



## Composition and abundance of rice field birds in the District of Yamoussoukro (central Côte d'Ivoire)

KOUADJA Kra Ehouabolet Sonia<sup>1</sup>, ODOUKPE Kadio Saint Guillaume<sup>1</sup>, KONAN Ekoun Michaël<sup>2</sup>, \*YAKOKORE-BEIBRO K. Hilaire<sup>1</sup>

<sup>1</sup>Unité de Recherche Biologie de la Conservation et Gestion de la Faune, Laboratoire des milieux naturels et conservation de la biodiversité, UFR Biosciences, Université Félix HOUPHOUËT-BOIGNY, 22 B.P. 582 Abidjan 22, Côte d'Ivoire

<sup>2</sup>Département de Biologie Animale; UFR des Sciences Biologiques ; Université Péléforo GON COULIBALY ; BP 1328 Korhogo, Côte d'Ivoire ;

[skouadja@gmail.com](mailto:skouadja@gmail.com) / Tel: (+225) 07 57 79 20 59

[sgodoukpe@yahoo.fr](mailto:sgodoukpe@yahoo.fr) / Tel: (+225) 07 07 77 57 98.

[micekoun.konan@upgc.edu.ci](mailto:micekoun.konan@upgc.edu.ci) / [micekoun@gmail.com](mailto:micekoun@gmail.com) / Tel: (+225) 07 57 64 88 63

[hyaokokore@yahoo.fr](mailto:hyaokokore@yahoo.fr) / Tel: (+225) 07 07 63 42 65

\*Corresponding Author: YAKOKORE-BEIBRO K. Hilaire: [hyaokokore@yahoo.fr](mailto:hyaokokore@yahoo.fr)

Submission 22<sup>nd</sup> August 2022. Published online at <https://www.m.elewa.org/Journals/> on 30<sup>th</sup> June 2023.  
<https://doi.org/10.35759/JABs.186.4>

### ABSTRACT

*Objectives:* A bird study was conducted from January to December 2017 on the rice fields of Nanan, Petit Bouaké and Zatta in Yamoussoukro District. The aim of this study was to identify birds of rice fields in the pre-forest areas of Côte d'Ivoire.

*Methodology and results:* During twice-monthly visits, all birds seen or heard, posed or flying in the rice fields, were recorded. A total of 95 bird species were recorded. They belong to 37 families divided into 15 orders with an abundance of 57172 birds. The most represented family is that Ardeidae with 11 species and the Village Weaver *Ploceus cucullatus* (Müller, 1776) is the most abundant species with a relative frequency of 57.84%. Open-space birds (59%) dominate rice fields and resident species account for 56% of the bird population. The composition and abundance of the species in the rice fields change according to the development of the rice rather than the seasons.

*Conclusions and application of the results:* This study shows the species of birds that depend on rice fields during an annual cycle. The results obtained will allow us to know and monitor these species in this particular agro ecosystem. This will also help to train and sensitize rice farmers to better manage these birds, which they very often consider to be harmful to their rice fields.

**Key words:** Birds - Diversity - Irrigated rice - Rice fields – Yamoussoukro.

## INTRODUCTION

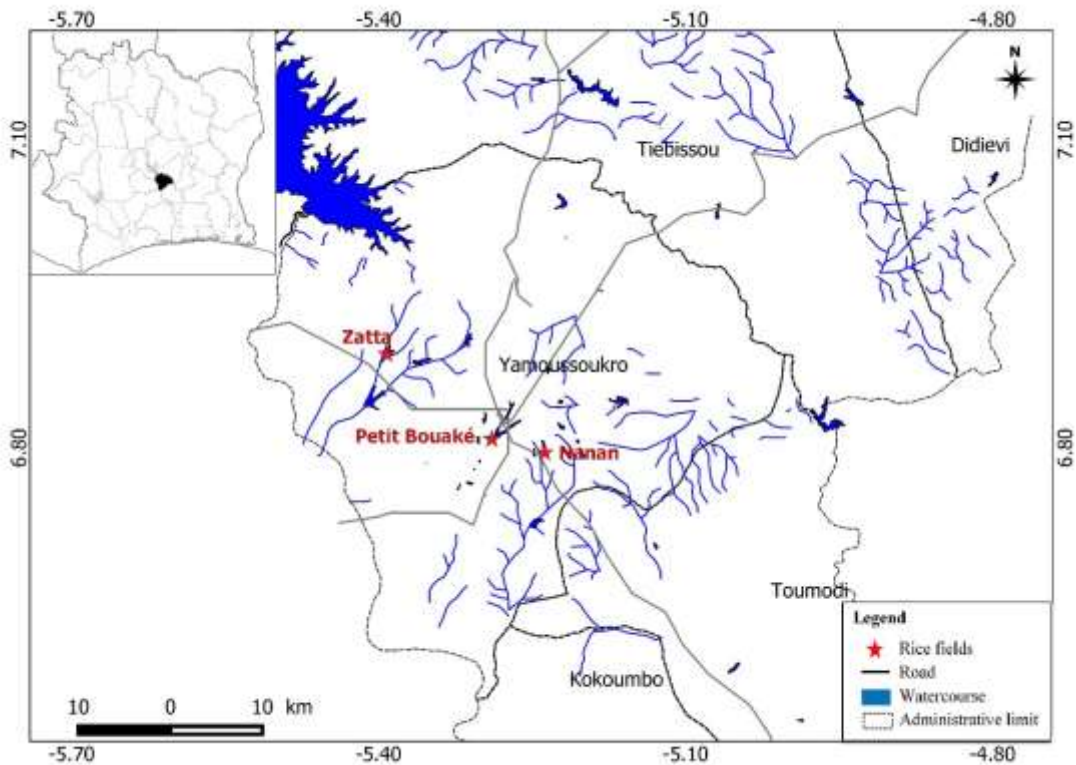
Birds have colonized a large part of available environments in earth surface because of their adaptive capacity, (Doctrinal *et al.*, 2005). Among these ecosystems available and populated by birds, there are natural wetlands. However, these wetlands have declined and become degraded worldwide (Moser *et al.*, 1996). Their loss has often been caused by drainage to create farmland such as rice field (Elphick, 2010). In fact, rice fields account for more than 15% of wetlands worldwide (Lawler, 2001). They have ecological value and play an important role in wildlife conservation, especially wetland birdlife. It is therefore necessary to deepen studies on the functioning of rice fields in order to contribute to a better conservation of bird biodiversity (Elphick, 2010; Triplet, 2015). Only research oriented in this direction that can, as suggested by Elphick (2010) determine how to extend the benefits of rice farming to wildlife without

hampering the economic viability of the agronomic system or its ability to provide food security to millions of people who depend on rice for survival. Numerous studies have shown the birdlife in different parts of the world as shown by the work of Remsen *et al.* (1991) in the United States; Manjit and Harjeet (1994) in India; Nachuha (2009) in Uganda and Wymenga and Zwarts (2010) in West Africa. In Côte d'Ivoire, preliminary studies on rice field birds have been carried out in the international wetland of Grand-Bassam in the south of the country (Oudouké and Yaokokoré-Béibro, 2014). This present study aims to acquire knowledge about rice-field birds in the savanna zones of Côte d'Ivoire. It will thus make it possible to characterize the avifauna of rice fields within Yamoussoukro District by determining its specific composition and its abundance.

## MATERIAL AND METHODS

The District of Yamoussoukro is located in northwest of Abidjan (5 ° 19'N / 4 ° 01'W) with 250 km as distance and 100 km in south to Bouaké town (7 ° 42'N / 5 ° 01'W) (Assé, 2003). The study area has a tropical transition climate characterized by four seasons: two dry seasons from November to mid-March and mid-July to mid-August; two rainy seasons from mid-March to mid-July and mid-August to late October (N'Guessan *et al.*, 2014). Yamoussoukro is located on a flat land covered with pre-forest savannah and characterized by a mosaic of savannah forests, very representative from the Guinean savanna

domain, scattered more or less densely with woodlands and intermixed with groves and forest islets (Konan and Yaokokoré-Béibro, 2014). The District of Yamoussoukro has 15 rice-growing perimeters; three of them were the subject of this study. These rice-growing areas: Nanan, Petit Bouaké and Zatta, have equipment to control water supply throughout the rice cycle and are subject to increase rice production. The rice-growing areas of Nanan and Petit Bouaké are urban sites, while Zatta, and is in peri-urban area, 9 km from the center of Yamoussoukro town, (Figure 1).



**Figure1:** Location of the three rice fields in the study

**Technical material:** Observation equipment consists of a pair of binoculars (Bresser Corvette 10x42). A Nikon Coolpix P900 digital camera was used to shoot bird species. A Sony ICD-PX440 dictaphone was used for recording the cries of bird species. West Africa Bird Identification Guide from Borrow and Demey (2012) and discography collection of African bird songs and cries from Chappuis (2000) were used to identify bird species.

**Birds inventory within rice farm:** Data recording were made twice per month from January to December 2017 and started from 6:30 to 10:30 am and from 3 to 6 pm, which corresponds to a sufficiently heterogeneous period of activity in the diurnal birds (Bibby *et al.*, 1992; Yaokokoré, 2001; Gibbons et Gregory, 2006). The method consisted of walking slowly along tracks perimeter during 20 minutes for 1 ha area. The inventories were done in two times; the observer remains static

for the first 10 minutes during that period he notes all bird species seen or heard, posed or in flight. The rest of the time is used to walk along the perimeter of the plot to detect cryptic or unperceived species during the first 10 minutes of sampling. (Odoukpé, 2015).

**Data analysis:** The list, full scientific names and biogeographical status of the bird species are according to Gill F *et al.*, (2022). The preferential habitat of the species is indicated according to Bennun *et al.*, (1996) and Yaokokoré (2001). The characterization of bird species based on their abundance has been done according to Thiollay (1986). To determine the stand structure, the relative frequency (Fr), Shannon-Wiener diversity index (H') and equitability index (J) were calculated using Microsoft Excel 2013 spreadsheet and Past version 2.17 c software. According to Thiollay's (1986) standards, the relative frequency  $Fr = \frac{n_i}{N} \times 100$  ( $n_i$ : sum of all

contacts with species *i* in all *k* enumeration points;  $N = \sum n_i$ : sum of contacts of all species observed on each rice field). Also, Shannon-Wiener diversity index ( $H'$ ) and equitability index ( $J$ ) were calculated using Microsoft Excel 2013 spreadsheet and Past software version 2.17 c. Principal component analysis (PCA) was performed in STATISTICA 10 software to assess the seasonal distribution of bird species. The mathematical expression of the Shannon-Wiener index ( $H'$ ) according to Ramade (2003) is:  $H' = -\sum (n_i/N) \times \ln (n_i/N)$

with ( $H'$ : Shannon-Weaver diversity index;  $n_i$ : number of individuals per species;  $N$ : total number of individuals of the stand inventoried per rice-growing perimeter;  $\ln$ : neperian logarithm). Pielou's equitability index ( $J$ ) is equal to  $J = H'/H'_{max}$  ( $H'$ : Shannon-Wiener diversity index;  $H'_{max} = \ln S$  with  $H'_{max}$ : maximum value of  $H'$  and  $S$ : number of species) (Pielou, 1966). Principal component analysis (PCA) was performed using STATISTICA 10 software to assess the seasonal distribution of bird species.

## RESULTS

### Specific composition of rice fields birds:

Inventories rice fields birds within the study area revealed 95 species grouped into 37 families of 15 orders (Table 1). The most represented families are Ardeidae with 11 species followed by Accipritidae, Scolopacidae, Ploceidae and Estrildidae with 6 species each. Then come the families of Charadriidae, Cuculidae and Cisticolidae with five species each. The resident species are 53 in number depending on the biogeographic status; there are 16 migratory species and the remaining 26 species have a mixed status

(Figure 2a). Depending on the preferred habitat, 56 species are from open habitats, 31 species are water birds and eight general forest species are *Accipiter badius* (Gmelin, 1788), *Tauraco persa* (Linnaeus, 1758), *Cuculus clamosus* Latham, 1802, *Lophoceros fasciatus* (Shaw, 1811), *Eurillas virens* (Cassin, 1857), *Chlorocichla simplex* (Hartlaub, 1855), *Bocagia minuta* (Hartlaub, 1858) and *Dicrurus adsimilis* (Bechstein, 1794) (Figure 2b). Photos of some bird species from the Yamoussoukro rice fields are shown in Figure 3.

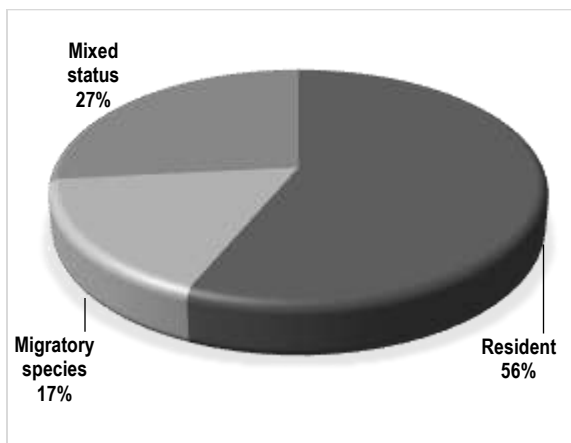


Figure 2a

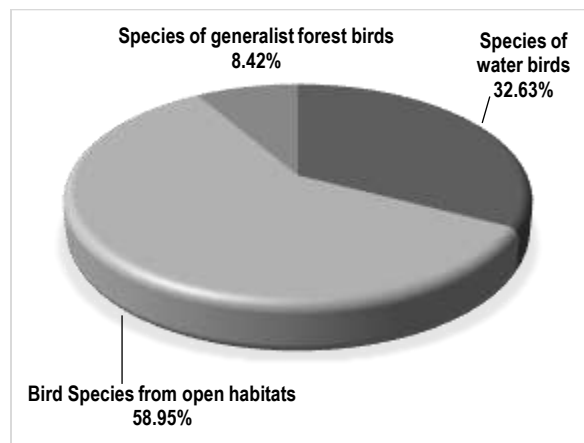


Figure 2b

**Figure 2:** Characterization of settlement bird of rice perimeters according to the biogeographical status (a) and the preferential habitat (b)

**Table 1:** Specific composition and abundance of Yamoussoukro rice field birds

N <sup>o</sup>	Orders / Families / Species	English Names	Cod e	B S	P H	J	F	M	A	My	Jn	Jl	At	S	O	N	D	PIA	Cn	Fr	A C
<b>Suliformes</b>																					
<b>Phalacrocoracidae</b>																					
1	<i>Microcarbo africanus</i> (Gmelin, 1789)	Reed Cormorant	Mica f	R	E	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	Ac
<b>Pelecaniformes</b>																					
<b>Ardeidae</b>																					
2	<i>Ixobrychus minutus</i> (Linnaeus, 1766)	Little Bittern	Ixomi	R/P	E	0	0	0	0	2	5	5	0	4	0	0	0	5	16	0,03	Ac
3	<i>Ixobrychus sturmii</i> (Wagler, 1827)	Dwarf Bittern	Ixost	M	E	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	Ac
4	<i>Nycticorax nycticorax</i> (Linnaeus, 1758)	Black-crowned Night Heron	Nycny	R/P	E	0	0	0	0	0	0	0	1	0	0	0	1	1	2	0	Ac
5	<i>Ardeola ralloides</i> (Scopoli, 1769)	Common Squacco Heron	Ardra	R/M	E	6	35	2	9	49	19	34	17	19	8	18	28	49	244	0,43	Ra
6	<i>Bubulcus ibis</i> (Linnaeus, 1758)	Cattle Egret	Bubib	R/M	E	81	391	50	86	253	70	114	246	104	151	314	191	391	2051	3,59	Re
7	<i>Butorides striata</i> (Linnaeus, 1758)	Green-backed Heron	Butst	R	E	3	8	3	7	24	46	65	59	48	25	14	9	65	311	0,54	Ra
8	<i>Egretta gularis</i> (Bosc, 1792)	Reef Heron	Egrgu	R/M	E	1	2	2	2	2	0	0	0	0	0	0	2	2	11	0,02	Ac
9	<i>Egretta garzetta</i> (Linnaeus, 1766)	Little Egret	Egrga	R/M	E	3	20	16	8	28	0	1	0	7	11	18	12	28	124	0,22	Ra
10	<i>Ardea intermedia</i> (Wagler, 1829)	Yellow-billed Egret	Ardin	R/M	E	18	114	19	18	21	4	13	0	4	13	13	19	114	256	0,45	Ra
11	<i>Ardea alba</i> Linnaeus, 1758	Great White Egret	Ardal	R/M	E	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	Ac
12	<i>Ardea purpurea</i> Linnaeus, 1766	Purple Heron	Ardpu	R/P	E	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	Ac
<b>Scopidae</b>																					
13	<i>Scopus umbretta</i> Gmelin, 1789	Hamerkop	Scoum	R	E	0	1	0	0	0	0	0	0	0	0	1	1	1	3	0,01	Ac
<b>Anseriformes</b>																					
<b>Anatidae</b>																					
14	<i>Dendrocygna viduata</i> (Linnaeus, 1766)	White-faced Duck	Denvi	R/M	E	0	0	0	5	10	11	4	0	0	0	0	0	11	30	0,05	Ac
<b>Accipitriformes</b>																					
<b>Accipitridae</b>																					
15	<i>Elanus caeruleus</i> (Desfontaines, 1789)	Black-shouldered Kite	Elaca	R	f.	0	1	3	0	1	0	2	0	0	0	0	0	3	7	0,01	Ac
16	<i>Milvus migrans</i> (Boddaert, 1783)	Black Kite	Milmi	M/P	f.	1	7	0	0	2	0	1	0	0	3	4	1	7	19	0,03	Ac
17	<i>Circus aeruginosus</i> (Linnaeus, 1758)	Eurasian Marsh-Harrier	Cirae	P	f.	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	Ac
18	<i>Accipiter badius</i> (Gmelin, 1788)	Shikra	Accba	R/M	F	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	Ac

N <sup>o</sup>	Orders / Families / Species	English Names	Cod e	B S	P H	J	F	M	A	My	Jn	Jl	At	S	O	N	D	PIA	Cn	Fr	A C
19	<i>Butastur rufipennis</i> (Sundevall, 1850)	Grasshopper Buzzard	Butru	M	f.	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	Ac
20	<i>Kaupifalco monogrammicus</i> (Temminck, 1824)	Lizard Buzzard	Kau mo	R	f.	0	4	0	0	0	0	0	0	0	0	0	0	4	4	0,0 1	Ac
<b>Falconiformes</b>																					
<b>Falconidae</b>																					
21	<i>Falco ardosiaecus</i> Vieillot, 1823	Grey Kestrel	Falar	R	f.	0	0	0	0	0	2	1	0	0	0	0	1	2	4	0,0 1	Ac
<b>Galliformes</b>																					
<b>Phasianidae</b>																					
22	<i>Pternistis bicalcaratus</i> (Linnaeus, 1766)	Double-spurred Francolin	Ptebi	R	f.	0	0	1	1	1	0	0	0	1	2	0	3	3	9	0,0 2	Ac
<b>Gruiformes</b>																					
<b>Rallidae</b>																					
23	<i>Crecopsis egregia</i> (W. Peters, 1854)	African Crake	Cree g	M/R	f.	8	3	1	2	24	14	19	12	16	20	24	20	24	163	0,2 9	Ra
24	<i>Zapornia flavirostra</i> (Swainson, 1837)	Blake Crake	Zapfl	R	E	7	11	10	1	8	13	15	15	13	21	36	29	36	179	0,3 1	Ra
25	<i>Gallinula chloropus</i> (Linnaeus, 1758)	Moorhen	Galc h	R/P	E	0	1	2	2	0	2	13	1	4	0	5	0	13	30	0,0 5	Ac
26	<i>Paragallinula angulata</i> Sundevall, 1850	Lesser Moorhen	Paran	R/M	E	0	0	0	0	0	0	1	1	0	0	0	0	1	2	0	Ac
<b>Charadriiformes</b>																					
<b>Jacaniidae</b>																					
27	<i>Actophilornis africanus</i> (Gmelin, 1789)	African Jacana	Actaf	R	E	10	50	8	22	76	91	291	92	80	4	6	30	291	760	1,3 3	R
<b>Rostratulidae</b>																					
28	<i>Rostratula benghalensis</i> (Linnaeus, 1758)	Painted Snipe	Rosb e	R/M	E	0	43	4	1	76	40	40	30	41	13	40	17	76	345	0,6	Ra
<b>Recurvirostridae</b>																					
29	<i>Himantopus himantopus</i> (Linnaeus, 1758)	Black-winged Stilt	Himh i	R/P	E	6	50	0	0	0	0	0	0	0	10	9	3	50	78	0,1 4	Ac
<b>Burhinidae</b>																					
30	<i>Burhinus senegalensis</i> (Swainson, 1837)	Senegal Thick-knee	Burs e	R	E	0	0	0	0	0	0	4	4	2	0	0	0	4	10	0,0 2	Ac
<b>Charadriidae</b>																					
31	<i>Charadrius hiaticula</i> Linnaeus, 1758	Ringed Plover	Chah i	P	E	7	12	7	5	0	0	0	0	0	2	17	3	17	53	0,0 9	Ac
32	<i>Charadrius forbesi</i> (Shelley, 1883)	Forbes's Plover	Chaf o	R/M	E	0	0	8	1	0	0	0	0	0	0	0	1	8	10	0,0 2	Ac
33	<i>Vanellus senegallus</i> (Linnaeus, 1766)	Wattled Plover	Vans e	R/M	E	21	15	0	3	0	5	24	21	0	12	12	0	24	113	0,2	Ra
34	<i>Vanellus albiceps</i> Gould, 1834	White-crowned Plover	Vana l	R/M	E	0	0	0	0	0	0	5	0	0	8	0	1	8	14	0,0 2	Ac
35	<i>Vanellus spinosus</i> (Linnaeus, 1758)	Spur-winged Plover	Vans p	R	E	128	225	78	65	232	186	406	432	317	31 8	149	217	406	2753	4,8 2	Re
<b>Scolopacidae</b>																					

N <sup>o</sup>	Orders / Families / Species	English Names	Cod e	B S	P H	J	F	M	A	My	Jn	Jl	At	S	O	N	D	PIA	Cn	Fr	A C
36	<i>Gallinago gallinago</i> (Linnaeus, 1758)	Common Snipe	Galga	P	E	2	7	5	1	0	0	0	0	1	2	20	27	27	65	0,11	Ac
37	<i>Numenius phaeopus</i> (Linnaeus, 1758)	Whimbrel	Numph	P	E	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	Ac
38	<i>Tringa nebularia</i> (Gunnerus, 1767)	Greenshank	Trine	P	E	19	33	19	27	0	0	0	0	3	5	9	21	33	136	0,24	Ra
39	<i>Tringa ochropus</i> Linnaeus, 1758	Green Sandpiper	Trioc	P	E	0	0	0	0	0	0	0	4	0	0	0	0	4	4	0,01	Ac
40	<i>Tringa glareola</i> Linnaeus, 1758	Wood Sandpiper	Trigl	P	E	98	567	146	17	0	0	1	125	18	87	172	91	567	1322	2,31	Re
41	<i>Actitis hypoleucos</i> (Linnaeus, 1758)	Common Sandpiper	Acthy	P	E	36	75	37	24	1	0	6	27	45	68	72	41	75	432	0,76	Ra
<b>Columbiformes</b>																					
<b>Columbidae</b>																					
42	<i>Turtur afer</i> (Linnaeus, 1766)	Blue-spotted Wood Dove	Turaf	R	f.	0	5	2	0	3	0	1	0	4	2	0	9	9	26	0,05	Ac
43	<i>Streptopelia semitorquata</i> (Rüppell, 1837)	Red-eyed Dove	Strse	R	f.	20	73	7	1	40	109	32	18	49	33	128	98	128	608	1,06	Re
44	<i>Spilopelia senegalensis</i> (Linnaeus, 1766)	Laughing Dove	Spise	R	f.	13	31	7	2	0	27	27	8	24	26	9	0	31	174	0,3	Ra
<b>Musophagiformes</b>																					
<b>Musophagidae</b>																					
45	<i>Tauraco persa</i> (Linnaeus, 1758)	Guinea Turaco	Taue	R	F	0	0	0	0	2	0	0	0	0	0	0	0	2	2	0	Ac
46	<i>Crinifer piscator</i> (Boddaert, 1783)	Western Grey Plantain-eater	Cripi	R	f.	0	0	0	0	6	0	0	0	0	0	1	0	6	7	0,01	Ac
<b>Cuculiformes</b>																					
<b>Cuculidae</b>																					
47	<i>Clamator jacobinus</i> (Boddaert, 1783)	Jacobin Cuckoo	Claja	M	f.	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	Ac
48	<i>Clamator levillantii</i> (Swainson, 1829)	Levillant's Cuckoo	Clale	M	f.	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	Ac
49	<i>Cuculus clamosus</i> Latham, 1802	Black Cuckoo	Cuccl	M/R	FF	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	Ac
50	<i>Chrysococcyx caprius</i> (Boddaert, 1783)	Dideric Cuckoo	Chrc	M/R	f.	0	0	0	0	2	0	2	0	1	0	0	1	2	6	0,01	Ac
51	<i>Centropus senegalensis</i> (Linnaeus, 1766)	Senegal Coucal	Cense	R	f.	0	5	0	0	4	5	3	2	0	1	0	1	5	21	0,04	Ac
<b>Apodiformes</b>																					
<b>Apodidae</b>																					
52	<i>Cypsiurus parvus</i> (Lichtenstein, 1823)	African Palm-Swift	Cyppa	R	f.	0	0	0	0	0	0	0	1	0	0	9	0	9	10	0,02	Ac
<b>Coraciiformes</b>																					
<b>Alcedinidae</b>																					
53	<i>Halcyon senegalensis</i> (Linnaeus, 1766)	Woodland Kingfisher	Halse	R/M	f.	0	0	1	0	2	0	2	2	1	4	1	0	4	13	0,02	Ac

N <sup>o</sup>	Orders / Families / Species	English Names	Cod e	B S	P H	J	F	M	A	My	Jn	Jl	At	S	O	N	D	PIA	Cn	Fr	A C
54	<i>Ispidina picta</i> (Boddaert, 1783)	Pygmy Kingfisher	Ispipi	R/M	f.	0	0	0	0	0	0	1	0	0	1	0	0	1	2	0	Ac
55	<i>Corythornis cristatus</i> Pallas, 1764	Malachite Kingfisher	Corocr	R	f.	0	0	0	0	0	1	4	4	4	2	1	0	4	16	0,0 3	Ac
<b>Coraciidae</b>																					
56	<i>Coracias abyssinicus</i> Hermann, 1783	Abyssinian Roller	Corab	M	f.	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	Ac
<b>Bucerotiformes</b>																					
<b>Bucerotidae</b>																					
57	<i>Lophoceros fasciatus</i> (Shaw, 1811)	Allied Hornbill	Lopfa	R	F	0	0	0	0	0	5	3	2	0	0	0	0	5	10	0,0 2	Ac
58	<i>Lophoceros nasutus</i> (Linnaeus, 1766)	African Grey Hornbill	Lopna	R	f.	0	0	0	0	1	4	0	0	0	0	0	0	4	5	0,0 1	Ac
<b>Passeriformes</b>																					
<b>Hirundinidae</b>																					
59	<i>Cecropis semirufa</i> (Sundevall, 1850)	Red-breasted Swallow	Cecse	R/M	f.	0	0	0	0	5	0	0	0	0	0	0	0	5	5	0,0 1	Ac
60	<i>Hirundo aethiopica</i> Blanford, 1869	Ethiopian Swallow	Hirae	R/M	f.	0	0	0	0	1	0	1	0	0	0	6	0	6	8	0,0 1	Ac
<b>Motacillidae</b>																					
61	<i>Motacilla flava</i> Linnaeus, 1758	Yellow Wagtail	Motfl	P	f.	4	8	1	0	0	0	0	0	0	14	101	51	101	179	0,3 1	Ra
62	<i>Anthus leucophrys</i> Vieillot, 1818	Plain-backed Pipit	Antle	R	f.	0	11	1	0	0	0	21	9	6	12	0	3	21	63	0,1 1	Ac
63	<i>Macronyx croceus</i> (Vieillot, 1816)	Yellow-throated Longclaw	Maccr	R	f.	25	30	13	8	4	5	9	5	7	5	2	8	30	121	0,2 1	Ra
<b>Pycnonotidae</b>																					
64	<i>Eurillas virens</i> (Cassin, 1857)	Little Greenbul	Eurvi	R	F	0	0	0	0	0	1	1	0	0	0	0	0	1	2	0	Ac
65	<i>Chlorocichla simplex</i> (Hartlaub, 1855)	Simple Greenbul	Chlsi	R	F	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	Ac
66	<i>Pycnonotus barbatus</i> (Desfontaines, 1789)	Garden Bulbul	Pycba	R	f.	0	14	9	3	8	0	4	0	0	0	6	2	14	46	0,0 8	Ac
<b>Muscicapidae</b>																					
67	<i>Saxicola rubetra</i> (Linnaeus, 1758)	Whinchat	Saxru	P	f.	1	9	2	1	0	0	0	0	0	0	3	6	9	22	0,0 4	Ac
<b>Turdidae</b>																					
68	<i>Turdus pelios</i> Bonaparte, 1850	African Thrush	Turpe	R	f.	0	2	0	0	2	0	1	5	0	0	0	0	5	10	0,0 2	Ac
<b>Macrosphenidae</b>																					
69	<i>Melocichla mentalis</i> (Fraser, 1843)	African Moustached Warbler	Melme	R	f.	0	0	0	0	1	3	0	0	0	0	0	0	3	4	0,0 1	Ac
<b>Cisticolidae</b>																					
70	<i>Cisticola erythrops</i> (Hartlaub, 1857)	Red-faced Cisticola	Ciser	R	f.	0	0	4	8	3	1	1	0	6	0	0	0	8	23	0,0 4	Ac
71	<i>Cisticola lateralis</i> (Fraser, 1843)	Whistling Cisticola	Cisla	R	f.	0	0	0	0	0	1	0	0	0	0	2	0	2	3	0,0 1	Ac



No	Orders / Families / Species	English Names	Cod e	B S	P H	J	F	M	A	My	Jn	Jl	At	S	O	N	D	PIA	Cn	Fr	A C
72	<i>Cisticola galactotes</i> (Temminck, 1821)	Winding Cisticola	Cisga	R	f.	15	32	33	28	33	33	51	15	23	62	49	45	62	419	0,73	Ra
73	<i>Prinia subflava</i> (Gmelin, 1789)	Tawny-flanked Prinia	Prisu	R	f.	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	Ac
74	<i>Camaroptera brachyura</i> (Vieillot, 1821)	Bleating Bush Warbler	Cambr	R	f.	0	0	0	0	2	2	0	0	0	0	0	0	2	4	0,01	Ac
<b>Nectariniidae</b>																					
75	<i>Cinnyris coccinigastrus</i> (Latham, 1802)	Splendid Sunbird	Cinc o	R	f.	0	0	0	0	0	0	1	0	0	1	0	0	1	2	0	Ac
<b>Laniidae</b>																					
76	<i>Lanius collaris</i> Linnaeus, 1766	Fiscal Shrike	Lanc o	R	f.	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	Ac
<b>Malaconotidae</b>																					
77	<i>Chlorophoneus sulfureopectus</i> (Lesson, 1831)	Orange-breasted Bush-shrike	Chls u	R	f.	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	Ac
78	<i>Bocagia minuta</i> (Hartlaub, 1858)	Marsh Tchagra	Boc mi	R	FF	0	0	0	0	4	0	0	0	0	3	0	0	4	7	0,01	Ac
79	<i>Tchagra senegalus</i> (Linnaeus, 1766)	Black-crowned Tchagra	Tchs e	R	f.	0	0	0	0	0	2	0	0	0	0	0	3	3	5	0,01	Ac
<b>Dicruridae</b>																					
80	<i>Dicrurus adsimilis</i> (Bechstein, 1794)	Fork-tailed Drongo	Dica d	R	F	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	Ac
<b>Corvidae</b>																					
81	<i>Corvus albus</i> Statius Muller, 1776	Pied Crow	Coral	R	f.	0	0	0	0	0	0	0	2	0	0	0	0	2	2	0	Ac
<b>Passeridae</b>																					
82	<i>Passer griseus</i> (Vieillot, 1817)	Grey-headed Sparrow	Pasgr	R	f.	0	0	0	0	8	0	0	6	2	26	0	3	26	45	0,08	Ac
<b>Ploceidae</b>																					
83	<i>Ploceus nigricollis</i> (Vieillot, 1805)	Black-necked Weaver	Ploni	R	f.	0	0	0	2	2	102	1	0	0	0	0	0	102	107	0,19	Ac
84	<i>Ploceus cucullatus</i> (Müller, 1776)	Village Weaver	Plocu	R	f.	3752	7122	2676	2404	5796	3480	1327	4164	1105	149	711	380	7122	33066	57,84	D
85	<i>Plocepasser superciliosus</i> (Shelley, 1873)	Compact Weaver	Plosu	R	f.	0	35	65	0	2	0	0	0	2	0	0	0	65	104	0,18	Ac
86	<i>Quelea erythrops</i> (Hartlaub, 1848)	Red-headed Quelea	Queer	M	f.	0	195	50	0	0	3500	514	2038	203	47	0	0	3500	6547	11,45	D
87	<i>Euplectes hordeaceus</i> (Linnaeus, 1758)	Black-winged Red Bishop	Eupho	R	f.	0	4	0	1	0	0	1	0	0	2	22	0	22	30	0,05	Ac
88	<i>Euplectes macroura</i> (Gmelin, 1789)	Yellow-mantled Widowbird	Eupma	R	f.	0	7	43	25	50	22	26	4	10	18	0	0	50	205	0,36	Ra
<b>Estrildidae</b>																					
89	<i>Lagonosticta senegala</i> (Linnaeus, 1766)	Red-billed Firefinch	Lags e	R	f.	0	0	0	0	1	0	1	2	0	1	0	0	2	5	0,01	Ac
90	<i>Estrilda melpoda</i> (Vieillot, 1817)	Orange-cheeked Waxbill	Estm e	R	f.	4	40	13	0	11	13	19	0	7	6	2	0	40	115	0,2	Ra
91	<i>Ortygospiza atricollis</i> (Vieillot, 1817)	Quail Finch	Ortat	R	f.	1	0	0	0	7	6	15	13	20	11	22	6	22	101	0,18	Ac
92	<i>Spermestes cucullata</i> (Swainson, 1837)	Bronze Mannikin	Spec u	R	f.	350	720	348	55	153	186	296	485	171	77	159	96	720	3096	5,42	D

N <sup>o</sup>	Orders / Families / Species	English Names	Code	BS	PH	J	F	M	A	My	Jn	Jl	At	S	O	N	D	PIA	Cn	Fr	AC
93	<i>Spermestes bicolor</i> (Fraser, 1843)	Red-backed Mannikin	Spebi	R	F	36	0	0	0	0	0	0	0	0	0	0	0	36	36	0,06	Ac
94	<i>Spermestes fringilloides</i> (Lafresnaye, 1835)	Magpie Mannikin	Spefr	R	f.	539	657	393	97	53	116	80	310	40	5	6	6	657	2302	4,03	Re
<b>Viduidae</b>																					
95	<i>Vidua macroura</i> (Pallas, 1764)	Pin-tailed Whydah	Vidma	R	f.	0	3	0	0	0	3	2	0	3	0	0	0	3	11	0,02	Ac
<b>Totaux</b>						<b>5215</b>	<b>10682</b>	<b>4089</b>	<b>2942</b>	<b>7018</b>	<b>8137</b>	<b>3513</b>	<b>8183</b>	<b>2416</b>	<b>1291</b>	<b>2195</b>	<b>1491</b>	<b>15223</b>	<b>57172</b>	<b>100</b>	

**BS** : Biogeographic Status ; **PH** : Preferential Habitat ; **R** : Resident ; **P** : Palearctic Migrator ; **M** : Intra-African migrator ; **E** : Water bird ; **f** : Open environments ; **F** : Secondary forest ; **FF** : Primary forest ; **J** : January ; **F** : February ; **M** : March ; **A** : April ; **My** : May ; **Jn** : June ; **Jl** : July ; **At** : August ; **S** : September ; **O** : October ; **N** : November ; **D** : December ; **PIA** : Punctual Index of Abundance ; **Cn** : Cumulative number ; **Rf** : Relative frequency ; **AC** : Abundance category ; **Code** : Code Bayer ; **Ac** : Accidental ; **Re** : Regular ; **Ra** : Rare ; **D** : Dominant.



**Figure 3a:** Hamerkop *Scopus umbretta* (Scopidae)



**Figure 3b:** Shikra *Accipiter badius* (Accipitridae)



**Figure 3c:** Senegal Thick-knee *Burhinus senegalensis* (Burhinidae)



**Figure 3d:** White-crowned Plover *Vanellus albiceps* (Charadriidae)



**Figure 3e:** Yellow Wagtail *Motacilla flava* (Motacilidae)



**Figure 3f:** Black-winged Red Bishop *Euplectes hordeaceus* (Ploceidae)



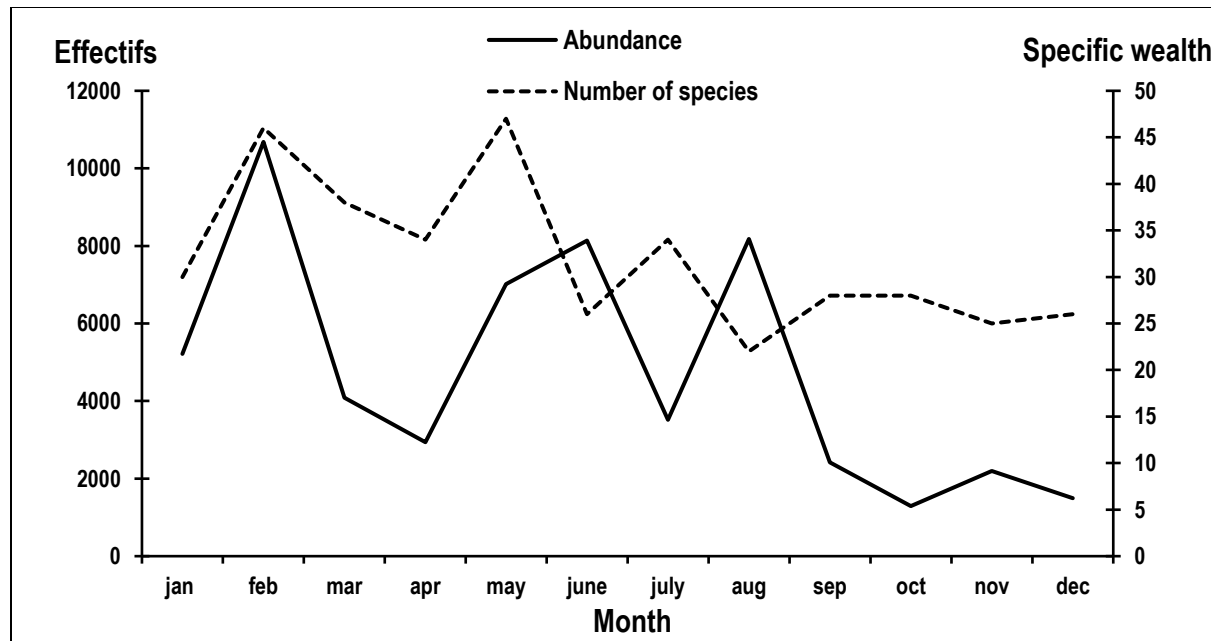
**Figure 3g:** Bronze Mannikin *Lonchura cucullata* (Estrildidae)

**Figure 3:** Images of some bird species encountered in Yamoussoukro rice fields  
Photos taken by Kouadja Sonia, 2017; 2018)

**Abundance of rice field birds:** Loading bird of rice fields in Yamoussoukro is estimated to 57172 individuals. The Shannon diversity index ( $H'$ ) is 1.79 with a fairness ( $J$ ) of 0.39 (Table 1) for all rice prospecting perimeters. The density of rice-field birds observed is estimated to 831 individuals per hectare. According to the index of species abundance, four categories of abundance are distinguished. The dominant species are three with 42709 individuals, representing 74.71% of the population. They are mainly represented by Village Weaver named *Ploceus cucullatus*, with a relative frequency of  $Fr = 57.84\%$ , followed by the Red-headed Quelea *Quelea erythrops* ( $Fr = 11.45\%$ ) and Bronze Mannikin *Spermestes cucullatus* ( $Fr = 5.42\%$ ). The category of regular species follows and contains six (6) species, being 9796 individuals representing 17.13% of the population. It is mainly represented by the Spur-winged Lapwing *Vanellus spinosus* ( $Fr = 4.82\%$ ), the Magpie Mannikin *Spermestes fringilloides* ( $Fr = 4.03\%$ ) and the Western Cattle Egret *Bubulcus ibis* ( $Fr = 3.59\%$ ). Then come the rare species comprising 16 species of 3516 individuals representing 6.15% of the population. The most important species in this category are the Common Sandpiper *Actitis*

*hypoleucos* ( $Fr = 0.76\%$ ), Rufous-winged Cisticola *Cisticola galactotes* (Temminck, 1821) ( $Fr = 0.73\%$ ), and Greater Painted-snipe *Rostratula benghalensis* ( $Fr = 0.60\%$ ). Finally, bird population is composed of 70 accidental species representing only 2.01% with 1151 individuals in sum. The dominant species are the Black-necked Weaver *Ploceus nigricollis* ( $Fr = 0.19\%$ ), Chestnut-crowned Sparrow-Weaver *Plocepasser superciliosus* ( $Fr = 0.18\%$ ) and Quailfinch *Ortygospiza atricollis* ( $Fr = 0.18\%$ ).

**Monthly variation in specific composition and abundance of rice birds:** During the 12 months of observation, specific richness within perimeters reached three well marked peaks. They were observed in February with 46 species, in May which is the highest peak with 47 species then in July with 34 species. The lowest value of the specific composition was observed in August with 22 species. In addition, species abundance peaks were observed in February with 10682 individuals, the highest value, in June with 8137 individuals and in August with 8183 individuals. The minimum value of abundance was observed in October with 1291 individuals (Figure 4).



**Figure 4:** Monthly variation in bird species composition and abundance in the Yamoussoukro rice perimeters from January to December 2017

**Seasonal distribution of rice field bird's species:** The distribution of the rice field bird species was demonstrated by a principal component analysis (PCA) from the species / season matrix. This analysis made permitted to distinguish three groups of species associated with the seasons along axis 1 of greater inertia (50.02% of inertia) and axis 2 (32.78% of inertia) (Figure 5). The first group contains the small rainy season (PSP) associated with the species *Nycticorax nycticorax* (Linnaeus, 1758) (Nycny), *Gallinula chloropus* (Linnaeus, 1758) (Galch), *Paragallinula angulata* Sundevall, 1850 (Paran), *Ispidina picta* (Boddaert, 1783) (Ispipi) and *Motacilla*

*flava* (Linnaeus, 1758) (Motfl). The second group consists of the small and long dry seasons, which are associated with the species *Numenius phaeopus* (Linnaeus, 1758) (Numph), *Circus aeruginosus* (Linnaeus, 1758) (Cirae), *Butastur rufipennis* (Sundevall, 1850) (Butru), *Coracias abyssinicus* Hermann, 1783 (Corab), *Lanius collaris* Linnaeus, 1766 (Lanco) and *Spermestes bicolor* (Fraser, 1843) (Spebi). The third group is that of the great rainy season to which the species *Elanus caeruleus* (Elaca), *Turtur afer* (Turaf), *Chrysococcyx caprius* (Boddaert, 1783) (Chrca), *Centropus senegalus* (Linnaeus, 1766) (Cense) and *Lophoceros fasciatus* (Lopfa) are attached.

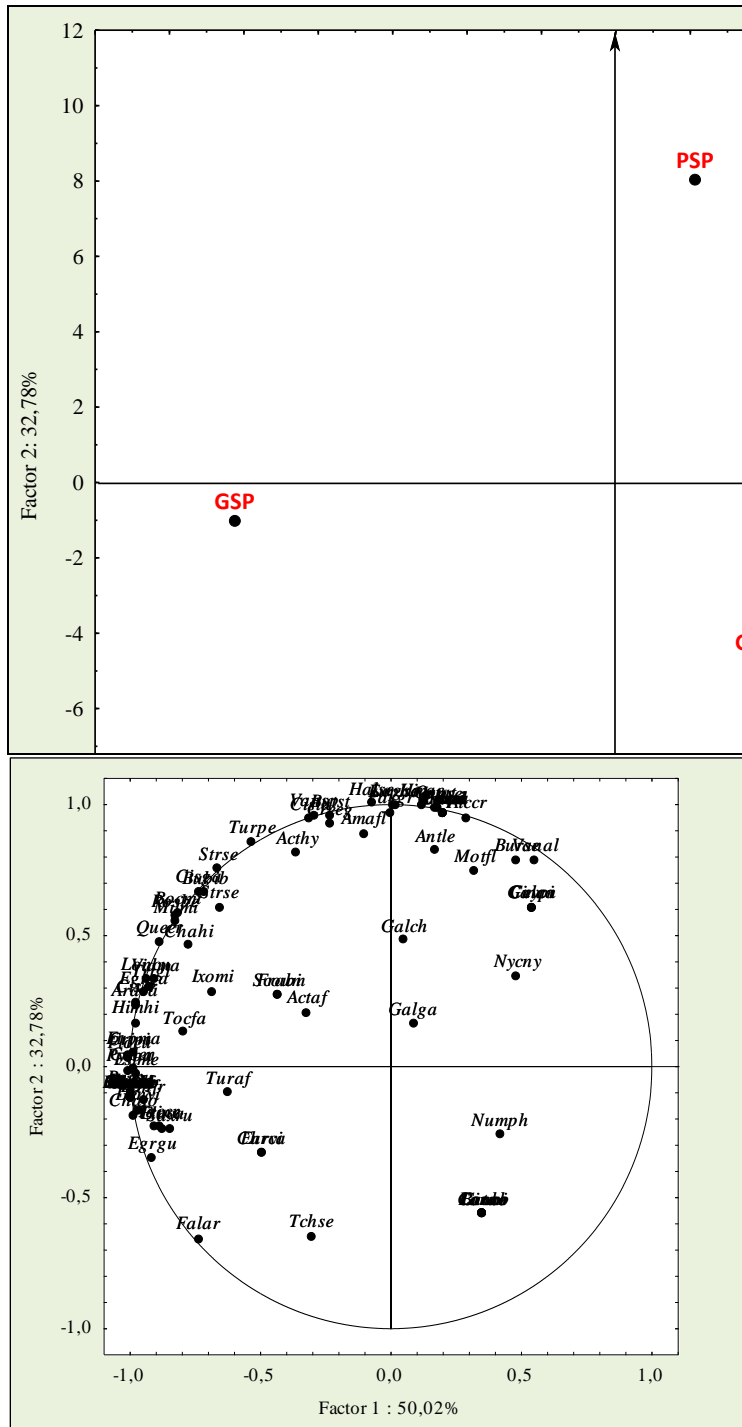


Figure 5: Seasonal distribution of bird species in rice fields of Yamoussoukro

## DISCUSSION

During the year of ornithological monitoring of rice fields in the Yamoussoukro district, the specific composition obtained shows that they are rich and diversified. Indeed, rice fields are in reality comparing to all others cultures, one

of the most diverse habitats for bird species (Sundar and Subramanya, 2010). In addition, Odoukpé and Yaokoré-Béibro (2014) recorded in a rice growing area in Grand Bassam in the south of the country, 100 species

of rice field birds. These results are substantially similar to those of this study. However, 32 bird species observed in the rice fields of Yamoussoukro have been added to the list of birds found in the rice fields of Côte d'Ivoire. The presence of some of these species is related to the fact that they are mostly savanna species. In addition, it was noted that a high percentage (59%) of birds from open habitats and 33% of birds of waterbirds. This is quite understandable especially since paddy fields are mainly used by grassland and wetland species (Sundar and Subramanya, 2010). Generalist forest species such as *Accipiter badius*, *Tauraco persa*, *Lophoceros fasciatus*, *Eurillas virens*, *Chlorocichla simplex*, *Bocagia minuta* and *Dicrurus adsimilis* have used the rice fields, taking advantage of available resources even though they are not open habitat species. Certainly, different species exploit rice fields at different times of the year, either for their feeding or for breeding (Brouder and Hill 1995; Fasola *et al.*, 1996; Tourenq *et al.*, 2004; Kurechi, 2007; Eadie *et al.*, 2008; Nachuha and Quinn, 2012). In fact, as indicated by Odoukpé and Yaokokoré-Béibro (2014), the topiic group of granivores constitutes the essential rice field birds' population in rice filling and ripening stages. Furthermore, evolutionary curves of

species composition and abundance of birds show a variation over the months. This variation would be influenced by the presence of rice in the perimeters. The bird diversity peaks observed during the study year on the rice perimeters would coincide with the vegetative phase of rice. Indeed, Townsend *et al.* (2006) also indicate that rice fields fluctuate in response to rice growth. Also, Odoukpé and Yaokokoré-Béibro (2014) pointed out that the rice fields are much more diversified at the beginning than at the end of the crop. In addition, it is at this time that the highest number of species and diversity index are recorded. The diversity of bird species was reduced in the second half of the year because of the presence of rice on the plots. The decrease of the number of birds in the rice fields is due to the departure of migratory waterbirds from the rice fields which is the case of some species in order to Pelecaniformes and Charadriiformes. Same observations from Konan and Yaokokoré-Béibro (2015) in Yamoussoukro lakes where birdlife facing changes with the departure of the majority of Palearctic migrants. The seasons did not influence the composition and abundance of the birds. This is due to the fact that the presence of birds in rice fields is rather linked to rice than to seasonal variations.

## CONCLUSION AND APPLICATION OF RESULTS

The ornithological monitoring carried out in the rice-growing areas of the Yamoussoukro Autonomous District provides an overview of the birds that frequent these agro-ecosystems. The avifauna is diverse, abundant and dominated by birds of open habitats and waterfowl. The gendarme weaver *Ploceus cucullatus* is the most abundant species. The composition and abundance of bird species in

the rice fields varied from month to month but were not influenced by the seasons. This study sheds light on the rice field birds that frequent the rice fields of Yamoussoukro. These avifaunal data could contribute to enriching the technical sheet of rice cultivation with regard to auxiliary and/or predatory species of rice fields.

## ACKNOWLEDGMENTS

First of all, I would like to thank all the rice farmers of Yamoussoukro for allowing me to work in their rice fields. I thank African Center

of Excellence on Climate Change, Biodiversity and Sustainable Agriculture for the funds made available to execute this research. Thanks to

my colleagues from the Ornithology Research Group and in particular members of the wetland birds and open habitats commission

for their support in writing this manuscript. Thanks also to Dr Danumah for his help in translating the article.

## REFERENCES

- Asse AF, 2003. Système de gestion du complexe des lacs artificiels de la ville de Yamoussoukro et son importance comme habitats des oiseaux d'eau en Côte d'Ivoire. DESS en protection de l'environnement et amélioration des systèmes agraires, Université de Cocody-Abidjan, 64 p.
- Bennun L, Dranzoa C, Pomeroy D, 1996. The forest birds of Kenyan and Uganda. *Journal of East African Natural History*, 85: 23-48.
- Bibby CJ, Burgess ND, Hill DA, 1992. *Bird Census Techniques*. London, Academic Press. 257p.
- Borrow N and Demey R, 2012. *Guide des Oiseaux de l'Afrique de l'Ouest*. Delachaux et Niestlé: Paris.
- Brouder SM and Hill JE, 1995. Winter flooding of ricelands provides waterfowl habitats. *California agriculture* 49: 58-64.
- Chapuis C, 2000. *African Birds Sounds*. Birds of North, west and Central Africa. Société Ornithologique de France. 181p + 15 CD. Vol. 1 (4 CD) et 2 (11 CD).
- Doctrinal D, Bicout D, Gauthier-Clerc M, Artois M, Sandoz A, Sabatier P, 2005. Rôle des oiseaux dans l'écologie de la fièvre du Nil occidental: exemple du Héron garde-bœuf en Camargue. *Environnement, Risques & Santé* Vol. 4, n°2, 9 p.
- Eadie JM, Elphick CS, Reinecke KJ, Miller MR, 2008. Wildlife values of North American ricelands. In Manley SW: *Conservation in Ricelands of North America*. The Rice Foundation.
- Elphick CS, 2010. Why study birds in rice fields? *Waterbirds*, 33(1): 1-7.
- Fasola M and Ruiz X, 1996. The value of rice fields as substitutes for natural wetlands for waterbirds in the Mediterranean region. *Colonial Waterbirds*, 19(1): 122-128.
- Gibbons DW and Gregory RD, 2006. *Birds*. In: Sutherland, WJ (ed.). 2006. *Ecological Census Techniques: A Handbook*. Second edition. Cambridge University Press. pp. 308-350.
- Gill F, Donsker D, Rasmussen P (Eds., 2022. *Liste mondiale des oiseaux du CIO* (v12.1). doi : 10.14344/COI.ML.12.1.
- Konan EM and Yaokokoré-Béibro KH, 2015. Variation temporelle du peuplement aviaire des écosystèmes lacustres de la ville de Yamoussoukro, centre de la Côte d'Ivoire. *International Journal of Biological and Chemical Sciences* 9(6): 2566-2581.
- Konan EM, Yaokokoré-Béibro KH, Odoukpé KSG, Kouadja KES, 2014. Avifaune de la ville de Yamoussoukro, centre de la Côte d'Ivoire. *European Scientific Journal*, 10(33): 63-75.
- Kurechi M, 2007. Restoring rice paddy wetland environments and the local sustainable society project for achieving co-existence of rice paddy agriculture with waterbirds at Kabukuri-numa, Miyagi Prefecture, Japan. *Global Environ. Research-English Ed.* 11: 140-144.
- Lawler SP, 2001. Rice fields as temporary wetlands: a review. *Israel Journal of Zoology*, 47: 513-528.
- Manjit SD and Harjeet KS, 1994. Agricultural ornithology: an India perspective, *Journal Biosciences*, vol 19, number 4, october, pp 391-402.



- Moser M, Prentice C, Frazier S, 1996. A Global Overview of Wetland Loss and Degradation, Proceedings of Ramsar COP6 (Brisbane 1996), Vol. 10/12, Technical Session B at p. 21.
- N'Guessan KA, Kouassi AM, Gnaboa R, Traoré KS, Houenou PV, 2014. Analyse de phénomènes hydrologiques dans un bassin versant urbanisé: Cas de la ville de Yamoussoukro (centre de la CI). *Larhyss Journal*, 17: 135-154.
- Nachuha S and Quinn JL, 2012. The distribution of colonial waterbirds in relation to Ugandan rice scheme. *Waterbirds* 35: 590-598.
- Nachuha S, 2009. Is waterbirds distribution within rice paddies of eastern Uganda affected by the different stages of rice growing? In Proceedings of the 12th PanAfrican Ornithological Congress 2008, Harebottle DM, Craig AJFK, Anderson MD, Rakotomanana H, Muchai M (eds). *Animal Demography Unit: Cape Town*; 44-49.
- Odoukpé KSG and Yaokokoré-Béibro KH, 2014. Avifaune des champs de riz de la zone humide de Grand-Bassam (Côte d'Ivoire). *International Journal of Biological and Chemical Sciences*, 8(4): 1458-1480.
- Odoukpé KSG, 2015. Avifaune d'un milieu de riziculture dans la zone humide de Grand-Bassam (sud-est Côte d'Ivoire): composition spécifique, dynamique des populations et impact sur les champs de riz. Thèse de Doctorat de l'Université Félix Houphouët Boigny de Cocody, Abidjan, Côte d'Ivoire; 276-284. 216 p + annexes.
- Pielou, EC, 1966. Shannon's Formula as a Measure of Specific Diversity: Its Use and Measure. *American Naturalist*, 100, 463-465.
- Ramade F, 2003. *Éléments d'écologie fondamentale*. Dunod, Paris, 690 p.
- Remsen JV, Swan MM, Cardiff SW, Rosenberg KV, 1991. The importance of the ricegrowing region of south-central Louisiana to winter populations of shorebirds, raptors, waders, and other birds. *Journal of Louisiana Ornithology* 1: 35-46.
- Sundar KSG and Subramanya S, 2010. Birds use of rice fields in the Indian Subcontinent. *Waterbirds*, 33(1): 44-70.
- Thiollay JM, 1986. Structure comparée du peuplement avien des trois sites de forêt primaire en Guyane. *La Terre et la Vie*, 41: 59-105.
- Tourenq C, Benhamou S, Sadoul N, Sandoz A, Mesléard F, Martin J-L, Hafner H, 2004. Spatial relationships between tree-nesting heron colonies and rice fields in the Camargue, France. *Auk*, 121: 192-202.
- Townsend SE, Pearlstine EV, Mazzotti FJ, Deren CW, 2006. Wading birds, shorebirds and waterfowl in rice fields within the Everglades agricultural area. *Florida Field Naturalist* 34 : 9-20.
- Triplet P, 2015. Les rizières, zones humides artificielles et habitats des oiseaux d'eau. *ResearchGate*, 16 pp.
- Wymenga E and Zwarts L, 2010. Use of rice fields by birds in West Africa. *Waterbirds*, 33(1): 97-104.
- Yaokokoré-Béibro KH, 2001. Avifaune des forêts classées de l'Est de la Côte d'Ivoire: données sur l'écologie des espèces et effet de la déforestation sur les peuplements. Cas des forêts classées de la Béki et de la Bossématié (Abengourou). Thèse de Doctorat, Université de Cocody, Abidjan, p. 245.