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# Diversity, Abundance, Richness, and Birds of Conservation Interest in Nyando Sugar Belt, Muhoroni Sub-County, Lake Victoria Basin, Western Kenya

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## Abstract

Thus far, no expedition has comprehensively surveyed the composition of bird species in the dilapidated habitats of Nyando sugar belt, Western Kenya. This has made it difficult unearthing equilibrium between agricultural growth and bird species conservation. In response, we conducted bird assessment by stratifying the expedition area into farmlands and shrub-land. We then sampled birds by the standard point count method and opportunistic counts within a 30 m radius parcel of land. We exhaustively observed 1450 birds of 122 species. The farmland recorded a density of 2.065 ± 1.11 birds per hectare whereas the shrub-land had a density of 1.644 ± 0.70 birds per hectare. Nyando sugar belt was a diverse community with a Shannon diversity index value (H') of 3.225 regardless of the birds being constrained in certain habitats. The magnitude of the disparity in true diversity indicated that the farmland was 4 times more diverse than the shrub-land. The facts promoted by this research validate the incorporation of bird conservation in the farmland and formulation of avian conservation strategies.

## Keywords

Diversity, Abundance, Richness, Birds, Nyando, Conservation, Migration, Forest Dependency, Kenya

## 1. Introduction

In Nyando sugar belt, more land is being converted from natural habitats into sugarcane plantations and human habitats. The remnant indigenous vegetation is unsustainably being overexploited for charcoal, firewood and construction

materials. Despite efforts to improve the management and conservation of this landscape, the problem of natural resource dilapidation and consequential loss of biodiversity continue to persist. Consistent with Serkecioglu (2004) birds are imperative in indicating alteration in the health status of the environment [1]. As per Gregory (2003) they make superb indicators for biodiversity, the environment and the sustainability of human activities [2]. This stresses the need to study their composition after every five years. Worldwide and particularly in Kenya, many studies on different aspects of birds have been undertaken. So far and despite all these efforts, no study has been carried out in Nyando sugar belt on the composition of birds, a gap that this expedition sought to fill.

According to IUCN, 2008, habitat loss is the main threat facing 85% of all the bird species documented in the IUCN Red List. Though human activities have allowed the expansion of a few species, they have caused population decreases or extinction in many other species. Globally, many bird species are declining, with 1227 species listed as threatened by BirdLife International and the IUCN (2009). As stated by Steadman (2006), an excess of 100 species of birds have become extinct in historical times, although the most dramatic human instigated extinctions ensued in the Pacific Ocean as humans populated the islands of Melanesia, Polynesia, and Micronesia during which, an estimated 750 - 1800 species of birds became extinct [3].

Birds reside in a wide range of ecological positions. Some are generalists, while others are highly specialized in their habitat or requirements for foraging. Even within a lone habitat, the niches occupied by various species vary, with some feeding in the forest canopy, others beneath the canopy, and still others on the floor of the forest. Forest birds may be insectivores, frugivorous, and nectarivores. According to Sekercioglu *et al.* (2006), birds of prey specialize in hunting mammals or other birds, while vultures are specialized scavengers [4].

The main objective of this survey was to provide results on different ornithological aspects of birds in Nyando sugar belt. We hypothesized that the diversity, abundance, and richness of birds were insignificant between the study sites. Specifically, we established the diversity, abundance, richness, migration status, and forest dependency and conservation status of birds. The knowledge obtained from this research will advantage the government of Kenya, non-governmental organizations, the local community and conservationists in reaching sound decisions on subjects relating to conservation of birds in Nyando sugar belt.

## 2. Materials and Methods

### 2.1. Study Area

This expedition was conducted in Nyando sugar belt, Latitude of 0˚ and 26' south and Longitude of 34˚52' east and 35˚19' east [5]. This region has two major bird habitats *i.e.* farmlands and shrubland. The highest levels of rainfall occur between March to June and October to mid-December whereas low levels occur in late December, January, and February. The main threat facing birds of this

area is the unsustainable exploitation of natural resources, particularly indigenous vegetation for charcoal, firewood and construction materials. Surprisingly no indigenous forest is left in Nyando sugar belt.

### 2.2. Data Collection Methods

For this bird survey, we preferred the standard point count method and opportunistic counts as the most applicable survey methods since they have proved effective for most researchers all over the world. Bibby *et al.* (1998) suggest fifty point count stations in each study area. In Nyando sugar belt, we randomly picked a total of five two kilometers long of line transects since they would collectively accommodate fifty 30 m radius point count plots, set at standard intervals of 200 m. We used GPS (Global Positioning System) to set and spot the sampling stations. The observers stood at the center of the point count plots and recorded all birds seen or heard for a period of 10 minutes. Bird observations were conducted at 6.30 a.m. to 10.30 a.m. and 3.30 p.m. to 6.30 p.m. on good weather days. The birds were then identified with Zimmerman bird identification key [6]. We consistently organized random walks to exhaustively search for new bird sightings.

## 3. Results

### 3.1. Bird Species Abundance

A total of 1450 individual birds belonging to 122 species from 46 families were documented. In the shrubland the Little Swift (*Apus affinis*), Common Bulbul (*Pycnonotus barbatus*) and Tropical Boubou (*Laniarius aethopicus*) were the most abundant bird species (Figure 1) whilst in the farmland, the Bronze Mannikin

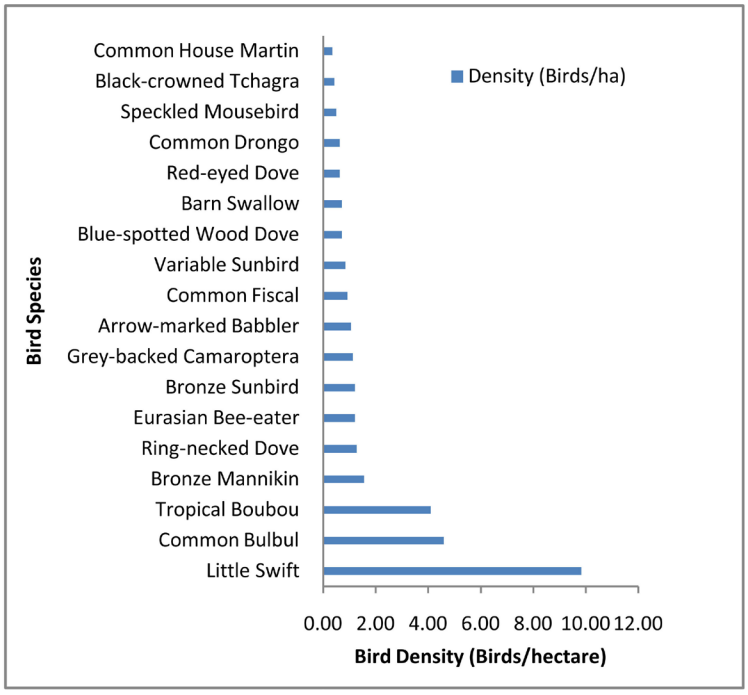


Figure 1. Shrubland bird density.

(*Spermestes cucculatus*), the Little Swift (*Apus affinis*), the Common Bulbul (*Pycnonotus barbatus*) and the Fan-tailed Widowbird (*Euplectes axillaris*) were the most abundant bird species respectively (Figure 2).

Bird species abundance in the farmland had a mean of 2.065 ± 1.11 birds per hectare whereas the shrubland had a mean of 1.644 ± 0.70 birds per hectare.

### 3.2. Bird Species Diversity

Species diversity index was determined by use of Shannon Weiner diversity index (H'). This was purposed to show the number of different categories of bird species in a data set. It also accounted for how the individual bird species were distributed among the other bird species. The statistic that birds species diversity index (H') value was 3.225 suggests that the study area was a diverse habitation in spite of birds being limited to specific habitats. The true diversity (Table 1) indicated that the magnitude of the difference in true diversity (effective number of species) revealed that the farmland was four times more diverse than the shrubland (Figure 3). We provided a checklist of all the bird species in Nyando sugar belt (**Appendix 1**).

### 3.3. Bird Species Richness

The farmlands had 86 species as contrasted to the indigenous shrub with 60 bird species (Table 2 and Figure 4). Shannon equitability index indicated that the

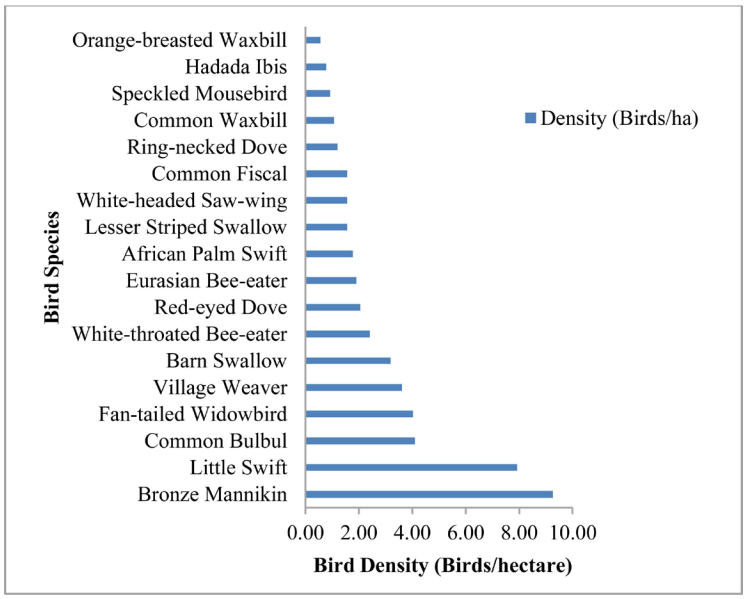


**Figure 2.** Agricultural farmlands bird density (Birds/hectare).

**Table 1.** Effective number of species (True diversity).

| Habitat | Shannon diversity index | Effective number of species |
|---|---|---|
| Farmland | 3.90 | 49 |
| Shrubland | 2.55 | 13 |

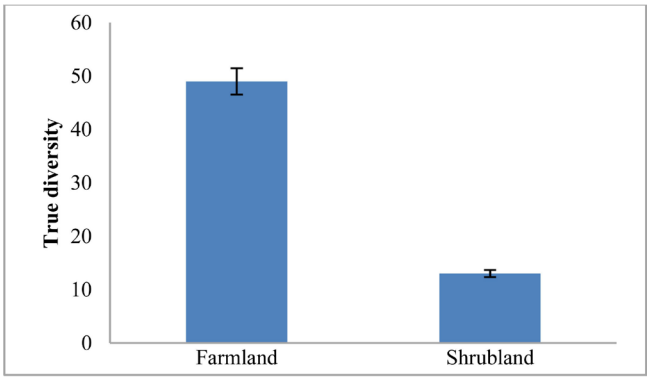


**Figure 3.** True diversity.

**Table 2.** Bird species richness per habitat.

| Habitat | Species Richness (S) | Shannon Equitability ($E_H$) |
|---|---|---|
| Shrubland | 60 | 0.6081 |
| Farmland | 86 | 0.8891 |

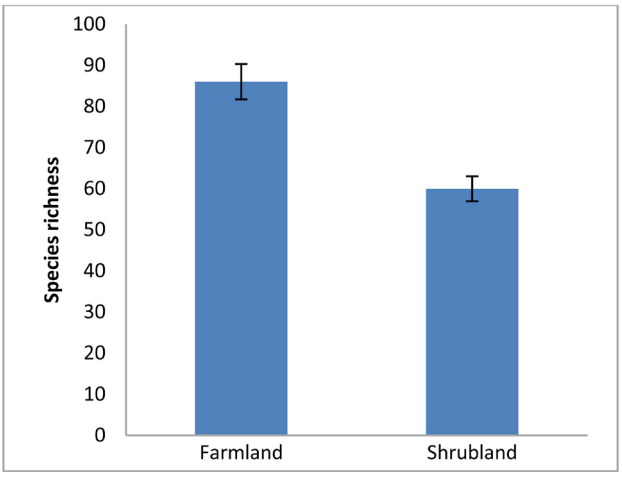


**Figure 4.** Bird species richness.

individual bird species were more evenly distributed in the farmlands than in the shrubland.

Species predictive curve modeled revealed that a complete bird community may not have been captured during the study. However, with more effort, species expected in Nyando sugar belt are at least 180 species (Figure 5). In the farmlands 86 bird species were cumulatively recorded while 60 bird species were observed in the shrubland (Figure 6).

### 3.4. IUCN Red Listed Species in Nyando Sugar Belt

A total of three species considered to be red-listed by IUCN were recorded: The Grey Crowned Crane (*Balearica regulorum*), endangered; the Fischer's Lovebird (*Agapornis fischeri*) near threatened; and the Steppe Eagle (*Aquila nepalensis*), endangered (Table 3).

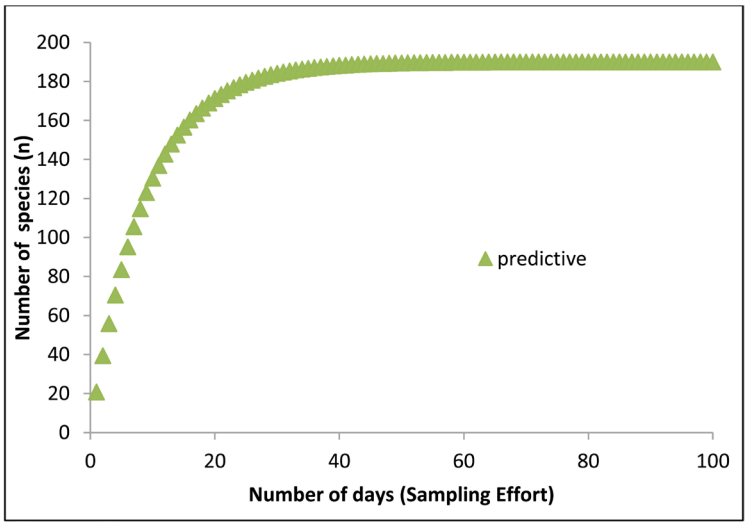


**Figure 5.** Species accumulation and predictive curves.

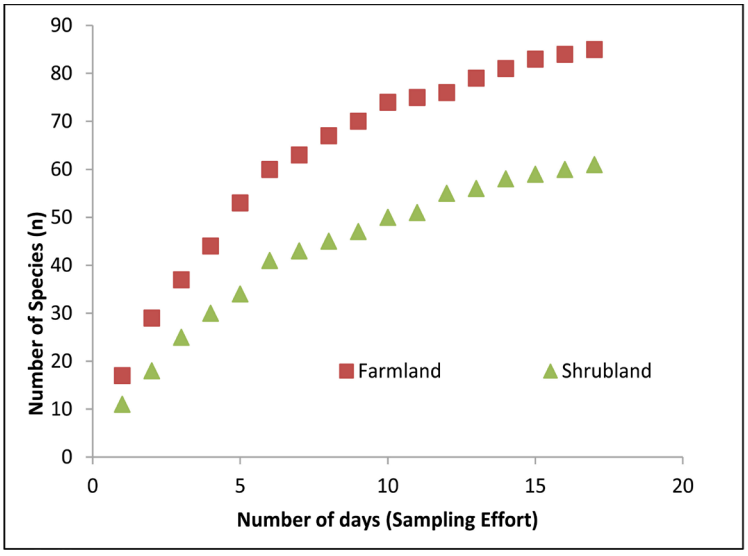


**Figure 6.** Species accumulation curves for the two habitats.

**Table 3.** Species listed in the IUCN red list.

| Common Name | Species Name | IUCN Status | Threat Score |
|---|---|---|---|
| Grey Crowned Crane | *Balearica regulorum* | Endangered | 2 |
| Fischer's Lovebird | *Agapornis fischeri* | Near Threatened | 5 |
| Steppe Eagle | *Aquila nepalensis* | Endangered | 2 |
| | | Total score | 9 |

### 3.5. Forest Dependency in Nyando Sugar Belt

Out of the 122 species of birds documented in Nyando sugar belt, there was no forest specialist (0%). Six birds (5%) were forest generalists (F), 40 birds (33%) forest visitors (f) while 76 birds (62%) were non-forest birds (**Figure 7**) and (**Appendix 2**).

The farmlands had the highest numbers of forest visitors (22), forest generalists (4) and non-forest birds (59) contrariwise; the shrubland had the lowest numbers of forest visitors (20), forest generalists (2) and non-forest birds (39) respectively. Both habitats recorded zero forest specialists (Figure 8).

### 3.6. Bird Migrants in Nyando Sugar Belt

Twenty-one (21) of the 122 species of birds observed in the study area were biome-characteristic species. In the entire landscape, there were 6 Afrotropical migrants (am) comprising of 5%, 12 Palearctic migrants (pm) comprising of 10% and 3 both Afrotropical and Palearctic migrants (am, pm) comprising of 2%. The rest of the birds (101) were residents comprising 83% (Figure 9).

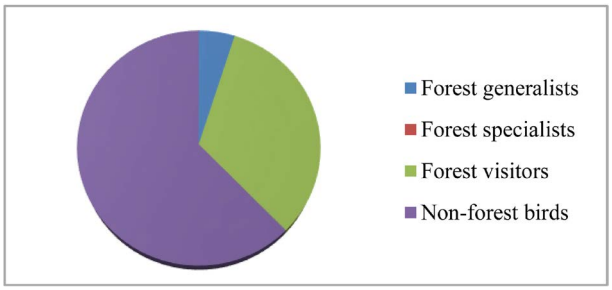


Figure 7. Forest dependency in Nyando sugar belt.

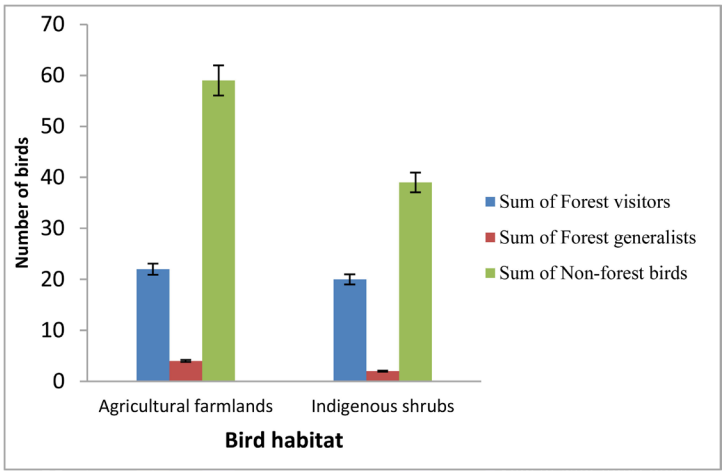


Figure 8. Forest dependency in the two habitats.

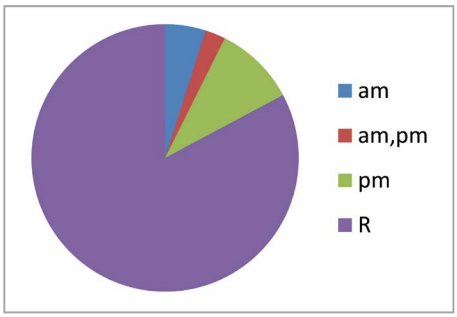


Figure 9. Migration status of birds in Nyando sugar belt.

## 4. Discussions

### 4.1. Bird Composition

Bird abundance expressed in birds per hectare was different between the two habitats and largely high in areas with extensive human agricultural activities and low towards degraded natural habitats. This result agrees with the findings of Chace and Walsh (2006) and [7] who resolved that human-disturbed habitats offer heterogeneous conditions that draw human tolerant species [8]. The higher bird abundance in the farmlands could be attributed to a small number of avian species that can cohabit with human beings such as the Bronze Mannikin (*Spermestes cucullatus*), Common Bulbul (*Pycnonotus barbatus*), House Sparrow (*Passer domesticus*) and the Grey-headed Sparrow (*Passer griseus*) [8]. According to Gloria, 2002 [8], Pennington and Brail (2011) correspondingly found comparable results and deduced that higher bird abundance in the farmlands with settlement was prompted by landscape heterogeneity [9].

The low abundance in the shrubland is in agreement with Doggart (2005), who ascribes this to habitat degradation through human invasive activities like cattle grazing, fuel wood collection, pasture burning and charcoal processing [10]. Gloria, 2002 attributes this observation to the decline in vegetation cover for concealing from predators, shelter, food resources and breeding materials leading to competitive exclusion [8]. Rodriguez attributes this lower abundance in the shrubs to the migrations of bird species in response to particular species requirement such as nesting materials and procreation sites [11].

The highest species diversity in the farmland indicates a complex community in which a high degree of species interaction is possibly contrary to a higher dominance observed in the shrubland. This implies that few bird species pre-dominate the habitats. Though shrubs showed less bird diversity, higher dominance was due to persistence of native and generalist species [9].

Based on the point count method, bird species richness was high in the farmland. This was most likely the case attributable to diversity of vegetation types that supply essential bird resources for their survival. According to Scheiner (2003), species richness is high when bird species are drawn from diverse communities [12]. As stated by Laube (2003), the structure of bird community is most likely modeled by the composition and organization of its ecological niche [13]. The decrease in bird species richness due to human hindrance has been exhibited in bird habitats of the tropical regions [14], and indisputably in the natural shrubs of Nyando sugar belt. Human shrub destruction appears to lessen the vital resources needed by various avian species.

### 4.2. Bird Species of Conservation Interest

During the expedition, we recorded a number of species of birds of international conservation concern. Bennun and Njoroge (1996) noted that some bird species have intrinsic conservation interest for the reason that they are either endangered, threatened, vulnerable, rare, or endemic [15]. In Nyando sugar belt, the

Fischer's Lovebird (*Agapornis fischeri*) was recorded as near threatened, Grey-crowned cranes (*Balearica regulorum*) as vulnerable, Steppe Eagle (*Aquila nepalensis*) as endangered and the Speckled Mousebird (*Colius striatus*) as endemic. This could be due to bird habitat loss which concurs with IUCN (2008) that habitat loss due to the growth of human activities such as urbanization, settlement and agricultural activities is the main threat facing 85% of all bird species described in the IUCN Red List.

Twenty-one (21) of the 122 species observed in Muhoroni Sub-County were biome-characteristic species. There were 12 Palearctic migrants (10%), 6 Afrotropical migrants (5%), 3 both Afrotropical and Palearctic migrants (2%). The presence of these migratory birds in Nyando sugar belt could be attributed to this expedition coinciding with the time (October) migrant species are recorded in Kenya. These results go with the findings by Zimmerman *et al.* (1996) [6]

### 4.3. Forest Dependency

In Muhoroni Sub-County 6 birds (5%) were forest generalists (F), 40 birds (33%) forest visitors (f) while 76 birds (62%) were non-forest birds. As the forest habitat becomes increasingly threatened, the birds they host are attracting enormous attention. According to Bennun (1996), studies on forest birds are worthwhile for at least two whys and wherefores [15]. First of all, the composition and richness of forest birds can signify its overall value for the conservation of biodiversity [16]. Secondly, habitat modification and its impacts and more hardly restoration can be gauged by censoring bird communities [17].

Conservationists need supplementary guidelines as to the worth of particular species of birds in pointing out forest condition. The 0% of 'forest specialists' (FF) is a signal that forests in Nyando have been altered to the magnitude that they cannot sustain forest specialists. As per Bennun and Njoroge (1999), forest generalists (F), occur in undisturbed forest and in forest edges, strips, gaps or in modified and fragmented forests [18]. However, forest generalists persistently continue to rely on forests for some resources [18]. The presence of these species in the Nyando sugar belt is attributed to the live fences composed of woody plants and scattered trees that provide breeding sites. Forest visitors (f species) comprised 33% of all the birds observed. Bennun (1999) defines them as those birds which are often observed in the forest but are not fully dependent upon it [18]. They can certainly survive in habitats where the forest has completely become extinct [15]. The presence of these species in Muhoroni is an indication of forest deterioration.

## 5. Conclusion

There was clear variation in the diversity, abundance, and richness of bird species in the farmland and shrubland in Nyando sugar belt. This authenticates that dilapidation of bird habitations is steering birds to areas inhabited by humans. This relocation could be due to a potential deterioration of avian resources in the

natural shrubs and an upwelling of these resources in the agricultural farms. Any pursuit that changes the original structure of habitat diversity influences the composition of the habitat. In a nutshell, anthropogenic activities that restore the complexity of the habitat incline to draw more bird species as juxtaposed to deteriorated indigenous habitats, and for that reason, surveys concerning the management of avian species within the farmland need to be spotlighted and allotted additional resources. To aid in the conservation of bird species in Nyando sugar belt, further research is necessary to keep an eye on the birds of conservation concern especially the IUCN red-listed species.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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## Additional Materials

### Appendix 1. Nyando Sugar Belt Checklist of Bird Species Observed

| Family | Common Name | Scientific Name | Migration | IUCN Red List Status |
|---|---|---|---|---|
| Accipitridae | African Black-shouldered Kite | *Elanus caeruleus* | R | LC |
| Accipitridae | Black Kite | *Milvus migrans* | am, pm | LC |
| Accipitridae | Common Buzzard | *Buteo buteo* | PM | LC |
| Accipitridae | Palm-nut Vulture | *Gypohierax angolensis* | R | LC |
| Accipitridae | Steppe Eagle | *Aquila nepalensis* | PM | EN |
| Accipitridae | Wahlberg's Eagle | *Aquila wahlbergi* | am | LC |
| Accipitridae | Western Banded Snake Eagle | *Circaetus cinerascens* | R | LC |
| Accipitridae | Western Marsh Harrier | *Circus aeruginosus* | PM | LC |
| Acciptridae | African Harrier Hawk | *Polyboroides typus* | R | LC |
| Turdidae | African Thrush | *Turdus pelios* | R | LC |
| Alaudidae | Fawn-coloured Lark | *Mirafra africanoides* | R | LC |
| Alaudidae | Flappet Lark | *Mirafra rufocinnamomea* | R | LC |
| Motacillidae | African Pied Wagtail | *Motacilla aguimp* | R | LC |
| Alcedinidae | Malachite Kingfisher | *Alcedo cristata* | R | LC |
| Alcedinidae | Woodland Kingfisher | *Halcyon senegalensis* | R | LC |
| Anatidae | White-faced Whistling Duck | *Dendrocygna viduata* | R | LC |
| Apodidae | African Palm Swift | *Cypsiurus parvus* | R | LC |
| Ardeidae | Black-headed Heron | *Ardea melanocephala* | R | LC |
| Ardeidae | Grey Heron | *Ardea cinerea* | am, pm | LC |
| Ardeidae | Little Egret | *Egretta garzetta* | R | LC |
| Ardeidae | Striated Heron | *Butorides striata* | R | LC |
| Campephagidae | Black Cuckooshrike | *Campephaga flava* | am | LC |
| Estrildidae | Bronze Mannikin | *Spermestes cucculatus* | R | LC |
| Ardeidae | Cattle Egret | *Bubulcus ibis* | am | LC |
| Capitonidae | Double-toothed Barbet | *Lybius bidentatus* | R | LC |
| Capitonidae | Spot-flanked Barbet | *Tricholaema lacrymosa* | R | LC |
| Charadriidae | African Wattled Plover | *Vanellus senegallus* | R | LC |
| Charadriidae | Spur-winged Plover | *Vanellus spinosus* | R | LC |
| Ciconiidae | Marabou Stork | *Leptoptilos crumeniferus* | R | LC |
| Sylviidae | Green-backed Eremomela | *Eremomela canescens* | R | LC |
| Cisticolidae | Grey-backed Camaroptera | *Camaroptera brachyura* | R | LC |
| Cisticolidae | Red-faced Cisticola | *Cisticola erythrops* | R | LC |

**Continued**

| | | | | |
|---|---|---|---|---|
| Cisticolidae | Tawny-flanked Prinia | *Prinia subflava* | R | LC |
| Cisticolidae | Winding Cisticola | *Cisticola galactotes* | R | LC |
| Coliidae | Blue-naped Mousebird | *Urocolius macrourus* | R | LC |
| Coliidae | Speckled Mousebird | *Colius striatus* | R | LC |
| Columbidae | African Green Pigeon | *Treron calvus* | R | LC |
| Columbidae | Blue-spotted Wood Dove | *Turtur afer* | R | LC |
| Columbidae | Red-eyed Dove | *Streptopelia semitorquata* | R | LC |
| Columbidae | Ring-necked Dove | *Streptopelia capicola* | R | LC |
| Columbidae | Speckled Pigeon | *Columba guinea* | R | LC |
| Coraciidae | Lilac-breasted Roller | *Coracias caudatus* | am | LC |
| Corvidae | Pied Crow | *Corvus albus* | R | LC |
| Malaconotidae | Black-crowned Tchagra | *Tchagra senegalus* | R | LC |
| Cuculidae | Common Cuckoo | *Cuculus canorus* | PM | LC |
| Cuculidae | Jacobin Cuckoo | *Clamator jacobinus* | am, pm | LC |
| Cuculidae | Klaas's Cuckoo | *Chrysococcyx klaas* | R | LC |
| Cuculidae | White-browed Coucal | *Centropus superciliosus* | R | LC |
| Dicruridae | Common Drongo | *Dicrurus adsimilis* | R | LC |
| Estrildidae | African Firefinch | *Lagonosticta rubricata* | R | LC |
| Estrildidae | Red-billed Firefinch | *Lagonosticta senegala* | R | LC |
| Estrildidae | Red-cheeked Cordon-bleu | *Uraeginthus bengalus* | R | LC |
| Fringillidae | Oriole Finch | *Linurgus olivaceus* | R | LC |
| Fringillidae | Yellow-fronted Canary | *Crithagra mozambica* | R | LC |
| Hirundinidae | Black Saw-wing | *Psalidoprocne pristoptera* | R | LC |
| Hirundinidae | Lesser Striped Swallow | *Cecropis abyssinica* | R | LC |
| Hirundinidae | Mosque Swallow | *Cecropis senegalensis* | R | LC |
| Hirundinidae | Red-rumped Swallow | *Cecropis daurica* | R | LC |
| Hirundinidae | Wire-tailed Swallow | *Hirundo smithii* | R | LC |
| Indicatoridae | Lesser Honeyguide | *Indicator minor* | R | LC |
| Jacanidae | African Jacana | *Actophilornis africanus* | R | LC |
| Laniidae | Common Fiscal | *Lanius collaris* | R | LC |
| Leiothrichidae | Arrow-marked Babbler | *Turdoides jardineii* | R | LC |
| Lybiidae | Yellow-fronted Tinkerbird | *Pogoniulus chrysoconus* | R | LC |
| Macrosphenidae | Moustached Grass Warbler | *Melocichla mentalis* | R | LC |
| Malaconotidae | Black-headed Gonolek | *Laniarius erythrogaster* | R | LC |
| Malaconotidae | Tropical Boubou | *Laniarius aethopicus* | R | LC |
| Nectariniidae | Bronze Sunbird | *Nectarinia kilimensis* | R | LC |
| Meropidae | Eurasian Bee-eater | *Merops apiaster* | pm | LC |

**Continued**

| | | | | |
|---|---|---|---|---|
| Apodidae | Little Swift | *Apus affinis* | R | LC |
| Meropidae | White-throated Bee-eater | *Merops albicollis* | am | LC |
| Motacillidae | Tree Pipit | *Anthus trivialis* | pm | LC |
| Motacillidae | Yellow Wagtail | *Motacilla flava* | pm | LC |
| Motacillidae | Yellow-throated Longclaw | *Macronyx croceus* | R | LC |
| Monarchidae | African Blue Flycatcher | *Elminia longicauda* | R | LC |
| Muscicapidae | African Paradise Flycatcher | *Terpsiphone viridis* | am | LC |
| Muscicapidae | Northern Black Flycatcher | *Melaenornis edolioides* | R | LC |
| Muscicapidae | Spotted Flycatcher | *Muscicapa striata* | pm | LC |
| Muscicapidae | Swamp Flycatcher | *Muscicapa aquatica* | R | LC |
| Muscicapidae | White-browed Scrub Robin | *Cercotrichas leucophrys* | R | LC |
| Musophagidae | Eastern Grey Plantain-eater | *Crinifer zonurus* | R | LC |
| Gruidae | Grey Crowned Crane | *Balearica regulorum* | R | V |
| Musophagidae | Ross's Turaco | *Musophaga rossae* | R | LC |
| Nectariniidae | Green-headed Sunbird | *Cyanomitra verticalis* | R | LC |
| Nectariniidae | Purple-banded Sunbird | *Cinnyris bifasciatus* | R | LC |
| Nectariniidae | Scarlet-chested Sunbird | *Chalcomitra senegalensis* | R | LC |
| Nectariniidae | Variable Sunbird | *Cinnyris venustus* | R | LC |
| Numididae | Helmeted Guineafowl | *Numida meleagris* | R | LC |
| Hirundinidae | Barn Swallow | *Hirundo rustica* | pm | LC |
| Oriolidae | Black-headed Oriole | *Oriolus larvatus* | R | LC |
| Accipitridae | Great Sparrowhawk | *Accipiter melanoleucus* | R | LC |
| Passeridae | Grey-headed Sparrow | *Passer griseus* | R | LC |
| Passeridae | House Sparrow | *Passer domesticus* | R | LC |
| Picidae | Cardinal Woodpecker | *Dendropicos fuscescens* | R | LC |
| Picidae | Nubian Woodpecker | *Campethera nubica* | R | LC |
| Picidae | Red-throated Wryneck | *Jynx ruficollis* | R | LC |
| Platysteiridae | Black-headed Batis | *Batis minor* | R | LC |
| Platysteiridae | Brown-throated Wattle-eye | *Platysteira cyanea* | R | LC |
| Ploceidae | Compact Weaver | *Ploceus superciliosus* | R | LC |
| Ploceidae | Fan-tailed Widowbird | *Euplectes axillaris* | R | LC |
| Ploceidae | Holub's Golden Weaver | *Ploceus xanthops* | R | LC |
| Ploceidae | Red-headed Weaver | *Anaplectes melanotis* | R | LC |
| Ploceidae | Spectacled Weaver | *Ploceus ocularis* | R | LC |
| Ploceidae | Village Weaver | *Ploceus cucullatus* | R | LC |
| Ploceidae | Yellow-backed Weaver | *Ploceus melanocephalus* | R | LC |
| Psittacidae | Fischer's Lovebird | *Agapornis fischeri* | R | NT |

**Continued**

| | | | | |
|---|---|---|---|---|
| Psittacidae | Meyer's Parrot | *Poicephalus meyeri* | R | LC |
| Pycnonotidae | Common Bulbul | *Pycnonotus barbatus* | R | LC |
| Pycnonotidae | Yellow-throated Leaflove | *Chlorocichla flavicollis* | R | LC |
| Scolopacidae | Common Sandpiper | *Actitis hypoleucos* | pm | LC |
| Scolopacidae | Green Sandpiper | *Tringa ochropus* | pm | LC |
| Sturnidae | Greater Blue-eared Starling | *Lamprotornis chalybaeus* | R | LC |
| Sturnidae | Red-billed Oxpecker | *Buphagus erythrorhynchus* | R | LC |
| Sturnidae | Rüppell's Starling | *Lamprotornis purpuroptera* | R | LC |
| Sturnidae | Superb Starling | *Lamprotornis superbus* | R | LC |
| Threskiornithidae | Hadada Ibis | *Bostrychia hagedash* | R | LC |
| Threskiornithidae | Sacred Ibis | *Threskiornis aethiopicus* | R | LC |
| Timaliidae | Black-lored Babbler | *Turdoides sharpei* | R | LC |
| Muscicapidae | Whinchat | *Saxicola rubetra* | pm | LC |
| Muscicapidae | White-browed Robin Chat | *Cossypha heuglini* | R | LC |
| Viduidae | Pin-tailed Whydah | *Vidua macroura* | R | LC |

**Legend:** NT: Near threatened; V: Vulnerable; LC: Least concern; am: Afrotropical migrant; pm: Palearctic migrant; R: Resident.

## Appendix 2. Nyando Sugar Belt Bird Species Showing Forest Category (See Legend for Initials Used)

| Common Name | Scientific Name | Forest Dependency |
|---|---|---|
| African Black-shouldered Kite | *Elanus caeruleus* | Non f |
| African Blue Flycatcher | *Elminia longicauda* | F |
| African Firefinch | *Lagonosticta rubricata* | Non f |
| African Green Pigeon | *Treron calvus* | F |
| African Harrier Hawk | *Polyboroides typus* | F |
| African Jacana | *Actophilornis africanus* | Non f |
| African Palm Swift | *Cypsiurus parvus* | Non f |
| African Paradise Flycatcher | *Terpsiphone viridis* | F |
| African Pied Wagtail | *Motacilla aguimp* | Non f |
| African Thrush | *Turdus pelios* | F |
| African Wattled Plover | *Vanellus senegallus* | Non f |
| Arrow-marked Babbler | *Turdoides jardineii* | Non f |
| Barn Swallow | *Hirundo rustica* | Non f |
| Black Cuckooshrike | *Campephaga flava* | f |
| Black Kite | *Milvus migrans* | Non f |
| Black Saw-wing | *Psalidoprocne pristoptera* | f |
| Black-crowned Tchagra | *Tchagra senegalus* | Non f |
| Black-headed Batis | *Batis minor* | Non f |

**Continued**

| | | |
|---|---|---|
| Black-headed Gonolek | *Laniarius erythrogaster* | Non f |
| Black-headed Heron | *Ardea melanocephala* | Non f |
| Black-headed Oriole | *Oriolus larvatus* | f |
| Black-lored Babbler | *Turdoides sharpei* | Non f |
| Blue-naped Mousebird | *Urocolius macrourus* | Non f |
| Blue-spotted Wood Dove | *Turtur afer* | f |
| Bronze Mannikin | *Spermestes cucculatus* | Non f |
| Bronze Sunbird | *Nectarinia kilimensis* | f |
| Brown-throated Wattle-eye | *Platysteira cyanea* | f |
| Cardinal Woodpecker | *Dendropicos fuscescens* | f |
| Cattle Egret | *Bubulcus ibis* | Non f |
| Common Bulbul | *Pycnonotus barbatus* | f |
| Common Buzzard | *Buteo buteo* | Non f |
| Common Cuckoo | *Cuculus canorus* | Non f |
| Common Drongo | *Dicrurus adsimilis* | Non f |
| Common Fiscal | *Lanius collaris* | Non f |
| Common Sandpiper | *Actitis hypoleucos* | Non f |
| Compact Weaver | *Ploceus superciliosus* | f |
| Double-toothed Barbet | *Lybius bidentatus* | f |
| Eastern Grey Plantain-eater | *Crinifer zonurus* | Non f |
| Eurasian Bee-eater | *Merops apiaster* | f |
| Fan-tailed Widowbird | *Euplectes axillaris* | Non f |
| Fawn-coloured Lark | *Mirafra africanoides* | Non f |
| Fischer's Lovebird | *Agapornis fischeri* | Non f |
| Flappet Lark | *Mirafra rufocinnamomea* | Non f |
| Great Sparrowhawk | *Accipiter melanoleucus* | F |
| Greater Blue-eared Starling | *Lamprotornis chalybaeus* | Non f |
| Green Sandpiper | *Tringa ochropus* | Non f |
| Green-backed Eremomela | *Eremomela canescens* | Non f |
| Green-headed Sunbird | *Cyanomitra verticalis* | f |
| Grey Crowned Crane | *Balearica regulorum* | Non f |
| Grey Heron | *Ardea cinerea* | Non f |
| Grey-backed Camaroptera | *Camaroptera brachyura* | f |
| Grey-headed Sparrow | *Passer griseus* | Non f |
| Hadada Ibis | *Bostrychia hagedash* | Non f |
| Helmeted Guineafowl | *Numida meleagris* | Non f |
| Holub's Golden Weaver | *Ploceus xanthops* | Non f |

**Continued**

| | | |
|---|---|---|
| House Sparrow | *Passer domesticus* | Non f |
| Jacobin Cuckoo | *Clamator jacobinus* | Non f |
| Klaas's Cuckoo | *Chrysococcyx klaas* | f |
| Lesser Honeyguide | *Indicator minor* | f |
| Lesser Striped Swallow | *Cecropis abyssinica* | Non f |
| Lilac-breasted Roller | *Coracias caudatus* | f |
| Little Egret | *Egretta garzetta* | non f |
| Little Swift | *Apus affinis* | Non f |
| Malachite Kingfisher | *Alcedo cristata* | Non f |
| Marabou Stork | *Leptoptilos crumeniferus* | Non f |
| Meyer's Parrot | *Poicephalus meyeri* | Non f |
| Mosque Swallow | *Cecropis senegalensis* | Non f |
| Moustached Grass Warbler | *Melocichla mentalis* | Non f |
| Northern Black Flycatcher | *Melaenornis edolioides* | Non f |
| Nubian Woodpecker | *Campethera nubica* | Non f |
| Oriole Finch | *Linurgus olivaceus* | F |
| Palm-nut Vulture | *Gypohierax angolensis* | Non f |
| Pied Crow | *Corvus albus* | Non f |
| Pin-tailed Whydah | *Vidua macroura* | Non f |
| Purple-banded Sunbird | *Cinnyris bifasciatus* | f |
| Red-billed Firefinch | *Lagonosticta senegala* | Non f |
| Red-billed Oxpecker | *Buphagus erythrorhynchus* | Non f |
| Red-cheeked Cordon-bleu | *Uraeginthus bengalus* | Non f |
| Red-eyed Dove | *Streptopelia semitorquata* | f |
| Red-faced Cisticola | *Cisticola erythrops* | Non f |
| Red-headed Weaver | *Anaplectes melanotis* | f |
| Red-rumped Swallow | *Cecropis daurica* | Non f |
| Red-throated Wryneck | *Jynx ruficollis* | f |
| Ring-necked Dove | *Streptopelia capicola* | f |
| Ross's Turaco | *Musophaga rossae* | F |
| Rüppell's Starling | *Lamprotornis purpuroptera* | F |
| Sacred Ibis | *Threskiornis aethiopicus* | Non f |
| Scarlet-chested Sunbird | *Chalcomitra senegalensis* | Non f |
| Speckled Mousebird | *Colius striatus* | Non f |
| Speckled Pigeon | *Columba guinea* | Non f |
| Spectacled Weaver | *Ploceus ocularis* | Non f |
| Spot-flanked Barbet | *Tricholaema lacrymosa* | Non f |

**Continued**

| | | |
|---|---|---|
| Spotted Flycatcher | *Muscicapa striata* | Non f |
| Spur-winged Plover | *Vanellus spinosus* | Non f |
| Steppe Eagle | *Aquila nepalensis* | Non f |
| Striated Heron | *Butorides striata* | Non f |
| Superb Starling | *Lamprotornis superbus* | Non f |
| Swamp Flycatcher | *Muscicapa aquatica* | f |
| Tawny-flanked Prinia | *Prinia subflava* | f |
| Tree Pipit | *Anthus trivialis* | f |
| Tropical Boubou | *Laniarius aethopicus* | f |
| Variable Sunbird | *Cinnyris venustus* | f |
| Village Weaver | *Ploceus cucullatus* | Non f |
| Wahlberg's Eagle | *Aquila wahlbergi* | Non f |
| Western Banded Snake Eagle | *Circaetus cinerascens* | F |
| Western Marsh Harrier | *Circus aeruginosus* | Non f |
| Whinchat | *Saxicola rubetra* | f |
| White-browed Coucal | *Centropus superciliosus* | Non f |
| White-browed Robin Chat | *Cossypha heuglini* | f |
| White-browed Scrub Robin | *Cercotrichas leucophrys* | Non f |
| White-faced Whistling Duck | *Dendrocygna viduata* | Non f |
| White-throated Bee-eater | *Merops albicollis* | Non f |
| Winding Cisticola | *Cisticola galactotes* | Non f |
| Wire-tailed Swallow | *Hirundo smithii* | Non f |
| Woodland Kingfisher | *Halcyon senegalensis* | Non f |
| Yellow Wagtail | *Motacilla flava* | Non f |
| Yellow-backed Weaver | *Ploceus melanocephalus* | Non f |
| Yellow-fronted Canary | *Crithagra mozambica* | f |
| Yellow-fronted Tinkerbird | *Pogoniulus chrysoconus* | Non f |
| Yellow-throated Leaflove | *Chlorocichla flavicollis* | f |
| Yellow-throated Longclaw | *Macronyx croceus* | Non f |

**Legend**: FF: Forest Specialist; F: Forest generalist; f: Forest visitor; Non f: Non forest bird.