

ECOLOGICAL SURVEY OF BIRD SPECIES IN ABUJA CONSERVATION PARKS

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Abstract

Urban parks seem to play important role in preserving the bird species' diversity and abundance. This study was conducted to identify bird species in four conservation parks: Jabi Lake Park, Millenium Park, Central Park and National Children Park n Zoo in Abuja from April - June 2023. A total of 312 individuals from 81 species were identified from the four parks. Each park recorded an average of 40- 54 species, National Children's Park recorded the highest species richness while Central Park had the least species recorded. Jabi Park recorded the highest count in the wetland habitat while Millenium Park recorded the highest number of bird populations in the woodland habitat. Kruks Wallis test conducted showed no difference in bird abundance in each habitat across the survey locations while Correlation analysis to test the hypothesis that tree density has an effect on the bird species richness also showed no correlation.

The study identified a potential connection between plant/tree species and specific bird populations. The dominant species commonly recorded in the parks include *Cypsiurus parvus* (African Palm swift), *Streptopelia senegalensis* (Laughing Dove), *Spermestes cucullata* (Bronze mannikin), *Ploceus cucullatus* (Village Weaver), *Pycnonotus barbatus* (Common Bulbul). The study revealed the dominance of generalist species over water and forest specialists' birds thus suggesting that urbanisation and human interference in these urban parks do not support the specialist birds. It is therefore recommended that future continuous monitoring be undertaken in these parks to monitor the trend and identify potential needs of these bird species which will therefore contribute towards strategies for biodiversity conservation.

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1. Introduction

The tropical rainforest harbours the highest number of bird species. There are 108 bird families in the world and 96 bird families in Africa with 1,012 species found in Nigeria (Adriana S. 2022, Alex O. 2016). These could be attributed to the temperature and humidity of the region which contributes to the vegetation and habitat structure of the birds. Several studies have shown that habitat structure is also a contributory factor in determining the diversity, abundance and conservation of bird species (W. Kang 2015).

The presence/absence of birds in an environment can serve as a hint to describe the state of an environment. Their high migratory properties also contribute towards seed dispersal and forest restoration of fruit-bearing trees. The diversity and abundance of these birds can be attributed to their adaptive characteristics to biogeographic conditions. Apart from their contribution to the ecosystem, they also serve as an attraction for tourists or bird watchers.

The increasing population and urbanisation and its effect on the ecosystem have attracted concerns from ecologists and other scientists from various fields globally (Esteban F.J. (2000), Chang H. et al (2015). Urban areas are being characterised by increased population, and infrastructural development such as housing, roads and other amenities for urban growth. This urbanisation process which however involves the modification of natural ecosystems contributes majorly to the changes in plant and animal biodiversity (M. Menon et al 2016). Urbanisation has been attributed to contributing to the decline in wildlife resources and biodiversity.

Researchers have suggested that bird species diversity and abundance have been on the decline due to the destruction of natural habitats such as deforestation and human interference (Leveau L. M. et al. 2022, Labiran J. et al. 2018) on the other hand, with the advent of climate change, one can suspect that changes in temperature and precipitation ranges might adversely affect birds species diversity and abundance. Few studies by some researchers were focused on the consequences of climate change on avian offspring production and has suggested that climate change has altered avian breeding and reproduction (Robert E Simmons et al (2004), Additionally, other several studies have been conducted to identify the influence of urban parks in the conservation of avian communities in several countries (Daqing Zhou 2012, Matthew T. et al 2003, Yang et al 2020, Kwaga B. T et al 2019) including other states in Nigeria (Okesodo et al 2016), there is, however, inadequate research on the quantitative analysis of

bird species and the effect of the reserved green parks on their richness and diversity in urban conservation parks in Abuja.

Abuja (Fig 1) the Federal Capital Territory (FCT) of Nigeria, West Africa which lies at latitude 9.07N and longitude 7.48E, and at an elevation of 840 m (2760 ft) above sea level (AGIS, 2013) is one of the fastest growing cities faced with the challenges of increasing population and urbanisation. The area is located in the geographical middle belt of Nigeria and does not experience the extreme climate characteristics of the North and South Nigeria, it experiences two major seasons: wet and dry seasons with an annual temperature range between 17°C- 35°C (Abuja GIS 2003). Since the creation of the FCT in the late 1980s (Abuja Master Plan 1979), there has been rapid migration of people from other rural areas into the city. However, despite the increased urbanisation, the Abuja master plan design made provisions for designated green areas reserved as conservation parks which also serve as recreational centres where the residents go for relaxation and connect with nature. These parks such as Millenium Park, Abuja Park and Zoo, Jabi Lake, Central City Park, Wonderland etc. are both natural and man-made parks where most species of plant and animal communities are presumably conserved both for recreational purposes and to prevent extinction of these native and non-native species while also balancing the ecosystem.

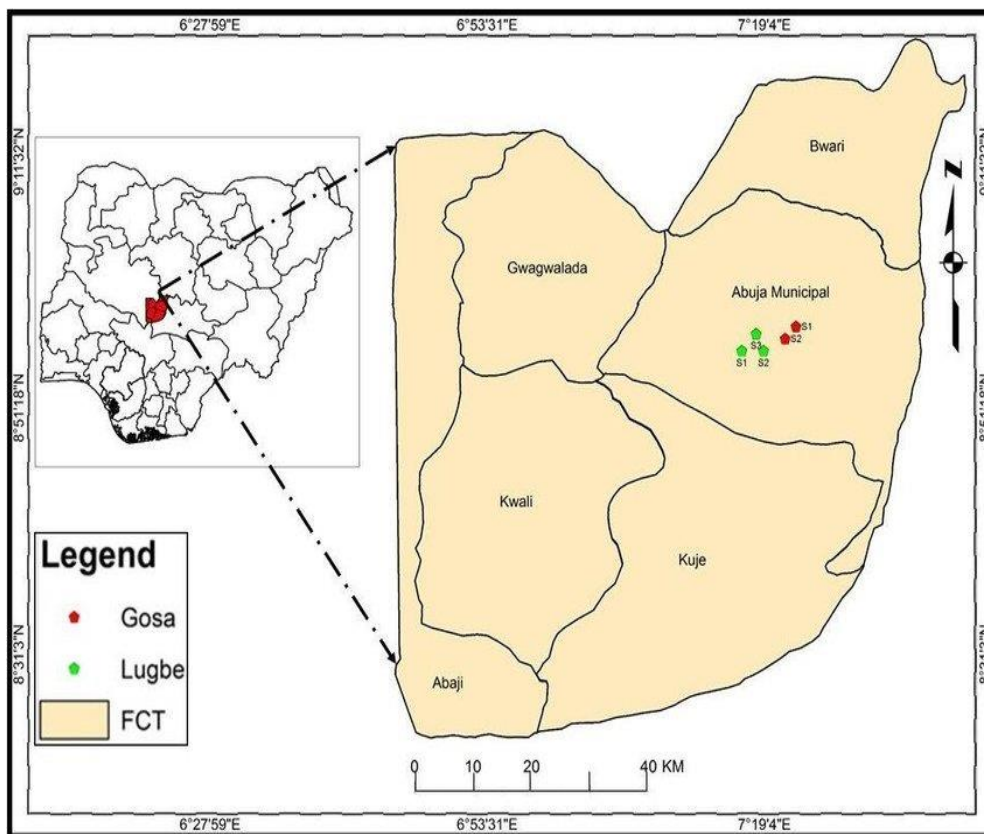


Fig 1: Map of Nigeria showing Abuja (Credit: Google)

1.1 Literature Review

Several studies and evidence have shown that bird species richness and diversity in urban area is attributed to several factors influencing them, including size of green space, vegetation structure, species composition, habitat structure, isolation, and human interference (Evans K. L et al 2009; W. Kang 2015; Esteban F.J. 2000). Additionally, according to Evans K. L et al 2009, local scale factors contribute more towards the bird species richness than regional scale factors, this is especially for species that are restricted by their habitat requirement. Different birds species have different adaptive characteristics to different types of vegetation, For example, Forest specialist birds will require areas with high vegetation cover, thick woodland and forest areas while water specialists thrive most in wetland areas.

Urban parks can be described as ‘islands’ in towns which serve as hotspots for biodiversity. Mikiñney, M.L (2006) reported that urban parks promote biodiversity by the introduction of non-native species through the avian population and human interference. While management of reserved areas is perceived to be one of the methods for the natural conservation of the environment and the bird species, Nevertheless, there is insufficient information on whether these parks provide sustainable habitats for the birds. (Okesodo et al 2016) reported the effect of landscape, vegetation and management practise on the abundance and diversity of birds in Oyo National Park, while Ihuma J.O et al 2016 carried out a study to evaluate the effect of tree species on the diversity of birds in a few areas within Abuja. Additionally, Esteben F.J. (2000) also noted that park size and age are also recognised as major factor for bird diversity and abundance. Moreover, internet data from bird sighting activities provided by tourists and birdwatchers in Abuja and Lagos have provided some checklists of the different bird species observed in various locations (eBird 2023), offering valuable insight into bird diversity in these cities which also indicates that ornithology is gaining notable interest in Nigeria. however, little scientific research is done on the quantitative analysis of the bird species richness and abundance in Major Parks in Abuja and a comparative evaluation of these conservation parks. Hence, this project was carried out to provide a scientific baseline survey and quantitative data on the diverse bird species present in four conservation/recreational parks (Millenium Park, Jabi Lake and Recreational Park, Central City Park and National Parks and Zoo) while also comparing the distribution and abundance in these parks in relation to the habitat structure structures.

1.2 Aim and Research Questions

Ecological monitoring is an important step in conservation and ecosystem balance. An ecological survey and assessment of birds in the selected urban parks in Abuja is believed to contribute towards determining the influence of these parks on the avian community and identifying potential conservation priorities, hence this research is aimed at providing information on the checklist of bird species and their abundance. The parks were chosen due to their size, popularity as one of the most visited tourist centres and habitat structure. Data collected will provide baseline information on the bird species present in these parks and inform the relationship between habitat structure and the bird population which will guide biodiversity conservation strategies and management.

The research seems to provide answers to the following questions.

1. What species are observed in each of the sample locations?
2. How does habitat structure and vegetation affect the abundance of birds in the different sample locations?
3. What differences are observed in the species richness and abundance in the four locations?

2. Methodology

2.1 Description of the study area.

Four urban parks (Millenium Park, Jabi Lake and Recreational Park, Central City Park and National Children Park n Zoo) all situated within Abuja, Nigeria were selected as sample locations for the study. These sites were selected based on the following considerations: major recreational parks with high vegetation coverage, different locations and sizes, diverse plant and tree species, similar habitat structures such as the wetland, grassland/Parkland and forest/Woodland areas, and rich bird resources where residents visit for bird watching. The sites are separated from each other by a minimum distance of 3km with the Jabi Lake being the farthest from the other three sites. (Fig 2)

a. Jabi Lake (Site 1)

Jabi Lake Park lies within coordinates 7.416433,9.069131 is situated in Jabi metropolis in Abuja is surrounded by a natural body of water in the Jabi district of Abuja. The surface of the lake is about 121 hectares. The recreational park consists of an open area majorly for workouts, small businesses, and a large vegetation area which serves as home to various birds and other plant communities. It also has a boat club where social activities like boating, rental services for tourist jet ski on the lake. The vegetation in this area is dominated by trees, water plants, shrubs and an open grassland.

b. Millenium Park (Site 2)

Millenium Park located within coordinates 7.421472,9.063753 can be identified as one of the largest public parks within Maitama District in Abuja. Commissioned in 2004 by Her Royal Highness, Queen Elizabeth II of England, the park was established to serve as a tourist attraction site and also a conserved area for natural vegetation, it covers a total area of about 80 acres. Due to its size and landscape, a large number of tourists visit the Park for various forms of social activities. The park is divided into two by a narrow river along its rectilinear axis. The vegetation in this area is dominated by mountainous forest trees, shrubs and open grasslands. As reported by Nwankwo M et al 2021, tree species identified include flamboyant trees (*Delonix regia*), Broome raintree (*Albizia lebbbeck*), Lombardy poplar (*Populus nigra*), weeping willow (*Salix babylonica*), flower-bearing plants such as dwarf poinciana (*Caesalpinia pulcherrima*), maidenhair fern (*Adiantum spp.*), and coleus (*Solenostemon*).

c. Central City Park (Site 3)

Central City Park located in the central area of the Federal Capital Territory Abuja with coordinates 7.49130,9.069131 is another popular recreational park where families bring their kids for fun and games. It covers a total of 4 hectares, The area is surrounded but commercial and residential centres, roads,

and walkways. The habitat feature in this area is dominated by open modified areas for games and other outdoor activities, such as a playground for kids, go-kart, paint ball, water park, lawn tennis court etc. the green spaces comprise of fruit trees, woodlands, shrubs and wetland area along the boundary of the park.

d. National Children's Park n Zoo (Site 4)

National Children's Park and Zoo located in the Asokoro area behind the presidential villa, is among the largest and most popular parks in the city of Abuja. The Park surrounded by mountains provides a delightful experience with various fragmented open spaces for family relaxation and site seeing also, the zoo area houses different animals both domestic and wild animals like rabbits, goats, crocodiles, snakes, tortoises, tigers, baboons etc . The vegetation in this area is surrounded by mountains and dominated by woodlands, shrub area with various plants and tree species and a lake adjoining other undeveloped area and the mountain.



Fig 2. Abuja map showing the four survey parks

2.2 Sampling design and data collection.

The study was carried out from April 2023 to June 2023 and the survey was conducted at random days for the duration of the survey. A reconnaissance visit was carried out in January to identify the sizes of

each survey park, the distance between the varying habitat structures, and the sample locations and coordinates. The coordinates for each sampling point were recorded using the Mergin Maps mobile app and uploaded to the QGIS software.

For every day of each survey, two sites were visited thus making it a total of six visits for each site throughout the period of survey in order to maximise accuracy. For each site, a minimum of 1hr 30 mins was spent before proceeding to the next site (Table 1). The driving distance between each site is about 15 minutes apart.

Table 1: Bird Survey timeline

Date/Time	6:30- 8.00am	8:20- 10:00 am
22/04/2023	JABI PARK	CENTRAL PARK
25/4/2023	CENTRAL PARK	JABI LAKE
1/5/2023	MILLENIM PARK	NATIONAL PARK N ZOO
12/5/2023	CENTRAL PARK	JABI LAKE
19/5/2023	NATIONAL PARK N ZOO	MILLENIUM PARK
20/5/2023	CENTRAL PARK	JABI LAKE
22/5/2023	MILLENIUM PARK	NATIONAL PARK N ZOO
23/5/2023	NATIONAL PARK N ZOO	MILLENIUM PARK
3/6/2023	CENTRAL PARK	JABI LAKE
10/6/2023	MILLENIUM PARK	NATIONAL PARK

2.3 Bird Survey.

The birds were surveyed using the point count method (Bibby et al 2000, Richard D. et. al 2004). This method was preferred as it gives easy access to individual points especially where the terrain is problematic to navigate. Surveys were carried out only in the early hours of the morning between 06.30am and 10.00 am where bird activities are highest and minimal human interference because human activities in the parks were more observed in the afternoon and continue till late in the evenings. Due to the varying habitat structure of the sample locations and in order to improve detectability and avoid bias, the stratified random sampling strategy was adopted where each of the sample sites was stratified accordingly into three vegetation habitats: Woodland, wetland and Parkland (Hills et al 2005, Buckland et al 2008). For each strata, random samples were collected at two points each with a minimum distance of 200m to avoid duplicate counts, it was noted that travel time to each survey point was 5mins. At each survey point, a minimum of 12 minutes was spent with a waiting period of 2 minutes to settle while bird data was collected within 10 minutes. It is worth noting that as recommended by Bibby et al 2001, with regards to distance sampling, all birds seen hovering in the sky or heard within an estimated radius of about 30m from the survey point were adequately recorded. Also, as recommended by David W. (2006),

during days of rain, cold weather and strong winds, no surveys were carried out, as this condition might influence bird activities and detectability. Identification and classification of species was aided by the use of Binoculars (10 x 42mm) and a field guidebook by Nik Borrow and Ron Demey 2021 respectively. Recording of bird sounds was done using the CornellLab Merlin bird App for sound reference as well as playback for identification.

2.4 Habitat Features Classification

At each point, the tree and shrub density was estimated within a radius of 50m from each survey point according to M.Menon et al 2016 and Lee et al 2008 method,. The inventory of trees was also noted. Using visual estimates, plant species were classified according to the height above ground (shrubs $\leq 2.5\text{m}$, trees $> 2.5\text{m}$) (Xu et al. 2022). The habitat structures were classified according to the tree abundance and dispersal within the 50m radius at each point. Water bodies with surrounding shrubs and trees ≤ 10 were classified as wetland, $7 \leq 20$ trees on the land were classified as Parkland and tree density of > 20 were classified as Woodland. Plant species were identified using the Plant ID App and taxonomic keys.

2.5 Data Analyses.

All data recorded on the field using field data sheets were computed electronically and summarised in a Microsoft Excel 2019 spreadsheet. Using the QED Statistics software, the data on bird counts were tested for normality and homogeneity of variance using the Shapiro-WilkTest ($p > 0.05$) prior to any statistical analysis. (Appendix 1). As there are multiple samples and data are not normally distributed, the Kruksal Wallis test was used to test significant differences in bird abundance across the habitats in each of the sites. Correlation analysis was used to test the hypothesis on the effect of tree density on bird species abundance. (Appendix 2)

3. Results

At the end of the survey, Table 2 shows the number of species in each of the parks. A total of 81 species and 1,251 individuals belonging to 39 families were recorded from the 24 sampling points across the various habitats in the four different parks (Table 3). Generally, the families Collumbidae, Estrildidae and Cisticolidae were dominant in these four locations representing 20.51%, 15.38% and 12.82% respectively. National Park recorded the highest number of bird species at 66% of the total species. Central Park has the least recorded species. however, in terms of total bird abundance, Millenium Park recorded the least number of bird counts (Appendix 1). Fig 3 and Fig 4 show the species richness and abundance across the different habitats in each of the park locations. The dominant species observed in Jabi Park include *Cypsiurus parvus* (African Palm swift) and *Ploceus cucullatus* (Village weaver) in the Woodland, *Spermestes cucullate* (Bronze Mannikin) and *Microcarbo africanus* (Long-tailed Commorant) in Wetland, *Corvinella corvina* (Yellow Billed Shrike) in Parkland. Millenium Park recorded *Milvus aegyptius* (Yellow billed Kite) and *Streptopelia vinacea* (Vinaceous Dove) as the dominant species in woodland, *Spermestes cucullata* (Bronze mannikin) and *Ploceus cucullatus* (Village Weaver) in wetland, while *Milvus aegyptius* (Yellow billed Kite) and *Bubulcus ibis* (Cattle egret) were common in the Parkland area. Also, *Apus affinis* (Little Swift), *Cypsiurus parvus* (African Palm swift) and *Ploceus cucullatus* (Village weaver) were dominant in Central Park as they were most abundant in the woodland, wetland and parkland area. *Pycnonotus barbatus* (Common Bulbul) was also recorded but most common in the wetland area of the park. Finally, the dominant species recorded in National Children Park include Yellow Billed Kite in wetland, Cattle egret in woodland and Pied Crow in Parkland (Appendix 3).

LOCATIONS	No OF SPECIES	Total Count
JABI PARK (SITE 1)	47	319
MILLENIUM PARK (SITE 2)	46	300
CENTRAL PARK (SITE 3)	40	305
NATIONAL CHILDREN PARK AND ZOO (SITE 4)	54	327

Table 2: Table showing the number of total bird species and counts across the survey sites.

Class	Family	Scientific name	Species	JABI PARK	MILLENIUM PARK	CENTRAL PARK	NATIONAL CHILDREN PARK
WS	Accipitridae	<i>Circus aeruginosus</i>	Marsh Harrier	1			
G		<i>Milvus aegyptius</i>	Yellow-Billed Kite	8	41	4	22
G	Alaudidae	<i>Galerida cristata</i>	Crested Lark		4		1
G		<i>Galerida modesta</i>	Sun Lark	5			1
G	Alcedinidae	<i>Halcyon malimbica</i>	Blue-Breasted Kingfisher				1
G		<i>Megaceryle maxima</i>	Giant Kingfisher				1
G		<i>Ispidina picta</i>	Pygmy Kingfisher		1		
G	Apodidae	<i>Cypsiurus parvus</i>	African Palm Swift	22	5	30	7
G		<i>Apus affinis</i>	Little Swift			70	
G		<i>Apus apus</i>	Village Common Swifts			10	
G	Ardeidae	<i>Bubulcus ibis</i>	Cattle Egret	11	14	3	22
WS		<i>Ardeola ralloides</i>	Squacco Heron			1	1
G		<i>Ardea melanocephala</i>	Black-Headed Heron	2			
G	Bucerotidae	<i>Tockus nasutus</i>	African Grey Hornbill		4		8
FF		<i>Tockus camurus</i>	Red-Billed dwarf Hornbill		1		1
WS	Charadriidae	<i>Vanellus senegallus</i>	African Wattled Lapwing	5	2		3
G	Cisticolidae	<i>Camaroptera brachyura</i>	Grey-Backed Camaroptera	3	15	3	3
FF		<i>Hypergerus atriceps</i>	Oriole Warbler	2			
G		<i>Cisticola chubbi</i>	Rock-Loving Cisticola		1		1
G		<i>Cisticola cantans</i>	Singing Cisticola		3		1
G		<i>Prinia subflava</i>	Tawny-Flanked Prinia	12	2	2	3
G	Columbidae	<i>Streptopelia hypopyrrha</i>	Adamawa Turtle Dove		2		3
G		<i>Turtur chalcospilos</i>	Black-Billed Wood Dove	2		1	3
FF		<i>Treron waalia</i>	Bruce's Green Pigeon		1		

G		<i>Streptopelia senegalensis</i>	Laughing Dove	12	14	14	15
G		<i>Streptopelia semitorquata</i>	Red-Eyed Dove		3		1
G		<i>Columba guinea</i>	Speckled Pigeon	1	2		6
FF		<i>Turtur tympanistria</i>	Tambourine Dove		1		
FF		<i>Streptopelia vinacea</i>	Vinaceous Dove	1	20	3	2
G	Corvidae	<i>Corvus albus</i>	Pied Crow	2	15	3	51
FF	Cuculidae	<i>Chrysococcyx caprius</i>	Diedric Cuckoo		1		
FF		<i>Chrysococcyx klaas</i>	Klaas Cuckoo		2	2	2
G		<i>Centropus senegalensis</i>	Senegal Coucal	5			8
G	Dicruridae	<i>Ptilostomus afer</i>	Piacpiac	1			
G	Emberizidae	<i>Emberiza tahapisi</i>	Cinnamon-Breasted Rock Bunting		1		
G		<i>Emberiza goslingi</i>	Gosling Bunting			1	
G	Estrildidae	<i>Estrilda troglodytes</i>	Black-Rumped Waxbill				7
G		<i>Spermestes cucullata</i>	Bronze Mannikin	20	25	16	20
G		<i>Estrilda caerulescens</i>	Lavender Waxbill				1
G		<i>Estrilda melpoda</i>	Orange-Cheeked Waxbill	5			
G		<i>Lagonosticta senegala</i>	Red-Billed Firefinch	2	1	2	2
G		<i>Uraeginthus bengalus</i>	Red-Cheeked Cordon-Bleu	3	5		13
G	Falconidae	<i>Falco tinnunculus</i>	Common Kestrel	2	2	2	1
FF		<i>Falco ardosiaceus</i>	Grey Kestrel			2	
WS	Hirundinidae	<i>Hirundo aethiopica</i>	Ethiopian Swallow			1	2
WS	Jacaniae	<i>Actophilornis africanus</i>	African Jacana	7			
G	Laniidae	<i>Corvinella corvina</i>	Yellow-Billed Shrike	34	2	1	3
FF	Malaconotidae	<i>Malaconotus blanchoti</i>	Grey-Headed Bushshrike	1	1		2
G		<i>Laniarius barbarus</i>	Yellow-Crowned Gonolek	9	2	2	2
G	Motacilidae	<i>Macronyx croceus</i>	Yellow-Throated Longclaw		1		

G	Muscicapidae	<i>Myrmecocichla aethiops</i>	Anteater Chat	2			
FF		<i>Melanornis edoloides</i>	Northern Black Flycatcher	7	4	1	
FF		<i>Terpsiphone viridis</i>	Paradise Flycatcher			4	
FF		<i>Cossypha niveicapilla</i>	Snowy-Crowned Robin Chat		1		
FF	Musophagidae	<i>Turaco violaceus</i>	Violet Turaco				1
G		<i>Crinifer piscator</i>	Western Grey Plantain-Eater	2	6	14	21
G	Nectariniidae	<i>Cinnyris cupreus</i>	Copper Sunbird			1	5
G		<i>Cyanomitra verticalis</i>	Green-Headed Sunbird				1
G		<i>Chalcomitra rubescens</i>	Scarlet-Chested Sunbird	4		2	3
G		<i>Cinnyris venustus</i>	Variable Sunbird	11	3	3	6
G	Paaseridae	<i>Passer griseus</i>	Northern Grey-Headed Sparrow	2	3	8	7
WS	Phaethontidae	<i>Microcarbo africanus</i>	Long-Tailed Cormorant	26	3	1	8
G	Phasianidae	<i>Pternistis bicalcaratus</i>	Double-Spurred Francolin	7	1	2	1
FF	Picidae	<i>Dendropicops fuscescens</i>	Cardinal Woodpecker	1			
G	Platysteiridae	<i>Platysteira cyanea</i>	Common Wattle-Eye		2		1
G	Ploceidae	<i>Ploceus luteolus</i>	Little Weaver	3			1
G		<i>Euplectes franciscanus</i>	Northern Red Bishop	5			2
G		<i>Ploceus cucullatus</i>	Village Weaver	26	43	47	15
G	Psittacidae	<i>Poicephalus meyeri</i>	Senegal Parrot	3	6	1	2
FF	Psittaculidae	<i>Psittacula krameri</i>	Rose-Ringed Parakeet	7			
G	Pycnonotidae	<i>Pycnonotus barbatus</i>	Common Bulbul	14	15	23	10
FF		<i>Arizelocichla chlorigula</i>	Yellow-Throated Greenbul	2			
FF		<i>Atimastillas flavicollis</i>	Yellow-Throated Leaflove		5		2
FF	Ramphastidae	<i>Pogonornis dubius</i>	Bearded Barbet			2	

FF		<i>Pogoniulus chrysoconus</i>	Yellow-Fronted Tinkerbird	7	2	2	7
WS	Scopidae	<i>Scopus umbretta</i>	Hamerkop	1		3	1
FF	Sturnidae	<i>Hylopsar purpureiceps</i>	Purple-headed Glossy Starling	1		2	1
GR	Sylviidae	<i>Melocichla mentalis</i>	Moustached Grass Warbler			1	
FF	Timiliidae	<i>Turdoides plebejus</i>	Brown Babbler	3		6	
G	Turidae	<i>Turdus pelios</i>	African Thrush	7	7	9	12
G	Zosteropidae	<i>Zosterops senegalensis</i>	Yellow White-Eye		5		
				319	300	305	327

G= Generalist, FF=Forest specialist, WS=Water Specialist.

Table 3: A checklist of birds recorded in the four selected parks during the study .

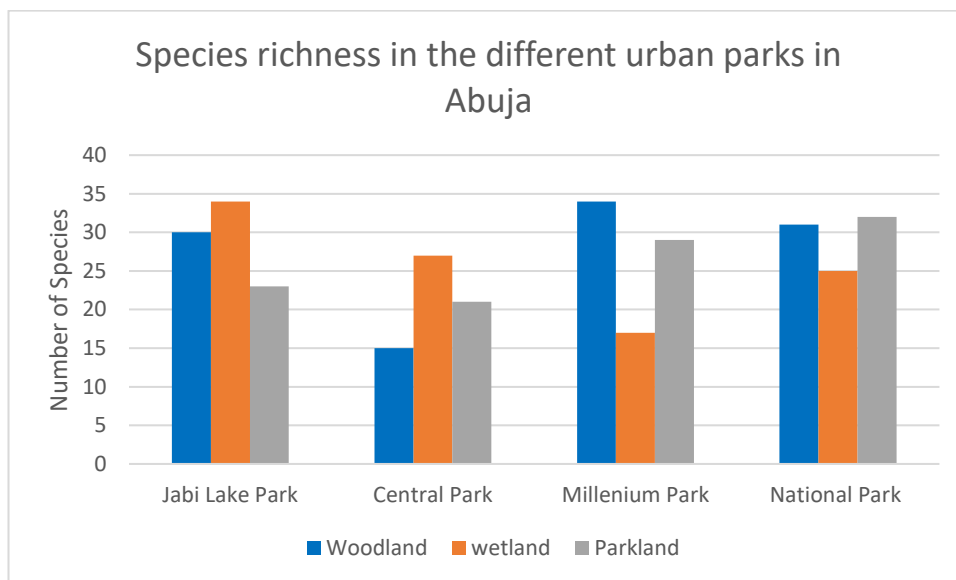


Fig 3: Graph showing the species richness across the habitat in the four survey locations.

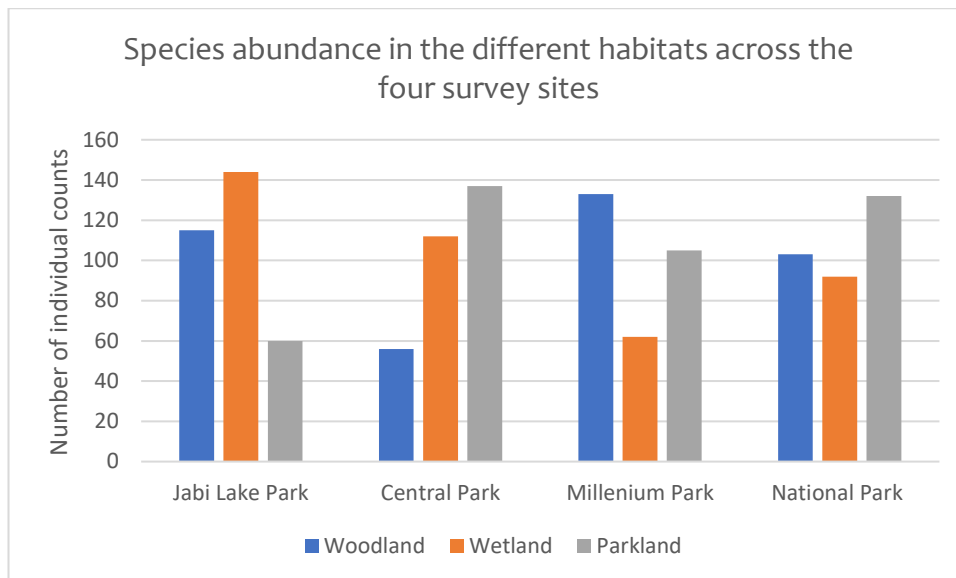


Fig 4: Graph showing the species abundance across the habitat in the four survey locations.

The Kruskal Wallis test conducted to analyse the difference in bird abundance in each of the habitats across the sites showed no significant difference in the median between the medians (Woodland $H=0.96$, $DF=3$, $P>0.05$, Wetland $H=1.48$, $DF=3$, $P>0.05$, Parkland $H=5.73$, $DF=3$, $P>0.05$). (Appendix 4) The vegetation structure surveyed is the tree density. Correlation analysis was conducted to test the hypothesis that tree density has an effect on bird abundance, and this also showed no correlation with the species abundance, However, it was noted that some species were more abundant in certain tree species such as the village weaver which were mostly in groups were seen commonly in the flamboyant tree (*Delonix regia*), Crested wattle tree (*Paraserianthes lophantha*) species.

Species were further classified into generalists, forest specialists (forest-dependent and forest visitors) and wetland specialists in accordance with the field guidebook to identify the differences in the species abundance in the four survey locations and it was observed that the generalists were most common with a percentage of 66.7% while 25.9% were forest specialists and 7.4% were water specialists as shown in Fig 5. Jabi Lake Park had the highest number of water specialist bird species while Millenium Park recorded the highest number of forest specialist birds (Fig 6). 23 species were ubiquitous; and observed in all the parks surveyed, while 10, 8, 8 and 5 species were recorded exclusively in Jabi Lake Park, Millenium Park, Central Park and National Children Park respectively.

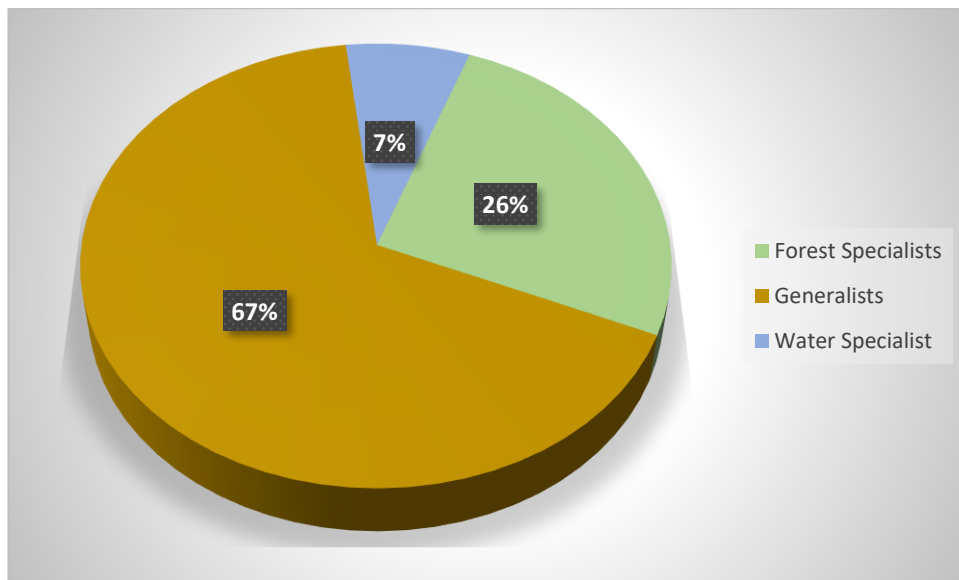


Fig 5: Graph showing bird species classification and the total percentage abundance in all the survey locations.

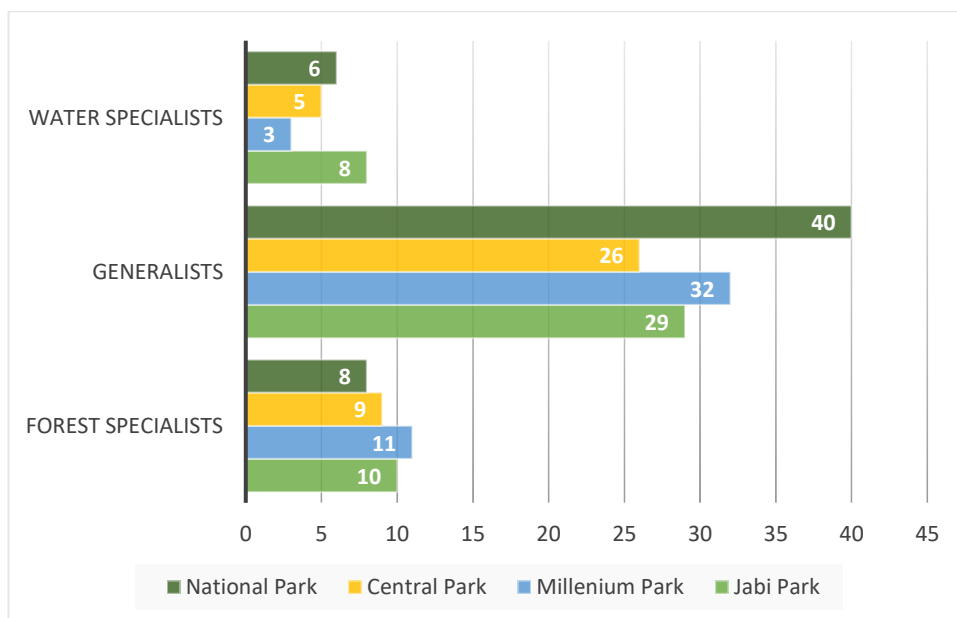


Fig 6: Graph showing the species classification and their richness in individual survey locations.

4. Discussion

The study revealed that the four urban parks support the diversity of bird species and the data shows birdlife presence irrespective of the habitat features in each of the parks. The average number of species identified in each of the parks was within the range of 40- 54 species which is less than the report from Kwaga B.T et al (2019) who identified 166 species from similar studies in Niger State. Okesodo et al. 2016 also reported 149 identified species from studies conducted in Oyo National Park, while Shiiuwa M et al. 2010 recorded an average of 130 species from each of the sites where similar studies were conducted. This study has revealed that even though bird activities were evident in these parks, they do not support bird species abundance as recorded in some parks of other states in Nigeria. This information is essential for the planning and management action towards improvement of conservation and ecosystem balance. Central Park which recorded the lowest number of species and bird count while National Children Park recorded the highest number of species could be attributed to the availability of green spaces according to the rating on land use, National Park has the most undisturbed green space. While green space availability can be a factor in the abundance and diversity of species, human interference and other activities within the sites could affect the diversity. As seen in Jabi Lake Park, the lake is the largest wetland area of the four parks but the species diversity especially the water specialists is not in congruence with Sabo B.B (2016) report on species in Hadejia-Nguru wetland and this could suggest that the boat hiking and other activities being done on the lake has an adverse influence on the bird diversity and abundance.

Furthermore, the dominance of generalist species over the forest and water specialist species could explain the reason for the non-significant difference in the effect of habitat structure on their diversity and abundance. This finding also suggests that generalist species are less likely to be influenced by specific habitat structures and this is in support of Emilia et al. 2015 findings that generalists are not really impacted by landscape or habitat characteristics.

Contrary to the expectation, the analysis showed no correlation between the tree density and bird abundance in all the parks unlike the report by Lameed G. A. (2011) in his study on Species diversity and abundance of wild birds in Dagona-Waterfowl Sanctuary Borno State, Nigeria but it suggested a relationship between the bird species and certain tree species as seen in Central Park which had very minimal green spaces as compared to the other parks but the non-native tree species (*Terminalia mantaly*, Persian Silk tree (*Albizia julibrissin*) which were more abundant provided habitat for bird species like the village weaver, little swifts, common swifts as these were the most abundant in the park. This insignificant difference in species diversity and abundance in all the parks has further proven

that heterogeneity in the plant/tree species also contributes to the variation in the availability of food, habitat, and other requirements for different groups of birds and this has been supported by various authors. Okesodo et al 2016 reported that different variables affect bird diversity and abundance which also include food availability and species tolerance to environmental changes which is also supported by Cody (1985) who also reported that the distribution of bird species is influenced by the occurrence of plant species that support their population. This also can be linked to Mikinney's, 2006 claim that urbanisation promotes biodiversity by the addition of non-native species to native species.

5. Conclusion

This survey has revealed the bird species diversity and abundance in the four selected urban parks in Abuja. The assessment provides quantitative evidence and further emphasizes the importance of urban parks in avian conservation and green space management. It can be concluded from the findings from this survey that the bird species diversity and abundance were strongly influenced by the avian behavioural pattern to green space available, plant/tree species and their habitat requirement. This was seen in the variations observed among the parks. Although few species were identified from the survey when compared with reports from other parks by other scientists, the abundance and diversity of bird species in the various parks still support the claim by Ihuma *et al* 2011 that urbanisation does not completely destroy habitat, however, critical actions need to be taken to promote conservation and biodiversity.

The connection of bird species to certain non-native plants as seen mostly in Central Park supports the claim that urbanisation promotes biodiversity by the addition of non-native species to native species (Mikinney, 2006) which provides habitat for breeding, feeding and brooding. The influence of the variation in plant/tree species on the availability of food, shelter and other requirements for different bird species has also revealed the importance of considering and preserving specific plant/tree species in urban conservation management to support bird biodiversity.

The lower abundance of water specialists and forest specialist species as compared to the generalists has shown that urbanization and human interference tend to negatively affect forest and water specialist birds as seen in the parks therefore, specific conservation strategies need to be put in place to promote the survival and population of these birds that are more vulnerable in urban areas.

As the dataset has provided a baseline information on species abundance in the four parks, it also serves as a reference point for future monitoring to detect trends, and identify potential conservation needs. It is pertinent to note that there may be some limitations in this study, this includes the limited time frame for field data collection which may not have considered the impact of seasonal variation on bird abundance and inadequate knowledge of plant taxonomy. Birds may exhibit various behaviours to adjust to seasonal variations, a limited study within a specific season might not adequately capture some important bird species such as migratory species that might be seen in certain seasons. Additionally, incomplete knowledge of the plant species minimises the ability to fully understand the relationship between bird species and their habitat. Birds species require certain plant species for food

and nesting sites, without the comprehensive knowledge of these plant/tree species in these urban parks, it will be impossible to identify the availability of food sources and nesting sites for different species which invariably affects the conservation and habitat restoration strategies. Therefore, while it is necessary for regular longer-term bird surveys in these urban parks spanning through multiple seasons, it should also include plant surveys with the collaboration of botanists who specialise in plant taxonomy and ecology. This will further enhance the reliability of data and improve the conservation strategies for the sustainability of avian abundance in these parks.

REFERENCES

Abuja Geographic Information Systems (2013). Land administration: Fresh land application procedure. http://www.agis.fct.gov.ng/land_admin.html Retrieved December 05, 2014

[Abuja Federal Capital Territory, Nigeria - eBird](#)

Alex Olatunji 2016. Student Report on FRM 402 Ecological Survey

Bibby C, Burgess N, Hill D, Mustoe S (2000). *Bird Census Techniques* (2nd Edition ed.). London, UK: Academic Press. 1–302

Chang Hsiang-Yi & Ya-Fu Lee (2015) Effects of area size, heterogeneity, isolation, and disturbances on urban park avifauna in a highly populated tropical city. *Urban Ecosyst* (2016) 19:257–274. DOI 10.1007/s11252-015-0481-5

Cody M. L (1985). An introduction to habitat selection in birds. In *Habitat selection in birds* (Cody ed.) Academic Press Inc., London pp 191-248

David W. Gibbons and Richard D. Gregory (2006). Birds. In *Ecological Census Techniques: A Handbook*. William J. Sutherland, ed. Published by Cambridge University Press. pp 308-350. ProQuest Ebook Central. <http://ebookcentral.proquest.com/lib/oxford/detail.action?docID=268225>.

[Different types of birds in Nigeria - Legit.ng](#) Adriana Simwa 2022

Emilia Carrara, Víctor Arroyo-Rodríguez, Jorge H. Vega-Rivera, Jorge E. Schondube, Sandra M. de Freitas, Lenore Fahrig (2015) Impact of landscape composition and configuration on forest specialist and generalist bird species in the fragmented Lacandona rainforest, Mexico. *Biological Conservation* 184 (2015) 117–126

Esteban Fernandes-Juricic (2000) Bird community composition patterns in urban parks of Madrid: The role of age, size and isolation. *Ecological Research* (2000) 15, 373-383.

Daqing Zhou • L. M. Chu (2012) How would size, age, human disturbance, and vegetation structure affect bird communities of urban parks in different seasons? *J Ornithol.* (2012) 153:1101–1112. DOI 10.1007/s10336-012-0839-x

Evans, K.L., Newson, S.E. And Gaston, K.J. (2009), Habitat influences on urban avian assemblages. *Ibis*, 151: 19-39. <https://doi.org/10.1111/j.1474-919X.2008.00898.x>

Ihuma, J.O; Tella, I; Madakan, S. P and Akpan, M,(2016) Frugivorous bird species diversity in relation to the diversity of Fruit tree species in reserved and designated green areas in the Federal capital territory, Nigeria. *Journal Of Research In Forestry, Wildlife And Environment* Volume 8, No 1 March 2016

Kwaga, B.T., Suleiman, J.M., Ringin, M.I.G. & Khobe, D (2019). Evaluation of Birds Species Abundance and Diversity in Borgu Sector of Kainji Lake National Park, Nigeria. *Global Journal of Science Frontier Research: H Environment & Earth Science*. Volume 19 Issue 3 Version 1.0 Year 2019.

LABIRAN Juliana and IWAJOMO Soladoye (2018). Factors Influencing Bird Species Richness and Abundance in Surulere Local Government Area of Lagos State, Nigeria. *Proceedings of 6th NSCB Biodiversity Conference; Uniuyo 2018* (183 - 188 pp)

Lee, D. C. and Marsden, S. J. (2008) Increasing the value of bird-habitat studies in tropical forests: choice of approach and habitat measures. *Bird Conserv. Internatn.* 18 (Suppl. 1): 109–124.

Lameed, G. A. (2011) Species diversity and abundance of wild birds in Dagona-Waterfowl Sanctuary Borno State, Nigeria. *African Journal of Environmental Science and Technology* Vol. 5(10), pp. 855-866, Available online at <http://www.academicjournals.org/AJEST>

Leveau L. M., Bocelli ML, Quesada-Acuña SG, González-Lagos C, Gutiérrez Tapia P, Franzoi Dri G, Delgado-V. CA, Garitano-Zavala Á, Campos J, Benedetti Y, Ortega-Álvarez R, Contreras Rodríguez AI, Souza López D, Fontana, CS, da Silva TW, Zalewski Vargas SS, Barbosa Toledo MC, Sarquis JA, Giraudo A, Echevarria AL, Fanjul M. E., Martínez MV, Haedo J, Cano Sanz LG, Peña Y, Fernandez V, Marinero V, Abilhoa V, Amorin R, Escobar Ibáñez JF, Juri MD, Camín S, Marone L, Piratelli AJ, Franchin AG, Crispim L, Morelli F. 2022. Bird diversity-environment relationships in urban parks and cemeteries of the Neotropics during breeding and non-breeding seasons. *PeerJ* 10:e14496 DOI 10.7717/peerj.14496

Manjula Menon, Prashanthi Devi M & Mohanraj Rangaswamy (2016) Avifaunal Richness and Abundance Along an Urban Rural Gradient with Emphasis on Vegetative and Anthropogenic Attributes in Tiruchirappalli, India, *Landscape Research*, 41:1, 131-148, DOI: 10.1080/01426397.2014.910294

Matthew Trager · Shahroukh Mistry (2003), Avian community composition of kopjes in a heterogeneous landscape. *Oecologia* (2003) 135:458–468. DOI 10.1007/s00442-003-1204-9

Mikinney, M.L (2006) *Urbanization as a major cause of biotic homogenisation*. *Biological Conservation*. 127:247-260

Nwankwo, M., Meng, Q., Yang, D., Liu, F. Effects of Forest on Birdsong and Human Acoustic Perception in Urban Parks: A Case Study in Nigeria. *Forests* 2022, 13, 994. <https://doi.org/10.3390/f13070994>

Nik Borrow, Ron Demey (2021). *Birds of Western Africa* (2nd Edition) HELM Bloomsbury Publishing Plc, UK.

Okesodo E.F. 2016. Diversity and Abundance of Avian Species in Old Oyo National Park Southwest Nigeria. *Merit Research Journal of Agricultural Science and Soil Sciences* (ISSN: 2350-2274) Vol. 4(11) pp. 147-157, December 2016.

Richard D. Gregory, David W. Gibbons, Paul F. Donald (2004). 'Bird census and survey techniques' in William J. Sutherland; Ian Newton; Rhys Green (2004). *Bird ecology and conservation: A handbook of techniques*. <https://doi.org/10.1093/acprof:oso/9780198520863.003.0002>. Pages 17–56.

Robert E Simmons, Phoebe Barnard, WRJ Dean, Guy F Midgley, Wilfried Thuiller & Greg Hughes (2004) Climate change and birds: perspectives and prospects from southern Africa, *Ostrich - Journal of African Ornithology*, 75:4, 295-308, DOI: 10.2989/00306520409485458

Stephen T. Buckland, Stuart J. Marsden And Rhys E. Green 2008. Estimating bird abundance: making methods work. *Bird Conservation International* (2008) 18:S91–S108. <https://doi.org/10.1017/S0959270908000294> Published online by Cambridge University Press.

Shiiwua Manu, Inaoyom Sunday Imong And Will Cresswel (2010). Bird species richness and diversity at montane Important Bird Area (IBA) sites in south-eastern Nigeria. *Bird Conservation International* (2010) 20:231–239. ^a BirdLife International, 2010 doi:10.1017/S0959270909990311.

The Master Plan for Abuja, the New Federal Capital of Nigeria (1979), Nigeria. Federal Capital Development Authority.

W. Kang 2015. Effects of habitat structure, human disturbance, and habitat connectivity on urban forest bird communities. *Urban Ecosyst.* DOI 10.1007/s11252-014-0433-5

Xu, Weizhen, Jiao Yu, Peilin Huang, Dulai Zheng, Yuxin Lin, Ziluo Huang, Yujie Zhao, Jiaying Dong, Zhipeng Zhu, and Weicong Fu. 2022. "Relationship between Vegetation Habitats and Bird Communities in Urban Mountain Parks" *Animals* 12, no. 18: 2470. <https://doi.org/10.3390/ani12182470>.

Xueru Yang, Xinwei Tan, Chuanwu Chen and Yanping Wang (2020). The influence of urban park characteristics on bird diversity in Nanjing, China. *Avian Research* <https://doi.org/10.1186/s40657-020-00234-5>

Appendix

1. Datasheet summary for bird survey in the four conservation Parks

Jabi Lake Park bird survey

JP 1 (Wetland) (7.418164,9.077235)		JP 2 WETLAND (7.419960,9.076215)		JP 3 Parkland (7.417980,9.075508)		JP 4 Woodland (7.419670,9.078347)		JP 5 Woodlan (7.416345,9.071979)	
Species	COUNT	Species	COUNT	Species	COUNT	Species	COUNT	Species	COUNT
African Jacana	6	African Wattled Lapwing	2	African Thrush	2	African Jacana	1	African Palm Swift	20
African Palm Swift	2	Black-Billed Wood Dove	1	African Wattled Lapwing	1	African Wattled Lapwing	2	African Thrush	4
African Thrush	1	Black-Headed Heron	2	Anteater Chat	2	Bronze Mannikin	9	Cattle Egret	1
Black-Billed Wood Dove	1	Cattle Egret	6	Bronze Mannikin	1	Brown Babbler	1	Common Kestrel	1
Bronze Mannikin	10	Common Bulbul	1	Brown Babbler	2	Cattle Egret	3	Grey-Backed Camaroptera	2
Cardinal Woodpecker	1	Grey-Backed Camaroptera	1	Common Bulbul	1	Common Bulbul	2	Hamerkop	1
Cattle Egret	1	Laughing Dove	1	Common Kestrel	1	Laughing Dove	3	Laughing Dove	2
Common Bulbul	10	Little Weaver	3	Double-Spurred Francolin	5	Long-Tailed Cormorant	3	Oriole Warbler	1
Double-Spurred Francolin	2	Long-Tailed Cormorant	22	Grey-Headed Bushshrike	1	Marsh Harrier	1	Piacpiac	1
Laughing Dove	4	Orange-Cheeked Waxbill	5	Laughing Dove	2	Northern Red Bishop	5	Scarlet-Chested Sunbird	2
Long-Tailed Cormorant	1	Oriole Warbler	1	Northern Black Flycatcher	4	Pied Crow	1	Senegal Coucal	1
Northern Black Flycatcher	3	Scarlet-Chested Sunbird	1	Northern Grey-Headed Sparrow	1	Red-Billed Firefinch	2	Tawny-Flanked Prinia	1
Northern Grey-Headed Sparrow	1	Senegal Coucal	2	Purple Glossy Starling	1	Speckled Pigeon	1	Variable Sunbird	1
Pied Crow	1	Tawny-Flanked Prinia	10	Red-Cheeked Cordon-Bleu	2	Western Grey Plantain-Eater	2	Village Weaver	25
Red-Cheeked Cordon-Bleu	1	Variable Sunbird	10	Rose-ringed Parakeet	2	Yellow-Billed Kite	1	Yellow-Billed Kite	2
Rose-Ringed Parakeet	5	Vinaceous Dove	1	Scarlet-Chested Sunbird	1	Yellow-Billed Shrike	4	Yellow-Billed Shrike	6
Senegal Coucal	2	Yellow-Billed Kite	1	Senegal Parrot	1	Yellow-Fronted Tinkerbird	1	Yellow-Fronted Tinkerbird	1
Senegal Parrot	2	Yellow-Billed Shrike	3	Sun Lark	3			Yellow-Throated Greenbul	1
Sun Lark	2	Yellow-Crowned Gonolek	2	Tawny-Flanked Prinia	1				
Yellow-Billed Kite	2	Yellow-Fronted Tinkerbird	5	Village Weaver	1				
Yellow-Billed Shrike	5	Yellow-Throated Greenbul	1	Yellow-Billed Kite	2				
				Yellow-Billed Shrike	16				
				Yellow-Crowned Gonolek	7				
21 species	63	21 Species	81	23 species	60	17 species	42	18 species	73

Datasheet for Central Park bird survey

CP1 Parkland (7.4916362,9.0637885)		CP2 WETLAND (7.4905247,9.0643515)		CP3 WETLAND (7.4904818,9.0639167)		CP4 woodland (7.4905367,9.0635361)		CP5 Parkland (7.4905348,9.0635115)	
Species	COUNT	Species	COUNT	Species	COUNT	Species	COUNT	Species	COUNT
African Palm Swift	10	African Thrush	4	African Palm Swift	5	African Palm Swift	6	African Palm Swift	9
Bronze Mannikin	2	Bearded Barbet	2	African Thrush	4	African Thrush	1	Bronze Mannikin	7
Common Bulbul	3	Black-Billed Wood Dove	1	Bronze Mannikin	6	Bronze Mannikin	1	Brown Babbler	2
Common Kestrel	1	Brown Babbler	4	Common Bulbul	11	Common Bulbul	2	Common Bulbul	5
Grey Kestrel	1	Cattle Egret	3	Double-Spurred Francolin	1	Copper Sunbird	1	Common Kestrel	1
Grey-Backed Camaroptera	2	Common Bulbul	2	Laughing Dove	3	Double-Spurred Francolin	1	Grey Kestrel	1
Laughing Dove	4	Ethiopian Swallow	1	Little Swift	5	Hamerkop	3	Klaas Cuckoo	1
Little Swift	40	Gosling Bunting	1	Paradise Flycatcher	4	Klaas Cuckoo	1	Purple Glossy Starling	2
Moustached Grass Warbler	1	Grey-Backed Camaroptera	1	Squacco Heron	1	Little Swift	20	Senegal Parrot	1
Northern Black Flycatcher	1	Laughing Dove	7	Tawny-Flanked Prinia	1	Scarlet-Chested Sunbird	2	Village Weaver	4
Northern Grey-Headed Sparrow	3	Little Swift	5	Variable Sunbird	1	Variable Sunbird	2	Western Grey Plantain-Eater	4
Pied Crow	2	Long-Tailed Cormorant	1	Village Weaver	4	Village Weaver	10	Yellow-Billed Kite	3
Village Swifts	10	Northern Grey-Headed Sparrow	5	Yellow-Billed Shrike	1	Vinaceous Dove	2	Yellow-Crowned Gonolek	1
Village Weaver	10	Pied Crow	1			Western Grey Plantain-Eater	3		
Western Grey Plantain-Eater	4	Red-Billed Firefinch	2			Yellow-Fronted Tinkerbird	1		
Yellow-Billed Kite	1	Tawny-Flanked Prinia	1						
Yellow-Crowned Gonolek	1	Vinaceous Dove	1						
		Village Weaver	19						
		Yellow-Fronted Tinkerbird	1						
		Western Grey Plantain-Eater	3						
17 SPECIES	96	20 SPECIES	65	13 SPECIES	47	15 SPECIES	56	13 SPECIES	41
Central Park		species	counts	No of trees					
Parkland	CP 1	17	96	7					
wetland	CP 2	20	65	10					
wetland	CP 3	13	47	5					
woodland	CP 4	15	56	12					
Parkland	CP 5	13	41	7					

Datasheet Summary for Millenium Park bird survey

MP1 Woodland (7.4992668,9.0716396)		MP2 wetland (7.4973382,9.0704885)		MP3 Woodland (7.4979794,9.0713544)		MP4 Parkland (7.4963139,9.0704153)		MP5 Parkland (7.498020,9.0707081)		MP6 Parkland (7.4988983,9.0699306)	
Species	COUNT	Species	COUNT	Species	COUNT	Species	COUNT	Species	COUNT	Species	COUNT
Adamawa Turtle Dove	2	African Grey Hornbill	4	African Thrush	1	African Thrush	2	Bronze Mannikin	3	African Palm Swift	5
African Thrush	1	African Thrush	1	Bronze Mannikin	20	Wattled Lapwing	2	Common Bulbul	1	African Thrush	2
Cattle Egret	1	Bronze Mannikin	2	Cinnamon-Breasted Rock Bunting	1	Bruce's Green Pigeon	1	Grey-Backed Camaroptera	3	Cattle Egret	2
Common Bulbul	3	Common Bulbul	4	Common Bulbul	4	Cattle Egret	11	Laughing Dove	4	Common Bulbul	3
Common Kestrel	1	Common Wattle-Eye	1	Common Kestrel	1	Double-Spurred	1	Pied Crow	1	Crested Lark	1
Crested Lark	1	Grey-Backed Camaroptera	3	Common Wattle-Eye	1	Grey-Backed Camaroptera	1	Red-Cheeked Cordon-Bleu	1	Grey-Backed Camaroptera	3
Grey-Backed Camaroptera	3	Klaas Cuckoo	1	Crested Lark	2	Laughing Dove	1	Senegal Parrot	1	Grey-Headed Bushshrike	1
Laughing Dove	6	Long-Tailed Cormorant	1	Diedric Cuckoo	1	Long-tailed Cormorant	1	Tawny-Flanked Prinia	1	Long-tailed Cormorant	1
Pied Crow	3	Northern Black Flycatcher	2	Grey-Backed Camaroptera	2	Pied Crow	5	Variable Sunbird	1	Northern Grey-Headed Sparrow	1
Red-Billed Hornbill	1	Northern Grey-Headed Sparrow	2	Klaas Cuckoo	1	Senegal Parrot	2	Yellow-Billed Kite	9	Pied Crow	3
Village Weaver	2	Pied Crow	3	Laughing Dove	3	Speckled Pigeon	2	Yellow-Billed Shrike	1	Red-Cheeked Cordon-Bleu	2
Vinaceous Dove	3	Red-Eyed Dove	2	Northern Black Flycatcher	2	Variable Sunbird	1			Singing Cisticola	1
Western Grey Plantain-Eater	1	Senegal Parrot	2	Pygmy Kingfisher	1	Vinaceous Dove	1			Village Weaver	1
Yellow-Billed Kite	16	Singing Cisticola	1	Red-Billed Firefinch	1	Yellow-Billed Kite	12			Western Grey Plantain-Eater	1
Yellow-Billed Shrike	1	Village Weaver	30	Red-Cheeked Cordon-Bleu	2	Yellow-Fronted Tinkerbird	1			Yellow White-Eye	5
Yellow-Crowned Gonolek	2	Western Grey Plantain-Eater	2	Red-Eyed Dove	1					Yellow-Throated Leaflove	3
Yellow-Throated Longclaw	1	Yellow-Fronted Tinkerbird	1	Rock-Loving Cisticola	1						
				Senegal Parrot	1						
				Singing Cisticola	1						
				Snowy-Crowned Robin Chat	1						
				Tambourine Dove	1						
				Tawny-Flanked Prinia	1						
				Variable Sunbird	1						
				Village Weaver	10						
				Vinaceous Dove	16						
				Western Grey Plantain-Eater	2						
				Yellow-Billed Kite	4						
				Yellow-Throated Leaflove	2						
17 SPECIES	48	17 SPECIES	62	28 species	85	15 species	44	11 Species	26	16 species	35
		Millenium Park	Species	Counts	Jo of Trees						
		MP 1	17	48	20						
		MP 2	17	62	15						
		MP 3	28	85	30						
		MP 4	15	44	8						
		MP 5	11	26	10						
		MP 6	16	35	10						

Datasheet summary for National Park bird survey

NP1 Parkland (7.5245498,9.0801939)		NP2 Parkland (7.5252784,9.0797694)		NP3 wetland (7.5266493,9.0795471)		NP4 wetland (7.5273841,9.0800673)		NP5 woodland (7.5256427,9.0809025)		NP6 woodland (7.5250283,9.0823119)	
Species	COUNT	Species	COUNT	Species	COUNT	Species	COUNT	Species	COUNT	Species	COUNT
Adamawa Turtle Dove	3	African Grey Hornbill	3	African Palm Swift	5	African Grey Hornbill	1	African Thrush	4	African Grey Hornbill	1
African Grey Hornbill	3	African Thrush	5	African Thrush	1	African Thrush	1	African Wattled Lapwing	2	Blue-Breasted Kingfisher	1
African Palm Swift	2	Black-Billed Wood Dove	3	Black-Rumped Waxbill	2	Common Bulbul	5	Bronze Mannikin	5	Bronze Mannikin	10
African Thrush	1	Bronze Mannikin	5	Cattle Egret	5	Crested Lark	1	Grey-Backed Camaroptera	2	Cattle Egret	11
African Wattled Lapwing	1	Cattle Egret	2	Common Kestrel	1	Klaas Cuckoo	1	Northern Red Bishop	2	Common Bulbul	1
Black-Rumped Waxbill	5	Common Bulbul	4	Ethiopian Swallow	1	Long-tailed Cormorant	1	Pied Crow	5	Copper Sunbird	5
Cattle Egret	4	Double-Spurred Francolin	1	Giant Kingfisher	1	Northern Grey-Headed Sparrow	1	Red-Cheeked Cordon-Bleu	4	Laughing Dove	4
Common Wattle-Eye	1	Green-Headed Sunbird	1	Grey-Backed Camaroptera	1	Pied Crow	20	Red-Eyed Dove	1	Lavender Waxbill	1
Ethiopian Swallow	1	Laughing Dove	2	Klaas Cuckoo	1	Rock-Loving Cisticola	1	Scarlet-Chested Sunbird	2	Little Weaver	1
Grey-Headed Bushshrike	2	Northern Grey-Headed Sparrow	2	Laughing Dove	4	Variable Sunbird	3	Senegal Coucal	6	Northern Grey-Headed Sparrow	1
Hamerkop	1	Pied Crow	5	Long-Tailed Cormorant	7	Western Grey Plantain-Eater	3	Sun Lark	1	Pied Crow	1
Laughing Dove	5	Purple Glossy Starling	1	Northern Grey-Headed Sparrow	1	Yellow-Billed Kite	3	Tawny-Flanked Prinia	2	Singing Cisticola	1
Northern Grey-Headed Sparrow	2	Red-Billed Firefinch	1	Red-Billed Firefinch	1	Yellow-Billed Shrike	1	Variable Sunbird	2	Speckled Pigeon	2
Pied Crow	20	Red-Cheeked Cordon-Bleu	4	Red-Billed Hornbill	1	Yellow-Throated Leaflove	2	Western Grey Plantain-Eater	5	Tawny-Flanked Prinia	1
Red-Cheeked Cordon-Bleu	5	Senegal Parrot	2	Squacco Heron	1			Yellow-Billed Kite	2	Variable Sunbird	1
Scarlet-Chested Sunbird	1	Speckled Pigeon	2	Western Grey Plantain-Eater	5			Yellow-Fronted Tinkerbird	2	Village Weaver	6
Senegal Coucal	2	Village Weaver	7	Yellow-Billed Kite	8					Vinaceous Dove	1
Speckled Pigeon	2	Western Grey Plantain-Eater	5	Yellow-Fronted Tinkerbird	2					Yellow-Billed Kite	1
Village Weaver	2	Yellow-Billed Kite	6							Yellow-Billed Shrike	2
Vinaceous Dove	1	Yellow-Crowned Gonolek	1							Yellow-Crowned Gonolek	1
Violet Turaco	1									Yellow-Fronted Tinkerbird	3
Western Grey Plantain-Eater	3										
Yellow-Billed Kite	2										
23 species	70	20 species	62	18 species	48	14 species	44	16 species	47	21 species	56
		National Park		species	Count	No. of trees					
		Parkland	NP 1	23	70	25					
		Parkland	NP 2	20	62	20					
		wetland	NP 3	18	48	4					
		wetland	NP 4	14	44	8					
		woodland	NP 5	16	47	15					
		woodland	NP 6	21	56	12					

2. Map showing the four (4) study locations with the sampling points





3. Pictures of some bird species observed in the study locations



Pied Crow in Central Park

Millenium Park

4. Kruksal Wallis test for bird abundance in each of the habitats across the four parks using QED Statistics software.

QED Statistics 1.5.4.502 - WOODLANDS

File Edit Simulation Single Sample Analysis of Frequency Two Samples Regression **ANOVAs** GLM Planning Help

Working Data

Document was last saved: Just now

1	6	2	1
20	1	2	4
4	1	20	2
2	2	1	1
9	1	1	15
1	1	7	11
4	3	2	1
2	1	1	5
1	20	3	2
2	2	1	4
1	2	5	1
5	10	1	1
3	2	9	1
1	3	2	2
5	1	3	6
1		1	4

Type of Adjustment

- ☒ Transform
- ☐ Relative
- ☐ Handling zeros
- ☐ Transpose

Reload Raw Data

- Log 10
- Log 10 (x+1)
- Log e
- Log e (x+1)
- Square Root

Selected Variable

-All-

This will cause the working data to revert to the untransformed raw data.

Reload Raw Data Submit

Raw Data Working Data

QED Statistics 1.5.4.502 - WOODLANDS

File Edit Simulation Single Sample Analysis of Frequency Two Samples Regression ANOVAs GLM Planning Help

Explore the Statistic: Kruskal-Wallis

Document was last saved: Just now

H	0.957778
DF	3
Prob.	0.811467
This means	There is no significant difference in medians between the treatments (H = 0.957778, DF = 3, P = >0.05)

QED Statistics 1.5.4.502 - WETLANDS

File

Edit

Simulation

Single Sample

Analysis of Frequency

Two Samples

Regression

ANOVAs

GLM

Planning

Help

Explore the Statistic: Kruskal-Wallis

H	1.48078
DF	3
Prob.	0.686714
This means	There is no significant difference in medians between the treatments (H = 1.48078, DF = 3, P = >0.05)

Raw Data

Working Data

Results

Expand

Explore

QED Statistics 1.5.4.502 - PARKLANDS	
File Edit Simulation Single Sample Analysis of Frequency Two Samples Regression ANOVAs GLM Planning Help	
Explore the Statistic: Kruskal-Wallis	
H	5.7351
DF	3
Prob.	0.125234
This means	There is no significant difference in medians between the treatments (H = 5.7351, DF = 3, P = >0.05)

Raw Data	Working Data	Results	Expand	Explore
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5. Correlation analysis