Structure and dynamics of granivorous birds inricefields lowlands of the YamoussoukroDistrict (Central Côte d'Ivoire).

.

ABSTRACT

Aims: To identify seed-eating birds and their dynamics in four rice-growing lowlands.
Place and Duration of Study: Nana, Petit Bouaké, Subiakro and Zattarice-growing lowlands in the Yamoussoukro district (Central Côte d'Ivoire) fromMay 2021 to April 2022.
Methodology: Seed-eating birds were surveyed using the line transect method between 6.30am and 6.30pm. At each site, four surveys were carried out per month.
Results: In total, 22 species of seed-eating birds belonging to six families and three orders were inventoried in the rice-growing lowlands of the Yamoussoukro district. Among them, Village weaver *Ploceus cucullatus*, Red-headed Quelea *Quelea erythrops* and Bronze Mannikin *Spermestes cucullata*werethe predominant species. Five other species, Red-eyed Dove *Streptopelia semitorquata*,Magpie Mannikin*Spermestes fringilloides*,Northern Grey-headed Sparrow*Passer griseus*,Yellow-mantled Widowbird*Euplectes macroura* andBlack-winged Bishop*Euplectes hordeaceus*wereregular in these lowland rice fields. Numbers of these seed-eating birds werehighest at the Subiakro site and at the spike development and maturation of the rice. In addition, their numbers werehighest between March and October and lowest between November and February.
Conclusion: This study indicates thateight seed-eating birds are likely to cause significant damage to rice crops, but their pressure could be reduced by planning harvests between November and February.

Keywords: Birds – Seed-eating – Variations – Ricefields – Yamoussoukro – Côte d'Ivoire.

1. INTRODUCTION

Rice, the main source of food for more than half the world's population [1-2], has many natural pests. Its main pests are weeds, insects, rodents, fish, birds and, to a lesser extent, molluscs and crustaceans. Microorganisms such as phytophagous nematodes, fungi and viruses that develop on rice also cause a wide variety of diseases [3-4]. Of all these natural pests, birds are certainly the best-known of rice crops [5].

The losses caused by these pests hamper the growthof rice [6]. Damage caused by pests has been estimated to millions of dollars worldwide[7-8]. These losses also pose a serious food security problem for subsistence farmers [9]. Hence, there is a need to protect rice fields from pest birds [10]. Thus, particular attention has been paid to their biology, ecology, and level of impact to consider reducing their harmful actions on rice fields [11-12]. In fact, losses are the consequence of many factors that require a perfect knowledge of the pests and the agronomic conditions of the rice crop [13].

In Africa, the most widespread and best-known species is undoubtedly the Red-billed Quelea*Quelea quelea* (Linnaeus, 1758), which is the main pest of cereal crops [14-18]. It's extremely large populations descend on fields in huge flights, causing serious economic losses [19-20]. In Côte d'Ivoire, other granivorous birds just as gregarious as the Red-billed

Quelea are found in rice fields [21-23]. In addition, [24] and [25] have shown that their damage is very extensive and variable in time and space. However, there is limited knowledge pertaining tothese birds. The aim of currentornithological study wasto identify seed-eating birds and their dynamics in the rice-growing lowlands of Yamoussoukro.

2. MATERIAL AND METHODS

2.1 Study Area

Yamoussoukro District (6°15 and 7°35 north latitude, and 4°40 and 5°40 west longitude) is located 245 km north-west of Abidjan [26]. It covers an area of 4,651 km2, approximately 1.7% of surface of Côte d'Ivoire. The terrain is slightly hilly, with an average altitude of 200 meters. The district is crisscrossed by a dense hydrological network comprising the Bandama, Kan and N'zi rivers and their tributaries, as well as around thirty lakes, ten of which are man-made [27]. The climate of the Yamoussoukro district is a transitional humid tropical type characterized by four seasons, including two dry seasons and two rainy seasons [28]. Rainfall in the region varies from 900 to 1100 mm per year, with an average temperature of around 26°C and relative humidity of between 75 and 85% [29]. There are several lowlandsYamoussoukro District, including Nanan (40 ha), Petit Bouaké (200 ha), Subiakro (140 ha) and Zatta (85 ha), where current study was carried out(Fig. 1).

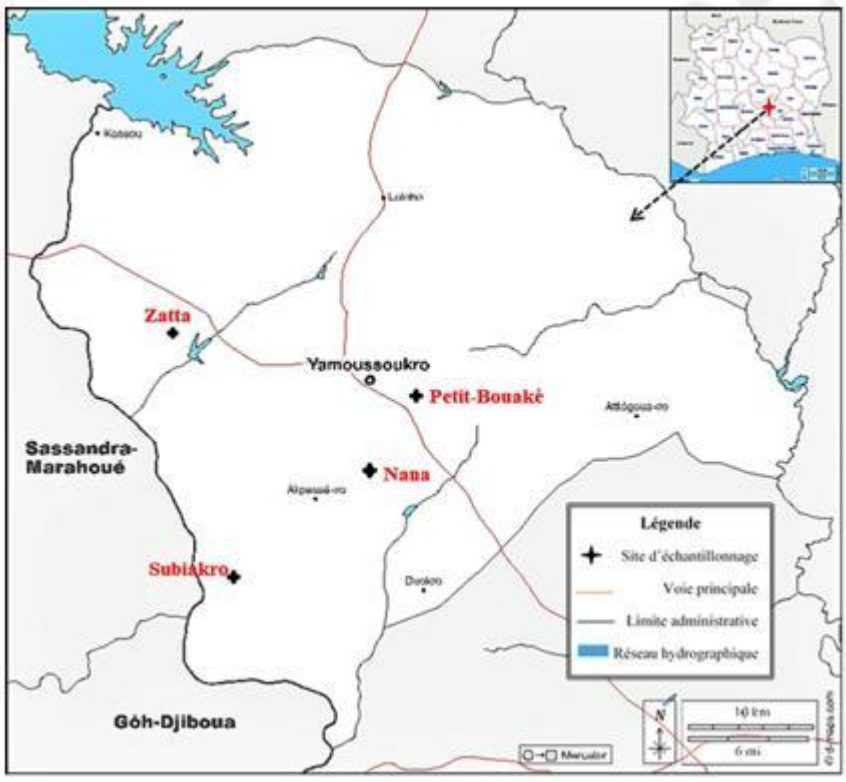

Fig. 1. Map showing the collection sites.

2.2 Data collection

Data were collected from May 2021 to April 2022 using the line transect method between 6:30 am and 6:30 pm [30]. At each site, four surveys were carried out per month. During

these surveys, birds were identified and counted using binoculars. Only terrestrial granivorous birds were considered in this study. Additional information such as habitat type, stage of rice cultivation and activity was recorded. In the lowland surveyed, the rice-growing stage considered were Seedbeds, Ploughing &Flooding, Sowing &Growing, Spike development&Maturation, Harvesting, Regrowth, and Uncultivated.Seed-eating birds were identified according to [31] and [32].

2.3 Data Analysis

Biogeographical status was defined according to [33]. For each species, the maximum number of individuals counted during a visitwas used for final analyses. The species observed were characterized based on their relative frequency. According to [34], a species is said to be D (Dominant), when its relative frequency is greater than or equals to 5%; Re (Regular), when its frequency rangesbetween 1 and 4.9%; Ra (Rare), when its frequency variesbetween 0.2 and 0.9%; Ac (Accidental), when it represents less than 0.2%. The relative frequency (Fr) is calculated using Microsoft Excel 2010 software based on the following mathematical formula:

$$Fr = \left(\frac{ni}{N}\right) * 100$$

ni: sum of all contacts with species i; N: ∑ni: sum of contacts with all species.

Anova test was used to compare the averages of granivorous birds between sites and stages of rice cultivation.Correspondence Factor Analysis (CFA) was used to present the distribution of seed-eating birds according to rice-growing stage. These statistical tests were performed using STATISTICA 7.1 software.

3. RESULTS

3.1 Diversity of seed-eating birds

An average of 4,186 ± 2,102 individuals belonging to 22 species of seed-eating birds, six families and three orders were estimated in the four rice-growing lowlands of Yamoussoukro. The most represented families were Estrildidae (8 species, 16% of individuals) and Ploceidae (6 species, 77% of individuals). Other families hadless than two species and there was only 7% of individuals (Table 1).

The most abundant species werethe Village Weaver *Ploceus cucullatus* (Fr = 44.6%), the Red-headed Quelea*Quelea erythrops* (Fr = 30.2%) and the Bronze Mannikin *Spermestes cucullata* (Fr = 9.6%). These three species accounted for more than 84% of the seed-eating birds recorded. Five other species, the Red-eyed Dove*Streptopelia semitorquata*, the Magpie Mannikin*Spermestes fringilloides*, the Northern Grey-headed Sparrow *Passer griseus*, the Yellow-mantled Widowbird *Euplectes macroura* and the Black-winged Bishop *Euplectes hordeaceus* are regular in these lowland rice fields. They accounted for around 13% of the total number of individuals. Other species accounted for only 3% of the individuals.

3.2 Spatial and Temporal Variation

Seed-eating bird numbers variedaccording to month and site. The highest numbers were observed between March and October, peaking in September (Fig. 2). In contrast, the lowest numbers were reported between November and February. The three most abundant species influenced this variation. Village weaver and Red-headed Quelea numbers increased from

March to September, when they reached their peak, and then gradually declined in the other months. However, Bronze Mannikin numbers werehigh between February and March, then remained relatively constant in the other months (Table 1).

The rice-growing lowland at Subiakro was the site visited by the most seed-eating birds. The other sites were visited by seed-eating birds in approximately the same proportions. These variations in numbers per site werestatistically significant (Anova, ddl = 3; F = 14.2; p = .001).

Seed-eating birds mainly visited the lowland rice fields during spike development and maturation of the rice (Fig. 3). They visited, in decreasing order, Harvested plots, Regrowing plots, Ploughing& Flooding plots and Sowing & Growing plots. However, there were few visits to uncultivated plots and seedbeds. The numbers of granivorous birds per rice-growing stage werestatistically different (Anova, ddl = 6; F = 3.26; p = .05).

Table 1. List of seed-eating bird species and their monthly numbers inthe surveyed sites from May 2021 to April 2022.

.

Ordres/Familles/Espèces	SB	May 21	June 21	July 21	Aug 21	Sept. 21	Oct. 21	Nov. 21	Déc. 21	Jan. 22	Feb. 22	March 22	April 22	Emax	Fr
GALLIFORMES															
Phasianidae															
Pternistis ahantensis (Temminck, 1854)	R						2							2	0.02
Pternistis bicalcaratus (Linnaeus, 1766)	R	1	1		3	3	6	15	4		5	13	5	15	0.14
COLUMBIFORMES															
Columbidae															
Streptopelia semitorquata (Rüppell, 1837)	R	426	153	91	74	80	339	293	156	200	163	289	505	505	4.66
Spilopelia senegalensis (Linné, 1766)	R	27	22	43	12	18	11	16	16	14	7	62	63	63	0.58
Turtur afer (Linné, 1766)	R		1	1	2	2	2						1	2	0.02
PASSERIFORMES															
Passeridae															
Passer griseus (Vieillot, 1817)	R	13	10	29	37	19	60	67	165	78		15	3	165	1.52
Ploceidae															
Amblyospiza albifrons (Vigors, 1831)	R			2	1	2								2	0.02
Ploceus cucullatus (Müller, PLS, 1776)	R	2305	2577	2994	3234	4835	2477	1360	746	645	305	830	1855	4835	44.60
Ploceus superciliosus (Shelley, 1873)	R			4			5				4	4	4	5	0.05
Quelea erythrops (Hartlaub, 1848)	M	600	1340	1500	1200	3274	722	567	3	31	520	1339	1219	3274	30.20
Euplectes hordeaceus (Linné, 1758)	R		3	25	116	86	28	38						116	1.07
Euplectes macroura (Gmelin, JF, 1789)	R	36	57	125	155	151	63	56	25	32	25	11	28	155	1.43
Estrildidae															
Spermestes cucullata (Swainson, 1837)	R	400	282	266	231	427	319	349	458	528	1043	1005	679	1043	9.62
Spermestes fringilloides (Lafresnaye, 1835)	R	60	216	441	231	308	157	61	91	71	18	179	338	441	4.07
Spermestes bicolor (Fraser, 1843)	R		15	8	27	14				2		4	10	27	0.25
Estrilda melpoda (Vieillot, 1817)	R	5	22	35	30	50	23	16	9	4	35	41	2	50	0.46
Ortygospiza atricollis (Vieillot, 1817)	R				36	55	39	25	73	49	28	61	14	73	0.67
Amandava subflava (Vieillot, 1819)	R							12	5	39	18		4	39	0.36
Lagonosticta senegala (Linné, 1766)	R		2		2		2			2				2	0.02
Lagonosticta rufopicta (Fraser, 1843)	R	3		4	1	2	2		5			8	7	8	0.07
Viduidae															

Vidua macroura (Pallas, 1764)	R			3	4	17								17	0.16
Vidua togoensis (Grote, 1923)	R									1				1	0.01
Total général		**3876**	**4701**	**5571**	**5396**	**9343**	**4257**	**2875**	**1756**	**1696**	**2171**	**3861**	**4737**	**10840**	

SB: Biogeographical Status; R: Residents; M: African migratory; Emax: Maximum number; Fr: Relative Frequency

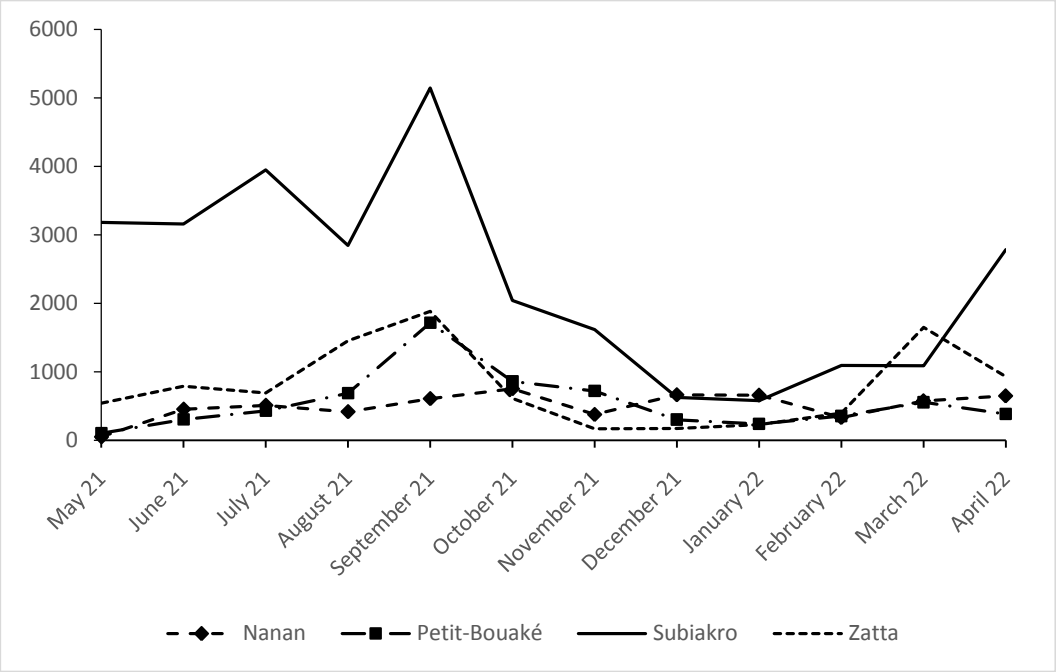

Fig. 2: Monthly variation in seed-eating bird numbers by site

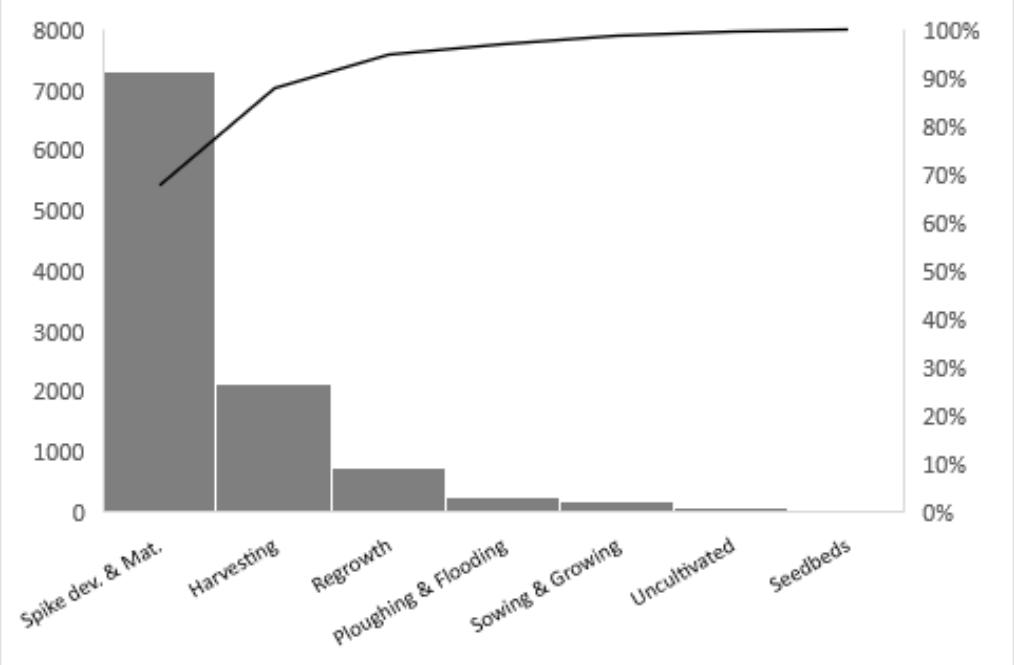

Figure 3: Proportion of seed-eating birds by rice-growing stage

3.1 Species distribution according to rice-growing stage

The species were distributed according to the stage of rice cultivation. Two groups of birds can be distinguished(Figure 4). The first group was composed of the following species

Streptopelia semitorquata, *Spilopelia senegalensis*, *Ortygospiza atricollis*, *Passer griseus* and *Lagonosticta senegala*, which werefound at the Seedbeds, Ploughing &Flooding, Sowing & Growing and Harvesting stages. Among these birds, the Red-eyed Dove was the species with the highest numbers at these stages (Fig. 5). The second group of birds found during the Spike development& Maturation, Regrowth and Uncultivated stages wascomposed of *Ploceus cucullatus*, *Quelea erythops*, *Lonchura cucullata*, *Lonchura fringilloides*, *Lonchura bicolor*, *Ploceus superciliosus* and *Amandava subflava*. Of these, the Village weaver and the Bronze Mannikin werepresent at all stages of rice cultivation. While Villageweaver numbers wereabundant at all stages apart from the Ploughing &Flooding stage, those of the Bronze Mannikin remained moderate and even virtually absent during the establishment of seedbeds. The numbers of Red-headed Quelea were high and became more abundant during the spike development and maturation of the rice (Fig. 5).

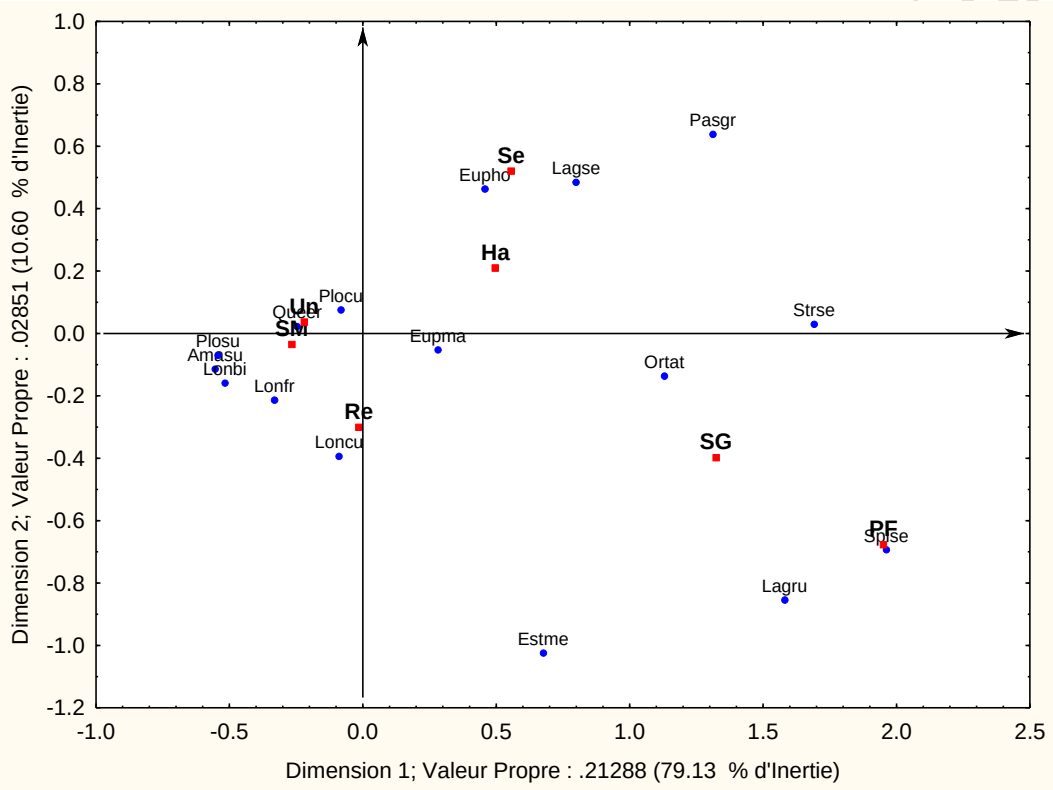

Figure 4: Seed-eating bird's numbers according to rice-growing stage

Se: Seedbeds; PF: Ploughing & Flooding; SG: Sowing & Growing; SM: Spike development& Maturation; Ha: Harvesting; Re: Regrowth; Un: Uncultivated.

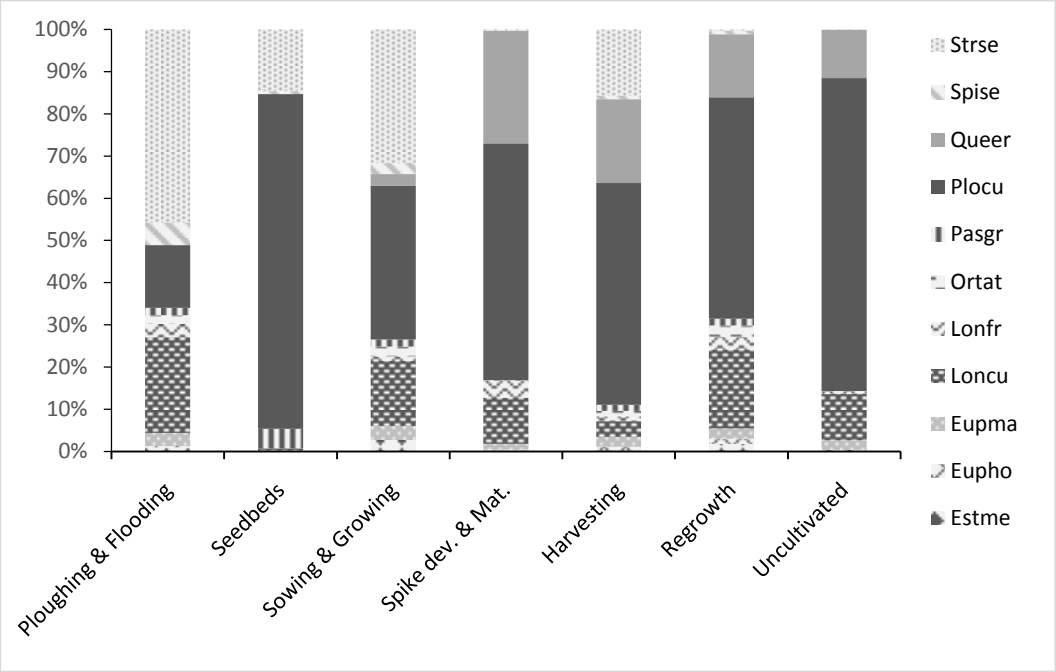

Figure 5: Seed-eating bird species proportions by rice-growing stage

4. DISCUSSION

Granivorous birds visited the rice-growing lowlands of Yamoussoukro to feed mainly on cultivated rice grains. These seed-eating birds belong mainly to the Ploceidae and Estrildidae families. These two families mainly contain granivorous birds, which have been reported in several studies to be responsible for most ofdamage to cereal crops [35-37]. Moreover, [7]states that the damage caused by birds is similar throughout the world and often concerns the same crops and the same groups of birds.

Numbers of these birds were quite high in the rice-growing lowlands of Yamoussoukro and were estimated at several thousand individuals every day. However, they were lower than those counted in the Grand-Bassam wetland by [21]and [24]. This difference should be due to the size of the cultivated plots, which covered several hectares in the Grand-Bassam wetland. The number of granivorous birds in rice fields is influenced by several parameters, including the field size [38].

The highest numbers were observed between March and October, which coincides with the period of intense rice cultivation in the region. This means that granivorous birds can find plenty of food available. They gather there, reproduce, and proliferate rapidly when they are not limited by the food available to raise their young. A drop in their numbers was observed between November and February. Similar results were reported in Grand-Bassan by[23] and [24]. This observation might be due to the reduction in the area under cultivation, but also the movements of certain birds such as the Red-headed Quelea, which migrate at this time. In addition, many granivorous birds do not behave in a very gregarious way during the breeding season.

Temporal variations in granivorous birds were almost similar from one site to another. However, the highest numbers were recorded in the rice-growing lowland of Subiakro. This site is one of the most important lowlands in terms of area and intensity of rice cultivation. In

addition, various types of vegetation and several other agricultural crops werefound near this lowland.The conditionsoffer granivorous birds a diversity of trophic resources and protection from predators [39]. In fact, the use of plant cover, hiding in the foliage of trees or in the shelter of a shrub appears to be an anti-predator strategy [40]. Although the other rice-growing lowlands also offer a variety of vegetation, granivores were less abundant. This difference might be due to the low intensity of rice cultivation at these sites. This situation is exacerbated by the lack of government support for rice growers.

Variations in the numbers of granivorous birds were strongly influenced by the presence and stage of rice grain development in the fields. However, the Village Weaver and the Bronze Mannikin were present at all stages of rice cultivation. These two passerines are fond of cultivated cereals in all their forms and feed on them as much as possible [41]. Another passerine, the Red-headed Quelea, is also fond of cultivated cereals but prefers the milky stage [23]. This species was mainly observed the rice heading stage. These three bird species hadthe highest numbers in the rice-growing lowlands of Yamoussoukro. [21] had already reported them as the most abundant species in the rice fields of Grand-Bassam. This similarity could be explained by the uniformity of the behavior of these passerines from one region to another. According to [5], they are the main species pest of rice crops in the Gulf of Guinea. While these small passerines prefer to feed on the ears of rice, turtle doves and other passerines take over when the rice grains are on the ground.The Red-eyed Dove is one of the most abundant species at these stages. Indeed, at harvest time, this species feeds exclusively on cultivated seeds [42].

5. CONCLUSION

The study of bird structure and dynamics in the rice-growing lowlands of Yamoussoukro showed that 22 granivorous species wereattracted by rice cultivation. These granivorous species mainly belong to the Ploceidae and Estrildidae families. Their numbers varieddepending on the site and the stage of rice cultivation. The most abundant species were*Ploceus cucullatus*, *Quelea erythrops* and *Spermestes* cucullata. In addition, five other species wereregular visitors, including*Streptopelia semitorquata*, which hadthe highest numbers during the rice gleaning stages.

REFERENCES

1. Gallais A. and Bannerot H. Improvement of cultivated species. Paris: Editions INRA, 1992.

2. Dogot T, Lebailly P, Dao CT, Pham VB, Tran TT, Xuan VT. Vietnamese countryside and rice production. Agriculture and development. 1997; 15:43-51.

3. Brenière J. Ten years of research on the enemies of rice in French-speaking Africa and Madagascar. Tropical Agronomy. 1966; 4:514-519. English

4. Pollet A. Insect pests of rice in Côte d'Ivoire II - the fauna encountered on irrigated rice in Central Côte d'Ivoire (Kotiessou). ORSTOM Notebook, Biology Series. 1977; XII(1): 3-23.

5. Ruelle P. First part: Pests – Seed-eating birds. In: Appert J, Deuse J, editors. Pests of food and vegetable crops in the tropics. G.-P. Maisonneuve and Larose and Agency for Cultural and Technical Cooperation, France, Paris; 1982.

6. Tréca B. The possibilities of combating waterbirds to protect rice fields in West Africa. Journal of Traditional Agriculture and Applied Botany. 1985; 23:191-213. English

7. De Grazio JW. World bird damage problems. Vertebrate Pest Conference Proceedings collection - Proceedings of the 8th Vertebrate Pest Conference. University of Nebraska–Lincoln; 1978.

8. Asoka Y. Predatory birds and farmers. Explore. 1982; 11(3): 20-21.

9. Hiron M, Rubene D, Mweresa CK, Ajamma UOY, Owino AE, Low M. Crop damage by granivorous birds despite protection efforts by human bird scarers in a sorghum field in western Kenya. Ostrich. 2014; 85(2): 153-159. DOI:10.2989/00306525.2014.937368

10. Billiet F. The impact of seed-eating birds on cereal crops in the central Niger delta in Mali. Tropicultura. 1983; 1(4):133-135.

11. Morel G. Rice cultivation and birds in the Senegal valley. Tropical Crop Protection Congress. 1965; 639-642.

12. Nasasagare RP, Ntakimazi G, Libois R. Study of factors influencing bird visits to rice fields. Scientific Bulletin of the National Institute for Environment and Nature Conservation. 2014; 13:28-34. English

13. Brenière J. Estimated losses due to rice pests in West Africa. Entomophaga. 1982; 27:71-80. English

14. Morel G, Bourlière F. Ecological research on Quelea quelea quelea L. from the lower valley of Senegal. I. Quantitative data on the annual cycle. Bulletin of the French Institute for Black Africa. 1955; 17A: 617-663. English

15. Morel G, Bourlière F. Ecological research on Quelea quelea quelea (L.) of the lower valley of Senegal II. The reproduction. Alauda. 1956; XXIV(2): 97-122. English

16. Morel G, Morel MY. A colony of Quelea quelea quelea (L.) established on reeds in Senegal. ORSTOM notebook, Biology series; 1974; 25:67-71. English

17. Manikowski S, N'diaye AB, Tréca B. Manual for crop protection against bird damage. FAO project TCP/SEN/OO53, Support for avian control; 1991.

18. Cheke RA, Venn JF, Jones PJ. Forecasting suitable breeding conditions for the red-billed quelea Quelea quelea in southern Africa. Journal of Applied Ecology. 2007; 44:523-533.

19. Mallamaire L. The fight against grain-eating birds in West Africa (Mauritania, Senegal, Sudan, Niger). Journal of Tropical Agriculture and Applied Botany. 1961; 8(4-5): 141-179. English

20. Elliott CCH. The pest status of the quelea. In: Bruggers RL, Elliott CCH, editors. Quelea quelea: Africa's bird pest. Oxford: Oxford University Press; 1989.

21. Odoukpé KSG, Yaokokoré-Béibro KH. Avifauna of the rice fields of the Grand-Bassam wetland (Côte d'Ivoire). International Journal of Biological and Chemical Science, 2014; 8(4): 1458-1480. English

22. Odoukpé KSG, Konan EM, Danho M, Yaokokoré-Béibro KH. Birds of the rice fields of Morofé, Yamoussoukro District (Ivory Coast). International Journal of Innovation and Applied Studies. 2020; 29(4): 1253-1263. English

23. Odoukpé KSG, Koné YS, Yaokokoré-Béibro KH. Variation in the numbers of two species of rice predator birds, the police weaver Ploceus cucullatus and the red-headed worker Quelea erythrops, in the wetland of Grand-Bassam, Côte d'Ivoire. Malimbus, 2021; 43(1): 53-61. English

24. Odoukpé KSG, Yaokokoré-Béibro KH. Assessment of damage caused to rice fields by birds in the Grand-Bassam wetland (Côte d'Ivoire). African Agronomy. 2016; 28(3): 78-88. English

25. Kouadja KES, Gnago AJ, Odoukpé KSG, Konan EM, Yaokokoré-Béibro KH. Bird diversity and impact of the use of nets in the fight against rice predatory birds in a rice-growing lowland in Yamoussoukro (Central Côte d'Ivoire). African Agronomy. 2021; 33(1): 107-118. English

26. Asse AF. Importance of the urban lakes of Yamoussoukro in the conservation of waterbirds in Ivory Coast. Ostrich, Journal of African Ornithology. 2007; 78(2): 523-525. English

27. Kollia C. Reciprocal influence of natural water quality andthe presence of aquatic plants. End of cycle dissertation, National Polytechnic Institute Houphouët-Boigny, Yamoussoukro. 1998; 54.

28. N'guessan KA, Kouassi AM, Gnaboa R, Traore KS, Houenou PV. Analysis of hydrological phenomena in an urbanized watershed: case of the city of Yamoussoukro (Central Ivory Coast). Larhyss Journal. 2014 ; 17:135-154.

29. Ekra KA. Comparative study of the effectiveness of aqueous extracts of neem grains (Azadirachta indica Juss) and eucalyptus leaves (Eucalyptus camaldulensis) in the fight against okra insects (Abelmoschus esculentus L). End of cycle dissertation, Higher School of Agronomy, Yamoussoukro. 2010; 52.

30. Yaokokoré-Béibro KH, Odoukpé KSG. Dynamics of the waterbird population in the rice fields of the Grand-Bassam wetland (Côte d'Ivoire). Alauda. 2015 ; 83(4): 255-262. French

31. Borrow N, Demey R, West African Bird Guide. Paris: Delachaux and Niestlé; 2008.

32. Chappuis C. African Birds sound: Birds of North, West and Central Africa. Booklet and 15 CDs, Société Ornithologique de France; 2000.

33. Dowsett RJ, Dowsett-Lemaire F. Ivory Coast. In: Dowsett RJ, Dowsett-Lemaire FA, editors. Contribution to the Distribution and Taxonomy of Afrotropical and Malagasy birds. Liège: Res. Rep. 5, Tauraco Press; 1993.

34. Thiollay JM. Comparative structure of the avian population of the three primary forest sites in Guyana. Earth Life. 1986; 41:59-105. French

35. Fayenuwo JO, Olakojo SA, Akande M, Amusa NA, Olujimi OA. Comparative evaluation of vertebrate pest damage on some newly developed quality protein maize (QPM) varieties in south-western Nigeria. African Journal of Agricultural Research. 2007; 2: 592-595.

36. Ofor MO, Ibeawuchi II, Oparaeke AM. Crop protection problems in production of maize and Guinea corn in Northern Guinea Savanna of Nigeria and control management. Nature & Science. 2009; 7:8-14.

37. Nasasagare RP, Ndayisaba ED, Libois R. Non-random depredation among seed-eating birds of the Kagogo-Gisumo marsh in Burundi. Scientific Bulletin on the Environment and Biodiversity. 2017; 2: 1-8. French

38. Rodenburg J, Demont M, Sow A, Dieng I. Bird, weed and interaction effects on yield of irrigated lowland rice. Crop protection. 2014; 66: 46-52.

39. Lahti DC, Lahti AR, Mansa JD. Associations between nesting Village Weavers, Ploceus cucullatus, and other animal species in The Gambia. Ostrich - Journal of African Ornithology. 2002; 73(1-2): 59-60.

40. Subramanya S. Non-random foraging in certain bird pests of field crops. Journal of Biosciences. 1994; 19: 369-380.

41. Da Camara-Smeets M, Manikowski S. Food preferences of Ploceus cucullatus in Chad. Malimbus. nineteen eighty one ; 3: 41-48.

42. Morel GJ, Morel MY. Comparative study of the diet of five species of doves in a semi-arid savannah of Senegal. First results. In: Kendeigh SC, Warszawa JP, editors. Proceedings of General Meeting of the Working Group on Granivorous Birds. IBP, PT Section: The Hague, Holland; 1970.