

The relative influence of habitat modification on bird assemblage in the university's domain of Notre Dame du Kasai in Kananga, the Democratic Republic of the Congo

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Research Article

Keywords: Birds, specific diversity, University of Notre Dame du Kasai, Democratic Republic of the Congo

Posted Date: June 21st, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1751034/v1>

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Abstract

The study was conducted at the University of Notre Dame du Kasai from 2019 to 2021, combined with observation and photography. The aim was to understand the characteristics of avifauna and the composition and diversity of species in this environment. The results of the study indicate that there are 72 species of birds representing 35 families and 12 orders. The order Passeriformes alone contains 50 or 69.4% of species and 22 or 62.9% of families. The order Accipitriformes has a single-family and four species. The other charges include one to two families with often a single species. Over time, the avian fauna of this university site has undergone many changes in its composition and diversity. The installation of the artificial eucalyptus forest associated with the various consecutive changes in habitats seems to be the main factor that modulates these characteristics. Indeed, most of the reputed forest species were observed from 2019 to 2021, coinciding with this forest's maximum vegetation cover. However, information gathered on the IUCN website reveals that the protection status of all these species comma on the common concern (LC).

1. Introduction

1.1 Objectives of the study

The birds of the Democratic Republic of the Congo (DRC) have been the subject of many studies (Kisasa et al. 2021, Kisasa et al. 2020, Punga and Ifuta 2015, Kisasa and Aloni 2011, Lippens and Wille 1976). The latter results from information collected in a few provinces according to their accessibility. When extrapolated to the whole of this large count enormous, local specificities of habitats have rarely been taken into account, such as forest type, savannah, miombos, climate, accessibility, anthropogenic activities, soil type, and regulations on biodiversity management. Monitoring the evolution of avian stands over time thus becomes a challenging and complex task in these large ecosystems. In addition to the inaccessibility of specific habitats so rich in avifauna, insecurity due to armed groups would be one of the obstacles to the monitoring of bird populations in time and space.

Each of these macro-ecosystems indeed has habitats that modulate the avian stand. Anthropogenic activities, for example, in a habitat can affect the reproductive success and fidelity of a bird to that habitat (Kisasa 2012a, b). Human activities, therefore, bring many changes in nature and the composition of the elements of biodiversity, such as the soil composition for nesting birds⁹ and the availability of food (Campbell 2012, Kisasa 2012c, Jose and Luis 1991). Using birds stands as a biological indicator of the ecological stability of a site by monitoring its rich specific over time has been the subject of several studies (Kisasa 2012a, Kisasa and Aloni 2011).

The human activities at the University of Notre Dame du Kasai (UKA) site and its surroundings induce its initial metamorphosis, whose consequences could impact the local distribution and diversity of the avian fauna that finds refuge there. This study aims to identify the different species according to their habitats in this site with a view to their better monitoring over time.

1.2 Habitat

Located northeast of the city of Kananga, in the province of Kasai Central (5° 53' 32" South, 22° 24' 10" East) and 30 minutes' walk from the Hight College Saint Louis, the UKA is erected on the plateau of kambote hill entirely bordered by streams.

The climate, soil, and vegetation of the UKA are those observed throughout the city of Kananga. This is the tropical savannah climate Aw₃, characterized by a cold, dry season of three months, with a monthly rainfall height of less

than 50mm according to the Koppen classification. The soil is sandy with vegetation consisting of grassy formations interspersed with forest galleries and small groves (Bushabu et al. 2014, Mbimbi 2013, Bushabu et al. 2007, S.G.E.C1999, Mabika 1983).

The province of Kasai Occidental was overflowed while collecting data used to produce the book entitled "The Birds of Zaire." Drowned in this document, the birds of the province and their local specificities are rarely highlighted.

Before the occupation of the site by the university, the vegetation of the savannah type with herbaceous and shrub dominance, dotted with groves, meadows, crops, and palm groves in *Elaeis guineensis*, covered the hill of Kambote and its plateau; the remains of forest galleries although very degraded, still run along the rivers and the heads of streams.

Since the acquisition of the site in 1996, the UKA has deployed two main programs: construction and the gradual reforestation of the area.

The current constructions concern the academic structures whose rectangular-shaped frame covers about 1/2 km² in the active part of the site. This is only about one-tenth of the extent of the university's domain.

Reforestation is done only with a single species of eucalyptus (*Acacia auriculiformes*, Fabaceae). This tree competes with and eliminates native species, especially herbaceous ones; It maintains a bald undergrowth of grasses, totally open, and a soil covered with dead leaves of its species. Over time, the trees of the first eucalyptus plantations around the buildings have reached about ten meters and offer a relatively closed crown (Fig. 1). A few feet of Mango (*Mangifera indica*) and Rauwolfia (*Rauvolfia vomitoria*) are lost in these plantations. The whole gives the occupied part of the site and appearance of a forested islet bathed in an ocean of pale-yellow grass cover.

The artificial forest engulfs the buildings; it creates a unique local habitat that serves as a place of rest, recreation, walking, and study for humans. It is also a place frequented by commensal birds that come to feed and shelter in eucalyptus trees and the roofs of human dwellings.

The inactive part of the site is an open environment dotted with a few oil palms. Nevertheless, it retains its natural plant physiognomy, and no physical limitation distinguishes it from the rest of the plateau. In the rest of the text, we use the term "natural" to refer to this initial feature of vegetation.

In the valleys where the streams flow, the development of fishponds along cliffs would be the preferred habitats for birds nesting in burrows. The artificial forest, the natural environment, and the fishponds form a mosaic of habitats that result in a corresponding avian stand in addition to permanent human activities. Our approach is to identify the avian diversity and the mode of settlement of the habitats of the UKA site, particularly the birds of the artificial forest.

2. Materials And Methods

2.1. Sampling

Data were collected in two periods. The first time between November and December 2019 (rainy season) and the second between July and August 2021 (dry season).

We carried out the observation associated with the photograph of the birds seen while exploring different habitats of the UKA property (Fonderflick 1998). For this purpose, we used the EOS 1200D canon camera mounted with a 6.3 200 mm lens. When walking along the paths and trails of the site to collect data, we adopted the strategy of hunting the cat: mobile and stationary. The movement speed varied from 5 to 8 minutes over 100 meters; parking could take 15 minutes or more depending on habitats, viewing hours, and human presence on site.

Field trips were between 6 a.m. and 10 a.m. and between 3 and 6 p.m. in local time. Indeed, observations on the actogram of the activities of the Malachite Kingfisher (*Alcedo cristata*) and most of the diurnal birds revealed an intense feeding activity of their young at these times chosen for our observations (Kisasa 2012c).

2.2 Identification

The species identification from the images taken was compared with the illustrations in the bird identification guides of the geographical region (Punga 2018, Punga and Ifuta 2015, Mabika 1983 Lippens and Wille 1976). Some confusing pictures were sent to the ornithological service of the Tervuren Museum (Belgium) for identification and closer comparisons with their samples or database. In addition, in the forest, as in the savannah, we also used evidence of presence collected on the ground and commonly used in ornithology, such as feathers and droppings of birds of prey (with bone remains and elytra), granivores (with seeds easy to identify) and nests. The list of birds in the artificial forest at Eucalyptus, grassy savannah, and each species' presence are marked with a cross (X) in Table 1. Since ponds are found outside the Eucalyptus plantation, their species are included in the grassy part.

3. Results

3.1. Composition

We have currently recorded 72 species divided into 35 families and 12 orders. The order Passeriformes alone contains 50 or 69.4% of species and 22 or 62.9% of families. The order Accipitriformes has a single-family and four species. The other charges include one to two families with often a single species. The avian diversity of the university site of Notre Dame du Kasai (UKA) is presented in Table 1.

3.2 Specific wealth

Table 1 indicates that the avian stand at the university site differs according to the habitats. The identified species in the recently created eucalyptus forest are *Aviceda cuculoides*, *Cinnyricinclus leucogaster*, *Emberiza flaviventris*, *Eurystomus glaucous*, *Halcyon leucocephala*, *Ispidina picta*, *Onychognathus Hartlaub*, *Platysteira peltata*, *Terpsiphone rufiventer*, *Terpsiphone rufocinerea*, and *Terpsiphone viridis*. Of all these species, *Platysteira peltata*, *Terpsiphone rufocinerea*, *Emberiza flaviventris*, *Terpsiformes Viridis*, and *Ispidina picta* have been the most regularly encountered and documented as forest species.

At the ponds we observed *Bocagia minuta*, *Eurillas curvirostris*, *Motacilla aguimp*, *Porphyrio alleni* and *Paragallinula angulata*. The other species have been observed in the wild.

In Passeriformes, there are five families better represented in several species. In descending order of the family Cisticolae with six species, the families Estrididae, Muscicapidae, and Ploceidae comprise five species, and the family Nectarinids with four species. The other families contain one to three species each. Figure 2 shows some of the species at the UKA site.

4. Discussion

4.1 Settlement

The avian fauna of the UKA site includes at this stage, a rather remarkable and varied avian population. In our opinion, this characteristic results from three different parameters:

First, the UKA is located outside the city, where human presence remains low and limited in the active part of the site. This fact keeps the initial habitat and its avian stand in their natural balance. The natural habitat does not have a barrier that can prevent the free movement of birds from one place to another; it shelters a fauna adapted to these types of environments. This would explain the preponderance of species of open habitats such as *Citicolina*, *Muscicapidae*, *Estrildidae*, and *Ploceidae*.

The second parameter concerns the structure of the active part. Here, in addition to the corresponding infrastructures of a university city, the artificial forest generated by the plantations offers another vision of the university site. The latter appears as a forest island that engulfs the buildings. This characteristic would attract another category of birds in particular species with intermediate ecology, such as *Aviceda cuculoides*, *Platysteria peltata*, *Terpsichore rufocinerea*, and *Terpsiphone Viridis*, and forest species represented here by *Cinnyricinclus leucogaster*, *Melaenornis pammelaina*, and *Onychognathus Hartlaub*.

Using of the active part is the last parameter. The administrative staff, few in number, limit their activity in and around the offices during the day and abandon the workplace at 3 p.m. local. During class hours, students and teachers are in the auditoriums. The majority of administrative staff and students do not stay on the site. Only visiting teachers and guards remain on the site in tiny numbers. Combined with the site's location, these facts reduce human disturbance and give the UKA domain a permanent relative calm. Indeed, the noise keeps the birds away, thus decreasing their affinity and reproductive success on a site (Kisasa 2012a, b, c, Kisasa and Aloni 2011). These are birds accustomed to human presence that usually colonize this site. As an indication, corvids, ploceids, nectarinids, monarchical, *Accipitridae*, and other species with variable ecology and behavior fall into this category.

4.2 Influence of habitats

Our results reflected a differential occupation of habitats about the specific richness and confirmed known ecological concepts. It is known, for example, that the animal population adjusts to the characteristics of the environment (Maron et al. 2011); in addition, the specific richness of an ecosystem is based on the variability of its plant physiognomy (Poschold et al. 2005); There is a relationship between the heterogeneity of habitats and the species richness of an ecosystem; the insular character of the environment (Blondel 1979, Blondel 1976) would also affect the population of biological diversity including birds (Zurita and Zuleta 2009, Boulinier et al.1998). These postulates, therefore, justify the results of this study.

In the case of the UKA domain, the natural habitat provides birds with a diversity of feeding, breeding, refuge, and resting places. These conditions satisfy the majority of the species listed in our study. The forest is an attractive environment for birds, and this is due to the diversity of its habitats (Mikko Mönkkönen et al.1997). The monospecific nature of the UKA forest contradicts this observation and provides few resources for its residents. We only saw a crow's nest in this forest. In one place, droppings on the ground were recorded, indicating that an individual spent the night there. The populations of regularly encountered species such as *Terpsiphones*, *Emberiza flaviventris*, and *Ispidina picta* were limited to individuals alone or in pairs but less abundant. These birds fly from one tree to another but come to capture insects, especially on the ground. The unique individual of *Acviceda*

cuculoides roams the treetops in search of its prey; we once raised it to the ground; once again, the bird carried an arthropod on its legs. This individual was only observed for a week before disappearing. Did he emigrate, or was he killed by the young humans who roam the forest to hunt birds? The male of *Cinnyricinclus leucogaster* explores the treetops while the female sometimes descends to the low branches. *Onychognathus Hartlaub* behaves like the male of the previous species; this species has been observed perched on the components of the Oil Palm (*Elaeis guineensis*) and feeding on insects on the trunk of the palm tree and on pond surface insects. *Platysteria peltata* explores the leafy part of the trees in search of insects and will also capture them on the ground. One *Terpsiphone rufoventer* has been observed twice; could she be the newcomer to this forest? The lack of flowering plants explains the scarcity of nectarinids in this habitat. Only *Cinnyris cupreus* has been observed on a few rare feet of *Rauwolfia vomitoria* and *Mangifera indica*. Our results support the finding that pure plantations are the poorest in bird species (Poschold et al. 2005, Van Elsen 2000) .

The ponds are of recent creation. La majorité d'entre eux étaient encore en chantier lors de notre passage de 2021. In addition to species with aquatic habits such as *Porphyrio alleni* and *Paragallinula angulata* rare to observe, other species such as Terpsiformes and *Cinnyricinclus* come to feed on water surface insects. *Montana again* was exclusively photographed at the edges of this habitat hunting insects; this species also frequents human dwellings and lands without fear in the plots of the city. In addition to the species associated with the different habitats, some species exploit the three types of habitats prospected. *Corvus Albus*, *Milvus aegyptius*, *M. migrans*, *Pycnonotis tricolor*, *Streptopelia semitorquata*, and *Turtur afer*.

Corvus Albus is omnivorous (Kisasa et al. 2021, Kisasa et al.2020). In the UKA domain, it frequents the surroundings of the kitchen and the cafeteria. It sometimes ventures into the forest near these places. On three occasions, it was chased in the woods, hounded by the *Terpsiphone Viridis* present in this place.

Both species of Kite flying in the sky are not limited to the UKA domain. They fly over the domain without a marked preference for either habitat. Associated with crows or not, a few individuals stand at the edge of the forest near the kitchen to pick up cook waste of animal nature.

We did not encounter *Streptopelia semitorquata* in the forest. This species is fond of grasslands, fallow land, and crops on the periphery of the active part of the domain. *Turtur afer* has only been observed twice in the forest, and its behavior resembles that of *S. semitorquata*. *Pycnonotis tricolor* exploits the habitats of the UKA domain indifferently. Indeed, reforestation is a good approach for various reasons and preserves the quality of the environment. Nevertheless, we believe that this reforestation should be integrated into a management plan that would consider the presence of pockets of natural habitats for the maintenance of the original avian fauna (Hadjister kotis 2000, Blondel 1976).

Conclusions

There is a rich avian stand in the university's domain of Notre Dame du Kasai in Kananga, consisting mainly of species from open environments such as savannahs. The eucalyptus plantation attracts forest species that are not very diverse.

An abundant and diverse avian fauna on a site is a source of curiosity for the walker, spiritual inspiration, creativity for the scientist, the artist of all kinds, and a suitable bioindicator of the tranquility of this site. Abundance and diversity are only achieved through the diversification of habitats for volatiles. As a result, we recommend that managers of the UKA domain diversify plantations into plant species that can attract more diversity of birds. To

preserve the biological diversity of the site, we recommend that the reforestation process, regardless of the option, incorporate landscape ecology standards.

To allow the avian stand to settle and get used to the familiar passages of humans, "bird hunting" should be prohibited throughout the university site.

Declarations

Acknowledgment

We thank Alain REYGEL of the Royal Museum of Natural Sciences of Belgium, who has always proceeded to the identification of the birds from the photos we sent him. The funding for this study was entirely supported by ourselves. Our gratitude to Jean Paul MUKENDI TSHIKA for his pertinent remarks regarding the form of this manuscript.

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Tables

Table 1 is available in the Supplementary Files section.

Figures

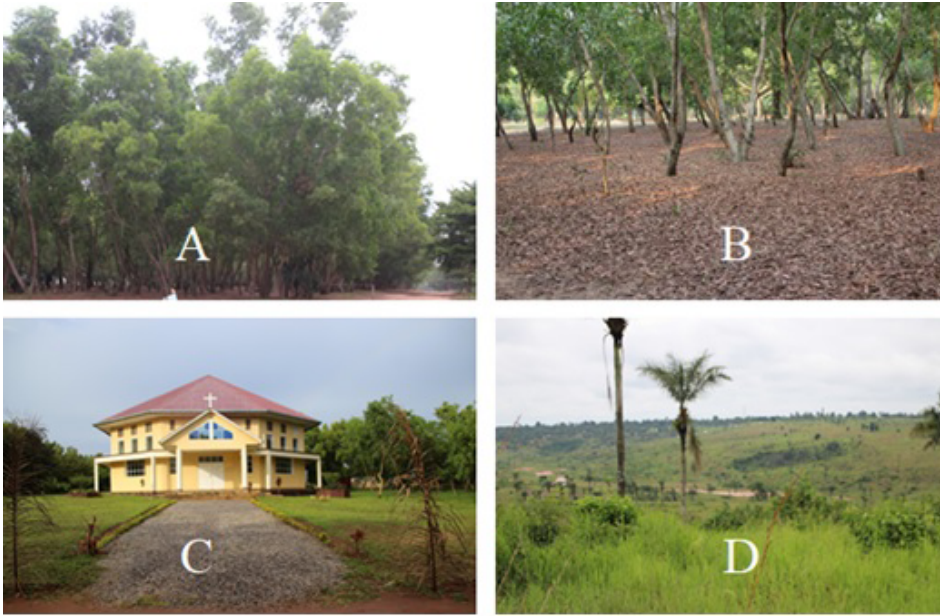


Figure 1

Some habitats of the UKA site. **A:** the eucalyptus forest with its **B:** shaped undergrowth; **C:** the church partially surrounded by the plantations; **D:** one of the views of the surrounding part called "natural."

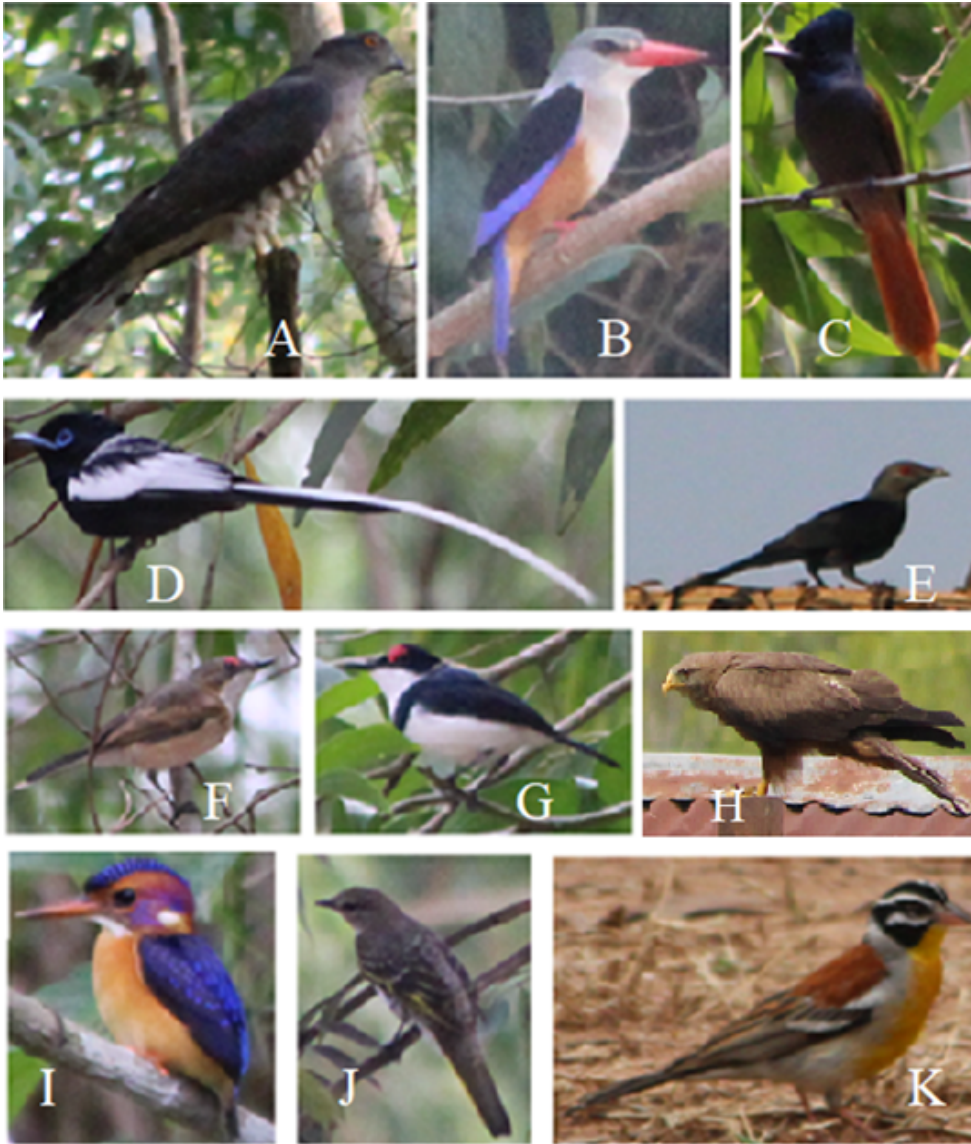


Figure 2

A sample of birds frequenting university's domain of Notre Dame du Kasai : A = *Aviceda cuculoides*; B = *Halcyon leucocephala*; C = *Terpsiphone viridis*; D = *Terpsiphone rufocinerea* E = *Onychognathus hartlaubi*; F = *Platysteira peltata*; G = *Platysteira peltata*; H = *Milvus aegyptius*; I = *Ispidina picta*; J = *Campephaga flava*; K = *Emberiza flaviventris*.

Supplementary Files

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- [Table1BirdsofUKAdomain.xlsx](#)