ISSN 2616-5872 Vol.6, Issue 4: 76-81, DOI: 10.25236/AJEE.2024.060411

Adaptations of Bird Community under the Influence of Human Activities: A Case Study on Nanjing Foreign Language School North Campus

Yuanqing Liu

Nanjing Foreign Language School, Nanjing City, Jiangsu Province, 210008, China

Abstract: *Birds living in urbanized areas face various survival challenges because humans alter the natural ecosystem drastically, including fragmentation of natural habitat, emission of toxic gases, increased noise and nighttime light, and accumulation of plastic wastes. However, many bird species have successfully adapted to urban life, and they have managed to utilize the limited resources fully. This paper intends to discuss the adaptations of avian communities to rapid human activities and the relationship between birds and humans. Field surveys were conducted from 2019 to 2023 to collect data on nesting behavior, foraging habits, and daily activities of common birds in Nanjing Foreign Language School North Campus. The findings underscore the resilience and plasticity of bird communities, while also emphasizing the need for effective conservation strategies to mitigate the negative effects of human-induced environmental changes.*

Keywords: *avian community, urban environment, behavioral adaptations*

1. Introduction

Urban areas are expanding rapidly in China as the population keeps growing and people are constantly immigrating into cities[5]. The increasing population density and infrastructure development have dramatically transformed natural landscapes, posing new pressures on the avian population. For instance, the replacement and fragmentation of natural vegetation, the alteration of the community of predators and food sources, and an increase in human disturbances and pollution concerning nighttime lights, chemicals, and noise[6]. Despite the negative impact human activities have on some native species, many birds have managed to adjust their life to the new environment and colonized the cities successfully[2]. It demonstrates the resilience of bird communities and also reveals the complex interplay between species and the changing environment[3]. Understanding these adaptive responses is crucial since it can provide insights into the resilience and vulnerability of different species, helping to identify those at greater risk of decline; inform conservation strategies, enabling more targeted and effective efforts to protect avian biodiversity; and studying these adaptations enhances our comprehension of broader ecological impacts and the sustainability of ecosystems under human influence.

This paper delves into nesting behaviors, foraging habits, and mortality rates of the common birds, including oriental magpie(Pica serica), azure-winged magpie(Cyanopica cyanus), Chinese blackbird(Turdus mandarinus), oriental turtle-dove(Streptopelia orientalis), Eurasian tree sparrow(Passer montanus), light-vented bulbul(Pycnonotus sinensis), and oriental magpie-robin(Copsychus saularis), under the influence of humans. Through this exploration, we hope to contribute to a deeper understanding of the challenges and opportunities faced by bird populations in an increasingly human-dominated world.

2. Study area

Nanjing Foreign Language School North Campus is situated in the Xuanwu District of Nanjing City, Jiangsu Province, China. The campus encompasses a total area of 45,057 square meters, with built-up areas accounting for 22,211 square meters (Fig. 1). Positioned in a highly urbanized region of Nanjing, where the ecosystem is significantly impacted[4], the school environment is characterized by dense infrastructure and high levels of human activity. The campus supports a vibrant community of approximately 4,000 students and 600 faculty and staff members, contributing to significant anthropogenic influence on the local environment. The daily presence and activities of such a large population inevitably impact the avian community residing within and around the school grounds.

ISSN 2616-5872 Vol.6, Issue 4: 76-81, DOI: 10.25236/AJEE.2024.060411

Factors such as noise pollution, human movement, building structures, and landscape modifications alter the natural habitats and behaviors of bird species in the area.

Given the intense urbanization and human activity, this setting provides a unique opportunity to study adaptations of the avian community. The campus' small size is also ideal for the observation of birds' nesting, foraging, and other ecological behaviors in an urban context with very limited resources.

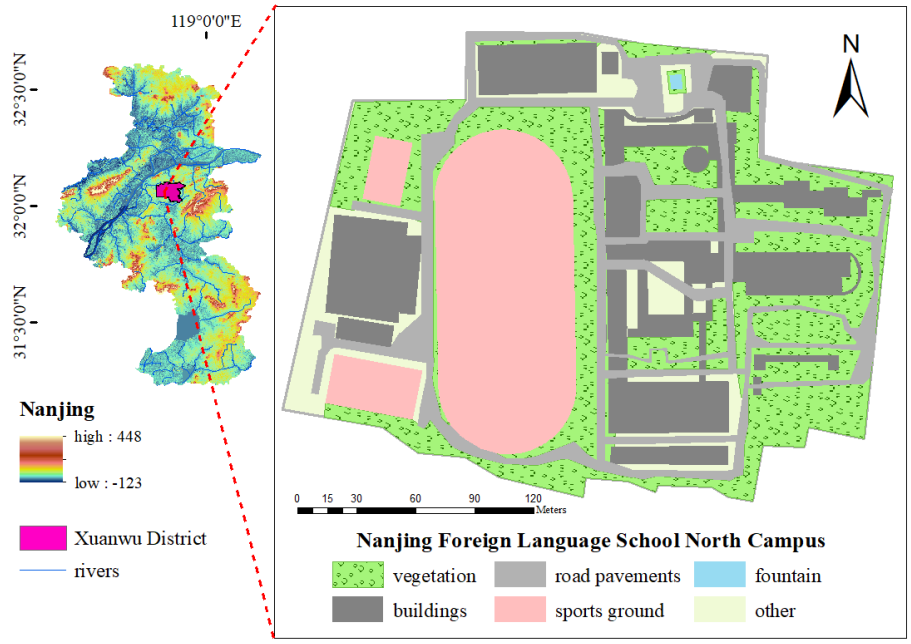

Figure 1: Location and land use of the study area

3. Nesting behavior

As human activities increasingly encroach upon natural habitats, the nesting behavior of bird communities has undergone significant transformations[1]. Birds, being highly adaptive creatures, often modify their nesting strategies to cope with the new challenges and opportunities presented by altered environments. These adaptations can be observed in changes to nest site selection and construction materials.

3.1 Data collection

We conducted systematic surveys of the study area weekly during the breeding seasons, which correspond to the peak nesting periods for most bird species. During each survey, we documented the bird species present and recorded the location of each newly constructed nest. This data collection spanned from 2019 to 2023, during which we identified and recorded a total of 46 nests. Environmental factors potentially influencing nest site selection, such as proximity to water sources, biodiversity of plants, availability of building materials, and levels of human activities, were recorded.

In instances where nests were superseded by new ones or had fallen, we collected these nests for further analysis. The collected nests were carefully examined in the laboratory to identify the materials used in their construction. Each type of material was categorized (e.g., twigs, leaves, synthetic materials), and their respective weights were measured using an analytical balance. This quantitative analysis allowed us to determine the proportion of natural versus anthropogenic materials used in nest construction and provided insights into the birds' adaptability to urban and altered environments.

3.2 Results

3.2.1 Nest site selection

According to the data recorded during our systematic surveys, a significant number of bird nests were found close to buildings and areas with high levels of human activity, often less than 5 meters away. This

ISSN 2616-5872 Vol.6, Issue 4: 76-81, DOI: 10.25236/AJEE.2024.060411

observation indicates a considerable degree of tolerance or adaptation by some bird species to urban environments (Fig. 2, Fig. 3).

Despite a small extent of reduction in the density of nests near human activity zones with severe noise pollution, our analysis did not reveal any clear patterns in nest site selection that could be directly attributed to varying levels of human disturbance. Birds appeared to choose nesting sites based on factors other than the intensity of human activities. Variables such as the availability of suitable nesting substrates, microhabitat conditions, interspecies competition and perhaps even species-specific preferences seemed to play more critical roles.

Furthermore, the temporal distribution of nest construction did not exhibit notable shifts to human activity peaks, such as at the beginning or end of school terms. Birds constructed nests throughout the breeding season, indicating a level of habituation to the constant presence of people and ongoing activities.

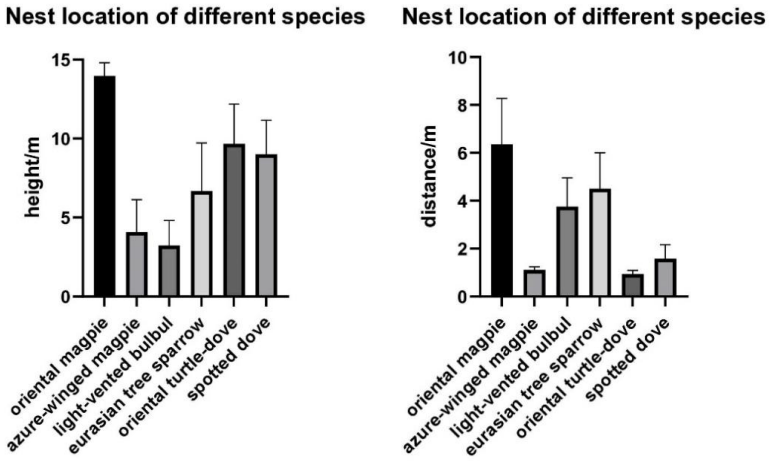

Figure 2 and Figure 3: Distribution of nest height and distance to buildings of various bird species

3.2.2 Nesting materials

Analyzing the superseded or fallen nests collected on campus, we separated the artificial materials from natural materials, and the proportion of man-made materials incorporated into each nest was calculated to understand the prevalence of nest construction. The common artificial materials identified in nests included polyester stuffing, plastic ropes, and plastic wrappings, which were primarily discarded by students.

Our analysis revealed significant variation in the use of man-made materials among different bird species. For instance, nests of the light-vented bulbul contained an average of 37.469% artificial materials (Fig. 4). In contrast, species such as the spotted doves and oriental turtle doves utilized nearly 100% natural materials in their nests (Fig. 5). This marked difference suggests that the availability of artificial materials in the environment does not uniformly affect all bird species. The choice of nesting materials is primarily dependent on the bird species and their preference.

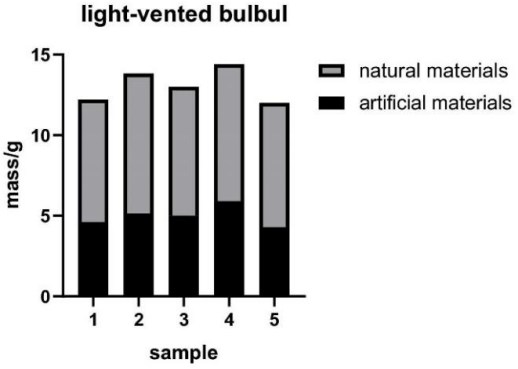

Figure 4: Nest material composition of light-vented bulbul

ISSN 2616-5872 Vol.6, Issue 4: 76-81, DOI: 10.25236/AJEE.2024.060411

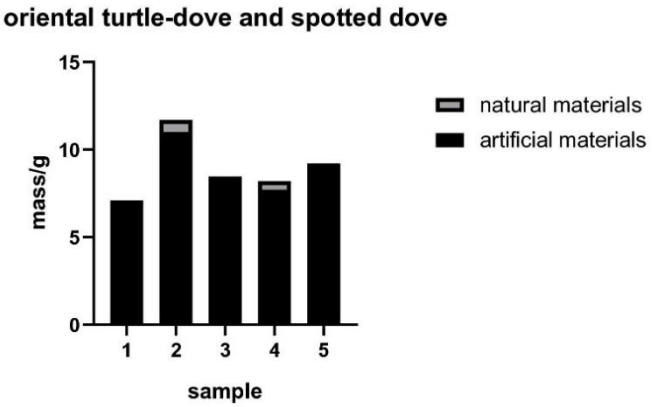

Figure 5: Nest material composition of oriental turtle-dove and spotted dove

Moreover, the incorporation of artificial materials in nests appears to reflect the adaptability and resourcefulness of certain species in urban settings. Birds that readily use synthetic materials may benefit from the structural properties or availability of these items, which could confer advantages such as enhanced nest durability or insulation.

These results suggest that while human activities are undoubtedly a factor in the environment, they do not singularly dictate nesting behavior. Instead, birds in this urbanized school campus demonstrate a high level of ecological plasticity, adapting their nesting strategies to a complex interplay of environmental factors. This adaptability might be crucial for their survival in urban settings, where traditional natural habitats are increasingly scarce.

4. Foraging habit

Nanjing Foreign Language School North Campus has high plant and insect biodiversity, providing the bird community with a rich and varied food supply. This natural abundance ensures that birds have access to sufficient and diverse food sources, supporting their nutritional needs and contributing to a robust avian community. However, rapid human activities have introduced anthropogenic food sources, which are very different from the natural ones, into the ecosystem. Birds have easy access to these sources like the remnants of human food near the cafeteria and in the sports fields. Therefore, adaptations to this environment can be partly reflected by changes in foraging habits.

4.1 Data collection

Field studies have been conducted every 3 days when foraging behaviors of birds reach the peak(early morning just after dawn and late afternoon just before dusk). We established fixed observation points across the campus. These included natural habitats such as gardens and wooded areas, and anthropogenic zones such as cafeteria vicinity and sports fields. We mapped the distribution of natural food resources, including the insect populations and plant species providing fruits or seeds in different seasons. Simultaneously, the availability of anthropogenic food sources was documented by surveying areas prone to food waste accumulation, noting the types and quantities of food items found.

4.2 Results

In our study, we assumed that the availability of anthropogenic food sources remained constant throughout the study period. This assumption allowed us to focus on the relationship between natural food availability and the frequency of anthropogenic food consumption by the bird community. The quantitative analysis of our data indicates a notable relationship between the availability of natural food sources and the frequency with which birds consume anthropogenic food (Fig. 6).

Our findings suggest that birds generally exhibit a preference for natural food sources, such as insects, seeds, and fruits, over human-provided food. However, when the availability of natural food decreases, birds appear more likely to rely on anthropogenic food sources. However, the results could be influenced by various confounding factors, such as temperature and precipitation. For instance, adverse weather conditions could reduce the availability of insects and other natural food sources, thereby forcing birds

ISSN 2616-5872 Vol.6, Issue 4: 76-81, DOI: 10.25236/AJEE.2024.060411

to forage more on anthropogenic food.

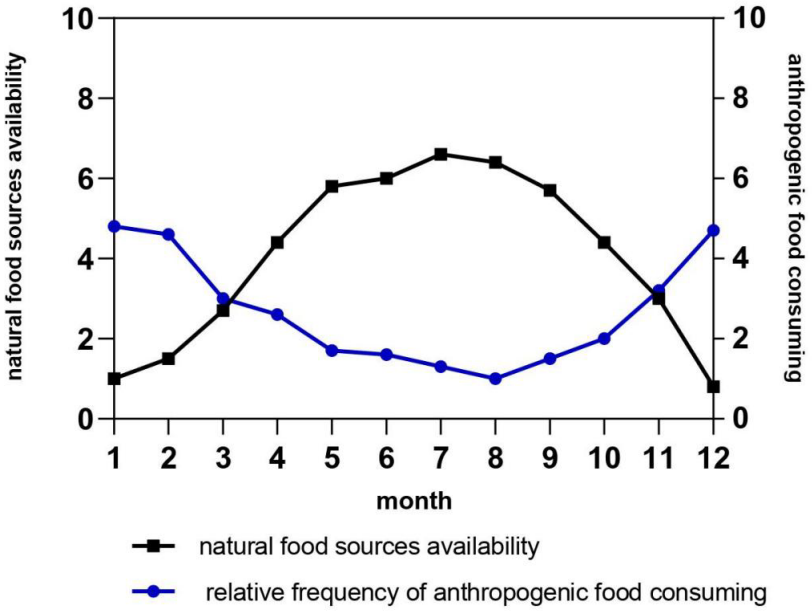

Figure 6: Variation of natural food sources availability and relative frequency of anthropogenic food consuming of birds. The quantity of natural food sources in January was estimated and set as 1; The quantity of anthropogenic food consumption was estimated and set as 1

5. Mortality

The urban environment poses numerous risks to bird communities, significantly impacting their survival and overall health. One of the most notable threats is the high frequency of bird collisions with built structures, particularly glass windows that they cannot perceive as barriers. These collisions are a significant source of mortality for birds in urban settings, where high-rise buildings and glass surfaces are prevalent[10]. Severe light pollution in the cities can also threaten the lives of migrating birds, which are distracted by artificial lights and grounded[8].

We aim to comprehensively investigate the influence of human activities on the mortality of the bird community on our campus, and develop methods to create a more bird-friendly environment by analyzing the results.

5.1 Data collection

To gain a thorough understanding of human-induced bird mortality on our campus, we conducted surveys among students and staff to gather information about incidents involving bird injuries or deaths. These surveys aimed to capture a wide range of data, including time, location, and possible causes.

In addition to the surveys, we carried out systematic field studies on a weekly basis throughout the year. During these field studies, we actively searched the campus for deceased birds, recording data on each discovery. This included noting the exact location, identifying the bird species, and determining the likely cause of death based on visible evidence and environmental factors.

5.2 Results

Many people reported incidents of birds trapped inside classrooms and repeatedly hitting glass windows, resulting in injuries and sometimes fatalities. These incidents occur frequently and mainly affect birds of relatively smaller sizes: such as Eurasian tree sparrow(Passer montanus), light-vented bulbul(Pycnonotus sinensis), oriental magpie-robin(Copsychus saularis). Additionally, collisions to the transparent surfaces are common among bigger birds like azure-winged magpie(Cyanopica cyanus) and Chinese blackbird(Turdus mandarinus).

ISSN 2616-5872 Vol.6, Issue 4: 76-81, DOI: 10.25236/AJEE.2024.060411

The rapidly growing population of wild cats on campus poses a significant threat to the avian community. These feral cats are efficient predators, and their increasing numbers have led to a rise in bird predation incidents. Bodies of birds killed and partially eaten by cats are frequently found on campus grounds, indicating a serious impact on local bird populations.

6. Conclusion

In the study, we looked into the details of the avian community's adaptations to thrive in highly urbanized environments. Their remarkable plasticity enables them to cope with the dramatic environmental changes induced by human activities. However, the ability of different species to manage these new challenges varies significantly. Some species can effectively exploit artificial materials and new food sources introduced by human presence, demonstrating their adaptability and resilience. For instance, birds like the light-vented bulbul (Pycnonotus sinensis) and azure-winged magpie (Cyanopica cyanus) have been observed incorporating man-made materials into their nests and altering their foraging habits to include anthropogenic food sources. Conversely, other species tend to maintain their original habits and are less adaptable to these changes. For these species, increasing human activities can pose significant threats. Birds such as the Eurasian tree sparrow (Passer montanus) and oriental magpie-robin (Copsychus saularis) often struggle to adjust to the urban landscape, resulting in higher mortality rates due to collisions with buildings and predation by feral cats.

Given these findings, it is crucial to create a more stable and supportive environment for all bird species to prevent the decrease in avian biodiversity due to human interference. Practical measures include the installation of bird-safe glass to prevent window collisions[9], and the implementation of humane strategies to manage the wild cat population[7]. Additionally, efforts to preserve and enhance the biodiversity of the region are essential. This can be achieved through the creation of green spaces, the protection of natural habitats, and the reduction of light pollution to prevent disorientation of nocturnally migrating birds.

By taking these steps, we can mitigate the adverse effects of urbanization on bird populations, ensuring that both adaptable and less adaptable species can coexist and thrive in urban environments. These conservation efforts not only benefit the avian community but also contribute to the overall health and biodiversity of the urban ecosystem.

References

[1] Erwin, R. M. "Responses to human intruders by birds nesting in colonies: experimental results and management guidelines." Colonial Waterbirds, 1989,104-108.
[2] Husté, A. and T. Boulinier. "Determinants of local extinction and turnover rates in urban bird communities." Ecological applications , 2007,17(1): 168-180.
[3] Kettel, E. F., et al."The breeding performance of raptors in urban landscapes: a review and meta-analysis." Journal of Ornithology, 2018,159: 1-18.
[4] Li, B., et al."Spatio-temporal assessment of urbanization impacts on ecosystem services: Case study of Nanjing City, China." Ecological Indicators , 2016,71: 416-427.
[5] Li, X., et al. "Urbanization and health in China, thinking at the national, local and individual levels." Environmental Health,2016,15: 113-123.
[6] Lowry, J. H., et al. "Determinants of urban tree canopy in residential neighborhoods: household characteristics, urban form, and the geophysical landscape." Urban Ecosystems, 2012,15: 247-266.
[7] Oppel, S., et al. "Habitat-specific effectiveness of feral cat control for the conservation of an endemic ground-nesting bird species." Journal of Applied Ecology, 2014,51(5): 1246-1254.
[8] Rodríguez, A., et al."Seabird mortality induced by land-based artificial lights." Conservation Biology, 2017, 31(5): 986-1001.
[9] Sheppard, C. D."Evaluating the relative effectiveness of patterns on glass as deterrents of bird collisions with glass." Global Ecology and Conservation , 2019,20: e00795.
[10] Van Doren, B. M., et al."Drivers of fatal bird collisions in an urban center." Proceedings of the National Academy of Sciences, 2021,118(24): e2101666118.