dialects used in urban and rural environments are very distinct from each other due to how the environment affects the bird's ability to project their calls. These projected differences between the two environments subjects, if Blue Jay's ability to communicate in high noise pollution environments is modulated in response to the sound computation, then the call profile will be different in comparison to the Rural Blue Jays.

Methodology

Subject and Site Selection

To beguine with the subject of this study, Cyanocitta cristata of the Corvidae family, Blue Jays, were selected for their range in vocalizations; however, for this initial molding, only a single call pattern of the blue jays was selected for the study. The Blue Jay' jeer' is a very loud and distinct vocalization that is a territory/grouping call that communicates to nearby Jays a subjects' interest or is used to defend against predators by pulling the group together (*The Blue Jay – Vocalizations* |, n.d.). As a survey study, there will be considerable variability in the health, size, age, and fitness of each of these organism's group. There will be a fair amount of assumptions made in the data the chief among them is that the blue jays in the area are local and not recently migrated.

Equipment Used

A directional microphone run through a Maserati recorder was set up and used to record up to 30 seconds to minute clips of blue jay activity focusing on the jeers. The recordings were taken in approximately the same seasonal period in similar climate conditions. Sound checks should be done with each use where the microphone is used to listen to an individual speaking around 75-100 feet away to determine functionality and that the equipment is calibrated correctly. All recordings should be taken at a minimum distance of 30 feet and a maximum of 100 feet from the microphone if possible. Raven lite software was used in the processing of recording into raw data of Hz to be analyzed using T charts and possibly other methods. The lite software only allows for the Hz and duration of the bird calls to be determined along with a visual representation that will not be used for the current analytics. Due to the limitations in place due to the software being a lite version without the full analytics tool kits. In the raven-lite software using the annotation tool, the recording is played, and the sectioned where the Jeers are heard with the bird call highest and lowest points used as guides for the boxing.

Procedures

Site selection for observation was made by comparing the population density of the locations of the recordings taking into account any local urban development and reserve locations. Due to the rural blue jays' movement patterns being far larger than urban blue jays, the locations will be categorized based on their general locations, with higher levels of specifics being disregarded due to their irrelevance in the analysis. The rural location survey was done in stow, Massachusetts 424 people per square mile (*Stow, Massachusetts Population 2021 (Demographics, Maps, Graphs)*, n.d.) with additional reservation, and habitat conservation areas in the local area make it a primary example of a rural environment. In contrast, Boston, Massachusetts, is the example for the best example of an urban environment with 14,388 people per square mile(city data) and a higher density of urban development (*Boston, Massachusetts Population 2021 (Demographics, Maps, Graphs)*, n.d.). All data should be collected either in the early morning or afternoon when the jays are the most active.

Results

The collection of two data sets of blue jay calls in Urban and Rural areas with twenty different calls annotated in each set. The annotations consist of the profile characteristics of each call consisting of Average low kHz, High kHz, the rage difference from the lowest section of the call and the highest pitch in the call, and the average duration of the calls. The P-value of Figure 1 C) P≈0.07796>0.05 and D) P≈0.3933>0.05; indicates no statistically relevant difference in the data sets. In verse, there is a positive that the P values of the Low and High-frequency differences in the two data sets are statistically viable. The average calculated difference between the background sound of the recording samples in the two data sets is Rural with a diff of 0.01 kHz from an average background of 1.7 kHz, and in Urban, there is a difference of 0.51 kHz from the average background of 1.9 kHz.

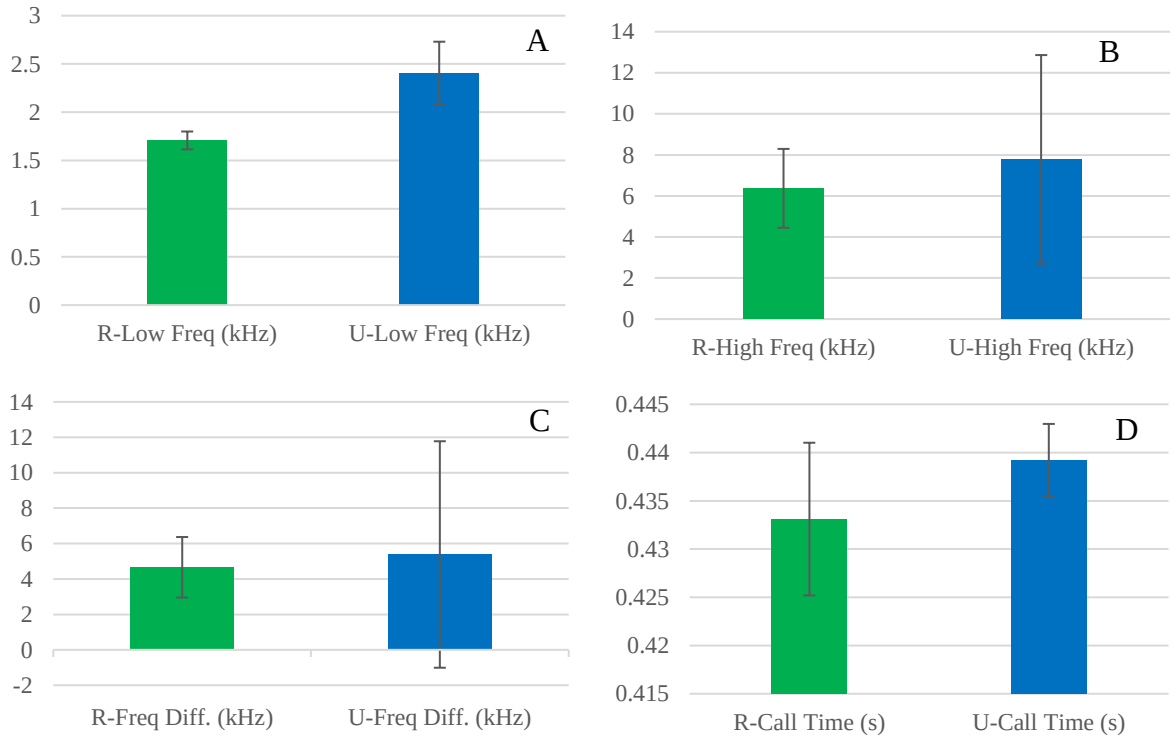

Figure 1: The following graphs visually represent the average mean and the standard deviation of various characteristics of Urban and Rural blue jay calls differentiated with a R or U before the graph subject. Graph A) compares low frequency values and has a P value of P≈0.000102<0.05; Graph B) high frequency values P≈0.009982<0.05, C) the difference between the low and high values P≈0.07796>0.05 D) Standard call time periods with a P≈0.3933>0.05.

Discussion

Blue Jays as a member of the corvid family of birds, are highly adapted to produce a wide range of pitches and tones for defense in the form of mocking and mobbing and for mate attraction. Additionally, it enables them to adapt to the conditions of their environment easier due to cultural pitches changing instead of biology adapting (Nevada, 2001; *The Blue Jay – Vocalizations* |, n.d.). The ability for birds to communicate is dependent on the bird's physiological ability and the environment they persist in, assuming only minor biological differences between Urban and Rural Jays, while the environmental factors have the greatest effect on the attenuation of the Jay calls (Morse, 1978). Urban Jays have higher minimum calls and have the highest maximum calls comparatively; Urban environments lack dense foliage makes the fidelity of the sounds farther away possibly more accurate if not for higher background noise pollution and other factors drowning out at farther ranges(Morse, 1978; Parris & Schneider, 2009). In Rural areas lower frequency's has an overall increase on the Blue jays fitness due to overcoming foliage breaking acoustic signals causing lower attenuation and degradation of calls (Morse, 1978; Tolentino et al., 2018). Both noise competition and noise dispersal are major challenges for blue jay fitness. However, the challenge pushes jays into developing and learning towards unique call ranges for their environment.

Basic call structures between Urban and Rural Jays call duration or kHz range do not change significantly between environments. This indicates that the tonal shifts are most likely cultural adaptations rather than genetic drift working due to the large vocalization range Blue Jays have as part of the Corvidae family, the superfamily grouping of avian that has ravens and crow (Nevada, 2001; *The Blue Jay – Vocalizations* |, n.d.) The call structure remains the same between rural and urban sites suggests that the only cultural adaptation is at work in this instance since the alteration in pitch suggesting that the message of the call is viable in both environments (Parris & Schneider, 2009).

There are several directions this research could go in the future to define further the environmental impact on the blue jay communication methods. The most prominent is extrapolating this methodology over more call types the blue jays perform; a more specific interest is the blue jays' whisper song', which consists mostly of soft twittering and warbling at a lower frequency (*The Blue Jay – Vocalizations* |, n.d.). How the whisper song is different in urban and rural environments to the possibility of the blue jays simply dropping this behavior in a cultural manner would be worth studying (Nevada, 2001; Parris & Schneider, 2009; *The Blue Jay – Vocalizations* |, n.d.). Another option for further is how the jays call change over the course of the seasons in a local area since in most research studies investigated for this paper, the season each recording was taken in was keeping the same, leaving the question open. Many of the facets of how mechanically the calls change are well known; the cultural aspect of learning to change the call is not well understood. An experimental test to discover the blue jays learning speed for

changing the pitch of their calls in different cultural groups would be interesting as a further research option—testing to see which jay type urban or rural would adapt quickly to a change in local tone or environmental constraints.

Conclusion

Communication is vital for social organisms' survival; as such, it is very quick to change to suit the environment if possible, either through cultural transition or evolutionary fitness. If environmental conditions really play such a vital determinant in blue jay call profiles, then there should be a significant change in pitch between urban and rural environments. Disparate environmental conditions in Urban and rural settings push the local Blue jays to have very different call patterns. Urban blue jays developed higher pitch calls that presumably allowed them to compete with urban noise pollution which is on average greater than rural background noise. Comparatively, jay call had a base lower pitch which allows it to have higher attenuation in dense foliage areas such as the forests. This understanding and documenting a divergence in call structure is vital for understanding the effects the urban environment has on local wildlife and social animals. A strong understanding of the base effects of development on wildlife is vital for conservation efforts witch can be complicated if the organism's cultural behaviors or development is very different from local specimens.

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