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The Role of Aquatic Bodies in Avifauna and Fish Conservation in Pandam Wildlife Park., Pandam, Plateau State, Nigeria

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Abstract: This study investigated the role of 2 perennial aquatic bodies (Lake Pandam and Kurmi stream) in the conservation of avifauna and fish in Pandam Wildlife Park. Kurmi stream is the major tributary to Lake Pandam. A combination of variable transect and synchronous sighting methods were used for avifauna census while the fish landing of licensed fishermen was used in determining fish diversity of Lake Pandam. Physical and chemical characteristics of the two water bodies were determined. Results obtained showed that 29 avifauna species were observed on the Lake and its shores. Each bird population varied significantly ($p<0.05$) between seasons. The white-face-tree duck (592.67±469.18) was the most abundant bird species and it occurred throughout the year on the Lake and its shore. A total of 29 fish species grouped into eighteen families were harvested from the Lake and listed. *Tilapia galilaea* (0.3673), *Tilapia zilli* (0.2824), *Tilapia nilotica* (0.2368), *Heterotus niloticus* (0.2824) and *Citharinus citherus* (0.2019) made the highest contribution to the diversity index of fish species in Lake Pandam. Significant ($p<0.05$) variation occurred in the total hardness, nitrate, bicarbonate, magnesium manganese and fluoride concentrations of the two water bodies.

Key words: Aquatic bodies, fish, Lake Pandam, *Tilapia galilaea*, Nigeria

INTRODUCTION

A nature reserve or national park is often judged on the number of species that it contains especially mammals, birds, fishes and plants and hence diversity has become central to the majority of evaluation schemes. Usher (1991) reported that diversity either of habitat or species is the most commonly used criterion in conservation evaluation.

For now, scientists believe that the best solution to the problem of endangered species involves preserving their habitats (Usher, 1991). Presently, there are more than 40 wildlife protection areas in Nigeria, including Pandam Wildlife Park (Ayeni *et al*., 1982). However, many of these conservation areas are imageries of themselves as there are no baseline information on the biological resources components. In Pandam Wildlife Park, the ecological setting appears inadequate as there are no information on biological resources and their distribution as well as management programmes to encompass necessary conservation strategies and ecological monitoring systems (personal communication with the management of the park).

Aquatic resources constitute an important component of the park resources. Pandam Lake occupies about 20ha of the park land area. In addition to the Lake are four major streams (River Li, Dogon Ruwa, Zurzurfar and Kurmi Stream) (Fig. 1). This implies that the aquatic bodies should be contributing immensely to the overall conservation of biodiversity in the park. However there is death of information on the physical and chemical characteristics as well as the status and diversity of the fauna and flora resources of the aquatic bodies. Hence, the constraint on the development of appropriate conservation strategies for the aquatic bodies in the park.

This situation informed the commencement of this study which aimed at providing information on the physical and chemical characteristics as well as the fish and water bird resources of the aquatic bodies in Pandam Wildlife Park.

MATERIALS AND METHODS

Study area: Pandam Wildlife Park is located south of Plateau State and lies between latitudes 8°35^{1} and 8°55^{1}N and Longitudes 8°00^{1} and 10°00^{1}E. It is bounded on the east by Namu and Kayarda towns, on the west and north by the Dep River and on the South by Aninjo and Pandam towns. The entire park lies within the northern guinea savanna (Fig. 1). The wet season extends from April to November, while the dry season starts from December and end in March. The mean monthly rainfall is between 0.00-243.5 cm. The annual mean temperature of the Pandam area is 32°C. The monthly mean temperature range from 25.8°C in August to 35.7°C in March (LBRB, 1982).

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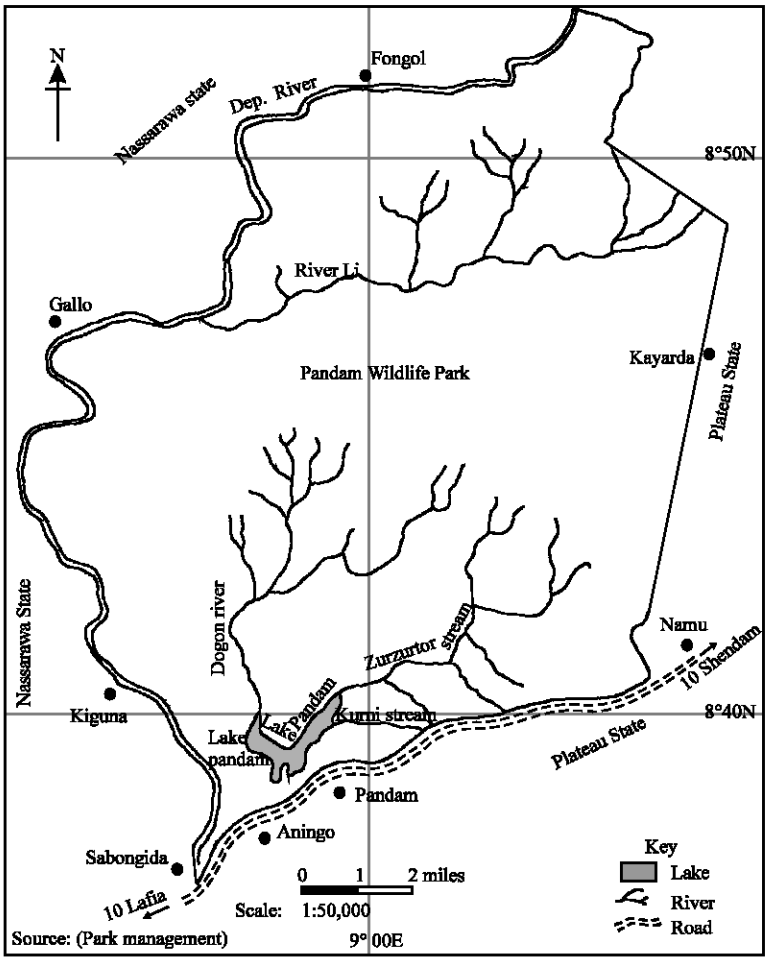

Fig. 1: Sketch map of Pandam wildlife park

The park is properly drained. The southern part is drained by the Kurmi, Zurzurfar and Dogon ruwa streams and their tributaries which rise from the eastern part of the park and drain into the Pandam Lake. The northern and Western sectors are drained by the Dep and Li rivers and their tributaries.

Data collection technique

Water bird census: Water birds were detected and counted using a combination of methods. First, game patrol routes at the shores of the Lake were walked to a maximum length of 3 km at a time (6:00-11:00 am and 3:00-6:00 pm). Observations were made along these routes at 5minutes intervals (stop count method) with the aid of binoculars. Secondly, local canoes were used to move on the Lake to observe and count birds in open water body. Thirdly, continuous count was carried out anytime the authors were carrying out a research activity around the Lake. The game guards were also encouraged to keep a record book of water bird species encountered during their routine patrol operations. In all these instances, whenever birds were sighted, their species name, number, cluster size and activity when first seen were recorded. These methodologies followed the description of Afolayan and Amvbode (1985) and FORMECU (1994).

Fish diversity determination: The fish landing of 5 fishermen given permit by the park management was used to compile species composition and to determine the diversity indices of fish species in Pandam Lake. The fishermen were made to set nets of different mesh sizes once a month and the catch obtained the following morning were assessed to determine the species and the number of each in the catch. The Keys obtained from Freshwater Fisheries, Research Institute, New Bussa were used for the assessment. The assessment was carried out for 12 months.

Water quality assessment: Assessment of water quality of 2 water bodies in the park viz: Lake Pandam and Kurmi stream was conducted. The methods employed by American Public Health Association (1992) for physical and chemical analysis of water public were used in this study. Indices measured were: Colour, turbidity, pH, total dissolved solids, salinity, conductivity, calcium, magnesium, chloride, bicarbonate, nitrate, nitrite, phosphate, fluoride, chlorine, iron, manganese, salinity and total hardness.

Data analysis: The diversity indices of fish species was determined using Shannon diversity index as described by Usher (1992). The model is as follows:

$$D = \sum[-P_i \ln P_i]$$

Where,

D = Shannon index; P_i is the proportion of the species in the sample.

Student T-test was used to determine if differences exist in the indices of water quality of the 2 bodies.

RESULTS

Seasonal occurrence of birds on pandam lake and its shores: A total of 29 species of birds were observed on the Lake and its shores (Table 1). Each bird population varied significantly ($p<0.05$) between seasons. The white face tree duck was the most abundant species and it occurred throughout the year. Spur winged plover, black headed heron and Osprey were absent from the lake during wet seasons. Migrants among the birds were cattle egret (*Ardeola ibis*), Squaco heron (*Ardea ralloides*), Black headed heron (*Ardea melanocephola*), African black duck (*Anas sparea)*, Osprey (*Pandion haliaetus*) and the Great sparrow hawk (*Accipitor melanoleucus*).

Fish species diversity in pandam lake: Fish species listed from harvest in Lake Pandam totaled 29 (Table 2) and these were grouped into 18 families. Species that made the highest contribution to the diversity index include *Tilapia galilaea* (0.3673), *Tilapia zilli* (0.2824), *Tilapia nilotica* (0.2368), *Heterotus niloticus* (0.2045) and *Citharinus citherus* (0.2019) while the least were contributed by *Tetradon fahaka* (0.0010), *Labeo senegalensis* (0.0010), *Heterobranchus* spp(0.0028), *Lates niloticus* (0.0036), Labeo coubre (0.0044), *Chrysichthys nigrodigitatus* (0.0044), *Hydrocynus Lineatus* (0.0058) and *Melapterurus electricus.* (0.0066).

Water quality of pandam lake and kurmi stream: The physical and chemical characteristics of Pandam Lake and Kurmi Stream waters are shown in Table 3. There was

Table 1: Monthly observation of birds of pandam lake at different seasons

Common name	Scientific name	Early wet season (April-June)	Late wet season July-Sept}	Early dry season {Oct-Dec)	Late dry season {Jan-March}
Giant Kingfisher	*Ceryle maxima*	16±2.53	1±4.30	3.33±2.87	7.77±1.47
Pied Kingfisher	*Ceryle rudis*	16±7.50	76±31.61	38±40.18	9±5.06
Blue breasted Kingfisher	*Halcyan malimbica*	11±2.53	6.67±2.92	18±5.06	17±6.70
Senegal Kingfisher	*Halcyan senegalensis*	5.33±1.47	3.67±2.92	9±2.52	7.33±2.92
Pigmy Kingfisher	*Ceyx picta*	9.33±1.47	14±4.38	16.33±3.87	8±2.53
Malachite Kingfisher	*Alcedo cristata*	6.33±1.47	7±5.06	3.67±2.92	5±2.53
Great white egret	*Egretta garmetla*	12.33±3.38	4±4.38	----------	8.33±3.87
Cattle egret	*Ardeala ibis*	221.33±41.23	35±38.27	76±144.28	199.33±21.70
White faced tree duck	*Dendrocygna violuata*	1174±198.32	58±644.62	201.33±33.04	592.67±469.18
White faced lapwing	*Vanellus albiceps*	8.67±0.13	12.67±1.47	17±10.12	5.33±1.47
Lily trotter	*Actopholormis africana*	217.67±83.10	304.53±57	238±117.35	207.67±22.12
Spur winged goose	*Plectropterus gambensis*	11±4.38	9.67±1.47	16.67±5.84	15.67±4.0
Spur winged plover	*Pluvialis squatarola*	----------	----------	1±4.303	----------
Night heron	*Nycticorax niticorax*	26±5.06	----------	5.33±23.38	33±7.59
Grey heron	*Ardea cinerea*	19.67±5.27	45.33±13.94	11.33±5.27	22.33±5.85
Purple heron	*Ardea purpurea*	3.33±7.73	----------	4.33±6.37	8.33±2.92
Squao heron	*Ardea ralliodes*	----------	4.33±19	91±50.81	----------
Goliath heron	*Ardea goliath*	4.67±10.23	----------	4.33±2.92	7.67±1.47
Black headed heron	*Ardea melanocephola*	----------	----------	3,00± 0.00	2.00± 0.00
Black kite	*Milous noigrans*	19.67±21.82	7.67±2.92	5.33±1.47	12.67±6.37
Tiger bittern	*Tigriarnis leucolopha*	5.33±2.92	1±2.53	0.33±1.47	3.33±1.69
Marsh harier	*Circus aeruginasus*	3.67±2.50	1.67±3.87	----------	1.33±2.92
African black duck	*Anas spanea*	----------	7.67±1.47	----------	13.13±3.00
African darter	*Haliaetus vocifer*	----------	2.67±1.47	0.67±0.84	2.00±0.00
West African river eagle	*Aythya nyroca*	4.33±3.87	2.33±1.47	0.35±1.47	5.33±2.92
Black crake	*Amaurorrus flavinostus*	19.67±3.87	27.67±3.87	13±2.53	12.67±6.87
Prgmy goose	*Nettapus auritus*	59.33±21.53	86.33±14.39	26.67±15.26	42.33±12.99
sprey	*Pandion haliactus*	3.33±2.93	----------	----------	4.33±10.23
Great sparrow hawk	*Accipitor melanoleucus*	----------	2.33±1.47	0.33±1.47	----------

Table 2: Diversity indices of fish species in pandam lake

Fish species	Average number harvested per month	Shannon indices $\sum(-P_i \ln P_i)$
Lepidosirenidae		
Protopterus annectens	3.08	0.0235
Polypteridae		
Polypterus senegalus	1.50	0.0130
Osteoglossidae		
Heterotis niloticus	58.17	0.2045
Mormyridae		
Marcusenius species	11.92	0.0684
Gymnarchdae		
Gymnarchus niloticus	27.33	0.1251
Characidae		
Hydrocynus lineatus	0.58	0.0058
Alestes baremose	2.42	0.0229
Alestes nurse	2.67	0.0209
Alestes maerocepidotus	0.75	0.0072
Hepsetidae		
Hepsetes odoe	0.5	0.0051
Citharinidae		
Distichodus species	3.58	0.0266
Citharinus citherus	56.02	0.02010
Cyprinidae		
Labeo coubie	0.42	0.0044
Labeo senegalensis	0.08	0.0010
Bagridae		
Bayrus bayad	10.17	0.0607
Chrysichthys nigrodigitalus	0.42	0.0044
Auchenogtaris occidentalis	7.08	0.0458
Schilbedae		
Siluranodou auritus	2.33	0.018
Claridae		
Clarias gariepinus	16.34	0.0866
Heterobranchus species	0.25	0.0028
Malapteruridae		
Malapterurus electricus	0.67	0.0066
Mochokidae		
Synodontis species	8.67	0.0536
Ophiocephalidae		
Ophiocephalus obscurus	22.00	0.1074
Centropmidae		
Lates niloticus	0.33	0.0036
Tetraodontidae		
Tetradon fahaka	0.08	0.0010
Cichlidae		
Tilapia galilaea	248.09	0.3673
Tilapia zilli	105.17	0.2824
Tilapia nilotica	74.92	0.2368
Tilapia aurea	47.25	0.1799
Totals	712.69	2.1774
Shannon index=2.1774		

no significant ($p>0.05$) difference in the colour, turbidity, total dissolved solids, conductivity, pH values, calcum, potassium, chloride, bicarbonate, carbonate, phosphate, fluoride, chlorine, iron, manganese and salinity for the two water bodies. However, the differences in some chemical indices viz: magnesium, nitrate, nitrite, total hardness and sulphate were significantly ($p<0.05$) higher in the Pandam Lake than in Kurmi Stream.

Table 3: Hydrochemical analysis of pandam water and dodon kurmi stream

	Mean values of parameters	
Parameters	Lake water samples	Stream water samples
Colour (Pi/Co units)	11.333[a]	9.167[a]
Turbidity (FTU)	5.167[a]	4.433[a]
Total Dissolved Solids		
(TDS) Mg L^{-1}	24.333[a]	22.967[a]
Conductivity Mg L^{-1}	48.867[a]	45.133[a]
PH	6.800[a]	6.633[a]
Calcium Mg L^{-1}	23.333[a]	17.000[a]
Magnesium Mg L^{-1}	7.320[a]	3.867[b]
Potassium Mg L^{-1}	4.267[a]	4.433[a]
Sulphate Mg L^{-1}	2.600[a]	1.000[b]
Chloride Mg L^{-1}	8.667[a]	7.233[a]
Bicarbonate Mg L^{-1}	27.333[a]	30.66[a]
Carbonate Mg L^{-1}	0.000	0.000
Nitrite Mg L^{-1}	13.067[a]	6.700[b]
Phosphate Mg L^{-1}	1.200[a]	1.533[a]
Flouride Mg L^{-1}	0.600[a]	1.000[a]
Chlorine Mg L^{-1}	0.010[a]	0.003[a]
Iron Mg L^{-1}	0.617[a]	0.507[a]
Manganese Mg L^{-1}	0.180[a]	0.070[b]
Salinity Mg L^{-1}	14.30[a]	11.95[a]
Total hardness Mg L^{-1}	56.67[a]	36.67[b]

Means with different superscripts are significantly different at $p<0.05$

DISCUSSION

Lake Pandam and Kurmi stream are the perennial water bodies in Pandam Wildlife Park. They are significant for the variety and number of wildlife species they sustain. Twenty nine bird species, 29 fish species, 3 hippopotamus and manatees depend on the lake for their survival. Kurmi stream is significant for its content of large number of alligator.

The study of biodiversity on fourteen wetland sites sharing similar ecological characteristics with Pandam Lake showed that about 48 water bird species were sighted in them (DFID, 2000). Therefore, the occurrence of 29 bird species on a single wetland site Pandam Lake is an indication of its rich avifauna diversity. Shannon index has a minimum value of zero in a monoculture and increases to a maximum value (infinity) where all individuals are in different species. It has therefore, a characteristic of becoming larger as a community become more diverse (Usher, 1992). Hence the Shannon index of 2.1774 obtained from this study is indicative of high fish diversity of Lake Pandam.

Results of the physical and chemical analysis of the 2 water bodies showed similarities in their physico-chemical properties. Variation in magnesium, sulphate nitrate, nitrite, manganese and total hardness exist between the water bodies with those of Lake Pandam being significantly ($p<0.05$) higher. The higher values obtained for lake Pandam shows the level of human

interference and environmental pollution during bird watching and fishing activities. Besides, waste products of the hippopotamus and manatees might have contributed to the high nitrate content of the Lake water. The high nitrate level (though not high enough to make the Lake eutrophic) suggest high phytoplankton and zooplankton levels in the Lake which in turn directly sustain the fish populations and indirectly the bird populations.

Each bird population varied ($p<0.05$) between seasons while some were completely absent during certain seasons indicating the occurrence of migrant birds at the Lake. The ecological significance of the Lake in providing food and breeding ground for the fish as well as for resident and migrant birds is thus a major function of Pandam Wildlife Park in biodiversity conservation.

CONCLUSION

In general, this study has provided baseline information on the fish and avifauna species richness of Lake Pandam which could be very adequate and useful for the preparation of a management plan. The species lists provided could be used to update both the fish and water bird resources of Nigeria as well as the conservation status of some of the species.

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