

Composition and Use Period of Bird Fauna in Fish Ponds in Kisangani City, Democratic Republic of the Congo

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Abstract

The present study was carried out between May 2 and April 9, 2016 in the the fish ponds at Kisangani city with the aim of determining the composition of the avifauna of the fish pond fauna and the seasonal period of their visit. The observations were performed with the naked eye or binoculars (brand Kite Forster 10×50 Waterproof Field 50 Japan). Results revealed 3305 individuals belonging to 85 species, 58 genres, 33 families and 14 orders. The Passeriformes order with 36 species is the most diverse. It is followed by Charadriiformes (10 species) and Pelecaniformes and Coraciiformes with 9 species each. The species such as *Bubulcus ibis*, *Centropus senegalensis*, *Eyx picta*, *Corvus albus*, *Egrtta garzetta*, *Estrilda melpoda*, *Halcyon senegalensis*, *Hirundo rustica*, *Hirundo senegalensis*, *Merops variegates*, *Milvus migrans*, *Motacila aguimp*, *Ploceus cucullatus*, *Ploceus nigerrimus*, *Psalidoprocne nitens*, *Tringa glareola* and *Turtur afer*, are permanent in fish ponds. Bird's frequency on the fish ponds increases during sub dry and emptying periods. For *Milvus migrans* species, the migratory period extends itself from June till September, while it goes from August to November for *Bubulcus ibis*, *Ardea purpurea*, *Egretta garzetta* and *Phalacrocorax africanus*.

Keywords

Biodiversity, Waterbirds, *Bubulcus ibis*, Kisangani Eco-region, Congo Basin

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1. Introduction

The Democratic Republic of the Congo (DRC) is one of the African countries with a mega-biodiversity. The DRC has important wildlife reserves in the world and includes the rarest animals found nowhere else of which the distribution of these species across the country is unevenly distributed. The ecological region of Kisangani occupies a strategic position in the Central Congolese Cuvette (CCC), where the

fauna is largely diversified [1-3]. DRC birdlife currently has 1099 species [4]. In Kisangani city, some studies were performed like: Tshimanuka [5] who reported 104 species of bird species belonging to 85 genera, 36 families and 14 orders in Kungulu Island; Upoki [6] inventoried 17 species and 9 genera of Bulbul (Pycnonotidae, Passeriformes) in the Masako Forest Reserve at Kisangani city (DRC). The work (creation) and clearing of fish ponds frequently lead to the loss of natural watery zones worldwide. But once cleaned, they serve to best dwelling for invertebrate and vertebrate

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species that intervene in bird's food [7].

The wetlands are the most diversified and productive ecosystems that provide essential and vital services for the survival of humanity. They are the cradles of the biodiversity upon which innumerable species of plants and animals depend for their survival [8]. Birds occupy all types of wetlands; some are strictly subservient and have morphological adaptations in the beak and legs. Wetland birds are distinguished from others by their more or less marked dependence on aquatic surfaces [9]. In the case of Kisangani city, data related to birds visiting on the fish ponds are more fragmentary than the result already acquired from forest areas [10] knowing that the wetlands of Kisangani region are of considerable importance in bird conservation [11]. We mention as an indication the work of Mwanza [12] who inventoried 69 bird species belonging to 26 families and 15 Orders in aquatic and swampy areas at the confluence of Kabondo brook and the Tshopo River. While, Danadu *et al.* [10] identified 23 species of aquatic and semi-aquatic birds in Kisangani city, and they added to that the best conditions for observing a great diversity of birds even during the dry season where they maintained conveniently the ponds full of fish. Andemwana *et al.* [11] observed 71 species of waterbirds in Kisangani wetlands among which 48 were migratory. In the end Malabo [13], has inventoried 22 bird species from the few fish ponds of Kisangani city during a period of 4 months between the periods of heavy and small rains. The present study was carried out in the 8 fish ponds which represent the whole city of Kisangani of which 4 have never been studied before. These sites are: EP Awazi, EP Biona, EP Mapakala and EP Konga kong.

However, Andemwana *et al.* [11] noted that the wetlands of Kisangani city are permanently subject to anthropogenic pressures: development for the purpose of subdivision, garbage dumps, backfilling of flowerbeds for food crops; fish farming, rice farming and rice-fish culture. This study finds its motivation for a better knowledge of the avian biodiversity frequenting fish ponds. Indeed, birds are very sensitive to the slightest change introduced into their habitat. Therefore, the permanent census and at regular intervals are crucial, this technique has the advantage of identifying as many species as possible. Barker *et al.* [14] reported that like all birds, wetland birds are threatened by predators, such as birds of prey, mammals, snakes, and humans. They are especially at the loss of their habitat due to changes, destruction, deforestation and human development. Birds are among the most endangered biodiversity due to the change introduced in their habitat. Given that the green belt surrounding the city is in perpetual decline, our study would like to know if disturbances in the habitat would have an impact on this bird fauna.

2. Material and Methods

2.1. Sites Description and Period of Study

The present study was carried out on the fish ponds at Kisangani city and surroundings between May 2015 and April 2016. Eight sites were selected: Awazi (Awa), Biona (Bio), Djasia (Dja), Djubu-djubu (Dju), Kankonda (Kan), Konga kong (kkg), Mapakala (Mla) and Scholasticat (Sco) (figure 1).

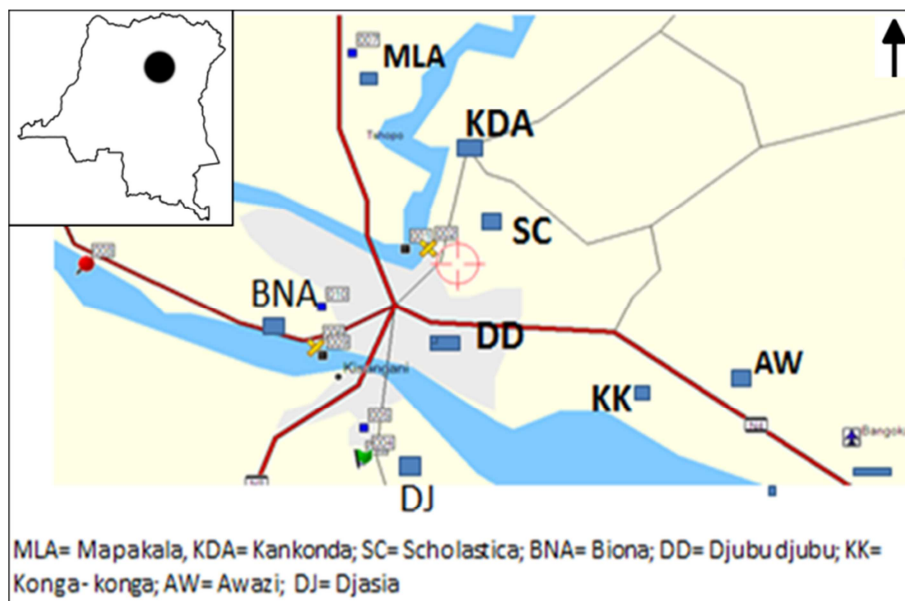


Figure 1. Sites of study.

Kisangani city is located in Central Africa, near the Equateur, in the northeastern part of the Congolese Central Basin (CCB)

at 00°30'34,3"N, 025°11'31"E and its altitude varies between 376m (Plateau medical) in the West and 450m (Plateau Boyoma) in the North East [19]. It is nearly an island located between the Congo River and Tshopo-Lindi Rivers. It has an area of 1910km² and bears a population estimated at 1.602.144 inhabitants (EDS, 2013-2014). It has a dense river system, dominated by the Congo River that divides the city into two parts, thus isolating the larger Lubunga municipality from five others on the right bank of the river. Its main tributary Lindi receives the waters of the Tshopo River. Its streams have in turn to collect waters from many tributaries flowing for the most part through the city. Precipitation is abundant although unevenly distributed throughout the year. The driest month is 60mm. There are two sub-dry seasons (December-February and June-August) and two sub-humid seasons (September-November and March-May).

Despite the hunting pressure and the destruction of habitats, all previous studies confirm the existence in the surroundings of the city of an important fauna diversity: 17 species of Pycnonotidae (birds) in the Masako Forest Reserve [19], 23 waterbirds species around the fish ponds and rivers [10], 16 primates species [15], 45 species of rodents and insectivores [16], 33 shrew species and 33 species of amphibians in the Yoko and Masako forest reserves respectively [17]. Plants covering the target ponds were *Rauvolfia vomitoria* (Apocinaceae), *Triumfetta cordifolia* (Tilliaceae), *Dioda scandense* (Rubiaceae), *Alchornia cordifolia* (Euphorbiaceae), *Eiceahornia crassipes* (Pontederiaceae), *Nephrolepis biserata* (Polypodiaceae), *Ficus mucoso* (Moraceae), *Rhyncospora corymbosa* (Cyperaceae), *Selaginella myosorum* (Selaginellaceae), *Bambusa vulgaris* (Poaceae), *Panicum maximum*, *Panicum rupens* et *Paspalum conjugatum* (Poaceae).

2.2. Biological Material

The biological materials of our study are composed of samples of birds identified in the eight fish ponds (figure 1).

2.3. Methodology and Data Collection

During one year, two days a week were reserved for field work, except days of heavy rain or intense cold where bird movements are very limited. In total we realized 96 outputs. The visual count was used to enumerate all species flying on the surface of the water or in the surrounding vegetation. This technique was applied when the bird population was less than 200 individuals and was at a distance not exceeding 200m. In

the opposite case, we turned to visual estimates [18]. The observation was performed with the naked eye or with binoculars (Kite Forster 10×50 Waterproof Field 50 Japan brand) in order to mitigate the margin of error due to bird movements as mentioned by Bapeamoni [18]. The observation time in each point did not exceed 25 minutes. The observation began at 7:00am and ended at 6:00pm interspersed with a break from noon to 3:00pm. The capture and recapture was done using Japanese nets placed in line on the pond dike. The readings came after every two hours. The bird removed from the net was photographed using a digital camera (Nikon Coolpix L25 brand) and placed in a birdhouse for identification, tagging and released later.

2.4. Data analysis

The relative abundance (Ar) was calculated using the formula:

$$Ar = \frac{ni}{N} \times 100 \quad (1)$$

Where: ni: the individual number in the species and N the total sum of gathered individuals.

The diversity index of Shannon (H'), has been used to calculate the diversity through the biotope such as:

$$H' = -\sum pi \cdot \text{Log} pi \quad (2)$$

Where: pi = ni/N with Ni embedded between 0 and N,

Pi is included in between 0 and 1, and corresponds to the total effective,

ni represents the sum of species I through the sample.

Equitability:

$$R = \frac{H}{H'_{max}} = \frac{H}{\log 2S}$$

in which H' represents Shannon index; S is the specific wealth. R varies between 0 and 1. It tends to 0 when one species contains the quasi-totality of species, but it is equal to 1 when the total sum is the same for all the species.

3. Results

The results of this study revealed a total of 3.305 birds grouped into 85 species, 32 families and 14 orders. Among which 1.162 wetland birds grouped into 30 species, 12 families and 6 orders (table 1).

Table 1. Systematic view on identified birds.

Order	Family	N°	Species
Falconiiformes	Accipitridae	1	<i>Micronisus gabar</i> (Daudin, 1802)
		2	<i>Accipiter badius</i> (Gmelin, GF., 1788)
		3	<i>Accipiter melanoleucus</i> (Smith)

Order	Family	N°	Species		
Anseriformes	Anatidae	4	<i>Milvus migrans</i> (Boddaert, 1783)		
		5	<i>Nettapus auritus</i> (Linnaeus, 1758)**		
Apodiformes	Apodidae	6	<i>Apus affinis</i> (Gray, 1830)		
		7	<i>Apus caffer</i> (Lichtenstein,)		
Charadriiformes	Charadriidae	8	<i>Apus batesi</i> (Sharpe, 1904)		
		9	<i>Calidris minuta</i> (Leisler, 1812)*		
		10	<i>Calidris temmincki</i> (Leisler, 1812)*		
		11	<i>Charadrius marginatus</i> (Vieillot, 1818)*		
		12	<i>Bubulcus ibis</i> (Linnaeus, 1758)*		
		Scolopacidae	13	<i>Tringa glareola</i> (Linnaeus, 1758)*	
			14	<i>Tringa nebularia</i> (Gunnerus 1767)*	
			15	<i>Tringa ochropus</i> (Linnaeus, 1758)*	
			16	<i>Actitis hypoleucos</i> (Linnaeus, 1758)*	
	Recurvirostridae	17	<i>Himantopus himantopus</i> (Linnaeus, 1758)*		
		18	<i>Actophilornis africanus</i> (Gmelin 1789)*		
	Ciconiformes	Threskiornithidae	19	<i>Threskiornis aethiopicus</i> (Latham, 1790)*	
	Pelecaniformes	Ardeidae	20	<i>Ardea purpurea</i> (Linnaeus, 1766)*	
21			<i>Ardea melanocephala</i> (Vigors 1826)*		
22			<i>Ardea cinerea</i> (Linnaeus, 1758)*		
23			<i>Egretta alba</i> (Linnaeus, 1758)*		
24			<i>Egretta garzetta</i> (Linnaeus, 1766)*		
25			<i>Egretta intermedia</i> (Wagler 1827)*		
26			<i>Butorides striata</i> (Linnaeus, 1758)*		
27			<i>Phalacrocorax africanus</i> (Gmelin 1789) **		
Columbiformes			Anhingidae	28	<i>Anhinga rufa</i> (Daudin, 1802)**
			Columbidae	29	<i>Turtur afer</i> (Linnaeus, 1766)
				30	<i>Turtur tympanistria</i> (Temminck 1809)
Coraciiformes	Alcedinidae	31	<i>Streptopelia semitorquata</i> (Rappell, 1837)		
		32	<i>Alcedo quadribrachys</i> (Bonaparte, 1851)*		
		33	<i>Alcedo cristata</i> (Pallas, 1764) *		
		34	<i>Alcedo leucogaster</i> (Fraser 1843)*		
		35	<i>Ceryle rudis</i> (Linnaeus, 1758)*		
		36	<i>Ceyx picta</i> (Boddaert 1783)*		
		37	<i>Halcyon malimbica</i> (Shaw, 1811)*		
		38	<i>Halcyon senegalensis</i> (Linnaeus, 1766)*		
Cuculiformes	Meropidae	39	<i>Merops variegatus</i> (Vieillot, 1817)		
		40	<i>Merops pusillus</i> (Muller, 1776)		
		Cuculidae	41	<i>Centropus senegalensis</i> (Linnaeus, 1766)	
			42	<i>Chrysococcyx caprius</i> (Boddaert, 1783)	
43	<i>Chrysococcyx klass</i> (Boddaert, 1783)				
Gruiiformes	Heliornithidae	44	<i>Podica senegalensis</i> (Vieillot, 1817)		
Ralliformes	Rallidae	45	<i>Amaurornis flavirostra</i> (Swainson, 1937)*		
	Phasianidae	46	<i>Crex egregia</i> (W. Peters 1838)		
Trogoniformes	Trogonidae	47	<i>Apaloderma narina</i> (Stephens, 1815)		
Psittaciformes	Psittacidae	48	<i>Psittacus erithacus</i> (Linnaeus, 1758)		
Passeriformes	Estrildidae	49	<i>Estrilda nonnula</i> (Vieillot, 1817)		
		50	<i>Estrilda melpoda</i> (Vieillot, 1817)		
		51	<i>Lonchura cucullata</i> (Swainson, 1937)		
		52	<i>Spermophaga haematina</i> (Vieillot, 1807)		
		53	<i>Corvus albus</i> (Muller, 1776)		
		Hirundinidae	54	<i>Hirundo rustica</i> (Linnaeus, 1758)	
			55	<i>Hirundo smithii</i> (Leach, 1818)	
			56	<i>Hirundo senegalensis</i> (Linnaeus, 1758)	
			57	<i>Psaldoprocne nitens</i> Cassin, 1857)	
		Muscicapidae	58	<i>Muscicapa aquatica</i> (Heuglin, 1864)	
			59	<i>Platysteira castanea</i> (Fraser, 1843)	
			60	<i>Terpsiphone rufiventer</i> (Swainson, 1937)	
			61	<i>Melaenornis edolioides</i> (G. R. Gray, 1840)	
	62		<i>Motacilla aguimp</i> (Linnaeus, 1758)		
	63		<i>Motacilla flava</i> (Linnaeus, 1758)		
	64		<i>Anthreptes collaris</i> (Vieillot, 1851)		
	Nectarinidae	65	<i>Anthreptes fraseri</i> (Jardine et Selby, 1843)		
		66	<i>Anthreptes gabonicus</i> (Hartlaub, 1861)		
		67	<i>Nectarinia chloropygia</i> (Jardine, 1842)		
		68	<i>Nectarinia venusta</i> (Shaw et Nodaer)		
69		<i>Cyanomitra verticalis</i> (Latham, 1790)			
70		<i>Andropadus gracilirostris</i> (Strickland, 1844)			
Pycnonotidae					

Order	Family	N°	Species
		71	<i>Eurillas virens</i> (Cassin, 1857)
		72	<i>Chlorocichla simplex</i> (Harthiaub, 1855)
		73	<i>Pycnonotus barbatus</i> (Desfontaines, 1789)
	Ploceidae	74	<i>Brachycope anomala</i> (Jehl, 1976)
		75	<i>Ploceus cucullatus</i> (Muller, 1776)
		76	<i>Ploceus nigerrimus</i> (Vieillot, 1819)
		77	<i>Ploceus ocularis</i> (Smith, 1839)
		78	<i>Ploceus pelzelni</i> (Harthiaub, 1887)
		79	<i>Ploceus aurantius</i> (Vieillot, 1805)
		80	<i>Pyrenestes ostrinus</i> (Vieillot, 1805)
		81	<i>Quelea cardinalis</i> (Harthiaub, 1887)
	Sylviidae	82	<i>Cisticola brachypterus</i> (Temminck, 1823)
	Timaliidae	83	<i>Malacocincla fulvescens</i> (Cassin, 1857)
	Turdidae	84	<i>Turdus pelios</i> (Bonaparte, 1851)
	Viduidae	85	<i>Vidua macroura</i> (Pallas, 1764).

Legend: N°: numbers of species; *land birds and **water birds.

As reported in the above table, 85 bird species grouped into 32 families and 14 orders were identified. The orders Passeriformes (36 species), Charadriiformes (10 species), Pelecaniformes and Coraciiformes (9 species each) are the most diversified. The distribution of the species identified according to the families shows that the family of Ploceidae

with 8 species is the most diversified. Alcedinidae and Ardeidae successively follow it with 7 species each. The others have 4 species each.

The plenty and specific diversity of species identified in the eight ponds are presented in the table 2 below.

Table 2. Plenty and Specific Diversity in the 8 fish Ponds.

N°	Species	Awa	BNA	DD	DJA	KDA	KK	MLA	SC	Total
1	<i>Accipiter badius</i>	-	-	0.03	-	0.03	-	-	-	0.06
2	<i>Accipiter melanoleus</i>	-	-	-	0,09	-	-	-	-	0.09
3	<i>Actitis hypoleucos</i>	-	-	-	-	0.03	-	-	-	0.03
4	<i>Actophilornis africanus</i>	-	-	0.71	0.95	0.15	0.27	0.3	0.48	2.86
5	<i>Alcedo cristata</i>	0.15	0	0.36	0,33	0.33	0,18	0.15	0	1.49
6	<i>Alcedo leucogaster</i>	0.06	-	-	-	-	-	-	-	0.06
7	<i>Alcedo quadribrachys</i>	-	-	0.06	-	0.09	-	-	-	0.15
8	<i>Amaurornis flavirostra</i>	0.12	0,09	0,3	0,27	0.06	0,03	0.15	-	1.01
9	<i>Andropadus gracilirostris</i>	-	-	-	-	0.03	-	0.03	-	0.06
10	<i>Eurillas virens</i>	-	0.3	-	0.09	0.36	-	-	-	0.74
11	<i>Anthreptes collaris</i>	-	-	-	-	0.27	-	0.21	-	0.48
12	<i>Anthreptes fraseri</i>	-	-	-	-	-	0,18	-	-	0.18
13	<i>Anthreptes gabonicus</i>	-	-	-	-	0.12	-	-	-	0.12
14	<i>Apaloderma narina</i>	-	-	-	-	-	-	0,06	-	0.06
15	<i>Apus affinis</i>	-	0.51	0.33	0.63	-	0.15	-	0.3	1.91
16	<i>Apus batesi</i>	-	0.27	0.09	0.27	-	0.15	0.18	-	0.9
17	<i>Apus cafer</i>	-	-	-	0.27	-	-	-	-	0.27
18	<i>Anhinga rufa</i>	-	-	0.06	-	-	-	-	0.03	0.09
19	<i>Ardea cinerea</i>	-	-	-	-	0.06	-	-	-	0.06
20	<i>Ardea melanocephala</i>	-	-	-	-	0,09	-	-	-	0.09
21	<i>Ardea purpurea</i>	-	-	-	0.33	0.3	-	-	0.24	0.86
22	<i>Cisticola brachypterus</i>	0.03	-	-	-	-	-	-	-	0.03
23	<i>Brachycope anomala</i>	-	-	0.42	-	-	-	0,36	-	0.77
24	<i>Bubulcus ibis</i>	-	-	-	-	0.06	0.57	-	5.84	6.46
25	<i>Butorides striata</i>	-	-	-	-	0.06	-	-	-	0.06
26	<i>Calidris minuta</i>	-	-	-	0,09	0.09	-	-	-	0.18
27	<i>Calidris temmincki</i>	-	-	-	-	0.03	-	-	-	0.03
28	<i>Centropus senegalensis</i>	0.15	0.09	0.36	-	0.68	0.21	-	-	1.49
29	<i>Ceryle rudis</i>	-	-	-	0,06	-	-	-	-	0.06
30	<i>Ceyx picta</i>	0.45	0.36	0.36	0.71	0.42	0,15	0.42	0.21	3.07
31	<i>Charadrius marginatus</i>	-	-	-	-	-	-	0.06	0.09	0.15
32	<i>Chlorocincla simplex</i>	-	0.21	-	-	0.24	-	0.09	-	0.54
33	<i>Chrysococcyx caprius</i>	-	-	0.09	-	0.03	-	-	-	0.12
34	<i>Chrysococcyx klass</i>	-	-	0.03	-	0.03	-	-	-	0.06
35	<i>Corvus albus</i>	-	0,24	0,09	0,24	0,06	-	-	0,86	1.49
36	<i>Crex egregia</i>	0.03	-	-	-	-	-	-	-	0.03
37	<i>Cyanomitra verticalis</i>	-	-	0,24	-	-	-	0.21	-	0.45
38	<i>Egretta alba</i>	-	-	0.03	0.03	0.15	0.12	-	0.06	0.39

N°	Species	Awa	BNA	DD	DJA	KDA	KK	MLA	SC	Total
39	<i>Egretta garzetta</i>	0.09	0.09	0.42	0.24	0.27	0.09	0.27	0.27	1.73
40	<i>Egretta intermedia</i>	-	-	0.03	0.03	0.06	0.09	-	-	0.21
41	<i>Estrilda melpoda</i>	0.3	0.66	0.98	0.54	-	0.03	0.65	0.39	3.54
42	<i>Estrilda nonnula</i>	0.15	0.06	0.09	0.18	-	-	0.3	-	0.77
43	<i>Halcyon malimbica</i>	-	-	-	0.03	0.06	-	-	0.09	0.18
44	<i>Halcyon senegalensis</i>	0.57	0.68	0.68	0.42	0.8	0.27	0.57	0.21	4.2
45	<i>Himantopus himantopus</i>	-	-	-	-	0.06	-	-	-	0.06
46	<i>Hirundo rustica</i>	-	0.51	0.92	0.57	-	0.57	-	-	2.56
47	<i>Hirundo senegalensis</i>	0.24	0.78	0.21	0.48	0	0.18	0	0	1.88
48	<i>Hirundo smithii</i>	-	-	0.03	-	-	-	-	-	0.03
49	<i>Quelea cardinalis</i>	-	-	-	0.12	-	-	-	-	0.12
50	<i>Lonchura cucullata</i>	0.66	1.91	1.37	0.48	0.3	0.48	0.42	-	5.6
51	<i>Malacocincla fulvescens</i>	-	-	0.03	-	0.06	-	-	-	0.09
52	<i>Melaenornis sp</i>	-	-	0.03	-	-	-	-	-	0.03
53	<i>Merops pusillus</i>	-	0.33	0.1	0.12	0.27	-	-	0.39	1.25
54	<i>Merops variegatus</i>	-	1.19	0.06	0.54	1.25	-	-	0.63	3.66
55	<i>Micronesus cabar</i>	-	0.03	-	-	-	-	-	-	0.03
56	<i>Milvus migrans</i>	0.36	0.42	0.69	0.77	0.92	0.98	0.48	1.43	6.04
57	<i>Motacilla aguimp</i>	0.21	-	0.18	0.33	0.24	0.15	-	0.09	1.19
58	<i>Motacilla flava</i>	0.06	-	0.09	0.21	0.12	-	-	0.06	0.54
59	<i>Muscicapa aquatica</i>	-	-	0.03	0.06	0.21	-	-	-	0.3
60	<i>Nectarinia chloropygia</i>	0.21	0.27	-	0.15	0.27	-	-	-	0.89
61	<i>Nectarinia venusta</i>	-	-	-	-	-	-	0.06	-	0.06
62	<i>Nettapus auritus</i>	-	-	-	-	0.06	-	-	-	0.06
63	<i>Phalacrocorax africanus</i>	-	0.18	1.01	0.57	1.52	0.51	0.33	0.8	4.91
64	<i>Pycnonotus barbatus</i>	0.36	0.33	0.09	-	0.09	0.15	0.18	-	1.19
65	<i>Plasteira castanea</i>	-	-	0.09	-	-	-	-	-	0.09
66	<i>Ploceus aurantius</i>	-	-	0.21	0.24	0.33	-	-	0.06	0.83
67	<i>Ploceus cucullatus</i>	0.24	0.63	1.94	1.01	1.37	0.45	0.33	0.15	6.1
68	<i>Ploceus nigerrimus</i>	0.39	0.06	0.21	0.51	3.22	0.39	-	0.15	4.91
69	<i>Ploceus ocularis</i>	-	-	-	0.12	0.33	-	-	-	0.45
70	<i>Ploceus pelzelni</i>	0.45	1.28	0.18	0.33	-	0.24	0.3	0.3	3
71	<i>Podica senegalensis</i>	-	-	0.18	-	-	-	-	-	0.18
72	<i>Psalidoprocne nitens</i>	0.33	0.75	0.65	0.6	0.48	0	0.33	0.42	3.54
73	<i>Psittacus erithacus</i>	-	-	-	-	-	0.06	0.12	-	0.18
74	<i>Pyrenestes ostrinus</i>	0.09	0.12	-	-	0.12	0.15	0.18	0.06	0.71
75	<i>Spermophaga haematina</i>	-	-	-	-	0.06	-	-	-	0.06
76	<i>Streptopelia semitorquata</i>	0.27	0.27	0.03	0	0.21	-	-	-	0.77
77	<i>Terpsiphone rufiventer</i>	-	-	0.12	0.12	-	-	-	-	0.24
78	<i>Threskiornis aethiopicus</i>	-	-	-	-	-	-	-	0.03	0.03
79	<i>Tringa glareola</i>	0.24	0.77	1.4	0.45	1.76	0.42	0.6	0.77	6.4
80	<i>Tringa nebularia</i>	-	0.15	0.24	-	0.12	-	-	-	0.51
81	<i>Tringa ochropus</i>	0.12	-	-	-	-	-	-	-	0.12
82	<i>Turdus pelios</i>	-	-	0.27	-	0.03	-	0.06	-	0.36
83	<i>Turtur afer</i>	0.15	0.33	0.15	0.09	0.95	0.15	-	-	1.82
84	<i>Turtur tympanistria</i>	-	-	-	-	0.06	-	-	-	0.06
85	<i>Vidua macroura</i>	0.03	0.15	0.15	0.45	0	-	0.15	0.27	1.19
Total		6.43	14.02	16.37	14.29	19.38	7.32	7.56	14.62	100
Sum (ni)		216	435	510	533	573	232	332	474	3305
Specific richness		31	33	50	44	51	30	40	33	85
Simpson_1-D		0.94	0.944	0.94	0.964	0.93	0.94	0.951	0.81	0.92
Shannon_H		3.07	3.13	3.3	3.3	3.48	3.05	3.18	2.39	3.11
Equitability J		0.93	0.89	0.85	0.92	0.8	0.91	0.92	0.72	0.86

Legend: Awa, Awazi; BNA, Bione; DD, Djubudjubu; DJA, Djassia; KDA, Kankonda; KK, Konga-konga; MLA, Mapakala and SC, Scolastica and -, absence.

For a total of 85 birds species identified, eight come in the 1st position with a relative abundance ranging between 4 and 6.46%. These are *Ploceus cucullatus* (6.10%), *Milvus migrans* (6.04%), *Lonchura cucullata* (5.60%), *Ploceus nigerrimus* (4.91%), for terrestrial species. *Bubulcus ibis* (6.46%), *Tringa glareola* (6.40%), *Phalacrocorax africanus* (4.91%) and *Halcyon senegalensis* (4.20%) for waterbirds.

However, 14 species come in 2nd position with a relative

abundance ranging between 1 and 2.9%. These are: *Apus affinis* (1.91%), *Centropus senegalensis* (1.49%), *Corvus albus* (1.49%), *Hirundo rustica* (2.56%), *Hirundo senegalensis* (1.88%) *Pupillus merops* (1.25%), *Motacilla aguimp* (1.19%), *Pycnonotus barbatus* (1.19%), *Turtur afer* (1.82%), *Vidua macroura* (1.19%) for terrestrial species. *Actophilornis africanus* (2.86%), *Alcedo cristata* (1.49%), *Amaurornis flavirostra* (1.01%) and *Egretta garzetta* (1.73%) for waterbirds. The other species have a very low relative

abundance of less than 1%. The site-specific distribution indicates that the Kankonda sites (51 species, $H' = 3.489$) and Djubu-djubu (50 species, $H' = 3.30$) are of the most diverse. Meanwhile the Awazi EPs (31 species, $H' = 3.07$), Konga-konga (30 species, $H' = 3.05$) and Scolastica (33 species $H' = 2.39$) are less diversified. The equitability index 1-D shows

that species are equitably distributed in fish ponds. Out of 85 identified species, eight are the first with the relative plenty varying between 4 and 6.46%.

The birds' distribution regarding season periods is presented in table 3.

Table 3. Avifauna distribution according to seasonal period.

Season Periods species	DS1			DS2			RS1
	December	January	February	June	July	August	September
<i>Accipiter baduis</i> (Gmelin, GF., 1788)				1			
<i>Accipiter melanoleus</i> (Smith)		1				1	
<i>Actitis hypoleucos</i> (Linnaeus, 1758)*			1				
<i>Actophilornis africanus</i> (Gmelin 1789)*	25		6	11	10	4	
<i>Alcedo cristata</i> (Pallas, 1764) *		15	11		8	1	4
<i>Alcedo leucogaster</i> (Fraser 1843)*							
<i>Alcedo quadribrachys</i> (Bonapate, 1851)*			1				26
<i>Amaurornis flavirostra</i> (Swainson, 1937)*		2			2		
<i>Andropadus gracilirostris</i> (Strickland, 1844)	1						
<i>Anhinga rufa</i> (Daudin, 1802)**			1		1		1
<i>Anthreptes collaris</i> (Vieillot, 1851)				4		3	3
<i>Anthreptes fraseri</i>			2	1			1
<i>Anthreptes gabonicus</i>							4
<i>Apaloderma narina</i> (Stephens, 1815)					2		
<i>Apus affinis</i> (Gray, 1830)	8	17		6	6	2	
<i>Apus batesi</i> (Sharpes, 1904)	4	1	3	6		1	7
<i>Apus caffer</i> (Lichtenstein.)	3						
<i>Ardea cinerea</i> (Linnaeus, 1758)*			1	1			
<i>Ardea melanocephala</i> (Vigors 1826)*	1						
<i>Ardea purpurea</i> (Linnaeus, 1766)*	9	5		4	4	3	
<i>Brachycope anomala</i> (Jehl, 1976)	1	2	5	1	2		4
<i>Butorides striata</i>						2	
<i>Bubulcus ibis</i> (Linnaeus, 1758)*	38	51	15	26			
<i>Calidris minuta</i> (Leisler, 1812)*	1	2		1	1		1
<i>Calidris temmincki</i> (Leisler, 1812)*	1						
<i>Centropus senegalensis</i> (Linnaeus, 1766)	2	3	12		5	7	
<i>Ceryle rudis</i> (Linnaeus, 1758)*		1			1		
<i>Ceyx picta</i> (Boddaert 1783)*	8	10	13	13	5	7	11
<i>Charadrius marginatus</i> (Vieillot, 1818)*		13			2	1	1
<i>Chlorocicla simplex</i> (Harthiaub, 1855)	1	3		2	3	2	2
<i>Chrysococcyx caprius</i> (Boddaert, 1783)							1
<i>Chrysococcyx klass</i> (Boddaert, 1783)							1
<i>Cistocola brachypterus</i> (Temminck, 1823)			1				
<i>Corvus albus</i> (Muller, 1776)	1	3		4	2	4	
<i>Crex egregia</i> (W. Peters 1838)					1		
<i>Cyanomitra verticalis</i> (Latham, 1790)			1	1		1	1
<i>Egretta alba</i> (Linnaeus, 1758)*	2	3	1				3
<i>Egretta garzetta</i> (Linnaeus, 1766)*	6	12	6	4			
<i>Egretta intermedia</i> (Linnaeus, 1758)*		2	4	1			
<i>Estrilda melpoda</i> (Vieillot, 1817)	13		13	5		31	9
<i>Estrilda nonnula</i> (Vieillot, 1817)	1		4		2	1	
<i>Eurillas virens</i> (Cassin, 1857)		2		12	3	2	4
<i>Halcyon malimbica</i> (Shaw, 1811)*		1					
<i>Halcyon senegalensis</i> (Linnaeus, 1766)*	2	34	3		42	26	1
<i>Himantopus himantopus</i> (Linnaeus, 1758)*	1						
<i>Hirundo rustica</i> (Linnaeus, 1758)	13	11	8	9	4	7	5
<i>Hirundo senegalensis</i>	10	6	5	9	2	5	4
<i>Hirundo smithii</i> (Leach, 1818)			1				
<i>Lonchura cucullata</i> (Swainson, 1937)		19	26	56		2	
<i>Malacocincla fulvescens</i> (Cassin, 1857)					1		
<i>Melaenornis edoloides</i> (G. R. Gray, 1840)			1				
<i>Merops pusillus</i> (Muller, 1776)	8	3	7		1	1	5
<i>Merops variegatus</i> (Vieillot, 1817)	19	9		21	15	6	8
<i>Micronesus cabar</i>				1			
<i>Milvus migrans</i> (Boddaert, 1783)	30	19	8				2
<i>Motacilla aguimp</i> (Linnaeus, 1758)	5	4	2		3	3	5

Season Periods <i>species</i>	DS1			DS2			RS1
	December	January	February	June	July	August	September
<i>Motacilla flava</i> (Linnaeus, 1758)			1	3		1	2
<i>Muscicapa aquatica</i> (Heuglin, 1864)		6		2			
<i>Nectarinia chloropygia</i> (Jardine, 1842)			1	2	14	6	2
<i>Nectarinia venusta</i> (Shaw et Nodaer)					1		
<i>Nettapus auritus</i> (Linnaeus, 1758)**							
<i>Phalacrocorax africanus</i> (Gmelin 1789)**	36	18	13	5	16		
<i>Platisteira castenea</i> (Fraser, 1843)				1			2
<i>Ploceus aurantius</i> (Vieillot, 1805)		1		4		8	1
<i>Ploceus cucullatus</i> (Muller, 1776)	1		8	44	16	3	
<i>Ploceus nigerrimus</i> (Vieillot, 1819)	28		17	15		2	43
<i>Ploceus ocularis</i> (Smith, 1839)			4			4	
<i>Ploceus pelzelni</i> (Harthiaub, 1887)	22	26	4			8	8
<i>Podica senegalensis</i> (Vieillot, 1817)		1			2	1	
<i>Psalidoprocne nitens</i> Cassin, 1857)	2	12	22	28	4	23	8
<i>Psittacus erithacus</i> (Linnaeus, 1758)	2			2			
<i>Pycnonotus barbatus</i> (Desfontaines, 1789)	12	2		2		5	
<i>Pyrenestes ostrinus</i>			4		3	8	15
<i>Quelea cardinalis</i> (Harthiaub, 1887)		4					
<i>Spermophaga haematina</i> (Vieillot, 1807)				1			
<i>Streptopelia semitorquata</i> (Rappell, 1837)	3		2			2	
<i>Terpsiphone rufiventer</i> (Swainson, 1937)	2	1		1	1	2	
<i>Threskiornis aethiopicus</i> (Latham, 1790)*							
<i>Tringa glareola</i> (Linnaeus, 1758)*	28	6	8	42	8	25	39
<i>Tringa nebularia</i> (Gunnerus 1767)*		2	2	7			4
<i>Tringa ochropus</i> (Linnaeus, 1758)*					4		
<i>Turdus pelios</i> (Reichenon 1905)	2	4	3			1	1
<i>Turtur afer</i> (Linnaeus, 1766)	1	3	1	3	2	14	
<i>Turtur tympanistria</i> (Temminck 1809)		1					1
<i>Vidua macroura</i> (Pallas, 1764)		4		22		3	
Monthly distribution	333	340	247	384	224	317	243
%	10.0	10.2	7.4	11.6	6.7	9.5	7.3
Seasonal periods distribution	27.8%		27.9%				23.6%
Total	1845 (55.8%)						1460 (44.17%)

Table 3. Continued.

Season Periods <i>species</i>	RS1		RS2			TOTAL
	October.	November	March	April	May	
<i>Accipiter baduis</i> (Gmelin, GF, 1788)		1				2
<i>Accipiter melanoleus</i> (Smith)					1	3
<i>Actitis hypoleucos</i> (Linnaeus, 1758)*						1
<i>Actophilornis africanus</i> (Gmelin 1789)*	8		7	4	21	96
<i>Alcedo cristata</i> (Pallas, 1764) *			9		2	50
<i>Alcedo leucogaster</i> (Fraser 1843)*	1				1	2
<i>Alcedo quadribrachys</i> (Bonapate, 1851)*			3	1		31
<i>Amaurornis flavirostra</i> (Swainson, 1937)*					2	6
<i>Andropadus gracilirostris</i> (Strickland, 1844)		1				2
<i>Anhinga rufa</i> (Daudin, 1802)**			1			4
<i>Anthreptes collaris</i> (Vieillot, 1851)	1		2	2	1	16
<i>Anthreptes fraseri</i>	1				1	6
<i>Anthreptes gabonicus</i>						4
<i>Apaloderma narina</i> (Stephens, 1815)						2
<i>Apus affinis</i> (Gray, 1830)	1		23		3	66
<i>Apus batesi</i> (Sharpes, 1904)	4		1		5	32
<i>Apus caffer</i> (Lichtenstein,)		2	1		3	9
<i>Ardea cinerea</i> (Linnaeus, 1758)*						2
<i>Ardea melanocephala</i> (Vigors 1826)*	2					3
<i>Ardea purpurea</i> (Linnaeus, 1766)*				3	1	29
<i>Brachycope anomala</i> (Jehl, 1976)	3		8			26
<i>Butorides striata</i>						2
<i>Bubulcus ibis</i> (Linnaeus, 1758)*		7	10	11	59	217
<i>Calidris minuta</i> (Leisler, 1812)*						6
<i>Calidris temmincki</i> (Leisler, 1812)*						1
<i>Centropus senegalensis</i> (Linnaeus, 1766)	5	4	1	4	7	50
<i>Ceryle rudis</i> (Linnaeus, 1758)*						2
<i>Ceyx picta</i> (Boddaert 1783)*	9		6	12	9	103

Season Periods <i>species</i>	RS1		RS2			TOTAL
	October.	November	March	April	May	
<i>Charadrius marginatus</i> (Vieillot, 1818)*		1				18
<i>Chlorocicla simplex</i> (Harthiaub, 1855)	1		4			18
<i>Chrysococcyx caprius</i> (Boddaert, 1783)	1		1		1	4
<i>Chrysococcyx klass</i> (Boddaert, 1783)				1		2
<i>Cistocola brachypterus</i> (Temminck, 1823)						1
<i>Corvus albus</i> (Muller, 1776)	12	11	6	7		50
<i>Crex egregia</i> (W. Peters 1838)						1
<i>Cyanomitra verticalis</i> (Latham, 1790)	2					6
<i>Egretta alba</i> (Linnaeus, 1758)*	4					13
<i>Egretta garzetta</i> (Linnaeus, 1766)*	4	7	6	9	4	58
<i>Egretta intermedia</i> (Linnaeus, 1758)*						7
<i>Estrilda melpoda</i> (Vieillot, 1817)		15	10	3	20	119
<i>Estrilda nonnula</i> (Vieillot, 1817)			2	9	7	26
<i>Eurillas virens</i> (Cassin, 1857)	1			1		25
<i>Halcyon malimbica</i> (Shaw, 1811)*	4	1				6
<i>Halcyon senegalensis</i> (Linnaeus, 1766)*		29	1		3	141
<i>Himantopus himantopus</i> (Linnaeus, 1758)*				1		2
<i>Hirundo rustica</i> (Linnaeus, 1758)	6	4	9	4	6	86
<i>Hirundo senegalensis</i>	9		13			63
<i>Hirundo smithii</i> (Leach, 1818)						1
<i>Lonchura cucullata</i> (Swainson, 1937)		33		46	6	188
<i>Malacocincla fulvescens</i> (Cassin, 1857)			2			3
<i>Melaenornis edoloides</i> (G. R. Gray, 1840)						1
<i>Merops pusillus</i> (Muller, 1776)	5	6			6	42
<i>Merops variegatus</i> (Vieillot, 1817)	19		7	11	8	123
<i>Micronesus cabar</i>						1
<i>Milvus migrans</i> (Boddaert, 1783)	32	43	24	15	30	203
<i>Motacilla aguimp</i> (Linnaeus, 1758)		13		3	2	40
<i>Motacilla flava</i> (Linnaeus, 1758)	6	2	3			18
<i>Muscicapa aquatica</i> (Heuglin, 1864)				2		10
<i>Nectarinia chloropygia</i> (Jardine, 1842)		2	1		2	30
<i>Nectarinia venusta</i> (Shaw et Nodaer)		1				2
<i>Nettapus auritus</i> (Linnaeus, 1758)**		2				2
<i>Phalacrocorax africanus</i> (Gmelin 1789)**			18	12	4	122
<i>Platisteira castenea</i> (Fraser, 1843)						3
<i>Ploceus aurantius</i> (Vieillot, 1805)			6	8		28
<i>Ploceus cucullatus</i> (Muller, 1776)	64	38	8	23		205
<i>Ploceus nigerrimus</i> (Vieillot, 1819)		10		12	17	144
<i>Ploceus ocularis</i> (Smith, 1839)			2		5	15
Table 3. (continued)						
<i>Ploceus pelzelni</i> (Harthiaub, 1887)		12		6	17	103
<i>Podica senegalensis</i> (Vieillot, 1817)			2			6
<i>Psaldiprocne nitens</i> Cassin, 1857)	4		7	3	6	119
<i>Psittacus erithacus</i> (Linnaeus, 1758)		2			2	8
<i>Pycnonotus barbatus</i> (Desfontaines, 1789)		25	3	4	29	82
<i>Pyrenestes ostrinus</i>	4		3	2	9	48
<i>Quelea cardinalis</i> (Harthiaub, 1887)						4
<i>Spermophaga haematina</i> (Vieillot, 1807)	1					2
<i>Streptopelia semitorquata</i> (Rappell, 1837)	7	2	8		2	26
<i>Terpsiphone rufiventer</i> (Swainson, 1937)				1		8
<i>Threskiornis aethiopicus</i> (Latham, 1790)*				1		1
<i>Tringa glareola</i> (Linnaeus, 1758)*	12	6		4	7	185
<i>Tringa nebularia</i> (Gunnerus 1767)*		1			1	17
<i>Tringa ochropus</i> (Linnaeus, 1758)*						4
<i>Turdus pelios</i> (Reichenon 1905)			1			12
<i>Turtur afer</i> (Linnaeus, 1766)	2	3	1	8		38
<i>Turtur tympanistris</i> (Temminck 1809)						2
<i>Vidua macroura</i> (Pallas, 1764)	9	2				40
Monthly distribution	255	284	213	212	253	3305
%	7.7	8.5	6.5	6.4	7.6	
Seasonal periods distribution			20.5%			3305
Total						

Legend: DS1: first dry season from June to August; DS2: second dry season from December to February; RS1: first rainy season from March to May; RS2: second rainy season from September to November.

According to the monthly birding attendance, the table revealed that the months of June (11.6%), January (10.2%) and December (10.0%) had high bird fish ponds. The months of July (6.7%), March (6.5%) and April (6.4%), on the other hand, showed low attendance.

The 18 species observed at least during 9 months out of 12 are permanent in the fish ponds, of which *Bubulcus ibis*, *Centropus senegalensis*, *Ceyx picta*, *Corvus albus*, *Egretta garzetta*, *Estrilda melpoda*, *Halcyon senegalensis*, *Hirundo rustica*, *Hirundo senegalensis*, *Merops pusillus*, *Merops variegatus*, *Milvus migrans*, *Motacila aguimp*, *Ploceus cucullatus*, *Ploceus nigerrimus*, *Psalidoprocne nitens*, *Tringa glareola et Turtur afer*. The total number of species recorded per seasonal period gives 57% for the subsistence periods against 43.5% for the sub-humid periods. We noted the periodic absence of *Actophilornis africanus* and *Ardea purpurea* from September to November; *Actophilornis africanus* and *Ardea purpurea* from September to November; *Bubulcus ibis* from July to November; *Egretta garzetta* from July to September and *Milvus migrans*, from June to September.

4. Discussion

The inventory of birds frequenting fish ponds in Kisangani city allowed us to identify 3.305 individuals grouped into 85 species, 58 genera, 32 families and 14 orders among which, 1162 waterbirds representing 30 species and 6 orders. The order of Passeriformes with 34 species was the most diversified followed by Charadriiformes (9 species). These results meet the observations of other ornithologists such as Upoki [6] in the Masako and Yoko Forest Reserves respectively in Kisangani city. Bapeamoni [18], in the humid zones of the North East of Pas de Calais in France and Tombal [19], in the continental humid zones Zehrez Chergui and Zehrez Charbi (wilaya of Djelfa) in Algeria. The abundance of Passeriformes finds its explanation among others by the high number of families and species contained in this order, the belt vegetation around the ponds composed mostly Poaceae attracting birds especially small. For Brizard [20], small passerines occupy a wide variety of hygrophilous herbaceous media favourable for wintering, reproduction and refuge of avian species. Also, Passeriformes have great abilities to adapt and live in a wider range of habitats and to better withstand human pressures on their habitat [21].

Considering only waterbirds, Pelecaniformes, Charadriiformes and Coraciiformes were the most diversified. This group contains, in fact, formidable predators that hunt their prey in shallow waters. They consume insects, crustaceans, molluscs, worms and occasionally they can catch fish, amphibians or larvae that live in swamps. As a

result, they contribute to the natural regulation of invertebrate and small vertebrate populations living in this biotope [22]. Ploceidae followed by Alcedinidae and Ardeidae are the most diverse. The abundance of Ploceidae in fish ponds is linked to the presence of aquariculture, maize and *Elaeis guinensis*, which are known to support nesting, breeding and protection for gendarme's weavers. We have indeed observed mono-specific colonies of *Ploceus cucullatus*, *Ploceus nigerrimus* and some *Ploceus aurantius* nests in the middle of the Kankonda, Djasia and Awazi ponds. The choice of this location would be related to their instinct of protection against the man who, very often will take the chicks in their nests. The Alcedinidae and Ardeidae are predatory species that find fish ponds as their hunting environment par excellence where they easily find their prey.

The relative abundance in the eight sites indicates that the species *Bubulcus ibis* (6.46%), *Tringa glareola* (6.40%), *Milvus migrans* (6.04%), *Ploceus cucullatus* (6.10%), *Lonchura cucullata* (5.60%), *Phalacrocorax africanus* (4.91%), *Halcyon senegalensis* (4.20%) are the most represented. We believe that the quality of their habitat, flood level fluctuations, the amount of food available and the low disturbance impact would explain this abundance. Similar observations were made by Elphick [23]. Furthermore, the abundance of *Bubulcus ibis* at the Scholasticat fish ponds, would be justified by the presence of cows reared by the Jesuit fathers in this site and the physical aspect of the environment which according to Birdlife International [24], responds to the preference for this species: the Heron cows-keeper frequents preferably pond areas, swamps, grazing alluvial valleys, composed of a dry meadow of heterogeneous plant structure and the herbaceous stratum not exceeding 40 to 50 cm. The high frequency of *Phalacrocorax africanus* at Kankonda, Djubu-djubu and Scholasticat fish ponds would indicate the abundance of fish in these ponds. We have several times observed it swimming or posted on the vestige of a tree cut in the middle of the pond or perched on a tree branch. It was during the subsidence and discharge periods that we recorded the high numbers of wading birds and raptors in the fish ponds. The distribution according to the fish ponds revealed that the Kankonda, Djubu-Djubu and Djasia sites are the most diversified both quantitatively and qualitatively. In addition to the fish ponds of Djubu djubu (very disturbed), the two others enjoy good environmental conditions: undisturbed, fish, very large surface, well maintained and a good vegetable belt [10]. Although highly disturbed, the presence of aquariculture and maize fields at the edge of Djubu-djubu ponds are factors that attract birds [24-25]. The lowest figures in terms of individuals and species recorded at Awazi, Konga-konga and Mapakala fish ponds are due to their proximity to human dwellings and

water sources where women and children come to draw water and swim.

Fish ponds attract bird populations that vary from one seasonal period to another. In addition to the granivorous and insectivores that we observed throughout this investigation in the belt vegetation, bird populations recorded in abundance over all the subsistence periods were inevitably those of birds of prey, piscivorous and wading birds. These are: *Milvus migrans*, *Accipiter baduis*, *Accipiter melanoleus*, *Ardea purpurea*, *Ardea cinerea*, *Ardea melanocephala*, *Phalacrocorax africanus*, *Egretta alba*, *Egretta garzetta*, *Egretta intermedia*, *Threskiornis aethiopicus*, *Tringa glareola*, *Tringa nebularia*, *Tringa ochropus*, *Himantopus himantopus*, *Actophilornis africanus* and *Ceyx picta*. In this study, it should be noted the periodic absence of some waterbird species such as: *Actophilornis africanus*, *Ardea purpurea*, *Bubulcus ibis*, *Egretta garzetta*, and *Milvus migrans* which are species of terrestrial birds; but Hafner *et al.* and Lefeuvrej [24-25] believe that this absence might be due to migratory behaviour. Furthermore, for most waterbirds, nuptial post migration would begin in July or end of August and end in October for some and in November for others. The migratory period of *Milvus migrans* was observed between June and September.

5. Conclusion

A study on the inventory of birds that frequent the fish ponds in Kisangani city has been carried out. The results revealed 85 species of which 30 are waterbirds. The order of Passeriformes successively followed by Charadriiformes, Pelecaniformes and Coraciiformes is most represented in the fish ponds of the city of Kisangani. The most diverse families are Ploceidae with 9 species followed by Alcedinidae and Ardeidae with 7 species each. The species most represented in the fish ponds are: *Bubulcus ibis*, *Milvus migrans*, *Tringa glareola*, *Ardea purpurea*, *Actophilornis africanus*, *Phalacrocorax africanus*, *Ploceus cucullatus*, *Ploceus nigerrimus*, *Lonchura cucullata*, *Turtur afer*, *Tringa glareola*, *Alcedo cristata*, *Ceyx picta*, *Halcyon senegalensis*, *Estrilda melopoda*.

The distribution among fish ponds revealed that the Kankonda, Djubu-djubu and Djasia sites are proving to be the best sites for bird attraction. The subsistence and emptying periods are the perfect time to observe a great diversity of birds in the fish ponds. It is also during the subsistence periods that we have observed the presence of non-permanent species in fish ponds in Kisangani city. Species like *Himantopus himantopus*, *Threskiornis aethiopicus*, *Crex egregia*, *Nettapus auritus* are migratory species. The migratory period of the species *Milvus migrans*

has been observed from June to September, whereas it is from July to November for the species *Bubulcus ibis*, *Ardea purpurea*, *Egretta garzetta* and *Phalacrocorax africanus*.

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