Diversity and Abundance of Avian Species of Owena Multipurpose Dam, Ondo State, Southwest, Nigeria

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Abstract

The use of wetlands and their resources is widespread among many diverse bird taxa of the world. The diversity and abundance of avian species in Owena Multipurpose dam was assessed out between January and June, 2016 to provide baseline information of the birds in this area. The line transects method with lengths ranging from 350 m-1000 m was adopted for the survey. Birds recorded were categorized into order, family, species, migratory status and feeding guild. Relative abundance of bird species and diversity indices were determined. Significance in mean bird density in the two seasons was determined using T-test while One-Way ANOVA was used to test for significance in bird diversity indices. A total of 35 bird species belonging to 20 families and 10 orders were recorded in the study area. The common species includes Ardea alba, Vanellus spinosus, Ardea cinerea, Phalacrocorax carbo, Milvus migrans, Ardea ralloides, Actophilornis africanus, Microcarbo africanus, and Bubulcus ibis. All the bird species recorded were in the Least Concern (LC) category. The bird species were categorized into seven feeding guilds. The granivores, insectivores and canivores were more in abundance than the nectarivores and frugivores. The order Passeriformes had the highest families (8) and species (17), followed by Pelecaniformes and Charadriiformes with 2 families each, 4 and 2 species respectively while others had one family each. The total mean number of bird was 428 ± 5.75/ observation. Lagonosticta sanguinodorsalis had the highest mean number (156.4/ observation) and relative abundance of 36.54% while Ardea cinerea and Phalacrocorax carbo had the lowest mean number (0.2/ observation) and relative abundance of 0.05% each. Transect 1 had the highest Shannon diversity index (H=1.664), while transect 3 had the least (1.168). All the transects had similar species evenness index except for transect 4. The findings can be attributed to the heterogeneity of the habitat resulting from alteration of the ecosystem through the construction of the dam. In conclusion, the Owena dam construction has both negative and positive impacts on avian species composition and abundance. The management programme of the Owena dam should incorporate avian conservation in the area.

Keywords: Wetland; Dam; Avian; Density; Diversity

Introduction

Birds have been considered as useful biological indicators because they are ecologically versatile and inhabit all kinds of habitats [1]. Wetlands are fringe habitats between terrestrial and aquatic ecosystems [2]. Many authors, notably Wilkinson, Berg, Beury, Ramsar believed that wetlands are highly important habitat for diverse fauna including mammals, birds, fishes, reptiles, amphibians, and aquatic invertebrates [2-4]. However, the importance of wetlands depend on many factors namely; wetland size, connectivity to surrounding areas, diversity of vegetation, water quality, food resources and topography [5]. According to James et al. the use of wetlands and their resources is widespread among many diverse bird taxa of the world. Birds use wetlands for breeding, nesting and teaching young, as a source of drinking water, for feeding, resting, shelter and for social interaction [6]. Wetlands provide food for birds in the form of plants, vertebrates, and invertebrates [4]. The aquatic avifauna is quite susceptible to the changes in wetlands. This helps us to know whether the area is ecologically healthy or getting polluted, as total absence of birds from an area may be considered as pollution indication or human disturbance such as excessive hunting or human pressure [7]. Submerged vegetation can attract a higher number of migratory birds in freshwater bodies [8]. According to the relation between wetlands and birds is shaped by many factors [9]. These include the availability, depth, and quality of water; the availability of food and shelter; and the presence or absence of predators. Birds have daily and seasonal dependencies on wetlands for food and other life-support systems. Niemi stated that avian adaptations to utilize wetlands and other aquatic systems are diverse and include anatomical, morphological, and behavioral changes [10]. James et al. stated that because numerous bird taxa depend on these critical habitats, wetlands are important components in the conservation and management of continental populations of ducks, shorebirds, and other wetland-dependent species [11].

In all the three types of wetlands (marine/coastal, inland or man-made), the most significant point of reference is water management. The water demand in Ondo State, Nigeria increased tremendously over the years rendering the facility to become grossly under-dimensional for the intended towns and villages, a development that called for a much larger supply scheme. Consequently, the Ondo State Government in 1976, commissioned the design of the Owena River Dam with the objective of supplying raw water from the resulting reservoir for the existing water scheme, but taken over by the Federal Government of Nigeria (through Benin-Owena River Basin Development Authority) and converted it to a multipurpose use in line with the functions of the River Basin Development Authorities. The design was reviewed to include in addition to provision of potable water, usage for irrigation

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of 3000 hectares of farmland, fisheries, as well as generation of hydro-electric power. The dam, sited on the Owena River about 14 km upstream of the old Owena water scheme, was designed to create an impoundment of 36.25 million cm³ gross capacity, covering an area of approximately 7.38 km² at the normal water level [12].

Construction of large dams have led to the extinction of many aquatic species, the disappearance of birds in floodplains, huge losses of forest, wetland and farmland, erosion of coastal deltas, and many other inmitigable impacts. Consequently, habitat loss and alteration causes the degradation of breeding sites, water level stabilization, sedimentation, nutrient inputs, invasion of exotic plants and animals [13-15]. Therefore, species’ responses to habitat loss are a central issue of contemporary conservation biology [16]. This study will make comprehensive baseline information of the birds in this area for the future as well as to create awareness for their conservation in the area.

Materials and Methods

The study area

The study area The Owena Multipurpose Dam is located at Km10, off Akure-Ilesha Road, Igbara-Oke in Ifedore Local Government Area of Ondo State, Nigeria (Figure 1) between latitude 7°15’N, longitude 5°5’E and latitude 7°4’N, longitude 4°47’E in south west Nigeria. The dam is about 300 m long and 9 m in its deepest part. It covers an area of about 790 sqkm. The dam is supplied with water from the Owena River and it covers an appropriate surface area of 7.8 sq km. Currently, the water from the dam is to feed the 60,000 m³/day capacity water treatment plant built beside the dam. Fishing activities by registered local fishermen are also presently taking place within the dam lake [12]. The annual mean temperature is 27.3°C, annual rainfall ranges from 1150 mm-2000 mm. Some common plant species in the area includes, nymphaea alba, eichhornia crassipes, ludwigia peploidies, panicum rapens, anacardium occidentale, ficus capensis, albizia zygia, polygonum lanigerium and also have different species of reptiles and amphibians.

Data collection

The line transect method as described by Bibby et al. was adopted for the survey. A total of five transects were placed at existing paths, tracts, and the river bank in the study area [17]. The length of each transect varied and ranged from 350 m-1000 m depending on the prevalent situation in the area. The transects were visited thrice. During each visit, transect were walked slowly and at every 50 m interval the observer stop for some minutes (10 minutes) to observe bird species. Readings were taken at intervals of each point with the help of Global Positioning System (GPS).

Surveys were carried out during early mornings (7.00-10.00 hr) and the evenings (16.00-18.30 hr.). The start time and end time for each

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transect was recorded. All birds observed or calls heard and recorded including those in flight were identified. A pair of binocular (Barska 8 x 32 with 8MP Digital camera) was used to aid in the identification of birds sighted while voice recorder (Sony digital voice recorder) was used to record bird calls and later played back to confirm through the call of birds downloaded. Birds recorded were categorized to species, family and order with the aid of field guide book on West African Birds by [18.

**Bird status and feeding guilds**

Birds sighted during the survey were categorized based on their migratory nature as follows: Resident Migrant (RM), Resident (R), and Migrant (M) according to Teneson and Ravichandran as well as their conservation status following IUCN Red Data list of species (2016 version). The feeding guilds of the birds was categorized into Insectivores (I), Nectarivores(N), Omnivores (O), Scavengers (S), Frugivores (F), Carnivores, Piscivores (P), and Granivore (G) according to Odewumi et al. and Nikunj et al. [19,20.]

**Calculations**

Relative abundance (%) of bird species was calculated using the expression:

\[
\text{Relative abundance} = \left( \frac{n}{N} \times 100 \right)
\]

Where \( n \) = Number of recorded bird species

\( N \) = Total number of birds observed [21].

**Diversity Index:** Shannon-Weiner diversity index was calculated using PAST (Paleontological statistics software package for education and data analysis) statistical software [v. 16]. The equation is given as:

\[
H' = - \sum_{i=1}^{S} \left( P_i \ln P_i \right)
\]

Where;

\( P_i \) = proportion of individual species

\( S \) = Total number of species of the site. (I.e. number of species sighted)

\( i \) = no of individual species.

**Statistical Analysis**

Data obtained were analyzed by both descriptive and inferential analysis. Diversity indices were determined using the PAST (Paleontological statistics software package for education and data analysis) statistical software [v. 16] [11]. Significance in mean bird density in the two seasons was determined using T-test while One-Way ANOVA was used to test for significance in bird diversity indices in the four transects.

**Results**

A total of 35 bird species belonging to 20 families and 10 orders were identified and recorded in the study area. The common species in the study area includes Great egret (Ardea alba), Spur winged lapwing (Vanellus spinosus), Grey heron (Ardea cinerea), Great cormorant (Phalacrocorax carbo), Black Kite (Milvus migrans), Squacco heron (Ardeola ralloides), African jacana (Actophilornis africanus), Long Tailed Cormorant (Microcarbo africanus) and Cattle egret (Bubulcus ibis) as shown in Table 1. However according to IUCN 2015 status categorization all the bird species recorded were in the Least Concern (LC) category. The table also shows that bird species were categorized into seven feeding guilds; Insectivores, Frugivores, Omnivores, Nectarivores, Granivores, Piscivores and the Carnivores. The order Passeriformes had the highest number of families (9) and species (17). This was followed by Pelecaniformes and Charadriiformes with 2 families each, (4) and (2) species respectively. The Columbiformes, Coraciformes, Suliformes, Accipitriformes, Cuculiformes, Galliformes and Anseriformes had one family each as shown in Table 2.

The hirundinidae family (Figure 2) had the highest number of species (6) of the total number of bird species observed in the study area. The Ardeidae family had (4) species, Columbidae, and Meropidae families had (3) species, Estrildidae, Ploceidae and Phalacrocoracidae had (2) individual species, the families Motacillidae, Jacanidae, Passeridae, Pycnonotidae, Cuculidae, Accipitridae, Bucerotidae, Charadriidae, Viduidae, Corvidae, Nectariniidae and Anatidae had one species each.

The total mean number of bird was 428 ± 5.75 individuals per observation (Table 3). However Fire finches (Lagonosticta sanguinolentus) had the highest mean number (156.4 per observation) and relative abundance of 36.54% (n=782). This was followed by village weaver (Ploceus cucullatus) with mean number of (136.6 per observation) and relative abundance of 31.92% (n=683). In contrast, grey heron (Ardea cinerea) and great cormorant (Phalacrocorax carbo) had the lowest mean number (0.2 per observation) and relative abundance of 0.05% each.

The result of the diversity index (Table 4) revealed that transect 1 had the highest Shannon diversity index (H’=1.664), followed by transect 5 (H’=1.510), transect 4 had (H’ =1.391), and transect 2 had (H’=1.240); while transect 3 had the least value (H’=1.168). All the transects had similar species evenness index except for transect 4.

**Discussion**

Wetlands are of great variety and birds’ adaptation as well as usage of wetland environment varies greatly from species to species. Differences in resources availability between habitats such as breeding sites, roosting materials, cover, food and water restricts some species to certain type of habitat while allowing others to be widely distributed. The study recorded 35 species of birds some of which are dependent on wetland such as jacana, herons, sparrow winged lapwing, egrets, white faced whistling duck, cormorants. Others such as weavers, finches, swallows, bee-eaters, whydahs, and mannikins are not wholly dependent on the dam. Though all the bird species recorded were under the Least Concern category of IUCN Red Data List, however, there is the need to ensure that the birds are conserved so that the local population will not decline. Bird species diversity index was low in the area but higher number of bird species and individuals were recorded in transect 1 and 5 which is located in open areas where structures such as buildings, electric poles and wires, and farmlands which have more grasses and shrub cover than in the other three transects (2, 3 and 4) along the banks of the dam. This agrees with the finding of Clergeant et al, Chale, Wash, Sandstorm et al [22-24]. that human disturbed areas provide heterogeneous habitats which attracts human tolerant bird species. Species that can co-exist with humans such as mannikins, swallows, pied crow, village weaver, common bulbul, finches etc. were recorded in the two transects.

Birds like white faced whistling duck were found on the vegetation on the water while spur winged lapwing were found at scattered shores. The grey heron recorded was found on a tree. The squacco heron were found during the survey majorly on the bare ground feeding along the mudflats on fishes and other vertebrates. However, African
vegetation. This can be attributed to the heterogeneity of the habitat
floating vegetation to pick up insects and vertebrates from the floating
jacanas' were found mostly around shallow area of the dam walking on

Citation:
S/N COMMON NAME ORDER FAMILY SCIENTIFIC NAME FEEDING GUILD MIGRATORY STATUS IUCN STATUS (2015)

1 Grey heron Pelecaniformes Ardeidae Ardea cinerea Carnivore Resident migrants LC
2 Squacco heron Pelecaniformes Ardeidae Ardea ralloides Carnivore Resident migrants LC
3 African jacana Charadriiformes Jacanidae Actophilornis africanaus Piscivores Resident LC
4 Yellow Billed Black kite Accipitriformes Accipitridae Milvus migrans Carnivore Migrants LC
5 Pied crow Passeriformes corvidae Corvus albus Scavenger Resident LC
6 Red eyed dove Columbiformes Columbidae Streptopelia semitorquata Granivore Resident LC
7 Grey headed sparrow Passeriformes Passeridae Passer griseus Granivore Resident migrants LC
8 Laughing dove Columbiformes Columbidae Spilopelia senegalensis Granivore Resident LC
9 Plain backed pipit Passeriformes Motacillidae Anthus leucophrys Granivore Resident migrants LC
10 Common bulbul Passeriformes Pycnonotidae Pycnonotus barbatus Insectivore Resident LC
11 Red chested swallow Passeriformes Hirundinidae Hirundo lucida Insectivore Resident LC
12 Senegal coucal Cuculiformes Cuculidae Centropus senegalensis Carnivore/ insecivore Resident LC
13 Village weaver Passeriformes Ploceidae Ploceus cucullatus Insectivore Resident migrants LC
14 Bronze Mannikin Passeriformes corvidae Pycnonotidae Pycnonotus sinensis Carnivore/ insecivore Resident LC
15 Grey Headed firefinch Passeriformes Estrildidae Lagonosticta sanguinodorsalis Granivore Resident migrants LC
16 White throated bee eater Coraciiformes Accipitridae Merops albicollis Carnivore insecivore Resident migrants LC
17 Double-spurred francolin Galliformes Phasianidae Francolinus bicalaratus Granivores Resident LC
18 Great comorant Suliformes Phalacrocoracidae Phalacrocorax carbo Carnivore Local migrant LC
19 Piping horn bill Coraciiformes Bucerotidae Ceratogyynna fluvatula Frugivores Resident LC
20 Cattle egret Pelecaniformes Ardeidae Bubulcus ibis Omnivores Resident LC
21 White faced whistling duck Anseriformes Anatidae Dendrocygna viduata Piscivores Resident LC
22 Great egret Pelecaniformes Ardeidae Ardea alba Carnivores Resident LC
23 Spur winged lap wing Charadriiformes Charadriidae Vanellus spinosus Omnivores Resident LC
24 Pin tailed whydah Passeriformes Virduidae Vidua major Carnivores Resident LC
25 Pearl breasted swallow Passeriformes Hirundinidae Hirundo albicollis Carnivore Resident LC
26 Double collared sunbird Passeriformes nectarinae Cinniulus chalybeus Carnivore Resident migrants LC
27 Orange cheeked waxbill Passeriformes Estrildidae Estrilda melpoda Granivores Resident migrants LC
28 Red throated bee eater Coraciiformes Meropidae Merops pusillus Carnivore Resident LC
29 Plain martin Passeriformes Pycnonotidae Riparia paludicola Carnivore Resident migrants LC
30 Blue breasted bee eater Coraciiformes Meropidae Merops philippinus Carnivore Resident LC
31 Red rumped swallow Passeriformes Hirundinidae Cecropis daurica Carnivore Resident LC
32 Greater striped swallow Passeriformes Hirundinidae Cecropis abyssinica Carnivore Resident LC
33 Vieillot’s Black weaver Passeriformes Ploceidae Ploceus nigerrimus Granivores Residents LC
34 Blue headed wood dove Columbiformes Columbidae Turtur brehmeri Granivores Resident LC
35 Long tailed cormorant Suliformes Phalacrocoracidae Microcarbo africanus Carnivores Resident LC

Table 1: Checklist of birds recorded during the survey in Owena Multipurpose Dam.

ORDER NO OF FAMILY % NO OF SPECIES %
Pelecaniformes 2 10 4 11.43
Charadriiformes 2 10 2 5.71
Accipitriformes 1 5 1 2.86
Columbiformes 1 5 3 8.57
Passeriformes 9 45 16 45.71
Cuculiformes 1 5 1 2.86
Coraciiformes 1 5 4 11.43
Galliformes 1 5 1 2.86
Suliformes 1 5 2 7.71
Anseriformes 1 5 1 2.86
TOTAL 20 100 35 100

Table 2: Bird order and family relative abundance at the Owena dam.

which is in support of what Weins stated in his research that the species composition of a specific area is inter-linked to the available resources in the area which includes physical structures of the habitat, food availability and biotic factors [25].

The granivores, insectivores and canivores were more abundant than the nectarivores and frugivores. This is a result of the disturbance/alteration to the ecosystem through the construction of the dam. This is in agreement with the findings of Odewumi et al. who reported that infrastructural development can lead to changes in bird species composition and abundance [19-26].

During the late dry season, the river level was extremely low and more birds were sighted especially black kite and white-faced whistling duck but in the rainy season, the water level was high and few birds were sighted. It was also observed that the population of black kite has reduced drastically as a result of their migration which may be due to them not having access to their prey. This may also be connected to reduced fishing activities in the rainy season in the area.

Conclusion
| SPECIES                        | NO OF INDIVIDUAL | MEAN         | R.A (%) | DENSITY (n/ha) |
|-------------------------------|------------------|--------------|---------|----------------|
| Rock fire finch               | 782              | 156.4 ± 39.34 | 36.54   | 625.6          |
| Village weaver                | 683              | 136.6 ± 94.97 | 31.92   | 546.4          |
| Chestnut breasted Mannikin    | 110              | 22 ± 1.25     | 5.14    | 88             |
| White throated bee eater      | 87               | 17.4 ± 2.00   | 4.07    | 69.6           |
| Black weaver                  | 73               | 14.6 ± 3.25   | 3.41    | 58.4           |
| White chested swallow         | 59               | 11.8 ± 5.20   | 2.76    | 47.2           |
| White faced whistling duck    | 55               | 11 ± 4.22     | 2.57    | 44             |
| Africa jacana                 | 32               | 6.4 ± 4.36    | 1.50    | 25.6           |
| Black kite                    | 22               | 4.4 ± 1.65    | 1.03    | 17.6           |
| Orange cheeked waxbill        | 22               | 4.4 ± 2.81    | 1.03    | 17.6           |
| Pin tailed whydah             | 21               | 4.2 ± 2.68    | 0.98    | 16.8           |
| Red breast ed swallow         | 18               | 3.6 ± 1.25    | 0.84    | 14.4           |
| Red high dove                 | 17               | 3 ± 1.22      | 0.79    | 13.6           |
| Long tailed comorant          | 15               | 3 ± 1.32      | 0.70    | 12             |
| Common bulbul                 | 14               | 2.8 ± 2.18    | 0.65    | 11.2           |
| Red rumped swallow            | 12               | 2.4 ± 2.0     | 0.56    | 9.6            |
| Blue breast ed bee eater      | 11               | 2.2 ± 1.54    | 0.51    | 8.8            |
| Plain backed pipit            | 11               | 2.2 ± 2.5     | 0.51    | 8.8            |
| Great egret                   | 11               | 2.2 ± 1.03    | 0.51    | 8.8            |
| Red throated bee eater        | 10               | 2 ± 1.89      | 0.47    | 8              |
| Laughing dove                 | 8                | 1.6 ± 0.96    | 0.37    | 6.4            |
| Senegal coucal                | 8                | 1.6 ± 0.5     | 0.37    | 6.4            |
| Greater striped swallow        | 8                | 1.6 ± 0.43    | 0.37    | 6.4            |
| Piping horn bill              | 7                | 1.4 ± 1.75    | 0.33    | 5.6            |
| blue headed wood dove         | 6                | 1.2 ± 0.48    | 0.28    | 4.8            |
| Grey headed sparrow           | 6                | 1.2 ± 0.50    | 0.28    | 4.8            |
| Squacco heron                 | 6                | 1.2 ± 1.19    | 0.28    | 4.8            |
| Double collared sunbird       | 5                | 1 ± 0.75      | 0.23    | 4              |
| Cattle egret                  | 5                | 1 ± 1.25      | 0.23    | 4              |
| Pied crow                     | 5                | 1 ± 0.25      | 0.23    | 4              |
| Spur winged lapwing           | 3                | 0.6 ± 0.47    | 0.14    | 2.4            |
| Plain martin                  | 3                | 0.6 ± 0.48    | 0.14    | 2.4            |
| Double spurred francolin      | 3                | 0.6 ± 0.4    | 0.14    | 2.4            |
| Grey heron                    | 1                | 0.2 ± 0.25    | 0.05    | 0.8            |
| Great cormorant               | 1                | 0.2 ± 0.25    | 0.05    | 0.8            |
| TOTAL                         | 2140             | 428 ± 5.75    | 100.00  | 1712           |

Table 3: mean number and relative abundance of bird species recorded at the Owena dam.

**Figure 2:** Frequency of occurrence of bird family in each order in the study area.
The state of wetland ecosystem. Monitoring of the sites should be carried out so as to control changes in the conservation of bird should be discouraged in the area. Regular conservation in the area. Human activities that could be detrimental management programme for the Owena dam should incorporate avian bird species recorded in the area. It is therefore recommended that the banks of the dam provides food, nesting place and hide out for some habitat types and with different feeding habit. The vegetation along the study area has led to the presence of species associated with different

Table 4: Avian species diversity index of each transect in the study area.

| Diversity Variables | TR1   | TR2   | TR3   | TR4   | TR5   |
|---------------------|-------|-------|-------|-------|-------|
| Individuals         | 913   | 215   | 268   | 85    | 659   |
| Dominance_D         | 0.3299a| 0.5409a| 0.5635a| 0.3738b| 0.4046b|
| Shannon_H           | 1.664± | 1.24± | 1.168± | 1.391± | 1.51±  |
| Evenness_ e^H/S     | 0.24±  | 0.216± | 0.2475b| 0.4018a| 0.2264a|
| Equitability_J      | 0.5383±| 0.4473b| 0.4555b| 0.604± | 0.5044a|

Note: Values with the same superscript are not significantly different at 95% confidence level.

The finding of this study revealed that construction of dam in the study area has led to the presence of species associated with different habitat types and with different feeding habit. The vegetation along the banks of the dam provides food, nesting place and hide out for some bird species recorded in the area. It is therefore recommended that the management programme for the Owena dam should incorporate avian conservation in the area. Human activities that could be detrimental to the conservation of bird should be discouraged in the area. Regular monitoring of the sites should be carried out so as to control changes in the state of wetland ecosystem.

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