URBAN BIRDS HAVE SHORTER FLIGHT INITIATION DISTANCES (FIDs) THAN RURAL COUNTERPARTS

Yesllen Godoy, Maria Molina, Erika Seidman, and Kyra Cooleen

ABSTRACT

Human disturbances, as a result of urbanization, interfere with animals' natural habitats. Animals such as birds must habituate in order to survive; they do this by displaying certain behavioral syndromes that allow them to adapt and succeed. Flight initiation distances (FID) can be used to quantitatively measure how tolerant birds are to humans before they feel threatened and fly away. To test whether birds from urban environments display greater levels of boldness, we measured flight initiation distances in both urban and rural environments. We found that birds from urban environments had shorter FIDs, indicating more boldness compared to rural birds. In both urban and rural habitats, the more days we observed the birds the shorter the FIDs were, suggesting that birds become more habituated to humans over time. This study did not take different bird species into account, rather the difference between rural and urban bird FIDs as the main focus. Our study concludes that birds are bolder as a result of human disturbances in urban environments.

Keywords: Birds; Boldness; Flight initiation distance; Rural; Urban

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INTRODUCTION

Human population greatly affects the overall wellbeing of wildlife ecosystems. The increasing amount of urbanization seen throughout the world drives all species to adapt to their ever-changing environment (Clucas 2012). Human disturbances have not only changed the environment, but also the species that live within it. Although there are varying population sizes used to distinguish between rural and urban densities, the population size used for this experiment to signify an urban area is over 50,000 people and a rural area is a population consisting of 2,500 people.

Humans have forced species to adapt and develop various methods to survive in densely populated and industrialized areas. Urban species have different behavioral syndromes than those of their rural counterparts; some may include changes in foraging, mating, or territorial responses (Tsurim 2008). If a species resides in an urban environment, it may have reduced sensitivity to vehicular traffic or be more habituated to people. Species residing in more rural locations may show increased protection over their territory or a heightened awareness of predators. A behavioral syndrome that is most likely to vary between urban and rural species is boldness. Boldness is defined as the tendency of an animal to engage in risky behavior (Atwell et al. 2012) and is seen in various aspects of the bird's behavior (i.e., how close it lands to something/distance it makes it fly away). Boldness can also be related to genetic plasticity, the ability of multiple phenotypes to be produced by a single genotype and is shown to have phenotypic

variability between species. Depending on the species in question, a bird's boldness intensity can vary. This variation can be seen within the same species or across different species, as well as in varying bird sizes (Bonier et al. 2007).

This experiment aimed to understand the behavioral changes seen in birds due to the impacts of urbanization. An indicator that can quantitatively measure a bird's boldness is flight initiation distance (FID), which is the distance between the source of disturbance and the bird at the point where it flies away in response. FID can be related to a bird's anti-predation awareness along with their confidence to detect any potential predators (Zhou and Liang 2020). Previous studies have indicated that larger bird species have increased flight initiation distances due to the increased amount of energy needed to fly away (Møiler 2008 and Blumstein et al. 2005). Other studies using FID as a unit of measurement have indicated a possible reduction in sensitivity to stressors in urban conditions (Mikula 2014). A bird's alertness to a potential threat can be associated with the startling distance; this is a distance at which a bird becomes aware of a predator. Therefore, a higher startling distance is positively related to FID (Cooper 2005). However, just as FID is unique to each species, so is the startling distance (Blumstein 2003).

For this experiment, we observed birds and measured their boldness in four locations with different population densities, two being rural and two being urban. It is hypothesized that birds in denser urban areas will have lower FIDs, indicating that they are bolder than their rural counterparts. Based on the location in which the birds were observed, we can hypothesize that birds who reside in more urban areas have a shorter FID than those of rural locations, which is indicative of greater boldness.

METHODS

Study Area. We conducted the study from October 21st, 2020 to November 3rd, 2020. To compare boldness in birds between urban and rural sites, we used two urban populations and two rural populations. The two urban environments used in the study were New Rochelle, NY consisting of 78,742 people and Franklin Square, NY consisting of 32,329 people. Putnam Valley, NY with 11,600 people and Hopewell Junction, NY with 454 people were considered rural areas (U.S. Census Bureau QuickFacts: United States). For this study, we considered Franklin Square to be an urban area.

Flight-initiation distance. FID measurements were taken throughout the day, for about an hour to an hour and a half. The observation site consisted of a bird feeder filled with bird food in either a backyard or a front yard of the observer's home. For each site, we used the same brand of bird food, it consisted of black oil sunflowers (*Helianthus annuus*), cracked corn (*Zea mays*), millet *(Pennisetum glaucum*) and milo (*Sorghum bicolor*). To measure FID, a metric tape was placed from the bird feeder and extended to where the observer was standing. The observer then started at the 0-foot mark and walked alongside the metric tape at a slow pace. At the moment the bird flew away, we recorded the distance between the observer and the startled bird. This

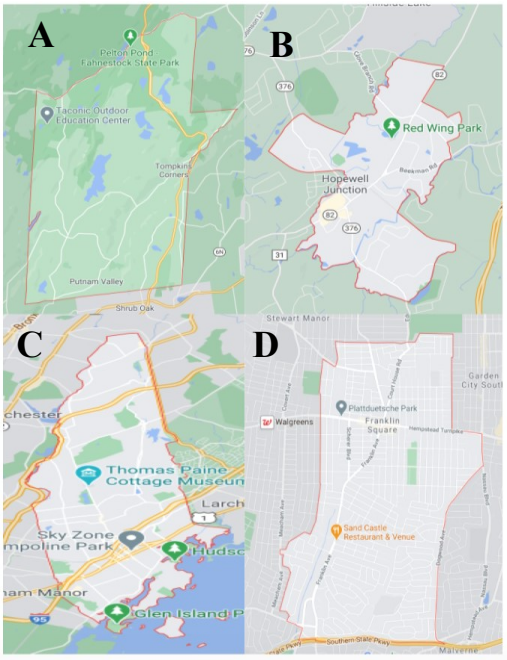

Figure 1. Map A represents Putnam Valley and map B represents Hopewell Junction. Map C represents New Rochelle and map D represents Franklin Square. Maps A and B display our rural sites and maps C and D represent our urban sites.

was repeated for each bird that was observed at each site for the three weeks. Over the three weeks, there were ten trials conducted in the suburban setting and eight conducted in the urban setting.

RESULTS

The four locations used in this experiment were plotted, via Microsoft Excel, based on their population to further understand their size differences (Fig. 2). The most urban location, New Rochelle, is approximately 2.5 times larger than Franklin Square and is approximately 175 times larger than the smallest rural town, Hopewell Junction. There was an inverse correlation between the average FID and population size found; the average FID has been shown to increase as the population size decreased (Fig. 3). The smallest rural town, Hopewell Junction, had an FID average of 18.04 feet, while the largest urban town, New Rochelle, had an FID average of 15.33 feet. The average FID for both rural towns was overall lower than the average for the urban towns (Fig. 4). This demonstrates that urbanized areas have bolder birds.

The daily FID for each location shows variability in the data, however, all but one location represents a decrease in FID (Fig. 4); this is represented by the negative slope. All locations, except Franklin Square, have a decreased FID, although for this location there is a substantial outlier that is likely to alter the values. Putnam Valley had the greatest change in FID, shown by the lowest FID of 10 feet and the highest FID of 36 feet. Hopewell Junction had the lowest change in FID, due to the shortest FID being 12 feet and the longest FID being 22 feet. The decreases in FID are most likely due to the amount of urbanization in the bird's respective location and/or how habituated to the observer the bird became. The total average FID per location shows a relationship between location and the average distance at which the birds flew away (Fig. 5). The outliers at each site can explain environmental differences such as a new bird coming to the feeder or if the color of our clothes was potentially alarming to the birds deterring their presence.

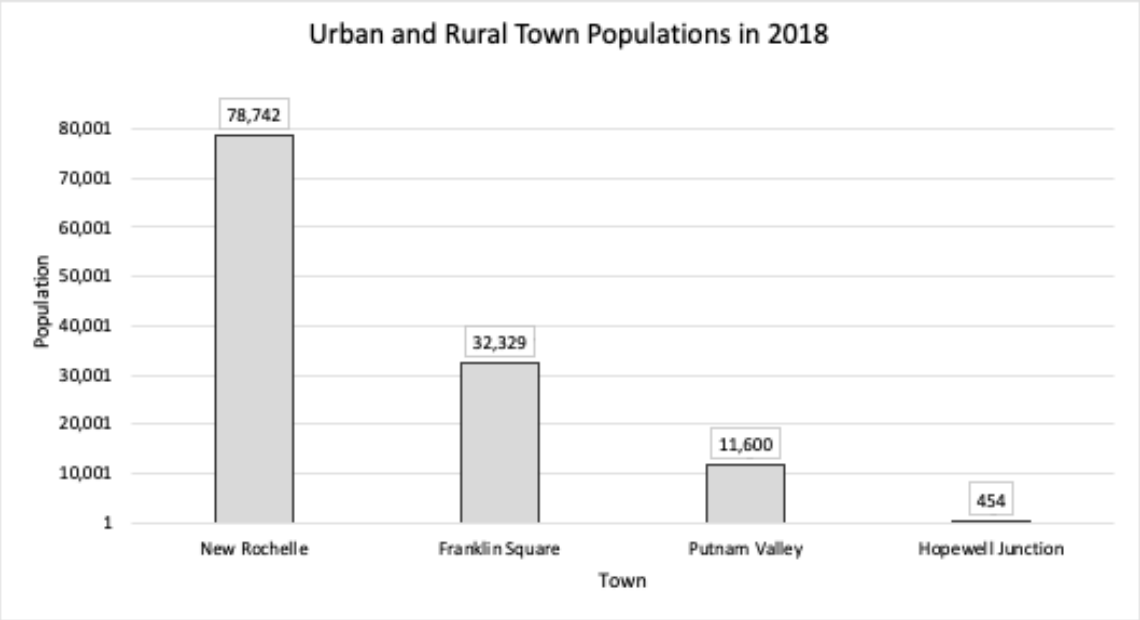

Figure 2. Population sizes for each town used in this experiment.

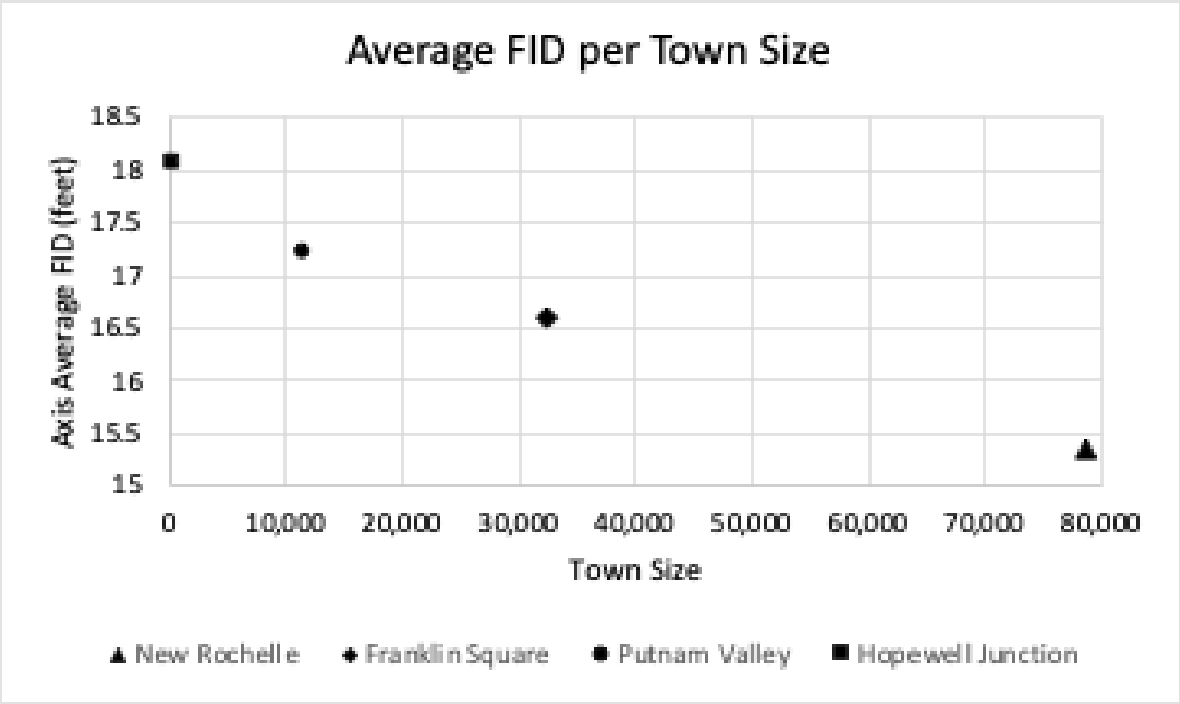

Figure 4. Average FID for the town size in which they were recorded. This shows the decrease in FID as the population size decreases.

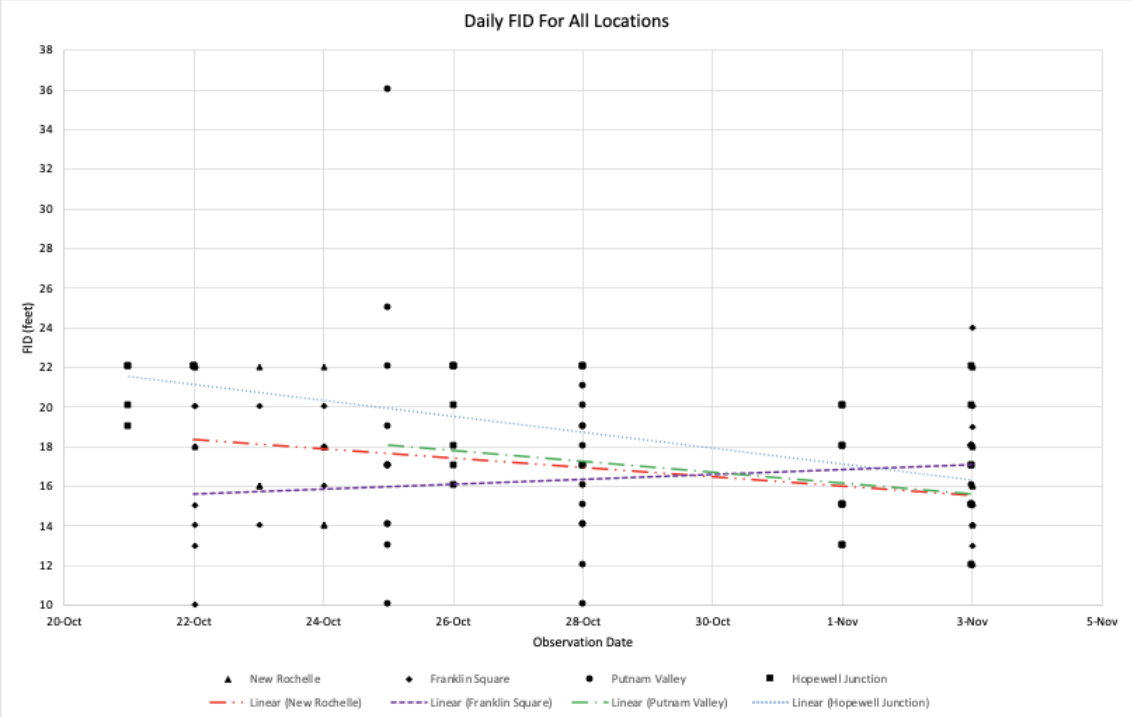

Figure 3. The daily FID for each location with a linear trendline for each location. All towns (except Franklin Square) show a decrease in FID, which is most likely due to the birds becoming desensitized to the observer's presence. The outlier on October 22nd, for Franklin Square, shows that the observer effect is not always true.

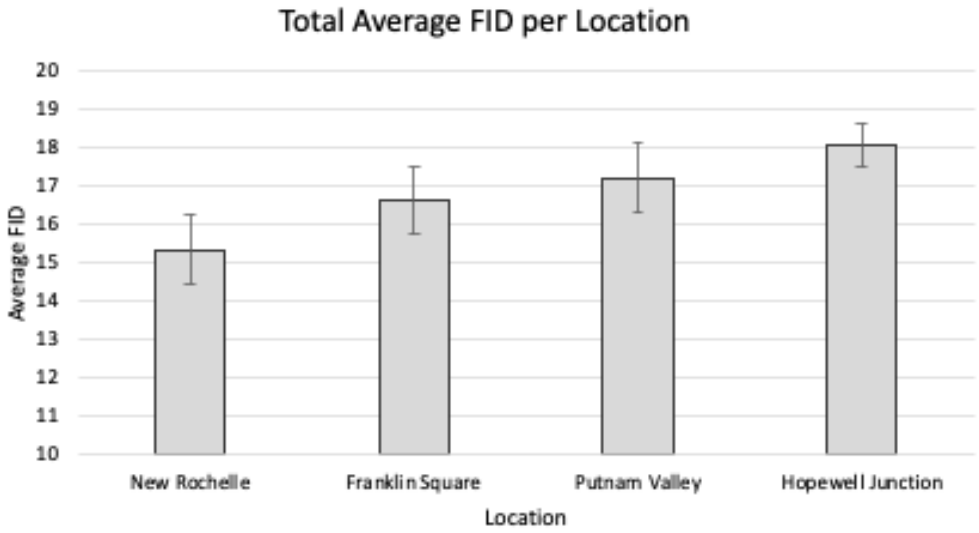

Figure 5. The average FIDs for each location with standard error bars representing the gradual increase in FID as the population size decreases.

DISCUSSION

In this study, we examined the boldness of birds in urban and rural areas, to test whether living in a more urbanized population causes birds to be bolder. Using flight initiation distance (FID) as a method of measurement, we compared data between four towns, two urban and two rural. New Rochelle and Franklin Square represented our urban towns. Putnam Valley and Hopewell Junction represented our rural towns. From the data collected, we were able to observe that urban birds had a shorter flight initiation distance compared to rural birds. This led us to believe that urban birds are also bolder than rural birds which can be caused by different factors. Boldness and disturbance tolerance are defined as the distance at which the animal moves to avoid the threat, they feel from the approaching human observer (Hall et al. 2020). Urban bird species having a shorter FID can be related to their desensitization toward external stimuli. Rural birds are more likely to be afraid of humans and will fly away at further distances which is shown by rural birds having a lower FID. Our results indicated that urban birds are bolder due to higher levels of disturbance and human exposure.

The main trend we observed from our results was the shorter flight initiation distances in birds that live in more urbanized areas. We observed that the average FID for our urban towns was shorter than in rural towns. A reason for this trend may be due to natural selection or it was achieved through phenotypic plasticity, which would allow for rapid behavioral adjustment to human disturbance (Lill and Vines 2015). This trend also led us to believe that urban birds are bolder than rural birds. Other studies have shown that urban birds know humans do not usually pose a threat resulting in the birds having a shorter FID (Vincze et al. 2016). It can also be due to factors such as sex, size, and age of the birds. We would expect shorter flight initiation distances because FID is supposed to decrease with an increasing amount of time that the species occupies urban environments (Davey 2019). Another trend that was noted is that as the observer continued to go to their observation site, the flight initiation distances decreased. This can be due to the birds becoming more accustomed to the observer (Dingemanse et al. 2010), which has led to a decrease in responsiveness to the FID test.

While conducting our study, we did not consider the kind of birds in our data collection sites and how that could have affected the birds' flight initiation distances. Boldness can be a species-specific trait that could have had an impact on our results (Evans et al. 2010). The size of the bird could also have had

an influence on the FID. According to Blumstein et al. (2005), bigger birds had larger flight initiation. Because we did not consider the different bird species in our data collection sites, we do not know how that could have influenced boldness. We also did not consider how the color of our clothes could have had an effect on flight initiation distances. According to the species confidence hypothesis, birds are more attracted to colors that resemble their feather, so it is possible that FID could be impacted by the color of the data collectors' clothing (Zou and Liang. 2020). Future experiments in this field should track the species of birds in their area in order to determine if there is a trend of FID values with different birds. It can also be beneficial for future work to consider the kind of clothes worn by the data collectors to make sure there is no influence on birds' flight initiation distance.

Urbanization as well as human disturbances are factors that affect the natural habitats of animals. If animals are unable to adapt to selective pressures in their environments this can cause a species to become extinct due to natural selection. Atwell et al. (2012) found that human disturbances in urban areas have led to the fast evolution of increased boldness. Therefore, it is important for animals, like birds in this case, to mitigate human disturbances in more urbanized environments in order to succeed and reproduce.

CONCLUSION

Determining if human population density affects bird behavior can be beneficial to our understanding of the human impact on the natural environment. For our study, we observed how close birds in areas of different population densities allowed an observer to approach before flying away. Our findings indicated a significant difference in flight initiation distances (FIDs) between birds observed in rural and urban areas. The differences in behavior by location confirm our hypothesis, stating that birds in more urban areas would have shorter FIDs than their rural counterparts. These urbanized birds demonstrate more boldness and less sensitivity to external stimuli. This conclusion helps us to understand the impact of human disturbances on birds and their behaviors. By comparing the behaviors across different populations, we can determine the effect of different stimuli on a population. Future studies wanting to further develop this research should consider species when collecting data, in order to obtain more accurate information. Another consideration may be to test different stimuli, other than a human approaching the food source. Along with understanding the impact of humans on bird populations, this data can be used to determine how successful a population of birds may be if introduced and how we can conserve populations in developing areas.

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AUTHOR CONTRIBUTIONS

Conceptualization (MM, YG, ES, KC), Data Collection (MM, YG, ES, KC), Data Curation (MM, YG, ES, KC), Formal Analysis (ES), Methodology (MM, YG, ES, KC), Project Administration (MM, YG, ES, KC), Resources (MM, YG, ES, KC), Visualization (MM, YG, ES, KC), Writing (introduction) (ES), Writing (discussion) (MM, YG), Writing (abstract) (YG), Writing (methods) (MM), Writing (results) (ES), Writing (conclusion) (KC), Writing (review and editing) (MM, YG, ES, KC).

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