Exploring bird biodiversity: a survey of avian richness in the dams of oke-ogun, Nigeria

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ABSTRACT

Wetland degradation, both natural and anthropogenic, impacts biodiversity and ecosystem services. Artificial wetlands, such as dams, may help mitigate the loss of natural wetlands, but their conservation potential is understudied. This research explores avian diversity, anthropogenic impacts, and community perceptions of bird species across three dams -Igboho, Okeho, and Kishi located in Oke-Ogun, Oyo State, Nigeria. Using the point count method, data were collected over six months (January to June). A total of 679 individual birds from 173 species were identified, distributed across 84 families and 37 orders. Igboho Dam hosted the most species (75), while Okeho Dam had the fewest (32). Bird diversity was analyzed with one-way ANOVA and PAST software, revealing significant differences in species richness and diversity across the dams. The study emphasizes the potential role of artificial wetlands in avian conservation and highlights the influence of human activities, such as farming and fishing, on bird populations. Recommendations for enhancing avian biodiversity and dam management are proposed.

Keywords: wetland degradation, avian diversity, artificial wetlands, anthropogenic impacts, conservation

INTRODUCTION

Birds are vital components of ecosystems, contributing significantly to ecological balance and offering various ecosystem services (Santangeli et al. 2024, Sekercioglu et al. 2016). They help regulate pest populations, disperse seeds, pollinate plants, and maintain overall environmental health (Mariyappan et al. 2023). Birds also serve as important bioindicators, reflecting the quality of the environments they inhabit (Fraixedas et al. 2020, Maznikova et al. 2024). With

their adaptability to different habitats ranging from dense forests to open farmlands, urban landscapes, and wetlands birds provide invaluable insights into the state of biodiversity and ecosystem stability (Birdlife International, 2020). Variations in avian richness and diversity across these habitats often indicate changes in habitat quality, making them key subjects of ecological research (Sulemana et al. 2022, Tu et al. 2020).

In Nigeria, extensive studies have been conducted on the effects of habitat fragmentation and agricultural practices on bird populations, particularly in forests and farmlands (T. Ma et al. 2022, Reino et al. 2009). However, wetlands critical habitats that support a wide range of bird species have been relatively underexplored. Wetlands are unique ecosystems that support high levels of biodiversity, particularly water-dependent bird species, also known as waterfowl (Kačergytė et al. 2021, Mcnew et al. 2023). These habitats are essential breeding grounds, feeding areas, and migration stopovers for many bird species. The importance of wetlands to global bird populations has been recognized through international conventions, such as the Ramsar Convention on Wetlands (1971), which highlights their role in supporting waterfowl and other biodiversity.

Unfortunately, wetlands around the world, including those in Nigeria, are facing significant degradation due to anthropogenic pressures (Edo & Albrecht, 2021, Olusola et al. 2016). Activities such as overfishing, pollution, agricultural expansion and the discharge of untreated waste into aquatic systems have led to the decline of many wetlands, threatening the biodiversity they sustain (Muthoka et al. 2024, Wear et al. 2021). Local communities often rely on wetlands for livelihoods, including fishing, farming, and water supply, which can exacerbate the pressure on these fragile ecosystems (Mccartney et al. 2011, Sakataka & Namisiko, 2014, Singha & Pal, 2023). The conversion of wetlands for agricultural or urban use further accelerates habitat loss, posing severe risks to the birds and other wildlife that depend on these environments.

As natural wetlands diminish, the role of artificial wetlands, such as dams, in biodiversity conservation becomes increasingly vital. Dams, constructed primarily for purposes such as irrigation, water supply, power generation, and flood control, can inadvertently offer alternative habitats for a range of bird species. Globally, several Ramsar-designated sites include dammed wetlands that have been shown to support significant populations of waterfowl and other birds (Cherkaoui et al. 2015, Hu et al. 2011, Kleijn et al. 2014). Although natural wetlands are irreplaceable in terms of ecological complexity, artificial wetlands may compensate for some

habitat loss if managed properly. Dams have the potential to host diverse bird assemblages, provided that they offer suitable conditions such as food availability, nesting sites, and protection from human disturbances (Abreu et al. 2020, Krištín, 2001).

In Nigeria, the Oke-Ogun region of Oyo State contains several artificially constructed dams that serve the local populace for water supply, irrigation, and other purposes. However, the avifauna associated with these dams remains inadequately documented. Understanding the bird species present, their diversity, and the factors influencing their occurrence in these artificial wetlands is pivotal for conservation planning. Given the increasing pressure on natural ecosystems, it is imperative to assess the potential of these dams to support bird populations and contribute to wider biodiversity conservation efforts in the region.

This study aims to address the knowledge gap by documenting the avian richness, assemblage structure, and habitat use in three selected dams Igboho, Okeho, and Kishi in the Oke-Ogun area of Oyo State, Nigeria. By conducting systematic bird surveys and assessing the influence of anthropogenic activities, this research endeavours to ascertain whether artificial wetlands can serve as effective habitats for birds in this region. Furthermore, the study will explore local community perceptions of birds and their attitudes towards conservation efforts, providing valuable insights into the potential for sustainable management of these dams.

In doing so, the study will contribute to the growing body of knowledge on the ecological role of artificial wetlands and offer recommendations for enhancing avian biodiversity in dammed environments. The findings are expected to inform policymakers, conservationists, and local stakeholders on the best practices for managing dams to support both human needs and biodiversity conservation.

METHODOLOGY

Study area

The research was conducted at three dams Igboho, Okeho, and Kishi located in the Oke-Ogun region of Oyo State, Nigeria. These dams vary in size and environmental characteristics. Igboho Dam, the largest, is situated in Orelope Local Government and is surrounded by tall grasses, shrubs, and fruit trees, with significant farming activity nearby. Okeho Dam, located in Kajola Local Government, is rocky and has dense thickets and savanna tree species in its vicinity. Kishi Dam, the smallest, is in Irepo Local Government and features a small forest patch and mangrove areas, providing habitat for diverse bird species.

Data collection

Bird surveys were conducted for six months, from January to June, covering both dry and rainy seasons. The point count method was used to assess bird species. Survey stations were randomly selected within a 100-meter radius around each dam, ensuring representative sampling. Observations were made twice daily, once in the morning (6:30 AM to 10:00 AM) and once in the evening (4:00 PM to 6:00 PM). Each station was visited twice per month, with each observation lasting 20 minutes within a 360-degree arc. Bird species were identified using 10x50 binoculars and the "Birds of Western Africa" field guide by Borrow and Demey (2014). A voice recorder was used to document bird calls, which were played back for verification.

Bird species were classified as water-dependent or terrestrial and further categorized into feeding guilds (e.g. insectivores, carnivores). Additionally, species were recorded as resident or migratory based on their observed behaviors. Data on bird abundance, species richness, and habitat characteristics were collected at each site.

Habitat and human activity assessment

Habitat variables were assessed using a five-point Likert scale. Parameters such as emergent vegetation cover, tree density, bare earth, and low perching habitats (logs, rocks) were measured around each dam. Anthropogenic activities, including fishing, farming, and water collection, were monitored by surveying a 100-meter perimeter around the dams. The number of fishermen, boats, farmers, and water tankers were recorded, and interviews were conducted with dam users (e.g. farmers, fishermen, dam staff) to gather information on local perceptions of birds and their conservation.

Data analysis

The collected data were analyzed using descriptive statistics to summarize bird species' richness, abundance, and habitat characteristics. One-way analysis of variance (ANOVA) was performed to test for significant differences in bird species diversity across the three dams and between the dry and rainy seasons. Bird diversity indices, including Simpson's Index and Shannon-Weiner Index, were calculated using the PAST (Paleontological Statistics) software to evaluate species dominance, evenness, and overall diversity. Follow-up tests were conducted to rank the dams based on their diversity of species. Habitat variables and human activity data were also compared across the dams to understand their impact on bird populations.

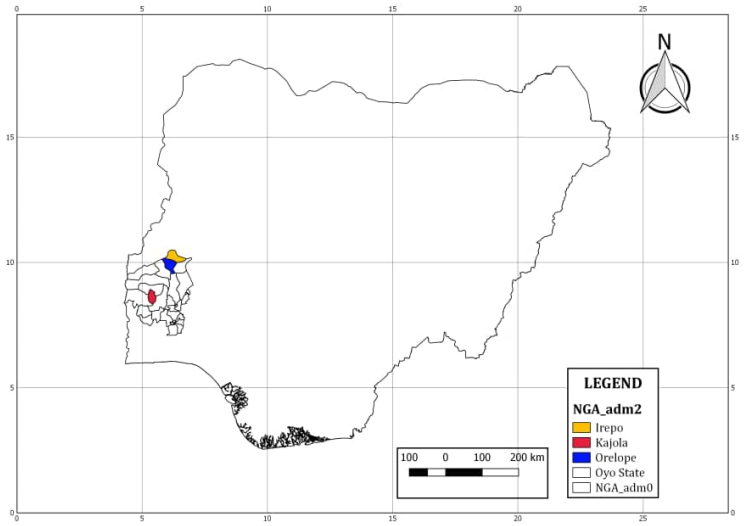


Figure 1: Map of Nigeria showing 3 Local Government Areas where the dams are situated

RESULTS

We surveyed a total of 679 individual birds across the three dams in Oke-Ogun, Oyo State, Nigeria, providing a comprehensive look at the avian diversity in these artificial wetland habitats. The highest number of birds was recorded at Igboho Dam with 309 individuals, followed by Kishi Dam with 210 individuals, and Okeho Dam with 160 individuals as shown in table 1. These birds represented 173 distinct species, classified into 37 different orders and 84 families. Igboho Dam had the most diverse bird population, with 14 orders and 35 families, while Okeho had 10 orders and 16 families, and Kishi had 13 orders and 33 families.

In terms of species richness, Igboho Dam hosted 75 species, making it the most species-rich site, while Okeho had the lowest diversity with 32 species, and Kishi recorded 66 species. This variation in species richness across the dams may be influenced by differences in habitat size, vegetation cover, and the extent of human activities around each dam.

Water birds, which depend heavily on the wetland environment, constituted a significant portion of the total species observed. At Igboho Dam, water birds made up 29% of the total species count (22 water bird species), while Okeho Dam had the highest proportion of water birds at 40% (13 species), and Kishi Dam recorded 24% of its species as water birds (16 species). This highlights the role of these dams in supporting water-dependent species despite being artificial habitats.

A notable finding of the study is the number of exclusive species found only in one specific dam. Igboho Dam had 32 species (43%) that were exclusive to its environment, indicating its unique ecological conditions or habitat features that might support these species. Kishi Dam followed with 23 species (35%) that were not found in the other dams, and Okeho Dam had

the fewest exclusive species, with only 3 species (9%) Figure 1. Despite these exclusive populations, 20 bird species were common across all three dams, suggesting some level of adaptability among these species.

Seasonal variations also played a role in species observations. Five bird species, including the African fish eagle (*Haliaeetus vocifer*), Grey heron (*Ardea cinerea*), Spur-winged lapwing (*Vanellus spinosus*), Intermediate egret *(Ardea intermedia*), and Squacco heron (*Ardeola ralloides*), were observed exclusively during the dry season. This seasonal exclusivity indicates the importance of studying bird populations across different times of the year to capture the full extent of biodiversity in these wetlands.

Moreover, we identified an endangered species at Igboho Dam: the Grey parrot (*Psittacus erithacus*), which is listed as endangered due to habitat loss and the illegal pet trade. These findings emphasize the conservation importance of these artificial wetlands, as they provide refuge for species facing global population declines. The other species recorded were classified as Least Concern by the International Union for Conservation of Nature (IUCN) from 2016 to 2018 (Appendix 1,2 and 3), indicating stable populations for the time being, though ongoing habitat protection remains critical to their continued survival.

Table 1: Bird Specie Composition and Richness

	IGBOHO DAM			OKEHO DAM			KISHI DAM		
Parameter	Terrestial Bird	Water Bird	TOTAL	Terrestial Bird	Water Bird	TOTAL	Terrestial Bird	Water Bird	TOTAL
Mean number of individuals	111	198	309	59	101	160	115	95	210
Species Richness	53	22	75	19	13	32	50	16	66
No of Families	24	11	35	9	7	16	27	6	33

Source: Field Survey

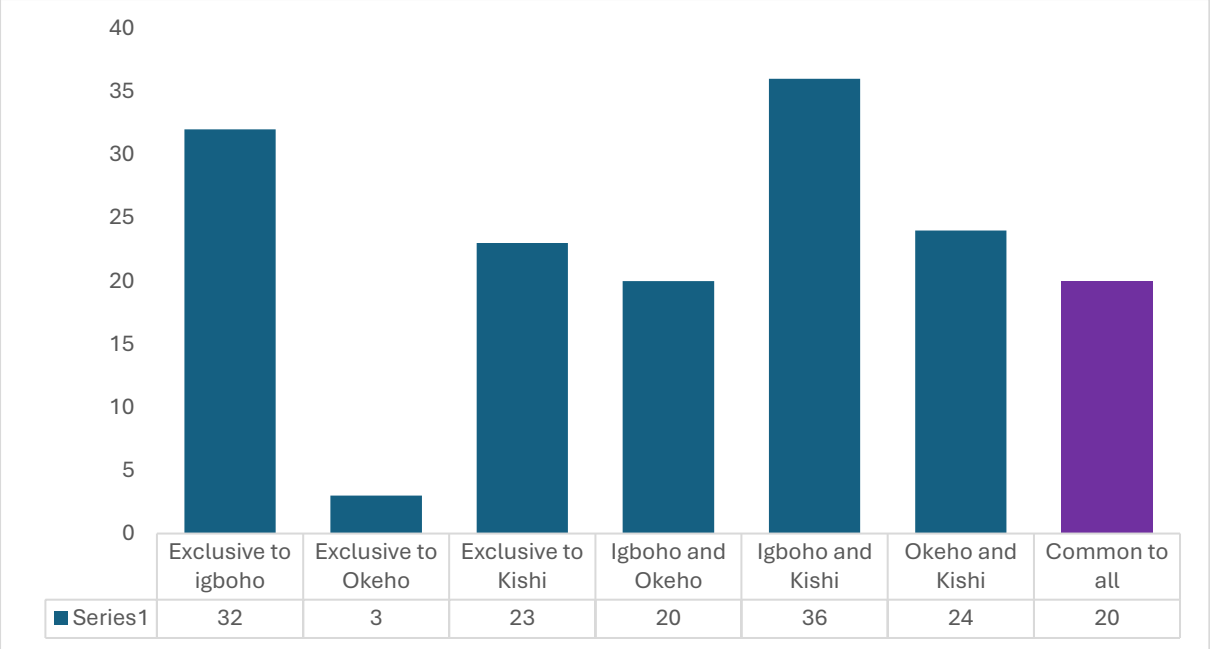
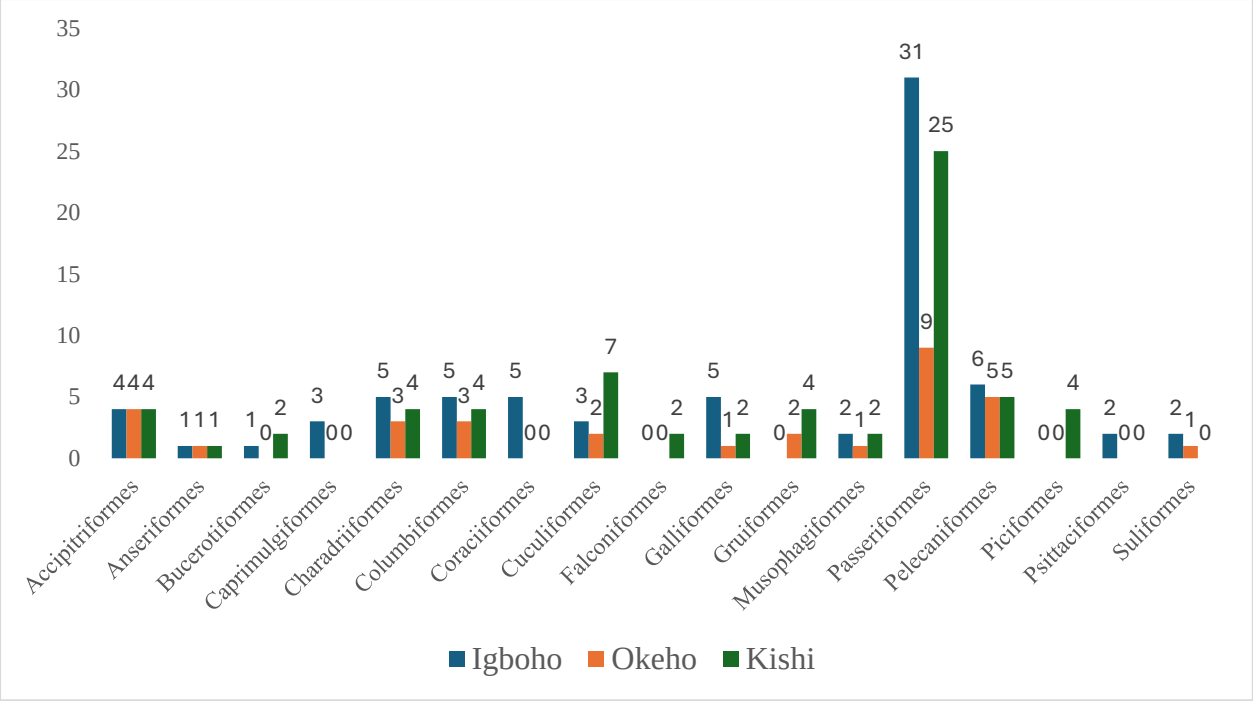


Figure 1: Common and exclusive bird species

The family Ardeidae had the highest number of bird species in both Igboho and Okeho Dams, with six species and five species, respectively. In contrast, at Kishi Dam, the family Ploceidae recorded the most species with six, followed closely by Ardeidae with five species. Additionally, the families Accipitridae, Alcedinidae, Cisticolidae, and Rallidae each had four species at Kishi Dam.

Most species recorded across the three dams belonged to the order Passeriformes, accounting for 41% of the species at Igboho Dam, 28% at Okeho Dam, and 38% at Kishi Dam, as illustrated in Figure 2.



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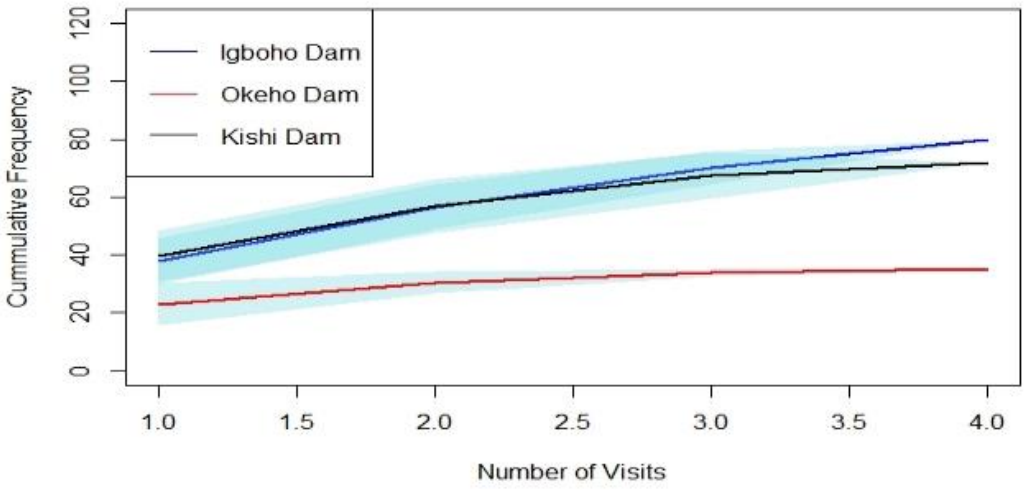
179 Figure 2: Order composition of birds in the three dams.

180 As illustrated in Figure 3, the number of bird species increased steadily with more visits and
181 began to slow down as the curve approached its peak. This indicates that the curve did not
182 plateau, suggesting that additional species could be recorded with further sampling,
183 particularly at Kishi Dam.



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185 Figure 3: Specie accumulation curve

During the rainy season, Igboho Dam recorded the highest relative abundance of bird species, whereas Kishi Dam had the lowest. In contrast, Kishi Dam exhibited the highest relative abundance during the dry season, while Okeho Dam had the lowest bird relative abundance during that time. There was a significant disparity in bird species abundance between the rainy and dry seasons at Igboho and Okeho Dams, while Kishi Dam maintained a consistent population across both seasons (Figure 4).

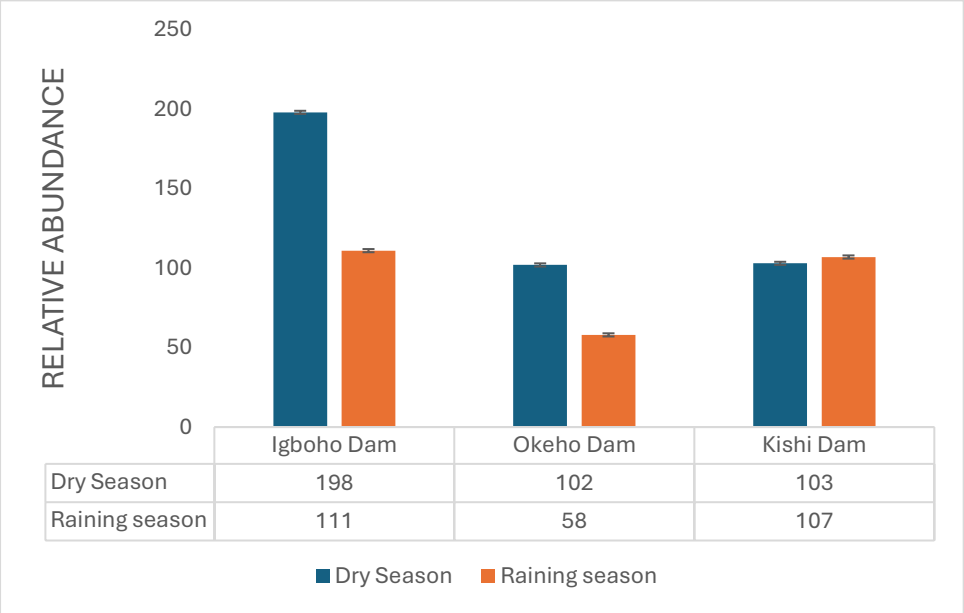

Figure 4: Bird species relative abundance

Kishi Dam exhibited the lowest species dominance, with Dominance Indices of 0.05407 and 0.07186 during the dry and rainy seasons, respectively. This reflects a high diversity of bird species at Kishi Dam, indicated by a Simpson Index (1-D) of 0.9459, a Shannon-Weiner Index (H) of 3.296, and an Evenness Index of 0.6138 during the dry season. In the rainy season, the corresponding values were 0.9281 for the Simpson Index (1-D), 3.24 for the Shannon-Weiner Index (H), and an Evenness Index of 0.5937. Conversely, Okeho Dam had the highest dominance index, measuring 0.5469 in the dry season and 0.1027 in the rainy season, leading to the lowest bird diversity with Simpson Indices of 0.4531 (H = 1.321) in the dry season and 0.8773 (H = 2.7) in the rainy season. Additionally, Igboho Dam recorded the lowest Evenness Index values of 0.1416 and 0.4872 during the dry and rainy seasons, respectively, as shown in Tables 2 and 3.

Moreover, there was no significant difference in water-dependent bird species across the three selected dams throughout the study, with a P-value of 0.634. However, a significant difference in bird species was observed among the dams ($P = 0.003$ at $P \leq 0.05$). A follow-up test indicated

that Kishi Dam ranked highest but was not significantly different from Igboho Dam, while Okeho Dam received the lowest rating.

Table 2: Diversity of bird species in the study area during the dry season

	IGBOHO	Lower	Upper	OKEHO	Lower	Upper	KISHI	Lower	Upper
Taxa_S	57	57	57	24	24	24	44	44	44
Individuals	603	603	603	424	424	424	259	259	259
Dominance_D	0.3483	0.2902	0.3737	0.5469	0.4766	0.595	0.05407	0.04596	0.06489
Simpson_1-D	0.6517	0.6262	0.7097	0.4531	0.405	0.5229	0.9459	0.9351	0.954
Shannon_H	2.088	2.007	2.3	1.321	1.185	1.503	3.296	3.181	3.386
Evenness_e^H/S	0.1416	0.1325	0.1767	0.1561	0.1363	0.1873	0.6138	0.5473	0.6713

Table 3: Diversity of bird species in the study area during the raining season

	IGBOHO	Lower	Upper	OKEHO	Lower	Upper	KISHI	Lower	Upper
Taxa_S	46	46	46	27	27	27	43	43	43
Individuals	228	228	228	215	215	215	261	261	261
Dominance_D	0.0831	0.0593	0.0960	0.1027	0.08422	0.123	0.0719	0.0538	0.0908
Simpson_1-D	0.9169	0.9038	0.9407	0.8973	0.8769	0.9157	0.9281	0.9091	0.9462
Shannon_H	3.11	3.026	3.289	2.7	2.567	2.818	3.24	3.103	3.346
Evenness_e^H/S	0.4872	0.4494	0.5832	0.551	0.4822	0.6202	0.5937	0.5187	0.6607

Based on the classification of birds into feeding guilds, our findings revealed that insectivores dominated the species composition. At Igboho Dam, insectivores accounted for the highest proportion, representing 31% of the species, followed by carnivores and omnivores, both at 11%, and granivores at 9%. Similarly, at Kishi Dam, insectivores were predominant, but they were followed by omnivores at 21%, carnivores at 16%, and granivores at 13%. Notably, Kishi Dam also recorded a high percentage of carnivores and granivores, each at 19%, followed by insectivores at 16%, omnivores at 13%, and frugivores at 7% (Figure 5).

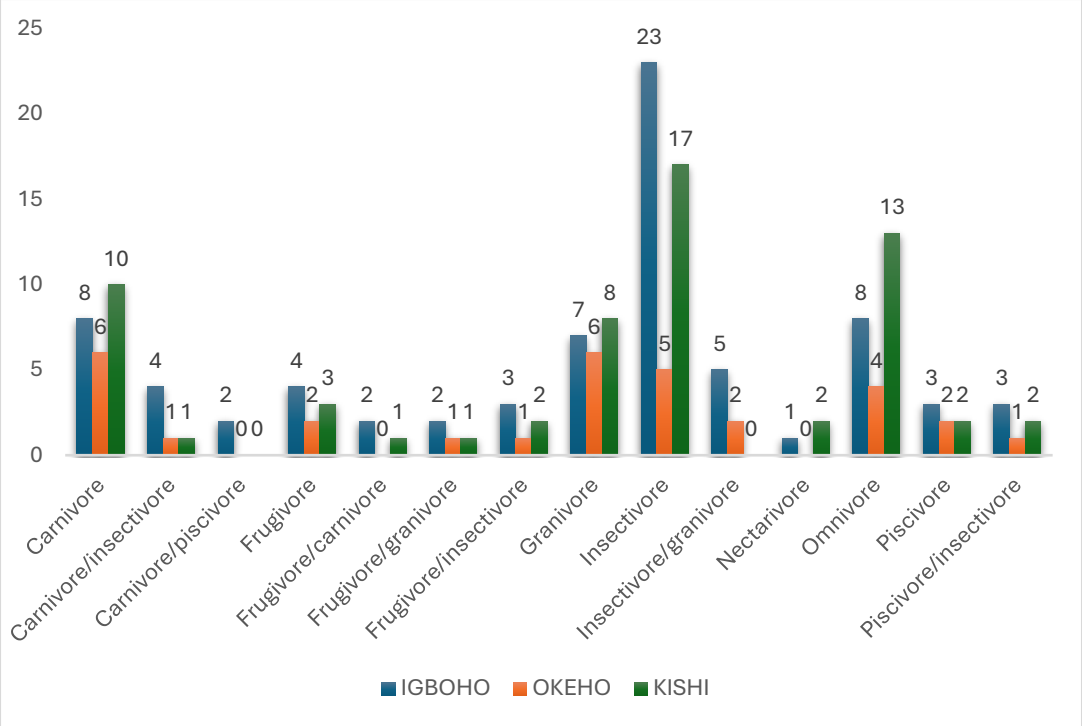

Figure 5: Bird feeding guild at during the study period.

Kishi Dam exhibited the highest tree density and abundance of low-perching habitats, while Okeho Dam had no recorded instances of bare earth. Igboho Dam faced the most severe threats, including fishing, farming, bird hunting, water collection, and grazing. Kishi Dam experienced fewer threats in comparison, while Igboho Dam encountered similar levels of threat severity. Additionally, the highest number of fishermen was observed at Igboho Dam (17), followed by Kishi Dam (13), with no fishermen recorded at Okeho. Igboho Dam also had the most farmers (35), while Okeho had the fewest (5). Furthermore, Kishi Dam recorded the highest number of gunshots from hunters (5), whereas no such occurrences were reported at Okeho Dam.

Various canoes and fishermen were present across the dams, with a total of 13 canoes observed at Igboho, 1 at Okeho, and 7 at Kishi. The impact of cattle rustlers, often referred to as Fulani herdsmen, is significant. Kishi Dam experienced the most disturbances from Fulani herdsmen, with 13 different herds of cattle observed during four site visits. In contrast, Igboho Dam recorded 5 herds, while Okeho Dam remained largely undisturbed due to its inaccessibility caused by the terrain and location.

DISCUSSION

The cumulative number of birds was significantly higher at Igboho Dam compared to Okeho and Kishi Dams. This can likely be attributed to its larger size, as it is the biggest of the three dams, as well as the high rate of farming activities and the abundance of fruiting trees in the area. According to Giosa et al. (2018), dam size is a major determinant of bird species richness and diversity. This finding aligns with previous studies by Webb et al. (2010), and Hsu et al. (2011). Gupta (2004) also noted that the congregation of waterbirds around dams is influenced by the availability of food sources, such as macrophytes, microphytes, and various organisms, as well as the shallowness of the water, which provides accessible roosting sites.

As Adhikari et al. (2018) pointed out, a simple count of species in a sample often underestimates the true species richness of an environment, as increased sampling efforts generally lead to a greater number of observed species. This concept is illustrated by a species accumulation curve, where the x-axis represents the number of individuals recorded, and the y-axis indicates the observed species richness (Figure 3). The curve demonstrated that the number of bird species generally increased with more monitored points, eventually plateauing, suggesting that additional species could still be detected with further sampling, particularly in Kishi Dam, due to the favorable vegetation structure around it. Previous research has shown that higher waterbird richness often correlates with greater vegetation structure and composition (Andrade et al. 2018, Davison et al. 2023, Henning & Remsburg, 2009, Hulbert, 2016), highlighting the significant interaction between vegetation characteristics and bird species richness (Cunningham et al. 2008).

All three sites exhibited a richness of insectivores, which made up the largest percentage of the total bird species. The classification of birds into feeding guilds confirmed that insectivores dominated the species composition. Insectivores are typically the most species-rich and abundant guild in tropical forests, displaying considerable variability in feeding behavior (Kikuchi, 2009, Novotný et al. 2006). Consequently, habitat variables at Igboho and Kishi Dams may have contributed to the higher abundance of insectivores in these areas. Similar findings were reported by Z. Ma et al. (2010). Granivores were particularly prevalent in farmlands, especially at Igboho Dam, likely due to the dominance of wild and cultivated grasses (Waltert et al. 2005).

Most of the dam area is characterized by grassy patches interspersed with tall trees, resembling savannah vegetation. A small area of grassland is also present within the water body, along with logs of wood on the surface, which are often utilized by birds. Species such as the African

Jacana, Black Crake, Common Moorhen, Lesser Moorhen, and Purple Swamp Hen were commonly found along the dam's banks, benefiting from the shallow water that provides access to tubers, plant shoots, insects, and worms. Katore (2017) reported similar findings. For example, whistling ducks utilized water bodies dominated by submerged vegetation for foraging and often rested on dead trees and reed beds along the edges, preferring to forage in the morning and loaf as temperatures rose (Rajpar and Zakaria, 2013). Similarly, Purple Swamp Hens favored the marshy habitats dominated by emergent vegetation at Igboho Dam, illustrating that microhabitat and microclimate preferences can vary among species (Hansbauer et al. 2010, Wang & Chu, 2021). Dense vegetation may hinder the movement and foraging efficiency of waterbirds, yet species such as swamp hens, moorhens, jacanas, herons, and crakes demonstrated a positive association with emergent vegetation at Igboho Dam. This finding aligns with the research by Safran et al. (1997), which examined benthic invertebrates at foraging sites for nine waterbird species in managed wetlands.

Additionally, the presence of mangroves and small forest patches at Kishi Dam contributed to the area's diversity, making it the dam with the highest diversity index. This observation supports the findings of MacArthur & Wilson (2001), who noted that avian diversity increases with vegetation complexity.

Fishing, farming, and water tanker activities pose significant threats to the bird populations in and around the dams. Intensive fishing practices exert unsustainable pressure on fish populations, adversely affecting birds that depend on them for food. The movement of boats and canoes by fishermen disrupts bird activities, particularly during the breeding season. Soka et al. (2013) identified livestock grazing and fishing as major illegal activities in their study area, which could have detrimental long-term effects on bird species diversity. Farmers also contribute to these disturbances, as agricultural encroachment into surrounding vegetation for farming, along with water diversion for irrigation, represents a significant threat to bird populations.

The use of various fertilizers, insecticides, and herbicides has both direct and indirect impacts on bird populations, as water contamination from these substances affects the survival of birds that depend on these resources. Igboho Dam experienced the highest severity of farming impacts, with a larger number of farmers utilizing the riverbanks for agricultural activities, while Okeho Dam faced the least threat from farming. Nevertheless, the application of fertilizers and pesticides was observed at all three dams. This corroborates with the findings of

Katore (2017) who stated in his research that the main pollution source are the insecticides and fertilizers used in agricultural areas by farmers.

Additionally, the significant noise pollution from large machines used for water pumping cannot be overlooked. Cattle grazing was particularly severe at Kishi Dam, with many herds recorded during the survey.

In addition to cattle grazing, hunters pose a major threat to bird diversity and abundance in the dams. Reports from dam users indicated that birds are often killed with guns, while others are scared away.

CONCLUSION

The research study highlighted that dams support a diverse array of bird species, with significant birdlife recorded in Igboho, Okeho, and Kishi dams. However, variations in bird species diversity and abundance were observed among the three sites, attributed to differing land use types, vegetation composition, food availability, predation risks, and human impacts. Notably, Igboho Dam is home to the Purple Swamphen (*Porphyrio porphyrio*), confirming its presence in southwestern Nigeria, where previous records were limited to the Lekki Peninsula in 1992 and the International Institute of Tropical Agriculture, Ibadan, in 2014. We identified a total of 173 bird species, suggesting that the dams also support other wildlife.

The findings further emphasize that dams play a crucial role in the survival of birds and other wildlife. However, anthropogenic activities and agricultural practices in and around the dams negatively impact the density and diversity of aquatic bird species. Pollution, human disturbances, and excessive fertilizer use further threaten these ecosystems. Therefore, restoring the original ecological features of the dams and implementing protective measures is essential for conserving avifauna.

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APPENDIX

Appendix 1: CHECKLIST OF BIRD SPECIES IN IGBOHO DAM

ORDER	FAMILY	COMMON NAME	SCIENTIFIC NAME	STATUS	FEEDING GUILD	MIGRATORY STATUS	IUCN STATUS	YEAR
Coraciiformes	Coraciidae	Abyssinian roller	*Coracias abyssinicus*	NWD	Insectivore	Migrants	LC	2017
Suliformes	Anhingidae	African darter	*Anhinga refa*	WD	Carnivore	Non-migrant	LC	2017
Coraciiformes	Alcedininae	African dwarf kingfisher	*Ispidina lecontei*	WD	Carnivore/insectivore	Non-migrant	LC	2016
Accipitriformes	Accipitridae	African fish eagle	*Haliaeetus vocifer*	WD	Piscivore	Non-migrant	LC	2016
Passeriformes	Oriolidae	African golden orioles	*Oriolus auratus*	NWD	Frugivore/insectivore	Full migrant	LC	2018
Columbiformes	Columbidae	African green pigeon	*Treron calvus*	NWD	Frugivore	Non-migrant	LC	2016
Bucerotiformes	Bucerotidae	African grey hornbill	*Lophoceros nasutus*	NWD	Omnivore	Non-migrant	LC	2016
Psittaciformes	Psittacidae	Grey parrot	*Psittacus erithacus*	NWD	Frugivore/granivore	Non-migrant	EN	2018

Charadriiformes	Jacanidae	African Jacana	*Actophilornis africanus*	WD	Piscivore	Resident/Nomadic	LC	2016
Charadriiformes	Haematopodidae	African oystercatcher	*Haematopus moquini*	WD	Piscivore/insectivore	Non-migrant	LC	2017
Caprimulgiformes	Apodidae	African palm swift	*Cypsiurus parvus*	NWD	Insectivore	Non-migrant	LC	2016
Passeriformes	Turdidae	African thrush	*Turdus Pelios*	NWD	Insectivore	Non-migrant	LC	2016
Passeriformes	Leiothrichidae	Arrow-marked babbler	*Turdoides jardineii*	NWD	Frugivore/Carnivore	Non-migrant	LC	2018
Gruiformes	Rallidae	Black crake	*Amaurornis flavirostra*	WD	Piscivore/insectivore	Non-migrant	LC	2016
Passeriformes	Ploceidae	Black headed weaver	*Ploceus melanocephalus*	NWD	Insectivore	Non-migrant	LC	2018
Accipitriformes	Accipitridae	Black shouldered kite	*Elanus axillaris*	NWD	Omnivore	Nomadic	LC	2016
Columbiformes	Columbidae	Blue-spotted wood dove	*Turtur afer*	NWD	Frugivore/Insectivore	Full migrant	LC	2016
Coraciiformes	Coraciidae	Broad billed roller	*Eurystomus Glaucurus*	NWD	Insectivore	Full migrant	LC	2016
Passeriformes	Estrildidae	Bronze mannikin	*Lonchura cucullata*	NWD	Granivore	Resident	LC	2016

Passeriformes	Leiotrichidae	Brown babbler	*Turdoides plebejus*	NWD	Frugivore/Carnivore	Resident	LC	2018
Passeriformes	Pycnonotidae	Common bulbul	*Pycnonotus barbatus*	NWD	Insectivore	Resident	LC	2016
Gruiformes	Rallidae	Common moorhen	*Gallinula chloropus*	WD	Piscivore/insectivore	Full migrant	LC	2016
Passeriformes	Platysteiridae	Brown-throated wattle-eye	*Platysteira cyanea*	NWD	Insectivore	Non-migrant	LC	2016
Suliformes	Phalacrocorcisae	Double-crested cormorant	*Phalacrocorax auritus*	WD	Piscivore	Full migrant	LC	2018
Galliformes	Phasianidae	Double-spurred francolin	*Pternistis bicalcaratus*	NWD	Granivore	Resident	LC	2016
Passeriformes	Dicruridae	Fork-tailed drogon	*Dicrurus adsmiilis*	NWD	Carnivore	Non-migrant	LC	2016
Pelecaniformes	Ardeidae	Goliath heron	*Ardea goliath*	WD	Carnivore/Piscivore	Full migrant	LC	2016
Pelecaniformes	Ardeidae	Grey heron	*Ardea cinerea*	WD	Carnivore	Resident migrants	LC	2016
Passeriformes	Cisticolidae	Olive-green camaroptera	*Camaroptera chloronota*	NWD	Insectivore	Non-migrant	LC	2016
Pelecaniformes	Ardeidae	Black-headed heron	*Ardea melanocephala*	WD	Carnivore/insectivore	Resident migrants	LC	2016
Musophagiformes	Musophagidae	Guinea turaco	*Tauraco persa*	NWD	Omnivore	Non-migrant	LC	2016

Pelecaniformes	Ardeidae	Intermediate egret	*Ardea intermedia*	WD	Omnivore	Full migrant	LC	2016
Columbiformes	Columbidae	Laughing dove	*Spilopelia senegalensis*	NWD	Frugivore/granivore	Resident migrants	LC	2018
Passeriformes	Pycnonotidae	Simple greenbul	*Chlorocichla simplex*	NWD	Frugivore	Non-migrant	LC	2018
Charadriiformes	Jacanidae	Lesser Jacana	*Microparra capensis*	WD	Insectivore	Non-migrant	LC	2017
Gruiformes	Rallidae	Lesser moorhen	*Paragallinula angulata*	WD	Insectivore	Resident	LC	2016
Cuculiformes	Cuculidae	Levaillant's cuckoo	*Clamator levaillantii*	NWD	Insectivore	Migrants	LC	2016
Pelecaniformes	Ardeidae	Little egret	*Egretta garzetta*	WD	Carnivore/Piscivore	Resident migrants	LC	2016
Passeriformes	Pycnonotidae	Little greenbul	*Eurillas virens*	NWD	Frugivore	Attitudinal migrant	LC	2016
Caprimulgiformes	Apodidae	Little swift	*Apus affinis*	NWD	Insectivore	Full migrant	LC	2016
Accipitriformes	Accipitridae	Lizard buzzard	*Kaupifalco monogrammicus*	NWD	Carnivore	Non-migrant	LC	2016
Coraciiformes	Alcedinidae	Malachite kingfisher	*Corythornis cristatus*	WD	Carnivore	Resident migrants	LC	2016

Caprimulgiformes	Apodidae	Mottled spinetail	*Telacanthura ussheri*	NWD	Insectivore	Non-migrant	LC	2018
Passeriformes	Ploceidae	Northern red bishop	*Euplectes franciscanus*	NWD	Insectivore/Granivore	Non-migrant	LC	2018
Passeriformes	Viduidae	Pin-tailed whydah	*Vidua macroura*	NWD	Granivore	Non-migrant	LC	2018
Passeriformes	Motacillidae	Plain backed pipit	*Anthus leucophrys*	NWD	Granivore	Non-migrant	LC	2018
Gruiformes	Rallidae	Purple swamphen	*Porphyrio porphyrio*	WD	Omnivore	Non Resident	LC	2016
Columbiformes	Columbidae	Red eyed dove	*Streptopelia semitorquata*	NWD	Granivore	Resident migrants	LC	2016
Cuculiformes	Cuculidae	Senegal coucal	*Centropus senegalensis*	NWD	Carnivore/insectivore	Non-migrant	LC	2016
Psittaciformes	Psittacidae	Senegal parrot	*Poicephalus senegalus*	NWD	Omnivore	Resident	LC	2016
Passeriformes	Muscicapidae	Snowy-Crowned Robin-Chat	*Cossypha niveicapilla*	NWD	Insectivore/Granivore	Non-migrant	LC	2016
Passeriformes	Turdidae	Song thrush	*Turdus philomelos*	NWD	Omnivore	Non-resident migrant	LC	2018

Charadriiformes	Charadriidae	Spur-winged lapwing	*Vanallus spinosus*	WD	Insectivore/Granivore	Non-resident migrant	LC	2018
Pelecaniformes	Ardeidae	Squacco heron	*Ardeola ralloides*	WD	Carnivore	Resident migrants	LC	2018
Passeriformes	Malaconotidae	Tropical boubou	*Laniarius aethiopicus*	NWD	Insectivore	Non-migrant	LC	2016
Passeriformes	Cisticolidae	Tawny-flanked prinia	*Prinia subflava*	NWD	Insectivore	Non-migrant	LC	2016
Columbiformes	Columbidae	Vinaceous dove	*Streptopelia vinacea*	NWD	Granivore	Migrants	LC	2016
Passeriformes	Ploceidae	Village weaver	*Ploceus cucullatus*	NWD	Insectivore/Granivore	Non-migrant	LC	2018
Passeriformes	Acrocephalidae	African reed warbler	*Acrocephalus baeticatus*	NWD	Insectivore	Migrants	LC	2016
Passeriformes	Nicatoridae	Western nicator	*Nicator chloris*	NWD	Insectivore	Non-migrant	LC	2017
Musophagiformes	Musophagidae	Western plantain eater	*Crinifer piscator*	NWD	Frugivore	Non-migrant	LC	2016
Passeriformes	Cisticolidae	Whistling cisticola	*Cisticola lateralis*	NWD	Insectivore	Non-migrant	LC	2016
Passeriformes	Ploceidae	Black winged bishop	*Euplectes*	NWD	Insectivore/Granivore	Non-migrant	LC	2016

Anseriformes	Anatidae	White-faced whistling duck	*Dendrocygna viduata*	WD	Omnivore	Full migrant	LC	2016
Charadriiformes	Charadriidae	White-crowned lapwing	*Vanellus albiceps*	WD	Frugivore/insectivore	Non-migrant	LC	2017
Passeriformes	Phylloscopidae	Willow warbler	*Phylloscopus trochilus*	NWD	Nectarivore	Full migrant	LC	2016
Passeriformes	Muscicapidae	Whinchat	*Saxicola rubetra*	NWD	Insectivore	Full migrant	LC	2016
Passeriformes	Cisticolidae	Winding cisticola	*Cisticola marginatus*	NWD	Insectivore	Non-migrant	LC	2017
Coraciiformes	Alcedinidae	Woodland kingfisher	*Halcyon senegalensis*	WD	Carnivore/insectivore	Full migrant	LC	2016
Cuculiformes	Cuculidae	Chattering yellowbill	*Ceuthmochares aereus*	NWD	Carnivore	Non-migrant	LC	2016
Accipitriformes	Accipitridae	Yellow-billed kite	*Milvus aegyptius*	NWD	Carnivore	Migrants	LC	2016
Passeriformes	Laniidae	Yellow billed shrike	*Corvinella corvina*	NWD	Insectivore	Non-migrant	LC	2016
Passeriformes	Ploceidae	Yellow mantled widowbird	*Euplectes macroura*	NWD	Insectivore	Non-migrant	LC	2016
Passeriformes	Motacillidae	Yellow throated longclaw	*Macronyx croceus*	NWD	Insectivore	Non-migrant	LC	2016

Passeriformes	Motacillidae	Western yellow wagtail	*Motacilla flava*	NWD	Granivore	Full migrant	LC	2018

Appendix 2: CHECKLIST OF BIRD SPECIES IN OKEHO DAM

ORDER	FAMILY	COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE	MIGRATORY STATUS	IUCN STATUS	YEAR
Suliformes	Anhingidae	African darter	*Anhinga refa*	WD	Carnivore	Non-migrant	LC	2017
Accipitriformes	Accipitridae	African fish eagle	*Haliaeetus vocifer*	WD	Piscivore	Non-migrant	LC	2016
Charadriiformes	Jacanidae	African jacana	*Actophilornis africanus*	WD	Piscivore	Resident/Nomadic	LC	2016
Gruiformes	Rallidae	Allen's gallinule	*Porphyrio alleni*	WD	Frugivore/Granivore	Full migrant	LC	2016
Passeriformes	Estrildidae	Black-and-white mannikin	*Lonchura bicolor*	NWD	Granivore	Resident	LC	2017
Gruiformes	Rallidae	Black crake	*Amaurornis flavirostra*	WD	Insectivores/Piscivore	Non-migrant	LC	2016

Passeriformes	Ploceidae	Black headed weaver	*Ploceus melanocephalus*	NWD	Insectivore	Non-migrant	LC	2018
Accipitriformes	Accipitridae	Black shouldered kite	*Elanus axillaris*	NWD	Omnivore	Nomadic	LC	2016
Columbiformes	Columbidae	Blue spotted wood ove	*Turtur afer*	NWD	Frugivore/Insectivore	Full migrant	LC	2016
Passeriformes	Estrildidae	Bronze mannikin	*Lonchura cucullate*	NWD	Granivore	Resident	LC	2016
Cuculiformes	Cuculidae	Diederik cuckoo	*Chrysococcyx caprius*	NWD	Insectivore	Full migrant	LC	2016
Galliformes	Phasianidae	Double spurred francolin	*Pternistis bicalcaratus*	NWD	Granivore	Resident	LC	2016
Pelecaniformes	Ardeidae	Great white egret	*Ardea alba*	WD	Omnivore	Full migrant	LC	2016
Pelecaniformes	Ardeidae	Green-backed heron	*Butorides striata*	WD	Carnivore	Full migrant	LC	2016
Pelecaniformes	Ardeidae	Grey heron	*Ardea cinerea*	WD	Carnivore	Resident migrants	LC	2016
Pelecaniformes	Ardeidae	Intermediate egret	*Ardea intermedia*	WD	Omnivore	Full migrant	LC	2016

Columbiformes	Columbidae	Laughing dove	*Spilopelia senegalensis*	NWD	Granivore	Resident migrants	LC	2018
Charadriiformes	Jacanidae	Lesser jacana	*Microparra capensis*	WD	Insectivore	Non-migrant	LC	2017
Passeriformes	Pycnonotidae	Little greenbul	*Eurillas virens*	NWD	Frugivore	Attitudinal migrant	LC	2016
Accipitriformes	Accipitridae	Lizard buzzard	*Kaupifalco monogrammicus*	NWD	Carnivore	Non-migrant	LC	2016
Passeriformes	Estrildidae	Magpie mannikin	*Lonchura fringilloides*	NWD	Granivore	Non-migrant	LC	2018
Passeriformes	Corvidae	Pied crow	*Corvus albus*	NWD	Scavenger	Resident	LC	2017
Columbiformes	Columbidae	Red eyed dove	*Streptopelia semitorquata*	NWD	Granivore	Resident migrants	LC	2016
Cuculiformes	Cuculidae	Senegal coucal	*Centropus senegalensis*	NWD	Carnivore/insectivore	Non-migrant	LC	2016
Charadriiformes	Charadriidae	Spur-winged lapwing	*Vanallus spinosus*	WD	Granivore/Insectivore	Non-resident migrant	LC	2018
Pelecaniformes	Ardeidae	Squacco heron	*Ardeola ralloides*	WD	Carnivore	Resident migrants	LC	2018
Passeriformes	Malaconotidae	Tropical boubou	*Laniarius aethiopicus*	NWD	Insectivore	Non-migrant	LC	2016

Passeriformes	Ploceidae	Village weaver	*Ploceus cucullatus*	NWD	Granivore/Insectivore	Non-migrant	LC	2018
Musophagiformes	Musophagidae	Western plantain eater	*Crinifer piscator*	NWD	Frugivore	Non-migrant	LC	2016
Anseriformes	Anatidae	White faced whistling duck	*Dendrocygna viduata*	WD	Omnivore	Full migrant	LC	2016
Accipitriformes	Accipitridae	Yellow billed kite	*Milvus aegyptius*	NWD	Carnivore	Migrants	LC	2016
Passeriformes	Ploceidae	Yellow mantled widowbird	*Euplectes macroura*	NWD	Insectivore	Non-migrant	LC	2016

Appendix 3: CHECKLIST OF BIRD SPECIES IN KISHI DAM

ORDER	FAMILY	COMMON NAME	SCIENTIFIC NAME	STATUS	FEEDING GUILD	MIGRATORY STATUS	IUCN STATUS	YEAR
Coraciiformes	Coraciidae	Abyssinian roller	*Coracias abyssinicus*	NWD	Insectivore	Migrants	LC	2017
Bucerotiformes	Bucerotidae	African grey hornbill	*Lophoceros nasutus*	NWD	Omnivore	Non-migrant	LC	2016
Charadriiformes	Jacanidae	African jacana	*Actophilornis africanus*	WD	Piscivores	Resident/Nomadic	LC	2016

Accipitriformes	Accipitridae	Scissor-tailed kite	*Chelictinia riocourii*	NWD	Omnivore	Full migrant	LC	2016
Passeriformes	Turdidae	African thrush	*Turdus pelios*	NWD	Insectivore	Non-migrant	LC	2016
Gruiformes	Rallidae	Allens gallinule	*Porphyrio alleni*	WD	Frugivore/Granvore	Full migrant	LC	2016
Piciformes	Lybiidae	Bearded barbet	*Lybius dubius*	NWD	Omnivore	Non-migrant	LC	2016
Passeriformes	Estrildidae	Black and white mannikin	*Lonchura bicolor*	NWD	Granivore	Resident	LC	2017
Gruiformes	Rallidae	Black crake	*Amaurornis flavirostra*	WD	Insectivore/Piscivore	Non-migrant	LC	2016
Passeriformes	Ploceidae	Black-headed weaver	*Ploceus nigricollis*	NWD	Insectivore	Non-migrant	LC	2018
Accipitriformes	Accipitridae	Black shouldered kite	*Elanus axillaris*	NWD	Omnivore	Nomadic	LC	2016
Passeriformes	Ploceidae	Blue billed malimbe	*Malimbus nitens*	NWD	Insectivore	Non-migrant	LC	2016
Coraciiformes	Alcedinidae	Blue breasted kingfisher	*Halcyon malimbica*	NWD	Omnivore	Resident	LC	2016
Columbiformes	Columbidae	Blue spotted wood dove	*Tutur afer*	NWD	Frugivore/Insectivore	Full migrant	LC	2016
Coraciiformes	Coraciidae	Broad billed roller	*Eurystomus Glaucurus*	NWD	Insectivore	Full migrant	LC	2016

Passeriformes	Estrildidae	Bronze mannikin	*Lonchura cucullata*	NWD	Granivore	Resident	LC	2016
Passeriformes	Leiotrichidae	Brown babbler	*Turdoides plebejus*	NWD	Frugivore/Carnivore	Resident	LC	2018
Passeriformes	Nectariniidae	Buff throated sunbird	*Chalcomitra adelberti*	NWD	Nectarivore	Non-migrant	LC	2016
Piciformes	Picidae	Cardinal woodpecker	*Dendropicos fuscescens*	NWD	Omnivore	Non-migrant	LC	2016
Passeriformes	Nectariniidae	Collared sunbird	*Hedydipna collaris*	NWD	Nectarivore	Non-migrant	LC	2016
Passeriformes	Pycnonotidae	Common bulbul	*Pycnonotus barbatus*	NWD	Insectivore	Resident	LC	2016
Falconiformes	Falconidae	Common kestrel	*Falco tinnunculus*	NWD	Carnivore	Full migrant	LC	2016
Gruiformes	Rallidae	Common moorhen	*Gallinula chloropus*	WD	Insectivore/Piscivore	Full migrant	LC	2016
Charadriiformes	Scolopacidae	Common sandpiper	*Actitis hypoleucos*	NWD	Omnivore	Full migrant	LC	2016
Passeriformes	Platysteiridae	Brown-throated wattle eye	*Platysteira cyanea*	NWD	Granivore	Non-migrant	LC	2016

Galliformes	Phasianidae	Double spurred francolin	*Pternistis bicalcaratus*	NWD	Granivore	Resident	LC	2016
Passeriformes	Dicruridae	Fork tailed drogons	*Dicrurus adsmiilis*	NWD	Carnivore	Non-migrant	LC	2016
Pelecaniformes	Ardeidae	Green backed heron	*Butorides striatus*	WD	Carnivore	Full migrant	LC	2016
Passeriformes	Nectariniidae	Green headed sunbird	*Cyanomitra verticalis*	NWD	Insectivore	Non-migrant	LC	2016
Bucerotiformes	Phoeniculidae	Green woodhoopoe	*Phoeniculus purpureus*	NWD	Insectivore	Non-migrant	LC	2016
Passeriformes	Cisticolidae	Olive-green camaroptera	*Camaroptera chloronota*	NWD	Insectivore	Non-migrant	LC	2016
Pelecaniformes	Ardeidae	Grey heron	*Ardea cinerea*	WD	Carnivore	Resident migrants	LC	2016
Falconiformes	Falconidae	Grey kestrel	*Falco ardosiaceus*	NWD	Carnivore	Non-migrant	LC	2016
Musophagiformes	Musophagidae	Guinea turaco	*Tauraco persa*	NWD	Omnivore	Non-migrant	LC	2016
Galliformes	Numididae	Helmeted guineafowl	*Numida meleagris*	NWD	Omnivore	Non-migrant	LC	2018
Pelecaniformes	Ardeidae	Intermediate egret	*Ardea intermedia*	WD	Omnivore	Full migrant	LC	2016

Columbiformes	Columbidae	Laughing dove	*Spilopelia senegalensis*	NWD	Granivore	Resident migrants	LC	2018
Charadriiformes	Jacanidae	Lesser jacana	*Microparra capensis*	WD	Insectivore	Non-migrant	LC	2017
Gruiformes	Rallidae	Lesser moorhen	*Paragallinula angulata*	WD	Insectivore	Resident	LC	2016
Passeriformes	Pycnonotidae	Little greenbul	*Eurillas virens*	NWD	Frugivore	Attitudinal migrant	LC	2016
Accipitriformes	Accipitridae	Lizard buzzard	*Kaupifalco monogrammicus*	NWD	Carnivore	Non-migrant	LC	2016
Coraciiformes	Alcedinidae	Malachite kingfisher	*Corythornis cristatus*	WD	Carnivore	Resident migrants	LC	2016
Passeriformes	Corvidae	Pied crow	*Corvus albus*	NWD	Scavenger	Resident	LC	2017
Coraciiformes	Alcedinidae	Pied kingfisher	*Ceryle rudis*	WD	Piscivores	Non-migrant	LC	2017
Passeriformes	Sturnidae	Purple starling	*Lamprotornis purpureus*	NWD	Omnivore	Non-migrant	LC	2018
Columbiformes	Columbidae	Red eyed dove	*Streptopelia semitorquata*	NWD	Granivore	Resident migrants	LC	2016
Passeriformes	Ploceidae	Red-vented malimbe	*Malimbus scutatus*	NWD	Insectivore	Non-migrant	LC	2016

Cuculiformes	Cuculidae	Senegal coucal	*Centropus senegalensis*	NWD	Carnivore/insectivore	Non-migrant	LC	2016
Charadriiformes	Charadriidae	Spur winged lapwing	*Vanallus spinosus*	WD	Granivore/Insectivore	Non-resident migrant	LC	2018
Pelecaniformes	Ardeidae	Squacco heron	*Ardeola ralloides*	WD	Carnivore	Resident migrants	LC	2018
Passeriformes	Malaconotidae	Tropical boubou	*Laniarius aethiopicus*	NWD	Insectivore	Non-migrant	LC	2016
Passeriformes	Cisticolidae	Twany flanked prinia	*Prinia subflava*	NWD	Insectivore	Non-migrant	LC	2016
Passeriformes	Ploceidae	Vieillot's black weaver	*Ploceus nigerrimus*	NWD	Granivore	Non-migrant	LC	2016
Piciformes	Lybiidae	Vieillot's barbet	*Lybius vieilloti*	NWD	Frugivore	Non-migrant	LC	2016
Columbiformes	Columbidae	Vinaceous dove	*Streptopelia vinacea*	NWD	Granivore	Migrants	LC	2016
Passeriformes	Ploceidae	Village weaver	*Ploceus cucullatus*	NWD	Granivore/Insectivore	Non-migrant	LC	2018
Pelecaniformes	Ardeidae	Cattle egret	*Bubulcus ibis*	WD	Omnivore	Full migrant	LC	2016
Musophagiformes	Musophagidae	Western plantain eater	*Crinifer piscator*	NWD	Frugivore	Non-migrant	LC	2016

Anseriformes	Anatidae	White faced whistling duck	*Dendrocygna viduata*	WD	Omnivore	Full migrant	LC	2016
Coraciiformes	Alcedinidae	Woodland kingfisher	*Halcyon senegalensis*	WD	Insectivore/Carnivore	Full migrant	LC	2016
Passeriformes	Pycnonotidae	Yellow throated greenbul	*Atimastillas flavicollis*	NWD	Carnivore	Non-migrant	LC	2016
Accipitriformes	Accipitridae	Yellow billed kite	*Milvus aegyptius*	NWD	Carnivore			
Passeriformes	Laniidae	Yellow billed shrike	*Corvinella corvina*	NWD	Insectivore	Non-migrant	LC	2016
Passeriformes	Ploceidae	Yellow mantled widowbird	*Euplectes macroura*	NWD	Insectivore	Non-migrant	LC	2016
Piciformes	Lybiidae	Yellow rumped tinkerbird	*Pogoniulus bilineatus*	NWD	Frugivore/Insectivore	Non-migrant	LC	2016
Passeriformes	Motacillidae	Yellow throated longclaw	*Macronyx croceus*	NWD	Insectivore	Non-migrant	LC	2016

Appendix 4: PICTURES OF SOME BIRDS ENCOUNTERED

Common Moorhen *Gallinula chloropus* and Purple Swamphen *Porphyrio porphyrio*

Black Crake *Amaurornis Flavirostra*