Bird Diversity Survey in the Boni–Dodori Forest System

Kenya (2015)

John Musina, Fleur Ng'weno, Martin Mwema, David Ngala, Martha Ngala, Albert Baya, Edson Mlamba, Timothy Mwinami, Dominic Chesire, Mohamed Alale, Ali Shizo, Ware Sawii Ware, Ilesi Mohamed, Baishe Binda, Balozi Mohamed, Ali Mohamed, Abdi Hassan, Mike Morris, John Bett and Rajan Amin

Acknowledgements

This expedition was a collaborative effort of several organizations including the Zoological Society of London (ZSL), National Museums of Kenya (NMK), World Wide Fund for Nature (WWF), Kenya Wildlife Service (KWS), Northern Rangeland Trust (NRT), Nature Kenya, A Rocha Kenya and Aweer Community Conservancy (ACC). All content and opinions expressed are solely those of the authors.

This study was funded by UKaid from the Department for International Development (DFID) through the UK DFID / DEFRA Darwin Initiative and through its Programme Partnership Agreement with WWF-UK; Kenya Wildlife Service; Size of Wales; WWF; and the Zoological Society of London.

The idea of carrying out a detailed avian survey in Boni–Dodori was initially put forward by Dr Rajan Amin. Raj has been and is still active in coordinating biodiversity studies in this region. Chris Gordon at the ZSL Country Office played an invaluable role in disbursing funds and linking the ornithological team from Nairobi with WWF-Kenya team in Lamu. We are particularly grateful to WWF, for providing transport and facilitating camping logistics at Mangai Village. Special thanks go to John Bett and Nickson Orwa at the WWF Lamu office. WWF also provided a 4WD vehicle and we are thankful to the driver Mr Yusuf for bearing with our weird three o'clock wake up calls. KWS and NRT also provided 4WD vehicles. We thank the driver Mr Bake for his dedication. Thank you to KWS rangers Mr Atik Atik and *'General'* Baitoti for looking after us. To Dr Jeff Worden and Mr Moses Litoroh of NRT, thank you for your moral and material support. Francis Kagema at Nature Kenya coast office helped with the transfer of mist-netting bamboo poles from Gede to Malindi and also provided extra cooking equipment. Thank you to Mangai Basecamp kitchen team led by Mr Amadei who not only prepared us lavish meals but also made sure that our tents were zipped up when it rained.

A Big Thank You to the ACC led by their Vice Chair Ahamed Mohamed and Manager Rufi Ali. Local scouts led by Ilesi Mohamed Ilesi and Baishe Binda were instrumental in guiding us through the sites. Kenya Police Reservists led by Mohamed Alale were a brave team of security guards with invaluable local knowledge. Thank you to Ali Shizo, Ware Sawii Ware, Balozi Mohamed, Ali Mohamed and Abdi Hassan.

Cover page photos: Clockwise from top left: Fischer's Turaco, *Tauraco fischeri* along River Dodori; male Red-headed Weaver, *Anaplectes rubriceps jubaensis* in full breeding plumage at Mangai village; Bird identification training at Mangai village; Kiangwe wooded grassland. Photography: John Musina (except Fig. 21 by Edson Mlamba).

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Summary List of Acronyms

ACC	[Designated / Proposed] Aweer Community Conservancy
DNA	Deoxyribonucleic acid
EBA	Endemic Bird Area
GOK	Government of Kenya
GPS	Global Positioning System
IBA	Important Bird Area
IUCN	International Union for Conservation of Nature
KBDCA	Kiunga-Boni-Dodori Conservation Area
KFS	Kenya Forest Service
KMNR	Kiunga Marine National Reserve
KPR	Kenya Police Reservist
KWS	Kenya Wildlife Service
LAPSSET	Lamu Port South Sudan-Ethiopia Transport corridor
NCC	North Coast Conservation
NRT	Northern Rangelands Trust
NR	National Reserve
TSC	Timed Species Count
WWF	World Wide Fund for Nature
ZSL	Zoological Society of London

John Musina[1*], Fleur Ng'weno[2], Martin Mwema[3], David Ngala[3], Martha Ngala[1], Albert Baya[3], Edson Mlamba[1], Timothy Mwinami[1], Dominic Chesire[1], Mohamed Alale[4], Ali Shizo[4], Ware Sawii Ware[4], Elias Mohamed[4], Baishe Bindra[4], Balozi Mohamed[4], Ali Mohamed[4], Abdi Hassan[4], Mike Morris[5], John Bett[6] and Rajan Amin[7]

[1]Ornithology Section, National Museums of Kenya, P.O. Box 40658, 00100 GPO, Nairobi.

[2]Nature Kenya, EANHS, P.O. Box 44486, 00100 GPO Nairobi.

[3]A Rocha Kenya, P.O. Box 25924, 00100 GPO Nairobi.

[4]Aweer Community Conservancy, c/o NCC P.O. Box 450, 80500 Lamu.

[5]WWF-Kenya, P.O. Box 62440, 00200 GPO, Nairobi.

[6]WWF-UK, The Living Planet Centre - Rufford House, Brewery Road Woking Surrey, GU21 4LL.

[7]Zoological Society of London, Regents Park, London NW1 4RY.

**Corresponding author: mhornbill@yahoo.com*

Summary

Boni and Dodori National Reserves (NRs) and the proposed Aweer Community Conservancy that lies between them, is a heterogeneous landscape that not only harbors a diverse range of birds but also acts as a significant stop-over and dispersal site for intra-African and Palaearctic migratory bird species.

Between 3rd and 15th April of 2014, we carried out an expedition in these three sites with the aim of updating the existing ornithological knowledge and improving biodiversity conservation awareness among the resident Aweer people.

We used Timed Species Counts (TSCs) and mist-netting to estimate the relative abundance and species diversity in different habitat types. We also used road counts and scientific birding to augment the species list of the area.

Overall, we recorded two hundred and twenty-nine (229) species of birds from 61 families. A combined bird checklist including lists from three previous surveys puts the species richness of Boni–Dodori forest system at 283 birds from a surveyed area of approximately 250 km^2, which is 11% of the total area of 2216 km^2. In comparison, Arabuko—Sokoke boasts a species richness of 270 birds from extensive surveys covering an area of 420 km^2 which is a more homogenous habitat predominantly *Cynometra*, *Brachystegia* and mixed forests, while Shimba Hills has just over 170 species of birds in 300 km^2.

Five (5) species are listed as threatened in the IUCN Red List. White-headed Vulture is classified as Critically Endangered, Lappet-faced Vulture and Basra Reed Warbler are Endangered while Somali Ostrich and Martial Eagle are Vulnerable. Six (6) other species classified as Near Threatened are: Southern Banded Snake Eagle, Bateleur, Crowned Eagle, Curlew Sandpiper, Fischer's Turaco and Plain-backed Sunbird.

We recorded fifteen (15) of the thirty (30) species restricted to the East African coastal forests endemic bird area. They include: Southern Banded Snake Eagle, Fischer's Turaco and Plain-backed Sunbird. Further, some of the species recorded that qualify the Boni–Dodori forest system as an IBA were nine (9) regionally threatened species: Somali Ostrich, African Darter, Great White Egret, White-headed Vulture, Ayres's Hawk Eagle, Martial Eagle, Crowned Eagle, African Finfoot and Little Yellow Flycatcher.

Fifty-one (51) species were migrants, and twenty-seven (27) of them were long distance Palaearctic migrants such as Eurasian Hobby and Amur Falcon whose flocks we observed roosting and feeding in palm savanna. Forty-eight (48) species were waterbirds occurring along Dodori River and in wetlands near Dodori Creek.

Among the terrestrial birds, eighty-three (83) species were forest birds. Eleven (11) of them were forest specialists. These were: Crowned Eagle, African Broadbill, Forest Batis, Blue-mantled Crested Flycatcher, Little Yellow Flycatcher, Black-headed Apalis, Fischer's Greenbul, Tiny Greenbul, Red-tailed Ant Thrush, Plain-backed Sunbird and Olive Sunbird. Thirty-one (31) were forest generalists and forty-one (41) species were forest visitors.

The thickets at Sankuri ridge are an ecotone – a transition zone between the forest to the west and the Acacia woodland to the east. These thickets had the highest catch rate of birds (0.11 birds $m^{-1}h^{-1}$) and a diversity index corresponding to 19 equally common species such as Northern Brownbul and Tropical Boubou. Forest habitats had a catch rate of 0.06 birds $m^{-1}h^{-1}$ with diversity indices corresponding to between 11 and 15 equally common species. Species were more evenly distributed in the forests than in the thickets. Some of the common species were: Fischer's Greenbul, Yellow-bellied Greenbul and Bearded Scrub Robin. Acacia woodland had the lowest catch rate of 0.04 birds $m^{-1}h^{-1}$ with a diversity index corresponding to approximately 6 equally common species. The dominant species were: Crested Francolin, Red-naped Bushshrike, Grey Wren Warbler and Northern Brownbul.

Boni–Dodori forest system is an environmentally and biologically heterogeneous system contributing significantly to global and regional avian diversity. However, the site is facing a myriad of immediate and imminent threats such as illegal logging, slashing and burning for agriculture, infrastructure development due to the Lamu Port South Sudan Ethiopia Transport (LAPSSET) project as well as onshore and offshore oil and wind energy exploration and security initiatives. Protecting this fragile ecosystem requires sorting out the persistent

conflicts of policy and legislation between sectors and the new Constitution. In addition, ambiguities and conflicting legislation associated with the land tenure rights of the Aweer people should be resolved, so that fair and legal arrangements can be established along with an integrated conservation and management program involving the local Aweer community, government and non-governmental organizations.

1 Introduction

The wooded habitats of coastal Kenya form part of the East African coastal forests biodiversity hotspot, an area known for globally significant levels of species richness and endemism (Burgess and Clarke, 2000, Mittermeier *et al.*, 2005). Much of this habitat in Kenya has been cleared for coastal development and agriculture (Mittermeier *et al.*, 2005), however, several state prescribed protected areas exist along the north Kenya coast. The Boni (1339 km^2) and Dodori (877 km^2) NRs in Garissa County and Lamu County respectively, were gazetted in 1976. They form part of the northern coastal protected areas, which includes the Kiunga Marine NR, listed as Important Bird Area (IBA) number 15 (Bennun and Njoroge, 1999).

Prior to gazettement the forests were the ancestral lands of the Aweer people, an indigenous hunter gatherer group, belonging to the Cushitic language family. At the time of the Shifta War (1963 – 1967) the Aweer were forcibly re-located by the state to settlements along the Bodhei Junction – Kiunga road. Gazettement of the Dodori and Boni National Reserves, resulted in their exclusion from the major part of their ancestral hunting and gathering grounds and religious sites, while the national hunting ban in 1977 ruled out their main livelihood, hunting, and forced them into subsistence agriculture, to which neither they nor the forest are suited.

The land between the two national reserves, and connecting them, is known as the Boni Forest, and the contiguous forest to the west is known as the Lungi Forest. These are the forests to which the Aweer were confined post gazettement of the NRs, and which are recognized as ancestral lands, a sub-set of Community Land[1], in the Kenyan Constitution (2010). The enactment of legislation to give effect to the provisions of the constitution is still however awaited, and the prevailing uncertainties with respect to land tenure for these forests are a constraint on forest conservation and the lives of the Aweer. Meanwhile growing pressures, and in particular those stemming from infrastructural and economic developments associated with the Lamu Port South Sudan-Ethiopia Transport corridor (LAPSSET), are driving encroachment and conversion of the forests in the south-west and illegal timber extraction. In this report, we refer to the whole forest area, the NRs, Boni and Lungi Forests, as Boni–Dodori forest system (Figure 1).

[1] Article 63 (d) (ii) in Chapter 5, Land and Environment; Special Issue: Kenya Gazette Supplement No, 55; The Constitution of Kenya, 2010.

Boni–Dodori forest system is mainly flat coastal plain, with a braided drainage system separated by marine sands and clay ridges. Rainfall ranges from about 500 mm to 800 mm per year, and is highest in the south-west. Towards the coast, several parallel fossilised sand dunes run south-west to north-east, the highest along the Mundane Range reaching up to 100 m at Sankuri ridge (Bennun and Njoroge, 1999).

Boni and Dodori NRs are indigenous open canopy forests of the Northern-Zanzibar-Inhambane coastal forest mosaic type. Boni is largely lowland dry forest, with big trees forming an open canopy with dense understory below; while Dodori contains patches of forest, dominated by *Manilkara, Afzelia* and others, surrounded by wooded grassland and dry bushland. There are occasional grass flood meadows in the alluvial valley of the Dodori (Mangai) River, and groundwater forests along its course. Elsewhere is a mix of bushland, grassland, woodland and groundwater forest. The forest occurs in patches, occupying slightly raised land in areas that are subject to seasonal flooding. Mangrove swamps occur along the Dodori creek. Notable important tree species include *Homalium abdessamadii*, *Croton megalocarpoides*, *Croton polytrichus*, *Excoecaria bussei* and the cycad *Encephalartos hildebrandtii* (Robertson and Luke, 1993).

Boni–Dodori forest system is considered to hold bird species characteristic of the East African Coast biome (Bennun and Njoroge, 1996). The Cheyney Expedition in the early 1970s recorded the restricted-range Fischer's Turaco, and four other East African Coast biome species (Mombasa Woodpecker, Fischer's Greenbul, Chestnut-fronted Helmet-shrike and Black-bellied Starling).

Recent extensive camera-trap based mammal surveys highlight the global importance of the northern coastal forests of Kenya for forest antelopes. The results strongly indicate that the Boni–Dodori forest system is the most important known population center for the critically endangered Aders' duiker *Cephalophus adersi*, worldwide (Amin *et al.*, 2014). Besides the Aders' duiker, the system contains other unique and critically endangered species, including a potentially new species of the giant elephant shrew (Rhynchocyoninae) (Andanje *et al.*, 2010) in the forests, Hirola *Beatragus hunteri*, in the interior and African Wild Dog *Lycaon pictus*, ranging throughout.

The Dodori and Boni NRs, which fall respectively under the jurisdiction of Lamu and Garissa County[2] Governments, are managed by the Kenya Wildlife Service (KWS). A management plan was drafted for the Kiunga-Boni-Dodori Conservation Area (KBDCA) by KWS in 2013 (KWS, 2013), but it acknowledges that only the Kiunga Marine National Reserve (KMNR) of the three NRs has a management structure – "the other two have no management system making them vulnerable to uncontrolled resource use and illegal activities such as poaching" (KWS, 2013). While there are also no formally mandated management arrangements for the Boni and Lungi forests, the indigenous knowledge and practices of the Aweer (and to some extent the 'Somali' pastoralists along the Garissa County fringes of the forests) have been recognized as directly contributing to the conservation of large portions of the whole forests that remain intact, some of which falls outside of the NRs. Insecurity and tsetse fly are also deemed to have played a role (Antipa, 2015).

Since their enforced resettlement and the ban on hunting in the mid 1970s the Aweer have been forced into subsistence agriculture, much of it dominated by maize cultivation. Significant sections of once virgin forest alongside the road linking the Aweer settlements have been cleared using slash and burn techniques. The forest soils however are soon depleted (that is, in 3-4 years), which has forced families into opening new plots. In Mangai, village most families 'own' between one to three kambas[3], separated into multiple plots, whose status correspond to the different stages, conversion through to depletion, with only two or three plots in current use (Morris *et al.*, 2011). The Aweer population living in the forest has significantly declined over the years and currently stands at an estimated 1800.

More worrying is the growing encroachment and conversion of Lungi forest in the west and south, where many much better equipped newcomers are making significant inroads. Valuable large trees such as *Brachylaena huillensis* and *Combretum schumanii* are being extracted for the carving industry further south on the coast. However, the area is still sparsely populated due to poor security, which in turn renders these forests largely inaccessible for survey or for eco-tourism (Bennun and Njoroge, 1999).

This study provides a systematic assessment of bird diversity in the different habitats found in Boni–Dodori forest system and attempts to document the most

[2] These have replaced the former Coast and North Eastern Province centres of government.
[3] One Kamba is typically a rectangular plot of 200x40 or 100x80 steps approximating to 1.3 acres.

pressing conservation challenges in view of the current legal and institutional uncertainties with respect to land tenure, both for the survival of the forest system and the lives and culture of the Aweer.

1.1 Survey Objectives

Prior to this expedition, there had been two recent bird surveys in Boni–Dodori forest system but the sampling effort in both surveys had been limited by security and logistical reasons. However, the second expedition highlighted the discovery of an unidentified bush shrike (Mwinami *et al.*, 2014; *see* Nature*Kenya*, 2013), which the team also had an interest in pursuing a follow up study. This survey's main objectives were as follows:

- To establish a baseline of the status of birds in the Boni–Dodori forest system including: creating of a species list (Bird Committee, 2009; Zimmerman *et al.*, 1996) and determining species richness, diversity and relative abundance in the different habitat types;
- To use the resulting data, especially on species endemic to this coastal forest biome, to highlight the conservation value of the area (as an IBA);
- To train local scouts in bird identification and biodiversity monitoring using three flagship bird species: Crested Guineafowl *Guttera pucherani*, Southern Banded Snake Eagle *Circaetus fasciolatus* and Fischer's Turaco *Tauraco fischeri*.

2 Materials and Methods

2.1 Study Area

The Boni–Dodori forest system covers an approximate area of 2,216 km^2. The two reserves are separated by a road that runs from Hindi to Kiunga town. During this survey, we sampled birds along a stretch of approximately 50 km from approximately 10 km west of Basuba village to the Acacia woodland just below and east of Sankuri ridge. We covered an average width of about 2.5 km on either side of the road, hence sampling an area of approximately 250 km^2 (Figure 1, below).

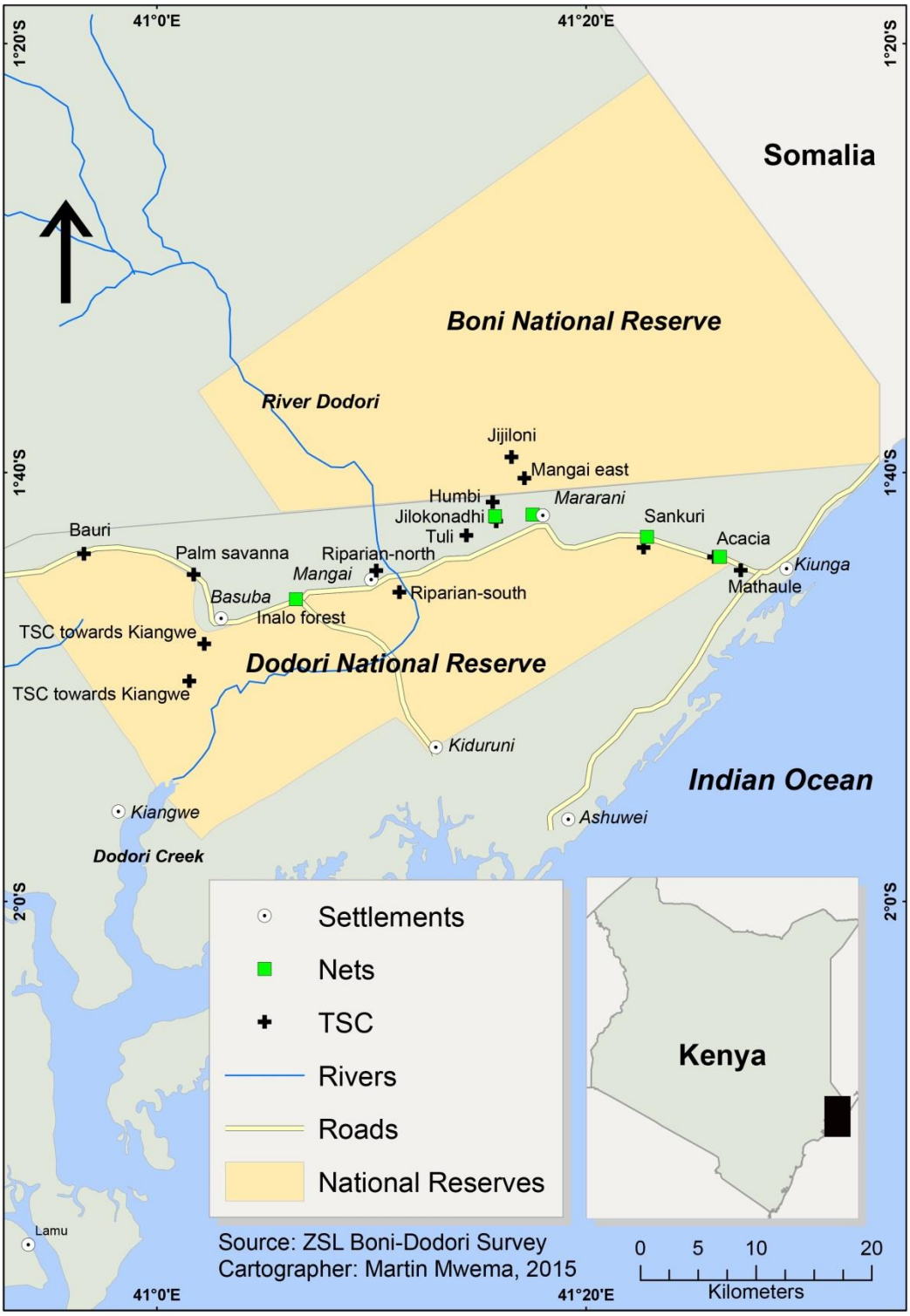

Figure 1: Survey sampling sites[4] in Boni–Dodori forest system.

[4] The Boni and Dodori National Reserve boundaries remain contested by neighboring communities. The river is also referred to as River Mangai.

2.2 Methods

We carried out an ornithological survey of Boni–Dodori forest system between 3rd and 15th of April 2014. We used both qualitative and quantitative bird survey techniques to update the species list and to derive species diversity and relative abundance indices of the area.

2.2.1 Qualitative Methods

2.2.1.1 Scientific birding

We carried out specific searches for birds in habitats adjacent to Hindi–Kiunga road. We conducted these searches in the late afternoons, starting from around 1600 h to 1800 h, weather permitting. From our base camp at Mangai village, we covered areas to the east towards Kiunga and to the west towards Hindi (Figure 1). We recorded species we saw or heard, the habitat in which they occurred and the duration we spent searching. We also recorded calls or songs of unusual or unidentified birds using a SONY ICD-PX 312 IC recorder and AR- 321 5 CORE uni-directional condenser. For waterbirds, we looked for birds in wetlands at the Kibokoni area, in the Dodori NR. At night and at dawn, we surveyed for nocturnal species such as the Sokoke Scops Owl by playing back their calls.

2.2.1.2 Timed Species Counts

Timed Species Counts (TSCs) provide a simple method of comparing the avifaunas of extensive areas by sampling representative habitats (Bibby *et al.*, 1998). In this study, we recorded data in six columns, corresponding to six 10-minute intervals during an hour long survey. We performed TSCs in all the broad habitat types representative of the Boni–Dodori forest system, namely: forest, slashed and burnt patches, forest edge, thicket, riparian gallery forest, seasonal wetland, woodland, wooded grassland, palm savanna and Acacia woodland. We determined the count routes beforehand from reconnaissance and previous survey maps. The routes covered an area between Baure wooded grasslands to the west and the Acacia woodlands to the east. Observers walked slowly along the mapped route, recording in a field note book, all birds seen or heard within the survey area. Once a species had been recorded, it was not recorded again when it appeared again during the same hour. For each hour, each species was assigned an index ranging from 0 to 6 (for an hour-long TSC), depending on whether it was recorded during the first 10 minutes (= 6), second ten minutes (= 5), down to 0 for a species not recorded during that count. We performed TSCs from sunrise for four hours (c. 0630 h – 1030 h).

In addition, we recorded basic survey parameters, and habitat and environmental variables at the beginning of each count. These included cloud cover

(percentage of sky covered), wind (general direction), temperature (cold, warm or hot), broad habitat type, human activity, date, start and end time, start and end coordinates of the route and the names of the observers. Changes in habitat types during the TSC were noted.

2.2.1.3 Road counts

We conducted road counts, especially for raptors. We drove at a constant speed of approximately 40 kmh^{-1} along the Hindi–Kiunga road, recording birds seen or heard from both sides of the road (*see* Malan, 2009). This method was used concurrently with scientific birding and the data used to construct the species list.

2.2.2 Quantitative Methods

2.2.2.1 Mist-netting

We used targeted mist-netting to capture understory forest birds that we would otherwise not have sampled effectively using the TSC, road count and scientific birding methods (Bibby *et al.*, 1998;Thompson, 2002).

We standardized mist-netting effort at five sites; three (3) forest sites at Jilokonadhi, Mararani and Inalo/Dhurwii, one (1) thicket site at Sankuri ridge and one (1) Acacia woodland site below the ridge towards Kiunga. Mist-netting and ringing were done twice at each site. We set up a 96 m long net-line consisting of 8 x 12 m nets along a line cut in the general habitat. We checked nets at least every hour, each ringing session lasted for about four hours from dawn (c. 0630 h – 1030 h). We identified, ringed and measured biometrics of each bird caught and then released them back into the wild. We collected blood and tissue samples from rare or difficult to identify species for DNA analysis.

2.3 Materials and Equipment

We used the following equipment during the scientific birding, TSCs and road counts: binoculars (8 x 42 and 10 x 42), sketch map with marked sample areas and routes, GPS receiver, field notebook, sound recording and play back equipment (SONY ICD-PX 312 IC recorder and AR- 321 5 CORE uni-directional condenser) and stop-watch.

For mist-netting, we used the following equipment: 8 x 12 m mist-nets, poles, string, bird bags (cloth bags with a draw-string, in which to hold netted birds), rings (variety of sizes), ringing pliers, stop-end ruler, spring balances (sizes 50g max. and 100g max.), flagging tape (for marking netting sites) and ringing data book.

2.4 Data Analysis

2.4.1 Relative Abundance Index (RAI)

We calculated the relative abundance index (RAI) for each species in each major habitat and overall for the surveyed area by taking the average score of all the counts for the corresponding TSCs (Appendix 2). We expect TSC scores in the unmodified version, that is, without estimation of distance from the ground or distance to the bird(s), to strongly reflect detectability as well as abundance (Pomeroy and Dranzoa, 1997; Davies, 2000).

TSCs do not take into account the number of individuals encountered. Therefore, the TSC relative abundance index for species found in flocks, such as the Amur Falcon and Eurasian Hobby, is not representative. This is also the case for species that differed widely in their detectability such as the Zanzibar Greenbul. Apart from ranking species based on their relative abundance index, we highlight the presence of threatened or East African coastal biome species.

We calculated mist-netting catch rates for each species caught as the total number of individuals caught divided by meter-net-hours multiplied by 100. We calculated species catch rates for each major habitat type and overall for the surveyed area.

2.4.2 Species Richness

We prepared species list from all the survey data. We also estimated species richness from the TSCs using the software EstimateS for Windows Version 9.1.0 (Colwell, 2013). We did spatial comparisons of species between sites and habitat types, and then subdivided them according to forest dependence categories (see Bennun, Dranzoa and Pomeroy, 1996).

2.4.3 Diversity Indices

We calculated Shannon–Weiner Index, Equability (Evenness) and Effective number of species at mist-netting sites as follows.

Shannon – Weiner Diversity Index (H'):

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

where p_i is the proportion of species i expressed as a proportion of the total number of individuals of all species 'S', ln is the natural logarithm, and Σ represents the total p_i . ln (p_i) for all species.

Equability (Evenness) Index (J):

$$H'/H_{max} = -\sum_{i=1}^{S} p_i \ln(p_i) \Big/ \ln(S)$$

where S = number of species ringed at each site.

Shannon–Weiner Diversity Index is simply an index of diversity but not diversity itself. For this reason, we converted Shannon-Weiner Index to true diversity by calculating the effective number of species *E*, as:

$E = \exp(H')$

We also calculated Bray–Curtis Similarity indices in PRIMER 5 for Windows V5.2 (Primer-E Ltd, 2002) to obtain a measure of species composition difference between two sites.

3 Results

Overall, we recorded a total of two hundred and twenty-nine (229) species of birds from 61 families (Figure 2; Appendix 3). The rarefied species accumulation curve and the Jackknife-1 species richness estimate (236 species) for the transect data are shown in Figure 2.

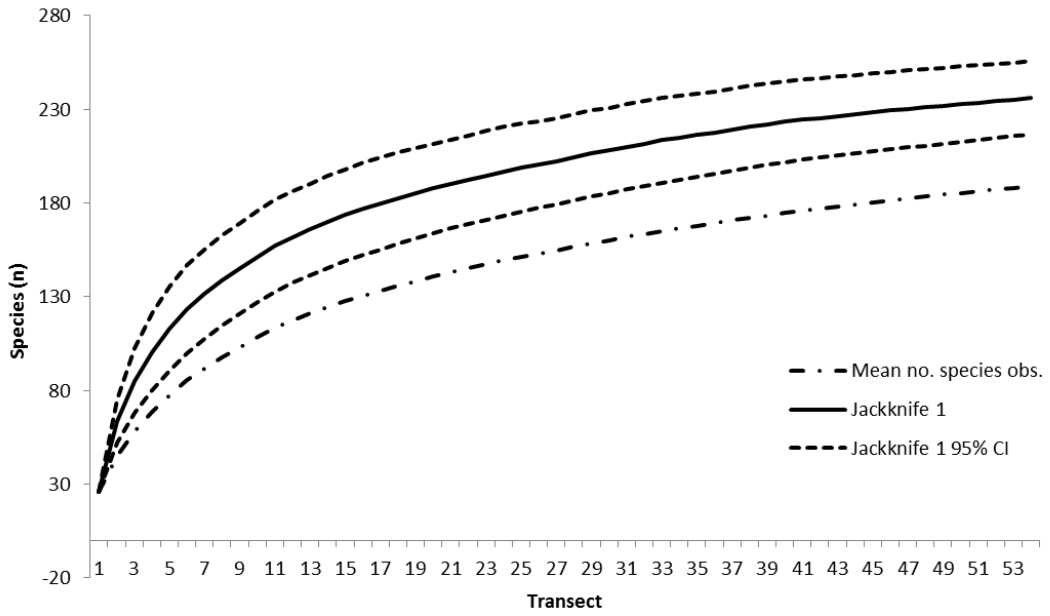

Figure 2: Rarefied species accumulation curve and Jackknife-1 species richness estimates based on the Timed Species Count (TSC) data.

Five (5) species are listed as threatened in the IUCN Red List (IUCN, 2015; Table 1). White-headed Vulture is classified as Critically Endangered, Lappet-faced Vulture and Basra Reed Warbler are Endangered while Somali Ostrich and Martial Eagle are Vulnerable. Six (6) other species classified as Near Threatened are: Southern Banded Snake Eagle, Bateleur, Crowned Eagle, Curlew Sandpiper, Fischer's Turaco and Plain-backed Sunbird (Table 2; Appendix 3).

The East African Coastal Forests biome has characteristic species whose ranges are restricted within this Endemic Bird Area (EBA) (BirdLife, 2014). We recorded fifteen (15) species restricted to this EBA: Southern Banded Snake Eagle, Fischer's Turaco, Mangrove Kingfisher, Mombasa Woodpecker, Chestnut-fronted Helmetshrike, Gorgeous (Four-coloured) Bushshrike, Little Yellow Flycatcher, Northern Brownbul, Fischer's Greenbul, Tiny Greenbul, Scaly Babbler, Black-bellied Starling, Plain-backed Sunbird, Mouse-coloured Sunbird and Malindi Pipit (Table 2, Appendix 3). In addition, some of the species recorded that qualify the Boni–Dodori forest system as an IBA were the following nine (9) regionally threatened species: Somali Ostrich, African Darter, Great White Egret, White-headed Vulture, Ayres's

Hawk Eagle, Martial Eagle, Crowned Eagle, African Finfoot and Little Yellow Flycatcher.

Table 1: A comparison of threatened and coastal endemic species present in Boni–Dodori forest system with other Kenyan coastal forest reserves.

Site	*IUCN Red List: Threatened species	IBA: Regionally Threatened species	East Coast biome species
Boni—Dodori	5	9	15
Arabuko—Sokoke	11	5	25
Shimba Hills	8	5	18

*IUCN Red List threatened species includes species classified as Vulnerable and above

Fifty-one (51) species were migrants, with either part or the entire population migrating within Africa or between Africa and Europe and Asia. Out of this, twenty-seven (27) species were long distance Palaearctic migrants including Eurasian Hobby and Amur Falcon. We often noted roosting and feeding flocks of these two species in the palm savanna.

Forty-eight (48) species were waterbirds, most of them occurring along Dodori (Mangai) River that flows through Mangai village, wetlands around Kibokoni area and in the southeastern part of Dodori NR (Figure 1).

Among the terrestrial birds, eighty-three (83) species were forest birds. We categorized them according to the extent to which they depend on the forest (Bennun, Dranzoa and Pomeroy, 1996). Eleven (11) were forest specialists. These are true forest birds characteristic of the interior of undisturbed forest. Thirty-one (31) were forest generalists, species that breed in the forest but may occur in undisturbed forest, forest edges and gaps. Forty-one (41) species were forest visitors, species that once in a while visit the forest but are not dependent on it (Appendix 3).

The true forest birds were: Crowned Eagle, African Broadbill, Forest Batis, Blue-mantled Crested Flycatcher, Little Yellow Flycatcher, Black-headed Apalis, Fischer's Greenbul, Tiny Greenbul, Red-tailed Ant Thrush, Plain-backed Sunbird and Olive Sunbird.

Table 2: IUCN Threatened and Near-Threatened species recorded during the survey. Also included are their EBA status, IBA category, migratory status and forest dependency.

No.	Common name	Scientific name	IUCN	EBA	IBA	MS	FD
	Ostrich						
1	Somali Ostrich	*Struthio camelus*	VU		RT		
	Accipitridae: eagles, kites, hawks						
2	White-headed Vulture	*Trigonoceps occipitalis*	CR		RT		
3	Lappet-faced Vulture	*Torgos tracheliotus*	EN				
4	Southern Banded Snake Eagle	*Circaetus fasciolatus*	NT	EAC			F
5	Bateleur	*Terathopius ecaudatus*	NT				
6	Martial Eagle	*Polemaetus bellicosus*	VU		RT		
7	(African) Crowned Eagle	*Stephanoaetus coronatus*	NT		RT		FF
	Scolopacidae: sandpipers						
8	Curlew Sandpiper	*Calidris ferruginea*	NT			PM	
	Musophagidae: turacos						
9	Fischer's Turaco	*Tauraco fischeri*	NT	EAC			F
	Sylviidae: Old World warblers						
10	Basra Reed Warbler	*Acrocephalus griseldis*	EN			PM	
	Nectariniidae: sunbirds						
11	Plain-backed Sunbird	*Anthreptes reichenowi*	NT	EAC			FF

IUCN Red List categories: EN = Endangered; VU = Vulnerable; NT = Near Threatened

EBA: EAC = East African Coastal biome species

IBA category: RT = Regionally Threatened species

MS: Migratory Status: PM = Palaearctic Migrant

FD: Forest Dependency: FF =Forest specialist species; F = Forest generalist species

3.1 Mist-netting

We caught and ringed a total of 256 birds comprising 43 species from 18 families, in approximately 40 hours of mist-netting. We caught, on average, ca. 0.07 birds per $m^{-1}h^{-1}$. Most of the species caught were from the family Pycnonotidae. The most abundant species in this family were Fischer's Greenbul in the forest, replaced by Northern Brownbul in the drier thickets and Acacia woodland. These two *Phyllastrephus* species (Figure 3) formed at least 20% of the total number of birds caught at any one site. For example, in the Acacia woodland close to 50% of the birds caught were Northern Brownbuls.

Figure 3: Northern Brownbul, *Phyllastrephus strepitans* (left) and Fischer's Greenbul, *Phyllastrephus fischeri* (right).
Overall, these two species had the highest catch rates (See Appendix 1).

Time of day affects bird activity and behavior, and this in turn affects chances of catching the birds. Many forest birds show an early morning activity peak which then slows down towards mid-day (Bibby *et al.*, 1998). In Boni–Dodori forest system, temperature rise is quite rapid in the morning. The heat surge slows bird activity. This decline in activity is illustrated in Figure 4.

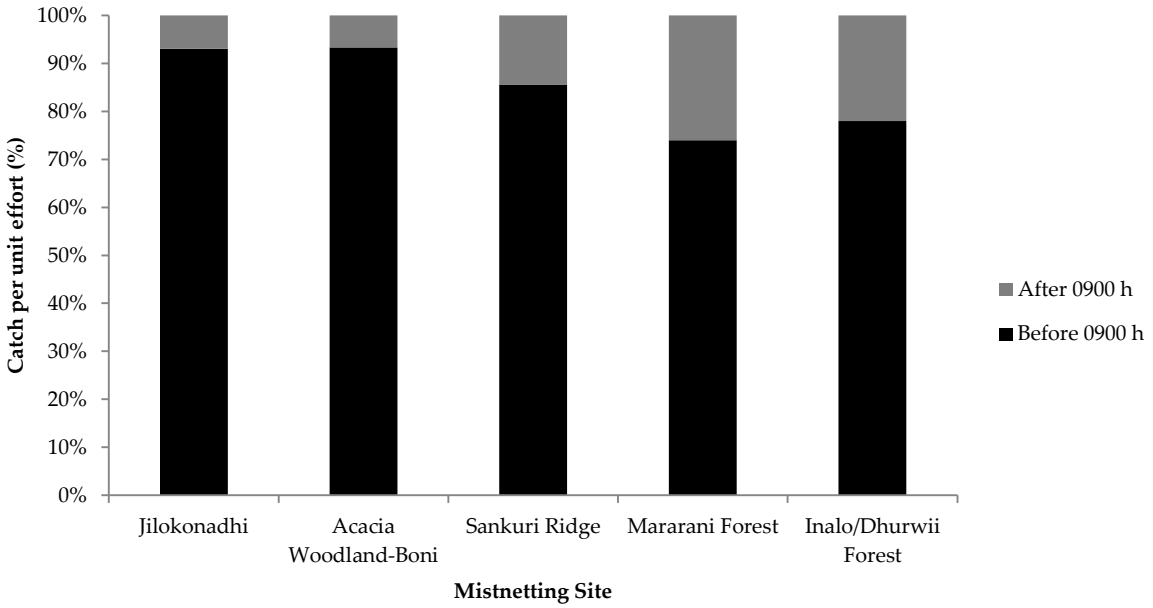

Figure 4: Percentage catch per unit effort between the first and the last two hours of mist-netting.
At mist-netting sites with open canopy, the catch per unit effort reduces to less than ten percent in the last two hours.

At all sites, more than 70% of the birds were caught before 0900 h. In fact, in sites with minimal undergrowth such as the Acacia woodland (Figure 5) and Jilokonadhi forest, the catch per unit effort dropped to less than 10% after 0900 h.

Figure 5: Ringing site in Acacia woodland.
The sparse undergrowth means that solar radiation quickly penetrates through the vegetation early in the day, thereby slowing bird activity, especially for passerines.

Forest sites had a catch rate of ca. 0.06 birds per $m^{-1}h^{-1}$ while in the Acacia woodland, the catch rate dropped to as low as 0.04 birds per $m^{-1}h^{-1}$. Thickets at Sankuri ridge had the highest catch rate of 0.11 birds per $m^{-1}h^{-1}$ (Figure 6).

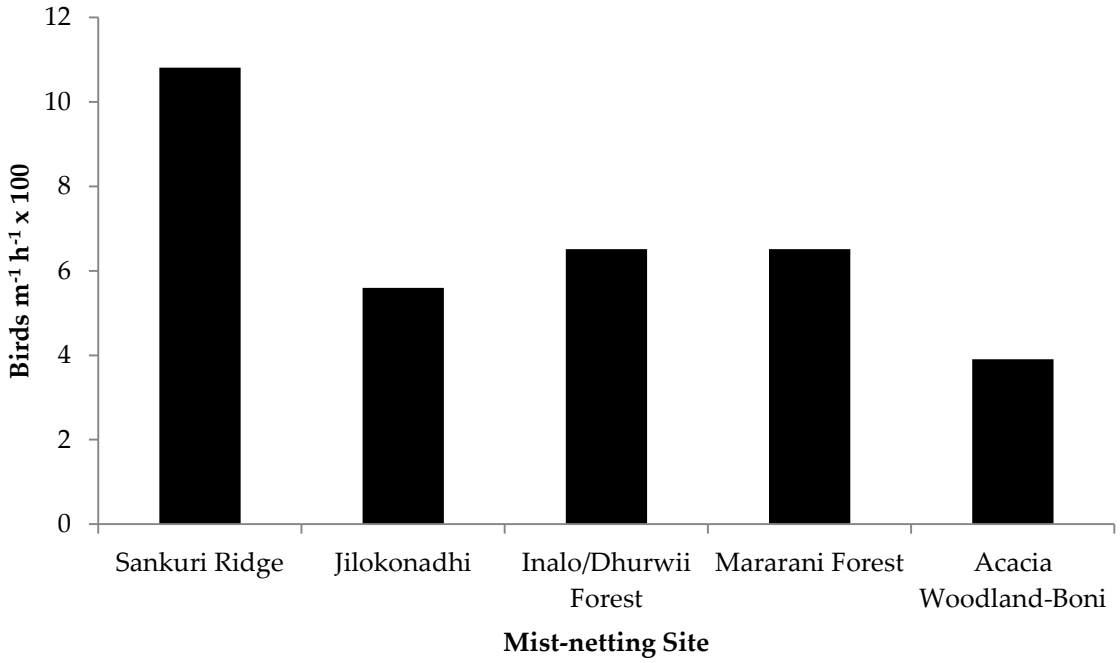

Figure 6: Catch rate of birds caught within the first three hours at the five mist-netting sites. The ecotone at Sankuri ridge stands out from the rest of the sites.

3.1.1 Species Diversity

The forest thickets at Sankuri ridge had the highest species diversity index while the Acacia woodland towards Kiunga had the lowest. Amongst the three forest sites, the diversity indices were similar (Table 3).

Table 3: Species diversity (Shannon–Weiner Index), Evenness (Equability) and effective number of species (E) in the five mist-netting sites.

Site	Shannon-Weiner Diversity Index	Equability Index	Effective No. of Species	Catch Rate	Abundance	No. of Species
Sankuri ridge	2.955	0.907	19	0.11	83	26
Jilokonadhi	2.674	0.925	15	0.06	43	18
Inalo/Dhurwii Forest	2.564	0.925	13	0.07	50	16
Mararani Forest	2.410	0.890	11	0.07	50	15
Acacia Woodland-Boni	1.857	0.775	6	0.04	30	11

We note that diversity and evenness indices suffer from the limitation of nonlinearity, and might therefore fail to effectively reflect differences in diversity between communities. We therefore used the effective number of species, E, as the true diversity of bird communities in the five sites.

The thickets at Sankuri ridge had a Shannon–Weiner index of 2.955 corresponding to 19 equally common species, while Mararani forest had a Shannon–Weiner index of 2.410 corresponding to 11 equally common species (Table 3). The thickets were almost twice as diverse as Mararani forest even though the difference in the values of the Shannon–Weiner indices was only about 18%.

The relatively high diversity recorded at the Sankuri ridge may have been due to the fact that this habitat lies between the forests and the Acacia woodland therefore sharing vegetation types with both. Consequently, the bird community comprised both forest species such as Peters's Twinspot, Ashy Flycatcher and Gorgeous Bushshrike (Figure 7) and Acacia woodland species such as Red-naped Bushshrike.

Figure 7: Ashy Flycatcher, *Muscicapa caerulescens*, (left) and Gorgeous Bushshrike, *Chlorophoneus viridis*, (right).
These two species occurred in both forest and thicket habitats.

The Acacia woodland community had the lowest effective number of species and equability index (Table 3) compared with the other communities, reflecting the fact that Acacia woodland vegetation is homogeneous and 47% of the birds caught in it were of just one species, Northern Brownbul.

It is important to note that forests had on average, a higher species evenness index than the forest thickets. This is probably because of the presence of more microhabitat types in the forest than in the thickets. The forests seem to sustain larger feeding guilds where dominant species have lower species richness than in thickets.

Naturally, the bird communities in the three forest sites were highly similar to each other, more than they were to those in the thickets and Acacia woodland. The

highest similarity index was between Mararani and Jilokonadhi forest (Table 4). This high similarity is probably because of the proximity of the two sites to each other. In Sankuri ridge thicket, the bird communities were composed of some species from Acacia woodland and some from the forest. Therefore, the thicket is an ecotone with more forest than Acacia woodland species.

Table 4: The Bray–Curtis similarity indices for the five mist-netting sites.

Site	Acacia Woodland	Inalo/Dhurwii Forest	Jilokonadhi Forest	Mararani Forest
Inalo/Dhurwii Forest	7			
Jilokonadhi Forest	21	76		
Mararani Forest	15	71	79	
Sankuri ridge Thicket	27	38	45	29

3.2 Timed Species Counts

We conducted a total of 54 TSCs spread out proportionately in the ten habitat types (Table 5).

Table 5: The number of TSCs in each habitat type, proportionate to the size of the habitat with respect to the total study area.

	Habitat Type	Number of TSCs	Number of species observed
1	Forest	4	34
2	Slashed and Burnt Patch	2	29
3	Forest Edge	1	40
4	Thicket	5	43
5	Riparian Gallery Forest	8	75
6	Acacia Woodland	6	60
7	Seasonal Wetland	2	29
8	Wooded Grassland	9	98
9	Palm Savanna	13	113
10	Woodland	4	46

The TSC scores for each species (as a measure of relative abundance index) in the different habitat types is shown in Appendix 2.

In total, we saw or heard 183 species of birds from 54 families during TSC surveys (Appendix 2). The most frequently encountered species included the Bearded Scrub Robin, Black-backed Puffback and Red-fronted Tinkerbird. Below, we highlight species with high relative abundance indices in ten habitat types where TSCs were performed.

3.2.1 Forest

Boni-Dodori forest system has extensive forest cover towards the Boni side. The two most common species in the forest were: Tropical Boubou and Eastern Nicator. Others included forest generalists such as Black-backed Puffback and Yellow-bellied Greenbul and forest visitors such as Bearded Scrub Robin, Emerald-spotted Wood Dove and Grey-backed Camaroptera. Forest specialists such as Blue-mantled Crested Flycatcher, Little Yellow Flycatcher, Olive Sunbird, African Broadbill, Forest Batis (Figure 8) and Tiny Greenbul (Figure 9) were present but not as common.

Figure 8: Female Forest Batis, *Batis mixta ultima* caught and ringed at Jilokonadhi forest. Forest Batis is a forest specialist that lives and breeds exclusively inside the forest. This species had not been previously recorded north of Arabuko-Sokoke Forest (Don Turner, *pers. comm.*), but it was seen during the preliminary bird survey in November 2013.

The Boni–Dodori forests, especially fragments adjacent to villages, are regularly slashed and burnt to create open patches where land is cropped for a few years then the forest is allowed to regenerate. In these open gaps the most common species included Spotted Palm Thrush and Speckled Mousebird. These are non-forest birds utilizing the open farmlands.

Figure 9: Tiny Greenbul, *Phyllastrephus debilis*.
Like the Forest Batis, this species is also a forest specialist confined to the interior of the forest.

3.2.2 Forest Edge

The forest edge is an altered habitat adjacent to the forest. In Boni–Dodori forest system, forest edge is a consequence of fragmentation caused by paths, roads and human settlements. This habitat type had relatively high species richness with a total of 40 species recorded. Among them were at least two forest specialists: Blue-mantled Crested Flycatcher and Little Yellow Flycatcher. The forest edge is important in facilitating dispersal of these specialists from one fragment to the other.

3.2.3 Thicket

Boni–Dodori thickets are composed of dense growth of shrubs, lianas and small trees. Due to this mix of plant forms, this habitat type had forest specialists, forest generalists, forest visitors and non-forest birds occurring side by side. For instance, Fischer's Greenbul, a forest specialist, and White-browed Coucal, a non-forest species, were both recorded here. The most common species here were Tropical Boubou, Eastern Nicator, Bearded Scrub Robin and Black-backed Puffback (Figure 10).

Figure 10: Black-backed Puffback, *Dryoscopus cubla affinis*, (left) and Bearded Scrub Robin, *Cercotrichas quadrivirgata*, (right).
These two species were the most common in the thickets at Sankuri ridge.

3.2.4 Riparian Gallery Forest

This is the wooded strip along the banks of Dodori (Mangai) River that runs from north to south through Mangai village. This habitat formed a transition zone between the terrestrial and aquatic environment with closed canopy tall trees, sparse undergrowth and thick leaf litter. Here, we recorded both terrestrial and aquatic species. For terrestrial birds, the forest is surprisingly pristine enough that forest specialists such as Olive Sunbird, Forest Batis, Blue-mantled Crested Flycatcher and Black-headed Apalis were fairly common. Aquatic birds recorded included African Darter and African Finfoot (Figure 11). Other species of note in this habitat were two species endemic to the coast, that is, Southern Banded Snake Eagle and Fischer's Turaco.

Figure 11: The shy and elusive, African Finfoot, *Podica senegalensis*, on the banks of Dodori River south of Mangai village.

3.2.5 Acacia Woodland

This habitat type is found below Sankuri ridge towards Kiunga. The Acacia trees spread out in a matrix of grass, bare ground and seasonal wetlands, interspersed with groves of non-Acacia woodland. The trees were not as dense as in the forests or thickets but still dense enough to light seasonal bush fires as observed through the presence of partially burnt tree stumps. The most common and vocal species here were the Red-naped Bushshrike and Grey Wren Warbler (Figure 12), followed closely by Crested Francolin, Spotted Palm Thrush and Northern Brownbul. Other notable species such as the coastal forest endemic Black-bellied Starling and the Near Threatened Bateleur occasionally visited this habitat.

Figure 12: Red-naped Bushshrike *Laniarius ruficeps*, (left) and Grey Wren Warbler, *Calamonastes simplex,* (right).
The Bushshrike is the most visible and vocal species in the Acacia woodland. It is believed to belong to the subspecies *kismayensis* but comparative genetic studies are needed to confirm this. The Grey Wren Warbler was also common in these woodlands.

3.2.6 Seasonal Wetlands

The seasonal wetlands where TSCs were conducted were found inside the Acacia woodland. Most of them were dry ponds surrounded by strips of dry grass tussocks around the edges. Some wetlands had thick clusters of bush around the basin. These seasonal wetlands shared most of their species with the larger Acacia woodland; hence the most abundant species were: Bearded Scrub Robin, Northern Brownbul, Red-naped Bushshrike and Crested Francolin. At one of the wetlands, grassland birds Grassland Pipit and Malindi Pipit (Figure 13) were recorded.

Figure 13: Malindi Pipit, *Anthus melindae.*
Some seasonal wetlands in the Acacia woodland have a strip of grass around their rim. In one of the wetlands we recorded this East African coastal biome species.

3.2.7 Wooded Grassland

Wooded grasslands form a significant part of Dodori NR. This habitat type is characterized by a mosaic of woody plants, shrubs or trees growing on grasslands. The ten most common species recorded were: Tropical Boubou, Black-backed Puffback, Bearded Scrub Robin, Eastern Nicator, Grey-backed Camaroptera, Red-fronted Tinkerbird, Yellow-bellied Greenbul, Amethyst Sunbird, Mombasa Woodpecker and Zanzibar Greenbul.

Even though uncommon, forest specialists such as Olive Sunbird, Black-headed Apalis, Little Yellow Flycatcher and Fischer's Greenbul were present in the woody patches. Coastal forest biome endemics such as Black-bellied Starling and Fischer's Turaco also utilize this habitat type.

Wooded grasslands are important stop over sites for migrating birds. Among some of the long distance migrants recorded here were: Amur Falcon, Eurasian Hobby and Eurasian Roller. Flocks of Amur Falcons and Eurasian Hobby temporarily use this habitat for feeding and roosting, occurring side by side with resident species such as Red-necked Spurfowl and Blue-naped Mousebird.

3.2.8 Palm Savanna

Palm savanna is a significant vegetation type of the reserves and probably the most common land cover type in Dodori NR. The extensive stands of *Hyphaene* doum palms often occur on riverine locations or in areas with drainage impediment. In some parts of Dodori, some wooded grasslands were exclusively *Hyphaene* doum palms and formed a large part of the riverine wooded grassland.

The most common avian communities in this habitat type were composed of species that are mostly forest generalists. They included: Tropical Boubou (Figure 14), Zanzibar Greenbul, Black-headed Oriole, Bearded Scrub Robin, Red-fronted Tinkerbird, Eastern Nicator and Yellow-bellied Greenbul. Surprisingly, in patches of grass and doum palms with groves of trees, forest dependent species such as Forest Batis, Blue-mantled Crested Flycatcher and Yellowbill (Figure 15) were found, though in low numbers.

Figure 14: Tropical Boubou, *Laniarus aethiopicus* (coastal subspecies *sublacteus*).
This was the most common species in the palm savanna. Note that this subspecies lacks white on the wing which is present on inland birds.

Figure 15: Yellowbill, *Ceuthmochares aereus*.
This species and the White-browed Coucal are the most widespread cuckoos occurring in forested and woody habitats.

Birds of prey such as the White-headed Vulture, Lappet-faced Vulture, Lizard Buzzard and Southern Banded Snake Eagle were also recorded in this habitat. The vultures evidently find it is easier to hunt for carcasses in the open glades between the palm stands than in the forests. The seasonally flooded sandy substrate within this palm complex acts as a dispersal site for waterbirds including Hadada Ibis and migratory waders such as Wood Sandpiper and Common Sandpiper.

3.2.9 Woodland

This habitat type had a low density of trees forming open patches with plenty of sunlight and limited shade. According to Kuchar and Mwenda (1982) the dominant woody plants comprise of *Cassia sp.*, *Lannea schweinfurthii*, *Oldfieldia*

somalensis, *Salacia madagascariensis*, *Uvaria acuminata*, *Cassipourea euryoides*, *Diospyros sp.*, *Combretum sp.*, *Strychnos sp.*, *Heinsia crinita*, *Dovyalis sp.*, *Grewia plagiophylla* and *Philenoptera bussei*.

These woody plants support an understory of shrubs and herbaceous plants including grasses. Towards the drier eastern parts of Boni–Dodori forest system, woodlands form a transition to the distinctive Acacia woodland, while towards the wetter parts, they form a transition to the early stages of primary or secondary forest. However, the area we surveyed did not have large tracts of pure woodland. The most common bird species found here were comparable to those in palm savanna. They included: Tropical Boubou, Black-backed Puffback, Eastern Nicator, Zanzibar Greenbul, Gorgeous Bushshrike, Northern Brownbul, Fischer's Greenbul, Narina Trogon, African Paradise Flycatcher, Fischer's Turaco, Mouse-colored Sunbird and Dark-backed Weaver (Figure 16). Some forest specialists such as Forest Batis and Little Yellow Flycatcher occasionally occurred here.

Figure 16: Mouse-colored Sunbird, *Cyanomitra veroxii,* (left) and Dark-backed Weaver, *Ploceus bicolor,* (right).
These species are found in both palm savanna and woodlands.

4 Discussion

4.1 Birds and Biodiversity

Boni and Dodori NRs and the proposed Aweer Community Conservancy between them, are part of the indigenous open canopy forests of the Northern–Zanzibar–Inhambane coastal forest mosaic. This mosaic can be classified into at least ten more or less homogeneous habitat types, namely: forest, slashed and burnt patches, forest edge, thicket, riparian gallery forest, Acacia woodland, seasonal wetland, wooded grassland, palm savanna and woodland. A total of two hundred and twenty-nine (229) species of birds were recorded in these habitats during the two-week survey. A combined bird checklist including lists from three previous surveys puts the species richness of Boni–Dodori forest system at two hundred and eighty-three (283) bird species. This checklist covers areas along or near the road from the Milimani 'midway barrel' to Acacia woodland near Kiunga; from Basuba to about 25 km south towards Kiangwe on Dodori creek; the vicinity of Mangai village and about 7 km north of Mararani village.

Besides Boni–Dodori forest system, there are two other major coastal forests within the East African coastal forests Endemic Bird Area (EBA) in Kenya. Arabuko—Sokoke forest, covering an area of about 420 km^2, boasts a species richness of 270 birds in more homogenous habitat dominated by *Cynometra*, *Brachystegia* and mixed forests (Jackson, 2004, January) while Shimba Hills with an area of about 300 km^2 has just over 170 species of birds (Musina *et al.*, 2014). Boni–Dodori forest system, with over 283 bird species recorded from an area of approximately 250 km^2 is probably the most diverse of the three. In addition, the combined NRs are 2216 km^2 and this species richness was recorded in just over 10 % of this total area and in about six weeks in total. Therefore, it is highly likely that increased sampling effort deeper into the reserves and carried out at different seasons, will continue to encounter additional species.

Boni–Dodori forest system shelters five (5) out of thirty-nine (39) threatened and six (6) out of thirty-three (33) Near Threatened bird species found in Kenya (Birdlife International, 2015). Out of the thirty (30) East African coastal biome species, fifteen (15) were found here. According to the IBA threat categories (Bennun and Njoroge, 1999), the area has 9 out of the 50 regionally threatened species found in Kenya. This puts Boni–Dodori forest system as the Kenyan coastal forest IBA with the highest number of regionally threatened species and the third highest number of East African coastal biome species after Arabuko—Sokoke and Shimba Hills (Bennun and Njoroge, 1999; Table 1).

As a stop-over site for migrants, the Boni–Dodori forest system supports more than twenty-seven (27) out of one hundred and forty-four (144) long distance Palaearctic migrants that winter in or migrate through Kenya (Bird Committee, 2009). It is possible that in late March and early April, spectacular concentrations of Palaearctic migrants such as Amur Falcons, Eurasian Hobbies, Eurasian Rollers and Common Cuckoos (Figure 17, below) move through the palm savanna on passage. The reserves are therefore a significant spring stop-over site along the Eurasian–East African flyway, supporting birds that migrate annually between breeding grounds in Eurasia and non-breeding sites in eastern and southern Africa (BirdLife International, 2008).

Figure 17: Female Common Cuckoo, *Cuculus canorus*, basking in the morning sun at Sankuri ridge. Two individuals, both male, were ringed at the site. Common Cuckoos are long distance Palaearctic migrants along the Eurasian–East African flyway.

In the Boni–Dodori forest system, it is not easy to delineate and describe habitat types based on the plant forms. For that reason, it is not easy to characterize the spatial diversity of bird populations in such a heterogeneous landscape. In fact, seasonal availability of resources caused by changing precipitation patterns as well as anthropogenic influences may also play a role in species diversity patterns by influencing species composition across the area (see Signor and Pinho, 2011). For instance, a wetland species, the African Fish Eagle, and a grassland species, Malindi Pipit, were observed in a dry but seasonally flooded wetland inside Acacia woodland where Bearded Scrub Robin and Red-naped Bushshrike were the most common species.

The eighty-three (83) species of forest birds observed represent 25% of Kenya's three hundred and thirty-five (335) forest birds (Bennun, Dranzoa and Pomeroy, 1996). These species were spread out in the forest, forest edge, riparian gallery forests, forest thickets, wooded grasslands, palm savannas and woodlands.

The effect of such a heterogeneous habitat on bird spatial diversity patterns is supported by the fact that some species tend to occupy certain habitats in particular. Among these are the eleven (11) forest specialists that form 10% of the one hundred and ten (110) true forest birds found in Kenya. The specialists are an initial measure of the relative conservation importance of this forest system. The proportion and relative abundance of the forest specialists to the thirty-one (31) forest generalists and the forty-one (41) forest visitors will shift according to future changes in forest structure. Increases in human activities such as slashing and burning, selective logging and cutting of trails to open up chunks of intact forest, will in the long term, cause the species richness of specialists to decline. For instance, burning causes changes in the physical structure of a plant community, that is, how the foliage is distributed vertically. These changes may significantly shift species diversity of specialists more than the actual composition of plants (MacArthur and MacArthur, 1961). This scenario is supported by a study by Gil-Tena *et al.*, (2008) in north eastern Spain, which reports that forest landscape characteristics had more influence on specialist than on generalist bird species richness.

The bird species in Boni–Dodori forest system are more evenly distributed than in the forest thickets where edge species increase species richness (Thiollay, 1999). In the mid and low canopies the most abundant species were: Fischer's Greenbul, Yellow-bellied Greenbul, Bearded Scrub Robin, Red-capped Robin Chat, Terrestrial Brownbul and Grey-backed Camaroptera. In the upper canopy, common species detected by sight and sound included: Tropical Boubou, Eastern Nicator, Black-backed Puffback and Zanzibar Greenbul. This multispecies coexistence can be explained by two critical factors: habitat heterogeneity and species specific niche selection (Arnold, 1988; Thiollay, 1999). For instance, a mid-canopy species such as Fischer's Greenbul is constrained to pristine forest patches while upper canopy species such as Tropical Boubou and Zanzibar Greenbul are also associated with forest edges and slashed and burnt gaps (Appendix 2).

The bird communities in forests at Jilokonadhi, Mararani and Inalo/Dhurwii, the riparian gallery forests and forest patches in the wooded grasslands exhibited a typical structure, i.e. occurrence of rare species such as Tiny Greenbul with few dominants such as Zanzibar Greenbul, found both at the community scale and

within each ecological guild. However, this structure changed in thickets at Sankuri ridge towards an increasing proportion of up to 19 equally common species and fewer rare species. The thickets differ from the forest habitats because the Sankuri ridge thickets are an ecotone representing an area of sharp transition with high species richness, genetic and phenotypic diversity across the wetter forests and the drier Acacia woodland.

According to Kirk, (2007), ecotones deserve special and high conservation investment because they potentially serve as speciation and biodiversity centers. The study also suggests that such ecotones are where populations are diverging to new species in the face of gene flow across the ecotone.

The Acacia woodland on the plain of the Boni–Dodori forest system towards Kiunga was characterized by uneven distribution of species, with only 6 equally common species. Among the most common that could be seen or heard were: Red-naped Bushshrike, Crested Francolin and Grey Wren Warbler. In the mid canopy, the Northern Brownbul dominated, even though, apart from mist-netting, it was difficult to detect this species by sight or sound. The Acacia woodland showed little similarity with other habitat types in the reserves, and for the first time dryland birds such as White-bellied Go-away-bird, Pink-breasted Lark and African Bare-eyed Thrush were observed. However, it is important to note that woodland birds show relatively poor relationship with habitat classification (Woinarski *et al.*, 1988), instead a majority of studies have found a positive correlation between habitat heterogeneity/diversity and species diversity (Tews *et al.*, 2004).

4.2 Conservation Issues

4.2.1 Challenges

Even though inadequately studied, the Boni–Dodori forest system is rich in birds and other biodiversity as our study reveals. Of immediate concern, however, is how to mitigate the myriad of imminent threats facing this Important Bird Area.

4.2.1.1 Logging and slash and burn agriculture

Like other coastal forests, the Boni–Dodori forest system suffers habitat modification from poaching of valuable trees such as *Brachylaena huillensis* and *Combretum schumannii* which are preferred for the carving industry and construction further south on the coast (Bennun and Njoroge, 1999). Selective logging for timber and poles continues to be a major problem. Regeneration of some of the logged-over forests seems to be prevented by repeat slashing and burning (Figure 18) by the Aweer people who since their enforced resettlement and the hunting ban are

significantly more dependent on agriculture for subsistence, and to a limited extent for cash, although their constrained access to markets forces them to rely as much or more on passing trade and hence lower prices (Morris *et al.*, 2011; WWF, 2010, June 15).

In addition, new settlers from other parts of Kenya are coming in and clearing large tracts of land for cultivation along the Hindi—Bodhei Junction, west of Lungi Forest. Unlike other coastal forests the area is still sparsely populated due in part to poor security, and this has largely restricted the impact of cultivation to areas near the villages dotted along the Hindi–Kiunga road (Figure 1).

Figure 18: Selective logging (left) and slashing and burning (right).

4.2.1.2 Energy exploration and exploitation

According to Pancontinental, an Australian oil and gas prospecting company, Lamu Basin could contain up to 3.7 billion barrels of oil (Mugwe, 2013, February 27). The Boni–Dodori forest system falls into oil exploration blocks L4 and L13 (Figure 19) leased to Swiss Oil by the Government of Kenya in 2008. Swiss Oil has completed initial 2-D surveys of these blocks. Adjacent to block L13 is an offshore block L5 where deep water drilling was done by a company called Woodside. If production of hydrocarbons becomes feasible in this block, then it is likely to be serviced by infrastructure cutting through fragile habitats of Dodori NR, between Basuba and Kiangwe. The expansion of the Basuba–Kiangwe road is underway (Figure 20). It is not known whether the conservation value of Dodori NR was taken into consideration.

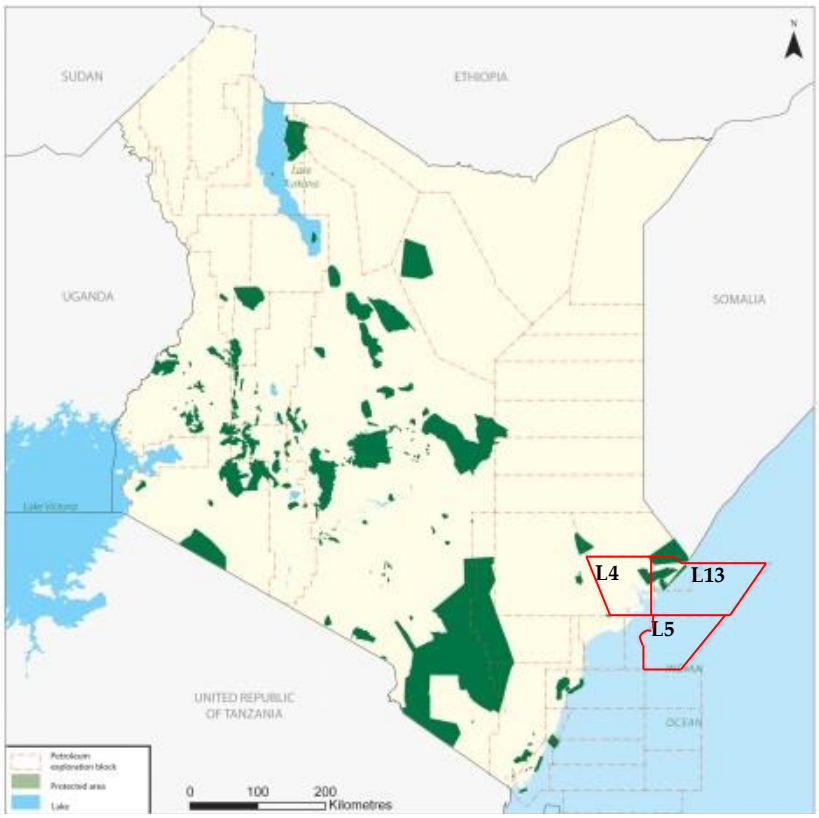

Figure 19: Oil exploration blocks in Boni–Dodori.
The blocks are depicted by red dotted lines on the backdrop of protected areas (green blocks). Boni and Dodori NRs are the dark green polygons at top right of Kenya coast line. Note that two exploration blocks (L4 and L13) cover more than half of the Boni–Dodori area (Source: www.crossborderinformation.com).

Figure 20: The expansion of Basuba–Kiangwe road.
This is part of the infrastructural developments to facilitate offshore extraction of energy. Without a proper environmental assessment, these road expansions might encroach into important habitats.

4.2.1.3 Infrastructure projects

Kenya has embarked on an ambitious project called 'The Lamu Port South Sudan Ethiopia Transport (LAPSSET) corridor' that, when complete, will be the country's second transport corridor after the Mombasa–Nairobi—Uganda corridor. Basically, this project is expected to build an oil refinery in Lamu, served with an oil pipeline, a railway line, a road and a fiber optic line running towards northern Kenya through Isiolo town. Whilst these developments are unlikely to directly affect the Boni-Dodori forest system, infrastructure and influx of workforce from elsewhere will open up the entire region for settlements, which will in turn trigger a land rush towards the NRs and the proposed Aweer Community Conservancy.

4.2.1.4 Weak governance

The Dodori–Boni NRs are now under the jurisdiction of Lamu and Garissa County Governments. Their boundaries are as yet not clearly dermacated and remain contested by the Aweer community, while management measures have yet to be established. It is also not clear which national government institution(s) has the mandate for the areas outside the NRs. Although KWS staff patrol the NRs and have a base at Bodhei Junction neither Boni NR nor Dodori NR is explicitly listed under KWS parks and reserves, but are instead shown as managed under Kiunga Marine Reserve (KWS, 2014).

The Kenya Forest Service (KFS) and previous national government administration had, as early as 1970s, proposed the gazettement of the Boni and Lungi Forests to become Forest Reserves. The Boni Forest Reserve would have been 18,500 ha, between and connecting the Boni and Dodori NRs. The proposed Lungi Forest Reserve would have been 9,500 ha, which includes forest areas south-west of Dodori NR. The confinement through forced resettlement of the Aweer people, who formerly ranged throughout and had ancestral claims to the whole forest complex, has put a significant obstacle in the way of any new attempt to gazette these forests. The Aweer maintain their ancestral claim to these areas. The Kenyan Constitution is unambiguous that ancestral lands of hunter and gatherer groups constitute 'Community Land'. Prior to being forced into cultivation the Aweer people were hunter and gatherers and moreover had a good track record with respect to conservation.

Confused legal and institutional arrangements, coupled with perennial insecurity and remoteness of the area, may explain why there have been few significant conservation projects taking place on the ground. Most notable of late are the USAID funded SECURE project (2009-2012), which aimed at securing land and

resource rights of indigenous coastal communities in order to consequently improve livelihoods and support biodiversity conservation and more sustainable natural resource management. Overlapping with this and superseding it is the Boni–Dodori Sustainable Forest Management Project being executed by WWF-Kenya. This project aims to ensure sustainable conservation of the forest landscape covering both the national and forest reserves in the Boni–Dodori forest system while sustaining the "integrity, resilience and conservation of the Boni-Dodori forest ecosystem and the associated bio-cultural systems of the forest communities". It is under the auspices of this project, that our survey was carried out.

4.2.2 Opportunities

The threats facing the Boni–Dodori forest system point to the need to resolve the underlying governance uncertainties and to establish a comprehensive and integrated conservation and management program that draws on the indigenous knowledge of the Aweer people together with the expertise of the various authorities. With a narrower focus on the management challenge we propose here a program that considers the following as possible areas of action.

1. Extending bird surveys where security allows, identifying critical habitats and recommending preliminary measures to protect these areas. Camera trap surveys in 2010 and 2015 have also confirmed the Boni–Dodori forest system to be of major importance to mammal conservation within the Eastern African coastal biodiversity hotspot with relatively undisturbed and complete communities of predators and herbivores (Wacher and Amin, 2014; Stokes, Wacher and Amin 2016). Both the bird and mammal surveys provide baseline data from which to measure future impacts on the forest species in this highly threatened East African coastal forest system. They also provide a basis for a long term monitoring program in future with quantitative measures for demonstrating the success of conservation action plans.

2. Building local capacity – people and agencies – to monitor the area's biodiversity and threats, and provide recommendations for management. During this expedition, we held two training workshops for community scouts, police reservists and other members of the ACC. We introduced basic bird identification techniques (Figure 21) and explained how three representative bird species, Crested Guineafowl *Guttera pucherina*, Southern Banded Snake Eagle *Circaetus fasciolatus*, and Fischer's Turaco *Tauraco fischeri*, can be used as indicators to monitor the status of the biodiversity of the forest

system. Towards achieving a long-term goal of setting up a biodiversity monitoring team, we handed out four field identification bird guide books to the chair of ACC.

3. Setting up an effective law enforcement monitoring system, comprising teams from KWS, KFS and ACC with adequate rangers and scouts, equipment, and routine reporting and informed planning mechanism.

4. Promoting conservation awareness among the Aweer community as well as Lamu and Garissa County and national policy makers, whose decisions regarding development in this area have an impact on the biodiversity. WWF, ZSL and NRT (NCC) are already actively involved in the area, on a range of projects covering socio-economics, biodiversity inventory, wildlife, security and monitoring. It is only prudent to encourage other public and private organizations to follow suit and roll out complementary conservation programs.

5. Preparing a comprehensive biodiversity map and reviewing the existing KWS Kiunga–Boni–Dodori Management Plan, based on current information provided by species, habitat, and socio-economic studies.

6. Enhancing and diversifying the livelihoods of the Aweer people, building on and extending present initiatives including, but not confined to: piloting bee-keeping using modern bee-hives, providing access to savings and loan facilities through Village Saving and Loan Associations, mitigating the negative impacts of human-wildlife conflicts on agricultural yields, encouraging agro-sylviculture and potentially eco-tourism (game spotting and bird watching, security permitting). If local security stabilizes, these actions will reduce the pressure, however minimal, on the forest as a source of honey, wood, charcoal and clandestine bush-meat.

7. Actively promote awareness amongst local, county and national level stakeholders (i.e. government, civil society and private sector) of the need for cross-sectoral and multi-levelled alignment and integration of all policies, legislation and practices to ensure conservation of the unique biodiversity of Boni—Dodori forest system and the culture of Aweer.

8. Last but not least, the persisting ambiguities and conflicting legislation associated with the land tenure rights of the Aweer need resolving as a matter of urgency, so that fair and legal arrangements can be established in which an integrated conservation and management program involving the local Aweer community, government and non-governmental organizations, can be established.

Figure 21: Training in basic bird identification and biodiversity monitoring at Mangai Village. Local scouts and police reservists from Mararani, Mangai and Basuba villages attended.

5 Conclusions

- This study, along with mammal surveys (Wacher and Amin, 2014; Stokes, Wacher and Amin 2016), have confirmed the Boni–Dodori forest system to be of major importance to biodiversity conservation within the Eastern African coastal biodiversity hotspot.

- Boni–Dodori forest system is an environmentally and biologically heterogeneous system. Therefore, many species are patchily spread and co-exist. However, some of these species occupy specific habitats. This suggests that conservation and management strategies should be implemented at a regional spatial scale and focus on the conservation of the environmental mosaic comprising of Boni and Dodori NRs, the proposed Aweer Community Conservancy, and Lungi forest reserve.

- Now that the Boni–Dodori forest system has been designated as an Important Bird Area (IBA) (Nature*Kenya*, 2014), a site of regional and global importance for bird conservation, we believe that investing in further biodiversity surveys is needed to establish a comprehensive baseline contributing to the

understanding of regional biological diversity and to the development of effective conservation strategies for the region. At the regional level, the available avian data suggests that migratory movements associated with environmental seasonality lead to seasonal variations in bird species richness and composition in this forest system. However, further studies should be conducted to investigate how seasonal variations may affect the patterns of spatial use of specific habitats during the migratory and non-migratory seasons (e.g. Signor and Pinho, 2011).

- The patchy distribution of many bird species and the seemingly high dispersal rates between habitat types suggest that populations of rare forest specialists may be maintained by a metapopulation dynamic process (Hanski 1998), a promising hypothesis to investigate in future studies.

- On the conservation front, the biodiversity importance of Boni–Dodori ecosystem needs to be recognized and incorporated into land use planning, with a focus on finding ways for the local communities to integrate development of the region while sustaining and gaining benefit from this unique heritage.

- A community based, integrated conservation and management program, building on the work already done by WWF, NRT and KWS, is urgently needed. This can only be realized and sustained, however, once the uncertainties relating to the land tenure rights of the Aweer are clarified, which would enable more effective integration within and between sector stakeholders, their policies, legislative frameworks and practices, and including the fullest engagement of the forest people – in line with the Kenyan Constitution.

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7 Appendices

7.1 Appendix 1: Species mist-netting catch rates in five habitats in Boni–Dodori forest system.

The mist-netting catch rates are calculated as the total number of individuals caught divided by meter-net-hours multiplied by 100. Names follow *Checklist of the Birds of Kenya*, 2009.

	Common Name	Scientific Name	Acacia Woodland	Inalo/Dhurwii Forest	Jilokonadhi Forest	Mararani Forest	Sankuri ridge	Total No. of Individuals	Catch rate: (Birds $m^{-1}h^{-1}x100$)
	Columbidae: Pigeons & doves								
1	Emerald-spotted Wood Dove	*Turtur chalcospilos*					4	4	**0.52**
	Cuculidae: Cuckoos & coucals								
2	Jacobin Cuckoo	*Clamator jacobinus*					2	2	**0.26**
3	Common Cuckoo	*Cuculus canorus*					2	2	**0.26**
	Trogonidae: Trogons								
4	Narina Trogon	*Apaloderma narina*			1	1		2	**0.13**
	Capitonidae: Barbets & tinkerbirds								
5	Red-fronted Tinkerbird	*Pogoniulus pusillus*					1	1	**0.13**
	Indicatoridae: Honeyguides								
6	Scaly-throated Honeyguide	*Indicator variegatus*			1	2	2	5	**0.22**
	Picidae: Woodpeckers								
7	Mombasa Woodpecker	*Campethera mombassica*				1		1	**0.13**
	Platysteiridae: Batises								

	Common Name	Scientific Name	Acacia Woodland	Inalo/Dhurwii Forest	Jilokonadhi Forest	Mararani Forest	Sankuri ridge	Total No. of Individuals	Catch rate: (Birds $m^{-1}h^{-1}x100$)
8	Forest Batis	*Batis mixta*		1	1	1		3	**0.13**
	Malaconotidae: Helmetshrikes, bushshrikes, tchagras & puffbacks								
9	Sulphur-breasted Bushshrike	*Chlorophoneus sulfureopectus*					2	2	
10	Gorgeous Bushshrike	*Chlorophoneus viridis*					2	2	**0.26**
11	Three-streaked Tchagra	*Tchagra jamesi*					1	1	**0.13**
12	Black-backed Puffback	*Dryoscopus cubla*					3	3	**0.39**
13	Red-naped Bushshrike	*Laniarius ruficeps (kismayensis?)*	1				1	2	**0.13**
14	Tropical Boubou	*Laniarius aethopicus*		3	1		1	5	**0.22**
	Monarchidae: Monarch Flycatchers								
15	Blue-mantled Crested Flycatcher	*Trochocercus cyanomelas*		3	1	4		8	**0.35**
16	African Paradise Flycatcher	*Terpsiphone viridis*	3		1	1	1	6	**0.20**
	Cisticolidae: Cisticolas & allies								
17	Tawny-flanked Prinia	*Prinia subflava*					3	3	**0.39**
18	Grey-backed Camaroptera	*Camaroptera brachyura*	1	5	2	3	4	15	**0.39**
19	Grey Wren Warbler	*Calamonastes simplex*	1					1	**0.13**
	Pycnonotidae: Bulbuls								
20	Common Bulbul	*Pycnonotus barbatus*	2					2	**0.26**
21	Zanzibar Greenbul	*Andropadus importunus*		1	2		6	9	**0.39**
22	Yellow-bellied Greenbul	*Chlorocichla flaviventris*		5	6	5	3	19	**0.62**
23	Terrestrial Brownbul	*Phyllastrephus terrestris*		5	4	5		14	**0.61**
24	Northern Brownbul	*Phyllastrephus strepitans*	14		2		12	28	**1.22**
25	Fischer's Greenbul	*Phyllastrephus fischeri*		7	7	10		24	**1.04**
26	Tiny Greenbul	*Phyllastrephus debilis*		2				2	**0.26**

	Common Name	Scientific Name	Acacia Woodland	Inalo/Dhurwii Forest	Jilokonadhi Forest	Mararani Forest	Sankuri ridge	Total No. of Individuals	Catch rate: (Birds $m^{-1}h^{-1}x100$)
27	Eastern Nicator	*Nicator gularis*		4	3		5	12	**0.52**
	Sylviidae: Old World warblers								
28	Marsh Warbler	*Acrocephalus palustris*					10	10	**1.30**
	Timaliidae: Babblers & chatterers								
29	Rufous Chatterer	*Turdoides rubiginosa*	1					1	**0.13**
	Turdidae: Thrushes								
30	Red-tailed Ant Thrush	*Neocossyphus rufus*		1		2		3	**0.20**
31	African Bare-eyed Thrush	*Turdus tephronotus*	3					3	**0.39**
	Muscicapidae: Chats, wheatears & Old World flycatchers								
32	Common Nightingale	*Luscinia megarhynchos*	1				1	2	**0.13**
33	Red-capped Robin Chat	*Cossypha natalensis*		5	3	6		14	**0.61**
34	Bearded Scrub Robin	*Cercotrichas quadrivirgata*		5	2	7	4	18	**0.59**
35	Ashy Flycatcher	*Muscicapa caerulescens*			1			1	**0.13**
	Nectariniidae: Sunbirds								
36	Collared Sunbird	*Hedydipna collaris*		1			7	8	**0.52**
37	Olive Sunbird	*Cyanomitra olivacea*		1	3	1		5	**0.22**
38	Mouse-colored Sunbird	*Cyanomitra veroxii*					2	2	**0.26**
39	Amethyst Sunbird	*Chalcomitra amethystina*					1	1	**0.13**
	Ploceidae: Weavers & relatives								
40	Black-necked Weaver	*Ploceus nigricollis*	2					2	**0.26**

	Common Name	Scientific Name	Acacia Woodland	Inalo/Dhurwii Forest	Jilokonadhi Forest	Mararani Forest	Sankuri ridge	Total No. of Individuals	Catch rate: (Birds $m^{-1}h^{-1}x100$)
41	Dark-backed Weaver	*Ploceus bicolor*		1	2	1	1	5	**0.16**
	Estrildidae: Waxbills								
42	Purple Grenadier	*Granatina ianthinogaster*	1					1	**0.13**
43	Peters's Twinspot	*Hypargos niveoguttatus*					2	2	**0.26**

7.2 Appendix 2: Species Relative Abundance Index (RAI) in ten habitat types where Timed Species Counts were conducted in Boni–Dodori forest system.

[Note: The RAI is proportionate to the number of TSCs conducted in each habitat type. See Table 5]. The number of species seen in each habitat type is indicated at the bottom. Names follow *Checklist of the Birds of Kenya*, 2009.

	Common name	Scientific name	Acacia woodland	Forest	Forest Edge	Forest Thicket	Riparian Forest	Seasonal Wetland	Slashed and Burnt Patch	Wooded Grassland	Palm Savanna	Woodland
	Numididae: guineafowl											
1	Crested Guineafowl	*Guttera pucherani*					0.50	2.50		0.56	0.46	0.75
	Phasianidae: quails, francolins, spurfowl and allies											
2	Coqui Francolin	*Francolinus coqui*								0.56		
3	Crested Francolin	*Francolinus sephaena*	4.00					4.00	4.50	0.56	0.69	
4	Red-necked Spurfowl	*Francolinus afer*								1.22	1.46	
	Anatidae: ducks and geese											
5	Egyptian Goose	*Alopochen aegyptiaca*					1.00					
	Ciconiidae: storks											
6	African Open-billed Stork	*Anastomus lamelligerus*					2.50					
7	Woolly-necked Stork	*Ciconia episcopus*	1.00				1.00					
8	Saddle-billed Stork	*Ephippiorhynchus senegalensis*					1.25					
9	Marabou Stork	*Leptoptilos crumeniferus*									0.46	
	Threskiornithidae: ibises and spoonbills											
10	Sacred Ibis	*Threskiornis aethiopicus*					2.00					
11	Hadada Ibis	*Bostrychia hagedash*	2.50		6.00	1.60	0.75			2.11	2.15	
12	African Spoonbill	*Platalea alba*					3.25					
	Ardeidae: herons, egrets and bitterns											
13	Striated Heron	*Butorides striata*										

	Common name	Scientific name	Acacia woodland	Forest	Forest Edge	Forest Thicket	Riparian Forest	Seasonal Wetland	Slashed and Burnt Patch	Wooded Grassland	Palm Savanna	Woodland
14	Grey Heron	*Ardea cinerea*					0.75					
15	Goliath Heron	*Ardea goliath*					1.00					
16	Great White Egret	*Ardea alba*					0.75					
17	Yellow-billed Egret	*Egretta intermedia*					1.25					
	Phalacrocoracidae: cormorants											
18	Great Cormorant	*Phalacrocorax carbo*					0.50					
	Anhingidae: darters											
19	African Darter	*Anhinga rufa*					2.00					
	Falconidae: falcons											
20	Amur Falcon	*Falco amurensis*					1.00			1.22	1.08	
21	Eurasian Hobby	*Falco subbuteo*								0.56	1.38	
	Accipitridae: diurnal birds of prey other than falcons											
22	African Fish Eagle	*Haliaeetus vocifer*	0.67				5.25				0.08	
23	White-headed Vulture	*Trigonoceps occipitalis*									0.08	
24	Black-chested Snake Eagle	*Circaetus pectoralis*	0.33				0.75	0.50				
25	Brown Snake Eagle	*Circaetus cinereus*					0.75					
26	Southern Banded Snake Eagle	*Circaetus fasciolatus*					1.00			0.22	0.46	
27	Bateleur	*Terathopius ecaudatus*	0.67							0.33	1.08	0.75
28	African Harrier Hawk	*Polyboroides typus*									0.15	
29	African Goshawk	*Accipiter tachiro*								0.44		
30	Little Sparrowhawk	*Accipiter minullus*									0.23	
31	Lizard Buzzard	*Kaupifalco monogrammicus*								0.89	0.46	
32	Tawny Eagle	*Aquila rapax*								0.22		
33	Wahlberg's Eagle	*Aquila wahlbergi*					0.75			0.33	0.15	
34	Ayres's Hawk Eagle	*Aquila ayresii*								0.56		
35	Martial Eagle	*Polemaetus bellicosus*									0.08	

	Common name	Scientific name	Acacia woodland	Forest	Forest Edge	Forest Thicket	Riparian Forest	Seasonal Wetland	Slashed and Burnt Patch	Wooded Grassland	Palm Savanna	Woodland
36	Crowned Eagle	*Stephanoaetus coronatus*								0.56		
	Heliornithidae: finfoots											
37	African Finfoot	*Podica senegalensis*					0.75					
	Burhinidae: thicknees											
38	Water Thick-knee	*Burhinus vermiculatus*					2.25					
	Charadriidae: plovers											
39	Spur-winged Plover	*Vanellus spinosus*					1.25					
40	Black-headed Plover	*Vanellus tectus*	2.00					3.50	2.50			
41	Senegal Plover	*Vanellus lugubris*									0.15	
	Jacanidae: jacanas											
42	African Jacana	*Actophilornis africanus*					3.00					
	Scolopacidae: sandpipers and relatives											
43	Green Sandpiper	*Tringa ochropus*					1.00					
44	Wood Sandpiper	*Tringa glareola*					2.25				0.31	
45	Common Sandpiper	*Actitis hypoleucos*					0.75				0.08	
	Glareolidae: Egyptian Plover, coursers and pratincoles											
46	Heuglin's Courser	*Rhinoptilus cinctus*	0.33									
	Pteroclidae: sandgrouse											
47	Black-faced Sandgrouse	*Pterocles decoratus*	1.00									
	Columbidae: pigeons and doves											
48	Red-eyed Dove	*Streptopelia semitorquata*	1.17			0.80	1.50	3.00	3.50	1.67	2.69	1.25
49	Ring-necked Dove	*Streptopelia capicola*								0.67		
50	Emerald-spotted Wood Dove	*Turtur chalcospilos*	3.00	3.00	6.00	1.40	1.50	2.00		1.89	2.00	2.75
51	Tambourine Dove	*Turtur tympanistria*		1.00	5.00		1.50				0.46	2.25
52	African Green Pigeon	*Treron calvus*		1.50	2.00					1.22	0.46	

	Common name	Scientific name	Acacia woodland	Forest	Forest Edge	Forest Thicket	Riparian Forest	Seasonal Wetland	Slashed and Burnt Patch	Wooded Grassland	Palm Savanna	Woodland
	Psittacidae: lovebirds and parrots											
53	African Orange-bellied Parrot	*Poicephalus rufiventris*							2.50			
	Musophagidae: turacos											
54	Fischer's Turaco	*Tauraco fischeri*		1.50	3.00	0.80	3.50			2.22	2.08	3.00
55	White-bellied Go-away-bird	*Corythaixoides leucogaster*	1.50									
	Cuculidae: cuckoos and coucals											
56	Jacobin Cuckoo	*Clamator jacobinus*								0.44	1.08	1.00
57	Thick-billed Cuckoo	*Pachycoccyx audeberti*									0.31	
58	Klaas's Cuckoo	*Chrysococcyx klaas*								1.11	0.92	
59	Diederik Cuckoo	*Chrysococcyx caprius*								0.67		
60	Yellowbill	*Ceuthmochares aereus*		1.25	5.00	1.60	1.75			0.22	0.62	2.50
61	White-browed Coucal	*Centropus superciliosus*		1.50		3.60	2.75			2.78	0.85	1.50
	Strigidae: typical owls											
62	African Wood Owl	*Strix woodfordii*					1.50			0.67		
63	African Barred Owlet	*Glaucidium capense*				1.20	1.50			0.67		
	Caprimulgidae: nightjars											
64	Fiery-necked Nightjar	*Caprimulgus pectoralis*				1.20	1.50			0.67		
65	Slender-tailed Nightjar	*Caprimulgus clarus*	1.00						3.00			
	Apodidae: swifts											
66	Böhm's Spinetail	*Neafrapus boehmi*									0.15	
67	African Palm Swift	*Cypsiurus parvus*	0.67	0.25			0.75			0.56	1.92	0.25
68	Little Swift	*Apus affinis*	0.83									
	Coliidae: mousebirds											
69	Speckled Mousebird	*Colius striatus*	0.50		5.00				4.00		0.38	
70	Blue-naped Mousebird	*Urocolius macrourus*								1.11		

	Common name	Scientific name	Acacia woodland	Forest	Forest Edge	Forest Thicket	Riparian Forest	Seasonal Wetland	Slashed and Burnt Patch	Wooded Grassland	Palm Savanna	Woodland
	Trogonidae: trogons											
71	Narina Trogon	*Apaloderma narina*		2.50	6.00	1.00	4.25			2.56	2.31	3.50
	Coraciidae: rollers											
72	Lilac-breasted Roller	*Coracias caudatus*									0.85	
73	Eurasian Roller	*Coracias garrulus*								1.33	1.38	
74	Broad-billed Roller	*Eurystomus glaucurus*									0.23	
	Alcedinidae: kingfishers											
75	Grey-headed Kingfisher	*Halcyon leucocephala*									0.77	
76	Striped Kingfisher	*Halcyon chelicuti*								1.11	1.31	
77	Mangrove Kingfisher	*Halcyon senegaloides*					2.50					
78	Malachite Kingfisher	*Alcedo cristata*					3.75					
79	Pied Kingfisher	*Ceryle rudis*					1.75					
	Meropidae: bee-eaters											
80	Little Bee-eater	*Merops pusillus*					1.25					
81	White-throated Bee-eater	*Merops albicollis*	2.83					4.00	2.50	0.33	0.46	
82	Northern Carmine Bee-eater	*Merops nubicus*									0.46	
	Upupidae: Hoopoe											
83	Hoopoe	*Upupa epops*	0.50						3.00			
	Phoeniculidae: wood-hoopoes											
84	Green Wood-hoopoe	*Pheoniculus purpureus*			2.00	0.20				1.22	0.85	1.00
85	Common Scimitarbill	*Rhinopomastus cyanomelas*	3.33	1.25	5.00	0.80	1.50			2.11	2.23	1.25
	Bucerotidae: hornbills											
86	Crowned Hornbill	*Tockus alboterminatus*			5.00					0.78	1.62	
87	Trumpeter Hornbill	*Bycanistes bucanitor*									0.46	1.50
	Capitonidae: barbets and tinkerbirds											
88	Red-fronted Tinkerbird	*Pogoniulus pusillus*	1.33	3.25	6.00	0.80	2.75	3.00	1.50	4.00	3.38	2.75

	Common name	Scientific name	Acacia woodland	Forest	Forest Edge	Forest Thicket	Riparian Forest	Seasonal Wetland	Slashed and Burnt Patch	Wooded Grassland	Palm Savanna	Woodland
89	Black-collared Barbet	*Lybius torquatus*					1.25			1.89	2.85	
	Indicatoridae: honeyguides											
90	Scaly-throated Honeyguide	*Indicator variegatus*					2.00			0.89	1.62	
	Picidae: wrynecks and woodpeckers											
91	Nubian Woodpecker	*Campethera nubica*	1.67					3.00	4.50		0.77	
92	Mombasa Woodpecker	*Campethera mombassica*			5.00	0.40	1.75			3.44	1.08	2.00
93	Green-backed Woodpecker	*Campethera cailliautii*			3.00		1.75			0.67	0.38	
94	Cardinal Woodpecker	*Dendropicos fuscescens*	1.17						1.50			
	Platysteiridae: batises, wattle-eyes and relatives											
95	Forest Batis	*Batis mixta*		2.00	4.00	0.60	5.25			1.11	0.38	2.50
96	Black-headed Batis	*Batis minor*		1.50	6.00	0.40	0.50			2.44	2.38	0.75
	Malaconotidae: helmetshrikes, bushshrikes, tchagras and puffbacks											
97	Retz's Helmetshrike	*Prionops retzii*								0.22	0.46	
98	Chestnut-fronted Helmetshrike	*Prionops scopifrons*								0.67	0.38	
99	Grey-headed Bushshrike	*Malaconotus blanchoti*	2.00	0.50		2.20		3.00	2.00	0.33	0.38	2.25
100	Sulphur-breasted Bushshrike	*Chlorophoneus sulfureopectus*	3.17		2.00	1.40				1.33	1.15	
101	Gorgeous Bushshrike	*Chlorophoneus viridis*		0.50	5.00	1.20				2.33	0.69	4.25
102	Three-streaked Tchagra	*Tchagra jamesi*	2.17					2.50	1.50			
103	Black-crowned Tchagra	*Tchagra senegalus*								1.78	1.77	
104	Black-backed Puffback	*Dryoscopus cubla*	1.83	4.25	6.00	4.20	3.50	3.00		4.44	2.54	5.25
105	Red-naped Bushshrike	*Laniarius ruficeps (kismayensis?)*	5.83			3.00		6.00	5.50			
106	Tropical Boubou	*Laniarius aethopicus*		6.00	6.00	5.80	4.50			5.78	4.23	6.00
	Campephagidae: cuckooshrikes											
107	Black Cuckooshrike	*Campephaga flava*								1.22	0.69	

	Common name	Scientific name	Acacia woodland	Forest	Forest Edge	Forest Thicket	Riparian Forest	Seasonal Wetland	Slashed and Burnt Patch	Wooded Grassland	Palm Savanna	Woodland
	Laniidae: shrikes											
108	Northern White-crowned Shrike	*Eurocephalus rueppelli*	0.83						3.00			
109	Red-backed Shrike	*Lanius collurio*	1.83							1.11	2.23	
110	Lesser Grey Shrike	*Lanius minor*								0.44		
	Oriolidae: orioles											
111	Eurasian Golden Oriole	*Oriolus oriolus*						0.50				
112	African Golden Oriole	*Oriolus auratus*									0.46	
113	Black-headed Oriole	*Oriolus larvatus*	3.00	1.25	6.00	1.80	1.00		3.00	2.56	3.54	1.75
	Dicruridae: drongos											
114	Square-tailed Drongo	*Dicrurus ludwigii*			4.00	1.20	3.25			0.67	0.08	0.75
115	Common Drongo	*Dicrurus adsimilis*	2.33			1.00		3.00		2.67	2.92	0.75
	Monarchidae: monarch flycatchers											
116	Blue-mantled Crested Flycatcher	*Trochocercus cyanomelas*		1.00	6.00	1.20	4.50			0.89	0.38	
117	Little Yellow Flycatcher	*Erythrocercus holochlorus*	0.67	2.25	6.00		1.00			1.56	1.23	1.50
118	African Paradise Flycatcher	*Terpsiphone viridis*	3.00	2.25	5.00	1.40	3.25			0.44	1.08	3.00
	Hirundinidae: saw-wings, swallows and martins											
119	Barn Swallow	*Hirundo rustica*	2.83					3.00		1.00	1.54	0.25
120	Wire-tailed Swallow	*Hirundo smithii*	1.00									
121	Lesser Striped Swallow	*Cecropis abyssinica*	0.67								0.38	
	Alaudidae: larks											
122	Flappet Lark	*Mirafra rufocinnamomea*								3.00	2.00	
123	Pink-breasted Lark	*Mirafra poecilosterna*	2.33									
	Cisticolidae: cisticolas and allies											
124	Coastal (Winding) Cisticola	*Cisticola galactotes*								0.33		
125	Siffling Cisticola	*Cisticola brachypterus*								1.78	1.77	

	Common name	Scientific name	Acacia woodland	Forest	Forest Edge	Forest Thicket	Riparian Forest	Seasonal Wetland	Slashed and Burnt Patch	Wooded Grassland	Palm Savanna	Woodland
126	Tawny-flanked Prinia	*Prinia subflava*	1.83				0.75			2.33	3.15	
127	Yellow-breasted Apalis	*Apalis flavida*	3.17			1.00		0.50				
128	Black-headed Apalis	*Apalis melanocephala*		1.75	4.00	1.00	4.75			1.67	0.69	2.25
129	Grey-backed Camaroptera	*Camaroptera brachyura*		3.50	6.00	4.40	3.50		0.50	4.11	2.38	3.00
130	Grey Wren Warbler	*Calamonastes simplex*	4.00					3.00	1.50			
	Pycnonotidae: bulbuls											
131	Common Bulbul	*Pycnonotus barbatus*										
132	Zanzibar Greenbul	*Andropadus importunus*	1.00	5.25	6.00	1.80	5.50	1.50	4.00	3.44	4.23	4.50
133	Yellow-bellied Greenbul	*Chlorocichla flaviventris*		3.50	6.00	2.00	2.50			3.78	2.92	0.25
134	Terrestrial Brownbul	*Phyllastrephus terrestris*				2.40	1.50					
135	Northern Brownbul	*Phyllastrephus strepitans*	3.67	1.50	6.00			6.00	5.50	1.33	2.46	4.25
136	Fischer's Greenbul	*Phyllastrephus fischeri*		1.00	4.00	2.20	5.25			1.11	1.00	3.75
137	Tiny Greenbul	*Phyllastrephus debilis*		0.31								
138	Eastern Nicator	*Nicator gularis*		5.75	6.00	5.60	1.50			4.33	3.31	4.50
	Sylviidae: Old World warblers											
139	Basra Reed Warbler	*Acrocephalus griseldis*								0.56		
140	Great Reed Warbler	*Acrocephalus arundinaceus*								0.33		
141	Sedge Warbler	*Acrocephalus schoenobaenus*					1.50					
142	Marsh Warbler	*Acrocephalus palustris*								0.44		
143	Willow Warbler	*Phylloscopus trochilus*	0.17								0.31	
144	Northern Crombec	*Sylvietta brachyura*	1.33		2.00					0.56	1.08	
	Timaliidae: illadopses, babblers and chatterers											
145	Rufous Chatterer	*Turdoides rubiginosa*	2.33						3.00			
146	Scaly Babbler	*Turdoides squamulata*				0.40				0.78	0.38	1.00

	Common name	Scientific name	Acacia woodland	Forest	Forest Edge	Forest Thicket	Riparian Forest	Seasonal Wetland	Slashed and Burnt Patch	Wooded Grassland	Palm Savanna	Woodland
	Sturnidae: starlings and oxpeckers											
147	Greater Blue-eared Starling	*Lamprotornis chalybaeus*								0.56	0.38	
148	Rüppell's Starling	*Lamprotornis purpuroptera*								0.22	1.08	
149	Black-bellied Starling	*Lamprotornis corruscus*	1.33				1.50		1.50	2.33	2.38	
	Turdidae: thrushes											
150	Red-tailed Ant Thrush	*Neocossyphus rufus*		0.50			2.25					
151	African Bare-eyed Thrush	*Turdus tephronotus*	2.83					0.50	3.50			
	Muscicapidae: chats, wheatears and Old World flycatchers											
152	Common Nightingale	*Luscinia megarhynchos*	0.83								0.38	
153	White-browed Robin Chat	*Cossypha heuglini*								0.78	1.85	
154	Red-capped Robin Chat	*Cossypha natalensis*		2.75	4.00	1.20	5.00			0.22	1.23	1.25
155	Spotted Palm (Morning) Thrush	*Cichladusa guttata*	4.00			1.20		3.50	6.00			1.25
156	Bearded Scrub Robin	*Cercotrichas quadrivirgata*	2.83	4.25	6.00	5.40	1.50	6.00	3.00	4.33	3.46	2.75
157	White-browed Scrub Robin	*Cercotrichas leucophrys*	2.00					3.50			0.46	
158	Pale Flycatcher	*Bradornis pallidus*	1.17					3.50	3.00	0.78	1.92	
159	Spotted Flycatcher	*Muscicapa striata*	0.33					1.00		0.33	0.46	
160	Ashy Flycatcher	*Muscicapa caerulescens*				1.20	4.25			0.67	0.69	
161	Lead-coloured Flycatcher	*Myioparus plumbeus*								1.00	1.92	
	Nectariniidae: sunbirds											
162	Plain-backed Sunbird	*Anthreptes reichenowi*		0.75								
163	Eastern Violet-backed Sunbird	*Anthreptes orientalis*	0.50									
164	Collared Sunbird	*Hedydipna collaris*		0.75	6.00	1.80	5.25			3.11	2.38	2.25
165	Olive Sunbird	*Cyanomitra olivacea*		0.75	5.00	0.80	5.50			2.33	1.85	0.75
166	Mouse-colored Sunbird	*Cyanomitra veroxii*	1.50				1.50					0.75
167	Amethyst Sunbird	*Chalcomitra amethystina*			6.00				2.00	3.44	1.85	1.50

	Common name	Scientific name	Acacia woodland	Forest	Forest Edge	Forest Thicket	Riparian Forest	Seasonal Wetland	Slashed and Burnt Patch	Wooded Grassland	Palm Savanna	Woodland
168	Purple-banded Sunbird	*Cinnyris bifasciatus*								1.00		0.50
169	Variable Sunbird	*Cinnyris venustus*	2.83					3.00				
	Ploceidae: weavers, bishops and widowbirds											
170	Black-necked Weaver	*Ploceus nigricollis*	0.33						2.00			
171	Golden Palm Weaver	*Ploceus bojeri*	1.00								0.08	
172	Village Weaver	*Ploceus cucullatus*				0.40						
173	Dark-backed Weaver	*Ploceus bicolor*		2.00	6.00	2.00	3.75			2.11	1.23	1.50
174	Red-headed Weaver	*Anaplectes melanotis*									0.31	
175	Red-billed Quelea	*Quelea quelea*										
	Estrildidae: waxbills											
176	Red-cheeked Cordon-bleu	*Uraeginthus bengalus*	0.33							1.11	0.31	
177	Peters's Twinspot	*Hypargos niveoguttatus*			3.00							
178	Bronze Mannikin	*Spermestes cucculatus*								0.56	0.15	
	Motacillidae: wagtails, longclaws and pipits											
179	Yellow-throated Longclaw	*Macronyx croceus*								0.89	0.92	
180	Grassland Pipit	*Anthus cinnamomeus*						3.50				
181	Malindi Pipit	*Anthus melindae*						3.50				
	Fringillidae: canaries, citrils, seedeaters and relatives											
182	Reichenow's Seedeater	*Crithagra reichenowi*									0.23	
183	Yellow-fronted Canary	*Crithagra mozambica*								0.33	1.54	
	No of species		**59**	**35**	**40**	**43**	**75**	**29**	**28**	**97**	**107**	**45**

7.3 Appendix 3: A checklist of birds of Boni–Dodori forest system (April 2014 survey).

Names and Sequence: According to the *Checklist of the Birds of Kenya*, 4th Ed, Bird Committee of EANHS, 2009. Some old names in brackets.

Location: Stretch of about 50 km along Hindi – Kiunga road from about 10 km west of Basuba village to the Acacia woodland plains just below and east of Sankuri ridge. We covered an average width of about 2.5 km on either side of the road.

Forest dependency categories (Bennun *et al.*, **1996**):

i) Forest specialist species (**FF species**): These are true forest birds, characteristic of the interior of undisturbed forest. They may persist in secondary forest and forest patches if their particular ecological requirements are met. They are rarely seen in non-forest habitats and breed exclusively in the forest.

ii) Forest generalist species (**F species**): May occur in undisturbed forest but are also regularly found in forest strips, edges and gaps, where they are likely to be more common than in the interior forest. They breed within the forest.

iii) Forest visitors (**f species**): these are often recorded in the forest but are not dependent on it. They are almost more common in non-forest habitats where they breed.

Migratory Status: AM= Afrotropical Migrant; **OM**= Migrant from the Oriental region; **PM** = Migrant from Palaearctic region; **MM**= Migrant from Malagasy region; **in lower case** migrants of that category may occur alongside resident, non-migratory individuals.

IUCN categories: EN = Endangered; **VU** = Vulnerable; **NT** = Near Threatened

EBA category: EAC = East African Coastal Biome

IBA category from Bennun & Njoroge, 1999: RT = Regionally Threatened

	Common Name	**Scientific Name**	**Forest Dependency**	**Migratory Status**	**IUCN Red List**	**EBA**	**IBA Category**	**Remarks**
	Ostrich							
1	Ostrich	*Struthio camelus*			VU		RT	Seen in western part of study area, near Milimani
	(Somali race)	*(S. (camelus) molybdophanes)*						
	Numididae: guineafowl							
2	Crested Guineafowl	*Guttera pucherani*	F					

	Common Name	Scientific Name	Forest Dependency	Migratory Status	IUCN Red List	EBA	IBA Category	Remarks
	Phasianidae: francolins & spurfowl							
3	Coqui Francolin	*Francolinus coqui*						
4	Crested Francolin	*Francolinus sephaena*						
5	Red-necked Spurfowl	*Francolinus afer*						
	Anatidae: ducks & Geese							
6	White-faced Whistling Duck	*Dendrocygna viduata*						
7	Spur-winged Goose	*Plectropterus gambensis*						
8	Knob-billed Duck	*Sarkidiornis melanotos*		am				
9	Egyptian Goose	*Alopochen aegyptiaca*						
	Ciconiidae: storks							
10	Yellow-billed Stork	*Mycteria ibis*		am				
11	African Open-billed Stork	*Anastomus lamelligerus*		am				
12	Black Stork	*Ciconia nigra*		PM				
13	Woolly-necked Stork	*Ciconia episcopus*						
14	Saddle-billed Stork	*Ephippiorhynchus senegalensis*						
15	Marabou Stork	*Leptoptilos crumeniferus*						
	Threskiornithidae: ibises & spoonbills							
16	Sacred Ibis	*Threskiornis aethiopicus*						
17	Hadada Ibis	*Bostrychia hagedash*						
18	African Spoonbill	*Platalea alba*						
	Ardeidae: herons & egrets							
19	Striated (Green-backed) Heron	*Butorides striata*						

	Common Name	Scientific Name	Forest Dependency	Migratory Status	IUCN Red List	EBA	IBA Category	Remarks
20	(Common) Squacco Heron	*Ardeola ralloides*		am, pm				
21	Cattle Egret	*Bubulcus ibis*		am				
22	Grey Heron	*Ardea cinerea*		am, pm				
23	Black-headed Heron	*Ardea melanocephala*						
24	Goliath Heron	*Ardea goliath*						
25	Great White Egret	*Ardea alba*					RT	
26	Yellow-billed (Intermediate) Egret	*Egretta intermedia*						
27	Little Egret	*Egretta garzetta*						
	Scopidae: hamerkop							
28	Hamerkop	*Scopus umbretta*						
	Pelecanidae: pelicans							
29	Pink-backed Pelican	*Pelecanus rufescens*						
	Phalacrocoracidae: cormorants							
30	Reed (Long-tailed) Cormorant	*Phalacrocorax africanus*						
31	Great Cormorant	*Phalacrocorax carbo*						
	Anhingidae: darters							
32	African Darter	*Anhinga rufa*					RT	
	Falconidae: falcons							
33	Amur Falcon	*Falco amurensis*		PM				
34	Eurasian Hobby	*Falco subbuteo*		PM				

	Common Name	Scientific Name	Forest Dependency	Migratory Status	IUCN Red List	EBA	IBA Category	Remarks
	Accipitridae: eagles, kites, hawks							
35	Bat Hawk	*Macheiramphus alcinus*	F					
36	African Fish Eagle	*Haliaeetus vocifer*						
37	White-headed Vulture	*Trigonoceps occipitalis*			CR		RT	
38	Lappet-faced Vulture	*Torgos tracheliotus*			EN			
39	Black-chested Snake Eagle	*Circaetus pectoralis*						
40	Brown Snake Eagle	*Circaetus cinereus*						
41	Southern Banded Snake Eagle	*Circaetus fasciolatus*	F		NT	**EAC**		
42	Bateleur	*Terathopius ecaudatus*			NT			
43	African Harrier Hawk	*Polyboroides typus*	f					
44	African Goshawk	*Accipiter tachiro*	F					
45	Little Sparrowhawk	*Accipiter minullus*	f					
46	Lizard Buzzard	*Kaupifalco monogrammicus*	f					
47	Tawny Eagle	*Aquila rapax*						
48	Wahlberg's Eagle	*Aquila wahlbergi*		am				
49	Ayres's Hawk Eagle	*Aquila ayresii*	F				RT	
50	Martial Eagle	*Polemaetus bellicosus*			VU		RT	
51	(African) Crowned Eagle	*Stephanoaetus coronatus*	FF		NT		RT	
	Heliornithidae: finfoots							
52	African Finfoot	*Podica senegalensis*					RT	
	Burhinidae: thick-knees							
53	Water Thick-knee	*Burhinus vermiculatus*						

	Common Name	Scientific Name	Forest Dependency	Migratory Status	IUCN Red List	EBA	IBA Category	Remarks
	Charadriidae: plovers (lapwings)							
54	Spur-winged Plover	*Vanellus spinosus*						
55	Black-headed Plover	*Vanellus tectus*						
56	Senegal Plover	*Vanellus lugubris*						
57	Grey Plover	*Pluvialis squatarola*		PM				
58	Common Ringed Plover	*Charadrius hiaticula*		PM				
59	Three-banded Plover	*Charadrius tricollaris*						
60	Greater Sand Plover	*Charadrius leschenaultii*		PM				
	Jacanidae: jacanas							
61	African Jacana	*Actophilornis africanus*						
	Scolopacidae: sandpipers							
62	Common Greenshank	*Tringa nebularia*		PM				
63	Green Sandpiper	*Tringa ochropus*		PM				
64	Wood Sandpiper	*Tringa glareola*		PM				
65	Common Sandpiper	*Actitis hypoleucos*		PM				
66	Little Stint	*Calidris minuta*		PM				
67	Curlew Sandpiper	*Calidris ferruginea*		PM	NT			
	Glareolidae: coursers & pratincoles							
68	Heuglin's Courser	*Rhinoptilus cinctus*						
69	Collared Pratincole	*Glareola pratincola*		am				
	Pteroclidae: sandgrouse							
70	Black-faced Sandgrouse	*Pterocles decoratus*						Seen flying over Sankuri ridge

	Common Name	Scientific Name	Forest Dependency	Migratory Status	IUCN Red List	EBA	IBA Category	Remarks
	Columbidae: pigeons & doves							
71	Feral Pigeon	*Columba livia*						Recorded at Mangai village
72	Red-eyed Dove	*Streptopelia semitorquata*	f					
73	Ring-necked Dove	*Streptopelia capicola*	f					
74	Emerald-spotted Wood Dove	*Turtur chalcospilos*	f					
75	Tambourine Dove	*Turtur tympanistria*	F					
76	African Green Pigeon	*Treron calvus*	F					
	Psittacidae: lovebirds & parrots							
77	African Orange-bellied Parrot	*Poicephalus rufiventris*						
	Musophagidae: turacos							
78	Fischer's Turaco	*Tauraco fischeri*	F		NT	**EAC**		
79	White-bellied Go-away-bird	*Corythaixoides leucogaster*						
	Cuculidae: cuckoos & coucals							
80	Jacobin (Black-and-white) Cuckoo	*Clamator jacobinus*		am, pm, om				
81	Thick-billed Cuckoo	*Pachycoccyx audeberti*	F					
82	Common Cuckoo	*Cuculus canorus*		PM				
83	Klaas's Cuckoo	*Chrysococcyx klaas*	f					
84	Diederik Cuckoo	*Chrysococcyx caprius*		am				
85	Yellowbill	*Ceuthmochares aereus*	F	am				
86	White-browed Coucal	*Centropus superciliosus*						
	Strigidae: typical Owls							
87	African Scops Owl	*Otus senegalensis*						

	Common Name	Scientific Name	Forest Dependency	Migratory Status	IUCN Red List	EBA	IBA Category	Remarks
88	African Wood Owl	*Strix woodfordii*	F					
89	African Barred Owlet	*Glaucidium capense*	F					
	Caprimulgidae: nightjars							
90	Fiery-necked Nightjar	*Caprimulgus pectoralis*	F					
91	Slender-tailed Nightjar	*Caprimulgus clarus*						
	Apodidae: swifts							
92	Böhm's Spinetail	*Neafrapus boehmi*	F					
93	Mottled Spinetail	*Telecanthura ussheri*	F					
94	African Palm Swift	*Cypsiurus parvus*						
95	Little Swift	*Apus affinis*						
96	White-rumped Swift	*Apus caffer*						
	Coliidae: mousebirds							
97	Speckled Mousebird	*Colius striatus*						
98	Blue-naped Mousebird	*Urocolius macrourus*						
	Trogonidae: trogons							
99	Narina Trogon	*Apaloderma narina*	F					
	Coraciidae: rollers							
100	Lilac-breasted Roller	*Coracias caudatus*		am				Lilac-throated race
101	Eurasian Roller	*Coracias garrulus*		PM				Migrating north
102	Broad-billed Roller	*Eurystomus glaucurus*	f	am, mm				

	Common Name	Scientific Name	Forest Dependency	Migratory Status	IUCN Red List	EBA	IBA Category	Remarks
	Alcedinidae: kingfishers							
103	Grey-headed Kingfisher	*Halcyon leucocephala*	f	am				
104	Striped Kingfisher	*Halcyon chelicuti*						
105	Mangrove Kingfisher	*Halcyon senegaloides*				**EAC**		
106	Malachite Kingfisher	*Alcedo cristata*						
107	Pied Kingfisher	*Ceryle rudis*						
	Meropidae: bee-eaters							
108	Little Bee-eater	*Merops pusillus*						
109	White-throated Bee-eater	*Merops albicollis*	f	AM				
110	Blue-cheeked Bee-eater	*Merops persicus*		PM				
111	Madagascar Bee-eater	*Merops superciliosus*		am, mm				
112	Northern Carmine Bee-eater	*Merops nubicus*		AM				
	Upupidae: hoopoe							
113	Hoopoe	*Upupa epops*		am, pm				
	Phoeniculidae: wood-hoopoes							
114	Green Wood-hoopoe	*Pheoniculus purpureus*						
115	Common Scimitarbill	*Rhinopomastus cyanomelas*						
	Bucerotidae: hornbills							
116	Crowned Hornbill	*Tockus alboterminatus*	f					
117	African Grey Hornbill	*Tockus nasutus*						
118	Trumpeter Hornbill	*Bycanistes bucanitor*	F					

	Common Name	Scientific Name	Forest Dependency	Migratory Status	IUCN Red List	EBA	IBA Category	Remarks
	Capitonidae: barbets & tinkerbirds							
119	Red-fronted Tinkerbird	*Pogoniulus pusillus*						
120	Black-collared Barbet	*Lybius torquatus*	f					
	Indicatoridae: honeyguides							
121	Lesser Honeyguide	*Indicator minor*	f					
122	Scaly-throated Honeyguide	*Indicator variegatus*	f					
123	Greater Honeyguide	*Indicator indicator*	f					
	Picidae: woodpeckers							
124	Nubian Woodpecker	*Campethera nubica*						
125	Mombasa Woodpecker	*Campethera mombassica*	F			**EAC**		
126	Green-backed (Little Spotted) Woodpecker	*Campethera cailliautii*	f					
127	Cardinal Woodpecker	*Dendropicos fuscescens*	f					
	Eurylaimidae: broadbills							
128	African Broadbill	*Smithornis capensis*	FF					Heard at Inalo/ Dhurwii forest
	Platysteiridae: batises							
129	Forest Batis	*Batis mixta*	FF					
130	Black-headed Batis	*Batis minor*						
	Malaconotidae: helmetshrikes, bushshrikes, tchagras & puffbacks							
131	Retz's Helmetshrike	*Prionops retzii*	f					
132	Chestnut-fronted Helmetshrike	*Prionops scopifrons*	F			**EAC**		

	Common Name	Scientific Name	Forest Dependency	Migratory Status	IUCN Red List	EBA	IBA Category	Remarks
133	Grey-headed Bushshrike	*Malaconotus blanchoti*						
134	Sulphur-breasted Bushshrike	*Chlorophoneus sulfureopectus*	f					
135	Gorgeous (Four-coloured) Bushshrike	*Chlorophoneus viridis*	F			**EAC**		
136	Three-streaked Tchagra	*Tchagra jamesi*						
137	Black-crowned Tchagra	*Tchagra senegalus*						
138	Black-backed Puffback	*Dryoscopus cubla*	F					
139	Red-naped Bushshrike	*Laniarius ruficeps (kismayensis?)*						
140	Tropical Boubou	*Laniarius aethopicus*	f					
	Campephagidae: cuckooshrikes							
141	Black Cuckooshrike	*Campephaga flava*	f	am				
	Laniidae: shrikes							
142	Northern White-crowned Shrike	*Eurocephalus rueppelli*						
143	Red-backed Shrike	*Lanius collurio*		PM				
144	Lesser Grey Shrike	*Lanius minor*		PM				
145	Long-tailed Fiscal	*Lanius cabanisi*						
	Oriolidae: orioles							
146	Eurasian Golden Oriole	*Oriolus oriolus*	f	PM				
147	African Golden Oriole	*Oriolus auratus*	f	AM				
148	(African) Black-headed Oriole	*Oriolus larvatus*	f					
	Dicruridae: drongos							
149	Square-tailed Drongo	*Dicrurus ludwigii*	F					
150	Common (Fork-tailed) Drongo	*Dicrurus adsimilis*						

	Common Name	Scientific Name	Forest Dependency	Migratory Status	IUCN Red List	EBA	IBA Category	Remarks
	Monarchidae: monarch Flycatchers							
151	Blue-mantled Crested Flycatcher	*Trochocercus cyanomelas*	FF					
152	Little Yellow Flycatcher	*Erythrocercus holochlorus*	FF			**EAC**	RT	
153	African Paradise Flycatcher	*Terpsiphone viridis*	f	am				
	Hirundinidae: swallows & martins							
154	Sand Martin	*Riparia riparia*		PM				
155	Barn Swallow	*Hirundo rustica*		PM				
156	Wire-tailed Swallow	*Hirundo smithii*						
157	Lesser Striped Swallow	*Cecropis abyssinica*						
158	Mosque Swallow	*Cecropis senegalensis*						
	Alaudidae: larks							
159	Flappet Lark	*Mirafra rufocinnamomea*						
160	Pink-breasted Lark	*Mirafra poecilosterna*						
	Cisticolidae: cisticolas & allies							
161	Siffling (Short-winged) Cisticola	*Cisticola brachypterus*						
162	Coastal (Winding) Cisticola	*Cisticola haematocephalus*						
163	Tawny-flanked Prinia	*Prinia subflava*	f					
164	Yellow-breasted Apalis	*Apalis flavida*	f					
165	Black-headed Apalis	*Apalis melanocephala*	FF					
166	Grey-backed Camaroptera	*Camaroptera brachyura*	f					
167	Grey Wren Warbler	*Calamonastes simplex*						

	Common Name	Scientific Name	Forest Dependency	Migratory Status	IUCN Red List	EBA	IBA Category	Remarks
	Pycnonotidae: bulbuls							
168	Common Bulbul	*Pycnonotus barbatus*	f					[ssp. dodsoni]
169	Zanzibar (Sombre) Greenbul	*Andropadus importunus*						
170	Yellow-bellied Greenbul	*Chlorocichla flaviventris*	F					
171	Terrestrial Brownbul	*Phyllastrephus terrestris*	F					
172	Northern Brownbul	*Phyllastrephus strepitans*	f			**EAC**		
173	Fischer's Greenbul	*Phyllastrephus fischeri*	FF			**EAC**		
174	Tiny Greenbul	*Phyllastrephus debilis*	FF			**EAC**		
175	Eastern Nicator	*Nicator gularis*	F					
	Sylviidae: Old World warblers							
176	Basra Reed Warbler	*Acrocephalus griseldis*		PM	EN			Migrating near Basuba
177	Great Reed Warbler	*Acrocephalus arundinaceus*		PM				Migrating near Basuba
178	Marsh Warbler	*Acrocephalus palustris*		PM				
179	Willow Warbler	*Phylloscopus trochilus*		PM				
180	Northern Crombec	*Sylvietta brachyura*						
	Timaliidae: babblers & chatterers							
181	Scaly Babbler	*Turdoides squamulata*				**EAC**		
182	Rufous Chatterer	*Turdoides rubiginosa*						
	Sturnidae: starlings & oxpeckers							
183	Greater Blue-eared Starling	*Lamprotornis chalybaeus*						
184	Ruppell's (Long-tailed) Starling	*Lamprotornis purpuroptera*						
185	Black-bellied Starling	*Lamprotornis corruscus*	F			**EAC**		
186	Violet-backed Starling	*Cynniricinclus leucogaster*	f	AM				

	Common Name	Scientific Name	Forest Dependency	Migratory Status	IUCN Red List	EBA	IBA Category	Remarks
187	Red-billed Oxpecker	*Buphagus erythrorhynchus*						
	Turdidae: thrushes							
188	Red-tailed Ant Thrush	*Neocossyphus rufus*	FF					
189	African Bare-eyed Thrush	*Turdus tephronotus*						
	Muscicapidae: chats, wheatears & Old World flycatchers							
190	Common Nightingale	*Luscinia megarhynchos*		PM				
191	White-browed Robin Chat	*Cossypha heuglini*	f					
192	Red-capped Robin Chat	*Cossypha natalensis*	F	am				
193	Spotted Palm (Morning) Thrush	*Cichladusa guttata*						
194	(Eastern) Bearded Scrub Robin	*Cercotrichas quadrivirgata*	f					
195	White-browed Scrub Robin	*Cercotrichas leucophrys*						
196	Common Rock Thrush	*Monticola saxatilis*		PM				
197	Pale Flycatcher	*Bradornis pallidus*						
198	Spotted Flycatcher	*Muscicapa striata*		PM				
199	Ashy Flycatcher	*Muscicapa caerulescens*	F					
200	Lead-coloured Flycatcher	*Myioparus plumbeus*	f					
	Nectariniidae: sunbirds							
201	Plain-backed Sunbird	*Anthreptes reichenowi*	FF		NT	**EAC**		
202	Eastern Violet-backed Sunbird	*Anthreptes orientalis*						
203	Collared Sunbird	*Hedydipna collaris*	F					
204	Olive Sunbird	*Cyanomitra olivacea*	FF					
205	Mouse-coloured Sunbird	*Cyanomitra veroxii*	f			**EAC**		
206	Amethyst Sunbird	*Chalcomitra amethystina*	f					

	Common Name	Scientific Name	Forest Dependency	Migratory Status	IUCN Red List	EBA	IBA Category	Remarks
207	Purple-banded Sunbird	*Cinnyris bifasciatus*	f					
208	Variable Sunbird	*Cinnyris venustus*	f					white-bellied race
	Ploceidae: weavers & relatives							
209	Grosbeak Weaver	*Amblyospiza albifrons*	f					
210	Black-necked Weaver	*Ploceus nigricollis*	f					
211	Golden Palm Weaver	*Ploceus bojeri*						
212	Village (Black-headed) Weaver	*Ploceus cucullatus*						
213	Dark-backed Weaver	*Ploceus bicolor*	F					
214	Red-headed Weaver	*Anaplectes melanotis*						red male, *jubaensis*
215	Red-billed Quelea	*Quelea quelea*		am				
216	Fan-tailed Widowbird	*Euplectes axillaris*						
	Estrildidae: waxbills							
217	Common Waxbill	*Estrilda astrild*						
218	Red-cheeked Cordon-bleu	*Uraeginthus bengalus*						
219	Purple Grenadier	*Granatina ianthinogaster*						
220	Peters's Twinspot	*Hypargos niveoguttatus*	F					
221	Bronze Mannikin	*Spermestes cucculatus*						
222	Black-and-white Mannikin	*Spermestes bicolor*	f					
	Viduidae: indigobirds & whydahs							
223	Pin-tailed Whydah	*Vidua macroura*						
	Motacillidae: wagtails, pipits, longclaws							
224	African Pied Wagtail	*Motacilla aguimp*						

	Common Name	Scientific Name	Forest Dependency	Migratory Status	IUCN Red List	EBA	IBA Category	Remarks
225	Yellow-throated Longclaw	*Macronyx croceus*						
226	Grassland Pipit	*Anthus cinnamomeus*						
227	Malindi Pipit	*Anthus melindae*				**EAC**		
	Fringillidae: canaries, citrils, seedeaters							
228	Yellow-fronted Canary	*Crithagra mozambica*						
229	Reichenow's (Yellow-rumped) Seedeater	*Crithagra reichenowi*						

7.4 Appendix 4: Locations of mist-netting sites and Timed Species Count transects.

Site Name	Activity	Northings	Eastings
Woodland south of Jilokonadhi	TSC	-1.70453	41.26366
Woodland south of Jilokonadhi	TSC	-1.70573	41.26115
Woodland south of Jilokonadhi	TSC	-1.70766	41.25683
Woodland south of Jilokonadhi	TSC	-1.71143	41.25675
Jilokonadhi, Humbiforest	TSC	-1.70203	41.2626
Jilokonadhi, Humbiforest	TSC	-1.89575	41.26287
Jilokonadhi, Humbiforest	TSC	-1.69221	41.26136
Jilokonadhi, Humbiforest	TSC	-1.68952	41.26099
Chiri	TSC	-1.71421	41.27774
Tuli	TSC	-1.71548	41.24044
Tuli	TSC	-1.71296	41.24037
Tuli	TSC	-1.70963	41.23838
Tuli	TSC	-1.70758	41.23767
Acacia towards Kiunga	TSC	-1.73233	41.43285
Acacia towards Kiunga	TSC	-1.73305	41.42601
Mathaule/Acacia	TSC	-1.74256	41.45369
Mathaule/Acacia	TSC	-1.74446	41.45256
Mathaule/Acacia	TSC	-1.74685	41.45364
Kakawele Dam/Acacia wooland	TSC	-1.74321	41.45279
Milangopiti Palm Savanna	TSC	-1.74603	41.02852
Milangopiti Palm Savanna	TSC	-1.74350	41.0257
Milangopiti Palm Savanna	TSC	-1.73656	41.01662
Milangopiti Palm Savanna	TSC	-1.74061	41.02096
Sankuri	TSC	-1.71767	41.38111
Sankuri	TSC	-1.72369	41.37866
Sankuri	TSC	-1.72493	41.37824
Sankuri	TSC	-1.72816	41.37694
10kms east of Mangai Village	TSC	-1.68437	41.29346
10kms east of Mangai Village	TSC	-1.67106	41.28553
Jijiloni	TSC	-1.66151	41.28014
Jijiloni	TSC	-1.65463	41.27566
Acacia towards Kiunga	TSC	-1.74228	41.45414
Acacia towards Kiunga	TSC	-1.74227	41.45414
Acacia towards Kiunga	TSC	-1.73633	41.45554
Acacia towards Kiunga	TSC	-1.73775	41.4529
Road to Kiangwe	TSC	-1.79340	41.03794
Road to Kiangwe	TSC	-1.79990	41.03695
Road to Kiangwe	TSC	-1.81772	41.03208
Road to Kiangwe	TSC	-1.82973	41.02522
Meresi	TSC	-1.75323	41.18658
Riparian forest along river south of Mangai airstrip	TSC	-1.75947	41.18852

Riparian forest along river south of Mangai airstrip	TSC	-1.76427	41.19138
Riparian forest along river south of Mangai airstrip	TSC	-1.76636	41.1954
Bauri – past Basuba	TSC	-1.72971	40.94345
Bauri – past Basuba	TSC	-1.72499	40.94318
Bauri – past Basuba	TSC	-1.73138	40.93754
Bauri – past Basuba	TSC	-1.73081	40.92793
Riparian forest along river north of Mangai Village	TSC	-1.74837	41.17509
Riparian forest along river north of Mangai Village	TSC	-1.74513	41.17289
Riparian forest along river north of Mangai Village	TSC	-1.73896	41.17125
Riparian forest along river north of Mangai Village	TSC	-1.74292	41.17053
Jilokonadhi	Mist-nets	-1.70013	41.26275
Jilokonadhi	Mist-nets	-1.70033	41.26266
Jilokonadhi	Mist-nets	-1.70042	41.2627
Jilokonadhi	Mist-nets	-1.70032	41.26293
Jilokonadhi	Mist-nets	-1.70113	41.26296
Inalo/Dhurwii Forest	Mist-nets	-1.76469	41.10814
Inalo/Dhurwii Forest	Mist-nets	-1.76463	41.10818
Inalo/Dhurwii Forest	Mist-nets	-1.76480	41.10836
Inalo/Dhurwii Forest	Mist-nets	-1.76544	41.10832
Sankuri ridge	Mist-nets	-1.71635	41.38078
Sankuri ridge	Mist-nets	-1.71601	41.38087
Sankuri ridge	Mist-nets	-1.71626	41.38142
Sankuri ridge	Mist-nets	-1.71613	41.38131
Acacia forest	Mist-nets	-1.73191	41.43753
Acacia forest	Mist-nets	-1.73170	41.43743
Acacia forest	Mist-nets	-1.73085	41.43758
Acacia forest	Mist-nets	-1.73120	41.43758
Acacia forest	Mist-nets	-1.73046	41.43762
Acacia forest	Mist-nets	-1.73205	41.4375
Acacia forest	Mist-nets	-1.73255	41.43791