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Specific diversity of avifauna of wetland of international importance of Southwest Benin (Ramsar site 1017)

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Abstract
This study aimed to determine the specific diversity of birds of wetland of international importance of south-west Benin (Ramsar site1017). Bird inventories were carried out from January 2015 to December 2016. Line transect and stationary point count methods were used. The study revealed the presence of 217 species belonging to 130 genera, 57 families and 17 orders. Biogeographically, 57.60% of the species are resident, 21.20% are both palearctic and afrotropical species, 17.05% are palearctic migrators species and 4.15% are afrotropical species. Regarding the preferred habitats, four main groups of species were identified: species of open habitats (41.47%); typical aquatic species (38.24%); forest-dependent species (3.22%) and mixed bird species (17.05%). One vulnerable specie (*Bleda eximius*) have been identified as well as seven near-threatened species (*Haematopus ostralegus*, *Calidris canutus*, *C. ferruginae*, *Limosa limosa*, *L. lapponica*, *Gallinago media*, *Numeius arquata* and *Rynchops flavirostris*) according to the UICN red list.

Keywords: Avifauna, diversity, wetlands, South-West, Benin

1. Introduction

Wetlands are recognized as the most productive ecosystems of the world [1-4]. They cover 4 to 6% of the earth's surface and offer huge opportunities for sustainable development [5, 6].

Benin's wetlands present a mosaic of wet natural habitats, rich in nutritive inputs and favorable to the establishment and growth of many animal species [7]. Such an asset makes these areas trophic, feeding, refuge, nesting and wintering sites for many bird species [6, 8, 9]. However, under the anthropogenic actions (land pressure, population growth, dredging of sand, use of prohibited fishing and hunting gear, poaching, pollution, excessive harvesting of wood for salt production activities) and climatic conditions (encroachment of the sea, irregular rainfall) [10, 11], these wetlands continually degrading and disappearing, which is all detrimental to the avifaunal diversity [12, 13].

By ratifying the Ramsar Convention on 24 january 2000, Benin has two wetlands of international importance in the South called Western complex (Ramsar site 1017) and Eastern Complex (Ramsar site 1018). However, many ornithological surveys have been often carried out in the Eastern complex [9, 14, 16, 17-20]. These studies focused on the specific diversity of the avifauna, the spatio-temporal distribution of waterbirds and the diet of some bird species. On the other hand, the Western complex has been very few studied [17, 21, 22].

Thus, the present study aims to establish the specific diversity of the avifauna of the wetland of international importance of southwestern Benin (Ramsar Site 1017).

2. Material and methods

2.1 Study area

The study area was located between latitude 6°10' and 6°17' North and longitude 1°54' and 1°57' East (Fig 1).

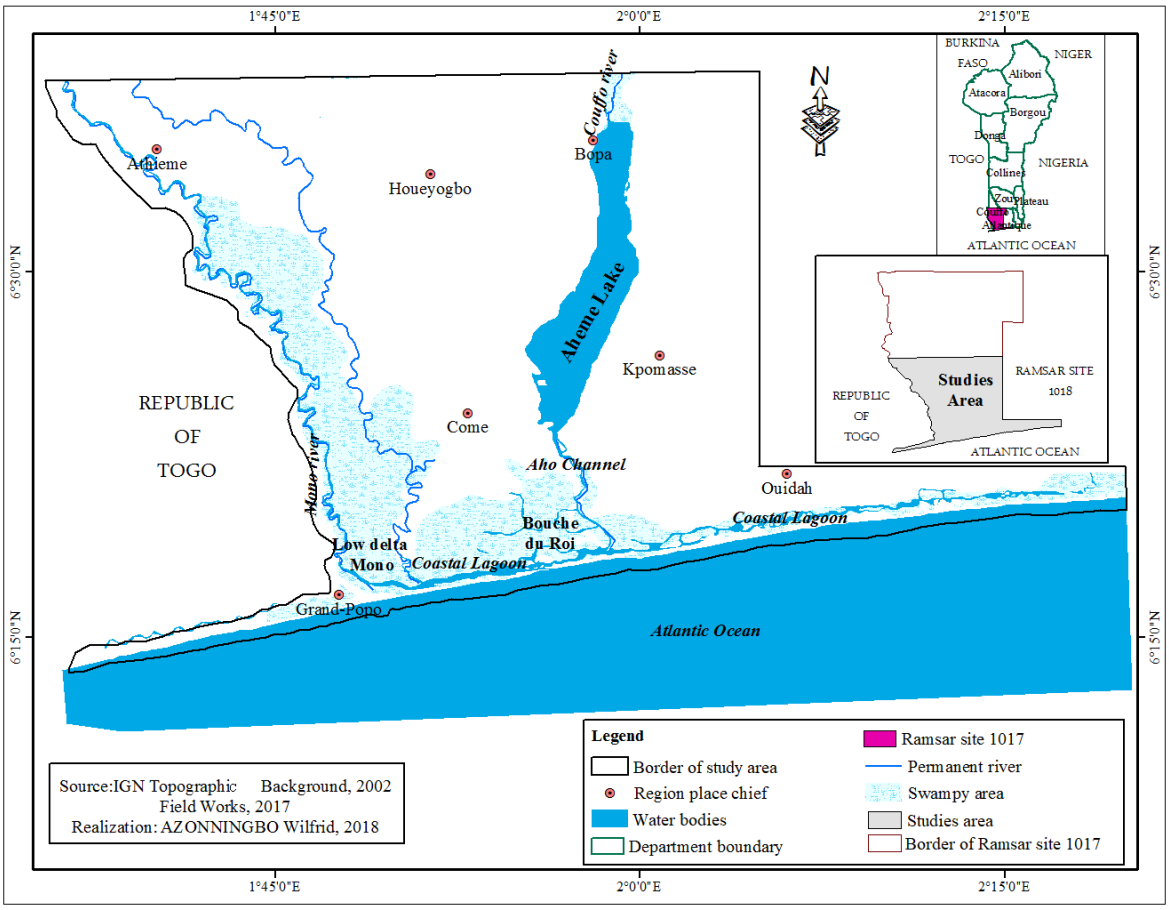

Fig 1: Location of the study area.

Soils are of modal types in coastal marine areas, hydromorphic with pseudogley, vertisoils in the median depression, sandy-clay on the continental shelves, halomorphic in estuarine areas, ferruginous and lithogenous [23]. The hydrographic network consists mainly of estuaries of Mono and Sazoué (towards the West), Ahémé Lake with its tributary the Couffo River and its effluent the Aho channel (in the Center) and a coastal lagoon 65 km long extending from Agoue to Togbin (eastward) [24]. The climate of the study area was subequatorial characterized by two rainy seasons from march to july and september to November and two dry seasons from november to february and august. The annual average of rainfall patterns was 1356 mm with a relative moisture content between 65 and 95% depending on the month. The average temperature is high in the dry season (29.5 °C) and relatively low in the rainy season. The vegetation is composed of a mosaic of mangroves, marshy savannahs, low meadows, plantations and aquatic vegetation [7]. Agriculture is the predominant activity followed by livestock farming, fishing, salt and oyster farming, tourism, trade and fluvio-lagunar transport.

2.2 Material

Pairs of binoculars (Minolta 10 x 50) and a far seeing (20 x 60) were used for the observation of the birds. Rowing canoes was used for moving on the water bodies. A GPS (Global Positioning System) was used to record the geographical coordinates, to trace the transects and to mark the different observation points. The guides of [25-27] help to identify the bird species.

2.3 Methods

Ornithological inventories were carried out from january 2015 to december 2016 during two days of observations per month, either 48 observations for the 24 months. The censures were made at the stations of Aheme lake, coast lagoon and lower delta of Mono River. These stations were selected due to the spatial heterogeneity of habitats. The preferred habitats of the birds were prospected: forest, flood savannahs, meadows, mangroves, plantations, mudflats, fields and fallows and water bodies.

Two techniques were used for the bird surveys: transects and stationary point counting. Indeed on water bodies, the inventory was done along the transects at a slow and steady progression interspersed with brief stops to record the additional information. In the other habitats prospected, the stationary point counting was made during 15 to 30 minutes. Observations were made between 7a.m and 6 p.m under favorable weather conditions and especially where the disturbance caused by the users of the water bodies was of lesser magnitude [28, 20, 9].

The counting of the bird species was systematic, exhaustive and carried out at 85% on board canoes, and at 15% by foot. When the bird group has fewer than 200 individuals and is close to the point of observation, they are counted individually. Otherwise, the counting was done in blocks of 10 individuals by multiplying the number of individuals in a block by the total number of blocks.

The list of species observed followed the nomenclature and the phylogenetic order of [25-27]. The biogeographic origins (residents, afrotropical or paleartics migrants) of the species were also from [27]. The classification of the birds species according to the preferred habitats (F: very dependent on

forests; M: mixed areas; O: Open habitats; H: water bodies) was from [9] and [29]. The threat status of the species was from [30- 32].

The relative frequency (Fr) of observation used to characterize the populations of each bird species followed the standard of [33]. According to the author, If:

$$\begin{cases} Fr \geq 5\,\% & \rightarrow \text{Dominant species (D)} \\ 1 \leq Fr \leq 4.9\,\% & \rightarrow \text{Regular species (Re)} \\ 0.2\,\% \leq Fr \leq 0.9 & \rightarrow \text{rare species (Ra)} \\ Fr \leq 0.2\,\% & \rightarrow \text{Accidental species (Ac)} \end{cases}$$

3. Results

3.1 Avian diversity

The inventories revealed 217 bird species distributed in 130 genera, 57 families and 17 orders (Table 1). Some photographs of bird species observed in the study area are showed in the Appendix.

The order of the Passeriformes dominated the population with 86 species distributed in 51 genera and 21 families. Then, followed the order of Charadriiformes with 37 species, 18 genera and 7 families; the order of Coraciformes with 15 species, 9 genera and 5 families and the order of Ciconiiformes with 15 species, 9 genera and 3 families. The order of Pelecaniformes, Lariformes and Falconiformes with 3 families each count 11, 10 and 3 species respectively. These 7 orders represent 81.56% of the avian diversity.

The best represented families in genera were Scolopacidae (9 genera); Ardeidae and Accipitridae (7 genera each), Pycnonotidae and Nectariniidae (6 genea each) and Ploceidae (5 genera).These 6 families represented 30.76% of the generic diversity. Twenty three (23) families have more than 2 genera, representing 40.35%. Twenty eight (28) families, or 49.12% were represented by only 1 gender.

Scolopacidae with 21 species (9.67%), Nectariniidae with 15 species (6.91%), Ardeidae with 13 species (6%), Ploceidae and Sternidaewith 11 species each (10.12%), Charadriidae with 9 species (4.14%), Accipitridae and Columbidae with 8 species each (7.36%), Cuculidae, Pycnonotidae and Malaconotidae with 7 species each (9.66%) were counted. These twelve (12) families account for 54.02% of the bird population. Twenty-one (21) families or 30.74% have more than 2 species. Twenty-five (25) families (Podicipedidae, Pelecanidae, Scopidae, Phalacrocoracidae, Ciconiidae, Threskiornithidae, Pandionidae, Falconidae, Jacanidae, Burhinidae, Haematopodidae, Laridae, Rynchopidae, Psittacidae, Musophagidae, Phoeniculidae, Capitonitidae, Alaudidae, Dicruridae, Timalïdae, Muscicapidae, Platysteiridae, Monarchidae, Prionopidae and Fringillidae) or 11.04% were represented only by a single species.

The best represented genera in number of species are: *Sterna* (9 species), *Charadrius* (6 species), *Egretta*, *Calidris*, *Tringa*, *Cinnyris*, *Merops Ploceus* et *Hirundo* (5 species each), *Chalcomitra*, *Cisticola*, et *Streptopelia* (4 species each), *Ardea*, *Campethera*, *Centropus*, *Cyanomitra*, *Euplectes*, *Lamprotornis*, *Laniaruis*, *Lanius*, *Lonchura*, *Turtur* and *Vidua* (3 species each).

The ratio between the total specific richness (217) and the total number of genera (130) is equal to 1.67; that is to say, about 2 species for a genera. This indicated a great generic diversity.

Table 1: List of bird species observed in the Wetlands of the Ramsar site 2017.

Orders/families/species	IA	HP	SB	SC
Podicipediformes				
Podicipedidae				
Tachybaptus ruficollis (Pallas, 1764)	Ac	H	R	LC
Pelecaniformes				
Pelecanidae				
Pelecanus rufescens (Gmelin, 1789)	Ra	H	M	LC
Scopidae				
Scopus umbretta (Gmelin, 1789)	Ac	H/O	R/M	LC
Phalacrocoracidae				
Phalacrocorax africanus (Gmelin, 1789)	D	H	R	LC
Ciconiiformes				
Ardeidae				
Ixobrychus minutus (Linné, 1766)	Ac	H	R/P	LC
Nycticorax nycticorax (Linné, 1758)	Ac	H	R/P	LC
Ardeola ralloides (Scopoli, 1769)	Ra	H	R/P	LC
Bubulcus ibis (Linné, 1758)	Re	H	R/M	LC
Butorides striata (Linné, 1758)	Re	H	R	LC
Ardea purpurea (Linné, 1766)	Ac	H	R/P	LC
Ardea cinerea (Linné, 1758)	Ra	H	R/P	LC
Ardea melanocephala (Vigors and Children, 1826)	Ac	H	R/M	LC
Egretta ardesiaca (Wagler, 1827)	Ra	H	R/M	LC
Egretta gularis (Bosc, 1792)	Ra	H	R/M	LC
Egretta garzetta (Linné, 1766)	D	H	R/M/P	LC
Egretta alba (Linné, 1758)	Ra	H	R/M/P	LC
Egretta intermedia (Wagler, 1829)	Ac	H	R/M	LC
Ciconiidae				
Anastomus lamelligerus (Temminck, 1823)	Ac	H	M/R	LC
Threskiornithidae				
Plegadis falcinellus (Linné, 1766)	Ac	H	R/P/V	LC
Anseriformes				
Anatidae				

Orders/families/species	IA	HP	SB	SC
Dendrocygna viduata (Linné, 1766)	D	H	R/M	LC
Sarkidiornis melanotos (Pennant, *1769*)	Ac	H	M	LC
Falconiformes				
Pandionidae				
Pandion haliaetus (Linné, 1758)	Ac	H	P/R	LC
Accipitridae				
Elanus caeruleus (Desfontaines, 1789)	Ac	O	R	LC
Milvus migrans (Boddaert, 1783)	Re	O	R/M/P	LC
Kaupifalco monogrammicus (Temminck, 1824)	Ac	O	R	LC
Circus aeruginosus (Linné, 1758)	Ac	H	P	LC
Circus pygargus (Linné, 1758)	Ac	H	R	LC
Accipiter badius (Gmelin, 1788)	Ac	O/H	R/M	LC
Aviceda cuculoides (Swainson, 1837)	Ac	O/H	R	LC
Haliaeetus vocifer (Daudin, 1800)	Ac	H	R	LC
Falconidae				
Falco tinnunculus (Linné, 1758)	Ac	O	R/P	LC
Galliformes				
Phasianidae				
Coturnix delegorguei (Delegorgue, 1847)	Ac	O/H	M/R	LC
Francolinus albogularis	Ac	O	M/R	LC
GRUIFORMES				
Rallidae				
Amaurornis flavirostra (Swainson, 1837)	Ac	H	R	LC
Crex egregia (Peters, 1854)	Ac	H	M/R	LC
Porphyrio alleni (Thomson, 1842)	Ac	H	M/R	LC
Porphyrio porphyrio (Linné, 1758)	Ra	H	R	LC
Gallinula angulata (Sundevall, 1850)	Ac	H	R/P	LC
Gallinula chloropus (Linné, 1758)	Ac	H	R/P	LC
Charadriiformes				
Jacanidae				
Actophilormis africana (Gmelin, 1789)	Ra	H	R	LC
Microparra capensis (Smith, 1839)	Ra	H	R/M	LC
Recurvirostridae				
Himantopus himantopus (Linné, 1758)	Re	H	R/P	LC
Recurvirostra avosetta (Linné, 1758)	Ac	H	P	LC
Haematopodidae				
Haematopus ostralegus (Linné, 1758)	Ac	H	P	NT
Burhinidae				
Burhinus senegalensis (Swainson, 1837)	Ac	H	R	LC
Glareolidae				
Glareola cinerea (Fraser, 1843)	Ac	H	R/P	LC
Glareola pratincola (Linné, 1766)	Ra	H	R/M/P	LC
Charadriidae				
Charadrius dubius (Scopoli, 1786)	Ra	H	P	LC
Charadrius hiacticula (Linné, 1758)	Ra	H	P	LC
Charadrius alexandrinus (Linné, 1758)	Ac	H	R/P	LC
Charadrius pecuarius (Temminck, 1823)	Ac	H	P	LC
Charadrius forbesi (Schelley, 1883)	Ac	H	P	LC
Charadrius marginatus (Vieillot, 1818)	Ac	H	R	LC
Pluvialis squatarola (Linné, 1758)	Ac	H	P	LC
Vanellus lugubris (Lesson, 1826)	Ac	H	M	LC
Vanellus spinolus (Linné, 1758)	Ac	H	R	LC
Scolopacidae				
Actitis hypoleucos (Linné, 1758)	Re	H	P	LC
Calidris canutus (Linné, 1758)	Ac	H	P	NT
Calidris alba (Pallas, 1764)	Ac	H	P	LC
Calidris ferruginea (Pontopidan, 1763)	Ra	H	P	NT
Calidris minuta (Pallas, 1764)	Ra	H	P	LC
Calidris alpina (Linnaeus, 1758)	Ac	H	P	LC
Limosa limosa (Linné, 1758)	Ac	H	P	NT
Limosa lapponica (Linné, 1758)	Ac	H	P	NT
Lymnocryptes minimus (Linné, 1758)	Ac	H	P/V	LC
Philomachus pugnax (Linné, 1758)	Ac	H	P	LC
Gallinago gallinago (Linné, 1758)	Ac	H	P	LC
Gallinago media (Latham, 1787)	Ac	H	P	NT
Numenius phaeopus (Linné, 1758)	Re	H	P	LC
Numenius arquata (Linné, 1758)	Ac	H	P	NT

Orders/families/species	IA	HP	SB	SC
Tringa nebularia (Gunnerus, 1767)	Ra	H	P	LC
Tringa erythropus (Pallas, 1764)	Ra	H	P	LC
Tringa stagnantilis (Bechstein, 1803)	Ra	H	P	LC
Tringa totanus (Linné, 1758)	Ra	H	P	LC
Tringa glaerola (Linné, 1758)	Ra	H	P	LC
Arenaria interpes (Linné, 1758)	Ac	H	P/V	LC
Tringa ochropus (Linné, 1758)	Ac	H	P	LC
Lariformes				
Laridae				
Larus fuscus (Linné, 1758)	Ac	H	P	LC
Sternidae				
Sterna maxima (Boddaert, 1783)	Re	H	R/M	LC
Sterna sandvicensis (Latham, 1787)	Re	H	P	LC
Sterna hirundo (Linné, 1758)	Ac	H	P	LC
Sterna albifrons (Pallas, 1764)	Ra	H	R/M/P	LC
Sterna hybrida (Pallas, 1811)	Ac	H	P	LC
Sterna leucopterus (Temminck, 1815)	Ac	H	P	LC
Sterna balaenarum (Strickland, 1853)	Ra	H	M	LC
Gelochelidon nilotica (Gmelin, *1789*)	Ra	H	R/P	LC
Chlidonias niger (Linné, *1758*)	D	H	P	LC
Sterna caspia (Pallas, 1770)	Re	H	R/P	LC
Sterna bagalensis (Lesson, 1831)	Ra	H	P	LC
Rynchopidae				
Rynchops flavirostris (Vieillot, 1816)	Ac	H	R/M	NT
Columbiformes				
Columbidae				
Streptopelia semitorquata (Ruppell, 1837)	Ac	O	R	LC
Streptopelia senegalensis (Linné, 1766)	Re	O	R	LC
Streptopelia vinacea (Gmelin, 1789)	Ac	O	R	LC
Streptopelia decipiens (Hartllaub, 1870)	Ac	O	R	LC
Treron calvus (Temminck, 1808)	Ac	O/F	R	LC
Turtur abyssinucus (Temminck, 1809)	Ac	O/F	R	LC
Turtur tympanistria (Temminck, *1809*)	Ac	O/F	R	LC
Turtur afer (Linné, 1766)	Ra	O	R	LC
Psittaciformes				
Psittacidae				
Agapornis pullarius (Linné, 1758)	Ac	O	R	LC
Musophagiformes				
Musophagidae				
Crinifer piscator (Boddaert, 1783)	Ac	O	R	LC
Cuculiformes				
Cuculidae				
Centropus grillii (Hartlaub, 1861)	Ac	O/F	M/R	LC
Centropus monachus (Rûppel, 1837	Ac	O	R	LC
Centropus senegalensis (Linné, 1766)	Ac	O	R	LC
Ceuthmochares aereus (Vieillot, 1817)	Ac	O/F	R	LC
Oxylophus levaillantii (Swainson, 1829)	Ac	O	M	LC
Chrysococcyx klaas (Stephens, 1815)	Ac	O	M/R	LC
Chrysococcyx caprius (Boddaert, 1783)	Ac	O	M/R	LC
Apodiformes				
Apodidae				
Apus affinis (Gray, 1830)	Ra	O/F	R	LC
Apus caffer (*Lichtenstein, 1823*)	Ac	O	R	LC
Cypsiurus parvus (Lichtenstein, 1823)	Ra	O	R	LC
Coraciiformes				
Alcedinidae				
Halcyon leucocephala (Lichtenstein, 1823)	Ac	O	M	LC
Halcyon senegalensis (Linné, 1766)	Ac	O	M/R	LC
Alcedo cristata (Pallas, 1764)	Ra	O	R/M	LC
Ceryle rudis (Linné, 1758)	Re	H	R	LC
Meropidae				
Merops malimbicus (Shaw, 1806)	Ac	O/F	R	LC
Merops nubicus (Gmelin, 1788)	Ac	O	R	LC
Merops pusillus (Muller, 1776)	Ac	O	R	LC
Merops bulocki (Vieillot, 1817)	Ac	O	R	LC
Merops albicollis (Vieillot, 1817)	Ra	O	R	LC
Coracidae				

Orders/families/species	IA	HP	SB	SC
Coracias naevius (Daudin, 1800)	Ac	O/F	M	LC
Coracias cyanogaster (Cuvier, 1816)	Ac	O/F	M	LC
Eurystomus glaucurus (Statius Müller, 1776)	Ac	O	M	LC
Phoeniculidae				
Phoeniculus purpureus (Miller, 1784)	Ac	O	R	LC
Bucerotidae				
Tockus fasciatus (Shaw, 1811)	Ac	O/H	R	LC
Tockus nasutus (Linné, 1766)	Ac	O	R	LC
Capitonitidae				
Pogoniulus chrysoconus (Temmick, 1852)	Ra	O	R	LC
Piciformes				
Picidae				
Mesopicos goertae (Wagler, 1827)	Ac	O/H	R	LC
Campethera punctuligera (Wagler, 1827)	Ac	O	R	LC
Campethera cailliautii (Malherbe, 1849)	Ac	O/F	R	LC
Alaudidae				
Eremopterix leucotis (Stanley, 1814)	Ac	O/H	R	LC
Passeriformes				
Hirundinidae				
Hirundo smithii (Leach, 1818)	Ac	O	R/M	LC
Hirundo semirufa (Sundevall, 1850)	Ra	O	R/M	LC
Hirundo leucosoma (Swainson, 1837)	Ra	O	R	LC
Hirundo nigrita (Gray,GR, 1845)	Ac	O	R	LC
Hirundo rustica (Linné, 1758)	Ac	O	P	LC
Motacillidae				
Macronyx croceus (Vieillot, 1816)	Ra	O	R	LC
Motacilla flava (Linné, 1758)	Ac	O	P	LC
Motacilla aguimp (Dumont, 1821)	Re	O	R	LC
Anthus leucophrys (Vieillot, 1818)	Ac	O	R	LC
Dicruridae				
Dicrurus adsimilis (Bechstein, 1794)	Ac	O/F	R	LC
Pycnonotidae				
Pycnonotus barbatus (Desfontaines, 1789)	Re	O	R	LC
Bleda eximius (Hartlaub, 1855)	Ac	F	R	VU
Chlorocichla flavicollis (Swainson, 1837)	Ac	O/F	R	LC
Thescelocichla leucopleura (Cassin, 1855)	Ac	O/F	R	LC
Andropadus graciliorostris	Ac	F	R	LC
Chlorocichla simplex (Hartlaub, 1855)	Ac	O/F	R	LC
Phyllastrephus albigularis (Sharpe, 1882)	Ac	F	R	LC
Turdidae				
Turdus pelios (Bonaparte, 1850)	Ac	O	R	LC
Saxicola rubetra (Linné, 1758)	Ac	O	P	LC
Timaliidae				
Turdoïdes reinwardtii (Swainson, 1831)	Ac	O/F	R	LC
Sylvidae				
Cistocola galactotes (Temminck, 1821)	Ac	O	R	LC
Cistocola ruficeps (Sharpe and Bouvier, 1876)	Ac	O	R	LC
Cisticola natalensis (Smith, 1843)	Ac	O	R	LC
Cisticola juncidis (Rafinesque, 1810)	Ac	O	R	LC
Campethera brachypterus (Vieillot, 1820)	Ac	O	R	LC
Hypergerus atriceps (Lesson, 1831)	Ac	O	R	LC
Muscicapidae				
Fraseria ocreata (Strickmaud, 1844)	Ac	F	R	LC
Platysteiridae				
Platysteira cyanea (Müller, 1776)	Ac	O	R	LC
Monarchidae				
Elminia longicauda (Swainson, 1838)	Ac	O/F	R	LC
Nectariniidae				
Anthreptes longuemarei (Lesson, 1831)	Ac	O	R	LC
Anthreptes gabonicus (Hartlaub, 1861)	Ac	O/F	R	LC
Hedydipna collaris (Vieillot, 1819)	Ac	O/F	R	LC
Cinnyris cupreus (Shaw, 1812)	Ac	O	R	LC
Cinnyris superbus (Shaw, 1811)	Ac	O/F	R	LC
Cinnyris chloropygius (Jardine, 1842)	Ac	O/F	R	LC
Cinnyris venustus (Shaw, 1834)	Ac	O/F	R	LC
Cinnyris coccinigastrus (Latham, 1802)	Ac	O	R	LC
Chalcomitra adelberti (Gervais, 1834)	Ac	F	R	LC

Orders/families/species	IA	HP	SB	SC
Chalcomitra senegalensis (Linné, 1766)	Ac	O	R	LC
Chalcomitra fuliginosa (Shaw, 1811)	Ac	O/F	R	LC
Chacomitra rubescens (Vieillot, 1819)	Ac	O/F	R	LC
Cyanomitra cyanolaema (Gervais, 1834)	Ac	O	R	LC
Cyanomitra olivacae (Smith, 1840)	Ac	O	R	LC
Cyanomitra verticalis (Latham, 1790)	Ac	O	R	LC
Laniidae				
Corvinella corniva (Shaw, 1809)	Ra	O	R	LC
Lanius collaris (Linné, 1766)	Ac	O	R	LC
Lanius senator (Linné, 1758)	Ac	O	P	LC
Lanius excubitor (Linné, 1758)	Ac	O	R	LC
Malaconotidae				
Dryoscopus gambemsis (Lichtenstein, 1823)	Ac	O	R	LC
Laniaruis barbarus (Linné, 1766)	Ra	O	R	LC
Laniarus leucorhynchus (Hartlaub, 1848)	Ac	F	R	LC
Laniarus ferrugineus (Shaw, 1809)	Ac	O	R	LC
Nilaus afer (Latham, 1802)	Ac	O	R	LC
Tchagra senegalus (Linné, 1766)	Ac	O	R	LC
Tchagra minuta (Hartlaub, 1858)	Ac	O	R	LC
Prionopidae				
Prionops plumatus (Shaw, 1809)	Ac	O	R	LC
Corvidae				
Corvus albus (Muller, 1776)	Ac	O	R	LC
Ptilostomus afer (Linné, 1766)	Ac	O	R	LC
Sturnidae				
Lamprotornis caudatus (Müller, 1776)	Ac	O/F	R	LC
Lamprotonis chloropterus (Swainson, 1838)	Ac	O/F	R	LC
Lamprotornis splendidus (Vieillot, 1822)	Ac	O/F	R/M	LC
Lamprotornis pulcher (Statius, 1776)	Ac	O/F	R	LC
Cinnyricinclus leucogaster (Boddaert, 1783)	Ac	O/F	R	LC
Onychognatus fulgidus (Hartlaub, 1849)	Ac	O/F	R	LC
Passeridae				
Passer grisseus (Vieillot, 1817)	Ra	O	R	LC
Petronia dentata (Petronia, 1850)	Ac	O	R	LC
Plocepasser superciliosus (Cretzhamar, 1827)	Ac	O	R	LC
Ploceidae				
Pachyphantes superciliosus (Shelley, 1873)	Ac	O	R	LC
Ploceus nigerrimus (Vieillot, 1805)	Ac	O	R	LC
Ploceus cucullatus (Muller, 1776)	D	O	R	LC
Ploceus luteolus (Lichtenstein, 1823)	Ac	O/F	R	LC
Ploceus tricolor (Hartlaub, 1854)	Ac	F	R	LC
Ploceus aurantius (Vieillot, 1805)	Ac	O	R	LC
Euplectes after (Gmelin, 1789)	Ac	O	R	LC
Euplectes macroura (Gmelin, 1789)	Ac	O	R	LC
Euplectes franciscanus (Linné, 1758)	Ac	O	R	LC
Malimbus nitens (Gray, 1831)	Ac	O/F	R	LC
Ambliospiza albifrons (Vigors, 1831)	Ac	O	R	LC
Estrildidae				
Spermestes fringilloides (Lafresnaye, 1835)	Ac	O	R	LC
Spermestes cucullata (Swainson, 1837)	Re	O	R	LC
Spermestes bicolor (Fraser, 1843)	Ac	O	R	LC
Lagonostica senegala (Linné, 1766)	Ac	O	R	LC
Lagonostica rufopicta (Fraser, 1843)	Ac	O	R	LC
Viduidae				
Vidua macroura (Pallas, 1764)	Ac	O	R	LC
Vidua camerunensis (Grote, 1922)	Ac	O	R	LC
Vidua chalybeata (Müller, 1776)	Ac	O	R	LC
Fringillidae				
Serinus mozambicus (Statius Muller, 1776)	Ac	O	R	LC

IA: abondance mark; Ac : Accidental ; D : Dominant ; Ra : Rare ; Re : Regular ; HP : Preferred Habitats ; H : aquatic ; F : forest ; O : open; SB : Biogeographic status; R : resident ; M : Afrotropical migratory ; P : Palearctic migratory ; SC : Status of Conservation ; LC : less threatened; NT : near-threatened ; VU : vulnerable).

3.1.1 Non-Passeriformes birds

This taxonomic group count 130 species distributed in 77 genera, 37 families and 16 orders (Table 2). They represented 59.90% of the avian population.

Table 2: Orders and families of Non-Passeriformes

Orders	Families	Number of genera	Number of species
Podicipediformes	Podicipedidae	1	1
Pelecaniformes	Pelicanidae	1	1
	Phalacrocoracidae	1	1
	Scopidae	1	1
Ciconiiformes	Ardeidae	7	13
	Ciconiidae	1	1
	Threskiornithidae	1	1
Anseriformes	Anatidae	2	2
Falconiformes	Pandionidae	1	1
	Accipitridae	7	8
	Falconidae	1	1
Galliformes	Phasianidae	2	2
Gruiformes	Rallidae	4	6
Charadriiformes	Jacanidae	2	2
	Recurvirostridae	2	2
	Haematopodidae	1	1
	Burhinidae	1	1
	Glareolidae	1	2
	Charadriidae	3	9
	Scolopacidae	9	21
Lariformes	Laridae	1	1
	Sternidae	3	11
	Rynchpidae	1	1
Columbiformes	Columbidae	3	8
Psittaciformes	Psittacidae	1	1
Musophagiformes	Musophagidae	1	1
Cuculiformes	Cuculidae	4	7
Apodiformes	Apodidae	2	3
	Alcedinidae	3	4
	Meropidae	1	5
Coraciiformes	Coraciidae	2	3
	Phoeniculidae	1	1
	Bucerotidae	1	2
Piciformes	Capitonidae	1	1
	Picidae	2	3
	Alaudidae	1	1

Seven (7) orders (Charadriiformes, Coraciformes, Ciconiiformes, Lariformes, Falconiformes, Cuculiformes and Piciformes) accounted for 70.58% of the families and 74.60% of the species. The order of Charadriiformes with 37 species of 7 families, has the greatest specific richness. It was followed by the order of Coraciformes with 15 species of 5 families. The order of Ciconiiformes with 15 species of 3 families occupied the third place and the order of Lariformes with 13 species of 3 families was in fourth place.

Seven (7) families accounted for 60.31% of the bird population in this taxonomic group. These included Scolopacidae (21 species), Ardeidae (13 species), Sternidae (11 species), Charadriidae (9 species), Columbidae and Accipitridae (8 species each) and Cuculidae (7 species).

3.1.2 Passeriformes birds

The Passeriformes order with 87 species belonging to 53 genera and 21 families represented 40.84% of the avian population (Fig 2).

Six (6) families accounted for 65.51% of the specific richness of this order. These were Nectariniidae (15 species), Ploceidae (11 species), Pycnonotidae and Malaconotidae (7 species each), Sturnidae and Sylvidae (6 species each) and Estrildidae (5 species).

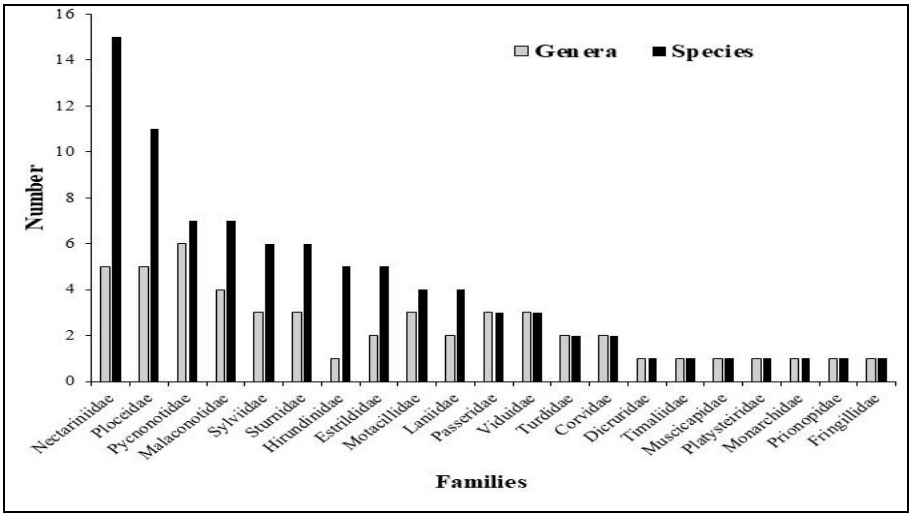

Fig 2: Number of genera and species per families of Passeriformes order.

3.2. Biogeographical origins

The inventoried species belonged to four biogeographical origins (Fig 3). Resident species dominated with 125 species (57.60%), followed by Palearctic migrants with 37 species (17.05%); Afrotropical migrants with 9 species (4.15%). Afrotropical and palearctic species represented 21.20% (46 species) of the avian population (Figure 3).

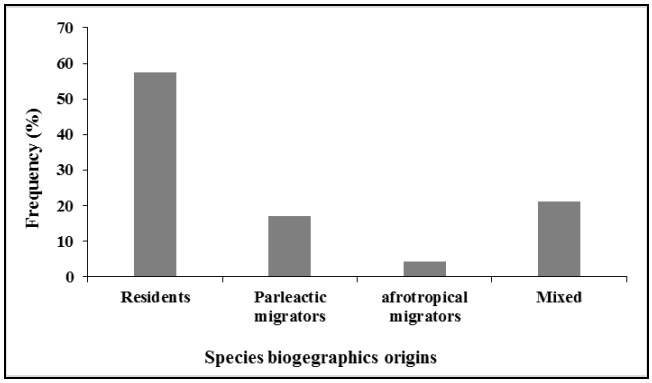

Fig 3: Biogeographical origins of the bird species

3.3. Preferred habitats

The preferred habitats of the observed bird species are presented in Fig 4.

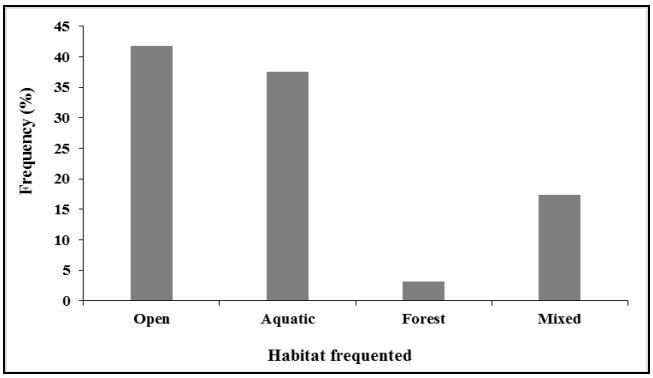

Fig 4: Preferred habitats of bird species

The species of the open environment predominated (O: 41.47%), followed by those of aquatic environments (A: 38.24%) and forests (F: 3.22%). Mixed status species represented 17.05% of the avian population.

3.4 Species of conservation concern

According to the IUCN Red List, 1 vulnerable (VU) specie (*Bleda eximius*) have been identified as well as seven (7) near-threatened (NT) species (*Haematopus ostralegus*, *Calidris canutus*, *C. ferruginae*, *Limosa limosa*, *L. lapponica*, *Gallinago media*, *Numenius arquata* and *Rynchops flavirostris*). The others species observed were of less threatened (LC).

4. Discussion

In wetland of international importance of southwest Benin, analysis of the distribution of species and their abundances over time showed that 217 bird species belonging to 130 genera, 57 families and 17 orders were recorded. The most important families of the avian population were Scolopacidae, Nectariniidae, Ardeidae, Ploceidae, Charadriidae, Sternidae, Accipitridae, Columbidae, Cuculidae, Pycnonotidae and Malaconotidae. Similar results have been obtained in Yankari (Bauchi) reserve in Nigéria [34], the wetland of Grand-Bassam [28] in Ivory Coast and Ombolo in Tanzani [30]. On the other hand, the specific diversity obtained in the present study is well below the 348 species inventoried in the wetland of the international importance of south-east Benin [9]. This difference in the observed results can result from the combination of the inventory methods used (direct observation, listening to songs and shout, capture by Japanese net) and the duration of the study, which was two years in this study versus ten years [9].

The Passeriformes order represented 40.84% of the avian population. Most of the species in this order were recorded by many authors [9, 16, 17, 21, 22]. The number of Passeriformes species obtained by [9] in the wetland of international importance of south-eastern Benin is about twice as high as that reported in this study. It should be noted that one hundred and thirty-one species mentioned by the author have not been observed in this study. *Scopus umbretta* (Hammerkop) of Scopidae family was also observed in wetland of southwest Benin.

Ten species (*Buteo augularis*, *Falco biarmicus*, *Treron waalia*, *Oena capensis*, *Upupa epops*, *Lybius vielloti*, *Picoides obsoletus*, *Coracina pectoralis*, *Phylloscopus sibilatrix* and *Sylvietta 0brachyura*) mentioned by [22] were not also observed in this study. This result can be explained by the destruction of some habitats due mainly to the anthropogenic pressure [36].

Biogeographically, resident and migratory species were predominant (more than 75%). These groups of bird species have a great preference for wetland areas because of their strong productivity and the availability of food resources [37].

Species of open habitats represented 41.47%. Their strong presence was the proof of a pronounced human pressure on the area linked to the development of agricultural activities and agglomerations [9, 38].

Annex: Photographs of bird species of the Wetland of international importance of South-West Benin

Egretta garzetta (Linné, 1766)

Egretta alba (Linné, 1758)

Egretta intermedia (Wagler, 1829)


Egretta ardesiaca (Wagler, 1827)


Ardeola ralloides (*Scopoli, 1769*)


Nycticorax nycticorax (Linné, 1758)


Anastomus lamelligerus (Temminck, 1823)


Porphyrio alleni (Thomson, 1842)


Vanellus spinolus (Linné, 1758)


Himantopus himantopus (Linné, 1758)


Sterna sandvicensis (*Latham, 1787*)


Alcedo cristata (Pallas, 1764)

5. Conclusion

The study of specific diversity of the avifauna of the international importance of the wetland of South-West Benin (Ramsar Site 1017) has showed the presence of 217 species birds of resident and migratory. The bird species of the open area are major. The high presence of birds from open environments is evidence of an increasingly degradation of the environment in relation to urbanization and agricultural activities. Thus, regular monitoring of these birds is necessary to better understanding of the mechanisms of its dynamics and their assemblage patterns.

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