Science World Journal Vol. 21(No 1) 2026 https://dx.doi.org/10.4314/swj.v21i1.8
www.scienceworldjournal.org
ISSN: 1597-6343 (Online), ISSN: 2756-391X (Print)
Published by Faculty of Science, Kaduna State University

Full Length Research Article

ASSESSMENT OF BIRD DIVERSITY IN SELECTED URBAN AREAS IN AWKA, ANAMBRA STATE, NIGERIA

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ABSTRACT
This study assesses bird diversity across selected urban environments, focusing on bird abundance, species richness, diversity metrics, and feeding guilds. A total of 247 birds were recorded, yielding an average of 41.17 ± 6.28 birds per site. Notably, residential sites exhibited the highest bird abundance (57.5 ± 4.5), while market sites had the lowest (28.5 ± 4.5). The Rock pigeon (*Columba livia*) emerged as the most prevalent species, highlighting its adaptability to urban habitats. A total of 19 species were identified, with the highest species richness recorded in residential areas (14.5 ± 0.5) compared to motor-park (4.5 ± 0.5) and market sites (3.5 ± 0.5). Statistical analyses indicated significant variations in species richness and diversity indices (F = 25.6689, P = 0.013), with residential areas demonstrating the greatest diversity (2.2865 ± 0.0845) and evenness (0.855 ± 0.02). The orders Columbiformes, Passeriformes, and Accipitriformes were the most widely represented. Feeding guild analysis revealed the highest granivore abundance in motor-park sites (31.5 ± 11.5), while residential sites supported the most omnivores (18 ± 0.0) and insectivores (18 ± 8.0). These findings underscore the importance of urban green spaces in supporting diverse bird communities and highlight the need for effective urban planning to enhance biodiversity in urban ecosystems.

Keywords: Bird diversity, Urban areas, Markets, Motor parks, Residential areas.

INTRODUCTION

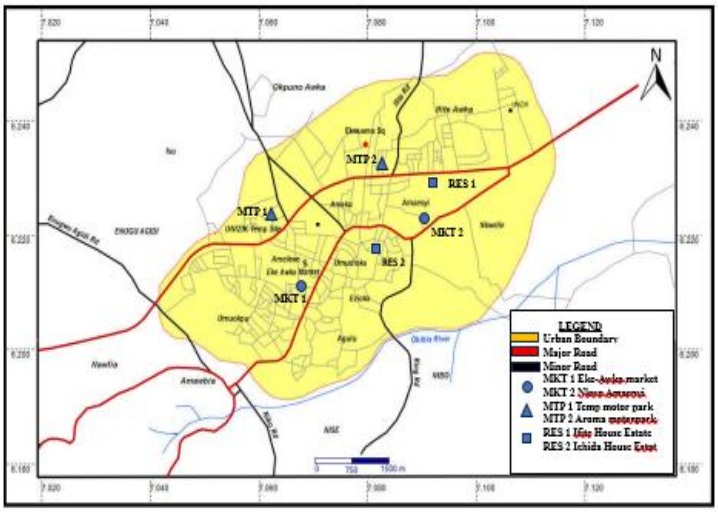
Urbanization is a dominant global trend that significantly alters natural habitats and impacts biodiversity worldwide (Soni *et al*., 2025). As cities expand, there is an increased concern regarding the decline of native wildlife, including avifauna, due to habitat fragmentation, pollution, and human disturbance (Yu *et al*., 2025). However, urban areas can also serve as refuges for certain bird species, contributing to overall landscape connectivity and regional biodiversity (Šálek*et al*., 2025).

Bird diversity is a vital indicator of ecosystem health and resilience (McCloy *et al*., 2024). Studies have shown that the composition and abundance of bird communities in cities are influenced by factors such as green space availability, habitat heterogeneity, and anthropogenic activities (Zhang *et al*., 2023). For instance, a comparative study in various urban settings revealed that parks and residential green spaces tend to support higher bird diversity than heavily built-up or industrial areas (Thompson *et al*., 2022).
Recent research has emphasized the importance of understanding urban bird assemblages to inform city planning and biodiversity conservation strategies (Bhakti *et al*., 2024). Moreover, emerging evidence suggests that urban environments can harbour both generalist and some specialized bird species, though the overall diversity often declines with increasing urban intensity (Moreno-García *et al*., 2025). This pattern underscores the need for localized assessments to identify priority areas for conservation and habitat management.
Despite the growing recognition of urban birds' ecological importance, limited studies have been conducted in many developing cities where rapid urban growth threatens existing habitats. Therefore, assessing bird diversity across different urban land-use types is crucial to understanding how urbanization influences avifauna and to developing sustainable urban planning practices.

This study aims to assess and compare bird diversity across three distinct urban sites—market, motor-park, and residential area in Awka. By identifying key habitat features associated with avifauna richness, this research seeks to contribute to the emerging body of knowledge on urban biodiversity conservation.

MATERIALS AND METHODS

Study Area



The study was conducted in Awka, the capital city of Anambra State, Nigeria (6°12'N, 7°04'E), a rapidly urbanizing region characterized by a tropical climate with distinct wet (April–October) and dry (November–March) seasons. Annual rainfall averages 1,800–2,000 mm, and temperatures range from 28°C to 33°C (Okeke *et al*., 2021). Six urban sites were selected to represent varying levels of human disturbance and habitat heterogeneity: two bustling markets (Eke Awka Market (6° 9' 17.37" N, 6° 47' 55.1") and NkwoAmenyi Market (6.18° N, 7.07° E)), two motor parks

(Aroma Junction Motor Park (6°13'37.873"N, 7°4'52.972"E) and UNIZIKTempsite Junction Motor Park (6.214° N, 7.087° E,)), and two residential areas (Ifite Waterboard Residential Estate (6.24°N, 7.09°E) and Ichida Residential Area (6.21°N, 7.07°E)). These sites were chosen based on their accessibility, representation of common urban land-use types, and preliminary reconnaissance surveys indicating potential bird activity. Each site covered an approximate area of 2–5 hectares, with markets featuring high human traffic and vendor stalls, motor parks dominated by vehicular activity and sparse vegetation, and residential areas comprising low-density housing with gardens and scattered trees.

Sampling design

The sampling design for this study employed a stratified sampling approach to assess bird diversity across different urban land-use types. The urban environment was stratified into three categories based on predominant human activities and habitat characteristics including market sites, motor-park sites, and residential sites. The study focused on six distinct sites, comprising two market sites, two motor-park sites, and two residential sites. The sites were selected to represent different urban habitats and anthropogenic influences on bird diversity. Three-point count stations were established within each site, allowing for a uniform assessment of avian diversity (Pacheco-Munoz *et al*., 2025).

Bird Survey

Bird diversity was assessed using point count methodology, a standardized protocol suitable for urban environments (Bibby *et al*., 2000). A total of three-point count locations were established in each site, with a minimum distance of 100 meters between them to reduce the potential for double counting individuals. Surveys were conducted twice a day during peak bird activity periods, specifically early morning (06:00–09:00 hours) and late afternoon (16:00–18:00 hours), to capture diurnal patterns. A 5-minutes acclimatization period was observed upon arrival at a point to minimize disturbance to the birds. Following acclimatization, a 10-minute observation period was initiated. During this time, all avian species observed and sound heard within a 50-meter radius from the point were recorded. Data were collected using Nikula binoculars (10 x 50) and field guides (Fry and Keith, 2020) to ensure accurate species identification. Photographs were taken using a Canon DSLR camera 2000D to confirm the identity of some of the species not easily identified in the field by checking with the field guides. Calls of unfamiliar birds were recorded with a recording device for further analysis. Global Positioning System reading was employed to locate the bird counting points and record the locations of the study area. All samplings were done by the same observer to minimize observer bias.

Data Analysis

Statistical analyses comparing bird species diversity and abundance across sites were performed using Statistical Package for Social Science 2020. bird species diversity was evaluated with the ShannonWiener diversity index (H), calculated as H = -Σ(pi * ln(pi)), where pi is the proportion of each species (Shannon and Weaver, 1949). Species richness (r) was determined for each habitat by counting the number of species observed (Deitmers *et al*., 1999), while species evenness (E) was assessed using the Evenness Index (J'), calculated as J' = H'/H max, where H' is the Shannon index and H max is the natural logarithm of the total number of species (Kiros *et al*., 2018). The Simpson Index (D), which measures the likelihood of two randomly selected individuals belonging to different species, was calculated using D = 1−Σn(n−1)/N(N−1), where n is the number of individuals of a species and N is the total number of individuals across all species (Gregorius and Gillet, 2008).

Ethical Considerations

The study was conducted in compliance with ethical guidelines for wildlife observation. Bird species were not captured or disturbed during surveys, and local permits were obtained to conduct the study in urban areas. Researchers adhered to principles of minimizing disturbance to both the avian population and local communities.

RESULTS

The result of the study on survey of bird diversity on selected urban areas is shown below

Bird abundance in urban areas.

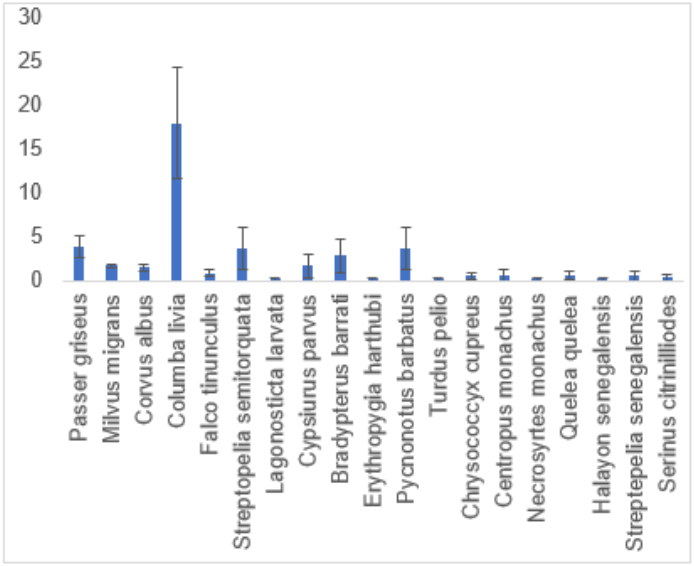


Fig 2. Bird species mean abundance in the study

A total of two hundred and forty-seven (247) birds were recorded throughout the study, resulting in an average of 41.17±6.28 per site. The residential sites had the highest mean bird abundance at 57.5±4.5, followed by the motor-park sites at 37.5±10.5, while the market sites had the lowest mean abundance at 28.5±4.5. The analysis of variance revealed no significant difference in bird abundance among the sites (F=4.3847, P=0.1287, P>0.05). The Rock pigeon (*Columba livia*) was the most common bird species, with a mean abundance of 18± 6.38, followed by the Northern grey-head sparrow (*Passer griseus*) at 3.83± 1.19, Red eye dove (*Streptopelia semitorquata*) at 3.67± 2.32 and Common bulbul (*Pycnonotus barbatus*) at 3.67 ± 2.44. The black-faced firefinch (*Lagonosticta larvata*), Brownback scrub robin (*Erythropygia harthubi*), African thrush (*Turdus pelio*), Hooded vulture (*Necrosyrtes monachus*), Woodland kingfisher (*Halayon senegalensis*) and African emerald cuckoo (*Chrysococcyx cupreus*) had the lowest mean abundance at 0.167±0.167.

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Bird species richness on urban sites

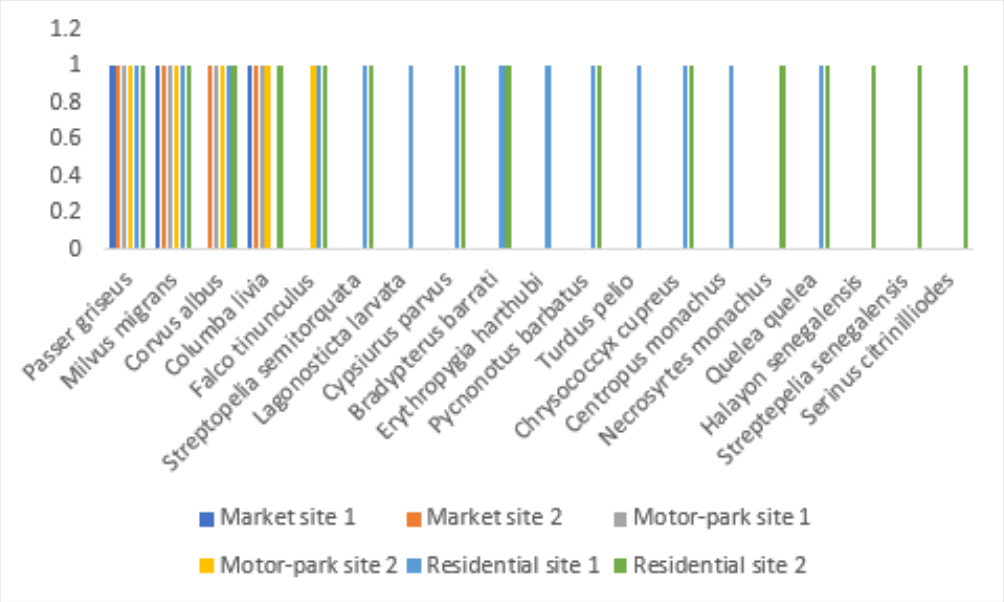

Fig. 3. Showing bird species richness in study sites

A total of nineteen (19) bird species were identified during the study, with African black kite (*Milvus migrans*), Northern grey-head sparrow (*Passer griseus*) and African pied crow (Corvus albus), being the most prevalent. The residential sites exhibited the highest average species richness at 14.5±0.5, followed by the motor-park sites at 4.5±0.5. In contrast, the market sites had the lowest average richness at 3.5±0.5. The analysis of variance for bird species richness across different sites showed a significant difference (F=147.99, P=0.001, P<0.05). The orders Columbiformes, Passeriformes and Accipitriformes were the most widely distributed, occurring in 100% of the samples each. Cuculiformes and Apodiformes with 33.33% and Coraciiformes with 16.67% were the least. The Rock pigeon (*Columba livia*) was the most common bird in the motor park and market with mean abundance of 31.5±11.5 and 20.5±5.5 respectively. The Red-eye dove (*Streptopelia semitorquata*) and Common bulbul (*Pycnonotus barbatus*) were the most common bird in the residential area with mean abundance of 11±0.0 each, followed by the Barrat's warbler (Bradypterusbarrati) with mean abundance of 8.5±2.5 represented.

Bird diversity metrics in urban sites

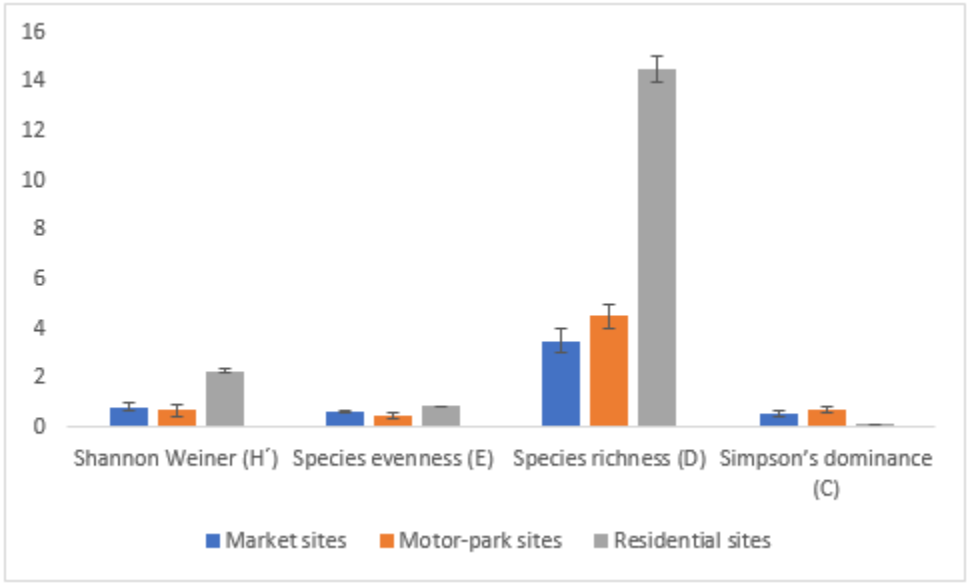

Fig. 4 showing Bird diversity metrics on selected study sites

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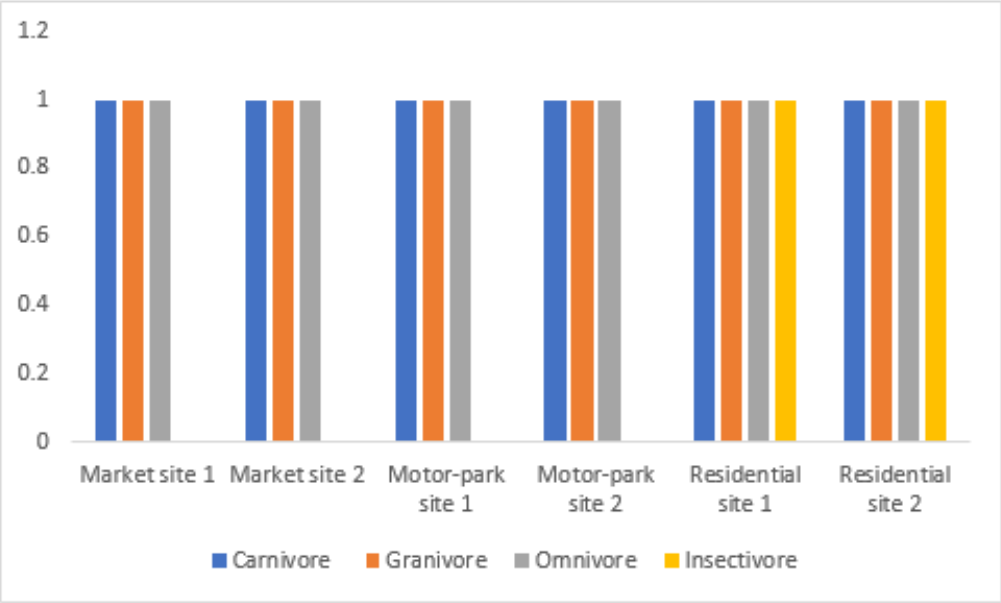
The residential sites (2.2865±0.0845) and market sites (0.812±0.168) displayed the highest diversity indices, whereas the motor-park sites (0.6835±0.2395) showed the lowest. The variance analysis for the diversity index was significant (F=25.6689, P=0.013, P<0.05). In terms of mean species richness, the residential sites (14.5±0.5) ranked highest, while the motor-park site (4.5±0.5) and market sites (3.5±0.5) had the lowest. The variance analysis for species richness was significant (F=147.99, P=0.001, P<0.05). Regarding the mean dominance index, the motor-park site (0.6865±0.1195) and market sites (0.5545±0.0925) exhibited the highest values, while the residential sites (0.13±0.012) had the lowest. The variance analysis for dominance was significant (F=11.0379, P=0.041, P<0.05). In terms of evenness, the residential sites exhibited the highest value (0.855±0.02), followed by market sites (0.6465±0.0605), while the motor-park sites had the lowest value (0.4465±0.1265). The analysis of variance for evenness did not show significant differences (F= 6.2391, P=0.085, P>0.05).

Bird feeding categories



The research identified four distinct feeding categories among the collected Carnivore, Granivore, Omnivore and Insectivore. The motor-park site exhibited the highest mean abundance of granivores (31.5±11.5), followed by the market sites (20.5±5.5). The residential sites were least in terms of granivores (18±3.0) The residential sites had the highest mean abundance of omnivores (18±0.0), while the market site (6±1.0) and motor-park site (3.5±0.5) were least. The residential sites had the highest mean abundance of carnivores (3.5±0.5), closely followed by the motor-park site (2.5±0.5) and market site (2.0±0.0). The residential sites had the highest abundance of insectivores (18±8.0). There were no insectivores in the market sites and motor-park sites.

DISCUSSION

The bird abundance and species richness across various urban environments reaffirms that urban areas can serve as viable habitats for birds, contingent on the availability of suitable resources (Chironet *et al*., 2024).

Despite the higher abundance in residential areas, the analysis of variance indicated no significant differences in bird abundance among the three site types (F = 4.3847, P = 0.1287). This is somewhat surprising given the varied habitat characteristics; however, similar results were documented by Floigl *et a*l. (2022), who found that while urban environments can exhibit differing species numbers, the total abundance might not reflect statistical significance due to overlapping habitat used by adaptable species such as the Rock pigeon (*Columba livia*). This pigeon type emerged as the most commonly recorded species (mean abundance of 18 ± 6.38), consistent with earlier studies highlighting its prevalence in urban habitats (Lim*et al*., 2023).

The observed variation in bird species richness across the sampled sites indicates a strong significant difference between the residential areas, motor parks and markets. This aligns with findings from Ramírez-Alborese*t al*. (2023), who documented that urban green spaces tend to harbour more species due to the structural complexity and resource availability. The presence of the African black kite (*Milvus migrans*) and Northern grey-headed sparrow (*Passer griseus*) contributes to the richness in residential zones, indicating that site design directly influences species diversity.

Examining the bird diversity metrics further elucidates these relationships. The significant variance in diversity indices across sites (F = 25.6689, P = 0.013) highlights the ecological value of residential locations in promoting diverse avian populations. Our finding that the residential sites had the lowest mean dominance index (0.13 ± 0.012) and the highest evenness (0.855 ± 0.02) suggests a balanced bird community, which is vital for ecosystem stability (Dong *et al*., 2025). The highest mean dominance in motor-park sites indicates that a few species dominate. This supports the hypothesis that monoculture or less diverse habitats may result in

dominant species overshadowing others, potentially leading to reduced biodiversity (Fonturbel *et al*., 2022).

The lack of insectivores in motor-park and market sites suggests potential habitat degradation affecting available food sources, a viewpoint supported by Şekercioğlu *et al.* (2023). The predominance of omnivores in residential zones could indicate a capacity to exploit diverse food resources, reinforcing the notion that urban configurations can influence feeding strategies and community structure.

Conclusion

The findings of this study indicate that urban environments, particularly residential areas, play a critical role in supporting bird diversity and abundance. Overall, these results emphasize the critical need for urban planning that incorporates green spaces to promote biodiversity and enhance the ecological health of urban ecosystems. Continued research is essential to ascertain the long-term impacts of urbanization on avian communities and to develop effective conservation strategies.

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