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Full Length Research Paper

BIRD DIVERSITY AND DISTRIBUTION IN THREE LAND-USE TYPES IN NNAMDI AZIKIWE UNIVERSITY AWKA, ANAMBRA STATE, NIGERIA.

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ABSTRACT

The increase in habitat destruction due to anthropogenic activities necessitates the study of bird species diversity and distribution for the purpose of conservation of wild bird species. This study was conducted on three selected sites (agricultural site, forested site, and developed site) in Nnamdi Azikiwe University Awka, using the line transect method. Eighteen bird species belonging to 7 orders and 10 families were recorded during the study. The highest mean number of birds was recorded in the developed site (7.17±0.77) followed by agricultural site (6.83±1.01) and forested sites (4.33±0.80). The developed site also recorded the least bird diversity index and species richness (H'= 1.82, r=2.13) compared to the forested site (H'= 2.09, r=2.46) and the agricultural site (H'= 2.34, r=3.32). The highest Simpson index of birds dominance (D=0.15) was recorded in developed site compared to the forested site (D=0.14) and agricultural site (D=0.12).The agricultural site recorded the least evenness (E=0.48) compared to the agricultural site (E=0.63) and forested site (E=0.64). The highest number of carnivorous and insectivorous bird species was recorded in the forest, while no granivore was recorded in the forest. The agricultural site recorded the highest number of granivore while the major birds recorded in the developed site were granivores and carnivores. The study showed that while some birds were well adapted to habitat modification, others were drastically affected by the change in their natural environment. It was therefore recommended that regular monitoring of various sites be conducted to check changes in the state of the environment for conservation.

Keywords: Conservation, habitat destruction, land-use type, species diversity, transect method

INTRODUCTION

Species diversity is on the decline around the world due to habitat destruction. New communities also emerge after such disturbances. The need to study species affected and communities formed, therefore, becomes imperative (Sodhi, 2005). Study on bird species diversity and distribution is important for conservation efforts in different protected area (Abie*et al*., 2019).

Habitat destruction is a major factor affecting birds' diversity; changes in vegetation composition, food, water and cover drastically affect bird diversity, abundance, and distribution (Abdar, 2013). According to new research by America Museum of Natural History of the 18,000 birds' species in the world; over 190 have gone extinct (Bird Checklist, 2017). Extinction of species and population declines may lead to deterioration of ecosystem services they provide to humans (Wenny *et al.*, 2011).

Birds perform many ecological functions ranging from pollination and seed dispersal to pest and disease control. They also serve as ecological indicators for environmental changes (Birdlife International, 2008). One role of ecology is to determine the factors affecting the distribution of species. Forestry policies, abandonment of agricultural land, urban development all cause profound change to bird diversity. There is need for comprehensive analyses of the relationship between land use and bird population changes. The understanding of the ecological factors controlling the stability and persistence of bird species is crucial in establishing conservation strategies that will diminish adverse impacts of human activity on their existence and survival (Diamond, 1988).

Due to intensive anthropogenic activities such as clearing of bushes for erection of classroom blocks, commercial buildings and motor parks including road constructions ongoing in Nnamdi Azikiwe University, Awka, these have influenced the natural habitats of birds. Thus, it is pertinent that a record of bird species should be assessed for easy compilation of birds' communities in, and for monitoring of birds decline or upsurge in Nnamdi Azikiwe University, Awka, for conservation purpose.

The main objective of this study was to assess the diversity and distribution of birds in three land-use types in Nnamdi Azikiwe University Awka. Specifically, the study aimed at identifying bird species that live in or visit the different land-use types in Nnamdi Azikiwe University Awka, identifying and assessing their feeding guilds, abundance, and diversity in different land-use types in Nnamdi Azikiwe University Awka.

MATERIALS AND METHODS

Study Area

The study was carried out in Nnamdi Azikiwe University Awka, Anambra State, Nigeria. Located on latitude 6º20' N, 6.333ºN and longitude 7º00' East, 7.000º East. It lies at an elevation of 300 meters above sea level in a valley on the plains of Mamu River and its primary vegetation is wooded savannah grassland. Awka lies in the tropical rainforest zone of Nigeria and experiences two distinct seasons: the wet seasons and dry season, between April to October and November to March

respectively. The average temperature is 28.5º C between June and December and 33º C between January and April.

The study was carried out at the campus of the Nnamdi Azikiwe University, Awka occupying over 100 acres of land with abundant flora and fauna(Ogbodo *et al*.2020). The land contains few streams, farmlands, and many buildings as well as forested areas. Human activities are high in certain areas and minimal in others.

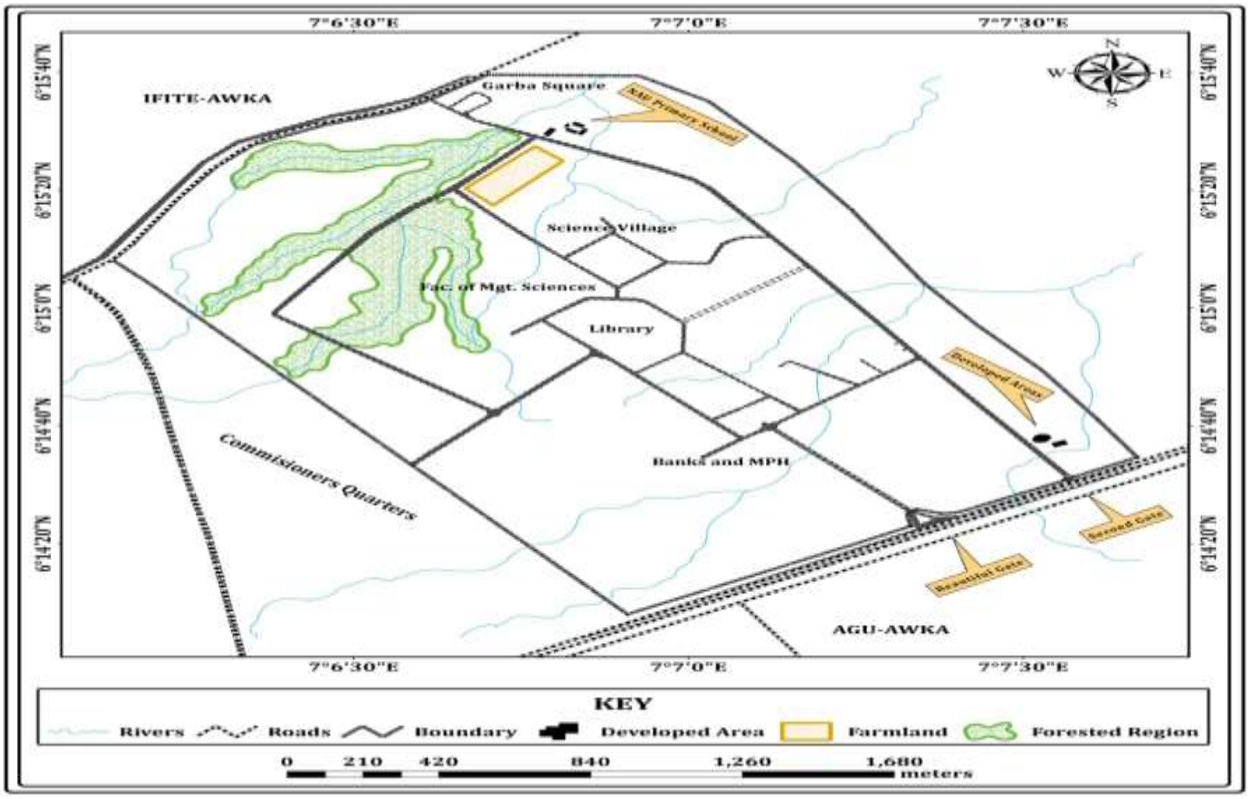


Figure 1: A map of Nnamdi Azikiwe University showing the selected study sites (Source: Physical Planning, Nnamdi Azikiwe University)

Data Collection

The line transect method as recommended by Ralph *et al*., (1993) was used for the study to assess the diversity and abundance of birds species in the study sites. Three sites each measuring 150m by 100m were used for the study. The survey was carried out early in the morning between 7 and 9am and in the evenings between 4 and 6pm for 15 minutes in each site. The study was done according to procedures recommended by Bibby *et al.* (2000). Total count of all birds observed, and species seen were recorded. The study was conducted between July and August for 6weeks. Birds detected by sight or sound were classified as within or beyond 100m of the transect line. Distant birds were viewed for identification purposes with the aid of binoculars. A digital camera, Canon EOS 700D, was used to take

photographs of birds sighted within the transect while a mobile phone, Samsung S9sound recorder, was used to record birds' calls for identification of bird species.

Data Analysis

The Shannon's diversity index (H'= - ∑ pi log pi), where pi is the proportion of individuals belonging to the i th species) was used to access the diversity of bird species at the different land-use type levels in order to identify the species diversity of each particular habitat (Shannon and Weaver, 1949).

Species richness (r) which is the number of different species present in an area was estimated for each habitat (Deitmers *et al*., 1999).

Evenness of bird species (E) was used to compare the similarity of the population size of each species. Evenness Index (*J'*) was calculated using the ratio of observed diversity to maximum diversity using the equation (Kiros *et al*., 2018).

J'=H'Hmax

where *H'* is the Shannon Wiener Diversity index and H_{max} is the natural log of total number of species.

Simpson Index (*D*) which measures the probability of any two individuals drawn from noticeably large community belonging to different species (Simpson, 1949) was calculated using the following formula:

D=1−Σn(n−1)N(N−1)

where *n* is the total number of birds of a particular species and *N* is the total number of birds of all species.

The relative abundance (%) of bird species was determined by using the expression:

Relative abundance (%) = n/N X 100

where n is numbers of particular recorded bird and N is total recorded bird species. (Zakaria *et al*., 2009)

RESULT

Species Richness

The study recorded a total of 18 bird species consisting of 13 resident and 5 migratory bird species (Plate 1). The most widely distributed bird species were the pied crow (*Corvus Albus*), the black kite (*Milvus migrans*), the African harrier-hawk (*Polyboroides typus*) and the Black sparrow hawk (*Accipiter melanoleucus*), while Woodland kingfisher (*Halcyon senegalensis*), African wood owl (*Strix woodfordii*) and Brownback woodpecker (*Dendropicos obsoletus*) were restricted to the forest (Plate 1) .

Species abundance

Species relative abundance

Species relative abundance in sites studied is shown in Figure 1. The mourning dove (*Zenaida macroura*) and the black scrub robin (*Cercotrichas podebe*) recorded the highest abundance in the developed site; the black kite (*Milvus migrans*) and African harrier-hawk (*Polyboroides typus*) recorded the highest abundance in the forest site while the pied crow (*Corvus albus*) recorded highest abundance in the agricultural site. There was no significant difference between the sites in terms of number of individual birds observed (t = 3.166667, p = 0.115136)


Mourning dove
Zenaida macroura
+ * !


Laughing dove
Spilopelia senegalensis
+* !


Red-eye dove
Streptopelia semitorquata
+ !


Ashy flycatcher
Muscicapa caerulescens
+ !


Pied crow
Corvus albus
+ * - !


Sahel bush sparrow
Gymnoris dentate
+ !


Black-back cisticola
Cisticola eximus
+ !


Northern grey-head sparrow
Passer griseus
+ * !


Anambra waxbill
Estrilda poliopareia
+ !


Black scrub robin
Cercotrichas podebe
* !


Black kite
Milvus migrans
+ * - ^


African harrier-hawk
Polyboroides typus
+* - ^


Black sparrow hawk
Accipiter melanoleucus
+ * - ^


Cassin's hawk eagle
Aquila Africana
+- ^


Woodland kingfisher
Halcyon senegalensis
- !


Eleonora falcon
Falco eleonorae
* - ^


African wood owl
Strix woodfordii
- !


Brownback woodpecker
Dendropicos obsoletus
- !

Key : Agricultural site + Forest site - Developed site * Resident bird ! Migratory bird ^

Plate 1: Bird species recorded at selected sites (agricultural, forested and developed) in Nnamdi Azikiwe University and their status

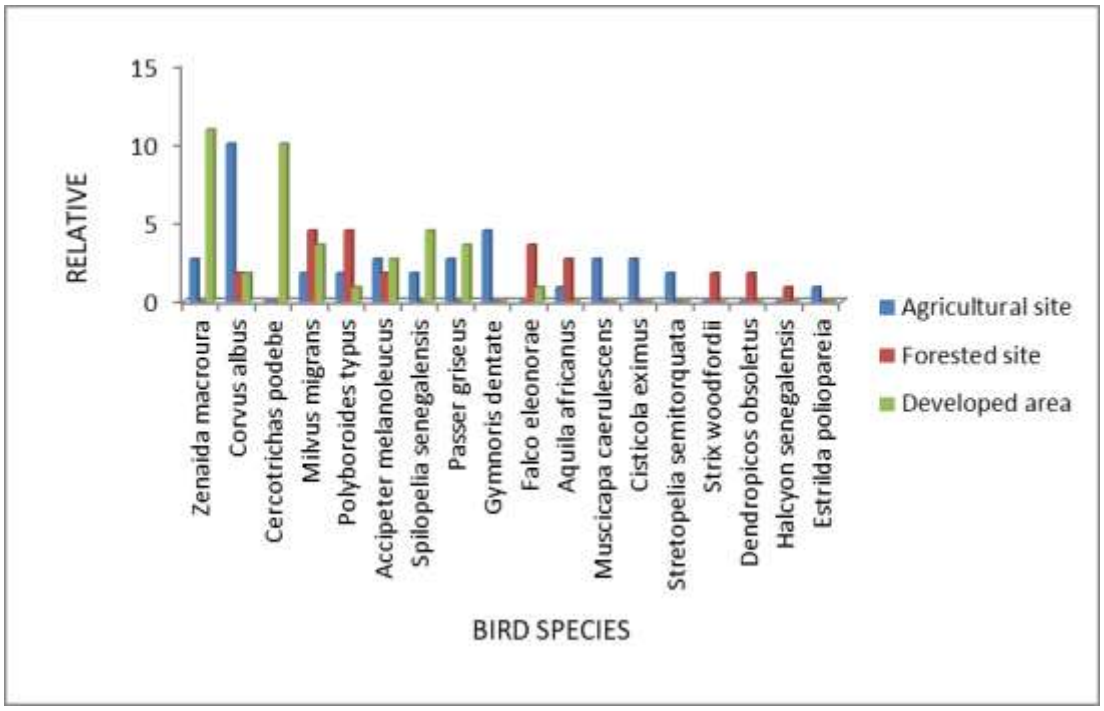


Figure 1: Relative abundance of birds in selected sites in Nnamdi Azikiwe University

Mean number of individuals per site

Mean number of individuals per site is shown in Figure 2. The developed site recorded highest mean number of birds and the forest the least.

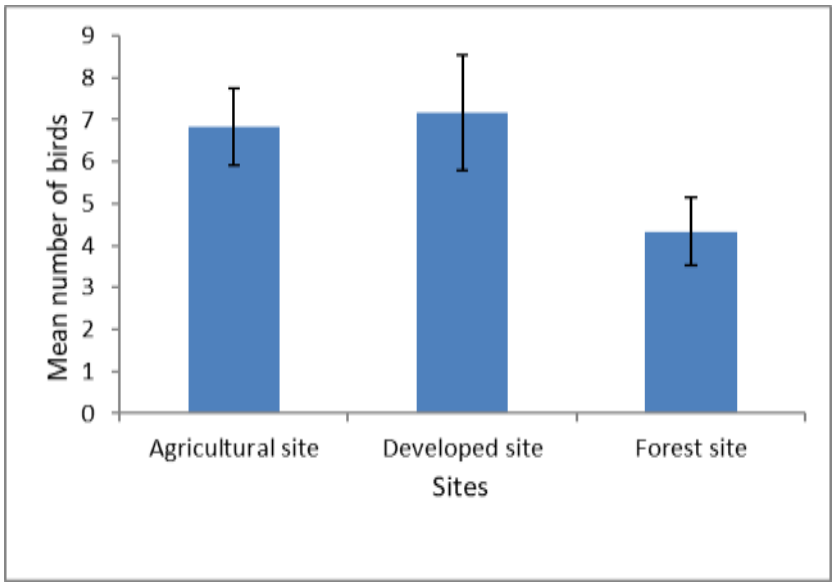


Figure 2: Mean number of bird individuals encountered per visit on selected sites at Nnamdi Azikiwe University

Species diversity

Bird species diversity is described using the diversity parameters in Table 1. The Agricultural site had the highest Shannon diversity index and the developed site the least. The forest site had the highest bird evenness and the developed site the least.

Table 1. Diversity parameters in selected sites in Nnamdi Azikiwe University Awka

Index	Agricultural site	Forested site	Developed area
Shannon weiner (H′)	2.34	2.09	1.82
Simpson's dominance (C)	0.12	0.14	0.15
Species evenness (*E*)	0.63	0.64	0.48
Species richness (*D*)	3.23	2.46	2.13

Bird feeding guild

Bird feeding guild is shown in Figure 3. Five feeding guilds of birds were recorded. The highest number of carnivores and insectivores was recorded in the forest. No granivore or foliage feeder was recorded in the forest. The highest number of granivore was recorded in the agricultural site. The major birds species recorded in the developed site were granivores and carnivores.

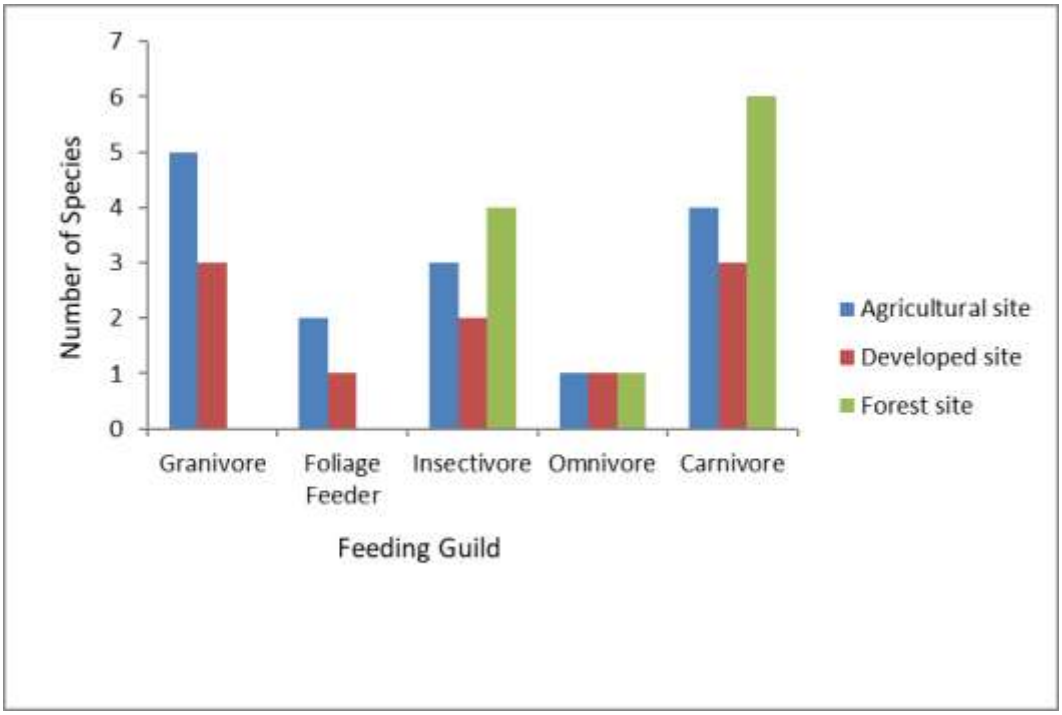


Figure 3. Feeding guild categories of bird species as classified in selected sites in Nnamdi Azikiwe University

DISCUSSION

The study of bird diversity and distribution is essential in understanding how the ecosystem functions. In this study it is pertinent for the purpose of record and conservation. The study recorded eighteen bird species belonging to 7 orders and 10 families. The low species richness suggests human impact on the ecosystem. Increasing anthropogenic human-influence can cause native species richness decline according to Lepczyk, *et al*. (2008). This is consistent with the ecosystem-stress hypothesis.

The most widely distributed birds species recorded were the pied crow (*Corvus Albus*), black kite (*Milvus migrans*), African harrier-hawk (*Polyboroides typus*) and black sparrow hawk (*Accipiter melanoleucus*). The birds with distribution restricted to the forest were the woodland kingfisher (*Halcyon senegalensis*), the African wood owl (*Strix woodfordii*) and the brownback woodpecker (*Dendropicos obsoletus)*. This suggests difference in bird response to urbanization due to varying levels of adaptation. This is in line with findings by Marzluff (2017) who reported that widely distributed species possess broad ecological tolerance that enable them thrive in multiple environments. On the reverse, species with highly specialized feeding and nesting requirements typically cannot adapt to urban environments and are sensitive to fragmentation (Evans *et al*., 2011).

The most abundant bird species recorded during the study were the mourning dove (*Zenaida macroura*), black scrub robin (*Cercotrichas podebe*), black kite (*Milvus migrans*), African harrier-hawk (*Polyboroides typus*) and the pied crow (*Corvus albus*). This finding suggests differences in bird species ability to use different habitats. This is in line with findings by Best *et al*, (1990) who stated that the extent of change in bird species composition and abundance depends on the specificity of each bird species habitat requirement and its tolerance to the changed environment. Past studies show that the relative abundance of bird species is associated with vegetation community and food resources, and positively correlated with habitat structural complexity (Caziani and Derlindati, 2000). It also shows that the level of distribution of bird species in habitat is normally as a result of an occurrence of plant species that support their population and to variation in species-specific requirements in the choice of habitat (Cody, 1985; Mangnall and Crowe, 2003). *Halcyon senegalensis* and *Estrilda poliopareia* recorded low abundance; an indication that they are not well adapted and grossly affected by the modification of their natural habitat.

The developed site recorded the highest mean number of birds followed by the agricultural site and the forest site. This seems to be due to readily available nesting and foraging materials in these areas compared to the undisturbed area. This finding is in line with past studies that report that bird abundance increases with urbanization. This however contrasts with that reported by Herkert (2009) who stated that habitat loss to urbanization affects avian species population through reduction in habitat quality.

The study showed that the agricultural site recorded the highest species richness and diversity index, followed by forested site and the developed area. This could be due to the abundance in food and shelter in these areas. The finding suggests that areas between high and low disturbance show higher diversity and species richness. This is in contrast with that reported by Matlock *et al*. (2002) who stated that forest patches and protected area in Sao Tome have higher retention of bird species than agricultural landscapes. It however supports the work by Okosodo *et al.* (2016) who reported more diverse bird species in farmlands than other study sites.

The study recorded five bird feeding guild. This could be due to loss or reduction of environmental resources used by birds through human activities. The highest number of insectivores was recorded in the forest. No granivore was recorded in the forest. The highest number of granivore was recorded in the agricultural site. The major birds recorded in the developed site were granivores and carnivores. This finding suggests that granivorous bird species increase with increasing urbanization and insectivorous species with decreasing urbanization. This is in line with past studies which indicate a pattern of increased prevalence of omnivores and granivores, with decreased prevalence of insectivores in urban areas (Kark *et al*., 2007). Increases in prevalence of omnivores such as pied crow are likely due to their habits of scavenging human refuse, enabling them to exploit new niches present in urban habitats (Lim and Sodhi, 2004). Increases in prevalence of native granivores are likely due to elevated levels of human bird feeding in urban areas (Daniels and Kirkpatrick, 2006; Parsons *et al*., 2006). The decrease in insectivore prevalence in urban species assemblages may be due to the scarcity of insects in urban habitats (Flückiger *et al*., 2002).

This current study includes some limitations. The study is limited to diurnal birds and does not cover aquatic birds.

CONCLUSION

This study concludes that variation in bird diversity and distribution in different habitat types is predominantly influenced by the level of urbanization. Land conversion for infrastructural and agricultural purposes is growing gradually. This may increase extinction risk for many threatened and endangered birds in the area, such as *Halcyon senegalensis*, *Strix woodfordii* and *Dendropicos obsoletus*. There is a need for biodiversity conservation integrating the remnant forest and other heterogonous habitats together with the surrounding agricultural landscape. The protection and conservation of some parts of the campus will serve as a haven for some of the bird species.

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