

Abundance, Density and Distribution of three wetland bird species: Cattle Egret (*Bubulcus ibis*), Black Crake (*Amaurornis flavirostris*) and Africana Jacana (*Actophilornis africanus*) of Ruzizi Delta, in Burundi and the Democratic Republic of Congo

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ABSTRACT

The study investigated the abundance, density, and distribution of three wetland bird species in the Ruzizi Delta from April 2019 to November 2021. The study was conducted in five sites of the Rusizi Burundian Delta and five sites of the Ruzizi Congolese Delta. The density of the Cattle Egret, Black Crake, and African Jacana was higher in the protected Rusizi Burundian Delta compared to the unprotected Ruzizi Congolese Delta. The distribution or fluctuation had a peak in May, the rainiest month, and a minimum in July, the least rainy month. The maximum was always higher for the protected Rusizi Burundian Delta, and lower for the unprotected Ruzizi Congolese Delta. The Qui Squarred test and the Student's t test showed that the differences in maximum and minimum fluctuations between the protected Rusizi Burundian Delta and the unprotected Ruzizi Congolese Delta were significant. The study suggests that the sustainability of the three wetland bird species and their acolytes in the Ruzizi Delta requires the creation of a protected area in the Ruzizi Congolese Delta wetlands.

Keywords: Wetland bird species; Abundance of a bird species; Density of a bird species; Distribution of a bird species; Fluctuation of a bird species

INTRODUCTION

Wetlands are one of the complex and interlinking ecosystems between aquatic and terrestrial habitat (Greenson, Clark, & Clark, 1979); (Zedler & Kercher, 2005); (Gajera, Mahato, & Kumar, 2012). Wetlands have global significance and value as an "ecosystem service". The major functions of wetland are: biodiversity support, water quality improvement, wood abatement, and carbon management (Greenson, Clark, & Clark, 1979). These are of great importance for wetland surrounding people, especially in the Ruzizi Congolese Delta in eastern of the Democratic Republic of Congo (DRC).

How to Cite:

Bashonga Bishobibiri Alexis¹, Eric Sande, Majaliwa Mwanjololo, Charles Kahindo, Claver Sibomana & Gaspard Ntakimazi (2023). Abundance, Density and Distribution of three wetland bird species: Cattle Egret (*Bubulcus ibis*), Black Crake (*Amaurornis flavirostris*) and Africana Jacana (*Actophilornis africanus*) of Ruzizi Delta, in Burundi and the Democratic Republic of Congo. Biolife. 11(4), 5-18.

DOI: <https://dx.doi.org/10.5281/zenodo.8433139>

Received: 12 August 2023; Accepted: 2 September 2023; Published online: 12 October 2023

The habitat features of wetland system have helped to flourish variety of living organisms including all major groups of animals such as birds (Greeson, Clark, & Clark, 1979).

Wetlands of tropical and subtropical areas considered to be rich centres of avi-fauna which are under immense human pressure on the maintenance and protection of biodiversity (Gajera, Mahato, & Kumar, 2012). The natural wetlands in each part of the globe are experiencing serious loss and threats from natural factors like climate change and from anthropogenic factors (Torell & Salamanca, 2015). As the wetland ecosystem degrading the dependent biodiversity are also facing threats for their survival (Torell & Salamanca, 2015); (Whitten & Bentley, 2007).

Wetlands are important area for birds and in supporting their species diversity and to regulate the ecological web (Hollis, Holland, Maltby, & Larson, 1988); (Baltzersen, 2011). The land use land cover changes by increasing urbanization and conversion of open space to agriculture are primary factors on the loss of natural wetlands. Natural wetlands are in decline throughout the world as the human population grows and as a result the dependent

aquatic bird species are under threat (Czech & Parson, 2009).

The paper documents abundance, density and distribution (fluctuation) of three wetland bird species: Cattle Egret (*Ardeidae*), *Bubulcus ibis* (Linnaeus, 1758), «Héron garde bœufs»; Black Crake (*Rallidae*), *Amaurornis flavirostris* (Swainson, 1837), «Râle à bec jaune»; and African Jacana (*Jacania*), *Actophilornis africanus* (Gmelin, 1789), «Jacane à poitrine dorée» in the low land of the Ruzizi Plain, main known as the Ruzizi Delta (Figure 1) both in the Democratic Republic of Congo (DRC) and in the Republic of Burundi. Sampling fieldwork were conducted two times per week, once in DRC and once in Burundi for eleven months from April 2019 to November 2021, except December 2019 as we were to Workshop in Benin and in Bukavu.

Investigations were conducted using direct observation on transect counts and point counts per site recording the bird individual number per species. Five sites were grouped for abundance, density and fluctuation calculation in the Ruzizi Congolese (RCD) and the Ruzizi Burundian Delta (RBD). Abundance is the number of individuals of species in a given area (Brower & Zar, 2022). Relative

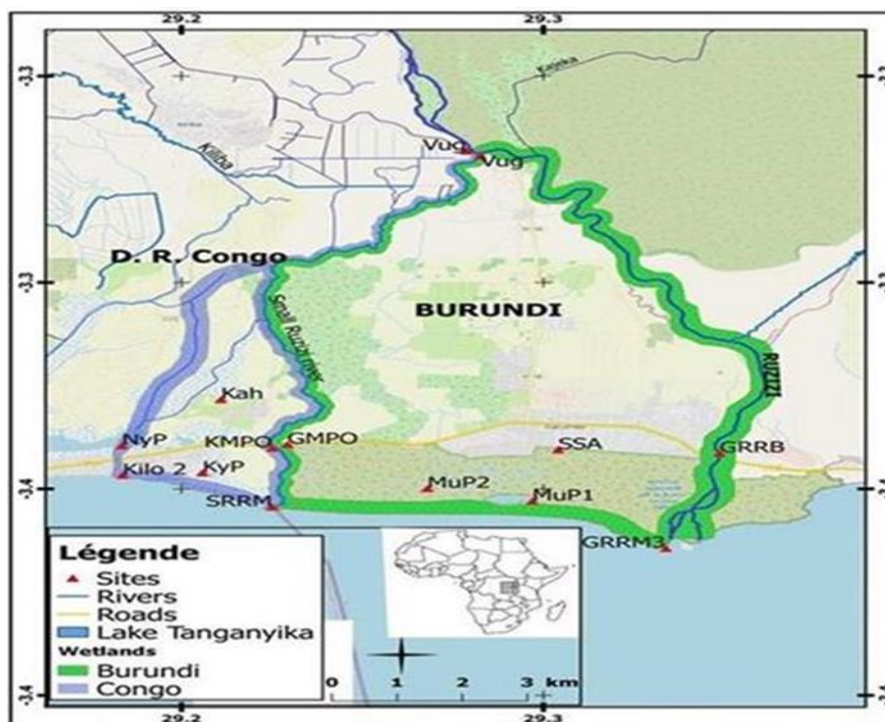


Figure-1. Map of study areas and study sites in the Ruzizi Delta of Burundi and the DRC

Source: Our fieldwork of 2019-2021

Legend: DRC, Democratic Republic of Congo

abundance was calculated as individual percentages per species for five sites of the RCD and the RBD (Brower & Zar, 2022). The density is the total number of individuals expressed per unit area of an area (Brower & Zar, 2022). Five sites were considered in the RCD and the RBD. Each site was visited once a year, three times for three years for a comparison of abundance, density and fluctuation of wetland bird species in the unprotected Ruzizi Congolese Delta and the protected Rusizi Burundian Delta. Binoculars and two telescopes were used to distinguish birds and to record bird species. A meter, a three meters length surveyor and a tape decametre were used to measure length, width, and depth of ponds, rivers, river banks and marshes and to withdraw dimensions of habitats and environmental features improvement and destruction.

A GPS Garmin was used to record geographical coordinates, length of sampling areas and sampling sites (Figure 2). A digital camera was used to capture birds and site features. A vehicle and a medium ship of the Centre for Research in Hydrobiology (CRH) were used for displacements. Bibliography from the CRH-Uvira, University of Burundi and from the Department of Zoology, Entomology and Fisheries Sciences of Makerere University Kampala Uganda were used for data analysis and finally internet and online literature helped us to write up this paper.

The main research question was how these three wetland bird species fit into their environment, the

unprotected Ruzizi Congolese Delta (RCD) and the 85% protected Rusizi Burundian Delta (RBD) for their lasting conservation and management planning.

We investigated abundance, density and distribution (fluctuation) of three lacking data wetland bird species and the bird communities they live with, their feeding and breeding areas, stakeholder's opinions to protect their habitats along rivers, the Lake Tanganyika shore areas, in ponds and marshes surrounding ponds and rivers, as well as in steppe and shrub areas of the protected and unprotected areas in DRC and Burundi. The paper focussed on providing information needed for protected Ruzizi Congolese Delta wetland creation and enforcement bird conservation management both in the Ruzizi Congolese Delta (RCD), the Rusizi Burundian Delta (RBD) and the northern part of Lake Tanganyika already inscribed on the World heritage List of UNESCO (MEEATU, Ramsar, & WWF, Atlas of Burundi's four Ramsar sites: Location and Resources, 2014).

Following documents are published about bird species for the Ruzizi Delta in the Democratic Republic of Congo (DRC) and in the Republic of Burundi. Ornithological importance of DRC and conservation issues in protected and unprotected areas including wetland areas, are published by (Demey & Louette, 2001). The Rusizi Burundian Delta is an Important Bird Areas (Nkezabahizi &



Figure 2 Some research materials for birds study in the Ruzizi Delta

Manirambona, 2011), (Dowset & Dowset-Lemaire, 1993) and (Gaugris, 1979) but since then, its bird checklist needs to be updated. In the book Burundi "Burundi Environmental analysis of countries" (Ndayizeye C., 2017) assesses Burundi's capacity to tackle environmental problems, gives institutional and political recommendations, as well as the roles and responsibilities of local governments in environmental protection.

According to (Nzigidahera, 2006), Burundi was concerned about the development of a strategic plan to adapt to the harmful effects of climate change. Following authors (Ntakimazi, Nzigidahera, Nicayenzi, & West, 2000) inventoried 120 bird species and their terrestrial or aquatic biotopes in the Rusizi Burundian Delta. Authors (Nkezabahizi & Bizimana, 2008) investigated Burundi's Important Bird Areas Status and Trends 2008 listing only two birds, the White-winged Tern (*Chlidonia leucopterus*) and the African Skimmer (*Rynchops flavirostris*) fulfilling the Ramsar Criteria A4i and A1 in the Rusizi Natural Reserve.

The very rich ornithological fauna of Rusizi Burundian National Park and Ramsar site includes 350 sedentary and migratory species and mammals such as hippos (MEEATU, Ramsar, & WWF, 2014).

This paper is unique for abundance, density and distribution (fluctuation) of three lacking data wetland bird species of the Ruzizi Delta both in the Ruzizi Congolese Delta (RCD) in DRC and in the Rusizi Burundian Delta (RBD) in Burundi. It will contribute to the expansion of protected areas in the DRC and to strengthening the management of protected areas in Burundi with a view to combating climate change, epidemics and disasters and preventing the extinction of certain species of birds (Chapman A. D., 2009); (Butchart, Stattersfield, & Collar, 2006); (Chapman A. D., 2005); (Deanna, Brunner, Nige, Karr, & Nielsen, 1998).

RESULTS

Pictures from the fieldwork

The paper is dealing with abundance, density and distribution (fluctuation) of three lacking data wetland bird species (Figure 3): the Cattle Egret, *Bubulcus ibis* (Fig. 3 A), the Black Crake, *Amaurornis*

flavirostris (Fig. 1 B) and the African Jacana, *Actophilornis africanus* (Fig. 1 C).

Density and fluctuations of Wetland bird species in the Ruzizi Delta:

Cattle Egret's densities per sampling area and sampling site:

Figure 4 presents Cattle Egret's densities in the Ruzizi Delta (RD) in the unprotected Ruzizi Congolese Delta (RCD) area and the protected Rusizi Burundian Delta (RBD) area, and per sampling sites. In the RCD, the Cattle Egret's densities were: 7 Cattle Egrets/ km² in the site of Kyamvubu (Kya); 6 cattle Egrets/ km² in the site of the Small Ruzizi River Mouth (SRRM); 23 Cattle Egrets /km² in the site of Kavimvira Border Office Ponds (KBOP); 8 Cattle Egrets/ km² in the site of Kahorohoro (Kah); and 9 Cattle Egrets in the site of Vugizo (Vug 1). In the whole RCD area, the mean density was 2 Cattle Egrets/ km². In the RBD area, the densities were: 32 Cattle Egrets/ km² in the site of the Great Rusizi River Mouth (GRRM); 11 Cattle Egrets/ km² in the site of Vugizo (Vug 2); 14 Cattle Egrets/ km² in the site of Steppe and Shrub Area (SSA); 28 Cattle Egrets/ km² in the site of Mukartutsi Ponds (MuP); and 12 Cattle Egrets/ km² in the site of Gatumba Migration Post Offices (GMPO). In the whole RBD area, the mean density is 6 Cattle Egrets/ km².

The densities of Cattle Egrets were highly significant in the protected RBD compared to the unprotected RCD ($\chi^2= 39.263$; DF= 6; $p < 0.001$).

Cattle Egret's fluctuations per sampling period in the Ruzizi Delta

Figure 5 presents the fluctuations of Cattle Egret per sampling periods in 2019-2021. In the unprotected RCD (Ruzizi Congolese Delta), Cattle Egret fluctuations peaked in May with an average of 32 records. The minimum occurred in July, the least rainy month of the year in the Ruzizi Delta with an average of 12 Cattle Egrets recorded. In the RBD (Rusizi Burundian Delta), Cattle Egret fluctuations peaked as well in May, with an average of 50 records and the minimum occurred in July with an average of 28 records.

There is a significant difference of Cattle Egret's fluctuations between protected RBD and the unprotected RCD ($T= 42.65$; DF=20; $p > 0.001$)¹.

¹ T, Student t-test



A Cattle Egret *Bubulcus ibis* (Linnaeus, 1758) «Héron garde boeufs» *africanus* from Kahorohoro flood village **Source:** Our fieldwork of June 2019

B Black Crake *Actophilornis africanus* «Râle a bec jaune» from Kyamvubu pond **Source:** Our fieldwork of June 2020

C African Jacana *Actophilornis africanus* «Jacana à poitrine» from Kyamvubu pond **Source:** Our fieldwork of June 2020

Figure-3. Three wetland bird species of the Ruzizi Congolese Delta

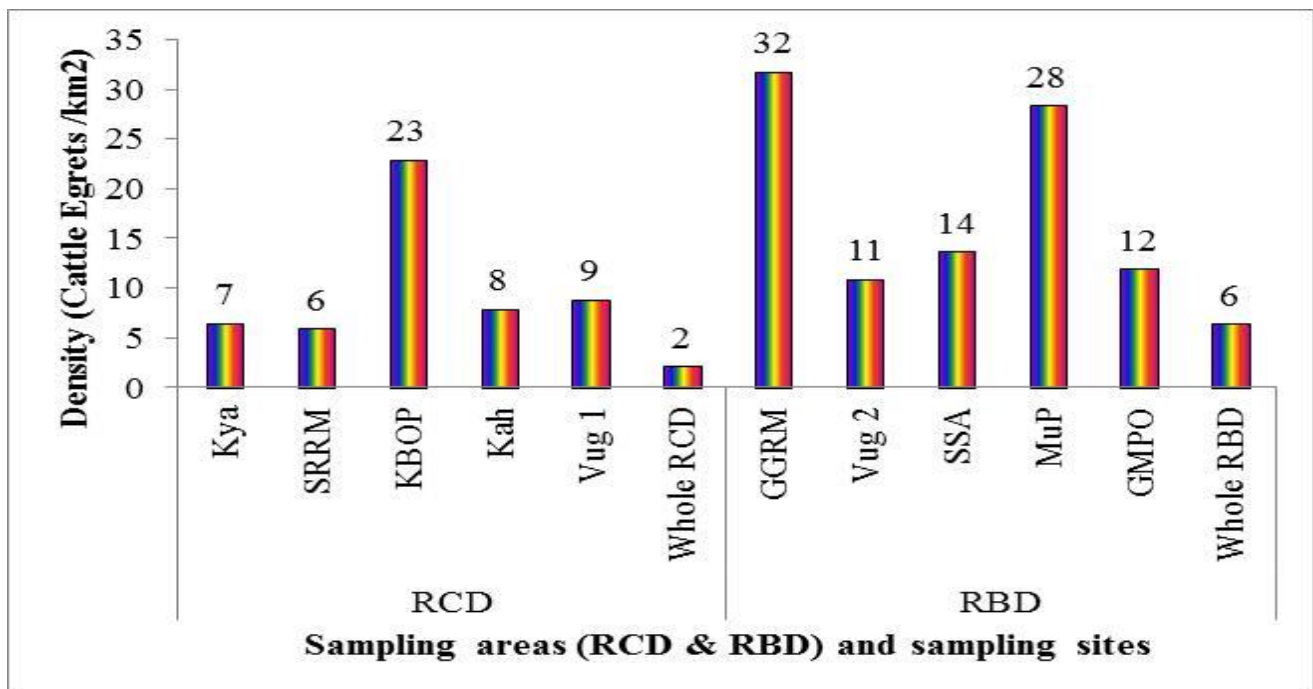


Figure 4 Cattle Egret’s densities per sampling area (RCD & RBD) and sampling site

Legend RCD: Ruzizi Congolese Delta in DRC; **RBD:** Rusizi Burundian Delta; **Kya:** Kyamvubu Pond Site; **SRRM:** Small Ruzizi River Mouth; **KBOP:** Kavimvira Border Office Ponds Site; **Kah:** Kahorohoro flooding Village Site; **Vug:** Vugizo Site; **GRRM:** Great Rusizi River Mouth; **Vug 2:** Vugizo site in the RBD; **SSA:** Site of Steppe and Shrub Areas; **MuP:** Site of Mukartutsi Ponds; **GMPO:** Gatumba Migration Post Offices.

Source: Our fieldwork 2019-2021

Densities of Black Crake per sampling areas and per sampling sites

Figure 6 presents the densities of Black Crake per sampling areas including the unprotected RCD (Ruzizi Congolese Delta) and the protected RBD

(Rusizi Burundian Delta) and per sampling sites. In the RCD, the densities were: 5 Black Crakes/ km² in the site of Kyamvubu (Kya); 5 Black Crakes/ km² in the site of the Small Ruzizi River Mouth (SRRM); 11 Black Crakes/ km² in the site of Kavimvira Border

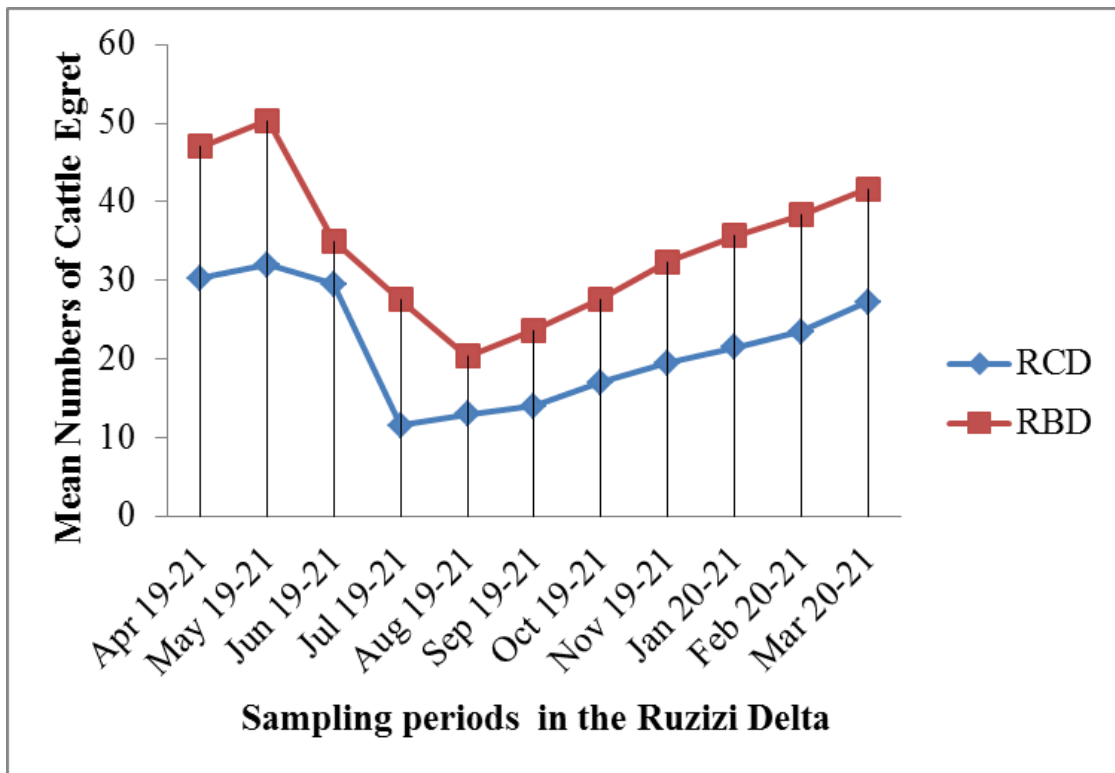


Figure 5 Cattle Egret’s fluctuations per sampling period in the Ruzizi Delta
RCD: Ruzizi Congolese Delta, in DRC; **RBD:** Rusizi Burundian Delta, in Burundi
Source: Our field work 2019-2021

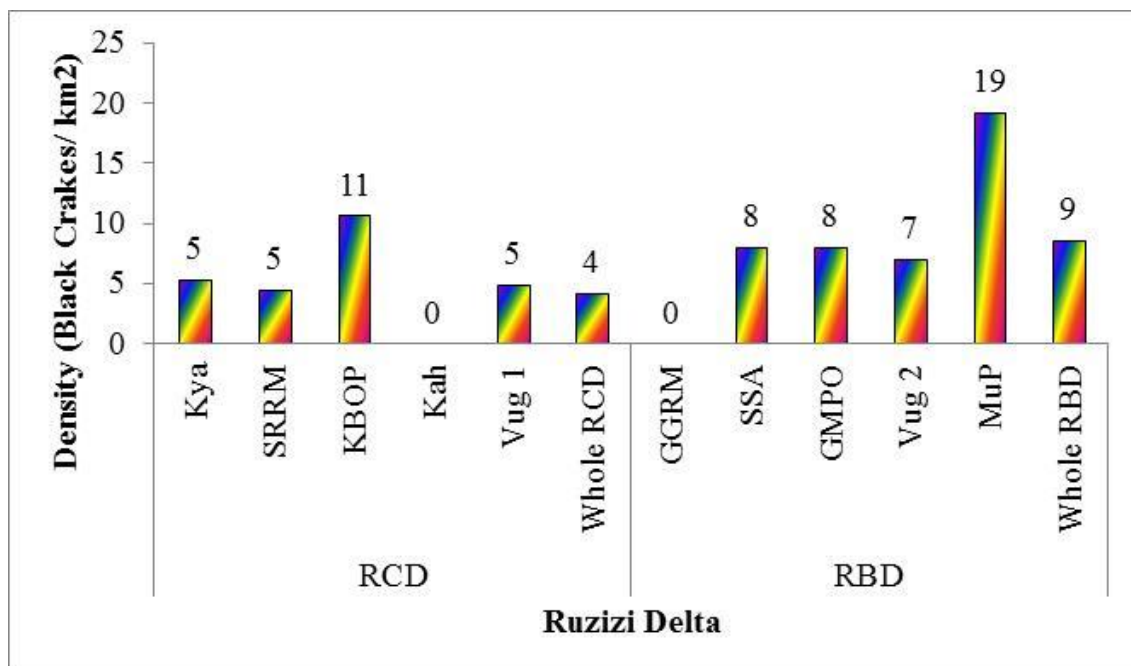


Figure 6 The densities of Black Crake per sampling area and sampling site
Legend RCD: Ruzizi Congolese Delta in DRC; **RBD:** Rusizi Burundian Delta; **Kya:** Kyamvubu Pond Site; **KBOP:** Kavimvira Border Office Ponds Site; **Kah:** Kahorohoro flooding Village Site; **Vug:** Vugizo Site; **GRRM:** Site of the Great Rusizi River Mouth; **SSA:** Site of Steppe and Shrub Areas; **MuP:** Site of Mukartutsi Ponds.
Source: Our fieldwork 2019-2021.

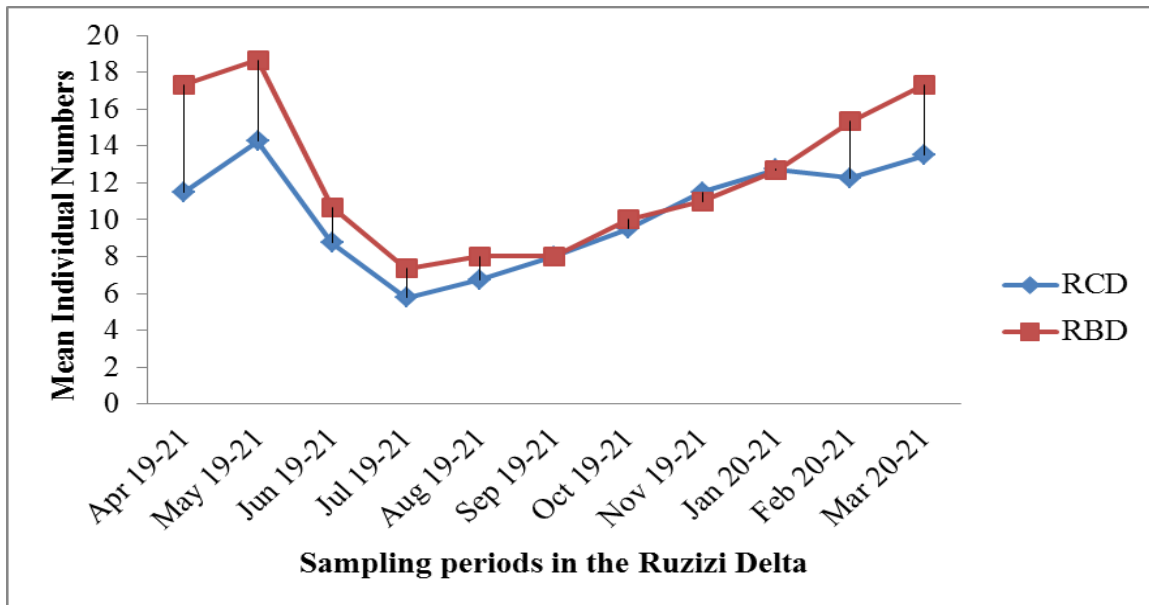


Figure 7 Black Crake occurrence per sampling period in the Ruzizi Delta
 RCD: Ruzizi Congolese delta, in DRC; RBD: Rusizi Burundian Delta, in Burundi
 Source: Our field work 2019-2021

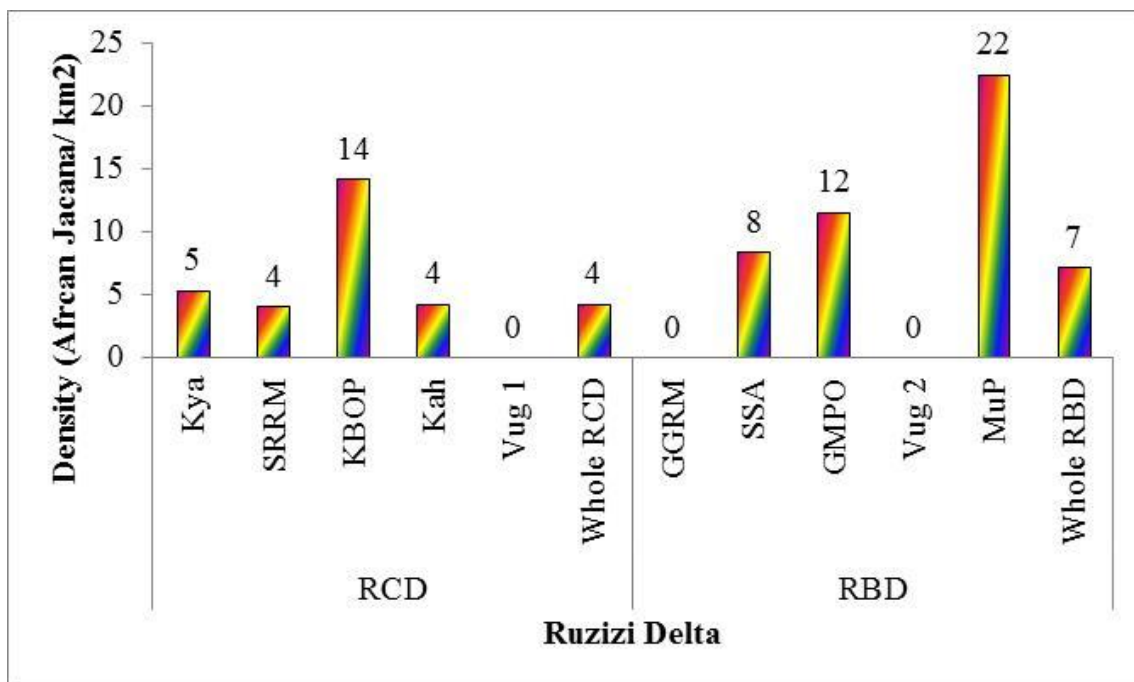


Figure 8 The densities of African Jacana per sampling area and sampling site
Legend RCD: Ruzizi Congolese Delta in DRC; RBD: Rusizi Burundian Delta; Kya: Kyamvubu Pond; SRRM: Small Ruzizi River Mouth; KBOP: Kavimvira Border Office Ponds Site; Kah: Kahorohoro flooding Village; Vug 1: Vugizo Site; GRRM: Great Rusizi River Mouth; GMPO: Gatumba Migration Post Offices; Vug 2: Vugizo site; SSA: Steppe and Shrub Areas; MuP: Mukartutsi Ponds.
 Source: Our fieldwork 2019-2021

Office Ponds (KBOP); zero Black Crake/ km² in the site of Kahorohoro (Kah); and 5 Black Crakes /km² in the site of Vugizo (Vug). In the whole RCD the density is 4 Black Crakes/ km².

In the RBD the densities were: Zero Black Crake in the site of Great Rusizi River Mouth (GRRM); 8 Black Crakes/ km² in the site of Steppe and Shrub Area (SSA); 8 Black Crakes/ km² in the site of Gatumba Migration Post Offices (GMPO); 7 Black

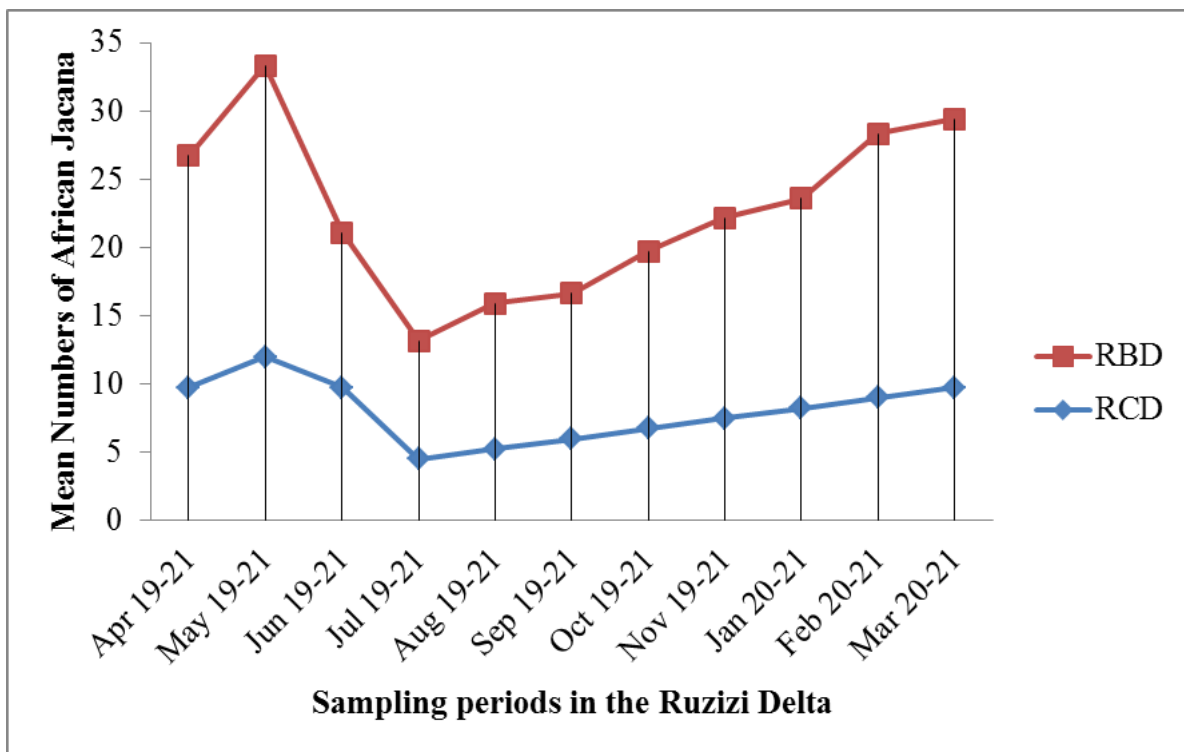


Figure 9 African Jacana fluctuations per sampling periods in the Ruzizi Delta
RCD: Ruzizi Congolese Delta, in DRC; **RBD:** Rusizi Burundian Delta, in Burundi
Source: Our fieldwork 2019-2021

Crakes in the site of Vugizo (Vug 2); and 19 Black Crakes/ km² in the site of Mukartutsi Ponds (MuP). In the whole RBD, the density is 9 Black Crakes/ km². The densities of Black Crake is highly significant in the protected Rusizi Burundian Delta compared to the unprotected Ruzizi Congolese Delta ($\chi^2=127.0045$; DF=7; $p<0.001$).

The fluctuations of Black Crake per sampling period

Figure 7 presents the fluctuations of Black Crake per sampling periods in the Ruzizi Delta during the 2019-2021 periods. In the Ruzizi Congolese Delta (RCD), the fluctuations peaked in May with an average of 14 Black Crakes recorded. The minimum fluctuations of six Black Crakes occurred in July, the least rainy month of the year.

In the Rusizi Burundian Delta (RBD), the Black Crake fluctuations peaked as well in May with an average of 19 birds, and the minimum fluctuations occurred in July with an average of seven records. The difference of Black Crakes fluctuations was not significant between the RBD and the RCD ($T_{cal}=0.126079$; DF=20; $p>0.001$)². That is because the

Black Crake is specialist of marshes which are permanent all-around ponds.

Densities of African Jacana per sampling areas and sampling sites

Figure 8 presents the densities of African Jacana per sampling areas of the unprotected RCD (Ruzizi Congolese Delta), and the protected RBD (Rusizi Burundian Delta), and per sampling sites. In the unprotected RCD, the densities were: 5 African Jacanas/ km² in the site of Kyamvubu (Kya); 4 African Jacanas/ km² in the site of the Small Ruzizi River Mouth; 14 African Jacanas/ km² in the site of Kavimvira Border Office Ponds (KBOP); 4 African Jacanas/ km² in the site of Kahorohoro (Kah); and zero African Jacanas/ km² in the site of Vugizo (Vug 1). In the whole RCD the density is 4 African Jacanas/ km². In the RBD the densities were: Zero African Jacana/ km² in the site of Great Rusizi River Mouth (GRRM); 8 African Jacanas/ km² in the site of Steppe and Shrub Area (SSA); 12 African Jacanas/ km² in the site of Gatumba Migration Post Offices (GMPO); Zero African Jacana/ km² in the site Vugizo (Vug 2); and 22 African Jacanas/ km² in the site of Mukartutsi Ponds (MuP). In the whole RBD, the

² T, Student t-test

density is 7 African Jacanas/ km². The densities of African Jacana were highly significant in the protected Rusizi Burundian Delta compared to the unprotected Ruzizi Congolese Delta ($\chi^2= 232.064$; DF=7; $p < 0.001$).

African Jacana's fluctuations per sampling period

Figure 9 presents African Jacana's fluctuations per sampling periods in in the Ruzizi Delta during the 2019-2021 periods. In the unprotected Ruzizi Congolese Delta (RCD), the fluctuations peaked in May with an average of 12 African Jacanas recorded. The minimum fluctuations occurred in July, the least rainy month of the year with an average of 5 African Jacanas recorded. In the Rusizi Burundian Delta (RBD), the African Jacana's fluctuations peaked as well in May with an average of 19 records. The minimum fluctuations occurred in July with an average of 9 African Jacanas recorded.

There is a highly significant difference of African Jacana's fluctuations between the protected RBD and the unprotected RCD ($T= 44.520$; DF= 20; $p < 0.001$)³.

DISCUSSION

Three lacking data wetland bird species:

Three wetland bird species with a data deficit in the Ruzizi Delta in the Democratic Republic of Congo (DRC) and the Republic of Burundi were targeted by this publication with a view to drawing the attention of decision-makers in the DRC to the creation of a protected area in the Ruzizi Congolese Delta wetlands as stipulated in the environmental protection laws of our constitution in the DRC (CPR, 2011)⁴.

Once created, the protected area of the Ruzizi Congolese Delta wetlands will strengthen the productivity capacities of farmers, breeders, fishermen and traffickers of agricultural fish and dairy products of the populations bordering the wetlands of the Ruzizi Congolese Delta. It will also strengthen the conservation efforts of the neighbouring Rusizi Burundian Delta National Park and Ramsar Site by ensuring the safety of Burundian birds, mammals and reptiles roaming the Ruzizi Congolese Delta (Bashonga, Sande, Ntakimazi, & Kahindo, 2023); (MEEATU, Ramsar, & WWF, Atlas of Burundi's four Ramsar sites: Location and Resources, 2014); (Demey & Louette, 2001);

(Ntakimazi, Nzigidahera, Nicayenzi, & West, 2000). It will then strengthen efforts to conserve the biodiversity of the northern part of Lake Tanganyika, already included on the UNESCO heritage list. The protected area of the Ruzizi Congolese Delta wetlands will finally contribute to the fight against global warming, epidemics and natural disasters like those of April 16 to 17, 2020 which caused the death of men and loss of homes and goods in the towns of Uvira (DRC) and Bujumbura in Burundi. We discuss the results on the abundance, density and distribution of the three lacking data wetland bird species of the Ruzizi delta in Burundi and the Democratic Republic of Congo.

Cattle Egret, *Bubulcus ibis* (Ardeidae)

Hérons and egrets are an important component of wetlands made up of marshes, shallow lakes, lagoons and temporary ponds (Stevenson, Skinner, & Smart, 1988); (Samraoui & Bélair, 1997) and they may act as biological markers of their habitats (Erwin & Custer, 2000). Unlike the two other wetland birds Black Crake and African Jacana, Cattle Egret was recorded in all the studied sites of Ruzizi Delta, in marshes along rivers, around ponds and along the Lake Tanganyika shore areas, as well as in steppes and shrubs of protected areas and even in unprotected areas of the Ruzizi Congolese Delta. Among set of physical characteristics which influence breeding success, prior to hatching, vandalism and then the anthropogenic influence on the reproductive success of Cattle Egrets breeding close to urban areas (Samraoui, Menai, & Boudjéma, 2007). In less than 10 years, the species was able to colonise lands located five degrees of latitude south of its former northern nesting grounds, thereby extending its distributional range into the hot arid regions of the Sahara Desert (Bachir, Ferrah, Barbraud, Céréghino, & Santoul, 2011).

The Cattle Egret has expanded its breeding range worldwide since the 19th century, although the explosive phase occurred principally between 1950 and 1970 (Parejo, Sánchez-Guzmán, & Avilés, 2001). In drylands of north-east Algeria the Cattle Egret colony, which was founded in 2003, increased from 124 pairs in 2007 to 250 pairs in 2011 and the number of trees used for nesting increased from 16 trees in 2007 to 40 in 2011 (Sbiki, Chenchouni, & Bachir, 2015). This is probably why in the unprotected Ruzizi

³ T, Student t-test

⁴ CPR, Cabinet du Président de la République

Congolese Delta the densities of Cattle Egret are significantly lower compared to the protected Rusizi Burundian Delta, because of the total absence of Cattle Egret nesting trees in the Ruzizi Congolese Delta (Sbiki, Chenchouni, & Bachir, 2015). Nesting areas of Cattle Egrets in the Ruzizi Congolese Delta are impenetrable marshes inside ponds and rivers made of reeds dominated by *Phragmites australis* and *Pennisetum purpureum* overexploited by local people for domestic usages (Parejo, Sánchez-Guzmán, & Avilés, 2001).

The global expansion of the Cattle Egret mainly resulted from extrinsic factors changing environmental conditions, e.g. establishment of new agricultural fields, an increase of irrigated areas and creation of landfills that provided new food resources (Bachir, Ferrah, Barbraud, Céréghino, & Santoul, 2011). However, factors intrinsic to the species also played a role, mainly its ability to survive under changing environmental conditions and to adapt its behaviour to cope with new environmental conditions and efficiently to exploit new habitats (Bachir, Barbraud, Céréghino, & Santoul, 2012); (Kushlan & Hafner, Heron conservation, 2000); (Nunes, Filho, Roos, & Mestre, 2010); (Arendt, 1988). Cattle Egret is the species that adapt well its behaviour in all the studied sites of the Ruzizi Delta compared to Black Crake and African Jacana.

Black Crake, *Amaurornis flavirostris* (Rallidae)

The family Rallidae, containing over 150 living or recently extinct species and having one of the widest distributions of any family of terrestrial vertebrates, has, in proportion to its size and interest, received less study than perhaps any other major group of birds (Olson, 1973). Widespread residents inhabiting freshwater wetlands over sub-Saharan Africa, the Black Crake, (*Amaurornis flavirostris*) Rallidae, is found throughout most of the continent, from the northern edge of the Sahel to the Cape Province, and from sea-level to 3000 m (Urban, Fry, & Keith, 1986).

Birds of wetland vegetation (reeds mixed with papyrus), Black Crakes pick their way gingerly, with continual low clucks, and occasionally a curious froglike note. Black Crake are widespread residents inhabiting freshwater wetlands over Sub-Saharan Africa (Bosque, 2009). The nest is a deep, neat bowl made from wetland plants and built by both sexes in marsh vegetation or on the ground in a dry location;

it is also sometimes constructed up to 3 m (9.8 ft) high in a bush (Steyn, 1980). It lays down two to six, usually three, cream or white and spotted with brown or chestnut eggs (Steyn, 1980). The sexes are similar, but the male is slightly larger (Steyn, 1980). Both parents, sometimes assisted by the young from previous broods, incubate for 13–19 days to hatching (Steyn, 1980). The habitat of this common to abundant species is freshwater marshes of all types, as long as there is some vegetation to provide cover (Crick, Dudley, Glue, & Thomson, UK birds are laying eggs earlier, 1997). They are diurnal omnivores, foraging by picking food items from the surface of water or aquatic vegetation, or probing into dead vegetation and mud (Crick, Dudley, Glue, & Thomson, UK birds are laying eggs earlier, 1997).

They consume a variety of animal foods including insects, snails, crustaceans, earthworms, small fish, frogs, bird eggs and nestlings, and carrion, as well as seeds and other parts of aquatic plants (Urban, Fry, & Keith, 1986); (Taylor, 1996) (Hockey, Dean, & Ryan, 2005). They sometimes consume blood and remove parasites from bleeding hippopotamuses and warthogs (Bosque, 2009). Feeding on flowing blood could have resulted from consumption of blood-engorged parasites (Bosque, 2009).

Among African land-birds, Yellow-billed Oxpecker *Buphagus africanus* and Red-billed Oxpecker are well known for their preference for feeding on blood and tissue from wounds and ears, as well as picking ticks and other ectoparasites from cattle and wild African mammals (Bezuidenhout & Stutterheim, 1980); (Weeks, 1999). Black Crake, in contrast, might be opportunistic blood feeders, sipping blood when opportunities arise (Bosque, 2009). We found that the densities of Black Crake were significantly higher in the protected Rusizi Burundian Delta compared to the unprotected Ruzizi Congolese Delta due to wetlands overexploitation and deterioration in DRC.

African Jacana, *Actophilornis africanus* (Jacanidae)

Jacanas are worldwide inhabitants of tropical and subtropical open wetlands and eight extant species in six genera are recognized in the family Jacanidae (Whittingham, Sheldon, & Emlen, 2000).

Four genera are monotypic and occur on three continents: *Microparra* Africa, *Irediparra* (Australia),

Hydrophasianus (Asia), and *Metopidius* (Asia) (Whittingham, Sheldon, & Emlen, 2000). Two other genera consist of two species: *Actophilornis africanus* (Africa) and *A. albinucha* (Madagascar), and *Jacana jacana* (South America) and *J. spinosa* (Central America) (Kitto & Wilson, 1966). The two *Jacana* species co-occur and hybridize only in a small area of western Panama, Central America (Kitto & Wilson, 1966). It is now clear that Jacanas are members of the Charadriiformes and probably are most closely related to painted-snipes, family Rostratulidae (Kitto & Wilson, 1966); (Sibley & Ahlquist, 1990) and (Strauch, 1978).

African jacanas (*Actophilornis africanus*) are waders in the family Jacanidae, identifiable by long toes and long claws that enable them to walk on floating vegetation in shallow lakes, their preferred habitat (Houde, 1994). They have chestnut upperparts with black wingtips, rear neck, and eyestripe (Lanyon & Hall, 1994). The underparts are also chestnut in the adults; only in juveniles they are white with a chestnut belly patch (Houde, Sheldon, & Krettman, 1995). The blue bill extends up as a coot-like head shield, and the legs and long toes are grey (Sheldon, Mccrackne, & Stuebing, 1995); (Slikas, 1997). African jacanas feed on insects and other invertebrates picked from the floating vegetation or the surface of the water (Jenni & Kirwan, 2020).

African jacanas breed throughout Sub-Saharan Africa where they are sedentary apart from seasonal dispersion and they lay four black-marked brown eggs in a floating nest (Jenni & Kirwan, 2020). The jacana has evolved a highly unusually polyandrous mating system, meaning that one female mates with multiple males and the male alone cares for the chicks (Houde, 1994). Such a system has evolved due to a combination of two factors: firstly, the lakes that the jacana lives on are so resource-rich that the relative energy expended by the female in producing each egg is effectively negligible (Jenni & Kirwan, 2020). Secondly the jacana, as a bird, lays eggs and eggs can be equally well incubated and cared for by a parent bird of either sex (Jenni & Kirwan, 2020). This means that the rate-limiting factor of the jacana's breeding is the rate at which the males can raise and care for the chicks (Jenni & Kirwan, 2020).

Such a system of females forming harems of males is in direct contrast to the more usual system of leks seen in animals such as stags and grouse, where the males compete and display in order to

gain harems of females (Sheldon, Mccrackne, & Stuebing, 1995). The parent that forms part of the harem is almost always the one that ends up caring for the offspring; in this case, each male jacana incubates and rears a nest of chicks (Jenni & Kirwan, 2020). The male African jacana has therefore evolved some remarkable adaptations for parental care, such as the ability to pick up and carry chicks underneath its wings (Jenni & Kirwan, 2020). A distinctive chestnut, white, and black waterbird has a sky-blue bill and enormous feet. The immature lacks the blue bill, shield and is brown-headed (Sheldon, Mccrackne, & Stuebing, 1995).

Resident and nomadic, this species trots on the surface of water lilies and other aquatic vegetation, using its long legs and ludicrously elongated toes to prevent it from sinking. It flies weakly, low over the water, with legs and toes (Jenni & Kirwan, 2020). The densities of African Jacana were higher in the protected Rusizi Burundian Delta compared to the unprotected Ruzizi Congolese Delta but the differences were not significant due probably to similar kinds of threats, habitats loss (Wang, Kuang, Tan, & Zhijun, 2018). Jacanas were not recorded in the Vugizo site of Ruzizi Congolese Delta and they were not found in the site of Great Rusizi River Mouth, due to the speed movement of Ruzizi River water in those areas. As well, the Black Crake was not recorded in the site of Kahorohoro in DRC and in the site of Great Ruzizi River Mouth in Burundi, probably due to absence of quiet and permanent marshes.

Previous studies

Further bird studies are needed in both the Ruzizi Congolese Delta and the Rusizi Burundian Delta in terms of resident bird species, migrant bird species, wetland bird species and waterbird species. Well conducted mist nettings are as well needed for small resident bird species in the Rusizi Burundian Delta. Bird studies in the Ruzizi Congolese Delta begun in 2001, with the support of John Bates from the Chicago RMNH (Field Museum of Natural History) USA, and then continued with the trip I did at the Royal Museum of Central African of Tervuren Belgium from October 5th to December 5th 2008 in the ornithological Laboratory led by Professor Louette Michel.

Then followed my Master's fieldwork from 2010 to 2011 and finally my doctoral research of which fieldwork were conducted from 2019 to 2021. The

vision of the doctoral research was the whole Ruzizi Congolese Plain, almost 67 kilometres length, but by luck of scholarship I focussed on the Ruzizi Delta in the Democratic Republic of Congo and Burundi. Bird migration studies are needed both in the Ruzizi Congolese Delta and the Rusizi Burundian Delta. Meanwhile, birds of the Lake Tanganyika Shore Areas in the Democratic Republic of Congo almost 677 kilometres have not yet been investigated. There may be new bird species there, and non-investigated migrant, wetland and water bird species.

Acknowledgment

I acknowledge the supervisors of my doctoral thesis, Professors Eric Sande Corresponding author of this paper from Makerere University Kampala Uganda and Gaspard Ntakimazi from the University of Burundi, and the members of my thesis Committee including Professors Majaliwa Mwanjololo, from the Makerere University Kampala Uganda, Charles Kahindo from the State University of Bukavu (UOB) and Claver Sibomana from the University of Burundi, for their useful comments. I acknowledge John Bates (PhD), Curator of the FMNH Chicago USA who trained me in bird and biodiversity inventory techniques, in the Albertine Rift, and Professor Louette Michel who trained me in birds of Ruzizi Plain taxonomy in his ornithological Laboratory of the Royal Museum of Central Africa in Tervuren Belgium. May they find here my deep gratitude! Professor Nshombo Muderhwa provided needed books for this paper and my doctoral thesis. May he find here our deep gratitude! I then acknowledge Honourable Alfred Maisha Bishobibiri, my son, for funding my doctoral academic fees. Mr. Alexandre Bashonga Heshima, my son as well, contributed to my doctoral publication papers fees. May he find here my sincere gratitude! I finally acknowledge all those who far or near contributed to the success of this paper and the success of my doctoral programme.

Conflicts of Interest

Authors declare that there is no conflict of interests regarding the publication of this paper.

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