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The Invasive Nipa Palm (*Nypa fruticans* Wurmb) and Avian Diversity at Okorombokho Wetlands, Nigeria

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Abstract: The avifauna of Okorombokho wetlands in Eastern Obolo, Akwa Ibom State was studied from March 2017 to August, 2017 to provide a species list and distribution of avians between the invasive nipa palm and true mangrove vegetation of the area. The area was divided into three (3) plots of 8 ha each comprised of (i) pure nipa (ii) mixed nipa-mangrove and (iii) pure mangrove forests respectively. Monthly bird counts were undertaken with the aid of a pair of binoculars. A total of 29 bird species belonging to 18 families and 10 orders were observed. The Order Ciconiiformes with 9 species (31.0%) had the greatest number of species while four orders Psittaciformes, Bucerotiformes, Pelecaniformes and Gruiformes had one (1) species each (3.4%). The species richness for the nipa palm, mixed nipa-mangrove and pure mangrove stands were 13, 25 and 22 respectively. The mixed forest had higher species richness and diversity 25 (1.2755) while the nipa forest had a low diversity value of 0.9555. It was inferred that a combination of factors including lack of habitat diversification in the provision of roosting/nesting spaces and edible fruit for resident birds were responsible for low avian species diversity in nipa dominated areas.

Keywords: Invasive, Nipa Palm, Avian Diversity, Wetland

INTRODUCTION

Birds are among the best monitors of environmental changes. Changes in their population, behaviour patterns and reproductive ability have often been used to examine long term effects of habitat fragmentation and perturbations. They play key ecological roles in wetland ecosystems as they occupy several trophic levels in the food web of nutrient cycles. As noted by Seymour and Simmons (2008), birds are good bioindicators of wetland habitat quality, productivity and stability because they respond quickly to changes in the habitat. Also, wetland habitat selection by waterfowl is influenced by complex characteristics including physical features, water chemistry, invertebrate fauna and aquatic vegetation.

Therefore, any change in the physical, chemical and biological factors of wetlands will affect the density, diversity and richness of avian fauna. This is particularly so with respect to aquatic vegetation. According to Balapure, Dutta and Vyas (2012) changes in the floral ecology due to the introduction of foreign or invasive species for instance may have adverse effects on symbiotes that are indigenous to a region of wetlands, hence the need to closely study and record the impacts of foreign or invasive species on established ecological systems.

Wetlands have been noted to be the most productive and biologically diverse ecosystem in the world (Joshi, 2012), but they are equally noted for being very fragile. The mangrove wetland ecosystem in the eastern Niger Delta, Nigeria, has been under stress for about a century now due to the impacts of an introduced Indo-Pacific mangrove palm (*Nypa*

fruticans Wurmb) from Singapore in 1906. Its impacts have been pervasive – affecting most of the Niger Delta estuaries especially those of the Cross, Qua Iboe and Imo Rivers. King and Udo (1997) described nipa palm as having aggressive vegetational succession occasioning the replacement of the dominant native mangrove macrophytes.

While the effects of this invasive species on the native mangrove macrophytes species are readily discernible, its effects on the associated animal community of the mangrove ecosystem (including birds) remain largely unknown. This has not been helped by the muddy terrain of the intertidal zone which makes access by foot very arduous, thereby discouraging research interests. As part of its teaching and research programmes, the Centre for Wetlands and Wastes Management Studies (CWWS) of the University of Uyo has since 2016, initiated and managed a Mangrove Restoration Project at Okorombokho, Eastern Obolo Local Government Area (LGA) of Akwa Ibom State. This present study which is one of the ongoing researches in the area was undertaken to provide a species list of avians and examine their relative abundance and distribution among pure mangrove, mixed mangrove-nipa and pure nipa dominated territories.

METHODOLOGY

The present study was conducted at Mmatazu Creek, Okorombokho, Eastern Obolo LGA, Nigeria (Fig. 1). It lies within the mangrove forest zone with two major seasons; a wet (April to October) and dry season (November to March). It is however, not unusual to have rainfall at any month of the year in this zone. Annual rainfall ranges from 2100 mm to 4050 mm.

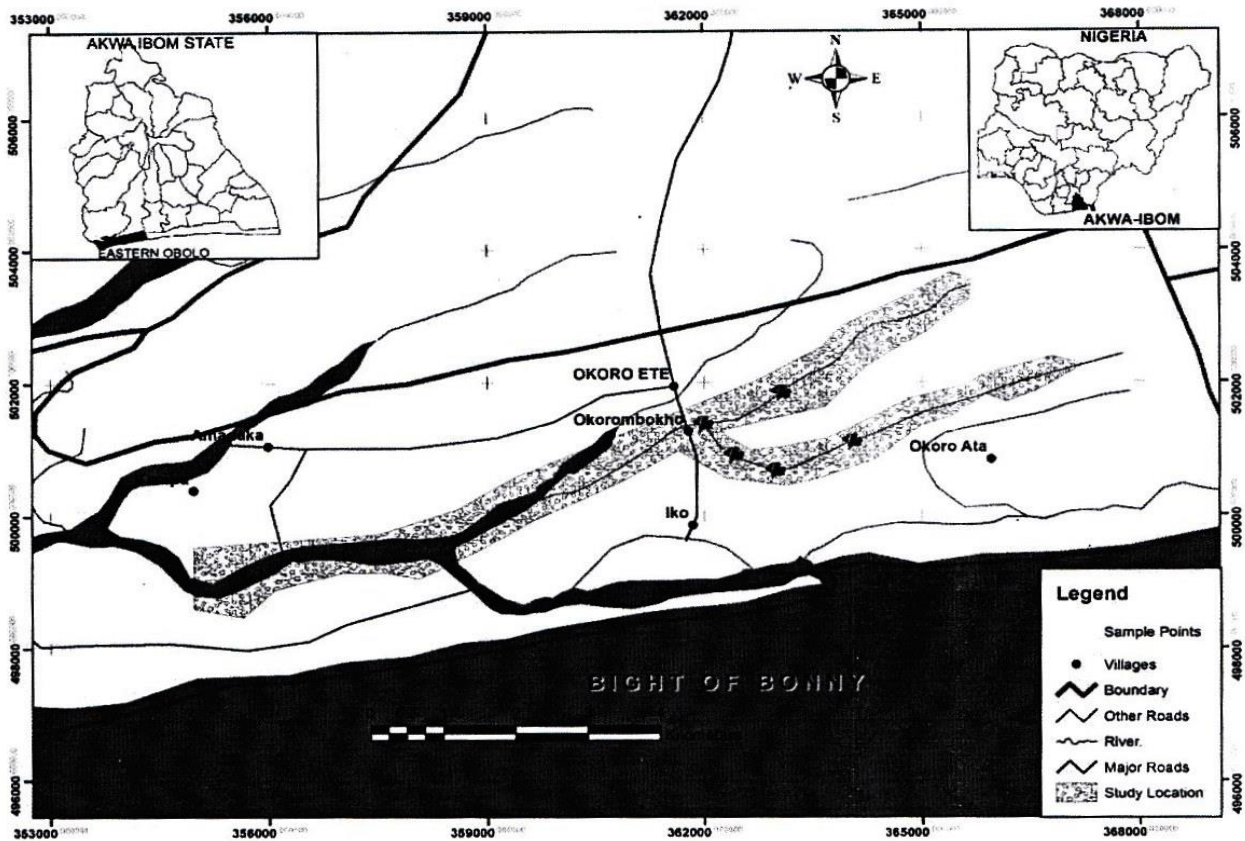


Fig. 1: Map of Eastern Obolo showing Mmatazu river in Okorombokho wetland.

The vegetation is dominated by mangrove species (*Rhizophora mangle*, *Avicennia africana*) and the highly invasive nipa palm (*Nypa fruticans*). The intertidal zone bordering the creek when exposed at low tide reveals a clay, peat and/or sandy substratum. Beyond the tidal mudflats are slightly elevated lands with firm soil and luxuriant growth of tangled vegetation fringed with scrambling sedges (*Fimbristylis* spp., *Scleria naumannia*), ferns (*Gleicheria* sp., *Selaginella* sp.), canes (*Calamus deeratus*) and epiphytic ferns such as *Phymatodes* sp. The dominant trees in these forested patches include the cabbage tree (*Anthocleista* sp.), Christmas bush (*Alchornea cordifolia*), boundary tree (*Dracaena arborea*), blood tree (*Harungana madagascariensis*) and oil palm tree (*Elaeis guineensis*). Cultivated tree plants such as mango (*Mangifera indica*), African pear (*Dacryodes edulis*), bush mango (*Irvingia gabonensis*) coconut palm (*Cocos nucifera*) and African breadfruit (*Treculia africana*) were common around village settlements.

The sampling area (Lat. 4°31'20"N, Long. 7°43'30"E and Lat. 4°24'17"N, Long. 7°49'40"E) was divided into three (3) plots of 8 ha each, corresponding to (i) pure mangrove (designated as M), (ii) mixed mangrove/nipa palm (MX) and (iii) pure nipa palm vegetation (N) respectively. Monthly bird counts were carried out for six months (March – August, 2017). Sighting and counting of birds on foot and with boat

were conducted in the morning (7.00a.m. – 12 noon) and afternoon to evening (3.00p.m – 7.00p.m.) subject to local weather conditions. Visual observations were made with the aid of a pair of binoculars (Nikon Action 10x 50) and photographs taken with a Nikon D3200 camera with Tamron 18-200mm zoom lens. Birds were identified using field guides (Serle, Morrel and Harting1984; Borrow and Demey, 2008). A modified fixed width transect count and distance sampling as described by Bennum and Howell (2004) was employed using the creek channel and existing trails as transects. This enabled us to count all species observed irrespective of their perpendicular distance on each side of the transect line. Species heard without being seen were recorded only once during counting to avoid overestimation due to repeated singing by the same individual. Birds' nests within the sampling locations were observed and counted.

Based on the frequency of bird sightings, the data obtained were used to calculate diversity and relative abundance. Diversity was calculated using the Shannon-Wiener index.

RESULTS AND DISCUSSION

In the present study, 10 avian orders represented by 18 families and 29 species were recorded (Table 1). Birds listed in the Endangered Species Act 11 of 1985 are indicated in the Table. From Fig. 2, the Order Ciconiiformes with 9 species (31.0%) had the greatest

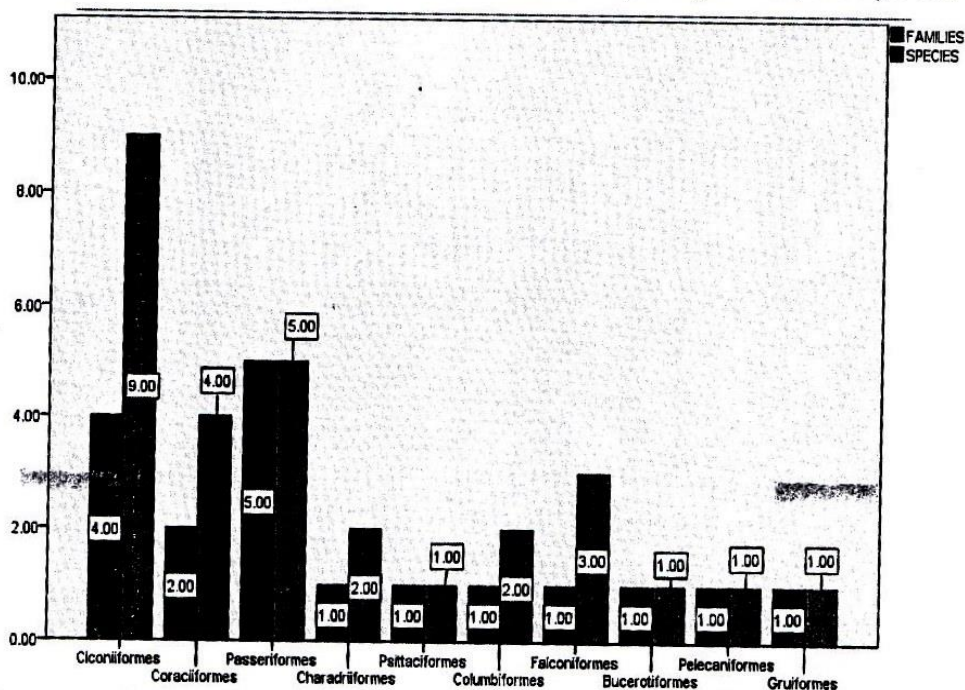
number of species in the sampling locations and was followed by the Orders Passeriformes (17.24%) and Coraciiformes (13.79%) respectively. The orders Psittaciformes, Bucerotiformes, Pelecaniformes and Gruiformes were the least (3.4%) with one bird species each.

Table 2 presents the number of species collected (species richness), sighting frequencies (abundance) and diversity. More species (25) were collected from the mixed mangrove/nipa vegetation, than from pure mangrove forest (22 species), while the nipa palm forest had the least with 13 species.

Table 1: Checklist of avian species in the three sampling plots at Okorombokho wetland and their conservation status

Oder/Family	Scientific Name	Common Name	N	MX	M
Pelecaniformes					
Phalacrocoracidae	<i>Phalacrocorax africanus</i>	Long-tailed cormorant	+	+	+
Ciconiiformes					
Scopidae	<i>Scopus umbretta</i> **	Hammerkop	+	+	+
Ciconiidae	<i>Ciconia episcopus</i> **	Woolly necked-stork	-	+	-
Threskiornithidae	<i>Plegadis falcinellus</i>	Glossy ibis	-	+	-
Ardeidae**	<i>Egretta garzetta</i>	Little egret	+	+	+
	<i>E. intermedia</i>	Intermediate egret	-	+	+
	<i>E. alba</i>	Great egret	+	+	+
	<i>E. gularis</i>	Western reef heron	+	+	+
	<i>Ardea cinerea</i>	Grey heron	-	+	+
	<i>A. purpurea</i>	Purple heron	-	+	-
Falconiformes *					
Accipitridae	<i>Gypohierax angolensis</i>	Vulturine fish eagle	-	+	+
	<i>Polyboroides typus</i>	African harrier-hawk	-	-	+
	<i>Milvus migrans</i>	Black kite	+	+	+
Gruiformes					
Heliornithidae	<i>Podica senegalensis</i>	African finfoot	-	+	+
Columbiformes					
Columbidae	<i>Treron calvus</i>	African green fruit pigeon	-	+	+
	<i>Streptopelia semitorquatus</i>	Red-eyed dove	-	+	+
Charadriiformes					
Scolopacidae	<i>Actitis hypoleucos</i>	Common sandpiper	+	+	+
	<i>Calidris ferruginea</i>	Curlew sandpiper	+	+	+
Psittaciformes					
Psittacidae	<i>Psittacus erithacus</i> *	African-grey parrot	-	+	+
Coraciiformes					
Alcedinidae	<i>Ceryle rudis</i>	Pied kingfisher	-	+	+
	<i>Halcyon senegalensis</i>	Senegal kingfisher	+	+	+
	<i>H. malimbica</i>	Blue breasted kingfisher	-	+	+
Meropidae	<i>Merops albicollis</i>	White-throated bee-eater	+	+	+
Bucerotiformes					
Bucerotidae	<i>Bycanistes fistulator</i>	Piping hornbill	-	+	+
Passeriformes					
Sturnidae	<i>Lamprotornis splendidus</i>	Splendid glossy starling	+	+	
Corvidae	<i>Corvus albus</i>	Pied crow	-	+	+
Pycnonotidae	<i>Pycnonotus barbatus</i>	Common garden bulbul	-	+	
Ploceidae	<i>Ploceus intermedius</i>	Lesser masked weaver	+	+	-
Platysteiridae	<i>Platysteira cyanea</i>	Scarlet-spectacled wattle-eye	-	+	-

* = Animals in Schedule 1 of Endangered Species Act 11 of 1985; ** = Animals in Schedule 2 of Act 11 of 1985.
+ = Present in Study Site; - = Not Observed; N = Pure nipa; Mx = Mixed nipa/ mangrove and M = Pure mangrove



Number of species and families of different avian orders

Figure 2: Bar chart showing number of families and species of different avian orders in the study area.

Table 2: Diversity Status of species in Okorombokho wetland environment

Parameters	Vegetation Type		
	Nipa Palm	Mixed	Mangrove
Species Richness	13	25	22
Abundance	72	275	322
Shannon Diversity	0.9555	1.2755	1.2687
Equitability index	0.1999	0.1432	0.1616

However, more sightings of specimens were made in the pure mangrove forest (322) than in the mixed (275) or nipa palm (72) vegetations and showing diversity indices of 1.2687, 1.2755 and 0.9555 respectively. Thus, the mixed nipa-mangrove plot had the highest diversity index in spite of the moderate sighting frequency. The equitability index indicates that the species were relatively distributed evenly represented.

The abundance of individual bird species in the three vegetation subtypes varied as shown from the sighting frequencies obtained. The relative abundance (%) for the Hammerkop (*Scopus umbretta*), Little egret (*Egretta garzetta*), and Long-tailed cormorant (*Phalacrocorax* sp.) in the pure nipa forest were 0.2970, 0.1111 and 0.0830 respectively. These are wading and diving birds that feed on fish and macro-invertebrates under the cover of the dense foliage provided. Fruit and seed-eating birds such as the African grey parrot (*Psittacus erithacus*), Piping hornbill (*Bycanistes* sp.), and the African green fruit pigeon (*Treron* sp.) were not recorded in the pure nipa forest (Table 1). They were however, represented in the pure mangrove (M) and mixed (MX) forests thus: *P. erithacus* (M=0.1087; MX = 0.0185), *Bycanistes* sp. (M = 0.0124; MX = 0.0072) and *Treron* sp. (M =

0.0093; MX = 0.0218). The cormorant (*Phalacrocorax* sp.) and Hammerkop (*Scopus* sp.) were the commonest species occurring across the three vegetation subtypes.

From the results presented, the pure nipa palm forest was lower in species richness (13) and in diversity (0.9555). This may not be unconnected with the habitat structure which offers very little diversification in niches and micro-niches presented, as well as in plant food production. Moses (1985) noted that nipa offers very little or no benefits to the mangrove ecosystem. A survey of birds' nests showed that only weaver birds (*Ploceus* spp.) were utilizing the nipa palm fronds for their nesting colonies. On the other hand, the mixed and pure mangrove forests contained various birds' nests, ranging from the massive nests of the Hammerkop to the nests of weavers, kites, eagles and that of hornbills in tree crevices. The nests of Hammerkop were observed to play additional ecological roles as some birds such as the Senegal kingfisher were observed nesting in the basal portion. In an environment facing increasing deforestation and habitat alteration with scanty firm embankment for burrow nesters, the Hammerkop's nest has added importance in the survival of some of these opportunists.



Fig. 3: Mixed flock of egrets sharing the available perching space in the nipa zone

Heavy and unsustainable human exploitation of mangrove species at Okorombokho has abetted the perching and waiting for low tide to expose the mudflats, it was common sight to observe mixed flocks of egrets and hammerkop sharing the available spaces on the few dead tree boles and branches (snags) within the nipa dominated areas (Fig. 3). This suggests that in addition to non-availability of food for frugivores in this zone, lack of suitable roosting and nesting spaces which could affect reproductive success also pose ecological challenge to other trophic groups.

Thiollay (1985) observed that apart from the mouse-brown sunbird (*Anthreptes gabonicus*) and orange weaver (*Ploceus aurantius*), there were no purely mangrove bird species in West Africa. However, with the long evolutionary history of the mangrove forest belt beginning from the Interpluvial period of over 40,000 yrs BP when the entire tropical rainforest of West Africa was eliminated except for three refugia; one being the Niger Delta, the others were Cape Palmas (Liberia) and Cape Three Points in Ghana (Happold, 1987), and with the subsequent attainment of great habitat complexity, several bird species (both aquatic and non-aquatic) have come to be associated with it (Thiollay, 1985; Nason, 1992). This same habitat complexity is yet to be attained in the nipa dominated zones which are still relatively in early succession stage in Nigeria. This may help to explain the depauperate content of its avian diversity.

The greater avian diversity observed in the mixed forest could result from diversification and increased heterogeneity as a consequence of nipa invasion. However, a pure nipa forest will lose that heterogeneity and species diversity as the mangrove becomes completely displaced. The Okorombokho wetlands harbour birds of conservation importance as

rapid advance of nipa in supplanting the true mangrove. While birds were roosting for the night as indicated in Table 1. Among these were the African grey parrot and Vulturine fish eagle which were observed to be locally abundant in this mangrove wetland. Other birds not frequently encountered elsewhere in the state but common here include the African green fruit pigeon, Blue-breasted kingfisher and the Scarlet-spectacled wattle-eye.

The study has indicated the threats posed to wetland avifauna by the continued expansion of nipa palm. Findings from the study revealed that the presence of nipa palm in an ecosystem tends to adversely affect avifauna abundance, richness and diversity. This has a lot of implications for wetlands particularly in their performance of ecosystem services. It can be inferred directly from the results, that the continued replacement of mangrove by nipa palm is capable of affecting the quality, productivity and stability of wetlands environment. Based on the findings of the study, it is recommended that efforts should be made by stakeholders – government, researchers/science communities, development partners and organized private sector to check further encroachment of natural ecosystem by nipa palm. Efforts such as that by the Centre for Wetlands and Waste Management Studies, University of Uyo and other institutions in restoring mangrove in a nipa invaded ecosystem should be supported. There is therefore an urgent need to pay more attention to nipa eradication and mangrove restoration programmes.

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