Assessment of Diversity and Richness of Avian Species within the Habitats of Eleiyele and Awba Dams Ibadan, Nigeria

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Abstract

It has been demonstrated that using birds to identify priority sites for conservation action and mitigation measures is an effective method. Between March and June of 2022, a field survey of birds was carried out in the Awba and Eleiyele dams in Oyo State, Nigeria, to ascertain the species diversity, abundance, and feeding guilds. The Line Transect Approach was used to acquire the data. Based on the species, migratory or non-migratory status, and feeding guild of the birds observed throughout the survey, different groups of birds were identified. The two dams' respective mean bird densities were calculated and compared using a t-test, and PAST software was used to examine species diversity indices. A total of 2,152 birds from 59 species (33 families and 12 orders) were counted, with 1,286 (59.76%) of them at Awba Dam and 866 (40.24%) at Eleiyele Dam. *Vanellusspinosus* was the species with the highest abundance in the Awba dam (n = 72; 8.31%), whereas *Oriolusnigripennis* had the highest abundance in the Eleiyele dam (n = 204; 15.86%). There was no discernible difference between the bird densities at Awba Dam (51.44 birds/km2) and Eleiyele Dam (30.95 birds/km2) (t value=1.679; p=0.097). Black-winged orioles were more numerous (8.16 birds/km2) at Awba Dam than Spur-winged lapwings were at Eleiyele Dam (72 birds/km2). Awba Dam has a higher Shannon diversity index and evenness score than Eleiyele Dam (3.102 and 0.654 vs. 3.702 and 0.862, respectively). In Eleiyele and Awba dams, the birds were divided into 10 and 8 feeding guilds, respectively. Insectivores (27, 33%) and carnivores (15, 19%) were the most commonly reported species. Two dams could potentially serve as locations for avian tourism and conservation due to their high avian richness if they are properly managed. In order to ensure the ecosystem's survival, it is advised that a strategy for avian conservation be implemented into the dam management programme.

Keywords: Bird density, Avitourism, avian conservation, Feeding guilds, Ibadan birds

Introduction

More than half of the world's wetlands have been lost due to historical and current rates of land alteration (Ma et al. 2010, Zedler and Kercher 2019), which has had an impact on species that depends on wetlands for survival (Paracuellos and Tellerá 2019). Worldwide efforts are being conducted to preserve significant wetlands at the national and international levels (Ibrahim and Aziz 2012; Tiéga 2018). Worldwide, more than 2020 wetlands totaling around 215 million ha have been recognised as Ramsar areas. Many of those wetlands are man-made (Zedler and Kercher 2019); they can range in size and other biophysical characteristics from small agricultural ponds to large water reservoirs (Sebastián-González et al. 2010; Lawler 2020; Sebastián-González et al. 2010; Hsu et al. 2018). The creation of artificial wetlands has the

potential to play a critical complementary role in biodiversity conservation (Márquez-Ferrando et al. 2014, Karakas 2017, Bellakhal et al. 2017), the maintenance of ecosystem services (Yang et al. 2008, Walton et al. 2015), as well as other adverse environmental effects (Winemiller et al. 2016, Poff et al. 2018).

According to Colwell and Taft (2020), water bodies are regarded as a crucial component that influences the population, diversity, and distribution of birds by influencing the aquatic flora, composition, and food resources. Water birds depend on wetlands, which sustain a wide variety of water bird groups (Grimmett and Inskipp 2018). Locals used the wetlands for a variety of livelihood-related activities, including fishing, farming, irrigation, bathing, grazing, and grass cutting, all of which contributed to the degradation of the wetland ecosystem and resulted in the loss of aquatic avifauna habitat (Manakadan et al. 2018). A wide variety of aquatic ecosystems are included in wetlands. Despite their smaller size when compared to marine and terrestrial biomes, they are among the most populous places on earth and are widely acknowledged as biodiversity hotspots (IPCC 2019).

According to Finlayson and Davidson (1999), wetlands make up more than 1,280 million hectares, or less than 3% of the Biosphere's total biome area. The productivity, endemism, and overall high specific richness of many wetlands, such as Ramsar sites, have a global conservation relevance. The most important point of reference for all three types of wetlands—marine/coastal, inland, and artificial—is water management (Odewumi et al. 2017, Kyohei and Toshio 2013). The main purposes of water reservoirs are for irrigation, agriculture, drinking water, energy production, flood prevention, recreation, and fishing. On the other hand, because of bird migration, these water reservoirs might be able to make up for lost natural wetlands and water plots (Kyohei and Toshio 2013).

Human activities influence the habitats of wildlife, and many development initiatives result in significant landscape changes. Many landscape changes, such as the building of water reservoirs, can result in the extinction of certain species or populations, as well as a decrease in the size and density of some populations (Ackermann et al. 1973).

Worldwide, there are more than 48,000 sizable dams that provide supplies of drinking water, produce hydroelectric power, irrigate land, and avoid floods (WWF 2016). In spite of the fact that more construction projects are being undertaken to suit the demands of the growing world population, there is growing worry over the long-lasting negative environmental effects of such hydrological infrastructure (Junk et al. 2013, Sun et al. 2012, WWF 2016). Large dams and barrages split apart river basins, causing the deterioration of complex ecosystems, the loss of important ecosystem services, and a decrease in biodiversity (Hagenmaier et al. 2016, Atnafu et al. 2018). 15% (50) of the 338 Important Bird and Biodiversity Areas (IBAs) around the world that BirdLife International categorised as "in Danger" (IBAs under very high pressure right now and in need of rapid action) are threatened.

Due to their need on yearly flooding to maintain ecosystem function, wetlands are particularly vulnerable to the presence of dams and river management activities (Junk et al. 2012; Sun et al. 2012). (BirdLife International, 2017) Nearly all (48) of the IBAs that are under risk from damming include wetlands, with 58% of them comprising or overlapping Ramsar wetlands

sites. As a result, a variety of waterbirds that depend on these wetlands, such as the Critically Endangered Siberian Crane (Grus leucogeranus) and Vulnerable White-naped Crane (Antigone vipio), have been negatively impacted by declining wetland water levels (BirdLife International 2017). Thus, it is crucial to conduct avifaunal research at the Eleiyele and Awba dams to protect biodiversity and its habitat.

Materialand Methods

Study Sites

This study was conducted near the Eleyele and Awba dam habitats in the Iddo and Ibadan North Local Government Areas of Ibadan, respectively, in Southwest Nigeria.

Eleyeledam

The site is situated between Latitude 7o20' and 7o25'N and Longitude 3o51' and 3o56'E in Ibadan, Nigeria. According to Ayeloja et al. (2014), it is situated in the Northwestern section of the city core of Ibadan, bordered by the Eleyele built-up area in the south, Apete in the east, Awotan in the north, and Ologuneru in the north-west. The dam is the second-largest body of water after Asejire that was built to provide water to the city of Ibadan and its surroundings. Additionally, it serves as a convenient supply of water for illustrious businesses like Fan milk Plc. In order to supply Ibadan city with raw water that would be treated for potable water, the dam was built in 1962 through an impoundment on the Ona River (Bolaji, 2010). After the Ona River's confluence with the Alagbaa River, the dam was built across the river. In order to prevent Eleyele Dam from siltation and to also act as an electricity pole, the Department of Forestry subsequently created a forest reserve there (Agbede&Ojelabi, 2017).

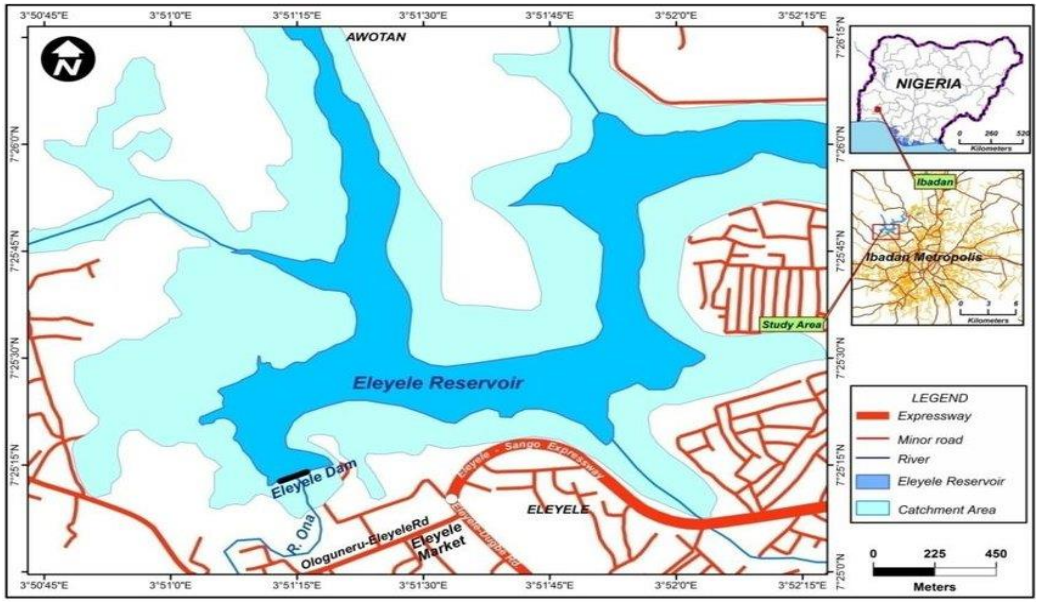

Figure 1: Map showing Eleiyeledam

Source: field survey 2022

Awba dam

According to Oduwole (1990), the location is situated in the southern part of the University of Ibadan campus (7o 26' N, 3o 53' E).According to Ugwumba (1990), it is located at a height of roughly 185 metres above sea level. It was built in April 1964 by damming the Awba stream with the sole purpose of retaining water for home use, research, and the production of table fish. Research on hydrobiology and fisheries also uses it (Ogundele, 1990). The amount of the dam that is filled with water fluctuates depending on the season and the pattern of rainfall. The water is calm, with sporadic mild multidirectional currents brought on by the breeze. The water is entropic and has very little turbidity (Hassan, 1974). The Reservoir has a surface area of 6 ha. According to Ugwumba (1990), the Reservoir is 8.3 m high, 110 m long with a crest of 12.2 m high. It has a maximum depth of 5.5 m and a maximum length of 700 m. It can hold about 230 million litres of water (Omotosho, 1981). The mean daily air temperature is 24.6°C. However, it became a site for tourism in 2018, and was christened Awba Dam Tourism Centre (University of Ibadan Bulletin, 2018)

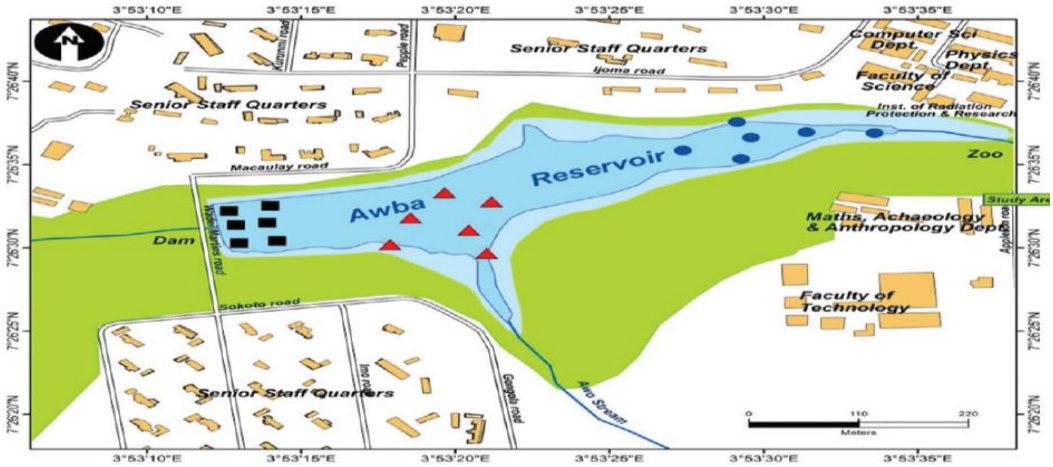

Figure 2: Map showing the Awba dam (green colour indicates the vegetation)

Source: field survey, 2022

DataCollection

The survey used the line transect technique as outlined by Bibby et al. (2020). Six transects were randomly distributed throughout the study area, three at each of the two dams (three transects total). Each transect had a constant width of 50 metres on either side and varied in length from 800 to 1000 metres depending on the local conditions. Twelve iterations of each transect were made. Each time, the researcher walked the transects gently and stopped every 200 metres for roughly 10 minutes to watch different bird species. Each point's precise location was captured using a GPS (Garmin 77). In the early mornings (0800–1000 h), the afternoons (1200–1400 h), and the nights (1600–1800 h), surveys were conducted. All birds heard or observed, even those in flight, were noted. Olympus binoculars were utilised to watch birds, and a Sony voice recorder was used to capture bird cries. An online database (www.xeno-

canto.org/explore) was used to find the calls. Using common field guides to West African birds, such as Borrow and Demey (2008) and Odewumi and Ariyo (2018), birds were recognised up to the species level.

SpeciesDiversityIndices

Species diversity was calculated using Shannon-Weiner diversity index, evenness and Simpson diversity index.

Bird abundance in the two dams was calculated using this formula

$$R=(\frac{n}{N})*100$$

where, R=Relative abundance

n = numberof recorded bird species N = totalnumberofbirds observed

Statisticalanalysis

Data were acquired, and both descriptive and inferential analysis were performed on them. The statistical programme PAST (Paleontological Statistics software package for teaching and data analysis) (version 16) was used to calculate diversity indices. A t-test was used to establish the significance of mean bird density in the two dams, and a One-Way ANOVA was employed to test the significance of bird diversity indices in the six locations at the two dams.

Results

Much of the banks of both lakes were overgrown with herbs interspersed by few trees. However, a total of 1897 trees were enumerated in 160 families, distributed among 22 genera with 24 species.

Table 1: Relative Abundance of Identified Tree species types at Awbadam

Family	Species	Common name	Local name	Origin	Freq	%
Fabaceae	*Afzeliabella*	Afzelia	Apa	Indigenous	41	2.1
Apocynaceae	*Albizia lebbeck*	East Indian walnut	Ayunre	Exotic	73	3.6
Anacardiaceae	*Alstoniaboonei*	Alstonia	Awun	Indigenous	101	5.2
Meliaceae	*Anacardium occidentale*	Cashew	Kaju	Exotic	69	3.1
Leguminoceae	*Azadirachta indica*	Neem	Dogonyaro	Exotic	43	2.1

Myrtaceae	*Delonix regia*	Flame of the forest	Panseke	Exotic	111	6.2
Euphorbaiceae	*Eucalyptus amaldulensis*	Redgum	-	Exotic	61	3.1
Irvingiaceae	*Elaeisguinensis*	Palm tree	Ope	Indigenous	132	7.2
Meliaceae	*Ervingiagabonensis*	Bush mango	Ooro	Indigenous	56	3.1
Meliaceae	*Khaya grandifolia*	African mahogany	Oganwo	Indigenous	97	5.2
Verbanaceae	*Khaya senegalensis*	African mahogany	Oganwo	Indigenous	113	4.6
Anacardiaceae	*Gmelina arborea*	White teak	-	Exotic	127	7.7
Fabaceae	*Lannea egregia*	Lannea	Opon	Exotic	65	3.6
Moraceae	*Leucaena leucochephala*	Leaucaena	-	Exotic	139	7.2
Moringaceae	*Milicia Excelsa*	Iroko	Iroko	Indigenous	54	2.5
Pinaceae	*Moringa oleifera*	Moringa	Ewe-igbale	Indigenous	67	3.1
Mangiferaceae	*Minus caribeae*	Pitch pine	Aho-yaayaa	Exotic	51	2.5
Sapotaceae	*Mangifera indica*	Mango	Mangoro	Exotic	89	4.6
Arecaceae	*Chrysophyllum albidum*	African white star apple	Agbalumo	Indigenous	35	2.1
Sterculiaceae	*Roystonea regia*	Royal palm	-	Exotic	71	2.5
Vernebaceae	*Sterculia setigera*	Karaya gum	Osse awere	Indigenous	57	3.1
Combretaceae	*Tectonia grandis*	Teak	Ewe eko	Exotic	71	4.1
Combretaceae	*Terminalia catapa*	Tropical almond	Furuntu	Indigenous	131	6.2
Terminalia africana	*Terminalia africana*	White afara	Idigbo	Indigenous	102	5.2
	Total				1897	100.0

Source: Field Survey, 2022

BirdSpeciesComposition andRichness

Eleiyele and Awba dams recorded a total of 59 bird species in 29 families and 8 orders (Table 1). There were 36 species in total in Eleiyele Dam, distributed among 16 families and 11 orders. 34 species from 13 families and 11 orders were present in Awba Dam. There were fourteen (14) species that were present at both dams, including the Broad-billed Roller (*Eurystomusglaucurus*), Common Bulbul (*Pycnonotus barbatus*), Diederik Cuckoo (*Chrysococcyxcaprius*), Green-headed Sunbird (*Cyanomitraverticalis*), Lizard Buzzard (*Kaupifalcomonogrammicus*), Purple Starling (*Lamprotornispurpureus*), Redeyeddove (*Streptopeliasemitorquata)*, Senegalcoucal (*Centropussenegalensis)*, Spur-winged lap wing (*Vanellusspinosus)*, Tawny-flankedprinia *(Priniasubflavai)*, Village weaver (*Ploceuscucullatus)*, Grey-backed camaroptera (*Camaroptera brachyuran*), Little green bul (*Andropadusvirens*) and Yellow-fronted Tinkerbird (*Pogoniuluschrysoconus)*. Thirty-three (33) species were found onlyat Eleiyele dam and 21species were exclusive to Awba dam.

Bird Species Abundance at Eleiyele and Awba Dams

During the current survey, 2152 distinct birds were counted at Eleiyele dam (n = 1286, 59.76%) and Awba dam (n = 866, 40.24%). Spur-winged Lapwings were the most prevalent bird in Eleiyele Dam (n = 72; 8.31%), followed by Village Weavers (n = 38; 4.39%), and Chestnut-breasted Nigritas (n = 1, 0.12%). Black-winged Orioles were the most prevalent bird at Awba Dam (n = 204; 15.86%), followed by Common Bulbuls (n = 165; 12.83%), and Great Cormorants (n = 2; 0.16%) (Table 1). Awba Dam has a higher average bird density than Eleiyele Dam (30.95 birds/km2) (51.44 birds/km2). There is no discernible difference in bird density between the two dams, according to a homogeneity test (t=1.679; p=0.097). But the Black-winged Oriole had the largest number at Awba Dam (8.16 birds/km2), while the Spur-winged Lapwing had the highest density at Eleiyele Dam (72 birds/km2).

Table 2: Some avian species identified during the study within the study sites

Family	Scientific Name	Species	ED	AD	ED	AD
Accipitridae	*Accipiter badius*	Shikra	_	_	X	_
Accipitridae	*Kaupifalcomono gramminus*	Lizard Buzzard	x	X	X	x
Accipitridae	*Polyboroides typus*	African Harrier Hawk	_	_	_	x
Accipitridae	*Milvus migrans*	Yellow-billed Kite	x	X	X	x
Falconidae	*Falco ardosiaceus*	Grey Kestrel	_	X	_	_
Accipitridae	*Accipiter tachiro*	African Goshawk	x	_	X	_
Accipitridae	*Elanus caeruleus*	Black-shouldered Kite	x	_x	x_	x

Source: Field Survey, 2022 *NB: x = sighted and/or heard, - = not sighted and/or heard*

Diversity Indices

Awba Dam had greater Shannon-Weiner and Simpson diversity indices than Eleiyele Dam (3.102 and 0.935, respectively) (3.702 and 0.971). According to the diversity t-test, there is no discernible difference between the two sites' bird species diversity (t=1.3613; p=0.177). According to Shannon Wiener, the bird species evenness was likewise found to be marginally higher at Awba Dam (0.862; 0.654) than at Eleiyele Dam (0.23; 0.57). In contrast, Eleiyele Dam (0.065) had higher species dominance than Awba Dam (0.029) (Figure 1).

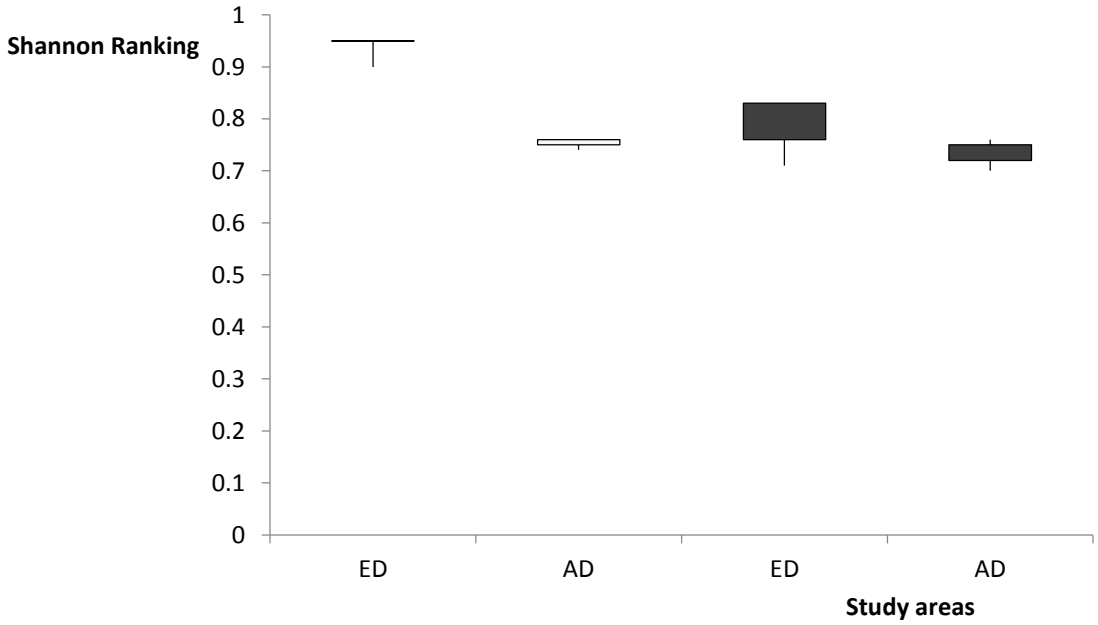

Figure 1: Bird species evenness across habitats during the study period.
Source: Field Survey 2022

Feeding guildsofbirdspeciesrecorded at the twodams

In Eleiyele and Awba dams, the birds were divided into 10 and 8 different feeding guilds, respectively. However, more insectivores (n=16; 34.04%; n=11; 32.35%) make up the bird species near the two dams. According to Table 3, there are few piscivores in the two dams (n=4; 8.51% and n=3; 8.82% in Eleiyele and Awba dams, respectively).

Table 3: Proportion of birds in different feeding guilds at the two dams

Feeding guilds	Eleiyeledam	Awba dam
Carnivores	0.281	0.923
Frugivores	0.568	0.233
Granivores	0.434	0.214
Insectivores	0.347	0.346

Omnivores	0.445	0.385
Insectivores/frugivores	0.346	0.583
Insectivores/granivores	0.443	0.832
Insectivores/nectarivores	0.115	0.283
Nectarivores	0.124	0.923
Piscivores	0.908	0.273
Scavengers	0.543	0.673

Source: Field Survey, 2022

Plate 1: Kingfisher

Source: Field survey, 2022

Plate 2: Harris Hawk

Source: Field survey, 2022

Plate 3: Young Lizard Buzzard

Source: field survey, 2022

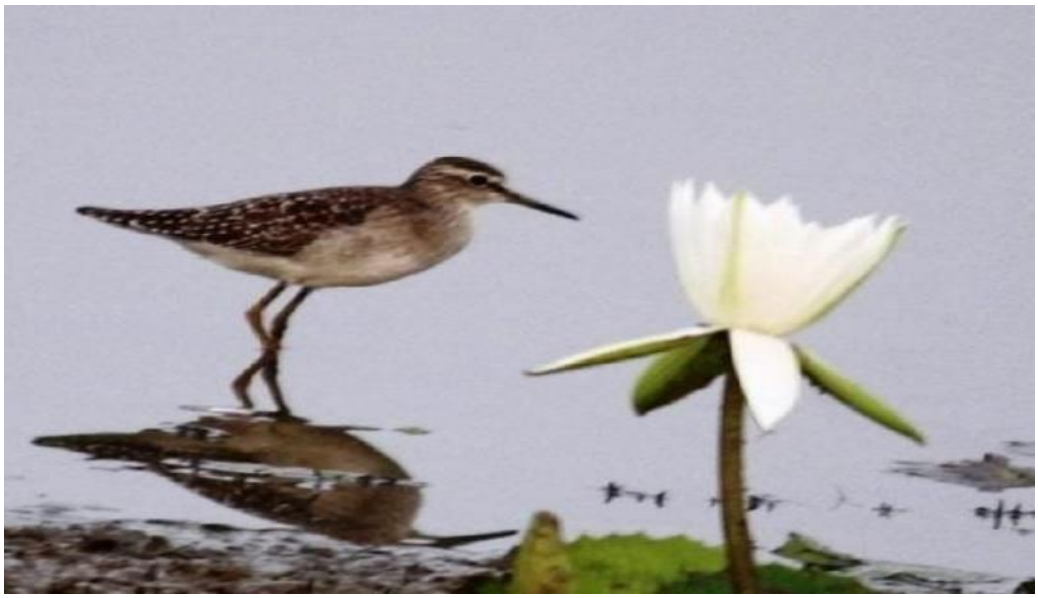

Plate 4: African Jacana

Source: Field survey, 2022

Plate 5: Senegal Cougal

Source: Field survey, 2022

Plate 6: Ibadan Malimbe

Source: Field survey, 2022

Plate 6: White-faced Whistling Duck

Source: Field survey, 2022

Discussion

Some species are confined to specific types of habitat while others are allowed to be widely dispersed due to differences in the resources that are available in different habitats, such as nesting locations, roosting materials, cover, food, and water (Ramsar Convention Bureau 2020). Although there are many different bird species in the two dams, Eleiyele dam recorded the most bird species, followed by Awba dam. This confirms the findings of Giosa et al. (2018), who found that while manmade wetlands have the capacity to support communities with a similar level of diversity, natural wetlands typically support more species and higher abundances. Additionally, it falls within the range of the birds that Lodhi & Rao (2017) saw at Samoha Dam.

The African Jacana, Grey-backed Heron, Spur-winged Lapwing, White-headed Lapwing, White-faced Whistling Duck, and Cormorants are just a few of the bird species that are completely or partially dependent on water. Egrets are another example.

In addition, some bird species, like the Red-eyed Dove, Vinaceous Wood Dove, Broad-billed Roller, Common Bulbul, and Village Weaver, rely on the local flora for habitat, nesting places, and food. According to Payne and colleagues (1989), Green and Baker (2019), Weins (1997), and Odewumi et al. (2017), the presence of a species in a particular habitat patch is influenced by a variety of factors, including that patch's food supply, water availability, habitat suitability, and climatic conditions. The IUCN Red List of 2017 placed every bird sighted near the two Dams in the Least Concern category. The dam ecology must to be maintained, though, in order to protect the birds that live there. During the survey, the African Jacanas were primarily located along the shallow section of the Awba dam.

On the vegetation on the lake, birds like the White-faced whistling duck were discovered, while Spur-winged Lapwings were strewn throughout the shoreline. The Awba dam's centre was home to a big population of Black-winged Orioles that were nesting there. This indicates that the variety of bird species observed was due to their propensity to inhabit or utilise various portions of the dam. This is consistent with the assertion made by (Sebastián-González and Green 2014) that water depth is significant because it affects habitat accessibility, as well as the claims made by Ma et al. (2010) and Guadagnin&Maltchik (2018) that shallower wetlands typically have more species because they are better suited to a wider range of non-diving water birds, which cannot forage in deep waters. According to Hamilton et al. (2017), many bird species will utilise farm dams in various ways. Dams can be crucial feeding locations for some species while acting as safe havens or permanently moist drought refuges for others.

Awba Dam's increased abundance, density, and diversity indices can be linked to the dense vegetation that surrounds it and the area's relatively untouched riparian forest, which provides cover for farming activities and serves as a roosting spot for birds. According to Fahrig et al. (2010), Chace and Walsh (2019), and Sandstrom et al. (2019), more vegetation supports a wider variety of bird species. The marshy terrain and shallow open water support a diversity of aquatic and semi-aquatic flora, which gives wetland birds a good range of food sources and a comfortable place to live (Arya et al. 2014). The overall recorded bird densities fell within the range of densities noted by Odewumi& Ariyo (2018). The distribution of different bird species

into various guilds of feeders is a sign that the ecosystem can support birds with a variety of niches. Wetlands offer birds a variety of food sources (such as amphibians, fish, and aquatic invertebrates like snails, insects, larvae, crustaceans, and aquatic annelids), protection from predators, and potential nurseries for their chicks, according to Odewumi and Ariyo (2018), Okagbare and Adeyanju (2018). This is in line with the findings of Nikunj et al. (2013), who suggested that varying species richness and evenness could be caused by differing eating behaviours and habitat layout. It also agrees with Joshi's (2012) claim that the presence of an abundant avifauna indicates that lakes are in good health. This is because lakes provide access to water, a safe habitat for adults and nestlings, food sources, and crucial nesting and roosting locations.

Conclusions

This study has demonstrated how the development of dams in the study regions has affected the composition and quantity of avian species (favouring more terrestrial species than water birds), as well as the presence of species associated with various habitat types and feeding patterns. Since the two locations are both rich in diversity and richness, it is advised that avian conservation be implemented there. To keep track of potential changes to wetland habitats in the future, the sites need to be regularly monitored.

References

AckermannWC,WhiteGF,WorthingtonEB.1973.(eds.)Man-madelakes:Theirproblems andenvironmentaleffects.*GeophysicalMonograph*17.AmericanGeophysicalUnion, Washington.847pp.

AryaM,RaoRJMishraAK2014.Avifaunaloccurrenceanddistributionofwetlandbirdsin SakhyaSagarandMadhavlakesinMadhavnationalpark,Shivpuri,India.*Journalof Environmental Biology*(35):703-708.

AtnafuN.,DejenE,VijverbergJ.2018.Assessmentoftheecologicalstatusandthreatsof WelalaandShesherwetlands,LakeTanaSub-Basin(Ethiopia).*JournalofWaterResource Prot*3 (7): 540-547.

BalcombeCK,AndersonJT,FortneyRH,KordekWS.2019.Wildlifeuseofmitigationand referencewetlands inWest Virginia.*Ecological Engineering*25: 85–99.

BellakhalM,NeveuA,Fertouna-BellakhalM,AleyaL.2017.Artificialwetlandsastoolsfor frogconservation:stabilityandvariabilityofreproductioncharacteristicsinSaharafrog populationsinTunisianman-madelakes.*Environmentalscienceandpollutionresearch* 24:34.

BhadjaP,VaghelaA.2013.StudyonAvifaunaldiversityfromtwofreshwaterreservoirsof Rajkot,Gujrat,India. Int.*JournalofResearchinZoology*, 3(2):16-20.

BibbyCJ. 1999.Making the most ofbirds as environmentalindicators.*Ostrich* 70: 81-88.BibbyCJ,BurgessND,HillDA.2020.BirdCensusTechniques(2nded).AcademicPress:

London.pp: 265.

BirdLifeInternational.2017.Oneineightofallbirdspeciesisthreatenedwithglobal extinctionIUCNRedListforbirds.Downloadedfromhttp://www.birdlife.orgon 28/03/2019.

BoraleRP,PatilJV,VyawaharePM.1994.StudyofpopulationoflocalmigratoryAquatic birdsobservedin and around Dhule.*Maharastra*32: 81-86.

DavidOH,HarperAT,RyanPD.2020.PAST:PalaeontologicalStatisticsSoftwarePackage forEducation and Data Analysis.*PalaeontologiaElectronica* 4:4-9

DiamondAW,DevlinCM.2019.Seabirdsasindicatorsofchangesinmarineecosystems: EcologicalmonitoringonMachiasSeaIsland.*EnvironmentalMonitoringandAssessment* 88: 153-175.

FahrigL,BaudryJ,BrotonsL,BurelFG,CristTO,FullerRJ,SiramiC,SiriwardenaGM, MartinJ.2010.Functionallandscapeheterogeneityandanimalbiodiversityinagricultural landscapes.*Ecology Letters* 14:101–112.

FinlaysonCM,DavidsonNC.1999.GlobalReviewofWetlandResourcesandPrioritiesfor WetlandInventory,Summaryreport.*In*FinlaysonC.MandA.G.Spiers(eds).Supervising Scientist Report144,Canberra, 1-13.

GiosaE,MammidesC,ZotosS.2018.Theimportanceofartificialwetlandsforbirds:Acase studyfromCyprus.*PLoS ONE*13(5):e0197286. https

GreenDM,BakerMG.2019.UrbanizationImpactsonhabitatandbirdcommunitiesina SonoranDesert ecosystem.*Landscape Urban Planning*968:1-15

GrimmettR,InskippT.2018.HtlmfieldguidesBirdsofSouthernIndia.OmBooks International,NewDelhi,India. 240pp

GuadagninDL,MaltchikL.2018.Habitatandlandscapefactorsassociatedwithneotropical waterbirdoccurrenceandrichnessinwetlandfragments.*BiodiversityandConservation*16: 1231–1244.

HagenmaierE,MingoiaS.WorthenN.2016.ImpactofDam-ReservoirSystemsonWetlands withanemphasisonJohnRedmondReservoir.*WetlandEnvironment*April,2016.pp35. http://academic.emporia.edu/aberjame/student/hagenmaier1/reservoirs.

HamiltonAJ,ChloéConortAB,ChristopherGM,JamesRG.2017.Waterbirduseoffarm damsinsouth-easternAustralia:abundanceandinfluenceof biophysicalandlandscape characteristics.*AvianResearch* 8:2DOI10.1186/s40657-016-0058-x

HsuCB,HsiehHL,YangL,WuSH,ChangJS,etal.2018.Biodiversityofconstructed wetlands forwastewater treatment.*EcologicalEngineering*37: 1533–1545.

IbrahimI,AzizNA.2012.TheRolesofInternationalNGOsintheConservationofBio-DiversityofWetlands.*Procedia—Socialand Behavioral Sciences* 42: 242–247.

IPCC.2019.Climatechangeandbiodiversity.IPCCTechnicalPaperV,Geneva,Switzerland. 77 pp.

JoshiPS.2012.AnannotatedchecklistofaquaticavifaunaofRajura,GodadaandDhanora lakes ofBuldhana District (MS.)India.*Science ResearchReporter* 2(1):30-33.

JunkWJ,AnS,FinlaysonCM,GopalB,KvetJ,MitchellSA,MitschWJ,RobartsRD.(2013) Currentstateofknowledgeregardingtheworld'swetlandsandtheirfutureunderglobal climate change: asynthesis.*Aquatic Science* 75:151–67.

KarakasR.2017.Ornithologicalimportanceofartificialponds:acasestudyatKabaklıPond, southeasternAnatolia,Turkey.*PaddyandWater Environment*15:919–930.

KressSW.2020.*Birder'sHandbook(1stedition)*.DorlingKindersleyPublishing,Inc.,New York. 322pp. ISBN-10-0789451530

KyoheiB,ToshioH.2013.Waterstorage,transportanddistribution-"Environmentalimpact assessment ofdams andreservoirs". Encyclopedia of life supportsystems (EOLSS)Pp24.

Nikunj BG,ArunKRM,VijayKV. 2013.Status,Distribution,and Diversity ofBirds inMining EnvironmentofKachchh,Gujarat.*InternationalJournalofBiodiversity*(Volume2013, Article ID 471618, 11 pages)

OdewumiOS,HagherI,AgbelusiEA.2015.EffectofDevelopmentonAvianDiversityand AbundanceinFederalUniversityofTechnology,Akure,South-westNigeria.*Applied Tropical Agriculture*20 (1): 24– 30

Odewumi OS,Okosodo EF, TalabiO. 2017.DiversityandAbundance ofAvianSpeciesof OwenaMultipurposeDam,OndoState,Southwest,Nigeria. *Journalof Biodiversity, Bioprospectusand Development* 4 (1): 1-6.

OdewumiOS,AriyoO.2018.AvianConservationinman-madeWetland:Acasestudyof AsejireandEleyeleDams,OyoState,Nigeria.*Journal ofSustainableDevelopmentinAfrica* 20(2):17-32.

OkagbareOH,AdeyanjuAT.2018.AvifaunarichnessinaquatichabitatsoftheInternational InstituteofTropicalAgriculture,Ibadan,Nigeria.*JournalofResearchinForestry,Wildlife &Environment*10(1): 85-93.

ParacuellosM,Telleri´aJL.2019.FactorsAffectingtheDistributionofaWaterbird Community:TheRoleofHabitatConfigurationandBirdAbundance.*Waterbirds*27:446– 453.

PayneAIL,CrawfordRJM,VanDalsenA.1989.*OceansofLifeoffSouthernAfrica*.(1sted.). VlaebergPublishing.Pp494. ISBN-10-0947461019

PoffNL,OldenJD,MerrittDM,PepinDM.2018.Homogenizationofregionalriverdynamics bydamsandglobalbiodiversityimplications.ProceedingsoftheNationalAcademyof SciencesoftheUnitedStatesofAmerica104:5732–5737.https://doi.org/10.1073/ pnas.0609812104 PMID: 17360379.

PuriSD,ViraniRS.2016.AvifaunaldiversityfromKhairbandhaLakeinGondiadistrict,

SaubererN,ZulkaKP,Abensperg-TraunM,BergHM,BieringerG,MilasowszkyN,MoserD, PlutzarC,PollheimerM,StorchC,TrostlR,ZechmeisterH,GrabherrG.2019.Surrogate taxaforbiodiversityinagriculturallandscapesofeasternAustria.*BiologicalConservation* 117(2): 181-190.

Sebastián-GonzálezE,GreenAJ.2014.HabitatUsebyWaterbirdsinRelationtoPondSize, WaterDepth,andIsolation:LessonsfromaRestorationinSouthernSpain.*Restoration Ecology*22: 311–318.

SekerciogluCH.2019.Increasingawarenessofavianecologicalfunction.*TrendinEcology and Evolution*21(8):464-471.0

SunZ, HuangQ, OppC, HennigT, MaroldU.2012.Impacts and implications of major changes caused by the Three Gorges Damin the middle reaches ofthe Yangtze River,China. *Water Resource Management* 26:3367–3378.

ThomsonJR,FleishmanE,MacNallyR,DobkinDS.2018.Comparisonofpredictorsetsfor speciesrichnessandthenumberofrarespeciesofbutterfliesandbirds.*Journalof Biogeography* 34(1): 90-101.

Tie´gaA. 2018. Ramsar Conventionon Wetlands: 40 Years of Biodiversity Conservation and Wise Use.*Journal of InternationalWildlife Law &Policy*14: 173–175.

Vielliard JME. 2020.Bird Community as an indicator of biodiversity:Results from quantitative surveys in Brazil.*Anais DaAcademiaBrasileiraDe Ciencias*72(3), 323-330.

Walton M, Vilas C, CañavateJ, Gonzalez-Ortegon E, PrietoA,etal.2015. A model for the future: Ecosystem services provided by the aquaculture activities of Vetala Palma, Southern Spain. *Aquaculture* 448:382–390.

WeinsJA. (1997) Scientific Responsibility and Responsible Ecology. *Conservation Ecology*1 (1):16.